## 2.5 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING SUMMARY OF FOUNDATION CONDITIONS

***[Section 2.5 Text, Tables and Figures are Historical Information.]***

The Watts Bar Nuclear Plant site is located on the right bank of Chickamauga Lake, approximately two miles downstream from Watts Bar Dam, at river mile 528.0 (Decatur quadrangle, 118-SW).

The site was first explored in 1950 when twenty holes, totaling 580 feet, were drilled. These shallow holes were predominantly wash borings to determine the approximate top of rock and were drilled toward Chickamauga Lake from the location of the present plant. No further work was done at this site until June 1970, when 49 top-of-rock determinations were made by refraction seismic methods. As shown on Figure 2.5-12, the seismic stations were laid out on a 400-foot grid with the lettered ranges oriented N22°W and the numbered sections oriented N68°E. Preliminary core drilling was started in July 1970, with 11 holes on 400-foot centers using the same grid that had been established for the seismic studies (Figure 2.5-12).

By the end of July 1970, engineering studies had progressed to the point where the portion of the site most suitable for the location of the major structures had been approximately determined. At this time 16 additional holes in this area were drilled on 200-foot centers. In mid-September, 29 more holes were added on 100-foot centers to fill in the area finally decided upon as the plant location. In all, 56 holes were drilled during exploration program.

The majority of the holes were drilled to Elevation 635, which is 55 feet below foundation grade and from 60 to 65 feet below the general elevation of the top of rock. As shown on Figure 2.5-13, the area of concentrated exploration lies between Ranges J and R and between Sections 59+00 and 66+00. Holes within these limits were examined with TV borehole equipment to confirm that the areas of non-recovery of core represented grinding of soft material and not cavities in the bedrock. Detailed individual logs of each hole in this area are presented in Figures 2.5-14 through 2.5-69.

Pressure bulb tests to determine the static characteristics of the foundation material were made in six holes by Geocel, Incorporated, and dynamic seismic tests were made by TVA personnel and Birdwell Division of Seismograph Service Corporation (Figure 2.5-70).

Construction excavations began in July 1973, and were completed in mid-April 1974. All excavation floors as well as numerous cutfaces and terrace-rock contacts were mapped and photographed by the project geologist (Figures 2.5-110 through 2.5-122). Prior to concrete emplacement the foundation bedrock was inspected and released by the project geologist. Foundation treatment during the excavations consisted of dental work and minor grouting and is submitted as Figures 2.5-139 through 2.5-144.

Figures represented in this report are based upon the following areal coverage:

1. Region - 200 mile radius from the site - ex: Regional Geologic Map (Figure 2.5-2)

2. Subregion - 65 to 100 mile radius from the site-ex: Subregional Fault Map (Figure 2.5-8).

3. Plant area - five mile radius from the site - ex: Geologic Map of the Plant Area (Figures 2.5-9 and 2.5-10)

4. Plant - Immediately related to location of the plant - ex: Drill Layouts, Photographs, and Individual Geologic Logs.

Physiographically, the site is located in the Tennessee section of the Valley and Ridge Province of the Appalachian Highlands (Figure 2.5-1). This section is the southernmost of the three sections comprising the Valley and Ridge Province and extends from the Tennessee River-New River divide southwestward into central Alabama. It is bounded on the west by the Appalachian Plateaus Province and on the east by the Blue Ridge Province.

The site is located along the northeast-southwest trending portion of the Tennessee River drainage basin. At the site area the elevation of the flood plain is approximately 700 feet and to the west of the plant location is a series of knobs reaching Elevation 900 feet. The plant lies on an alluvial terrace of approximate Elevation 735 feet (Figures 2.5-11).

The site is located in the folded and faulted Southern Appalachian Structural Province and in the Southern Appalachian Tectonic Subdivision. A Modified Mercalli Intensity (MM) VIII earthquake is assumed to occur at the site with accelerations of 0.18g's horizontal and 0.12g's vertical for safe shutdown earthquake (SSE) requirements.

Regional and subregional fault maps are provided as Figures 2.5-7 and 2.5-8 and cover radii of 200 and 100 miles, respectively.

The plant site is situated in a bend of the Tennessee River that has been covered by alluvial terrace deposits (Figures 2.5-11). Beneath these deposits lies the Middle Cambrian Conasauga Formation, an interbedded shale and limestone upon which the Category I structures are founded. The regional strike of this formation is approximately N35°- 40°E (Figure 2.5-110) and beds for the most part dip to the southeast. However, because of relatively complex folding at the site, the attitudes of the bedding range from horizontal to vertical. Photographs, sections, and maps of the excavations of the plant showing rock quality and structural complexity are included in this report as Figures 2.5-110 through 2.5-122.

## 2.5.1 Basic Geology and Seismic Information

The Watts Bar Nuclear Plant site is located in Rhea County, Tennessee, on the right side of the Tennessee River at river mile 528, about two miles south of Watts Bar Dam (Figure 2.5-9). Exploration was started in 1950 when twenty holes, totaling 580 feet, were drilled. Drilling was on a grid with lettered ranges oriented N22°W and numbered stations oriented N68°E (Figures 2.5-12 and 2.5-13). The range lettering begins to the east at range A and extends westward on 100-foot intervals down the alphabet to Z. The letter "I" was omitted from all ranging. The station numbering begins to the south with station 89+00 and extends northward on 100-foot intervals to station 48+00. Exploration locations used throughout the program are found by the intersection of these lettered ranges and numbered stations such as L-68+00.

Drilling was begun with holes on 400-foot spacings, and as engineering studies progressed and subsurface information became available in July, 1970, the spacing was reduced first to 200-foot spacings and finally in mid-September to holes 100 feet on center under the major structures (Figure 2.5-13). The majority of the holes were drilled to Elevation 635 feet, which is 55 feet below foundation grade and from 60 to 65 feet below the general elevation of the top of rock.

Layouts and summaries of all drilling are furnished as Figures 2.5-12, 2.5-13, and 2.5-70. Individual graphic logs of all holes are presented as Figures 2.5-14 through 2.5-69.

Dynamic seismic tests and pressure bulb tests were made in and between selected holes in the main plant area to determine the in situ dynamic characteristics of the foundation rock (Figures 2.5-70 through 2.5-109). Details of these investigations are in Sections 2.5.1.2.9 and 2.5.1.2.11.

### 2.5.1.1 Regional Geology

#### 2.5.1.1.1 Regional Physiography

Except as otherwise indicated, this section is referenced from Fenneman[23].

The Watts Bar Nuclear Plant is located in the Tennessee section of the Valley and Ridge Province of the Appalachian Highlands (Figure 2.5-1).

The Valley and Ridge Province is a long narrow belt trending NE-SW that is bordered by the Appalachian Plateau on the west and by the Blue Ridge Province on the east. It extends for 1,200 miles, from eastern New York to central Alabama. Its maximum width is 80 miles, and its width barely reaches 35 miles in New York. The maximum width in east Tennessee is 40 miles, which is near the average for the south half of the province.

Geologically, this province represents the eastern margin of the Paleozoic interior sea. Structurally it is part of an anticlinorium, the successor to a geosyncline which sank intermittently for ages as it received sediments from the concurrently rising old land surface on the east.

Of the stratified Paleozoic rocks involved in the folding, all outcropping at one place or another, there are great differences in hardness. In the humid climate of eastern United States, limestone (unless cherty) is generally weathered away most rapidly. Shale is usually slightly more resistant, but both are subject to weathering. Well-cemented, siliceous sandstone and conglomerates are the most resistant. As selective erosion is particularly conspicuous in this region, and as folding and thrust faulting may bring the same stratum to the surface repeatedly, a few resistant formations produce several ridges. Sandstones are the most significant ridge makers.

Viewed empirically, the Valley and Ridge Province is a low-land (an assemblage of valley floors separated by long, narrow, even-topped mountain ridges). Either of these elements may predominate. The mountains may be widely spaced and isolated, or so closely ranged that the lowlands are disconnected or absent. The valley floors are entrenched by streams. Morphologically the province is one of folded mountains, in which resistant strata form ridges, and weaker rocks are worn down to lowlands, which in themselves further eroded in a still later cycle. The lateral compression that made the folds also caused thrust faults. Indeed, much of the eastern province boundary is delineated by thrust faults, along which the older and more resistant rocks were pushed westward over the younger and weaker rocks. By these means a much broader belt was reduced to one-half, perhaps to one-third, of its former width. It was from the extremely mountainous topography thus described that the present surface was developed. The major steps in the process were: (1) general peneplaning, (2) upwarping, (3) reduction of the weaker rocks to plains at lower levels, and (4) further uplift and dissection.

The physical characteristics of this province are intimately connected with its streams, which are primarily causes, not effects of the present topography. Adjustment of drainage to structure produces a condition in which streams follow the strike as much as possible, keeping on belts of soft rock. They cross the hard rocks through "water gaps" as rarely as possible and then by the most direct route (i.e., at right angles). The tendency is for drainage to become longitudinal, but this tendency stops when down cutting has reached a stage when every divide is being worn down equally on both sides.

The drainage of this province at an earlier stage was mainly transverse. Longitudinal streams were a subsequent development. In the struggle between longitudinal subsequent streams and transverse consequent streams, the former often captured the latter, and with each capture one hard-rock crossing was eliminated, and the "water gap" became a "wind gap." The final result of a succession of such captures tends to show a "trellised" pattern. The course of any larger stream is a series of rectangular offsets. An intelligent glance at the stream pattern of the Valley and Ridge Province is sufficient to show the great extent to which its drainage has been revamped. Most of the longitudinal streams have developed by slow headward growth, and most of the old transverse streams have vanished. The many deserted wind gaps are impressive.

The Valley and Ridge Province is divided into three parts, designated respectively as the Hudson Valley, Middle, and Tennessee (or southern) sections. The Hudson Valley section is not involved in the physiography of the site region and will not be discussed further. The boundary between the Middle and Tennessee sections is at the divide between the New and Tennessee Rivers in southwest Virginia. Within the Valley and Ridge Province, only the southwest portion of the Middle section and the northeast portion of the Tennessee section are involved in the regional physiography.

A gradual change in structure of the Middle section begins to be noticeable in central Virginia. Toward the south the folds become more closely compressed and then overturned toward the northwest. The number of thrust faults increases toward the south, so that in southwestern Virginia it is the rule rather than the exception that anticlines are broken by thrust faults dipping to the southeast. The combined effect of these factors is that nearly all beds dip toward the southeast. North of the New River-Tennessee River divide the valley peneplain in the New River drainage basin is traceable throughout a belt 15 miles wide for a distance of 60 miles. Abrupt highlands bound the section on both sides.

In the Tennessee section the width of the Valley and Ridge Province is somewhat less than in the northern two sections, and the area of valley floor is a larger fraction of the total. Boundaries against the highlands on both sides continue to be clear and abrupt. The major part of the drainage makes its final escape through a transverse valley west of Chattanooga, where the Tennessee River flow into the Appalachian Plateau Province.

Of the rocks found in the Tennessee section, the sandstones are the predominant ridge-makers. The Clinch sandstone for instance, makes the prominent mountain ridges north of Knoxville. The Rockwood is another. A number of low ridges or broad swells in the lowlands are made by cherty beds in the great mass of Cambrian and Ordovician dolomite, mainly the Knox Group, which underlies more of the valley surface than any other rock. Other low ridges are made by sandy members in the Cambrian formations which are mainly shale and limestone. Most of the lowland, not on the Knox dolomite, is on Cambrian and Ordovician limestones and shales or on similar weak rock of Mississippian age.

The Tennessee section is bounded on the northwest by the Appalachian Plateau Province. These two provinces are separated by a prominent southeast facing escarpment 1,000 to 1,200 feet high, whose summit is capped by Pennsylvanian sandstones resting on Mississippian limestone.

On the southeast the Tennessee section is bounded by the Blue Ridge Province, generally with a sharp physiographic contrast.

The northeastern limit of the Tennessee section is fixed arbitrarily at the Tennessee-New River divide, where mountain ridges are numerous and valley floors narrow and high, generally near 2,500 feet. Valley floors broaden and decline toward the southwest and some of the ridges terminate and new ones appear. Clinch Mountain near the median line of the province is the one great continuing feature. The southwestern terminus of the mountain ridges is about 10 miles northeast of Knoxville. From that latitude southward to Georgia the relief features are of the lower order, (i.e., carved from the valley floor). These features include low ridges, knobs, and all stream valleys. They also include strips of smoother lowland below 800 feet whose maximum width in Tennessee is five or six miles along the main rivers, such as the Tennessee and Hiwassee.

In regard to the drainage of the Tennessee section, a longitudinal profile of this section using the general level of the hilltops in the eroded valley floor is very flat below Knoxville and steepens progressively upstream from that point to the New River divide. A similar profile using stream levels would show a slight upturn in passing from the Tennessee River basin to that of the Coosa River basin. The Tennessee descends the slope for 250 miles to Chattanooga, then turns westward into the plateau. Just beyond the low divide the Coosa begins and flows down the gentle profile. Both streams are fed by long tributaries from the southeast and receive very little water from the plateau on the northwest.

There is little direct evidence as to the time or manner in which the main features of the present drainage plan were developed. The pattern suggests that the streams flowing northwestward from the Blue Ridge may have continued their courses as antecedents across the rising mountains and plateaus to the Ohio and Mississippi Rivers just as the New River continues to do. On the other hand, drainage may have been turned to the southwest in consequent streams following development of synclines during the formation of the folds. In the former case the change awaited the growth of subsequent streams, mainly along anticlinal axes, or at least on the weaker rocks. According to this hypothesis, the branches of the growing Tennessee captured the northwest-flowing streams, one at a time, from the Hiwassee to the Watauga.

Miller[85] suggests that East Tennessee is divided into three major physiographic regions, the Unaka Mountains Province, the Valley and Ridge Province, and the Cumberland Plateau Province.

Overall, the topographic and geologic "grain" of east Tennessee is elongated northeast-southwest in conformity with the trend of the Appalachian region. Thus the rock formations, topography, and rock structures are generally arranged in belted patterns trending about 30 degrees east of north.

Northwest of the Valley and Ridge Province lies the Appalachian Plateaus Province (Figure 2.5-1). This province ranges in width from 30 to 200 miles, and is about 1,000 miles long, extending from New York to Alabama. Along its border with the Valley and Ridge Province, is an abrupt topographic rise known as the Allegheny Front, which is called the Cumberland Escarpment in Tennessee. This escarpment is breached by the Pine Mountain thrust fault and the Sequatchie fault and anticline which are the western-most of the Valley and Ridge thrust faults. The surface expression of the Appalachian Plateau Province ranges from 1,000 to 2,000 feet above sea level and is gently rolling with localized areas of higher elevations. As shown on Figure 2.5-2, most of this province is underlain by Pennsylvanian sandstones and shales. The rocks are gently folded into a broad syncline. The drainage of this province does not show the preferred NE-SW flow of the Valley and Ridge, but instead is random.

Farther to the northwest lies the Interior Low Plateaus (Figure 2.5-1). This province is about 300 miles by 300 miles and covers most of middle Tennessee and Kentucky. Toward the center of this province lie two large shallow basins called the Nashville basin and the Lexington plain. These two basins were formed by breaching and erosion along the Cincinnati Arch, and are underlain by the Nashville and Jessamine Domes. This province is underlain predominantly by Ordoviclian and Mississippian limestones. Drainage is at random. At the western edge of the region lies the East Gulf Coastal Plain along the Mississippi Embayment.

Immediately southeast of the Valley and Ridge Province lies the Blue Ridge Province, which is about 15 to 70 miles wide and extends for 600 miles from Pennsylvania to Georgia. Within the Blue Ridge are the highest mountains of the eastern United States with elevations generally ranging from 1,500 to 5,000 feet and reaching a maximum of 6,684 feet. These mountains are characterized by rugged terrain, heavily forested slopes, and rushing streams with waterfalls[84].

Farther to the southeast lies the Piedmont Province, which is about 40 to 130 miles wide, about 1,000 miles long, and extends from New York southwestward to Alabama. Surface elevations in the southern portion are about 1,000 feet near the border with the Blue Ridge and decrease eastward to about 500 feet near the Fall Line. Elevations gently decrease northward and are about 100 to 500 feet near the northern portion of the province. Erosion of the underlying saprolitic soils has produced a smooth, rolling landscape.

2.5.1.1.2 Regional Tectonics and Geology

The regional tectonics and regional geology of the Watts Bar Nuclear Plant are shown on Figures 2.5-4 and 2.5-2, respectively.

The Watts Bar Nuclear Plant site is located in the complexly folded and faulted Valley and Ridge Province of the Appalachian Highlands. Other physiographic divisions of the region are shown on Figure 2.5-1 and have been discussed in Section 2.5.1.1.1.

Within the site region (radius of 200 miles) sedimentary rocks from Tertiary to Precambrian age and igneous and metamorphic rocks of Paleozoic to Precambrian age are found (Figure 2.5-2).

In the Valley and Ridge Province, as well as the Appalachian Plateaus, Interior Low Plateaus, and Central Lowland Provinces to the west and northwest, sedimentary rocks of Paleozoic age predominate. In the Blue Ridge and Piedmont Provinces to the southeast, igneous and metamorphic rocks of Paleozoic to Precambrian age predominate. Tertiary rocks are present at the extreme south-southeastern edge of the region and Cretaceous aged rocks are found along the region's western edge.

As can be seen in Figures 2.5-2, 2.5-4, 2.5-7, and 2.5-8, most of the major faulting of the region lies within the Valley and Ridge Province. These northeast-southwest trending thrust faults were formed near the end of Paleozoic time when the part of the crust now represented by the Piedmont and Blue Ridge Provinces was pushed westward against the side of the geosynclinal trough that then existed in the northwestern part of the region.[52]

Insofar as the Watts Bar Nuclear Plant is located in the Valley and Ridge Province, the following discussion relates to that province.

Within the Valley and Ridge Province sedimentary rocks from Pennsylvanian to Cambrian age are found with those of Cambrian and Ordovician age predominating. In Tennessee, the Rome Formation and the Conasauga, Knox and Chickamauga Groups makeup the majority of the bedrock of the Valley and Ridge Province. They outcrop as repeated belts that trend NE-SW as the result of major Paleozoic thrust faulting from the southeast. The maximum exposed thickness of the Middle Cambrian Rome is about 1,200 feet. It is composed mostly of shales, siltstones, and sandstones. The Middle Cambrian Conasauga Group is mainly alternating shale and limestone along the southeastern border of the province and nearly all shale along the northwest border of the province. It is about 2,000 feet thick and forms the bedrock for the Watts Bar Nuclear Plant. The Knox Group is 2,500 to 3,000 feet thick and is of Late Cambrian to Early Ordovician age. It is mostly dolomite with some limestone.

The Chickamauga Group is Middle Ordovician in age and ranges in thickness from about 8,000 feet in the southeast to 2,000 feet in the northwest. It is mainly alternating layers of limestone, siltstone, and shale. Elsewhere in the Valley and Ridge, are sandstones, shales, and limestones of Late Ordovician to Pennsylvanian age.

The geologic structure of the Valley and Ridge is characterized by numerous elongate folds and thrust faults that trend northeast-southwest (Figures 2.5-7 and 2.5-8). In the southern section of the province the faults, and in most places the bedding, dip southeast. These orientations are the result of folding and fracturing during a mountain building episode 230 to 260 million years ago.[84]

There is no evidence that any of the thrust faults can be considered to be active faults still undergoing movement. Geologic evidence indicates that the final episode of movement occurred during the Pennsylvanian or Permian periods, or at least 230 million years ago.[107]

Rodgers[102] points out that:

> Southeast of the Cumberland Escarpment (the border with the aforementioned Appalachian Plateau Province) is a belt 16 to 20 miles wide in which almost all the rocks dip southeast, the rock sequences being repeated in belt after belt between southeast-dipping faults of large throw. Major folds are rare, and even smaller folds are found mainly close to the thrust faults. On the other hand, minor cross faults are common and minor thrust faults abundant, especially close to the major faults. The major faults that dominate this belt can be classed into three groups or families, here named after prominent members, the Kingston, Whiteoak Mountain, and Saltville families of faults. Almost all these faults bring up the Rome (Cambrian) for many miles, generally in the northeastern part of their courses; elsewhere the Conasauga Group or in places the lower beds of the Knox Group lie next southeast of them. Almost any formation above the Rome may lie next northwest; perhaps the Chickamauga limestone and its shale equivalents are the most common. In general, the dips of these faults are moderate, probably about parallel in any given area to the average dips of the rocks above them, but in several areas they are nearly horizontal.

Approximately one mile northwest of the Watts Bar Nuclear Plant lies the Kingston fault and about four miles to the southeast lies the Whiteoak Mountain fault. These faults are prominent members of two of the three families of faults that dominate Rodgers' "belt of dominant folding"--the Kingston, Whiteoak Mountain, and Saltville families. The Kingston fault begins in Anderson County, Tennessee and runs for about 175 miles southwest through Tennessee, across the northwest corner of Georgia and may extend into Alabama (Figure 2.5-7). The Whiteoak Mountain fault begins in southwest Virginia and extends for a length of about 235 miles southwestward across Tennessee into northwest Georgia.

The site is within the folded and faulted Southern Appalachian Structural Province. The province is dominated by thrust faults that extend parallel to the NE-SW regional strike for many miles[102] and is shown on Figures 2.5-7 and 2.5-8). Elongate folds, usually the synclinal limbs of broken anticline - syncline couplets, parallel the regional strike within the major thrust blocks (Figures 2.5-2 and 2.5-3). The region is also characterized by shear in the vertical plane normal to regional strike and overturning of folds to the northwest.

There are at least three contrasting models for the Late-Paleozoic Alleghanian deformation: a thin-skinned tectonic compression model, a thick-skinned tectonic compression model, and a thin-skinned gravity spreading and slide (or glide) model, each related to uplift of an eastern mobile thermal core.[83] Further discussion of this deformation will be presented in Section 2.5.1.1.4.

2.5.1.1.3 Regional Geologic Setting

The Watts Bar Nuclear Plant is located in the Valley and Ridge Province of the Appalachian Highlands. This province is made up of a series of folded and faulted mountains and valleys which are underlain by Paleozoic sedimentary formations totaling 40,000 feet in thickness[52].

The Valley and Ridge Province is bounded on the northwest by the Appalachian Plateaus Province, an assemblage of predominantly Mississippian and Pennsylvanian aged sediments which are basically flat-lying and form an abrupt escarpment along the border with the Valley and Ridge Province.

Farther to the west and northwest lies the Interior Low Plateaus Province of the Interior Plains. This province contains predominantly rocks of Ordovician through Mississippian age and again is basically flat-lying (Figure 2.5-2).

To the southeast the Valley and Ridge Province is bordered by the Blue Ridge Province which is made up mostly of Precambrian granite and gneiss and Late Precambrian sedimentary rocks somewhat metamorphosed but less so than the formations in the Piedmont Province (Reference 52 and Figure 2.5-2).

Along the western edge of the Blue Ridge Province, the lower Paleozoic formations of the Valley and Ridge Province are turned up steeply at the contact with the uplifted Precambrian rocks. In places this is a fault contact and provides a sharp structural boundary between the two provinces (Reference 52 and Figure 2.5-2).

Farther to the southeast, across the Blue Ridge Province, lies the Piedmont Province. The rocks here are mostly metamorphics, such as gneiss and schist, with some marble and quartzite, and were derived by metamorphism of older sedimentary and volcanic rocks. Some less intensively metamorphosed rocks, including considerable slate, occur along the eastern part of the province from southern Virginia to Georgia. This area, called the Carolina Slate Belt, makes up about 20% of the province. Another 20% of the province is granite, or granite gneiss.

Swingle[122] suggests that in regard to the geologic setting:

> The Appalachian Mountain System, the dominant tectonic element of the Southeastern U.S. extends from the Cumberland Plateau eastward to the Atlantic Coastal Plain. Composed of miogeosynclinal deposits to the west and eugeosynclinal rocks eastward many of the structural features of this system are generally inferred to have resulted from the presumably Late Paleozoic "Appalachian revolution." However, the sedimentary and deformational history of this region is quite lengthy, and also quite complex, extending from Late Precambrian throughout the Paleozoic. Evidence for Precambrian diastrophism and later periods of deformation including plutonism, vulcanism and metamorphism is found in the metamorphic and plutonic rocks as well as in the sedimentary sequences. After the Late Paleozoic deformation the mountain system was extensively eroded, peneplaned (perhaps three times) and the present landforms carved by differential erosion.

#### 2.5.1.1.4 Regional Geologic History

The Watts Bar Nuclear Plant area lies near the western border of what was the active portion of the Appalachia geosyncline during most of the Paleozoic Era. During the early portion of the era, in Cambrian time, sands and clays were deposited in shallow, muddy water and these consolidated to form sandstone and shales of the Rome Formation. The syncline gradually depressed and the sea became deeper and broader. At the beginning of the deposition of the Conasauga, the sea received a small amount of sand and much clay. The sediment load gradually changed until at the end of the Conasauga only limy deposits were being laid down. Throughout the succeeding Knox deposition, the sea was deep and still as indicated by the great thickness of limestones and dolomites that were deposited. At the close of the Knox, most of the area was uplifted slightly and exposed to erosion. By the Middle Ordovician the land had subsided again and was covered by a shallow and oscillating sea in which a great thickness of limestone and calcareous shale was deposited. At the end of Paleozoic time, during the Allegheny orogenic episode, the rocks at the site were folded and faulted and tilted to the southeast. Since the Paleozoic time, weathering and erosion have been the dominant geologic processes at the site with sediment accumulation being restricted to the alluvial and flood plain deposits of the Holston River.

Precambrian rocks of the region are exposed on the southeast side of the line trending northeast-southwest approximately 35 miles southeast from the site (Figure 2.5-2). They are located in the Blue Ridge and Piedmont Provinces. They have been faulted, fractured, folded and metamorphosed. Some of them appear to be igneous in origin and some sedimentary. Beneath all of the rocks exposed west of the Blue Ridge, at depths ranging from 2,500 feet to 18,000 feet, are rocks similar to those exposed in the mountains. Called the 'basement complex' these rocks underwent many changes in the more than one billion years since they formed.

Miller[84] points out that:

> The ancient basement complex is overlain in the easternmost counties of Tennessee by very old, less metamorphosed or otherwise altered sedimentary rocks of Precambrian age. These rocks form the majority of the Precambrian exposed in Tennessee and are collectively called the Ocoee series. Their age ranges from one billion to 600 million years. Most of these rocks appear to have formed in a marine or transitional environment and may have had an original combined thickness of 50,000 feet. It appears that some of the basement rocks of granitic composition were also once sediments that have been transformed by a long episode of pressure, heat, and chemical activity. Some of these crystalline rocks are, however, probably igneous in origin. Also exposed in northeastern Tennessee are lavas and tuffs in the Mount Rodgers Group. These rocks were formed by volcanoes, although the Mount Rodgers Group also contains some rocks of sedimentary origin.

Lower Cambrian rocks in Tennessee are in the Chilhowee Group. Their area of outcrop is restricted to the far eastern part of the state, where they form some of the more prominent mountains.

Miller[84] suggests that:

> These Lower Cambrian rocks in Tennessee, like those of the underlying Precambrian, indicate that there must have been land areas nearby to supply the great amounts of erosional debris making up the rocks. These sediments may have been derived from a continental area to the west and from volcanic islands to the east. If the continent of Africa was juxtaposed with North America at the time, the sediment could have come from that source.

Although no rocks equivalent to the Chilhowee Group are present beneath the Central Basin of the Interior Low Plateaus Province, post-Chilhowee Cambrian rocks are preserved there. They are presumed to be the equivalent of the Shady or Rome Formation and overlie a 'granite wash'- a weathered detritus of basement crystalline rocks. This indicates that the Nashville Dome (Figure 2.5-2) must have been part of an area above water at least as early as Late Precambrian time and was being eroded throughout Early Cambrian time. The products of this erosion were washed eastward to be incorporated in the thick wedge of sediments making up the Ocoee and Chilhowee rocks. Then beginning with the later part of Early Cambrian time, the seas advanced over the area that is now Middle Tennessee with associated deposition of carbonates with interbedded mud and sand. This was a shallow continental shelf environment.

With regard to the Ordovician period of the regional geologic history, Miller[84] suggests that:

The deposition of carbonates that began in Cambrian time continued into Ordovician time in what is now Tennessee. The rocks that formed from the sediments deposited from Upper Cambrian to Lower Ordovician time are called the Knox Group. These rocks are exposed over wide areas in the Valley and Ridge and extend beneath the surface throughout Tennessee and other areas of the east-central United States, although they are referred to by other names elsewhere... In the Valley and Ridge the Knox ranges in thickness from 2,500 to 3,000 feet, but it thickens progressively westward to 5,500 feet in northwest middle Tennessee.

The origin of dolomite, such as that in the Knox Group, has been the subject of much study. It appears that subtle changes in the environment of deposition and variations in the chemistry of sea water play a critical role in whether limestone or dolomite forms. Recent studies indicate that the calcium carbonate forms in a quiet, shallow water environment just below the lowest tides. Evaporation of magnesium rich sea water results in the alteration of this sediment to calcium magnesium carbonate (dolomite).

Emergence of the land in Tennessee at the end of the Early Ordovician exposed the carbonate sediments over many thousands of square miles. Weathering began immediately and cave systems began to develop. Many of these collapsed to form sinkholes. The irregular pattern of distribution of the Pond Spring formation indicates it may have been deposited in depressions (sinkholes) on the sea floor at the beginning of Chickamauga time. Also, the presence of extensive zones in the Upper Knox of angular fragments of rocks (breccia) have been interpreted by some as debris resulting from the collapse of cave roofs.

Subsidence of this weathered landscape began after an undetermined length of time. As the sea advanced over the area, lime sediment again accumulated. Rocks formed from this sediment are called the Chickamauga Group, which is about 2,000 feet thick. As it was being deposited in the northwest part of what is now the Valley and Ridge, the Athens shale was forming as a 7,000 foot thick wedge of mud sediment to the southeast. This mud represents an abrupt change in the sedimentation pattern in the area. One interpretation of this change is that a new land area to the east was formed by mountain building forces. This episode of deformation has been named the Blountian orogeny in Tennessee. The maximum deformation was to the northeast of Tennessee. Some of the structures in the Great Smoky Mountains are thought to be the result of this orogeny, although most of them are due to Late Paleozoic deformation.

As the sediments of the Chickamauga Group were being deposited in the east, lime was also being formed in shallow water westward in Middle Tennessee. The limestone beds formed from these sediments are now exposed in the Central Basin and are present in the subsurface beneath the Cumberland Plateau and Highland Rim surfaces.

Toward the end of the time during which the Stone River Chickamauga sediments were deposited, there was volcanic activity in what is now North Carolina and Virginia. Ash from these volcanoes was carried by winds across Tennessee and the seven state area where it settled in the sea and collected as distinct beds interlayered with the Chickamauga rocks in East Tennessee and those of equivalent age in Middle Tennessee. Such ash beds are now chemically altered and are called bentonites. They range up to several feet in thickness and are exposed in various places in the Central Basin and in the Valley and Ridge.

Toward the end of the Ordovician period there was uplift of the Nashville Dome in the western part of the region.

In the western part of the region, deposition of carbonate sediment continued into Silurian time although there was uplift with associated erosion in some places. Mud was sporadically washed into the sea, as evidenced by shales interbedded with Silurian age limestones. Depositional conditions were considerably different in East Tennessee in Silurian time. The Clinch sandstone appears to have formed as a beach deposit on the leading edge of a westward advancing sea.[84]

In East Tennessee, Silurian rocks are exposed only along the eastern Cumberland Plateau Escarpment and on a few other ridges in the Valley and Ridge. Silurian sediments were deposited elsewhere in this area, but structural deformation and erosion have made their original extent difficult to determine[84].

With regard to the Devonian period, Miller[84] suggests that:

> There was uplift in the land and some erosion at the end of Silurian time west of the present Valley and Ridge in Tennessee, but in most places it is not possible to determine how much, for two subsequent major episodes of erosion during the Devonian in some places removed all the rocks overlying the Middle Ordovician. In the Early Devonian... the lime that was collecting at the end of Silurian time continued to be deposited...
>
> When the Late Devonian sea advanced across the land, conditions had changed dramatically compared with other invasions of the ocean, and the environment was like few others in all the geologic history of this region. This sea eventually spread over much of the east-central United States, depositing a black, carbonaceous mud over hundreds of thousands of square miles. This black mud, containing rotted organic matter, became the Chattanooga shale... The Chattanooga has a maximum thickness of 1,850 feet in East Tennessee.
>
> Most of the sediment of the Chattanooga sea was fine mud, some derived locally from residual clays on the erosional surface, and some from land areas far to the east. At the base of the Chattanooga in some areas, and interbedded with the shale in others, is sandstone that was probably derived from nearby land areas such as islands created during the prior period of uplift.
>
> Radioactive dating of micas in the shale has shown an age of 340 million years before the present, or Late Devonian, for the Chattanooga. The problem of reconstructing the correct environment of its deposition is, however, more difficult. At the time of its deposition it apparently covered all of the Tennessee west of the Unakas. Erosion has removed the shale from West Tennessee, most of the Central Basin, and most of the Valley and Ridge where structural deformation of the region has further obscured its distribution.

With regard to the Mississippian period, Miller[84] suggests that:

> Deposition of greenish-gray mud marked the beginning of Mississippian time in Tennessee...
>
> Deposition of carbonate sediment continued through most of Mississippian time in this region and the environments in which the sediments collected were complex. Cross-bedding in some of the limestones indicates they formed in a zone of wave or strong current action. Other units seem to have been deposited in quiet water. Clastic sediments were also being carried into the sea by currents or by the wind, for there is considerable sand and shale in these rocks. These limestones, shales and sandstones have a combined thickness of more than 700 feet in Middle Tennessee and are as much as 5,000 feet in total thickness in East Tennessee.

> The last formation to be deposited in Mississippian time in Tennessee was the Pennington Formation. Some of the shale formed in a transitional environment and the presence of thin coal beds indicates some swamps existed. Most of the Pennington, however, is of marine origin. The shales were formed from mud washed in from land areas, and the limestone and dolomite zones represent times when the mud and silt were mostly absent. Mississippian rocks crop out over the entire Highland Rim. Some hills in the Central Basin underlie the entire Cumberland Plateau (beneath Pennsylvanian rocks) and are present on some ridges in East Tennessee.
>
> In summary, during most of Mississippian time in Tennessee, shallow seas, teeming with life, covered the area. There were shifting currents, migrating shorelines, and various sources of clastic sediment. Mississippian sediments once extended without break across what is now the Central Basin, but almost all have been stripped away by erosion. At the close of the period much of the land was nearly at sea level, with tidal flats and the beginnings of swamp forest into which mud was washed. Dying vegetation collected on the bottom of these swamps and eventually formed thin coal beds as the plant material was buried and compressed.

With regard to the Pennsylvanian period, Miller[84] suggests that:

> Pennsylvanian rocks in Tennessee are dominated by two major lithologies, sandstone and shale. There are lesser amounts of siltstone, conglomerate, and coal. From the study of the characteristics and inter-relationships of these rocks, their environments of deposition have been reconstructed.
>
> It appears that in many places there is no definite boundary between the Mississippian and Pennsylvanian systems in Tennessee. Such gradational conditions may be interpreted as migration of environments of deposition. There were advancing shorelines along which beach barriers existed, with lagoons or coastal swamps landward where mud and organic matter collected, and on the seaward side of the barriers carbonate and mud collected. Today these beach barriers are preserved as the dense cross-bedded locally pebbly sandstones we see on the Cumberland Plateau. The coals and shales interbedded with the sands formed in lagoons, swamps, and tidal flats. The Upper Pennington shales and carbonates were formed in a transitional and marine environment.
>
> Since there are numerous complex sequences of the sandstones, shales and coals in the Pennsylvania, they can be interpreted as oscillations of the shorelines and their adjacent environments...
>
> As the shoreline migrated, the near, relatively narrow beach area, together with tidal deltas, became extensive covers of sand which advanced over the muds formed in the lagoonal swamp areas.

Other features of the rocks exhibit more clues as to their origin. The effects of channeling in the rocks can be seen in several places. Some were caused by tidal scour cutting through the beach barrier, or by currents in the tidal flats behind the beach zones. In addition to the beach barrier sands, there were tidal deltas. These deltas were wedges of mostly sand created by tidal currents moving through gaps in the beach area. Similar channels in tidal deltas can be seen along the present Atlantic shores and other coastal areas.

Pennsylvanian time was generally very warm, perhaps tropical in this area, for there was profuse growth of the swamp forest. As this vegetation died, it collected on the swamp floor where it decomposed in a low oxygen environment. At first peat formed, and later, as mud washed over it or advancing sand bars encroached and covered it, the peat was compacted to form lignite. With the passage of time and greater compaction from more and more overlying sediment it became bituminous coal.

The original extent of Pennsylvanian sedimentation is not definitely known, but it is likely that sediments similar to those now preserved on the Cumberland Plateau extended completely across what is now the area of the Highland Rim and Central Basin and that they were connected to Pennsylvanian sediments preserved today in Western Kentucky... Although the former extent of these rocks east of the plateau is also unknown, they did extend at least 15 miles east of the Cumberland Plateau escarpment...

Not all of Tennessee was a great single swamp at any one time. But as the shorelines advanced or retreated, swampy areas developed throughout much of Tennessee and large parts of what is now the east-central United States. There are numerous coal beds in rocks of this age in Kentucky, Alabama, Georgia, the Virginias, Pennsylvania, and other eastern states.

Only the early part of Pennsylvanian history is recorded in rocks preserved in Tennessee. These sediments have a composite thickness of about 4,000 feet. Any younger rocks of this system that might have been deposited have been removed by erosion. Therefore, the topmost Pennsylvanian beds preserved mark the last known depositional history of the state during the Paleozoic Era. Toward the end of Pennsylvanian time, an episode of rock deformation began and profoundly altered the geologic structure...

With regard to the Late Paleozoic mountain building of the Southern Appalachians, Miller[84] stresses the plate tectonics theory as advocated by Dewey and Bird,[19] and suggests that:

The Appalachian Mountain chain has a long and complex history, with some deformation that occurred as early as Precambrian time. The last major episode of orogenic activity that affected the region of the Southern Appalachians occurred toward the end of the Paleozoic Era, when sediments that had been collecting along the eastern edge of North America for many millions of years were buckled and fractured into a long, high range of mountains. This mountain-building episode has been called the Allegheny orogeny, and it resulted in the basic structures of the Appalachian provinces from Pennsylvania southward into Alabama. The extent of deformation west and south of Central Alabama is not known because of the thick sequence of younger sediments overlying the structures.

One of the basic problems in understanding the complex history of the earth has been to explain adequately the origin of such great belts of folded mountains as the Appalachians. What forces could have warped and fractured many thousands of feet of sediments into lofty ranges of mountains? The movement of great plates of the earth's outer mantle and crust is a process that could have built such mountains. The concept that segments of the earth's 'skin' have, throughout geologic time, been floating or drifting like vast 'rafts' on a plastic zone in the mantle is not new. It was first suggested at the turn of this century. But the theory of plate tectonics, which refers to the movements and associated structures of these plates as an explanation for various features of the earth, has only recently been accepted. Essentially the concept involves the movement of major segments or plates of the earth's crust and the upper part of the mantle, with the plates colliding or sliding under or past each other in some places, and moving apart in others. The rate of movement is extremely slow--a maximum of about six inches per year. Yet in light of the vast length of time such movements have been occurring, this rate of movement can account for a great distance in a short geologic time span. For example, at this rate in only 10,000 years a plate could move a distance of one mile.

Where plates meet, the one composed of heavier material (oceanic crust, composed chiefly of basalt) slides under a plate composed of lighter material (continental crust, composed chiefly of granite). Where plates move apart, new material, in the form of molten rock, oozes up from the underlying mantle to fill the gap. The plates are apparently driven into motion by uneven heating within a plastic zone in the underlying mantle. The uneven heating creates movement called convection currents. An example of a 'gap' area today is the Mid-Atlantic Ridge, a sea floor mountain chain with a great rift valley in its center.

The Western and Eastern Hemisphere plates are moving away from each other along this rift. The material filling the gap is produced by volcanic activity such as that presently occurring in Iceland, which is centered on the rift. An example of plates meeting each other is the western coast of South America where the Pacific plate is 'diving under' that continent. A deep oceanic trench is present where the plates meet. There the leading edge of the South American plate is buckled into a great range of fold mountains, the Andes. There are also numerous earthquakes and much volcanic activity along this boundary.

Such regional structural features as the Appalachians can be explained by plate tectonics. This may be illustrated by the following sequence of events in Late Paleozoic (Permian) time. Movement of the oceanic plate toward the edge of the North American continental plate cause a down-warping of the sediments and the development of a trench along the plate boundary. The heavy oceanic crust (basalt) descended beneath the continent and was consumed in the underlying mantle, where it was melted in part to form magma. The beat of the molten material caused the mass to rise and form a 'swelling' above it. This upward movement initiated faulting by the pressure it created, and also some gravity sliding of sediments on the flanks of the uplifted mass. This molten mass also moved outward, away from the trench, creating lateral forces which caused thrust faults and folding toward the continental shelf area. Granite intrusions were also formed in the upper zone of the molten core (Piedmont granites).

The great folds and thrust faults now seen in the Unakas may have been formed in this general manner. The combined belts of Piedmont (overlain by younger sediments to the east), Blue Ridge (Unakas), Valley and Ridge, and Cumberland Plateau (that portion that is structurally deformed) are over 300 miles wide in some places. Such massive deformation over a length of at least 1,000 miles required enormous upward and lateral pressures. The present topography of the Unakas and Valley and Ridge is the result of the erosion of rocks uplifted, tilted, or folded linear belts of these rock in the valley have variable resistance to erosion, and the weathering-erosion processes have left more resistant units as ridges, but 'weaker' rocks have been cut into valleys.

The Cumberland Plateau marks the western-most deformation in Tennessee during the Allegheny orogeny, with thrust faults and bedding-plane faults extending well into this area. Some beds are vertical or are overturned.

By the end of Permian time the structural framework of the Southern Appalachians was nearly complete. During the next period, the Triassic, there was block faulting and some associated igneous activity to the east (from the Connecticut Valley to South Carolina), but it cannot be determined that this deformation had important effects on Tennessee rocks.

Although the present extent of Permian rocks in the Eastern United States is very restricted and none are present in Tennessee, this period was one of great importance in the geologic history of our state. After the Permian much of the eastern interior of the North American continent was above sea level never to be inundated to the present time. There began a long episode of erosion, lasting into Cretaceous time in West Tennessee and up to the present in East Tennessee. This represents a minimum of 135 million years with no preserved rock record. Only the features produced by mountain building and erosion give us clues as to what occurred during that great expanse of time in Tennessee.

In regard to the mechanics of Valley and Ridge deformation, Reference [98] suggests that:

> There are presently at least three contrasting models for the Alleghanian deformation: a thin-skinned tectonic compression model, a thick-skinned tectonic compression model, and a thin-skinned gravity spreading and slide (or glide) model, each related to uplift of an eastern mobile thermal core.[83]
>
> A thin-skinned tectonic compression model would consist first of uplift and thrusting in the eastern Appalachians. A thin slab of miogeosynclinal and shelf sediments many hundreds of square miles in extent would then be pushed westward and deformed from east to west above a regional decollement.
>
> A thick-skinned tectonic compression model would result from the generation of compressional forces in the eastern Appalachians (Piedmont-Blue Ridge) to such an extent that flowage and faulting were induced westward across the miogeosyncline to the shelf. Major faults would extend into the basement, and basement rocks would flow upward into the cores of Alleghanian anticlines.
>
> A gravity spreading and slide model requires vertical uplift in the eastern Appalachians. Rocks of the Cumberland Plateau, Valley and Ridge and Blue Ridge would slide westward above a regional decollement which had a net westward slope, and would be deformed from west to east when the block broke up along its toe.

The attitude of southern Appalachian thrust faults at depth has been of major concern to geologists during the past few decades. Rodgers argues that the major thrusts do not extend downward into the subjacent basement. Rather, he maintains that the faults flatten at depth in or beneath the Rome Formation, and extend under the Valley and Ridge as a regional decollement that separates sedimentary strata beneath the decollement and the crystalline basement rock from younger Paleozoic strata. Cooper, following the ideas of E. 0. Ulrich and Charles Butts, denies the regional decollement concept. Rather, he maintains that Appalachian folds and faults are rooted and reflect ancient movements in the subjacent basement. Geophysical studies have been used to illustrate both structural concepts. Sears and Robinson used gravity data to show that basement was involved under the Bane anticline in Virginia. Edsall has cast doubt on their findings with his seismic reflection study of the same structure. Watkins, using gravity and magnetic data, has supported the thin-skinned concept. A recent reflection seismic profile made in the site area by Geophysical Services Incorporated clearly supports the thin-skinned concept (Figure 2.5-160).

Articles that have been published regarding the Consortium for Continental Reflection Profiling (COCORP) reflection profiles support the concept of thin-skinned tectonics for the Appalachians. Brown and others,[156] and Cook and others,[157] in their abstracts submitted at the American Geophysical Union National Meeting in Washington, D.C. (May 27 to June 1, 1979), presented their interpretation that the Blue Ridge and much of the Piedmont are allocthonous and that the Brevard fault zone is rooted to a larger horizontal thrust. Cook and others subsequently published their findings in Geology.[157] TVA continues to support the thin-skinned concept and anticipates that future COCORP and other findings will prove this concept factual.

The oldest faults and folds of the Alleghanian orogeny are beneath the Cumberland Plateau and northwest side of the Valley and Ridge Province suggesting that thin-skinned gravity sliding was the mechanism of formation of Valley and Ridge structure[83]. Repetition of the Rome Formation on the seven thrust faults along the western side of the Valley and Ridge is evidence that a regional decollement extends under the Valley and Ridge in the Rome.

Pennsylvanian strata are involved in folds and faults on the northwest side of the Valley and Ridge, and Mississippian strata are broken and folded across the Valley and Ridge. This is evidence that latest Valley and Ridge deformation is post-Carboniferous. Coastal plain strate of Cretaceous age extend unfaulted across the Valley and Ridge in Alabama, and Triassic igneous dikes transect the Valley and Ridge in Virginia, proving the age of Valley and Ridge deformation is Permian (Late Paleozoic).

There is no direct evidence regarding fluid pore pressures in the Rome during sliding. However, if high pressure existed it seems likely that elevated pore pressures were in the Rome, which is considerably more sandy than the overlying Conasauga and probably had more porosity and permeability. The thick shales and limestones of the Conasauga could act as an excellent seal for any high pressure zone below. Upon thrusting, the seal eventually was broken, pore water could then escape, and movement no longer occurred in the decollement zone.

The Rome presently is highly indurated and well cemented. For this reason it is very unlikely that pore fluids could be reintroduced into the formation in sufficient quantities over a large region in order to reestablish the conditions that existed during thrusting. Before thrusting could resume, a tilt of the sedimentary units would have to occur (gravity slide model) or severe compressional forces would have to be initiated (thin-skinned compressional or thick-skinned compressional model). The tangential forces, whether compressional or gravity, that provided the impetus for thrust movements are very unlikely to recur.

Since early 1900, many prominent geologists, including Keith, Rodgers, Gwinn, Harris, King, Furguson, Milici, Miller, Stearnes, Wilson and Swingle, have recognized that the faults in the Valley and Ridge flatten with depth. The significance of the recent confirmation of the thin-skinned concept (Figure 2.5-160) is that the faults outcropping at the surface are not related to geologic structures in the basement. In 1973, G. D. Swingle estimated that basement surface to be at a depth of 13,000 feet. This means that the infrequent earthquakes which occur in the Valley and Ridge with normal hypocenters do not relate in any way with the ancient (noncapable) faults outcropping at the surface.

Further discussion of the Valley and Ridge faults is found in Section 2.5.3.

The Mesozoic Era was characterized within the region mostly by erosion that has continued until the present. However, deposits are found along the region edge from west-northwest to southwest along the Mississippi Embayment (Figure 2.5-2).

The Cenozoic Era is represented in the region only by the Tertiary deposits that lie at the extreme south-southeastern edge of the region.

2.5.1.1.5 Regional Lithologic, Stratigraphic, and Structural Geology

The majority of the bedrock within the Valley and Ridge Province is comprised of the Rome Formation and the Conasauga, Knox, and Chickamauga Groups. As can be seen on Figures 2.5-2, 2.5-3 and 2.5-9, these formations occur repeatedly in northeast-southwest trending bands as a result of Paleozoic thrust faulting that is described in Sections 2.5.1.1.2, 2.5.1.1.4, and 2.5.1.1.6.

The Rome Formation is Middle Cambrian in age and it is about 1,200-1,500 feet thick[33]. It is predominantly a variegated (red, green, yellow) shale and siltstone; however, there is gray, fine-grained sandstone in the middle and western parts of the Valley and Ridge and abundant limestone and dolomite in the eastern parts. The Rome is considered the basal sedimentary formation in the Valley and Ridge and as shown on Figure 2.5-3, at or near its base probably lies the 'sole fault' from which the major thrust faults emerge and come toward the surface. A complete discussion of the theory of this faulting is provided in Section 2.5.1.1.4. Beneath the Rome in the Valley and Ridge Province is the Precambrian 'basement complex.'

The Conasauga Group is Middle and Late Cambrian in age and is about 2,000 feet thick. It is composed mainly of shale and limestone in the southeastern portion of the province, and is predominantly shale near the northwestern border. The Knox Group is of Late Cambrian to Early Ordovician age and is 2,500-3,000 feet thick. The Knox in the center and northwestern belts of the Valley and Ridge is siliceous, well bedded, and predominantly dolomite, and magnesian limestone. To the southeast, much dark limestone is present and the rocks are only sparsely cherty.

The Chickamauga Group is of Middle Ordovician age and ranges in thickness from about 2,000 feet in the northwestern part of the region to about 8,000 feet in the southeastern part. It is composed of alternating layers of gray and maroon limestone, calcareous siltstone, and shale.

The remaining portion of the Valley and Ridge is underlain by sandstones, shales and limestones of Late Ordovician to Pennsylvanian age, and lesser amounts of Early Cambrian dolomite.

The geologic structure of the Valley and Ridge is characterized by elongate folds and thrust faults that trend northeast-southwest. The faults dip toward the southeast. Two geologic sections (Figures 2.5-3 and 2.5-11) are provided to show the structural relationships of the Watts Bar Nuclear Plant site to the region. Figure 2.5-3 is essentially normal to the regional trend and indicates the relationship of the Valley and Ridge to the adjacent Blue Ridge and Appalachian Plateau Provinces. Figure 2.5-11 is a geologic section through the site area and illustrates the structural relationship of the site to the site area. It also illustrates the relationship of the Kingston and Whiteoak Mountain faults to the site. Discussions of this faulting have been represented in Sections 2.5.1.1.2, 2.5.1.1.4, and 2.5.1.1.6.

Immediately southeast of the Valley and Ridge Province lies the Blue Ridge Province (Figure 2.5-1). Within this province, rock units predominantly consist of slate, phyllite, schist, gneiss, granite, pegmatite, and quartzite. These are Precambrian and Lower Paleozoic metamorphics generally of amphibolite grade. The schist and gneiss are considered the oldest rocks of the region[98]. Recent radiometric dating places the peak of Paleozoic metamorphism at a minimum of 430 million years before present (BP).[9] Pegmatites are younger with recorded age determinations of 380 million years BP.[9] The Blue Ridge Province is highly deformed and its northwestern boundary generally coincides with major faults, along which metamorphic rocks have been thrust to the northwest over younger unmetamorphosed sedimentary rocks of the Valley and Ridge (Figure 2.5-3).

Farther to the southeast lies the Piedmont Province (Figure 2.5-1) which is underlain by metamorphosed volcanic and sedimentary and igneous rocks (Figure 2.5-2). These rocks have been faulted and intensely distorted. Radiometric dates indicate that regional metamorphism occurred in this province at the time period of 300 to 520 million years BP[9].

Immediately northwest of the Valley and Ridge Province, lies the Appalachian Plateaus Province (Figure 2.5-1), which is underlain predominantly by sandstones, and shales of Pennsylvanian age (Figures 2.5-2 and 2.5-3). Rock strata are gently folded into a broad syncline (Figure 2.5-3).

Farther to the northwest lies the Interior Low Plateaus Province (Figure 2.5-1), which is underlain predominantly by sedimentary rock mostly limestone of Ordovician and Mississippian age with lesser amounts of sandstone and shale of Pennsylvanian age (Figure 2.5-2). The rock strata are gently inclined over the Cincinnati Arch, which includes the Nashville and Jessamine Domes (Figure 2.5-4).

2.5.1.1.6 Regional Tectonics

The tectonic map of the region surrounding the Watts Bar Nuclear Plant is given as Figure 2.5-4. This site is located in the folded and faulted Valley and Ridge physiographic province, as described in Section 2.5.1.1.1. This province is characterized by elongate northeast-southwest trending ridges and valleys formed by a series of echelon thrust faults that dip to the southeast and commonly cause the overturning of the strata to the northwest (Figures 2.5-3, 2.5-7, and 2.5-8). Immediately northwest of the Valley and Ridge Province lies the Appalachian Plateaus Province that regionally exhibits strata that are gently folded into a broad syncline. Farther to the northwest within the Interior Low Plateaus Province lies the Cincinnati Arch, a northeast-southwest trending arch with two structural domes, the Nashville and Messamine Domes, located on either end with the Cumberland Saddle between. To the southeast of the Valley and Ridge Province lies the Blue Ridge Province, composed of an assemblage of severely contorted Precambrian sedimentary and metamorphic rocks. Farther to the southeast, beyond the Bervard fault zone, lie the Paleozoic metamorphics and intrusives of the Piedmont. Swingle[122] describes the basic tectonic units of the region as follows:

## Cumberland Plateau

West of the Valley and Ridge this province is mainly comprised of relatively flat-lying Pennsylvanian and older sediments totaling a mile or more in thickness. The main structural features are the Pine Mountain and Cumberland overthrusts along which upper layers of the sedimentary sequence have moved short distances westward. A spectacular faulted anticline (Sequatchie) occurs near the middle of the region extending over 150 miles in Tennessee and Alabama. Its axis is nearly straight, paralleling the main structural lineament of the Appalachians, and is essentially horizontal. The fold is breached by erosion resulting in a valley, three miles or so wide, whose floor is 1,000 feet or more below the general level of the Plateau.

## Valley and Ridge

In this province, 40 or so more miles across in Tennessee, is a generally conformable sequence of Paleozoic (Cambrian to Pennsylvanian) sediments of varying thickness but which probably averages three or so miles. Imbricate thrusts, mainly southeast dipping, repeat segments of the sequence across the province. These faults are of large stratigraphic throw and some extend for hundreds of miles along the structural grain of the Appalachians. The faults in the southeastern portion of the province have in their thrust blocks clastic sediments which coarsen and thicken south-eastward in marked contrast to the generally carbonate sequence to the northwest. The Valley and Ridge rocks although folded tightly in places and locally strongly crushed, are relatively unmetamorphosed. Weak fracture cleavage is present in select rock types near the middle and eastern portions of the region but slaty cleavage has not been observed in the rocks of this province.

## Blue Ridge

This province can be conveniently divided into two north-east trending segments, one dominantly sedimentary in the northwest and the second, dominantly crystalline, to the southeast. The crystalline segment, about 30 miles wide at the latitude of Gatlinburg, is composed chiefly of mica, hornblende and other types of gneisses and schists plus granitic and ultramafic intrusives. These rocks are considered mainly Precambrian and at least in part constitute the basement complex upon which the sediments of the eastern Blue Ridge were deposited. The dominantly sedimentary portion of the Blue Ridge, near Gatlinburg, is Precambrain (with but minor early Cambrian rocks). Two sequences of chiefly clastic rocks are present, the Lower Cambrian Chilhowee Group, about a mile thick, which extends for several hundred miles eastern Blue Ridge, and the underlying Ocoee sediments which are really quite restricted. The Ocoee clastics are at least five miles thick and possibly twice this amount. They are, in contrast with the overlying Chilhowee, metamorphosed to slates, phyllites, and locally schists, and have obviously been deposited in quite a different environment than the overlying Paleozoic rocks.

The structural features of this portion of the Blue Ridge are world famous, this being the classic Appalachian area of tremendous overthrusts as evidenced by several fenster areas and klippen. The Grandfather Mountain Window, 75 miles northeast of Gatlinburg, is evidence of the 30 mile westward transport of the Blue Ridge. Near Gatlinburg the limestone-floored cove areas (Tuckaleechee, Cades, Wears, and others) are windows in the Blue Ridge thrust sheet and indicate westward horizontal movements approximating 10 miles.

Piedmont

This province, over 150 miles across, is the least deciphered of the Southern Appalachians. The surficial distribution of its rocks is generally known but their ages, stratigraphic, structural and metamorphic relationships are poorly understood. The Piedmont is commonly divided into somewhat linear belts which generally parallel the northeast strike of the Appalachians. From the Atlantic Coastal Plain westward to the Blue Ridge the more conspicuous of these belts are:

1. The Carolina slate belt, some 50 miles wide and having a strike length of over 400 miles. The rocks of this area are characteristically felsic and mafic volcanics intercalated with partly tuffaceous siltstones and slates. Their thickness is unknown but is probably over two miles. These rocks are but slightly dynamically metamorphosed but near plutons are strongly altered. Their age is unknown but they are presumably Precambrian or Early Paleozoic.

2. The Charlotte Plutonic Belt west of the slates is about 30 miles across and typified by rocks of approximately granitic composition. These intrusives are believed to be of Paleozoic age, possibly spanning several periods of that era.

3. The Kings Mountain Belt, a narrow dejective zone of Late Precambrian or Early Paleozoic quartzite, marble, conglomerate and schist, separates the slate belt and the Inner Piedmont.

4. The Inner or Western Piedmont, 50 miles wide, dominated by mica gneisses and schists. Here the regional metamorphism of the Appalachians peaks in the sillimanite-garnet zone. The age of the rocks of this area was long believed to be Precambrian but the possibility of a Paleozoic age is now entertained. Granitic rocks are also present here as well as significant ultramafic plugs and dikes.

5. The Brevard Belt separates the Inner Piedmont and Blue Ridge. This belt, a narrow zone of phyllite, schist and locally limestone, is characterized by its rocks being less metamorphosed than those in adjacent belts. Some workers surmise that this belt is a major fault zone; others believe it is synclinal.

As can be seen on Figure 2.5-2, most of the major faulting of the region lies within the Valley and Ridge Province. These northeast-southwest trending thrust faults were formed near the end of Paleozoic time, when the part above the crust now represented by the Piedmont and Blue Ridge Provinces, was pushed westward against the side of the geosynclinal trough that then existed in the northwestern part of the region.[52]

There were several episodes of tectonic activity during the Paleozoic Era. However, one episode caused the major deformations of the rock strata in the vicinity of the Watts Bar Nuclear Plant[107]. This is referred to as the Allegheny episode, which occurred during either the Pennsylvanian or Permian periods, at least 230 million years ago.

It is generally accepted that these thrust faults do not extend into the basement, but are bounded below by a lateral sole fault in some relatively incompetent formation above the basement. The consistent repetition of the Rome Formation as the basal formation of the thrust blocks substantiates that the thrust blocks do not extend to the basement. In 1973 G. D. Swingle[123] prepared a cross section within the central Tennessee section of the Valley and Ridge Province, which shows the basement to be at a depth of 13,000 feet and a sole fault to be at a depth of 9,000 feet. This recent publication supports the previous concept of a sole fault above the basement rooks.[145]

Additional discussion of these thrust faults concern their age and mechanics of formation and are found in Sections 2.5.1.1.2, and 2.5.1.1.4.

There are no specific leveling data which can be used to determine if regional uplift or subsidence is occurring in the area. However, if minor adjustments are occurring, they are regional phenomena whose effects would be uniform over the site and the surrounding area and no differential stresses would be imposed on the plant structures.

Consultation with members of the Tennessee Department of Transportation and inter-TVA organizations reveals no evidence of foundation stress relief resulting in the movement of any major structure, such as a bridge, dam, or steam plant within the Valley and Ridge.

Slightly acidic ground water produces solutioning in carbonate rocks. The extent of solutioning is dependent upon the mineralogic composition of the rocks. In those areas where the rooks are limestones and dolomites, solutioning is most severe. The degree of solutioning decreases as the rocks grade toward more siliceous and clayey sediments. In those sediments which do not contain carbonate materials, solution is negligible[98]. Solutioning in Valley and Ridge carbonates generally advances along structural features, such as joints and bedding[36, 50]. Advanced stages of solutioning produces nearly planar zones which diminish in size with depth.

Solutioning of carbonate rock is expressed at the ground surface by surface depressions and dropouts commonly referred to as sinks. Sinks generally result from the raveling of soil overburden into the underlying caves and fissures. The shapes of the sinks are governed by the extent to which raveling has progressed, and in the overburden thickness. As expressed above, the higher the carbonate content, the more extensive and severe is the solutioning. The rock at the plant is the Conasauga Formation, an interbedded limestone and shale. Severe karstic features typical of high carbonate rocks, such as the Knox, are not found anywhere within the Conasauga Formation.

There are no waste injection wells in use in East Tennessee, except at the Oak Ridge reservation, located approximately 35 miles to the northeast from the plant. Therefore, no problems will be encountered as a result of injection of materials into the subsurface strata.

No problems will be encountered by man's activities, such as mining or fluid extraction since none of these activities, except the removal of minor amounts of ground water, have been or will be carried on beneath any of the structures. Even if ground water were extracted near the plant, it would not affect the geologic competence of the foundations since we are dealing with highly consolidated hard rocks. Water beneath the plant site flows through fractures in the rock and in pore spaces in the overburden. The permeability of the foundation rock is low. A discussion of site ground water conditions is presented in Section 2.4.13.

TVA will assure that no mineral extractions will take place within the site exclusion radius.

Coal and petroleum are presently being extracted from beneath the Cumberland Plateau several miles to the west of the Watts Bar Nuclear Plant. But no known commercial quantities of either are known to exist in the Valley and Ridge Province of Tennessee[32]. There are no existing or abandoned coal mines, nor gas or oil wells, within five miles of the site.

2.5.1.1.7 Groundwater

The Watts Bar Nuclear Plant is regionally a part of the Valley and Ridge ground-water system, as described in Section 2.4.13. The source of recharge is precipitation, which averages about 50 inches annually, of which an estimated 8 to 10 inches reaches the water table. In this region, water levels normally reach peak elevations in February and March and are at minimum levels in late summer and early fall. Water occurs regionally under water table conditions and moves relatively short distances, generally less than one mile before being discharged to springs and watercourses. Most ground water occurrence and active movement are at depths of less than 300 feet.

Geologic formations of the region consist of dolomite, limestone, shale, and sandstone. Regionally, few of the shale formations and none of the sandstone formations have significant groundwater potential.

The most significant water bearing formation in the region is the Knox Dolomite, in which water occurs in solutionally enlarged openings formed along bedding planes and fractures. Discharge from the Knox is a major source of base flow in streams. Large springs, yielding a million gallons per day or more, are fairly common in outcrop belts of the Knox.

The Conasauga Formation, on which the plant site is located, is one of the poorer aquifers of the region and does not normally yield more than 10 gpm to a well.

### 2.5.1.2 Site Geology

#### 2.5.1.2.1 Site Physiography

The Watts Bar Nuclear Plant is located in the Tennessee section of the Valley and Ridge Province of the Appalachian Highland (Figure 2.5-1). The regional physiography has been discussed in Section 2.5.1.1.1.

The Watts Bar Nuclear Plant is located near the western edge at a shallow bend of the Tennessee River known locally as McDonald Bend. This bend is on the west side of the river and lies between river miles 528 and 529. The plant is located in Rhea County, Tennessee, about one air mile downstream from the Watts Bar Dam.

Figures 2.5-9 and 2.5-10 are submitted as a composite geologic map of the plant area and cover a radius of five miles from the site. Topography is shown on these figures based on a 20-foot contour interval. As can be seen on these figures, topography is controlled by the underlying formations. The plant is founded on bedrock that was overlain by alluvial terrace deposits with the average elevation around 735. To the west of the plant lie knobs of the Rome Formation reaching Elevation 900. A floodplain surrounds the bend on the inside of the meander. The general elevation of this flood plain is about 700. The general water surface of the Tennessee River is Elevation 683.

With regard to the age of these alluvial deposits, Rodgers[102] suggests that:

> Much of the bottom alluvium along the rivers and smaller streams is clearly very young, some bodies having been deposited in their present position within historic time. The older parts of it, however, may date back several tens of thousands of years. The alluvium of the terraces is older, of course, than the bottom alluvium, and that of the higher terraces than that of the lower. Though there is little direct evidence on the age of these deposits, they are probably largely, if not entirely, Pleistocene.

As shown on Figures 2.5-9 and 2.5-10, southeast across the Tennessee River are northeast-southwest trending ridges rising to Elevation 1100. Northwest from the plant lie knobs reaching to Elevation 1000.

2.5.1.2.2 Site Lithologic, Stratigraphic, and Structural Geologic Conditions

Of the numerous sedimentary formations of Paleozoic age in the plant area (Figures 2.5-9 and 2.5-10) only one, the Conasauga formation of Middle Cambrian age, is involved in the foundation for the proposed plant. At the site the Conasauga is overlain by high level terrace deposits laid down by the Tennessee River in one of its ancestral courses and by more recent alluvial deposits near the present lake shore. The Rome Formation underlies the Conasauga to the northwest and to the southeast, across Chickamauga Lake, the Conasauga in turn is overlain by limestone and dolomite of the Knox group. Neither of these formations will be involved in plant construction.

The unconsolidated deposits overlying bedrock are composed primarily of alluvial deposits on the elevated flood plain near the lake shore and terrace materials, deposited by the Tennessee River when flowing at a higher level, over the bench that covers most of the site area. The alluvium is composed of fine-grained, finely sorted, silts and clays, with micaceous sand and some quartz gravel. The thickness of the unit varies, but excavations showed an average thickness of 30 feet. Near the base of the terrace bench the alluvial deposits thin out to a feather edge. Included in the alluvial material are some fairly well defined beds of tough, blue-gray clay, containing carbonized fragments of wood. These are interpreted as old slough fillings.

The terrace deposits are much older than the recent flood plain deposits and their edge is marked by a distinct topographic bench some 30 feet high which lies from 200 to 1000 feet northwest of the edge of Chickamauga Lake. Drillings showed the thickness of the terrace deposits to vary from a minimum of 30 feet to a maximum of 46 feet.

Approximately the upper half of the unit is composed of sandy, silty, clay and the lower half is much coarser, consisting of pebbles, cobbles, and small boulders of quartz or quartzitic sandstone embedded in a sandy clay matrix.

In contrast to the conditions at the Sequoyah site, very little residual material derived from weathering of the underlying shale is present under the terrace deposits at the Watts Bar site. In excavations a foot or two of residual clay was encountered, but in most instances the terrace deposits are immediately underlain by a few feet of soft, but unweathered, shale.

In regard to the residuum, Rodgers[102] suggests:

> The residual mantle in East Tennessee, as elsewhere in the south, is commonly very characteristic of the individual formations over which it lies, and can often be used for their identification;... Relatively pure limestone and dolomite produce a deep fairly clay residuum, normally sharply set off from the bedrock... In places residuum over limestone or dolomite has accumulated to depths of hundreds of feet, especially where the bedrock contains chert, or silica that on weathering forms chert, so that the residuum is protected from sheet erosion... Impure limestone, on the other hand weathers less deeply (though equally irregularly); the weathered material is less sharply set off from the unweathered and commonly it grades from merely leached material next to the bedrock into thoroughly reconstituted residuum or soil toward the surface of the ground.
>
> Much of the generally shallow residuum over shale retains the original volume of the bedrock and such structures as bedding and fossils, but its calcium carbonate or other cementing material is leached, so that typically the rock is converted into weak, punky silty clay, and its iron is oxidized and redistributed along cracks. In

> general the residuum grades down into the unweathered shale. Over some shale the upper part of the residuum is more thoroughly broken down to a clay soil, but over much of it weathered shale chips persist to the grass roots and are turned up abundantly by the plow...

As to the age of the residuum, Rodgers[102] further reveals that:

> The age of the residuum is even less definite. Weathering is going on and presumably some residuum is being formed now...

As previously suggested by Rodgers[102], there is no sharp interface between the residuum and the sound rock. Instead, a variation of weathering conditions exists, grading from soil down to unweathered rock, unlike most limestone areas where sharp interface exists between soil residuum and virtually unweathered rock.

The bedrock at the site is the lower portion of the Conasauga Formation of the Middle Cambrian age. The Conasauga is of interbedded shale and limestone.

The shale, where fresh and unweathered, is dark greenish-gray to maroon, banded, and fissile. Because of the structural deformation to which the Conasauga has been subjected, the fissility of the shale is emphasized. In many instances the shale in cores from a structurally complex zone is recovered as fissile, platy fragments. The limestone interbeds are medium gray, medium crystalline, sandy and contain thin zones of glauconite grains scattered throughout. Thickness of the individual limestone beds is usually less than six inches.

The composite Geologic Map of the Plant Area is submitted as Figures 2.5-9 and 2.5-10. The subsurface geologic structure through this area is exhibited as Figure 2.5-11 entitled Geologic Section through the Plant Area. These three drawings are based on a circle of five-mile radius centered on the site.

As shown on Figures 2.5-9 and 2.5-10, approximately 1000 feet northwest of the plant is the inferred belt of the Rome Formation, which is subsequently in fault contact with the Chickamauga Group. Approximately one mile to the southeast lies the nearest outcrop of the Knox Group. Descriptions of these formations are provided on Figures 2.5-9 and 2.5-10.

The structural relationships of these formations to the site are shown on Figure 2.5-11. Insofar as they are quite distant from the site and are of no concern in regard to the plant, they will not be discussed further.

The presence of intense folding and minor faulting within the foundation bedrock at the Watts Bar Nuclear Plant is shown in Figures 2.5-109 through 2.5-138.

Cores taken from the site prior to excavation were contorted, folded, sheared, faulted, contained calcite-filled fractures and often contained slicken-sided bedding surfaces.

Dips of most cores (Figures 2.5-14 through 2.5-69) were taken periodically down the core and are shown on the geologic log. Cores frequently exhibited dips ranging from vertical to horizontal and containing every angle between. Abrupt changes in dip were seen in the cores, indicating minor faulting or shearing. Excavations revealed this to be the case. Geologic logs of borings are provided as Figures 2.5-14 through 2.5-69.

2.5.1.2.3 Site Structural Geology

The geologic structure, as well as the lithologic and stratigraphic sequences, have been discussed in Section 2.5.1.2.2 and will not be repeated here. Figures 2.5-9 and 2.5-10 present formation sequences and descriptions.

As was true at the Sequoyah site, the controlling feature of the geologic structure at the Watts Bar site is the Kingston fault. The trace of the fault lies along the prominent ridge approximately one mile from the site area (Figures 2.5-9 and 2.5-10). This is one of the major overthrusts characteristic of the Valley and Ridge province which developed at or before the close of the Paleozoic movement.

As shown on the geologic section on Figure 2.5-11, the Kingston fault dips to the southeast, under the plant site, and along it steeply dipping beds of the Rome Formation have been thrust over gently dipping strata of the Chickamauga Limestone. The distance of the fault from the plant site, slightly over one mile, and the dip of the fault plane, 30° or more, indicate that the plane of the fault is at least 2,000 feet deep at the site.

The highly deformed character of the Conasauga Formation at the Watts Bar site is a function of its lithology and structural history. Lithologically, the formation consists of several hundred feet of interstratified shale and limestone. In the plant site area, shale beds make up 84% of the formation and limestone beds the remaining 16%. The shale strata are much less competent than the interstratified limestone strata. The general strike of the strata is N30°E, and the overall dip is to the southeast, but the many small, tightly folded, steeply pitching anticlines and synclines result in many local variations to the normal trend.

Stratigraphically, the Conasauga Formation is overlain by 2,500 to 3,000 feet of massive dolomite and limestone of the Knox Group and is underlain by 800 to 1,200 feet of sandstone and shale of the Rome Formation. Sometime in the course of the Appalachian orogeny, these formations were thrust northwestward on the Kingston thrust sheet, which overrode the underlying rocks for an undetermined distance. Before the thrusting ceased, the belt of Conasauga on which the plant site is located was compressed between the two massive blocks of the much more competent underlying Rome Formation and the overlying Knox Group. As a result of the very marked difference in competency between the limestone and shale in the Conasauga, and the much greater disparity between the competency of the Rome and Knox and that of the Conasauga, the latter was folded, contorted, crumpled, sheared, and broken by small faults.

2.5.1.2.4 Surface Geology

An area based on a circle of a five-mile radius extending from the site was mapped in detail and presented as Figures 2.5-9 and 2.5-10, Geologic Maps of the Plant Area. These two figures each contain segments that together cover the area investigated.

The geologic findings presented on Figure 2.5-11 conform with the previous broad interpretations of the Tennessee Division of Geology's published and unpublished field sheets, Rodgers[102], and TVA file maps of the Watts Bar area. These sources of information were consulted frequently during the course of the mapping program. All strikes and dips represent locations of actual data collection by TVA, although more were collected and plotted but for the sake of clarity only the representative ones were plotted on the final drawings. Dashed lines indicate approximate contacts and dotted lines represent inferred contacts. Detailed mapping of the foundation bedrock was performed by the project geologist and maps, sections and photographs are submitted as Figures 2.5-110 through 2.5-138.

2.5.1.2.5 Site Geologic History

The geologic history of the area including the site is discussed in Sections 2.5.1.1.2, 2.5.1.1.5 and 2.5.1.1.6. The depositional and tectonic history described in these sections apply to the site as well and will not be repeated here.

The Watts Bar Nuclear Plant area has been above sea level since at least the close of the Paleozoic Era, and the present physiographic configuration is the result of erosional processes over the last 230 million years.

Rodgers[102] points out that:

> The age of the Valley Floor and associated surfaces is not certain; the relatively small amount of subsequent erosion argues for a Late Cenozoic through pre-pleistocene age, but certain sinkhole deposits found on the Valley Floor surface are thought to be very Early Cenozoic...
>
> No evidence of the age of the Upland surface can be obtained in East Tennessee and vicinity, but it must be much older than the Valley Floor surface.

The local stratigraphic sequence is provided on Figures 2.5-9 and 2.5-10. This is a composite explanation for both figures, as described in the figure notes.

2.5.1.2.6 Plot Plan

The site was first explored in 1950 when twenty holes, totaling 580 feet, were drilled. Subsequent work was done in June, 1970, when 49 top of rock determinations were made by refraction seismic methods. Core drilling of 56 holes was begun in July, 1970, and continued into September, 1970. Drilling was performed using NX-wire line core drills. Drill layouts are provided as Figures 2.5-12 and 2.5-13. Special studies consisting of borehole television observations of selected core holes, down hole elastic moduli determinations, Menard pressure bulb tests, and cross-hole rock dynamic studies were carried out and are submitted as Figures 2.5-70 through 2.5-109.

Excavation maps, sections, and photographs are supplied as Figures 2.5-110 through 2.5-138.

2.5.1.2.7 Bedrock Foundation Characteristics

Figures 2.5-110 through 2.5-111 show the relationship of the Category I structures and Turbine Buildings to the underlying geologic conditions. The in situ engineering characteristics of the bedrock beneath the two reactors are provided on Figure 2.5-109. These surveys were performed using the cross-hole velocity technique between selected drill holes in each reactor.

Rock properties are discussed in Sections 2.5.1.2.12 and 2.5.4.2.2.

2.5.1.2.8 Excavation and Backfill

Reference Section 2.5.4.5.

2.5.1.2.9 Evaluation of Geologic Conditions

Behavior of surficial material and substrata during earthquakes can only be inferred in a general way, because no evidence of movement in recent times has been found, as discussed in Section 2.5.1.1.2 through 2.5.1.1.6. The fact that the site is located in the folded and faulted Valley and Ridge Province indicates that the area was subjected to movement, which has been previously discussed and dated as pre-Mesozoic.

As shown on Figures 2.5-110 through 2.5-138, faults and folds exist in the foundation bedrock. The mechanics of this folding has been related to stresses imparted during the Paleozoic when the less competent Conasauga Formation was folded between two competent formations - the Knox above and the Rome below. The mechanics of this folding has been discussed fully in Sections 2.5.1.2.2 and 2.5.1.2.3. Age dating of wood particles from the terrace deposits at Watts Bar indicated the terraces are at least 32,400± years BP. Although faults were seen in the Watts Bar bedrock, none were seen to intersect or offset the overlying terrace deposits. Therefore the minimum age of the faults is considered to be 32,400 years BP. Further discussion of these faults and age dating methods is in Section 2.5.3.2.

Weathering was seen to be structurally controlled in the bedrock at the Watts Bar Nuclear Plant. At the plant the weathering was seen to extend more deeply into the troughs of tight synclinal folds than into the rocks beneath anticlinal folds. This is because the weathering solutions can more easily penetrate down the bedding toward the bottom of the syncline.

As a result of removing approximately 40 feet of overburden in the general plant area, destressing of the freshly exposed shale caused some local raveling. Tests and experience both showed the raveling to be a function of destressing rather than air slaking and weathering processes normally associated with the degradation of shale.

The de-stressing process was restrained by requiring all horizontal surfaces to be covered with at least 4 inches of concrete within 48 hours after completion of excavation to final grade. In general, complete coverage of horizontal surfaces was accomplished within 8 hours after excavation to final grade. Cleanup before placement of concrete was done with hand labor and light air or water jets so as to not disturb the shale left in place. Vertical surfaces were covered within two weeks after exposure with a cast-in-place concrete wall.

No problems will be encountered by man's activities such as mining or fluid extraction or injection, since none of these activities, except the removal of minor amounts of ground water, have been or will be carried out beneath the structures. Even if ground mater were extracted near the plant, it would not affect the geologic competence of the foundation because of the consolidated hard rock condition. Further discussions of fluid extraction or injection and mineral extraction have been discussed in Section 2.5.1.1.6.

For soil properties see Section 2.5.4.2.1.

#### 2.5.1.2.10 Groundwater

Groundwater occurs under water-table conditions in very small openings along fractures and bedding planes in the Conasauga Shale. The porosity appears to be very low, probably not in excess of 0.01%. The thickness of the water-bearing zone in bedrock is less than 50 feet.

Water occurs in the alluvial material overlying bedrock in pore spaces between particles. Because of small grain size and poor sorting, this material is poorly water-bearing. Average saturated thickness is about 23 feet.

The average depth to the water table in the plant area in the period of high water levels is 11 feet. Groundwater discharge is to Chickamauga Lake or to Yellow Creek and its tributaries.

#### 2.5.1.2.11 Geophysical Surveys

A Regional Bouguer Gravity Anomaly Map and a Regional Magnetic Map are presented as Figures 2.5-5 and 2.5-6, respectively. No significant site-related anomalies are indicated on either map.

Dynamic studies were initiated at the Watts Bar site to obtain data for computation of elastic moduli for earthquake design criteria. Laboratory tests were deemed inadequate because of a wide variation in the attitude and physical character of the rock. Tests consisted of the following:

1. Continuous logging procedures for seven holes located in the reactor, turbine and Auxiliary Buildings (Figure 2.5-70).

2. Cross hole shooting at one location within each of the reactor foundations (Figure 2.5-109).

The seven test hole series was done by the Birdwell Division of Seismograph Service Corporation. Using their standard 3-D velocity, gamma-gamma density, and caliper logging tools to make velocity, bulk density, and hole diameter measurements. Cross hole surveys were made by TVA using a Hall-Sears MP-4 type geophone coupled to a Geo Space GT-2B refraction seismograph and Model DRO-6-32 recording oscillograph.

Results of Dynamic Testing Program

The Birdwell 3-D velocity system produced excellent records, but they were unable to differentiate shear wave arrival times. In the folded shale strata, the shear wave velocity is probably very close to the compressional wave velocity of the water filling the holes, thus masking the shear arrival times. To offset the lack of true shear velocities, Birdwell applied an empirical formula using compressional velocities and bulk densities to derive shear velocities. The Birdwell survey gives detailed information on the elastic properties of the foundation rock. This information is presented in the form of strip logs and computer printouts in Figures 2.5-71 through 2.5-108. No attempt was made to record shear velocities in the cross hole studies; however, compressional velocities were very close those computed by Birdwell. Cross hole data are presented in Figure 2.5-109.

#### 2.5.1.2.12 Soil and Rock Properties

Uphole logs were run on seven of the core holes and the results are provided on the individual geologic logs and printouts (Figures 2.5-71 through 2.5-108). Dynamic moduli were determined using the cross-hole technique and the results are provided as Figure 2.5-109.

Additional rock properties as well as soil properties are discussed in Section 2.5.4.2.

## 2.5.2 Vibratory Ground Motion

### 2.5.2.1 Seismicity

The evaluation of the earthquake hazard at the Watts Bar site involves consideration of the seismic history not only of the immediate area but of the entire southeast and adjacent areas. The most seismically active areas in the region under consideration are:

1. The Upper Mississippi Embayment, Especially the New Madrid Region of Arkansas, Kentucky, Missouri, and Tennessee

   This region has been active seismically since the appearance of Europeans and very probably long before that. A few great earthquakes and thousands of light to moderately strong shocks have been centered in the Upper Mississippi Embayment area[95,120]. Light to moderate shocks are still occurring at a frequency of a few per year in this zone. The 1811-1812 epicentral area is 285 miles west-northwest of the Watts Bar site and the only site effects have been and would be the attenuated effects from major events in the New Madrid area.

2. The Lower Wabash Valley of Illinois and Indiana

   This area has been the focus of several moderately strong historic earthquakes. Here again, the only effects at the Watts Bar site from future shocks epicentered in this area would be greatly attenuated as the mouth of the Wabash River is 235 miles to the northwest.

3. South Carolina Area

   There is an apparent zone of seismic activity extending from Charleston, South Carolina, on the southeast northwestward across the Piedmont.[1] One of the country's greatest earthquakes occurred near Charleston in 1886.[21] Minor to moderate shocks have occurred subsequently along this alignment. Charleston is 285 miles southeast of the Watts Bar site and effects from any major shocks in this zone would be attenuated in the site area.

4. Southern Appalachian Tectonic Province

   This zone extends from central Virginia to central Alabama from the western edge of the Piedmont across the Cumberland Plateau. The Watts Bar site lies within this province which is a region of continuing minor earthquake activity. Light to moderate shocks occur at an average frequency of one or two per year. The activity is not uniform, as periods of several shocks per year are followed by periods of no perceptible shocks.

In addition to these four major areas, shocks of light to moderate intensity from widely scattered epicenters have occurred at other localities in the southeastern United States.

The destructive and near destructive earthquakes in the United States through 1972 (as compiled by the U.S. Geological Survey) are shown on Figure 2.5-146.

Figures 2.5-161 through 2.5-184 list in chronological order seismic events that have occurred within an approximate 250-mile radius of the Watts Bar site, as well as larger events beyond the 250-mile radius which have affected the site.

Of the events listed in the tabulation, only 40 are known, or can reasonably be inferred to have been felt at the Watts Bar site, and five of these events were major shocks at distances of over 250 miles from the site.

An annotated list of the earthquakes which have affected the Watts Bar site follows:

| | |
|---|---|
| December 16, 1811 | 36.6°N - 89.8°W |
| January 23, 1812 | 36.6°N - 89.8°W |
| February 7, 1812 | 36.6°N - 89.8°W |

These were the strongest shocks of the great series of earthquakes of 1811-1812 centered in the Mississippi Valley and known collectively as the New Madrid earthquake. This series consisted of thousands of individual shocks and the three strongest have had an intensity of MM XII assigned to their epicentral areas, and were felt over an area of about 2,000,000 square miles. According to isoseismal maps (Figures 2.5-147 and 2.5-148) the strongest shocks of this series resulted in intensities of MM VI in the Watts Bar area.

January 4, 1843 35.2°N - 90°W

A severe earthquake centered in the Mississippi Valley was felt over some 400,000 square miles in a 12-state area. Chimneys were thrown down in Memphis, Nashville, and St. Louis. The intensity was perhaps as high as MM X in the epicentral area. This shock was perceptibly felt over the entire Tennessee Valley and may have had an intensity as high as MM IV or V in the Watts Bar area.

August 31, 1861 36.6°N - 78.5°W

An earthquake with an epicentral intensity of MM VI near Wilkesboro, North Carolina, affected an area of 300,000 miles[49]. The intensity at the Watts Bar site is from the felt area map (Figure 2.5-149) to have been MM II - III.

August 31, 1886 32.9°N - 80.0°W

The great Charleston, South Carolina, earthquake was felt over the entire eastern United States. Its maximum intensity in the epicentral area was MM X, but in the Watts Bar area it was MM VI (Reference 21 and Figure 2.5-150).

October 31, 1895 37.0°N - 89.4°W

A strong earthquake centered at Charleston, Missouri, affected an area of 1,000,000 square miles in 23 states. It threw down chimneys and damaged buildings at various places in the Mississippi Valley, including Memphis, Tennessee. The earthquake was felt over the entire Tennessee Valley, but it was of low intensity in eastern Tennessee.

May 31, 1897 37.3°N - 80.7°W

The Giles County, Virginia, quake of May 31, 1897, is reported to have been the maximum event to have occurred in the Southern Appalachian Tectonic Province. Hopper and Bollinger[49] indicate that the felt area was approximately 280,000 square miles. They evaluate the intensity as having been MM VII to MM VIII. Earlier sources, as summarized in the 1965 edition of "Earthquake History of the United States, Part 1" by R. A. Eppley,[22] had assigned a maximum intensity of MM VIII to this event. In the 1973 edition of "Earthquake History of the United States" by Coffman and von Hake,[14] the maximum intensity has been downrated to MM VII. This was done apparently on the size of the felt area, which more nearly approximates the felt area to be expected in the eastern United States from a MM VII event than from a MM VIII event.

The isoseismal map (Figure 2.5-149) indicates that the Watts Bar site lies near the MM IV - MM V boundary so the intensity experienced at the site was either a low MM V or a high MM IV.

May 29, 1902 35.1°N - 85.3°W

A "strong shock" (intensity V) shook houses and awakened sleepers in Chattanooga.[22,87]

October 18, 1902 35.0°N - 85.3°W

A moderate shock affected some 1,500 square miles in Georgia and Tennessee. It was felt from Dalton to Chattanooga. The maximum intensity was IV-V, but is not known to have been felt as far to the northeast as the Watts Bar plant site[22,87,131].

March 4, 1904 35.7°N - 83.5°W

The epicenter of this earthquake was between Maryville and Sevierville, but the disturbance was felt along the mountain front over a distance of 90 to 100 miles. The shock affected an area of about 5,000 square miles, but the intensity was nowhere above V and over much of the felt area it was much lower[22,87,131].

March 28, 1913 36.2°N - 83.7°W

This event with an epicentral intensity of MM VII occurred a few miles northeast of Knoxville, Tennessee. Although it was of moderately strong intensity, it only affected an area from 2000 square miles[87] to 2,700 square miles[1]. It is probable that the intensity at Watts Bar was MM III or less.

April 17, 1913 35.3°N - 84.2°W

This moderately strong earthquake was felt over an area of about 3500 square miles in eastern Tennessee, western North Carolina, northern Georgia, and northwestern South Carolina. The intensity was higher (V-VI) along the major axis of the affected area between Ducktown and Kiser. As shown by the map (Figure 2.5-151), the earthquake was not felt in the Watts Bar area, but it was felt some miles away.[20,22,87]

May 2, 1913 35.5°N - 84.4°W

A light shock of several seconds duration was felt near Madisonville, Tennessee. This shock, intensity III, was centered approximately 35 miles from the plant site.[114,131]

January 23, 1914 35.6°N - 85.5°W

A sharp local shock (V) was felt at Niota and Sweetwater, some 25 miles from the plant site[22,76,114,131].

February 21, 1916 35-5°N - 82.5°W

This strong earthquake, intensity VII, was centered in the mountains of western North Carolina. It affected an area of 500,000 square miles in the Carolinas, Georgia, Tennessee, Alabama, Kentucky, and Virginia. It was felt over nearly all of Tennessee, but was most severe in the mountains of eastern Tennessee. Chimneys were damaged at Sevierville and plaster was shaken from walls at Bristol, Morristown, and Knoxville. At Memphis, there was considerable motion in the higher stories of buildings. The earthquake affected the Watts Bar area at intensities between III and IV (Figure 2.5-152).[22,51,124]

October 18, 1916 33.5°N - 86.2°W

A strong earthquake centered near Easonville, Alabama, was felt over an area of 100,000 square miles in a seven-state area. About two-thirds of Tennessee was affected by this earthquake, but there was no damage in the state. The disturbance was felt strongly at Chattanooga, Nashville, Waynesboro, Carthage, Sparta, McMinnville, Lewisburg, and other points in central Tennessee. A light shock was noticed in Knoxville and Clinton. At the Watts Bar plant site, the intensity was not more than III (Figure 2.5-153).

June 21, 1918 36.1°N - 84.1°W

Centered near Lenoir City, this moderate shock (IV-V) affected an area of 3,000 square miles. The epicenter was about 30 miles from the Watts Bar area and probably had an intensity not exceeding III at the Watts Bar site[22,76,87,131].

December 24, 1920 36°N - 85°W

A moderately strong shock was felt at a number of localities in eastern Tennessee including Rockwood, Glen Alice, Spring City, Harriman, Decatur, and Crossville. Many sleepers were awakened and the entire village of Glen Alice was aroused. This earthquake, with a maximum intensity of V, was centered about 25 miles from the Watts Bar plant site and is not known to have affected the site area.[22,114,131]

December 15, 1921 35.8 °N - 84.6°W

An earthquake of "considerable intensity" was felt along the western portion of the Appalachian Valley from Kingston and Rockwood to Decatur and Dayton and as far eastward as Athens. The maximum intensity was V, with the epicenter located approximately 15 miles northeast of Watts Bar. This shock probably resulted in the highest intensity (IV-V) at the site from a nearby earthquake[87,88,114,131].

October 20, 1924 35.0°N - 82.6°W

A strong earthquake (V-VI) centered in Pickens County, South Carolina, was felt over 56,000 square miles in the Carolinas, Georgia, Tennessee, Virginia, and Florida. Although buildings were strongly shaken in the epicentral area, there was little damage. The intensity in eastern Tennessee was nowhere greater than III. At the Watts Bar plant site, the intensity was less than II (Figure 2.5-154).[22,87,93,115]

October 8, 1927 35.0°N - 85.3°W

A moderately strong earthquake was felt in all parts of Chattanooga and suburban areas, including North Chattanooga, East Ridge, Lookout Mountain, Signal Mountain, St. Elmo, and Red Bank. The shock was felt in small and large buildings. Lights trembled and loose objects were disturbed. Other mild shocks were reported within a few hours following this shock. The shock is not known to have been felt in the Watts Bar area.[87,115]

November 2, 1928 35.8°N - 82.8°W

A strong earthquake centered in the mountains of Madison County, North Carolina, was felt over an area of 40,000 square miles in a six-state area. The maximum intensity was VII, but in Tennessee the intensity diminished from VI along the state line to extinction somewhere in central Tennessee. At the Watts Bar plant site, the intensity was less than III.[22,91,127]

August 30, 1930 35.9°N - 84.4°W

This earthquake was felt at Kingston, Lenoir City, Lawnville, Oliver Springs, and other points west and southwest of Knoxville. The maximum intensity was V. The epicenter was located 30 miles northeast of Watts Bar and probably the intensity did not exceed III to IV at the site.[114,127]

March 31, 1938 35.6°N - 83.6°W

An earthquake centered in the mountains in the Little Tennessee Basin was widely felt in Tennessee and North Carolina. In Tennessee it was felt at Copperhill, Parksville, Knoxville, and Sweetwater where the intensities ranged from III to I. The shock is not known to have affected any part of Tennessee west of Sweetwater.[87,127]

October 19, 1940 35.0°N - 85.0°W

An earthquake which shook houses and rattled loose objects awoke thousands of sleepers in Chattanooga. It affected some 1,100 square miles in Tennessee and Georgia. It was felt as far north as Charleston and Birchwood but at very low intensities (Figure 2.5-155). It was not reported to have been felt in the Watts Bar area.[81,114,127]

September 8, 1941 35.0°N - 85.3°W

An earthquake was felt throughout Chattanooga and as far west as Jasper. It was especially strong in the Lookout Mountain area where walls vibrated, loose objects rattled, and glassware was broken. This earthquake is not known to have been felt upstream from Chattanooga.[114,127]

June 14, 1945 35.0°N - 84.5°W

This shock, centered near Cleveland, Tennessee, where the intensity was V, was felt over an area of 4,000 square miles in southeastern Tennessee and northwestern Georgia. It was felt northeastward to Knoxville, southwestward to Chattanooga, and southeastward to Blue Ridge, Georgia. The felt area of this shock was never mapped, but the shock may have affected the Watts Bar area at an intensity of III or less[22,127].

April 6, 1946 35.2°N - 84.9°W

Another light shock was felt at Cleveland, Tennessee. This shock was not reported felt outside of the city.[127]

December 27, 1947 35.0°N - 85.3°W

A light earthquake (IV) felt in Chattanooga, Tennessee, and Fort Oglethorpe, Rossville, Ringgold, and Boynton, Georgia, affected an area of 300 miles. It was centered east of the Missionary Ridge fault, where houses shook, loose objects rattled and piano wires popped. The shock is not known to have been felt any nearer to Watts Bar than Chattanooga[114,127].

January 22, 1954 35.3°N - 84.4°W

A light earthquake was felt over much of McMinn County from Athens to Etowah and Englewood. It is not known to have been felt outside of the county.[87,127]

September 7, 1956 35.5°N - 84.0°W

A quake of epicentral intensity MM VI centered between Knoxville, Tennessee, and Middlesboro, Kentucky, was felt over an area estimated to have been from 8,000 square miles[1] to 10,000 square miles[9] in Tennessee, Kentucky, North Carolina, and Virginia. The Watts Bar site lies outside the limits of the felt area.

June 23, 1957 35°54'N - 84°14'W

A light local earthquake was felt in western Knox County and nearby sections of Anderson and Loudon Counties. At Dixie Lee Junction and in neighboring communities, people were awakened by the 'jumping' of houses and the rattling of loose objects.[114,127]

June 12, 1959 35°21'N - 84°20'W

A light earthquake was felt over an area of 900 square miles in eastern Tennessee and western North Carolina. It was most strongly felt at Tellico Plains and Mount Vernon where an intensity of IV was attained.[127]

April 15, 1960 35.8°N - 83.9°W

A shock of intensity V, centered near Knoxville, Tennessee, was felt over a 1,300 square mile area. In the vicinity of Watts Bar the intensity was not more than II to III.[87]

August 24, 1966 35.9°N - 83.9°W

There is no record that this shock of intensity IV, centered near Knoxville, Tennessee, was felt in the Watts Bar area.[87]

November 9, 1968 38.0°N - 88.5°W

This earthquake, centered in southern Illinois, with an epicentral intensity of VII was felt over a 400,000 square mile area in 23 states, including Tennessee, and in Canada. In the Watts Bar area it had an approximate intensity between II and III (Figure 2.5-156).[26,87]

July 13, 1969 36.1°N - 83.7°W

The epicenter of this intensity IV shock was located northeast of Knoxville, Tennessee. There is no record of this shock being felt in the Watts Bar area (Figure 2.5-157)[87].

November 19, 1969 37.4°N - 81.0°W

This intensity V shock, with its epicenter in southern West Virginia, was felt in Knoxville, Tennessee, with an intensity between II and III. There is no indication it was felt at the Watts Bar site (Figure 2.5-158)[4].

November 30, 1973 35.8°N - 84.0°W

This shock affected a relatively small area in and around Maryville, Tennessee with an intensity of MM VI; however, the felt area was approximately 25,000 square miles in Tennessee, North Carolina, Georgia, South Carolina, Virginia, and Kentucky.[5,6,89] The isoseismal map (Figure 2.5-159) indicates that the intensity at the Watts Bar site did not exceed MM IV and may have been less. This event is of interest in that after-shock measurements indicate the possibility of a hypocentral depth of less than four kilometers. For other shocks in the region hypocenters have been reported at depths of over five kilometers, indicating that the energy release normally occurred in basement rocks (+15,000 foot depth) below the sedimentary cover.

Light shocks have been centered in the Chattanooga area, near Cleveland, and in the Rockwood-Spring City area near the site. Great distant earthquakes have affected the area with intensities equal or greater than the maximum intensities of the several shocks centered within 50 or 60 miles of the site. Of the 35 earthquakes identified in the foregoing annotated list, only 11 are positively known to have been felt at Watts Bar. Of these, three were centered in the Mississippi Valley, one at Charleston, South Carolina, one in Alabama, one in Illinois, and five at various centers in East Tennessee, Virginia, and western North Carolina. In addition to these, it is probable that a few other shocks might have affected the area at very low intensities.

Presented as Figures 2.5-161 through 2.5-184 are four tabulations of earthquake data through March 1, 1975 based on epicentral intensities and geodetic coordinates. These were prepared at TVA's request by the Health Physics Division of the Oak Ridge National Laboratory from computerized data assembled for a report entitled Seismic History and Seismicity of the Southeastern Region of the United States.[173]

The first tabulation lists all historic earthquakes in an area encompassing slightly more than a 250 mile radius from the Watts Bar site.

The second tabulation lists all historic earthquakes with a Richter scale magnitude greater than 4.3 (MMV+) in the same area.

The third tabulation lists all historic earthquakes with a Richter scale magnitude greater than 4.3 (MMV+) in the southeastern United States.

The fourth tabulation lists all historic earthquakes with a Richter scale magnitude greater than 6.3 (MMVIII+) in the southeastern United States.

On Figure 2.5-145 epicenters of all historic quakes within 200 miles of the Watts Bar site are plotted. No earthquake induced geologic hazards have been reported within the plant region.

### 2.5.2.2 Geologic Structures and Tectonic Activity

'Seismic and Geologic Siting Criteria for Nuclear Power Plants' (10 CFR Part 100 - Appendix A) states in Section IV (a) (6) that the tectonics of a specified site shall be identified with either (1) a 'tectonic structure' or if reasonable correlation cannot be established with a 'tectonic structure', the site shall be identified with (2) a 'tectonic province.' In Sections III (h) and (i) a tectonic structure and a tectonic province are defined. A 'tectonic structure' is defined as a large scale dislocation or distortion within the earth's crust whose extent is measured in miles. A 'tectonic province' is defined as a region of the North American continent characterized by a uniformity of the geologic structures contained therein.

In recognition of the fact that sites in the southern Appalachians cannot reasonably be tied to any one 'tectonic structure,' AEC in evaluation of the Sequoyah Nuclear Plant defined a 'Southern Appalachian Tectonic Province.' This province is bounded on the east by the western margin of the Piedmont Province; on the west by the western limits of the Cumberland Plateau; on the south by the overlap of the Gulf Coastal Plain Province; and on the north by the re-entrant in the Valley and Ridge Province near Roanoke, Virginia. The limits of the province are shown on Figure 2.5-145. Under this concept, maximum accelerations at the site shall be determined by assuming that the largest historic earthquake known in the province occurred adjacent to the site. For the Watts Bar site, this earthquake would be the May 31, 1897, quake in Giles County, Virginia, which had a reported epicentral intensity of MM VIII.

Regional geologic and tectonic maps are submitted as Figures 2.5-2 and 2.5-4, respectively. An earthquake epicenter map of the region is presented as Figure 2.5-145. Although no capable faults exist in the region, regional and subregional fault maps are submitted as Figures 2.5-7 and 2.5-8, respectively. Discussions of the regional geology and regional tectonics were provided previously in Sections 2.5.1.1.2 and 2.5.1.1.6, respectively.

### 2.5.2.3 Correlation of Earthquake Activity With Geologic Structures to Tectonic Provinces

There is no known correlation between earthquakes which have occurred in the region and any surficial tectonic structures. As discussed in Section 2.5.2.2, the Watts Bar site lies in the Southern-Appalachian Tectonic Province, as defined in the PSAR for the Sequoyah Nuclear Plant.

The maximum historic felt intensity at the site (MM VI) was derived from the 1811-1812 New Madrid events, the 1886 Charleston, South Carolina, shock, and MM IV - V from the 1897 Giles County, Virginia, quake. These epicenters were, respectively, 285, 285, and 255 miles from the site which indicates that the most severe site intensities have resulted from major earthquakes centered at distant points rather than from local shocks.

2.5.2.4 Maximum Earthquake Potential

The maximum historic earthquake reported in this province was of intensity MM VIII and occurred in Giles County, Virginia, in 1897. Although this earthquake is listed as an intensity MM VIII, there is considerable evidence that it should be reevaluated as an intensity MM VII. This is well documented in the McGuire Nuclear Station PSAR. Even though this earthquake occurred 255 miles northeast of Watts Bar, this intensity, MM VIII, is assumed to occur adjacent to the site for the purpose of defining the SSE.

Watts Bar Nuclear Plant is located in the same province as TVA's Sequoyah Nuclear Plant, and the Sequoyah PSAR and FSAR describe in detail some selection procedures for determining maximum ground acceleration values. Briefly, empirical relationships by Gutenberg and Richter, Hershberger, Kanai-Kawasumi, Wiggins, and Blume were used to estimate the maximum ground acceleration.

The relationships by Kansi-Kawasumi, Wiggins, and Blume result in very small ground accelerations. The Gutenberg-Richter and Hershberger relationships were developed from accelerograms obtained from practically all overburden sites. The Gutenberg-Richter relationship is felt to be conservative for bedrock since it, in itself, is conservative among other intensity-acceleration relationships. Using the Gutenberg-Richter relationship for a ground motion of intensity MM VIII resulted in an acceleration of 0.14 g. If one assumes that ground surface accelerations are greater than bedrock accelerations by a factor of approximately 1½ this factor gives 0.093 g for bedrock accelerations.

Similar reasoning was applied to the selection of a maximum acceleration level for TVA's Sequoyah Nuclear Plant. The empirical relationships mentioned above indicated that a maximum acceleration level of 0.14 g for the SSE would be conservative. The Sequoyah FSAR (Section 2.5.2.4) contains a summary of a meeting held on November 13, 1969, between DRL staff members, AEC structural and geological-seismological consultants for Sequoyah, and TVA. The purpose of this meeting was to discuss earthquake design criteria for Sequoyah. In that meeting AEC's consultants were of the opinion that the maximum top of rock acceleration should be 0.18 g for the SSE. Accordingly, Sequoyah was designed for a maximum horizontal acceleration of 0.18 g and a maximum vertical ground acceleration of 0.12g.

Both Sequoyah and Watts Bar Nuclear Plants are located in the Southern Appalachian Tectonic Province approximately 31 miles apart. The Giles County, Virginia, earthquake of 1897, rated as an MMVIII, was assumed to occur at each of the respective sites for purposes of defining the SSE.

Therefore, in view of the agreement reached in the meeting discussed previously and the factors discussed in the previous paragraph, the Watts Bar Nuclear Plant has been designed for a maximum horizontal top-of-rock acceleration of 0.18 g for the SSE and a maximum vertical top-of-rock acceleration of 0.12 g.

Figures 2.5-236a and 2.5-236b show the site seismic design response spectra for the operating basis earthquake (OBE) and SSE, respectively, for all damping ratios used in the design of rock-supported structures. Vertical design response spectra are two-thirds (2/3) of the corresponding horizontal spectra.

The original seismic design basis for Watts Bar Nuclear Plant is 0.18 g as discussed above. However, in the course of their review for the operating license, NRC requested additional information concerning the seismic design basis. This culminated in the development of a site specific response spectrum. This spectrum represents the 84th percentile of 13 actual earthquake recordings and has a peak acceleration of 0.22 g. This site specific spectrum was used for evaluation of present designs and not as a design basis. The development of the site specific spectrum is presented in the following reports.

1. Justification of the Seismic Design Criteria Used for the Sequoyah, Watts Bar, and Bellefonte Nuclear Plants - Phase I, TVA, April 1978.

2. Justification of the Seismic Design Criteria Used for the Sequoyah, Watts Bar, and Bellefonte Nuclear Plants - Phase II, TVA, August 1978.

3. Prediction of strong motions for Eastern North America on the Basis of Magnitude, Weston Geophysical Report for TVA, August 1978.

4. Earthquake Ground Motion Study in the Vicinity of the Sequoyah Nuclear Power Plant, Weston Geophysical Report for TVA, February 1979.

5. Justification of the Seismic Design Criteria Used for the Sequoyah, Watts Bar, and Bellefonte Nuclear Plants - Phase II - Responses to NRC Questions 1 through 6, TVA, June 1979.

In response to the NRC staff's review of the liquefaction potential of the soils along the essential raw cooling water (ERCW) pipeline and 1E conduit alignments (see Section 2.5.4.8), a site-specific study of the top-of-ground motion for the Watts Bar Nuclear Plant was made. The results of this study are contained in a report entitled, 'Site-Specific Top-of-Ground Motions for ERCW Pipeline' dated September 23, 1983. The result of this study was an 84th percentile peak ground acceleration of 0.22 g. This peak acceleration was used for the liquefaction evaluation in Section 2.5.4.8. As a result of NRC concerns about the above report, the report was resubmitted and supplemented with responses to the NRC concerns.[158] The result of this resubmitted report was an 84th percentile peak ground acceleration of 0.26 g.

During the review of these reports, the NRC staff specified that a peak ground acceleration of 0.40 g should be used. Therefore 0.40 g was used for the peak top-of-ground horizontal acceleration for the liquefaction evaluation along the ERCW pipeline and 1E conduit alignments.

In response to various seismic analysis and geotechnical concerns the original seismic design basis was supplemented with additional criteria. These criteria are termed "Evaluation Seismic Criteria" and "New Design/Modification Seismic Criteria."

## 2.5.2.5 Seismic Wave Transmission Characteristics of the Site

As stated previously in Section 2.5.2.4, the design response spectrum is not site dependent. Soil properties for bedrock and soil strata under the plant site are detailed in Section 2.5.4.

## 2.5.2.6 Safe Shutdown Earthquake (SSE)

The plant was designed for an SSE with a maximum rock acceleration of 0.18 g horizontally and 0.12 g vertically. Response spectra for horizontal motion are shown in Figure 2.5-236b.

## 2.5.2.7 Operating Basis Earthquake(OBE)

Examination of the recorded seismic history of the Southern Appalachian Tectonic Province reveals that there have been six earthquakes of intensity MM VII, or MM VI - VII. As discussed in Section 2.5.2.1, the maximum intensity felt at the site from earthquakes outside the province was probably MM V or MM VI. Therefore, it is reasonable to expect an MM VII during the operating life of the plant.

Assuming the OBE is an MM VII and using the same empirical relationships discussed in Section 2.5.2.4, the accelerations are less than one-half those of the SSE. According to 10 CFR 100, Appendix A, the OBE must be at least one half of the SSE. Therefore, the maximum horizontal and vertical ground accelerations for the OBE are 0.09 g and 0.06 g, respectively. The response spectra for the OBE are one-half of the response spectra for the SSE and are shown in Figure 2.5-236a.

## 2.5.3 Surface Faulting

### 2.5.3.1 Geologic Conditions of the Site

The lithologic, stratigraphic, and structural geologic conditions of the site and the area surrounding the site have been discussed in Sections 2.5.1.2.2 through 2.5.1.2.5. A regional geologic map is provided as Figure 2.5-1. A subregional geologic section is provided as Figure 2.5-3. A geologic map of the plant area and a geologic section through the plant area are provided as Figures 2.5-9, 2.5-10 and 2.5-11. Regional and subregional fault maps are provided as Figures 2.5-7 and 2.5-8, respectively.

### 2.5.3.2 Evidence of Fault Offset

Section 2.8.5, Geologic Structure, of the Watts Bar Nuclear Plant Preliminary Safety Analysis Report stated that the foundation strata were 'folded, contorted, crumpled, sheared, and broken by small faults.' These structural complexities were demonstrated to be confined to the Middle Cambrian Conasauga Formation, a weaker shale and limestone unit lying between more massive sandstones of the Rome Formation below, and massive overlying dolomite and limestone of the Knox Formation.

When foundation excavation and preparation for the plant began in July, 1973, daily geologic studies of the foundation areas were undertaken. These consisted of geologic mapping of the foundation, including floors and walls of all cuts, photographing the geologic conditions exposed, and preparing geologic plans and sections. Initial excavation began in the Turbine Building area and progressed to the Reactor Building area.

In mid-December 1973, when the foundation for the Reactor Building was partially excavated, AEC regulatory staff geologists were invited to visit the site to inspect the complex foundation conditions including the frequency and magnitude of faulting and shearing. On December 20, 1973, Mr. James Skrove of the AEC staff visited the site and inspected the foundation areas exposed.

On January 25, 1974, a request was received by TVA from the AEC Directorate of Licensing requesting an interim report documenting the geology of the foundation as it existed in December 1973. Because much of the foundation rock in the reactor areas was not exposed in December, 1973, this report was delayed until foundation excavation was completed so that the geologic conditions of the entire foundation area could be evaluated. The last major segment of the foundation was exposed in mid-April 1974 and the report was submitted to NRC shortly thereafter.

In discussing the length, attitude, and senses of movements of the faults exposed in the excavations, the larger thrust faults shown on the plan view geologic maps (Figures 2.5-110 and 2.5-111) extend completely across the powerhouse foundation in a N35-40° E direction and dip 30-45° southeast. One fault trace was mapped over a horizontal distance of 450 feet across the powerhouse foundation, and others were projected across distances of 250 feet to 300 feet. Because the traces of these faults were indistinguishable on horizontal surfaces where they paralleled bedding in the shale, their continuity was determined by following them downward along a vertical excavation surface and projecting a bearing of N35-40° E across the intervening horizontal surface into the next vertical cut where the faults were normally found to recur. This fault detection technique is illustrated in Figure 2.5-123 where approximately 175 feet of fault trace can be observed cutting across the Auxiliary Building foundation, into the vertical wall at an approximate location of A5-9 feet and 6 feet south of the east-west reactor centerline, across the southeast of Unit 1 perimeter, and into the vertical cut wall in the background. A closeup of the inset area of Figure 2.5-123 is shown in Figure 2.5-124.

Although the faults at the site cut entirely across the power house foundation and are expected to continue northeastward and southwestward for an unknown distance, these faults are confined to the Conasauga formation and do not intersect or displace any other stratigraphic formation. They have neither the horizontal nor stratigraphic displacement of the Kingston fault, located one mile northwest of the site, or of the Chattanooga and Whiteoak Mountain fault systems farther to the northwest and southeast, respectively. As shown in the geologic section along A-A' in Figure 2.5-11, the weaker Conasauga shale was confined, during thrust movement, between the more massive Rome sandstone below, and the Knox limestones and dolomites above. As a result of the tremendous disparity in strength, the Conasauga was intensely contorted, crumpled, and faulted.

These characteristics were predicted and outlined in the Preliminary Safety Analysis Report of the Watts Bar Nuclear Plant and were known from the data collected during foundation investigations of the Watts Bar Steam Plant and Watts Bar Dam 3/4 mile to the northeast. The same strike belt of Conasauga Formation provides the foundation for all of these projects. The folded sequences at the site are all homaxial in that they, as well as the major Valley and Ridge fault slices, are related genetically to only one longitudinal axial direction. Superimposed or cross-folding or faulting with longitudinal axes oriented in directions other than that of a regional trend, N35-40° E, were not encountered. This, in conjunction with data obtained from regional geologic and topographic maps, is evidence of a northwestward sense of movement.

Recurrence of compressional surges throughout the late Paleozoic orogenic episode, causing the structural deformation at the site, is evident. The direction of impingement of the compressional forces, however, was inherently from the southeast throughout this period.

In regard to the geometric relations of the faults to folded and warped beds which were truncated by the faults, movement of adjacent rock units across fault planes was not always measurable as one primary displacement. Distributive faulting is predominant throughout the area in which movement took place along bedding planes and closely spaced fractures as well as along the thrust faults and shears. Where bedding plane movement occurred along 'bedding thrusts' in limestones and competent shale horizons, slickensides are oriented in a northwest direction.

Bedding thrusts and minor thrust faults located in areas devoid of thick limestone beds are generally characterized by finely ground shale fragments and thin grey plastic clay seams along the fault as shown in Figure 2.5-125. The absence of competent strata in these areas allowed considerable sliding along low angle fault traces, developing a thin gouge or clay seam.

Disparity of stratigraphic lineation and the presence of drag folds, normally found where stronger beds slipped past weaker ones, was commonplace throughout the site area. Due to frictional resistance along discordant fault planes, thin limestone beds flanked by shale were commonly warped and buckled near their truncated ends (at the fault trace) in the direction of the adjacent block movement. The confining but weaker shales permitted a considerable amount of flexural buckling of the limestone beds prior to rupture. (See Figures 2.5-126, and 2.5-127, 2.5-112, 2.5-113, and 2.5-114.)

Structural elements were considerably less complex in the southeastern and northwestern segments of the powerhouse foundation than in the belt of rock that extended generally N40 degrees E from the northwest corner of the Turbine Building foundation, diagonally across the center of the Control Building foundation, through the eastern segment of the Auxiliary Building and into the Unit 2 reactor foundation (see Figures 2.5-112, 2.5-113, 2.5-115, 2.5-116, 2.5-117, and 2.5-128). Although rock competency is measured on a relative basis, the thick limestone beds, which were found to predominate in this strike belt, were capable of transmitting the compressive forces much farther than the weaker shaly strata in the southeastern and northwestern segments of the powerhouse foundation. This resulted in massive folded sequences containing broadly undulating asymmetrical and recumbent folds which plunged both northeast and southwest along strike.

Characteristically, when the region was subjected to compression, multitudes of folds of every possible size developed. The stronger strata were folded into broad synclines and anticlines, whereas weaker strata developed low angle thrusts drag folds and parasitic folds. The thin layers of weaker shale interlaminated between the stronger limestone units abound with parasitic folds. Digitations were also found along some of the larger folds, adding to the structural complexity of the foundation rock. The presence of these features made detailed mapping of the horizontal excavation surfaces extremely difficult. Detection of fault traces across these areas was almost impossible unless clay seams were present along the fault planes.

As a result of the distributive faulting, shale horizons were crumpled and displaced as the more massive limestone horizons absorbed the brunt of the compressive forces and moved to the northwest. Where the massive limestones formed large drag-folded horizontal or plunging anticlines and synclines, the adjoining weaker shale was squeezed into tightly compressed folds, commonly ground into thin platy fragments and extruded into the cores of the tight limestone drag folds.

Except where plainly evident in deep vertical cuts, actual displacement of rock units along the faults could not be measured because of the absence of stratigraphic change on either side of the fault, structural complexity, and by the absence of key horizons. The only detectable continuous horizon on which displacement could be measured was a broadly folded, faulted fivefoot-thick massive limestone which was encountered in the N line vertical wall excavation (Figure 2.5-113), and which continued along strike through the Q-4 vertical wall (Figure 2.5-115), into the S-4 vertical wall (Figure 2.5-116), and into the Unit 2 reactor cavity (Figure 2.5-117). Though folded and faulted along its entire length, measured displacement did not exceed 6-8 feet.

Displacements ranging from one to three feet were measured in several vertical wall cuts as shown in the geologic sections, Figures 2.5-115, 2.5-120, 2.5-126 and 2.5-129. As shown in Figure 2.5-126, the left block of the normal fault in Unit 1 west wall has moved down approximately one foot with respect to the right block. Scale can be approximated by the 6 x 6 mesh wire at the base of the wall. True fault gouge has not developed along the fault plane, but a thin zone of finely ground shale particles delineates the trace of the fault.

The normal fault shown in Figure 2.5-129 had a measurable displacement of 1.5 feet. Such faults, which dip northward, were rarely observed. The fault could not be traced into the Unit 1 cavity area, nor into the vertical cut northeast of the reactor area. It was therefore considered to be a minor fault related to adjustments associated with thrusting.

Displacement shows considerable variation throughout the plant site area but is considered to be minor in both extent and consequence. Although several low angle thrusts and shears show that considerable horizontal movement may have occurred (see geologic Section C-B, Figure 2.5-117), no extreme vertical displacements were observed in the foundation strata.

In summarizing the existing data in an attempt to more clearly understand the fault-fold geometrical relationships, it is concluded that the faulting and folding developed contemporaneously, over a considerable length of time. The presence or absence of thick limestone beds apparently is the dominant factor in determining the type of structure. Long, low angle thrusts and shears developed along bedding planes in predominantly shale areas. In areas of thick limestone sequences broad undulating folded anticlines and synclines developed with their associated higher angle thrusts and subsidiary normal faults. Compressional forces acting on thick limestone strata were dissipated in forming broad folds until the rupture limit was reached and faulting occurred. The interlaminated, brittle, weaker shales were pinched into tight folds within the broadly undulating limestone and then were sheared along with the limestone.

In regard to the relationship of the foundation faults to through-going major faults, the controlling feature of the geologic structure at the Watts Bar site is the Kingston fault. The trace of this fault lies along the northwest side of the prominent ridge approximately one mile northwest of the site area as shown on the geologic map of the plant area (Figures 2.5-9 and 2.5-10). The Kingston fault is one of the major overthrusts characteristic of the Valley and Ridge province. As shown on the geologic map and section (Figures 2.5-9 through 2.5-11), the fault dips to the southeast approximately 30° or more and is considered to be approximately 2,000 feet deep at the site. Along the fault, steeply dipping beds of the Rome Formation have been thrust over gently dipping strata of the Chickamauga Limestone.

The Kingston fault is only one of the several lengthy thrust faults that characterizes the geologic structure of the Appalachian Valley, which is a part of the Valley and Ridge physiographic province. The Kingston fault is essentially parallel to the Chattanooga fault which lies approximately five miles northwest of the plant site; the White Oak Mountain fault, approximately 3.9 miles southeast of the plant site; and the Copper Creek fault, approximately 6.3 miles southeast of the plant site. The structural deformation resulting in thrust fault development is attributed to the Allegheny orogeny which culminated at the end of the Paleozoic Era. It is postulated that these major tectonic structures have been inactive since the cessation of the orogenic movement. The duration of this orogenic epoch has not been precisely determined in the region since Pennsylvanian strata are the youngest rocks known to have been affected. Some deformation is thought to have continued after the initial development of the major faults because some of the thrust sheets are folded. This late structural development represents the final phase of the orogeny. The only undeformed mappable units in the region are the unconsolidated materials: alluvial deposits, including high-level terrace deposits as well as recent flood plain alluvium, and residuum that nearly everywhere mantles bedrock. The alluvium along the Tennessee River channel and its tributaries ranges in age from less than a decade at the top to several tens of thousands of years at the base. The coarse terrace gravel deposits are much older and are considered to have been deposited during the Pleistocene.

The intensely deformed character of the Conasauga shale upon which the Watts Bar plant is being built is a function of its lithology and of its structural history. The Conasauga Formation is overlain stratigraphically by 2,500 feet to 3,000 feet of massive dolomite and limestone of the Knox Group and is underlain by 800 to 1,200 feet of sandstone and shale of the Rome Formation. During the course of the Allegheny orogeny, these formations were thrust northwestward on the Kingston thrust sheet which overrode the underlying rocks for an undetermined distance. During the thrust movement, the Conasauga Formation was compressed between the two massive blocks of the competent underlying Rome Formation and the overlying Knox Group. As a result of the marked difference in competency, the Conasauga shale was folded, contorted, crumpled, sheared, and broken by small faults as evidenced in the Watts Bar foundation.

The minor faulting in the plant foundation is therefore directly related to the major through-going fault systems. As indicated in Sections 2.5.1.1.2, 2.5.1.1.4, and 2.5.1.1.6, investigations in the region have revealed that the several named faults are merely branches of a single, nearly flat, sole fault developed in a relatively less competent formation just above the crystalline basement.

In regard to the bedrock-terrace deposit relationship, an investigation was conducted throughout the plant site to document specific occurrences where faulting was found to be terminated by the overlying, blanketing terrace gravel deposit. Several occurrences were found as shown in Figures 2.5-132 through 2.5-136. In Figure 2.5-132, the fault plane is seen to displace the thin limestone beds in the bottom left corner, and is truncated by a thin iron oxide crust at the base of the overlying terrace gravel in the top right corner. Figure 2.5-134 and associated Figures 2.5-135 and 2.5-136 show an occurrence where a fault plane, which extended diagonally across the entire Auxiliary Building foundation, is delineated by a 1/4 inch blue-grey clay seam. It can be seen that the fault plane is truncated by the thin iron oxide crust at the base of the overlying terrace gravel deposit. The upper three feet of shale has weathered to saprolite which retains the relict shale structure. The ¼-inch blue-grey plastic clay seam extended downward along the fault plane for the entire 30 foot exposure of the vertical cut as shown in Figure 2.5-135. Discoloration and saprolitization of the near-surface shale from a blue-grey to buff color is common at the site, and is caused by normal weathering processes.

In the base of the terrace gravel, at the interface with the saprolitic residuum, a thin zone of iron oxide concentration was commonly observed. The origin of this deep reddish-brown indurated crust of iron oxide is attributed to iron saturated water movement along the contact between the overlying terrace gravel and the saprolitic shale residuum. The terrace gravel is highly permeable, offering very little impedance to ground water percolation. At the base of the terrace gravel, however, the downward moving ground water is met with a considerable decrease in permeability and moves laterally. This results in the accumulation of the iron oxide crust, which in some places blankets the upper surface of the saprolitic material and conforms to the micro-topography. Because of hematite cementation, the crust becomes indurated.

Though found dispersed through the entire thickness of the terrace deposits (see Figure 2.5-137), crusts that truncate fault planes provide additional proof that no movement has taken place along the faults subsequent to their formation.

The terrace gravel was deposited over the site area when the ancestral Tennessee River was flowing at a much higher elevation in the past. Except where cut by present stream drainage patterns, the terrace deposits are represented by broad, flat to gently rolling topography between approximate elevations of 700-740 feet. The terrace deposits have been relatively well preserved on the inside curve of the meanders of the Tennessee River, but have been removed where the Tennessee River impinges on knobby topography, for example, the River Knobs area southwest of the plant site. North of Watts Bar Dam, normal pool elevation is approximately 741 feet, covering the terrace deposits.

The appearance, thickness, color, size, and depositional characteristics of the basal gravel differs considerably around the walls of the excavation at the plant site. In general, trends were observed in the basal gravel deposit from southeast to northwest as follows:

1. General thinning of the gravel-bearing material varying from a thickness of 18-20 feet of gravel mixed with sand and silt at the southeast to approximately six feet of clean, coarse gravel in the northwest corner of the excavation.

2. The thick sandy matrix, prevalent in the southeast plant area, decreases considerably northwestward. Thick interlaminated sand sequences dispersed throughout the terrace gravel in the southeast are absent in the northwest plant area.

3. Iron oxide staining, predominant through the entire thickness of the gravel deposit in the southeastern extremities of the plant site, is virtually nonexistent in the northwest section, which has a high content of clean, white terrace gravel in a clean washed, sandy matrix. Though the iron oxide crust was not always found at the contact between the Conasauga shale and the overlying terrace gravel deposit, concentrations of hematite-stained gravel, sand, and clay particles were everywhere present, because of lateral water movement along the contact. The sparse development of deep hematite staining in the northwest segment of the foundation is possibly due to protection by the overlying thick impermeable slough clay deposit which is not present in the southeastern segment of the site area.

4. Gravel size increased from pea-gravel (1/2-3/4 inch diameter) in lenses dispersed throughout the entire 18-20 foot thickness of the deposit in the southeast, to 8-10 inch diameter cobbles and smaller pebbles in the thinner six-foot terrace gravel deposit in the northwest corner of the excavation.

5. Crossbedding and preserved remnants of ancient stream channels found in the southeastern segment of the plant site area were absent in the northwest.

   In the northwest corner of the powerhouse foundation the basal gravel is sharply delineated both at the top and bottom. Above the gravel is a three-to-four-foot thick layer of dark grey to black slough clay containing organic fragments (see Figures 2.5-122 and 2.5-138). This sequence is absent in the extreme southeastern area of the plant site and in its place is 18-25 feet of iron-stained sands interspersed throughout with well-defined one-eighth to one foot thick pebble layers. The pebbles in these layers are mostly less than two to three inches in diameter.

The presence in the basal gravel of large (8-10 inch diameter) pebbles and cobbles at the northwest margin of the plant site area, compared to the much smaller pebbles and gravels at the southeast margin subtly suggests that the main course of the old Tennessee River was once located near the northwest margin. Although this concept implies a long period of time for the main river channel to migrate some 2,000 to 3,000 feet southeastward to its present course, such migration is not improbable. The present configuration of the river channel indicates that in this stretch of the river southeastward migration would be progressing even today were it not for the artificial conditions created by man in impounding Chickamauga Lake. The lake essentially creates an artificial base level, which impedes lateral erosion processes in the river channel.

The sharp contact between the bedrock and the basal gravel deposit, with the absence of any major thickness of silts and sands except where interspersed within the voids of the basal gravel, strengthens the concept of a migrating river channel. The scouring action of the bedload in the main river channel, according to this concept, provided the necessary abrasive action to erode the bedrock surface to its present elevation. The gravel was deposited on this surface as velocity decreased when the river continued its southeastward migration.

In late February 1974, partially carbonized wood fragments were found in the north face of the main plant excavation embedded in a dark, tough, organic clay overlying the basal gravel layer of the terrace deposits. The occurrence is shown graphically on Figure 2.5-122 and pictorially on 2.5-138. Approximately two kilograms of material were collected, divided into three samples, and submitted to the Radioisotope Laboratory, Dicar Corporation, Cleveland, Ohio for carbon 14 dating. To preclude any unintentional bias on the part of the laboratory, the samples were submitted 'blind.' That is, no data on geographic location or stratigraphic position were furnished.

Upon receipt of the samples in the laboratory they were examined under 20x magnification, the obvious debris removed, and each sample fragmented into pieces one centimeter by one centimeter. The material was then subjected to three cycles of saturation in 2.0 normal NaOH, filtration, and drying. The treated samples were then pyrolized and the $^{14}CO_2$ collected for radioactive counting.

The median age of all samples is 32,400 years BP with median deviations of +2150 and -3000 years. We feel that these data represent a minimum rather than a maximum age. The samples when collected were completely saturated to the point of being 'spongy.' The samples occurred at Elevation 717.5 and groundwater observations in the immediate area indicated that the permanent water table, prior to excavation, stood at or above Elevation 721 even during the dry months of August, September, and October. This indicates that the material had been continually saturated. Even though percolation rates through the tough, organic clay surrounding the samples must have been very low, any migration of water through and around the material would tend to minimize the apparent age. It is probable that the true age of these wood fragments is in excess of 35,000 years.

Potassium-Argon (K-Ar) Dating

Samples of the Conasauga Formation with a high glauconite content were collected at two different locations in the main plant excavation and were submitted to the USGS Branch of Isotope Geology for K-Ar dating. One sample was obtained from strata showing minimum structural deformation, while the other was obtained from strata in and immediately adjacent to one of the small faults or shears cutting across the foundation.

Though realizing that glauconite is not an ideal geochronometer, it was felt that any significant divergence in apparent ages of the two samples might indicate (1) evidence of sufficient temperature and pressure increase associated with the shearing and faulting to have 'reset', either wholly or in part, the K-Ar 'clock', or (2) evidence of geologically recent readjustment of the K-Ar 'clock' in the material from the sheared area.

The analyses were made by Dr. John D. Obradovich at the USGS laboratory in Denver, Colorado. The apparent ages determined were $387 \pm 8 \times 10^6$ years for the samples from 'undisturbed' strata and $389 \pm 8 \times 10^6$ years for the sample from the shear zone. The two ages are essentially the same, approximately $390 \times 10^6$ years, for both samples.

The age of sedimentation for the Conasauga Formation is approximately $530 \times 10^6$ years - upper Middle Cambrian. The radiometric age of $390 \times 10^6$ years is approximately 26% younger. As Dr. Obradovich points out, this anomaly may reflect partial but not total loss of argon 40 during the Allegheny approximately $250 \times 10^6$ years ago or could result from burial at a depth of 5,000 to 7,000 feet since the Paleozoic. Either of these alternatives is viable for the Watts Bar area. However, the radiometric age determination falls within the scatter of other K-Ar data of comparable age and a major tectonic event is not necessary to explain the deviation between the radiometric and true ages.

As Dr. Obradovich further points out, the agreement in ages between the 'undisturbed' and 'sheared' samples indicates that any effects related to shearing were insufficient to cause any significant loss of radiogenic argon. This indicates that the time-temperature regime associated with the shear zone in recent geologic times was not enough to reduce the apparent age of the glauconite in the sheared area as compared to the age of the material from the undisturbed area.

Although the precise time when the shearing took place could not be determined by these analyses, the data obtained provide additional support for the conclusions reached from the other investigations that the small faults and shears in the foundation of the Watts Bar Plant are ancient structures which do not adversely affect the suitability of the foundation.

In summary, the bedrock at the Watts Bar Nuclear Plant site was faulted and folded contemporaneously during an orogenic epoch which culminated in the late Paleozoic approximately 250 million years ago. The faults and shears originated primarily along bedding planes at low angles in the incompetent shales. In the zone of competent limestone beds the faults are more discordant, occurring within broad undulating folds.

Since the end of the orogeny, the bedrock and its' contained shears and faults have been subjected to reannealing pressures, recementation, surficial erosion and weathering from some unknown preexisting elevation to the elevation at which it was subjected to the abrasive scour by coarse terrace gravel. This probably occurred in Pleistocene time. The bedrock was subsequently buried by thick gravel, sand, and clay deposits. There is no present-day surficial expression of the subsurface faults at the site.

2.5.3.3 Earthquakes Associated With Capable Faults

There are no historically reported earthquakes that can be reasonably associated with surface faults, any parts of which are within 5 miles of the site. Furthermore, no earthquake-surface fault relationships have been determined anywhere within the region.

2.5.3.4 Investigations of Capable Faults

That faults of great linear extent are present in the Valley and Ridge Province of East Tennessee was recognized by the earliest geologists to study the area (Troost, 1837, 1840, 1841 and Safford, 1856, 1859, 1869). While they did not assign specific ages to the faulting, they pointed out that it occurred long before the cycle began that resulted in the 'Valley and Ridge' topography developed by differential erosion of harder and softer strata.

The second generation of geologic studies in the area was made in the late 1800s and early 1900s by geologists of the U.S. Geological Survey. This work resulted in a series of 18 geologic folios (Campbell, 1899; Hayes, 1894, 1894a, 1894b, 1895, 1895a, 1895b; Keith, 1895, 1896, 1896a, 1896b, 1901, 1903, 1904, 1905, 1905a, 1907, 1907a) each covering a 30-minute quadrangle. This series provided the first detailed mapping of the area and basically interpreted the relationship and extent of the various fault sheets. In all of these folios the point is stressed that the folding and faulting culminated at the end of the Carboniferous and subsequently the area has been subjected only to broad epierogenic warping. No mention or inference of geologically recent faulting is made in any of these folios. These investigations, in addition to the folios, produced other professional papers and reports (Hayes, 1891, 1892, 1895, 1899; Hayes and Campbell, 1894; Keith, 1896, 1902, 1902a, 1923; Willis, 1893). These as well presented the thesis that faulting had culminated in the Late Paleozoic and had not recurred subsequently.

The third generation of studies, which has resulted in a mass of detailed data began in the 1940s and has continued to the present. The scope of these studies has ranged from textbooks and USGS professional papers to master's theses submitted to various universities in the area. The more significant publications resulting from this work are Bridge, 1950; Colton, 1970; Cooper, 1961, 1964; Ferguson and Jewell, 1951; Dietz, 1972; Gwinn, 1964; Hack, 1965, 1966; Harris, 1965, 1970; King, 1949, 1950, 1955, 1964, 1964a, 1969; King and Ferguson, 1960; Milici, 1962, 1963, 1967, 1968, 1968a, 1970; Miller, 1962; Neuman and Nelson, 1965; Owens, 1970; Rodgers, 1949, 1950, 1953, 1953a, 1963, 1964, 1967, 1970; Stearns, 1954, 1955; Swingle, 1961; and Wilson and Stearns, 1958. In none of these publications is any active faulting since the Paleozoic described, implied, or inferred. A search of all available data has failed to disclose any report of post-Paleozoic movement along any fault in the Valley and Ridge Province.

The early geologists, Troost and Safford, recognized that faults existed in the Valley and Ridge Province in Tennessee, but made no inference as to their attitudes at depth. The first geologist to recognize that these faults possibly could flatten out with depth and also have been folded and faulted subsequent to initial formation was Keith (1902a, 1905a, 1907, 1907a, 1923, 1927). However, major credit for the derivation of the 'thin-skinned' tectonic theory as applied to the southern Appalachian area rests with Rodgers (1949, 1950, 1953, 1953a, 1963. 1964, 1967, 1970). Although most of the geologic community working in the area sided with Rodgers (Gwinn, 1964; Harris, 1965, 1970; King, 1950, 1955, 1964, 1964a, 1969; King and Ferguson, 1960; Milici, 1962, 1963, 1970; Miller, 1962; Stearns, 1954, 1955; Swingle, 1961; Wilson and Stearns, 1958) some were unconvinced (Cooper, 1961, 1964).

It was not until early 1974 that definitive evidence was released to support the 'thin-skinned' hypotheses. At that time, Geophysical Services Incorporated published an advertising brochure describing reflection seismic data they had available for sale. The example of a reflection profile used in their brochure was made along U.S. Highway 70 from near Kingston, Tennessee, to the vicinity of Knoxville, Tennessee. This profile essentially at right angles to the regional strike is reproduced in Figure 2.5-160.

The vertical scale of this profile is represented in seconds. This indicates the double travel time necessary for the shock wave to descend to the reflector and return to the surface. Assuming a wave velocity of 20,000 feet per second, the times indicated equate to depths in thousands of feet. The 'thin-skinned' tectonic structure of the upper strata, above the 1.5 second (15,000 foot) line, is clearly indicated. The depth of approximately 15,000 feet to basement strata in this area is confirmed by gravity and magnetic data.[128]

The significance of the confirmation of 'thin-skinned' tectonics in the area in relation to the geologic and seismic considerations of the Watts Bar plant lies in the fact that data now exist to show the separation of faults cropping out at the surface from geologic structures in the basement at a depth of approximately 15,000 feet or 4.5 kilometers. This means that earthquakes with hypocenters at depths of five or more kilometers cannot be associated with faults cropping out at the surface even though the epicenter (surface projection of the hypocenter) falls on or near the trace of the fault.

During investigations for the Clinch River Breeder Reactor Plant,[98] samples of faulted material were collected and radiometrically dated. These samples were from the Copper Creek fault and were collected about 15 miles west of Knoxville and about 30 miles from the Watts Bar Nuclear Plant. This fault is of the Whiteoak Mountain family. The results of these age determinations (280-290 ± 10 million years) indicate the movement of these faults occurred during the Late Paleozoic[102,113,125]. Furthermore, as indicated in Section 2.5.3.2, the bedrock fault - terrace relationship dates and the glauconite dates at the site indicate no recent movements along the bedrock faults.

TVA has drilled holes through some of the major faults in eastern Tennessee. Diamond core borings at Chickamauga Dam went through the Missionary Ridge fault and the cores through the fault zone came out unbroken. Upon being hammered, however, the core did break along the fault. The fault was not simply 'healed' or recemented with secondary deposits of calcite or dolomite, but was a very tight contact along which apparently pulverized material had recrystallized.

Core borings have been made through the Knoxville fault at the former Tellico Project in eastern Tennessee. Here again the core through the fault was recovered unbroken.

Therefore, the evidence available from all of the geologic studies that have been made suggests that all of the Appalachian Valley faults, including the Kingston and Whiteoak Mountain faults, are inactive. Regional and subregional fault maps are provided as Figures 2.5-7 and 2.5-8.

#### 2.5.3.5 Correlation of Epicenters With Capable Faults

The relationships between regional faulting and regional tectonics is discussed in Sections 2.5.1.1.5, 2.5.1.1.6, and 2.5.3.4.

No capable faults have been identified within the site region.

#### 2.5.3.6 Description of Capable Faults

No capable faults have been identified with the site region.

#### 2.5.3.7 Zone Requiring Detailed Faulting Investigation

Not pertinent to the site as no capable faults have been identified within the site region.

#### 2.5.3.8 Results of Faulting Investigations

Details of regional, site, and foundation faulting, dating techniques used, and results, are provided in Sections 2.5.3.2 and 2.5.3.4.

### 2.5.4 Stability of Subsurface Materials

#### 2.5.4.1 Geologic Features

The Conasauga formation of the Middle Cambrian age is the principal foundation rock found at the site. This formation is discussed in Sections 2.5.1.1.6, 2.5.1.2.7, and 2.5.1.2.9.

### 2.5.4.2 Properties of Subsurface Materials

#### 2.5.4.2.1 In Situ Soils

##### 2.5.4.2.1.1 General Description

The unconsolidated deposits overlying bedrock are composed primarily of alluvial deposits on the elevated flood plain near the lake shore and terrace materials, deposited by the Tennessee River when flowing at a higher level, over the bench that covers most of the site area. The alluvium is composed of fine-grained, finely sorted silts and clays, with micaceous sand and some quartz gravel. The thickness of the unit varies, but drilling showed an average thickness of approximately 25 feet. Near the base of the terrace bench the alluvial deposits thin out to a feather edge. Included in the alluvial material are some fairly well defined beds of tough, blue-gray clay, containing carbonized fragments of wood. These are interpreted as old slough fillings.

The terrace deposits are much older than the recent flood plain deposits and their edge is marked by a distinct topographic bench some 30 feet high which lies from 200 to 1,000 feet northwest of the edge of Chickamauga Lake. Recent drillings show the thickness of the terrace deposits to vary from a minimum of 31 feet to a maximum of 46 feet. The average thickness is 40 feet.

Approximately the upper half of the unit is composed of sandy, silty clay and the lower half is much coarser, consisting of pebbles, cobbles, and small boulders of quartz or quartzitic sandstone embedded in a sandy clay matrix.

In contrast to the conditions at the Sequoyah site, very little residual material derived from weathering of the underlying shale is present under the terrace deposits at the Watts Bar site. In a few holes a foot or two of residual clay was encountered, but in most instances the terrace deposits are immediately underlain by a few feet of soft but unweathered shale.

##### 2.5.4.2.1.2 Investigations

Field Investigations and Testing

Soil investigations were conducted at the site for the major features. Figures 2.5-185 and 2.5-185a shows the locations of borings for the soil investigations for the various features at the site.

The field exploration for in situ soils consisted of split-spoon borings, using standard penetration test procedures for all features, and borings for undisturbed sampling for most features, auger borings to determine the top of rock, and test pits to obtain undisturbed samples. Although most borings were made using dry procedures, some borings, specifically for the liquefaction study, were made using drilling mud with a fishtail bit to advance the boring.

The split-spoon borings were made at the plant site using the methods specified in ASTM D 1586. The purpose of these borings was to obtain disturbed soil samples for laboratory testing and to determine the standard penetration resistance, N, of the in situ soils. Disturbed samples from the split-spoon borings were sealed in glass jars after removal from the soil sampler and taken to TVA's Materials Testing Laboratory for tests.

Undisturbed soil sample borings were made to obtain undisturbed samples for laboratory testing. The soil samples were obtained using various types of samplers. The ends of each tube were sealed immediately after removal from the boring to preserve the natural moisture content of the sample.

The types of borings made for any feature were based on the design requirements for each feature. In addition to the borings made for SPT samples and undisturbed samples, a number of locations were tested using a cone penetrometer. The results of this testing are described in Reference [167].

Field Investigation and Sampling Techniques Along the ERCW Pipeline and 1E Conduit Alignments

As a result of the NRC's interest in the techniques used in the field for the investigations of the soils along the ERCW pipeline and 1E conduit alignments, the following specific information is furnished.

The initial field investigation was completed between July 24 and August 19, 1975 with two Mobile model B-50 drills. The standard penetration test (SPT) borings were advanced by dry methods using 3-3/8 inch inside diameter hollow stem augers. Standard-2 inch split-barrel samplers complying with specification ASTM D 1586 and equipped with light duty spring retainers were used for sampling. The string of tools was exclusively AW drill rods. Table 2.5-28 provides information on the weight of various lengths of drill rod. Table 2.5-29 provides the depth of each split-spoon boring from which the drill rod weight may be obtained. Safety-type 140-lb drive hammers were used. One wrap of rope was used on the cathead. Blow counts were recorded for each 0.5' interval driven and sample recovery recorded. Drilling and sampling were in accordance with ASTM D 1586 procedures. Sample descriptions were recorded on both the drilling log and sample tags. Samples were immediately sealed in glass pint jars and temporarily stored in an onsite building to avoid extreme temperatures.

The undisturbed sampling borings were also advanced by dry methods, but using 6-inch inside diameter hollow stem augers. Samples were taken with 5-inch diameter thin-walled tubas attached to a piston-type sampler conforming to specifications in ASTM D 1587. Samples were sealed on both ends with at least 1-inch of beeswax-paraffin sealing wax. Depths of sample recovery were recorded on drill logs and sample tags. Samples were transported on rubber-padded racks for temporary storage to an onsite building to avoid extreme temperatures. A covered vehicle with rubber-padded racks was used to transport the samples from temporary storage to TVA's Singleton Materials Engineering Laboratory. Certified soils technicians performed all handling, moving, and transportation of specimens.

A subsequent field exploration was completed between May 30 and July 3, 1979. Equipment used was a CME-55 drill and a Mobile B-50 drill. The methods and sampling equipment used on the SPT borings exactly match those described above for the report of March 17, 1976. Tables 2.5-28 and 2.5-30 provide information about the drilling equipment used for each boring.

Rotary drilling methods were used between sampling elevations in the undisturbed sample borings. Bentonite drilling fluid was used. The 5½ inch wide drag bit was equipped with baffles which deflected the drilling fluid upward. Samples were obtained with 5-inch diameter thin-walled tubes attached to a piston sampler.

Samples were sealed on both ends with a beeswax-paraffin mixture and temporarily stored onsite to protect them from extreme temperatures. They were transported to the laboratory on rubber-padded racks in a vehicle driven by a soils technician.

No engineering testing was required on these samples. However, following standard practice, the tube samples were extracted and unit weights and general classification tests conducted and recorded.

Additional SPT borings were completed between November 4 and 24, 1981. All borings were drilled with a Mobile B-61 drill. Procedures followed the recommendations in Table 2.5-31. Tables 2.5-32 and 2.5-33 provide information about the drill rig and equipment used for each boring.

On all Watts Bar Nuclear Plant ERCW assignments, one drill operator was assigned to, and stayed with, a specific drill. Exceptions would normally occur only in case of illness or other personal emergencies. Such situations are not documented.

Ropes used in drilling standard penetration test borings are normally replaced when noticeably worn on the initiative of either the driller or inspector. There are no specific guidelines or documentation. During the 1975 and 1979 investigations, it is judged that the ropes were used and somewhat limp. During the 1981 investigations, the ropes were new and stiff in accordance with specific instructions.

During all investigations, a 140-lb Mobile safety-type drive hammer, Model 006981, was used.

Test pits were excavated by a Gradall excavator equipped with a 3 $yd^3$ smooth bucket. Side walls were excavated to about a 1 to 1 slope. Dewatering was facilitated by installing a section of perforated 18-inch diameter pipe surrounded by a $\pm$ 3/4 inch crushed stone filter. Undisturbed samples were obtained by benching into the side wall and hand trimming 1 $ft^3$ blocks with handtools. The trimmed top and sides were covered with three alternating layers of cheesecloth and paraffin. The sample was then cut at the bottom which was covered in a similar manner. Samples were placed in a wooden box surrounded with damp sawdust padding. A soil technician immediately transported the blocks on styrofoam pads to the laboratory.

Laboratory Testing

The following laboratory tests were made on all split-spoon samples:

1. Moisture content

2. Atterberg limits (ASTM D 423 and D 424)

3. Grain size tests (ASTM D 422)

4. Classification (ASTM D 2487)

For features where undisturbed borings were located based on information obtained from the split-spoon borings, the results obtained from these tests were used in the assessment of the existing soil characteristics. In order to assure continuity between the split-spoon borings and the companion undisturbed boring, undisturbed soil samples were subjected to moisture content, Atterberg limits, grain size and classification tests.

Soil strength tests were conducted on the soils. The particular soil tests conducted on any given feature were dependent on design requirements. Following is a list of the soil tests that were conducted in the laboratory to determine the soil characteristics necessary for design.

1. Unconfined compression (UC)--This test is used in defining the allowable bearing of a foundation on clay. Also, the sensitivity of a soil can be determined by using the UC test on remolded samples.

2. Unconsolidated-undrained (Q)--This test is used to determine representative soil conditions during and immediately after construction.

3. Consolidated-undrained (R)--This test is used in the analysis of clay foundations or embankments where the rate of construction permits partial consolidation, or on natural slopes, or cuts in clay which are subject to rapid drawdown.

4. Consolidated-drained (S) direct shear--This test is representative of conditions where complete dissipation of pore pressures occurs, such as in soil foundation subject to long-term loads.

5. Cyclic Q--This test was conducted on soils that had a sensitivity of 4 or greater, as determined by the UC tests on undisturbed and remolded samples.

6. Cyclic R--This test was conducted on soils that exhibited a potential for liquefaction based on parameters reported by D'Appolonia (Journal of the Soil Mechanics and Foundations Division, ASCE, January 1970).

7. Consolidation--This test was used to provide parameters for determining the settlement below a structure that was constructed on or above a fine grained soil layer.

Table 2.5-1 indicates the soil strength tests that were conducted on representative samples for any given feature. Laboratory testing was carried out by TVA's Materials Testing Laboratory and the U.S. Army Engineers Waterways Experiment Station. The Waterways Experiment Station conducted the Cyclic R tests used to determine the liquefaction potential of soils in the intake channel. Laboratory tests were performed in accordance with ASTM standards where applicable. Procedures that are generally and widely accepted were employed for those laboratory tests that have not been standardized by ASTM.

2.5.4.2.1.3 Test Results and Selection of Design Properties

The classification of the soil found at this site is displayed on graphic logs (see Figures 2.5-186 to 2.5-202 and 2.5-282 through 2.5-338). The symbols used for classification of soils are in accordance with ASTM D 2487. In addition, it is standard TVA practice to add the prefix 'G-' to the symbol of soils containing 12% or more gravel particles but do not classify as gravel. The following prefixes are used in boring 150 designations:

1. SS - Split-spoon boring

2. US - Undisturbed boring

3. PAH - Auger boring

500kV Transformer Yard (Non-Category I Feature)

Borings US-1 and US-2, as shown on Figure 2.5-186, has ground Elevations of 743.2 and 742.1, respectively. Sampling started near the final grade at Elevation 730 in silty or clayey sand. The lean or nonplastic sands extend to about Elevation 717, at which elevation the water table was encountered. Below this elevation. terrace deposits consisting of poorly graded, silty, sandy gravel extend to about Elevation 706, which is top of the weathered shale. Undisturbed sampling was impaired by the nonplastic, sandy soil structure of high gravel content. Dry soil densities are from about 95 to 113 pcf with corresponding void ratios from 0.48 to 0.78. A saturated, lean silt, ML, in US-1 at Elevation 714.7 to 714.1 had the low density of 87.9 pcf and a void ratio of 0.92; but the standard penetration resistance at this elevation resulted in 50 blows. One sample each in US-1 and US-2, being fine grained, allowed unconfined compression testing which resulted in 2.2 and 1.5 tsf. These soils exhibit low sensitivity. The results of the laboratory testing are summarized in Table 2.5-2.

Overall, the favorable laboratory test results were confirmed by high standard penetration resistance as shown in companion borings 2 feet apart from the undisturbed borings. An increase of penetration resistance with depth, primarily due to increased gravel content, is apparent. However, in both borings above Elevation 718, strata with less than 10 blows per foot were determined. A correlation of these low N-values with laboratory tests does not bear out a particular instability.

In the transformer yard, subsoils are generally of high density and medium to high soil penetration resistance. The non-uniformity in bearing capacity of soils above Elevation 715 should not effect differential settlement as long as loads do not exceed 1.5 tsf.

<u>500kV Switchyard (Non-category I Feature)</u>

Boring US-3 (see Figure 2.5-186) in the area of the switchyard shows similar subsoil characteristics to soils in the transformer yard. Silty sands grade into gravelly, silty sands below Elevation 727 and into well-graded, silty gravel below the water table at Elevation 714. A 2-foot gravel layer overlies highly weathered shale which classified CL, SM, G-CL, and SC. Standard penetration tests show very hard consistency below Elevation 715, but immediately above this elevation an isolated, relatively weak layer exists from Elevations 716 to 719. This G-SM layer contains about 30% fines, is of low plasticity, and has relatively low dry density, averaging 106 pcf. Immediately above it, soils of similar texture show high penetration resistance.

With 10 feet of very firm to hard subsoils between Elevations 730 and 720, it will largely depend on the size of the superimposed load and its influence on the low-blow soil layer above the water table in order to predict settlement of switchyard foundations.

Switchyard subsoils based on only one boring, are not unlike those in the adjacent transformer yard, except for a weak layer above the water table, Elevation 715. Soils 10 feet thick overlying this loose layer, owing to hard consistencies, will provide some bridging. Consolidation of the sandy soils will be rapid. Barring localized unstable conditions, allowable soil bearing capacities are in excess of 1.5 tsf. The results of the laboratory testing are summarized in Table 2.5-3.

<u>Cooling Towers (Non-Category I Feature)</u>

Borings SS-4, SS-5, SS-6, US-7 and US-8 were located in the area of the north tower, as shown on Figure 2.5-185. Graphic logs are shown in Figure 2.5-187. Fine-grained subsoils are evident to about Elevation 725 and are underlain by silty sands open interspersed with cherty gravel. The weathered shale in this area was determined at about Elevation 709, and in two borings, SS-4 and US-8, the top of shale coincides with the water table. In borings SS-5, SS-6, and US-7 the water table was located between Elevations 716 and 718. A marked increased in penetration resistance was generally found below Elevation 713 when gravel content increased above 30%. The center of the tower at boring SS-6 shows marginal blow counts ranging from six to nine to Elevation 715. The four borings along the perimeter indicate greater firmness and penetration resistance. Unconfined compressive strength tests performed on soils above Elevation 721 indicate allowable bearing capacities from 1 to 6 tsf with a low sensitivity ratio. Consolidation tests resulted in $C_c$ values from 0.07 to 0.22, indicative of low to moderate soil compressibility. Only one SM soil from boring US-7, Elevations 723.9 to 722.6, had a $C_c$ of 0.31, revealing medium compressibility. Preconsolidation indices, Pc, were from 1 to about 4 tsf. High preconsolidation loads, especially in the surficial soils, appear to be the results of desiccation. The results of the laboratory testing are summarized in Table 2.5-4. Borings SS-9, SS-10, SS-11, US-12 and US-13 were located in the area of the south tower, as shown in Figure 2.5-49. Graphic logs are shown in Figure 2.5-187. Cohesive subsoils generally above the water table are of the CL, Ch, gL, and MB types, and unconfined compressive strengths were found to be appreciably lower than that of soils in the area of the north tower. It will be noted that plasticity indices of the subsoils are higher than those established for soils in the north tower foundation.

At the time of the investigation the water table in these five borings was established between Elevations 719 and 714. UC values range from 0.4 to 3.6 tsf, but the average unconfined

compressive strength is 1.3 tsf. These are not sensitive soils. Foundation soils generally exhibit lover dry densities, higher void ratios, and somewhat lower preconsolidation loads, ranging as indicated in Table 2.5-5.

The two locations of the cooling towers indicate a marked difference in subsoil conditions. The soils in the area of the north tower founded on insensitive alluvial soils of fairly high preconsolidation, especially along the perimeter of the tower. The center boring shows reduced bearing capacity in the top 20 feet. This weakened condition exists along a line running from boring SS-5 to SS-10. The soils in the area of the south tower, as shown by various soils parameters, do not have the same overall stability, mainly due to saturated soil strata at or immediately above the water table. Bearing capacities as low as 0.4 tsf were determined on these nonsensitive subsoils. Below Elevation 715 soil stability is greatly increased. Due to the weaker soil strata for the south tower, both towers were constructed on pile foundations that bear in bedrock.

CCW Pumping Station (Non-Category I Feature)

Borings SS-14 through SS-18, as shown on Figure 2.5-188, had ground elevations ranging from 733.3 to 736.0. The water table was established at about Elevation. 720. Sampling was required only below Elevation 715, and the upper 20 feet of overburden was augered without obtaining samples. Visually, these soils were classified fine-grained, cohesive silts and clays.

In borings SS-14 and SS-15, about two feet of fine-grained, cohesive soils are present between Elevations 715 and 713. Materials between 715 and 705 are terrace sands and gravels. The rounded gravel and sand-size particles are made up of quartz, quartzite, and a small amount of chert. Gravel contents in these materials are variable and as high as 58%. Beneath the terrace deposit, weathered shale is overlying the sound shale which was encountered at about Elevation 702. Shaly soils classified lean clay (CL), silt (ML), and silty sand (SM), with shaly gravel reflecting the varying degrees of weathering.

Natural moisture contents are generally moderate except for a layer of silty clay (ML-CL) encountered in boring SS-15. This material shows a moisture content exceeding the liquid limit, thus indicating weakness. The soft consistency was also confirmed by standard penetration testing and a low number of blows. High penetration resistance of subsoils, however, is indicated throughout the foundation except for the above-mentioned isolated weak layer.

In summary, subsoils at this site appear to be stable, with the exception of a small pocket of cohesive soil located between Elevation 713 and Elevation 715 in boring SS-15. This material was excavated during the preparation of the foundation. The underlying granular terrace deposit is considered dense. Standard penetration blow counts indicate the weathered shale to be hard.

The granular material could be tested for sensitivity, but the probability of liquefaction for soils of this texture and high density is remote. Below Elevation 715, fine-grained soils are either of shaly configuration or present in minimal quantity. The recommended allowable safe bearing capacity as determined by inplace testing is estimated to be in excess of 2.0 tsf.

Service and Office Buildings (Non-Category I Feature)

Borings SS-19 through SS-24, as shown on Figure 2.5-189, had ground surface elevations ranging from 733.8 to 744.5. The overburden depth varied from 38.5 to 46.5 feet, with shaly bedrock encountered between Elevation 695 to Elevation 700. The water table was established at about Elevation 725.

Sampling and in-place standard penetration testing were carried out from footing grade to bedrock. Above the proposed grade elevation, no sampling or testing was done. In three of the borings, SS-19, SS-20, and SS-24, sampling below Elevation 727 shows a relatively uniform soil profile consisting of silty sand and gravelly, silty sand, SM and G-SM, extending to about Elevation 712, underlain by 4 to 10 feed of poorly graded gravel, GP. Beneath these alluvial materials 5 to 11 feet of hard, weathered shale, ML, CL, and G-SM-SC, overlie bedrock.

Standard penetration resistance in these borings reveals a pronounced weakness, N<10, in the silty sand, SM strata to Elevation 715 in borings SS-20 and SS-24 and to Elevation 717 in SS-19. In boring SS-24, above Elevation 720, a layer of stiff, lean clay, 3 feet thick, has a relatively high bearing capacity, but is not considered of sufficient thickness to effectively bridge over the weak underlying silty sands.

Borings SS-21, SS-22 and SS-23 indicate that footings at Elevation 709 will be founded on 3 to 6 feet of clean, poorly graded gravel, GP, which is underlain by 3 to 8 feet of residual, weathered shale, ML and G-SM-SC. These soils are of high relative density or hard consistency, as determined by standard penetration resistance.

In summary, this foundation exploration at the proposed site for the Service and Office Buildings discloses nonuniform soil bearing capacities. In the area of borings SS-21, SS-22, and SS-23, footings located at Elevation 709 will be founded on poorly graded gravel of bearing capacities in excess of 4,000 psf. In the area of borings SS-19, SS-20, and SS-24, footings to be founded between Elevation 718 and Elevation 727 will be in weak, silty sands with bearing capacities ranging from 500 to 1,500 psf. Under these conditions, settlement, even under light loads, could be significant.

The foundation for the Service Building consists of piles driven to bedrock and the foundation for the office building consists of spread footings on undisturbed soil or Class A backfill.

Diesel Generator Building (Category I Feature)

Borings SS-25 through SS-28, as shown on Figure 2.5-190, had ground elevations ranging from 734.1 to 735.0. Undisturbed borings were made to sample typical representative soil types identified in the split-spoon borings. The water table was established at about Elevation 727.

The graphic logs reveal firm silty gravel under the entire building area uniformly below Elevation 713, with lean clay, silt of low plasticity, and sandy silt above the building foundation.

The Diesel Generator Building is rectangular in plan with dimensions approximately 120 feet by 95 feet. The grade floor slab consists of diesel fuel storage tanks encased in concrete and is approximately 10 feet thick with the bottom at approximately Elevation 732.

The bearing pressure under the grade slab will be approximately 2,500 psf. As can be seen from the summary of the test data given in Table 2.5-6 and the standard-penetration data shown on Figure 2.5-190, it cannot be assured that the material between Elevation 713 and the grade slab is capable of safely supporting 2,500 psf. The silty gravel from Elevation 713 to the top of rock is capable of supporting the imposed load as shown by the standard-penetration data given in Figure 2.5-190. The results of the laboratory testing are summarized in Table 2.5-6.

In order to assure a safe foundation for the building, the fine grained soils above the in situ gravel were removed and replaced with granular fill as illustrated in Figure 2.5-226. The criteria for the granular fill is discussed In Section 2.5.4.5.2.

Intake Station and Channel (Category I Feature)

The intake channel is a man-made feature extending approximately 800 feet from the edge of the reservoir through the flood plain to the intake pumping station. The bottom of the channel is Elevation 660, and is 50 feet wide. Channel earth side slopes are one vertical on four horizontal. The nominal ground surface is Elevation 695. Groundwater is near Elevation 685. The location of the channel with respect to the plant layout is shown in Figure 2.1-5. The channel is illustrated in Figure 2.4-99.

The layout of holes is as shown on Figure 2.5-185 and 2.5-185a. Three lines of borings at about 200 feet spacing (borings 30-34, 35-39, and 41-45) were laid out parallel to the intake channel with additional borings near the river bank (40 and 46) and in the slough on the flood plain (47 and 48). Boring 29 was drilled during early site investigation. The layout included 19 (30-48) standard-penetration split-spoon borings with sufficient undisturbed borings (adjacent to split-spoon borings) to sample all types of soils in the profile.

Initial alternate split-spoon borings were taken to the top of rock to obtain general rock elevations and to confirm the presence of firm gravel in the lower part of the soil profile as was indicated in the earlier site exploration. Successive split-spoon borings were made into the firm gravel between these initial borings in order to confirm the general uniformity of soils above the gravel. Borings 33, 36, 38, and 44 were not made since the uniformity of the profile was disclosed by the other borings. Graphic logs of all borings are shown on Figures 2.5-191 through 2.5-195.

The graphic logs reveal firm silty and sandy gravel under the entire intake channel area, below about Elevation 665 across the flood plain, and below Elevation 675 at the intake structure. Above the gravel are lean clays, silts of low plasticity, and silty sands.

Index tests for soil classification, moisture, mechanical analysis, and Atterberg limits on the split-spoon samples were used to reflect locations for undisturbed borings for sampling all types of soils in the profile. Since the split-spoon borings confirmed gravel in the lower part of the soil profile, the undisturbed samples were taken only in soils above the gravel. Five continuous undisturbed borings were made beside split-spoon borings at these locations. Sampling and testing of the basal gravel is described below.

Laboratory tests on undisturbed samples are recorded in Tables 2.5-7 through 2.5-9. Included in these tables is standard-penetration data in the split-spoon boring adjacent to each undisturbed boring. On both the logs and the tables, samples are identified by capital letters and lowercase letters.

The identification system of using uppercase and lowercase letters can be described as follows. Capital letters identify the representative undisturbed samples that are subjected to strength tests. Lowercase letters identify other undisturbed samples and disturbed samples considered to be the same soil as a corresponding capital letter sample. Letter designations on graphic logs and data tabulations permit easier reading of the soil profile and provide a record of the adequacy of the selective sampling and testing. The letter designations are completely arbitrary and apply only to the one project, or even to a single project feature.

The process for selecting test samples is described as follows. Split-spoon standard penetration borings are made to explore the area. The disturbed samples are examined for index properties. This data, with penetration records, is used to determine soil types distribution in the profile in order to select specific locations at which to obtain inclusive representative undisturbed samples for strength testing. Letters are assigned to the indicated separate soil types. The undisturbed samples are taken and tested also for index properties, and density and void ratio. Letter designations are then finalized, with some changes in previous designations, and with possible variations in some "same" samples' properties, because of judgment designation based on all properties. Representative undisturbed samples are given capital letter identifications and are tested for strength.

The silty sand is deposited on top of the firm gravel from approximate Elevation 665 to 680, and the lean clay (or silt) from approximate Elevation 680 to 695. Strength properties of these soils in situ were obtained from the test results shown on Tables 2.5-7 through 2.5-9. The results of the shear tests are plotted in graphical form (Figures 2.5-247 through 2.5-250) and a value of c and $\phi$ was selected for design.

The soils exploration disclosed a possible weak layer of lean clay soil at approximate Elevation 690 to 685 in borings US-30 and US-36, which are on opposite sides of the channel near the reservoir. The test results indicate the minimum strength properties of this material as $\phi = 3°$ and c = 500 psf.

Cohesive soil samples were tested for sensitivity. Of the many samples, the four with sensitivity greater than 2 were remolded to in situ density and moisture content and had unconsolidated undrained (Q) shear tests run. The results are shown in Tables 2.5-8 and 2.5-9. The tests do not indicate serious strength loss.

The liquefaction potential of the site soil deposits are discussed in Section 2.5.4.8.

The basal gravel is located on top of rock at approximate Elevation 650, and extends to approximate Elevation 665. A trench was made in the flood plain for access to the basal gravel for undisturbed sampling. Gravel sizes up to 6-inches and water conditions in wet weather prevented useful undisturbed sampling. Successive essentially saturated grab samples were taken to a depth of 4-feet with a reasonably tight clamshell bucket. Fines contents in the samples so obtained were about 3%, compared with about 5 to 10% in previous boring sampling. Samples were scalped to maximum 2-inch size, scooped into a 12-inch-cube direct shear box, consolidated in submerged condition under equivalent overburden pressure of 3000 psf, and sheared under submerged conditions. Figures 2.5-203, 2.5-204, and 2.5-205 show gradation and shear test results. The gravel strength used in design is $\phi = 42°$ and c = 0. The shear test results show an 0-load intercept of 0.4 to 0.6 tsf, representing interlock of particles in the shear box. Since the magnitude of this effect in the gravel mass cannot be assured, it is ignored in the basic stability analyses.

Due to unexpected soil conditions encountered during the excavation of the intake channel, an additional investigation was made and this information is provided in Section 2.5.5.2.2.

Class 1E Electrical Conduits Alignment (Category I Feature)

The Class 1E conduits furnish electrical power and control for the pumps, valves, screens, control boards, etc., at the intake pumping station. The soils investigation for the conduit alignment was to establish the dynamic soil properties along the alignment and to provide soil strength information for any slopes that would have to be qualified if the conduits were constructed in the slopes. The layout for the soils investigation is shown on Figure 2.5-273. The graphic logs for borings 49 through 63 are shown on Figures 2.5-196 and 2.5-197, and for borings 171 through 177 are shown on Figures 2.5-174 through 2.5-280. The graphic logs indicate that the over-burden varies from 24 to 60 feet thick. Weathered shale is encountered at depths of 10 to 32 feet. The water table was established between Elevation 690 and Elevation 710. Figure 2.5-281 shows a profile along the 1E conduit bank from the ERCW pump station to the main plant with borings spaced along the a1ignment.

The overburden consists primarily of lean clay (CL) and silt (ML and MH) with small quantities of silty and gravelly sand (SM and G-SM), and silty gravel (GM and GP-GM). Below the top of the weathered shale the laminated shaly materials are classified as sand-sized soil. The granular portion of the soils above the shale is made up of silicious and micaceous sand and subangular to rounded sandstone and cherty gravel.

The standard penetration test results shown on the graphic logs indicate soils of a medium to stiff consistency with blow counts usually between 10 and 30 blows per foot. In a few instances, usually near the water table, the penetration results indicate a loose or soft consistency. The liquefaction potential of the samples with a loose consistency was evaluated and is discussed in Section 2.5.4.8.

The results of the laboratory testing are summarized in Tables 2.5-10 and 2.5-11. The strength values used in design are represented in Table 2.5-12. The values used for design (Table 2.5-12) are low averages for all of the strength data shown in Tables 2.5-10, 2.5-11 and 2.5-24. The results for each type shear test are plotted in graphical form (Figures 2.5-206 through 2.5-208), and a value below the average for c and ϕ is selected to be a conservative value to use in the design. There were no sensitive soils encountered in the investigation. The dynamic soil properties are discussed in Section 2.5.4.4.2.

<u>ERCW Piping Alignment (Category I Feature)</u>

The ERCW piping furnishes water for cooling the reactor during emergency condition. Additional piping along the same alignment furnishes water for extinguishing fires (High Pressure Fire Protection (HPFP) piping). The soils investigation for the piping alignment was to establish the dynamic soil properties along the alignment and to provide soil strength information for any slopes that would have to be qualified if the piping were constructed in the slopes. The results of the investigation of the dynamic soil properties are provided in Section 2.5.4.4. The location of the borings for the soils investigation is shown on Figure 2.5-185. The graphic logs for all soil borings are shown on Figure 2.5-198 through 2.5-202, 2.5-282 through 2.5-330, 2.5-332 and 2.5-333. The graphic logs indicate an overburden that varies from 10 to 66 feet, and averages 37 feet. Weathered shale was encountered at the surface at one boring location and at depths up to 37, feet over the remaining portion of the site. Bedrock ranges from Elevation 668 to Elevation 699 with an average elevation of 685.6.

Alluvial soils consist of lean to fat clay (CL and CH), lean to highly plastic silt (ML and MH), along with smaller amounts of silty and clayey sand (SM and SC), and silty and clayey gravel (GM and GC). The coarse-grained portion of these soils includes silicious and micaceous sands and rounded to subangular gravel of 1-inch maximum-recovered size. Below the top of weathered shale the laminated residual materials classify lean clay and silt (CL and ML), silty and clayey sand (SM and SC), and silty or clayey gravel (GC and GM).

In situ standard penetration testing disclosed the alluvium to be of medium to stiff consistency. In some borings, usually near the water table, the penetration results indicate a soil with a loose or soft consistency. The liquefaction potential of the samples with a loose consistency was evaluated and is discussed in Section 2.5.4.8.

The residual shaly soils are generally of stiff to hard consistency. The only weakness established in these subsoils was near the contact with the overlying aluvium.

The results of the laboratory testing are summarized in Table 2.5-24. The strength values used in design are represented in Table 2.5-12. The values used for design are low averages for the strength data shown in Tables 2.5-10, 2.5-11, and 2.5-24 except for the strengths of organic samples. The results of each type shear test are plotted in graphical form (Figures 2.5-207, 2.5-241, and 2.5-242) and a conservative value below the average for c and $\phi$ is selected for use in the design. There were no sensitive soils encountered in the investigation. The dynamic soil properties are discussed in Section 2.5.4.4.2.

The shear strengths of the organic samples were not considered in the selection of design values, because the organic samples were not representative of the soils through which the piping will be constructed. The organic samples appear in only boring SS-107 and that boring is located approximately 100-feet from the piping alignment.

Boring SS-107 is located in an intermittent stream and the graphic log (Figure 2.5-202) shows that bedrock is shallow. Boring SS-94, similar to boring SS-107, is located in an intermittent stream, but located along the piping alignment and also has a shallow depth to bedrock. This indicates that during construction, organic deposits located along the piping alignment would be exposed and removed.

Cyclic Testing - ERCW Piping and 1E Conduit Alignments

In the process of reviewing the potential liquefaction of the soils along the ERCW piping and 1E conduit alignments (Section 2.5.4.8) several samplers were selected for cyclic testing. Two stages of testing were done. The initial stage consisted of cyclic triaxial (R) tests on undisturbed samples obtained from borings and is described as follows.

Silty sand (SM) and sand silts (ML) are present in borings 49, 50, 59, 60, 65, 67, 87, and 88. The location of these borings are shown in Figures 2.5-185 and 2.5-185a. Graphic logs are shown in Figures 2.5-196, 2.5-197, 2.5-198, and 2.5-200. In borings 49, 67, 87, and 88, the SM and ML material with standard penetration test blow counts of about 10 or less are either below the top of weathered shale or above the water table. Based on the information obtained from the borings of the in situ soils, the nonplastic SM material with low blow counts in boring SS-50 (approximate Elevation 698.0) and SS-65 (approximate Elevation 710.0) are judged to be the most susceptible to liquefaction. These two areas were investigated to obtain samples for cyclic testing.

Additional split-spoon borings were located as close as possible to the original locations of SS-50 and SS-65. The split-spoon borings were to locate the material desired for cyclic testing. Once located, undisturbed borings were drilled 5 feet from the split-spoon boring to retrieve the samples. For location SS-50, two undisturbed borings were made, one 5-feet and the other 10-feet from the additional split-spoon boring. Undisturbed samples were recovered from both borings. Figure 2.5-339 shows the graphic logs for the original split-spoon borings (SS-50 and SS65) along with the additional split-spoon (SS-50-1 and SS-65-1) and undisturbed (US-50-1 , US-50-1A, and US-65-1) borings. The laboratory test data for the undisturbed borings are given in Table 2.5-34. Grain size curves for these samples are given in Figures 2.5-340 through 2.5-352.

The soils selected for cyclic testing were from US-50-1 at Elevations 698.9-696.6 (sample 2), 696.4-695.3 (sample 3) and 695.3-694.5 (sample 4). These samples contain 85%, 88%, and 53% sand, respectively, with the remainder being silt and clay in about a 3:1 ratio. Sample 4, with 53% sand, was the first sample selected for cyclic testing. It served both as a useful test and as a calibration sample. Samples 2 and 3 are nonplastic and contain 82% and 88% sand, respectively, and have the highest sand content and the lowest silt and clay content of all the samples. Sample 3 contains the least silt (9%) and clay (3%) and the second highest void ratio (1.002). The sample (sample 2 in boring US-50-IA) with the lowest dry density (79.2 $lb/ft^3$) and highest void ratio (1.148) contains 67% sand, 22% silt, and 11% clay. It was not selected for testing and is not considered critical based on the test results for sample 4 and the high (33%) fines content.

The results of the cyclic tests are presented in Table 2.5-36 and Figure 2.5-353. These tests were all performed with an effective confining pressure of 1,000 $lb/ft^2$ which represents a vertical pressure of 2,000 $lb/ft^2$ (approximately 15-20-feet of overburden soil). These test conditions approximate field conditions. The cyclic stress ratio ($\sigma_d/2\sigma_3$) was conservatively limited to 0.5. Cyclic tests for samples 2 and 4 were performed on undisturbed specimens. For sample 3, a reconstituted specimen was used because of a large gravel in the tube sample. For the reconstituted specimens, a moist tamping method was adopted in which the material was placed in five layers with each layer compacted to a prescribed dry unit weight. The final density of the test specimen was the same as the in situ density.

The second stage of cyclic testing consisted of cyclic triaxial (R) tests on silty sands and cyclic simple shear tests on clayey silts and silty clays. The samples for this testing were obtained from block samples from two test pits along the piping alignment. The test pits and the results of the cyclic testings are described in a report entitled, 'Watts Bar Nuclear Plant Liquefaction Evaluation of the ERCW Pipeline Route' (Reference 167).

The test pit samples are considered to be representative of actual field conditions based on a comparison of the soil classification, grain size distribution, and densities of the test pit samples, with samples from the soil borings.

Tables 2.5-37 and 2.5-38 are comparisons of the classification data for the samples from test pits 1 and 2, respectively, with the classification data for SM soils from the split-spoon borings closest to each test pit respectively. Figure 2.5-354 is a plot of the gradation of the samples from test pit 1 compared with the range of gradations for the split-spoon samples given in Table 2.5-37. Figure 2.5-355 is a plot of the gradation of the samples from test pit 2 compared with the range of gradations for the split-spoon samples given in Table 2.5-38. The information contained in these tables and figures shows that the data on the undisturbed block samples correlates very well with the data from the split-spoon borings nearest the test pits.

Tables 2.5-39 and 2.5-40 are tabulations of the classification data for the split-spoon samples from the borings along the ERCW pipeline in the area south of the cooling towers and in the main plant area, respectively, and have a factor of safety less than 1.05 as calculated and presented by our consultant in the report, 'Liquefaction Evaluation of the ERCW Pipeline Route - Watts Bar Nuclear Plant'[168]. These factors of safety are calculated on the basis of standard-penetration test blow counts and are summarized in Table 1 of the referenced report. Figure 2.5-356 is a plot showing the mean gradation for the test pit samples in comparison with the maximum, minimum, and mean gradations of the split-spoon samples in Table 2.5-39. Figure 2.5-357 shows the same information, but for the split-spoon samples In Table 2.5-40. These two figures show reasonably good correlation between the gradation of the test pit samples and the gradations of the split-spoon samples that have the lowest factors of safety in the liquefaction analysis.

Table 2.5-41 is a comparison of the classification and density data on the test pit samples and the undistributed SM samples taken along the ERCW pipeline. The average dry density for the undisturbed samples from the soil borings was 90.4 $lb/ft^3$ and for the undisturbed samples from the test pits was 86.4 $lb/ft^3$. This is reasonably good agreement. Since the test pit samples had a lower density than the samples from the undisturbed borings, this indicates that the results from the test pit samples are not only valid but are representative of the worst field conditions at the site.

<u>In Situ Basal Gravel</u>

As a result of the NRC staff's concerns about the properties of the basal gravel at the site, an additional soil investigation was conducted in the vicinity of Category I soil-supported structures between June 4 and July 6, 1979. The soil exploration and testing program was designed to determine the properties of the in situ basal gravel and the weathered shale.

Twenty-six borings were drilled at the six locations shown on Figure 2.5-358. Samplers used included 2 inch outside diameter split-spoon sampler; a 7¾-inch outside diameter Sprague and Henwood soil-sampling core barrel; a 5 inch outside diameter Shelby tube sampler; and a 6 inch outside diameter heavy-duty flat spiral slit sampler.

The split-spoon borings were first made and the soil stratification was identified. The split-spoon borings were drilled approximately to the top of bedrock (auger refusal). After completion of the split-spoon borings, the Sprague and Henwood sampler was used in an attempt to take undisturbed samples of the basal gravel at location 125. Hollow stem augers (with 6 inch inside diameter stem) were removed after being used to advance the boring to the top of the basal gravel. A casing was then placed in the boring to stabilize the hole and allow entrance of the Sprague and Henwood sampler. Using drilling water, the sampler was then rotated and advanced slowly to refusal or until the sampling interval was completed. The coarser fraction of the basal gravel was recovered, but the fines were washed away by the drilling water. Three unsuccessful sampling attempts were made in this manner at locations 125 and 128 with the same results. The Sprague and Henwood sampler was abandoned after the cutting edge of the sampler had been worn.

Attempts were also made to obtain undisturbed samples of basal gravel using 5 inch outside diameter Shelby tube samplers. Relatively undisturbed samples were obtained by rotating Shelby tubes through the basal gravel and penetrating the weathered shale (clay residuum) below it to form a plug. Samples taken by this method were disturbed to some extent but represent the best among the possibilities to obtain samples of the basal gravel suitable for in situ density determination. Some of the basal gravel samples increased in volume showing more material recovered than the sampler penetrated. This volume increase was apparently due to shifting and realignment of the gravel as the sampler was rotated into the material. Several attempts were made to obtain the basal gravel samples with Shelby tubes because the gravel layer containing material larger than 5 inches in diameter caused refusal or displacement of the sampler.

Additionally, undisturbed Shelby tube samples were also obtained from the upper portion of the weathered shale residuum having an N (standard penetration number of the blow counts) value below 30.

The final phase of the sampling program consisted of drilling six heavy-duty sampler borings to supplement the representative basal gravel material obtained during the undisturbed phase of sampling. Due to the design limitations of the heavy-duty sampler, the maximum particle size recovered was 3 inches to 4 inches in diameter.

Graphic logs shown in Figures 2.5-359 through 2.5-364 indicate the soil profile; number of blow counts; natural moisture content; soil classification; Atterberg limits; groundwater elevation; sampling elevation; and shear strength and consolidation test data. Profiles were not plotted at locations where only representative samples were obtained.

The borings indicated that the top of in situ basal gravel stratum varied from Elevation 710.5 to 714.0 and extended to elevations ranging from Elevation 706.0 to 709.0. The materials encountered between the existing (finished) grade elevation to the top of the in situ basal gravel consisted of surficial crushed stone or sod underlain by a lean clay fill and/or fine-grained material (mostly in situ alluvium). The investigation of these materials was not included in this program since all Category I soil-supported structures are founded either on in situ basal gravel or compacted granular fill after excavating all the material overlying the in situ basal gravel or bedrock. Furthermore, the backfill and the in situ alluvium above the foundation elevation will not have a significant effect on the bearing capacity of the subject foundations.

The in situ basal gravel was classified from a poorly graded silty sand to a well graded sandy, silty gravel. The N values for the in situ basal gravel ranged from 16 to 50+.

Weathered shale was encountered directly below the basal gravel. The thickness of weathered shale residuum ranged from approximately 7.4 feet to 23 feet. When soil classification terminology is used, the weathered shale varied from a lean clay to lean silt to a gravelly silty sand. The N values for the weathered shale are mainly in the 50+ range which indicates that, in general, it is a hard material. The top uppermost portion of weathered shale (generally the interface between the basal gravel and the hard weathered shale) revealed somewhat lower N values ranging from 20 to 32. This indicates that even the relatively weaker layer of weathered shale has a very stiff consistency. Boring SS-130 revealed a local spot in the weathered shale with N value equal to 3. In order to investigate this soft spot, a confirmatory boring SS-130A was drilled within 15 feet of SS-130. The standard penetration test was conducted and the N values at the location were 24 and 27 and there was no evidence of any soft material. Therefore, it was concluded that the soft spot was either a localized small picket or the standard penetration test was conducted on a disturbed material (before cleaning the hole).

Bedrock (auger refusal) was encountered between Elevations 687.9 and 701.6. The water table ranged from Elevations 711.5 to 724.0.

All split-spoon samples were tested for natural moisture content, Atterberg limits, and/or grain size distribution. The in situ densities of the relatively undisturbed basal gravel samples were determined. All stones larger than 2 inches were removed from the representative disturbed samples of basal gravel. The remaining material (minus 2-inch material) was loosely placed at natural moisture content in a 0.5 $ft^3$ (12 inch by 12 inch by 6 inch) specimen box of the direct shear machine. The specimen was inundated with water and consolidated under a load of 2,000 $lb/ft^2$ which is approximately equal to the effective overburden pressure on the in situ basal gravel (computed from the original ground contours). Consolidated densities were then computed for each sample. Test specimens were remolded to approximately the consolidated and the in situ densities and tested for direct shear S (consolidated-drained) strength. The basal gravel material from boring location 125 could not be remolded to the low dry density value of 97 $ft^3$. Therefore, the test was performed at a dry density of 113.8 $ft^3$, the lowest density attainable. The in situ and consolidated densities and the direct shear test results are presented in Table 2.5-42. The strength envelopes are shown in Figure 2.5-365. The grain size distribution curves of the representative basal gravel are shown in Figures 2.5-366 through 2.5-371. Photos of the representative basal gravel material are presented in Figures 2.5-372 and 2.5-373.

Undisturbed samples of the top portion of the weathered shale (interface between the basal gravel and hard weathered shale) were tested for natural moisture content; Atterberg limits; density; triaxial Q (unconsolidated-undrained); triaxial R (consolidated-undrained); and consolidation tests. The test results are presented in Table 2.5-43. The Q, R, and R strength envelopes are shown in Figures 2.5-374 through 2.5-376.

The soil properties adopted for determining the bearing capacities of the foundations for soil-supported Category I structures are presented in Table 2.5-44. Most of the adopted properties were evaluated on the basis of the soil investigation program discussed above. The properties which are assumed in the absence of test data are conservative.

2.5.4.2.2 Rock

2.5.4.2.2.1 Engineering Description of Bedrock

The geology at the Watts Bar Nuclear Plant site consists of interbedded shales and limestones of the lower Conasauga Formation, Middle Cambrain age, overlain by alluvial material averaging 40 feet in thickness. The structural geology of the area is extremely complex, and can best be described as a system of small tight folds and crinkles superimposed on an average strike of N30°E and an average dip of 30°-45°E.

During the borehole investigation it was not possible to correlate individual shale and limestone beds between holes.

Except for some soft areas at the bedrock surface, both the shale and the limestone appear fresh and unweathered, and there is no evidence of solution in the limestone horizons.

In order to make an engineering analysis of the rock, and to provide a tenable means of logging the complex geology in the core, the following classification system was developed:

| Rock Type | Description |
|---|---|
| 0 | Core Loss--Zones of core not recovered either because of grinding between harder overlying and underlying strata or because they were too soft or fragmented to be recovered by conventional hard rock drilling methods. No cavities were observed with the borehole TV apparatus. For engineering purposes, all zones of core loss are assumed to be Type I rock. |
| 1 | Soft Shale--Material which, when removed from the core barrel, can be easily scratched with a fingernail, or is in such small, although sound and unweathered pieces, that it resembles an agglomerate rather than solid rock. The physical character of the soft shale is generally a function of intense folding and crinkling, and is not generally attributed to weathering. In most instances the individual shale particles are bounded by slicken-sided surfaces. |
| 2. | Hard Shale--Shale which, when removed from the core barrel, cannot be easily scratched with a fingernail. It is recovered in relatively large discrete pieces which may break down upon exposure to discs of shale (also called 'poker chips').<br><br>Slickensides are present but are not as plentiful as in the soft shale, and are generally concentrated along bedding surfaces. |
| 3 | Limestone--Pieces of core that are either entirely composed of limestone or are composed predominantly of limestone with a few thin shale stringers. |

Photographs showing the general nature of the three rock types are presented in Figure 2.5-209. Watts Bar Nuclear Plant shale specimens tested in the University of Illinois Rock Mechanics Laboratory[142] demonstrate the following additional physical properties:

| Rock Type | Unit Weight pcf | Natural Water Content, % | Liquid Limit | Plastic Limit | Plasticity Index |
|---|---|---|---|---|---|
| 1 | 157 to 165 | 4.6 | 18.8 | 19.6 | Nonplastic |
| 2 | 160 to 169 | 1.3 to 2.5 | -- | -- | Nonplastic |

The average core contains about 16% limestone. Soft shale, including core loss, averages about 37% in the upper 50-feet of rock and 19% for the interval from 50-feet to 150-feet into rock. The increase in percent soft shale near the rock surface is most likely the result of the combined effects of stress relief and superficial weathering.

The water table is in the alluvium, 20 to 30 feet above the bedrock surface throughout the main plant area. Of the six boles in the plant area which were water pressure tested, none revealed water takes in the bedrock. The bedrock surface varies from Elevation 690 to 700, averaging 697.

2.5.4.2.2.2 Test Program

Figure 2.5-210 shows the layout of holes tested and the tests performed in each. Both Menard Pressure meter tests and Birdwell 3D sonic logs were made.

In all, 72 Pressure meter Tests were performed in six holes. The pressure meter testing program was designed to determine the static compressibility of the shales at the site.

The Birdwell sonic logs were obtained to determine dynamic moduli for use in the earthquake analysis. Continuous logs were made in seven holes, four of which were also tested with the pressure meter.

2.5.4.2.2.3 Description of Testing Techniques

2.5.4.2.2.3.1 Menard Pressuremeter

The Menard Pressuremeter is a relatively simple device designed to stress the walls of a borehole to obtain the compressibility of soil and low strength rock in situ.

Dixon[139] presents the following description of the operation of the Menard Pressure meter:

The Pressuremeter equipment consists of a combination volumeter-manometer connected to a cylindrical borehole expansion device, or probe. The probe consists of a steel tube surrounded by two flexible rubber membranes. The interior membrane forms the measuring cell, and the exterior membrane provides guard cells at the two ends of the probe. The guard cell is activated by gas pressure and is used to reduce end effects on the measuring cell to provide an essentially two-dimension, cylindrical stress condition. The measuring cell is pressurized with water and kept at a slightly higher pressure than the guard cell to ensure that it is always pressing against the borebole wall. Two concentric tubes connect the volumeter to the probe. An adapter connects the probe to a standard drill rod for lowering and raising the probe within the borehole.

After lowering the probe to the desired depth, pressure is applied to the borehole wall by inflating the rubber membranes. In addition to providing a means for applying increments of pressure to the measuring cell, the volumeter-manometer measures the radial expansion under each pressure increment by measurement of water flow into the probe.

The Pressuremeter Test is performed with each pressure increment being held steady for one minute.

For the six holes tested at Watts Bar, the upper 20 feet of rock was drilled in 5-foot increments, and one pressuremeter test was performed in each increment. The remainder of each hole was drilled in 10-foot increments, again with one test in each increment. Probes 36-inches and 18-inches long were available, but most tests were performed with the short probe so that the probe could be positioned entirely within one of the three rock types. Emphasis was placed on obtaining test values for each rock as a function of depth. Testing was done immediately after drilling each increment to minimize rock disturbance around the bore hole resulting from relaxation and exposure to drilling fluid.

The deformation modulus is calculated from Pressure meter data using the following equation (Menard[144], Dixon[139], Hendron[143], et al):

$$E = \frac{\Delta P - (\Delta q_{iv})(K_v)}{\Delta V - (\Delta P_a)}$$

where:

$E$ = deformation modulus in situ
$\Delta P$ = pressure change
$\Delta V$ = volume change
$\Delta q_{iv}$ = term correcting for pressure required to expand rubber membrane in air
$\Delta P_a$ = term correcting for compressibility of the measuring system
$K_v$ = constant relating borehole volume deformation to linear radial information.

Because the Pressure meter system is comparatively flexible, its accuracy becomes questionable when the rock modulus is greater than 0.75 to 1.0 x 10 psi. The Pressure meter tends to underestimate the modulus for high modulus materials. For this reason, Pressure meter testing at Watts Bar was confined chiefly to the shale.

2.5.4.2.2.3.2 Birdwell Bore hole Logging

Details of the Birdwell testing program are presented in Section 2.5.1.2.11.

2.5.4.2.2.4 Test Results for Menard Pressure meter

Deformation moduli from individual tests are shown in Figures 2.5-33, 2.5-42, 2.5-52, 2.5-54, 2.5-56, and 2.5-65. These values are plotted in Figure 2.5-211 as a function of depth below the bedrock surface for rock types 1 and 2. Results of tests performed in zones of no core recovery, or of tests performed in mixed rock types, are not included in Figure 2.5-211.

The solid lines in Figure 2.5-211 show the assumed average measured E as a function of depth for rock types 1 and 2. These average lines are drawn to be conservative for both shales, but reflect the trend toward increasing modulus with depth. On the basis of a comparison between Pressure meter moduli and moduli determined from laboratory consolidation and laboratory triaxial tests on shale, Hendron[143] recommends dividing moduli obtained by use of the Pressure meter by 3 to estimate the actual modulus which governs the settlement of a structure on shale. This correction is designed to account for three uncertainties: (1) vertical loading by a building versus horizontal loading by the pressure meter, (2) a drained condition during building erection versus an undrained condition during the fast Pressure meter test, and (3) uncertainties in the exactness of Pressure meter values. Hendron developed his correction factor of 3 from tests on horizontally bedded shale where the horizontal deformation modulus parallel to the bedding was measured by the Pressure meter.

Commonly, this modulus is several times greater than that perpendicular to the bedding. At Watts Bar, where beds have an average dip of 30°-45° and are also highly contorted on a small scale, it is expected that vertical and horizontal moduli will be approximately equal. Thus, the first consideration for applying the correction factor is nearly eliminated. Accordingly, a correction factor of 2 is used for the shales at Watts Bar.

In Figure 2.5-211, the dashed lines are derived by dividing the curve for average measured values of E by 2. The dashed lines are assumed to be the actual in situ deformation moduli under drained conditions, and are used for the ensuing settlement calculations. For rock type 1, soft shale, the modulus increases from 5,000 to 50,000 psi in the first 60 feet of rock, and is assumed to continue at 40,000 psi below 60 feet. The modulus for rock type 2, hard shale, increases from 25,000 psi to 300,000 psi in the first 140 feet of rock and is assumed to continue at 300,000 psi below 140 feet.

2.5.4.2.2.5 Comparison of Results from Menard Pressuremeter and Birdwell 3D Sonic Logger

The dynamic moduli obtained with sonic apparatus such as the Birdwell 3D sonic logger are generally higher than static moduli such as those obtained with the Menard Pressure meter. Dynamic moduli cannot generally be used for foundation settlement analyses without first being reduced by some empirical correction factor. For this reason, the static moduli from the pressure meter are considered more reliable for settlement analysis, and are used exclusively to determine the settlement characteristics of the foundation at Watts Bar.

In Figure 2.5-212, the dynamic moduli and static moduli are compared at the pressure meter test locations. As shown in the figure, the ratio (E dynamic/E static) decreases from over 50 to less than 10 with increasing modulus. Deere, Merritt, and Coon[137] show a similar decrease in (E dynamic/E static) with increasing modulus. There are at least three factors contributing to the higher dynamic moduli: (1) dynamic moduli are calculated at much lower stress levels than static moduli, (2) dynamic stresses are applied for an extremely short period of time compared to static stresses, and (3) dynamic stresses are imparted to a smaller volume of rock than static stresses.

This correlation shows that not only must dynamic moduli be reduced for use in a static settlement analysis, but also that this reduction is not a constant.

2.5.4.2.2.6 Settlement Analysis

2.5.4.2.2.6.1 Introduction

In order to estimate probable building settlements based on the Menard Pressuremeter data, Figure 2.5-211, and on data showing the distribution of rock types with depth, Figures 2.5-33, 2.5-42, 2.5-52, 2.5-54, 2.5-56, and 2.5-65, the following procedure has been uti1ized:

1. Divide the rock into layers

2. Calculate the increase in vertical stress at the center of each layer using charts from Newmark.[147]

3. Estimate the average deformation modulus for each layer using the borehole logs and pressuremeter data.

4. Using the calculated stresses and moduli, determine vertical strains and deformations for each layer.

5. Sum the deformations for all layers to obtain surface settlement.

This procedure is described in detail in the following sections, and results are presented for the six holes tested with the pressure meter.

In addition to settlement calculations made for the six core holes tested with the pressure meter, the following calculations are made for comparison:

1. Settlement assuming all rock types to be type 1, soft shale, with modulus as shown by the dashed line in Figure 2.5-211.

2. Settlement assuming all rock to be type 2, hard shale, with modulus as shown by dashed line in Figure 2.5-211.

3. Settlement assuming all rock to be type 3, limestone, with modulus of $1 \times 10^6$ psi for all depth intervals.

4. Settlement based on an average bore hole with 40% type 1, 50% type 2, and 10% type 3 rock in the first 50 feet of rock; and 20% type 1, 50% type 2, and 10% type 3 rock below 50 feet into rock.

The calculations are based on the assumption that the entire semi-infinite mass under the foundation is made up of material distributed in the same fashion as that under the center of the foundation. No correction can be made for the contingency that different material may appear under the corner of the footing than at the center. However, by using this technique, settlements can be bracketed by determining the bore holes whose average moduli would produce the maximum and minimum settlements, and an estimate can be made of the maximum probable differential settlements.

2.5.4.2.2.6.2 Determination of Stresses at Depth

The distribution of stresses below a flexible circular footing can be obtained using the influence factors presented in Figure 2.5-213. These influences are derived from the Boussinesq stress equations through the use of Newmark's charts.[147] To obtain the stress increase at any depth imposed by a flexible circular foundation, the influence factor for the depth and footing size in question is multiplied by the average stress on the foundation. For example, for a 100-foot-diameter foundation loaded with 5 ksf, the vertical stress increase 100-feet below the footing is (5 ksf) (0.3) = 1.5 ksf. Calculations to determine surface settlement are carried to a depth where the stress increase is less than 10% of the applied surface stress, or approximately two times the footing diameter, as shown in Figure 2.5-213. Since large footings stress deeper material, and since the moduli for the shales increase with depth, the effective stiffness of the foundation will increase with footing size. For this reason, calculations are made for footings 10-, 50-, 100-, and 200-feet in diameter.

The average stress on the 132-foot-diameter mats under the Reactor Buildings will be approximately 5 ksf. The Auxiliary Building, on a mat detached from the Reactor Building mats, will impart an average stress of 4 to 5 ksf to the foundations, and the turbine mat foundations will be loaded to between 6 and 7 ksf. The remainder of the Turbine Building outside the turbine mats will be founded on individual column footings with foundation pressures approaching 10 ksf.

Assuming the Reactor Building to be founded below 10-feet of overburden at 120 pcf and 5-feet of shale at 160 pcf, and assuming the water table to be 20-feet below the surface, the effective stress removed from the foundation surface by excavation of overburden will be approximately:

(0.12) (20) + (0.12-0.06) (20) + (0.16-0.06) (5) = 4.1 ksf.

Since the weight of the reactor is not appreciably larger than the effective weight of removed overburden, settlement under the Reactor Building will be limited chiefly to the recovery of heave experienced during excavation. After construction, as the water table is allowed to rise to its original elevation, the effective stress applied by the reactor will be decreased to 3.4 ksf, less than the effective weight of the overburden, and settlement should cease, followed by rebound potentially as great as the previous settlement.

In order to estimate settlements during construction, a footing pressure of 5 ksf is used. These settlements can be extrapolated linearly to footings with different average pressures.

2.5.4.2.2.6.3 Computation of Average Modulus of Deformation for Each Layer

To calculate average moduli, the bedrock is divided into 5-foot layers to 60- feet, 10-foot layers to 200-feet, and 50-foot layers to 400-feet. Where boring logs are available (the upper 50-feet or rock in holes 29, 41, 43, and 52, and the upper 150-feet of rock in holes 20 and 39), actual percentages of each rock type are used to calculate the average modulus for each 5- or 10-foot layer. For holes where no core was taken for the interval between 50- and 150-feet into rock, average percentages for this depth interval in holes 20 and 39 are used; 20% type 1, 70% type 2, and 10% type 3 rock. These percentages are assumed to continue below 150-feet into rock for all holes.

The average modulus for each depth interval is found by converting the equation for adding springs in series to:

$$E_{ia} = \frac{100}{\frac{P_1}{E_1} + \frac{P_2}{E_2} + \frac{P_3}{E_3}}$$

where

$E_{ia}$ = average E for 5-, 10-, or 50-foot-depth interval in question

$P_1$ = actual or estimated percent type 1 rock in interval

$P_2$ = actual or estimated percent type 2 rock in interval

$P_3$ = actual or estimated percent type 3 rock in interval

$E_1$ = modulus for type 1 rock at center of interval, taken from dashed line for type 1 rock in Figure 2.5-211

$E_2$ = modulus for type 2 rock at center of interval, taken from dashed line for type 2 rock in Figure 2.5-211.

$E_3$ = assumed modulus for limestone, $1 \times 10^6$ psi for all depth intervals.

The average moduli for each depth interval are shown in Figure 2.5-214 for zones where core was taken and actual percentages of each rock type are known.

2.5.4.2.2.6.4 Determination of Surface Settlement

The settlement for each depth interval is obtained using:

$$S_i = \frac{\sigma_i \; t_i}{E_{ia}}$$

where:

$\sigma_i$ = stress at the center of depth interval i, calculated using Figure 2.5-213
$t_i$ = thickness of depth interval i

Total surface settlement, $S_s$, at the center of each flexible circular footing is obtained by summing all s below the footing.

For comparison, the edge of a flexible footing will settle approximately two-thirds of the center settlement[152]. A rigid footing will settle approximately 0.8 times the center settlement of a flexible circular footing.[145]

Whether or not a slab is rigid or flexible, according to De Simone,[138] is a function of the moment of inertia of the slab, the relative stiffnesses of the slab material and foundation rock, and width of the slab. Using De Simone's relationship and moduli for the average hole, and assuming that the structure itself adds no rigidity to the foundation slab, the following slab thicknesses are required in order to be considered rigid:

| Slab Diameter Feet | Thickness to be Considered Rigid Feet |
|---|---|
| 10 | 1.5 |
| 50 | 5.7 |
| 100 | 10.3 |
| 200 | 18.3 |

These thicknesses are conservative since the walls within a structure such as nuclear plant will increase rigidity appreciably.

Once the total settlement is obtained, an average effective deformation modulus can be calculated for each hole using:

$$E = \frac{2\,qr\,(1 - v^2)}{S_s}$$

where:

E = average deformation modulus which would produce calculated surface settlement
q = foundation pressure
r = foundation radius
v = Poisson's ratio, assumed 0.20
$S_s$ = total surface settlement at center of flexible footing

Surface settlements and deformation moduli are presented for each set of calculations in Table 2.5-13 and settlements are compared in Figure 2.5-215.

For the six holes for which settlements have been calculated, settlements are between the values calculated by assuming that all rock is either type 1 or type 2. S ranges from 0.11-inches for a 10-foot-diameter footing on hole 43, to 1.18-inches for a 200-foot-diameter footing on hole 29. E for the average hole ranged from 17,000 psi for a 10-foot-diameter footing to 83,000 psi for a 200-foot-diameter footing.

2.5.4.2.2.6.5 Determination of Site Uniformity

The same method of settlement analysis could be employed to calculate settlements and average moduli for the 28 other core holes in the immediate plant area. However, Figure 2.5-216 allows easy empirical extrapolation of information from the six pressure meter holes to the remaining holes in the plant area. This extrapolation has been developed for the 10-foot-diameter footings only, because the small footings are most sensitive to the presence of soft shale near the surface of the bedrock. A similar extrapolation could be developed for larger footings.

In Figure 2.5-216, it is assumed that type 2 rock, hard shale, is the average rock type at the plant site. It is further assumed that equal parts of type 1 rock and type 3 rock do not change the modulus from that if all rock were type 2. It follows then that the average modulus should be a function of

(% type 1 rock) - (% type 3 rock)

for the depth interval receiving the most stress from the footing. In Figure 2.5-216, this function is plotted versus deformation modulus for the 20-foot-depth interval below 10-foot diameter footings. All holes tested with the pressure meter except N-65 follow the well-established trend. The curve showing all type 1, type 2, or type 3 rock is also presented for comparison.

Using the boring legs and the relationship shown in Figure 2.5216, the average deformation moduli for the 10-foot-diameter footings for all holes in the plant areas have been estimated and are plotted in Figure 2.5-217. Except for a higher modulus zone of rock delineated by the dashed lines through the Auxiliary Building, conditions appear to be uniform across the site.

2.5.4.2.2.6.6 Improvement of Foundation Uniformity by Removing to 10-Feet of Surface Rock

Because a large part of the variation between holes shown in Figure 2.5-217 arises from soft shale near the bedrock surface where it has the most influence on settlement, it is expected that with the removal of 5- to 10- feet of surface rock the moduli in Figure 2.5-217 will become even more uniform. To partially verify this effect, detailed settlement calculations were made for the pressuremeter boles assuming 10-foot-diameter footings founded 10-feet into rock. Table 2.5-14 shows that: (1) the magnitude of average settlements is halved, and that (2) differential settlement due to varying rock quality is decreased by a factor of 5 with removal of the upper 10-feet of rock.

Since a major part of the plant is to be founded 5- to 10-feet into rock, the advantages of removing the upper rock should be fully realized.

2.5.4.2.2.6.7 Bearing Capacity

An estimate of the minimum bearing capacity of the shale can be made using the following assumptions:

1. All rock is type 1.

2. Footing has no surcharge (center of excavation).

3. Factor of safety of 3 against bearing capacity failure.

4. 0 = 25° for the shale.

5. E = 10,000 psi.

6. Previous studies[136] show the unconfined compressive strength of shale to be approximately E/100. E/200 = 50 psi is assumed to account for the slicken-sided and contorted nature of the shale.

With these assumptions, the allowable bearing capacity for a footing 10-feet in diameter using the relationship shown by Terazghi and Peck[151] is 26 ksf. This value is greater than any anticipated loads at the Watts Bar Nuclear Plant. Bearing capacity will be governed by tolerable differential settlements.

2.5.4.2.2.7 Behavior of Watts Bar Lock

2.5.4.2.2.7.1 Moduli Calculated from Lock Settlement

Watts Bar Dam, constructed in 1939, is situated less than 2 miles upstream from the present nuclear plant site. The left end of the dam and the lock are founded on the same material which will form the foundation for the nuclear plant. During construction, a number of settlement points were placed on various blocks within the lock, and settlements were monitored for the period between April 1940 and June 1942. Most of the lock was placed within an original water course, and less than 5-feet of alluvium and 5-feet of rock were excavated to foundation grade. A simplified plan of the lock foundation is shown in Figure 2.5-218, and a typical settlement curve is shown in Figure 2.5-219.

With known settlements and foundation load distributions, the deformation moduli shown in Figure 2.5-218 have been calculated using Newmark's chart for vertical displacements[146] which assumes a perfectly flexible foundation. This assumption is most valid for point E, for which a large part of the settlement can be attributed to the adjacent fill. The effective modules at point E should be compared with that of a footing 100- to 200-feet in diameter at the nuclear plant. The modulus of deformation at point E, 99,000 psi, is equal to the highest modulus hole under a 200-foot-diameter footing at the nuclear plant, indicating that the assumptions made concerning the modulus of deformation for deep rock at the nuclear plant are slightly conservative.

For points A through D on the upper guard well, moduli range from 23,500 psi to 89,000 psi, with the two higher moduli on the lock side of each block. Since the blocks are high with respect to their base size, and since they are triangular in shape with the heaviest load on the lock side of the foundation, additional calculations have been made assuming them to be rigid with rotation about their centers of gravity. The resulting moduli, 43,000 and 49,000 psi, should be compared with moduli calculated for footings at the nuclear plant approximately 25-feet in diameter and founded 5-feet into shale. From Table 2.5-14, the average E for a 10-foot footing founded 10-feet into rock is 33,000 psi. Since the modulus for a larger footing would be greater, the calculated moduli at the lock and at the nuclear plant appear to agree perfectly.

The calculations based on lock settlement verify the validity of assumptions and techniques used to estimate deformation moduli at the nuclear plant, settlement of the lock serves as a large scale foundation test for the nuclear plant foundation.

2.5.4.2.2.7.2 Settlement of Lock and Nuclear Plant as a Function of Time

Figure 2.5-219 shows settlement of block R-10 (point F in Figure 2.5-218) with respect to three important events: (1) completion of construction of the block, (2) flooding of the cofferdam, and (3) the start of reservoir filling. By August 1940, when the block was completed, approximately 65% of the total settlement had taken place. Eight months later, settlements were nearly complete. As the cofferdam was flooded, reducing the effective stress on the block foundation, settlement ceased, and one-third of the previous settlement was recovered as heave during the next six months. Between April 1941 and January 1942, the cyclic nature of the settlement curve is most likely response to the lake level behind Chickamauga Dam.

The average foundation stress at block R-10 was approximately 6.5 ksf before the cofferdam was flooded, a stress similar to those expected at the nuclear plant. However, at the lock the effective weight of removed overburden was only 0.8 ksf as opposed to 4.1 ksf at the nuclear plant. Because of this difference, it is expected that an even greater percentage of total settlement will be realized during construction of the nuclear plant.

Settlement should cease as the water table is allowed to retain its original elevation around the nuclear plant, and as shown at the lock, heave can be expected at this time as effective stresses on the foundation are reduced.

Since two periods of differential movement are expected during construction, and during raising of the water table around the plant installation of utility lines passing between buildings was delayed as long as possible during the plant construction to allow the water table to almost return to the original ground water level around the plant.

2.5.4.2.2.8 Excavation Experience in the Rutledge Shale at Watts Bar Lock

Exploratory holes were drilled in the area of the Watts Bar Dam navigation lock by TVA and Corps of Engineers personnel. The following remarks[150] relate the experience during drilling and subsequent excavation.

> . . . Most of these holes penetrated dark gray sandy fissile shale with thin layers of interbedded dense gray sandstone. The core recovery was poor, leaving only the hard sandy shale and thin layer of sandstone after the soft fissile shale was washed away by the drilling operation. The cores indicated a rather level rock formation with little weathering at the surface.
>
> After the foundation excavation was started the true nature of the rock surface was revealed. The shale was soft and weathered for a foot or two below the surface, and below this limit the shale was consistently uniform in character although the dip of the beds varied between wide limits. The shale was somewhat harder than was at first expected and disintegrated very little on exposure to the weather. It proved practical to dig the shale with a power shovel without blasting.

At the powerhouse where blasting was required, the perimeter of the area was line drilled prior to blasting to minimize damage to adjacent rock.

Core drilling experiences at the lock have been duplicated at the nuclear plant site except that core loss decreased with depth and the 'sandstone' at the lock site has been reinterpreted to be a glauconitic limestone. It is expected that excavation conditions at the nuclear plant will duplicate those at the lock.

During excavation, it was found that weathered shale could be identified as being brown, rusty, and 'rotten,' while fresh shale was dark gray to black. The rock under the lock is described as having hundreds of small, sharp, overtured folds plunging to the northeast. It was found that the small-scale folds 'strengthened the shale against sliding, but they always made hand scaling difficult for it was impossible to follow any one bed.'

Information from the 'Final Geologic Report of the Watts Bar Project' by P. P. Fox[140] states:

> To obtain a satisfactory surface on the shales under the lock, a saw-toothed surface was cut into the shale, after an attempt to scale blocks R-10, L-2, and R-2 as a flat surface. This method proved to be much faster and better than any other tried. On the flat surfaces innumerable small, partially detached, loose, and fragile particles of shale existed in spite of all care in scaling, but by the notched method the hard beds could be exposed on the top of the benches and the softer shale left undisturbed in the nearly vertical faces.

TVA Technical Report No. 9[150] describes the excavation operation as follows:

> . . . Power shovels excavated to within 6 inches of the neat line and grade for the lock walls. The final excavation was performed by hand picks and pneumatic tools approximately 24 hours before the placing of concrete. The final scaling left the bedrock stepped or with a saw-tooth relief, the more horizontal areas cut to a plant along the more durable sandstone strata. Experience proved that the rock did not disintegrate as rapidly as expected and that final scaling of only 3 inches from walls and floors, where no truck traffic was expected, would be sufficient . . .

Several specimens of shale from the clear plant site were tested with a newly developed slaking durability test in the University of Illinois Rock Mechanics Laboratory[142]. The test is based on the percent of an oven-dry specimen retained in a 2-mm mesh drum after 10 minutes of rotation. This value is compared with the plasticity index of the shale. The test is sensitive to the shale's ability to withstand stress relief and cyclic wetting and drying. Since the shales at Watts Bar are nonplastic, cyclic wetting and drying is not of chief concern because it does not cause appreciable swelling and shrinkage. However, the percent retained in the durability test was 30% for type 1 shale and 80% for type 2 shale. From past experience, durability becomes a matter of concern when the percent retained falls below 95%. The low durability of the Watts Bar shale is attributed to its slicken-sided and contorted nature, which makes it susceptible to deterioration upon stress relief.

The results of the durability test are borne out in observations made by Fox[141] during construction of Watts Bar lock. Upon examination of the lock foundation, Mr. Fox expressed the opinion that wetting and drying was not the chief source of deterioration in the shale, but that stress relief causing parting along preexisting planes of weakness, such as joints and slickensided surfaces, was most responsible for deterioration. Mr. Fox thought that final scaling should be followed in less than two hours by placement of the first lift of concrete. As experience was gained, it was found that stress relief was not a problem if the first pour came within 24 hours of scaling.

2.5.4.2.2.9 Evaluation of Settlement

2.5.4.2.2.9.1 Initial Settlement Monitoring

The initial program to monitor settlement began in October 1973 to record structural movements during construction. The location of the settlement stations are provided in Figures 3.8.4-66 and 3.8.4-67. Figure 2.5-585 shows details of a typical settlement monument. In general, the monuments were read monthly for selected monuments and terminated for the rest. The recorded settlement data are given in Tables 2.5-67 through 2.5-70. The differential settlement readings between rock-supported structures are provided in Table 2.5-71. During the course of construction several settlement stations became inaccessible (and are so labeled) either because they were physically buried or were impossible or extremely difficult to reach. All accessible settlement stations were last read during December 1981 and January 1982 when three additional surveys were run. During each of these surveys all accessible stations were read except for locations SS-4, -5, -6, -7, -13, -14, -15, and -16. These eight were read once in January 1982 and again in a special survey during February 1982. All eight are in highly congested areas and were previously labeled as inaccessible. These stations were only accessible using specially modified level tripods and survey rods. Six of these eight stations are in the annulus.

During construction, several monuments were relocated for various reasons. Monuments 1 and 2 had associated relocated Monuments 1A, 1B, and 2A. These and their corresponding old monuments were all read for a sufficiently long period that they constitute essentially separate data. The Diesel Generator Building monuments were relocated from the inside to the outside of the building in April 1980. In excess of 7 years' data are available for the interior monuments. Other monuments were relocated several months after original installation and were subsequently read for periods of more than 7 years. These are not identified by a letter (1A, 2B, etc), but the relocation dates are given in Tables 2.5-69 and 2.5-70 and the monuments are identified as reset. Their settlements prior to reset are small and are not carried forward; in effect truncating several months of earlier records. This is done for two reasons. First, the total duration of record (over 7 years) is large compared to the several months truncated. Second, the magnitudes of the "measured settlements" at the time of reset are small and generally less than the apparent random fluctuations of the data. Absolute magnitude of error allowed in typical surveys of these monuments is on the order of from 0.01- to 0.06-feet depending on the monument and length of run. However, the actual error of closure for the surveys was generally less than 0.01-feet.

2.5.4.2.2.9.2 Evaluation of the Program

Rock supported Category I structures were designed for total settlement of 1-to 2-inches and differential settlements of 1-inch. The settlement of rock supported structures was not deemed to control the design of the building. Table 2.5-72 provides the design settlement (total and differential), the maximum recorded settlement, and the current settlement measurement for each rock supported structure. The maximum recorded settlement shown in Table 2.5-72 is for a single monthly reading with both preceding and following readings indicating smaller settlement. The current settlement reading is the average of the three readings from December 1981 to January 1982 unless otherwise noted.

The time versus settlement plots of Unit 1 and 2 Reactor Buildings, shown in Figures 2.5-586 and 2.5-587, respectively, reflect the latest reliable data available. Readings were discontinued June 1978 because settlement stations became inaccessible. The survey data of January and February 1982 were not used for the plots of the Units 1 and 2 Reactor Building because the surveyors experienced considerable difficulty in reaching the settlement stations in the annulus. However, the current data is presented in Table 2.5-70. For the Unit 1 Reactor Building, the maximum and minimum settlement stations were inaccessible after March 1978, and October 1977, respectively. The Unit 2 Reactor Building settlement was discontinued in June 1978 because the settlement stations became inaccessible.

Updated time versus settlement plots are provided in Figures 2.5-588 and 2.5-589 for the Auxiliary Control Building, the Diesel Generator Building, and the Intake Pumping Station.

The measured settlements have not approached the design criteria of 1-inch of differential settlement between buildings or 1- to 2-inches of total settlement with respect to the surrounding area. In general the maximum settlement of rock-supported structures had occurred by 1977, and thereafter the settlements have been stable. The maximum settlement of 0.056-feet (0.67-inches) was recorded April 1980. The maximum differential settlement of 0.038-feet between the Reactor Building Unit 1 and the Auxiliary Building was recorded August 3, 1977. The measured differential settlement of 0.060-feet, August 1977, between settlement stations (SS) 18 and 23 was judged to be a measurement error for three reasons. First, the differential settlements one month before and after were recorded to be 0.018-feet and 0.024-feet, respectively. Second, the latest reading between SS18 and SS23 was recorded to be 0.023-feet of differential settlement. Third, the maximum settlement recorded a year before and after the error was 0.036-feet between SS18 and SS23.

TVA has fulfilled the commitment of monitoring rock-supported structures since the structure loading is essentially complete on all rock-supported buildings, and all the total and differential settlements are well within the design criteria allowables. Settlement readings will no longer be reported for rock-supported structures.

The settlement monitoring of the soil-supported Category I structures include the Diesel Generator Building and the waste packaging area. Table 2.5-72 provides the design settlement (total and differential), the maximum recorded settlement, and the current settlement measurement for these structures. The Diesel Generator Building is founded on compacted 1032 crushed stone (an engineered granular fill) underlain by basal gravel and bedrock. This foundation was deemed to have negligible settlement or differential settlement. The Diesel Generator Building as laid out and designed is not controlled by settlement. The connections were designed to allow for a differential settlement of 3-inches for the ERCW piping, ¾-inch for expansion/deflection fittings on electrical conduits, and 1-inch between the cable trays and rigid conduits in conduit banks (electrical conduits).

The design of the waste packaging area was similar to that of the Diesel Generator Building. The settlement of the building was taken into account when designing the connections between the buildings. The waste packaging area does not have connecting ERCW pipes, other Category I pipes, or Category I electrical conduits. The waste packaging area was designed for 1-inch of differential settlement between the Auxiliary Building and itself.

Based on our evaluation, the total and differential settlements are not significant; there are no trends being exhibited; there has been no adverse structural performance; and there are no anticipated problems from the settlement of Category I structures.

2.5.4.2.2.9.3 Differential Settlement Not Incorporated in Design Criteria

The design 1-inch differential settlement between adjacent rock-supported structures was not incorporated into the design of piping and electrical components passing between adjacent rock-supported structures. The affected items pass between the Unit 1 Reactor Building and Auxiliary Building and between the Unit 2 Reactor Building and the Auxiliary Building. This design deficiency is covered in NCR WBNCEB8108.

The effect of the failure to include the 1-inch differential settlement between adjacent rock-supported structures would be limited to HVAC duct, cable trays, Category I piping, instrument lines, and conduit (plus their related supports) which pass between adjacent buildings. Through evaluation TVA has determined that all such HVAC duct, cable trays, and their supports can withstand a 1-inch settlement as is. TVA has also determined by analysis of settlement data on all Category I structures in the main plant area that the differential settlement of adjacent structures would not be 1-inch, but rather the maximum differential would be less than ½-inch. (This ½-inch figure is based on settlement which occurred in 1976 and early 1977 which is before the great majority of utility lines were installed.) The analysis also demonstrates that after 1982 additional settlement will be less than ¼-inch.

By the engineering judgment of TVA design personnel, the conservatism inherent in the design of the plant is sufficient to accept the effects of this settlement on Category I piping, conduit, and instrumentation lines without causing line failure or adversely affecting safe operation of the plant.

To confirm this analysis, a system for monitoring future differential settlement was developed.

2.5.4.2.2.9.4 Monitoring Program for Differential Movement

Instrumentation for monitoring future differential settlement has been designed and installed. Details of the relative movement detectors (RMDS) are shown in Figure 2.5-590. Their locations are shown on Figure 3.8.4-66. Settlement was monitored until January 1984. At that time it was determined that future settlement would be insignificant. TVA memo on settlement stations dated February 6, 1984 stated that the settlement monitoring program was no longer needed. TVA calculation WCG-1-861 Settlement Monitoring provides further justification for this determination. On that basis, monitoring of differential settlement has been discontinued and is not required at WBN.

2.5.4.3 Exploration

The relationship between Category I foundations and the in situ soil or fill materials are described in the following sections:

| | |
|---|---|
| *In Situ* Soil Investigations | Section 2.5.4.2.1 |
| Borrow Investigations | Section 2.5.4.5 |
| Excavation and Backfill | Section 2.5.4.5 |

The corresponding information with regard to rock is found in Section 2.5.1.2.6.

2.5.4.4 Geophysical Surveys

2.5.4.4.1 Rock Characteristics

The rock characteristics have been discussed in Sections 2.5.1.2.7 and 2.5.4.2.2. with regard to dynamic moduli.

2.5.4.4.2 Soil Characteristics

In situ soil dynamic studies were made at the Watts Bar site to obtain data for computation of elastic moduli for earthquake design criteria. Tests consisted of the following:

1. Down-hole seismic surveys for 4 stations in the intake channel, for 1 station for the Diesel Generator Building, and for 25 stations for the Class 1E conduit and ERCW piping alignments.

2. Seismic refraction surveys along two lines in the Diesel Generator Building and along four lines in the intake channel.

2.5.4.4.2.1 Equipment

1. Intake Channel and Diesel Generator Building

   The equipment used to record the time arrivals for compressional and shear wave velocities was a Bison signal enhancement seismograph, Model 1570B, a Bison strip chart recorder, a Hall-Sears MP-4 pressure type geophone, and a 8-hz Mark Products geophone.

2. Class 1E Conduits and ERCW Piping Alignments

The equipment used for recording seismic waveforms through the soil consisted of a Bison Instruments signal enhancement seismograph, model 1575, strip chart seismic recorder and blaster, and a Hall-Sears MP-4 hydrophone.

2.5.4.4.2.2 Velocity Measurement Procedures

1. Intake Channel and Diesel Generator Building

The seismic refraction surveys were made by placing a geophone at the end of a traverse line and generating a signal by hitting a steel plate with a sledge hammer at various measured distances from the geophone. The refraction lines were surveyed in both directions and the results averaged. The seismic down-hole surveys were made by placing a geophone down a cased hole near the top of rock and the energy (usually a cap plus a few inches of primacord) was detonated on the surface 20 feet from the top of the hole. Down-hole seismic measurements were made in four directions from the hole.

2. Class 1E Conduits and ERCW Piping Alignments

Figure 2.5-227 shows a plan view and vertical section of a typical test configuration for an in situ soil dynamic property measurement. The soil test bore hole was cased with a vinyl tube, capped on the lower end to prevent water from leaking into the surrounding soil. The hydrophone was lowered into the test hole to a depth such that it was both immersed in the water and not touching the bottom of the hole. The depth (z) in Figure 2.5-227 is the difference in elevation between the hydrophone center and the point of sonic energy application. Seismic waves were generated either by striking a steel plate with a sledgehammer or by exploding two feet of primacord about one foot below ground. For each borehole, either explosives or sledgehammer was used as the single type of energy source for the survey as soil sonic attenuation conditions required. That is, a single type of energy was used for the entire sequence of measurements at each hole.

The detection of shear waves by a hydrophone in a water-filled bore hole has been shown to be most effective when the vertical shear wave component is incident at about 45 degrees to the hole axis (Reference 171). Therefore, the point of energy application on the surface was a distance (x) from the hole axis equal to the hydrophone depth (z) below surface. Four independent seismic waveforms were recorded for each borehole with the energy source locations placed in a 90-degree array at a horizontal distance (x) from the hole axis and oriented north, south, east, and west of the hole, as shown in Figure 2.5-227. Where this orientation was not possible, the whole array was rotated about the borehole axis by the angle $\phi$, also shown in Figure 2.5-227. In all cases the time trace of the seismic wave form was recorded for later careful analysis.

2.5.4.4.2.3 Data Analysis and Results

1. Intake Channel and Diesel Generator Building

In Situ Soil Dynamic Results--Compressional wave velocities were obtained from down-hole and refraction surveys. Shear wave velocities were measured from a few of the seismic refraction traverses, but there was no attempt to measure them by the down-hole survey. When no shear wave measurements were made, an assumed Poisson's ratio was used to calculate shear wave velocities.

An assumed Poisson's ratio of 0.45 was used for all downhole measurements, and Poisson's ratios of 0.35 to 0.46 were used for the various compressional velocity zones along the six seismic refraction traverses. The saturated soils gave higher compressional velocity values than those above the water table. Therefore, it was assumed that a high water content was the primary reason for the higher values. A Poisson's ratio of 0.45 or greater was used below the water table to offset the high compressional velocities so that more realistic shear velocities could be calculated.

The average results from the in situ dynamic program are given in Tables 2.5-15 and 2.5-16. Details pertinent to the program and detailed results are given in Figures 2.5-228 through 2.5-233.

2. Class 1E Conduits and ERCW Piping Alignments

Data analysis was performed by measuring time intervals from detonation to geophone arrival for the compression wave (P-wave) and, where possible, for the shear wave (S-wave). The P-wave arrival is identified as the first deviation of the linear time trace. The S-wave is identified by any change in amplitude, frequency or both of the sinusoidal compressional wave at approximately twice (1.99 - 3.67) the first arrival time of the compressional wave. Shear wave first arrival could not be identified on all records. Only those records identified were used in the analysis. Straight line propagation paths were assumed for all analyses. The density value used for the analysis was the mean of those obtained by laboratory testing of soil samples. Converting travel time measurements to dynamic moduli values was performed on a Hewlett-Packard programmable calculator using programs specifically written for this purpose. The equations relating seismic velocities to dynamic moduli may be found in any standard text on geophysics. Statistical analysis of the data was performed in a similar manner. Data acquisition and reduction accuracy, though performed by standard practices, are very near 'state-of-the-art.' Efforts are still continuing toward developing improved methods of shear wave generation and detection.

In situ soil dynamic moduli and statistical analysis results are presented in Table 2.5-17 for the Watts Bar site.

The fact that the mean hydrophone depth (z) is the difference in elevation between the center of the hydrophone and the elevation of the points of energy application should be noted. This fact explains why in some cases the depth (z) could be greater than the depth of refusal. The cases where it is several feet less may be attributed to obstructions in the vinyl bore hole casing.

Large standard deviations in the compressional and shear velocities may be attributed either to soil velocity anisotropism or to difficulty in recognizing wave arrival times either because of noise or wave attenuation.

2.5.4.4.2.4 Data Analysis and Results - Evaluation Seismic Criteria and New Design/Modification Seismic Criteria (Set B and Set B + C)

The dynamic soil property results used in the seismic analyses were reevaluated using current technology to more precisely reflect their elevation and plant variations. Separate layered soil profile were established for WBN soil-supported structures (Diesel Generator Building, Additional Diesel Generator Building and Refueling Water Storage Tank) and for the North Steam Valve Room. The dynamic soil properties used in the soil-structure interaction analyses of these structures are summarized in Tables 2.5-17A through 2.5-17D. Figures 2.5-233A through 2.5-233K referenced in these tables define the strain-dependent soil shear modulus and strain-dependent soil damping ratio.

2.5.4.5 Excavations and Backfill

2.5.4.5.1 Earthfill

The term 'earthfill' refers to soil which is obtained from onsite borrow areas and compacted in multiple lifts to form a fill meeting specified standards.

2.5.4.5.1.1 Investigation

Investigations for borrow centered in two major areas; (1) the area that required excavations for the structures in the main plant area, and (2) onsite borrow areas. The areas investigated for borrow are shown on Figures 2.5-220 for the main plant area, and Figures 2.5-221 and 2.5-221a for the onsite borrow areas. The onsite borrow areas are located on a topographic map in the upper right corner of the figure, with each individual borrow area shown in more detail elsewhere on the figure.

The usual method of sampling consisted of continuous augering to plant finish grade or to top of bedrock or to the ground water level, depending on the design requirements. The soil recovered from the auger borings for laboratory testing was placed in plastic bags. In some areas test pits were excavated to obtain bag samples. Representative samples of each borrow soil type were sealed in glass jars immediately upon removal from the auger boring or test pit for laboratory index testing.

The soils material from the borrow investigation was tested by family type groups. Soil classes were selected for each area upon completion of the compaction tests. To determine the borrow soil characteristics and to aid in establishing the soil classes in the borrow areas, the following index tests were performed on each typical borrow soil:

1. Atterberg limits (ASTM D 423 and D 424)

2. Grain size (ASTM D 422)

3. Classification (ASTM D 2487)

4. Standard compaction tests (ASTM D 698)

On earthfill selected to be used for construction of qualified fills, the following additional tests were performed as needed on each soil class in order to establish design properties.

1. Unconsolidated - Undrained (Q) Shear Strength (ASTM D 2850).

2. Consolidated - Undrained (R) Shear Strength (Standardized TVA Procedure).

3. Consolidated - Drained (S) Shear Strength (ASTM D 3080).

The Q test specimens were remolded at 3% above optimum moisture content. The R and S test specimens were remolded at 3% below optimum moisture content. S shear tests were conducted using a direct shear machine.

2.5.4.5.1.2 Test Results

The results of the soil classification are shown on the graphic logs in Figure 2.5-222 for the main plant areas, and in Figures 2.5-223, 2.5-224, 2.5-260 through 2.5-270 and 2.5-377 through 2.5-519 for the onsite borrow areas. Auger borings for borrow are identified with the prefix 'PAH.' Tables 2.5-18, 2.5-19, 2.5-19a and 2.5-45 through 2.5-53 summarize the results obtained from the borrow investigations.

Main Plant Area

Initially, all samples obtained in this investigation were visually grouped and classified according to the Unified Soil Classification System. Six major soil types, MH, ML, CL, SM, SC, SM-SC, are present in cut areas. These materials were then regrouped according to their index properties and subjected to standard compaction testing. As shown on the family of curves (see Figure 2.5-235), three main classes were established:

1. Class I, representing 11% of the total, classified clayey sand (SC) with an optimum moisture of 13.6% and a maximum density of 116.3 pcf. Soils represented by this class had an average moisture content of 22.3, or 8.7% above optimum.

2. Class II accounted for 54% and classified sandy, lean clay (CL) with an optimum moisture content of 17.9% and a maximum density of 101.1 pcf. Soils represented by this class had an average moisture content of 23.3, or 54% above optimum.

3. Class III amounted to 35% and classified sandy, plastic silt (MH) with an optimum moisture content of 21.8% and a maximum density of 101.1 pcf. Soils represented by this class had an average moisture content of 24.5, or 2.7% above optimum.

In summary, this investigation in the main plant area has established that borrow soils of a satisfactory type, but of relatively high moisture content, are present in cut areas at the site. Materials of acceptable moisture content were present in the transformer yard, the 500-kV switchyard, and cooling tower areas. Materials in the Reactor Building, Plant Building, and intake channel areas required drying before using these soils as fill.

The borrow soil types identified in the intake channel were remolded and tested for shear strength. The results are shown in Table 2.5-21. The results are shown in graphical form (Figure 2.5-251). As indicated by the graphical plot (Figure 2.5-251) the value selected for design is conservative.

Onsite Borrow Areas

The onsite borrow areas which are shown on Figures 2.5-221 and 2.5-221A were completed after the completion of the borrow investigation in the main plant area described above. The results of the borrow investigation are described in relationship to the results obtained from the borrow investigation in the main plant area.

Area 1, which covers approximately 13 acres, lies about 2,500 feet east of the main plant area. The soil profile, as established by the eight auger borings drilled in this area, consists of 8 to 13 feet of reddish-brown silt (ML and MH), underlain by 7 to 16 feet of brown lean clay (CL) (see Figure 2.5-223). The majority of these fine-grained essentially impervious soils have natural moisture contents near the plastic limit. This area will supply about 280,000 cubic yards of borrow material.

Area 2 is located about 3,700 feet west-northwest of the main plant site and covers about 8 acres. The predominant soil type encountered in this area is a lean clay (CL) (see Figure 2.5--223). Some silt of medium plasticity (MH) and a small amount of fat clay (CH) are also present. As in area 1, the upper soils are reddish brown to a depth of 4 to 7 feet with the underlying soils colored brown. This area will supply about 170,000 cubic yards of borrow.

In area 3, two borings were drilled and reddish brown to brown lean clay (CL) was encountered. (See Figure 2.5-223). Secondary soils are lean silt (ML) and clayey gravel (GC) with the gravel consisting of subrounded quartizite. This area is located about 3,600 feet west-southwest of the power plant and extends over 3 acres. About 50,000 cubic yards of fill will be available from area 3.

In area 4, located southwest of the plant and covering approximately 6 acres, seven borings were drilled and alluvial sandy lean clay (CL) was encountered (see Figure 2.5-224). Secondary soils are silty sand (SM) and sandy silt (ML) which are slightly micaceous. This area, located southwest of the power plant, covers about 100,000 cubic yards of borrow.

Area 7 covers approximately 12 acres and is borings located southwest of the main plant area. Eleven borings were drilled and the predominant soil encountered was a lean clay (CL). Secondary soils encountered were a lean clayey-silt (CL-ML) and a lean silt (ML). Minor quantities of a fat clayey-silt (CH-MH) and a fat silt (MH) were also encountered. Approximately 145,000 cubic yards of material is available from the area.

Subsoils in the areas are similar in texture and plasticity to the borrow soils determined in the soil investigation previously reported. Soil properties are listed in Table 2.5-19. The natural moisture contents are from 2 to 8% above optimum. Close moisture control during placement will be required to assure adequate compaction. In summarizing, these additional borrow sources at Watts Bar Nuclear Plant will yield approximately 0.7 million cubic yards of impervious fill with satisfactory characteristics.

Borrow area number 4 was selected as a source for any soil necessary for the construction of qualified fills. The area was selected based on; (1) the quantity of borrow material available, and (2) the information provided on the graphic logs. Table 2.5-25 presents laboratory test data on the borrow classes available in borrow area 4. The strength values used for design are shown in Table 2.5-12. The results for each type shear test are plotted in graphical form (Figures 2.5-244 through 2.5-246), and a conservative value below the average for c and $\phi$ is selected for use in the design. The values used for design (Table 2.5-12) are low averages for the strength data shown in Table 2.5-25.

Due to the need to construct the underground barrier trenches to resolve the issue of potentially liquefiable soils along portions of the ERCW piping and 1E conduit alignments, several additional onsite borrow areas were investigated for use as safety-related fill. The additional areas are shown on Figures 2.5-220, 2.5-221, and 2.5-221a. These areas are identified as Trench A, Trench B, Areas 9, 10, 11, 12, 13, and 2c, and the future 161-kV switchyard. The central laboratory investigated each of these areas and developed moisture-density compaction curves (ASTM D 698) for each area. The testing identified several soil classes for each area. The laboratory strength testing consisted of consolidated undrained (R) shear tests on each soil class. Samples were molded to 95% of maximum dry density (ASTM D 698) and 3% below optimum moisture content. Samples were subsequently saturated prior to shearing. Due to the desire for a higher design cohesion, borrow classes with a cohesion intercept (c) less than 0.2 tons/ft$^2$ were retested at a higher density. These samples were remolded to 100% of maximum dry density (ASTM D 698) and 3% below optimum moisture content. Samples were saturated prior to shearing. The test results for each borrow area are shown on Tables 2.5-45 through 2.5-53. The results of this testing were evaluated to provide soil properties to use in the design and analysis of the underground barrier trenches.

The backfill used for Trench A came from borrow areas Trench A, 9, 10, 2c, and the future 161-kV switchyard. Thus, materials from these areas were evaluated for the Trench A design soil properties. Since two different degrees of compaction were used in Trench A, separate evaluations were made. The first evaluation, shown on Figure 2.5-520, was for Earthfill A which was placed at 95% of maximum dry density, and the second evaluation, shown on Figure 2.5-521, was for Earthfill A1 which was placed at 100% of maximum dry density. In the second evaluation, the data for sands was deleted from the evaluation, since only fine-grained soils were used for Earthfill A1.

The backfill used for Trench B came from borrow areas Trench B, 12, 2c, 13, and the future 161-kV switchyard. Thus, materials from those areas were evaluated for the Trench B design soil properties. Since two different degrees of compaction were also used in Trench B, separate evaluations were made. The first evaluation, shown on Figure 2.5-522, was for Earthfill A which was placed at 95% of maximum dry density, and the second evaluation, shown on Figure 2.5-523, was for Earthfill A1 which was placed at 100% of maximum dry density. In the second evaluation, the data for sands was deleted from the evaluation since only fine-grained soils were used for Earthfill A1. Figure 2.5-583 provides a summary of the above borrow evaluations.

2.5.4.5.1.3 <u>Field Work</u>

Prior to construction, the central laboratory prepared a family of compaction curves for all soil classes at the site (see Figures 2.5-235, 2.5-271, 2.5-524 through 2.5-533). The soil classes were further divided into subclasses for use by the inspectors of backfill placing and the project laboratory for construction control and day-to-day testing of fill compaction. These tests were performed by the project laboratory and were for dry density, moisture content, and degree of compaction. A minimum of at least one set of tests for each 2,000 cubic yards of fill placed was performed throughout the course of the work. Additional sampling and testing were done as required by the inspectors or engineers in charge.

The quality of the backfill was documented by measuring the inplace density. The inplace compaction was expressed as a percent of the maximum density at optimum moisture content for the backfill material being placed. A backfill log book was maintained containing all pertinent information concerning daily backfill operation.

In addition, a penetrometer was used, correlated with penetration charts prepared by the central laboratory (see Figures 2.5-234, 2.5-272, and 2.5-534 through 2.5-543) to maintain a continual check on the compaction of the backfill. At Watts Bar Nuclear Plant, Class A backfill was placed around all Category I structures. This material, which was selected earth placed in not more than 6-inch layers, had a minimum required compaction of 95% of the maximum standard density at optimum moisture content. Class A1 backfill used in portions of the underground barrier trenches had the same requirements except it had a minimum required compaction of 100% of maximum density optimum moisture content.

The limits of excavation and the backfill placed around the Category I structures are shown in Figures 2.5-225, 2.5-226, and 2.5-226a.

Class B backfill is placed around non-Category I structures. This material, which was selected earth placed in not more than 9-inch layers, had a minimum required compaction of 90% of the maximum standard density at optimum moisture content.

A third class of fill was also used, Class C, using unclassified fills to be placed in approximately 12-inch layers and was compacted with hauling equipment. This fill class was used in areas not requiring Class A or B fills, or highway and railroad fills, such as spoil areas.

The fill used to form the channel slopes in the intake channel was composed of material originally excavated from the intake channel. The material was compacted to 95% of maximum density at optimum moisture content.

Earthfill borrow areas were worked in a manner which ensured a suitable material for compaction. They were excavated in layers so that widely varying soil classes were not mixed during placement and compaction. Any conditioning which the soil requires is normally accomplished in the borrow areas prior to hauling it to the earthfill site. This conditioning included control of moisture content and removal of deleterious materials. All borrow areas were maintained such that adequate drainage of ground water and surface runoff was provided. Drainage was accomplished by sloping excavations, crowning, channels, dikes, sumps, and pumping, as necessary.

Compaction of large areas of earthfill was accomplished using crawler-drawn or self-propelled sheep-foot rollers. Soils in areas of limited access were compacted with small power tampers or rollers. Compaction and all other earthwork was suspended during periods of inclement weather.

In areas where earth fills with differing compaction requirements adjoin, the compacted fill with the higher degree of compaction was placed prior to the placement of fill of lower density requirements.

2.5.4.5.1.4 Construction Control

All earthfills including engineered granular fills, were placed, tested and controlled in general accordance with applicable ASTM standards.[172]

All fill operations were accomplished in the presence of a trained inspector. The inspector had the authority to suspend fill operations whenever weather or material conditions were judged unsuitable. His responsibilities included material quality, selection, excavation, hauling, placement, and compaction control. Placement was controlled either through the use of compaction control in-place density tests or by a procedural specification supplied by the engineer. This testing determined soil classification, moisture content, in place density, relative density (granular fill only), and degree of compaction (earthfill only). The frequency of testing was in accordance with ASTM requirements.[172] The inspector may have required additional testing to conclusively identify material or check compaction. A project laboratory was established at the plant site to perform the necessary testing. Project drawings and a series of construction control procedures relayed unique construction requirements to the construction personnel.

2.5.4.5.2 Granular Fill

2.5.4.5.2.1 General

Granular fill materials were used at the site for several purposes, such as structural fill, backfill, to establish a working surface, and for road foundations. The material was obtained from offsite commercial sources. The location and use of any type of material was determined by the engineer for any safety-related feature.

2.5.4.5.2.2 Section 1032 Material

A granular fill material, consisting of crushed stone or sand and gravel, was placed around and below safety-related features in lieu of earthfill in certain locations. The granular fill material was suitable for compaction to a dense, stable mass and consists of sound, durable particles which were graded within the following limits:

| | Percent by Weight | |
|---|---|---|
| Passing | Minimum | Maximum |
| 1¼-inch Sieve | 100 | |
| 1-inch Sieve | 95 | 100 |
| ¾-inch Sieve | 70 | 100 |
| 3/8-inch Sieve | 50 | 85 |
| No. 4 Sieve | 33 | 65 |
| No. 10 Sieve | 20 | 45 |
| No. 40 Sieve | 8 | 25 |
| No. 200 Sieve | 0 | 10 |

The material was free of soft friable particles, salt, alkali, organic matter or an adherent coating and reasonably free of thin, flat, or elongated pieces.

Laboratory shear strength tests were performed on the granular material to establish design properties. The testing consisted of triaxial (Q&R) and direct (S) shear tests. The tests were made on samples compacted to 70% and 80% of maximum relative density (ASTM D 2049). The samples composition were varied to provide three separate gradations for testing.

The three gradations tested were as follows:

| | Percent (by Weight) Passing | | |
|---|---|---|---|
| Sieve Size | Maximum Fines | Average Fines | Minimum Fines |
| 1-1/4 inch | 100 | 100 | 100 |
| 1-inch | 100 | 100 | 95 |
| 3/4-inch | 100 | 88 | 70 |
| 3/8-inch | 85 | 67 | 51 |
| No. 4 | 65 | 49 | 33 |
| No. 10 | 45 | 32 | 20 |
| No. 40 | 25 | 17 | 8 |
| No. 200 | 10 | 5 | 0 |

Minimum and maximum densities were determined in accordance with ASTM D 2049.

The triaxial shear tests (Q&R) were made in a 4-inch diameter testing machine on particles passing the 3/4-inch sieve. The direct shear tests (S) were made using a 12-inch square shear box on particles passing the 1-1/4-inch sieve. The results of the shear testing are shown on Table 2.5-54, and the values to use for design are shown on Table 2.5-55. Figures 2.5-544 through 2.5-547 are graphical plots of the test results with the adopted design values for each type of shear test.

The apparent shear strength values for the R test were not presented because the test results were determined to be inconsistent. On tests at 80% relative density, two of the three sets of the R tests showed significant negative pore water pressures during the tests. It is unrealistic for a saturated fill of this granular material to develop negative pore pressures. During earthquakes, pool draw downs, or conditions of steady seepage, a crushed stone fill would more likely develop positive pore pressures rather than negative pore pressures. Thus as indicated on Table 2.5-55, pore pressures were incremented during analysis to check the effect of pore pressure buildup.

The test results indicated that the coarse particle-size distribution (minimum fine distribution) produced a slightly higher friction angle along with a marked increased in cohesion intercept. Part of the 'cohesion' appeared to be the result of interlocking of the angular particles. Overall, the shear strength increased as particle size increased.

Consolidation tests were not made on the granular material, since consolidation would be negligible at the densities the fill is placed and because any connections between adjacent structures would not be made until after any minor consolidation had occurred.

In areas where this granular material was placed adjacent to an earthfill, the granular fill was placed and compacted prior to the placement of the earthfill. Granular fill was placed and compacted to a relative density as specified on drawings or in construction specifications and as determined by ASTM D 2049. The moisture content of the material was adjusted as necessary to obtain the required relative density. The construction control program for granular fill was discussed in Section 2.5.4.5.1.4.

As a result of inquiries by NRC about the granular material used to support the Diesel Generator Building, the following tables and figures are provided:

1. Table 2.5-56 showing the compaction results;

2. Figure 2.5-548 showing a statistical summary of the compaction test results; and

3. Table 2.5-57 showing sieve analysis results on the material stockpile during the period which the granular fill material was placed for the Diesel Generator Building.

2.5.4.5.2.3 Section 1075 Material

This was a free-draining granular fill material, consisting of crushed stone or sand and gravel; it was frequently used to establish a working surface on top of soil or weathered rock, or to develop a good interface between earthfill and weathered rock, or to act as a surface cover for an area such as a switchyard. It was also used as a structural fill.

The granular fill material was graded within the following limits:

| | Percent (by Weight) Passing | | |
|---|---|---|---|
| Sieve Size | Bottom Layer | Alternate Bottom Layer | Top 2" Layer |
| 1-1/2-inch | 100 | 100 | -- |
| 1-inch | 90-100 | -- | -- |
| 3/4-inch | 40-75 | 30-75 | 100 |
| 1/2-inch | 15-35 | -- | 90-100 |
| 3/8-inch | 0-15 | 5-15 | 40-75 |
| No. 4 | 0-5 | 0-5 | 5-25 |
| No. 8 | -- | -- | 0-10 |
| No. 16 | -- | -- | 0-5 |

The material was free of soft friable particles, salt, alkali, organic matter, or an adherent coating and reasonably free of thin, flat, or elongated pieces.

In areas where the material is used, it was placed and compacted using a procedural specification given on drawings or in construction specifications.

#### 2.5.4.6 Groundwater Conditions

The normal ground water level for the main plant was at Elevation 726, which is 2-feet below plant grade. This level was determined when making soil borings in the main plant area. Each structure in the main plant area was designed for the normal ground water level at Elevation 710 for service load conditions, although most structural design for hydrostatic forces were controlled by the PMF.

In order to control groundwater seepage into any structure, each construction joint up to grade had a seal embedded across the joint to prevent the passage of water. Dewatering during construction was controlled by routing any seepage into the excavation to sumps in the excavation and pumping the seepage away from the excavation. No significant difference in the groundwater conditions were noticed from that described in the PSAR as a result of the construction. Refer to Section 2.4.13 for a detailed discussion of the groundwater conditions at the site.

The design groundwater for the ERCW pipeline and 1E conduit alignments was determined in conjunction with a study of the potential liquefaction of the soils along the alignments. The program to monitor the groundwater and the results of that program are presented in Appendices A and B of 'Watts Bar Nuclear Plant - Liquefaction Evaluation of the ERCW Pipeline Route'[167]. Since that report was issued, additional monitoring of the groundwater was done and the data is reported in Table 2.5-58. Based on the review by the NRC staff of the groundwater study in Reference [167], it was determined the seasonal groundwater did not adequately meet the criteria of a 25-year groundwater. On the basis of discussions with the NRC staff, the groundwater data was reanalyzed to arrive at a more representative 25-year groundwater level. The results of that reanalysis are discussed below.

The methods used in estimating the 25-year high groundwater level along the ERCW pipeline were essentially the same as those used previously to predict the normal seasonal high water table (see Reference [167] Appendix B for description of methods). Basically these methods involved extrapolating the historic high water levels recorded in site observation (control) wells located outside the ERCW pipeline area for which long-term water level records were available, to the ERCW piezometers for which only short-term records exist. The primary difference between the current and previous evaluations lay in the selection of the historic high water levels recorded in site control wells (B2, B3, B4, and B5). Since only 11 years of groundwater level records existed for the site control wells, it became necessary to assume a direct relationship between groundwater levels and rainfall in estimating the 25-year high water table. That is, we assumed that the 25-year high water table was associated with the 25-year high rainfall during the normal wet season of the year (November through March).

Monthly rainfall data for the period 1940-1983 recorded at a gauging station at Watts Bar Dam located near WBNP were used in the analysis. A probability distribution of November-March rainfall is presented in Figure 2.5-591. As indicated in this figure, the rainfall recorded for the 1973-74 period approximately corresponds to a 25-year event. Since groundwater level measurements at WBNP are also available for this period, the maximum water table measured on February 8, 1974, is assumed to approximately represent the 25-year high water table. The February 8, 1974, water levels for control wells B2, B3, B4, and B5 were subsequently used to estimate the 25-year water levels in the ERCW piezometers. Results are presented in Table 2.5-73 along with previous estimates for comparison. A contour map of the predicted 25-year water table in the ERCW pipeline vicinity is shown in Figure 2.5-592. A profile comparing the normal and 25-year water tables is presented in Figure 2.5-593.

In general, the 25-year water table is one to two feet higher than the previously estimated seasonal high water table. The only significant exception is piezometer P5. Note that no groundwater was ever detected in P5 from the time it was constructed (October 26, 1981) until it was destroyed (November 15, 1981). Water level in P5 was assumed to be one foot below the bottom of the piezometer, and the seasonal high level was predicted using the same methods used for the other ERCW piezometers. However, as requested by the NRC Staff, the P5 data have been disregarded in the current analysis, and the 25-year level at the P5 location has been estimated by linear interpolation of the predicted levels at adjacent piezometers P4 and P6. Although we believe the method used previously to be a valid and conservative method for predicting water levels at P5, we have agreed to the more conservative NRC approach. The resulting predicted 25-year water table position does not significantly affect the liquefaction potential at the P5 location.

2.5.4.7 Response of Soil and Rock to Dynamic Loading

The response of soil and rock to dynamic loading is discussed in Section 2.5.4.4. Soil-structure interaction and soil-embedded structures are discussed in Sections 3.7.2.4 and 3.7.2.1.1.

2.5.4.8 Liquefaction Potential

The liquefaction potential of all slopes and soil deposits were evaluated by using empirical rules based on observed performance and by comparing the soil conditions and earthquake characteristics at the site with similar sites that have liquefied[155].

The empirical rules used are based on the Japanese experience during the Niigata earthquake. It was observed that the following general coincident conditions could cause liquefaction:

1. The percentage of silt and clay-size particles should be less than 10%.

2. The particle diameter at 60% passing should be between 0.2 mm and 1.0 mm.

3. The uniformity coefficient should be between 2 and 5.

4. The blow count from Standard Penetration Tests should be less than 15.

Also, Reference [1] states that experience suggests liquefaction might occur for soils having a relative density less than 50% during ground motions with accelerations in excess of approximately 0.1 g; and that for relative densities greater than 75%, liquefaction for most earthquake loadings is unlikely.

Intake Channel

Using the rules outlined above, one layer of potentially liquefiable soil was found in the intake channel. This soil deposit was a layer of silty sand extending from Elevation 665 to Elevation 680 in the intake channel side slopes. The location of the channel with respect to the plant layout is shown in Figure 2.1-5. The channel is shown in Figure 2.4-99. The zone of potential liquefaction is shown in Sections A-A and B-B of Figure 2.4-99.

The Waterways Experiment Station of the Corps of Engineers performed cyclic triaxial shear tests on samples from this layer of silty sand. The results of the testing program are presented in Table 2.5-22. TVA performed parallel cyclic triaxial shear tests on similar samples, with the results presented in Table 2.5-23. The results from the parallel tests showed reasonable agreement, particularly for the isotropic loading cases.

A dynamic 2-dimensional finite element analysis was performed for the intake channel. The details of this analysis are discussed in Section 2.5.5.2.1. From this analysis the number of equivalent cycles for various levels of shear stress was determined using the procedures outlined by Lee and Chan[156]. Comparing the computed shear stress and number of cycles with the test results indicates that liquefaction would occur. Both sets of test results were used in the liquefaction evaluation and both indicated complete or partial liquefaction. Therefore, it was decided to excavate beyond the limits of the final channel to the top of firm gravel and compact the excavated material back in place to the final channel cross section (Figure 2.5-239) with controlled compaction density and moisture content. The compaction criteria are discussed in Section 2.5.4.5.

ERCW Pipeline and 1E Conduit Alignments

The plan of the ERCW piping and 1E conduit is shown on Figure 2.5-273. The plan shows (1) the location and routing of the piping and conduits, (2) boring locations, and (3) contours of the ground surface. The soils below the pipes and conduits were evaluated for liquefaction potential using the empirical rules outlined above in this section and the soils were judged to be nonliquifiable. Based on the NRC staff's review, the soils were subsequently reevaluated. The reevaluation included additional borings along the alignments (using the same as well as different drilling techniques); excavating test pits to obtain hand-carved undisturbed block samples; cyclic triaxial shear tests; monitoring the groundwater; and using different criteria for evaluating the soils for liquefaction. The additional borings along the piping and conduit alignments are discussed in Section 2.5.4.2.1.2. The purpose of the additional borings was to decrease the spacing of borings to approximately 100-feet along the piping and conduit alignments and to investigate apparent soft layers of fine sands. The majority of the additional borings were made with dry drilling procedures using a hollow stem auger to advance the borings. The borings added to investigate apparent soft layers were made with wet drilling procedures using drilling mud and fishtail bit to advance the boring.

Profiles were prepared to show the relationship of the safety-related piping and conduits to the soil deposits. A profile of the ERCW pipes is provided in Figures 2.5-549 through 2.5-553. The 1E electrical conduit profiles are provided in Figures 2.5-554 through 2.5-556. The profiles provide the following information:

a. Pertinent boring logs along the routes showing blow counts and the classification of the in situ soil.

b. The elevation of original grade, final grade, top of weathered shale, and the top of rock. (Note: Fill material was used to backfill around the pipes and to achieve final grade.)

c. The electrical conduit and ERCW pipelines and their elevation to scale.

d. The 24-hour water table and the design groundwater.

Figure 2.5-273 is a plan of the piping and conduit which shows the locations where the sections are drawn.

Test pits were excavated at two locations along the pipeline and are discussed in Section 2.5.4.2.1.2. The test pits were made to obtain undisturbed block samples to determine in situ densities and for cyclic triaxial testing.

A series of standpipe piezometers were installed along the pipeline to monitor the groundwater to establish a design groundwater level. The result of this monitoring is discussed in Section 2.5.4.6.

Several evaluations of potential soil liquefaction have been made. The criteria have varied from (1) evaluations based upon empirical rules derived from records of historical events, to (2) evaluations using laboratory cyclic shear testing, to (3) evaluations using empirical rules based on standard penetration testing, grain size analysis, and a correlation procedure developed to Seed and Idriss.[159]

<u>Liquefaction Evaluation - Based on Empirical Rules</u>

The first approach to the evaluation of the liquefaction potential of soils was done using grain size distribution outlined empirical rules. Only those silty sands above the top of weathered shale were evaluated since all materials below that point are merely rock fragments which have been given a soil classification.

Figures 2.5-557 through 2.5-563 are grain-size distribution curves for SM material in borings SS-50, SS-60, and SS-63. These curves show that the silty sands are well-graded materials rather than the uniformly graded materials one associates with liquefiable soils. In addition, a comparison of these gradation curves with those for materials which are known to liquefy, including the potentially liquefiable sand encountered in the intake channel, shows that the gradation characteristics are not typical of those for liquefiable soils.

The electrical conduits follow the route defined by borings 49, 50, 51, 52, 53, 57, and 58. The graphic logs of the borings for the Class 1E electrical conduits show that the SM and G-SM materials are not present in extensive layers. These materials are present in isolated pockets. For instance, the SM and G-SM material in SS-50 extending from Elevations 689.0 to 699.0 is not encountered in either SS-49, SS-51, or SS-59. Rather, thin layers of silty sand no more than 1 to 1-1/2 feet thick are found at elevations which do not correlate with boring 50. Approximately 5 feet of SM and G-SM material is found above the top of weathered shale in boring SS-53. However, the undisturbed boring SS-53 which was made only 5 feet away encountered on SM or G-SM material above top of weathered shale. One therefore concludes that the silty sand in SS-53 is not an extensive layer. The layers of silty sand in borings SS-60 and SS-63 are not extensions of the same layers since the silty sand of SS-53 is an isolated pocket. Similarly, the remainder of the borings show no evidence to suggest extensive layering of silty sands.

Borings 59 and 51 clearly establish that the silty sands encountered in the other borings for the electrical conduits are not extensions of the potentially liquefiable sands encountered in the intake channel since only a thin layer of silty sand is encountered in 51 and none in 59. The investigation of the intake channel revealed that the continuous layers of silty sand tapered out at the intake pumping station. This investigation substantiates that the silty sands shown in borings along the 1E conduits are not continuous layers. Finally, a comparison of the gradation characteristics of the potentially liquefiable sands of the intake channel (a typical gradation curve is presented in Figure 2.5-566) with those of the silty sands along the conduit and pipeline routes, shown in Figures 2.5-557 through 2.5-565, shows that the sands are not similar.

The criteria used to assess the potential for liquefaction along the ERCW pipeline route is similar to that used for the Class 1E conduits. The ERCW pipelines follow the route shown on Figure 2.5-273. Silty sand was encountered below the water table at various locations along the pipeline route. These silty sands were evaluated: (1) using the above empirical rules; (2) by comparing the gradation characteristics to those of materials known to liquefy; and (3) by the procedures described in References [160] and [161].

The only borings in which silty sands were encountered in quantities to warrant evaluation were SS-88, -90, and -92. The silty sands encountered between Elevations 699.0 to 712.0 in SS-88, and 709 to 718 in SS-90, show blow counts as high as 50 and typically between 20 to 40. Evaluating these materials using the procedures of References [160] and [161] showed no potential for liquefaction.

Figures 2.5-564 and 2.5-565 are gradation curves for the silty sands found between Elevations 714.0 to 722.0 in boring SS-92 (Figure 2.5-200). These figures show the silty sands to be well-graded materials whereas liquefaction is normally associated with uniformly graded materials. In addition, the percentage of silt and clay present in these samples (42%) is significantly above 50 the range of 10% or less specified in many criteria. A comparison of these materials with the potentially liquefiable silty sands of the intake channel shows that the materials are not similar in their gradation characteristics. The gradation characteristics of the silty sands of the intake channel are uniform which meet the empirical criteria for liquefaction potential, whereas the materials along the pipeline route do not meet the criteria. This dissimilarity of materials, in conjunction with the pattern in which silty sands were encountered along the pipeline route, establishes that these sands are not extensions of the potentially liquefiable sand found in the intake channel. The intake channel soils are discussed in Section 2.5.5. A distinct, continuous layer of silty sand is visible in the graphic logs of the borings in the intake channel. However, the borings show that this layer tapers out and the potentially liquefiable sand of the intake channel is confined to the floodplain.

The elevation of the water table is not shown on the graphic log for boring SS-92 (Figure 2.5-200). However, it is possible to infer the elevation of the water table from other borings around SS-92 and along the alternate route just east of the cooling towers (see Figure 2.5-273). Specifically, the water table elevation was determined in borings SS-65, -67, -87, -88, -93 through -95, -104, -105, -107, and -108. In those borings, the elevation of the water table varies from a minimum elevation of 693 to a maximum elevation of approximately 704. From Figure 2.5-273 it is apparent that the borings mentioned above surround SS-92. Furthermore, the area in which SS-92 was taken has no apparent topological features which could result in an unusually high water table. Therefore, it is reasonable to infer that the elevation of the water table in SS-92 is approximately 702 and certainly no more than Elevation 705. If a water table elevation of 703 is assumed for boring SS-92 and with a 3 to 4 feet fluctuation, the SM material between Elevations 714 and 722 is typically 10 to 11 feet above the water table. Therefore, the SM material in boring SS-92 will normally be in an unsaturated state and cannot liquefy.

In summary, the soils along the routes for the Class 1E conduits and ERCW pipelines have been evaluated for liquefaction potential. This evaluation has considered: (a) the graphic logs for the materials encountered; (b) the results of the laboratory tests on undisturbed samples of these materials; (c) the location of and fluctuations in the water table; (d) the location of top of weathered shale; (e) a determination of the extent of the liquefiable sands of the intake channel; (f) the simplified procedures of Seed and Idriss,[160] and (g) the information presented by Shannon & Wilson and Agbabian Associates.[161] Based on these criteria it is concluded that the soils along both routes will not liquefy.

<u>Liquefaction Evaluation - Based on Cyclic Triaxial Shear Tests</u>

The second approach to the evaluation of the liquefaction potential of soils was done using cyclic triaxial shear testing. This was in response to NRC and WES concerns with the initial liquefaction evaluation and the results of cyclic triaxial shear testing in the intake channel. The results of the cyclic triaxial shear testing on soils along the ERCW pipeline and 1E conduit alignments are given in Section 2.5.4.2.1.2 (Cyclic Triaxial (R) Testing - ERCW Pipeline and 1E Conduit Alignment).

The water table used in the analysis was based upon 24-hour readings in borings since a 25-year water table was not established for the site. Groundwater is discussed in detail in Section 2.5.4.6

The blow counts of the alluvial soils are given in Figures 2.5-549 through 2.5-556. The extent of the alluvial sand is provided in Figures 2.5-567 and 2.5-568. The cyclic triaxial shear test characteristics of alluvial soil susceptible to liquefaction are discussed in Section 2.5.4.2.1.2.

The liquefaction analysis consisted of one-dimensional dynamic response computations performed for soil columns in the free field. These analyzes indicate an equivalent cyclic shear stress of 325 $lb/in^2$ at a depth of 15 to 20 feet. This depth corresponds to the location of SM material encountered in the borings. The resulting cyclic stress ratio is 0.32.

The profile selected and analyzed is based on boring SS-50-1 (Figure 2.5-339) which contained the most SM material. The surface elevation is 716.9. Around Elevations 685.0 and 690.0 the blow count increases to +50 and is identified as 'top of weathered shale.' This is assumed as 'top of rock' for the liquefaction evaluation. Thus the depth of the profile is 30 feet. The water table is about 15 to 20 feet below the ground surface in borings SS-50, SS-50-1, SS-65, and SS-65-1. The profile analyzed is fairly typical of those along the ERCW route. This generalized soil profile is shown graphically in Figure 2.5-569.

The soil unit weight (moist) was assumed to be 120 $lb/ft^3$. The shear wave velocity of the soil is taken as 1,000 ft/s. This value is in agreement with data obtained from the intake channel and elsewhere on the site. The strain dependent shear modulus and damping ratio properties of these soils are assumed to conform with the relationships developed by Seed for sand. The coefficient of earth pressure at rest ($K_o$) is conservatively taken as 0.5. All soil properties are assumed to be constant with depth.

The rock has a unit weight of 165 $lb/ft^3$ and a shear wave velocity of 5,900 ft/s.

The postulated site SSE is based on an intensity MM VII-VIII or VIII event. Such an event would be approximately a magnitude 5.5 to perhaps a 6.0. The seismic input at the site is defined as a 0.18 g earthquake at top of rock. The liquefaction evaluation was performed using an artificial accelerogram which conforms to Regulatory Guide 1.60 requirements. Peak accelerations of 0.18 g, 0.225 g, and 0.25 g were considered.

The accelerogram was also high band pass filtered to eliminate frequencies greater than 5 Hz for three cases and 25 Hz for two cases. In all, five different analyses were performed and are listed below.

| Case | Maximum Acceleration | Applied at Top of | Upper Frequency Cutoff |
|---|---|---|---|
| 1 | 0.25 g | Ground | 5 Hz |
| 2 | 0.18 g | Ground | 5 Hz |
| 3 | 0.225 g | Ground | 5 Hz |
| 4 | 0.25 g | Ground | 25 Hz |
| 5 | 0.18 g | Rock | 25 Hz |

The most appropriate seismic loading is Case 1 where the 0.25 g accelerogram is applied at top of ground with a 5-Hz upper frequency cutoff. The results from Case 1 essentially envelop all other cases except for Case 5 where the input is at top of rock.

The dynamic response analysis was performed using the computer program SHAKE. Irregular shear stress time histories were not calculated. The equivalent uniform cyclic stress was taken as 65% of the maximum cyclic shear stress within each layer of the profile as calculated by SHAKE.

The results of the analyses are given in Table 2.5-59. The maximum and equivalent uniform stresses within each layer and the peak accelerations at the top of each layer are summarized in Table 2.5-59 for all five earthquake input conditions.

For material located about 17.5 feet below the surface (approximately the elevation of the samples which were tested cyclically), the maximum shear stress is:

$\tau_{max}$ = 500 lb/ft$^2$

The average shear stress is:

$\tau_{avg}$ = 0.65, $\tau_{max}$ = 325 lb/ft$^2$

The vertical pressure at 17.5 feet is:

$\sigma_v = \delta h$ = (120 pcf) (17.5 ft) = 2100 lb/ft$^2$

Assuming $K_0$ = 0.5, the horizontal stress is:

$\sigma_h = 0.5\ \sigma_v$ = 1050 lb/ft$^2$, use $\sigma_h = \sigma_3$ = 1000 lb/ft$^2$

The cyclic stress ratio is:

$$\frac{\sigma_d}{2\sigma_3} = \frac{\tau_{avg}}{\sigma_3} = \frac{325\ lb / ft^2}{1000\ lb / ft^2} = 0.32$$

Figure 2.5-353 shows the most susceptible sample will survive six load cycles with this stress ratio. Only five uniform load cycles should occur from a 0.18 to 0.25 g event. This event is an intensity VIII earthquake and is characterized as an $m_{blg}$ 5.8. Extrapolating Seed and Idriss data:

| Magnitude | Number Of Cycles | Equivalent Uniform Cyclic Stress |
|---|---|---|
| 7 | 10 | 0.65 max |
| 7-1/2 | 20 | 0.65 max |
| 8 | 30 | 0.65 max |

Five cycles of uniform load have been conservatively assumed for a magnitude 5.5 to 6.0 event. Factors of safety against the development of 5% strain are given in Tables 2.5-60 and 2.5-61 and Figure 2.5-570. These factors of safety were calculated only for seismic loading case 1. Results are presented for cases where the water table is not considered and where it is located 16.5 feet below the surface. The 16.5 feet groundwater depth is in the upper range as determined by the borings and the exact number 16.5 feet is chosen for convenience only. Factors of safety were calculated for both the reconstituted sample (sample 3) and for the in situ (undisturbed) sample (sample 2). The in situ sample is more representative of field conditions. It should be noted that these factors of safety are against the development of 5% strain and not against actual liquefaction which, if it occurs, occurs at strains in excess of 10% for the samples tested.

The scatter of the test results tabulated on Table 2.5-36 and plotted as shown on Figure 2.5-353 were anticipated due to the variations in the soil. These tests were conducted on in situ (undisturbed) soil samples. Only the soils judged most susceptible to liquefaction were selected for testing. Of the three samples selected for testing, all available specimens were tested. Sample 3 shows some scatter. All specimens from sample 3 were reconstituted due to the presence of a large gravel particle. Three of the four test points for US-50-1, sample 3, form the classical curve for cyclic test results. However, the fourth point (the lower point at 3 cycles) is off the curve. The curve was constructed by using the test results for the cyclic stress ratios of 0.44, 0.26, and 0.17. The remaining two curves were constructed essentially parallel to the first curve.

Comparisons of the stresses induced by the earthquake and the stresses required to cause a given strain level provide a means to determine the potential compressive strains in the soil. These potential compressive strains represent the strains that would develop in that part of the soil if it were not constrained by the surrounding soil.[164] These strains may, therefore, be considered as the strain potential caused by the earthquake and can be used to assess the deformation (settlement and lateral movement) potential of the soil.

A criterion of 5% strain is generally used for evaluating the stability of embankments subjected to earthquake shaking. This criterion has been established on the basis of correlations between the results of seismic stability evaluations and the performance of earth dams which have been subject to significant earthquake loading.[163, 164] These case histories show that if the computed strains in the embankment are smaller than 5%, the earthquake has no significant effect on the stability and integrity of the dam. However, it should not be concluded that the stability and integrity of the embankment is impaired if the computed strains exceed 5% at some locations within the embankment. The effect of computed strains exceeding 5% depends on the zone of the embankment in which they may occur, and on the relative extent and location within a specific zone.

The cyclic strength stability may be evaluated by using Figure 2.5-353 and a cyclic stress ration of 0.32. This shows:

1. US-50-1, sample 3, experiences 5% strain at 6 cycles of load. These 6 cycles are close enough to the postulated 5 cycles due to the SSE to indicate this layer may experience up to approximately 5% strain. This is a reconstituted test specimen; an undisturbed in situ specimen should perform even better.

2. US-50-1, sample 2, experiences 5% strain until the loading greatly exceeds 10 cycles.

3. US-50-1, sample 4, experiences less than 5% strain at 1000 cycles and is essentially unresponsive to cyclic loadings.

In general, only one sample is likely to experience 5% strain (actually strain potential). This implies the earthquake will have no significant effect on the stability and integrity of the soils along the route. Also, it should be noted that this zone is confined above and below by soils that are relatively less susceptible to liquefaction. Figure 2.5-353 clearly shows that samples 2 and 4 will not liquefy under the adopted earthquake loading conditions.

Liquefaction Evaluation - Based on SPT Data and Seed and Idriss Correlation

The third approach to the evaluation of the liquefaction potential of the soils at the site was made using standard penetration test (SPT) data, a correlation procedure developed by Seed and Idriss (1981)[ 159] and additional cyclic triaxial tests. Additional split-spoon borings were made adjacent to some existing borings. These additional borings were made with drilling mud and a fishtail bit. The results of this additional drilling are given in Section 2.5.4.2.1.1. The correlation procedure developed by Seed and Idriss (1981) differentiates between clean sands and dirty sands. The fine sands at the site are relatively dirty or silty with fines content (minus No. 200 sieve) ranging up to 50%. The cyclic performance of the silty sands is better than for clean sands when both materials have the same blow count or other similar characteristics.

This increased performance under cyclic loading is accounted for in the Seed and Idriss (1981) procedure. The additional cyclic tests were made on undisturbed block samples obtained from two test pits excavated along the ERCW piping alignment.

Several reports were submitted to the NRC on this evaluation. The initial report, Reference 166, was issued February 8, 1982. The liquefaction evaluation was based on a seismic input of 0.18 g at the top of ground. The report also provided the results of a study to project the seasonal high groundwater levels for use in the liquefaction evaluation. These seasonal high groundwater levels were used in this and all subsequent liquefaction evaluations as the design groundwater. Additional water level readings from the groundwater monitoring program are given in Table 2.5-58. This evaluation concluded that although a few samples (3) had factors of safety against potential liquefaction less than one, the areas of concern were isolated and unlikely to cover a large lateral area and the potential settlement was insignificant. The second report Reference 167, was an update of the initial report, Reference 166. The second report, Reference 167, basically expressed the same conclusions as the initial report, Reference 166. However, this report, Reference 167, contained cyclic triaxial test results showing that the samples that had factors of safety less than one, using the Seed and Idriss (1981) procedures, would not liquefy.

Due to NRC concerns about the seismic input to the liquefaction evaluation, an additional study was made. The seismic input to the evaluation was 0.22 g at the top of ground. This revised seismic input was based on the results of a site-specific study and as discussed in Section 2.5.4.2. The third report, Reference 168, containing the results of this evaluation, was issued in November 1982. The report indicated that additional samples were susceptible to liquefaction, but the samples were localized and there were no indications that the liquefiable zones were continuous. In addition, the cyclic triaxial tests showed that these additional samples would not liquefy. The potential settlement due to the postulated liquefaction was also considered minimal.

As a result of several meetings with the NRC and the NRC's review[166, 167, 168] the seismic input and the procedure for evaluating liquefaction were changed. The seismic input was changed from 0.22 g to 0.40 g at top of ground as discussed in Section 2.5.2.4. The procedure for evaluating liquefaction was changed from the Seed and Idriss (1981) procedure to the Seed and Idriss (1971) procedure. Both procedures are simplified methods for evaluating the liquefaction potential of sands, but the Seed and Idriss (1981) procedure provides a modification that accounts for presence of fines in the sand samples. In order to resolve the issue of potentially liquefiable soils at the site, TVA used the Seed and Idriss (1971) procedure.

The results of the liquefaction evaluation based on a seismic input of 0.40 g at top of ground and the Seed and Idriss (1971) procedure are presented as follows:

1. Tables 2.5-62 through 2.5-64 tabulates the samples that would potentially liquefy, i.e., (FS$\leq$1.0).

2. Figure 2.5-273 shows the layout of the ERCW piping and 1E conduits and the location of the sections that show the piping and conduit profiles.

3. Figures 2.5-571 through 2.5-575 show profiles of the ERCW piping and the borings along the alignment. The borings have been marked to indicate the design groundwater, top of weathered shale, and the samples that will potentially liquefy.

4. Figures 2.5-576 through 2.5-579 show profiles of the 1E conduit banks and the borings along the alignment. The borings have been marked to indicate the design groundwater, top of weathered shale, and the samples that will potentially liquefy.

The result of this evaluation is that the zones of potentially liquefiable materials are apparently continuous in some areas along the pipeline and conduit alignments and that some method of remedial treatment is needed. The method of remedial treatment to prevent the lateral flow of liquefied soils, the method of analysis, and the results are described in Sections 2.5.5.1.2 and 2.5.5.2.3.

As discussed in Section 2.5.4.6, the groundwater level was revised to reflect an estimated 25-year groundwater. The influence of this slightly higher groundwater on the liquefaction analysis and potential settlement due to liquefaction was discussed with the NRC staff. The staff indicated they concur with TVA's judgement that the higher groundwater will have negligible effects on the results of the liquefaction and settlement evaluations; therefore, no additional evaluations for the piping or conduits are needed.

The potential settlement of the soils along the ERCW pipeline and 1E conduit alignments, due to an earthquake sufficient to cause liquefaction, were evaluated for each report, References 166, 167, 168. All studies revealed that the potential settlement was insignificant or minimal and the performance of the piping or conduits would not be affected. When the peak ground acceleration was increased to 0.40 g (see Section 2.5.2.4) and the method of evaluating for potential liquefaction was changed to the Seed and Idriss (1971) procedure, the extent of the soils that would potentially liquefy increased, thereby significantly increasing the amount of potential settlement. The theoretical settlement at each boring location along the ERCW pipeline and 1E conduit alignments was calculated twice. The initial settlement evaluation was based on a paper by Lee and Albaise (1974) Reference 165). The second evaluation was based on a criteria provided by the NRC staff. The method and results of each evaluation are described below.

The evaluation based on Lee and Albaise's paper assumed the test data for a Monterey sand was applicable and the in situ relative density of the fine sands was 50%. Using test data for a Monterey sand is conservative, since the $D_{50}$ for the fine sands at the Watts Bar site is in the range of 0.07 mm to 0.15 mm, and the test data shown in Figure 6 of the Lee and Albaise paper indicates that a finer sand will experience a lower volumetric strain. The use of an in situ relative density of 50% is also conservative, since the relative densities of the undisturbed block samples from the test pits ranged from 61% to 69% for two of the samples and above 70% for the other sample. The test data shown in Figure 7 of the Lee and Albaise paper indicates that a soil with a lower relative density will experience a higher volumetric strain. Based on Figure 7 of the Lee and Albaise paper, a Monterey sand sample with an initial relative density of 50% that subsequently liquefies will experience approximately 1.5% volumetric strain. For the initial settlement evaluation sand (SM or SP) samples that were theoretically susceptible to liquefaction were considered to experience 1.5% volumetric strain, and silt (ML) samples were considered to experience 0.75% volumetric strain. Figures 2.5-571 through 2.5-578 show the potential settlement calculated using the 1.5% strain (1.5%ξ) criteria at each boring along the pipeline and conduit alignments.

The criteria specified by the NRC staff is shown in Table 2.5-65 has a maximum volumetric strain of 6%. The criteria specifies a volumetric strain even for samples that will not liquefy. The results of the evaluation for potential settlement at each boring along the pipeline and conduits using the 6% strain (6%ξ) criteria are also shown on Figures 2.5-571 through 2.5-578. As can be noted, the potential settlement using the 6% criteria is significantly higher than the results using the 1.5% strain criteria. However, in order to resolve the issue of the potential settlement due to soil liquefaction, the results of the settlement evaluation based on the NRC staff's criteria (6%ξ) was used for evaluating the need for remedial treatment for the pipeline and conduits. The evaluation of the piping for the potential settlement along the ERCW piping alignment is described in Section 3.7.3.12. The evaluation of the conduits for the potential settlement along the 1E conduit alignment Is discussed in Section 3.7.2.1.3.

### 2.5.4.9 Earthquake Design Basis

For the Earthquake Design Basis, see Sections 2.5.2.6 and 2.5.2.7 and Section 3.7.

### 2.5.4.10 Static Analysis

#### 2.5.4.10.1 Settlement

All Category I structures, except for small structures such as electrical manholes and hand holes, are founded either on bedrock or engineered granular fill. Settlement computations, where made, were based on the Theory of Consolidation developed by Terzaghi with the equation for settlement of a layer of soil being:

$$S = H\left[\frac{e_1 - e_2}{1 + e_1}\right]$$

S = settlement In layer

H = initial thickness of layer

$e_1$ = initial void ratio of material before loading

$e_2$ = final void ratio after loading

The allowable settlement for any structure is dependent on the amount of deflection any associated piping and electrical connections will be able to withstand. Any potential differential settlement is accounted for in the design and analysis of the structural foundation.

Consolidation tests were made on the fine-grained soils which overlie the in situ gravel for the Diesel Generator Building (see Table 2.5-6 for a summary of these tests). Consolidation tests were not made for the fine-grained soils beneath any other Category I structures. The results of the investigation for the Diesel Generator Building indicated that settlement might be a problem and for this reason the fine-grained soils above the in situ gravel were removed and replaced with compacted granular fill. On other Category I structures where the structural load would cause a net increase in pressure on a fine-grained soil layer, the fine-grained soil layer has been removed and the structural foundation supported on granular material (see Figures 2.5-225, 2.5-226, and 2.5-226A for typical sections of these other Category I structures).

Some Category I structures are founded on fine-grained soils. However, none of these structures cause an increase in the net soil pressure in the supporting fine-grained soil layer. These structures are basically manholes and hand holes for the conduit and piping systems. These structures are floating foundations, where the weight of material removed is equal to or greater than the structural weight added. Consolidation tests were not warranted and not made on soil layers below these structures.

#### 2.5.4.10.2 Bearing Capacity

The ultimate bearing capacities for the Category I soil-supported structures were computed using Terzaghi's equations[169] and DeBeer's equations modified by Vesic.[170] Analysis for bearing capacity was made for the weakest soil layer encountered between the bottom of the foundations and the top of rock.

Soil profiles under each structure are based on the results of field investigations as reported in Section 2.5.4.2.1. Ultimate bearing capacities were computed using the appropriate shear test data. The theoretical minimum ultimate bearing capacities for any loading case were used to determine safety factors. The ultimate bearing capacities and the factors of safety against bearing type failures are reported in Table 2.5-66.

The remaining soil-supported structures (Class IE electrical system manholes and hand holes for conduits and piping system) are supported on floating foundations, where the weight of material removed is equal to or greater than the structural weight added. There would be no net increase in pressure on the supporting soil layers.

Based on the foregoing soil investigation and the analysis, it is confirmed that all the Category I soil-supported structures are adequately founded and are safe against bearing type failure.

### 2.5.4.11 Safety-Related Criteria for Foundations

#### 2.5.4.11.1 General

The foundation material beneath Category I features are either in situ soil, compacted granular fill, or in situ rock. Structural loads are transferred to this material through concrete foundations. The configurations of these foundations vary but all are some form of either a mat or spread footing. Some of these foundations rest on a mass concrete placed on bedrock. Detailed foundation descriptions are found in Section 3.8.5. The type of foundation beneath each Category I structure is shown on Figures 2.5-225, 2.5-226, and 2.5-226a.

#### 2.5.4.11.2 Rock Strength

Refer to Sections 2.5.4.2.2.6 and 2.5.4.2.2.7.

#### 2.5.4.11.3 Soil Strength

The allowable bearing pressure for soil-supported foundations was determined by methods outlined in Section 2.5.4.10.2 using a factor of safety of 3. Settlement analyses are made and, if necessary, the design bearing capacity is reduced to limit determination from stress relief and exposure.

### 2.5.4.12 Techniques to Improve Subsurface Conditions

Several techniques were used to improve subsurface conditions. The techniques included excavation and backfill, subsurface grouting, and placing concrete on freshly exposed shale to prevent further weathering from exposure.

The excavation and backfill technique was used in three locations: (1) in the intake channel, (2) below the Diesel Generator Building, and (3) below the refueling water storage tanks. In the intake channel, due to presence of possible liquefiable soils, it was decided to excavate beyond the limits of the final channel to the top of firm gravel and to compact the excavated material back in place to the final channel cross section with controlled compaction. The compaction density and moisture content criteria for Class A fill is described in Section 2.5.4.5.1.3. For the Diesel Generator Building, it could not be assured that the material directly below the structure could safely carry the load. Therefore, in order to assure a safe foundation for the building, the material between the top of firm gravel and the grade slab was removed and replaced with granular fill as illustrated in Figure 2.5-226. This is a sound durable stone well graded with a maximum size. The criteria for the granular fill is discussed in Section 2.5.4.5.2. The refueling water storage tank is being treated in the same manner as the Diesel Generator Building except that the granular fill will be compacted to a density of 85% of maximum relative density.

The technique of subsurface grouting was used as follows. On March 28, 1974, while drilling 3-inch percussion holes for No. 9 J-Bar installation in the No. 2 reactor cavity south wall, a disintegrated shale pocket was intersected which allowed accumulated water and shale fragments to be blown out nearby drill holes. Suspecting possible solution or cavity development in the reactor wall, a geologic investigation was initiated to determine the conditions and extent of the zone and to develop an adequate treatment program.

On March 29, 1974, 10 holes were drilled, Nos. 6 through 15, into the wall at angles shown on the accompanying drill layout diagram for horizontal holes (Figure 2.5-139).

The disintegrated shale pocket was outlined as shown on Figure 2.5-140, with its centroid at an approximate elevation of 671.0, and extending in a generalized S 40° W direction along regional strike.

On April 1, 1974, 12 additional vertical holes were drilled, Nos. 16 through 27, as shown on the drill layout diagram for vertical holes (Figure 2.5-142). Of the 12 additional holes drilled, 7 holes intersected the disintegrated shale pocket. This information provided a basis for establishing an approximation of the extent and shape of the disintegrated zone.

The disintegrated zone developed along an area where a subsidiary fault intersected a through-going fault which strikes approximately N 35-40°E and dips 45° southeast.

The zone is complicated by a small anticlinal fold, in all probability a drag fold developed during movement along the larger fault. The fault and the folded structure were exposed at the southeast corner of the reactor cavity wall and continue northeastward. In this structurally complex area the less competent shale strata were ground into small fragments, making the material prone to disintegration upon exposure to water.

The disintegrated shale zone in reactor No. 2 foundation was grouted on April 19, 1974.

Water was pumped into hole Nos. 8 and 11. Water began to flow out of the top holes in the following order: Nos. 16, 17, 19, 20, 22, 23, 28, 18, 21.

The main flow of water was flowing from No. 16. The water was allowed to flow until it became clear, at which time the hole was plugged with a wood plug and the main flow shifted to hole Nos. 19 and 20. These were allowed to run until the water was clear. This method of plugging holes and shifting of main flow was as follows:

1. Plugged No. 20--main flow shifted to No. 19.

2. Plugged No. 19--main flow shifted to Nos. 17 and 22.

3. Plugged No. 17--main flow shifted to No. 22.

4. Plugged No. 22--main flow shifted to No. 23.

5. Plugged No. 23--slight flow from Nos. 18 and 24.

Water pressure was held at approximately 5 to 10 psi through the flushing operation. After all holes were flushed, the hoses were disconnected from Nos. 8 and 11 and allowed to drain for one hour.

Grouting was begun by pouring a 1 to 1 mixture of grout into hole No. 19. When three and one-half bags were poured into this bole, grout began flowing out through hole No. 8. When the valve was closed on hole No. 8, hole No. 19 stopped receiving grout. Grouting continued according to the following sequence.

1. When hole No. 19 stopped receiving grout, grout was poured through hole No. 16. Hole No. 16 stopped receiving grout after four bags were poured into it.

2. Poured grout into hole No. 17. After one and one-half bags were poured, grout ran out of hole No. 11, which was then shut off.

3. Alternating between holes Nos. 16, 17, 19, and 20, grout was poured until they would no longer receive grout. An additional four bags were poured into these holes.

4. Poured grout into holes Nos. 18 and 23. Both received grout very slowly, and a total of one-half bag was placed into these holes.

5. Holes Nos. 28, 27, 25, 26, 22, and 21 were filled with grout, but too, only that required to fill holes--approximately one-half bag of grout.

A total of 14 bags of grout was poured into this area. Grout did not flow from any of the top holes at any time while grout was being poured into another hole.

The following day, all holes in which grout had settled out were filled to the top. Some of these holes had settled as much as six feet.

In order to back up the 'disintegrated shale zone' treatment and to ensure against possible free passage of ground water around the south and east reactor cavity walls, 28 percussion holes were drilled on April 25 and 26 as indicated on Figure 2.5-144.

Grout application started on April 30, 1974, by gravity feed from the top of the hole at approximate Elevation 690 for holes 1 through 10, and at approximate Elevation 687 for holes 11 through 28. As each consecutive hole was initially filled, all prior holes were backfilled. Grouting proceeded from holes 1 through 28 in the following order.

1. Holes 1 through 9 were started with a 3:1 water/cement ratio grout even though visible water was standing at various depths. Water was not blown from holes because of the potential for further agitation of the south wall zone. After an initial application of 3:1 grout, subsequent filling was with 1:1 or 3/4:1 grout.

2. Holes 10 through 28 were initially blown free of water. First grout application was with a 1:1 mix. Near the end of the program a 3/4:1 mix was used. No between hole connections occurred in this series during the blowing operation.

The operation started at 8:25 a.m. with all initial fillings completed by 1:50 p.m. Backfill operations continued until 2:40 p.m., at which time all holes were considered to have stopped accepting grout. On May 1, 1974, all holes were 'topped out' with dry cement.

A total of 255 gallons of grout was mixed using 22 bags of cement. Of this total about 14 gallons were wasted. Because of the continuous refilling of holes, an exact distribution was impractical. Approximate total acceptance for each hole is indicated in Table 2.5-20. No excessive grout takes were apparent; therefore, no additional holes were drilled and the program was considered complete.

For the structures founded on bedrock, there was a need to protect the rock from stress relief and weathering after excavation to grade. Protection was provided by covering freshly exposed bedrock with concrete.

#### 2.5.4.13 Construction Notes

No significant construction problems were encountered and no major design changes were initiated due to the foundation rock. In order to eliminate potential massive overbreak, initial construction plans precluded the use of explosives. Excavations were completed by drilling closely spaced percussion holes along all cut faces and removing the rock by use of rippers, backhoes, and paving breakers. Groundwater was easily handled after the terrace material was removed.

## 2.5.5 Stability of Slopes

### 2.5.5.1 Slope Characteristics

#### 2.5.5.1.1 ERCW Intake Channel Slopes

The intake channel is a man-made feature extending approximately 800-feet from the edge of the reservoir through the flood plain to the intake pumping station. The results of the soils exploration and testing are presented in Section 2.5.4.2.1.3. Characteristics of the slopes and the underlying soil deposit are also presented in Section 2.5.4.2.1.3.

#### 2.5.5.1.2 Underground Barrier for Protection Against Potential Soil Liquefaction

The underground barrier is a manmade feature extending along the ERCW pipeline and 1E conduit alignments in the area north of the intake pump station and south of the cooling towers and 500-kV switchyard. The purpose of the underground barrier is to prevent the lateral flow of soils should an earthquake occur that could liquefy some of the soils below the ERCW piping and 1E conduits. The underground barrier is located between the safety-related piping and conduits and the area towards which the material would attempt to flow should the soils liquefy. The liquefaction evaluation is presented in Section 2.5.4.8.

The underground barrier was constructed by excavating two trenches. The location of the underground barrier trenches is shown on Figure 2.5-580. The location was based on the extent of the potentially liquefiable soils along the piping and conduit alignments as shown on Figures 2.5-571 through 2.5-578. Figure 2.5-582 shows the layout of the underground barrier trenches in relation to the borings which indicate potentially liquefiable material.

The trenches were backfilled with soils excavated from the trenches, if acceptable, soil from approved onsite borrow areas and granular fill from off-site commercial sources. The method of construction and construction control was in accordance with the requirements and notes on Figures 2.5-580 and 2.5-581. The results of the soils investigation and testing of the borrow materials are described in Section 2.5.4.5.1. The design and analysis of the underground barrier is described in Section 2.5.5.2.3.

As can be seen on the layout (Figure 2.5-582) and on the profiles, some borings with potentially liquefiable material will not be included in the area encompassed by the underground barriers and no remedial treatment is being planned. Each of these areas is discussed in detail as follows:

1. At boring SS-143 (Figure 2.5-571, sheet 2 of 4) and its associated borings (SS-143A, B, and C), the soil is localized; the liquefiable material is a thin layer which would produce small settlements. In three of the borings, it is unrealistic to expect the material to liquefy. The G-SP-SM (Elevation 693.0) in boring SS-143 is part of the basal gravel that exists at the site (the "G" indicates the sample has greater than 12% gravel); the CL-ML (Elevation 697.0) in boring SS-143C should not liquefy due to the high percentage of fines; and the SM (Elevation 696.0) in boring SS-143B with a blow count of 21. The results of an extensive test program on the basal gravel is discussed in Section 2.5.4.2.1.3 (In Situ Basal Gravel).

2. At borings SS-146 and SS-147 (Figure 2.5-571, sheet 2 of 4) both samples shown to be susceptible to liquefaction are in the basal gravel. Also, the blow counts (13 and 18) of the samples (13 and 18) indicate a fairly firm material.

3. At boring SS-153 (Figure 2.5-571, sheet 3 of 4) the sample (G-SW-SM at Elevation 707.0) represents a thin isolated pocket and the sample is in the basal gravel.

4. In the main plant area (Figures 2.5-571, sheet 4 of 4, 2.5-572 through 2.5-575, and 2.5-577 and 2.5-578), there are no problems related to soil flow during liquefaction since there are no slopes in the area. Potential settlement in this area is discussed in Section 2.5.4.8.

5. In the southern part of the switchyard, soils encountered in borings SS-53, SS-54, SS-55, SS-62, and SS-61, show some liquefaction potential. However, liquefaction does not appear to be realistic. In boring SS-53 (Figure 2.5-579) the two samples, an ML (Elevation 711.0) and an SM (Elevation 707.0) with apparent liquefaction potential have high blow counts (20 and 18) and one, the ML, has a high plasticity index (PI-18.4). In boring SS-54 (Figure 2.5-579) the two samples, an ML (Elevation 703.0) and an SM (Elevation 701.0) that apparently would liquefy have high blow counts (19 and 21) and have medium to high plasticity indices (PI = 10.4 and 16.8). At boring SS-55 (Figure 2.5-579) the two ML samples (Elevations 714.0 and 709.0) have blow counts that are good to high (14 and 19) and the plasticity indices are high (PI 18.4 and 14.3). At boring SS-62 (Figure 2.5-579) the blow count of the potentially liquefiable material (Elevation 687.0) is good (14) and the plasticity index is high for an SM (PI - 13.8). In addition, the layer is very thin and is probably weathered shale rather than alluvium. At boring SS-61 (Figure 2.5-579) the material is localized, located at the surface where it will not affect any soils overlying it; and it is a long distance from the conduit bank.

#### 2.5.5.2 Design Criteria and Analysis

##### 2.5.5.2.1 Design Criteria and Analyses for the Essential Raw Coolant Water Intake Channel Slopes

The static design cases and the conditions and factors of safety associated with each are shown below:

| Case | Factor of Safety |
|---|---|
| 1. Normal operating condition: reservoir Elevation 675, ground-water Elevation 685. | 1.5 |

| | |
|---|---|
| 2. Sudden drawdown due to loss of downstream dam: groundwater Elevation 685; reservoir drawdown Elevation 685 to 666. | 1.1 |
| 3. Construction condition: groundwater Elevation 685, channel dry. | 1.25 |

The earthquake design cases are the same as Case 1 and 2 above combined with a Safe Shutdown Earthquake. The minimum factor of safety must be equal to or greater than 1.0.

Static Analysis

Slip circle analysis using the Modified Swedish method were performed for the static design Case 2. The critical circle, which has a factor of safety of 2.5, is shown in Figure 2.5-238. The combination of events comprising design Cases 1 and 3 are less than those for Case 2. Since the factor of safety for Case 2 is 2.5, then the factor of safety for Cases 1 and 3 will be greater than that required for these cases.

The soils exploration in Section 2.5.4.2.1.3 disclosed a possible weak layer of lean clay soil at approximate Elevation 680 to 685 in borings US-30 and US-36, which are on opposite sides of the channel near the reservoir. The test results indicate the minimum strength properties of this material as $\phi = 3°$ and c = 500 psf. Wedge analyses were performed for design Case 2 assuming a failure plane at Elevation 680, using these strength properties under the wedge. The minimum wedge, which has a factor of safety of 3.7, is shown in Figure 2.5-238. By inspection again, design Cases 1 and 3 are satisfied.

Earthquake Analysis

The soils exploration results presented in Section 2.5.4 revealed some silty sands that were possibly subject to liquefaction under earthquake excitation. Section 2.5.4.8 deals with the evaluation of the liquefaction potential following the performance of cyclic triaxial shear tests on these silty sands. The cyclic testing program showed that this material would liquefy when subjected to earthquake motion. It was therefore decided to excavate this material and compact it back into place as described in Section 2.5.4.5. Section 2.5.4.2.1.3 presents the results of normal shear tests on the remolded channel area soils. The more important cohesion value is conservatively taken as 1,200 psf; friction angle is assigned an average value of 15 degrees. The two values are the same as the undisturbed values for the in situ clay above Elevation 680.

A dynamic 2-dimensional finite element analysis for earthquake design Case 2 was performed on the intake slopes using in situ test results in Section 2.5.4.2.1.3. By inspection, design Case 2 controls for seismic analysis and is the only case considered. The finite element analysis considered the soil to behave as an elastic medium with a constant damping of 10% of critical.

The soil deposit was modeled from the centerline of the intake channel to a distance of 350-feet beyond the crest of the intake channel side slope and from the top of the soil deposit to a fixed boundary at bedrock. Earthquake motion is input into the model at this fixed boundary at bedrock. The four artificial time histories discussed in Section 3.7 were each in turn used as input directly into the base of the model. Acceleration profiles for the intake channel were then prepared for the accelerations produced by each of the four records. An average acceleration was then calculated from the four profiles for use as seismic coefficients and taking into account the location of the various failure planes to be investigated by a pseudostatic approach (see Figure 2.5-237). Accordingly, for a failure plane at Elevations 650.0 (at or directly above bedrock) to 665.0, a seismic coefficient.of 0.30 g was calculated for the SSE. Similarly, a seismic coefficient of 0.40 g was calculated for the SSE for a failure plane at Elevation 680.0

Pseudostatic wedge analyses were performed for earthquake design Case 2 using seismic coefficients obtained from the finite element analysis, to determine the lateral extent of excavation required to obtain a minimum factor of safety equal to or greater than 1.0. The soil properties used in the pseudostatic wedge analyses are the same as in the static analyzes except the liquefiable sand is assumed to have no strength (Figure 2.5-237).

Section A-A, Figure 2.5-237 shows the wedge failure at Elevation 650 which has a factor of safety equal to 1.12. The factor of safety increases for wedges considered further behind the crest of the slope.

Section B-B, Figure 2.5-237 shows the wedge failure at Elevation 665. The factor of safety is 1.04 if the failure plane is in the firm gravel and is 1.57 if the failure plane occurs in the replacement material. The factor of safety increases for wedges considered further behind the crest of the slope. As a result of these analyses, excavation will be made down to firm gravel and laterally back to the point directly below the crest of the slope, and then to the surface with a slope not steeper than one vertical on 1.5 horizontal as shown in Figure 2.5-239.

Section C-C, Figure 2.5-237, shows a wedge analysis for failure at Elevation 680 considering the replacement material in place and no strength in the in situ soil below Elevation 680 behind the wedge. This wedge has a factor of safety of 2.77. If a larger wedge is considered at Elevation 680, the factor of safety decreases since the driving force increases, but the resistance to sliding remains constant. If a wedge is considered approximately 160-feet back from the crest of the slope, the factor of safety would be 1.0. This wedge is shown in Figure 2.5-240. For this failure wedge to occur, the silty sand material must completely liquefy about 160 feet back from the crest of the slope. This is very unlikely, but using the method outlined by Newmark in Geotechnique Volume 15, 1965, the horizontal displacements for this wedge were evaluated. The following equation was used to evaluate the displacement:

$$U = \frac{6V^2}{2gN}$$

where: U = displacement

V = velocity

g = acceleration of gravity

N = coefficient which when multiplied by weight of sliding mass results in resistance to sliding

As outlined previously, the seismic coefficient used for this wedge was 0.4 g. The velocity corresponding to this acceleration was evaluated by using Newmark's standard earthquake[94] where 0.5 g is related to a velocity of 24-inches per second. The horizontal displacement calculated in this manner is less than 1-foot for the Safe Shutdown Earthquake, which would not obstruct the intake channel.

Section B-B, Figure 2.5-237, also shows the results of investigating the sensitivity of the factor of safety through varying the strength properties of the firm gravel. By increasing the friction angle by 3 degrees or increasing cohesion by 100 psf, the factor of safety increases by about 0.1.

A dike will be left in place at the reservoir end of the channel while excavation and replacement in the channel is accomplished in the dry. When the dike is removed, some of the excavation and replacement will be under water. Rockfill will be used as the replacement material in this area, to the same one on four side slope. The strength of the rockfill is assumed to be $\phi = 45°$ and c = 0.0. The factors of safety for all wedges considering the above strength are reported below in Section 2.5.5.2.2.

2.5.5.2.2 Additional Analyses Due to Unexpected Soil Conditions Encountered During Excavation of the Intake Channel

Description of Condition

Section 2.5.5.2.1 describes the design criteria and analyses performed for qualification of the intake channel side slopes. Figure 2.5-239 shows a typical cross-section to which the channel was to have been constructed, including a layer of basal gravel approximately 15-feet thick extending from Elevation 665 to Elevation 650.

During the excavation of the channel, TVA construction personnel encountered unexpected soil conditions in the layer of firm gravel. Therefore, test trenches and pits were excavated into the firm gravel to better define the soil conditions. On the upstream side of the channel, conditions were as expected except that from the pumping station to about halfway to the river, top of rock was determined to be at about Elevation 663. Therefore, excavation in this area was made to top of rock, and about 18 inches of granular fill compacted to 85% maximum relative density was placed to provide a dry working base for placement of the compacted fill. The strength characteristics of the granular fill are better than the basal gravel and the compacted earthfill, and no additional design and analysis was required. On the downstream side of the channel, layers of sand and one layer of clay were found to exist in the firm gravel. From the pumping station to about halfway to the river, top of rock was found to be at about Elevation 656. It was decided to excavate down to rock in this area and place the layer of granular fill (if needed to obtain a dry base) and then compacted earthfill as originally planned. Additional stability analyses have been made to verify the limits of excavation and are presented below. In the remainder of the downstream side, difficulties were encountered in excavating the trenches and test pits to top of rock due to the water table.

Samples of the sand and clay material in this area were collected by TVA's Singleton Materials Laboratory for evaluation. Preliminary examination of the sandy material by the soils laboratory and comparison of its characteristics with the empirical rules concerning evaluation of liquefaction potential outlined in Section 2.5.4.8 indicated a possibility for liquefaction during a seismic event.

Accordingly, a program of additional soils borings was formulated to determine the lateral and vertical extent of the sand and clay layers and to better define top of rock. Figure 2.5-252 is a plan view of the channel which shows the locations of the additional soils borings. Figures 2.5-253, 2.5-254, and 2.5-255 show the soils profile obtained from the additional borings. The exploration program determined that the lowest bedrock elevation occurred near the mouth of the channel downstream side at Elevation 650. In addition, a program of cyclic triaxial testing of the sandy material and static testing of the clay material, under R conditions (saturated, consolidated, undrained) in both cases, was instituted. Sandy material from two representative locations was tested at TVA's Singleton Materials Laboratory. The results of that testing are presented in Table 2.5-26. The results of static R testing on the clay material are shown in Table 2.5-27. The results of the exploration and testing program were evaluated to determine the need for additional analysis. These results indicated a probable liquefaction of the sand layer during a seismic event. In addition, the strength properties of the clay layer were too low to stabilize overlying slopes. Additional analyses have been made to determine new limits of excavation to top of rock for the downstream side of the channel extending from the reservoir to approximately halfway to the pumping station.

Additional Analyses

As outlined above, additional stability analyses were made for those portions of the downstream side of the channel with bedrock elevations ranging from 656 (approximately halfway to the reservoir) to 650 at the reservoir end of the channel. The analyses assumed that the excavated material would be compacted and placed as fill in the same manner as that used in other areas of the intake channel. The strength properties of the remolded material are $\phi = 15°$ and c = 1200 psf, the same values used in the original analysis, as determined by tests on the remolded soil. The liquefiable material adjoining the remolded slopes is assumed to have no strength. The most critical design case has been established above to be that for sudden draw down plus an SSE, for which the minimum factor of safety is 1.0. Therefore, the results presented below are for that case only.

From bedrock Elevation 660 to Elevation 656 the limits of excavation will be as shown in Figure 2.5-256. The factor of safety for a wedge failure along a plane at 656 is 1.12. The slope is therefore stable against failure by sliding.

Figure 2.5-257 shows the limits of excavation for a section with a bedrock elevation of 650. The factor of safety for a wedge failure along a plane at Elevation 650 is 1.0. This factor of safety is considered adequate, since it was computed with the use of extremely conservative assumptions. As shown on Figure 2.5-257, the factor of safety was computed assuming that the entire zone of sandy material extending from Elevation 680 to 650 liquefies completely during a seismic event. This is a very conservative assumption. Furthermore, the assumption has been made that no shear strength exists along the failure plane where it passes through the sandy zone; again, this is a very conservative assumption. Even a small amount of shear strength in the liquefiable zone along the failure plane would make the safety factor greater than 1.0.

The final configuration of the rockfill side slopes at the reservoir end of the intake channel, as discussed in Section 2.5.5.2.1, are also affected by the unexpected solid conditions encountered. On the upstream side of the mouth of the intake channel the firm gravel layer will be left in place and rockfill placed on top of it from Elevation 665 to 695. On the downstream side the rockfill will be placed on bedrock down to Elevation 650.

Figure 2.5-258 shows a typical cross section of the rockfill slopes on the upstream side of the channel. The factor of safety against sliding along a plane at Elevation 665 is 1.5.

The downstream side of the channel with rockfill placed on a bedrock elevation of 650 is shown in Figure 2.5-259. The factor of safety for a wedge failure at 650 is 1.30, and the slope is therefore stable.

### 2.5.5.2.3 Design Criteria and Analysis for the Underground Barrier for the ERCW Pipeline and 1E Conduit Alignment

The location of the underground barrier is shown on Figure 2.5-580. The underground barrier was analyzed for the following cases:

| Case | | Required Factor of Safety |
|---|---|---|
| I. | During earthquake but prior to liquefaction (reduced passive pressure assumed to act) | 1.0 |
| II. | After earthquake and after liquefaction (no passive pressure assumed) | 1.0 |

Figure 2.5-583 is a summary of the analysis of the underground barrier. The figure shows: a loading diagram of how the underground barrier was analyzed, a summary of the design parameter and criteria used in the stability analyses, and a summary of results of the stability analysis for each cross-section. Figure 2.5-584 is a plan of the area showing the locations of the as-built cross-sections.

As shown in the summary of the design parameters and criteria, the shear strengths of the alluvial sands (i.e., potentially liquefiable sands) have been assumed to be reduced during the earthquake. This was done to acknowledge the possibility that some strength loss in alluvial sands may occur during the earthquake. The magnitudes of the strength reduction, 50% of cohesion and 30% of angle of internal friction, was based on engineering judgement and is considered reasonable and conservative for the material.

The results of the stability analysis for each cross-section are provided for two sets of analyses representing "during earthquake" and "after earthquake" conditions for different potential failure planes. The "during earthquake" analyses show the stability of the barrier when the barrier mass is subjected to the peak acceleration, complete liquefaction of sands for the active earth pressure, and consider partial passive (reduced) earth resistance. The "after earthquake" analyses show the stability of the barrier after the earthquake and consider complete (postulated) liquefaction of the saturated alluvial sands for the active earth pressure and complete loss of downstream passive resistance. Depending on the section geometry and materials used as backfill, between one and five assumed failure planes were analyzed for each cross-section and design case.

Due to the need to complete the construction of the barrier prior to fuel load, the trench excavation was started prior to completion of the laboratory testing of the back fill soils. The barrier width was based on assumed design soil properties. The results of the evaluation of the initial laboratory shear strength test showed that the design cohesion was approximately half the needed cohesion to stabilize the barrier. To eliminate the need to widen the barrier, additional laboratory shear strength tests were made on backfill soils remolded to a higher level (100% Standard Compaction ASTM D 698) of compaction. The results of this testing showed that the cohesion was increased sufficiently to allow the barrier to be stable. The soil test results are presented in section 2.5.4.5.1. Since it was not necessary for the entire barrier to be constructed at the higher compaction level (100%), additional analyses were made to determine what elevation the lower compaction level (95%) could be used.

During excavation of the south end (near the pump station) of trench B, the depth of the trench was deeper than the exploratory borings had indicated. Stability analysis performed at the time the excavation was open indicated a need for a higher shear strength for the back fill material or to make the trench significantly wider. The option of using 1075 crushed stone with higher shear strength properties in lieu of earth fill A1 was selected. The properties of the 1075 crushed stone are shown in Figure 2.5-583. The use of the crushed stone met the higher shear strength requirements and provided the additional stability needed for actual field conditions. Also, since the construction period for the trench B barrier extended through a winter season, the option to use crushed stone facilitated completion of construction. Each change of back fill material in a cross-section presented a potential failure plane which was checked in the analysis.

Section 2.5.4.6 describes the study made to determine the design groundwater elevation for the piping and conduit alignments. As discussed in Section 2.5.4.6, the groundwater level was revised to reflect a 25-year groundwater. The influence of this higher groundwater on the analysis of the underground barrier was discussed with the NRC Staff. The Staff indicated they concur with TVA's judgment that the higher groundwater level will have a minimal effect on the results of the stability analysis, thus not requiring any additional evaluation of the stability of the underground barrier.

Figures 2.5-594 through 2.5-597 are representative cross-sections along the centerline of trench A. As shown on Figure 2.5-583, the results of a stability analysis for station 6+78 of trench A are not provided because the soil profile was not identified above the top of shale. This is not considered critical to the overall summary since the other 17 of the 18 cross-sections of trench A were analyzed and found to be adequate. The stability results are provided for two different potential failure planes, which are shown on the representative cross-sections (Figures 2.5-594 through 2.5-597) at (1) the top of weathered shale (A) and (2) the interface between the 95% and 100% maximum dry density fill (B). Figures 2.5-598 through 2.5-601 provide the summaries of in-place density and moisture-quality control tests conducted on the fill materials during construction of trench A.

Figures 2.5-602 through 2.5-605 are representative cross-sections along the centerline of trench B. Since trench B was back filled with compacted crushed stone in addition to earth fill, additional potential failure planes were identified at the various material interfaces and analyzed. The stability summary on Figure 2.5-583 provides the results on two of these potential failure planes. The first, at the top of weathered shale (A), is provided for each section. The second, at one of the other potential failure planes, represents the lowest factor of safety for that cross-section other than at the top of weathered shale. Figure 2.5-606 through 2.5-610 provide the summaries of in-place density and moisture quality control tests conducted on the fill material during construction of trench B.

Figures 2.5-608 and 2.5-609 show that one quality control test had results that did not meet the required criteria for backfill in trench B compacted to 100% of maximum dry density. This failure to meet criteria was identified after trench construction was completed and a nonconformance report (NCR 5804) was issued. The failure to meet required criteria resulted from the inadvertent use of the improper compaction control curve during construction. This resulted in the test sample being undercompacted by 1.3% and having too high a moisture content by 0.7% . The fill represented by the test sample was located near the top of the 100% maximum dry density backfill zone. This location is not critical to the analysis results. Therefore, the disposition of the NCR was use-as-is.

Figure 2.5-584 shows the final grading for the area of the underground barrier. Analyses of the underground barrier reveal that the as-built barrier meets or exceeds all design requirements.

### 2.5.5.3 Logs of Borings

Refer to Section 2.5.4.3 for the location of all in situ soil borings. Refer to Section 2.5.1.2.6 for the location of all rock borings.

### 2.5.5.4 Compaction Specifications

The compaction specification for earth and rock fills are discussed in Section 2.5.4.5.

## 2.5.6 Embankments

There are no embankments at the site which are used for plant flood protection or for impounding cooling water required for the operation of the nuclear power plant.

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Codes

Code of Federal Regulations Title 29 Sections 1910.109 and 1926.900, Title 10, Part 100, Appendix A

Standards
ASTM - American Society for Testing and Materials

| | |
|---|---|
| ASTM C 33-90 | Concrete Aggregates |
| ASTM C 88-83 | Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM C 131-89 | Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 535-89 | Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM D 422-63 | Standard Method for Particle-Size Analysis of Soils |
| ASTM D 653-90 | Standard Terminology Relating to Soil, Rock, and Contained Fluids. |
| ASTM D 698-78 | Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-Pound (2.49-kg) Rammer and 12-Inch (305 mm) Drop |
| ASTM D 1556-82 | Standard Test Method for Density of Soils in Place by the Sand-Cone Method |
| ASTM D 2167-84 | Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber-Balloon Method. |

| | |
|---|---|
| ASTM D 2216-80 | Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures |
| ASTM D 2487-85 | Standard Test Method for Classification of Soils for Engineering Purposes |
| ASTM D 2922-81 | Standard Test Methods for Density of Soil and Soil Aggregate in Place By Nuclear Methods (shallow depth) |
| ASTM D 4253-83 | Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table |
| ASTM D 4254-83 | Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density |
| ASTM D 4318-84 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D 4318-84 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |

**TABLE 2.5-1**
**(SHEET 1 of 1)**

**SOIL STRENGTH TESTS**

**Historical Information**

| | UC | | Q | | Cyclic | | R | S | Consolidation |
|---|---|---|---|---|---|---|---|---|---|
| Un*-Undisturbed | | | | | | | | | |
| Re*-Remolded | Un* | Re* | Un* | Re* | Q | R | | | |
| Transformer Yard Switchyard | X | | | | | | | | |
| Cooling Tower Area | X | | | | | | | | X |
| CCW Pumping Station | | | | | | | | | |
| Intake Channel | X | X | X | X | X | X | X | | |
| Diesel Generator Building | X | X | X | X | | | | | X |
| AE Conduits Alignment | X | X | X | | X[1] | X | X | | |
| ERCW Piping Alignment | X | X | X | | X[1] | X | X | | |
| Office and Service Building | | | | | | | | | |

X indicates this type of soil test was conducted on this feature

1. Q-cyclic to be run if some soils show liquefaction potential

**TABLE 2.5-2**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION FOR 500-KV TRANSFORMER YARD**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Nat. Moist. | Grain Size Analysis Gravel % | Grain Size Analysis Sand % | Grain Size Analysis Silt % | Grain Size Analysis Clay % | $D_{10}$ mm | Atterberg Limits Liquid Limit % | Atterberg Limits Plasticity Index % | Dry Density pcf | Void Ratio | Unconfined Compression Undisturbed tsf | Unconfined Compression Remolded tsf | Sensitivity Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-1; station 66+34, P+17; surface elevation 743.2 | | | | | | | | | | | | | | |
| 730.2-729.2 | SM | 16.0 | 0 | 57 | 24 | 19 | -- | 25.9 | 3.3 | 106.2 | 0.59 | | | |
| 727.7-725.8 | ML | 19.6 | 1 | 48 | 27 | 24 | -- | 29.6 | 5.2 | 105.1 | 0.61 | 2.2 | 1.3 | 1.7 |
| 725.0-722.8 | SM | 17.6 | 6 | 54 | 25 | 15 | -- | 27.6 | 4.6 | 106.5 | 0.59 | | | |
| 721.6-720.7 | G-SM | 15.4 | 20 | 46 | 21 | 13 | -- | 27.0 | 3.7 | 112.2 | 0.51 | | | |
| 720.7-719.8 | SM | 8.7 | 4 | 77 | 13 | 6 | .025 | NP | NP | 108.9 | 0.55 | | | |
| 718.9-716.8 | G-SM | 12.8 | 12 | 69 | 14 | 5 | .025 | NP | NP | 111.8 | 0.50 | | | |
| 716.2-714.7 | SM | 29.0 | 0 | 82 | 13 | 5 | .026 | NP | NP | 94.5 | 0.78 | | | |
| 714.7-714.1 | ML | 33.3 | 0 | 40 | 40 | 20 | -- | 29.2 | 3.0 | 87.9 | 0.92 | | | |
| Boring US-2; station 66+84, M+82; surface elevation 742.1 | | | | | | | | | | | | | | |
| 729.4-728.9 | MH | 23.2 | 0 | 21 | 35 | 44 | -- | 53.1 | 23.1 | 98.2 | 0.75 | 1 5 | 1.4 | 1.1 |
| 728.9-728.1 | SC | 20.5 | 0 | 51 | 36 | 13 | -- | 31.3 | 8.4 | 102.8 | 0.63 | | | |
| 726.3-725.5 | SC | 17.8 | 0 | 52 | 27 | 21 | -- | 36.5 | 13.0 | 105.4 | 0.62 | | | |
| 725.5-724.8 | SM | 11.5 | 8 | 70 | 18 | 4 | .025 | NP | NP | 113.0 | 0.48 | | | |
| 724.0-721.7 | SM | 16.8 | 0 | 66 | 26 | 8 | -- | NP | NP | 96.5 | 0 74 | | | |
| 720.2-718.9 | SM | 14.8 | 6 | 60 | 22 | 12 | -- | NP | NP | 107.3 | 0 56 | | | |
| 718.1-717.4 | SM | 16 5 | 9 | 62 | 21 | 8 | -- | NP | NP | 107.9 | 0 59 | | | |

**TABLE 2.5-3**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - 500-KV SWITCHYARD**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbo | Nat. Moist. | Gravel % | Grain Size Analysis Sand % | Silt % | Clay % | $D_{10}$ mm | Atterberg Limits Liquid Limit % | Plasticity Index % | Dry Density pcf | Void Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-3; station 69+72, O+60; surface elevation 733.2 | | | | | | | | | | | |
| 729.2-728.0 | SM | 15.3 | 0 | 63 | 14 | 23 | -- | 36.0 | 11.6 | 112.5 | 0.50 |
| 726.7-725.7 | G-SM | 16.6 | 13 | 43 | 24 | 20 | -- | 32.4 | 8.6 | 112.7 | 0.50 |
| 724.2-723.3 | G-SM | 13.9 | 26 | 45 | 15 | 14 | -- | NP | NP | 111.6 | 0.49 |
| 723.3-722.8 | G-SM | 13.2 | 28 | 49 | 13 | 10 | -- | NP | NP | 93 8 | 0.78 |
| 721.1-720.6 | G-SM | 16.2 | 14 | 55 | 15 | 16 | -- | 25.5 | 0.8 | 105.3 | 0.59 |
| 717.2-716.6 | G-SM | 15.8 | 17 | 54 | 17 | 12 | -- | 23.8 | 2.7 | 107.8 | 0.56 |

**TABLE 2.5-4**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - NORTH COOLING TOWER**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Nat. Moist. | Grain Size Analysis Gravel % | Sand % | Silt % | Clay % | $D_{10}$ mm | Atterberg Limits Liquid Limit % | Plasticity Index % | Dry Density pcf | Void Ratio | Unconfirmed Compression Undisturbed tsf | Remolded tsf | | Sensitivity Ratio | Consolidation Cc | Pc tsf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-7; station 60+98, D+16; surface elevation 735.9 | | | | | | | | | | | | | | | | | |
| 730.8-729.6 | MH | 27.3 | 0 | 30 | 29 | 41 | -- | 53.3 | 20.0 | 97.1 | 0.79 | 4.1 | 4.8 | 0.9 | 0.08 | | 2.68 |
| 727.4-726.0 | ML | 24.2 | 0 | 44 | 29 | 27 | -- | 35.9 | 10.2 | 100.9 | 0.68 | 3.4 | 4.1 | 0.8 | 0.20 | | 4.11 |
| 724.4-723.9 | ML | 26.6 | 0 | 35 | 36 | 29 | -- | 37.6 | 11.5 | 97.8 | 0.72 | 1.1 | 1.0 | 1.1 | | | |
| 723.9-722.6 | SM | 21.1 | 3 | 67 | 22 | 8 | .007 | NP | NP | 96.5 | 0.76 | | | | 0.31 | | -- |
| 721.8-719.5 | SM | 25.9 | 0 | 63 | 24 | 13 | -- | NP | NP | 94.2 | 0.80 | | | | | | |
| 718.8-718.0 | ML | 29.4 | 0 | 49 | 31 | 20 | -- | 30.1 | 5.6 | 91.1 | 0.80 | | | | 0.22 | | 1 01 |
| 718.0-716.6 | SM | 19.3 | 0 | 88 | 10 | 2 | .06 | NP | NP | 95.8 | 0.78 | | | | | | |
| 716.0-714.8 | SM | 27.6 | 0 | 82 | 13 | 5 | .02 | NP | NP | 98.0 | 0.73 | | | | 0.09 | | - |
| Boring US-8; station 61+86, A-51; surface elevation 733.7 | | | | | | | | | | | | | | | | | |
| 713.4-730.6 | CL | 17.0 | 0 | 25 | 47 | 28 | -- | 26.8 | 10.8 | 107.3 | 0.55 | 2.5 | 2.4 | 1.0 | | | |
| 730.6-728.3 | MH | 26.2 | 0 | 28 | 21 | 51 | -- | 53.9 | 19.6 | 99.4 | 0.70 | 6.1 | 6.1 | 1.0 | 0.09 | | 3.5 |
| 728.0-727.3 | MH | 28.9 | 0 | 21 | 26 | 53 | -- | 58.4 | 26.0 | 94.9 | 0.80 | 4.8 | 3.9 | 1.2 | 0.07 | | 3.4 |
| 727.3-726.3 | SM | 18.2 | 0 | 56 | 22 | 22 | -- | 32.4 | 6.2 | 108.3 | 0.57 | | | | 0.14 | | -- |
| 724.7-723.3 | ML | 20.2 | 0 | 49 | 23 | 28 | -- | 36.5 | 11.4 | 105.5 | 0.62 | 2.6 | 2.3 | 1.1 | 0.15 | | 1.9 |
| 721.7-720.8 | CL | 23.1 | 0 | 36 | 31 | 33 | -- | 41.2 | 17.0 | 102.6 | 0.66 | 2.9 | 2.7 | 1.1 | 0.15 | | 2.7 |
| 720.8-720.3 | SM | 18.0 | 0 | 55 | 28 | 18 | -- | 28.3 | 3.5 | 106.0 | 0.60 | | | | | | |
| 719.1-718.6 | SM | 19.9 | 0 | 53 | 24 | 23 | -- | 30.2 | 7.1 | 105.4 | 0.62 | | | | | | |
| 718.6-718.1 | SM | 17.4 | 0 | 57 | 26 | 17 | -- | 29.5 | 6.1 | 105.8 | 0.59 | | | | 0.11 | | -- |
| 718.1-717.9 | G-SM | 11.8 | 37 | 37 | 16 | 10 | -- | NP | NP | -- | -- | | | | | | |
| 716.4-715.6 | G-SP-SM | 7.4 | 34 | 57 | 7 | 2 | .09 | NP | NP | -- | -- | | | | | | |

**TABLE 2.5-5**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION -SOUTH COOLING TOWER**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

Atterberg Limits

| Elevation | Soil Symbol | Nat. Moist | Grain Size Analysis Gravel | Sand | Silt | Clay | $D_{10}$ | Liquid Limit | Plasticity Index | Dry Density | Void Ratio | Unconfirmed Undisturbed | Compression Remolded | Sensitivity Ratio | Consolidation Cc | Pc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | % | % | % | mm | % | % | pcf | | tsf | tsf | | | |
| Boring US-12; station 60+08, E+65; surface elevation 736.8 | | | | | | | | | | | | | | | | |
| 729.8-729.0 | CL | 27.1 | 0 | 22 | 39 | 39 | -- | 48.3 | 22.8 | 97.0 | 0.94 | 3 6 | 2.1 | 1.7 | 0.18 | 3.11 |
| 729.0-728.4 | ML | 25.8 | 0 | 30 | 43 | 27 | -- | 40.1 | 12.4 | 98.9 | 0.72 | | | | | |
| 726.7-725.9 | CH | 27.0 | 0 | 28 | 34 | 38 | -- | 53.6 | 27.3 | 97.5 | 0.73 | 1.9 | 1 9 | 1.0 | 0.17 | 2.8 |
| 725.9-725.4 | SM | 18.2 | 0 | 55 | 29 | 16 | -- | NP | NP | 104.8 | 0.60 | | | | | |
| 723.8-722.4 | SM | 23.0 | 0 | 61 | 21 | 18 | -- | 29.8 | 4.9 | 102.0 | 0.66 | | | | | |
| 721.7-720.7 | SM | 24.8 | 0 | 54 | 23 | 23 | -- | 33.3 | 5.5 | 97.8 | 0.74 | | | | 0.15 | -- |
| 720.7-719.7 | SM | 31.1 | 0 | 82 | 14 | 4 | 03 | NP | NP | 86.5 | 0.56 | | | | | |
| 718.8-716.5 | MH | 35.0 | 0 | 6 | 59 | 35 | -- | 50.4 | 17.6 | 87.3 | 0.97 | 0 4 | 0 3 | 1 3 | 0.36 | 2.6 |
| 715.8-714.9 | ML | 31.6 | 0 | 34 | 39 | 28 | -- | 38.8 | 9.5 | 88.9 | 0.92 | 0.6 | 0.5 | 1.2 | | |
| 714.9-713.5 | SM | 25.3 | 0 | 88 | 11 | 7 | 02 | NP | NP | 90.9 | 0.87 | | | | 0.17 | -- |
| Boring US-13; station 68+86, A+91; surface elevation 741.2 | | | | | | | | | | | | | | | | |
| 731.1-730.2 | CH | 27.2 | 0 | 21 | 34 | 45 | -- | 50.2 | 26.6 | 94.9 | 0.77 | | | | | |
| 730.2-728.8 | CL | 23.1 | 0 | 49 | 27 | 24 | -- | 32.1 | 8.8 | 101.4 | 0.64 | 1 9 | 1 2 | 1.6 | 0.14 | 1.8 |
| 728.2-725.8 | ML | 26.6 | 0 | 45 | 35 | 20 | -- | 30.9 | 6.7 | 98.6 | 0.70 | | | | | |
| 725.2-722.8 | ML | 31.2 | 0 | 22 | 44 | 34 | -- | 42.7 | 14.7 | 91.3 | 0.88 | 0.9 | 0.6 | 1.5 | 0.20 | 1.3 |
| 722.2-719.9 | ML | 32.9 | 0 | 35 | 40 | 25 | -- | 36.6 | 11.1 | 89.1 | 0.89 | | | | | |
| 719.2-717.3 | CL | 32.1 | 0 | 32 | 41 | 27 | -- | 36.4 | 13.1 | 88.3 | 0.93 | | | | | |
| 717.3-716.9 | ML | 29.6 | 0 | 21 | 44 | 35 | -- | 44.4 | 17.4 | 94.2 | 0.82 | 1 4 | 0 6 | 2.3 | | |
| 716.2-715.3 | ML | 30.2 | 0 | 21 | 44 | 35 | -- | 46.7 | 17.9 | 93.4 | 0.85 | 0 9 | 0 9 | 1.0 | 0.24 | 1.4 |
| 715.3-713.8 | SC | 25.0 | 0 | 51 | 28 | 21 | -- | 26.6 | 8.1 | 99.8 | 0.69 | | | | | |
| 713.2-712.6 | CL | 25.4 | 0 | 35 | 37 | 28 | -- | 30.2 | 12.8 | 99.4 | 0.70 | 0.4 | 0.3 | 1.3 | | |
| 712.6-712.1 | CL | 26.1 | 0 | 48 | 31 | 21 | -- | 27.3 | 7.8 | 99.6 | 0.70 | | | | 0.12 | 2.3 |

**TABLE 2.5-6**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION -DIESEL GENERATOR BUILDING**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Soil Type | Nat. Moist | Std. Penet. | Sand | Silt | Grain Size Analysis** Clay | $D_{10}$ | $D_{50}$ | $D_{60}$ | Cu | Atterb. Limits Liquid Limit | Plastic Index | Dry Dens | Void Ratio | Undisturbed Triaxial Q $\phi$ | c | Remolded Triaxial Q $\phi$ | c | Undix. Uncon. Compr. | Remolded Unconf. Compr. | Sensitivity Ratio | Consolidation $C_c$ | $P_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | *** | % | % | % | mm | mm | mm | | % | % | pcf | | deg | tsf | deg | tsf | tsf | tsf | | | tsf |
| Boring US-25; surface elevation 734.6 | | | | | | | | | | | | | | | | | | | | | | | | |
| 720.1 -717.9 | CL | J | 31.9 | 6 | 3 | 51 | 46 | -- | | | | 48.2 | 25.5 | 90.2 | 1,063 | 1.5 | 1.22 | 0 0 | 0.85 | 1.96 | | 2.8 | | |
| 717.1-715.5 | CL | I | 32.9 | 6 | 18 | 45 | 37 | -- | | | | 36.0 | 18.6 | 89.4 | 0.887 | 0.8 | 0.38 | 0 0 | 0.05 | 0.81 | 8 | 4.5 | 0.33 | 2.0 |
| 715.5-715.1 | SM | K | 31.0 | 2 | 69 | 19 | 12 | .002 | .13 | .14 | 70.0 | NP | NP | 89.7 | 0.868 | 3.3 | 0.53 | | | | | | | |
| 714.6-713.0 | SP-SM | I | 29.3 | 2 | 89 | 5 | 6 | 05 | .28 | .29 | 5.8 | NP | NP | 90.8 | 0.870 | | | | | | | | | |
| Boring US-26; surface elevation 735.0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 720.0-717-6 | CL | J | 31.2 | 7 | 8 | 49 | 43 | -- | | | | 47,8 | 25.4 | 90.5 | 0.883 | 4.7 | 0.28 | 0.5 | 0.20 | 0.91 | 0.31 | 2.9 | 0.30 | 2.6 |
| 717.0-715.8 | CL | I | 30.4 | 3 | 27 | 45 | 28 | -- | | | | 31.9 | 14.0 | 91.0 | 0.861 | 1.2 | 0.43 | 0.0 | 0.13 | .081 | 0.17 | 4.8 | 0.32 | 1.8 |
| 715.8-714.5 | SM | K | 30.9 | 4 | 62 | 29 | 9 | .006 | 0.9 | .12 | 20.0 | NP | NP | 89.7 | 0.884 | 6.7 | 0.57 | | | | | | 0.18 | 1.2 |
| 714.0-711.7 | ML-CL | H | 30.1 | 4 | 46 | 34 | 20 | -- | | | | 26.5 | 5.6 | 90.0 | 0.888 | 7.5 | 0.55 | 4.0 | 0.25 | 0.23 | 0.05 | 4.6 | 0.21 | 1.5 |
| Boring US-28; surface elevation 734.0 | | | | | | | | | | | | | | | | | | | | | | | | |
| 720.0-718.1 | CL | J | 28.6 | 7 | 9 | 51 | 40 | -- | | | | 46.0 | 22.9 | 94 3 | 0.803 | 8 5 | 1.03 | 7.5 | 0 55 | 2.30 | 0.82 | 2 8 | | |
| 717.0-714.6 | CL | J | 35.0 | 2 | 10 | 48 | 42 | -- | | | | 45.0 | 25.0 | 85.9 | 0.963 | 3.0 | 0.25 | 1.0 | 0.10 | 0.72 | 0 22 | 3 3 | 0.22 | 2.0 |
| 714.0-712.5 | CL | H | 32.1 | 3 | 37 | 42 | 21 | -- | | | | 27.3 | 8.2 | 88.2 | 0.903 | 4.6 | 0.20* | | | 0.35 | 0.05 | 7.0 | 0.44 | 1.7 |

* After remodeling, the test specimens slumped under their own weight and could not be tested.
** No gravel in samples taken.
*** Standard penetration blows per foot in adjacent split-spoon boring.

Undisturbed borings made from building foundation (El 720) to top of firm gravel.
Water table El 727±.

**TABLE 2.5-7**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - ESSENTIAL RAW COOLING WATER SUPPLY**
**SUMMARY OF LABORATORY TEST DATA**

| Elevation | Soil Symbol | Nat. Moist % | Gravel % | Grain Size Analysis Sand % | Silt % | Clay % | $D_{10}$ mm | Atterberg Limits Liquid Limit % | Plasticity Index % | D y Dens pcf | Void Ratio | Triaxial Q φ deg | Triaxial Q c tsf | Triaxial R φ deg. | Triaxial R c tsf | Apparent Triaxial R φ deg. | Apparent Triaxial R c tsf | Effective Unconfined Undisturbed tsf | Compression Rem Ided t f | Sensitivity Ration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring SS-29; station 88+35, E+03; surface elevation 699.4 | | | | | | | | | | | | | | | | | | | | |
| 685.4-683.0 | ML-CL | 24.5 | 0 | 48 | 32 | 20 | -- | 24.5 | 4.1 | 96.4 | 0.73 | 4.2 | 0.95 | 12.0 | 0.25 | 27.7 | 0.08 | 0.3 | 0.4 | 0.8 |
| 682.0-681.1 | ML | 17.6 | 0 | 48 | 37 | 15 | -- | NP | NP | 99.5 | 0.69 | | | | | | | | | |
| 681.1-680.1 | CL | 24.4 | 0 | 30 | 45 | 25 | -- | 29.2 | 7.4 | 96.3 | 0.74 | | | | | | | 0.4 | 0.3 | 1.3 |
| 679.4-677.0 | SM | 29.2 | 0 | 82 | 11 | 7 | 0.2 | NP | NP | 91.6 | 0.84 | 21.3 | 0.43 | 17.0 | 0.22 | 32.5 | 0.03 | | | |
| 676.4-675.1 | SM | 29.2 | 0 | 82 | 11 | 7 | .02 | NP | NP | 91.6 | 0.84 | 21.3 | 0.43 | 17.0 | 0.22 | 32.5 | 0.03 | | | |
| 675.1-674.0 | SM | 29.0 | 0 | 67 | 21 | 12 | -- | NP | NP | 94.6 | 0.78 | | | | | | | | | |
| 673.4-671.0 | SM | 30.0 | 0 | 69 | 20 | 11 | -- | NP | NP | 93.0 | 0.80 | | | | | | | | | |
| 667.4-665.5 | SM | 26.6 | 0 | 61 | 25 | 14 | -- | NP | NP | 96.0 | 0.76 | 12.0 | 1.40 | | | | | | | |

WBN

TABLE 2.5-8
(SHEET 1 of 1)

WATTS BAR NUCLEAR PLANT

SOIL INVESTIGATION - INTAKE CHANNEL SUMMARY OF LABORATORY TEST DATA

Historical Information

| Elevation | Soil Symbol | Soil Type % | Nat. Moist ** | Std. Penet % | Grain Size Analysis* Sand % | Silt mm | Clay | $D_{10}$ mm | $D_{50}$ | $D_{60}$ mm | $C_u$ | Atterb. Limits Liq. Limit % | Plastic. Index % | Dry Dens. pcf | Void Ratio tsf | Undisturbed Triexial Q ϕ deg | c tsf | Remolded Triexial Q ϕ. deg | c tsf | Undisturbed Triexial R ϕ deg | c tsf | Undis. Unconf. Compr. | Remolded Uconf. Compr | Sensitivity Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-31; surface elevation 691.5 | | | | | | | | | | | | | | | | | | | | | | | | |
| 689.5-687.3 | CL | D | 28.9 | 6 | 16 | 45 | 49 | - | | | | 46.2 | 20.4 | 89.6 | 0.897 | 6.5 | 0.50 | | | 10.5 | 0.85 | 0.66 | 0.81 | 0.8 |
| 686.5-684.7 | CL | D | 27.5 | 6 | 13 | 33 | 54 | - | | | | 46.3 | 25.3 | 93.5 | 0.796 | 13.0 | 0.80 | | | 14.0 | 0.41 | 1.22 | 1.37 | 0.9 |
| 683.5-681.4 | CL | c | 24.3 | 13 | 5 | 45 | 50 | -- | | | | 41.2 | 20.9 | 102.4 | 0.634 | | | | | | | | | |
| 680.5-678.0 | SM | g | 28.3 | 6 | 85 | 11 | 4 | 03 | .160 | .170 | 5.7 | NP | NP | 94.5 | .771 | | | | | | | | | |
| 677.5-676.5 | CL | a | 25.3 | 10 | 15 | 48 | 35 | -- | | | | 30.3 | 12.2 | 99.9 | .687 | | | | | | | | | |
| 676.5-675.1 | SM | G | 25.7 | 1 | 73 | 16 | 11 | 004 | .160 | .170 | 42.2 | NP | NP | 95.4 | 0.767 | | | | | 35.0 | 0.00 | | | |
| 674.5-673.1 | SM | g | 25.1 | 0 | 71 | 20 | 9 | 006 | .110 | .130 | 21.7 | NP | NP | 97.8 | .716 | | | | | | | | | |
| 671.5-669.0 | SM-SC | f | 26.6 | 0 | 50 | 30 | 20 | -- | | | | 22.2 | 4.7 | 95.1 | .767 | | | | | | | | | |
| Boring US-35; surface elevation 704.4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 702.4-700.3 | CL | C | 27.0 | 6 | 21 | 43 | 36 | -- | | | | 42.6 | 18.1 | 93.3 | 0.814 | 11.5 | 0.75 | | | 9.0 | 0.60 | 0 68 | 0.66 | 1.0 |
| 699.4-697.2 | CL | C | 22.6 | 12 | 19 | 47 | 34 | -- | | | | 39.0 | 15.2 | 100.3 | 0.719 | 21.7 | 1 23 | | | 24.5 | 0.70 | 2 07 | 1.86 | 1.1 |
| 696.4-695.0 | CL | C | 22.9 | 21 | 19 | 48 | 33 | -- | | | | 38.2 | 14.6 | 101.0 | 0.682 | 21.5 | 1.50 | | | 16.3 | 1.30 | 3.67 | 2.55 | 1.4 |
| 693.4-691.7 | ML | E | 22.2 | 11 | 39 | 37 | 24 | -- | | | | 34.0 | 10.1 | 95.4 | 0.788 | 25.5 | 0 85 | 24.0 | 0.50 | 9.0 | 0.87 | 1.68 | 0.69 | 2.4 |
| 690.4-688.7 | SM | F | 25.8 | 10 | 51 | 33 | 16 | 0015 | 081 | .100 | 66.7 | NP | NP | 94.7 | 0.800 | | | | | 9.5 | 0.80 | | | |
| 687.4-685.4 | ML | E | 23.9 | 10 | 37 | 43 | 20 | -- | | | | 29.3 | 4.0 | 97.5 | 0.751 | 16.5 | 1 10 | | | 11.9 | 0.45 | 0 97 | 0.56 | 1.7 |
| 684.4-683.0 | SM | G | 25.1 | 8 | 79 | 10 | 11 | 0035 | .190 | .230 | 65.7 | NP | NP | 93.0 | 0.801 | 31.0 | | 0.40 | | | | | | |
| Boring US-40; surface elevation 693.4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 691.4-690.6 | SM | f | 7.7 | 2 | 50 | 34 | 16 | .002 | .075 | .090 | 45.0 | 27.4 | 3.7 | 87.4 | .907 | | | | | | | | | |
| 690.6-689.5 | SM | f | 1.6 | 2 | 56 | 29 | 15 | .002<br>5 | .091 | .120 | 48.0 | 21.1 | 0.5 | 92.8 | .802 | | | | | | | | | |
| 688.4-686.5 | SM-SC | F | 28.4 | 2 | 54 | 26 | 20 | .001 | .090 | .130 | 130.0 | 26.3 | 6.0 | 86.4 | 0.952 | 20.5 | 0 35 | | | 14.5 | 0 00 | | | |
| 685.4-684.4 | SM | F | 25.9 | 3 | 56 | 25 | 19 | .001 | .093 | .140 | 22.4 | 3.0 | 2.4 | 0.807 | 7.5 | 0.22 | | | | 0.00 | | | | |
| 684.4-683.4 | CL | B | 25.7 | 3 | 42 | 31 | 27 | -- | | | | 29.2 | 10.8 | 93.7 | 0.789 | 2.5 | 0.60 | | | 11.5 | 0.24 | 48 | 19 | 2.5 |
| 682.4-680.4 | CL | D | 27.4 | 9 | 21 | 41 | 38 | -- | | | | 40.5 | 17.7 | 93.9 | 0.795 | 3.5 | 1.06 | | | 11.5 | 0.82 | 29 | 68 | 1.9 |
| 679.4-677.0 | SM | G | 26.9 | 4 | 85 | 9 | 6 | .03 | .180 | .200 | 6.7 | NP | NP | 94.8 | 0.792 | | | | | 40.5 | 0.65 | | | |
| 676.4-674.5 | SM | G | 26.1 | 2 | 76 | 17 | 7 | .012 | .150 | .175 | 14.6 | NP | NP | 95.7 | 0.778 | 6 0 | 0.25 | | | 38.0 | 0.13 | | | |
| 673.4-671.6 | SM | g | 24.5 | 7 | 78 | 14 | 8 | .012 | .160 | .170 | 14.2 | NP | NP | 100.4 | .684 | | | | | | | | | |
| 670.4-669.4 | CL | a | 23.5 | 6 | 35 | 37 | 28 | -- | | | | 0.0 | 11.3 | 103.1 | .647 | | | | | | | | | |
| 669.4-668.3 | SM | g | 31.1 | 7 | 82 | 12 | 6 | .030 | .170 | .170 | 5.7 | NP | NP | 99.9 | .669 | | | | | | | | | |

* No gravel in samples taken.
** Standard penetration blows per foot in adjacent split-spoon boring.
Undisturbed borings made to top of firm gravel.
Water table El 685±.

**TABLE 2.5-9**
**SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - CLASS IE CONDUITS**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Type Soil ** | Nat. Moist % | Std. Penet ** | Sand % | Silt % | Clay % | Grain Size Analysis* $D_{10}$ mm | $D_{50}$ mm | $D_{60}$ mm | $C_u$ | Atterb. Limit Liq. Limit % | Plastic Index % | Dry Dens. pcf | Void Ratio | Undisturbed Triaxial Q φ deg | c tsf | Remolded Triaxial Q φ deg | c tsf | Undisturbed Triaxial R φ deg | c tsf | Undist. Unconf. Compr. tsf | Remolded Unconf. Compr. tsf. | Sensitivity Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-41; surface elevation 705.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 703.9-701.5 | CL | A | 19.5 | 10 | 30 | 43 | 27 | | | | | 30.3 | 11.3 | 104.1 | 0.644 | 20.5 | 0.80 | | | 15.1 | 0.34 | 1.03 | 0.80 | 1.3 |
| 700.9-699.6 | CL | A | 20.4 | 11 | 49 | 23 | 28 | | | | | 34.4 | 11.0 | 104.5 | 0.632 | 28.5 | 0.40 | | | | | 1.24 | 1.31 | 1.0 |
| 697.9-696.3 | CL | A | 25.1 | 12 | 29 | 42 | 29 | | | | | 37.2 | 12.7 | 96.4 | 0.749 | 18.5 | 1.35 | | | 24.0 | 0.22 | 1.41 | 1.18 | 1.2 |
| 694.9-692.2 | ML | E | 24.8 | 24 | 45 | 37 | 18 | | | | | 28.9 | 4.3 | 98.0 | 0.734 | 19.5 | 0.80 | | | 17.5 | 0.38 | 0.85 | 0.45 | 1.9 |
| 689.9-688.3 | SM | F | 27.6 | 12 | 61 | 20 | 19 | .001 | .0150 | .190 | 190.0 | NP | NP | 91.9 | 0.916 | 19.0 | 0.50 | | | | | | | |
| Boring US-46; surface elevation 694.3 | | | | | | | | | | | | | | | | | | | | | | | | |
| 692.3-690.9 | CL | B | 27.2 | 4 | 30 | 41 | 29 | | | | | 37.2 | 13.8 | 89.5 | .870 | 15.0 | 0.45 | 7.5 | 0.40 | 13.2 | 0.34 | 0.55 | 0.22 | 2.5 |
| 689.3-688.2 | SM | g | 17.3 | 3 | 84 | 7 | 9 | .01 | .180 | .190 | 19.0 | NP | NP | -- | -- | | | | | | | | | |
| 688.2-687.1 | CL | b | 27.6 | 4 | 40 | 32 | 28 | -- | -- | -- | -- | 30.5 | 11.4 | 90.3 | .865 | | | | | | | | | |
| 686.3-683.5 | CL | B | 26.7 | 3 | 41 | 34 | 25 | -- | -- | -- | -- | 28.7 | 8.9 | 91.3 | .846 | 3.5 | 0.25 | 1.5 | 0.15 | 13.3 | 0.27 | 0.25 | 0.11 | 2.3 |
| 683.3-681.3 | CL | b | 30.1 | 4 | 32 | 38 | 30 | -- | -- | -- | -- | 32.5 | 11.6 | 92.2 | 814 | | | | | | | | | |
| 680.3-678.3 | CL | B | 29.9 | 5 | 22 | 46 | 32 | -- | -- | -- | -- | 39.3 | 17.3 | 90.1 | .885 | 8.0 | 0.70 | | | 13.9 | 0.37 | 0.43 | 0.29 | 1.5 |
| 674.3-673.3 | M | G | 24.4 | 4 | 80 | 11 | 9 | .009 | .170 | .175 | 19.4 | NP | NP | 96.6 | .764 | 33.3 | 0.15 | | | | | | | |
| 673.3-671.9 | SM | f | 23.9 | 3 | 54 | 29 | 17 | .0001 | .085 | .110 | -- | NP | NP | 98.5 | .724 | | | | | | | | | |
| 671.3-668.9 | SM | f | 25.1 | 4 | 66 | 21 | 13 | .002 | .110 | .160 | 80.0 | NP | NP | 98.6 | .716 | | | | | | | | | |
| 668.3-666.3 | SM | f | 24.7 | 12 | 60 | 28 | 12 | .001 | .130 | .170 | .170.0 | NP | NP | 101.4 | .668 | | | | | | | | | |

* No gravel in samples taken.

** Standard penetration blows per foot in adjacent split-spoon boring.

Undisturbed borings made to top of firm gravel.

Water table El 685±.

**WBN**
**TABLE 2.5-10**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - CLASS IE CONDUITS**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| | | | | | | | | | | | | | | | Unconfined | | | | | Triaxial R | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Atterb. Limits | | | | Compression | | | Triaxial Q | | Natural | | Direct Shear | |
| | Soil | Soil | | | Std.. | Grain-Size Analysis | | | | | Liq. | Plastic | Dry. | Void | Sens. | | | Undisturbed | | Moisture | | S | |
| Elevation | Symbol | Type | Nat | Moist. | Penetr | Gravel | Sand | Silt | Clay | D10 | Limit | Index | Dens | Ratio | Undis. | Rem | Ratio | ϕ | c | ϕ | c | ϕ | c |
| | | | % | % Sat. | | % | % | % | % | mm | % | % | pcf | | tsf | tsf | | deg. | tsf | deg. | tsf | deg. | tsf |
| Boring US-55, Surface El. 727.1 | | | | | | | | | | | | | | | | | | | | | | | |
| 726.1-723.7 | ML | D | 21.2 | 86.2 | 15 | 0 | 23 | 37 | **40** | -- | 49.8 | 21.5 | 101.3 | 0.655 | 1.8 | 1.5 | 1.2 | 25.2 | 1.00 | 28.8 | 0.35 | 23.0 | 0.80 |
| 723.1-721.4 | ML | d | 20.1 | 100.0 | 18 | 1 | 30 | 29 | **40** | -- | 44.7 | 16.9 | 112.7 | 0.484 | | | | | | | | | |
| 720.1-717.8 | CL | b | 18.4 | 93.1 | 15 | 0 | 40 | 28 | **32** | -- | 40.7 | 17.2 | 110.9 | 0.54 | | | | | | | | | |
| 717.1-715.1 | CL | b | 21.2 | 94.6 | 15 | 0 | 37 | 28 | | -- | 44.6 | 20.5 | 105.6 | 0.609 | | | | | | | | | |
| 714.1-712.5 | ML | d | 24.2 | 100.0 | 22 | 0 | 22 | 34 | 44 | -- | 49.2 | 19.8 | 102.6 | 0.649 | | | | | | | | | |
| 711.1-710.2 | CL | B | 19.2 | 85.2 | 21 | 6 | 33 | 33 | 28 | -- | 35.1 | 14.5 | 104.9 | 0.614 | | | | | 2.05 | | | 34.0 | 0.20 |
| 708.1-707.2 | CL | b | 21.8 | 95.1 | 23 | 0 | 33 | 35 | 32 | -- | 44.3 | 18.5 | 105.0 | 0.629 | 2.8 | 2.0 | 1.4 | 7.0 | | | | | |
| 702.1-701.0 | SC | I | 19.0 | 85.8 | 20 | 0 | 54 | 25 | 21 | -- | 34.0 | 11.1 | 106.5 | 0.603 | | | | | | | | 30.0 | 0.27 |
| 699.8-697.8 | CL | b | 23.0 | 94.6 | 20 | 8 | 33 | 31 | 28 | -- | 50.2 | 23.7 | 101. | .6560 | | | | | | | | | |
| 697.1-695.3 | -SM | I | 19.5 | 83.5 | 25 | 15 | 51 | 22 | 12 | 0.004 | 40.5 | 13.5 | 105.8 | 0.655 | | | | 12.5 | 0.56 | 8.5 | 1.75 | 27.0 | 1.14 |
| Boring US-59, Sufrace El. 699.7 | | | | | | | | | | | | | | | | | | | | | | | |
| 698.7-696.3 | ML-CL | G | 23.8 | 93.7 | 6 | 0 | 32 | 50 | 18 | -- | 22.7 | 5.4 | 98.0 | 0.664 | 1.6 | 0.5 | 3.2 | 4.3 | 1.50 | 31.0 | 0.45 | 30.0 | 0.18 |
| 695.7-694.5 | CL | C | 32.7 | 87.8 | 2 | 0 | 24 | 56 | 20 | -- | 27.8 | 7.7 | 83.1 | 0.977 | 0.2 | 0.1 | 2.0 | 3.0 | 0.15 | 29.0 | 0.06 | | |
| 692.6-692.1 | G-CL* | c | 20.0 | 70.9 | 6 | 11 | 37 | 35 | 17 | -- | 23.9 | 8.5 | 95.1 | 0.753 | | | | | | | | | |
| 692.1-690.3 | CL* | B | 23.6 | 81.8 | 6 | 6 | 31 | 50 | 13 | -- | 36.1 | 12.6 | 94.5 | 0.780 | | | | | | | | | |
| 689.7-688.3 | GC* | f | 17.1 | 92.3 | 20 | 29 | 25 | 32 | 14 | -- | 39.8 | 15.7 | 113.5 | 0.507 | | | | | | | | 21.0 | 0.87 |
| Boring US-61, Surface El. 700.7 | | | | | | | | | | | | | | | | | | | | | | | |
| 699.7-697.3 | SM | J | 24.8 | 85.1 | 12 | 0 | 57 | 25 | 18 | -- | NP | NP | 95.0 | 0.801 | | | | 29.5 | 0.50 | 30.0 | 0.35 | | |
| 696.7-694.3 | SM | J | 24.8 | 97.1 | 10 | 0 | 69 | 22 | 9 | 0.0075 | NP | NP | 100.4 | 0.692 | | | | 15.0 | 1.32 | 32.3 | 0.55 | 35.5 | 0.00 |
| 693.7-692.6 | G-SC* | i | 21.1 | 82.1 | 24 | 32 | 36 | 24 | 8 | 0.0065 | 34.7 | 14.7 | 101.1 | 0.716 | | | | | | | | | |
| 692.6-692.2 | G-SC* | i | 17.8 | -- | 24 | 31 | 35 | 22 | 12 | 0.003 | 37.2 | 13.2 | -- | -- | | | | | | | | | |

*Weathered shale.

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**TABLE 2.5-11**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**SOIL INVESTIGATION - CLASS IE CONDUITS**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Soil Type | Nat. Moist. | | Std. Penetr | Gravel | Grain Size Analysis Sand | Silt | Clay | D10 | Atterb. Limits Liq. Limit | Plastic Index | Dry Dens | Void Ratio | Unconfined Compression Undis. | Sens. Rem. | Ratio | Triaxial Q Undisturbed ϕ | c | Triaxial R Natural Moisture ϕ | c | Direct Shear S ϕ | c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | % Sat | | % | % | % | % | mm | % | % | pcf | | tsf | tsf | | deg. | tsf | deg. | tsf | deg. | tsf |
| Boring US-51, Surface El. 724.4 | | | | | | | | | | | | | | | | | | | | | | | |
| 722.4-720.0 | CL | b | 21.8 | 100.0 | 15 | 0 | 32 | 29 | 39 | -- | 46.8 | 21.1 | 105.9 | 0.579 | | | | | | | | | |
| 719.4-717.1 | MH | H | 20 8 | 88.5 | 19 | 0 | 26 | 28 | 46 | -- | 54.8 | 21.1 | 104.1 | 0.644 | 1.9 | 1.4 | 1.4 | 4.0 | 3.20 | 20.8 | 1.10 | 26.0 | 0.47 |
| 716.4-714.1 | CL | b | 21 5 | 96.7 | 18 | 0 | 31 | 32 | 37 | -- | 46.4 | 20.4 | 105.8 | 0.605 | | | | | | | | | |
| 713.4-711.6 | ML | d | 22.1 | 98 4 | 17 | 0 | 30 | 32 | 38 | -- | 47.4 | 18.9 | 105.4 | 0.610 | | | | | | | | | |
| 710.4-708.0 | CL | B | 23.2 | 93 7 | 14 | 0 | 20 | 38 | 42 | -- | 49.5 | 21.7 | 101.3 | 0.670 | 2.7 | 2.0 | 1.4 | 11.4 | 1.35 | 28.5 | 0.58 | 31.5 | 0.15 |
| 707.4-706.1 | ML | d | 24.1 | 93 9 | 20 | 0 | 27 | 42 | 31 | -- | 45.0 | 16.6 | 100.3 | 0.700 | | | | | | | | | |
| 704.4-703.8 | CL | b | 16.4 | 83.2 | 32 | 4 | 31 | 39 | 26 | -- | 37.5 | 14.3 | 109.1 | 0.527 | | | | | | | | | |
| Boring US-53, Surface El. 726.8 | | | | | | | | | | | | | | | | | | | | | | | |
| 725.3-723.4 | MH | H | 22.5 | 93.7 | 16 | 0 | 12 | 45 | 43 | -- | 56.4 | 23 1 | 103.2 | 0.653 | 8.8 | 5.4 | 1.6 | 23.0 | 3.00 | 19.4 | 1.57 | | |
| 722.8-720.4 | ML | D | 24.8 | 92.9 | 13 | 0 | 18 | 38 | 44 | -- | 49.2 | 19.8 | 99.7 | 0.741 | 4.3 | 3.2 | 1.3 | 5.5 | 2.55 | 21.0 | 1.57 | 31.0 | 0.30 |
| 719.8-717.4 | CL | b | 20.9 | 95.3 | 15 | 0 | 38 | 31 | 31 | -- | 40.9 | 16.0 | 106 4 | 0.596 | | | | | | | | | |
| 716.8-714.7 | CL | b | 18.5 | 96.2 | 14 | 0 | 40 | 26 | 34 | -- | 41.1 | 17.7 | 111.5 | 0 523 | | | | | | | | | |
| 713.8-712.1 | ML | d | 17.9 | 99.5 | 27 | 0 | 34 | 32 | 34 | -- | 43.3 | 16.2 | 113.5 | 0.485 | | | | | | | | | |
| 710.8-710.0 | MH | h | 22.9 | 97.2 | 20 | 0 | 25 | 32 | 43 | -- | 54.5 | 23.6 | 103.1 | 0.635 | | | | | | | | | |
| 707.8-706.7 | CL | B | 20.7 | 88.4 | 18 | 0 | 35 | 32 | 33 | 0.00 | 43.7 | 19.9 | 103.7 | 0.637 | 2.3 | 1.7 | 1.4 | 14.0 | 1.65 | 28.0 | 0.37 | 35.0 | 0.34 |
| 705.8-705.0 | SC | i | 17.2 | 76.2 | 34 | 7 | 76 | 7 | 10 | 0.008 | 29.2 | 7.1 | 104.0 | 0.602 | | | | | | | | | |

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## TABLE 2.5-12
## (SHEET 1 of 1)

## SOIL DESIGN VALUES

Historical Information

| | Q | | R | | *R | | S | $\gamma_m$ | $\gamma s$ | $\gamma_S$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | φ | c(tsf) | φ | c (tsf) | φ | c(tsf) | φ | c(tsf) | (pcf) | (pcf) |
| In-situ | | | | | | | | | | |
| IE Conduits | ° | 1.2 | | | | | 31° | 0.25 | | |
| ERCW & HPFP Piping | 1 ° | 0.6 | | | | | 32° | 0.20 | | |
| ERCW Pipeline and IE Conduits | | | | | | | | | | |
| a. Sands | | | 14° | 0.2 | 28° | 0.4 | | | 119 | 124 |
| b. Fine Grained | | | 14° | 0 2 | 28° | 0.4 | | | 120 | 123 |
| Borrow Area 4 | ° | 1.05 | 16° | 0.075 | 30° | 1.0 | 32° | 0 | 121 | 128 |

*R-test at natural moisture content for In-situ soil and at moist conditions for borrow.

**TABLE 2.5-13**
**(SHEET 1 of 1)**

**SURFACE SETTLEMENTS (S) AND AVERAGE DEFORMATION MODULI (E) FOR CENTER OF FLEXIBLE CIRCULAR FOOTINGS LOADED WITH 5 KSF**

Historical Information

| | | 10-Foot-Dia Footing | | 50-Foot-Dia Footing | | 100 Foot-Dia Footing | | 200 Foot-Dia Footing | |
|---|---|---|---|---|---|---|---|---|---|
| | | S | E | | E | S | E | | E |
| Hole | Station | in. | psi x $10^3$ | in | psi x $10^3$ | in | psi x $10^3$ | in | psi x $10^3$ |
| 20 | L-61 | 0.36 | 11 | 0.63 | 32 | 0.84 | 48 | 1.04 | 77 |
| 29 | M-63 | 0.41 | 10 | 0.78 | 26 | 0.95 | 42 | 1.18 | 68 |
| 39 | N-65 | 0.22 | 18 | 0.60 | 33 | 0.77 | 52 | 0.97 | 82 |
| 41 | O-60 | 0.27 | 15 | 0.54 | 37 | 0.70 | 57 | 0.94 | 85 |
| 43 | O-62 | 0.11 | 36 | 0.39 | 51 | 0.55 | 73 | 0.79 | 100 |
| 52 | P-65 | 0.22 | 18 | 0.49 | 41 | 0.64 | 62 | 0.88 | 91 |
| Average Hole | | 0.24 | 17 | 0.56 | 36 | 0.73 | 55 | 0.97 | 83 |
| All Type 1 Rock | | 0.46 | 8.7 | 1.06 | 19 | 1.48 | 27 | 2.18 | 37 |
| All Type 2 Rock | | 0.10 | 39 | 0.27 | 74 | 0.39 | 102 | 0.54 | 148 |
| All Type 3 Rock | | 0.0082 | 1000 | 0.041 | 1000 | 0.082 | 1000 | 0.16 | 1000 |

| | 300-Foot-Dia Footing | |
|---|---|---|
| | S, | E |
| Hole | in | psi x $10^3$ |
| Average | 1.21 | 99 |

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**TABLE 2.5-14**
**(SHEET 1 of 1)**

**EFFECT OF REMOVING TOP 10 FEET OF ROCK ON SETTLEMENT OF 10-FOOT DIAMETER FLEXIBLE FOOTING**

Historical Information

| | | Surface Rock Included | | Top 10 Feet of Rock Removed | |
|---|---|---|---|---|---|
| Hole | Station | S, inches | E , psi x 10 | S, inches | E psi x 10 |
| 20 | L-61 | 0.36 | 11 | 0.15 | 27 |
| 29 | M-63 | 0.41 | 10 | 0.15 | 27 |
| 39 | N-65 | 0.22 | 18 | 0.14 | 28 |
| 41 | 0-60 | 0.27 | 15 | 0.09 | 44 |
| 43 | 0-62 | 0.11 | 36 | 0.11 | 36 |
| 52 | P-65 | 0.22 | 18 | 0.10 | 40 |
| | | 0.24 | 17 | 0.12 | 33 |
| Maximum Differential Settlement | | 0.30 | | 0.06 | |

**TABLE 2.5-15**
**(SHEET 1 of 1)**

**AVERAGE IN SITU DOWN-HOLE SOIL DYNAMICS**
**DIESEL GENERATOR BUILDING**

Historical Information

| Compressional Velocity Ft/Sec | Shear Velocity Ft/Sec | Dynamic Shear Modulus psi | Dynamic Young's Modulus psi |
|---|---|---|---|
| 3459 | 1042 | 21,110 | 61,230 |
| | INTAKE CHANNEL | | |
| 3123 | 942 | 17,100 | 50,050 |

**TABLE 2.5-16**
**(SHEET 1 of 1)**

**AVERAGE SEISMIC REFRACTION SOIL DYNAMICS**
**DIESEL GENERATOR BUILDING**

Historical Information

| Velocity Zones Elevations | Compressional Velocity Ft/Sec | Shear Velocity Ft/Sec | Dynamic Shear Modulus psi | Dynamic Young's Modulus psi |
|---|---|---|---|---|
| 734-728 | 1250 | 599 | 7,000 | 18,915 |
| 728-715 | 3162 | 1382 | 37,885 | 104,725 |
| 715-695 | 6100 | 1660 | 53,530 | 156,310 |
| | | **INTAKE CHANNEL** | | |
| 695-678 | 1183 | 537 | 5,610 | 15,370 |
| 678-653 | 4917 | 1261 | 34,370 | 99,283 |

**TABLE 2.5-17**
**(SHEET 1 of 1)**

**IN-SITU SOIL DYNAMIC PROPERTIES WATTS BAR NUCLEAR POWER PLANT**
**CLASS IE CONDUITS AND ERCW PIPING**

Historical Information

| Borehole Number | Surface Elevation (Feet) | Depth of Refusal (Feet) | ∅ | Hydrophone Depth (Feet) (2) | | | Hole Axle To Energ Source (Feet) (X) | Compressional Velocity (M asured) (Ft/Sec) | | | Shear Veloc ty (Measu ed) (Ft/S c) | | | Poisson's Ratio (Calculated) | | | Young's Modulus PSI x $10^5$ (Calculated) | | | Shear Modulus PSI x $10^4$ (Calculated) | | | Simple Size (N) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | M | SD | SEM | | M | SD | SEM | M | SD | SEM | M | SD | SEM | M | SD | SEM | M | SD | SEM | |
| SS-49 | 716.9 | 39.3 | 0 | 37.4 | 1.5 | .7 | 37.9 | 2843 | 380 | 190 | 1169 | 52 | 26 | .39 | .04 | .02 | 1.01 | .09 | .05 | 3.63 | .32 | .16 | 4 |
| SS-53 | 727.0 | 43.4 | 0 | 41.7 | - | - | 41.7 | 3603 | 332 | 166 | 1257 | 99 | 50 | .43 | .01 | .00 | 1.21 | .19 | .09 | 4.2 | .66 | .33 | 4 |
| SS-55 | 727.0 | 60.1 | 0 | 45.2 | - | - | 45.2 | 3623 | 200 | 100 | 1172 | 74 | 37 | .44 | .01 | .01 | 3.02 | 3.81 | 1.90 | 3.65 | .45 | .22 | 4 |
| SS-56 | 727.1 | 48.7 | 0 | 37.3 | - | - | 37.3 | 3687 | 130 | 58 | 933 | 472 | 211 | .45 | .01 | .00 | .96 | .17 | 0.8 | 3.30 | .62 | .28 | 5 |
| SS-59 | 699.7 | 28.6 | 0 | 25.0 | .6 | .3 | 26.8 | 4045 | 630 | 315 | 1395 | 192 | 96 | .43 | .02 | .01 | 1.5 | .42 | .21 | 5.24 | 1.51 | .76 | 4 |
| SS-60 | 726.1 | 45.9 | 0 | 36.1 | - | - | 36.1 | 2763 | 121 | 70 | 1292 | 85 | 49 | .36 | .01 | .01 | 1.21 | .15 | .09 | 4.44 | .59 | .34 | 4 |
| SS-62 | 697.7 | 23.2 | 0 | 22.0 | .4 | .2 | 22.0 | 2364 | 210 | 121 | 962 | 260 | 150 | .40 | .05 | .03 | .71 | .35 | .20 | 2.58 | 1.34 | .77 | 3 |
| SS-63 | 727.1 | 37.9 | 0 | 35.4 | .5 | .23 | 36.4 | 3339 | 140 | 70 | 1357 | 105 | 53 | .40 | .02 | .01 | 1.37 | .20 | .10 | 4.91 | .77 | .38 | 4 |
| SS-65 | 726.0 | 50.5 | 0 | 48.0 | - | - | 48.0 | 3195 | 267 | 133 | 1349 | 45 | 23 | .39 | .02 | .01 | 1.35 | .098 | .049 | 4.83 | .33 | .16 | 4 |
| SS-67 | 728.6 | 44.5 | 0 | 43.7 | - | - | 43.7 | 2469 | 160 | 113 | 1245 | 145 | 102 | .33 | .02 | .02 | 1.10 | .23 | .16 | 4.15 | .96 | .68 | 2 |
| SS-69 | 734.7 | 66.1 | 0 | 44.0 | - | - | 44.8 | 2998 | 282 | 141 | 1408 | 232 | 116 | .36 | .03 | .02 | 1.45 | .43 | .02 | 5.37 | 1.68 | 8.41 | 4 |
| SS-71 | 740.2 | 59.4 | 0 | 57.5 | - | - | 57.5 | 2242 | 28 | 16 | 1165 | 16 | 9 | .32 | 0.0 | 0.0 | .95 | .02 | .02 | 3.60 | 0.10 | 0.06 | 3 |
| SS-73 | 737.2 | 37.8 | 0 | 36.2 | - | - | 36.2 | 1919 | 6 | 3 | 980 | 15 | 8 | .32 | .01 | .00 | .68 | .02 | .01 | 2.55 | .07 | .04 | 3 |
| SS-75 | 722.7 | 41.5 | 0 | 30.4 | 2.4 | 1.2 | 30.0 | 3566 | 307 | 154 | 1502 | 34 | 42 | .39 | .04 | .02 | 1.66 | .15 | .07 | 6.0 | .67 | .34 | 4 |
| SS-84 | 733.4 | 35.6 | 0 | 34.3 | - | - | 34.3 | 4750 | 321 | 160 | 1756 | 77 | 39 | .42 | .01 | .00 | 2.33 | 0.21 | 0.10 | 8.19 | .71 | .35 | 4 |
| SS-86 | 727.5 | 38.5 | 30 | 34.9 | - | - | 34.9 | 3677 | 288 | 132 | 1434 | 67 | 39 | .41 | .01 | .01 | 1.54 | .15 | .08 | 5.46 | .51 | .30 | 3 |
| SS-88 | 720.2 | 42.1 | 47 | 36.8 | 5.1 | 2.5 | 36.5 | 3025 | 495 | 247 | 1100 | 95 | 48 | .42 | .02 | .01 | .92 | .02 | .01 | 3.23 | .55 | .27 | 4 |
| SS-92 | 728.9 | 45.3 | 26 | 44.6 | 3.3 | 1.9 | 44.1 | 2336 | 116 | 67 | 963 | 5 | 3 | .40 | .01 | .01 | .69 | .01 | .01 | 2.46 | .02 | .01 | 3 |
| SS-96 | 718.8 | 31.8 | 0 | 31.1 | - | - | 31.1 | 4247 | 227 | 114 | 1830 | 70 | 35 | .38 | .02 | .01 | 2.46 | .17 | .08 | 8.89 | .67 | .34 | 4 |
| SS-99 | 717.6 | 29.8 | 0 | 29.0 | - | - | 29.0 | 1899 | 83 | 42 | 700 | 13 | 7 | .42 | .01 | 0.0 | .37 | .01 | .01 | 1.30 | .48 | .02 | 4 |
| SS-101 | 724.5 | 24.8 | 0 | 23.5 | - | - | 23.5 | 4000 | 748 | 432 | 1637 | 157 | 90 | .39 | .03 | .02 | 2.0 | .40 | .23 | 7.15 | 1.33 | .77 | 3 |
| SS-103 | 733.1 | 44.0 | 0 | 42.7 | - | - | 42.7 | 3375 | 245 | 123 | 1498 | 24 | 12 | .38 | .02 | .01 | 1.64 | .06 | .03 | 5.96 | .19 | .10 | 4 |
| SS-105 | 699.4 | 10.0 | 0 | 8.0 | - | - | 8.0 | 2050 | 352 | 176 | 919 | 75 | 38 | .36 | .05 | .02 | .61 | .01 | .01 | 2.25 | .37 | .18 | 4 |
| SS-107 | 694.5 | 26.0 | 0 | 26.4 | 1.5 | .9 | 25.8 | 3498 | 552 | 319 | 1498 | 170 | 98 | .39 | .02 | .01 | 1.66 | .40 | .23 | 6.0 | 1.39 | .08 | 3 |
| SS-108 | 697.0 | 16.8 | 0 | 15.8 | - | - | 15.8 | 2887 | 252 | 145 | 1126 | 36 | 21 | .41 | .01 | .01 | .95 | .01 | .00 | 3.36 | .02 | .01 | 3 |

NOTES:
1. Locations of soil dynamic test holes are shown on Figure 2.5-185,
2. Geometry of dynamic measurement configuration is shown in Figure 2.5-151.
3. Hydrophone depth (Z) is the difference in elevation between hydrophone center and shot point.
4. Best estimate of density is 123 lbs/$ft^3$.
5. M = arithmetic mean, SD = standard deviation, and SEM = standard error of the mean.
6. In-situ soil dynamic measurements were performed and interpreted by TVA Geologic Services Branch.

**TABLE 2.5-17A**
**(SHEET 1 of 1)**

**DYNAMIC SOIL PROPERTIES - DIESEL GENERATOR BUILDING**

Historical Information

| Elevation | Material | Total Weight | Poisson's Ratio | Low Strain Shear Modulus | Shear Modulus vs. Strain | Damping Ratio vs. Strain | Remarks |
|---|---|---|---|---|---|---|---|
| 741 to 730 | Class A Backfill | 120 pcf | 0.35 | $G_{max}$ = 4.5 x $10^6$psf | Figure 2.5-233A | Figure 2.5-233B | Vary $G_{max}$ $\pm$50% |
| 732 to 727 | Crushed Stone (above groundwater) | 133pcf | 0.40 | G = 1000 $k_2$-$\sigma_m^{1/2}$<br>($k_2$) max = 100<br>ko = 1-sin $\phi$ =0.4 | Figure 2.5-233C | Figure 2.5-233D | Vary ($k_2$) max $\pm$50% |
| 727 to 713 | Crushed Stone (below groundwater) | 142 pcf | 0.40 | G = 1000 $k_2$-$\sigma_m^{1/2}$<br>($k_2$) max = 100<br>ko = 1-sin $\phi$ =0.4 | Figure 2.5-233C | Figure 2.5-233D | Vary ($k_2$) max $\pm$50% |
| 730 to 718 | In-Situ Cohesive Soils | 120 pcf | 0.35 | $G_{max}$ = 4.5 x $10^6$ psf | Figure 2.5-233E | Figure 2.5-233F | Vary $G_{max}$ $\pm$50% |
| 718 to 713 | In-Situ Non-Plastic Soils* | 120 pcf | 0.38 | G = 1000 $k_2$-$\sigma_m^{1/2}$<br>($k_2$) max = 38<br>ko = 0.5 | Figure 2.5-233G | Figure 2.5-233H | Vary ($k_2$) max $\pm$50% |
| 713 to 708 | Basal Gravel | 143 pcf | 0.46 | G = 1000 $k_2$-$\sigma_m^{1/2}$<br>($k_2$) max = 365<br>ko = 1-sin$\phi$ = 0.4 | Figure 2.5-233I | Figure 2.5-233J | Vary ($k_2$) max $\pm$50% |
| 708 to 693 | Weathered Shale | 127 pcf | 0.35 | $G_{max}$ = 12.8 x $10^6$ psf<br>(Vs. = 1800 fps) | Figure 2.5-233K | Figure 2.5-233K | Vary $G_{max}$ $\pm$50% |

* Includes CL-ML material with N values less than 10 blows per foot. For discussion of liquefaction potential for Watts Bar soils, see FSAR Section 2.5.4.8. Note: Design groundwater level = Elev. 727.

**TABLE 2.5-17B**
**(SHEET 1 of 1)**

**DYNAMIC SOIL PROPERTIES - ADDITIONAL DIESEL GENERATOR BUILDING[1]**

Historical Information

| Elevation | Material | Total Weight | Poisson's Ratio | Low Strain Shear Modulus | Shear Modulus vs. Strain | Damping Ratio vs. Strain | Remarks |
|---|---|---|---|---|---|---|---|
| 741 to 730 | Class A Backfill | 120 pcf | 0.35 | $G_{max}$ = 4.5 x $10^6$ psf | Figure 2.5-233A | Figure 2.5-233B | Vary $G_{max}$ $\pm$ 50% |
| 730 to 718 | In-Situ Cohesive Soils | 120 pcf | 0.35 | $G_{max}$ = 4.5 x $10^6$ psf | Figure 2.5-233E | Figure 2.5-233F | Vary $G_{max}$ $\pm$ 50% |
| 718 to 712 | In-Situ Non-Plastic Soils* | 120 pcf | 0.38 | G = 1000 $k_2$-$\sigma^{1/2}$<br>($k_2$) max = 38<br>ko = 0.5 | Figure 2.5-233G | Figure 2.5-233H | Vary ($k_2$)max $\pm$ 50% |
| 712 to 709 | Basal Gravel | 143 pcf | 0.46 | G = 1000 $k_2$-$\sigma^{1/2}$<br>($k_2$) max = 365<br>ko = 1-sin $\phi$ = 0.4 | Figure 2.5-233I | Figure 2.5-233J | Vary ($k_2$)max $\pm$ 50% |
| 709 to 693 | Weathered Shale | 127 pcf | 0.35 | $G_{max}$ = 12.8 x $10^6$ psf<br>(Vs. = 1800 fps | Figure 2.5-233K | Figure 2.5-233K | Vary $G_{max}$ $\pm$ 50% |

*Includes CL-ML material with N values less than 10 blows per foot. For discussion of liquefaction potential for Watts Bar soils, See FSAR Section 2.5.4.8. Note: Design groundwater level = Elev 727.

[1] The ADGU, as described in WBN's UFSAR and design bases, is not functional. Pending the outcome of ongoing analysis, this SSC may be deleted from the UFSAR.

# TABLE 2.5-17C
# (SHEET 1 of 1)

## DYNAMIC SOIL PROPERTIES - REFUELING WATER STORAGE TANKS

Historical Information

| Elevation | Material | Total Weight | Poisson's Ratio | Low Strain Shear Modulus | Shear Modulus vs. Strain | Damping Ratio vs. Strain | Remarks |
|---|---|---|---|---|---|---|---|
| 732 to 713 | Class A Backfill | 120 pcf | 0.35 | Gmax = $4.5 \times 10^6$ psf | Figure 2.5-233A | Figure 2.5-233B | Vary $G_{max}$ $\pm$ 50% |
| 728 to 713 | Crushed Stone | 142 pscf | 0.40 | G = 1000 $k_2$-$\sigma_m^{1/2}$ | Figure 2.5-233C | Figure 2.5-233D | Vary $(k_2)$ max $\pm$50% |
| | | | | $(k_2)$ max = 100 | | | |
| | | | | ko = 1 -sin $\phi$ = 0.4 | | | |
| 728 to 719 | In-Situ Cohesive Soils | 120 pcf | 0.35 | $G_{max}$ = $4.5 \times 10^6$ psf | Figure 2.5-233E | Figure 2.5-233F | Vary $G_{max}$ $\pm$ 50% |
| 719 to 713 | In-Situ Non Plastic Soils* | 120 pcf | 0.38 | G = 1000 $k_2$-$\sigma_m^{1/2}$ | Figure 2.5-233G | Figure 2.5-233H | Vary $(k_2)$ max $\pm$ 50% |
| | | | | $(k_2)$ max = 38 | | | |
| | | | | ko = 1-sin $\phi$ = 0.5 | | | |
| 713 to 706 | Basal Gravel | 143 pcf | 0.46 | G = 1000 $k_2$-$\sigma_m^{1/2}$ | Figure 2.5-233I | Figure 2.5-233J | Vary $(k_2)$ max $\pm$ 50% |
| | | | | (k2) max = 365 | | | |
| | | | | ko = 1-sin $\phi$ = 0.4 | | | |
| 706 to 693 | Weathered Shale | 127 pcf | 0.35 | Gmax = $12.8 \times 10^6$ psf | Figure 2.5-233K | Figure 2.5-233K | Vary $G_{max}$ $\pm$ 50% |
| | | | | (Vs. = 1800 fps) | | | |

*Includes CL - ML material with N values less than 10 blows per foot. For discussion of liquefaction potential for Watts Bar soils, See FSAR Section 2.5.4.8. Note: Design groundwater level - Elevation 727.

**TABLE 2.5-17D**
**(SHEET 1 of 1)**

**DYNAMIC SOIL PROPERTIES - NORTH STEAM VALVE ROOM**

Historical Information

| Elevation | Material | Total Weight | Poisson's Ratio | Low Strain Shear Modulus | Shear Modulus vs. Strain | Damping Ratio vs. Strain | Remarks |
|---|---|---|---|---|---|---|---|
| 728 to 683 | Class A Backfill | 120 pcf | 0.35 | $G_{max}$ = 4.5 X $10^6$ psf | Figure 2.5-233A | Figure 2.5-233B | Vary $G_{max}$ ± 50% |
| 728 to 716 | In-Situ Cohesive Soils | 120 pcf | 0.35 | $G_{max}$ = 4.5 x $10^6$ psf | Figure 2.5-233E | Figure 2.5-233F | Vary $G_{max}$ ± 50% |
| 716 to 698 | Basal Gravel | 143 pcf | 0.46 | G = 1000 $k_2$-$\sigma_m^{1/2}$ | Figure 2.5-233I | Figure 2.5-233J | Vary ($k_2$) max ± 50% |
| | | | | ($k_2$) max = 365 | | | |
| | | | | ko = 1-sin $\phi$ = 0.4 | | | |
| 698 to 683 | Weathered Shale | 127 pcf | 0.35 | $G_{max}$ = 12.8 x $10^6$ psf | Figure 2.5-233K | Figure 2.5-233K | Vary $G_{max}$ ± 50% |
| | | | | (Vs. = 1800 fps) | | | |

Note: Design groundwater level - Elevation 727

**WBN**
**TABLE 2.5-18**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**BORROW INVESTIGATION**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| | | Natural | | | Grain-Size Analysis | | | | | | | | | | | | Atterberg Limits | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Percent | Moisture | | | | | | Sand | | | Silt | | | Clay | | | Liquid Limit | | | Plasticity Index | | |
| | of | % | | | % | | | % | | | % | | | % | | | % | | | % | | |
| Symbol | Total | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg.. | Min.. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg |
| CL | 24.1 | 17.2 | 40.5 | 24.1 | 0 | 0 | 0 | 26 | 36 | 32 | 29 | 32 | 30 | 33 | 45 | 37 | 35.1 | 46.8 | 40.2 | 13.9 | 26.8 | 19.2 |
| MH | 34.0 | 19.0 | 33.9 | 24.9 | 0 | 0 | 0 | 22 | 26 | 24 | 271 | 30 | 29 | 47 | 48 | 48 | 50.1 | 51.7 | 50.9 | 17.9 | 18.5 | 18.2 |
| SM-SC | 9.9 | 5.6 | 35.1 | 22.2 | 0 | 0 | 0 | 50 | 60 | 55 | 19 | 26 | 23 | 21 | 24 | 23 | 24.3 | 24.4 | 24.4 | 5.2 | 5.5 | 5.4 |
| ML | 28.4 | 15.5 | 29.8 | 22.6 | 0 | 4 | 2 | 34 | 41 | 38 | 20 | 28 | 24 | 35 | 38 | 36 | 39.4 | 41.8 | 40.6 | 13.2 | 15.7 | 14.2 |
| SM | 2.1 | 37.6 | 53.8 | 45.5 | -- | -- | 0 | -- | -- | 52 | -- | -- | 23 | -- | -- | 25 | -- | -- | 30.1 | -- | -- | 6.9 |
| SC | 1.4 | 19.3 | 26.9 | 46.2 | -- | -- | 0 | -- | -- | 54 | -- | -- | 24 | -- | -- | 22 | -- | -- | 28.8 | -- | -- | 10.8 |

**TABLE 2.5-19**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**ADDITIONAL BORROW AREAS**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| | | Natural Moister % | | | Grain Size Analysis: Gravel % | | | Grain Size Analysis: Sand % | | | Grain Size Analysis: Silt % | | | Grain Size Analysis: Clay % | | | Atterberg Limits: Liquid Limit % | | | Atterberg Limits: Plasticity Index % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Symbol | Percent of Total | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. |
| Borrow Area No. 1 | | | | | | | | | | | | | | | | | | | | | | |
| CL | 56 | 21.6 | 30.4 | 25.7 | 0 | 0 | 0 | 9 | 29 | 19.0 | 34 | 45 | 39.0 | 37 | 46 | 42.0 | 41.6 | 49.8 | 45.9 | 17.7 | 22.6 | 20.0 |
| MH | 28 | 22.8 | 28.3 | 25.6 | 0 | 0 | 0 | 9 | 13 | 11.0 | 45 | 47 | 46.0 | 42 | 44 | 41.0 | 51.6 | 57.5 | 54.5 | 21.6 | 24.0 | 22.5 |
| ML | 16 | 24.2 | 31.3 | 28.4 | 0 | 0 | 0 | -- | -- | 11.0 | -- | -- | 46.0 | -- | -- | 43.0 | -- | -- | 49.7 | -- | -- | 17.6 |
| Borrow Area No. 2 | | | | | | | | | | | | | | | | | | | | | | |
| CL | 74 | 12.0 | 27.2 | 21.4 | 0 | 0 | 0 | 13 | 24 | 20.0 | 39 | 54 | 44.0 | 31 | 40 | 36.0 | 37.5 | 46.6 | 43.5 | 14.9 | 22.0 | 18.9 |
| MH | 21 | 22.4 | 36.0 | 27.0 | 0 | 0 | 0 | 7 | 12 | 10.0 | 39 | 40 | 40.0 | 49 | 53 | 51.0 | 56.1 | 62.1 | 59.1 | 23.7 | 29.1 | 26.4 |
| CH | 5 | 19.1 | 20.1 | 19.6 | -- | -- | 0 | -- | -- | 11.0 | -- | -- | 42.0 | -- | -- | 47.0 | -- | -- | 55.3 | -- | -- | 30.6 |
| Borrow Area No. 3 | | | | | | | | | | | | | | | | | | | | | | |
| CL | 50 | 20.9 | 24.2 | 22.3 | 0 | 0 | 0 | 18 | 45 | 32 0 | 28 | 38 | 33 0 | 27 | 44 | 36 0 | 36 0 | 43 6 | 39 8 | 14 2 | 22 5 | 18 4 |
| ML | 25 | 24.3 | 24.5 | 24.4 | 0 | 0 | 0 | -- | -- | 30 0 | -- | -- | 26 0 | -- | - | 44.0 | -- | -- | 47.3 | -- | - | 16.7 |
| GC | 25 | -- | -- | 10.5 | -- | -- | 43 | -- | -- | 33 0 | -- | -- | 10 0 | -- | - | 14 0 | -- | -- | 33 0 | -- | - | 12 7 |
| Borrow Area No. 4 | | | | | | | | | | | | | | | | | | | | | | |
| CL | 57 | 21 2 | 24 3 | 35 5 | 0 | 0 | 0 | 25 | 38 | 31 5 | 34 | 41 | 37 5 | 28 | 34 | 31 0 | 31 8 | 38 1 | 35 0 | 9 1 | 15 9 | 12 5 |
| ML | 7 | 22.6 | 23.3 | 24.0 | -- | -- | 0 | - | -- | 33.0 | -- | -- | 30.0 | -- | -- | 37.0 | -- | - | 40.7 | -- | - | 14 1 |
| SM | 36 | 18 7 | 40 1 | 22 8 | -- | -- | 0 | - | -- | 51 0 | -- | -- | 28 0 | -- | -- | 21 0 | -- | - | 24 0 | -- | - | 2.4 |

**TABLE 2.5-19A**
**(SHEET 1 of 1)**

**SOIL PROPERTIES, BORROW AREA 7**

| Soil Symbol | % of Total | Natural Moisture Content | | | Gravel | | | Sand | | | Silt | | | Clay | | | Liquid Limit | | | Plasticity Index | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max % | Min % | Avg % | Max % | Min % | Avg % | Max % | Min % | Avg % | Max % | Min % | Avg % | Max % | Min % | Avg % | Max % | Min % | Avg % | Max % | Min % | Avg % |
| CL | 51.2 | 26.3 | 20.8 | 24.0 | 0 | 0 | 0 | 38 | 7 | 21 | 53 | 37 | 44 | 50 | 23 | 36 | 49 | 30 | 39 | 25 | 9 | 16 |
| CL-ML | 29.3 | 24.9 | 20.4 | 22.8 | 0 | 0 | 0 | 39 | 11 | 24 | 46 | 34 | 40 | 49 | 25 | 35 | 46 | 27 | 38 | 18 | 5 | 13 |
| ML | 12.2 | 27.7 | 21.1 | 23.5 | 0 | 0 | 0 | 38 | 13 | 30 | 38 | 31 | 35 | 49 | 26 | 34 | 43 | 32 | 38 | 14 | 4 | 10 |
| CH-MH | 4.9 | 33.7 | 26.5 | 30.1 | 0 | 0 | 0 | 8 | 5 | 7 | 44 | 44 | 44 | 51 | 48 | 50 | 54 | 52 | 53 | 25 | 23 | 24 |
| MH | 2.4 | 26.9 | 26.9 | 26.9 | 0 | 0 | 0 | 6 | 6 | 6 | 43 | 43 | 43 | 51 | 51 | 51 | 53 | 53 | 53 | 23 | 23 | 23 |

**WBN**

**TABLE 2.5-20**
**(SHEET 1 of 1)**

**GROUT USAGE**

Historical Information

| Hole Number | Total Gallons of Grout | Hole Number | Total Gallons of Grout |
|---|---|---|---|
| 1 | 4 | 15 | 4 |
| 2 | 4 | 16 | 13 |
| 3 | 4 | 17 | 13 |
| 4 | 8 | 18 | 13 |
| 5 | 9 | 19 | 6 |
| 6 | 4 | 20 | 10 |
| 7 | 4 | 21 | 11 |
| 8 | 4 | 22 | 10 |
| 9 | 4 | 23 | 9 |
| 10 | 7 | 24 | 9 |
| 11 | 14 | 25 | 10 |
| 12 | 15 | 26 | 10 |
| 13 | 13 | 27 | 10 |
| 14 | 4 | 28 | 9 |

**TABLE 2.5-21**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT INTAKE CHANNEL**
**SUMMARY OF LABORATORY TEST DATA REMOLDED CHANNEL AREA SOILS**

Historical Information

| Symbols | CL | CL | ML | SM | SM |
|---|---|---|---|---|---|
| Mechanical and Hydrometer Analysis | | | | | |
| Gravel, % | 0 | 0 | 0 | 0 | 0 |
| Sand, % | 39 | 15 | 47 | 61 | 80 |
| S lt, % | 32 | 44 | 32 | 23 | 9 |
| Clay, % | 29 | 41 | 21 | 16 | 11 |
| Atterberg Limits | | | | | |
| Liquid Lim t, % | 30.8 | 41.2 | 28.0 | 20.9 | NP |
| Plastic lim ts, % | 17.5 | 21.6 | 22.3 | 19.5 | NP |
| Plasticity index, % | 13.3 | 19.6 | 5.7 | 1.4 | NP |
| Standard Proctor Compaction | | | | | |
| Average natural moisture, % | 25.5 | 25.8 | 23.6 | 25.7 | 25.5 |
| Optimum moisture, % | 17.0 | 20.7 | 17.5 | 16.0 | 18.4 |
| Maximum density, pcf | 109.9 | 102.8 | 108.9 | 111.8 | 107.2 |
| Tr axial Q shear strength at 95% | | | | | |
| of maximum density with +4% moisture | | | | | |
| $\phi$, degrees | 4.8 | 8.5 | 15.0 | 22.0 | 31.3 |
| c, tsf | 0.95 | 0.90 | 0.80 | 0.65 | 0.55 |

**TABLE 2.5-22**
**(SHEET 1 of 1)**

**TVA SOIL TESTING LABORATORY**
**SUMMARY OF TEST RESULTS WATTS BAR LIQUEFACTION STUDY**

Historical Information

| Test No. | Kc | γd | B | σ1c | σ3c | σac | R | $N_L$ | $N_{5*}$ | $N_{10*}$ | $N_{15*}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 88.3 | 0.97 | 10.2 | 10.2 | 3.67 | 0.180 | 8 | -- | -- | -- |
| 2 | 1.0 | 88.2 | 0.99 | 10.2 | 10.2 | 3.57 | 0.175 | 12 | -- | -- | -- |
| 3 | 1.0 | 89.4 | 0.99 | 10.2 | 10.2 | 2.15 | 0.105 | 428 | -- | -- | -- |
| 4 | 1.5 | 87.8 | 0.97 | 10 0 | 6.7 | 2.80 | * | - | 6 | 7 | 7 |
| 5 | 1.5 | 87.8 | 0.97 | 10 0 | 6.7 | 2.00 1.07 | -- | -- | 46 | 50 | 53 |
| 6 | 1 5 | 87 5 | 0 98 | 10 0 | 6 7 | | -- | -- | 500 | 606 | 690 |
| 7 | 2 0 | 88.3 | 0.98 | 10.0 | 5 0 | 2.40 | | | 2 | 3 | 4 |
| 8 | 2.0 | 88.3 | 0.98 | 10.0 | 5.0 | 2.05 | -- | -- | 9 | 10 | 10 |
| 9 | 2 0 | 88.3 | 0.98 | 10.0 | 5 0 | 1.50 | -- | -- | 34 | 36 | 38 |

Donoation: Kc = σ1c/σ3c

γd = dry density of specimen in pcf.

B is coefficient of pore pressure.

σ1c or σ3c is the consolidation pressure in the axial or lateral direction respectively in psi

σac is the axial cyclic stress in psi

R = σac/2 σ3c when σ1c = σ3c (Kc = 1).

NL is the number of cycles required to cause liquefaction.

$N_{5, 10,}$ or $_{15}$ is the number of cycles required to cause axial strain of 5, 10, or 15 percent

*For anisotropic loading, strain is for compression only.

**Liquefaction did not occur under anisotropic loading.

**TABLE 2.5-23**
**SHEET 1 of 1**

**WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS**
**SUMMARY OF TEST RESULTS WATTS BAR LIQUEFACTION STUDY**
**ISOTROPIC LOADING**

Historical Information

| Test No. | Density $\gamma_{dry}$ pcf | Back Pressure psi | B | $\sigma_a$ or &dc psi | &dc psi | &dc 2&$_a$ | Accel g | Cycles to initial Liquefaction | % Strain @ initial Liquefaction | Cycles to 10% Strain* | Cycles to 20% Strain* | $K_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Isotropic Loading | | | | | | |
| 1 | 94.7 | 65.0 | 0.970 | 10.2 | 4 04 | 0 198 | 0 136 | 16 | 2.6 | 17(12.2) | 19(22.1) | 1.0 |
| 2 | 88.5 | 60.0 | 0.980 | 10.2 | 3.64 | 0.179 | 0. 23 | 5 | 0.6 | 6(12.8) | 7(22.1) | 1.0 |
| 3 | 88.4 | 60.0 | 0.980 | 10.2 | 2.57 | 0.126 | 0.086 | 51 | 0.9 | 52(18.6) | 53(22.2) | 1.0 |
| 4 | 85.7 | 60.0 | 0.980 | 10.2 | 3.34 | 0.156 | 0. 07 | 5 | 0.4 | 6(22 3) | 7(22 3) | 1.0 |
| 4A | 88.7 | 60 0 | 0.980 | 10 2 | 3 82 | 0 187 | 0 28 | 4 | 0 4 | 5(17.2) | 6(22.2) | 1 0 |
| | | | | | | Anisotropic Loading | | | | | | |
| 5 | 86.4 | 65.0 | 0.970 | 6.8 | 2.11 | - | - | -** | - | 1(21.2) | 1(21.2) | 1.5 |
| 6 | 89.2 | 4.0 | 0 980 | 6 8 | 1.01 | - | - | - | - | 23(9.7) | 2(20.7) | 1.5 |
| 7 | 88.1 | 4.0 | 0.970 | 6 8 | 0.70 | - | - | - | - | 170(16.4) | 71(21.6) | 1.5 |
| 8 | 87.8 | 5.0 | 0.980 | 5 1 | 1.94 | - | - | - | - | 1(20 5) | 1(20.5) | 2.0 |
| 9 | 90.1 | 5.0 | 0.980 | 5 1 | 0.94 | - | - | - | - | 14(13.6) | 9(20.7) | 2.0 |
| 10 | 88.9 | 5 0 | 0 970 | 5 1 | 0.57 | - | - | - | - | 32(10.3) | 4(20.6) | 2 0 |

Note: Terms defined in text.

* Number of cycles shown is the cycle closest to 10% and 20% strain for the two columns. The number in parenthesis is the actual strain. For isotropic loading, the strain is for both compression and extension. For anisotropic loading, the strain is only for compression.

**Initial liquefaction did not develop in anisotropically consolidated specimens.

$\gamma_{dry}$ = Dry unit weight of soil.
B = Ratio of the change in pore water pressure to an induced change in chamber pressure.
$\sigma_a$ = Ambient consolidation stress.
$\sigma_{3c}$ = Effective confining stress at the end of consolidation.
$\sigma_{dc}$ = Cyclic deviator stress.
$\sigma_{1c}$ = Effective axial stress.
$K_c$ = $\sigma_{1c}/\sigma_{3c}$.
G = Acceleration.

**TABLE 2.5-24**
**(SHEET 1 of 2)**

**WATTS BAR NUCLEAR PLANT**
**ERCW AND HPFP SYSTEMS SOIL INVESTIGATION**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Soil Type | Nat. Moist. % | Nat. Moist. % Sat. | Std. Penetr. | Gravel % | Grain-size Analysis Sand % | Grain-size Analysis Silt % | Grain-size Analysis Clay % | D10 mm | Atterb. Limits Liq. Limit % | Atterb. Limits Plastic. Index % | Dry Dens. pcf | Void Ratio | Unconfined Compression Undis. tsf | Unconfined Compression Rem. tsf | Sens. Ratio | Triaxial Q Undisturbed $\phi$ deg | Triaxial Q Undisturbed c tsf | Natural Moisture Triaxial R $\phi$ deg | Natural Moisture Triaxial R c tsf | Direct Shear S $\phi$ deg | Direct Shear S c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boring US- 75 Surface El. 722.7** | | | | | | | | | | | | | | | | | | | | | | | |
| 721.7-720.4 | CL | b | 18.7 | 86.8 | 26 | 5 | 35 | 28 | 32 | --- | 40.2 | 16.9 | 106.7 | 0.580 | | | | | | | | | |
| 718.7-716.4 | SM | I | 19.6 | 78.3 | 20 | 1 | 69 | | 14 | --- | 32.3 | 7.5 | 100.3 | 0.674 | | | | 29.5 | 0.26 | 33.5 | 0.30 | | |
| **Boring US- 77 Surface El. 731.1** | | | | | | | | | | | | | | | | | | | | | | | |
| 730.1-727.7 | CH | A | 20.2 | 64.1 | 9 | 0 | 19 | 33 | 48 | --- | 58.9 | 26.9 | 92.5 | 0.854 | 3.8 | 3.5 | 1.1 | 18.4 | 1.70 | 12.0 | 2.90 | 30.0 | 1.25 |
| 727.1-725.7 | ML | D | 22.2 | 82.6 | 18 | 0 | 43 | 34 | 23 | --- | 36.4 | 8.6 | 98.4 | 0.734 | | | | | | 25.5 | 1.10 | 35.5 | 0.38 |
| 724.1-721.7 | CL | b | 31.1 | 95.3 | 10 | 0 | 20 | 52 | 28 | --- | 44.7 | 17.4 | 89.9 | 0.888 | | | | | | | | | |
| 721.1-718.7 | CH | A | 31.9 | 97.2 | 10 | 0 | 13 | 52 | 35 | --- | 52.1 | 20.6 | 89.7 | 0.893 | 1.8 | 1.8 | 1.0 | 8.0 | 0.90 | 24.5 | 0 25 | 26.5 | 0 62 |
| 718.1-715.7 | CL | B | 31.6 | 95.4 | 4 | 0 | 10 | 53 | 37 | --- | 49.0 | 24.5 | 85.5 | 0.901 | 1.3 | 1.1 | 1.2 | 6.5 | 0.40 | 21.5 | 0 71 | | 0.14 |
| 715.1-712.7 | SM | J | 28.9 | 97.0 | 3 | 0 | 67 | 20 | 13 | .0032 | NP | NP | 92.2 | 0.783 | | | | 3.0 | 0.60 | 26.5 | 0 50 | | 0.07 |
| 712.1-711.5 | SP-SM | j | 23.6 | 87.0 | 6 | 0 | 90 | 7 | 3 | .075 | NP | NP | 97.4 | 0.731 | | | | | | | | | |
| **Boring US-92 Surface El. 728.9** | | | | | | | | | | | | | | | | | | | | | | | |
| 727.9-725.5 | ML | D | 24.3 | 82.5 | 8 | 0 | 33 | 26 | 41 | --- | 46.0 | 13.8 | 95.4 | 0.819 | 3.9 | 3.2 | 1.2 | 22.5 | 1.14 | 24.5 | 0.70 | 1.08 | 1.08 |
| 724.9-722.5 | SM | I | 19.6 | 80.1 | 14 | 0 | 57 | 28 | 15 | --- | 31.7 | 7.9 | 96.5 | 0.684 | | | | 19.5 | 0.73 | 25.2 | 0.90 | | |
| 721.9-719.5 | SM | I | 18.0 | 75.7 | 5 | 0 | 59 | 20 | 21 | --- | 28.1 | 4.3 | 103.1 | 0.644 | | | | 30.5 | 0.85 | 21.5 | 1.30 | 31.0 | 0.25 |
| 718.9-716.5 | G-SC | i | 14.0 | 68.5 | 5 | 20 | 50 | 17 | 13 | --- | 29.0 | 7.8 | 109.1 | 0.556 | | | | | | | | | |
| 715.9-714.9 | SM | J | 16.0 | 58.3 | 10 | 5 | 74 | 15 | 6 | .013 | NP | NP | 96.6 | 0.740 | | | | | | 31.2 | 0.45 | | |
| 712.9-712.4 | G-SM | j | 16.7 | 62.4 | 43 | 13 | 66 | 13 | 8 | .012 | NP | NP | 97.3 | 0.713 | | | | | | | | | |
| **Boring US-94 Surface El. 697.9** | | | | | | | | | | | | | | | | | | | | | | | |
| 696.9-695.9 | SM | j | 24.6 | 100 | 24 | 0 | 54 | 37 | 9 | .0075 | NP | NP | 104.8 | 0.585 | | | | | | | | | |
| 695.9-694.8 | GC | f | 20.3 | 75 3 | 42 | 46 | 29 | 16 | 9 | .0065 | 39.8 | 16.6 | 98.4 | 0.738 | | | | | | | | | |
| 693.9-691.8 | GC | f | 12.3 | 47 7 | 36 | 41 | 40 | 14 | 5 | .0 8 | 35.7 | 13.5 | 101.7 | 0.720 | | | | | | | | | |
| 690.9-689.8 | GC | f | 13 6 | 79 3 | 50+ | 46 | 38 | 12 | 4 | 0 9 | 35 2 | 12 5 | 116.3 | 0.470 | | | | | | | | | |

**TABLE 2.5-24**
**(SHEET 2 OF 2)**

**WATTS BAR NUCLEAR PLANT**
**ERCW AND HPFP SYSTEMSSOIL INVESTIGATION**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Soil Type | Nat. Moist. % | Nat. Moist. % Sat. | Std. Penetr. | Gravel % | Grain-size Analysis Sand % | Silt % | Clay % | D10 mm | Atterb. Limits Liq. Limit % | Plastic. Index % | Dry Dens. pcf | Void Ratio | Unconfined Compression Undis. tsf | Rem. tsf | Sens. Ratio | Triaxial Q Undisturbed $\phi$ deg | c tsf | Natural Moisture Triaxial R $\phi$ deg | c tsf | Direct Shear S $\phi$ deg | c tsf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US- 97 Surface El. 717.9 | | | | | | | | | | | | | | | | | | | | | | | |
| 716.9-714.5 | CL | B | 20.8 | 89.1 | 4 | 0 | 25 | 44 | 31 | --- | 35.6 | 17.7 | 102.8 | 0.626 | 1.8 | 1.8 | 1.0 | 22.5 | 0.44 | 21.5 | 103 | 33.0 | 0.12 |
| 713.9-711.5 | CL | b | 16.3 | 91.5 | 15 | 0 | 43 | 34 | 23 | --- | 37.4 | 20.6 | 113.1 | 0.474 | | | | | | | | | |
| 710.9-709.7 | SC | i | 19.5 | 90.0 | 13 | 6 | 45 | 25 | 24 | --- | 31.3 | 11.1 | 106.5 | 0.583 | | | | | | | | 25.5 | 0.59 |
| Boring US- 103 Surface El. 733.1 | | | | | | | | | | | | | | | | | | | | | | | |
| 724.1-721.7 | MH | H | 24.4 | 90.0 | 19 | 10 | 33 | 18 | 39 | --- | 54.3 | 20.6 | 96.7 | 0.735 | 3.5 | 5.0 | 0.7 | 26.5 | 1.27 | 18.5 | 1.67 | 33.0 | 0.45 |
| 721.1-719.1 | MH | H | 31.1 | 85.9 | 12 | 0 | 34 | 22 | 44 | --- | 50.9 | 20.9 | 89.3 | 0.780 | 2.6 | 4.9 | 0.5 | 15.0 | 1.65 | 24.0 | 1.15 | 32.5 | 0.56 |
| 718.1-717.4 | ML | D | 26.1 | 91.6 | 16 | 0 | 38 | 31 | 31 | --- | 47.8 | 16.7 | 96.2 | 0.779 | | | | | | | | 32.0 | 0.21 |
| Boring US- 103 Surface El. 714.4 | | | | | | | | | | | | | | | | | | | | | | | |
| 713.7-711.9 | CL | B | 12 7 | 64.6 | 8 | 0 | 43 | 34 | 23 | --- | 28.4 | 11.3 | 108.7 | 0.523 | 1.4 | 1.1 | 1.3 | 18.0 | 1.25 | 25.0 | 0.85 | 34.6 | 0.20 |
| 707.7-707.3 | GC | f | 15.4 | --- | 40 | 46 | 32 | 11 | 11 | .004 | 26.6 | 10.2 | --- | --- | | | | | | | | | |
| 707.3-707.0 | GM | f | 34.3 | --- | 40 | 62 | 13 | 17 | 8 | .008 | 40.7 | 14.6 | --- | --- | | | | | | | | | |
| 704.7-704.0 | CL | b | 15.1 | 67 | 32 | 8 | 33 | 31 | 28 | --- | 44.1 | 21.6 | 105.2 | 0.608 | | | | | | | | | |
| 704.0-703.4 | GM | f | 19 8 | 74 | 32 | 45 | 27 | 22 | 6 | .012 | 39.8 | 8.6 | 99.7 | 0.741 | | | | | | | | | |
| Boring US-107 Surface El. 694.5 | | | | | | | | | | | | | | | | | | | | | | | |
| 693.5-691.6 | CL | C | 24.0 | 82.9 | 2 | 0 | 49 | 33 | 18 | --- | 24.8 | 7.6 | 94.9 | 0.789 | | | | | | | | | |
| 690.5-688.1 | G-OH | A | 53.2 | 93.2 | 1 | 16 | 23 | 28 | 33 | --- | 55.6 | 30.1 | 66.3 | 1.466 | 0.3 | 0.3 | 1.0 | 2.5 | 0.12 | 11.0 | 0.22 | | |
| 687.5-686.4 | G 0L | b | 24.9 | 99.1 | 15 | 20 | 25 | 31 | 24 | --- | 32.2 | 16.9 | 99.3 | 0.666 | | | | | | | | | |
| 684.5-683.5 | OL | D | 78.1 | 87.9 | 15 | 0 | 40 | 49 | 11 | .005 | 38.7 | 4.7 | 53.5 | 2.348 | 0.5 | 0.2 | 2.5 | 2.0 | | | | | |
| 678.5-677.7 | ML | D | 32.9 | 87.9 | 12 | 0 | 29 | 52 | 19 | --- | 39.6 | 12.5 | 85.0 | 0.989 | | | | | | | | | |
| 675.5-674.7 | G ML | d | 21 7 | 98 3 | 20 | 29 | 43 | 17 | 11 | 0042 | 37.9 | 10.9 | 105.9 | 0.597 | | | | | | | | | |
| Boring US- 108 Surface El. 697.0 | | | | | | | | | | | | | | | | | | | | | | | |
| 696.0-693.7 | CL | C | 24.4 | 88.5 | 2 | 0 | 28 | 46 | 26 | --- | 26.4 | 7.9 | 95.6 | 0.731 | 0.6 | 0.2 | 3.0 | 0.8 | 0.35 | 30.5 | 0.08 | 31.5 | 0.20 |
| 693.0-691.0 | GM | F | 16.9 | 81.2 | 20 | 62 | 20 | 11 | 7 | .011 | 28.9 | 13.3 | 110.2 | 0.581 | | | | 17.0 | 0.10 | | | | |
| 689.0-688.7 | GM | f | 21.4 | --- | 21 | 56 | 22 | 17 | 5 | .019 | NP | NP | --- | --- | | | | | | | | | |

**TABLE 2.5-25**
**SHEET 1 of 1**

**WATTS BAR NUCLEAR PLANT**
**SUMMARY OF LABORATORY TEST DATA**
**BORROW SOIL CLASSES**

Historical Information

| Class | If | IId | IIIb |
|---|---|---|---|
| Symbol | SM | CL | ML |
| Mechanical and Hydrometer Analysis | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 51 | 38 | 33 |
| Silt, percent | 28 | 34 | 30 |
| Clay, percent | 21 | 28 | 37 |
| Atterberg Limits | | | |
| Liquid limit, percent | 24.0 | 31.8 | 40.7 |
| Plastic limit, percent | 21.6 | 22.7 | 26.6 |
| Plasticity index, percent | 2.4 | 9.1 | 14.1 |
| Shrinkage limit, percent | -- | -- | -- |
| Standard Proctor Compaction | | | |
| Optimum moisture, percent | 15.1 | 17.6 | 20.4 |
| Maximum density, pcf | 113.3 | 108.9 | 103.7 |
| Penetration resistance, psi | | | |
| Shear Strength at 3% Above Optimum Moisture and at 95% of Maximum Density | | | |
| Triaxial Q: $\phi$ degrees | 8.5 | 6.6 | 2.5 |
| c tsf | 1.18 | 0.92 | 1.40 |
| Shear Strength at 3% Below Optimum Moisture and at 95% of maximum Density | | | |
| Triaxial R: $\phi$ degrees | 32.0 | 29.0 | 24.0 |
| c tsf | 0.85 | 1.15 | 1.35 |
| Direct Shear S: $\phi$ degrees | 34.0 | 38.0 | 44.5 |
| c tsf | 0.58 | 0.40 | 0.18 |

**WBN**
**TABLE 2.5-26**

**SHEET 1 of 1**

# WATTS BAR NUCLEAR PLANT
# INTAKE CHANNEL SAND MATERIAL
# SUMMARY OF CYCLIC LOADING TEST DATA

Historical Information

| Sample No. | Dry* Density rd (pc ) | Pore Pressure Coefficient B | Consolidation Pressure Axial &1c (psi) | Consolidation Pressure Lateral &3c (psi) | &1c/&3c | &ac/2 &3c | % Strain at 1000 Cycles | Number of Cycles to Strain at** Liquefaction | 5% | 10% | 20% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Isotropic Loading | | | | | | |
| 6 | 92.1 | 0.95 | 17.5 | 17.5 | 1.0 | 0.45 | | 9 | 10 | 12 | 20 |
| 6 | 91.1 | 0.99 | 17.5 | 17.5 | 1.0 | 0.26 | | 192 | 196 | 200 | 206 |
| 6 | 90.7 | 1.00 | 17.5 | 17.5 | 1.0 | 0.11 | 0.2 | Static R Test | | | |
| D-1 | 111.3 | 0 98 | 20.0 | 20 0 | 1.0 | 0.43 | | 19 | 23 | 34 | 60 |
| D-1 | 110.8 | 0.97 | 20.0 | 20.0 | 1.0 | 0.26 | | 122 | 30 | 138 | 164 |
| D-1 | 110.8 | 0.97 | 20.0 | 20.0 | 1.0 | 0.10 | 0 | Static R Test | | | |
| | | | | | Anisotropic Loading | | | | | | |
| 6 | 93.1 | 0.97 | 35.0 | 17.5 | 2 0 | 0.44 | | | 127 | 228 | 500 |
| 6 | 01.9 | 0.97 | 35.0 | 17.5 | 2.0 | 0.25 | 0.5 | Static R Test | | | |
| 6 | 92.9 | 0.98 | 35.0 | 17.5 | 2.0 | 0.11 | 0.2 | Static R Test | | | |
| D-1 | 111.6 | 1.00 | 40.0 | 2.0 | 2.0 | 0.45 | | | 161 | 70 | 89 |
| D-1 | 112.2 | 0.97 | 40.0 | 2.0 | 2.0 | 0.25 | 0 | Static R Test | | | |
| D-1 | 112 6 | 0 98 | 40 0 | 2.0 | 2 0 | 0 11 | 0 | | | | |

* After consolidation.
** Zero to peak compressive strain.

**TABLE 2.5-27**
**SHEET 1 of 1**

**WATTS BAR NUCLEAR PLANT**
**INTAKE CHANNEL CLAY MATERIAL**
**SUMMARY OF STATIC TEST DATA**

Historical Information

| Elevation | Location | Soil Symbol | Nat. Moist % | Nat. Moist % Sat | Gravel Clay % | Grain Size Analysis Sand % | Grain Size Analysis Silt % | Grain Size Analysis - % | Atterb. Limits Liq. Limit % | Atterb. Limits Plastic Index % | Dry Dens. Pcf | Void Ration | Apparent ϕ deg | Apparent c tsf | Effective ϕ deg | Effective c tsf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 660.7-660.0 | A-2 | SC | 26.0 | 85.5 | 0 | 52 | 26 | 22 | 26.3 | 9.2 | 92.1 | .816 | 10.5 | 0.80 | 31.7 | 0.04 |
| 660.6-660.0 | B-1 | CL | 27.9 | 95.5 | 0 | 23 | 42 | 35 | 34.4 | 17.3 | 93.8 | .790 | 11.0 | 0.53 | 26.5 | 0.23 |
| 660.6-660.0 | C-1 | CL | 33.9 | 96.3 | 0 | 15 | 35 | 50 | 48.8 | 28.1 | 85.9 | .970 | 12.0 | 0.35 | 28.0 | 0.03 |
| 660.6-656.0 | D-1 | CL | 37.9 | 97.4 | 0 | 07 | 46 | 47 | 42.3 | 23.4 | 82.8 | 1.021 | 13.0 | 0.05 | 29.5 | 0.00 |

Average R Strength For Analysis
$\phi = 12°$
c = 900 psf

**TABLE 2.5-28**
**SHEET 1 of 1**

**DRILL ROD LENGTHS AND WEIGHTS VERSUS SPT SAMPLE DEPTHS APPLYING TO 1976 AND 1979 REPORTS**

Historical Information

| Boring Depth | Drill Rod* (AW) Weight | Drill Rod* AW) Length |
|---|---|---|
| (ft) | (ft) | (lbs) |
| 0 - 5 | 5 | 21 |
| 5   10 | 10 | 42 |
| 10 - 15 | 15 | 63 |
| 5   20 | 20 | 84 |
| 20   25 | 25 | 05 |
| 25   30 | 30 | 126 |
| 30   35 | 35 | 147 |
| 35   40 | 40 | 168 |
| 40   45 | 45 | 89 |
| 45 - 50 | 50 | 210 |
| 50 - 55 | 55 | 231 |
| 55 - 60 | 60 | 252 |
| 60 - 65 | 65 | 273 |
| 65 - 70 | 70 | 294 |
| 70 - 75 | 75 | 315 |

| | |
|---|---|
| Weight of safety hammer and drive stem | 178.8 lbs |
| Weight of safety hammer | 140.0 lbs |
| Weight of drive stem | 38.8 lbs |
| Weight of split barrel sampler | 15.7 lbs |
| Length of split barrel sampler | 2.8 ft |

*rods in 5 ft increments

**TABLE2.5-29**
**(SHEET 1 of 1)**

**WATTS BAR NUCLEAR PLANT**
**ERCW CONDUIT – 1976 REPORT**

Historical Information

| Boring No. | Drill No. | Drill Model | Boring Depth |
|---|---|---|---|
| SS-65 | 91930 | Mobile B-50 | 50.5 |
| SS-67 | 91930 | Mobile B-50 | 44.5 |
| SS-69 | 91930 | Mobile B-50 | 66.1 |
| SS-71 | 91930 | Mobile B-50 | 59.4 |
| SS-73 | 92251 | Mobile B-50 | 37.8 |
| SS-74 | 92251 | Mobile B-50 | 34.2 |
| SS-75 | 92251 | Mobile B-50 | 41.5 |
| US-75 | 92251 | Mobile B-50 | 10.0 |
| SS-76 | 92251 | Mobile B-50 | 31.5 |
| SS-77 | 92251 | Mobile B-50 | 40.9 |
| US-77 | 92251 | Mobile B-50 | 22.0 |
| SS-78 | 92251 | Mobile B-50 | 25.5 |
| SS-82 | 91930 | Mobile B-50 | 37.5 |
| SS-84 | 91930 | Mobile B-50 | 35.6 |
| SS-86 | 92251 | Mobile B-50 | 38.5 |
| SS-87 | 92251 | Mobile B-50 | 43.4 |
| SS-88 | 91930 | Mobile B-50 | 42.1 |
| SS-90 | 91930 | Mobile B-50 | 58.8 |
| SS-92 | 91930 | Mobile B-50 | 45.3 |
| US-92 | 92251 | Mobile B-50 | 22.0 |
| SS-93 | 91930 | Mobile B-50 | 19.3 |
| SS-94 | 92251 | Mobile B-50 | 12.2 |
| US-94 | 92251 | Mobile B-50 | 8.2 |
| SS-95 | 92251 | Mobile B-50 | 21.3 |
| SS-96 | 91930 | Mobile B-50 | 31.8 |
| SS-97 | 91930 | Mobile B-50 | 45.2 |
| SS-97A | 91930 | Mobile B-50 | 14.5 |
| US-97A | 92251 | Mobile B-50 | 8.3 |
| SS-99 | 91930 | Mobile B-50 | 29.8 |
| SS-101 | 91930 | Mobile B-50 | 24.8 |
| SS-103 | 91930 | Mobile B-50 | 44.0 |
| US-103 | 92251 | Mobile B-50 | 19.1 |
| SS-104 | 91930 | Mobile B-50 | 33.3 |
| SS-105 | 92251 | Mobile B-50 | 10.0 |
| SS-106 | 92251 | Mobile B-50 | 31.9 |
| US-106 | 92251 | Mobile B-50 | 10.5 |
| SS-107 | 91930 | Mobile B-50 | 26.0 |
| US-107 | 92251 | Mobile B-50 | 23.3 |
| SS-108 | 91930 | Mobile B-50 | 16.8 |
| US-108 | 92251 | Mobile B-50 | 8.3 |

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**PAGE 1 of 1**

**WATTS BAR NUCLEAR PLANT**
**ERCW CONDUIT – 1979 REPORT**

Historical Information

| Boring No. | Drill No. | Drill Model | Boring Depth |
|---|---|---|---|
| SS-131 | 92357 | CME-55 | 36.0 |
| SS-132 | 419991 | CME-75 | 38.0 |
| SS-133 | 419991 | CME-75 | 39.5 |
| SS-134 | 419991 | CME-75 | 45.5 |
| SS-135 | 419991 | CME-75 | 45.0 |
| SS-136 | 91930 | Mobile B-50 | 44.0 |
| SS-137 | 419991 | CME-75 | 32.0 |
| SS-138 | 419991 | CME-75 | 42.5 |
| SS-139 | 92357 | CME-75 | 54.0 |
| SS-140 | 419991 | CME-75 | 38.5 |
| SS-141 | 419991 | CME-75 | 39.5 |
| SS-142 | 419991 | CME-75 | 46.5 |
| SS-143 | 419991 | CME-75 | 46.0 |
| SS-144 | 419991 | CME-75 | 45.5 |
| SS-145 | 419991 | CME-75 | 40.5 |
| SS-146 | 91930 | Mobile B-50 | 71.5 |
| SS-147 | 91930 | Mobile B-50 | 57.5 |
| SS-148 | 419991 | CME-75 | 38.0 |
| SS-149 | 419991 | CME-75 | 36.0 |
| SS-150 | 419991 | CME-75 | 21.0 |
| SS-151 | 419991 | CME-75 | 34.0 |
| SS-152 | 91930 | Mobile B-50 | 26.0 |
| SS-153 | 91930 | Mobile B-50 | 26.0 |
| SS-154 | 419991 | CME-75 | 31.5 |
| SS-155 | 91930 | Mobile B-50 | 21.0 |
| SS-156 | 419991 | CME-75 | 21.0 |
| SS-157 | 91930 | Mobile B-50 | 25.5 |
| SS-158 | 419991 | CME-75 | 28.0 |
| SS-159 | 419991 | CME-75 | 33.5 |
| SS-160 | 91930 | Mobile B-50 | 33.5 |
| SS-161 | 419991 | CME-75 | 37.0 |
| SS-162 | 91930 | Mobile B-50 | 31.5 |
| SS-163 | 419991 | CME-75 | 33.5 |
| SS-164 | 91930 | Mobile B-50 | 40.0 |
| SS-165 | 419991 | CME-75 | 41.0 |
| SS-166 | 91930 | Mobile B-50 | 37.0 |
| SS-167 | 91930 | Mobile B-50 | 34.5 |
| SS-168 | 419991 | CME-75 | 37.0 |
| SS-169 | 419991 | CME-75 | 39.0 |
| SS-170 | 419991 | CME-75 | 71.0 |

**TABLE 2.5-31**
**(SHEET 1 of 2)**

**RECOMMENDED PROCEDURES AND GUIDELINES FOR STANDARD PENETRATION TESTING**

Historical Information

General

The procedures shall conform to ASTM D 1586 with the following modifications and additions.

Drilling

1. Rotary drilling methods and drilling mud shall be used. Casing shall not be used except as needed in the upper few feet of the boring to provide good circulation of the drilling mud.

2. Drilling mud shall be sufficiently viscuous to lift the cuttings out of the boring and provide a clean hole at the time of sampling, to minimize caving and sloughing of the borehole walls, and to minimize water losses. As a guideline, the marsh funnel viscosity of the drilling mud should be equal to or greater than 40.

3. The hole diameter shall be 4" to 5."

4. The drilling bits shall be fishtail bits equipped with deflectors to provide radial or upward discharge of the drilling fluid. The use of bits that discharge drilling fluid directly down onto the soil at the bottom of the borehole is not permitted.

5. The hole shall be thoroughly cleaned of cuttings prior to sampling.

6. The depth of the borehole shall be measured after drilling and prior to insertion of the sampler into the borehole. (This can be accomplished from knowledge of the lengths of drill rods in the hole during drilling.)

Sampling

1. The required sampler dimensions are given in ASTM D 1586. Typically, however, these samplers are manufactured with a slightly larger inside diameter to provide a space for thin liners. It is preferred to use the typical sampler but without using the liners.

2. The level of drilling mud in the boring is required by ASTM D 1586 to be at or above the ground water level. However, in rotary drilling, it is desirable and practical to have the water level essentially at the ground surface during both drilling and sampling.

3. The depth of the drill hole shall be measured after inserting the sampler. This depth shall be compared with the depth measured after drilling to indicate any accumulation of cuttings in the borehole.

4. A rope-and-cathead system shall be used to lift and release the falling weight. Two turns of rope shall be provided around the cathead.

**TABLE 2.5-31**
**(SHEET 2 of 2)**

**RECOMMENDED PROCEDURES AND GUIDELINES FOR STANDARD PENETRATION TESTING**

5. The sampler should driven for the full 18". A record of the blows for each 6" of drive should be maintained.

6. After recovering the sample, the length of recovery shall be measured, and the entire sample shall be examined and classified.

7. Samples shall be stored in glass jars sealed to preserve the natural water content of the soil. The pieces of samples shall be maintained as intact as possible (i.e., intact sample pieces should not be broken up and mixed together).

Record Keeping

In addition to the usual boring log, a log shall be maintained for each sample. It is suggested that this log be on an 8-1/2" by 11" sheet of paper showing the entire sample length. Information to be shown thereon includes:

1. Total length of drive of the sampler (usually 18").

2. Position of the recovered sample in the sampler.

3. Total recovery (in inches) and percent recovery.

4. The record of the blows for each 6" of drive.

5. The description and classification of the sample along its length (different segments may have different description and classifications if changes in soil type occur in the sample.)

6. Identification of the jars containing the pieces of the sample.

**TABLE 2.5-32**
**PAGE 1 of 1**

**DRILL ROD LENGTHS AND WEIGHTS VERSUS SPT SAMPLE DEPTHS**

**1981 REPORT**

Historical Information

| Boring Depth (ft) | Drill Rod* (AW) Length (ft) | Drill Rod* (AW) Weight (lbs) |
|---|---|---|
| 0 - 6.5 | 5 | 21 |
| 6.5 - 9.0 | 10 | 42 |
| 9.0 - 14.0 | 15 | 63 |
| 14.0 - 19.0 | 20 | 84 |
| 19.0 - 24.0 | 25 | 105 |
| 24.0 - 29.0 | 30 | 126 |
| 29.0 - 34.0 | 35 | 147 |
| 34.0 - 39.0 | 40 | 168 |

| | |
|---|---|
| Weight of safety hammer and drive stem | 178.8 lbs |
| Weight of safety hammer | 140.0 lbs |
| Weight of drive stem | 38.8 lbs |
| Weight of split barrel sampler | 15.7 lbs |
| Length of split barrel sampler | 2.8 ft |

*rods in 5 ft increments

**TABLE 2.5-33**
**SHEET 1 of 1**

**WATTS BAR NUCLEAR PLANT**
**ERCW CONDUIT – 1981 REPORT**

Historical Information

| Boring No. | Drill No. | Drill Model | Boring Depth |
|---|---|---|---|
| | | | |
| SS-49A | 93634 | Mobile B-61 | 25.0 |
| | | | |
| SS-50A | 93634 | Mobile B-61 | 26.8 |
| | | | |
| SS-65B | 93634 | Mobile B-61 | 26.5 |
| | | | |
| SS-134A | 93634 | Mobile B-61 | 26.0 |
| | | | |
| SS-135A | 93634 | Mobile B-61 | 26.5 |
| | | | |
| SS-138A | 93634 | Mobile B-61 | 26.0 |
| | | | |
| SS-138B | 93634 | Mobile B-61 | 24.5 |
| | | | |
| SS-138C | 93634 | Mobile B-61 | 24.5 |
| | | | |
| SS-143A | 93634 | Mobile B-61 | 30.5 |
| | | | |
| SS-143B | 93634 | Mobile B-61 | 29.5 |
| | | | |
| SS-143C | 93634 | Mobile B-61 | 30.0 |
| | | | |
| SS-158A | 93634 | Mobile B-61 | 21.5 |
| | | | |
| SS-161A | 93634 | Mobile B-61 | 26.5 |
| | | | |
| SS-163A | 93634 | Mobile B-61 | 30.5 |

**TABLE 2.5-34**
**SHEET 1 of 1**

**WATTS BAR NUCLEAR PLANT**

**ESSENTIAL RAW COOLING WATER PIPING SYSTEM LIQUEFACTION INVESTIGATION**
**SUMMARY OF LABORATORY TEST DATA**

Historical Information

| Elevation | Soil Symbol | Nat. Moist. % | % Sat. | Gravel % | Grain-Size Analysis Sand % | Silt % | Clay % | D10 mm | Atterb. Limits Liq. Limit % | Plastic Index % | Dry Dens. pcf | Void Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring No. US-50-1, 1650.0S 785.0E, Surface Elevation 716.9 | | | | | | | | | | | | |
| 701.4-700.7 | SM | 27.6 | 89.6 | 0 | 59 | 25 | 16 | -- - | 31.6 | 6.1 | 92.4 | .841 |
| 698.9-696.6 | SM | 33.0 | 87.5 | 0 | 82 | 14 | 4 | .0504 | NP | NP | 84 0 | .002 |
| 696.4-695.3 | SM | 28.9 | 93.6 | 0 | 88 | 9 | 3 | .0567 | NP | NP | 93 1 | .828 |
| 695.3-694.5 | SM | 31.1 | 95.9 | 0 | 53 | 34 | 13 | .0029 | 23 1 | 1 0 | 90 4 | .863 |
| 694.2-692-1 | SM | 30 5 | 99 5 | 0 | 80 | 15 | 5 | 0245 | NP | NP | 93 5 | 829 |
| Boring No. US-50-1A, 1645.0S 785.0E, Surface Elevation 717.0 | | | | | | | | | | | | |
| 703.9-702.5 | SM | 25.9 | 87.6 | 0 | 64 | 24 | 12 | .0035 | NP | NP | 95.0 | 796 |
| 701.6-699.4 | SM | 37.8 | 88.7 | 0 | 67 | 22 | 11 | .0033 | NP | NP | 79.2 | 1.148 |
| Boring No. US-65-1, 1367.0S 1005.7E, Surface Elevation 726.9 | | | | | | | | | | | | |
| 711.9-709.6 | SM | 22.2 | 65.1 | 0 | 70 | 22 | 8 | .0078 | NP | NP | 88.6 | .904 |
| 709.4-707.3 | SM | 22.7 | 68.8 | 2 | 60 | 25 | 13 | ---- | NP | NP | 90.3 | .879 |
| 707.2-705.2 | SM | 33.4 | 94.2 | 0 | 65 | 24 | 11 | .0039 | NP | NP | 87.0 | .951 |
| 705.2-704.0 | SM | 31.6 | 100 | 3 | 49 | 32 | 16 | ---- | 26.1 | 2.8 | 92.3 | .835 |
| 703.8-703.2 | ML | 34.3 | 100 | 1 | 44 | 35 | 20 | ---- | 28.2 | 5.0 | 90.8 | .861 |
| 703.0-701.8 | G-SM | 18.8 | ---- | 32 | 48 | 14 | 6 | .0205 | NP | NP | ---- | ---- |

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**TABLE 2.5-35**
**(SHEET 1 of 2)**

**LABORATORY PROCEDURE FOR PERFORMING CYCLIC TRIAXIAL TESTS**

Historical Information

1. Test specimens were hand-trimmed from the undisturbed samples by a senior technician using a split-trimming tube 2.8 feet in diameter and 6.3 feet in height.

2. After removal from the trimming tube, the specimen was encased in a rubber membrane, the average thickness of which had been previously determined, and was then placed on the bottom platen of the triaxial testing machine.

3. The membrane was sealed at the top and bottom platens with O-rings. A small vacuum of about 5' of mercury was applied to the specimen.

4. Measurements of specimen diameter were made with pi tape at the center and at the quarter points. The specimen height was determined with a steel rule at 90° intervals around the specimen.

5. After zeroing the readout of axial load, deformation, pore water pressure, and cell pressure, the cyclic triaxial cell was assembled. Then the vacuum in the specimen was gradually reduced to zero while simultaneously increasing cell pressure to 3 $lb/in^2$.

6. The specimen was flushed continuously and slowly with 10' waterhead until no air bubbles were observed exiting from the specimen.

7. A back pressure was then applied to the specimen in an increment of 10 $lb/in^2$. The pressure differential between the cell and back pressure was maintained at 3 $lb/in^2$ throughout the saturation phase.

8. Step 6 was repeated at every level of the back pressure increment. At the final stage of back pressure saturation, Skempton's pore pressure parameter B was checked with drainage lines closed and at 6-$lb/in^2$ confining pressure. The parameter B was defined as:

   $$B = \frac{u}{{}_3}$$

   where u = pore pressure increase

   $_3$ = an increase in confining pressure

9. After completion of saturation, the specimen was consolidated overnight at 2000-$lb/ft^2$ confining pressure.

10. Prior to the cyclic loading test, the B value was checked again. Step 6 was repeated if needed.

11 During consolidation, the change in height and the volume change of the specimen

**TABLE 2.5-35**
**(SHEET 2 of 2)**

**LABORATORY PROCEDURE FOR PERFORMING CYCLIC TRIAXIAL TESTS**

were measured. Thus, the area, volume, and dry density of the specimen after consolidation could be calculated.

12. In addition, specimen and pore water pressure system leaks were checked by closing the drainage lines and measuring pore water pressure response. The change of pore water pressure was less than 2% of the confining pressure over a 5-minute interval.

13. The specimen was cyclically loaded without drainage using a pneumatic system which applied a square wave with a degraded rise time at a frequency of 1 Hz. (See NRC publication NUREG-0031, page 96.)

14. During cyclic loading, changes in axial load and deformation, pore water pressure, and confining pressure were recorded on 8' photosensitive paper using a Honeywell Visicorder.

15. Cyclic loading was continued until a double-amplitude strain of 20% was attained.

16. After completion of cyclic loading, the test specimen was dried in a conventional oven for determination of moisture content.

**TABLE 2.5-36**
**SHEET 1 of 1**
**RESULTS OF STRESS-CONTROLLED CYCLIC TRIAXIAL TESTS ON ERCW ROUTE SOILS**

Historical Information

| Boring No.(Sample No.) | Dry Density $\gamma d$ (lb/ft2) | Confining Pressure $\sigma_3$ (lb/ft2) | Consolidation Ration $K_C = \sigma_1/\sigma_3$ | Average Stress Ration $\sigma_d/2\sigma_3$ | Number of Cycles To: Initial Liquefaction* | Double Amplitude Strain 5% | 10% | 15% | 20% |
|---|---|---|---|---|---|---|---|---|---|
| US-50-1 (2) | 90.2 | 1000 | 2.0 | 0.52 | 45 | 10 | 39 | | |
| | | | | 0.51 | | | | 74 | 106 |
| US-50-1 (3) | 93.9 | 1000 | 2.0 | 0.44 | | 3 | | | |
| | | | | 0.43 | | | 8 | | |
| | | | | 0.42 | 10 | | | 13 | |
| | | | | 0.41 | | | | | 20 |
| US-50-1 (3) | 93.9 | 1000 | 2.0 | 0.27 | | | 3 | | |
| | | | | 0.28 | | | | 12 | |
| US-50-1 (3) | 93.9 | 1000 | 2.0 | 0.26 | | 28 | 104 | 247 | |
| | | | | 0.25 | | | | | 303 |
| US-50-1 (3) | 93.9 | 1000 | 2.0 | 0.17 | 0.2% Strain after 1000 cycles of cyclic stress, ▤☒/$\sigma_3$ = 0.27. | | | | |
| US-50-1 (4) | 97.0 | 1000 | 2.0 | 0.51 | 3% Strain after 1000 cycles of cyclic stress, ▤☒/$\sigma_3$ = 0.79. | | | | |

*Defined as ▤☒ = $\sigma_3$

**WBN**

**TABLE 2.5-37**
**SHEET 1 of 1**

## SUMMARY OF CLASSIFICATION DATA

Historical Information

| | | | | Fines (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pit No. | Sample No. | Gravel(%) | Sand (%) | Silt (%) | Clay (%) | Class | LL | PI | W (%) |
| 1 | 1A-1 | 0 | 57 | 27 | 16 | SM | NP | NP | 24.7 |
| (El. 706.6) | 1A-2 | 0 | 67 | 21 | 12 | SM | NP | NP | 28.6 |
| | 1A-3 | 0 | 63 | 23 | 13 | SM | NP | NP | 28.5 |
| | 1A-4 | 0 | 64 | 24 | 12 | SM | NP | NP | 26.9 |

| Split-Spoon Boring Sample | Elevation | Gravel(%) | Sand (%) | Fines (%) | Class | LL | PI | W (%) |
|---|---|---|---|---|---|---|---|---|
| SS-134 | | 0 | 74 | 26 | SM | NP | NP | 29.3 |
| | | 0 | 69 | 31 | SM | NP | NP | 27.5 |
| SS-134A | 710.2 | 0 | 65 | 35 | SM | 23.0 | 1.0 | 30.0 |
| | 709.6 | 0 | 69 | 31 | SM | NP | NP | 29.1 |
| | 707.7 | 0 | 63 | 37 | SM | 24.0 | 2.0 | 27.9 |
| | 707.2 | 0 | 57 | 43 | SM | 24.0 | 1.0 | 28.9 |
| | 706 4 | 0 | 68 | 32 | SM | NP | NP | 31 9 |
| SS-135 | 714.5 | 0 | 51 | 49 | SM | 31.0 | 3.0 | 24.3 |
| | 712.5 | 0 | 67 | 33 | SM | NP | NP | 22.8 |
| | 710.5 | 0 | 71 | 29 | SM | NP | NP | 24.3 |
| | 798.5 | 0 | 71 | 29 | SM | NP | NP | 34.2 |
| | 706.8 | 0 | 67 | 33 | SM | 22.0 | 1.0 | 27.0 |
| | 704.2 | 0 | 63 | 35 | SM | NP | NP | 30.9 |

**TABLE 2.5-38**
**SHEET 1 of 1**

**SUMMARY OF CLASSIFICATION DATA**

Historical Information

| Pit No. | Sample No. | Gravel (%) | Sand (%) | Fines (%) Silt (%) | Fines (%) Clay (%) | Class | LL | PI | w (%) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2A-1 | 0 | 69 | 22 | 9 | SM | NP | NP | 26,7 |
| Red to | 2A-2 | 0 | 69 | 20 | 11 | SM | NP | NP | 28.9 |
| Brown Sand | 2A-3 | 0 | 66 | 25 | 9 | SM | NP | NP | 26.1 |
| (el. 707.5) | 2A-4 | 0 | 67 | 23 | 10 | SM | NP | NP | 26.2 |
| 2 | 1A-1 | 0 | 66 | 25 | 9 | SM | NP | NP | 33.3 |
| Dark Brown | 1A-2 | 0 | 64 | 25 | 11 | SM | NP | NP | 32.4 |
| Sand | 1A-3 | 0 | 64 | 26 | 10 | SM | NP | NP | 31.2 |
| (el. 706.5) | | | | | | | | | |

| Split-Spoon Boring Sample | Elevation | Gravel (%) | Sand (%) | Fines (%) | Class | LL | PI | w (%) |
|---|---|---|---|---|---|---|---|---|
| SS-138 | 712.0 | 0 | 51 | 49 | SM | 28.1 | 2.5 | 24.0 |
| SS-138A | 713.2 | 0 | 50 | 50 | SM | 29.0 | 3.0 | 25.1 |
| | 711.2 | 0 | 64 | 36 | SM | NP | NP | 22.1 |
| | 707.4 | 0 | 60 | 40 | SM | 28.0 | 2.0 | 35.6 |
| | 705.4 | 0 | 69 | 31 | SM | 22.0 | 1.0 | 27.8 |
| | 705.0 | 0 | 79 | 21 | SM | NP | NP | 29.1 |
| | 703.0 | 0 | 79 | 21 | SM | NP | NP | 38.4 |
| SS-138B | 710.6 | 0 | 58 | 42 | SM | 27.0 | 3.0 | 24.7 |
| | 708.6 | 0 | 54 | 46 | SM | 34.0 | 5.0 | 36.2 |
| | 706.6 | 0 | 63 | 37 | SM-SC | 27.0 | 5.0 | 30.0 |
| SS-138C | 710.6 | 0 | 62 | 38 | SM-SC | 27.0 | 4.0 | 27.5 |
| | 708.6 | 0 | 54 | 46 | SC | 31.0 | 11.0 | 34.1 |

**TABLE 2.5-39**
**SHEET 1 of 1**

**SUMMARY OF CLASSIFICATION DATA**

Historical Information

| Split-Spoon Boring Sample | Elevation | Gravel (%) | Sand (%) | Fines (%) | Class | LL | PI | w (%) |
|---|---|---|---|---|---|---|---|---|
| SS 49A | 690.7 | 2 | 67 | 31 | SM | NP | NP | 30.0 |
| SS 50 | 697.8 | 0 | 57 | 43 | SM | NP | NP | 28.2 |
| SS 50 | 693.8 | 0 | 53 | 47 | SM | NP | NP | 31.5 |
| SS 134 | 710.5 | 0 | 74 | 26 | SM | NP | NP | 29.3 |
| SS 134A | 709.5 | 0 | 65 | 35 | SM | 23.0 | 1.0 | 30.0 |
| SS 135A | 708.5 | 0 | 71 | 29 | SM | NP | NP | 34.2 |
| SS-65 | 706.0 | 0 | 66 | 34 | SM | 28.9 | 3.5 | 28.2 |
| SS-65B | 709.2 | 0 | 62 | 34 | SM | 25 0 | 1.0 | 33.1 |
| SS-65B | 707.2 | 0 | 66 | 34 | SM | 25.0 | 1.0 | 32.5 |
| SS-138A | 707.2 | | 46 | 44 | SM | 25.0 | 2.0 | 28.1 |
| SS-140 | 706.7 | 0 | 64 | 36 | SM | NP | NP | 38.7 |

TABLE 2.5-40

SUMMARY OF CLASSIFICATION DATA

*Historical Information*

| Split-Spoon Boring Sample | Elevation | Gravel% | Sand% | Fines % | Class | LL | PI | (%) |
|---|---|---|---|---|---|---|---|---|
| SS 158 | 711.5 | 0 | 56 | 44 | SM | 22.7 | 2.5 | 32.2 |
| SS 162 | 713.8 | 0 | 64 | 36 | SM | NP | NP | 34.3 |
| SS 163 | 717.0 | 0 | 55 | 45 | SM | 27 2 | 3 3 | 31.1 |
| SS 163 | 715.0 | 0 | 57 | 43 | SM | 29.7 | 4.7 | 33.5 |
| SS 163A | 717.5 | 0 | 55 | 45 | SM | 30.0 | 3.0 | 36.3 |
| SS 84 | 713.4 | 0 | 58 | 42 | SM | 24.8 | 2.2 | 30.1 |
| SS-128 | 712.1 | 0 | 83 | 16 | SM | NP | NP | 23.7 |
| SS-125 | 714.4 | 0 | 92 | 8 | SM | NP | NP | 20.0 |
| SS-25 | 715.6 | 0 | 52 | 48 | SM | NP | NP | 29.2 |
| SS-130 | 715.7 | 0 | 77 | 23 | SM | NP | NP | 17.8 |
| SS-130 | 713.7 | 0 | 85 | 15 | SM | NP | NP | 15.5 |

TABLE 2.5-41 (Sheet 1 of 2)

COMPARISON OF CLASSIFICATION AND DENSITY
DATA OF TEST PIT AND UNDISTRIBUTED BORING SAMPLES

*Historical Information*

| Pit No. | Sample No. | Class | Gravel (%) | Sand (%) | Silt (%) | Clay (%) | LL (%) | PI (%) | W (%) | pcf$^{d}$ | $R_D$[1] (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| 1 | 1A-1 | SM | 0 | 57 | 27 | 16 | NP | NP | 24.7 | 91.6 | 88.5 |
| (el. 706.6) | 1A-2 | SM | 0 | 67 | 21 | 12 | NP | NP | 28.6 | 88.7 | 78.5 |
| | 1A-3 | SM | 0 | 63 | 23 | 14 | NP | NP | 28.5 | 89.5 | 81.5 |
| | 1A-4 | SM | 0 | 64 | 24 | 12 | NP | NP | 26.9 | 88.8 | 78.9 |
| | | | | | | | | | | | |
| 2 | 2A-1 | SM | 0 | 69 | 22 | 9 | NP | NP | 26.7 | 84.6 | 68.8 |
| Red to | 2A-2 | SM | 0 | 69 | 20 | 11 | NP | NP | 28.9 | 82.9 | 61.9 |
| Brown Sand | 2A-3 | SM | 0 | 66 | 25 | 9 | NP | NP | 26.1 | 83.6 | 64.7 |
| (el. 707.5) | 2A-4 | SM | 0 | 67 | 23 | 10 | NP | NP | 26.2 | 82.8 | 61.5 |
| | | | | | | | | | | | |
| 2 | 1A-1 | SM | 0 | 66 | 25 | 9 | NP | NP | 33.3 | 85.7 | 61.7 |
| Dark Brown | 1A-2 | SM | 0 | 64 | 25 | 11 | NP | NP | 32.4 | 86.1 | 63.3 |
| Sand | 1A-3 | SM | 0 | 64 | 26 | 10 | NP | NP | 31.2 | 86.4 | 64.3 |
| (el. 706.5) | | | | | | | | | | | |

TABLE 2.5-41 (Sheet 2 of 2)

COMPARISON OF CLASSIFICATION AND DENSITY
DATA OF TEST PIT AND UNDISTRIBUTED BORING SAMPLES

Historical Information

| | | Grain Size Analysis | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Undistributed | | Gravel | Sand | Silt | Clay | LL | PI | W | | | $R_D$[1] |
| Boring No. | el[2] | Class | (%) | (%) | (%) | (%) | (%) | (%) | (%) | pcf[d] | (%) |
| | | | | | | | | | | | |
| US-50-1 | 701.4 | SM | 0 | 59 | 25 | 16 | 31.6 | 6.1 | 26.6 | 92.4 | ND3 |
| | 698.9 | SM | 0 | 82 | 14 | 5 | NP | NP | 33.0 | 84.0 | ND |
| | 696.4 | SM | 0 | 88 | 9 | 4 | NP | NP | 28.9 | 93.1 | ND |
| | 695.3 | SM | 0 | 53 | 34 | 14 | 23.1 | NP | 31.1 | 90.4 | ND |
| | 694.2 | SM | 0 | 80 | 15 | 5 | NP | NP | 30.5 | 93.5 | ND |
| | | | | | | | | | | | |
| US-50-1A | 703.9 | SM | 0 | 64 | 24 | 12 | NP | 1.0 | 25.9 | 95.0 | ND |
| | 701.6 | SM | 0 | 67 | 22 | 11 | NP | NP | 37.8 | 79.2 | ND |
| | | | | | | | | | | | |
| US-65-1 | 711.9 | SM | 0 | 70 | 22 | 8 | NP | NP | 22.2 | 88.6 | ND |
| | 709.4 | SM | 2 | 60 | 25 | 13 | NP | NP | 22.7 | 90.3 | ND |
| | 707.2 | SM | 0 | 65 | 24 | 11 | NP | NP | 33.4 | 87.0 | ND |
| | 705.2 | SM | 3 | 49 | 30 | 16 | 26.1 | 2.8 | 31.6 | 92.3 | ND |
| | | | | | | | | | | | |
| US-77 | 715.1 | SM | 0 | 67 | 22 | 13 | NP | NP | 28.9 | 92.2 | ND |
| | | | | | | | | | | | |
| US-92 | 715.9 | SM | 5 | 74 | 15 | 6 | NP | NP | 16.0 | 96.6 | ND |

Notes:

[1] $R_D$ was determined in accordance with ASTM D2049.
[2] Elevation at top of sample.
[3] Not Determined.

TABLE 2.5-42

WATTS BAR NUCLEAR PLANT

SOIL-SUPPORTED STRUCTURES REPRESENTATIVE BASAL GRAVEL SAMPLES
SUMMARY OF LABORATORY TEST DATA

*Historical Information*

| Boring No | Soil Elevation | Symbol | Average In-Situ Dry Density (From Shelby Tubes) | Consolidated Dry Density (From 12" x 12" x 6" Shear Box) | Direct Shear Tests | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Test Dry Density | ϕ | c | Test Dry Density | ϕ | c |
| | | | pcf | pcf | pcf | deg | tsf | pcf | deg | deg |
| 125 | 711.4-705.2 | GP-GM | 97.0 | 121.6 | 113.8 | 40.0 | 0.00 | 121.3 | 41.0 | 0.03 |
| 126 | 714.1-708.0 | G-SM | 131.3 | 121.8 | 120.0 | 36.5 | 0.00 | --- | --- | --- |
| 127, 128 | 711.2-708.6 | GP-GM | 126.9 | 133.7 | 123.7 | 42.0 | 0.00 | 132.5 | 43.5 | 0.07 |
| 129 | 712.1-706.6 | GP-GM | 117.0 | 122.0 | 116.2 | 39.0 | 0.00 | 123.6 | 41.0 | 0.0 |
| 130 | 712.1-705.0 | G-SM | 120.3 | 121.6 | 120.8 | 37.5 | 0.10 | --- | --- | --- |

TABLE 2.5-43 (SHEET 1 of 2)

WATTS BAR NUCLEAR PLANT
SOIL-SUPPORT STRUCTURES UNDISTRIBUTED SAMPLING
SUMMARY OF LABORATORY TEST DATA

Historical Information

| Elevation | Soil Symbol | Nat. Moist % | % Sat. | Gravel % | Grain-Size Analysis Sand % | Silt % | Clay % | D10 mm | Atterb. Limits Liq. Limit % | Plastic Index % | Dry Dens. pcf | Void Ratio | Triaxial Q Undisturbed N deg. | c tsf | Apparent N deg. | c tsf | Saturated Triaxial R Effective N deg. | c tsf | Consolidation Cc | Cr | Pc tsf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-125, 104.3 S 382, SE, Surface elevation 727.4 | | | | | | | | | | | | | | | | | | | | | |
| 706.8-705.8 | GW | 11.1 | --- | 62 | 33 | 5 | 0 | .3024 | NP | NP | --- | --- | | | | | | | | | |
| 705.8-705.3 | G-SP-SM | 27.8 | 100.0 | 22 | 70 | 8 | 0 | .1524 | NP | NP | 98.4 | .699 | | | | | | | | | |
| 705.3-704.3 | G-SP-SM | 22.0 | 88.0 | 12 | 80 | 8 | 0 | .1700 | NP | NP | 100.1 | .671 | | | | | | | | | |
| Boring US-126, 184.5 N 379.9 E, Surface elevation 729.1 | | | | | | | | | | | | | | | | | | | | | |
| 709.6-709.1 | GP-GM | 9.1 | --- | 54 | 38 | 8 | 0 | .1348 | NP | NP | 131.3 | --- | | | | | | | | | |
| 709.1-707.5 | SM | 19.0 | 83.4 | 6 | 46 | 38 | 10 | .0045 | 29.1 | 3.4 | 106.4 | .636 | 8.0 | 1.03 | 30.8 | 0.00 | 37.5 | 0.00 | 0.14 | 0.01 | 2.4 |
| Boring US-126A, 186.4 N 381.9 E, Surface elevation 729.1 | | | | | | | | | | | | | | | | | | | | | |
| 709.4-707.90 | SM | 17.3 | 82.1 | 11 | 66 | 19 | 4 | .0248 | NP | NP | 108.8 | .579 | | | | | | | | | |
| Boring US-127, 235.8 N 117.5 E, Surface elevation 728.2 | | | | | | | | | | | | | | | | | | | | | |
| 711.2-709.6 | GP | 7.8 | 85.4 | 63 | 33 | 4 | 0 | .2789 | NP | NP | 135.0 | .243 | | | | | | | | | |
| 709.0-707.2 | G-SM | 23.3 | 90.5 | 14 | 56 | 22 | 8 | .0083 | 37.3 | 8.6 | 100.5 | .708 | 5.0 | 0.78 | 15.2 | 0.25 | 22.6 | 0.15 | 0.15 | 0.01 | 5.0 |
| 707.0-705.3 | SM | 24.4 | 96.1 | 1 | 49 | 42 | 8 | .0067 | 35.9 | 5.0 | 100.9 | .697 | | | | | | | | | |
| Boring HD-127, 235.8 N 122.5 E, Surface elevation 728.1 | | | | | | | | | | | | | | | | | | | | | |
| 709.9-709.3 | GP | 23.9 | --- | 61 | 34 | 5 | 0 | .2410 | NP | NP | --- | --- | | | | | | | | | |
| 709.1-707.2 | G-SM-SC | 15.3 | 90.2 | 13 | 57 | 26 | 4 | .0156 | 26.7 | 6.4 | 117.6 | .410 | | | | | | | | | |
| Boring US-128, 191.3 N 7.5 W, Surface elevation 727.1 | | | | | | | | | | | | | | | | | | | | | |
| 710.1-708.1 | GP-GM | 8.6 | --- | 61 | 33 | 6 | 0 | .1816 | NP | NP | 128.7 | --- | | | | | | | | | |
| 702.9-702.4 | ML-CL | 30.2 | --- | 0 | 40 | 48 | 12 | .0035 | 43.5 | 17.2 | 105.1 | --- | | | | | | | | | |
| Boring US-128A, 183.7 N 7.5 W, Surface elevation 727.1 | | | | | | | | | | | | | | | | | | | | | |
| 710.6-710.1 | GP-GM | 10.1 | --- | 52 | 40 | 8 | 0 | .1073 | NP | NP | 122.6 | --- | | | | | | | | | |
| 710.1-708.6 | CL | 18.7 | 82.8 | 0 | 10 | 57 | 33 | --- | 40.8 | 18.5 | 105.6 | .621 | 14.0 | 0.60 | 23.5 | 0.20 | 34.5 | 0.00 | 0.13 | 0.01 | 2.3 |
| Boring SH-128, 189.3 N 7.5 W, Surface elevation 727.1 | | | | | | | | | | | | | | | | | | | | | |
| 707.8-706.1 | G-SM | 10.9 | 71.0 | 15 | 57 | 24 | 4 | 0148 | 28.3 | 4.7 | 121.1 | .427 | | | | | | | | | |
| 703.1-702.7 | SC | 24.6 | --- | 1 | 49 | 37 | 13 | 0035 | 31.0 | 10.9 | --- | --- | | | | | | | | | |

TABLE 2.5-43 (Sheet 2 of 2)

WATTS BAR NUCLEAR PLANT
SOIL-SUPPORT STRUCTURES UNDISTRIBUTED SAMPLING
SUMMARY OF LABORATORY TEST DATA

Historical Information

| Elevation | Soil Symbol | Nat. Moist % | % Sat. | Gravel % | Grain-Size Analysis Sand % | Silt % | Clay % | D10 mm | Atterb. Limits Liq. Limit % | Plastic Index % | Dry Dens. pcf | Void Ratio | Triaxial Q Undisturbed N deg. | c Tsf | Saturated Triaxial R Apparent N deg. | c Tsf | Effective N deg. | c Tsf | Consolidation Cc | Cr | Pc tsf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boring US-129, 144.3 N 227.5 W, Surface elevation 725.3 | | | | | | | | | | | | | | | | | | | | | |
| 708.3-707.0 | GP-GM | 15.3 | --- | 45 | 45 | 10 | 0 | 0756 | NP | NP | 111.2 | --- | | | | | | | | | |
| 707.0-706.1 | CL-CH | 30.4 | 93.5 | 1 | 25 | 34 | 40 | ---- | 50.6 | 25.1 | 90.7 | .898 | 0.5 | 0.59 | 14.3 | 0.23 | 25.0 | 0.00 | 0.32 | 0.06 | 0.8 |
| Boring HD-129, 144.3 N 232.5 W, Surface elevation 725.6 | | | | | | | | | | | | | | | | | | | | | |
| 709.1-707.7 | GP-GM | 14.8 | 100.0 | 53 | 35 | 8 | 4 | .0671 | 19.2 | 3.0 | 127.7 | .367 | | | | | | | | | |
| 707.7-706.5 | G-CH | 33.4 | 94.8 | 18 | 16 | 39 | 27 | ----- | 51.9 | 26.0 | 87.7 | .981 | | | | | | | | | |
| Boring US-130, 95.7 S 142.5 W, Surface elevation 724.7 | | | | | | | | | | | | | | | | | | | | | |
| 710.2-709.7 | GP-GM | 11.0 | 95.9 | 49 | 39 | 8 | 4 | .0650 | NP | NP | 129.0 | .311 | | | | | | | | | |
| 709.7-709.4 | GP-GM | 8.8 | 100.0 | 67 | 25 | 5 | 3 | .3090 | NP | NP | 138.5 | .213 | | | | | | | | | |
| 704.7-703.3 | CL | 29.5 | 95.1 | 0 | 9 | 58 | 33 | ---- | 48.2 | 20.8 | 92.4 | .851 | 2.0 | 1.17 | 15.0 | 0.15 | 24.5 | 0.10 | 0.22 | 0.02 | 3.6 |
| 703.2-701.1 | G-SM-SC | 8.8 | ---- | 17 | 61 | 18 | 4 | .0217 | 25.8 | 6.4 | 108.1 | --- | | | | | | | | | |
| 700.7-699.3 | SC | 14.8 | ---- | 0 | 63 | 32 | 5 | .0112 | 27.6 | 7.7 | 119.9 | --- | | | | | | | | | |
| Boring HD-130, 95.7 S 137.5 W, Surface elevation 724.7 | | | | | | | | | | | | | | | | | | | | | |
| 707.7-706.3 | GP-GM | 11.1 | ---- | 52 | 41 | 7 | 0 | .1777 | NP | NP | 107.5 | --- | | | | | | | | | |
| 706.2-705.4 | G-SM | 12.4 | 81.9 | 30 | 58 | 9 | 3 | .0523 | NP | NP | 119.7 | .411 | | | | | | | | | |
| 705.4-704.4 | CL | 24.1 | 99.3 | 0 | 12 | 54 | 34 | ---- | 48.8 | 24.0 | 104.4 | .683 | | | | | | | | | |
| Boring SS-130-A, 100.0 S 130.0 W, Surface elevation 724.7 | | | | | | | | | | | | | | | | | | | | | |
| 706.0-705.6 | GC | 12.5 | 64.2 | 47 | 35 | 11 | 7 | .0144 | 29.1 | 8.5 | 112.0 | .536 | | | | | | | | | |
| 705.6-704.0 | CH-MH | 24.8 | 93.8 | 0 | 9 | 52 | 39 | ---- | 57.5 | 28.4 | 100.3 | .743 | | | | | | | | | |

TABLE 2.5-44

WBNP – BEARING CAPACITY – CATEGORY I SOIL-SUPPORTED STRUCTURES
ADOPTED SOIL PROPERTIES FOR BEARING CAPACITY DETERMINATION

Historical Information

| | Unit Weight (PCF) | | | Strength Tests | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Q | | R | | R or S | |
| Material | Moist | Sat. | Sub | ϕ (DEG) | C (PSF) | ϕ (DEG) | C (PSF) | ϕ (DEG) | C PSF) |
| Granular fill | 133 | 142 | 80 | | 1400 | 38[a] | 0[a] | 38 | 700 |
| In-situ gravel (N > 50) | 125 | 143 | 72 | 3 [a] | 0[a] | 39[a] | 0[a] | 39 | 0 |
| In-situ gravel (N = 16, 17) | 120[a] | 130[a] | 68[a] | 3 [a] | 0[a] | 30[a] | 0[a] | 30[a] | 0[a] |
| Weathered shale | - | 127 | 64 | 0 | 1600 | 18 | 300 | 27 | 0 |

[a] Properties assumed.

TABLE 2.5-45

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION TRENCH A
SUMMARY OF LABORATORY TEST DATA BORROW SOIL CLASSES

Historical Information

| Class | I | II | III |
|---|---|---|---|
| Symbol | SM-SC | SC | CL |
| Mechanical and Hydrometer Analysis | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 70 | 51 | 40 |
| Silt, percent | 15 | 24 | 29 |
| Clay, percent | 15 | 25 | 31 |
| Atterberg Limits | | | |
| Liquid limit, percent | 24 | 28 | 34 |
| Plastic limit, percent | 19 | 17 | 19 |
| Plasticity index, percent | 5 | 11 | 15 |
| Shrinkage limit, percent | -- | -- | -- |
| Standard Proctor Compaction | | | |
| Optimum moisture, percent | 13.1 | 14.1 | 15.9 |
| Maximum density, pcf | 116.6 | 114.4 | 110.8 |
| Penetration resistance, psi | 910 | 840 | 760 |
| Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight | | | |
| Triaxial R: o, degrees | 15.0 | 14.8 | 18.0 |
| c, tsf | 0.29 | 0.11 | 0.03 |
| Shear Strength at 3% Dry of Optimum Moisture and at 100% of Maximum Unit Weight | | | |
| Triaxial R: o, degrees | -- | 15.7 | 16.8 |
| c, tsf | -- | 0.19 | 0.10 |
| Percent of class in area | 8 | 61 | 31 |
| Natural moisture content, percent | 18.5 | 19.4 | 20.7 |

TABLE 2.5-45a

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION, TRENCH A SUPPLEMENTAL BORROW
SUMMARY OF LABORATORY TEST DATA BORROW SOIL CLASSES

Historical Information

| Group | 1 | 2 | 3 |
|---|---|---|---|
| Symbol | ML | SM | ML |
| Mechanical and Hydrometer Analysis | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 16 | 54 | 43 |
| Silt, percent | 44 | 31 | 15 |
| Clay, percent | 40 | 15 | 22 |
| Atterberg Limits | | | |
| Liquid limit, percent | 47 | 26 | 34 |
| Plastic limit, percent | 29 | 25 | 26 |
| Plasticity index, percent | 18 | 1 | 8 |
| Shrinkage limit, percent | -- | -- | -- |
| Standard Protoctor Compaction | | | |
| Optimum moisture, percent | 21.4 | 17.3 | 18.8 |
| Maximum density, pcf | 99.7 | 108.4 | 105 3 |
| Penetration resistance, psi | 1180 | 860 | 800 |
| Shear Strength at 3% Dry of Optimum Moisture and at 100% of maximum Unit Weight | | | |
| Triaxial R: $\phi$, degrees | 13.0 | 11.6 | 12.9 |
| c, tsf | 0.45 | 0.46 | 0 69 |
| Percent of class in area | -- | -- | |
| Natural moisture content, percent | -- | -- | -- |

*Group 2 tested at 95 percent of maximum unit weight.

TABLE 2.5-46

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION TRENCH B
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL CLASSES

Historical Information

| Class | I | II | III |
|---|---|---|---|
| Symbol | SM | SM-SC | CL |
| Mechanical and Hydrometer Analysis | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 66 | 55 | 43 |
| Silt, percent | 22 | 24 | 28 |
| Clay, percent | 12 | 21 | 29 |
| Atterberg Limits | | | |
| Liquid limit, percent | NP | 28 | 30 |
| Plastic limit, percent | N | 22 | 19 |
| Plasticity index, percent | NP | 6 | 11 |
| Shrinkage limit, percent | -- | -- | -- |
| Standard Proctor Compaction | | | |
| Optimum moisture, percent | 15.3 | 15.6 | 15.8 |
| Maximum density, pcf | 110.7 | 110.3 | 109.8 |
| Penetration resistance, psi | 770 | 1025 | 1425 |
| Shear Strength at 3% Dry of Optimum Moisture | 7 6 | 5.5 | 10.4 |
| and at 95% of Maximum Unit Weight | 1.67 | 1.05 | 0.32 |
| Triaxial R: o, degrees | | | |
| c, tsf | | | |
| Percent of class in area | 26 | 22 | 52 |
| Natural moisture content, percent | 25.0 | 28.4 | 22.2 |

TABLE 2.5-47

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 9
SUMMARY OF LABORATORY TEST DATA BORROW SOIL CLASSES

Historical Information

| | | |
|---|---|---|
| Class | I | II |
| Symbol | CL | CL-ML |
| Mechanical and Hydrometer Analysis | | |
| Gravel, percent | 0 | 0 |
| Sand, percent | 24 | 32 |
| Silt, percent | 40 | 27 |
| Clay, percent | 36 | 41 |
| Atterberg Limits | | |
| Liquid limit, percent | 31 | 40 |
| Plastic limit, percent | 15 | 25 |
| Plasticity index, percent | 16 | 15 |
| Shrinkage limit, percent | -- | -- |
| Standard Proctor Compaction | | |
| Optimum moisture, percent | 16.4 | 19.6 |
| Maximum density, pcf | 110.3 | 104.0 |
| Penetration resistance, psi | 350 | 680 |
| Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight | | |
| Triaxial R: $\phi$, degrees | 12.3 | 8.0 |
| c, tsf | 0.11 | 0.57 |
| Shear Strength at 3% Dry of Optimum Moisture and at 100% of Maximum Unit Weight | | |
| Triaxial R: $\phi$, degrees | 11.6 | -- |
| c, tsf | 0.28 | -- |
| Percent of class in area | 50 | 50 |
| Natural moisture content, percent | 18.1 | 21.7 |

TABLE 2.5-48

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 10
SUMMARY OF LABORATORY TEST DATA BORROW SOIL CLASSES

Historical Information

| | | |
|---|---|---|
| Class | I | II |
| Symbol | CL | CL-ML |
| Mechanical and Hydrometer Analysis | | |
| Gravel, percent | 0 | 0 |
| Sand, percent | 33 | 19 |
| Silt, percent | 31 | 33 |
| Clay, percent | 36 | 48 |
| Atterberg Limits | | |
| Liquid limit, percent | 39 | 45 |
| Plastic limit, percent | 23 | 26 |
| Plasticity index, percent | 16 | 19 |
| Shrinkage limit, percent | -- | -- |
| Standard Proctor Compaction | | |
| Optimum moisture, percent | 20.6 | 25.4 |
| Maximum density, pcf | 103.0 | 93.3 |
| Penetration resistance, psi | 620 | 860 |
| Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight* | 11.9 | 15.2 |
| Triaxial R: $\phi$, degrees | 0.21 | 0.09 |
| c, tsf | | |
| Shear Strength at 3% Dry of Optimum Moisture and at 100% of Maximum Unit Weight | | |
| Triaxial R:$\phi$, degrees | -- | 15 0 |
| c, tsf | -- | 0.12 |
| Percent of class in area | 86 | 14 |
| Natural moisture content, percent | 23.9 | 27.6 |

*At a density of 90 pcf on class II.

TABLE 2.5-49

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 11
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL CLASSES

Historical Information

| | |
|---|---|
| Class | I |
| Symbol | ML |
| Mechanical and Hydrometer Analysis | |
| Gravel, percent | 0 |
| Sand, percent | 21 |
| Silt, percent | 35 |
| Clay, percent | 44 |
| Atterberg Limits | |
| Liquid limit, percent | 44 |
| Plastic limit, percent | 29 |
| Plasticity index, percent | 15 |
| Shrinkage limit, percent | -- |
| Standard Proctor Compaction | |
| Optimum moisture, percent | 22.2 |
| Maximum density, pc | 99.8 |
| Penetration resistance, psi | 850 |
| Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight* | |
| Triaxial R: $\phi$, degrees | 13.2 |
| c, tsf | 0.21 |
| Percent of class in area | 100 |
| Natural moisture content, percent | 26.9 |

TABLE 2.5-50

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 12
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL CLASSES

Historical Information

| Class | I | II | III |
|---|---|---|---|
| Symbol | SM | CL-ML | CL-ML |
| **Mechanical and Hydrometer Analysis** | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 50 | 22 | 22 |
| Silt, percent | 26 | 39 | 40 |
| Clay, percent | 24 | 39 | 38 |
| **Atterberg Limits** | | | |
| Liquid limit, percent | 32 | 40 | 42 |
| Plastic limit, percent | 25 | 25 | 26 |
| Plasticity index, percent | 7 | 15 | 16 |
| Shrinkage limit, percent | -- | -- | -- |
| **Standard Proctor Compaction** | | | |
| Optimum moisture, percent | 16.8 | 17.8 | 19.2 |
| Maximum density, pcf | 108.8 | 106 5 | 103.7 |
| Penetration resistance, psi | 1165 | 1150 | 1140 |
| **Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight** | | | |
| Triaxial R: $\phi$, degrees | 9.5 | 12.0 | 16.4 |
| c, tsf | 0.57 | 0.29 | 0.04 |
| **Shear Strenght at 3% Dry of Optimum Moisture and at 100% of Maximum Unit Weight** | | | |
| Triaxial R: $\phi$, degrees | | -- | 12.5 |
| c, tsf | -- | | 0.39 |
| Percent of class in area | 12 | 55 | 33 |
| Natural moisture content, percent | 21.6 | 24 9 | 25.2 |

TABLE 2.5-51

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 13
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL CLASSES

Historical Information

| Class | I | II | III |
|---|---|---|---|
| | | | |
| Symbol | ML | ML | MH |
| | | | |
| Mechanical and Hydrometer Analysis | | | |
| Gravel, percent | 0 | 0 | 0 |
| Sand, percent | 24 | 23 | 12 |
| Silt, percent | 42 | 39 | 41 |
| Clay, percent | 34 | 38 | 47 |
| | | | |
| Atterberg Limits | | | |
| Liquid limit, percent | 37 | 41 | 52 |
| Plastic limit, percent | 26 | 27 | 35 |
| Plasticity index, percent | 11 | 14 | 17 |
| Shrinkage limit, percent | --- | --- | --- |
| | | | |
| Standard Proctor Compaction | | | |
| Optimum moisture, percent | 19.2 | 20.0 | 23.3 |
| Maximum density, pcf | 106.6 | 105.1 | 98.8 |
| Penetration resistance, psi | 650 | 800 | 740 |
| | | | |
| Shear Strength at 3% Dry of Optimum Moisture | | | |
| and at 95% of Maximum Unit Weight | | | |
| Triaxial R: $\phi$, degrees | 15.6 | 14.5 | 18.3 |
| c, tsf | 0.15 | 0.14 | 0.02 |
| | | | |
| Shear Strength at 3% Dry of Optimum Moisture | | | |
| and at 100% of Maximum Unit Weight | | | |
| Triaxial R: $\phi$, degrees | 11.7 | 14.5 | 14.7 |
| c, tsf | 0.66 | 0.51 | 0.44 |
| | | | |
| Percent of class in area | 45 | 50 | 5 |
| | | | |
| Natural moisture content, percent | 19.6 | 22.7 | 27.6 |

TABLE 2.5-52

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION
BORROW AREA 2C
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL CLASSES

Historical Information

| Class | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| Symbol | ML | SM-SC | CL | CL | CL-ML | MH |
| **Mechanical and Hydrometer Analysis** | | | | | | |
| Gravel, percent | 0 | 0 | 0 | 0 | 0 | 0 |
| Sand, percent | 48 | 65 | 48 | 30 | 23 | 5 |
| Silt, percent | 40 | 16 | 23 | 34 | 39 | 40 |
| Clay, percent | 12 | 19 | 29 | 36 | 38 | 55 |
| **Atterberg Limits** | | | | | | |
| Liquid limit, percent | NP | 25 | 36 | 41 | 44 | 62 |
| Plastic limit, percent | NP | 19 | 22 | 24 | 27 | 35 |
| Plasticity index, percent | NP | 6 | 14 | 17 | 17 | 27 |
| Shrinkage limit, percent | --- | --- | --- | --- | --- | --- |
| **Standard Proctor Compaction** | | | | | | |
| Optimum moisture, percent | 12.1 | 13.9 | 16.6 | 18.1 | 19.5 | 26.8 |
| Maximum density, pcf | 117.7 | 114.0 | 109.0 | 106.2 | 103.5 | 90.8 |
| Penetration resistance, psi | 1000 | 1125 | 1050 | 760 | 840 | 950 |
| **Shear Strength at 3% Dry of Optimum Moisture and at 95% of Maximum Unit Weight*** | | | | | | |
| Triaxial R: $\phi$, degrees | 17.5 | ** | 13.4 | 9.0 | 18.1 | 19.0 |
| c, tsf | 0.63 | ** | 0.11 | 0.33 | 0.00 | 0.00 |
| **Shear Strength at 3% Dry of Optimum Moisture and at 100% of Maximum Unit Weight***** | | | | | | |
| Triaxial R: $\phi$, degrees | --- | --- | 13.0 | --- | 15.3 | 17.4 |
| c, tsf | --- | --- | 0.58 | --- | 0.22 | 0.24 |
| Percent of class in area | 1 | 1 | 3 | 31 | 63 | 1 |
| Natural moisture content, percent | 21.7 | 20.5 | 26.4 | 22.9 | 23.6 | 31.6 |

*Class VI tested at 90.0 pcf
**Class II is less than 1% of total borrow and no shear tests were conducted on this class.
***Class VI tested at 105% of maximum unit weight.

TABLE 2.5-53

WATTS BAR NUCLEAR PLANT
ERCW LIQUEFACTION BORROW AREA 2C EXTENSION
SUMMARY OF LABORATORY TEST DATA
BORROW SOIL GROUPS

Historical Information

| Group | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Symbol | CL | CL | CL | CL | CL- MH | MH | CL | CL - ML | SM |
| Mechanical and Hydrometer Analysis | | | | | | | | | |
| Gravel Percent | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sand percent | 23 | 30 | 24 | 20 | 23 | 15 | 36 | 42 | 55 |
| Silt Percent | 48 | 42 | 43 | 40 | 36 | 27 | 36 | 33 | 30 |
| Clay Percent | 29 | 28 | 33 | 40 | 41 | 58 | 28 | 25 | 14 |
| Atterberg Limits | | | | | | | | | |
| Liquid limit, percent | 34 | 34 | 40 | 41 | 47 | 58 | 37 | 35 | 21 |
| Plastic limit, percent | 21 | 22 | 24 | 24 | 28 | 32 | 23 | 23 | 20 |
| Plasticity index, percent | 13 | 12 | 16 | 17 | 19 | 26 | 14 | 12 | 1 |
| Shrinkage limit, percent | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Standard Proctor Compaction | | | | | | | | | |
| Optimum moisture, percent* | 16.6 | 17.3 | 18.8 | 20.2 | 21.7 | 28.1 | 16.6 | 16.6 | 14.8 |
| Maximum density, pcf | 109.0 | 107.7 | 104.8 | 102.3 | 99.6 | 88.0 | 109.0 | 109.0 | 112.8 |
| Penetration resistance, psi | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Percent of group in area | 3 | | | | | 3 | | 3 | 1 |
| Natural moisture content, percent | 21.5 | 16.4 | 21.5 | 21.8 | 26.5 | 27.2 | 14.0 | 16.6 | 10.1 |

*Standard proctor compaction results are based on borrow area 2C family of curves.

Note: Shear strength tests were not conducted on the extension of borrow area 2C.

TABLE 2.5-54

SUMMARY OF LABORATORY TEST DATA

Historical Information

| | Maximum Fines Graduation | | Average Fines Graduation | | Minimum Fines Graduation | |
|---|---|---|---|---|---|---|
| Minimum density, pcf | 107.1 | | 103.1 | | 108.7 | |
| Maximum density, pcf | 143.1 | | 139.5 | | 143.9 | |
| | $\phi$ | C tsf | $\phi$ | C tsf | $\phi$ | C tsf |
| Triaxial Shear (Q) | | | | | | |
| At 80% $R_d$ | 38.7 | 0.73 | 38.3 | 1.46 | 40.5 | 1.91 |
| At 70% $R_d$ | 38.5 | 0.50 | 42.5 | 0.80 | 42.0 | 1.64 |
| Triaxial Shear (R) | | | | | | |
| At 80% $R_d$ | 39.3 | 1.93 | 41.8 | 0.99 | 43.7 | 0.34 |
| Direct Shear (S) | | | | | | |
| At 80% $R_d$ | 39.4 | 0.30 | 42.0 | 0.52 | 44.2 | 0.63 |
| At 70% $R_d$ | 36.0 | 0.35 | 44.0 | 0.24 | 42.5 | 0.52 |

$R_d$ = Relative density

TABLE 2.5-55

GRANULAR MATERIAL DESIGN VALUES
SECTION 1032 MATERIAL

Historical Information

| Relative Density | Unit Weight | | Shear Strength Values | | | |
|---|---|---|---|---|---|---|
| | $Y_m$ (pcf) | $Y_{sat}$ (pcf) | Q | | R&S* | |
| | | | $\phi$ | C (tsf) | $\phi$ | C (tsf) |
| 80% | 135 | 143 | 39° | 1.0 | 40° | 0.5 |
| 70% | 133 | 142 | 39° | 0.7 | 38° | 0.35 |

*For an analysis where pore pressure buildup has to be considered, estimated pore pressure should be incremented (suggest 10% increments) to a reasonable maximum level to check the effect of pore pressure buildup.

$Y_m$ = Moist unit weight

$Y_{sat}$ = Saturated unit weight

Q = Unconsolidated - undrained triaxial shear test

$\bar{R}$ = Consolidated - undrained triaxial shear test (effective)

S = Direct shear test

TABLE 2.5-56

WATTS BAR NUCLEAR PLANT

RELATIVE DENSITY TEST RESULTS ON ENGINEERED
GRANULAR FILL BENEATH THE DIESEL GENERATOR BUILDING

Historical Information

| Sample | Max. Dry Density (pcf) | Min. Dry Density (pcf) | Field Density (pcf) | Relative Density (%) |
|---|---|---|---|---|
| 158 | 144.6 | 100.4 | 132.0 | 78 |
| 159 | 144.6 | 100.4 | 133.0 | 80 |
| 160 | 144.6 | 100.4 | 135.0 | 84 |
| 162 | 144.6 | 100.4 | 137.75 | 82 |
| 163 | 144.6 | 100.4 | 136.5 | 87 |
| 164 | 144.6 | 100.4 | 131.25 | 77 |
| 167 | 144.6 | 100.4 | 135.50 | 85 |
| 168 | 144.6 | 100.4 | 138.00 | 89 |
| 169 | 144.6 | 100.4 | 135.75 | 85 |
| 170 | 144.6 | 100.4 | 131.50 | 77 |
| 171 | 144.6 | 100.4 | 136.75 | 87 |
| 172 | 144.6 | 100.4 | 133.25 | 81 |
| 178 | 144.6 | 100.4 | 130.25 | 75 |
| 179 | 144.6 | 100.4 | 131.5 | 77 |
| 180 | 144.6 | 100.4 | 131.0 | 76 |
| 184 | 144.6 | 100.4 | 130.75 | 78 |
| 185 | 144.6 | 100.4 | 137.5 | 88 |
| 186 | 144.6 | 100.4 | 130.5 | 76 |
| 190 | 144.6 | 100.4 | 138.5 | 90 |
| 191 | 144.6 | 100.4 | 136.25 | 86 |
| 192 | 144.6 | 100.4 | 134.75 | 83 |
| 194 | 144.6 | 100.4 | 128.75 | 72 |
| 195 | 144.6 | 100.4 | 132.0 | 78 |
| 196 | 144.6 | 100.4 | 131.5 | 77 |
| 199 | 144.6 | 100.4 | 129.5 | 76 |
| 200 | 144.6 | 100.4 | 137.25 | 88 |
| 201 | 144.6 | 100.4 | 130.75 | 77 |
| 204 | 144.6 | 100.4 | 125.75 | 66 |
| 205 | 144.6 | 100.4 | 127.75 | 70 |
| 206 | 144.6 | 100.4 | 127.75 | 70 |
| 210 | 144.6 | 100.4 | 128.25 | 71 |
| 211 | 144.6 | 100.4 | 137.0 | 87 |
| 212 | 138.8 | 109.9 | 133.5 | 83 |
| 213 | 138.8 | 109.9 | 137.0 | 96 |
| 214 | 138.8 | 109.9 | 136.5 | 93 |
| 217 | 138.8 | 109.9 | 133.75 | 86.5 |
| 218 | 138.8 | 109.9 | 136.5 | 94.5 |

TABLE 2.5-57 (Sheet 1 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| SCREEN SIZE | | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PERCENT PASSING | | | | | | | | | |
| SPECIFICATION LIMITS 1032.02 | | | | 100 | 95 100 | 70 100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 |
| DATE | TIME | SAMPLE SOURCE | SAMPLE WT.(LBS) | | | | | | | | | | |
| 3-21-75 | 12:10 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 91.1 | 66.6 | 44.5 | 26.2 | NA | 10.4 | NA | 4 1 |
| 3-25-75 | 1:00 PM | TVA Stockpile | 15.0 | 100.0 | 100.0 | 91.1 | 76.7 | 54.2 | 32.1 | NA | 10.2 | NA | 3 9 |
| 3-26-75 | 11:15 AM | TVA Stockpile | 16.7 | 100.0 | 97.2 | 87.2 | 62.4 | 43.7 | 26.8 | NA | 5.7 | NA | |
| 3-27-75 | 2:30 PM | TVA Stockpile | 16.7 | 100.0 | 93.6 | 85.8 | 65.3 | 47.1 | 24.4 | NA | 11.2 | NA | 4.8 |
| 3-28-75 | 9:15 AM | TVA Stockpile | 16.6 | 100.0 | 100.0 | 93.0 | 79.3 | 58.2 | 38.0 | NA | 14.4 | NA | 4.4 |
| 3-31-75 | 9:40 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 92.9 | 66.6 | 42.2 | 23.9 | NA | 9.5 | NA | 4.2 |
| 4-1-75 | 10:30 AM | TVA Stockpile | 15.0 | 100.0 | 96.2 | 93.7 | 78.4 | 56.9 | 34.1 | NA | 13.4 | NA | 5.1 |
| 4-2-75 | 12:00 PM | TVA Stockpile | 16.4 | 100.0 | 100.0 | 91.6 | 64.6 | 42.6 | 24.5 | NA | 9.0 | NA | 3.9 |
| 4-3-75 | 10:45 AM | TVA Stockpile | 16.3 | 100.0 | 98.1 | 90.1 | 74.3 | 55.8 | 31.6 | NA | 5.3 | NA | 1.6 |
| 4-4-75 | 9:30 AM | TVA Stockpile | 17.0 | 100.0 | 97.8 | 92.1 | 77.2 | 59.6 | 38.7 | NA | 13.5 | NA | 4.2 |
| 4-7-75 | 12:30 PM | TVA Stockpile | 16.7 | 100.0 | 98.7 | 95.6 | 77.2 | 57.6 | 34.3 | NA | 10.3 | NA | 4.4 |
| 4-8-75 | 12:15 PM | TVA Stockpile | 16.7 | 100.0 | 95.7 | 88.3 | 61.9 | 39.9 | 25.1 | NA | 10.1 | NA | 3.4 |
| 4-9-75 | 12:10 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 95.8 | 77.5 | 53.2 | 32.1 | NA | 11.7 | NA | 3.4 |
| 4-10-75 | 1:00 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 87.2 | 49.9 | 32.2 | 20.0 | NA | 8.9 | NA | 3.9 |
| 4-11-75 | 10:00 AM | TVA Stockpile | 20.0 | 100.0 | 98.6 | 90.5 | 63.6 | 44.0 | 26.5 | NA | 8.8 | NA | 3.0 |
| 4-14-75 | 10:00 AM | TVA Stockpile | 20.0 | 100.0 | 98.5 | 91.6 | 64.0 | 40.8 | 33.5 | NA | 8.6 | NA | 4.8 |
| 4-15-75 | 10:15 AM | TVA Stockpile | 20.0 | 100.0 | 100.0 | 91.2 | 67.7 | 41.3 | 23.4 | NA | 8.1 | NA | 2.7 |

WBN

TABLE 2.5-57 (Sheet 2 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| SCREEN SIZE | | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PERCENT PASSING | | | | | | | | | |
| SPECIFICATION LIMITS 1032.02 | | | | 100 | 95-100 | 70-100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 |
| DATE | TIME | SAMPLE SOURCE | SAMPLE WT.(LBS) | | | | | | | | | | |
| 4-16-75 | 12:05 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 88.9 | 63.9 | 43.1 | 26.4 | NA | 9.7 | NA | 3.8 |
| 4-17-75 | 2:00 PM | TVA Stockpile | 16.5 | 100.0 | 100.0 | 91.7 | 64.6 | 42.8 | 24.5 | NA | 9.2 | NA | 4.0 |
| 4-18-75 | 1:35 PM | TVA Stockpile | 16.8 | 100.0 | 99.0 | 94.2 | 73.7 | 54.4 | 33.9 | NA | 11.5 | NA | 4.8 |
| 4-21-75 | 3:30 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 91.3 | 54.5 | 33.4 | 19.8 | NA | 8.5 | NA | 3.6 |
| 4-22-75 | 3:30 PM | TVA Stockpile | 16.6 | 100.0 | 100.0 | 87.6 | 55.0 | 34.1 | 19.3 | NA | 7.9 | NA | 3.4 |
| 4-23-75 | 12:05 | TVA Stockpile | 20.0 | 100.0 | 99.0 | 92.9 | 64.5 | 25.7 | 19.3 | NA | 10.1 | NA | 2.1 |
| 4-24-75 | 10:00 AM | Diesel Generator Fds | 20.0 | 100.0 | 100.0 | 95.7 | 81.2 | 59.1 | 32.9 | NA | 9.5 | NA | 4.2 |
| 4-25-75 | 10:50 AM | TVA Stockpile | 16.7 | 100.0 | 97.1 | 86.3 | 56.9 | 37.8 | 24.1 | NA | 9.1 | NA | 3.8 |
| 4-28-75 | 9:30 AM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 95.7 | 81.0 | 60.1 | 38.8 | NA | 14.5 | NA | 4.6 |
| 4-29-75 | 12:30 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 90.2 | 72.6 | 54.7 | 35.3 | NA | 12.8 | NA | 3.9 |
| 4-30-75 | 1:00 PM | TVA Stockpile | 16.9 | 100.0 | 100.0 | 95.3 | 72.2 | 49.8 | 30.3 | NA | 11.1 | NA | 3.5 |
| 5-1-75 | 10:00 AM | TVA Stockpile | 15.0 | 100.0 | 100.0 | 94.2 | 73.9 | 48.3 | 31.1 | NA | 16.3 | NA | 8.9 |
| 5-2-75 | 10:00 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 94.7 | 77.9 | 56.3 | 35.9 | NA | 13.9 | NA | 4.5 |
| 5-5-75 | 1:00 PM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 94.1 | 81.0 | 63.4 | 42.8 | NA | 17.2 | NA | 5.6 |
| 5-6-75 | 9:00 AM | TVA Stockpile | 17.0 | 100.0 | 100.0 | 97.5 | 78.5 | 57.0 | 35.7 | NA | 11.6 | NA | 3.8 |
| 5-7-75 | 8:30 AM | TVA Stockpile | 16.9 | 100.0 | 98.9 | 91.6 | 64.4 | 44.3 | 27.1 | NA | 10.3 | NA | 3.6 |
| 5-8-75 | 12:45 PM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 92.2 | 74.8 | 53.9 | 34.3 | NA | 12.3 | NA | 3.9 |

TABLE 2.5-57 (Sheet 3 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| | | | | PERCENT PASSING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCREEN SIZE | | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 |
| SPECIFICATION LIMITS 1032.02 | | | | 100 | 95-100 | 70-100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 |
| DATE | TIME | SAMPLE SOURCE | SAMPLE WT.(LBS) | | | | | | | | | | |
| 5-9-75 | 1:01 PM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 98.2 | 74.5 | 51.5 | 31.7 | NA | 11.9 | NA | 3.7 |
| 5-12-75 | 10:00 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 95.7 | 77.4 | 53.2 | 32.2 | NA | 11.7 | NA | 3.4 |
| 5-13-75 | 1:00 PM | TVA Stockpile | 16.7 | 100.0 | 98.1 | 91.9 | 75.4 | 55.5 | 35.9 | NA | 12.5 | NA | 4.0 |
| 5-14-75 | 9:45 AM | TVA Stockpile | 16.9 | 100.0 | 100.0 | 89.3 | 65.7 | 43.1 | 28.1 | NA | 10.1 | NA | 4.3 |
| 5-15-75 | 9:45 AM | TVA Stockpile | 17.0 | 100.0 | 100.0 | 93.2 | 73.4 | 52.4 | 32.8 | NA | 13.0 | NA | 4.5 |
| 5-16-75 | 10:30 AM | TVA Stockpile | 16.6 | 100.0 | 100.0 | 91.4 | 71.3 | 49.4 | 29.3 | NA | 10.1 | NA | 4.3 |
| 5-19-75 | 9:45 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 97.7 | 76.1 | 54.9 | 34.1 | NA | 10.2 | NA | 3.5 |
| 5-20-75 | 1:30 PM | TVA Stockpile | 16.1 | 100.0 | 100.0 | 86.9 | 52.2 | 30.0 | 15.0 | NA | 6.6 | NA | 8.3 |
| 5-21-75 | 9:30 AM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 95.6 | 80.9 | 60.0 | 38.4 | NA | 14.5 | NA | 4.6 |
| 5-22-75 | 10:00 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 87.3 | 49.9 | 32.2 | 19.9 | NA | 8.9 | NA | 3.9 |
| 5-23-75 | 9:30 AM | TVA Stockpile | 16.6 | 100.0 | 100.0 | 91.7 | 71.4 | 49.4 | 29.1 | NA | 10.2 | NA | 4.3 |
| 5-27-75 | 9:30 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 87.2 | 49.8 | 32.3 | 20.0 | NA | 8.9 | NA | 3.8 |
| 5-28-75 | 9:30 AM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 96.3 | 72.6 | 54.8 | 35.3 | NA | 12.8 | NA | 3.8 |
| 5-29-75 | 9:30 AM | TVA Stockpile | 16.7 | 100.0 | 98.6 | 86.4 | 64.4 | 43.3 | 24.3 | NA | 8.6 | NA | 3.5 |
| 5-30-75 | 9:30 AM | TVA Stockpile | 16.3 | 100.0 | 97.3 | 95.4 | 73.4 | 56.0 | 36.8 | NA | 13.7 | NA | 4.5 |
| 6-2-75 | 9:15 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 87.2 | 49.8 | 32.2 | 20.0 | NA | 8.9 | NA | 3.8 |

TABLE 3.5-57 (Sheet 4 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| SCREEN SIZE | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | PERCENT PASSING | | | | | | | | |
| SPECIFICATION LIMITS 1032.02 | | | 100 | 95-100 | 70-100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 | | |
| DATE | TIME | SAMPLE SOURCE | | SAMPLE WT.(LBS) | | | | | | | | | | |
| 6-3-75 | 1:00 PM | TVA Stockpile | | 15.4 | 100.0 | 100.0 | 81.3 | 54.0 | 30.2 | 20.2 | NA | 14.5 | NA | 4.8 |
| 6-4-75 | 10:30 AM | TVA Stockpile | | 16.6 | 100.0 | 100.0 | 91.7 | 66.9 | 43.7 | 24.5 | NA | 9.5 | NA | 3.2 |
| 6-5-75 | 5:00 PM | TVA Stockpile | | 16.8 | 100.0 | 98.1 | 91.2 | 73.3 | 53.1 | 29.8 | NA | 11.2 | NA | 4.5 |
| 6-6-75 | 9:30 AM | TVA Stockpile | | 15.3 | 100.0 | 97.3 | 95.2 | 73.3 | 55.9 | 36.5 | NA | 13.5 | NA | 3.7 |
| 6-9-75 | 10:00 AM | TVA Stockpile | | 16.6 | 100.0 | 100.0 | 95.6 | 77.7 | 58.0 | 33.8 | NA | 10.5 | NA | 3.5 |
| 6-10-75 | 10:00 AM | TVA Stockpile | | 16.5 | 100.0 | 100.0 | 91.5 | 71.1 | 49.1 | 29.0 | NA | 9.0 | NA | 2.8 |
| 6-12-75 | 7:30 AM | TVA Stockpile | | 16.6 | 100.0 | 99.5 | 95.8 | 77.5 | 57.6 | 34.4 | NA | 10.3 | NA | 3.5 |
| 6-13-75 | 9:30 AM | TVA Stockpile | | 16.6 | 100.0 | 100.0 | 97.7 | 82.2 | 63.5 | 41.3 | NA | 16.7 | NA | 5.9 |
| 6-16-75 | 9:30 AM | TVA Stockpile | | 16.6 | 100.0 | 99.6 | 95.7 | 77.5 | 57.9 | 34.4 | NA | 10.3 | NA | 3.4 |
| 6-17-75 | 12:30 PM | TVA Stockpile | | 16.7 | 100.0 | 97.2 | 91.9 | 77.4 | 57.4 | 35.6 | NA | 12.0 | NA | 2.5 |
| 6-18-75 | 9:30 AM | TVA Stockpile | | 16.7 | 100.0 | 100.0 | 93.8 | 76.8 | 56.5 | 35.1 | NA | 11.6 | NA | 2.8 |
| 6-19-75 | 9:30 AM | TVA Stockpile | | 16.7 | 100.0 | 100.0 | * | 67.1 | 48.6 | 29.8 | NA | 9.6 | NA | 3.4 |
| 6-20-75 | 1:00 PM | TVA Stockpile | | 15.1 | 100.0 | 100.0 | 99.9 | 75.6 | 51.5 | 26.9 | NA | 7.1 | NA | 1.5 |
| 6-23-75 | 9:30 AM | TVA Stockpile | | 16.6 | 100.0 | 97.8 | 90.4 | 69.8 | 46.9 | 27.3 | NA | 11.3 | NA | 4.2 |
| 6-24-75 | 9:30 AM | TVA Stockpile | | 16.7 | 100.0 | 99.8 | 93.3 | 64.1 | 38.0 | 22.4 | NA | 8.3 | NA | 3.2 |
| 6-25-75 | 9:30 AM | TVA Stockpile | | 15.6 | 100.0 | 100.0 | 95.2 | 77.0 | 58.2 | 33.6 | NA | 8.7 | NA | 1.6 |

*Omitted by mistake

TABLE 3.5-57 (Sheet 5 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| | | | | PERCENT PASSING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCREEN SIZE | | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 |
| SPECIFICATION LIMITS 1032.02 | | | | 100 | 95-100 | 70-100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 |
| DATE | TIME | SAMPLE SOURCE | SAMPLE WT.(LBS) | | | | | | | | | | |
| 6-26-75 | 9:30 PM | TVA Stockpile | 16.7 | 100.0 | 99.6 | 95.5 | 77.9 | 57.8 | 34.6 | NA | 11.0 | NA | 4.2 |
| 6-27-75 | 10:00 AM | TVA Stockpile | 15.8 | 100.0 | 100.0 | 92.0 | 56.1 | 37.1 | 22.9 | NA | 9.4 | NA | 3.3 |
| 6-30-75 | 9:30 AM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 89.4 | 67.4 | 48.6 | 29.9 | NA | 9.8 | NA | 3.1 |
| 7-1-75 | 12:30 PM | TVA Stockpile | 16.2 | 100.0 | 99.2 | 90.1 | 75.6 | 57.8 | 31.2 | NA | 4.8 | NA | 1.7 |
| 7-2-75 | 10:30 AM | TVA Stockpile | 16.5 | 100.0 | 100.0 | 91.8 | 64.7 | 42.7 | 24.5 | NA | 9.0 | NA | 4.0 |
| 7-3-75 | 9:30 AM | TVA Stockpile | 16.5 | 100.0 | 97.4 | 94.7 | 73.1 | 52.5 | 30.7 | NA | 8.3 | NA | 2.5 |
| 7-9-75 | 5:30 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 93.2 | 68.3 | 96.7 | 27.5 | NA | 8.7 | NA | 3.1 |
| 7-10-75 | 10:00 AM | TVA Stockpile | 16.8 | 100.0 | 97.7 | 89.7 | 73.3 | 53.7 | 34.3 | NA | 12.9 | NA | 3.6 |
| 7-11-75 | 9:30 AM | TVA Stockpile | 15.7 | 100.0 | 100.0 | 89.2 | 61.7 | 41.9 | 23.9 | NA | 7.0 | NA | 2.6 |
| 7-14-75 | 9:30 AM | TVA Stockpile | 15.8 | 100.0 | 100.0 | 91.8 | 56.4 | 37.6 | 22.7 | NA | 9.5 | NA | 3.5 |
| 7-15-75 | 2:00 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 97.6 | 75.9 | 54.8 | 34.2 | NA | 10.2 | NA | 3.4 |
| 7-16-75 | 1:00 PM | TVA Stockpile | 15.8 | 100.0 | 100.0 | 96.5 | 79.6 | 58.4 | 34.0 | NA | 9.9 | NA | 0.0 |
| 7-17-75 | 2:00 PM | TVA Stockpile | 16.4 | 100.0 | 100.0 | 98.0 | 77.0 | 57.7 | 35.0 | NA | 9.2 | NA | 1.6 |
| 7-18-75 | 2:00 PM | TVA Stockpile | 15.2 | 100.0 | 100.0 | 99.4 | 76.0 | 51.4 | 27.2 | NA | 7.5 | NA | 0.0 |
| 7-21-75 | 1:00 PM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 96.1 | 75.5 | 52.8 | 31.3 | NA | 10.1 | NA | 3.2 |
| 7-22-75 | 1:30 PM | TVA Stockpile | 16.5 | 100.0 | 100.0 | 97.5 | 77.0 | 51.9 | 28.7 | NA | 9.7 | NA | 4.0 |
| 7-23-75 | | TVA Stockpile | 16.8 | 100.0 | 100.0 | 95.6 | 80.4 | 64.8 | 43.3 | NA | 16.6 | NA | 6.5 |

TABLE 3.5-57 (Sheet 6 of 6)

WATTS BAR NUCLEAR PLANT
SIEVE ANALYSIS OF 1032 GRAVEL
TENNESSEE VALLEY AUTHORITY

Historical Information

| | | | | PERCENT PASSING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCREEN SIZE | | | | 1-1/4 in | 1 in | 3/4 in | 3/8 in | #4 | #10 | #16 | #40 | #100 | #200 |
| SPECIFICATION LIMITS 1032.02 | | | | 100 | 95-100 | 70-100 | 50-85 | 36-65 | 20-45 | NA | 8-25 | NA | 0-10 |
| DATE | TIME | SAMPLE SOURCE | SAMPLE WT.(LBS) | | | | | | | | | | |
| 7-24-75 | 10:30 PM | TVA Stockpile | 16.7 | 100.0 | 100.0 | 97.5 | 64.9 | 40.2 | 21.7 | NA | 6.8 | NA | 1.2 |
| 7-25-75 | | TVA Stockpile | 16.8 | 100.0 | 100.0 | 92.2 | 74.8 | 53.9 | 34.3 | NA | 12.3 | NA | 3.9 |
| 7-28-75 | 9:30 AM | TVA Stockpile | 16.9 | 100.0 | 100.0 | 95.3 | 63.4 | 46.5 | 28.6 | NA | 8.6 | NA | 2.4 |
| 7-29-75 | 7:10 AM | TVA Stockpile | 16.2 | 100.0 | 99.1 | 90.2 | 75.3 | 57.8 | 31.1 | NA | 4.9 | NA | 1.1 |
| 7-30-75 | 0:30 AM | TVA Stockpile | 16.8 | 100.0 | 100.0 | 85.6 | 68.8 | 43.2 | 26.1 | NA | 8.9 | NA | 3.6 |

TABLE 2.5-58 (Sheet 1 of 18)

WATTS BAR NUCLEAR PLANT
ERCW – PIEZOMETERS
WATER LEVEL READINGS

*Historical Information*

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| MARCH | | | | | | | | | |
| 1 | 698.6 | 712.9 | 713.5 | 711.2 | 703.4 | 713.2 | 716.3 | -- | 680.61 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | 698.9 | 713.0 | 713.6 | 711.4 | 703.0 | 713.0 | 716.1 | 0.00 | 681.83 |
| 5 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 1.20 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | 698.6 | 713.0 | 713.2 | 711.4 | 703.6 | 713.2 | 716.3 | 0.00 | 681.99 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | 699.0 | 713.3 | 714.0 | 711.5 | 703.2 | 713.3 | 717.3 | 0.00 | 682.04 |
| 11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.93 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 15 | 698.8 | 713.3 | 714.0 | 711.5 | 702.9 | 712.7 | 717.1 | -- | 681.87 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.25 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.30 | -- |
| 18 | 699.1 | 713.4 | 714.1 | 711.6 | 703.4 | 713.3 | 717.1 | 0.20 | 681.95 |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 22 | 699.3 | 713.2 | 713.6 | 711.6 | 703.1 | 713.1 | 716.9 | 0.47 | 680.90 |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | 699.4 | 713.3 | 713.5 | 711.4 | 703.0 | 713.1 | * | 0.00 | 679.45 |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | 698.9 | 712.9 | 712.9 | 710.8 | 702.7 | 712.3 | * | 0.00 | 681.38 |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.41 | -- |

*Destroyed

TABLE 2.5-58 (Sheet 2 of 18)

WATTS BAR NUCLEAR PLANT
ERCW – PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| APRIL | | | | | | | | | |
| 1 | 698.9 | 712.7 | 712.8 | 710.6 | 702.7 | 709.9[1] | * | 0.00 | 680.74 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | 698.7 | 712.7 | 712.3 | 709.9 | 702.6 | 707.3 | -- | 0.21 | 679.45 |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | 698.5 | 712.6 | 712.1 | 709.0 | 702.6 | 707.3 | -- | 0.54 | 680.31 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | 698.4 | 712.5 | 712.1 | 707.7 | 702.8 | 707.4 | -- | 0.00 | 680.41 |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | 698.4 | 712.3 | 711.4 | 707.3 | 702.7 | 707.2 | 707.7** | 0.00 | 680.04 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.49 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | 698.5 | 712.7 | 713.1 | 709.0 | 702.8 | 707.3 | 716.5 | 0.00 | 680.5 |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | 698.6 | 712.1 | 710.7 | 706.8 | 702.6 | 707.1 | 716.4 | 0.00 | 680.54 |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.66 | -- |
| 26 | 698.6 | 711.9 | 710.1 | 706.3 | 702.7 | 707.0 | 716.8 | 0.18 | 680.96 |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.11 | -- |
| 28 | 698.5 | 711.9 | 710.0 | 706.2 | 702.6 | 707.1 | 716.9 | 0.00 | 681.32 |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

*Destroyed
**Repaired
[1]Dropping due to nearby excavation for CML

TABLE 2.5-58 (Sheet 3 of 18)

WATTS BAR NUCLEAR PLANT
ERCW – PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| MAY | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | 698.2 | 711.9 | 709.8 | 705.9 | 702.6 | 707.2 | 716.9 | 0.00 | 682.18 |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | 698.8 | 711.7 | 709.5 | 705.7 | 702.5 | 707.2 | 716.8 | 0.41 | 682.35 |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | 698.7 | 711.8 | 710.7 | 705.6 | 702.5 | 707.3 | 716.8 | 0.00 | 682.57 |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | 698.7 | 711.9 | 711.0 | 705.6 | 702.5 | 707.2 | 716.7 | 0.00 | 682.40 |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | 698.6 | 712.0 | 711.0 | 705.8 | 702.5 | 707.2 | 716.8 | 0.00 | 682.17 |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | 698.5 | 712.1 | 710.9 | 705.9 | 702.5 | 707.2 | 716.8 | 0.00 | 682.16 |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 1.78 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | 698.9 | 712.3 | 711.7 | 705.9 | 702.5 | 707.4 | 716.9 | 0.00 | 682.13 |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.38 | -- |
| 27 | 699.0 | 712.5 | 711.9 | 706.1 | 702.5 | 707.3 | 716.9 | 0.00 | 682.60 |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.70 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

TABLE 2.5-58 (Sheet 4 of 18)

WATTS BAR NUCLEAR PLANT
ERCW – PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Level Lake |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | | | | | | | | | |
| 1 | 699.4 | 712.6 | 712.1 | 706.2 | 702.5 | 707.4 | 716.9 | 0.00 | 682.77 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | 699.3 | 712.6 | 712.0 | 706.4 | 702.5 | 707.5 | 716.9 | 0.00 | 682.35 |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | 699.1 | 712.6 | 712.2 | 706.5 | 702.4 | 707.4 | 716.9 | 0.00 | 682.31 |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | 699.0 | 712.6 | 712.3 | 706.5 | 702.5 | 707.4 | 716.8 | 0.00 | 682.11 |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | 698.9 | 712.5 | 713.0 | 706.7 | 702.5 | 707.3 | 716.7 | 0.00 | 682.41 |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | 699.3 | 712.6 | 713.0 | 706.6 | 702.5 | 707.3 | 716.7 | 0.00 | 682.45 |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | 699.7 | 712.6 | 712.9 | 706.6 | 702.5 | 707.3 | 716.6 | 0.00 | 683.01 |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | 699.7 | 712.4 | 712.5 | 706.8 | 702.4 | 707.3 | 716.5 | 0.00 | 682.57 |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 1.83 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.16 | -- |
| 28 | 700.0 | 712.6 | 712.8 | 706.8 | 702.5 | 707.4 | 716.6 | 0.00 | 682.87 |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | 700.0 | 712.5 | 712.7 | 706.8 | 702.4 | 707.4 | 717.1 | 0.00 | 682.64 |

TABLE 2.5-58 (Sheet 5 of 18)

WATTS BAR NUCLEAR PLANT
ERCW – PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| JULY | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | 700.0 | 712.6 | 712.8 | 706.7 | 702.4 | 707.3 | 717.0 | 0.00 | 682.77 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | 700.1 | 712.6 | 712.7 | 706.9 | 702.5 | 707.3 | 716.9 | 0.03 | 681.93 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.22 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | 700.0 | 712.6 | 712.8 | 706.9 | 702.4 | 707.4 | 716.9 | 0.00 | 683.50 |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | 700.1 | 712.5 | 712.8 | 706.8 | 702.4 | 707.4 | 716.9 | 0.00 | 682.7 |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | 700.0 | 712.5 | 712.8 | 706.8 | 702.3 | 707.3 | 717.0 | 0.00 | 682.26 |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.42 | -- |
| 22 | 700.1 | 712.5 | 712.7 | 706.8 | 702.3 | 706.7 | 716.8 | 0.02 | 683.46 |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | 700.0 | 712.3 | 712.7 | 706.7 | 702.4 | 706.4 | 716.2 | 0.00 | 682.57 |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.29 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- |
| 29 | 700.0 | 712.7 | 712.7 | 706.9 | 702.3 | 706.4 | 716.7 | 0.00 | 682.05 |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.12 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.97 | -- |

TABLE 2.5-58 (Sheet 6 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| AUGUST | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | 700.2 | 712.7 | 712.7 | 706.8 | 702.5 | 706.5 | 716.8 | 0.00 | 683.99 |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | 700.1 | 712.7 | 712.7 | 706.7 | 702.4 | 706.4 | 716.8 | 0.00 | 683.70 |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.21 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.50 | -- |
| 9 | 700.2 | 712.7 | 712.7 | 706.7 | 702.4 | 707.4 | 716.7 | 0.63 | 682.83 |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.35 | -- |
| 11 | 700.1 | 712.7 | 712.6 | 706.7 | 702.5 | 708.0 | 716.7 | 0.13 | 682.90 |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | 699.9 | 711.9 | 712.5 | 706.7 | 702.4 | 708.9 | 716.9 | 0.33 | 681.23 |
| 17 | -- | -- | -- | -- | -- | -- | -- | 1.26 | -- |
| 18 | 700.2 | 712.8 | 712.7 | 706.7 | 702.5 | 707.1 | 717.0 | 0.02 | 682.40 |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | 699.9 | 712.6 | 712.7 | 706.7 | 702.5 | 709.7* | 717.0 | 0.52 | 682.63 |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | 700.0 | 712.7 | 712.7 | 706.7 | 702.5 | 710.0 | 716.9 | 0.00 | 682.68 |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.10 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | 699.9 | 712.6 | 712.5 | 706.7 | 702.4 | 709.6 | 716.8 | 0.17 | 682.40 |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.53 | -- |

*Changed 2.6 since 18th.

TABLE 2.5-58 (Sheet 7 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| SEPT. | | | | | | | | | |
| 1 | 699.9 | 712.5 | 712.6 | 706.7 | 702.5 | 709.8 | 716.8 | 0.03 | 682.50 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.25 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | 699.9 | 712.5 | 712.3 | 706.5 | 702.4 | 710.4 | 717.0 | 0.00 | 681.8 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | 699.8 | 712.5 | 712.5 | 706.6 | 702.5 | 710.5 | 717.2 | 0.00 | 681.19 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.22 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | 699.6 | 712.3 | 712.3 | 706.6 | 702.5 | 710.5 | 717.1 | 0.08 | 680.86 |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.11 | -- |
| 15 | 699.7 | 712.5 | 712.4 | 706.6 | 702.5 | 710.6 | 717.1 | 0.00 | 682.10 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | 699.8 | 712.3 | 712.3 | 708.3 | 702.4 | 710.4 | 717.0 | 0.00 | 681.70 |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | 699.2 | 712.3 | 713.1 | 708.7 | 702.5 | 710.3 | 716.9 | 0.00 | 682.04 |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.44 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.09 | -- |
| 27 | 698.9 | 712.4 | 713.3 | 709.4 | 702.4 | 710.5 | 716.9 | 0.00 | 681.55 |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | 698.9 | 712.4 | 713.2 | 709.6 | 702.4 | 710.5 | 716.9 | 0.00 | 682.33 |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

*Changed 2.6 since 18th.

TABLE 2.5-58 (Sheet 8 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| OCT 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | 698.4 | 712.5 | 713.6 | 709.9 | 702.4 | 710.3 | 716.9 | 0.00 | 682.14 |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | 698.8 | 712.3 | 713.0 | 710.2 | 702.4 | 710.2 | 716.9 | 0.00 | 681.92 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 1.38 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.04 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.77 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | 699.4 | 712.6 | 713.9 | 710.5 | 702.6 | 711.1 | 717.3 | 0.69 | 681.34 |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.35 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | 699.7 | 713.2 | 714.4 | 710.7 | 702.6 | 711.3 | 717.1 | 0.00 | 680.74 |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | 698.8 | 713.2 | 714.3 | 710.9 | 702.5 | 711.0 | 717.1 | 0.00 | 681.43 |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

TABLE 2.5-58 (Sheet 9 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| NOV. | | | | | | | | | |
| 1 | 698.2 | 712.8 | 713.3 | 710.7 | 702.5 | 711.0 | 711.1 | 0.00 | 679.77 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 2.32 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.05 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | 698.1 | 712.6 | 712.8 | 710.2 | 702.7 | 711.6 | 717.2 | 0.00 | 680.29 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.60 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | 697.8 | 712.5 | 712.5 | 709.9 | 702.7 | 711.6 | 717.1 | 0.00 | 680.60 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 1.48 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.41 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.08 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.78 | -- |
| 22 | 698.7 | 712.8 | 712.9 | 710.1 | 702.7 | 712.3 | 717.5 | 0.16 | 680.00 |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.19 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 1.53 | 28 |
| 29 | 699.5 | 712.8 | 712.7 | 710.0 | 703.8 | 712.8 | 717.7 | 0.00 | 680.32 |
| 30 | -- | -- | -- | -- | -- | -- | -- | 1.03 | -- |

TABLE 2.5-58 (Sheet 10 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| 1982 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| DEC. | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 2.79 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.08 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.69 | -- |
| 6 | 700.2 | 713.1 | 713.5 | 710.4 | 703.5 | 713.4 | 718.2 | 0.00 | 682.32 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.88 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.15 | -- |
| 13 | 699.9 | 713.2 | 714.1 | 710.8 | 703.4 | 713.2 | 718.2 | 0.00 | 681.1 |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 1.59 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.08 | -- |
| 20 | 700.3 | 713.6 | 714.4 | 711.4 | 703.0 | 713.4 | 718.5 | 0.00 | 683.0 |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.05 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.04 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.16 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.60 | -- |
| 27 | 700.1 | 713.8 | 714.5 | 711.2 | 702.7 | 712.5 | 717.8 | 0.00 | 681.31 |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.72 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.11 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

TABLE 2.5-58 (Sheet 11 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| JAN | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 1.13 | -- |
| 3 | 700.0 | 713.6 | 714.6 | 711.7 | 703.0 | 713.1 | 718.2 | 0.00 | 681.02 |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.26 | -- |
| 10 | 699.8 | 713.4 | 714.3 | 711.5 | 702.8 | 712.8 | 718.5 | 0.10 | 679.00 |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.04 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | 699.5 | 713.2 | 713.9 | 711.0 | 702.7 | 712.5 | 718.3 | 0.00 | 680.30 |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.26 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.33 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | 699.3 | 713.3 | 713.9 | 711.1 | 702.9 | 712.6 | 718.3 | 0.00 | 680.10 |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.08 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.06 | -- |
| 31 | 699.0 | 713.3 | 713.8 | 711.0 | 702.7 | 712.4 | 718.6 | 0.00 | 678.42 |

TABLE 2.5-58 (Sheet 12 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| FEB. | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 1.87 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.08 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.11 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.35 | -- |
| 7 | 699.3 | 713.3 | 713.9 | 711.2 | 702.7 | 713.4 | 718.8 | 0.00 | 680.64 |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 1.34 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.16 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | 700.0 | 713.5 | 713.7 | 711.0 | 703.2 | 713.7 | 718.7 | 0.00 | 681.00 |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | 699.5 | 713.3 | 713.2 | 710.7 | 702.7 | 712.7 | 718.3 | 0.48 | 680.11 |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | 699.4 | 713.1 | 712.9 | 710.4 | 702.7 | 712.7 | 719.0 | 0.00 | 677.46 |

TABLE 2.5-58 (Sheet 13 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall In. | Level Lake |
|---|---|---|---|---|---|---|---|---|---|
| MARCH | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.63 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.41 | -- |
| 7 | 699.0 | 713.4 | 713.9 | 710.8 | 703.2 | 712.8 | 718.8 | 0.00 | 678.77 |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | 698.9 | 713.5 | 714.5 | 710.6 | 702.8 | 712.6 | 718.9 | 0.00 | 679.64 |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 1.31 | -- |
| 21 | 698.5 | 713.5 | 713.9 | 711.0 | 702.9 | 712.5 | 718.6 | 0.00 | 678.32 |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.27 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.02 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.43 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.53 | -- |
| 28 | 698.3 | 713.2 | 713.9 | 710.7 | 702.9 | 712.1 | 718.4 | 0.00 | 676.98 |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.37 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.06 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.45 | -- |

TABLE 2.5-58 (Sheet 14 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| APRIL | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.13 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.61 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | 698.2 | 713.0 | 713.7 | 710.9 | 702.9 | 712.8 | 718.6 | 0.00 | 677.21 |
| 5 | -- | -- | -- | -- | -- | -- | -- | 3.71 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.03 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.50 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 1.02 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | 700.0 | 713.5 | 714.3 | 711.2 | 703.5 | 714.3 | 719.0 | 0.04 | 684.35 |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.12 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.98 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | 00 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | 700.2 | 714.0 | 715.4 | 711.6 | 702.8 | 713.1 | 719.2 | 0.13 | 683.78 |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.90 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.53 | -- |
| 25 | 699.9 | 714.3 | 715.7 | 712.1 | 703.0 | 713.0 | 719.1 | 0.00 | 683.84 |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

TABLE 2.5-58 (Sheet 15 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| MAY | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | 700.1 | 714.1 | 715.2 | 712.1 | 702.7 | 712.5 | 719.1 | 0.00 | 683.44 |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.75 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.62 | -- |
| 9 | 699.9 | 713.8 | 714.8 | 711.8 | 702.6 | 712.2 | 718.9 | 0.00 | 684.15 |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.29 | -- |
| 16 | 699.8 | 713.8 | 714.9 | 711.7 | 702.6 | 712.1 | 718.9 | 0.16 | 683.74 |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 1.47 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.77 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.53 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.78 | -- |
| 23 | 700.3 | 714.0 | 714.6 | 711.5 | 703.7 | 713.5 | 719.0 | 0.58 | 687.77 |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.22 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | 700.2 | 713.6 | 714.5 | 711.2 | 702.7 | 712.5 | 719.1 | 0.00 | 683.62 |

TABLE 2.5-58 (Sheet 16 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.34 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | 700.2 | 713.3 | 714.5 | 711.2 | 702.6 | 712.1 | 718.9 | 0.50 | 684.83 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | 700.1 | 713.2 | 713.6 | 710.4 | 702.5 | 711.8 | 718.7 | 0.00 | 684.28 |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.07 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.75 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 2.08 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 1.42 | -- |
| 20 | 699.8 | 713.1 | 713.9 | 711.0 | 702.5 | 711.4 | 718.8 | 0.00 | 684.09 |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | 0.20 | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.18 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | 698.9 | 712.6 | 712.9 | 710.4 | 702.5 | 711.7 | 718.6 | 0.19 | 683.94 |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.16 | -- |

TABLE 2.5-58 (Sheet 17 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| JULY | | | | | | | | | |
| 1 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.05 | -- |
| 5 | 698.6 | 712.3 | 712.4 | 710.1 | 702.5 | 711.5 | 718.5 | 0.14 | 683.89 |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | 698.3 | 712.0 | 712.0 | 709.8 | 702.5 | 711.1 | 718.2 | 0.00 | 683.47 |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | 698.2 | 711.9 | 711.6 | 709.7 | 702.5 | 710.4 | 718.0 | 0.00 | 682.78 |
| 19 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 22 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 23 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 24 | | | | | | | | 0.04 | -- |
| 25 | 696.2 | 711.7 | 711.5 | 709.4 | 702.5 | 711.5 | 718.1 | -- | 683.35 |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.16 | -- |

TABLE 2.5-58 (Sheet 18 of 18)

WATTS BAR NUCLEAR PLANT
ERCW - PIEZOMETERS
WATER LEVEL READINGS

| Date 1983 | P-1 | P-2 | P-3 | P-4 | P-6 | P-7 | P-8 | Rainfall in. | Lake Level |
|---|---|---|---|---|---|---|---|---|---|
| AUG. | | | | | | | | | |
| 1 | 697.0 | 711.3 | 711.7 | 709.6 | 702.5 | 710.9 | 718.3 | 0.01 | 683.17 |
| 2 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 3 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 4 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 5 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 6 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 8 | 695.0 | 711.3 | 711.0 | 709.2 | 702.5 | 710.5 | 717.8 | 0.00 | 682.95 |
| 9 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | 0.79 | -- |
| 12 | -- | -- | -- | -- | -- | -- | -- | 0.01 | -- |
| 13 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 14 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 15 | 695.2 | 711.3 | 711.5 | 708.9 | 702.4 | 710.5 | 719.6 | 0.00 | 682.86 |
| 16 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 17 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 18 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 19 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 20 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 21 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 22 | 693.8 | 711.4 | 710.7 | 708.9 | 702.4 | 710.2 | 717.5 | 0.00 | 682.73 |
| 23 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 24 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 25 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 26 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 27 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 28 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 29 | 693.7 | 711.4 | 710.6 | 708.8 | 702.4 | 709.4 | 717.4 | 0.00 | 683.10 |
| 30 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |
| 31 | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- |

TABLE 2.5 59

ERCW ROUTE LIQUEFACTION EVALUATION
MAXIMUM AND AVERAGE ELEMENT STRESSES AND PEAL ACCELERATION AT THE TOP OF EACH LAYER

Historical Information

| Layer | Depth (Feet) | Top of Ground | | | | Top of Rock |
|---|---|---|---|---|---|---|
| | | 0.25g 5Hz | 0.18g 5 Hz | 0.225g 5 Hz | 0.25g 25 Hz | 0.18g 25 Hz |
| Max Element Stresses (pcf) | | | | | | |
| 1 | 1.5 | 44 | 32 | 39 | 50 | 80 |
| 2 | 4.5 | 132 | 95 | 118 | 149 | 239 |
| 3 | 7.5 | 220 | 159 | 196 | 244 | 395 |
| 4 | 10.5 | 308 | 221 | 275 | 339 | 549 |
| 5 | 13.5 | 396 | 283 | 351 | 433 | 692 |
| 6 | 16.6 | 484** | 344 | 429 | 520 | 814 |
| 7 | 19.5 | 566** | 407 | 502 | 600 | 942 |
| 8 | 22.5 | 645 | 466 | 574 | 671 | 1044 |
| 9 | 25.5 | 720 | 522 | 643 | 734 | 1130 |
| 10 | 28.5 | 790 | 575 | 709 | 793 | 1198 |
| Average Element Stresses* (pcf) | | | | | | |
| 1 | 1.5 | 29 | 21 | 25 | 33 | 52 |
| 2 | 4.5 | 86 | 62 | 77 | 97 | 155 |
| 3 | 7.5 | 143 | 103 | 127 | 159 | 257 |
| 4 | 10.5 | 200 | 144 | 179 | 220 | 357 |
| 5 | 13.5 | 257 | 184 | 228 | 281 | 449 |
| 6 | 16.5 | 315 | 224 | 279 | 338 | 536 |
| 7 | 19.5 | 368 | 265 | 326 | 390 | 612 |
| 8 | 22.5 | 419 | 303 | 373 | 436 | 679 |
| 9 | 25.5 | 468 | 339 | 418 | 477 | 735 |
| 10 | 28.5 | 514 | 374 | 461 | 515 | 779 |
| Top of Layer Acceleration (g) | | | | | | |
| 1 | 0 | .24 | .17 | .22 | .28 | .44 |
| 2 | 3 | .24 | .17 | .22 | .28 | .44 |
| 3 | 6 | .24 | .17 | .22 | .27 | .44 |
| 4 | 9 | .24 | .17 | .21 | .26 | .43 |
| 5 | 12 | .24 | .17 | .21 | .25 | .41 |
| 6 | 15 | .23 | .17 | .21 | .25 | .39 |
| 7 | 18 | .23 | .16 | .20 | .24 | .36 |
| 8 | 21 | .22 | .16 | .20 | .22 | .32 |
| 9 | 24 | .21 | .15 | .19 | .22 | .27 |
| 10 | 27 | .20 | .15 | .18 | .22 | .22 |
| 11 | 30 | .20 | .14 | .18 | .23 | .20 |

*Average element stress 0.65* max element stress
**Assume 500 psf at 17.5 feet

TABLE 2.5-60

FACTORS OF SAFETY WITH DEPTH WHEN THE WATER TABLE IS NOT CONSIDERED

Historical Information

| Layer | Depth (Feet) | σ v (psf) | σ h (psf) | τ/σ3 | τ f | τ f | FS = τf/ τ avg |
|---|---|---|---|---|---|---|---|
| For Sample 3 - Reconstituted | | | | | | | |
| 1 | 1.5 | 180 | 90 | 0.34 | 31 | 29 | 1.07 |
| 2 | 4.5 | 540 | 270 | 0.34 | 92 | 86 | 1.07 |
| 3 | 7.5 | 900 | 450 | 0.34 | 153 | 143 | 1.07 |
| 4 | 10.5 | 1260 | 630 | 0.34 | 214 | 200 | 1.07 |
| 5 | 13.5 | 1620 | 810 | 0.34 | 275 | 257 | 1.07 |
| 6 | 16.5 | 1980 | 990 | 0.34 | 337 | 315 | 1.07 |
| 7 | 19.5 | 2340 | 1170 | 0.34 | 398 | 368 | 1.08 |
| 8 | 22.5 | 2700 | 1350 | 0.34 | 459 | 419 | 1.10 |
| 9 | 25.5 | 3060 | 1530 | 0.34 | 520 | 468 | 1.11 |
| 10 | 28.5 | 3420 | 1710 | 0.34 | 581 | 514 | 1.13 |
| For Sample 2 - In situ | | | | | | | |
| 1 | 1.5 | 180 | 90 | 0.60 | 54 | 29 | 1.86 |
| 2 | 4.5 | 540 | 270 | 0.60 | 162 | 86 | 1.88 |
| 3 | 7.5 | 900 | 450 | 0.60 | 270 | 143 | 1.89 |
| 4 | 10.5 | 1260 | 630 | 0.60 | 378 | 200 | 1.89 |
| 5 | 13.5 | 1620 | 810 | 0.60 | 486 | 257 | 1.89 |
| 6 | 16.5 | 1980 | 990 | 0.60 | 594 | 315 | 1.89 |
| 7 | 19.5 | 2340 | 1170 | 0.60 | 702 | 368 | 1.91 |
| 8 | 22.5 | 2700 | 1350 | 0.60 | 810 | 419 | 1.93 |
| 9 | 25.5 | 3060 | 1530 | 0.60 | 918 | 468 | 1.96 |
| 10 | 28.5 | 3420 | 1710 | 0.60 | 1026 | 514 | 2.00 |

Notation:

$\bar{\sigma}v$ = effective vertical stress

$\bar{\sigma}h$ = effective horizontal stress

τ/σ3 = cyclic stress ration

τf = cyclic shear stress corresponding to 5% strain

τavg = average on effective shear stress

FS = Factor of Safety against 5% cyclic strain potential

TABLE 2.5-62 (Sheet 1 of 5)

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| SS-49 | 700.9 | 13 | SM-SC | 28.3 | 6.5 | 25.1 | 0.074 | 49.0 | SS-49 |
| | | | | | | | | | |
| SS-49A | 700.7 | 5 | SM | NP | NP | 26.5 | 0.110 | 31.0 | same sample |
| | 700.7 | 5 | SM | 23.0 | 1.0 | 29.0 | 0.990 | 42.0 | |
| | 698.7 | 6 | SM | 23.0 | 1.0 | 29.9 | 0.990 | 41.0 | |
| | 696.7 | 5 | SM | NP | NP | 31.8 | 0.120 | 29.0 | same sample |
| | 696.7 | 5 | SM | 29.0 | 4.0 | 32.4 | 0.080 | 47.0 | |
| | 692.7 | 5 | SM | 23.0 | 1.0 | 28.7 | 0.080 | 47.0 | |
| | 690.7 | 6 | SM | NP | NP | 30.0 | 0.120 | 31.0 | |
| | 688.7 | 17 | SM | NP | NP | 31.2 | 0.120 | 38.0 | same sample |
| | 688.7 | 17 | SM | NP | NP | 21.2 | 0.650 | 19.4 | |
| | | | | | | | | | |
| SS-131 | 699.9 | 4 | SM | 30.8 | 6.9 | 28.1 | 0.080 | 48.0 | SS-131 |
| | 697.9 | 5 | SM | 25.9 | 3.3 | 30.1 | 0.080 | 45.0 | |
| | 695.9 | 5 | SM | 25.9 | 3.3 | 29.7 | 0.080 | 45.0 | |
| | 693.9 | 7 | SM | NP | NP | 26.2 | 0.085 | 45.0 | |
| | 691.9 | 7 | SM | NP | NP | 24.0 | 0.085 | 45.0 | |
| | | | | | | | | | |
| SS-50A | 702.2 | 14 | SM | NP | NP | 25.5 | 0.010 | 35.0 | SS-50A |
| | 700.2 | 11 | SM | 27.0 | 2.0 | 28.8 | 0.100 | 37.0 | same sample |
| | 700.2 | 11 | SM | NP | NP | 26.9 | 0.173 | 22.0 | |
| | 698.2 | 13 | SM | 26.0 | 2.0 | 27.4 | 0.100 | 38.0 | same sample |
| | 698.2 | 13 | SM | NP | NP | 28.8 | 0.120 | 29.0 | |
| | 696.2 | 9 | SM | NP | NP | 33.5 | 0.130 | 26.0 | same sample |
| | 696.2 | 9 | SM | NP | NP | 33.5 | 0.120 | 26.0 | |
| | 694.2 | 5 | SM | NP | NP | 38.4 | 0.090 | 39.0 | |
| | | | | | | | | | |
| SS-50 | 701.8 | 10 | SM | 34.1 | 7.6 | 22.4 | 0.084 | 47.0 | |
| | 697.8 | 5 | SM | NP | NP | 28.2 | 0.098 | 43.0 | |
| | 695.8 | 8 | SM | NP | NP | 29.1 | 0.093 | 43.0 | |
| | 693.8 | 2 | SM | NP | NP | 31.5 | 0.087 | 47.0 | |
| | 691.8 | 10 | G-SM | NP | NP | 23.7 | 0.190 | 33.9 | |
| | | | | | | | | | |
| SS-133 | 704.0 | 19 | G-SM | NP | NP | 17.3 | 0.250 | 29.0 | SS-133 |
| | | | | | | | | | |
| SS-134 | 710.5 | 3 | SM | NP | NP | 29.3 | 0.148 | 26.0 | SS-134 |
| | 708.5 | 8 | SM | NP | NP | 27.5 | 0.141 | 31.0 | |
| | | | | | | | | | |
| SS-134A | 709.5 | 4 | SM | 23.0 | 1.0 | 30.0 | 0.105 | 35.0 | same sample |
| | 709.5 | 4 | SM | NP | NP | 29.1 | 0.110 | 30.0 | |
| | 707.5 | 9 | SM | 24.0 | 2.0 | 27.9 | 0.100 | 27.0 | same sample |
| | 707.5 | 9 | SM | 24.0 | 1.0 | 28.9 | 0.090 | 43.0 | |

TABLE 2.5-62 (Sheet 2 of 5)

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| SS-135 | 712.0 | 11 | SM | 34.1 | 8.7 | 23.6 | - | - | SS-135 |
| | 710.9 | 12 | SM | 30.0 | 4.4 | 20.1 | - | - | |
| | 708.9 | 8 | SM | NP | NP | - | - | - | |
| | 706.9 | 8 | SM | NP | NP | - | - | - | |
| | 704.9 | 8 | SM | NP | NP | 25.3 | - | - | |
| | | | | | | | | | |
| SS-135A | 714.5 | 13 | SM | 31.0 | 3.0 | 24.3 | 0.078 | 48.0 | SS-135A |
| | 712.5 | 7 | SM | NP | NP | 22.8 | 0.105 | 33.0 | |
| | 710.5 | 7 | SM | NP | NP | 24.3 | 0.120 | 29.0 | |
| | 708.5 | 5 | SM | NP | NP | 34.2 | 0.120 | 29.0 | |
| | 706.5 | 8 | SM | 22.0 | 1.0 | 27.0 | 0.120 | 33.0 | |
| | 704.5 | 7 | SM | NP | NP | 30.9 | 0.100 | 35.0 | |
| | | | | | | | | | |
| SS-65B | 713.2 | 9 | SM | 29.0 | 2.0 | 25.7 | 0.085 | 43.0 | SS-65B |
| | 711.2 | 6 | SM | 25.0 | 1.0 | 27.5 | 0.090 | 41.0 | |
| | 709.2 | 3 | SM | 25.0 | 1.0 | 33.1 | 0.100 | 38.0 | same sample |
| | 709.2 | 3 | SM | NP | NP | 32.9 | 0.110 | 31.0 | |
| | 707.2 | 5 | SM | 25.0 | 1.0 | 32.5 | 0.100 | 34.0 | |
| | 705.2 | 7 | SM | 26.0 | 2.0 | 27.1 | 0.075 | 50.0 | same sample |
| | 705.2 | 7 | SM | 25.0 | 1.0 | 30.8 | 0.100 | 35.0 | |
| | | | | | | | | | |
| SS-65 | 712.0 | 12 | SM | 33.1 | 6.6 | 21.5 | 0.077 | 48.0 | SS-65 |
| | 710.0 | 10 | SM | NP | NP | 15.7 | 0.132 | 32.5 | |
| | 708.0 | 7 | SM | 30.1 | 5.1 | 23.7 | 0.091 | 43.0 | |
| | 706.0 | 5 | SM | 28.9 | 3.5 | 28.2 | 0.140 | 34.0 | |
| | 704.0 | 8 | - | - | - | - | - | - | no sample |
| | | | | | | | | | |
| SS-136 | 710.9 | 5 | SM | NP | NP | 26.3 | 0.100 | 40.0 | SS-136 |
| | 708.9 | 8 | SM | NP | NP | 28.5 | 0.122 | 35.0 | |
| | 706.9 | 12 | SM | NP | NP | 21.9 | 0.145 | 33.0 | |
| | | | | | | | | | |
| SS-137 | 712.9 | 9 | SM | 25.9 | 1.8 | 20.7 | - | - | SS-137 |
| | | | | | | | | | |
| SS-138 | 713.2 | 6 | SM | 28.1 | 2.5 | 23.4 | 0.079 | 49.0 | SS-138 |
| | 711.2 | 7 | SM | 28.1 | 2.5 | 24.5 | 0.79 | 49.0 | |
| | 705.2 | 13 | SM | 26.4 | 2.3 | 15.0 | - | - | |
| | | | | | | | | | |
| SS-138A | 713.2 | 8 | SM | 29.0 | 3.0 | 25.1 | 0.073 | 50.0 | SS-138A |
| | 711.2 | 8 | SM | NP | NP | 22.1 | 0.100 | 36.0 | |
| | 709.2 | 12 | SM | 29.0 | 1.0 | 27.1 | 0.073 | 49.0 | |
| | 707.2 | 4 | SM | 28.0 | 2.0 | 35.6 | 0.090 | 41.0 | |
| | 705.2 | 9 | SM | 22.0 | 1.0 | 27.8 | 0.140 | 31.0 | same sample |
| | 705.2 | 9 | SM | NP | NP | 29.1 | 0.180 | 21.0 | |

TABLE 2.5-62 (Sheet 3 of 5)

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| SS-138B | 710.6 | 8 | SM | 27.0 | 3.0 | 24.7 | 0.090 | 42.0 | SS-138B |
| | 708.6 | 9 | SM | 34.0 | 5.0 | 36.2 | 0.080 | 46.0 | |
| | 706.6 | 8 | SM-SC | 27.0 | 5.0 | 30.0 | 0.105 | 35.0 | |
| | 704.6 | 7 | SM-SC | 26.0 | 5.0 | 32.5 | 0.110 | 35.0 | |
| | | | | | | | | | |
| SS-138C | 710.6 | 8 | SM-SC | 27.0 | 4.0 | 27.5 | 0.095 | 38.0 | SS-138C |
| | | | | | | | | | |
| SS-139 | 711.5 | 8 | SM | NP | NP | 15.5 | 0.110 | 35.0 | SS-139 |
| | 709.5 | 9 | SM | NP | NP | 18.2 | 0.110 | 35.0 | |
| | 705.5 | 14 | SM | NP | NP | 22.1 | 0.375 | 13.0 | |
| | | | | | | | | | |
| SS-140 | 706.7 | 4 | SM | NP | NP | 38.7 | 0.110 | 36.0 | SS-140 |
| | | | | | | | | | |
| SS-87 | 707.6 | 12 | SM | 31.6 | 6.2 | 27.5 | 0.078 | 48.0 | SS-87 |
| | | | | | | | | | |
| SS-141 | 704.6 | 17 | G-SM | NP | NP | 7.8 | 0.79 | 19.0 | SS-141 |
| | | | | | | | | | |
| SS-143 | 695.1 | 7 | - | - | - | - | - | - | no sample |
| | 693.1 | 9 | G-SP-SM | NP | NP | 13.5 | 1.80 | 12.0 | |
| | | | | | | | | | |
| SS-143A | 701.0 | 3 | SM-SC | 21.0 | 5.0 | 21.2 | 0.093 | 45.0 | SS-143A |
| | 697.0 | 8 | SM | 37.0 | 11.0 | 43.1 | 0.130 | 41.0 | |
| | | | | | | | | | |
| SS-143B | 696.3 | 21 | SM | 37.0 | 7.0 | 27.7 | 0.300 | 34.0 | SS-143B |
| | | | | | | | | | |
| SS-146 | 702.4 | 13 | G-SM | 21.6 | 1.9 | 14.6 | 0.200 | 25.0 | SS-146 |
| | | | | | | | | | |
| SS-147 | 701.7 | 18 | G-SM | NP | NP | 17.1 | 0.460 | 14.0 | SS-147 |
| | | | | | | | | | |
| SS-153 | 707.7 | 15 | G-SW-SM | NP | NP | 10.8 | 2.500 | 10.0 | SS-153 |
| | | | | | | | | | |
| SS-158 | 711.5 | 2 | SM | 22.9 | 2.5 | 32.2 | 0.088 | 44.0 | SS-158 |
| | | | | | | | | | |
| SS-159 | 712.0 | 20 | G-SM | NP | NP | 13.7 | 0.430 | 21.0 | SS-159 |
| | | | | | | | | | |
| SS-160 | 720.9 | 15 | SM | NP | NP | 22.5 | 0.134 | 39.0 | SS-160 |
| | 718.9 | 7 | SM | 24.2 | 1.7 | 23.8 | 0.173 | 34.0 | |
| | 716.9 | 12 | SM | 27.0 | 3.0 | 25.8 | 0.153 | 33.0 | |
| | 714.9 | 5 | SM-SC | 32.1 | 8.5 | 30.2 | 0.105 | 46.0 | |
| | 710.9 | 5 | GM | 26.2 | 2.2 | 24.3 | 0.210 | 37.0 | |
| | | | | | | | | | |
| SS-161A | 720.9 | 10 | SM | 26.0 | 2.0 | 23.8 | 0.120 | 32.0 | SS-161A |

TABLE 2.5-62 (Sheet 4 of 5)

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | 718.9 | 13 | SM | NP | NP | 17.8 | 0.230 | 17.0 | same sample |
| | 718.9 | 13 | SM | NP | NP | 17.0 | 0.180 | 20.0 | |
| | | | | | | | | | |
| SS-161 | 718.4 | 9 | SM | NP | NP | 18.4 | 0.230 | 24.0 | SS-161 |
| | 716.4 | 10 | SM | NP | NP | 21.5 | 0.220 | 24.0 | |
| | 708.4 | 19 | G-SM | NP | NP | 12.7 | 0.220 | 32.0 | |
| | | | | | | | | | |
| SS-162 | 717.8 | 20 | SM | 28.3 | 1.6 | 27.7 | 0.090 | 47.0 | SS-162 |
| | 715.8 | 19 | SM | 27.6 | 3.0 | 30.2 | 0.122 | 39.0 | |
| | 713.8 | 5 | SM | NP | NP | 34.3 | 0.155 | 36.0 | |
| | 711.8 | 11 | G-SW-SM | NP | NP | 20.4 | 2.000 | 11.0 | |
| | | | | | | | | | |
| SS-163 | 721.0 | 5 | SM-SC | 30.4 | 7.1 | 28.4 | 0.084 | 47.0 | SS-163 |
| | 719.0 | 6 | SM-SC | 30.4 | 7.1 | 26.9 | 0.084 | 47.0 | |
| | 717.0 | 3 | SM | 27.2 | 3.3 | 31.1 | 0.097 | 45.0 | |
| | 715.0 | 4 | SM | 29.7 | 4.7 | 33.5 | 0.090 | 43.0 | |
| | 713.0 | 17 | G-SM | 28.7 | 3.8 | 27.8 | 0.190 | 26.0 | |
| | | | | | | | | | |
| SS-163A | 721.5 | 7 | SM | 31.0 | 7.0 | 28.9 | 0.080 | 48.0 | SS-163A |
| | 719.5 | 11 | SP-SM | NP | NP | 28.2 | 0.220 | 8.0 | |
| | 717.5 | 4 | SM | 30.0 | 3.0 | 36.3 | 0.080 | 45.0 | |
| | 715.5 | 5 | SM | 31.0 | 5.0 | 34.3 | 0.098 | 43.0 | |
| | | | | | | | | | |
| SS-80 | 721.2 | 3 | SM | 41.6 | 14.6 | 29.1 | 0.120 | 44.0 | SS-80 |
| | 715.2 | 7 | SM | 24.5 | 0.7 | 25.4 | 0.061 | 29.0 | |
| | | | | | | | | | |
| SS-164 | 719.0 | 9 | SM-SC | 31.5 | 8.6 | 27.4 | 0.240 | 33.0 | SS-164 |
| | 717.0 | 15 | G-SP-SM | NP | NP | 16.2 | 0.750 | 12.0 | |
| | 715.0 | 20 | G-SP-SM | NP | NP | 20.9 | 0.340 | 10.0 | |
| | 713.0 | 11 | SM | 31.1 | 5.7 | 26.6 | 0.174 | 33.0 | |
| | | | | | | | | | |
| SS-165 | 716.7 | 3 | SM-SC | 30.7 | 8.1 | 23.3 | - | - | SS-165 |
| | 714.7 | 2 | SM-SC | 30.7 | 8.1 | 34.4 | - | - | |
| | | | | | | | | | |
| SS-84 | 713.4 | 2 | SM | 24.8 | 2.2 | 30.1 | 0.110 | 41.0 | SS-84 |
| | | | | | | | | | |
| SS-130 | 715.7 | 10 | SM | NP | NP | 17.8 | 0.240 | 22.0 | SS-130 |
| | 713.7 | 9 | SM | NP | NP | 15.5 | 0.290 | 15.0 | |
| | | | | | | | | | |
| SS-128 | 712.7 | 2 | SM | NP | NP | 23.7 | 0.280 | 16.0 | SS-128 |
| | | | | | | | | | |
| SS-127 | 712.2 | 0 | SM-SC | 23.3 | 4.4 | 36.1 | 0.079 | 48.0 | SS-127 |

TABLE 2.5-62 (Sheet 5 of 5)

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| SS-125 | 714.4 | 2 | SM | NP | NP | 29.0 | 0.130 | 8.0 | SS-125 |
| | 708.4 | 16 | G-SP-SM | NP | NP | 21.7 | 0.660 | 8.0 | |
| | 706.4 | 17 | G-SP-SM | NP | NP | 12.8 | 3.00 | 10.0 | |
| | | | | | | | | | |
| SS-25 | 715.6 | 2 | SM | NP | NP | 29.2 | 0.076 | 48.0 | SS-25 |
| | | | | | | | | | |
| SS-28 | 713.4 | 10 | SM | NP | NP | 31.0 | 0.18 | 27.5 | SS-28 |
| | | | | | | | | | |
| SS-170 | 719.2 | 4 | G-SM-SC | 34.8 | 11.5 | 29.1 | 0.125 | 42.0 | SS-170 |
| | 717.2 | 17 | G-SM-SC | 34.8 | 11.5 | 23.6 | 0.125 | 42.0 | |
| | 715.2 | 18 | G-SM-SC | NP | NP | 19.2 | 0.450 | 11.0 | |

TABLE 2.5-63 (Sheet 1 of 2)

SUMMARY OF SPT SAMPLES OF SILTS (ML) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Conten (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| SS-49 | 698.9 | 14 | ML | 28.8 | 5.3 | 26.1 | 0.070 | 53.0 | |
| | 696.9 | 12 | ML | 28.8 | 5.3 | 26.8 | 0.064 | 53.0 | |
| SS-49A | 694.7 | 6 | ML | 22.0 | 1.0 | 28.3 | 0.070 | 53.0 | same sample |
| | 694.7 | 6 | ML | 22.0 | 3.0 | 28.0 | 0.070 | 54.0 | |
| | 692.7 | 5 | ML | NP | NP | 27.8 | 0.070 | 56.0 | |
| SS-50A | 694.2 | 5 | ML | 29.0 | 3.0 | 34.8 | 0.070 | 55.0 | |
| SS-50 | 703.8 | 10 | ML | 37.5 | 11.3 | 22.1 | 0.050 | 54.0 | |
| SS-132 | 702.1 | 13 | ML | 43.1 | 15.2 | 25.7 | - | - | |
| | 700.1 | 15 | ML | 45.8 | 17.5 | 23.4 | - | - | |
| SS-135 | 714.9 | 12 | ML | 42.2 | 13.8 | 26.3 | <0.074 | 69.0 | |
| SS-135A | 706.5 | 8 | ML | 27.0 | 2.0 | 32.1 | 0.073 | 51.0 | same sample |
| | 706.5 | 8 | ML | 29.0 | 7.0 | - | - | - | |
| | 704.5 | 7 | ML | 25.0 | 2.0 | 32.1 | 0.073 | 50.0 | |
| SS-65B | 715.2 | 14 | ML | 35.0 | 6.0 | 26.7 | 0.060 | 60.0 | |
| SS-65 | 714.0 | 16 | ML | 46.1 | 15.6 | 29.2 | 0.030 | 72.0 | |
| SS-136 | 712.9 | 9 | ML | 32.8 | 5.7 | 25.0 | 0.070 | 53.0 | |
| SS-137 | 714.9 | 11 | ML | 35.6 | 9.6 | 24.2 | 0.058 | 62.0 | |
| | 710.9 | 7 | ML | 31.7 | 5.6 | 25.0 | 0.070 | 52.0 | |
| | 708.9 | 8 | ML | 31.7 | 5.6 | 25.3 | 0.070 | 52.0 | |
| SS-138 | 709.2 | 7 | ML | 32.7 | 5.9 | 28.4 | 0.070 | 53.0 | |
| | 707.2 | 5 | ML-CL | 27.0 | 5.1 | 29.6 | 0.067 | 52.0 | |
| SS-139 | 707.5 | 7 | ML | 31.0 | 3.9 | 32.8 | 0.056 | 63.0 | |
| SS-140 | 710.7 | 12 | ML | 34.1 | 6.2 | 25.0 | 0.061 | 54.0 | |
| | 708.7 | 3 | ML | - | - | 17.4 | 0.073 | 50.0 | |
| SS-87 | 711.6 | 13 | ML | 37.4 | 12.9 | 43.9 | 0.038 | 62.0 | |

TABLE 2.5-63 (Sheet 2 of 2)

SUMMARY OF SPT SAMPLES OF SILTS (ML) BELOW ERCW PIPELINES HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No. | Elev.(ft) | SPT Blow Counts | Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| SS-143C | 696.6 | 3 | CL-ML | 32.0 | 10.0 | 46.5 | < 0.074 | 72.0 | |
| SS-101 | 712.5 | 3 | ML | 24.7 | 2.0 | 31.9 | 0.072 | 53.0 | |
| SS-159 | 718.0 | 6 | CL-ML | 26.8 | 4.2 | 29.4 | 0.064 | 59.0 | |
| SS-161A | 714.9 | 5 | ML | 38.0 | 12.0 | 35.7 | 0.055 | 58.0 | |
| SS-161 | 714.4 | 3 | CL-ML | 36.8 | 13.2 | 35.8 | - | - | |
| | 712.4 | 5 | ML | 25.7 | 2.3 | 30.9 | 0.076 | 51.0 | |
| SS-80 | 719.2 | 5 | ML | 24.6 | 2.4 | 28.1 | 0.075 | 51.0 | |
| SS-164 | 721.0 | 6 | CL-ML | 36.0 | 12.1 | 28.2 | 0.059 | 53.0 | |
| SS-165 | 720.7 | 5 | ML | 37.4 | 11.5 | 31.9 | 0.060 | 58.0 | |
| | 718.7 | 6 | CL-ML | 39.0 | 14.2 | 31.2 | 0.015 | 63.0 | |
| SS-166 | 720.5 | 13 | ML | 48.8 | 19.8 | 13.0 | 0.011 | 87.0 | |
| | 718.5 | 11 | ML | 48.8 | 19.8 | 11.0 | 0.011 | 87.0 | |
| | 716.5 | 6 | CL-ML | 31.4 | 9.1 | 28.4 | 0.056 | 63.0 | |
| SS-84 | 711.4 | 3 | ML | 24.5 | 1.3 | 31.4 | 0.070 | 52.0 | |
| SS-130 | 717.7 | 7 | ML | 35.7 | 11.3 | 20.8 | - | - | |
| SS-26 | 718.0 | 3 | ML | 24.4 | 0.6 | 29.7 | 0.051 | 61.0 | |
| | 716.0 | 4 | ML | NP | NP | 31.0 | 0.074 | 51.0 | |
| SS-27 | 713.1 | 3 | ML | 23.1 | 2.9 | 24.5 | 0.072 | 51.0 | |
| SS-169 | 119.1 | 8 | CL-ML | 43.0 | 17.0 | 31.8 | 0.021 | 78.0 | |
| | 117.1 | 6 | ML | 41.4 | 13.7 | 34.3 | 0.043 | 68.0 | |
| | 115.1 | 6 | ML | 41.4 | 13.7 | 32.3 | 0.043 | 68.0 | |
| | 113.1 | 5 | ML | 40.8 | 13.7 | 33.1 | 0.043 | 65.0 | |

TABLE 2.5-64

SUMMARY OF SPT SAMPLES OF SILTY SANDS (SM) BELOW ELECTRICAL CONDUITS HAVING FACTOR OF SAFETY LESS THAN UNITY FOR 0.4 G PEAK GROUND SURFACE ACCELERATION

Historical Information

| Boring No. | Elev. (ft) | SPT Blow Counts | Soil Type | Liquid Limit | Plasticity Index | Water Content (%) | D 50 (mm) | Fines Content (%) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| SS-171 | 708.2 | 6 | SM | NP | NP | 26.7 | 0.20 | 13.0 | |
| | 706.2 | 9 | SP-SM | NP | NP | 26.5 | 0.26 | 7.0 | |
| | 704.2 | 9 | SP-SM | NP | NP | 24.1 | 0.27 | 9.0 | |
| | 702.2 | 12 | SP-SM | NP | NP | 30.9 | 0.27 | 8.0 | |
| SS-53 | 708.0 | 18 | SM | 27.1 | 3.1 | 19.6 | 0.15 | 40.0 | |
| SS-173 | 709.0 | 20 | SM-SC | 37.0 | 12.0 | 20.6 | 0.086 | 47.0 | |
| SS-63 | 713.1 | 17 | SM | 36.0 | 10.0 | 21.6 | 0.078 | 48.0 | |
| | 711.1 | 10 | SM | 36.0 | 10.0 | 20.7 | 0.078 | 48.0 | |
| | 709.1 | 10 | SM | 36.0 | 10.0 | 27.0 | 0.078 | 48.0 | |
| SS-57 | 715.0 | 14 | SP-SM | NP | NP | 6.4 | 0.75 | 9.0 | |

TABLE 2.5-65

STRAIN CRITERIA FOR DETERMINING
POTENTIAL SETTLEMENT OF SOILS SUBJECT
TO EARTHQUAKE WITH PEAK TOP-OF-GROUND
ACCELERATION OF 0.40g AT
WATTS BAR NUCLEAR PLANT

Historical Information

| | PERCENT VERTICAL STRAIN (%Ev) | |
|---|---|---|
| MATERIAL CLASSIFICATION | BELOW WATER TABLE | ABOVE/BELOW WATER TABLE |
| SP (<12% fines) | 6[1] | 3[2] |
| SM or ML (clean) | 3[1] | 1.5[2] |
| SC | 1[1] | 0.5[2] |
| CL or ML-CL | 0.75[1] | 0.5[3] |

Notes:

1) If potentially liquefiable

2) If loose N<15 but not potentially liquefiable

3) If soft N<5 but not potentially liquefiable

4) Classification of SP-SM will be treated as SP for criteria

5) Classification of G-SM or SM-SC will be treated as SM for criteria

TABLE 2.5-66

WBNP – SOIL BEARING CAPACITIES AND FACTORS OF SAFETY
FOR SOIL - SUPPORTED CATEGORY I STRUCTURES

Historical Information

| Structures | Ultimate Soil Bearing Capacity (KSF) | Sustained Loads: Actual Soil Bearing Maximum (KSF) | Sustained Loads: Actual Factor of Safety | Dynamic Loads: Soil Bearing Maximum (KSF) | Dynamic Loads: Factor of Safety |
|---|---|---|---|---|---|
| Diesel Generator Building | 20.0 | 3.5 | 5.7 | 5.5 | 3.6 |
| Refueling Water Storage Tanks I and II | 20.0 | 2.3 | 8.7 | 8.6 | 2.3 |
| ERCW Standpipe Structure I | 20.0 | 1.7 | 11.8 | 4.5 | 4.4 |
| ERCW Standpipe Structure II | 20.0 | 1.9 | 10.5 | 4.7 | 4.3 |
| Discharge Overflow Structure | 20.0 | 1.9 | 10.5 | 5.3 | 3.8 |
| Refueling Water Storage Pipe Tunnels A and B | 20.0 | 2.5 | 8.0 | 3.3 | 6.1 |
| Waste Packaging Area | 20.0+ | 1.4 | 14.0+ | 6.7 | 3.0+ |

TABLE 2.5-67 (Sheet 1 of 2)

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

| | SETTLEMENT POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SE | | SW | | NE | | NW | |
| | SS-1 | | SS-2 | | SS-3 | | SS-4 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 10-31-75 | | | 742.015' | | | | 742.033' | - |
| 11-24-75 | 742.047' | - | 742.017 | .002 | 742.044' | - | 742.038 | .005 |
| 12-16-75 | 742.046 | -.001 | 742.018 | .003 | 742.044 | .000 | 742.038 | .005 |
| 01-14-76 | 742.045 | -.002 | 742.017 | .002 | 742.041 | -.003 | 742.036 | .003 |
| 02-11-76 | 742.043 | -.004 | 742.015 | .000 | 742.038 | -.006 | 742.034 | .001 |
| 03-13-76 | 742.035 | -.012 | 742.006 | -.009 | 742.031 | -.013 | Not Run | |
| 04-15-76 | 742.037 | -.010 | 742.009 | -.006 | 742.032 | -.012 | Not Run | |
| 05-11-76 | 742.041 | -.006 | 742.011 | -.004 | 742.037 | -.007 | Not Run | |
| 06-11-76 | 742.035 | -.012 | 742.005 | -.010 | 742.030 | -.014 | 742.021 | -.012 |
| 07-14-76 | 742.032 | -.015 | 742.004 | -.011 | 742.028 | -.016 | 742.023 | -.010 |
| 08-10-76 | 742.040 | -.007 | 742.010 | -.005 | 742.034 | -.010 | 742.030 | -.003 |
| 09-14-76 | 742.035 | -.012 | 742.006 | -.009 | 742.031 | -.013 | 742.025 | -.008 |
| 10-13-76 | 742.038 | -.009 | 742.008 | -.007 | 742.026 | -.018 | 742.031 | -.002 |
| 11-09-76 | Poor Closure Not Used | | | | | | | |
| 12-09-76 | 742.027 | -.020 | 741.996 | -.009 | 742.026 | -.018 | 742.018 | -.015 |
| 01-12-77 | 742.032 | -.015 | 742.001 | -.014 | 742.033 | -.011 | 742.024 | -.009 |
| 02-10-77 | 742.033 | -.014 | 742.004 | -.011 | 742.032 | -.012 | 742.026 | -.007 |
| 03-15-77 | 742.032 | -.015 | 742.002 | -.013 | 742.028 | -.016 | 742.023 | -.010 |
| 04-11-77 | 742.030 | -.017 | 742.000 | -.015 | 742.026 | -.018 | 742.021 | -.012 |
| 05-10-77 | 742.028 | -.019 | 741.997 | -.018 | 742.023 | -.021 | 742.017 | -.016 |
| 06-06-77 | 742.027 | -.020 | 741.997 | -.018 | 742.022 | -.022 | 742.017 | -.016 |
| 07-06-77 | 742.032 | -.015 | 742.000 | -.015 | 742.025 | -.019 | 742.022 | -.012 |
| 08-03-77 | 742.021 | -.026 | 741.989 | -.026 | 742.015 | -.029 | 742.011 | -.022 |
| 09-12-77 | 742.024 | -.023 | 741.992 | -.023 | 742.023 | -.021 | 742.018 | -.015 |
| 10-11-77 | 742.024 | -.023 | 741.971 | -.024 | 742.023 | -.021 | 742.017 | -.016 |
| 11-07-77 | 742.021 | -.026 | 741.990 | -.025 | 742.021 | -.023 | 742.017 | -.016 |
| 12-15-77 | 742.026 | -021 | 741.995 | -.020 | 742.027 | -.017 | 742.022 | -.011 |
| 01-09-78 | 742.021 | -026 | 741.990 | -.025 | 742.030 | -.024 | 742.017 | -.016 |
| 02-02-78 | 742.022 | -.025 | 741.992 | -.023 | 742.023 | -.021 | 742.020 | -.013 |
| 03-03-78 | 742.017 | -.030 | 741.985 | -.030 | 742.018 | -.026 | 742.011 | -.022 |
| 04-03-78 | 742.015 | -.032 | 741..981 | -.031 | 742.016 | -.028 | 742.008 | -.025 |
| 05-04-78 | 742.015 | -.032 | 741.984 | -.031 | 742.015 | -.029 | 742.010 | -.023 |
| 06-05-78 | 742.013 | -.034 | 741.982 | -.033 | 742.013 | -.031 | 742.008 | -.025 |
| 07-10-78 | 742.012 | -.035 | 741.982 | -.033 | 742.011 | -.033 | 742.009 | -.023 |
| 08-04-78 | 742.010 | -.037 | 741.979 | -.036 | 742.010 | -.034 | 742.006 | -.025 |
| 09-29-78 | 742.013 | -.034 | 741.983 | -.032 | 742.013 | -.031 | 742.010 | -.024 |
| 01-21-79 | 742.019 | -.028 | 741.989 | -.026 | 742.020 | -.024 | 742.015 | -.027 |
| 04-11-79 | 742.009 | -.038 | 741.977 | -.038 | 742.010 | -.034 | 742.004 | -.023 |
| 07-26-79 | 742.006 | -.041 | 741.976 | -.039 | 742.010 | -.034 | 742.003 | -.018 |
| 10-23-79 | 742.009 | -.038 | 741.977 | -.038 | 742.012 | -.032 | 742.005 | -.029 |
| 01-20-80 | 742.003 | -.044 | 741.972 | -.043 | 742.004 | -.040 | 742.000 | -.030 |
| 04-29-80 | 742.003 | -.044 | 741.971 | -.044 | 742.004 | -.040 | 741.998 | -.028 |
| 10-09-80 | 742.009 | -.038 | 741.976 | -.039 | 742.011 | -.033 | 742.005 | -.033 |
| 04-10-81 | 741.998 | -.049 | 741.966 | -.049 | 741.999 | -.045 | 741.993 | -.035 |
| 04-10-81 | *743.744 | - | *743.454 | - | *742.010 | - | *744.044 | -.028 |
| 10-07-81 | 743.757 | -.013 | 743.457 | -.013 | 744.023 | -.013 | 744.058 | -.040 |

TABLE 2.5-67 (Sheet 2 of 2)

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

| | SETTLEMENT POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SE | | SW | | NE | | NW | |
| | SS-1 | | SS-2 | | SS-3 | | SS-4 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 12-22-81 | 743.752 | -.008 | Not Run | - | 744.019 | -.009 | 744.056 | +.0014- |
| 01-20-82 | 743.744 | 0.0 | Not Run | - | 744.013 | +.003 | 744.048 | +.0012 |
| 01-29-82 | 743.752 | +.008 | 743.463 | +.009 | 744.020 | +.010 | 744.055 | +.0011 |
| AVG* | *743.749 | +.005 | - | - | 744.017 | +.007 | 744.053 | +.009 |
| I => initial reading + =>up -=>down | | | | | | | | |

* Monument moved from inside to outside of building. Initial elevation reset.

TABLE 2.5-68

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

| | SETTLEMENT POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SE | | SW | | NE | | NW | |
| | SS-45 | | SS-46 | | SS-47 | | SS-48 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 03-15-77 | 728.982 | - | 728.951 | - | 728.996 | - | 728.975 | - |
| 04-11-77 | 723.980 | -.002 | 723.977 | -.004 | 728.992 | -.004 | 728. 970 | -.005 |
| 05-10-77 | 723.976 | -006 | 728.973 | -.008 | 728.988 | -.008 | 728.966 | -.009 |
| 06-06-77 | 728.980 | -002 | 728.976 | -.005 | 728.991 | -.005 | 728.970 | -.005 |
| 07-06-77 | 728.982 | 0 | 728.976 | -.005 | 728.991 | -.005 | 728.972 | -.005 |
| 08-03-77 | 728.962 | -.020 | 728.957 | -.024 | 728.973 | -.023 | 728.953 | -.022 |
| 08-12-77 | 728.974 | -.008 | 728..970 | -.011 | 728.935 | -.011 | 728.965 | -.010 |
| 10-11-77 | 728.976 | -.006 | NR | - | 728.959 | -.007 | 728. 968 | -.007 |
| 11-07-77 | NR | - | 728.961 | -.020 | 728.973 | -.018 | 728. 956 | -.019 |
| 12-15-77 | NR | - | 728.976 | -.005 | 728.993 | -.003 | 728. 970 | -.005 |
| 01-09-78 | NR | - | 728.974 | -.007 | 728.990 | -.006 | 728.965 | -.007 |
| 02-02-78 | 728.973 | -.000 | NR | - | 728.979 | -.017 | 728.995 | -.020 |
| 03-03-78 | 728.971 | -.011 | 728.969 | -.012 | 728.985 | -.011 | 728.963 | -.012 |
| 04-03-78 | 728.968 | -.012 | 728.965 | -.016 | 728.981 | -.015 | 728.959 | -.016 |
| 05-04-78 | 728.974 | -.008 | 728.971 | -.010 | 728.986 | -.010 | 728.963 | -.012 |
| 06-05-78 | 728.963 | -.019 | 728.960 | -.021 | 728.977 | -.019 | 728.955 | -.020 |
| 07-10-78 | 728.961 | -.021 | 728.957 | -.024 | 728.975 | -.021 | 728.955 | -.020 |
| 08-04-78 | 728.955 | -.027 | 728.951 | -.030 | 728.968 | -.028 | 728.952 | -.023 |
| 09-29-78 | 728.968 | -.014 | NR | - | 728.983 | -.013 | 728.962 | -.013 |
| 01-21-79 | 728.969 | -.013 | NR | - | 728.072 | -.004 | 728.963 | -.007 |
| 01-11-79 | 728.950 | -.032 | 728.951 | -.030 | 728.973 | -.023 | 728.949 | -.016 |
| 07-25-79 | 728.959 | -.023 | 728.961 | -.020 | 728.980 | -.016 | 728.958 | -.017 |
| 10-22-79 | NR | - | 728.955 | -.026 | 728.976 | -.020 | 728.953 | -.022 |
| 01-19-80 | 728.945 | -.037 | 728.946 | -.035 | 728.968 | -.028 | NR | - |
| 04-23-80 | 728.939 | -.043 | 728.940 | -.041 | 728.962 | -.034 | NR | - |
| 10-09-80 | 728.955 | -.027 | 728.953 | -.028 | 728.974 | -.022 | NR | - |
| 04-10-81 | NR | - | 728.947 | -.034 | 728.970 | -.026 | NR | - |
| 10-07-81 | NR | - | 728.957 | -.024 | 728.981 | -.015 | NR | - |
| 12-22-81 | 728.943 | -.039 | 728.947 | -.034 | 728.973 | -.023 | NR | - |
| 01-18-82 | 728.940 | -.042 | 728.946 | -.035 | 728.970 | -.026 | NR | - |
| 01-27-82 | 728.942 | -.040 | 728.947 | -.034 | 728.972 | -.024 | 728.946 | -.029 |
| 02-11-82 | - | - | - | - | - | - | 728.944 | -.031 |
| AVG | *723.942 | -.040 | *728.947 | -.034 | *728.972 | -.024 | **728.945 | -.030 |

*Last three readings. **Last two readings.

TABLE 2.5-69 (Sheet 1 of 3)

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-2 | | SS-3 | | SS-4 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 10-17-74 | 652.031 | | 652.003 | | | | | |
| 11-25-74 | Inaccessible | - | 652.008 | -.001 | | | | |
| 12-19-74 | 652.039 | +.008 | Not Read | - | 652.051 | | | |
| 01-23-75 | 652.037 | +.006 | Not Read | - | 652.049 | -.002 | | |
| 02-24-75 | 652.036 | +.005 | Not Read | - | 652.046 | -.005 | | |
| 03-21-75 | No Data | - | Not Read | - | 652.033 | -.018 | | |
| 05-09-75 | 652.049 | +.018 | 652.021 | +.012 | 652.062 | -.011 | | |
| 06-04-75 | 652.037 | +.006 | 652.011 | +.002 | 652.050 | -.001 | | |
| 07-02-75 | Not Read | - | Not Read | - | Not Read | - | | |
| 07-21-75 | Not Read | - | Not Read | - | Not Read | - | | |
| 08-22-75 | Not Read | - | Not Read | - | Not Read | - | | |
| 09-10-75 | Not Read | - | Not Read | - | Not Read | - | | |
| 10-31-75 | 652.036 | +.005 | 652.006 | -.003 | 652.049 | -.002 | | |
| 11-24-75 | 652.038 | +.007 | 652.008 | -.001 | 652.050 | -.001 | | |
| 12-16-75 | 652.040 | +.009 | 652.007 | -.002 | 652.053 | -.002 | | |
| 01-14-76 | 652.040 | +.009 | 652.009 | 0.0 | 652.051 | 0.0 | | |
| 01-11-76 | 652.041 | +.010 | 652.008 | -.001 | 652.052 | -.001 | | |
| 03-13-76 | 652.046 | +.015 | 652.016 | -.007 | 652.057 | -.006 | | |
| 04-15-76 | 652.050 | +.019 | 652.017 | -.008 | 652.059 | -.005 | | |
| 05-11-76 | 652.067 | +.036 | 652.014 | -.005 | 652.047 | -.004 | | |
| 06-11-76 | 652.042 | +.011 | 652.010 | -.001 | 652.054 | -.003 | | |
| 07-14-76 | 652.038 | +.007 | 652.007 | -.002 | 652.052 | -.001 | | |
| 08-10-76 | 652.036 | +.005 | 652.001 | -.008 | 652.052 | -.001 | | |
| 09-14-76 | 652.030 | +.001 | 652.000 | -.009 | 652.048 | -.003 | | |

WBN

TABLE 2.5-69 (Sheet 2 of 3)

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-2 | | SS-3 | | SS-3A | | SS-4 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 10-13-76 | 652.034 | +.003 | | | 652.004 | -.005 | 652.048 | -.003 | | | | |
| 11-09-76 | Poor Closure Not Used | - | | | Poor Closure Not Used | - | Poor Closure Not Used | - | | | | |
| 12-09-76 | Not Run | - | | | Not Run | - | Not Run | - | | | | |
| 01-12-77 | Not Run | - | | | Not Run | - | Not Run | - | | | | |
| 02-10-77 | Not Run | - | | | Not Run | - | Not Run | - | | | | |
| 03-15-77 | 652.036 | +.005 | 741.128 | i | 652.022 | +.013 | 652.052 | +.001 | | | 727.829 | i |
| 04-11-77 | 652.029 | -.002 | Not Run | - | 651.977 | -.012 | 652.049 | +.002 | | | 727.826 | -.003 |
| 05-10-77 | 652.022 | -.009 | 741.121 | -.007 | 651.991 | -.018 | 652.046 | +.005 | | | 727.827 | -.002 |
| 06-06-77 | 652.027 | -.004 | 741.131 | +.003 | 651.999 | -.010 | 652.052 | +.001 | | | 727.833 | +.004 |
| 07-06-77 | Not Run | - | Not Run | - | Not Run | - | Not Run | - | | | 727.833 | +.003 |
| 08-03-77 | Not Run | - | 741.128 | 0.0 | Not Run | - | Not Run | - | 741.418 | i | 727.828 | -.001 |
| 09-12-77 | Not Run | - | 741.114 | -.014 | Not Run | - | Not Run | - | 741.402 | -.016 | 727.816 | -.013 |
| 10-11-77 | Not Run | - | 741.117 | -.011 | Not Run | - | Not Run | - | 741.404 | -.014 | 727.815 | -.003 |
| 11-07-77 | Not Run | - | 741.109 | -.019 | Not Run | - | Not Run | - | 741.336 | -.022 | 727.816 | -.018 |
| 12-15-77 | Permanently Inaccessible | - | 741.124 | -.004 | Permanently Inaccessible | | Permanently Inaccessible | | 741.412 | -.006 | 727.826 | -.003 |
| 01-09-78 | | | 741.109 | -.019 | | | | | 741.397 | -.021 | 727.811 | -.003 |
| 02-02-78 | | | 741.105 | -.023 | | | | | 741.391 | -.027 | Not Run | - |
| 03-03-78 | | | 741.111 | -.017 | | | | | 741.396 | -.022 | 727.815 | -.014 |
| 04-03-78 | | | 741.120 | -.008 | | | | | 741.405 | -.013 | 727.821 | -.008 |
| 05-04-78 | | | 741.125 | -.003 | | | | | 741.412 | -.006 | 727.828 | -.001 |
| 06-05-78 | | | 741.118 | -.010 | | | | | 741.407 | -.011 | 727.822 | +.007 |
| 07-10-78 | | | 741.135 | +.007 | | | | | 741.421 | -.003 | 727.841 | +.012 |
| 08-04-78 | | | 741.129 | +.001 | | | | | 741.416 | -.002 | 727.830 | +.001 |
| 09-29-78 | | | 741.119 | -.009 | | | | | 741.410 | -.008 | 727.826 | -.003 |

WBN

TABLE 2.5-69 (Sheet 3 of 3)

SETTLEMENT MONITORING PROGRAM
WASTE MANAGEMENT BUILDING

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-2 | | SS-3 | | SS-3A | | SS-4 | |
| DATE | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. | ELEV. | DIFF. |
| 02-02-79 | | | 741.102 | -.026 | | | | | 741.386 | -.032 | 727.810 | -.019 |
| 04-07-79 | | | 741.109 | -.019 | | | | | 741.378 | -.020 | 727.820 | -.009 |
| 07-19-79 | | | 741.123 | -.005 | | | | | 741.414 | -.004 | 727.834 | +.005 |
| 10-17-79 | | | 741.115 | -.013 | | | | | 741.404 | -.014 | 727.824 | -.005 |
| 01-21-80 | | | 741.107 | -.021 | | | | | 741.397 | -.021 | 727.815 | -.014 |
| 04-23-80 | | | 741.118 | -.010 | | | | | 741.407 | -.010 | 727.827 | -.002 |
| 12-18-81 | | | Not Run | - | | | | | | - | 727.807 | -.022 |
| 01-07-82 | | | Not Run | - | | | | | | - | 727.820 | -.009 |
| 01-21-82 | | | Not Run | - | Not Run | | Not Run | - | Not Run | - | 727.814 | -.015 |
| AVG* | | | - | - | - | - | - | - | | - | 727.814 | -.015 |

# SETTLEMENT MONITORING PROGRAM

Historical Information

WATTS BAR NUCLEAR PLANT

POWERHOUSE

**Best Available Historical Image**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 1

| | SETTLEMENT POINTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-1B | | SS-2 | | SS-2A | | SS-3 | | SS-4 | | SS-5 | | SS-6 | | SS-7 | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 10-16-73 | | | | | | | | | | | | | | | | | | | | | JAB 12-31-81 | STB 1-26-82 |
| 11-19-73 | | | | | | | | | | | | | | | | | | | | | ↓ | ↓ |
| 12-17-73 | 656.536 | i | | | | | | | | | | | | | | | | | | | | |
| 1-16-74 | Not Read | - | | | | | | | | | | | | | | | | | | | | |
| 2-20-74 | 656.534 | -.002 | | | | | 672.176 | i | | | | | | | | | | | | | | |
| 3-18-74 | Inacc.* | | | | | | 672.173 | -.003 | | | | | | | | | | | | | | |
| 4-15-74 | | | | | | | 672.175 | -.001 | | | 690.079 | i | | | | | | | | | | |
| 5-13-74 | | | | | | | 672.171 | -.005 | | | 690.076 | -.003 | | | | | | | | | | |
| 6-11-74 | | | | | | | RS* 675.693 | - | | | 690.081 | +.002 | | | | | | | | | | |
| 7-15-74 | | | | | | | 675.695 | +.002 | | | 690.085 | +.006 | | | | | | | | | | |
| 8-13-74 | | | | | | | 675.688 | -.005 | | | 690.077 | -.002 | | | | | | | | | | |
| 9-16-74 | | | | | | | 675.691 | -.002 | | | 694.125** | -.001 | | | | | | | | | | |
| 10-17-74 | | | | | | | 675.693 | 0 | | | 694.120 | -.006 | | | | | | | | | | |
| 11-18-74 | | | | | | | 675.682 | -.011 | | | 694.118 | -.008 | | | | | | | | | | |
| 12-18-74 | | | | | | | 675.691 | -.002 | 692.017 | i | 694.120 | -.006 | | | | | | | | | | |
| 1-20-75 | | | | | | | 675.690 | -.003 | 692.012 | -.005 | 694.118 | -.008 | | | | | 696.641 | i | | | | |
| 2-19-75 | | | | | | | 675.686 | -.007 | 692.014 | -.003 | 694.119 | -.007 | | | 696.632 | i | 696.649 | +.008 | 696.616 | i | | |
| 3-17-75 | | | 676.014 | i | | | 675.689 | -.004 | 692.014 | -.003 | 694.122 | -.004 | | | 696.626 | -.006 | 696.641 | 0 | 696.609 | -.007 | | |
| 5-6-75 | | | 676.020 | +.006 | | | 675.694 | +.001 | 692.015 | -.002 | 694.122 | -.004 | | | 696.625 | -.007 | 696.640 | -.001 | 696.605 | -.011 | | |
| 6-2-75 | | | 676.015 | +.001 | | | 675.688 | -.005 | 692.015 | -.002 | 694.122 | -.004 | | | 705.292 | *0 0 | 705.318*1 | 0 | 705.324*2 | -.001 | | |
| 7-7-75 | | | 676.012 | -.002 | | | 675.681 | -.012 | 692.005 | -.012 | 694.119 | -.007 | | | 705.281 | -.011 | 705.306 | -.012 | 705.313 | -.012 | | |
| 7-21-75 | | | 676.020 | +.006 | | | 675.691 | -.002 | 692.019 | +.002 | 694.127 | +.001 | | | Not Run | - | 705.325 | +.007 | 705.331 | +.006 | | |
| 8-18-75 | | | 676.012 | -.002 | | | 675.681 | -.012 | 692.015 | -.002 | 694.114 | -.012 | | | 705.281 | -.011 | 705.308 | -.010 | 705.313 | -.012 | | |
| 9-10-75 | | | 676.018 | +.004 | | | 675.688 | -.005 | 692.016 | -.001 | 694.124 | -.002 | | | N R | - | Not Run | - | Not Run | - | | |

*RS Point reset to new location

i Initial reading

** Reset to 694.126 on 8/23/74

*0 Reset to 705.292 on 5-6-75

*1 Reset to 705.318 on 5/6/75

*2 Reset to 705.325 on 5/6/75

SETTLEMENT MONITORING PROGRAM

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 2

Watts Bar Nuclear Plant

Powerhouse

Historical Information

| | SETTLEMENT POINTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-1B | | SS-2 | | SS-2A | | SS-3 | | SS-4 | | SS-5 | | SS-6 | | SS-7 | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 10-31-75 | | | 676.012 | -.002 | 692.008 | i | 675.685 | -.008 | 692.009 | -.008 | 694.116 | -.010 | | | Not Run | - | Not Run | - | Not Run | - | JAD 12-31-81 | [illegible] 1-26-82 |
| 11-14-75 | | | 676.021 | +.007 | 692.017 | +.009 | 675.695 | +.002 | 692.021 | +.004 | 694.125 | -.001 | | | NR | - | NR | - | NR | - | ↓ | ↓ |
| 12-16-75 | | | 676.003 | -.011 | 691.999 | -.009 | 675.675 | -.018 | 692.000 | -.017 | 694.107 | -.019 | | | 705.290 | -.002 | 705.318 | 0 | 705.324 | +.001 | | |
| 1-14-76 | | | 676.016 | +.002 | 692.012 | +.004 | 675.688 | -.005 | 692.014 | -.003 | 694.120 | -.006 | 729.033 | i | 705.284 | -.008 | 705.308 | -.010 | 705.318 | -.007 | | |
| 2-11-76 | | | 676.018 | +.004 | 692.016 | +.008 | 675.683 | -.005 | 692.014 | -.003 | 694.124 | -.002 | 729.040 | +.007 | 705.290 | -.002 | 705.317 | -.001 | 705.326 | +.001 | | |
| 3-18-76 | | | 676.022 | +.008 | 692.020 | +.012 | 675.693 | 0 | 692.019 | +.002 | 694.126 | 0 | 729.027 | -.006 | 705.279 | -.013 | 705.307 | -.011 | 705.315 | -.010 | | |
| 4-15-76 | | | 676.016 | +.002 | 692.014 | +.006 | 675.684 | -.009 | 692.011 | -.006 | 694.120 | -.006 | 729.036 | +.003 | 705.301 | +.009 | 705.325 | +.007 | 705.331 | +.006 | | |
| 5-11-76 | | | 676.019 | +.005 | 692.020 | +.012 | 675.680 | -.004 | 692.017 | 0 | 694.126 | 0 | 729.037 | +.004 | 705.307 | +.015 | 705.330 | +.012 | 705.335 | +.010 | | |
| 6-11-76 | | | 676.014 | 0 | 692.010 | +.002 | 675.680 | -.013 | 692.004 | -.013 | 694.115 | -.011 | 729.028 | -.009 | 705.294 | +.002 | 705.317 | -.001 | 705.322 | -.003 | | |
| 7-14-76 | | | 676.012 | -.002 | 692.016 | +.008 | 675.677 | -.016 | 692.009 | -.008 | 694.121 | -.005 | 729.031 | -.002 | 705.311 | +.019 | 705.332 | +.014 | 705.336 | +.011 | | |
| 8-10-76 | | | 676.023 | +.009 | 692.023 | +.015 | 675.688 | -.005 | 692.015 | -.002 | 694.129 | +.003 | 729.037 | +.004 | 705.308 | +.016 | 705.329 | +.011 | 705.334 | +.009 | | |
| 9-14-76 | | | 676.006 | -.008 | 692.003 | -.005 | 675.670 | -.023 | 691.996 | -.021 | 694.110 | -.016 | 729.027 | -.006 | 705.280 | -.012 | 705.311 | -.007 | 705.314 | -.011 | | |
| 10-13-76 | | | 676.014 | 0 | 692.010 | +.002 | 675.677 | -.016 | 692.004 | -.013 | 694.117 | -.009 | 729.030 | -.003 | 705.294 | +.002 | 705.320 | +.002 | 705.327 | +.002 | | |
| 11-9-76 | | | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | | |
| 12-9-76 | | | 675.994 | -.020 | 691.992 | -.016 | 675.658 | -.035 | 691.984 | -.033 | 694.099 | -.027 | 729.020 | -.013 | 705.264 | -.028 | 705.295 | -.023 | 705.300 | -.025 | | |
| 1-12-77 | | | 676.002 | -.012 | 692.000 | -.008 | 675.664 | -.029 | 691.993 | -.024 | 694.109 | -.017 | 729.017 | -.016 | Not Run | - | Not Run | - | Not Run | - | | |
| 2-10-77 | | | 676.009 | -.005 | 692.011 | +.003 | 675.673 | -.020 | 692.002 | -.015 | 694.119 | -.007 | 729.026 | -.007 | NR | - | NR | - | NR | - | | |
| 3-15-77 | | | 676.012 | -.002 | 692.016 | +.008 | 675.673 | -.020 | 692.006 | -.011 | 694.123 | -.003 | Not Run | - | 705.283 | -.009 | 705.313 | -.005 | 705.318 | -.007 | | |
| 4-11-77 | | | 676.010 | -.004 | Not Run | - | 675.673 | -.020 | 692.001 | -.016 | 694.115 | -.011 | NR | - | 705.282 | -.010 | 705.311 | -.007 | 705.315 | -.010 | | |
| 5-10-77 | | | 676.005 | -.009 | 691.996 | -.012 | 675.666 | -.027 | 691.986 | -.031 | 694.102 | -.024 | 729.018 | -.015 | 705.273 | -.019 | 705.303 | -.015 | 705.306 | -.019 | | |
| 6-6-77 | | | 676.026 | +.012 | 692.018 | +.010 | 675.685 | -.008 | 692.010 | -.007 | 694.123 | -.003 | 729.026 | -.007 | 705.287 | -.005 | 705.312 | -.006 | 705.316 | -.009 | | |
| 7-6-77 | | | 676.018 | +.004 | 692.017 | +.009 | 675.677 | -.016 | 692.007 | -.010 | 694.118 | -.008 | 729.035 | +.002 | 705.287 | -.005 | 705.316 | -.002 | 705.317 | -.008 | | |
| 8-3-77 | | | 675.989 | -.025 | 691.993 | -.015 | 675.648 | -.045 | 691.182 | -.035 | 694.098 | -.028 | 729.011 | -.022 | 705.264 | -.028 | 705.292 | -.026 | 705.294 | -.031 | | |
| 9-12-77 | | | 676.009 | -.005 | 692.006 | -.002 | 675.669 | -.024 | 691.995 | -.022 | 694.111 | -.015 | 729.024 | -.009 | 705.279 | -.013 | 705.304 | -.014 | 705.308 | -.017 | | |

SETTLEMENT MONITORING PROGRAM

**Best Available Historical Image**

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| SETTLEMENT MONITORING PROGRAM<br>POWERHOUSE<br>TABLE 2.5-70<br>SHEET 3 |

WATTS BAR NUCLEAR PLANT

POWERHOUSE

Historical Information

| | SETTLEMENT POINTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-1B | | SS-2 | | SS-2A | | SS-3 | | SS-4 | | SS-5 | | SS-6 | | SS-7 | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 10-11-77 | | | 676.018 | +.004 | 692.015 | +.007 | 675.677 | -.016 | 692.002 | -.015 | 694.124 | -.002 | 729.026 | -.007 | 705.282 | -.010 | 705.312 | -.006 | 705.314 | -.011 | JAD 12/31/81 | BTB 1-26-82 |
| 11-7-77 | | | 675.995 | -.019 | 691.997 | -.011 | 675.656 | -.037 | 691.986 | -.031 | 694.104 | -.022 | 729.010 | -.023 | 705.268 | -.024 | 705.296 | -.022 | 705.299 | -.026 | ↓ | ↓ |
| 12-15-77 | | | 676.019 | +.005 | 692.014 | +.006 | 675.680 | -.013 | 692.005 | -.012 | 694.124 | -.002 | 729.022 | -.011 | 705.281 | -.011 | 705.311 | -.007 | 705.311 | -.014 | | |
| 1-9-78 | | | 676.010 | -.004 | 692.010 | +.002 | 675.669 | -.024 | 691.998 | -.019 | 694.120 | -.006 | 729.022 | -.011 | NOT RUN | - | NOT RUN | - | NOT RUN | - | | |
| 2-2-78 | | | 676.016 | +.002 | 692.016 | -.008 | 675.676 | -.017 | 692.008 | -.009 | 694.126 | 0 | 729.027 | -.006 | NR | - | NR | - | NR | - | | |
| 3-3-78 | | | 676.006 | -.008 | 692.004 | -.004 | 675.667 | -.026 | 691.994 | -.023 | 694.113 | -.013 | 729.017 | -.016 | 705.280 | -.012 | 705.310 | -.008 | 705.310 | -.015 | | |
| 4-3-78 | | | NOT RUN | - | 692.004 | -.004 | 675.664 | -.029 | 691.991 | -.026 | 694.112 | -.014 | 729.017 | -.016 | 705.274 | -.018 | 705.304 | -.014 | 705.304 | -.021 | | |
| 5-4-78 | | | N.R. | - | NOT RUN | - | 675.670 | -.023 | 691.998 | -.019 | 694.117 | -.009 | 729.017 | -.011 | NR | - | NR | - | NR | - | | |
| 6-[illegible]-78 | | | PERMANENTLY INACCESSIBLE | | NR | - | 675.672 | -.021 | 692.000 | -.017 | 694.116 | -.010 | 729.014 | -.019 | 705.271 | -.021 | 705.300 | -.018 | 705.301 | -.024 | | |
| 7-10-78 | | | | | 692.006 | -.002 | 675.662 | -.031 | 691.992 | -.025 | 694.110 | -.016 | 729.015 | -.018 | 705.271 | -.021 | NR | - | | | | |
| 8-4-78 | | | | | 691.996 | -.012 | NOT RUN | - | 691.984 | -.033 | 694.101 | -.025 | 729.010 | -.023 | | | | | | | | |
| 9-29-78 | | | | | 692.011 | +.002 | NOT RUN | - | 691.999 | -.018 | 694.115 | -.011 | 729.020 | -.013 | | | | | | | | |
| 1-19-79 | | | | | 692.012 | +.004 | NOT RUN | - | NR | | 694.122 | -.004 | | | | | | | | | | |
| 4-11-79 | | | | | 692.004 | -.004 | 675.659 | -.034 | NR | | 694.10[illegible] | -.018 | | | | | | | | | | |
| 7-20-79 | | | | | 692.013 | +.005 | NR | - | NR | | NR | - | | | | | | | | | | |
| 10-18-79 | | | | | 692.012 | +.004 | 675.673 | -.020 | NR | | 694.117 | -.009 | | | | | | | | | | |
| 1-10-80 | | | | | 691.999 | -.009 | 675.656 | -.037 | NR | | 694.105 | -.021 | | | | | | | | | | |
| 4-29-80 | | | | | 691.994 | -.014 | 675.655 | -.038 | NR | | 694.098 | -.028 | | | | | | | | | | |
| 10-4-80 | | | | | | | | | | | | | | | | | | | | | | |
| 4-8-81 | | | | | | | | | | | | | | | | | | | | | | |
| 10-6-81 | | | | | | | | | | | | | | | | | | | | | | |
| 12-18-81 | | | | | 691.981 | -.027 | 675.643 | -.050 | NOT RUN | - | 694.091 | -.035 | NOT RUN | - | NOT RUN | - | NOT RUN | - | NOT RUN | - | JAD 1-25-82 | BTB 1-26-81 |
| 1-8-82 | | | | | 692.007 | -.001 | 675.663 | -.030 | NR | - | 694.113 | -.013 | NR | - | NR | - | NR | - | NR | - | JAD 2-11-82 | BTB 2-17-82 |
| 1-22-82 | | | | | 692.001 | -.007 | 675.660 | -.033 | NR | - | 694.110 | -.016 | 728.993 | -.040 | 705.266 | -.026 | 705.296 | -.022 | 705.297 | -.028 | JAD 2-17-82 | BTB 2-17-82 |

SETTLEMENT MONITORING PROGRAM

WATTS BAR NUCLEAR PLANT

POWERHOUSE

**Best Available Historical Image**

Historical Information

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 4

| | SETTLEMENT POINTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-1 | | SS-1A | | SS-1B | | SS-2 | | SS-2A | | SS-3 | | SS-4 | | SS-5 | | SS-6 | | SS-7 | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 2-12-82 | | | | | | | | | | | | | 728.995 | -.038 | 705.263 | -.029 | 705.293 | -.025 | 705.294 | -.031 | JMH 2-25-82 | [illegible] 2-25-82 |
| AVG | | | | | *691.996 | -.012 | *675.655 | -.038 | - | - | *694.105 | -.021 | **728.994 | -.039 | **705.265 | -.027 | **705.295 | -.023 | **705.296 | -.029 | JMH 2-25-82 | [illegible] 2-25-82 |

* LAST THREE READING  ** LAST TWO READING

SETTLEMENT MONITORING PROGRAM

WATTS BAR NUCLEAR PLANT

POWERHOUSE

Best Available Historical Image

Historical Information

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SETTLEMENT MONITORING PROGRAM**
**POWERHOUSE**
**TABLE 2.5-70**
**SHEET 5**

| | SETTLEMENT POINTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SS-8 | | SS-9 | | SS-10 | | SS-11 | | SS-12 | | SS-13 | | SS-14 | | SS-15 | | SS-16 | | SS-17 | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 3-18-74 | | | | | 690.032 | i | | | | | | | | | | | | | | | JAD 1-4-82 | [illegible] 1-26-82 |
| 4-15-74 | | | | | 690.033 | +.001 | | | | | | | | | | | | | 690.091 | i | ↓ | ↓ |
| 5-13-74 | | | | | 690.031 | -.001 | | | | | | | | | | | | | 690.088 | -.003 | | |
| 6-11-74 | | | | | 690.035 | +.003 | | | | | | | | | | | | | 690.086 | -.005 | | |
| 7-15-74 | | | | | 690.035 | +.003 | | | | | | | | | | | | | 690.090 | -.001 | | |
| 8-13-74 | | | | | 690.027 | -.005 | | | | | | | | | | | | | 690.081 | -.010 | | |
| 8-23-74 | | | | | 694.217 | RS - | | | | | | | | | | | | | 694.098 | RS | | |
| 9-16-74 | | | | | 694.220 | +.003 | | | | | 696.590 | i | | | 696.605 | i | | | 694.091 | -.007 | | |
| 10-17-74 | | | | | 694.212 | -.005 | | | | | 696.585 | -.005 | 696.593 | i | 696.605 | 0 | | | 694.095 | -.003 | | |
| 11-18-74 | | | | | 694.212 | -.005 | | | | | 696.585 | -.005 | 696.593 | 0 | 696.604 | -.001 | | | 694.095 | -.003 | | |
| 12-18-74 | | | | | 694.214 | -.003 | | | | | 704.807* | +.001 | 704.792** | 0 | 704.767*** | 0 | | | 694.095 | -.003 | | |
| 1-20-75 | | | | | 694.213 | -.004 | | | | | 704.803 | -.003 | 704.793 | +.001 | 704.766 | -.001 | | | 694.097 | -.001 | | |
| 2-19-75 | | | | | 694.211 | -.006 | | | | | 704.805 | -.001 | 704.796 | +.004 | 704.770 | +.003 | | | 694.097 | -.001 | | |
| 3-17-75 | | | | | 694.210 | -.007 | | | | | 704.802 | -.004 | 704.792 | 0 | 704.766 | -.001 | | | 694.097 | -.001 | | |
| 5-6-75 | | | | | 694.208 | -.009 | | | | | 704.801 | -.005 | 704.790 | -.002 | 704.763 | -.004 | | | 694.100 | +.002 | | |
| 6-2-75 | | | | | 694.207 | -.010 | | | | | 704.793 | -.013 | 704.786 | -.006 | 704.760 | -.007 | | | 694.097 | -.001 | | |
| 7-7-75 | | | | | 694.193 | -.024 | | | | | 704.790 | -.016 | 704.783 | -.009 | 704.759 | -.008 | | | 694.093 | -.005 | | |
| 7-21-75 | | | | | 694.208 | -.009 | | | | | 704.802 | -.004 | 704.794 | +.002 | 704.772 | +.005 | | | 694.101 | +.003 | | |
| 8-18-75 | | | | | 694.203 | -.014 | | | | | 704.787 | -.019 | 704.778 | -.014 | 704.756 | -.011 | | | 694.088 | -.010 | | |
| 9-10-75 | | | | | 694.202 | -.015 | | | | | 704.799 | -.007 | 704.788 | -.004 | 704.766 | -.001 | | | 694.096 | -.002 | | |
| 10-31-75 | | | | | 694.198 | -.019 | | | | | 704.788 | -.018 | 704.778 | -.014 | 704.755 | -.012 | | | 694.091 | -.007 | | |
| 11-24-75 | | | | | 694.212 | -.005 | | | | | 704.804 | -.002 | 704.796 | +.004 | 704.771 | +.004 | | | 694.103 | +.005 | | |
| 12-17-75 | | | | | 694.190 | -.027 | | | | | 704.791 | -.015 | 704.783 | -.009 | 704.758 | -.009 | | | 694.086 | -.012 | | |
| 1-14-76 | | | | | 694.206 | -.011 | | | | | 704.797 | -.009 | 704.788 | -.004 | 704.764 | -.003 | 728.930 | i | 694.099 | +.001 | | |

RS - POINT RESET

* POINT RESET TO 704.806 ON 11-18-74

** POINT RESET TO 704.792 ON 11-18-74

*** POINT RESET TO 704.767 ON 11-18-74

SETTLEMENT MONITORING PROGRAM

WATTS BAR NUCLEAR PLANT

POWERHOUSE

Best Available Historical Image

Historical Information

**WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT**

**SETTLEMENT MONITORING PROGRAM POWERHOUSE TABLE 2.5-70 SHEET 6**

SETTLEMENT POINTS

| DATE | SS-8 | | SS-9 | | SS-10 | | SS-11 | | SS-12 | | SS-13 | | SS-14 | | SS-15 | | SS-16 | | SS-17 | | BY | CHKD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | | |
| 2-11-76 | | | 728.953 | i | 694.207 | -.010 | 729.033 | i | | | 704.804 | -.002 | 704.795 | +.003 | 704.771 | +.004 | 728.991 | +.011 | 694.101 | +.003 | JAD 1-4-82 | 878 1-26-82 |
| 3-18-76 | | | 728.942 | -.011 | 694.205 | -.012 | 729.023 | -.010 | | | 704.797 | -.009 | 704.790 | -.002 | 704.764 | -.003 | 728.987 | +.007 | 694.105 | +.007 | ↓ | ↓ |
| 4-15-76 | | | 728.946 | -.007 | 694.201 | -.016 | 729.027 | -.006 | | | 704.795 | -.011 | 704.787 | -.005 | 704.763 | -.004 | 728.990 | +.010 | 694.096 | -.002 | | |
| 5-11-76 | | | 728.946 | -.007 | 694.205 | -.012 | 729.028 | -.005 | | | 704.795 | -.011 | 704.785 | -.007 | 704.763 | -.004 | 728.986 | +.006 | 694.101 | +.003 | | |
| 6-11-76 | | | 728.934 | -.019 | 694.192 | -.025 | 729.016 | -.017 | | | Not Run | — | Not Run | — | Not Run | — | 728.986 | +.006 | 694.089 | -.009 | | |
| 7-14-76 | 729.034 | i | 728.936 | -.017 | 694.195 | -.022 | 729.019 | -.014 | 728.995 | i | 704.787 | -.019 | 704.779 | -.013 | 704.757 | -.010 | [illegible] | +.007 | 694.094 | -.004 | | |
| 8-10-76 | 729.039 | +.005 | 728.940 | -.013 | 694.200 | -.017 | 729.023 | -.010 | 729.002 | +.007 | 704.785 | -.021 | 704.778 | -.014 | 704.755 | -.012 | 728.983 | +.003 | 694.102 | +.004 | | |
| 9-14-76 | 729.033 | -.001 | 728.934 | -.019 | 694.183 | -.034 | 729.020 | -.013 | 728.997 | +.002 | 704.786 | -.020 | 704.779 | -.013 | 704.754 | -.013 | [illegible] | +.008 | 694.088 | -.010 | | |
| 10-13-76 | 729.039 | +.005 | 728.942 | -.011 | 694.191 | -.026 | 729.026 | -.007 | 729.001 | +.006 | 704.787 | -.019 | 704.779 | -.013 | 704.758 | -.009 | [illegible] | +.002 | 694.095 | -.003 | | |
| 11-9-76 | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | Poor Closure Not Used | — | | |
| 12-9-76 | 729.026 | -.008 | 728.932 | -.021 | 694.174 | -.043 | 729.013 | -.020 | 728.987 | -.008 | 704.766 | -.040 | 704.762 | -.030 | 704.737 | -.030 | 728.979 | -.001 | 694.074 | -.024 | | |
| 1-12-77 | 729.029 | -.005 | 728.937 | -.016 | 694.184 | -.033 | Not Run | — | 728.991 | -.004 | 704.770 | -.036 | 704.767 | -.025 | 704.741 | -.026 | Not Run | — | 694.082 | -.016 | | |
| 2-10-77 | 729.030 | -.004 | 728.951 | -.002 | 694.193 | -.024 | 729.027 | -.006 | 728.991 | -.004 | 704.785 | -.021 | 704.780 | -.012 | 704.761 | -.006 | NR | — | 694.093 | -.005 | | |
| 3-15-77 | 729.032 | -.002 | Not Run | — | 694.195 | -.022 | 729.018 | -.015 | 728.991 | -.004 | 704.787 | -.019 | 704.784 | -.008 | 704.758 | -.009 | 728.978 | -.002 | 694.096 | -.002 | | |
| 4-11-77 | 729.027 | -.007 | 728.933 | -.020 | 694.189 | -.028 | 729.015 | -.018 | 728.988 | -.007 | 704.780 | -.026 | 704.776 | -.016 | 704.752 | -.015 | Not Run | — | 694.090 | -.008 | | |
| 5-10-77 | 729.023 | -.011 | 728.926 | -.027 | 694.174 | -.043 | 729.013 | -.020 | 728.984 | -.011 | 704.772 | -.034 | 704.771 | -.021 | 704.743 | -.024 | 728.977 | -.003 | 694.082 | -.016 | | |
| 6-6-77 | 729.027 | -.007 | 728.932 | -.021 | 694.196 | -.021 | 729.011 | -.022 | 728.987 | -.006 | 704.780 | -.026 | 704.779 | -.013 | 704.753 | -.014 | 728.975 | -.005 | 694.097 | -.001 | | |
| 7-6-77 | 729.035 | +.001 | 728.937 | -.016 | 694.190 | -.027 | 729.015 | -.018 | 728.997 | +.002 | 704.783 | -.023 | 704.780 | -.012 | 704.754 | -.013 | 728.975 | -.005 | 694.094 | -.004 | | |
| 8-3-77 | 729.016 | -.018 | 728.915 | -.038 | 694.165 | -.052 | 729.000 | -.033 | 728.976 | -.019 | 704.756 | -.050 | 704.755 | -.037 | 704.726 | -.041 | 728.980 | .000 | 694.070 | -.028 | | |
| 9-12-77 | Not Run | — | 728.929 | -.024 | 694.178 | -.039 | 729.007 | -.026 | 728.988 | -.007 | 704.770 | -.036 | 704.769 | -.023 | 704.743 | -.024 | 728.974 | -.006 | 694.081 | -.017 | | |
| 10-11-77 | NR | — | 728.936 | -.017 | 694.188 | -.029 | 729.013 | -.020 | 728.984 | -.011 | Not Run | — | Not Run | — | 704.752 | -.015 | 728.969 | -.012 | 694.095 | -.003 | | |
| 11-7-77 | 729.015 | -.019 | 728.920 | -.033 | 694.172 | -.045 | 729.012 | -.021 | 728.975 | -.020 | NR | — | NR | — | NR | — | 728.971 | -.009 | 694.076 | -.020 | | |
| 12-15-77 | Not Run Inaccessible | — | 728.936 | -.017 | 694.194 | -.023 | 729.018 | -.015 | Not Run Inacc. | — | NR Inacces. | — | NR | — | NR | — | 728.971 | -.009 | 694.096 | -.002 | | |
| 1-9-78 | 729.025 | -.009 | 728.934 | -.019 | 694.187 | -.030 | 729.012 | -.021 | 728.985 | -.010 | NR | — | NR | — | NR | — | Not Run | | 694.092 | -.006 | | |

SETTLEMENT MONITORING PROGRAM

WATTS BAR NUCLEAR PLANT

POWERHOUSE

**Best Available Historical Image**

Historical Information

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

**SETTLEMENT MONITORING PROGRAM**
**POWERHOUSE**
**TABLE 2.5-70**
**SHEET 7**

SETTLEMENT POINTS

| | SS-8 | | SS-9 | | SS-10 | | SS-11 | | SS-12 | | SS-13 | | SS-14 | | SS-15 | | SS-16 | | SS-17 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 2-2-78 | 729.033 | -.001 | 728.940 | -.013 | 694.193 | -.024 | 729.016 | -.017 | Not Run | — | Not Run | — | Not Run | — | | | 728.965 | -.015 | 694.098 | .000 | JAD 1-4-82 | [illegible] 1-26-82 |
| 3-3-78 | Not Run | - | 728.928 | -.025 | 694.183 | -.034 | 729.007 | -.026 | 728.982 | -.013 | 704.771 | -.035 | 704.768 | -.024 | | | 728.963 | -.017 | 694.086 | -.012 | | |
| 4-3-78 | 729.022 | -.012 | 728.925 | -.028 | 694.178 | -.039 | 729.003 | -.030 | 728.980 | -.015 | NR | - | NR | - | | | Not Run | - | 694.084 | -.014 | | |
| 5-4-78 | 729.025 | -.009 | 728.933 | -.020 | [illegible] | -.031 | [illegible] | -.026 | 728.984 | -.011 | NR | - | NR | - | | | NR | - | 694.090 | -.008 | | |
| 6-5-78 | 729.013 | -.015 | 728.922 | -.031 | 694.186 | -.031 | [illegible] | -.030 | 728.978 | -.017 | NR | - | | | | | | | 694.089 | -.009 | | |
| 7-10-78 | 729.019 | -.015 | 728.921 | -.032 | 694.174 | -.043 | 729.002 | -.031 | 728.980 | -.015 | | | | | | | | | 694.082 | -.016 | | |
| 8-4-78 | 729.015 | -.019 | 728.913 | -.040 | 694.168 | -.049 | 728.995 | -.038 | 728.976 | -.019 | | | | | | | | | 694.073 | -.025 | | |
| 9-29-78 | | | 728.929 | -.024 | 694.183 | -.034 | 729.008 | -.025 | | | | | | | | | | | Not Run | - | | |
| 1-19-79 | | | 728.934 | -.019 | 694.184 | -.033 | 729.016 | -.017 | | | | | | | | | | | NR | - | | |
| 4-9-79 | | | 728.916 | -.037 | 694.175 | -.042 | 729.000 | -.033 | | | | | | | | | 728.966 | -.014 | 694.083 | -.015 | | |
| 7-24-79 | NR | - | 728.926 | -.027 | 694.182 | -.035 | 728.999 | -.034 | NR | - | NR | - | NR | - | NR | - | NR | - | 694.090 | -.008 | | |
| 10-22-79 | NR | - | 728.920 | -.033 | 694.178 | -.039 | NR | - | NR | - | NR | - | NR | - | NR | - | NR | - | 694.090 | -.008 | | |
| 1-19-80 | NR | - | 728.913 | -.040 | 694.168 | -.049 | 728.991 | -.042 | NR | - | NR | - | NR | - | NR | - | NR | - | 694.076 | -.022 | | |
| 4-29-80 | NR | - | 728.909 | -.044 | 694.161 | -.056 | 728.993 | -.040 | " | - | " | - | " | - | " | - | " | - | Not Run | - | | |
| 12-22-81 | 729.010 | -.024 | 728.917 | -.036 | 694.157 | [illegible] | 729.000 | -.033 | " | - | " | - | " | - | " | - | " | - | 694.063 | -.035 | | |
| 1-18-82 | 729.006 | -.028 | 728.914 | -.039 | 694.181 | -.036 | 728.995 | -.038 | " | - | " | - | " | - | " | - | " | - | 694.085 | -.013 | JAD 2-11-82 | [illegible] 2-17-82 |
| 1-27-82 | 729.009 | -.025 | 728.917 | -.036 | 694.175 | -.042 | 729.000 | -.033 | NR | - | 704.761 | -.045 | 704.759 | -.033 | 704.733 | -.034 | 728.950 | -.030 | 694.083 | -.015 | JAD 2-11-82 | [illegible] 2-17-82 |
| 2-11-82 | 729.010 | -.024 | N.R | - | 694.170 | -.047 | N.R. | - | NR | - | 704.759 | -.047 | 704.758 | -.034 | 704.731 | -.036 | 728.948 | -.032 | NR | - | JMH 2-25-82 | [illegible] 2-25-82 |
| AVG. | *** 729.009 | -.025 | * 728.916 | -.037 | *** 694.171 | -.046 | * [illegible] | [illegible] | NR | - | ** 704.760 | -.046 | ** 704.759 | -.033 | ** 704.732 | -.035 | ** 728.949 | -.031 | * 694.077 | -.021 | JMH 2-25-82 | [illegible] 2-25-82 |

* LAST THREE READINGS ** LAST TWO READINGS *** LAST FOUR READINGS

WATTS BAR NUCLEAR PLANT
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SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 8

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SS-18 | | SS-19 | | SS-20 | | | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 10-16-73 | 689.531 | i | | | 689.502 | i | | | JAD 1-4-82 | JTB 1-26-92 |
| 11-19-73 | 689.542 | +.011 | 689.505 | i | 689.505 | +.003 | | | ↓ | ↓ |
| 12-17-73 | 689.538 | +.007 | 689.512 | +.007 | INAC. | - | | | | |
| 1-6-74 | 689.538 | +.007 | 689.500 | -.005 | INAC. | - | | | | |
| 2-20-74 | 689.541 | +.010 | 689.502 | -.003 | INAC. | - | | | | |
| 3-18-74 | 689.540 | +.009 | 689.501 | -.004 | 689.509 | +.007 | | | | |
| 4-15-74 | 689.538 | +.007 | 689.501 | -.004 | 689.508 | +.006 | | | | |
| 5-13-74 | 689.540 | +.009 | 689.504 | -.001 | 689.511 | +.009 | | | | |
| 6-11-74 | 689.535 | +.004 | 689.504 | -.001 | 689.510 | +.008 | | | | |
| 6-11-74 | 694.039 | RS | 694.046 | RS | 693.972 | RS | | | | |
| 7-15-74 | 694.033 | -.006 | 694.043 | -.003 | 693.971 | -.001 | | | | |
| 8-13-74 | 694.037 | -.002 | 694.042 | -.004 | 693.972 | 0.0 | | | | |
| 9-16-74 | 694.032 | -.007 | 694.039 | -.007 | 693.973 | +.001 | | | | |
| 10-17-74 | READING ERROR | - | 694.037 | -.009 | 693.972 | 0.0 | | | | |
| 11-18-74 | 694.027 | -.012 | 694.020 | -.026 | 693.959 | -.013 | | | | |
| 12-18-74 | 694.043 | +.004 | 694.036 | -.010 | 693.976 | +.004 | | | | |
| 1-20-75 | 694.042 | +.003 | 694.033 | -.013 | 693.971 | -.001 | | | | |
| 2-19-75 | 694.043 | +.004 | 694.037 | -.009 | 693.975 | +.003 | | | | |
| 3-17-75 | 694.042 | +.003 | 694.033 | -.013 | 693.972 | 0.0 | | | | |
| 5-6-75 | 694.031 | -.008 | 694.032 | -.014 | 693.964 | -.008 | | | | |
| 6-2-75 | 694.037 | -.002 | 694.041 | -.005 | 693.971 | -.001 | | | | |
| 7-7-75 | 694.033 | -.006 | 694.037 | -.009 | 693.966 | -.006 | | | | |
| 7-21-75 | 694.039 | 0.0 | 694.043 | -.003 | 693.975 | +.003 | | | | |
| 8-18-75 | 694.021 | -.018 | 694.027 | -.019 | 693.957 | -.015 | | | | |

RS POINT RESET INAC - INACCESSIBLE

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HISTORICAL INFORMATION

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WATTS BAR NUCLEAR PLANT
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SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 9

| | SETTLEMENT POINTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SS-18 | | SS-19 | | SS-20 | | | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 9-10-75 | 694.035 | -.004 | 694.036 | -.010 | 693.972 | 0.0 | | | JRB 1-4-82 | JTB 1-26-82 |
| 10-31-75 | 694.039 | 0.0 | 694.035 | -.011 | 693.972 | 0.0 | | | | ↓ |
| 11-24-75 | 694.046 | +.007 | 694.037 | -.009 | 693.976 | +.004 | | | | |
| 12-17-75 | 694.052 | +.013 | 694.043 | -.003 | 693.983 | +.011 | | | | |
| 1-14-76 | 694.053 | +.014 | 694.043 | -.003 | 693.984 | +.012 | | | | |
| 2-11-76 | 694.052 | +.013 | 694.043 | -.003 | 693.982 | +.010 | | | | |
| 3-18-76 | 694.041 | +.002 | 694.036 | -.010 | 693.972 | 0.0 | | | | |
| 4-15-76 | 694.047 | +.008 | 694.045 | -.001 | 693.978 | +.006 | | | | |
| 5-11-76 | 694.052 | +.013 | 694.049 | +.003 | 693.983 | +.011 | | | | |
| 6-11-76 | 694.022 | -.017 | 694.026 | -.020 | 693.957 | -.015 | | | | |
| 7-14-76 | 694.038 | -.001 | 694.043 | +.003 | 693.973 | +.001 | | | | |
| 8-10-76 | 694.033 | -.006 | 694.038 | -.008 | 693.970 | -.002 | | | | |
| 9-14-76 | 694.024 | -.015 | 694.027 | -.019 | 693.959 | -.013 | | | | |
| 10-13-76 | 694.042 | +.003 | 694.042 | -.004 | 693.978 | +.006 | | | | |
| 11-9-76 | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - | | | | |
| 12-9-76 | 694.037 | +.002 | 694.033 | -.013 | 693.971 | -.001 | | | | |
| 1-12-77 | 694.043 | +.004 | 694.038 | -.008 | 693.975 | +.003 | | | | |
| 2-10-77 | 694.051 | +.012 | 694.049 | +.003 | 693.985 | +.013 | | | | |
| 3-15-77 | 694.046 | +.007 | 694.046 | 0.0 | 693.980 | +.008 | | | | |
| 4-11-77 | 694.033 | -.006 | 694.032 | -.014 | 693.965 | -.007 | | | | |
| 5-10-77 | 694.034 | -.005 | 694.035 | -.011 | 693.968 | -.004 | | | | |
| 6-6-77 | 694.045 | +.006 | 694.048 | +.002 | 693.979 | +.007 | | | | |
| 7-6-77 | 694.034 | -.005 | 694.042 | -.004 | 693.972 | 0.0 | | | | |
| 8-3-77 | 693.999 | -.040 | 694.006 | -.040 | 693.935 | -.037 | | | | |

HISTORICAL INFORMATION

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WATTS BAR NUCLEAR PLANT
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SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 10

| | SETTLEMENT POINTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SS-18 | | SS-19 | | SS-20 | | | | | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | ELEV | DIFF | BY | CHKD |
| 9-12-77 | 694.027 | -.012 | 694.035 | -.011 | 693.966 | -.006 | | | JAD 1-4-82 | [illegible] 1-26-82 |
| 10-11-77 | 694.049 | +.010 | 694.050 | +.004 | 693.978 | +.006 | | | | ↓ |
| 11-7-77 | 694.041 | +.002 | 694.043 | -.003 | 693.980 | +.008 | | | | |
| 12-15-77 | 694.044 | +.005 | 694.041 | -.005 | 693.978 | +.006 | | | | |
| 1-9-78 | 694.057 | +.018 | 694.055 | +.009 | 693.993 | +.021 | | | | |
| 2-2-78 | 694.057 | +.018 | 694.054 | +.008 | 693.992 | +.020 | | | | |
| 3-3-78 | 694.039 | 0.0 | 694.036 | -.010 | 693.974 | +.002 | | | | |
| 4-3-78 | 694.031 | -.008 | 694.032 | -.014 | 693.966 | -.006 | | | | |
| 5-4-78 | 694.041 | +.002 | 694.041 | -.005 | 693.976 | +.004 | | | | |
| 6-5-78 | 694.035 | -.004 | 694.041 | -.005 | 693.974 | +.002 | | | | |
| 7-10-78 | 694.021 | -.018 | 694.032 | -.014 | 693.962 | -.010 | | | | |
| 8-4-78 | 694.030 | -.009 | 694.042 | -.004 | Not Read | - | | | | |
| 9-29-78 | 694.036 | -.003 | 694.041 | -.005 | 693.978 | +.006 | | | | |
| 1-5-79 | Not Run | - | 694.044 | -.002 | 693.984 | +.012 | | | | |
| 4-9-79 | 694.029 | -.010 | 694.029 | -.017 | 693.967 | -.005 | | | | |
| 7-20-79 | Not Run | - | 694.033 | -.013 | 693.969 | -.003 | | | | |
| 10-19-79 | 694.029 | -.010 | 694.032 | -.014 | 693.968 | -.004 | | | | |
| 1-18-80 | NR | - | 694.030 | -.016 | 693.969 | -.003 | | | | |
| 4-25-80 | NR | - | 694.028 | -.018 | 693.975 | +.003 | | | | |
| 12-15-81 | 694.024 | -.015 | 694.027 | -.019 | 693.963 | -.009 | | | | [illegible] 1-26-82 |
| 1-8-82 | 694.036 | -.003 | 694.037 | -.009 | 693.974 | +.002 | | | JAD 2-11-82 | [illegible] 2-17-82 |
| 1-22-82 | 694.033 | -.006 | 694.032 | -.014 | 693.968 | -.004 | | | JAD 2-17-82 | [illegible] 2-17-82 |
| AVG * | 694.031 | -.008 | 694.032 | -.014 | 693.968 | -.004 | | | JAD 2-22-82 | [illegible] 2-22-82 |
| | | | | | | | | | | |

* Last Three Readings

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**SETTLEMENT MONITORING PROGRAM**
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**TABLE 2.5-70**
**SHEET 11**

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | |
|---|---|---|---|---|---|---|
| | SS-21 | | SS-22 | | SS-23 | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF |
| 6-11-74 | | | | | | |
| -15-74 | | | | | | |
| 8-13-74 | | | | | | |
| 9-16-74 | | | | | 709.840 | i |
| 10-17-74 | 710.006 | i | | | 709.869 | +.029 |
| 11-18-74 | NOT RUN | – | | | 709.870 | +.030 |
| 12-18-74 | 710.004 | -.002 | | | 709.874 | -.034 |
| 1-20-75 | 709.997 | -.009 | | | 709.871 | +.031 |
| 2-19-75 | 710.000 | -.006 | | | 709.869 | +.029 |
| 3-17-75 | 709.996 | -.010 | | | 709.869 | +.029 |
| 5-6-75 | 709.991 | -.015 | | | 709.863 | +.023 |
| 6-2-75 | 709.989 | -.017 | | | 709.861 | +.021 |
| 7-7-75 | 709.992 | -.014 | | | 709.861 | +.021 |
| 7-21-75 | 709.995 | -.011 | | | 709.859 | +.019 |
| 8-18-75 | 709.984 | -.022 | 709.999 | i | 709.858 | +.018 |
| 9-10-75 | 709.996 | -.010 | 710.008 | +.009 | 709.861 | +.021 |
| 10-31-75 | NOT RUN | – | 710.008 | +.009 | 709.870 | +.030 |
| 11-24-75 | 709.997 | -.009 | 710.008 | +.009 | 709.871 | +.031 |
| 12-16-75 | 710.005 | -.001 | 710.017 | +.018 | 709.881 | +.041 |
| 1-14-76 | 710.002 | -.004 | 710.014 | +.015 | 709.869 | +.029 |
| 2-11-76 | 710.004 | -.002 | 710.017 | +.018 | 709.875 | +.035 |
| 3-18-76 | 709.995 | -.011 | 710.010 | +.011 | 709.871 | +.031 |
| 4-15-76 | 709.998 | -.008 | 710.014 | +.015 | 709.872 | +.032 |
| 5-11-76 | 710.003 | -.003 | 710.018 | +.019 | 709.874 | +.034 |

Best Available Historical Image

SETTLEMENT MONITORING PROGRAM
POWERHOUSE
TABLE 2.5-70
SHEET 12

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | |
|---|---|---|---|---|---|---|
| | SS-21 | | SS-22 | | SS-23 | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF |
| 6-11-76 | 709.976 | -.030 | 709.994 | -.005 | 709.867 | +.027 |
| 7-14-76 | 709.993 | -.013 | 710.012 | +.013 | 709.868 | +.028 |
| 8-10-76 | 709.990 | -.016 | 710.010 | +.011 | 709.862 | +.022 |
| 9-14-76 | 709.978 | -.028 | 709.996 | -.003 | 709.868 | +.028 |
| 10-13-76 | 709.996 | -.010 | 710.011 | +.012 | 709.870 | +.030 |
| 11-9-76 | Poor Closure Not Used | - | Poor Closure Not Used | - | Poor Closure Not Used | - |
| 12-9-76 | 709.986 | -.020 | 710.003 | +.004 | Not Run | - |
| 1-12-77 | 710.000 | -.006 | 710.014 | +.015 | 709.871 | +.031 |
| 2-10-77 | 710.005 | -.001 | 710.018 | +.019 | 709.885 | +.045 |
| 3-15-77 | 709.999 | -.007 | 710.016 | +.017 | 709.868 | +.028 |
| 4-11-77 | 709.990 | -.016 | 710.007 | +.008 | 709.873 | +.033 |
| 5-10-77 | 709.986 | -.020 | 710.004 | +.005 | 709.869 | +.029 |
| 6-6-77 | 710.000 | -.006 | 710.019 | +.020 | 709.867 | +.027 |
| 7-6-77 | 709.992 | -.014 | 710.010 | +.011 | 709.860 | +.020 |
| 8-3-77 | 709.953 | -.053 | 709.976 | -.023 | 709.867 | +.027 |
| 9-12-77 | 709.984 | -.022 | 710.003 | +.004 | 709.859 | +.019 |
| 10-11-77 | 710.002 | -.004 | 710.019 | +.020 | 709.864 | +.024 |
| 11-7-77 | 709.987 | -.019 | 710.004 | +.005 | 709.869 | +.029 |
| 12-15-77 | 709.987 | -.019 | 710.008 | +.009 | 709.866 | +.026 |
| 1-9-78 | 710.002 | -.004 | 710.020 | +.021 | 709.872 | +.032 |
| 2-2-78 | 709.998 | -.008 | 710.021 | +.022 | 709.871 | +.031 |
| 3-3-78 | 709.989 | -.017 | 710.006 | +.007 | 709.865 | +.025 |
| 4-3-78 | 709.978 | -.028 | 710.000 | +.001 | 709.864 | +.024 |
| 5-4-78 | 709.989 | -.017 | 710.011 | +.012 | 709.863 | +.023 |

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TABLE 2.5-70
SHEET 13

HISTORICAL INFORMATION

| | SETTLEMENT POINTS | | | | | |
|---|---|---|---|---|---|---|
| | SS-21 | | SS-22 | | SS-23 | |
| DATE | ELEV | DIFF | ELEV | DIFF | ELEV. | DIFF |
| 6-5-78 | 709.978 | -.028 | 710.002 | +.003 | 709.858 | +.018 |
| 7-10-78 | 709.978 | -.028 | 709.997 | -.002 | 709.854 | +.014 |
| 8-4-78 | 709.987 | -.019 | 710.006 | +.007 | 709.854 | +.014 |
| 9-29-78 | 709.989 | -.017 | 710.011 | +.012 | 709.857 | +.017 |
| 1-5-79 | 709.996 | -.010 | 710.012 | +.013 | 709.858 | +.018 |
| 4-9-79 | 709.979 | -.027 | 710.000 | +.001 | 709.868 | +.028 |
| 7-20-79 | 709.978 | -.028 | 710.002 | +.003 | 709.851 | +.011 |
| 10-19-79 | 709.981 | -.025 | 710.007 | +.008 | 709.855 | +.015 |
| 1-18-80 | 709.983 | -.023 | 710.005 | +.006 | 709.854 | +.014 |
| 4-28-80 | 709.978 | -.028 | 709.999 | 0.0 | 709.861 | +.021 |
| 12-18-81 | 709.978 | -.028 | 709.997 | -.002 | 709.855 | +.015 |
| 1-7-82 | 709.986 | -.020 | 710.009 | +.010 | 709.862 | +.022 |
| 1-22-82 | 709.979 | -.027 | 710.003 | +.004 | 709.864 | +.024 |
| AVG * | 709.981 | -.025 | 710.003 | +.004 | 709.860 | +.020 |

* LAST THREE READINGS

Best Available Historical Image

TABLE 2.5-71

DIFFERENTIAL SETTLEMENT BETWEEN ROCK SUPPORTED STRUCTURES

HISTORICAL INFORMATION

| | Settlement Station | Initial Reading | | Maximum Differential Settlement | | | | Most Recent Differential Settlement | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Date | Elevation (Feet) | Date | Elevation (Feet) | S (Feet) | ΔS (Feet) | Date | Elevation (Feet) | S (Feet) | ΔS (Feet) |
| Auxiliary Control Building and Turbine Building Settlement Stations (The turbine building is noncategory I.) | SS20 | 10-17-74 | 693.972 | 04-25-80 | 693.975 | +0.003 | 0.031 | 01-22-82 | 693.968[1] | -0.004 | 0.021 |
| | SS21 | 10-17-74 | 710.006 | 04-25-80 | 709.978 | -0.028 | | 01-22-82 | 709.981[1] | -0.025 | |
| | SS19 | 08-18-75 | 694.027 | 08-04-78 | 694.042 | +0.015 | 0.008 | 01-22-82 | 694.032[1] | +0.005 | 0.001 |
| | SS22 | 08-18-75 | 709.999 | 08-04-78 | 710.006 | +0.007 | | 01-22-82 | 710.003[1] | +0.004 | |
| | SS18 | 09-16-74 | 694.032 | 06-11-76 | 694.022 | -0.010 | 0.037* | 01-22-82 | 694.031[1] | -0.001 | 0.021 |
| | SS23 | 09-16-74 | 709.840 | 06-11-76 | 709.867 | +0.027 | | 01-22-82 | 709.860[1] | +0.020 | |
| Reactor Building Unit 1 and Auxiliary Building Settlement Stations | SS15 | 01-14-76 | 704.764 | 08-03-77 | 704.726 | -0.038 | 0.038 | 02-12-82 | 704.732[2] | -0.032 | 0.001 |
| | SS16 | 01-14-76 | 728.980 | 08-03-77 | 728.980 | 0.000 | | 02-12-82 | 728.949[2] | -0.031 | |
| | SS12 | 07-14-76 | 728.995 | 01-12-77 | 728.991 | -0.004 | 0.013 | 03-03-78 | 728.982[3] | -0.013 | 0.003 |
| | SS13 | 07-14-76 | 704.787 | 01-12-77 | 704.770 | -0.017 | | 03-03-78 | 704.771[3] | -0.016 | |
| Reactor Building Unit 2 and Auxiliary Building Settlement Stations | SS4 | 01-14-76 | 729.033 | 07-14-76 | 729.031 | -0.002 | 0.029 | 02-12-82 | 728.994[2] | -0.039 | 0.020 |
| | SS5 | 01-14-76 | 705.284 | 07-14-76 | 705.311 | +0.027 | | 02-12-82 | 705.265[2] | -0.019 | |
| | SS7 | 07-14-76 | 705.336 | 12-09-76 | 705.300 | -0.036 | 0.028 | 02-12-82 | 705.296[2] | -0.040 | 0.015 |
| | SS8 | 07-14-76 | 729.034 | 12-09-76 | 729.026 | -0.008 | | 02-12-82 | 729.009[4] | -0.025 | |

*This is the second highest differential settlement for SS18 and SS23, the highest is peculiarly high in August of 1977.

S=Settlement   ΔS=Differential Settlement

(1) Average of three readings from December 22, 1981, January 18, 1982, and January 27, 1982.
(2) Average of two readings from January 27, 1982 and February 12, 1982, difficult conditions.
(3) Single reading of March 3, 1978.
(4) Average of four readings from December 22, 1981, January 18, 1982, January 27, 1982, and February 12, 1982.

WBN

TABLE 2.5.5-72

SETTLEMENT MONITORING PROGRAM OF CATEGORY 1 STRUCTURES

HISTORICAL INFORMATION

| Structure | Foundation Material | Design Total Settlement | Design Differential Settlement | Maximum Measured Total Settlement | Date | Updated Measured Total Settlement | Date | Settlement Station |
|---|---|---|---|---|---|---|---|---|
| Unit 1 R.B. | Rock | 1 to 2 inches | 1 inch | 0.60 | 08-03-77 | 0.55(1) | 02-12-82 | SS-13 |
| Unit 2 R.B. | Rock | 1 to 2 inches | 1 inch | 0.37 | 08-03-77 | 0.35(1) | 02-12-82 | SS-7 |
| Aux. & Control Building | Rock | 1 to 2 inches | 1 inch | 0.67 | 04-29-80 | 0.55(2) | 02-12-82 | SS-10 |
| Intake Pumping Station | Rock | 1 to 2 inches | 1 inch | 0.38 | 02-02-79 | 0.13(3) | 04-23-80 | SS-3? |
| Diesel Generator Building | Compacted Granular Backfill on In Situ Gravel on Rock | NEGLIGIBLE | NEGLIGIBLE | 0.59 | 04-10-81 | 0.53(4&5) | 01-29-82 | SS-1 |
| Waste Packaging Area | Compacted Granular Backfill on In Situ Gravel on Rock | NEGLIGIBLE | NEGLIGIBLE | 0.52 | 04-28-80 | 0.48(4) | 01-29-82 | SS-45 |

(1)Average of two readings for January 27, 1982, and February 12, 1982; difficult conditions

(2)Average of four readings from December 22, 1981; January 18, 1982; January 27, 1982; and February 12, 1982.

((3)Single reading on April 23, 1980.

(4)Average of three readings from December 22, 1981; January 18, 1982; and January 27, 1982.

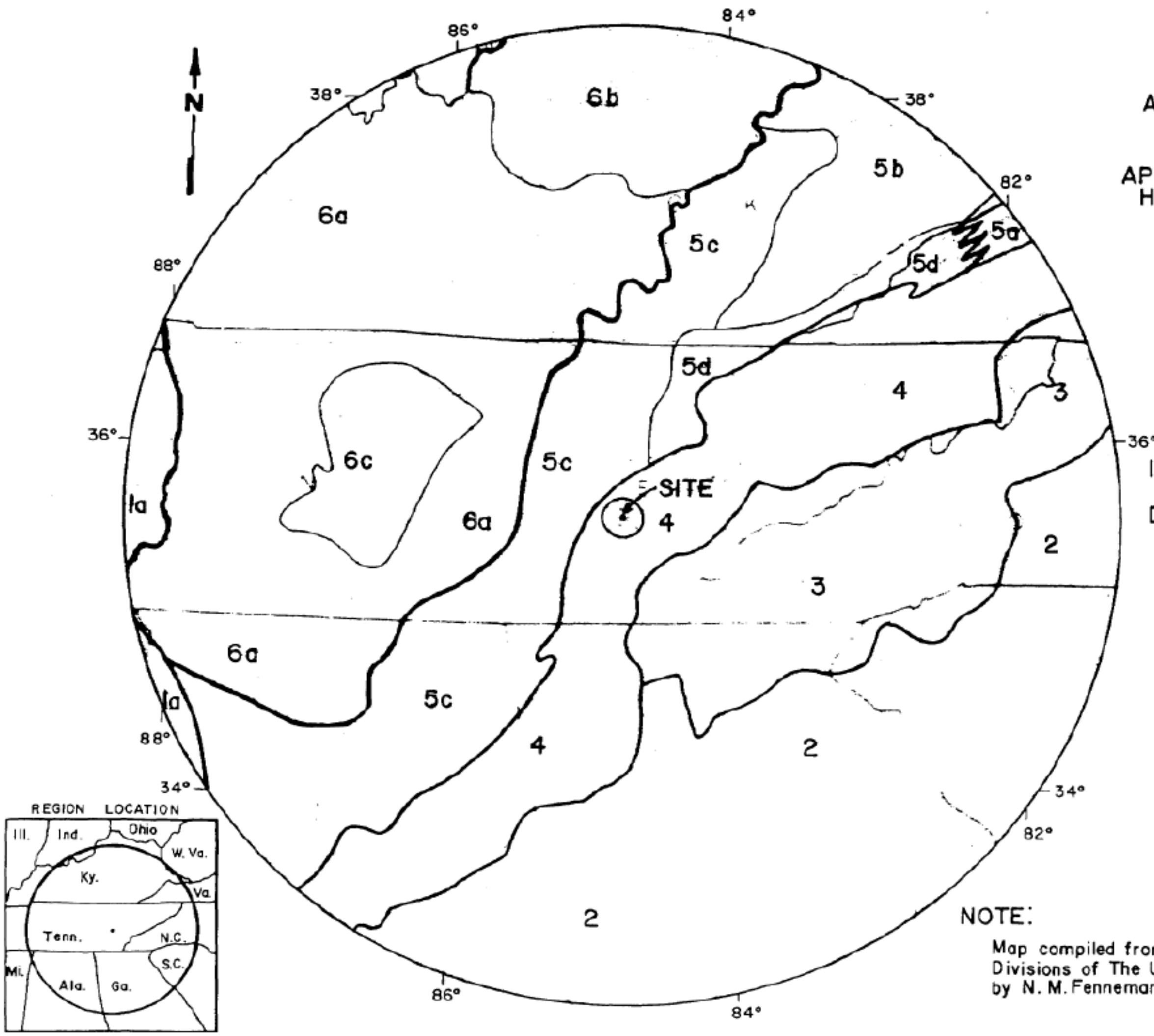
(5)Corrected to reset value on April 10,1981.

TABLE 2.5-73

SUMMARY OF GROUND-WATER LEVEL ESTIMATES

Historical Information

| ERCW PIEZOMETER | 25-YEAR GROUND-WATER ESTIMATE | PREVIOUS ESTIMATE |
|---|---|---|
| P1 | 702.9 | 701 |
| P2 | 717.6 | 716 |
| P3 | 716.8 | 715 |
| P4 | 714.4 | 713 |
| P5 | 712.5 | 705 |
| P6 | 710.2 | 709 |
| P7 | 718.4 | 717 |
| P8 | 723.4 | 722 |




## EXPLANATION

ATLANTIC PLAIN DIVISION
- 1 – COASTAL PLAIN
  - (1a) East Gulf Coastal Plain

APPALACHIAN HIGHLANDS DIVISION
- 2 – PIEDMONT PROVINCE
- 3 – BLUE RIDGE PROVINCE
- 4 – VALLEY AND RIDGE PROVINCE
- 5 – APPALACHIAN PLATEAUS PROVINCE
  - (5a) Allegeny Mountain Section
  - (5b) Kanawha Section
  - (5c) Cumberland Plateau Section
  - (5d) Cumberland Mountain Section

INTERIOR PLAINS DIVISION
- 6 – INTERIOR LOW PLATEAUS PROVINCE
  - (6a) Highland Rim Section
  - (6b) Lexington Plain
  - (6c) Nashville Basin

*"HISTORICAL INFORMATION"*

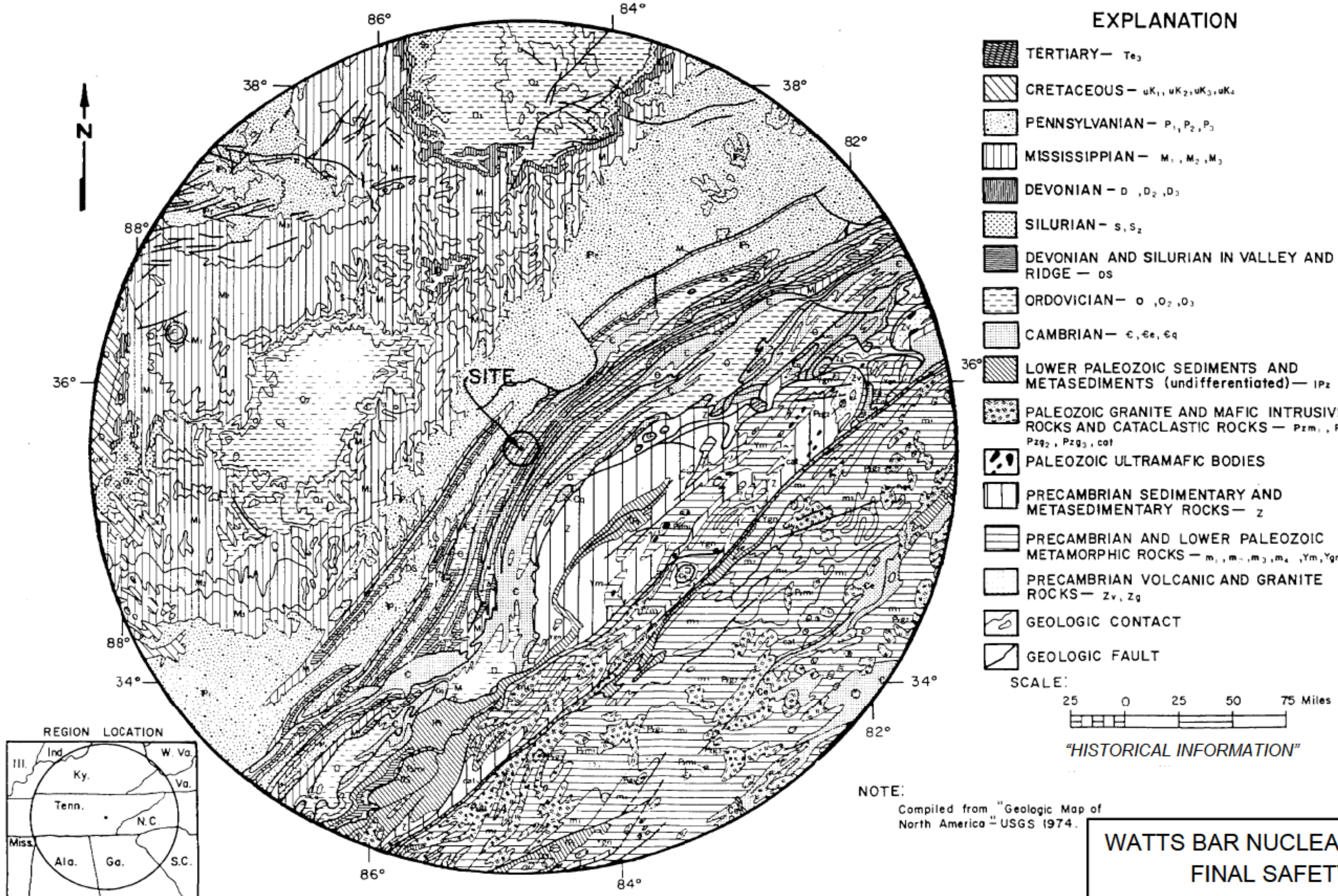
SCALE:
25 0 25 50 Miles

NOTE:
Map compiled from "Physical Divisions of The United States" by N. M. Fenneman, Edition of 1946 Reprinted 1949

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Physiographic Map

FIGURE 2.5-1




"HISTORICAL INFORMATION"

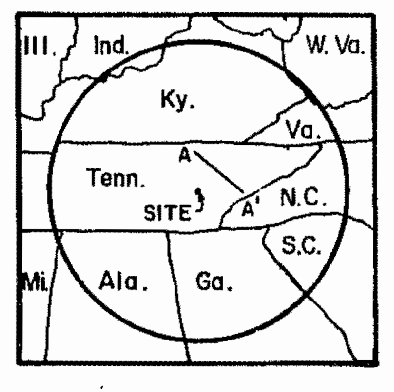
NOTE:
Compiled from "Geologic Map of North America" USGS 1974.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Geologic Map

FIGURE 2.5-2


REGION LOCATION:




NOTE:

Surface Data: Cattermole, Englund, Finlayson, King, Neuman, Rodgers, Swingle.
Subsurface Data: Harris
Depth to Basement: Milici

Compiled by D. H. Roeder, 1974

UNPUBLISHED

LEGEND:

KNOX GROUP: CAMBRO-ORDOVICIAN AGE

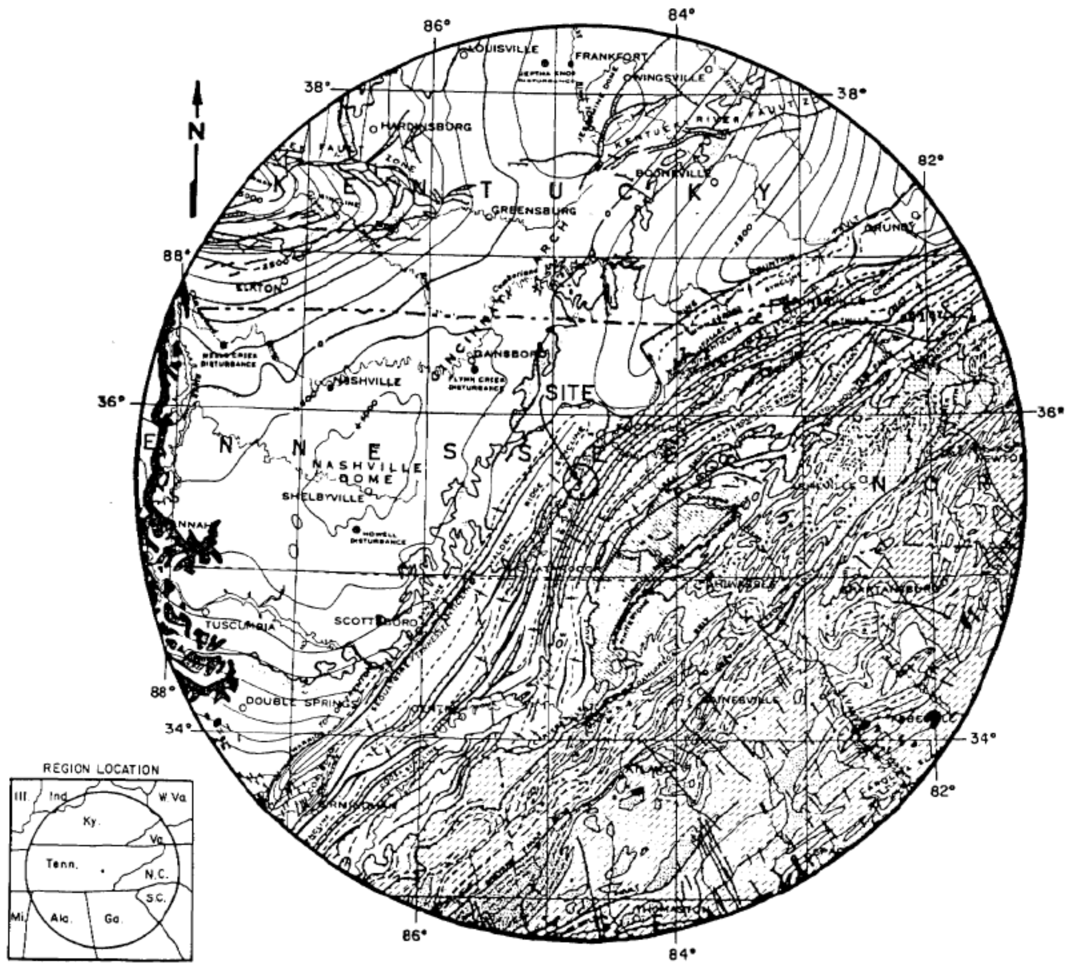
SCALE:

0 5 10 KILOMETERS
HORIZONTAL AND VERTICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Subregional Geologic Section

FIGURE 2.5-3




## EXPLANATION

**METAMORPHIC ROCKS**
- Paleozoic metamorphic rocks
- Precambrian metamorphic rocks

**INTRUSIVE IGNEOUS ROCKS**
- Mesozoic dikes, sills and stocks
- Small dikes and other intrusive bodies
- Ultramafic bodies
- Paleozoic felsic intrusive bodies
- Paleozoic mafic intrusive bodies

**SEDIMENTARY ROCKS**
- Precambrian sedimentary and volcanic rocks

**GEOLOGIC BOUNDARIES**
- Base of Cretaceous sedimentary rocks
- Base of Pennsylvanian sedimentary rocks

**STRUCTURAL FEATURES**
- Window
- Thrust fault
- Normal fault
- Lateral fault
- Buried fault
- Unclassified faults
- En echelon fault system
- Elongate, closely compressed anticline
- Anticlinal axis
- Dome
- Synclinal axis
- Structure contours on top of Trenton Limestone (on top of Oriskany Sandstone in West Virginia)
- Intensely disturbed, localized uplift
- Trend lines in metamorphic rocks

NOTE:
Compiled from "Tectonic Map of The United States"— USGS & AAPG, 1961.

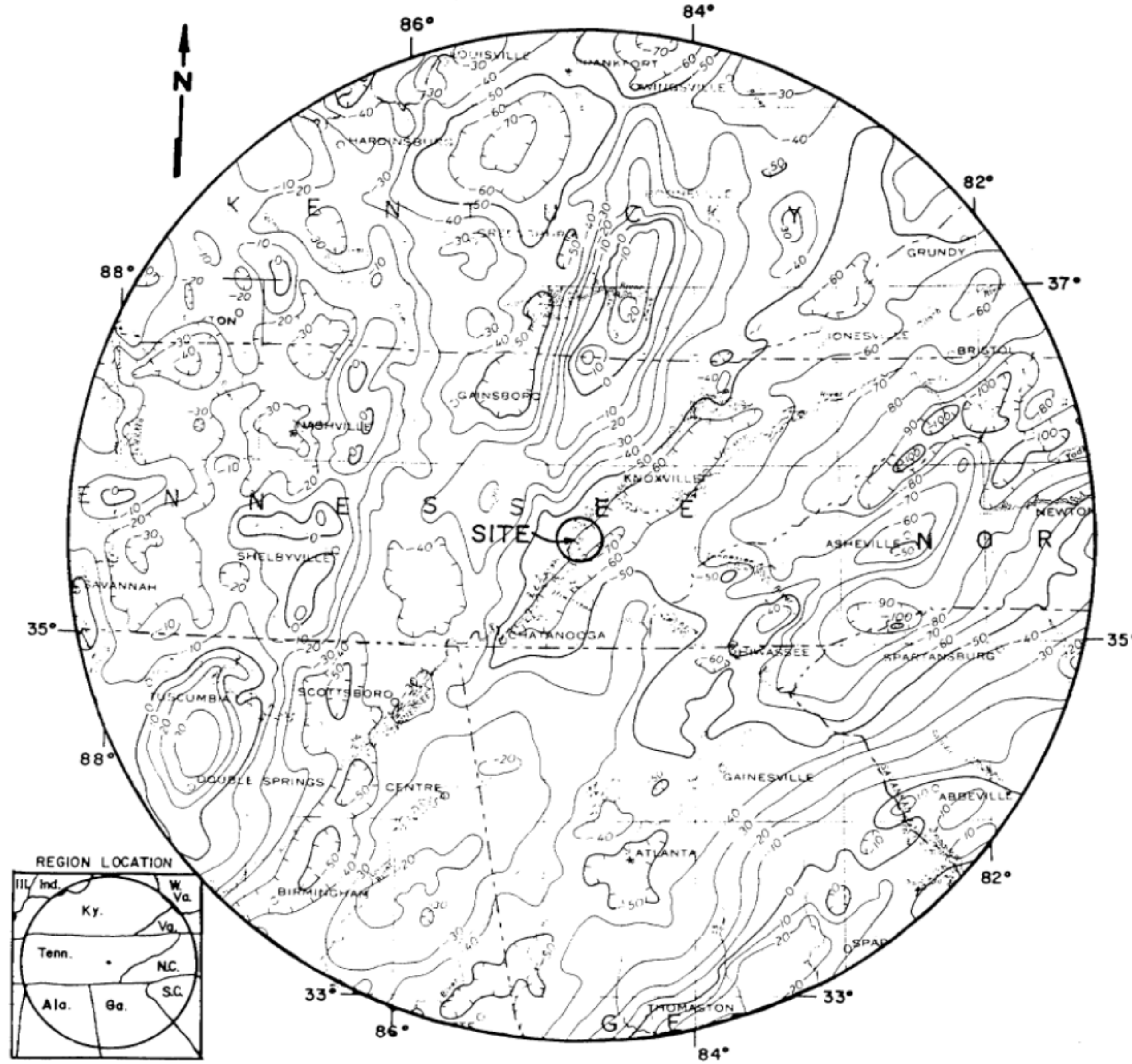
SCALE:
25 0 25 50 Miles

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Tectonic Map

FIGURE 2.5-4




By the
AMERICAN GEOPHYSICAL UNION
Special Committee for the Geophysical
and Geological Study of the Continents
G. P. Woollard, Chairman
and the
U.S. GEOLOGICAL SURVEY
H. R. Joesting, Coordinator

SCALE:
40 0 40 80 Miles

APPROXIMATELY 1 INCH TO 40 MILES
CONTOUR INTERVAL 10 MILLIGALS
REDUCTION DENSITY 2.67 G PER CM$^3$

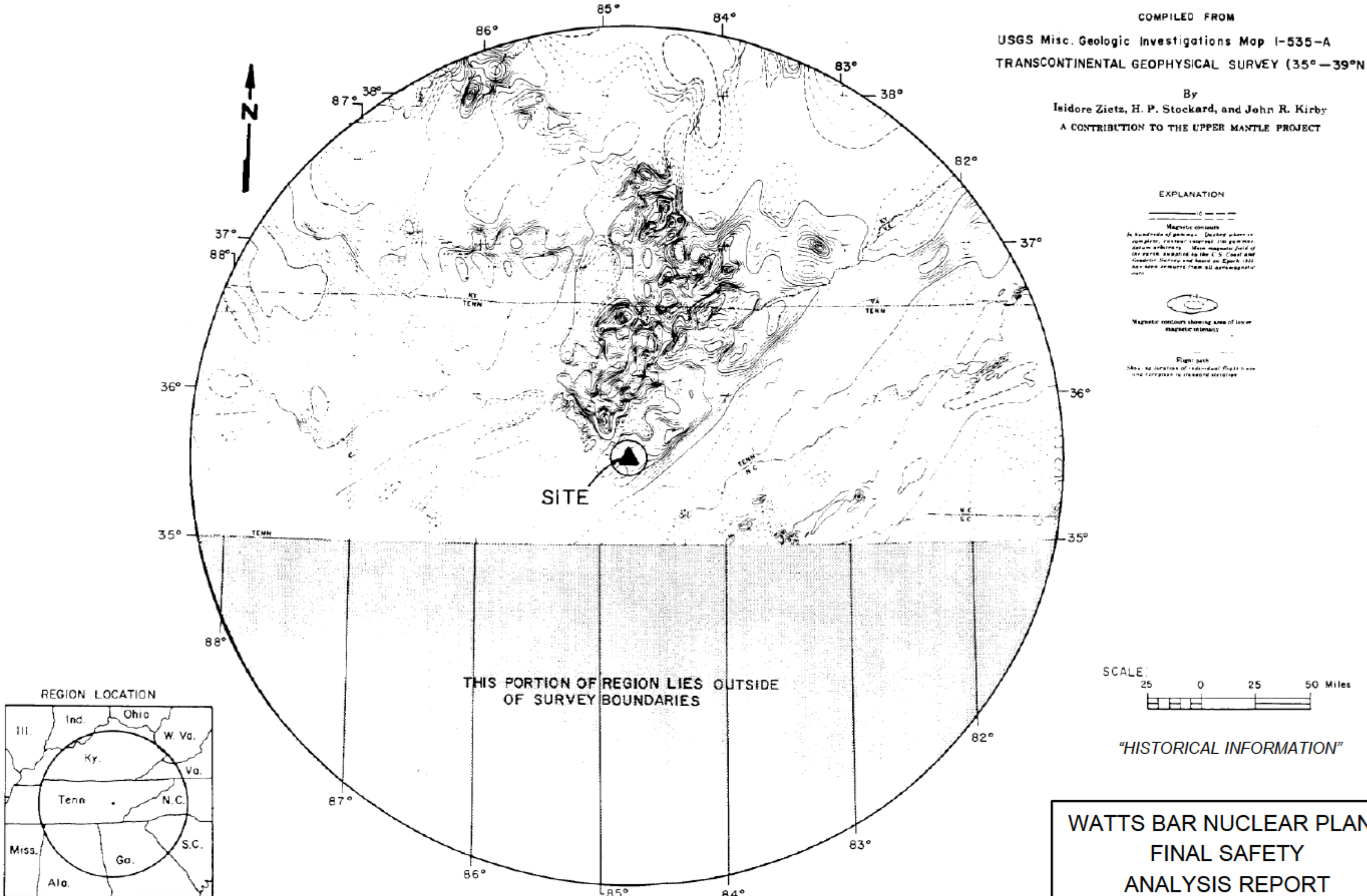
Datum is 980 1188 gals, gravity pier at Commerce Bldg., Washington, D. C.
All gravity meters used in obtaining data for this map were calibrated against Mexico City—Point Barrow pendulum traverse
1964

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Bouguer Gravity
Anomaly Map

FIGURE 2.5-5

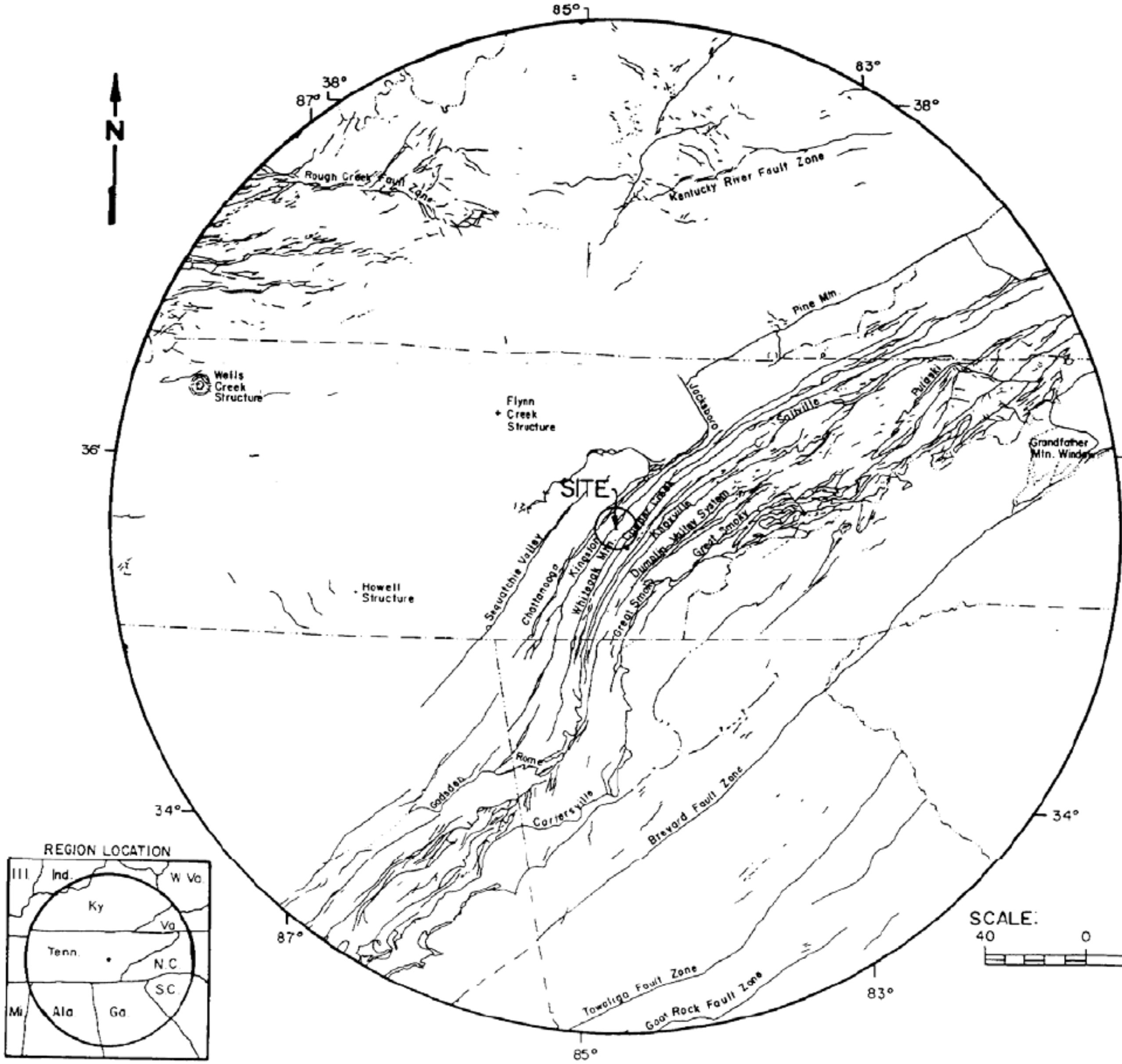


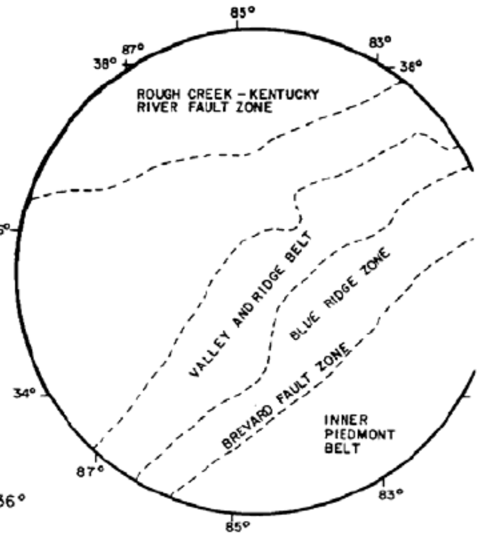

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Magnetic Map

FIGURE 2.5-6




BOUNDARIES OF MAJOR FAULT BELTS

LEGEND:

- Surface fault
- Inferred fault, queried where doubtful
- Faulted complex, astrobleme or cryptovolcanic structure
- State boundaries

NOTE:

Specific data and published sources for indicated faults and fault systems are available in TVA - Geologic Services Branch files.

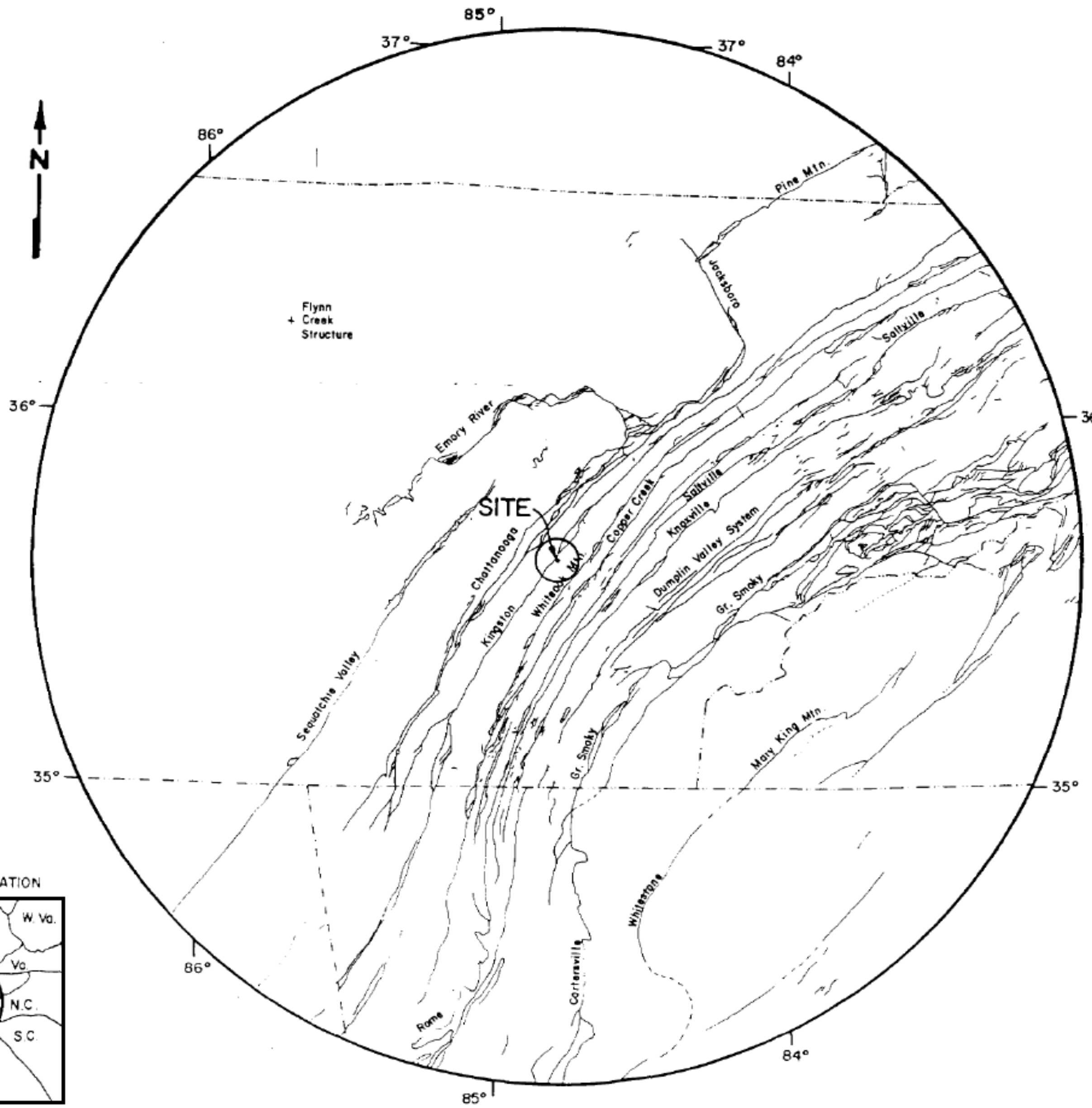
SCALE:
40 0 40 MILES

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Regional Fault Map

FIGURE 2.5-7




LEGEND:

Surface fault

Inferred fault, queried where doubtful

Faulted complex, astrobleme or cryptovolcanic structure

State boundaries

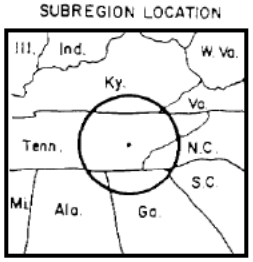
NOTE:

Specific data and published sources for indicated faults and fault systems are available in TVA - Geologic Services Branch files.

SCALE:

20 0 20 MILES

SUBREGION LOCATION

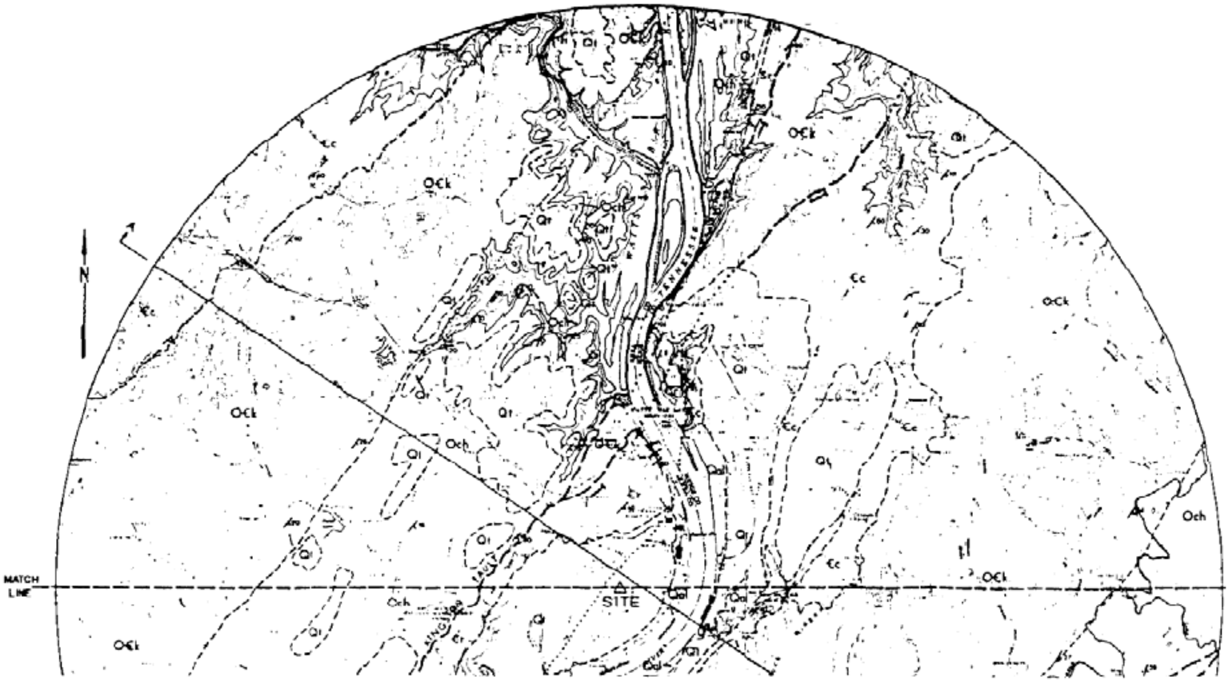



*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Subregional Fault Map

FIGURE 2.5-8




## DESCRIPTION OF MAP UNITS

**QUATERNARY**

- **Qal** — ALLUVIUM--Soil, shaly to sandy; contains abundant pebbles and cobbles of various lithologies and textures, generally waterworn. Mapped only in flood plain of the Tennessee River.
- **Qt** — TERRACE DEPOSITS--Soil, shaly to sandy; with rounded pebbles and cobbles; generally stratified. Represents at least two earlier flood plain levels of the Tennessee River.

**SILURIAN**

- **Sr** — ROCKWOOD FORMATION--Shale, yellowish-brown to reddish; with numerous thin layers of yellowish-brown to gray siltstone, and a few thin beds of fine-grained gray sandstone. Thickness about 200 feet.

**ORDOVICIAN**

- **Och** — CHICKAMAUGA LIMESTONE--Limestone, light- to medium-gray, slabby to medium-bedded; shaly limestone abundant. Estimated thickness 1800 feet.

**CAMBRIAN AND ORDOVICIAN**

- **OЄk** — KNOX GROUP--Dolomite, light- to dark-gray, fine- to coarse-grained; and limestone, medium-gray to bluish-gray, generally fine-grained. Thin- to thick-bedded. Weathers to cherty rubble. Thickness about 2600 feet.

**CAMBRIAN**

- **Єc** — CONASAUGA GROUP--Shale, calcareous in upper part, becoming arenaceous and silty toward base; zones of shaly gray limestone, as much as 100 feet thick, scattered throughout but concentrated in upper half. Estimated thickness as much as 2000 feet.
- **Єr** — ROME FORMATION--Shale, siltstone, and sandstone with local beds of gray limestone near base. Shale variegated, reddish and greenish, micaceous, and arenaceous. Numerous thin siltstone layers. Sandstone beds generally fine-grained, thin- to medium-bedded. Base not exposed; estimated thickness 1000 feet.

## GEOLOGIC SYMBOLS

- Contact, approximately located, dotted where concealed
- Fault, approximately located, dotted where concealed. On hanging wall of thrust fault
- Strike and dip of beds
- Approximate strike and dip of crumpled beds
- Syncline, showing strike of axial plane
- Minor anticline, showing strike of axial plane

NOTES:

(1) Map consists of two slightly overlapping North and South segments that match along the indicated line. Cross section A-A' extends across both segments and is shown in profile as Geologic Section Through Plant Area (Fig. 2.5-11).

(2) Geologic map by TVA. Based on field data, on data from the Spring City (GM 118-NE) and Ten Mile (GM 124-NW) geologic quadrangle maps published by the Tennessee Division of Geology (1964), and on the Geologic Map of East Tennessee (Rodgers, 1953).

(3) Description of Map Units and Geologic Symbols represent a composite legend for both North and South segments.

SCALE: 1 — 1/2 — 0 — 1 Mile

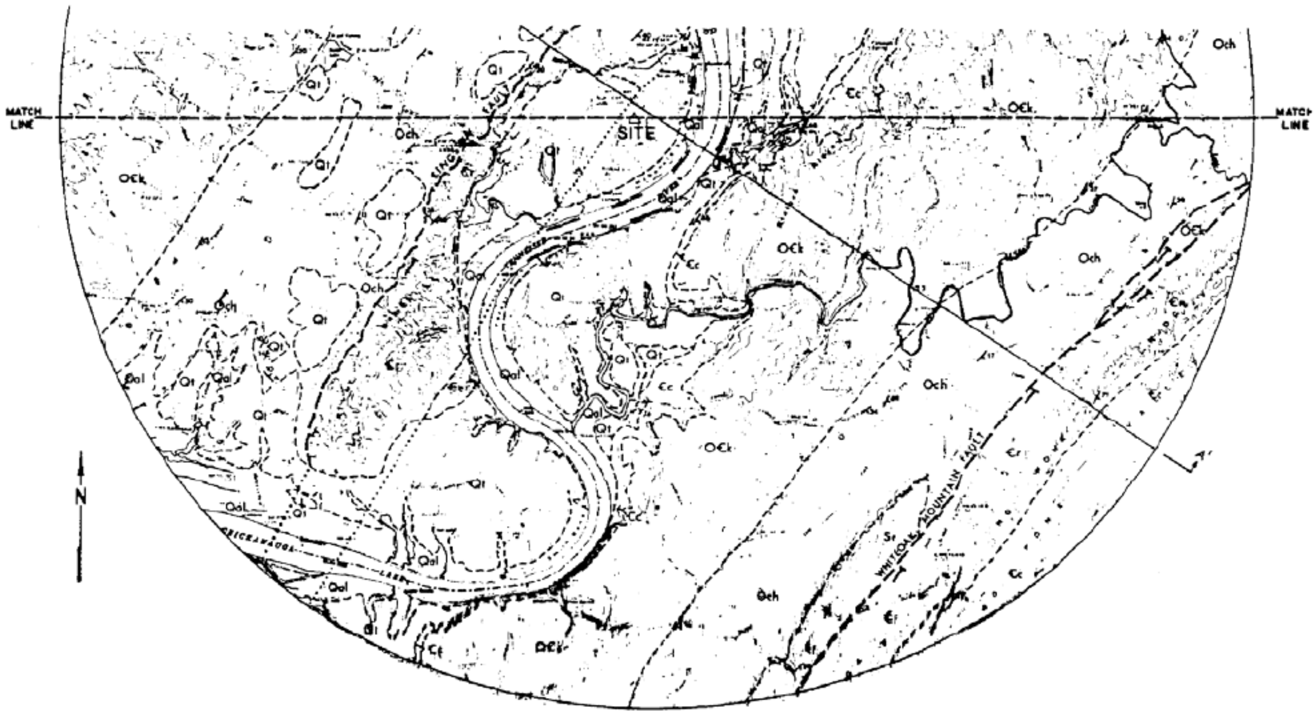
CONTOUR INTERVAL 20 FEET

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Geologic Map of Plant Area
(North Segment)

FIGURE 2.5-9




DESCRIPTION OF MAP UNITS

**QUATERNARY**

- **Qal** ALLUVIUM--Soil, shaly to sandy; contains abundant pebbles and cobbles of various lithologies and textures, generally waterworn. Mapped only in flood plain of the Tennessee River.
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**SILURIAN**

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**ORDOVICIAN**

- **Och** CHICKAMAUGA LIMESTONE--Limestone, light- to medium-gray, slabby to medium-bedded; shaly limestone abundant. Estimated thickness 1800 feet.

**CAMBRIAN AND ORDOVICIAN**

- **OЄk** KNOX GROUP--Dolomite, light- to dark-gray, fine- to coarse-grained; and limestone, medium-gray to bluish-gray, generally fine-grained. Thin- to thick-bedded. Weathers to cherty rubble. Thickness about 2600 feet.

**CAMBRIAN**

- **Єc** CONASAUGA GROUP--Shale, calcareous in upper part, becoming arenaceous and silty toward base; zones of shaly gray limestone, as much as 100 feet thick, scattered throughout but concentrated in upper half. Estimated thickness as much as 2000 feet.
- **Єr** ROME FORMATION--Shale, siltstone, and sandstone with local beds of gray limestone near base. Shale variegated, reddish and greenish, micaceous, and arenaceous. Numerous thin siltstone layers. Sandstone beds generally fine-grained, thin- to medium-bedded. Base not exposed; estimated thickness 1000 feet.

GEOLOGIC SYMBOLS

- Contact, approximately located, dotted where concealed
- Fault, approximately located, dotted where concealed. On hanging wall of thrust fault
- Strike and dip of beds
- Approximate strike and dip of crumpled beds
- Syncline, showing strike of axial plane
- Minor anticline, showing strike of axial plane

NOTES:

(1) Map consists of two slightly overlapping North and South segments that match along the indicated line. Cross section A-A' extends across both segments and is shown in profile as Geologic Section Through Plant Area (Fig. 2.5-11).

(2) Geologic map by TVA. Based on field data, on data from the Spring City (GQ 118-NE) and Ten Mile (GQ 125-NW) geologic [illegible]

(3) Description of Map Units and Geologic Symbols represent a composite [illegible] for both North and South segments.

SCALE:

1/2 0 1 MILE

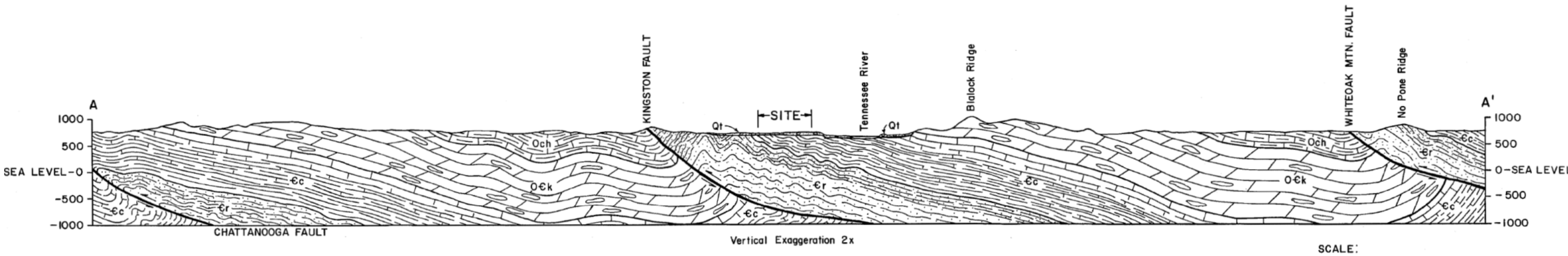
CONTOUR INTERVAL 20 FEET

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Geologic Map of Plant Area
(South Segment)

FIGURE 2.5-10




Vertical Exaggeration 2x

SCALE:
2000 0 2000 Feet

LEGEND:

QUATERNARY

Qt – Alluvial terrace deposits

ORDOVICIAN

Och – Chickamauga Group

CAMBRIAN & ORDOVICIAN

OꞒk – Knox Group

CAMBRIAN

Ꞓc – Conasauga Formation

Ꞓr – Rome Formation

NOTES:

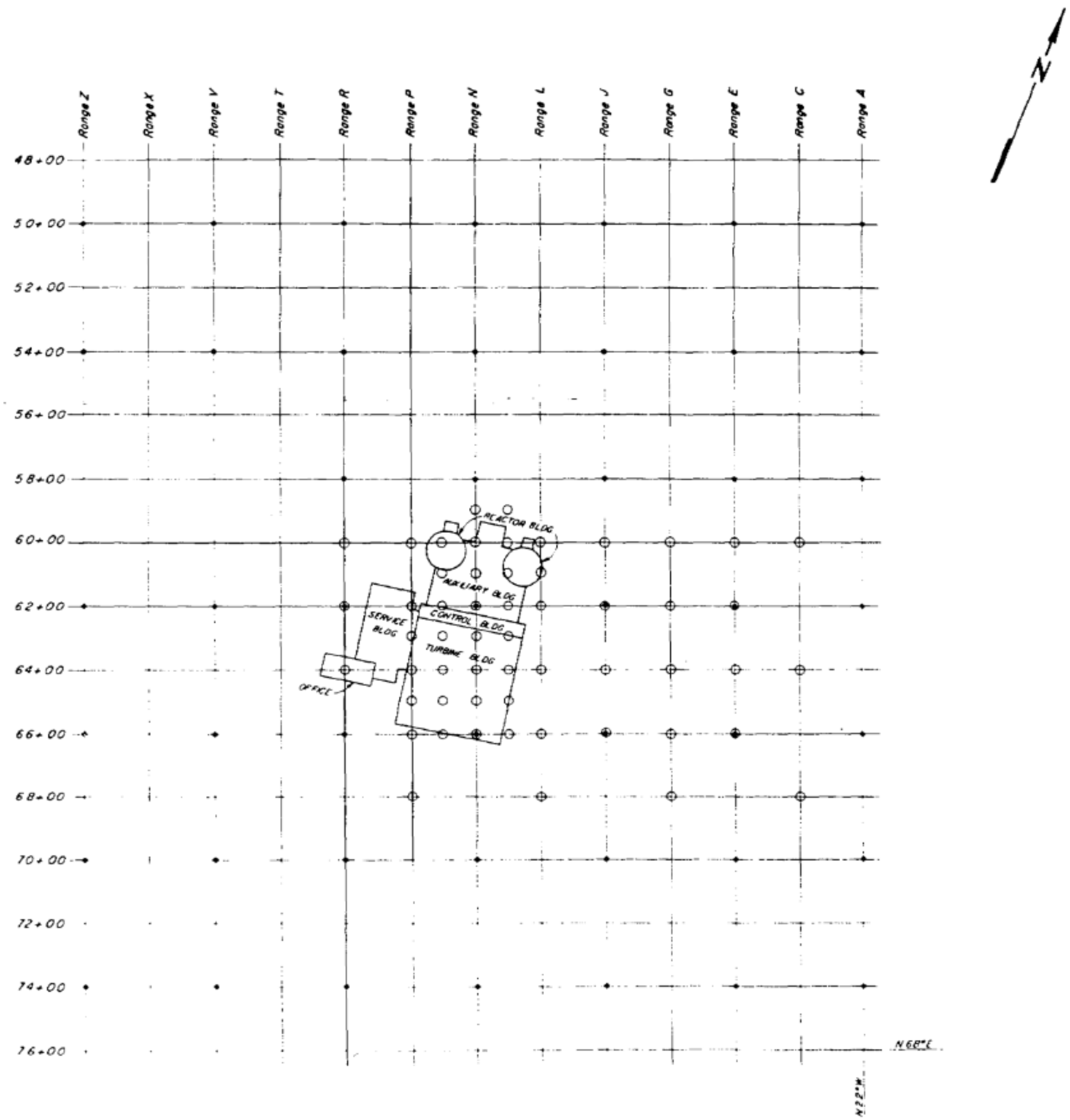
1. For location of section, see Geologic Map of the Plant Area.
2. Configuration of bedding shown on section is generalized, and does not portray all minor folds that may be present in the subsurface.

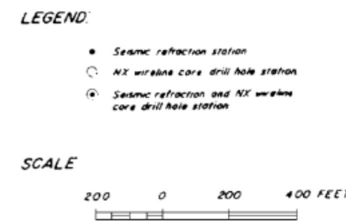
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Geologic Section Through
Plant Area

FIGURE 2.5-11



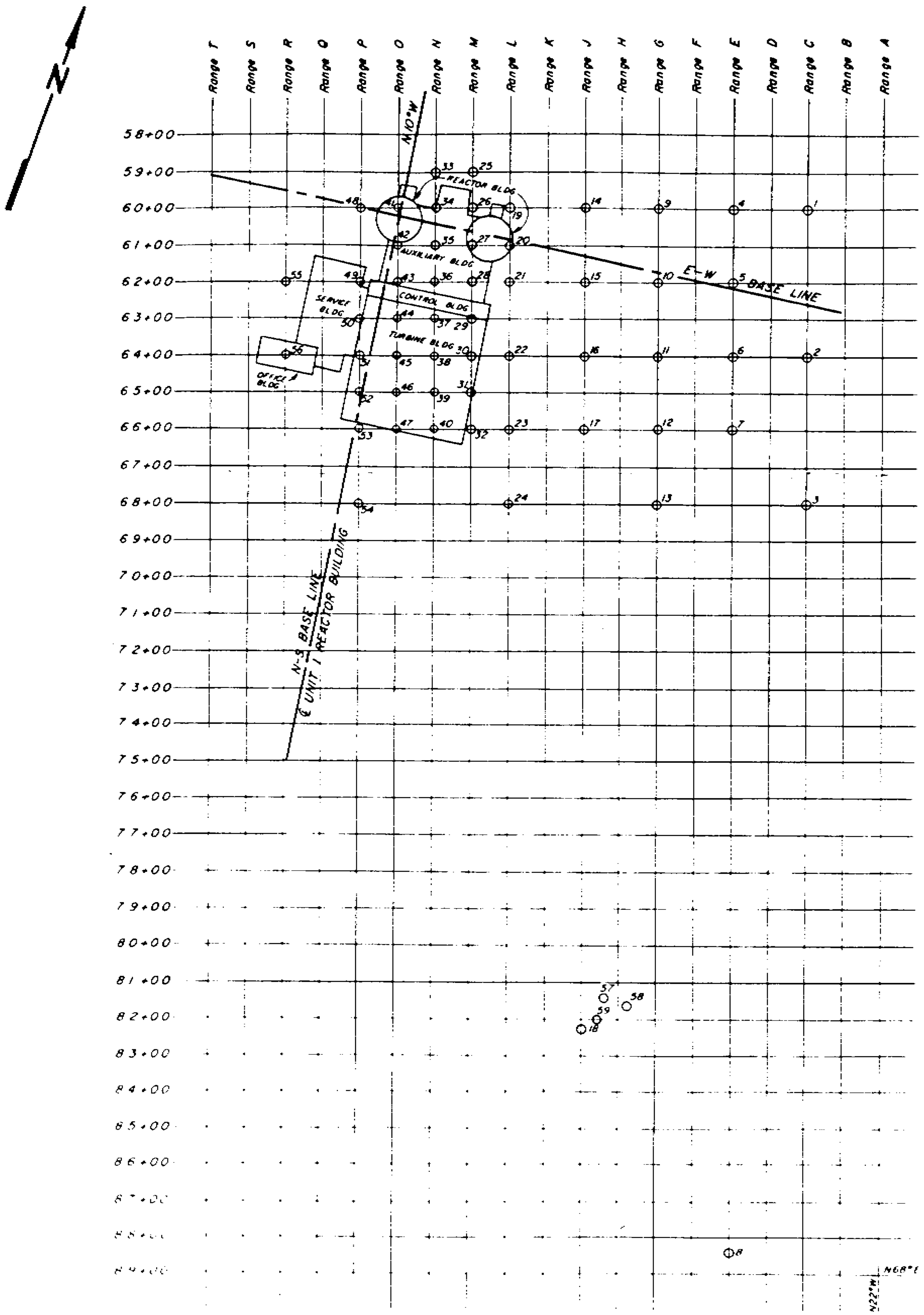




"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Core Drill Hole and
Seismic Refraction Locations

FIGURE 2.5-12



| Hole Number | Station Number | Surface Elevation | Top of Rock Elevation | Bottom of Hole Elevation | Average Ground Water Elevation August-December 1970 |
|---|---|---|---|---|---|
| 1 | C-60+00 | 739.1 | 697.1 | 634.2 | |
| 2 | C-64+00 | 730.7 | 696.7 | 636.7 | 719.5 |
| 3 | C-68+00 | 736.2 | 698.2 | 635.2 | 718.4 |
| 4 | E-60+00 | 734.6 | 700.1 | 634.2 | 720.0 |
| 5 | E-62+00 | 736.1 | 693.0 | 636.4 | |
| 6 | E-64+00 | 735.9 | 689.5 | 634.2 | 724.1 |
| 7 | E-66+00 | 735.3 | 696.3 | 635.0 | |
| 8 | E-88+40 | 699.4 | 650.1 | 598.1 | |
| 9 | G-60+00 | 734.5 | 702.8 | 634.3 | 721.5 |
| 10 | G-62+00 | 734.9 | 694.1 | 661.2 | |
| 11 | G-64+00 | 734.2 | 698.2 | 634.2 | 720.9 |
| 12 | G-66+00 | 736.2 | 694.0 | 636.2 | 720.3 |
| 13 | G-68+00 | 739.8 | 701.2 | 639.3 | |
| 14 | J-60+00 | 733.4 | 697.4 | 633.4 | 721.6 |
| 15 | J-62+00 | 732.0 | 696.0 | 657.4 | 721.3 |
| 16 | J-64+00 | 735.7 | 700.2 | 654.6 | 721.2 |
| 17 | J-66+00 | 738.6 | 692.8 | 638.1 | 720.6 |
| 18 | J-82+25 | 700.1 | 662.3 | 612.2 | |
| 19 | L-60+00 | 733.2 | 699.6 | 656.0 | 721.6 |
| 20 | L-61+00 | 729.7 | 698.1 | 548.4 | |
| 21 | L-62+00 | 733.1 | 690.9 | 647.1 | 721.1 |
| 22 | L-64+00 | 736.6 | 694.4 | 636.6 | 721.2 |
| 23 | L-66+00 | 741.9 | 699.9 | 651.9 | 719.6 |
| 24 | L-68+00 | 738.0 | 700.8 | 638.0 | 719.3 |
| 25 | M-59+00 | 732.2 | 698.4 | 634.1 | |
| 26 | M-60+00 | 729.1 | 701.1 | 634.6 | |
| 27 | M-61+00 | 732.9 | 690.2 | 634.6 | |
| 28 | M-62+00 | 733.4 | 695.0 | 634.8 | |
| 29 | M-63+00 | 734.7 | 691.4 | 639.5 | |
| 30 | M-64+00 | 737.[illegible] | 699.9 | 679.7 | |
| 31 | M-65+00 | 741.2 | 699.0 | 678.9 | |
| 32 | M-66+00 | 742.[illegible] | 699.5 | 678.1 | |
| 33 | N-59+60 | 728.4 | 697.4 | 634.8 | |
| 34 | N-60+30 | 730.[illegible] | 698.3 | 634.4 | 723.[illegible] |
| 35 | N-61+00 | 732.5 | 696.2 | 635.4 | |
| 36 | N-62+00 | 733.9 | 688.9 | 658.5 | 72[illegible].2 |
| 37 | N-63+00 | 735.7 | 693.7 | 634.7 | |
| 38 | N-64+00 | 738.2 | 695.9 | 641.5 | 72[illegible].2 |
| 39 | N-65+00 | 742.[illegible] | 699.6 | 548.8 | |
| 40 | N-66+00 | 742.[illegible] | 700.3 | 656.8 | 71[illegible] |
| 41 | O-60+00 | 732.[illegible] | 696.7 | 646.7 | |
| 42 | [illegible]-61+00 | 732.[illegible] | [illegible] | 635.0 | |
| 43 | [illegible]-62+00 | [illegible] | [illegible] | [illegible] | |
| 44 | [illegible]-63+00 | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible]-64+00 | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible]-65+00 | [illegible] | [illegible] | [illegible] | |
| 47 | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| 51 | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible]-62+00 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Hole Number | Station Number | Surface Elevation | Top of Rock Elevation | Bottom of Hole Elevation |
|---|---|---|---|---|
| 57 | 19+89S 9+80E | 702.2 | 669.2 | 617.7 |
| 58 | 19+91S 10+38E | 699.4 | 665.1 | 615.0 |
| 59 | 20+45S 9+66E | 699.4 | 662.0 | 610.0 |

"HISTORICAL INFORMATION"

*LEGEND:*

○ *Nx wireline core drill hole station*

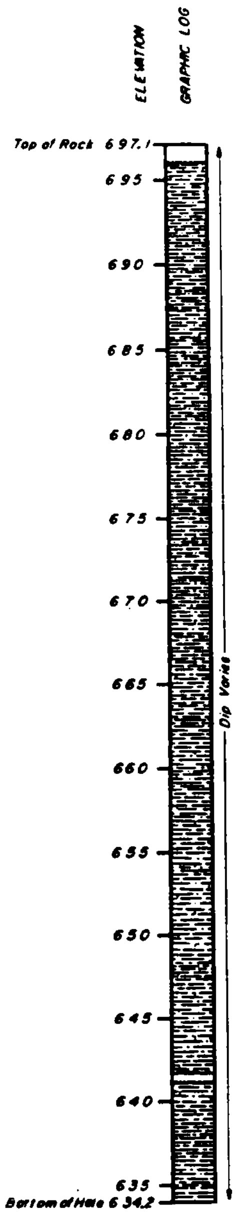
*SCALE:*

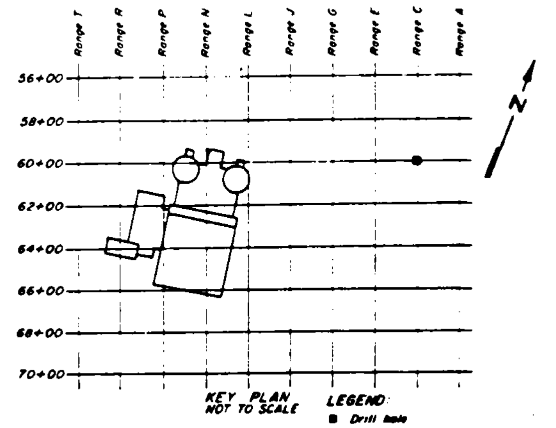
200 0 200 400 Feet

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Core Drill Layout and Summary

FIGURE 2.5-13

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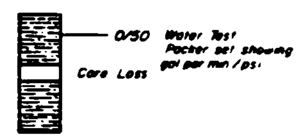



NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

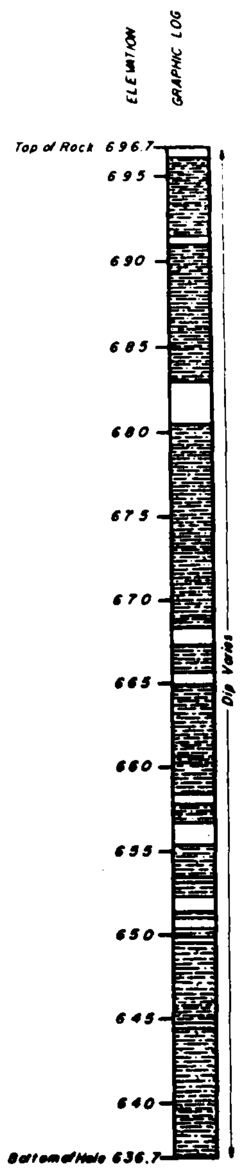
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

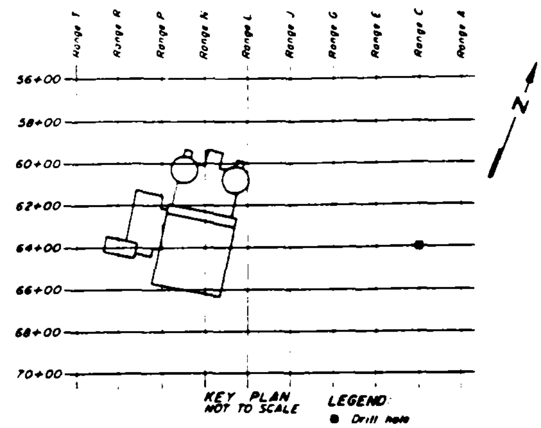
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 1
STA. C-60+00

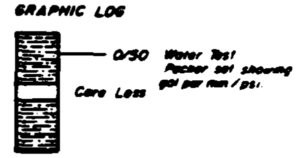
FIGURE 2.5-14




**LEGEND:**

**GRAPHIC LOG**




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

**GENERAL ROCK DESCRIPTION**

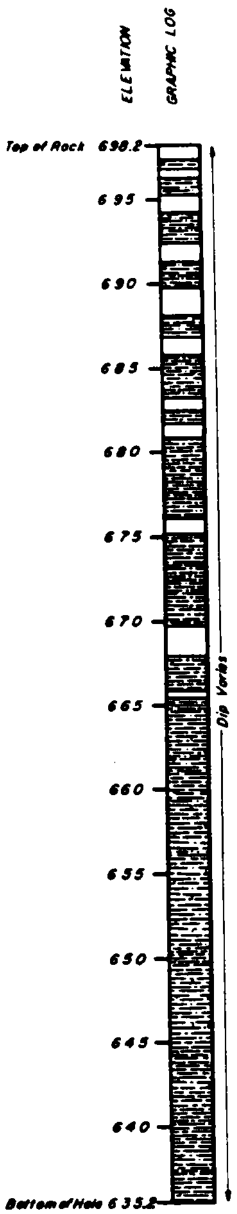
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

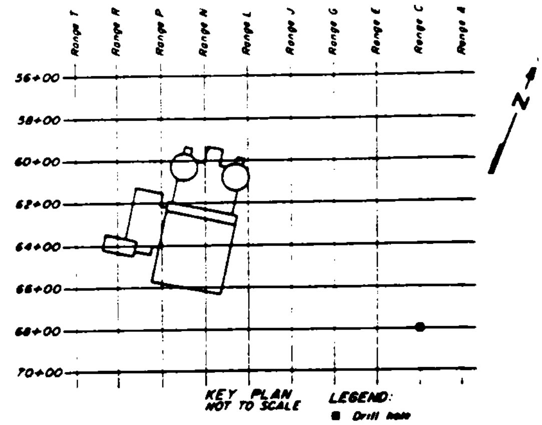
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 2
STA. C-64+00

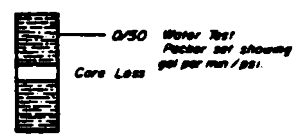
FIGURE 2.5-15




**LEGEND:**

**GRAPHIC LOG**




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

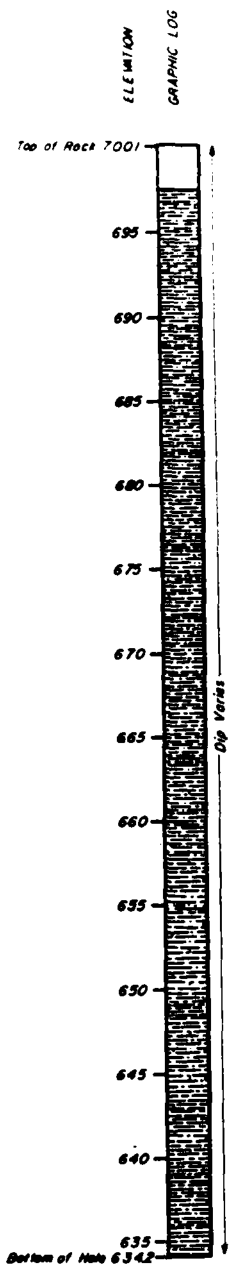
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

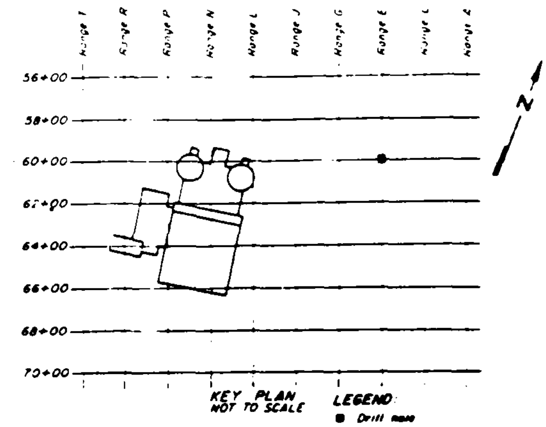
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 3
STA. C-68+00

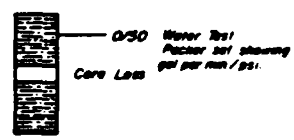
FIGURE 2.5-16




**LEGEND:**

**GRAPHIC LOG**




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

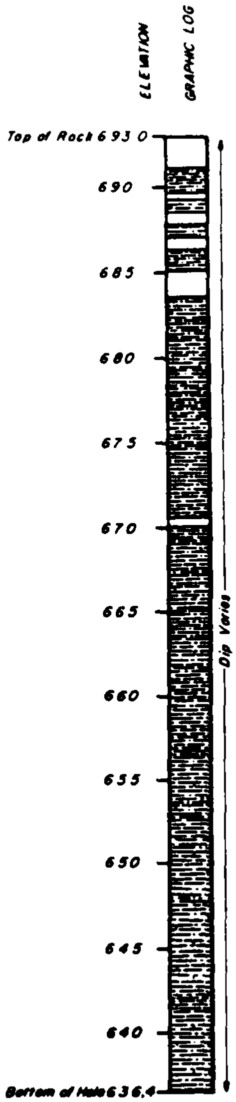
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

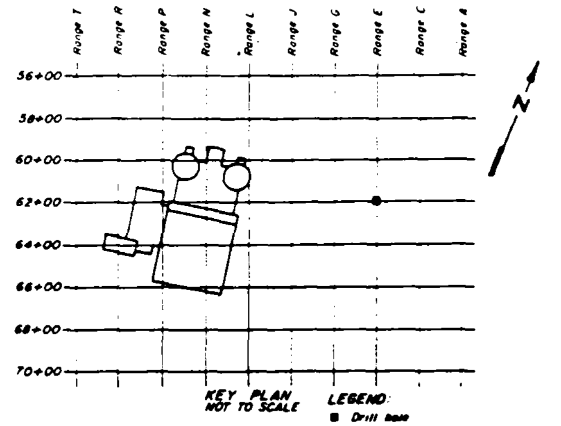
"HISTORICAL INFORMATION"

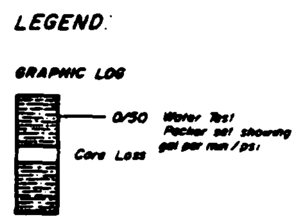
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 4
STA. E-60+00

FIGURE 2.5-17




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

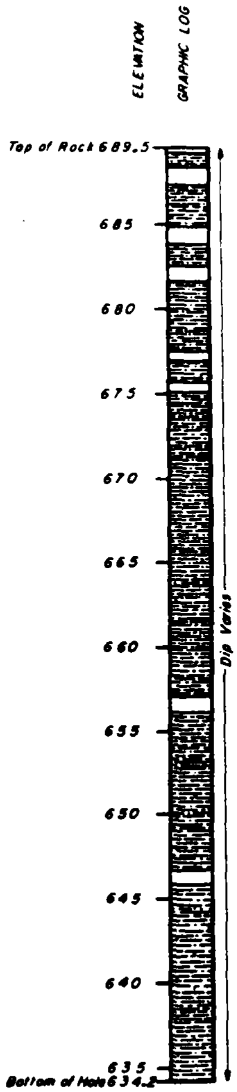
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

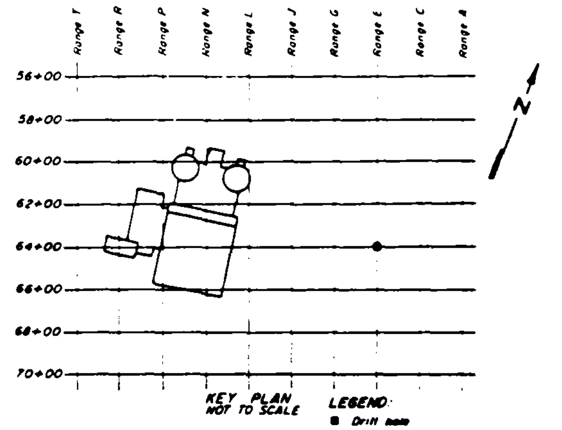
*"HISTORICAL INFORMATION"*

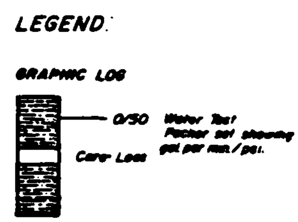
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 5
STA. E-62+00

FIGURE 2.5-18




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

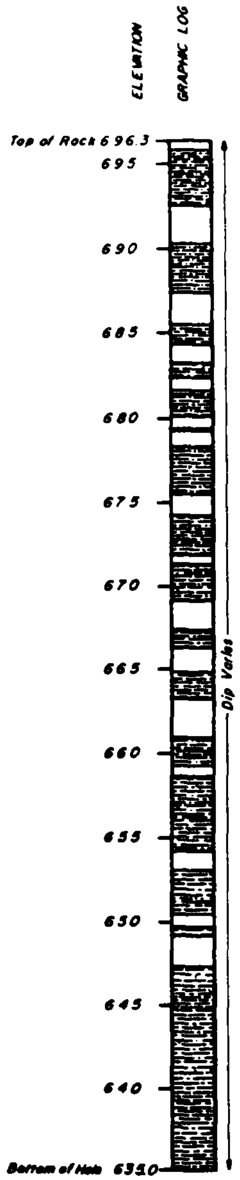
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

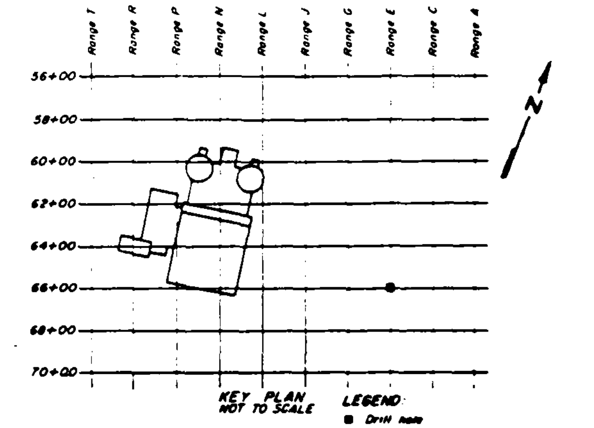
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

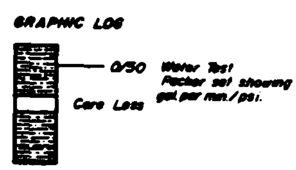
Graphic Log
Hole 6
STA. E-64+00

FIGURE 2.5-19




**LEGEND:**




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

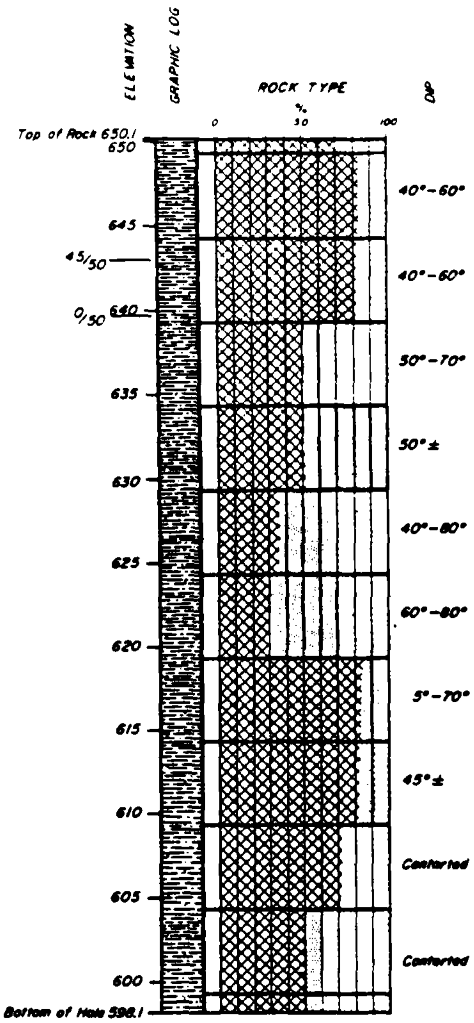
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 7
STA. E-66+00

FIGURE 2.5-20




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.
3. FOR CORE DRILL HOLE LOCATION SEE DRAWING 85 GE 1 822K1825.

## LEGEND

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

**GENERAL ROCK DESCRIPTION**

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

- Type 0 - Core Loss
- Type 1 - Soft shale 1 to 10
- Type 2 - Hard shale 5 to 60
- Type 3 - Limestone 100+

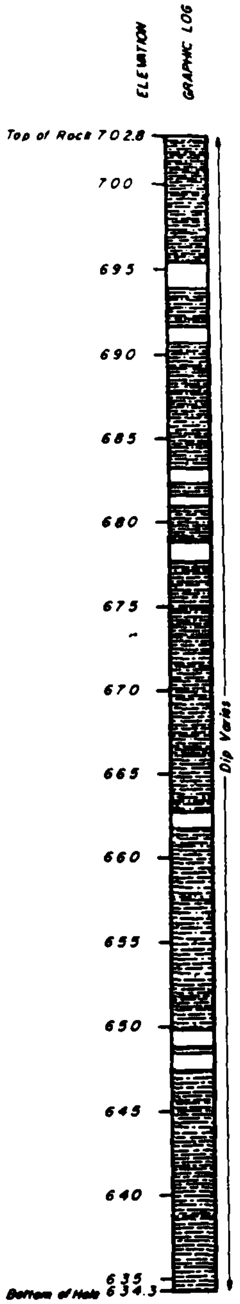
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

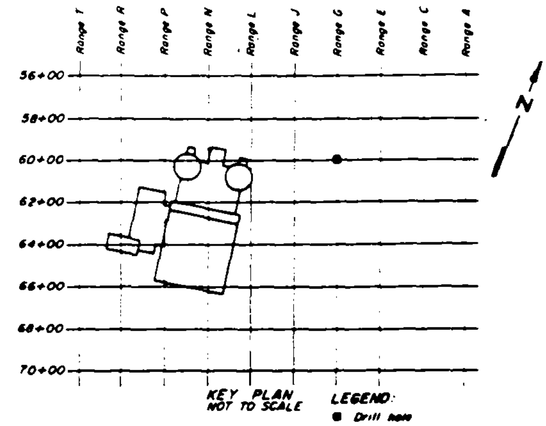
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 8
STA. E-88+40

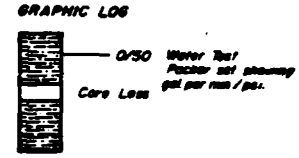
FIGURE 2.5-21




LEGEND:

GRAPHIC LOG




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

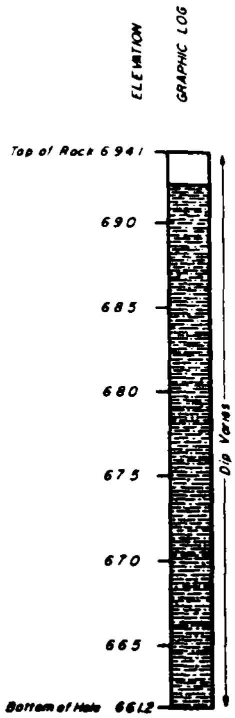
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

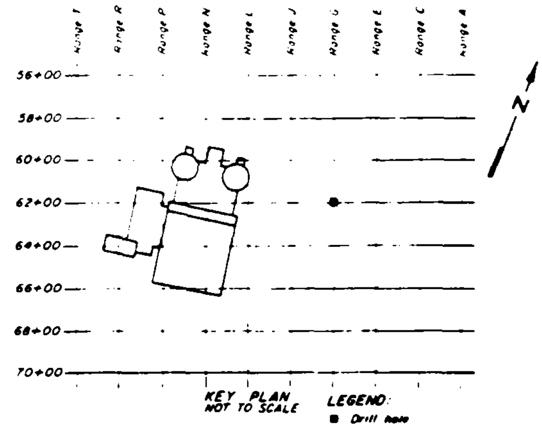
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 9
STA. G-60+00

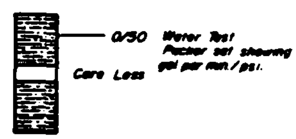
FIGURE 2.5-22




LEGEND:

GRAPHIC LOG




NOTE:

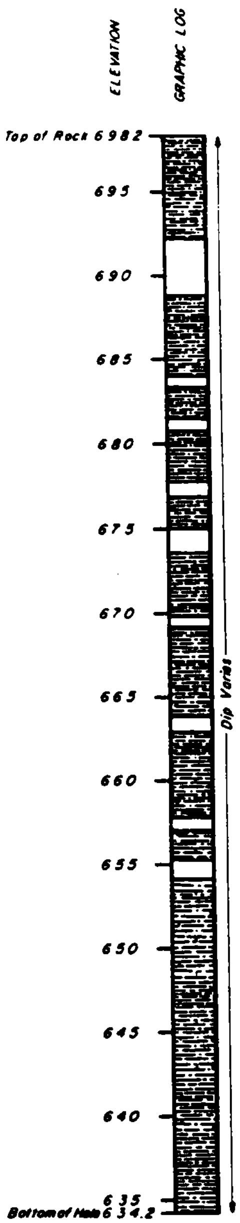
THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

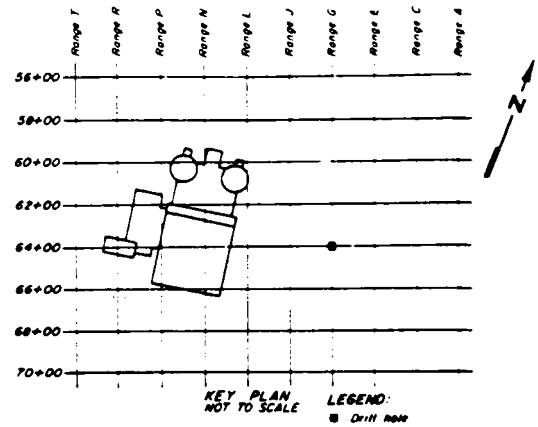
GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

"HISTORICAL INFORMATION"

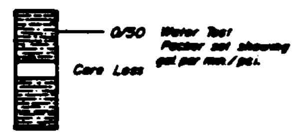
| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
| --- |
| Graphic Log<br>Hole 10<br>STA. G-62+00<br><br>FIGURE 2.5-23 |




**LEGEND:**

**GRAPHIC LOG**




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

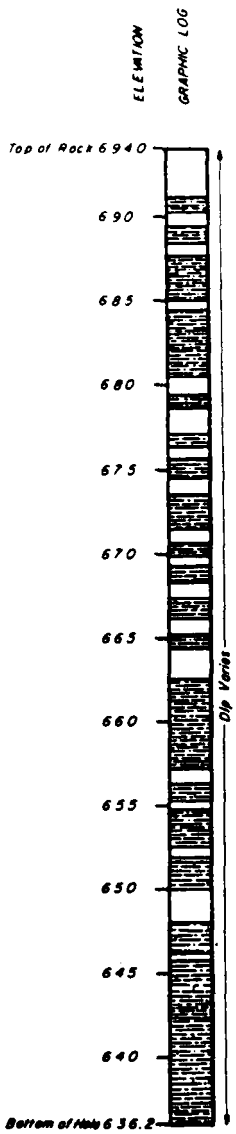
THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

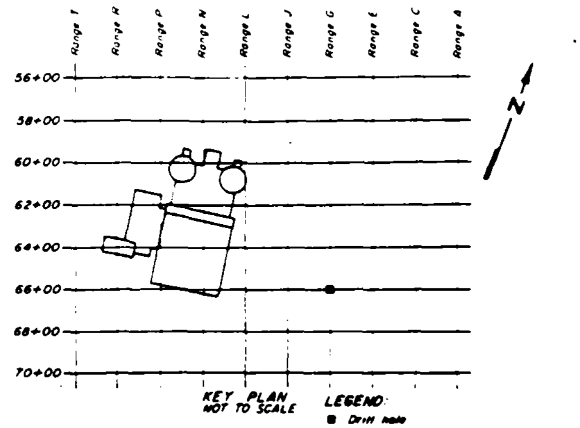
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 11
STA. G-64+00

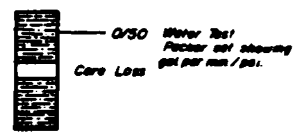
FIGURE 2.5-24




LEGEND:

GRAPHIC LOG




NOTE:

THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

GENERAL ROCK DESCRIPTION

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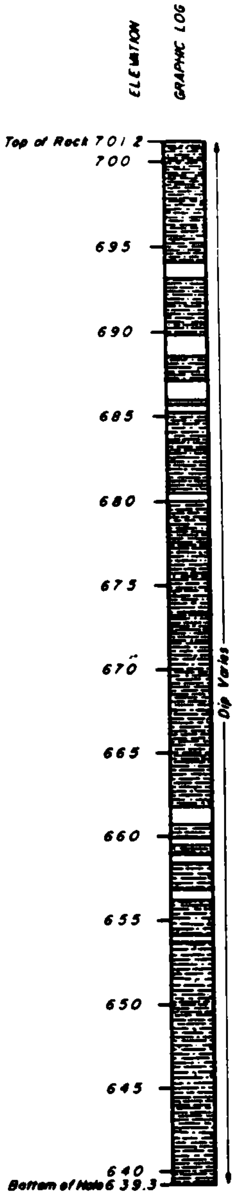
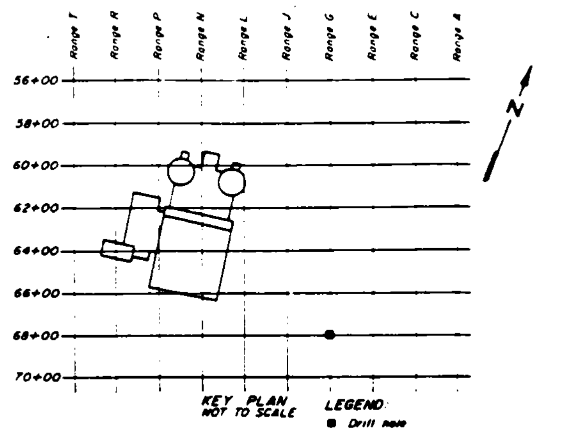
"HISTORICAL INFORMATION"

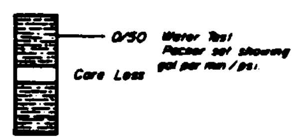
| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 12<br>STA. G-66+00<br><br>FIGURE 2.5-25 |




LEGEND:

GRAPHIC LOG




NOTE:

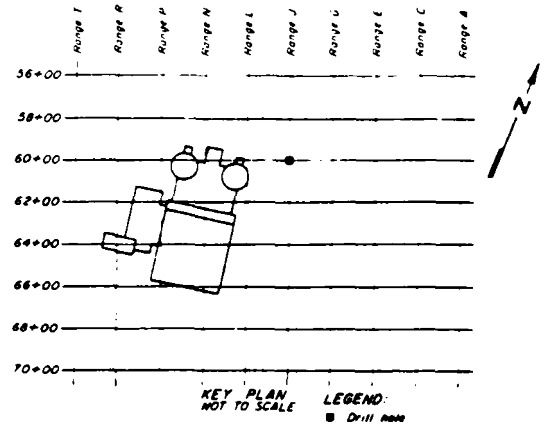
THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

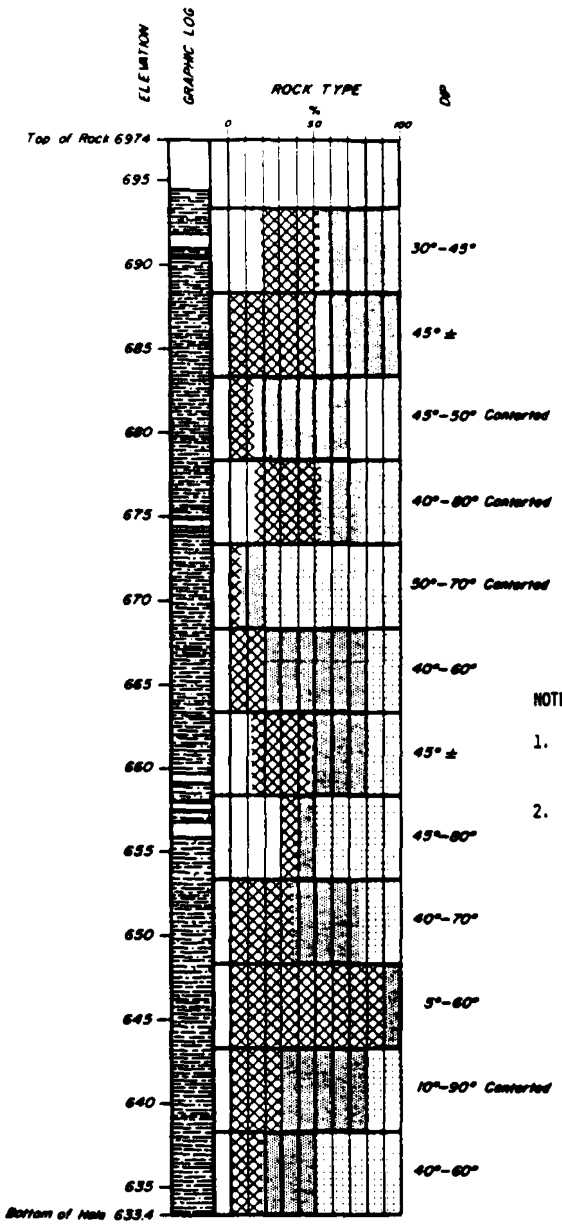
GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
| --- |
| Graphic Log<br>Hole 13<br>STA. G-68+00<br><br>FIGURE 2.5-26 |



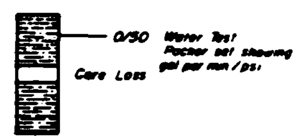




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

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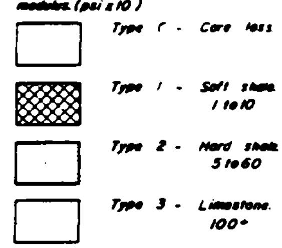
ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)



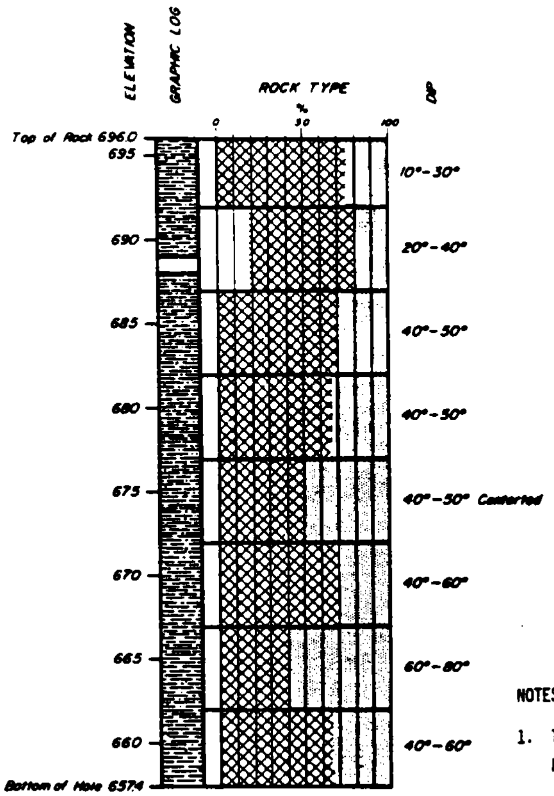

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

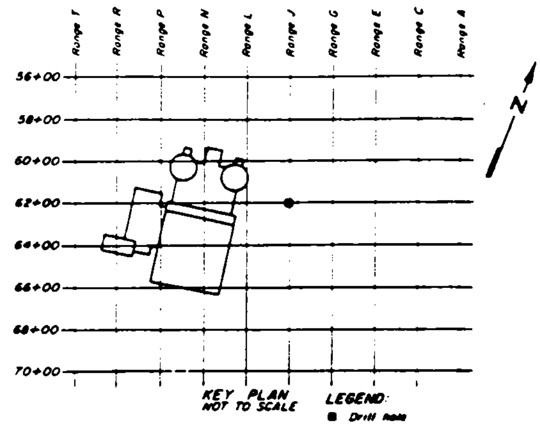
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 14
STA. J-60+00

FIGURE 2.5-27




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

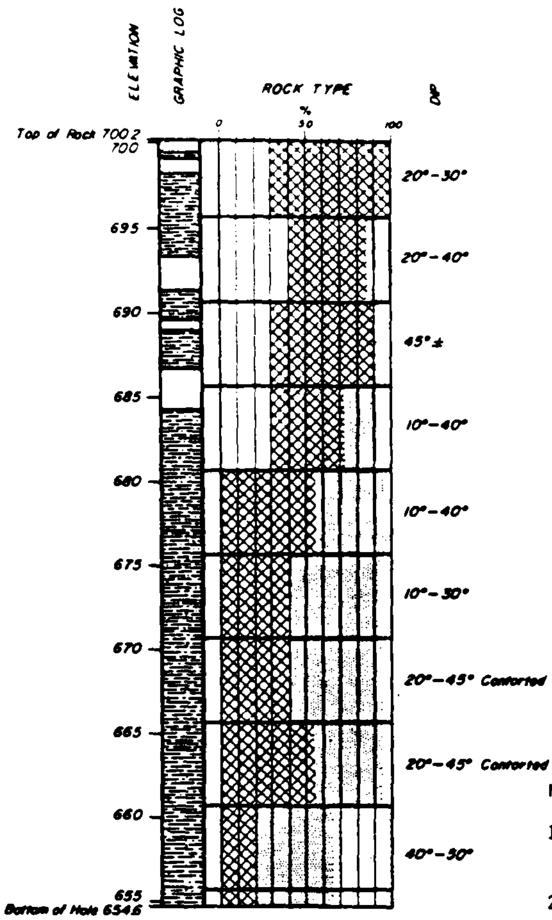
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

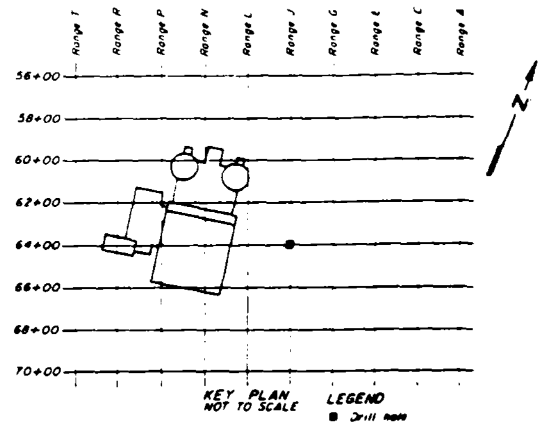
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 15
STA. J-62+00

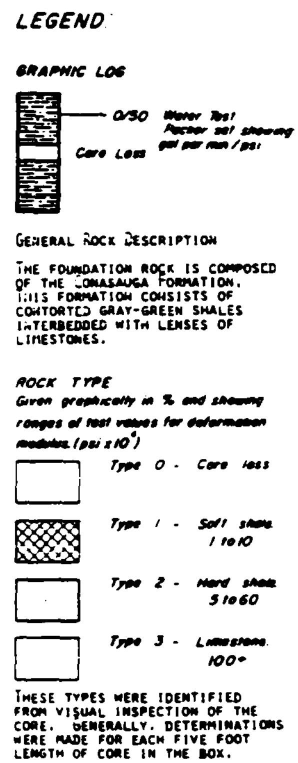
FIGURE 2.5-28




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

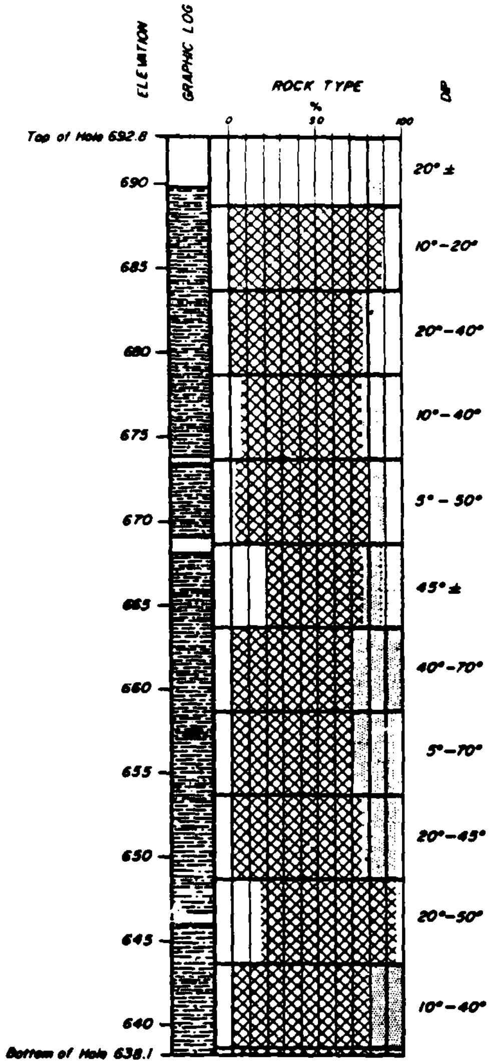


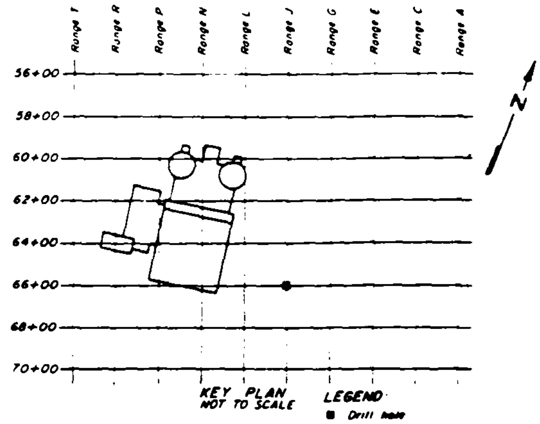

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 16
STA. J-64+00

FIGURE 2.5-29




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

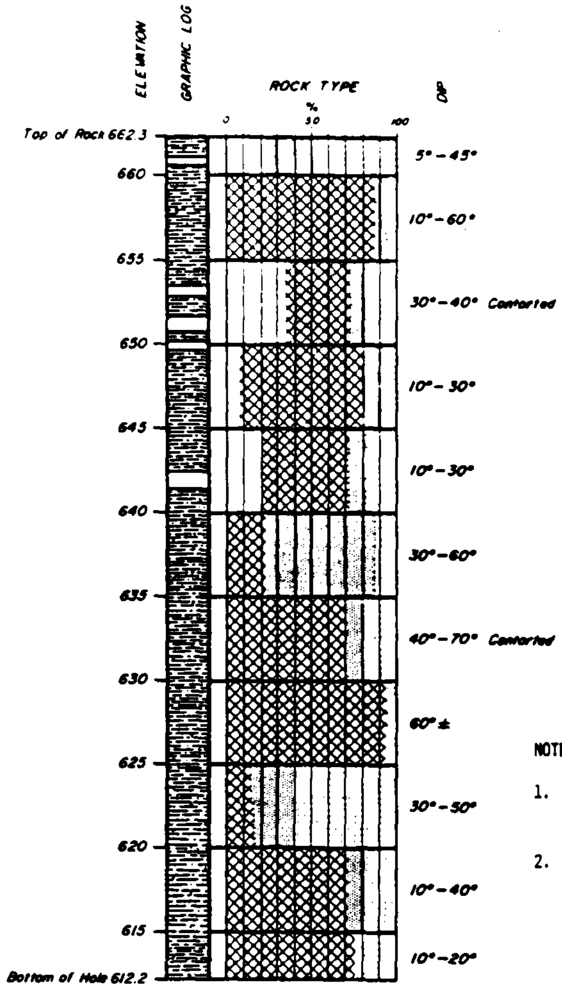
Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 17<br>STA. J-66+00<br><br>FIGURE 2.5-30 |




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.
3. FOR CORE DRILL HOLE LOCATION SEE DRAWING 65 GE 1 822K1825.

## LEGEND

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

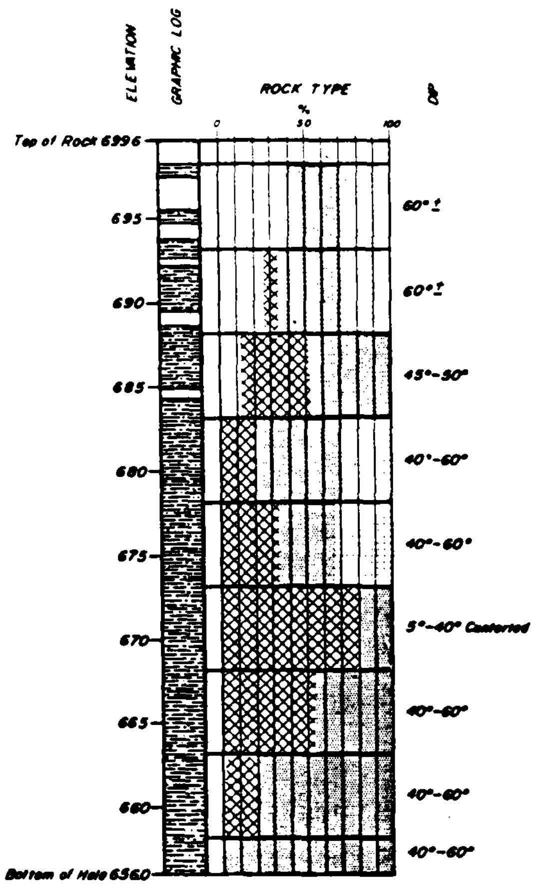
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

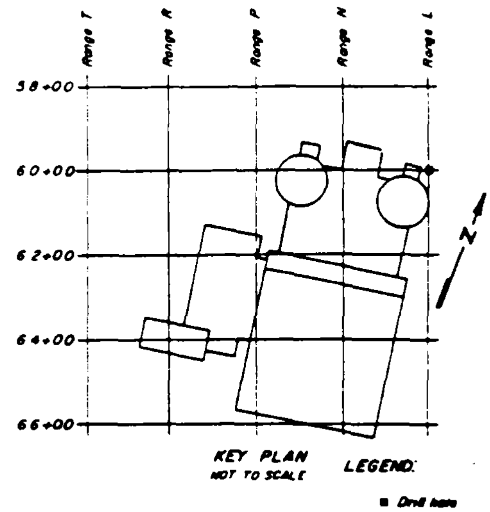
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 18
STA. J-82+25

FIGURE 2.5-31




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 699.6 AND 661.2. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gpl per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

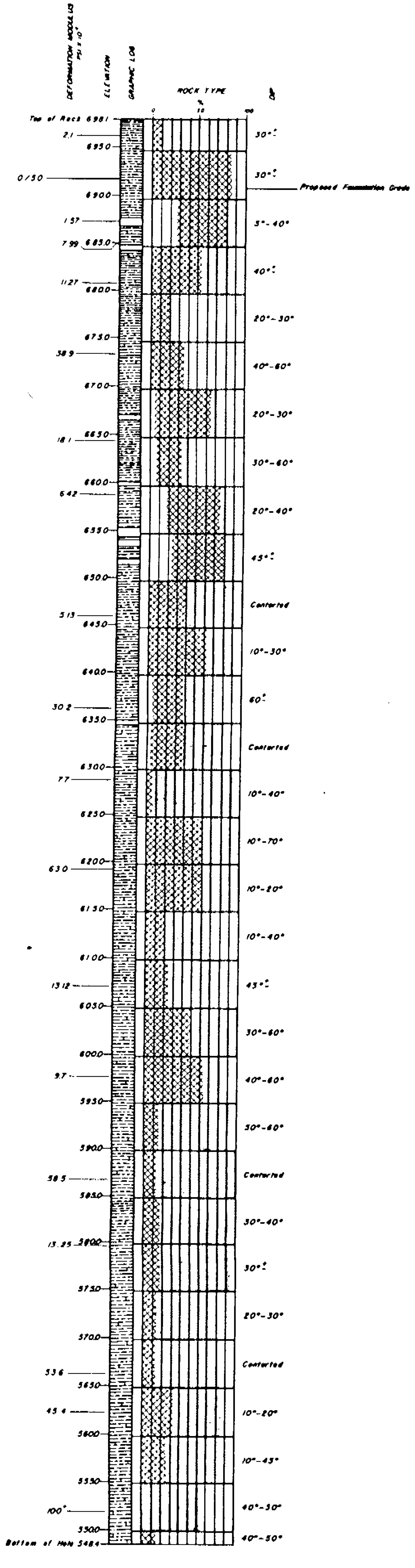
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

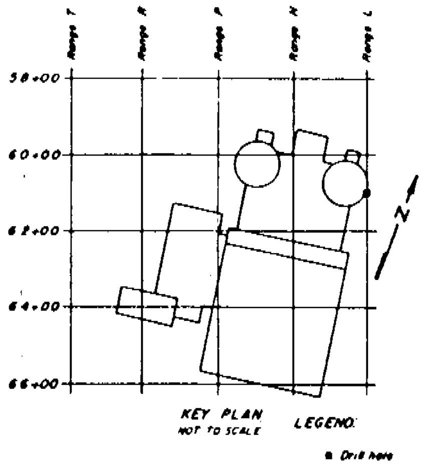
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 19
STA. L-60+00

FIGURE 2.5-32




LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10^4)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

NOTES:

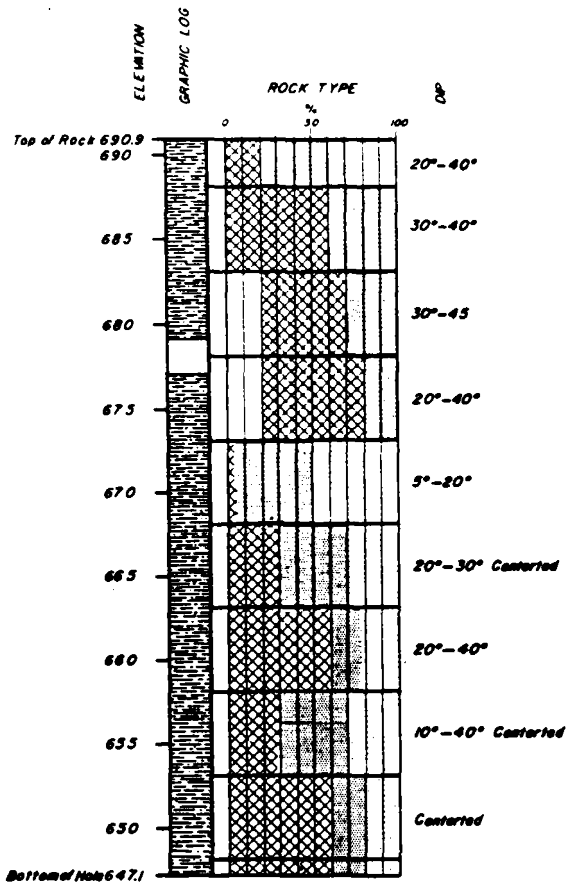
1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 698.1 AND 619.7. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

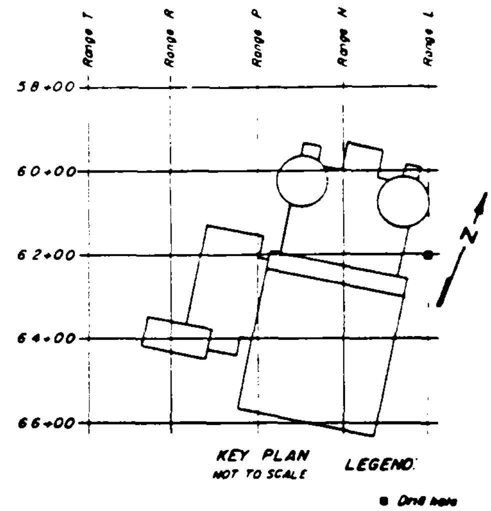
*HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 20
STA. L-61+00

FIGURE 2.5-33




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 690.9 AND 651.1. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

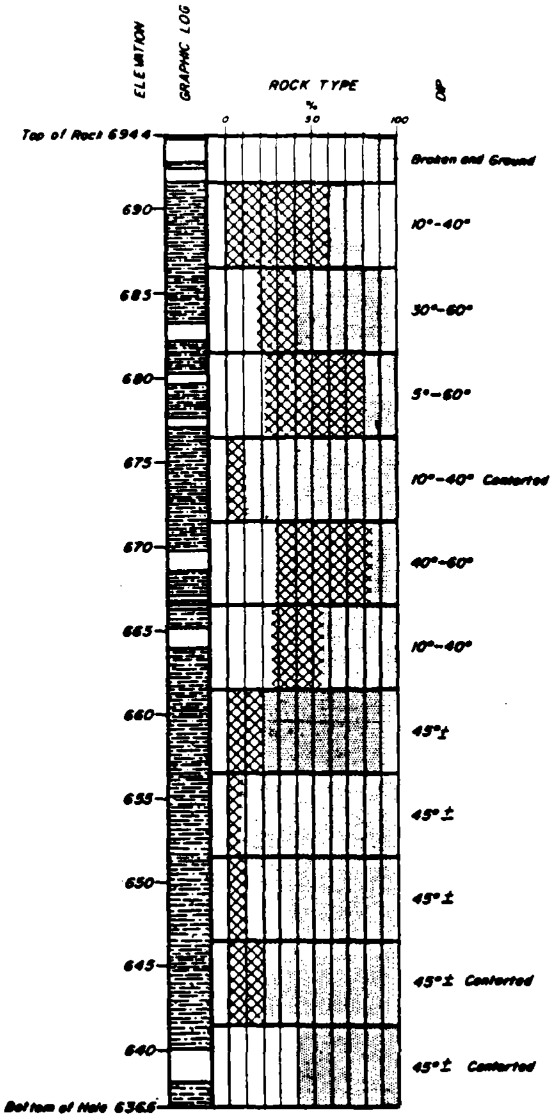
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

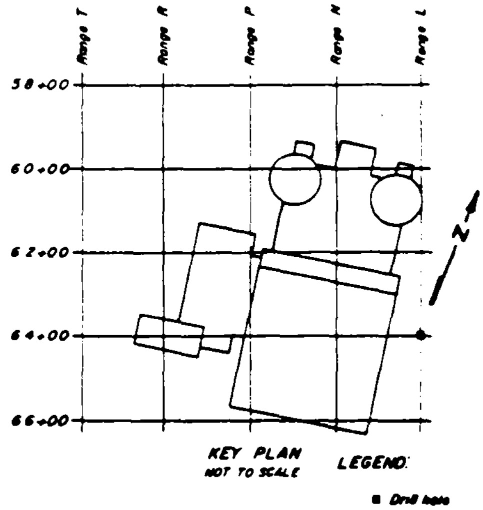
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 21
STA. L-62+00

FIGURE 2.5-34




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

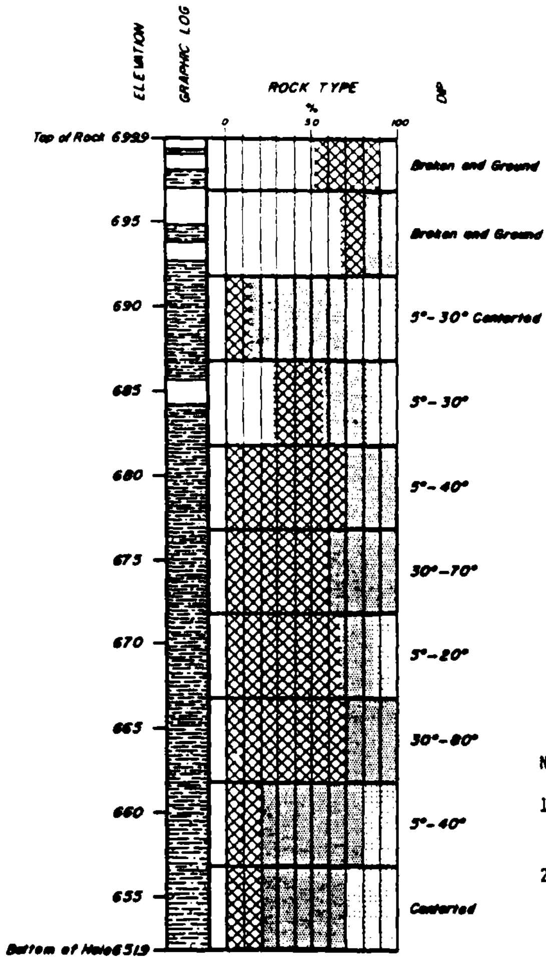
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

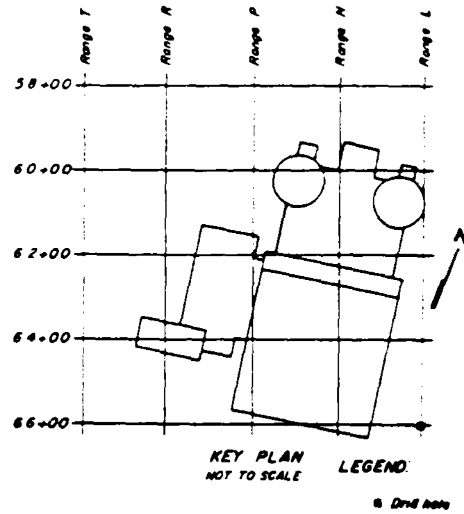
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 22
STA. L-64+00

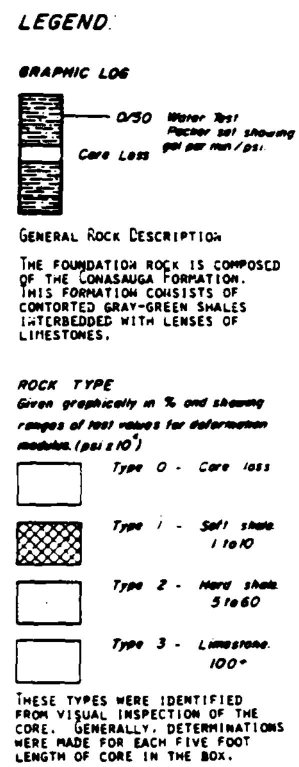
FIGURE 2.5-35




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

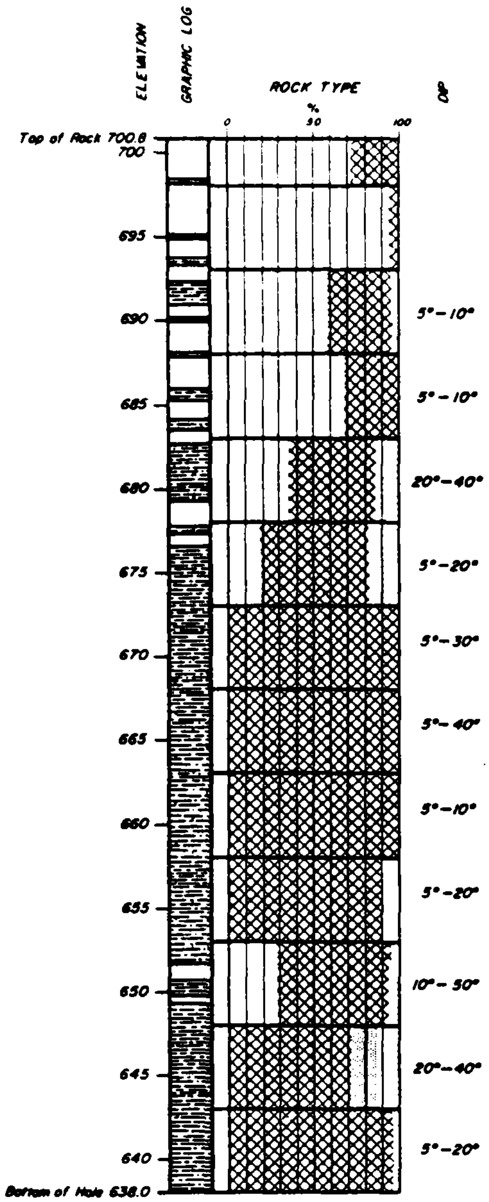


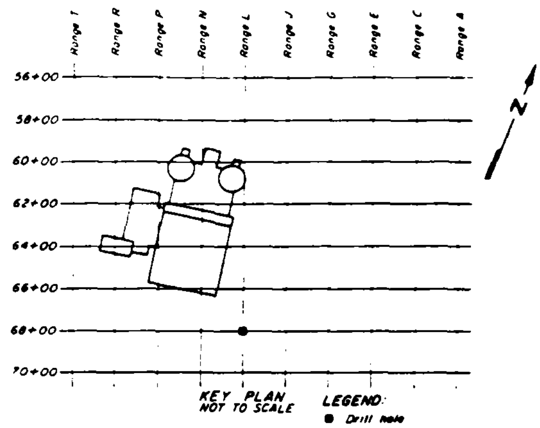

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 23
STA. L-66+00

FIGURE 2.5-36



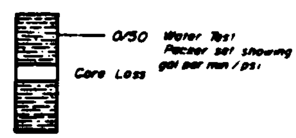




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

## LEGEND

**GRAPHIC LOG**

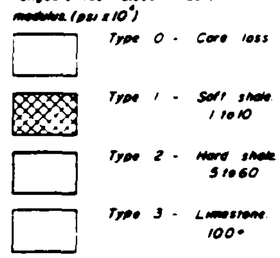



GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

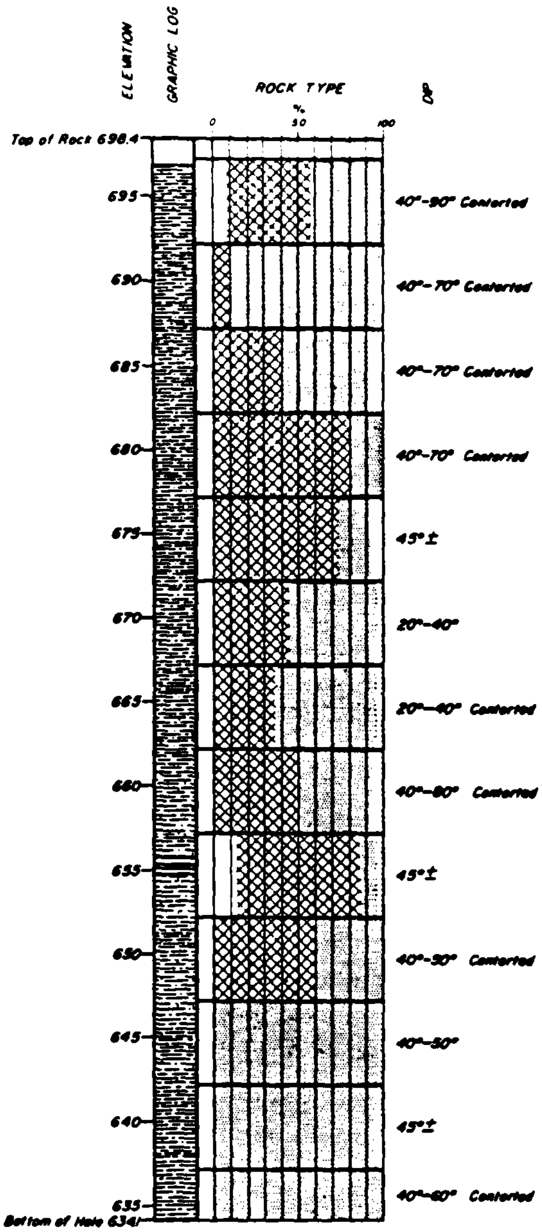
*Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)*

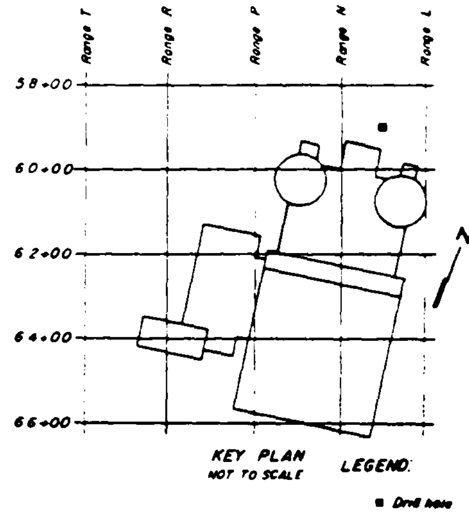



THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 24<br>STA. L-68+00<br><br>FIGURE 2.5-37 |




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 698.4 AND 651.2. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

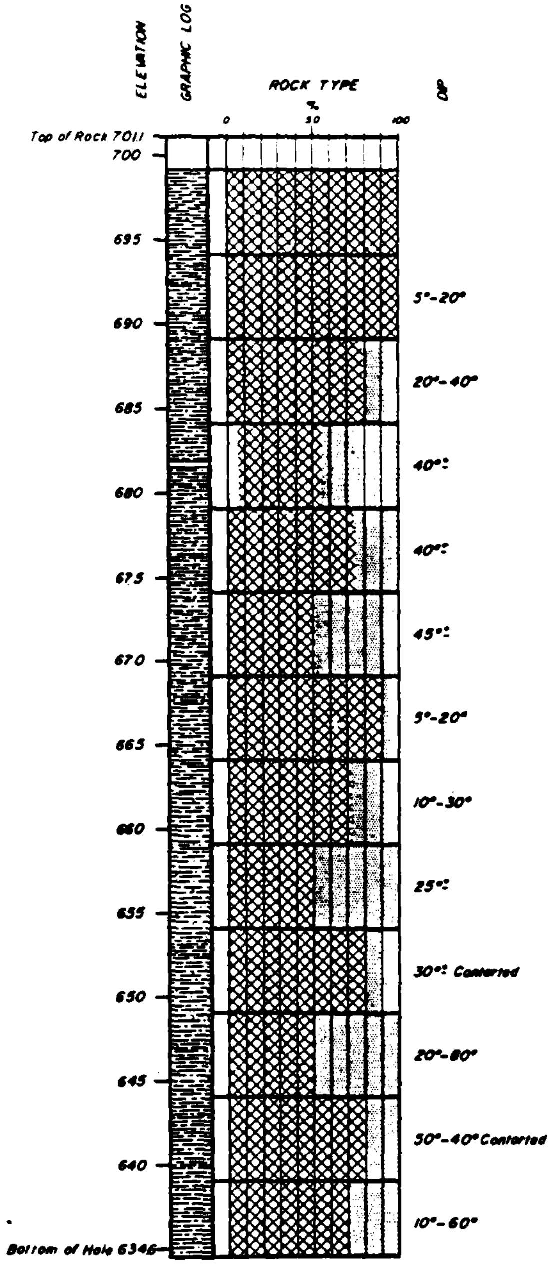
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

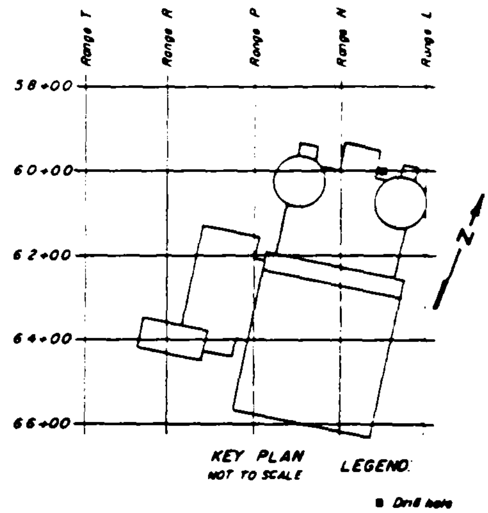
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 25
STA. M-59+00

FIGURE 2.5-38




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 701.1 AND 639.1. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

## LEGEND

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

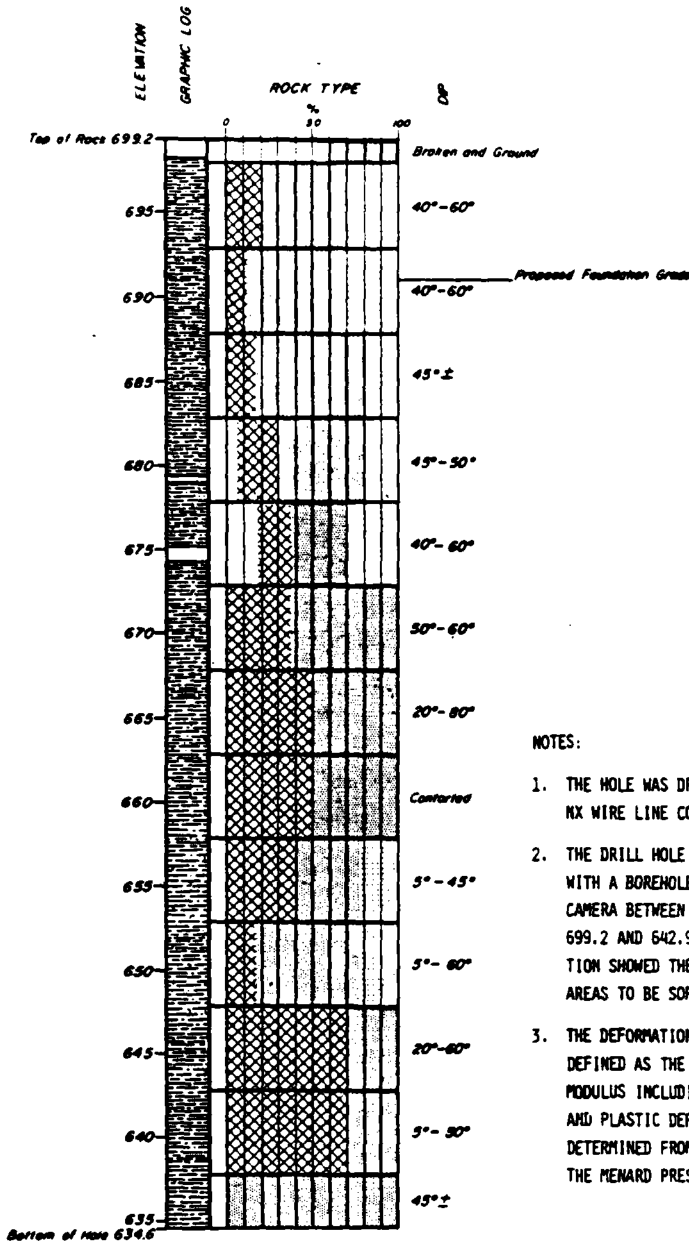
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT

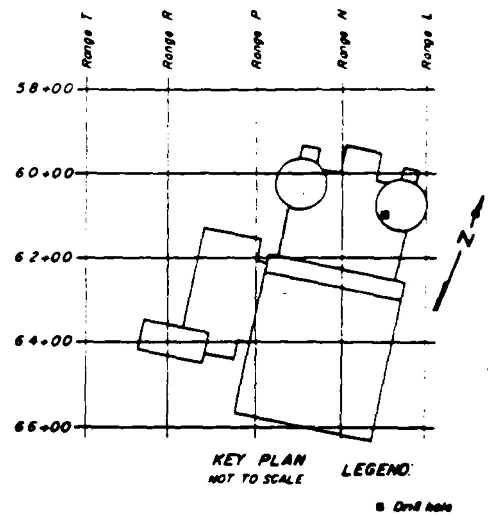
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 26
STA. G-60+00

FIGURE 2.5-39




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 699.2 AND 642.9. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

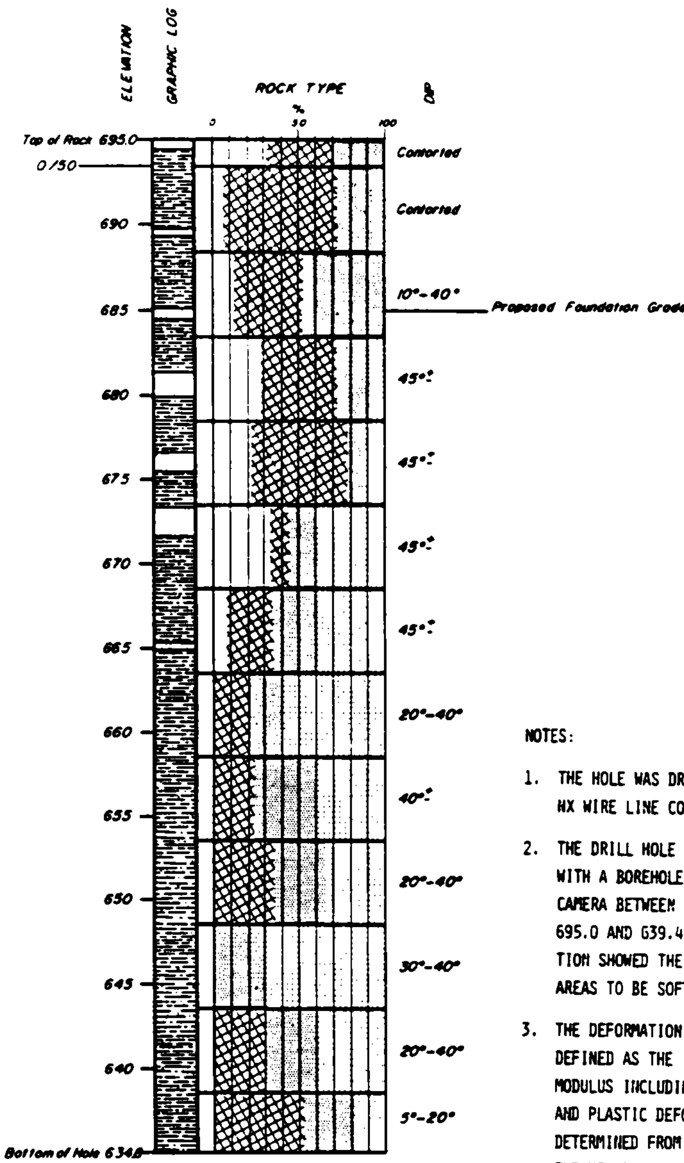
Type 2 - Hard shale 5 to 60

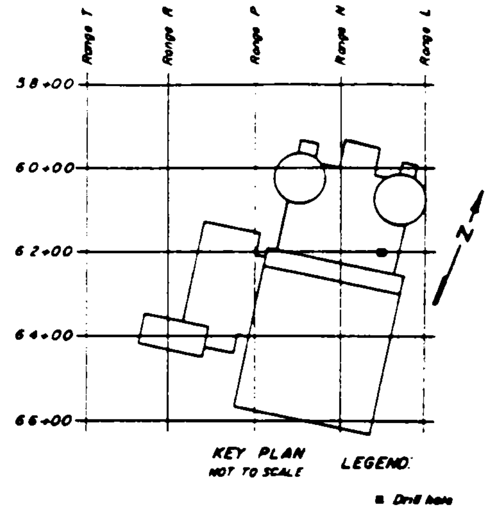
Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 27<br>STA. M-61+00<br><br>FIGURE 2.5-40 |




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 695.0 AND 639.4. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

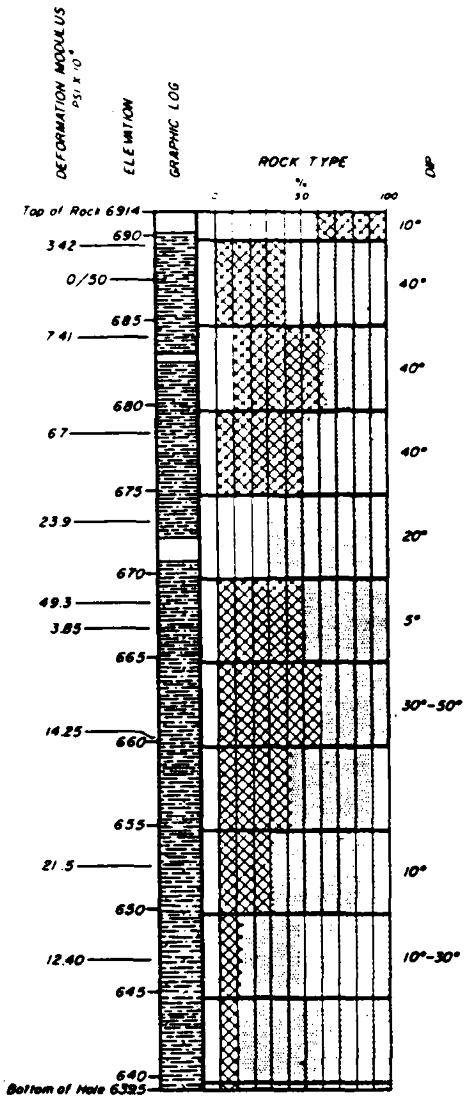
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

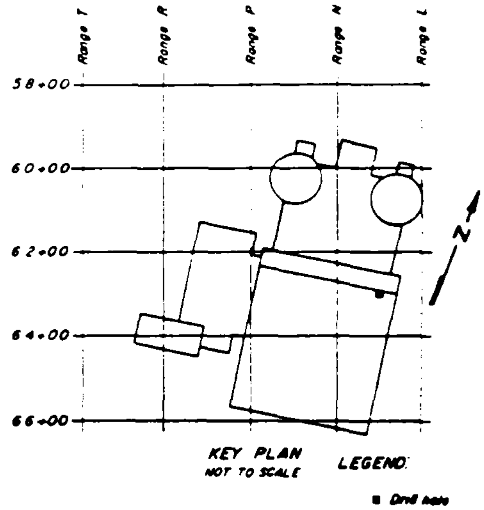
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 28
STA. M-62+00

FIGURE 2.5-41



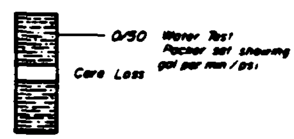




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 691.4 AND 646.7. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

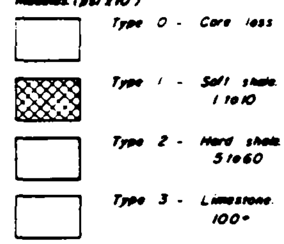



GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

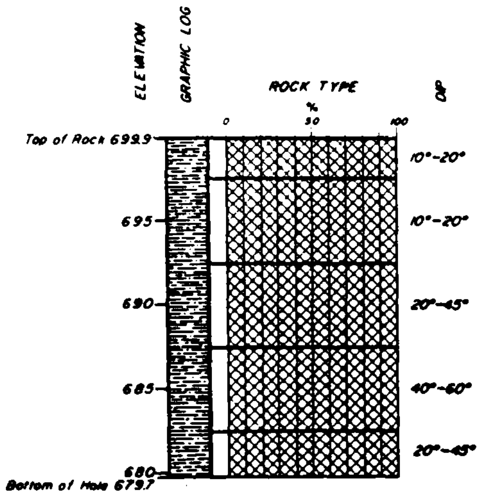
Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

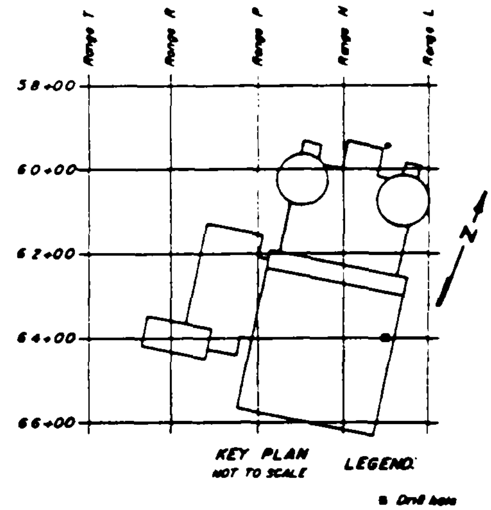



THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 29<br>STA. M-63+00<br><br>FIGURE 2.5-42 |



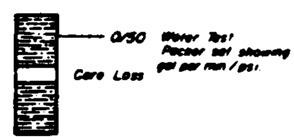




**NOTES:**

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

**LEGEND**

GRAPHIC LOG

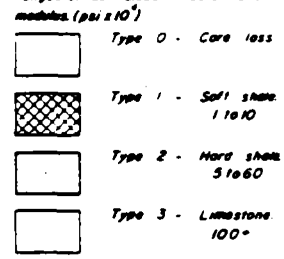



GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

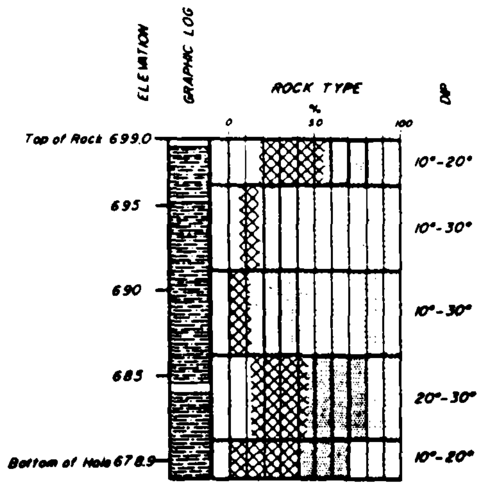
Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)

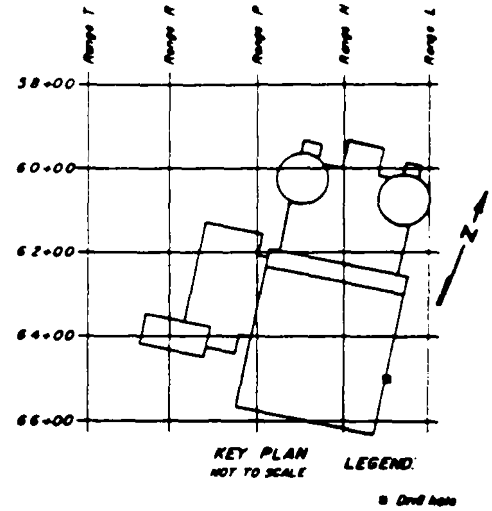



THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| Graphic Log<br>Hole 30<br>STA. M-64+00<br><br>FIGURE 2.5-43 |




LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi.

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

- Type 0 - Core loss
- Type 1 - Soft shale 1 to 10
- Type 2 - Hard shale 5 to 60
- Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

NOTES:

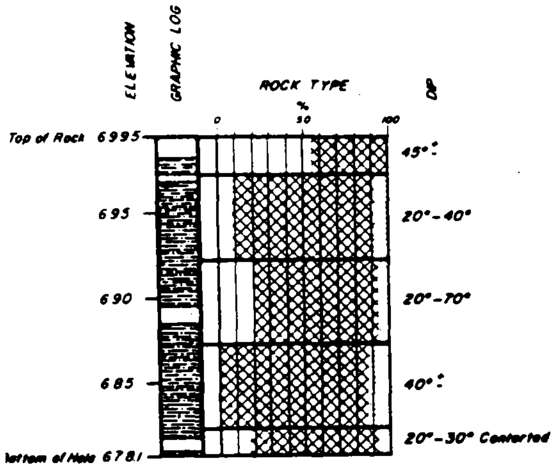
1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

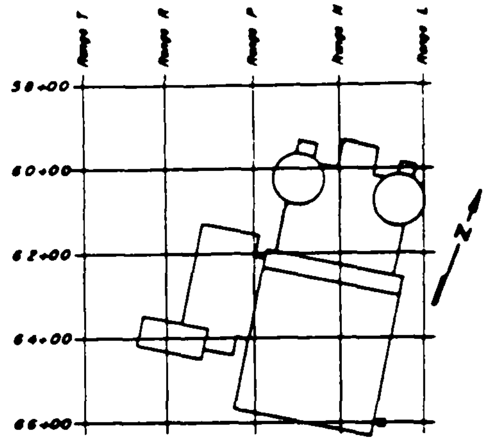
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 31
STA. M-65+00

FIGURE 2.5-44




KEY PLAN
NOT TO SCALE

LEGEND

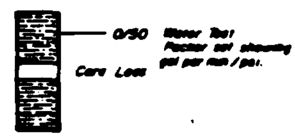
• Drill hole

NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

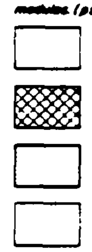



GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)



Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

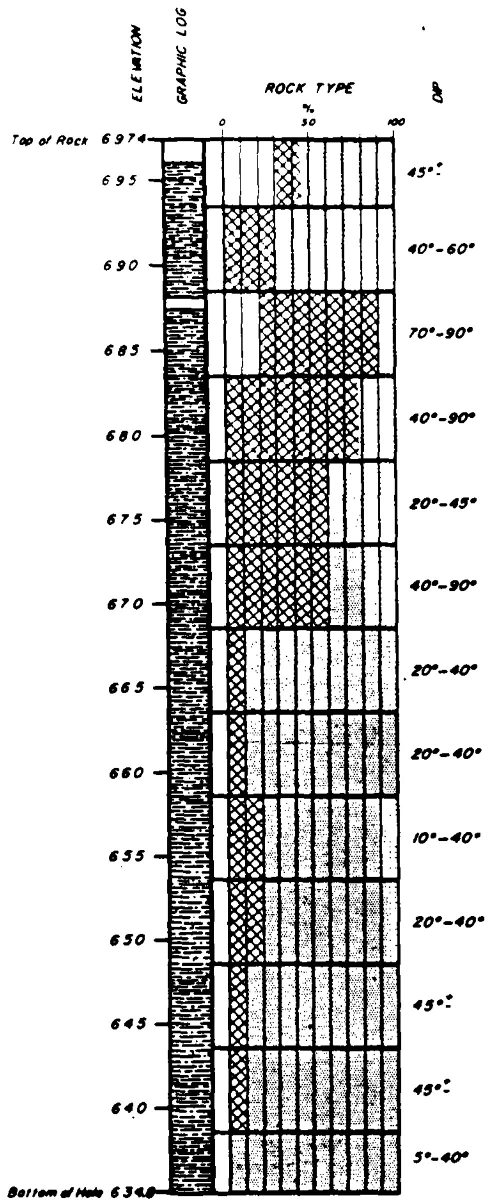
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

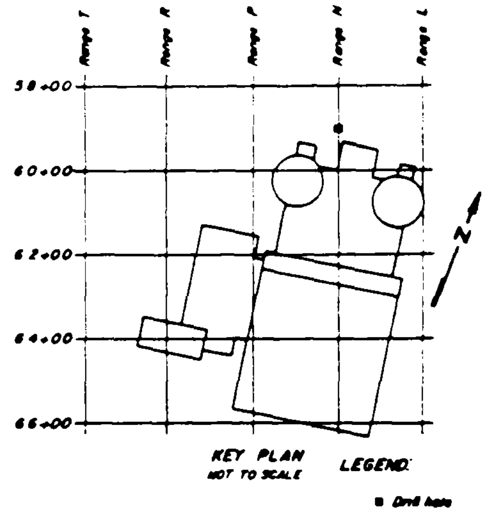
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 32
STA. M-66+00

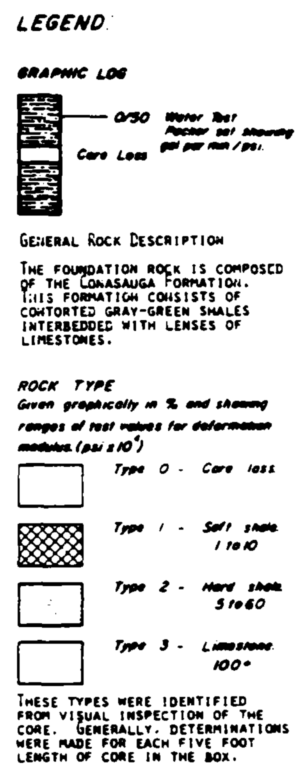
FIGURE 2.5-45




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 697.1 AND 644.4. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

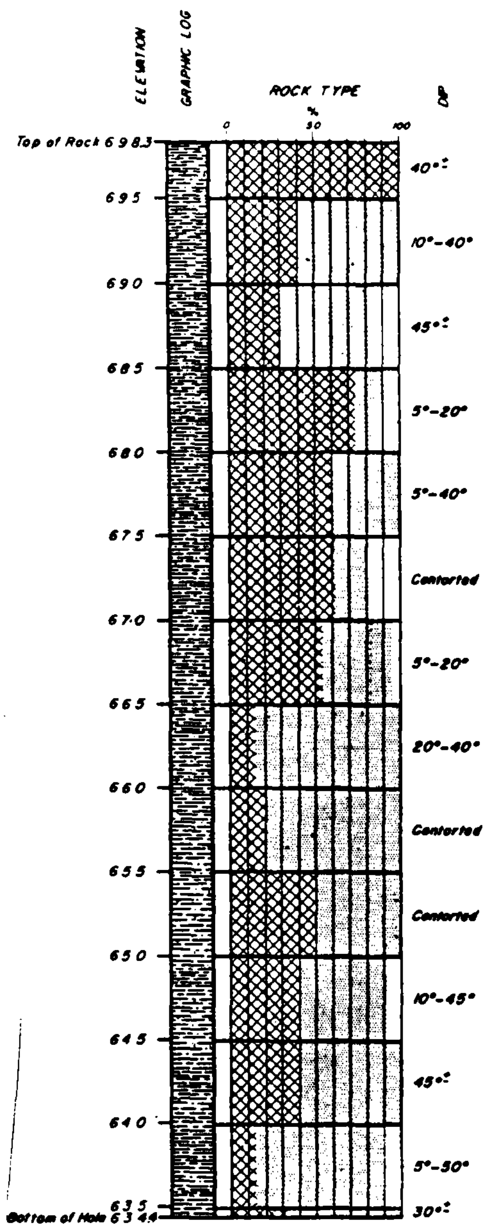


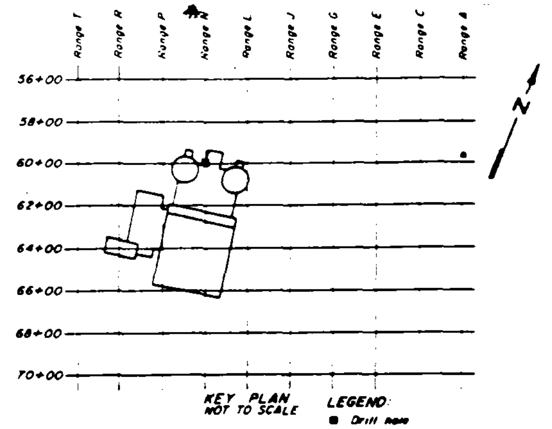

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 33
STA. N-59+00

FIGURE 2.5-46




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 698.3 AND 639.6. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

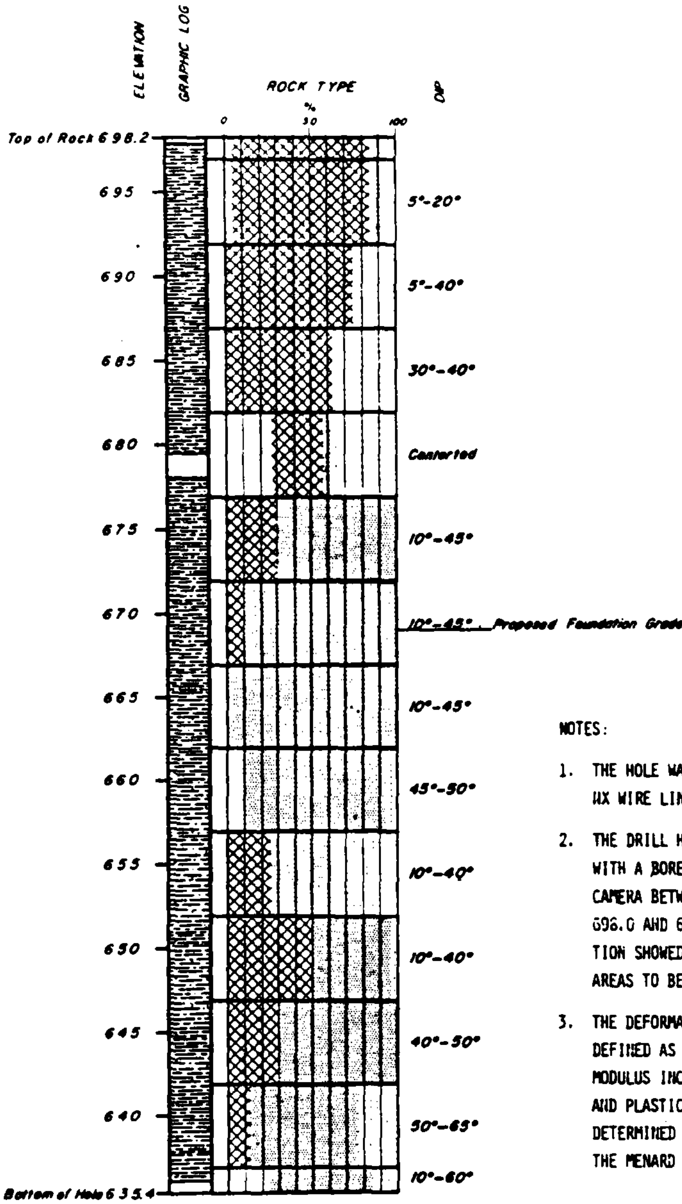
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

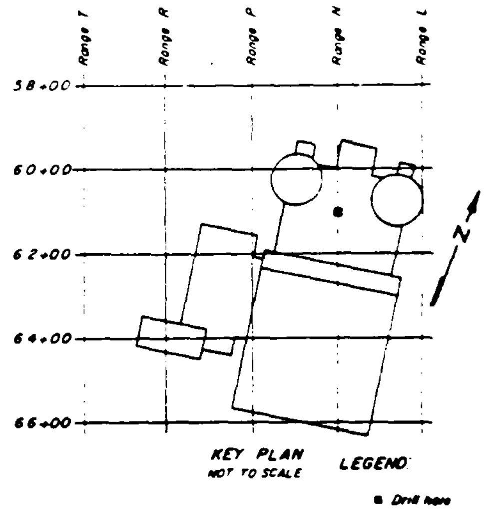
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 34
STA. N-60+00

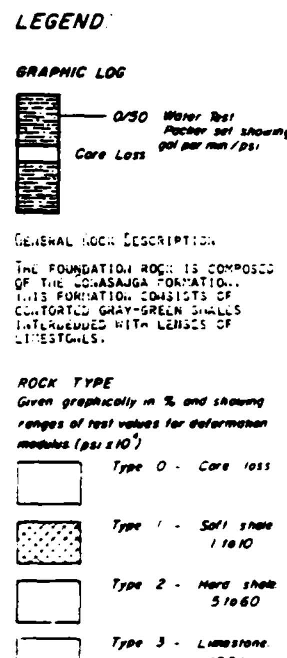
FIGURE 2.5-47




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 696.0 AND 647.5. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

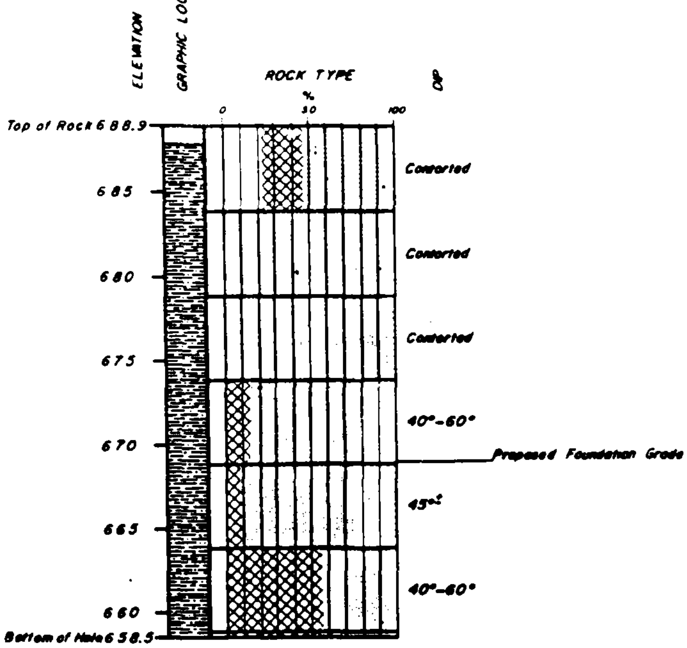


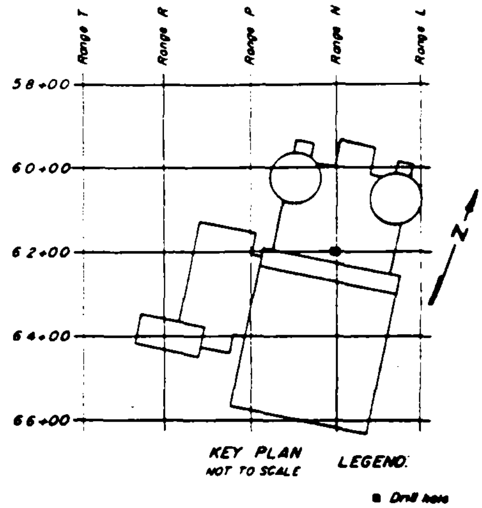

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 35
STA. N-61+00

FIGURE 2.5-48




LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

NOTES:

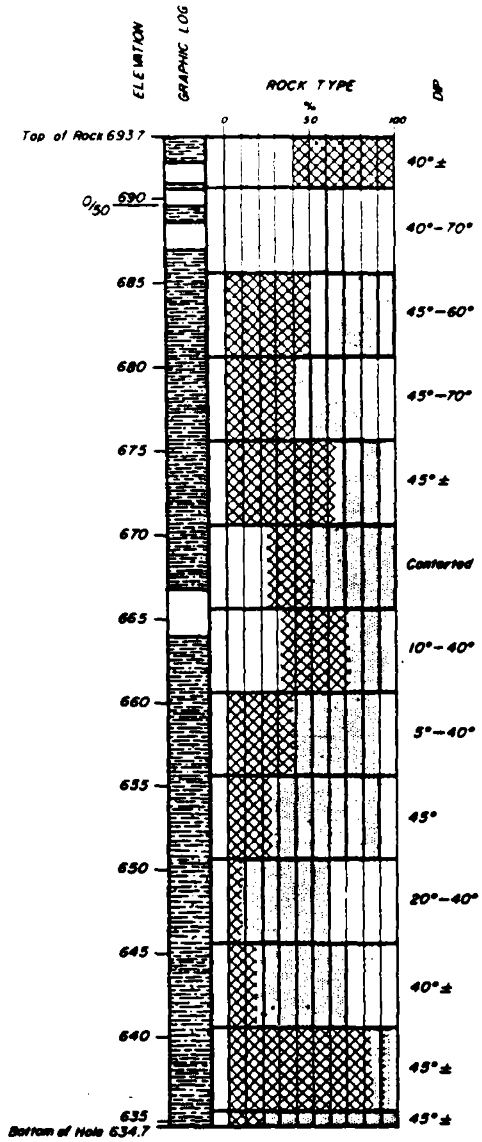
1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 688.9 AND 663.9. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

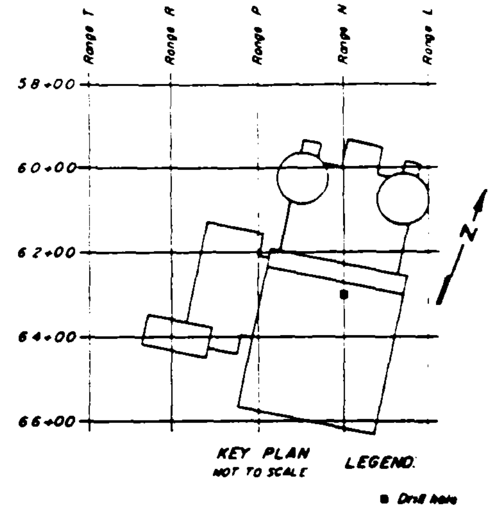
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 36
STA. N-62+00

FIGURE 2.5-49




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 693.7 AND 657.7. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone. 100+

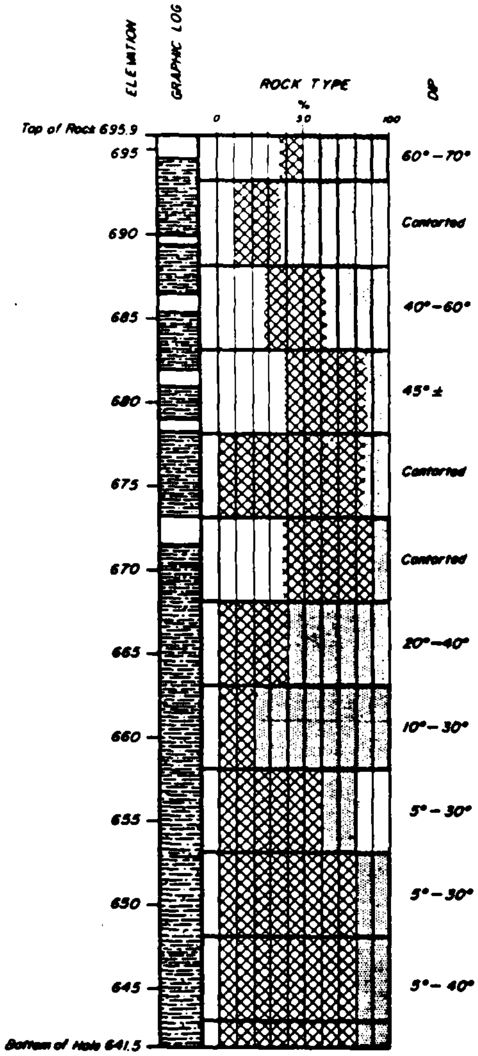
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

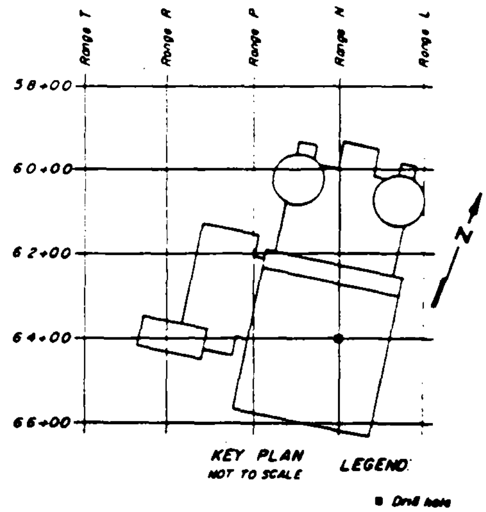
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 37
STA. N-63+00

FIGURE 2.5-50




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

## LEGEND

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

**GENERAL ROCK DESCRIPTION**

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus ($psi \times 10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

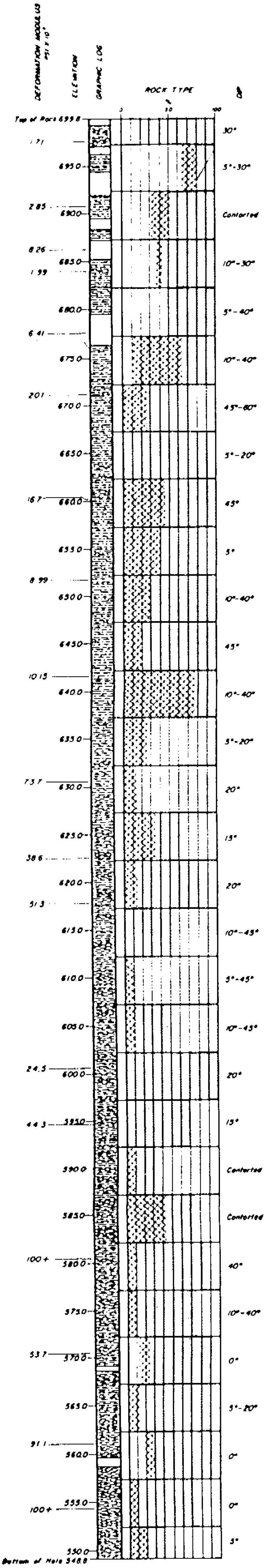
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

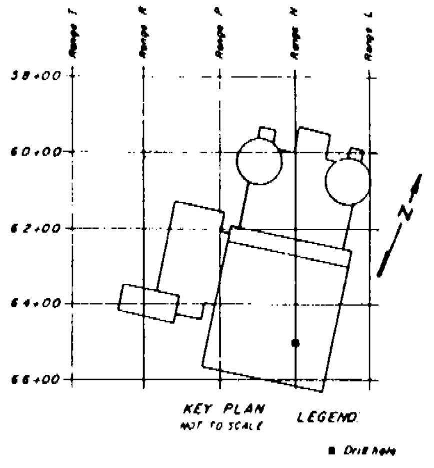
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 38
STA. N-64+00

FIGURE 2.5-51




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 699.8 AND 641.0. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water "ps" Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10^4)

Type 0 Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

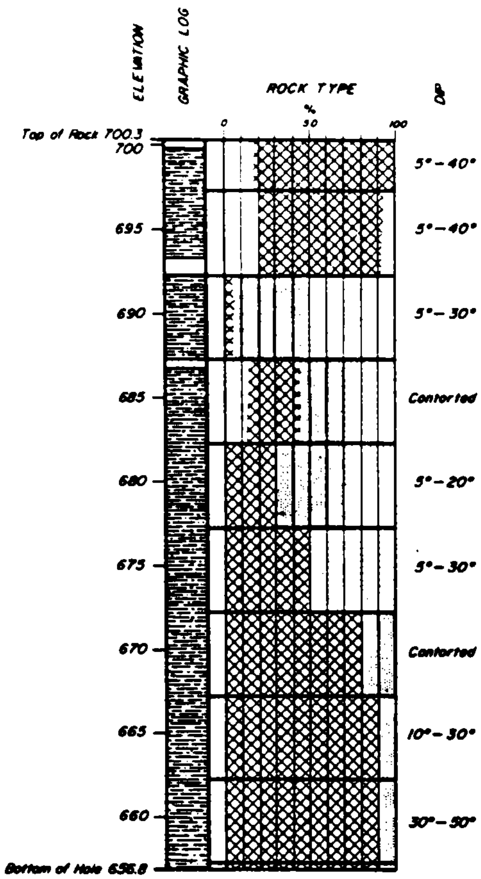
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

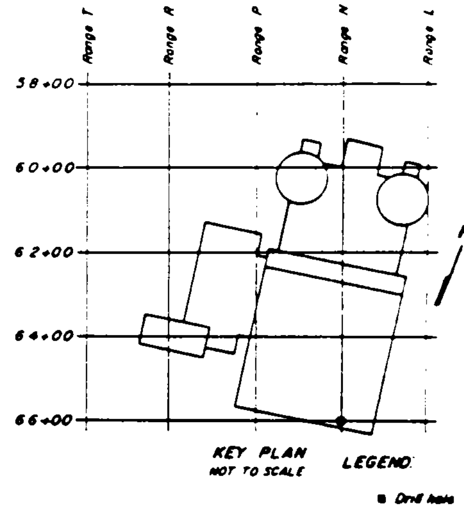
*HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 39
STA. N-65+00

FIGURE 2.5-52




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10^4)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

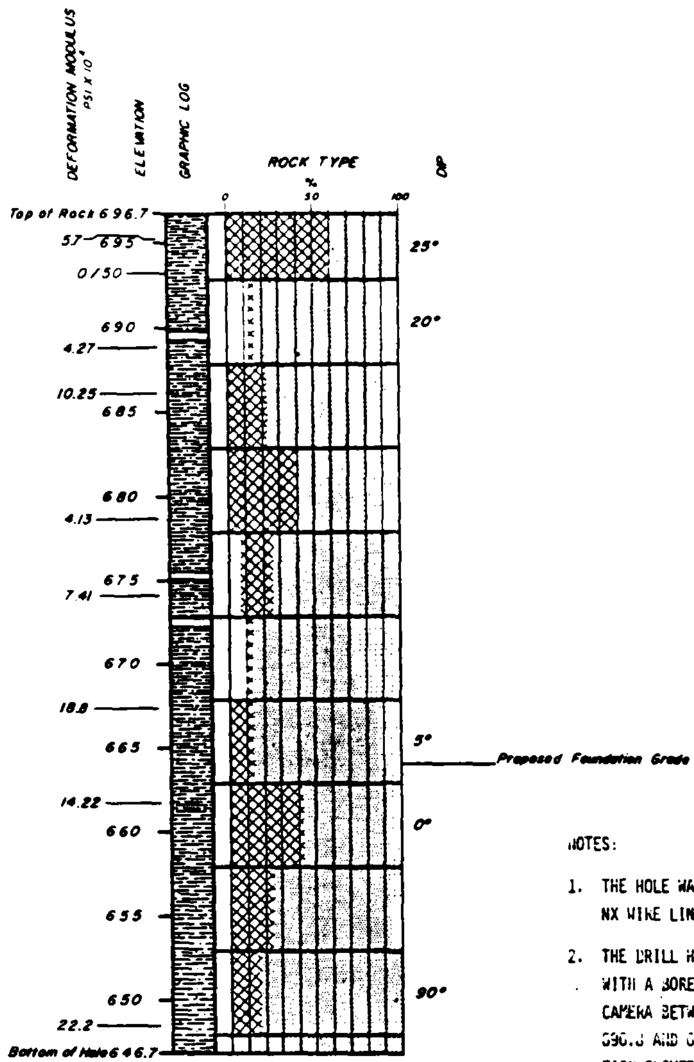
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

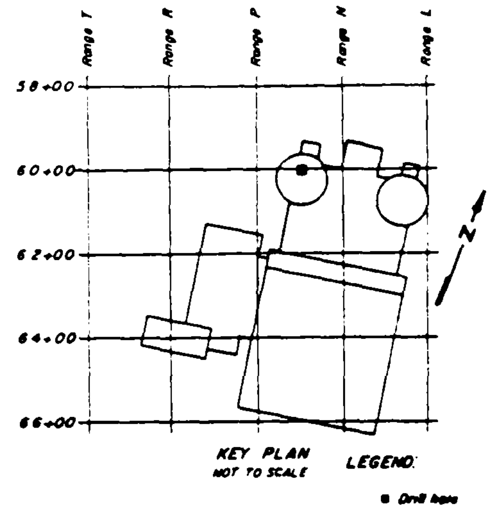
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 40
STA. N-66+00

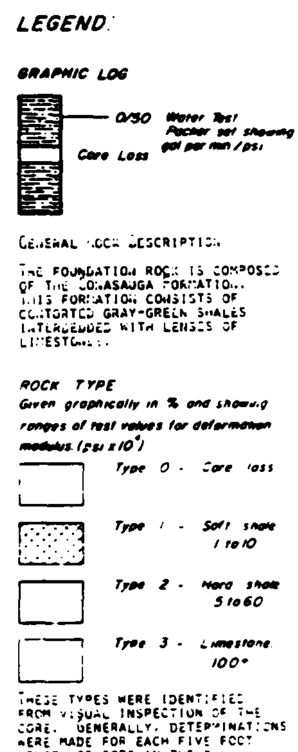
FIGURE 2.5-53




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 690.0 AND 650.0. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

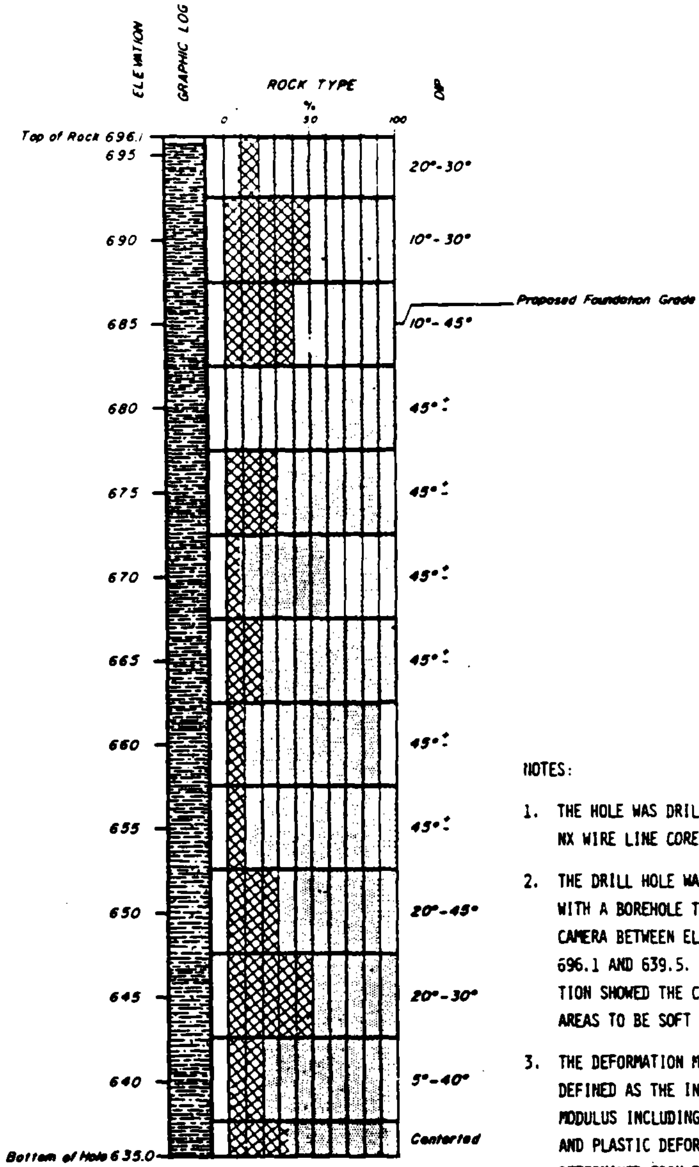


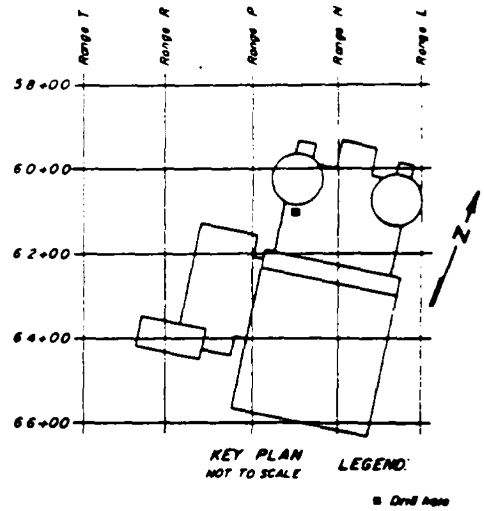

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 41
STA. O-60+00

FIGURE 2.5-54




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 696.1 AND 639.5. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

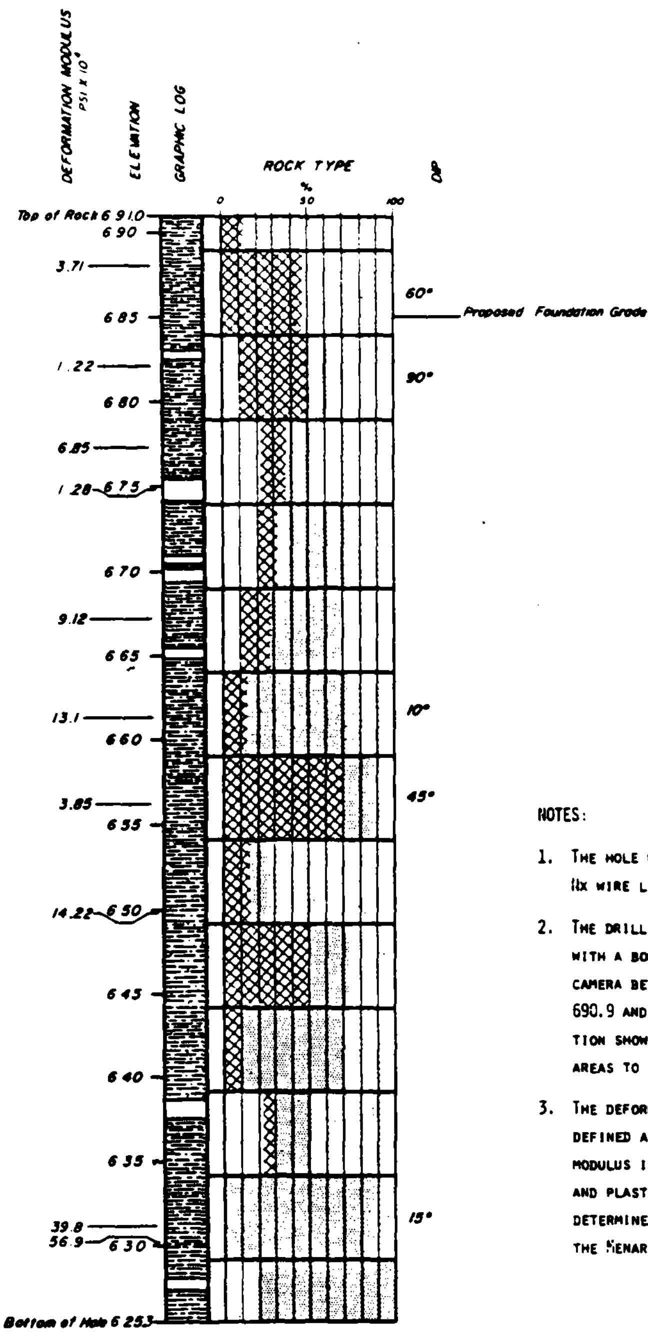
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

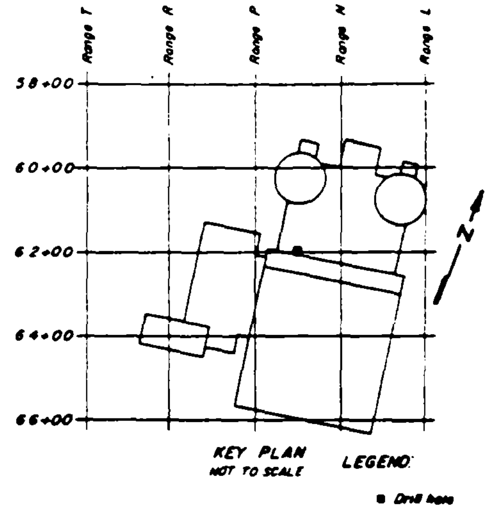
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 42
STA. O-61+00

FIGURE 2.5-55



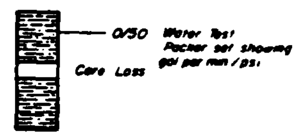




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 690.9 AND 645.2. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

**LEGEND:**

**GRAPHIC LOG**




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

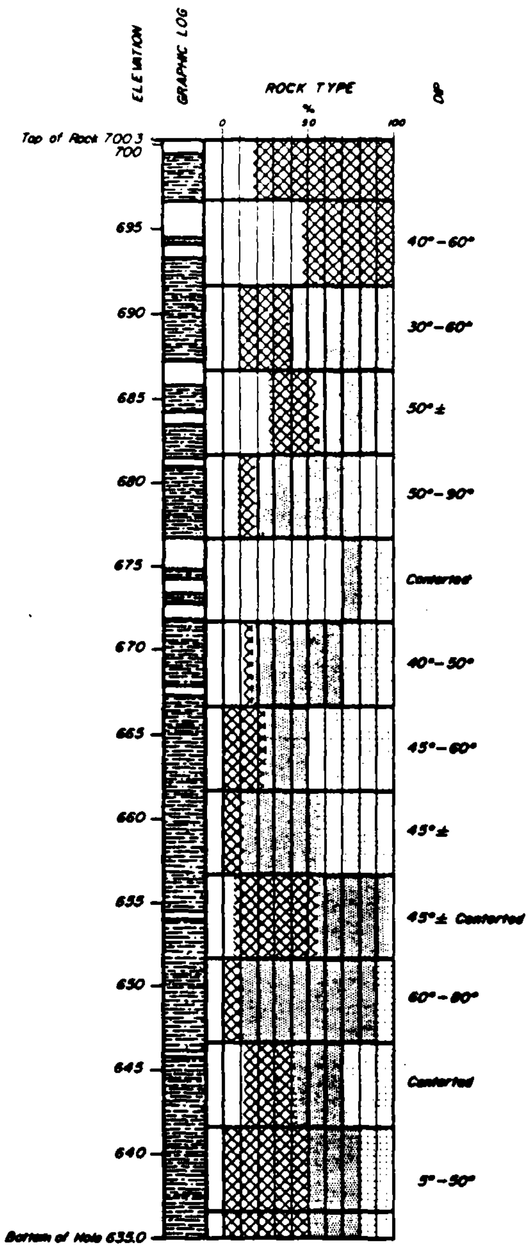
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

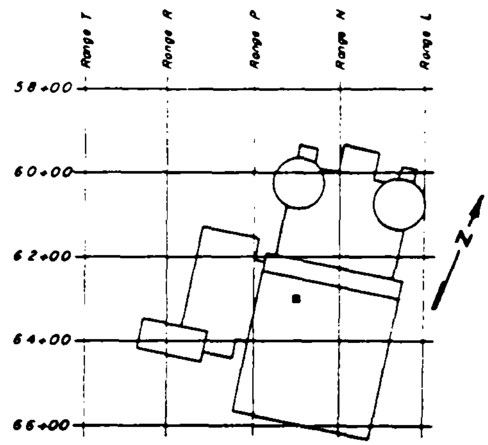
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 43
STA. O-62+00

FIGURE 2.5-56




KEY PLAN
NOT TO SCALE

LEGEND:
■ Drill hole

NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 699.9 AND 663.7. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi.
Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE
Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss
Type 1 - Soft shale 1 to 10
Type 2 - Hard shale 5 to 60
Type 3 - Limestone 100+

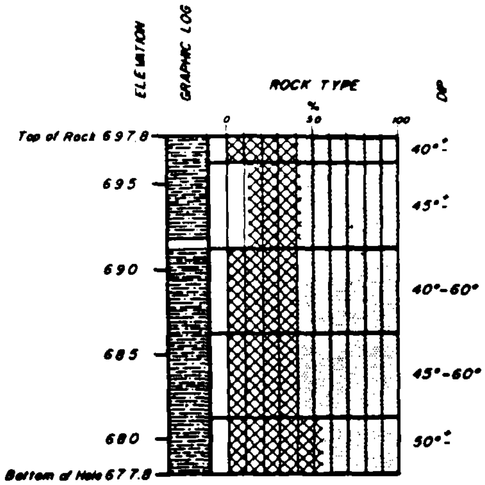
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

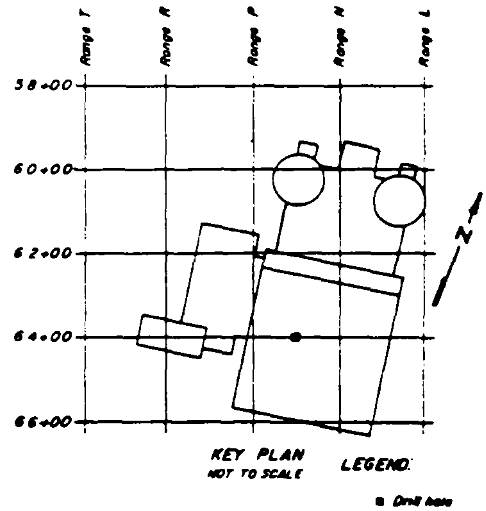
"HISTORICAL INFORMATION"

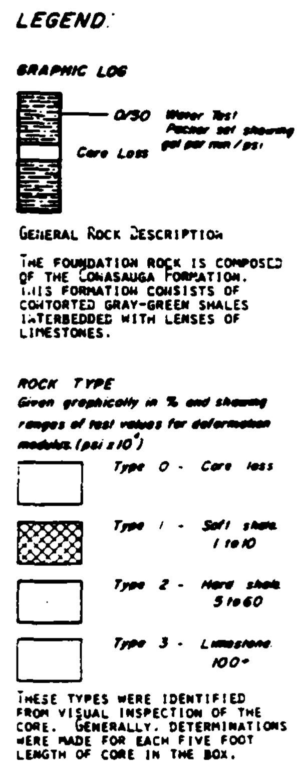
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 44
STA. O-63+00

FIGURE 2.5-57




NOTES:

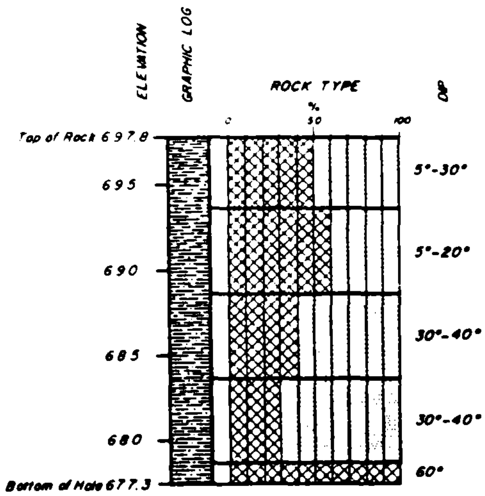
1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

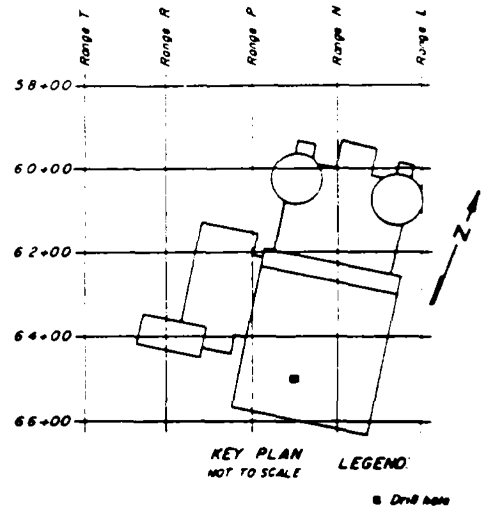
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 45
STA. O-64+00

FIGURE 2.5-58



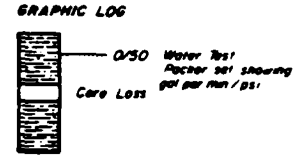




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

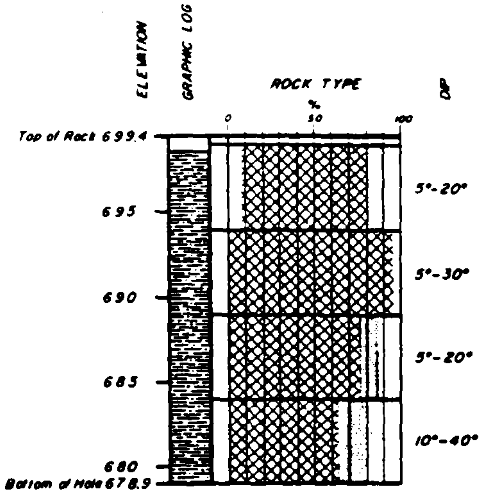
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

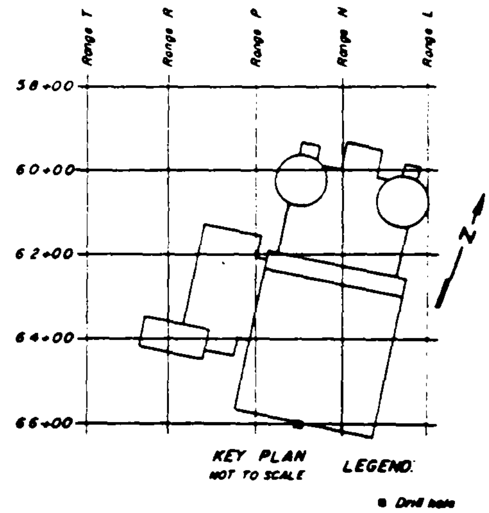
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 46
STA. O-65+00

FIGURE 2.5-59




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

**LEGEND**

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

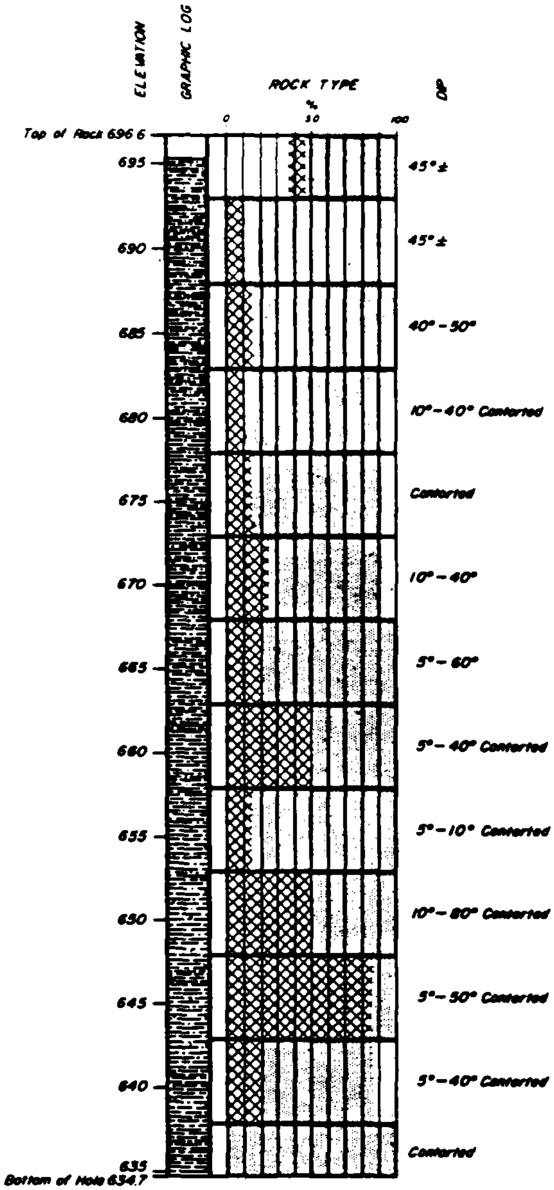
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

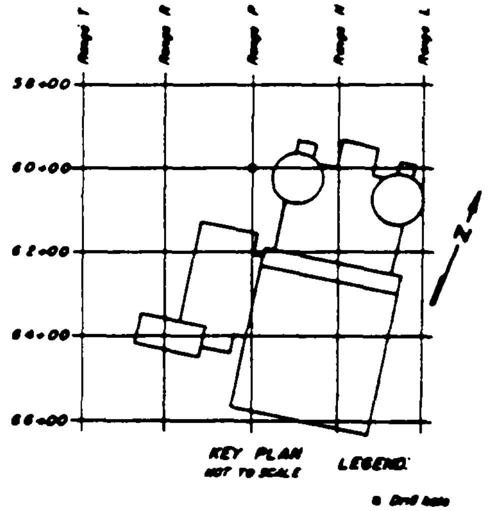
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 47
STA. O-66+00

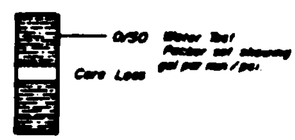
FIGURE 2.5-60




LEGEND:

GRAPHIC LOG

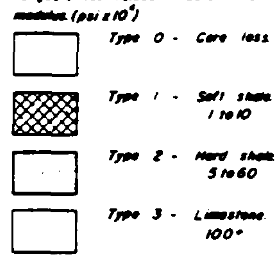



GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)




THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

NOTES:

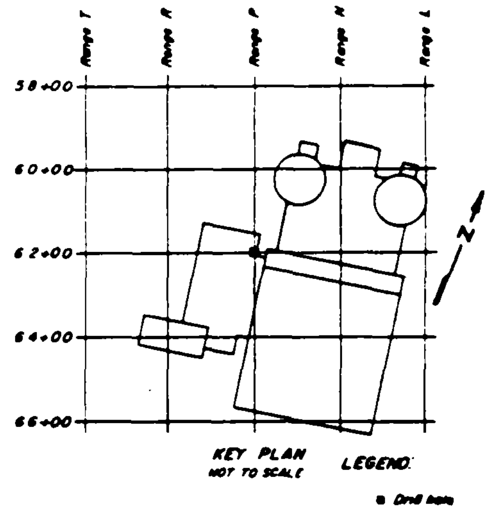
1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 696.4 AND 647.1. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

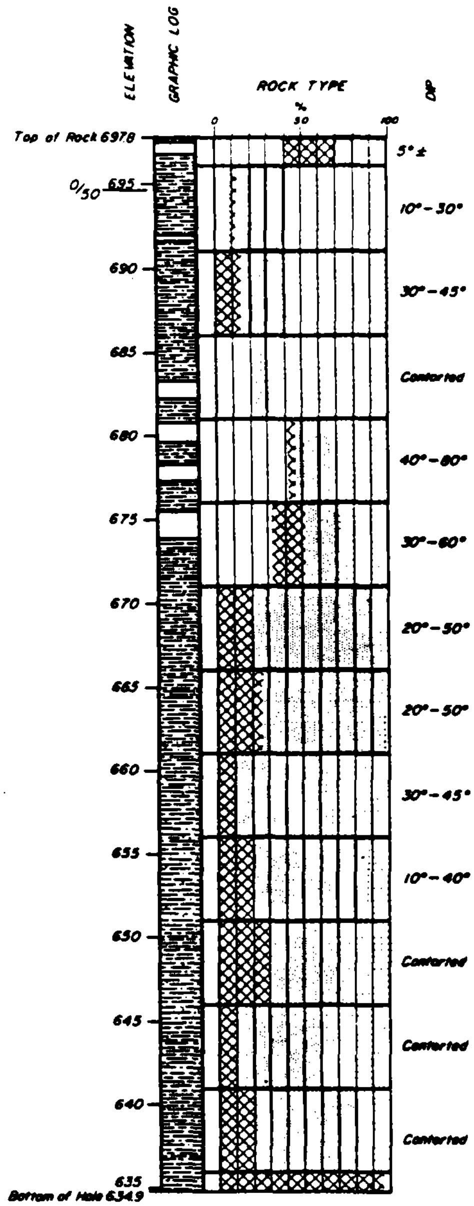
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 48
STA. P-60+00

FIGURE 2.5-61




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 697.4 AND 642.1. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

**LEGEND**

**GRAPHIC LOG**

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

**ROCK TYPE**

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10^4)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

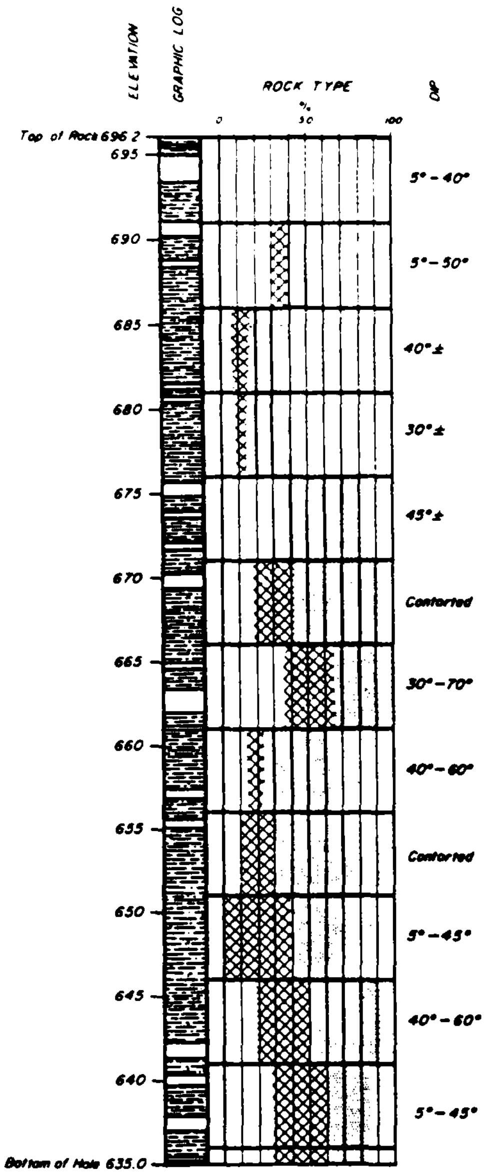
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

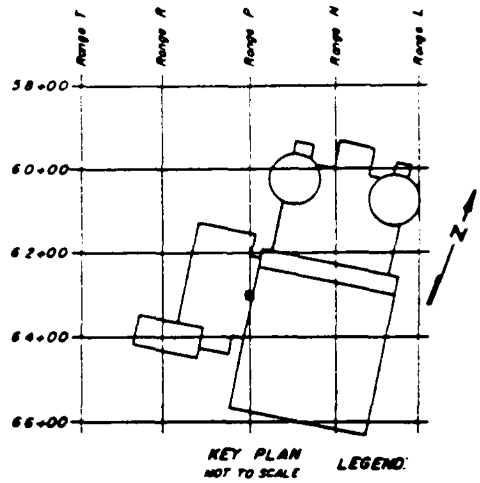
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 12
STA. G-66+00

FIGURE 2.5-25



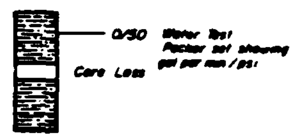




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 696.8 AND 652.5. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE.
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

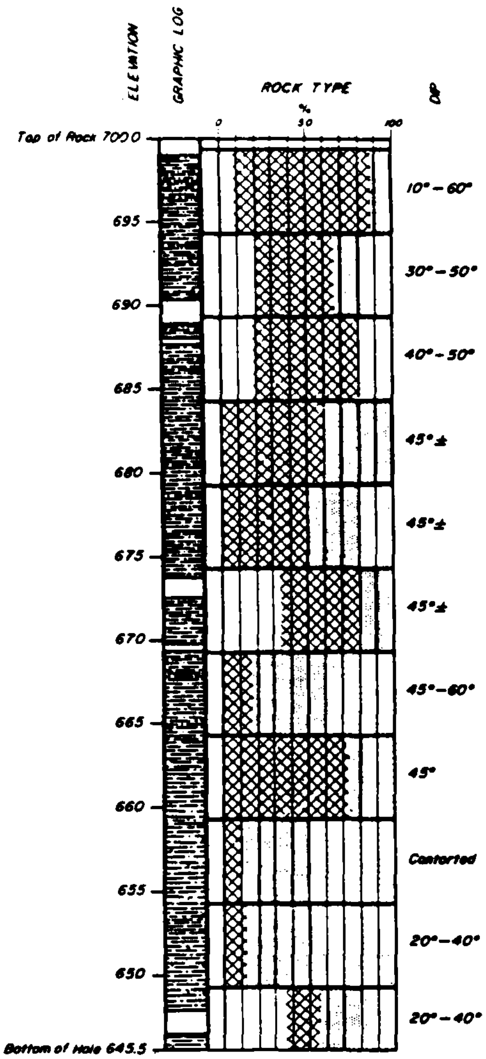
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

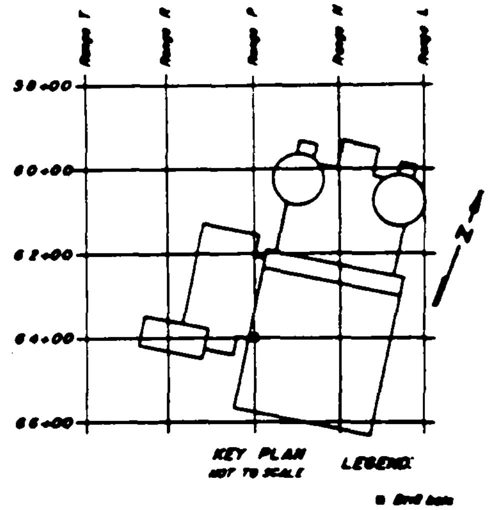
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 50
STA. P-63+00

FIGURE 2.5-63

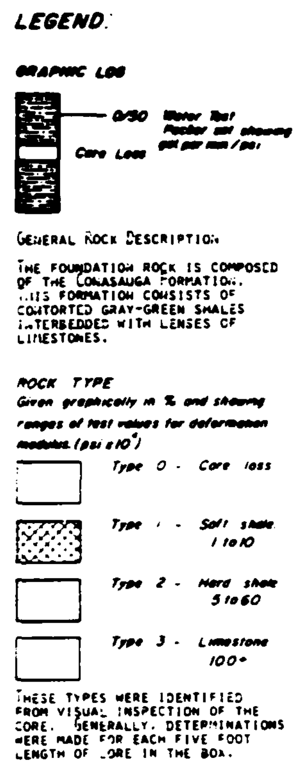



NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.

2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

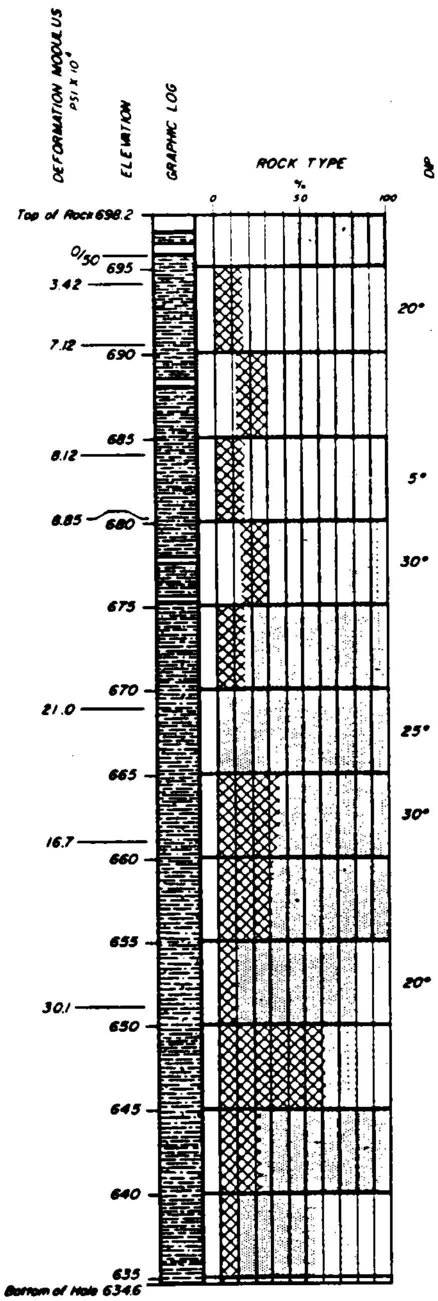


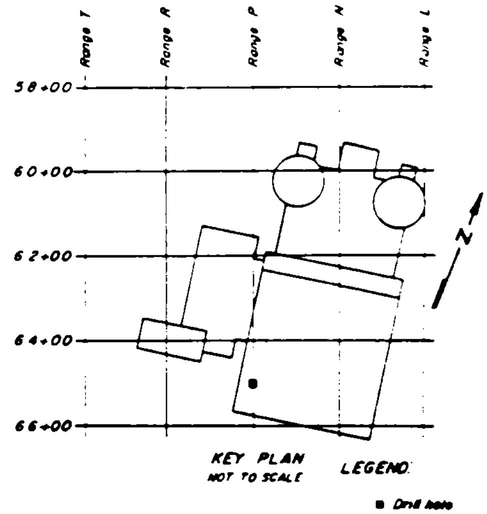

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 51
STA. P-64+00

FIGURE 2.5-64




NOTES:

1. THE HOLE WAS DRILLED WITH AN NX WIRE LINE CORE DRILL.
2. THE DRILL HOLE WAS INSPECTED WITH A BOREHOLE TELEVISION CAMERA BETWEEN ELEVATIONS 698.2 AND 649.2. THE INSPECTION SHOWED THE CORE LOSS AREAS TO BE SOFT SHALE,
3. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10^4)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

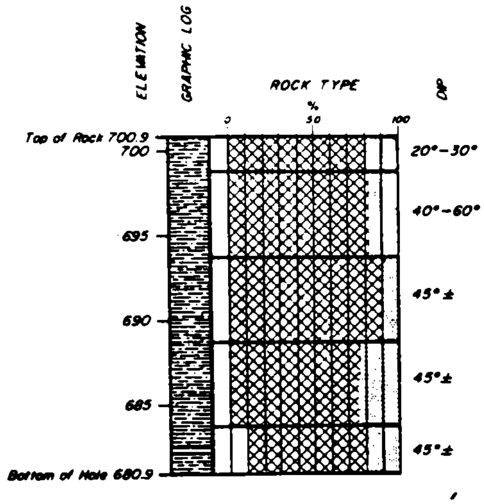
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

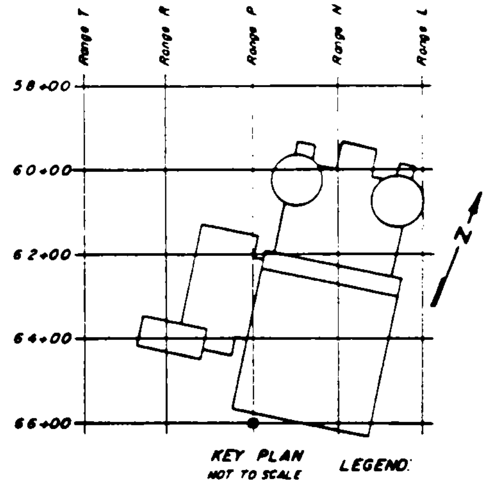
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 52
STA. P-65+00

FIGURE 2.5-65




LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gpi per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

NOTES:

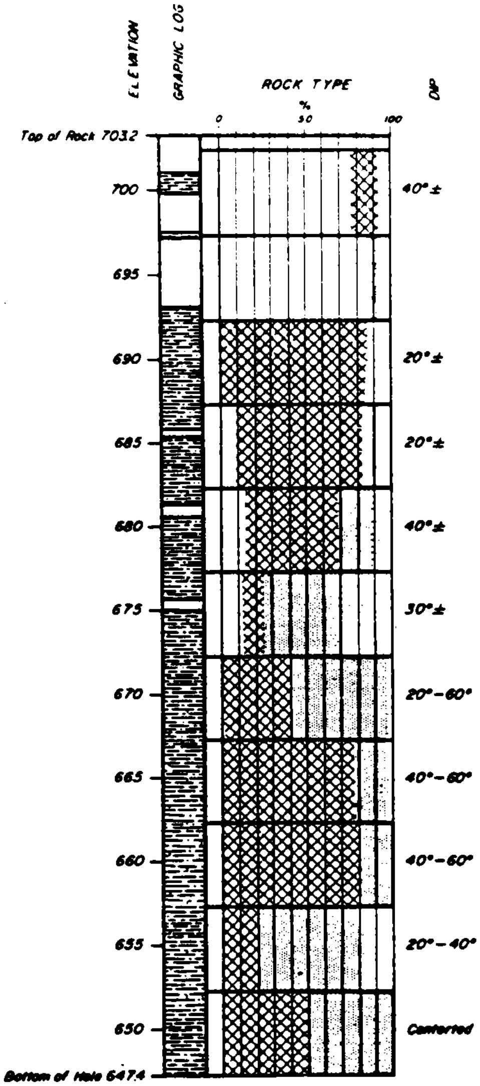
1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

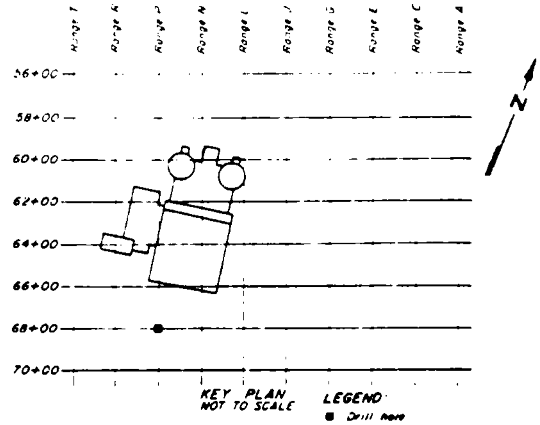
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 53
STA. P-66+00

FIGURE 2.5-66




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min / psi

Core Loss

GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss.

Type 1 - Soft shale. 1 to 10

Type 2 - Hard shale. 5 to 60

Type 3 - Limestone. 100+

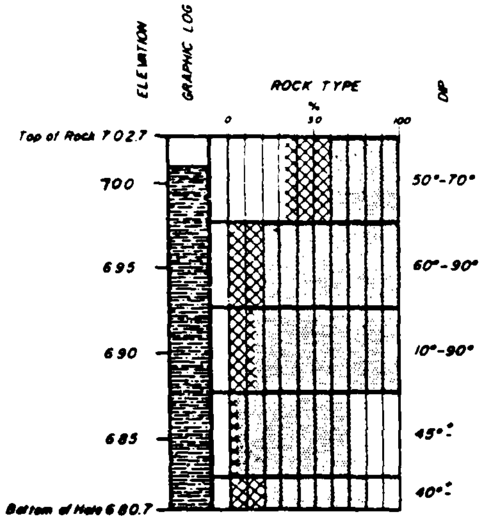
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

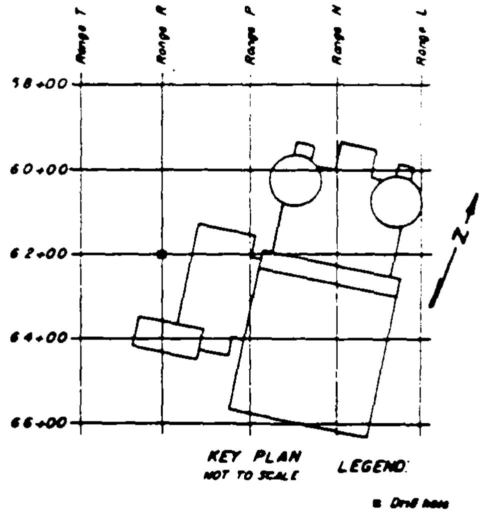
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 54
STA. P-68+00

FIGURE 2.5-67



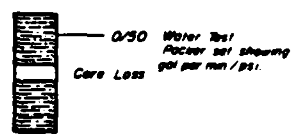




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

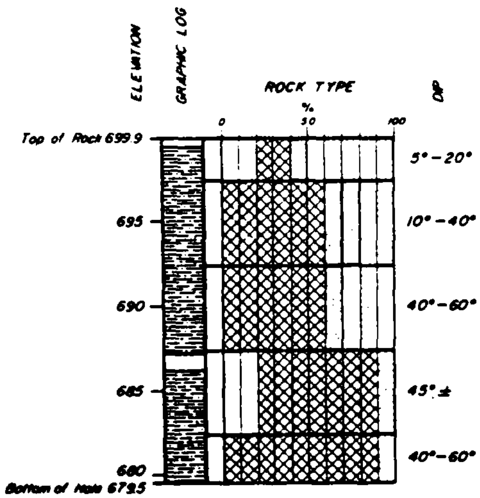
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

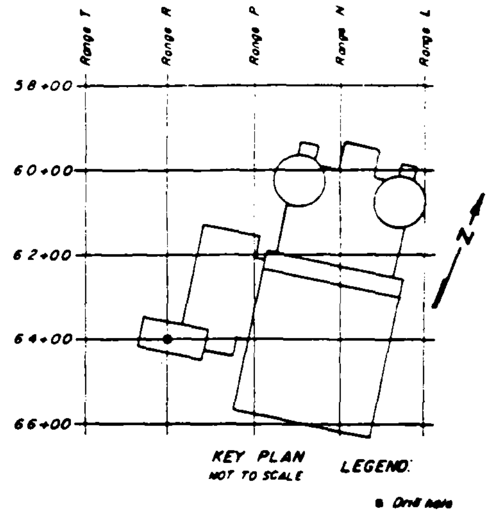
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 55
STA. R-62+00

FIGURE 2.5-68



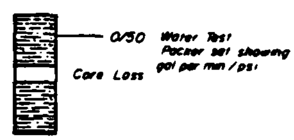




NOTES:

1. THE HOLE WAS DRILLED WITH A NX WIRE LINE CORE DRILL.
2. THE DEFORMATION MODULUS IS DEFINED AS THE IN-SITU SECANT MODULUS INCLUDING BOTH ELASTIC AND PLASTIC DEFORMATION AS DETERMINED FROM THE RESULTS OF THE MENARD PRESSUREMETER TESTS.

LEGEND:

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x $10^4$)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

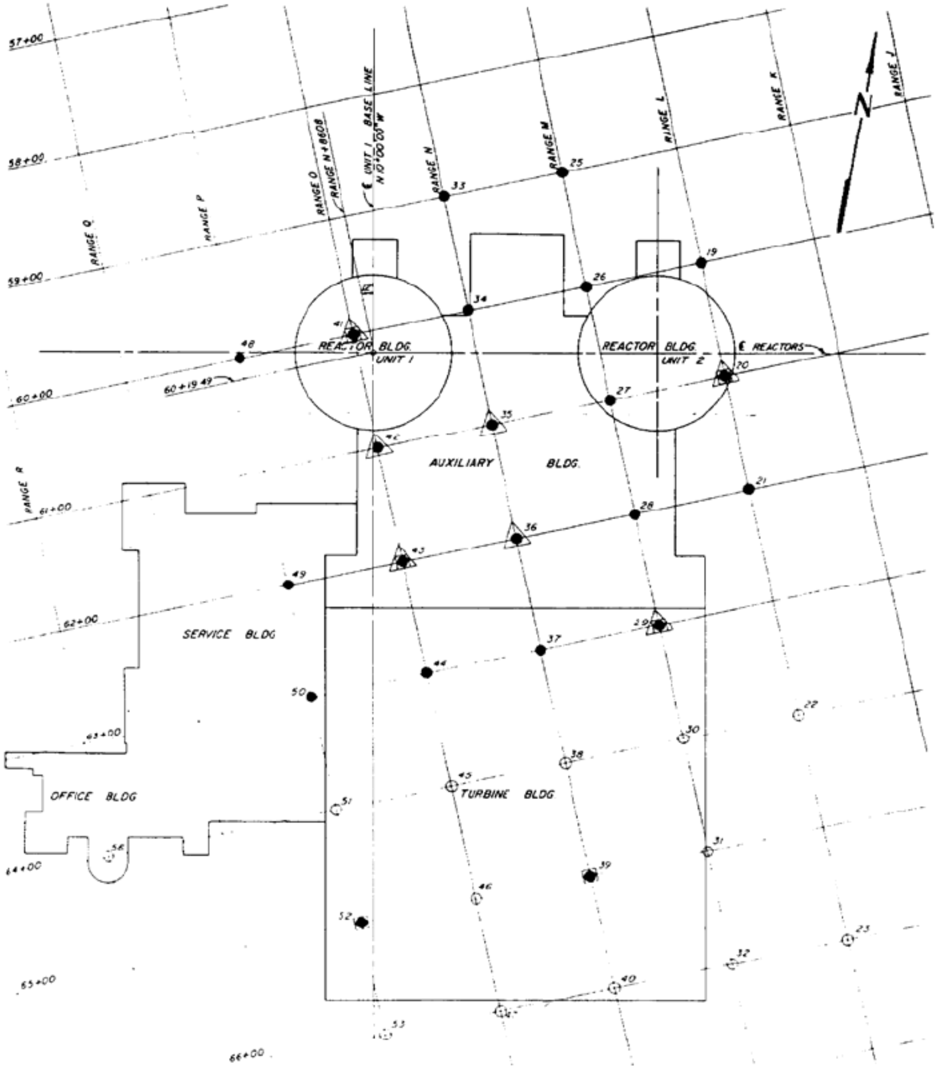
THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log
Hole 56
STA. R-64+00

FIGURE 2.5-69




PLAN

SUMMARY

| HOLE NUMBER | STATION NUMBER | SURFACE ELEVATION | TOP OF ROCK ELEVATION | BOTTOM OF HOLE ELEVATION | AVERAGE GROUND WATER ELEVATION AUGUST-DECEMBER 1970 |
|---|---|---|---|---|---|
| 19 | L-60+00 | 733.2 | 699.6 | 656.0 | 721.6 |
| 20 | L-61+00 | 729.7 | 698.1 | 548.4 | |
| 21 | L-62+00 | 733.1 | 690.9 | 647.1 | 721.6 |
| 22 | L-64+00 | 736.6 | 694.4 | 636.6 | 721.2 |
| 23 | L-66+00 | 741.9 | 699.9 | 651.9 | 719.6 |
| 25 | M-59+00 | 732.2 | 696.4 | 634.1 | |
| 26 | M-60+00 | 729.1 | 701.1 | 634.6 | |
| 27 | M-61+00 | 732.9 | 699.2 | 634.6 | |
| 28 | M-62+00 | 733.4 | 695.0 | 634.8 | |
| 29 | M-63+00 | 734.7 | 691.4 | 639.5 | |
| 30 | M-64+00 | 737.5 | 699.9 | 679.7 | |
| 31 | M-65+00 | 741.2 | 699.0 | 678.9 | |
| 32 | M-66+00 | 742.3 | 699.5 | 678.1 | |
| 33 | N-59+00 | 728.4 | 697.4 | 634.8 | 723.0 |
| 34 | N-60+00 | 730.6 | 696.3 | 634.4 | |
| 35 | N-61+00 | 732.5 | 696.2 | 635.4 | |
| 36 | N-62+00 | 733.9 | 688.9 | 658.5 | 721.2 |
| 37 | N-63+00 | 735.7 | 693.7 | 634.7 | |
| 38 | N-64+00 | 738.2 | 695.9 | 641.5 | 719.6 |
| 39 | N-65+00 | 742.1 | 699.8 | 548.8 | |
| 40 | N-66+00 | 742.5 | 700.3 | 656.8 | 719.6 |
| 41 | O-60+00 | 732.8 | 696.7 | 646.7 | |
| 42 | O-61+00 | 732.5 | 696.1 | 635.0 | |
| 43 | O-62+00 | 733.9 | 691.0 | 625.3 | |
| 44 | O-63+00 | 736.7 | 700.3 | 635.0 | |
| 45 | O-64+00 | 741.2 | 697.8 | 677.8 | |
| 46 | O-65+00 | 743.6 | 697.8 | 677.3 | |
| 47 | O-66+00 | 743.9 | 699.4 | 678.9 | |
| 48 | P-60+00 | 732.6 | 696.0 | 634.7 | |
| 49 | P-62+00 | 736.1 | 697.8 | 634.9 | |
| 50 | P-63+00 | 741.2 | 696.2 | 635.0 | |
| 51 | P-64+00 | 744.7 | 700.0 | 645.5 | 719.8 |
| 52 | P-65+00 | 745.2 | 696.2 | 634.6 | |
| 53 | P-66+00 | 743.8 | 700.9 | 660.9 | |
| 56 | R-64+00 | 742.4 | 695.9 | 679.5 | |

LEGEND

- NX WIRELINE CORE DRILL HOLE.
- DRILL HOLE SURVEYED WITH BORE HOLE TELEVISION.
- DRILL HOLE SURVEYED WITH MENARD PRESSUREMETER.
- DRILL HOLE SURVEYED WITH CONTINUOUS VELOCITY LOGGER.

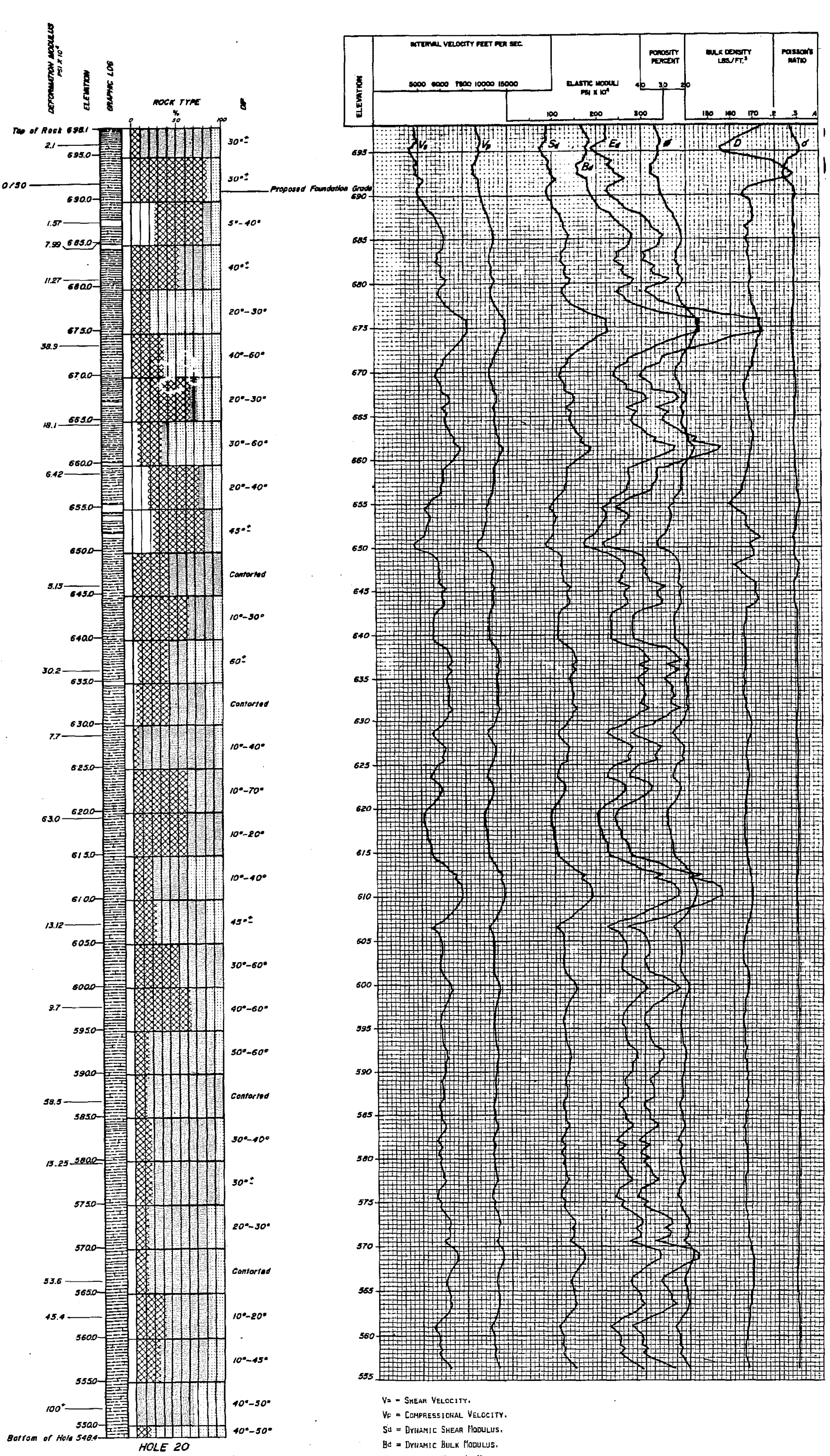
SCALE
50 0 50 100 Feet

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Special Studies
Layout and Summary

FIGURE 2.5-70




Vs = Shear Velocity.
Vp = Compressional Velocity.
Sd = Dynamic Shear Modulus.
Bd = Dynamic Bulk Modulus.
Ed = Dynamic Young's Modulus.
ϕ = Porosity.
D = Density.
σ = Poisson's Ratio.

NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 698.1 and 619.7. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.

LEGEND:

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

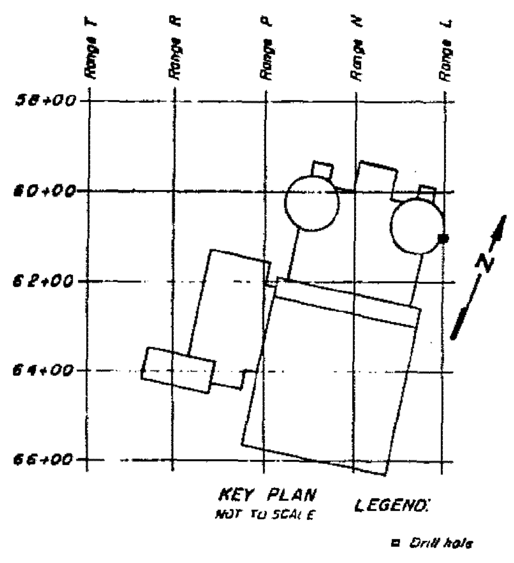
General Rock Description

The foundation rock is composed of the Conasauga Formation. This formation consists of contorted gray-green shales interbedded with lenses of limestones.

ROCK TYPE
Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss.
Type 1 - Soft shale 1 to 10
Type 2 - Hard shale 5 to 60
Type 3 - Limestone 100+

These types were identified from visual inspection of the core. Generally, determinations were made for each five foot length of core in the box.




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log and
Elastic Moduli
STA. L-61+00

FIGURE 2.5-71

## B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00 0.0 0.0 729.70 181.60 5 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 32.0 | 8625. | 4804. | * | 87. | 165. | 223. | 34. | 175.5 | 0.275 | 2.763 |
| 32.5 | 8766. | 4828. | * | 87. | 170. | 222. | 33. | 172.4 | 0.282 | 2.713 |
| 33.0 | 8937. | 4841. | * | 85. | 176. | 219. | 32. | 168.0 | 0.292 | 2.642 |
| 33.5 | 9173. | 4907. | * | 86. | 185. | 223. | 31. | 164.9 | 0.300 | 2.592 |
| 34.0 | 9183. | 4809. | * | 80. | 185. | 209. | 31. | 159.9 | 0.311 | 2.511 |
| 34.5 | 8940. | 4589. | * | 71. | 174. | 187. | 33. | 155.5 | 0.321 | 2.441 |
| 35.0 | 9055. | 4675. | * | 74. | 179. | 195. | 32. | 156.7 | 0.318 | 2.461 |
| 35.5 | 8905. | 4788. | * | 82. | 175. | 213. | 32. | 166.1 | 0.297 | 2.612 |
| 36.0 | 8711. | 4915. | * | 93. | 169. | 237. | 33. | 179.2 | 0.266 | 2.823 |
| 36.5 | 8329. | 4758. | * | 89. | 155. | 225. | 36. | 183.0 | 0.258 | 2.884 |
| 37.0 | 8421. | 4859. | * | 95. | 158. | 237. | 35. | 186.1 | 0.251 | 2.934 |
| 37.5 | 8373. | 4877. | * | 97. | 157. | 241. | 36. | 189.2 | 0.243 | 2.984 |
| 38.0 | 8883. | 5145. | * | 107. | 176. | 267. | 32. | 187.3 | 0.248 | 2.954 |
| 38.5 | 8994. | 5053. | * | 98. | 180. | 249. | 32. | 178.0 | 0.269 | 2.803 |
| 39.0 | 9040. | 4908. | * | 88. | 180. | 226. | 32. | 168.6 | 0.291 | 2.652 |
| 39.5 | 9101. | 4893. | * | 86. | 182. | 222. | 31. | 166.1 | 0.297 | 2.612 |
| 40.0 | 9279. | 4976. | * | 88. | 190. | 230. | 30. | 165.5 | 0.298 | 2.602 |
| 40.5 | 9386. | 5121. | * | 96. | 195. | 248. | 30. | 169.9 | 0.288 | 2.672 |
| 41.0 | 9535. | 5202. | * | 99. | 201. | 255. | 29. | 169.9 | 0.288 | 2.672 |
| 41.5 | 9719. | 5315. | * | 104. | 209. | 267. | 28. | 170.5 | 0.287 | 2.682 |
| 42.0 | 10233. | 5597. | * | 115. | 232. | 296. | 26. | 170.5 | 0.287 | 2.682 |
| 42.5 | 10364. | 5681. | * | 119. | 238. | 306. | 25. | 171.1 | 0.285 | 2.692 |
| 43.0 | 10614. | 5805. | * | 124. | 249. | 319. | 24. | 170.5 | 0.287 | 2.682 |
| 43.5 | 10887. | 5883. | * | 125. | 261. | 323. | 23. | 167.4 | 0.294 | 2.632 |
| 44.0 | 11048. | 5999. | * | 131. | 269. | 338. | 22. | 168.6 | 0.291 | 2.652 |
| 44.5 | 11232. | 6099. | * | 135. | 278. | 349. | 22. | 168.6 | 0.291 | 2.652 |
| 45.0 | 11187. | 6045. | * | 132. | 276. | 341. | 22. | 167.4 | 0.294 | 2.632 |
| 45.5 | 11130. | 6028. | * | 132. | 273. | 340. | 22. | 168.0 | 0.292 | 2.642 |
| 46.0 | 10942. | 5942. | * | 128. | 264. | 332. | 23. | 168.6 | 0.291 | 2.652 |
| 46.5 | 10518. | 5697. | * | 118. | 244. | 304. | 24. | 168.0 | 0.292 | 2.642 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 32.0 - 46.5
Figure 2.5-72

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

L-61+00   0.0   0.0   729.70   181.60   5   1   1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|
| 47.0 | 10569. | 5739. * | 120. | 247. | 309. | 24. | 168.6 | 0.291 | 2.652 |
| 47.5 | 10417. | 5670. * | 117. | 240. | 303. | 25. | 169.2 | 0.290 | 2.662 |
| 48.0 | 10875. | 5919. * | 128. | 261. | 330. | 23. | 169.2 | 0.290 | 2.662 |
| 48.5 | 10750. | 5851. * | 125. | 255. | 322. | 23. | 169.2 | 0.290 | 2.662 |
| 49.0 | 10869. | 5916. * | 128. | 261. | 330. | 23. | 169.2 | 0.290 | 2.662 |
| 49.5 | 11396. | 6217. * | 142. | 287. | 365. | 21. | 169.9 | 0.288 | 2.672 |
| 50.0 | 11199. | 6096. * | 136. | 277. | 350. | 22. | 169.2 | 0.290 | 2.662 |
| 50.5 | 10650. | 5783. * | 122. | 250. | 314. | 24. | 168.6 | 0.291 | 2.652 |
| 51.0 | 10512. | 5722. * | 120. | 244. | 308. | 24. | 169.2 | 0.290 | 2.662 |
| 51.5 | 10809. | 5898. * | 127. | 258. | 328. | 23. | 169.9 | 0.288 | 2.672 |
| 52.0 | 11010. | 6007. * | 132. | 268. | 341. | 22. | 169.9 | 0.288 | 2.672 |
| 52.5 | 11482. | 6280. * | 145. | 291. | 373. | 21. | 170.5 | 0.287 | 2.682 |
| 53.0 | 12214. | 6711. * | 167. | 330. | 428. | 19. | 171.7 | 0.284 | 2.702 |
| 53.5 | 12890. | 7099. * | 187. | 368. | 481. | 17. | 172.4 | 0.282 | 2.713 |
| 54.0 | 13944. | 7697. * | 221. | 431. | 566. | 15. | 173.0 | 0.281 | 2.723 |
| 54.5 | 13903. | 7675. * | 220. | 428. | 563. | 15. | 173.0 | 0.281 | 2.723 |
| 55.0 | 13913. | 7698. * | 222. | 429. | 568. | 15. | 173.6 | 0.279 | 2.733 |
| 55.5 | 13923. | 7721. * | 224. | 430. | 573. | 15. | 174.2 | 0.278 | 2.743 |
| 56.0 | 13246. | 7329. * | 201. | 389. | 515. | 16. | 173.6 | 0.279 | 2.733 |
| 56.5 | 12872. | 7090. * | 187. | 367. | 479. | 17. | 172.4 | 0.282 | 2.713 |
| 57.0 | 12368. | 6812. * | 173. | 339. | 442. | 18. | 172.4 | 0.282 | 2.713 |
| 57.5 | 11887. | 6532. * | 158. | 313. | 406. | 20. | 171.7 | 0.284 | 2.702 |
| 58.0 | 11389. | 6243. * | 144. | 287. | 370. | 21. | 171.1 | 0.285 | 2.692 |
| 58.5 | 11039. | 6035. * | 134. | 269. | 345. | 22. | 170.5 | 0.287 | 2.682 |
| 59.0 | 10992. | 5997. * | 132. | 267. | 339. | 23. | 169.9 | 0.288 | 2.672 |
| 59.5 | 10473. | 5714. * | 120. | 242. | 308. | 25. | 169.9 | 0.288 | 2.672 |
| 60.0 | 10417. | 5656. * | 116. | 240. | 300. | 25. | 168.6 | 0.291 | 2.652 |
| 60.5 | 10361. | 5612. * | 114. | 237. | 295. | 25. | 168.0 | 0.292 | 2.642 |
| 61.0 | 10708. | 5772. * | 120. | 253. | 310. | 24. | 166.7 | 0.295 | 2.622 |
| 61.5 | 10985. | 5906. * | 125. | 266. | 324. | 23. | 166.1 | 0.297 | 2.612 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 47.0 - 61.5

Figure 2.5-73

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|
| 62.0 | 10948. | 5886. * | 124. | 264. | 322. | 23. | 166.1 | 0.297 | 2.612 |
| 62.5 | 11780. | 6349. * | 145. | 306. | 376. | 20. | 166.7 | 0.295 | 2.622 |
| 63.0 | 11910. | 6419. * | 148. | 313. | 384. | 20. | 166.7 | 0.295 | 2.622 |
| 63.5 | 11578. | 6271. * | 143. | 296. | 368. | 21. | 168.0 | 0.292 | 2.642 |
| 64.0 | 10930. | 5920. * | 127. | 264. | 328. | 23. | 168.0 | 0.292 | 2.642 |
| 64.5 | 11402. | 6191. * | 139. | 287. | 360. | 21. | 168.6 | 0.291 | 2.652 |
| 65.0 | 11225. | 6095. * | 135. | 278. | 349. | 22. | 168.6 | 0.291 | 2.652 |
| 65.5 | 11130. | 6058. * | 134. | 274. | 346. | 22. | 169.2 | 0.290 | 2.662 |
| 66.0 | 11303. | 6167. * | 139. | 282. | 359. | 21. | 169.9 | 0.288 | 2.672 |
| 66.5 | 11633. | 6347. * | 148. | 299. | 380. | 20. | 169.9 | 0.288 | 2.672 |
| 67.0 | 11801. | 6454. * | 153. | 308. | 394. | 20. | 170.5 | 0.287 | 2.682 |
| 67.5 | 12259. | 6705. * | 165. | 332. | 425. | 19. | 170.5 | 0.287 | 2.682 |
| 68.0 | 12145. | 6627. * | 161. | 326. | 415. | 19. | 169.9 | 0.288 | 2.672 |
| 68.5 | 13036. | 7112. * | 185. | 375. | 477. | 17. | 169.9 | 0.288 | 2.672 |
| 69.0 | 12958. | 7053. * | 182. | 371. | 468. | 17. | 169.2 | 0.290 | 2.662 |
| 69.5 | 12503. | 6789. * | 168. | 345. | 433. | 18. | 168.6 | 0.291 | 2.652 |
| 70.0 | 11996. | 6514. * | 154. | 318. | 398. | 19. | 168.6 | 0.291 | 2.652 |
| 70.5 | 11612. | 6290. * | 143. | 297. | 371. | 20. | 168.0 | 0.292 | 2.642 |
| 71.0 | 11029. | 5974. * | 129. | 268. | 334. | 22. | 168.0 | 0.292 | 2.642 |
| 71.5 | 11041. | 5966. * | 128. | 269. | 333. | 22. | 167.4 | 0.294 | 2.632 |
| 72.0 | 11098. | 5982. * | 129. | 271. | 333. | 22. | 166.7 | 0.295 | 2.622 |
| 72.5 | 11091. | 5963. * | 127. | 271. | 330. | 22. | 166.1 | 0.297 | 2.612 |
| 73.0 | 10985. | 5891. * | 124. | 266. | 322. | 23. | 165.5 | 0.298 | 2.602 |
| 73.5 | 10992. | 5895. * | 124. | 266. | 322. | 23. | 165.5 | 0.298 | 2.602 |
| 74.0 | 10609. | 5646. * | 112. | 247. | 293. | 24. | 163.6 | 0.302 | 2.572 |
| 74.5 | 10204. | 5387. * | 101. | 228. | 265. | 26. | 161.7 | 0.307 | 2.541 |
| 75.0 | 10175. | 5314. * | 97. | 226. | 255. | 26. | 159.2 | 0.313 | 2.501 |
| 75.5 | 9717. | 5116. * | 91. | 207. | 238. | 28. | 161.1 | 0.308 | 2.531 |
| 76.0 | 9916. | 5291. * | 99. | 216. | 258. | 27. | 164.2 | 0.301 | 2.582 |
| 76.5 | 9966. | 5385. * | 105. | 219. | 271. | 27. | 167.4 | 0.294 | 2.632 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 62.0 - 76.5

Figure 2.5-74

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 77.0 | 9843. | 5305. | * | 101. | 214. | 262. | 27. | 166.7 | 0.295 | 2.622 |
| 77.5 | 9661. | 5207. | * | 98. | 206. | 253. | 28. | 166.7 | 0.295 | 2.622 |
| 78.0 | 9512. | 5165. | * | 97. | 200. | 250. | 29. | 168.6 | 0.291 | 2.652 |
| 78.5 | 9338. | 5131. | * | 98. | 193. | 250. | 30. | 171.7 | 0.284 | 2.702 |
| 79.0 | 8831. | 4886. | * | 89. | 173. | 229. | 33. | 173.6 | 0.279 | 2.733 |
| 79.5 | 8681. | 4714. | * | 81. | 166. | 209. | 34. | 168.6 | 0.291 | 2.652 |
| 80.0 | 8785. | 4782. | * | 83. | 170. | 215. | 33. | 169.2 | 0.290 | 2.662 |
| 80.5 | 9797. | 5358. | * | 106. | 212. | 272. | 28. | 170.5 | 0.287 | 2.682 |
| 81.0 | 10295. | 5630. | * | 117. | 234. | 300. | 25. | 170.5 | 0.287 | 2.682 |
| 81.5 | 10642. | 5722. | * | 117. | 249. | 304. | 24. | 166.1 | 0.297 | 2.612 |
| 82.0 | 10857. | 5716. | * | 114. | 258. | 297. | 23. | 161.1 | 0.308 | 2.531 |
| 82.5 | 10875. | 5787. | * | 118. | 260. | 308. | 23. | 163.6 | 0.302 | 2.572 |
| 83.0 | 10744. | 5747. | * | 117. | 254. | 305. | 24. | 164.9 | 0.300 | 2.592 |
| 83.5 | 10737. | 5802. | * | 122. | 254. | 314. | 24. | 167.4 | 0.294 | 2.632 |
| 84.0 | 10494. | 5766. | * | 123. | 244. | 316. | 24. | 171.7 | 0.284 | 2.702 |
| 84.5 | 11089. | 6091. | * | 137. | 272. | 353. | 22. | 171.7 | 0.284 | 2.702 |
| 85.0 | 10803. | 5922. | * | 129. | 258. | 333. | 23. | 171.1 | 0.285 | 2.692 |
| 85.5 | 10761. | 5913. | * | 130. | 256. | 333. | 23. | 171.7 | 0.284 | 2.702 |
| 86.0 | 10918. | 6013. | * | 134. | 264. | 345. | 23. | 172.4 | 0.282 | 2.713 |
| 86.5 | 10949. | 6002. | * | 133. | 265. | 342. | 23. | 171.1 | 0.285 | 2.692 |
| 87.0 | 10575. | 5700. | * | 117. | 246. | 303. | 24. | 166.7 | 0.295 | 2.622 |
| 87.5 | 10224. | 5512. | * | 109. | 230. | 283. | 26. | 166.7 | 0.295 | 2.622 |
| 88.0 | 10109. | 5449. | * | 107. | 225. | 277. | 26. | 166.7 | 0.295 | 2.622 |
| 88.5 | 10104. | 5444. | * | 107. | 225. | 276. | 26. | 166.7 | 0.295 | 2.622 |
| 89.0 | 10173. | 5456. | * | 106. | 228. | 276. | 26. | 165.5 | 0.298 | 2.602 |
| 89.5 | 10168. | 5453. | * | 106. | 228. | 276. | 26. | 165.5 | 0.298 | 2.602 |
| 90.0 | 10173. | 5456. | * | 106. | 228. | 276. | 26. | 165.5 | 0.298 | 2.602 |
| 90.5 | 10178. | 5472. | * | 107. | 228. | 278. | 26. | 166.1 | 0.297 | 2.612 |
| 91.0 | 10726. | 5767. | * | 119. | 253. | 309. | 24. | 166.1 | 0.297 | 2.612 |
| 91.5 | 11455. | 6159. | * | 136. | 289. | 352. | 21. | 166.1 | 0.297 | 2.612 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 77.0 - 91.5

Figure 2.5-75

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 92.0 | 11702. | 6291. | * | 142. | 302. | 368. | 20. | 166.1 | 0.297 | 2.612 |
| 92.5 | 11836. | 6363. | * | 145. | 309. | 376. | 20. | 166.1 | 0.297 | 2.612 |
| 93.0 | 11959. | 6429. | * | 148. | 315. | 384. | 19. | 166.1 | 0.297 | 2.612 |
| 93.5 | 11455. | 6159. | * | 136. | 289. | 352. | 21. | 166.1 | 0.297 | 2.612 |
| 94.0 | 11951. | 6425. | * | 148. | 315. | 384. | 19. | 166.1 | 0.297 | 2.612 |
| 94.5 | 11709. | 6279. | * | 141. | 302. | 365. | 20. | 165.5 | 0.298 | 2.602 |
| 95.0 | 11375. | 6100. | * | 133. | 285. | 345. | 21. | 165.5 | 0.298 | 2.602 |
| 95.5 | 11475. | 6170. | * | 136. | 290. | 354. | 21. | 166.1 | 0.297 | 2.612 |
| 96.0 | 11687. | 6268. | * | 140. | 301. | 364. | 20. | 165.5 | 0.298 | 2.602 |
| 96.5 | 11680. | 6264. | * | 140. | 300. | 364. | 20. | 165.5 | 0.298 | 2.602 |
| 97.0 | 11758. | 6305. | * | 142. | 304. | 368. | 20. | 165.5 | 0.298 | 2.602 |
| 97.5 | 11605. | 6239. | * | 139. | 297. | 362. | 21. | 166.1 | 0.297 | 2.612 |
| 98.0 | 11523. | 6210. | * | 139. | 293. | 359. | 21. | 166.7 | 0.295 | 2.622 |
| 98.5 | 11944. | 6421. | * | 148. | 314. | 383. | 20. | 166.1 | 0.297 | 2.612 |
| 99.0 | 11523. | 6226. | * | 140. | 293. | 362. | 21. | 167.4 | 0.294 | 2.632 |
| 99.5 | 11322. | 6133. | * | 136. | 283. | 352. | 21. | 168.0 | 0.292 | 2.642 |
| 100.0 | 10912. | 5925. | * | 128. | 263. | 330. | 23. | 168.6 | 0.291 | 2.652 |
| 100.5 | 10756. | 5840. | * | 124. | 255. | 320. | 23. | 168.6 | 0.291 | 2.652 |
| 101.0 | 10115. | 5492. | * | 110. | 226. | 283. | 26. | 168.6 | 0.291 | 2.652 |
| 101.5 | 9895. | 5373. | * | 105. | 216. | 271. | 27. | 168.6 | 0.291 | 2.652 |
| 102.0 | 10254. | 5554. | * | 112. | 232. | 289. | 26. | 168.0 | 0.292 | 2.642 |
| 102.5 | 10797. | 5834. | * | 123. | 257. | 318. | 23. | 167.4 | 0.294 | 2.632 |
| 103.0 | 11186. | 6029. | * | 131. | 276. | 339. | 22. | 166.7 | 0.295 | 2.622 |
| 103.5 | 11098. | 5981. | * | 129. | 271. | 333. | 22. | 166.7 | 0.295 | 2.622 |
| 104.0 | 10942. | 5898. | * | 125. | 264. | 324. | 23. | 166.7 | 0.295 | 2.622 |
| 104.5 | 11054. | 5958. | * | 128. | 269. | 331. | 22. | 166.7 | 0.295 | 2.622 |
| 105.0 | 10351. | 5593. | * | 113. | 236. | 292. | 25. | 167.4 | 0.294 | 2.632 |
| 105.5 | 10100. | 5457. | * | 108. | 225. | 278. | 26. | 167.4 | 0.294 | 2.632 |
| 106.0 | 9925. | 5376. | * | 105. | 217. | 271. | 27. | 168.0 | 0.292 | 2.642 |
| 106.5 | 9895. | 5359. | * | 104. | 216. | 269. | 27. | 168.0 | 0.292 | 2.642 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 92.0 - 106.5
Figure 2.5-76

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5  1  1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
| 107.0 | 10616. | 5736. | * | 119. | 248. | 307. | 24. | 167.4 | 0.294 | 2.632 |
| 107.5 | 10815. | 5844. | * | 123. | 258. | 319. | 23. | 167.4 | 0.294 | 2.632 |
| 108.0 | 10803. | 5823. | * | 122. | 257. | 316. | 23. | 166.7 | 0.295 | 2.622 |
| 108.5 | 10587. | 5706. | * | 117. | 247. | 303. | 24. | 166.7 | 0.295 | 2.622 |
| 109.0 | 10335. | 5557. | * | 111. | 235. | 287. | 25. | 166.1 | 0.297 | 2.612 |
| 109.5 | 9951. | 5350. | * | 103. | 218. | 266. | 27. | 166.1 | 0.297 | 2.612 |
| 110.0 | 9557. | 5138. | * | 95. | 201. | 245. | 29. | 166.1 | 0.297 | 2.612 |
| 110.5 | 9391. | 5049. | * | 91. | 194. | 237. | 30. | 166.1 | 0.297 | 2.612 |
| 111.0 | 9391. | 5036. | * | 91. | 194. | 235. | 30. | 165.5 | 0.298 | 2.602 |
| 111.5 | 9432. | 5058. | * | 91. | 196. | 237. | 30. | 165.5 | 0.298 | 2.602 |
| 112.0 | 9473. | 5080. | * | 92. | 198. | 239. | 29. | 165.5 | 0.298 | 2.602 |
| 112.5 | 9642. | 5171. | * | 95. | 205. | 248. | 28. | 165.5 | 0.298 | 2.602 |
| 113.0 | 9642. | 5171. | * | 95. | 205. | 248. | 28. | 165.5 | 0.298 | 2.602 |
| 113.5 | 9685. | 5194. | * | 96. | 206. | 250. | 28. | 165.5 | 0.298 | 2.602 |
| 114.0 | 9906. | 5326. | * | 102. | 216. | 264. | 27. | 166.1 | 0.297 | 2.612 |
| 114.5 | 9906. | 5339. | * | 103. | 216. | 266. | 27. | 166.7 | 0.295 | 2.622 |
| 115.0 | 9951. | 5363. | * | 103. | 218. | 268. | 27. | 166.7 | 0.295 | 2.622 |
| 115.5 | 10090. | 5438. | * | 106. | 224. | 276. | 26. | 166.7 | 0.295 | 2.622 |
| 116.0 | 10685. | 5774. | * | 120. | 252. | 311. | 24. | 167.4 | 0.294 | 2.632 |
| 116.5 | 11238. | 6072. | * | 133. | 278. | 344. | 22. | 167.4 | 0.294 | 2.632 |
| 117.0 | 11414. | 6183. | * | 139. | 287. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 117.5 | 12460. | 6749. | * | 165. | 342. | 427. | 18. | 168.0 | 0.292 | 2.642 |
| 118.0 | 12046. | 6541. | * | 156. | 320. | 402. | 19. | 168.6 | 0.291 | 2.652 |
| 118.5 | 12826. | 6964. | * | 176. | 363. | 455. | 17. | 168.6 | 0.291 | 2.652 |
| 119.0 | 12979. | 7064. | * | 182. | 372. | 470. | 17. | 169.2 | 0.290 | 2.662 |
| 119.5 | 13057. | 7107. | * | 184. | 377. | 476. | 17. | 169.2 | 0.290 | 2.662 |
| 120.0 | 13057. | 7107. | * | 184. | 377. | 476. | 17. | 169.2 | 0.290 | 2.662 |
| 120.5 | 12751. | 6940. | * | 176. | 359. | 454. | 17. | 169.2 | 0.290 | 2.662 |
| 121.0 | 12389. | 6743. | * | 166. | 339. | 428. | 18. | 169.2 | 0.290 | 2.662 |
| 121.5 | 11914. | 6469. | * | 152. | 313. | 393. | 20. | 168.6 | 0.291 | 2.652 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 107.0 - 121.5
Figure 2.5-77

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00        0.0        0.0        729.70        181.60   5   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 122.0 | 11556. | 6260. | * | 142. | 295. | 367. | 21. | 168.0 | 0.292 | 2.642 |
| 122.5 | 11142. | 6035. | * | 132. | 274. | 341. | 22. | 168.0 | 0.292 | 2.642 |
| 123.0 | 10379. | 5594. | * | 113. | 237. | 292. | 25. | 166.7 | 0.295 | 2.622 |
| 123.5 | 9856. | 5299. | * | 101. | 214. | 261. | 27. | 166.1 | 0.297 | 2.612 |
| 124.0 | 10423. | 5604. | * | 113. | 239. | 292. | 25. | 166.1 | 0.297 | 2.612 |
| 124.5 | 10645. | 5708. | * | 116. | 249. | 302. | 24. | 165.5 | 0.298 | 2.602 |
| 125.0 | 10750. | 5765. | * | 119. | 254. | 308. | 24. | 165.5 | 0.298 | 2.602 |
| 125.5 | 10839. | 5798. | * | 120. | 258. | 311. | 23. | 164.9 | 0.300 | 2.592 |
| 126.0 | 10833. | 5795. | * | 119. | 258. | 310. | 23. | 164.9 | 0.300 | 2.592 |
| 126.5 | 10833. | 5795. | * | 119. | 258. | 310. | 23. | 164.9 | 0.300 | 2.592 |
| 127.0 | 10627. | 5685. | * | 115. | 248. | 299. | 24. | 164.9 | 0.300 | 2.592 |
| 127.5 | 10627. | 5685. | * | 115. | 248. | 299. | 24. | 164.9 | 0.300 | 2.592 |
| 128.0 | 10627. | 5714. | * | 117. | 249. | 303. | 24. | 166.1 | 0.297 | 2.612 |
| 128.5 | 10674. | 5753. | * | 119. | 251. | 308. | 24. | 166.7 | 0.295 | 2.622 |
| 129.0 | 10942. | 5912. | * | 126. | 264. | 327. | 23. | 167.4 | 0.294 | 2.632 |
| 129.5 | 11401. | 6160. | * | 137. | 287. | 355. | 21. | 167.4 | 0.294 | 2.632 |
| 130.0 | 11645. | 6292. | * | 143. | 299. | 370. | 20. | 167.4 | 0.294 | 2.632 |
| 130.5 | 11778. | 6364. | * | 146. | 306. | 378. | 20. | 167.4 | 0.294 | 2.632 |
| 131.0 | 11522. | 6210. | * | 139. | 293. | 359. | 21. | 166.7 | 0.295 | 2.622 |
| 131.5 | 11401. | 6130. | * | 135. | 286. | 349. | 21. | 166.1 | 0.297 | 2.612 |
| 132.0 | 11225. | 6020. | * | 129. | 277. | 336. | 22. | 165.5 | 0.298 | 2.602 |
| 132.5 | 10936. | 5865. | * | 123. | 263. | 319. | 23. | 165.5 | 0.298 | 2.602 |
| 133.0 | 10827. | 5806. | * | 120. | 258. | 312. | 23. | 165.5 | 0.298 | 2.602 |
| 133.5 | 10668. | 5706. | * | 116. | 250. | 301. | 24. | 164.9 | 0.300 | 2.592 |
| 134.0 | 10616. | 5679. | * | 115. | 248. | 298. | 24. | 164.9 | 0.300 | 2.592 |
| 134.5 | 10622. | 5682. | * | 115. | 248. | 298. | 24. | 164.9 | 0.300 | 2.592 |
| 135.0 | 10774. | 5778. | * | 119. | 255. | 309. | 23. | 165.5 | 0.298 | 2.602 |
| 135.5 | 10762. | 5771. | * | 119. | 255. | 309. | 23. | 165.5 | 0.298 | 2.602 |
| 136.0 | 10768. | 5775. | * | 119. | 255. | 309. | 23. | 165.5 | 0.298 | 2.602 |
| 136.5 | 10833. | 5810. | * | 120. | 258. | 313. | 23. | 165.5 | 0.298 | 2.602 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 122.0 - 136.5
Figure 2.5-78

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

L-61+00   0.0   0.0   729.70   181.60   5   1   1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
| 137.0 | 10948. | 5871. | * | 123. | 264. | 320. | 23. | 165.5 | 0.298 | 2.602 |
| 137.5 | 11225. | 6035. | * | 130. | 277. | 338. | 22. | 166.1 | 0.297 | 2.612 |
| 138.0 | 11328. | 6075. | * | 132. | 282. | 342. | 21. | 165.5 | 0.298 | 2.602 |
| 138.5 | 11335. | 6079. | * | 132. | 283. | 342. | 21. | 165.5 | 0.298 | 2.602 |
| 139.0 | 11116. | 5977. | * | 128. | 272. | 332. | 22. | 166.1 | 0.297 | 2.612 |
| 139.5 | 11116. | 5977. | * | 128. | 272. | 332. | 22. | 166.1 | 0.297 | 2.612 |
| 140.0 | 11110. | 5973. | * | 128. | 272. | 332. | 22. | 166.1 | 0.297 | 2.612 |
| 140.5 | 10882. | 5865. | * | 124. | 261. | 321. | 23. | 166.7 | 0.295 | 2.622 |
| 141.0 | 10726. | 5767. | * | 119. | 253. | 309. | 24. | 166.1 | 0.297 | 2.612 |
| 141.5 | 10780. | 5810. | * | 121. | 256. | 315. | 23. | 166.7 | 0.295 | 2.622 |
| 142.0 | 10888. | 5868. | * | 124. | 261. | 321. | 23. | 166.7 | 0.295 | 2.622 |
| 142.5 | 10888. | 5868. | * | 124. | 261. | 321. | 23. | 166.7 | 0.295 | 2.622 |
| 143.0 | 10888. | 5868. | * | 124. | 261. | 321. | 23. | 166.7 | 0.295 | 2.622 |
| 143.5 | 10570. | 5683. | * | 116. | 246. | 300. | 24. | 166.1 | 0.297 | 2.612 |
| 144.0 | 10468. | 5642. | * | 114. | 241. | 297. | 25. | 166.7 | 0.295 | 2.622 |
| 144.5 | 10674. | 5739. | * | 118. | 251. | 306. | 24. | 166.1 | 0.297 | 2.612 |
| 145.0 | 10780. | 5781. | * | 119. | 256. | 310. | 23. | 165.5 | 0.298 | 2.602 |
| 145.5 | 10774. | 5778. | * | 119. | 255. | 309. | 23. | 165.5 | 0.298 | 2.602 |
| 146.0 | 11110. | 5958. | * | 127. | 272. | 329. | 22. | 165.5 | 0.298 | 2.602 |
| 146.5 | 11110. | 5943. | * | 126. | 272. | 326. | 22. | 164.9 | 0.300 | 2.592 |
| 147.0 | 10780. | 5781. | * | 119. | 256. | 310. | 23. | 165.5 | 0.298 | 2.602 |
| 147.5 | 10519. | 5641. | * | 114. | 244. | 295. | 24. | 165.5 | 0.298 | 2.602 |
| 148.0 | 10314. | 5531. | * | 109. | 234. | 284. | 25. | 165.5 | 0.298 | 2.602 |
| 148.5 | 10780. | 5795. | * | 120. | 256. | 312. | 23. | 166.1 | 0.297 | 2.612 |
| 149.0 | 10468. | 5628. | * | 114. | 241. | 294. | 25. | 166.1 | 0.297 | 2.612 |
| 149.5 | 10319. | 5548. | * | 110. | 235. | 286. | 25. | 166.1 | 0.297 | 2.612 |
| 150.0 | 10674. | 5739. | * | 118. | 251. | 306. | 24. | 166.1 | 0.297 | 2.612 |
| 150.5 | 10468. | 5628. | * | 114. | 241. | 294. | 25. | 166.1 | 0.297 | 2.612 |
| 151.0 | 10674. | 5739. | * | 118. | 251. | 306. | 24. | 166.1 | 0.297 | 2.612 |
| 151.5 | 10780. | 5795. | * | 120. | 256. | 312. | 23. | 166.1 | 0.297 | 2.612 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 137.0 - 151.5
Figure 2.5-79

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 152.0 | 10888. | 5839. | * | 122. | 261. | 316. | 23. | 165.5 | 0.298 | 2.602 |
| 152.5 | 11110. | 5958. | * | 127. | 272. | 329. | 22. | 165.5 | 0.298 | 2.602 |
| 153.0 | 10833. | 5810. | * | 120. | 258. | 313. | 23. | 165.5 | 0.298 | 2.602 |
| 153.5 | 10418. | 5587. | * | 111. | 239. | 289. | 25. | 165.5 | 0.298 | 2.602 |
| 154.0 | 10319. | 5534. | * | 109. | 234. | 284. | 25. | 165.5 | 0.298 | 2.602 |
| 154.5 | 10270. | 5508. | * | 108. | 232. | 281. | 26. | 165.5 | 0.298 | 2.602 |
| 155.0 | 10726. | 5752. | * | 118. | 253. | 307. | 24. | 165.5 | 0.298 | 2.602 |
| 155.5 | 10524. | 5644. | * | 114. | 244. | 295. | 24. | 165.5 | 0.298 | 2.602 |
| 156.0 | 10894. | 5842. | * | 122. | 261. | 316. | 23. | 165.5 | 0.298 | 2.602 |
| 156.5 | 11231. | 6038. | * | 131. | 278. | 339. | 22. | 166.1 | 0.297 | 2.612 |
| 157.0 | 11529. | 6198. | * | 138. | 293. | 357. | 21. | 166.1 | 0.297 | 2.612 |
| 157.5 | 11529. | 6214. | * | 139. | 293. | 360. | 21. | 166.7 | 0.295 | 2.622 |
| 158.0 | 11231. | 6053. | * | 132. | 278. | 341. | 22. | 166.7 | 0.295 | 2.622 |
| 158.5 | 11468. | 6181. | * | 137. | 290. | 356. | 21. | 166.7 | 0.295 | 2.622 |
| 159.0 | 11408. | 6149. | * | 136. | 287. | 352. | 21. | 166.7 | 0.295 | 2.622 |
| 159.5 | 10839. | 5857. | * | 124. | 259. | 320. | 23. | 167.4 | 0.294 | 2.632 |
| 160.0 | 11590. | 6278. | * | 143. | 296. | 369. | 21. | 168.0 | 0.292 | 2.642 |
| 160.5 | 12173. | 6594. | * | 158. | 327. | 407. | 19. | 168.0 | 0.292 | 2.642 |
| 161.0 | 12303. | 6680. | * | 162. | 334. | 419. | 18. | 168.6 | 0.291 | 2.652 |
| 161.5 | 12234. | 6659. | * | 162. | 331. | 417. | 19. | 169.2 | 0.290 | 2.662 |
| 162.0 | 11900. | 6477. | * | 153. | 313. | 395. | 20. | 169.2 | 0.290 | 2.662 |
| 162.5 | 11645. | 6338. | * | 147. | 299. | 378. | 20. | 169.2 | 0.290 | 2.662 |
| 163.0 | 11348. | 6177. | * | 139. | 284. | 359. | 21. | 169.2 | 0.290 | 2.662 |
| 163.5 | 11060. | 6020. | * | 132. | 270. | 341. | 22. | 169.2 | 0.290 | 2.662 |
| 164.0 | 10948. | 5959. | * | 130. | 265. | 334. | 23. | 169.2 | 0.290 | 2.662 |
| 164.5 | 11060. | 6020. | * | 132. | 270. | 341. | 22. | 169.2 | 0.290 | 2.662 |
| 165.0 | 11231. | 6098. | * | 135. | 278. | 349. | 22. | 168.6 | 0.291 | 2.652 |
| 165.5 | 11414. | 6183. | * | 139. | 287. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 166.0 | 11414. | 6183. | * | 139. | 287. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 166.5 | 11597. | 6282. | * | 143. | 297. | 370. | 21. | 168.0 | 0.292 | 2.642 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 152.0 - 166.5

Figure 2.5-80

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
L-61+00   0.0   0.0   729.70   181.60   5   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

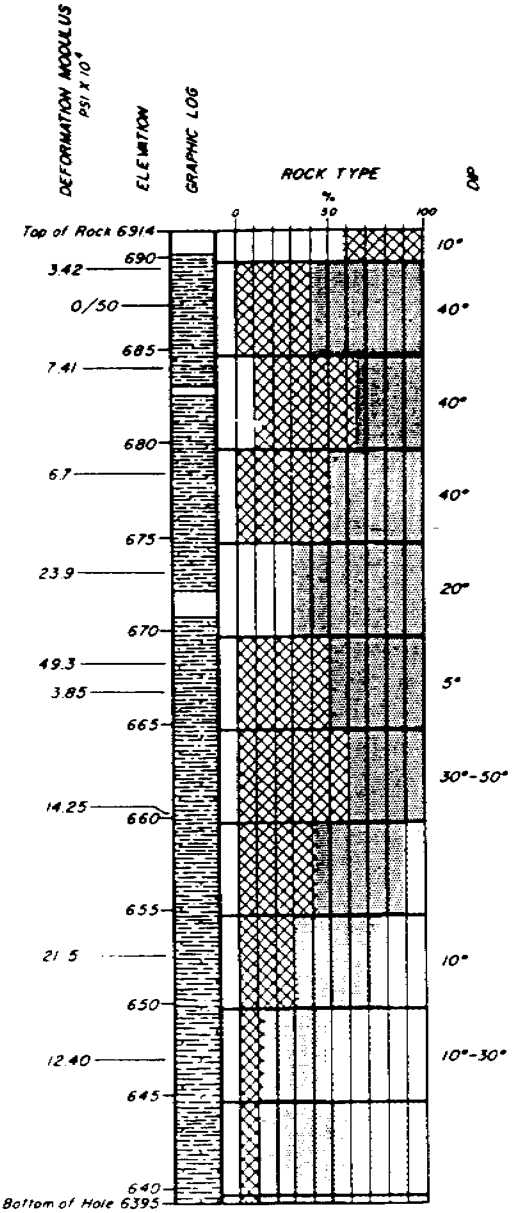
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
| 167.0 | 11414. | 6168. | * | 137. | 287. | 355. | 21. | 167.4 | 0.294 | 2.632 |
| 167.5 | 11123. | 6010. | * | 130. | 273. | 337. | 22. | 167.4 | 0.294 | 2.632 |
| 168.0 | 10633. | 5745. | * | 119. | 249. | 308. | 24. | 167.4 | 0.294 | 2.632 |
| 168.5 | 10281. | 5541. | * | 110. | 233. | 286. | 25. | 166.7 | 0.295 | 2.622 |
| 169.0 | 9951. | 5363. | * | 103. | 218. | 268. | 27. | 166.7 | 0.295 | 2.622 |
| 169.5 | 10184. | 5476. | * | 107. | 228. | 279. | 26. | 166.1 | 0.297 | 2.612 |
| 170.0 | 10429. | 5607. | * | 113. | 240. | 292. | 25. | 166.1 | 0.297 | 2.612 |
| 170.5 | 10479. | 5634. | * | 114. | 242. | 295. | 25. | 166.1 | 0.297 | 2.612 |
| 171.0 | 10429. | 5593. | * | 112. | 239. | 290. | 25. | 165.5 | 0.298 | 2.602 |
| 171.5 | 10680. | 5727. | * | 117. | 251. | 304. | 24. | 165.5 | 0.298 | 2.602 |
| 172.0 | 10474. | 5617. | * | 113. | 241. | 292. | 25. | 165.5 | 0.298 | 2.602 |
| 172.5 | 10732. | 5755. | * | 118. | 254. | 307. | 24. | 165.5 | 0.298 | 2.602 |
| 173.0 | 11116. | 5977. | * | 128. | 272. | 332. | 22. | 166.1 | 0.297 | 2.612 |
| 173.5 | 11468. | 6181. | * | 137. | 290. | 356. | 21. | 166.7 | 0.295 | 2.622 |
| 174.0 | 11842. | 6383. | * | 147. | 309. | 380. | 20. | 166.7 | 0.295 | 2.622 |
| 174.5 | 12098. | 6537. | * | 154. | 323. | 399. | 19. | 167.4 | 0.294 | 2.632 |
| 175.0 | 12303. | 6664. | * | 161. | 334. | 416. | 18. | 168.0 | 0.292 | 2.642 |
| 175.5 | 12098. | 6569. | * | 157. | 323. | 405. | 19. | 168.6 | 0.291 | 2.652 |
| 176.0 | 11515. | 6252. | * | 142. | 293. | 367. | 21. | 168.6 | 0.291 | 2.652 |
| 176.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 177.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 177.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 178.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 178.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 179.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 179.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 180.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 180.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 181.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 181.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

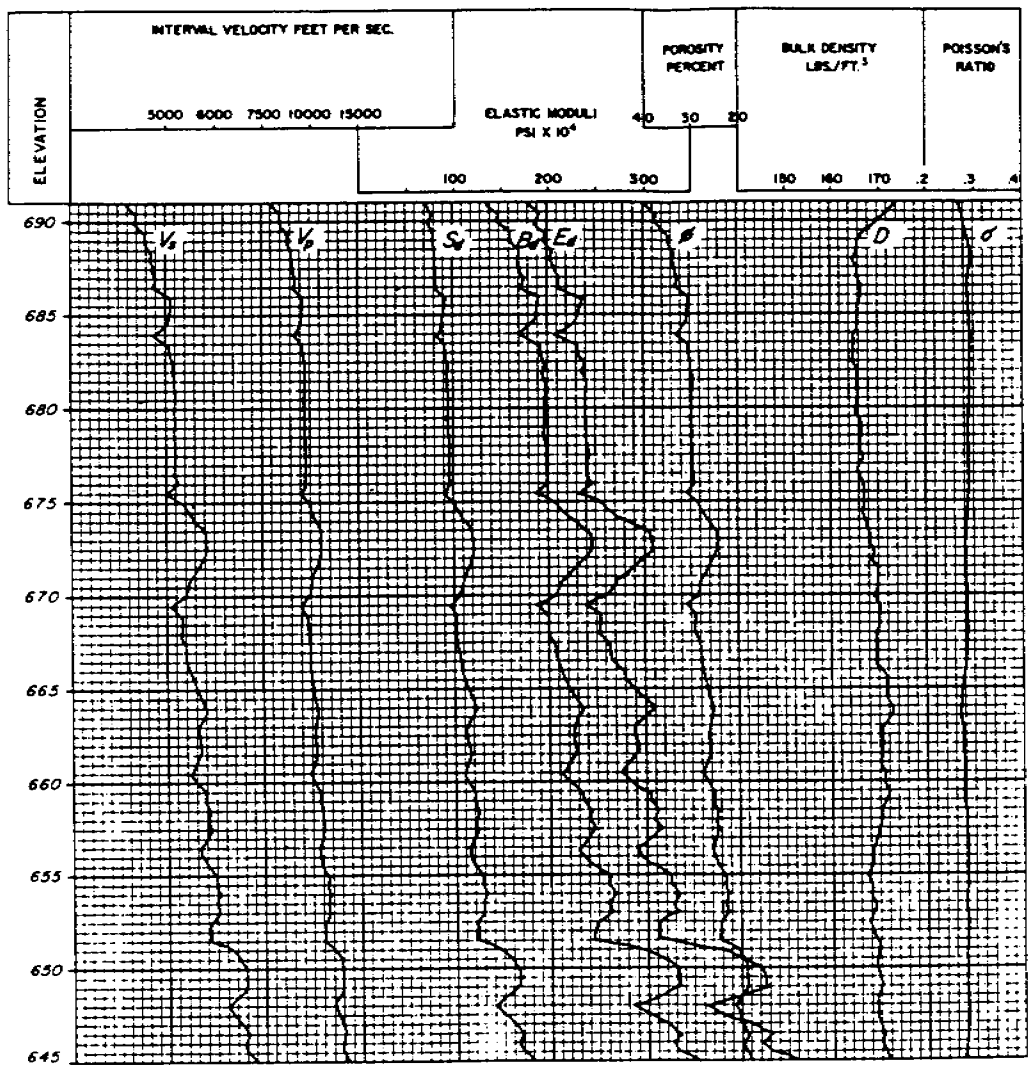
3-D ELASTIC PROPERTIES TABULATION
STA. L-61+00
DEPTH 167.0 - 176.0
Figure 2.5-81

Best Available Historical Image

# Figure 2.5-82 - Historical




HOLE 29

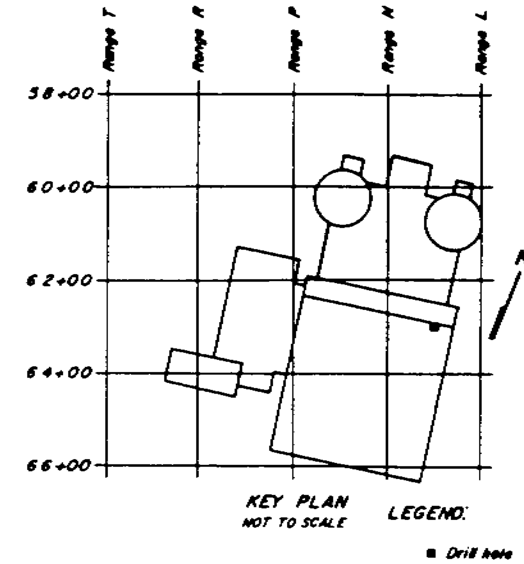



LEGEND:

Vs = Shear Velocity.
Vp = Compressional Velocity.
Sd = Dynamic Shear Modulus.
Bd = Dynamic Bulk Modulus.
Ed = Dynamic Young's Modulus.
ø = Porosity.
D = Density.
σ = Poisson's Ratio.

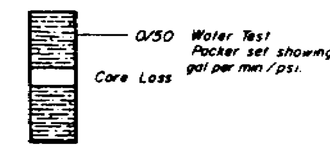
NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 691.4 and 646.7. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.




LEGEND:

GRAPHIC LOG




GENERAL ROCK DESCRIPTION

THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALES INTERBEDDED WITH LENSES OF LIMESTONES.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus. (psi x 10⁴)

Type 0 Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

THESE TYPES WERE IDENTIFIED FROM VISUAL INSPECTION OF THE CORE. GENERALLY, DETERMINATIONS WERE MADE FOR EACH FIVE FOOT LENGTH OF CORE IN THE BOX.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GRAPHIC LOG AND
ELASTIC MODULI
STA. M-63+00

Figure 2.5-82

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

M-63+00    0.0    0.0    734.70    95.20    1  1  1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 44.0 | 7813. | 4333. | * | 71. | 135. | 180. | 40. | 174.2 | 0.278 | 2.743 |
| 44.5 | 8160. | 4484. | * | 74. | 147. | 191. | 37. | 171.7 | 0.284 | 2.702 |
| 45.0 | 8099. | 4419. | * | 72. | 145. | 184. | 38. | 169.9 | 0.288 | 2.672 |
| 45.5 | 8492. | 4589. | * | 76. | 159. | 197. | 35. | 167.4 | 0.294 | 2.632 |
| 46.0 | 8527. | 4585. | * | 75. | 160. | 195. | 35. | 166.1 | 0.297 | 2.612 |
| 46.5 | 8703. | 4679. | * | 78. | 167. | 203. | 34. | 166.1 | 0.297 | 2.612 |
| 47.0 | 8696. | 4664. | * | 78. | 166. | 202. | 34. | 165.5 | 0.298 | 2.602 |
| 47.5 | 8770. | 4715. | * | 80. | 169. | 207. | 33. | 166.1 | 0.297 | 2.612 |
| 48.0 | 8845. | 4755. | * | 81. | 172. | 210. | 33. | 166.1 | 0.297 | 2.612 |
| 48.5 | 8766. | 4725. | * | 80. | 169. | 208. | 33. | 166.7 | 0.295 | 2.622 |
| 49.0 | 9319. | 5023. | * | 91. | 191. | 235. | 30. | 166.7 | 0.295 | 2.622 |
| 49.5 | 9314. | 5008. | * | 90. | 191. | 233. | 30. | 166.1 | 0.297 | 2.612 |
| 50.0 | 9273. | 4985. | * | 89. | 189. | 231. | 30. | 166.1 | 0.297 | 2.612 |
| 50.5 | 9150. | 4919. | * | 87. | 184. | 225. | 31. | 166.1 | 0.297 | 2.612 |
| 51.0 | 8763. | 4699. | * | 79. | 169. | 205. | 33. | 165.5 | 0.298 | 2.602 |
| 51.5 | 9277. | 4975. | * | 88. | 189. | 229. | 30. | 165.5 | 0.298 | 2.602 |
| 52.0 | 9314. | 4995. | * | 89. | 191. | 231. | 30. | 165.5 | 0.298 | 2.602 |
| 52.5 | 9442. | 5063. | * | 92. | 196. | 238. | 29. | 165.5 | 0.298 | 2.602 |
| 53.0 | 9356. | 5030. | * | 91. | 193. | 235. | 30. | 166.1 | 0.297 | 2.612 |
| 53.5 | 9442. | 5076. | * | 92. | 196. | 239. | 29. | 166.1 | 0.297 | 2.612 |
| 54.0 | 9450. | 5081. | * | 93. | 197. | 240. | 29. | 166.1 | 0.297 | 2.612 |
| 54.5 | 9408. | 5058. | * | 92. | 195. | 238. | 30. | 166.1 | 0.297 | 2.612 |
| 55.0 | 9403. | 5055. | * | 92. | 195. | 238. | 30. | 166.1 | 0.297 | 2.612 |
| 55.5 | 9399. | 5066. | * | 92. | 195. | 239. | 30. | 166.7 | 0.295 | 2.622 |
| 56.0 | 9395. | 5064. | * | 92. | 194. | 239. | 30. | 166.7 | 0.295 | 2.622 |
| 56.5 | 9399. | 5066. | * | 92. | 195. | 239. | 30. | 166.7 | 0.295 | 2.622 |
| 57.0 | 9446. | 5091. | * | 93. | 197. | 242. | 29. | 166.7 | 0.295 | 2.622 |
| 57.5 | 9446. | 5104. | * | 94. | 197. | 243. | 29. | 167.4 | 0.294 | 2.632 |
| 58.0 | 9437. | 5087. | * | 93. | 196. | 241. | 29. | 166.7 | 0.295 | 2.622 |
| 58.5 | 9446. | 5091. | * | 93. | 197. | 242. | 29. | 166.7 | 0.295 | 2.622 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. M-63+00
DEPTH 44.0 - 58.5

Figure 2.5-83

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
M-63+00   0.0   0.0   734.70   95.20   1   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 59.0 | 9494. | 5130. | * | 95. | 199. | 246. | 29. | 167.4 | 0.294 | 2.632 |
| 59.5 | 9150. | 4944. | * | 88. | 185. | 228. | 31. | 167.4 | 0.294 | 2.632 |
| 60.0 | 9702. | 5242. | * | 99. | 208. | 257. | 28. | 167.4 | 0.294 | 2.632 |
| 60.5 | 9887. | 5342. | * | 103. | 216. | 267. | 27. | 167.4 | 0.294 | 2.632 |
| 61.0 | 10143. | 5494. | * | 109. | 227. | 283. | 26. | 168.0 | 0.292 | 2.642 |
| 61.5 | 10508. | 5706. | * | 118. | 244. | 306. | 24. | 168.6 | 0.291 | 2.652 |
| 62.0 | 10550. | 5728. | * | 119. | 246. | 308. | 24. | 168.6 | 0.291 | 2.652 |
| 62.5 | 10539. | 5736. | * | 120. | 245. | 310. | 24. | 169.2 | 0.290 | 2.662 |
| 63.0 | 10381. | 5650. | * | 117. | 238. | 301. | 25. | 169.2 | 0.290 | 2.662 |
| 63.5 | 10089. | 5518. | * | 112. | 225. | 288. | 26. | 170.5 | 0.287 | 2.682 |
| 64.0 | 9850. | 5387. | * | 107. | 214. | 275. | 27. | 170.5 | 0.287 | 2.682 |
| 64.5 | 9752. | 5334. | * | 105. | 210. | 269. | 28. | 170.5 | 0.287 | 2.682 |
| 65.0 | 9666. | 5274. | * | 102. | 206. | 263. | 28. | 169.9 | 0.288 | 2.672 |
| 65.5 | 9162. | 5011. | * | 92. | 186. | 238. | 31. | 170.5 | 0.287 | 2.682 |
| 66.0 | 9494. | 5192. | * | 99. | 199. | 255. | 29. | 170.5 | 0.287 | 2.682 |
| 66.5 | 9480. | 5185. | * | 99. | 199. | 254. | 29. | 170.5 | 0.287 | 2.682 |
| 67.0 | 9480. | 5173. | * | 98. | 199. | 253. | 29. | 169.9 | 0.288 | 2.672 |
| 67.5 | 9635. | 5257. | * | 101. | 205. | 261. | 28. | 169.9 | 0.288 | 2.672 |
| 68.0 | 9649. | 5265. | * | 102. | 206. | 262. | 28. | 169.9 | 0.288 | 2.672 |
| 68.5 | 9703. | 5294. | * | 103. | 208. | 265. | 28. | 169.9 | 0.288 | 2.672 |
| 69.0 | 9822. | 5397. | * | 108. | 214. | 277. | 27. | 171.7 | 0.284 | 2.702 |
| 69.5 | 9892. | 5435. | * | 109. | 217. | 281. | 27. | 171.7 | 0.284 | 2.702 |
| 70.0 | 10007. | 5511. | * | 113. | 222. | 290. | 27. | 172.4 | 0.282 | 2.713 |
| 70.5 | 10159. | 5608. | * | 117. | 229. | 301. | 26. | 173.0 | 0.281 | 2.723 |
| 71.0 | 10326. | 5713. | * | 122. | 236. | 313. | 25. | 173.6 | 0.279 | 2.733 |
| 71.5 | 10159. | 5608. | * | 117. | 229. | 301. | 26. | 173.0 | 0.281 | 2.723 |
| 72.0 | 10079. | 5525. | * | 113. | 225. | 290. | 26. | 171.1 | 0.285 | 2.692 |
| 72.5 | 10084. | 5528. | * | 113. | 225. | 290. | 26. | 171.1 | 0.285 | 2.692 |
| 73.0 | 10138. | 5558. | * | 114. | 227. | 293. | 26. | 171.1 | 0.285 | 2.692 |
| 73.5 | 10128. | 5552. | * | 114. | 227. | 292. | 26. | 171.1 | 0.285 | 2.692 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. M-63+00
DEPTH 59.0 - 73.5
Figure 2.5-84

# B I R D W E L L 3-D E L A S T I C P R O P E R T I E S T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
M-63+00 0.0 0.0 734.70 95.20 1 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

| | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DEPTH | VP | VS | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
| 74.0 | 9977. | 5469. * | 110. | 220. | 284. | 27. | 171.1 | 0.285 | 2.692 |
| 74.5 | 9789. | 5379. * | 107. | 212. | 275. | 28. | 171.7 | 0.284 | 2.702 |
| 75.0 | 9982. | 5485. * | 111. | 221. | 286. | 27. | 171.7 | 0.284 | 2.702 |
| 75.5 | 10278. | 5661. * | 119. | 234. | 306. | 25. | 172.4 | 0.282 | 2.713 |
| 76.0 | 10329. | 5676. * | 119. | 236. | 306. | 25. | 171.7 | 0.284 | 2.702 |
| 76.5 | 10491. | 5751. * | 122. | 243. | 314. | 24. | 171.1 | 0.285 | 2.692 |
| 77.0 | 10433. | 5719. * | 121. | 241. | 310. | 25. | 171.1 | 0.285 | 2.692 |
| 77.5 | 10575. | 5784. * | 123. | 247. | 317. | 24. | 170.5 | 0.287 | 2.682 |
| 78.0 | 10416. | 5683. * | 118. | 240. | 305. | 25. | 169.9 | 0.288 | 2.672 |
| 78.5 | 10212. | 5558. * | 113. | 230. | 291. | 26. | 169.2 | 0.290 | 2.662 |
| 79.0 | 10273. | 5592. * | 114. | 233. | 294. | 25. | 169.2 | 0.290 | 2.662 |
| 79.5 | 10474. | 5701. * | 119. | 242. | 306. | 25. | 169.2 | 0.290 | 2.662 |
| 80.0 | 10896. | 5902. * | 126. | 262. | 326. | 23. | 168.0 | 0.292 | 2.642 |
| 80.5 | 10890. | 5913. * | 127. | 262. | 328. | 23. | 168.6 | 0.291 | 2.652 |
| 81.0 | 11005. | 5975. * | 130. | 267. | 335. | 23. | 168.6 | 0.291 | 2.652 |
| 81.5 | 10896. | 5931. * | 128. | 262. | 331. | 23. | 169.2 | 0.290 | 2.662 |
| 82.0 | 10959. | 5965. * | 130. | 265. | 335. | 23. | 169.2 | 0.290 | 2.662 |
| 82.5 | 10624. | 5768. * | 121. | 249. | 312. | 24. | 168.6 | 0.291 | 2.652 |
| 83.0 | 10570. | 5753. * | 121. | 247. | 312. | 24. | 169.2 | 0.290 | 2.662 |
| 83.5 | 10516. | 5738. * | 121. | 244. | 311. | 24. | 169.9 | 0.288 | 2.672 |
| 84.0 | 11625. | 6343. * | 147. | 299. | 380. | 20. | 169.9 | 0.288 | 2.672 |
| 84.5 | 12027. | 6562. * | 158. | 320. | 406. | 19. | 169.9 | 0.288 | 2.672 |
| 85.0 | 12311. | 6717. * | 165. | 335. | 426. | 18. | 169.9 | 0.288 | 2.672 |
| 85.5 | 12319. | 6737. * | 167. | 336. | 430. | 18. | 170.5 | 0.287 | 2.682 |
| 86.0 | 12319. | 6737. * | 167. | 336. | 430. | 18. | 170.5 | 0.287 | 2.682 |
| 86.5 | 11958. | 6525. * | 156. | 316. | 402. | 19. | 169.9 | 0.288 | 2.672 |
| 87.0 | 11365. | 6201. * | 141. | 285. | 363. | 21. | 169.9 | 0.288 | 2.672 |
| 87.5 | 11625. | 6343. * | 147. | 299. | 380. | 20. | 169.9 | 0.288 | 2.672 |
| 88.0 | 12097. | 6616. * | 161. | 324. | 414. | 19. | 170.5 | 0.287 | 2.682 |
| 88.5 | 12376. | 6785. * | 170. | 339. | 437. | 18. | 171.1 | 0.285 | 2.692 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. M-63+00
DEPTH 74.0 - 88.5

Figure 2.5-85

Best Available Historical Image

## B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
M-63+00 0.0 0.0 734.70 95.20 1 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

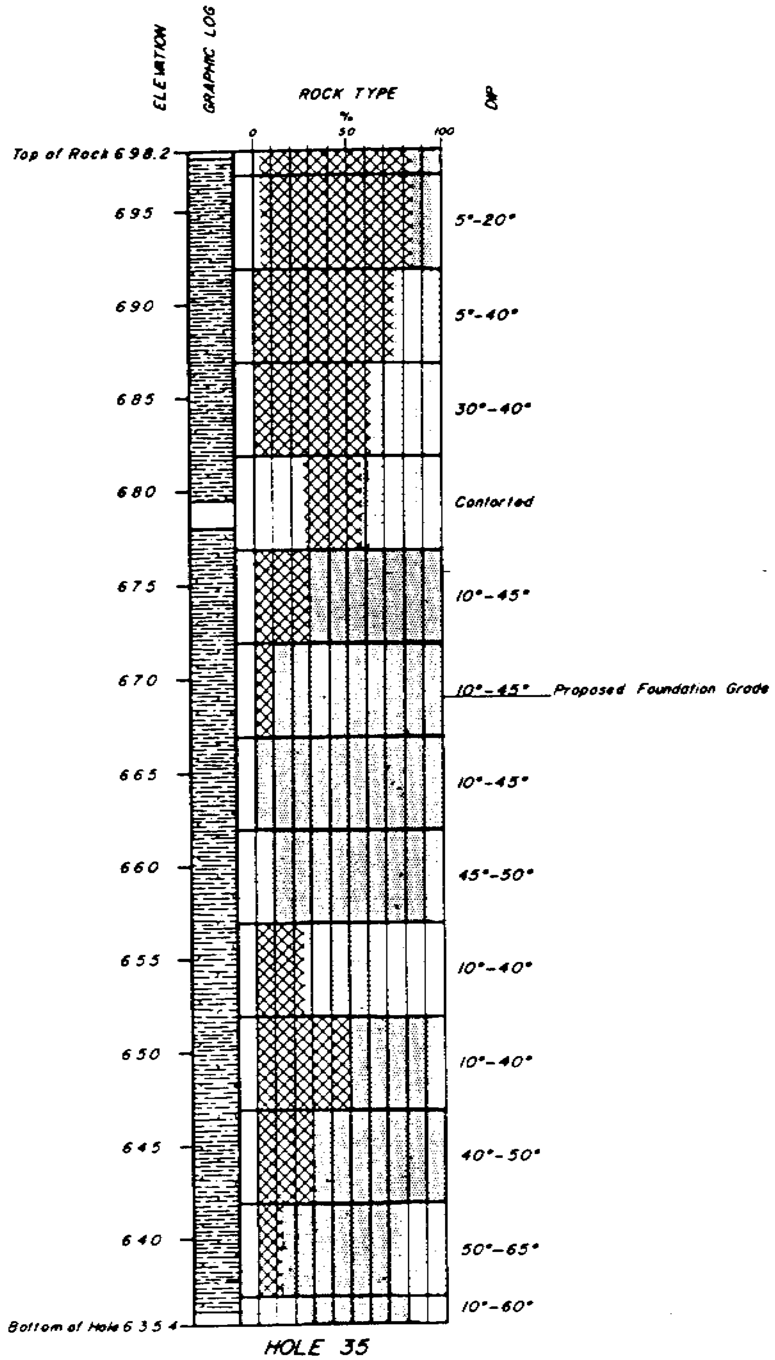
| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 89.0 | 12160. | 6666. | * | 164. | 327. | 422. | 19. | 171.1 | 0.285 | 2.692 |
| 89.5 | 12303. | 6760. | * | 169. | 335. | 435. | 18. | 171.7 | 0.284 | 2.702 |
| 90.0 | 12763. | 7029. | * | 184. | 361. | 471. | 17. | 172.4 | 0.282 | 2.713 |
| 90.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 91.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 91.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 92.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 92.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

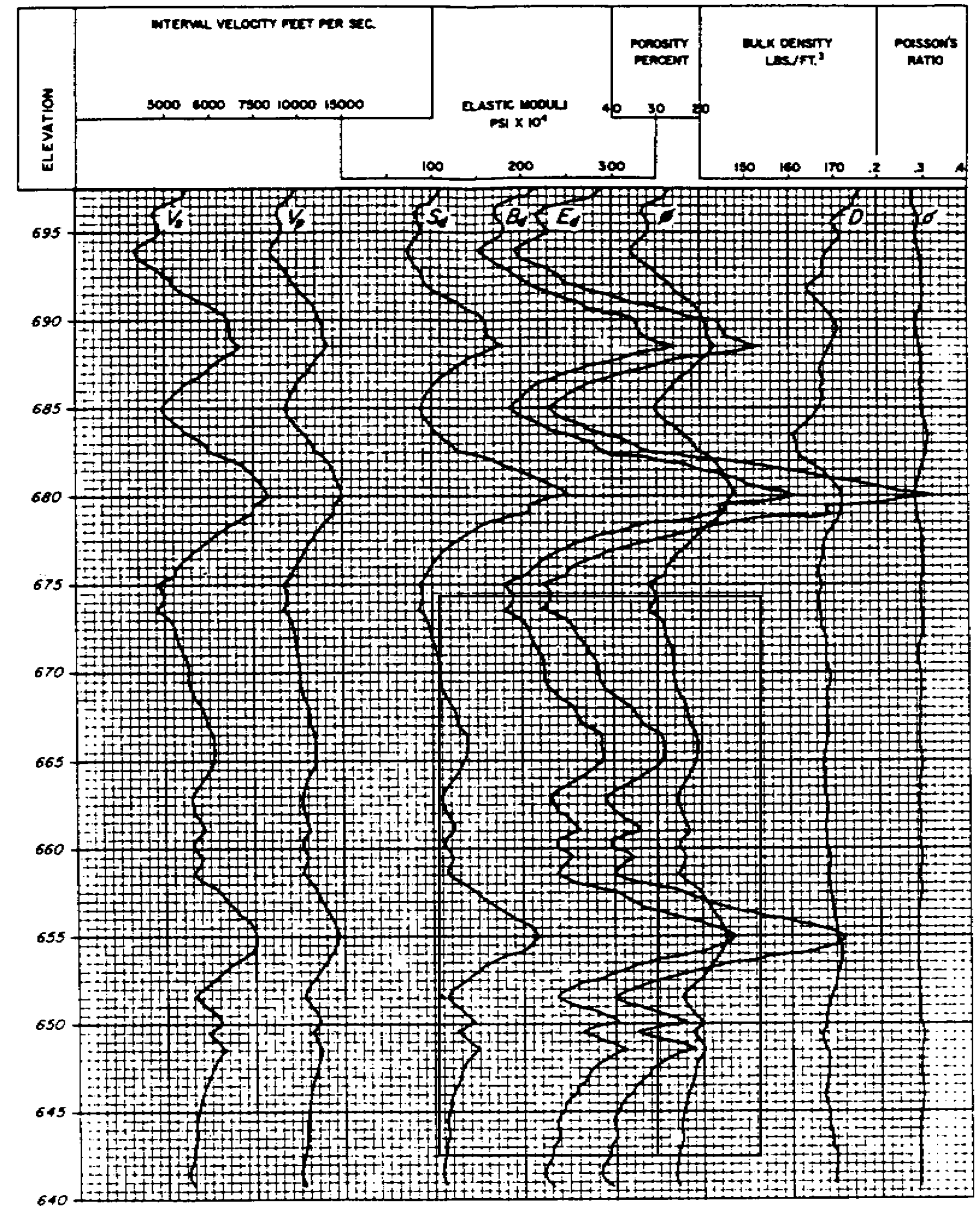
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. M-63+00
DEPTH 89.0 - 90.0

Figure 2.5-86

Best Available Historical Image




LEGEND:

$V_S$ = Shear Velocity.

$V_P$ = Compressional Velocity.

$S_d$ = Dynamic Shear Modulus.

$B_d$ = Dynamic Bulk Modulus.

$E_d$ = Dynamic Young's Modulus.

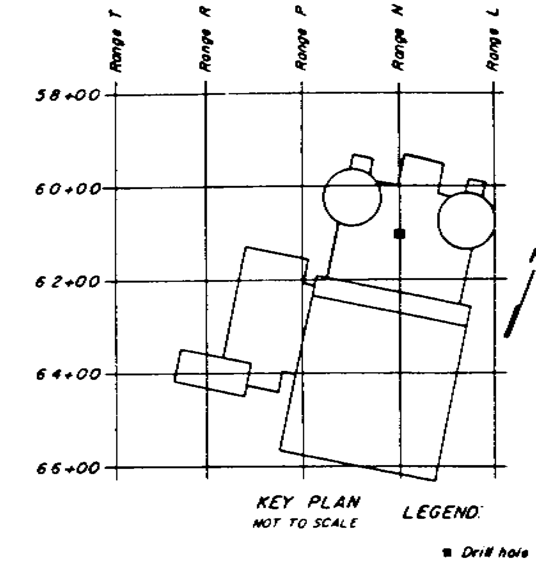
$\phi$ = Porosity.

D = Density.

$\sigma$ = Poisson's Ratio.

NOTES:

1. The hole was drilled with an NX wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 698.0 and 647.5. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.




LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

General Rock Description

The foundation rock is composed of the Conasauga formation. This formation consists of contorted gray-green shales interbedded with lenses of limestones.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

These types were identified from visual inspection of the core. Generally, determinations were made for each five foot length of core in the box.

HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log and
Elastic Moduli
STA. N-61+00
FIGURE 2.5-87

# BIRDWELL 3-D ELASTIC PROPERTIES TABULATION

TENNESSEE VALLEY AUTHORITY
N-61+10 0.0 0.0 732.50 97.10 2 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 35.0 | 9789. | 5465. | * | 113. | 213. | 289. | 27. | 176.1 | 0.274 | 2.773 |
| 35.5 | 9595. | 5333. | * | 107. | 204. | 274. | 28. | 174.9 | 0.277 | 2.753 |
| 36.0 | 8766. | 4861. | * | 89. | 170. | 227. | 33. | 174.2 | 0.278 | 2.743 |
| 36.5 | 8675. | 4755. | * | 83. | 166. | 215. | 34. | 171.1 | 0.285 | 2.692 |
| 37.0 | 8929. | 4860. | * | 86. | 176. | 222. | 32. | 169.2 | 0.290 | 2.662 |
| 37.5 | 8975. | 4932. | * | 90. | 178. | 231. | 32. | 171.7 | 0.284 | 2.702 |
| 38.0 | 8584. | 4695. | * | 81. | 163. | 209. | 34. | 170.5 | 0.287 | 2.682 |
| 38.5 | 8226. | 4477. | * | 73. | 149. | 189. | 37. | 169.2 | 0.290 | 2.662 |
| 39.0 | 8462. | 4572. | * | 75. | 158. | 195. | 35. | 167.4 | 0.294 | 2.632 |
| 39.5 | 8968. | 4845. | * | 85. | 177. | 219. | 32. | 167.4 | 0.294 | 2.632 |
| 40.0 | 9383. | 5070. | * | 93. | 194. | 240. | 30. | 167.4 | 0.294 | 2.632 |
| 40.5 | 9697. | 5174. | * | 95. | 207. | 247. | 28. | 164.2 | 0.301 | 2.582 |
| 41.0 | 10246. | 5481. | * | 107. | 231. | 278. | 26. | 164.9 | 0.300 | 2.592 |
| 41.5 | 10851. | 5849. | * | 123. | 259. | 319. | 23. | 166.7 | 0.295 | 2.622 |
| 42.0 | 11712. | 6375. | * | 148. | 303. | 383. | 20. | 169.2 | 0.290 | 2.662 |
| 42.5 | 12183. | 6663. | * | 163. | 328. | 420. | 19. | 170.5 | 0.287 | 2.682 |
| 43.0 | 12183. | 6679. | * | 165. | 328. | 423. | 19. | 171.1 | 0.285 | 2.692 |
| 43.5 | 12247. | 6698. | * | 165. | 332. | 425. | 19. | 170.5 | 0.287 | 2.682 |
| 44.0 | 12956. | 7052. | * | 182. | 371. | 468. | 17. | 169.2 | 0.290 | 2.662 |
| 44.5 | 12018. | 6526. | * | 155. | 319. | 400. | 19. | 168.6 | 0.291 | 2.652 |
| 45.0 | 11328. | 6121. | * | 135. | 283. | 350. | 21. | 167.4 | 0.294 | 2.632 |
| 45.5 | 10846. | 5846. | * | 123. | 259. | 318. | 23. | 166.7 | 0.295 | 2.622 |
| 46.0 | 10032. | 5434. | * | 107. | 222. | 277. | 27. | 168.0 | 0.292 | 2.642 |
| 46.5 | 9708. | 5233. | * | 98. | 208. | 255. | 28. | 166.7 | 0.295 | 2.622 |
| 47.0 | 9383. | 5070. | * | 93. | 194. | 240. | 30. | 167.4 | 0.294 | 2.632 |
| 47.5 | 9142. | 4927. | * | 87. | 184. | 226. | 31. | 166.7 | 0.295 | 2.622 |
| 48.0 | 9490. | 5076. | * | 92. | 198. | 238. | 29. | 164.9 | 0.300 | 2.592 |
| 48.5 | 10017. | 5317. | * | 99. | 220. | 259. | 27. | 163.0 | 0.304 | 2.562 |
| 49.0 | 10530. | 5529. | * | 106. | 243. | 277. | 25. | 160.5 | 0.310 | 2.521 |
| 49.5 | 11232. | 5930. | * | 123. | 277. | 321. | 22. | 161.7 | 0.307 | 2.541 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. N-61+00
DEPTH 35.0 - 49.5

Figure 2.5-88

Best Available Historical Image

## BIRDWELL 3-D ELASTIC PROPERTIES TABULATION

TENNESSEE VALLEY AUTHORITY

N-61+00 0.0 0.0 732.50 97.10 2 1 1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 50.0 | 11517. | 6080. | * | 129. | 291. | 337. | 21. | 161.7 | 0.307 | 2.541 |
| 50.5 | 12912. | 6889. | * | 168. | 366. | 437. | 17. | 164.2 | 0.301 | 2.582 |
| 51.0 | 13505. | 7297. | * | 192. | 402. | 497. | 16. | 167.4 | 0.294 | 2.632 |
| 51.5 | 14134. | 7712. | * | 218. | 441. | 561. | 14. | 169.9 | 0.288 | 2.672 |
| 52.0 | 14526. | 7982. | * | 236. | 467. | 606. | 14. | 171.7 | 0.284 | 2.702 |
| 52.5 | 15145. | 8341. | * | 259. | 508. | 663. | 13. | 172.4 | 0.282 | 2.713 |
| 53.0 | 13772. | 7567. | * | 212. | 420. | 545. | 15. | 171.7 | 0.284 | 2.702 |
| 53.5 | 13874. | 7605. | * | 214. | 426. | 549. | 15. | 171.1 | 0.285 | 2.692 |
| 54.0 | 12450. | 6793. | * | 169. | 343. | 436. | 18. | 169.9 | 0.288 | 2.672 |
| 54.5 | 11815. | 6416. | * | 150. | 308. | 387. | 20. | 168.6 | 0.291 | 2.652 |
| 55.0 | 11135. | 6031. | * | 132. | 274. | 341. | 22. | 168.0 | 0.292 | 2.642 |
| 55.5 | 10514. | 5682. | * | 117. | 244. | 302. | 24. | 167.4 | 0.294 | 2.632 |
| 56.0 | 10097. | 5456. | * | 107. | 225. | 278. | 26. | 167.4 | 0.294 | 2.632 |
| 56.5 | 9710. | 5234. | * | 99. | 208. | 255. | 28. | 166.7 | 0.295 | 2.622 |
| 57.0 | 9580. | 5164. | * | 96. | 202. | 248. | 29. | 166.7 | 0.295 | 2.622 |
| 57.5 | 9007. | 4867. | * | 86. | 179. | 221. | 32. | 167.4 | 0.294 | 2.632 |
| 58.0 | 9248. | 4984. | * | 89. | 188. | 231. | 30. | 166.7 | 0.295 | 2.622 |
| 58.5 | 9239. | 4980. | * | 89. | 188. | 231. | 31. | 166.7 | 0.295 | 2.622 |
| 59.0 | 8999. | 4850. | * | 85. | 178. | 219. | 32. | 166.7 | 0.295 | 2.622 |
| 59.5 | 9493. | 5129. | * | 95. | 199. | 246. | 29. | 167.4 | 0.294 | 2.632 |
| 60.0 | 9670. | 5225. | * | 99. | 206. | 255. | 28. | 167.4 | 0.294 | 2.632 |
| 60.5 | 9715. | 5262. | * | 100. | 208. | 259. | 28. | 168.0 | 0.292 | 2.642 |
| 61.0 | 9806. | 5325. | * | 103. | 212. | 266. | 28. | 168.6 | 0.291 | 2.652 |
| 61.5 | 9995. | 5427. | * | 107. | 221. | 277. | 27. | 168.6 | 0.291 | 2.652 |
| 62.0 | 10087. | 5477. | * | 109. | 225. | 282. | 26. | 168.6 | 0.291 | 2.652 |
| 62.5 | 10087. | 5490. | * | 110. | 225. | 284. | 26. | 169.2 | 0.290 | 2.662 |
| 63.0 | 10087. | 5490. | * | 110. | 225. | 284. | 26. | 169.2 | 0.290 | 2.662 |
| 63.5 | 10236. | 5558. | * | 112. | 231. | 290. | 26. | 168.6 | 0.291 | 2.652 |
| 64.0 | 10441. | 5669. | * | 117. | 241. | 302. | 25. | 168.6 | 0.291 | 2.652 |
| 64.5 | 10759. | 5842. | * | 124. | 256. | 321. | 23. | 168.6 | 0.291 | 2.652 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. N-61+00
DEPTH 50.0 - 64.5
Figure 2.5-89

# BIRDWELL 3-D ELASTIC PROPERTIES TABULATION

TENNESSEE VALLEY AUTHORITY

N-61+00 0.0 0.0 732.50 97.10 2 1 1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 65.0 | 10877. | 5906. | * | 127. | 261. | 328. | 23. | 168.6 | 0.291 | 2.652 |
| 65.5 | 10992. | 5969. | * | 130. | 267. | 335. | 23. | 168.6 | 0.291 | 2.652 |
| 66.0 | 11351. | 6164. | * | 138. | 284. | 357. | 21. | 168.6 | 0.291 | 2.652 |
| 66.5 | 11351. | 6164. | * | 138. | 284. | 357. | 21. | 168.6 | 0.291 | 2.652 |
| 67.0 | 11414. | 6182. | * | 138. | 287. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 67.5 | 11414. | 6182. | * | 138. | 287. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 68.0 | 11175. | 6053. | * | 133. | 276. | 343. | 22. | 168.0 | 0.292 | 2.642 |
| 68.5 | 10884. | 5895. | * | 126. | 261. | 326. | 23. | 168.0 | 0.292 | 2.642 |
| 69.0 | 10553. | 5716. | * | 118. | 246. | 306. | 24. | 168.0 | 0.292 | 2.642 |
| 69.5 | 10241. | 5561. | * | 112. | 232. | 290. | 26. | 168.6 | 0.291 | 2.652 |
| 70.0 | 10292. | 5588. | * | 114. | 234. | 293. | 25. | 168.6 | 0.291 | 2.652 |
| 70.5 | 10395. | 5644. | * | 116. | 238. | 299. | 25. | 168.6 | 0.291 | 2.652 |
| 71.0 | 10716. | 5818. | * | 123. | 253. | 318. | 24. | 168.6 | 0.291 | 2.652 |
| 71.5 | 10941. | 5941. | * | 128. | 264. | 331. | 23. | 168.6 | 0.291 | 2.652 |
| 72.0 | 10343. | 5616. | * | 115. | 236. | 296. | 25. | 168.6 | 0.291 | 2.652 |
| 72.5 | 10343. | 5616. | * | 115. | 236. | 296. | 25. | 168.6 | 0.291 | 2.652 |
| 73.0 | 10765. | 5859. | * | 125. | 256. | 323. | 23. | 169.2 | 0.290 | 2.662 |
| 73.5 | 10494. | 5712. | * | 119. | 243. | 307. | 24. | 169.2 | 0.290 | 2.662 |
| 74.0 | 10337. | 5627. | * | 116. | 236. | 298. | 25. | 169.2 | 0.290 | 2.662 |
| 74.5 | 10765. | 5859. | * | 125. | 256. | 323. | 23. | 169.2 | 0.290 | 2.662 |
| 75.0 | 11669. | 6351. | * | 147. | 301. | 380. | 20. | 169.2 | 0.290 | 2.662 |
| 75.5 | 12005. | 6534. | * | 156. | 318. | 402. | 19. | 169.2 | 0.290 | 2.662 |
| 76.0 | 12425. | 6779. | * | 168. | 341. | 434. | 18. | 169.9 | 0.288 | 2.672 |
| 76.5 | 13119. | 7158. | * | 188. | 380. | 484. | 16. | 169.9 | 0.288 | 2.672 |
| 77.0 | 13722. | 7504. | * | 207. | 416. | 533. | 15. | 170.5 | 0.287 | 2.682 |
| 77.5 | 14102. | 7712. | * | 219. | 440. | 563. | 14. | 170.5 | 0.287 | 2.682 |
| 78.0 | 13966. | 7656. | * | 216. | 431. | 556. | 15. | 171.1 | 0.285 | 2.692 |
| 78.5 | 13428. | 7378. | * | 202. | 399. | 518. | 16. | 171.7 | 0.284 | 2.702 |
| 79.0 | 12376. | 6785. | * | 170. | 339. | 437. | 18. | 171.1 | 0.285 | 2.692 |
| 79.5 | 11867. | 6490. | * | 155. | 311. | 399. | 20. | 170.5 | 0.287 | 2.682 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. N-61+00
DEPTH 65.0 - 79.5

Figure 2.5-90

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

N-61+00    0.0    0.0    732.50    97.10   2  1  1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 80.0 | 11301. | 6181. | * | 140. | 282. | 362. | 21. | 170.5 | 0.287 | 2.682 |
| 80.5 | 10658. | 5815. | * | 124. | 251. | 319. | 24. | 169.9 | 0.288 | 2.672 |
| 81.0 | 10340. | 5628. | * | 116. | 236. | 298. | 25. | 169.2 | 0.290 | 2.662 |
| 81.5 | 10745. | 5834. | * | 124. | 255. | 320. | 24. | 168.6 | 0.291 | 2.652 |
| 82.0 | 11418. | 6185. | * | 139. | 288. | 358. | 21. | 168.0 | 0.292 | 2.642 |
| 82.5 | 11814. | 6399. | * | 148. | 308. | 384. | 20. | 168.0 | 0.292 | 2.642 |
| 83.0 | 10920. | 5900. | * | 126. | 263. | 325. | 23. | 167.4 | 0.294 | 2.632 |
| 83.5 | 11461. | 6193. | * | 138. | 290. | 358. | 21. | 167.4 | 0.294 | 2.632 |
| 84.0 | 11966. | 6481. | * | 152. | 316. | 393. | 19. | 168.0 | 0.292 | 2.642 |
| 84.5 | 11483. | 6235. | * | 141. | 291. | 365. | 21. | 168.6 | 0.291 | 2.652 |
| 85.0 | 11182. | 6072. | * | 134. | 276. | 346. | 22. | 168.6 | 0.291 | 2.652 |
| 85.5 | 11063. | 6007. | * | 131. | 270. | 339. | 22. | 168.6 | 0.291 | 2.652 |
| 86.0 | 10890. | 5898. | * | 126. | 262. | 326. | 23. | 168.0 | 0.292 | 2.642 |
| 86.5 | 10777. | 5837. | * | 123. | 256. | 319. | 23. | 168.0 | 0.292 | 2.642 |
| 87.0 | 10564. | 5722. | * | 119. | 246. | 307. | 24. | 168.0 | 0.292 | 2.642 |
| 87.5 | 10505. | 5704. | * | 118. | 244. | 306. | 24. | 168.6 | 0.291 | 2.652 |
| 88.0 | 10348. | 5619. | * | 115. | 236. | 296. | 25. | 168.6 | 0.291 | 2.652 |
| 88.5 | 10343. | 5630. | * | 116. | 236. | 298. | 25. | 169.2 | 0.290 | 2.662 |
| 89.0 | 10395. | 5658. | * | 117. | 239. | 301. | 25. | 169.2 | 0.290 | 2.662 |
| 89.5 | 10262. | 5586. | * | 114. | 233. | 294. | 25. | 169.2 | 0.290 | 2.662 |
| 90.0 | 10217. | 5588. | * | 115. | 231. | 295. | 26. | 170.5 | 0.287 | 2.682 |
| 90.5 | 10092. | 5519. | * | 112. | 225. | 288. | 26. | 170.5 | 0.287 | 2.682 |
| 91.0 | 10038. | 5477. | * | 110. | 223. | 283. | 26. | 169.9 | 0.288 | 2.672 |
| 91.5 | 10082. | 5501. | * | 111. | 225. | 286. | 26. | 169.9 | 0.288 | 2.672 |
| 92.0 | 10302. | 5634. | * | 117. | 235. | 300. | 25. | 170.5 | 0.287 | 2.682 |
| 92.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 94.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 94.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

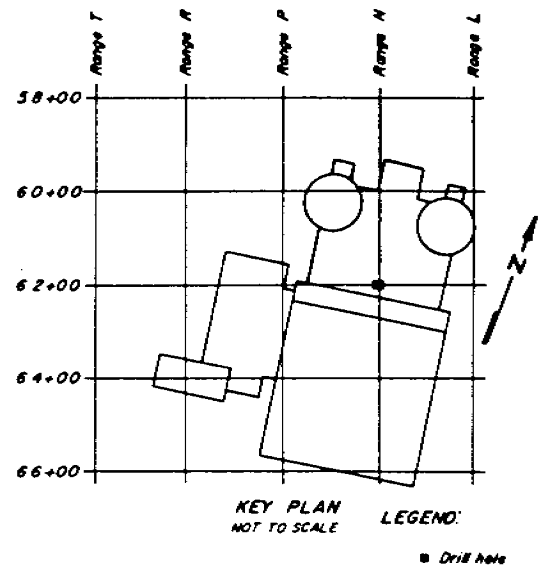
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

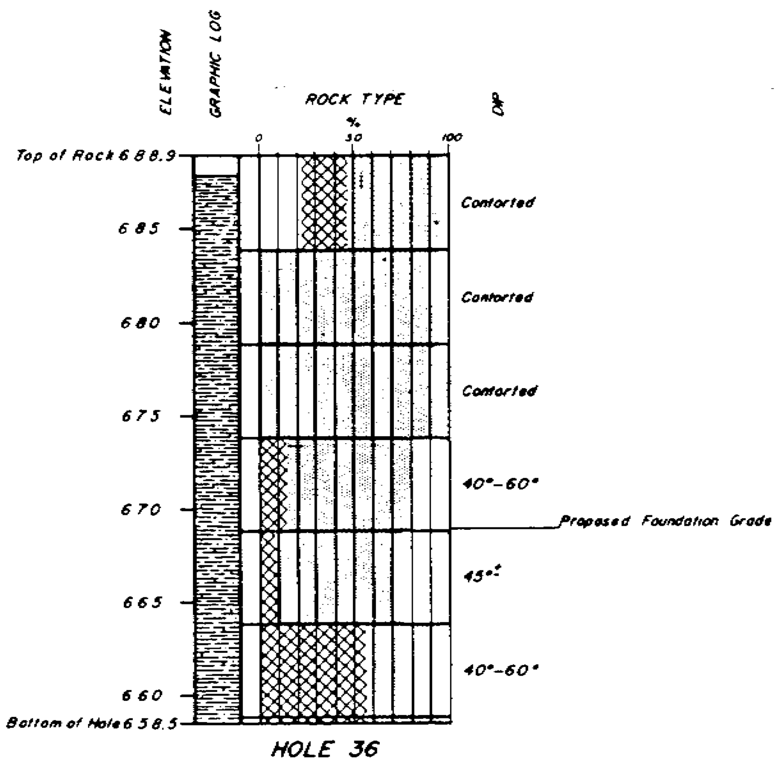
3-D ELASTIC PROPERTIES TABULATION
STA. N-61+00
DEPTH 80.0 - 92.0

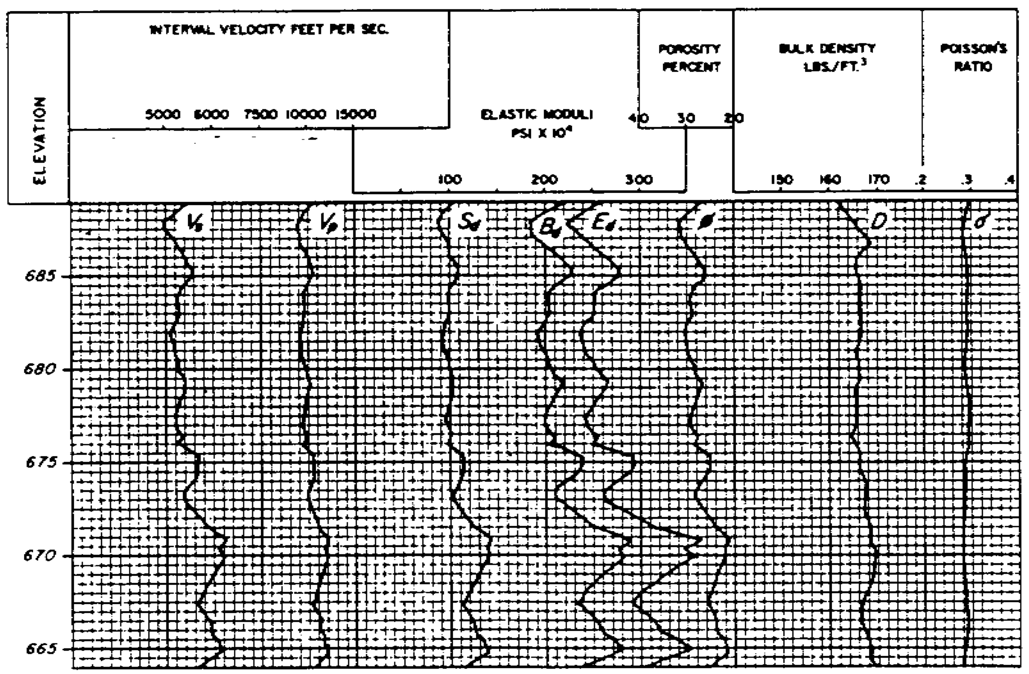
Figure 2.5-91

Best Available Historical Image

# Figure 2.5-92 - Historical




LEGEND:

Vs = Shear Velocity.
Vp = Compressional Velocity.
Sd = Dynamic Shear Modulus.
Bd = Dynamic Bulk Modulus.
Ed = Dynamic Young's Modulus.
Ø = Porosity.
D = Density.
σ = Poisson's Ratio.

NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 688.9 and 663.9. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.

LEGEND

GRAPHIC LOG

0/50 Water Test Packer set showing gal per min/psi

Core Loss

General Rock Description

The foundation rock is composed of the Conasauga Formation. This formation consists of contorted gray-green shales interbedded with lenses of limestones.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

These types were identified from visual inspection of the core. Generally, determinations were made for each five foot length of core in the box.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GRAPHIC LOG AND
ELASTIC MODULI
STA. N-62+00

Figure 2.5-92

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

N-62+00   0.0   0.0   733.90   75.40   1   1   1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 45.0 | 10118. | 5370. | * | 101. | 225. | 264. | 26. | 163.0 | 0.304 | 2.562 |
| 45.5 | 9536. | 5088. | * | 92. | 200. | 239. | 29. | 164.2 | 0.301 | 2.582 |
| 46.0 | 9146. | 4905. | * | 86. | 184. | 223. | 31. | 165.5 | 0.298 | 2.602 |
| 46.5 | 9115. | 4925. | * | 88. | 183. | 227. | 31. | 167.4 | 0.294 | 2.632 |
| 47.0 | 9303. | 5076. | * | 94. | 191. | 243. | 30. | 169.9 | 0.288 | 2.672 |
| 47.5 | 9517. | 5168. | * | 97. | 200. | 251. | 29. | 168.6 | 0.291 | 2.652 |
| 48.0 | 9885. | 5315. | * | 101. | 215. | 262. | 27. | 166.1 | 0.297 | 2.612 |
| 48.5 | 10190. | 5478. | * | 108. | 229. | 279. | 26. | 166.1 | 0.297 | 2.612 |
| 49.0 | 10135. | 5463. | * | 107. | 226. | 278. | 26. | 166.7 | 0.295 | 2.622 |
| 49.5 | 9715. | 5249. | * | 99. | 208. | 257. | 28. | 167.4 | 0.294 | 2.632 |
| 50.0 | 9539. | 5154. | * | 96. | 201. | 248. | 29. | 167.4 | 0.294 | 2.632 |
| 50.5 | 9587. | 5180. | * | 97. | 203. | 251. | 29. | 167.4 | 0.294 | 2.632 |
| 51.0 | 9591. | 5183. | * | 97. | 203. | 251. | 29. | 167.4 | 0.294 | 2.632 |
| 51.5 | 9415. | 5087. | * | 93. | 195. | 242. | 30. | 167.4 | 0.294 | 2.632 |
| 52.0 | 9319. | 5035. | * | 92. | 191. | 237. | 30. | 167.4 | 0.294 | 2.632 |
| 52.5 | 9389. | 5061. | * | 92. | 194. | 239. | 30. | 166.7 | 0.295 | 2.622 |
| 53.0 | 9483. | 5098. | * | 93. | 198. | 242. | 29. | 166.1 | 0.297 | 2.612 |
| 53.5 | 9596. | 5172. | * | 96. | 203. | 249. | 29. | 166.7 | 0.295 | 2.622 |
| 54.0 | 9689. | 5222. | * | 98. | 207. | 254. | 28. | 166.7 | 0.295 | 2.622 |
| 54.5 | 9939. | 5357. | * | 103. | 218. | 267. | 27. | 166.7 | 0.295 | 2.622 |
| 55.0 | 9925. | 5336. | * | 102. | 217. | 265. | 27. | 166.1 | 0.297 | 2.612 |
| 55.5 | 9741. | 5237. | * | 98. | 209. | 255. | 28. | 166.1 | 0.297 | 2.612 |
| 56.0 | 9622. | 5173. | * | 96. | 204. | 249. | 29. | 166.1 | 0.297 | 2.612 |
| 56.5 | 9500. | 5108. | * | 93. | 199. | 242. | 29. | 166.1 | 0.297 | 2.612 |
| 57.0 | 9530. | 5124. | * | 94. | 200. | 244. | 29. | 166.1 | 0.297 | 2.612 |
| 57.5 | 9801. | 5256. | * | 99. | 211. | 256. | 28. | 165.5 | 0.298 | 2.602 |
| 58.0 | 9626. | 5175. | * | 96. | 204. | 249. | 28. | 166.1 | 0.297 | 2.612 |
| 58.5 | 10374. | 5591. | * | 112. | 237. | 291. | 25. | 166.7 | 0.295 | 2.622 |
| 59.0 | 10425. | 5619. | * | 114. | 240. | 294. | 25. | 166.7 | 0.295 | 2.622 |
| 59.5 | 10289. | 5559. | * | 112. | 233. | 289. | 25. | 167.4 | 0.294 | 2.632 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. N-62+00
DEPTH 45.0 - 59.5
Figure 2.5-93

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

N-62+00   0.0   0.0   733.90   75.40   1   1   1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

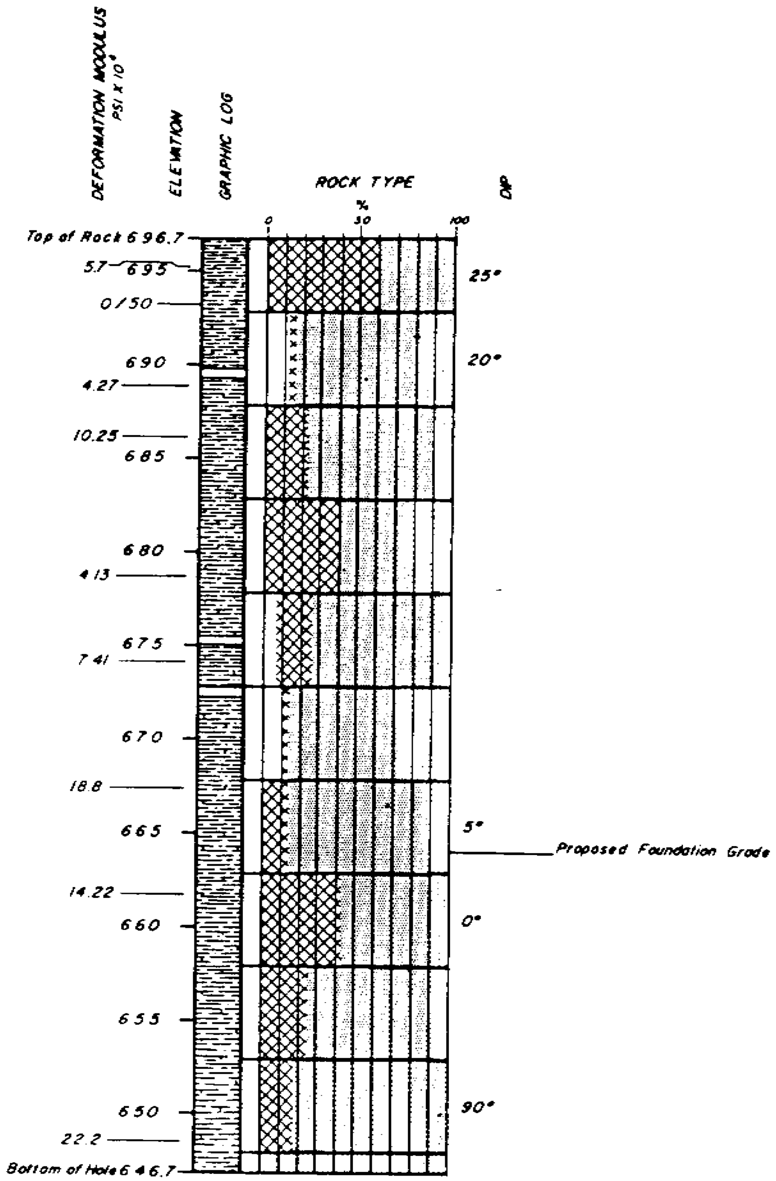
| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 60.0 | 10011. | 5423. | * | 107. | 221. | 275. | 27. | 168.0 | 0.292 | 2.642 |
| 60.5 | 9724. | 5267. | * | 101. | 209. | 260. | 28. | 168.0 | 0.292 | 2.642 |
| 61.0 | 9760. | 5287. | * | 101. | 210. | 262. | 28. | 168.0 | 0.292 | 2.642 |
| 61.5 | 10130. | 5487. | * | 109. | 226. | 282. | 26. | 168.0 | 0.292 | 2.642 |
| 62.0 | 10442. | 5670. | * | 117. | 241. | 302. | 25. | 168.6 | 0.291 | 2.652 |
| 62.5 | 10713. | 5831. | * | 124. | 253. | 320. | 24. | 169.2 | 0.290 | 2.662 |
| 63.0 | 11449. | 6231. | * | 142. | 289. | 366. | 21. | 169.2 | 0.290 | 2.662 |
| 63.5 | 11153. | 6085. | * | 136. | 275. | 350. | 22. | 169.9 | 0.288 | 2.672 |
| 64.0 | 11332. | 6183. | * | 140. | 284. | 361. | 21. | 169.9 | 0.288 | 2.672 |
| 64.5 | 11018. | 6011. | * | 132. | 268. | 341. | 22. | 169.9 | 0.288 | 2.672 |
| 65.0 | 10848. | 5905. | * | 127. | 260. | 328. | 23. | 169.2 | 0.290 | 2.662 |
| 65.5 | 10576. | 5743. | * | 120. | 247. | 310. | 24. | 168.6 | 0.291 | 2.652 |
| 66.0 | 10380. | 5622. | * | 115. | 238. | 296. | 25. | 168.0 | 0.292 | 2.642 |
| 66.5 | 10278. | 5554. | * | 111. | 233. | 288. | 25. | 167.4 | 0.294 | 2.632 |
| 67.0 | 10477. | 5661. | * | 116. | 242. | 299. | 25. | 167.4 | 0.294 | 2.632 |
| 67.5 | 10750. | 5808. | * | 122. | 255. | 315. | 24. | 167.4 | 0.294 | 2.632 |
| 68.0 | 10811. | 5856. | * | 124. | 258. | 321. | 23. | 168.0 | 0.292 | 2.642 |
| 68.5 | 11147. | 6052. | * | 133. | 274. | 344. | 22. | 168.6 | 0.291 | 2.652 |
| 69.0 | 11319. | 6161. | * | 139. | 283. | 357. | 21. | 169.2 | 0.290 | 2.662 |
| 69.5 | 10805. | 5881. | * | 126. | 258. | 326. | 23. | 169.2 | 0.290 | 2.662 |
| 70.0 | 10184. | 5557. | * | 113. | 229. | 291. | 26. | 169.9 | 0.288 | 2.672 |
| 70.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 71.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 71.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 72.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 72.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 73.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 73.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 74.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 74.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

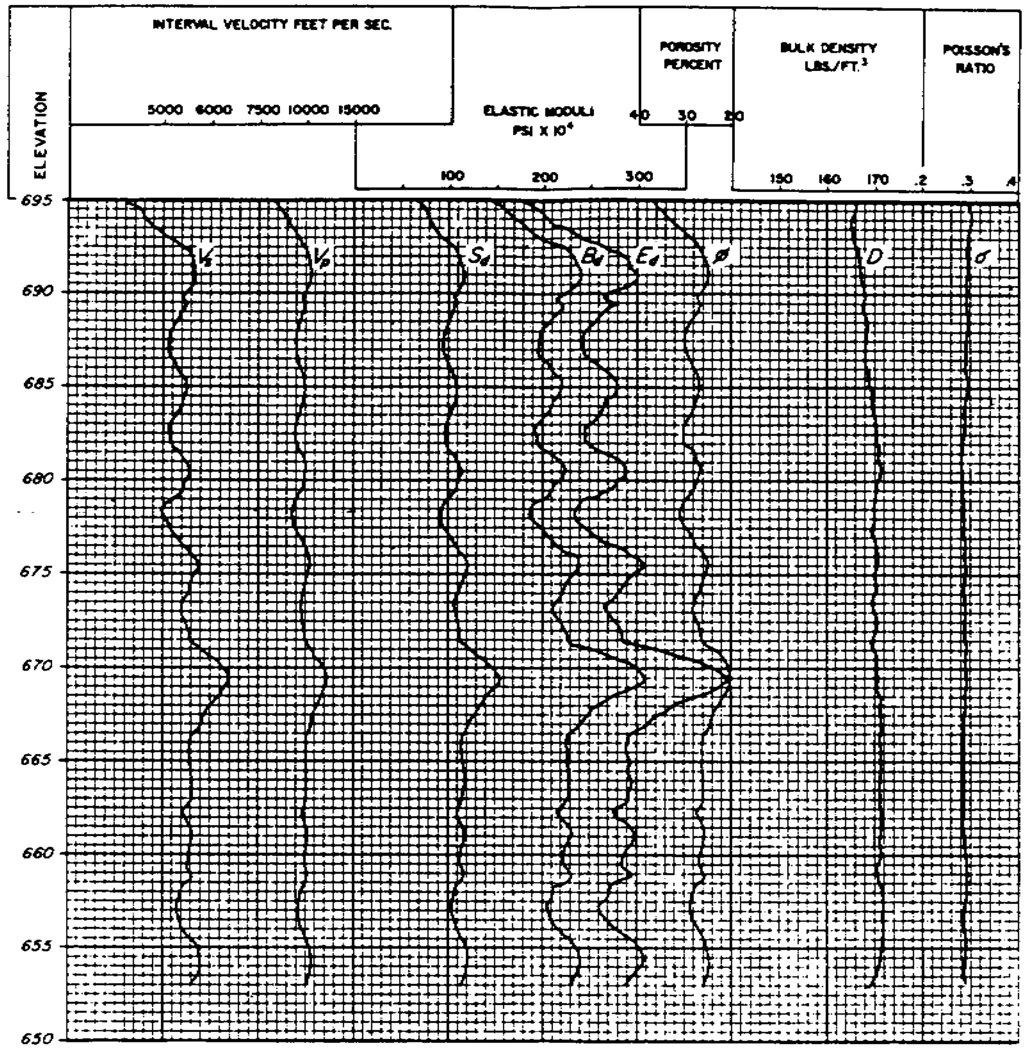
3-D ELASTIC PROPERTIES TABULATION
STA. N-62+00
DEPTH 60.0 - 70.0

Figure 2.5-94

Best Available Historical Image




HOLE 41




LEGEND:

Vs = Shear Velocity.

Vp = Compressional Velocity.

Sd = Dynamic Shear Modulus.

Bd = Dynamic Bulk Modulus.

Ed = Dynamic Young's Modulus.

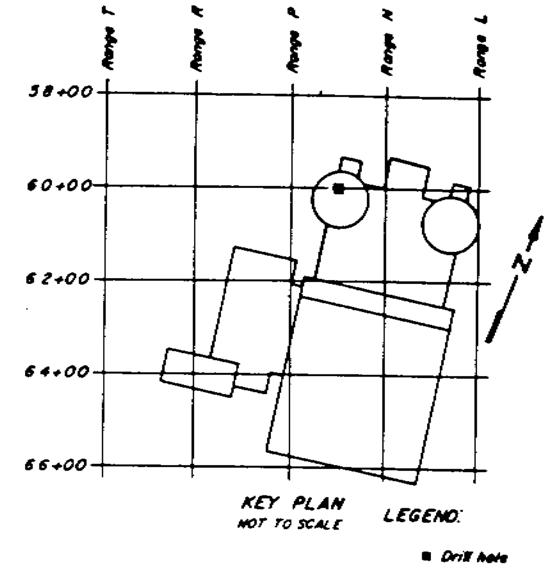
Ø = Porosity.

D = Density.

σ = Poisson's Ratio.

NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 696.8 and 650.8. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.

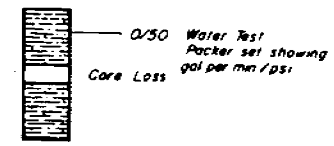



KEY PLAN
NOT TO SCALE

LEGEND:
▪ Drill hole

LEGEND:

GRAPHIC LOG




General Rock Description

The foundation rock is composed of the Conasauga Formation. This formation consists of contorted gray-green shales interbedded with lenses of limestones.

ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10⁴)

Type 0 - Core loss

Type 1 - Soft shale 1 to 10

Type 2 - Hard shale 5 to 60

Type 3 - Limestone 100+

These types were identified from visual inspection of the core. Generally, determination were made for each five foot length of core in the box.

HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Graphic Log and
Elastic Moduli
STA. O-60+00
FIGURE 2.5-95

B I R D W E L L  3-D  E L A S T I C  P R O P E R T I E S  T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-60+00 0.0 0.0 732.80 86.10 5 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 38.0 | 8262. | 4442. | * | 71. | 150. | 183. | 37. | 166.1 | 0.297 | 2.612 |
| 38.5 | 8638. | 4632. | * | 77. | 164. | 199. | 34. | 165.5 | 0.298 | 2.602 |
| 39.0 | 8855. | 4737. | * | 80. | 172. | 207. | 33. | 164.9 | 0.300 | 2.592 |
| 39.5 | 9260. | 4953. | * | 87. | 189. | 227. | 30. | 164.9 | 0.300 | 2.592 |
| 40.0 | 9613. | 5155. | * | 95. | 203. | 246. | 29. | 165.5 | 0.298 | 2.602 |
| 40.5 | 10186. | 5476. | * | 107. | 229. | 279. | 26. | 166.1 | 0.297 | 2.612 |
| 41.0 | 10382. | 5596. | * | 113. | 238. | 292. | 25. | 166.7 | 0.295 | 2.622 |
| 41.5 | 10424. | 5618. | * | 114. | 239. | 294. | 25. | 166.7 | 0.295 | 2.622 |
| 42.0 | 10488. | 5667. | * | 116. | 243. | 300. | 25. | 167.4 | 0.294 | 2.632 |
| 42.5 | 10340. | 5587. | * | 113. | 236. | 292. | 25. | 167.4 | 0.294 | 2.632 |
| 43.0 | 9839. | 5329. | * | 103. | 214. | 266. | 27. | 168.0 | 0.292 | 2.642 |
| 43.5 | 10081. | 5447. | * | 107. | 224. | 277. | 26. | 167.4 | 0.294 | 2.632 |
| 44.0 | 9792. | 5304. | * | 102. | 212. | 263. | 28. | 168.0 | 0.292 | 2.642 |
| 44.5 | 9568. | 5182. | * | 97. | 202. | 252. | 29. | 168.0 | 0.292 | 2.642 |
| 45.0 | 9388. | 5085. | * | 94. | 194. | 242. | 30. | 168.0 | 0.292 | 2.642 |
| 45.5 | 9383. | 5083. | * | 94. | 194. | 242. | 30. | 168.0 | 0.292 | 2.642 |
| 46.0 | 9383. | 5083. | * | 94. | 194. | 242. | 30. | 168.0 | 0.292 | 2.642 |
| 46.5 | 9603. | 5202. | * | 98. | 203. | 253. | 29. | 168.0 | 0.292 | 2.642 |
| 47.0 | 9740. | 5289. | * | 102. | 209. | 263. | 28. | 168.6 | 0.291 | 2.652 |
| 47.5 | 10021. | 5441. | * | 108. | 222. | 278. | 27. | 168.6 | 0.291 | 2.652 |
| 48.0 | 10016. | 5452. | * | 109. | 222. | 280. | 27. | 169.2 | 0.290 | 2.662 |
| 48.5 | 9824. | 5347. | * | 104. | 213. | 269. | 27. | 169.2 | 0.290 | 2.662 |
| 49.0 | 9731. | 5297. | * | 102. | 209. | 264. | 28. | 169.2 | 0.290 | 2.662 |
| 49.5 | 9550. | 5210. | * | 99. | 202. | 256. | 29. | 169.9 | 0.288 | 2.672 |
| 50.0 | 9294. | 5071. | * | 94. | 191. | 243. | 30. | 169.9 | 0.288 | 2.672 |
| 50.5 | 9336. | 5094. | * | 95. | 193. | 245. | 30. | 169.9 | 0.288 | 2.672 |
| 51.0 | 9379. | 5129. | * | 97. | 194. | 249. | 30. | 170.5 | 0.287 | 2.682 |
| 51.5 | 9736. | 5325. | * | 104. | 210. | 268. | 28. | 170.5 | 0.287 | 2.682 |
| 52.0 | 10071. | 5521. | * | 112. | 224. | 289. | 26. | 171.1 | 0.285 | 2.692 |
| 52.5 | 10076. | 5524. | * | 113. | 225. | 289. | 26. | 171.1 | 0.285 | 2.692 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-60+00
DEPTH 38.0 - 52.5

Figure 2.5-96

Best Available Historical Image

BIRDWELL 3-D ELASTIC PROPERTIES TABULATION

TENNESSEE VALLEY AUTHORITY
O-60+00 0.0 0.0 732.80 86.10 5 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
| 53.0 | 9881. | 5404. | * | 107. | 216. | 276. | 27. | 170.5 | 0.287 | 2.682 |
| 53.5 | 9736. | 5325. | * | 104. | 210. | 268. | 28. | 170.5 | 0.287 | 2.682 |
| 54.0 | 9252. | 5048. | * | 93. | 189. | 241. | 30. | 169.9 | 0.288 | 2.672 |
| 54.5 | 9128. | 4980. | * | 91. | 184. | 234. | 31. | 169.9 | 0.288 | 2.672 |
| 55.0 | 9132. | 4982. | * | 91. | 184. | 234. | 31. | 169.9 | 0.288 | 2.672 |
| 55.5 | 9440. | 5138. | * | 96. | 197. | 249. | 29. | 169.2 | 0.290 | 2.662 |
| 56.0 | 9663. | 5272. | * | 102. | 206. | 262. | 28. | 169.9 | 0.288 | 2.672 |
| 56.5 | 9924. | 5428. | * | 108. | 218. | 279. | 27. | 170.5 | 0.287 | 2.682 |
| 57.0 | 10376. | 5675. | * | 118. | 238. | 305. | 25. | 170.5 | 0.287 | 2.682 |
| 57.5 | 10429. | 5704. | * | 120. | 240. | 308. | 25. | 170.5 | 0.287 | 2.682 |
| 58.0 | 10191. | 5561. | * | 113. | 230. | 292. | 26. | 169.9 | 0.288 | 2.672 |
| 58.5 | 10047. | 5495. | * | 111. | 223. | 286. | 26. | 170.5 | 0.287 | 2.682 |
| 59.0 | 9983. | 5434. | * | 108. | 220. | 278. | 27. | 169.2 | 0.290 | 2.662 |
| 59.5 | 9745. | 5304. | * | 103. | 210. | 265. | 28. | 169.2 | 0.290 | 2.662 |
| 60.0 | 9787. | 5340. | * | 104. | 212. | 269. | 28. | 169.9 | 0.288 | 2.672 |
| 60.5 | 9929. | 5417. | * | 108. | 218. | 277. | 27. | 169.9 | 0.288 | 2.672 |
| 61.0 | 10076. | 5497. | * | 111. | 224. | 285. | 26. | 169.9 | 0.288 | 2.672 |
| 61.5 | 10126. | 5511. | * | 111. | 226. | 286. | 26. | 169.2 | 0.290 | 2.662 |
| 62.0 | 10707. | 5842. | * | 125. | 253. | 322. | 24. | 169.9 | 0.288 | 2.672 |
| 62.5 | 11415. | 6228. | * | 142. | 288. | 366. | 21. | 169.9 | 0.288 | 2.672 |
| 63.0 | 11734. | 6417. | * | 151. | 304. | 390. | 20. | 170.5 | 0.287 | 2.682 |
| 63.5 | 11869. | 6491. | * | 155. | 311. | 399. | 20. | 170.5 | 0.287 | 2.682 |
| 64.0 | 11601. | 6345. | * | 148. | 298. | 381. | 20. | 170.5 | 0.287 | 2.682 |
| 64.5 | 11160. | 6118. | * | 138. | 276. | 355. | 22. | 171.1 | 0.285 | 2.692 |
| 65.0 | 10808. | 5925. | * | 130. | 258. | 333. | 23. | 171.1 | 0.285 | 2.692 |
| 65.5 | 10585. | 5803. | * | 124. | 248. | 319. | 24. | 171.1 | 0.285 | 2.692 |
| 66.0 | 10424. | 5714. | * | 121. | 240. | 310. | 25. | 171.1 | 0.285 | 2.692 |
| 66.5 | 10110. | 5542. | * | 113. | 226. | 291. | 26. | 171.1 | 0.285 | 2.692 |
| 67.0 | 10061. | 5515. | * | 112. | 224. | 289. | 26. | 171.1 | 0.285 | 2.692 |
| 67.5 | 10066. | 5518. | * | 112. | 224. | 289. | 26. | 171.1 | 0.285 | 2.692 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. O-60+00
DEPTH 53.0 - 67.5
Figure 2.5-97

Best Available Historical Image

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
O-60+00   0.0   0.0   732.80   86.10   5 1 1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

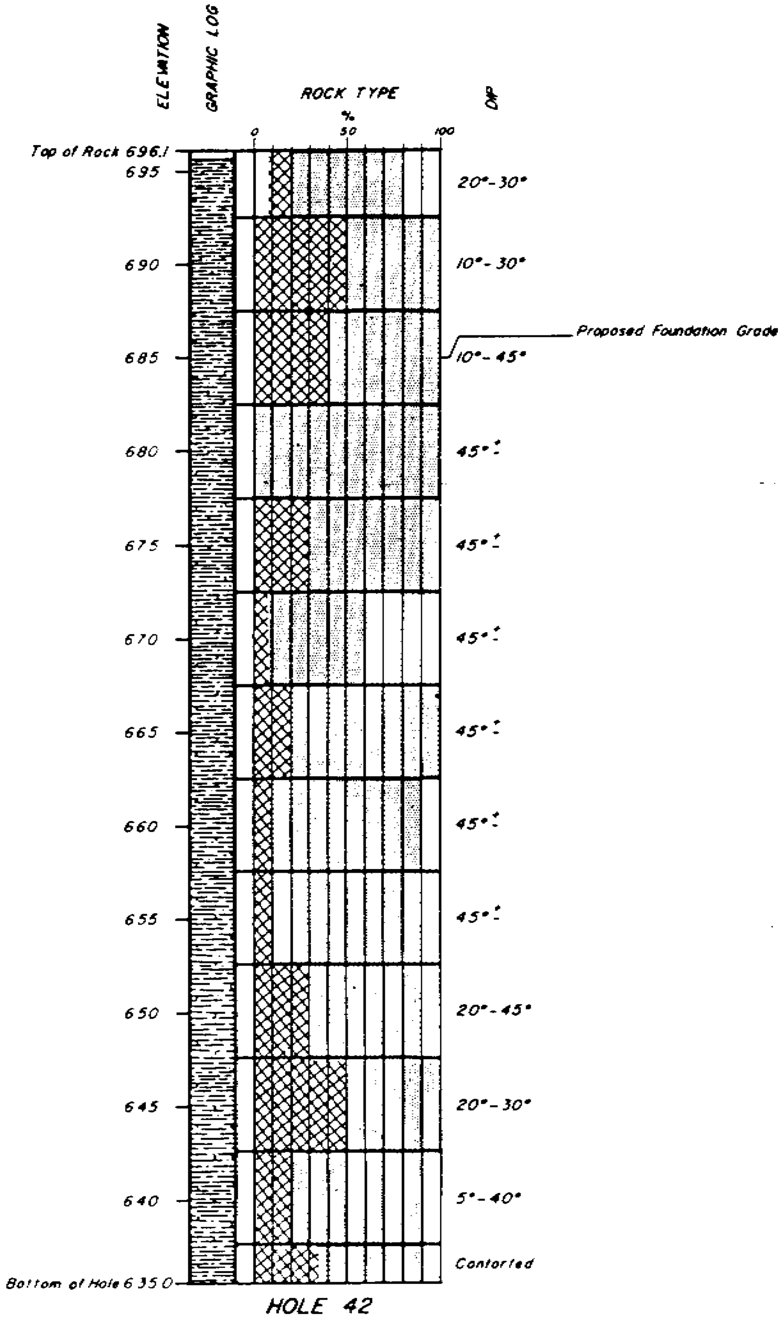
| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
| 68.0 | 10115. | 5545. | * | 113. | 226. | 292. | 26. | 171.1 | 0.285 | 2.692 |
| 68.5 | 10115. | 5545. | * | 113. | 226. | 292. | 26. | 171.1 | 0.285 | 2.692 |
| 69.0 | 10160. | 5570. | * | 115. | 228. | 294. | 26. | 171.1 | 0.285 | 2.692 |
| 69.5 | 10110. | 5542. | * | 113. | 226. | 291. | 26. | 171.1 | 0.285 | 2.692 |
| 70.0 | 10120. | 5548. | * | 114. | 227. | 292. | 26. | 171.1 | 0.285 | 2.692 |
| 70.5 | 9829. | 5388. | * | 107. | 214. | 275. | 27. | 171.1 | 0.285 | 2.692 |
| 71.0 | 9963. | 5462. | * | 110. | 220. | 283. | 27. | 171.1 | 0.285 | 2.692 |
| 71.5 | 10160. | 5570. | * | 115. | 228. | 294. | 26. | 171.1 | 0.285 | 2.692 |
| 72.0 | 10211. | 5598. | * | 116. | 231. | 297. | 26. | 171.1 | 0.285 | 2.692 |
| 72.5 | 10071. | 5521. | * | 112. | 224. | 289. | 26. | 171.1 | 0.285 | 2.692 |
| 73.0 | 9973. | 5467. | * | 110. | 220. | 284. | 27. | 171.1 | 0.285 | 2.692 |
| 73.5 | 10055. | 5499. | * | 111. | 224. | 286. | 26. | 170.5 | 0.287 | 2.682 |
| 74.0 | 10257. | 5609. | * | 116. | 233. | 298. | 25. | 170.5 | 0.287 | 2.682 |
| 74.5 | 9815. | 5380. | * | 107. | 213. | 275. | 27. | 171.1 | 0.285 | 2.692 |
| 75.0 | 9722. | 5329. | * | 105. | 209. | 269. | 28. | 171.1 | 0.285 | 2.692 |
| 75.5 | 9585. | 5255. | * | 102. | 203. | 262. | 29. | 171.1 | 0.285 | 2.692 |
| 76.0 | 9585. | 5255. | * | 102. | 203. | 262. | 29. | 171.1 | 0.285 | 2.692 |
| 76.5 | 9722. | 5329. | * | 105. | 209. | 269. | 28. | 171.1 | 0.285 | 2.692 |
| 77.0 | 9910. | 5432. | * | 109. | 217. | 280. | 27. | 171.1 | 0.285 | 2.692 |
| 77.5 | 10206. | 5595. | * | 116. | 230. | 297. | 26. | 171.1 | 0.285 | 2.692 |
| 78.0 | 10360. | 5679. | * | 119. | 237. | 306. | 25. | 171.1 | 0.285 | 2.692 |
| 78.5 | 10407. | 5705. | * | 120. | 240. | 309. | 25. | 171.1 | 0.285 | 2.692 |
| 79.0 | 10413. | 5695. | * | 119. | 240. | 307. | 25. | 170.5 | 0.287 | 2.682 |
| 79.5 | 10308. | 5624. | * | 116. | 235. | 299. | 25. | 169.9 | 0.288 | 2.672 |
| 80.0 | 10155. | 5514. | * | 111. | 228. | 286. | 26. | 168.6 | 0.291 | 2.652 |
| 80.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 81.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 81.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 82.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 82.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

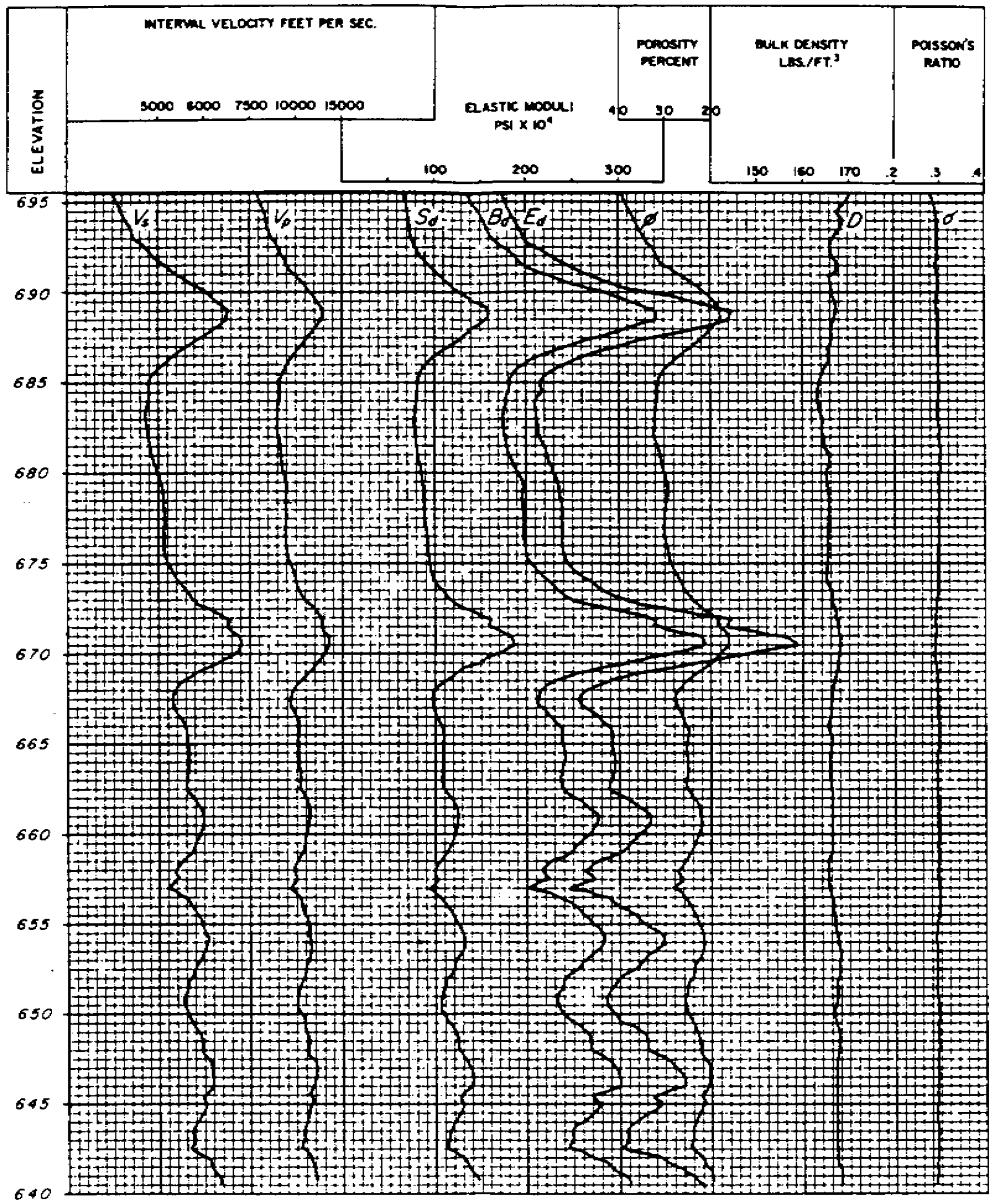
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. O-60+00
DEPTH 68.0 - 80.0

Figure 2.5-98

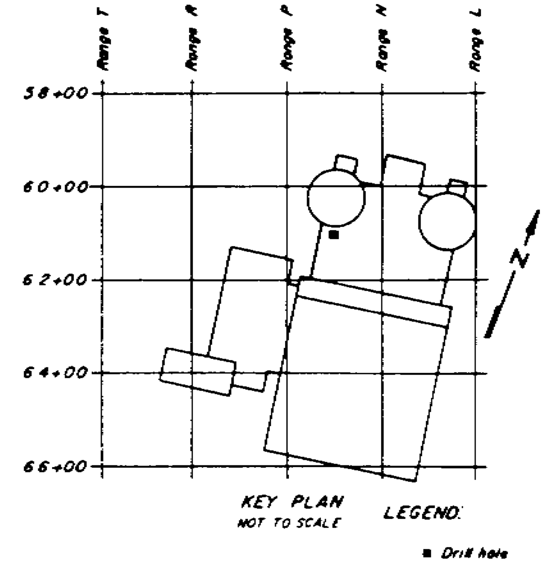
Best Available Historical Image




LEGEND:

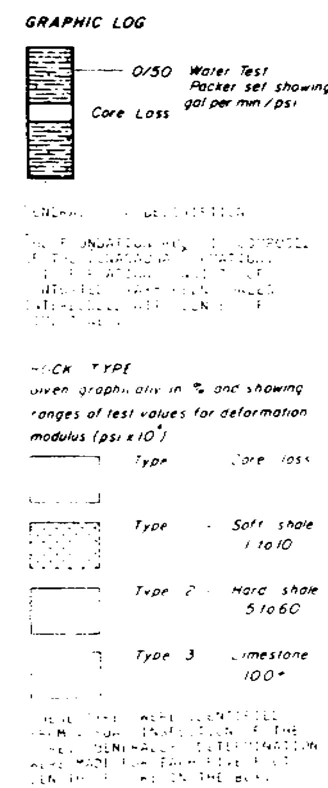
Vs = Shear Velocity.
Vp = Compressional Velocity.
Sd = Dynamic Shear Modulus.
Bd = Dynamic Bulk Modulus.
Ed = Dynamic Young's Modulus.
Ø = Porosity.
D = Density.
σ = Poisson's Ratio.




NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 696.1 and 639.5. The inspection showed the core loss area to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.

*LEGEND*




HISTORICAL INFORMATION"

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| Graphic Log and Elastic Moduli STA. O-61+00 FIGURE 2.5-99 |

BIRDWELL 3-D ELASTIC PROPERTIES TABULATION

TENNESSEE VALLEY AUTHORITY

0-61+00 0.0 0.0 732.50 97.50 4 1 1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MODULI IN 10 TO 4TH LBS/SQ. INCH | | | | | | |
| 37.0 | 7834. | 4285. | * | 68. | 136. | 174. | 40. | 170.5 | 0.287 | 2.682 |
| 37.5 | 7988. | 4338. | * | 68. | 141. | 177. | 39. | 168.6 | 0.291 | 2.652 |
| 38.0 | 8140. | 4398. | * | 70. | 146. | 181. | 38. | 167.4 | 0.294 | 2.632 |
| 38.5 | 8234. | 4471. | * | 73. | 150. | 188. | 37. | 168.6 | 0.291 | 2.652 |
| 39.0 | 8407. | 4543. | * | 75. | 156. | 193. | 36. | 167.4 | 0.294 | 2.632 |
| 39.5 | 8539. | 4591. | * | 76. | 161. | 196. | 35. | 166.1 | 0.297 | 2.612 |
| 40.0 | 8902. | 4786. | * | 82. | 175. | 213. | 33. | 166.1 | 0.297 | 2.612 |
| 40.5 | 9126. | 4919. | * | 87. | 184. | 225. | 31. | 166.7 | 0.295 | 2.622 |
| 41.0 | 9455. | 5121. | * | 95. | 197. | 246. | 29. | 168.0 | 0.292 | 2.642 |
| 41.5 | 10067. | 5398. | * | 104. | 223. | 270. | 26. | 165.5 | 0.298 | 2.602 |
| 42.0 | 10632. | 5716. | * | 117. | 249. | 304. | 24. | 166.1 | 0.297 | 2.612 |
| 42.5 | 11380. | 6134. | * | 135. | 285. | 351. | 21. | 166.7 | 0.295 | 2.622 |
| 43.0 | 11960. | 6446. | * | 149. | 315. | 387. | 19. | 166.7 | 0.295 | 2.622 |
| 43.5 | 12467. | 6736. | * | 164. | 343. | 424. | 18. | 167.4 | 0.294 | 2.632 |
| 44.0 | 12467. | 6720. | * | 162. | 343. | 421. | 18. | 166.7 | 0.295 | 2.622 |
| 44.5 | 11824. | 6357. | * | 145. | 308. | 376. | 20. | 166.1 | 0.297 | 2.612 |
| 45.0 | 11131. | 5984. | * | 128. | 273. | 333. | 22. | 166.1 | 0.297 | 2.612 |
| 45.5 | 10408. | 5582. | * | 111. | 238. | 289. | 25. | 165.5 | 0.298 | 2.602 |
| 46.0 | 9871. | 5293. | * | 100. | 214. | 260. | 27. | 165.5 | 0.298 | 2.602 |
| 46.5 | 9385. | 5020. | * | 90. | 194. | 233. | 30. | 164.9 | 0.300 | 2.592 |
| 47.0 | 9174. | 4895. | * | 85. | 185. | 221. | 31. | 164.2 | 0.301 | 2.582 |
| 47.5 | 9054. | 4818. | * | 82. | 180. | 213. | 32. | 163.6 | 0.302 | 2.572 |
| 48.0 | 9058. | 4820. | * | 82. | 180. | 214. | 32. | 163.6 | 0.302 | 2.572 |
| 48.5 | 8983. | 4780. | * | 81. | 177. | 210. | 32. | 163.6 | 0.302 | 2.572 |
| 49.0 | 8983. | 4780. | * | 81. | 177. | 210. | 32. | 163.6 | 0.302 | 2.572 |
| 49.5 | 8983. | 4793. | * | 81. | 177. | 212. | 32. | 164.2 | 0.301 | 2.582 |
| 50.0 | 8983. | 4793. | * | 81. | 177. | 212. | 32. | 164.2 | 0.301 | 2.582 |
| 50.5 | 9026. | 4828. | * | 83. | 179. | 215. | 32. | 164.9 | 0.300 | 2.592 |
| 51.0 | 9066. | 4849. | * | 84. | 181. | 217. | 32. | 164.9 | 0.300 | 2.592 |
| 51.5 | 9142. | 4902. | * | 86. | 184. | 223. | 31. | 165.5 | 0.298 | 2.602 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-61+00
DEPTH 37.0 - 51.5

Figure 2.5-100

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-61+00   0.0   0.0   732.50   97.50   4   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 52.0 | 9223. | 4946. | * | 87. | 187. | 227. | 31. | 165.5 | 0.298 | 2.602 |
| 52.5 | 9305. | 4990. | * | 89. | 191. | 231. | 30. | 165.5 | 0.298 | 2.602 |
| 53.0 | 9432. | 5058. | * | 91. | 196. | 237. | 30. | 165.5 | 0.298 | 2.602 |
| 53.5 | 9428. | 5056. | * | 91. | 196. | 237. | 30. | 165.5 | 0.298 | 2.602 |
| 54.0 | 9471. | 5079. | * | 92. | 197. | 239. | 29. | 165.5 | 0.298 | 2.602 |
| 54.5 | 9471. | 5079. | * | 92. | 197. | 239. | 29. | 165.5 | 0.298 | 2.602 |
| 55.0 | 9471. | 5079. | * | 92. | 197. | 239. | 29. | 165.5 | 0.298 | 2.602 |
| 55.5 | 9466. | 5077. | * | 92. | 197. | 239. | 29. | 165.5 | 0.298 | 2.602 |
| 56.0 | 9510. | 5100. | * | 93. | 199. | 241. | 29. | 165.5 | 0.298 | 2.602 |
| 56.5 | 9514. | 5102. | * | 93. | 199. | 241. | 29. | 165.5 | 0.298 | 2.602 |
| 57.0 | 9514. | 5102. | * | 93. | 199. | 241. | 29. | 165.5 | 0.298 | 2.602 |
| 57.5 | 9642. | 5171. | * | 95. | 205. | 248. | 28. | 165.5 | 0.298 | 2.602 |
| 58.0 | 9871. | 5293. | * | 100. | 214. | 260. | 27. | 165.5 | 0.298 | 2.602 |
| 58.5 | 10062. | 5396. | * | 104. | 223. | 270. | 26. | 165.5 | 0.298 | 2.602 |
| 59.0 | 10316. | 5546. | * | 110. | 234. | 286. | 25. | 166.1 | 0.297 | 2.612 |
| 59.5 | 10632. | 5716. | * | 117. | 249. | 304. | 24. | 166.1 | 0.297 | 2.612 |
| 60.0 | 11442. | 6167. | * | 137. | 289. | 354. | 21. | 166.7 | 0.295 | 2.622 |
| 60.5 | 12459. | 6732. | * | 164. | 342. | 423. | 18. | 167.4 | 0.294 | 2.632 |
| 61.0 | 12385. | 6692. | * | 162. | 338. | 418. | 18. | 167.4 | 0.294 | 2.632 |
| 61.5 | 13333. | 7222. | * | 189. | 392. | 489. | 16. | 168.0 | 0.292 | 2.642 |
| 62.0 | 13428. | 7273. | * | 192. | 398. | 496. | 16. | 168.0 | 0.292 | 2.642 |
| 62.5 | 12772. | 6918. | * | 173. | 360. | 448. | 17. | 168.0 | 0.292 | 2.642 |
| 63.0 | 11832. | 6393. | * | 148. | 309. | 382. | 20. | 167.4 | 0.294 | 2.632 |
| 63.5 | 10904. | 5892. | * | 125. | 262. | 324. | 23. | 167.4 | 0.294 | 2.632 |
| 64.0 | 10260. | 5530. | * | 110. | 232. | 285. | 26. | 166.7 | 0.295 | 2.622 |
| 64.5 | 9829. | 5284. | * | 100. | 213. | 259. | 27. | 166.1 | 0.297 | 2.612 |
| 65.0 | 9783. | 5259. | * | 99. | 211. | 257. | 28. | 166.1 | 0.297 | 2.612 |
| 65.5 | 9875. | 5309. | * | 101. | 215. | 262. | 27. | 166.1 | 0.297 | 2.612 |
| 66.0 | 10110. | 5436. | * | 106. | 225. | 275. | 26. | 166.1 | 0.297 | 2.612 |
| 66.5 | 10414. | 5585. | * | 111. | 239. | 289. | 25. | 165.5 | 0.298 | 2.602 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-61+00
DEPTH 52.0 - 66.5
Figure 2.5-101

# B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-61+00    0.0    0.0    732.50    97.50  4  1  1
WATTS BAR NUCLEAR PLANT,  RHEA COUNTY,  TENNESSEE

| DEPTH | VP | VS | | MODULI IN 10 TO 4TH LBS/SQ. INCH SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 67.0 | 10362. | 5571. | * | 111. | 236. | 288. | 25. | 166.1 | 0.297 | 2.612 |
| 67.5 | 10414. | 5599. | * | 112. | 239. | 291. | 25. | 166.1 | 0.297 | 2.612 |
| 68.0 | 10466. | 5627. | * | 113. | 241. | 294. | 25. | 166.1 | 0.297 | 2.612 |
| 68.5 | 10466. | 5627. | * | 113. | 241. | 294. | 25. | 166.1 | 0.297 | 2.612 |
| 69.0 | 10414. | 5599. | * | 112. | 239. | 291. | 25. | 166.1 | 0.297 | 2.612 |
| 69.5 | 10357. | 5568. | * | 111. | 236. | 288. | 25. | 166.1 | 0.297 | 2.612 |
| 70.0 | 10408. | 5596. | * | 112. | 239. | 291. | 25. | 166.1 | 0.297 | 2.612 |
| 70.5 | 10785. | 5799. | * | 120. | 256. | 312. | 23. | 166.1 | 0.297 | 2.612 |
| 71.0 | 11013. | 5921. | * | 126. | 267. | 326. | 23. | 166.1 | 0.297 | 2.612 |
| 71.5 | 11197. | 6020. | * | 130. | 276. | 337. | 22. | 166.1 | 0.297 | 2.612 |
| 72.0 | 11137. | 5988. | * | 128. | 273. | 333. | 22. | 166.1 | 0.297 | 2.612 |
| 72.5 | 10961. | 5893. | * | 124. | 265. | 323. | 23. | 166.1 | 0.297 | 2.612 |
| 73.0 | 10785. | 5799. | * | 120. | 256. | 312. | 23. | 166.1 | 0.297 | 2.612 |
| 73.5 | 10572. | 5684. | * | 116. | 246. | 300. | 24. | 166.1 | 0.297 | 2.612 |
| 74.0 | 10160. | 5448. | * | 106. | 227. | 275. | 26. | 165.5 | 0.298 | 2.602 |
| 74.5 | 9918. | 5319. | * | 101. | 216. | 262. | 27. | 165.5 | 0.298 | 2.602 |
| 75.0 | 10116. | 5425. | * | 105. | 225. | 273. | 26. | 165.5 | 0.298 | 2.602 |
| 75.5 | 9558. | 5126. | * | 94. | 201. | 243. | 29. | 165.5 | 0.298 | 2.602 |
| 76.0 | 10367. | 5574. | * | 111. | 237. | 289. | 25. | 166.1 | 0.297 | 2.612 |
| 76.5 | 10632. | 5716. | * | 117. | 249. | 304. | 24. | 166.1 | 0.297 | 2.612 |
| 77.0 | 10853. | 5850. | * | 123. | 260. | 319. | 23. | 166.7 | 0.295 | 2.622 |
| 77.5 | 11084. | 5974. | * | 128. | 271. | 333. | 22. | 166.7 | 0.295 | 2.622 |
| 78.0 | 11332. | 6123. | * | 135. | 283. | 350. | 21. | 167.4 | 0.294 | 2.632 |
| 78.5 | 11338. | 6126. | * | 135. | 283. | 351. | 21. | 167.4 | 0.294 | 2.632 |
| 79.0 | 11156. | 6043. | * | 132. | 275. | 342. | 22. | 168.0 | 0.292 | 2.642 |
| 79.5 | 10865. | 5885. | * | 126. | 260. | 324. | 23. | 168.0 | 0.292 | 2.642 |
| 80.0 | 10753. | 5825. | * | 123. | 255. | 318. | 23. | 168.0 | 0.292 | 2.642 |
| 80.5 | 10430. | 5636. | * | 115. | 240. | 297. | 25. | 167.4 | 0.294 | 2.632 |
| 81.0 | 10378. | 5608. | * | 114. | 237. | 294. | 25. | 167.4 | 0.294 | 2.632 |
| 81.5 | 10225. | 5525. | * | 110. | 231. | 285. | 26. | 167.4 | 0.294 | 2.632 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-61+00
DEPTH 67.0 - 81.5

Figure 2.5-102

# B I R D W E L L  3-D  E L A S T I C  P R O P E R T I E S  T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

0-61+00    0.0    0.0    732.50    97.50  4  1  1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 82.0 | 10281. | 5541. | * | 110. | 233. | 286. | 25. | 166.7 | 0.295 | 2.622 |
| 82.5 | 10436. | 5625. | * | 114. | 240. | 295. | 25. | 166.7 | 0.295 | 2.622 |
| 83.0 | 10638. | 5734. | * | 118. | 249. | 306. | 24. | 166.7 | 0.295 | 2.622 |
| 83.5 | 10968. | 5926. | * | 127. | 265. | 328. | 23. | 167.4 | 0.294 | 2.632 |
| 84.0 | 11026. | 5957. | * | 128. | 268. | 332. | 22. | 167.4 | 0.294 | 2.632 |
| 84.5 | 11032. | 5961. | * | 128. | 268. | 332. | 22. | 167.4 | 0.294 | 2.632 |
| 85.0 | 11456. | 6190. | * | 138. | 289. | 358. | 21. | 167.4 | 0.294 | 2.632 |
| 85.5 | 11576. | 6255. | * | 141. | 295. | 365. | 21. | 167.4 | 0.294 | 2.632 |
| 86.0 | 11699. | 6321. | * | 144. | 302. | 373. | 20. | 167.4 | 0.294 | 2.632 |
| 86.5 | 11699. | 6321. | * | 144. | 302. | 373. | 20. | 167.4 | 0.294 | 2.632 |
| 87.0 | 11072. | 5982. | * | 129. | 270. | 334. | 22. | 167.4 | 0.294 | 2.632 |
| 87.5 | 11312. | 6112. | * | 135. | 282. | 349. | 21. | 167.4 | 0.294 | 2.632 |
| 88.0 | 11072. | 5982. | * | 129. | 270. | 334. | 22. | 167.4 | 0.294 | 2.632 |
| 88.5 | 10785. | 5828. | * | 123. | 256. | 317. | 23. | 167.4 | 0.294 | 2.632 |
| 89.0 | 10620. | 5738. | * | 119. | 249. | 308. | 24. | 167.4 | 0.294 | 2.632 |
| 89.5 | 10669. | 5765. | * | 120. | 251. | 310. | 24. | 167.4 | 0.294 | 2.632 |
| 90.0 | 10508. | 5678. | * | 116. | 243. | 301. | 24. | 167.4 | 0.294 | 2.632 |
| 90.5 | 11305. | 6108. | * | 135. | 282. | 349. | 22. | 167.4 | 0.294 | 2.632 |
| 91.0 | 11492. | 6225. | * | 140. | 291. | 363. | 21. | 168.0 | 0.292 | 2.642 |
| 91.5 | 11824. | 6405. | * | 149. | 308. | 384. | 20. | 168.0 | 0.292 | 2.642 |
| 92.0 | 11960. | 6494. | * | 153. | 316. | 396. | 19. | 168.6 | 0.291 | 2.652 |
| 92.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 93.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 94.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 94.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 95.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 95.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 96.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 96.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

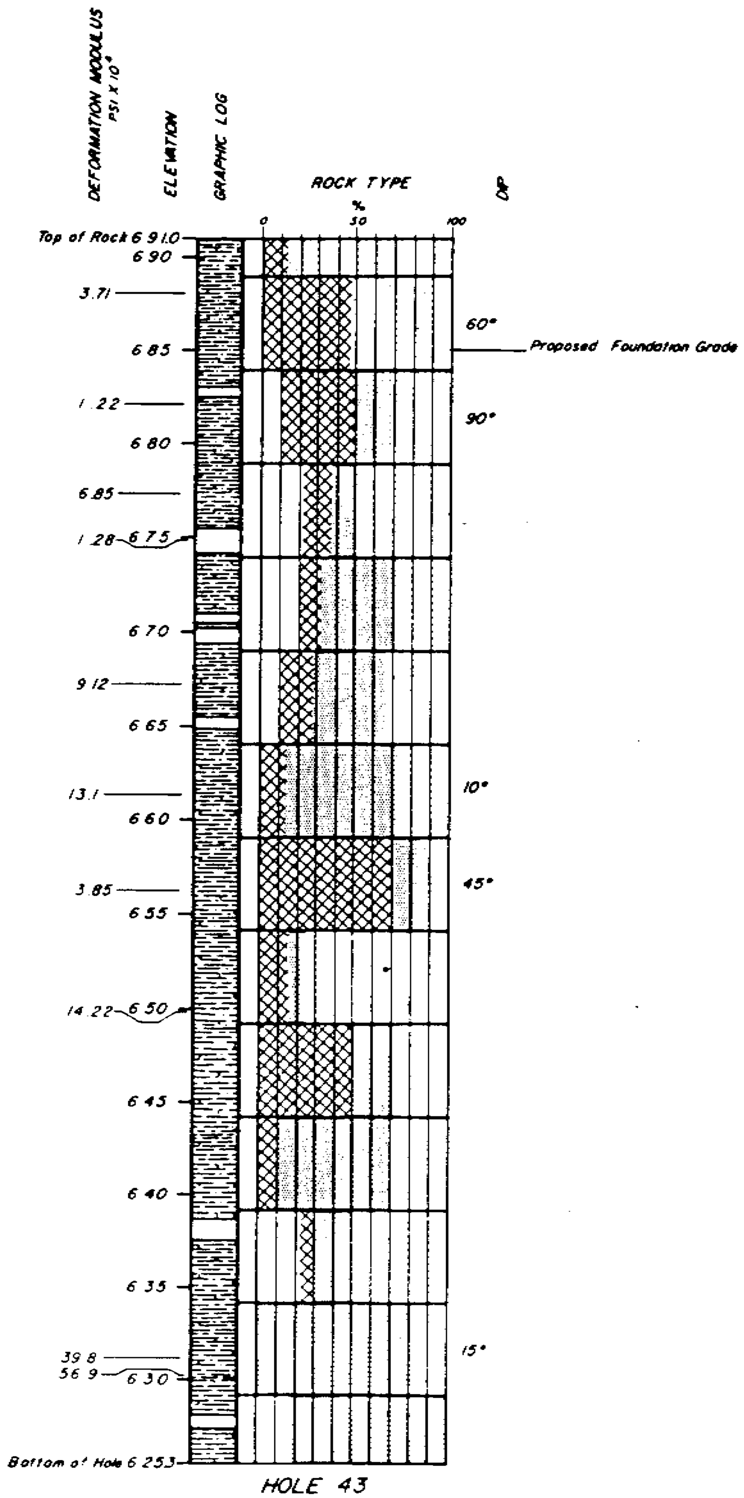
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

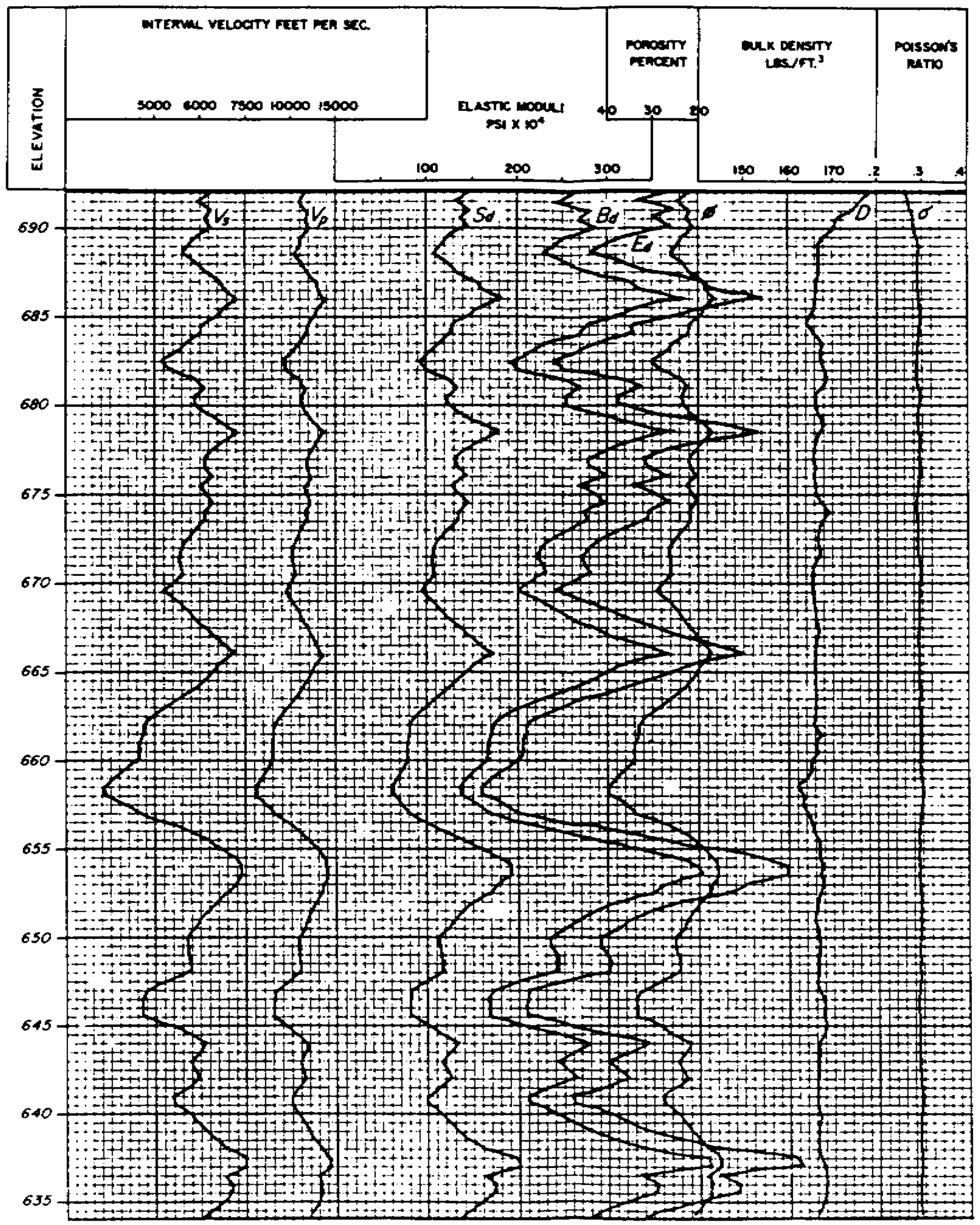
3-D ELASTIC PROPERTIES TABULATION
STA. O-61+00
DEPTH 82.0 - 92.0

Figure 2.5-103

Best Available Historical Image

# Figure 2.5-104 - Historical




LEGEND:

$V_s$ = Shear Velocity.

$V_p$ = Compressional Velocity.

$S_d$ = Dynamic Shear Modulus.

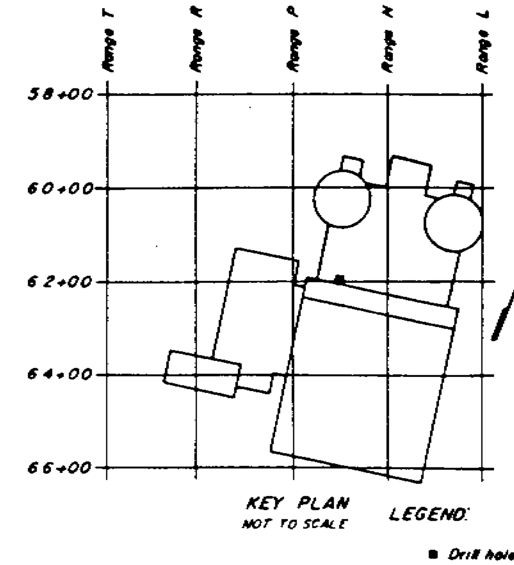
$B_d$ = Dynamic Bulk Modulus.

$E_d$ = Dynamic Young's Modulus.

$\phi$ = Porosity.

D = Density.

$\sigma$ = Poisson's Ratio.

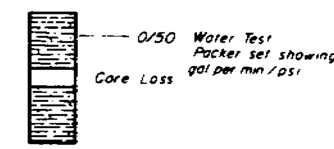



NOTES:

1. The hole was drilled with an Nx wire line core drill.
2. The drill hole was inspected with a borehole television camera between elevations 690.9 and 645.2. The inspection showed the core loss areas to be soft shale.
3. The deformation modulus is defined as the in-situ secant modulus including both elastic and plastic deformation as determined from the results of the Menard pressuremeter tests.
4. The borehole survey for the dynamic elastic moduli was made by the Birdwell Division of Seismograph Service Corporation.

LEGEND

GRAPHIC LOG




ROCK TYPE

Given graphically in % and showing ranges of test values for deformation modulus (psi x 10^4)

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GRAPHIC LOG AND
ELASTIC MODULI
STA. O-62+00

Figure 2.5-104

# B I R D W E L L 3-D E L A S T I C P R O P E R T I E S T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY

0-62+00 0.0 0.0 733.90 108.60 3 1 1

WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 43.0 | 11024. | 6208. | * | 148. | 270. | 376. | 22. | 178.6 | 0.268 | 2.813 |
| 43.5 | 10458. | 5851. | * | 130. | 243. | 332. | 25. | 176.7 | 0.272 | 2.783 |
| 44.0 | 11230. | 6241. | * | 147. | 280. | 375. | 22. | 174.9 | 0.277 | 2.753 |
| 44.5 | 11074. | 6085. | * | 137. | 271. | 352. | 22. | 171.7 | 0.284 | 2.702 |
| 45.0 | 11436. | 6269. | * | 145. | 289. | 373. | 21. | 171.1 | 0.285 | 2.692 |
| 45.5 | 10716. | 5819. | * | 123. | 253. | 318. | 24. | 168.6 | 0.291 | 2.652 |
| 46.0 | 10436. | 5639. | * | 115. | 240. | 297. | 25. | 167.4 | 0.294 | 2.632 |
| 46.5 | 10159. | 5489. | * | 109. | 228. | 281. | 26. | 167.4 | 0.294 | 2.632 |
| 47.0 | 10786. | 5828. | * | 123. | 256. | 317. | 23. | 167.4 | 0.294 | 2.632 |
| 47.5 | 11154. | 6027. | * | 131. | 274. | 339. | 22. | 167.4 | 0.294 | 2.632 |
| 48.0 | 12151. | 6549. | * | 154. | 325. | 400. | 19. | 166.7 | 0.295 | 2.622 |
| 48.5 | 12368. | 6666. | * | 160. | 337. | 414. | 18. | 166.7 | 0.295 | 2.622 |
| 49.0 | 13252. | 7143. | * | 184. | 387. | 475. | 16. | 166.7 | 0.295 | 2.622 |
| 49.5 | 12360. | 6645. | * | 158. | 336. | 410. | 18. | 166.1 | 0.297 | 2.612 |
| 50.0 | 11933. | 6399. | * | 146. | 313. | 380. | 20. | 165.5 | 0.298 | 2.602 |
| 50.5 | 11199. | 5975. | * | 126. | 276. | 329. | 22. | 164.2 | 0.301 | 2.582 |
| 51.0 | 11076. | 5955. | * | 127. | 270. | 330. | 22. | 166.1 | 0.297 | 2.612 |
| 51.5 | 10317. | 5588. | * | 113. | 235. | 293. | 25. | 168.0 | 0.292 | 2.642 |
| 52.0 | 9906. | 5366. | * | 104. | 216. | 270. | 27. | 168.0 | 0.292 | 2.642 |
| 52.5 | 9356. | 5068. | * | 93. | 193. | 241. | 30. | 168.0 | 0.292 | 2.642 |
| 53.0 | 9539. | 5180. | * | 98. | 201. | 252. | 29. | 168.6 | 0.291 | 2.652 |
| 53.5 | 10701. | 5825. | * | 124. | 253. | 319. | 24. | 169.2 | 0.290 | 2.662 |
| 54.0 | 11112. | 6034. | * | 132. | 273. | 342. | 22. | 168.6 | 0.291 | 2.652 |
| 54.5 | 10762. | 5801. | * | 121. | 255. | 314. | 23. | 166.7 | 0.295 | 2.622 |
| 55.0 | 10774. | 5807. | * | 121. | 256. | 314. | 23. | 166.7 | 0.295 | 2.622 |
| 55.5 | 11300. | 6106. | * | 135. | 282. | 348. | 22. | 167.4 | 0.294 | 2.632 |
| 56.0 | 12154. | 6599. | * | 158. | 326. | 409. | 19. | 168.6 | 0.291 | 2.652 |
| 56.5 | 13075. | 7082. | * | 182. | 377. | 470. | 17. | 168.0 | 0.292 | 2.642 |
| 57.0 | 12360. | 6662. | * | 160. | 337. | 414. | 18. | 166.7 | 0.295 | 2.622 |
| 57.5 | 11737. | 6310. | * | 143. | 303. | 370. | 20. | 166.1 | 0.297 | 2.612 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-62+00
DEPTH 43.0 - 57.5

Figure 2.5-105

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-62+00   0.0   0.0   733.90   108.60   3   1   1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 58.0 | 11244. | 6045. | * | 131. | 278. | 340. | 22. | 166.1 | 0.297 | 2.612 |
| 58.5 | 11321. | 6102. | * | 134. | 282. | 347. | 21. | 166.7 | 0.295 | 2.622 |
| 59.0 | 11697. | 6289. | * | 142. | 301. | 368. | 20. | 166.1 | 0.297 | 2.612 |
| 59.5 | 10999. | 5928. | * | 126. | 267. | 327. | 23. | 166.7 | 0.295 | 2.622 |
| 60.0 | 11422. | 6156. | * | 136. | 288. | 353. | 21. | 166.7 | 0.295 | 2.622 |
| 60.5 | 11599. | 6283. | * | 143. | 297. | 370. | 21. | 168.0 | 0.292 | 2.642 |
| 61.0 | 11138. | 6077. | * | 135. | 274. | 349. | 22. | 169.9 | 0.288 | 2.672 |
| 61.5 | 11230. | 6083. | * | 134. | 278. | 347. | 22. | 168.0 | 0.292 | 2.642 |
| 62.0 | 10820. | 5847. | * | 123. | 258. | 319. | 23. | 167.4 | 0.294 | 2.632 |
| 62.5 | 10398. | 5618. | * | 114. | 238. | 295. | 25. | 167.4 | 0.294 | 2.632 |
| 63.0 | 10123. | 5483. | * | 109. | 226. | 282. | 26. | 168.0 | 0.292 | 2.642 |
| 63.5 | 10036. | 5423. | * | 106. | 222. | 275. | 26. | 167.4 | 0.294 | 2.632 |
| 64.0 | 10154. | 5459. | * | 107. | 227. | 277. | 26. | 166.1 | 0.297 | 2.612 |
| 64.5 | 10258. | 5515. | * | 109. | 232. | 283. | 26. | 166.1 | 0.297 | 2.612 |
| 65.0 | 9852. | 5297. | * | 101. | 214. | 261. | 27. | 166.1 | 0.297 | 2.612 |
| 65.5 | 9482. | 5098. | * | 93. | 198. | 241. | 29. | 166.1 | 0.297 | 2.612 |
| 66.0 | 10056. | 5407. | * | 105. | 223. | 272. | 26. | 166.1 | 0.297 | 2.612 |
| 66.5 | 10468. | 5642. | * | 115. | 241. | 297. | 25. | 166.7 | 0.295 | 2.622 |
| 67.0 | 10803. | 5822. | * | 122. | 257. | 316. | 23. | 166.7 | 0.295 | 2.622 |
| 67.5 | 11355. | 6136. | * | 136. | 284. | 352. | 21. | 167.4 | 0.294 | 2.632 |
| 68.0 | 11687. | 6315. | * | 144. | 301. | 373. | 20. | 167.4 | 0.294 | 2.632 |
| 68.5 | 12413. | 6690. | * | 161. | 340. | 417. | 18. | 166.7 | 0.295 | 2.622 |
| 69.0 | 12967. | 6989. | * | 176. | 371. | 455. | 17. | 166.7 | 0.295 | 2.622 |
| 69.5 | 12105. | 6524. | * | 153. | 323. | 397. | 19. | 166.7 | 0.295 | 2.622 |
| 70.0 | 11756. | 6336. | * | 144. | 305. | 374. | 20. | 166.7 | 0.295 | 2.622 |
| 70.5 | 11285. | 6082. | * | 133. | 281. | 345. | 22. | 166.7 | 0.295 | 2.622 |
| 71.0 | 10861. | 5854. | * | 123. | 260. | 319. | 23. | 166.7 | 0.295 | 2.622 |
| 71.5 | 10195. | 5495. | * | 109. | 229. | 281. | 26. | 166.7 | 0.295 | 2.622 |
| 72.0 | 9610. | 5180. | * | 96. | 204. | 250. | 29. | 166.7 | 0.295 | 2.622 |
| 72.5 | 9125. | 4918. | * | 87. | 183. | 225. | 31. | 166.7 | 0.295 | 2.622 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. O-62+00
DEPTH 58.0 - 72.5

Figure 2.5-106

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-62+00  0.0  0.0  733.90  108.60  3  1  1
WATTS BAR NUCLEAR PLANT, RHEA COUNTY, TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 73.0 | 8832. | 4748. | * | 81. | 172. | 210. | 33. | 166.1 | 0.297 | 2.612 |
| 73.5 | 8796. | 4753. | * | 82. | 171. | 211. | 33. | 167.4 | 0.294 | 2.632 |
| 74.0 | 8697. | 4688. | * | 79. | 167. | 205. | 34. | 166.7 | 0.295 | 2.622 |
| 74.5 | 8697. | 4688. | * | 79. | 167. | 205. | 34. | 166.7 | 0.295 | 2.622 |
| 75.0 | 8693. | 4662. | * | 78. | 166. | 201. | 34. | 165.5 | 0.298 | 2.602 |
| 75.5 | 8393. | 4501. | * | 72. | 155. | 188. | 36. | 165.5 | 0.298 | 2.602 |
| 76.0 | 8051. | 4307. | * | 66. | 143. | 171. | 38. | 164.9 | 0.300 | 2.592 |
| 76.5 | 7859. | 4160. | * | 61. | 136. | 158. | 40. | 162.4 | 0.305 | 2.551 |
| 77.0 | 7876. | 4191. | * | 62. | 136. | 161. | 40. | 163.6 | 0.302 | 2.572 |
| 77.5 | 8406. | 4473. | * | 71. | 155. | 184. | 36. | 163.6 | 0.302 | 2.572 |
| 78.0 | 8733. | 4671. | * | 78. | 168. | 202. | 34. | 164.9 | 0.300 | 2.592 |
| 78.5 | 9549. | 5121. | * | 94. | 201. | 243. | 29. | 165.5 | 0.298 | 2.602 |
| 79.0 | 10513. | 5652. | * | 114. | 243. | 297. | 24. | 166.1 | 0.297 | 2.612 |
| 79.5 | 11443. | 6183. | * | 138. | 289. | 357. | 21. | 167.4 | 0.294 | 2.632 |
| 80.0 | 12116. | 6546. | * | 155. | 324. | 400. | 19. | 167.4 | 0.294 | 2.632 |
| 80.5 | 13039. | 7045. | * | 179. | 375. | 464. | 17. | 167.4 | 0.294 | 2.632 |
| 81.0 | 13430. | 7275. | * | 192. | 398. | 496. | 16. | 168.0 | 0.292 | 2.642 |
| 81.5 | 13554. | 7323. | * | 194. | 405. | 501. | 15. | 167.4 | 0.294 | 2.632 |
| 82.0 | 12923. | 7000. | * | 178. | 368. | 459. | 17. | 168.0 | 0.292 | 2.642 |
| 82.5 | 12678. | 6850. | * | 169. | 354. | 438. | 17. | 167.4 | 0.294 | 2.632 |
| 83.0 | 11938. | 6434. | * | 149. | 314. | 386. | 20. | 166.7 | 0.295 | 2.622 |
| 83.5 | 11414. | 6152. | * | 136. | 287. | 353. | 21. | 166.7 | 0.295 | 2.622 |
| 84.0 | 11054. | 5943. | * | 127. | 269. | 328. | 22. | 166.1 | 0.297 | 2.612 |
| 84.5 | 10814. | 5829. | * | 122. | 258. | 317. | 23. | 166.7 | 0.295 | 2.622 |
| 85.0 | 10349. | 5592. | * | 113. | 236. | 292. | 25. | 167.4 | 0.294 | 2.632 |
| 85.5 | 10359. | 5597. | * | 113. | 237. | 293. | 25. | 167.4 | 0.294 | 2.632 |
| 86.0 | 10485. | 5665. | * | 116. | 242. | 300. | 25. | 167.4 | 0.294 | 2.632 |
| 86.5 | 10552. | 5701. | * | 117. | 245. | 304. | 24. | 167.4 | 0.294 | 2.632 |
| 87.0 | 10530. | 5689. | * | 117. | 244. | 302. | 24. | 167.4 | 0.294 | 2.632 |
| 87.5 | 9689. | 5235. | * | 99. | 207. | 256. | 28. | 167.4 | 0.294 | 2.632 |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. 0-62+00
DEPTH 73.0 - 87.5
Figure 2.5-107

Best Available Historical Image

B I R D W E L L   3-D   E L A S T I C   P R O P E R T I E S   T A B U L A T I O N

TENNESSEE VALLEY AUTHORITY
0-62+30   0.0   0.0   733.90   108.60   3   1   1
WATTS BAR NUCLEAR PLANT,  RHEA COUNTY,  TENNESSEE

MODULI IN 10 TO 4TH LBS/SQ. INCH

| DEPTH | VP | VS | | SHEAR | BULK | YOUNGS | POROS. | DENSITY | POISSON | RHO |
|---|---|---|---|---|---|---|---|---|---|---|
| 88.0 | 8809. | 4760. | * | 82. | 171. | 212. | 33. | 167.4 | 0.294 | 2.632 |
| 88.5 | 8690. | 4707. | * | 80. | 167. | 208. | 34. | 168.0 | 0.292 | 2.642 |
| 89.0 | 8683. | 4703. | * | 80. | 166. | 207. | 34. | 168.0 | 0.292 | 2.642 |
| 89.5 | 8711. | 4719. | * | 81. | 167. | 209. | 34. | 168.0 | 0.292 | 2.642 |
| 90.0 | 9600. | 5213. | * | 99. | 203. | 255. | 29. | 168.6 | 0.291 | 2.652 |
| 90.5 | 10408. | 5638. | * | 115. | 239. | 298. | 25. | 168.0 | 0.292 | 2.642 |
| 91.0 | 11285. | 6097. | * | 134. | 281. | 347. | 22. | 167.4 | 0.294 | 2.632 |
| 91.5 | 10968. | 5927. | * | 127. | 265. | 328. | 23. | 167.4 | 0.294 | 2.632 |
| 92.0 | 10518. | 5669. | * | 116. | 244. | 299. | 24. | 166.7 | 0.295 | 2.622 |
| 92.5 | 10693. | 5763. | * | 119. | 252. | 309. | 24. | 166.7 | 0.295 | 2.622 |
| 93.0 | 10968. | 5912. | * | 126. | 265. | 326. | 23. | 166.7 | 0.295 | 2.622 |
| 93.5 | 10452. | 5633. | * | 114. | 241. | 296. | 25. | 166.7 | 0.295 | 2.622 |
| 94.0 | 9737. | 5248. | * | 99. | 209. | 257. | 28. | 166.7 | 0.295 | 2.622 |
| 94.5 | 9848. | 5308. | * | 101. | 214. | 262. | 27. | 166.7 | 0.295 | 2.622 |
| 95.0 | 10479. | 5662. | * | 116. | 242. | 300. | 25. | 167.4 | 0.294 | 2.632 |
| 95.5 | 10861. | 5869. | * | 124. | 260. | 322. | 23. | 167.4 | 0.294 | 2.632 |
| 96.0 | 11221. | 6048. | * | 132. | 277. | 341. | 22. | 166.7 | 0.295 | 2.622 |
| 96.5 | 11811. | 6366. | * | 146. | 307. | 378. | 20. | 166.7 | 0.295 | 2.622 |
| 97.0 | 12413. | 6690. | * | 161. | 340. | 417. | 18. | 166.7 | 0.295 | 2.622 |
| 97.5 | 13623. | 7361. | * | 196. | 409. | 506. | 15. | 167.4 | 0.294 | 2.632 |
| 98.0 | 13696. | 7418. | * | 199. | 414. | 515. | 15. | 168.0 | 0.292 | 2.642 |
| 98.5 | 12321. | 6690. | * | 163. | 335. | 420. | 18. | 168.6 | 0.291 | 2.652 |
| 99.0 | 12703. | 6898. | * | 173. | 356. | 447. | 17. | 168.6 | 0.291 | 2.652 |
| 99.5 | 12695. | 6893. | * | 173. | 356. | 446. | 17. | 168.6 | 0.291 | 2.652 |
| 100.0 | 12163. | 6588. | * | 157. | 326. | 407. | 19. | 168.0 | 0.292 | 2.642 |
| 100.5 | 11728. | 6337. | * | 145. | 303. | 375. | 20. | 167.4 | 0.294 | 2.632 |
| 101.0 | 11010. | 5920. | * | 126. | 267. | 326. | 23. | 166.1 | 0.297 | 2.612 |
| 101.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 102.0 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |
| 102.5 | 0. | 0. | * | 0. | 0. | 0. | 0. | 0.0 | 0.0 | 0.0 |

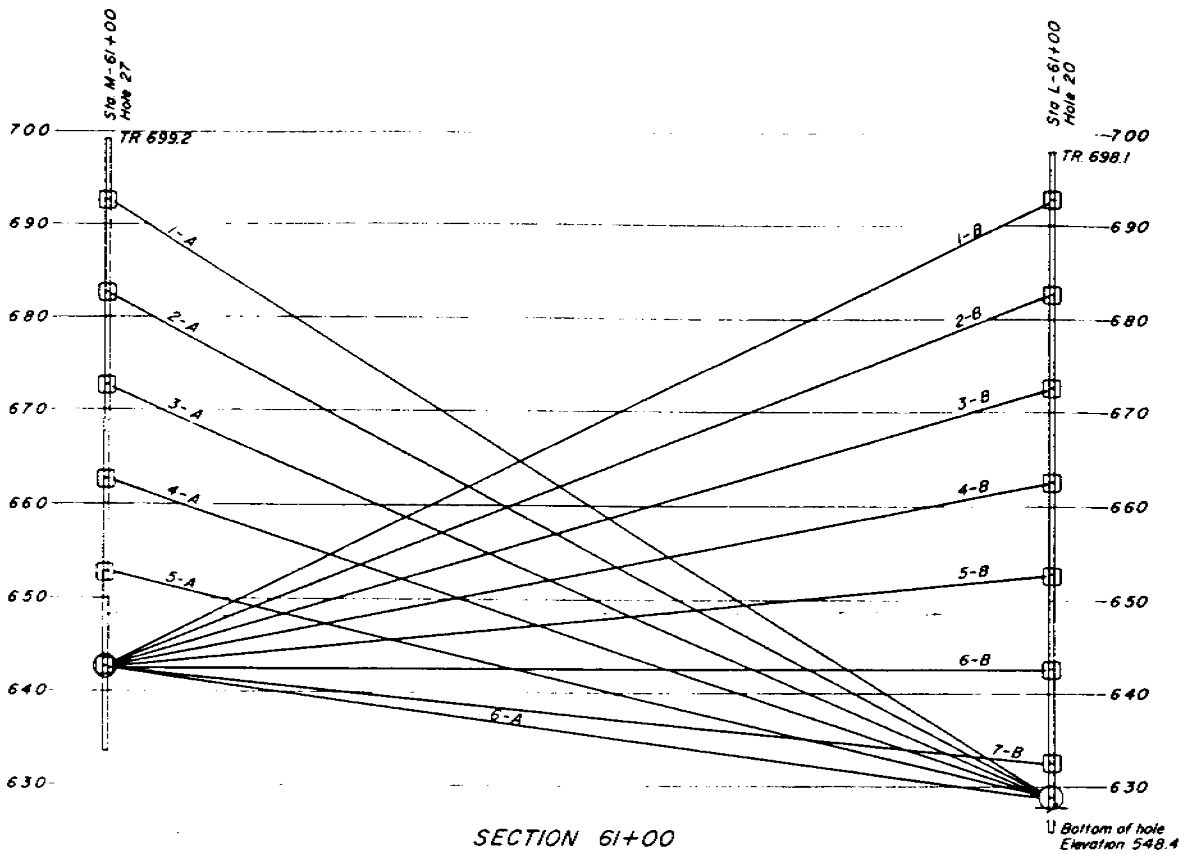
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

3-D ELASTIC PROPERTIES TABULATION
STA. O-62+00
DEPTH 88.0 - 101.0

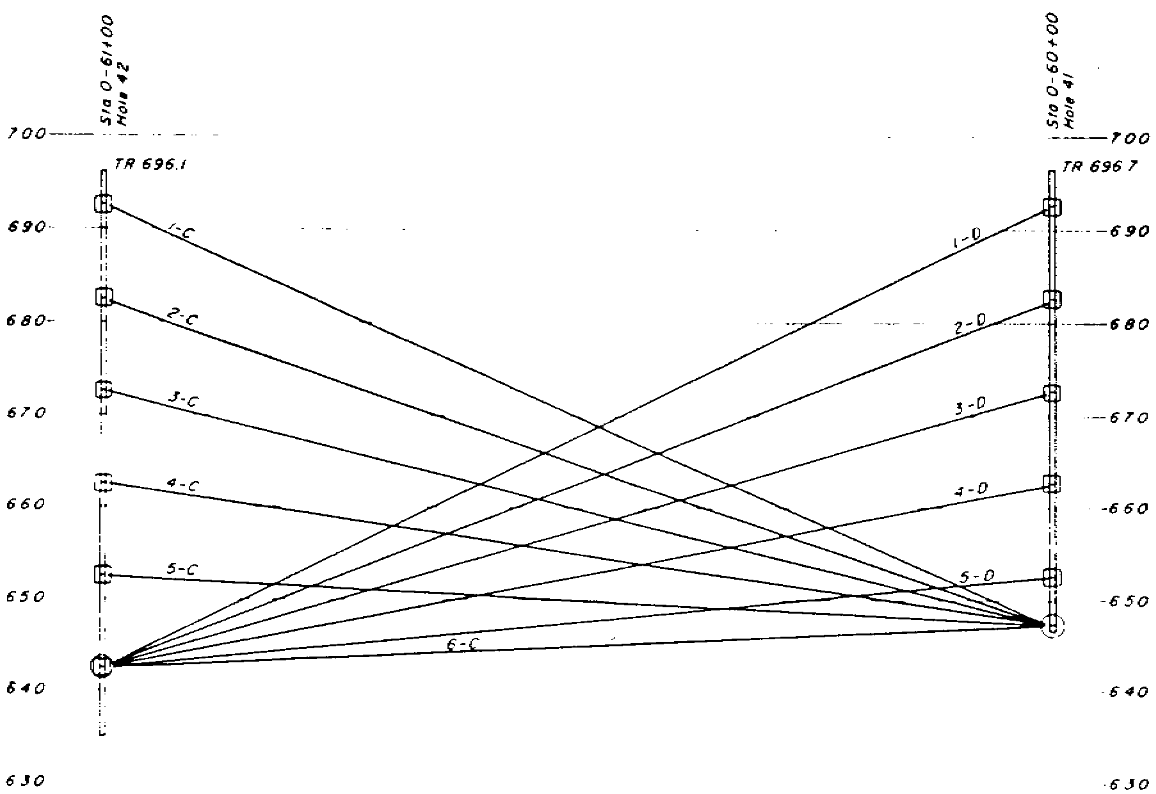
Figure 2.5-108

Best Available Historical Image

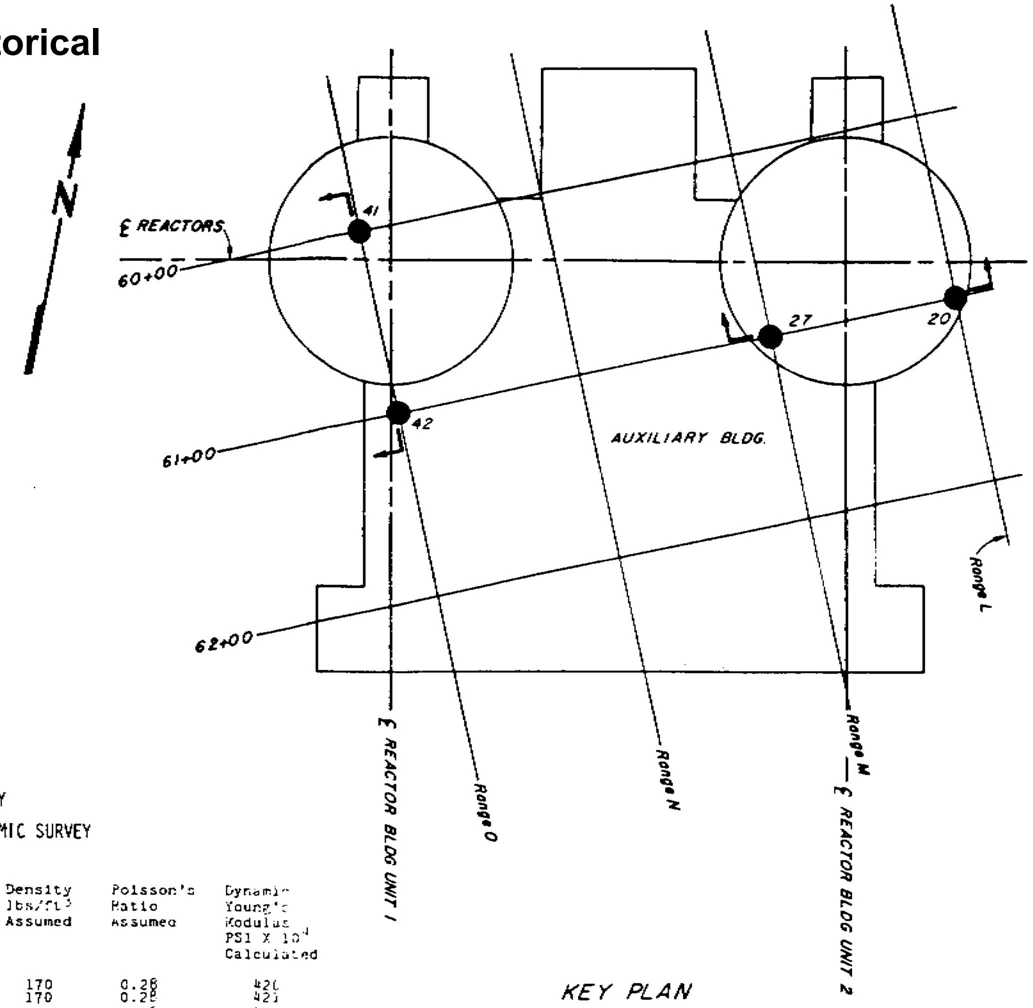
# Figure 2.5-109 - Historical




SECTION 61+00




RANGE O




KEY PLAN

SUMMARY

CROSS-HOLE DYNAMIC SURVEY

| Line Number | Compressional Velocity ft/sec. measured | Shear Velocity ft/sec. Calculated | Density lbs/ft$^3$ Assumed | Poisson's Ratio Assumed | Dynamic Young's Modulus PSI X $10^4$ Calculated |
|---|---|---|---|---|---|
| 1-A | 13182 | 6734 | 170 | 0.28 | 420 |
| 2-A | 12114 | 6696 | 170 | 0.28 | 421 |
| 3-A | 13053 | 7232 | 170 | 0.26 | 491 |
| 4-A | 12718 | 7030 | 170 | 0.28 | 464 |
| 5-A | 12953 | 7160 | 170 | 0.28 | 481 |
| 6-A | 12208 | 6748 | 170 | 0.28 | 427 |
| 1-B | 9936 | 5311 | 165 | 0.3 | 261 |
| 2-B | 10566 | 5743 | 170 | 0.29 | [illegible] |
| 3-B | 10686 | 5811 | 170 | 0.29 | [illegible] |
| 4-B | [illegible] | [illegible] | 170 | 0.28 | [illegible] |
| 5-B | [illegible] | [illegible] | 170 | [illegible] | [illegible] |
| 6-B | [illegible] | [illegible] | 170 | 0.29 | [illegible] |
| 7-B | [illegible] | [illegible] | 170 | [illegible] | [illegible] |
| | | | | | |
| 1-C | 11070 | 6119 | 170 | 0.28 | [illegible] |
| 2-C | 9709 | [illegible] | 165 | 0.29 | [illegible] |
| 3-C | 10779 | 5959 | 170 | [illegible] | [illegible] |
| 4-C | 10141 | 5606 | 170 | 0.28 | [illegible] |
| 5-C | 11122 | 6148 | 170 | 0.28 | [illegible] |
| 6-C | 11209 | 6196 | 170 | 0.28 | [illegible] |
| 1-D | 11632 | 6430 | 170 | 0.28 | [illegible] |
| 2-D | 11977 | [illegible] | 170 | [illegible] | [illegible] |
| 3-D | [illegible] | [illegible] | 170 | [illegible] | [illegible] |
| 4-D | [illegible] | [illegible] | 170 | 0.28 | [illegible] |
| 5-D | 10334 | [illegible] | 170 | 0.28 | [illegible] |

NOTES:

1. THE LINES ON THE SECTIONS BETWEEN SHOT POINTS AND GEOPHONE LOCATIONS INDICATE ONLY THE TRAVEL DIRECTION OF THE COMPRESSIONAL WAVE.
2. THE FOUNDATION ROCK IS COMPOSED OF THE CONASAUGA FORMATION. THIS FORMATION CONSISTS OF CONTORTED GRAY-GREEN SHALE INTERBEDDED WITH LENSES OF LIMESTONE.
3. THE ASSUMED DENSITIES AND POISSON'S RATIOS ARE BASED ON THE RESULTS FROM THE BOREHOLE SURVEYS THAT WERE MADE BY THE BIRDWELL DIVISION OF SIESMOGRAPH SERVICE CORPORATION.

"HISTORICAL INFORMATION"

LEGEND:

NX WIRELINE CORE DRILL HOLE

TR - TOP OF ROCK ELEVATION.

GEOPHONE SETTING.

SHOT LOCATION.

SCALE:

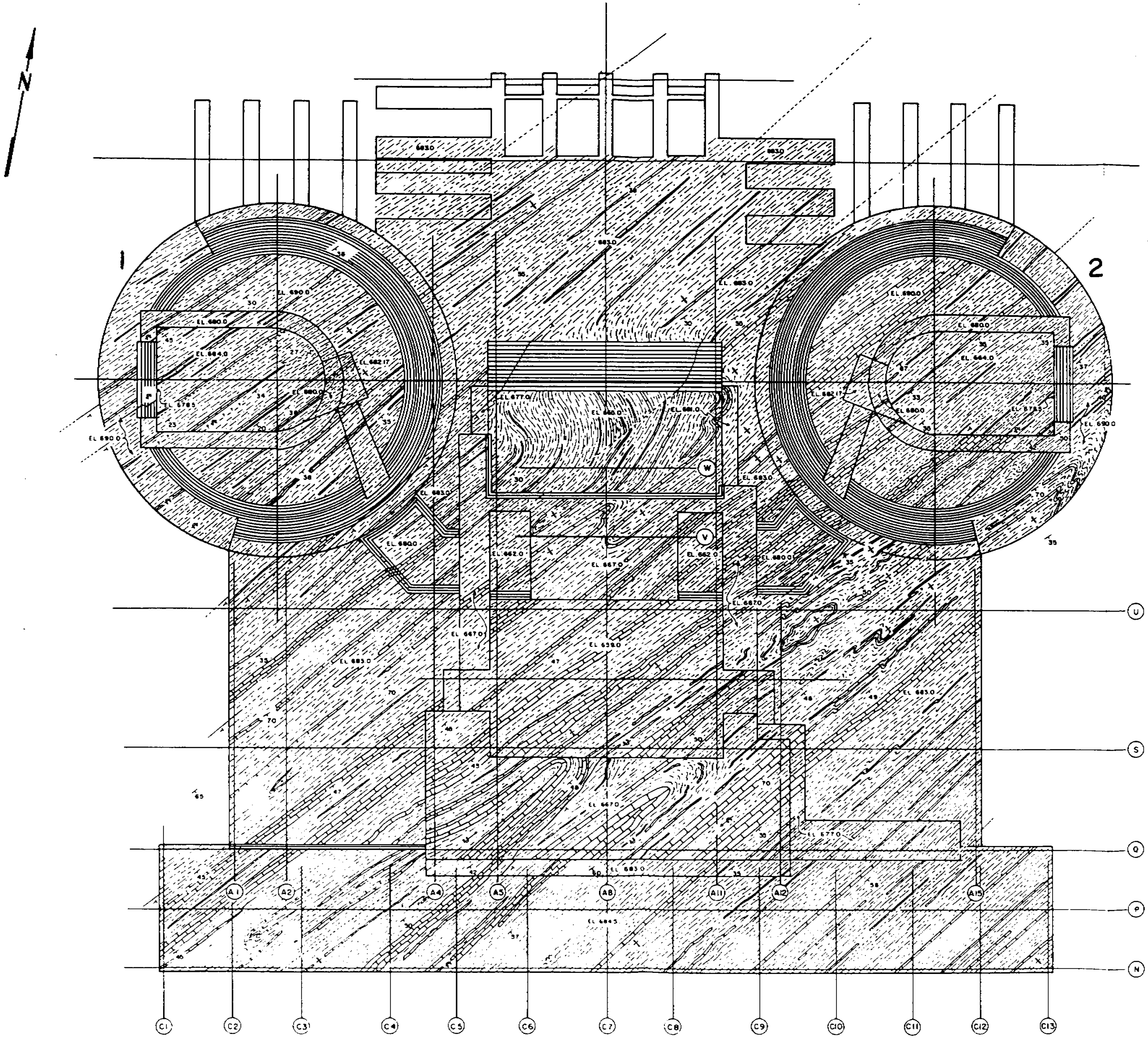
PLAN 50 0 50 100 Feet

SECTION 10 0 10 20 Feet

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CROSS-HOLE DYNAMIC
SECTIONS AND SUMMARY

Figure 2.5-109




LEGEND

- Limestone
- Shale
- Thrust fault
  T, upper plate; dashed where inferred
- Strike and dip of beds
- Crumbled beds and average dip
- Anticlinal axis
- Synclinal axis
- Overturned anticline showing direction of dip of limbs and direction of plunge
- Overturned syncline showing direction of dip of limbs and direction of plunge
- Doubly plunging anticline
- Doubly plunging syncline

NOTES

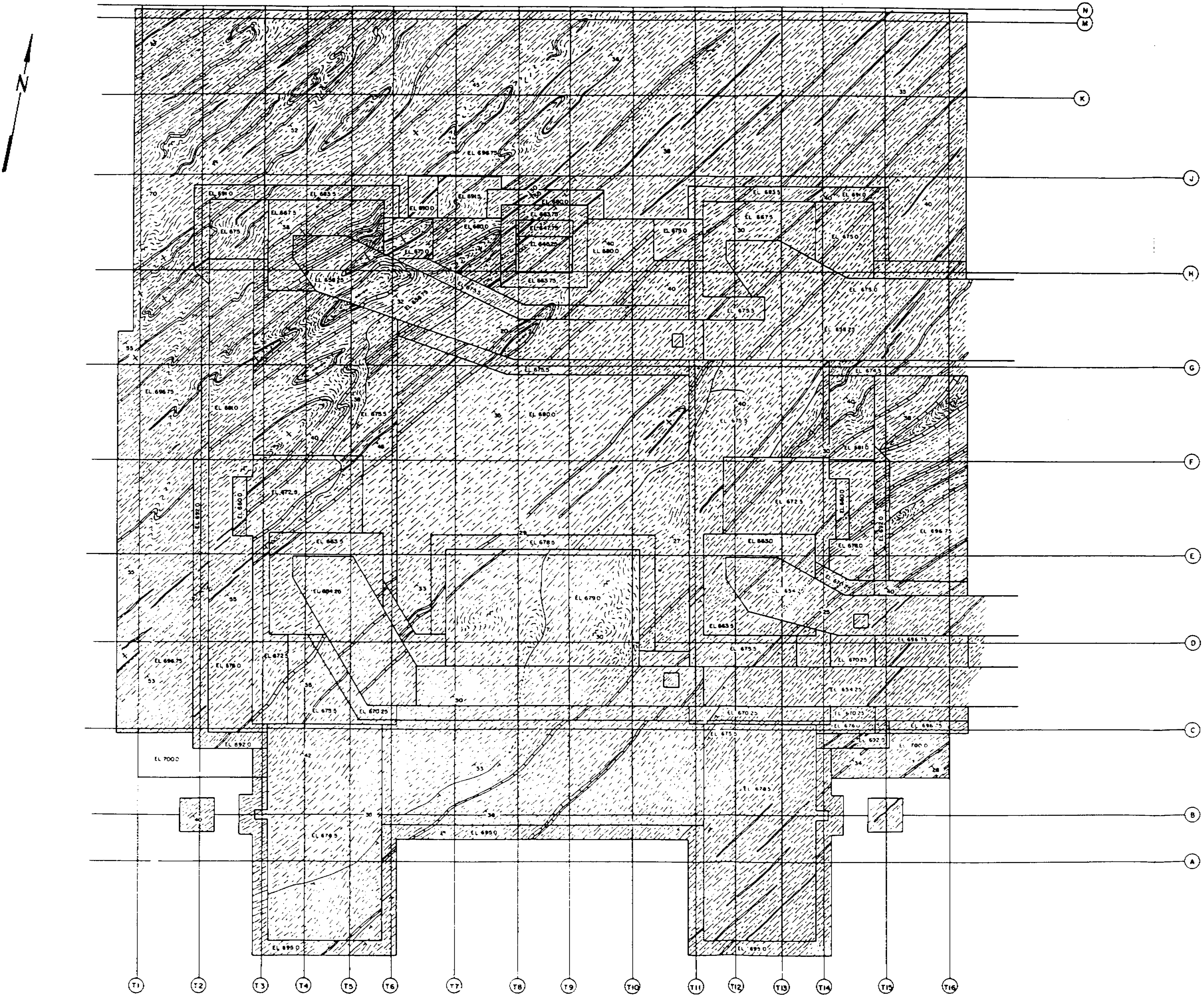
1. Due to the complexly folded and contorted characteristics of the foundation rock, plan view geology presentation has been simplified considerably
2. Turbine and control building outline taken from construction drawing number 4W10072-1 R2 which was revised as construction progressed
3. Discordant lithologic presentation due to elevation changes across neat vertical line construction excavations
4. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age

*HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Plan View Geologic Map of
Reactor, Auxiliary, and
Control Buildings

FIGURE 2.5-110




LEGEND

- Limestone
- Shale
- Thrust fault
  T, upper plate; dashed where inferred
- Strike and dip of beds
- Crumpled beds and average dip
- Anticlinal axis
- Synclinal axis
- Overturned anticline showing direction of dip of limbs and direction of plunge
- Overturned syncline showing direction of dip of limbs and direction of plunge
- Doubly plunging anticline
- Doubly plunging syncline

NOTES

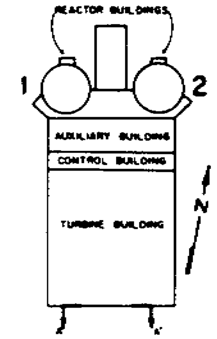
1. Due to the complexly folded [illegible] contorted characteristics of th[illegible] rock, plan view geology presen[illegible] simplified considerably
2. Turbine and control bu[illegible] taken from construction drawin[illegible] R3 which was revised as con[illegible]
3. Discordant lithologic presen[illegible] tion changes across neat ver[illegible] struction excavations
4. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age

*HISTORICAL INFORMATION"*

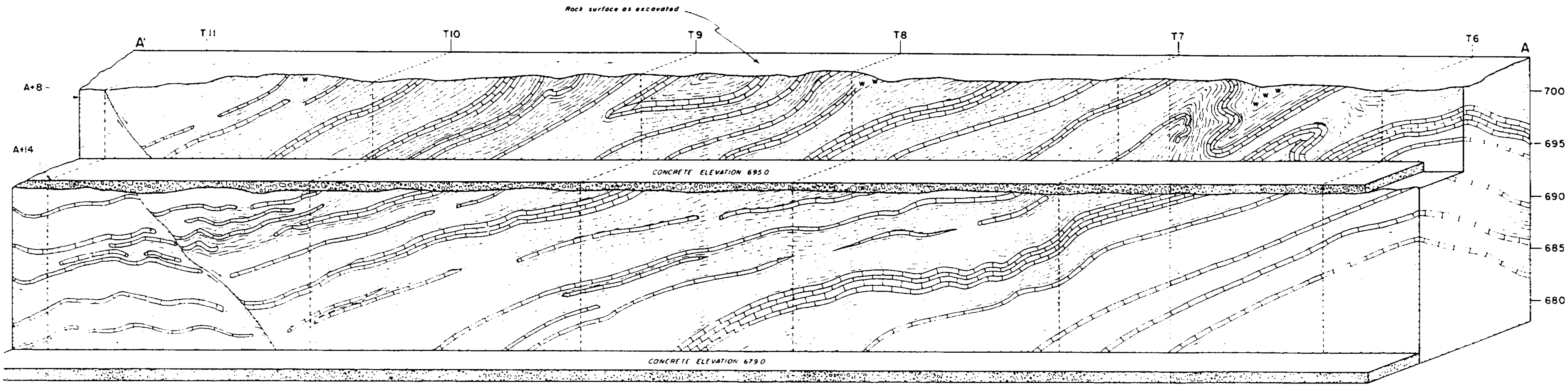
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Plan View Geologic
Map of Turbine Building

FIGURE 2.5-111




NOT TO SCALE
KEY PLAN




SECTION LOOKING SOUTH

LEGEND

- THRUST FAULT
- LIMESTONE - FINE- TO COARSE-GRAINED, WHITE TO DARK GREY TO PINK. THIN, MEDIUM TO MASSIVE BEDDED. SOME BEDS GLAUCONITIC AND/OR ARGILLACEOUS.
- SHALE - VARICOLORED RED, GREY, GREEN AND PURPLE. FISSILE, CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED, CRUMPLED, CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES.
- WEATHERED - SLAKED, OR WEATHERED SHALE, WEATHERED GLAUCONITIC LIMESTONE AND/OR CLAY, REMOVED PRIOR TO EMPLACEMENT OF PROTECTIVE CONCRETE.
- PROTECTIVE CONCRETE

NOTES:

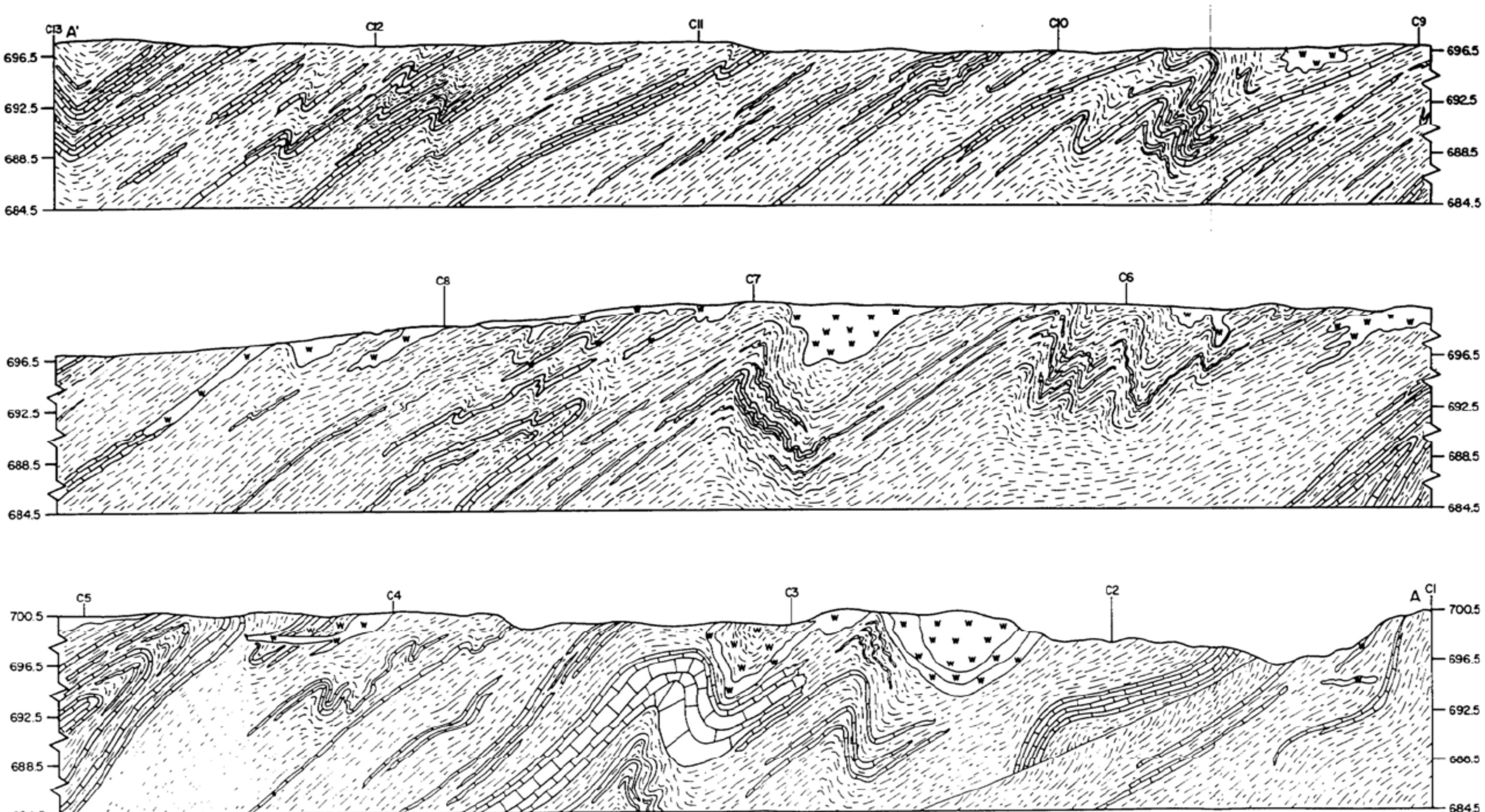
1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified

*HISTORICAL INFORMATION"*

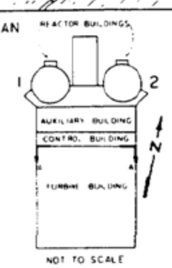
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Geologic Section Along A+8
and A+14 Lines from T6 to T11

FIGURE 2.5-112




KEY PLAN




LEGEND

- THRUST FAULT
- LIMESTONE - FINE- TO COARSE-GRAINED. WHITE TO DARK GREY TO PINK. THIN. MEDIUM TO MASSIVE BEDDED. SOME BEDS GLAUCONITIC AND-OR ARGILLACEOUS.
- SHALE - VARICOLORED RED. GREY. GREEN AND PURPLE. FISSILE. CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED. CRUMPLED. CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES.
- WEATHERED - SLAKED, OR WEATHERED SHALE. WEATHERED GLAUCONITIC LIME-STONE AND/OR CLAY. REMOVED PRIOR TO EMPLACEMENT OF PROTECTIVE CONCRETE.

NOTES:

1. All rock in excavation identified as lower Conasauga Formation of Middle Cambrian age.
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified considerably.
3. This section viewed south.

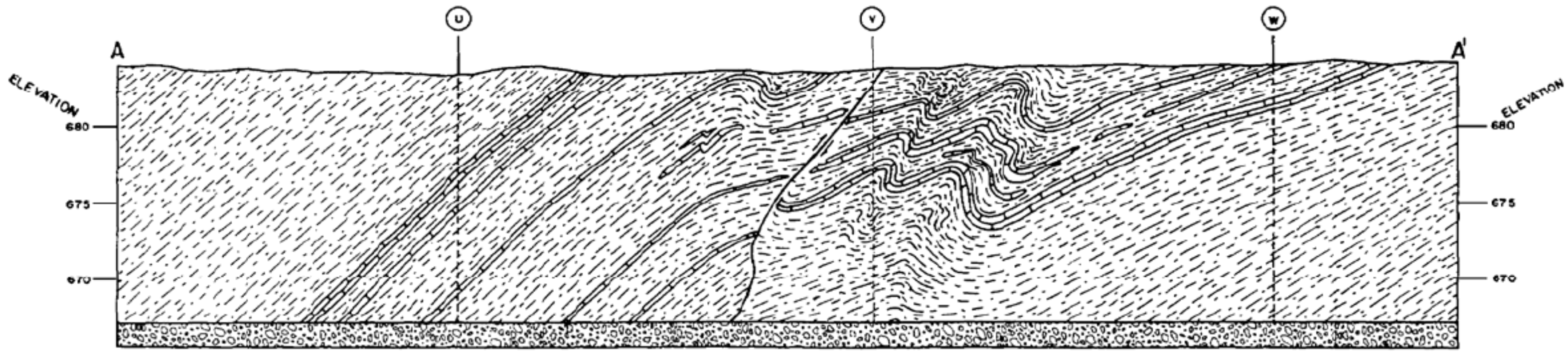
SCALE: 4 0 4 8 Feet

*"HISTORICAL INFORMATION"*

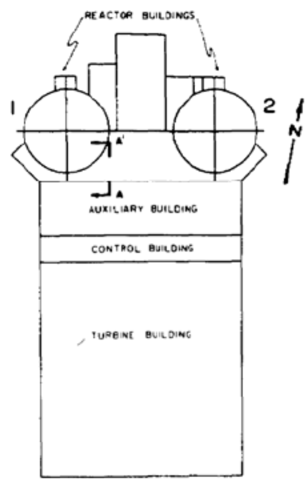
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Geologic Section Along
N Line from C1 to C13

FIGURE 2.5-113




VIEWED WEST




NOT TO SCALE
KEY PLAN

LEGEND

- THRUST FAULT
- LIMESTONE - FINE- TO COARSE-GRAINED, WHITE TO DARK GREY TO PINK, THIN, MEDIUM TO MASSIVE BEDDED. SOME BEDS GLAUCONITIC AND, OR ARGILLACEOUS.
- SHALE - VARICOLORED RED, GREY, GREEN AND PURPLE, FISSILE, CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED, CRUMPLED, CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES.
- PROTECTIVE CONCRETE

NOTES:

1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age.
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified considerably.

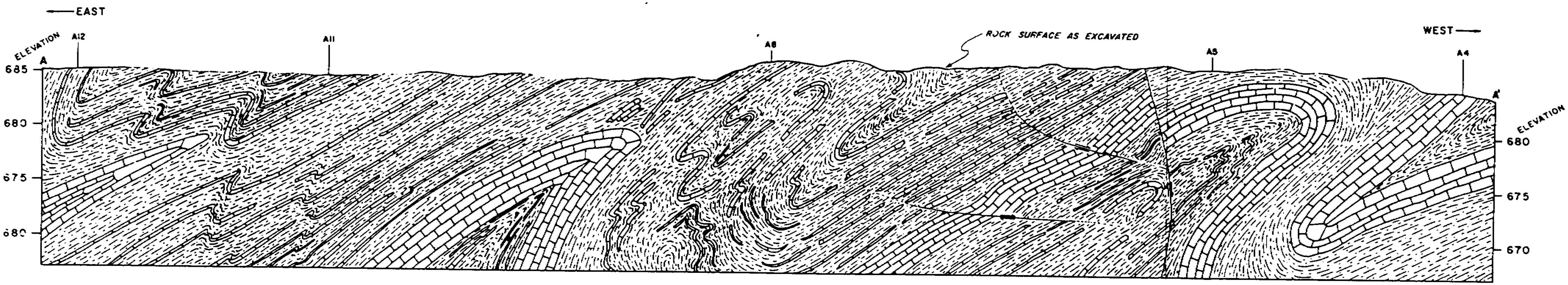
SCALE:

4 0 4 8 Feet

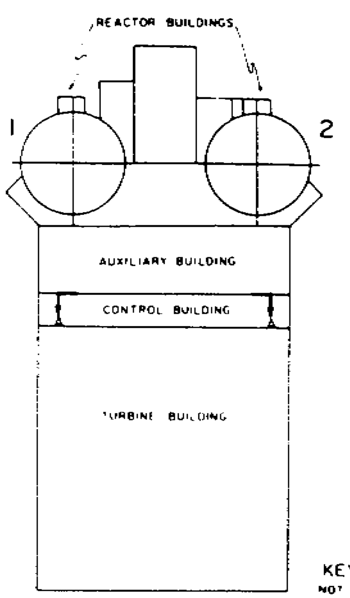
*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Section Along A4+9.5
From T+3.5 to W+12.5
Looking West
FIGURE 2.5-114




VIEWED SOUTH




KEY PLAN
NOT TO SCALE

N

LEGEND

- THRUST FAULT
- LIMESTONE - FINE- TO COARSE-GRAINED, WHITE TO DARK GREY TO PINK, THIN, MEDIUM TO MASSIVE BEDDED, SOME BEDS GLAUCONITIC AND/OR ARGILLACEOUS.
- SHALE - VARICOLORED RED, GREY, GREEN AND PURPLE, FISSILE, CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED, CRUMPLED, CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES.

NOTES:

1. All rock encountered in excavation identified as Lower Conasauga Formation of Middle Cambrian age
2. Due to complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified considerably

"HISTORICAL INFORMATION"

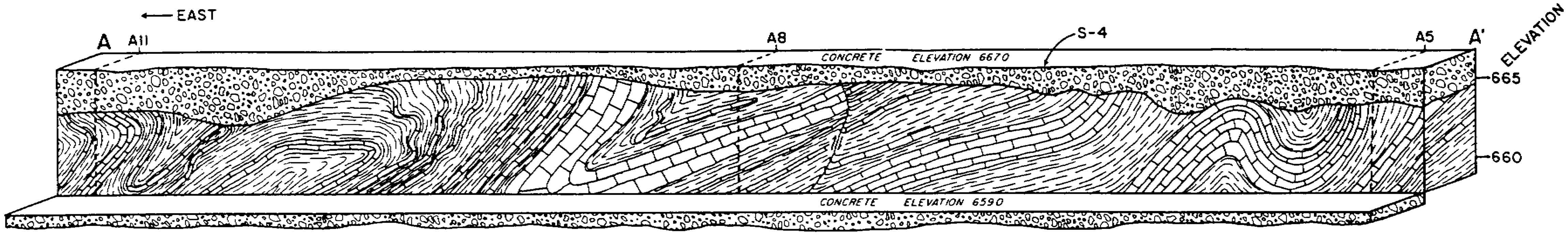
SCALE

4 0 4 8 FEET

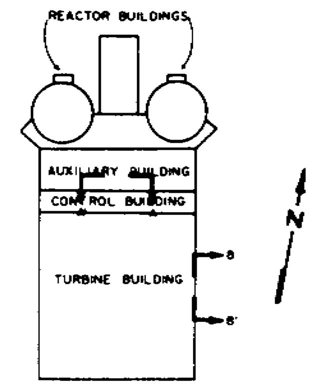
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GEOLOGIC SECTION AND
PANORAMIC PHOTOGRAPH
Q-4 LINE FROM A4-3 TO A12+3

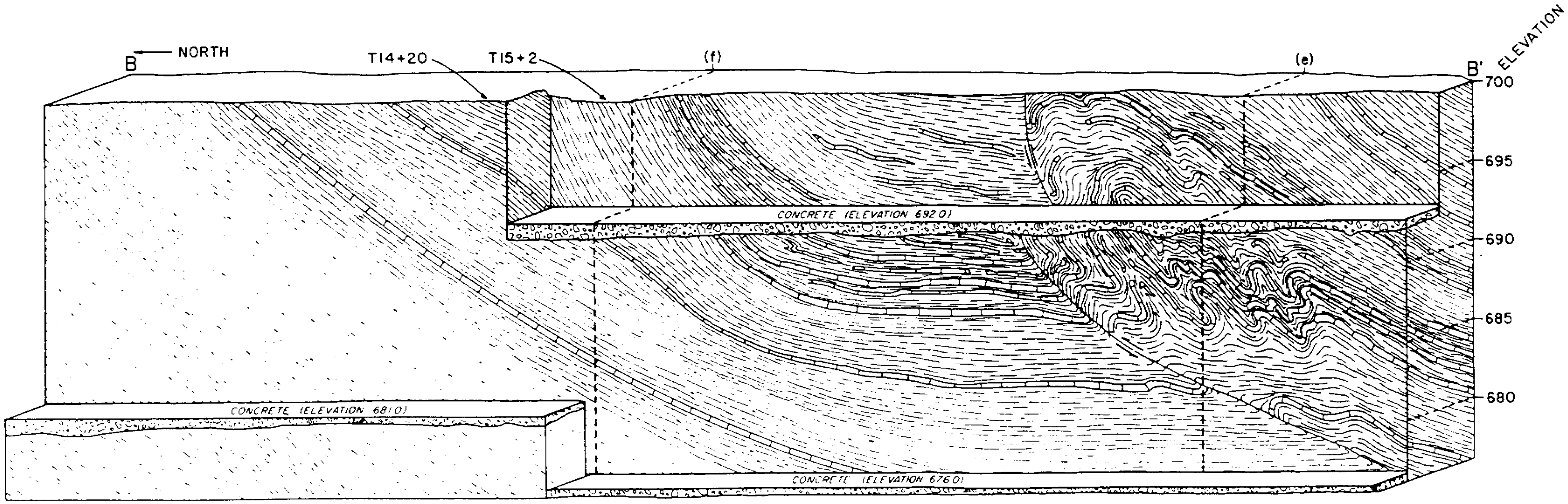
Figure 2.5-115




SECTION ALONG S-4
LOOKING SOUTH




KEY PLAN
NOT TO SCALE




SECTION ALONG T14+20 & T15+2
LOOKING EAST

LEGEND

- Thrust fault
- Limestone - Fine- to coarse-grained, white to dark grey to pink, thin, medium to massive bedded, some beds glauconitic and, or argillaceous.
- Shale - Varicolored red, grey, green and purple, fissile, calcareous shale which frequently is tightly folded, crumpled, contorted and bounded by slickensided surfaces.
- Protective concrete

*"HISTORICAL INFORMATION"*

SCALE

4 0 4 8 Feet

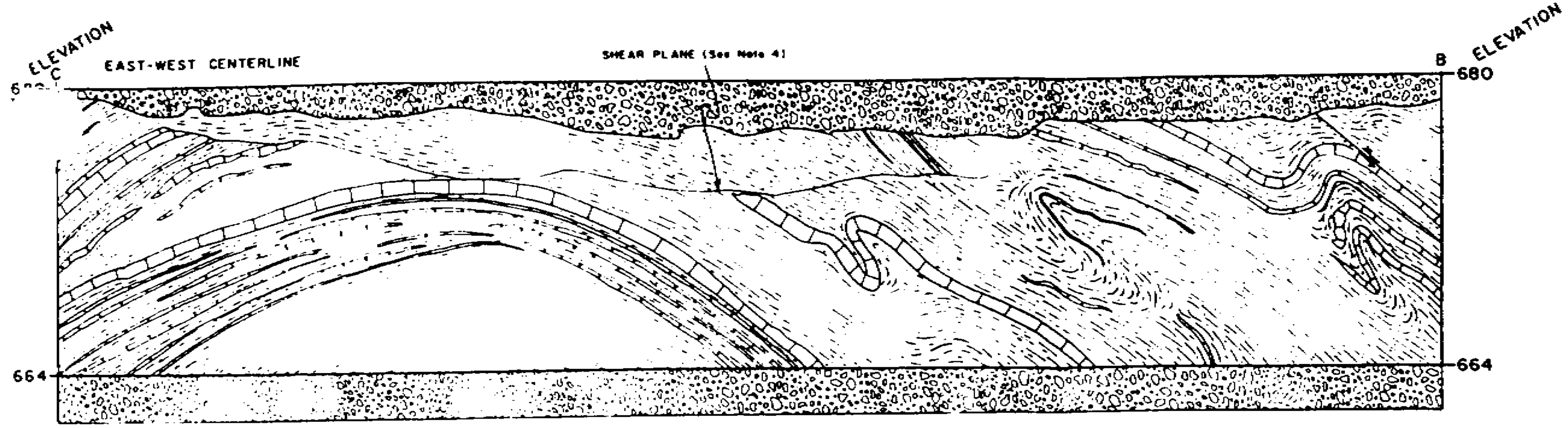
NOTES

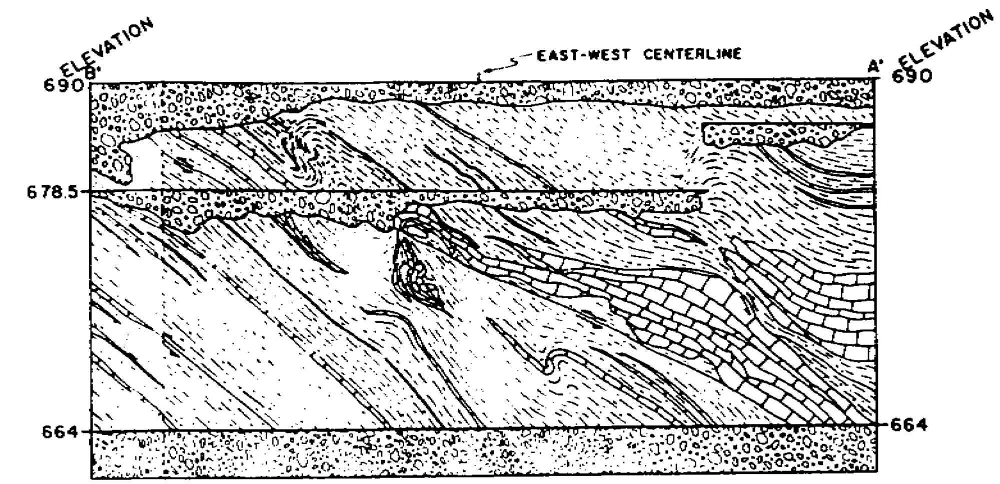
1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified.

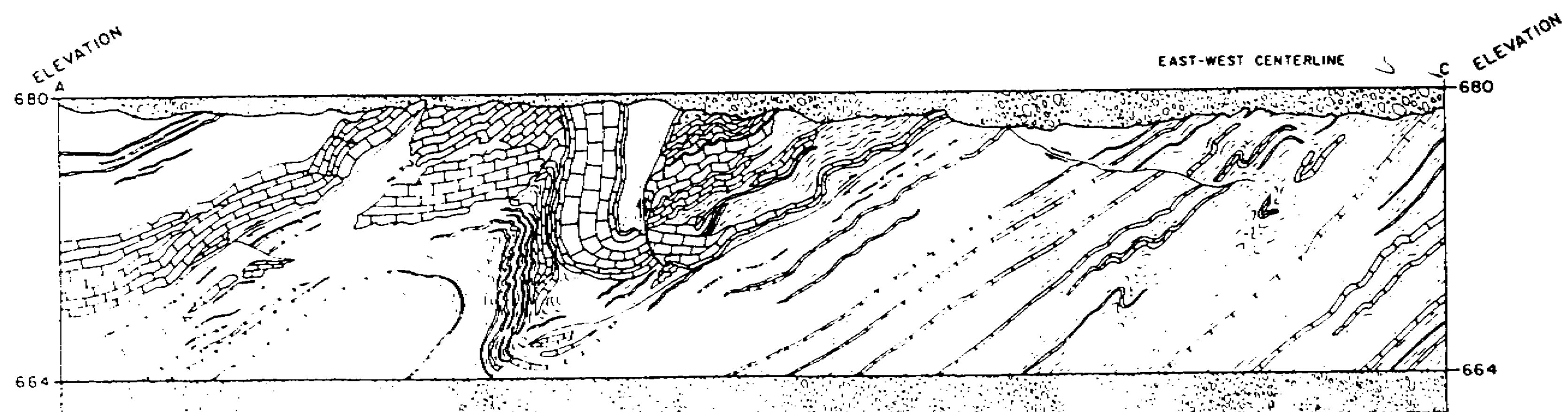
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

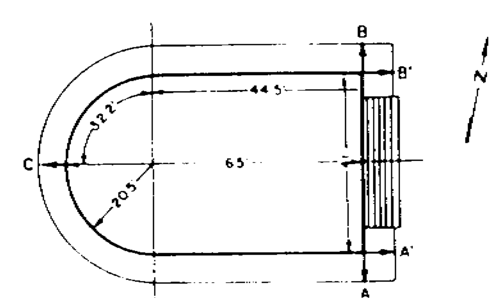
GEOLOGIC SECTIONS
AUXILIARY AND TURBINE BUILDINGS

Figure 2.5-116




KEY PLAN

LEGEND

- THRUST FAULT
- LIMESTONE - FINE TO COARSE GRAINED, WHITE TO DARK GREY TO PINK, THIN, MEDIUM TO MASSIVE BEDDED. SOME BEDS GLAUCONITIC AND/OR ARGILLACEOUS.
- SHALE - VARICOLORED RED, GREY, GREEN AND PURPLE, FISSILE, CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED, CRUMPLED, CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES
- WEATHERED [illegible] WEATHERED SHALE, WEATHERED [illegible] LIMESTONE AND/OR CLAY REMOVED PRIOR TO EMPLACEMENT OF PROTECTIVE CONCRETE
- PROTECTIVE CONCRETE

NOTES

1. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified considerably
2. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
3. Graphic presentations not to scale due to photographic distortions
4. Strata above shear plane gives evidence to have been displaced to the northwest

"HISTORICAL INFORMATION"

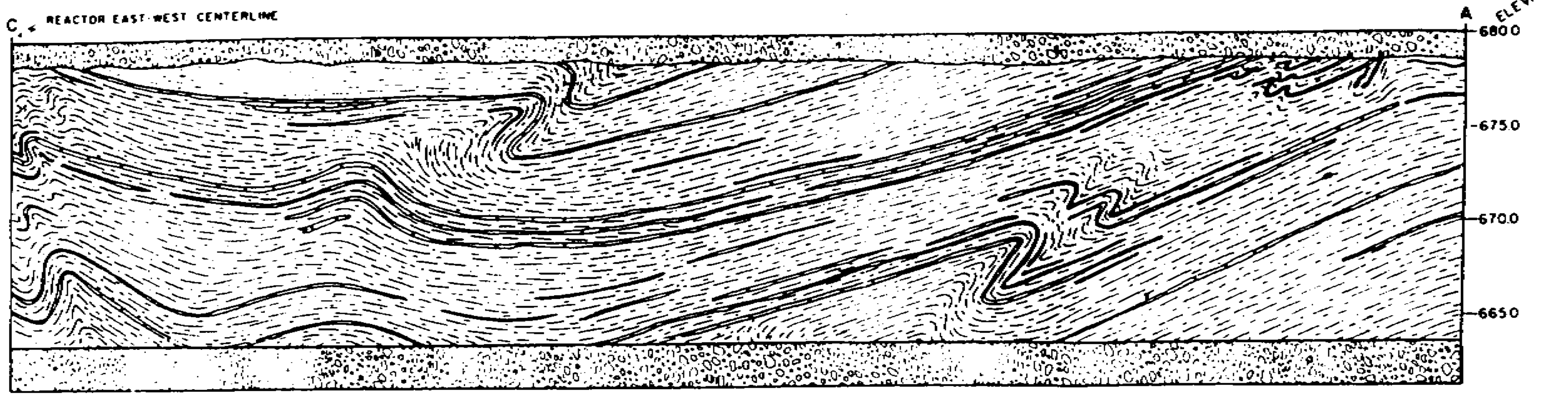
SCALE

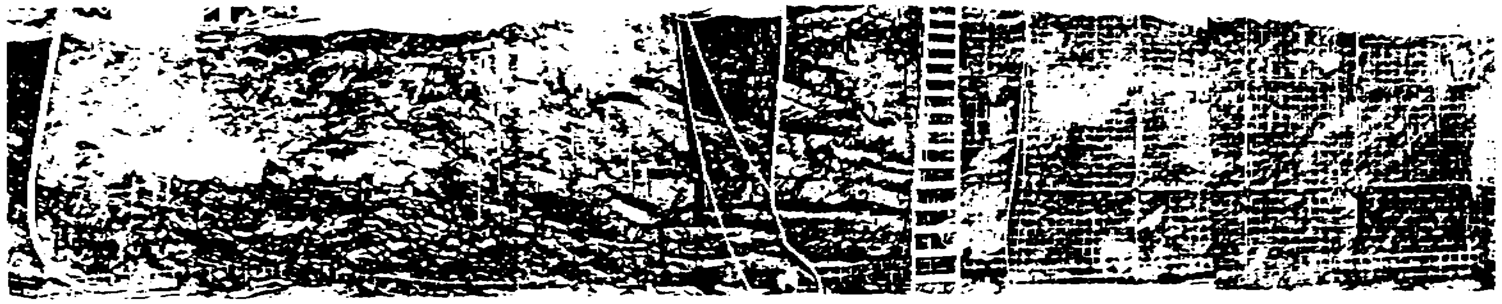
See note 3

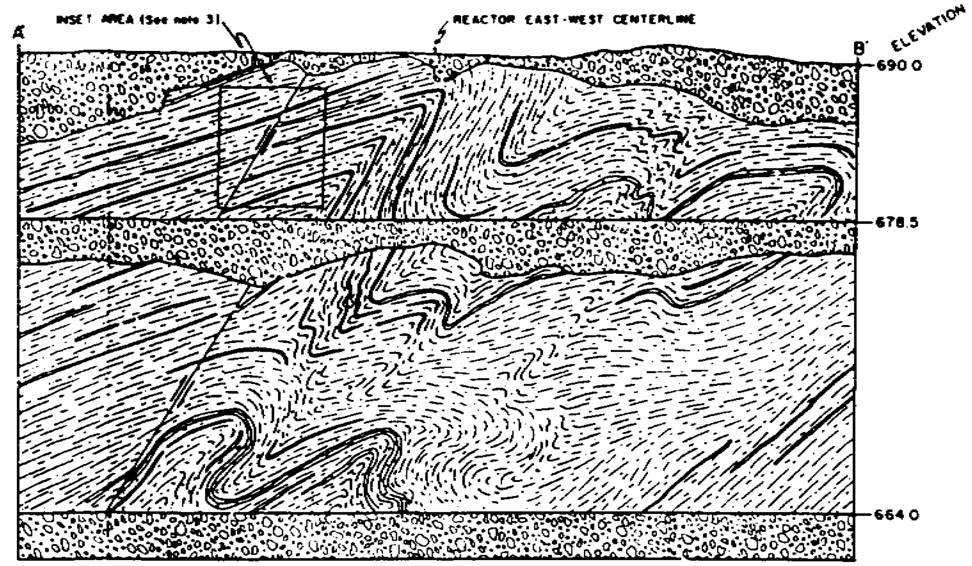
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

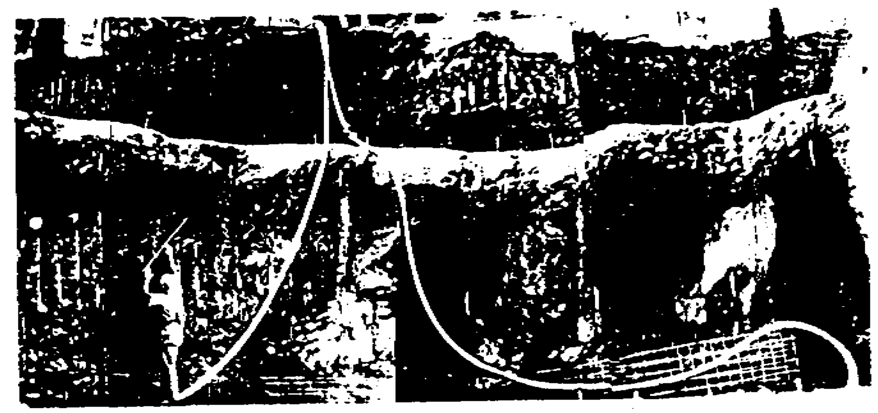
UNIT 2
GEOLOGIC SECTIONS AND
PANORAMIC PHOTOGRAPHS

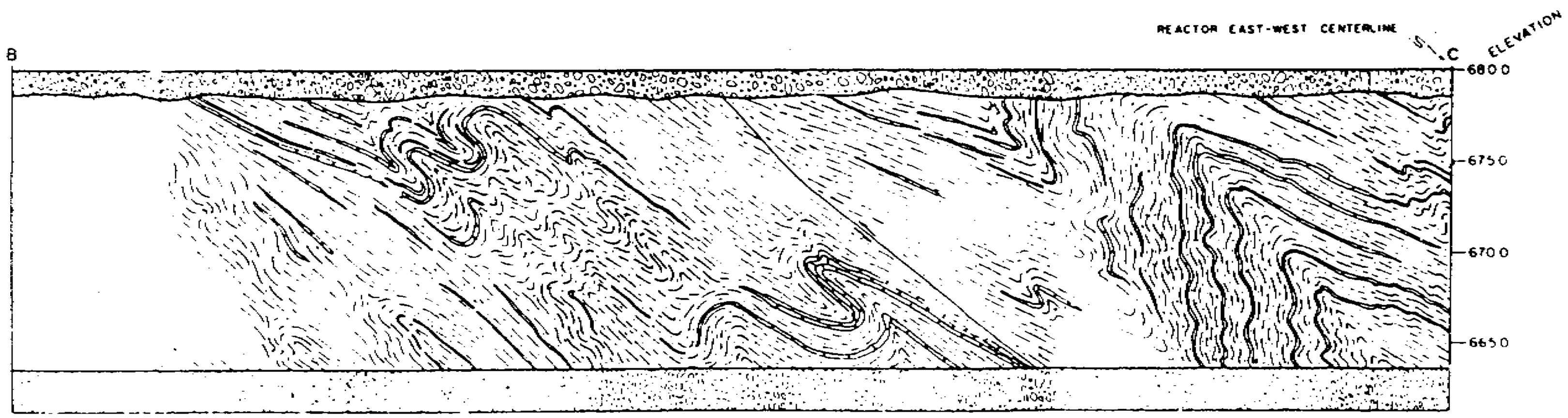
Figure 2.5-117



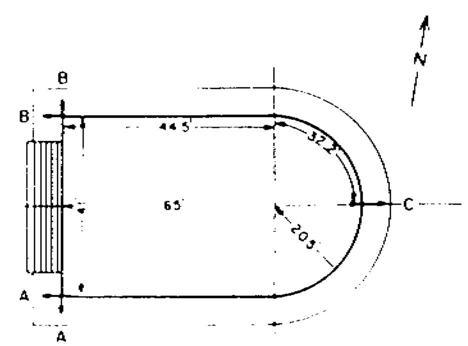








*"HISTORICAL INFORMATION"*




KEY PLAN

NOTES

1. Due to the completely folded and contorted characteristics of the foundation rock, the geologic sections have been simplified considerably
2. Graphic presentations not to scale due to photographic distortions
3. See closeup photograph of inset area (Photograph #14186-1)
4. All rock encountered in excavation identified as Lower Conasauga Formation of Middle Cambrian age

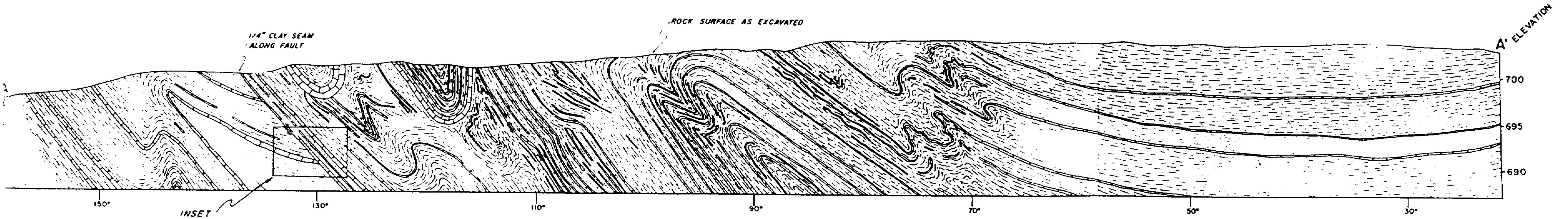
SCALE
See note 3

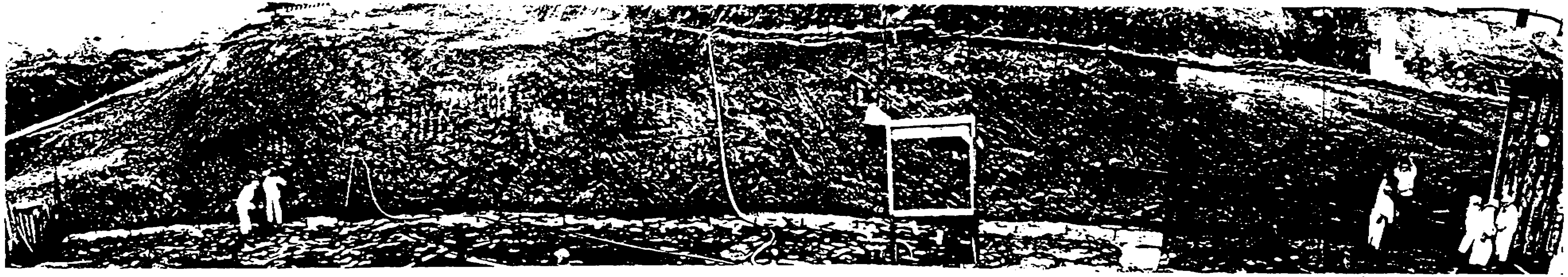
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

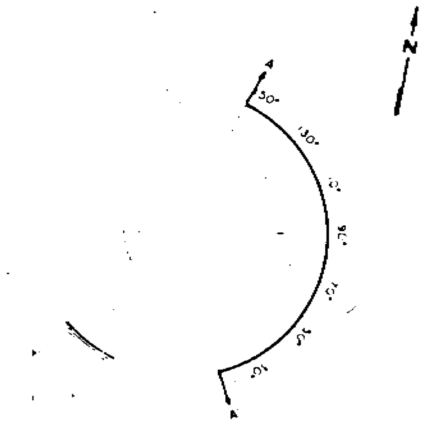
UNIT 1
GEOLOGIC SECTIONS AND
PANORAMIC PHOTOGRAPHS

Figure 2.5-118

# Figure 2.5-119 - Historical






KEY PLAN

LEGEND

- Thrust fault
- Limestone - Fine- to coarse-grained, white to dark grey to pink, thin, medium to massive bedded, some beds glauconitic and/or argillaceous.
- Shale - Varicolored red, grey, green and purple, fissile, calcareous shale which frequently is tightly folded, crumpled contorted and bounded by slickensided surfaces.

NOTES:

1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified
3. See closeup photograph of inset area (photograph N° 90863E)

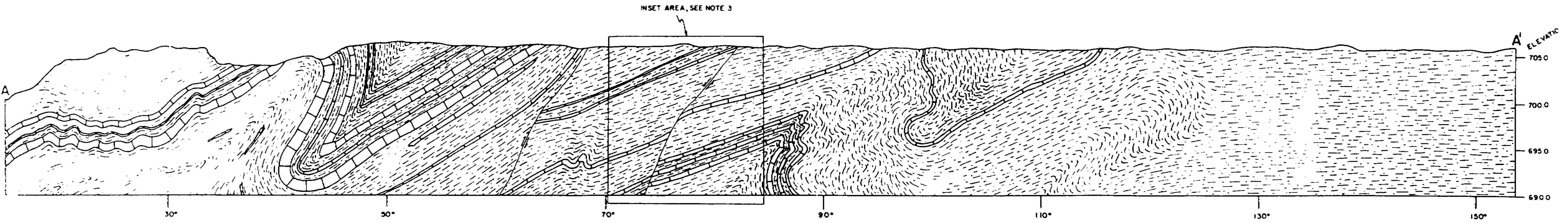
"HISTORICAL INFORMATION"

SCALE

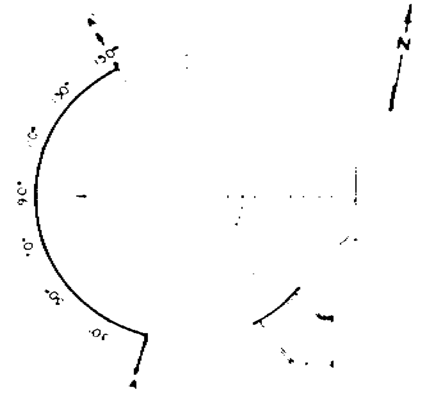
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GEOLOGIC SECTION AND PANORAMIC PHOTOGRAPH OF REACTOR 2 EAST PERIMETER WALL

Figure 2.5-119




VIEWED WEST




KEY PLAN

LEGEND

THRUST FAULT

LIMESTONE - FINE TO COARSE GRAINED, WHITE TO DARK GREY TO PINK, THIN, MEDIUM TO MASSIVE BEDDED, SOME BEDS GLAUCONITIC AND OR ARGILLACEOUS

SHALE - VARICOLORED RED, GREY, GREEN AND PURPLE, FISSILE, CALCAREOUS SHALE WHICH FREQUENTLY IS TIGHTLY FOLDED, CRUMPLED, CONTORTED AND BOUNDED BY SLICKENSIDED SURFACES

NOTES

1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified
3. See closeup photograph of inset area (photograph 88906 ...)

SCALE

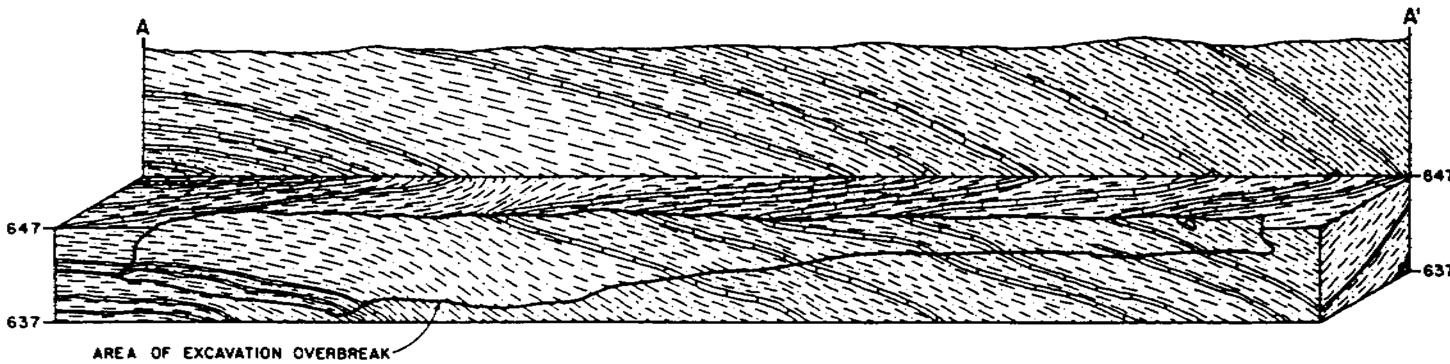
4 0 4 8 FEET

"HISTORICAL INFORMATION"

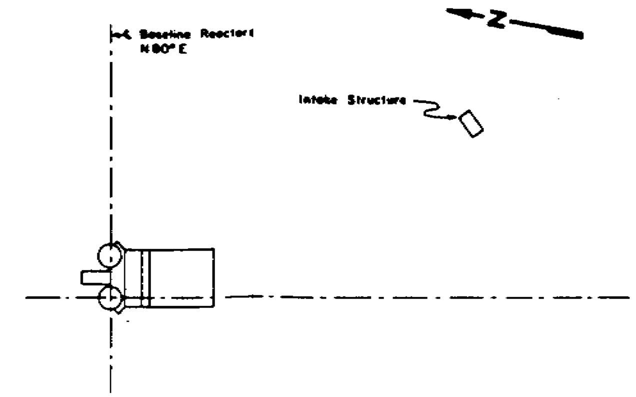
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GEOLOGIC SECTION AND PANORAMIC PHOTOGRAPH OF REACTOR 1 WEST PERIMETER WALL

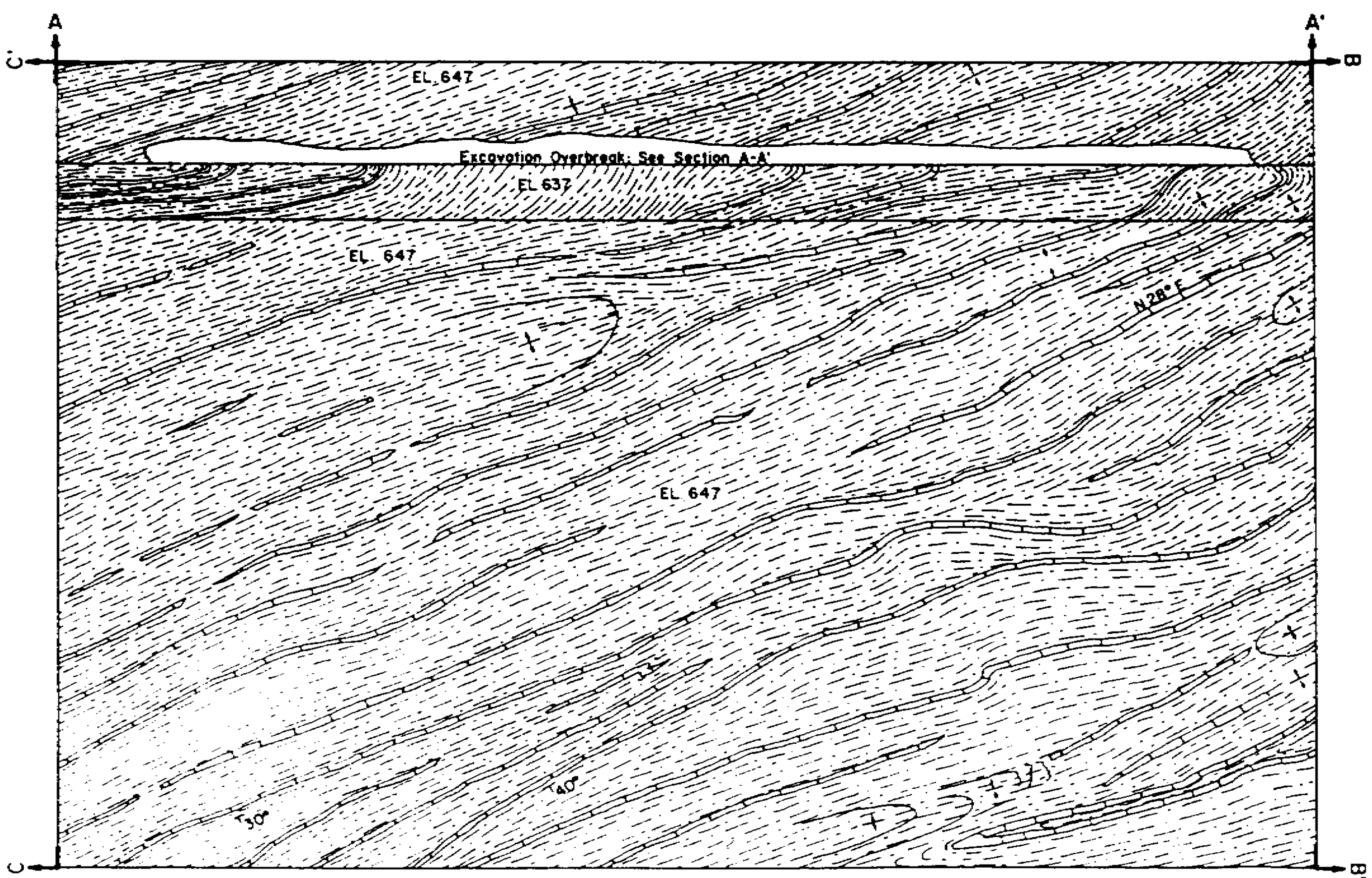
Figure 2.5-120



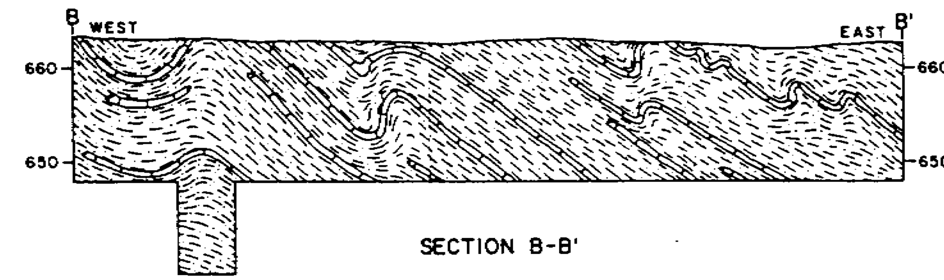

SECTION A-A'



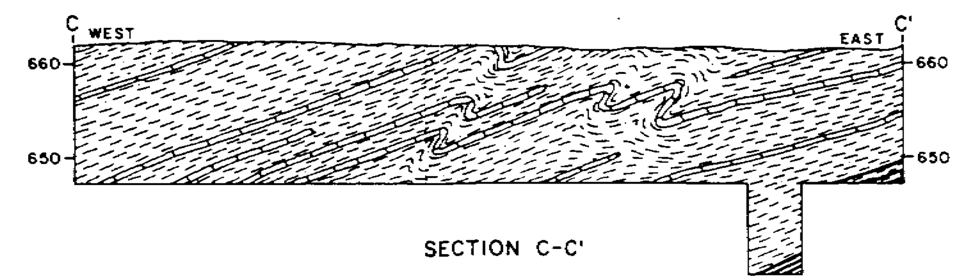

KEY PLAN
NOT TO SCALE




PLAN




SECTION B-B'



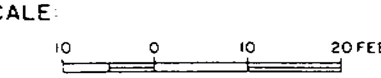

SECTION C-C'

NOTES:

1. All rock encountered in excavation identified as lower Conasauga Formation of Middle Cambrian age
2. Due to the complexly folded and contorted characteristics of the foundation rock, the geologic sections have been simplified

*"HISTORICAL INFORMATION"*

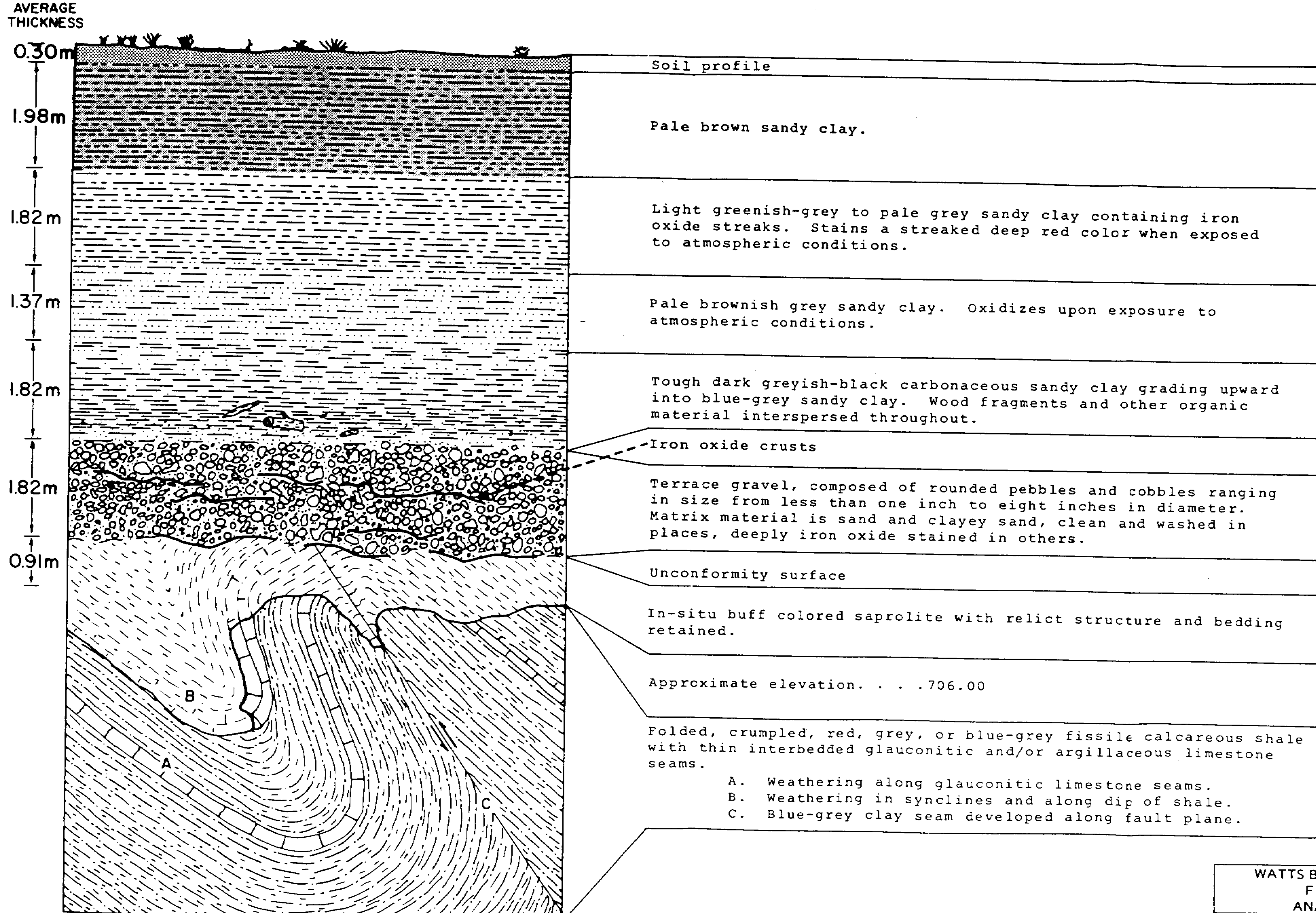
SCALE:




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GEOLOGIC PLAN AND SECTIONS
INTAKE STRUCTURE FOUNDATION

Figure 2.5-121

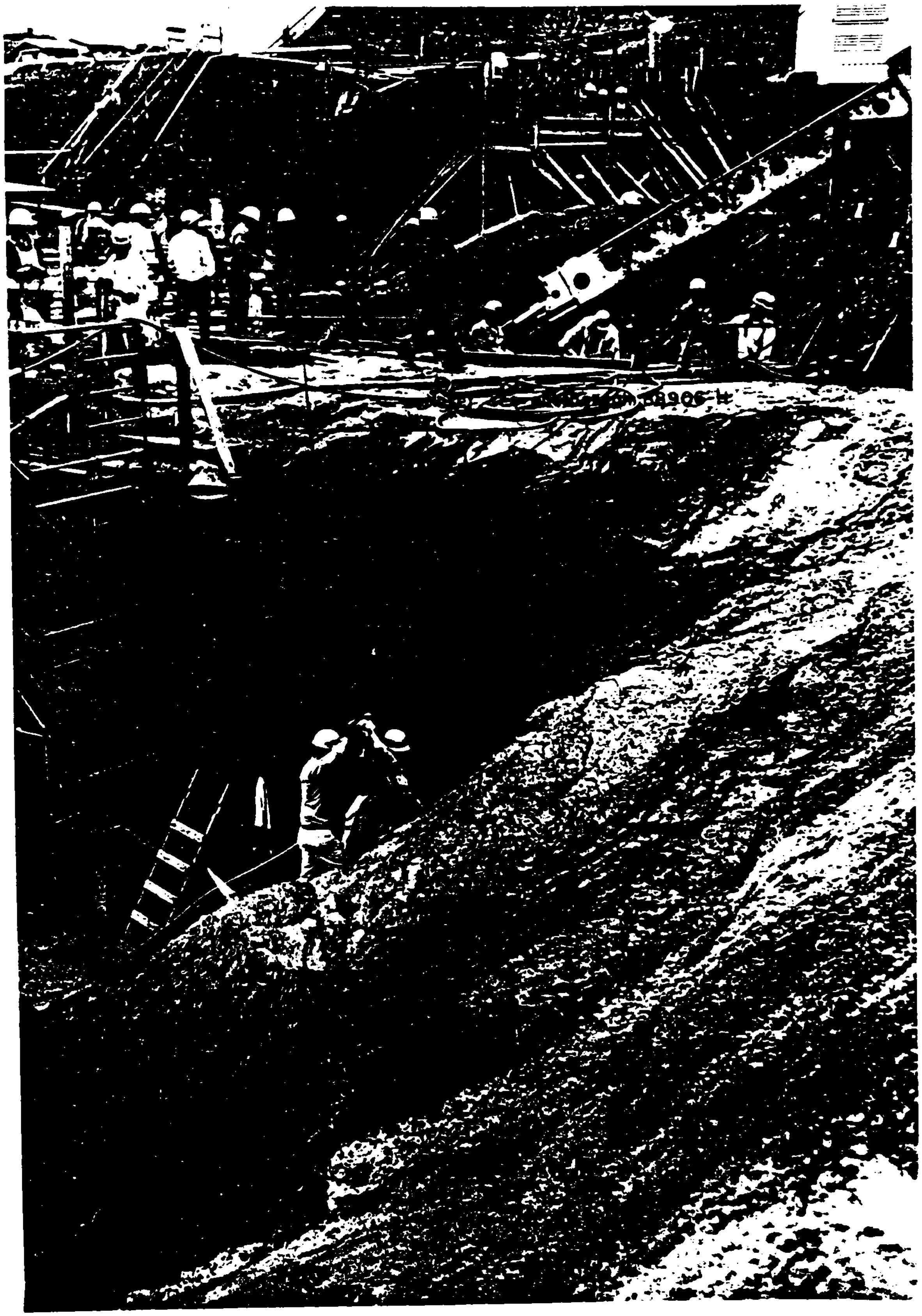



"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GENERALIZED GEOLOGIC SECTION
AND SOIL PROFILE

Figure 2.5-122

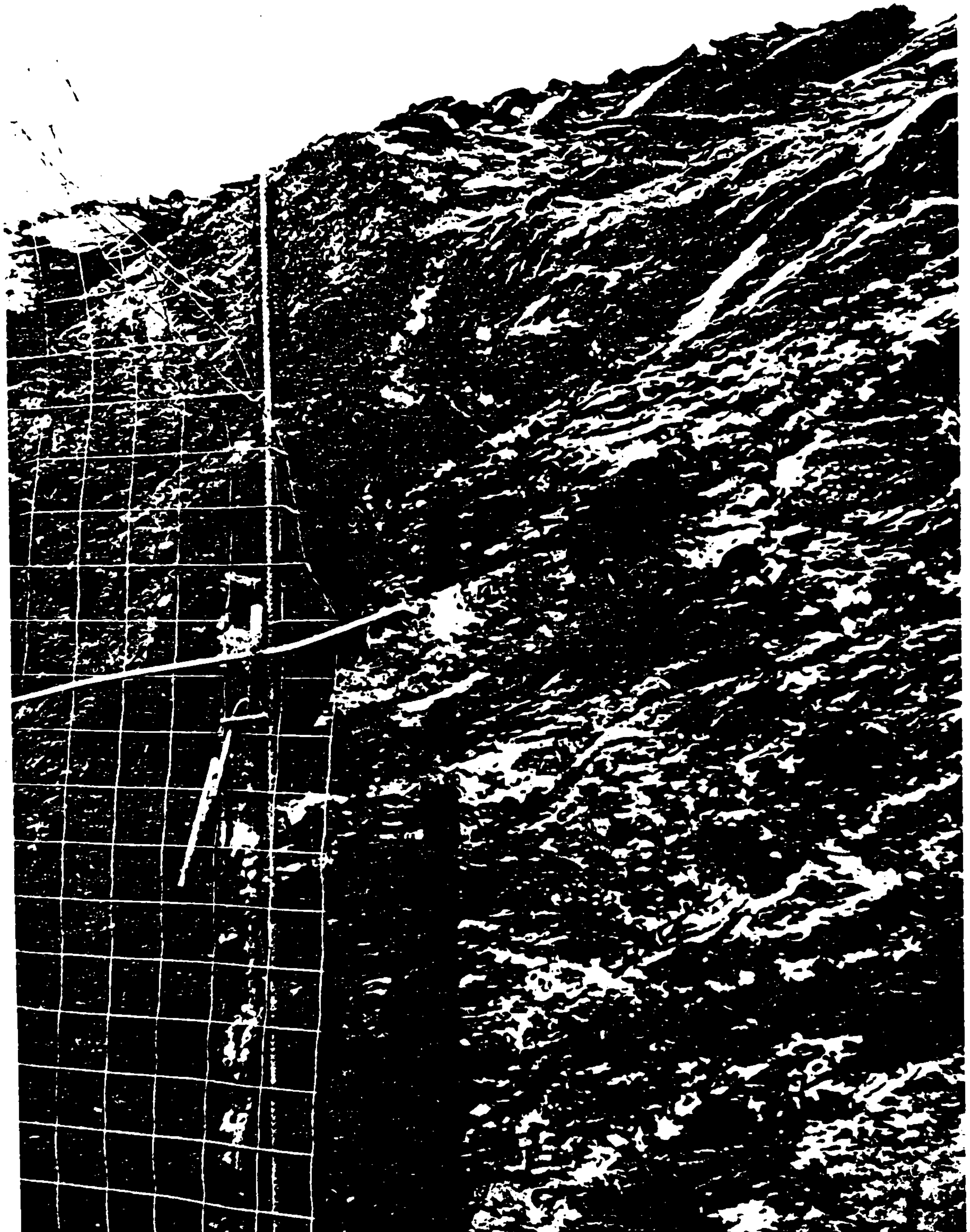


Watts Bar Nuclear Plant
Tennessee Valley Authority
88902-P January 16, 1974
Gary W. Krantz, Knoxville

Fault shown cutting across Auxiliary Building at A4+28 feet and east-west reactor center-line, through SE perimeter of Reactor #1, and into Auxiliary Building West Wall near U line. Viewed southwest.

Figure 2.5-123

**BEST AVAILABLE HISTORICAL IMAGE**

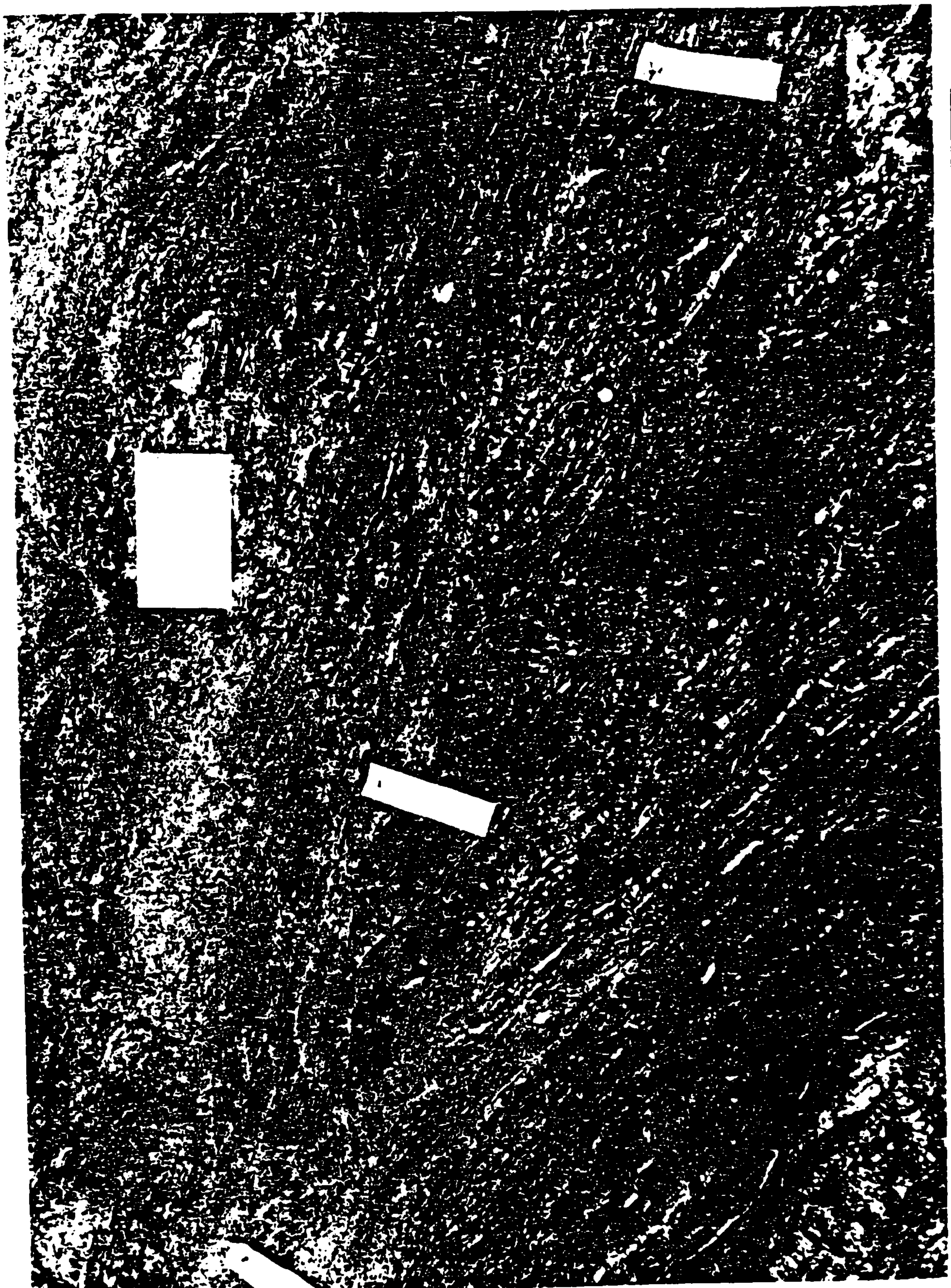


Watts Bar Nuclear Plant
Tennessee Valley Authority
88906-H December 13, 1973
Gary W. Krantz, Knoxville

Fault in Auxiliary Building Wall, approximately 9 feet west of A5 and 6 feet south of east-west reactor centerline. Fault continues across SE perimeter of Reactor #1. Viewed southwest.

Figure 2.5-124

**BEST AVAILABLE HISTORICAL IMAGE**

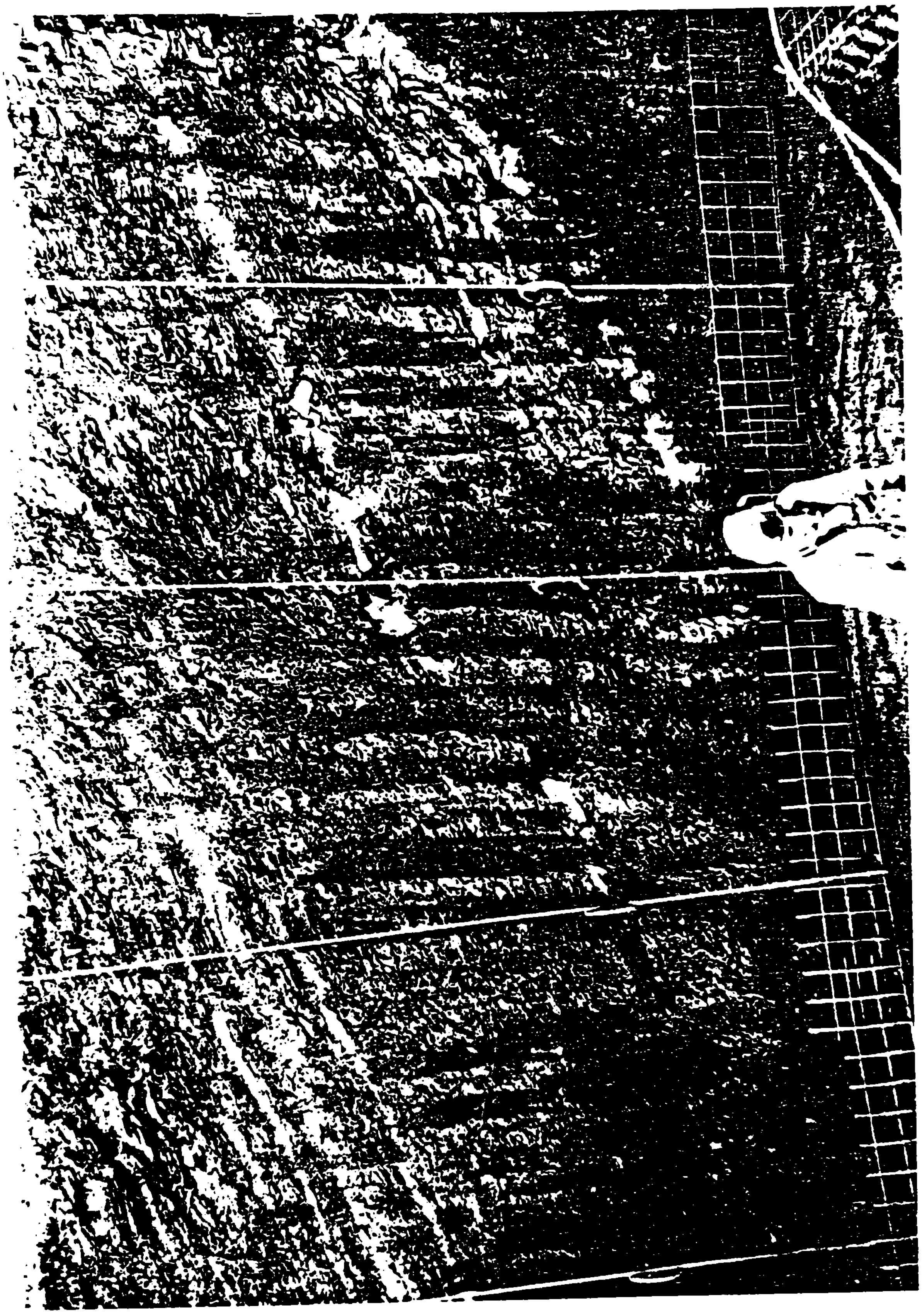


Watts Bar Nuclear Plant
Tennessee Valley Authority
90865-B March 7, 1974
Gary W. Krantz, Knoxville

Minor thrust fault and associated one-eighth inch clay seam located in east foundation cut at q line and C13+12 feet. Viewed east.

Figure 2.5-125 UP

BEST AVAILABLE HISTORICAL IMAGE



Closeup of Reactor #1 normal fault at 72 degrees. Viewed west.

Watts Bar Nuclear Plant
Tennessee Valley Authority
88906-L December 17, 1973
Gary W. Krantz, Knoxville

Figure 2.5-126

**BEST AVAILABLE HISTORICAL IMAGE**

Watts Bar Nuclear Plant
Tennessee Valley Authority
14186-1 March 14, 1974
Gary M. Krantz, Knoxville

Closeup of fault in Reactor #1 cavity west wall between elevations of 678.5 and 690.0 feet. Viewed west. Scale: 1 inch = 0.56 feet.

Figure 2.5-127

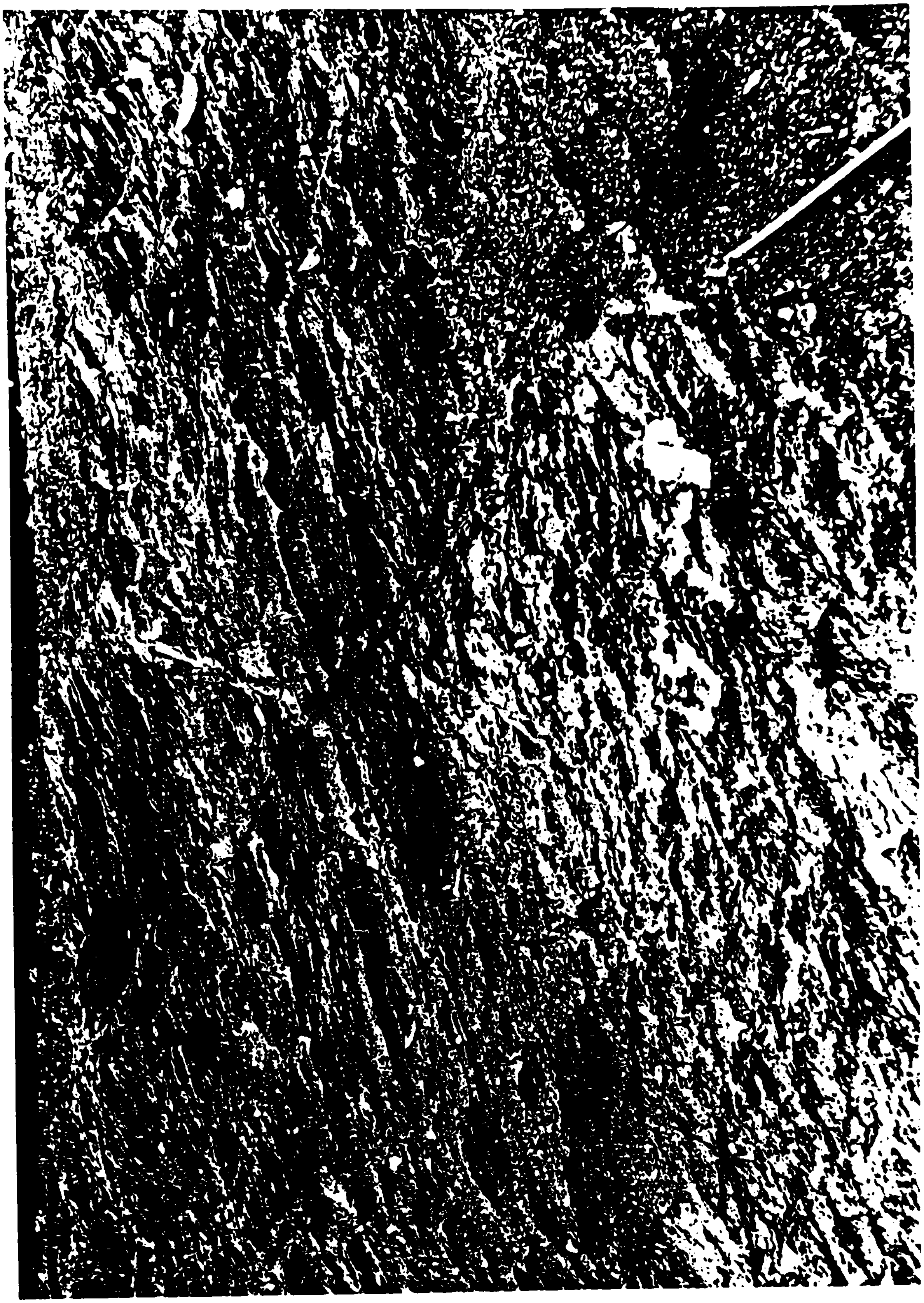
**BEST AVAILABLE HISTORICAL IMAGE**

Watts Bar Nuclear Plant
Tennessee Valley Authority
88906-I December 13, 1973
Gary W. Krantz, Knoxville

Fault in Auxiliary Building at A11 and east-west reactor centerline. Fault continues NE through NW perimeter of Reactor #2 Building. Viewed northeast.

Figure 2.5-128

**BEST AVAILABLE HISTORICAL IMAGE**

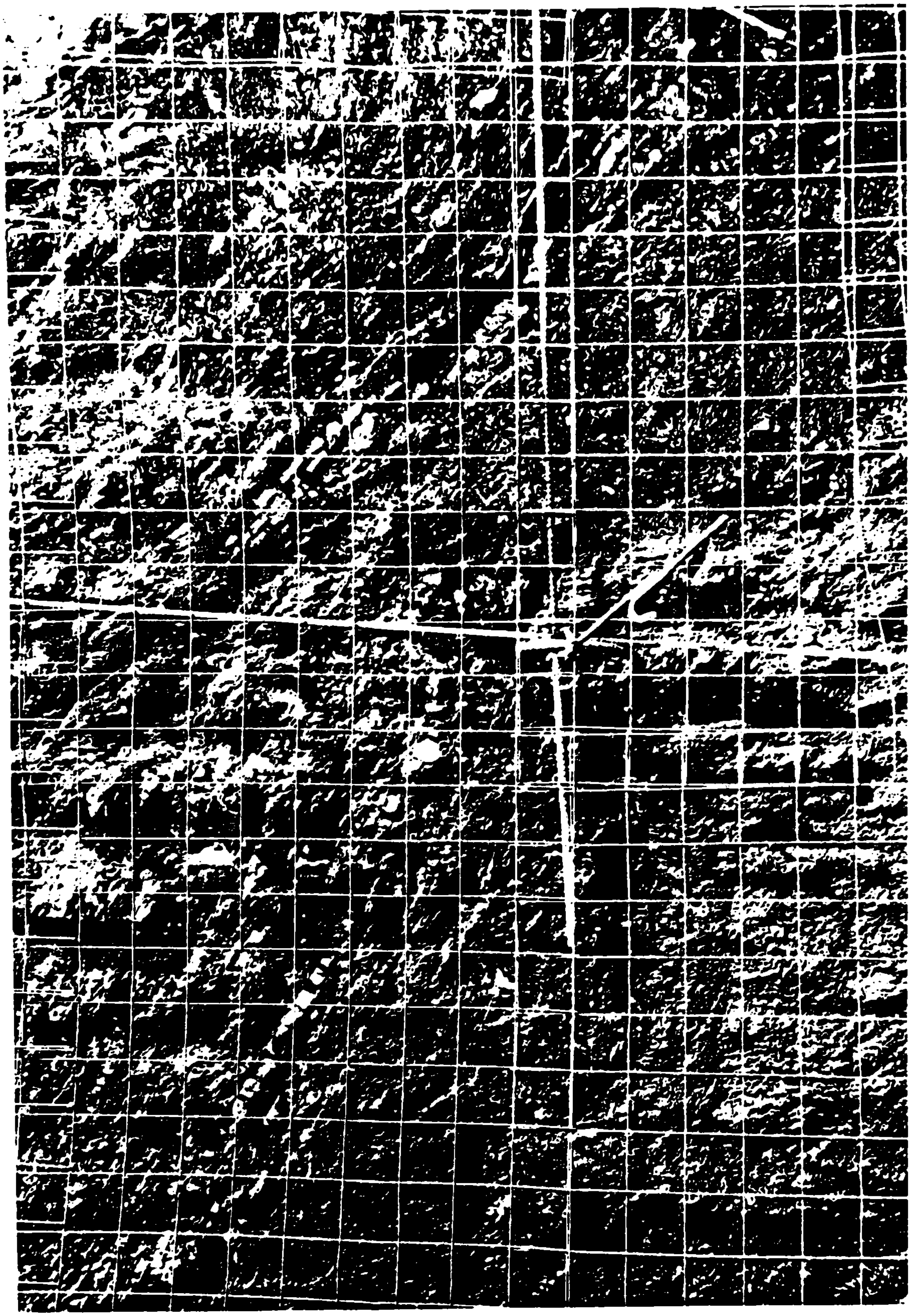


Watts Bar Nuclear Plant
Tennessee Valley Authority
88902-J January 16, 1974
Gary W. Krantz, Knoxville

Gravity or normal fault on northeast Reactor #1 perimeter at 233 degrees. Fault plane dips north at 40 degrees. Viewed west.

Figure 2.5-129

**BEST AVAILABLE HISTORICAL IMAGE**



Watts Bar Nuclear Plant
Tennessee Valley Authority
90863 E February 1, 1974
Gary W. Krantz, Knoxville

Fault in Reactor #2 East Wall at approximately 130 degrees. Viewed east.

Figure 2.5-130

BEST AVAILABLE HISTORICAL IMAGE

| | |
|---|---|
| Watts Bar Nuclear Plant<br>Tennessee Valley Authority<br>90863 P February 20, 1974<br>Gary W. Krantz, Knoxville | Fault in Reactor #2 Cavity Wall at approximately 354 degrees. Elevation 680.0 at base.<br>Viewed southwest. |

Figure 2.5-131

BEST AVAILABLE HISTORICAL IMAGE

Watts Bar Nuclear Plant
Tennessee Valley Authority
90865 H March 7, 1974
Gary W. Krantz Knoxville

Fault in south wall of discharge channel showing truncation by overlying terrace gravel deposit.

Figure 2.5-132

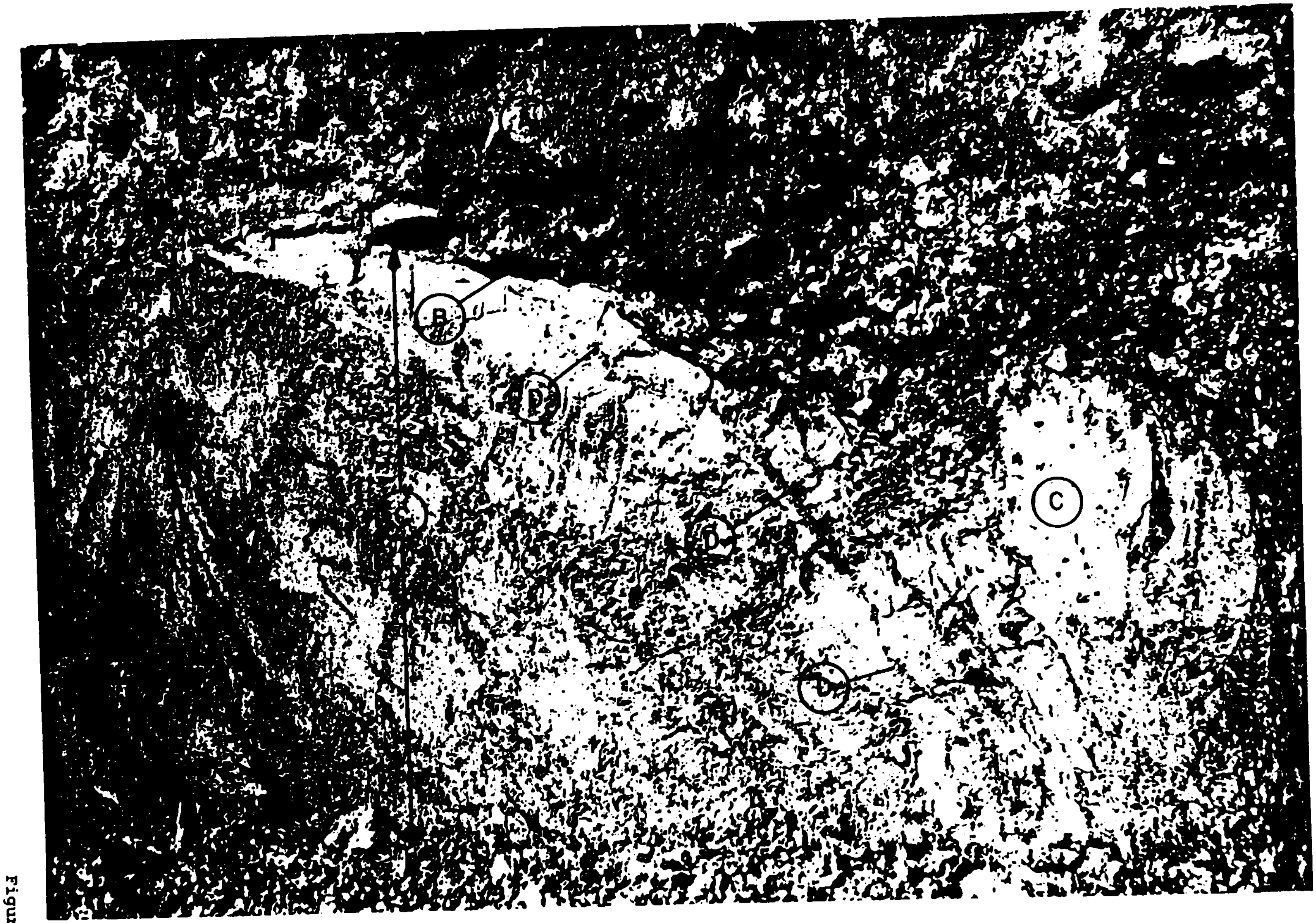
**BEST AVAILABLE HISTORICAL IMAGE**

Fault in north wall of discharge channel showing truncation by terrace gravel deposit.

Watts Bar Nuclear Plant
Tennessee Valley Authority
90865D March 7, 1974
Gary M. Krantz, Knoxville

Figure 2.5-133

BEST AVAILABLE HISTORICAL IMAGE




| | |
|---|---|
| Watts Bar Nuclear Plant<br>Tennessee Valley Authority<br>88902-P January 16, 1974<br>Gary W. Krantz, Knoxville | Fault truncation by terrace gravel deposit at 20 feet east of A8 and 18.50 feet north of Y. Elevation at bench cut is 706.35. Viewed north.<br>A = Terrace gravel deposit<br>B = Iron oxide crust<br>C = Buff colored saprolitic shale residuum<br>D = Blue-grey clay seam along fault |

Figure 2.5-134

**BEST AVAILABLE HISTORICAL IMAGE**

Watts Bar Nuclear Plant
Tennessee Valley Authority
January 16, 1974
Gary W. Krantz, Knoxville

Fault in vertical excavation cut at 20 feet east of A8 and 18.50 feet north of Y. Viewed north. For enlargement of inset area see next photograph.

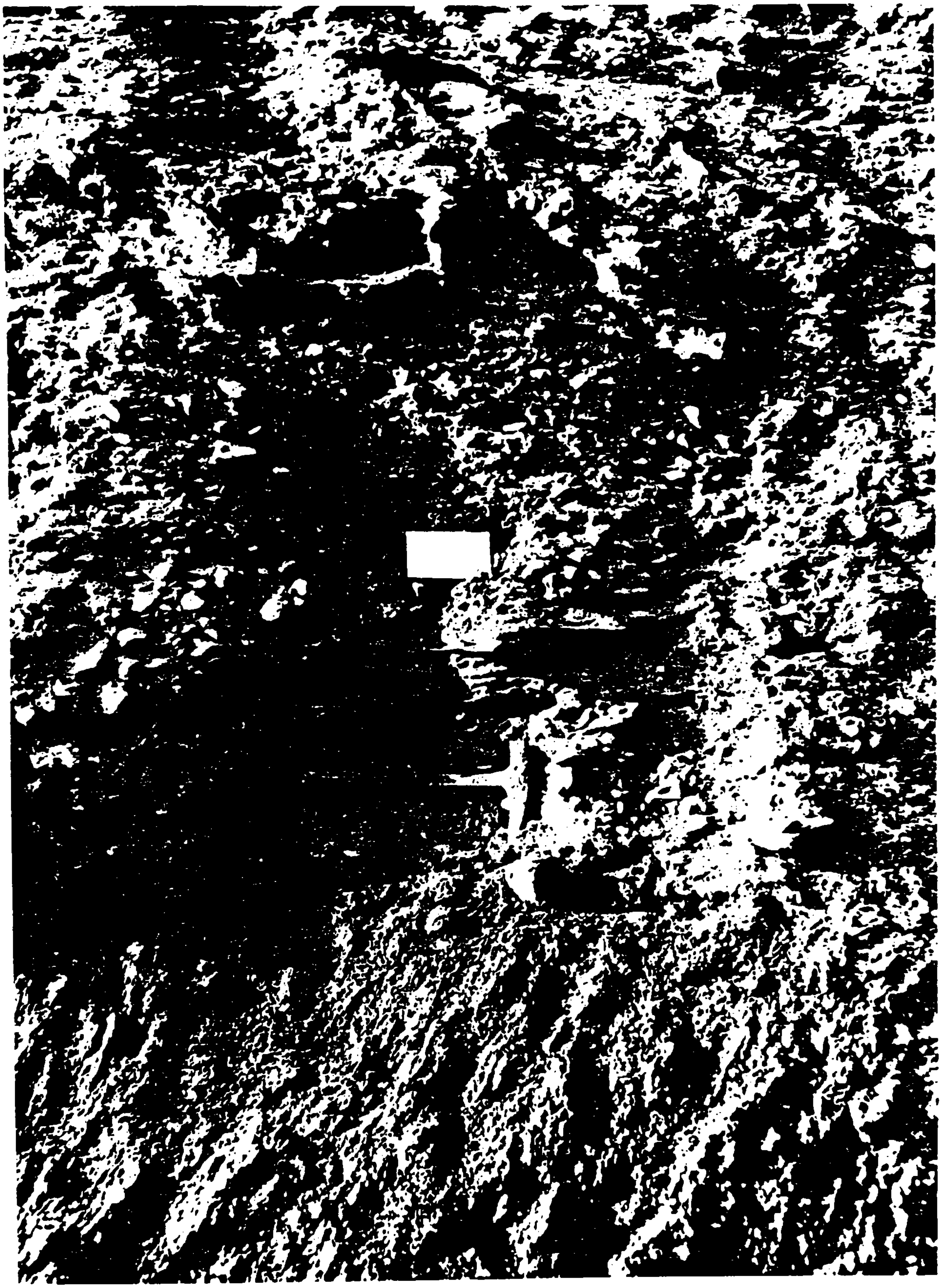
Figure 2.5-135

**BEST AVAILABLE HISTORICAL IMAGE**

Watts Bar Nuclear Plant
Tennessee Valley Authority
January 16, 1974
Gary W. Krantz, Knoxville

Inset Area. Blue-grey clay seam along fault trace where truncated by terrace gravel deposit. Location: 20 feet east of A8 and 18.50 feet north of Y. Viewed north.

Figure 2.5-136

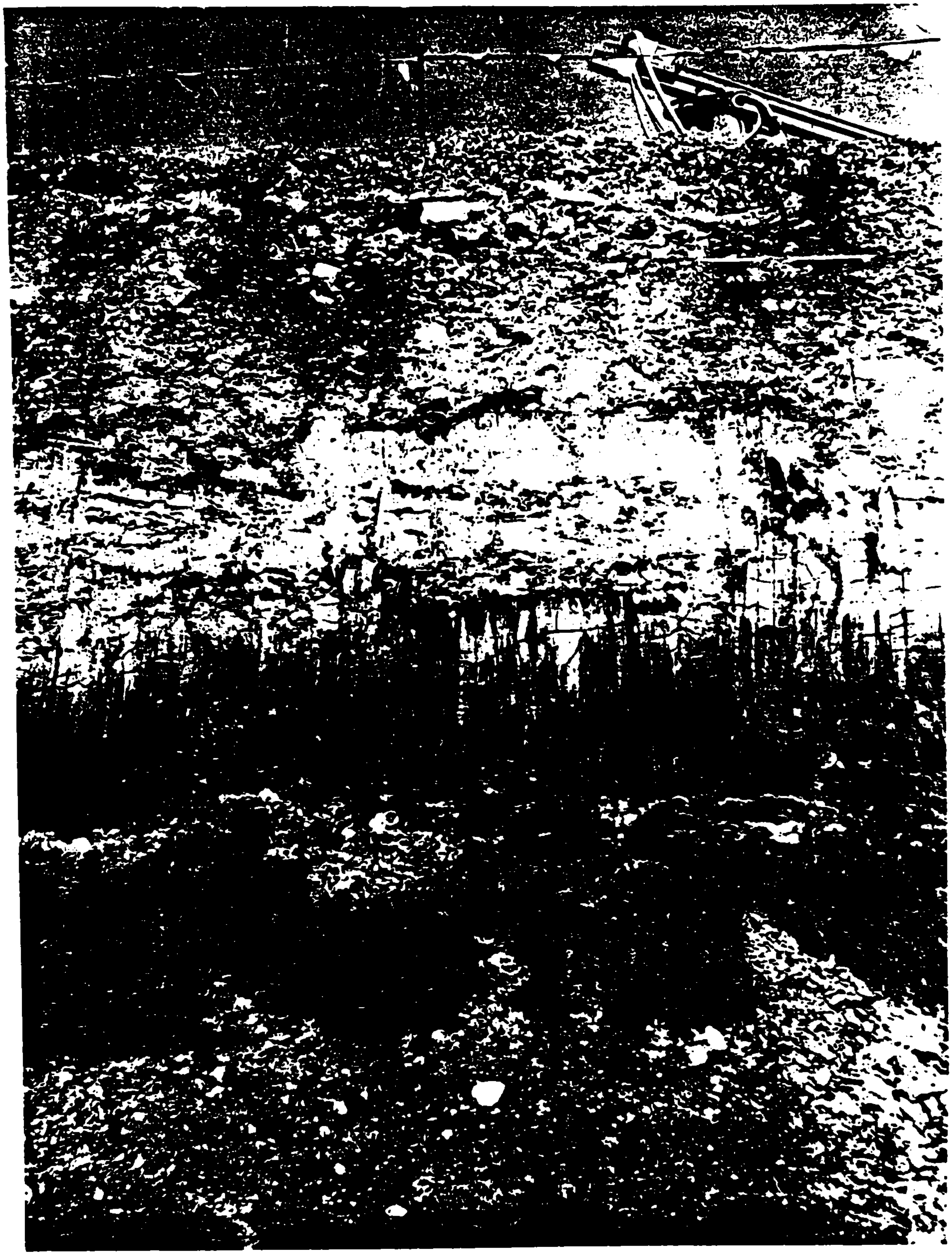


Watts Bar Nuclear Plant
Tennessee Valley Authority
90865-C March 7, 1974
Gary W. Krantz, Knoxville

Saprolite - terrace gravel contact. Hematitic crusts are seen to be dispersed at several levels in the terrace gravel. Viewed south in the exhaust cut approximately 150 feet east of the powerhouse foundation.

Figure 2.5-137

**BEST AVAILABLE HISTORICAL IMAGE**

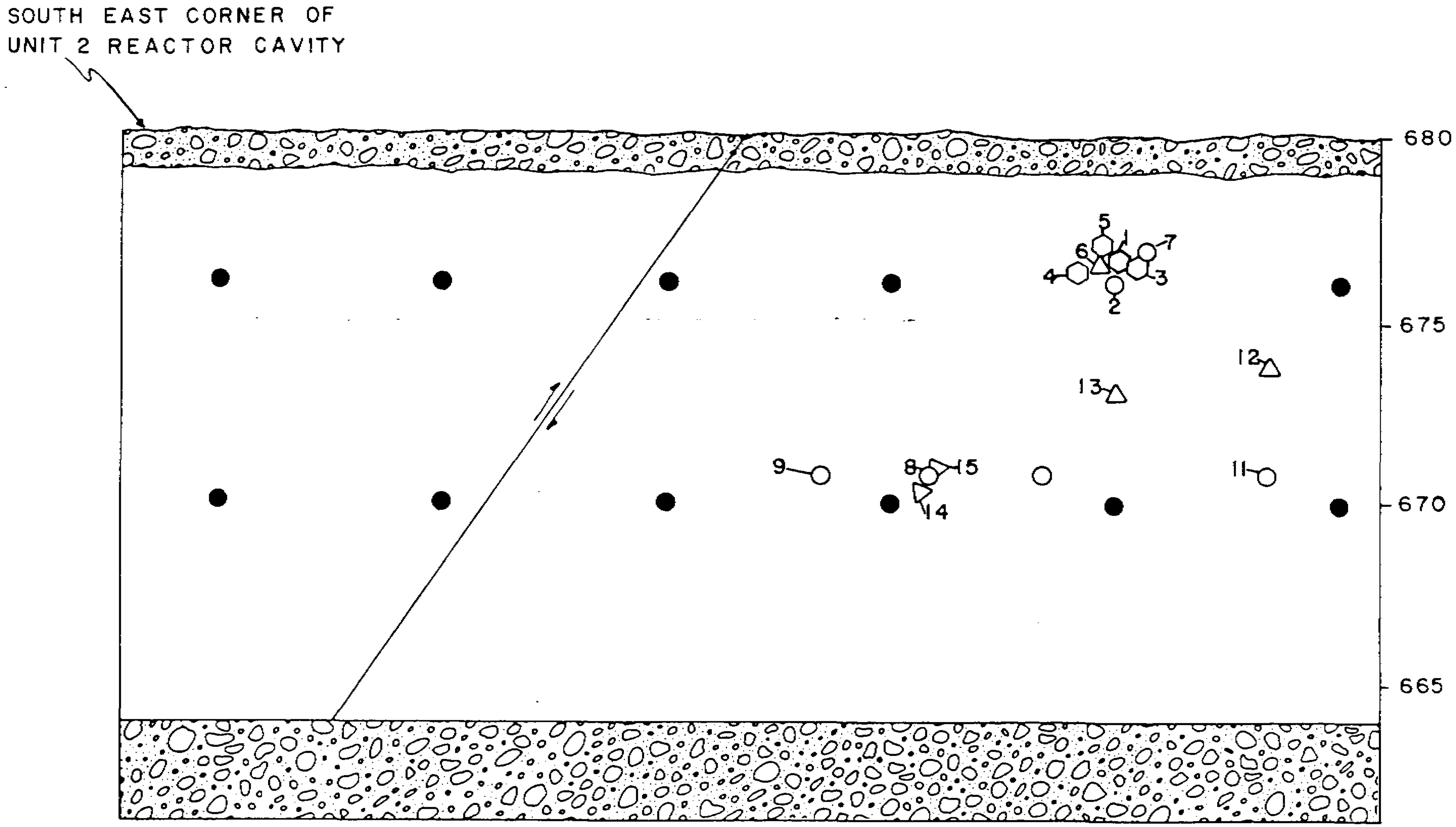


Watts Bar Nuclear Plant
Tennessee Valley Authority
8654 P March 11, 1974
Gary W. Krantz Knoxville

Site of wood specimen collection for Carbon 14 age dating. Location is 3 feet above terrace gravel deposit. Scale: Opened Brunton compass = 8.5 inches. Location: Approximately 18.5' North of Y at A5 line. Approximate elevation 717.5.

Figure 2.5-138

**BEST AVAILABLE HISTORICAL IMAGE**




PERCUSSION HOLE LAYOUT FOR HORIZONTAL AND ANGLED HOLES

1 ⬡
2 ⬡
3 ⬡ } Drilled during J-bar installation
4 ⬡
5 ⬡
6 △
7 ○------Angle hole inclined 36° bearing S 40° E
8 ○-----Horizontal bearing S 8-10° E
9 ○-----Horizontal bearing S 8-10° E
10 ○-----Horizontal bearing S 8-10° E
11 ○-----Horizontal bearing S 50° E
12 △---- Horizontal bearing S 50° E
13 △----Horizontal bearing S 50° E
14 △----Horizontal bearing S 60° E
15 △----Angle hole inclined 30° bearing S 8° E

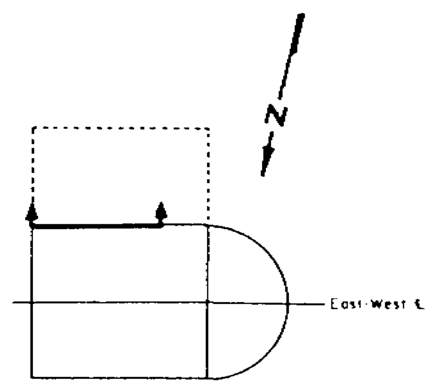
LEGEND

○ Exploration hole where disintegrated zone was intersected

△ Exploration hole where disintegrated zone was not intersected

● #9 J-Bar, grouted in with hi-early neat cement grout

Protective concrete




KEY PLAN
Reactor 2 Cavity Excavation
0 30 Feet

NOTE:
1. Bearings taken with a hand-held Brunton compass.

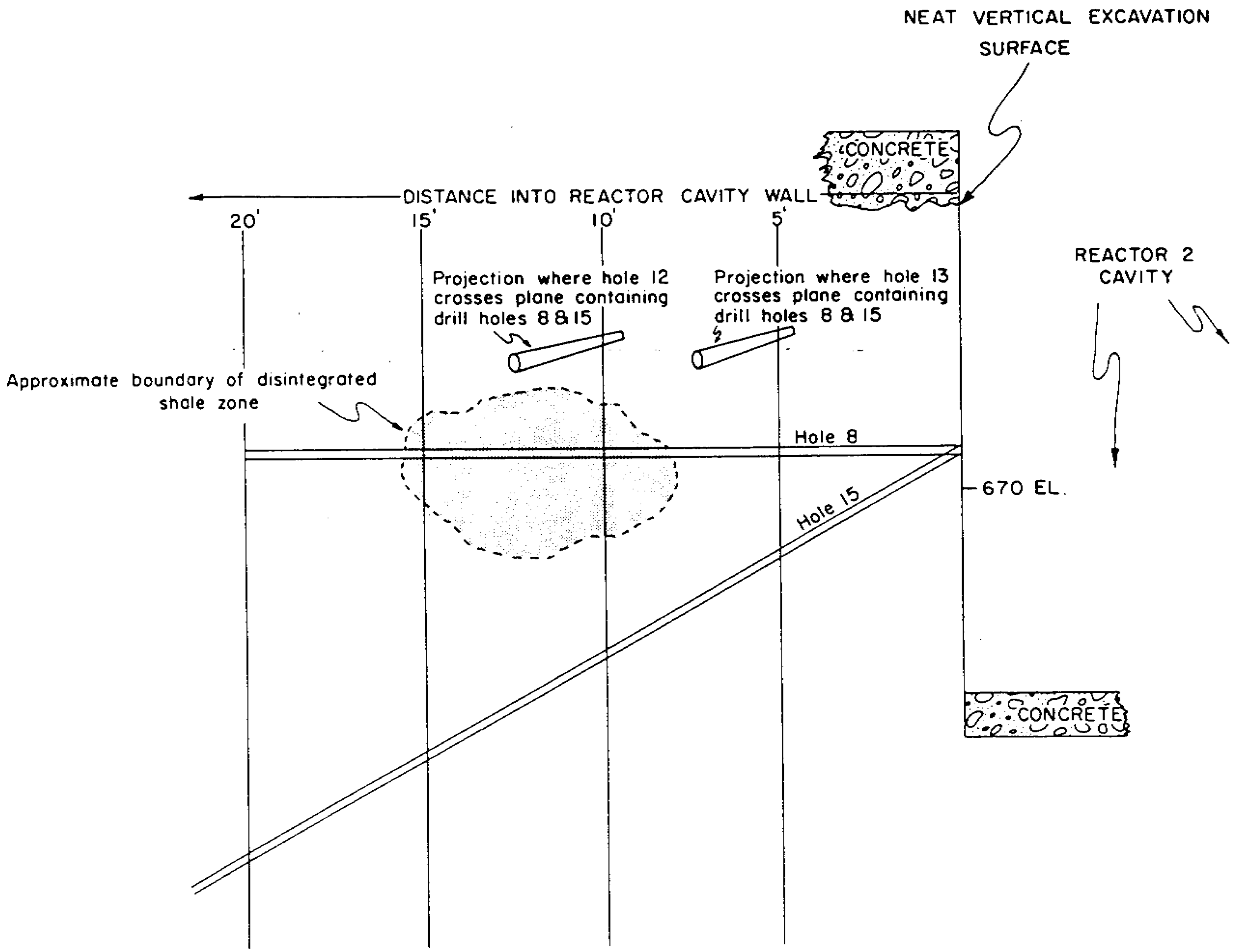
"HISTORICAL INFORMATION"

SCALE:
0 4 Feet

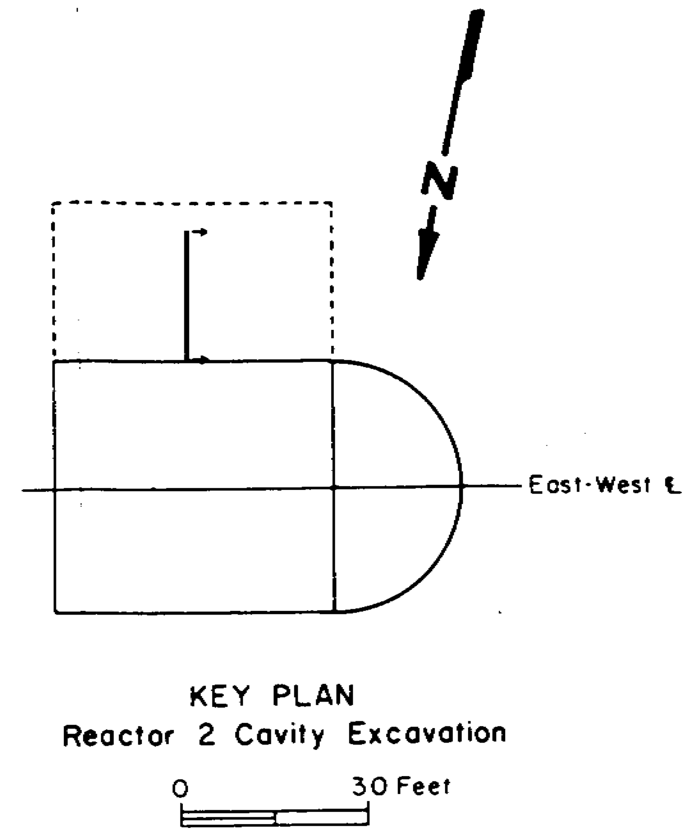
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LAYOUT DIAGRAM FOR
HORIZONTAL AND ANGLE HOLES

Figure 2.5-139




VIEWED WEST




"HISTORICAL INFORMATION"

SCALE:

0 4 Feet

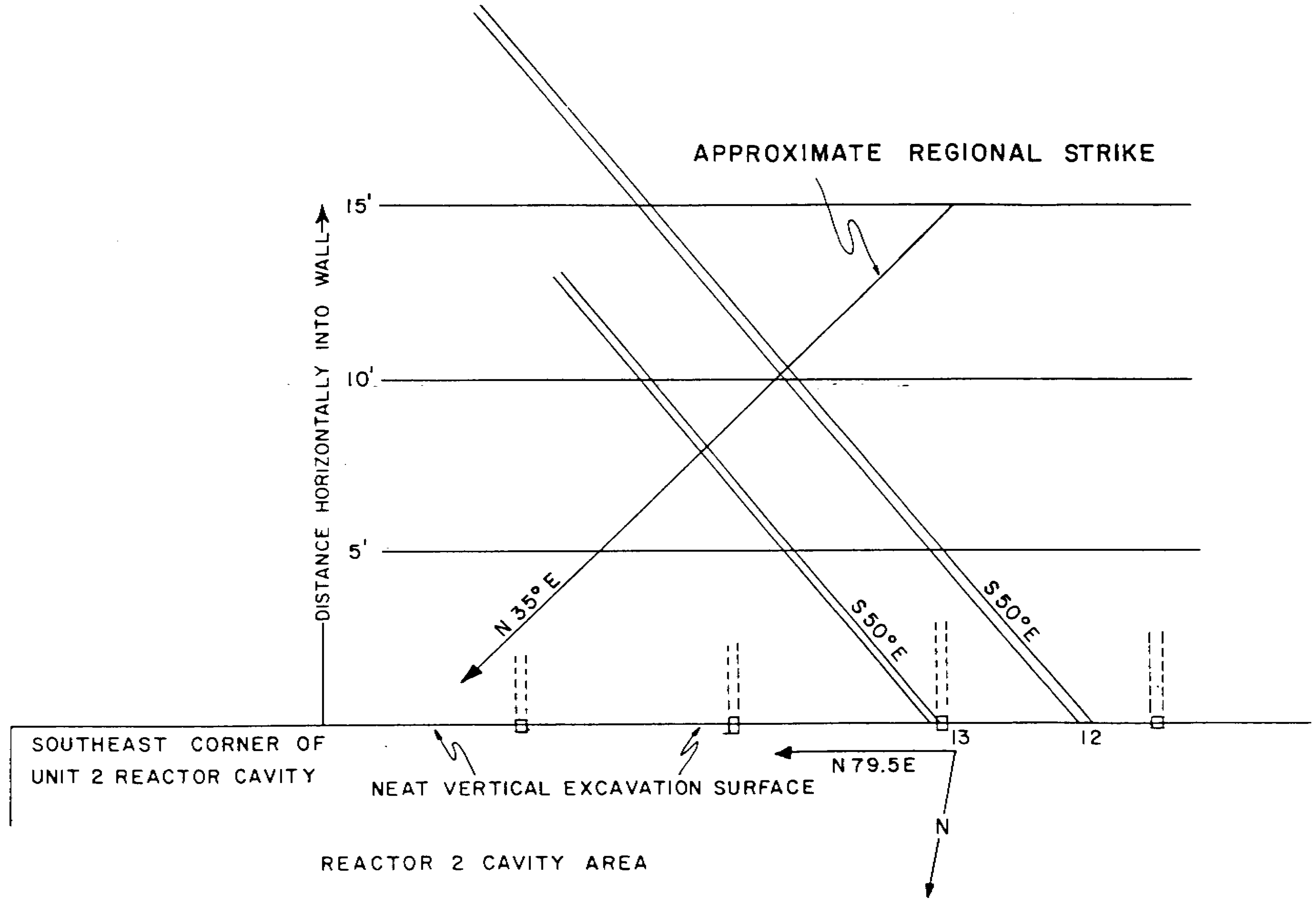
NOTE:

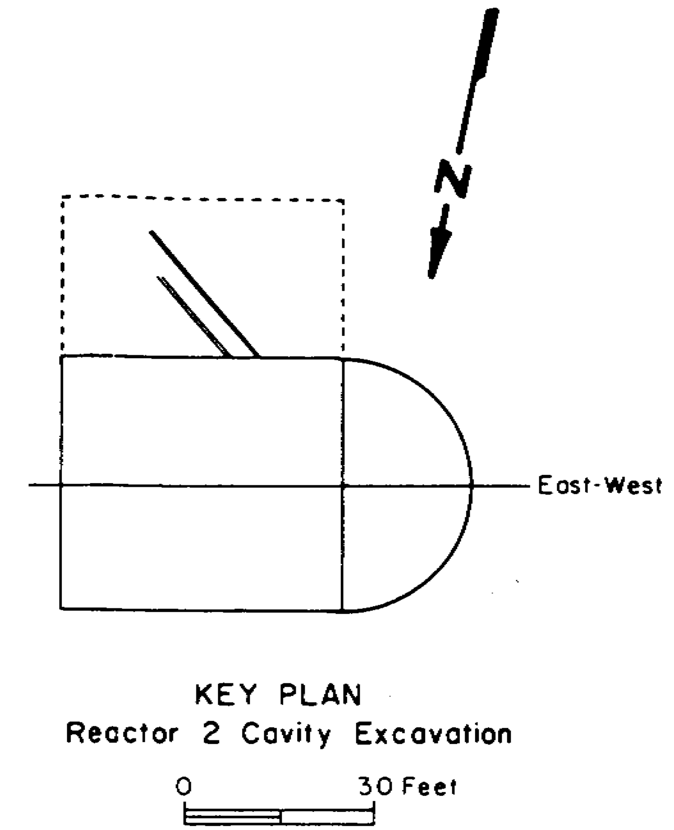
1. Bearings taken with a hand-held Brunton compass.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

PLANE INTERSECTING
DISINTEGRATED SHALE POCKET

Figure 2.5-140




LEGEND:

# 9 J-Bars grouted with hi-early neat cement grout. Out of plane of the drawing.

Percussion holes drilled horizontally

SCALE:

0 — 4 Feet

NOTE:

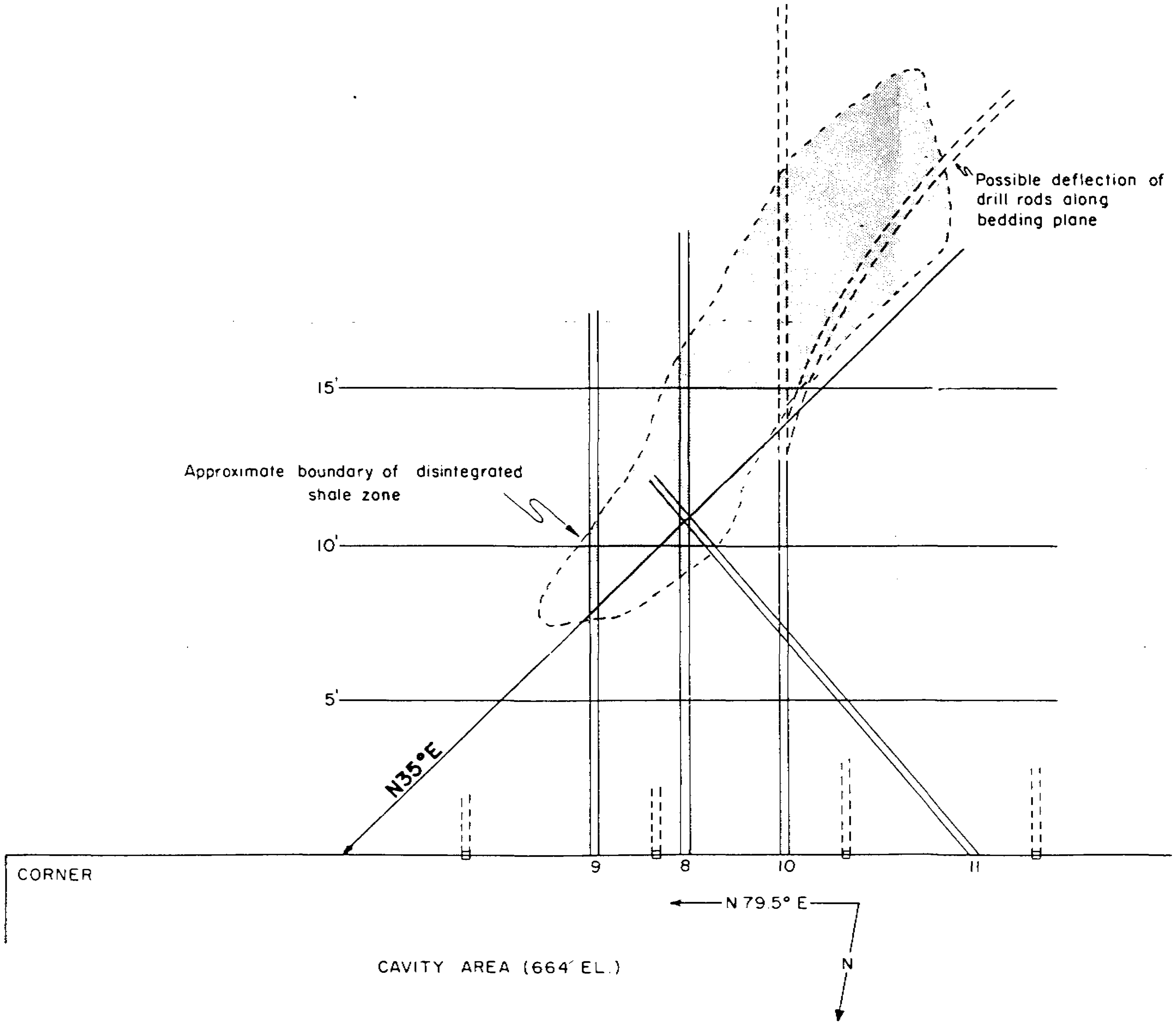
1. Bearings taken with a hand-held Brunton compass

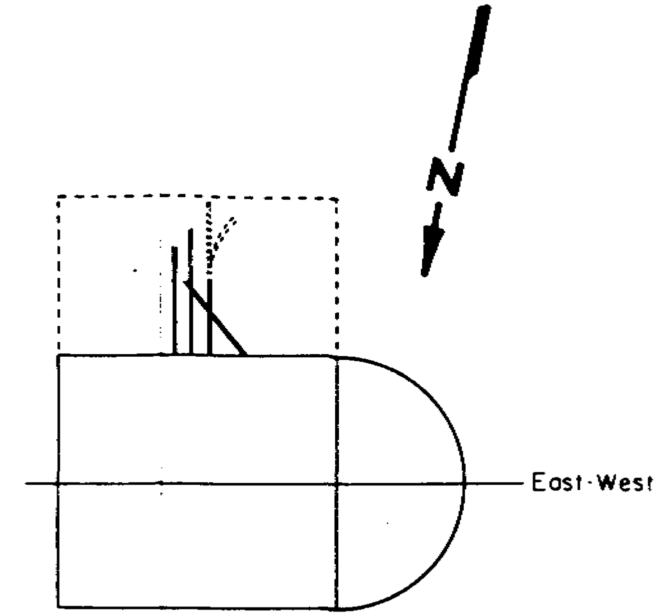
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

PLANE VIEW ONTO
THE 673 ELEVATION

Figure 2.5-141




KEY PLAN
Reactor 2 Cavity Excavation

0 30 Feet

LEGEND:

- #9 J-Bars, grouted with hi-early neat cement grout
- Percussion holes drilled horizontally.

*"HISTORICAL INFORMATION"*

SCALE:

0 4 Feet

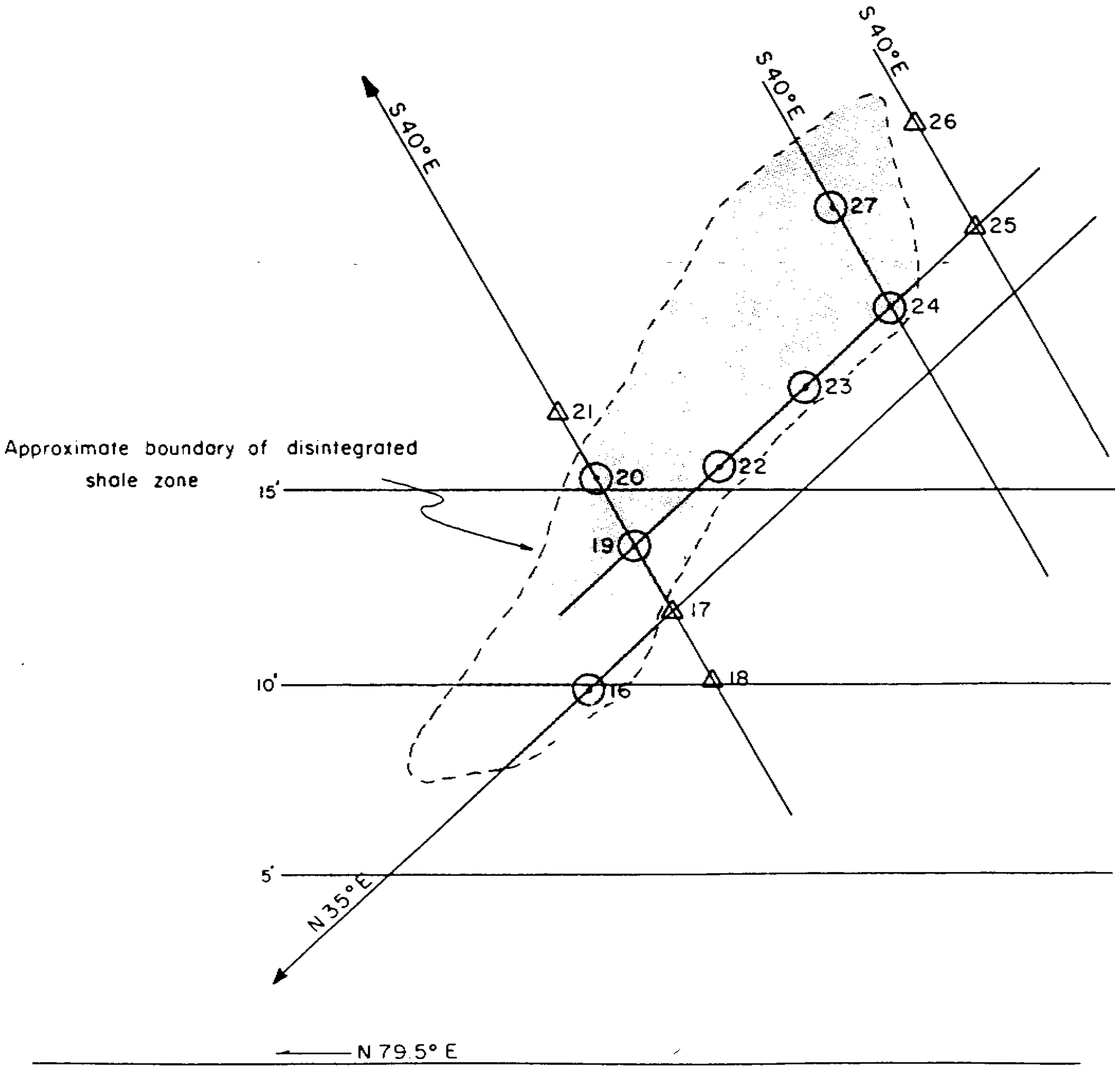
NOTE:

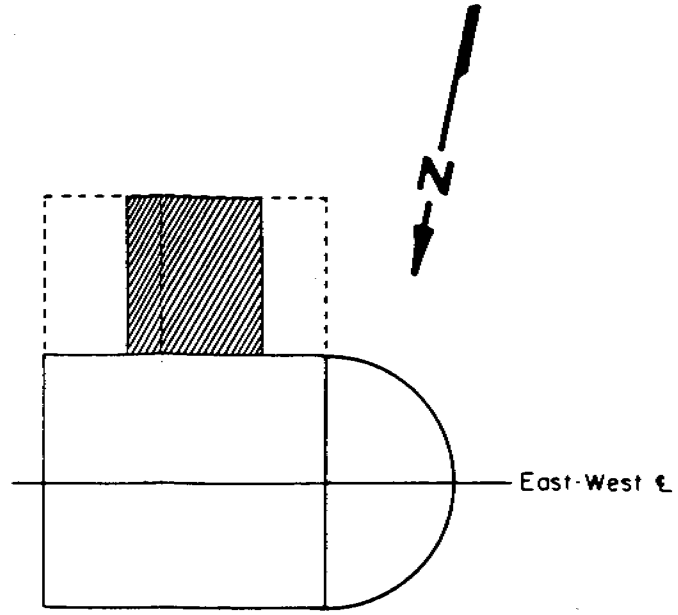
1. Bearings taken with a hand-held Brunton compass.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

PLANE VIEW ONTO
THE 671 ELEVATION

Figure 2.5-142




**KEY PLAN**
Reactor 2 Cavity Excavation

0 30 Feet

LEGEND:

△ Drill hole....Zone of disintegrated shale not intersected.

⊙ Drill hole...Zone of disintegrated shale intersected.

"HISTORICAL INFORMATION"

SCALE:

0 4 Feet

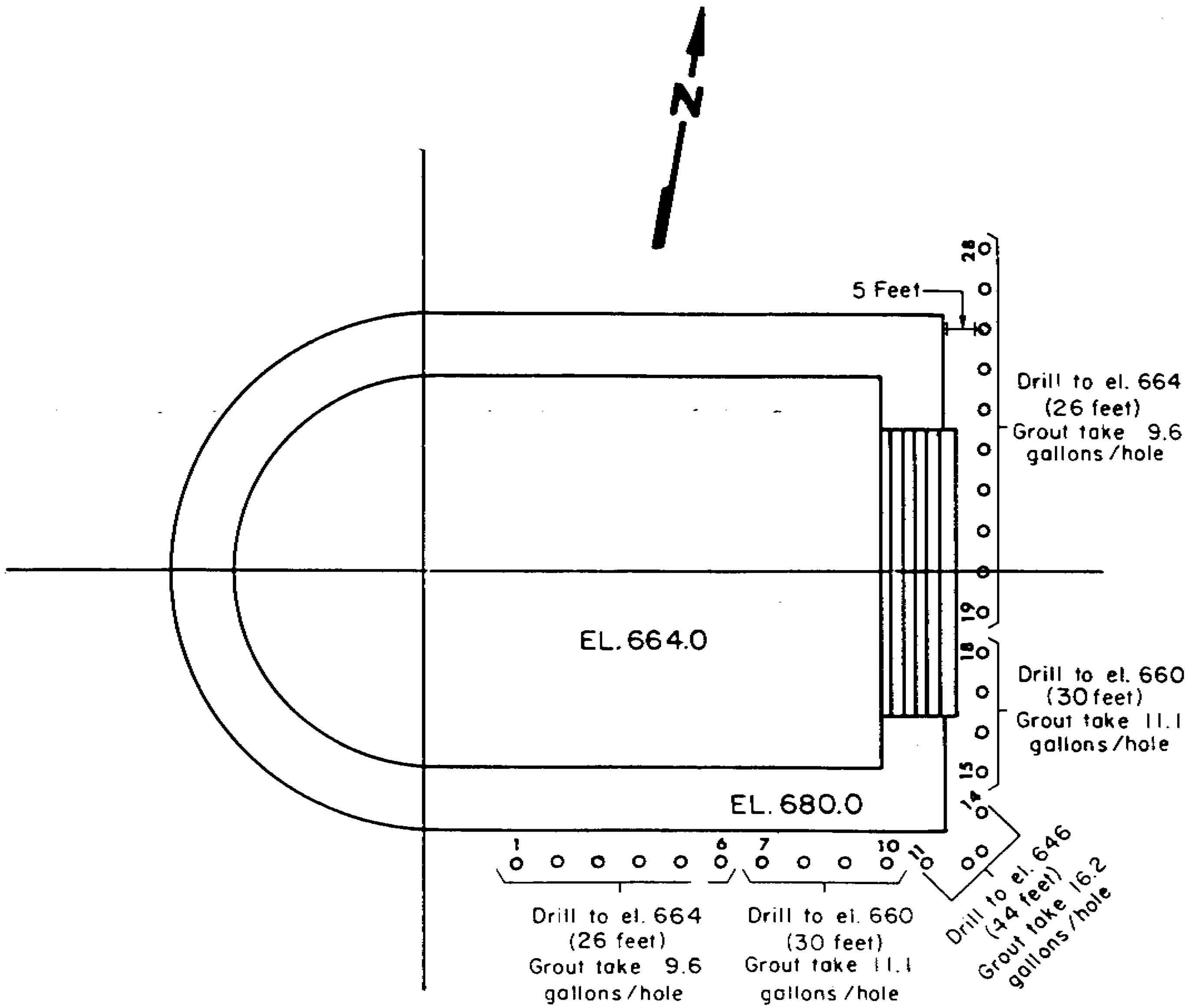
NOTE:

1. Bearings taken with a hand-held Brunton compass.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

DRILL LAYOUT DIAGRAM FOR VERTICAL HOLES VIEWED ONTO THE 671 ELEVATION

Figure 2.5-143




NOTES:

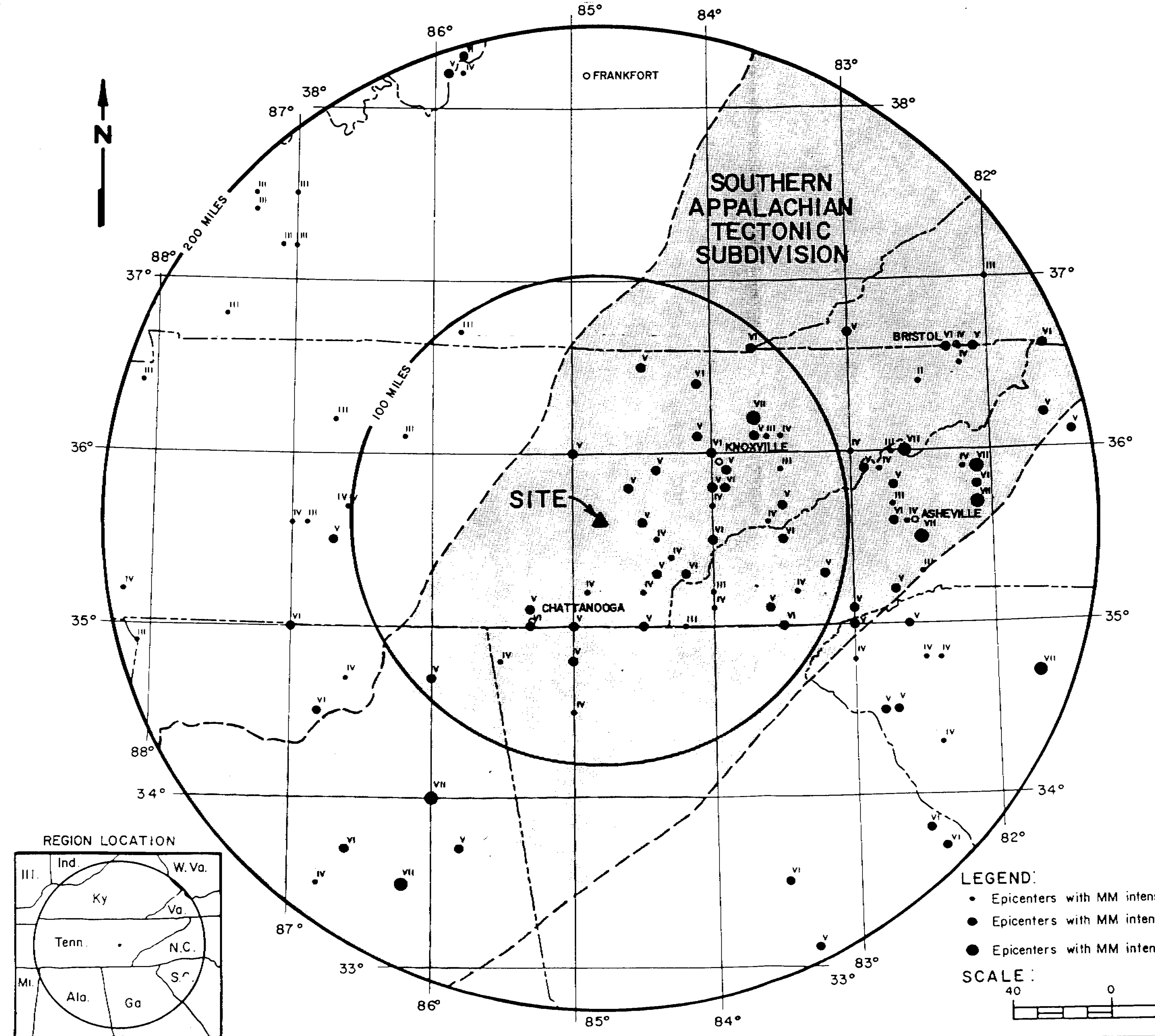
1. Drawing not to scale.
2. Grout take computations based on 3 inch percussion hole volumes.
3. Percussion holes drilled on 4 foot centers, 5 feet from vertical walls as shown.
4. Where grout takes occur in excess of 2 gallons more than specified, split space grout holes to 2 foot centers.

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

REACTOR 2
GROUT LAYOUT

Figure 2.5-144




MODIFIED MERCALLI INTENSITY SCALE OF 1931 (ABRIDGED)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale)

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing truck. Duration estimated. (III Rossi-Forel Scale)

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls made creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. (IV to V Rossi-Forel Scale)

V. Felt by nearly everyone; many awakened. Some dishes, windows, etc. broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale)

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale)

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars. (VIII Rossi-Forel Scale)

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbed persons driving motor cars. (VIII + to IX Rossi-Forel Scale)

IX. Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX + Rossi-Forel Scale)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale)

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

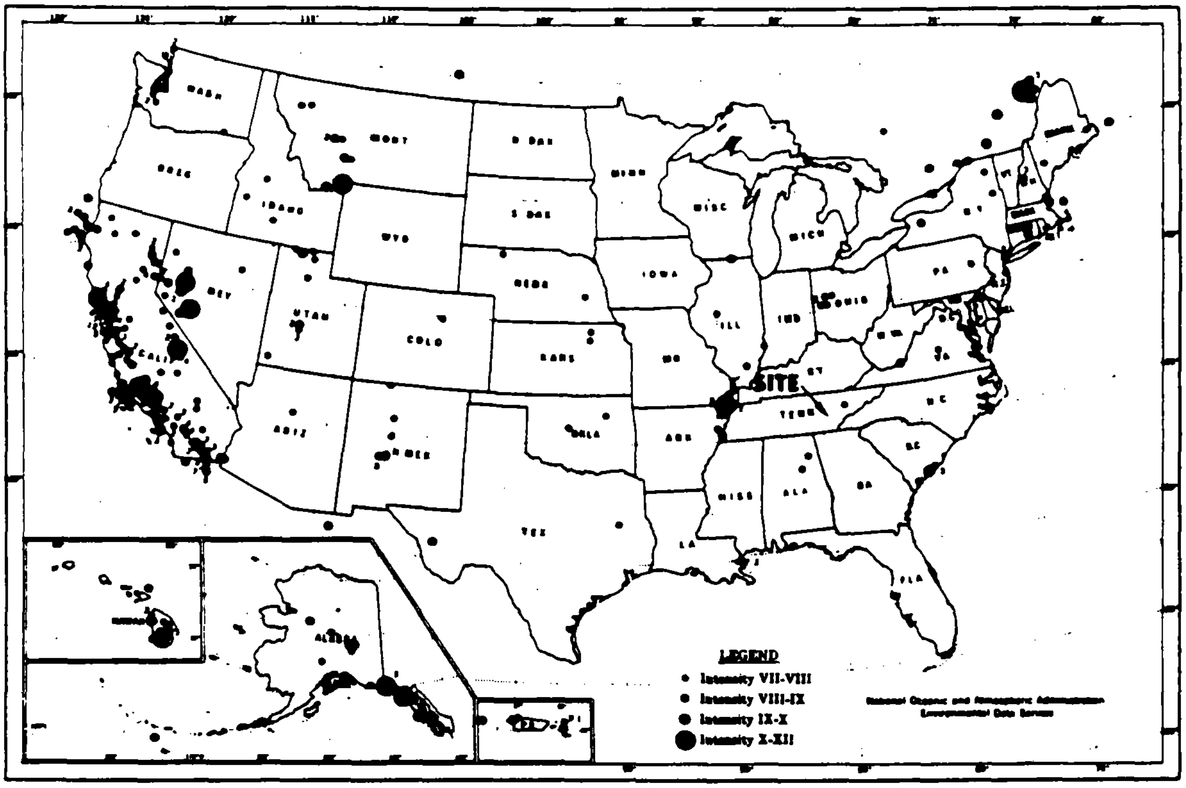
XII. Damage total. Waves seen on ground surfaces. Lines of slight and level distorted. Objects thrown upward into the air.

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

EARTHQUAKE EPICENTERS

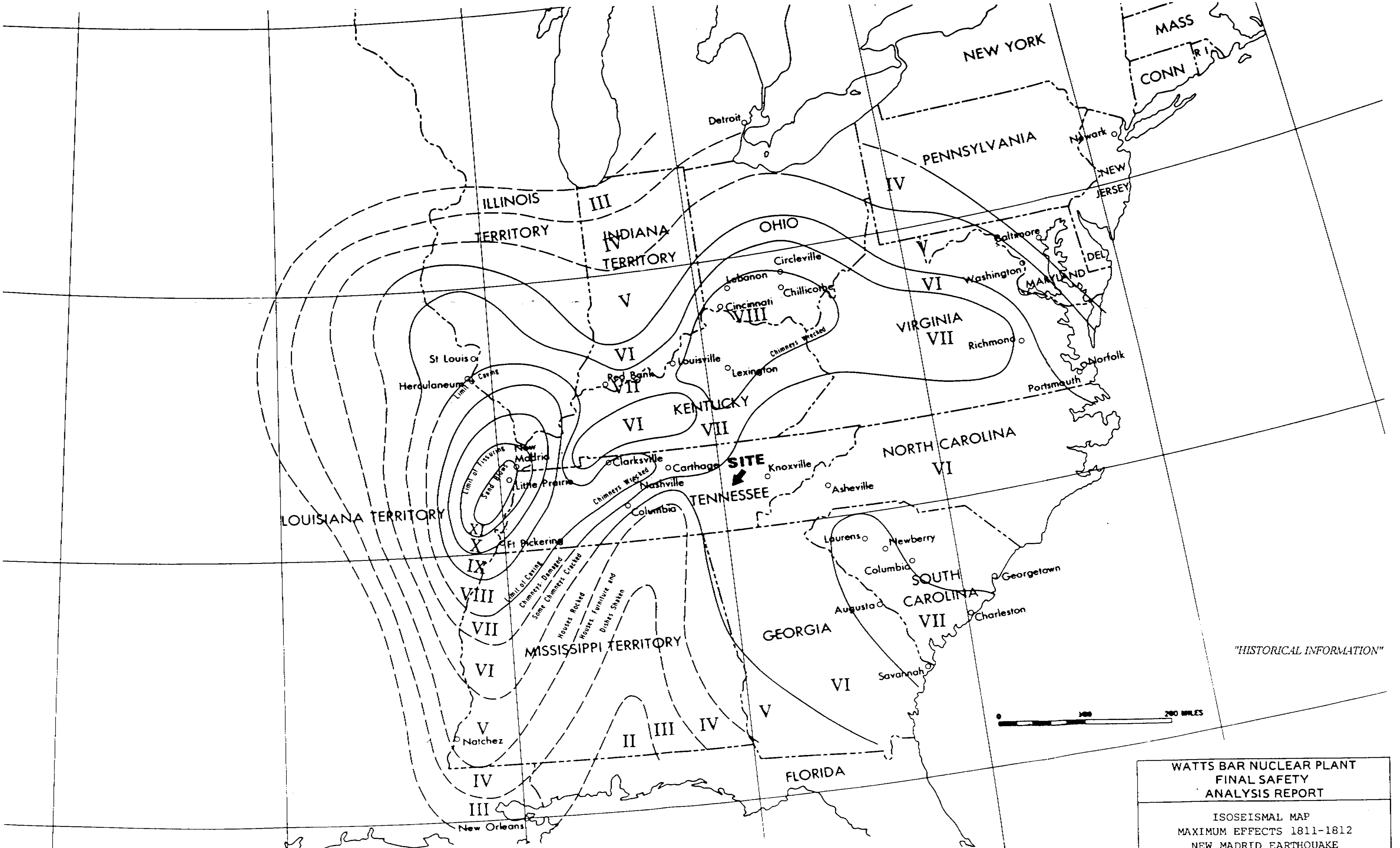
Figure 2.5-145




Damaging earthquakes in the United States from earliest history through 1972.
*(From NOAA, 1974)*

**HISTORICAL**

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| MAJOR EARTHQUAKES IN UNITED STATES THROUGH 1972<br><br>Figure 2.5-146 |

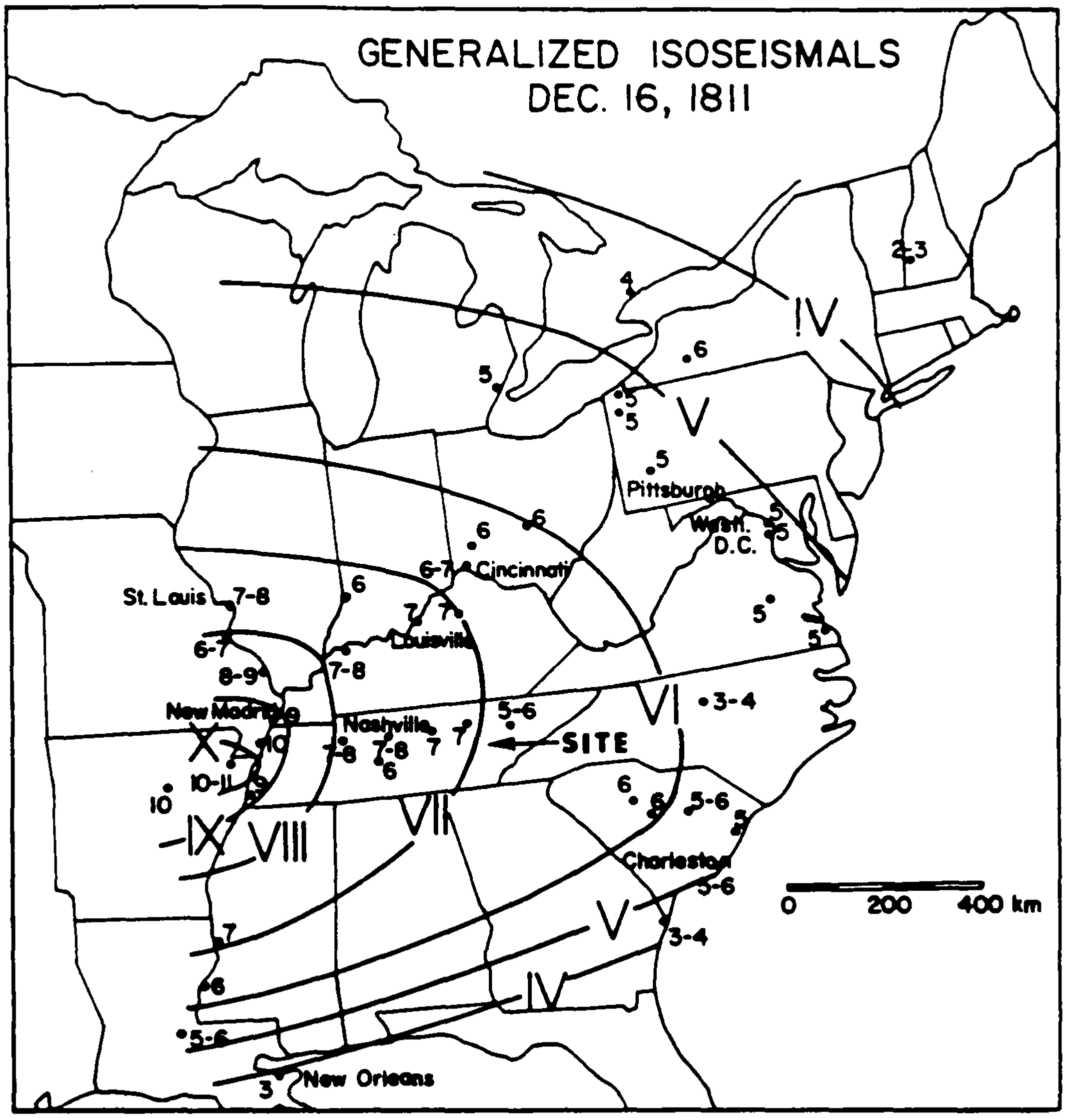



Composite isoseismal map of the New Madrid earthquakes of 1811-1812, showing maximum effects of series. *(From Stearns and Wilson, 1972)*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ISOSEISMAL MAP
MAXIMUM EFFECTS 1811-1812
NEW MADRID EARTHQUAKE

Figure 2.5-147

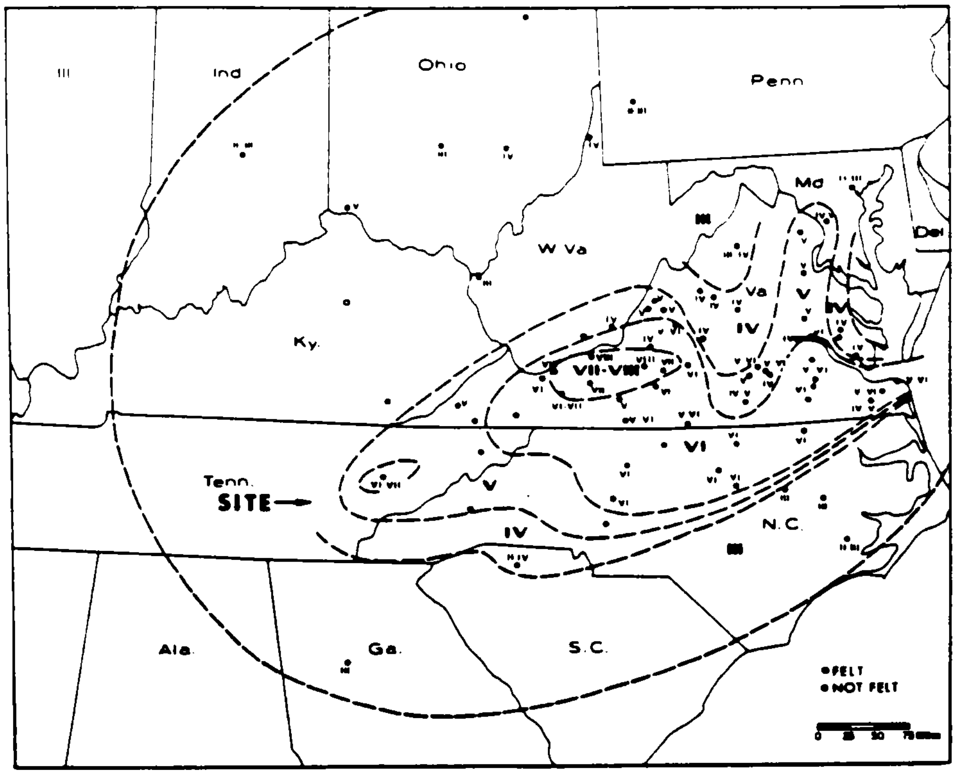



Generalized isoseismal map of the New Madrid earthquake of December 16, 1811. *(From Nuttli, 1972)*

**HISTORICAL**

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP<br>1811 NEW MADRID EARTHQUAKE<br><br>Figure 2.5-148 |

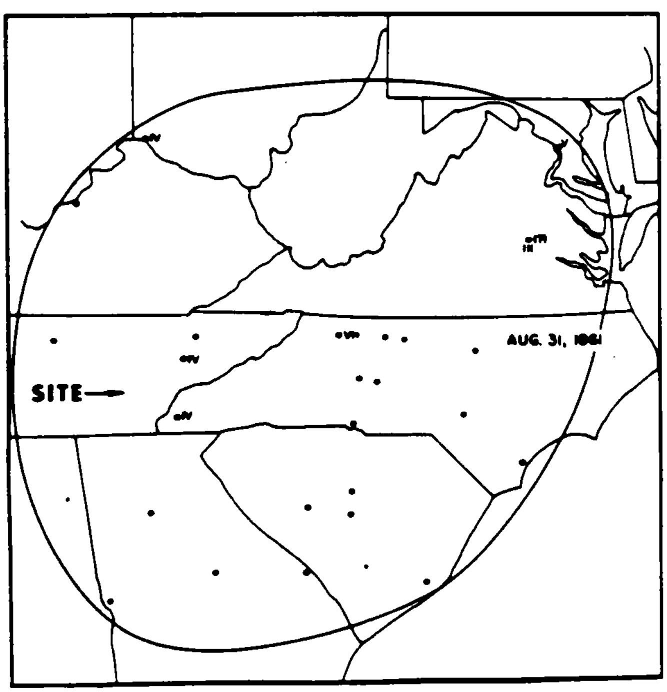
EARTHQUAKE OF MAY 31 1897 GILES COUNTY VIRGINIA
MONDAY 1358 Hrs FELT AREA 280 000 SQ MI




A

From Hopper and Bollinger 1971

EARTHQUAKE OF AUGUST 31, 1861,
VIRGINIA, (SATURDAY, 0522 Hrs.),
FELT AREA 300,000 SQ. MI., (BOLLINGER, 1969)




B

From Hopper and Bollinger, 1971

HISTORICAL

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| FELT AREA MAPS<br>Figure 2.5-149 |

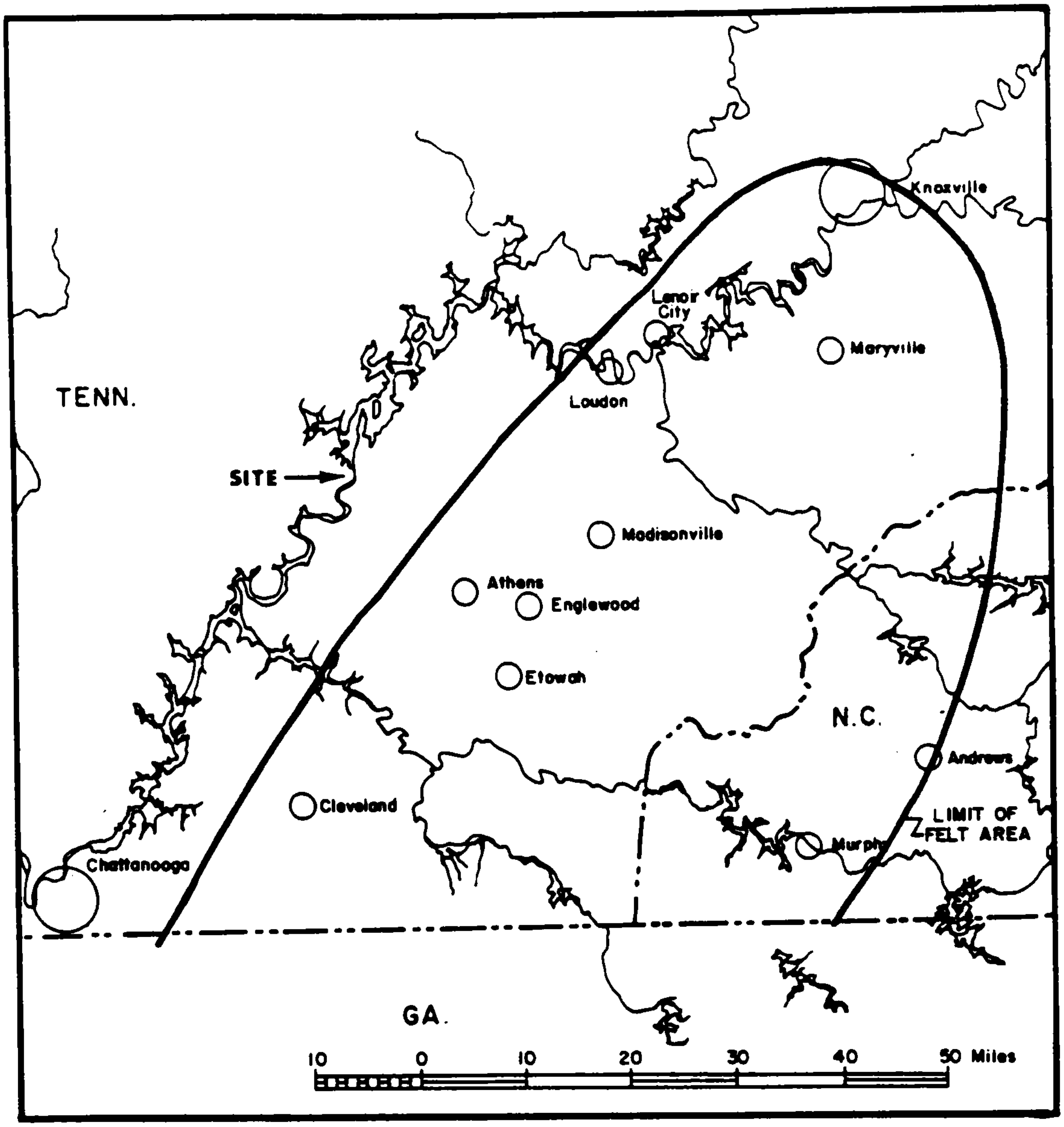

Isoseismal map of the Charleston, South Carolina earthquake of August 31, 1886.
*(From Dutton, 1889)*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ISOSEISMAL MAP
1886 CHARLESTON, S.C.
EARTHQUAKE

Figure 2.5-150

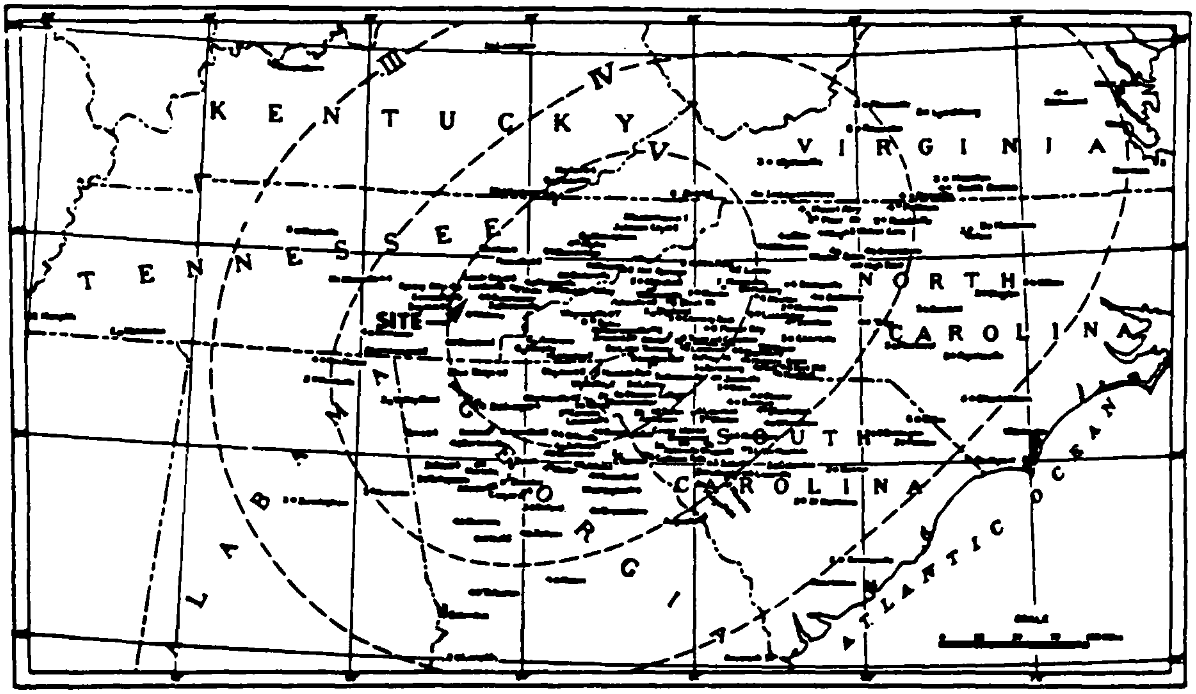
**HISTORICAL**




Felt area map of the east Tennessee earthquake of April 17, 1913.
*(From Gordon, 1913)*

**HISTORICAL**

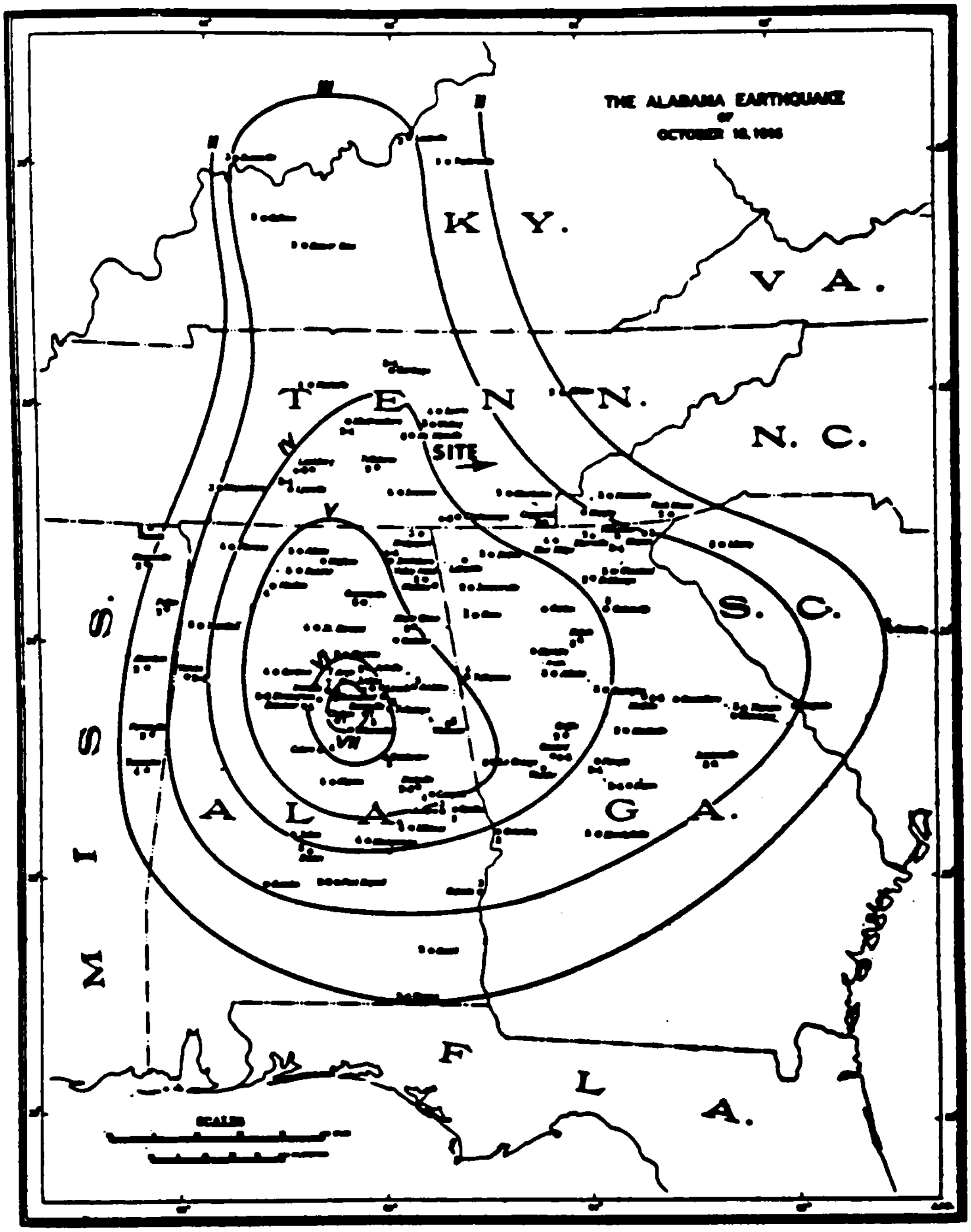
| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| FELT AREA MAP<br>EAST TENNESSEE EARTHQUAKE OF<br>APRIL 17, 1913<br>Figure 2.5-151 |




Isoseismal map of the Southern Appalachians earthquake of February 21, 1916. *(From Tabor, 1916)*

**HISTORICAL**

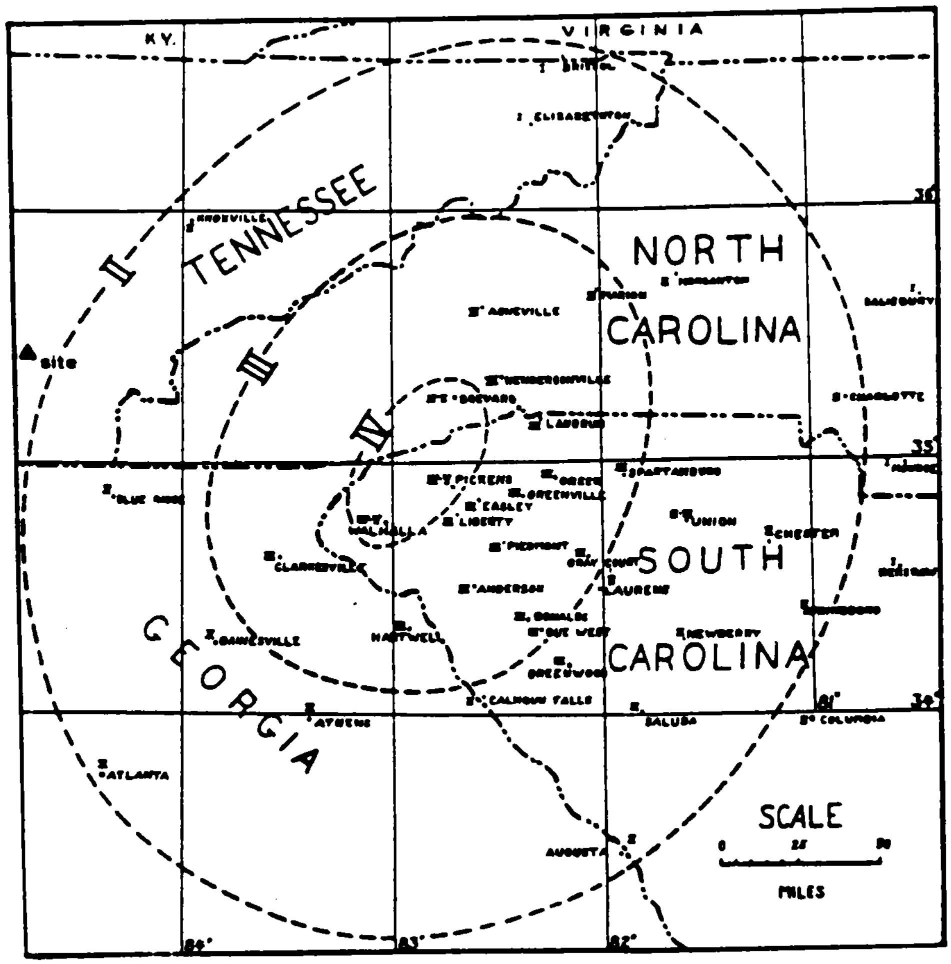
| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP 1916 SOUTHERN APPALACHIAN EARTHQUAKE<br><br>Figure 2.5-152 |




Isoseismal map of the Alabama earthquake of October 18, 1916. *(From Finch, 1916)*

**HISTORICAL**

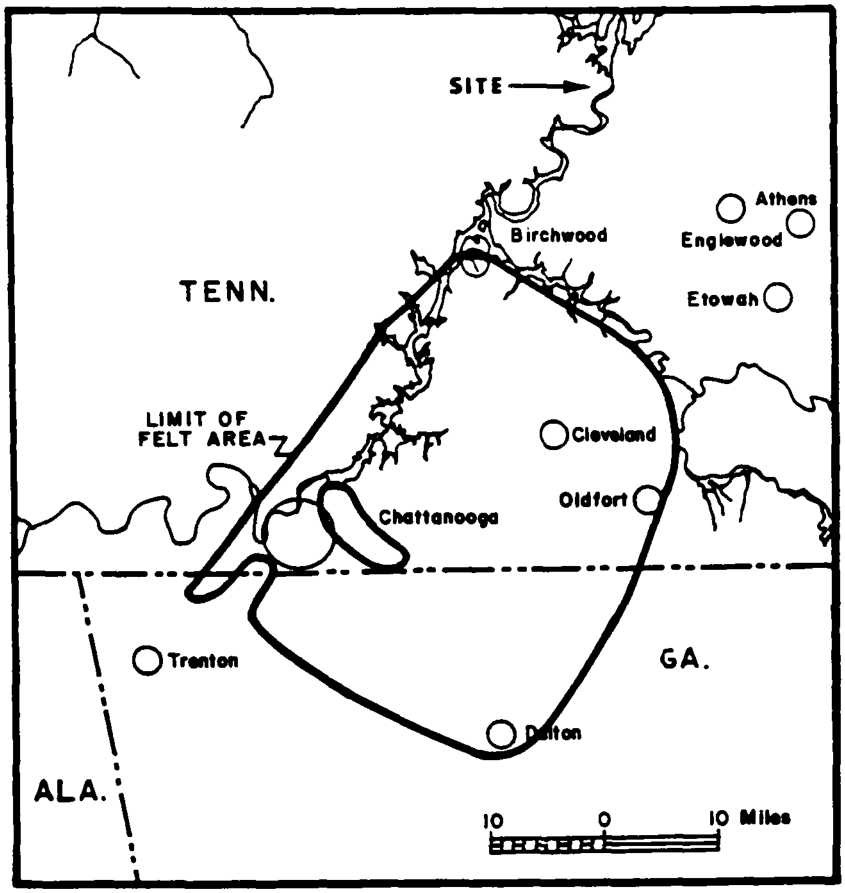
| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
| --- |
| ISOSEISMAL MAP<br>1916 ALABAMA EARTHQUAKE<br><br>Figure 2.5-153 |




Isoseismal map of the Southern Appalachian earthquake of October 20, 1924. *(From Neumann, 1924)*

**HISTORICAL**

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP 1924 SOUTHERN APPALACHIAN EARTHQUAKE<br><br>Figure 2.5-154 |



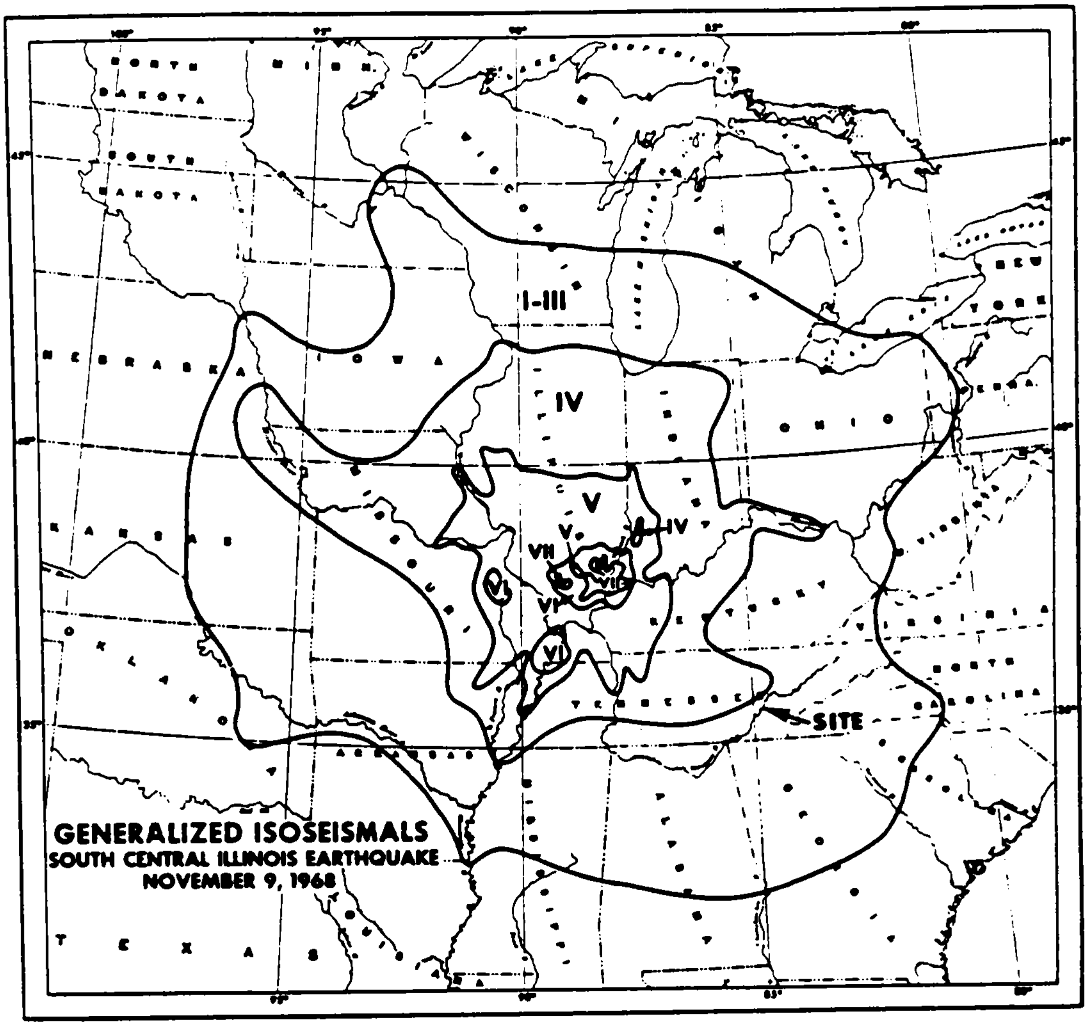

Felt area map of the Chattanooga earthquake of October 19, 1940.
*(From Brill, 1940)*

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FELT AREA MAP
1940 CHATTANOOGA EARTHQUAKE

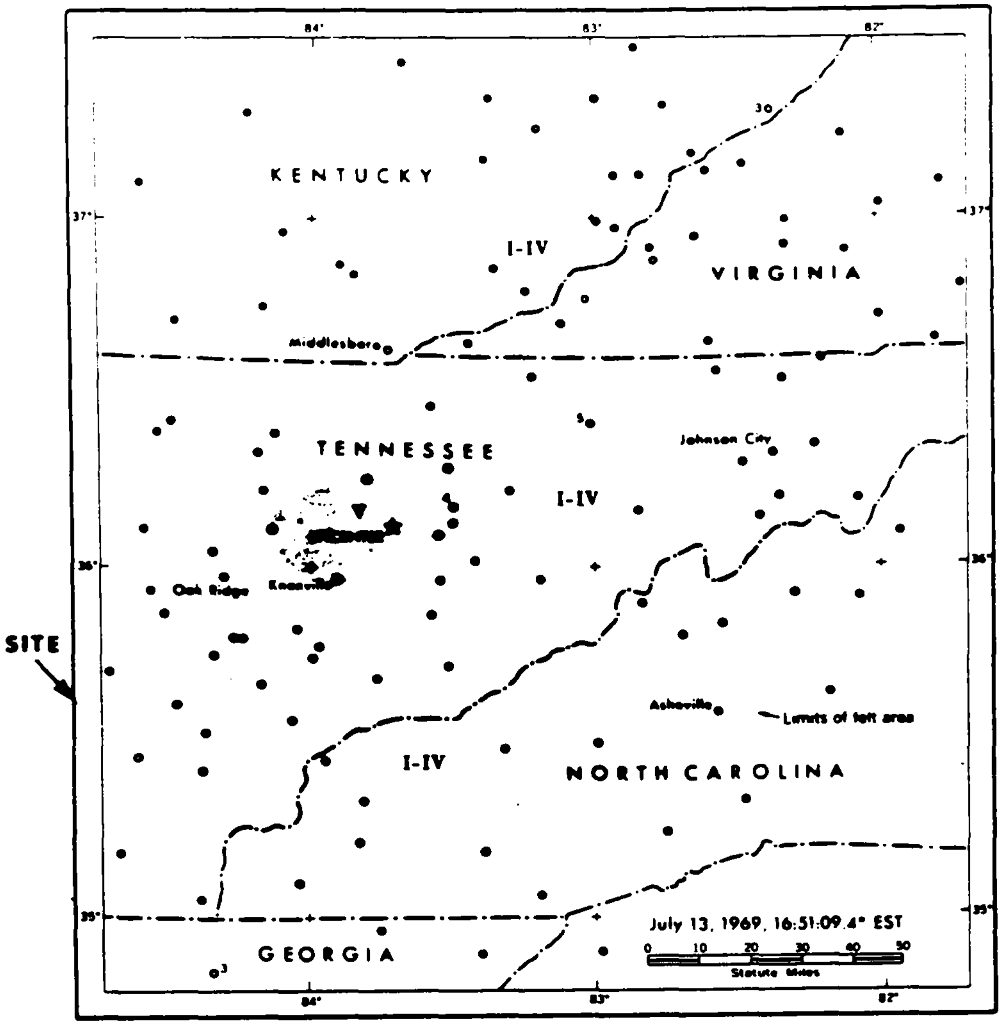
Figure 2.5-155




Isoseismal map of the Hamilton County, Illinois earthquake of November 9, 1968.
*(From Gordon and others, 1968)*

**HISTORICAL**

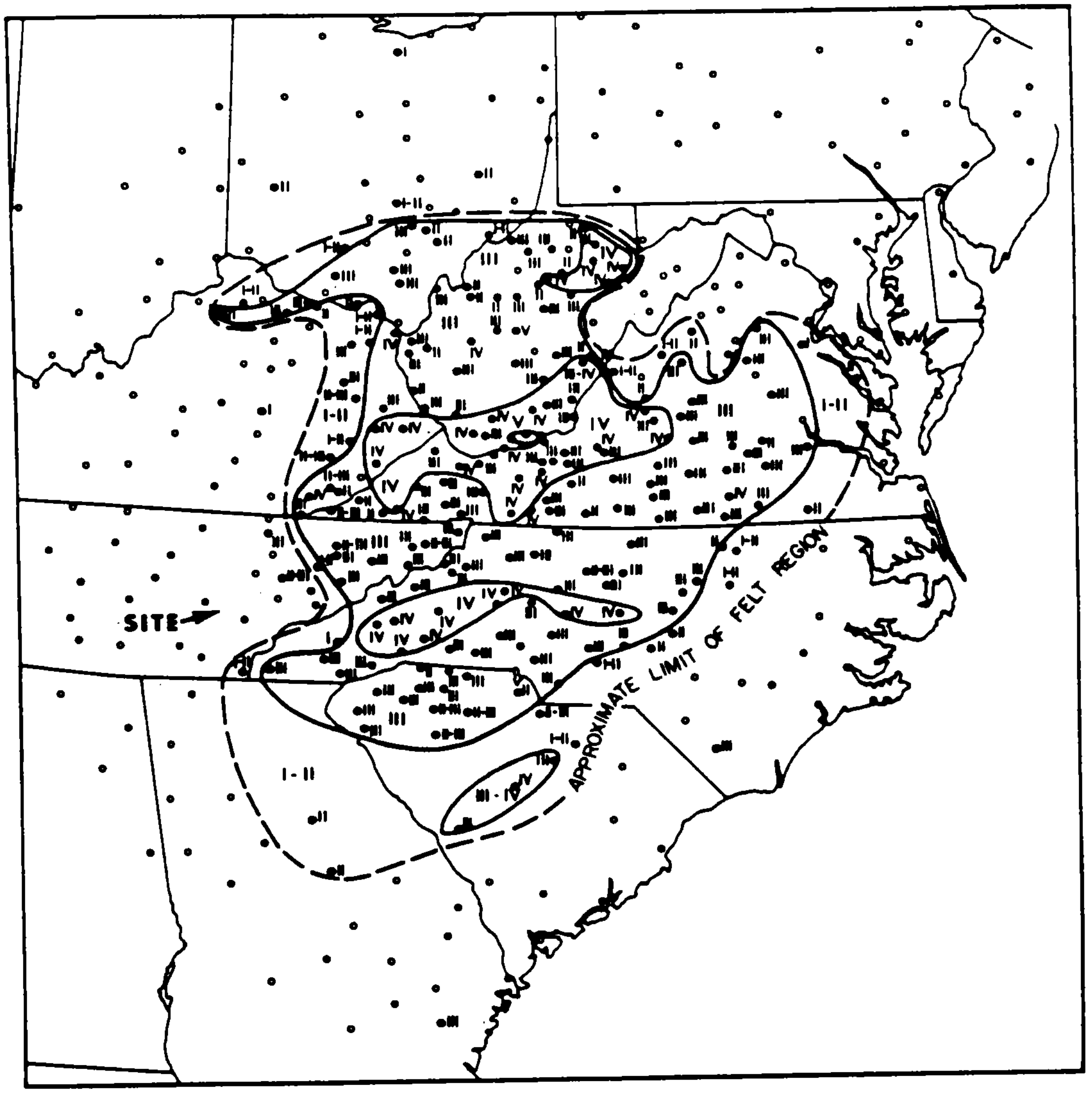
| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP 1968 SOUTHERN ILLINOIS EARTHQUAKE<br>Figure 2.5-156 |




Felt area map of the East Tennessee earthquake of July 13, 1969. (*From NOAA, 1971*)

## HISTORICAL

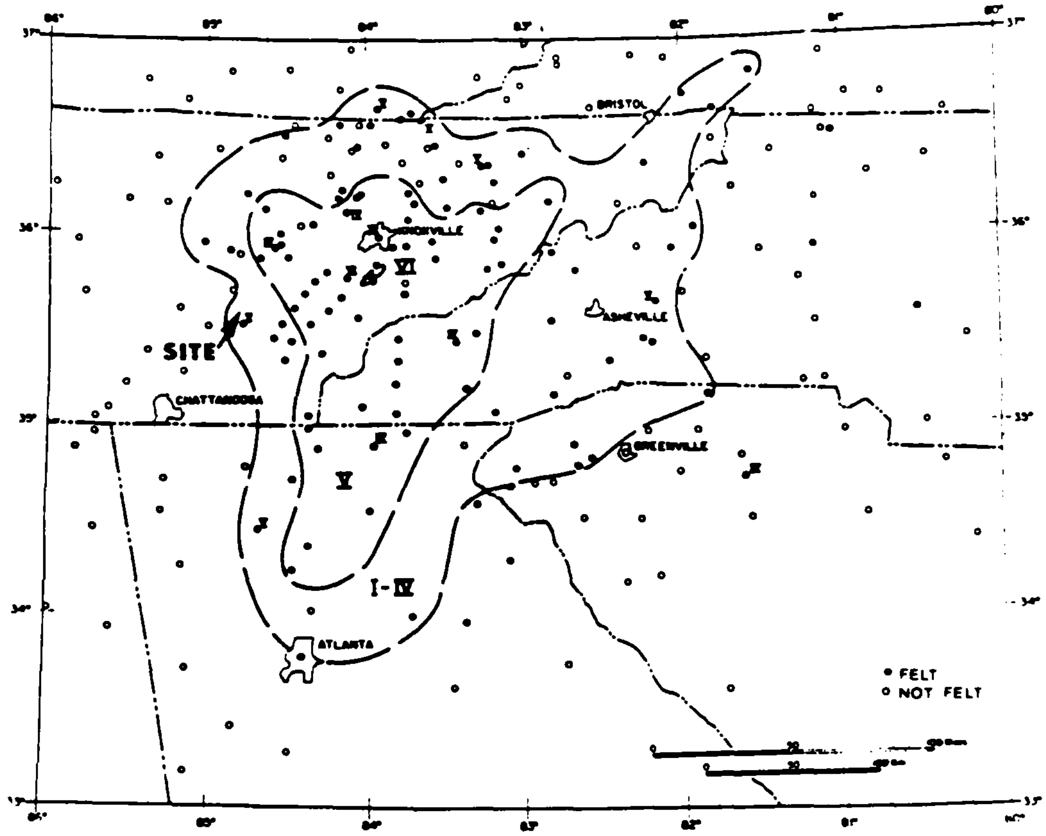
| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| FELT AREA MAP<br>EAST TENNESSEE EARTHQUAKE<br>JULY 13, 1969<br><br>Figure 2.5-157 |




Isoseismal map of the Elsgood, West Virginia earthquake of November 19, 1969. (*From Bollinger and Hopper, 1972*)

**HISTORICAL**

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP<br>ELSGOOD, WEST VIRGINIA EARTHQUAKE<br>NOVEMBER 20, 1969<br><br>Figure 2.5-158 |

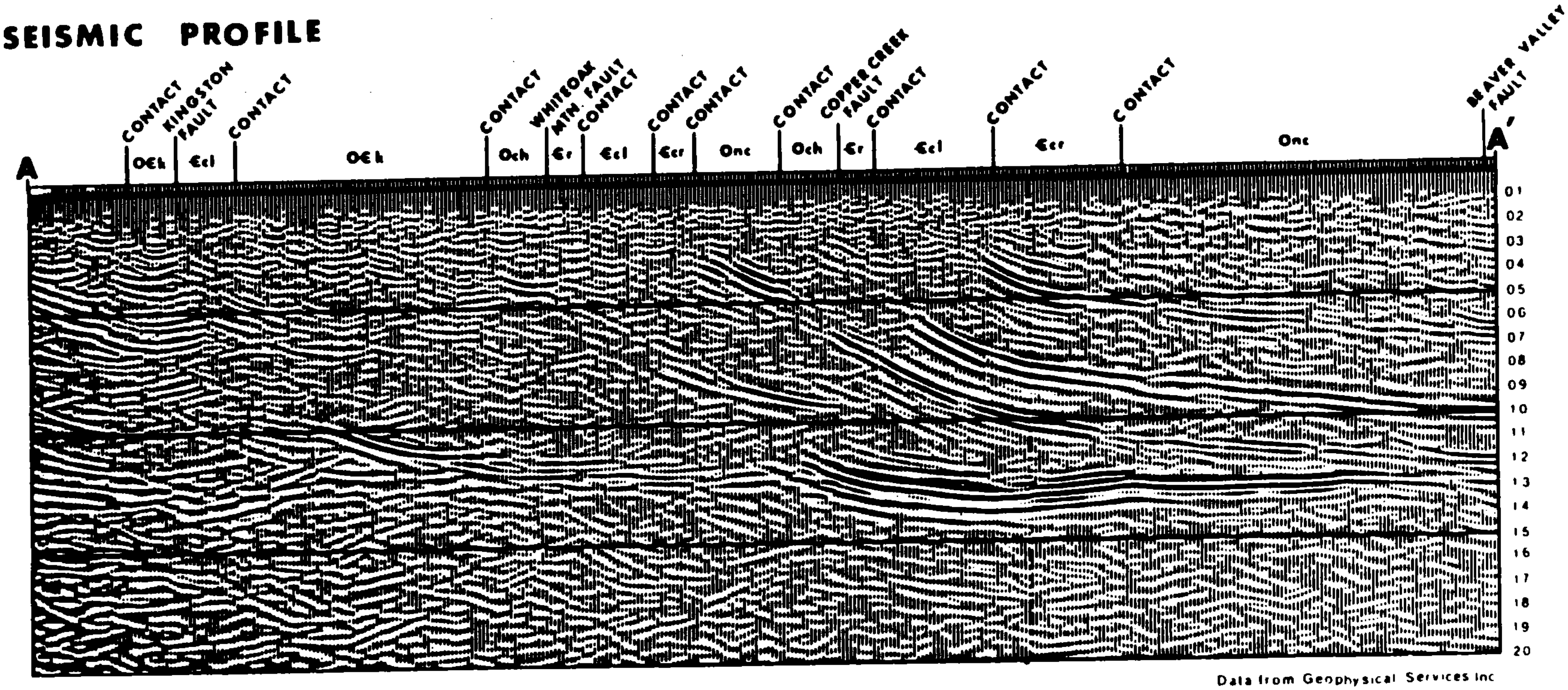



Isoseismal map of the Maryville-Alcoa, Tennessee earthquake of November 30, 1973. (*From Bollinger and others, 1973*)

**HISTORICAL**

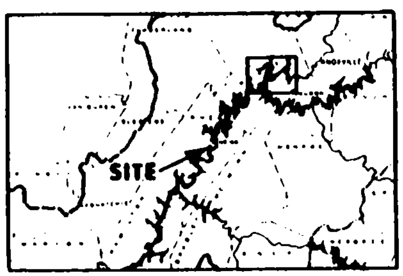
| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| ISOSEISMAL MAP<br>MARYVILLE-ALCOA EARTHQUAKE<br>NOVEMBER 30, 1973<br><br>Figure 2.5-159 |

## SEISMIC PROFILE

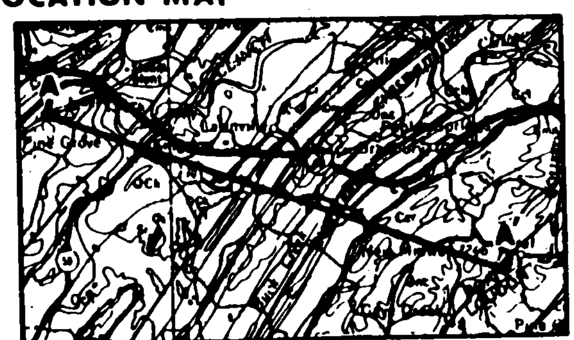



Data from Geophysical Services Inc

## INDEX MAP




## LOCATION MAP



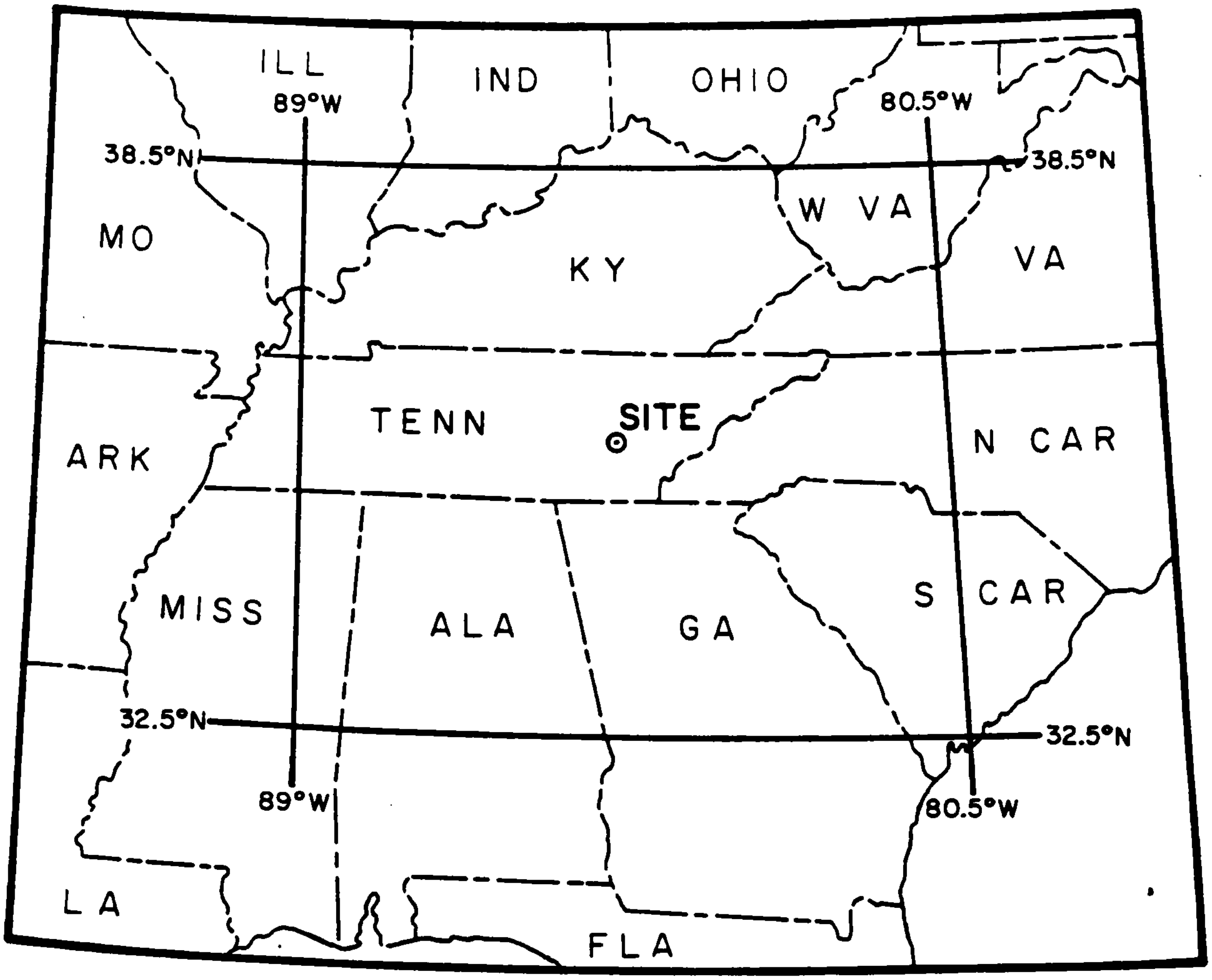

From Hardeman, 1966

**HISTORICAL**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SEISMIC REFLECTION PROFILE

Figure 2.5-160




HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INDEX MAP - ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST

Figure 2.5-161

SEISMIC HISTORY OF THE SOUTHEAST REGION OF THE UNITED STATES

THIS IS A CHRONOLOGICAL LISTING OF ALL EARTHQUAKES HAVING EPICENTERS IN THE RECTANGULAR PORTION OF THE SOUTH-EAST REGION BOUNDED BY THE FOLLOWING GEODETIC COORDINATE LINES --

SOUTHERN BOUNDARY - 32.5 -DEGREE NORTH LATITUDE
NORTHERN BOUNDARY - 38.5 -DEGREE NORTH LATITUDE
EASTERN BOUNDARY - 80.5 -DEGREE WEST LONGITUDE
WESTERN BOUNDARY - 89.0 -DEGREE WEST LONGITUDE

| YEAR | DATE | TIME-HR-MIN-SEC | LAT - LONG | LOCALITY AND NOTES | FELT-SQ.MI. | MAG/INT | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1776 | NOV 6 | 0 0 0.0 | (35.0 83.0) | JACKSON CO.,WEST NC | | IV-V | -6 |
| 1799 | APR 11 | 8 20 0.0 | (34.3 80.6) | CAMDEN,SC-STRONG | | | B-14 |
| 1817 | JAN 8 | 9 34 0.0 | (37.0 81.0) | VA-NC-SC-MD AREA | | | B-9 |
| 1829 | MAY 0 | 0 0 0.0 | (35.6 88.8) | JACKSON,TENN-STRONG | | | -7 |
| 1839 | SEP 5 | 0 0 0.0 | (36.7 88.6) | MAYFIELD,KY | | III-IV | D-6 |
| 1843 | AUG 9 | 0 0 0.0 | (35.6 87.0) | COLUMBIA AND SOMERVILLE,TENN | | III-IV | -6 |
| 1844 | NOV 28 | 12 0 0.0 | (36.0 84.0) | KNOXVILLE,TENN | | VI | BD-5,6 |
| 1852 | APR 29 | 18 0 0.0 | (36.6 81.6) | VA-NC-TENN REGION | 150000 | VI | BD-5,6,10 |
| 1854 | NOV 22 | 21 0 0.0 | (37.1 81.5) | TAZEWELL CITY,VA | | | -9 |
| 1859 | MAR 22 | 0 0 0.0 | (37.2 81.5) | TAZEWELL CITY,VA | | | B-9 |
| 1872 | MAR 26 | 0 0 0.0 | (37.1 88.6) | PADUCAH,KY | | III | -6 |
| 1872 | JUN 17 | 20 0 0.0 | (33.1 83.3) | MILLEDGEVILLE,GA | | V | D-5 |
| 1874 | FEB 10 | 0 0 0.0 | (35.7 82.1) | MCDOWELL COUNTY,NC-50-100 SHOCKS FROM FEB 10 TO APR 17 | | II-VII | ABF-6,5 |
| 1874 | FEB 22 | 0 0 0.0 | (35.7 82.1) | MCDOWELL CO. NC-MOST SEVERE OF SERIES | | II-VII | ABF-6,5 |
| 1874 | MAR 17 | 0 0 0.0 | (35.7 82.1) | MCDOWELL-AFTERSHOCK | | II-VII | BF-6,5 |
| 1874 | MAR 26 | 0 0 0.0 | (35.7 82.1) | MCDOWELL-AFTERSHOCK | | II-VII | BF-6,5 |
| 1874 | APR 14 | 0 0 0.0 | (35.7 82.1) | MCDOWELL-AFTERSHOCK | | II-VII | BF-6,5 |
| 1874 | APR 17 | 0 0 0.0 | (35.7 82.1) | MCDOWELL-AFTERSHOCK | | II-VII | BF-6,5 |
| 1875 | JUL 28 | 23 5 0.0 | (33.1 83.3) | MILLEDGEVILLE,GA | | | B-7 |
| 1875 | NOV 2 | 2 55 0.0 | (33.8 82.5) | NORTHERN GEORGIA | 25000 | VI | AB-5,6 |
| 1875 | NOV 12 | 7 0 0.0 | (35.9 83.9) | KNOXVILLE,TENN | | III-IV | B-6 |
| 1876 | SEP 25 | 6 0 0.0 | (38.0 88.0) | S ILL-S IND-W KY AREA | | VI | A-6 |
| 1876 | SEP 25 | 6 15 0.0 | (38.0 88.0) | S ILL-S IND-W KY-2ND AND STRONGEST SHOCK | | VI | -6 |
| 1876 | DEC 21 | 15 30 0.0 | (36.9 81.1) | WYTHEVILLE,VA | | | -9 |
| 1877 | APR 26 | 22 0 0.0 | (35.2 83.4) | FRANKLIN,NC | | III-IV | -6 |
| 1877 | MAY 25 | 0 0 0.0 | (35.9 83.9) | KNOXVILLE,TENN | | III-IV | -6 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38-5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 1 OF 8
Figure 2.5-162

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1877 | NOV 16 | 7 20 | 0.0 | (35.5 | 84.0) | W NC AND E TN-<br>FELT AT KNOXVILLE,TN<br>AND MURPHY,NC | 5000 | IV-V | D-9,5 |
| 1878 | NOV 24 | 1 0 | 0.0 | (35.1 | 84.0) | MURPHY,NC | | III-IV | B-6,7 |
| 1879 | JUL 26 | 17 45 | 0.0 | (37.0 | 89.0) | CAIRO AND MOUND CITY,<br>ILLINOIS | | II-III | -6 |
| 1879 | OCT 26 | 0 0 | 0.0 | (34.5 | 81.1) | WINNSBORO,SC | | | -7 |
| 1879 | DEC 12 | 24 0 | 0.0 | (35.2 | 80.8) | CHARLOTTE,NC | | V-VI | A-5 |
| 1879 | DEC 13 | 7 0 | 0.0 | (35.2 | 80.8) | CHARLOTTE-AFTERSHOCK | | | -5 |
| 1880 | JAN 28 | 0 0 | 0.0 | (36.0 | 82.7) | BALD MOUNTAIN,NC | | | AB-6 |
| 1880 | JAN 29 | 0 0 | 0.0 | (36.0 | 82.7) | BALD MTN-AFTERSHOCK | | II-III | B-6 |
| 1880 | FEB 10 | 0 0 | 0.0 | (36.0 | 82.7) | BALD MTN-AFTERSHOCK | | II-III | B-6 |
| 1882 | OCT 15 | 17 30 | 0.0 | (35.1 | 84.0) | MURPHY,NC | | III-IV | -6 |
| 1884 | MAR 31 | 10 0 | 0.0 | (33.1 | 83.3) | MILLEDGEVILLE,GA | | III | -7 |
| 1884 | APR 10 | 11 46 | 0.0 | (35.2 | 84.0) | OGEETA,CHEROKEE CO.,<br>NC-LOW RUMBLING SOUND<br>OF EARTHQUAKE HEARD,<br>NO TREMOR REPORTED | | | B-6 |
| 1884 | AUG 25 | 0 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | IV | 4BD-6 |
| 1885 | FEB 2 | 12 10 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | | IV | B-9 |
| 1885 | AUG 6 | 13 0 | 0.0 | (36.2 | 81.6) | BLUE RIDGE MTNS.,<br>WATAUGA CO.,WEST NC | | IV-V | BD-5 |
| 1885 | AUG 11 | 0 0 | 0.0 | (36.2 | 81.6) | BLUE RIDGE MTNS.,<br>WATAUGA CO.,WEST NC | | IV | -7 |
| 1885 | OCT 17 | 22 30 | 0.0 | (33.0 | 82.8) | SANDERSVILLE,GA | | IV | -7 |
| 1886 | FEB 5 | 1 0 | 0.0 | (32.8 | 88.0) | SUMTER CO.,ALA | 1600 | V | -5 |
| 1886 | FEB 13 | 0 0 | 0.0 | (32.8 | 88.0) | SUMTER CO.,ALA | | | -5 |
| 1886 | SEP 1 | 5 0 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | | | -9 |
| 1886 | SEP 25 | 2 56 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | | | A-9 |
| 1886 | SEP 25 | 3 10 | 0.0 | (36.9 | 81.1) | WYTHEVILLE-AFTERSHOCK | | | A-9 |
| 1888 | MAR 17 | 0 0 | 0.0 | (36.4 | 82.5) | JONESBORO,TENN | | | F-6 |
| 1889 | SEP 28 | 0 0 | 0.0 | (35.2 | 84.5) | PARKSVILLE,POLK CO.,<br>TN-NIGHT,LIGHT SHOCK | | III-IV | -6 |
| 1891 | JUL 27 | 2 28 | 0.0 | (37.9 | 87.5) | EVANSVILLE,IND | | VI | D-5 |
| 1895 | JUL 27 | 0 0 | 0.0 | (35.2 | 88.2) | SAVANNAH,TENN | | III-IV | -6 |
| 1895 | OCT 1 | 0 0 | 0.0 | (35.2 | 88.2) | MEMPHIS,TENN-LT SHOCK | | III | -6 |
| 1897 | MAY 1 | 4 0 | 0.0 | (37.0 | 89.0) | ILL-W TN-W KY-S IND | | IV-V | -5,6 |
| 1897 | MAY 3 | 17 18 | 0.0 | (37.1 | 80.7) | NEAR ROANOKE,VA | 150000 | VI-VII | BD-5,6,9 |
| 1897 | MAY 31 | 18 58 | 0.0 | (37.3 | 80.7) | GILES COUNTY,VA | 280000 | VIII | ABCD-5,6,9 |
| 1897 | SEP 4 | 0 0 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | | | -9 |
| 1897 | OCT 22 | 3 20 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | 20000 | V | F-5,9,6 |
| 1898 | FEB 5 | 20 0 | 0.0 | (37.0 | 81.0) | PULASKI-WYTHEVILLE,VA | | IV | B-9 |
| 1898 | MAR 30 | 0 30 | 0.0 | (36.7 | 85.8) | MT.HERMON,MONROE CO.,<br>KENTUCKY | | III | -6 |
| 1898 | NOV 25 | 20 0 | 0.0 | (37.0 | 81.0) | PULASKI-WYTHEVILLE,VA | | IV-V | B-9 |
| 1899 | FEB 13 | 9 30 | 0.0 | (37.0 | 81.0) | WESTERN VA- 4 SHOCKS,<br>STRONGLY FELT IN E TN | 30000 | V | AF-5,6,9 |
| 1899 | APR 30 | 2 5 | 0.0 | (38.5 | 87.0) | SOUTHWESTERN,IND | 40000 | VI-VII | D-5,6 |
| 1902 | MAY 17 | 0 0 | 0.0 | (37.3 | 80.7) | PEARISBURG,VA | | | -9 |
| 1902 | MAY 29 | 7 30 | 0.0 | (35.1 | 85.3) | CHATTANOOGA,TENN | | V | BDF-5,6 |

WATTS BAR NUCLEAR PLANT
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EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 2 OF 8
Figure 2.5-163

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1902 | OCT 18 | 18 | 0 | 0.0 | (35.0 | 85.3) | SE TENN-NW GEORGIA | 1500 | III-V | AP-6 |
| 1902 | OCT 18 | 22 | 0 | 0.0 | (35.0 | 85.3) | TN-GA AREA-MAIN SHOCK | 1500 | V-VI | AP-6,5 |
| 1904 | MAR 5 | 0 | 30 | 0.0 | (35.7 | 83.5) | MARYVILLE,TENN | 5000 | V | BP-5,6 |
| 1905 | JAN 27 | 0 | 0 | 0.0 | (34.0 | 86.0) | NEAR GADSDEN,ALA | 250000 | VIII | ACD-6,5 |
| 1905 | JAN 28 | 0 | 0 | 0.0 | (34.0 | 86.0) | GADSDEN-SECOND SHOCK | 250000 | VIII | ACD-6,5 |
| 1908 | DEC 31 | 0 | 0 | 0.0 | (36.9 | 89.0) | BLANDVILLE,KY-SEVERAL LIGHT SHOCKS | | | |
| 1909 | OCT 8 | 10 | 0 | 0.0 | (34.8 | 85.0) | NW GA-FELT AT DALTON AND RINGGOLD,GA | 800 | IV-V | -7 |
| 1911 | APR 22 | 1 | 0 | 0.0 | (35.2 | 82.7) | CAESAR'S HEAD,SC,BLUE RIDGE AT NC-SC BORDER | 600 | V | C-6,5,7 |
| 1912 | OCT 23 | 1 | 15 | 0.0 | (32.7 | 83.5) | DUBLIN,MACON AND PERRY,GA | 1500 | IV | -7 |
| 1912 | DEC 7 | 19 | 10 | 0.0 | (34.7 | 81.7) | UNION COUNTY,SC | | III-IV | -6,5 |
| 1913 | JAN 1 | 18 | 28 | 0.0 | (34.7 | 81.7) | UNION COUNTY,SC | 43000 | VII-VIII | BD-5,6 |
| 1913 | MAR 13 | 5 | 0 | 0.0 | (34.5 | 85.0) | CALHOUN AND GORDON COUNTIES,GA | | IV | -7 |
| 1913 | MAR 28 | 21 | 50 | 0.0 | (36.2 | 83.7) | KNOXVILLE,TENN | 2700 | VII | BD-6,5 |
| 1913 | APR 17 | 16 | 30 | 0.0 | (35.3 | 84.2) | NEAR DUCKTOWN,TN | 3500 | V-VI | BD-6,5 |
| 1913 | MAY 2 | 6 | 0 | 0.0 | (35.5 | 84.4) | NEAR MADISONVILLE,TN | | III | H-6 |
| 1913 | JUN 9 | 15 | 30 | 0.0 | (35.8 | 88.9) | HUMBOLDT,TENN | | III | BP-6 |
| 1913 | AUG 3 | 16 | 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | IV | B-6 |
| 1914 | JAN 24 | 3 | 24 | 0.0 | (35.6 | 84.5) | NIOTA AND SWEETWATER IN SE TENN | | IV-V | AP-6,5 |
| 1914 | JAN 24 | 3 | 41 | 0.0 | (35.6 | 84.5) | NIOTA AND SWEETWATER IN SE TENN-AFTERSHOCK | | IV-V | AP-6,5 |
| 1914 | MAR 5 | 20 | 5 | 0.0 | (33.5 | 83.5) | NEAR ATLANTA,GA | 100000 | VI | -6,5 |
| 1915 | JAN 14 | 9 | 20 | 0.0 | (36.6 | 82.1) | BRISTOL,TENN-VA | | III-IV | -6 |
| 1915 | FEB 5 | 6 | 55 | 0.0 | (37.6 | 88.7) | HARRISBURG,ILL | | IV-V | -7 |
| 1915 | OCT 26 | 7 | 40 | 0.0 | (36.7 | 88.6) | MAYFIELD,KY | | V | DP-5,6 |
| 1915 | OCT 29 | 6 | 0 | 0.0 | (35.8 | 82.7) | NEAR MARSHALL,NC | 1200 | V | B-5,6 |
| 1916 | FEB 21 | 22 | 39 | 0.0 | (35.5 | 82.5) | NEAR WAYNESVILLE,NC | 500000 | VI-VII | ABD-6,5 |
| 1916 | MAR 2 | 5 | 2 | 0.0 | (34.5 | 82.7) | ANDERSON,SC-6 SHOCKS | | IV-V | -7 |
| 1916 | AUG 26 | 18 | 35 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-STRONG,LINCOLNTON,NC REPORTED THREE SHOCKS | 3800 | V | AB-6 |
| 1916 | AUG 26 | 19 | 36 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-AFTERSHOCK | 3800 | V | AB-5,6 |
| 1916 | OCT 18 | 22 | 4 | 0.0 | (33.5 | 86.2) | BIRMINGHAM,ALA | 170000 | VII | ACD-6,5,7 |
| 1916 | OCT 19 | 3 | 52 | 0.0 | (33.5 | 86.2) | BIRMINGHAM-AFTERSHOCK | | | A-6 |
| 1916 | OCT 19 | 8 | 0 | 0.0 | (36.7 | 88.7) | MAYFIELD,KY | | III | -6 |
| 1916 | OCT 22 | 0 | 0 | 0.0 | (33.5 | 86.2) | BIRMINGHAM-AFTERSHOCK | | | A-6 |
| 1916 | NOV 4 | 12 | 15 | 0.0 | (33.5 | 86.2) | BIRMINGHAM-AFTERSHOCK | | | A-6 |
| 1917 | JAN 2 | 9 | 30 | 0.0 | (36.1 | 83.9) | NEAR MCMILLAN,KNOX CO.,TN-THOUGHT BY SOME TO BE EXPLOSION | | | F-6 |
| 1917 | JAN 25 | 21 | 15 | 0.0 | (36.1 | 83.5) | JEFFERSON CITY,TENN | | III | A-6 |
| 1917 | JAN 26 | 12 | 15 | 0.0 | (36.1 | 83.5) | TALBOTT,JEFFERSON CO. TENN-AFTERSHOCK | | III | A-6 |
| 1917 | JAN 27 | 20 | 0 | 0.0 | (36.1 | 83.5) | JEFFERSON CITY,TENN-AFTERSHOCK | | III | -6 |

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EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 3 OF 8
Figure 2.5-164

Best Available Historical Image

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1917 | MAR 5 | 2 | 7 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN-ACCOUNT SUGGESTS ANOTHER UNREPORTED SHOCK A FEW DAYS EARLIER | | III | D-6 |
| 1917 | MAR 25 | 21 | 15 | 0.0 | (36.1 | 83.5) | JEFFERSON CITY AND TALBOTT,TENN | | III-IV | AB-6,7 |
| 1917 | MAR 26 | 12 | 50 | 0.0 | (36.1 | 83.5) | TALBOTT,TENN-AFTERSHOCK | | III | B-6 |
| 1917 | MAR 27 | 20 | 0 | 0.0 | (36.1 | 83.5) | JEFFERSON CITY,TENN-TALBOTT AFTERSHOCK | | III-IV | D-6 |
| 1917 | APR 19 | 0 | 0 | 0.0 | (37.0 | 82.0) | SW VIRGINIA | | III | -9,6 |
| 1917 | JUN 30 | 2 | 23 | 0.0 | (32.7 | 87.5) | ROSEMARY,ALA | | V | AB-6,5,7 |
| 1917 | JUN 30 | 2 | 50 | 0.0 | (32.7 | 87.5) | ROSEMARY-AFTERSHOCK | | V | B-6,7 |
| 1918 | JAN 16 | 15 | 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | V | BD-6 |
| 1918 | JUN 22 | 0 | 59 | 0.0 | (36.1 | 84.1) | NEAR LENOIR CITY,TENN | 3000 | IV-V | AB-6,5,7 |
| 1920 | APR 7 | 20 | 45 | 0.0 | (36.4 | 88.1) | SPRINGVILLE,TENN-ONE SHOCK,A HEAVY JAR, QUAKE QUESTIONABLE | | III | -6 |
| 1920 | DEC 24 | 7 | 0 | 0.0 | (36.0 | 85.0) | ROCKWOOD,TENN | | V | B-6,5 |
| 1921 | JUL 15 | 0 | 0 | 0.0 | (36.6 | 82.3) | MENDOTA,VA | | V-VI | D-6,5,9 |
| 1921 | SEP 2 | 14 | 0 | 0.0 | (36.2 | 86.3) | STATESVILLE,TENN-SEVERAL SHOCKS FELT | | III | B-6 |
| 1921 | DEC 15 | 13 | 20 | 0.0 | (35.8 | 84.6) | NEAR KINGSTON,TENN-FELT FROM KINGSTON TO DAYTON,EAST TO ATHENS | | V | BD-6 |
| 1922 | MAR 22 | 22 | 30 | 0.0 | (37.3 | 88.6) | SOUTHERN ILL | 25000 | V | AD-6,5 |
| 1922 | MAR 23 | 2 | 20 | 0.0 | (37.3 | 88.6) | S ILL-SECOND SHOCK | 25000 | V | D-6,5 |
| 1922 | MAR 23 | 21 | 45 | 0.0 | (37.0 | 88.0) | WESTERN KENTUCKY | | V | -6,5 |
| 1922 | MAR 30 | 2 | 20 | 0.0 | (35.5 | 86.7) | FARMINGTON,MARSHALL CO.,TENN | | V | B-6 |
| 1922 | MAR 30 | 2 | 21 | 0.0 | (36.5 | 82.2) | ARCADIA,SULLIVAN CO., TENN | | IV | A-6 |
| 1922 | MAR 30 | 22 | 20 | 0.0 | (36.5 | 82.2) | ARCADIA-AFTERSHOCK | | IV | -6 |
| 1923 | OCT 18 | 19 | 30 | 0.0 | (35.3 | 82.5) | HENDERSONVILLE AND SALUDA,NC | | | -7 |
| 1923 | OCT 28 | 17 | 15 | 0.0 | (34.9 | 88.1) | RIVERTON,ALA | | III | -7 |
| 1924 | JAN 1 | 1 | 6 | 0.0 | (34.8 | 82.5) | GREENVILLE,SC | | IV | -7 |
| 1924 | APR 2 | 11 | 15 | 0.0 | (37.1 | 88.6) | PADUCAH,KY | | IV | -6 |
| 1924 | OCT 20 | 8 | 30 | 0.0 | (35.0 | 82.6) | PICKENS COUNTY,SC | 56000 | V | BD-5,6 |
| 1924 | NOV 13 | 5 | 30 | 0.0 | (36.6 | 82.1) | BRISTOL,TENN-VA | | IV-V | AD-6,7 |
| 1925 | APR 27 | 4 | 5 | 0.0 | (38.0 | 87.5) | SOUTHWESTERN,IND | 100000 | V-VI | BD-5,6 |
| 1925 | MAY 13 | 12 | 0 | 0.0 | (36.7 | 88.6) | MAYFIELD,KY | 3000 | V | -5,6 |
| 1925 | MAY 15 | 0 | 0 | 0.0 | (37.0 | 81.0) | SWIFT CREEK,VA | | | A-9 |
| 1925 | SEP 2 | 11 | 55 | 0.0 | (37.8 | 87.6) | NEAR HENDERSON,KY | 75000 | V-VI | ACD-5,6 |
| 1926 | MAR 22 | 14 | 30 | 0.0 | (37.6 | 88.7) | HARRISBURG,ILL | | IV | -7 |
| 1926 | JUL 8 | 9 | 50 | 0.0 | (35.9 | 82.1) | SOUTH MITCHELL CO.,NC | | VI-VII | BCDF-6,5 |
| 1927 | MAY 7 | 8 | 28 | 0.0 | (36.5 | 89.0) | NEAR NEW MADRID,MO | 130000 | VII | BD-6,5 |
| 1927 | JUN 16 | 12 | 0 | 0.0 | (34.7 | 86.0) | NEAR SCOTTSBORO,ALA | 2500 | V | BDF-6,5 |
| 1927 | JUL 20 | 8 | 58 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN-QUAKE QUESTIONABLE | | | BDF-6 |
| 1927 | OCT 8 | 12 | 56 | 0.0 | (35.0 | 85.3) | CHATTANOOGA,TENN | | V | AD-6 |

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EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 4 OF 8
Figure 2.5-165

Best Available Historical Image

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1928 | MAR 7 | 2 45 | 0.0 | (35.6 | 86.9) | REPORTED AT FRANKLIN, LYNNVILLE,COLUMBIA IN MIDDLE TENN | | II-III | B-1,6 |
| 1928 | NOV 3 | 4 3 | 0.0 | (36.0 | 82.6) | NE TENN-W NC BORDER REGION-FELT IN ALA, GA,VA,KY AND SC | 40000 | VI-VII | CD-5,6,1,9 |
| 1928 | NOV 20 | 3 45 | 0.0 | (35.9 | 82.8) | W NC-E TENN BDR.AREA-FELT AT ASHVILLE AND HOT SPRINGS,NC, JOHNSON CITY AND GREENVILLE,TENN | 10000 | IV | -6 |
| 1929 | OCT 28 | 2 15 | 0.0 | (34.3 | 82.4) | DUE WEST,SC | | | B-1 |
| 1930 | AUG 30 | 9 28 | 0.0 | (35.9 | 84.4) | E TENN NEAR KINGSTON-FELT ALSO AT LENOIR CITY,OLIVER SPRINGS, AND LAWNVILLE,TENN | | V | B-1,6 |
| 1930 | OCT 16 | 21 50 | 0.0 | (36.0 | 84.0) | KNOXVILLE,TENN | | III-IV | ABD-1,6 |
| 1930 | OCT 17 | 2 15 | 0.0 | (36.0 | 84.0) | KNOXVILLE-AFTERSHOCK | | | -6 |
| 1930 | DEC 10 | 0 2 | 0.0 | (34.3 | 82.4) | DUE WEST,SC | 300 | | A-1 |
| 1931 | APR 1 | 23 30 | 0.0 | (36.8 | 87.5) | HOPKINSVILLE AND LOVELACEVILLE,KY-FELT AT CAIRO,ILL | | III | -1,6 |
| 1931 | MAY 5 | 12 18 | 0.0 | (33.7 | 86.6) | NORTHERN ALA-FELT IN GA AND POSSIBLY SC | 6500 | V-VI | BD-1,6,5 |
| 1931 | MAY 6 | 12 18 | 0.0 | (34.3 | 82.4) | DUE WEST,SC (POSSIBLE DATE MAY 5 TO CORRES-POND TO N ALA SHOCK) | | | B-1 |
| 1931 | NOV 27 | 9 23 | 0.0 | (36.2 | 86.7) | NASHVILLE,TENN | | III | -6,1 |
| 1934 | OCT 30 | 2 26 | 0.0 | (37.5 | 88.5) | NEAR HARTSVILLE,POPE COUNTY,ILL-ON HEROD FAULT | 1500 | IV | -1 |
| 1935 | JAN 1 | 8 15 | 0.0 | (35.1 | 83.6) | GA-NC BORDER-DAMAGE AT DAHLONEGA,GA,AND ALMOND AND GAY,NC, CENTERED NEAR HAYES-VILLE,NC,FELT IN TENN | 7000 | V | BD-6,5,1 |
| 1936 | JAN 1 | 8 0 | 0.0 | (35.0 | 84.2) | GA-NC BDR.BETWEEN BLUE RIDGE,GA AND MURPHY,NC-FELT ALSO IN DUCKTOWN BASIN OF TENN | | III | -6,2 |
| 1938 | MAR 31 | 10 10 | 0.0 | (35.6 | 83.6) | NC-TENN BORDER AREA-FELT FROM ASHVILLE AND MURPHY,NC TO KNOXVILLE,TENN | | III-IV | -6,2 |
| 1939 | MAY 5 | 3 45 | 0.0 | (33.7 | 85.8) | ANNISTON,ALA-FELT ALSO AT OXFORD LAKE, BLUE MTN.,TALLEDEGA, CHOCCOLOCCO,JENIFER | | V | D-5,6,2 |
| 1939 | JUN 24 | 10 0 | 0.0 | (34.7 | 86.6) | HUNTSVILLE,ALA | | | AB-2,6 |
| 1939 | JUN 24 | 11 27 | 0.0 | (34.7 | 86.6) | HUNTSVILLE-2ND AND STRONGEST SHOCK, FELT AT PULASKI,TENN | | III-IV | AB-2,6 |
| 1939 | JUN 24 | 12 45 | 0.0 | (34.7 | 86.6) | HUNTSVILLE-AFTERSHOCK | | | B-2,6 |
| 1940 | MAY 31 | 19 3 | 0.0 | (37.1 | 88.6) | PADUCAH,KY-FELT AT CAIRO,ILL | 1000 | IV-V | D-6,2 |
| 1940 | OCT 19 | 5 55 | 0.0 | (35.0 | 85.0) | S TENN-N GA BDR AREA-FELT IN CHATTANOOGA, CLEVELAND,CHARLESTON, TENN,AND DALTON AND RINGGOLD,GA | 500 | IV | BD-6,2 |
| 1940 | DEC 25 | 1 50 | 0.0 | (35.9 | 82.9) | ASHEVILLE,NC-GREEN-VILLE,TENN BORDER RGN | | III | A-2,6 |
| 1940 | DEC 25 | 6 49 | 0.0 | (35.9 | 82.9) | NC-TENN MAIN SHOCK | 7000 | V | ABD-6,2 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
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EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 5 OF 8
Figure 2.5-166

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | DEC 26 | 5 | 0 | 0.0 | (35.7 | 82.7) | NC-TENN AFTERSHOCK, FELT AT ASHEVILLE,NC | | III | B-6 |
| 1941 | MAR 4 | 6 | 15 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN-FELT AT ROCKFORD,BLOUNT COUNTY,TENN | | III | B-3,6 |
| 1941 | MAY 10 | 11 | 12 | 0.0 | (35.6 | 82.6) | ASHEVILLE,NC | | III | -6,3 |
| 1941 | SEP 8 | 9 | 45 | 0.0 | (35.0 | 85.3) | CHATTANOOGA,TENN | 100 | III-IV | B-1,6 |
| 1942 | NOV 1 | 3 | 20 | 0.0 | (34.5 | 81.1) | WINNSBORO,SC | | | F-3 |
| 1943 | JUL 29 | 4 | 30 | 0.0 | (33.5 | 82.0) | AUGUSTA,GA-SEISMIC ORIGIN QUESTIONED | | | -3 |
| 1945 | JUN 14 | 3 | 25 | 0.0 | (35.0 | 84.5) | CLEVELAND,TENN-FELT TO BLUE RIDGE,GA | 4000 | V | E-6,3,5 |
| 1945 | JUL 26 | 11 | 32 | 20.0 | 34.3 | 81.4 | MURRAY LAKE,SC-NEAR COLUMBIA | 25000 | IV-V | BD-6,3,5 |
| 1946 | APR 7 | 5 | 0 | 0.0 | (35.2 | 84.9) | CLEVELAND,TENN | | III-IV | BP-3 |
| 1947 | JUN 6 | 12 | 55 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | III | B-6 |
| 1947 | DEC 28 | 0 | 5 | 0.0 | (35.0 | 85.3) | SE TENN-NW GA AREA-FELT STRONGLY IN MISSIONARY RIDGE AND CHATTANOOGA AREA OF TENN AND ROSSVILLE,GA | 300 | IV | D-6,3 |
| 1948 | FEB 10 | 0 | 4 | 0.0 | (36.4 | 84.1) | LAFOLLETTE,TENN | | V-VI | B-6,3 |
| 1949 | SEP 16 | 21 | 30 | 0.0 | (36.7 | 83.0) | NEAR PENNINGTON GAP, LEE CO.,VA | | II-III | A-6 |
| 1949 | SEP 17 | 9 | 30 | 0.0 | (36.7 | 83.0) | LEE CO.,VA-MAIN SHOCK,WIDELY FELT | | IV-V | B-9,3,6 |
| 1950 | JUN 19 | 4 | 19 | 0.0 | (35.7 | 84.0) | ALCOA,TENN-FELT AT KNOXVILLE,TENN AND IN N CAROLINA | | IV | BD-6,3,11 |
| 1952 | FEB 6 | 16 | 12 | 0.0 | (33.5 | 86.8) | BIRMINGHAM,ALA | 100 | IV | D-3 |
| 1952 | JUN 11 | 20 | 20 | 0.0 | (36.6 | 82.4) | JOHNSON CITY,TENN | | | -3 |
| 1953 | NOV 10 | 14 | 53 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | | B-3,11 |
| 1953 | DEC 5 | 13 | 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | | B-11 |
| 1954 | JAN [illegible] | 2 | 25 | 0.0 | (36.6 | 83.7) | MIDDLESBORO,KY-FELT IN KY,TN,VA AND NC | | VI | D-3,5 |
| 1954 | JAN 22 | 0 | 0 | 0.0 | (35.3 | 84.4) | NEAR ETOWAH AND ATHENS,TENN | | V | BD-3,5 |
| 1955 | JAN 6 | 20 | 30 | 0.0 | (36.6 | 82.2) | BRISTOL,TENN-VA-FELT BY FEW ON UPPER FLOOR OF TALL BLDGS IN KNOXVILLE,TENN | | IV | -9,3 |
| 1955 | JAN 12 | 17 | 25 | 0.0 | (35.8 | 84.0) | BLOUNT AND KNOX CTYS. TN-FELT AT BLUE GRASS AND MARYVILLE,TENN | | IV | -3 |
| 1955 | JAN 25 | 19 | 34 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | IV | B-3 |
| 1955 | SEP 28 | 7 | 1 | 42.0 | (36.6 | 81.4) | NC-VA BORDER AREA | 1700 | V | BD-3,5 |
| 1956 | JAN 5 | 8 | 0 | 0.0 | (34.3 | 82.4) | DUE WEST,SC | | IV | A-3 |
| 1956 | JAN 5 | 8 | 30 | 0.0 | (34.3 | 82.4) | DUE WEST-AFTERSHOCK | | IV | -3 |
| 1956 | MAY 19 | 19 | 0 | 0.0 | (34.3 | 82.4) | DUE WEST,SC | | IV | AB-3 |
| 1956 | MAY 27 | 23 | 25 | 0.0 | (34.3 | 82.4) | DUE WEST-AFTERSHOCK | | IV | B-3 |
| 1956 | SEP 7 | 13 | 36 | 1.0 | 35.5 | 84.0 | NEAR KNOXVILLE,TENN-FELT IN TN,KY AND NC | 8300 | VI | ABD-3,5,1 |
| 1956 | SEP 7 | 13 | 49 | 20.0 | 35.5 | 84.0 | EAST TENN-AFTERSHOCK | 8300 | VI | BD-3,5,11 |
| 1956 | SEP 9 | 22 | 45 | 0.0 | (35.7 | 86.6) | COLLEGE GROVE,TENN | | IV | B-3 |
| 1957 | JAN 25 | 18 | 15 | 0.0 | (36.6 | 83.7) | NORTOWN,KY-A SUBURB OF MIDDLESBORO,KY | | VI | -3 |

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EARTHQUAKE LISTING
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 6 OF 8
Figure 2.5-167

Best Available Historical Image

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1957 | MAR 26 | 8 27 6.0 | (37.0 | 88.4) | PADUCAH,KY-FELT AT SMITHLAND,KY | | V | BDF-3,5 |
| 1957 | APR 23 | 9 23 39.0 | (34.5 | 86.8) | N ALA-FELT ALSO IN GA | 11500 | VI | BD-5,3,11 |
| 1957 | MAY 14 | 14 24 58.0 | (35.7 | 82.0) | W NC-FELT SC AND TN | 8100 | VI | BD-5,3,11 |
| 1957 | JUN 23 | 6 34 18.0 | 36.5 | 84.5 | E-CENTRAL TENN-FELT IN HARDIN VALLEY AND CLINCH R.VALLEY AND AT CONCORD,DIXIE LEE JUNCTION,OAK RIDGE,TN | | V | -5,3,11 |
| 1957 | JUL 2 | 9 33 1.0 | (35.5 | 82.5) | W NC-FELT STRONGLY IN MADISON AND BUNCOMBE, COUNTY,NC AND DAMAGE AT FLAG POND,TENN | | VI | D-5,3 |
| 1957 | NOV 24 | 20 6 17.0 | 35.0 | 83.5 | NC-TENN BDR.RGN.-FELT IN SC,NC,GA AND TENN | 4100 | VI | BD-5,3 |
| 1958 | JAN 28 | 4 57 0.0 | (37.0 | 89.0) | ILL-KY-MO BORDER AREA | 300 | V | D-3,5 |
| 1958 | MAY 16 | 22 30 0.0 | (35.6 | 82.6) | ASHEVILLE,NC | | IV | -3 |
| 1958 | OCT 20 | 6 16 0.0 | (34.5 | 82.8) | ANDERSON,SC | | V | BF-5,3 |
| 1958 | NOV 8 | 2 41 43.0 | 38.4 | 87.9 | ILL-IND BORDER-FELT IN ILL,IND,MO AND KY | 33000 | VI | D-3,5,11 |
| 1959 | JUN 13 | 1 15 0.0 | (35.4 | 84.3) | TELLICO PLAINS,TENN-FELT IN SEVERAL CTYS OF E TENN AND CHEROKEE CTY,NC | 900 | IV | B-3,5 |
| 1959 | AUG 12 | 18 6 7.0 | 35.0 | 87.0 | ALA-TN BORDER AREA | 2800 | VI | BD-3,5,11 |
| 1960 | FEB 9 | 14 0 6.0 | (35.3 | 82.5) | HENDERSON COUNTY,NC | | | -3 |
| 1960 | APR 15 | 10 10 10.0 | (35.8 | 84.0) | NEAR KNOXVILLE,TENN | 1300 | V | BD-3,5 |
| 1962 | JUN 27 | 1 28 55.7 | 37.7 | 88.5 | S ILL-FELT IN PADUCAH AND WICKLIFFE,KY AND IN MO | | 5.5 | BD-3,5,11 |
| 1963 | APR 11 | 17 45 0.0 | (34.8 | 82.4) | GREENVILLE,SC | | IV | B-3 |
| 1963 | AUG 3 | 0 37 50.3 | 37.0 | 88.8 | ILL-KY BORDER AREA-DEPTH ABOUT 13 KM | | 3.6 | BD-3,5 |
| 1963 | OCT 28 | 22 38 35.0 | 36.7 | 81.0 | NEAR GALAX,VA-FELT IN VA AND NC | 1300 | V | ABD-3,5,9 |
| 1963 | OCT 29 | 1 57 0.0 | 36.7 | 81.0 | GALAX,VA-AFTERSHOCK | 1300 | V | BD-3,9 |
| 1964 | JAN 20 | 13 37 52.0 | (35.9 | 82.2) | CANE RIVER,NC AREA | | IV | -3 |
| 1964 | FEB 18 | 10 31 11.5 | 34.8 | 85.5 | DE KALB CO.,NE ALA-FELT IN GA,DEPTH 15KM | | 4.4 | B-3 |
| 1964 | MAR 13 | 1 20 18.1 | 32.8 | 83.4 | CENTRAL GA-FELT IN BALDWIN,BIBB,JONES AND WILKINSON COUNTY | 400 | 4.4 | B-3 |
| 1964 | APR 20 | 19 4 46.0 | (34.0 | 81.0) | NEAR COLUMBIA,SC | | V | B-3 |
| 1964 | JUL 29 | 0 0 0.0 | (36.0 | 83.9) | KNOXVILLE,TENN | | | -3 |
| 1964 | OCT 11 | 16 30 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | | -3 |
| 1965 | SEP 9 | 4 37 16.0 | (34.7 | 81.2) | CHESTER,SC | | | A-3 |
| 1965 | SEP 9 | 14 42 20.0 | (34.7 | 81.2) | CHESTER,SC-AFTERSHOCK | | | A-3 |
| 1965 | SEP 10 | 7 32 0.0 | (34.7 | 81.2) | CHESTER,SC-AFTERSHOCK | | | A-3 |
| 1965 | SEP 12 | 17 25 2.0 | (34.7 | 81.2) | CHESTER,SC-AFTERSHOCK | | | A-3 |
| 1966 | AUG 24 | 6 0 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | IV | B-3 |
| 1967 | OCT 23 | 9 4 10.0 | 33.4 | 80.7 | S CENTRAL SC-FELT AT GOOSE CREEK, COLUMBIA COTTAGEVILLE, AND CHARLESTON | | 3.8 | -3 |
| 1968 | MAR 8 | 5 38 15.0 | 37.3 | 80.8 | NEAR NARROWS,VA | | 3.9 | -4,9,11 |
| 1968 | SEP 22 | 21 41 18.0 | 34.0 | 81.5 | CENTRAL SC-FELT AT COLUMBIA | 400 | 3.7 | B-4,11 |

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ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 7 OF 8
Figure 2.5-168

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1968 | NOV 9 | 17 1 41.0 | 38.0 | 88.5 | SOUTHERN ILL-FELT IN 23 STATES AND CANADA | 400000 | 5.3 | D-4,11 |
| 1968 | DEC 11 | 15 0 0.0 | (38.3 | 85.7) | LOUISVILLE,KY | | V | -3,16 |
| 1969 | JUL 13 | 21 51 9.4 | 36.1 | 83.7 | E TENN-FELT IN PARTS OF KY,NC,TENN,AND VA | | 3.5 | A-4 |
| 1969 | JUL 14 | 9 13 14.5 | 36.1 | 83.7 | E TENN-AFTERSHOCK | | 1.0 | -12 |
| 1969 | NOV 20 | 1 0 9.0 | 37.4 | 81.0 | SOUTHERN PART W VA-FELT IN VA,GA,OHIO, KY,MD,NC,SC,W VA,AND TN ,DEPTH ABOUT 1 KM | | 4.3 | D-4 |
| 1969 | DEC 11 | 10 19 14.1 | 35.1 | 83.0 | E NC-FELT AT SYLVA AND COLUMBUS,NC,AND GREENVILLE,PICKENS,SC | | | -4 |
| 1970 | SEP 10 | 1 41 10.0 | 36.1 | 81.4 | NW NORTH CAROLINA FELT IN NW N.CAROLINA | 2000 | 2.5 | -4,12,1 |
| 1971 | MAR 14 | 17 27 51.3 | 33.1 | 87.9 | CARROLTON,ALA-FELT | | 4.5 | -4 |
| 1971 | MAY 19 | 12 54 3.4 | 33.3 | 80.6 | ORANGEBURG-BOWMAN AREA ,SC-FELT | | 3.4 | -4 |
| 1971 | JUL 13 | 11 41 44.0 | (34.7 | 82.9) | SENECA,SC | | IV | AP-13,12 |
| 1971 | JUL 31 | 20 16 55.6 | 33.4 | 80.7 | S CAROLINA-FELT IN ORANGEBURG,CO AREA | 1300 | III | -4,13 |
| 1971 | AUG 11 | 3 52 7.0 | (33.2 | 80.7) | ORANGEBURG,SC-SLIGHT | | | -13,12 |
| 1971 | OCT 9 | 16 43 33.8 | 35.9 | 83.5 | N CAROLINA-MINOR DAMAGE IN GATLINBURG-COSBY AREA | | 3.4 | D-4 |
| 1973 | JAN 7 | 22 56 6.1 | 37.4 | 87.3 | KENTUCKY | | 3.2 | -4 |
| 1973 | OCT 30 | 22 58 39.0 | 35.8 | 84.0 | E TENN | | 3.4 | P-17 |
| 1973 | NOV 30 | 7 48 41.2 | 35.8 | 84.0 | E TENN-MINOR DAMAGE AT MARYVILLE | | 4.6 | P-17 |
| 1974 | AUG 2 | 8 52 9.8 | 33.8 | 82.4 | GEORGIA-MINOR DAMAGE BOBBY BROWN ST. PARK | | 4.8 | P-17 |
| 1975 | FEB 10 | 18 52 48.3 | 36.1 | 83.6 | E TENN | | 3.0 | -12 |
| 1975 | MAR 1 | 11 50 0.2 | 33.5 | 88.0 | MISSISSIPPI | | 3.2 | -17 |

Best Available Historical Image

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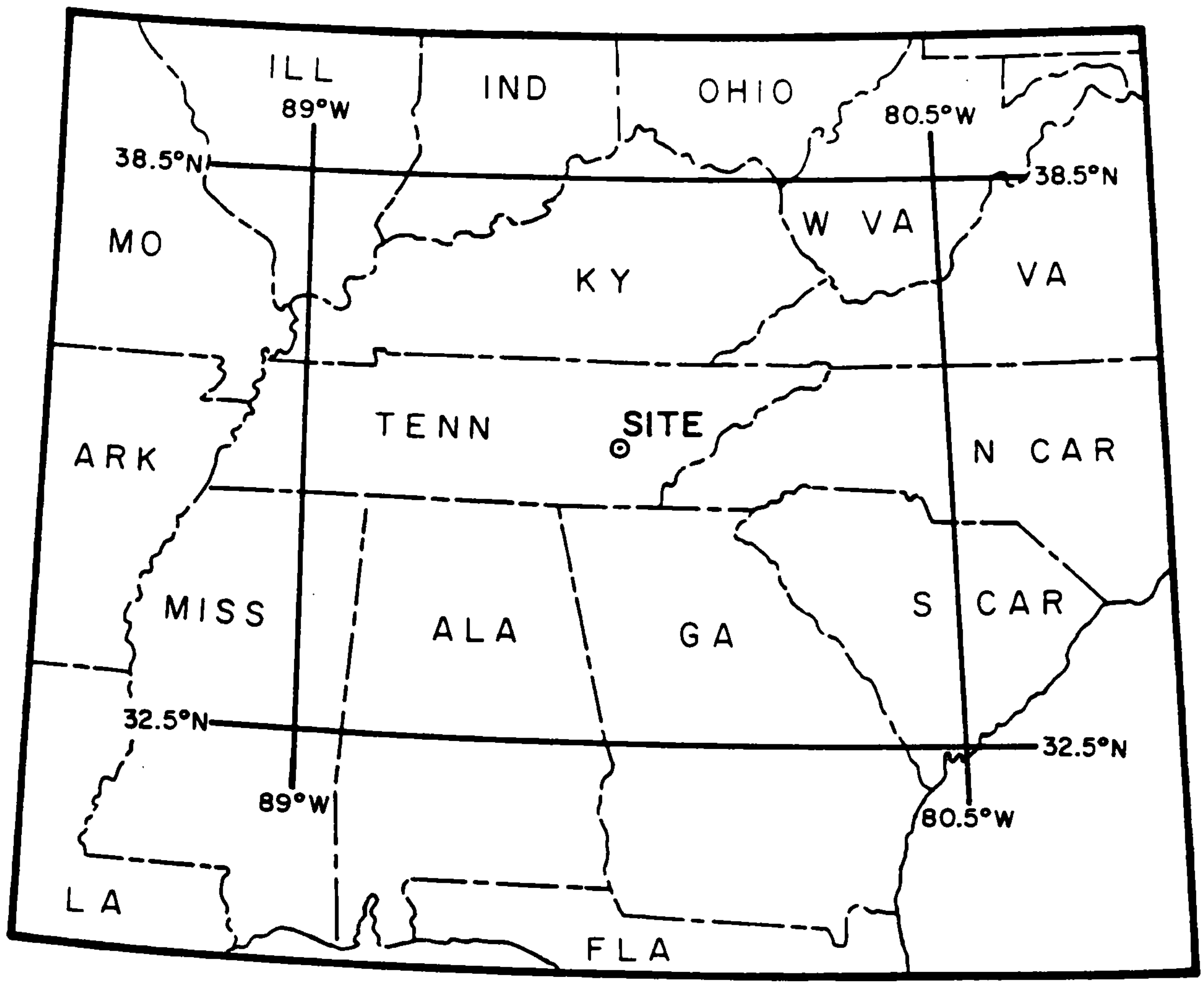
ALL EARTHQUAKES
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 8 OF 8
Figure 2.5-169




Historical

WATTS BAR NUCLEAR PLANT
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INDEX MAP - EARTHQUAKES
4.3 RICHTER OR GREATER
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST

Figure 2.5-170

SEISMIC HISTORY OF THE SOUTHEAST REGION OF THE UNITED STATES

THIS IS A CHRONOLOGICAL LISTING OF ALL EARTHQUAKES HAVING EPICENTERS IN THE RECTANGULAR PORTION OF THE SOUTH-EAST REGION BOUNDED BY THE FOLLOWING GEODETIC COORDINATE LINES --

SOUTHERN BOUNDARY - 32.5 -DEGREE NORTH LATITUDE
NORTHERN BOUNDARY - 38.5 -DEGREE NORTH LATITUDE
EASTERN BOUNDARY - 80.5 -DEGREE WEST LONGITUDE
WESTERN BOUNDARY - 89.0 -DEGREE WEST LONGITUDE

AND HAVING A RICHTER SCALE MAGNITUDE EQUAL TO OR GREATER THAN 4.3

| YEAR | DATE | TIME-HR-MIN-SEC | LAT - LONG | LOCALITY AND NOTES | FELT-SQ.MI. | MAG/INT | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1844 | NOV 28 | 12 0 0.0 | (36.0 84.0) | KNOXVILLE,TENN | | VI | BD-5,6 |
| 1852 | APR 29 | 18 0 0.0 | (36.6 81.6) | VA-NC-TENN REGION | 150000 | VI | BD-5,6,10 |
| 1872 | JUN 17 | 20 0 0.0 | (33.1 83.3) | MILLEDGEVILLE,GA | | V | D-5 |
| 1875 | NOV 2 | 2 55 0.0 | (33.8 82.5) | NORTHERN GEORGIA | 25000 | VI | AB-5,6 |
| 1876 | SEP 25 | 6 0 0.0 | (38.0 88.0) | S ILL-S IND-W KY AREA | | VI | A-6 |
| 1876 | SEP 25 | 6 15 0.0 | (38.0 88.0) | S ILL-S IND-W KY-2ND AND STRONGEST SHOCK | | VI | -6 |
| 1879 | DEC 12 | 24 0 0.0 | (35.2 80.8) | CHARLOTTE,NC | | V-VI | A-5 |
| 1886 | FEB 5 | 1 0 0.0 | (32.8 88.0) | SUMTER CO.,ALA | 1600 | V | -5 |
| 1891 | JUL 27 | 2 28 0.0 | (37.9 87.5) | EVANSVILLE,IND | | VI | D-5 |
| 1897 | MAY 3 | 17 18 0.0 | (37.1 80.7) | NEAR ROANOKE,VA | 150000 | VI-VII | BD-5,6,9 |
| 1897 | MAY 31 | 18 58 0.0 | (37.3 80.7) | GILES COUNTY,VA | 280000 | VIII | ABCD-5,6,9 |
| 1897 | OCT 22 | 3 20 0.0 | (36.9 81.1) | WYTHEVILLE,VA | 20000 | V | F-5,9,6 |
| 1899 | FEB 13 | 9 30 0.0 | (37.0 81.0) | WESTERN VA- 4 SHOCKS, STRONGLY FELT IN E TN | 30000 | V | AF-5,6,9 |
| 1899 | APR 30 | 2 5 0.0 | (38.5 87.0) | SOUTHWESTERN,IND | 40000 | VI-VII | D-5,6 |
| 1902 | MAY 29 | 7 30 0.0 | (35.1 85.3) | CHATTANOOGA,TENN | | V | BDF-5,6 |
| 1902 | OCT 18 | 22 0 0.0 | (35.0 85.3) | TN-GA AREA-MAIN SHOCK | 1500 | V-VI | AF-6,5 |
| 1904 | MAR 5 | 0 30 0.0 | (35.7 83.5) | MARYVILLE,TENN | 5000 | V | BF-5,6 |
| 1905 | JAN 27 | 0 0 0.0 | (34.0 86.0) | NEAR GADSDEN,ALA | 250000 | VIII | ACD-6,5 |
| 1905 | JAN 28 | 0 0 0.0 | (34.0 86.0) | GADSDEN-SECOND SHOCK | 250000 | VIII | ACD-6,5 |
| 1911 | APR 22 | 3 0 0.0 | (35.2 82.7) | CAESAR'S HEAD,SC,BLUE RIDGE AT NC-SC BORDER | 600 | V | C-6,5,7 |
| 1913 | JAN 1 | 18 28 0.0 | (34.7 81.7) | UNION COUNTY,SC | 43000 | VII-VIII | BD-5,6 |
| 1913 | MAR 28 | 21 50 0.0 | (36.2 83.7) | KNOXVILLE,TENN | 2700 | VII | BD-6,5 |
| 1913 | APR 17 | 16 30 0.0 | (35.3 84.2) | NEAR DUCKTOWN,TN | 3500 | V-VI | BD-6,5 |
| 1914 | MAR 5 | 20 5 0.0 | (33.5 83.5) | NEAR ATLANTA,GA | 100000 | VI | -6,5 |
| 1915 | OCT 26 | 7 40 0.0 | (36.7 88.6) | MAYFIELD,KY | | V | DF-5,6 |
| 1915 | OCT 29 | 6 0 0.0 | (35.8 82.7) | NEAR MARSHALL,NC | 1200 | V | B-5,6 |
| 1916 | FEB 21 | 22 39 0.0 | (35.5 82.5) | NEAR WAYNESVILLE,NC | 500000 | VI-VII | ABD-6,5 |

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EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
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LONGITUDE 80.5-89.0 WEST
SHEET 1 OF 3
Figure 2.5-171

Best Available Historical Image

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1916 | AUG 26 | 18 35 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-STRONG,LINCOLNTON,NC REPORTED THREE SHOCKS | 3800 | V | AB-6 |
| 1916 | AUG 26 | 19 36 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-AFTERSHOCK | 3800 | V | AB-5,6 |
| 1916 | OCT 18 | 22 4 | 0.0 | (33.5 | 86.2) | BIRMINGHAM,ALA | 170000 | VII | ACD-6,5,7 |
| 1917 | JUN 30 | 2 23 | 0.0 | (32.7 | 87.5) | ROSEMARY,ALA | | V | AB-6,5,7 |
| 1917 | JUN 30 | 2 50 | 0.0 | (32.7 | 87.5) | ROSEMARY-AFTERSHOCK | | V | B-6,7 |
| 1918 | JAN 16 | 15 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | V | BD-6 |
| 1920 | DEC 24 | 7 0 | 0.0 | (36.0 | 85.0) | ROCKWOOD,TENN | | V | B-6,5 |
| 1921 | JUL 15 | 0 0 | 0.0 | (36.6 | 82.3) | MENDOTA,VA | | V-VI | D-6,5,9 |
| 1921 | DEC 15 | 13 20 | 0.0 | (35.8 | 84.6) | NEAR KINGSTON,TENN-FELT FROM KINGSTON TO DAYTON,EAST TO ATHENS | | V | BD-6 |
| 1922 | MAR 22 | 22 30 | 0.0 | (37.3 | 88.6) | SOUTHERN ILL | 25000 | V | AD-6,5 |
| 1922 | MAR 23 | 2 20 | 0.0 | (37.3 | 88.6) | S ILL-SECOND SHOCK | 25000 | V | D-6,5 |
| 1922 | MAR 23 | 21 45 | 0.0 | (37.0 | 88.0) | WESTERN KENTUCKY | | V | -6,5 |
| 1922 | MAR 30 | 2 20 | 0.0 | (35.5 | 86.7) | FARMINGTON,MARSHALL CO.,TENN | | V | B-6 |
| 1924 | OCT 20 | 8 30 | 0.0 | (35.0 | 82.6) | PICKENS COUNTY,SC | 56000 | V | BD-5,6 |
| 1925 | APR 27 | 4 5 | 0.0 | (38.0 | 87.5) | SOUTHWESTERN,IND | 100000 | V-VI | BD-5,6 |
| 1925 | MAY 13 | 12 0 | 0.0 | (36.7 | 88.6) | MAYFIELD,KY | 3000 | V | -5,6 |
| 1925 | SEP 2 | 11 55 | 0.0 | (37.8 | 87.6) | NEAR HENDERSON,KY | 75000 | V-VI | ACD-5,6 |
| 1926 | JUL 8 | 9 50 | 0.0 | (35.9 | 82.1) | SOUTH MITCHELL CO.,NC | | VI-VII | BCDF-6,5 |
| 1927 | MAY 7 | 8 28 | 0.0 | (36.5 | 89.0) | NEAR NEW MADRID,MO | 130000 | VII | BD-6,5 |
| 1927 | JUN 16 | 12 0 | 0.0 | (34.7 | 86.0) | NEAR SCOTTSBORO,ALA | 2500 | V | BDF-6,5 |
| 1927 | OCT 8 | 12 56 | 0.0 | (35.0 | 85.3) | CHATTANOOGA,TENN | | V | AD-6 |
| 1928 | NOV 3 | 4 3 | 0.0 | (36.0 | 82.6) | NE TENN-W NC BORDER REGION-FELT IN ALA, GA,VA,KY AND SC | 40000 | VI-VII | CD-5,6,1,9 |
| 1930 | AUG 30 | 9 28 | 0.0 | (35.9 | 84.4) | E TENN NEAR KINGSTON-FELT ALSO AT LENOIR CITY,OLIVER SPRINGS, AND LAWNVILLE,TENN | | V | B-1,6 |
| 1931 | MAY 5 | 12 18 | 0.0 | (33.7 | 86.6) | NORTHERN ALA-FELT IN GA AND POSSIBLY SC | 6500 | V-VI | BD-1,6,5 |
| 1935 | JAN 1 | 8 15 | 0.0 | (35.1 | 83.6) | GA-NC BORDER-DAMAGE AT DAHLONEGA,GA,AND ALMOND AND GAY,NC, CENTERED NEAR HAYES-VILLE,NC,FELT IN TENN | 7000 | V | BD-6,5,1 |
| 1939 | MAY 5 | 3 45 | 0.0 | (33.7 | 85.8) | ANNISTON,ALA-FELT ALSO AT OXFORD LAKE, BLUE MTN.,TALLEDEGA, CHOCCOLOCCO,JENIFER | | V | D-5,6,2 |
| 1940 | DEC 25 | 6 49 | 0.0 | (35.9 | 82.9) | NC-TENN MAIN SHOCK | 7000 | V | ABD-6,2 |
| 1945 | JUN 14 | 3 25 | 0.0 | (35.0 | 84.5) | CLEVELAND,TENN-FELT TO BLUE RIDGE,GA | 4000 | V | B-6,3,5 |
| 1948 | FEB 10 | 0 4 | 0.0 | (36.4 | 84.1) | LAFOLLETTE,TENN | | V-VI | B-6,3 |
| 1954 | JAN 2 | 2 25 | 0.0 | (36.6 | 83.7) | MIDDLESBORO,KY-FELT IN KY,TN,VA AND NC | | VI | D-3,5 |
| 1954 | JAN 22 | 0 0 | 0.0 | (35.3 | 84.4) | NEAR ETOWAH AND ATHENS,TENN | | V | BD-3,5 |

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4.3 RICHTER OR GREATER
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LONGITUDE 80.5-89.0 WEST
SHEET 2 OF 3
Figure 2.5-172

Best Available Historical Image

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1955 | SEP 28 | 7 1 42.0 | (36.6 | 81.4) | NC-VA BORDER AREA | 1700 | V | BD-3,5 |
| 1956 | SEP 7 | 13 36 1.0 | 35.5 | 84.0 | NEAR KNOXVILLE,TENN-<br>FELT IN TN,KY AND NC | 8300 | VI | ABD-3,5,11 |
| 1956 | SEP 7 | 13 49 20.0 | 35.5 | 84.0 | EAST TENN-AFTERSHOCK | 8300 | VI | BD-3,5,11 |
| 1957 | JAN 25 | 18 15 0.0 | (36.6 | 83.7) | NOETOWN,KY-A SUBURB<br>OF MIDDLESBORO,KY | | VI | -3 |
| 1957 | MAR 26 | 8 27 6.0 | (37.0 | 88.4) | PADUCAH,KY-FELT AT<br>SMITHLAND,KY | | V | BDF-3,5 |
| 1957 | APR 23 | 9 23 39.0 | (34.5 | 86.8) | N ALA-FELT ALSO IN GA | 11500 | VI | BD-5,3,11 |
| 1957 | MAY 14 | 14 24 58.0 | (35.7 | 82.0) | W NC-FELT SC AND TN | 8100 | VI | BD-5,3,11 |
| 1957 | JUN 23 | 6 34 18.0 | 36.5 | 84.5 | E-CENTRAL TENN-FELT<br>IN HARDIN VALLEY AND<br>CLINCH R.VALLEY AND<br>AT CONCORD,DIXIE LEE<br>JUNCTION,OAK RIDGE,TN | | V | -5,3,11 |
| 1957 | JUL 2 | 9 33 1.0 | (35.5 | 82.5) | W NC-FELT STRONGLY IN<br>MADISON AND BUNCOMBE,<br>COUNTY,NC AND DAMAGE<br>AT FLAG POND,TENN | | VI | D-5,3 |
| 1957 | NOV 24 | 20 6 17.0 | 35.0 | 83.5 | NC-TENN BDR.RGN.-FELT<br>IN SC,NC,GA AND TENN | 4100 | VI | BD-5,3 |
| 1958 | JAN 28 | 4 57 0.0 | (37.0 | 89.0) | ILL-KY-MO BORDER AREA | 300 | V | D-3,5 |
| 1958 | OCT 20 | 6 16 0.0 | (34.5 | 82.8) | ANDERSON,SC | | V | BF-5,3 |
| 1958 | NOV 8 | 2 41 43.0 | 38.4 | 87.9 | ILL-IND BORDER-FELT<br>IN ILL,IND,MO AND KY | 33000 | VI | D-3,5,11 |
| 1959 | AUG 12 | 18 6 7.0 | 35.0 | 87.0 | ALA-TN BORDER AREA | 2800 | VI | BD-3,5,11 |
| 1960 | APR 15 | 10 10 10.0 | (35.8 | 84.0) | NEAR KNOXVILLE,TENN | 1300 | V | BD-3,5 |
| 1962 | JUN 27 | 1 28 55.7 | 37.7 | 88.5 | S ILL-FELT IN PADUCAH<br>AND WICKLIFFE,KY<br>AND IN MO | | 5.5 | BD-3,5,11 |
| 1963 | OCT 28 | 22 38 35.0 | 36.7 | 81.0 | NEAR GALAX,VA-FELT<br>IN VA AND NC | 1300 | V | ABD-3,5,9 |
| 1963 | OCT 29 | 1 57 0.0 | 36.7 | 81.0 | GALAX,VA-AFTERSHOCK | 1300 | V | BD-3,9 |
| 1964 | FEB 18 | 10 31 11.5 | 34.8 | 85.5 | DE KALB CO.,NE ALA-<br>FELT IN GA,DEPTH 15KM | | 4.4 | B-3 |
| 1964 | MAR 13 | 1 20 18.1 | 32.8 | 83.4 | CENTRAL GA-FELT IN<br>BALDWIN,BIBB,JONES<br>AND WILKINSON COUNTY | 400 | 4.4 | B-3 |
| 1964 | APR 20 | 19 4 46.0 | (34.0 | 81.0) | NEAR COLUMBIA,SC | | V | B-3 |
| 1968 | NOV 9 | 17 1 41.0 | 38.0 | 88.5 | SOUTHERN ILL-FELT IN<br>23 STATES AND CANADA | 400000 | 5.3 | D-4,11 |
| 1968 | DEC 11 | 15 0 0.0 | (38.3 | 85.7) | LOUISVILLE,KY | | V | -3,16 |
| 1969 | NOV 20 | 1 0 9.0 | 37.4 | 81.0 | SOUTHERN PART W VA-<br>FELT IN VA,GA,OHIO,<br>KY,MD,NC,SC,W VA,AND<br>TN ,DEPTH ABOUT 3 KM | | 4.3 | D-4 |
| 1971 | MAR 14 | 17 27 51.3 | 33.1 | 87.9 | CARROLTON,ALA-FELT | | 4.5 | -4 |
| 1973 | NOV 30 | 7 48 41.2 | 35.8 | 84.0 | E TENN-MINOR DAMAGE<br>AT MARYVILLE | | 4.6 | F-17 |
| 1974 | AUG 2 | 8 52 9.8 | 33.8 | 82.4 | GEORGIA-MINOR DAMAGE<br>BOBBY BROWN ST. PARK | | 4.8 | F-17 |

WATTS BAR NUCLEAR PLANT
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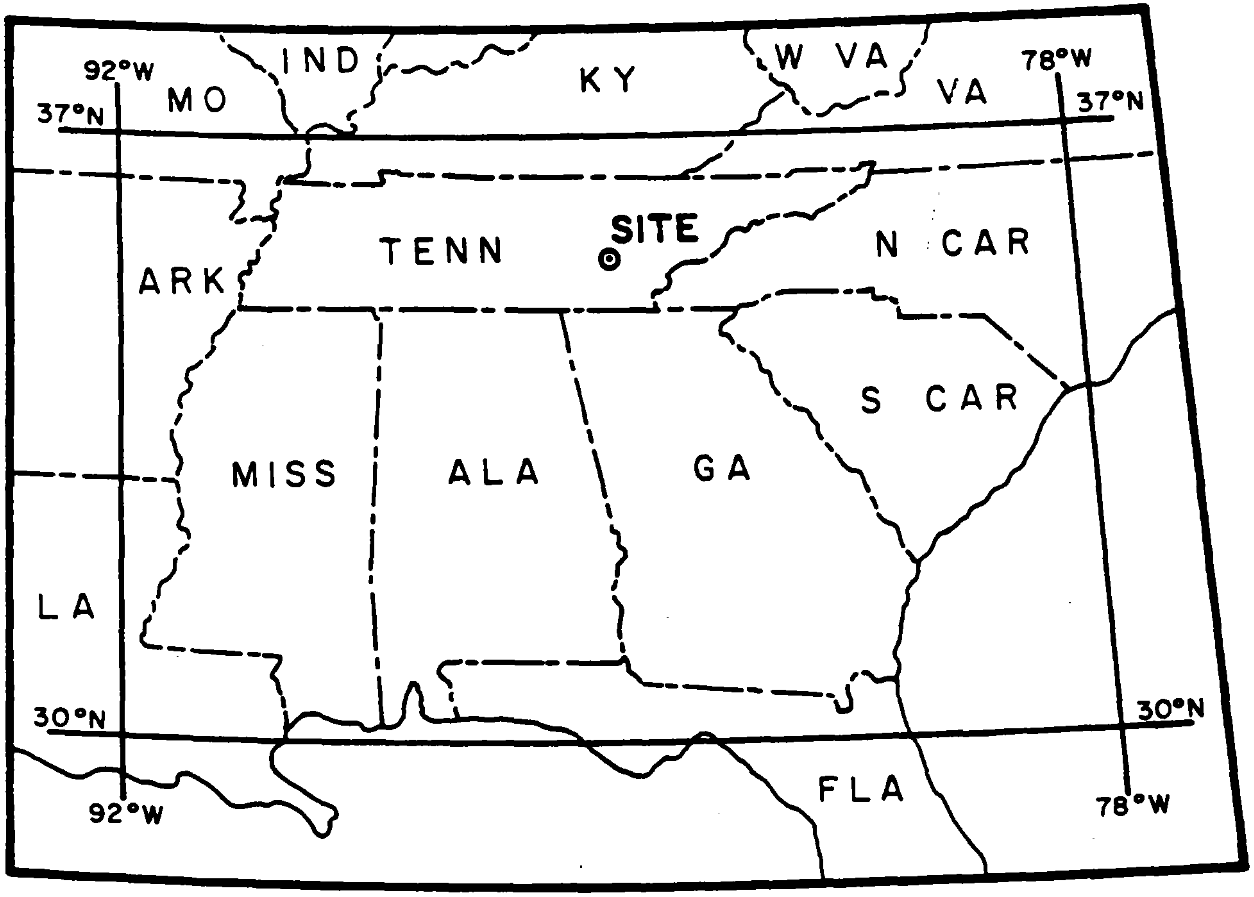
EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 32.5-38.5 NORTH
LONGITUDE 80.5-89.0 WEST
SHEET 3 OF 3
Figure 2.5-173




**Historical**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
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INDEX MAP - EARTHQUAKES
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST

Figure 2.5-174

## SEISMIC HISTORY OF THE SOUTHEAST REGION OF THE UNITED STATES

THIS IS A CHRONOLOGICAL LISTING OF ALL EARTHQUAKES HAVING EPICENTERS IN THE RECTANGULAR PORTION OF THE SOUTH-EAST REGION BOUNDED BY THE FOLLOWING GEODETIC COORDINATE LINES --

SOUTHERN BOUNDARY - 30.0 -DEGREE NORTH LATITUDE

NORTHERN BOUNDARY - 37.0 -DEGREE NORTH LATITUDE

EASTERN BOUNDARY - 78.0 -DEGREE WEST LONGITUDE

WESTERN BOUNDARY - 92.0 -DEGREE WEST LONGITUDE

AND HAVING A RICHTER SCALE MAGNITUDE EQUAL TO OR GREATER THAN 4.3

| YEAR | DATE | TIME-HR-MIN-SEC | LAT - LONG | LOCALITY AND NOTES | FELT-SQ.MI. | MAG/INT | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1811 | DEC 16 | 8 0 0.0 | (36.6 89.6) | NEW MADRID,MO-FELT EXTENSIVELY EASTWARD, PERHAPS THE STRONGEST EVER IN U.S.,LIMITED DAMAGE BECAUSE POP. SPARCE,INTENSITY-XII | 2000000 | | ABCD -5,6 |
| 1812 | JAN 23 | 15 0 0.0 | (36.6 89.6) | NEW MADRID,MO-SECOND MAIN SHOCK OF SERIES, INTENSITY-XII | 2000000 | | ABCD-5,6 |
| 1812 | FEB 7 | 9 45 0.0 | (36.6 89.6) | NEW MADRID,MO-THIRD MAIN SHOCK OF SERIES, INTENSITY-XII | | | ABCD-5,6 |
| 1841 | DEC 28 | 5 50 0.0 | (36.5 89.2) | NEAR HICKMAN,KY | | V | -16 |
| 1843 | JAN 5 | 1 0 0.0 | (35.2 90.0) | W TENN-FELT TO EAST | 400000 | VII | BCD-5,6 |
| 1844 | NOV 28 | 12 0 0.0 | (36.0 84.0) | KNOXVILLE,TENN | | VI | BD-5,6 |
| 1852 | APR 29 | 18 0 0.0 | (36.6 81.6) | VA-NC-TENN REGION | 150000 | VI | BD-5,6,10 |
| 1855 | FEB 2 | 8 0 0.0 | (37.0 78.6) | CHARLOTTE COURT HOUSE,VA | 9000 | V | -16 |
| 1861 | AUG 31 | 10 22 0.0 | (36.6 78.5) | VIRGINIA | 300000 | VI | D-5,9,6,10 |
| 1865 | AUG 17 | 15 0 0.0 | (36.5 89.5) | NEW MADRID,MO-FELT WIDELY OVER MISS VAL. | 24000 | VII | D-6,5 |
| 1872 | JUN 17 | 20 0 0.0 | (33.1 83.3) | MILLEDGEVILLE,GA | | V | D-5 |
| 1875 | NOV 2 | 2 55 0.0 | (33.8 82.5) | NORTHERN GEORGIA | 25000 | VI | AB-5,6 |
| 1875 | DEC 23 | 4 45 0.0 | (36.6 78.5) | ARVONIA,VA-5 SHOCKS IN QUICK SUCCESSION | 50000 | VII | ABD-5,9 |
| 1878 | MAR 12 | 10 0 0.0 | (36.8 89.2) | COLUMBUS,KY | | V | CF-5,6 |
| 1878 | NOV 19 | 5 52 0.0 | (36.7 90.4) | TENN-MO-KY-ILL AREA | 150000 | VI-VIII | AD-6,5 |
| 1879 | DEC 12 | 24 0 0.0 | (35.2 80.8) | CHARLOTTE,NC | | V-VI | A-5 |
| 1883 | JAN 11 | 7 12 0.0 | (37.0 89.2) | CAIRO,ILL-MAIN SHOCK | 80000 | V-VI | AD-6,5 |
| 1883 | APR 12 | 8 30 0.0 | (37.0 89.2) | CAIRO,ILL-AFTERSHOCK | | VI-VII | DF-5,6 |
| 1883 | JUN 11 | 0 0 0.0 | (35.2 90.0) | MEMPHIS,TENN | | VI-VII | -7 |
| 1883 | DEC 5 | 15 20 0.0 | (36.3 91.8) | MELBOURNE,ARK | | V | BCD-5 |
| 1884 | JAN 18 | 13 0 0.0 | (34.3 78.0) | WILMINGTON,NC | | V | D-5 |

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EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 1 OF 6
Figure 2.5-175

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1886 | FEB 5 | 1 0 | 0.0 | (32.8 | 88.0) | SUMTER CO.,ALA | 1600 | V | -5 |
| 1886 | AUG 28 | 1 30 | 0.0 | (33.1 | 80.2) | SUMMERVILLE,SC-<br>CHARLESTON FORESHOCK | | V | -14 |
| 1886 | SEP 1 | 2 51 | 0.0 | (32.9 | 80.0) | FIFTEEN MILES NW OF<br>CHARLESTON,SC-ONE<br>OF STRONGEST EVER TO<br>OCCUR IN U.S.,EXTEN-<br>SIVE DAMAGE,INTEN-<br>SITY X | 2000000 | | ABCD-5,6,8 |
| 1886 | SEP 1 | 2 59 | 0.0 | (32.9 | 80.0) | CHARLESTON,SC-2ND<br>MAIN SHOCK,INT-X | 2000000 | | ABCD-5,6,8 |
| 1886 | SEP 1 | 5 5 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | | -14 |
| 1886 | SEP 4 | 4 1 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | VI | -8,14 |
| 1886 | SEP 6 | 4 6 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | VI | -8,14 |
| 1886 | SEP 21 | 10 15 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | V-VI | -14 |
| 1886 | SEP 27 | 19 2 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | VI | -14 |
| 1886 | OCT 22 | 19 45 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | 30000 | VII-VIII | -5,8,14 |
| 1886 | NOV 5 | 17 20 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | 10000 | VI-VII | -5,14 |
| 1887 | JAN 4 | 11 44 | 0.0 | (32.9 | 80.0) | CHARLESTON-AFTERSHOCK | | VI | -14 |
| 1887 | AUG 2 | 18 36 | 0.0 | (37.0 | 89.2) | CAIRO,ILL | | V | D-5,6 |
| 1888 | JAN 12 | 15 54 | 0.0 | (32.9 | 80.0) | CHARLESTON,SC | | VII | -14 |
| 1889 | JUL 20 | 1 32 | 0.0 | (35.2 | 90.0) | MEMPHIS,TENN | | V-VII | D-6,5 |
| 1891 | SEP 27 | 4 55 | 0.0 | (37.0 | 89.2) | CAIRO,ILL | | V | D-5,6 |
| 1895 | OCT 31 | 11 8 | 0.0 | (37.0 | 89.4) | NEAR CHARLESTON,MO-<br>4 ACRES OF GROUND<br>SANK FORMING A LAKE,<br>CONSIDERABLE DAMAGE<br>AT CAIRO,ILL,FELT<br>EXTENSIVELY EASTWARD | 1000000 | VIII-IX | ACD-6,5 |
| 1897 | OCT 22 | 1 20 | 0.0 | (36.9 | 81.1) | WYTHEVILLE,VA | 20000 | V | F-5,9,6 |
| 1899 | FEB 13 | 9 30 | 0.0 | (37.0 | 1.0) | WESTERN VA- 4 SHOCKS,<br>STRONGLY FELT IN E TN | 30000 | V | AF-5,6,9 |
| 1900 | OCT 13 | 4 15 | 0.0 | (30.4 | 81.7) | JACKSONVILLE,FLA-8<br>DISTINCT SHOCKS FELT | | V | AF-5 |
| 1902 | MAY 29 | 7 30 | 0.0 | (35.1 | 85.3) | CHATTANOOGA,TENN | | V | BDF-5,6 |
| 1902 | OCT 18 | 22 0 | 0.0 | (35.0 | 85.3) | TN-GA AREA-MAIN SHOCK | 1500 | V-VI | AF-6,5 |
| 1903 | JAN 24 | 1 15 | 0.0 | (32.1 | 81.1) | NEAR SAVANNAH,GA | 10000 | VI | BD-5 |
| 1904 | MAR 5 | 0 30 | 0.0 | (35.7 | 83.5) | MARYVILLE,TENN | 5000 | V | BF-5,6 |
| 1905 | JAN 27 | 0 0 | 0.0 | (34.0 | 86.0) | NEAR GADSDEN,ALA | 250000 | VIII | ACD-6,5 |
| 1905 | JAN 29 | 0 0 | 0.0 | (34.0 | 86.0) | GADSDEN-SECOND SHOCK | 250000 | VIII | ACD-6,5 |
| 1905 | AUG 22 | 5 8 | 0.0 | (36.9 | 89.6) | NEAR SIKESTON,MO-FELT<br>OVER WIDE AREA | 40000 | IV VI | BD-6,7 |
| 1907 | APR 19 | 8 30 | 0.0 | (32.9 | 80.0) | CHARLESTON,SC | 10000 | V | D-5 |
| 1908 | OCT 28 | 0 27 | 0.0 | (37.0 | 89.2) | CAIRO,ILL | 5000 | V | B-6,5 |
| 1909 | OCT 23 | 7 10 | 0.0 | (37.0 | 89.5) | SOUTHEASTERN,MO | 40000 | V-VI | -5,6 |
| 1911 | APR 22 | 3 0 | 0.0 | (35.2 | 82.7) | CAESAR'S HEAD,SC,BLUE<br>RIDGE AT NC-SC BORDER | 600 | V | C-6,5,7 |
| 1912 | JUN 12 | 10 30 | 0.0 | (32.9 | 80.0) | SUMMERVILLE,SC | 35000 | VII | D-5 |
| 1912 | JUN 20 | 0 0 | 0.0 | (32.0 | 81.0) | SAVANNAH,GA | | V | F-5 |
| 1913 | JAN 1 | 18 28 | 0.0 | (34.7 | 81.7) | UNION COUNTY,SC | 43000 | VII-VIII | BD-5,6 |
| 1913 | MAR 28 | 21 50 | 0.0 | (36.2 | 83.7) | KNOXVILLE,TENN | 2700 | VII | BD-6,5 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 2 OF 6
Figure 2.5-176

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1913 | APR 17 | 16 30 | 0.0 | (35.3 | 84.2) | NEAR DUCKTOWN,TN | 3500 | V-VI | BD-6,5 |
| 1914 | MAR 5 | 20 5 | 0.0 | (33.5 | 83.5) | NEAR ATLANTA,GA | 100000 | VI | -6,5 |
| 1914 | SEP 22 | 7 4 | 0.0 | (33.0 | 80.3) | NEAR SUMMERVILLE,SC | 30000 | V | B-5 |
| 1915 | OCT 26 | 7 40 | 0.0 | (36.7 | 88.6) | MAYFIELD,KY | | V | DF-5,6 |
| 1915 | OCT 29 | 6 0 | 0.0 | (35.8 | 82.7) | NEAR MARSHALL,NC | 1200 | V | B-5,6 |
| 1915 | DEC 7 | 18 40 | 0.0 | (36.7 | 89.1) | CAIRO,ILL | 60000 | V-VI | D-6,5 |
| 1916 | FEB 21 | 22 39 | 0.0 | (35.5 | 82.5) | NEAR WAYNESVILLE,NC | 500000 | VI-VII | ABD-6,5 |
| 1916 | AUG 26 | 18 35 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-STRONG,LINCOLNTON,NC REPORTED THREE SHOCKS | 3800 | V | AB-6 |
| 1916 | AUG 26 | 19 36 | 0.0 | (36.0 | 81.0) | STATESVILLE AND TAYLORSVILLE,NC-AFTERSHOCK | 3800 | V | AB-5,6 |
| 1916 | OCT 18 | 22 4 | 0.0 | (33.5 | 86.2) | BIRMINGHAM,ALA | 170000 | VII | ACD-6,5,7 |
| 1916 | DEC 19 | 5 42 | 0.0 | (36.6 | 89.3) | HICKMAN,KY-TWO SHOCKS | | V-VII | BD-6,5 |
| 1917 | JUN 30 | 2 23 | 0.0 | (32.7 | 87.5) | ROSEMARY,ALA | | V | AB-6,5,7 |
| 1917 | JUN 30 | 2 50 | 0.0 | (32.7 | 87.5) | ROSEMARY-AFTERSHOCK | | V | B-6,7 |
| 1918 | JAN 16 | 15 45 | 0.0 | (35.9 | 83.9) | KNOXVILLE,TENN | | V | BD-6 |
| 1918 | OCT 13 | 21 30 | 0.0 | (36.1 | 91.1) | BLACK ROCK,ARK | | V | AB-5,6 |
| 1920 | DEC 24 | 7 0 | 0.0 | (36.0 | 85.0) | ROCKWOOD,TENN | | V | B-6,5 |
| 1921 | JUL 15 | 0 0 | 0.0 | (36.6 | 82.3) | MENDOTA,VA | | V-VI | D-6,5,9 |
| 1921 | DEC 15 | 13 20 | 0.0 | (35.8 | 84.6) | NEAR KINGSTON,TENN-FELT FROM KINGSTON TO DAYTON,EAST TO ATHENS | | V | BD-6 |
| 1922 | MAR 21 | 21 45 | 0.0 | (37.0 | 88.0) | WESTERN KENTUCKY | | V | -6,5 |
| 1922 | MAR 30 | 2 20 | 0.0 | (35.5 | 86.7) | FARMINGTON,MARSHALL CO.,TENN | | V | B-6 |
| 1922 | MAR 30 | 4 53 | 0.0 | (35.2 | 90.0) | MEMPHIS,TN-FELT IN TN,KY,MO AND ILL | | V | -6 |
| 1923 | OCT 28 | 17 10 | 0.0 | (35.5 | 90.3) | MARKED TREE,ARK | 40000 | VII | CD-5,6,7 |
| 1923 | NOV 26 | 23 25 | 0.0 | (35.2 | 90.2) | E ARK AND W TENN-FELT STRONGLY AT MEMPHIS | | VI | -6 |
| 1924 | JAN 1 | 3 5 | 0.0 | (35.4 | 90.3) | NEAR MEMPHIS,TENN | 30000 | V | -6,5 |
| 1924 | MAR 2 | 11 18 | 0.0 | (36.9 | 89.1) | E KY NEAR CAIRO,ILL | 25000 | V | -5,6 |
| 1924 | OCT 20 | 8 30 | 0.0 | (35.0 | 82.6) | PICKENS COUNTY,SC | 56000 | V | BD-5,6 |
| 1925 | MAY 13 | 12 0 | 0.0 | (36.7 | 88.6) | MAYFIELD,KY | 3000 | V | -5,6 |
| 1926 | JUL 8 | 9 50 | 0.0 | (35.9 | 82.1) | SOUTH MITCHELL CO.,NC | | VI-VII | BCDF-6,5 |
| 1927 | MAY 7 | 8 28 | 0.0 | (36.5 | 89.0) | NEAR NEW MADRID,MO | 130000 | VII | BD-6,5 |
| 1927 | JUN 16 | 12 0 | 0.0 | (34.7 | 86.0) | NEAR SCOTTSBORO,ALA | 2500 | V | BDF-6,5 |
| 1927 | AUG 13 | 16 0 | 0.0 | (36.4 | 89.5) | TIPTONVILLE,TENN | | V | D-6 |
| 1927 | OCT 8 | 12 56 | 0.0 | (35.0 | 85.3) | CHATTANOOGA,TENN | | V | AD-6 |
| 1928 | NOV 3 | 4 3 | 0.0 | (36.0 | 82.6) | NE TENN-W NC BORDER REGION-FELT IN ALA, GA,VA,KY AND SC | 40000 | VI-VII | CD-5,6,1,9 |
| 1930 | AUG 30 | 9 28 | 0.0 | (35.9 | 84.4) | E TENN NEAR KINGSTON-FELT ALSO AT LENOIR CITY,OLIVER SPRINGS, AND LAWNVILLE,TENN | | V | B-1,6 |
| 1931 | MAY 5 | 12 18 | 0.0 | (33.7 | 86.6) | NORTHERN ALA-FELT IN GA AND POSSIBLY SC | 6500 | V-VI | BD-1,6,5 |
| 1931 | DEC 17 | 3 36 | 0.0 | (34.0 | 89.7) | BATESVILLE,MISS | 65000 | VI-VII | D-5,6,1 |
| 1933 | DEC 9 | 8 40 | 0.0 | (35.8 | 90.2) | MANILA,ARK | | V | DF-5,6,1 |

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EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 3 OF 6
Figure 2.5-177

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1934 | AUG 20 | 0 47 0.0 | (37.0 | 89.2) | NEAR RODNEY,SE MO | 30000 | V-VI | AD-6,1,5 |
| 1935 | JAN 1 | 8 15 0.0 | (35.1 | 83.6) | GA-NC BORDER-DAMAGE AT DAHLONEGA,GA,AND ALMOND AND GAY,NC, CENTERED NEAR HAYES-VILLE,NC,FELT IN TENN | 7000 | V | BD-6,5,1 |
| 1939 | MAY 5 | 3 45 0.0 | (33.7 | 85.8) | ANNISTON,ALA-FELT ALSO AT OXFORD LAKE, BLUE MTN.,TALLADEGA, CHOCCOLOCCO,JENIFER | | V | D-5,6,2 |
| 1940 | DEC 25 | 6 49 0.0 | (35.9 | 82.9) | NC-TENN MAIN SHOCK | 7000 | V | ABD-6,2 |
| 1941 | NOV 17 | 3 9 0.0 | (35.5 | 89.7) | NEAR COVINGTON,TENN | | V | BD-6,3,5 |
| 1945 | JUN 14 | 3 25 0.0 | (35.0 | 84.5) | CLEVELAND,TENN-FELT TO BLUE RIDGE,GA | 4000 | V | B-6,3,5 |
| 1947 | DEC 16 | 3 27 0.0 | (35.7 | 90.0) | NEAR OSCEOLA,ARK-IN THE MEMPHIS AREA | 10000 | V | D-6,1 |
| 1948 | FEB 10 | 0 4 0.0 | (36.4 | 84.1) | LAFOLLETTE,TENN | | V-VI | B-6,3 |
| 1949 | JAN 14 | 3 45 0.0 | (36.5 | 89.5) | W TENN-E ARK-SE MO AREA-FELT STRONGLY AT TIPTONVILLE,MEMPHIS | 7000 | V | B-6,3 |
| 1952 | FEB 20 | 22 34 39.0 | 36.4 | 89.5 | TENN-MO BORDER NEAR TIPTONVILLE,TENN-FELT ALSO IN ARK AND KY | | V | D-3,5 |
| 1952 | JUL 16 | 23 48 10.0 | 36.2 | 89.6 | DYERSBURG,TENN | | VI | AD-3,5 |
| 1952 | NOV 19 | 0 0 0.0 | (32.8 | 80.0) | CHARLESTON,SC | | V | D-5,3 |
| 1954 | JAN 7 | 2 25 0.0 | (36.6 | 83.7) | MIDDLESBORO,KY-FELT IN KY,TN,VA AND NC | | VI | D-3,5 |
| 1954 | JAN 22 | 0 0 0.0 | (35.3 | 84.4) | NEAR ETOWAH AND ATHENS,TENN | | V | BD-3,5 |
| 1954 | FEB 2 | 4 53 0.0 | (36.7 | 90.3) | POPLAR BLUFF,MO-FELT IN PARTS OF MO,ARK, ILL,AND TENN | | VI | D-3,5,11 |
| 1955 | JAN 25 | 7 24 30.0 | 35.6 | 90.3 | TENN-ARK-MO BDR. RGN-FELT FROM LEPANTO,ARK TO PADUCAH,KY AND BIRMINGHAM,ALA | 30000 | VI | D-3,5 |
| 1955 | FEB 1 | 14 45 0.0 | (30.4 | 89.1) | GULFPORT,MISS | | V | BD-3,5 |
| 1955 | MAR 29 | 9 2 40.0 | (36.0 | 89.5) | FINLEY,TENN-FELT AT CARUTHERSVILLE,MO | | VI | BD-3,5,11 |
| 1955 | SEP 5 | 1 45 0.0 | (36.0 | 89.5) | NEAR FINLEY AND DYERSBURG,TENN | | V | BD-3,11 |
| 1955 | SEP 28 | 7 1 42.0 | (36.6 | 81.4) | NC-VA BORDER AREA | 1700 | V | BD-3,5 |
| 1955 | DEC 13 | 7 41 0.0 | (36.0 | 89.5) | WESTERN DYER CO.TENN-FELT AT FINLEY,TENN | | V | A-3,5 |
| 1955 | DEC 13 | 7 56 0.0 | (36.0 | 89.5) | DYER CO.-AFTERSHOCK | | V | -3,5 |
| 1956 | JAN 29 | 4 14 15.0 | 35.6 | 89.6 | TENN-ARK BORDER NEAR COVINGTON,TENN | | VI | D-3,5 |
| 1956 | SEP 7 | 13 36 1.0 | 35.5 | 84.0 | NEAR KNOXVILLE,TENN-FELT IN TN,KY AND NC | 8300 | VI | ABD-3,5,11 |
| 1956 | SEP 7 | 13 49 20.0 | 35.5 | 84.0 | EAST TENN-AFTERSHOCK | 8300 | VI | BD-3,5,11 |
| 1956 | OCT 29 | 9 23 44.0 | (36.1 | 89.4) | CARUTHERSVILLE,MO | | V | B-5,3,11 |
| 1957 | JAN 25 | 18 15 0.0 | (36.6 | 83.7) | NOETOWN,KY-A SUBURB OF MIDDLESBORO,KY | | VI | -3 |
| 1957 | MAR 26 | 8 27 6.0 | (37.0 | 88.4) | PADUCAH,KY-FELT AT SMITHLAND,KY | | V | BDF-3,5 |
| 1957 | APR 23 | 9 23 39.0 | (34.5 | 86.8) | N ALA-FELT ALSO IN GA | 11500 | VI | BD-5,3,11 |
| 1957 | MAY 14 | 14 24 58.0 | (35.7 | 82.0) | W NC-FELT SC AND TN | 8100 | VI | BD-5,3,11 |

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EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
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SHEET 4 OF 6
Figure 2.5-178

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1957 | JUN 23 | 6 34 18.0 | 36.5 | 84.5 | E-CENTRAL TENN-FELT IN HARDIN VALLEY AND CLINCH R.VALLEY AND AT CONCORD,DIXIE LEE JUNCTION,OAK RIDGE,TN | | V | -5,3,11 |
| 1957 | JUL 2 | 9 33 1.0 | (35.5 | 82.5) | W NC-FELT STRONGLY IN MADISON AND BUNCOMBE, COUNTY,NC AND DAMAGE AT FLAG POND,TENN | | VI | D-5,3 |
| 1957 | NOV 24 | 20 6 17.0 | 35.0 | 83.5 | NC-TENN BDR.RGN.-FELT IN SC,NC,GA AND TENN | 4100 | VI | BD-5,3 |
| 1958 | JAN 26 | 16 56 0.0 | (35.1 | 90.0) | MEMPHIS,TENN-FELT IN SE MO | | V | D-3,5 |
| 1958 | JAN 28 | 4 57 0.0 | (37.0 | 89.0) | ILL-KY-MO BORDER AREA | 300 | V | D-3,5 |
| 1958 | APR 8 | 22 25 33.0 | (36.2 | 89.1) | OBION CO.,TENN | 400 | V | B-3,5 |
| 1958 | APR 26 | 7 30 0.0 | (36.3 | 89.5) | LAKE CO.,TENN-FELT AT CARUTHERSVILLE,MO | | V | B-3,5 |
| 1958 | OCT 20 | 6 16 0.0 | (34.5 | 82.8) | ANDERSON,SC | | V | BF-5,3 |
| 1958 | NOV 19 | 18 15 0.0 | (30.3 | 91.1) | BATON ROUGE,LA | | V | F-3,5 |
| 1959 | FEB 13 | 8 37 0.0 | (36.2 | 89.5) | BOGOTO,TENN-2 SHOCKS | 200 | V | B-3,5 |
| 1959 | AUG 3 | 6 8 30.0 | 33.0 | 79.5 | SE S CAROLINA-FELT IN LARGE AREA OF E GA | 25000 | VI | BD-3,,11 |
| 1959 | AUG 12 | 18 6 7.0 | 35.0 | 87.0 | ALA-TN BORDER AREA | 2800 | VI | BD-3,5,11 |
| 1959 | OCT 27 | 2 7 28.0 | (34.5 | 80.3) | NE S CAROLINA-FELT IN NC,STRONG AT MCBEE,SC | 4800 | VI | BD-3,5 |
| 1959 | DEC 21 | 15 25 0.0 | (36.0 | 89.5) | FINLEY,TENN-FELT IN SE MO | 400 | V | D-3,,11 |
| 1960 | JAN 28 | 21 38 0.0 | (36.0 | 89.5) | DYER COUNTY,TENN | | V | B-5,3 |
| 1960 | MAR 12 | 12 47 48.0 | 33.0 | 79.0 | NEAR COAST OF SC-FELT AT CHARLESTON | 3500 | V | -5,3 |
| 1960 | APR 15 | 10 10 10.0 | (35.8 | 84.0) | NEAR KNOXVILLE,TENN | 1300 | V | BD-3,5 |
| 1960 | APR 21 | 10 45 0.0 | (36.3 | 89.5) | LAKE COUNTY,TENN | | V | BF-5,3 |
| 1960 | JUL 24 | 3 37 30.0 | (33.0 | 80.0) | CHARLESTON,SC | | V | D-3,5 |
| 1962 | FEB 2 | 6 43 34.0 | 36.5 | 89.6 | NEW MADRID,MO-FELT IN ARK,ILL,KY,MO AND TN | 35000 | VI | BD-3,5,11 |
| 1962 | JUL 23 | 6 5 18.4 | 36.1 | 89.8 | SOUTHERN MO-FELT ALSO IN ARK AND TENN | | VI | BD-3,5 |
| 1963 | MAR 3 | 17 30 13.0 | 36.7 | 90.1 | SE MO | 100000 | 4.5 | BD-5,3,11 |
| 1963 | OCT 28 | 22 38 35.0 | 36.7 | 81.0 | NEAR GALAX,VA-FELT IN VA AND NC | 1300 | V | ABD-3,5,9 |
| 1963 | OCT 29 | 1 57 0.0 | 36.7 | 81.0 | GALAX,VA-AFTERSHOCK | 1300 | V | BD-3,9 |
| 1964 | FEB 18 | 10 31 11.5 | 34.8 | 85.5 | DE KALB CO.,NE ALA-FELT IN GA,DEPTH 15KM | | 4.4 | B-3 |
| 1964 | MAR 13 | 1 20 18.1 | 32.8 | 83.4 | CENTRAL GA-FELT IN BALDWIN,BIBB,JONES AND WILKINSON COUNTY | 400 | 4.4 | B-3 |
| 1964 | APR 20 | 19 4 46.0 | (34.0 | 81.0) | NEAR COLUMBIA,SC | | V | B-3 |
| 1966 | FEB 12 | 4 32 14.7 | 35.9 | 90.0 | NE ARK-FELT AT DELBRIDGE,BLYTHEVILLE, MANILA,LEACHVILLE AND STEEL,ARK | | 4.1 | -3 |
| 1968 | FEB 10 | 1 34 32.0 | 36.6 | 89.5 | NEW MADRID,MO REGION | | 4.5 | -4,11 |
| 1970 | DEC 24 | 10 17 57.1 | 36.7 | 89.5 | NEW MADRID,MO-FELT AT POPLAR BLUFF | | 4.8 | -4 |
| 1971 | MAR 14 | 17 27 51.3 | 33.1 | 87.9 | CARROLTON,ALA-FELT | | 4.5 | -4 |
| 1971 | OCT 1 | 18 49 39.4 | 35.8 | 90.4 | JONESBORO,ARK-FELT IN ALA,IND,ILL,KY,MISS, MO AND TN | | VI | D-4 |

Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 5 OF 6
Figure 2.5-179

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1972 | FEB 3 | 23 11 8.4 | 33.5 | 80.4 | NEAR ORANGEBURG,SC-<br>FELT THROUGHOUT SC,<br>WESTERN NC AND AT<br>AUGUSTA,GA.DEPTH 5KM | 4.5 | -4 |
| 1972 | MAR 29 | 20 38 31.9 | 36.1 | 89.8 | NEW MADRID,MO AREA-<br>FELT IN MO,TENN,ARK,<br>ILL,KY AND MISS | V | -4 |
| 1972 | JUN 19 | 5 46 15.3 | 37.0 | 89.1 | CAPE GIRARDEAU,MO-<br>FELT IN WICKLIFFE,MO<br>AND KEVIL,KY | 4.5 | -4 |
| 1973 | NOV 30 | 7 48 41.2 | 35.8 | 84.0 | E TENN-MINOR DAMAGE<br>AT MARYVILLE | 4.6 | F-17 |
| 1974 | AUG 2 | 8 52 9.8 | 33.8 | 82.4 | GEORGIA-MINOR DAMAGE<br>BOBBY BROWN ST. PARK | 4.8 | F-17 |
| 1974 | NOV 22 | 5 25 55.5 | 32.9 | 80.1 | SOUTH CAROLINA<br>NORTH CHARLESTON<br>SUMMERVILLE AREAS | 4.7 | F-17 |



WATTS BAR NUCLEAR PLANT
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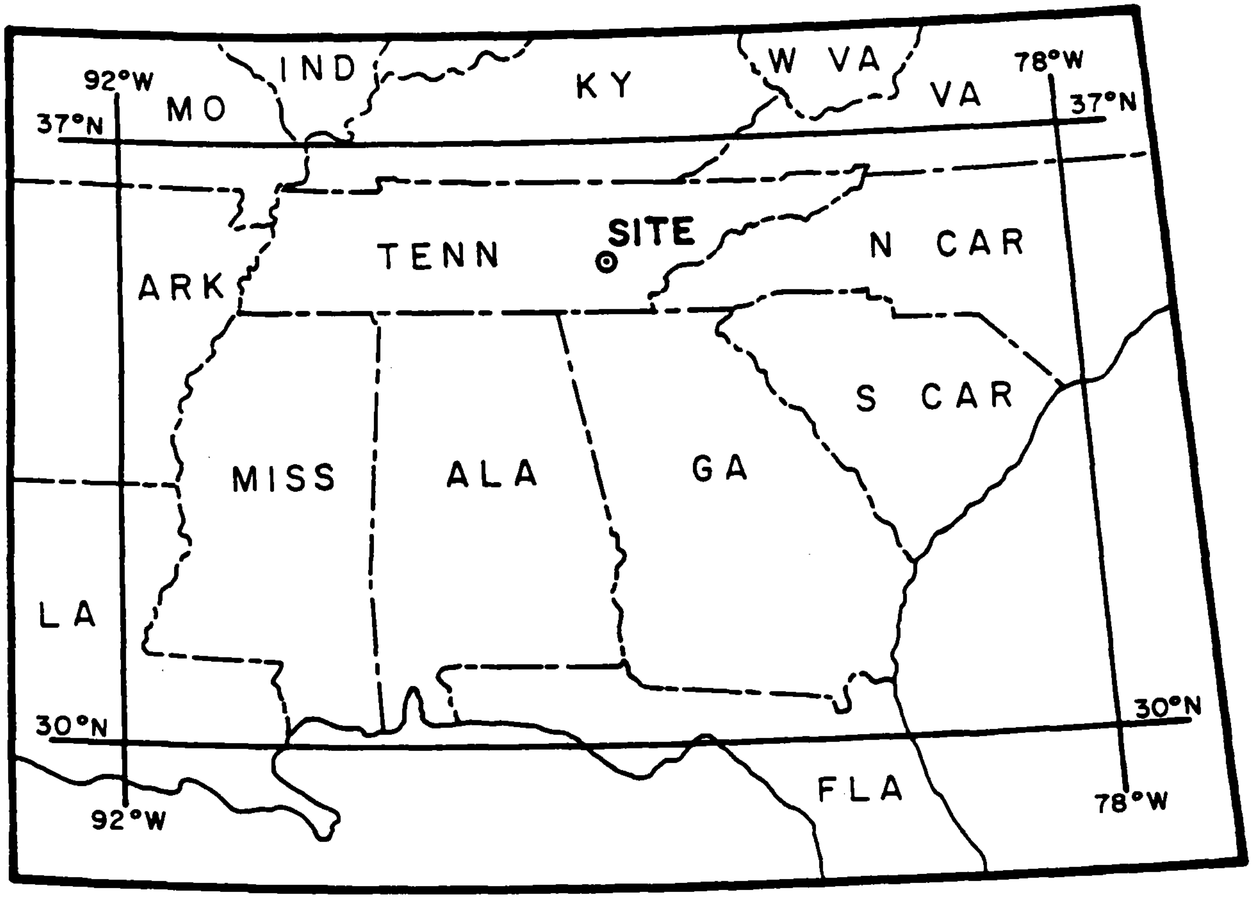
EARTHQUAKE LISTING
4.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 6 OF 6
Figure 2.5-180






WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INDEX MAP - EARTHQUAKES
6.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST

Figure 2.5-181

## SEISMIC HISTORY OF THE SOUTHEAST REGION OF THE UNITED STATES

THIS IS A CHRONOLOGICAL LISTING OF ALL EARTHQUAKES HAVING EPICENTERS IN THE RECTANGULAR PORTION OF THE SOUTH-EAST REGION BOUNDED BY THE FOLLOWING GEODETIC COORDINATE LINES --

SOUTHERN BOUNDARY - 30.0 -DEGREE NORTH LATITUDE
NORTHERN BOUNDARY - 37.0 -DEGREE NORTH LATITUDE
EASTERN BOUNDARY - 78.0 -DEGREE WEST LONGITUDE
WESTERN BOUNDARY - 92.0 -DEGREE WEST LONGITUDE

AND HAVING A RICHTER SCALE MAGNITUDE EQUAL TO OR GREATER THAN 6.3

| YEAR | DATE | TIME-HR-MIN-SEC | LAT - LONG | LOCALITY AND NOTES | FELT-SQ.MI. | MAG/INT | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1811 | DEC 16 | 8 0 0.0 | (36.6 89.6) | NEW MADRID,MO-FELT EXTENSIVELY EASTWARD, PERHAPS THE STRONGEST EVER IN U.S.,LIMITED DAMAGE BECAUSE POP. SPARCE,INTENSITY-XII | 2000000 | | ABCD -5,6 |
| 1812 | JAN 23 | 15 0 0.0 | (36.6 89.6) | NEW MADRID,MO-SECOND MAIN SHOCK OF SERIES, INTENSITY-XII | 2000000 | | ABCD-5,6 |
| 1812 | FEB 7 | 9 45 0.0 | (36.6 89.6) | NEW MADRID,MO-THIRD MAIN SHOCK OF SERIES, INTENSITY-XII | | | ABCD-5,6 |
| 1886 | SEP 1 | 2 51 0.0 | (32.9 80.0) | FIFTEEN MILES NW OF CHARLESTON,SC-ONE OF STRONGEST EVER TO OCCUR IN U.S.,EXTENSIVE DAMAGE,INTENSITY X | 2000000 | | ABCD-5,6,8 |
| 1886 | SEP 1 | 2 59 0.0 | (32.9 80.0) | CHARLESTON,SC-2ND MAIN SHOCK,INT-X | 2000000 | | ABCD-5,6,8 |
| 1886 | SEP 1 | 5 5 0.0 | (32.9 80.0) | CHARLESTON-AFTERSHOCK | | | -14 |
| 1895 | OCT 31 | 11 8 0.0 | (37.0 89.4) | NEAR CHARLESTON,MO-4 ACRES OF GROUND SANK FORMING A LAKE, CONSIDERABLE DAMAGE AT CAIRO,ILL,FELT EXTENSIVELY EASTWARD | 1000000 | VIII-IX | ACD-6,5 |
| 1905 | JAN 27 | 0 0 0.0 | (34.0 86.0) | NEAR GADSDEN,ALA | 250000 | VIII | ACD-6,5 |
| 1905 | JAN 28 | 0 0 0.0 | (34.0 86.0) | GADSDEN-SECOND SHOCK | 250000 | VIII | ACD-6,5 |



WATTS BAR NUCLEAR PLANT
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EARTHQUAKE LISTING
6.3 RICHTER OR GREATER
LATITUDE 30-37 NORTH
LONGITUDE 78-92 WEST
SHEET 1 OF 1
Figure 2.5-182

LIST OF REFERENCES
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Best Available Historical Image

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| EARTHQUAKE LISTING<br>LIST OF REFERENCES<br>Figure 2.5-183 |

THE FOLLOWING NOTES APPLY TO VARIOUS SYMBOLS AND CODE LETTERS USED IN THE EARTHQUAKE LIST

---

ALL DATES AND TIMES ARE GIVEN IN GREENWICH MEAN TIME.

FOR THE EVENTS PRIOR TO 1928, ZEROS IN THE SEC, MIN, OR HOUR COLUMNS MEANS THAT THE TIME OF THE EVENT IS NOT ACCURATELY KNOWN.

PARENTHESIS AROUND THE COORDINATES OF THE EPICENTER INDICATES THE LOCATION OF AN ISOLATED FELT REPORT OR THE APPROXIMATE CENTER OF THE REPORTED FELT AREA AND THAT THE EVENT WAS NOT INSTRUMENTALLY LOCATED.

IN THE -MAG/INT- COLUMN , THE RICHTER MAGNITUDE OF THE EARTHQUAKE IS GIVEN IN ARABIC NUMBERS WITH A DECIMAL POINT . IF THE MAGNITUDE IS NOT AVAILABLE , THE ESTIMATED INTENSITY, ON THE MODIFIED MERCALLI SCALE , IS GIVEN IN ROMAN NUMERALS. IF NEITHER OF THESE MEASURES OF THE SIZE OF THE EARTHQUAKE ARE AVAILABLE , THIS COLUMN IS LEFT BLANK.

THE FIRST NUMBERED REFERENCE CITED IN THE REFERENCE LIST CONTAINS THE BEST DESCRIPTION AND MOST COMPLETE DISCUSSION OF THE VARIOUS EFFECTS OF THAT EARTHQUAKE. SOME OF THE EFFECTS AND CHARACTERISTICS ARE SUMMARIZED USING THE LETTER CODES BELOW.

A- INDICATES THAT THIS EARTHQUAKE WAS FOLLOWED BY AN AFTERSHOCK SEQUENCE , THE INDIVIDUAL EVENTS OF WHICH ARE NOT INCLUDED IN THE LISTING UNLESS THEY ARE IDENTIFIED AS SUCH.

B- INDICATES THAT VARIOUS RUMBLINGS, GROANS, AND OTHER EARTH NOISES WERE REPORTED ACCOMPANYING THE EARTHQUAKE.

C- INDICATES THAT VISIBLE TOPOGRAPHIC CHANGES OCCURRED AS A RESULT OF THE EARTHQUAKE.

D- INDICATES DAMAGE OR CHANGES TO STRUCTURES SUCH AS CHIMNEYS THROWN DOWN , CONCRETE OR PLASTER CRACKED , MOVEMENT OF FURNITURE OR FIXTURES , ETC.

F- INDICATES A SHARPLY FELT LOCAL SHOCK.

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WATTS BAR NUCLEAR PLANT
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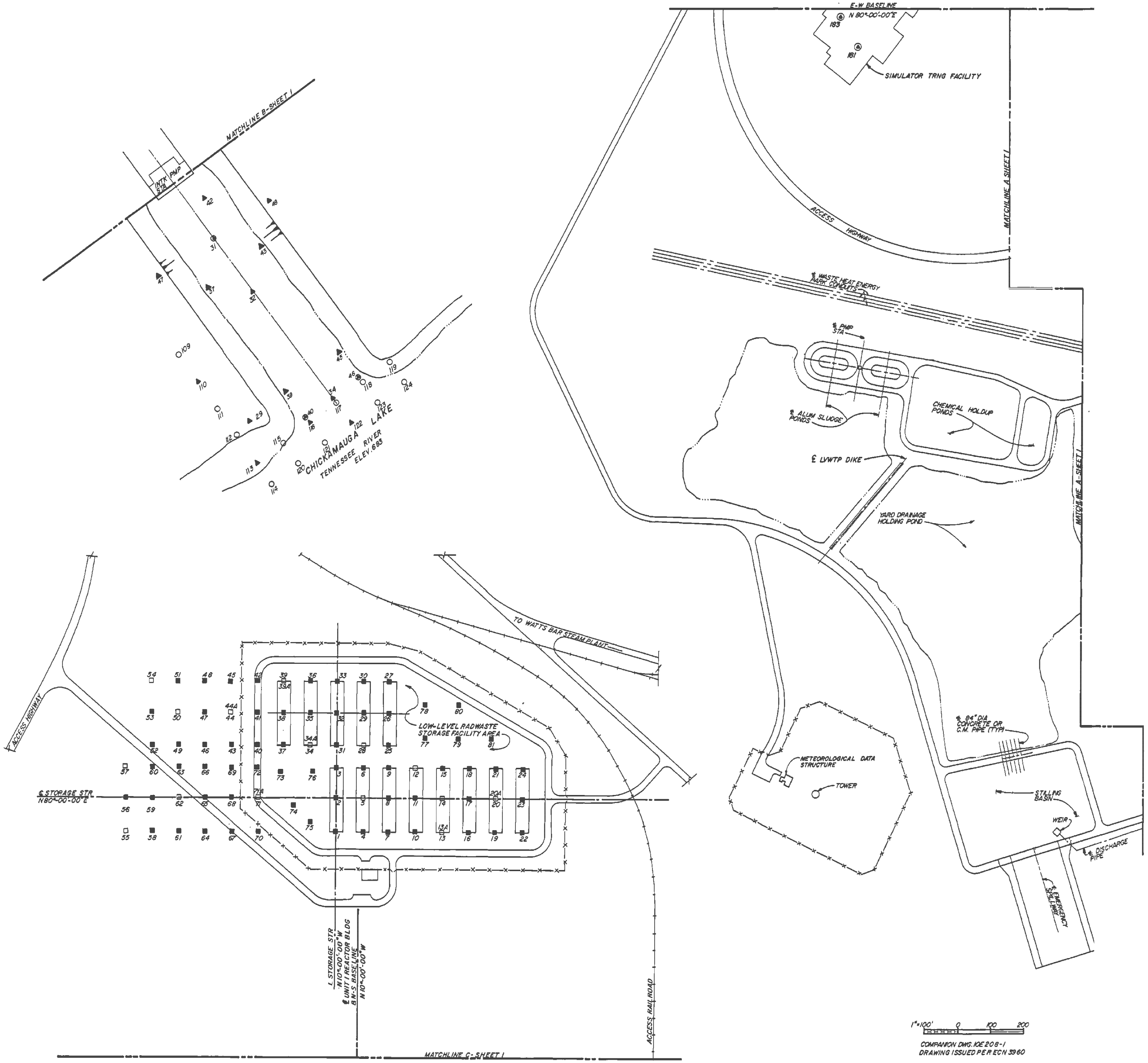
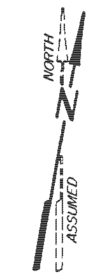
EARTHQUAKE LISTING
NOTES

Figure 2.5-184

**SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390**

**FIGURE 2.5-185**




## CORRELATION OF SOIL BORINGS TO SOIL REPORTS

| SYMBOL | BORING SEQ * | FEATURE | REPORT REFERENCE |
|---|---|---|---|
| ◬ | 1-3 | 500 KV TRANSFORMER YD | CSB 771006 050 |
| ▲ ◬ | 4-13 (SS1-6) (US4-7) | COOLING TOWERS | CSB 771006 050 |
| ▲ | 14-18 (15-19) | CCW PUMPING STATION | CSB 771006 050 |
| ▲ | 19-24 (1-6) | SERVICE BUILDING | CSB 771006 050 |
| ▲ ◬ | 25-28 (39-41) | DIESEL GENERATING BLDG. | CSB 771006 050 |
| ▲ ◬ | 29-48 (19-38) | INTAKE CHANNEL | CSB 771006 050 |
| ▲ ◬ | 49-108 (1-60) | ERCW & HPFP SYSTEM | CSB 771006 050 |
| ▲ ○ | 109-124 | INTAKE CHANNEL | CSB 761112 006 |
| ◬ | 125-130 | SOIL SUPPORTED STRUCTURE | CSB 790927 002 |
| ▲ ◬ | 131-170 | ERCW PIPING ALIGNMENT | CSB 791101 701 |
| ▲ | 171-177 | IE ELECT. CONDUIT BANKS | CSB 820129 301 |
| ◩ | 178-180 | WATER TREATMENT PLANT | WBN 820408 003 |
| ● | 1-5 | ERCW PIPE SUPPORT SLAB | CSB 790817 003 |
| ⊖ | 1-5 | VOLUME REDUCTION BLDG | CSB 820709 302 |
| ■ □ | 1-81 | LLRW STORAGE AREA | CSB 810424 301 |
| ▲ ◬ | 181-186 | SIMULATOR TRNG FACILITY | B46 860527 001 |
| ▲ ◬ | 187-192 | LLRW FACILITY | B46 860603 006 |

* NUMBERS IN PARENTHESIS ARE BORING NUMBERS AS SHOWN IN SOILS REPORTS, IF DIFFERENT FROM DRAWING.

*LEGEND:*

- ▲ *SOIL BORING FOR SPLIT SPOON SAMPLING .*
- ◬ *SOIL BORING FOR SPLIT SPOON AND UNDISTURBED SAMPLING.*
- ■ *BORING FOR SPLIT SPOON SAMPLING (LOW LEVEL RADWASTE STORAGE AREA)*
- □ *BORING FOR SPLIT SPOON AND UNDISTURBED SAMPLING (LOW LEVEL RADWASTE STORAGE AREA)*
- ○ *SOIL AUGER BORING (INTAKE CHANNEL)*

WATTS BAR
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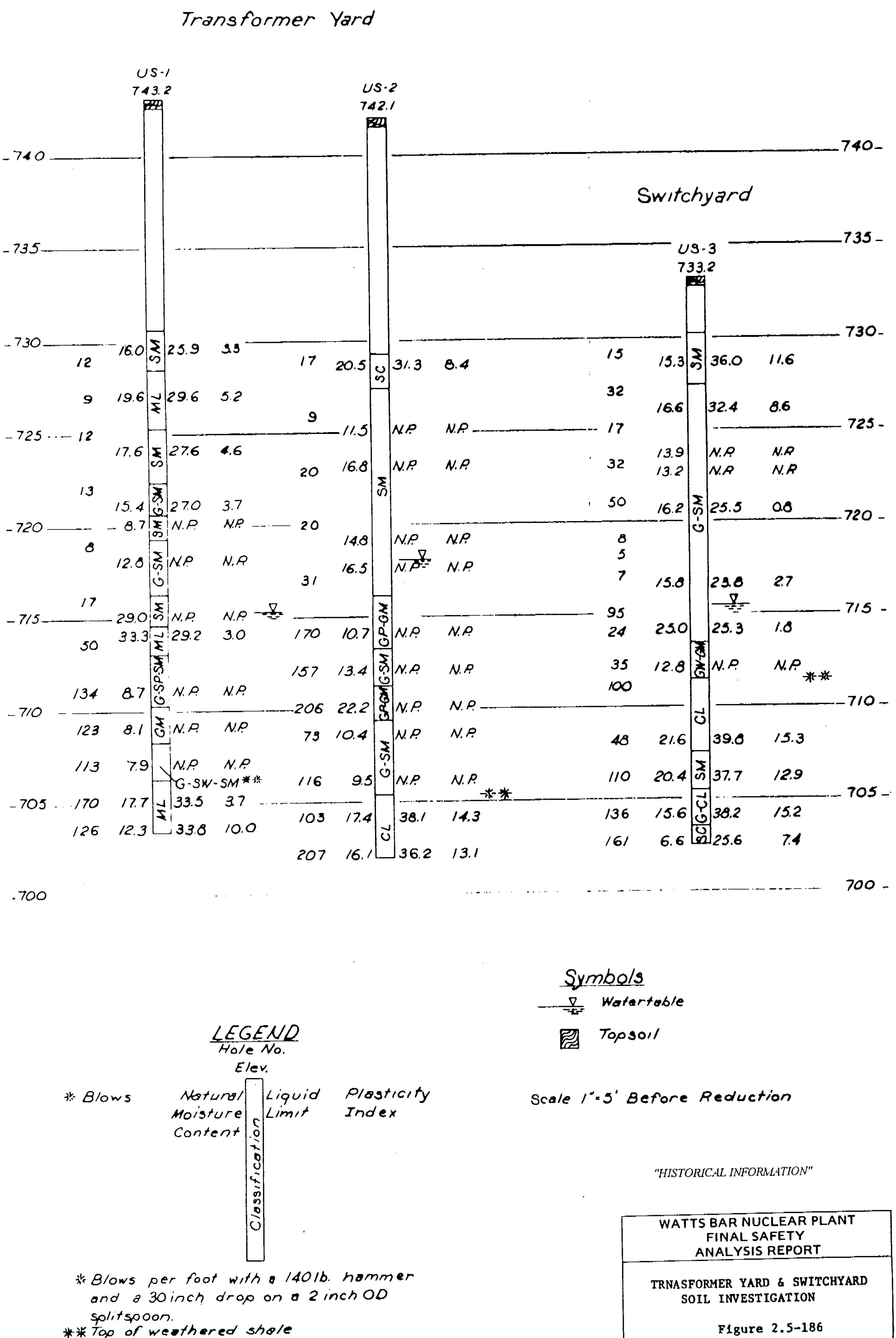
YARD
SOIL BORINGS
LOCATION PLAN
SHEET 2 - IN SITU
TVA DWG NO. 10E208-2 R2
FIGURE 2.5-185A

CAD MAINTAINED DRAWING

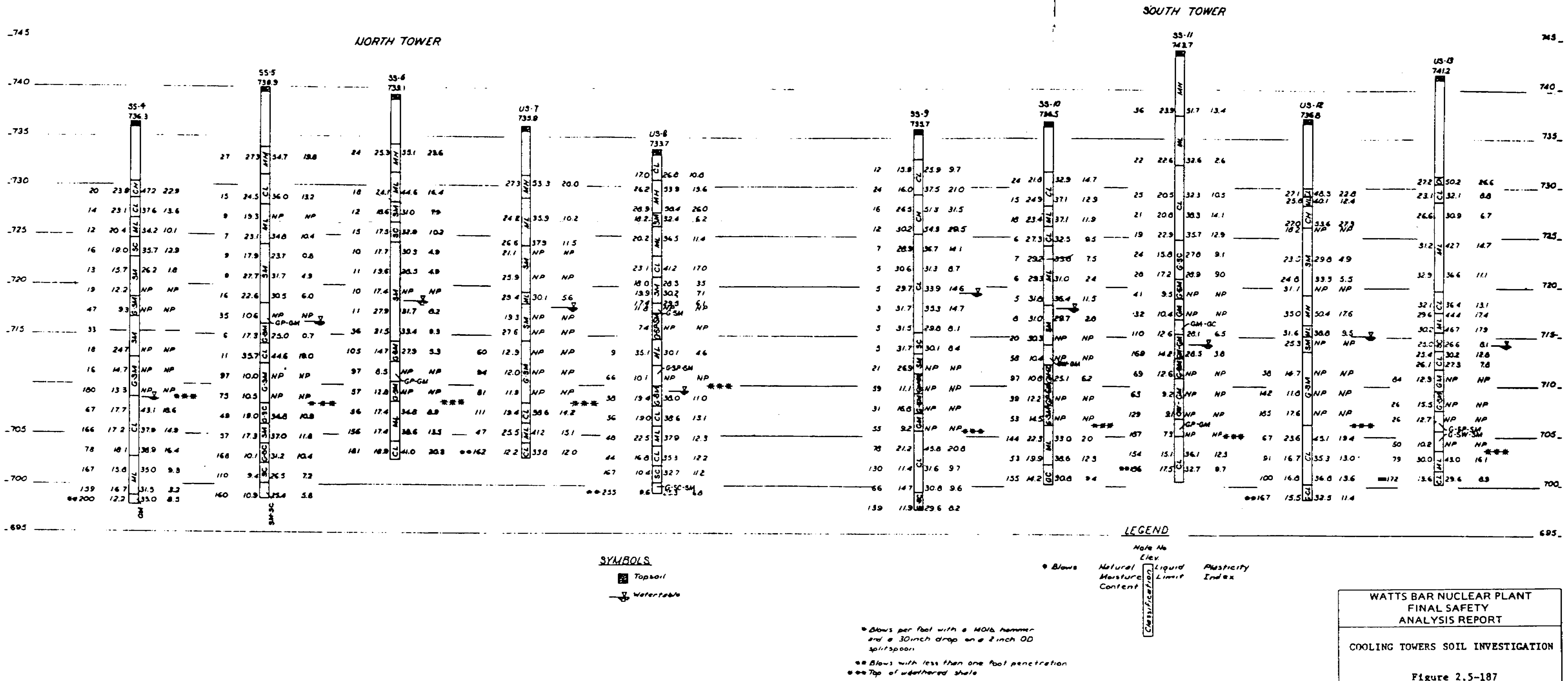



"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

TRNASFORMER YARD & SWITCHYARD
SOIL INVESTIGATION

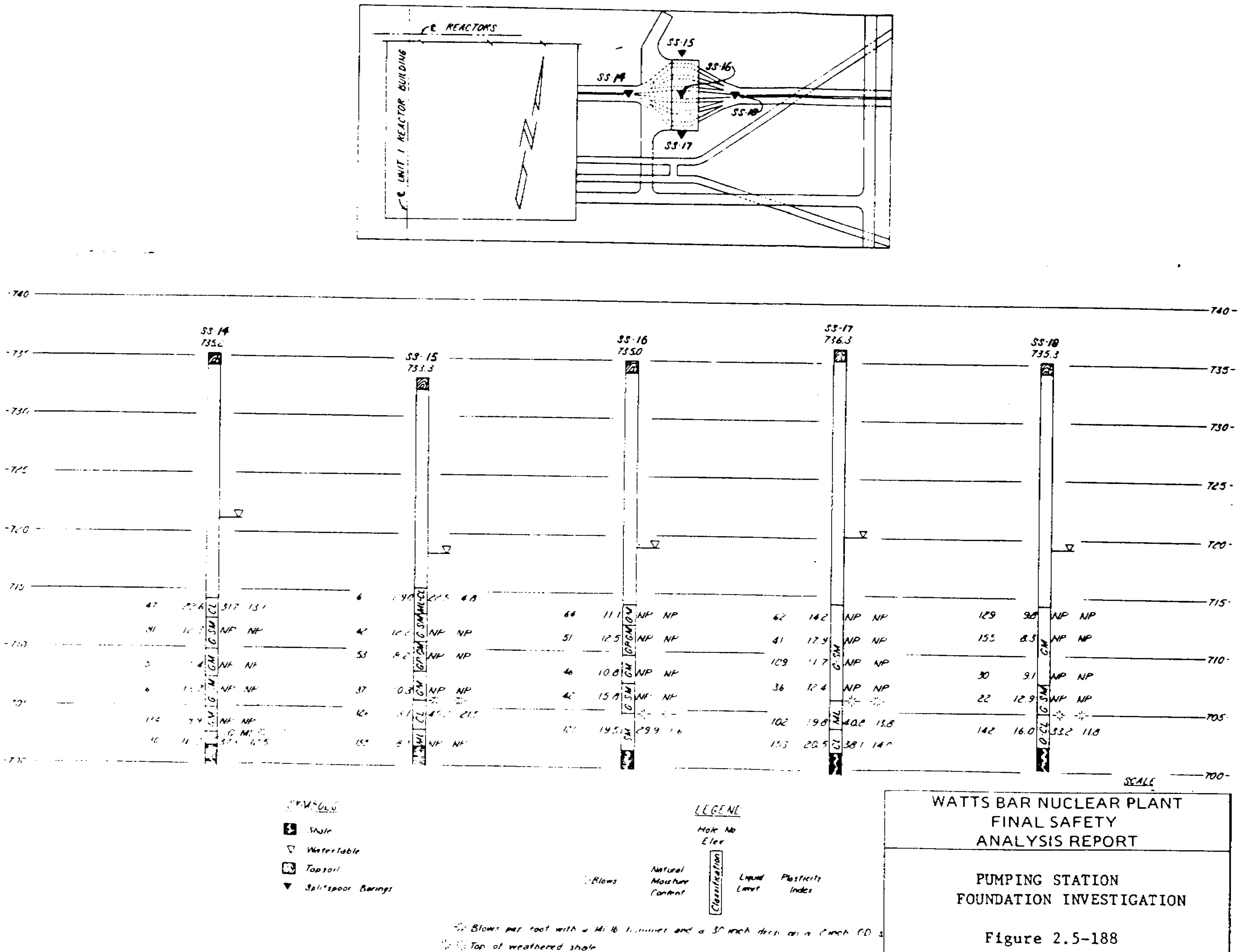
Figure 2.5-186




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

COOLING TOWERS SOIL INVESTIGATION

Figure 2.5-187




WATTS BAR NUCLEAR PLANT
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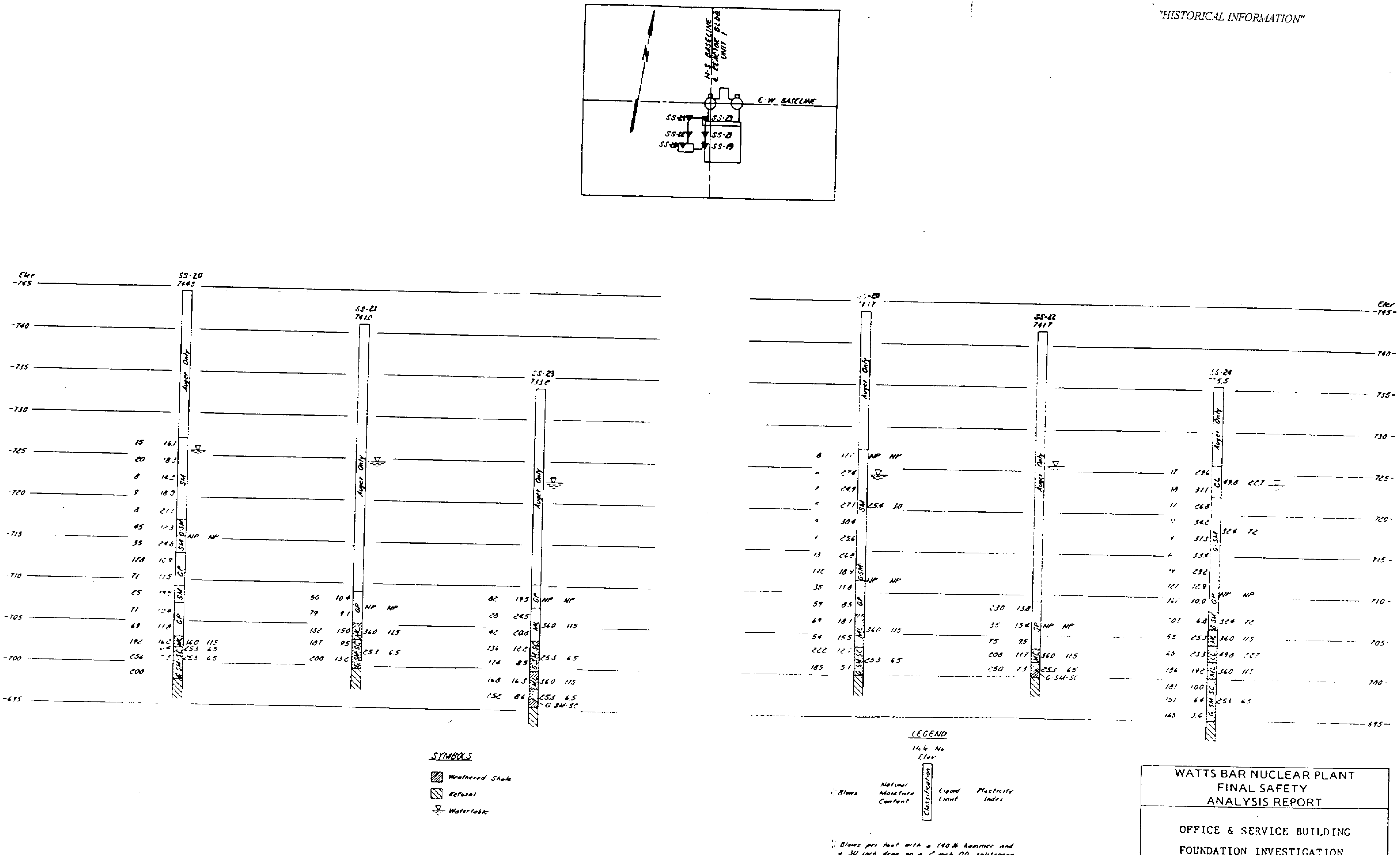
PUMPING STATION
FOUNDATION INVESTIGATION

Figure 2.5-188

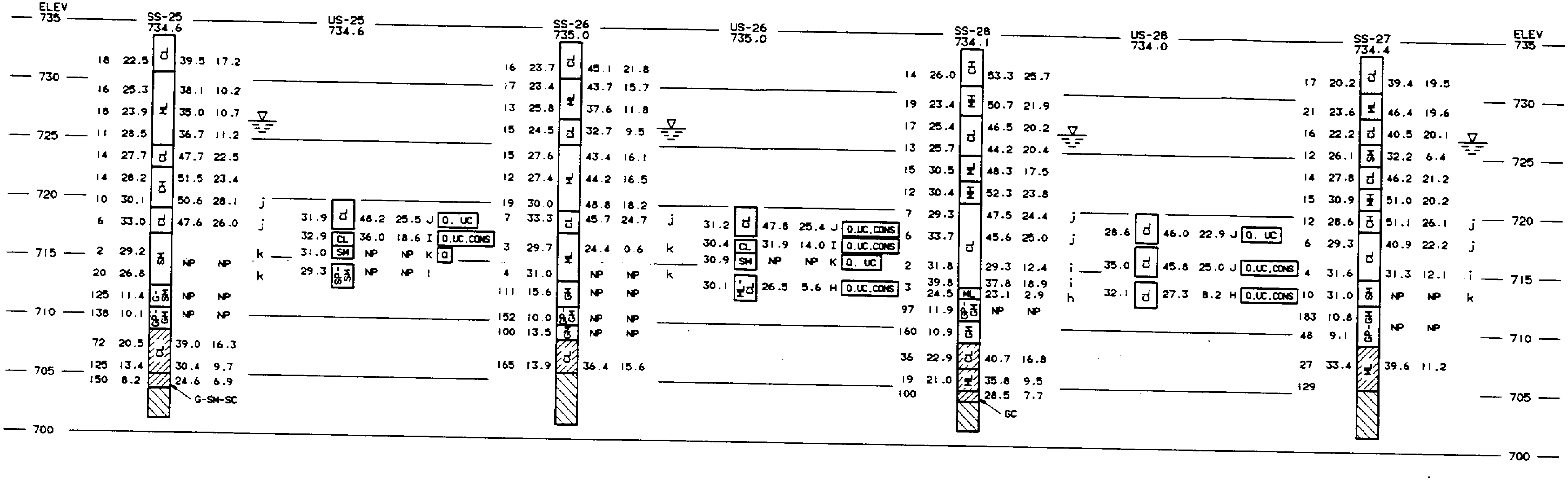
"HISTORICAL INFORMATION"



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

OFFICE & SERVICE BUILDING
FOUNDATION INVESTIGATION

Figure 2.5-189




SYMBOLS

- WEATHERED SHALE
- REFUSAL
- WATERTABLE
- Q = UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
- UC = UNCONFINED COMPRESSION TEST
- CONS = CONSOLIDATION TEST

LEGEND

HOLE NO. ELEV.

* BLOWS | NATURAL MOISTURE CONTENT | CLASSIFICATION | LIQUID LIMIT | PLASTICITY INDEX | SOIL TYPE | ENGINEERING TESTS

* BLOWS PER FOOT WITH A 140 LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

NOTE UNDISTURBED BORINGS DRILLED FROM BUILDING BOTTOM FLOOR, ELEVATION 720, TO TOP OF FIRM GRAVEL

"HISTORICAL INFORMATION"

SCALE 1" = 5'

Amendment 63

WATTS BAR NUCLEAR PLANT
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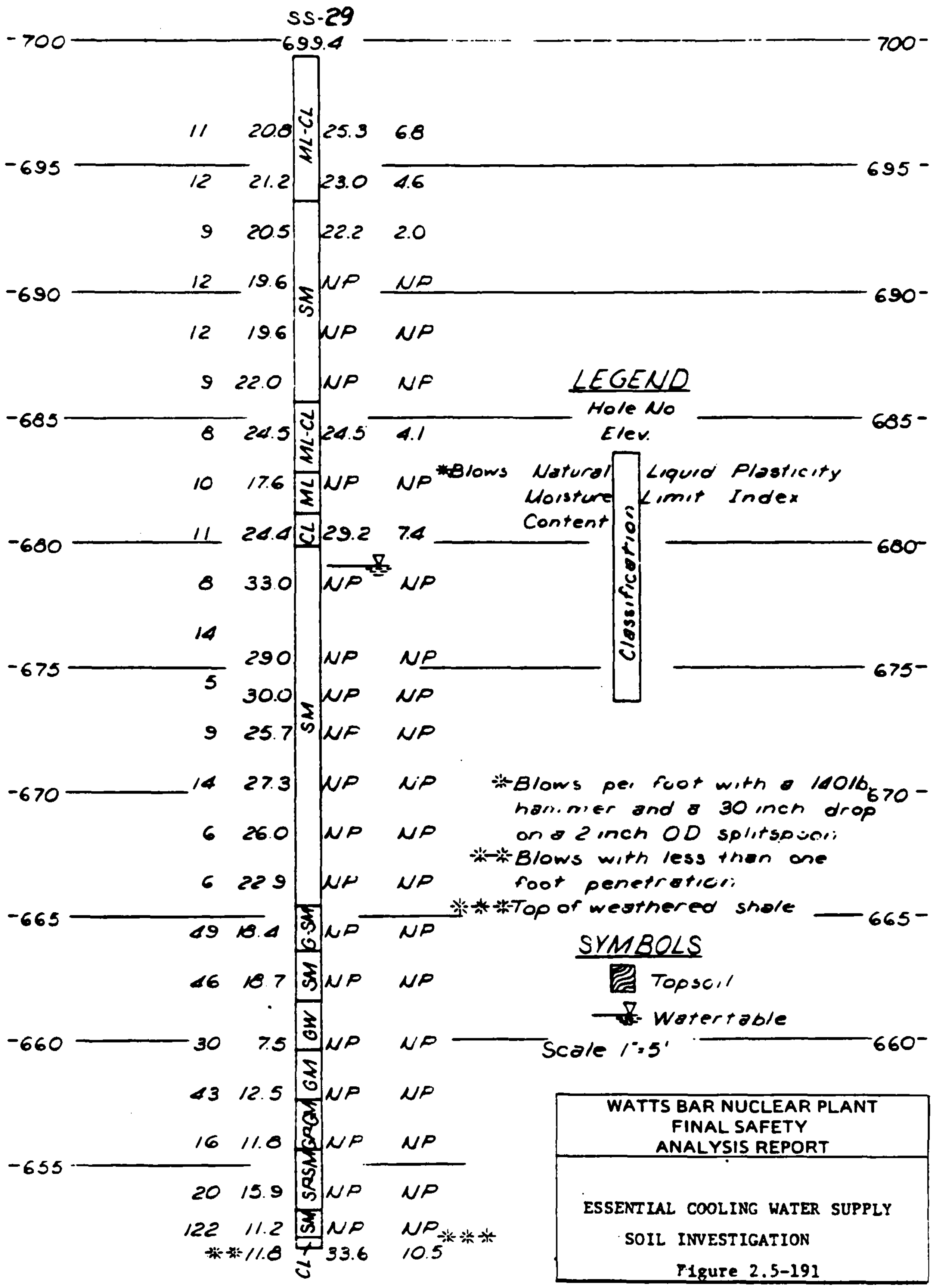
DIESEL GENERATOR BUILDING

SECTION AA & BB
FOUNDATION INVESTIGATION

FIGURE 2.5-190

WBN-MIS484.0.0.0.JAW




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
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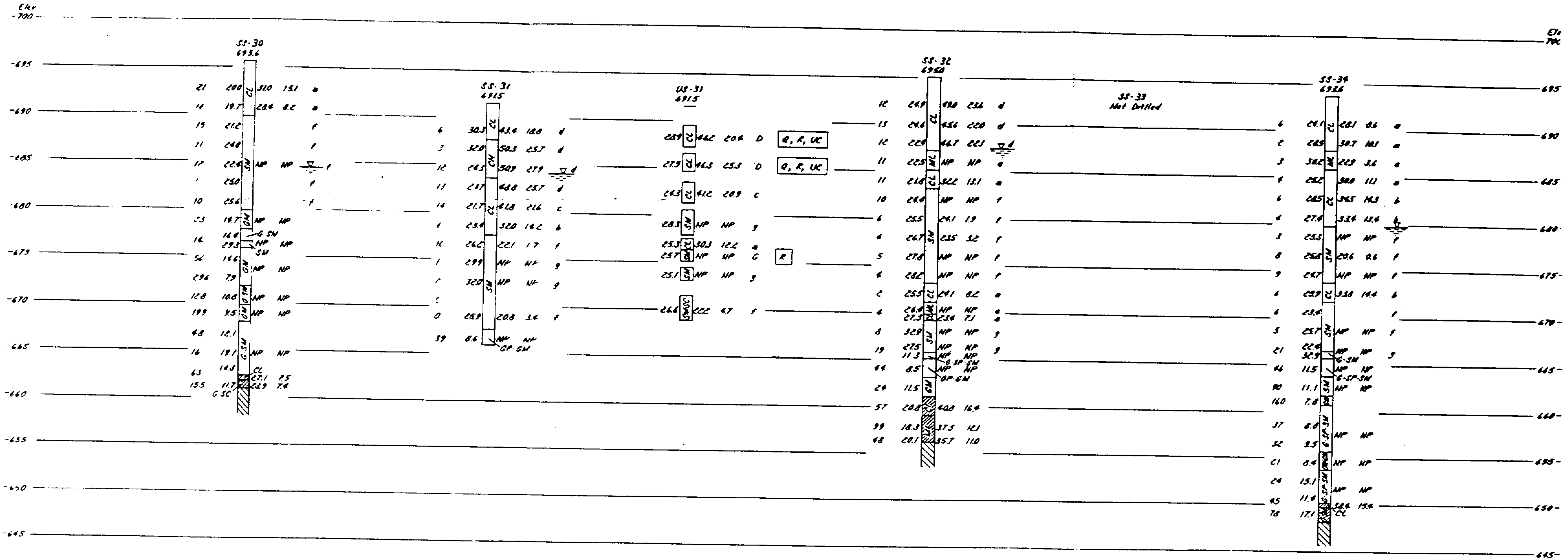
ESSENTIAL COOLING WATER SUPPLY
SOIL INVESTIGATION
Figure 2.5-191

Best Available Historical Image



SYMBOLS

- Weathered shale
- Refusal
- Watertable
- Q Unconsolidated undrained triaxial compression test
- R Consolidated undrained triaxial compression test
- UC Unconfined compression test

LEGEND

Hole No / Elev — *Blows — Natural Moisture Content — Classification — Liquid Limit — Plasticity Index — Soil Type — Engineering Tests

*Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon

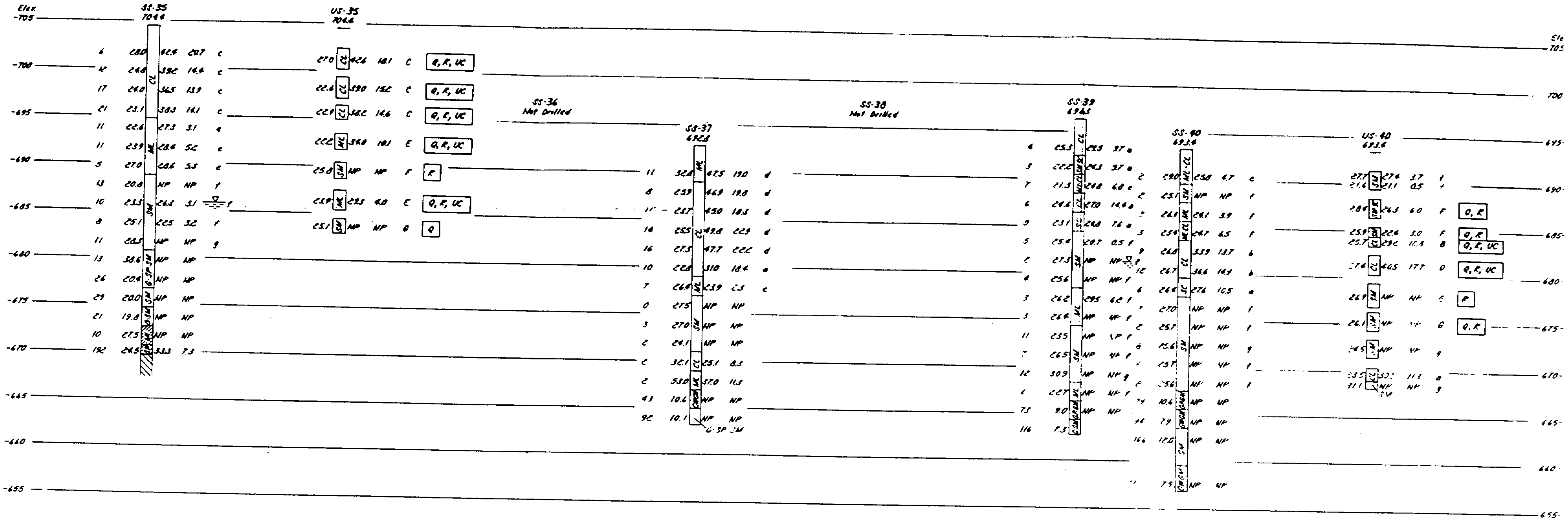
Note: Undisturbed borings drilled to top of firm gravel

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL, SECTION DD
FOUNDATION INVESTIGATION

Figure 2.5-192




SYMBOLS

Weathered shale

Refusal

Watertable

Q - Unconsolidated undrained triaxial compression test

R - Consolidated undrained triaxial compression test

UC - Unconfined compression test

LEGEND

Hole No. Elev.

Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Engineering Tests

Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon

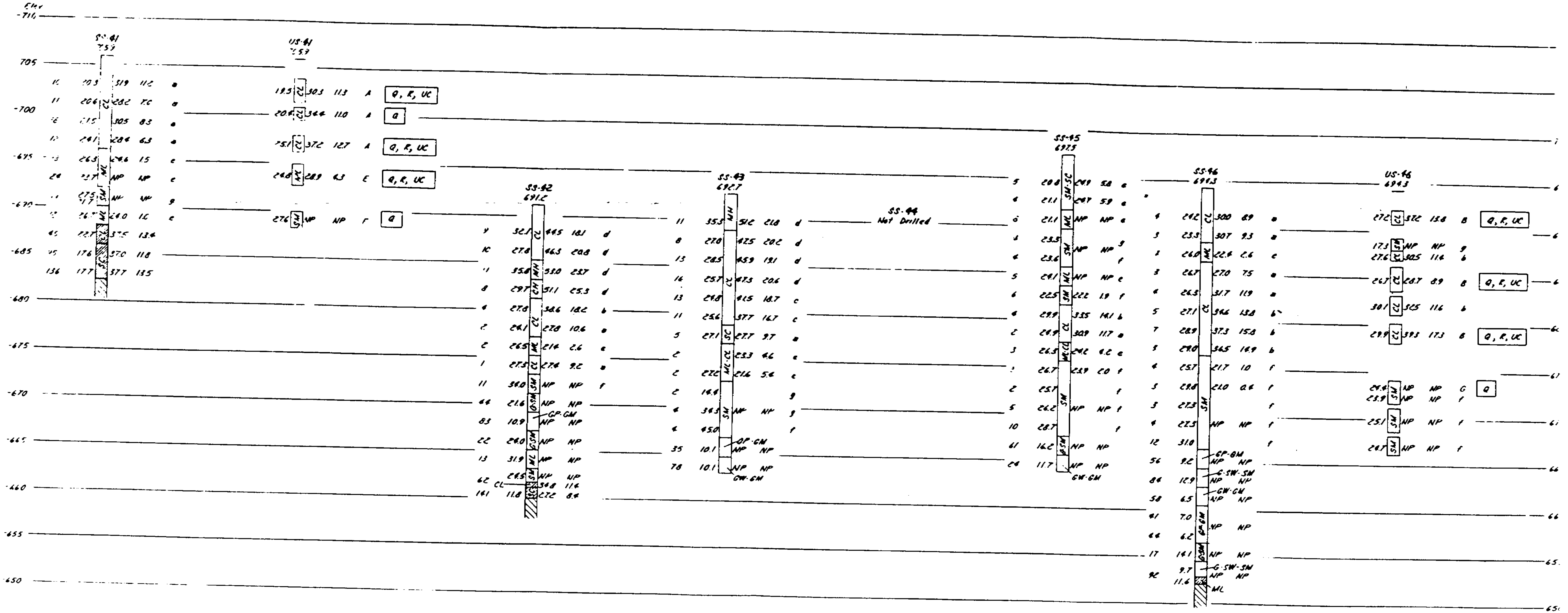
Note: Undisturbed borings drilled to top of firm gravel

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL, SECTION EE
FOUNDATION INVESTIGATION

Figure 2.5-193




SYMBOLS

Q - Unconsolidated undrained triaxial compression test

R - Consolidated undrained triaxial compression test

UC - Unconfined compression test

Weathered shale

Refusal

LEGEND

Hole No.
Elev

| Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Engineering Tests |
|---|---|---|---|---|---|---|

Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon

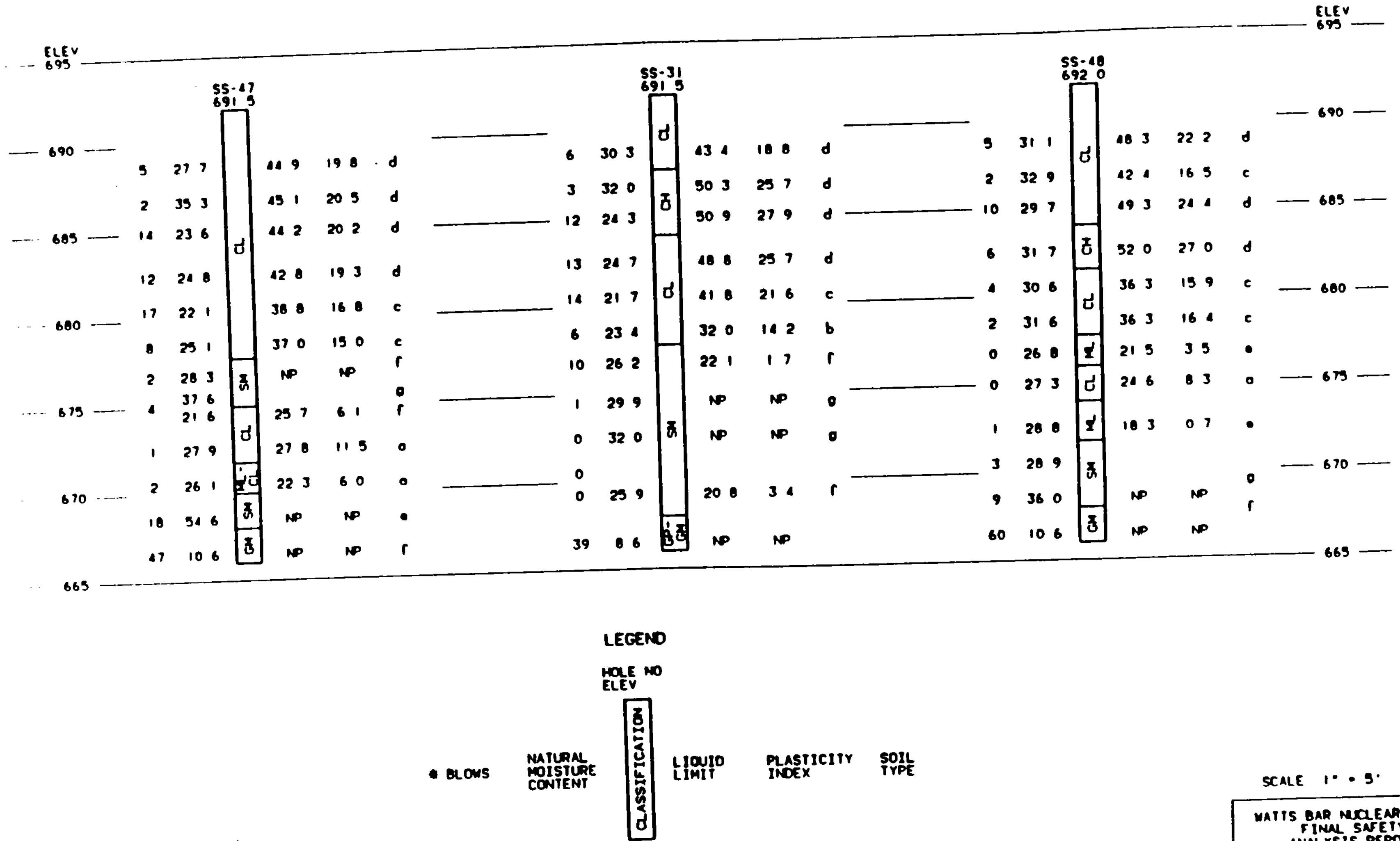
Note: Undisturbed borings drilled to top of firm gravel

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL, SECTION CC
FOUNDATION INVESTIGATION

Figure 2.5-194




* BLOWS PER FOOT WITH A 140 LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

SCALE 1" = 5'

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

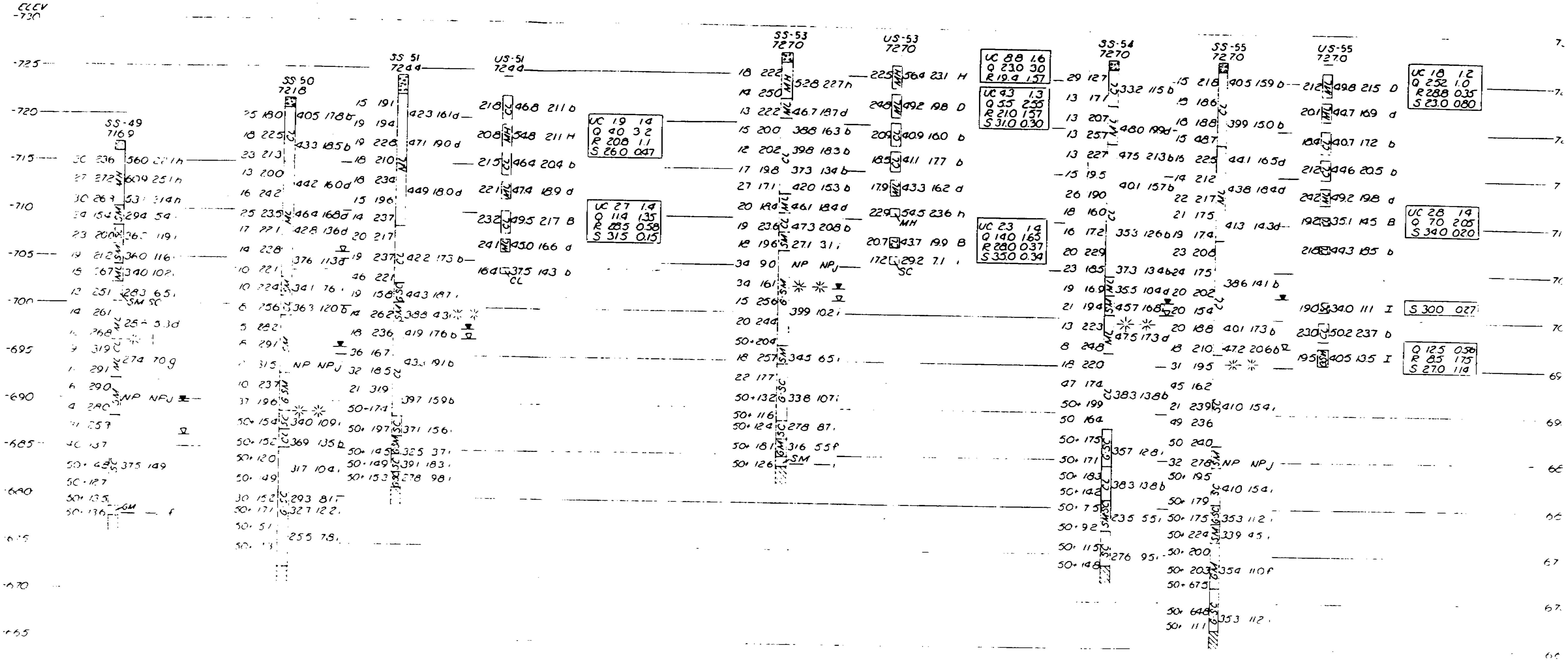
INTAKE CHANNEL

SECTION FF
FOUNDATION INVESTIGATION

FIGURE 2 5-195

Best Available Historical Image

WBN M15483 0 0 0 JAW




SYMBOLS

- Silty clay
- Limestone gravel
- Refusal

Q - Unconsolidated undrained triaxial compression test

R - Consolidated undrained triaxial compression test

S - Consolidated drained direct shear test

UC - Unconfined compression test

1 hour water table reading

24 hour water table reading

LEGEND

Boring No / Elevation

* Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Type Test | Friction Angle (degrees) or Unconfined Compressive Strength (tsf) | Cohesion (tsf) or Sensitivity Ratio

* Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon sampler

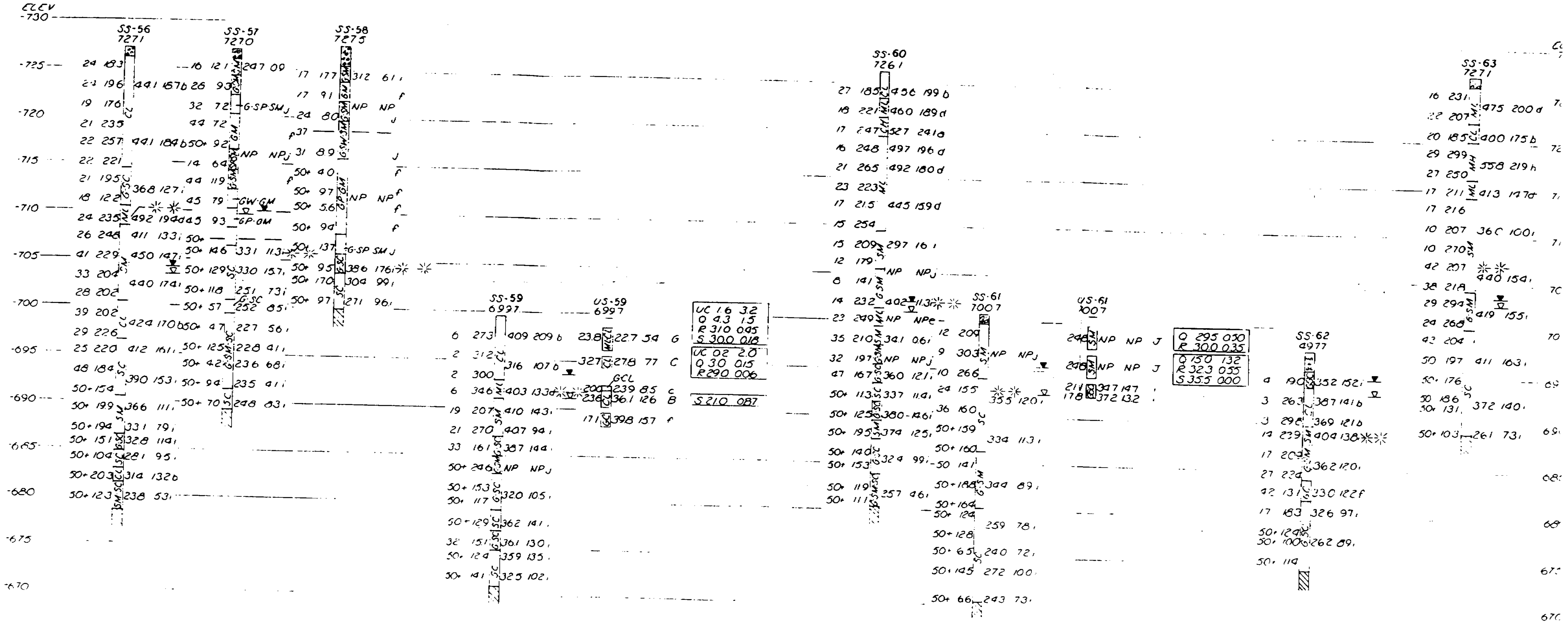
* Top of weathered shale

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUITS
SOIL INVESTIGATION

Figure 2.5-196




SYMBOLS

- Limestone gravel
- Refusal

Q - Unconsolidated undrained triaxial compression test

R - Consolidated undrained triaxial compression test

S - Consolidated drained direct shear test

UC - Unconfined compression test

- 1 hour water table reading
- 24 hour water table reading

LEGEND

Boring No.
Elevation

Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Type Test | Friction Angle (degrees) or Unconfined Compressive Strength | Cohesion (tsf) or Sensitivity Ratio

*Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon sample

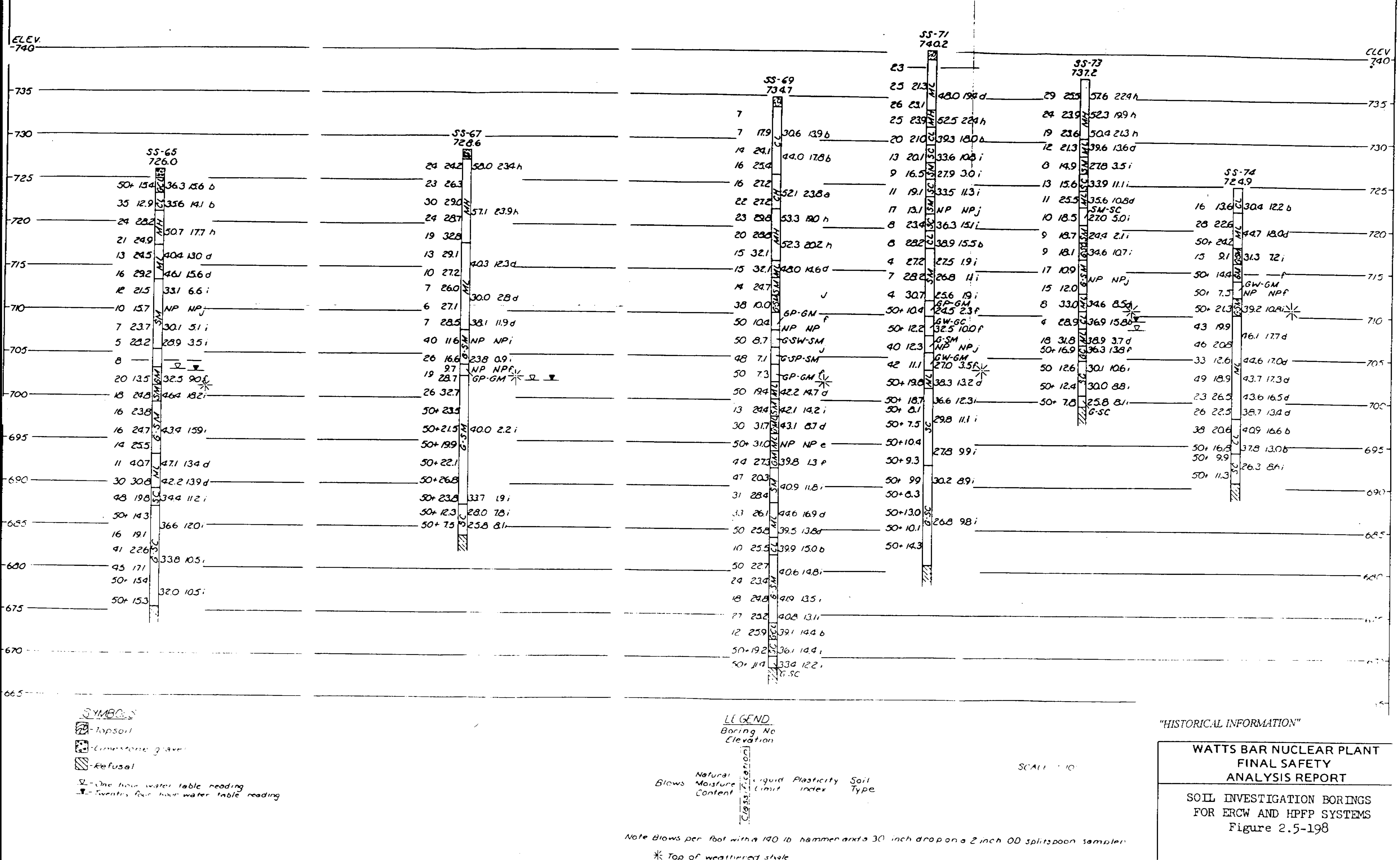
Top of weathered shale

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUITS
SOIL INVESTIGATION

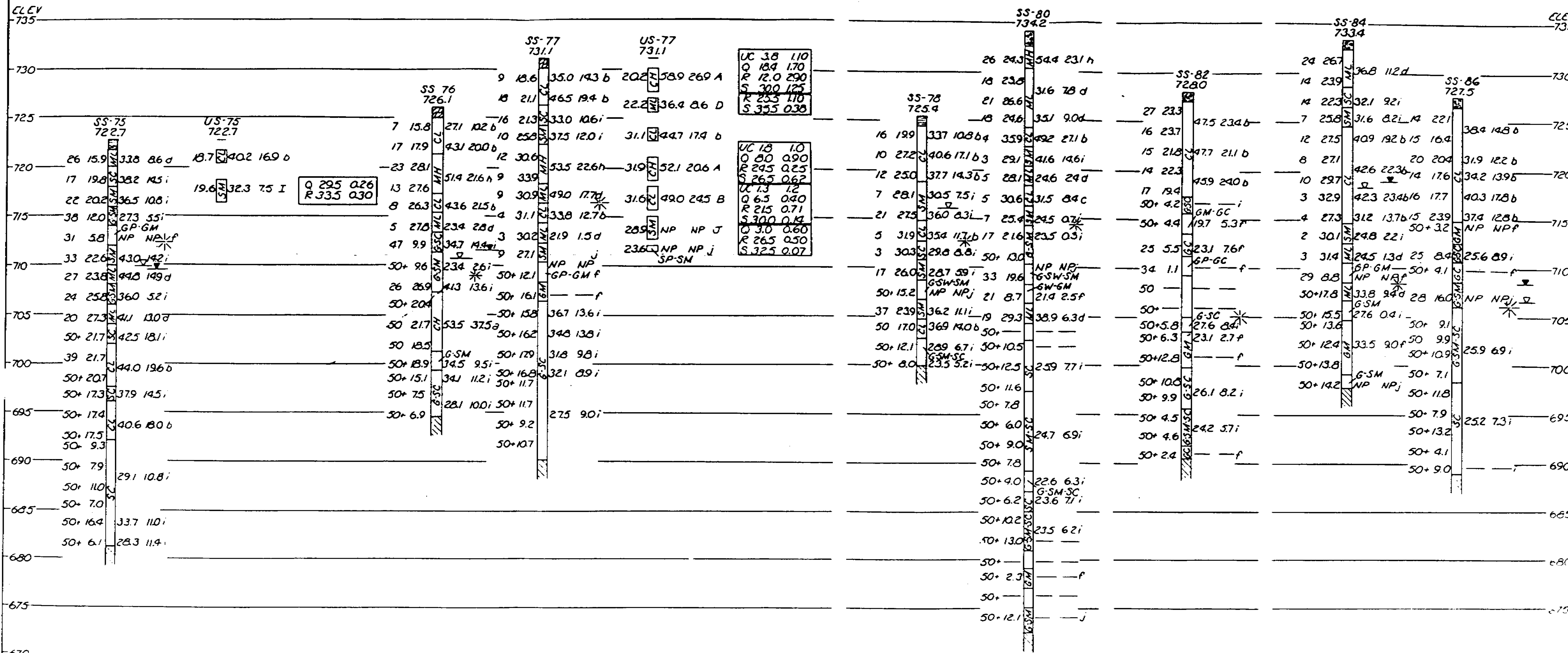
Figure 2.5-197




"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL INVESTIGATION BORINGS
FOR ERCW AND HPFP SYSTEMS
Figure 2.5-198




"HISTORICAL INFORMATION"

SCALE: 1"=10'

SYMBOLS

- Topsoil
- Limestone, gravel
- Clayey silt
- Refusal

Q - Unconsolidated undrained triaxial compression test
R - Consolidated undrained triaxial compression test at natural moisture
S - Consolidated drained direct shear test
UC - Unconfined compression test
▽ - One hour water table reading
▼ - Twentey-four hour water table reading

LEGEND

Boring No
Elevation

Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Type Test | Friction Angle (degrees) or Unconfined Compressive Strength (tsf) | Cohesion (tsf) or Sensitivity Ratio

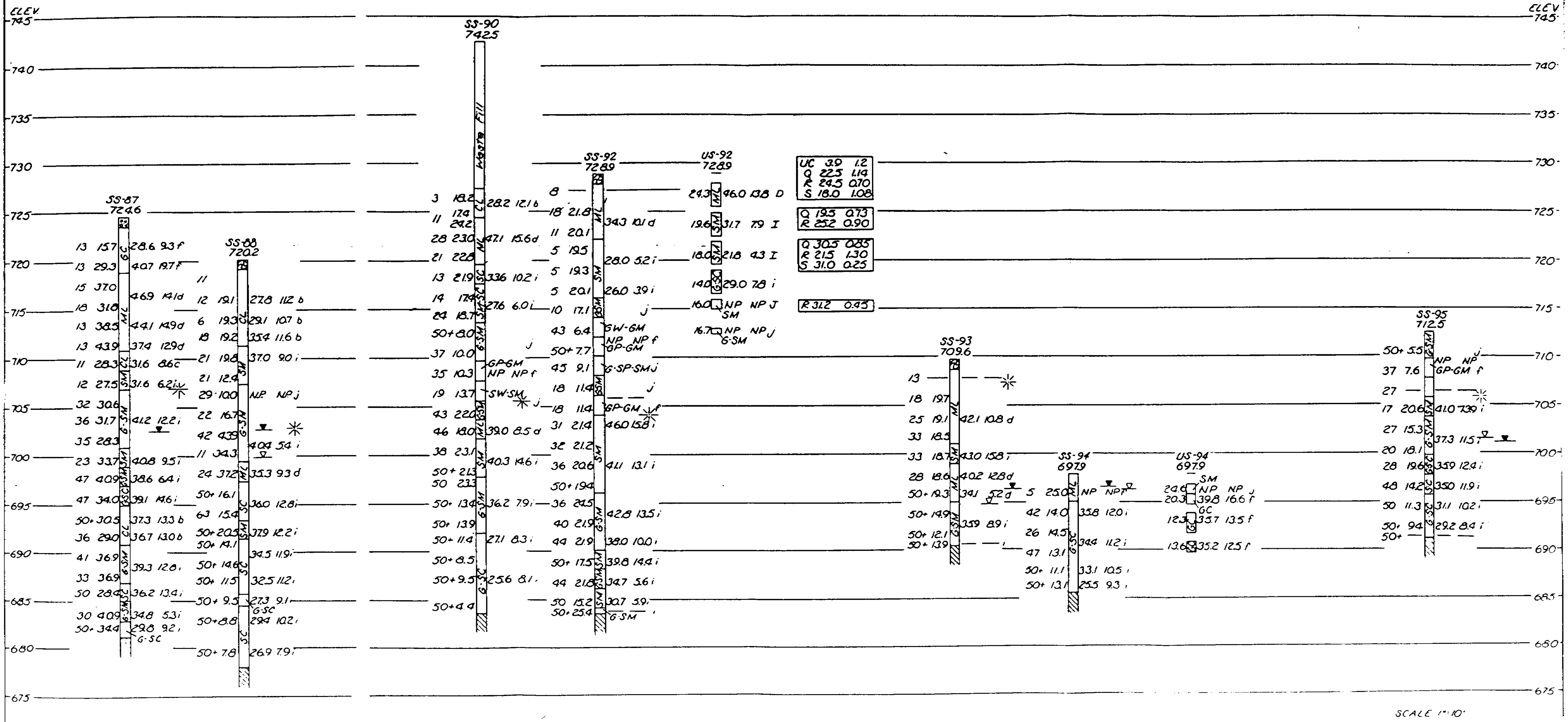
Note: Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon sampler

✳ Top of weathered shale

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL INVESTIGATION BORINGS
FOR ERCW AND HPFP SYSTEMS
Figure 2.5-199

## Figure 2.5-200 - Best Available Historical Image




SYMBOLS

- Topsoil
- Limestone, gravel
- Refusal

Q - Unconsolidated undrained triaxial compression test
R - Consolidated undrained triaxial compression test at natural moisture
S - Consolidated drained direct shear test
UC - Unconfined compression test
▽ - One hour water table reading
▼ - Twentey four hour water table reading

LEGEND

Boring No. Elevation

Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type

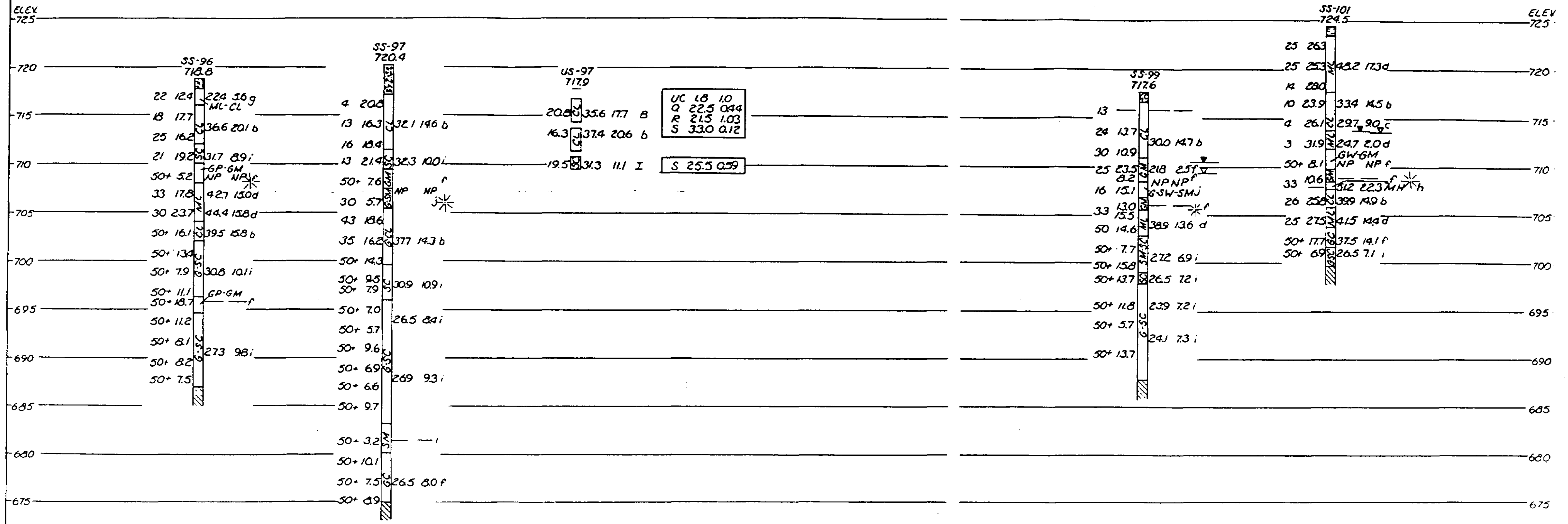
Type Test | Friction Angle (degrees) or Unconfined Compressive Strength (tsf) | Cohesion (tsf) or Sensitivity Ratio

Note: Blows per foot with a 140 lb. hammer and a 30 inch drop on a 2 inch OD splitspoon sampler

✳ Top of weathered shale

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL INVESTIGATION BORINGS
FOR ERCW AND HPFP SYSTEMS
Figure 2.5-200




"HISTORICAL INFORMATION"

SYMBOLS

- Topsoil
- Limestone gravel
- Clayey silt
- Refusal

Q - Unconsolidated undrained triaxial compression test
R - Consolidated undrained triaxial compression test at natural moisture
S - Consolidated drained direct shear test
UC - Unconfined compression test
- One hour water table reading
- Twentey four hour water table reading

LEGEND

Boring No.
Elevation

Blows | Natural Moisture Content | Classification | Liquid Limit | Plasticity Index | Soil Type | Type Test | Friction Angle (degrees) or Unconfined Compressive Strength (tsf) | Cohesion (tsf) | Sensitivity Ratio

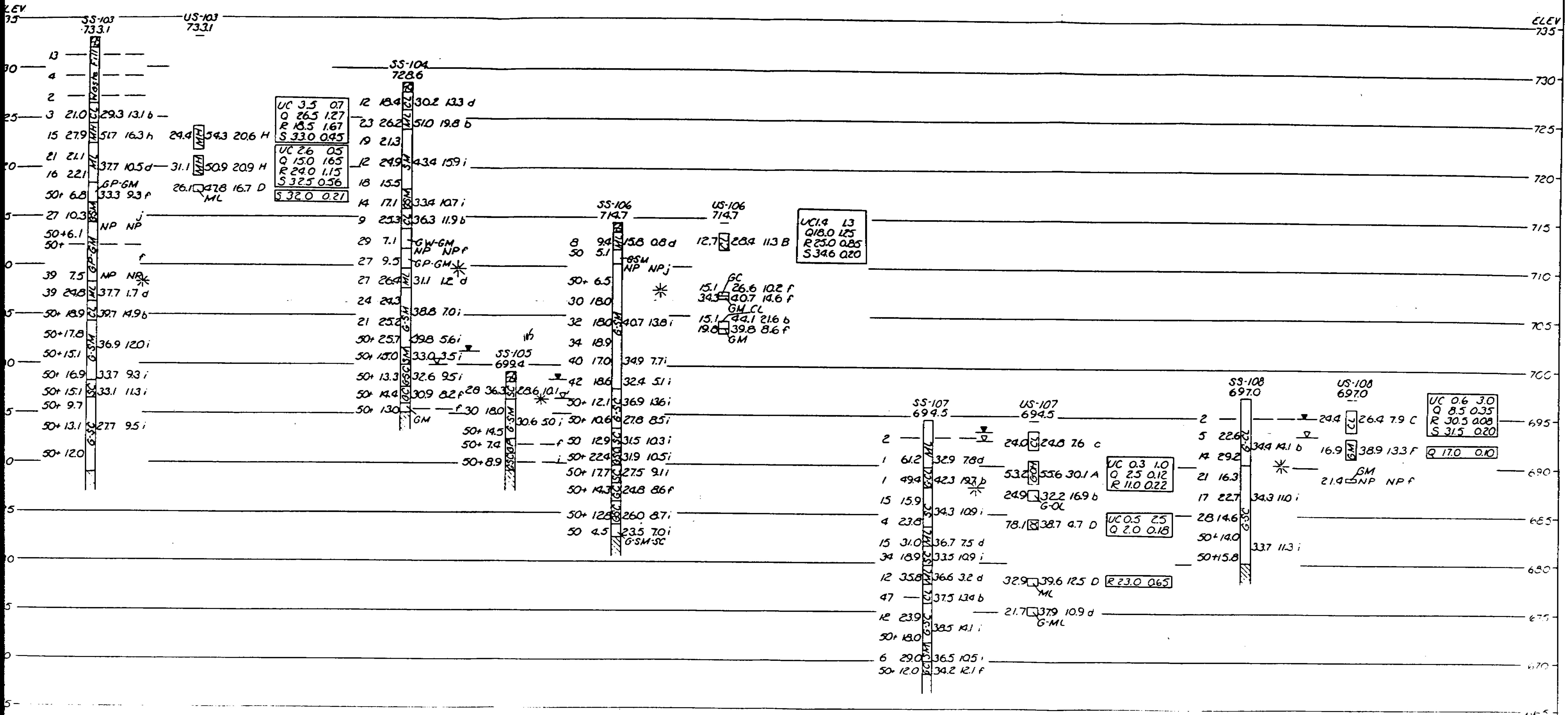
Note: Blows per foot with a 140 lb. hammer and a 30 inch drop on a 2 inch OD splitspoon sampler

Top of weathered shale

SCALE: 1" = 10'

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL INVESTIGATION BORINGS
FOR ERCW AND HPFP SYSTEMS
Figure 2.5-201




SYMBOLS

Topsoil

Refusal

Q-Unconsolidated undrained triaxial compression test
R-Consolidated undrained triaxial compression test at natural moisture
S-Consolidated drained direct shear test
UC-Unconfined compression test
One hour water table reading
Twentey four hour water table reading

LEGEND

Boring No. / Elevation — Blows — Natural Moisture Content — Classification — Liquid Limit — Plasticity Index — Soil Type — Type Test — Friction Angle (degrees) or Unconfined Compressive Strength (tsf) — Cohesion (tsf) — Sensitivity Ratio

Note Blows per foot with a 140 lb hammer and a 30 inch drop on a 2 inch OD splitspoon sampler

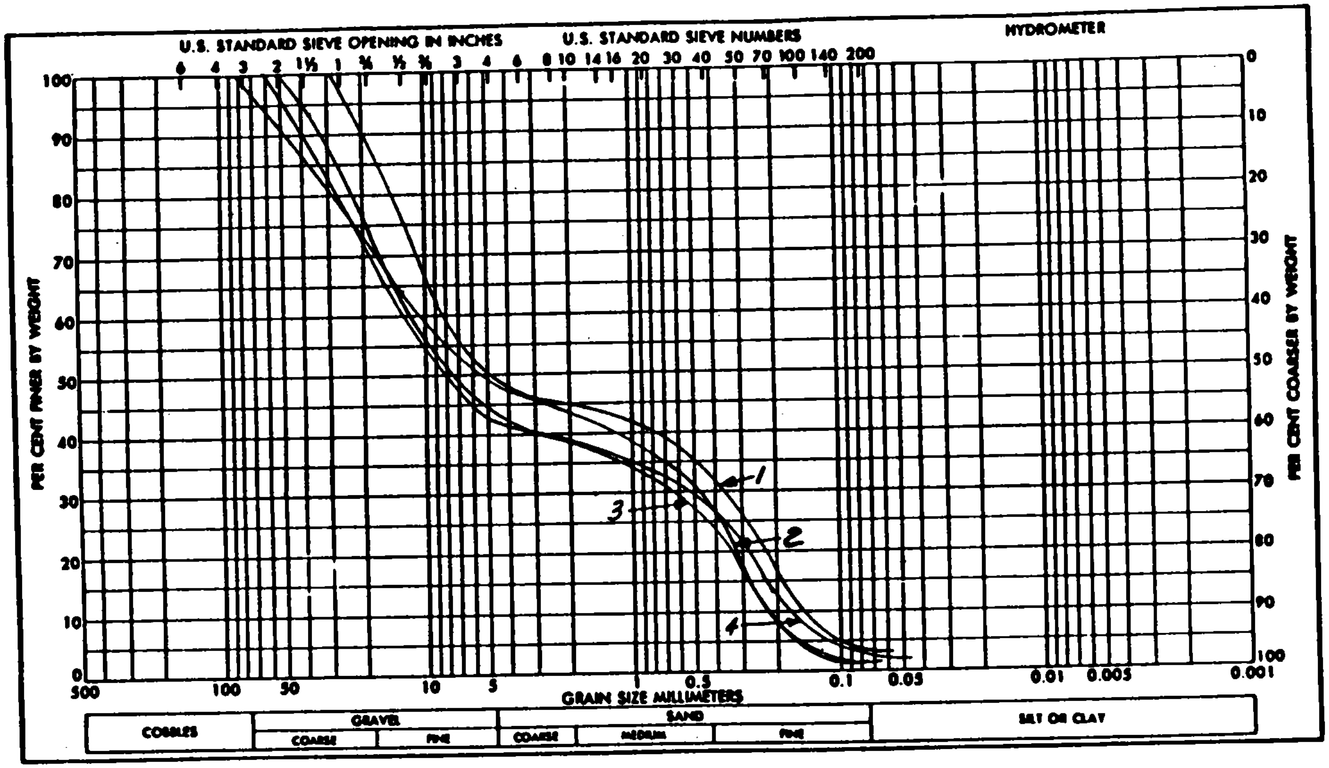
✳ Top of weathered shale

"HISTORICAL INFORMATION"

SCALE 1"=10'

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL INVESTIGATION BORINGS
FOR ERCW AND HPFP SYSTEMS
Figure 2.5-202




| | | | |
|---|---|---|---|
| Soil Symbol | GP | Liquid Limit, % | |
| Moisture Content, % | | Plastic Limit, % | |
| Specific Gravity | | Plasticity Index, % | |
| | | Shrinkage Limit, % | |

| Remarks: |
|---|
| |
| |
| |
| |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

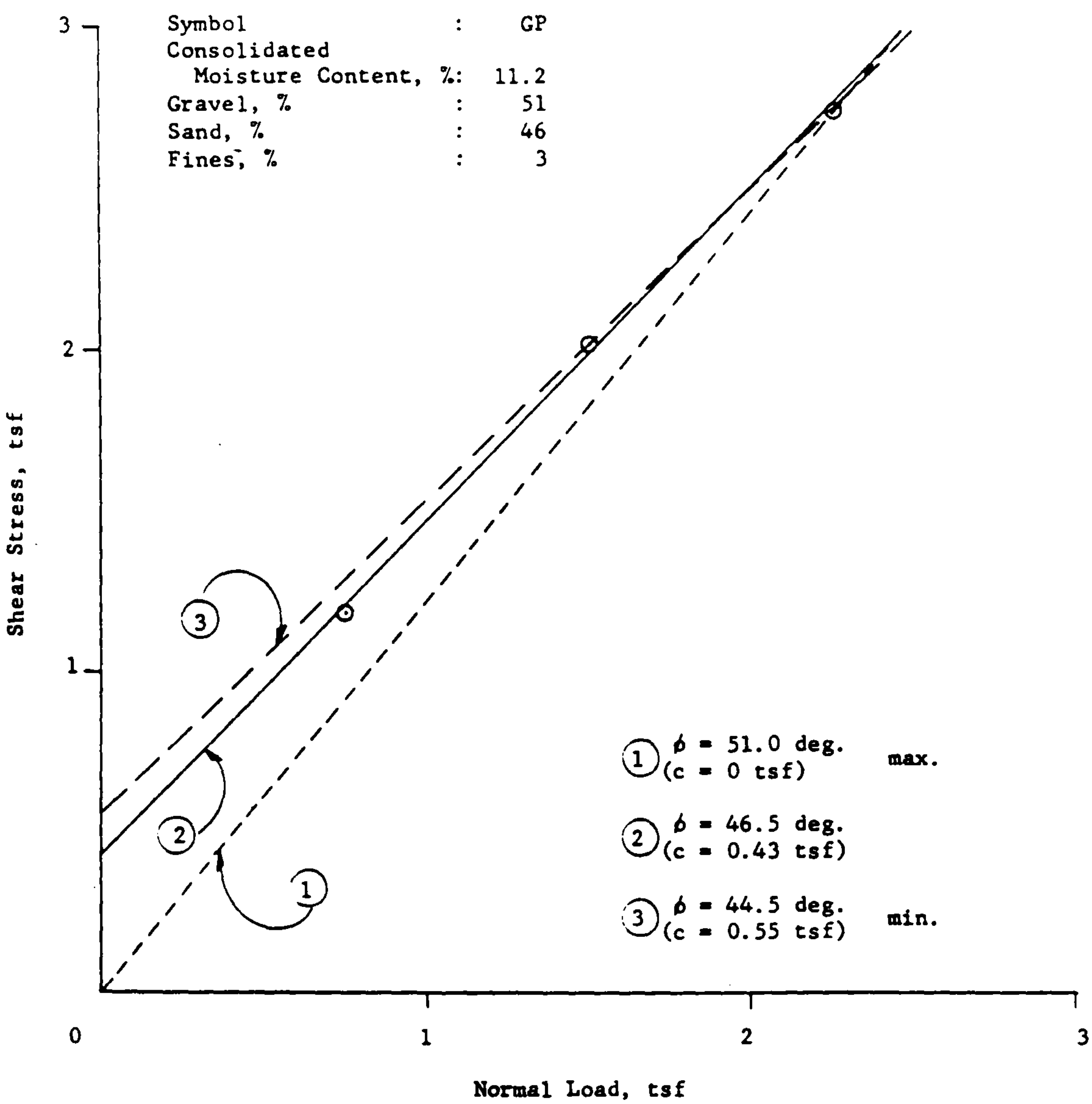
INTAKE CHANNEL TRENCH

Figure 2.5-203

Best Available Historical Image

WATTS BAR NUCLEAR PLANT - INTAKE CHANNEL

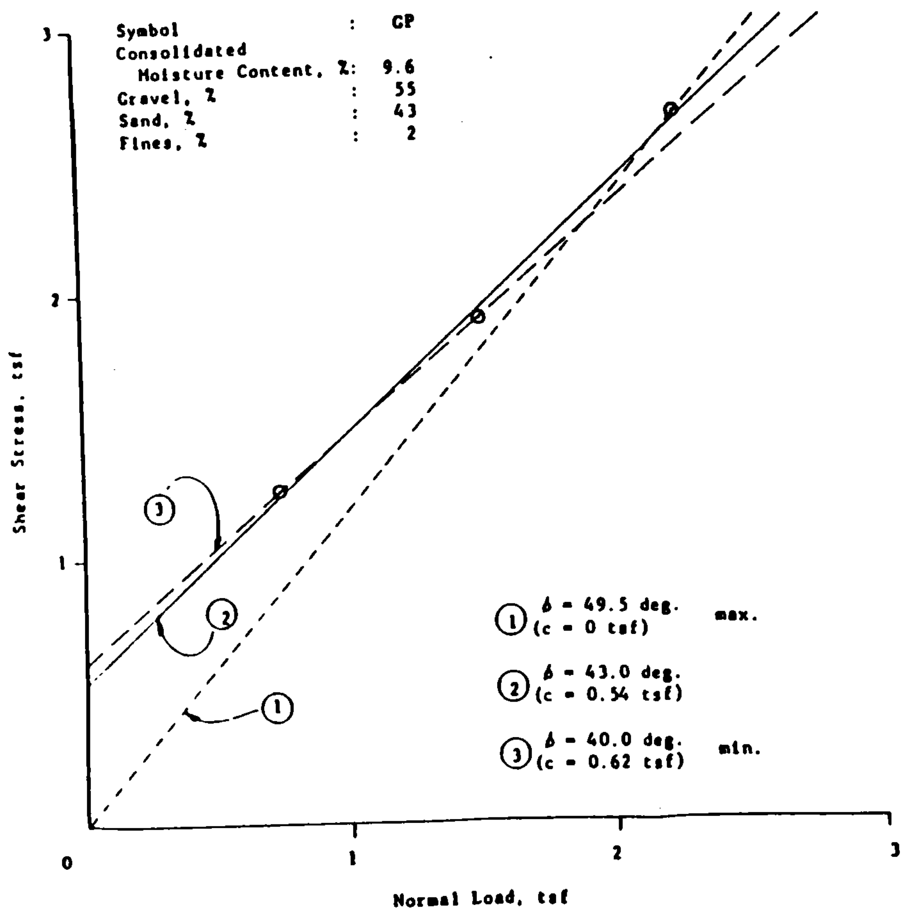
TEST 1




| Normal Load tsf | Consolidated* Deformation in. | Shear Stress tsf | Consolidated* Dry Density pcf |
|---|---|---|---|
| 0.75 | 0.1833 | 1.17 | 118.9 |
| 1.50 | 0.1543 | 2.02 | 120.5 |
| 2.25 | 0.2013 | 2.76 | 120.3 |

*Under an overburden pressure of 3000 psf.

Figure 2.5-204




| Normal Load (tsf) | Consolidated* Deformation (in) | Shear Stress (tsf) | Consolidated* Dry Density (psf) |
|---|---|---|---|
| 0.75 | 0.0987 | 1.25 | 126.3 |
| 1.50 | 0.0987 | 1.89 | 126.3 |
| 2.25 | 0.0842 | 2.65 | 125.5 |

*Under an overburden pressure of 3000 psf.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL

STRENGTH EVALUATION
TEST 2

Figure 2.5-205

Best Available Historical Image

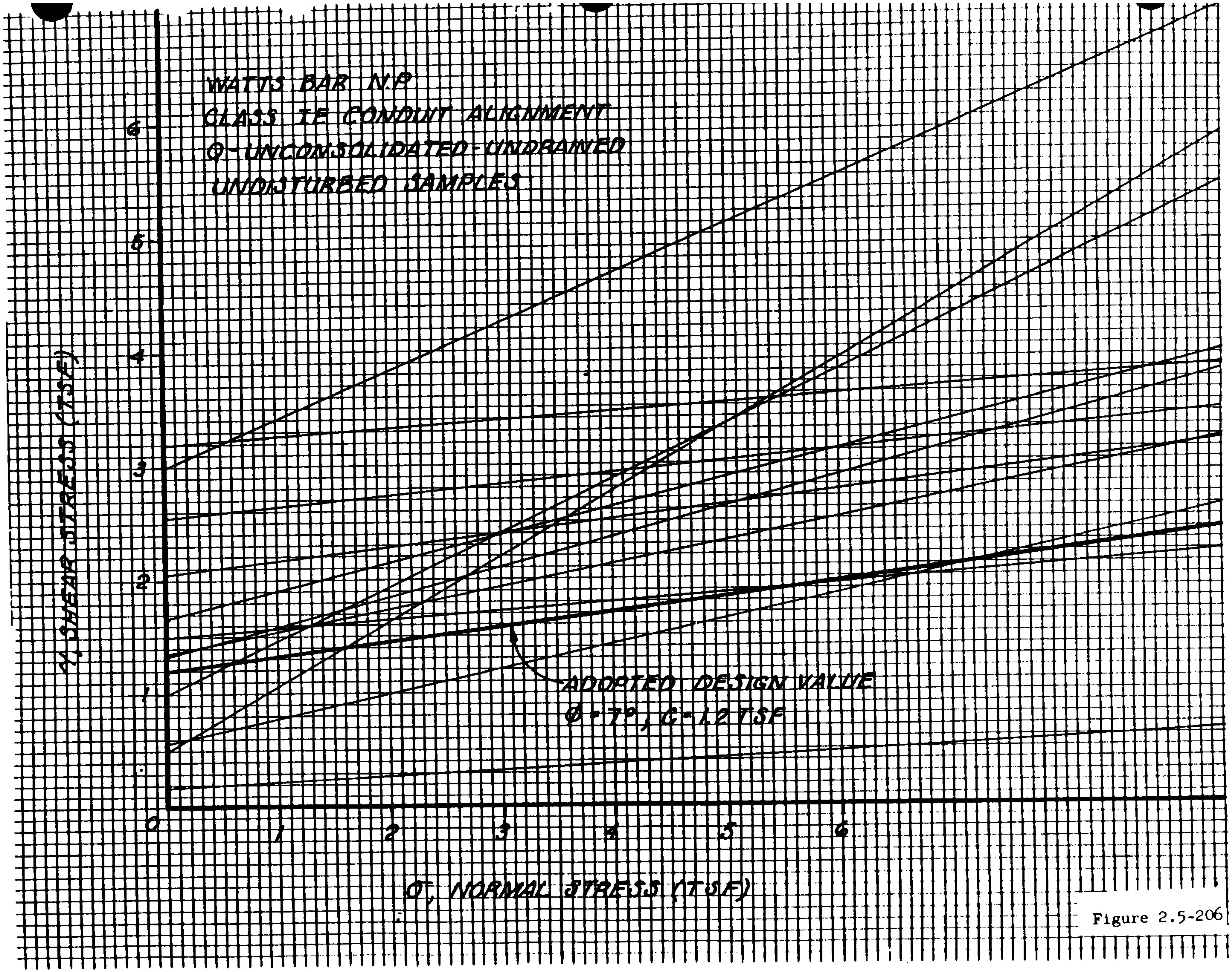
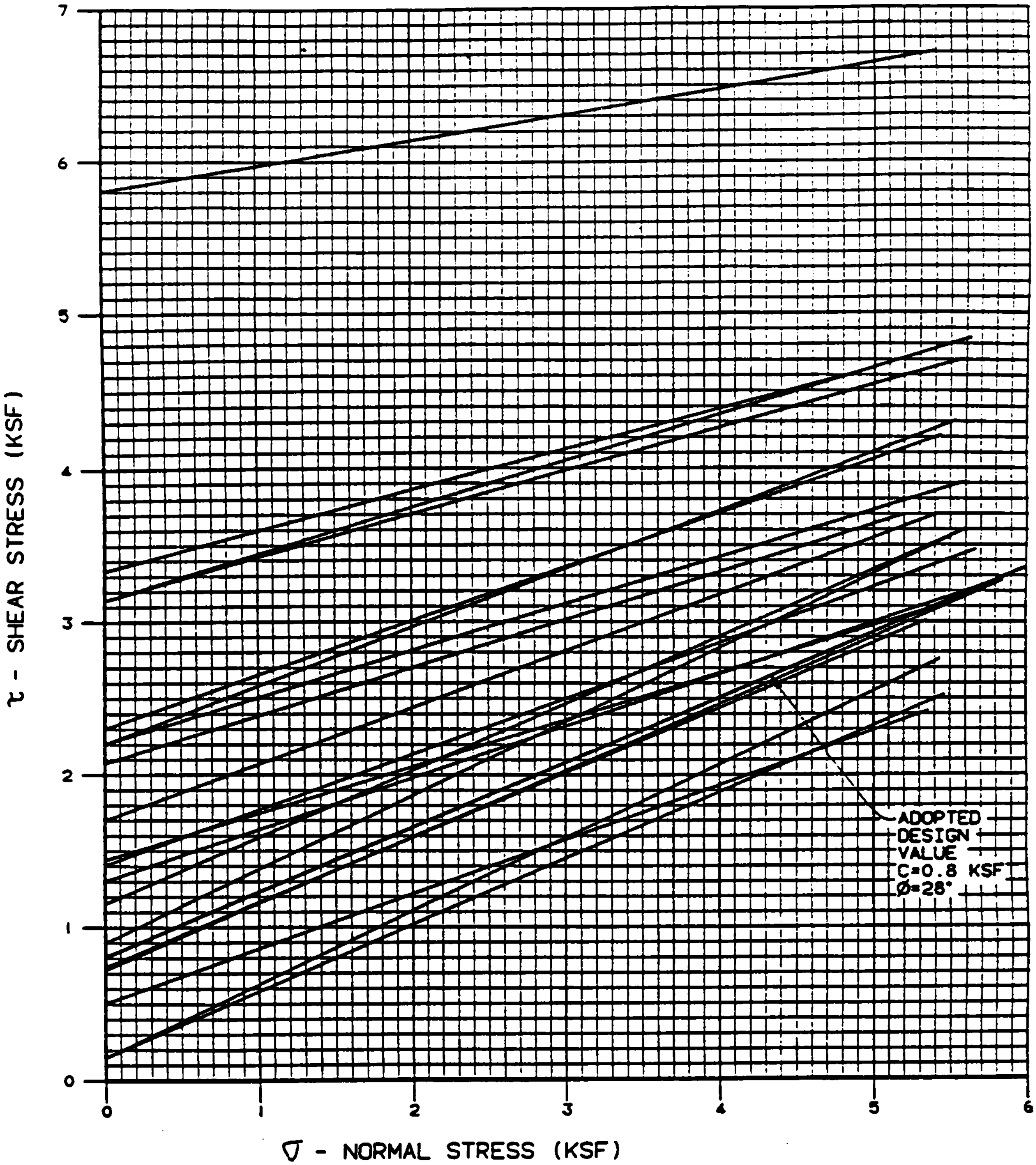



Figure 2.5-206

Best Available Historical Image




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPING AND
IE CONDUIT ALIGNMENTS
R (CONSOLIDATED-UNDRAINED)
SILT AND CLAY SAMPLES
NATURAL MOISTURE CONTENT

Figure 2.5-207

Best Available Historical Image

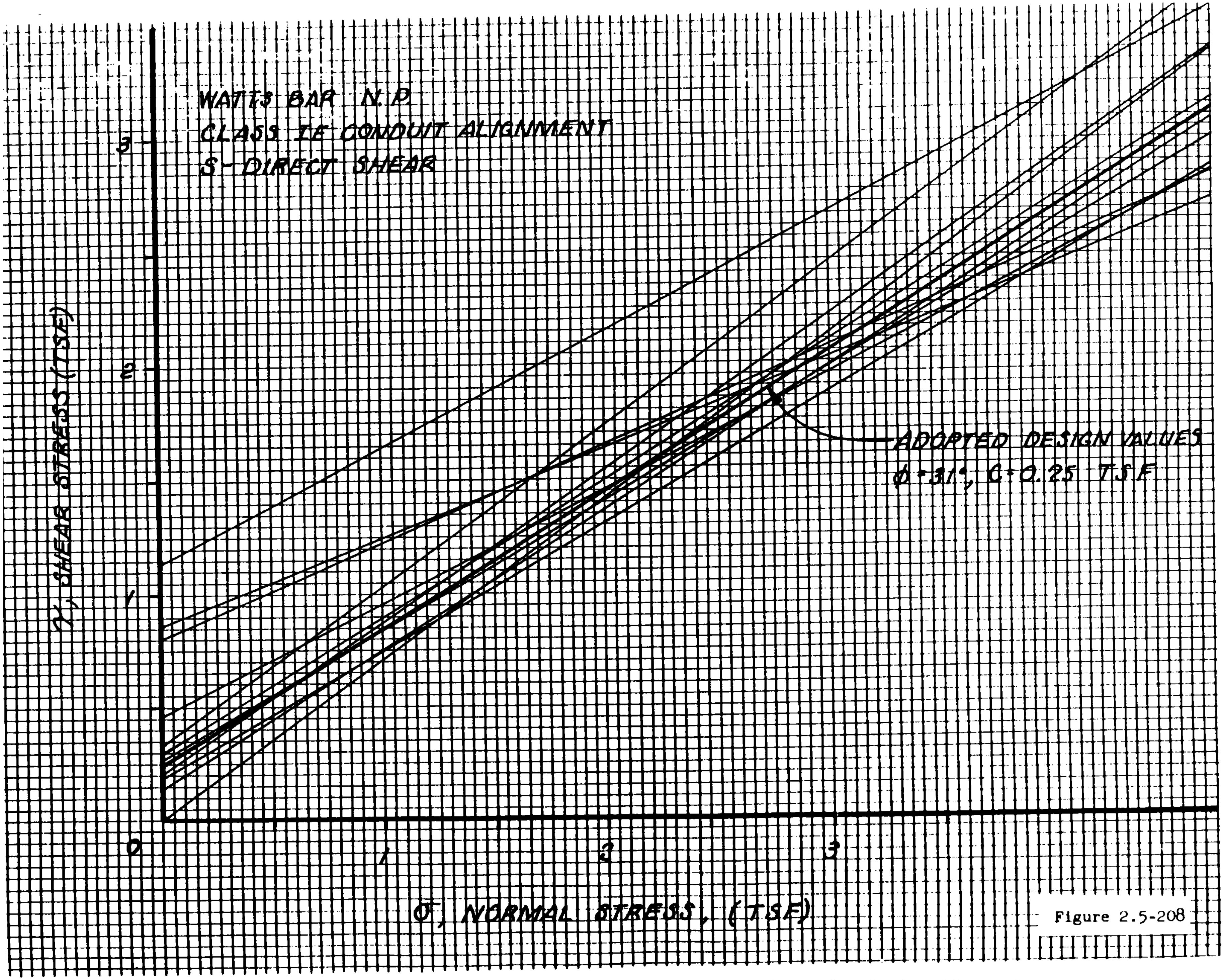
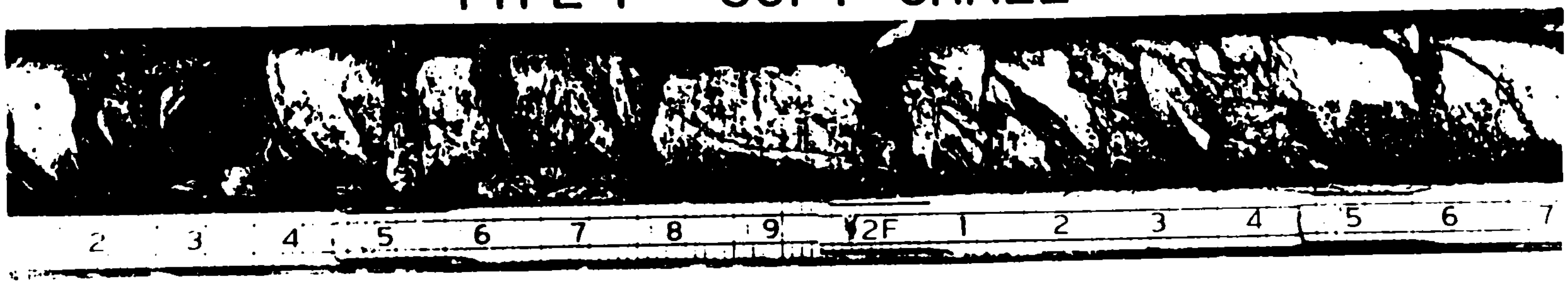


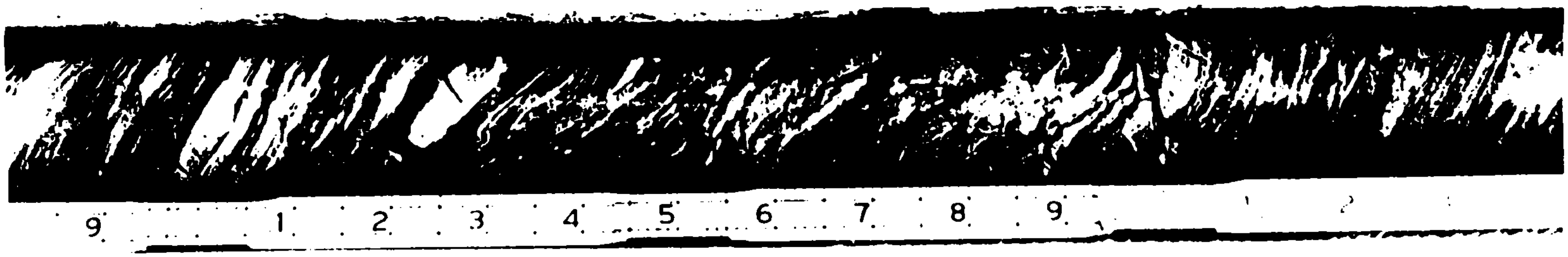

Figure 2.5-208

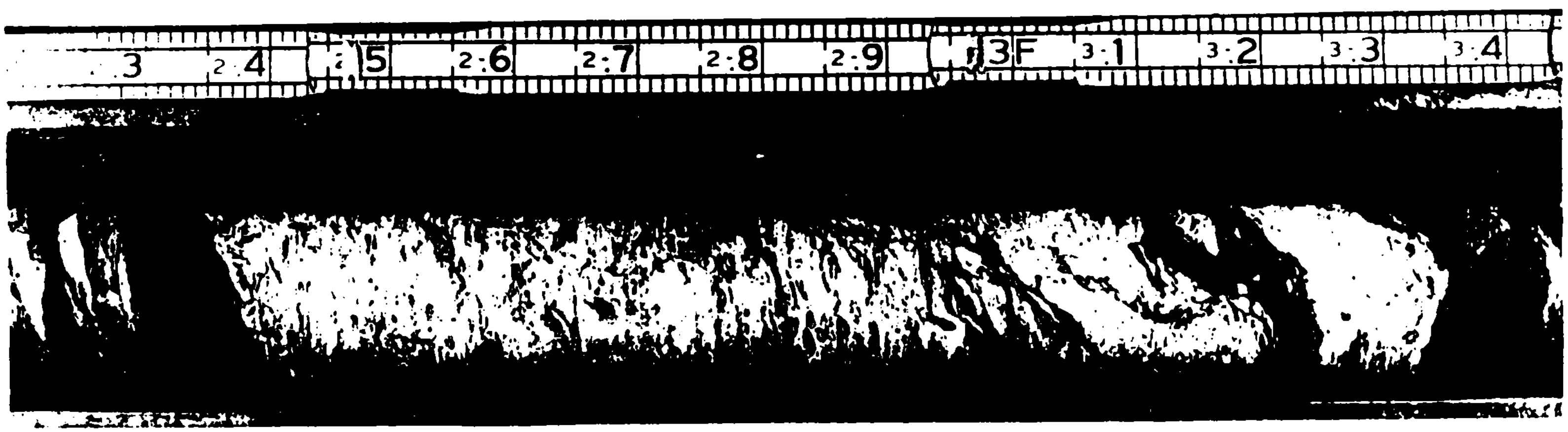
Best Available Historical Image

TYPE 1 – SOFT SHALE



TYPE 2 – HARD SHALE

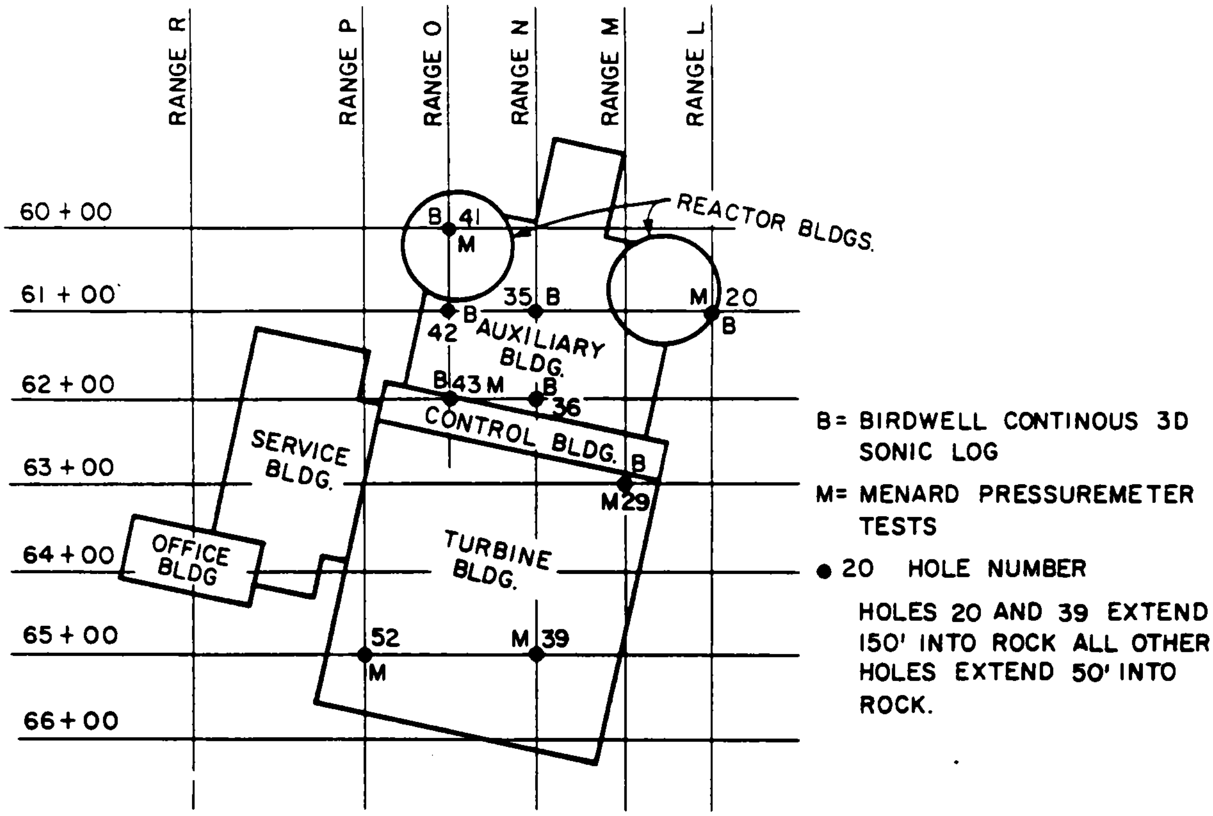




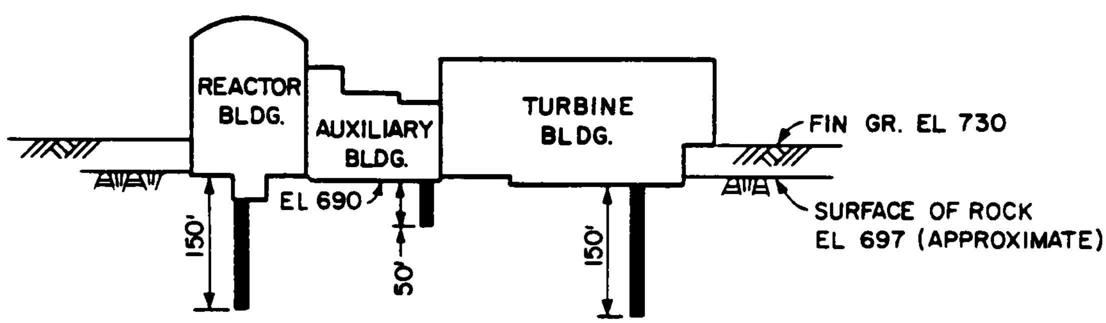
TYPE 3 – LIMESTONE

Figure 2.5-209

Best Available Historical Image




PLAN
Scale 1" = 200'



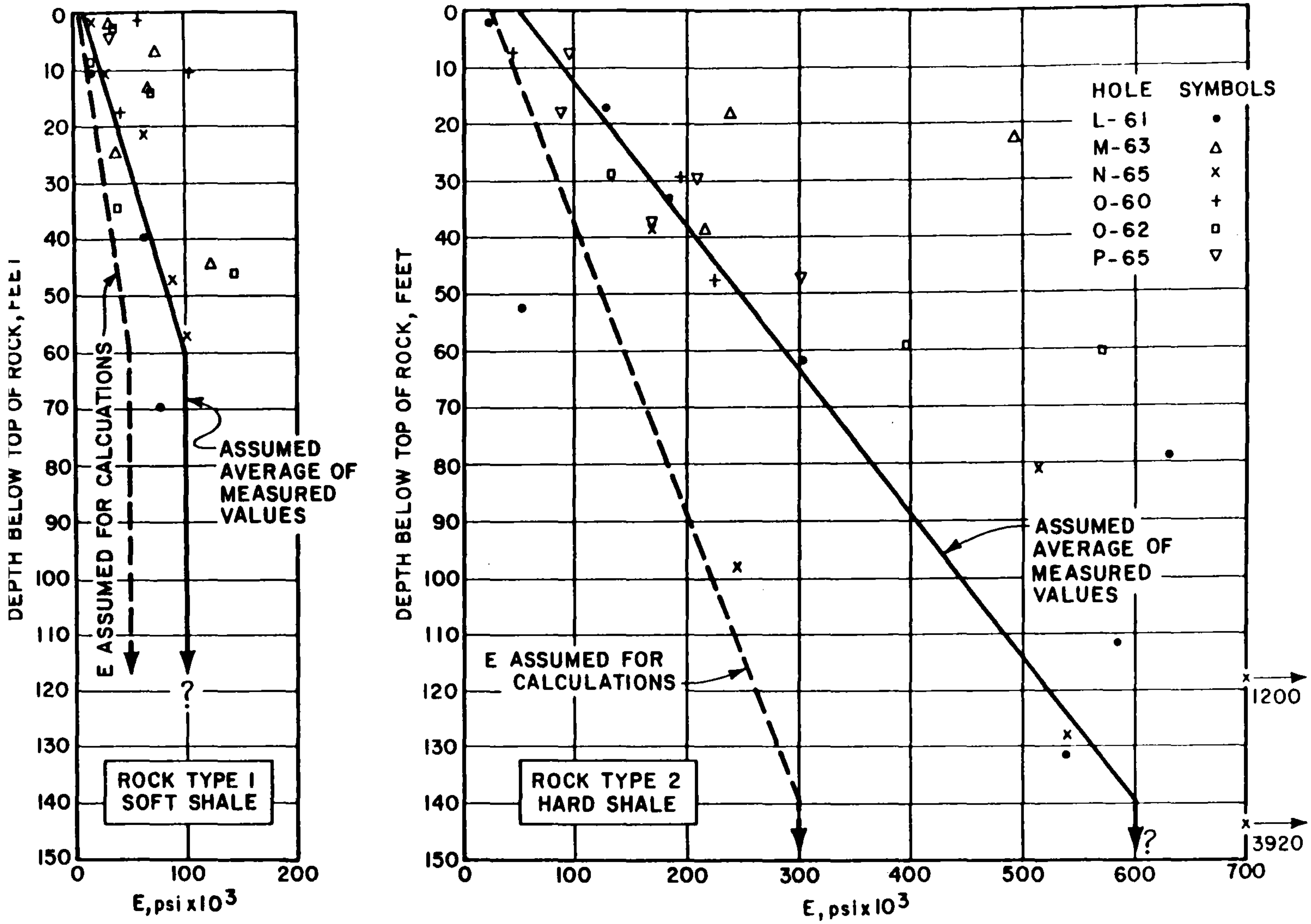

PROFILE
Scale 1" = 200'

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LOCATION OF TEST HOLES

Figure 2.5-210

Best Available Historical Image

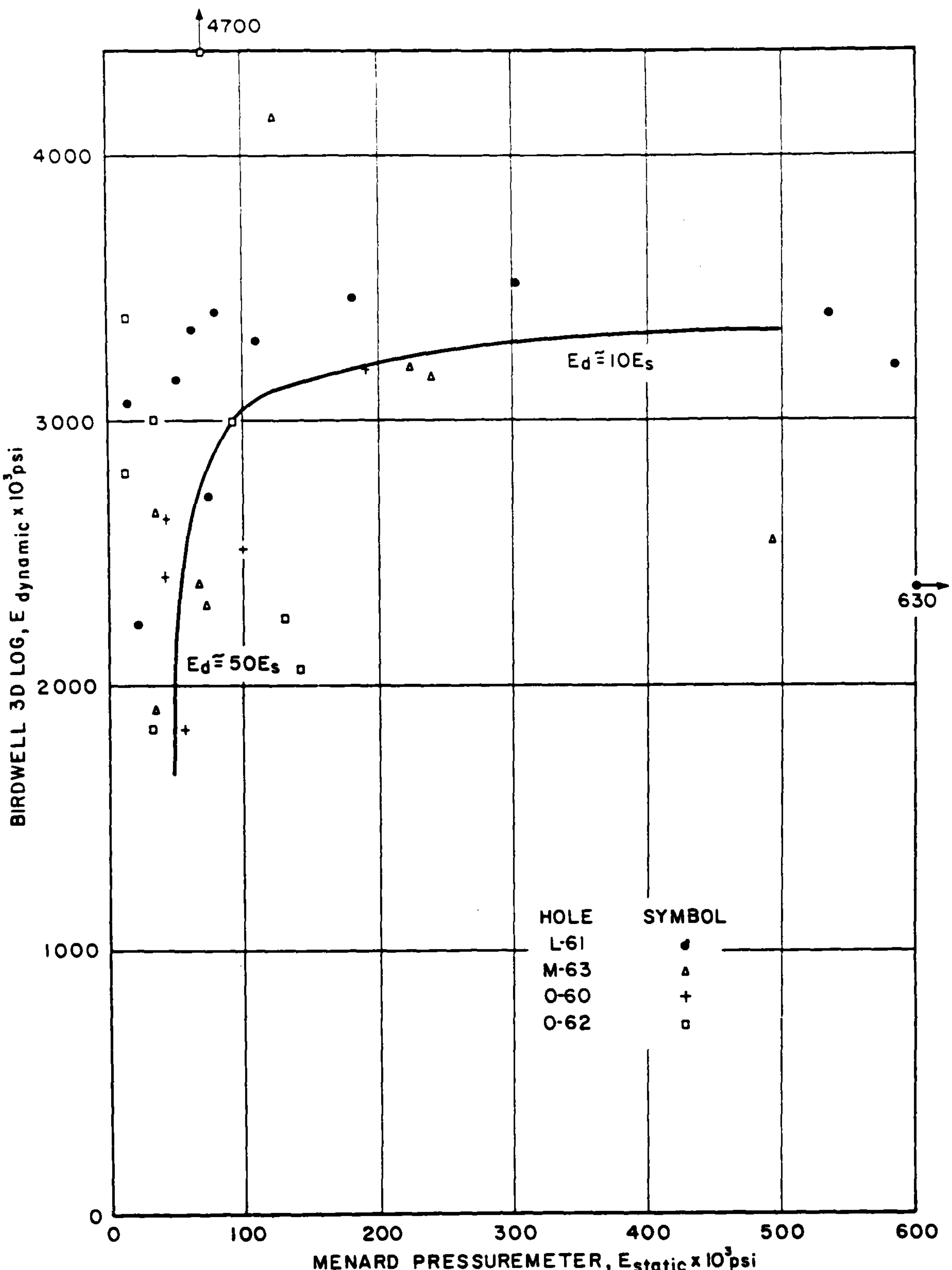



Best Available Historical Image

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

DEFORMATION MODULI FROM MENARD PRESSUREMETER TESTS

Figure 2.5-211

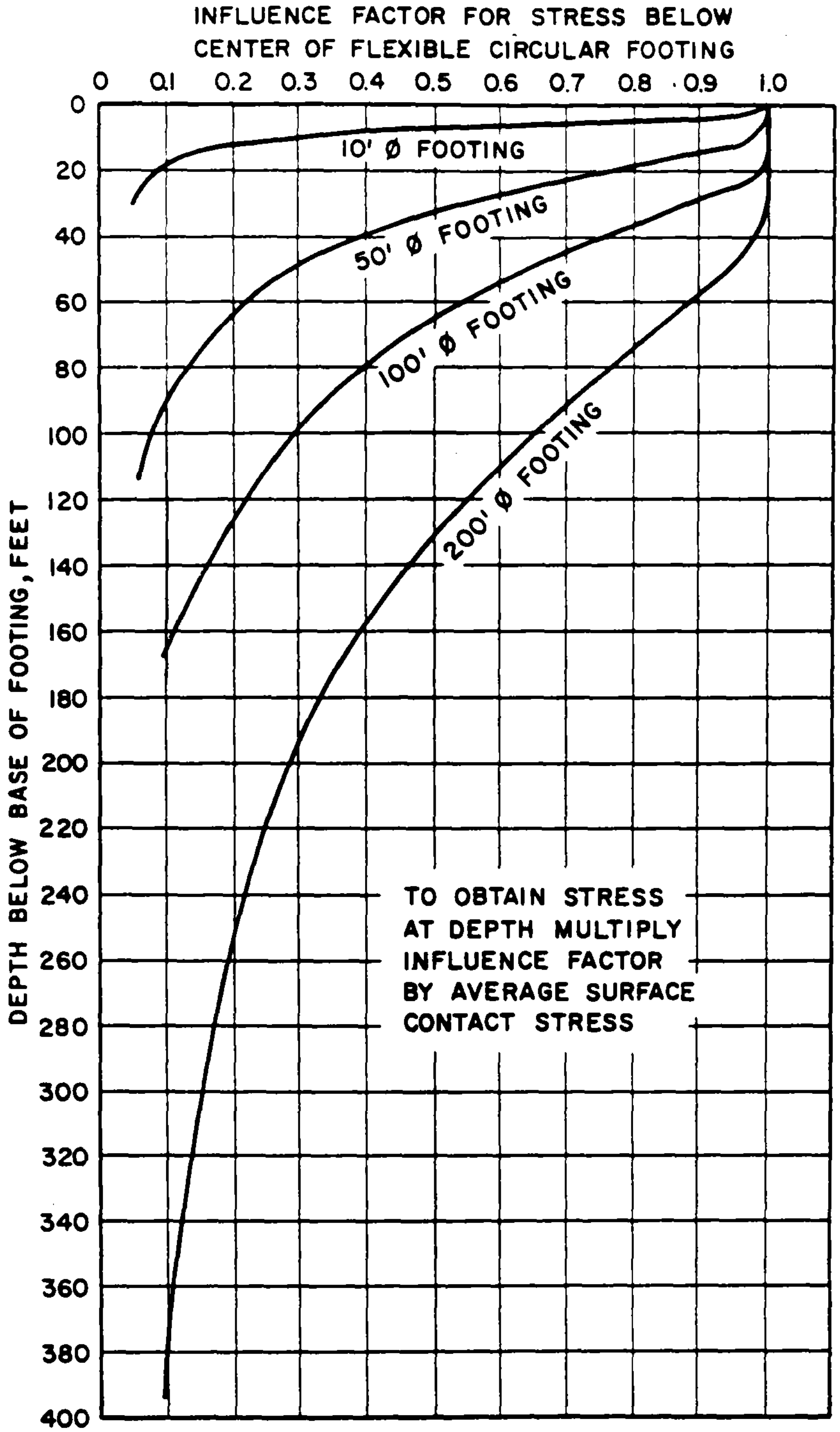



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

COMPARISON OF MODULI OBTAINED WITH MENARD PRESSUREMETER AND BIRDWELL 3D SONIC LOGGER

Figure 2.5-212

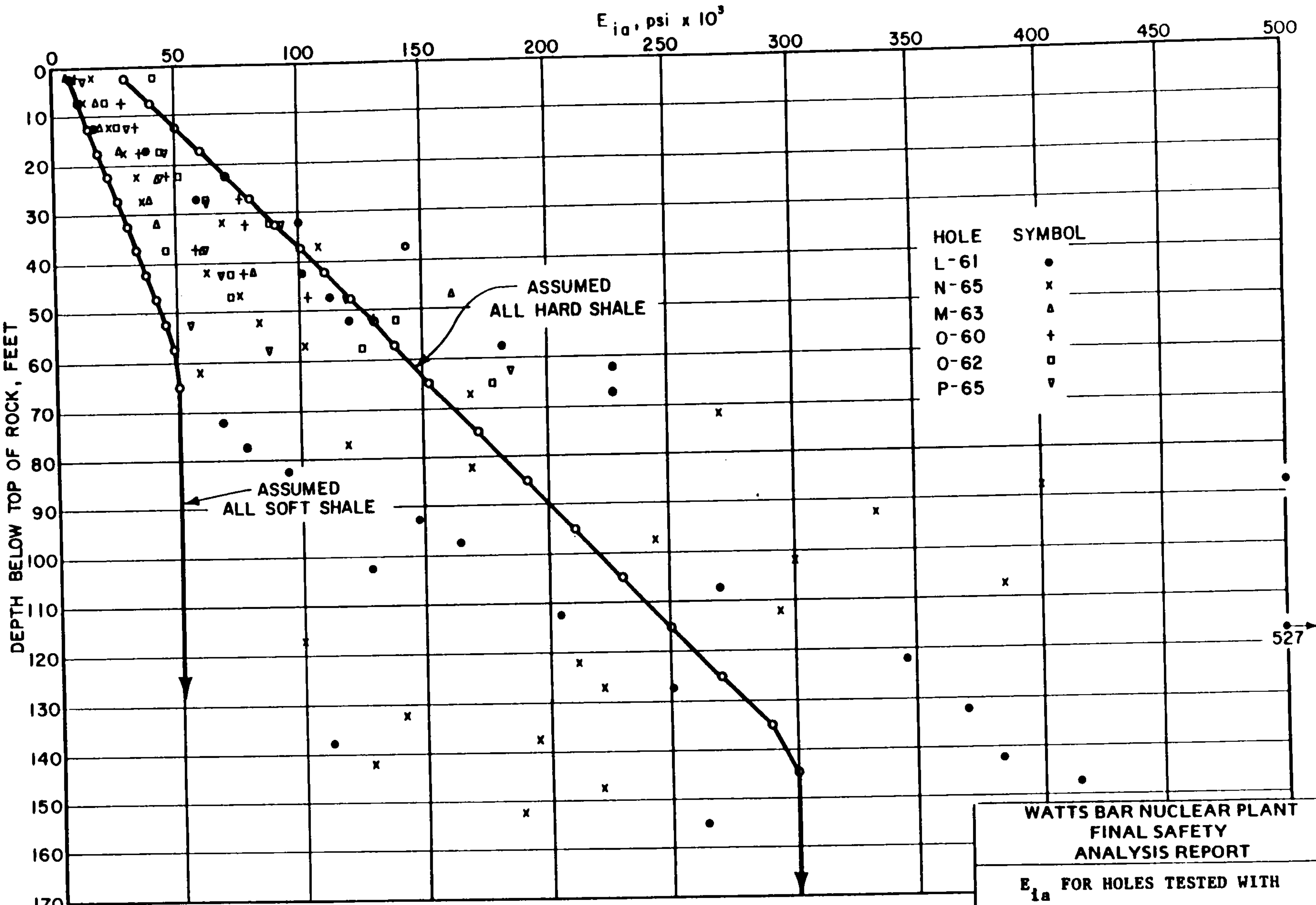
Best Available Historical Image




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INFLUENCE FACTORS FOR DETERMINING STRESSES BELOW THE CENTER OF FLEXIBLE CIRCULAR FOOTING 10, 50, 100, AND 200 FT. IN DIAMETER

Figure 2.5-213

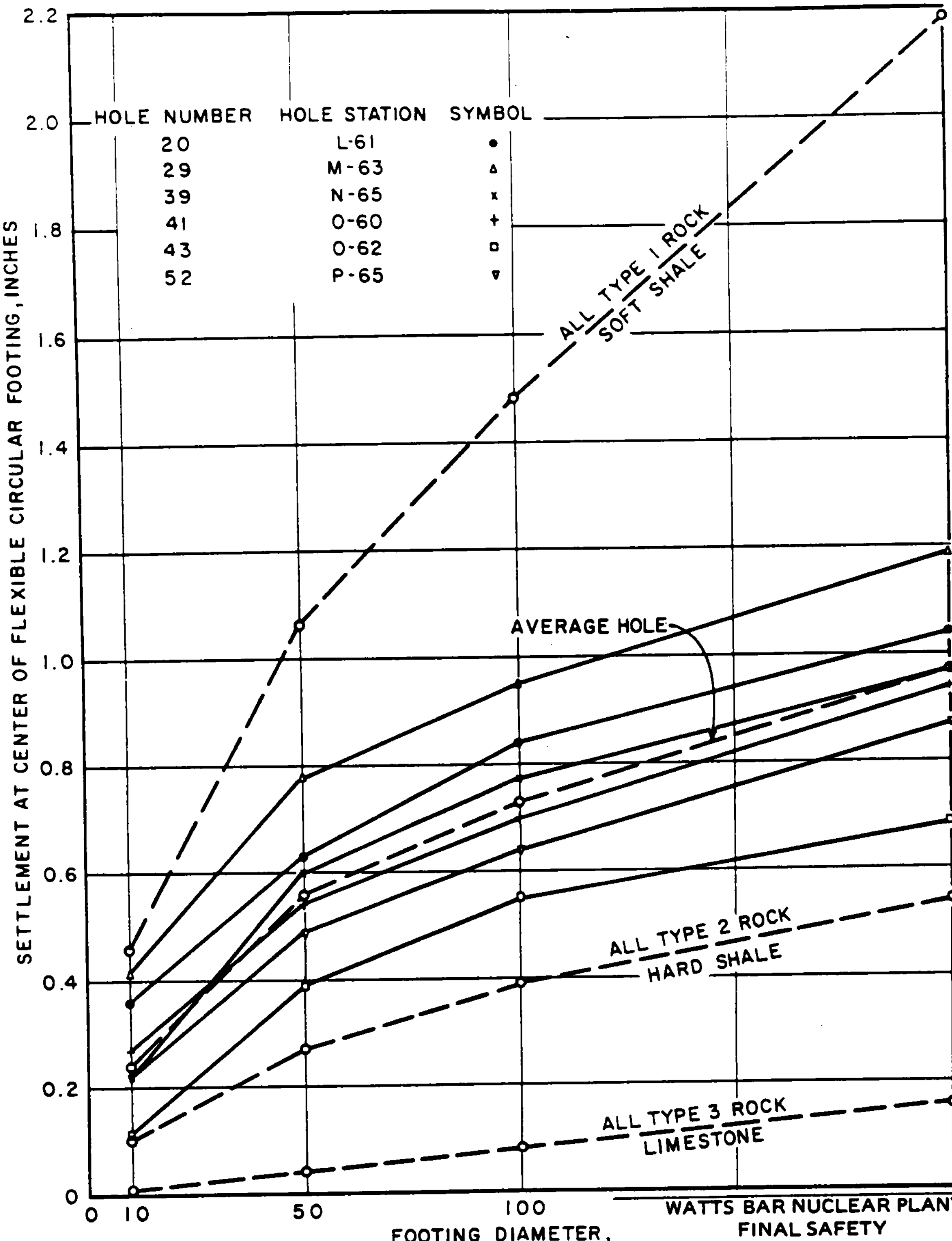



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

$E_{ia}$ FOR HOLES TESTED WITH MENARD PRESSUREMETER

Figure 2.5-214

Best Available Historical Image

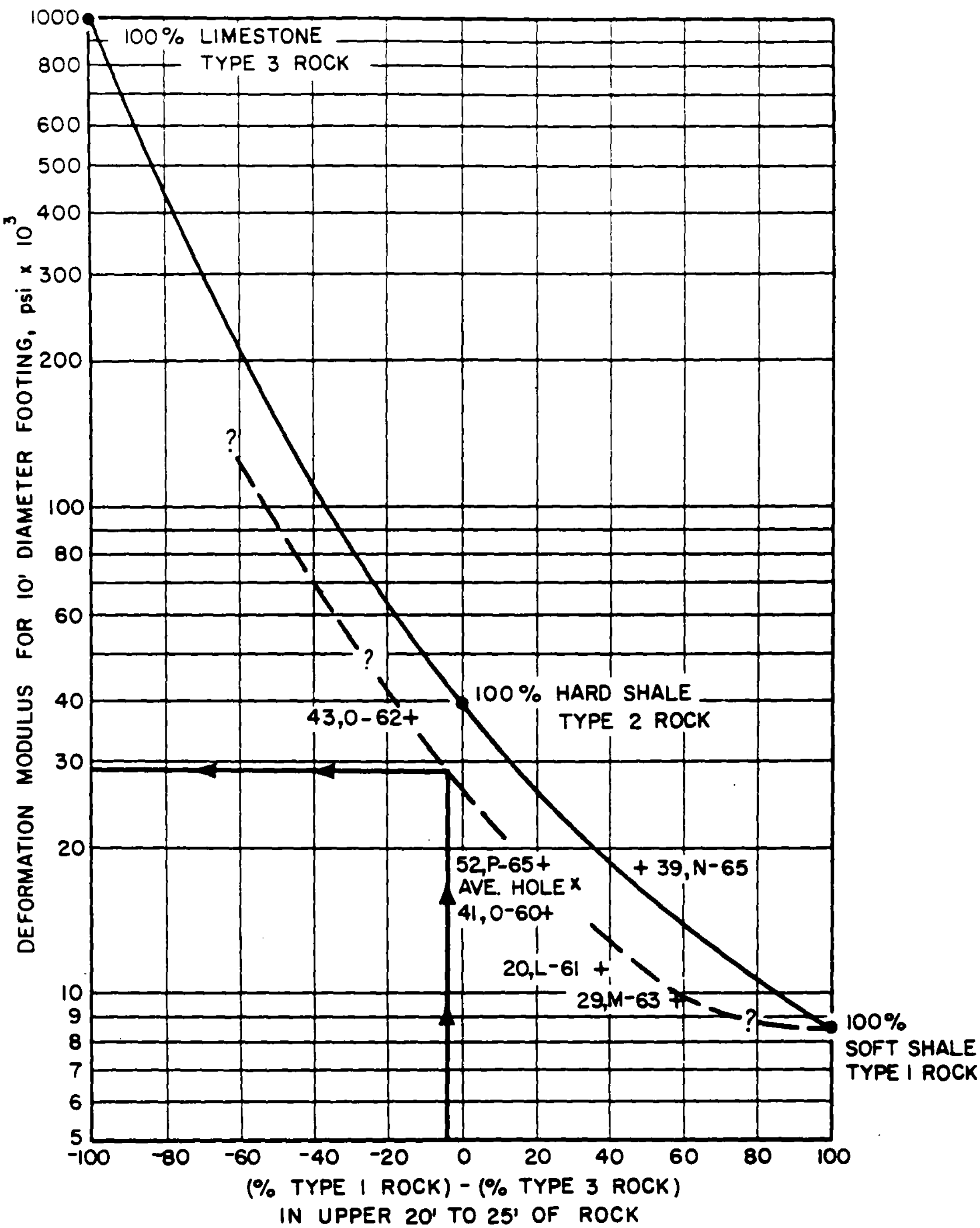



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT AT CENTER OF FLEXIBLE CIRCULAR FOOTING LOADED WITH SKSF

Figure 2.5-215

Best Available Historical Image

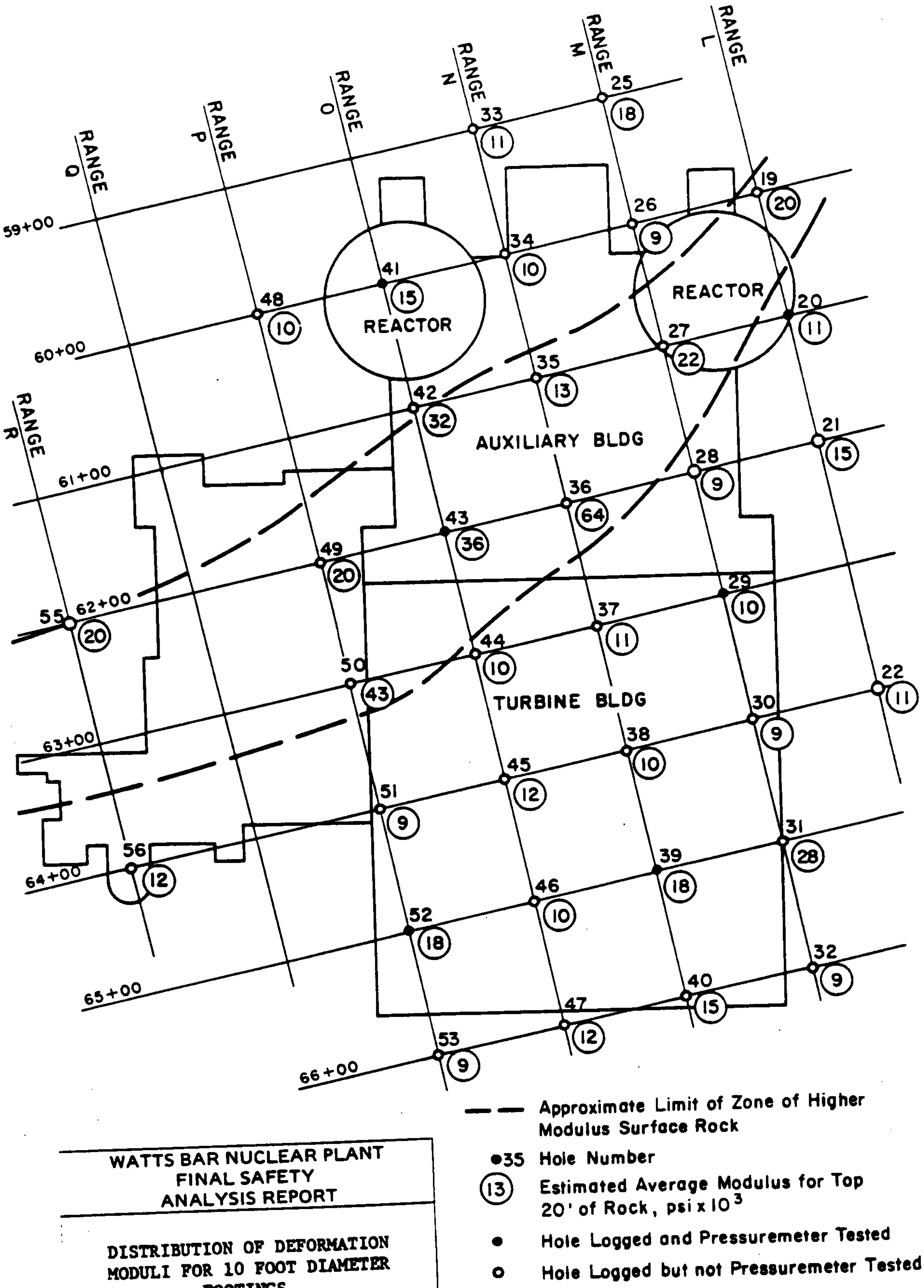



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CORRELATION USED TO ESTIMATE AVERAGE MODULI FOR HOLES WHERE DETAILED CALCULATIONS WERE NOT MADE

Figure 2.5-216

Best Available Historical Image

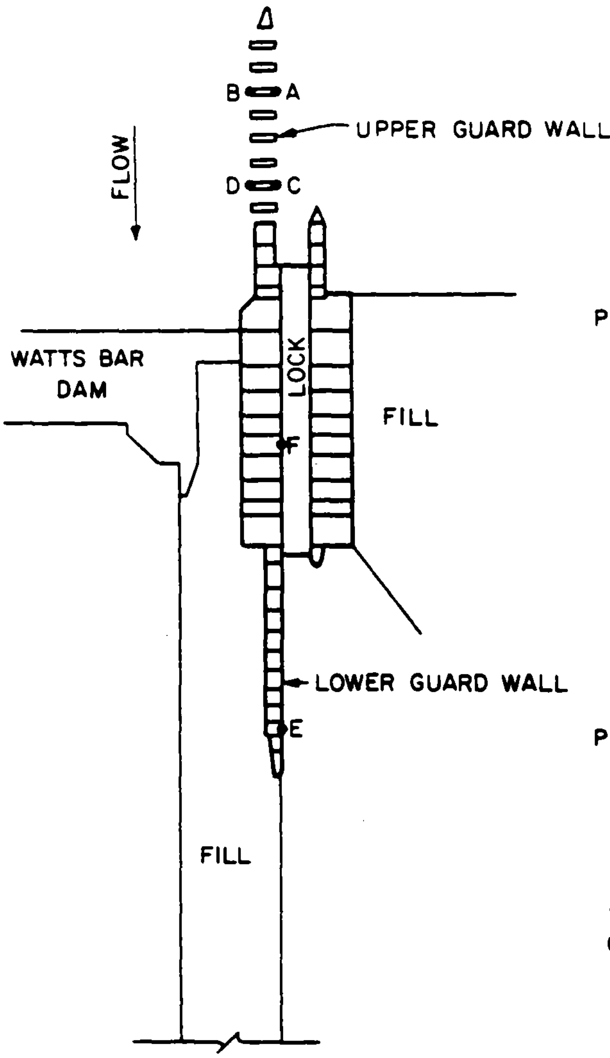



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

DISTRIBUTION OF DEFORMATION MODULI FOR 10 FOOT DIAMETER FOOTINGS

Figure 2.5-217

Best Available Historical Image




CALCULATED DEFORMATION MODULI

| POINT | Deformation modulus calculated from settlement data assuming flexible foundation |
|---|---|
| A | 25,000 psi |
| B | 89,000 psi |
| C | 23,500 psi |
| D | 43,000 psi |
| E | 99,000 psi |

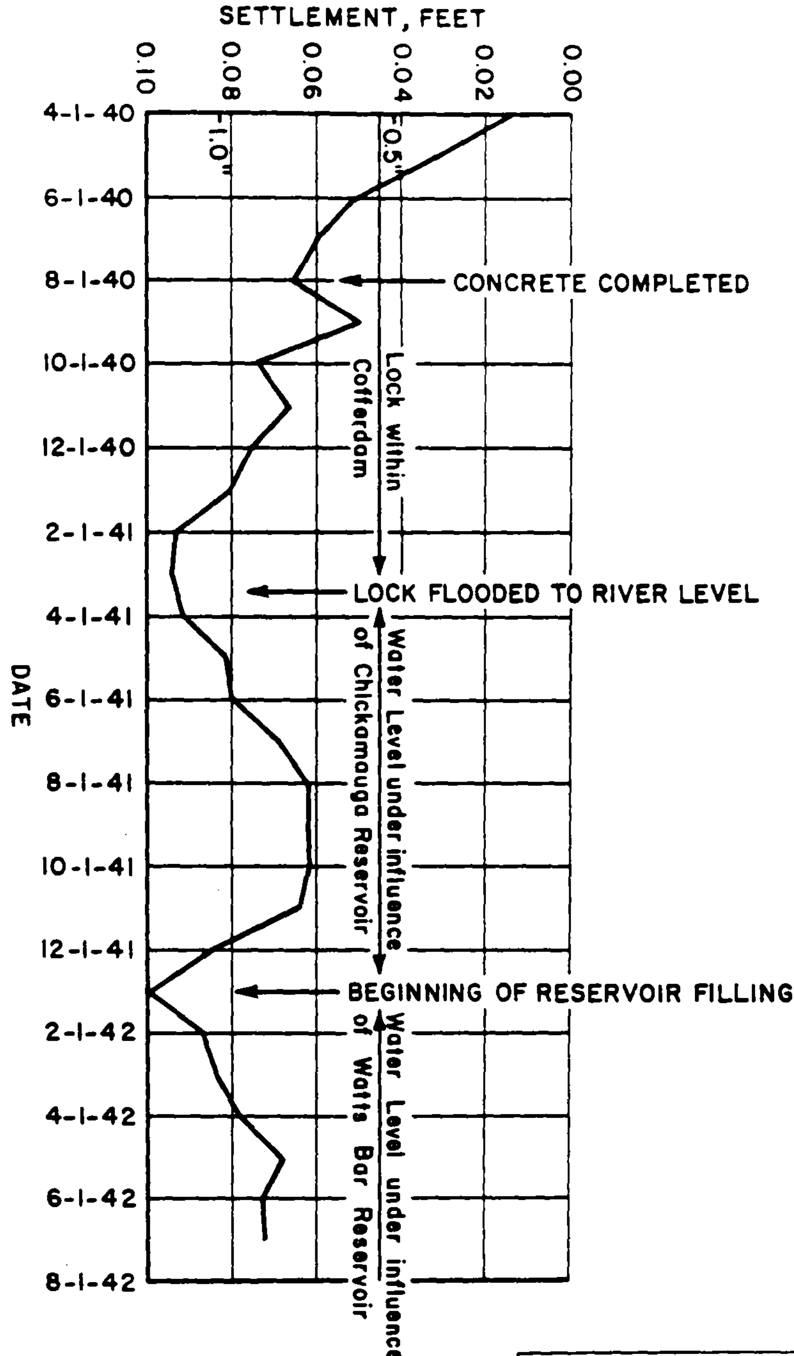
| POINT | Deformation modulus calculated from settlement data assuming rigid foundation |
|---|---|
| A-B | 43,000 psi |
| C-D | 49,000 psi |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SIMPLIFIED PLAN OF LOCK FOUNDATION SHOWING LOCATION OF MODULUS CALCULATIONS

Figure 2.5-218

Best Available Historical Image




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT OF FACE OF BLOCK R-10
(Point F, fig. 16)

Figure 2.5-219

Best Available Historical Image

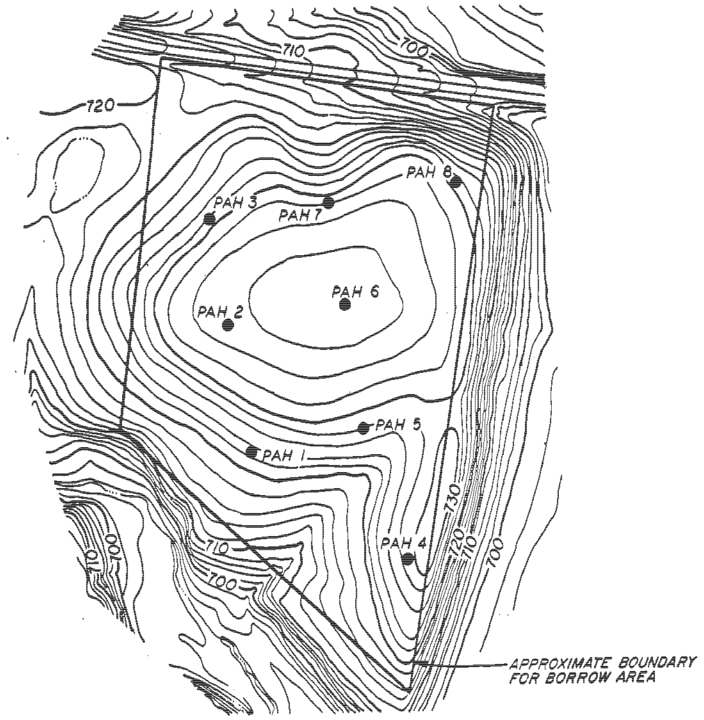

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

YARD

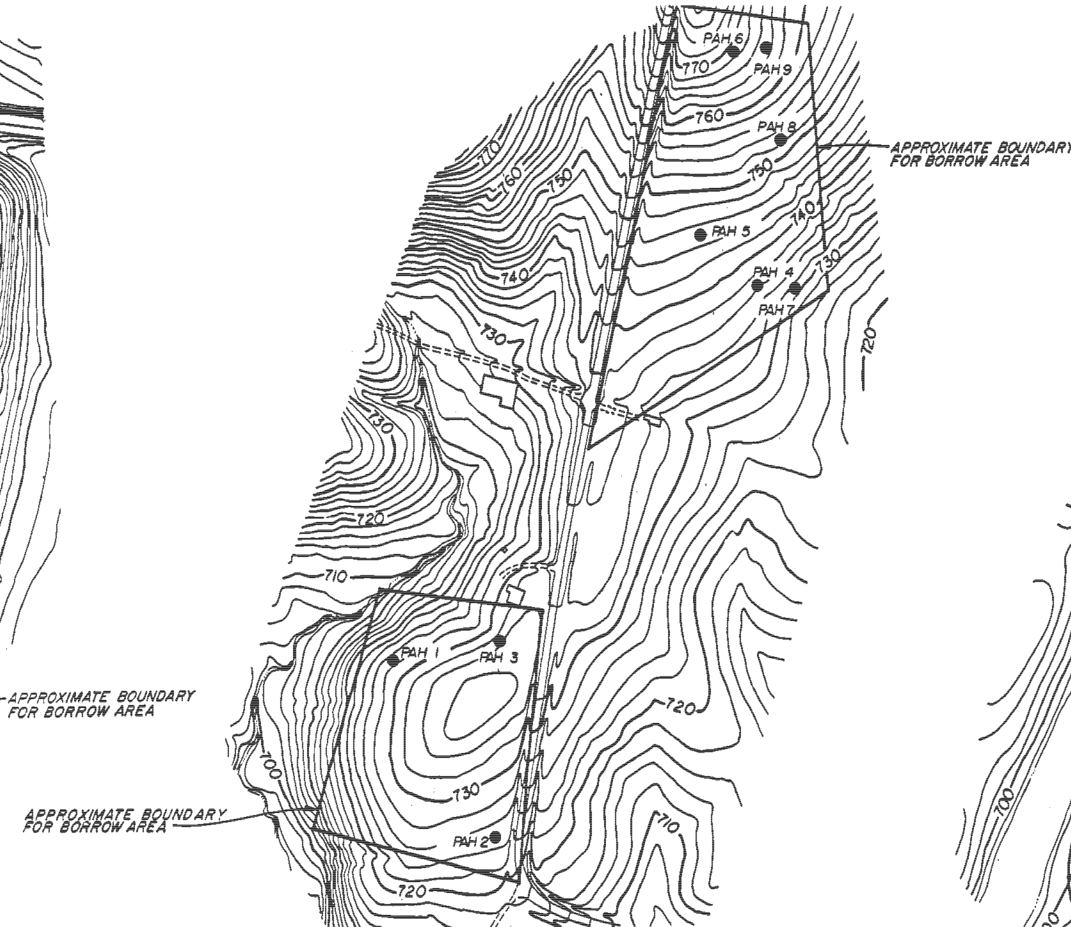
SOIL INVESTIGATIONS
BORROW SOILS

TVA DWG NO. 10W331 R3
FIGURE 2.5-220

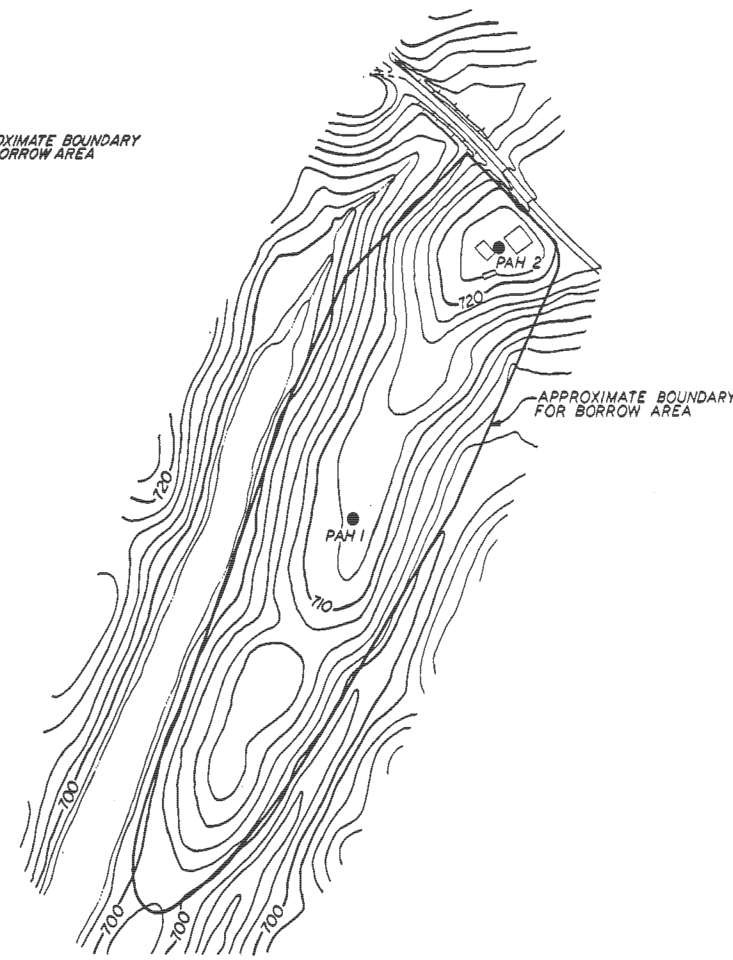
CAD MAINTAINED DRAWING



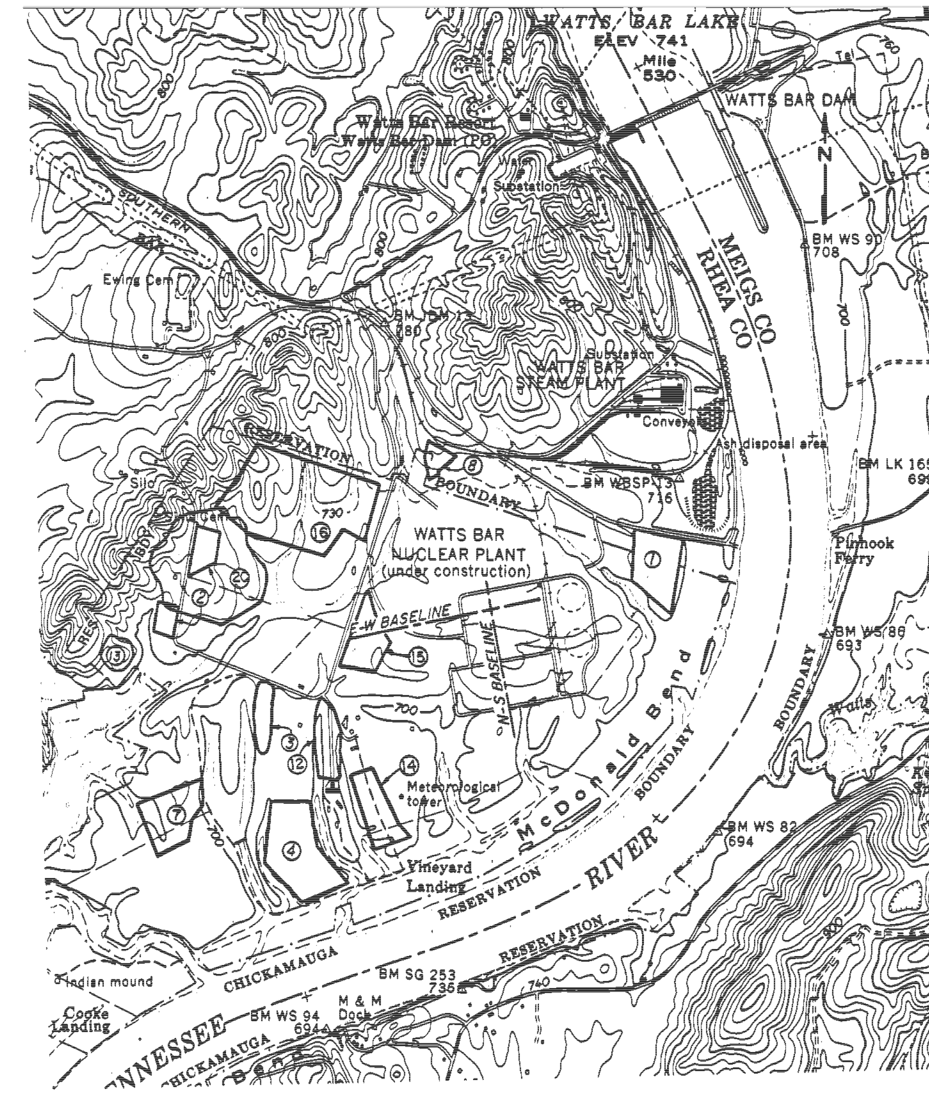

BORROW AREA 1




BORROW AREA 2




BORROW AREA 3




LOCATION PLAN

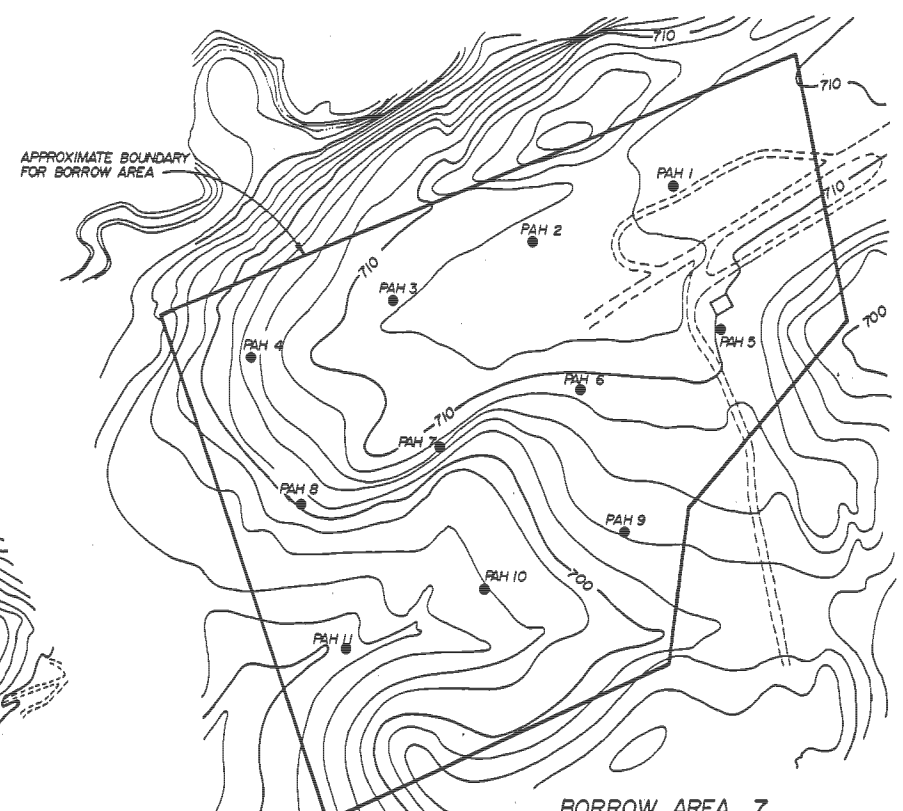
1"=1000'  0  1000  2000

LEGEND:

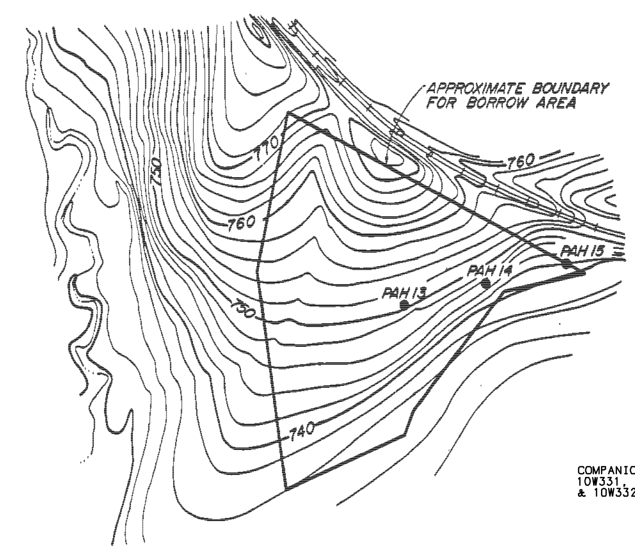
● AUGER BORINGS

NOTE:
BORROW AREAS 5 AND 6 WERE NEVER ASSIGNED.
ALL REFERENCES TO AREAS 5 AND 6 ARE FROM THE MAIN PLANT AREA AND ARE TO BE CLASSIFIED UNDER GENERAL PLANT SOIL CLASSIFICATION. BORROW AREA 2 WAS, AT INTERVALS DURING CONSTRUCTION, KNOWN AS BORROW AREAS 2A AND 2B.


BORROW AREA 4




BORROW AREA 7




BORROW AREA 8

NOT TO SCALE EXCEPT AS NOTED

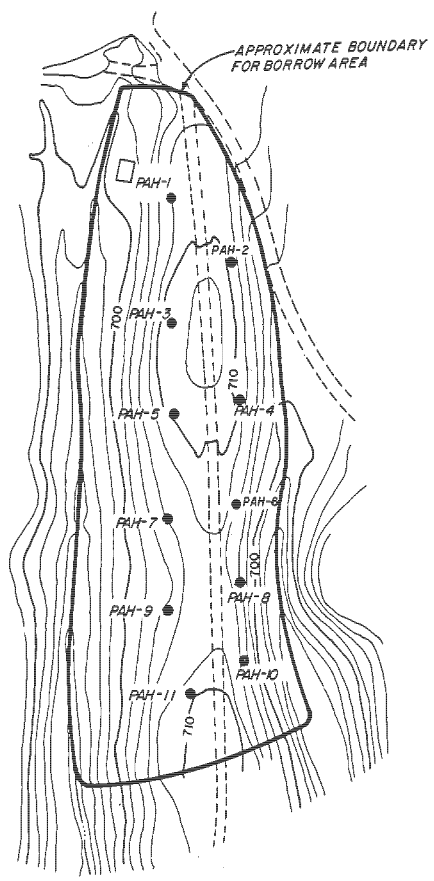
COMPANION DRAWINGS:
10W331, 10W332-2
& 10W332-3

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

YARD
SOIL INVESTIGATIONS
BORROW SOILS

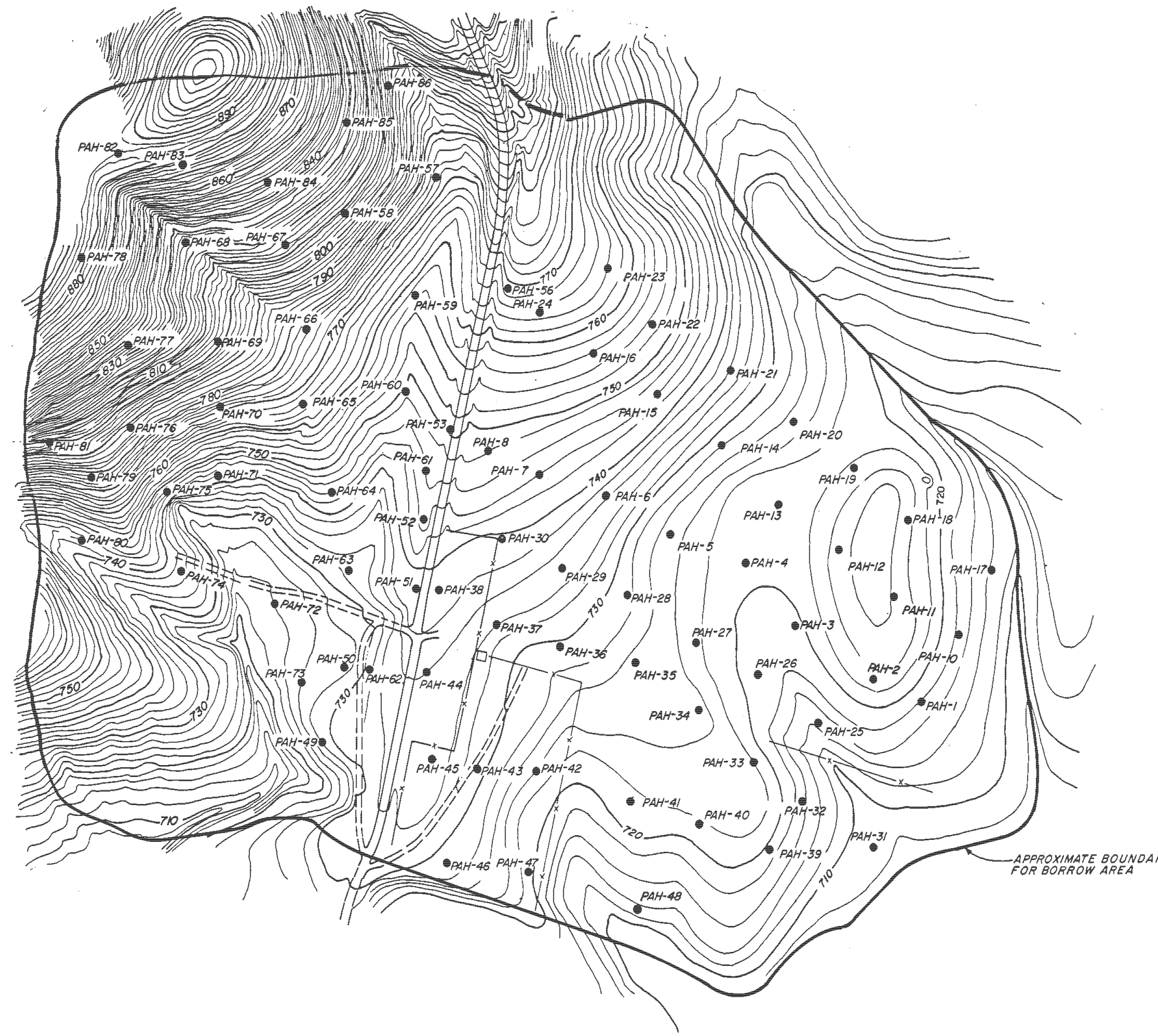
TVA DWG NO. 10W332-1 R6
FIGURE 2.5-221

CAD MAINTAINED DRAWING




BORROW AREA 12


BORROW AREA 13




BORROW AREA 2C

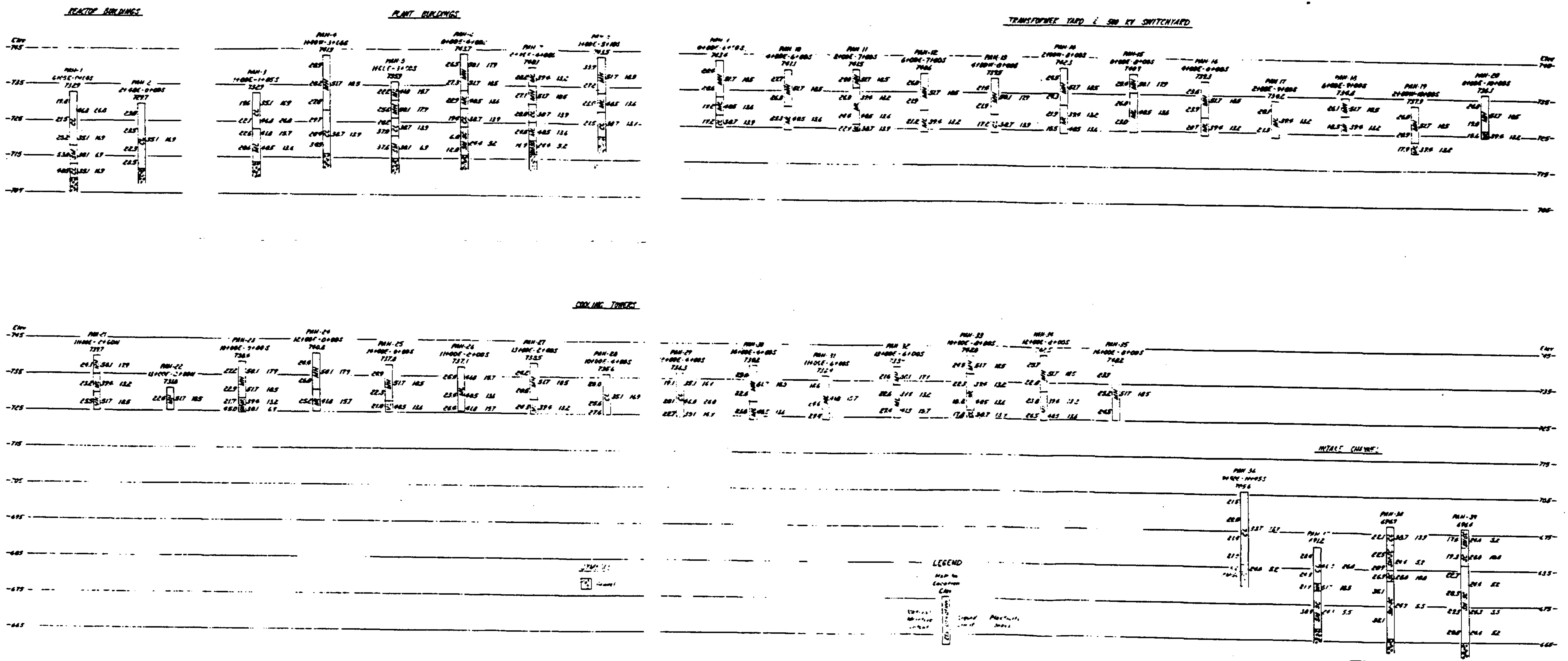
LEGEND:
● AUGER BORING

COMPANION DRAWINGS:
10W331, 10W332-1
& 10W332-3

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

YARD
SOIL INVESTIGATIONS
BORROW SOILS

TVA DWG NO. 10W332-2 R2
FIGURE 2.5-221A

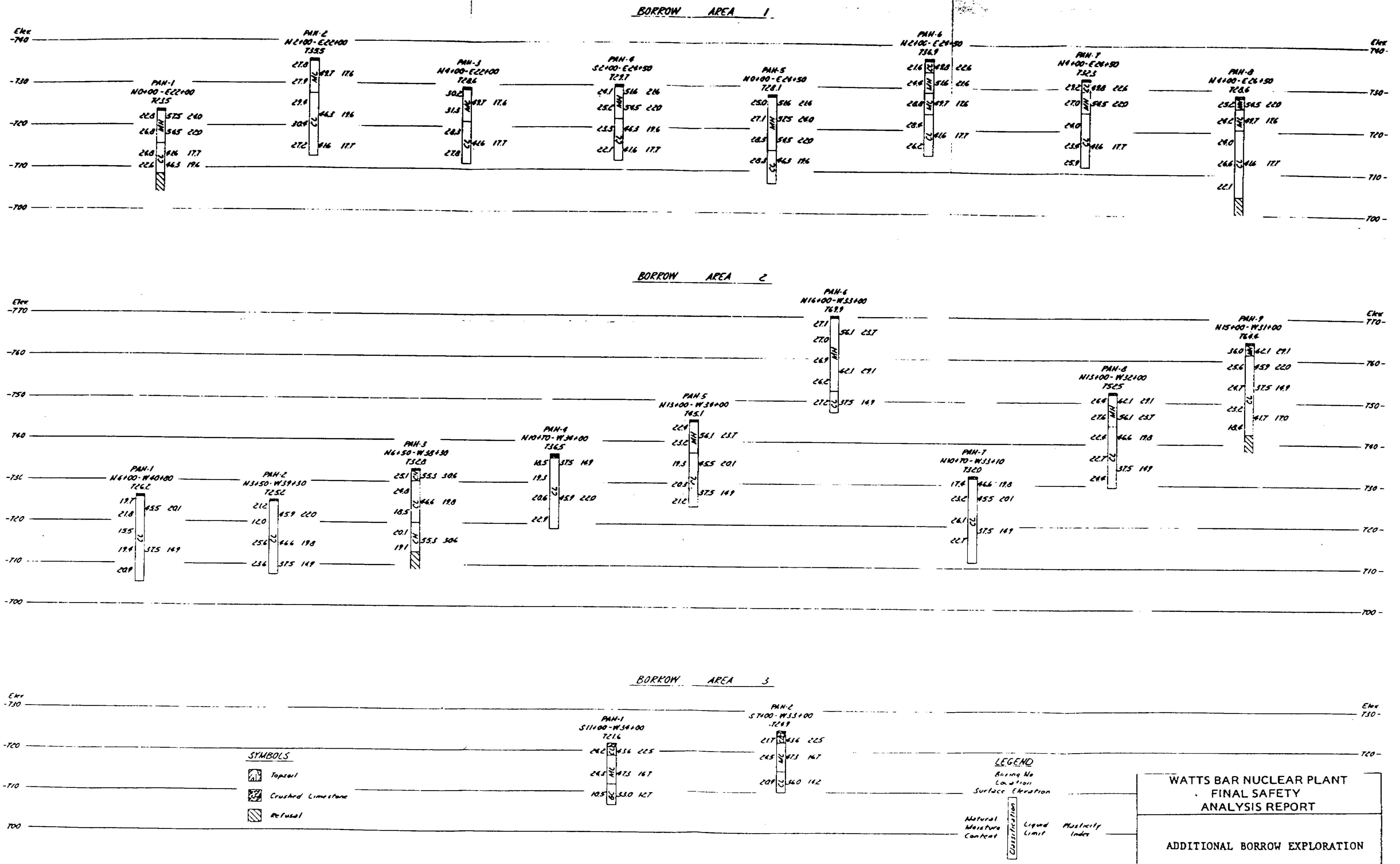



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

BORROW INVESTIGATION

Figure 2.5-222

"HISTORICAL INFORMATION"

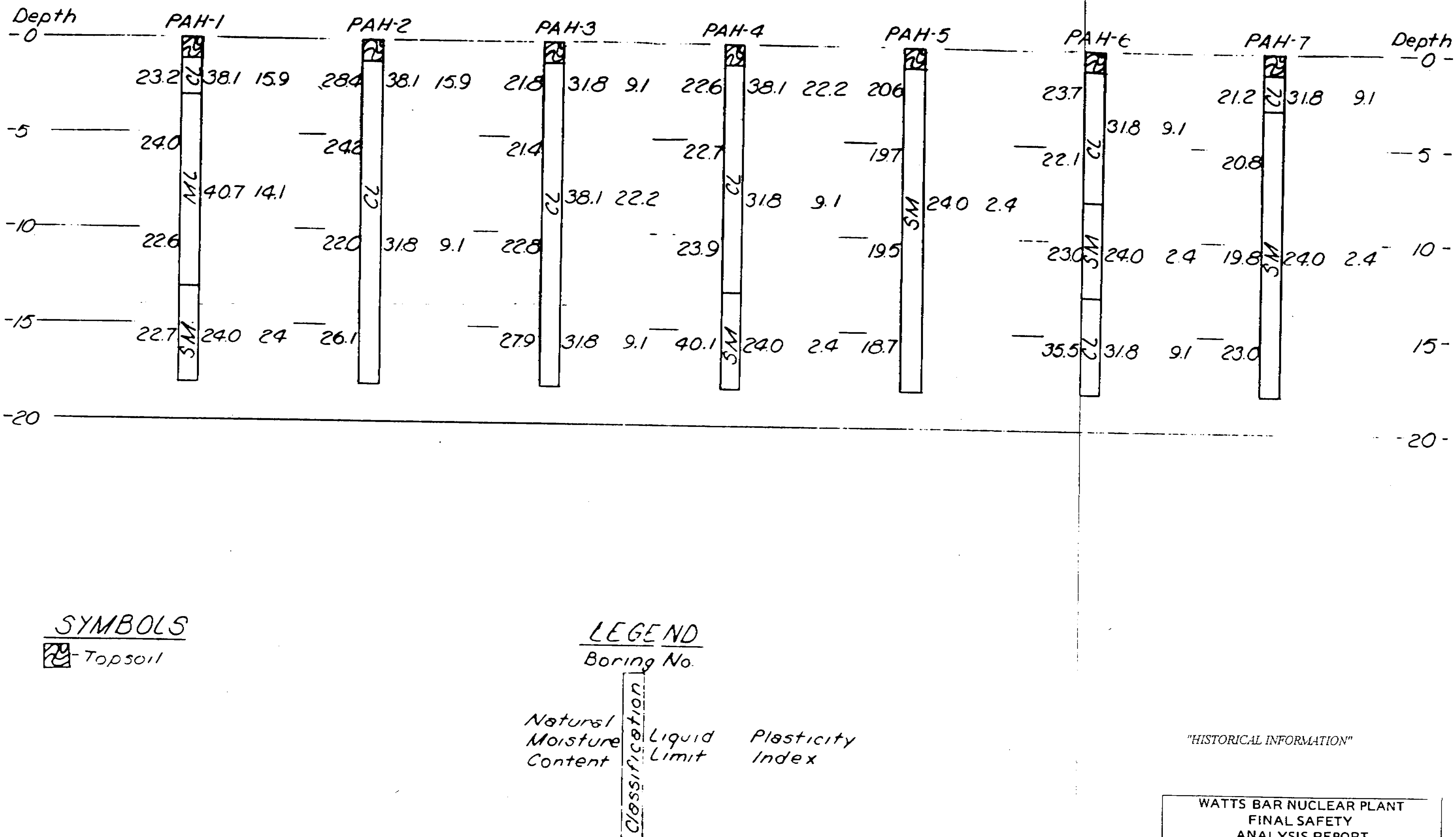



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ADDITIONAL BORROW EXPLORATION

Figure 2.5-223

"HISTORICAL INFORMATION"

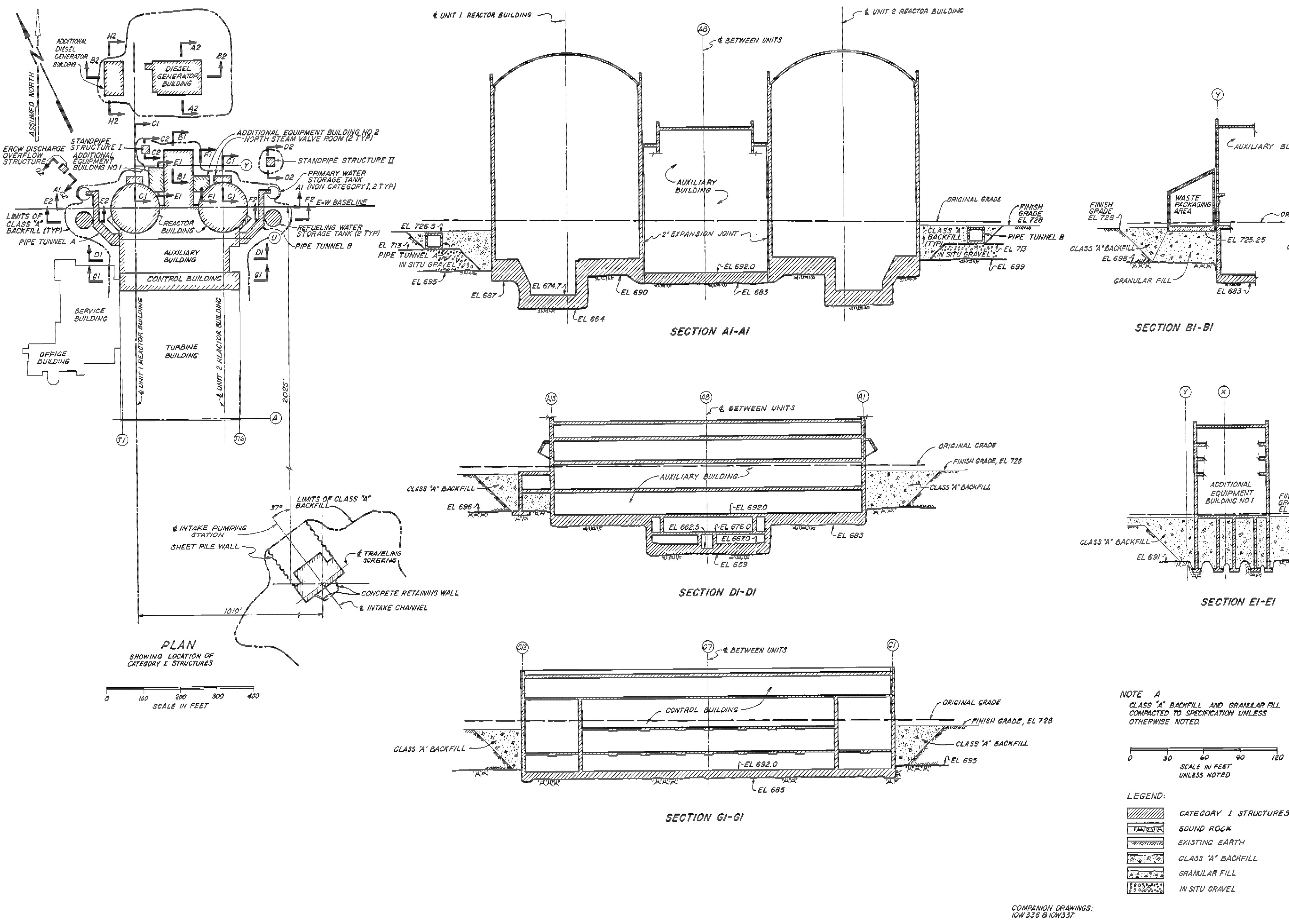



"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ADDITIONAL BORROW AREA 4

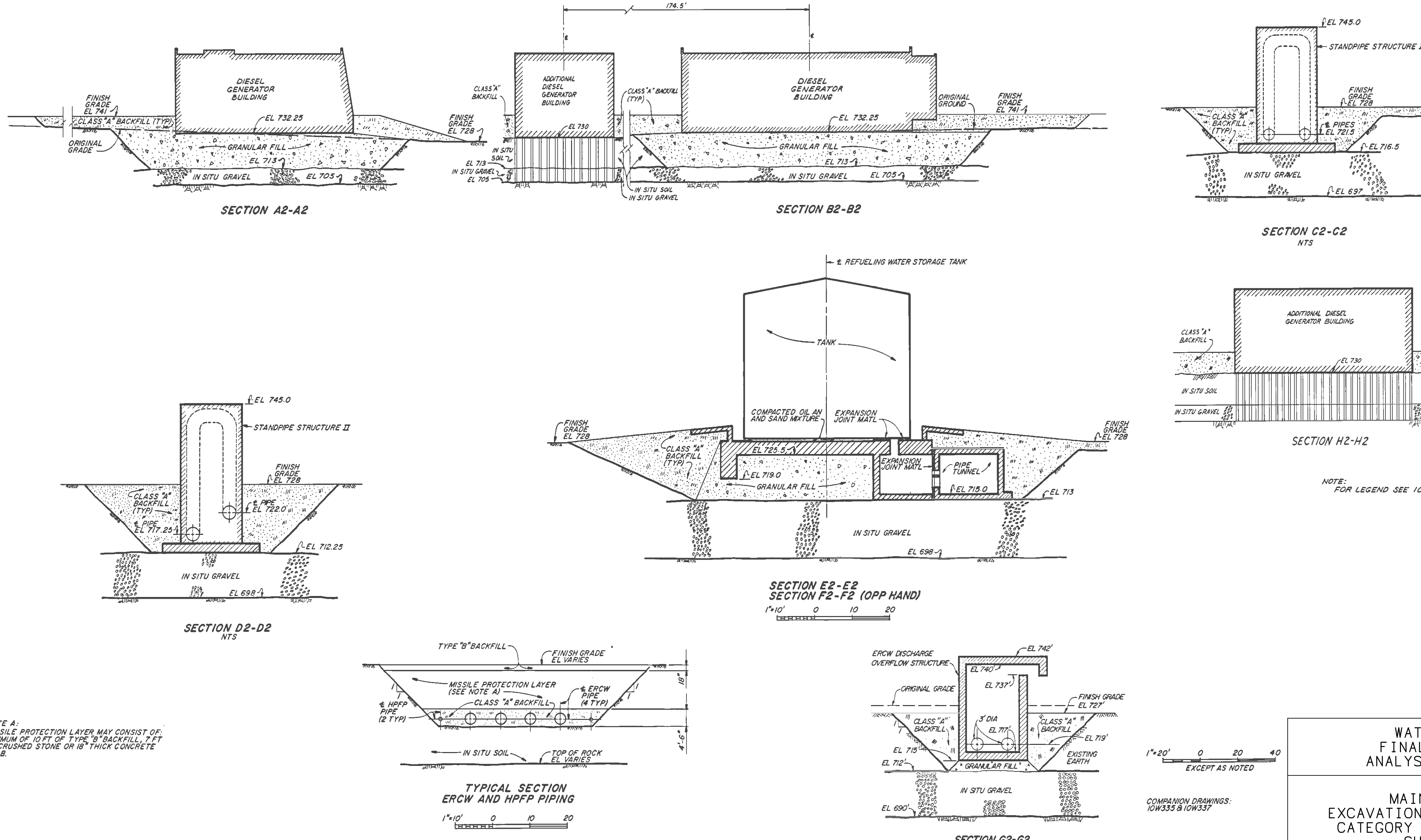
Figure 2.5-224




WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

MAIN PLANT
EXCAVATION AND BACKFILL
CATEGORY I STRUCTURES
SHEET 1
TVA DWG NO. 10W335 R4
FIGURE 2.5-225

CAD MAINTAINED DRAWING




NOTE:
FOR LEGEND SEE 10W335

NOTE A:
MISSILE PROTECTION LAYER MAY CONSIST OF: MINIMUM OF 10 FT OF TYPE "B" BACKFILL, 7 FT OF CRUSHED STONE OR 18" THICK CONCRETE SLAB.

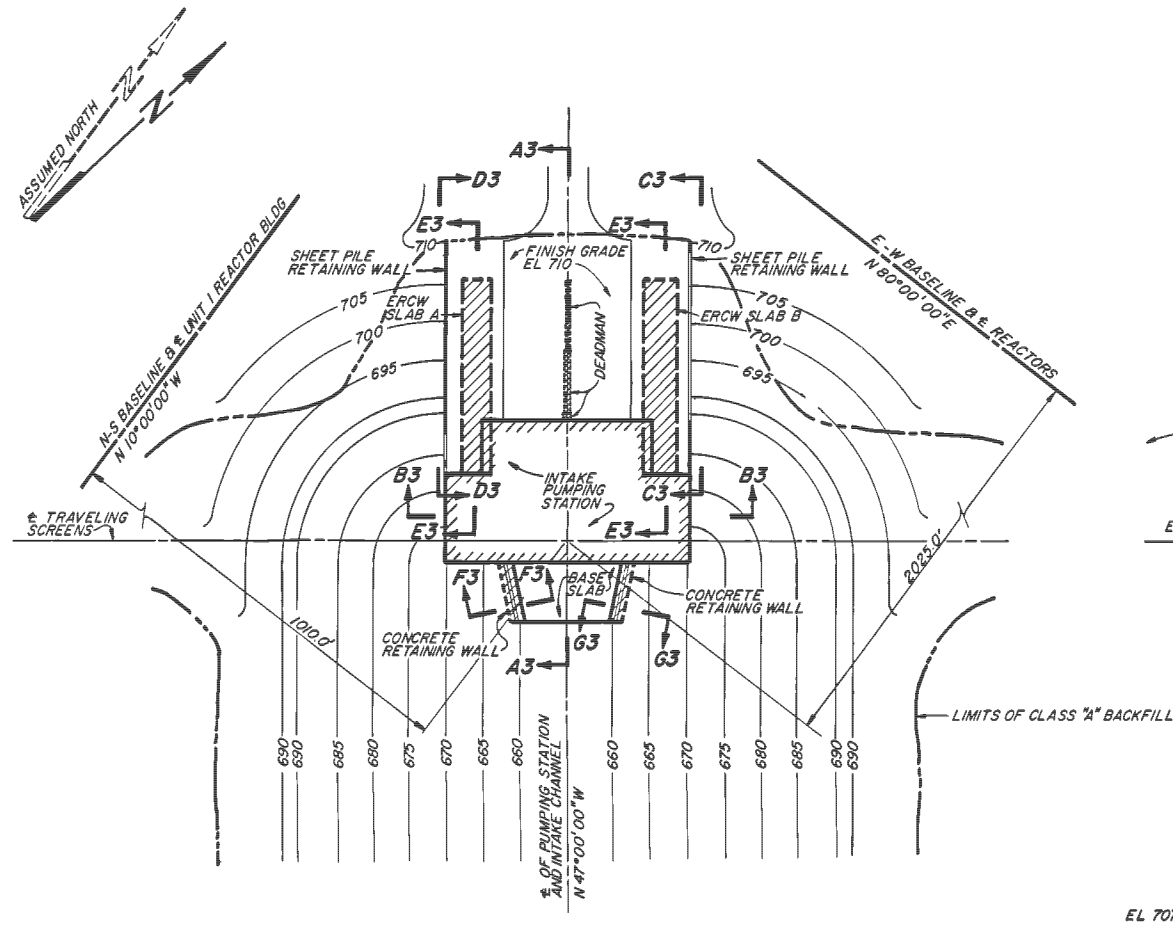
1"=20' 0 20 40
EXCEPT AS NOTED

COMPANION DRAWINGS:
10W335 & 10W337

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

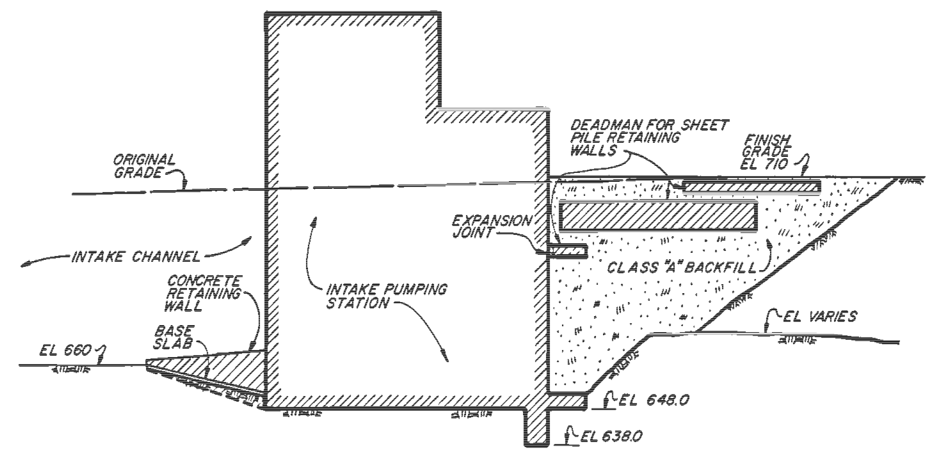
MAIN PLANT
EXCAVATION AND BACKFILL
CATEGORY I STRUCTURES
SHEET 2
TVA DWG NO. 10W336 R4
FIGURE 2.5-226

CAD MAINTAINED DRAWING

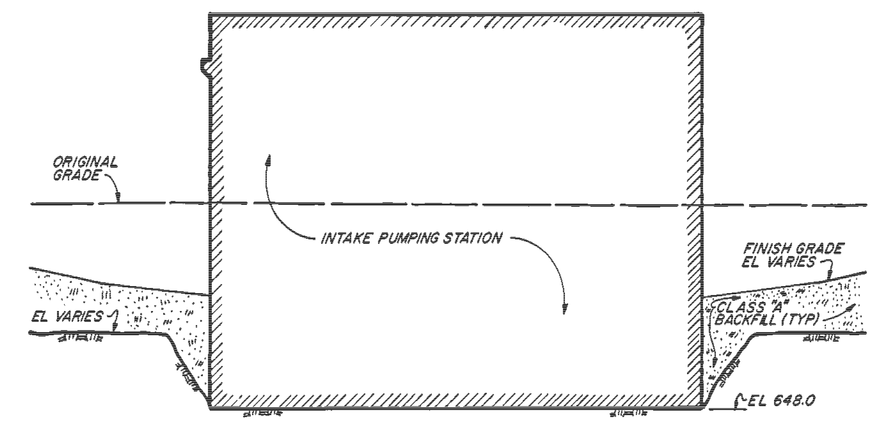



PLAN

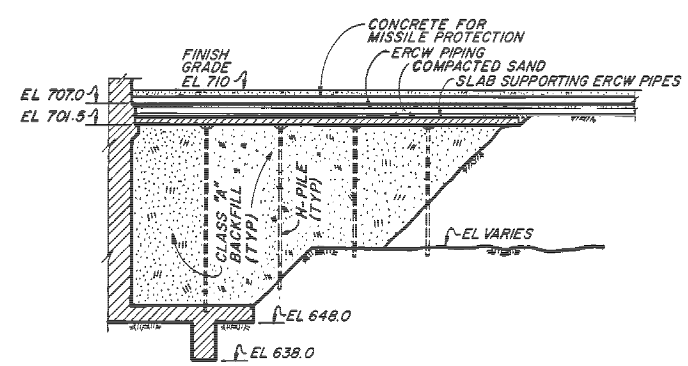
1"=40' 0 40 80



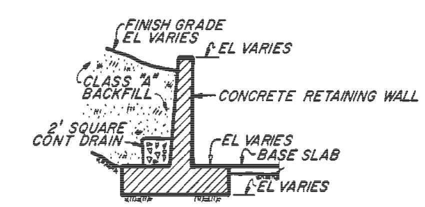

SECTION A3-A3




SECTION B3-B3



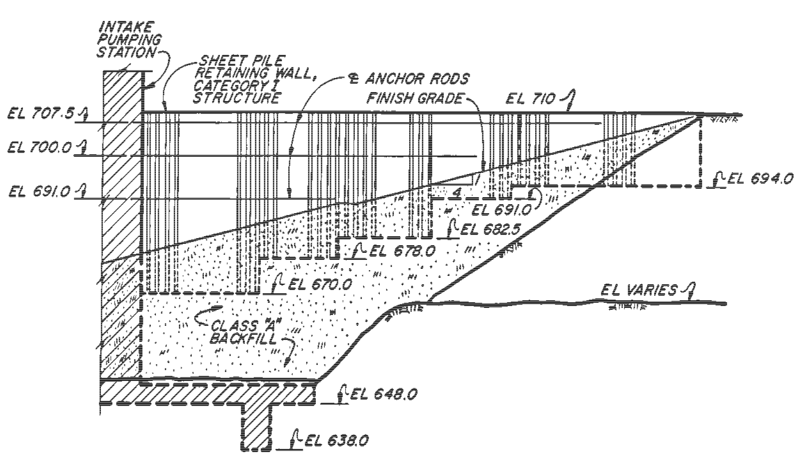

SECTION E3-E3




SECTIONS F3-F3 & G3-G3

NTS

NOTE:
FOR LEGEND SEE 10W335




SECTION C3-C3
SECTION D3-D3 (OPP HAND)

NTS

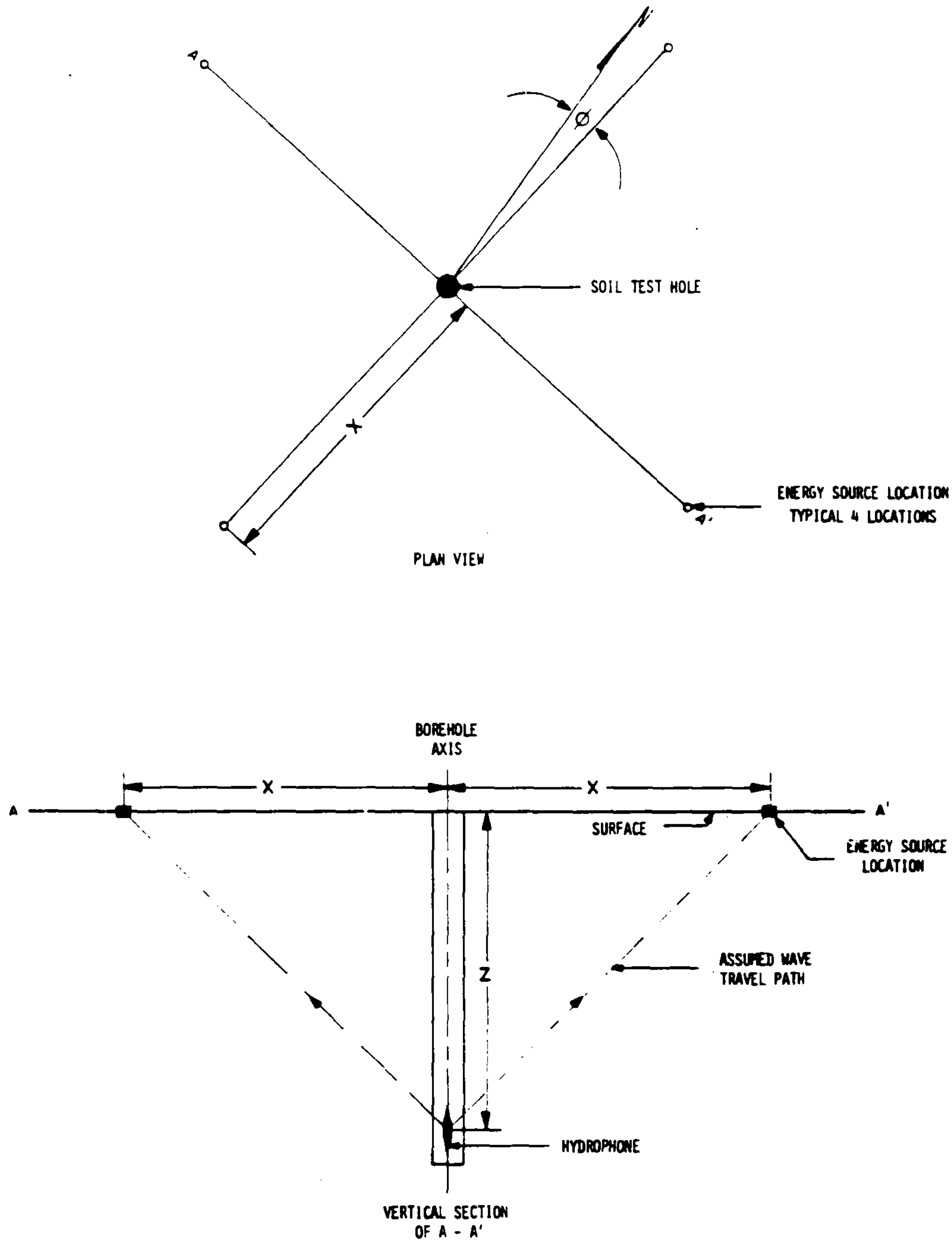
1"=20' 0 20 40
EXCEPT AS NOTED

COMPANION DRAWINGS:
10W335 & 10W336

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

MAIN PLANT
EXCAVATION AND BACKFILL
CATEGORY I STRUCTURES
SHEET 3
TVA DWG NO. 10W337 R2
FIGURE 2.5-226A

CAD MAINTAINED DRAWING



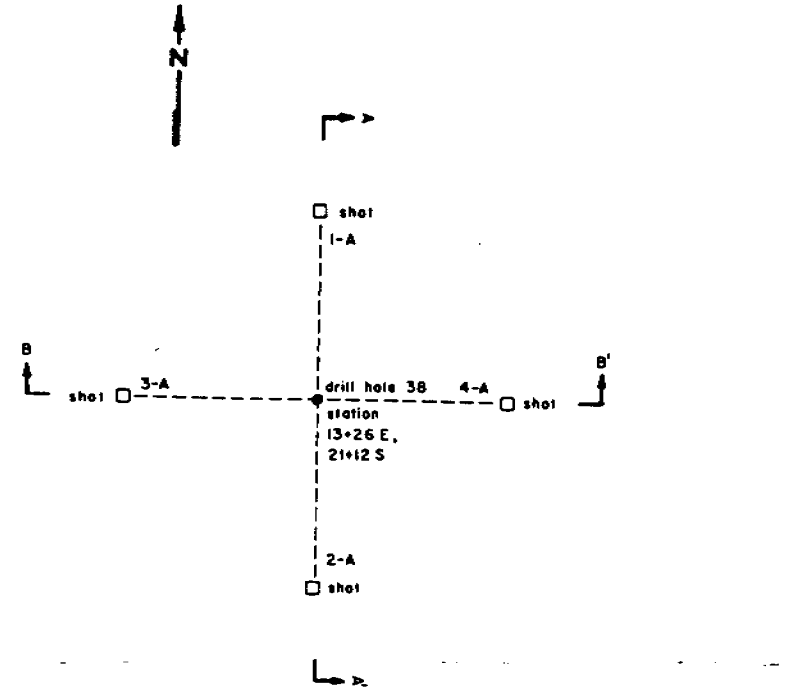

NOTES:

1. THIS DRAWING SHOWS A TYPICAL PLAN VIEW AND VERTICAL SECTION VIEW FOR ALL IN-SITU SOIL DYNAMIC MEASUREMENTS.
2. FOR DRILL HOLE LOCATIONS SEE FIGURE 2.5-185
3. COMPRESSIONAL AND SHEAR WAVES WERE EITHER OBTAINED BY STRIKING A STEEL PLATE WITH A SLEDGEHAMMER OR BY EXPLODING TWO FEET OF PRIMACORD ONE FOOT BELOW GROUND.
4. FOR EACH BOREHOLE EITHER EXPLOSIVES OR SLEDGEHAMMER WAS USED AS THE ENERGY SOURCE. A SINGLE TYPE OF SOURCE WAS USED FOR EACH HOLE, AS CONDITIONS REQUIRED.
5. WHERE POSSIBLE, ENERGY SOURCE LOCATIONS ARE PLACED IN A $90^{\circ}$ ARRAY AT HORIZONTAL DISTANCE X FROM BOREHOLE AND ORIENTED NORTH, SOUTH, EAST, AND WEST. OTHERWISE, THE WHOLE ARRAY MAY BE ROTATED ABOUT THE BOREHOLE AXIS BY THE ANGLE ϕ ABOVE.

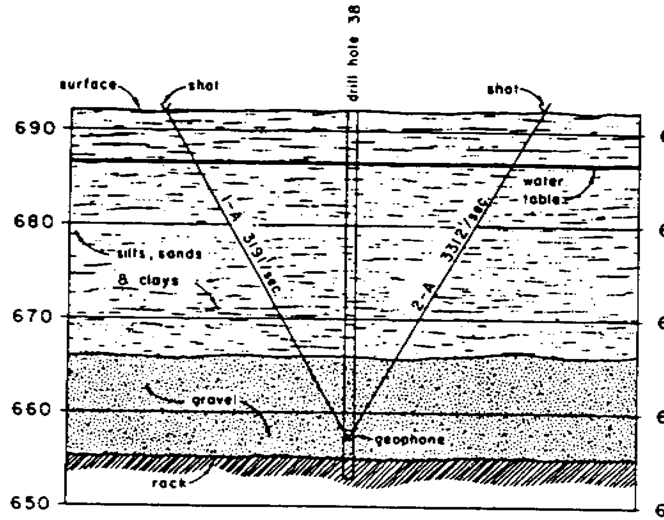
**Historical**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

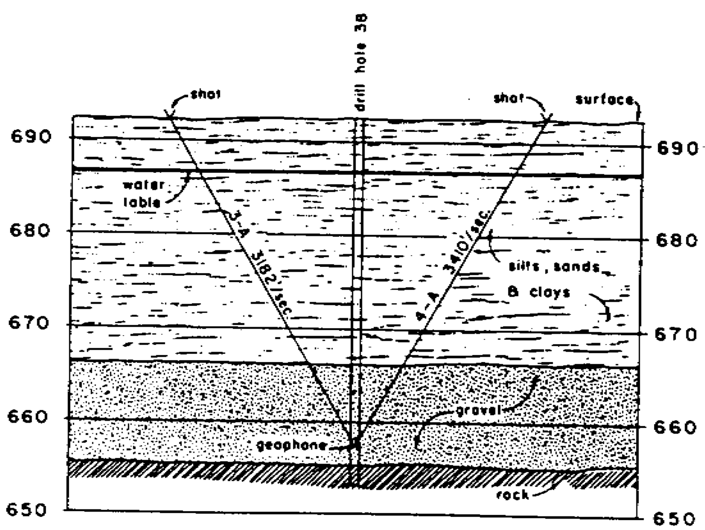
TYPICAL IN-SITU SOIL DYNAMICS
MEASUREMENT LAYOUT & SECTION
Figure 2.5-227



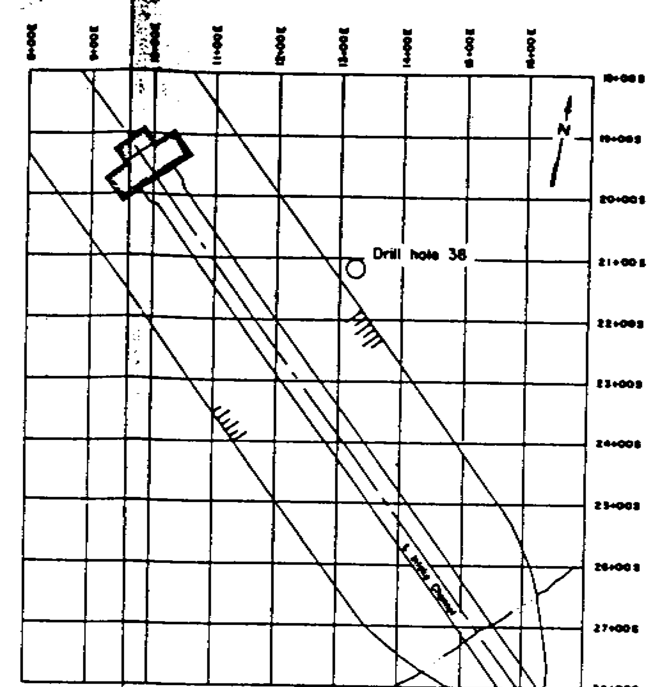

PLAN




SECTION A-A'




SECTION B-B'




KEY PLAN

| Seismic Line Number | Seismic Path distance (Feet) | Compressional Velocity Ft./Sec. Measured | Shear Velocity Ft./Sec. Calculated | Density Lbs/Cu.Ft. Assumed | Poisson's Ratio Assumed | Dynamic Shear Modulus psi x 10$^3$ Calculated | Dynamic Young's Modulus psi x 10$^3$ Calculated |
|---|---|---|---|---|---|---|---|
| 1 - A | 40.31 | 3191 | 962 | 90 | 0.45 | 17.97 | 52.11 |
| 2 - A | 40.31 | 3312 | 999 | 90 | 0.45 | 19.36 | 56.13 |
| 3 - A | 40.31 | 3182 | 959 | 90 | 0.45 | 17.87 | 51.81 |
| 4 - A | 40.31 | 3410 | 1028 | 90 | 0.45 | 20.52 | 59.50 |
| Average | 40.31 | 3274 | 987 | 90 | 0.45 | 18.28 | 54.85 |

NOTES:

1. The lines on the sections between shot points and geophone locations indicate only the travel direction of compressional waves.

2. The types of soils are based on general soil data obtained from the Construction Services Branch.

4. The equipment used in making the time measurements consisted of a Bison seismograph 1570B and recorder 1540, and a Hall Sears geophone HP-8.

5. Using all 4 seismic lines the shear modulus with a 67% confidence interval is 17,670 psi to 20,180 psi and with a 90% confidence interval it is 16,410 psi to 21,440 psi.

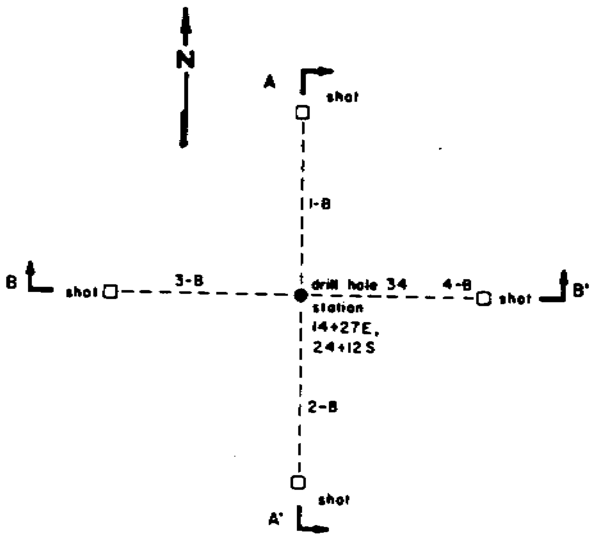
"HISTORICAL INFORMATION"

SCALE: 100 0 100 100 Feet

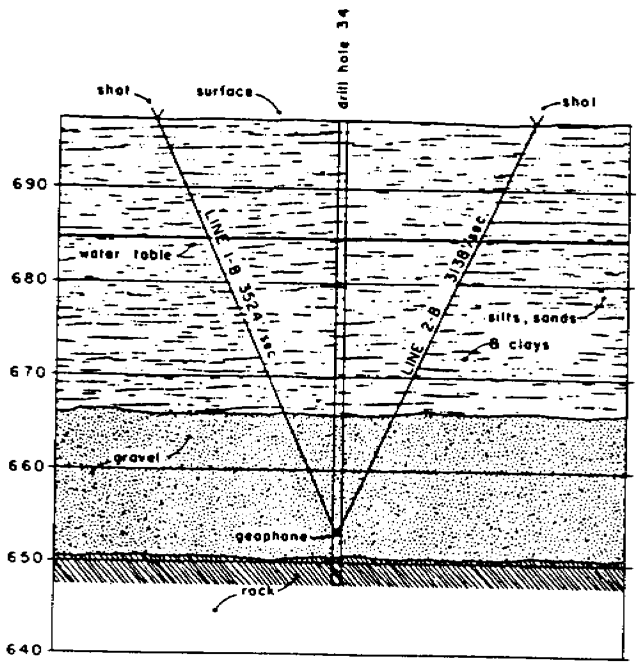
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL DYNAMICS INTAKE CHANNEL
STATION 13+ 26E, 21 + 12S

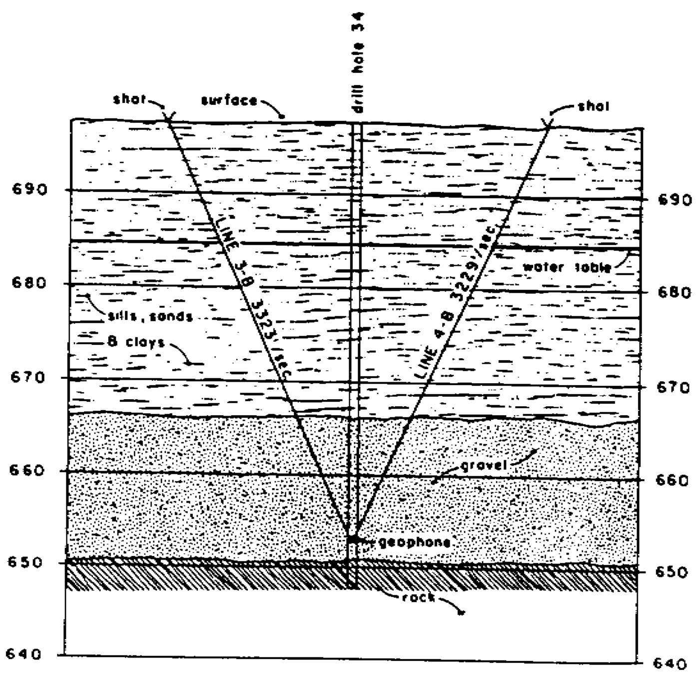
Figure 2.5-228



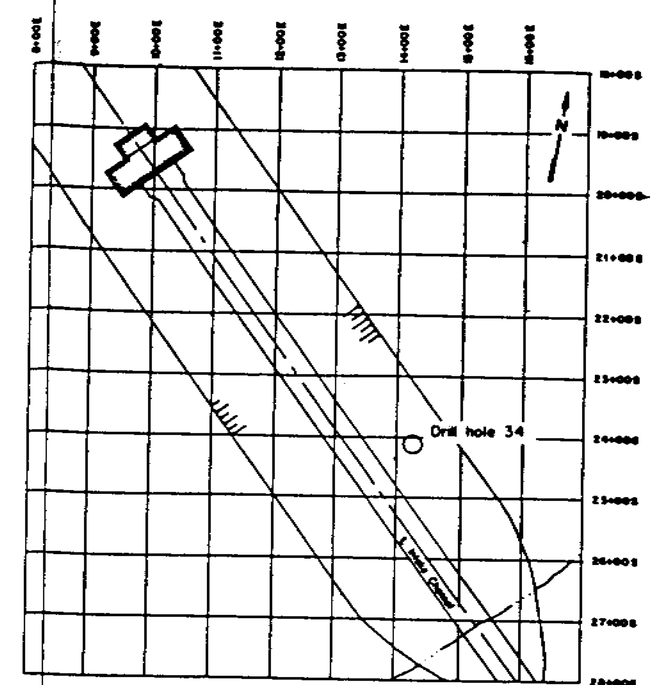

PLAN




SECTION A-A'




SECTION B-B'




KEY PLAN

| Seismic Line Number | Seismic Path Distance (Feet) | Compressional Velocity Ft./Sec. Measured | Shear Velocity Ft./Sec. Calculated | Density Lbs/Cu.Ft. Assumed | Poisson's Ratio Assumed | Dynamic Shear Modulus psi x $10^3$ Calculated | Dynamic Young's Modulus psi x $10^3$ Calculated |
|---|---|---|---|---|---|---|---|
| 1 - B | 49.24 | 3524 | 1062 | 90 | 0.45 | 21.91 | 63.55 |
| 2 - B | 49.24 | 3138 | 946 | 90 | 0.45 | 17.38 | 50.39 |
| 3 - B | 49.24 | 3323 | 1002 | 90 | 0.45 | 19.48 | 56.51 |
| 4 - B | 49.24 | 3229 | 973 | 90 | 0.45 | 18.39 | 53.35 |
| Average | 49.24 | 3303 | 996 | 90 | 0.45 | 19.25 | 55.83 |

NOTES:

1. The lines on the sections between shot points and geophone locations indicate only the travel direction of compressional waves.

2. The types of soils are based on general soil data obtained from the Construction Services Branch.

4. The equipment used in making the time measurements consisted of a Bison seismograph 1570B and recorder 1540, and a Hall Sears geophone MP-8.

5. Using all 4 seismic lines the shear modulus with a 67% confidence interval is 17,340 psi to 21,230 psi and with a 90% confidence interval it is 15,390 psi to 23,180 psi.

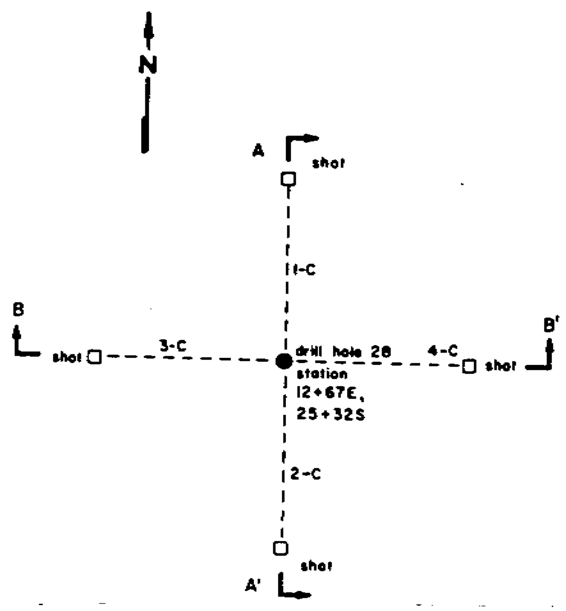
"HISTORICAL INFORMATION"

SCALE: 10 0 10 20 Feet

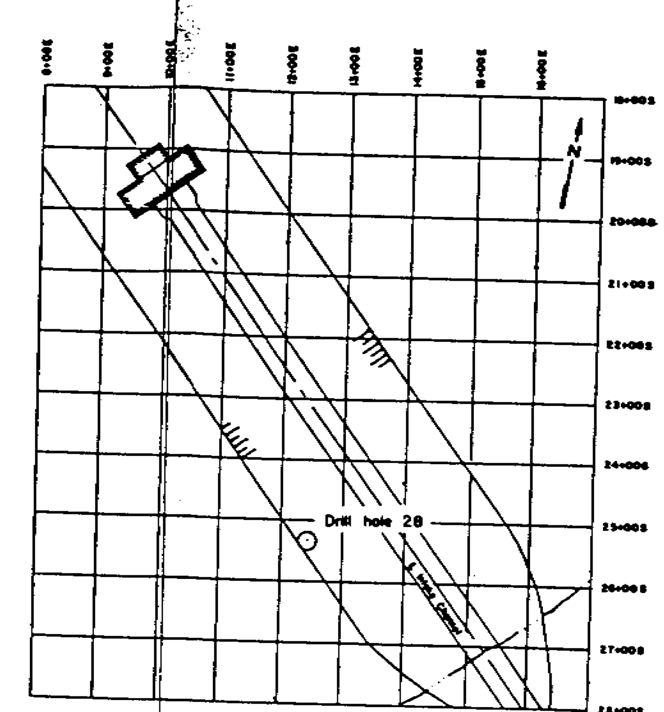
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL DYNAMICS INTAKE CHANNEL
STATION 14 + 27E, 24 + 12S

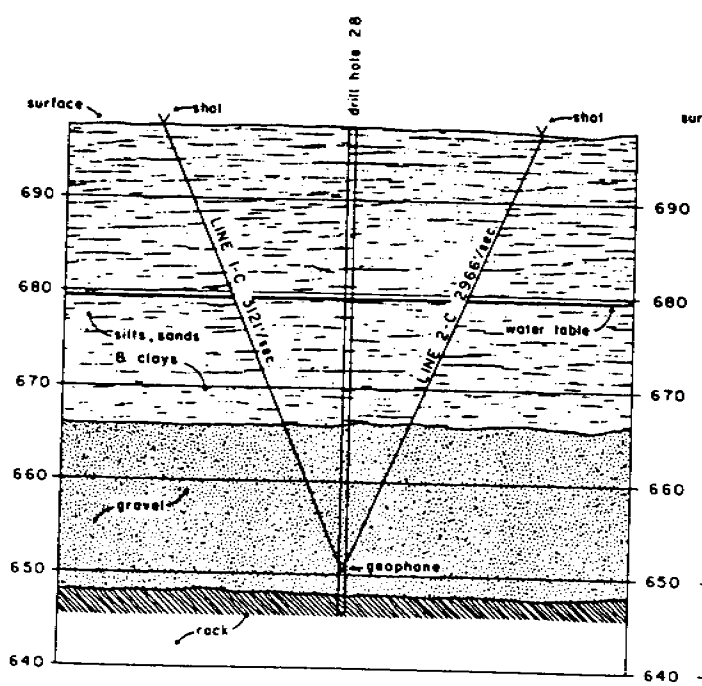
Figure 2.5-229



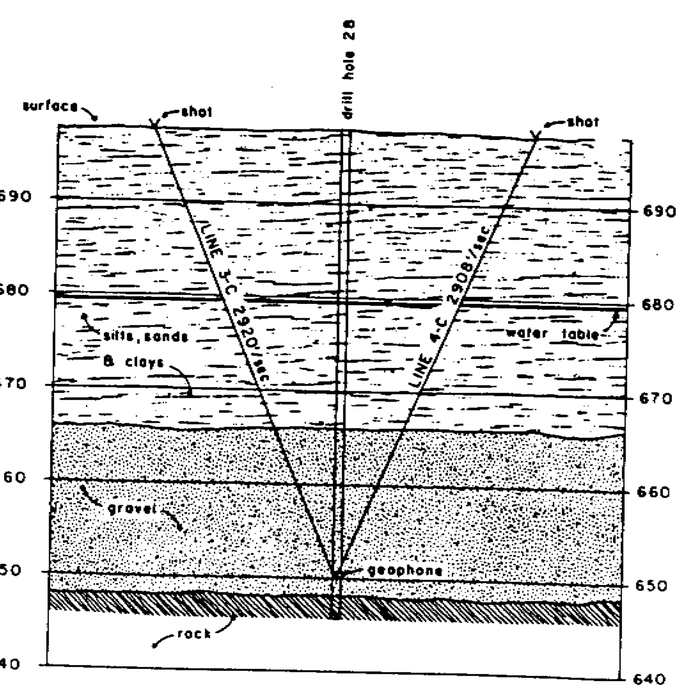

PLAN




KEY PLAN




SECTION A-A'




SECTION B-B'

| Seismic Line Number | Seismic Path Distance (Feet) | Compressional Velocity Ft./Sec. Measured | Shear Velocity Ft./Sec. Calculated | Density Lbs/Cu.Ft. Assumed | Poisson's Ratio Assumed | Dynamic Shear Modulus psi x $10^3$ Calculated | Dynamic Young's Modulus psi x $10^3$ Calculated |
|---|---|---|---|---|---|---|---|
| 1 - C | 52.0 | 3121 | 941 | 90 | 0.45 | 17.19 | 49.84 |
| 2 - C | 52.0 | 2966 | 894 | 90 | 0.45 | 15.52 | 45.02 |
| 3 - C | 52.0 | 2920 | 880 | 90 | 0.45 | 15.05 | 43.63 |
| 4 - C | 52.0 | 2908 | 877 | 90 | 0.45 | 14.92 | 43.27 |
| Average | 52.0 | 2979 | 898 | 90 | 0.45 | 15.66 | 45.41 |

NOTES:

1. The lines on the sections between shot points and geophone locations indicate only the travel direction of compressional waves.

2. The types of soils are based on general soil data obtained from the Construction Services Branch.

4. The equipment used in making the time measurements consisted of a Bison seismograph 1570B and recorder 1540, and a Hall Sears geophone HP-8.

5. Using all 4 seismic lines the shear modulus with a 67% confidence interval is 14,620 psi to 16,710 psi and with a 90% confidence interval it is 13,570 psi to 17,760 psi.

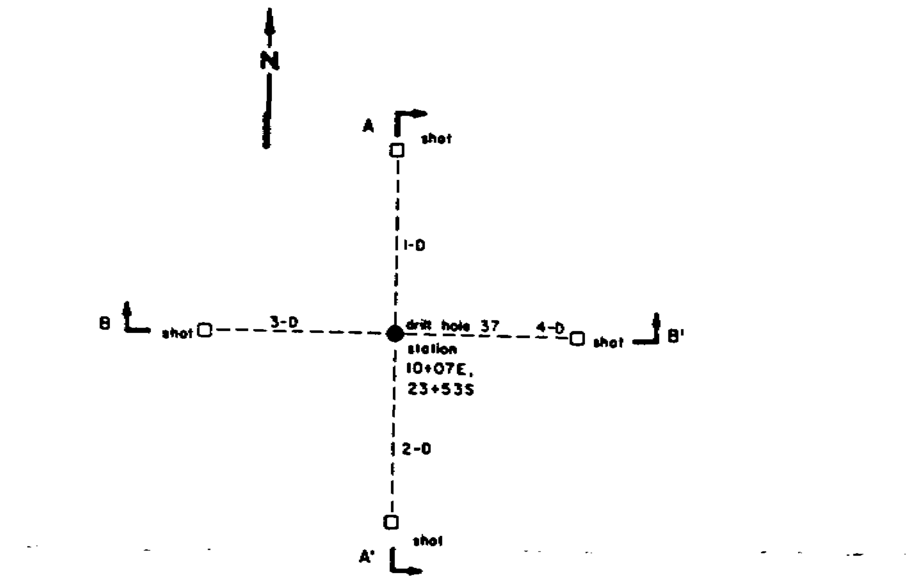
"HISTORICAL INFORMATION"

SCALE: 10 0 10 20 Feet

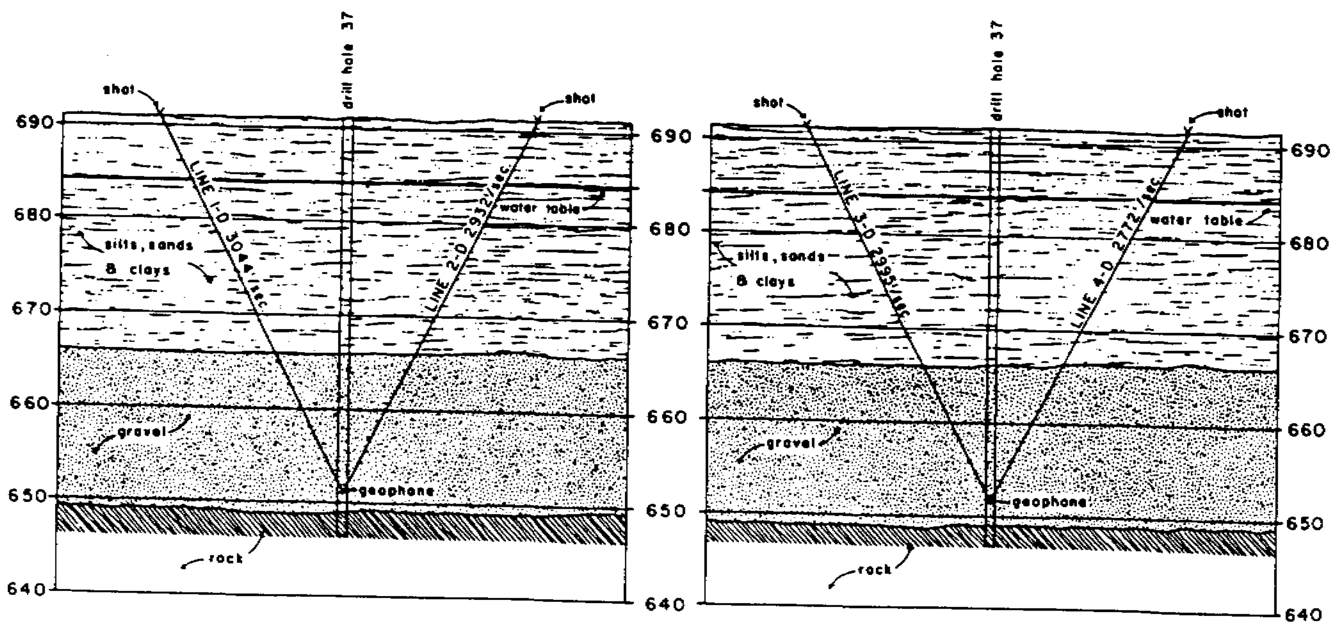
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL DYNAMICS INTAKE CHANNEL
STATION 12 + 67E, 25 + 32S

Figure 2.5-230

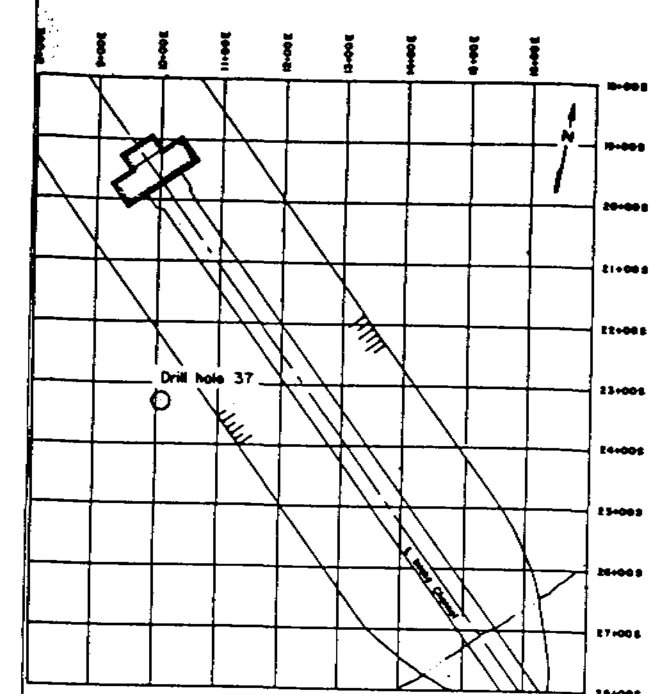



PLAN




SECTION A-A'

SECTION B-B'




KEY PLAN

| Seismic Line Number | Seismic Path Distance (Feet) | Compressional Velocity Ft./Sec. Measured | Shear Velocity Ft./Sec. Calculated | Density Lbs/Cu.Ft. Assumed | Poisson's Ratio Assumed | Dynamic Shear Modulus psi x $10^3$ Calculated | Dynamic Young's Modulus psi x $10^3$ Calculated |
|---|---|---|---|---|---|---|---|
| 1 - D | 44.72 | 3044 | 918 | 90 | 0.45 | 16.35 | 47.42 |
| 2 - D | 44.72 | 2932 | 884 | 90 | 0.45 | 15.17 | 43.99 |
| 3 - D | 44.72 | 2995 | 903 | 90 | 0.45 | 15.83 | 45.90 |
| 4 - D | 44.72 | 2772 | 836 | 90 | 0.45 | 13.56 | 39.32 |
| Average | 44.72 | 2936 | 885 | 90 | 0.45 | 15.21 | 44.11 |

NOTES:

1. The lines on the sections between shot points and geophone locations indicate only the travel direction of compressional waves.

2. The types of soils are based on general soil data obtained from the Construction Services Branch.

4. The equipment used in making the time measurements consisted of a Bison seismograph 1570B and recorder 1540, and a Hall Sears geophone MP-8.

5. Using all 4 seismic lines the shear modulus with a 67% confidence interval is 14.010 psi to 16.430 psi and with a 90% confidence interval it is 12.800 psi to 17.650 psi.

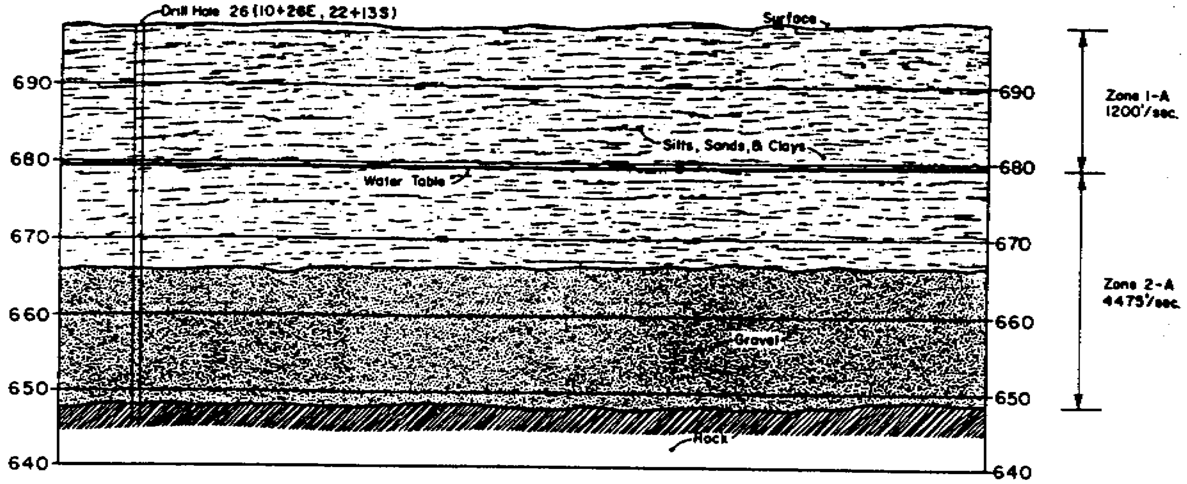
"HISTORICAL INFORMATION"

SCALE: 10 0 10 20 Feet

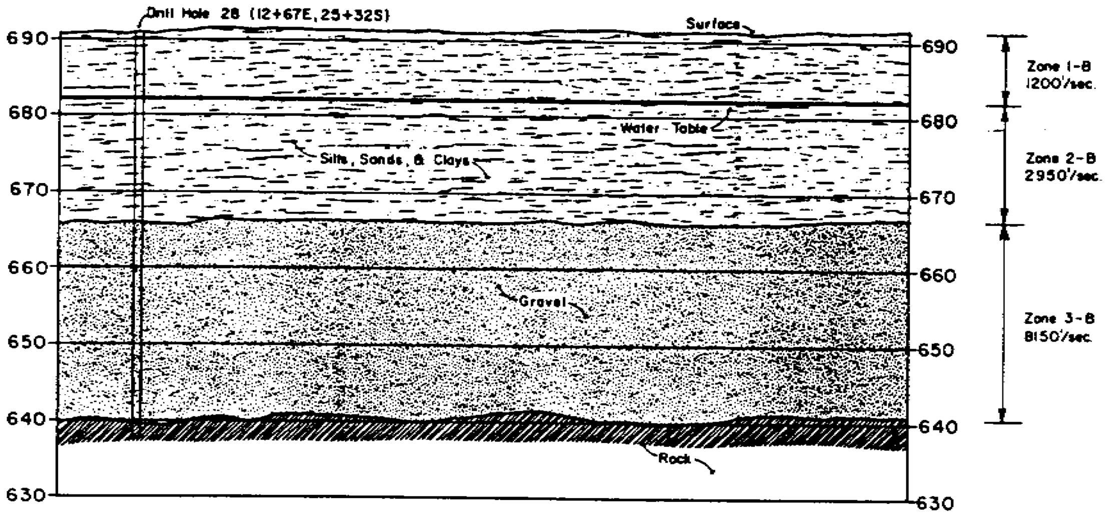
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL DYNAMICS INTAKE CHANNEL
STATION 10 + 07E, 23 + 53S

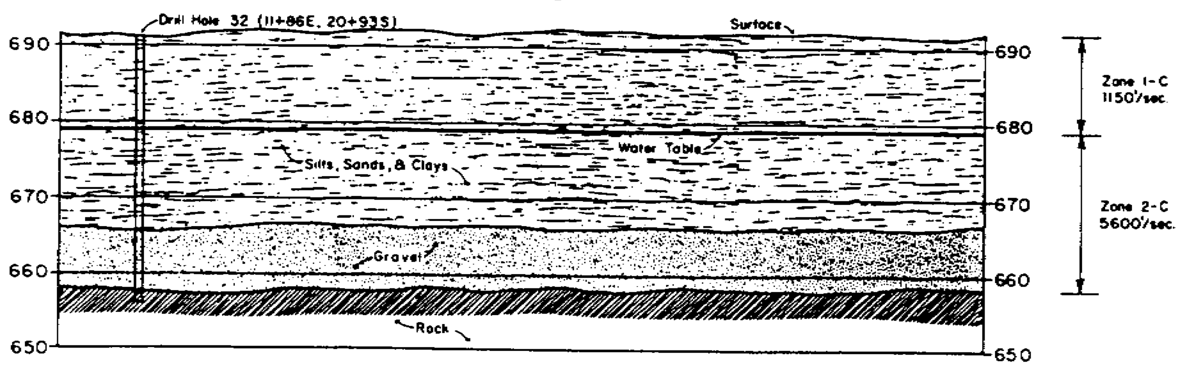
Figure 2.5-231



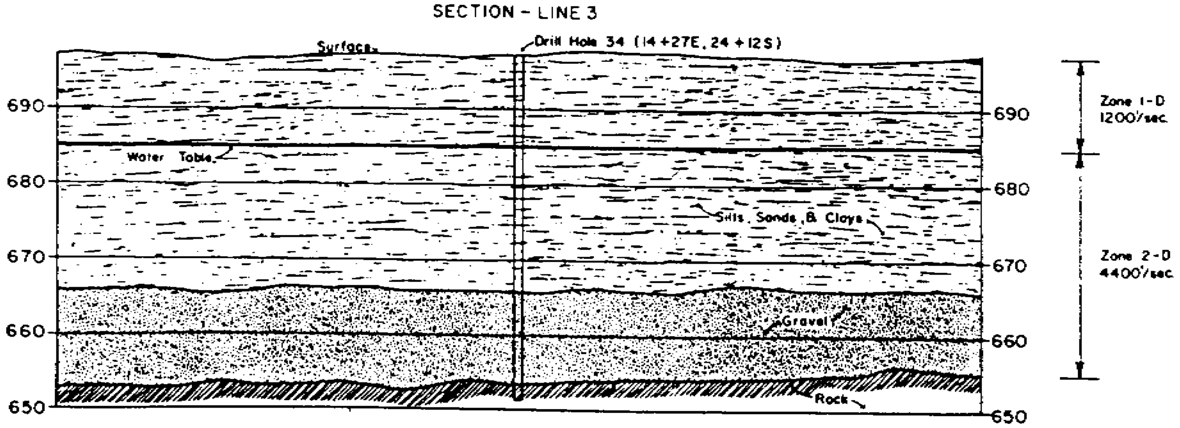

SECTION - LINE 1




SECTION - LINE 2



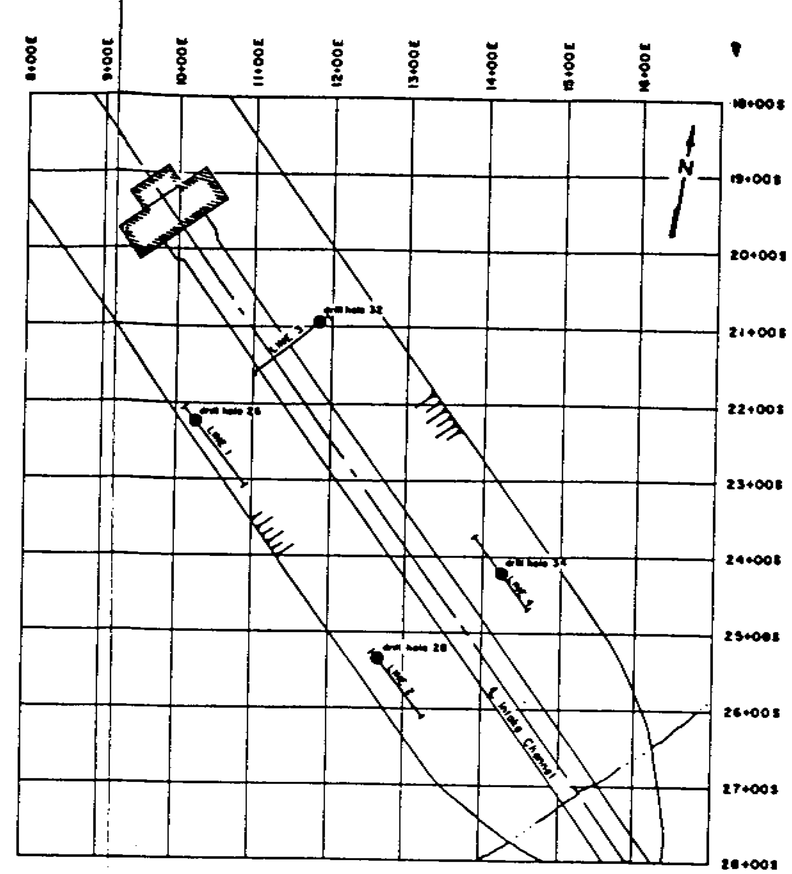

SECTION - LINE 3




SECTION - LINE 4

NOTES:

1. THE TYPES OF SOILS ARE BASED ON GENERAL SOIL DATA OBTAINED FROM THE CONSTRUCTION SERVICES BRANCH.
2. THE EQUIPMENT USED IN MAKING THE REFRACTION SURVEY CONSISTED OF A BISON SEISMOGRAPH 1570B AND RECORDER 1540.
3. THE REFRACTED COMPRESSIONAL VELOCITY OF 8150'/SEC. FOR LINE 2 IS ABNORMALLY HIGH FOR SATURATED GRAVELS. THIS VELOCITY IS NOT COMPATABLE WITH THE UP-HOLE SEISMIC VELOCITY MEASUREMENTS AND DOES NOT COMPARE FAVORABLE WITH LINES 1, 3 AND 4.
4. THE SOIL VELOCITIES BELOW THE WATER TABLE DO NOT DIFFERENTIATE BETWEEN SILTS AND GRAVELS. THIS MAY BE THE RESULT OF THE GRADATIONAL NATURE OF THE SOIL.
5. REFRACTED SHEAR VELOCITIES FOR ZONES 1 AND 2 ALONG LINES 1, 3 AND 4 WERE OBTAINED.
6. THE REFRACTION SEISMIC LINES WERE SURVEYED IN TWO DIRECTIONS WITH APPARENT VELOCITIES BEING AVERAGED FOR EACH LINE.




KEY PLAN

SCALE: 0 100Feet

SEISMIC REFRACTION LINES
SOIL DYNAMIC PROPERTIES

| SEISMIC REFRACTION LINE | VELOCITY ZONES ELEVATIONS | COMPRESSIONAL VELOCITY FT./SEC. MEASURED | SHEAR VELOCITY FT./SEC. | DENSITY LBS./CU. FT. ASSUMED | POISSON'S RATIO CALCULATED | DYNAMIC SHEAR MODULUS PSI x $10^3$ CALCULATED | DYNAMIC YOUNG'S MODULUS PSI x $10^3$ CALCULATED |
|---|---|---|---|---|---|---|---|
| LINE 1 | 697 - 679 | 1200 | 545 MEASURED | 90 | 0.37 | 5.77 | 15.80 |
| | 679 - 648 | 4750 | 1130 MEASURED | 90 | 0.46 | 32.44 | 94.72 |
| LINE 2 | 691 - 682 | 1200 | 545 CALCULATED | 90 | 0.37 | 5.77 | 15.80 |
| | 682 - 666 | 2950 | 803 CALCULATED | 90 | 0.46 | 12.51 | 36.54 |
| | 666 - 640 | 8150 | 2218 CALCULATED | 90 | 0.46 | 95.50 | 278.86 |
| LINE 3 | 691 - 679 | 1150 | 522 MEASURED | 90 | 0.37 | 5.29 | 14.51 |
| | 679 - 658 | 5600 | 1524 MEASURED | 90 | 0.46 | 45.09 | 131.66 |
| LINE 4 | 697 - 685 | 1200 | 545 MEASURED | 90 | 0.37 | 5.77 | 15.80 |
| | 685 - 654 | 4400 | 1150 MEASURED | 90 | 0.46 | 25.67 | 75.13 |

DYNAMIC SHEAR MODULUS
SEISMIC LINES 1, 3 AND 4
STANDARD DEVIATION

| ZONE | 67% CONFIDENCE INTERVAL PSI x $10^3$ | 90% CONFIDENCE INTERVAL PSI x $10^3$ | AVERAGE PSI x $10^3$ |
|---|---|---|---|
| 1 | 5.33 TO 5.88 | 5.05 TO 6.16 | 5.61 |
| 2 | 9.85 TO 24.54 | 14.68 TO 54.11 | 34.40 |

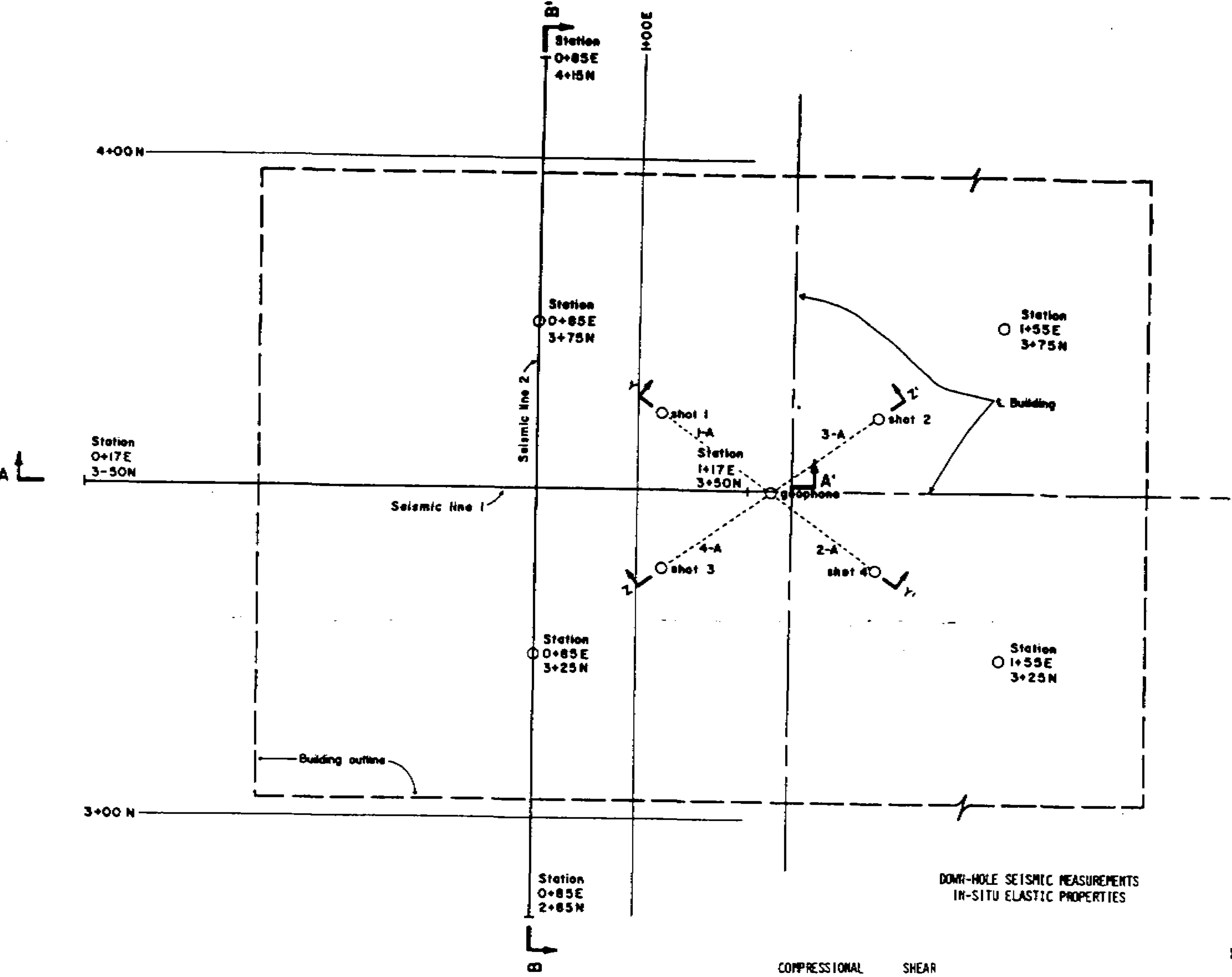
*"HISTORICAL INFORMATION"*

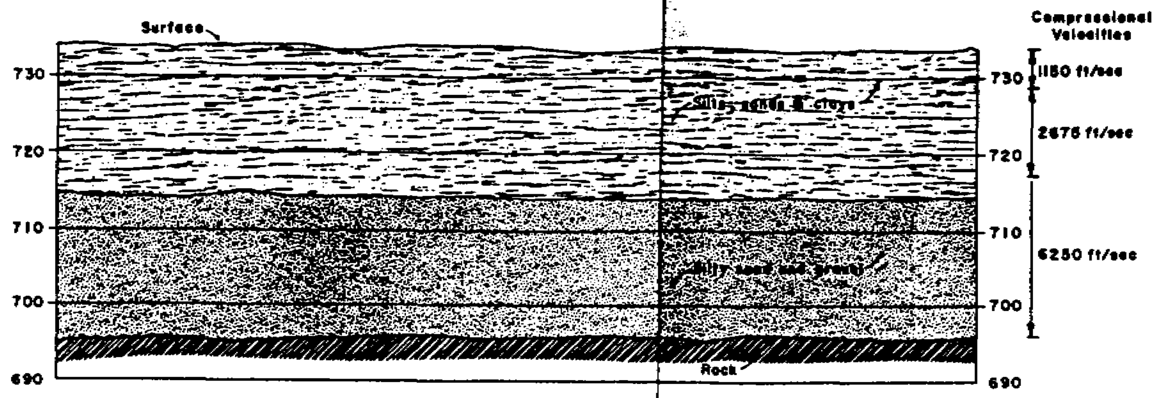
SCALE: 10 0 10 20 Feet

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

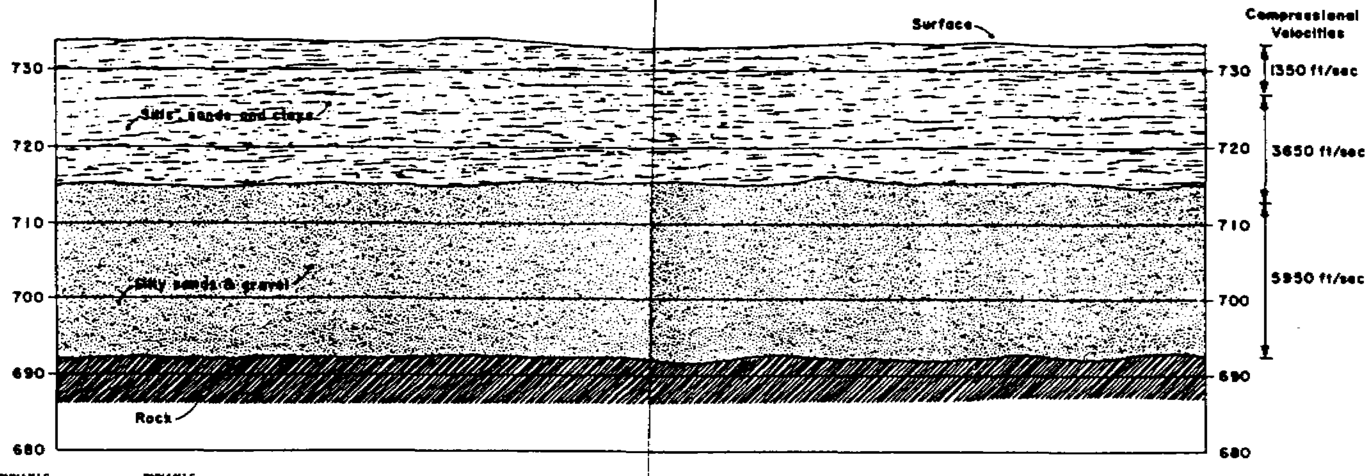
SEISMIC REFRACTION DYNAMIC PROPERTIES INTAKE CHANNEL

Figure 2.5-232

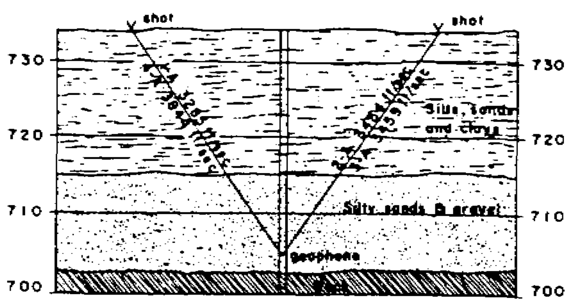



SECTION A-A'




SECTION B-B'




SECTIONS Y-Y' & Z-Z'

DOWN-HOLE SEISMIC MEASUREMENTS
IN-SITU ELASTIC PROPERTIES

| SEISMIC LINE NUMBER | SEISMIC PATH DISTANCE (FEET) | COMPRESSIONAL VELOCITY FT./SEC. MEASURED | SHEAR VELOCITY FT./SEC. CALCULATED | DENSITY LBS./CU. FT. ASSUMED | POISSON'S RATIO ASSUMED | DYNAMIC SHEAR MODULUS PSI x $10^3$ CALCULATED | DYNAMIC YOUNG'S MODULUS PSI x $10^3$ CALCULATED |
|---|---|---|---|---|---|---|---|
| 1 - A | 36.06 | 3205 | 966 | 90 | 0.45 | 18.13 | 52.56 |
| 2 - A | 36.06 | 3434 | 1035 | 90 | 0.45 | 20.81 | 60.34 |
| 3 - A | 36.06 | 3354 | 1011 | 90 | 0.45 | 19.85 | 57.56 |
| 4 - A | 36.06 | 3844 | 1159 | 90 | 0.45 | 26.07 | 75.61 |
| AVERAGE | 36.06 | 3459 | 1042 | 90 | 0.45 | 21.11 | 61.23 |

STANDARD DEVIATION
DOWN-HOLE SEISMIC MEASUREMENTS
DYNAMIC SHEAR MODULUS PSI x $10^3$

| 67% CONFIDENCE INTERVAL | 90% CONFIDENCE INTERVAL |
|---|---|
| 17.79 TO 24.63 | 14.37 TO 28.05 |

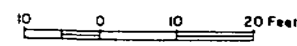
SEISMIC REFRACTION LINES
IN-SITU DYNAMIC PROPERTIES

| SEISMIC REFRACTION LINE | VELOCITY ZONES ELEVATIONS | COMPRESSIONAL VELOCITY FT./SEC. MEASURED | SHEAR VELOCITY FT./SEC. | DENSITY LBS./CU. FT. ASSUMED | POISSON'S RATIO CALCULATED | DYNAMIC SHEAR MODULUS PSI x $10^3$ CALCULATED | DYNAMIC YOUNG'S MODULUS PSI x $10^3$ CALCULATED |
|---|---|---|---|---|---|---|---|
| 1 | 734 TO 729 | 1150 | 552 CALCULATED | 90 | 0.35 | 5.92 | 15.99 |
| | 729 TO 717 | 2675 | 1176 CALCULATED | 90 | 0.38 | 26.88 | 74.19 |
| | 717 TO 697 | 6250 | 1701 CALCULATED | 90 | 0.46 | 56.16 | 163.99 |
| 2 | 734 TO 727 | 1350 | 645 MEASURED | 90 | 0.35 | 8.08 | 21.84 |
| | 727 TO 713 | 3650 | 1587 MEASURED | 90 | 0.38 | 48.89 | 135.26 |
| | 713 TO 692 | 5950 | 1619 CALCULATED | 90 | 0.46 | 50.90 | 148.63 |

NOTES:

1. THE TYPES OF SOILS ARE BASED ON GENERAL SOIL DATA OBTAINED FROM CONSTRUCTION SERVICES BRANCH.
2. THE EQUIPMENT USED IN MAKING THE REFRACTION SURVEY CONSISTED OF A BISON SEISMOGRAPH 1570B AND RECORDER 1540.
3. THE WATER TABLE FOR THE SEISMIC LINES WAS NOT RECORDED.
4. THE REFRACTION SEISMIC LINES WERE SURVEYED IN TWO DIRECTIONS WITH APPARENT VELOCITIES BEING AVERAGED FOR EACH LINE.

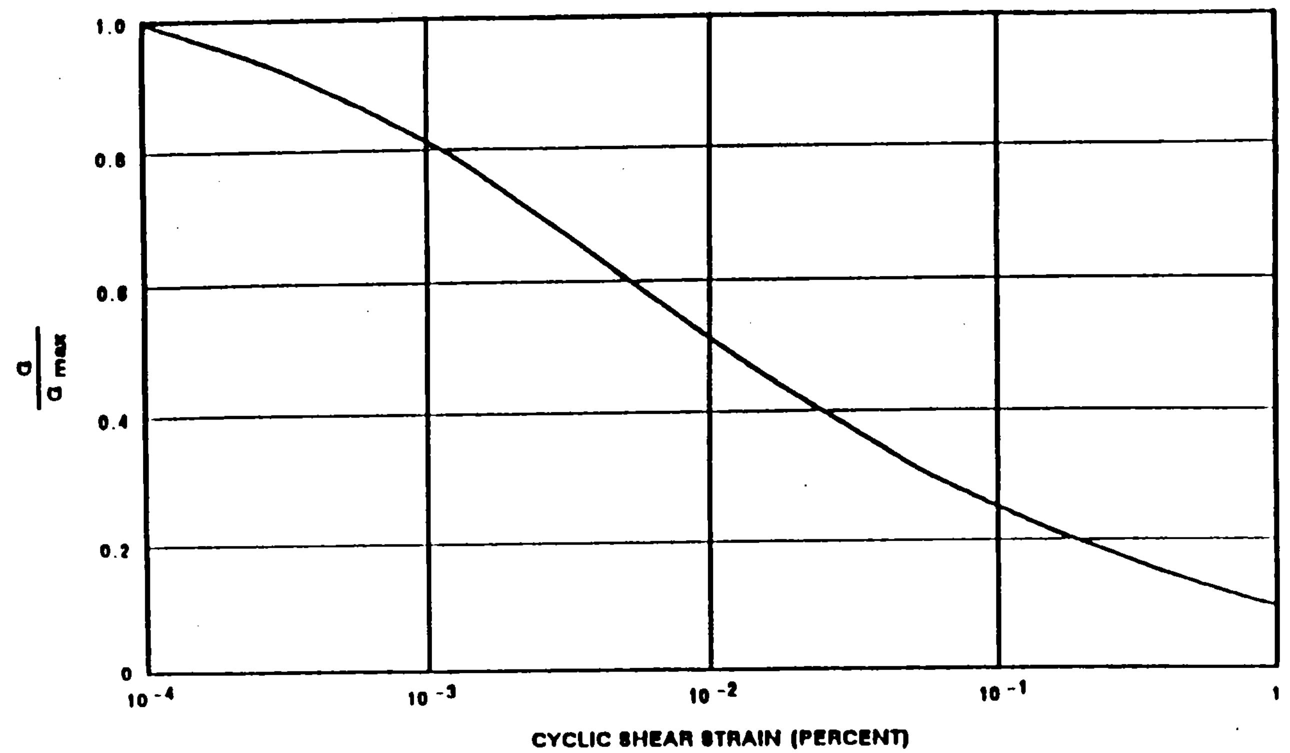
SCALE:




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

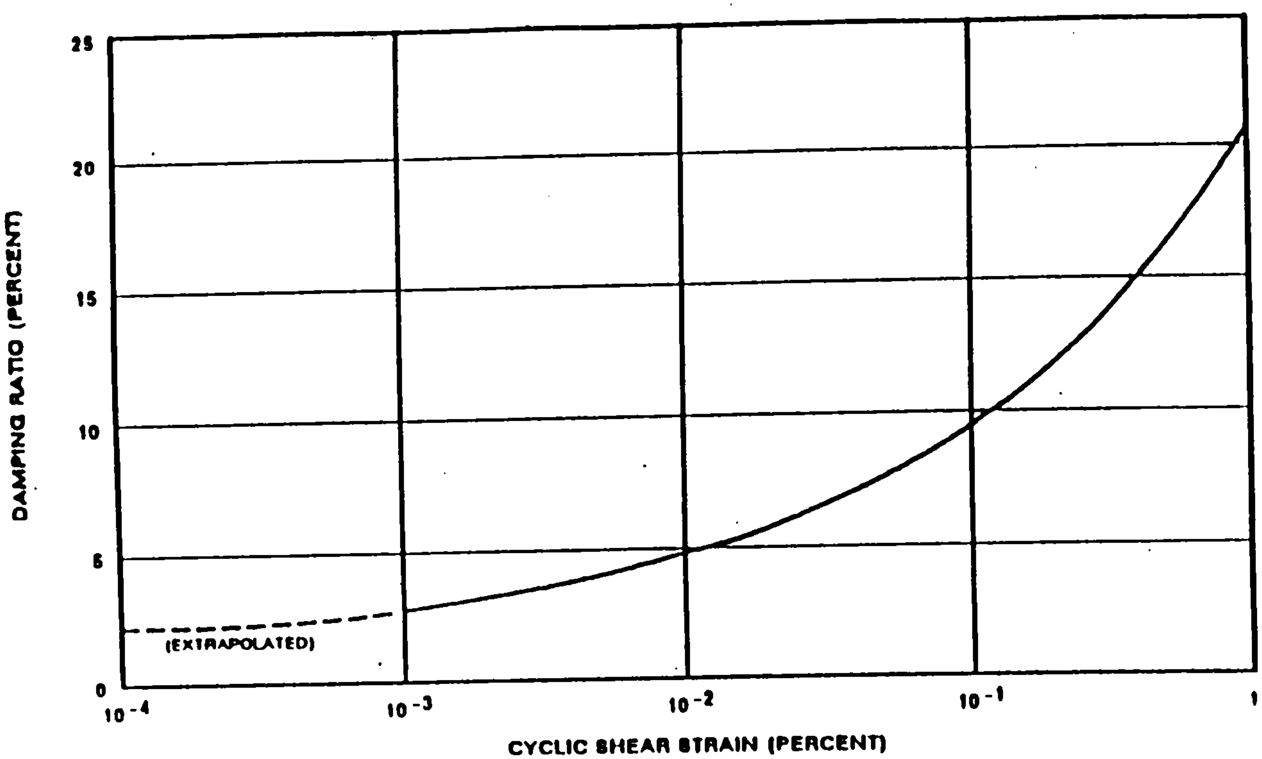
SOIL DYNAMICS DEISEL GENERATOR
BUILDING DOWN HOLE SEISMIC 8
REFRACTION MEASUREMENT
Figure 2.5-233

"HISTORICAL INFORMATION"




HISTORICAL

| |
|---|
| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
| CLASS A BACKFILL<br><br>SHEAR MODULUS REDUCTION<br>WITH SHEAR STRAIN |
| Figure 2.5-233A |




HISTORICAL

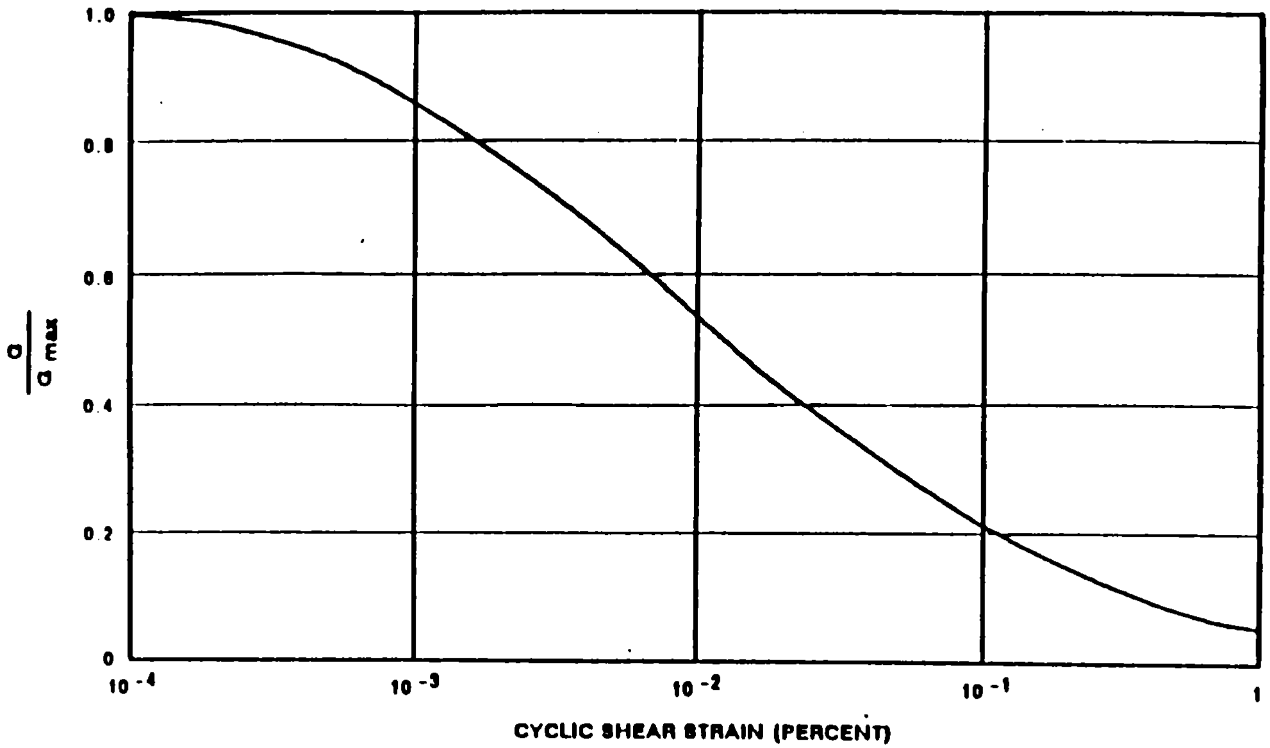
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS A BACKFILL

DAMPING RATIO VARIATION
WITH SHEAR STRAIN

Figure 2.5-233B

HISTORICAL




HISTORICAL

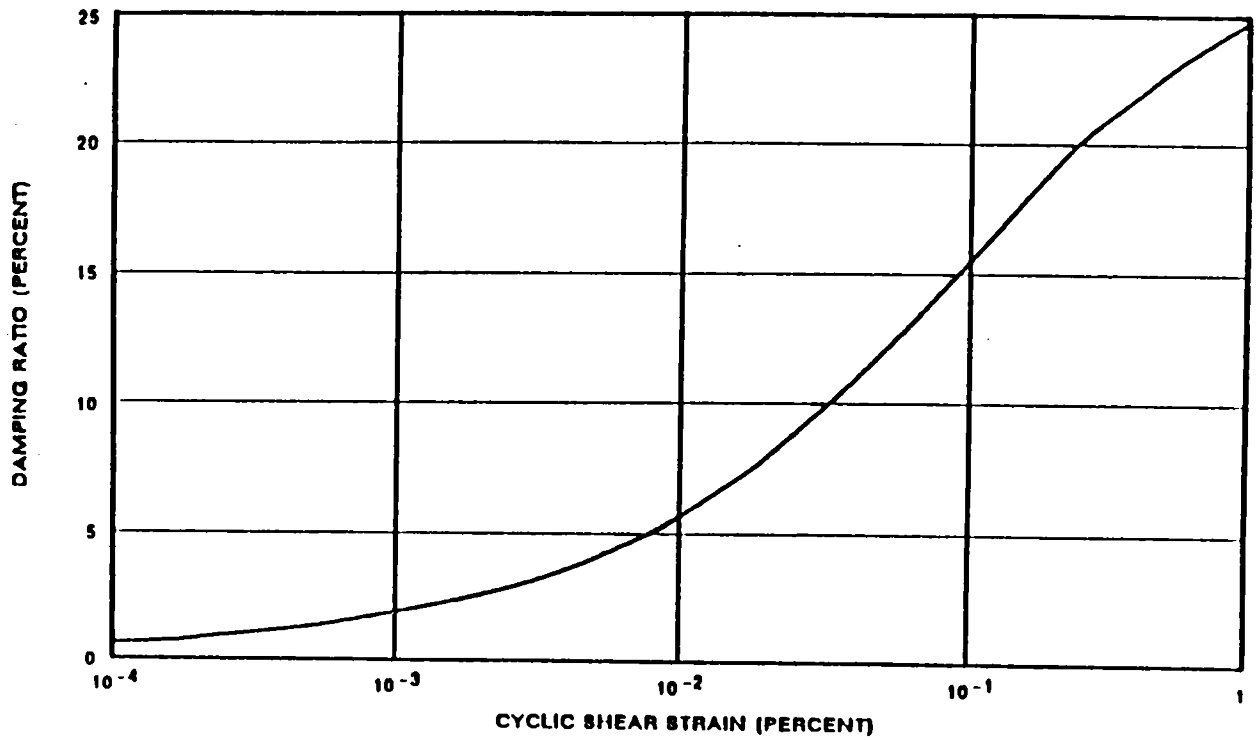
HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CRUSHED STONE BACKFILL

SHEAR MODULUS REDUCTION
WITH SHEAR STRAIN

Figure 2.5-233C



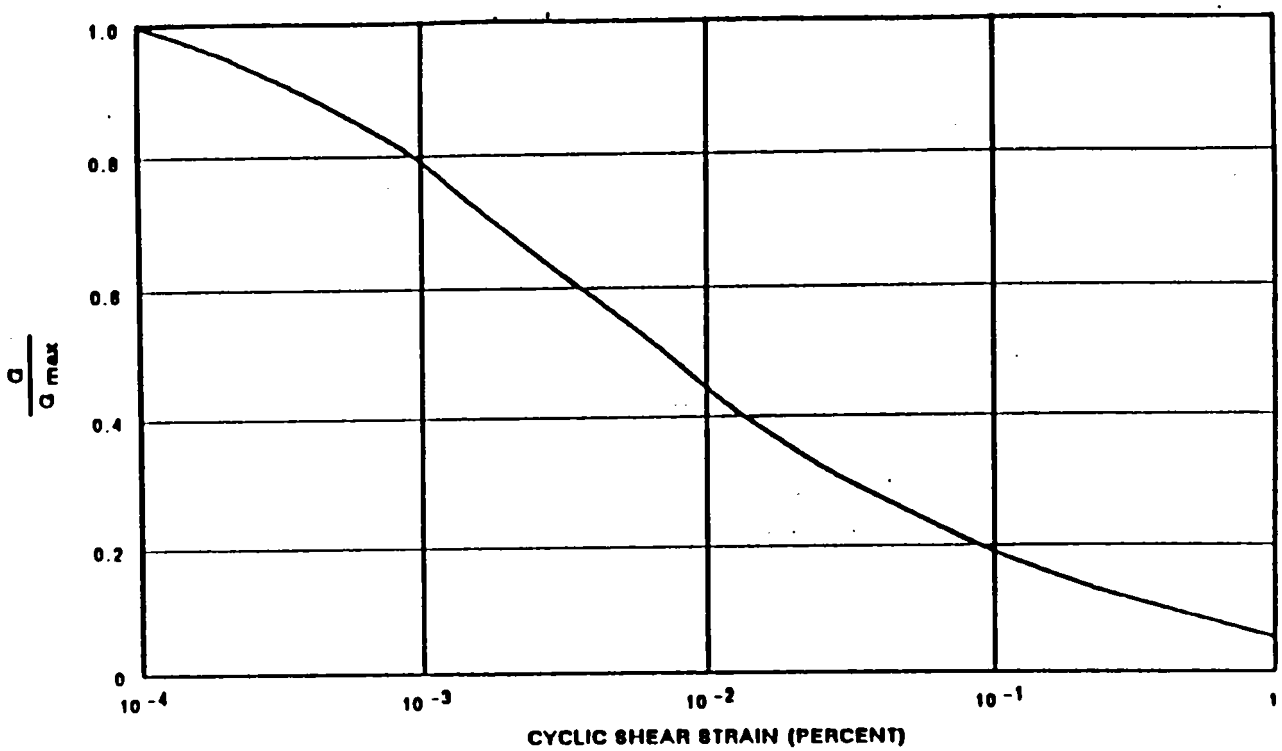

HISTORICAL
HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CRUSHED STONE BACKFILL

DAMPING RATIO VARIATION
WITH SHEAR STRAIN

Figure 2.5-233D




HISTORICAL

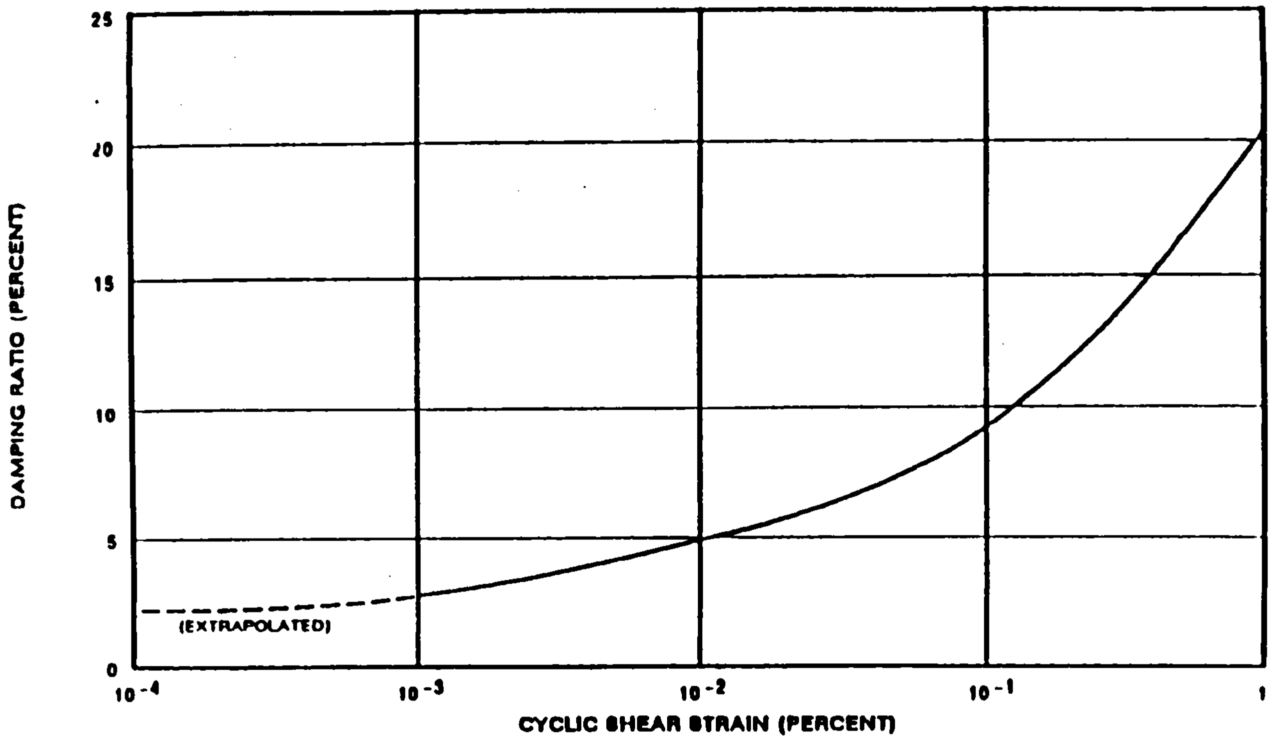
HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

IN SITU COHESIVE SOILS

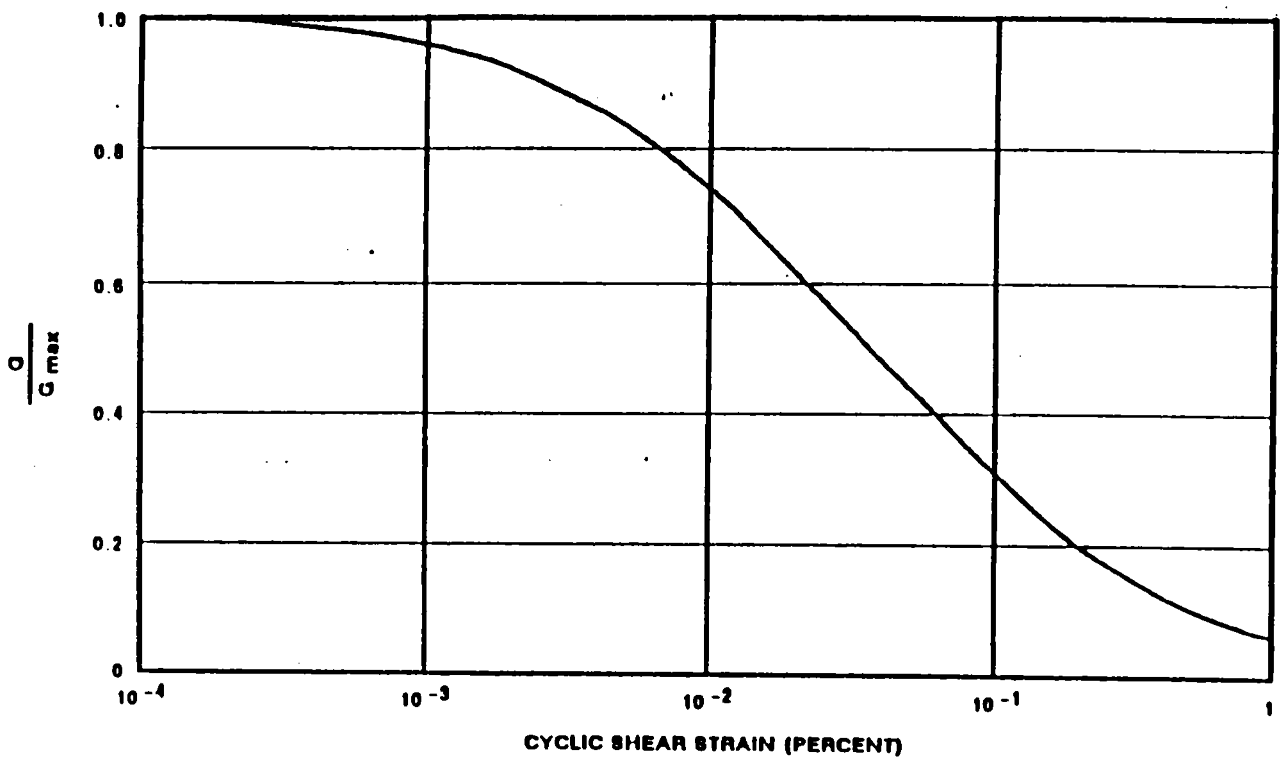
SHEAR MODULUS REDUCTION
WITH SHEAR STRAIN

Figure 2.5-233B




HISTORICAL

| |
|---|
| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
| IN SITU COHESIVE SOILS<br><br>DAMPING RATIO VARIATION<br>WITH SHEAR STRAIN |
| Figure 2.5-233F |



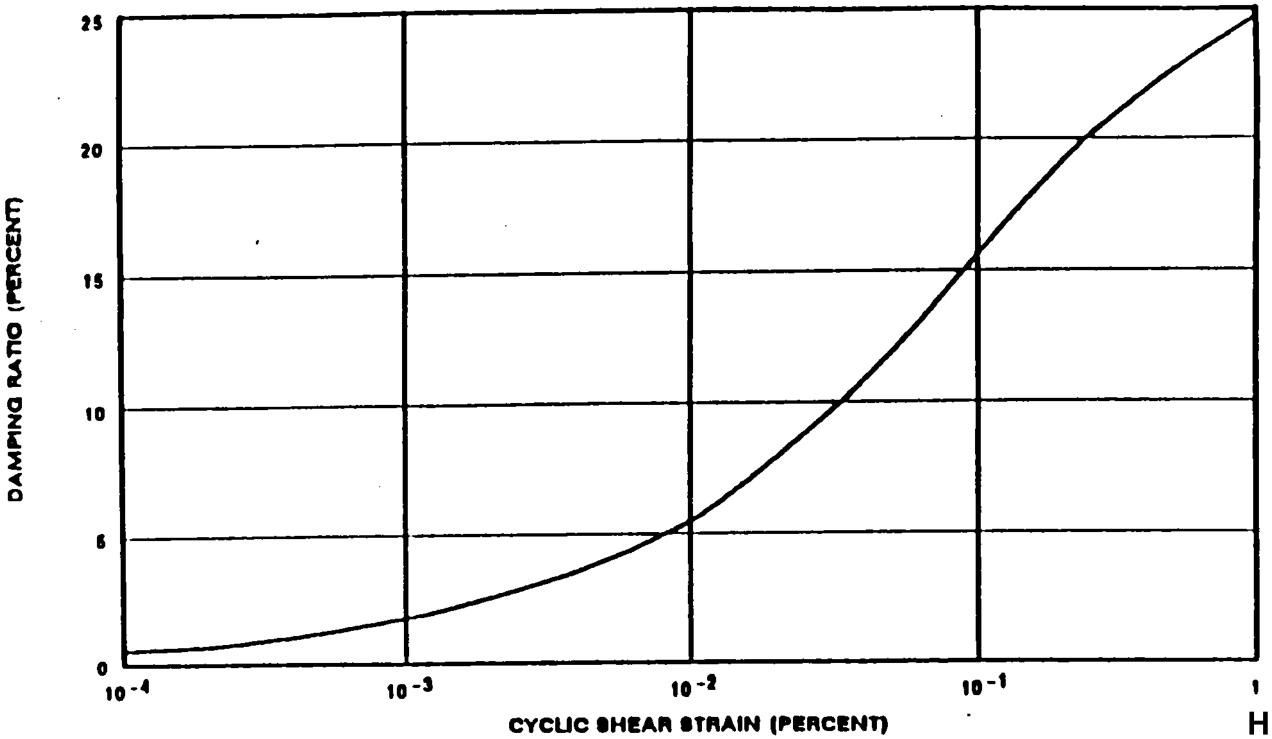

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

NON-PLASTIC IN SITU SOIL

SHEAR MODULUS REDUCTION
WITH SHEAR STRAIN

Figure 2.5-233G




HISTORICAL

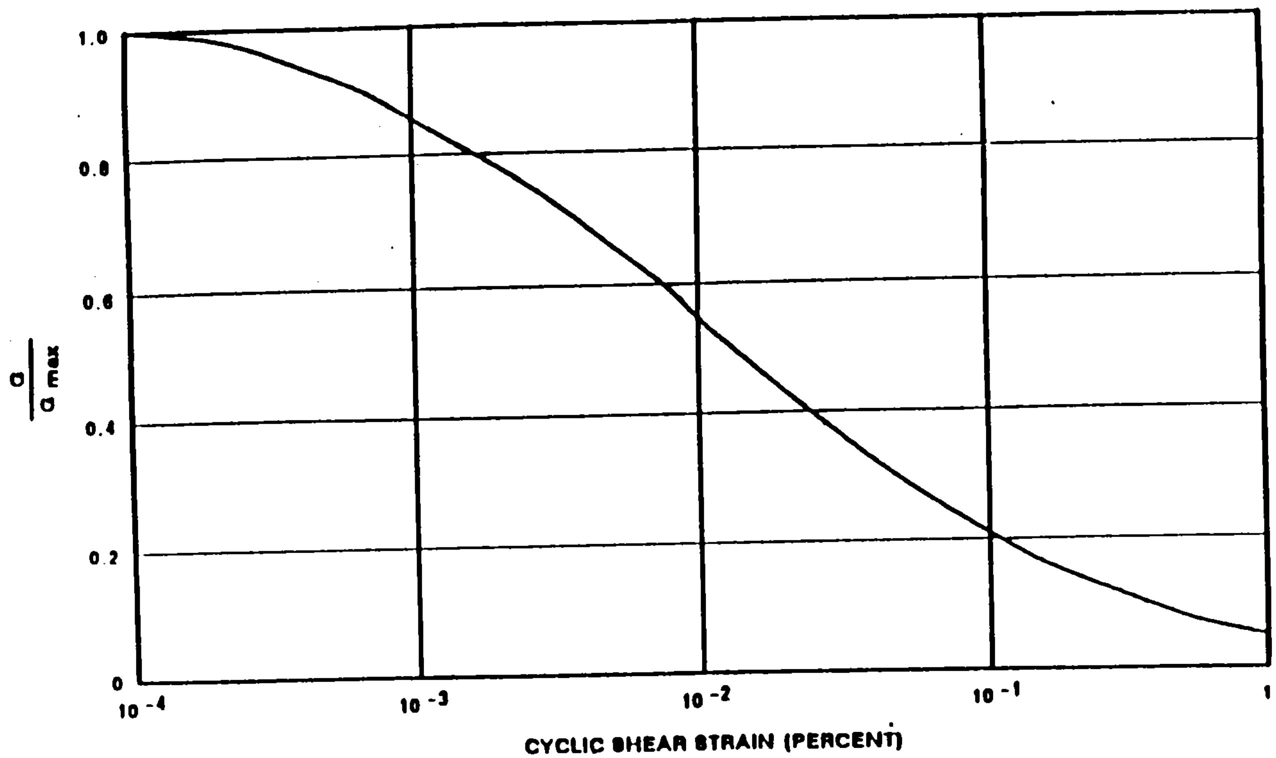
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

NON-PLASTIC IN SITU SOILS

DAMPING RATIO VARIATION
WITH SHEAR STRAIN

Figure 2.5-233H

HISTORICAL




HISTORICAL

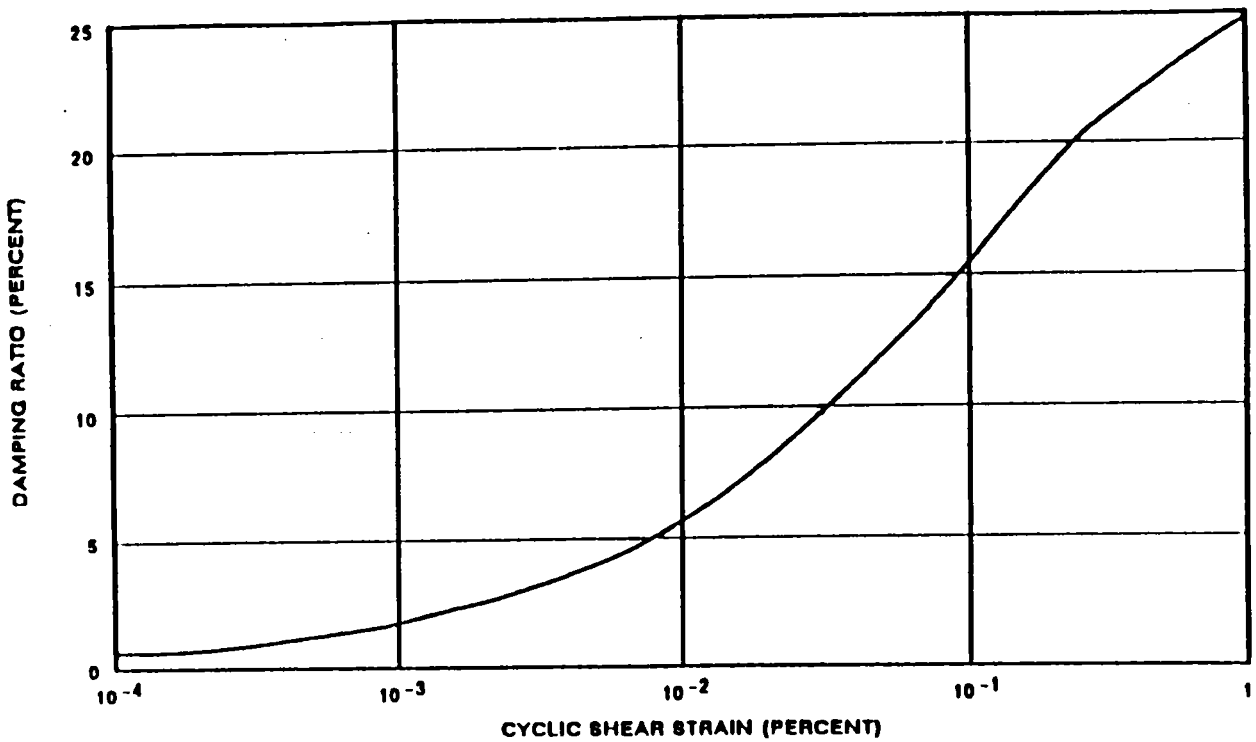
HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

BASAL GRAVEL

SHEAR MODULUS REDUCTION
WITH SHEAR STRAIN

Figure 2.5-233I




HISTORICAL

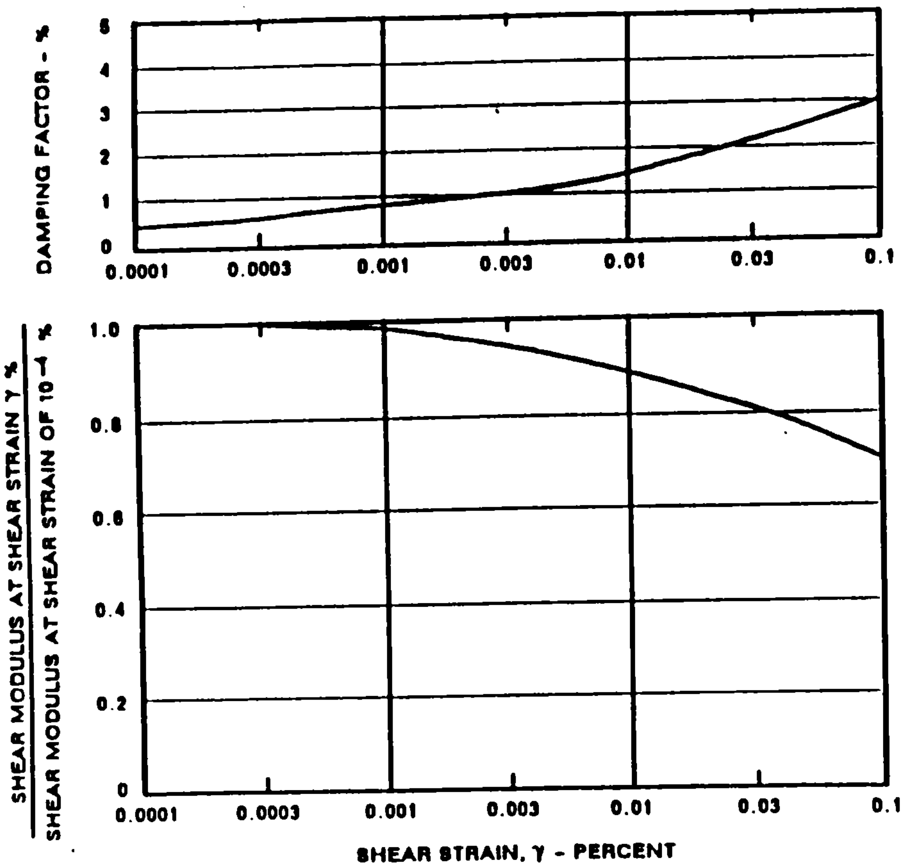
HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

BASAL GRAVEL

DAMPING RATIO VARIATION
WITH SHEAR STRAIN

Figure 2.5-233J



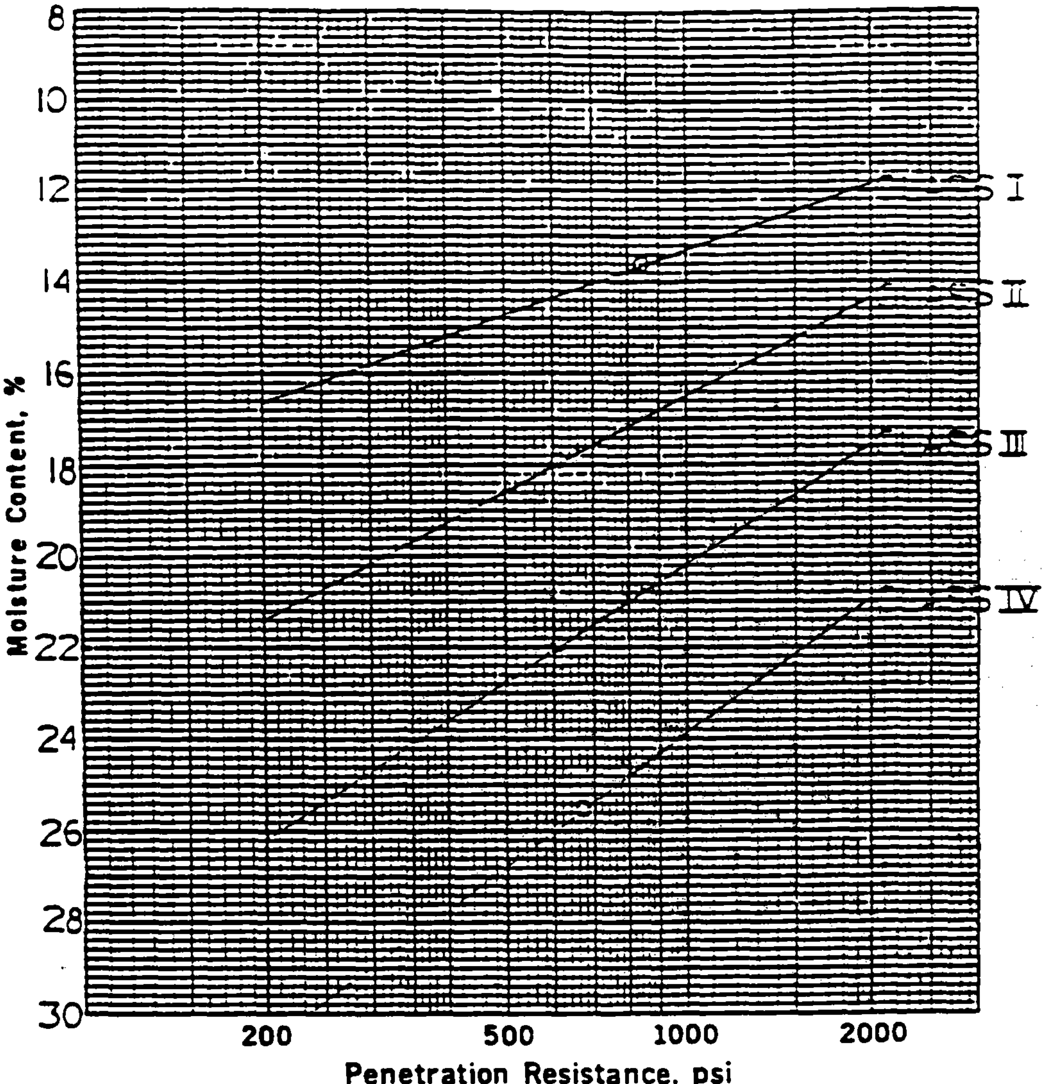

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**WEATHERED SHALE**

**SHEAR MODULUS AND DAMPING**
**VARIATION WITH SHEAR STRAIN**

**Figure 2.5-233K**




| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-SC | 13.6 | 116.3 | 850 |
| II-CL | 17.9 | 108.0 | 615 |
| III-MH | 21.8 | 101.1 | 615 |
| IV-MH | 25.5 | 94.2 | 680 |
| | | | |

Remarks:

REVISED 12-8-82

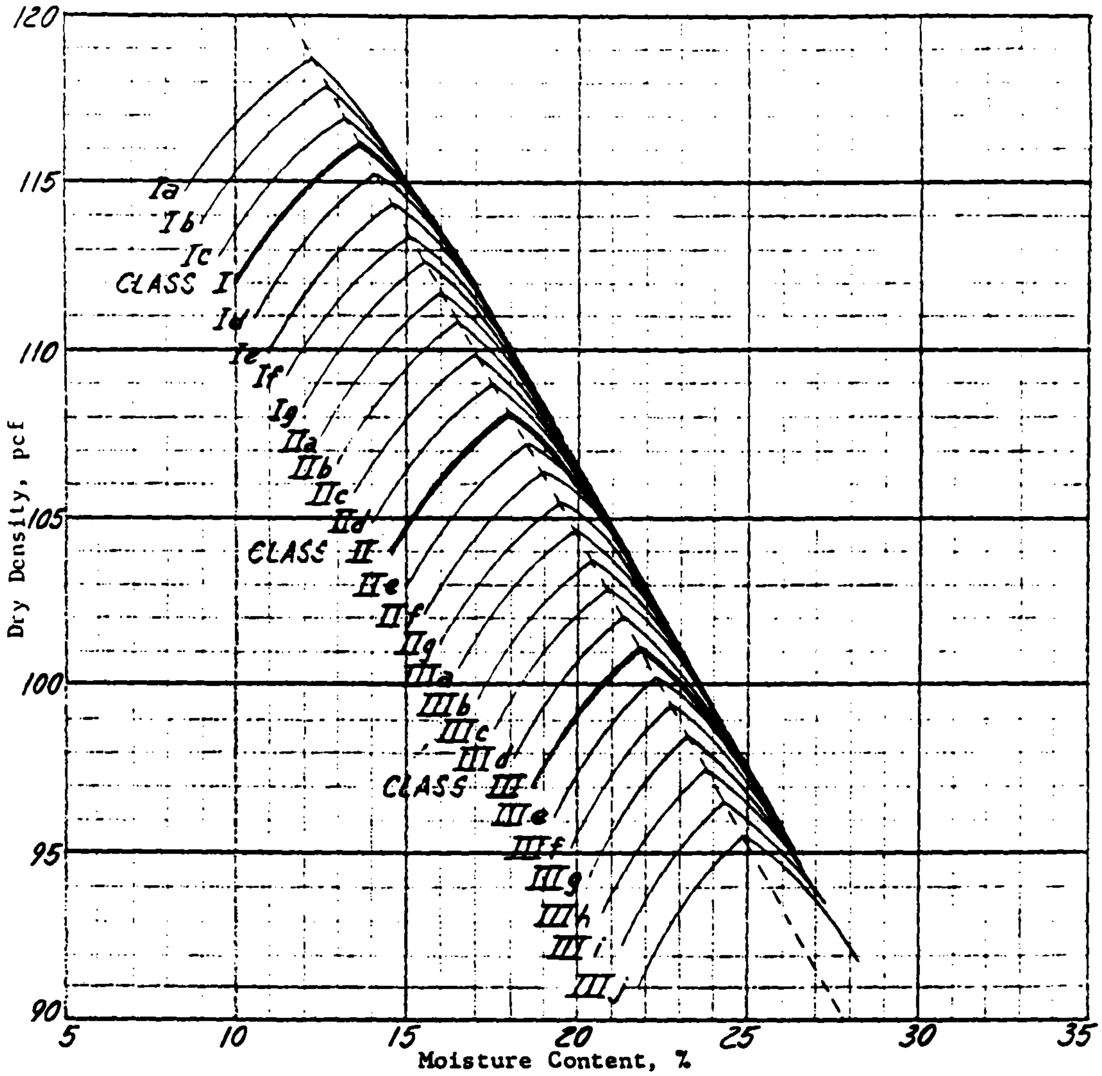
○ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

MAIN PLANT BORROW AREAS

MOISTURE-PENETRATION TEST

Figure 2.5-234




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-SC | 0 | 54 | 25 | 21 | 2.71 | 25.4 | 7.8 | 13.6 | 116.3 |
| II-CL | 0 | 35 | 29 | 36 | 2.73 | 41.9 | 18.6 | 17.9 | 108.0 |
| III-MH | 0 | 24 | 30 | 46 | 2.76 | 50.6 | 22.1 | 21.8 | 101.1 |
| | | | | | | | | | |
| | | | | | | | | | |

| Plus No. 4 Specific Gravity, SSD | |
|---|---|
| Plus No. 4 Absorption, % | |

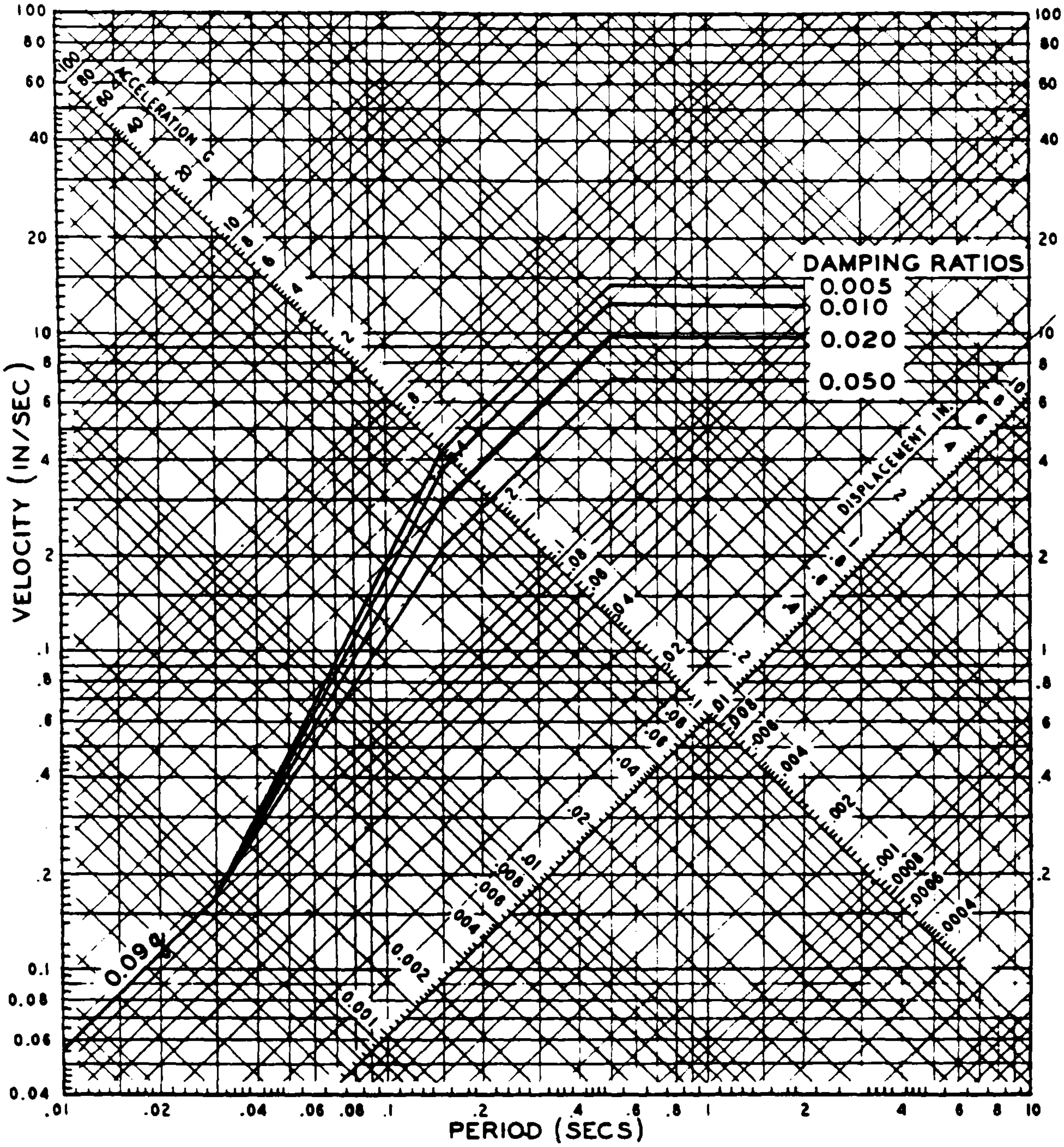
Remarks:

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

COMPACTION TEST
BORROW AREAS (family of curves)
date tested 1-5-73

Figure 2.5-235

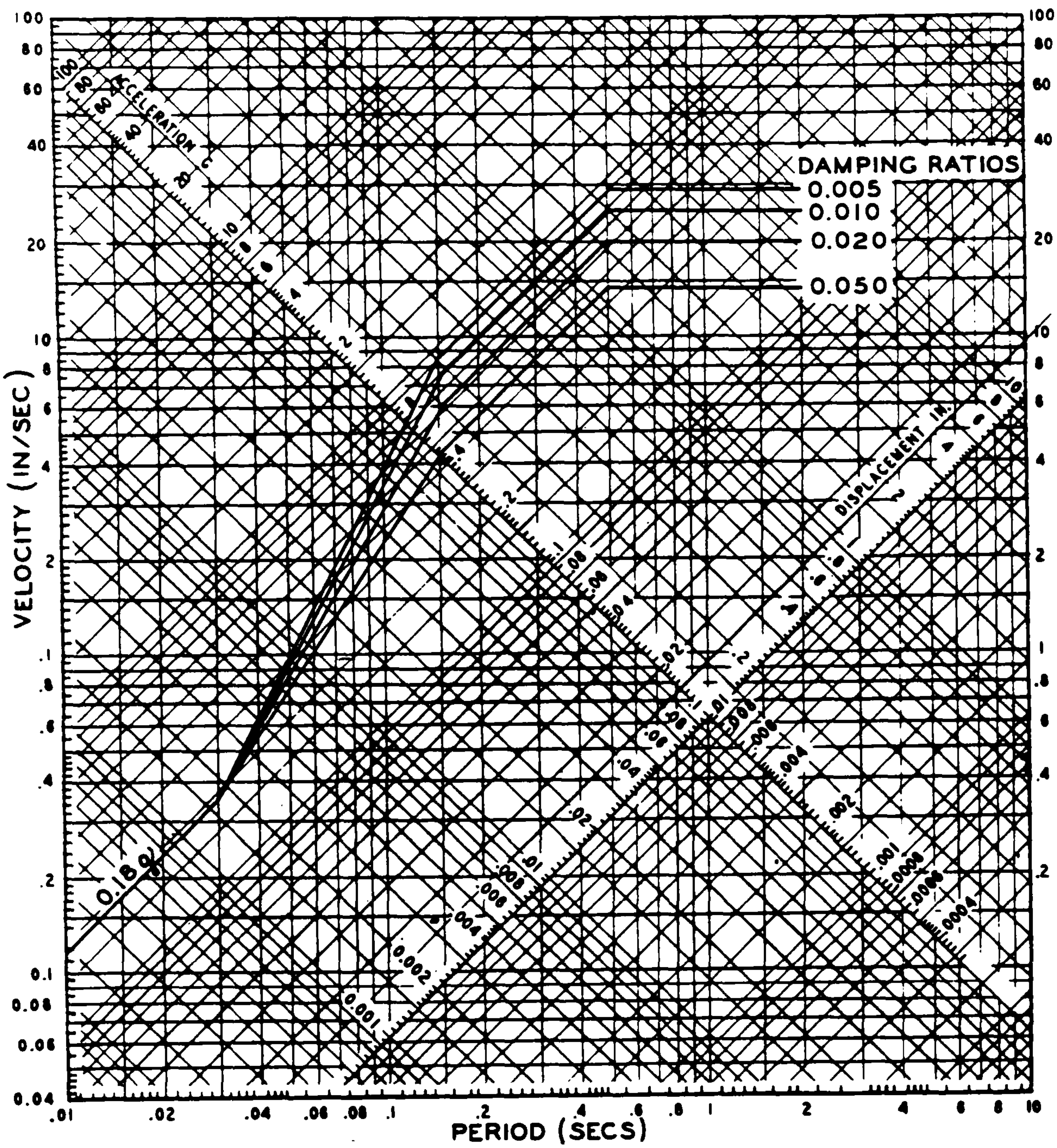
Soil Form 14




**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

OPERATING BASIS EARTHQUAKE RESPONSE SPECTRA FOR ROCK SUPPORT STRUCTURES

Figure 2.5-236a

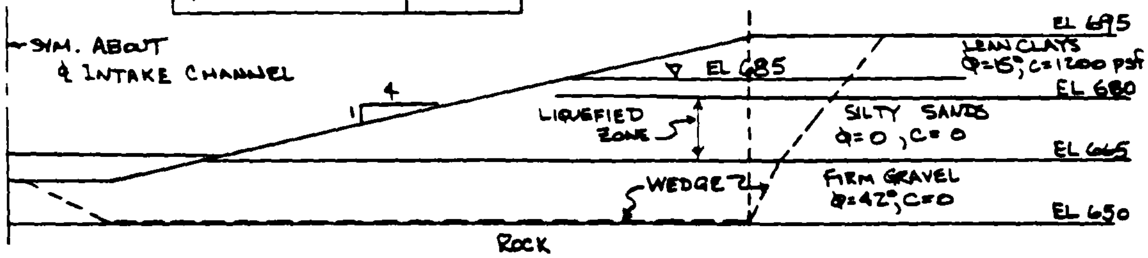



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SAFE SHUTDOWN EARTHQUAKE
RESPONSE SPECTRA FOR ROCK SUPPORT
STURCTURES

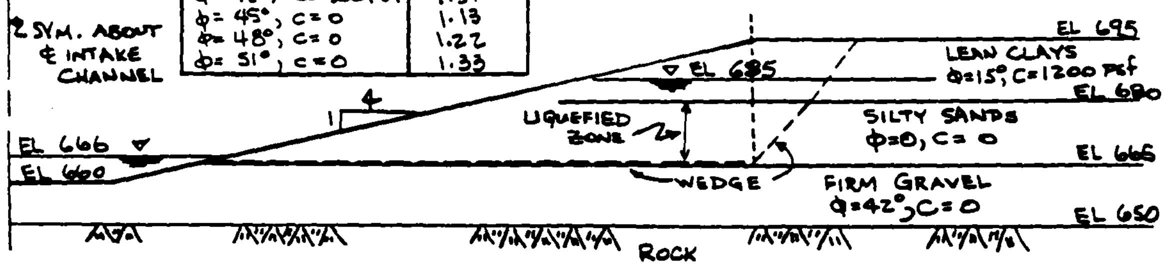
Figure 2.5-236b

| EARTHQUAKE DESIGN CASE 2 WEDGE @ EL. 650 | |
|---|---|
| Soil Properties Used for Resistance on Sliding Wedge | Factor of Safety |
| $\phi = 42°$, $C = 0$ | 1.12 |
| $\phi = 45°$, $C = 0$ | 1.20 |



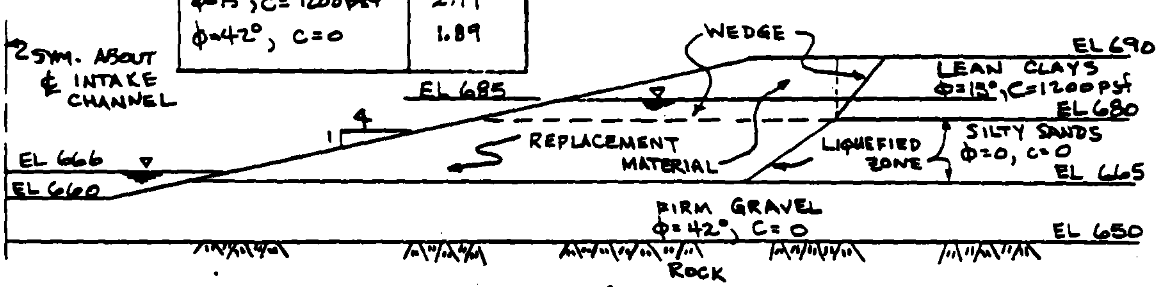

SECTION A-A

| EARTHQUAKE DESIGN CASE 2 WEDGE @ EL 665 | |
|---|---|
| Soil Properties Used for Resistance on Sliding Wedge | Factor of Safety |
| $\phi = 15°$, $C = 1200$ psf | 1.57 |
| $\phi = 42°$, $C = 0$ | 1.04 |
| $\phi = 42°$, $C = 100$ psf | 1.13 |
| $\phi = 42°$, $C = 200$ psf | 1.22 |
| $\phi = 42°$, $C = 300$ psf | 1.31 |
| $\phi = 45°$, $C = 0$ | 1.13 |
| $\phi = 48°$, $C = 0$ | 1.22 |
| $\phi = 51°$, $C = 0$ | 1.33 |




SECTION B-B

| EARTHQUAKE DESIGN CASE 2 WEDGE @ EL 680 | |
|---|---|
| Soil Properties Used for Resistance on Sliding Wedge | Factor of Safety |
| $\phi = 15°$, $C = 1200$ psf | 2.77 |
| $\phi = 42°$, $C = 0$ | 1.89 |




SECTION C-C

FIGURE 2.5-237
INTAKE CHANNEL
SEISMIC STABILITY ANALYSIS

NOTE:
Soils above firm gravel will be removed and replaced as compacted fill with controlled compaction density and moisture content at least as far back as the critical wedges shown.
See Figure 2.5-239

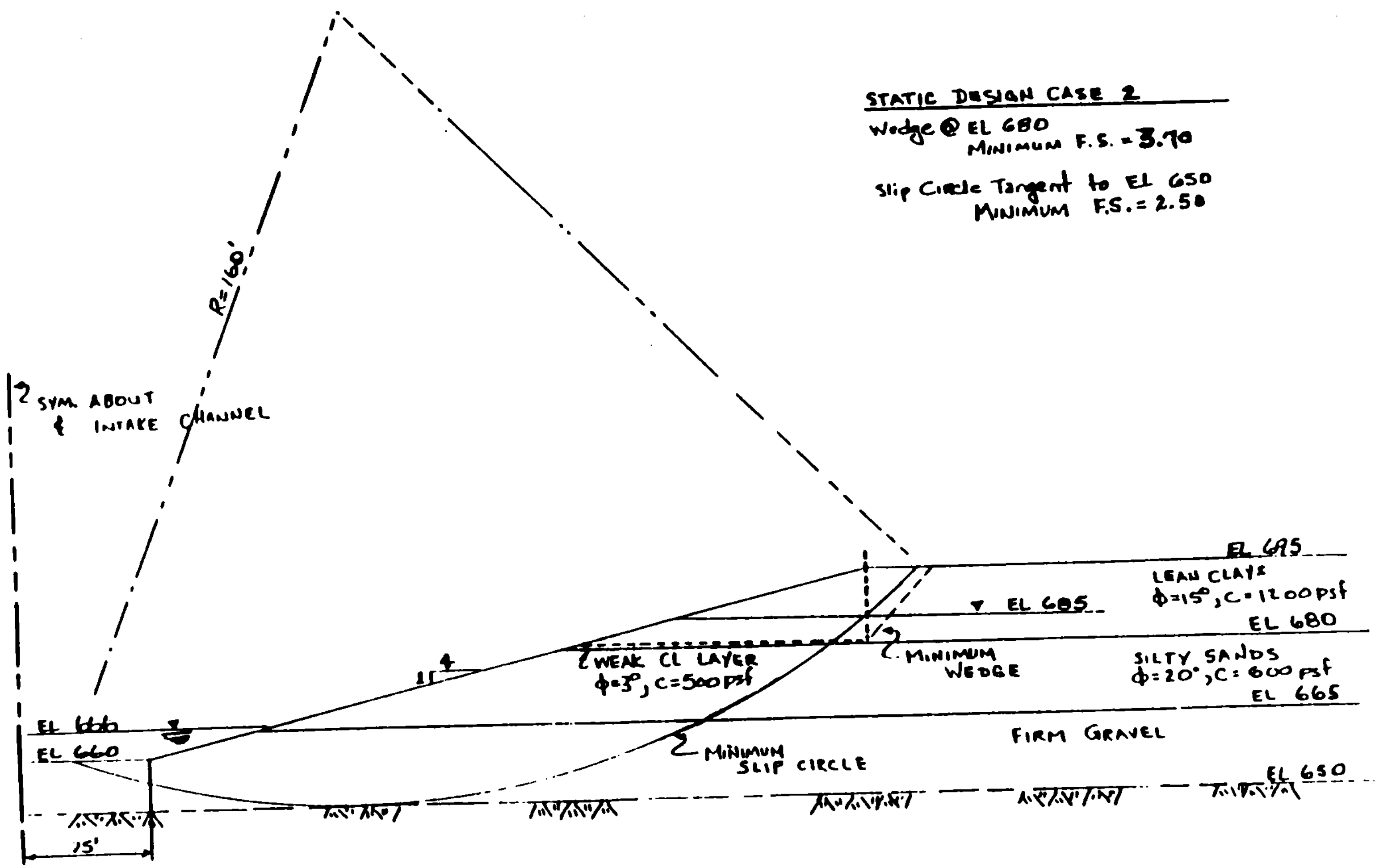
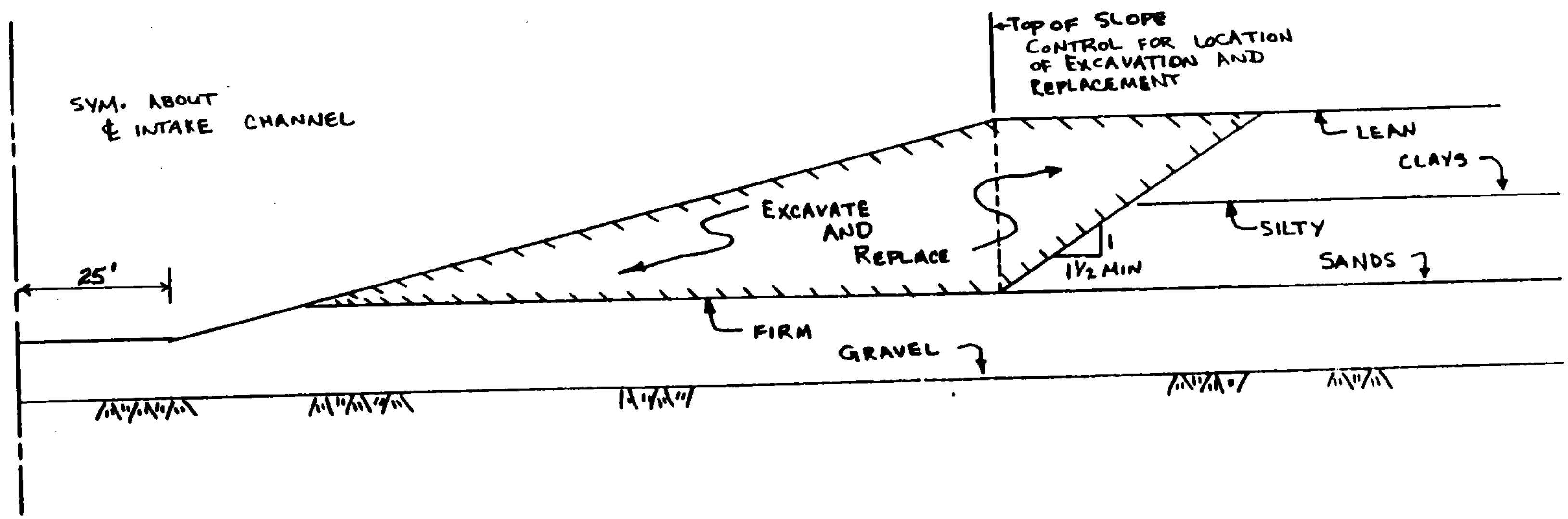


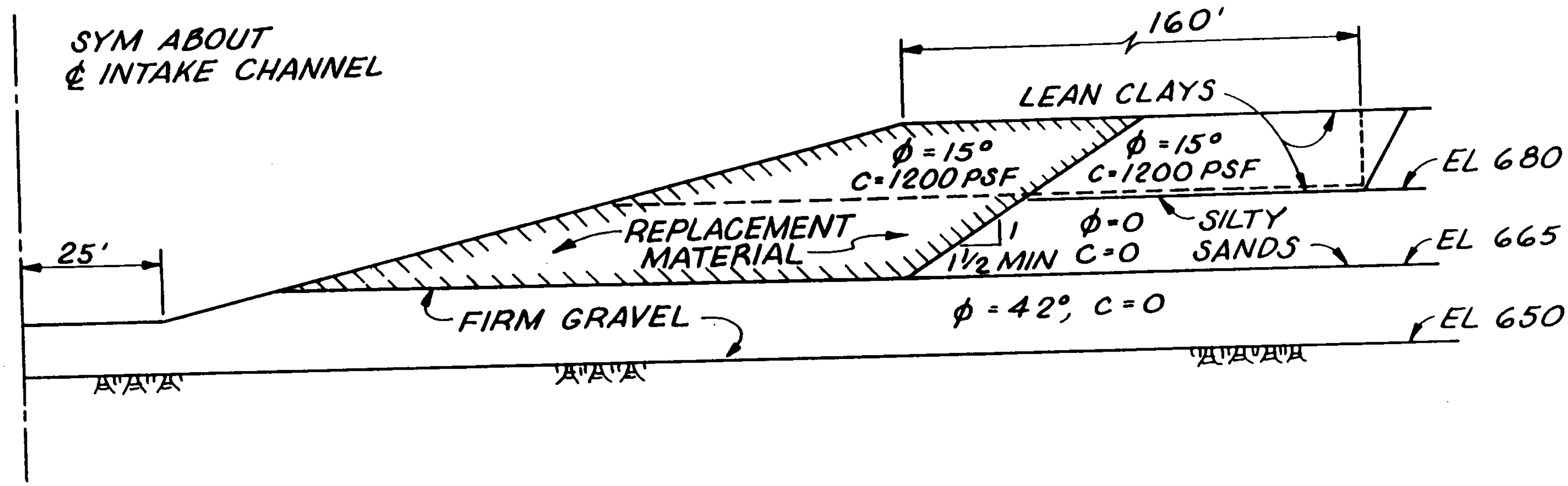

FIGURE 2.5-238

HISTORICAL




HISTORICAL

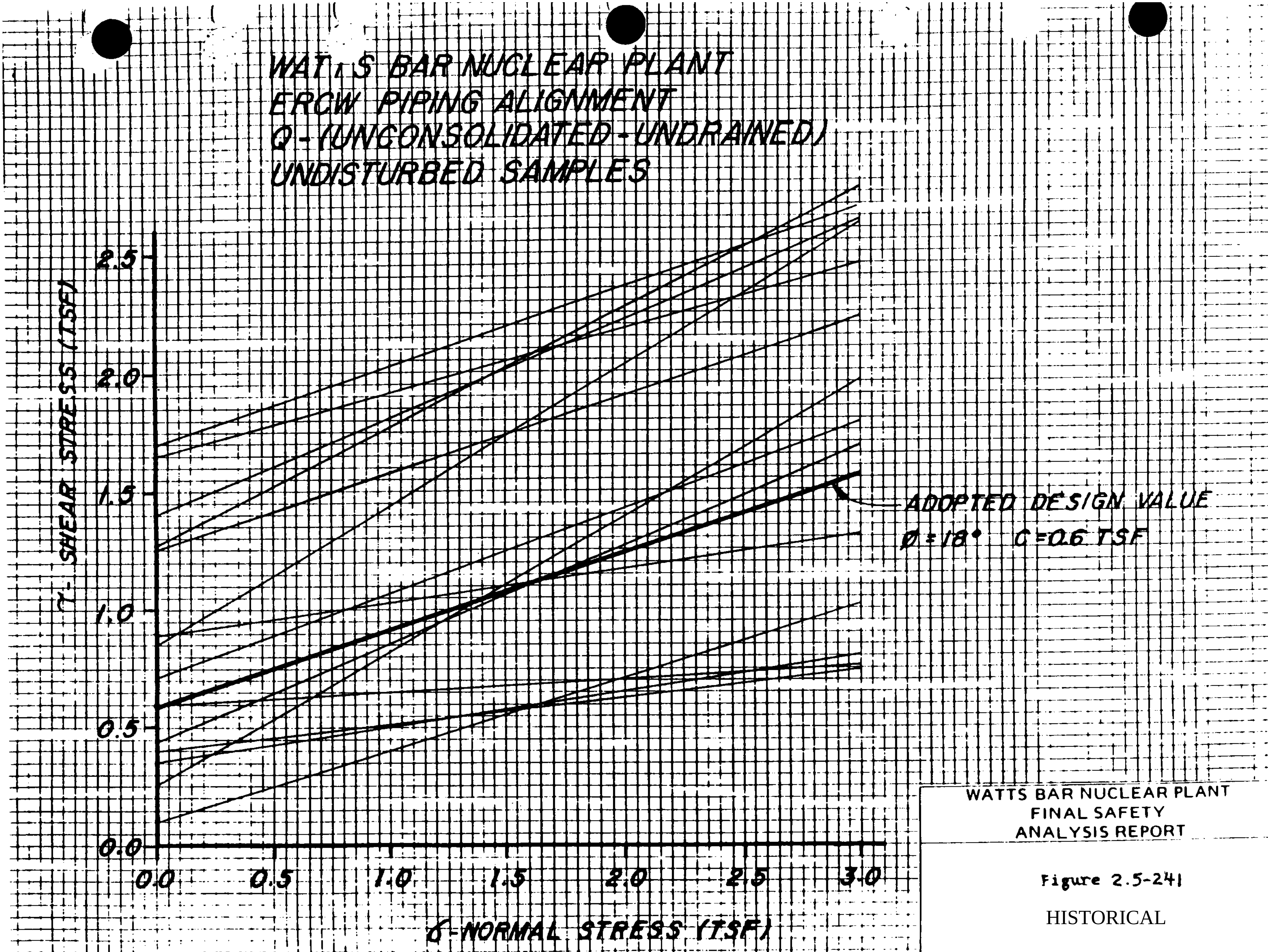
FIGURE 2.5-239
INTAKE CHANNEL - LATERAL
EXCAVATION & REPLACEMENT




WEDGE USED TO DETERMINE HORIZONTAL DISPLACEMENT OF THE INTAKE CHANNEL BY NEWMARK'S METHOD

FIGURE 2.5-240

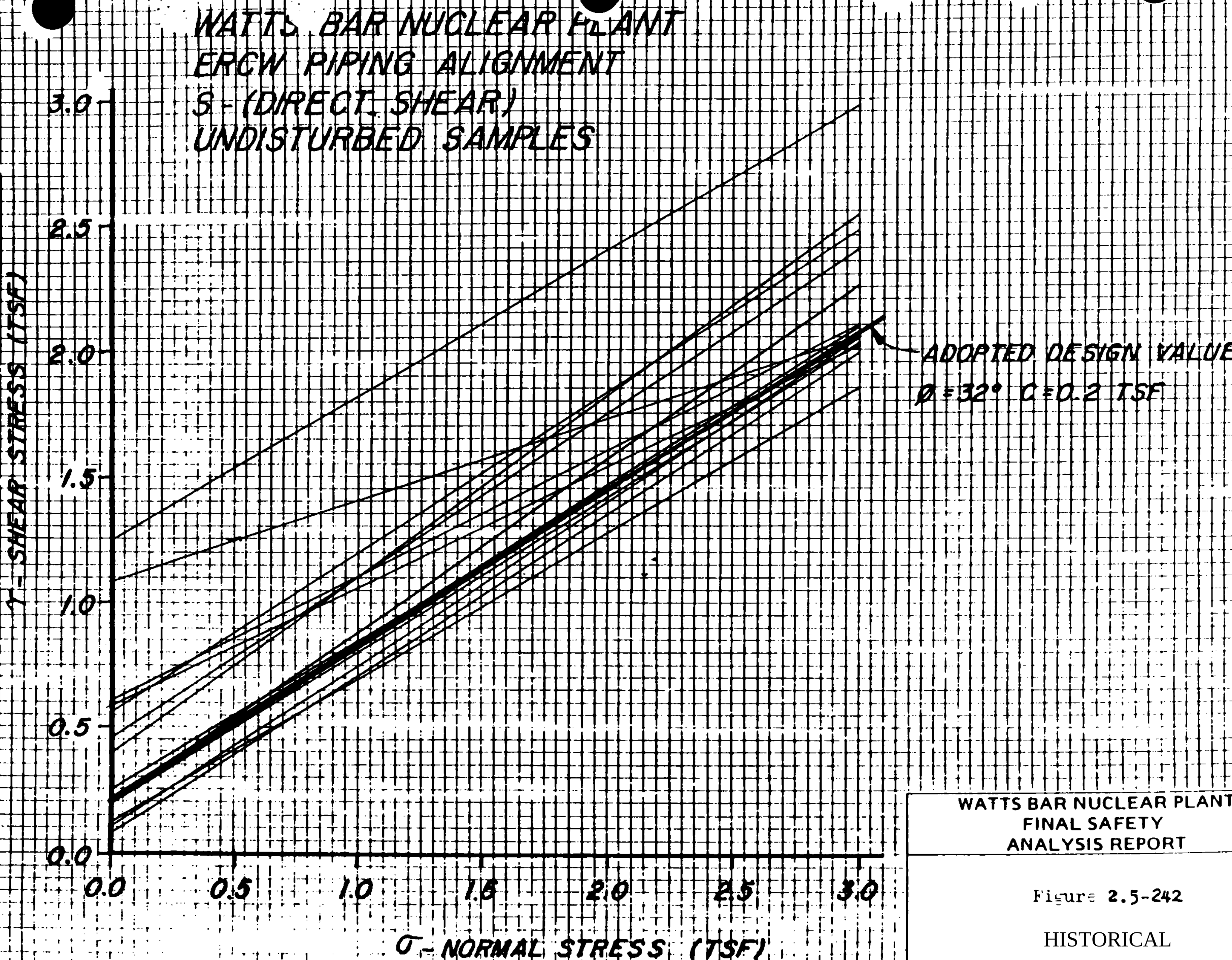
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-241

HISTORICAL



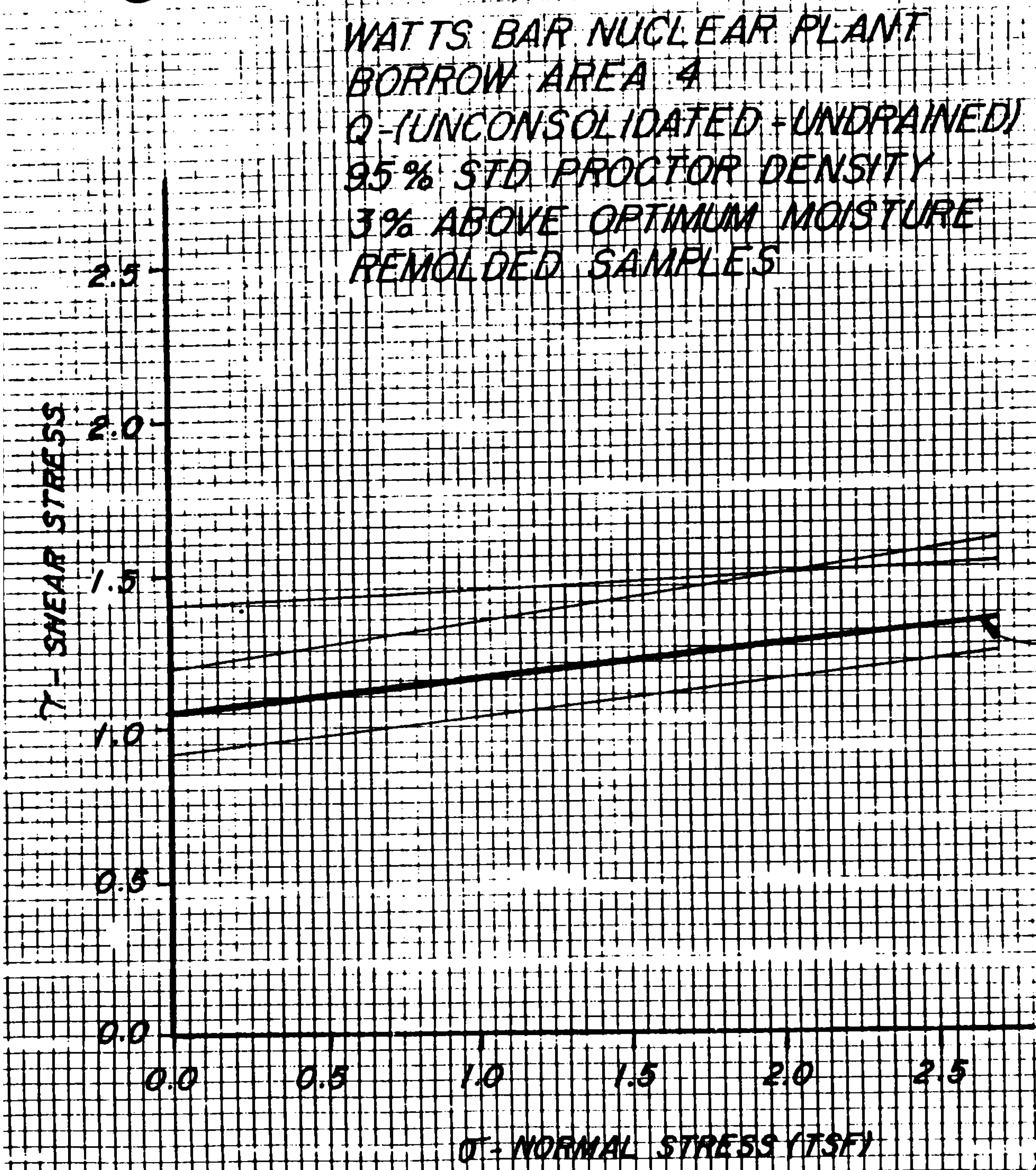

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-242

HISTORICAL

FIGURE 2.5-243

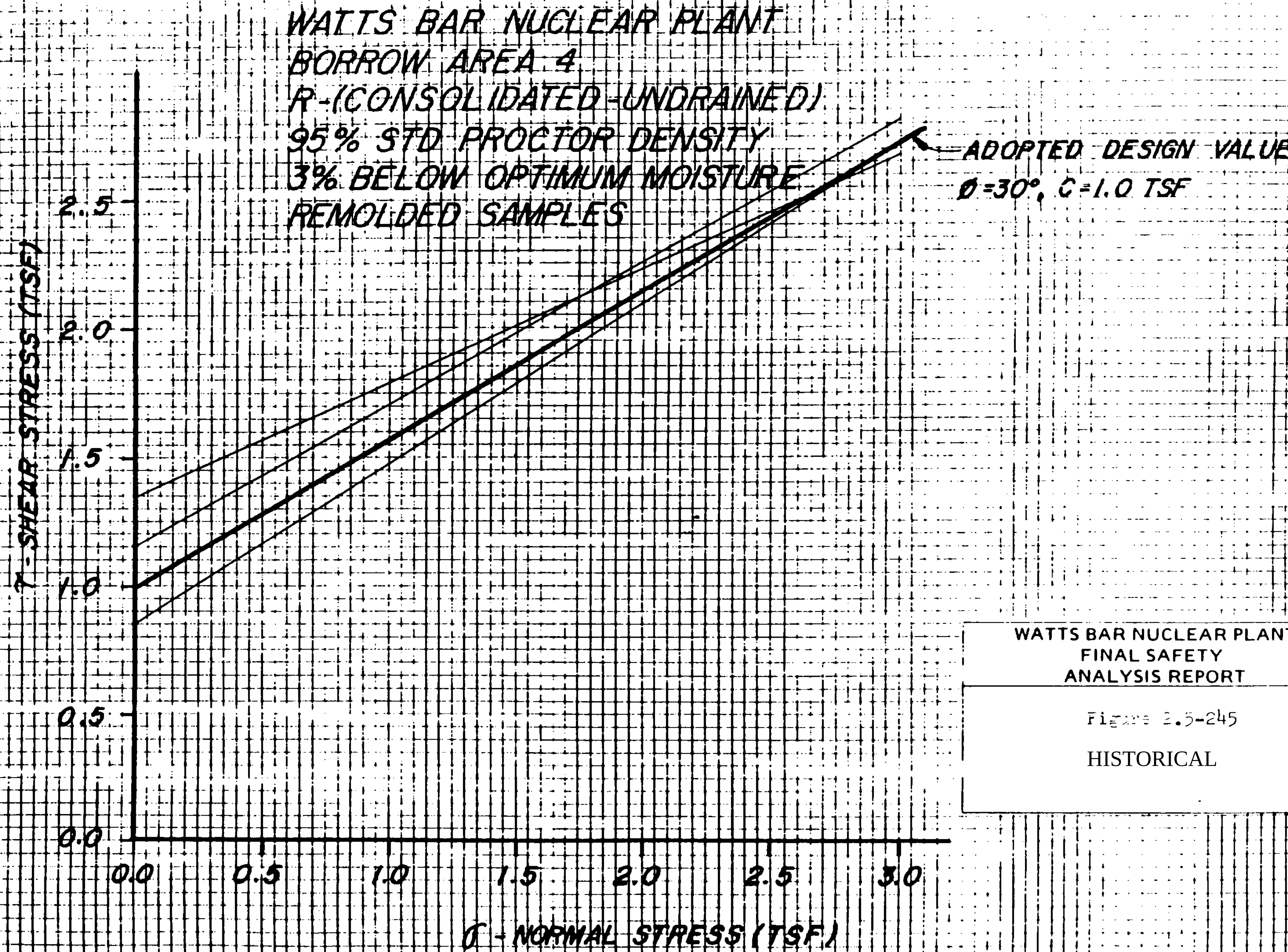
DELETED IN INITIAL UFSAR




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-244

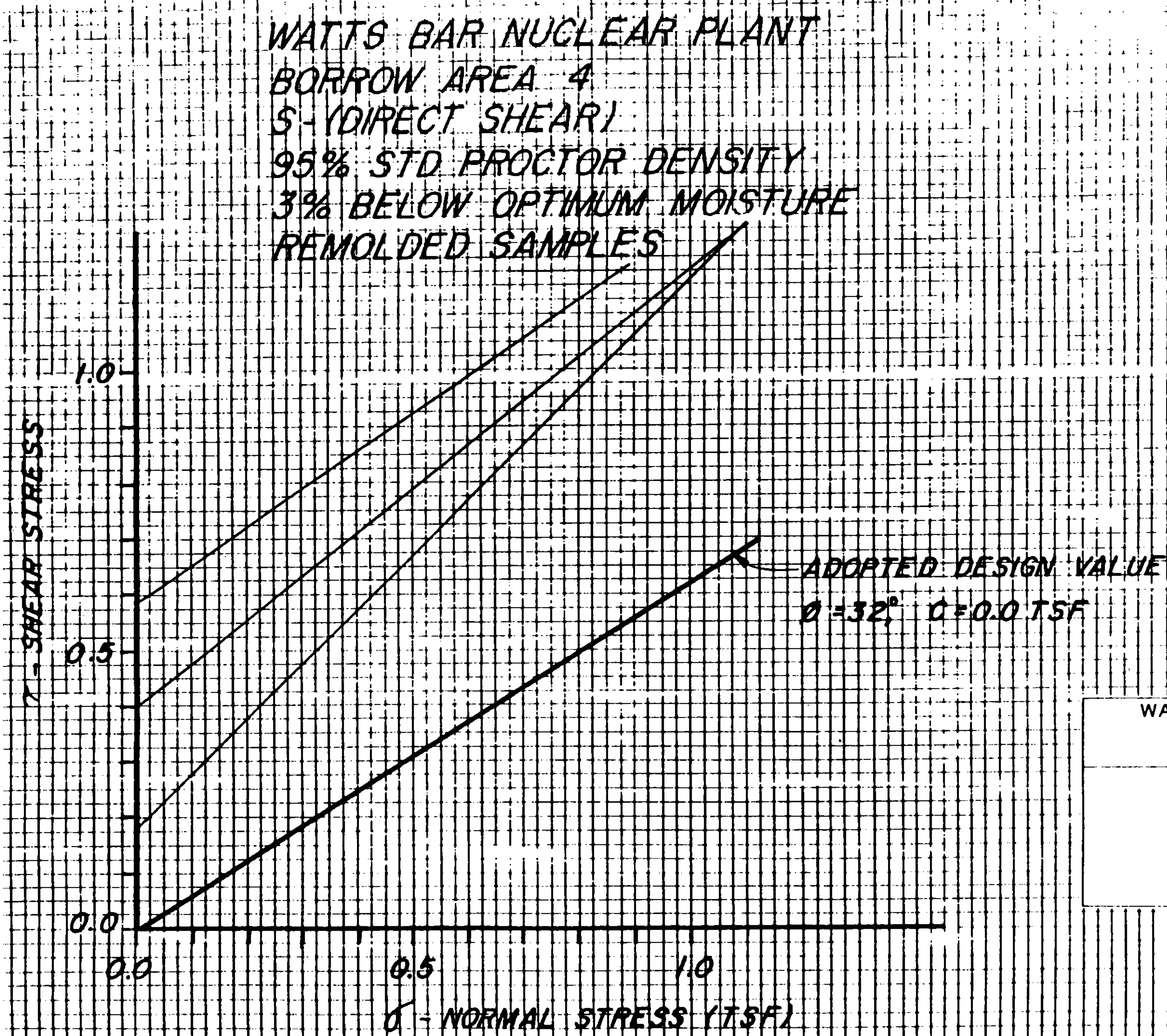
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-245

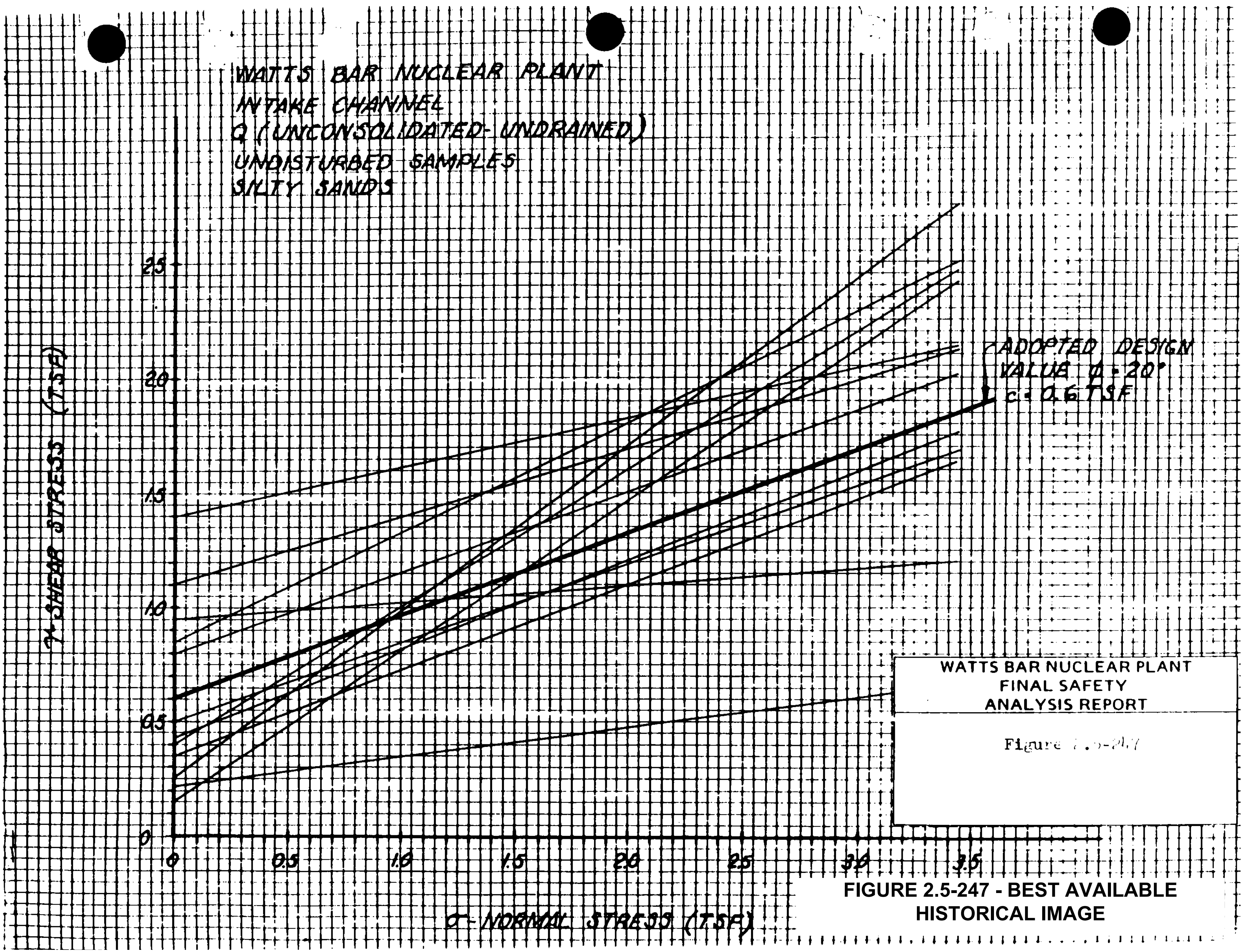
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-246

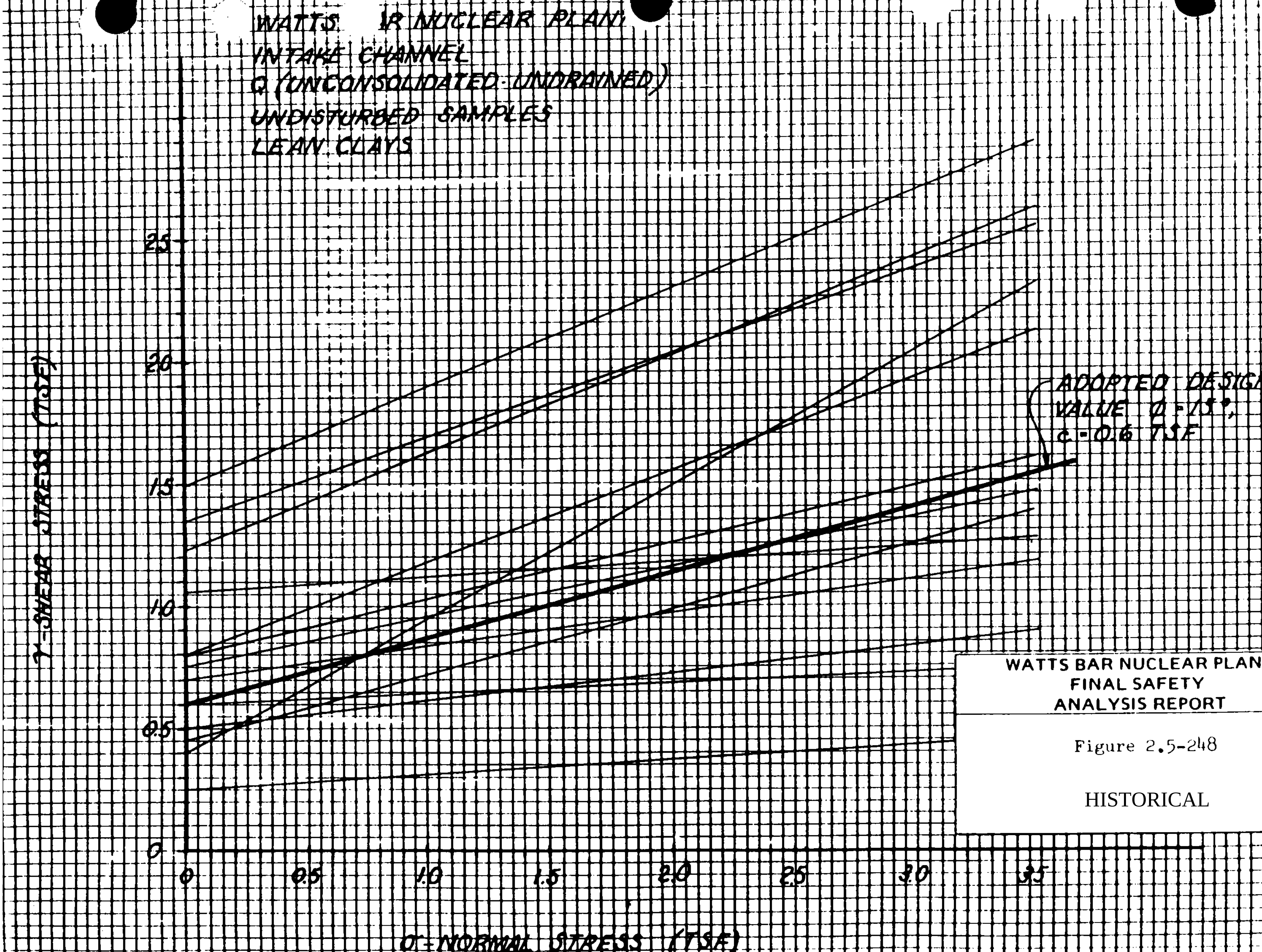
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-247

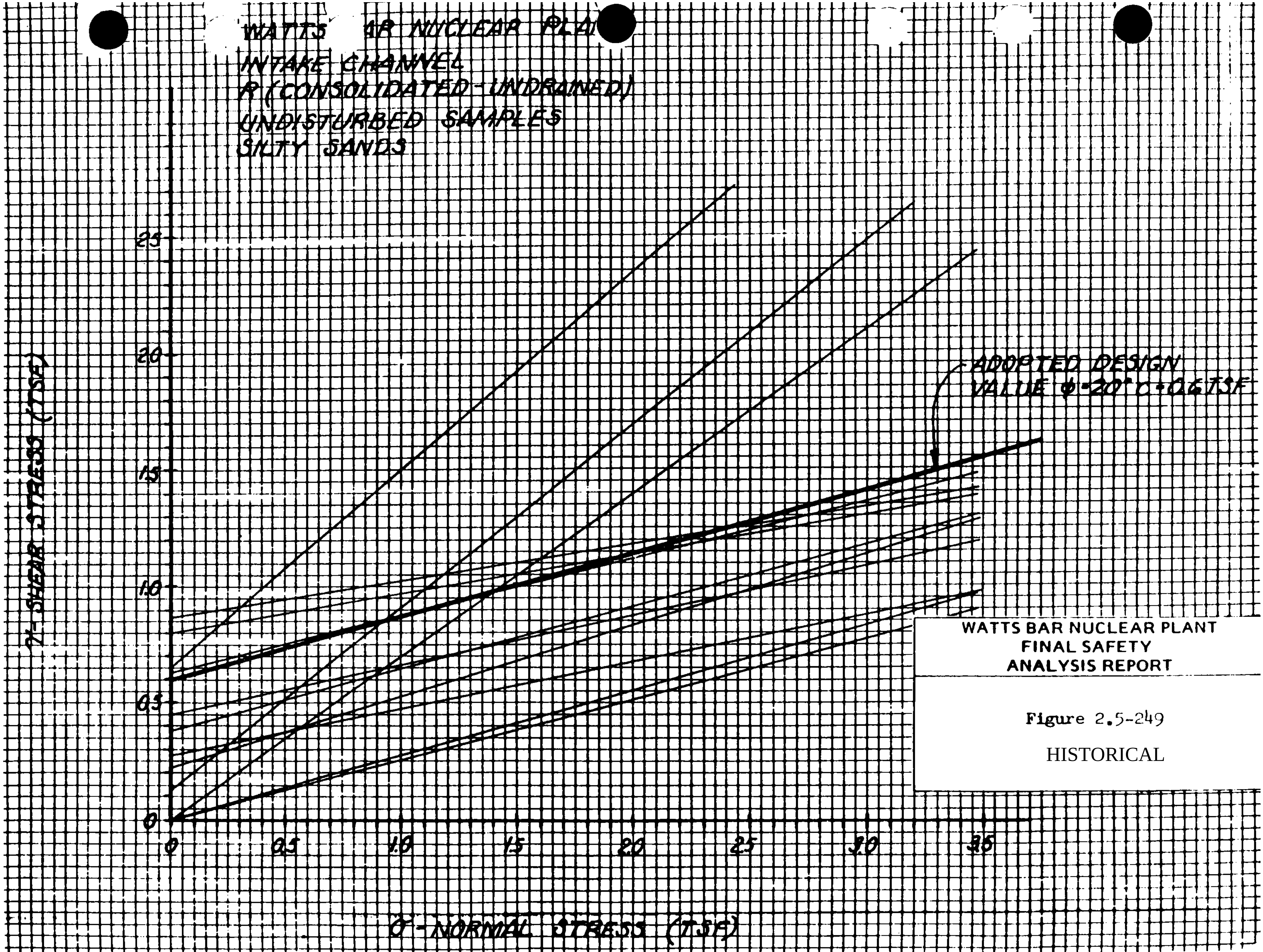
**FIGURE 2.5-247 - BEST AVAILABLE HISTORICAL IMAGE**




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-248

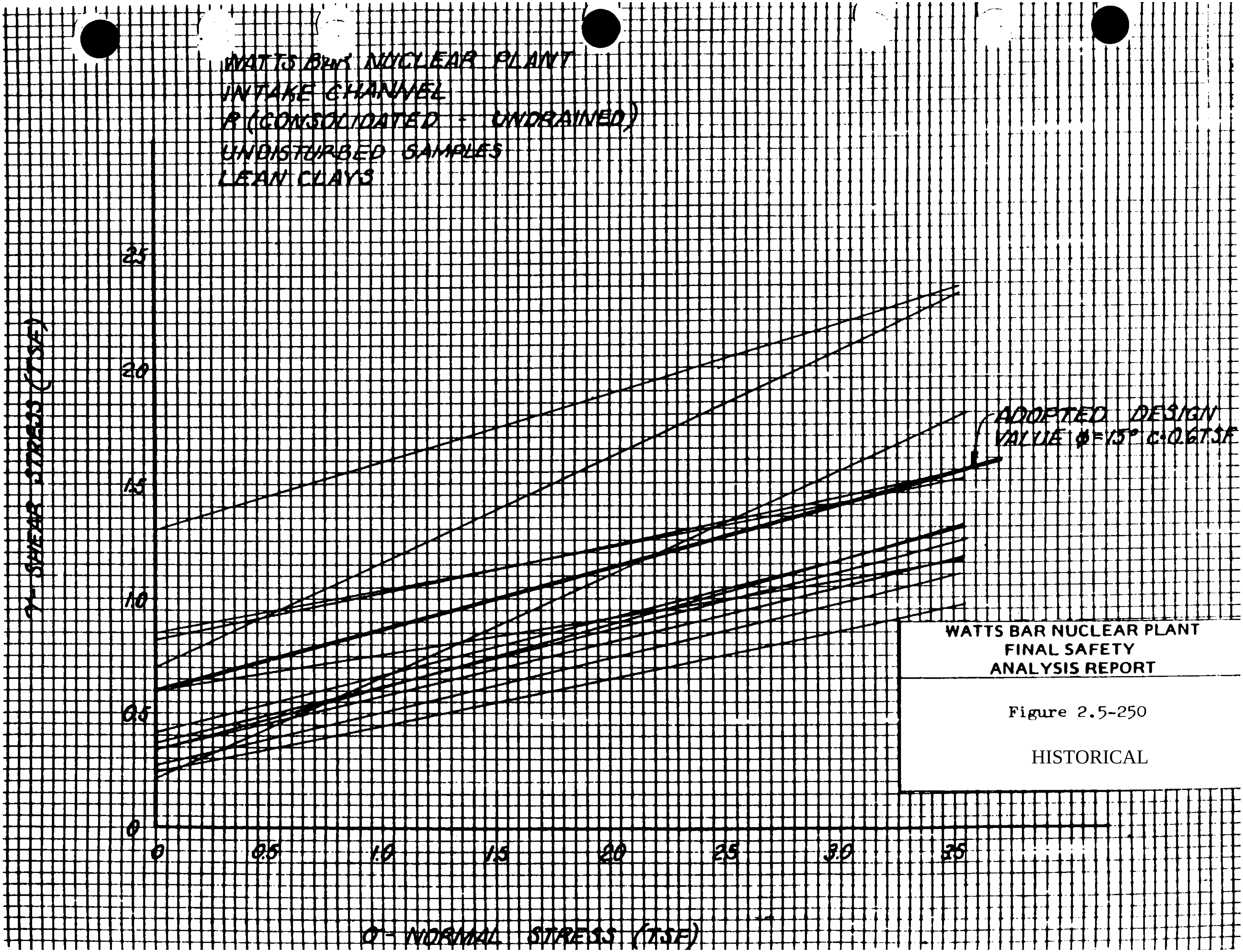
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-249

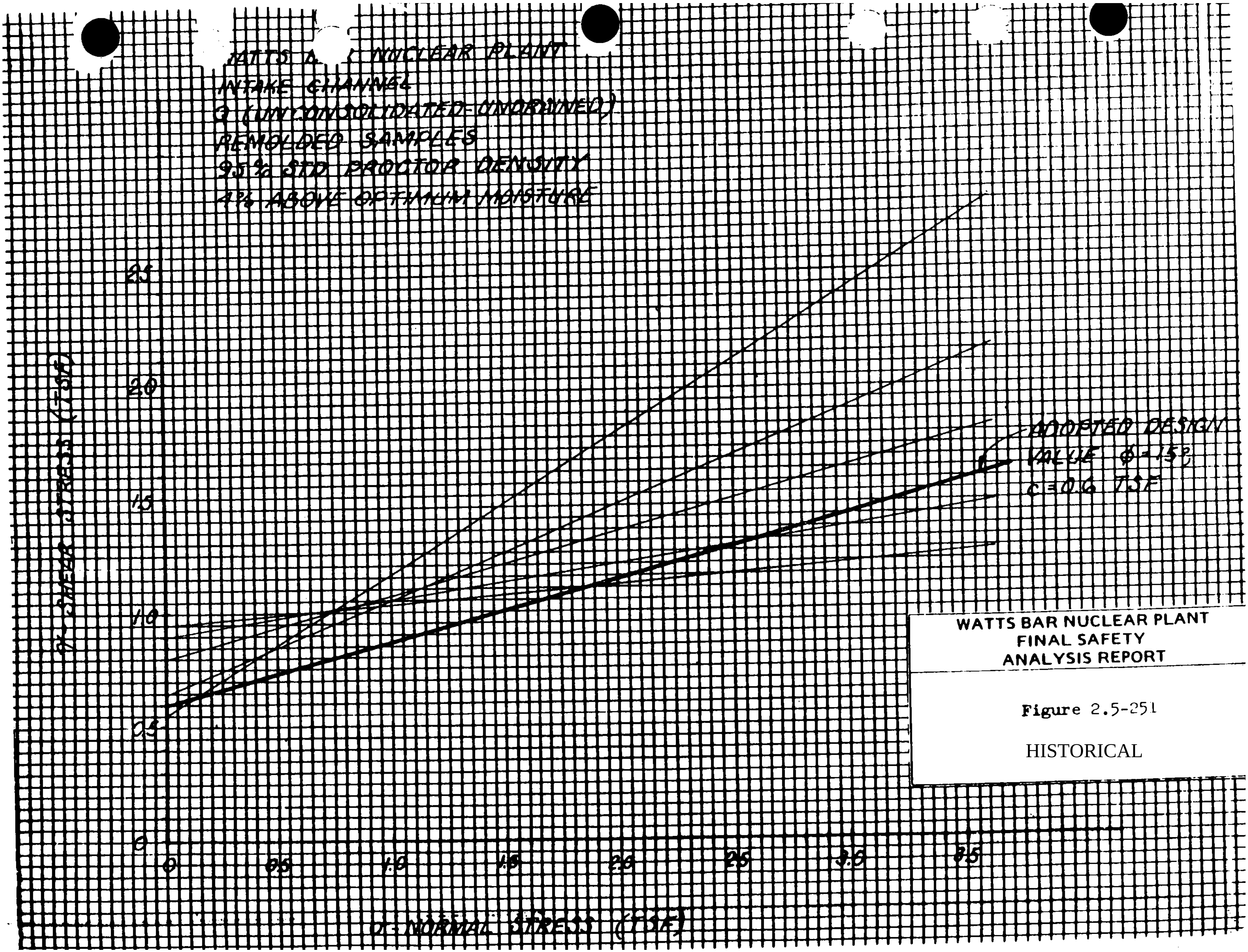
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-250

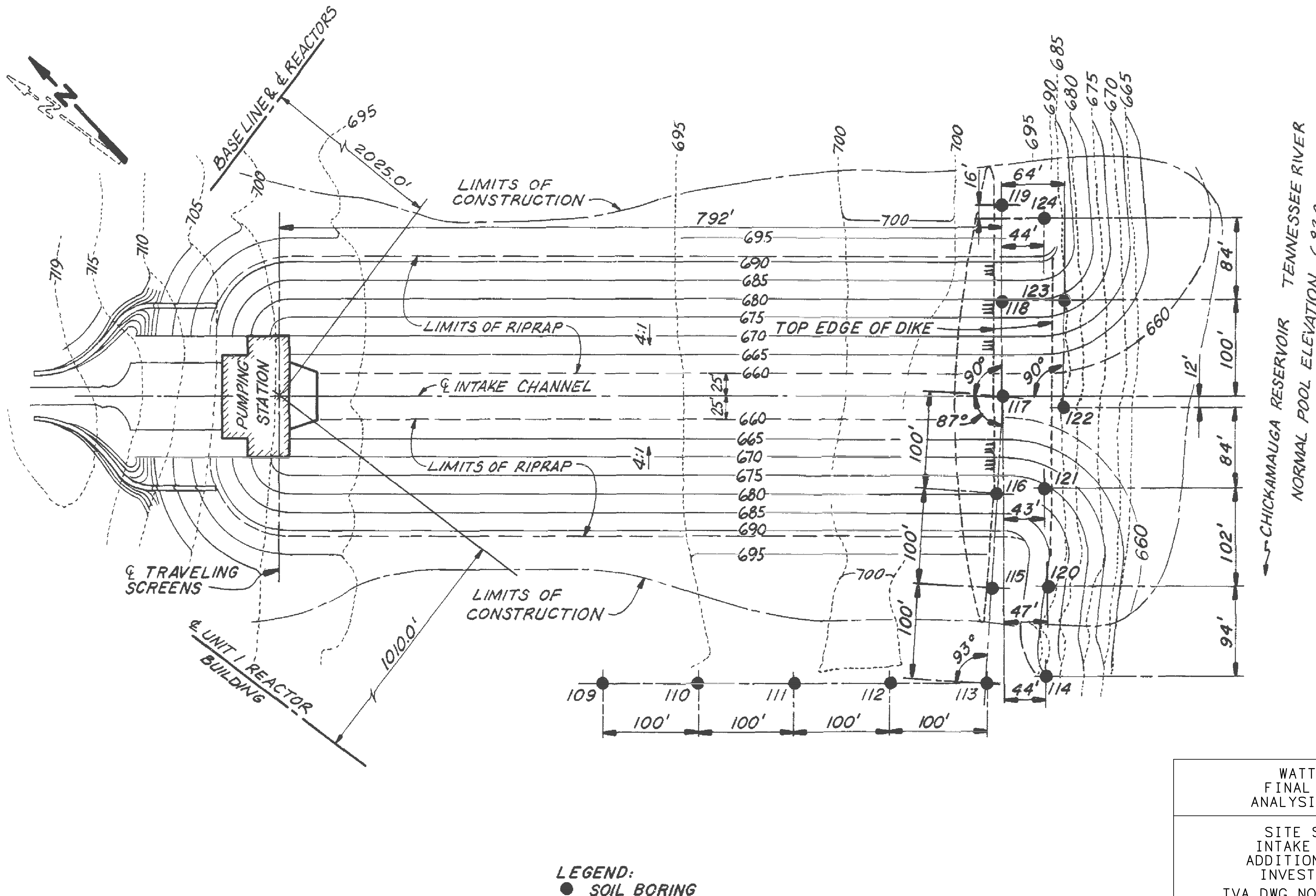
HISTORICAL




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Figure 2.5-251

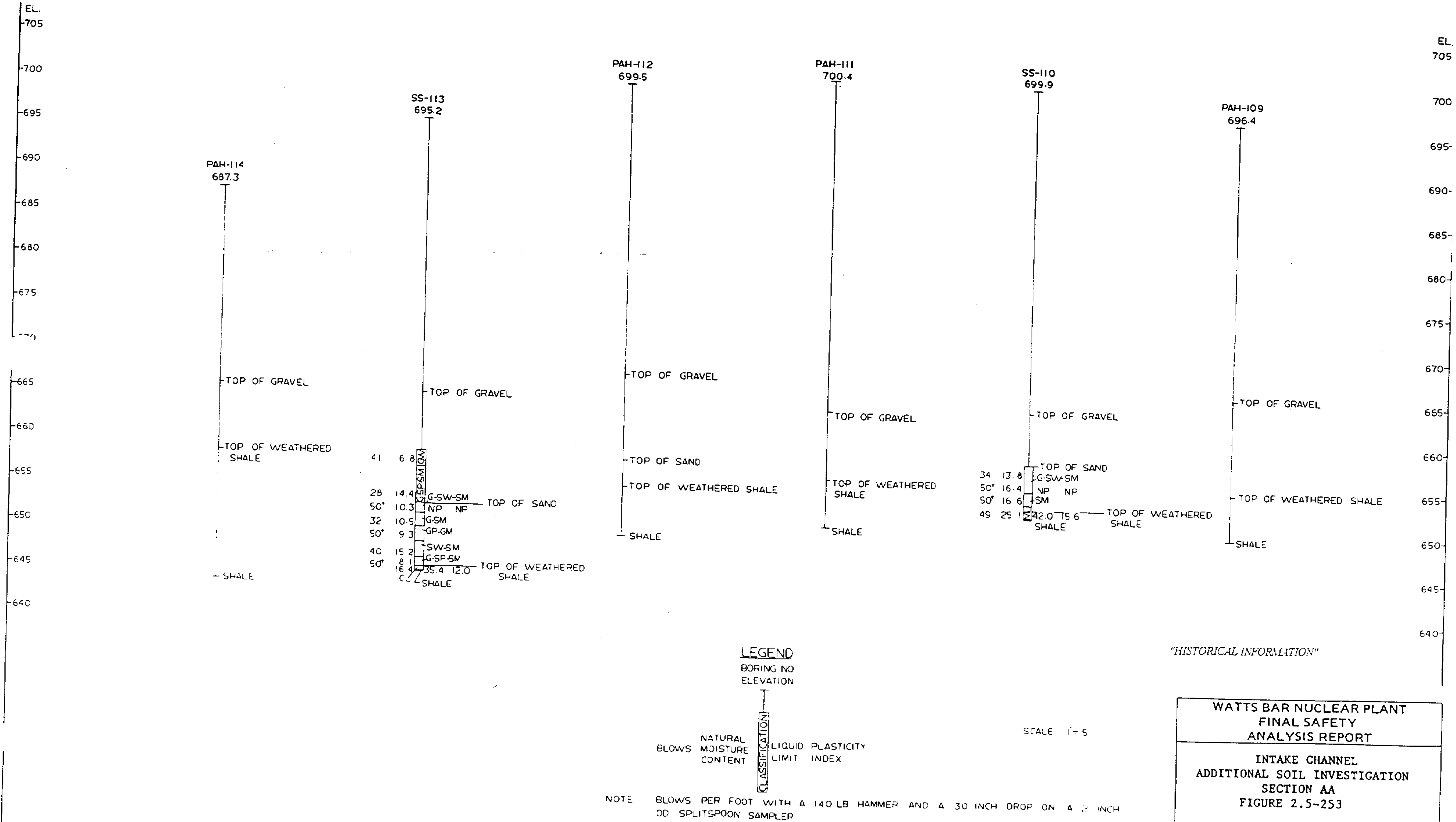
HISTORICAL




WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

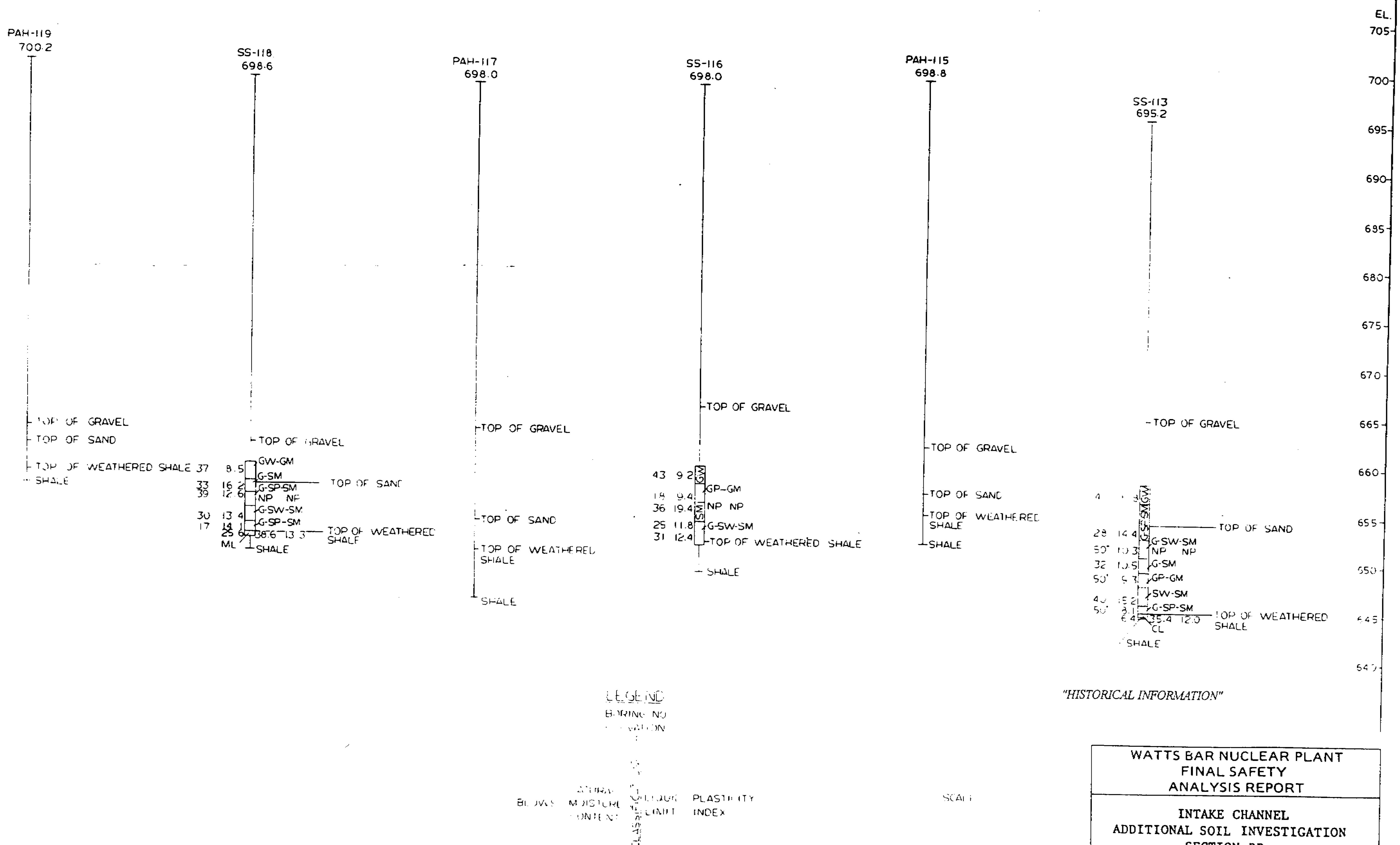
SITE STUDIES
INTAKE CHANNEL
ADDITIONAL SOILS
INVESTIGATION

TVA DWG NO. 10B333 R2
FIGURE 2.5-252




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

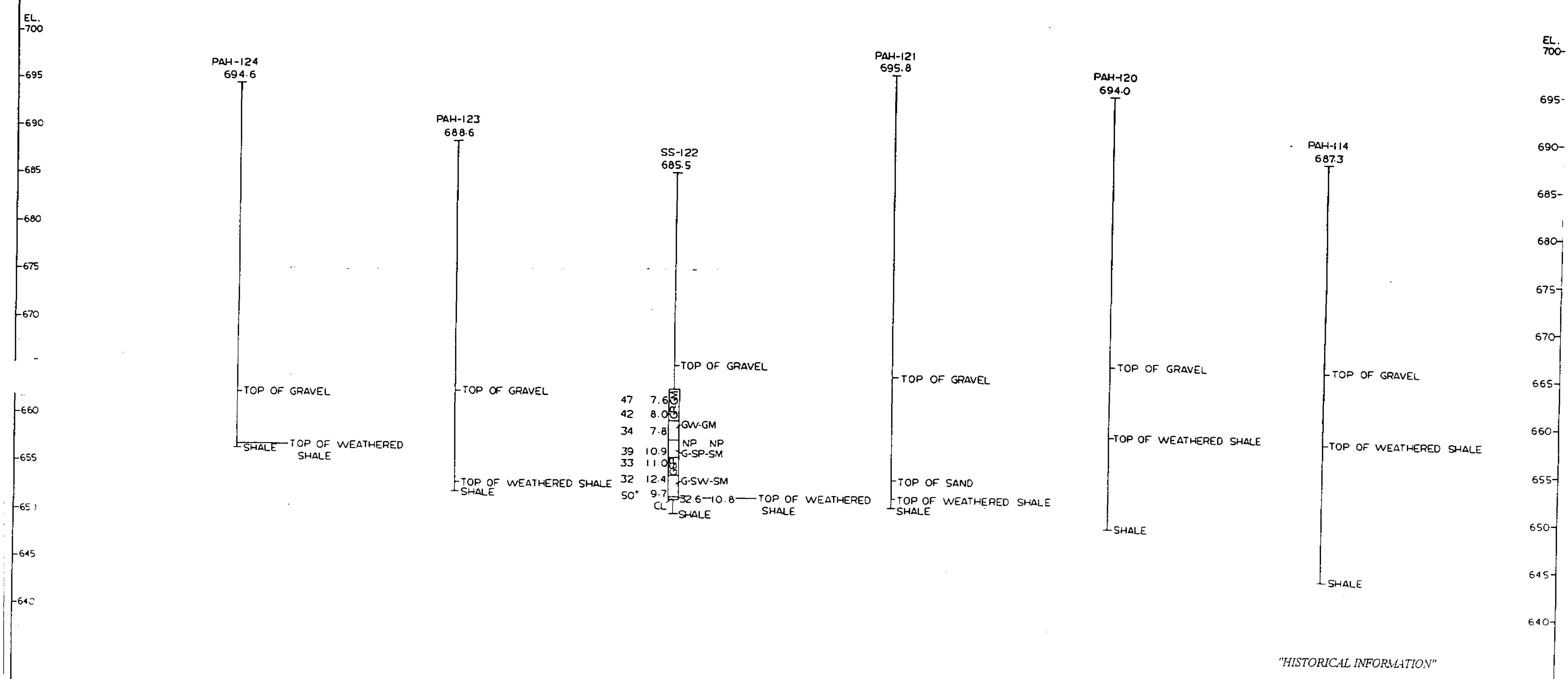
INTAKE CHANNEL
ADDITIONAL SOIL INVESTIGATION
SECTION AA
FIGURE 2.5-253




NOTE: BLOWS PER FOOT WITH A 140 LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON SAMPLER

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL
ADDITIONAL SOIL INVESTIGATION
SECTION BB
FIGURE 2.5-254



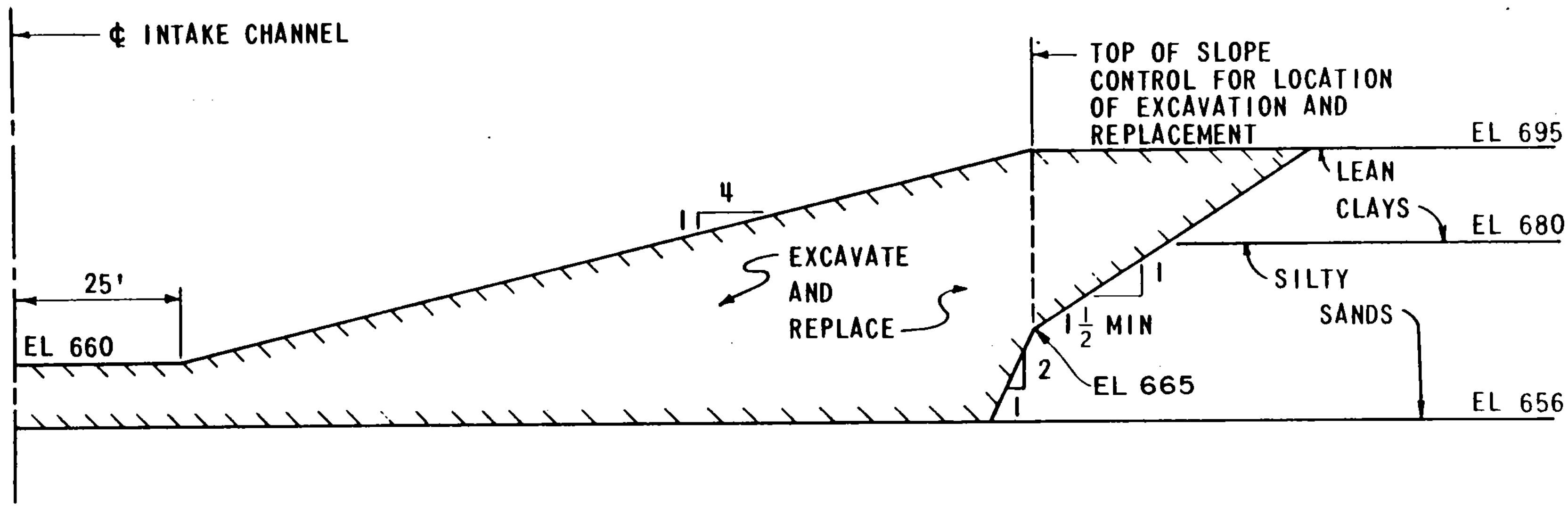

NOTE BLOWS PER FOOT WITH A 140 LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON SAMPLER

*"HISTORICAL INFORMATION"*

SCALE: 1"=5'

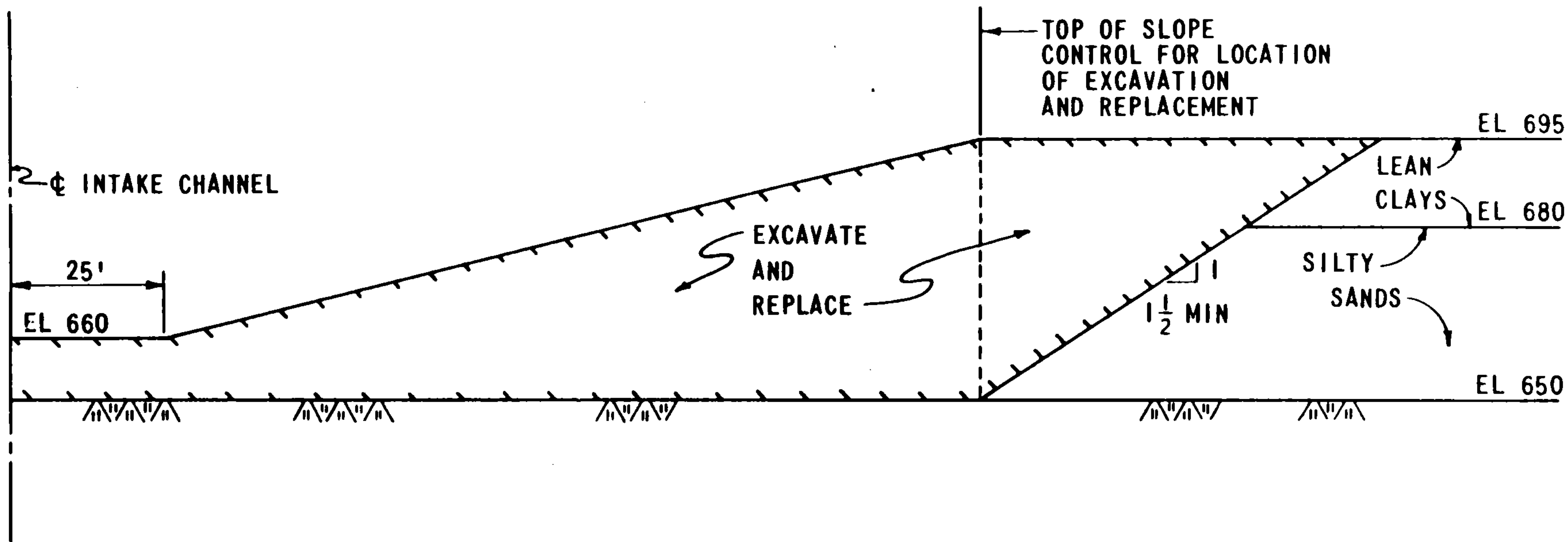
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL
ADDITIONAL SOIL INVESTIGATION
SECTION CC
FIGURE 2.5-255



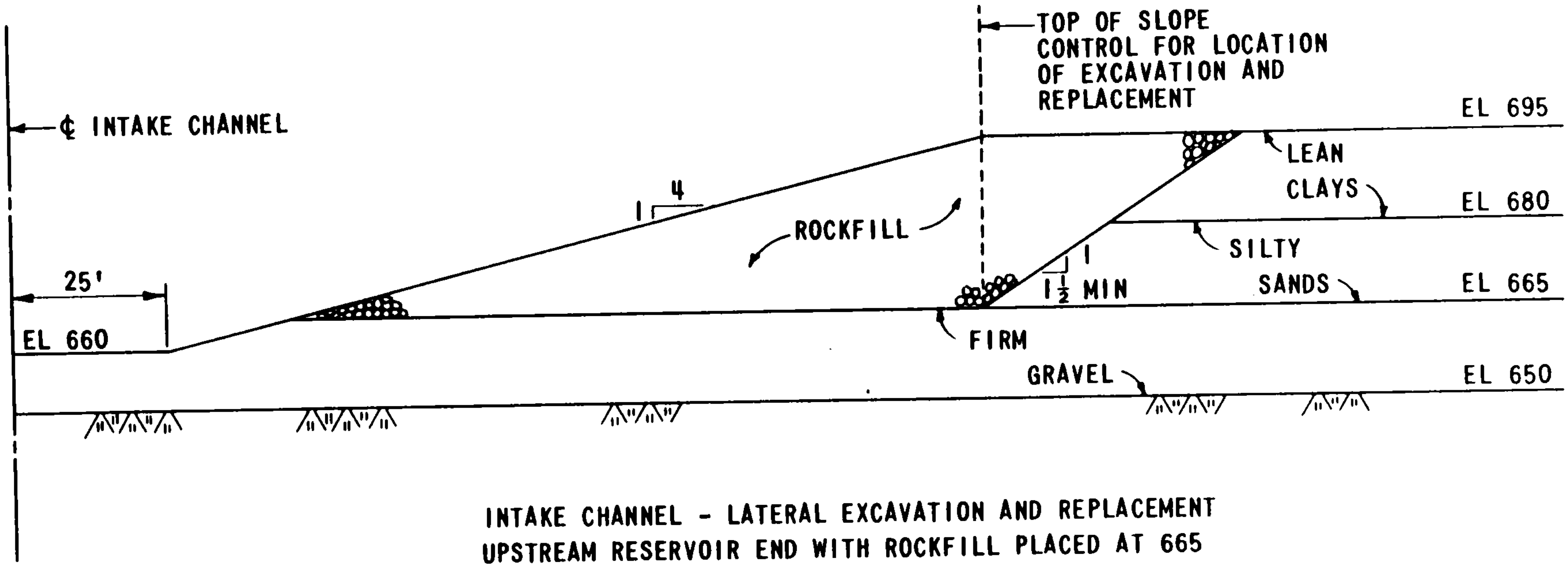

INTAKE CHANNEL - LATERAL EXCAVATION AND REPLACEMENT
DOWNSTREAM SIDE OF INTAKE CHANNEL WITH BEDROCK AT 656

FIGURE 2.5-256



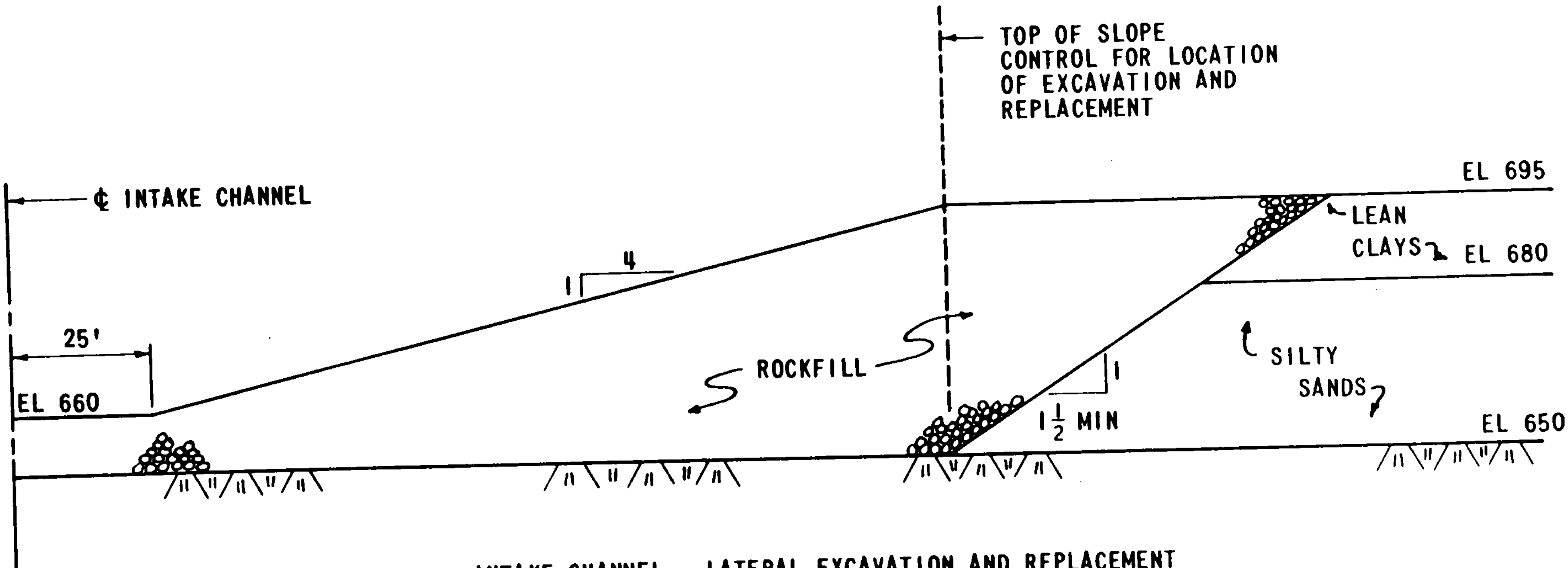

INTAKE CHANNEL - LATERAL EXCAVATION AND REPLACEMENT
DOWNSTREAM SIDE OF INTAKE CHANNEL WITH BEDROCK AT 650

FIGURE 2.5-257




INTAKE CHANNEL - LATERAL EXCAVATION AND REPLACEMENT
UPSTREAM RESERVOIR END WITH ROCKFILL PLACED AT 665

FIGURE 2.5-258




INTAKE CHANNEL - LATERAL EXCAVATION AND REPLACEMENT
DOWNSTREAM RESERVOIR END WITH ROCKFILL PLACED AT EL 650

FIGURE 2.5-259

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-1 Station 15+53S Range 43+82W Surface El 699.1

Date Drilled 10-6-80 To 10-6-80 Prepared By JLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | ML | | | | | |
| | | | | 23.4 | 42 | 14 | | |
| | 695 | | | 21.2 | 33 | 4 | | |
| 5 | | | CL | | | | | |
| | | | | 23.1 | 35 | 13 | | |
| | 690 | | | | | | | |
| 10 | | | | | | | | |
| | | | | 24.2 | 30 | 9 | | |
| | 685 | | | | | | | ▽ DISCONTINUED |
| 15 | | | | | | | | |
| | 680 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-1
FIGURE 2.5-260

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-2 Station 15+92S Range 45+78W Surface El 693.3

Date Drilled 10-6-80 To 10-6-80 Prepared By JLB Checked By

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | CL-ML | 20.4 | 41 | 15 | | |
| | 695 | | | | | | | |
| 5 | | | ML | 20.8 | 33 | 12 | | |
| | 690 | | | | | | | |
| 10 | | | | 26.3 | 34 | 13 | | |
| | | | | | | | | DISCONTINUED |
| | 685 | | | | | | | |
| 15 | | | | | | | | |
| | 680 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-2
FIGURE 2.5 26I

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P  Feature BORROW AREA 7

Boring PAH-3  Station 16+31S  Range 47+74W  Surface El 695.2

Date Drilled 10-7-80 To 10-7-80  Prepared By JLB  Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 695 | | CL-ML | 21.9 | 36 | 12 | | |
| | | | CL | 23.2 | 32 | 10 | | |
| 5 | 690 | | CL | | | | | |
| | | | CL | 25.5 | 31 | 10 | | |
| 10 | 685 | | CL | | | | | |
| | | | CL | 26.2 | 32 | 12 | | |
| | | | | | | | | DISCONTINUED |
| 15 | 680 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-3
FIGURE 2.5-282

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-4 Station 16+71S Range 49+70 Surface El 695.5

Date Drilled 10-7-80 To 10-7-80 Prepared By JLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 695 | | CL-ML | 21.7 | 40 | 15 | | |
| 5 | 690 | | CL-ML | 22.7 | 38 | 13 | | |
| 10 | 685 | | ML | 27.7 | 43 | 13 | | |
| 15 | 680 | | CL | 25.1 | 45 | 25 | | |
| | | | CL | 24.4 | 44 | 21 | | |
| 20 | 675 | | | | | | | DISCONTINUED |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-4
FIGURE 2.5-263

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-5 Station 17+51S Range 43+58W Surface El 700.

Date Drilled 10-9-80 To 10-9-80 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 700 | | ML | 24.2 | 42 | 11 | | |
| 5 | 695 | | CL-ML | 20.7 | 28 | 5 | | |
| 10 | 690 | | | 24.9 | 34 | 10 | | |
| 15 | 685 | | | | | | | ▽ NO RECOVERY – WET MATERIAL |
| | | | | | | | | DISCONTINUED |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-5
FIGURE 2.5-264

# TENNESSEE VALLEY AUTHORITY
## SINGLETON MATERIALS ENGINEERING LABORATORY
## SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-6 Station 17+915 Range 45+54W Surface El 698.

Date Drilled 10-7-80 To 10-7-80 Prepared By JLB Checked By

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | | ML | 21.1 | 32 | 7 | | |
| | 695 | | | | | | | |
| 5 | | | CL | 25.6 | 31 | 9 | | |
| | 690 | | | | | | | |
| 10 | | | CL-ML | 24.1 | 27 | 6 | | |
| | 685 | | | | | | | DISCONTINUED |
| 15 | | | | | | | | |
| | 680 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-6
FIGURE 2.5-265

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-7 Station 18+30S Range 47+50W Surface El 697.1

Date Drilled 10-7-80 To 10-7-80 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | CL-ML | | | | | |
| | | | CL-ML | 21.9 | 49 | 18 | | |
| | 695 | | CL-ML | | | | | |
| 5 | | | CL-ML | 23.1 | 40 | 15 | | |
| | 690 | | | | | | | |
| 10 | | | CL | 25.7 | 34 | 12 | | |
| | 685 | | | | | | | ▽ |
| 15 | | | | | | | | NO RECOVERY - WET MATERIAL |
| | 680 | | | | | | | DISCONTINUED |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-7
FIGURE 2.5-266

# TENNESSEE VALLEY AUTHORITY
## SINGLETON MATERIALS ENGINEERING LABORATORY
## SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P Feature BORROW AREA 7

Boring PAH-8 Station 18+69S Range 49+46W Surface El 697.1

Date Drilled 10-7-80 To 10-7-80 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 695 | | CL | 22.7 | 43 | 18 | | |
| 5 | | | CL-ML | 23.6 | 38 | 13 | | |
| | 690 | | | | | | | |
| 10 | | | MH | 26.9 | 53 | 23 | | |
| | 685 | | | | | | | |
| 15 | | | CL | 24.7 | 42 | 19 | | |
| | 680 | | | | | | | DISCONTINUED |
| 20 | | | | | | | | |
| | 675 | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-8
FIGURE 2.5-267

**HISTORICAL**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS,PA,HA,TP BORING)
FIGURE 2.5-268
SHEET 1 OF 1

SINGLE ... SO ... ATORY ... NG)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-9 Station 19 + 89S Range 45 + 30W Surface El 699.0

Date Drilled 10-9-80 To 10-9-80 Prepared By CLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | | CL | 21.6 | 39 | 16 | | |
| | 695 | | | | | | | |
| 5 | | | CL-ML | 23.6 | 41 | 16 | | |
| | 690 | | | | | | | |
| 10 | | | CL | 22.5 | 39 | 16 | | |
| | 685 | | | 24.9 | 33 | 12 | | |
| 15 | | | | | | | | DISCONTINUED |
| | 680 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

APR 13 1988

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-10 Station 20+28S Range 47+26W Surface El 698.2

Date Drilled 10-9-80 To 10-9-80 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | | CL | 25.2 | 47 | 22 | | |
| | 695 | | | | | | | |
| 5 | | | CL ML | 25.1 | 46 | 18 | | |
| | 690 | | | | | | | |
| 10 | | | CH MH | 26.5 | 52 | 23 | | |
| | 685 | | | | | | | |
| 15 | | | CL | 25.7 | 48 | 23 | | |
| | 680 | | | | | | | DISCONTINUED |
| 20 | | | | | | | | |
| | 675 | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-10
FIGURE 2.5-269

# TENNESSEE VALLEY AUTHORITY
## SINGLETON MATERIALS ENGINEERING LABORATORY
## SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 1

Project WATTS BAR N. P. Feature BORROW AREA 7

Boring PAH-11 Station 20 + 68S Range 49 + 26W Surface El 696.5

Date Drilled 10-9-80 To 10-9-80 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | CL | | | | | |
| | 695 | | CL | 21.0 | 49 | 23 | | |
| 5 | | | CL | 21.2 | 44 | 19 | | |
| | 690 | | CL | | | | | |
| | | | CL | 25.2 | 46 | 22 | | |
| 10 | | | CL | | | | | |
| | 685 | | CH-MH | | | | | |
| | | | CH-MH | 33.7 | 54 | 25 | | |
| 15 | | | CH-MH | | | | | |
| | 680 | | | | | | | DISCONTINUED |
| 20 | | | | | | | | |
| | 675 | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

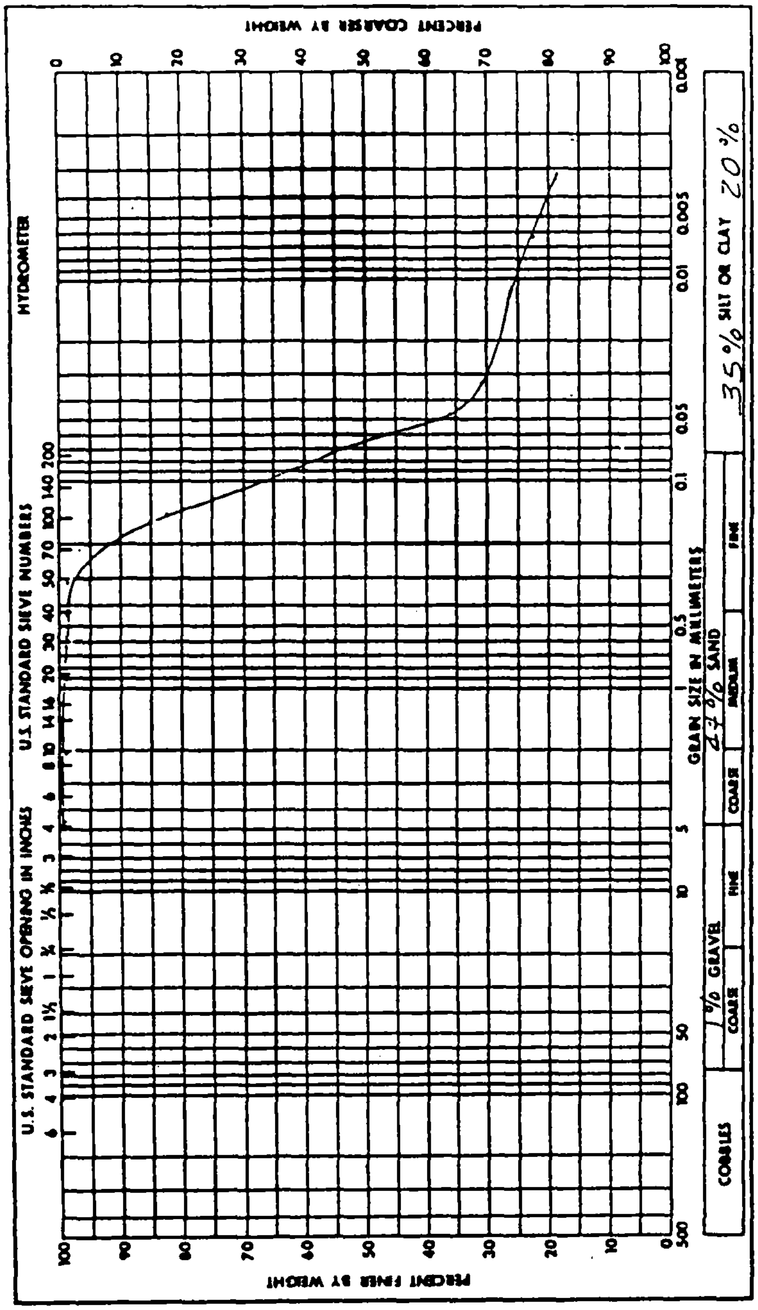
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE-BORROW AREA 7-BORING PAH-11
FIGURE 2.5-270

HISTORICAL

**WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT**

**LIQUEFACTION
FIGURE 2.5-351**

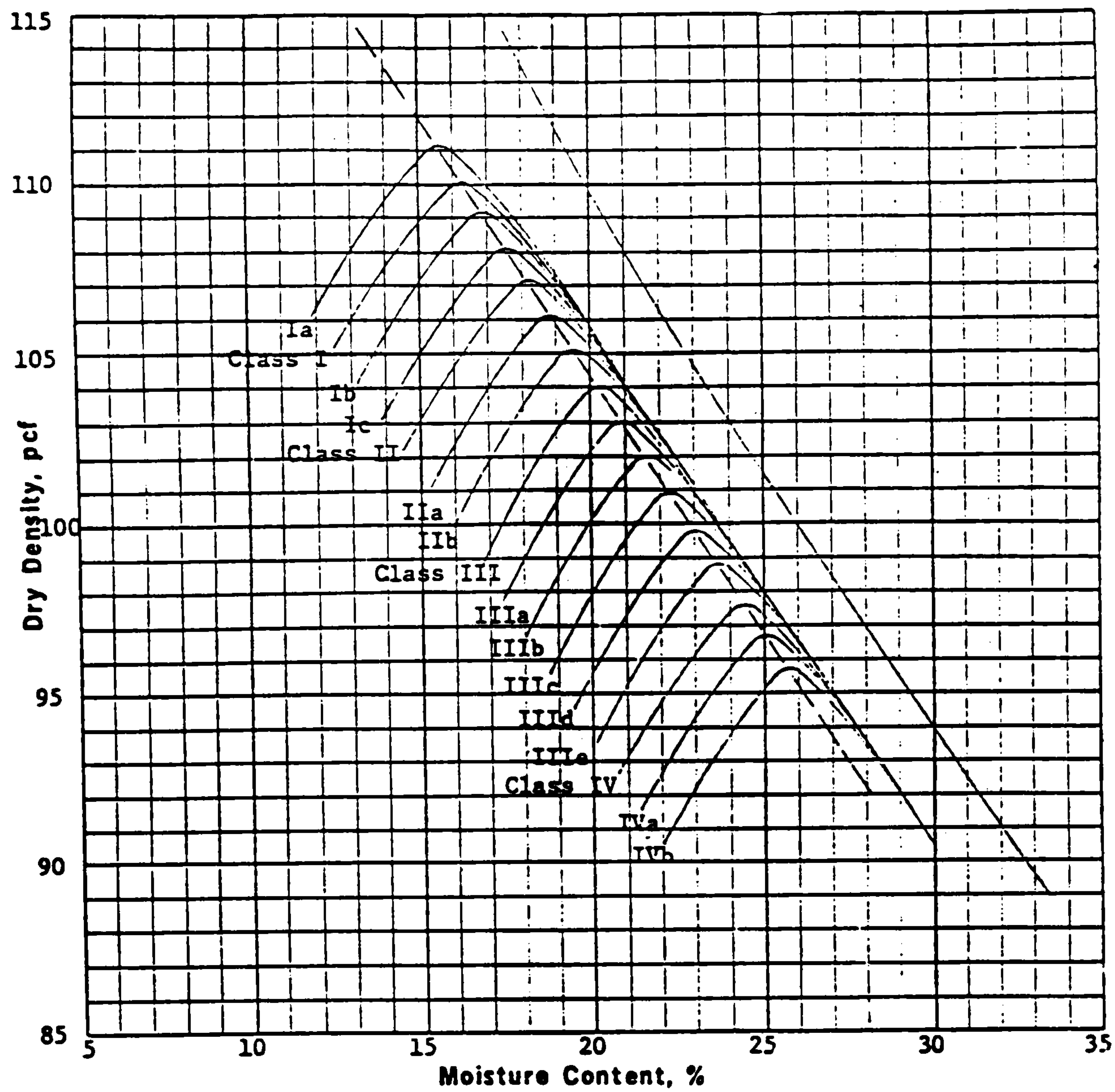



## GRAIN SIZE ANALYSIS

| | |
|---|---|
| Project Watts Bar N. P. | |
| Feature Liquefaction | |
| Boring No. US-65-1 | Sample No. 5 |
| Station 1367.0 S | Range 1005.7 E |
| Date 7-13-74 | Elevation 703.8-703.[illegible] |

| | |
|---|---|
| Remarks: | |

| | | | |
|---|---|---|---|
| Soil Symbol | ML | Liquid Limit, % | 28.2 |
| Moisture Content, % | 34.3 | Plastic Limit, % | 23.2 |
| Specific Gravity | 2.71 | Plasticity Index, % | 5.0 |
| | | Shrinkage Limit, % | |




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-CL | 0 | 32 | 39 | 29 | 2.75 | 34 | 11 | 16.2 | 110.1 |
| II-CL | 0 | 34 | 35 | 31 | 2.72 | 34 | 12 | 18.2 | 107.2 |
| III-CL | 0 | 19 | 39 | 42 | 2.74 | 43 | 18 | 20.2 | 104.0 |
| IV-CH-MH | 0 | 6 | 42 | 52 | 2.74 | 54 | 25 | 24.4 | 97.7 |

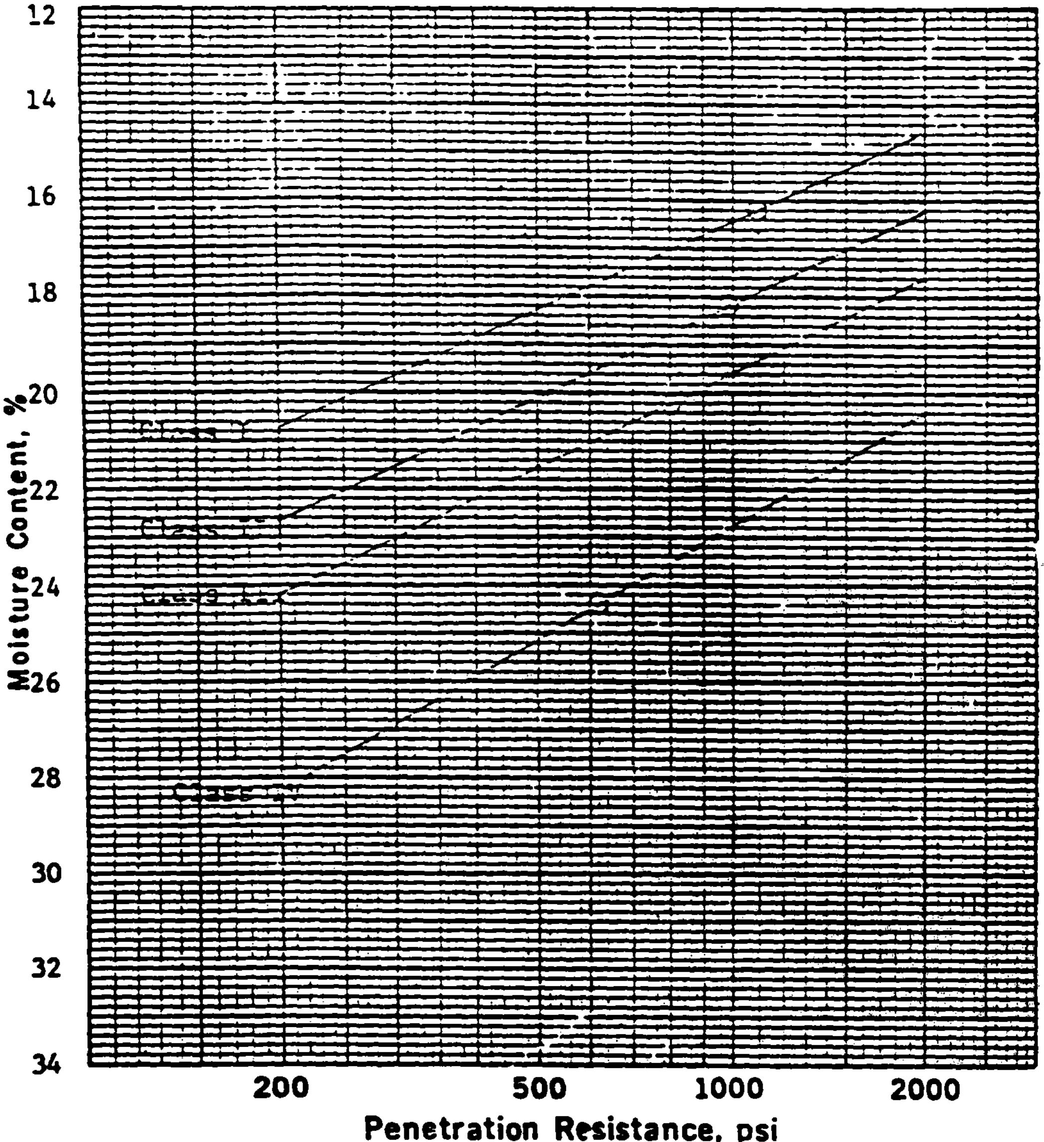
| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | |
| Plus No. 4 Absorption, % | |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

COMPACTION TEST (FAMILY OF CURVES)
BORROW AREA 7
FIGURE 2.5-271

TVA 10201 (CONST-12-76) Tested by: CHF Reviewed by: CEF




| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-CL | 16.2 | 110.1 | 1100 |
| II-CL | 18.2 | 107.2 | 980 |
| III-CL | 20.2 | 104.0 | 800 |
| IV-CH-MH | 24.4 | 97.7 | 620 |
| | | | |

Remarks:

⊙ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

MOISTURE-PENETRATION TEST-
BORROW AREA 7
FIGURE 2.5-272

TVA 10200 (CONST-6-77) Tested by: CHF Reviewed by: OBF

SECURITY-RELATED INFORMATION, WITHHELD UNDER 10 CFR 2.390
FIGURE 2.5-273

SOIL PROFILE (SS, PA, HA, TP BORING)

SHEET 1 OF 1

PROJECT WATTS BAR N. P. FEATURE 1 E CONDUIT BANKS

BORING SS-171 STATION 760:1 E RANGE 1276.9 S SURFACE El 721.2

DATE DRILLED 11-25-81 TO 12-1-81 PREPARED BY JLB CHECKED BY ℍPℙ

Scale: 1"=5'

Depth markers: 0, 5, 10, 15, 20, 25, 30, 35

Elevation markers: 720, 715, 710, 705, 700, 695

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 20 | SM-SC | 24.6 | 40 | 14 |
| 11 | SM-SC | 26.4 | 42 | 15 |
| 6 | SM | 26.7 | | |
| 9 | SP-SM | 26.5 | NP | NP |
| 9 | SP-SM | 24.1 | | |
| 12 | SP-SM | 30.9 | | |
| 50 | SM | 19.7 | 37 | 11 |
| 50 | ML | 23.4 | NP | NP |

REMARKS:

- 1032 - GRAVEL FILL
- ALLUVIUM
- WEATHERED SHALE
- BEDROCK

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
IE CONDUIT BANKS
FIGURE 2.5-274

SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

SHEET 1 OF _

PROJECT: WATTS BAR N. P. FEATURE: I E CONDUIT BANKS

BORING: SS-172 STATION: 672.25E RANGE: 1227.75S SURFACE El: 728.0

DATE DRILLED: 12-7-81 TO 12-7-81 PREPARED BY: JLB CHECKED BY: HPM

| DEPTH | El | SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | |
| 0 | | | | | | | 1032-GRAVEL FILL |
| | 725 | 17 | CL | 19.4 | | | |
| | | | | | 34 | 15 | BACKFILL |
| 5 | | 14 | | 20.9 | | | |
| | | 8 | | 23.3 | 36 | 16 | |
| | 720 | | | | | | |
| | | 15 | | 21.4 | 41 | 18 | |
| 10 | | | | | | | |
| | | 17 | | 19.9 | 36 | 13 | |
| | 715 | 34 | | 19.2 | 38 | 15 | |
| 15 | | 33 | CL-ML | 23.5 | 48 | 21 | ALLUVIUM |
| | | 29 | | 20.6 | 39 | 17 | |
| | 710 | | | | | | |
| | | 15 | CL | 26.1 | 40 | 17 | |
| 20 | | | | | | | |
| | | 15 | | 23.7 | 42 | 18 | |
| | 705 | 30 | GM | 13.8 | 34 | 9 | |
| 25 | | 43 | SM | 22.0 | 35 | 8 | |
| | | 50 | | 22.5 | 36 | 10 | |
| | 700 | | | | | | WEATHERED SHALE |
| | | 50+ | SM-SC | 21.2 | 35 | 11 | |
| 30 | | 50 | | 21.9 | 36 | 12 | |
| | 695 | 41 | SM | 22.6 | 36 | 11 | |
| 35 | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
ID CONDUIT BANKS
FIGURE 2.5-275

SOIL PROFILE (SS, PA, HA, TP BORING)



PROJECT WATTS BAR N. P. FEATURE 1 E CONDUIT BANKS

BORING SS-173 STATION 583.3E RANGE 1177.8 S SURFACE El 728.1

DATE DRILLED 12-2-81 TO 12-3-81 PREPARED BY JLB CHECKED BY H

| DEPTH (1"=5') | El | SPT (N) | GROUP | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 1032-GRAVEL FILL |
| | 725 | 18 | CL | 22.3 | 46 | 20 | ALLUVIUM |
| 5 | | 20 | CL-ML | 21.9 | 41 | 14 | |
| | 720 | 16 | CL | 19.3 | 40 | 16 | |
| 10 | | 23 | ML | 20.4 | 39 | 13 | |
| | | 25 | SC | 17.8 | 30 | 9 | |
| | 715 | 37 | SC | 18.8 | 33 | 12 | |
| 15 | | 28 | ML-MH | 25.0 | 49 | 17 | |
| | 710 | 25 | SC | 20.9 | 35 | 13 | |
| 20 | | 20 | SM-SC | 20.6 | 37 | 12 | |
| | | 28 | SM | 24.6 | 55 | 20 | WEATHERED SHALE |
| | | | CH-MH | | 57 | 27 | |
| | 705 | 50+ | SM | 22.9 | 42 | 14 | |
| 25 | | 21 | SM | 36.6 | 41 | 9 | |
| | 700 | 40 | SM | 23.5 | 48 | 11 | |
| 30 | | 25 | SM | 25.8 | 36 | 10 | |
| | | 34 | SM | 24.9 | 39 | 13 | |
| | 695 | 30 | SM-SC | 20.5 | 33 | 9 | |
| 35 | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
ID CONDUIT BANKS
FIGURE 2.5-276 (SHEET 1 OF 2)

| DEPTH | EL | (N) | U G | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | |
| 35 | | 50+ | SMSC | 17.6 | 33 | 10 | WEATHERED SHALE |
| | 690 | 50 | SMSC | 18.5 | 29 | 7 | |
| | | 50+ | SC | 17.0 | 30 | 9 | |
| 40 | | | | | | | BEDROCK |
| | 685 | | | | | | |
| 45 | | | | | | | |
| 50 | | | | | | | |
| 55 | | | | | | | |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |
| 75 | | | | | | | |
| 80 | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
ID CONDUIT BANKS
FIGURE 2.5-276 (SHEET 2 OF 2)

SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

SHEET 1 OF _

PROJECT WATTS BAR N. P. FEATURE I E CONDUIT BANKS

BORING SS-174 STATION 490.75E RANGE 1123.75S SURFACE El 728.0

DATE DRILLED 12-3-81 TO 12-4-81 PREPARED BY JLB CHECKED BY HPN

| DEPTH (1"=5') | El | SPT (N) | GOL OG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 1032-GRAVEL FILL |
| | 725 | 40 | ML | 21.5 | 43 | 15 | BACKFILL |
| 5 | | 18 | CL | 19.4 | 39 | 18 | |
| | | 33 | ML | 21.9 | 44 | 15 | |
| | 720 | 47 | CL | 19.1 | 40 | 18 | |
| 10 | | 47 | ML | 25 4 | 44 | 15 | |
| | 715 | 45 | | 21.3 | 38 | 12 | |
| 15 | | 40 | SC | 15.5 | 32 | 13 | |
| | | 41 | | CL ML 19.0 | 39 | 15 | |
| | 710 | 50+ | SM | 18.3 | NP | NP | ALLUVIUM |
| 20 | | 50+ | GC | 14.2 | — | — | |
| | 705 | 50+ | | CLML 21.3 | 44 | 16 | WEATHERED SHALE |
| 25 | | 50+ | | — | — | — | |
| | | 50+ | ML | 21.6 | 40 | 13 | |
| | 700 | 50+ | SM | 21.6 | 38 | 12 | |
| 30 | | 50+ | | SM-SC 18.8 | 32 | 8 | |
| | 695 | | | | | | |
| 35 | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
ID CONDUIT BANKS
FIGURE 2.5-277

SOIL PROFILE (SS, PA, HA, TP BORING)

SHEET 1 OF

PROJECT WATTS BAR N. P. FEATURE 1 E CONDUIT BANKS

BORING SS-175 STATION 405.75E RANGE 1072.8S SURFACE El 728.0

DATE DRILLED 12-3-81 TO 12-4-81 PREPARED BY JLB CHECKED BY HPA

Depth scale 1"=5'; depth 0–35; El 725–700

| REMARKS | SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|---|
| 1032-GRAVEL FILL (0–5) | | | | | |
| ALLUVIUM | 14 | SC | 15.9 | 37 | 17 |
| | 21 | CL-ML | 24.5 | 47 | 20 |
| | 19 | SC | 17.8 | 37 | 16 |
| | 31 | ML | 20.8 | 40 | 13 |
| | 38 | SC | 15.5 | 32 | 12 |
| WEATHERED SHALE | 22 | CH | 33.0 | 54 | 26 |
| | 33 | SM | 25.0 | 38 | 10 |
| | 47 | SM | 23.6 | 39 | 12 |
| | 42 | SM | 23.1 | 43 | 15 |
| | 30 | SM | 31.4 | NP | NP |
| | 41 | SM | 25.7 | | |
| DISCONTINUED | | | | | |

Added by Amendment 49

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
1D CONDUIT BANKS
FIGURE 2.5-278

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

SHEET 1 OF ___

PROJECT: WATTS BAR N. P. FEATURE: 1 E CONDUIT BANKS

BORING: SS-176 STATION: 377.25E RANGE: 968.75S SURFACE El: 728.0

DATE DRILLED: 12-7-81 TO 12-8-81 PREPARED BY: JLB CHECKED BY: HPH

Depth scale 1"=5' (0–35); El 725, 720, 715, 710, 705, 700

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| | | | | | 1032-GRAVEL FILL |
| 35 | SC | 15.5 | 32 | 12 | BACKFILL |
| 29 | SM | 11.0 | 20 | 1 | |
| 47 | SP-SM | 5.3 | NP | NP | |
| 50+ | SM | 11.1 | | | ALLUVIUM |
| 50+ | SM-SC | 27.2 | 26 | 5 | |
| | GP-GM | 7.8 | | | |
| 50+ | GM | 13.3 | NP | NP | |
| 50+ | GM | 11.5 | | | |
| 50+ | GM | 13.0 | | | |
| 50+ | CL-ML | 27.5 | 41 | 16 | WEATHERED SHALE |
| 47 | SM-SC | 21.5 | 39 | 13 | |
| 50+ | SM-SC | 19.6 | 36 | 12 | |
| 50+ | CL-ML | 23.8 | 40 | 13 | |
| 50+ | SM-SC | 20.6 | 36 | 11 | |
| | | | | | DISCONTINUED |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
(SS, PA, HA, TP BORING)
1D CONDUIT BANKS
FIGURE 2.5-279

# TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS,PA,HA,TP BORING)

SHEET 1 OF __

PROJECT WATTS BAR N.P. FEATURE I.E. CONDUIT BANKS

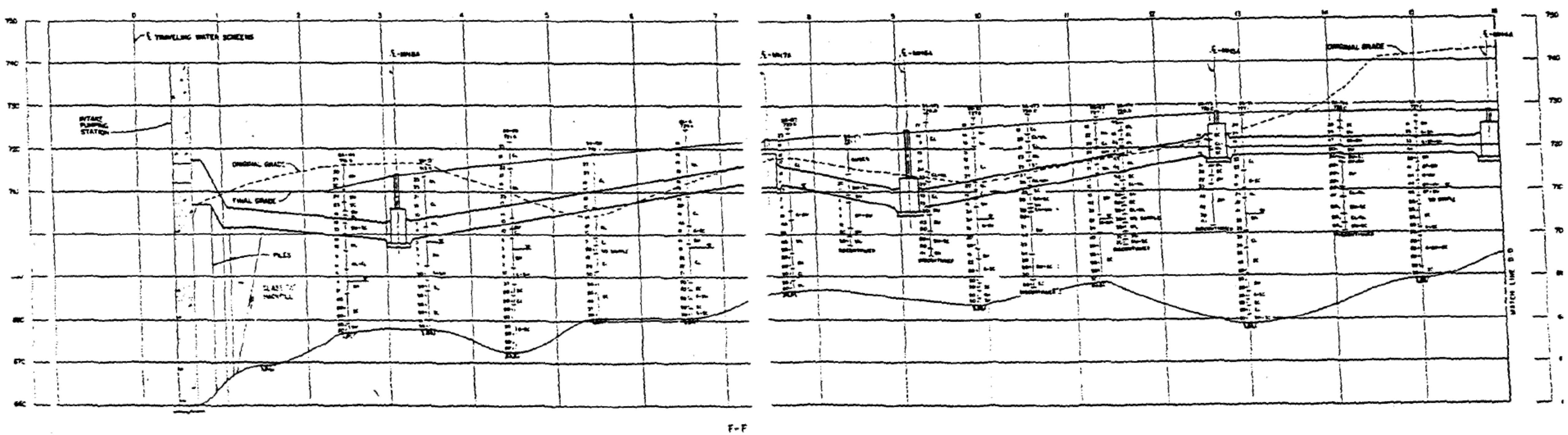
BORING SS-177 STATION 353.25E RANGE 753.75S SURFACE El 728.0

DATE DRILLED 12-10-81 TO 12-10-81 PREPARED BY JLB CHECKED BY HPN

| DEPTH | El | SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|
| 1" = 5' | | | | | | | |
| 0 | | | | | | | 1032-GRAVEL FILL |
| | 725 | 50+ | CL | 16.7 | 34 | 15 | BACKFILL |
| | | 50 | | 8.5 | NP | NP | |
| 5 | | 20 | | 15.4 | 24 | 1 | |
| | 720 | 50+ | SM | 13.8 | | | |
| 10 | | 50+ | | 14.2 | | | |
| | | 50+ | | SP-SM 9.2 | | | |
| | 715 | 50+ | | SW-SM 16.3 | | | ALLUVIUM |
| 15 | | | | | NP | NP | |
| | | 50+ | SM | 11.2 | | | |
| | 710 | 50+ | | SP-SM 11.7 | | | |
| 20 | | 50+ | SM | 13.1 | | | |
| | | 50+ | | 12.1 GP-GM | | | WEATHERED SHALE |
| | 705 | | | | | | |
| | | 50+ | | 8.2 SM-SC | 26 | 6 | |
| 25 | | | (hatched) | | | | BEDROCK |
| | 700 | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

SOIL PROFILE
(SS, PA, HA, TP BORING)
ID CONDUIT BANKS
FIGURE 2.5-280

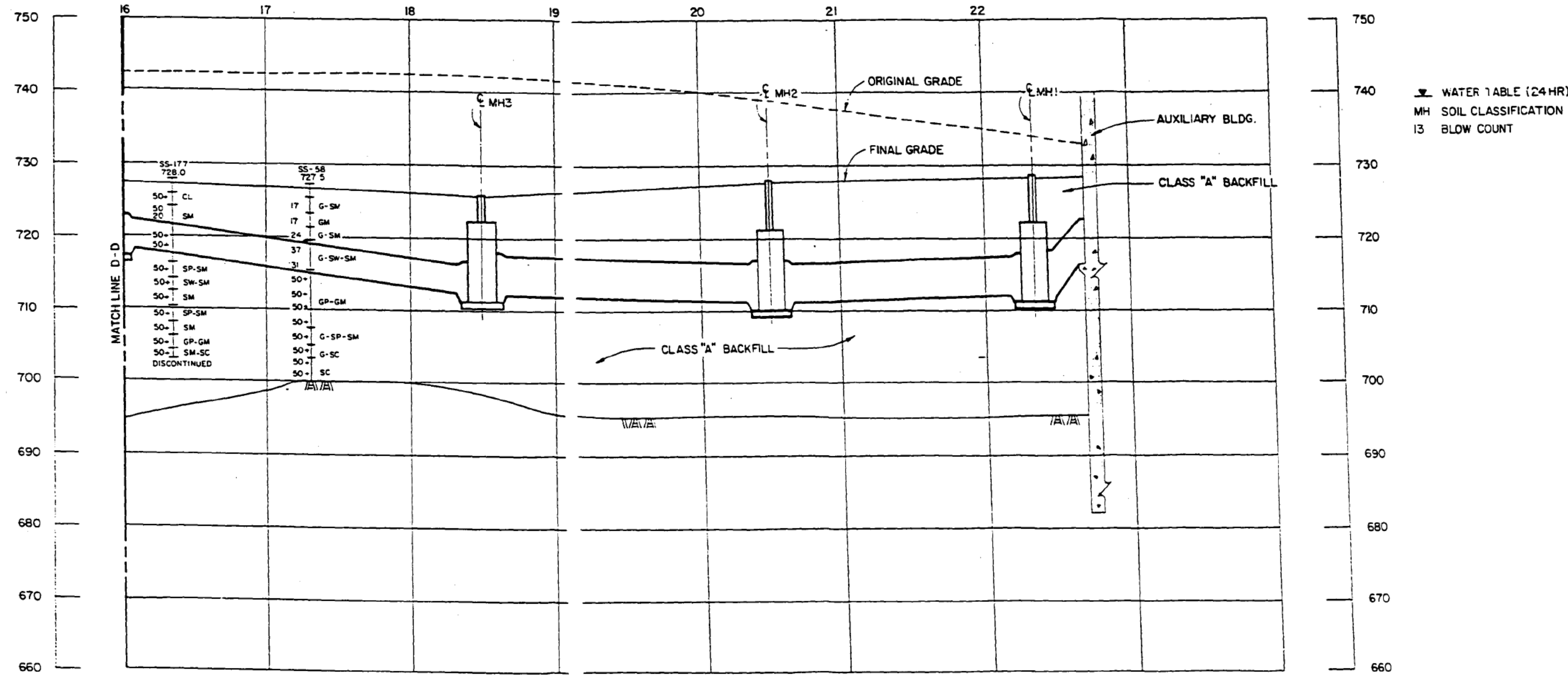



▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT

**Watts Bar Nuclear Plant**
**Final Safety Analysis Report**

Category 1 Conduit Banks
Section FF, Sheet 1 of 2
Figure 2.5-281

**Historical**




Watts Bar Nuclear Plant
Final Safety Analysis Report

Category 1 Conduit Banks
Section FF, Sheet 2 of 2
Figure 2.5-281

Historical

# WATTS BAR NUCLEAR PLANT ERCW
## SOIL PROFILE

| Boring SS-49 | Boring SS-49A | Prepared by |
|---|---|---|
| Station 1821.9S Range 868.7E | Station 1820.3S Range 871.93E | JLB |
| Surface El 716.9 | Surface El 711.7 | Checked by |
| Date Drilled 7-7-75 to 7-7-75 | Date Drilled 11-16-81 to 11-18-81 | HPM |

Elevation scale (El): 715, 710, 705, 700, 695, 690, 685, 680, 675

**Boring SS-49**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 30 | MH | 23.6 | 56.0 | 22.1 |
| 27 | MH | 27.2 | 60.9 | 25.1 |
| 30 | MH | 26.8 | 53.1 | 21.4 |
| 24 | SM | 15.4 | 29.4 | 5.4 |
| 23 | SC | 20.0 | 36.2 | 11.9 |
| 19 | SM | 21.2 | 36.0 | 11.6 |
| 18 | SM | 26.7 | 34.0 | 10.2 |
| 13 | SM-SC | 25.1 | 28.3 | 6.5 |
| 14 | ML | 26.1 | 28.8 | 5.3 |
| 12 | ML | 26.8 | | |
| 9 | ML-CL | 31.9 | 27.4 | 7.0 |
| 11 | ML-CL | 29.1 | | |
| 6 | SM | 29.0 | NP | NP |
| 4 | SM | 28.0 | | |
| 31 | SC | 25.3 | | |
| 50 | SC | 13.7 | | |
| 50 | SC | 14.8 | 37.5 | 14.9 |
| 50 | SC | 12.7 | | |
| 50 | SC | 13.5 | | |
| 50 | GM | 13.5 | — | — |

**Boring SS-49A**

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| | | | | | ROADBED GRAVEL |
| 17 | CL-ML | 21.1 | 32 | 8 | ALLUVIUM |
| 14 | SM | 21.4 | 30 | 6 | |
| 9 | SM | 24.6 | 29 | 3 | |
| 5 | SM | 26.5 / 21.6 | 28 / NP | 3 / NP | |
| 5 | SM | 26.5 / 29.0 | 23 | 1 | |
| 6 | SM | 29.9 | | | |
| 5 | SM | 31.8 / 32.4 | NP / 29 | NP / 4 | |
| 6 | ML | 28.3 / 28.0 | 22 / 22 | 1 / 3 | |
| 5 | CL | 27.8 / 28.7 | NP / 28 / 23 | NP / 17 / 1 | |
| 6 | SM | 30.0 | NP | NP | |
| 17 | SM | 31.2 / 21.2 | NP | NP | |
| 50 | SM-SC | 18.9 | 37 | 13 | WEATHERED SHALE |
| | | | | | DISCONTINUED |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-282

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

**SOIL PROFILE**
**FIGURE 2.5-283**
**SHEET 1 OF 2**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-131 Station 1755.0S Range 805.0E Surface El 713.9

Date Drilled 6-1-79 To 6-4-79 Prepared By JLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | ASPHALT |
| | | 25 | ML | 24.3 | 48.8 | 18.4 | | |
| | 710 | 25 | | 19.5 | 39.0 | 14.7 | | LEAN CLAY AND SILT FILL |
| 5 | | | | | | | | |
| | | 21 | | 19.3 | | | | |
| | | | CL | | 35.2 | 11.5 | | |
| | | 18 | | 20.7 | | | | |
| | 705 | | | | | | | |
| 10 | | 10 | | 25.9 | 37.1 | 13.3 | | ALLUVIAL LEAN CLAY AND SILT |
| | | 7 | ML | 22.2 | 28.5 | 5.2 | | |
| | 700 | 4 | | 28.1 | 30.8 | 6.9 | ▼ | |
| 15 | | | | | | | | |
| | | 5 | | 30.1 | | | ▽ | |
| | | | | | 25.9 | 3.3 | | |
| | | 5 | SM | 29.7 | | | | ALLUVIAL SAND |
| | 695 | | | | | | | |
| 20 | | 7 | | 26.2 | | | | |
| | | 7 | | 24.0 | NP | NP | | |
| | | 50+ | GSM | 20.6 | | | | ALLUVIAL GRAVEL |
| | 690 | | | | | | | |
| 25 | | | | | | | | |
| | | 50+ | CL | 17.2 | 38.0 | 14.9 | | |
| | | 50 | | 15.8 | | | | |
| | 685 | | | | | | | |
| 30 | | 50+ | SC | 15.9 | 32.7 | 11.2 | | WEATHERED SHALE |
| | | 50+ | | 14.9 | | | | |
| | 680 | 16 | | 14.1 | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-283
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-131 Station 1755.0S Range 805.0E Surface El 713.9

Date Drilled 6-1-79 To 6-4-79 Prepared By JLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | ASPHALT |
| | | 25 | ML | 24.3 | 48.8 | 18.4 | | LEAN CLAY AND SILT FILL |
| | 710 | 25 | CL | 19.5 | 39.0 | 14.7 | | |
| 5 | | 21 | CL | 19.3 | 35.2 | 11.5 | | |
| | | 18 | CL | 20.7 | | | | |
| | 705 | | | | | | | ALLUVIAL LEAN CLAY AND SILT |
| 10 | | 10 | CL | 25.9 | 37.1 | 13.3 | | |
| | | 7 | ML | 22.2 | 28.5 | 5.2 | | |
| | 700 | 4 | SM | 28.1 | 30.8 | 6.9 | ▼ | ALLUVIAL SAND |
| 15 | | 5 | SM | 30.1 | 25.9 | 3.3 | ▽ | |
| | | 5 | SM | 29.7 | | | | |
| | 695 | | | | | | | |
| 20 | | 7 | SM | 26.2 | | | | |
| | | 7 | SM | 24.0 | NP | NP | | |
| | | 50+ | GSM | 20.6 | | | | ALLUVIAL GRAVEL |
| | 690 | | | | | | | |
| 25 | | 50+ | CL | 17.2 | 38.0 | 14.9 | | WEATHERED SHALE |
| | | 50 | SC | 15.8 | | | | |
| | 685 | | | | | | | |
| 30 | | 50+ | SC | 15.9 | 32.7 | 11.2 | | |
| | | 50+ | SC | 14.9 | | | | |
| | 680 | 16 | | 14.1 | | | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-131

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 35 | | 50 | SC | 10.8 | 32.7 | 11.2 | | WEATHERED SHALE |
| | | | | | | | | BEDROCK |
| | 675 | | | | | | | |
| 40 | | | | | | | | |
| | 670 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-283**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-50 | Boring SS-50A | Prepared by |
|---|---|---|
| Station 1664.75 Range 787.5E | Station 1668.75 Range 787.8E | |
| Surface El 721.8 | Surface El 717.2 | Checked by HPM |
| Date Drilled 7-23-75 to 7-23-75 | Date Drilled 11-19-81 to 11-19-81 | |

Boring SS-50 (El scale 720 to 670)

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 25 | CL | 18.0 | 40.5 | 17.8 |
| 18 | CL | 22.5 | 43.3 | 18.5 |
| 23 | CL | 21.3 | | |
| 13 | ML | 20.0 | 44.2 | 16.0 |
| 16 | ML | 24.2 | | |
| 25 | ML | 23.5 | 46.4 | 16.8 |
| 17 | ML | 22.1 | 42.8 | 13.6 |
| 14 | ML | 22.8 | 37.5 | 11.3 |
| 10 | ML | 22.1 | | |
| 10 | SM | 22.4 | 34.1 | 7.6 |
| 8 | CL | 25.6 | 36.3 | 12.0 |
| 5 | SM | 28.2 | | |
| 8 | SM | 29.1 | | |
| 2 | SM | 31.5 | NP | NP |
| 10 | G-SM | 23.7 | | |
| 37 | G-SM | 19.6 | | |
| 50 | SC | 15.4 | 34.0 | 10.9 |
| 50 | CL | 15.2 | 36.9 | 13.5 |
| 50 | G-SC | 12.0 | 31.7 | 10.4 |
| 50 | G-SC | 14.9 | | |
| 30 | G-SC | 15.2 | 29.3 | 8.1 |
| 50 | G-SC | 17.1 | 32.7 | 12.2 |
| 50 | G-SC | 5.1 | 25.5 | 7.8 |
| 50 | G-SC | 7.3 | — | — |

Boring SS-50A

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| | | | | | ROADBED GRAVEL |
| 22 | CL-ML | 19.9 | 43 | 16 | FILL |
| 16 | ML | 19.8 | 42 | 15 | |
| 22 | ML | 21.5 | 41 | 13 | ALLUVIUM |
| 25 | SM | 20.9 | | | |
| 22 | SM | 24.4 | 38 | 11 | |
| 20 | SM | 25.3 | 35 | 9 | |
| 14 | SM | 25.5 | NP | NP | |
| 11 | SM | 28.8 / 26.9 | 27 / NP | 2 / NP | |
| 13 | SM | 27.4 / 28.8 | 26 / NP | 2 / NP | |
| 9 | SM | 33.5 / 34.5 | NP | NP | |
| 5 | SM / ML | 38.4 / 34.8 | 29 | 3 | |
| | SM / ML | 25.1 | NP | NP | |
| 23 | ML | | 37 | 10 | WEATHERED SHALE |
| 50 | SM-SC | 20.1 | 35 | 12 | DISCONTINUED |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-284

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-285
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-132 Station 1560.0 S Range E 785.0 E Surface El 719.1

Date Drilled 6-4-79 To 6-5-79 Prepared By JLB Checked By

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5 | | | | | | | | |
| 0 | | | | | | | | |
| | | 22 | CL | 19.6 | | | | ALLUVIAL SANDY LEAN CLAY |
| | 715 | | | | | | | |
| 5 | | 22 | | 20.3 | | | | |
| | | 19 | | 22.3 | 44.7 | 17.9 | | |
| | 710 | 14 | | 21.3 | | | | |
| 10 | | | | | | | | |
| | | 15 | | 21.8 | | | | |
| | | 13 | | 23.5 | | | ▼ | |
| | 705 | | | | | | | |
| 15 | | 14 | | 23.6 | 42.0 | 17.8 | ▽ | |
| | | 13 | ML | 25.7 | 43.1 | 15.2 | | ALLUVIAL LEAN SILT |
| | 700 | 15 | | 23.4 | 45.8 | 17.5 | | |
| 20 | | | | | | | | |
| | | 5 | CL | 25.9 | 40.4 | 16.8 | | |
| | | 50+ | | — | — | — | | NO SAMPLE RECOVERY |
| | 695 | | | | | | | |
| 25 | | 18 | CL | 22.7 | 40.8 | 16.6 | | LAMINATED RESIDUAL CLAY |
| | | 29 | | 19.3 | | | | |
| | 690 | 50+ | SC | 20.2 | | | | WEATHERED SHALE |
| 30 | | 50+ | | 16.5 | 37.1 | 12.9 | | |
| | | 50+ | | 15.6 | | | | |
| | 685 | | | | | | | |
| 35 | | 48 | | 16.6 | | | | |

Project WATTS BAR N. P. Boring SS-132

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 35 | | | | | | | | |
| | | 37 | SC | 19.1 | 37.1 | 12.9 | | NO SAMPLE RECOVERY |
| | | 50+ | | | | | | |
| | 680 | | | | | | | BEDROCK |
| 40 | | | | | | | | |
| | 675 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-285**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-286
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-133 Station 1361.0S Range 7850.0E Surface El 725.0

Date Drilled 6-4-79 To 6-4-79 Prepared By JLB Checked By [illegible]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 725 | | | | | | | AUGER |
| | | 23 | CL | 15.7 | | | | LEAN CLAY TO SANDY LEAN CLAY, FILL |
| 5 | 720 | 18 | | 16.6 | 39.9 | 20.5 | | |
| | | 16 | | 18.9 | | | | |
| | | 12 | | 19.7 | 42.6 | 17.4 | | |
| 10 | 715 | 12 | | 22.9 | | | | |
| | | 11 | | 21.7 | 43.9 | 19.2 | | ▽ ▼ |
| 15 | 710 | 9 | | 22.5 | | | | |
| | | 2 | | 23.6 | 37.7 | 16.3 | | |
| | | 4 | | 32.9 | 39.1 | 16.7 | | |
| 20 | 705 | 19 | GSM | 17.3 | NP | NP | | ALLUVIAL GRAVEL |
| | | 48 | ML | 20.1 | 42.8 | 13.8 | | WEATHERED SHALE |
| 25 | 700 | 28 | | 28.3 | | | | |
| | | 40 | | 24.0 | 35.1 | 1.5 | | |
| | | 50+ | | 20.8 | | | | |
| 30 | 695 | 50+ | SM | 18.0 | | | | |
| | | | | | 32.3 | 8.1 | | |
| | | 50 | | 16.1 | | | | |
| | | 50+ | CL | 12.7 | 31.7 | 11.0 | | |
| 35 | 690 | | | | | | | |

Project WATTS BAR N. P. Boring SS-133

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 35 | 690 | | | | | | | |
| | | 50+ | ML | 11.1 | | | | WEATHERED SHALE |
| | | | | | 28.6 | 5.1 | | |
| | | 50+ | | 15.3 | | | | |
| | | | | | | | | BEDROCK |
| 40 | 685 | | | | | | | |
| 45 | 680 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-286**
**SHEET 2 OF 2**

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-287**
**SHEET 1 OF 2**

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-134 Station 1373.0S Range 900.0 E Surface El 726.5

Date Drilled 6-6-79 To 6-7-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 725 | 10 | CL | 20.0 | | | | ALLUVIAL SANDY LEAN CLAY |
| | | 16 | CL | 16.9 | 28.0 | 8.4 | | |
| 5 | 720 | 14 | CL | 18.9 | | | | |
| | | 15 | CL | 18.7 | 36.2 | 17.1 | | |
| 10 | | 8 | CL | 21.7 | | | | |
| | 715 | 13 | CL | 20.9 | 39.1 | 19.5 | | |
| | | 2 | CL | 23.8 | | | | |
| 15 | | 3 | SM | 29.3 | | | | ALLUVIAL SAND |
| | 710 | 8 | SM | 27.5 | NP | NP | | |
| 20 | | 27 | GM | 11.4 | | | | ALLUVIAL GRAVEL |
| | 705 | 50+ | GM | 10.0 | | | | |
| | | 50+ | CL | 18.1 | | | | WEATHERED SHALE |
| 25 | | 50+ | CL | 18.1 | 39.3 | 15.2 | | |
| | 700 | 50+ | CL | 16.5 | | | | |
| 30 | | 50+ | CL | 16.6 | | | | |
| | 695 | 50+ | SC | 20.4 | 36.7 | 13.5 | | |
| | | 42 | SC | 16.2 | | | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P    Boring SS-134

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | 690 | 50+ | CL | 15.2 | 35.6 | 13.3 | | |
| | | 50+ | | 15.8 | 37.2 | 13.4 | | WEATHERED SHALE |
| 40 | | 50+ | SC | 14.7 | 35.6 | 12.1 | | |
| | 685 | 50+ | | 15.1 | | | | |
| | | 50+ | CL | 18.7 | 33.4 | 11.4 | | |
| 45 | | 50+ | | — | — | — | | NO SAMPLE RECOVERY |
| | 680 | | | | | | | BEDROCK |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-287
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-134 | Boring SS-134A | Prepared by JLB |
|---|---|---|
| Station 1370.0 S Range 900.0E | Station 1370.0 S Range 905.0E | |
| Surface El 726.5 | Surface El 725.5 | Checked by HPM |
| Date Drilled 6-6-79 to 6-7-79 | Date Drilled 11-6-81 to 11-9-81 | |

Elevation scale (El): 725, 720, 715, 710, 705, 700, 695, 690, 685, 680

**Boring SS-134**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 10 | | 20.0 | | |
| 16 | | 16.9 | 28.0 | 8.4 |
| 14 | | 18.9 | | |
| 15 | CL | 18.7 | 36.2 | 17.1 |
| 8 | | 21.7 | | |
| 13 | | 20.9 | 39.1 | 19.5 |
| 2 | | 23.8 | | |
| 3 | SM | 29.3 | | |
| 8 | | 27.5 | NP | NP |
| 27 | GM | 11.4 | | |
| 50 | | 10.0 | | |
| 50 | CL | 18.1 | | |
| 50 | | 18.1 | 39.3 | 15.2 |
| 50 | | 16.5 | | |
| 50 | | 16.6 | | |
| 50 | SC | 20.4 | 36.7 | 13.5 |
| 42 | | 16.2 | | |
| 50 | CL | 15.2 | 35.6 | 13.3 |
| 50 | | 15.8 | 37.2 | 13.4 |
| 50 | SC | 14.7 | 35.6 | 12.1 |
| 50 | | 15.1 | | |
| 50 | CL | 18.7 | 33.4 | 11.4 |
| 50 | | — | — | — |

**Boring SS-134A**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 13 | | 13.4 | 29 | 10 |
| 25 | | 16.1 | 32 | 12 |
| 17 | | 15.6 | 35 | 17 |
| 13 | CL | 19.8 | 31 | 12 |
| 10 | | 21.8 | 41 | 20 |
| 12 | | 19.4 | 34 | 15 |
| 4 | | 25.3 | 42 | 17 |
| | SM | 30.0 | 23 | 1 |
| 4 | | 29.1 | NP | NP |
| 9 | | 27.9 | 24 | 2 |
| | | 28.9 | 24 | 1 |
| 27 | | 31.9 | NP | NP |
| | SW-SM | 16.3 | 27 | 2 |
| 39 | GR-GM | 11.2 | NP | NP |
| 50 | | — | — | — |
| 50 | SM-SC | 20.7 | 40 | 15 |

REMARKS: FILL; ALLUVIUM; WEATHERED SHALE; DISCONTINUED

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-288

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-289**
**SHEET 1 OF 2**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-135 Station 1370.0 S Range 1000.0 E Surface El 726.9

Date Drilled 5-30-79 To 6-1-79 Prepared By JLB Checked By CBG

Depth scale 1" = 5' (Depth: 0, 5, 10, 15, 20, 25, 30, 35; El: 725, 720, 715, 710, 705, 700, 695)

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| 7 | CL | — | 30.9 | 12.2 | | SANDY LEAN CLAY FILL |
| 13 | CL | 19.4 | 32.7 | 9.7 | | |
| 13 | CL | 19.3 | 37.8 | 19.6 | | |
| 21 | ML | — | 48.0 | 19.6 | | ALLUVIAL SANDY SILT |
| 14 | ML | 26.7 | 46.5 | 16.5 | | |
| 12 | ML | 26.3 | 42.2 | 13.8 | | |
| 11 | SM | 23.6 | 34.1 | 8.7 | | ALLUVIAL SAND |
| 12 | SM | 20.1 | 30.0 | 4.4 | | |
| 8 | SM | — | | | | ▽ ▼ |
| 8 | SM | — | NP | NP | | |
| 8 | SM | 25.3 | | | | |
| 8 | CL | — | 32.3 | 11.8 | | LAMINATED RESIDUAL CLAY |
| 22 | G-SM | 28.9 | 44.5 | 15.8 | | WEATHERED SHALE |
| 26 | SM | 25.7 | 43.5 | 16.7 | | |
| 50 | SM | 20.4 | 38.9 | 12.7 | | |
| 48 | SM | 21.3 | 38.6 | 12.4 | | |
| 43 | SM | 23.3 | 37.9 | 10.5 | | |

Project WATTS BAR N. P. Boring SS-135

| Depth (1" = 5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | CL | 17.9 | 34.3 | 11.3 | | |
| | 690 | 50+ | CL | — | 35.1 | 13.1 | | |
| | | 50+ | SC | 15.6 | 34.1 | 12.0 | | WEATHERED SHALE |
| 40 | | 50+ | CL | 12.3 | 30.7 | 10.7 | | |
| | 685 | | | | | | | |
| | | 50+ | CL | 20.6 | 36.1 | 16.1 | | |
| 45 | | 50+ | CL | 11.2 | 28.5 | 8.7 | | |
| | | | | | | | | BEDROCK |
| | 680 | | | | | | | |
| 50 | | | | | | | | |
| | 675 | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-289
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| | | |
|---|---|---|
| Boring SS-135<br>Station 1373.0 S Range 1000.0 E<br>Surface Elev 726.9<br>Date Drilled 5-30-79 To 6-1-79 | Boring SS-135A<br>Station 1363.3 S Range 1004.5 E<br>Surface Elev 726.5<br>Date Drilled 11-9-81 To 11-10-81 | Prepared By JLB<br><br>Checked By HPM |

| El | SPT (N) | LOG | W | LL | PI | SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 725 | 7 | CL | — | 30.9 | 12.2 | 19 | CL | 16.1 | 29 | 7 | |
| | 13 | CL | 19.4 | 32.7 | 9.7 | 20 | CL | 16.6 | 33 | 13 | FILL |
| | 13 | | 19.3 | 37.8 | 19.6 | | | | | | |
| | | | | | | 21 | CL-ML | 19.8 | 40 | 15 | |
| 720 | 21 | ML | — | 48.0 | 19.6 | 19 | ML | 24.7 | 41 | 13 | |
| | 14 | ML | 26.7 | 46.5 | 16.5 | 19 | ML | 26.7 | 41 | 12 | |
| 715 | 12 | | 26.3 | 42.2 | 13.8 | 13 | SM | 24.3 | 31 | 3 | |
| | 11 | SM | 23.6 | 34.1 | 8.7 | 7 | SM | 22.8 | | | |
| | 12 | SM | 20.1 | 30.0 | 4.4 | 7 | SM | 24.3 | NP | NP | |
| 710 | 8 | SM | — | — | — | 5 | SM | 34.2 | | | ALLUVIUM |
| | 8 | SM | — | —<br>NP | —<br>NP | 8 | ML | 27.0<br>32.1 | 22<br>27 | 1<br>2 | |
| 705 | 8 | SM | 25.3 | | | 7 | ML<br>SM | —<br>32.1<br>30.9 | 39<br>25<br>NP | 7<br>2<br>NP | |
| | 8 | CL | — | 32.3 | 11.8 | 50 | GM-GC | 16.7 | — | — | |
| | 22 | G-SM | 28.9 | 44.5 | 15.8 | 36 | GM | 30.1 | 46 | 14 | |
| 700 | 26 | SM | 25.7 | 43.5 | 16.7 | | | | | | DISCONTINUED |
| | 50 | SM | 20.4 | 38.9 | 12.7 | | | | | | WEATHERED SHALE |
| 695 | 48 | SM | 21.3 | 38.6 | 12.4 | | | | | | |
| | 43 | SM | 23.3 | 37.9 | 10.5 | | | | | | |
| | 50 | CL | 17.9 | 34.3 | 11.3 | | | | | | |
| 690 | 50 | CL | — | 35.1 | 13.1 | | | | | | |
| | 50 | SC | 15.6 | 34.1 | 12.0 | | | | | | |
| | 50 | CL | 12.3 | 30.7 | 10.7 | | | | | | |
| 685 | | CL | | | | | | | | | |
| | 50 | CL | 20.6 | 36.1 | 16.1 | | | | | | |
| | 50 | CL | 11.2 | 29.5 | 8.7 | | | | | | |
| 680 | | | | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-290

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-65 | Boring SS-65B | Prepared by JLB |
|---|---|---|
| Station 1374.8S Range 1097.5E | Station 1362.3S Range 1091.0E | |
| Surface El 726.0 | Surface El 727.2 | Checked by HPM |
| Date Drilled 7-25-75 to 7-25-75 | Date Drilled 11-13-81 to 11-13-81 | |

El: 725, 720, 715, 710, 705, 700, 695, 690, 685, 680, 675

**Boring SS-65**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 50 | SCL | 15.4 | 36.3 | 15.6 |
| 35 | CL | 12.9 | 35.6 | 14.1 |
| 24 | MH | 28.2 | 50.7 | 17.7 |
| 21 | | 24.9 | | |
| 13 | ML | 24.5 | 40.4 | 13.0 |
| 16 | | 29.2 | 46.1 | 15.6 |
| 12 | SM | 21.5 | 33.1 | 6.6 |
| 10 | | 15.7 | NP | NP |
| 7 | | 23.7 | 30.1 | 5.1 |
| 5 | | 28.2 | 28.9 | 3.5 |
| 8 | | — | — | — |
| 20 | GM | 13.5 | 32.5 | 9.0 |
| 18 | SM | 24.8 | 46.4 | 18.2 |
| 16 | G-SM | 23.8 | | |
| 16 | | 24.7 | 43.4 | 15.9 |
| 14 | | 25.5 | | |
| 11 | ML | 40.7 | 47.1 | 13.4 |
| 30 | | 30.8 | 42.2 | 13.9 |
| 48 | SC | 19.8 | 34.4 | 11.2 |
| 50+ | G-SC | 14.3 | | |
| | | | 36.6 | 12.0 |
| 16 | | 19.1 | | |
| 41 | | 22.6 | | |
| | | | 33.8 | 10.5 |
| 45 | | 17.1 | | |
| 50+ | | 15.4 | | |
| | | | 32.0 | 10.5 |
| 50 | | 15.3 | | |

**Boring SS-65B**

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| 1 | SC | 14.1 | 28 | 3 | FILL |
| 20 | CL | 12.5 | 32 | 14 | |
| 25 | MH | 28.3 | 55 | 8 | ALLUVIUM |
| 18 | | 28.9 | 51 | 15 | |
| 12 | ML | 29.1 | 42 | 12 | |
| 14 | | 26.7 | 35 | 6 | |
| 9 | SM | 25.7 | 29 | 2 | |
| 6 | | 27.5 | | | |
| | | | 25 | 1 | |
| 3 | | 33.1 / 32.9 | NP | NP | |
| 5 | | 32.5 | 25 | 1 | |
| 7 | | 27.1 / 30.8 | 26 / 25 | 2 / 1 | |
| 37 | | 32.7 / 10.7 | NP | NP | |
| | | 21.9 | 44 | 14 | WEATHERED SHALE |
| | | | | | DISCONTINUED |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-291

**HISTORICAL**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-292
SHEET 1 OF 2

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-136 Station 1373.7 S Range 1215.0 E Surface El 726.9

Date Drilled 6-22-79 To 6-22-79 Prepared By JLB Checked By [signature]

Depth scale 1"=5'; Depth 0, 5, 10, 15, 20, 25, 30, 35; El 725, 720, 715, 710, 705, 700, 695

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| | | | | | | TOPSOIL |
| 19 | CL | 19.2 | 38.8 | 20.3 | | LEAN CLAY FILL |
| 6 | CL | 22.5 | 49.7 | 24.2 | | |
| 14 | MH | 25.8 | 51.1 | 20.4 | | ALLUVIAL SANDY SILT |
| 17 | ML | 26.5 | | | | |
| | ML | | 40.7 | 11.4 | | |
| 14 | ML | 25.8 | | | | |
| 11 | ML | 23.7 | | | | |
| | ML | | 32.8 | 5.7 | | |
| 9 | ML | 25.0 | | | | |
| 5 | SM | 26.3 | | | | ALLUVIAL SAND |
| 8 | SM | 28.5 | | | | |
| | SM | | NP | NP | | |
| 12 | SM | 21.9 | | | | |
| 50+ | GP-GM | 15.1 | | | | ALLUVIAL GRAVEL |
| 50+ | ML-CL | 19.1 | | | | WEATHERED SHALE |
| | ML-CL | | 41.7 | 16.7 | | |
| 50+ | ML-CL | 17.2 | | | | |
| 34 | CL | 20.3 | 37.2 | 13.4 | | |
| 31 | SM | 21.6 | | | | |
| | SM | | 36.3 | 11.7 | | |
| 50+ | SM | 16.9 | | | | |
| 50+ | SM | 17.4 | 34.0 | 7.0 | | |

Project WATTS BAR N. P. Boring SS-136

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | | 50 | SM | 21.0 | 33.3 | 3.7 | | |
| | 690 | 50+ | SM | 20.3 | | | | |
| | | | | | | | | WEATHERED SHALE |
| | | 50+ | SC | 12.6 | 35.3 | 13.2 | | |
| 40 | | | | | | | | |
| | 685 | 50+ | SC | 12.8 | | | | |
| | | | | | 31.4 | 9.6 | | |
| | | 50+ | SC | 14.9 | | | | |
| | | | | | | | | BEDROCK |
| 45 | | | | | | | | |
| | 680 | | | | | | | |

Depth scale continues: 50, 55, 60, 65, 70, 75, 80

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-292**
**SHEET 2 OF 2**

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-293**
**SHEET 1 OF 1**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-137 Station 1375.0 S Range 1300.0 E Surface El 726.9

Date Drilled 6-7-79 To 6-8-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | TOPSOIL |
| | 725 | 20 | ML | 19.0 | 35.2 | 10.9 | | ALLUVIAL SANDY LEAN CLAY OR SILT |
| | | 7 | CL | 21.2 | | | | |
| 5 | | 11 | CL | 21.0 | 42.0 | 17.1 | | |
| | 720 | 15 | CL | 26.5 | | | | |
| 10 | | 14 | ML | 25.1 | 43.9 | 14.1 | | ALLUVIAL SANDY SILT |
| | 715 | 11 | ML | 24.2 | 35.6 | 9.6 | | |
| | | 9 | SM | 20.7 | 25.9 | 1.8 | | ALLUVIAL SAND |
| 15 | | | | | | | | ▽ ▼ |
| | | 7 | ML | 25.0 | | | | ALLUVIAL LEAN CLAY OR SILT |
| | 710 | | ML | | 31.7 | 5.6 | | |
| | | 8 | ML | 25.3 | | | | |
| 20 | | 3 | CL | 33.9 | 34.7 | 10.7 | | |
| | 705 | 32 | GM | 9.6 | NP | NP | | ALLUVIAL GRAVEL |
| | | 41 | ML | 21.1 | | | | WEATHERED SHALE |
| 25 | | | ML | | 42.6 | 14.9 | | |
| | | 50+ | ML | 22.8 | | | | |
| | 700 | | | | | | | |
| | | 39 | CL | 23.0 | | | | |
| | | | CL | | 40.8 | 16.5 | | |
| 30 | | 50+ | CL | 20.4 | | | | |
| | 695 | 50+ | CL | 16.9 | 36.5 | 13.0 | | |
| | | | | | | | | BEDROCK |
| 35 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-294**
**SHEET 1 OF 2**

Project WATTS BAR N P Feature ERCW ALIGNMENT

Boring SS-138 Station 1373.0 S Range 1400.0 E Surface El 727.2

Date Drilled 6-8-79 To 6-11-79 Prepared By JLB Checked By [signature]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | TOPSOIL |
| | 725 | 18 | CL | 15.7 | 34.3 | 16.9 | | ALLUVIAL LEAN CLAY TO FAT SILT |
| | | 23 | MH | 28.5 | 55.0 | 24.1 | | |
| 5 | | 15 | | 27.5 | | | | |
| | 720 | 13 | ML | 30.1 | 48.0 | 19.7 | | ALLUVIAL SANDY SILT |
| 10 | | 10 | | 25.6 | 40.2 | 14.5 | | |
| | 715 | 9 | | 22.3 | 31.6 | 7.8 | | |
| | | 6 | SM | 23.4 | 28.1 | 2.5 | | ALLUVIAL SAND |
| 15 | | 7 | | 24.5 | | | | ▼ |
| | 710 | 7 | ML | 28.4 | 32.7 | 5.9 | | ▽ ALLUVIAL SANDY SILT OR SANDY LEAN CLAY |
| 20 | | 5 | ML-CL | 29.6 | 27.0 | 5.1 | | |
| | 705 | 13 | SM | 15.0 | 26.4 | 2.3 | | ALLUVIAL SAND |
| | | 16 | G-SM | 26.8 | | | | WEATHERED SHALE |
| 25 | | 43 | | 26.7 | | | | |
| | 700 | 32 | | 29.3 | NP | NP | | |
| 30 | | 50+ | SM | 20.4 | | | | |
| | 695 | 50+ | | 14.6 | | | | |
| | | 50+ | SC | 20.5 | 34.9 | 12.0 | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-138

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | SC | 14.8 | 34.9 | 12.0 | | |
| | 690 | | | | | | | WEATHERED SHALE |
| | | 32 | SM | 22.1 | 33.0 | 6.2 | | |
| 40 | | 50- | SM | 21.8 | | | | |
| | | 50+ | | 12.1 | NP | NP | | |
| | 685 | | | | | | | BEDROCK |
| 45 | | | | | | | | |
| | 680 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-294**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-138 | Boring SS-138A | |
|---|---|---|
| Station 1373.0S Range 1400.0E | Station 1368.8S Range 1406.5E | Prepared by JLB |
| Surface El 727.2 | Surface El 726.7 | Checked by HPM |
| Date Drilled 6-8-79 to 6-11-79 | Date Drilled 11-12-81 to 11-12-81 | |

**Boring SS-138**

| El | SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|---|
| 725 | 18 | CL | 15.7 | 34.3 | 16.9 |
| | 23 | MH | 28.5 | 55.0 | 24.1 |
| | 15 | MH | 27.5 | | |
| 720 | 13 | ML | 30.1 | 48.0 | 19.7 |
| | 10 | ML | 25.6 | 40.2 | 14.5 |
| 715 | 9 | ML | 22.3 | 31.6 | 7.8 |
| | 6 | SM | 23.4 | 28.1 | 2.5 |
| | 7 | SM | 24.5 | | |
| 710 | 7 | ML | 28.4 | 32.7 | 5.9 |
| | 5 | ML-CL | 29.6 | 27.0 | 5.1 |
| 705 | 13 | SM | 15.0 | 26.4 | 2.3 |
| | 16 | G-SM | 26.8 | | |
| | 43 | G-SM | 26.7 | | |
| 700 | 32 | G-SM | 29.3 | NP | NP |
| | 50+ | SM | 20.4 | | |
| 695 | 50+ | SM | 14.6 | | |
| | 50+ | SC | 20.5 | 34.9 | 12.0 |
| | 50+ | SC | 14.8 | | |
| 690 | 32 | SM | 22.1 | 33.0 | 6.2 |
| | 50+ | SM | 21.8 | | |
| 685 | 50+ | SM | 12.1 | NP | NP |
| 680 | | | | | |

**Boring SS-138A**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 50 | GC | 6.7 | 35 | 18 |
| 32 | ML-MH | 27.3 | 50 | 19 |
| 19 | ML | 30.9 | 48 | 18 |
| 16 | ML | 27.1 | 39 | 13 |
| 12 | ML | 25.1 | 33 | 6 |
| 8 | SM | 25.1 | 29 | 3 |
| 8 | SM | 22.1 | NP | NP |
| 12 | SM | 27.1 | 29 | 1 |
| 4 | SM | 35.6 / 28.1 | 28 / 25 | 2 / 2 |
| 9 | SM | 27.8 / 29.1 | 22 / NP | 1 / NP |
| 22 | GM / SM | 10.6 / 38.4 | NP | NP |
| 50+ | SM | 25.8 | 36 | 2 |

**REMARKS:** FILL; ALLUVIUM; WEATHERED SHALE; DISCONTINUED

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-295

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-296**
**SHEET 1 OF 2**

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-139 Station 1375.0 S Range 1500.0E Surface El 727.5

Date Drilled 6-11-79 To 6-12-79 Prepared By JLB Checked By [signature]

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | TOPSOIL |
| | 725 | 16 | CL | 15.8 | 34.7 | 17.3 | | SANDY LEAN CLAY FILL |
| | | 11 | | 14.4 | | | | |
| 5 | | 9 | CL-CH | 22.0 | 50.1 | 25.0 | | ALLUVIAL LEAN TO FAT CLAY |
| | 720 | 10 | | 25.9 | | | | |
| 10 | | 15 | ML | 26.4 | 47.2 | 17.7 | | ALLUVIAL SANDY SILT |
| | | 13 | | 23.8 | 36.9 | 11.0 | | |
| | 715 | 9 | | 19.2 | | | | |
| 15 | | 8 | SM | 15.5 | NP | NP | | ALLUVIAL SANDY SILT AND SILTY SAND |
| | 710 | 9 | | 18.2 | | | | |
| 20 | | 7 | ML | 32.8 | 31.0 | 3.9 | ▽ (water table) | |
| | | 14 | SM | 22.1 | NP | NP | | |
| | 705 | 50+ | GM | 7.5 | | | | ALLUVIAL GRAVEL |
| 25 | | 49 | CL | 17.0 | 36.7 | 14.6 | | WEATHERED SHALE |
| | 700 | 50+ | SC | 18.9 | 33.1 | 11.5 | | |
| | | 50+ | | 13.7 | | | | |
| 30 | | | | | | | | |
| | | 50+ | | 16.0 | 32.9 | 12.6 | | |
| | 695 | 50+ | | 11.8 | | | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-139

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | | 50+ | SM | 15.0 | NP | NP | | |
| | 690 | 50+ | | 12.2 | | | | |
| | | 50+ | CL | 13.1 | 30.6 | 10.0 | | |
| 40 | | | | | | | | |
| | | 50+ | | 9.5 | — | — | | |
| | 685 | | | | | | | |
| | | 50+ | | 10.7 | — | — | | WEATHERED SHALE |
| 45 | | | | | | | | |
| | | 50+ | G-SC | 18.0 | — | — | | |
| | 680 | 50+ | | 10.1 | | | | |
| | | | | | 30.7 | 10.3 | | |
| 50 | | 50+ | | 16.6 | | | | |
| | | 50+ | GSMSC | 13.4 | 27.2 | 7.0 | | |
| | 675 | 50+ | GSM | 9.4 | NP | NP | | |
| | | | | | | | | BEDROCK |
| 55 | | | | | | | | |
| | 670 | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-296**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-297
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-140 Station 1334.2S Range 1560.8 E Surface El 726.7

Date Drilled 6-11-79 To 6-11-79 Prepared By JLB Checked By ACG

Depth 1"=5' (scale 0, 5, 10, 15, 20, 25, 30, 35); El (scale 725, 720, 715, 710, 705, 700, 695)

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| 21 | CL | 12.7 | 35.0 | 17.4 | | ALLUVIAL SILT AND CLAY |
| 8 | CL | 13.9 | — | — | | |
| 9 | CL | 20.0 | 43.1 | 19.0 | | |
| 16 | CH-MH | 27.4 | 60.9 | 30.0 | | |
| 11 | ML | 22.0 | 36.5 | 7.4 | | |
| 8 | ML | 24.3 | | | | |
| 7 | ML | 24.6 | 34.1 | 6.2 | | |
| 12 | ML | 25.0 | | | | |
| 3 | ML | 17.4 | NP | NP | | |
| 4 | SM | 38.7 | | | | ALLUVIAL SAND |
| 29 | CL | 17.4 | 43.1 | 18.4 | | LAMINATED RESIDUUM |
| 44 | ML-CL | 18.3 | 44.2 | 18.7 | | WEATHERED SHALE |
| 40 | ML | 21.9 | 35.2 | 6.1 | | |
| 50 | CL | 16.8 | 36.9 | 14.0 | | |
| 41 | SM | 22.3 | 37.4 | 7.4 | | |
| 50+ | CL-ML | 20.0 | 36.3 | 13.2 | | |
| 50+ | ML-CL | 18.7 | 35.4 | 10.8 | | |

Project WATTS BAR N. P. Boring SS-140

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | CL | 11.3 | 32.2 | 11.4 | | WEATHERED SHALE |
| | 690 | 50+ | | — | — | — | | BEDROCK |
| 40 | | | | | | | | |
| | 685 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-297
SHEET 2 OF 2

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-298**
**SHEET 1 OF 2**

Project WATTS BAR N. P  Feature ERCW ALIGNMENT

Boring SS-141  Station 1187.5 S  Range 1707.5 E  Surface El 724.6

Date Drilled 6-11-79  To 6-12-79  Prepared By JLB  Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 16 | CL | 14.6 | 29.7 | 13.8 | | ALLUVIAL CLAY |
| | 720 | 14 | | 15.7 | 32.1 | 15.7 | | |
| 5 | | 16 | G-CL | 9.9 | 35.1 | 18.6 | | |
| | | 16 | | 11.8 | 34.5 | 18.0 | | |
| 10 | 715 | 9 | CL | 19.3 | 36.2 | 16.6 | | |
| | | 1 | | 24.7 | | | | ▽ ▼ |
| | | 18 | SP-SM | 19.0 | 27.4 | 5.9 | | ALLUVIAL SAND |
| 15 | 710 | 14 | CL | 23.7 | 27.6 | 7.2 | | ALLUVIAL CLAY |
| | | 23 | G-SM | 8.5 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| 20 | 705 | 17 | | 7.8 | | | | |
| | | 31 | CL | 16.6 | 37:4 | 14.5 | | LAMINATED RESIDUUM |
| | | 10 | | 22.6 | | | | |
| 25 | 700 | 21 | ML | 20.7 | 36.7 | 6.8 | | |
| | | 50+ | CL | 14.2 | 34.7 | 11.8 | | WEATHERED SHALE |
| 30 | 695 | 50+ | | 12.2 | 33.2 | 11.8 | | |
| | | 50+ | ML | 17.2 | 36.9 | 11.7 | | |
| | | 50+ | | 8.7 | 28.0 | 5.4 | | |
| 35 | 690 | | | | | | | |

Project WATTS BAR N. P Boring SS-141

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | SC | 14.4 | 30.1 | 9.4 | | |
| | | 50+ | CL | 10.6 | 25.8 | 7.7 | | WEATHERED SHALE |
| | 685 | 50+ | CL-ML | 9.8 | 22.6 | 5.0 | | |
| 40 | | | | | | | | BEDROCK |
| 45 | 680 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-298
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-299
SHEET 1 OF 2

Project WATTS BAR N.P Feature ERCW ALIGNMENT

Boring SS-142 Station 1012.5 S Range 1882.5 E Surface El 721.8

Date Drilled 6-12-79 To 6-13-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 720 | 13 | CL | 14.1 | 33.9 | 19.0 | | ALLUVIAL CLAY |
| | | 24 | CL | 13.9 | 31.7 | 14.2 | | |
| 5 | | 18 | GCL | 14.0 | 36.1 | 17.9 | | |
| | 715 | 11 | CL | 14.8 | 37.9 | -19.2 | | ▽ ▼ |
| 10 | | 12 | ML-CL | 20.1 | 38.7 | 13.5 | | |
| | 710 | 15 | ML-CL | 22.4 | | | | |
| | | 11 | CL | — | 38.4 | 15.0 | | |
| 15 | 705 | 12 | CL | 23.3 | | | | |
| | | 10 | CL | 21.9 | 36.7 | 16.4 | | |
| 20 | | 16 | CL | 17.0 | | | | |
| | 700 | 9 | CL | 24.1 | 41.3 | 17.6 | | |
| | | 4 | CL | 26.2 | 42.0 | 20.2 | | |
| 25 | 695 | 11 | GCL | 19.0 | 48.4 | 26.6 | | LAMINATED RESIDUUM |
| | | 33 | CL | 15.1 | 35.4 | 13.7 | | |
| 30 | | 24 | ML-CL | 17.9 | 35.8 | 12.3 | | |
| | 690 | 50+ | CL | 13.0 | 35.6 | 15.7 | | WEATHERED SHALE |
| | | 49 | ML-CL | 15.7 | 34.4 | 10.0 | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-142

Depth 1" = 5' (scale marks: 35, 40, 45, 50, 55, 60, 65, 70, 75, 80)

El (scale marks: 685, 680, 675, 670)

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| 41 | G-SC | 14.7 | — | — | | |
| 50+ | SC | 11.3 | 31.5 | 10.6 | | |
| 50+ | SC | 8.7 | | | | |
| 50+ | SC | 7.6 | 26.7 | 8.1 | | WEATHERED SHALE |
| 50+ | SC | 7.8 | | | | |
| 50+ | SC | 12.6 | | | | |
| | | | | | | BEDROCK |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-299**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-300
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-143 Station 965.0 S Range 1923.2 E Surface El 723.1

Date Drilled 6-14-79 To 6-14-79 Prepared By JLB Checked By [illegible]

| Depth 1"=5 | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 10 | CL | 16.3 | 31.9 | 16.8 | | |
| | 720 | 24 | | 16.4 | 30.5 | 12.7 | | |
| 5 | | 13 | | 15.9 | 35.3 | 17.0 | | |
| | 715 | 10 | | 20.9 | 35.4 | 16.1 | | |
| 10 | | 9 | | 19.4 | | | ▼ ▽ | |
| | | 9 | ML-CL | 22.4 | 37.4 | 13.6 | | ALLUVIAL CLAY |
| | 710 | 9 | | 22.9 | 38.9 | 13.3 | | |
| 15 | | 9 | | 22.7 | 36.2 | 11.5 | | |
| | 705 | 6 | CL | 21.8 | 39.3 | 18.2 | | |
| 20 | | 7 | | 25.0 | | | | |
| | | 3 | | 29.0 | 42.2 | 22.4 | | |
| | 700 | 4 | | 25.6 | | | | |
| 25 | | 4 | | 29.0 | 35.2 | 16.2 | | |
| | 695 | 7 | | | | | | NO SAMPLE RECOVERY |
| 30 | | 9 | | GSPSM 13.5 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| | | 2 | CL | — | 31.2 | 15.5 | | ALLUVIAL CLAY |
| | 690 | 17 | | 11.4 | — | — | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-143

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| -35 | | 27 | SM | 21.2 | 28.9 | 2.6 | | LAMINATED RESIDUUM |
| | 685 | 50 | SC | 16.3 | 30.8 | 9.7 | | |
| | | 50 | | 11.1 | | | | |
| 40 | | | | | | | | WEATHERED SHALE |
| | | 50 | | 13.9 | 29.8 | 10.9 | | |
| | 680 | 34 | G-SC | 15.2 | 29.6 | 9.2 | | |
| 45 | | 50 | SC | 14.0 | 28.0 | 7.6 | | |
| | | | | | | | | BEDROCK |
| | 675 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-300
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-143 | Boring SS-143A | |
|---|---|---|
| Station 969.0S  Range 1923.2E | Station 975.0S  Range 1930.0E | Prepared by JLB |
| Surface El 723.1 | Surface El 723.0 | Checked by HPM |
| Date Drilled 6-14-79 to 6-14-79 | Date Drilled 11-19-81 to 11-20-81 | |

**Boring SS-143** (El scale 720 to 675)

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 13 | | 16.3 | 31.9 | 16.9 |
| 24 | | 16.4 | 30.5 | 12.7 |
| 13 | CL | 15.9 | 35.3 | 17.0 |
| 10 | | 20.9 | 35.4 | 16.1 |
| 9 | | 19.4 | | |
| 9 | | 22.4 | 37.4 | 13.6 |
| 9 | ML-CL | 22.9 | 38.9 | 13.3 |
| 9 | | 22.7 | 36.2 | 11.5 |
| 6 | | 21.8 | 39.3 | 18.2 |
| 7 | | 25.0 | | |
| 3 | CL | 29.0 | 42.2 | 22.4 |
| 4 | | 25.6 | | |
| 4 | | 29.0 | 35.2 | 16.2 |
| 7 | | — | — | — |
| 9 | G-SP-SM | 13.5 | NP | NP |
| 2 | CL | — | 31.2 | 15.5 |
| 17 | | 11.4 | — | — |
| 27 | SM | 21.2 | 28.9 | 2.6 |
| 50 | | 16.3 | 30.8 | 9.7 |
| 50+ | SC | 11.1 | | |
| 50+ | | 13.9 | 29.8 | 10.9 |
| 34 | G-SC | 15.2 | 29.6 | 9.2 |
| 50+ | SC | 14.0 | 28.0 | 7.6 |

**Boring SS-143A**

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| 12 | SC | 15.0 | 33 | 16 | FILL |
| 20 | | 13.3 | 31 | 13 | |
| 13 | CL | 19.6 | 35 | 16 | |
| 12 | CL-ML | 21.8 | 33 | 10 | |
| 9 | SC | 22.4 | 29 | 10 | ALLUVIUM |
| 4 | | 36.5 / 30.1 | 41 / 43 | 20 / 13 | |
| 2 | ML | 21.6 | 39 | 11 | |
| 8 | CL | 37.2 | 36 | 19 | |
| 1 | | 29.1 | 38 | 18 | |
| 0 | SC | 41.4 | 39 | 20 | |
| 3 | SM-SC | 21.2 | 21 | 5 | |
| 4 | CL | 24.9 | 25 | 8 | |
| 8 | SC | 43.1 | 37 | 11 | |
| 16 | | 33.8 | 34 | 12 | |
| 31 | SM | 25.9 | NP | NP | WEATHERED SHALE |
| | | | | | DISCONTINUED |



HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-301

SOIL PROFILE (SS, PA, HA, TP BORING)

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-144 Station 865.1S Range 1923.2 E Surface El 729.0

Date Drilled 6-13-79 To 6-14-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 11 | CL | 17.2 | 41.8 | 25.8 | | ALLUVIAL CLAY |
| | 725 | 16 | CL | 14.0 | 39.0 | 20.5 | | |
| 5 | | 19 | ML-CL | 20.8 | | | | |
| | | 20 | ML-CL | 20.2 | 36.6 | -12.8 | | |
| | 720 | | | | | | | |
| 10 | | 22 | ML-CL | 17.4 | | | | |
| | | 18 | CL | 19.9 | | | | |
| | 715 | 20 | CL | 18.9 | 37.7 | 14.8 | | |
| 15 | | 20 | CL | 20.2 | | | | ▽ ▼ |
| | | 15 | CL | 25.3 | 41.8 | 25.8 | | |
| | 710 | | | | | | | |
| 20 | | 19 | ML-CL | 24.7 | 43.5 | 16.7 | | |
| | | 8 | ML-CL | 20.9 | | | | |
| | 705 | 5 | CL | 24.4 | 42.6 | 16.7 | | |
| 25 | | 3 | CL | 27.0 | 38.0 | 15.8 | | |
| | | 14 | CL-CH | 21.1 | 50.6 | 24.6 | | |
| | 700 | 17 | ML | 22.6 | — | — | | LAMINATED RESIDUUM |
| 30 | | 37 | ML-CL | 18.3 | 39.8 | 14.9 | | |
| | 695 | 16 | SM-SC | 26.4 | 35.1 | 11.5 | | |
| 35 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-302**
**SHEET 1 OF 2**

Project WATTS BAR N. P. Boring SS-144

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| -35 | | | | | | | | LAMINATED RESIDUMM |
| | | 17 | SM-SC | 19.2 | 35.1 | 11.5 | | |
| | | 30 | | 17.2 | | | | |
| | 690 | | | | | | | |
| -40 | | 42 | CL | 18.8 | 36.7 | 13.9 | | WEATHERED SHALE |
| | | 50+ | SC | 19.8 | 36.0 | 13.7 | | |
| | 685 | 50 | SMSC | 17.5 | 31.7 | 9.0 | | |
| -45 | | 50+ | CL | 5.7 | 26.6 | 7.5 | | BEDROCK |
| | 680 | | | | | | | |
| -50 | | | | | | | | |
| -55 | | | | | | | | |
| -60 | | | | | | | | |
| -65 | | | | | | | | |
| -70 | | | | | | | | |
| -75 | | | | | | | | |
| -80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-302**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-303
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-145 Station 665.0 S Range 1923.2 E Surface El 737.1

Date Drilled 6-14-79 To 6-19-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 735 | 15 | CL | 17.3 | 41.6 | 23.2 | | CLAY FILL |
| | | 21 | ML-CL | 19.0 | | | | |
| 5 | | | | | 39.1 | 14.3 | | |
| | | 25 | | 17.9 | | | | |
| | 730 | 23 | ML | 22.8 | 47.2 | -19.1 | | |
| 10 | | 20 | ML-CL | 18.6 | 42.1 | 16.1 | | ALLUVIAL FILL |
| | 725 | 17 | | 19.0 | | | | |
| | | | | | 41.3 | 16.6 | | |
| | | 16 | | 17.3 | | | | |
| 15 | | | | | | | | |
| | | 9 | SM | 17.1 | | | | ALLUVIAL SILTY SAND |
| | 720 | 10 | | 13.7 | | | | |
| | | | | | NP | NP | | |
| 20 | | 14 | | 9.3 | | | | |
| | 715 | 21 | GSPSM | 11.0 | | | | ALLUVIAL GRAVELLY SAND |
| | | 22 | GSM | 14.5 | 23.8 | 3.6 | | |
| 25 | | 50+ | | 7.1 | | | | |
| | 710 | 37 | G-SP-SM | 8.7 | | | | |
| 30 | | 50+ | | 8.5 | NP | NP | | |
| | 705 | 35 | GM | 8.2 | | | | ALLUVIAL GRAVEL |
| | | 33 | GPGM | 8.2 | | | | |
| 35 | | | | | | | | |

Project WATTS BAR N.P. Boring SS-145

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | | 13.4 | 38.7 | 16.2 | | |
| | 700 | 50+ | CL | 13.7 | 33.0 | 11.4 | | WEATHERED SHALE |
| | | 50+ | | 8.4 | 26.8 | 8.1 | | |
| 40 | | | | | | | | BEDROCK |
| | 695 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-303
SHEET 2 OF 2

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| SOIL PROFILE<br>FIGURE 2.5-304<br>SHEET 1 OF 2 |

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-146 Station 565.0 S Range 1923.2 E Surface El 741.4

Date Drilled 6-19-79 To 6-20-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | | | | | | | | |
| | 740 | 17 | CL | 10.0 | 29.3 | 12.8 | | |
| | | 20 | CL | 13.9 | 29.6 | 11.1 | | |
| 5 | | | CL | | | | | CLAY FILL |
| | 735 | 11 | CL | 12.6 | 30.7 | 12.0 | | |
| | | 13 | CL | 13.5 | 36.0 | -19.2 | | |
| 10 | | 14 | CL-ML | 14.2 | 47.7 | 21.2 | | |
| | 730 | 22 | ML | 13.4 | 44.9 | 14.9 | | |
| | | 21 | CL-ML | 10.2 | | | | ALLUVIAL SILT & CLAY |
| 15 | | | CL-ML | | 39.2 | 13.7 | | |
| | 725 | 20 | CL-ML | 11.1 | | | | |
| | | 13 | SMSC | 12.3 | 28.4 | 6.3 | | SILTY CLAYEY SANr |
| 20 | | 16 | G-SM | 12.8 | | | | |
| | 720 | 10 | SM | 11.2 | | | | ALLUVIAL GRAVELLY SAND |
| | | 16 | G-SM | 7.1 | | | | |
| 25 | | | | | | | | |
| | 715 | 10 | SM | 16.4 | NP | NP | | |
| | | 10 | SM | 16.5 | | | | ALLUVIAL SAND |
| 30 | | 14 | SM | 8.4 | | | | |
| | 710 | 39 | GP | 3.2 | | | | ALLUVIAL GRAVEL |
| | | 13 | G-SM | 14.6 | 21.6 | 1.9 | | ALLUVIAL GRAVELLY SAND |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-146

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50 | G-SP | 4.6 | | | | ALLUVIAL GRAVELLY SAND |
| | 705 | | | | | | | |
| | | 41 | GM | 5.5 | | | | ALLUVIAL GRAVEL |
| 40 | | 47 | G-SM | 7.2 | | | | ALLUVIAL GRAVELLY SAND |
| | 700 | | | | NP | NP | | |
| | | 36 | GM | 6.6 | | | | ALLUVIAL GRAVEL |
| | | 26 | | 7.8 | | | | |
| 45 | | | G-SP | 12.1 | | | | |
| | 695 | 22 | ML | 27.4 | 35.9 | 4.1 | | LAMINATED RESIDUUM |
| | | 19 | ML-CL | 26.0 | 38.6 | 12.6 | | |
| 50 | | 50+ | | 14.0 | 36.8 | 13.6 | | WEATHERED SHALE |
| | 690 | | | | | | | |
| | | 16 | SC | 19.5 | 38.5 | 14.3 | | LAMINATED RESIDUUM |
| | | 6 | ML-MH | 18.5 | 49.7 | 18.6 | | |
| 55 | | | | | | | | |
| | 685 | 39 | ML | 16.8 | | | | |
| | | | | | 37.6 | 11.6 | | |
| | | 13 | | 17.7 | | | | |
| 60 | | 26 | | 14.5 | | | | |
| | 680 | | | | 32.0 | 4.5 | | |
| | | 9 | | 19.2 | | | | |
| | | 22 | CL | 16.8 | | | | WEATHERED SHALE |
| 65 | | | | | | | | |
| | 675 | 31 | | 15.4 | 33.0 | 10.8 | | |
| | | 30 | | 15.0 | | | | |
| 70 | | 50+ | SM | 17.3 | NP | NP | | |
| | 670 | 50+ | ML-CL | 7.6 | 23.3 | 6.4 | | BEDROCK |
| 75 | | | | | | | | |
| | 665 | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-304**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-305
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-147 Station 464. 1S Range 1866. 4 E Surface El 741 .7

Date Drilled 6-20-79 To 6-21-79 Prepared By JLB Checked By gcJ

Depth (1"=5): 0, 5, 10, 15, 20, 25, 30, 35

El: 740, 735, 730, 725, 720, 715, 710

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| 16 | CL | 15.2 | | | | CLAY FILL |
| 22 | | 16.3 | 30.4 | 12.0 | | |
| 16 | | 17.1 | | | | |
| 38 | CL | 14.3 | 34 .1 | -17.6 | | |
| 31 | CH | 24.0 | 51 .3 | 24.5 | | ALLUVIAL CLAY |
| 20 | CL-ML | 20.4 | 43.1 | 17.4 | | |
| 25 | | 20.5 | 39.7 | 15.1 | | |
| 15 | | 17.4 | — | — | | |
| 10 | SM | 14.4 | | | | ALLUVIAL SAND |
| 11 | | 15.9 | | | | |
| 11 | | 14.0 | NP | NP | | |
| 12 | G-SM | 17.4 | | | | ALLUVIAL GRAVELLY SAND |
| 14 | SM | 11.0 | | | | ALLUVIAL SAND |
| 15 | GM-GC | 12.2 | 24.6 | 4.8 | | ALLUVIAL GRAVEL |
| 28 | GSPSM | 5.8 | NP | NP | | |
| 40 | GSMSC | 11.7 | 23.4 | 4.3 | | |
| 50+ | GSPSM | 7.6 | NP | NP | | |

Project WATTS BAR N. P. Boring SS-147

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | 705 | 50+ | GP-GM | 7.7 | | | | ALLUVIAL GRAVEL |
| | | 29 | GP-GM | 8.5 | NP | NP | | ∇ |
| 40 | | 18 | G-SM | 17.1 | | | | |
| | 700 | 47 | ML | 28.5 | 36.8 | 5.2 | | WEATHERED SHALE |
| | | 30 | ML | 21.8 | 39.2 | 12.0 | | LAMINATED RESIDUUM |
| 45 | 695 | 20 | ML | 34.1 | 48.2 | 10.5 | | |
| | | 50+ | ML | 19.0 | 42.5 | 15.2 | | WEATHERED SHALE |
| 50 | | 43 | ML | 20.5 | 37.8 | 11.9 | | |
| | 690 | 21 | ML | 25.0 | 44.4 | 16.8 | | LAMINATED RESIDUUM |
| | | 24 | CL | 17:8 | 35.2 | 13.1 | | |
| 55 | 685 | 28 | CL | 16.1 | 28.6 | 7.9 | | WEATHERED SHALE |
| | | 50+ | CL | 10.7 | 29.1 | 7.3 | | BEDROCK |
| 60 | 680 | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-305**
**SHEET 2 OF 2**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-306
SHEET 1 OF 1

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-148A Station 265.0 S Range 1923.0 E Surface El 715.4

Date Drilled 6-19-79 To 6-19-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 715 | | | | | | | |
| | | 10 | CL | 12.3 | 27.2 | 10.9 | | ALLUVIAL CLAY |
| | | 16 | | 15.3 | 33.7 | 16.5 | | |
| 5 | 710 | 17 | | 15.3 | | | | |
| | | 25 | | 15.8 | 28.3 | 10.4 | | |
| 10 | 705 | 19 | | 12.5 | 29.4 | 14.3 | | |
| | | 30 | | 11.9 | 30.2 | 12.7 | | |
| | | 50 | | 16.6 | 31.4 | 13.4 | | DISCONTINUED |
| 15 | 700 | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-307**
**SHEET 1 OF 2**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-148B Station 259.0S Range 1865.5 E Surface El 736.6

Date Drilled 6-19-79 To 6-21-79 Prepared By JLB Checked By [signature]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI. | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 735 | | | | | | | |
| 5 | 730 | | | | | | | NO SAMPLING ALLUVIAL CLAY |
| 10 | 725 | | | | | | | |
| 15 | 720 | 38 | G-SM | 8.2 | | | | ▽ ▼ ALLUVIAL GRAVELLY SAND |
| | | 26 | G-SM | 11.2 | NP | NP | | |
| 20 | | 23 | GW-GM | 7.0 | | | | ALLUVIAL GRAVEL |
| | 715 | 25 | ML | 20.3 | 44.8 | 16.1 | | LAMINATED RESIDUUM |
| | | 50+ | ML | 17.1 | 45.9 | 18.9 | | WEATHERED SHALE |
| 25 | | 50+ | ML | 19.4 | | | | |
| | 710 | | | | 36.3 | 10.2 | | |
| | | 50+ | ML | 19.4 | | | | |
| 30 | | 37 | ML | 20.1 | 38.8 | 11.2 | | |
| | 705 | 46 | CL-ML | 17.6 | 40.9 | 15.2 | | |
| | | 41 | CL | 14.8 | 34.9 | 12.3 | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-148B

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | CL | 9.8 | 30.1 | 11.2 | | WEATHERED SHALE |
| | 700 | 50+ | ML | 6.6 | 23.5 | 7.1 | | |
| | | | | | | | | BEDROCK |
| 40 | | | | | | | | |
| | 695 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-307
SHEET 2 OF 2

TENNESSEE VALLEY AUTHORITY
SINGLETON MATERIALS ENGINEERING LABORATORY
SOIL PROFILE (SS, PA, HA, TP BORING)

Sheet 1 Of 2

Project WATTS BAR N P  Feature ERCW ALIGNMENT

Boring SS-149  Station 65 0 S  Range 1923.5 E  Surface El 705.9

Date Drilled 6-20-79 To 6-21-79  Prepared By JLE  Checked By [signature]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 705 | | | | | | | |
| | | 7 | | 14.4 | 32.5 | 16.8 | | ALLUVIAL CLAY |
| | | 11 | CL | 18.2 | 31.9 | 11.0 | | |
| 5 | 700 | 10 | | 20.5 | 36.1 | 16.0 | | |
| | | 13 | SC | 17.3 | 30.9 | -11.7 | | ALLUVIAL CLAYEY SAND |
| 10 | | 23 | | 23.7 | 43.4 | 15.0 | | LAMINATED RESIDUUM |
| | 695 | 16 | ML | 25.8 | 36.4 | 4.9 | | |
| | | 29 | | 21.9 | 38.6 | 8.1 | | |
| 15 | 690 | 40 | CL | 19.3 | 45.0 | 19.3 | | WEATHERED SHALE |
| | | 25 | | 22.9 | 36.2 | 8.5 | | |
| 20 | | 35 | ML | 20.5 | | | | |
| | 685 | 30 | CL-ML | 17.4 | 32.4 | 8.8 | | |
| | | 43 | SM | 15.7 | 28.9 | 3.2 | | |
| 25 | 680 | 50+ | GSMSC | 12.7 | 29.1 | 6.1 | | |
| | | 50+ | | 9.5 | 31.4 | 10.4 | | |
| 30 | | 50+ | ML | 14.9 | 27.8 | 3.6 | | |
| | 675 | 50+ | SM-SC | 8.0 | 22.3 | 5.0 | | |
| | | 50+ | | 11.7 | | | | |
| 35 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE

Figure 2.5-308
SHEET 1 OF 2

Project WATTS BAR N. P. Boring SS-149

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | 670 | 50+ | GSM | 4.2 | NP | NP | | WEATHERED SHALE |
| | | | | | | | | BEDROCK |
| 40 | 665 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-308
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-309
SHEET 1 OF 1

HISTORICAL

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-150 Station 135.0 N Range 1923.2 E Surface El 709.1

Date Drilled 6-22-79 To 6-22-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 22 | CL | 14.8 | 27.3 | 8.9 | | ALLUVIAL CLAY |
| | 705 | 13 | CL | 17.5 | 33.0 | 13.7 | | |
| 5 | | 16 | CL | 17.8 | | | | |
| | | 50 | ML | 20.7 | 30.5 | 4.5 | | WEATHERED SHALE |
| 10 | 700 | 50+ | ML | 17.3 | | | | ▽ ▼ |
| | | 34 | CL | 14.9 | 33.2 | 11.4 | | |
| | 695 | 50 | CL | 16.2 | 37.2 | 13.5 | | |
| 15 | | 50+ | CL | 12.8 | 29.4 | 9.0 | | |
| | | 50+ | SM-SC | 6.3 | 23.7 | 6.7 | | |
| | 690 | 50+ | SM-SC | 8.3 | | | | |
| 20 | | | | | | | | BEDROCK |
| 25 | 685 | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

**HISTORICAL**

Project WATTS BAR N.P Feature ERCW ALIGNMENT

Boring SS-151 Station 285.8 N Range 1824.9E Surface El 717.5

Date Drilled 6-25-79 To 6-25-79 Prepared By JLB Checked By

Depth scale: 1"=5'

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 715 | 15 | CL | 16.1 | 36.3 | 16.3 | | ALLUVIAL CLAY & SILT |
| | | 10 | CL | 17.4 | 30.3 | 11.0 | | |
| 5 | | 40 | ML | 11.5 | NP | NP | | |
| | 710 | 50+ | GSP-SM | 5.6 | — | — | | ALLUVIAL GRAVELLY SAND |
| 10 | | 50 | GSP-SM | 4.9 | NP | NP | | |
| | | 23 | CL-ML | 13.9 | 41.2 | 16.3 | | LAMINATED RESIDUUM |
| | 705 | 21 | CL | 19.0 | 39.2 | 15.4 | | ▽ |
| 15 | | 25 | SM | 19.9 | | | | ▽ WEATHERED SHALE |
| | 700 | | SM | | 36.8 | 10.9 | | |
| | | 32 | SM | 18.7 | | | | |
| 20 | | 50 | CL | 16.4 | 37.3 | 15.0 | | |
| | | 50+ | CL | 6.9 | 28.1 | 9.5 | | |
| | 695 | 50+ | CL | 7.0 | 25.1 | 7.3 | | |
| 25 | | 50+ | | | | | | NO SAMPLE RECOVERY |
| | 690 | 50+ | SC | 6.9 | | | | WEATHERED SHALE |
| | | 50+ | SC | 7.0 | 24.5 | 7.8 | | |
| 30 | | 50+ | SC | 5.7 | | | | |
| | 685 | 50+ | GML | 3.9 | — | — | | |
| 35 | | | | | | | | BEDROCK |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-311
SHEET 1 OF 1

**HISTORICAL**

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-152 Station 465.1 N Range 1693.1 E Surface El 719.6

Date Drilled 6-25-79 To 6-25-79 Prepared By JLB Checked By [signature]

Depth scale: 1"=5'

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 23 | CL | 12.6 | 32.3 | 14.9 | | ALLUVIAL CLAY |
| | 715 | 21 | CL | 17.8 | 27.9 | 10.6 | | |
| 5 | | 19 | CL | 17.5 | 34.8 | 18.7 | | |
| | | 22 | CL | 15.6 | 30.1 | -11.1 | | |
| 10 | 710 | 50+ | G-SM | 4.6 | NP | NP | | ALLUVIAL GRAVELLY SAND (▽ ▼) |
| | | 23 | GSPSM | 13.9 | | | | |
| | 705 | 24 | ML | 24.6 | 37.1 | 10.4 | | LAMINATED RESIDUUM |
| 15 | | 19 | ML-CL | 22.4 | 41.3 | 16.0 | | |
| | | 27 | CL | 26.2 | 40.8 | 17.0 | | |
| 20 | 700 | 50+ | CL | 15.3 | 32.7 | 11.8 | | WEATHERED SHALE |
| | | 50+ | CL | 14.5 | | | | |
| | | 50+ | CL | 9.4 | 26.0 | 9.3 | | |
| 25 | 695 | 50+ | ML-CL | 5.9 | 24.0 | 6.7 | | BEDROCK |
| 30 | 690 | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-312
SHEET 1 OF 1

**HISTORICAL**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-153 Station 585.0N Range 1540.0E Surface El 719.7

Date Drilled 6-26-79 To 6-26-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | FILL |
| | | 49 | GCL | 14.8 | 31.3 | 15.9 | | |
| | | 18 | CL-CH | 19.4 | 49.1 | 28.6 | | ALLUVIAL CLAY |
| 5 | 715 | 32 | CL | 13.5 | 23.5 | 7.5 | | |
| | | 13 | CL | 14.7 | 28.3 | -11.8 | | |
| 10 | 710 | 50+ | GSPSM | — | NP | NP | | ▽ ALLUVIAL GRAVEL |
| | | 15 | GSWSM | 10.8 | | | | |
| | | 48 | MECL | 20.2 | 48.5 | 21.4 | | WEATHERED SHALE |
| 15 | 705 | 50+ | CL-ML | 16.3 | 38.1 | 13.3 | | |
| | | 50+ | CL | 14.8 | | | | |
| | | | | | 37 3 | 14.7 | | |
| 20 | 700 | 50+ | CL | 12.7 | | | | |
| | | 50+ | | 8.3 | 28.9 | 9.4 | | |
| | | 50+ | SC | 5.7 | | | | |
| | | | | | 24.2 | 7.5 | | |
| 25 | 695 | 50+ | | 4.7 | | | | BEDROCK |

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35; El: 715, 710, 705, 700, 695, 690

## HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

SOIL PROFILE
FIGURE 2.5-313
SHEET 1 OF 1

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-154 Station 633.5 N Range 1444.4E Surface El 719.7

Date Drilled 6-26-79 To 6-26-79 Prepared By JLB Checked By [signature]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 25 | CL | 14.8 | 31.6 | 13.7 | | |
| | 715 | 25 | CL | 13.2 | 27.6 | 10.7 | | ALLUVIAL CLAY |
| 5 | | 23 | CL | 14.1 | 23.0 | 9.2 | | |
| | | 20 | CL | 13.1 | | | | ∇ |
| 10 | 710 | 50+ | GSM | 8.8 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| | | 29 | GSPSM | 10.2 | | | | |
| | 705 | 20 | CL | 17.4 | | | | LAMINATED RESIDUUM |
| 15 | | | CL | | 38.2 | 15.6 | | |
| | | 27 | CL | 17.6 | | | | |
| | | 50+ | CL | 9.6 | | | | |
| 20 | 700 | 50+ | CL | 8.0 | 29.4 | 10.8 | | |
| | | 50+ | CL | 6.1 | | | | |
| | | 50+ | SC | 5.5 | | | | WEATHERED SHALE |
| 25 | 695 | | SC | | 26.0 | 8.5 | | |
| | | 50+ | SC | 5.3 | | | | |
| | | 50+ | CL | 8.7 | 24.0 | 7.5 | | |
| | | 50+ | ML-CL | 5.4 | — | — | | |
| 30 | 690 | | | | | | | |
| | | 50+ | ML-CL | 7.2 | 23.0 | 6.9 | | |
| | | | | | | | | BEDROCK |
| 35 | 685 | | | | | | | |

**HISTORICAL**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-155 Station 664.1 N Range 1410.0 E Surface El 719.5'

Date Drilled 6-26-79 To 6-26-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | FILL |
| | | 22 | CL | 16.3 | 26.8 | 10.7 | | |
| | 715 | 35 | CL | 12.9 | | | | ALLUVIAL CLAY |
| 5 | | 20 | CL | 14.9 | 35.9 | 20.5 | | |
| | | 21 | CL-ML | 12.3 | 19.7 | -4.7 | | |
| 10 | 710 | 32 | G-SM | 17.5 | | | | ALLUVIAL GRAVELLY SAND |
| | | 23 | G-SM | 12.5 | NP | NP | | |
| | | 36 | GSPSM | 11.7 | | | | |
| 15 | 705 | | | | | | | LAMINATED RESIDUUM |
| | | 28 | CL | 16.0 | 38.0 | 16.0 | | |
| | | 50+ | CL | 5.6 | | | | WEATHERED SHALE |
| 20 | 700 | 50+ | CL | 15.5 | 26.6 | 8.8 | | |
| | | 50+ | ML-CL | 6.5 | 23.7 | 6.3 | | DISCONTINUED |
| 25 | 695 | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-315**
**SHEET 1 OF 1**

**HISTORICAL**

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-156 Station 664.8 N Range 1210 0 E Surface El 720.4

Date Drilled 6-26-79 To 6-26-79 Prepared By JLB Checked By GCP

Depth scale: 1" = 5

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 720 | | | | | | | |
| | | 14 | CL | 13.0 | 30.8 | 14.3 | | ALLUVIAL SILT & CLAY |
| | | 10 | CL | 17.7 | 32.4 | 15.0 | | |
| 5 | 715 | 16 | ML | 29.1 | 37.2 | 2.9 | | |
| | | 15 | M-CL | 14.7 | 22.4 | -6.4 | | |
| 10 | 710 | 13 | ML | 18.0 | 15.9 | 1.3 | | |
| | | 29 | GSM | 13.2 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| | | 22 | GSPSM | 8.1 | | | | |
| 15 | 705 | 34 | M-CL | 20.3 | 33.2 | 10.6 | | WEATHERED SHALE |
| | | 41 | M-CL | 15.0 | 30.3 | 6.5 | | |
| 20 | 700 | 50+ | SC | .13.7 | 32.6 | 11.2 | | |
| | | 50+ | SC | 6.9 | — | — | | BEDROCK |
| 25 | 695 | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-316**
**SHEET 1 OF 1**

**HISTORICAL**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-157 Station 664.8 N Range 1110.0 E Surface El 723.5

Date Drilled 6-27-79 To 6-27-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | LIMESTONE-GRAVEL |
| | | 10 | | 15.4 | 29.3 | 13.1 | | CLAY FILL |
| | 720 | 20 | | 12.4 | 24.0 | 8.1 | | |
| 5 | | 19 | CL | 18.6 | 38.7 | 17.7 | | ALLUVIAL CLAY |
| | 715 | 17 | | 17.9 | 33.2 | 16.3 | | |
| 10 | | 20 | | 18.3 | | | | |
| | | 13 | | 22.6 | 37.6 | 17.2 | | ▽ ▽ |
| | 710 | 39 | G-SM | 13.3 | | | | ALLUVIAL GRAVELLY SAND |
| 15 | | 33 | | 9.2 | | | | |
| | 705 | 33 | ML | 23.2 | | | | |
| 20 | | 43 | | 21.8 | NP | NP | | WEATHERED SHALE |
| | | 50+ | SM | 15.1 | | | | |
| | 700 | 50+ | | 16.4 | | | | |
| 25 | | 50+ | | 10.6 | | | | BEDROCK |
| | 695 | | | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |

SOIL PROFILE
FIGURE 2.5-317
SHEET 1 OF 1

BEST AVAILABLE
HISTORICAL

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-158 Station 664.8 N Range 1010.0 E Surface El 727.5

Date Drilled 6-26-79 To 6-27-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | Fill | | | | | CLAY FILL |
| | 725 | 8 | CL | 13.6 | | | | |
| | | 17 | CL | 15.4 | 28.0 | 9.8 | | |
| 5 | | 13 | CL | 19.1 | | | | ALLUVIAL CLAY |
| | 720 | 11 | CL | 17.3 | 26.9 | 11.0 | | |
| 10 | | 9 | CL | 18.4 | | | | |
| | 715 | 7 | CL | 23.0 | 34.0 | 12.2 | | |
| | | 3 | CL | 27.6 | | | | |
| 15 | | 2 | SM | 32.2 | 22.9 | 2.5 | | ALLUVIAL SAND |
| | 710 | 39 | G-SM | 9.7 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| 20 | | 49 | ML | 21.5 | 28.0 | 2.8 | | WEATHERED SHALE |
| | 705 | 28 | ML | 24.7 | | | | |
| | | 50+ | CL-ML | 18.7 | 30.8 | 8.8 | | |
| 25 | | 50- | CL-ML | 11.3 | 26.6 | 5.4 | | |
| | 700 | 50+ | CL | 6.7 | 24.2 | 8.2 | | |
| | | | Rock | | | | | BEDROCK |
| 30 | | | | | | | | |
| | 695 | | | | | | | |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-158 | Boring SS-158A | Prepared by |
|---|---|---|
| Station 664.8N Range 1010.0E | Station 658.8N Range 1015.0E | JLB |
| Surface El 727.5 | Surface El 727.6 | Checked by |
| Date Drilled 6-26-79 to 6-26-79 | Date Drilled 11-20-81 to 11-20-81 | HPM |

Boring SS-158

| El | SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|---|
| | 8 | | 13.6 | | |
| 725 | 17 | CL | 15.4 | 28.0 | 9.8 |
| | 13 | CL | 19.1 | | |
| 720 | 11 | CL | 17.3 | | |
| | | CL | | 26.9 | 11.0 |
| | 9 | CL | 18.4 | | |
| 715 | 7 | CL | 23.0 | | |
| | | CL | | 34.0 | 12.2 |
| | 3 | CL | 27.6 | | |
| | 2 | SM | 32.2 | 22.9 | 2.5 |
| 710 | 39 | G-SM | 9.7 | NP | NP |
| | 49 | ML | 21.5 | | |
| | | ML | | 28.0 | 2.8 |
| 705 | 28 | ML | 24.7 | | |
| | 50+ | CL-ML | 18.7 | 30.8 | 8.8 |
| | 50+ | CL-ML | 11.3 | 26.6 | 5.4 |
| 700 | 50+ | CL | 6.7 | 24.2 | 8.2 |
| 695 | | | | | |

Boring SS-158A

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| | | | | | GRAVEL ROADBED |
| 20 | CL | 16.1 | 26 | 9 | FILL |
| 15 | CL | 21.2 | 43 | 23 | FILL |
| 15 | CL | 21.0 | 36 | 15 | ALLUVIUM |
| 19 | CL | 23.2 | 41 | 18 | ALLUVIUM |
| 15 | ML | 24.8 | 19 | 7 | ALLUVIUM |
| 8 | ML | 25.2 | 32 | 8 | ALLUVIUM |
| 4 | CL | 30.6 | 31 | 13 | ALLUVIUM |
| 3 | SC | 27.8 | 35 | 15 | ALLUVIUM |
| 50+ | GM | 24.1 | NP | NP | ALLUVIUM |
| 23 | SM | 24.5 | 31 | 6 | WEATHERED SHALE |
| | | | | | DISCONTINUED |

BEST AVAILABLE - HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-318

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-319
SHEET 1 OF 1

**HISTORICAL**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-159 Station 640.0 N Range 810.0 E Surface El 731.7

Date Drilled 6-27-79 To 6-27-79 Prepared By JLB Checked By QCL

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | GRAVEL |
| | 730 | 11 | CL | 16.4 | 31.2 | 11.8 | | |
| | | 21 | CL | 25.6 | — | — | | |
| 5 | 725 | 17 | CL | 26.6 | — | — | | |
| | | 18 | ML | 23.8 | 39.5 | 13.2 | | ALLUVIAL CLAY |
| 10 | | 14 | ML | 25.6 | | | | |
| | 720 | 11 | CL | 25.8 | 32.8 | 13.4 | | |
| | | 6 | CL-ML | 29.4 | 26.8 | 4.2 | | |
| 15 | | | | | | | | ∇ (water level) |
| | 715 | 5 | CL | 27.1 | 34.6 | 16.1 | | |
| | | 3 | CL | 25.6 | 29.3 | 13.3 | | |
| 20 | | 20 | G-SM | 13.7 | NP | NP | | ALLUVIAL GRAVEL |
| | 710 | 50+ | GM | 9.9 | | | | |
| | | 43 | CL | 20.2 | 38.7 | 16.4 | | |
| 25 | 705 | 43 | CL-ML | 28.4 | 36.1 | 12.6 | | |
| | | 41 | CL | 21.3 | 39.4 | 15.7 | | WEATHERED SHALE |
| | | 50+ | CL | 18.4 | 37.0 | 14.3 | | |
| 30 | 700 | 43 | CL | 9.7 | 31.4 | 11.9 | | |
| | | 50+ | CL | 10.6 | | | | DISCONTINUED |
| 35 | | | | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-320
SHEET 1 OF 1

BEST AVAILABLE
HISTORICAL IMAGE

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-160 Station 566.0 N Range 740.0 E Surface El 732.9

Date Drilled 6-27-79 To 6-27-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI. | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | | 13 | CL | 21.5 | 35.8 | 17.9 | | CLAY FILL |
| | 730 | | | | | | | |
| | | 21 | CL | 22.8 | 39.2 | 16.1 | | ALLUVIAL CLAY |
| 5 | | | | | | | | |
| | | 21 | CL | 21.4 | | | | |
| | 725 | 15 | SM | 14.7 | 30.2 | -6.0 | | |
| 10 | | 13 | SM | 24.0 | 30.0 | 6.0 | | |
| | | 15 | SM | 22.5 | NP | NP | | ALLUVIAL SAND |
| | 720 | 7 | SM | 23.8 | 24.2 | 1.7 | | |
| 15 | | | | | | | | ▽ ▼ |
| | | 12 | SM | 25.8 | 27.0 | 3.0 | | |
| | 715 | 5 | SM-SC | 30.2 | 32.1 | 8.5 | | |
| 20 | | 21 | GM | 22.0 | 26.2 | 2.2 | | ALLUVIAL GRAVEL |
| | | 5 | GM | 24.3 | | | | |
| | 710 | 50+ | GP-GM | 9.6 | NP | NP | | |
| 25 | | 39 | SM-SC | 16.8 | 29.5 | 7.5 | | |
| | 705 | 29 | CL | 21.1 | 38.7 | 16.3 | | WEATHERED SHALE |
| | | 50+ | ML | 16.9 | 30.6 | 6.7 | | |
| 30 | | 50+ | CL-ML | 15.1 | 23.7 | 15.9 | | |
| | 700 | 50+ | CL-ML | 10.1 | | | | |
| | | | | | | | | DISCONTINUED |
| 35 | | | | | | | | |

HISTORICAL

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-161 Station 488.0N Range 670.0E Surface El 732.4

Date Drilled 6-28-79 To 6-28-79 Prepared By JLB Checked By CCJ

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 730 | 20 | CH | 26.2 | 57.6 | 30.0 | | ALLUVIAL SAND TO CLAY |
| | | 14 | ML | 21.1 | 41.2 | 14.4 | | |
| 5 | | 9 | CL-ML | 25.1 | 43.0 | 16.5 | | |
| | 725 | 8 | SC | 28.2 | 34.4 | -11.9 | | |
| 10 | | 5 | CL | 25.3 | 29.7 | 8.4 | | |
| | 720 | 6 | SC | 25.3 | 30.8 | 9.4 | | ALLUVIAL SILT & SAND |
| | | 9 | SM | 18.4 | NP | NP | | ∇ |
| 15 | | 10 | | 21.5 | | | | |
| | 715 | 3 | CL-ML | 35.8 | 36.8 | 13.2 | | |
| 20 | | 5 | ML | 30.9 | 25.7 | 2.3 | | |
| | 710 | 37 | GM | 11.1 | NP | NP | | ALLUVIAL GRAVEL |
| | | 19 | G-SM | 12.7 | | | | |
| 25 | | 45 | CL-ML | 21.0 | | | | WEATHERED SHALE |
| | 705 | 50+ | | 16.8 | 41.1 | 16.6 | | |
| 30 | | 50+ | | 18.6 | | | | |
| | 700 | 25 | | 19.8 | 38.9 | 14.3 | | |
| | | 50+ | CL | 22.2 | 46.1 | 20.4 | | |
| | | | SC | 12.2 | 29.1 | 9.6 | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-161

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| -35 | | 50+ | SC | 7.7 | 29.1 | 9.6 | | WEATHERED SHALE |
| | -695 | 50+ | | 6.3 | | | | DISCONTINUED |
| -40 | | | | | | | | |
| | -690 | | | | | | | |
| -45 | | | | | | | | |
| -50 | | | | | | | | |
| -55 | | | | | | | | |
| -60 | | | | | | | | |
| -65 | | | | | | | | |
| -70 | | | | | | | | |
| -75 | | | | | | | | |
| -80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-321**
**SHEET 2 OF 2**

# WATTS BAR NUCLEAR PLANT ERCW
## SOIL PROFILE

| Boring SS-161 | Boring SS-161A | Prepared by JLB |
|---|---|---|
| Station 488.0 N Range 670.0 E | Station 488.0N Range 675.0E | Checked by HPM |
| Surface El 732.4 | Surface El 732.9 | |
| Date Drilled 6-28-79 to 6-28-79 | Date Drilled 11-23-81 to 11-23-81 | |

**Boring SS-161**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 20 | CH | 26.2 | 57.6 | 30.0 |
| 14 | ML | 21.1 | 41.2 | 14.4 |
| 9 | CL-ML | 25.1 | 43.0 | 16.5 |
| 8 | SC | 28.2 | 34.4 | 11.9 |
| 5 | CL | 25.3 | 30.8 | 9.4 |
| 6 | SC | 25.3 | 29.7 | 8.4 |
| 9 | SM | 18.4 | NP | NP |
| 10 | | 21.5 | | |
| 3 | CL-ML | 35.8 | 36.8 | 13.2 |
| 5 | ML | 30.9 | 25.7 | 2.3 |
| 37 | GM | 11.1 | NP | NP |
| 19 | G-GM | 12.7 | | |
| 45 | CL-ML | 21.0 | | |
| 50+ | | 16.8 | 41.1 | 16.6 |
| 50+ | | 18.6 | | |
| 25 | | 19.8 | 38.9 | 14.3 |
| 50+ | CL | 22.2<br>12 2 | 46.1 | 20.4 |
| 50+ | SC | 7.7 | 29.1 | 9.6 |
| 50+ | | 6.3 | | |

**Boring SS-161A**

| SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|
| 33 | CH | 28.4 | 62 | 34 |
| 26 | SM | 19.2 | 39 | 12 |
| 13 | CL | 24.3 | 36 | 13 |
| 12 | SM-SC | 21.8 | 32 | 8 |
| 9 | SC | 22.4 | 28 | 8 |
| 10 | SM | 23.8 | 26 | 2 |
| 13 | | 17.8 | NP | NP |
| 23 | SC | 14.0 | 29 | 9 |
| 5 | ML | 35.7 | 38 | 12 |
| 5 | CL | 33.0<br>32.4 | 32<br>27 | 13<br>9 |
| 50 | SM | 15.4 | | |
| 40 | GP-GM | 10.3 | NP | NP |
| 16 | SM | 44.2 | | |

REMARKS: ALLUVIUM

WEATHERED SHALE

DISCONTINUED

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT

SOIL PROFILE FIGURE 2.5-322

**BEST AVAILABLE HISTORICAL IMAGE**

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-323**
**SHEET 1 OF 1**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-162 Station 488.0 N Range 560.0E Surface El 733.8

Date Drilled 6-28-79 To 6-28-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | LIMESTONE GRAVEL |
| | | 13 | CL | 14.4 | 37.1 | 21.4 | | |
| | 730 | 17 | CH | 21.6 | 67.1 | 41.7 | | ALLUVIAL CLAY |
| 5 | | 14 | | 28.4 | | | | |
| | | 20 | SM | 16.4 | 31.6 | - 7.1 | | |
| | 725 | | | | | | | |
| 10 | | 34 | | 22.7 | 31.0 | 6.6 | | |
| | | 27 | G-SM | 20.7 | 29.1 | 3.8 | | ALLUVIAL SAND |
| | 720 | 36 | | 23.0 | 31.6 | 4.9 | | |
| 15 | | | | | | | | ▽ ▼ |
| | | 20 | SM | 27.7 | 28.3 | 1.6 | | |
| | | 19 | | 30.2 | 27.6 | 3.0 | | |
| | 715 | | | | | | | |
| 20 | | 5 | | 34.3 | | | | |
| | | 11 | GSW-SM | 20.4 | NP | NP | | |
| | 710 | 50+ | GM | 10.9 | | | | ALLUVIAL SAND & GRAVEL |
| 25 | | 50+ | SM | 12.3 | | | | |
| | | 50+ | CL-ML | 18.6 | | | | |
| | 705 | | | | 38.6 | 13.9 | | WEATHERED SHALE |
| | | 50+ | | 14.3 | | | | |
| 30 | | 50+ | CL | 12.0 | 32.0 | 10.8 | | DISCONTINUED |
| | 700 | | | | | | | |
| 35 | | | | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-324**
**SHEET 1 OF 1**

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-163 Station 488.0 N Range 450.0 E Surface El 737.0

Date Drilled 6-28-79 To 6-28-79 Prepared By JLB Checked By [signature]

Depth scale 1" = 5: 0, 5, 10, 15, 20, 25, 30, 35; El scale: 735, 730, 725, 720, 715, 710, 705

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| | | | | | | GRAVEL |
| 19 | CL | 18.3 | 31.7 | 13.3 | | ALLUVIAL CLAY |
| 17 | GP-GM | 3.4 | NP | NP | | ALLUVIAL GRAVEL |
| 18 | MH | 25.2 | 54.0 | 20.9 | | ALLUVIAL CLAY & SILT |
| 10 | CL-ML | 24.7 | 40.0 | 15.3 | | |
| 9 | CL-ML | 27.7 | | | | |
| 5 | SM | 19.7 | NP | NP | | ALLUVIAL SAND |
| 5 | SM-SC | 27.1 | | | | |
| 5 | SM-SC | 28.4 | 30.4 | 7.1 | | |
| 6 | SM-SC | 26.9 | | | | ▽ ▼ |
| 3 | SM | 31.1 | 27.2 | 3.3 | | |
| 4 | SM | 33.5 | 29.7 | 4.7 | | |
| 17 | G-SM | 27.3 | 28.7 | 3.8 | | ALLUVIAL GRAVEL |
| 50+ | G-SM | 7.8 | NP | NP | | |
| 50+ | GP-GM | 12.1 | | | | |
| 50+ | ML | 18.5 | 43.6 | 16.2 | | WEATHERED SHALE |
| 50+ | ML | 21.2 | 37.3 | 9.0 | | |
| 50+ | ML | 2.7 | — | — | | |
| | | | | | | DISCONTINUED |

WATTS BAR NUCLEAR PLANT ERCW
SOIL PROFILE

| Boring SS-163 | Boring SS-163A | Prepared by JLB |
|---|---|---|
| Station 488.0 N Range 450.0E | Station 480.5N Range 441.0E | Checked by HPM |
| Surface El 737.0 | Surface El 737.5 | |
| Date Drilled 6-28-79 to 6-28-79 | Date Drilled 11-24-81 to 11-24-81 | |

**Boring SS-163**

| El | SPT (N) | LOG | W | LL | PI |
|---|---|---|---|---|---|
| | | (hatched) | | | |
| -735 | 19 | CL | 18.3 | 31.7 | 13.3 |
| | 17 | GP-GM | 3.4 | NP | NP |
| | 18 | MH | 25.2 | 54.0 | 20.9 |
| -730 | 10 | CL-ML | 24.7 | 40.0 | 15.3 |
| | 9 | | 27.7 | | |
| -725 | 5 | SM | 19.7 | NP | NP |
| | 5 | | 27.1 | | |
| | 5 | SM-SC | 28.4 | 30.4 | 7.1 |
| -720 | 6 | | 26.9 | | |
| | 3 | SM | 31.1 | 27.2 | 3.3 |
| -715 | 4 | | 33.5 | 29.7 | 4.7 |
| | 17 | G-SM | 27.3 | 28.7 | 3.8 |
| | 50+ | | 7.8 | NP | NP |
| -710 | 50+ | GP-GM | 12.1 | | |
| | 50+ | ML | 18.5 | 43.6 | 16.2 |
| | 50+ | | 21.2 | 37.3 | 9.0 |
| -705 | 50+ | | 2.7 | — | — |
| -700 | | | | | |

**Boring SS-163A**

| SPT (N) | LOG | W | LL | PI | REMARKS |
|---|---|---|---|---|---|
| | | | | | ASPHALT |
| | | | | | GRAVEL ROADBED |
| | | | | | CLAY FILL |
| 25 | MH | 31.9 | 60 | 24 | |
| 23 | SM-SC | 22.6 | 37 | 13 | |
| 23 | SC | 22.5 | 33 | 10 | |
| 15 | | 18.8 | 30 | 9 | ALLUVIUM |
| 9 | SM | 25.8 | 31 | 6 | |
| 7 | | 28.9 | 31 | 7 | |
| 11 | SP-SM | 28.2 | NP | NP | |
| | CL | | 31 | 10 | |
| 4 | SM | 36.3 | 30 | 3 | |
| 5 | CL / SM | 33.9 / 34.3 | 31 / 31 | 9 / 5 | |
| 50+ | SP-SM | 16.2 | | | |
| 40 | | 16.4 | NP | NP | |
| 50+ | GP-GM | 13.9 | | | |
| 50+ | SM | 13.2 / 20.5 | 40 | 12 | WEATHERED SHALE |
| | | | | | DISCONTINUED |

BEST HISTORICAL AVAILABLE IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-325

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-326
SHEET 1 OF 2

BEST AVAILABLE HISTORICAL IMAGE

Project WATTS BAR N.P. Feature ERCW ALIGNMENT

Boring SS-164 Station 488.0 N Range 230.0 E Surface El 741.0

Date Drilled 6-28-79 To 6-29-79 Prepared By JLB Checked By [illegible]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | BACKFILL |
| | 740 | 20 | G-CL | 6.9 | 28.3 | 10.5 | | ALLUVIAL SAND & GRAVEL |
| | | 14 | SM-SC | 16.7 | 27.0 | 5.4 | | |
| 5 | 735 | 50+ | G-SM | 1.7 | NP | NP | | |
| | | 20 | CL-ML | 24.7 | 48.7 | 21.3 | | ALLUVIAL CLAY & SILT |
| 10 | | 31 | CH-MH | — | 52.7 | 24.5 | | |
| | 730 | 21 | SM-SC | 20.8 | 38.6 | 12.7 | | ALLUVIAL SAND |
| | | 15 | ML | 22.3 | | | | ALLUVIAL CLAY & SILT |
| 15 | | | | | 39.4 | 13.1 | | |
| | 725 | 16 | | 25.6 | | | | |
| | | 9 | CH | 26.2 | 60.3 | 36.3 | | |
| 20 | | 6 | CL-ML | 28.2 | 36.0 | 12.1 | | |
| | 720 | 9 | SM-SC | 27.4 | 31.5 | 8.6 | | ALLUVIAL SAND & GRAVEL |
| | | | | | | | | ▼ |
| | | 15 | G-SP-SM | 16.2 | | | | ▽ |
| 25 | | | | | NP | NP | | |
| | 715 | 20 | | 20.9 | | | | |
| | | 11 | SM | 26.6 | 31.1 | 5.7 | | |
| 30 | | 50+ | G-SP-SM | 11.0 | | | | |
| | 710 | 50 | | 14.9 | NP | NP | | |
| | | 26 | CL | 13.2 | 46.7 | 22.7 | | WEATHERED SHALE |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-164

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | 705 | 39 | CL-ML | 14.0 | 45.0 | 18.9 | | WEATHERED SHALE |
| | | 50+ | G-SM | — | — | — | | |
| | | 50+ | | 7.4 | — | — | | |
| 40 | 700 | | | | | | | BEDROCK |
| 45 | 695 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

**BEST AVAILABLE HISTORICAL IMAGE**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-326
SHEET 2 OF 2

**BEST AVAILABLE HISTORICAL IMAGE**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-327
SHEET 1 OF 2

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-165 Station 488.0 N Range 120.0 E Surface El 740.7

Date Drilled 6-29-79 To 6-29-79 Prepared By JLB Checked By [illegible]

| Depth 1"=5 | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 740 | | | | | | | SANDY SILT |
| | | 50+ | | — | — | — | | |
| 5 | 735 | 13 | CL | 19.8 | 31.2 | 13.0 | | |
| | | 20 | CL-CH | 27.2 | 50.6 | 23.6 | | ALLUVIAL CLAY & SILT |
| 10 | 730 | 18 | ML | 20.7 | 44.7 | 16.3 | | |
| | | 11 | CL-ML | 22.9 | 35.8 | 12.2 | | |
| | | 13 | ML | 28.5 | 44.5 | 16.6 | | |
| 15 | 725 | 11 | CL | 26.7 | 36.7 | 14.4 | | |
| | | 12 | SM | 21.8 | 34.1 | 9.2 | | |
| 20 | 720 | 5 | ML | 31.9 | 37.4 | 11.5 | | ALLUVIAL SAND & SILT |
| | | 6 | CL-ML | 31.2 | 39.0 | 14.2 | | |
| | | 3 | SM-SC | 33.3 | 30.7 | 8.1 | | |
| 25 | 715 | 2 | SM-SC | 34.4 | | | | |
| | | 27 | GSC | 17.7 | — | — | | |
| 30 | 710 | 50 | GP-GM | 10.5 | | | | ALLUVIAL GRAVEL |
| | | 47 | GP-GM | 10.5 | NP | NP | | |
| | | 34 | GW-GM | 11.6 | | | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-165

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 35 | 705 | 49 | ML | 19.0 | 37.1 | 11.6 | | LAMINATED RESIDUUM |
| | | 50 | | 7.9 | 27.6 | 7.7 | | |
| | | 50+ | G-SC | — | — | — | | NO SAMPLE RECOVERY |
| 40 | 700 | 50+ | | 8.7 | 27.6 | 7.7 | | LAMINATED RESIDUUM |
| | | | | | | | | DISCONTINUED |
| 45 | 695 | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-327
SHEET 2 OF 2

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-328<br>SHEET 1 OF 2 |

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-166 Station 488.0 N Range 10.0 E Surface El 740.5

Date Drilled 6-29-79 To 6-29-79 Prepared By JLB Checked By [signature]

| Depth (1"=5) | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | 740 | | | | | | | |
| | | 12 | CL | 20.5 | 38.5 | 18.4 | | FILL |
| | | 50+ | GSM | 3.0 | NP | NP | | |
| 5 | 735 | 24 | GP.GM | 0 7 | | | | |
| | | 17 | CL-ML | 25.1 | 48.1 | 21.1 | | ALLUVIAL SILT & CLAY |
| 10 | 730 | 17 | CL-ML | 24.0 | | | | |
| | | 21 | CL | 25.8 | 39.6 | 15.9 | | |
| | | 12 | ML | 24.2 | 30.0 | 5.6 | | |
| 15 | 725 | 18 | CL-ML | 23.4 | 33.2 | 10.8 | | |
| | | 16 | CL-ML | 28.1 | 40.3 | 14 6 | | |
| 20 | 720 | 13 | ML | 29.6 | 48.8 | 19.8 | ▼ | |
| | | 11 | ML | 32.2 | | | ▽ | |
| | | 6 | CL-ML | 28.4 | 31.4 | 9.1 | | |
| 25 | 715 | 5 | CL | 29.3 | 36.8 | 14.3 | | |
| | | 5 | SC | 27.1 | 26.7 | 9.6 | | ALLUVIAL SAND OR GRAVEL |
| 30 | 710 | 50+ | G-SP-SM | 12.6 | NP | NP | | |
| | | 50+ | G-SP-SM | 10.1 | | | | |
| | | 50- | CL-ML | 15.2 | 34.1 | 10.7 | | WEATHERED SHALE |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-166

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 35 | 705 | 50+ | ML | 13.8 | 31.5 | 7.4 | | WEATHERED SHALE |
| | | 50+ | | 12.9 | — | — | | |
| | | | | | | | | DISCONTINUED |
| 40 | 700 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-328
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-329
SHEET 1 OF 1

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-167 Station 420.0 N Range 83.3 W Surface El 739.7

Date Drilled 7-2-79 To 7-2-79 Prepared By JLB Checked By [signature]

| SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|
| 18 | CL-ML | 17.0 | 27.7 | 6.2 | | FILL |
| 12 | CL | 13.4 | 29.8 | 10.4 | | FILL |
| 13 | CL | 21.8 | 43.2 | 25.0 | | FILL |
| 25 | G-SC | 23.7 | — | — | | FILL |
| 23 | CH-MH | 25.6 | 51.9 | 23.4 | | ALLUVIAL CLAY |
| 21 | CH-MH | 22.6 | | | | ALLUVIAL CLAY |
| 16 | CL-ML | 25.1 | 43.4 | 18.5 | | ALLUVIAL CLAY |
| 14 | CL-ML | 27.4 | 46.0 | 19.4 | | ALLUVIAL CLAY |
| 14 | CL | 27.3 | 46.5 | 21.6 | | ALLUVIAL CLAY |
| 13 | CL | 28.8 | | | | ALLUVIAL CLAY |
| 10 | CL | 30.2 | 44.7 | 19.5 | | ALLUVIAL CLAY |
| 6 | CL | 32.1 | | | | ALLUVIAL CLAY |
| 5 | CL | 31.8 | 32.7 | 12.1 | | ALLUVIAL CLAY |
| 2 | CL | 34.1 | 31.0 | 15.2 | | ALLUVIAL CLAY |
| 50+ | GSM | 10.1 | NP | NP | | ALLUVIAL GRAVELLY SAND |
| 50+ | CL-ML | 12.8 | 26.2 | 4.6 | | WEATHERED SHALE |
| 50+ | CL-ML | 10.9 | 30.1 | 7.2 | | WEATHERED SHALE |
| | | | | | | BEDROCK |

Depth (1"=5): 0, 5, 10, 15, 20, 25, 30, 35

El: 735, 730, 725, 720, 715, 710, 705

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-330
SHEET 1 OF 2

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-168 Station 319.8 N Range 65.3 W Surface El 739.6

Date Drilled 7-2-79 To 7-3-79 Prepared By JLB Checked By [illegible]

| Depth | El | SPT (N) | Log | W | LL | PI. | X. | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 0 | | | | | | | | |
| | | 17 | CL-ML | 15.5 | 28.9 | 6.2 | | CLAY FILL |
| | 735 | 11 | | 16.5 | | | | |
| 5 | | | | | | | | |
| | | 12 | | 16.9 | 27.4 | 7.0 | | |
| | | 12 | CL | 17.3 | | | | |
| 10 | 730 | 8 | | 16.6 | 29.6 | 9.5 | | |
| | | 14 | | 20.1 | 43.6 | 22.8 | | |
| 15 | 725 | | | | | | | |
| | | 18 | CL-CH | 25.9 | 50.7 | 27.2 | | ALLUVIAL CLAY |
| | | 9 | | 25.6 | 41.8 | 20.5 | | |
| 20 | 720 | 11 | | 28.6 | | | | |
| | | | | | 43.7 | 19.5 | | |
| | | 7 | CL | 31.1 | | | | |
| | | 2 | | 29.0 | 36.7 | 18.6 | | |
| 25 | 715 | 1 | | 28.4 | 25.5 | 9.0 | | |
| | | 50+ | GP-GM | 9.5 | NP | NP | | ALLUVIAL GRAVEL |
| 30 | 710 | 50+ | GW-GM | 8.9 | | | | |
| | | 50+ | CL | 17.2 | 36.2 | 13.7 | | WEATHERED SHALE |
| | | 50+ | | 13.9 | 34.1 | 13.1 | | |
| 35 | 705 | | | | | | | |

Project WATTS BAR N.P. Boring SS-168

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | 50+ | SC | 8.5 | 27.3 | 8.0 | | WEATHERED SHALE |
| | | 50+ | | 7.3 | | | | |
| | | | | | | | | DISCONTINUED |
| 40 | 700 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-330
SHEET 2 OF 2

FIGURE 2.5-331

DELETED IN INITIAL UFSAR

FINAL SAFETY ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-332
SHEET 1 OF 2

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-169 Station 320.0 N Range 348.0 E Surface El 741.1

Date Drilled 7-2-79 To 7-2-79 Prepared By JLB Checked By [signature]

| Depth (1"=5') | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | |
| | 740 | 17 | | 16.7 | 31.2 | 11.8 | | |
| 5 | | 18 | | 14.9 | | | | |
| | 735 | 16 | CL | 18.4 | 32.6 | 13.6 | | ALLUVIAL CLAY |
| | | 13 | | 17.9 | 33.3 | 15.3 | | |
| 10 | | 14 | | 16.8 | | | | |
| | 730 | 19 | CH | 24.5 | 51.5 | 29.3 | | |
| 15 | | 15 | CL | 21.0 | 44.6 | 24.7 | | |
| | 725 | 10 | | 26.9 | 43.3 | 20.1 | | |
| | | 10 | ML CL | 27.6 | 42.1 | 17.3 | | |
| 20 | | 13 | ML | 32.3 | 48.4 | 17.2 | | |
| | 720 | 8 | CL-ML | 31.8 | 43.0 | 17.0 | | ALLUVIAL SILT |
| 25 | | 6 | ML | 34.3 | 41.4 | 13.7 | | |
| | 715 | 6 | | 32.3 | | | | |
| | | 5 | | 33.1 | 40.8 | 13.7 | | |
| 30 | | 50+ | GSM | 10.4 | NP | NP | | ALLUVIAL GRAVEL |
| | 710 | 50+ | GP-GM | 9.7 | | | | |
| | | 50+ | CL-ML | 14.7 | 36.8 | 12.0 | | WEATHERED SHALE |
| 35 | | | | | | | | |

Project WATTS BAR N. P.   Boring SS-169

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | 705 | 50 | CL | 17.0 | 38.1 | 14.5 | | WEATHERED SHALE |
| | | 50+ | SC | 11.0 | 29.0 | 9.8 | | |
| | | 50+ | | 6.3 | | | | |
| 40 | | | | | | | | DISCONTINUED |
| | 700 | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-332
SHEET 2 OF 2

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-333**
**SHEET 1 OF 2**

**BEST AVAILABLE HISTORICAL IMAGE**

Project WATTS BAR N. P. Feature ERCW ALIGNMENT

Boring SS-170 Station 420.0N Range 348.0 E Surface El 741.2

Date Drilled 7-2-79 To 7-2-79 Prepared By JLB Checked By [signature]

| Depth | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1"=5' | | | | | | | | |
| 0 | | | | | | | | SANDY SILT |
| | 740 | 18 | CL-ML | 15.6 | 30.1 | 8.5 | | |
| | | 14 | CL-ML | 16.2 | 27.8 | 6.0 | | |
| 5 | 7.35 | 15 | CL-ML | 15.8 | | | | |
| | | 24 | CL | 17.6 | 31.8 | -12.3 | | ALLUVIAL CLAY |
| 10 | | 21 | CH | 25.2 | 61.5 | 34.2 | | |
| | 730 | 13 | CL | 19.3 | 44.0 | 21.2 | | |
| | | 7 | CL | 23.5 | 33.4 | ·13.7 | | |
| 15 | | | | | | | | |
| | 725 | 14 | ML-CL | 25.5 | 44.5 | 27.5 | | |
| | | 14 | ML-CL | 29.5 | | | | |
| 20 | | 12 | SM | 21.9 | 32.6 | 7.4 | | |
| | 720 | 4 | G-SMSC | 29.1 | 34.8 | 11.5 | [water level symbols] | |
| | | 17 | G-SMSC | 23.6 | | | | |
| 25 | | | GSWSM | | | | | ALLUVIAL SAND & GRAVEL |
| | 715 | 18 | GSWSM | 19.2 | | | | |
| | | 31 | GSM | 12.1 | NP | NP | | |
| 30 | | 50+ | GSWSM | 42.5 | | | | |
| | 710 | 50+ | G-SM | 10.4 | | | | |
| | | 21 | GM | 17.8 | — | — | | |
| 35 | | | | | | | | |

Project WATTS BAR N. P. Boring SS-170

| Depth 1"=5' | El | SPT (N) | Log | W | LL | PI | X | Remarks |
|---|---|---|---|---|---|---|---|---|
| 35 | | | | | | | | |
| | 705 | 28 | ML | 21.6 | 42.7 | 15.9 | | |
| | | 50+ | CL | 11.5 | 32.9 | 11.4 | | WEATHERED SHALE |
| 40 | | 50+ | | 15.6 | 37.0 | 13.5 | | |
| | 700 | | | | | | | BEDROCK |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |
| 70 | | | | | | | | |
| 75 | | | | | | | | |
| 80 | | | | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-333
SHEET 2 OF 2

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-334
SHEET 1 OF 2

BEST AVAILABLE HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-1 STATION: 1 RANGE: G SURFACE EL: 741.7
DATE DRILLED: 6-14-82 TO 6-14-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 740 | 26 | | 13.3 | | | SI SD, DK BRN, MST, MIC, HOMO, (FL) |
| 5 | | 21 | CL | 15.6 | 29 | 12 | CL SI SD, MD-DK BRN, MST, MIC, HOMO (FL) |
| | 735 | 16 | | 16.1 | | | CL SI SD, DKBRN, MST, MIC, HOMO, (FL) |
| | | 50+ | | 18.6 | | | SD CL SI, DKBRN, MST, MIC, HOMO, (FL) 1032 GRAVEL - NO SAMPLE |
| 10 | | 24 | CL | 24.7 | 43 | 18 | SI CL, MD-LT TN, MOTT, MST, HOMO, MIC (ALL.) |
| | 730 | 22 | | 22.1 | | | SI SD, MD TN-YEL TN, MOTT, MST, HOMO (ALL.) |
| 15 | | 14 | CL-ML | 24.2 | | | CL SI, MD TN-YEL TN, MOTT, MST, HOMO (ALL.) |
| | 725 | 18 | | 29.1 | 39 | 14 | CL SD SI, MD TN-YEL TN, MOTT, MST, HOMO (ALL.) |
| 20 | 720 | 5 | SM | 31.0 | 30 | 2 | SD CL SI, MD TN, MST, HOMO, MIC, (ALL.) |
| 25 | 715 | 10 | SM | 25.2 | 25 | 3 | SI SD, MD TN, V MST, HOMO, MIC, (ALL.) |
| 30 | 710 | 50+ | GP-GM | 10.2 | NP | NP | GV SD, MD TN-BLK BRN, W, STRAT. (ALL.) |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-334
SHEET 2 OF 2

BEST AVAILABLE
HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-1 STATION: 1 RANGE: G SURFACE EL: 741.7
DATE DRILLED: 6-14-82 TO 6-14-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | 37 | SM-SC | 24.5 | 38 | 12 | WTH SH, MD TN-BLK GY, MST, LAM-STRAT. |
| 40 | | | | | | | BEDROCK (EL.704.0) |
| | 700 | | | | | | |
| 45 | | | | | | | |
| | 695 | | | | | | |
| 50 | | | | | | | |
| | 690 | | | | | | |
| 55 | | | | | | | |
| | 685 | | | | | | |
| 60 | | | | | | | |
| | 680 | | | | | | |
| 65 | | | | | | | |
| | 675 | | | | | | |
| 70 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

BEST AVAILABLE HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-335
SHEET 1 OF 2

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-2 STATION: 1 RANGE: C SURFACE EL: 741.5
DATE DRILLED: 6-11-82 TO 6-11-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 740 | 34 | CL | 13.4 | 30 | 11 | DTY SD,MD-DKBRN,MST,MIC,HOMO(FL.) |
| 5 | | 20 | | 15.9 | | | CL SI SD,MD-DKBRN,MST,MIC,HOMO(FL.) |
| | 735 | 17 | CL | 17.1 | 31 | 12 | CL SI SD,MD BRN,MST,MIC,HOMO(FL.) |
| | | 53+ | | 17.6 | | | CL SD SI,MD BRN,MST,MIC,HOMO(FL.) |
| | | | SM | 2.6 | NP | NP | ANG LS GR |
| 10 | | 20 | ML-MH | 24.5 | 51 | 20 | SD CL SI,MD-LT BRN,MST,MIC, HOMO (ALL.) |
| | 730 | 22 | | 26.4 | | | SD CL SI, MD BRN-TN, MST, MIC, HOMO (ALL.) |
| 15 | | 14 | ML | 23.0 | | | SD CL SI, MD BRN-TN, MST, MIC, HOMO (ALL.) |
| | 725 | 20 | | 31.5 | 43 | 14 | CL SI, MD BRN-TN-WHT, MST,MIC, HOMO (ALL.) |
| 20 | | | | | | | |
| | 720 | 6 | SM-SC | 26.3 | 29 | 6 | DTY SD, MD BRN, W, MIC, HOMO, (ALL.) |
| 25 | | | | | | | NO RECOVERY |
| | 715 | 4 | | | | | |
| 30 | | | | | | | |
| | 710 | 50+ | GP-GM | 12.0 | NP | NP | GV SD, MD BRN, W, HOMO, (±45% SB RD GV) (ALL.) |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-335
SHEET 2 OF 2

BEST AVAILABLE HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-2 STATION: 1 RANGE: C SURFACE EL: 741.5
DATE DRILLED: 6-11-82 TO 6-11-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | 30 | CL | 26.5 | 28 | 20 | MD CL, MD BRN-GRN, MST, STRAT-SHLY (RES.) |
| | | | | | | | REFUSAL (EL. 704.3) |
| 40 | 700 | | | | | | |
| 45 | 695 | | | | | | |
| 50 | 690 | | | | | | |
| 55 | 685 | | | | | | |
| 60 | 680 | | | | | | |
| 65 | 675 | | | | | | |
| 70 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-336
SHEET 1 OF 2

BEST AVAILABLE
HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-3 STATION: 6 RANGE: D SURFACE EL: 741.5
DATE DRILLED: 6-8-82 TO 6-9-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL. | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 740 | 13 | CL | 16.6 | 30 | 12 | SD CL SI,DK BRN,MST,MIC,HOMO,FL |
| 5 | | 15 | | 18.3 | | | SD CL SI,DK BRN,R TN MST,MIC,FL |
| | 735 | 27 | CL | 18.0 | 29 | 12 | SD CL SI,DK BRN,MST,MIC,HOMO,FL |
| | | 50+ | | 17.3 | | | SD CL SI,DK BRN,MST,HOMO,MIC,FL |
| 10 | | 50+ | | | | | 1032 GRAVEL (NO SAMPLE TAKEN) |
| | 730 | 29 | CL | 22.1 | 41 | 18 | CL SI SD, MD YEL TN, MOTT, MST, HOMO, (ALL.) |
| 15 | | 18 | | 23.4 | | | CL SD SI,MD TN-LT BRN, MOTT, MST, HOMO, (ALL.) |
| | 725 | 16 | CL-ML | 30.2 | 39 | 14 | CL SD SI, MD TN-LT BRN, MOTT, MST, HOMO, (ALL.) |
| 20 | 720 | 9 | CL-ML | 32.5 | 38 | 13 | CL SD SI, MD TN-LT BRN, MOTT, MST, HOMO, (ALL.) |
| 25 | 715 | 9 | CL | 34.7 | 35 | 13 | FN SD SI CL, MD BRN, MST, HOMO, MIC, (ALL.) |
| 30 | 710 | 50+ | GP-GM | 24.2 | NP | NP | GV CL SI SD, MD BRN-TN-BLK, MOTT, MST, HOMO, (ALL.) |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-336
SHEET 2 OF 2

**BEST AVAILABLE HISTORICAL IMAGE**

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-3 STATION: 6 RANGE: D SURFACE EL: 741.5
DATE DRILLED: 6-8-82 TO 6-9-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | 20 | | 58.4 | 43 | 9 | FN SD SI, DK BRN-BLK, MOTT, MST (ALL.) |
| | | | Σ ω | 22.8 | 34 | 8 | CL SI, MD BRN-BLK, MOTT, MST, SHLY, (RES.) |
| 40 | | | | | | | REFUSAL-BEDROCK (EL. 702.8) |
| | 700 | | | | | | |
| 45 | | | | | | | |
| | 695 | | | | | | |
| 50 | | | | | | | |
| | 690 | | | | | | |
| 55 | | | | | | | |
| | 685 | | | | | | |
| 60 | | | | | | | |
| | 680 | | | | | | |
| 65 | | | | | | | |
| | 675 | | | | | | |
| 70 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-337
SHEET 1 OF 1

BEST AVAILABLE
HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-4 STATION: 9 RANGE: H SURFACE EL: 740.7
DATE DRILLED: 6-15-82 TO 6-16-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | TOPSOIL |
| | | 9 | CL | 19.2 | 35 | 14 | CL SI, MD BRN, MST, HOMO, MIC (FL) |
| 5 | | 4 | | 23.0 | | | FN SD CL SI, MD BRN, MST, HOMO, MIC (FL) |
| | 735 | 4 | CL | 19.9 | 32 | 12 | SAME AS ABOVE |
| | | 4 | | 29.3 | | | CL SI,DK BRN,V MST,HOMO,MIC(FL) |
| | | | SM | 11.7 | NP | NP | DTY SD,DK GY,VMST,HOMO(PSD)(FL) |
| 10 | | 50+ | GM | 8.5 | NP | NP | 1032 |
| | 730 | | | | | | |
| | | 25 | CL | 21.8 | 48 | 22 | CL SD SI, MD TN-YEL TN-GY, MOTT, MST, HOMO (ALL.) |
| 15 | | 22 | | 24.9 | | | CL SI SD, MD TN-YEL TN-GY, MOTT, MST, MIC, HOMO (ALL.) |
| | 725 | 16 | CL-ML | 28.4 | 39 | 14 | SD CL SI, MD TN-YEL TN-GY, MOTT, MST, MIC, HOMO (ALL.) |
| 20 | | | | | | | |
| | 720 | 9 | CL | 30.8 | | | SI CL, MD TN-GY-BLK, MOTT, MST, HOMO (ALL.) |
| | | | | | 41 | 21 | |
| 25 | | | | | | | |
| | 715 | 5 | | 31.2 | | | MD CL, MD TN-LT BRN, MOTT, V. MST, HOMO (W/TR MIC) (ALL.) |
| 30 | | | | | | | |
| | 710 | 50+ | SP-SM | 9.8 | NP | NP | GV SD, (40% SB RD GV) MD BRN, W, HOMO (ALL.) |
| | | 50+ | | 11.2 | | | WTH SH, MD GY, D, LAM (RES.) |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | REFUSAL (EL. 705.5) |

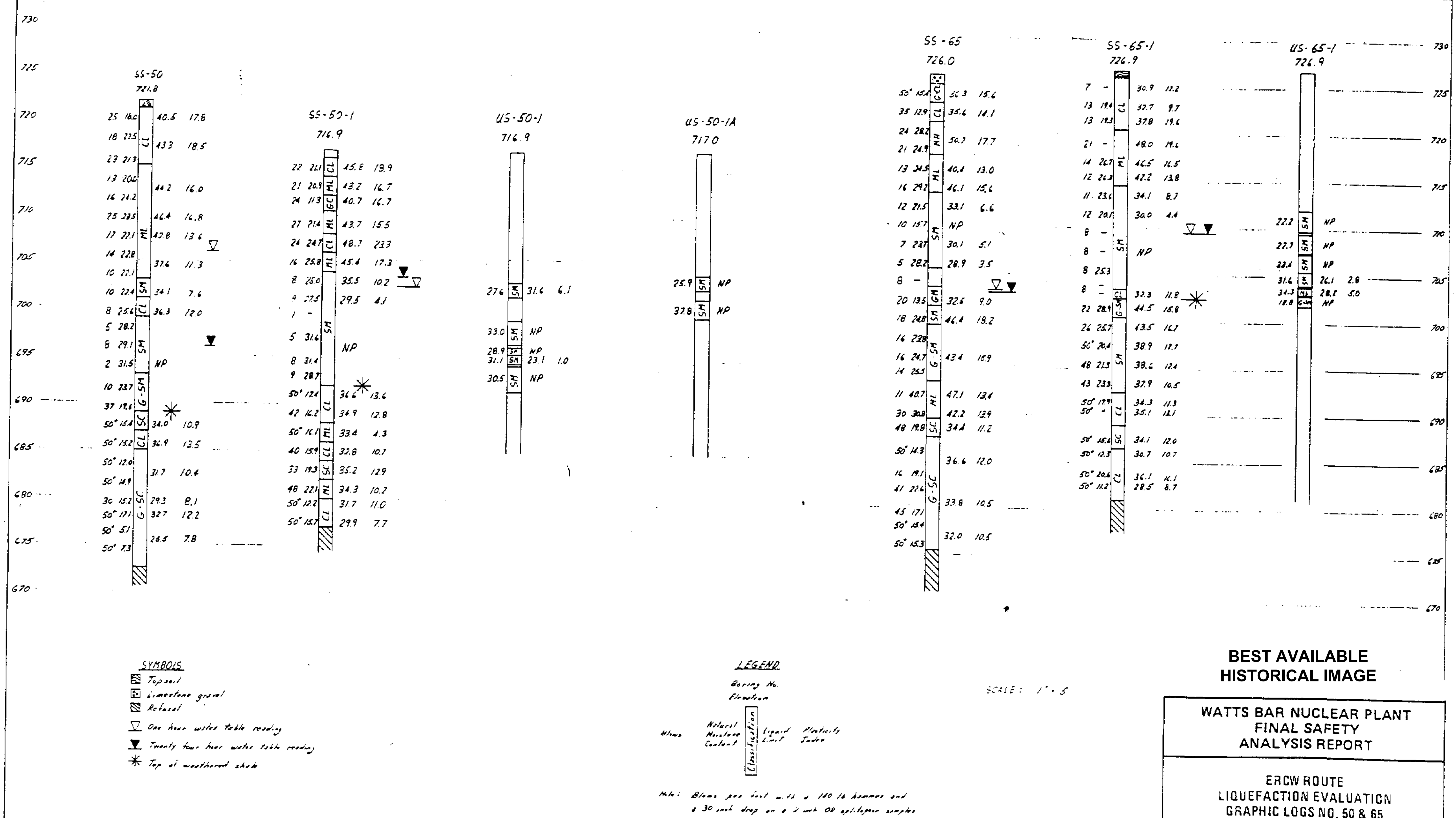
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-338
SHEET 1 OF 1

BEST AVAILABLE
HISTORICAL IMAGE

PROJECT: WATTS BAR N.P. FEATURE: VOL REDUC & SOLID SYS BLDG
BORING: SS-5 STATION: 9 RANGE: B SURFACE EL: 737.1
DATE DRILLED: 6-9-82 TO 6-10-82 PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | GRAVELLY ROADBED |
| | 735 | 11 | CL | 17.7 | 28 | 11 | CL SI, DK BRN, MST, HOMO, MIC (W/TR LS GV)(FL) |
| | | 6 | | 21.4 | | | CL SI,DK BRN,MST,HOMO,MIC(FL) |
| 5 | | 50+ | | | | | 1032 - NO SAMPLE RECOVERED |
| | 730 | | | | | | |
| | | 16 | CL | 22.8 | 38 | 19 | CL SD SI, BRN-GY, MST, STRAT, MIC (ALL.) |
| 10 | | 15 | | 19.3 | | | CL SI SD, LT BRN-GY, MST, STRAT (ALL.) |
| | 725 | 18 | CL | 25.9 | 35 | 12 | CL SI SD, LT BRN-GY, MST (ALL.) |
| 15 | | 23 | ML | 26.8 | 48 | 18 | CL SI SD, MD BRN-CRM, MST, BLKY (ALL.) |
| | | 18 | | 30.0 | | | SI CL, MD-LT BRN, MOTT, MST, HOMO (ALL.) |
| | 720 | | | | | | |
| 20 | | | | | | | |
| | | 4 | CL | 30.7 | 32 | 15 | CL SD SI, MD BRN-TN, W, HOMO, MIC (ALL.) |
| | 715 | | | | | | |
| 25 | | 50+ | GP-GM | 20.2 | NP | NP | GV SD (±40% SB RD GV) MD BRN, W, HOMO (ALL.) |
| | 710 | | | | | | |
| 30 | | | SM-SC | | 34 | 10 | |
| | 705 | 50+ | | 15.9 | | | WTH LS & CL, LT BLU-DK BRN-BLK, MST, LAM (3-IN.THK)(RES.) |
| 35 | | | | | | | REFUSAL (EL. 703.8) |
| 1''=5' | | *Lab. Classif. | | | | | |




**BEST AVAILABLE HISTORICAL IMAGE**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

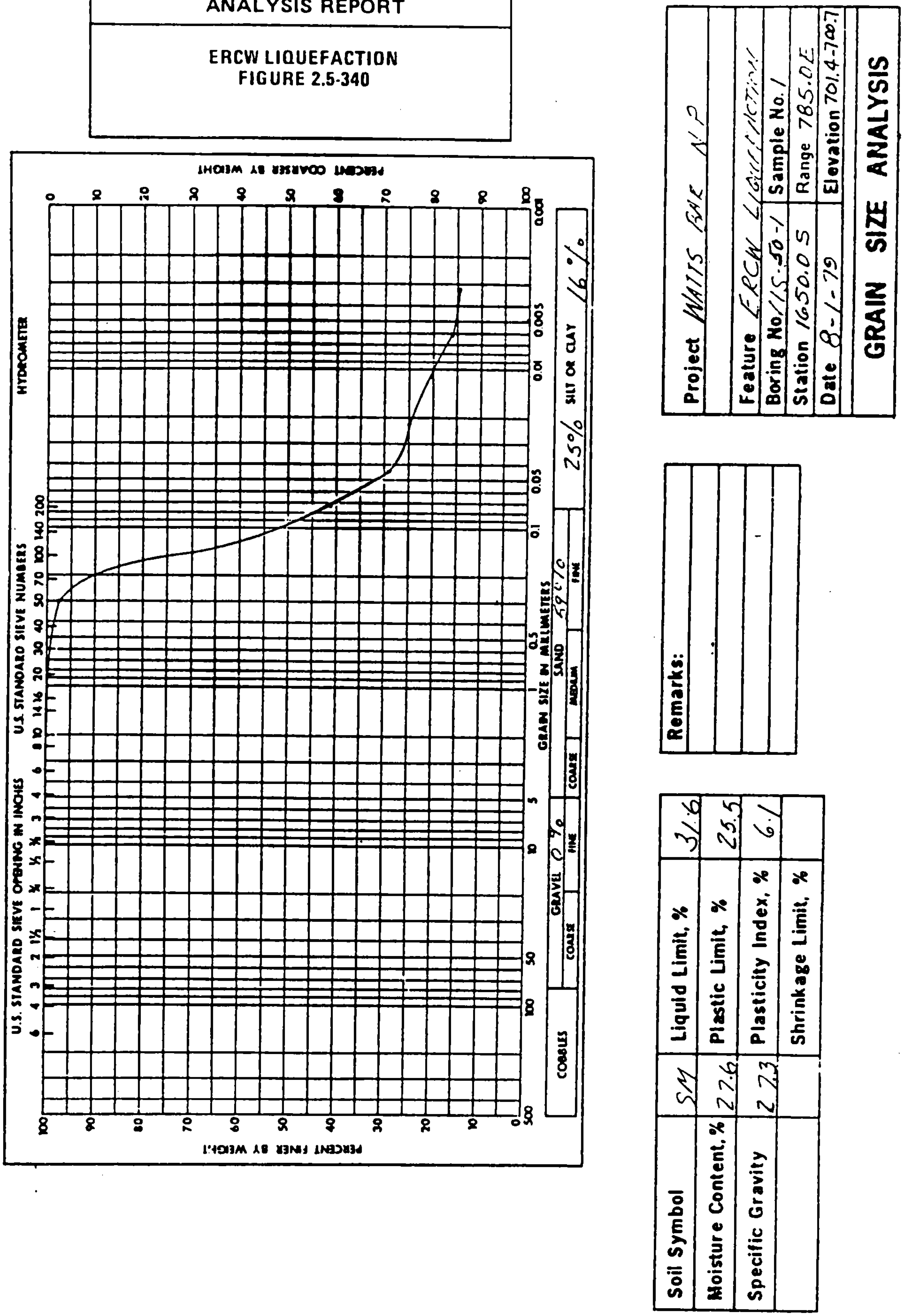
ERCW ROUTE
LIQUEFACTION EVALUATION
GRAPHIC LOGS NO. 50 & 65
FIGURE 2.5-339

"HISTORICAL INFORMATION"

**BEST AVAILABLE HISTORICAL IMAGE**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

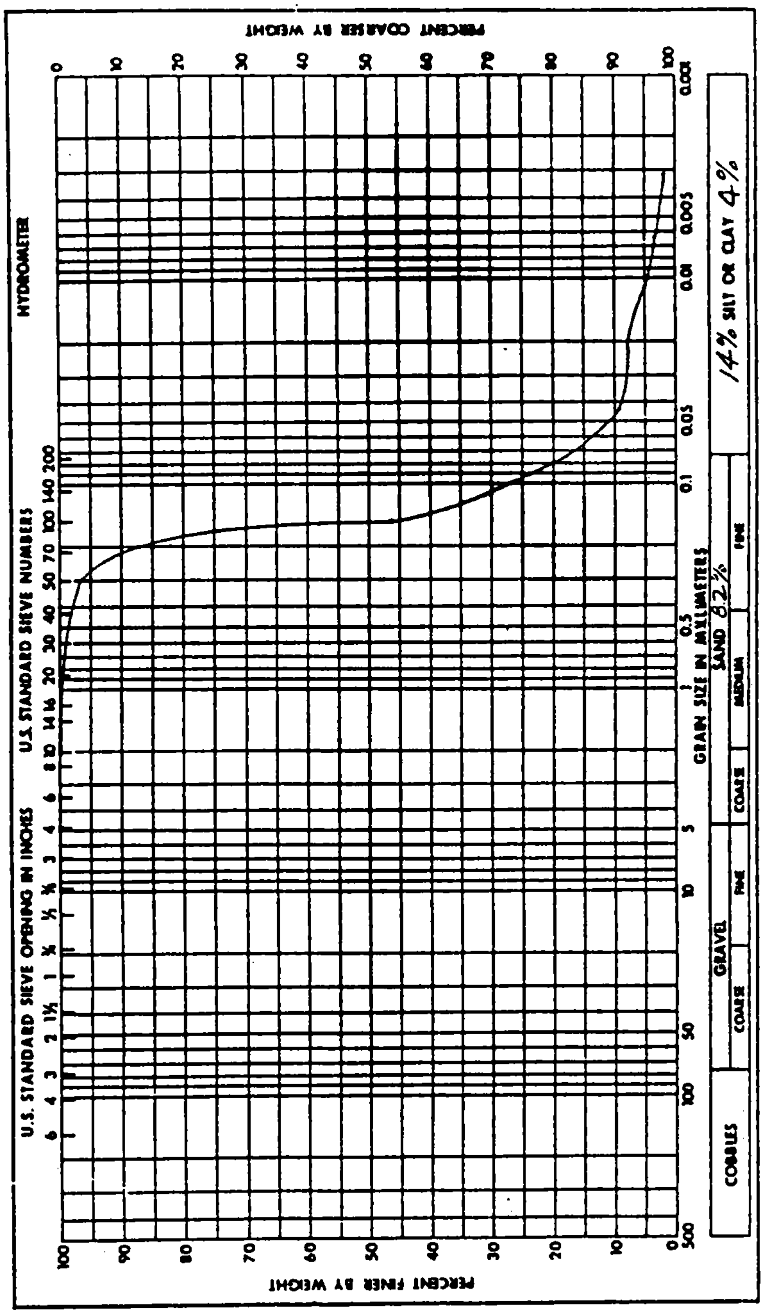
ERCW LIQUEFACTION
FIGURE 2.5-340



**HISTORICAL**

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| ERCW LIQUEFACTION<br>FIGURE 2.5-341 |

ATTACHMENT 6
CONST-QCP 5.3




| | |
|---|---|
| Project | WATTS BAR NP |
| Feature | ERCW LIQUEFACTION |
| Boring No. GS-50-1 | Sample No. 2 |
| Station 1650.0 S | Range 785.0 E |
| Date 7-20-79 | Elevation 698.9-696.6 |

**GRAIN SIZE ANALYSIS**

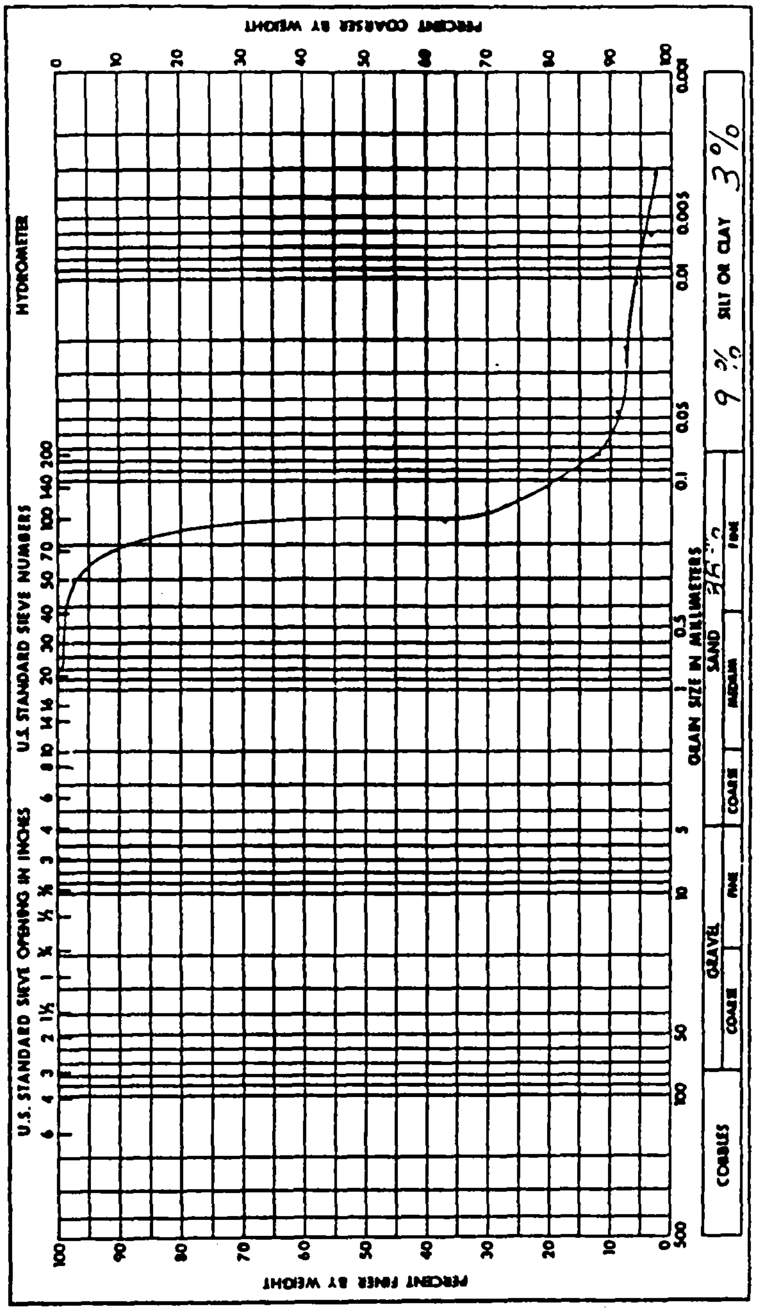
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 33.0 | Plastic Limit, % | NP |
| Specific Gravity | 2.70 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

**HISTORICAL**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LIQUEFACTION
FIGURE 2.5-342




## GRAIN SIZE ANALYSIS

| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | US-50-1 |
| Sample No. | 3 |
| Station | 1650.0S |
| Range | 785.0E |
| Date | 7-16-79 |
| Elevation | 696.4-695.3 |

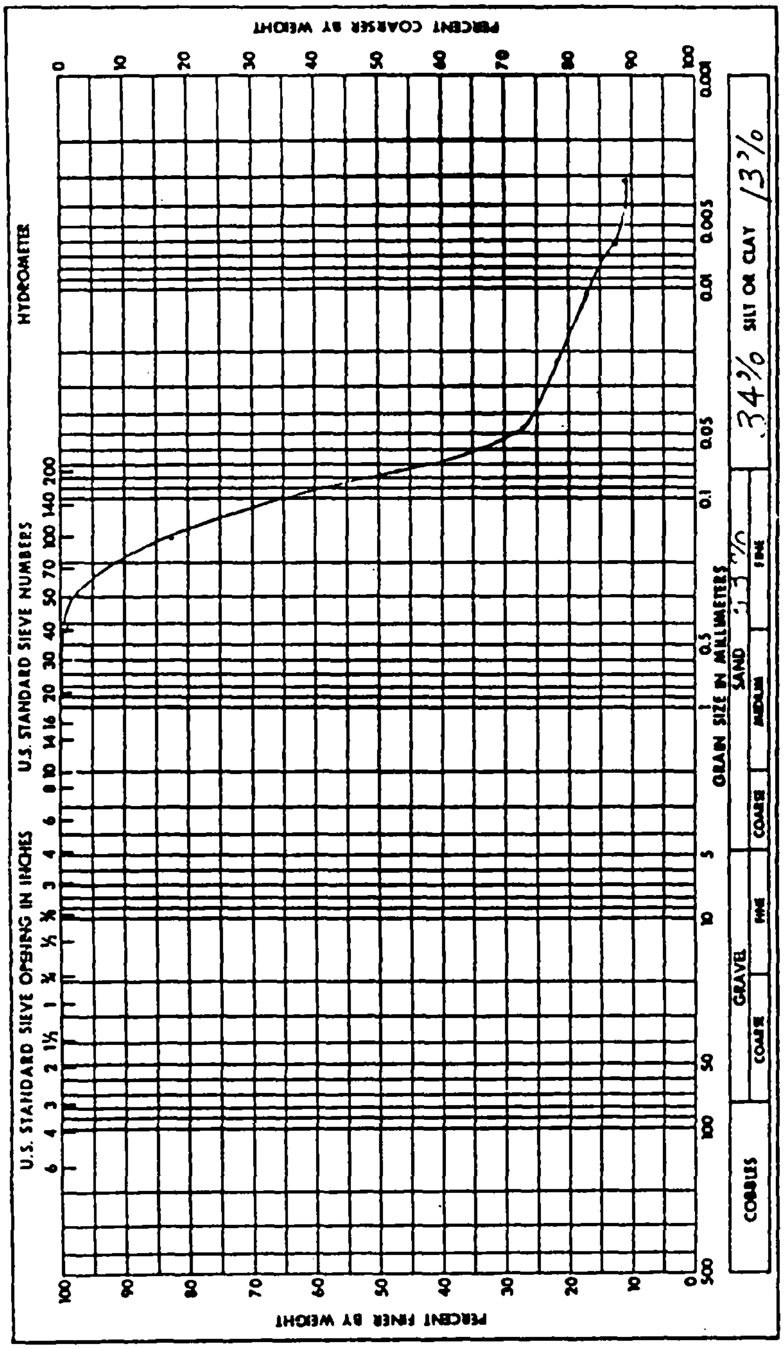
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | N.P. |
| Moisture Content, % | 28.9 | Plastic Limit, % | N.P. |
| Specific Gravity | 2.73 | Plasticity Index, % | N.P. |
| | | Shrinkage Limit, % | |

BEST AVAILABLE
HISTORICAL IMAGE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LIQUEFACTION
FIGURE 2.5-343




| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | LS-50-1 |
| Sample No. | 3 |
| Station | 1650.0S |
| Range | 785.0E |
| Date | 7-16-79 |
| Elevation | 695.3-694.5 |

**GRAIN SIZE ANALYSIS**

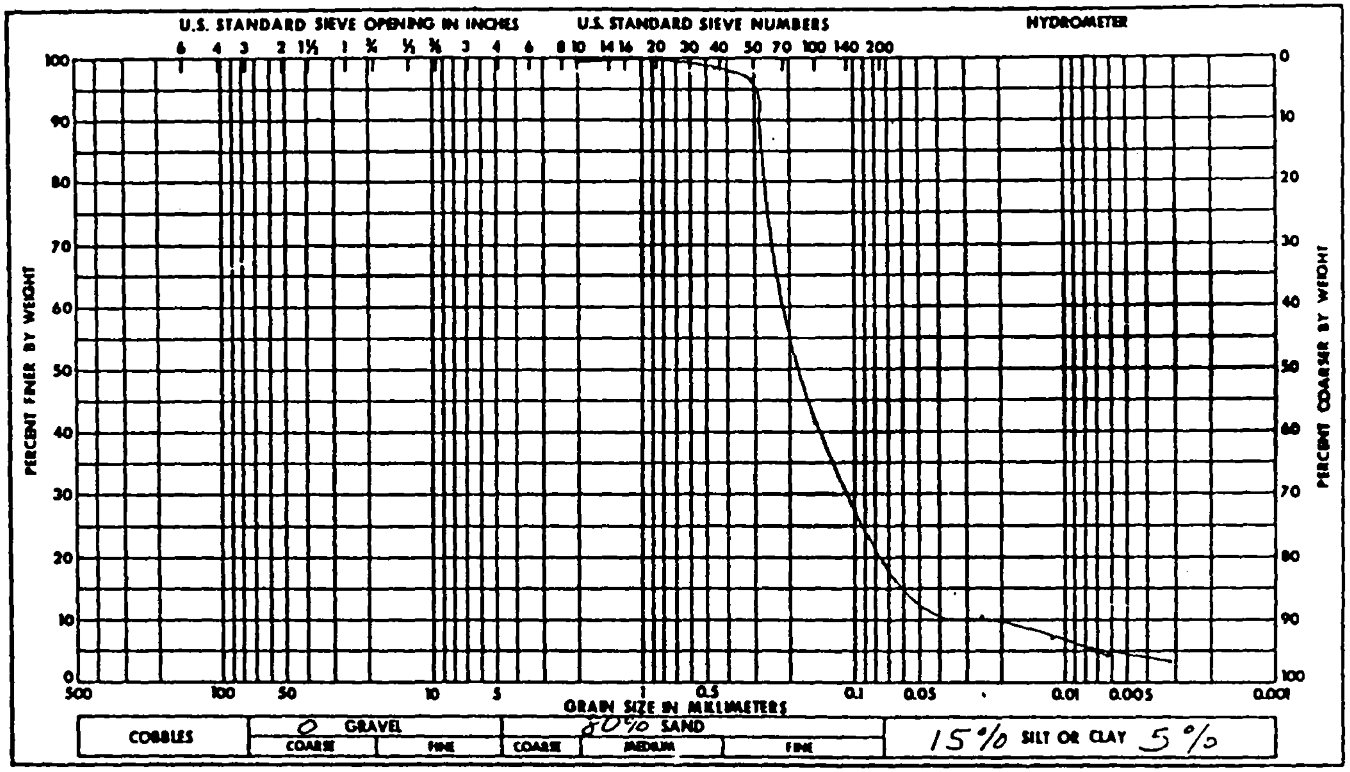
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 23.1 |
| Moisture Content, % | 31.1 | Plastic Limit, % | 22.1 |
| Specific Gravity | 2.70 | Plasticity Index, % | 1.0 |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-344**




| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 30.5 | Plastic Limit, % | NP |
| Specific Gravity | 2.74 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

Remarks:

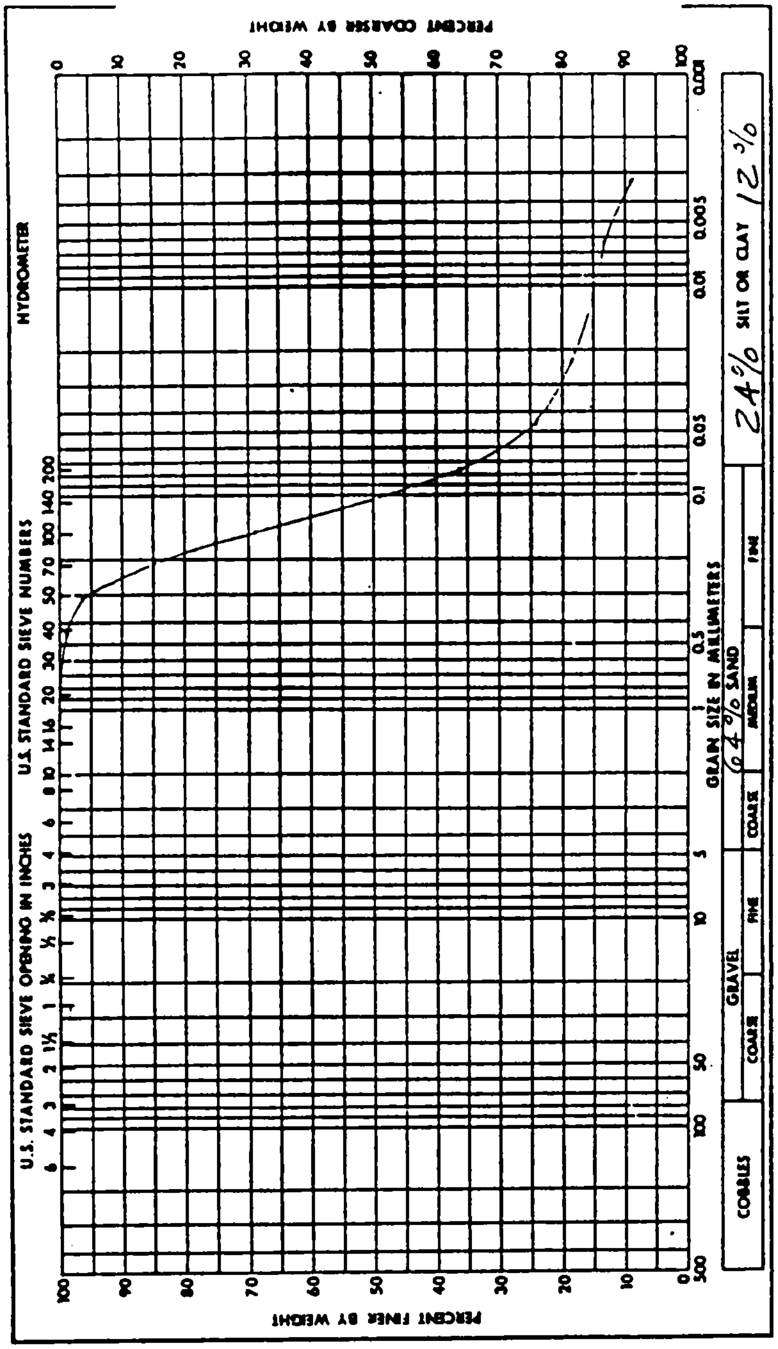
| | |
|---|---|
| Project Watts Bar N.P. | |
| Feature Liquefaction | |
| Boring No. US-50-1 | Sample No. 4 |
| Station 1650.0S | Range 785.0E |
| Date 7-13-79 | Elevation 694.2-692.1 |

**GRAIN SIZE ANALYSIS**

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-345**




**GRAIN SIZE ANALYSIS**

| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | US-50-1A |
| Sample No. | 1 |
| Station | 1645.0E |
| Range | 7E5.0E |
| Date | 7-13-79 |
| Elevation | 703.9-702 |

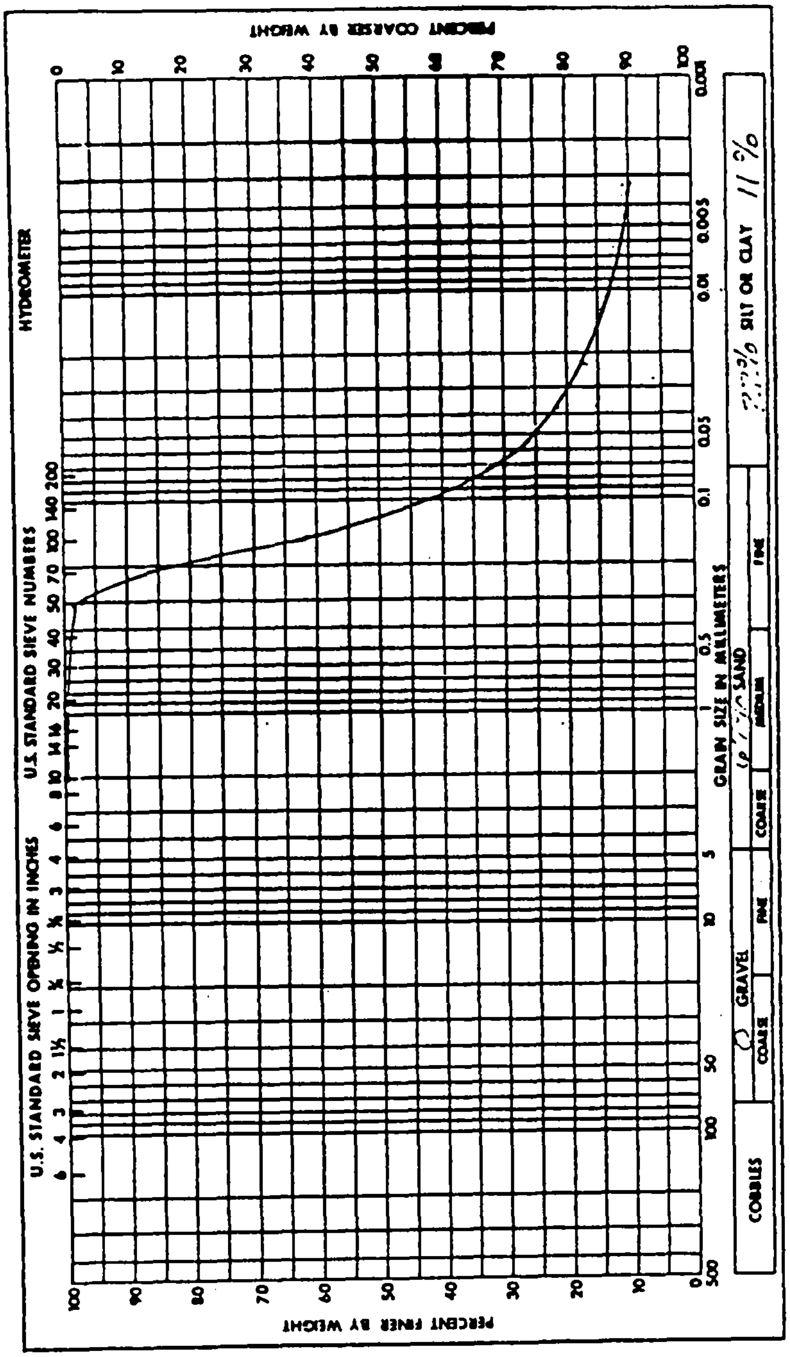
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 25.9 | Plastic Limit, % | NP |
| Specific Gravity | 2.73 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-346**




| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | US-50-1A |
| Sample No. | 2 |
| Station | 1645.05 |
| Range | 785.0 E |
| Date | 7-13-79 |
| Elevation | 701.6-692.4 |

**GRAIN SIZE ANALYSIS**

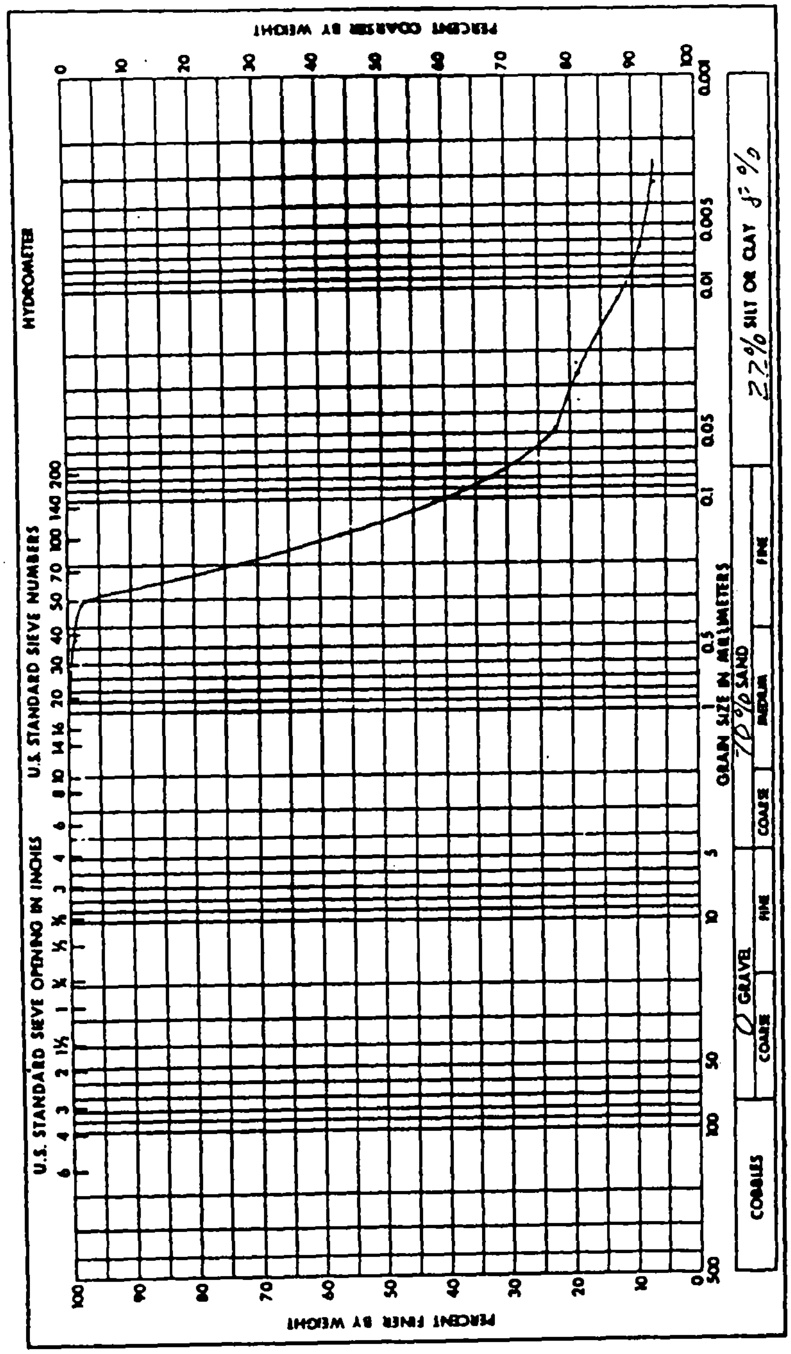
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 37.3? | Plastic Limit, % | NP |
| Specific Gravity | 2.73? | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-347**




| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | CS-65-1 |
| Sample No. | 1 |
| Station | 1367.0 S |
| Range | 1005.7 E |
| Date | 7-13-79 |
| Elevation | 711.9-709.6 |

**GRAIN SIZE ANALYSIS**

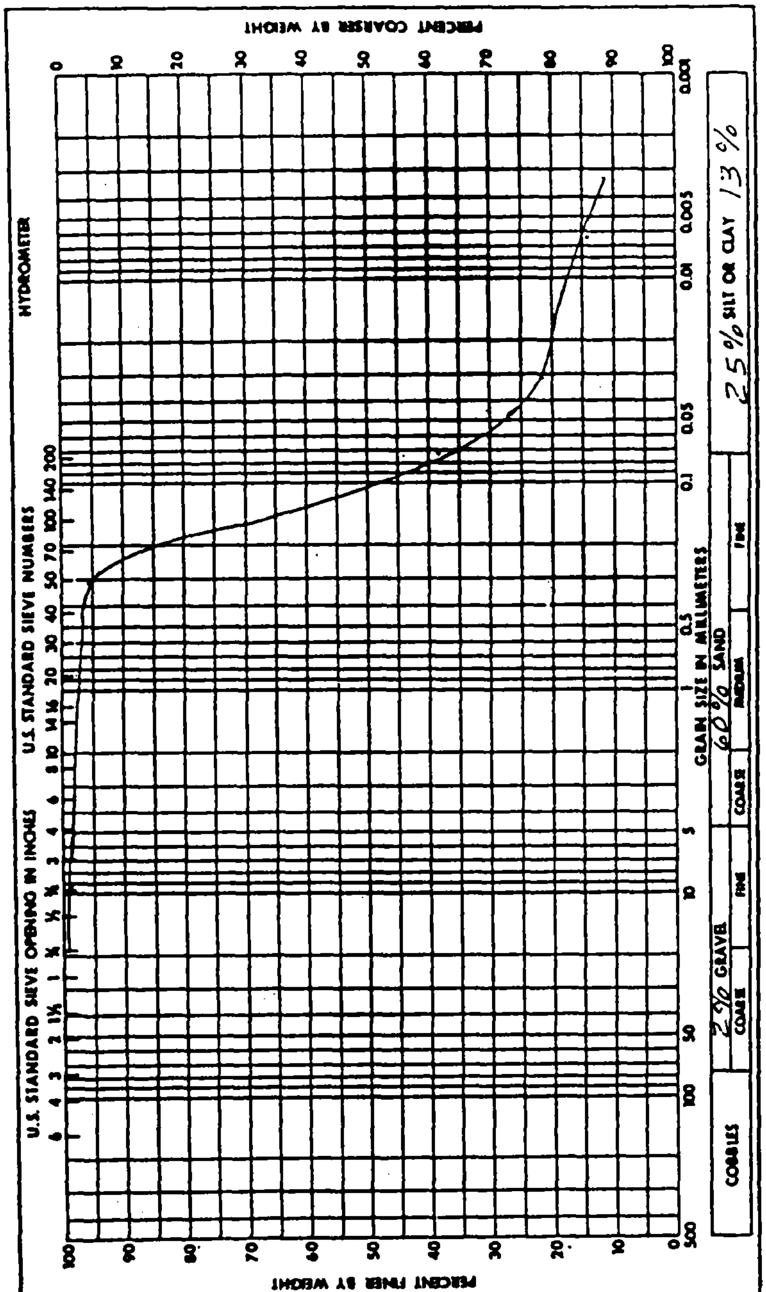
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 22.2 | Plastic Limit, % | NP |
| Specific Gravity | 2.70 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-348**




| | |
|---|---|
| Project Watts Bar N.P. | |
| Feature Liquefaction | |
| Boring No. US-65-1 | Sample No. 2 |
| Station 1367.0 S | Range 1005.7 E |
| Date 7-13-79 | Elevation 709.4-707.3 |

**GRAIN SIZE ANALYSIS**

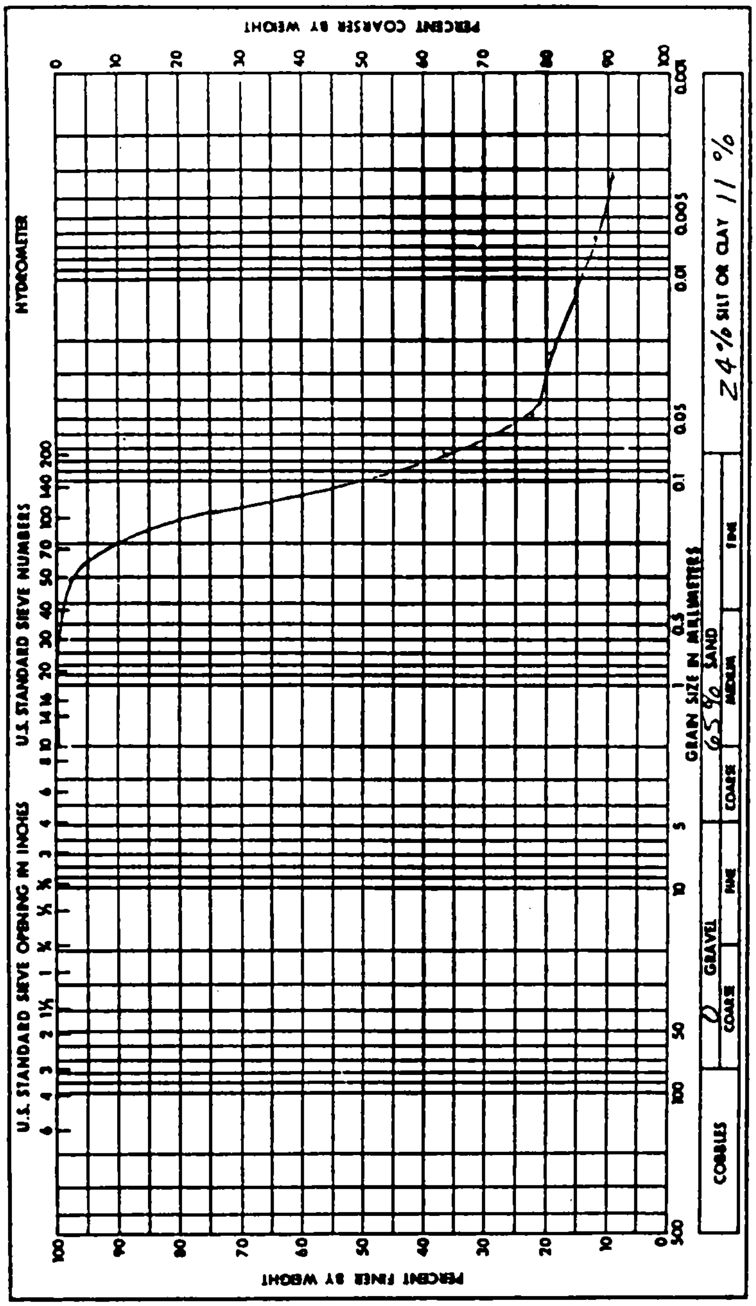
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 22.7 | Plastic Limit, % | NP |
| Specific Gravity | 2.72 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

**LIQUEFACTION**
**FIGURE 2.5-349**




| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | Liquefaction |
| Boring No. | 15-65-1 |
| Sample No. | 3 |
| Station | 1367.0 S |
| Range | 1005.7 E |
| Date | 7-13-79 |
| Elevation | 727.2-705.8 |

**GRAIN SIZE ANALYSIS**

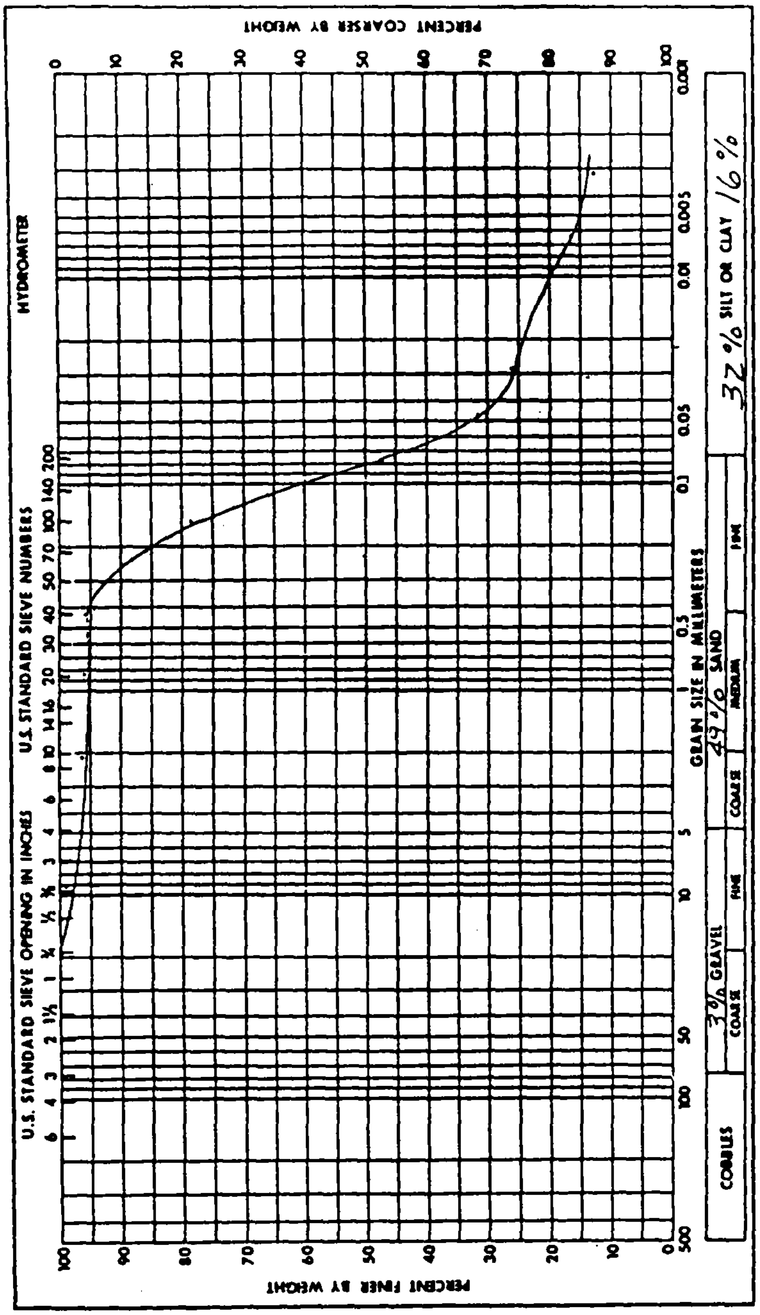
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | 33.4 | Plastic Limit, % | NP |
| Specific Gravity | 2.72 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION**
**FIGURE 2.5-350**




| | |
|---|---|
| Project Watts Bar N. P. | |
| Feature Liquefaction | |
| Boring No. LS-65 | Sample No. 4 |
| Station 1367.0 S | Range 1005.7 E |
| Date [illegible] | Elevation 705.2-704.0 |

**GRAIN SIZE ANALYSIS**

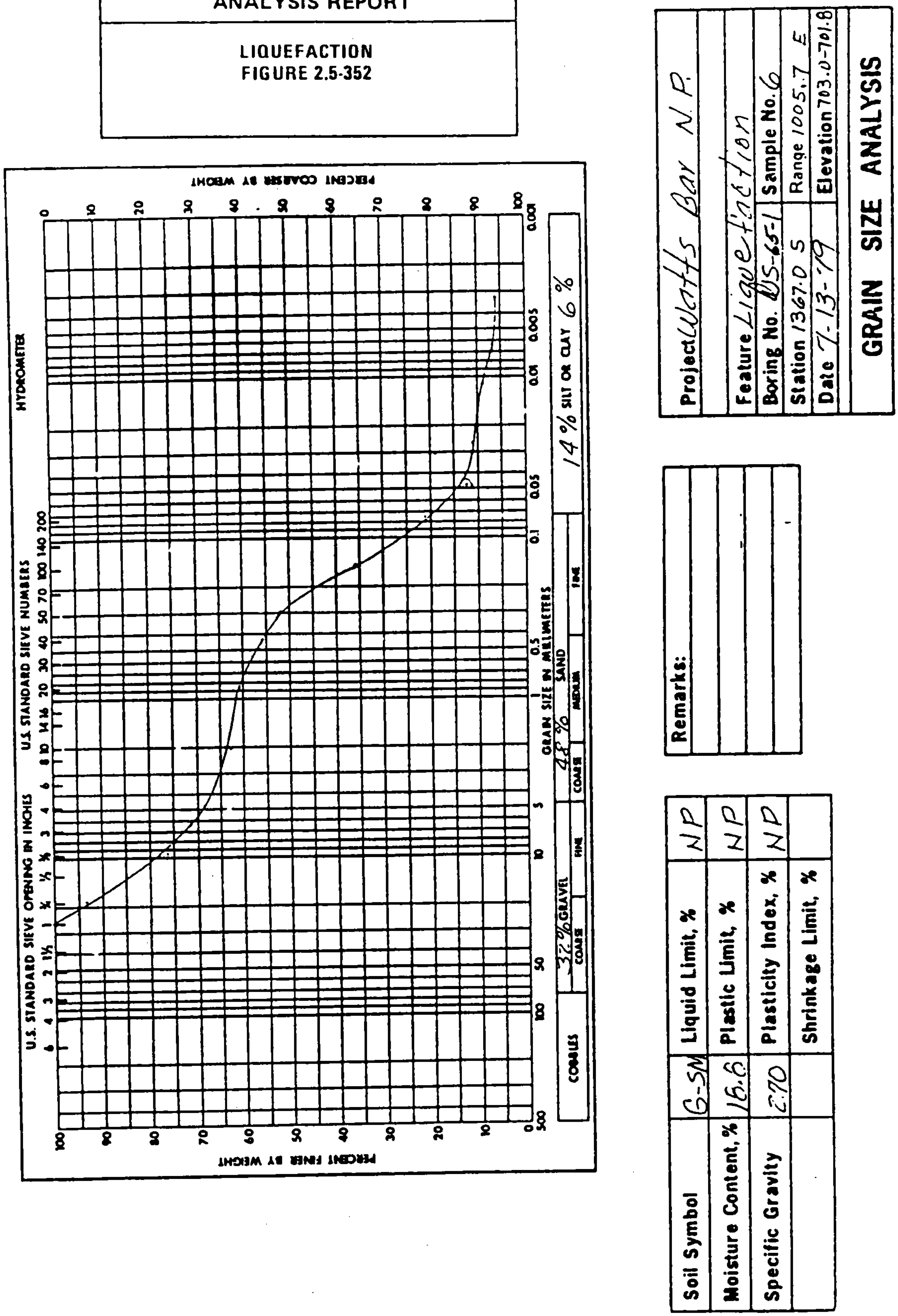
Remarks:

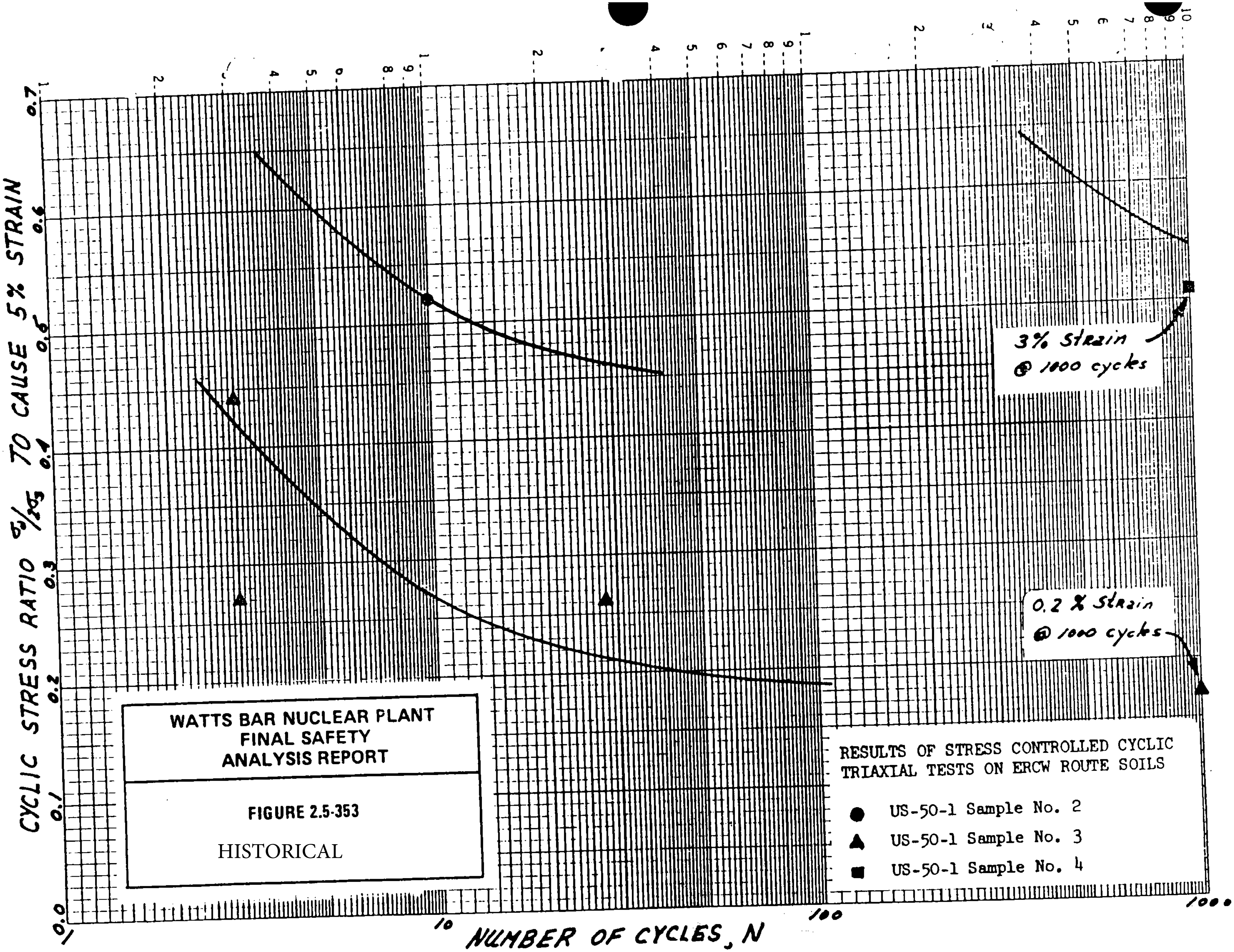
| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 26.1 |
| Moisture Content, % | 31.6 | Plastic Limit, % | 23.3 |
| Specific Gravity | 2.71 | Plasticity Index, % | 2.8 |
| | | Shrinkage Limit, % | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LIQUEFACTION
FIGURE 2.5-352






WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

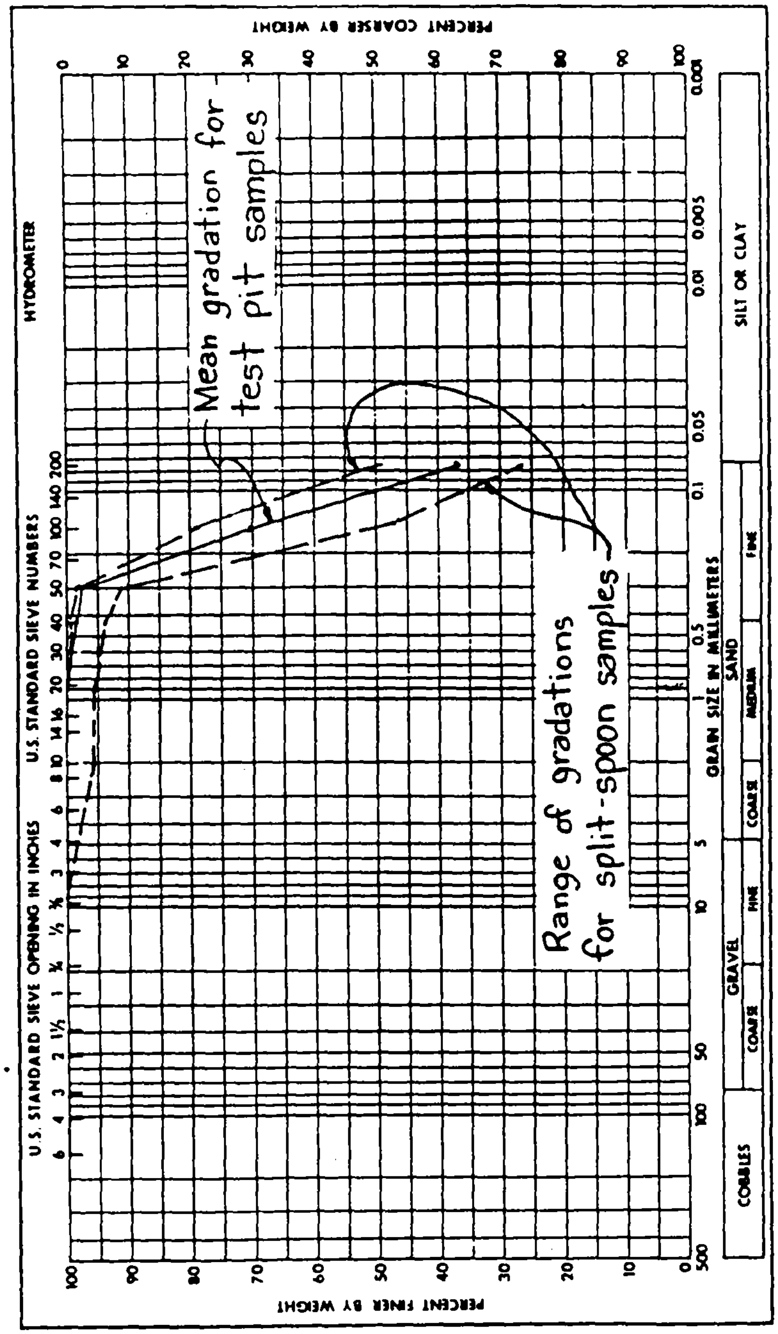
FIGURE 2.5-353

HISTORICAL

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION STUDY**
**ERCW PIPELINE**
**FIGURE 2.5-354**




Project Watts Bar Nuclear Plant Liquefaction Study
Feature ERCW Pipeline

Figure 1

**GRAIN SIZE ANALYSIS**

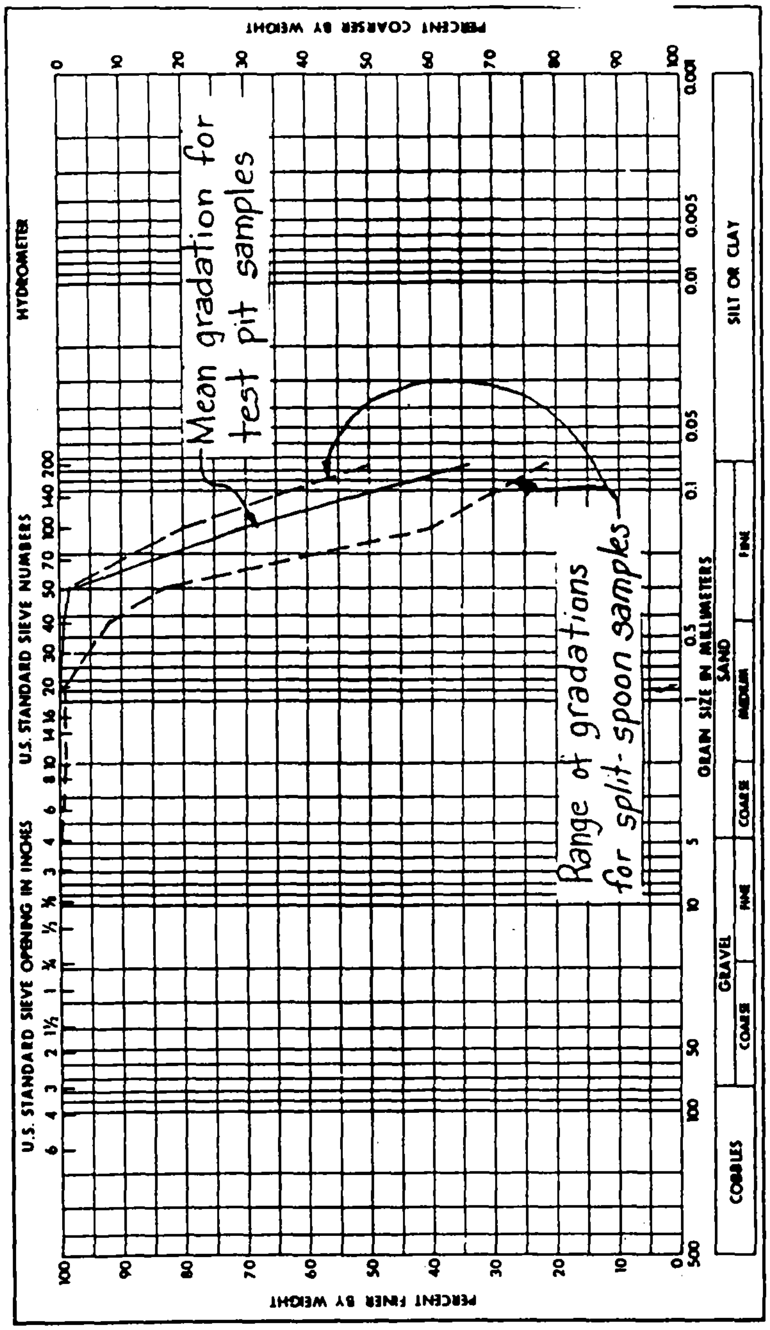
Remarks: Comparison of Test Pit #1 samples with SM samples from split-spoon borings 134, 134A, & 135A

| | | | |
|---|---|---|---|
| Soil Symbol | | Liquid Limit, % | |
| Moisture Content, % | | Plastic Limit, % | |
| Specific Gravity | | Plasticity Index, % | |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION STUDY**
**ERCW PIPELINE**
**FIGURE 2.5-355**



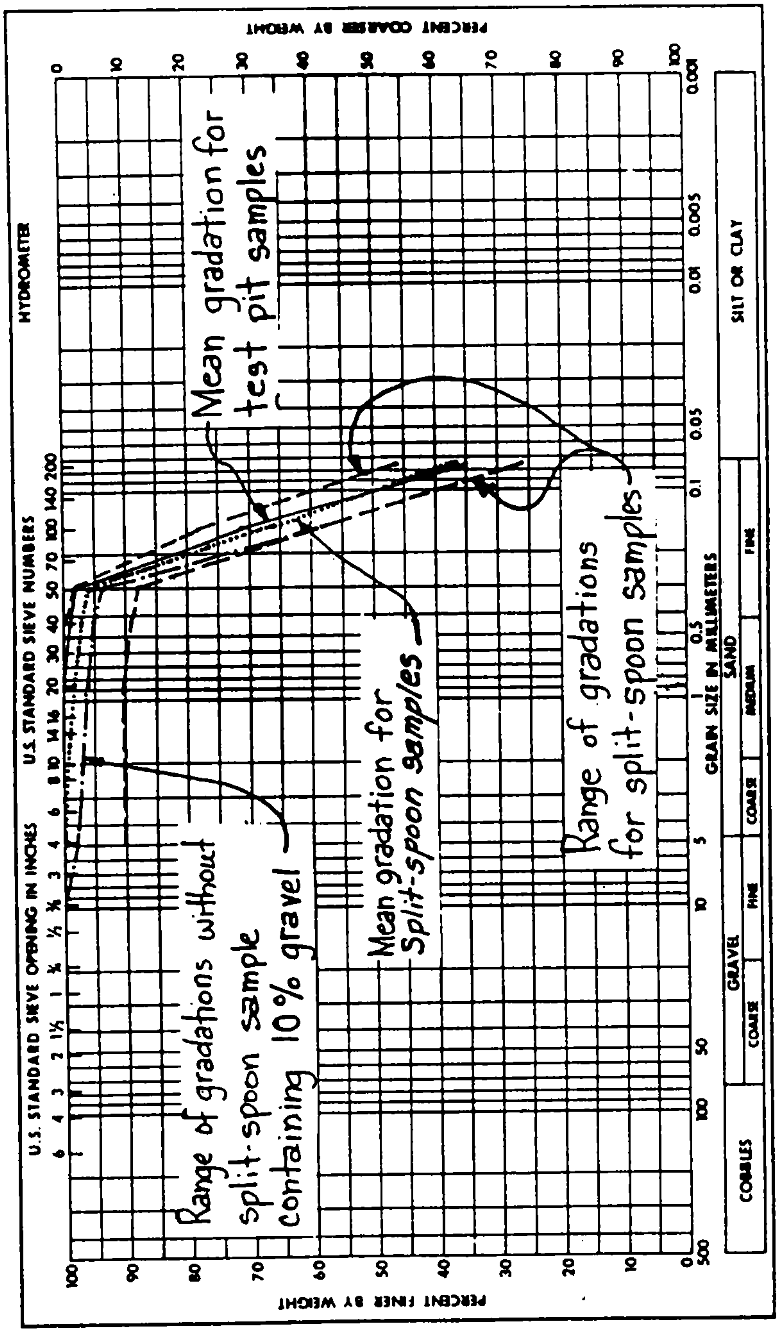

| Soil Symbol | Liquid Limit, % |
|---|---|
| Moisture Content, % | Plastic Limit, % |
| Specific Gravity | Plasticity Index, % |
| | Shrinkage Limit, % |

Remarks: Comparison of Test Pit #2 samples with SM (without gravel) samples from split-spoon borings 138, 138A, 138B, 138C, & 139

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**LIQUEFACTION STUDY**
**ERCW PIPELINE**
**FIGURE 2.5-356**




Project Watts Bar Nuclear Plant
Liquefaction Study
Feature ERCW Pipeline

Figure 3

**GRAIN SIZE ANALYSIS**

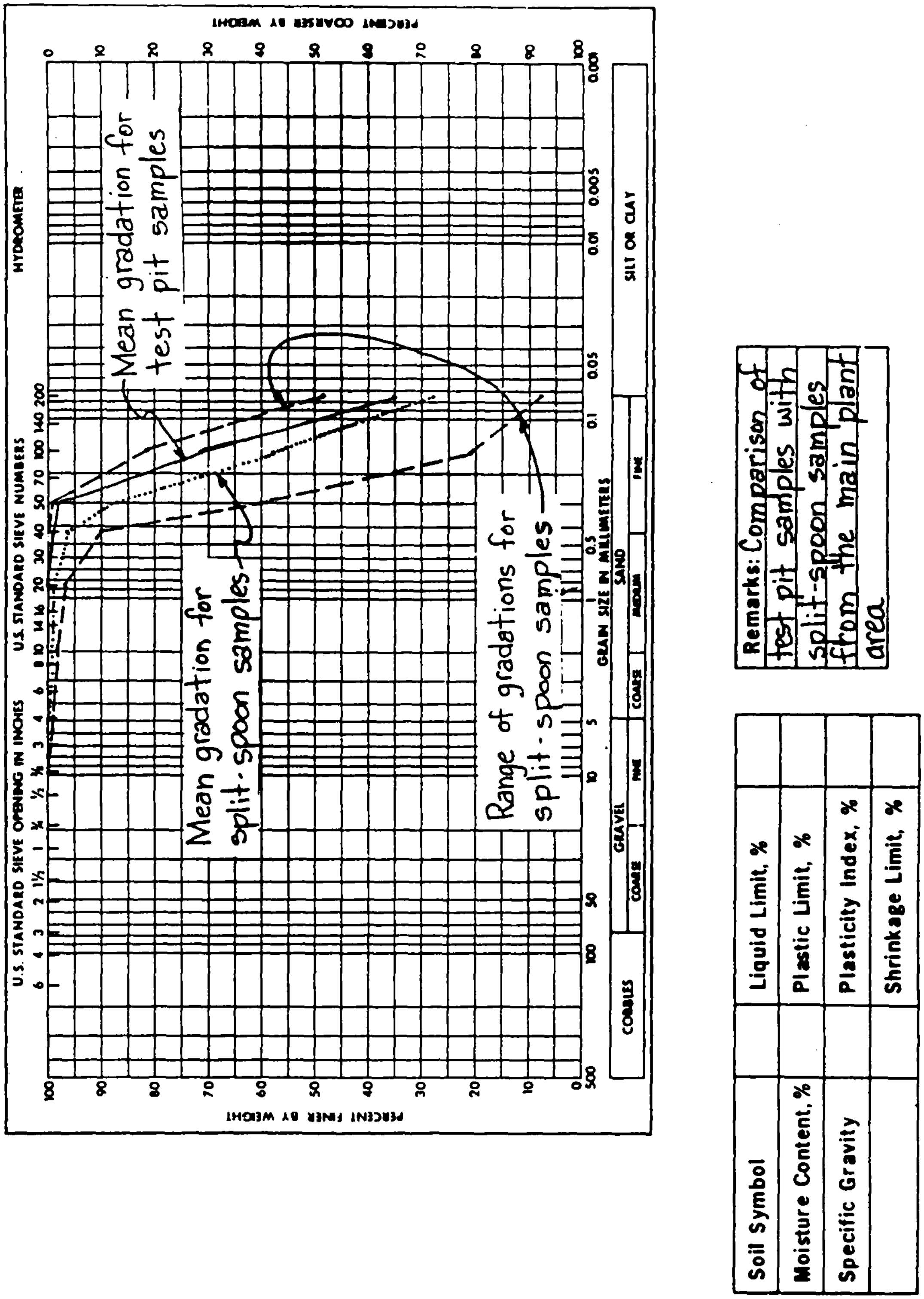
Remarks: Comparison of test pit samples with split-spoon samples from south of the cooling towers

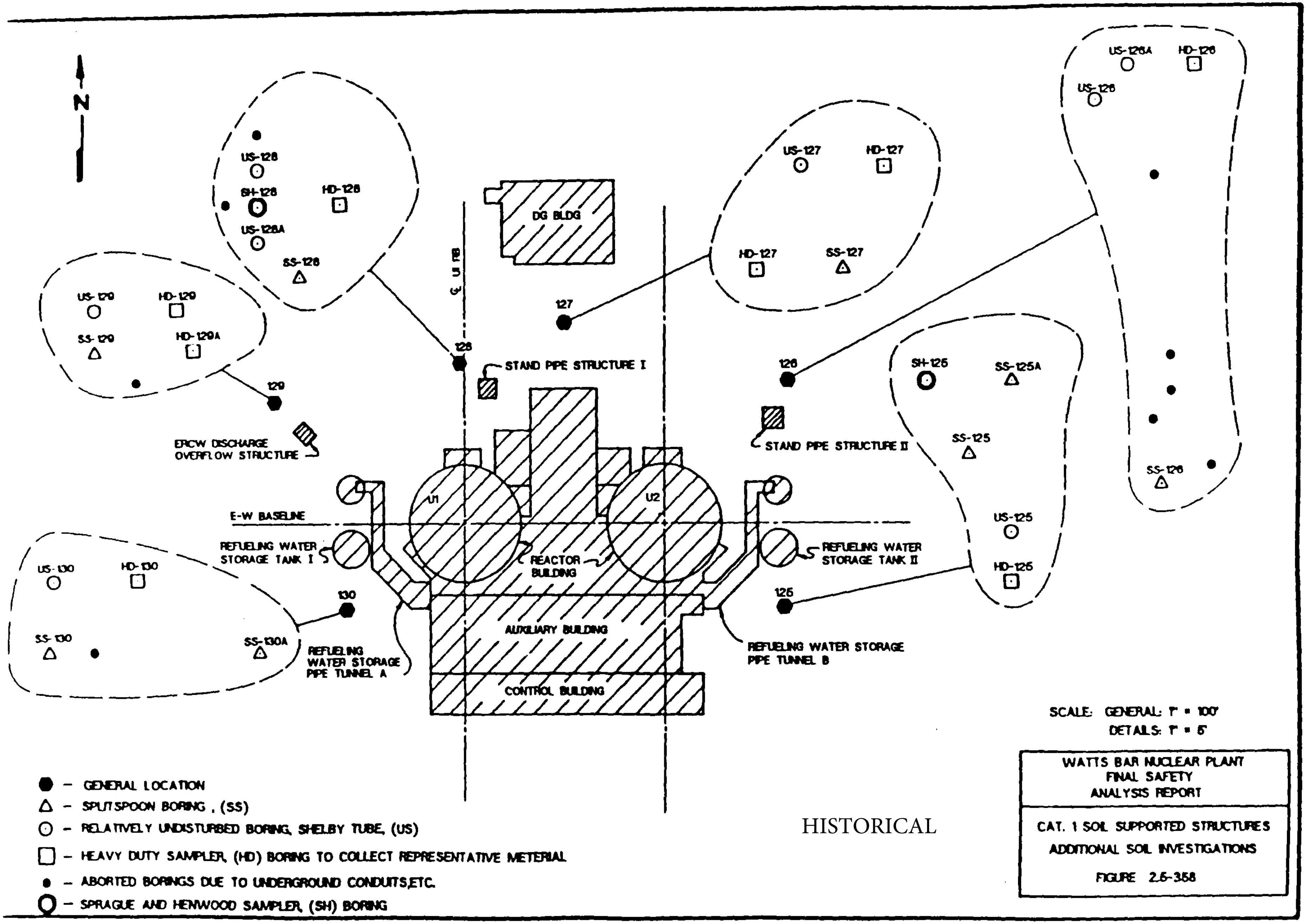
| | | | |
|---|---|---|---|
| Soil Symbol | | Liquid Limit, % | |
| Moisture Content, % | | Plastic Limit, % | |
| Specific Gravity | | Plasticity Index, % | |
| | | Shrinkage Limit, % | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

LIQUEFACTION STUDY
ERCW PIPELINE
FIGURE 2.5-357



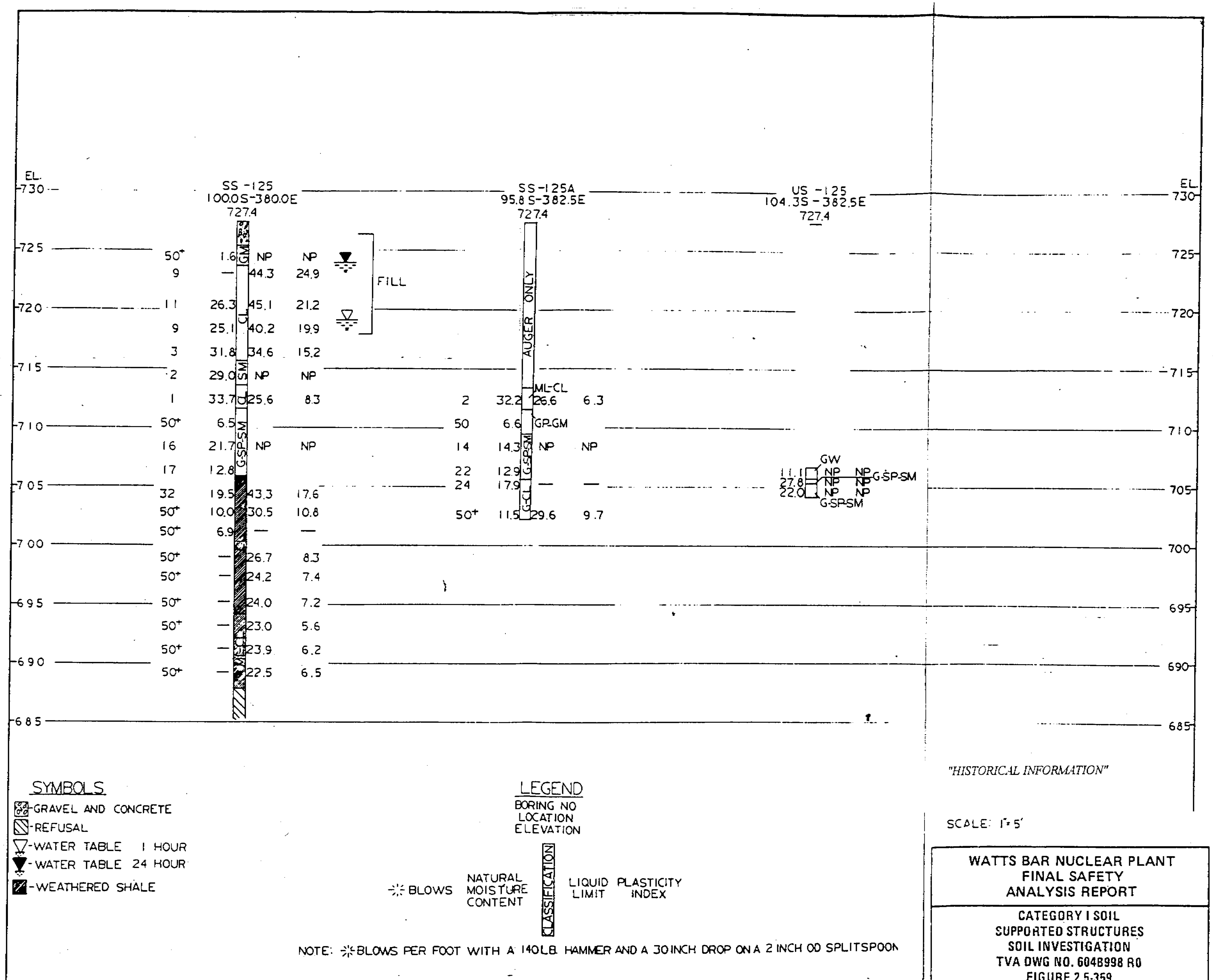



HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

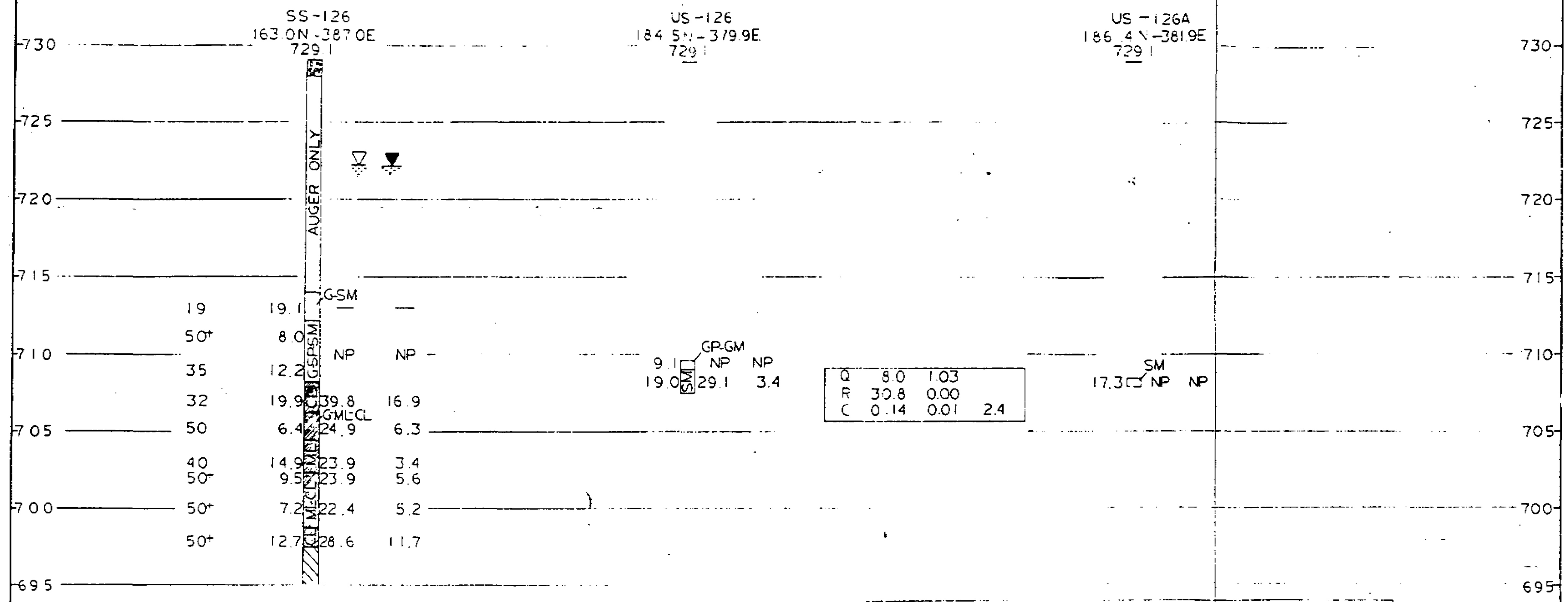
CAT. 1 SOIL SUPPORTED STRUCTURES
ADDITIONAL SOIL INVESTIGATIONS

FIGURE 2.5-358




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I SOIL
SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 604B998 R0
FIGURE 2.5-359




## SYMBOLS

- GRAVEL
- REFUSAL
- Q - UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
- R - CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST SATURATED
- C - CONSOLIDATION TEST
- WATER TABLE 1 HOUR
- WATER TABLE 24 HOUR
- WEATHERED SHALE

## LEGEND

BORING NO.
LOCATION
ELEVATION

*BLOWS | NATURAL MOISTURE CONTENT | CLASSIFICATION | LIQUID LIMIT | PLASTICITY INDEX

| TYPE TEST | FRICTION ANGLE (DEGREES) / COMPRESSION INDEX | OR RECOMPRESSION INDEX | COHESION (TSF) / PRECONSOLIDATION (TSF) |
|---|---|---|---|

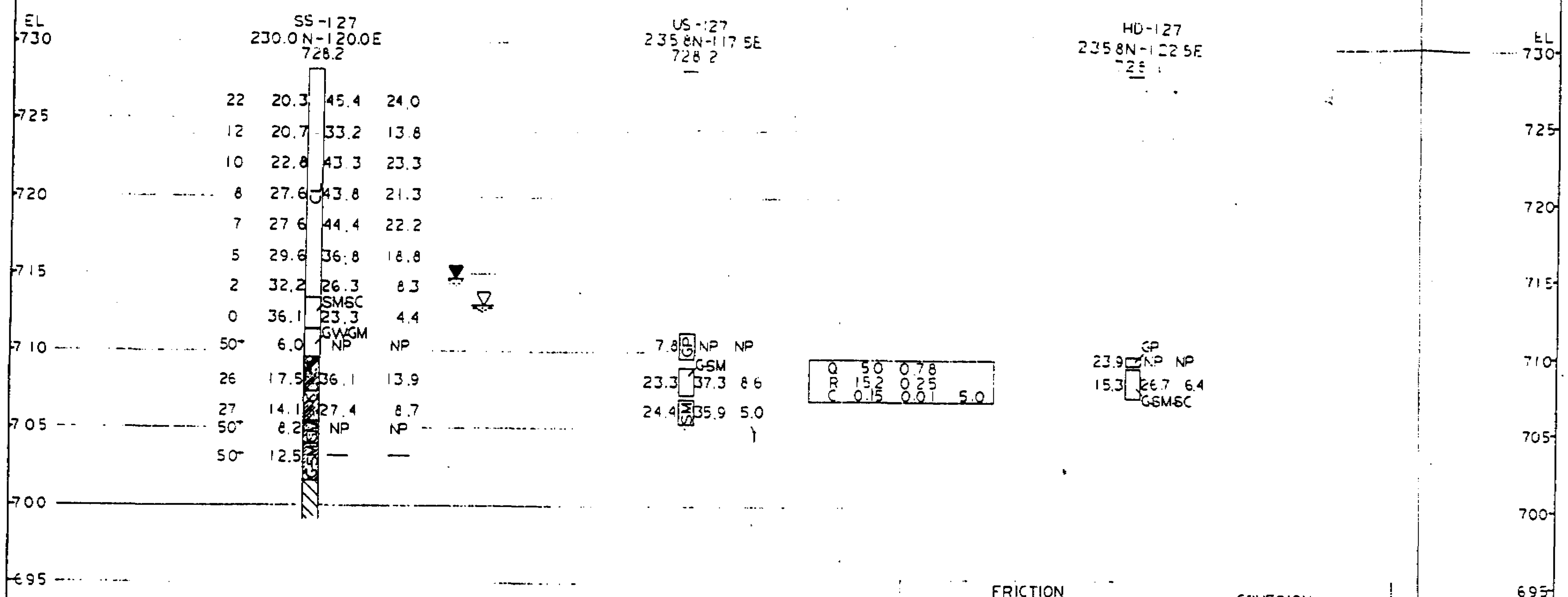
"HISTORICAL INFORMATION"

SCALE: 1"=5'

NOTE: * BLOWS PER FOOT WITH A 140LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I SOIL
SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 604B999 R0
FIGURE 2.5-360




| Blows | Moisture | LL | PI |
|---|---|---|---|
| 22 | 20.3 | 45.4 | 24.0 |
| 12 | 20.7 | 33.2 | 13.8 |
| 10 | 22.8 | 43.3 | 23.3 |
| 8 | 27.6 | 43.8 | 21.3 |
| 7 | 27.6 | 44.4 | 22.2 |
| 5 | 29.6 | 36.8 | 18.8 |
| 2 | 32.2 | 26.3 | 8.3 |
| 0 | 36.1 | 23.3 | 4.4 |
| 50+ | 6.0 | NP | NP |
| 26 | 17.5 | 36.1 | 13.9 |
| 27 | 14.1 | 27.4 | 8.7 |
| 50+ | 8.2 | NP | NP |
| 50+ | 12.5 | — | — |

US-127: 7.8 GP NP NP; 23.3 GSM 37.3 8.6; 24.4 SM 35.9 5.0

HD-127: 23.9 GP NP NP; 15.3 GSMSC 26.7 6.4

## SYMBOLS

- REFUSAL
- Q - UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
- R - CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST SATURATED
- C - CONSOLIDATION TEST
- WATER TABLE 1 HOUR
- WATER TABLE 24 HOUR
- WEATHERED SHALE

## LEGEND

BORING NO
LOCATION
ELEVATION

BLOWS | NATURAL MOISTURE CONTENT | CLASSIFICATION | LIQUID LIMIT | PLASTICITY INDEX

TYPE TEST | FRICTION ANGLE (DEGREES) | COHESION (TSF) | COMPRESSION INDEX OR RECOMPRESSION INDEX | PRECONSOLIDATION (TSF)

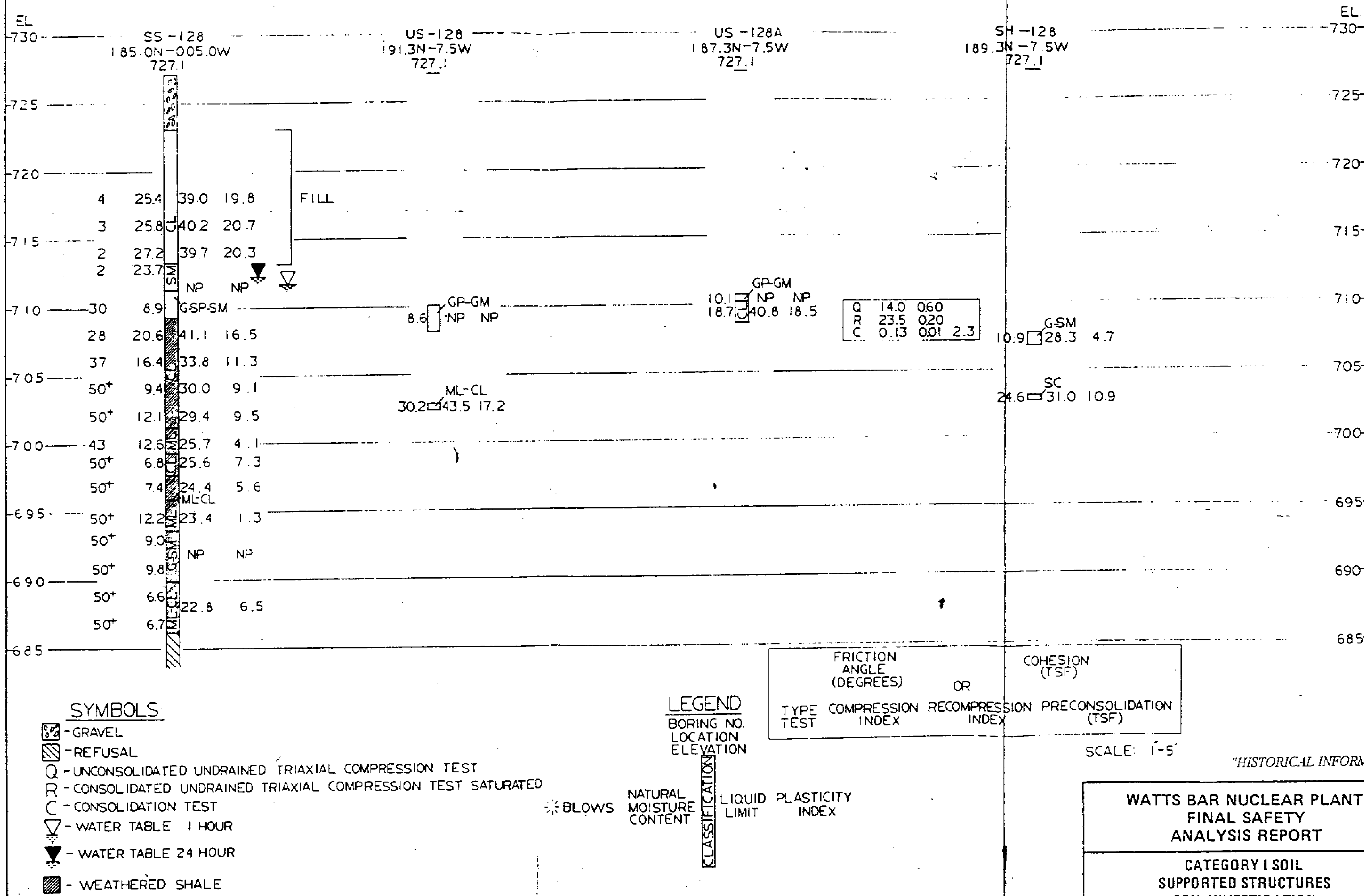
NOTE: BLOWS PER FOOT WITH A 140 LB HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

"HISTORICAL INFORMATION"

SCALE 1"=5'

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

CATEGORY I SOIL SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 604B1000 R0
FIGURE 2.5-361



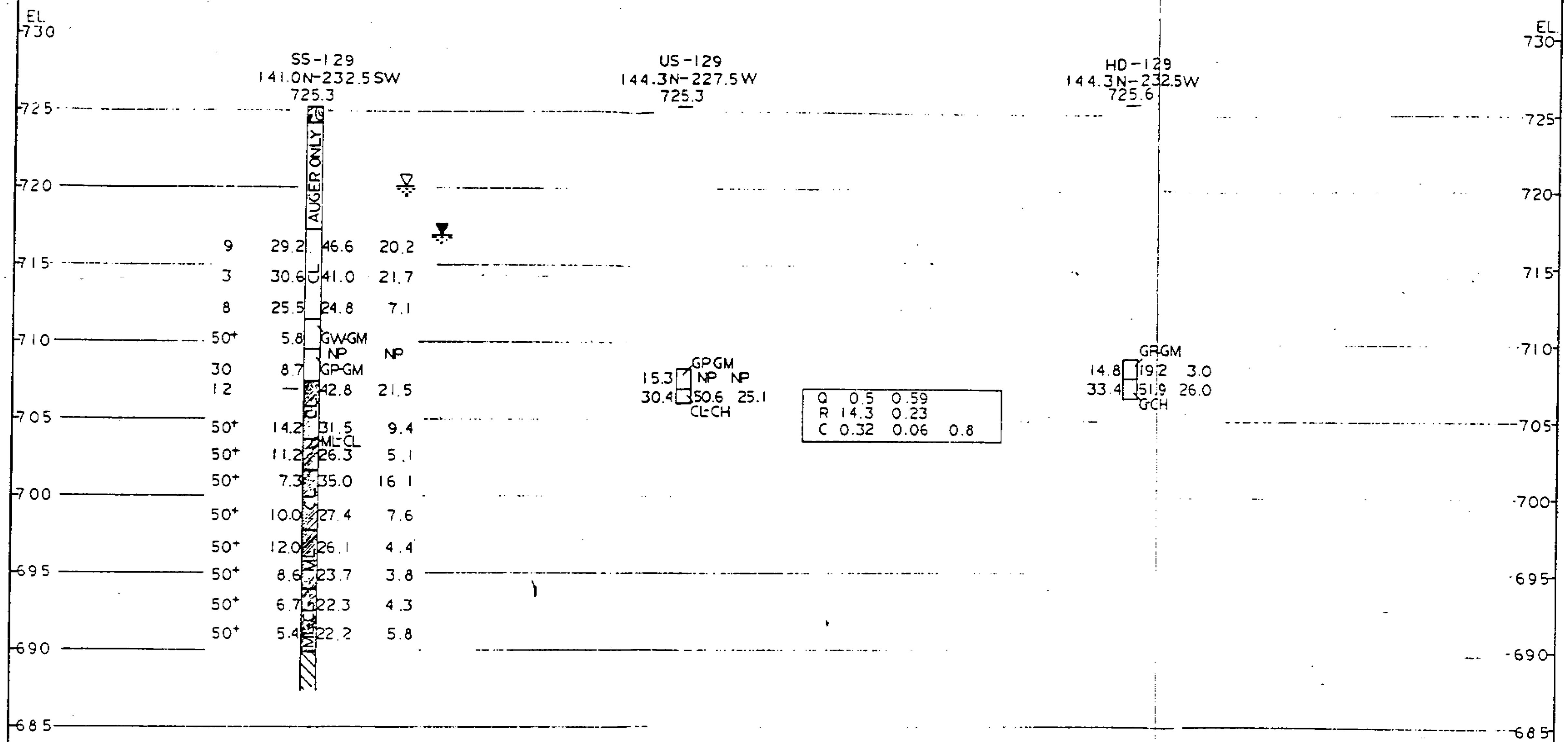

NOTE: ☼ BLOWS PER FOOT WITH A 140 LB. HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

SCALE: 1"=5'

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I SOIL
SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 60481001 R0
FIGURE 2.5-362




SYMBOLS

- TOPSOIL
- REFUSAL

Q — UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
R — CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST SATURATED
C — CONSOLIDATION TEST

- WATER TABLE 1 HOUR
- WATER TABLE 24 HOUR
- WEATHERED SHALE

LEGEND

BORING NO
LOCATION
ELEVATION

TYPE TEST — FRICTION ANGLE (DEGREES) COMPRESSION INDEX — OR RECOMPRESSION INDEX — COHESION (TSF) PRECONSOLIDATION (TSF)

※BLOWS — NATURAL MOISTURE CONTENT — CLASSIFICATION — LIQUID LIMIT — PLASTICITY INDEX

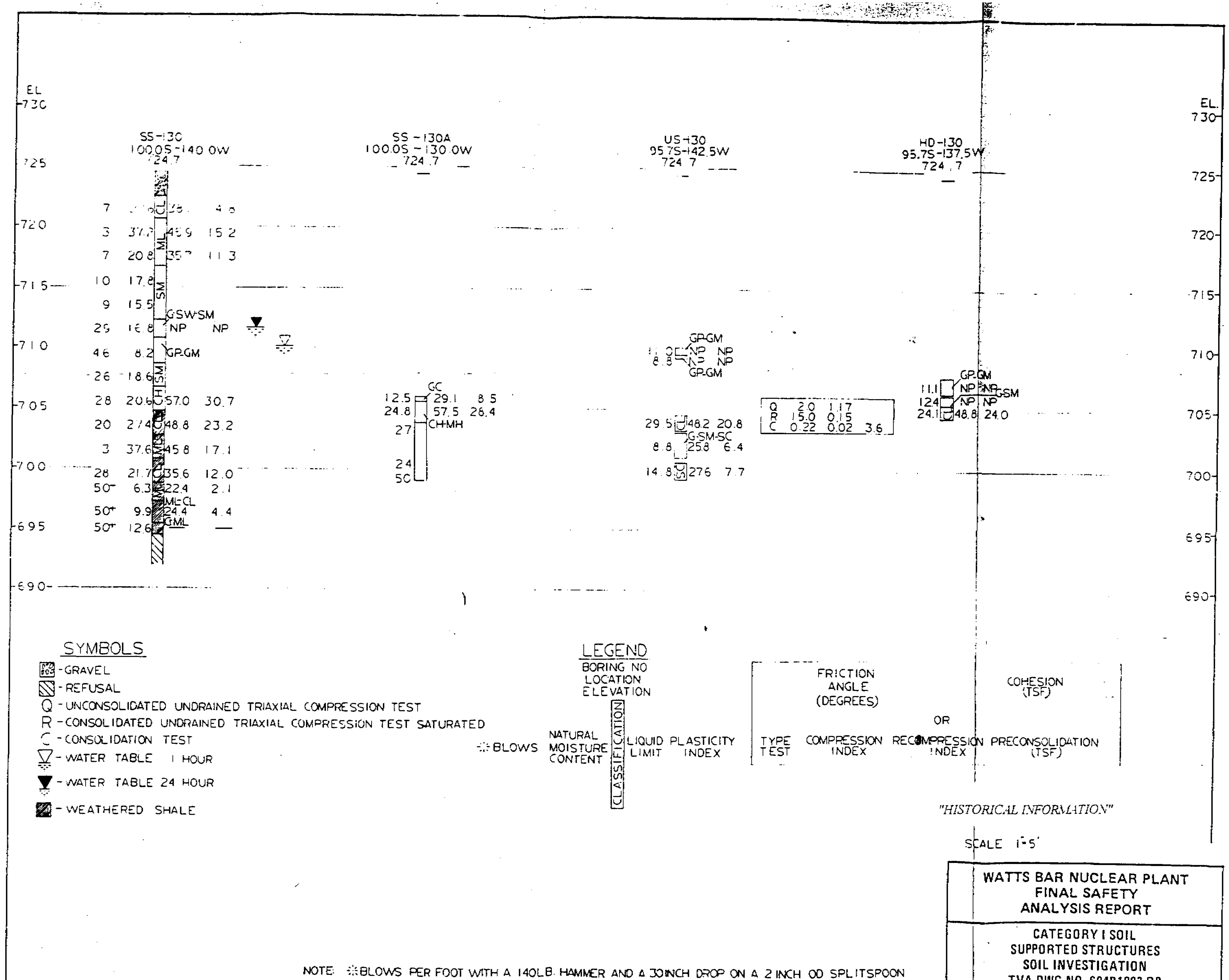
SCALE: 1"=5'

NOTE: ※BLOWS PER FOOT WITH A 140 LB. HAMMER AND A 30 INCH DROP ON A 2 INCH OD SPLITSPOON

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I SOIL
SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 604B1002 R0
FIGURE 2.5-363

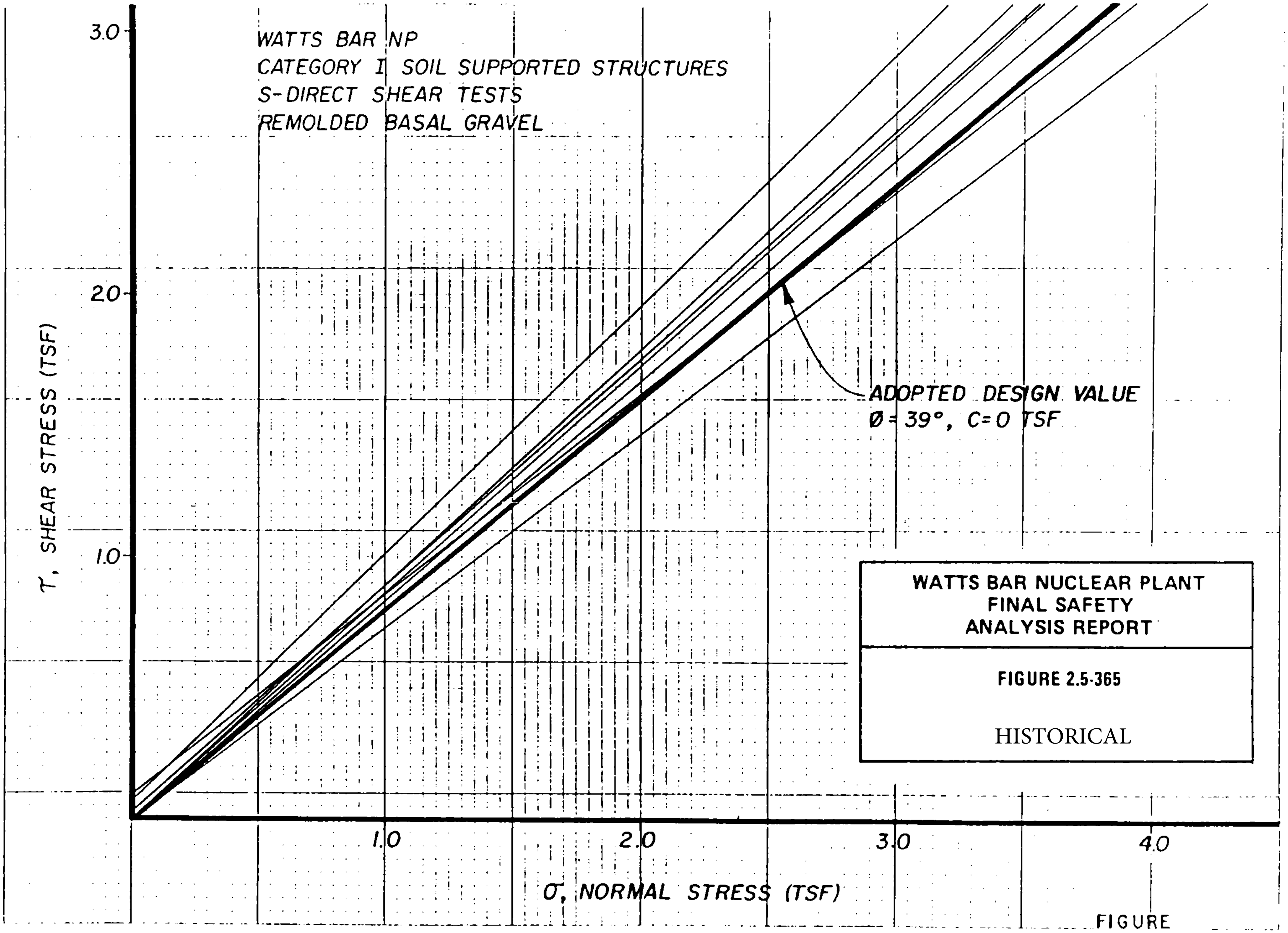



"HISTORICAL INFORMATION"

SCALE 1"=5'

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I SOIL
SUPPORTED STRUCTURES
SOIL INVESTIGATION
TVA DWG NO. 604B1003 R0
FIGURE 2.5-364




WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

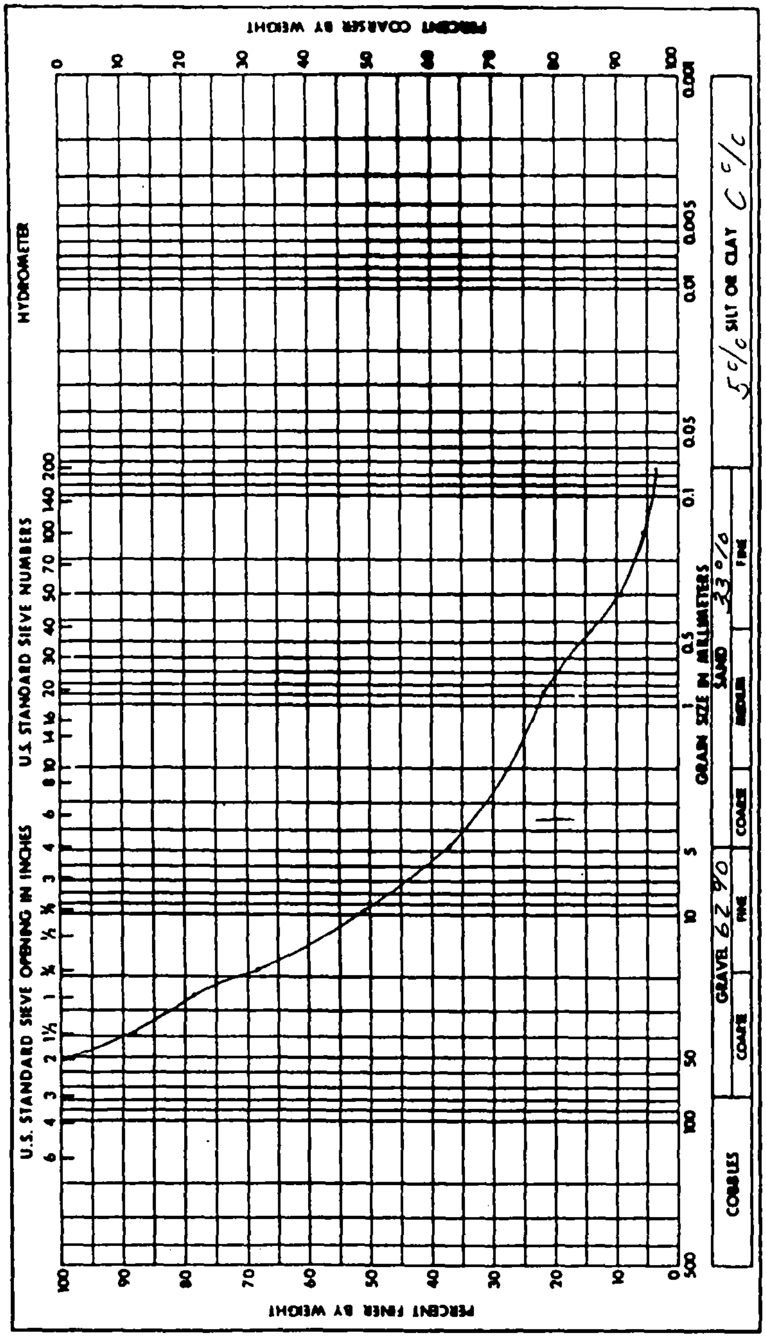
FIGURE 2.5-365

HISTORICAL

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL SUPPORTED STRUCTURES**
**FIGURE 2.5-386**




## GRAIN SIZE ANALYSIS

| | |
|---|---|
| Project | WATTS BAR NP |
| Feature | Soil Supported Structures |
| Boring No. | US-125 |
| Sample No. | 3 Pt 2 |
| Station | 104.35 |
| Range | 382.5E |
| Date | 8-3-73 |
| Elevation | 706.8-705.8 |

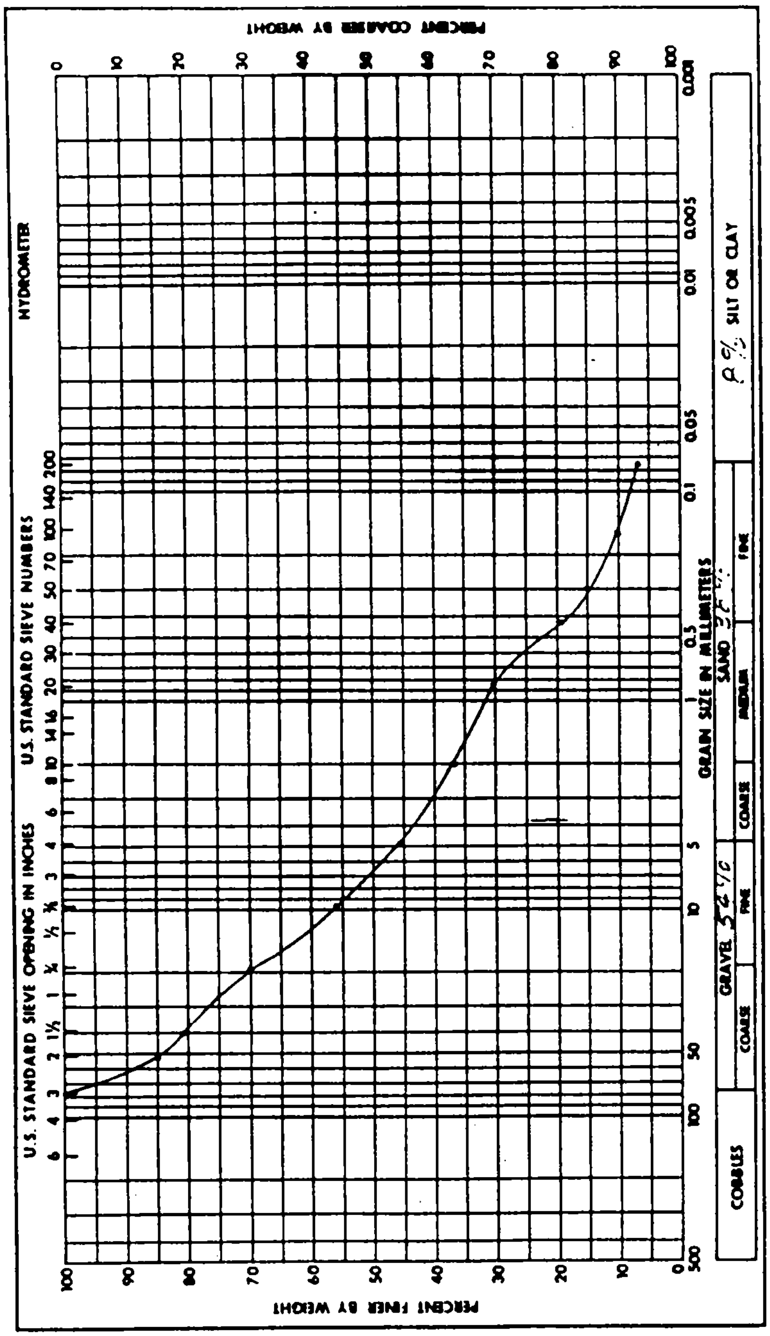
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | GW | Liquid Limit, % | NP |
| Moisture Content, % | 11.1 | Plastic Limit, % | NP |
| Specific Gravity | 2.58 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

**SOIL SUPPORTED STRUCTURES**
**FIGURE 2.5-367**




| | |
|---|---|
| Project | WATTS BAR LP |
| Feature | Soils Supported Structure |
| Boring No. US-184 | Sample No. 4 R1 |
| Station 184.5N | Range 379.9E |
| Date 8-31-79 | Elevation 709.6-709.1 |

**GRAIN SIZE ANALYSIS**

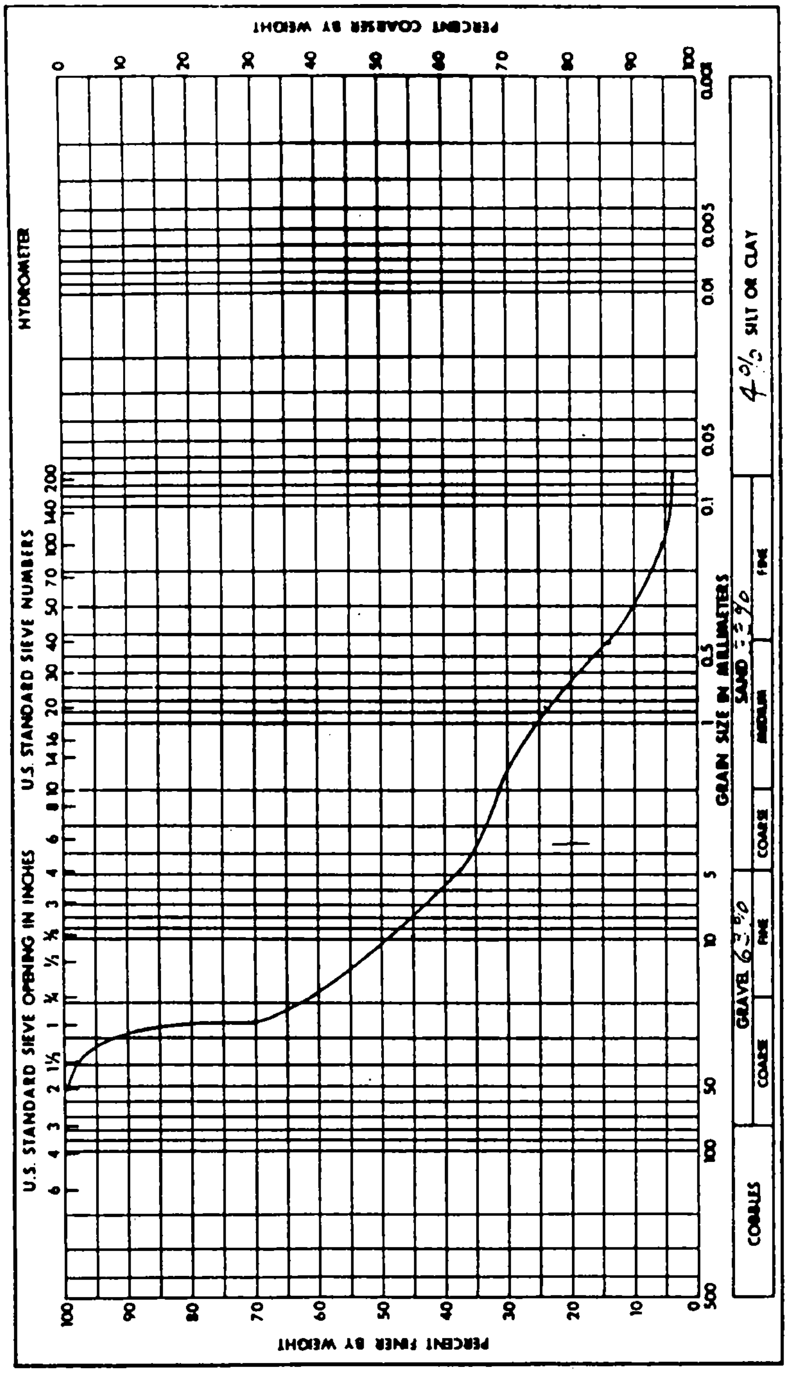
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | GP-GM | Liquid Limit, % | NP |
| Moisture Content, % | 9.1 | Plastic Limit, % | NP |
| Specific Gravity | 2.61 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL SUPPORTED STRUCTURES**
**FIGURE 2.5-368**




| | |
|---|---|
| Project WATTS BAR N.P. | |
| Feature SOIL SUPPORTED STRUCTURES | |
| Boring No. US-127 | Sample No. 1 |
| Station 235.8N | Range 117.5E |
| Date 6-6-73 | Elevation 742-709.6 |

**GRAIN SIZE ANALYSIS**

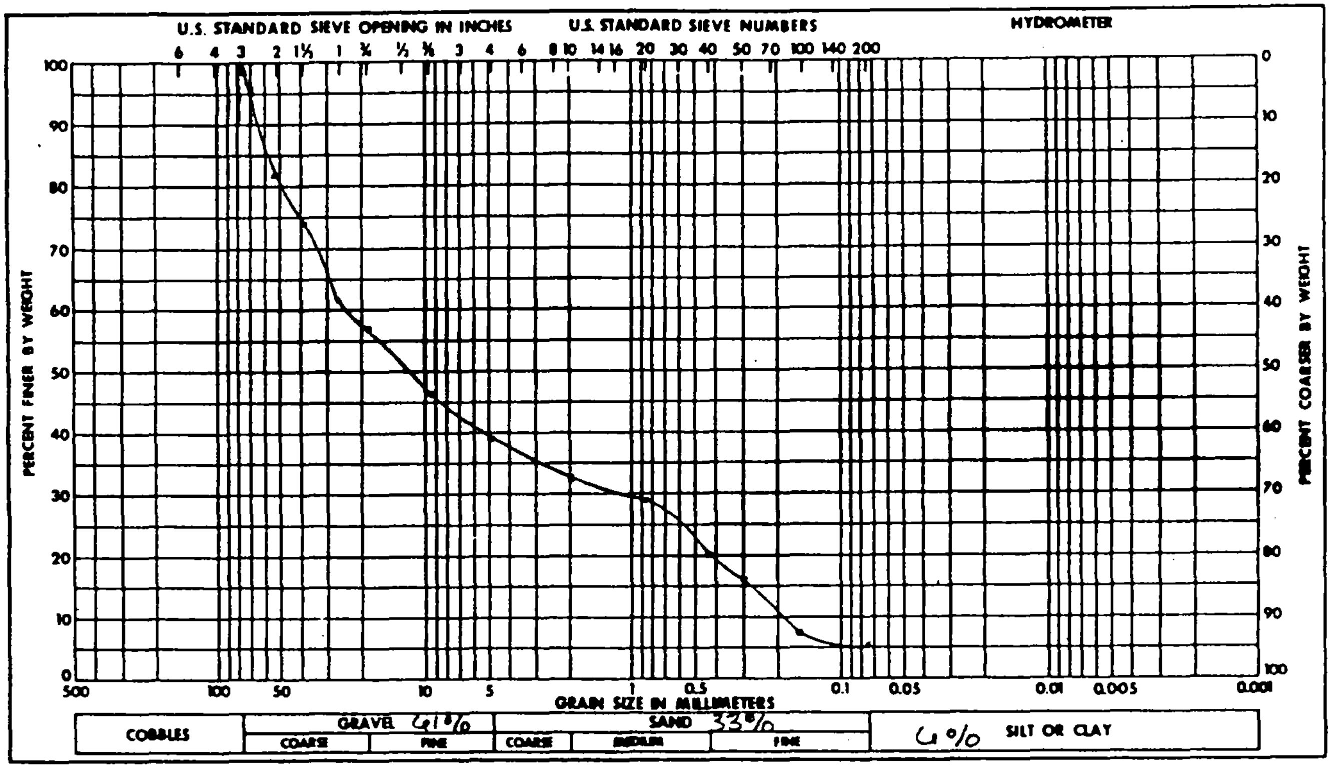
Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | GP | Liquid Limit, % | NP |
| Moisture Content, % | 7.8 | Plastic Limit, % | NP |
| Specific Gravity | 2.58 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL SUPPORTED STRUCTURES**
**FIGURE 2.5-369**




| | | | |
|---|---|---|---|
| Soil Symbol | GP-GM | Liquid Limit, % | NP |
| Moisture Content, % | 8.6 | Plastic Limit, % | NP |
| Specific Gravity | 2.62 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

**Remarks:**

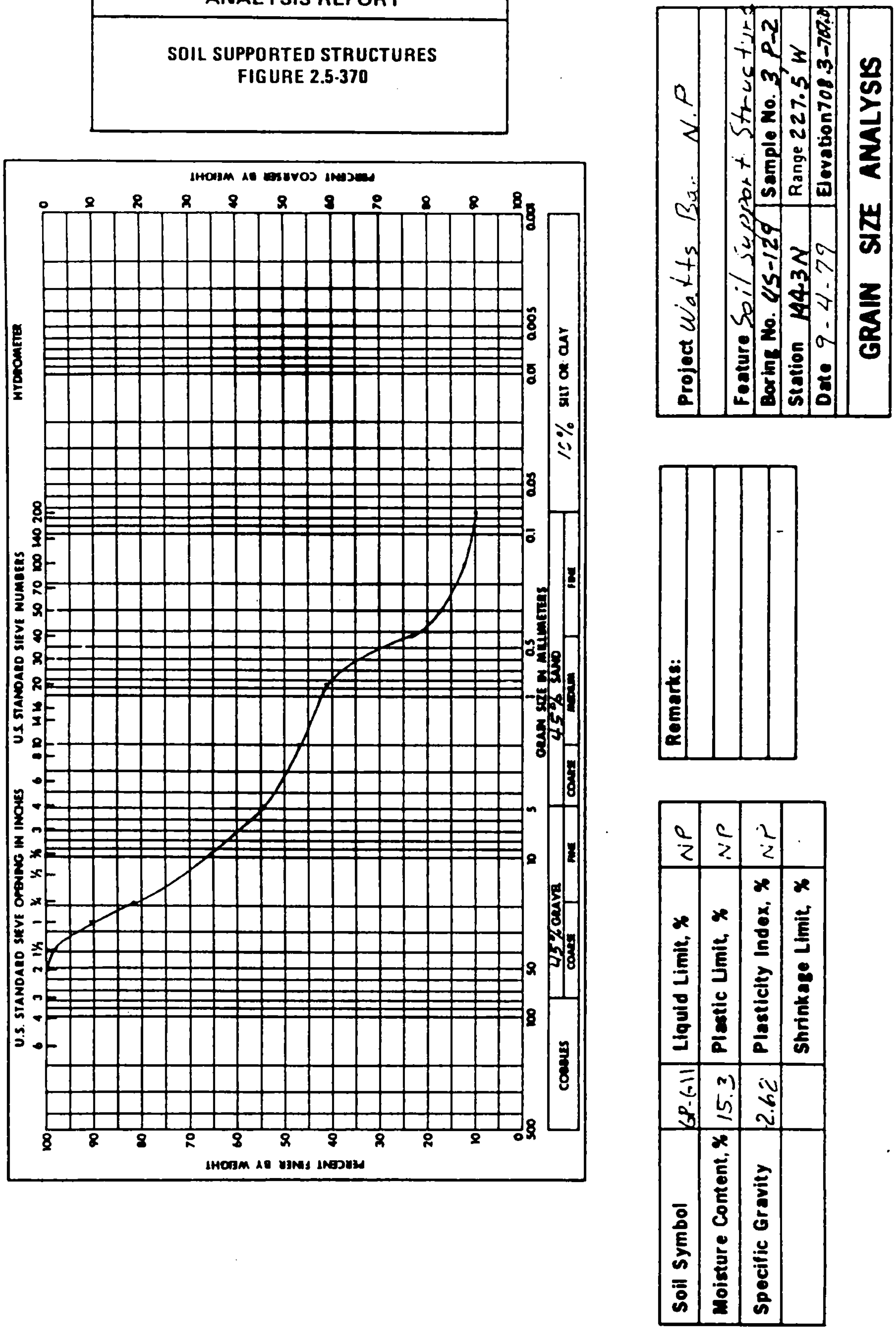
| | |
|---|---|
| Project WATTS BAR-UP | |
| Feature Soil Supported Structures | |
| Boring No. US-128 | Sample No. 2 |
| Station 191.3N | Range 7.5W |
| Date 8-31-79 | Elevation 710.1-708.1 |

**GRAIN SIZE ANALYSIS**

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

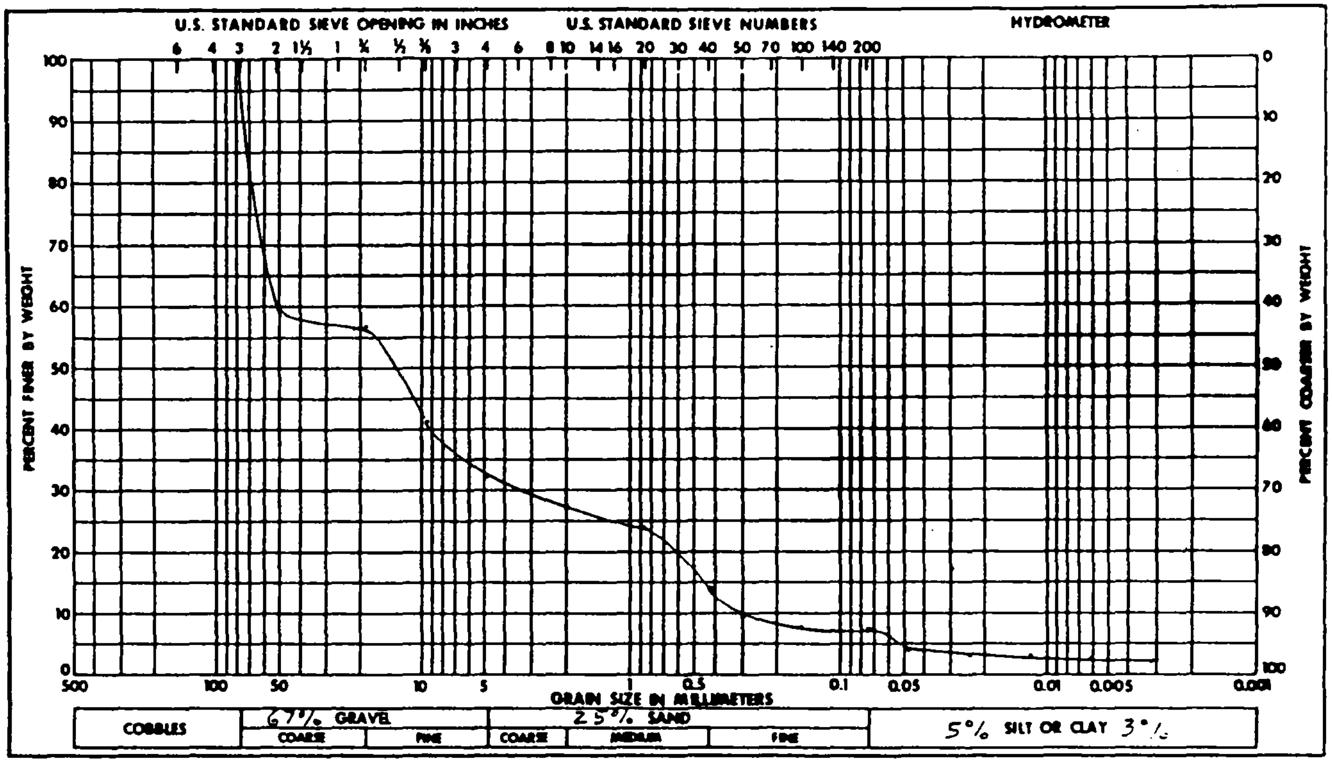
**SOIL SUPPORTED STRUCTURES**
**FIGURE 2.5-370**



HISTORICAL

**WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT**

**SOIL SUPPORTED STRUCTURES
FIGURE 2.5-371**

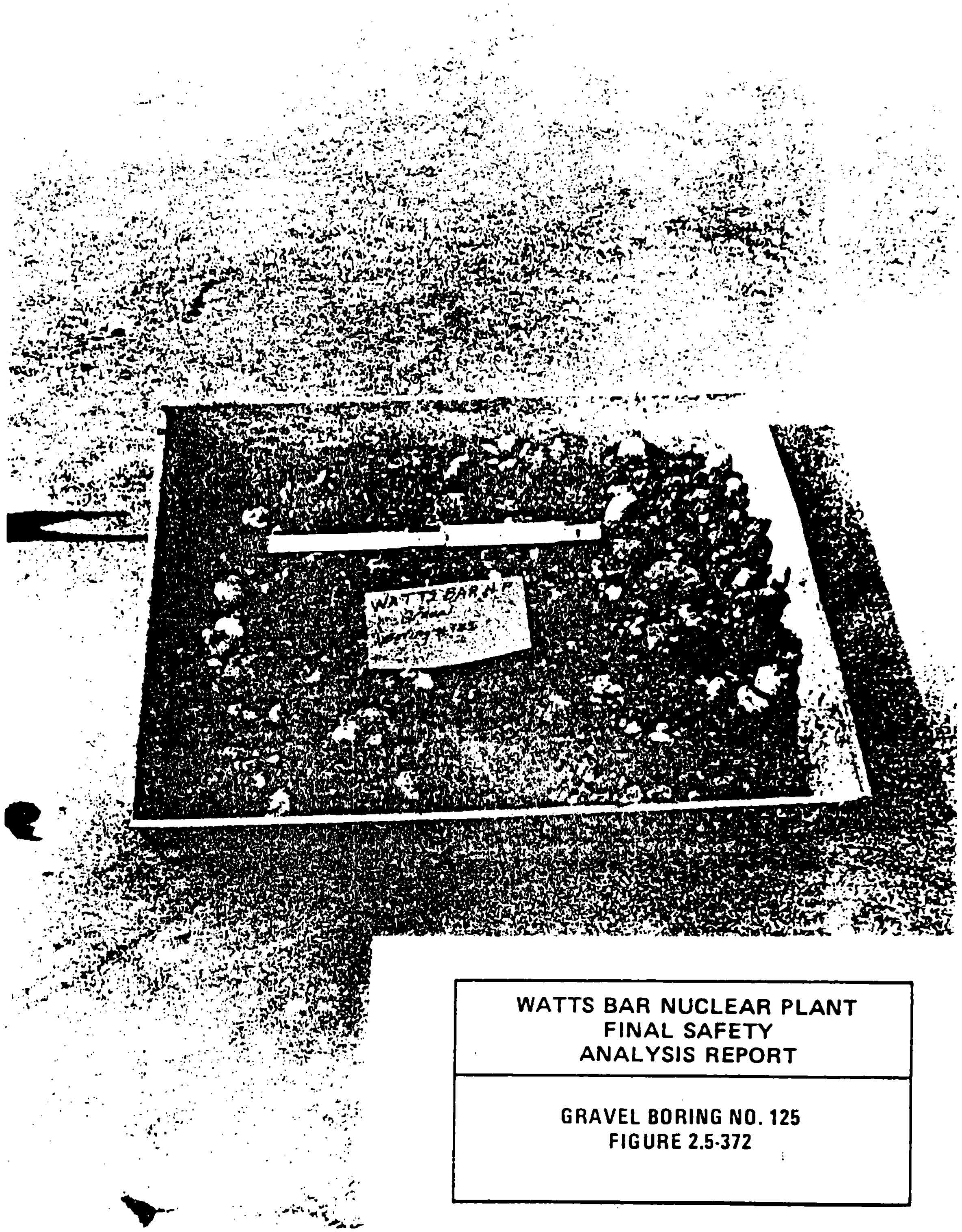



| | | | |
|---|---|---|---|
| Soil Symbol | GP-GM | Liquid Limit, % | NP |
| Moisture Content, % | 8.8 | Plastic Limit, % | NP |
| Specific Gravity | 2.59 | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | -- |

| |
|---|
| Remarks: |

| | |
|---|---|
| Project WATTS BLF N.P | |
| Feature Soil Supported Structure | |
| Boring No. US-130 | Sample No. 2 P-2 |
| Station 95+75 | Range 142.5 W |
| Date 9-4-79 | Elevation 709.7-709.4 |

**GRAIN SIZE ANALYSIS**



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

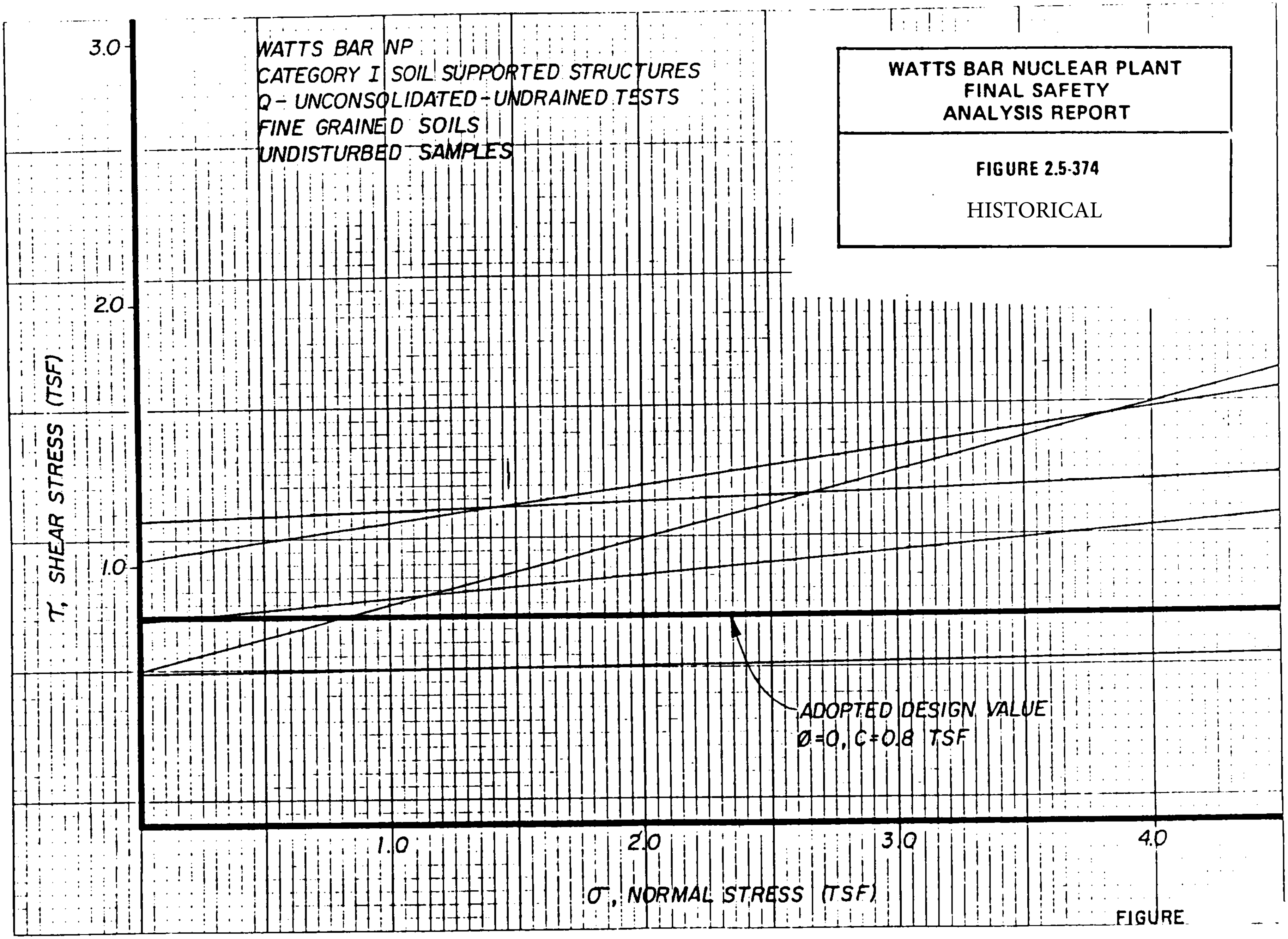
GRAVEL BORING NO. 125
FIGURE 2.5-372

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

GRAVEL BORING NO. 129
FIGURE 2.5-373

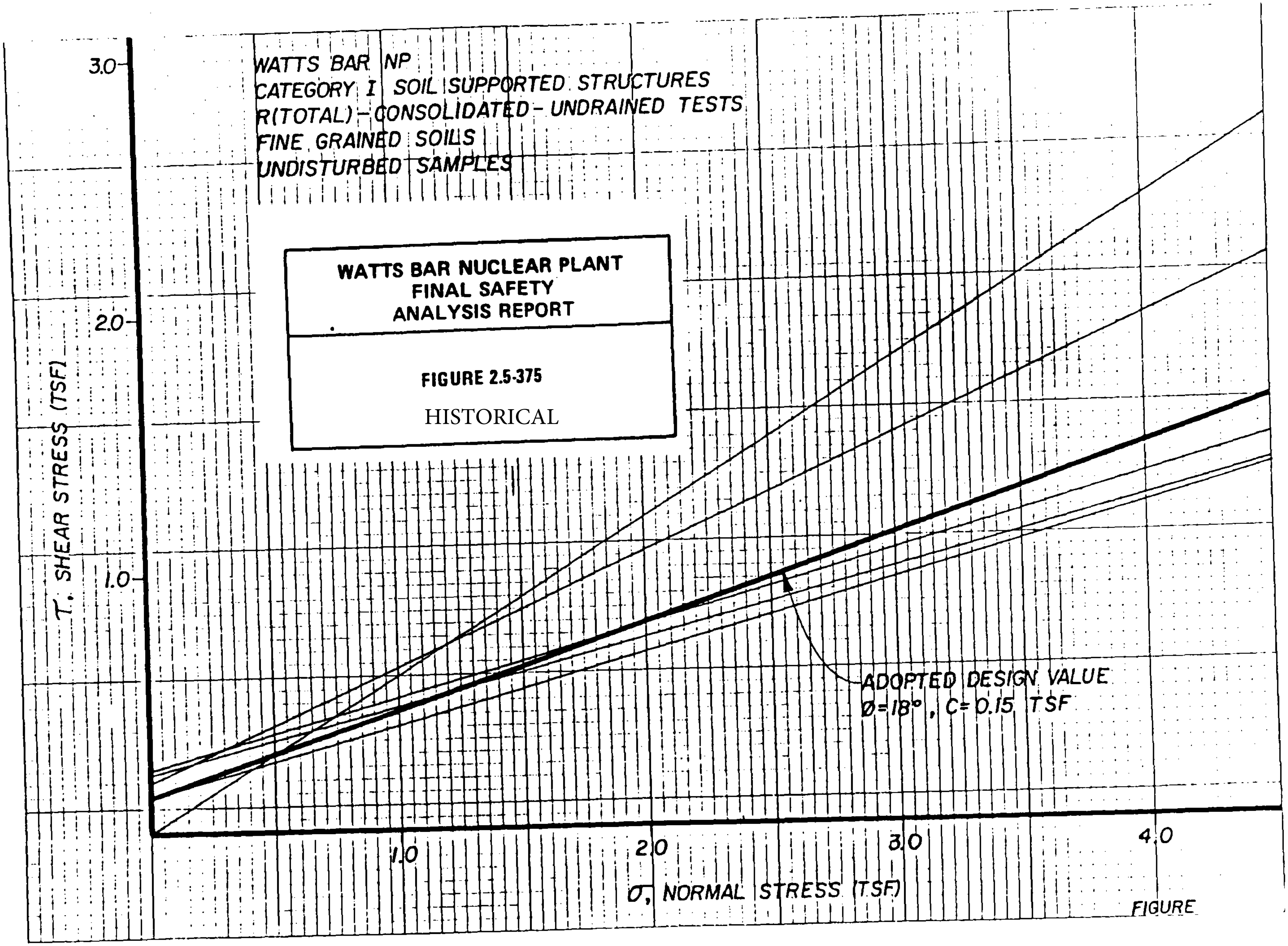
HISTORICAL




**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**FIGURE 2.5-374**

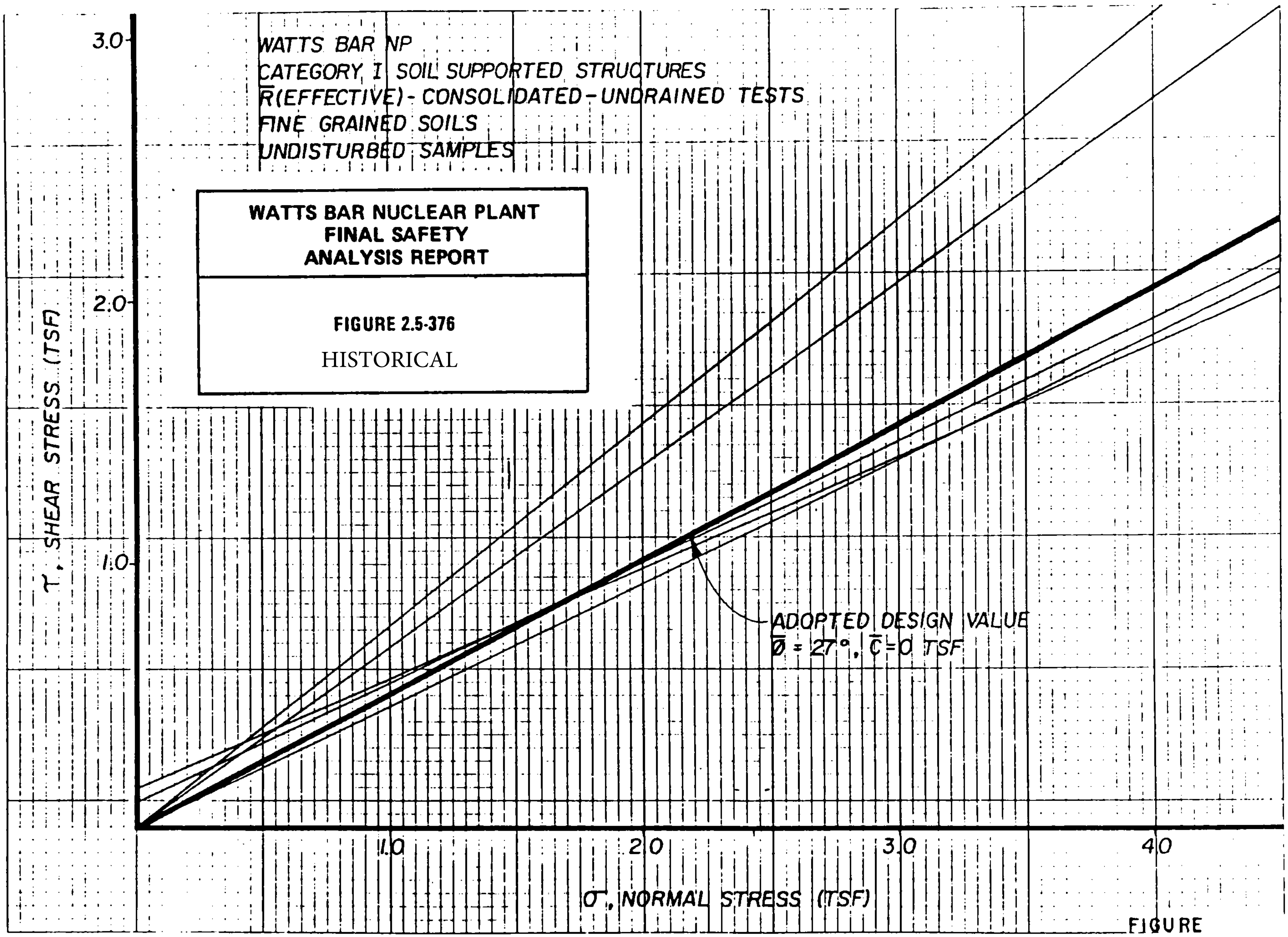
HISTORICAL




**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**FIGURE 2.5-375**

HISTORICAL




**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**FIGURE 2.5-376**

HISTORICAL

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-377
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-1 STATION: 8+65.2 RANGE: SURFACE EL: 730.2
DATE DRILLED: 5/30/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | TOPSOIL |
| | | | SC | 12.2 | 29 | 12 | GV CL, BRN, MST, SP FL |
| 5 | 725 | | | | | | |
| | | | SC | 13.0 | 29 | 12 | GV CL, BRN, V MST, SP FL |
| 10 | 720 | | | | | | |
| | | | | 8.8 | | | (SHALE SHOTROCK) CL GV, GY, MST, SP FL |
| 15 | 715 | | | | | | |
| | | | | 7.3 | | | (SHALE SHOTROCK) CL GV, GY, MST, SP FL |
| 20 | 710 | | | | | | |
| | | | SC-SM | 25.8 | 29 | 7 | SD SI, R-BRN, MST, MIC, ALL ORIG SOIL |
| 25 | 705 | | | | | | |
| | | | SM | 16.5 | NP | NP | SI SD, R-BRN, V MST, ALL |
| | | | CL | 10.6 | 33 | 14 | SI SD, ±20% GV, R-BRN, W, ALL |
| | | | | | | | ROU AUGG - GV |
| | | | | 26.3 | | | WEATHERED SHALE |
| 30 | 700 | | | | | | DISCONTINUED. EL 700.7 |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-378
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-2 STATION: 7+00 RANGE: SURFACE EL: 733.4
DATE DRILLED: 5/27/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 5 | 730 | | SC | 11.8 | 30 | 13 | SD GV, BRN-GY, WOOD, MST, SP FL |
| 10 | 725 | | SC | 10.3 | 30 | 13 | SD GV, BRN; WOOD, WIRE & PLASTIC DBR, MST, SP FL |
| 15 | 720 | | SC | 12.1 | 30 | 13 | GV SI CL, BRN, MST, SP FL |
| | 715 | | SC | 20.3 | 30 | 13 | SI CL, TR GV, BRN, V MST, SP FL |
| 20 | | | SC | 16.2 | 30 | 13 | GV CL, BRN, MST, SP FL |
| 25 | 710 | | SC | 22.0 | 30 | 13 | SI CL, BRN, MST, ALL, ORIG SOIL |
| 30 | 705 | | SM-SC | 32.5 | 27 | 5 | SD SI, R-BRN, V MST, ALL, MIC |
| 35 | 700 | | SM-SC | 32.3 | 27 | 5 | SD SI, R BRN, V MST, ALL, MIC |
| 1''=5' | | * Lab. Classif. | | 18.1 | | | WEATHERED SHALE |
| | | | | | | | DISCONTINUED EL 697.2 |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-379
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-3 STATION: 5+50 RANGE: SURFACE EL: 728.9
DATE DRILLED: 5/27/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | SPOIL FILL |
| 5 | 725 | | SC | 12.0 | 30 | 13 | GV CL, BRN-GY, MST, WOOD, SP FL |
| | | | CL | 15.5 | 33 | 14 | SI CL, BRN, MST, SP FL |
| 10 | 720 | | SC | 22.6 | 30 | 13 | SI CL - FT CL MIX, BRN-GY, V MST, SP FL |
| 15 | 715 | | SC | 18.9 | 30 | 13 | SI CL, BRN, MST, ALL, ORIG SOIL |
| 20 | 710 | | SC | 20.0 | 30 | 13 | SI CL, BRN, MST, ALL |
| 25 | 705 | | SC | 18.8 | 30 | 13 | SI CL, BRN, V MST, ALL |
| 30 | 700 | | SM-SC | 24.5 | 29 | 7 | CL SI SD, BRN, W, ALL |
| | | | CH | 34.9 | 54 | 35 | FT CL, GY, V MST, MIC, ALL |
| | | | | 17.6 | | | WEATHERED SHALE |
| 35 | 695 | | | | | | DISCONTINUED. EL 696.5 |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-380
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-4 STATION: 4+00 RANGE: SURFACE EL: 720.5
DATE DRILLED: 5/27/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | SOD - TOPSOIL |
| | | | SC | 10.4 | 25 | 8 | GV CL SD, GY-R, MST, SP FL |
| 5 | 715 | | | | | | |
| | | | SC | 11.2 | 25 | 8 | GV CL SD, GY-R, MST, SP FL |
| 10 | 710 | | | | | | |
| | | | CL | 17.7 | 27 | 11 | SI SD, GY, V MST, ALL |
| 15 | 705 | | CL | 20.1 | 27 | 11 | SI SD CL, BRN, W, ALL |
| | | | CL | 20.5 | 27 | 11 | SD CL, TR GV, BRN, V MST, ALL |
| 20 | 700 | | | | | | |
| | | | SP-SM | 28.3 | NP | NP | SI SD, BRN, W, ALL |
| | | | | | | | REFUSAL - SHALE. EL 698.5 |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-381**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-5 STATION: 2+50 RANGE: SURFACE EL: 712.3
DATE DRILLED: 5/31/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 710 | | CL | 21.1 | 36 | 16 | SI CL, BRN, MST, ALL |
| 5 | | | | | | | |
| | 705 | | CL | 23.0 | 36 | 16 | SI CL, BRN, MST, ALL |
| 10 | | | | | | | |
| | 700 | | CL | 22.7 | 36 | 16 | SI CL, BRN, MST, ALL |
| 15 | | | CL | 22.9 | 36 | 16 | SI CL, TR RD GV, BRN, MST, ALL |
| | 695 | | CL | 20.0 | 36 | 16 | SI CL, TR RD GV, BRN, V MST, ALL |
| 20 | | | | | | | |
| | 690 | | CL | 20.8 | 27 | 11 | SI CL, DK BRN, V MST, ALL |
| 25 | | | CL | 26.2 | 27 | 11 | CL SI, DK BRN, W, ALL |
| | | | | 17.9 | | | WEATHERED SHALE |
| | 685 | | | | | | DISCONTINUED. EL 685.8 |
| 30 | | | | | | | |
| | 680 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-382**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH A
BORING: PAH-6 STATION: 1+00 RANGE: SURFACE EL: 707.1
DATE DRILLED: 5/31/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | CL | 17.7 | 33 | 14 | GV CL, BRN, MST, SP FL |
| 5 | | | | | | | |
| | 700 | | SM-SC | 22.4 | 29 | 7 | SD CL, TN, MST, ALL (ORIG SOIL) |
| 10 | | | | | | | |
| | 695 | | SM-SC | 23.7 | 29 | 7 | SD CL, TN V MST, ALL |
| 15 | | | SM-SC | 35.8 | 27 | 5 | CL SD, TR RD FN GV, TN, W, ALL |
| | 690 | | | | | | |
| | | | | 17.8 | | | WEATHERED SHALE |
| 20 | | | | | | | DISCONTINUED. EL 688.1 |
| | 685 | | | | | | |
| 25 | | | | | | | |
| | 680 | | | | | | |
| 30 | | | | | | | |
| | 675 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-383**
**SHEET 1 OF 2**

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-1 STATION: 1+00 ℄ RANGE: SURFACE EL: 712.0
DATE DRILLED: 5/31/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 710 | | CL | 18.4 | 26 | 8 | SD SI CL, BRN, MST, FL |
| 5 | | | CL | 14.7 | 35 | 13 | SI CL, BRN, MST, TR GV, FL |
| | 705 | | CL | 17.2 | 35 | 13 | SD CL, BRN, MST, ALL (ORIG SOIL) |
| 10 | | | | | | | |
| | 700 | | CL | 20.6 | 26 | 8 | SD CL, BRN, MST, ALL |
| 15 | | | | | | | |
| | 695 | | CL | 25.0 | 26 | 8 | SI CL, BRN, MST, ALL |
| 20 | | | | | | | |
| | 690 | | SM | 25.1 | 27 | 3 | ALT STRATA - SI SD & CL SI, TN-BRN, V MST, ALL |
| 25 | | | | | | | |
| | 685 | | SM | 30.2 | NP | NP | ALT STRATA - SI SD & CL SI, TN-BRN, W, ALL |
| 30 | | | SM | 26.7 | NP | NP | SI SD, GY-TN, V MST, ALL |
| | 680 | | | | | | |
| 35 | | | SM | 21.0 | NP | NP | SI SD, TN, V MST, ALL |
| 1''=5' | | * Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-383
SHEET 2 OF 2

PROJECT: WATTS BAR N.P.    FEATURE: ERCW TRENCH B
BORING: PAH-1    STATION: 1+00    RANGE:    SURFACE EL: 712.0
DATE DRILLED: 5/31/83 TO    PREPARED BY: MHD    CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 675 | | | | | | |
| | | | SP-SM | 10.6 | NP | NP | SD GV, BRN, V MST, ALL |
| 40 | | | | | | | |
| | | | | | | | BASEL GRAVEL |
| | 670 | | | 10.3 | | | WEATHERED SHALE |
| | | | | | | | DISCONTINUED. EL 669.5 |
| 45 | | | | | | | |
| | 665 | | | | | | |
| 50 | | | | | | | |
| | 660 | | | | | | |
| 55 | | | | | | | |
| | 655 | | | | | | |
| 60 | | | | | | | |
| | 650 | | | | | | |
| 65 | | | | | | | |
| | 645 | | | | | | |
| 70 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-384
SHEET 1 OF 2

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-2 STATION: 2+25 RANGE: SURFACE EL: 713
DATE DRILLED: 6/1/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 710 | | | | | | |
| 5 | | | CL | 19.2 | 35 | 13 | SI CL, TR GV, BRN, MST, FL |
| | 705 | | | | | | |
| 10 | | | CL | 21.3 | 35 | 13 | SI CL, BRN, MST, ALL |
| | 700 | | | | | | |
| 15 | | | CL | 24 | 35 | 13 | SI CL, BRN, MST, ALL |
| | 695 | | | | | | |
| 20 | | | SM-SC | 27.4 | 31 | 8 | CL SD, BRN, W, ALL |
| | 690 | | | | | | |
| 25 | | | SM | 27.5 | NP | NP | ALT STRATA - SI SD & CL SI, TN-BRN, V MST, ALL |
| | 685 | | SM | 26.7 | NP | NP | ALT STRATA - SI SD & CL SI, TN-BRN, V MST, ALL |
| 30 | | | | | | | |
| | 680 | | SP-SM | | NP | NP | |
| 35 | | | | 17.3 | | | GV SD, BRN-TN, W, ALL |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-384
SHEET 2 OF 2

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-2 STATION: 2+25 RANGE: SURFACE EL: 713
DATE DRILLED: 6/1/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 675 | | | 12.8 | | | WEATHERED SHALE |
| 40 | | | | | | | DISCONTINUED. EL 674.0 |
| | 670 | | | | | | |
| 45 | | | | | | | |
| | 665 | | | | | | |
| 50 | | | | | | | |
| | 660 | | | | | | |
| 55 | | | | | | | |
| | 655 | | | | | | |
| 60 | | | | | | | |
| | 650 | | | | | | |
| 65 | | | | | | | |
| | 645 | | | | | | |
| 70 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-385
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-3 STATION: 3+50 RANGE: SURFACE EL: 701.3
DATE DRILLED: 6/1/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 700 | | SM-SC | 24.2 | 31 | 8 | SD SI CL, BRN, MST, ALL |
| 5 | 695 | | SM | 37.0 | 28 | 4 | SD SI, BRN, V MST, ALL |
| 10 | 690 | | SM-SC | 26.4 | 31 | 8 | SD SI, TN, V MST, ALL |
| 15 | | | SM | 29.2 | 28 | 4 | SI SD, R-TN, V MST, ALL |
| | 685 | | | 20.3 | | | WEATHERED SHALE |
| | | | | | | | DISCONTINUED. EL 684.8 |
| 20 | 680 | | | | | | |
| 25 | 675 | | | | | | |
| 30 | 670 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-386
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-4 STATION: 4+75 RANGE: SURFACE EL: 700.4
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 700 | | | | | | |
| | | | CL | 28.2 | 26 | 8 | SD SI CL, GY, W, ALL |
| 5 | 695 | | | | | | |
| | | | SM | 18.0 | NP | NP | SD SI, GY, W, ALL |
| 10 | 690 | | CL-ML | 26.7 | 23 | 5 | SD SI, GY, W, ALL |
| | | | | 24.9 | | | WEATHERED SHALE |
| | | | | | | | DISCONTINUED. EL 688.9 |
| 15 | 685 | | | | | | |
| 20 | 680 | | | | | | |
| 25 | 675 | | | | | | |
| 30 | 670 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-387
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW TRENCH B
BORING: PAH-5 STATION: 6+00 RANGE: SURFACE EL: 702.7
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 700 | | CL | 20.6 | 26 | 8 | SD SI CL, TN-GY, MST, ALL |
| 5 | | | | | | | |
| | 695 | | CL | 30 | 26 | 8 | SL SD SI, TN-GY, V MST, ALL |
| 10 | | | CL | 22.9<br>15.3 | 30 | 13 | LAM RESD CL, MST<br>WEATHERED SHALE |
| | 690 | | | | | | DISCONTINUED. EL 691.2 |
| 15 | | | | | | | |
| | 685 | | | | | | |
| 20 | | | | | | | |
| | 680 | | | | | | |
| 25 | | | | | | | |
| | 675 | | | | | | |
| 30 | | | | | | | |
| | 670 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-388
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-1 STATION: 1592.0E RANGE: 190.6S SURFACE EL: 738.8
DATE DRILLED: 06/02/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL - GV |
| | | | CL | 15.3 | 28 | 13 | SI CL, TR GV, TN, MST, FL |
| 5 | 735 | | | | | | |
| | | | ML | 22.0 | 43 | 14 | SI CL, R, MST, ALL |
| 10 | 730 | | | | | | |
| | | | ML | 24.0 | 41 | 14 | SI CL, R-BRN, MST, ALL |
| 15 | 725 | | | | | | DISCONTINUED. EL 723.8 |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-389
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-2 STATION: 1618.7E RANGE: 323.5S SURFACE EL: 740.4
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | TOPSOIL |
| | | | ML | 18.8 | 43 | 14 | SI CL, GY-TN, MOTT, MST, ALL |
| 5 | 735 | | ML | 24.6 | 41 | 14 | SI CL, R, MST, ALL |
| 10 | 730 | | ML | 23.2 | 41 | 14 | SD CL, R, MST, ALL |
| 15 | 725 | | | | | | DISCONTINUED. EL 725.4 |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-390
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-3 STATION: 1605.2E RANGE: 465.2S SURFACE EL: 742.1
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 740 | | | | | | |
| 5 | | | ML | 21.4 | 43 | 14 | SD SI CL, R, MST, ALL |
| | 735 | | | | | | |
| 10 | | | ML | 24.4 | 41 | 14 | SD SI CL, R, MST, ALL |
| | 730 | | ML | 18.4 | 41 | 14 | SD CL, R-BRN, MST, ALL |
| 15 | | | | | | | |
| | 725 | | | | | | DISCONTINUED. EL 727.1 |
| 20 | | | | | | | |
| | 720 | | | | | | |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-391A
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-4 STATION: 1606.0E RANGE: 616.6S SURFACE EL: 743.3
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL - MIXED W/GRAVEL |
| 5 | 740 | | ML | 20.3 | 43 | 14 | SD SI, R, MST, ALL |
| 10 | 735 | | ML | 23.2 | 41 | 14 | SD SI CL, R, MST, ALL |
| 15 | 730 | | ML | 21.0 | 41 | 14 | SD SI CL, R, MST, ALL |
| | | | | | | | DISCONTINUED. EL 728.3 |
| 20 | 725 | | | | | | |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-392
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-5 STATION: 1604.9E RANGE: 767.3S SURFACE EL: 737.8
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 735 | | CL | 18.5 | 33 | 17 | SI CL, BRN, MST, ALL |
| 5 | | | | | | | |
| | | | CL | 20.8 | 33 | 17 | SI CL, BRN, MST, ALL |
| | 730 | | | | | | |
| 10 | | | | | | | |
| | | | ML | 22.9 | 43 | 14 | SD CL SI, R, MST, ALL |
| | 725 | | | | | | |
| 15 | | | | | | | DISCONTINUED. EL 723.8 |
| | 720 | | | | | | |
| 20 | | | | | | | |
| | 715 | | | | | | |
| 25 | | | | | | | |
| | 710 | | | | | | |
| 30 | | | | | | | |
| | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-393
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-6 STATION: 1576.3E RANGE: 902.2S SURFACE EL: 735.6
DATE DRILLED: 6/2/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | | | | | TOPSOIL |
| 5 | | | CL | 15.4 | 29 | 14 | SI CL, TN-BRN, MST, FL |
| | 730 | | CL | 20.4 | 33 | 17 | (BURIED TOPSOIL) SI TO SI CL, TN-BRN, MST-V MST, ALL |
| 10 | 725 | | ML | 24.0 | 43 | 14 | SI CL, BRN, MST, ALL |
| 15 | 720 | | | | | | DISCONTINUED. EL 720.6 |
| 20 | 715 | | | | | | |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-394
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-7 STATION: 1730.2E RANGE: 160.1S SURFACE EL: 735.7
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | | | | | TOPSOIL |
| | | | CL | 16.3 | 29 | 14 | SI CL, BRN, MST, ALL |
| 5 | 730 | | | | | | |
| | | | CL | 17.8 | 33 | 17 | SI CL, GY, MST, ALL |
| 10 | 725 | | | | | | |
| | | | CL | 20.4 | 33 | 17 | SI CL, GY, MST, ALL |
| | | | ML | 14.6 | 41 | 14 | SD SI, GY, MST, ALL |
| 15 | 720 | | | | | | |
| | | | | | | | DISCONTINUED. EL 720.7 |
| 20 | 715 | | | | | | |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-395
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.  FEATURE: ERCW BORROW AREA 9
BORING: PAH-8  STATION: 1785.7E  RANGE: 290.0S  SURFACE EL: 737.3
DATE DRILLED: 6/3/83  TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 735 | | CL | 20.3 | 28 | 13 | SI CL, TN, MST, ALL |
| 5 | | | | | | | |
| | 730 | | CL | 18.8 | 35 | 17 | SI CL, BRN, MST, ALL |
| 10 | | | | | | | |
| | 725 | | ML | 20.5 | 41 | 14 | SI CL, R, MST, ALL |
| 15 | | | | | | | DISCONTINUED. 723.3 |
| | 720 | | | | | | |
| 20 | | | | | | | |
| | 715 | | | | | | |
| 25 | | | | | | | |
| | 710 | | | | | | |
| 30 | | | | | | | |
| | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-396
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-9 STATION: 1802.0E RANGE: 439.7S SURFACE EL: 740.0
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | |
| | | | CL | 13.6 | 28 | 13 | SI CL, BRN, MST, ALL |
| 5 | 735 | | | | | | |
| | | | CL | 23.0 | 43 | 14 | SI CL, R, MST, ALL |
| 10 | 730 | | | | | | |
| | | | ML | 20.9 | 41 | 14 | SD SI CL, R, MST, ALL |
| 15 | 725 | | | | | | DISCONTINUED. EL 726.0 |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-397
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.  FEATURE: ERCW BORROW AREA 9
BORING: PAH-10  STATION: 1787.1E  RANGE: 584.7S  SURFACE EL: 744.2
DATE DRILLED: 6/3/83  TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | CL | 13.2 | 28 | 13 | SI CL, TR GV, BRN, MST, FL |
| 5 | 740 | | | | | | |
| | | | CL | 17.7 | 29 | 14 | SI CL, BRN, MST, ALL (ORIG SOIL) |
| 10 | 735 | | | | | | |
| | | | ML | 22.8 | 43 | 14 | SI CL, R, MST, ALL |
| 15 | 730 | | | | | | DISCONTINUED. EL 730.2 |
| 20 | 725 | | | | | | |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-398
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-11 STATION: 1750.5E RANGE: 726.7S SURFACE EL: 740.9
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | TOPSOIL |
| | | | CL | 16.8 | 29 | 14 | SI CL, BRN, MST, ALL |
| 5 | 735 | | CL | 18.1 | 33 | 17 | SI CL, BRN, MST, ALL |
| 10 | 730 | | CL | 19.8 | 35 | 17 | SI CL, BRN, V MST, ALL |
| | | | ML | 22.3 | 43 | 14 | SD SI, BRN, V MST, ALL |
| 15 | 725 | | | | | | DISCONTINUED. EL 725.9 |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-399
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: ERCW BORROW AREA 9
BORING: PAH-12 STATION: 1708.3E RANGE: 866.6S SURFACE EL: 739.1
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | CL | 13.7 | 28 | 13 | SI CL, BRN, MST, ALL |
| 5 | 735 | | | | | | |
| | | | CL | 25.1 | 35 | 17 | SI CL, BRN, V MST, ALL |
| 10 | 730 | | | | | | |
| | | | CL | 22.4 | 35 | 17 | SI CL, BRN, V MST, ALL |
| 15 | 725 | | | | | | DISCONTINUED. EL 725.1 |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

SOIL PROFILE
FIGURE 2.5-400
SHEET 1 OF 1

PROJECT: WATTS BAR N. P. FEATURE: BORROW AREA 10
BORING: PAH-1 STATION: 11+23.2E RANGE: 3+68.2N SURFACE EL: 733.8
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 730 | | CL-ML | 25.2 | 41 | 15 | SI CL, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | 725 | | CL-ML | 24.0 | 41 | 15 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 720 | | CL-ML | 23.9 | 41 | 15 | SI CL, R-BRN, MST, ALL |
| 15 | | | | | | | |
| | 715 | | | | | | |
| 20 | | | | | | | |
| | 710 | | | | | | |
| 25 | | | | | | | |
| | 705 | | | | | | |
| 30 | | | | | | | |
| | 700 | | | | | | APR 13 1988 |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-401
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 10
BORING: CH-2 STATION: 9+72.1E RANGE: 4+08.5N SURFACE EL: 737.2
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | *LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 735 | | CL-ML | 26.1 | 41 | 15 | SI CL, R, MST, ALL |
| 5 | | | | | | | |
| | 730 | | CL-ML | 21.5 | 41 | 15 | SI CL, R, MST, ALL |
| 10 | | | | | | | |
| | 725 | | | | | | |
| 15 | | | | | | | |
| | 720 | | | | | | |
| 20 | | | | | | | |
| | 715 | | | | | | |
| 25 | | | | | | | |
| | 710 | | | | | | |
| 30 | | | | | | | |
| | 705 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

APR 13 1988

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-402
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 10
BORING: CH-3 STATION: 9+84.6E RANGE: 4+91.1N SURFACE EL: 734.5
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL-ML | 22.7 | 41 | 15 | SI CL, BRN, MST, ALL |
| 5 | 730 | | | | | | |
| | | | CL-ML | 27.6 | 45 | 19 | FT CL, BRN, MST, ALL |
| 10 | 725 | | | | | | |
| 15 | 720 | | | | | | |
| 20 | 715 | | | | | | |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | 700 | | | | | | APR. 1 3 1988 |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-403
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 11
BORING: PAH-1 STATION: 6+06.9W RANGE: 1+48.4S SURFACE EL: 736.1
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | ML | 28.1 | 44 | 16 | CL SI, R, MST, ALL |
| 5 | 730 | | ML | 30.4 | 45 | 16 | CI SI, R, MST, ALL |
| 10 | 725 | | ML | 28.7 | 45 | 16 | CL SI, BRN, V MST, ALL |
| 15 | 720 | | | | | | |
| 20 | 715 | | | | | | |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-404
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 11
BORING: PAH-2 STATION: 7+60.1W RANGE: 1+89.0S SURFACE EL: 742.0
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | GRAVEL |
| 5 | 735 | | ML | 27.1 | 44 | 16 | SI CL, R, MST, ALL |
| 10 | 730 | | ML | 33.7 | 45 | 16 | CL SI, R-BRN, MST, ALL |
| 15 | 725 | | ML | 27.9 | 45 | 16 | CL SI, R-BRN, MST, ALL |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-405
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 11
BORING: PAH-3 STATION: 6+93.1W RANGE: 1+15.2S SURFACE EL: 741.9
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | GRAVEL |
| 5 | | | ML | 23.4 | 44 | 16 | SI CL, R-BRN, MST, ALL |
| | 735 | | | | | | |
| 10 | | | ML | 26.7 | 44 | 16 | SI CL, R-BRN, MST, ALL |
| | 730 | | | | | | |
| 15 | | | ML | 23.2 | 44 | 16 | SI CL, BRN, MST, ALL |
| | 725 | | | | | | |
| 20 | | | | | | | |
| | 720 | | | | | | |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-406
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 11
BORING: PAH-4 STATION: 7+16.8W RANGE: 0+83.0S SURFACE EL: 741.1
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | GRAVEL |
| 5 | 735 | | ML | 26.8 | 44 | 16 | CL SI, R-BRN, MST, ALL |
| 10 | 730 | | ML | 27.8 | 44 | 16 | CL SI, R-BRN, MST, ALL |
| 15 | 725 | | ML | 27.0 | 44 | 16 | CL SI, R-BRN, MST, ALL |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-407
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 11
BORING: PAH-5 STATION: 8+39.7W RANGE: 1+40.2S SURFACE EL: 738.7
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | GRAVEL |
| 5 | 735 | | ML | 22.6 | 45 | 16 | SI CL, R-BRN, MST, ALL |
| 10 | 730 | | ML | 26.8 | 49 | 15 | SI CL, R-BRN, MST, ALL |
| 15 | 725 | | ML | 22.8 | 45 | 16 | SD SI CL, BRN, MST, ALL |
| 20 | 720 | | | | | | |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-408
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-1 STATION: RANGE: SURFACE EL: 709.6
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | CL | 25.7 | 40 | 17 | SI CL, BRN, MST, ALL |
| 5 | 705 | | | | | | |
| | | | CL | 27.1 | 40 | 17 | SI CL, BRN, MST, ALL |
| 10 | 700 | | | | | | |
| | | | CL | 26.6 | 40 | 17 | SI CL, BRN, V MST, ALL |
| 15 | 695 | | | | | | DISCONTINUED. |
| 20 | 690 | | | | | | |
| 25 | 685 | | | | | | |
| 30 | 680 | | | | | | |
| 35 | 675 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-409
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-2 STATION: RANGE: SURFACE EL: 708.3
DATE DRILLED: 6/3/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | ML | 24.7 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | 700 | | ML | 27.4 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 695 | | ML | 25.6 | 40 | 13 | SI CL, R-BRN, V MST, ALL |
| 15 | | | | | | | DISCONTINUED. |
| | 690 | | | | | | |
| 20 | | | | | | | |
| | 685 | | | | | | |
| 25 | | | | | | | |
| | 680 | | | | | | |
| 30 | | | | | | | |
| | 675 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-410
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-3 STATION: RANGE: SURFACE EL: 711.5
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 710 | | | | | | |
| 5 | | | CL | 25.1 | 40 | 17 | FT CL, R, MST, ALL |
| | 705 | | ML | 23.7 | 40 | 13 | FT CL, R, MST, ALL |
| 10 | | | | | | | |
| | 700 | | CL | 25.7 | 40 | 17 | SI CL, R-BRN, MST, ALL |
| 15 | | | | | | | |
| | 695 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 690 | | | | | | |
| 25 | | | | | | | |
| | 685 | | | | | | |
| 30 | | | | | | | |
| | 680 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-411
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-4 STATION: RANGE: SURFACE EL: 707.7
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 705 | | ML | 23.2 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | 700 | | ML | 24.1 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 695 | | ML | 25.9 | 40 | 13 | SI CL, BRN, V MST, ALL |
| 15 | | | | | | | |
| | | | | | | | DISCONTINUED. |
| | 690 | | | | | | |
| 20 | | | | | | | |
| | 685 | | | | | | |
| 25 | | | | | | | |
| | 680 | | | | | | |
| 30 | | | | | | | |
| | 675 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-412
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-5 STATION: RANGE: SURFACE EL: 709.7
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | ML | 26.7 | 40 | 13 | FT CL, R, MST, ALL |
| 5 | 705 | | | | | | |
| | | | ML | 23.8 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | 700 | | | | | | |
| | | | ML | 25.2 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 15 | 695 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 20 | 690 | | | | | | |
| 25 | 685 | | | | | | |
| 30 | 680 | | | | | | |
| 35 | 675 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-413
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-6 STATION: RANGE: SURFACE EL: 705.7
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | | | | | TOPSOIL |
| | | | CL | 26.2 | 40 | 17 | FT CL, BRN, MST, ALL |
| 5 | 700 | | | | | | |
| | | | CL | 26.1 | 40 | 17 | FT CL, BRN, MST, ALL |
| 10 | 695 | | | | | | |
| | | | CL | 23.7 | 40 | 17 | SI CL, BRN, MST, ALL |
| 15 | 690 | | | | | | DISCONTINUED. |
| 20 | 685 | | | | | | |
| 25 | 680 | | | | | | |
| 30 | 675 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-414
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-7 STATION: RANGE: SURFACE EL: 706.0
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | | | | | |
| 5 | | | CL | 25.7 | 40 | 17 | FT CL, R-BRN, MST, ALL |
| | 700 | | ML | 25.8 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | 695 | | ML | 23.6 | 40 | 13 | SI CL, BRN, MST, ALL |
| 15 | 690 | | | | | | DISCONTINUED. |
| 20 | 685 | | | | | | |
| 25 | 680 | | | | | | |
| 30 | 675 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-415
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-7 STATION: RANGE: SURFACE EL: 744.0 est
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL | 22.5 | 42 | 18 | FT CL, R, MST, ALL |
| 5 | 740 | | | | | | |
| | | | CL | 24.9 | 42 | 18 | SI CL, R, MST, ALL |
| 10 | 735 | | CL | 20.1 | 35 | 14 | CL SI, TN, MST, RESD |
| 15 | 730 | | CL | 22.0 | 35 | 14 | CL SI, TN, MST, RESD |
| 20 | 725 | | | | | | DISCONTINUED. |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-416**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-8 STATION: RANGE: SURFACE EL: 706.3
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | | | | | TOPSOIL |
| 5 | | | ML | 23.7 | 40 | 13 | FT CL, R, MST, ALL |
| | 700 | | ML | 23.3 | 40 | 13 | SI CL, BRN, MST, ALL |
| 10 | 695 | | CL | 23.5 | 40 | 17 | SI CL, BRN, MST, ALL |
| 15 | 690 | | | | | | DISCONTINUED. |
| 20 | 685 | | | | | | |
| 25 | 680 | | | | | | |
| 30 | 675 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-417**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-9 STATION: RANGE: SURFACE EL: 703.7
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: PA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 700 | | CL | 22.3 | 40 | 17 | SI CL, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | | | ML | 25.6 | 40 | 13 | MD CL, R-BRN, MST, ALL |
| | 695 | | | | | | |
| 10 | | | | | | | |
| | | | ML | 24.6 | 40 | 13 | SI CL, BRN, V MST, ALL |
| | 690 | | | | | | |
| 15 | | | | | | | |
| | | | | | | | DISCONTINUED. |
| | 685 | | | | | | |
| 20 | | | | | | | |
| | 680 | | | | | | |
| 25 | | | | | | | |
| | 675 | | | | | | |
| 30 | | | | | | | |
| | 670 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-418**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-10 STATION: RANGE: SURFACE EL: 706.0
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 705 | | | | | | |
| 5 | | | ML | 25.7 | 40 | 13 | FT CL, R-BRN, MST, ALL |
| | 700 | | SM-SC | 25.1 | 30 | 8 | SI CL, R-BRN, MST, ALL |
| 10 | 695 | | SM-SC | 20.2 | 29 | 6 | SI CL, BRN, MST, ALL |
| 15 | | | | | | | |
| | 690 | | | | | | DISCONTINUED. |
| 20 | 685 | | | | | | |
| 25 | 680 | | | | | | |
| 30 | 675 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-419
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 12
BORING: PAH-11 STATION: RANGE: SURFACE EL: 710.4
DATE DRILLED: 6/6/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 710 | | | | | | |
| | | | ML | 24.9 | 40 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | 705 | | | | | | |
| | | | SM-SC | 21.6 | 29 | 6 | SD SI CL, R-BRN, MST, ALL |
| 10 | 700 | | | | | | |
| | | | SM-SC | 19.5 | 29 | 6 | SI SD, R-BRN, MST, ALL |
| 15 | 695 | | | | | | DISCONTINUED. |
| 20 | 690 | | | | | | |
| 25 | 685 | | | | | | |
| 30 | 680 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-420
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-1 STATION: RANGE: SURFACE EL: 723.1
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 720 | | CL-ML | 21.3 | 35 | 11 | SI CL, BRN, MST, RESD |
| 5 | | | | | | | |
| | 715 | | CL | 23.0 | 43 | 20 | SI CL, BRN, MST, RESD |
| 10 | | | | | | | |
| | 710 | | CL | 22.3 | 43 | 20 | SI CL, BRN, MST, RESD |
| 15 | | | | | | | |
| | 705 | | CL | 20.4 | 43 | 20 | SI CL, BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-421**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-2 STATION: RANGE: SURFACE EL: 728.6
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL, SPOIL GRAVEL |
| 5 | 725 | | CL | 27.6 | 36 | 13 | SI CL, PURP, MST, RESD |
| 10 | 720 | | CL | 23.9 | 36 | 13 | SI CL, PURP, MST, RESD |
| 15 | 715 | | CL | 20.2 | 36 | 13 | SI CL, PURP, MST, RESD |
| 20 | 710 | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |

1''=5'

*Lab. Classif.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-422
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-3 STATION: RANGE: SURFACE EL: 723.4
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | CL-ML | 14.9 | 35 | 11 | SI CL, BRN, MST, RESD |
| 5 | | | | | | | |
| | 715 | | CL | 31.9 | 43 | 20 | SI CL, BRN, SAT, RESD |
| 10 | | | | | | | |
| | 710 | | | | | | DISCONTINUED (WET). |
| 15 | | | | | | | |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-423
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-4 STATION: RANGE: SURFACE EL: 742.1
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 740 | | CL-ML | 14.9 | 35 | 11 | CL SI, BRN, MST, RESD |
| 5 | | | | | | | |
| | 735 | | CL-ML | 22.5 | 35 | 11 | CL SI, BRN, MST, RESD |
| 10 | | | | | | | |
| | 730 | | CL-ML | 25.7 | 45 | 17 | CL SI, BRN, MST, RESD |
| 15 | | | | | | | |
| | 725 | | CL-ML | 28.3 | 45 | 17 | CL SI, BRN, MST, RESD |
| 20 | | | | | | | |
| | 720 | | | | | | DISCONTINUED. |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-424
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-5 STATION: RANGE: SURFACE EL: 723.5
DATE DRILLED: TO PREPARED BY: MHD CHECKED BY: CCG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 720 | | | | | | |
| 5 | | | ML | 22.2 | 42 | 14 | CL SI, BRN, MST, RESD |
| | 715 | | | | | | |
| 10 | | | ML | 23.1 | 42 | 14 | CL SI, BRN, MST, RESD |
| | 710 | | | | | | |
| 15 | | | ML | 20.9 | 42 | 14 | CL SI, BRN, MST, RESD |
| | 705 | | ML | 22.1 | 42 | 14 | CL SI, BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-425
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-6 STATION: RANGE: SURFACE EL: 730.5
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | TOPSOIL |
| 5 | 725 | | ML | 22.3 | 42 | 14 | CL SI, BRN, MST, RESD |
| 10 | 720 | | ML | 15.3 | 42 | 14 | CL SI, BRN, MST, RESD |
| | | | CL | 17.2 | 36 | 13 | CL SI, PUR-BRN, MST, RESD |
| 15 | 715 | | CL | 13.7 | 36 | 13 | CL SI, PUR-BRN, MST, RESD |
| 20 | 710 | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-426
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-7 STATION: RANGE: SURFACE EL: 728.8
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 725 | | CL-ML | 18.1 | 35 | 11 | CL SI, BRN, MST, RESD |
| 10 | 720 | | ML | 19.9 | 42 | 14 | CL SI, LT BRN, MST, RESD |
| 15 | 715 | | CL | 21.5 | 36 | 13 | CL SI, PUR-BRN, MST, RESD |
| 20 | 710 | | CL | 18.0 | 36 | 13 | CL SI, PUR-BRN, MST, RESD |
| | | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |

1''=5'

*Lab. Classif.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-427
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-8 STATION: RANGE: SURFACE EL: 740.1
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | TOPSOIL |
| | | | CL | 22.6 | 36 | 13 | CL SI, BRN, MST, RESD |
| 5 | 735 | | | | | | |
| | | | CL | 24.8 | 36 | 13 | CL SI, BRN, MST, RESD |
| 10 | 730 | | | | | | |
| | | | CL | 24.2 | 36 | 13 | CL SI, BRN, MST, RESD |
| 15 | 725 | | | | | | |
| | | | CL-ML | 21.5 | 45 | 17 | CL SI, BRN, V MST, RESD |
| 20 | 720 | | | | | | DISCONTINUED. |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-428
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-9 STATION: RANGE: SURFACE EL: 714.2
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | CL | 18.9 | 43 | 20 | CL SI, LT BRN, MST, RESD |
| 5 | 710 | | | | | | |
| | | | CL | 20.9 | 43 | 20 | CL SI, LT BRN, MST, RESD |
| 10 | 705 | | | | | | |
| | | | CL-ML | 17.7 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| 15 | 700 | | | | | | |
| | | | CL-ML | 18.0 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| 20 | 695 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-429
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-10 STATION: RANGE: SURFACE EL: 713.0
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | SPOIL FILL |
| | 710 | | | | | | |
| 5 | | | CL-ML | 21.0 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| | 705 | | | | | | |
| 10 | | | CL-ML | 20.8 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| | 700 | | | | | | |
| 15 | | | CL-ML | 16.3 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| | 695 | | CL-ML | 18.5 | 37 | 12 | CL SI, LT BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 690 | | | | | | |
| 25 | | | | | | | |
| | 685 | | | | | | |
| 30 | | | | | | | |
| | 680 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-430
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-11 STATION: RANGE: SURFACE EL: 730.5
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: CBG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | TOPSOIL |
| 5 | 725 | | CL-ML | 21.0 | 35 | 11 | CL SI, BRN, MST, RESD |
| 10 | 720 | | CL-ML | 18.4 | 35 | 11 | CL SI, TR GV, BRN, MST, RESD |
| 15 | 715 | | CL-ML | 17.4 | 35 | 11 | CL SI, BRN, MST, RESD |
| 20 | 710 | | | | | | DISCONTINUED |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-431
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-12 STATION: RANGE: SURFACE EL: 745.8
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: CRG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 745 | | | | | | TOPSOIL |
| | | | CL-ML | 18.2 | 35 | 11 | CL SI, BRN, MST, RESD |
| 5 | 740 | | MH | 25.6 | 52 | 17 | CL SI, BRN, MST, RESD - |
| 10 | 735 | | MH | 27.4 | 52 | 17 | CL SI, TR BENT, BRN, MST, RESD |
| 15 | 730 | | MH | 29.7 | 52 | 17 | CL SI, BRN, MST, RESD |
| 20 | 725 | | | | | | |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-432
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-13 STATION: RANGE: SURFACE EL: 701.0
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: CEG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 700 | | | | | | TOPSOIL, SPOIL |
| | | | ML | 23.1 | 44 | 16 | CL SI, BRN, MST, RESD |
| 5 | 695 | | ML | 19.1 | 44 | 16 | CL SI, BRN, MST, RESD |
| 10 | | | ML | 16.4 | 44 | 16 | SI CL, TR BENT, BRN, MST, RESD |
| | 690 | | | | | | DISCONTINUED. |
| 15 | 685 | | | | | | |
| 20 | 680 | | | | | | |
| 25 | 675 | | | | | | |
| 30 | 670 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-433
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-14 STATION: RANGE: SURFACE EL: 698.9
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: CEG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 695 | | CL-ML | 16.6 | 35 | 11 | CL SI, BRN, MST, RESD |
| 10 | 690 | | CL | 21.3 | 40 | 18 | SI CL, TR BENT, BRN, MST, RESD |
| | | | CL | 22.1 | 40 | 18 | SI CL, TR BENT, BRN, MST, RESD |
| 15 | 685 | | CL | 20.4 | 40 | 18 | SI CL, TR BENT, BRN, MST, RESD |
| 20 | 680 | | | | | | DISCONTINUED. |
| 25 | 675 | | | | | | |
| 30 | 670 | | | | | | |
| 35 | 665 | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

SOIL PROFILE
FIGURE 2.5-434
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-15 STATION: RANGE: SURFACE EL: 733.1
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE, TOPSOIL |
| | 730 | | ML | 26.4 | 44 | 16 | SI CL, TR BENT, BRN, MST, RESD |
| 5 | | | | | | | |
| | 725 | | CL | 28.6 | 40 | 18 | SI CL, TR BENT, BRN, MST, RESD |
| 10 | | | | | | | |
| | 720 | | CL-ML | 18.6 | 35 | 11 | CL SI, BRN, MST, RESD |
| 15 | | | | | | | |
| | 715 | | CL-ML | 20.0 | 35 | 11 | CL SI, BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 710 | | | | | | |
| 25 | | | | | | | |
| | 705 | | | | | | |
| 30 | | | | | | | |
| | 700 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

"HISTORICAL INFORMATION"

SOIL PROFILE
FIGURE 2.5-435
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 13
BORING: PAH-16  STATION:  RANGE:  SURFACE EL: 745.3
DATE DRILLED: 8/26/83 TO  PREPARED BY: MHD  CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 745 | | | | | | TOPSOIL |
| | | | CL-ML | 17.3 | 35 | 11 | CL SI, BRN, MST, RESD |
| 5 | 740 | | | | | | |
| | | | CL-ML | 24.1 | 35 | 11 | CL SI, BRN, MST, RESD |
| 10 | 735 | | | | | | |
| | | | ML | 27.1 | 44 | 16 | CL SI, BRN, MST, RESD |
| 15 | 730 | | | | | | |
| | | | ML | 28.6 | 44 | 16 | CL SI, BRN, MST, RESD |
| 20 | 725 | | | | | | DISCONTINUED. |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-436
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-17 STATION: RANGE: SURFACE EL: 693.0
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 690 | | | | | | |
| 5 | | | ML | 23.5 | 44 | 16 | SI CL, BRN, MST, RESD |
| | 685 | | ML | 25.7 | 44 | 16 | SI CL, BRN-GY, MST, RESD |
| 10 | | | | | | | |
| | | | CL | 19.6 | 40 | 18 | SI CL, BRN-GY, MST, RESD |
| | 680 | | | | | | |
| 15 | | | | | | | DISCONTINUED (GV). |
| | 675 | | | | | | |
| 20 | | | | | | | |
| | 670 | | | | | | |
| 25 | | | | | | | |
| | 665 | | | | | | |
| 30 | | | | | | | |
| | 660 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE FIGURE 2.5-437 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 13
BORING: PAH-18 STATION: RANGE: SURFACE EL: 697.9
DATE DRILLED: 8/26/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 695 | | ML | 19.7 | 44 | 16 | CL SI, BRN, MST, RESD |
| 5 | | | | | | | |
| | 690 | | ML | 26.7 | 44 | 16 | CL SI, TN, MST, RESD |
| 10 | | | | | | | |
| | 685 | | ML | 22.3 | 44 | 16 | CL SI, TN, MST, RESD |
| 15 | | | | | | | |
| | 680 | | ML | 20.3 | 44 | 16 | CL SI, TN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 675 | | | | | | |
| 25 | | | | | | | |
| | 670 | | | | | | |
| 30 | | | | | | | |
| | 665 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| SOIL PROFILE<br>FIGURE 2.5-438<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-1  STATION:  RANGE:  SURFACE EL: 714.2
DATE DRILLED: 6/7/83 TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | CL | 18.2 | 29 | 12 | SI CL, TN-BRN, MST, ALL |
| 5 | 710 | | | | | | |
| | | | SM-SC | 20.5 | 26 | 7 | CL SD, ±20% FN RD GV, TN, V MST, ALL |
| | | | | | | | SD GV, ±40% FN RD GV, ALL |
| 10 | 705 | | | | | | |
| | | | CL | 19.5 | 29 | 12 | FT SI, GRN-GY, MST, RESD |
| 15 | 700 | | | | | | WTH GY SHL |
| | | | | | | | DISCONTINUED. |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-439
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-2 STATION: RANGE: SURFACE EL: 722.1
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 720 | | CL-ML | 27.5 | 38 | 13 | SI CL, R, MST, ALL |
| 5 | | | | | | | |
| | 715 | | CL-ML | 29.6 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 710 | | SC | 27.2 | 34 | 14 | SI CL, R-TN, V MST, ALL |
| 15 | | | SC | 27.9 | 34 | 14 | CL SI SD, BRN, V MST, ALL |
| | 705 | | | | | | W SI SD |
| 20 | | | | | | | DISCONTINUED. |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

PROJECT. WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-3 STATION: RANGE: SURFACE EL: 717.2
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 715 | | CL-ML | 20.6 | 38 | 13 | SI CL, TN, MST, ALL |
| 5 | | | | | | | |
| | 710 | | SC | 24.3 | 34 | 14 | SI CL, TN, MST, ALL |
| 10 | | | SC | 26.1 | 34 | 14 | SD SI CL, TN, V MST, ALL |
| | 705 | | | | | | W SD SI CL |
| | | | | | | | DISCONTINUED. |
| 15 | | | | | | | |
| | 700 | | | | | | |
| 20 | | | | | | | |
| | 695 | | | | | | |
| 25 | | | | | | | |
| | 690 | | | | | | |
| 30 | | | | | | | |
| | 685 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-441
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-4 STATION: RANGE: SURFACE EL: 718
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 715 | | CL | 21.1 | 29 | 12 | SI CL, TN-BRN, V MST, ALL |
| 5 | | | | | | | |
| | 710 | | | | | | DISCONTINUED. |
| 10 | | | | | | | |
| | 705 | | | | | | |
| 15 | | | | | | | |
| | 700 | | | | | | |
| 20 | | | | | | | |
| | 695 | | | | | | |
| 25 | | | | | | | |
| | 690 | | | | | | |
| 30 | | | | | | | |
| | 685 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-442
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-5 STATION: RANGE: SURFACE EL: 723.1
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 720 | | | | | | |
| 5 | | | CL-ML | 19.6 | 42 | 16 | CL SI, TN, MST, ALL |
| | 715 | | | | | | |
| 10 | | | CL | 24.8 | 42 | 18 | CL SI, TN, MST, ALL |
| | 710 | | | | | | |
| 15 | | | | | | | W CL SI |
| | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-443
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-6  STATION:  RANGE:  SURFACE EL: 735.6
DATE DRILLED: 6/8/83  TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | | | | | TOPSOIL |
| | | | CL-ML | 28.4 | 42 | 16 | FT CL, R, MST, ALL |
| 5 | 730 | | | | | | |
| | | | CL | 23.3 | 35 | 14 | SI CL, TN, MST, ALL |
| 10 | 725 | | | | | | |
| | | | CL | 22.7 | 35 | 14 | SI CL, TN, MST, ALL |
| 15 | 720 | | | | | | |
| | | | CL | 22.9 | 31 | 11 | CL SI, TN, V MST, ALL |
| 20 | 715 | | | | | | DISCONTINUED. |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-444
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-8 STATION: RANGE: SURFACE EL: 749.1
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL | 20.8 | 33 | 13 | SI CL, BRN, MST, ALL |
| 5 | 745 | | | | | | |
| | | | CL-ML | 23.7 | 42 | 16 | SI CL, R, MST, ALL |
| 10 | 740 | | | | | | |
| | | | CL-ML | 25.6 | 42 | 16 | FT CL, R, MST, RESD |
| 15 | 735 | | | | | | |
| | | | CL | 20.8 | 39 | 16 | FT SI, DK R, MST, RESD (SL AUGG) |
| 20 | 730 | | | | | | DISCONTINUED. |
| 25 | 725 | | | | | | |
| 30 | 720 | | | | | | |
| 35 | 715 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

SOIL PROFILE
FIGURE 2.5-445
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-10 STATION: RANGE: SURFACE EL: 713.4
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 710 | | CL | 17.4 | 29 | 12 | CL SI, TN, MST, RESD |
| 10 | 705 | | CL | 14.3 | 29 | 12 | CL SI, GRN-TN, MST, RESD |
| 15 | 700 | | | | | | DISCONTINUED. |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-446
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-11 STATION: RANGE: SURFACE EL: 723.4
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | |
| 5 | | | CL-ML | 25.3 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| | 715 | | | | | | |
| 10 | | | CL-ML | 24.3 | 38 | 13 | CL SI SD, BRN, MST, ALL |
| | 710 | | | | | | SI CL SD, W |
| 15 | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |

1''=5'

* Lab. Classif.

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-447**
**SHEET 1 OF 1**

*"HISTORICAL INFORMATION"*

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-12  STATION:  RANGE:  SURFACE EL: 724.3
DATE DRILLED: 6/7/83  TO  PREPARED BY: MHD  CHECKED BY: BM

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 720 | | CL-ML | 26.2 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | 715 | | CL-ML | 26.4 | 38 | 13 | CL SI SD, R-BRN, V MST, ALL |
| 15 | 710 | | | | | | W CL SI SD |
| | | | | | | | DISCONTINUED. |
| 20 | 705 | | | | | | |
| 25 | 700 | | | | | | |
| 30 | 695 | | | | | | |
| 35 | 690 | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-448
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-13  STATION:  RANGE:  SURFACE EL: 718.7
DATE DRILLED: 6/8/83  TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 715 | | | | | | |
| 5 | | | CL | 19.3 | 34 | 14 | SI CL, BRN, V MST, ALL |
| | | | | | | | SI CL, W |
| | 710 | | | | | | |
| 10 | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 15 | | | | | | | |
| | 700 | | | | | | |
| 20 | | | | | | | |
| | 695 | | | | | | |
| 25 | | | | | | | |
| | 690 | | | | | | |
| 30 | | | | | | | |
| | 685 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-449
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-14 STATION: RANGE: SURFACE EL: 730.0
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | *LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | SPOIL FILL & BURIED TOPSOIL |
| 5 | 725 | | | | | | |
| | | | CL | 20.3 | 39 | 18 | SI CL, TN-BRN, MST, ALL |
| 10 | 720 | | | | | | |
| | | | CL | 26.5 | 39 | 18 | FT CL, R-BRN, MST, ALL |
| 15 | 715 | | | | | | |
| | | | CL-ML | 25.9 | 42 | 16 | SI CL, R-BRN, MST, ALL |
| 20 | 710 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-450
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-15 STATION: RANGE: SURFACE EL: 739.7
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL-ML | 25.0 | 42 | 16 | FT CL, R, MST, RESD |
| 5 | 735 | | | | | | |
| | | | CL | 23.6 | 39 | 18 | FT CL, R, MST, RESD |
| 10 | 730 | | | | | | |
| | | | CL | 23.0 | 42 | 18 | FT SI, TN, MST, RESD |
| 15 | 725 | | | | | | |
| | | | CL | 22.8 | 39 | 18 | FT SI, TN, MST, RESD |
| 20 | 720 | | | | | | DISCONTINUED. |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-451<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAM-16  STATION:  RANGE:  SURFACE EL: 749.8
DATE DRILLED: 6/7/83 TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CH-MH | 30.5 | 64 | 31 | FT SI, DK R, MST, RESD |
| 5 | 745 | | | | | | |
| | | | CL | 27.1 | 39 | 16 | FT SI, DK R, MST, RESD |
| 10 | 740 | | | | | | |
| | | | CL | 27.6 | 39 | 16 | FT SI, DK R, MST, RESD |
| 15 | 735 | | | | | | |
| | | | CL | 25.0 | 39 | 16 | FT SI, DK R, MST, RESD |
| 20 | 730 | | | | | | DISCONTINUED. |
| 25 | 725 | | | | | | |
| 30 | 720 | | | | | | |
| 35 | 715 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE FIGURE 2.5-452 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT. WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAM-17 STATION: RANGE: SURFACE EL: 713.7
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL - V MST |
| 5 | 710 | | ML | 17.1 | NP | NP | SD SI, LT TN, V MST, ALL |
| | | | | | | | DISCONTINUED. |
| 10 | 705 | | | | | | |
| 15 | 700 | | | | | | |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE FIGURE 2.5-453 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-18 STATION: RANGE: SURFACE EL: 722.9
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | |
| 5 | | | CL-ML | 25.7 | 38 | 13 | SD SI CL, R-BRN, MST, ALL |
| | 715 | | | | | | |
| 10 | | | CL-ML | 26.8 | 38 | 13 | CL SD SI, R-BRN, V MST, ALL |
| | 710 | | | | | | |
| 15 | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-454
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-19 STATION: RANGE: SURFACE EL: 721.8
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BH

| DEPTH ft. | EL | SPT (N) | *LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | |
| 5 | | | CL | 21.8 | 34 | 14 | SI CL, R-TN, MST, ALL |
| | 715 | | | | | | |
| 10 | | | CL | 25.6 | 34 | 14 | SI CL, R-TN, V MST, ALL |
| | 710 | | | | | | |
| 15 | | | | | | | W CL SD |
| | 705 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-455
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-20 STATION: RANGE: SURFACE EL: 722.5
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | |
| 5 | | | CL | 18.6 | 34 | 14 | CL SI, BRN, MST, ALL |
| | 715 | | | | | | |
| 10 | | | CL | 23.2 | 34 | 14 | SI CL, BRN, V MST, ALL |
| | 710 | | | | | | |
| 15 | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-456<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.
BORING: PAH-21 STATION:
DATE DRILLED: 6/8/83 TO

FEATURE: BORROW AREA 2C
RANGE: SURFACE EL: 733.2
PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 730 | | | | | | |
| 5 | | | CL | 23.3 | 39 | 18 | SI CL, R-BRN, MST, ALL |
| | 725 | | | | | | |
| 10 | | | CL | 28.5 | 33 | 13 | CL SI, DK R, MST, RESD |
| | 720 | | | | | | |
| 15 | | | CL-ML | 26.2 | 42 | 16 | SI CL, TN-BRN, MST, RESD |
| | 715 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 710 | | | | | | |
| 25 | | | | | | | |
| | 705 | | | | | | |
| 30 | | | | | | | |
| | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-457
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-22 STATION: RANGE: SURFACE EL: 747.8
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 745 | | CH-MH | 32.6 | 64 | 31 | FT SI, DK R, MST, RESD |
| 5 | | | | | | | |
| | 740 | | CL | 31.2 | 39 | 16 | FT SI, DK R, MST, RESD |
| 10 | | | | | | | |
| | 735 | | CL | 26.9 | 39 | 16 | FT SI, DK R, MST, RESD |
| 15 | | | | | | | |
| | 730 | | CL | 24.3 | 39 | 16 | FT SI, DK R, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 725 | | | | | | |
| 25 | | | | | | | |
| | 720 | | | | | | |
| 30 | | | | | | | |
| | 715 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-458
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.
BORING: PAH-23 STATION:
DATE DRILLED: 6/7/83 TO

FEATURE: BORROW AREA 2C
RANGE: SURFACE EL: 759.9
PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | LOG* | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL-ML | 22.8 | 42 | 16 | SI CL, R, MST, ALL |
| 5 | 755 | | | | | | |
| | | | CL-ML | 27.5 | 42 | 16 | FT CL, R, MST, ALL |
| 10 | 750 | | | | | | |
| | | | CL-ML | 29.4 | 42 | 16 | FT CL, R, MST, ALL |
| 15 | 745 | | | | | | |
| | | | CL | 23.2 | 39 | 16 | FT SI, DK R, MST, RESD |
| 20 | 740 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 735 | | | | | | |
| 30 | 730 | | | | | | |
| 35 | 725 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

SOIL PROFILE
FIGURE 2.5-459
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-24 STATION: RANGE: SURFACE EL: 757.3
DATE DRILLED: 6/7/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 755 | | CL | 24.3 | 42 | 18 | FT SI, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | 750 | | CL | 28.4 | 42 | 18 | FT SI, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 745 | | CL | 29.2 | 35 | 14 | SI CL, R, V MST, ALL |
| 15 | | | | | | | |
| | 740 | | CL | 28.7 | 39 | 18 | CL SI, GY-TN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 735 | | | | | | |
| 25 | | | | | | | |
| | 730 | | | | | | |
| 30 | | | | | | | |
| | 725 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-460
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.
BORING: PAH-25 STATION:
DATE DRILLED: 6/9/83 TO

FEATURE: BORROW AREA 2C
RANGE: SURFACE EL: 714.2
PREPARED BY: MHD CHECKED BY: BH

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 710 | | ML | 26.2 | 18 | 1 | SD SI, GY, W, ALL |
| | | | | | | | DISCONTINUED. |
| 10 | 705 | | | | | | |
| 15 | 700 | | | | | | |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |

1''=5'

*Lab. Classif.

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-461<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-26 STATION: RANGE: SURFACE EL: 716.0
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: βA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 715 | | | | | | TOPSOIL |
| 5 | | | CL | 18.8 | 29 | 12 | SI SD CL, BRN, V MST, ALL |
| | 710 | | | | | | W GY-TN SI SD |
| | | | | | | | DISCONTINUED. |
| 10 | 705 | | | | | | |
| 15 | 700 | | | | | | |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-462
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-27 STATION: RANGE: SURFACE EL: 720.7
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | TOPSOIL |
| | | | CL | 19.9 | 29 | 12 | SI CL, BRN, V MST, ALL |
| 5 | 715 | | | | | | |
| | | | CL-ML | 23.2 | 38 | 13 | SI CL, BRN, V MST, ALL- |
| 10 | 710 | | | | | | W SD CL |
| | | | | | | | DISCONTINUED. |
| 15 | 705 | | | | | | |
| 20 | 700 | | | | | | |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-463
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-28 STATION: RANGE: SURFACE EL: 727.0
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 725 | | | | | | TOPSOIL |
| 5 | | | CL | 20.5 | 39 | 18 | SI CL, TN-BRN, MST, ALL |
| | 720 | | | | | | |
| 10 | | | CL | 20.9 | 35 | 14 | SI CL, TN-BRN, MST, ALL |
| | 715 | | | | | | |
| | | | CL | 25.0 | 35 | 14 | CL SI, TN, V MST, ALL |
| 15 | | | | | | | W CL SI |
| | 710 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 705 | | | | | | |
| 25 | | | | | | | |
| | 700 | | | | | | |
| 30 | | | | | | | |
| | 695 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-464
SHEET 1 OF 1

"HISTORICAL INFORMATION"

SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-29 STATION: RANGE: SURFACE EL: 733.1
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | CL | 21.4 | 42 | 18 | SI CL, TN, MST, ALL |
| 5 | | | CL | 28.3 | 39 | 18 | FT CL, TN, MST, RESD |
| | 725 | | | | | | |
| 10 | | | CL | 30.0 | 42 | 18 | FT SI, TN, MST, RESD |
| | 720 | | | | | | |
| 15 | | | CL | 25.9 | 42 | 18 | FT SI, TN, MST, RESD |
| | 715 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 710 | | | | | | |
| 25 | | | | | | | |
| | 705 | | | | | | |
| 30 | | | | | | | |
| | 700 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-466<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-30  STATION:  RANGE:  SURFACE EL: 740.5
DATE DRILLED: 6/8/83 TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | | | | | TOPSOIL |
| 5 | 735 | | CL | 20.9 | 39 | 18 | SI CL, TN, MST, ALL |
| 10 | 730 | | CL | 19.1 | 39 | 18 | CL SI, TN, MST, RESD |
| 15 | 725 | | CL | 22.6 | 35 | 14 | SI CL, TN, MST, RESD |
| | | | CL | 21.5 | 42 | 18 | SI CL, TN, MST, RESD |
| 20 | 720 | | | | | | DISCONTINUED. |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE FIGURE 2.5-466 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-31 STATION: RANGE: SURFACE EL: 743.0 est.
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BJ

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 740 | | CL-ML | 22.2 | 42 | 16 | SI CL, R, MST, ALL |
| 5 | | | | | | | |
| | 735 | | CL-ML | 21.7 | 42 | 16 | SI CL, R, MST, ALL |
| 10 | | | | | | | |
| | 730 | | CL | 21.2 | 39 | 18 | SI CL, BRN, MST, RESD |
| 15 | | | | | | | |
| | 725 | | CL | 20.1 | 43 | 20 | SI CL, BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 720 | | | | | | |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-467
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-32 STATION: RANGE: SURFACE EL: 713.7
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 710 | | | | | | |
| 5 | | | CL | 20.6 | 29 | 12 | CL SI, TN, V MST, ALL |
| | 705 | | | | | | |
| 10 | | | | | | | W CL SI |
| | | | | | | | DISCONTINUED. |
| | 700 | | | | | | |
| 15 | | | | | | | |
| | 695 | | | | | | |
| 20 | | | | | | | |
| | 690 | | | | | | |
| 25 | | | | | | | |
| | 685 | | | | | | |
| 30 | | | | | | | |
| | 680 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-468
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-33 STATION: RANGE: SURFACE EL: 721.1
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | TOPSOIL |
| | | | CL-ML | 23.5 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | 715 | | CL-ML | 26.1 | 38 | 13 | SD SI CL, R, MST, ALL |
| 10 | 710 | | CL | 27.6 | 34 | 14 | SD CL SI, TN, V MST, ALL |
| 15 | | | | | | | W SD SI |
| | 705 | | | | | | DISCONTINUED. |
| 20 | 700 | | | | | | |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-469
SHEET 1 OF 1

*"HISTORICAL INFORMATION"*

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA 2C
BORING: PAH-34  STATION:  RANGE:  SURFACE EL: 722.7
DATE DRILLED: 6/9/83 TO  PREPARED BY: MHD  CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 720 | | CL-ML | 23.1 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | | | | | | | |
| | 715 | | CL-ML | 26.0 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | |
| | 710 | | CL | 27.3 | 34 | 14 | SI CL, R-TN, V MST, ALL |
| 15 | | | | | | | W SI CL |
| | 705 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-470
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.
BORING: PAH-35 STATION:
DATE DRILLED: 6/8/83 TO

FEATURE: BORROW AREA 2C
RANGE: SURFACE EL: 724.6
PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | | | CL-ML | 19.9 | 38 | 13 | SI CL, BRN, MST, ALL |
| 5 | 720 | | | | | | |
| | | | CL-ML | 26.1 | 38 | 13 | SI CL, BRN-TN, MST, ALL |
| 10 | 715 | | | | | | |
| | | | CL | 26.3 | 34 | 14 | SI CL, TN, V MST, ALL |
| 15 | 710 | | | | | | W CL SD |
| | | | | | | | DISCONTINUED. |
| 20 | 705 | | | | | | |
| 25 | 700 | | | | | | |
| 30 | 695 | | | | | | |
| 35 | 690 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-471<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-36 STATION: RANGE: SURFACE EL: 728.2
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 725 | | CL | 20.2 | 35 | 14 | SI CL, TN-BRN, MST, ALL |
| 5 | | | | | | | |
| | 720 | | CL | 22.0 | 42 | 18 | CL SI, R-BRN, MST, RESD |
| 10 | | | | | | | |
| | 715 | | CL | 21.5 | 42 | 18 | CL SI, R-BRN, MST, RESD |
| 15 | | | | | | | |
| | 710 | | CL | 21.7 | 35 | 14 | CL SD SI, TN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 705 | | | | | | |
| 25 | | | | | | | |
| | 700 | | | | | | |
| 30 | | | | | | | |
| | 695 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-472<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.    FEATURE: BORROW AREA 2C
BORING: PAH-37    STATION:    RANGE:    SURFACE EL: 733.3
DATE DRILLED: 6/9/83 TO    PREPARED BY: MHD    CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 730 | | | | | | |
| 5 | | | CL | 21.0 | 35 | 14 | SI CL, TN, MST, ALL |
| | 725 | | | | | | |
| 10 | | | CL | 23.0 | 42 | 18 | SI CL, TN, MST, ALL |
| | 720 | | | | | | |
| 15 | | | CL | 23.7 | 39 | 18 | CL SI, TN, MST, RESD |
| | 715 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 710 | | | | | | |
| 25 | | | | | | | |
| | 705 | | | | | | |
| 30 | | | | | | | |
| | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-473
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-38 STATION: RANGE: SURFACE EL: 738.4
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | GV DBR & TOPSOIL |
| | 735 | | | | | | |
| 5 | | | CL-ML | 22.1 | 42 | 16 | SI CL, TN, MST, ALL |
| | 730 | | | | | | |
| 10 | | | CL | 21.9 | 42 | 18 | CL SI, TN, MST, RESD |
| | 725 | | | | | | |
| 15 | | | CL | 23.0 | 42 | 18 | CL SI, TN, MST, RESD |
| | 720 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 715 | | | | | | |
| 25 | | | | | | | |
| | 710 | | | | | | |
| 30 | | | | | | | |
| | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-474
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-39 STATION: RANGE: SURFACE EL: 716.5
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 715 | | | | | | TOPSOIL |
| 5 | | | CL-ML | 20.7 | 38 | 13 | SD SI CL, R-BRN, V MST, ALL |
| | 710 | | | | | | |
| 10 | | | CL-ML | 19.2 | 38 | 13 | SD SI CL, TR GV, R-BRN, V MST, ALL |
| | 705 | | | | | | |
| 15 | | | | | | | W CL SD |
| | 700 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 695 | | | | | | |
| 25 | | | | | | | |
| | 690 | | | | | | |
| 30 | | | | | | | |
| | 685 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-475
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-40 STATION: RANGE: SURFACE EL: 721.1
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | TOPSOIL |
| 5 | | | CL-ML | 24.6 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| | 715 | | CL-ML | 24.8 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 10 | | | | | | | W SI CL |
| | 710 | | | | | | DISCONTINUED. |
| 15 | | | | | | | |
| | 705 | | | | | | |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

"HISTORICAL INFORMATION"

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SOIL PROFILE**
**FIGURE 2.5-476**
**SHEET 1 OF 1**

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-41 STATION: RANGE: SURFACE EL: 720.6
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | TOPSOIL |
| | | | CL-ML | 25.4 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | 715 | | | | | | |
| | | | CL-ML | 27.4 | 38 | 13 | SI CL, R-BRN, V MST, ALL |
| 10 | 710 | | | | | | W SI CL |
| | | | | | | | DISCONTINUED. |
| 15 | 705 | | | | | | |
| 20 | 700 | | | | | | |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-477
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.
BORING: PAH-42 STATION:
DATE DRILLED: 6/9/83 TO

FEATURE: BORROW AREA 2C
RANGE:
SURFACE EL: 723.0
PREPARED BY: MHD CHECKED BY: EA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | CL-ML | 22.3 | 42 | 16 | SI CL, BRN, MST, ALL |
| 5 | | | | | | | |
| | 715 | | CL | 19.7 | 42 | 18 | CL SI, R-TN, MST, ALL |
| 10 | | | | | | | |
| | | | CL | 24.7 | 42 | 18 | CL SI, TN, V MST, ALL |
| | 710 | | | | | | |
| 15 | | | | | | | W CL SI |
| | 705 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 700 | | | | | | |
| 25 | | | | | | | |
| | 695 | | | | | | |
| 30 | | | | | | | |
| | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-478
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.
BORING: PAH-43 STATION:
DATE DRILLED: 6/9/83 TO

FEATURE: BORROW AREA 2C
RANGE: SURFACE EL: 730.6
PREPARED BY: MHD CHECKED BY: RH

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | |
| 5 | 725 | | CL-ML | 21.8 | 42 | 16 | SI CL, R-BRN, MST, ALL |
| 10 | 720 | | CL-ML | 21.4 | 42 | 16 | CL SI, TN-BRN, MST, RESD |
| 15 | 715 | | CL | 20.0 | 33 | 13 | CL SI, DK R, MST, RESD |
| 20 | 710 | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-479
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-44 STATION: RANGE: SURFACE EL: 736.1
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | | | | | ROADBED GRAVEL |
| | | | CL | 18.3 | 39 | 18 | SI CL, TN-BRN, MST, ALL |
| 5 | 730 | | CL-ML | 26.5 | 42 | 16 | SI CL, R, MST, ALL |
| 10 | 725 | | CL | 23.6 | 42 | 18 | CL SI, TN, MST, ALL |
| 15 | 720 | | CL-ML | 22.8 | 42 | 16 | CL SI, TN, MST, ALL |
| 20 | | | | | | | SD & GV |
| | 715 | | | | | | DISCONTINUED. |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-480
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-45 STATION: RANGE: SURFACE EL: 736.4
DATE DRILLED: 6/8/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 735 | | | | | | GRAVEL - SPOILED SOILS |
| 5 | 730 | | CL | 23.4 | 42 | 18 | SI CL, R, MST, ALL |
| 10 | | | CL | 21.4 | 42 | 18 | CL SI, R, MST, ALL |
| | 725 | | CL | 24.1 | 42 | 18 | CL SI, TN, MST, RESD |
| 15 | 720 | | CL | 22.7 | 42 | 18 | CL SI, TN, MST, RESD |
| 20 | 715 | | | | | | DISCONTINUED. |
| 25 | 710 | | | | | | |
| 30 | 705 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE FIGURE 2.5-481 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-46 STATION: RANGE: SURFACE EL: 729.0 est.
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL | 22.5 | 33 | 13 | SI CL, BRN, MST, ALL |
| 5 | 725 | | | | | | |
| | | | CL | 23.2 | 42 | 18 | CL SI, R-BRN, MST, ALL |
| 10 | 720 | | | | | | |
| | | | CL | 25.0 | 42 | 18 | CL SI, R-BRN, MST, ALL |
| 15 | 715 | | | | | | |
| | | | CL | 24.0 | 42 | 18 | CL SI, R-BRN, MST, ALL |
| 20 | 710 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-482
SHEET 1 OF 1

"HISTORICAL INFORMATION"

SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-47 STATION: RANGE: SURFACE EL: 721.0 est.
DATE DRILLED: 6/10/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | TOPSOIL |
| | | | CL-ML | 21.2 | 38 | 13 | SI CL, R-BRN, MST, ALL |
| 5 | 715 | | | | | | |
| | | | CL | 28.0 | 29 | 12 | SI CL, R-BRN, MST, ALL |
| 10 | 710 | | | | | | W SI CL (NO SAMPLE) |
| | | | | | | | DISCONTINUED. |
| 15 | 705 | | | | | | |
| 20 | 700 | | | | | | |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-483
SHEET 1 OF 1

*"HISTORICAL INFORMATION"*

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-48 STATION: RANGE: SURFACE EL: 713.7
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 710 | | CL | 19.4 | 29 | 12 | SI CL, BRN-TN, MST, ALL |
| | | | | | | | SD SI CL, TN, W |
| 10 | 705 | | | | | | DISCONTINUED. |
| 15 | 700 | | | | | | |
| 20 | 695 | | | | | | |
| 25 | 690 | | | | | | |
| 30 | 685 | | | | | | |
| 35 | 680 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-484
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-49 STATION: RANGE: SURFACE EL: 729.7
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL | 19.6 | 43 | 20 | SI CL, BRN, MST, ALL |
| 5 | 725 | | | | | | |
| | | | CL | 23.4 | 33 | 13 | SI CL, DK BRN-TN, MST, ALL |
| 10 | 720 | | | | | | |
| | | | CL-ML | 22.9 | 42 | 16 | SI CL, R, MST, ALL |
| 15 | 715 | | | | | | |
| | | | CL | 22.7 | 42 | 18 | CL SI, TN-BRN, MST, ALL |
| 20 | 710 | | | | | | W CL SI |
| | | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-485
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-50 STATION: RANGE: SURFACE EL: 730.0
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | |
| | | | CL | 18.4 | 43 | 20 | SI CL, TR FN GV, TN-BRN, MST, ALL |
| 5 | 725 | | | | | | |
| | | | CL | 18.6 | 39 | 18 | CL SI, TN, MST, RESD |
| 10 | 720 | | | | | | |
| | | | CL | 19.2 | 35 | 14 | CL SI, TN, V MST, RESD |
| 15 | 715 | | | | | | |
| | | | | | | | W SI |
| 20 | 710 | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | 695 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| SOIL PROFILE FIGURE 2.5-486 SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-51 STATION: RANGE: SURFACE EL: 739.8
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | ROADFILL |
| 5 | 735 | | CL | 21.3 | 39 | 18 | SI CL, R-BRN, MST, ALL |
| 10 | 730 | | CL-ML | 22.9 | 42 | 16 | SI CL, R, MST, ALL |
| 15 | 725 | | CL-ML | 24.2 | 42 | 16 | SI CL, R, MST, ALL |
| 20 | 720 | | | | | | DISCONTINUED. |
| 25 | 715 | | | | | | |
| 30 | 710 | | | | | | |
| 35 | 705 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-487
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-52 STATION: RANGE: SURFACE EL: 743.7
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: BA

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | RANDOM ROADFILL |
| 5 | 740 | | | | | | |
| | | | CL-ML | 23.1 | 42 | 16 | SI CL, R-BRN, MST, ALL |
| 10 | 735 | | | | | | |
| | | | CL-ML | 22.7 | 42 | 16 | SI CL, R-BRN, MST, ALL |
| 15 | 730 | | | | | | |
| | | | CL | 21.9 | 39 | 18 | SI CL, R-BRN, MST, ALL |
| 20 | 725 | | | | | | DISCONTINUED. |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-488
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA 2C
BORING: PAH-53 STATION: RANGE: SURFACE EL: 750.6
DATE DRILLED: 6/9/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 750 | | | | | | RANDOM ROADFILL |
| 5 | 745 | | CL-ML | 23.5 | 42 | 16 | SI CL, R-BRN, MST, ALL |
| 10 | 740 | | CL-ML | 23.6 | 42 | 16 | SI CL, R, MST, ALL |
| 15 | 735 | | CL-ML | 37.1 | 42 | 16 | SI CL, R V MST, ALL |
| 20 | 730 | | | | | | W SI CL |
| | | | | | | | DISCONTINUED. |
| 25 | 725 | | | | | | |
| 30 | 720 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-489
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-56 STATION: RANGE: SURFACE EL: 769.0 est
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: CBE

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE; SP FL |
| 5 | 765 | | CL | 23.2 | 44 | 19 | FT CL, BRN, MST, RESD |
| 10 | 760 | | CL-ML | 24.2 | 42 | 16 | FT CL, BRN, MST, RESD |
| 15 | 755 | | CL | 26.7 | 48 | 21 | FT CL, BRN, MST, RESD |
| 20 | 750 | | | | | | |
| 25 | 745 | | | | | | |
| 30 | 740 | | | | | | |
| 35 | 735 | | | | | | |

1''=5'

*Lab. Classif.

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-490<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.    FEATURE: BORROW AREA EXT 2C
BORING: PAH-57    STATION:    RANGE:    SURFACE EL: 774.1
DATE DRILLED: 8/25/83 TO    PREPARED BY: MHD    CHECKED BY: CBG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | | | CL | 11.5 | 33 | 11 | CL SI, BRN, MST, RESD |
| 5 | 770 | | | | | | |
| | | | CL | 20.4 | 44 | 19 | CL SI, BRN, MST, RESD |
| 10 | 765 | | | | | | |
| | | | CL-ML | 20.6 | 40 | 14 | CL SI, BRN, MST, RESD |
| 15 | 760 | | | | | | |
| | | | CL-ML | 24.9 | 36 | 12 | CL SI, BRN, V MST, RESD |
| 20 | 755 | | | | | | DISCONTINUED. |
| 25 | 750 | | | | | | |
| 30 | 745 | | | | | | |
| 35 | 740 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| SOIL PROFILE<br>FIGURE 2.5-491<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-58 STATION: RANGE: SURFACE EL: 798.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 795 | | CH-MH | 26.6 | 53 | 24 | CL SI, BRN, MST, RESD |
| 5 | | | | | | | |
| | 790 | | CL-ML | 21.3 | 36 | 12 | CL SI, BRN, MST, RESD |
| 10 | | | | | | | |
| | 785 | | CL-ML | 26.3 | 40 | 14 | CL SI, BRN, MST, RESD |
| 15 | | | | | | | |
| | 780 | | CL | 22.6 | 39 | 17 | CL SI, TN-BRN, MST, RESD |
| 20 | | | | | | | |
| | 775 | | | | | | |
| 25 | | | | | | | |
| | 770 | | | | | | |
| 30 | | | | | | | |
| | 765 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-492
SHEET 1 OF 1

*"HISTORICAL INFORMATION"*

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-59 STATION: RANGE: SURFACE EL: 755.0
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL 755 | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | CL | 12.7 | 33 | 11 | SI CL, BRN, MST, RESD |
| 5 | 750 | | | | | | |
| | | | CL | 21.4 | 45 | 22 | SI CL, BRN, MST, RESD - |
| 10 | 745 | | | | | | |
| | | | CL | 18.8 | 48 | 21 | SI CL, TN, TR LS GV, MST, RESD |
| 15 | 740 | | | | | | |
| | | | CL-ML | 22.2 | 42 | 16 | CL SI, GRN-TN, MST, RESD |
| 20 | 735 | | | | | | DISCONTINUED. |
| 25 | 730 | | | | | | |
| 30 | 725 | | | | | | |
| 35 | 720 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-493
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-60 STATION: RANGE: SURFACE EL: 748.2
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: DEG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | (PREVIOUSLY CUT SURFACE) |
| | 745 | | CL | 17.5 | 44 | 20 | SI CL, TN, MST, TERRACE ALL |
| 5 | | | | | | | |
| | | | ML | 16.1 | 37 | 11 | GV SI, DK BRN, MST, TERRACE ALL |
| | 740 | | | | | | |
| 10 | | | | | | | |
| | | | SM-SC | 17.9 | 35 | 11 | SI CL, BRN, TR GV |
| | 735 | | | | | | |
| 15 | | | | | | | |
| | | | CL-ML | 20.1 | 40 | 14 | CL SI, R-BRN, MST, RESD |
| | 730 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 725 | | | | | | |
| 25 | | | | | | | |
| | 720 | | | | | | |
| 30 | | | | | | | |
| | 715 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-494
SHEET 1 OF 1

*"HISTORICAL INFORMATION"*

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-61 STATION: RANGE: SURFACE EL: 745.0 est
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 745 | | | | | | CUT SURFACE |
| | | | SM-SC | 15.5 | 35 | 11 | GV CL, DK BRN, MST, TERRACE ALL |
| 5 | 740 | | | | | | |
| | | | CL-ML | 20.3 | 40 | 14 | GV CL, DK BRN, MST, TERRACE ALL |
| 10 | 735 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 15 | 730 | | | | | | |
| 20 | 725 | | | | | | |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-495
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-62 STATION: RANGE: SURFACE EL: 731.0 est
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 730 | | | | | | CUT SURFACE |
| | | | CH-MH | 23.1 | 53 | 24 | SI CL, BRN, MST, RESD |
| 5 | 725 | | CH-MH | 23.3 | 53 | 24 | CL SI, BRN, MST, RESD |
| | | | CH-MH | 22.2 | 53 | 24 | CL SI, BRN, MST, RESD |
| 10 | 720 | | | | | | REFUSAL. BEDROCK. |
| 15 | 715 | | | | | | |
| 20 | 710 | | | | | | |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | | | | | | | |

1''=5'

* Lab. Classif.

| WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT |
| --- |
| SOIL PROFILE<br>FIGURE 2.5-496<br>SHEET 1 OF 1 |

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-63 STATION: RANGE: SURFACE EL: 730.8
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | 730 | | SM-SC | 16.4 | 35 | 11 | CUT SURFACE<br>CL SI, BRN, MST, RESD |
| 5 | 725 | | CH-MH | 24.6 | 53 | 24 | FT CL, LT BRN, MST, RESD |
| 10 | 720 | | ML | 18.0 | 37 | 11 | CL SI, R-BRN, MST, RESD |
| 15 | 715 | | ML | 16.7 | 37 | 11 | CL SI, R-BRN, MST, RESD |
| 20 | 710 | | | | | | DISCONTINUED. |
| 25 | 705 | | | | | | |
| 30 | 700 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-497
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-64 STATION: RANGE: SURFACE EL: 744.1
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| 5 | 740 | | ML | 19.0 | 37 | 11 | SI CL, BRN, D, RESD |
| 10 | 735 | | ML | 23.6 | 37 | 11 | SI CL, BRN, MST, RESD |
| 15 | 730 | | ML | 23.3 | 37 | 11 | SI CL, BRN, MST, RESD |
| | | | | | | | V MST W/SH & W/BENTANITE |
| | | | | | | | DISCONTINUED. |
| 20 | 725 | | | | | | |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-498
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.
BORING: PAH-65 STATION:
DATE DRILLED: 8/24/83 TO

FEATURE: BORROW AREA EXT 2C
RANGE: SURFACE EL: 766.0
PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 765 | | CL-ML | 14.3 | 40 | 14 | SI CL, R-BRN, MST, RESD |
| 5 | 760 | | MH | 19.8 | 67 | 29 | SI CL, R-BRN, MST, RESD |
| 10 | 755 | | CL-ML | 15.8 | 40 | 14 | SI CL, R-BRN, MST, RESD, TR GV |
| 15 | 750 | | CL | 15.7 | 44 | 19 | SI CL, TR GV, R-BRN, MST, RESD |
| 20 | 745 | | | | | | DISCONTINUED. |
| 25 | 740 | | | | | | |
| 30 | 735 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-499
SHEET 1 OF 1

"HISTORICAL INFORMATION"

PROJECT: WATTS BAR N.P.
BORING: PAH-66 STATION:
DATE DRILLED: 8/24/83 TO

FEATURE: BORROW AREA EXT 2C
RANGE: SURFACE EL: 776.9
PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 775 | | CL-ML | 13.6 | 40 | 14 | SI CL, R-BRN, MST, RESD |
| 5 | | | | | | | |
| | 770 | | CL-ML | 19.1 | 40 | 14 | SI CL, R-BRN, MST, RESD |
| 10 | | | | | | | |
| | 765 | | CL-ML | 16.1 | 37 | 12 | CL SI, TR GV, BRN, MST, RESD |
| 15 | | | CL-ML | 17.5 | 37 | 12 | CL SI, TR GV, BRN, MST, RESD |
| | 760 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 755 | | | | | | |
| 25 | | | | | | | |
| | 750 | | | | | | |
| 30 | | | | | | | |
| | 745 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | * Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-566
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.
BORING: PAH-67 STATION:
DATE DRILLED: 8/25/83 TO

FEATURE: BORROW AREA EXT 2C
RANGE: SURFACE EL: 815.0
PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL 815 | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | MH | 28.2 | 67 | 29 | FT CL, R, MST, RESD |
| 5 | 810 | | | | | | |
| | | | MH | 32.7 | 67 | 29 | FT CL, R, MST, RESD |
| 10 | 805 | | | | | | |
| | | | CL | 24.7 | 44 | 20 | CL SI, TN, MST, RESD |
| 15 | 800 | | | | | | |
| | | | CL | 22.1 | 44 | 20 | CL SI, TN, MST, RESD |
| 20 | 795 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 790 | | | | | | |
| 30 | 785 | | | | | | |
| 35 | 780 | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-501
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-68 STATION: RANGE: SURFACE EL: 824.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | | | CL | 12.9 | 35 | 15 | CL SI, TN, MST, RESD |
| | 820 | | | | | | |
| 5 | | | | | | | |
| | | | CH-MH | 19.5 | 53 | 24 | CL SI, YEL-TN, MST, RESD |
| | 815 | | | | | | |
| 10 | | | | | | | |
| | | | CL | 20.6 | 39 | 17 | CL SI, TN, MST, RESD |
| | 810 | | | | | | |
| 15 | | | | | | | |
| | | | CL-ML | 14.5 | 36 | 12 | CL SI, TN, MST, RESD |
| | 805 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 800 | | | | | | |
| 25 | | | | | | | |
| | 795 | | | | | | |
| 30 | | | | | | | |
| | 790 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-502
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-69 STATION: RANGE: SURFACE EL: 802.2
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 800 | | CL | 11.2 | 35 | 15 | SI CL, R-BRN, D, RESD |
| 5 | 795 | | CL | 21.3 | 44 | 19 | SI CL, TR GV, D, RESD |
| 10 | 790 | | CH-MH | 20.1 | 53 | 24 | CL SI, MST, RESD |
| 15 | 785 | | CL-ML | 18.3 | 36 | 12 | CL SI, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| 25 | 780 | | | | | | |
| 30 | 775 | | | | | | |
| 35 | 770 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-503
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-70 STATION: RANGE: SURFACE EL: 772.0
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: JEL

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 770 | | CL | 17.3 | 33 | 11 | SI CL, R-BRN, MST, RESD |
| 5 | | | | | | | |
| | 765 | | CH-MH | 24.7 | 53 | 24 | SI CL, R-BRN, MST, RESD |
| 10 | | | | | | | |
| | 760 | | CL | 24.8 | 44 | 20 | SI CL, R-BRN-WHT, MST, RESD |
| 15 | | | | | | | |
| | 755 | | CL | 24.4 | 44 | 20 | SI CL, R-BRN-WHT, MST, RESD |
| 20 | | | | | | | |
| | 750 | | | | | | DISCONTINUED. |
| 25 | | | | | | | |
| | 745 | | | | | | |
| 30 | | | | | | | |
| | 740 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-504
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-71 STATION: RANGE: SURFACE EL: 742.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 740 | | CL | 8.9 | 33 | 11 | CL SI, BRN, D, RESD |
| 5 | | | | | | | |
| | 735 | | CL | 13.4 | 35 | 15 | CL SI, BRN, MST, RESD |
| 10 | | | | | | | |
| | 730 | | CL-ML | 17.2 | 37 | 12 | CL SI, BRN, MST, RESD |
| 15 | | | | | | | |
| | 725 | | CL | 20.3 | 45 | 22 | SI CL, BRN, MST, RESD |
| 20 | | | | | | | DISCONTINUED. |
| | 720 | | | | | | |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-505
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-72 STATION: RANGE: SURFACE EL: 725.8
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 725 | | | | | | FL SP |
| | | | CL | 15.8 | 39 | 17 | CL SI, BRN, MST, RESD |
| 5 | | | CL | 16.9 | 39 | 17 | CL SI, LT BRN-BRN, MST, RESD |
| | 720 | | | | | | |
| | | | CL | 26.4 | 45 | 22 | CL SI, BRN, MST, |
| 10 | | | | | | | |
| | 715 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 15 | | | | | | | |
| | 710 | | | | | | |
| 20 | | | | | | | |
| | 705 | | | | | | |
| 25 | | | | | | | |
| | 700 | | | | | | |
| 30 | | | | | | | |
| | 695 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-506
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-73 STATION: RANGE: SURFACE EL: 721.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 720 | | | | | | CUT SURFACE |
| | | | CL-ML | 23.0 | 40 | 14 | CL SI, BRN, MST, RESD |
| 5 | | | | | | | |
| | 715 | | ML | 19.0 | 22 | 2 | CL SI, GY, V MST, RESD |
| | | | ML | 18.7 | 22 | 2 | SI CL, BRN, MST, RESD |
| 10 | | | CL-ML | 17.4 | 37 | 12 | SI CL, DK BRN, MST, RESD |
| | 710 | | | | | | DISCONTINUED. |
| 15 | 705 | | | | | | |
| 20 | 700 | | | | | | |
| 25 | 695 | | | | | | |
| 30 | 690 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-507
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-74 STATION: RANGE: SURFACE EL: 736.5
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 735 | | CH-MH | 34.4 | 53 | 24 | CL SI, TN, V MST, RESD |
| 5 | | | | | | | |
| | 730 | | CL | 39.6 | 48 | 21 | CL SI, TN, V MST, RESD |
| 10 | | | | | | | |
| | 725 | | CL | 40.4 | 48 | 21 | CL SI, TN, V MST, RESD |
| 15 | | | ML | 26.8 | 22 | 2 | SI CL, (BENT), GRN-TN, V MST, RESD |
| | 720 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 715 | | | | | | |
| 25 | | | | | | | |
| | 710 | | | | | | |
| 30 | | | | | | | |
| | 705 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-508
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.  FEATURE: BORROW AREA EXT 2C
BORING: PAH-75  STATION:  RANGE:  SURFACE EL: 742.3
DATE DRILLED: 8/25/83 TO  PREPARED BY: MHD  CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 740 | | CL | 8.7 | 34 | 13 | SL CI, TN, D, RESD |
| 5 | | | | | | | |
| | 735 | | CL-ML | 14.5 | 37 | 12 | CL SI, TN, MST, RESD |
| 10 | | | | | | | |
| | 730 | | CL-ML | 24.2 | 37 | 12 | CL SI, TN, MST, RESD |
| 15 | | | | | | | |
| | 725 | | CL-ML | 24.3 | 42 | 16 | |
| 20 | | | | | | | |
| | 720 | | | | | | DISCONTINUED. |
| 25 | | | | | | | |
| | 715 | | | | | | |
| 30 | | | | | | | |
| | 710 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-509
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-76 STATION: RANGE: SURFACE EL: 787.0
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 785 | | CL | 16.6 | 34 | 13 | SI CL, TR GV, D, RESD |
| 5 | | | | | | | |
| | 780 | | CL-ML | 16.2 | 36 | 12 | CL SI, MST, RESD |
| 10 | | | | | | | |
| | 775 | | CL | 17.8 | 30 | 11 | CL SI, MST, BRN, RESD |
| 15 | | | CL | 16.8 | 30 | 11 | CL SI, MST, BRN, RESD |
| | 770 | | | | | | |
| 20 | | | | | | | DISCONTINUED. |
| | 765 | | | | | | |
| 25 | | | | | | | |
| | 760 | | | | | | |
| 30 | | | | | | | |
| | 755 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-510
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-77 STATION: RANGE: SURFACE EL: 836.0
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 835 | | | | | | CUT SURFACE |
| | | | CL | 20.1 | 34 | 13 | SI CL, TN, MST, RESD |
| 5 | 830 | | CL | 16.9 | 33 | 12 | SI CL, PK-TN, MST, RESD |
| 10 | 825 | | CL-ML | 12.1 | 36 | 12 | SI CL, TN, MST, RESD, TR GV |
| 15 | 820 | | CL-ML | 14.6 | 36 | 12 | SI CL, TN, MST, RESD |
| 20 | 815 | | | | | | DISCONTINUED. |
| 25 | 810 | | | | | | |
| 30 | 805 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-511
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-78 STATION: RANGE: SURFACE EL: 882.3
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 880 | | SC | 12.4 | 40 | 16 | CL SI, TN, MST, RESD |
| 5 | | | | | | | |
| | 875 | | SC | 10.3 | 40 | 16 | CL SI, TN, MST, RESD |
| 10 | | | | | | | |
| | 870 | | CL-ML | 9.9 | 36 | 12 | CL SI, TN, TR GV, MST, RESD |
| 15 | | | | | | | |
| | 865 | | CL-ML | 8.6 | 36 | 12 | CL SI, TN, TR GV, MST, RESD |
| 20 | | | | | | | |
| | | | | | | | DISCONTINUED. |
| | 860 | | | | | | |
| 25 | | | | | | | |
| | 855 | | | | | | |
| 30 | | | | | | | |
| | 850 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-512
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-79 STATION: RANGE: SURFACE EL: 777.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL |
| | 775 | | CL | 15.5 | 33 | 12 | CL SI, BRN, MST, RESD |
| 5 | 770 | | CL | 14.6 | 34 | 12 | CL SI, TR GV, BRN, MST, RESD |
| 10 | 765 | | CL | 16.5 | 34 | 12 | CL SI, TR GV, R-BRN, MST, RESD |
| 15 | 760 | | CL | 16.7 | 34 | 12 | CL SI, BRN, MST, RESD |
| 20 | 755 | | | | | | DISCONTINUED. |
| 25 | 750 | | | | | | |
| 30 | 745 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-513
SHEET 1 OF 1

PROJECT: WATTS BAR N.P.
BORING: PAH-80 STATION:
DATE DRILLED: 8/25/83 TO

FEATURE: BORROW AREA EXT 2C
RANGE: SURFACE EL: 744.0
PREPARED BY: MHD CHECKED BY: [handwritten initials]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | | | CL | 13.8 | 34 | 13 | CL SI, TN, MST, RESD |
| 5 | 740 | | | | | | |
| | | | CL | 22.6 | 39 | 17 | CL SI, TN, MST, RESD |
| 10 | 735 | | | | | | |
| | | | CL | 21.9 | 44 | 20 | CL SI, TN, MST, RESD |
| 15 | 730 | | | | | | |
| | | | CL | 21.4 | 44 | 20 | CL SI, TN, MST, RESD |
| 20 | 725 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 720 | | | | | | |
| 30 | 715 | | | | | | |
| 35 | 710 | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-514
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-81 STATION: RANGE: SURFACE EL: 802.0
DATE DRILLED: 8/24/83 TO PREPARED BY: MHD CHECKED BY: CBG

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 800 | | CL | 7.8 | 33 | 12 | CL SI, TR GV, TN, MST, RESD |
| 5 | | | | | | | |
| | 795 | | CL | 11.1 | 30 | 11 | CL SI, TR GV, TN, MST, RESD |
| 10 | | | CL | 14.2 | 30 | 11 | CL SI, TR LS GV, R-BRN, MST, RESD |
| | 790 | | | | | | |
| 15 | | | CL | 12.3 | 30 | 11 | CL SI, TR LS GV, R-BRN, MST, RESD |
| | 785 | | | | | | DISCONTINUED. |
| 20 | | | | | | | |
| | 780 | | | | | | |
| 25 | | | | | | | |
| | 775 | | | | | | |
| 30 | | | | | | | |
| | 770 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-515
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-82 STATION: RANGE: SURFACE EL: 884.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: [signature]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | | | SC | 11.4 | 40 | 16 | CL SI, D, RESD |
| 5 | 880 | | | | | | |
| | | | SC | 11.6 | 40 | 16 | CL SI, D, RESD |
| 10 | 875 | | SC | 12.8 | 40 | 16 | CL SI, TR GV, D, RESD |
| 15 | 870 | | SC | 12.4 | 40 | 16 | CL SI, D, RESD |
| 20 | 865 | | | | | | DISCONTINUED. |
| 25 | 860 | | | | | | |
| 30 | 855 | | | | | | |
| 35 | 850 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-516
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-83 STATION: RANGE: SURFACE EL: 872.0
DATE DRILLED: TO 8/25/83 PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 870 | | CL | 16.7 | 35 | 15 | CL SI, R-BRN, D, RESD |
| 5 | 865 | | SM | 10.1 | 22 | 1 | CL SI, TR GV, TN, MST, RESD |
| 10 | 860 | | CL | 10.2 | 33 | 12 | CL SI, TR GV, BRN, MST, RESD |
| 15 | 855 | | CL | 8.1 | 30 | 11 | CL SI, GV, BRN |
| | | | | | | | DISCONTINUED. |
| 20 | 850 | | | | | | |
| 25 | 845 | | | | | | |
| 30 | 840 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-517
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-84 STATION: RANGE: SURFACE EL: 846.0
DATE DRILLED: TO 8/25/83 PREPARED BY: MHD CHECKED BY: [illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | 845 | | | | | | CUT SURFACE |
| | | | CL-ML | 20.3 | 36 | 12 | CL SI, BRN, MST, RESD |
| 5 | 840 | | CL | 21.4 | 33 | 11 | CL SI, R-BRN, MST, RESD |
| | | | CL | 22.5 | 34 | 12 | SI CL, BRN, MST, RESD |
| 10 | 835 | | CL | 21.0 | 44 | 19 | SI CL, BRN, MST, RESD |
| 15 | 830 | | CL | 18.7 | 34 | 12 | SI CL, R-BRN, MST, RESD |
| 20 | 825 | | | | | | DISCONTINUED. |
| 25 | 820 | | | | | | |
| 30 | 815 | | | | | | |
| 35 | | | | | | | |

1''=5'

*Lab. Classif.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL PROFILE
FIGURE 2.5-518
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-85 STATION: RANGE: SURFACE EL: 834.0
DATE DRILLED: TO 8/25/83 PREPARED BY: M CHECKED BY:

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | | | CL | 18.8 | 34 | 13 | CL SI, TN, MST, RESD |
| 5 | 830 | | | | | | |
| | | | CL-ML | 12.3 | 30 | 12 | CL SI, TN, MST, RESD |
| 10 | 825 | | | | | | |
| | | | CL-ML | 13.0 | 36 | 12 | CL SI, TN, MST, RESD |
| 15 | 820 | | | | | | |
| | | | CL | 13.4 | 33 | 12 | CL SI, YEL-TN, MST, RESD |
| 20 | 815 | | | | | | |
| | | | | | | | DISCONTINUED. |
| 25 | 810 | | | | | | |
| 30 | 805 | | | | | | |
| 35 | 800 | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

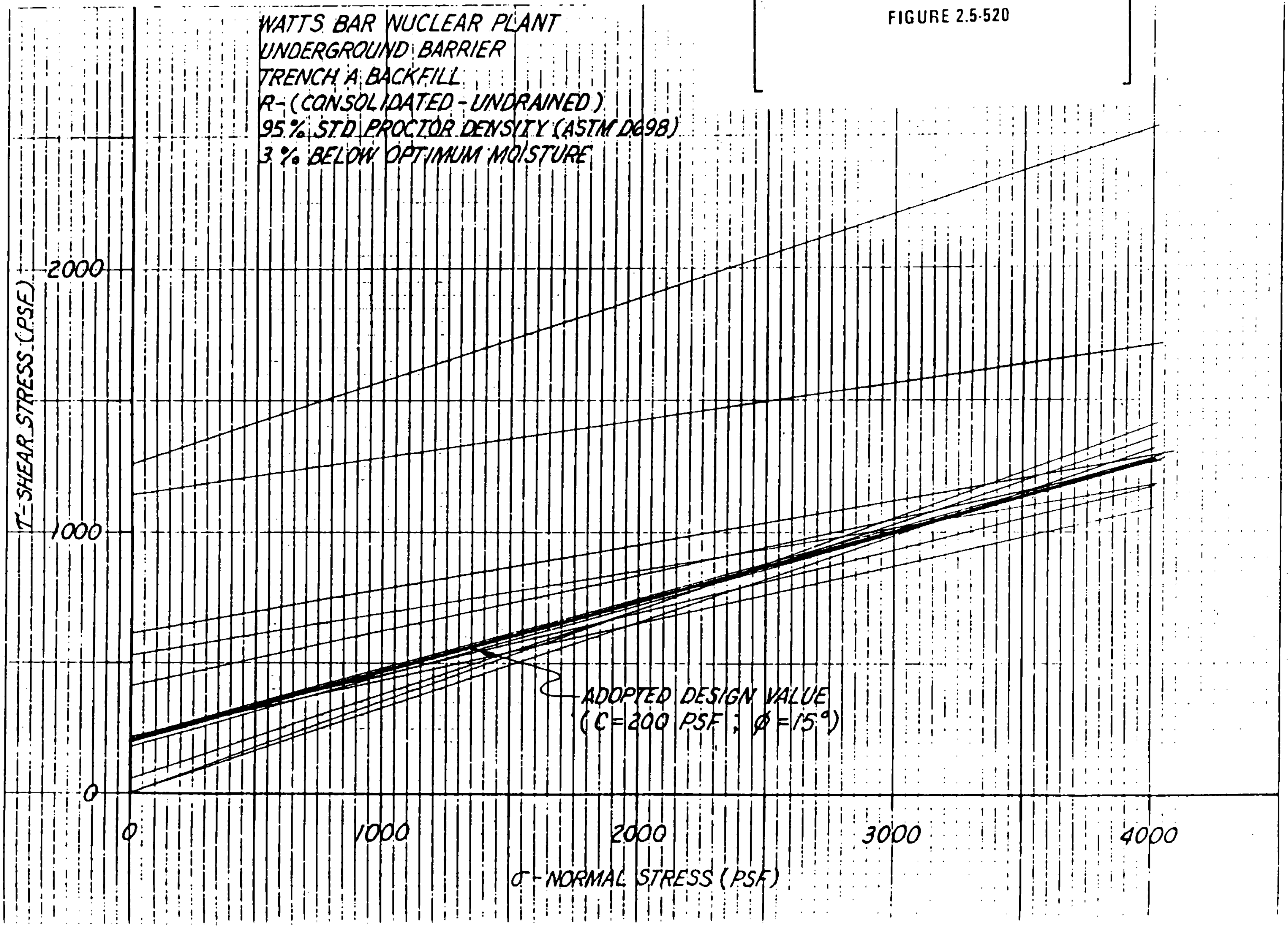
SOIL PROFILE
FIGURE 2.5-519
SHEET 1 OF 1

PROJECT: WATTS BAR N.P. FEATURE: BORROW AREA EXT 2C
BORING: PAH-86 STATION: RANGE: SURFACE EL: 802.0
DATE DRILLED: 8/25/83 TO PREPARED BY: MHD CHECKED BY: CL[illegible]

| DEPTH ft. | EL | SPT (N) | * LOG | W | LL | PI | FIELD DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | CUT SURFACE |
| | 800 | | CL | 13.6 | 34 | 13 | CL SI, TN, MST, RESD |
| 5 | 795 | | CL-ML | 18.5 | 36 | 12 | CL SI, TN, MST, RESD |
| 10 | 790 | | CL-ML | 18.7 | 36 | 12 | CL SI, TN, MST, RESD |
| 15 | 785 | | CL-ML | 16.4 | 36 | 12 | CL SI, TN, MST, RESD |
| 20 | 780 | | | | | | DISCONTINUED. |
| 25 | 775 | | | | | | |
| 30 | 770 | | | | | | |
| 35 | | | | | | | |
| 1''=5' | | *Lab. Classif. | | | | | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

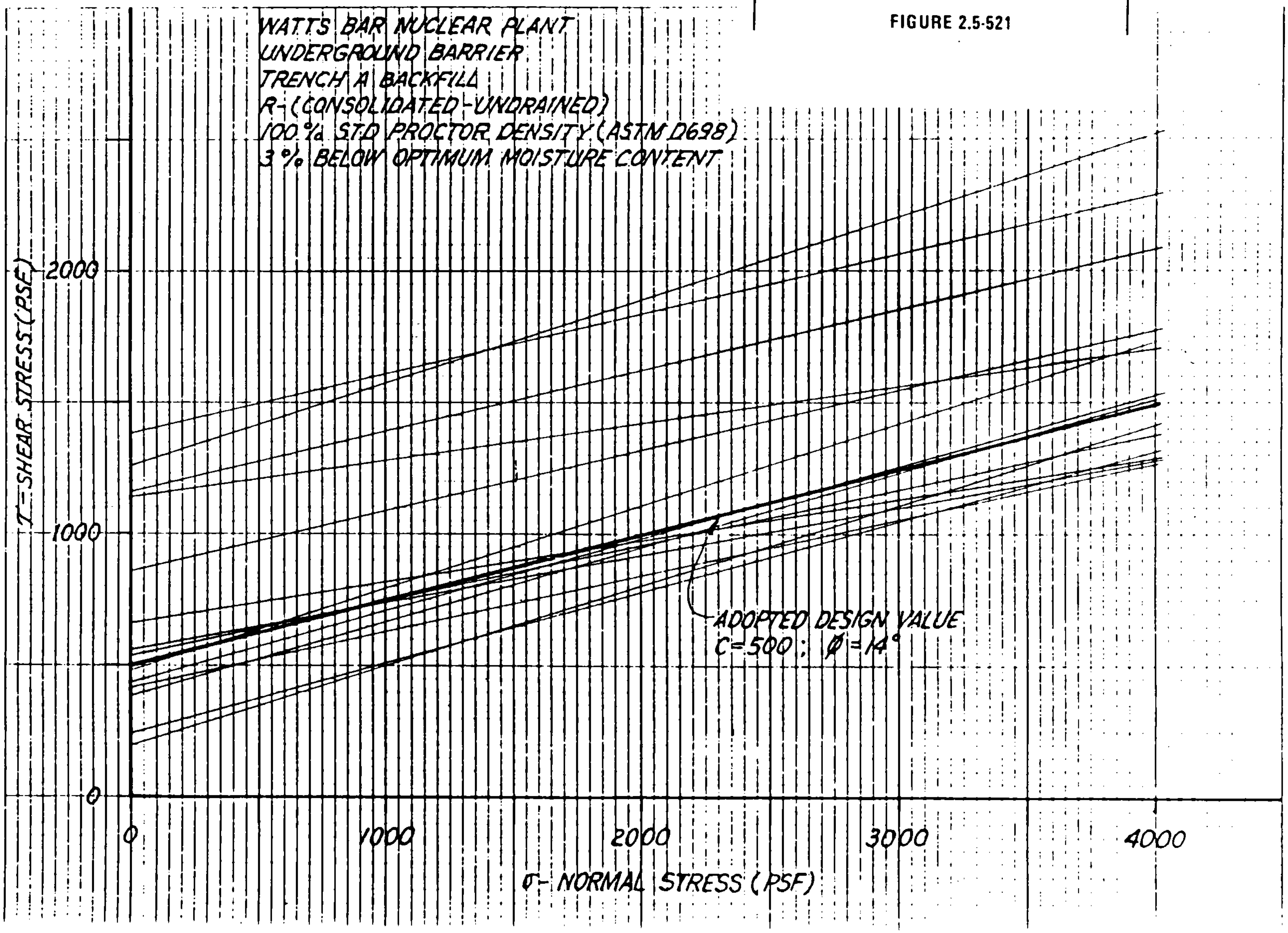
FIGURE 2.5-520



**HISTORICAL**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-521



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

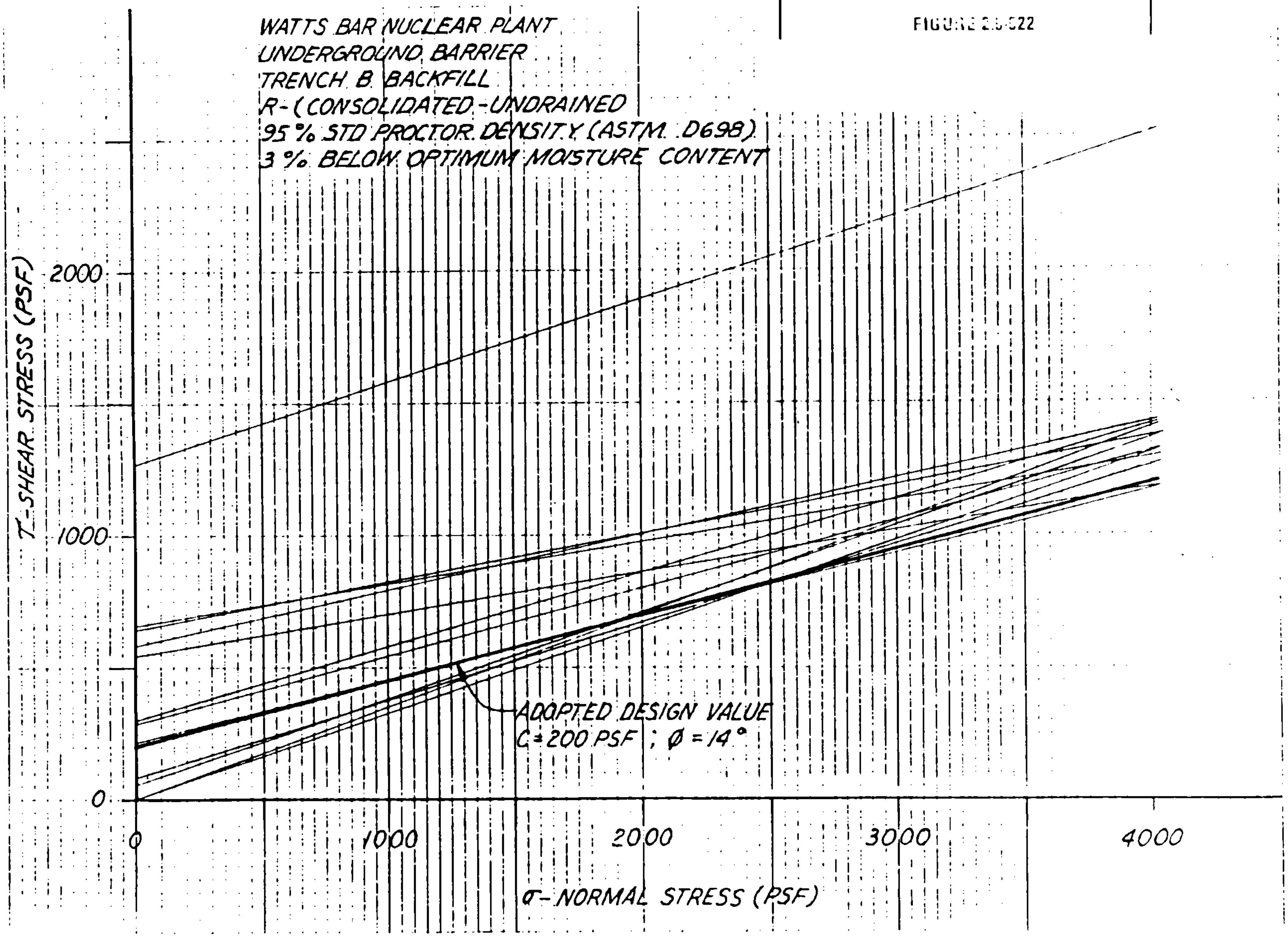
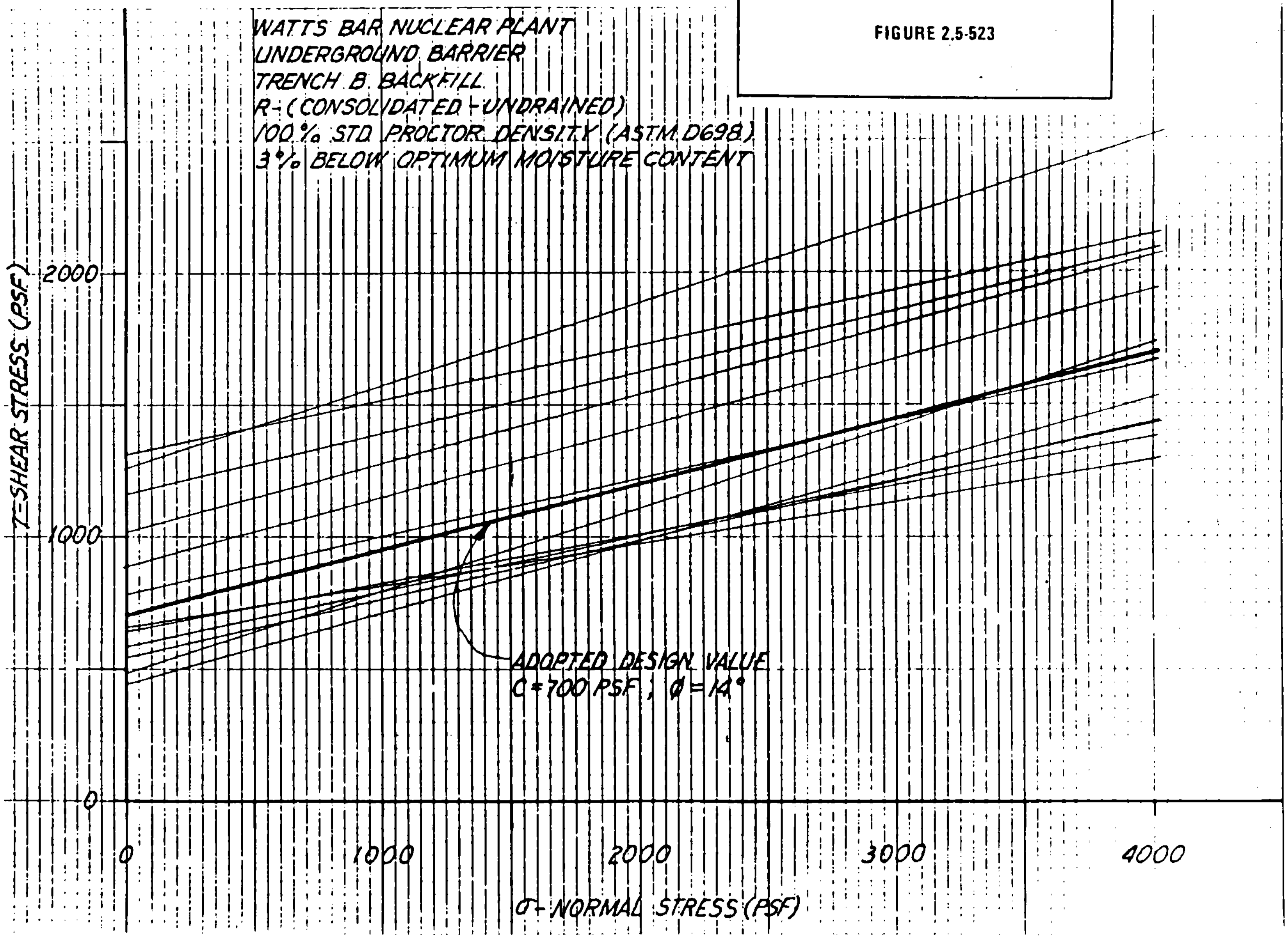


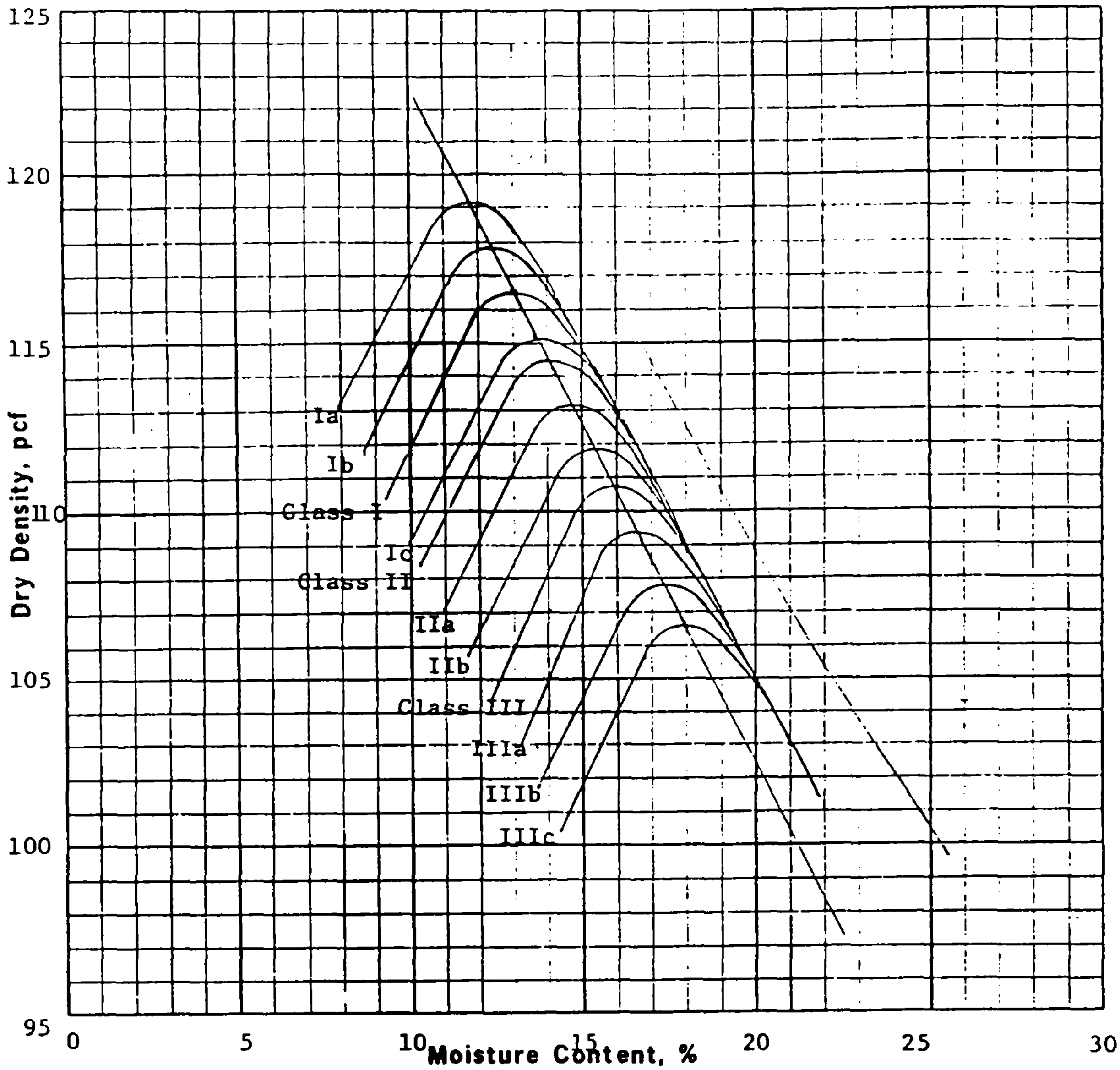

FIGURE 2.5-322

HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-523





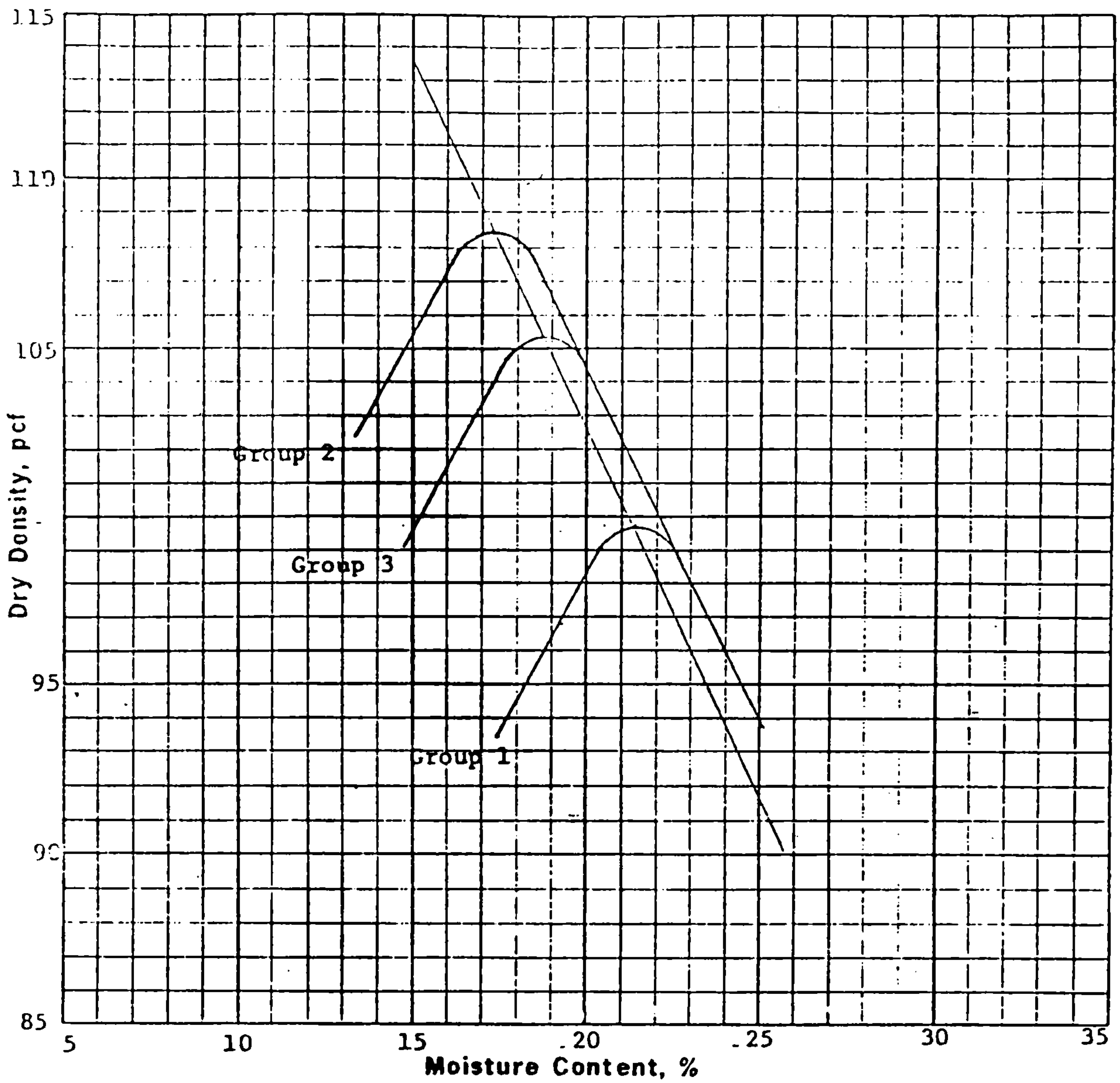

| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-SM-SC | 0 | 70 | 15 | 15 | 2.66 | 24 | 5 | 13.1 | 116.6 |
| II-SC | 0 | 51 | 24 | 25 | 2.69 | 28 | 11 | 14.1 | 114.4 |
| III-CL | 0 | 40 | 29 | 31 | 2.69 | 34 | 15 | 15.9 | 110.8 |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
TRENCH A, BORROW
FIGURE 2.5-524



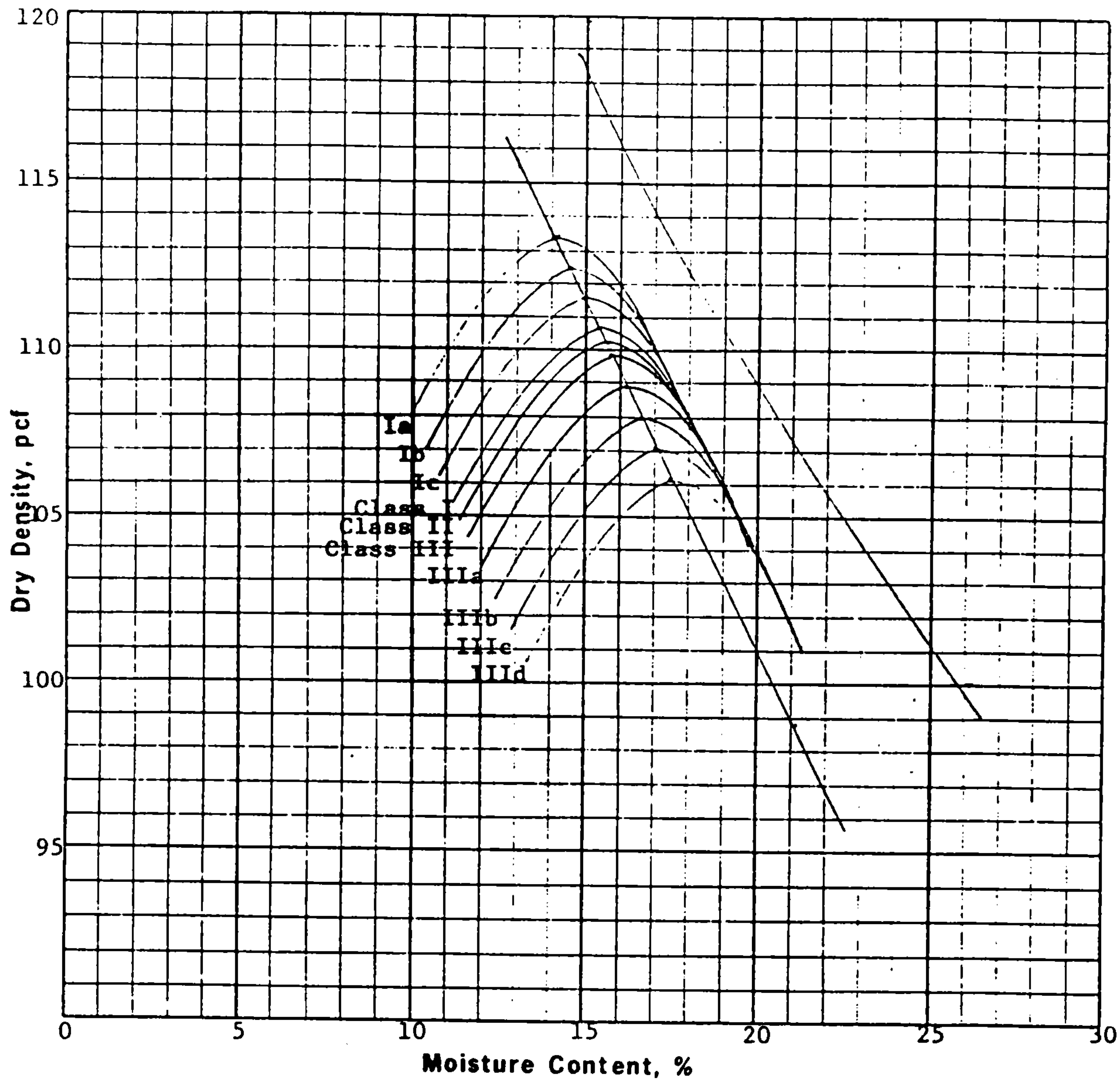

| Soil Group | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| 1-ML | 0 | 16 | 44 | .40 | 2.73 | 47 | 18 | 21.4 | 99.7 |
| 2-SM | 0 | 54 | 31 | 15 | 2.72 | 26 | 1 | 17.3 | 108.4 |
| 3-ML | 0 | 43 | 35 | 22 | 2.73 | 34 | 8 | 18.8 | 105.3 |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

| Remarks: |
|---|
| Group 1 Silty sand fraction, upper |
| Group 2 Sand fraction, lower |
| Group 3 Composite, stockpile |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION, TRENCH A
SUPPLEMENTAL BORROW
FIGURE 2.5-525



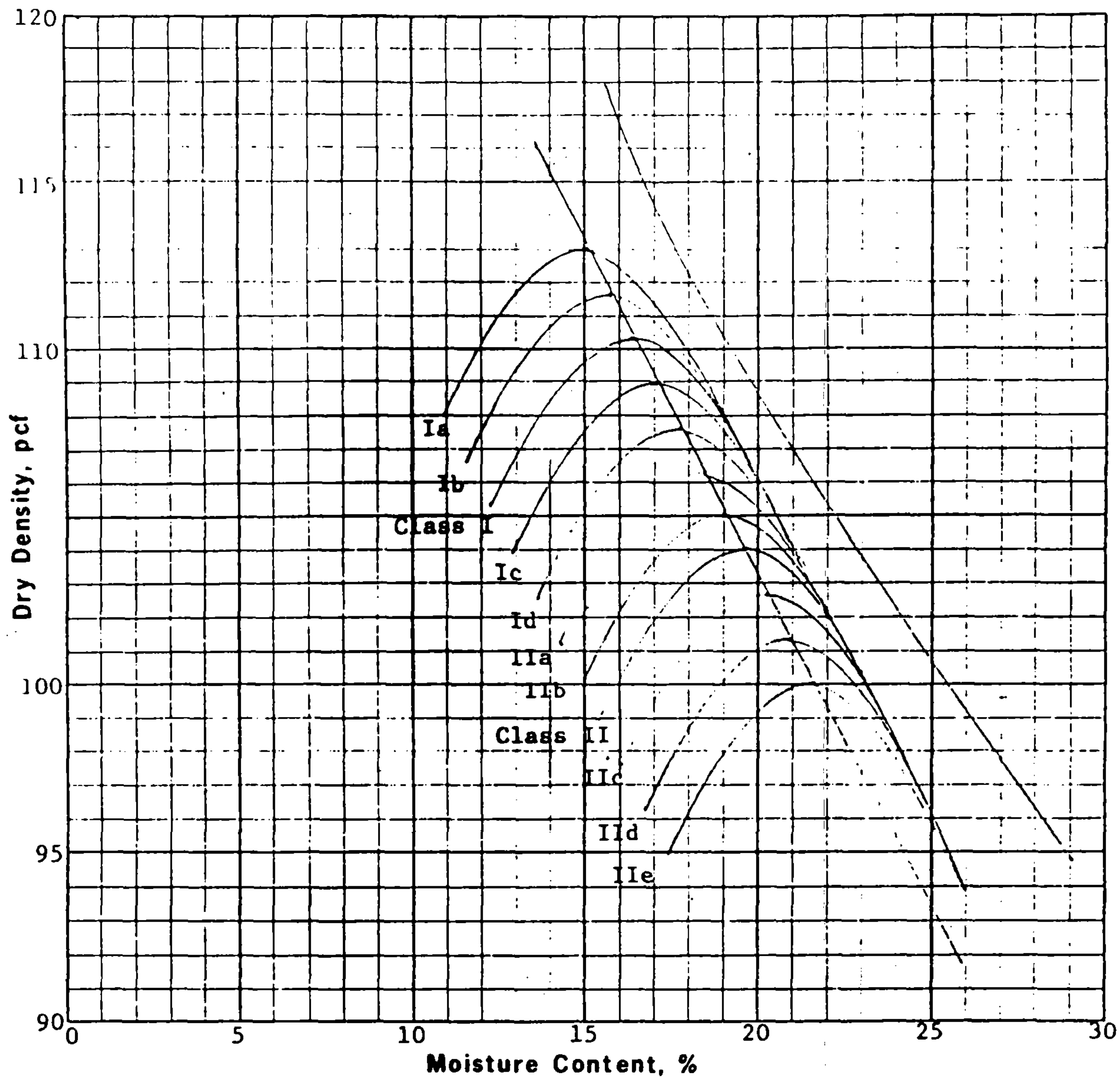

| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-SM | 0 | 66 | 22 | 12 | 2.65 | NP | NP | 15.3 | 110.7 |
| II-SM-SC | 0 | 55 | 24 | 21 | 2.67 | 28 | 6 | 15.6 | 110.3 |
| III-CL | 0 | 43 | 28 | 29 | 2.69 | 30 | 11 | 15.8 | 109.8 |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
TRENCH B
FIGURE 2.5-526




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-CL | 0 | 24 | 40 | 36 | 2.66 | 31 | 16 | 16.4 | 110.3 |
| II-CL-ML | 0 | 32 | 27 | 41 | 2.70 | 40 | 15 | 19.6 | 104.0 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

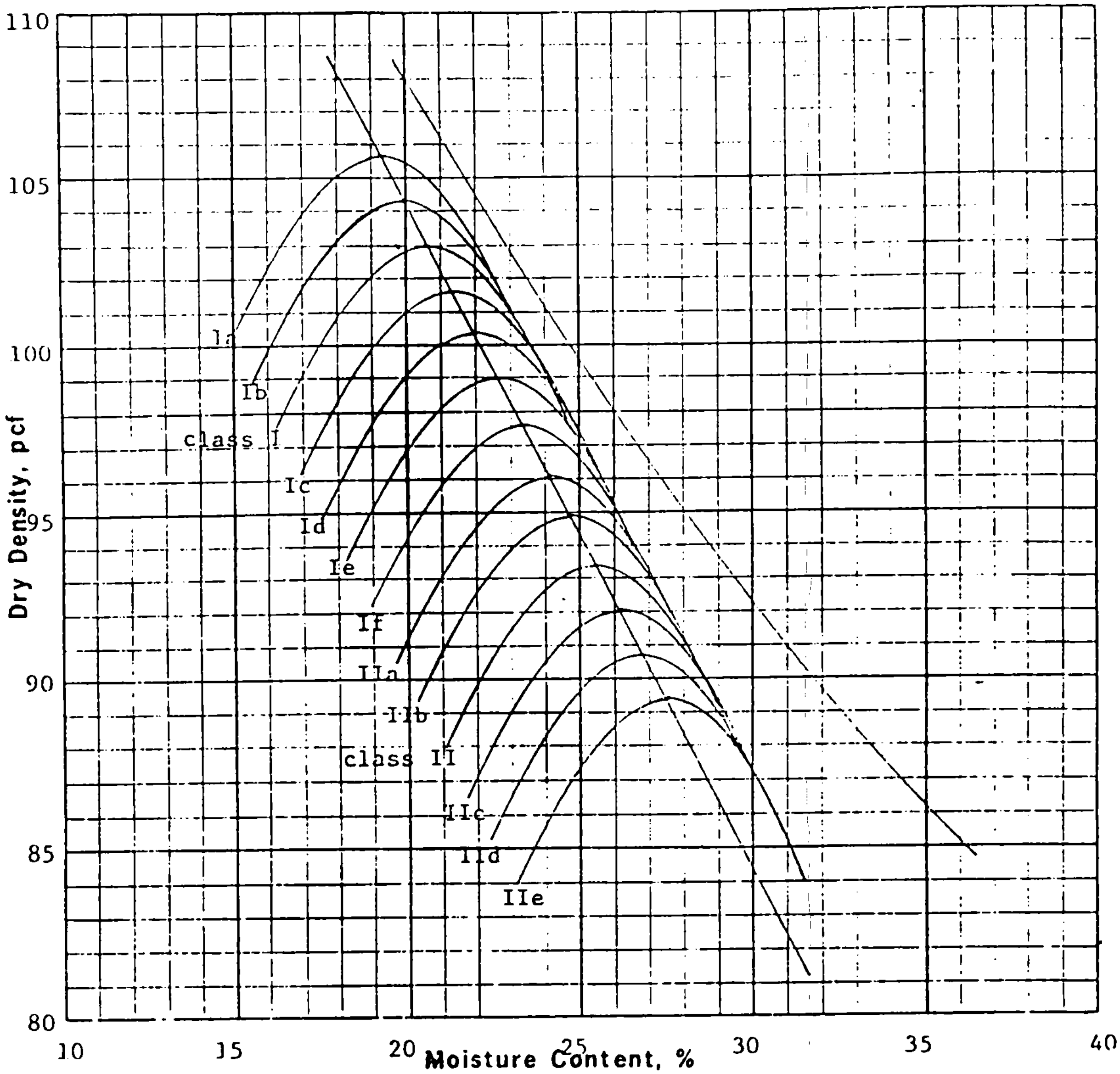
| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 9
FIGURE 2.5-527

**HISTORICAL**




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-CL | 0 | 33 | 31 | 36 | 2.65 | 39 | 16 | 20.6 | 103.0 |
| II-CL-ML | 0 | 19 | 33 | 48 | 2.65 | 45 | 19 | 25.4 | 93.3 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

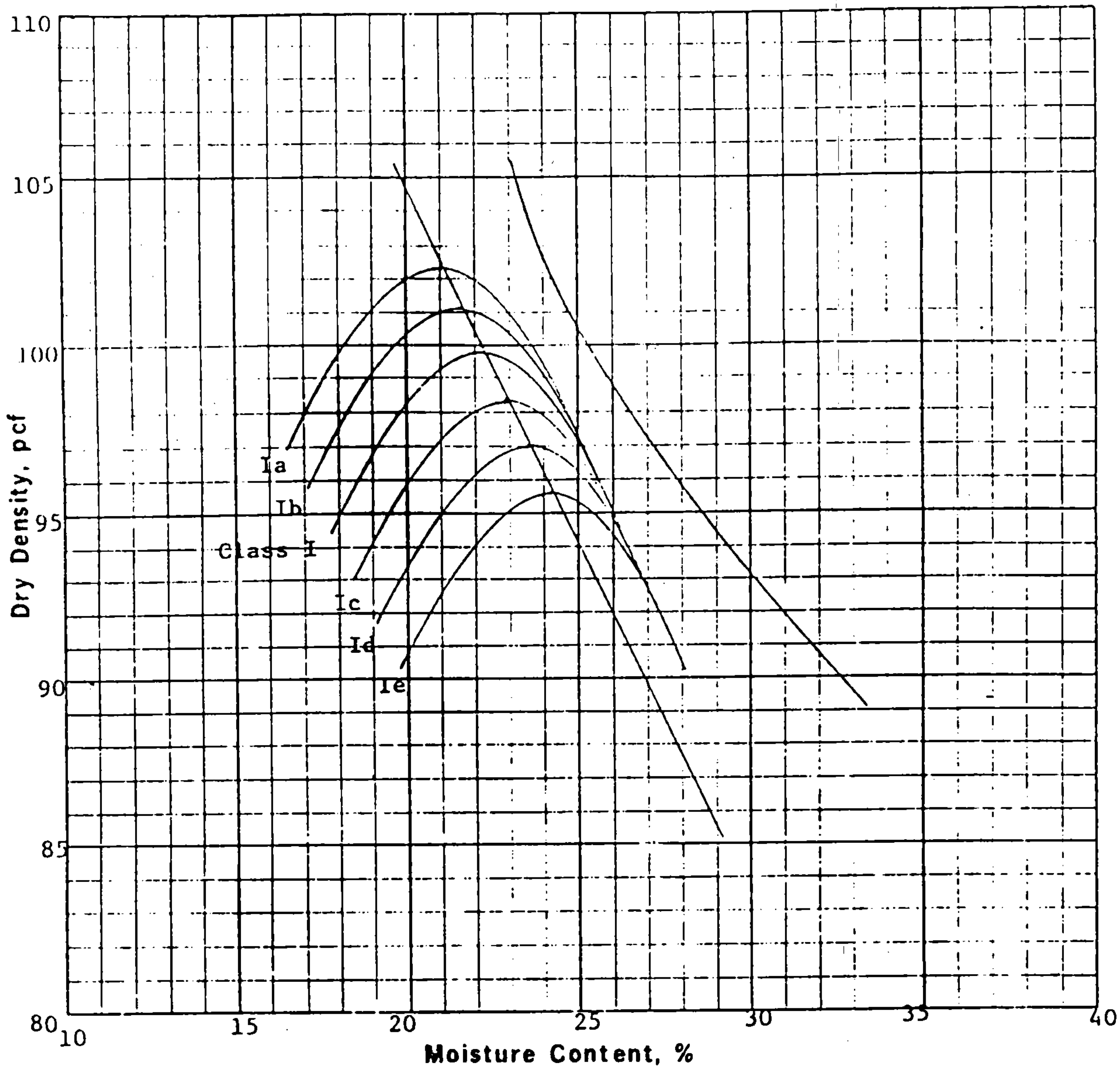
| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 10
FIGURE 2.5-528

HISTORICAL



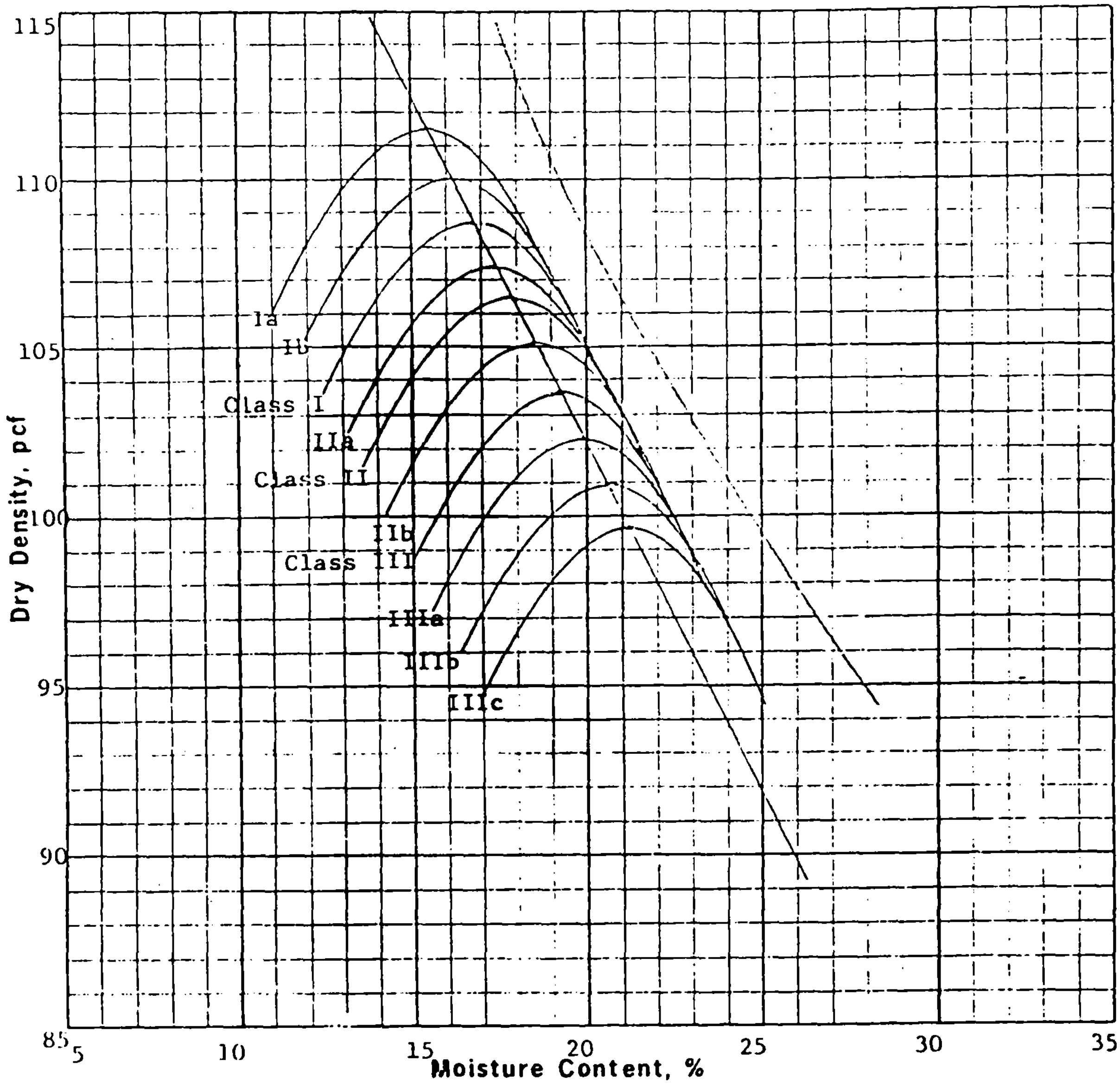

| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-ML | 0 | 21 | 35 | 44 | 2.71 | 44 | 15 | 22.2 | 99.8 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 11
FIGURE 2.5-529



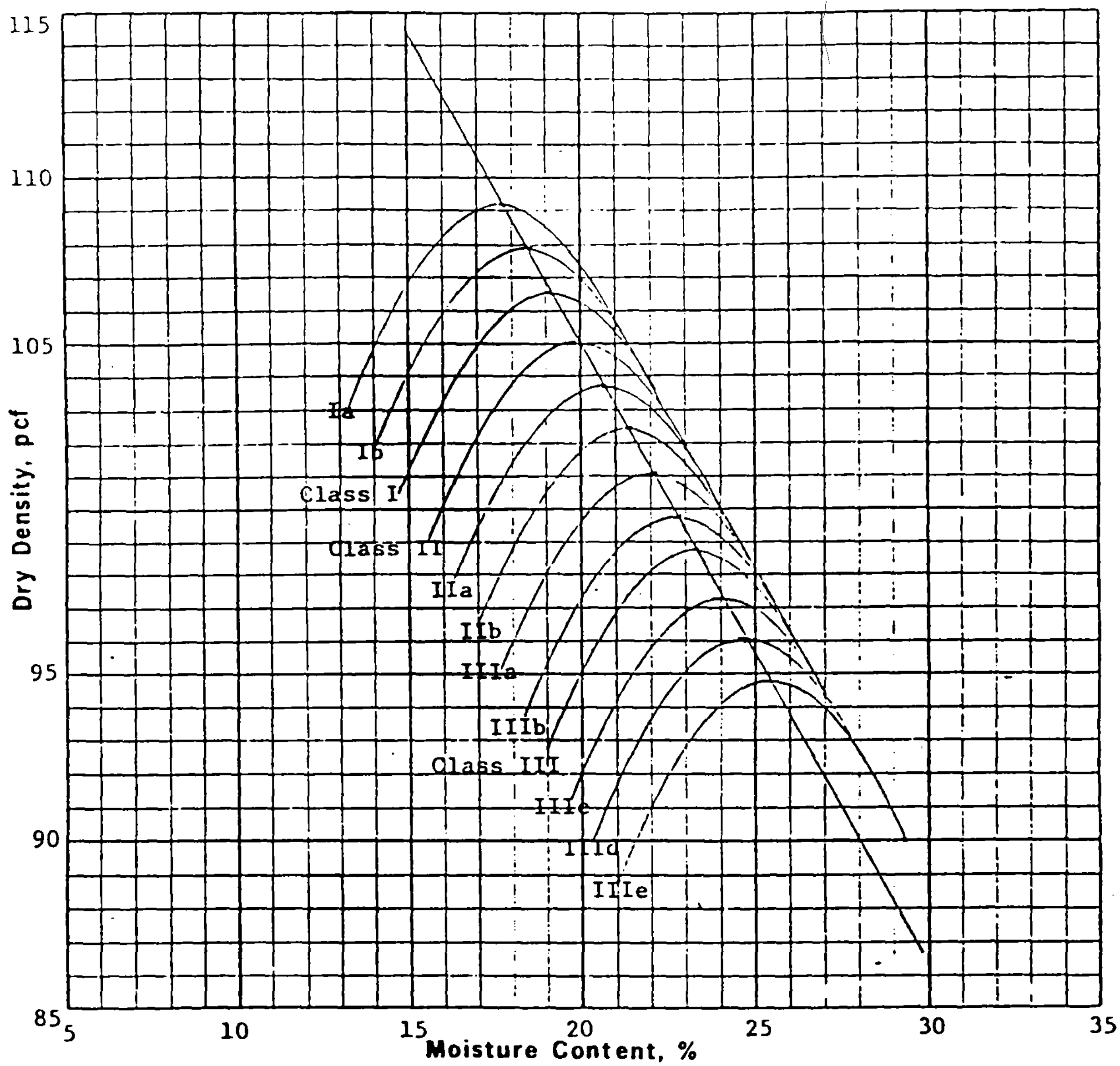

| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-SM | 0 | 50 | 26 | 24 | 2.69 | 32 | 7 | 16.8 | 108.8 |
| II-CL-ML | 0 | 22 | 39 | 39 | 2.70 | 40 | 15 | 17.8 | 106.5 |
| III-CL-ML | 0 | 22 | 40 | 38 | 2.66 | 42 | 16 | 19.2 | 103.7 |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 12
FIGURE 2.5-530



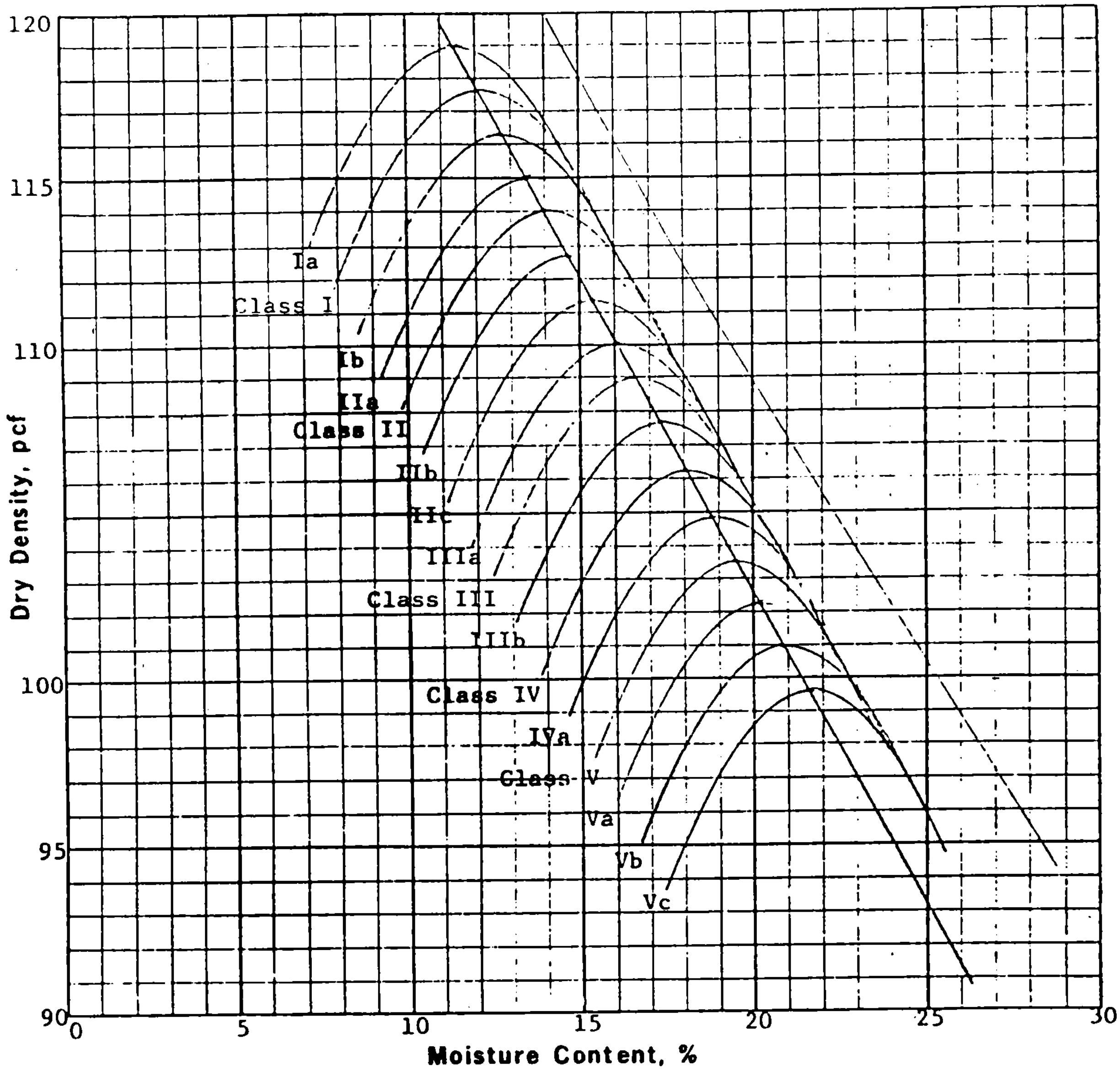

| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-ML | 0 | 24 | 42 | 34 | 2.71 | 37 | 11 | 19.2 | 106.6 |
| II-ML | 0 | 23 | 39 | 38 | 2.73 | 41 | 14 | 20.0 | 105.1 |
| III-MH | 0 | 12 | 41 | 47 | 2.74 | 52 | 17 | 23.3 | 98.8 |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 13
FIGURE 2.5-531




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| I-ML | 0 | 48 | 40 | 12 | 2.63 | NP | NP | 12.1 | 117.7 |
| II-SM-SC | 0 | 65 | 16 | 19 | 2.68 | 25 | 6 | 13.9 | 114.0 |
| III-CL | 0 | 48 | 23 | 29 | 2.67 | 36 | 14 | 16.6 | 109.0 |
| IV-CL | 0 | 30 | 34 | 36 | 2.68 | 41 | 17 | 18.1 | 106.2 |
| V-CL-ML | 0 | 23 | 39 | 38 | 2.70 | 44 | 17 | 19.5 | 103.5 |

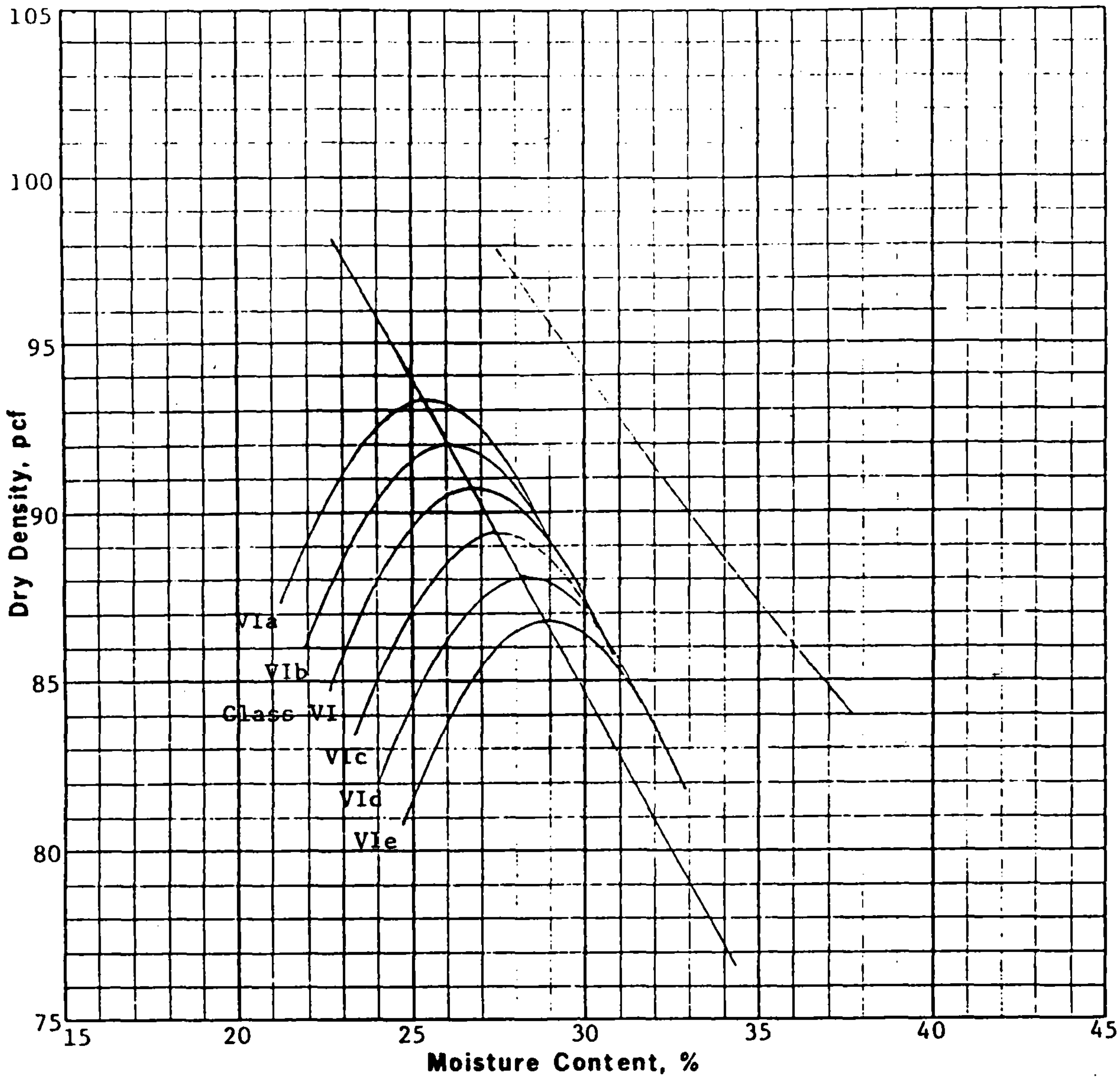
| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 2C
FIGURE 2.5-532

**HISTORICAL**




| Soil Class | Gravel % | Sand % | Silt % | Clay % | Specific Gravity | LL % | PI % | Optimum Moisture, % | Maximum Density, pcf |
|---|---|---|---|---|---|---|---|---|---|
| VI-MH | 0 | 5 | 40 | 55 | 2.74 | 62 | 27 | 26.8 | 90.8 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| | |
|---|---|
| Plus No. 4 Specific Gravity, S S D | -- |
| Plus No. 4 Absorption, % | -- |

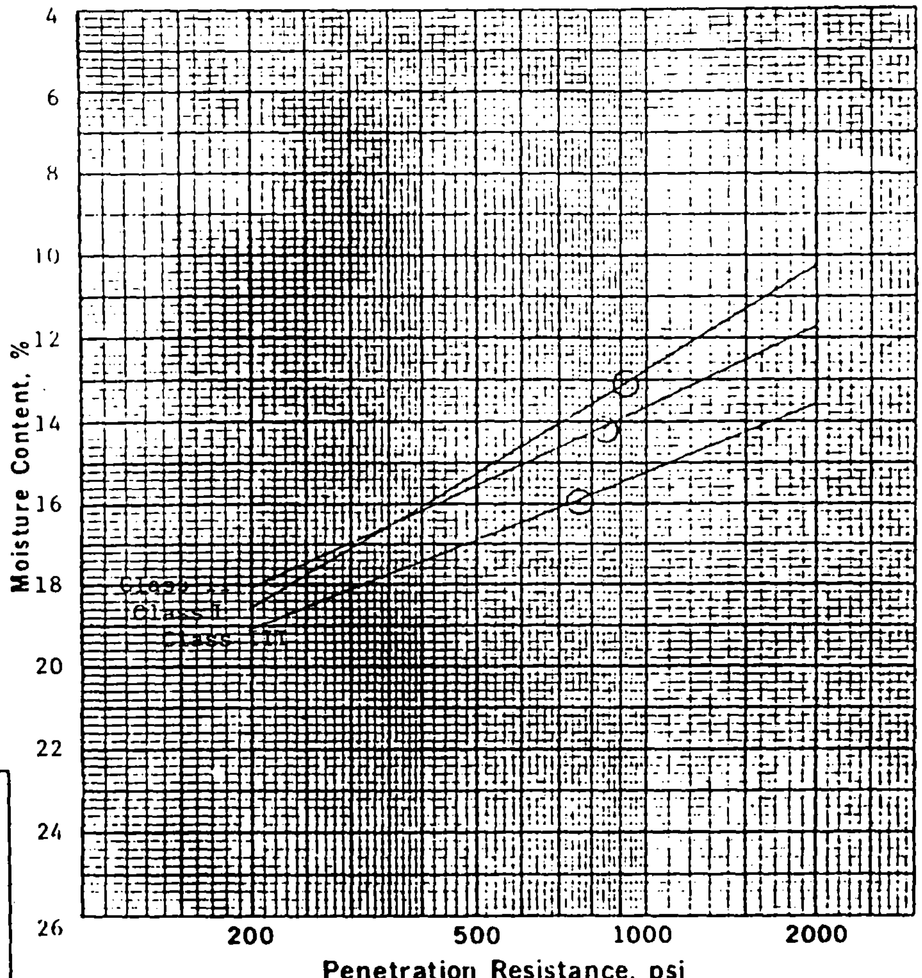
Remarks:

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 2C
FIGURE 2.5-533

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SOIL LIQUEFACTION
TRENCH A
FIGURE 2.5-5[illegible]



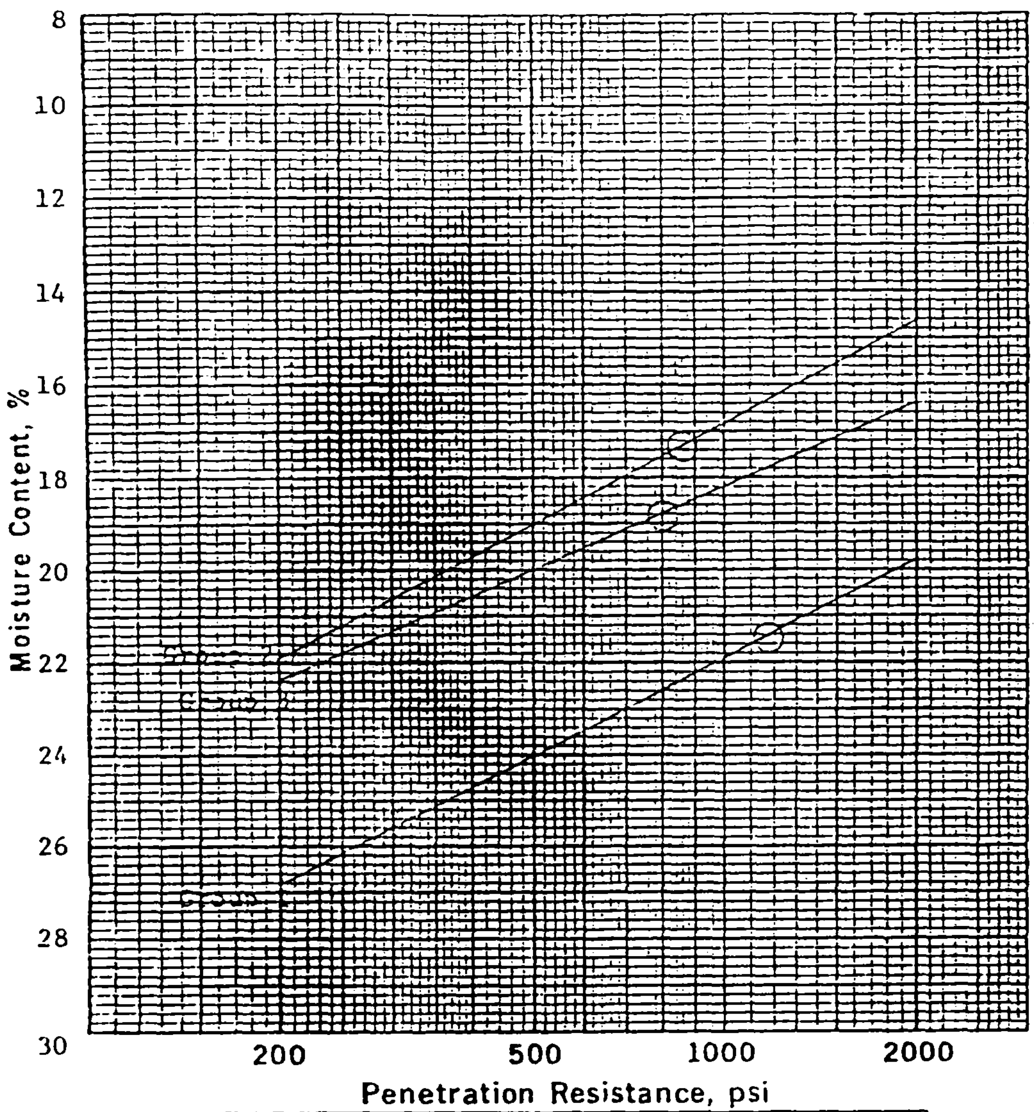

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-SM-SC | 13.1 | 116.6 | 910 |
| II-SC | 14.1 | 114.4 | 840 |
| III-CL | 15.9 | 110.8 | 760 |
| | | | |
| | | | |

**Remarks:**

○ **Denotes Optimum Moisture**

| | |
|---|---|
| **Project** | Watts Bar Nuclear Plant<br>ERCW Liquefaction |
| **Feature** | Trench A |
| **ASTM Designation** | D 698A |
| **Date Tested** | 6-6-83 |

**MOISTURE - PENETRATION TEST**



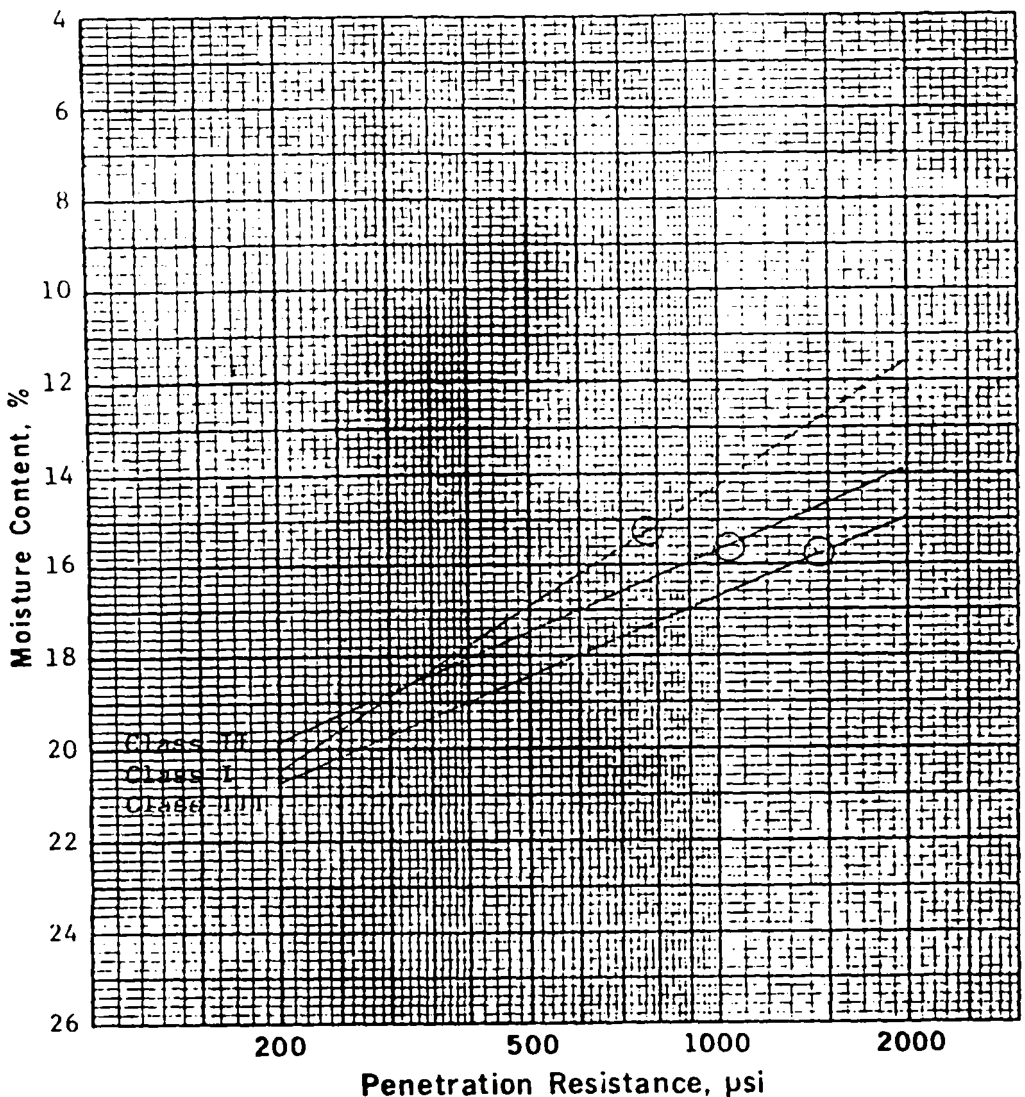

| Soil Group | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| 1-ML | 21.4 | 99.7 | 1180 |
| 2-SM | 17.3 | 108.4 | 860 |
| 3-ML | 18.8 | 105.3 | 800 |
| | | | |
| | | | |

| Remarks: |
|---|
| |
| |
| |
| |

◯ Denotes Optimum Moisture

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**ERCW LIQUEFACTION, TRENCH A**
**SUPPLEMENTAL BORROW**
**FIGURE 2.5-535**



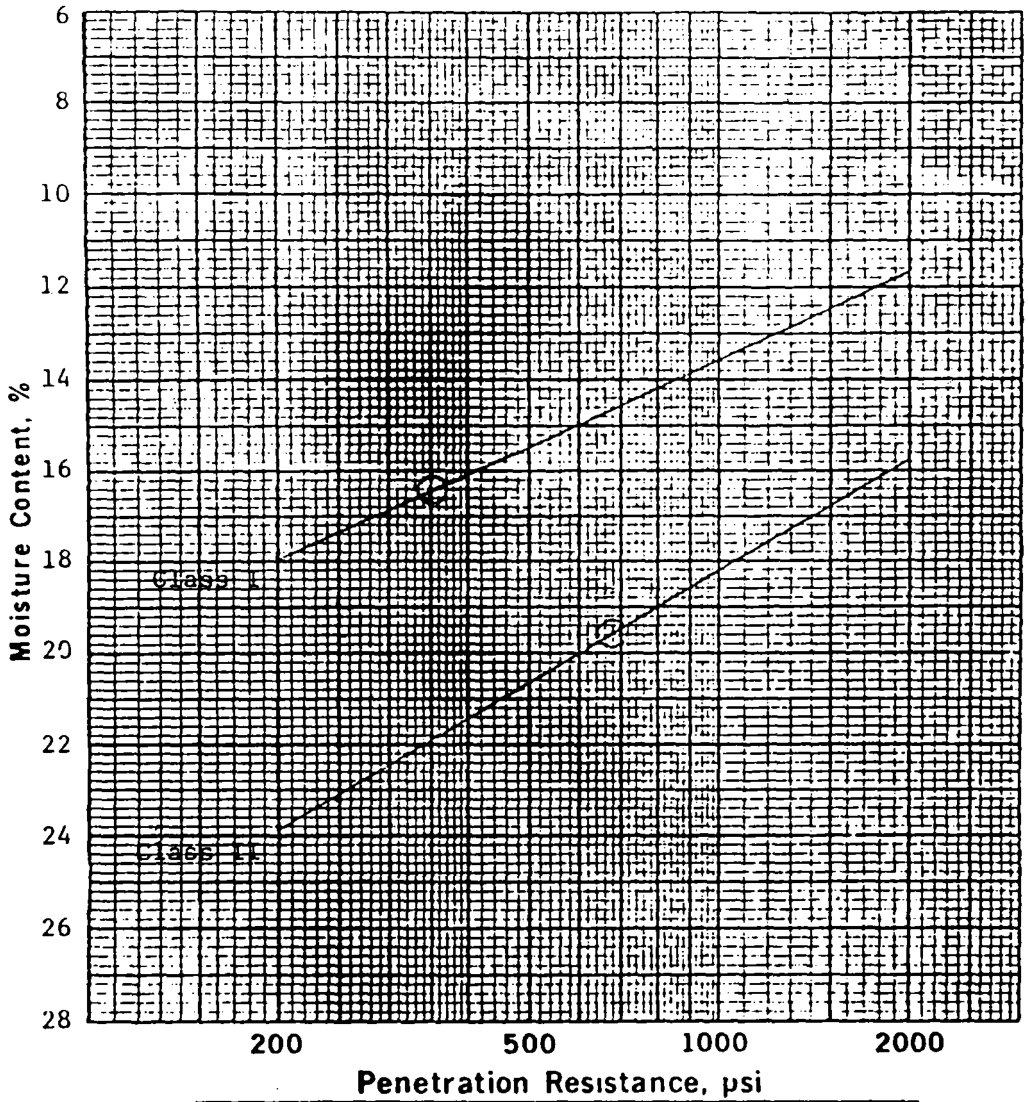

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-SM | 15.3 | 110.7 | 770 |
| II-SM-SC | 15.6 | 110.3 | 1025 |
| III-CL | 15.8 | 109.8 | 1425 |
| | | | |
| | | | |

Remarks:

◯ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
TRENCH B
FIGURE 2.5-536



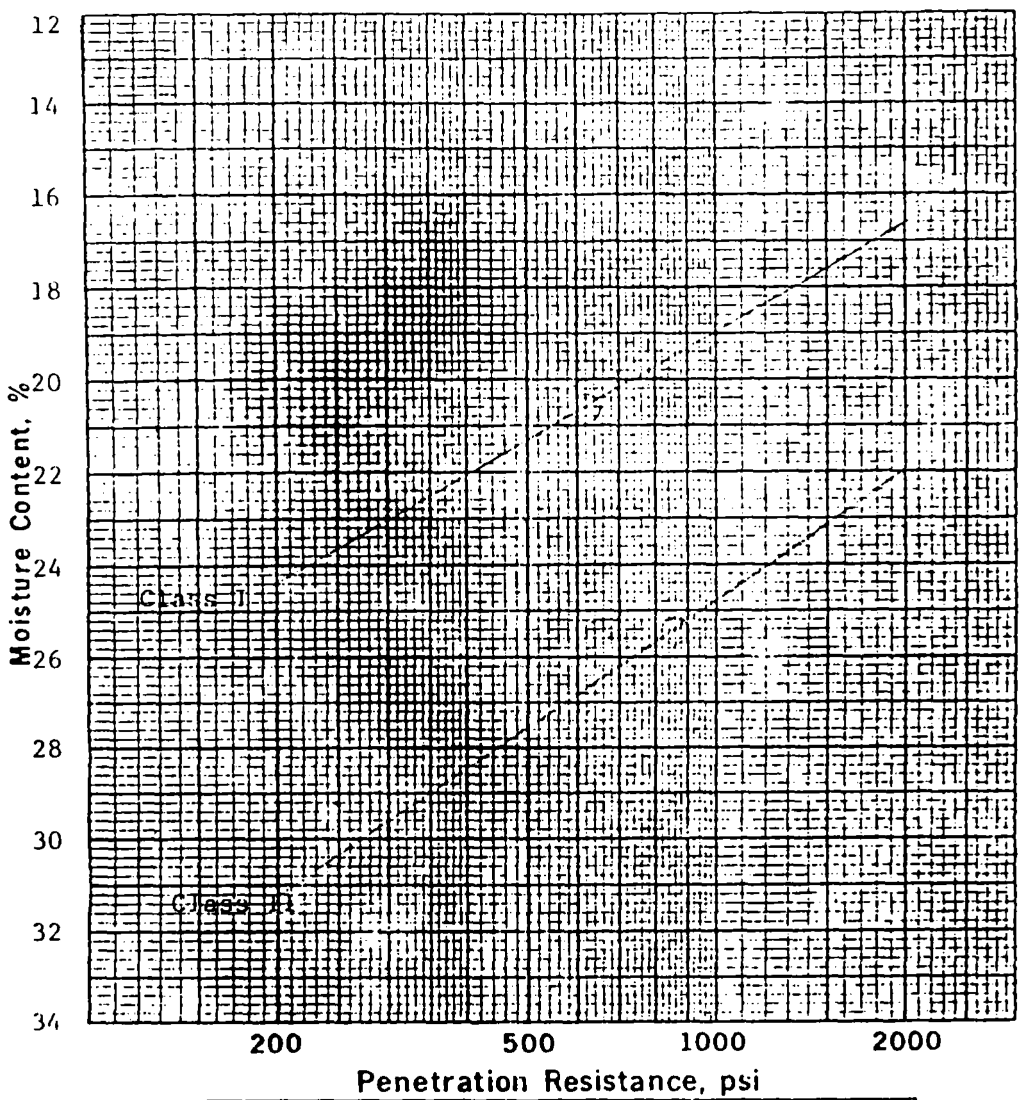

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-CL | 16.4 | 110.3 | 350 |
| II-CL-ML | 19.6 | 104.0 | 680 |
| | | | |
| | | | |
| | | | |

Remarks:

○ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 9
FIGURE 2.5-537



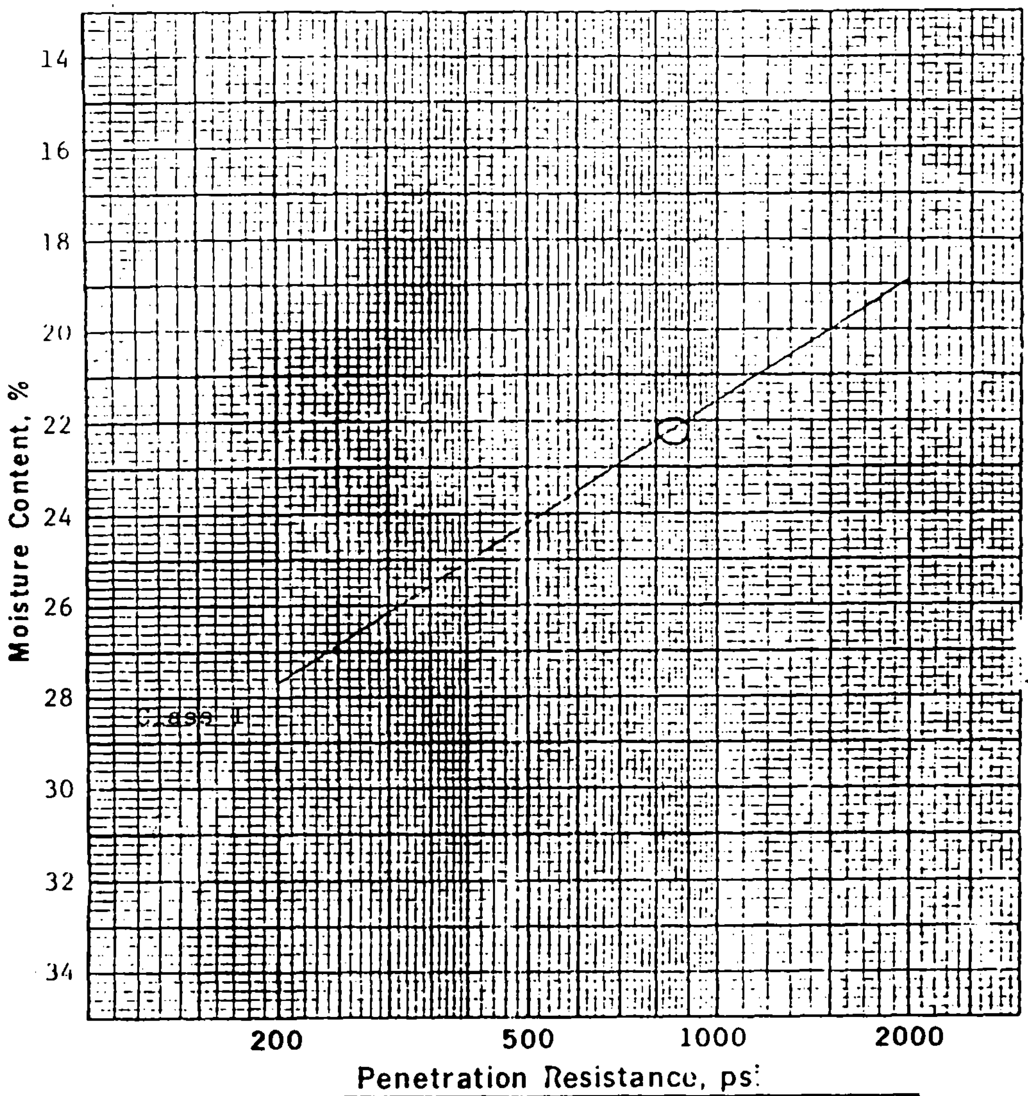

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-CL | 20.6 | 103.0 | 620 |
| II-CL-ML | 25.4 | 93.3 | 860 |
| | | | |
| | | | |
| | | | |

Remarks:

◯ Denotes Optimum Moisture

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**ERCW LIQUEFACTION**
**BORROW AREA 10**
**FIGURE 2.5-538**



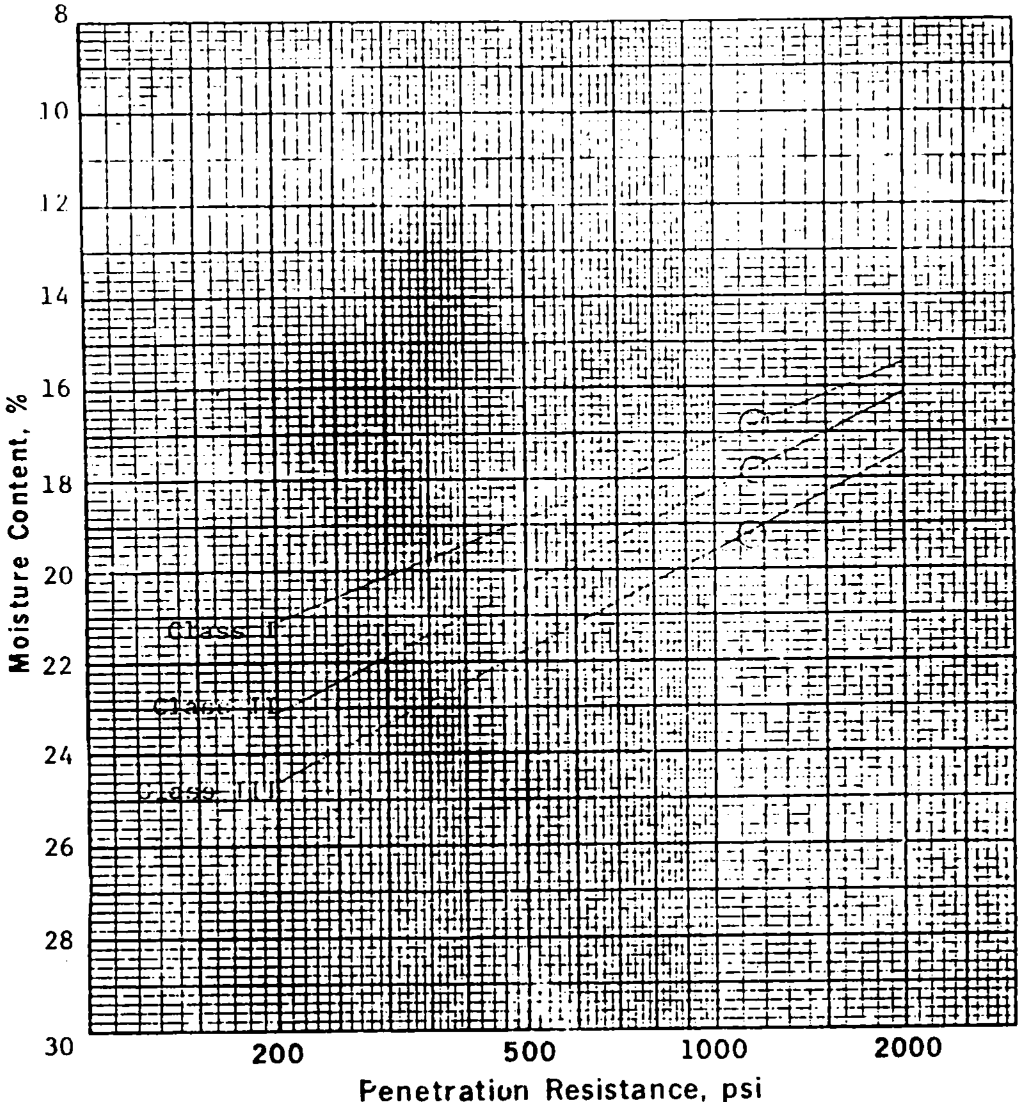

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-ML | 22.2 | 99.8 | 850 |
| | | | |
| | | | |
| | | | |
| | | | |

Remarks:

○ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 11
FIGURE 2.5-539



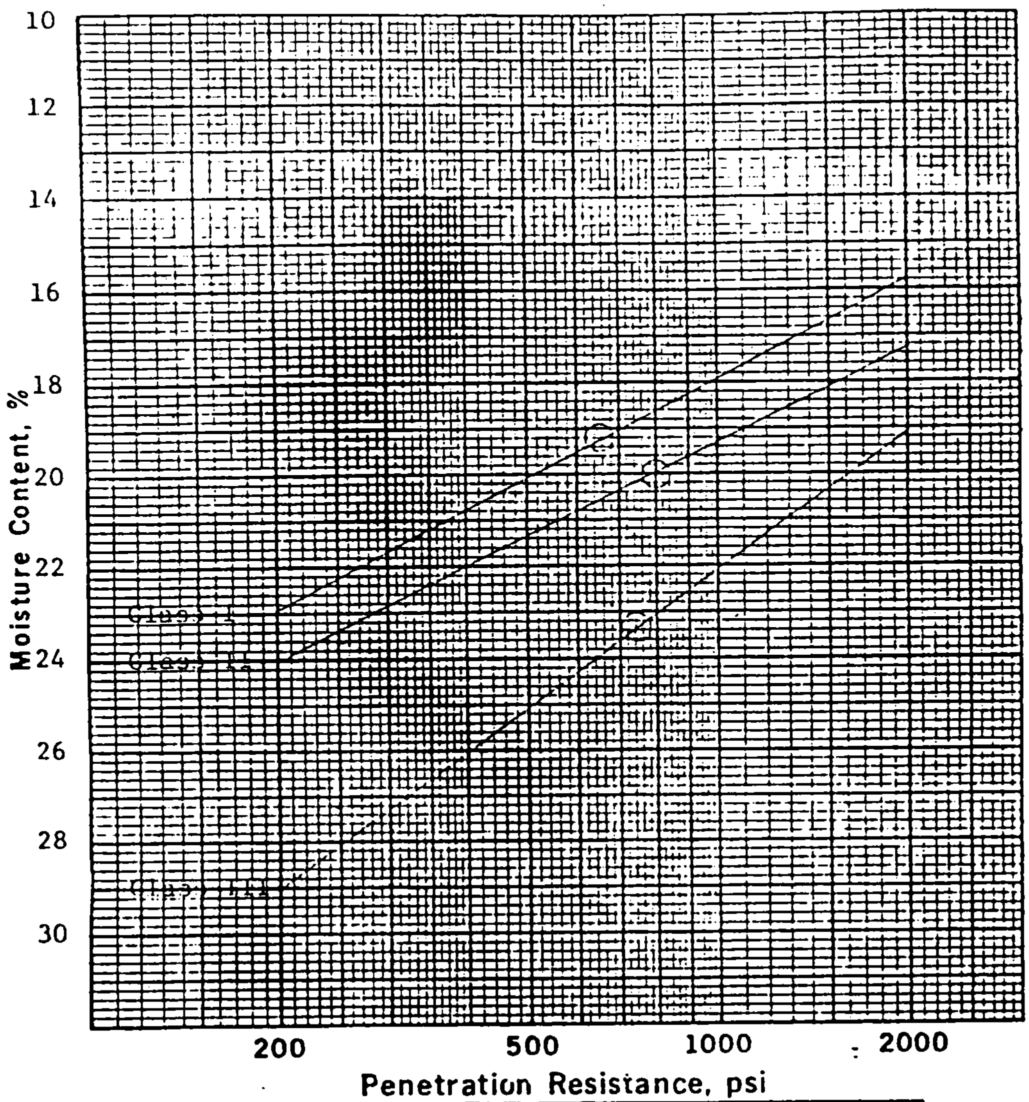

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-ML | 16.8 | 108.8 | 1165 |
| CL-II-ML | 17.8 | 106.5 | 1150 |
| CL-III-ML | 19.2 | 103.7 | 1145 |
| | | | |
| | | | |

| Remarks: |
|---|
| |
| |
| |
| |

○ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 12
FIGURE 2.5-540



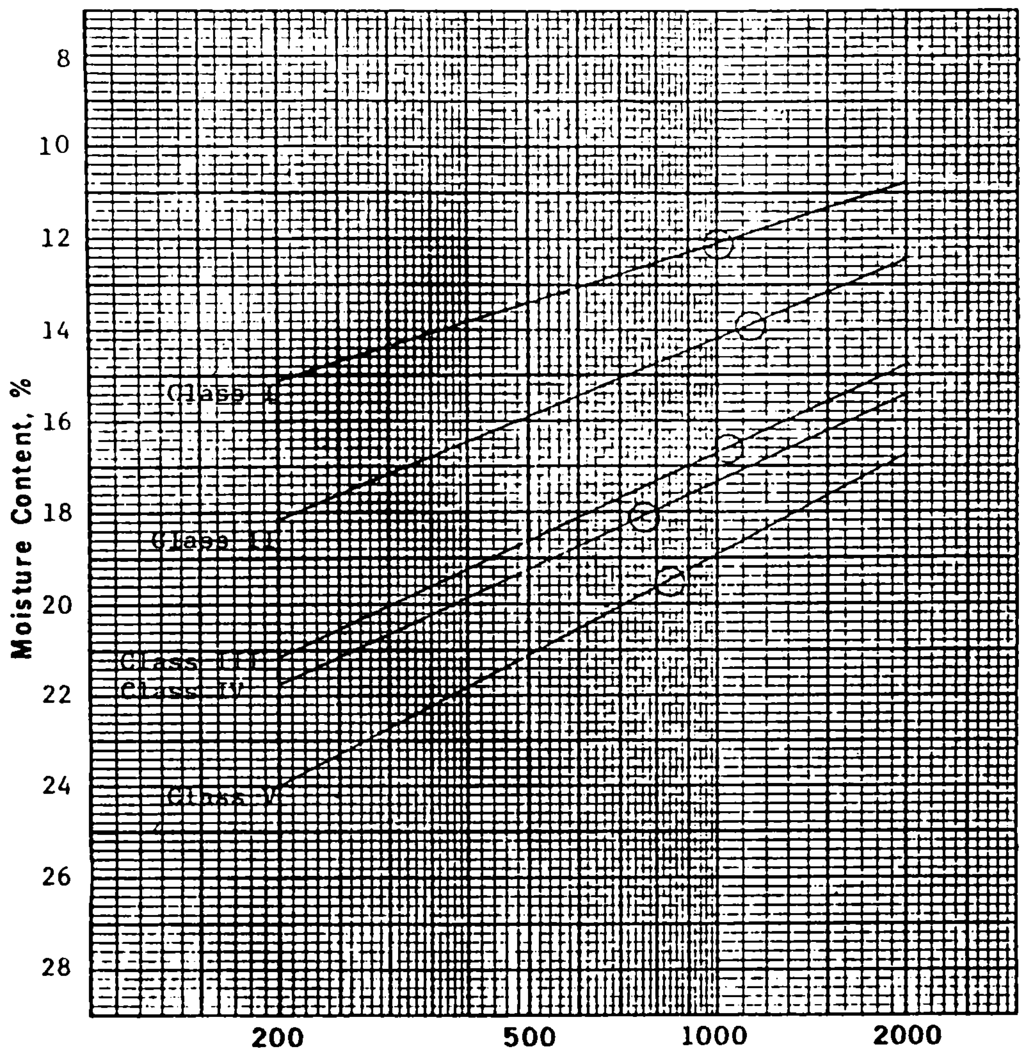

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-ML | 19.2 | 106.6 | 650 |
| II-ML | 20.0 | 105.1 | 800 |
| III-MH | 23.3 | 98.8 | 740 |
| | | | |
| | | | |

Remarks:

○ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 13
FIGURE 2.5-541



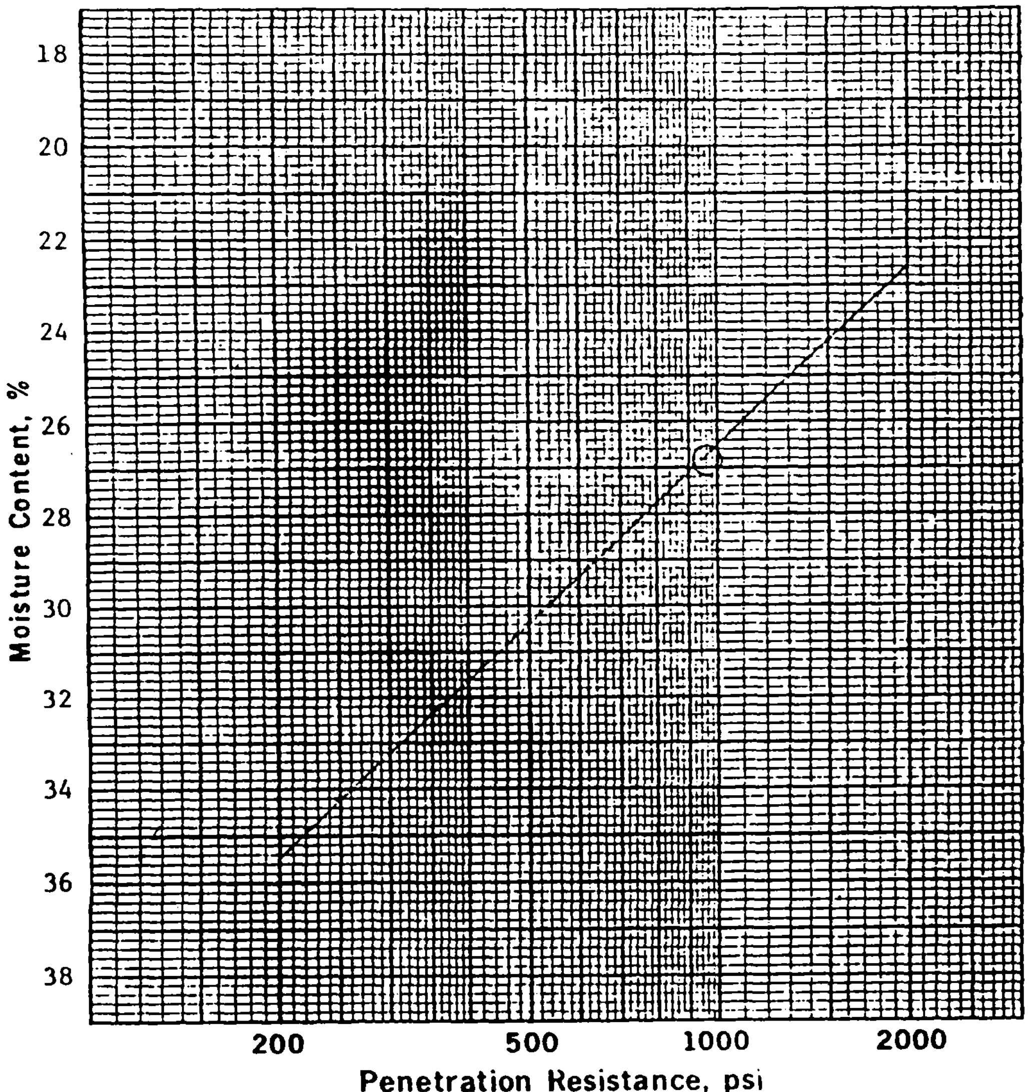

| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| I-ML | 12.1 | 117.7 | 1000 |
| II-SM-SC | 13.9 | 114.0 | 1125 |
| III-CL | 16.6 | 109.0 | 1050 |
| IV-CL | 18.1 | 106.2 | 760 |
| V-CL-ML | 19.5 | 103.5 | 840 |

**Remarks:**

○ Denotes Optimum Moisture

**WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT**

**ERCW LIQUEFACTION BORROW AREA 2C**
**FIGURE 2.5-542**




| Soil Class | Optimum Moisture, % | Maximum Density, pcf | Penetration Resistance, psi |
|---|---|---|---|
| VI-MH | 26.8 | 90.8 | 950 |
| | | | |
| | | | |
| | | | |
| | | | |

| Remarks: |
|---|
| |
| |
| |
| |

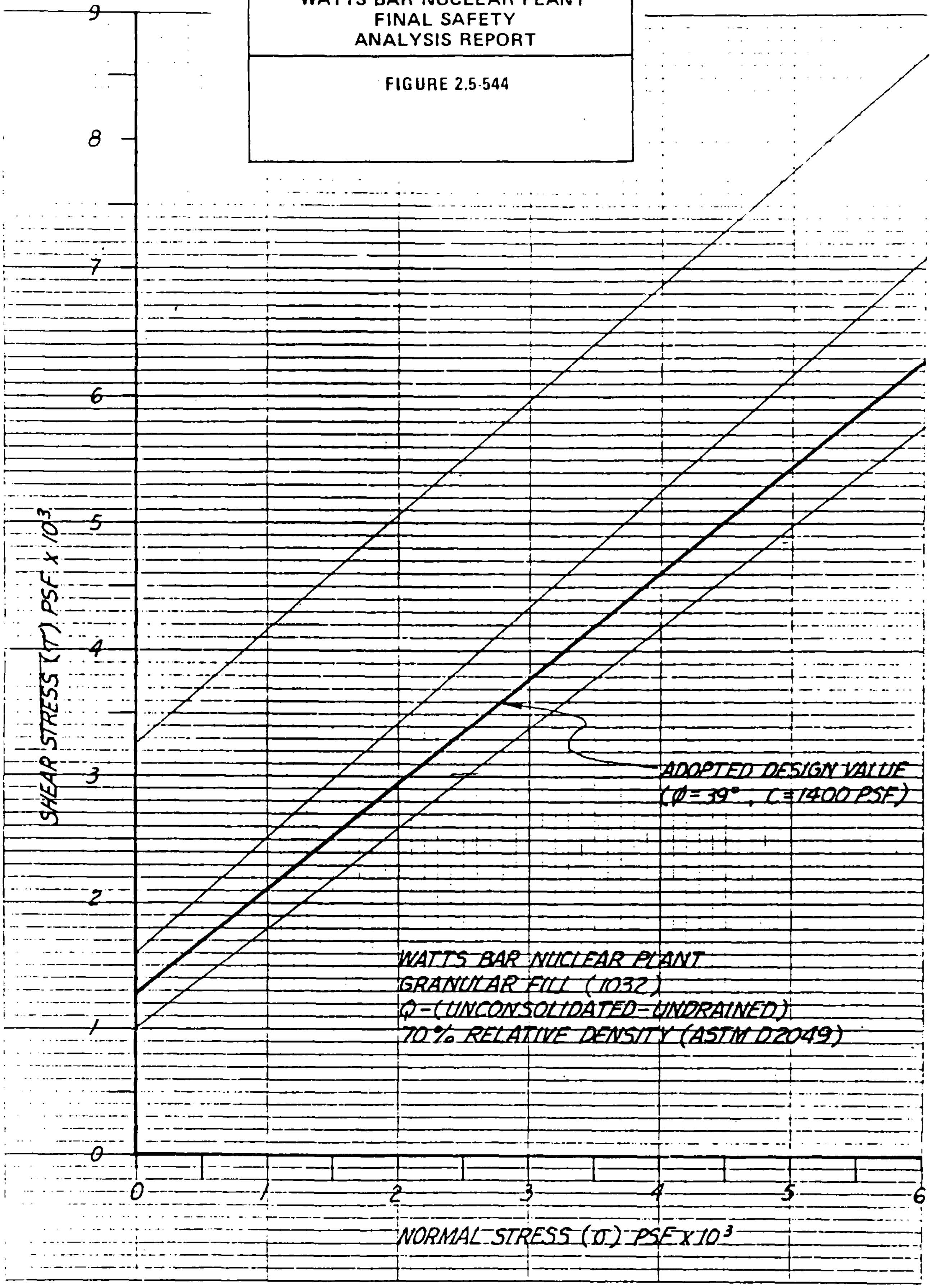
◯ Denotes Optimum Moisture

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW LIQUEFACTION
BORROW AREA 2C
FIGURE 2.5-543

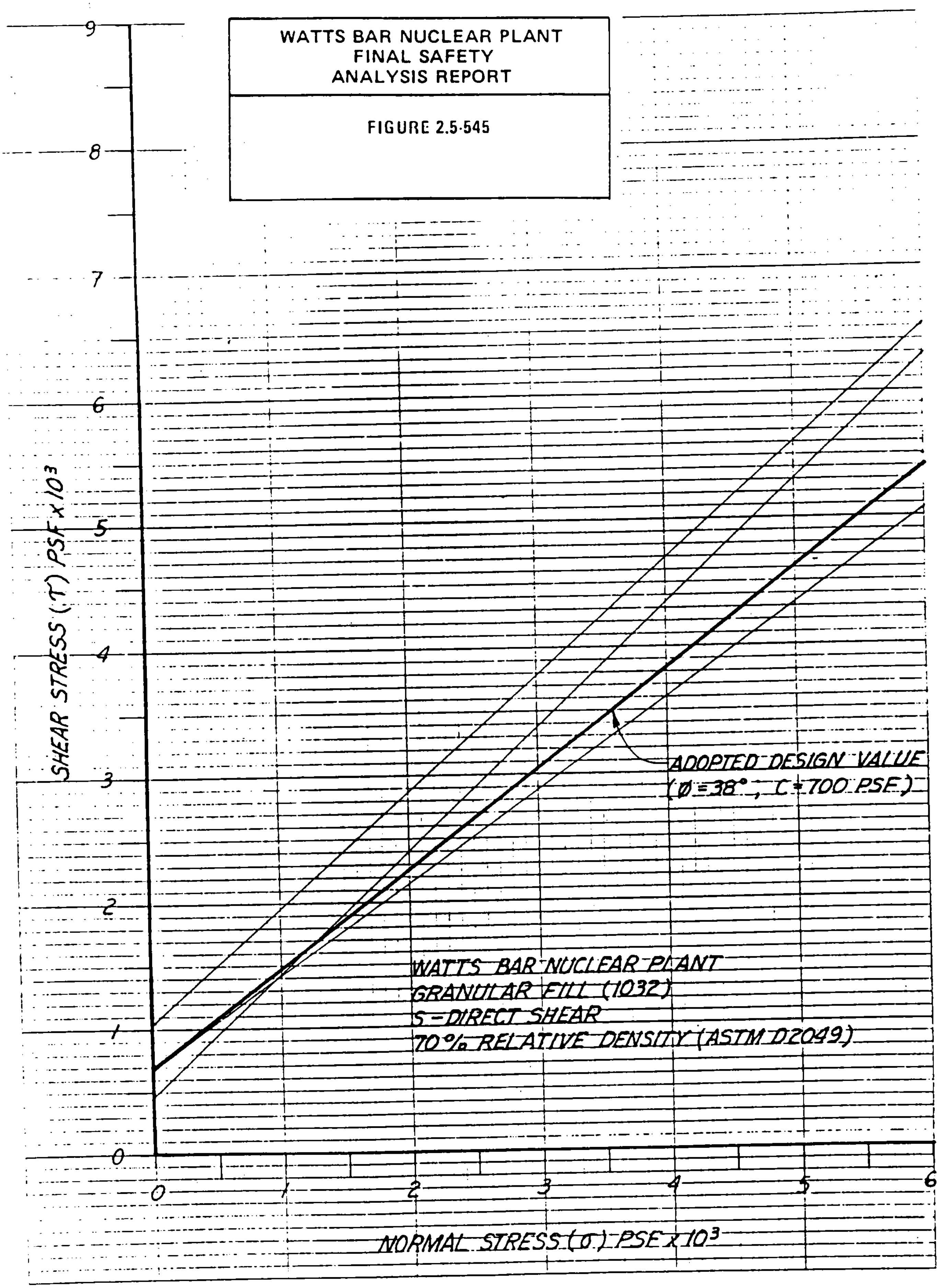
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-544



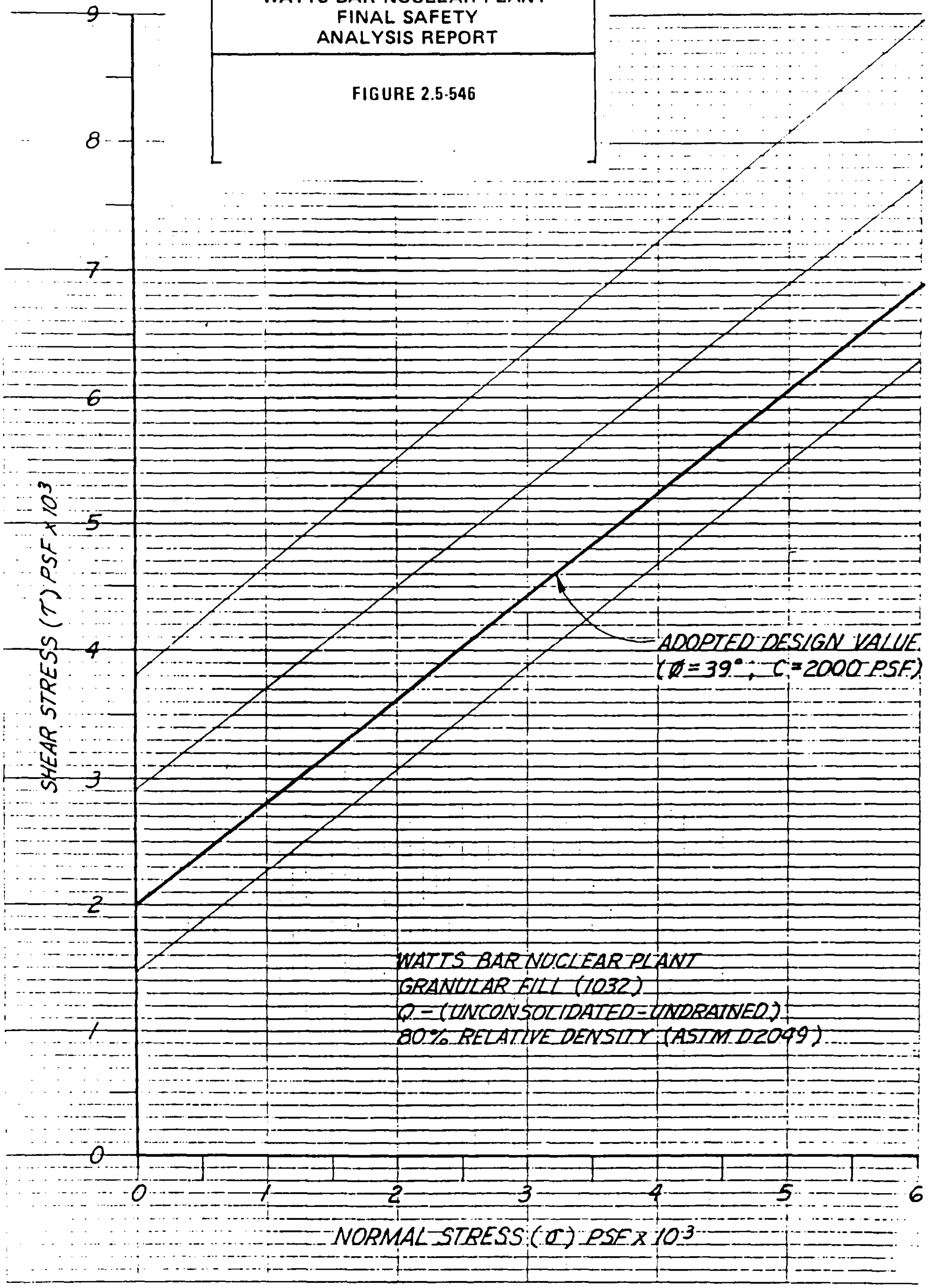
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-545



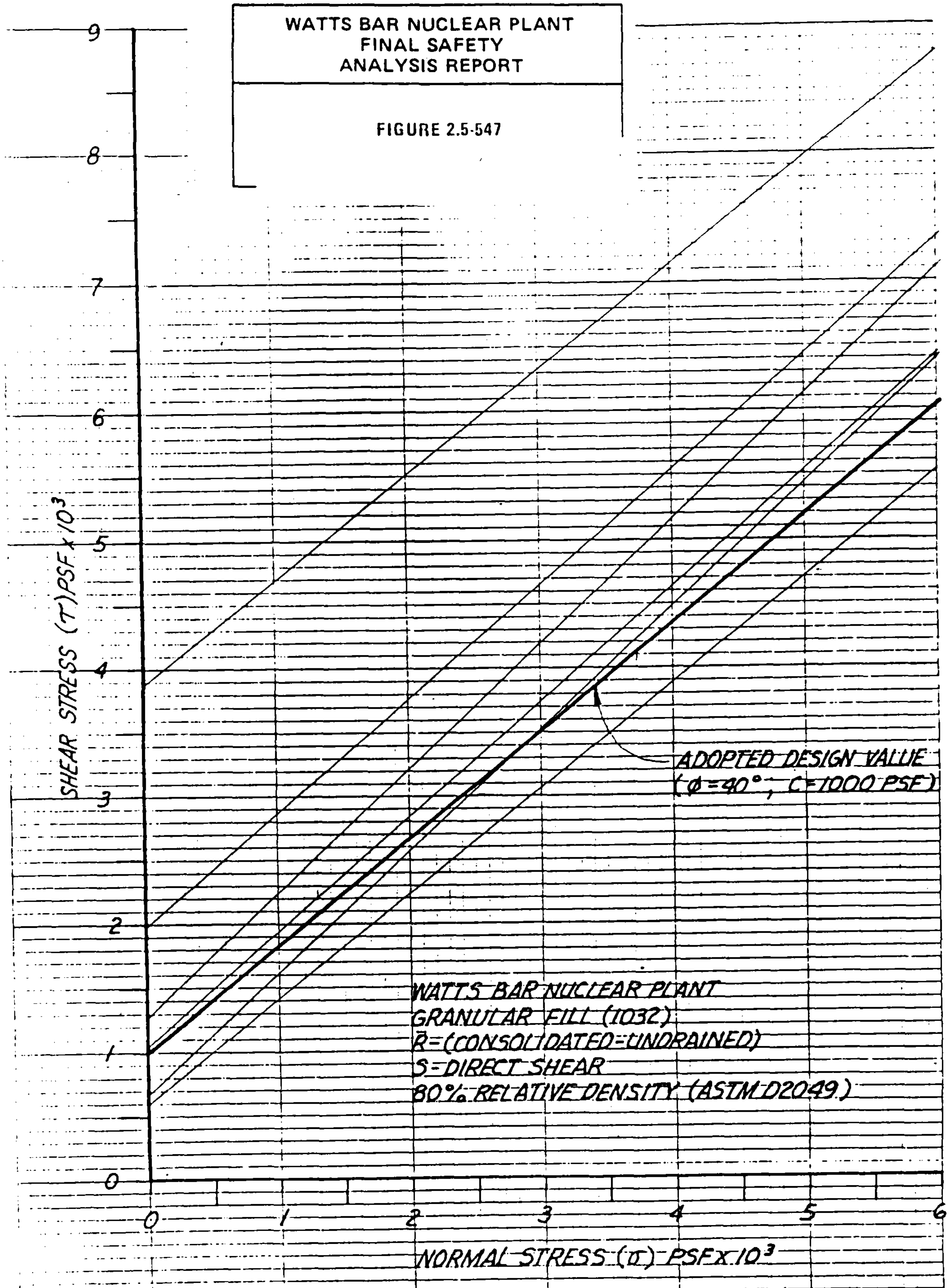
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-546



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-547



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-548

Summary of granular fill test data - relative density
Feature: DIESEL GENERATOR BUILDING
Period: 3-28-75 to 4-24-75 Test No. ______ to ______
Part II Section ______ Prepared by ______

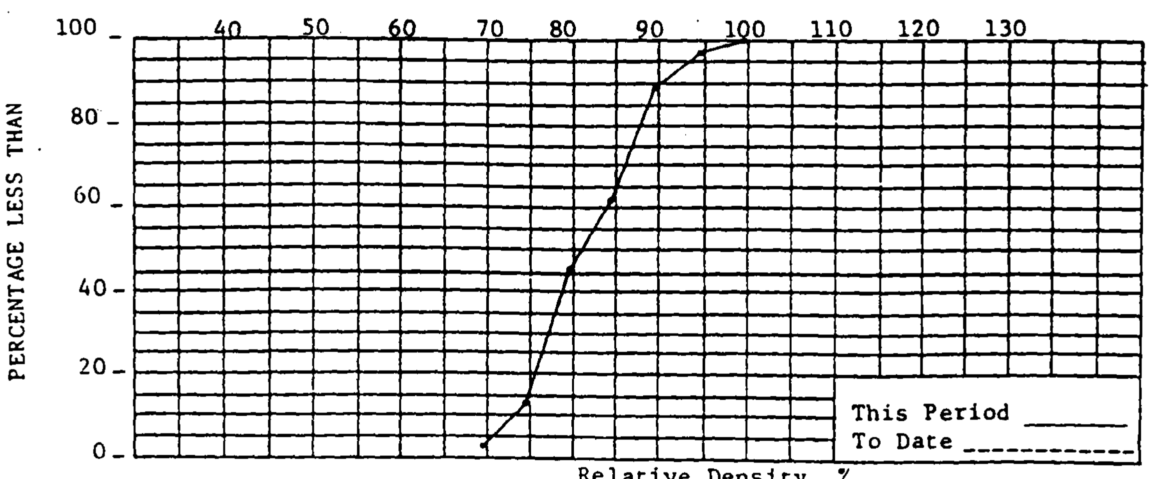
RELATIVE DENSITY, %

| | PLOT THIS COLUMN | PREV. CUM. F | THIS PERIOD FREQUENCY (F) | F | CUM F | CUM % | TO DATE F | CUM F | CUM % |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| 55.0 | 59.9 | | | | | | | | |
| 60.0 | 64.9 | | | | | | | | |
| 65.0 | 69.9 | | \| | 1 | 1 | 2.7 | | | |
| 70.0 | 74.9 | | \|\|\|\| | 4 | 5 | 13.5 | | | |
| 75.0 | 79.9 | | 卌 卌 \|\| | 12 | 17 | 45.9 | | | |
| 80.0 | 84.9 | | 卌 \| | 6 | 23 | 62.2 | | | |
| 85.0 | 89.9 | | 卌 卌 | 10 | 33 | 89.2 | | | |
| 90.0 | 94.9 | | \|\|\| | 3 | 36 | 97.2 | | | |
| 95.0 | 99.9 | | \| | 1 | 37 | 100.0 | | | |
| 100.0 | 104.9 | | | | | | | | |
| 105.0 | 109.9 | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| TOTALS | | | - - | - - | 37 | - - | - - | | - - |

Specification Source 1032 MATERIAL

| | PREV. | THIS PERIOD | TO DATE |
|---|---|---|---|
| Avg. Relative Density | | | 81.0% |

Specified Min. 70 % AS DETERMINED BY ASTM D2049




Remarks THESE TESTS COVER ALL DENSITY TESTS FOR THE CRUSHED STONE PLACED BELOW THE DIESEL GENERATOR BUILDING AT WATTS BAR NUCLEAR PLANT.


WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 1 of 4

FIGURE 2.5-549


▽ DESIGN WATER TABLE
▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
—WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 2 of 4

FIGURE 2.5-549

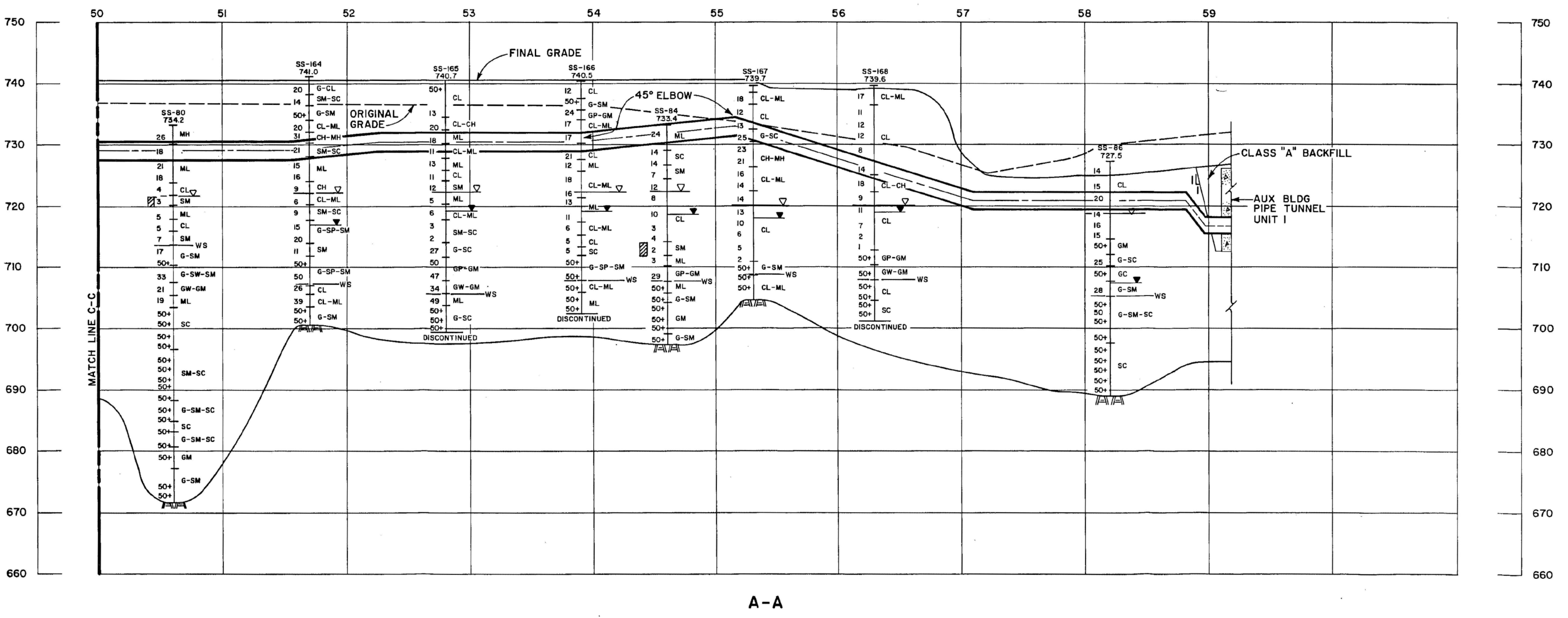

▽ DESIGN WATER TABLE
▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22 g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 3 of 4

FIGURE 2.5-549



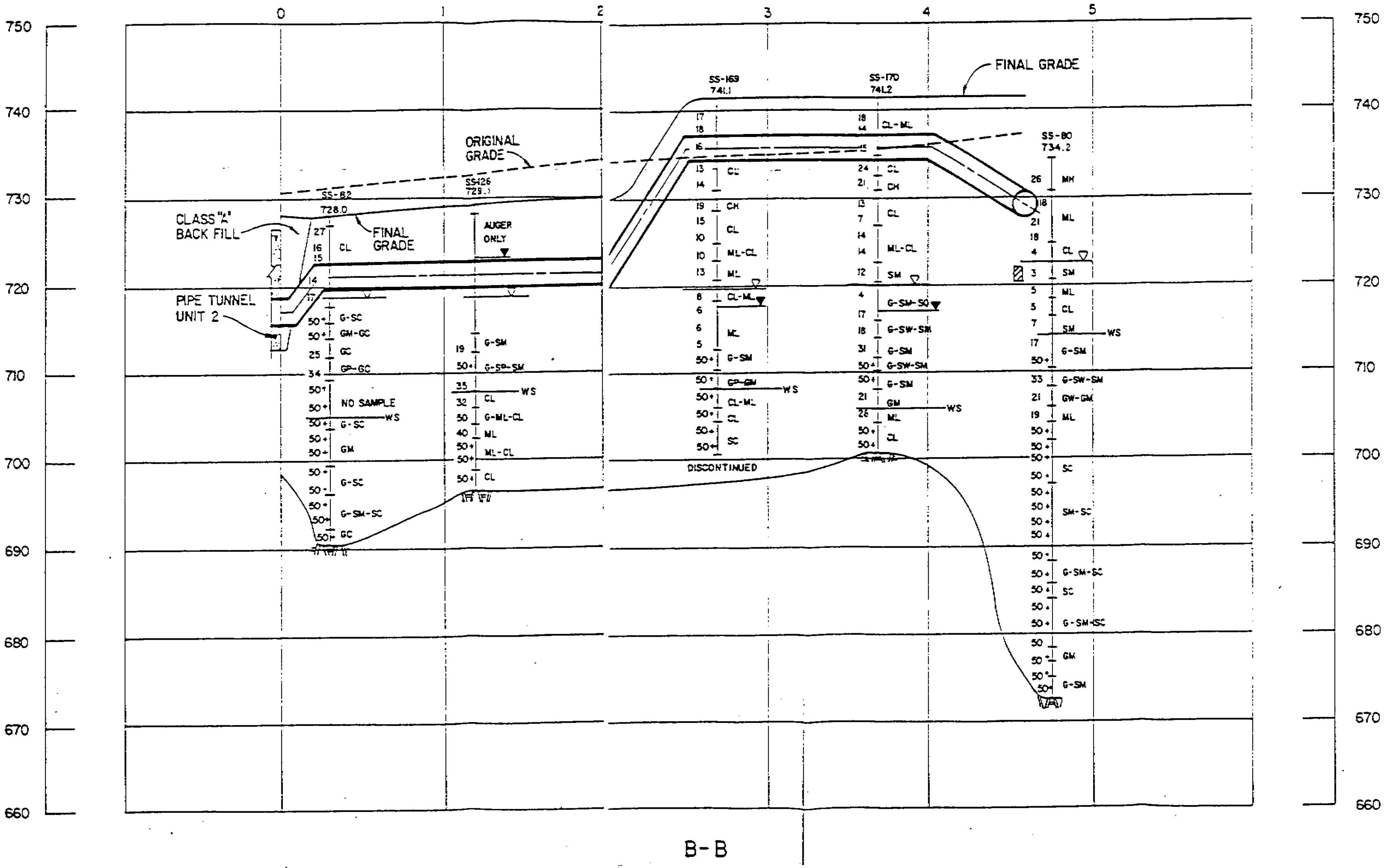

▽ DESIGN WATER TABLE
▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 4 of 4

FIGURE 2.5-549



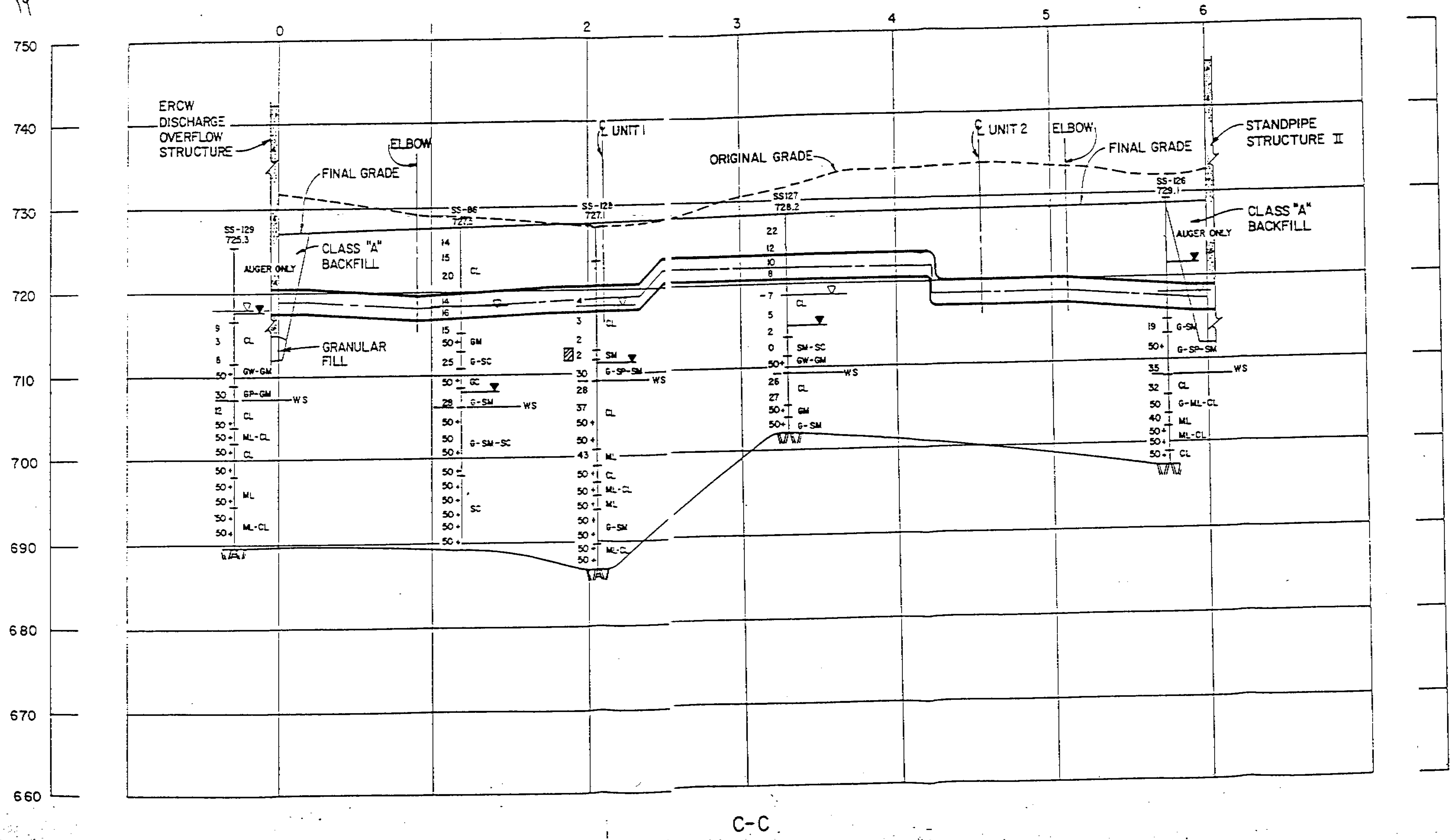

DESIGN WATER TABLE
WATER TABLE (24HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION B-B
FIGURE 2.5-550



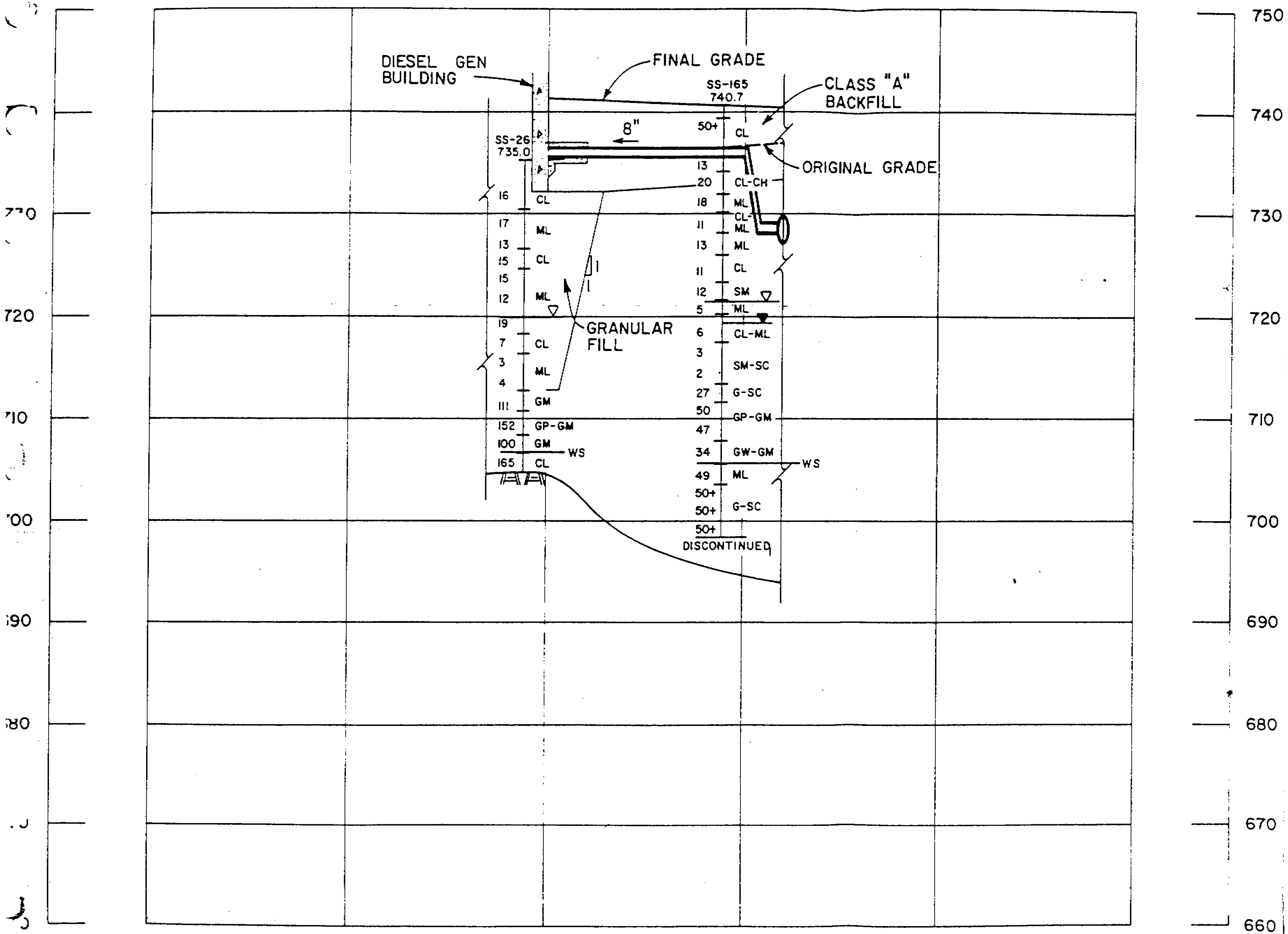

DESIGN WATER TABLE
WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION C-C
FIGURE 2.5-551




D-D

▽ DESIGN WATER TABLE

▼ WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

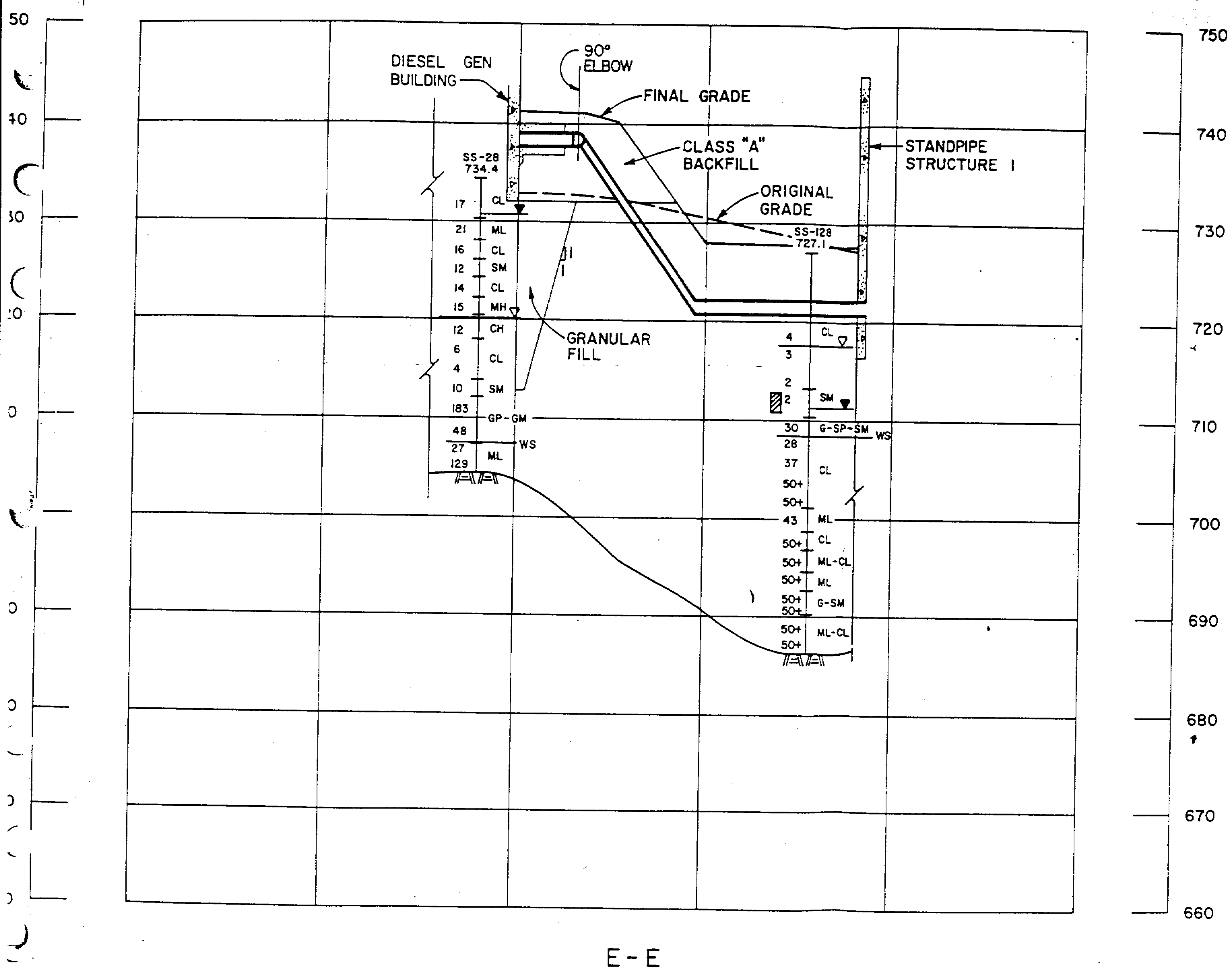
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

*"HISTORICAL INFORMATION"*

| WATTS BAR NUCLEAR PLANT<br>FINAL SAFETY<br>ANALYSIS REPORT |
|---|
| ERCW PIPELINE<br>SECTION D-D<br>FIGURE 2.5-552 |




DESIGN WATER TABLE

WATER TABLE (24HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS(1981) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

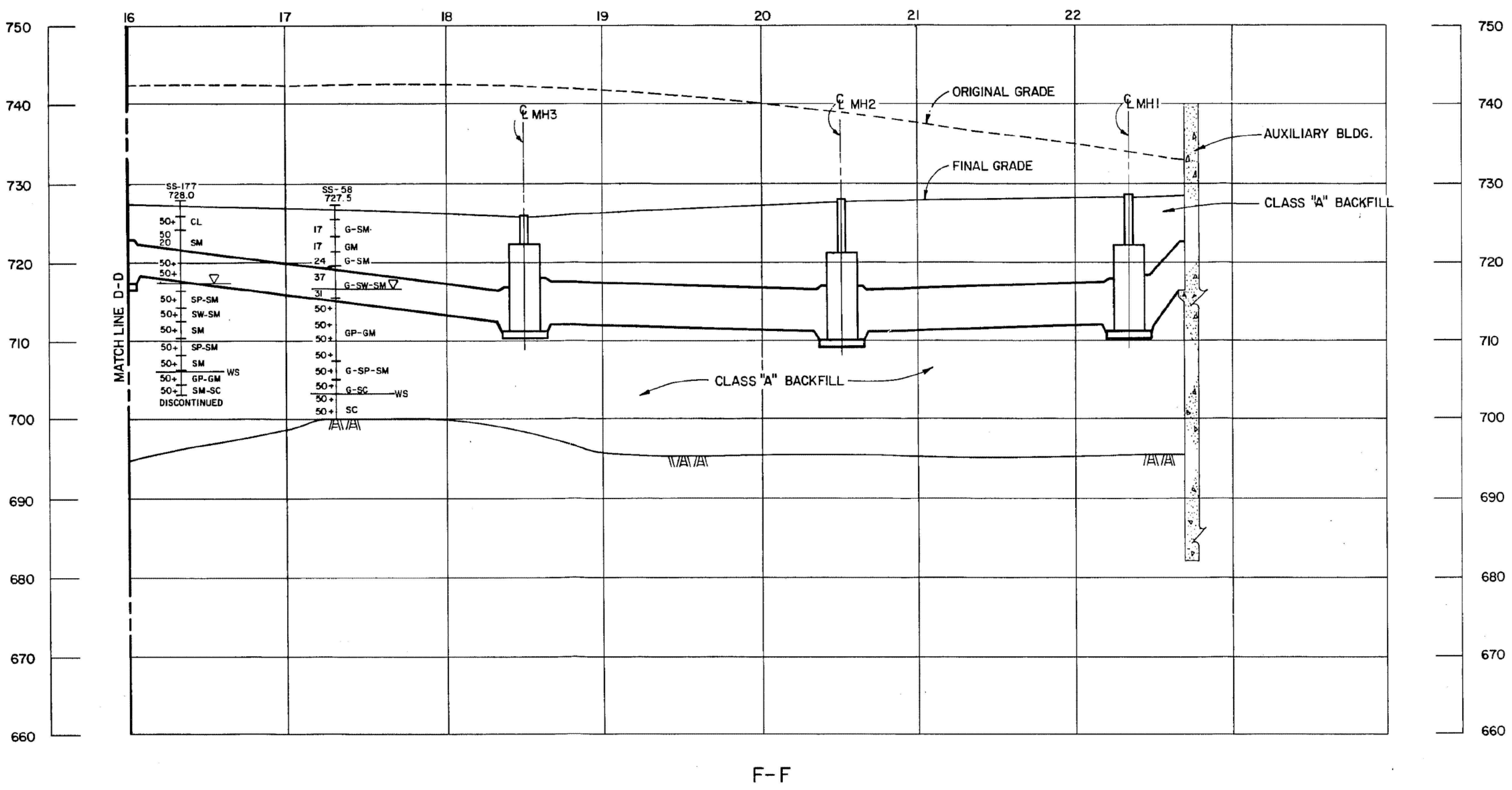
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION E-E
FIGURE 2.5-553


WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Category I Electrical Conduits
Section F-F Sheet 1 of 2

FIGURE 2.5-554



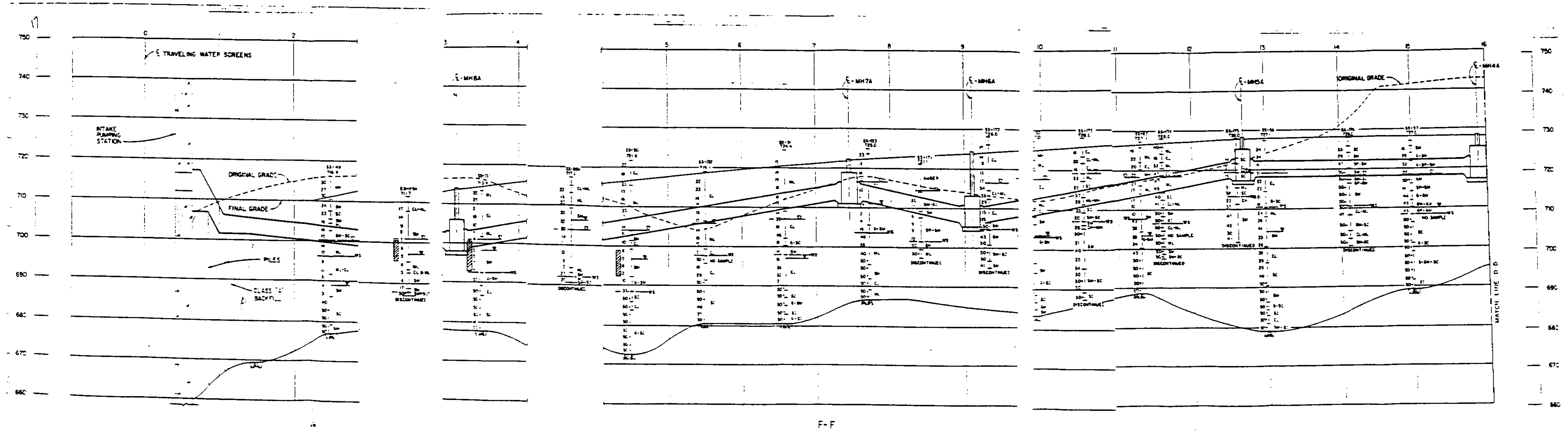

∇ DESIGN WATER TABLE
▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
_WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEE-IDRISS (1981) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Category I Electrical Conduits
Section F-F Sheet 2 of 2

FIGURE 2.5-554



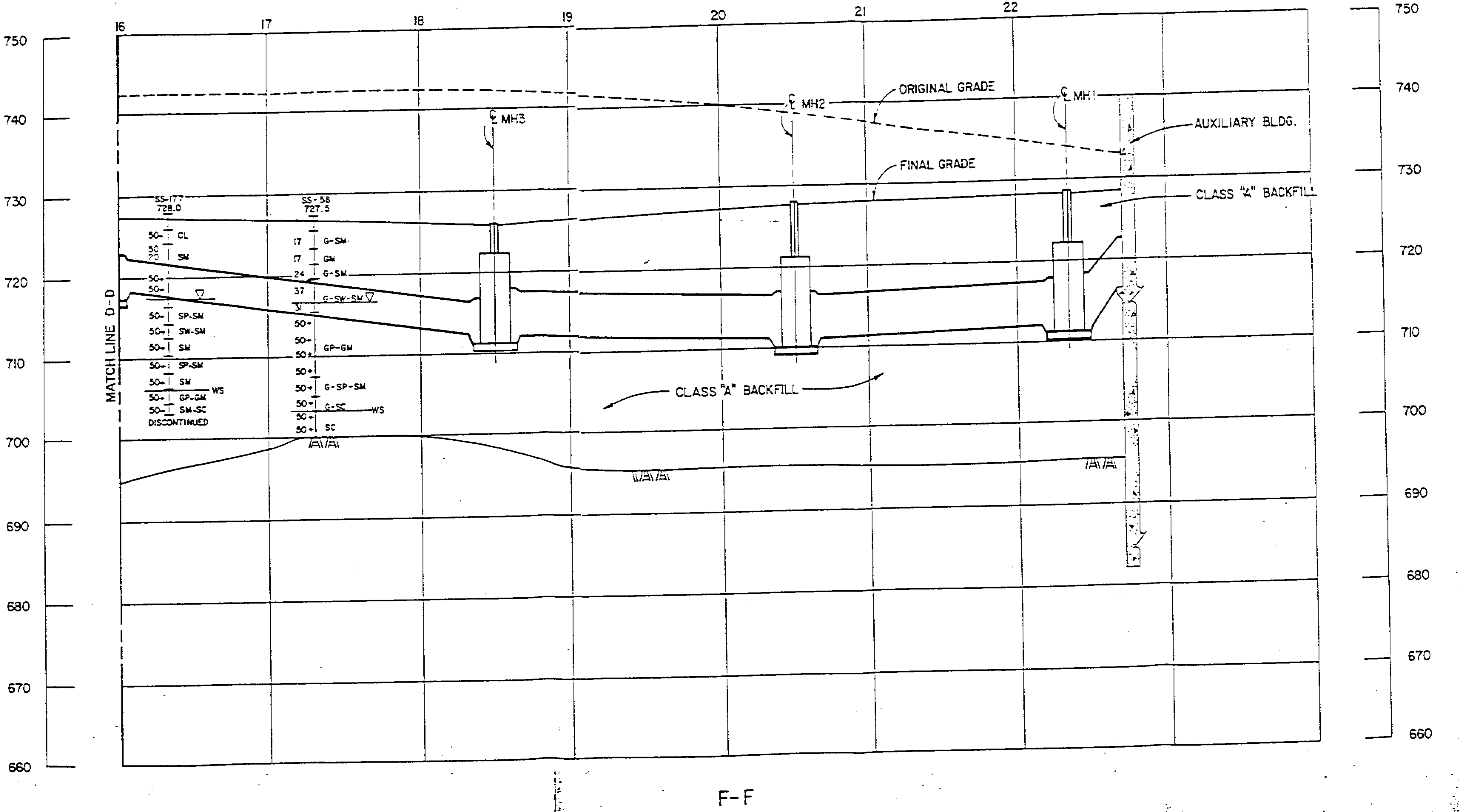

℄ DESIGN WATER TABLE
WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
—WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY : ELECTRICAL CONDUITS
SECTION F-F SHEET 1 OF 2
FIGURE 2.5-554

"HISTORICAL INFORMATION"



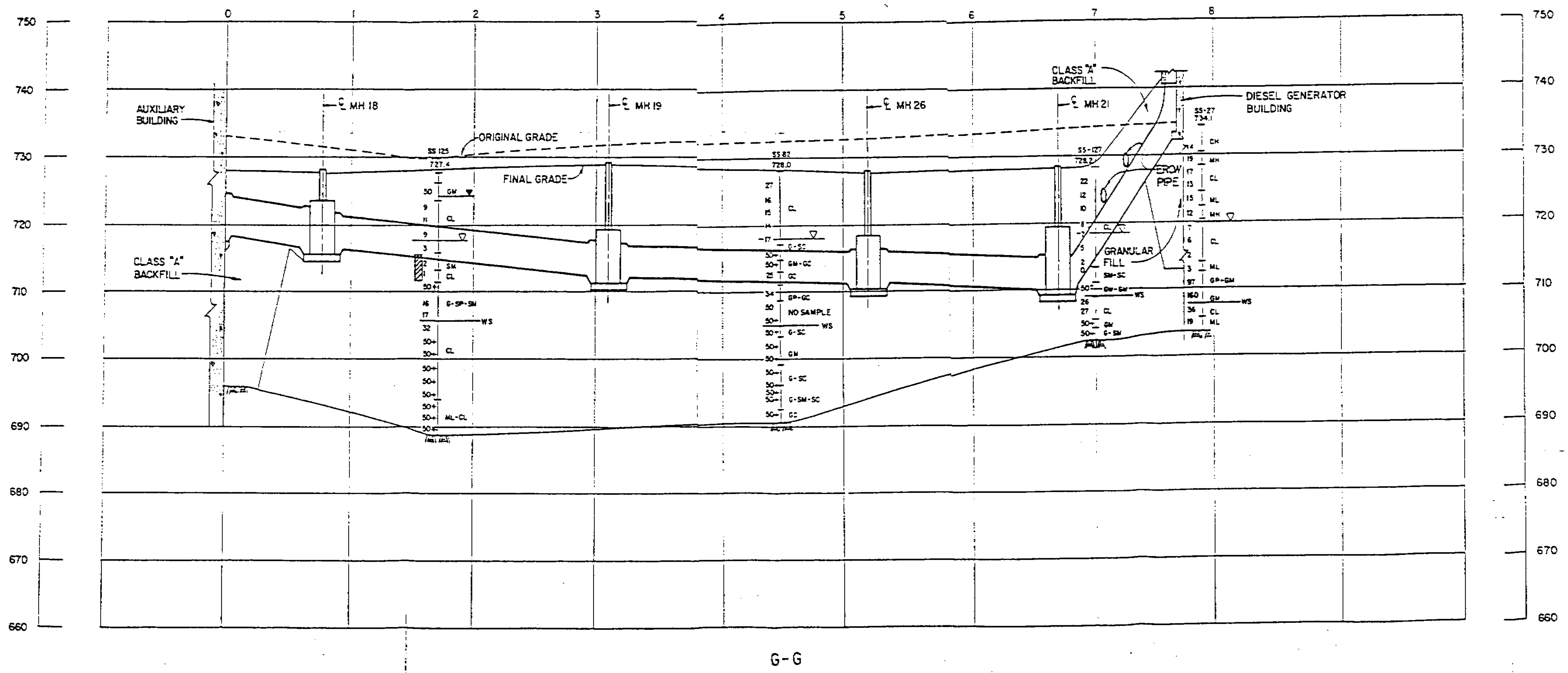

DESIGN WATER TABLE
WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEE-IDRISS (1981) CORRELATION FOR SANDS.

*"HISTORICAL INFORMATION"*

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION F-F SHEET 2 OF 2
FIGURE 2.5-554



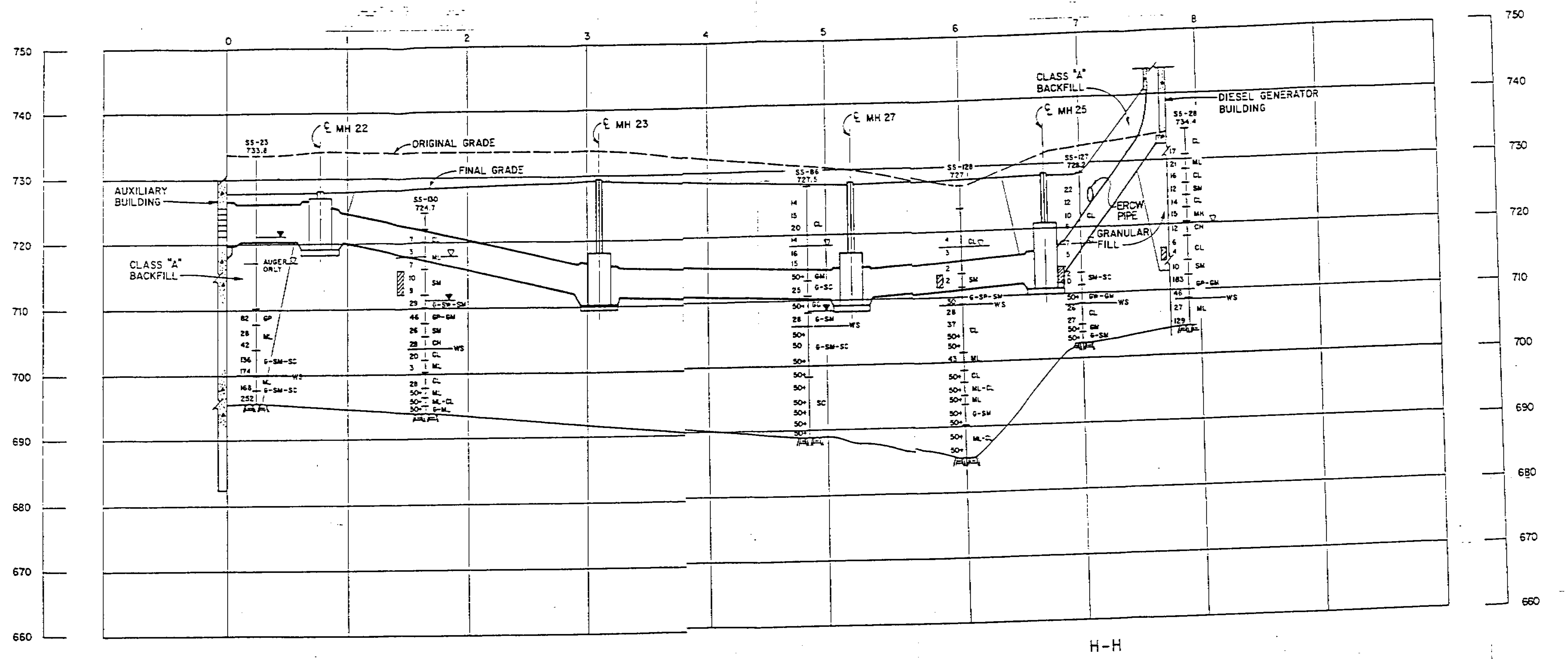

DESIGN WATER TABLE
WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22 g AND SEED-IDRISS (1981) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION G-G
FIGURE 2.5-555




DESIGN WATER TABLE
WATER TABLE (24HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE: LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.22g AND SEED-IDRISS(1981) CORRELATION FOR SANDS

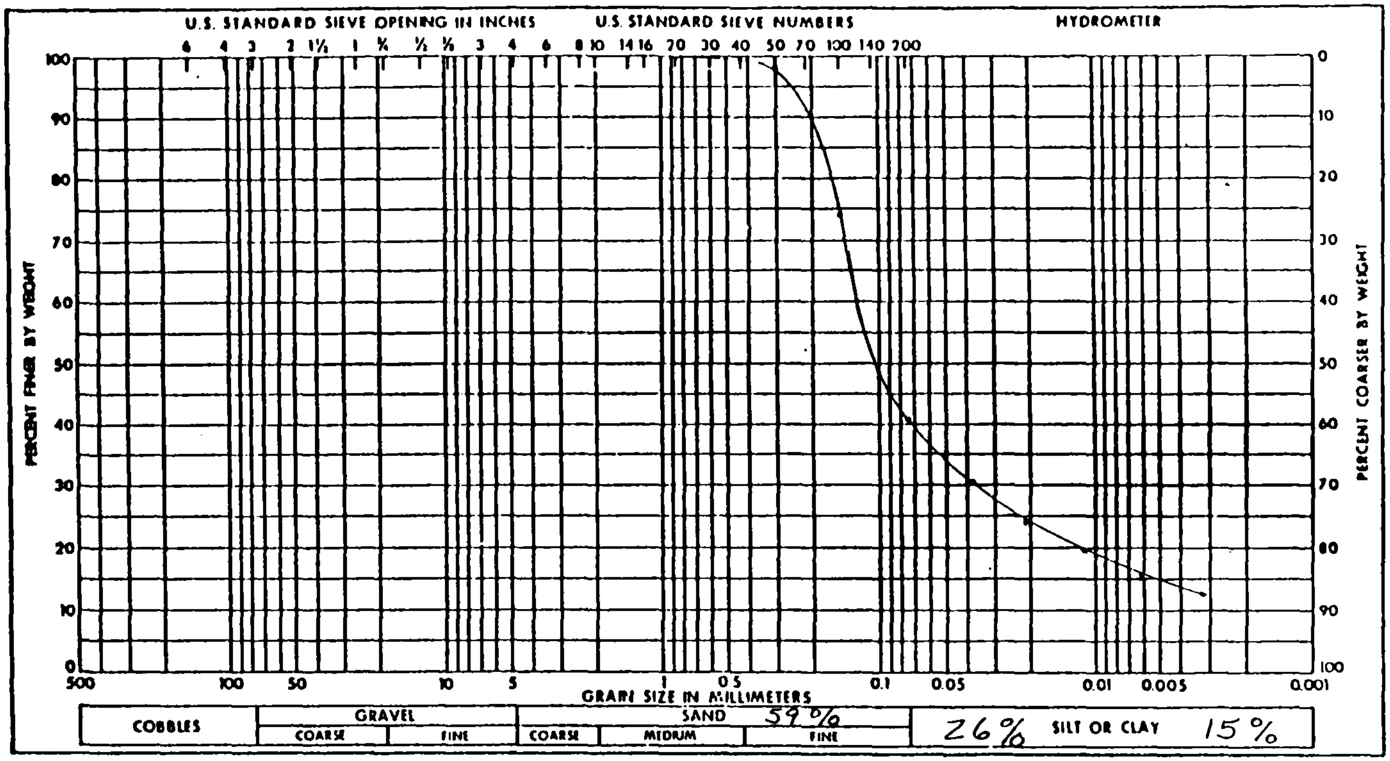
"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION H-H
FIGURE 2.5-556

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUIT
FIGURE 2.5-557




| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | | Plastic Limit, % | NP |
| Specific Gravity | | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

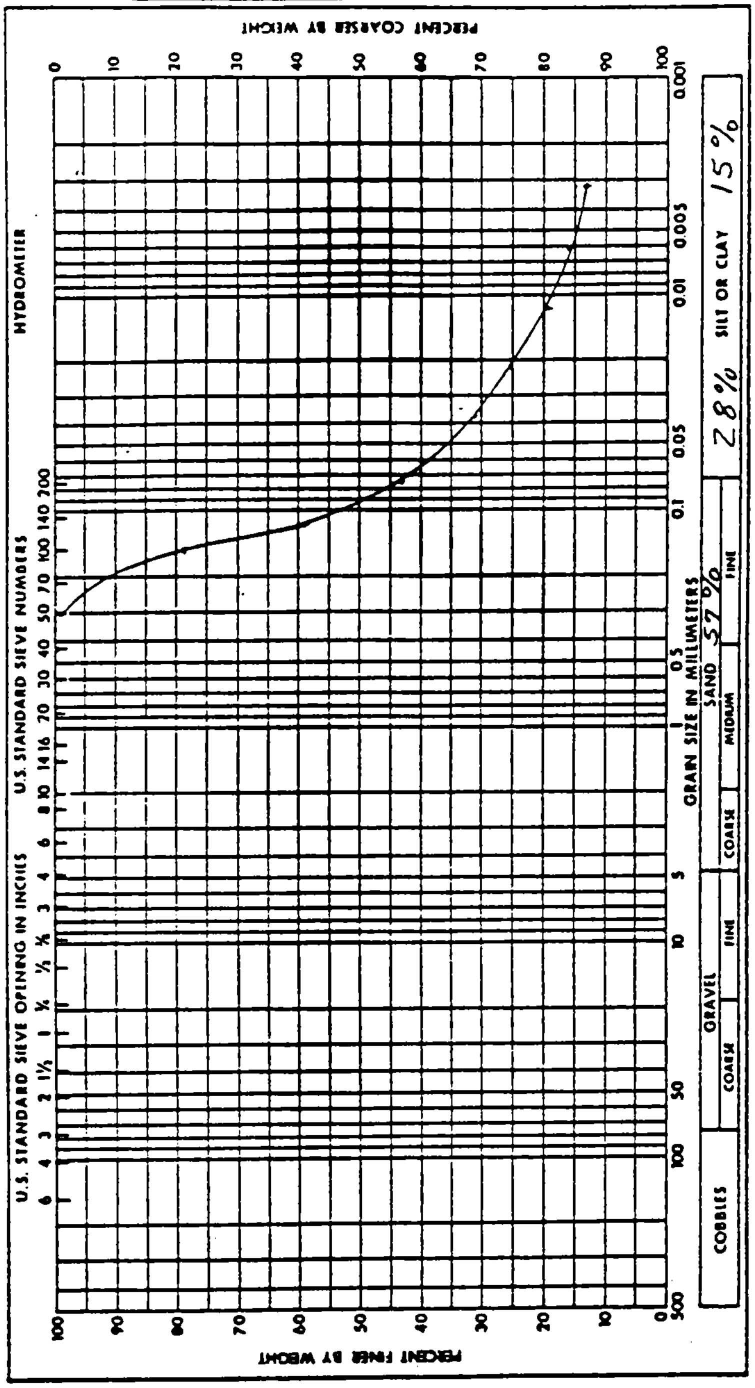
Remarks:
N=5
w=28.2

| | |
|---|---|
| Project Watts Bar N.P. | |
| Feature Class IE Conduit | |
| Boring No. SS-50 | Sample No. GP-9 |
| Station | Offset |
| Date 10-1-75 | Elevation |

GRAIN SIZE ANALYSIS

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUIT
FIGURE 2.5-558

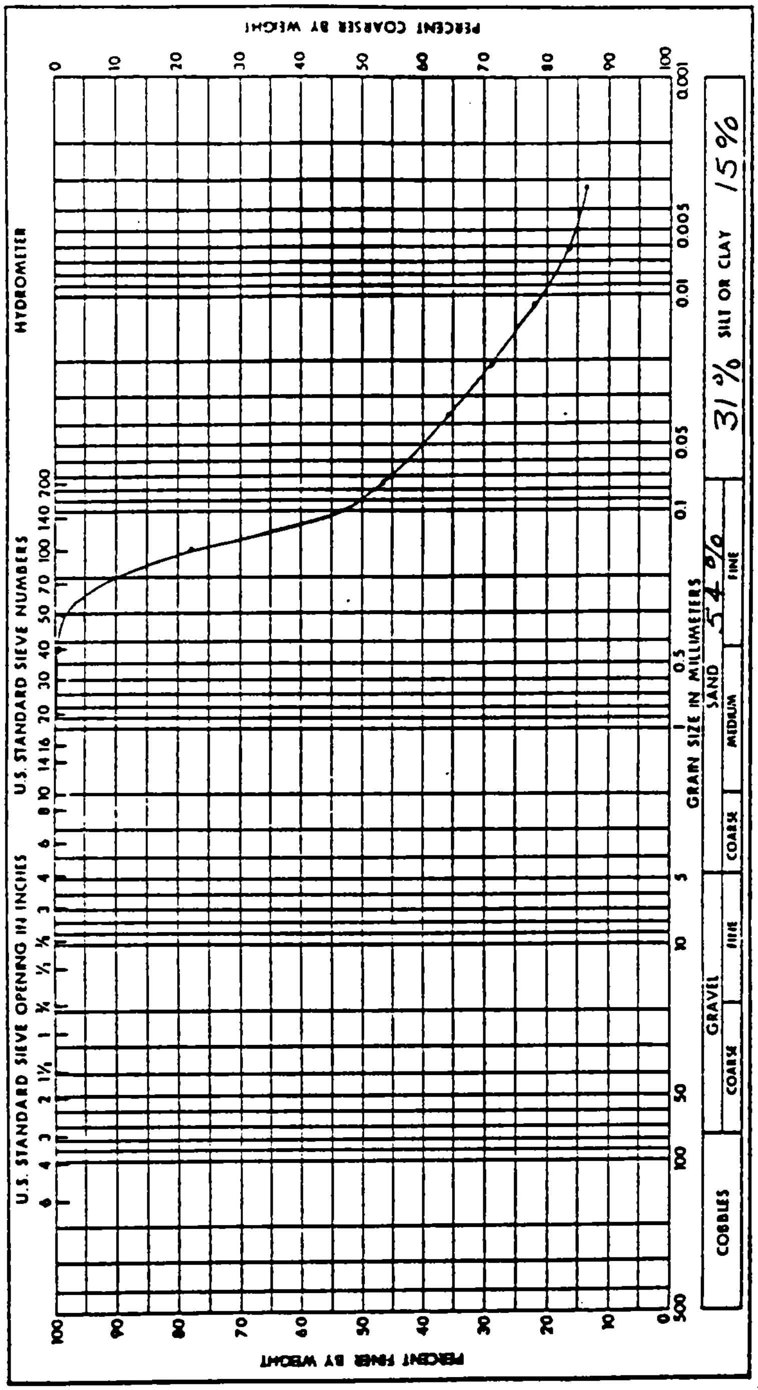



| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | | Plastic Limit, % | NP |
| Specific Gravity | | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

Remarks:
N = 8
ω = 29.1

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUIT
FIGURE 2.5-559




| | |
|---|---|
| Project WATTS BAR N.P. | |
| Feature CLASS IE CONDUIT | |
| Boring No. SS-50 | Sample No. Gp. 11 |
| Station | Offset |
| Date 10-7-75 | Elevation |

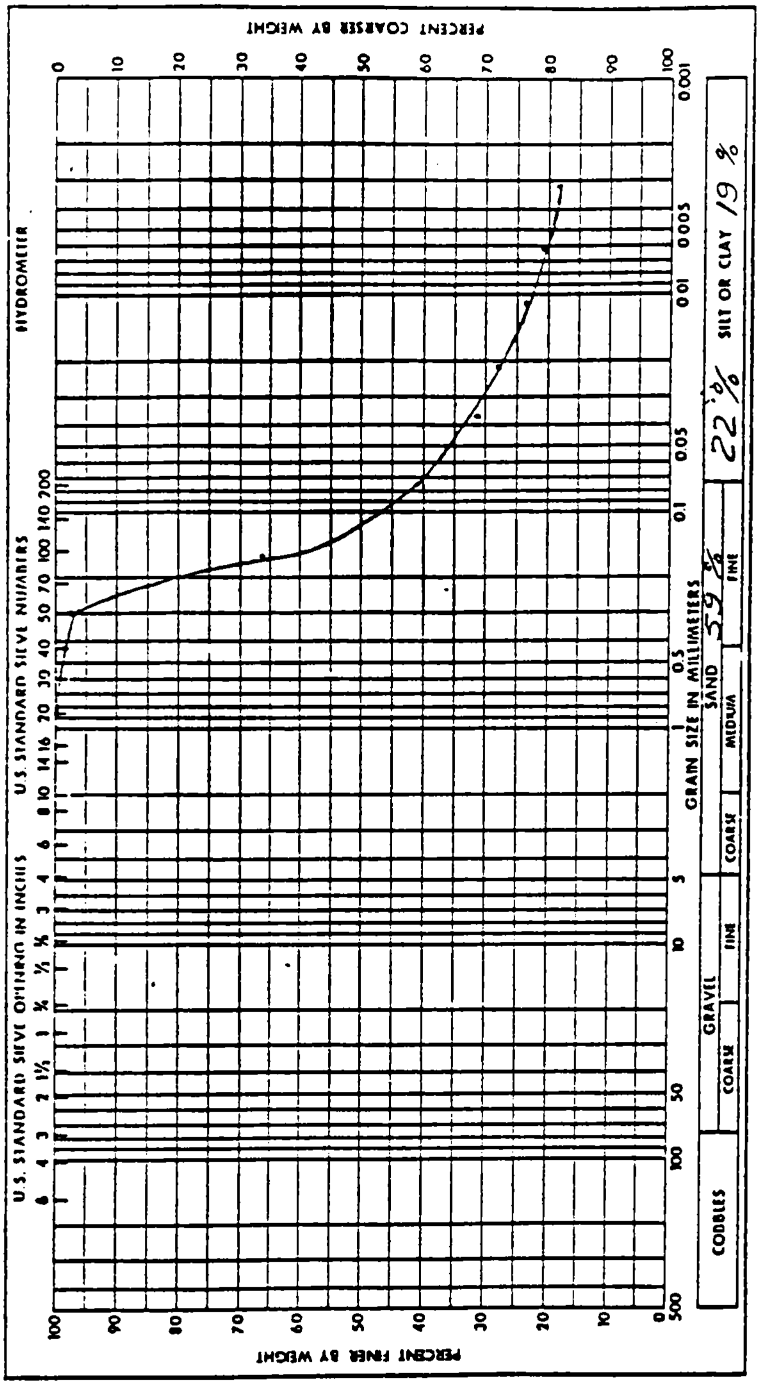
GRAIN SIZE ANALYSIS

Remarks:
N = 2
w = 31.5

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | | Plastic Limit, % | NP |
| Specific Gravity | | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

IE CONDUIT
FIGURE 2.5-560

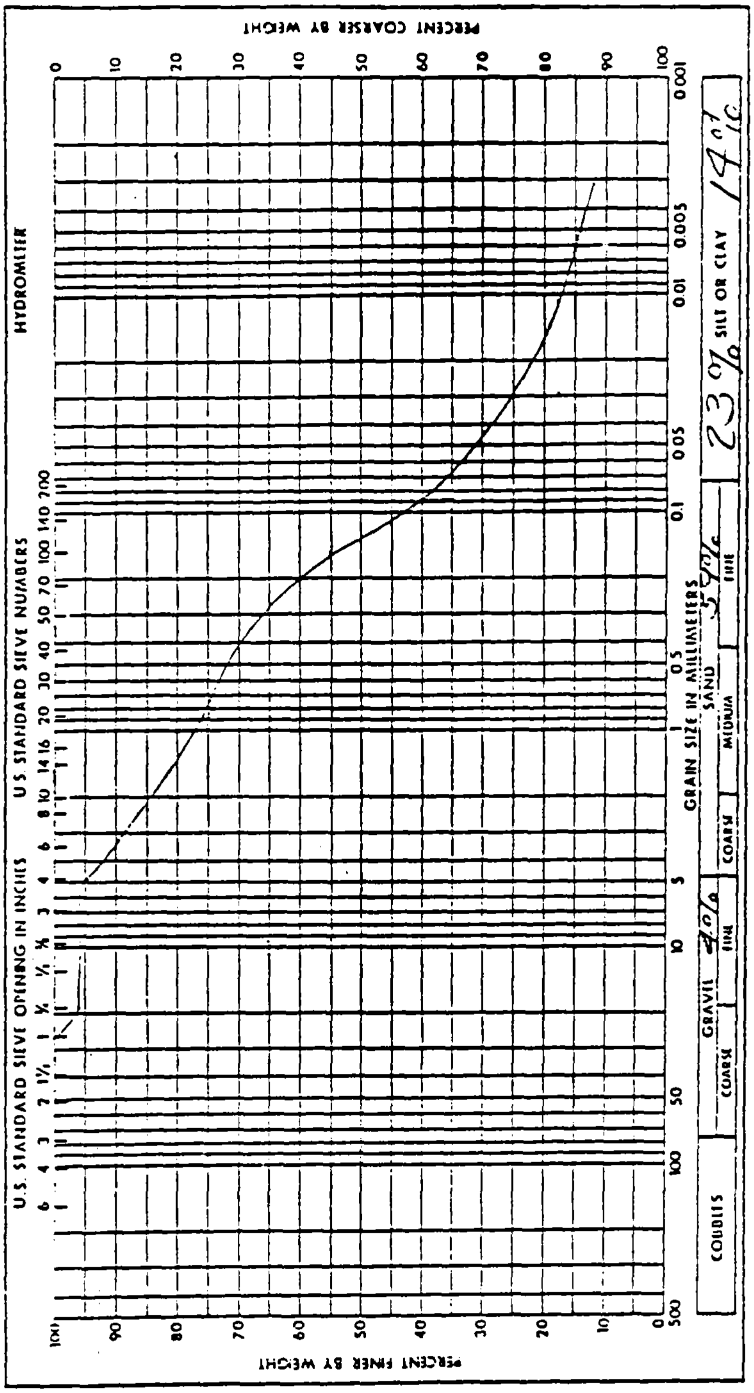



| Remarks: |
|---|
| N = 15 |
| ω = 20.9 |

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 29.7 |
| Moisture Content, % | | Plastic Limit, % | 28.1 |
| Specific Gravity | | Plasticity Index, % | 1.6 |
| | | Shrinkage Limit, % | |

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**IE CONDUIT**
**FIGURE 2.5-561**




| | |
|---|---|
| Project | Watts Bar N.P. |
| Feature | IE Conduit |
| Boring No. | SS-61 |
| Sample No. | 10A |
| Station | |
| Offset | |
| Date | 1-16-76 |
| Elevation | |

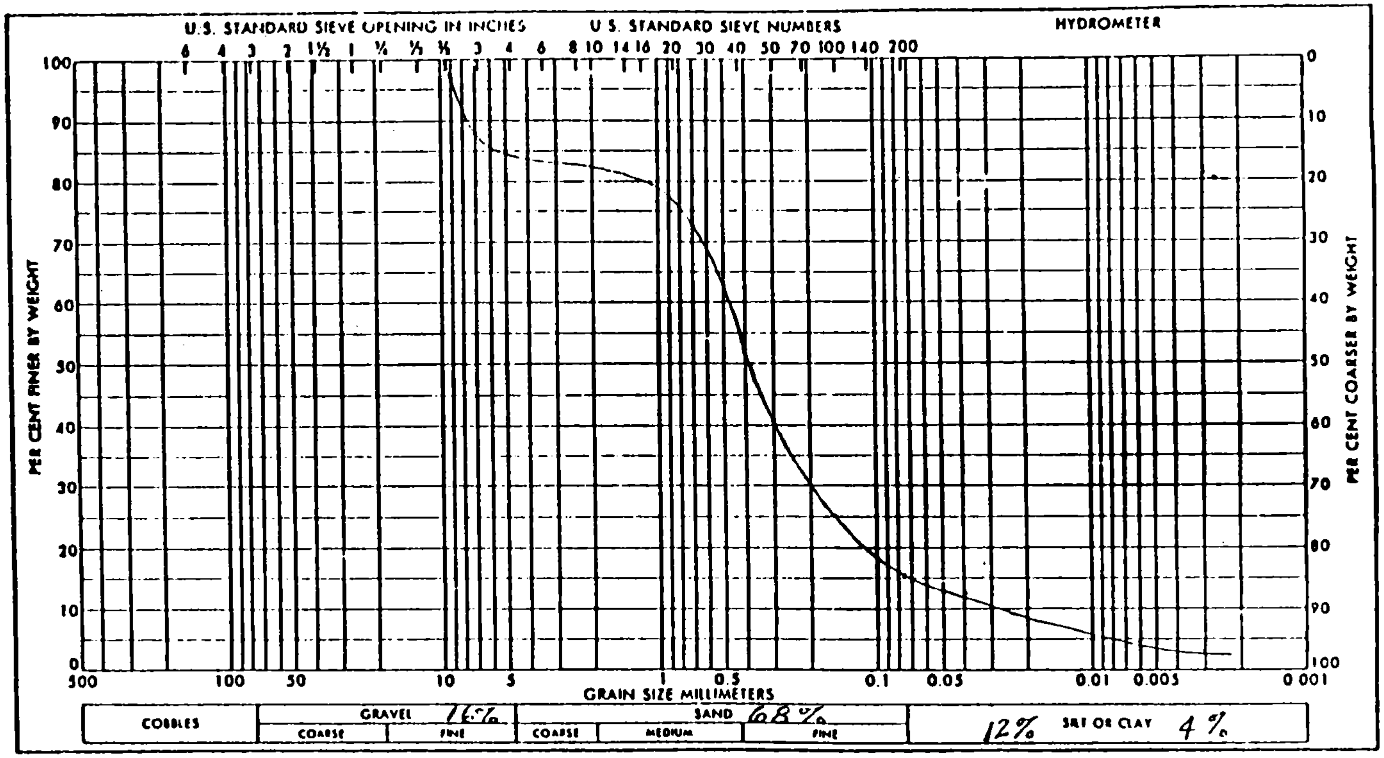
**GRAIN SIZE ANALYSIS**

**Remarks:**
N=16
w=14.9

| | |
|---|---|
| Soil Symbol | SM |
| Moisture Content, % | |
| Specific Gravity | |
| Liquid Limit, % | NP |
| Plastic Limit, % | NP |
| Plasticity Index, % | NP |
| Shrinkage Limit, % | |

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

**FIGURE 2.5-562**




| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | NP |
| Moisture Content, % | | Plastic Limit, % | NP |
| Specific Gravity | | Plasticity Index, % | NP |
| | | Shrinkage Limit, % | |

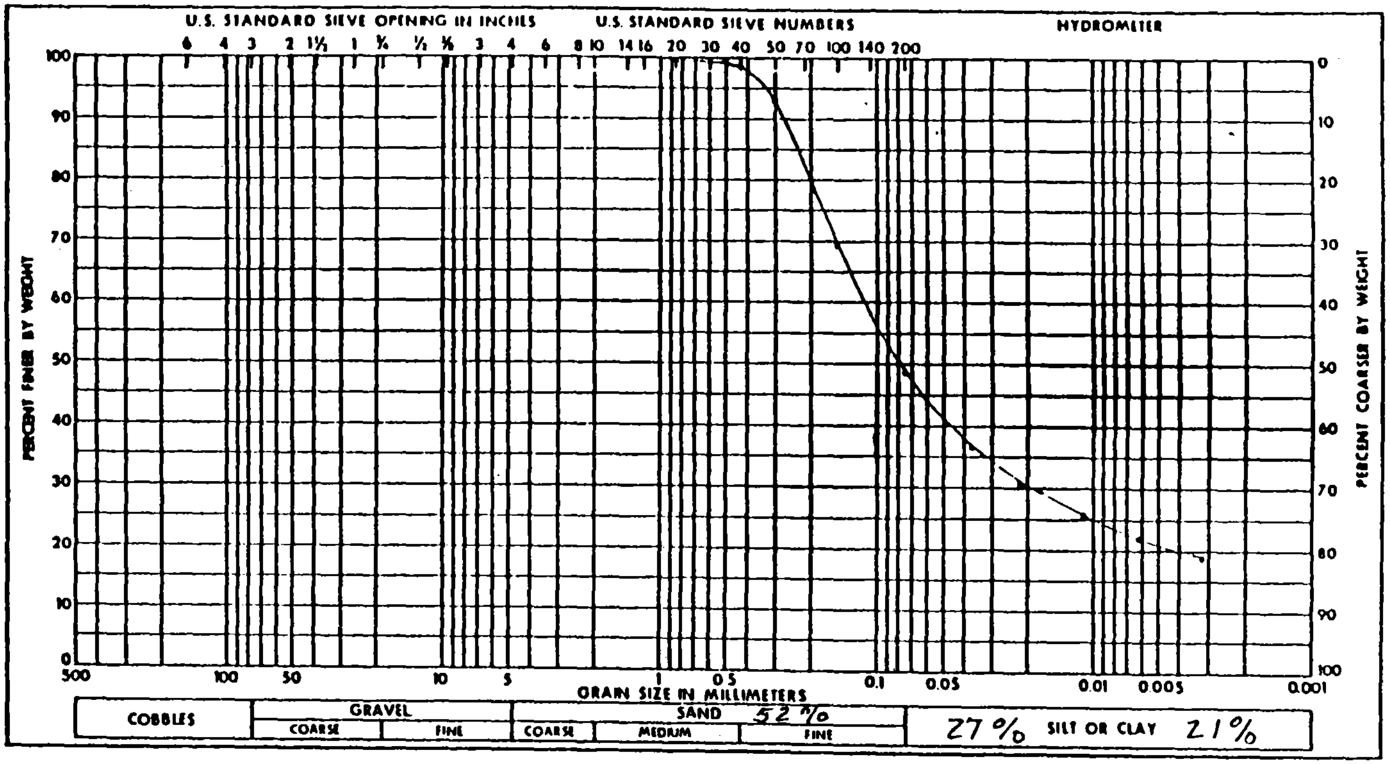
Remarks:
N = 8
ω = 14.1

Project WATTS BAR NP
Feature
Boring No. SS-66 Sample No. 11A
Station Offset
Date 5-7-76 Elevation

GRAIN SIZE ANALYSIS

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CLASS IE CONDUIT
FIGURE 2.5-563




| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 36.0 |
| Moisture Content, % | | Plastic Limit, % | 26.0 |
| Specific Gravity | | Plasticity Index, % | 10.0 |
| | | Shrinkage Limit, % | |

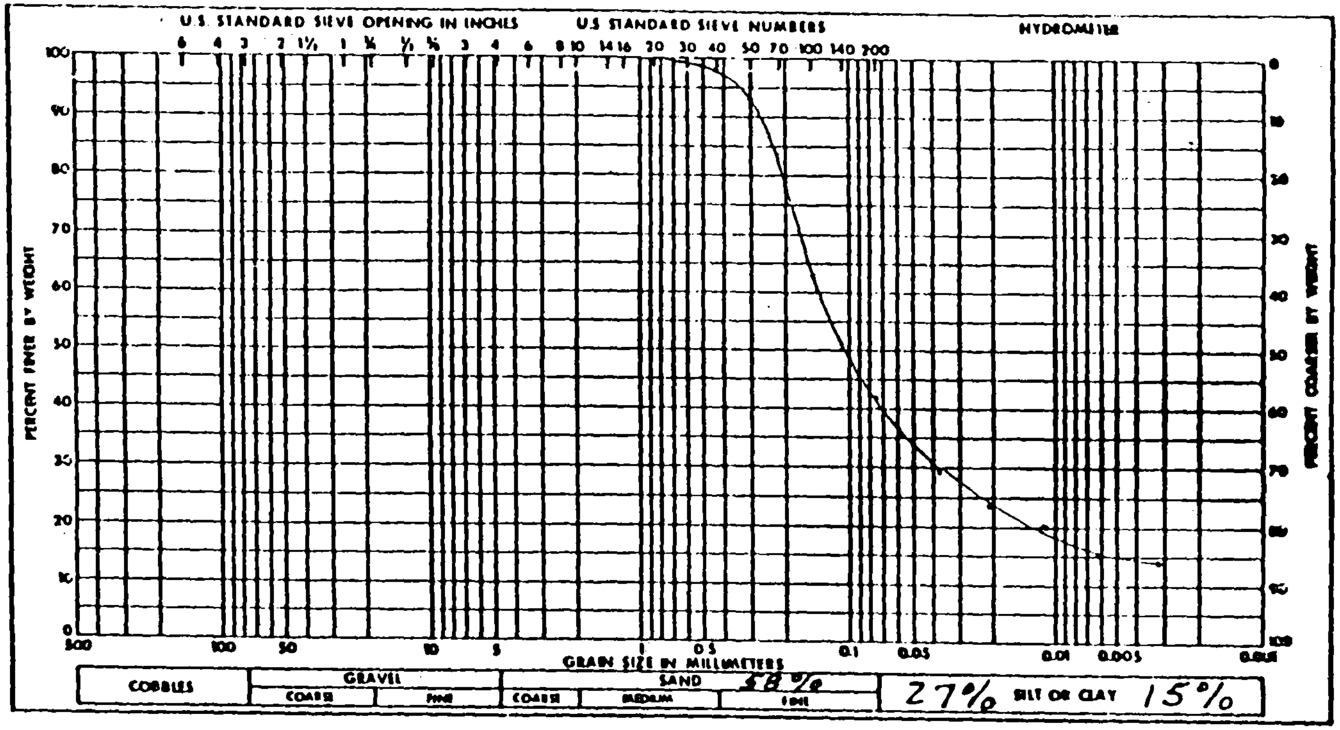
| Remarks: |
|---|
| N = 10 |
| ω = 20.7 |
| |
| |

| | |
|---|---|
| Project WATTS BAR N.P | |
| | |
| Feature CLASS IE CONDUIT | |
| Boring No. SS-63 | Sample No. 6-5 |
| Station | Offset |
| Date 10-4-75 | Elevation |

GRAIN SIZE ANALYSIS

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW & HPFP SYSTEM
FIGURE 2.5-564




| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 28.0 |
| Moisture Content, % | | Plastic Limit, % | 22.8 |
| Specific Gravity | | Plasticity Index, % | 5.2 |
| | | Shrinkage Limit, % | |

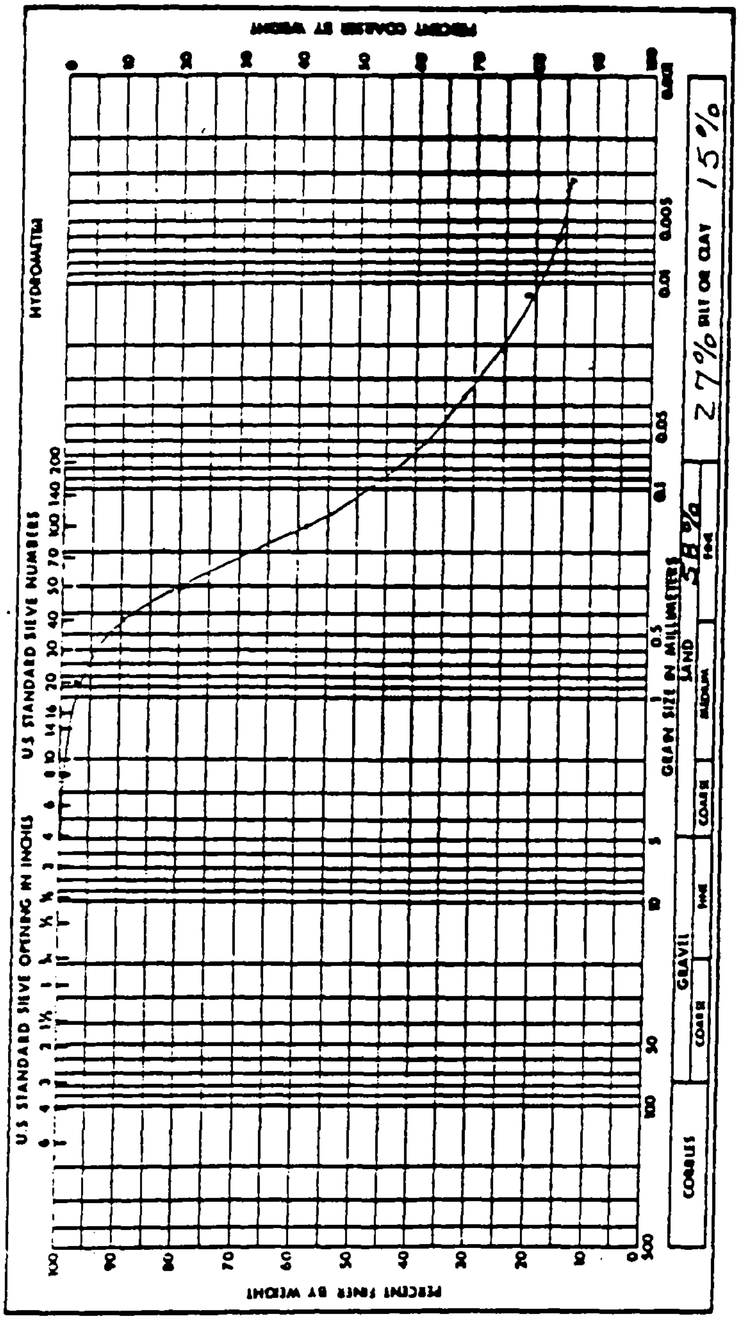
| Remarks: |
|---|
| N=5 |

| | |
|---|---|
| Project WATTS BAR N.P. | |
| Feature ERCW & HPFP SYSTEM | |
| Boring No. SS-92 | Sample No. 3A,4A |
| Station | Offset |
| Date 11-26-75 | Elevation 719,720.5 |

**GRAIN SIZE ANALYSIS**

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW & HPFP SYSTEM
FIGURE 2.5-565

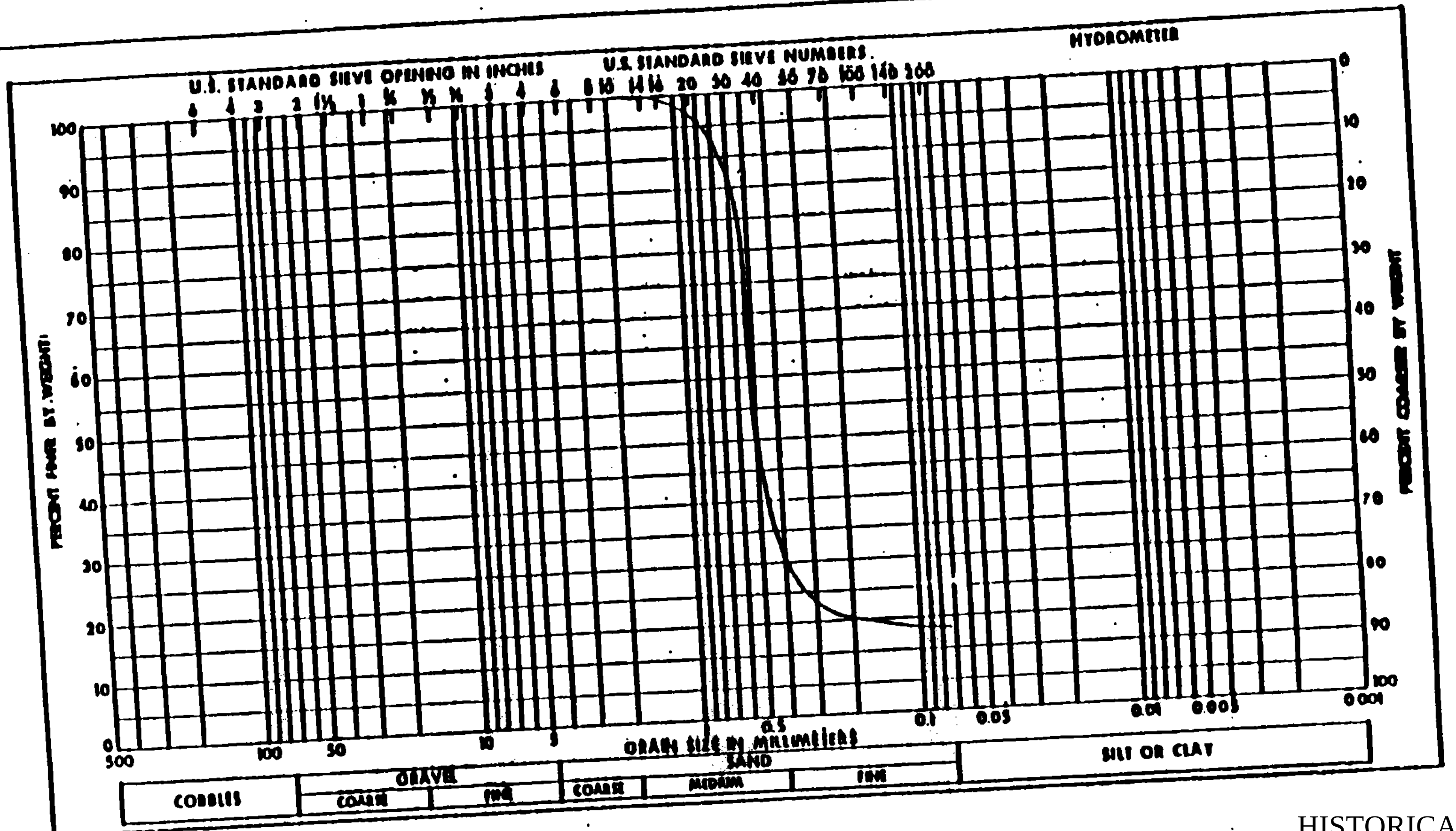



| | |
|---|---|
| Project WATTS BAR N.P. | |
| Feature ERCW & HPFP SYSTEM | |
| Boring No. SS-92 | Sample No. 5A |
| Station | Offset |
| Date 11-26-75 | Elevation 716.9 |

**GRAIN SIZE ANALYSIS**

Remarks:

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | 26.0 |
| Moisture Content, % | 20.1 | Plastic Limit, % | 22.1 |
| Specific Gravity | | Plasticity Index, % | 3.9 |
| | | Shrinkage Limit, % | |




HISTORICAL

| | | | |
|---|---|---|---|
| Soil Symbol | SM | Liquid Limit, % | |
| Moisture Content, % | | Plastic Limit, % | |
| Specific Gravity | | Plasticity Index, % | |
| | | Shrinkage Limit, % | |

Remarks:

$D_{60}$ = 0.53

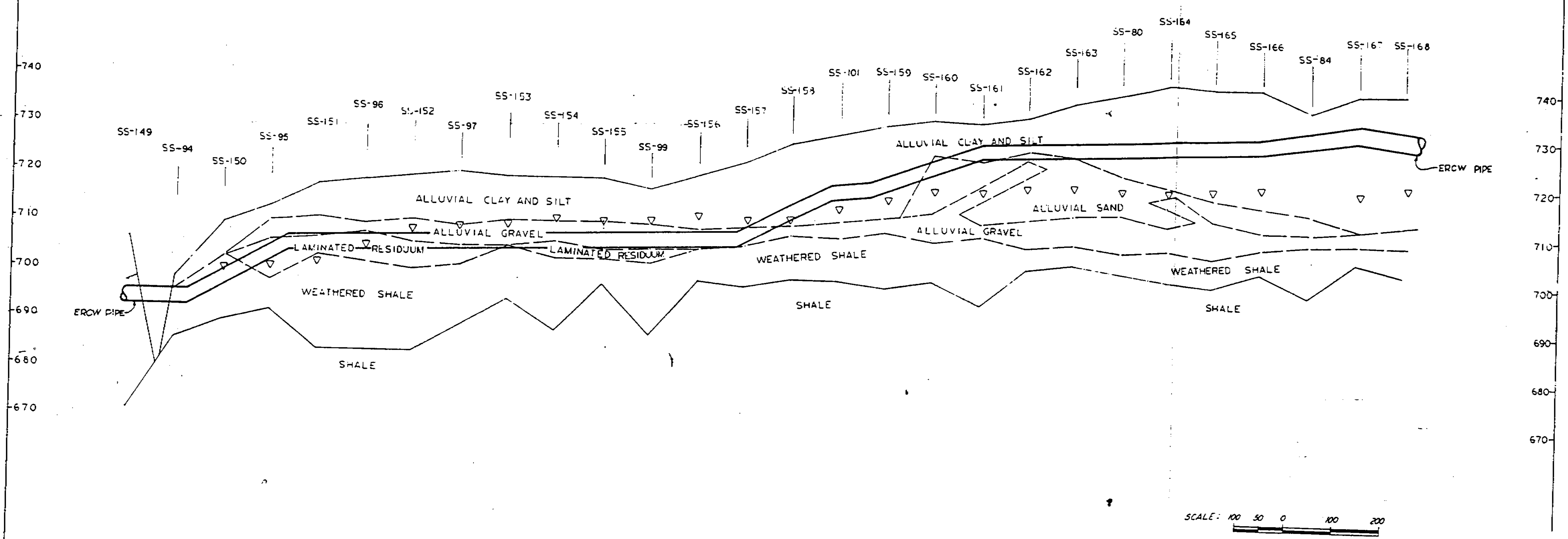
$\gamma_D$ 96.1 pcf
W 12.4 %

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

INTAKE CHANNEL

GRAIN SIZE ANALYSIS

Figure 2.5-566




SYMBOLS

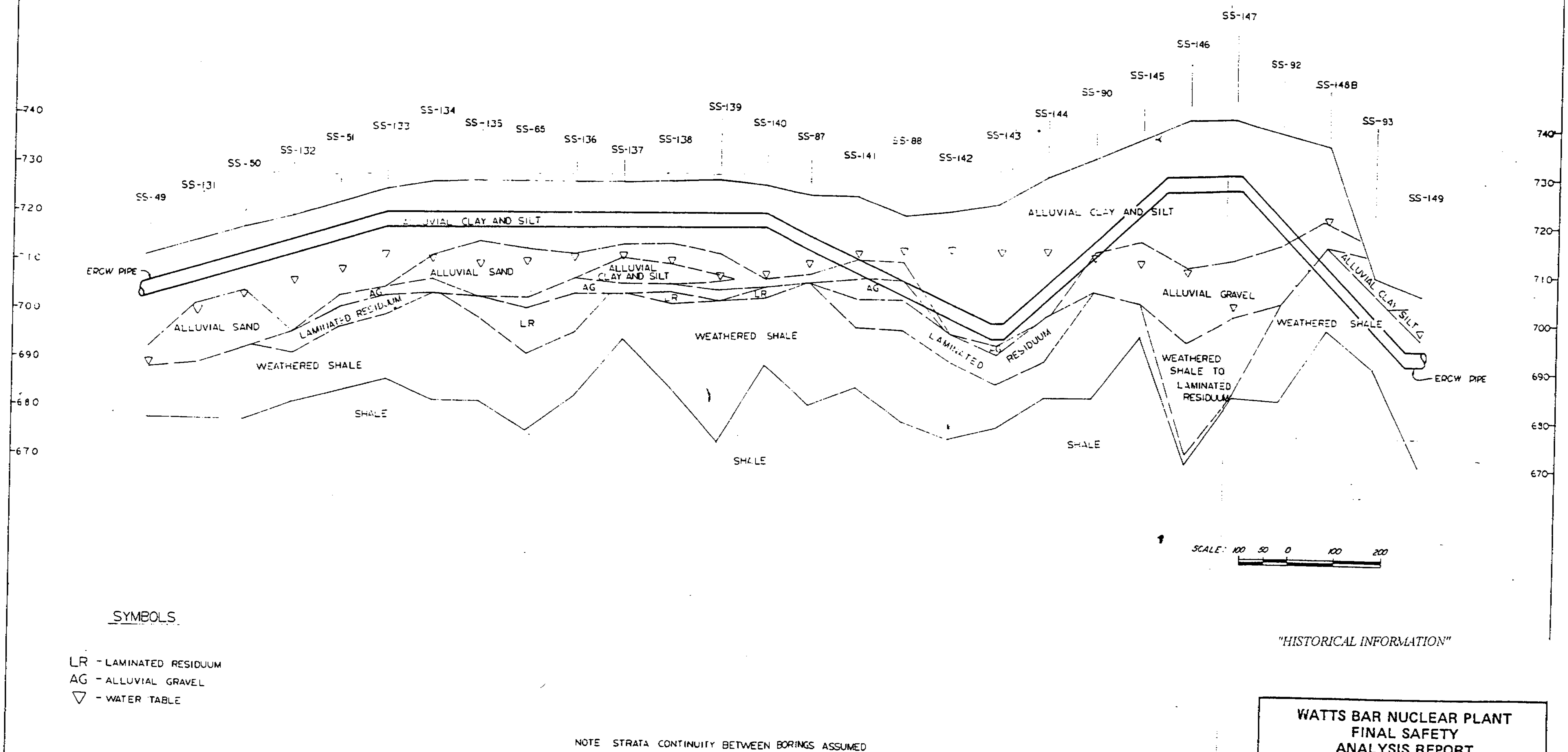
▽ -WATER TABLE

NOTE: STRATA CONTINUITY BETWEEN BORINGS ASSUMED

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

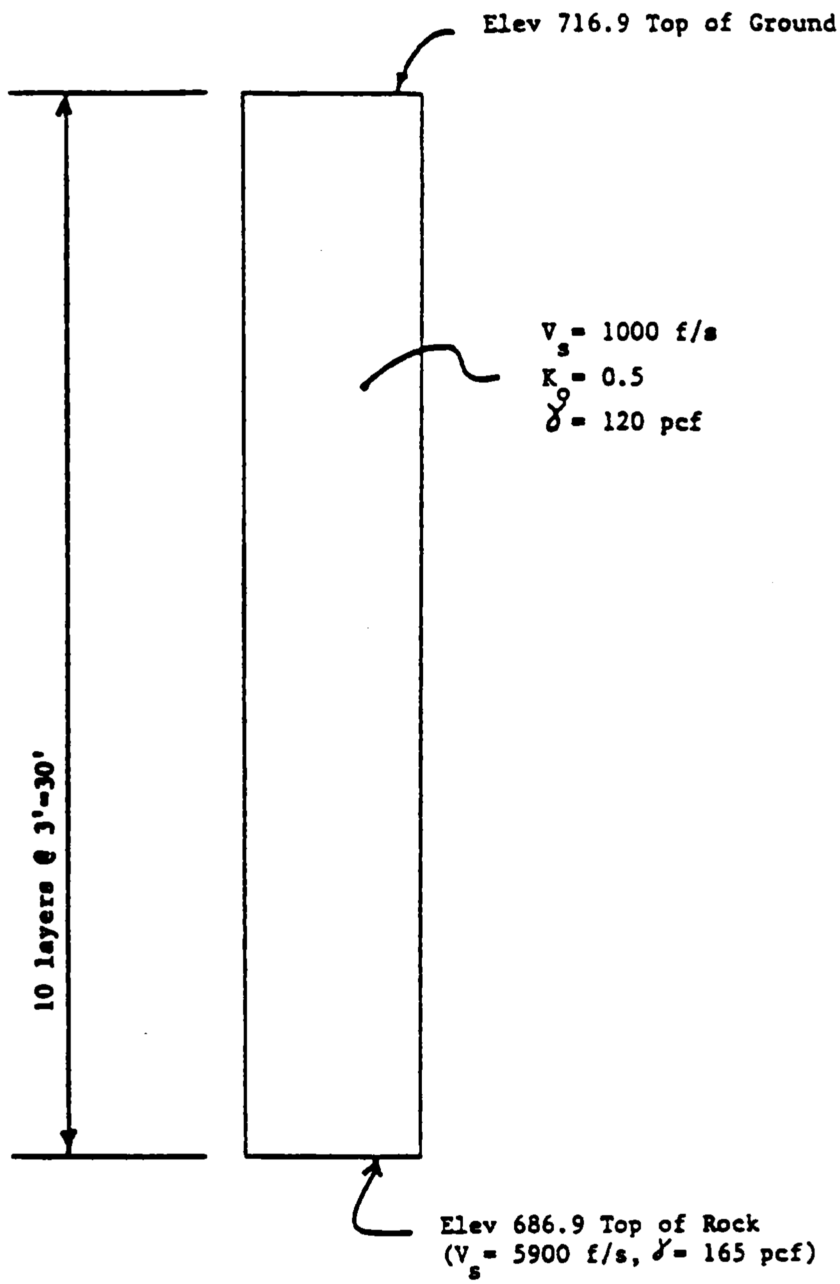
ERCW PIPING SYSTEM
GENERALIZED PROFILE
TVA DWG NO. 604K1009 R0
FIGURE 2.5-567




"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

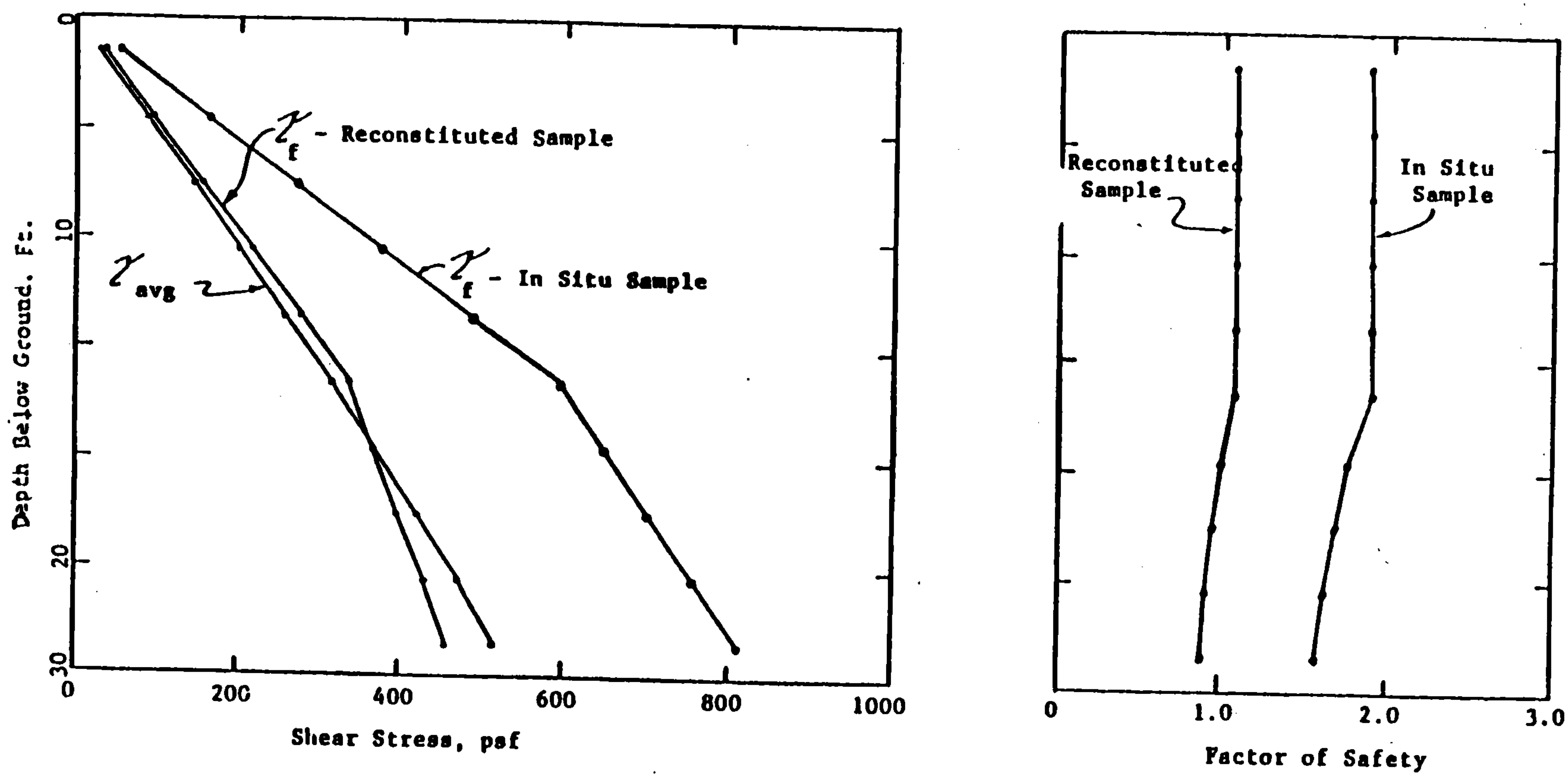
ERCW PIPING SYSTEM
GENERALIZED PROFILE
TVA DWG NO. 604K1010 R0
FIGURE 2.5-568




One-Dimensional Soil Profile Used for Liquefaction Evaluation

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-569




Comparison of Induced Shear Stress ($\tau_{avg}$) and Shear Stress Required to cause 5% strain ($\tau_f$) and Resulting Factors of Safety with Depth Below Ground Surface.

HISTORICAL

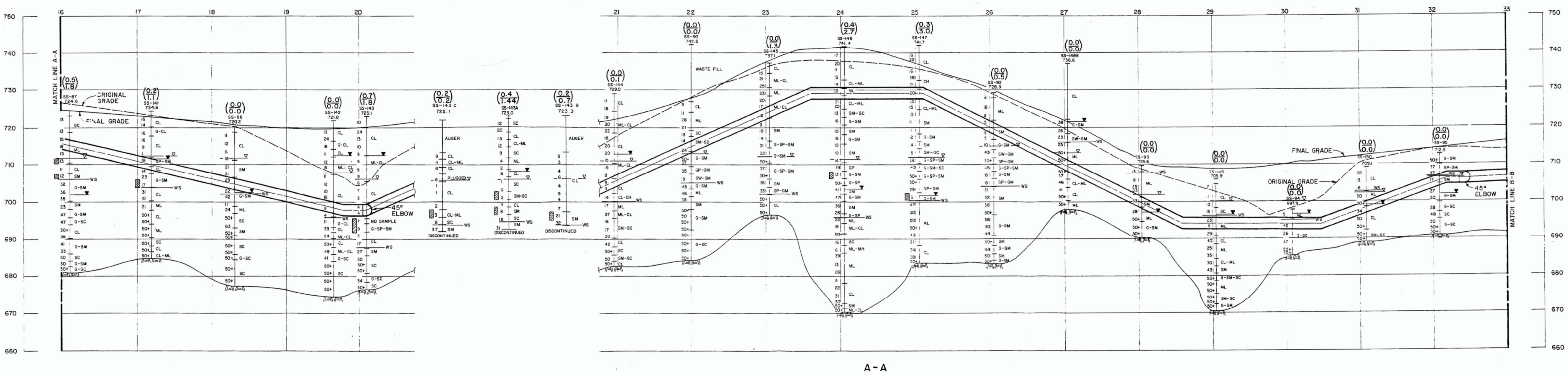
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-570


WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 1 of 4

FIGURE 2.5-571




A-A

(0.3 / 3.0) POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES)
POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- ▽ DESIGN WATER TABLE
- ▼ WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- ▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

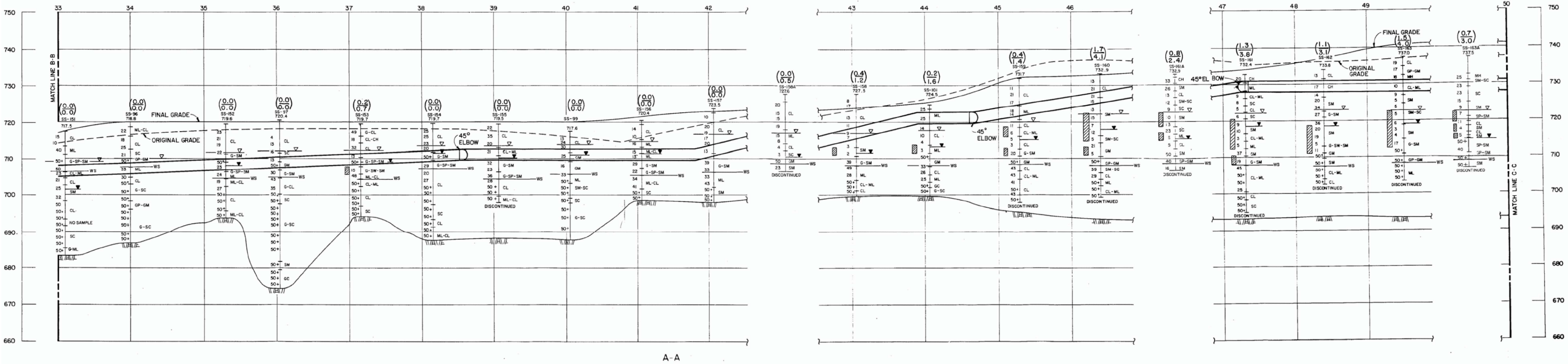
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 2 of 4

FIGURE 2.5-571




$\left(\frac{0.7}{3.0}\right)$ POTENTIAL SETTLEMENT BASED ON 1.5 % ε CRITERIA (INCHES)
POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- ▽ DESIGN WATER TABLE
- ▼ WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- ▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED-IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

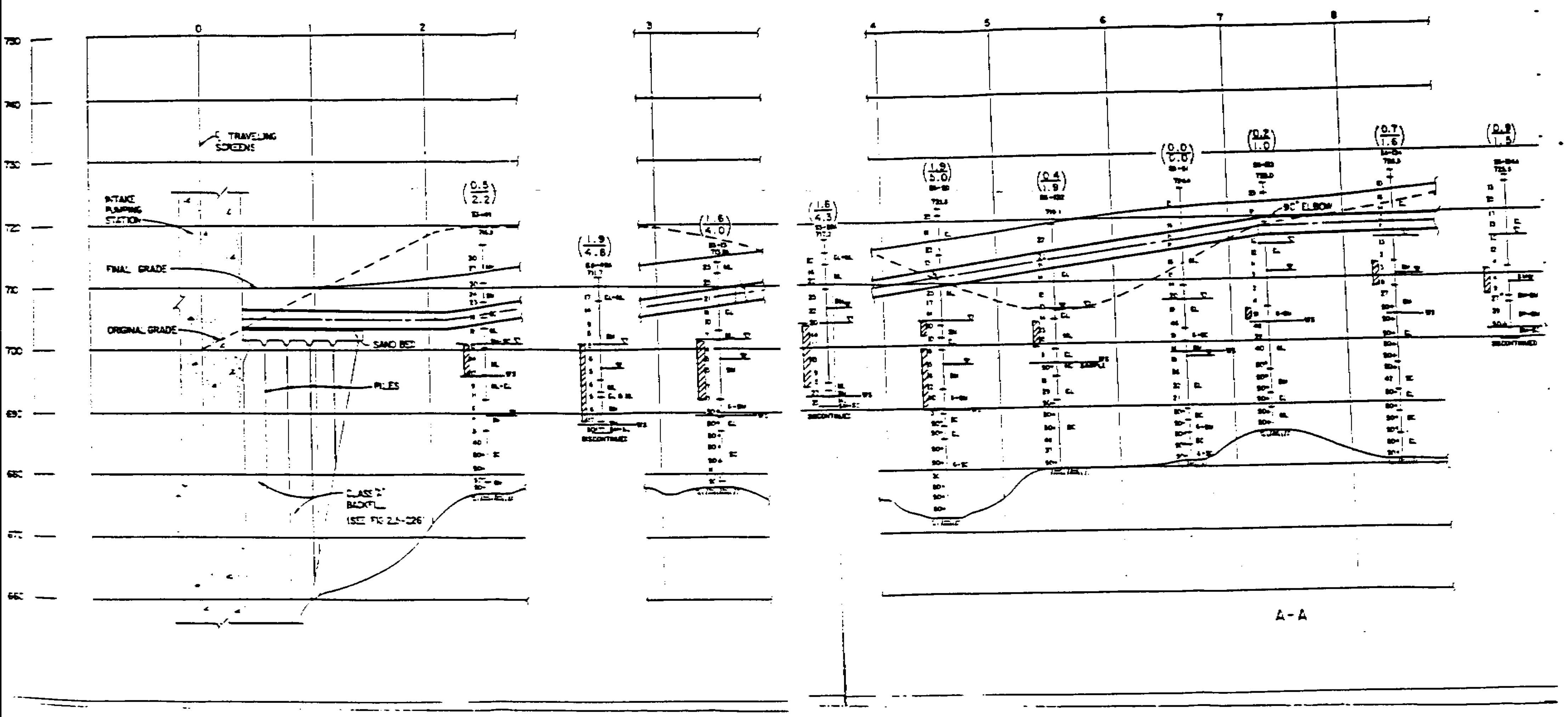
ERCW Pipeline
Section A-A Sheet 3 of 4

FIGURE 2.5-571


WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW Pipeline
Section A-A Sheet 4 of 4

FIGURE 2.5-571

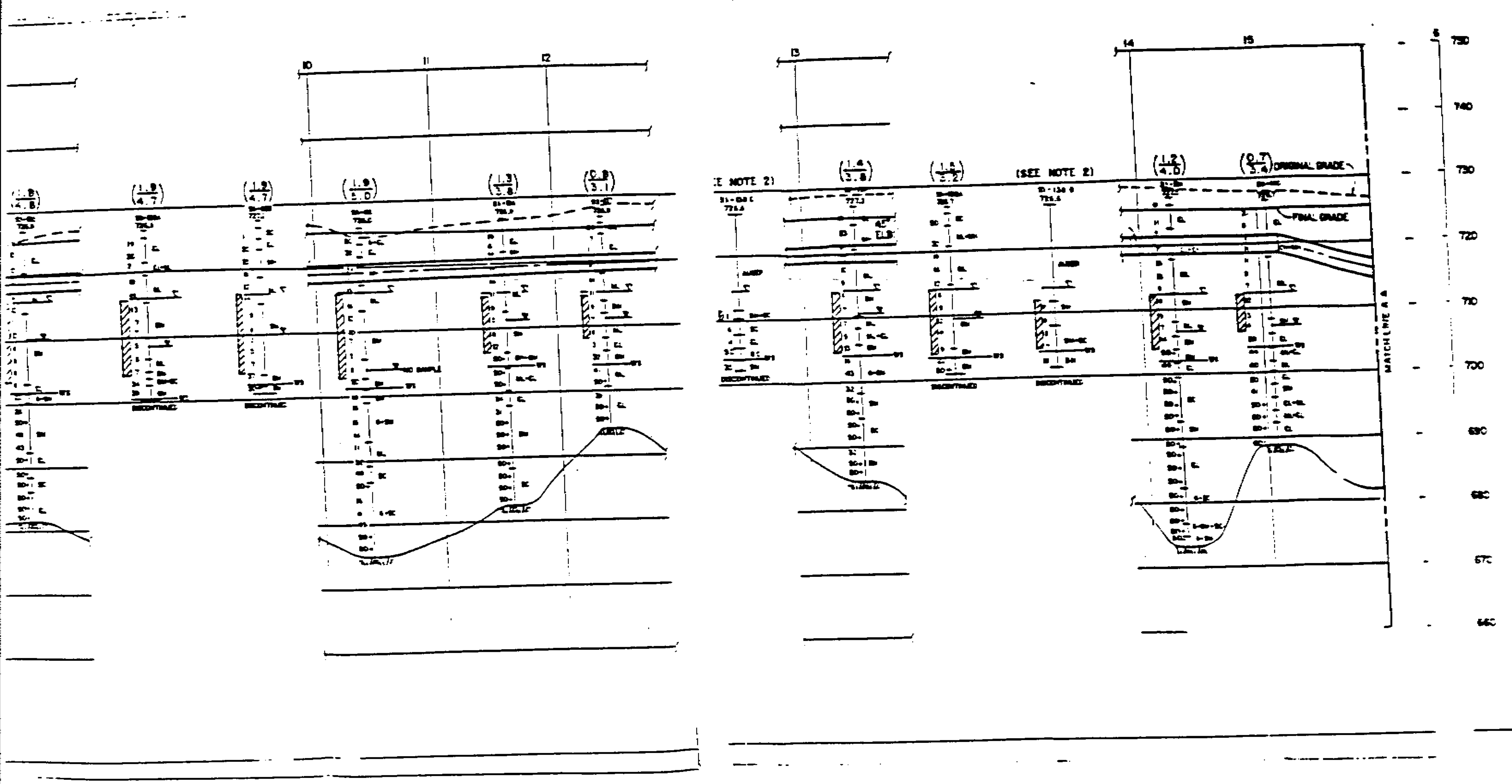



"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION A-A SHEET 1 OF 4
FIGURE 2.5-571

Sheet 1 of 2




(0.7 / 3.4) POTENTIAL SETTLEMENT BASED ON 1.5 ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

DESIGN WATER TABLE

WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE 1)

-WS WEATHERED SHALE

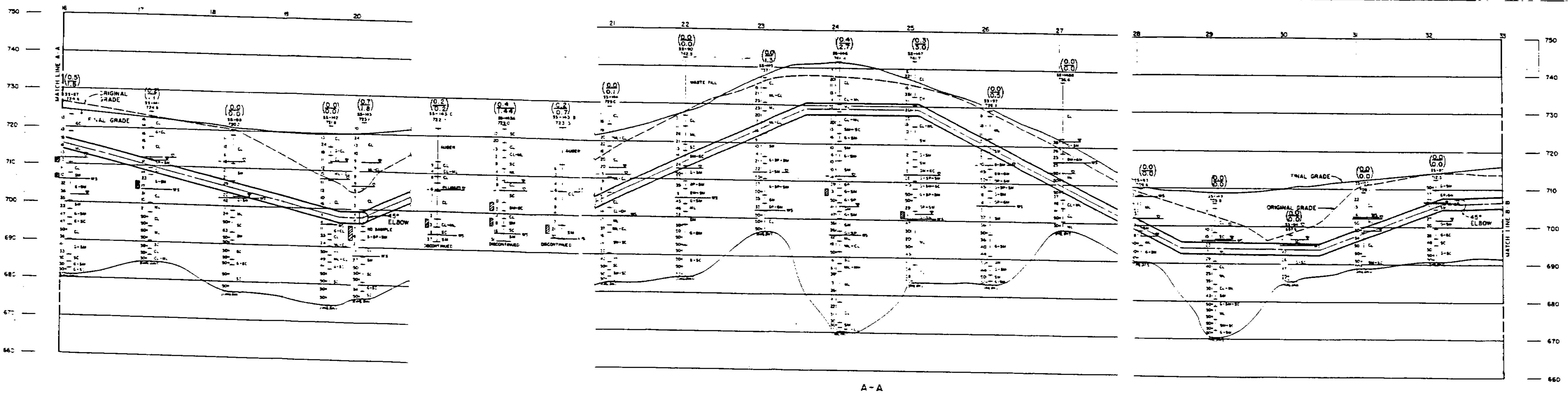
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED-IDRISS (1971) CORRELATION FOR SANDS.
2. POTENTIAL SETTLEMENT WAS NOT CALCULATED BECAUSE THE BORING WAS AUGERED DOWN BELOW THE ELEVATION OF THE PIPE.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION A-A SHEET 1 OF 4
FIGURE 2.5-571




(0.3 / 3.0) POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

DESIGN WATER TABLE

WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

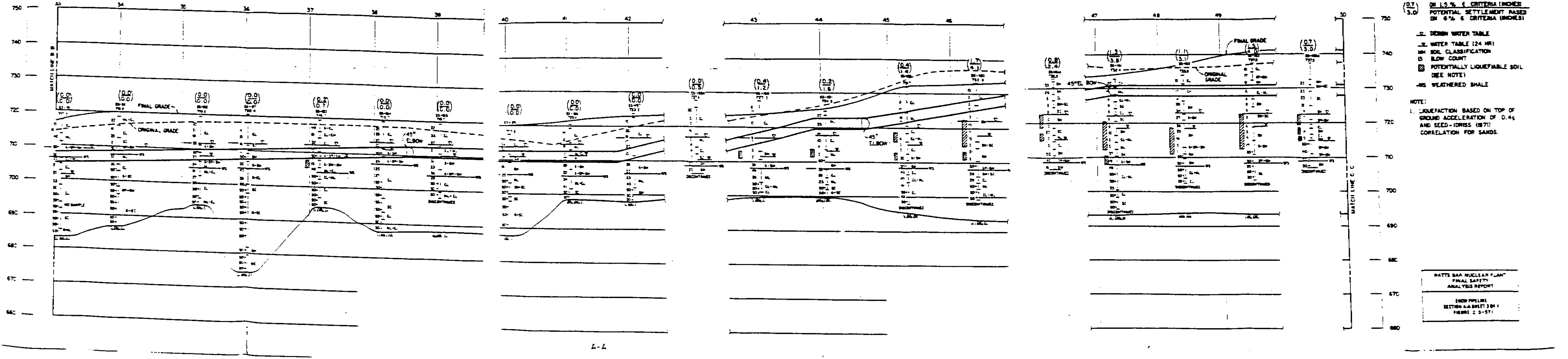
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

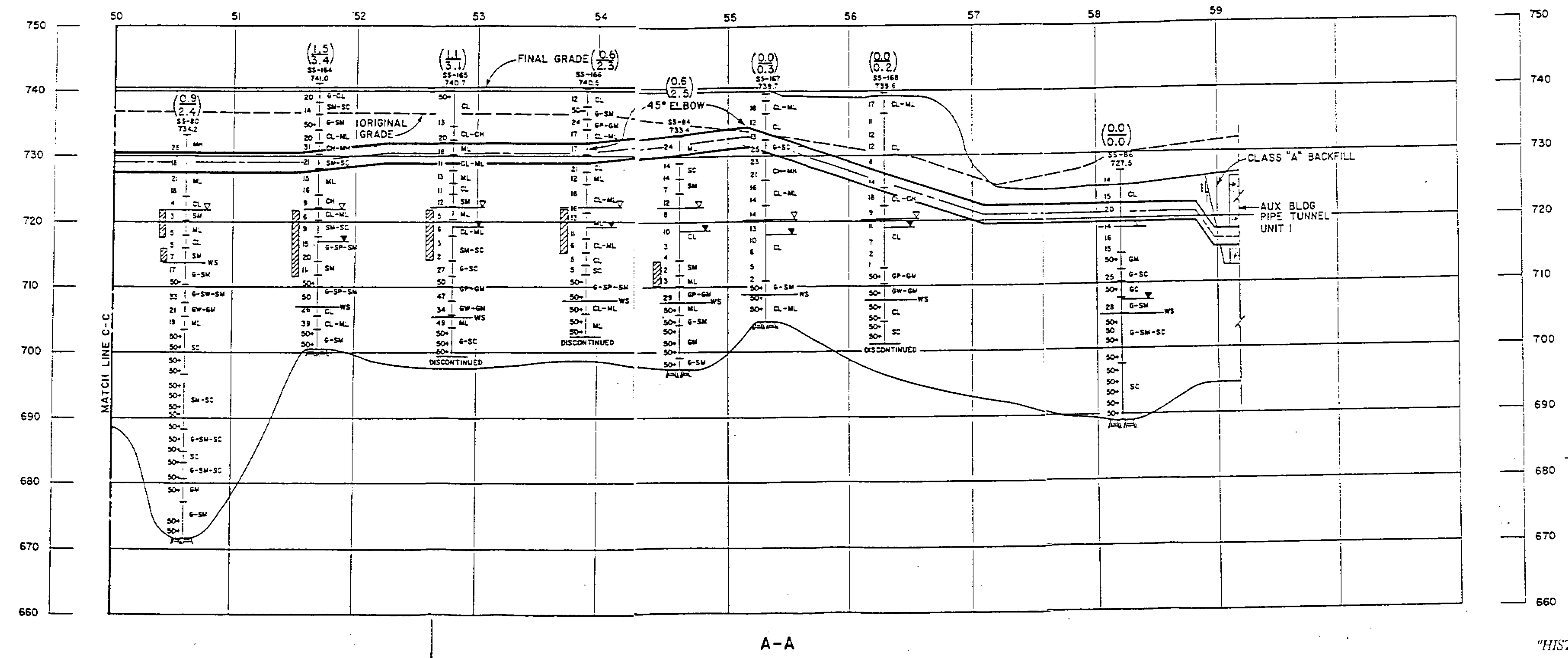
WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION A-A SHEET 7 OF 8
FIGURE 2.5-57

"HISTORICAL INFORMATION"




INFORMATION"




$\left(\frac{0.6}{2.3}\right)$ POTENTIAL SETTLEMENT BASED ON 1.5 % ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6 % ε CRITERIA (INCHES)

- ▽ DESIGN WATER TABLE
- ▼ WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- ▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

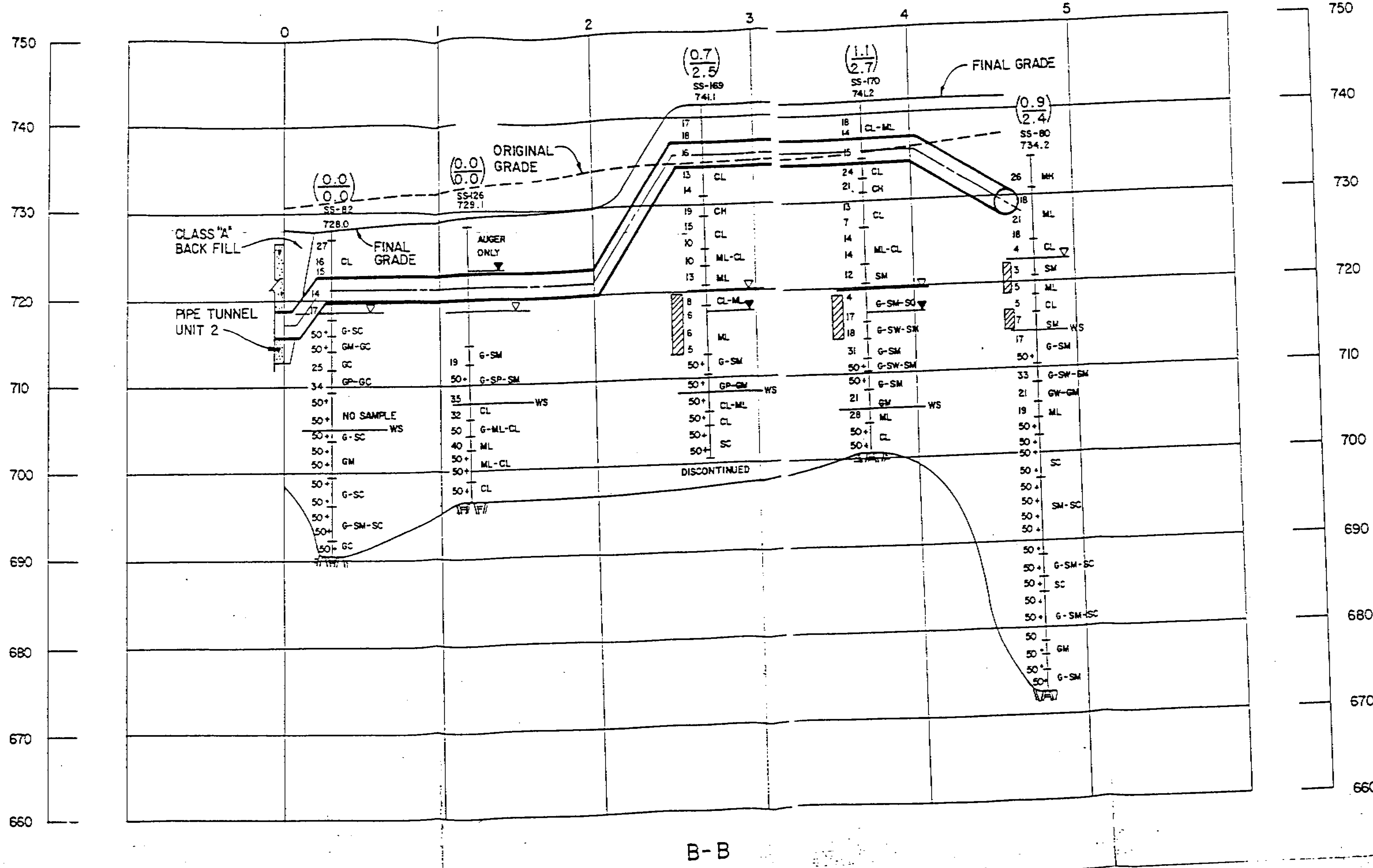
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRIS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION A-A SHEET 4 OF 4
FIGURE 2.5-571

"HISTORICAL INFORMATION"




(0.9 / 2.4) POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- DESIGN WATER TABLE
- WATER TABLE (24HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

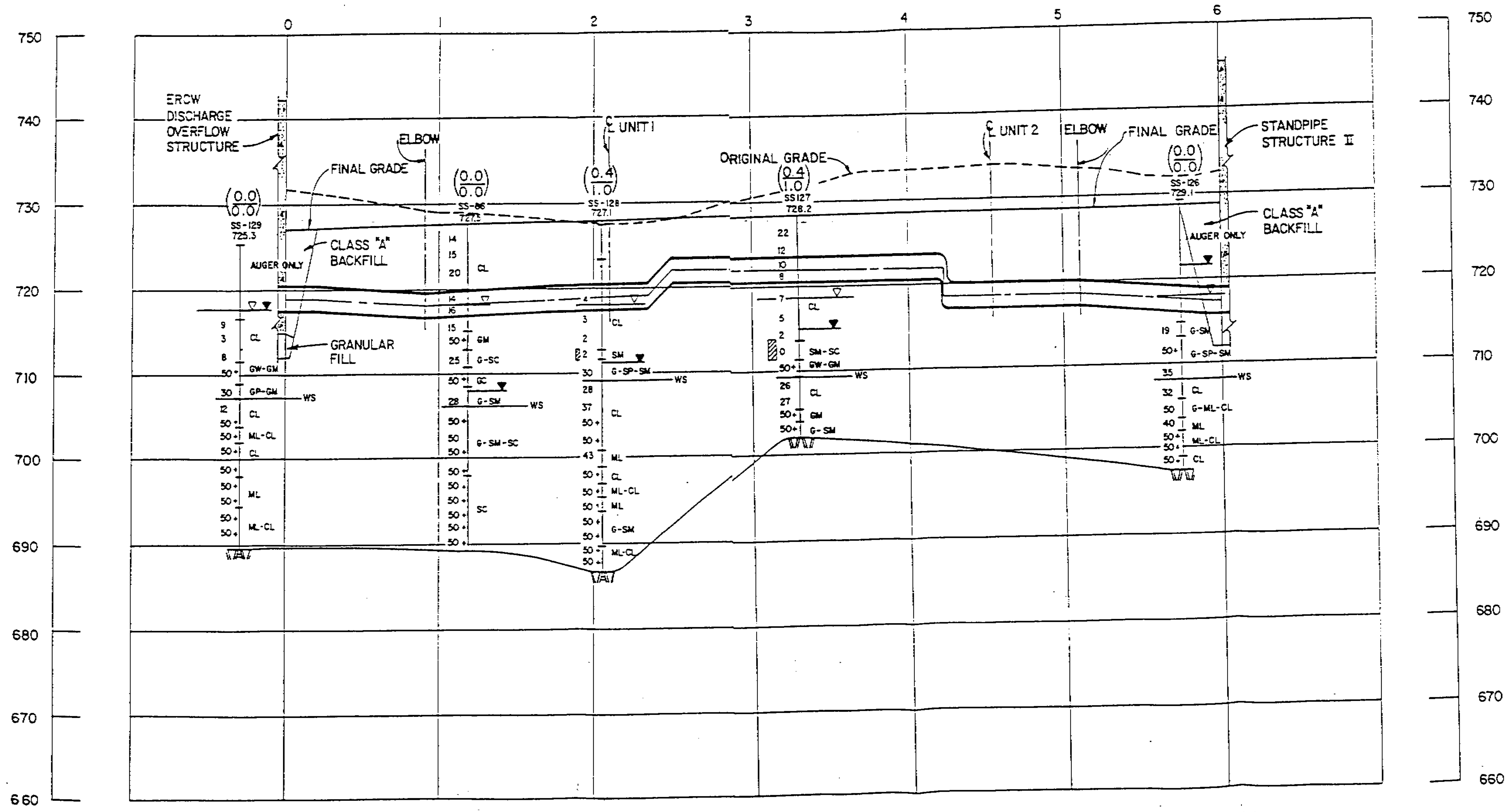
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION B-B
FIGURE 2.5-572




(0.4 / 1.0) POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- ▽ DESIGN WATER TABLE
- ▼ WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- ▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

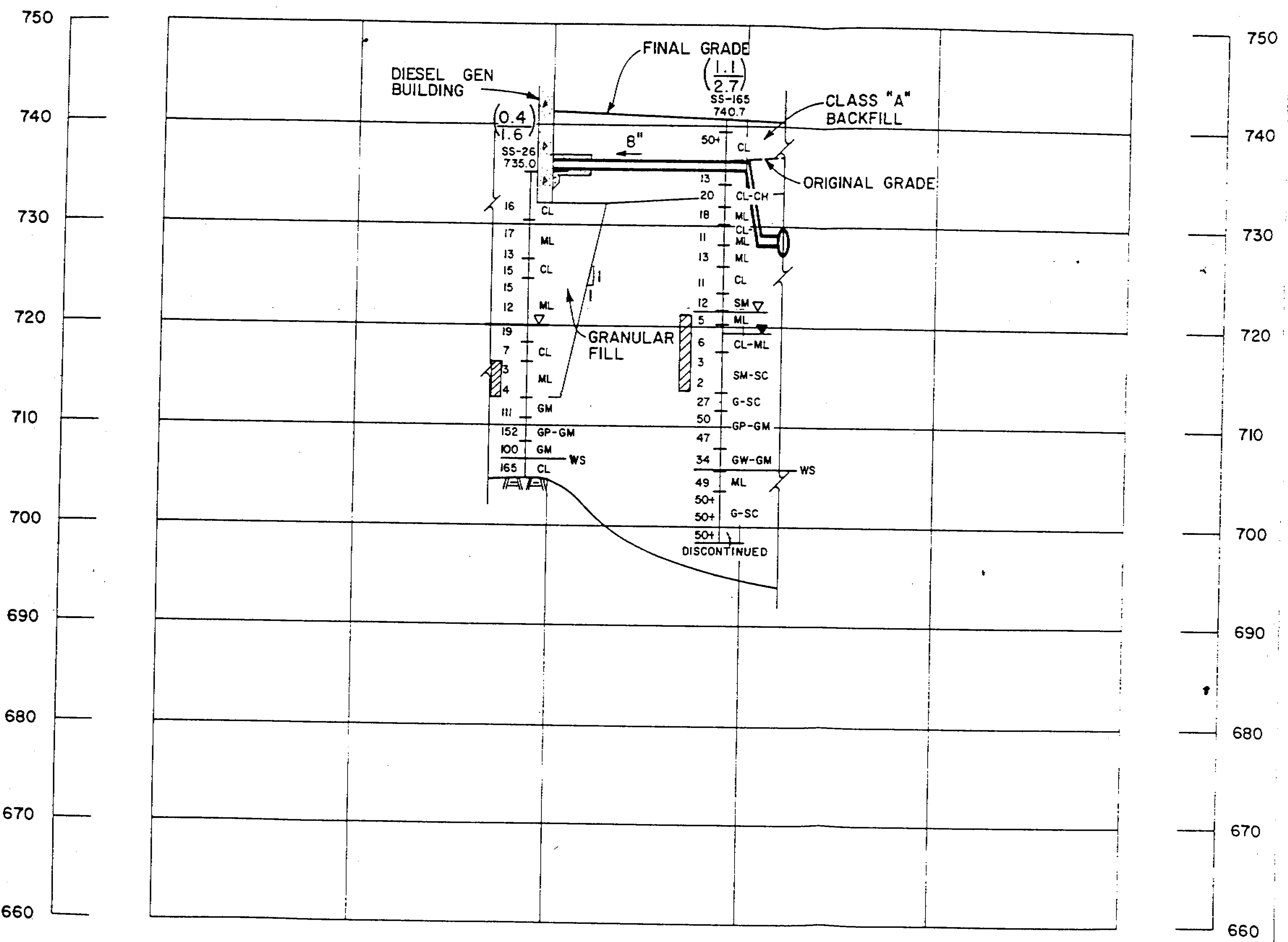
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED-IDRISS (1971) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION C-C
FIGURE 2.5-573




D - D

| $\left(\frac{1.1}{2.7}\right)$ | POTENTIAL SETTLEMENT BASED ON 1.5 % ϵ CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6 % ϵ CRITERIA (INCHES) |
|---|---|
| ▽ | DESIGN WATER TABLE |
| ▼ | WATER TABLE (24 HR) |
| MH | SOIL CLASSIFICATION |
| 13 | BLOW COUNT |
| ▨ | POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE) |
| -WS | WEATHERED SHALE |

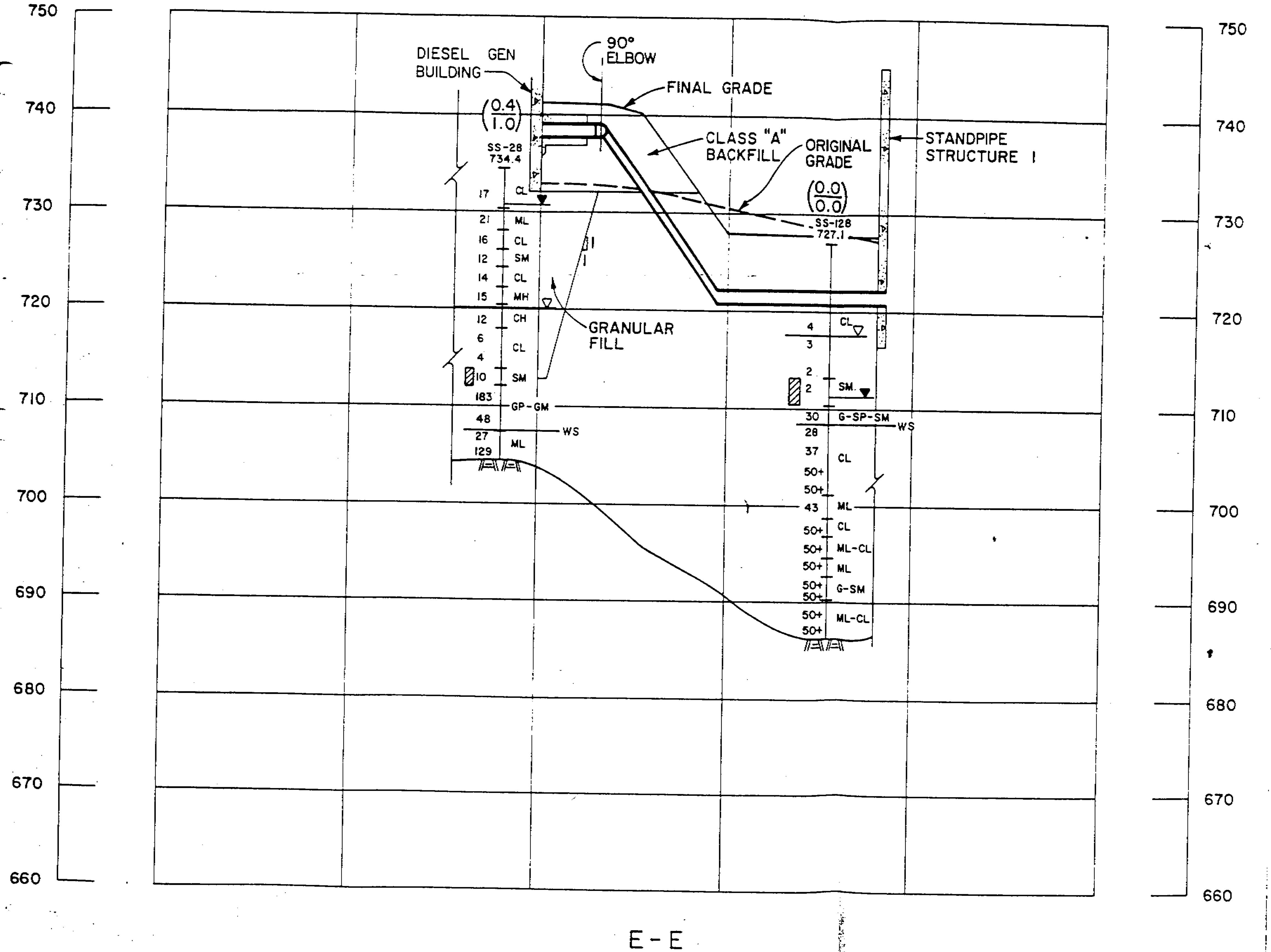
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION D-D
FIGURE 2.5-574




(0.4 / 1.0) POTENTIAL SETTLEMENT BASED ON 1.5 % ϵ CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ϵ CRITERIA (INCHES)

▽ DESIGN WATER TABLE

▼ WATER TABLE (24HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

NOTE:

1 LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

ERCW PIPELINE
SECTION E-E
FIGURE 2.5-575


(0.3) POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES)
(1.1) POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- ▽ DESIGN WATER TABLE
- ▼ WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- ▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- -WS WEATHERED SHALE

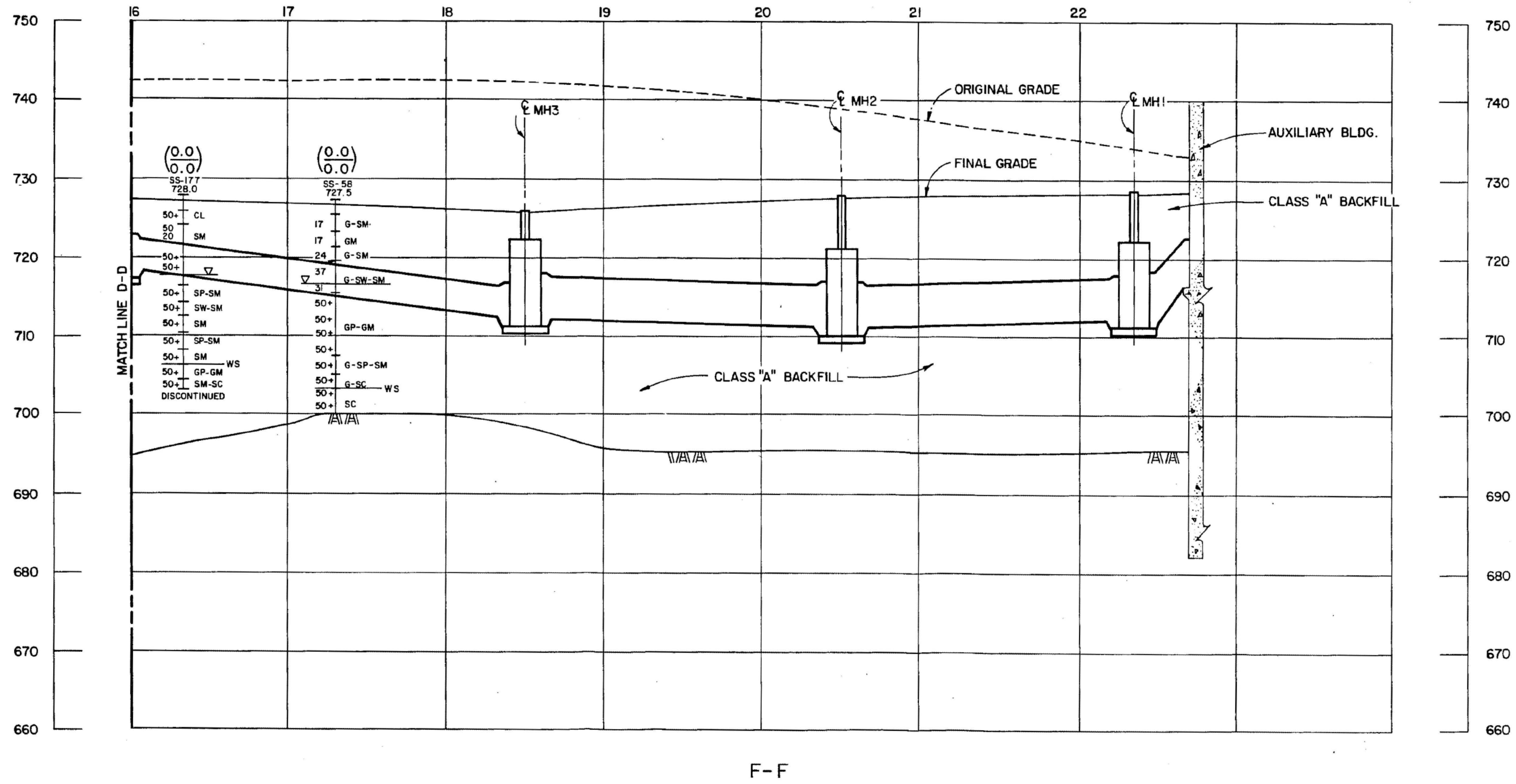
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Category I Electrical Conduits
Section F-F Sheet 1 of 2

FIGURE 2.5-576




F-F

(0.0/0.0) POTENTIAL SETTLEMENT BASED ON 1.5 % ∈ CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6 % ∈ CRITERIA (INCHES)

▽ DESIGN WATER TABLE

▼ WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

NOTE:

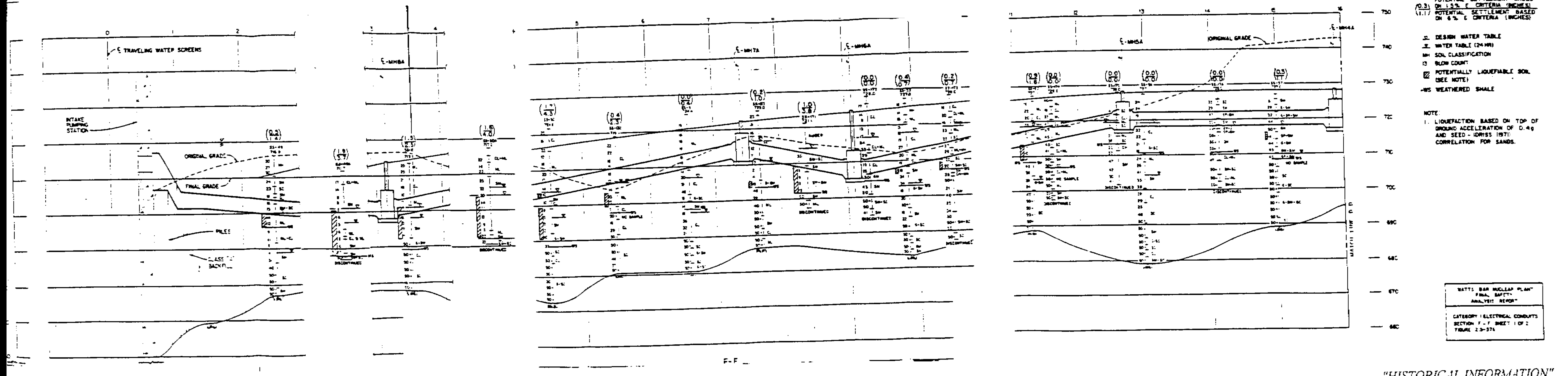
1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

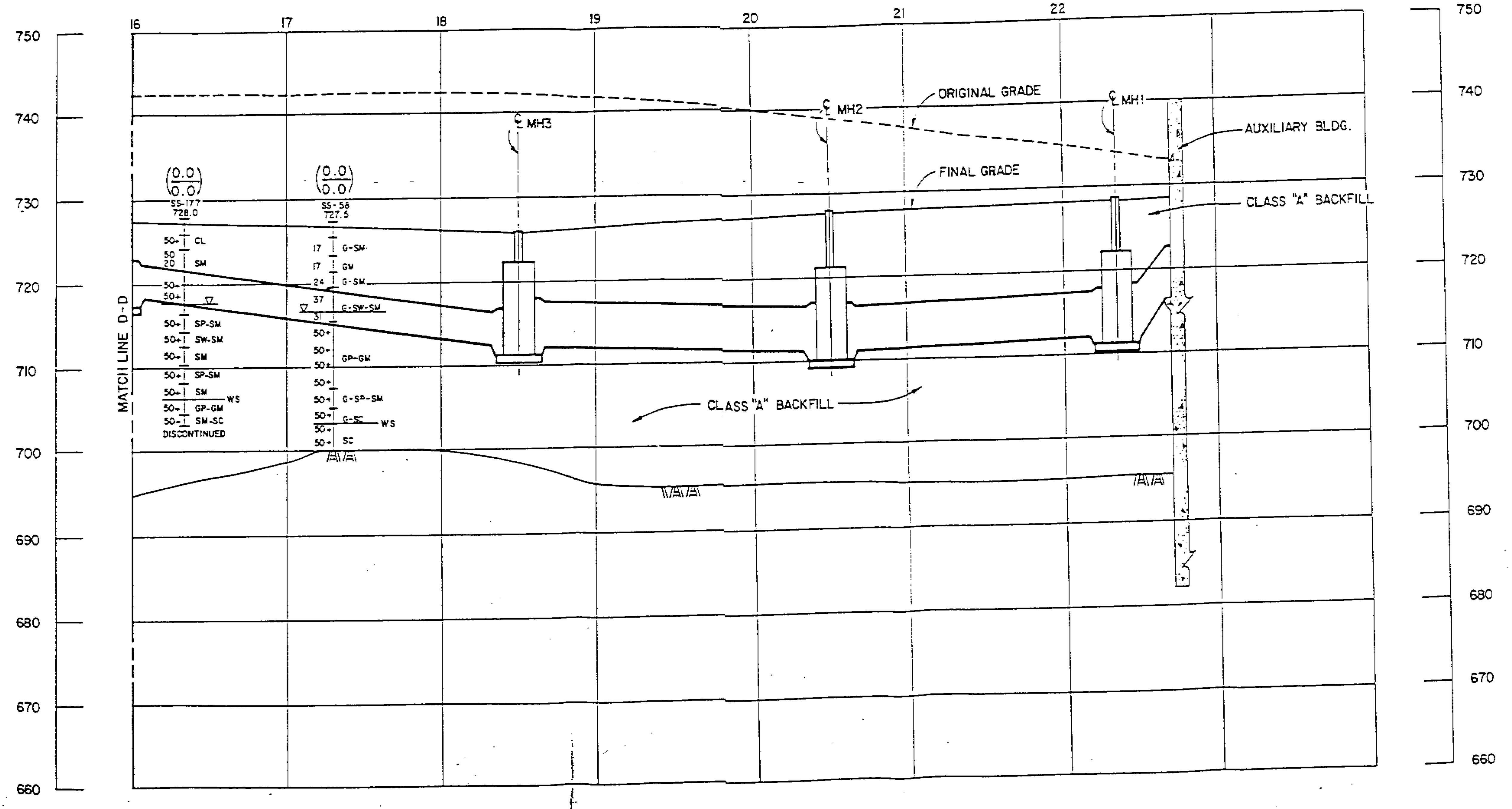
Category I Electrical Conduits
Section F-F Sheet 2 of 2

FIGURE 2.5-576

# FIGURE 2.5-576 SHEET 1 OF 2




*"HISTORICAL INFORMATION"*




(0.0/0.0) POTENTIAL SETTLEMENT BASED ON 1.5 % ∈ CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6 % ∈ CRITERIA (INCHES)

▽ DESIGN WATER TABLE

▼ WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

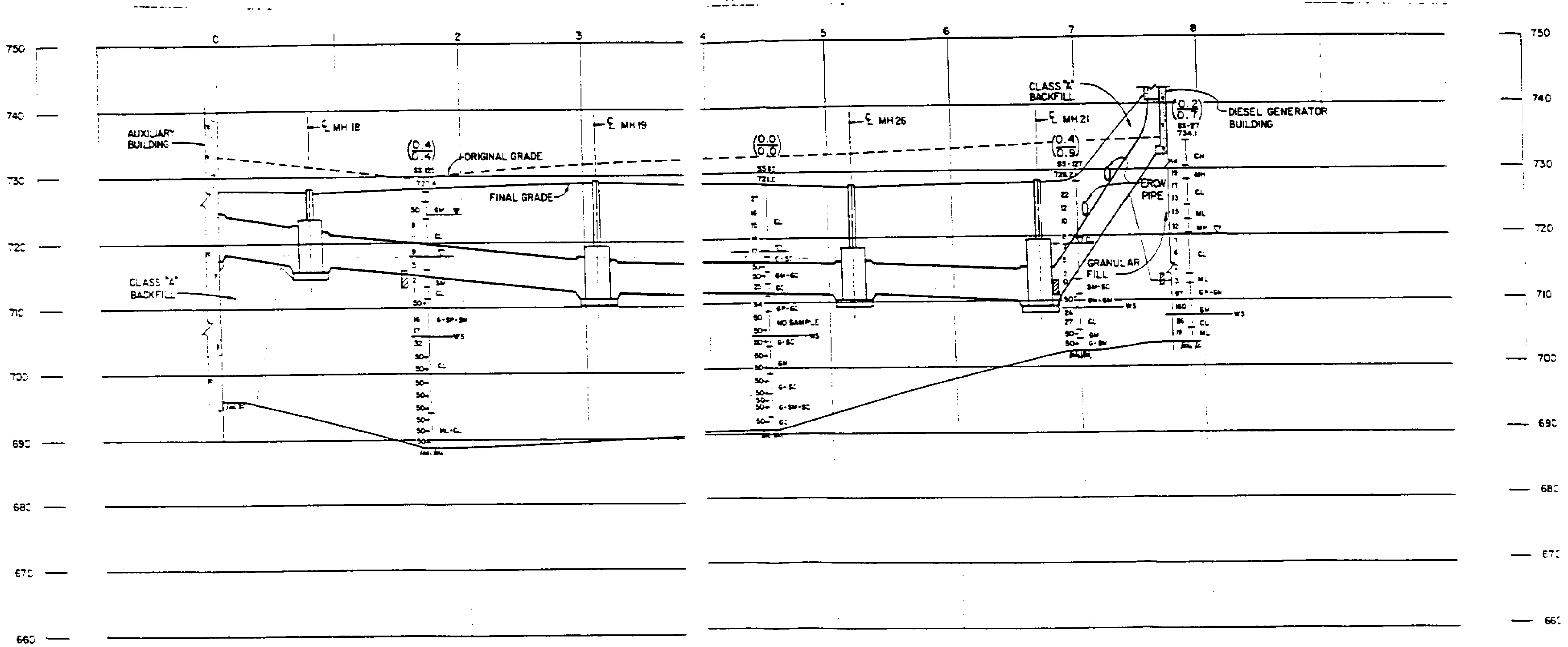
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION F-F SHEET 2 OF 2
FIGURE 2.5-576




G-G

$\frac{(0.2)}{(0.7)}$ POTENTIAL SETTLEMENT BASED ON 1.5 % ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6 % ε CRITERIA (INCHES)

DESIGN WATER TABLE

WATER TABLE (24 HR)

MH SOIL CLASSIFICATION

13 BLOW COUNT

POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)

-WS WEATHERED SHALE

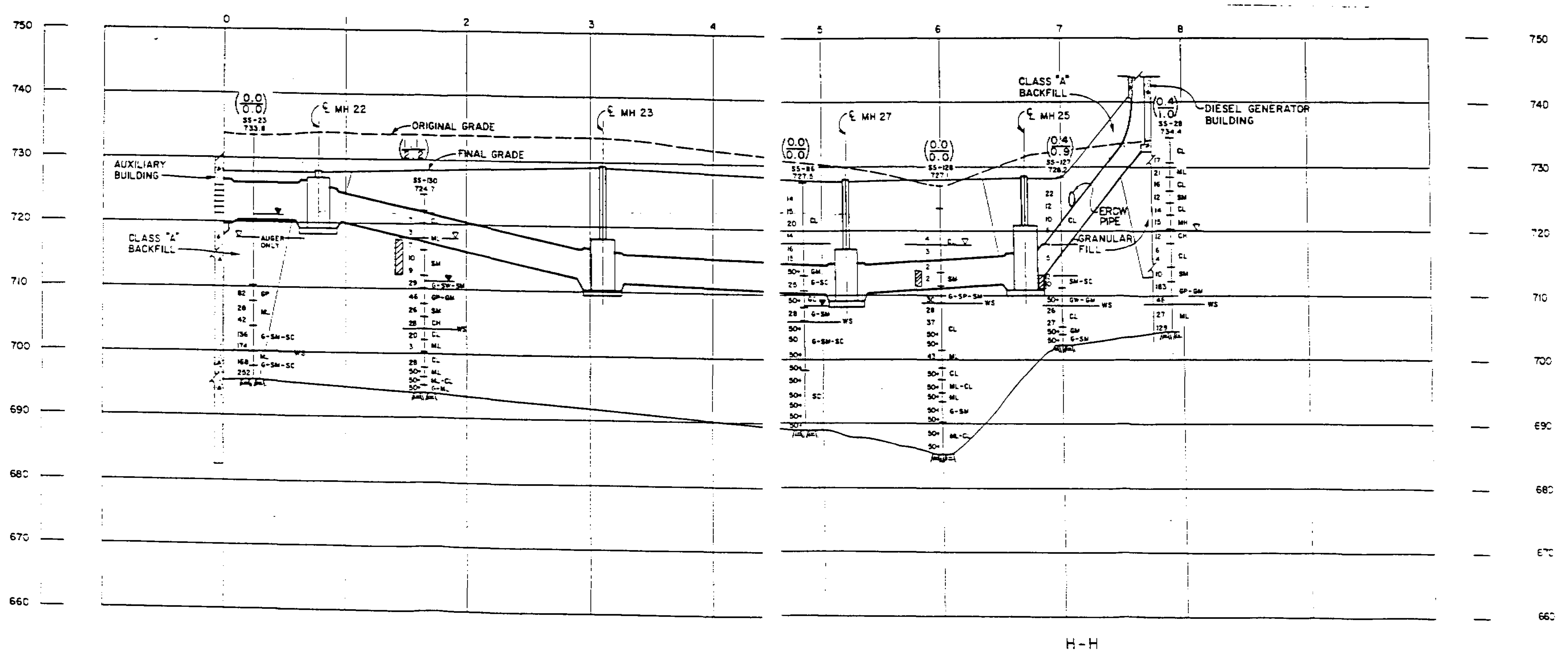
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED-IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION G-G
FIGURE 2.5-577

"HISTORICAL INFORMATION"




$\left(\frac{0.4}{1.0}\right)$ POTENTIAL SETTLEMENT BASED ON 1.5% ε CRITERIA (INCHES) / POTENTIAL SETTLEMENT BASED ON 6% ε CRITERIA (INCHES)

- DESIGN WATER TABLE
- WATER TABLE (24 HR)
- MH SOIL CLASSIFICATION
- 13 BLOW COUNT
- POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
- WS WEATHERED SHALE

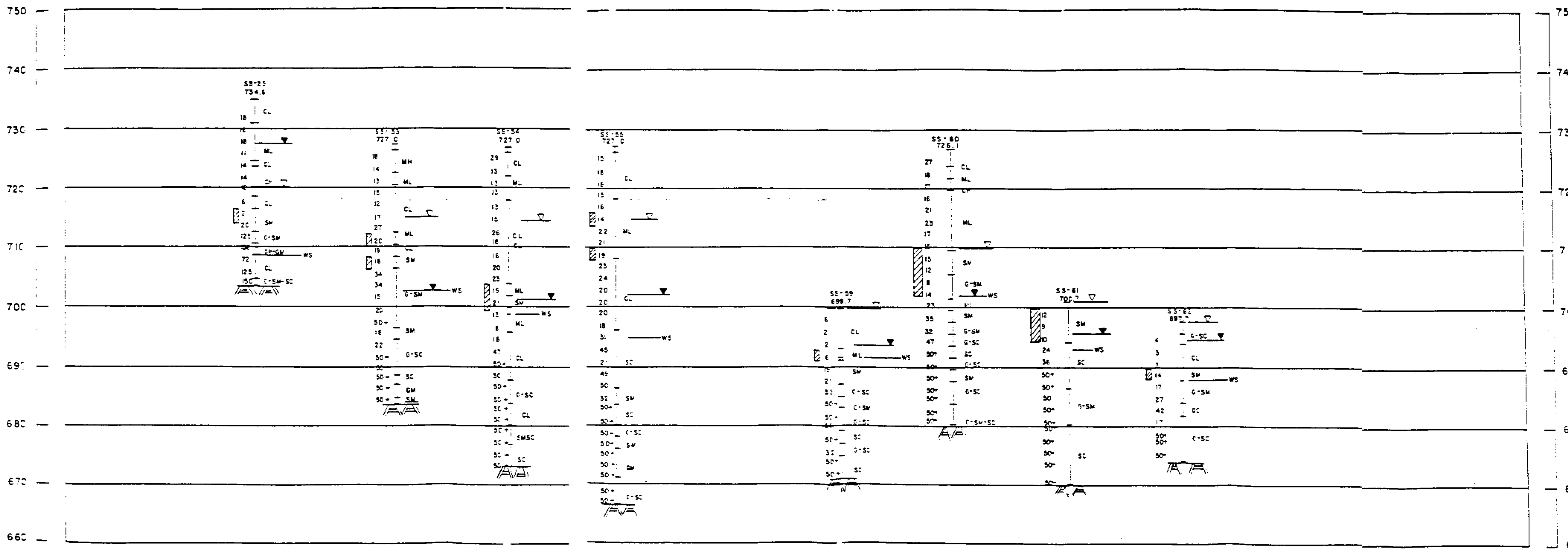
NOTE:

1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED - IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CATEGORY I ELECTRICAL CONDUITS
SECTION H-H
FIGURE 2.5-578

"HISTORICAL INFORMATION"




▽ DESIGN WATER TABLE
▼ WATER TABLE (24 HR)
MH SOIL CLASSIFICATION
13 BLOW COUNT
▨ POTENTIALLY LIQUEFIABLE SOIL (SEE NOTE)
-WS WEATHERED SHALE

NOTE:

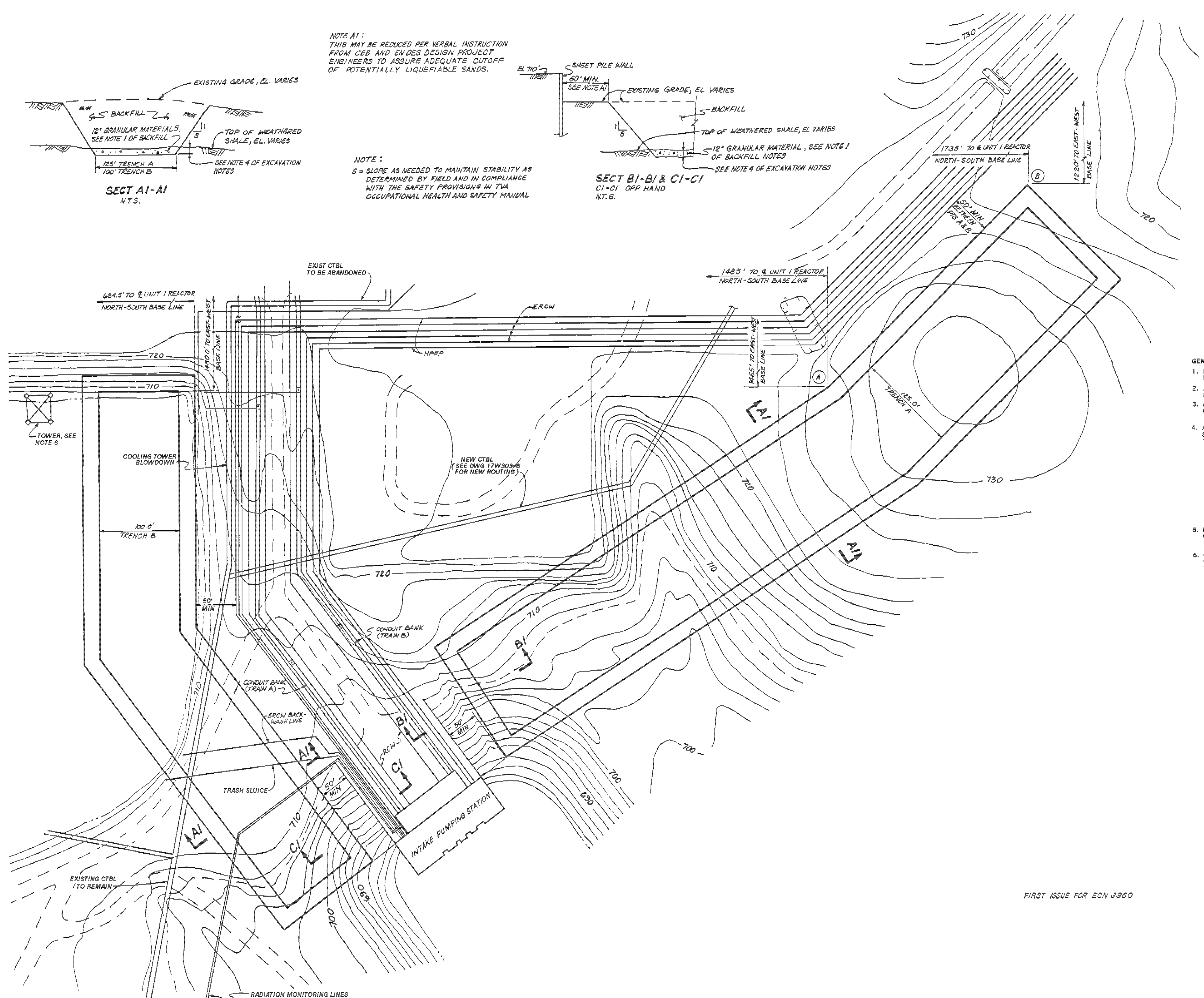
1. LIQUEFACTION BASED ON TOP OF GROUND ACCELERATION OF 0.4g AND SEED-IDRISS (1971) CORRELATION FOR SANDS.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

MISCELLANEOUS ERCW PIPING
AND IE CONDUIT
SOIL BORINGS
FIGURE 2.5-579

"HISTORICAL INFORMATION"

CAD MAINTAINED DRAWING




ASSUMED NORTH

GENERAL NOTES:

1. BACKFILL IS CATEGORY 1 AND THE QUALITY ASSURANCE REQUIRED IS DEFINED IN THE FOLLOWING NOTES AND ON DWG 10N213-2.
2. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION G-9, EXCEPT AS NOTED.
3. ALL EXCAVATION AND BACKFILL SHALL BE DONE UNDER THE DIRECT SUPERVISION OF A QUALIFIED SOILS INSPECTOR, EXCEPT WHEN EXCAVATING FORMERLY SPIOLED MATERIAL.
4. AS BUILT CROSS-SECTIONS OF EACH TRENCH SHALL BE RECORDED. THE CROSS SECTION SHALL BE MADE AT 50 FOOT STATIONS ALONG THE TRENCH CENTERLINE. THE INFORMATION TO BE RECORDED FOR EACH CROSS-SECTION SHALL INCLUDE:
   a. ELEVATION AND LOCATION OF ALL SURFACE BREAKS IN THE PROFILE.
   b. ELEVATION OF THE TOP OF WEATHERED SHALE, TOP OF BASEL GRAVEL (IF ENCOUNTER) AND TOP OF SAND SILTY SAND IN THE SIDE WALLS OF THE EXCAVATION SLOPES. THE INSPECTOR SHALL PROVIDE THE IDENTIFICATION OF THESE MATERIALS.
   c. FINAL GRADE
5. FINAL GRADING PER DRAWING 10W245 SHALL BE MADE AND SEEDING TO RESTORE VEGETATION TO THE AREAS AFFECTED BY THIS WORK SHALL BE APPLIED AS NECESSARY.
6. COORDINATE WITH POWER, DIVISION OF TRANSMISSION SYSTEM ENGINEERING AND CONSTRUCTION, THE LOCATION OF THE TRENCH WITH RESPECT TO THE TRANSMISSION TOWER FOR THEIR EVALUATION OF THE NEED FOR SUPPORT OF THE TOWER FOUNDATION.

FIRST ISSUE FOR ECN 3960

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

YARD
UNDERGROUND BARRIERS
FOR
POTENTIAL SOIL LIQUEFACTION

TVA DWG NO. 10N213-1 RD
FIGURE 2.5-580

CAD MAINTAINED DRAWING

EXCAVATION NOTES:

1. A STOCKPILE AREA FOR FINE GRAINED CLAYS AND SILTS, AND A SEPARATE STOCKPILE AREA FOR THE SANDS AND SILTY SANDS ARE TO BE ESTABLISHED. SEPARATE STOCKPILES FOR EACH TRENCH MAY BE ESTABLISHED AT THE OPTION OF THE FIELD. AS EACH TRENCH IS EXCAVATED THE FINE GRAINED CLAYS AND SILTS ARE TO BE VISUALLY SEPARATED FROM THE SANDS AND SILTY SANDS AND DISTRIBUTED TO THE APPROPRIATE STOCKPILE. THE STOCKPILE AREAS ARE TO BE ESTABLISHED IN A MANNER THAT WILL ALLOW DRAINAGE OF THE STOCKPILED MATERIAL IN ORDER THAT IT CAN BE RECLAIMED FOR BACKFILL. THE SURFACES OF THE STOCKPILE AREAS ARE TO BE GRADED TO PREVENT PONDING AND TO MINIMIZE INFILTRATION OF RAINFALL AND RUNOFF.
2. MATERIAL ENCOUNTERED IN THE EXCAVATION THAT WAS PREVIOUSLY SPOILED DURING PLANT CONSTRUCTION SHALL BE SPOILED IN A NEW LOCATION.
3. BASEL GRAVEL MAY BE ENCOUNTERED BELOW THE SANDS AND SILTY SANDS IN MANY AREAS OF THE TRENCH EXCAVATION. THE BASEL GRAVEL SHALL BE SPOILED.
4. EACH TRENCH IS TO BE EXCAVATED TO THE WEATHERED SHALE (SAPROLITE). THE EXCAVATION IS TO BE CARRIED INTO THE WEATHERED SHALE TO A DEPTH WHERE THE SAPROLITE MATERIAL EXHIBITS ROCK-LIKE CHARACTERISTICS SUCH AS BEDDING STRUCTURE AND JOINTS. THE DEPTH OF EXCAVATION INTO THE WEATHERED SHALE SHALL BE DETERMINED BY A QUALIFIED SOILS INSPECTOR. EXCAVATION TO SOUND, UNWEATHERED ROCK IS NOT REQUIRED.
5. BEST MANAGEMENT PRACTICE FOR RUNOFF SHOULD BE USED FOR STOCKPILES AND SPOILPILE AREAS.
6. EACH TRENCH SHALL BE DEWATERED AND MAINTAINED IN A MANNER THAT WILL ALLOW THE EXCAVATION AND PLACEMENT OF EARTHFILL TO BE DONE IN AN ENVIRONMENT SUFFICIENTLY DRY TO COMPLY WITH THE MOSITURE CONTENT REQUIREMENTS OF EARTHFILL NOTE 3. DEWATERING IS ALSO NECESSARY TO MAINTAIN THE STABILITY OF EXCAVATION SLOPES AND ADJACENT STRUCTURES AND FEATURES. THE DEWATERING TECHNIQUES USED BY CONST MUST BE EFFECTIVE AND RELIABLE AND MEET THE APPROVAL OF EN DES. PARTICULAR CARE SHALL BE TAKEN TO PREVENT THE MOVEMENT, MIGRATION, FLOW, SLUMPING, OR LOSS OF THE SANDS AND SILTY SANDS IN THE TRENCH EXCAVATIONS. PROGRESSIVELY GRADED REVERSE FILTERS OF SANDS, GRAVELS, AND/OR CRUSHED STONE, AS APPROPRIATE, SHALL BE IMMEDIATELY PLACED OVER ANY SANDY MATERIALS THAT EXHIBIT TENDENCIES FOR MOVEMENT, MIGRATION, FLOW, SLUMPING, OR LOSS.
7. PRIOR TO PLACEMENT OF ANY BACKFILL, THE SURFACE OF THE WEATHERED SHALE SHALL BE REASONABLY WELL CLEANED OF ANY SOIL OR LOOSE DEBRIS AND/OR ANY ROCK OVER 4"± THAT MAY REMAIN AFTER THE EXCAVATION PROCESS. AIR OR WATER SHALL NOT BE USED IN THE CLEANUP OF THE WEATHERED SHALE SURFACE.
8. THE PROCESS OF EXCAVATING INTO THE WEATHERED SHALE TO THE SPECIFIED DEPTH, CLEANING THE SURFACE. AND PLACEMENT OF THE GRANULAR MATERIAL AS SPECIFIED IN EARTHFILL NOTE 1 SHALL BE KEPT AS SHORT AS REASONABLE TO PREVENT DETERIORATION OF THE WEATHERED SHALE SURFACE.

EARTHFILL NOTES:

AFTER THE TRENCH HAS BEEN EXCAVATED TO THE SPECIFIED DEPTH (EXCAV NOTE 4) THE FOLLOWING STEPS SHALL BE TAKEN TO BACKFILL EACH TRENCH:

1. PLACE AND COMPACT A MINIMUM OF 12 INCHES OF GRANULAR MATERIAL MEETING THE REQUIREMENTS OF SECTION 1075 (BOTTOM LAYER) OF GENERAL CONSTRUCTION SPECIFICATION T-1. THE FOLLOWING GRADATION IS ALSO ACCEPTABLE.

| SQUARE SIEVE SIZE | PERCENT PASSING BY WEIGHT |
|---|---|
| 1-1/2 INCHES | 100 |
| 3/4 INCH | 30-75 |
| 3/8 INCH | 5-15 |
| NO. 4 | 0-5 |

THE GRANULAR MATERIAL SHALL BE PLACED IN MAXIMUM 10 INCH LOOSE LIFTS AND COMPACTED WITH A MINIMUM OF 6 COMPLETE PASSES BY A DYNAPAC CA25 VIBRATORY ROLLER, OR AN EN DES APPROVED EQUAL.

2. EARTHFILL TO FILL THE TRENCHES SHALL BE OBTAINED FROM STOCKPILES AND BORROW AREAS APPROVED BY EN DES. THE PURPOSE OF THE BACKFILLING SEQUENCE PROVIDED BELOW IS TO PLACE THE SANDS AND SILTY SANDS AT A HIGHER ELEVATION AND AT A HIGHER DENSITY THAN THEY NATURALLY EXIST. THE MATERIAL FOR BACKFILLING THE TRENCHES SHALL BE OBTAINED FROM THE FOLLOWING SOURCES IN THE ORDER SHOWN.
   (a) MATERIAL FROM THE STOCKPILE OF FINE-GRAINED CLAYS AND SILTS ESTABLISHED DURING THE TRENCH EXCAVATION. THIS MATERIAL SHOULD BE DISTRIBUTED UNIFORMALLY AND COMPACTED ALONG THE LENGTH OF THE TRENCH.
   (b) MATERIAL FROM THE STOCKPILE OF SANDS AND SILTY SANDS, ESTABLISHED DURING THE TRENCH EXCAVATION. THIS MATERIAL SHOULD BE DISTRIBUTED UNIFORMALLY AND COMPACTED ALONG THE LENGTH OF THE TRENCH.
   (c) MATERIAL FROM APPROVED BORROW AREAS MAY BE USED TO SUPPLEMENT ANY ADDITIONAL MATERIAL NEEDED FOR FILLING THE TRENCHES.
   (d) MATERIAL FOR BACKFILLING TRENCH A SHALL BE OBTAINED FROM TRENCH A STOCKPILE, BORROW AREAS 9,10, AND 2C, AND MATERIAL FROM REGRADING FUTURE 161 KV SWITCHYARD.
   (e) MATERIAL FOR BACKFILLING TRENCH B SHALL BE OBTAINED FROM TRENCH B STOCKPILE, BORROW AREAS 12,13, AND 2C, AND MATERIAL FROM REGRADING FUTURE 161 KV SWITCHYARD.

   A MINIMUM OF 10 FEET OF FINE GRAINED MATERIAL FROM CATEGORIES (a) AND (c) ABOVE SHALL BE PLACED BEFORE MATERIAL FROM CATEGORY (b) CAN BE PLACED.
3. EARTHFILL SHALL BE UNIFORMLY COMPACTED IN LAYERS WHICH WHEN COMPACTED DO NOT EXCEED A THICKNESS OF 6 INCHES. COMPACTION SHALL BE ACCOMPLISHED WITH A TAMPING (SHEEPSFOOT) ROLLER (REX PACTOR 3-50, OR AN EN DES APPROVED EQUAL). TWO EARTHFILL TYPES ARE DEFINED AS FOLLOWS:
   (a) TYPE A; EARTHFILL COMPACTED TO AT LEAST 95% OF MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698 (STANDARD PROCTOR).
   (b) TYPE A1; EARTHFILL COMPACTED TO AT LEAST 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698.

   MOISTURE CONTENT OF ALL EARTHFILL SHALL BE WITHIN ± 3% OF OPTIMUM MOISTURE CONTENT.
4. EARTHFILL PLACEMENT INSTRUCTIONS:
   (a) GENERAL: THE DATUM FOR FILL PLACEMENT SHALL BE A PLANE SURFACE CONNECTING THE TOP OF SHALE ON OPPOSING TRENCH SIDEWALLS AS DETERMINED AT THE 50 FOOT CROSS-SECTION STATIONS AS IDENTIFIED BY THE SOILS INSPECTOR. (SEE GENERAL NOTE 4B). IN CASES WHERE IRREGULARITIES IN THE TRENCH BOTTOM RESULT IN LESS THAN THE REQUIRED DEPTH OF TYPE A1 EARTHFILL NOTIFY EN DES GEOLOGY AND GEOTECHNICAL ENGINEERING GROUP OF THE CIVIL ENGINEERING SUPPORT BRANCH (CEB). SUCH CASES WILL BE EVALUATED ON AN INDIVIDUAL BASIS AND VERBAL INSTRUCTIONS PROVIDED TO THE FIELD.
   (b) TRENCH A:
      (1) TYPE A1 EARTHFILL SHALL BE PLACED FROM THE GRANULAR 1075 MATERIAL TO A LINE 10 FEET ABOVE THE DATUM.
      (2) TYPE A EARTHFILL SHALL BE USED FROM THE TOP OF THE TYPE A1 MATERIAL TO FINAL GRADE.
   (c) TRENCH B: EARTHFILL PLACEMENT INSTRUCTIONS FOR TRENCH B ARE A FUNCTION OF THE DEPTH FROM FINAL GRADE TO THE DATUM.
      (1) FOR 25 FEET OR LESS: TYPE A1 EARTHFILL SHALL BE PLACED FROM THE GRANULAR 1075 MATERIAL TO WITHIN 8 FEET OF FINAL GRADE. THE REMAINDER OF THE TRENCH SHALL BE TYPE A EARTHFILL.
      (2) FOR A DEPTH GREATER THAN 25 FEET BUT LESS THAN 40 FEET: GRANULAR MATERIAL MEETING THE REQUIREMENTS OF EARTHFILL NOTE 1 SHALL BE PLACED TO WITHIN 25 FEET OF FINAL GRADE. TYPE A1 EARTHFILL SHALL BE PLACED FROM A DEPTH OF 25 FEET TO 8 FEET. THE REMAINDER OF THE TRENCH SHALL BE TYPE A EARTHFILL.
      (3) FOR A DEPTH GREATER THAN 40 FEET OR FOR CASES OF UNUSUAL EXCAVATION GEOMETRY. CONTACT THE GEOLOGY AND GEOTECHNICAL ENGINEERING GROUP IN CEB FOR INSTRUCTIONS. SUCH CASES WILL BE EVALUATED ON AN INDIVIDUAL BASIS AND VERBAL INSTRUCTIONS PROVIDED TO THE FIELD.
5. IN-PLACE DRY DENSITY TESTS USING THE SAND CONE (ASTM D1556) OR RUBBER BALLOON (ASTM D2167) TEST METHODS SHALL BE MADE AT A RATE OF 1 TEST FOR EACH 2000 CUBIC YARDS OF EARTHFILL PLACED (IN PLACE VOLUMN). BLOCK SAMPLES SHALL BE OBTAINED AS OUTLINED IN SECTION 11.3 OF GENERAL CONSTRUCTION SPECIFICATION G-9, EXCEPT THAT THE MINIMUM FREQUENCY OF SAMPLING SHALL CONFORM TO EACH OF THE FOLLOWING:
   (a) ONE SAMPLE SHALL BE TAKEN FOR EACH 50,000 CUBIC YARDS OF FILL PLACED THROUGHTOUT THE COURSE OF THE WORK.
   (b) ONE SAMPLE SHALL BE TAKEN FOR EACH 20 DAYS OF FILL PLACING THROUGHOUT THE COURSE OF THE WORK.
   (c) A MINIMUM OF THREE SAMPLES SHALL BE TAKEN IN EACH TRENCH. A MINIMUM OF ONE OF THESE THREE SAMPLES IN EACH TRENCH SHALL BE TAKEN IN THE SAND OR SILTY SAND (SEE EARTHFILL NOTE 2b) IF MORE THAN 10,000 CUBIC YARDS ARE PLACED. A MINIMUM OF ONE OF THESE THREE SAMPLES IN EACH TRENCH SHALL BE TAKEN FROM THE FILL COMPACTED TO 100% OF MAXIMUM DRY DENSITY.

   IN LIEU OF MEETING THE REQUIREMENTS OF THE FIRST TWO SENTENCES OF THE FOURTH PARAGRAPH OF SECTION 11.2 OF GENERAL CONSTRUCTION SPECIFICATION G-9, THE FOLLOWING TESTING TO CONFIRM CORRELATION WITH THE LABORATORY COMPACTION CURVES SHALL BE MADE. AT LEAST ONE 3-POINT MOISTURE-DENSITY COMPACTION TEST SHALL BE PERFORMED FOR EACH 50 ROUTINE TESTS ON SOIL BEING USED FOR FILL, REGARDLESS OF SOIL TYPES.
6. EXCEPTIONS AND SUBSTITUTIONS TO THE ABOVE MATERIAL OR PLACEMENT SEQUENCE ARE:
   (a) GRANULAR MATERIAL MEETING THE REQUIREMENTS OF SECTION 1032 OF GENERAL CONSTRUCTION SPECIFICATION T-1 MAY BE USED IN LIEU OF ANY OF THE ABOVE EARTHFILL MATERIALS. THE GRANULAR MATERIAL SHALL BE PLACED IN A MAXIMUM LOOSE LIFT THICKNESS OF 10 INCHES AND UNIFORMALLY COMPACTED WITH A VIBRATORY ROLLER TO AN AVERAGE RELATIVE DENSITY OF 85% OR GREATER FOR ALL TESTS, WITH A MINIMUM OF 80% RELATIVE DENSITY FOR INDIVIDUAL TESTS AS DETERMINED BY ASTM D2049 PROCEDURES.

       THE MOISTURE CONTENT SHALL BE ADJUSTED AS NECESSARY TO ASSURE ADEQUATE COMPACTION. IN-PLACE DENSITY TESTS USING THE SAND CONE (ASTM D1556) OR RUBBER BALLOON (ASTM D2167) OR NUCLEAR MOISTURE-DENSITY GAUGE (ASTM D2922 AND D3017) TEST METHODS SHALL BE MADE AT A RATE OF 1 PER EVERY 500 CUBIC YARDS OF GRANULAR MATERIAL PLACED WITH A MINIMUM OF ONE TEST EACH DAY THE MATERIAL IS PLACED. COMPLETE DOCUMENTATION OF QUANTITY AND LOCATIONS WHERE THE MATERIAL WAS USED SHALL BE RECORDED AND SUBMITTED TO EN DES FOR REVIEW WITH THE MONTHLY FILL QUALITY CONTROL REPORTS REQUIRED BY G-9.
   (b) EARTHFILL FROM BORROW AREAS APPROVED FOR USE IN THE TRENCHES BY EN DES MAY BE SUBSTITUTED FOR ANY OF THE MATERIALS EXCAVATED FROM THE TRENCHES AND STOCKPILED FOR USE AS BACKFILL.
   (c) FOR BACKFILLING BELOW AND AROUND THE CCW BLOWDOWN LINE, MATERIAL MEETING THE GRADATION REQUIREMENTS OF EARTHFILL NOTE 1 MAY BE USED. THE MATERIAL SHALL BE PLACED IN MAXIMUM 6 INCH LOOSE LIFTS AND COMPACTED AS FOLLOWS:

       DIRECTLY BELOW THE PIPE THE GRANULAR MATERIAL SHALL BE COMPACTED AS REASONABLE AS POSSIBLE, IN THE INSPECTORS JUDGEMENT, USING SMALL PLATE COMPACTORS (WACKER) FROM BOTH SIDES. WHERE SMALL VIBRATORY ROLLERS (BOMAG BW60) CAN BE OPERATED, IN THE INSPECTORS JUDGEMENT, A MINIMUM OF 6 TO 8 PASSES SHALL BE MADE.
7. THE ERCW BACKWASH LINE WAS REPAIRED AS PART OF MR A568528. THE REPAIR WAS OUTSIDE THE LIMITS OF THE UB, HOWEVER THE EXCAVATION ENCROACHED UPON THE UB. THE BACKFILL FOR THE EXCAVATION SHALL BE DONE AS FOLLOWS. PROCEDURES IN WBN MAI-22 SHALL BE OBSERVED EXCEPT AS MODIFIED BELOW.
   (a) ANY LOOSE MATERIALS SHALL BE REMOVED FROM THE EXCAVATION PRIOR TO PLACEMENT OF BACKFILL MATERIAL.
   (b) EARTHFILL FROM BORROW AREA 16 (CLASSES I OR II) IS ACCEPTABLE AS TYPE A EARTHFILL. GRANULAR MATERIAL MEETING THE REQUIREMENTS OF SECTION 1032 MAY BE USED IN LIEU OF EARTHFILL. TO AVOID DAMAGE TO THE PIPE, SAND MEETING THE REQUIREMENTS OF ASTM C33 MAY BE USED IN THE IMMEDIATE AREA (12 INCHES ±) OF THE PIPE.
   (c) THESE MATERIALS SHALL BE PLACED IN 4 INCH LOOSE LAYERS, AND COMPACTED WITH SMALL PLATE TAMPERS (WACKER) OR SMALL VIBRATORY ROLLERS (BOMAG - BW35 OR BW60S).
   (d) THE MATERIALS SHALL BE COMPACTED AS FOLLOWS:

| | |
|---|---|
| TYPE A EARTHFILL | 95% MAX DRY DENSITY (ASTM D698)<br>±3% OPTIMUM MOISTURE CONTENT |
| 1032 GRANULAR FILL | 85% RELATIVE DENSITY (AVERAGE FOR ALL TESTS)<br>80% RELATIVE DENSITY (MINIMUM FOR ANY ONE TEST)<br>ADJUST MOISTURE CONTENT AS NECESSARY TO OBTAIN COMPACTION |
| ASTM C33 SAND | 75% RELATIVE DENSITY (AVERAGE FOR ALL TESTS)<br>70% RELATIVE DENSITY (MINIMUM FOR ANY ONE TEST)<br>ADJUST MOISTURE CONTENT AS NECESSARY TO OBTAIN COMPACTION |

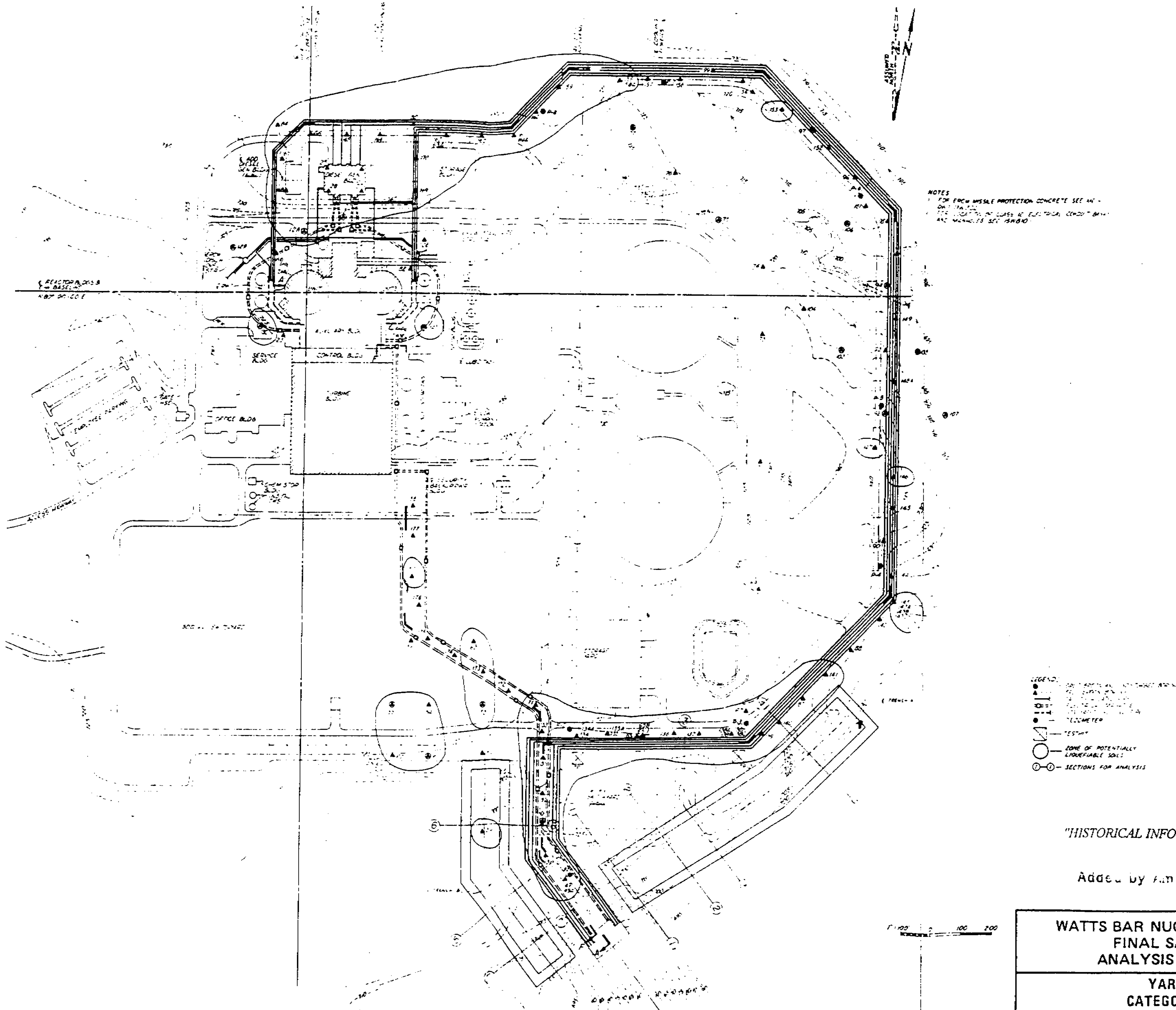
   (e) IN-PLACE DENSITY TESTS USING THE SAND CONE (ASTM D1556) OR RUBBER BALLOON (ASTM D2167) TEST METHODS SHALL BE MADE AT A RATE OF 1 TEST FOR EVERY 3rd LIFT STARTING AT THE 2nd LIFT.
   (f) "AS-BUILT" CROSS SECTIONS OF THE UNDERGROUND BARRIER SHALL BE MODIFIED AS NECESSARY TO SHOW THE EXCAVATION AND BACKFILL. THE CORRECTED "AS-BUILT" SECTIONS SHALL BE FORWARDED TO DNE WITHIN 4 WEEKS AFTER COMPLETION OF BACKFILLING. A COPY OF THE SUBMITTAL SHALL BE SENT TO THE GEOLOGY AND GEOTECHNICAL ENGINEERING SECTION.

*FIRST ISSUE FOR ECN 3960*

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

YARD
UNDERGROUND BARRIERS
FOR
POTENTIAL SOIL LIQUEFACTION

TVA DWG NO. 10N213-2 RE
FIGURE 2.5-581




"HISTORICAL INFORMATION"

Added by Amendment 50

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

YARD
CATEGORY I
ERCW PIPING AND CONDUITS
PLAN
FIGURE 2.5-582

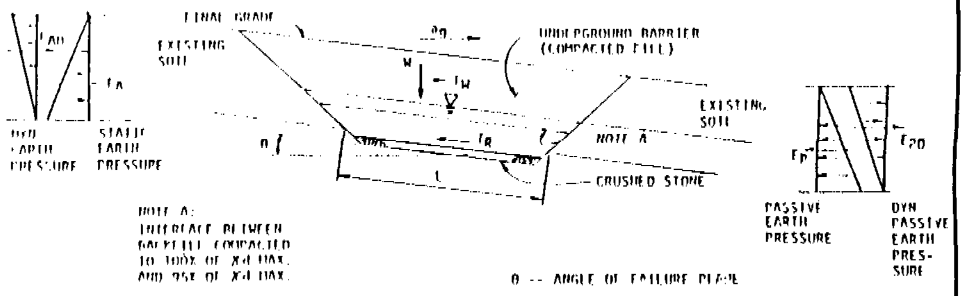
FIGURE 2.5-583

WATTS BAR NUCLEAR PLANT

REMEDIAL TREATMENT FOR POTENTIAL SOIL LIQUEFACTION

STABILITY ANALYSIS SUMMARY

LOAD DIAGRAM




## ANALYSIS CASES

| CASE | | DESCRIPTION | FACTOR OF SAFETY |
|---|---|---|---|
| I | - | DURING EARTHQUAKE BUT PRIOR TO LIQUEFACTION (REDUCED PASSIVE PRESSURE ASSUMED TO ACT) | $FS = \frac{F_R + (E_{PX} - E_{PDX})}{E_{AX} + E_{ADX} + F_{WX} + W_X} \geq 1.0$ |
| II | | AFTER EARTHQUAKE AND AFTER LIQUEFACTION (NO PASSIVE PRESSURE ASSUMED) | $FS = \frac{F_R}{E_{AX} + W_X} \geq 1.0$ |
| $F_R$ | - | SLIDING RESISTANCE DUE TO THE SHEAR STRENGTH OF THE COMPACTED FILL $F_R = \gamma H_{EFF} \tan \phi + CL$ | |
| $F_W$ | - | HORIZONTAL SEISMIC FORCE CAUSED BY THE ACCELERATION OF THE UNDERGROUND BARRIER. $F_W = W a_g$, $(F_{WX} = F_W \cos \theta)$ | |
| $E_A$ | - | EARTH PRESSURE * = $\frac{\gamma H^2 K_a}{2}$, $(E_{AX} = E_A \cos \theta)$ | |
| $E_{AD}$ | - | DYNAMIC EARTH PRESSURE * = $E_A a_g$, $(E_{ADX} = E_{AD} \cos \theta)$ | |
| $E_P$ | - | PASSIVE EARTH PRESSURE * = $\frac{\gamma H^2 K_p}{2}$, $(E_{PX} = E_P \cos \theta)$ | |
| $E_{PD}$ | - | DYNAMIC PASSIVE EARTH PRESSURE * = $E_P a_g$, $(E_{PDX} = E_{PD} \cos \theta)$ | |
| W | | WEIGHT OF BARRIER, $W_X = W \sin \theta$ | |
| X | | COMPONENT OF FORCE/LOAD ALONG THE FAILURE PLANE | |
| * | | INCLUDES WATER PRESSURE | |

## MATERIAL PROPERTIES

| | UNIT WEIGHTS (PCF) | | | R TEST (NAT'L MOISTURE) | | R TEST (SATURATED) | |
|---|---|---|---|---|---|---|---|
| | $\gamma_M$ | $\gamma_{SAT}$ | $\gamma_{SUB}$ | φ | C(TSF) | φ | C(TSF) |
| IN SITU MATERIALS | | | | | | | |
| ALLUVIAL CLAYS AND SILTS | 120 | 123 | 61 | 20° | 0.4 | 14° | 0.2 |
| ALLUVIAL SANDS | | | | | | | |
| PRIOR TO EARTHQUAKE | 119 | 124 | 62 | 20° | 0.4 | 14° | 0.2 |
| DURING EARTHQUAKE | 119 | 124 | 62 | 20 | 0.2 | 10° | 0.1 |
| AFTER LIQUEFACTION | - | 120 | 58 | - | - | 0° | 0 |
| BASEL GRAVEL | 120 | 130 | 68 | - | - | 30° | 0 |
| COMPACTED FILL (BORROW MATERIALS) | | | | | | | |
| @ 95% $\gamma_{D MAX}$ | | | | | | | |
| TRENCH A | 117 | 126 | 64 | - | - | 15° | 0.1 |
| TRENCH B | 117 | 126 | 64 | - | - | 15° | 0.1 |
| @ 100% $\gamma_{D MAX}$ | | | | | | | |
| TRENCH A | 123 | 130 | 68 | - | - | 14° | 0.25 |
| TRENCH B | 123 | 130 | 68 | - | - | 14° | 0.35 |
| SPOIL MATERIAL[7] | 110 | 115 | 53 | - | - | 24° | 0 |
| | | | | Q TEST | | R & S TEST | |
| CRUSHED STONE | | | | φ | C(TSF) | φ | C(TSF) |
| 1032 SECTION MATERIAL | 135 | 143 | 81 | 0° | 1.0 | 40° | 0.5 |
| 1075 SECTION MATERIAL | 135 | 143 | 81 | 40° | 0 | 40° | 0 |

SAFETY FACTORS TRENCH A[1]

| STATION | DURING EARTHQUAKE[5] FAILURE PLANE | | POST EARTHQUAKE[6] FAILURE PLANE | |
|---|---|---|---|---|
| | A[3] | B[4] | A[3] | B[4] |
| 0+78 | 1.36 | 1.62 | 3.09 | 4.79 |
| 1+28 | 1.51 | 1.66 | 5.44 | 7.20 |
| 1+78 | 1.42 | 1.44 | 5.54 | 8.37 |
| 2+28 | 1.35 | 1.35 | 10.32 | 18.43 |
| 2+78 | 1.42 | 1.45 | 6.98 | 8.14 |
| 3+28 | 1.26 | 1.20 | 4.55 | 4.65 |
| 3+78 | 1.22 | 1.21 | 4.05 | 4.21 |
| 4+28 | 1.21 | 1.16 | 4.07 | 4.63 |
| 4+78 | 1.17 | 1.12 | 3.05 | 3.31 |
| 5+28 | 1.11 | 1.10 | 2.69 | 2.90 |
| 5+78 | 1.01 | 1.17 | 1.63 | 2.34 |
| 6+28 | 1.05 | 1.11 | 1.66 | 2.02 |
| 6+78[2] | | | | |
| 7+28 | 1.20 | 1.23 | 1.79 | 1.87 |
| 7+78 | 1.16 | 1.11 | 1.66 | 1.62 |
| 8+28 | 1.22 | 1.17 | 1.64 | 1.76 |
| 8+78 | 1.22 | 1.17 | 1.66 | 1.61 |
| 9+28 | 1.41 | 1.32 | 2.20 | 1.98 |

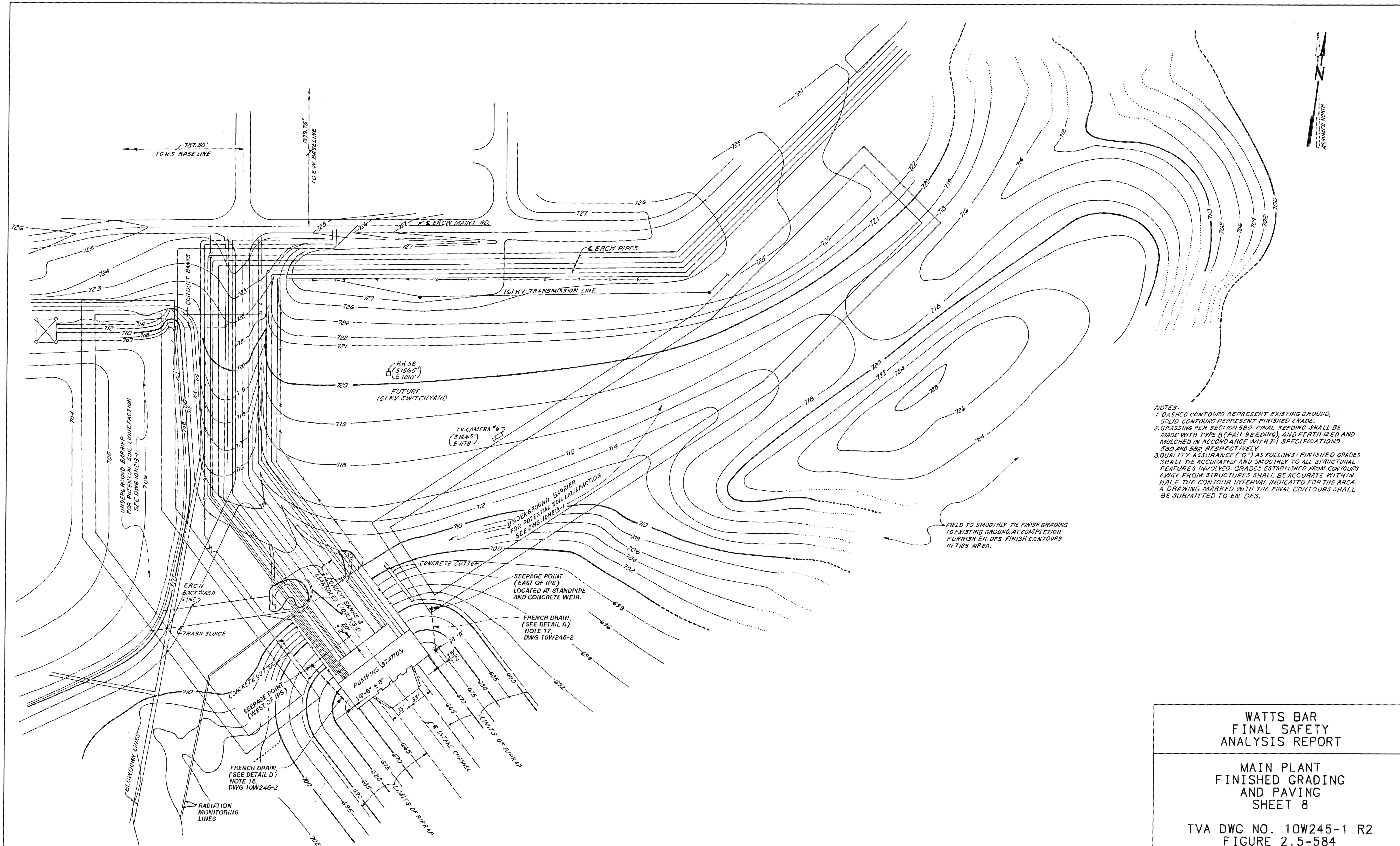
SAFETY FACTORS TRENCH B[1]

| STATION | DURING EARTHQUAKE[5] FAILURE PLANE | | POST EARTHQUAKE[6] FAILURE PLANE | |
|---|---|---|---|---|
| | A[8] | B[9] | A[8] | B[9] |
| 0+50 | 1.05 | 1.48[10] | 7.00 | 18.32[11] |
| 1+00 | 1.93 | 1.43[10] | 6.00 | 18.13[11] |
| 1+50 | 1.81 | 1.61[10] | 4.57 | 29.71[11] |
| 2+00 | 1.78 | 1.74[10] | 5.24 | 24.03[11] |
| 2+50 | 1.00 | 1.88[11] | 2.28 | 10.02[12] |
| 3+00 | 1.39 | 1.06[4] | 2.57 | 4.14[12] |
| 3+50 | 2.21 | 1.09[4] | 8.73 | 4.37[4] |
| 4+00 | 1.79 | NA | 16.57 | NA |
| 4+50 | 1.78 | NA | 17.50 | NA |
| 5+00 | 1.82 | NA | 18.49 | NA |
| 5+50 | 2.26 | NA | 34.39 | NA |
| 6+00 | 2.18 | NA | 32.65 | NA |

NOTES:

1. SEE FIGURE 2.5-586 FOR A PLAN SHOWING THE LOCATIONS OF THE CROSS-SECTIONS.
2. NOT INCLUDED. SOIL PROFILE NOT IDENTIFIED.
3. FAILURE PLANE IN COMPACTED FILL IMMEDIATELY ABOVE CRUSHED STONE
4. FAILURE PLANE AT INTERFACE OF 95%/100% $\gamma_{D MAX}$ COMPACTED FILL
5. STABILITY DURING EARTHQUAKE INCLUDING PASSIVE PRESSURE CALCULATED USING REDUCED STRENGTHS.
6. STABILITY AFTER EARTHQUAKE ASSUMING NO PASSIVE PRESSURE.
7. MATERIAL FROM ORIGINAL POWERHOUSE EXCAVATION. INCLUDES BASEL GRAVEL AND SHALE BLASTED FROM EXCAVATION. SPREAD BY PANS AND ONLY COMPACTION IS BY SPREADING EQUIPMENT.
8. FAILURE PLANE AT BASE OF CROSS-SECTION.
9. THE USE OF CRUSHED STONE AS WELL AS EARTHFILL ALLOWED FOR SEVERAL POTENTIAL FAILURE PLANES. THE FACTORS-OF-SAFETY GIVEN REPRESENT THE MINIMUM FS FOR POTENTIAL FAILURE PLANES OTHER THAN THAT GIVEN IN NOTE 8
10. FAILURE PLANE AT INTERFACE BETWEEN 1032 CRUSHED STONE MATERIAL AND 95% $\gamma_{D MAX}$ COMPACTED FILL.
11. FAILURE PLANE AT INTERFACE BETWEEN 1032 AND 1075 CRUSHED STONE MATERIALS.
12. FAILURE PLANE AT INTERFACE BETWEEN 1075 CRUSHED STONE MATERIAL AND 100% $\gamma_{D MAX}$ COMPACTED FILL.
13. NA-NOT AVAILABLE-NO OTHER DEFINED POTENTIAL FAILURE PLANE.

# FIGURE 2.5-583

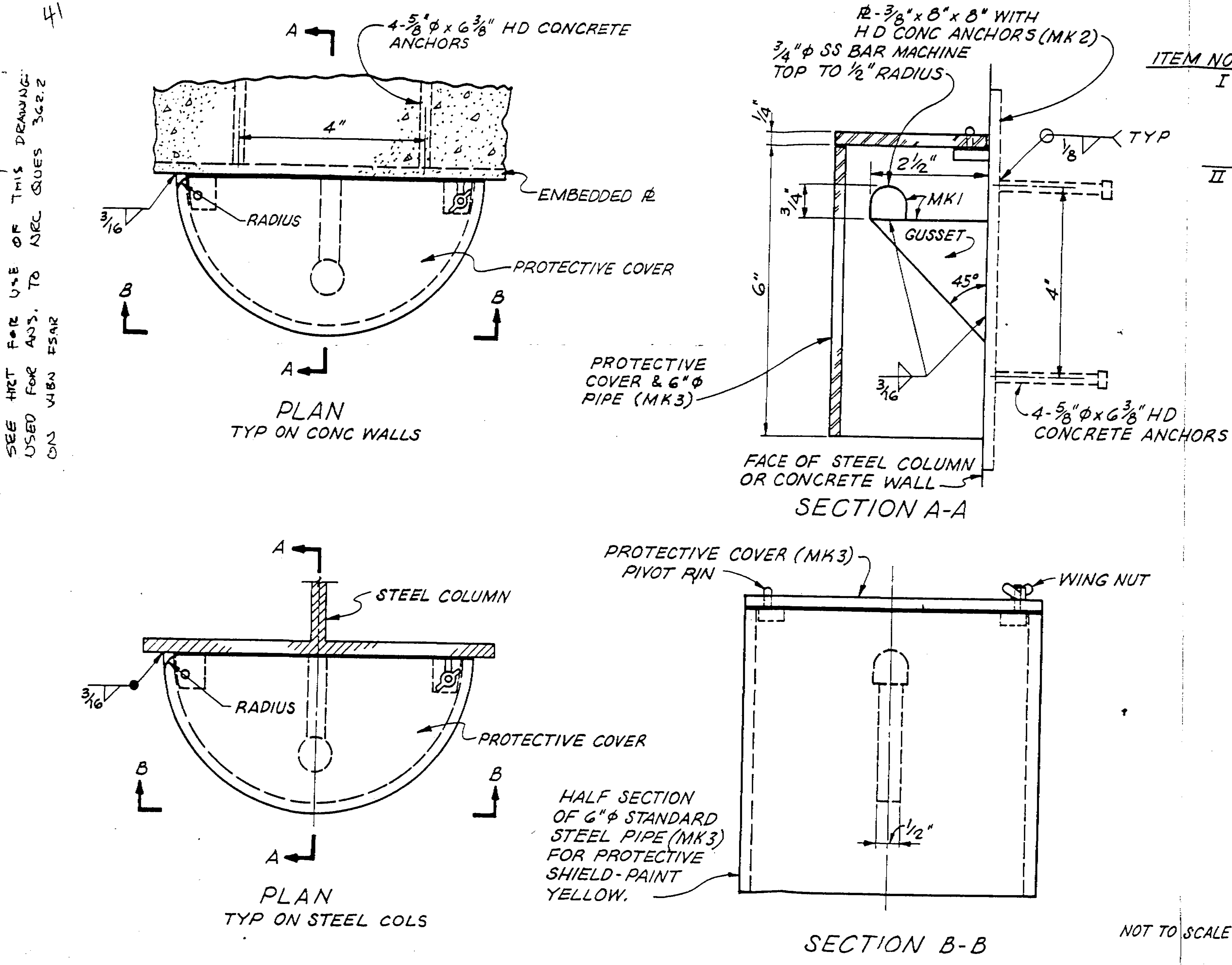



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

MAIN PLANT
FINISHED GRADING
AND PAVING
SHEET 8

TVA DWG NO. 10W245-1 R2
FIGURE 2.5-584

CAD MAINTAINED DRAWING




| ITEM NO | |
|---|---|
| I | LOCATED ON STEEL COLUMN-MK1 & MK3 REQ'D: SS-22, SS-25, SS-29, SS-30, SS-31, SS-32 SS-33, SS-42, SS-43. |
| II | LOCATED ON CONCRETE WALL-MK1, MK2, & MK3 REQ'D: SS-2, SS-3, SS-5, SS-6, SS-7, SS-10, SS-13, SS-14, SS-15, SS-17, SS-18 SS-19, SS-20, SS-21, SS-23, SS-24, SS-26, SS-26, SS-27, SS-27, SS-28 SS-28, & SS-44 |

NOTES:

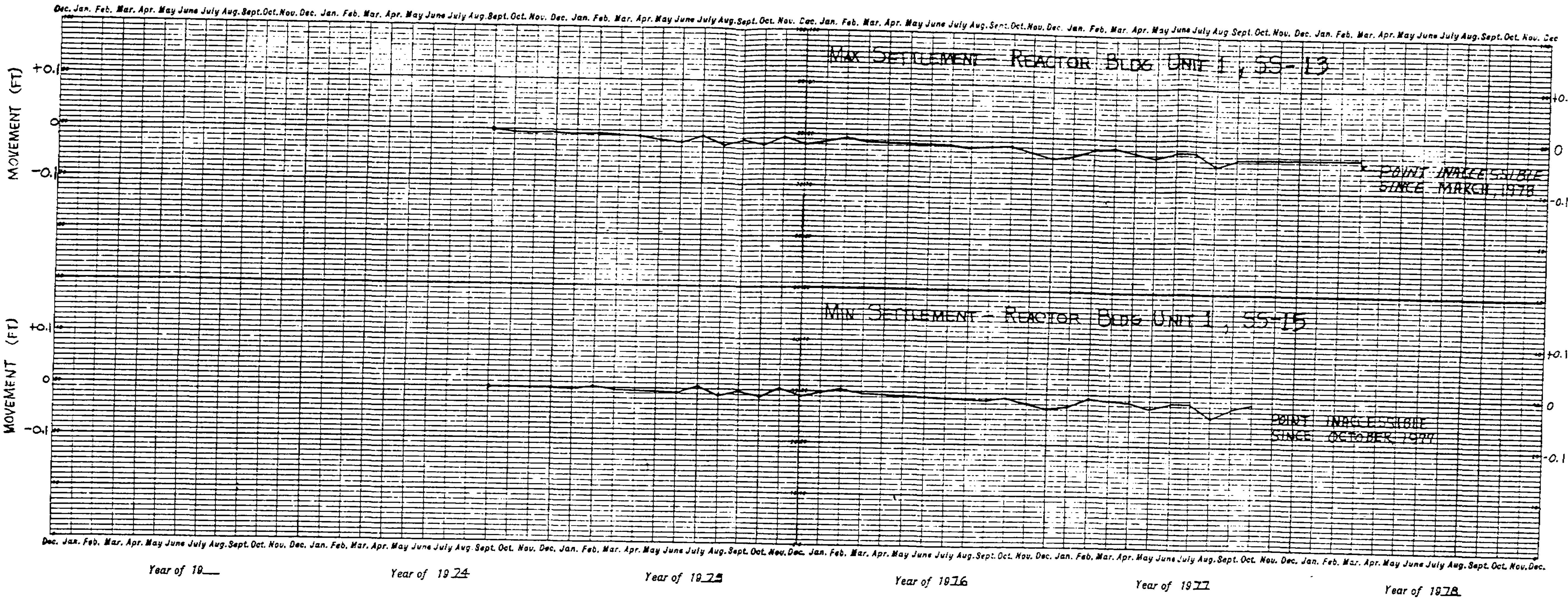
1. FOR REFERENCE AND LOCATIONS OF SETTLEMENT STATIONS, SEE DWG NO 10N 203-1 & 2.
2. FABRICATION COVERED BY FF-37.

"HISTORICAL INFORMATION"

NOT TO SCALE

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

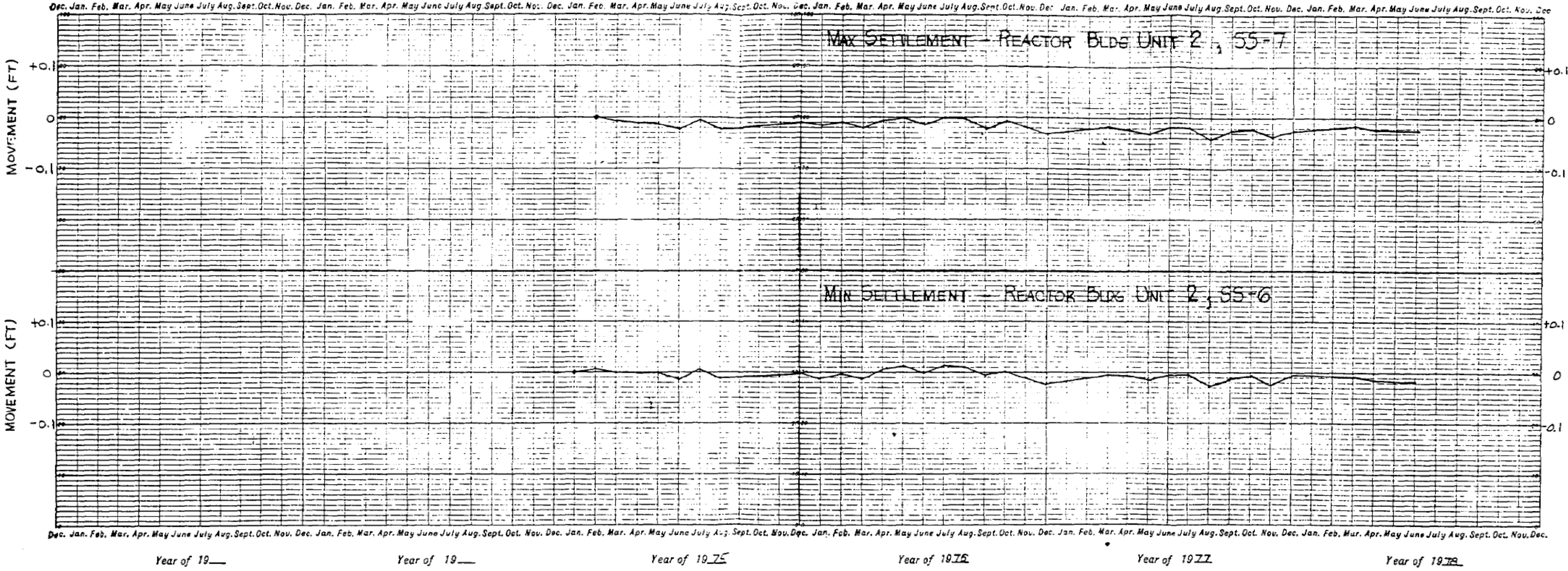
POWERHOUSE
SETTLEMENT STATIONS
BENCH MARK ASSEMBLY
FIGURE 2.5-585




"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT VS. TIME FOR
UNIT 1 REACTOR BUILDING
FIGURE 2.5-586

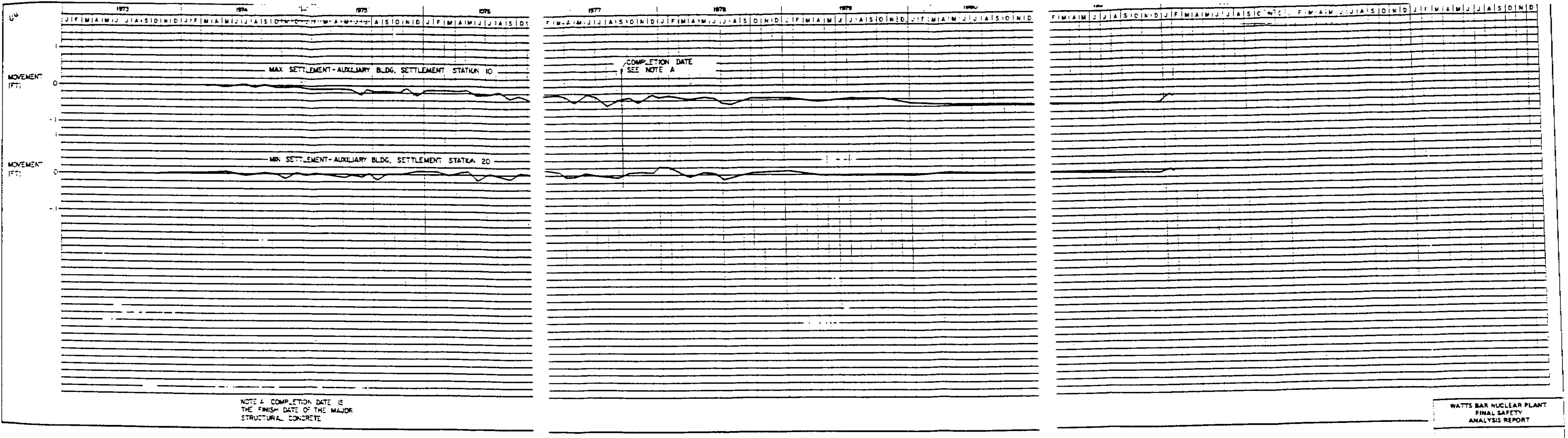



"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SETTLEMENT VS. TIME FOR
UNIT 2 REACTOR BUILDING
FIGURE 2.5-587

## FIGURE 2.5-588   HISTORICAL

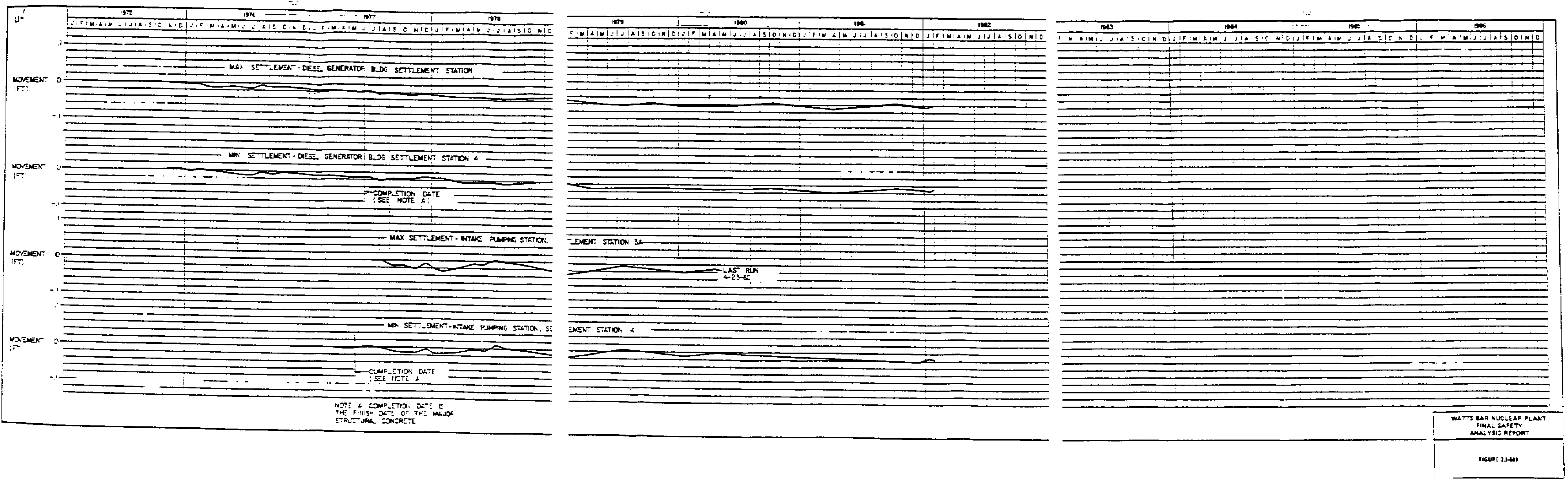


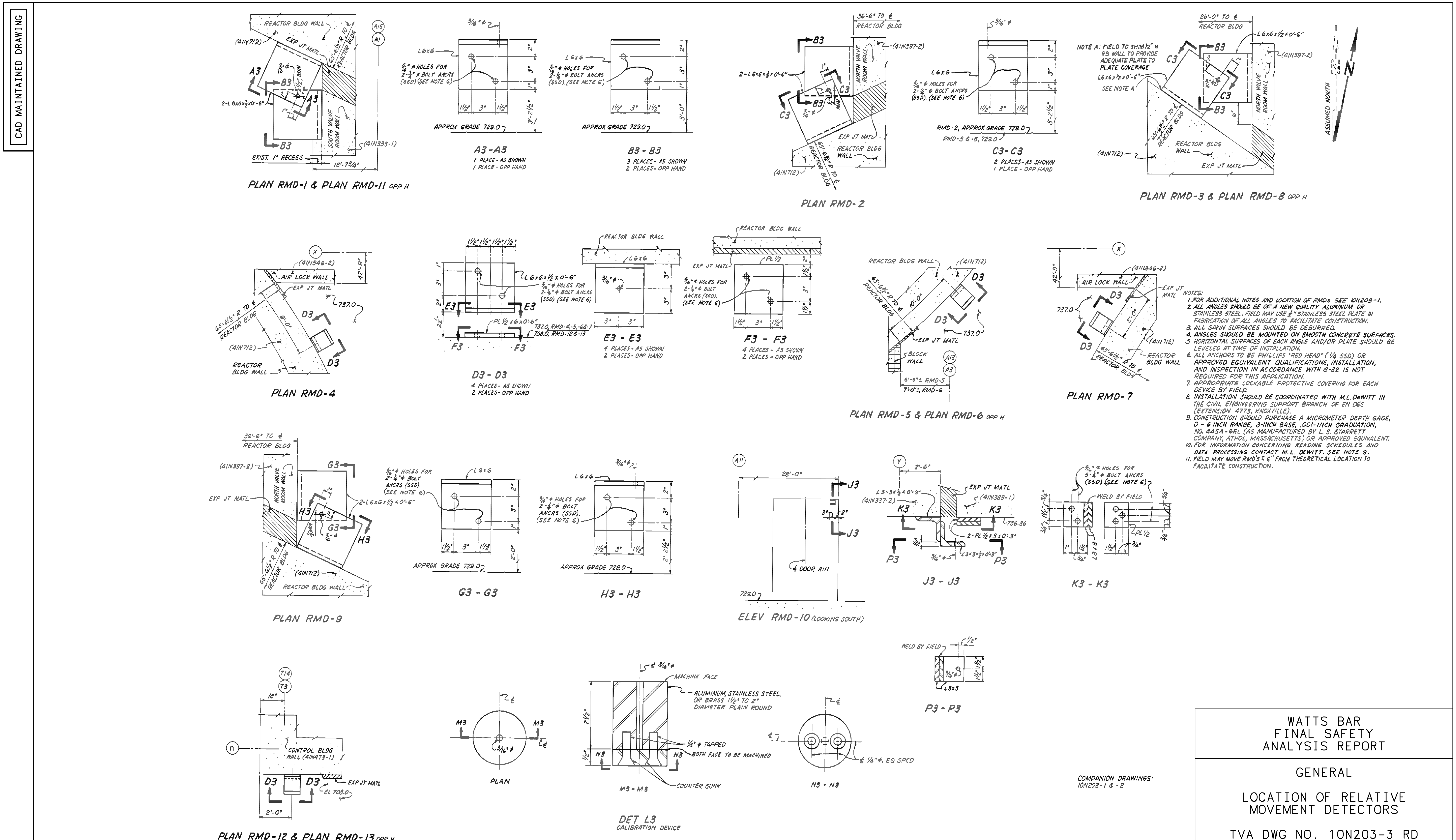

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

FIGURE 2.5-588

"HISTORICAL INFORMATION"

# FIGURE 2.5-589 HISTORICAL



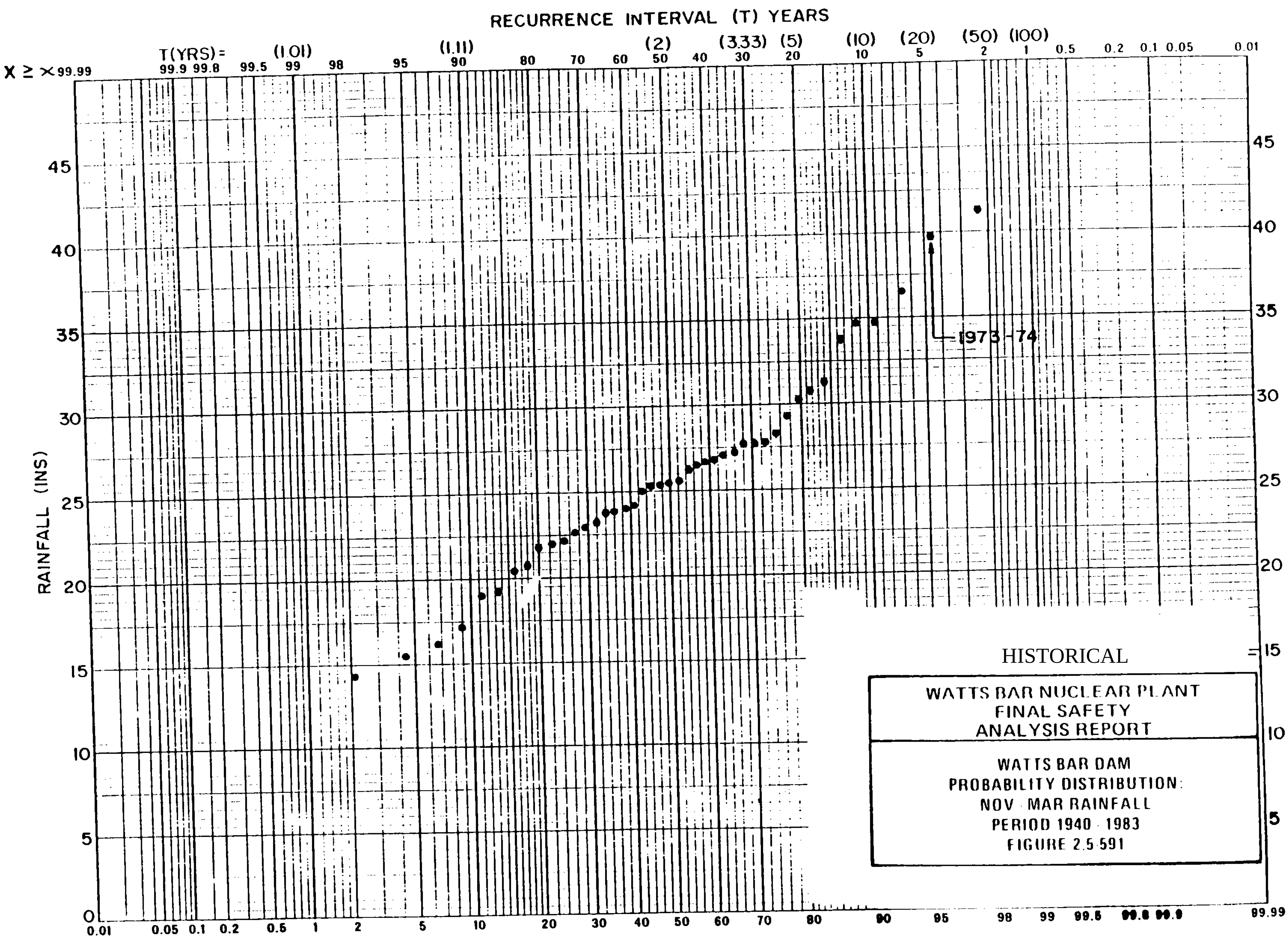



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

GENERAL

LOCATION OF RELATIVE
MOVEMENT DETECTORS

TVA DWG NO. 10N203-3 RD
FIGURE 2.5-590

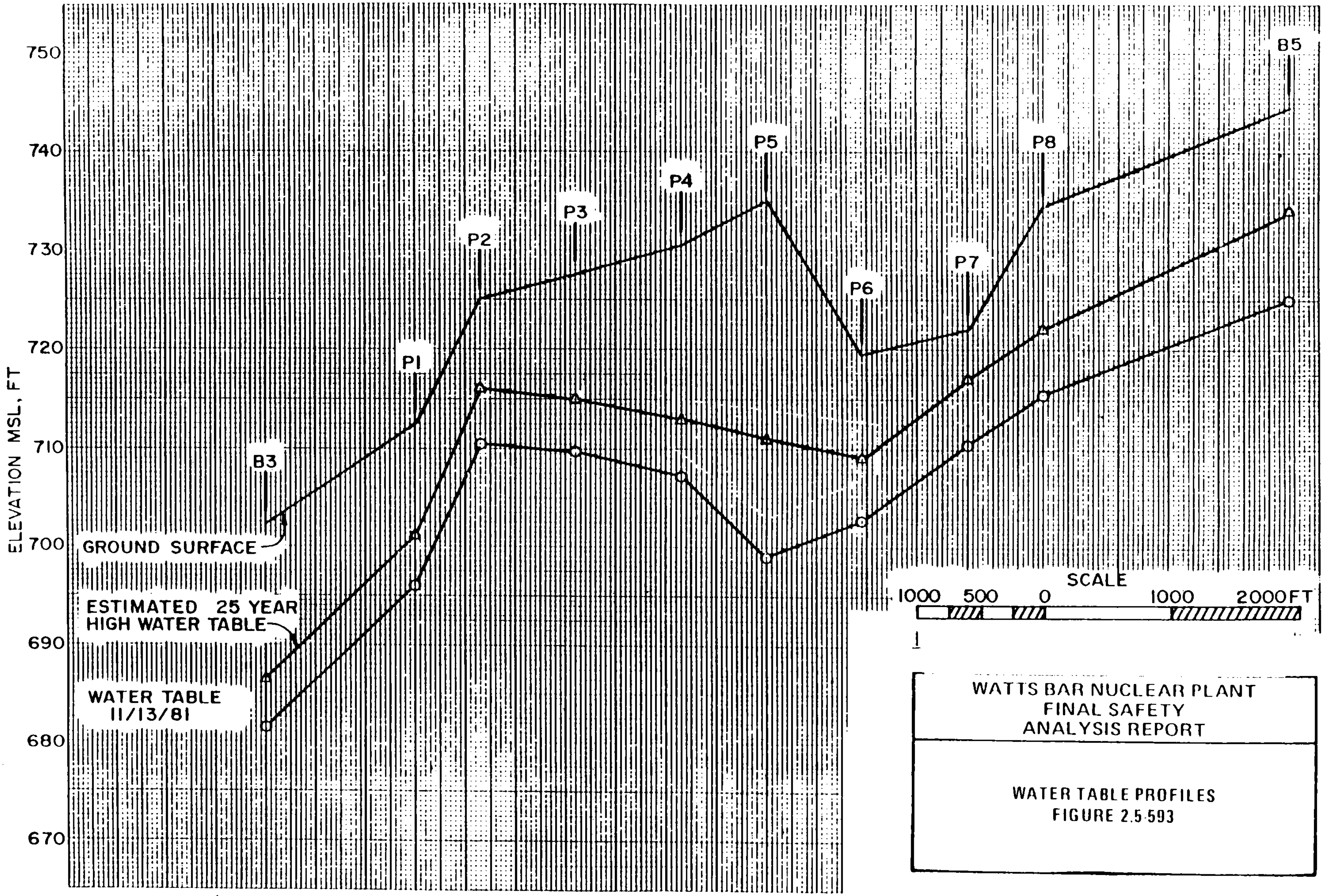



HISTORICAL

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

WATTS BAR DAM
PROBABILITY DISTRIBUTION:
NOV - MAR RAINFALL
PERIOD 1940 - 1983
FIGURE 2.5-591

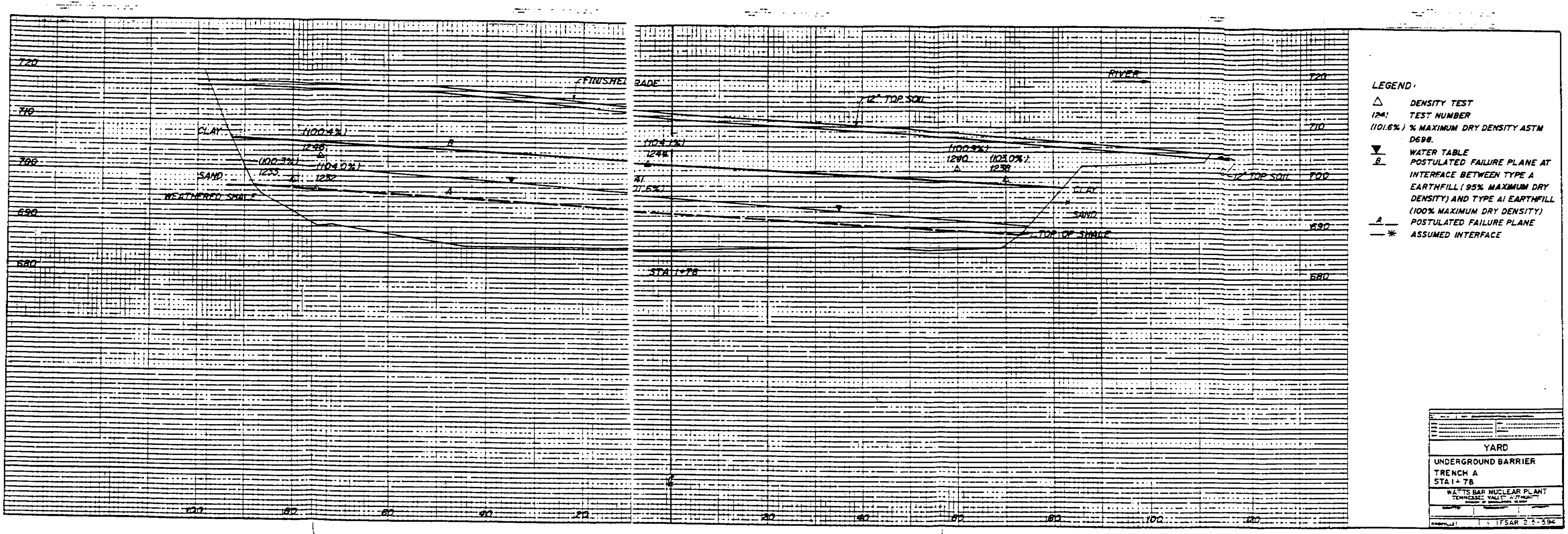
SECURITY-RELATED INFORMATION, WITHHELD UNDER 10 CFR 2.390
FIGURE 2.5-592



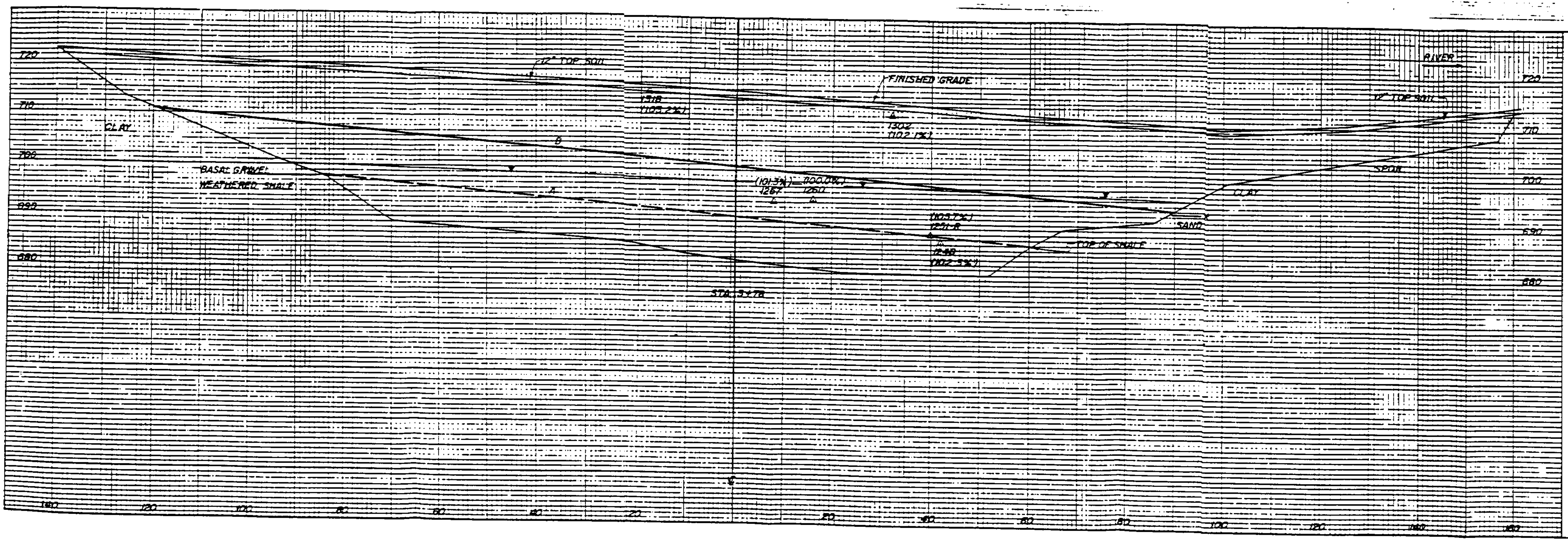

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

WATER TABLE PROFILES
FIGURE 2.5-593

HISTORICAL




"HISTORICAL INFORMATION"




LEGEND:

- △ DENSITY TEST
- 1251 TEST NUMBER
- (101.6%) % MAXIMUM DRY DENSITY ASTM D698.
- ▼ WATER TABLE
- B POSTULATED FAILURE PLANE AT INTERFACE BETWEEN TYPE A EARTHFILL (95% MAXIMUM DRY DENSITY) AND TYPE A1 EARTHFILL (100% MAXIMUM DRY DENSITY)
- A POSTULATED FAILURE PLANE
- —* ASSUMED INTERFACE

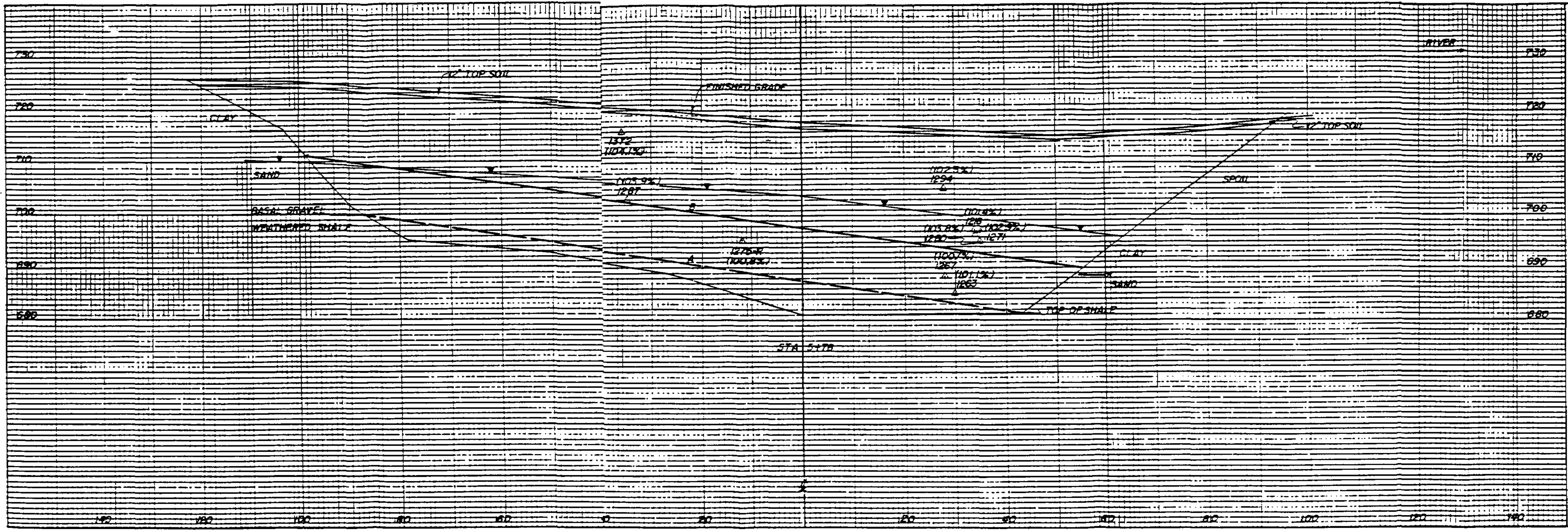
YARD

UNDERGROUND BARRIER
TRENCH A
STA 3+76

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

FSAR 2.5-595

"HISTORICAL INFORMATION"




LEGEND:
△ DENSITY TEST
1216 TEST NUMBER
(101.6%) % MAXIMUM DRY DENSITY ASTM D698
▼ WATER TABLE
B POSTULATED FAILURE PLANE AT INTERFACE BETWEEN TYPE A EARTHFILL (95% MAXIMUM DRY DENSITY) AND TYPE A1 EARTHFILL (100% MAXIMUM DRY DENSITY)
A POSTULATED FAILURE PLANE
—* ASSUMED INTERFACE

**FIGURE 2.5-596**

YARD
UNDERGROUND BARRIER
TRENCH A
STA 5+78
WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
FSAR 2.5-596

"HISTORICAL INFORMATION"

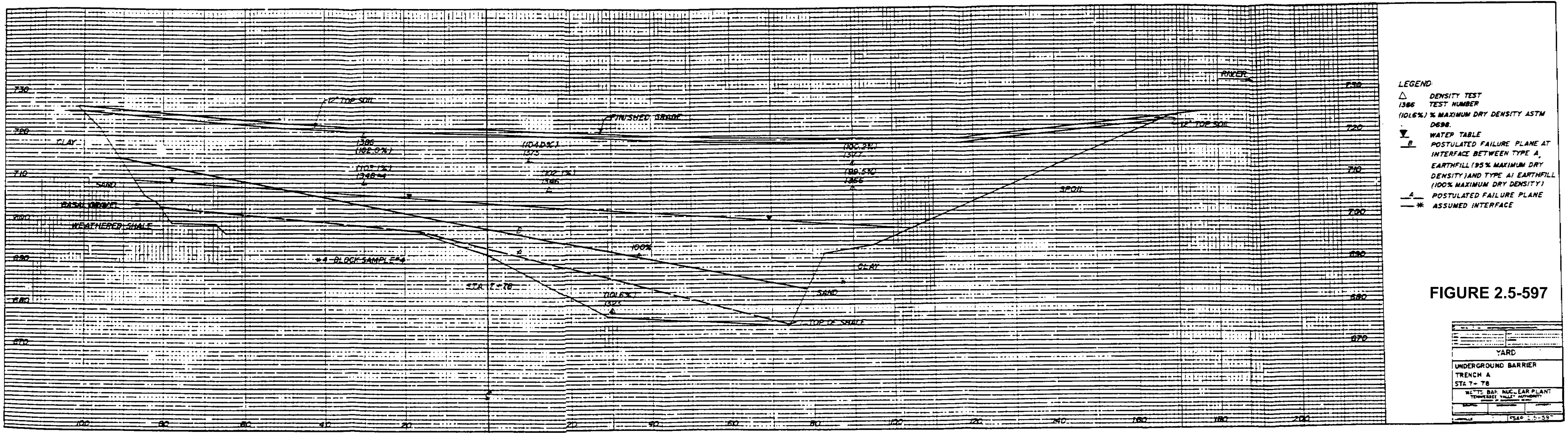



**FIGURE 2.5-597**

*"HISTORICAL INFORMATION"*

**SUMMARY OF EARTHFILL TEST DATA - DENSITY**
**FIGURE 2.5-598**

QP-2.01 ~~R~~ SW
Atch F R4 11-5-83



FEATURE: UNDERGROUND BARRIER – TRENCH A - 95% $\gamma_{DMAX}$ FILL
DATE: 9-30-83 TO: 10-22-83 TEST NO.: 1351 TO: 1390
PART: I SECTION: 52A (A) PREPARED BY: W.S. WOODLEE

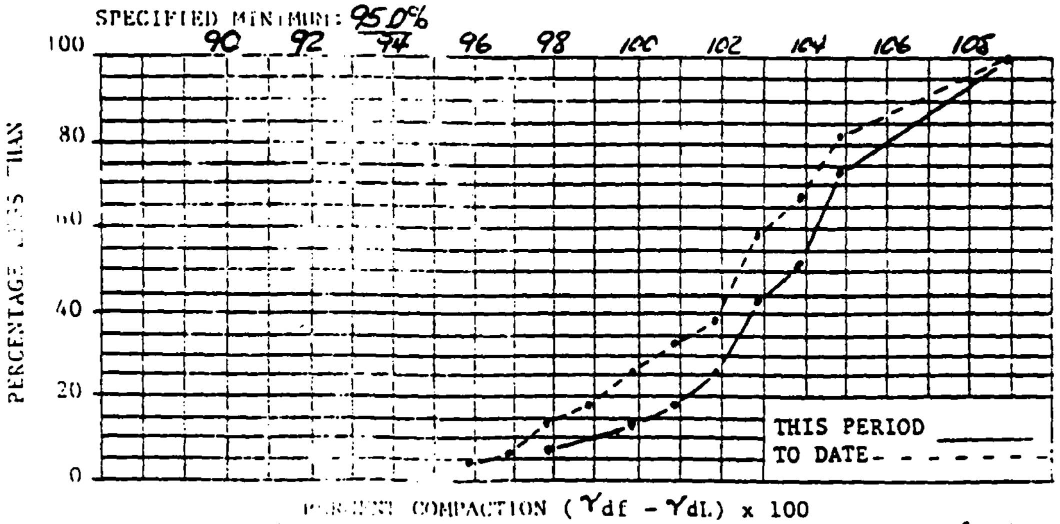
| | PLOT THIS COL. | PREV CUM F | THIS PERIOD FREQUENCY (F) | THIS PERIOD F | THIS PERIOD CUM F | THIS PERIOD CUM % | TO DATE F | TO DATE CUM F | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|
| 90.0 | 91.9 | | | | | | | | |
| 92.0 | 92.9 | | | | | | | | |
| 93.0 | 93.9 | | | | | | | | |
| 94.0 | 94.9 | | | | | | | | |
| 95.0 | 95.9 | 3 | | | | | 3 | 3 | 4.5 |
| 96.0 | 96.9 | 4 | | | | | 1 | 4 | 6.0 |
| 97.0 | 97.9 | 8 | II | 2 | 2 | 7.4 | 6 | 10 | 14.9 |
| 98.0 | 98.9 | 10 | | | | | 2 | 12 | 17.9 |
| 99.0 | 99.9 | 13 | II | 2 | 4 | 14.8 | 5 | 17 | 25.4 |
| 100.0 | 100.9 | 14 | I | 1 | 5 | 18.5 | 2 | 19 | 28.4 |
| 101.0 | 101.9 | 19 | II | 2 | 7 | 25.9 | 7 | 26 | 38.8 |
| 102.0 | 102.9 | 27 | ~~IIII~~ | 5 | 12 | 44.4 | 13 | 39 | 58.2 |
| 103.0 | 103.9 | 31 | II | 2 | 14 | 51.9 | 6 | 45 | 67.2 |
| 104.0 | 104.9 | 35 | ~~IIII~~-I | 6 | 20 | 74.1 | 10 | 55 | 82.1 |
| 105.0 | 108.9 | 40 | ~~IIII~~-II | 7 | 27 | 100.0 | 12 | 67 | 100.0 |
| TOTALS | | 40 | – – | – – | 27 | – – | – – | 67 | – – |

Left axis label: PERCENT COMPACTION ($\gamma_{df}$ – $\gamma_{dL}$) x 100

SPECIFICATION SOURCE: DWG #10N213-2 R2

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL DRY DENSITY, $\gamma_{df}$, pcf | 105.5 | 105.8 | 105.6 |
| AVG MAXIMUM DRY DENSITY, $\gamma_{dL}$, pcf | 104.0 | 102.6 | 103.4 |
| MEAN VARIATION $\gamma_{df}$ – $\gamma_{dL}$, pcf | +1.5 | +3.2 | +2.2 |

SPECIFIED MINIMUM: 95.0%




SW 11-5-83

REMARKS: THIS IS THE FINAL ANALYSIS FOR TYPE A FILL COMPACTION.
INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH REV 4 OF WBNP-QCP-2.01. SW

W. Scott Woodlee 11-5-83

HISTORICAL

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SUMMARY OF EARTHFILL**
**TEST DATA - MOISTURE CONTENT**
**FIGURE 2.5-599**

SUMP

WBNP-QCP-2.01 ~~R3~~ R4 SW 11-5-83
Attachment C
OP

Sheet 2 of 2

FEATURE: UNDERGROUND BARRIER - TRENCH A - 95% $\gamma_{DMAX}$ FILL
DATE: 9-30-83 TO: 10-22-83 TEST NO.: 1351 TO: 1390
PART: I SECTION: 52A (A) PREPARED BY: W.S. WOODLEE

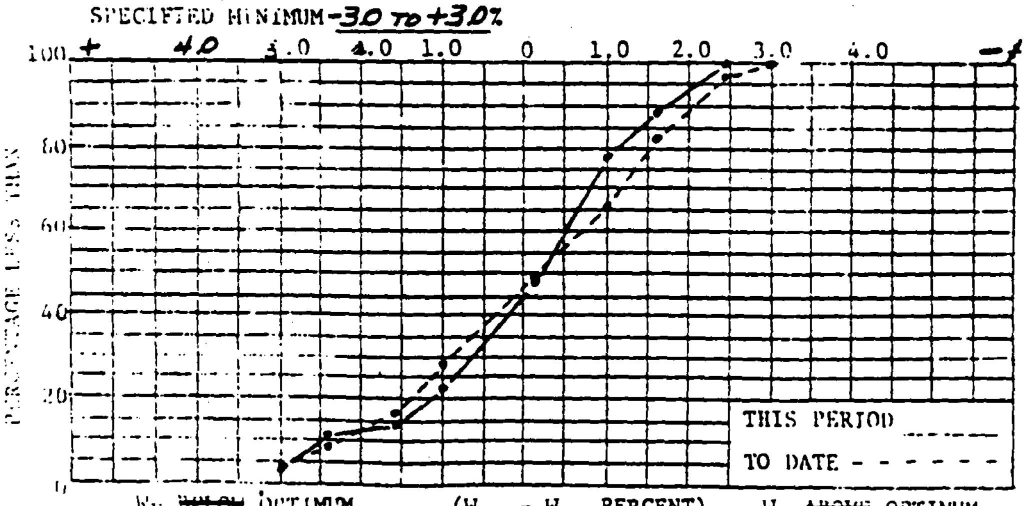
| $(W_F - W_0)$, PERCENT | PLOT THIS COL | PREV CUM F | THIS PERIOD FREQUENCY (F) | THIS PERIOD F | THIS PERIOD CUM F | THIS PERIOD CUM % | TO DATE F | TO DATE CUM F | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|
| $W_F$ ABOVE OPT +4.6 | 5.2 | | | | | | | | |
| 3.9 | 4.5 | | | | | | | | |
| 3.1 | 3.8 | | | | | | | | |
| 2.5 | 3.0 | 2 | / | 1 | 1 | 3.7 | 3 | 3 | 4.5 |
| 1.8 | 2.4 | 3 | // | 2 | 3 | 11.1 | 3 | 6 | 9.0 |
| 1.1 | 1.7 | 7 | / | 1 | 4 | 14.8 | 5 | 11 | 16.4 |
| 0.4 | 1.0 | 13 | // | 2 | 6 | 22.2 | 8 | 19 | 28.4 |
| PLOT 0 +0.3 | -0.3 | 20 | ////-// | 7 | 13 | 48.1 | 14 | 33 | 49.3 |
| 0.4 | 1.0 | 23 | ////-/// | 8 | 21 | 77.8 | 11 | 44 | 65.7 |
| 1.1 | 1.7 | 32 | /// | 3 | 24 | 88.9 | 12 | 56 | 83.6 |
| 1.8 | 2.4 | 38 | /// | 3 | 27 | 100.0 | 9 | 65 | 97.0 |
| $W_F$ BELOW OPT 2.5 | 3.0 | 40 | | | | | 2 | 67 | 100.0 |
| 3.1 | 3.8 | | | | | | | | |
| 3.9 | 4.5 | | | | | | | | |
| -4.6 | 5.2 | | | | | | | | |
| TOTALS | NA | 40 | -- | -- | 27 | -- | -- | 67 | -- |

SPECIFICATION SOURCE: DWG.#10N213-2 R2

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL MOISTURE CONTENT, $W_F$, % | 18.9 | 19.8 | 19.3 |
| AVG OPTIMUM MOISTURE CONTENT, $W_0$, % | 19.4 | 20.0 | 19.6 |
| MEAN VARIATION $(W_F - W_0)$, % | -0.5 | -0.2 | -0.3 |

SPECIFIED MINIMUM -3.0 TO +3.0%

SW 11-5-83




$W_F$ ~~BELOW~~ ABOVE OPTIMUM $(W_F - W_0$, PERCENT$)$ $W_F$ ~~ABOVE~~ BELOW OPTIMUM

REMARKS: THIS IS THE FINAL ANALYSIS FOR TYPE A FILL COMPACTION

INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH R 4 OF WBNP-QCP-2.01. SW

W. Scott Woodlee 11-5-83
INSPECTOR

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SUMMARY OF EARTHFILL
TEST DATA - DENSITY
FIGURE 2.5-600

BNP-QCP-2.01 ~~R~~ R4 SW 11-5-83
ttachment F
OP

Sheet 4 of 4

FEATURE: UNDERGROUND BARRIER – TRENCH A – 100% $\gamma_{DMAX}$ FILL
DATE: 9-30-83 TO: 10-9-83 TEST NO.: 1347 TO: 1364
PART: I SECTION: 52A (A1) PREPARED BY: W.S. WOODLEE

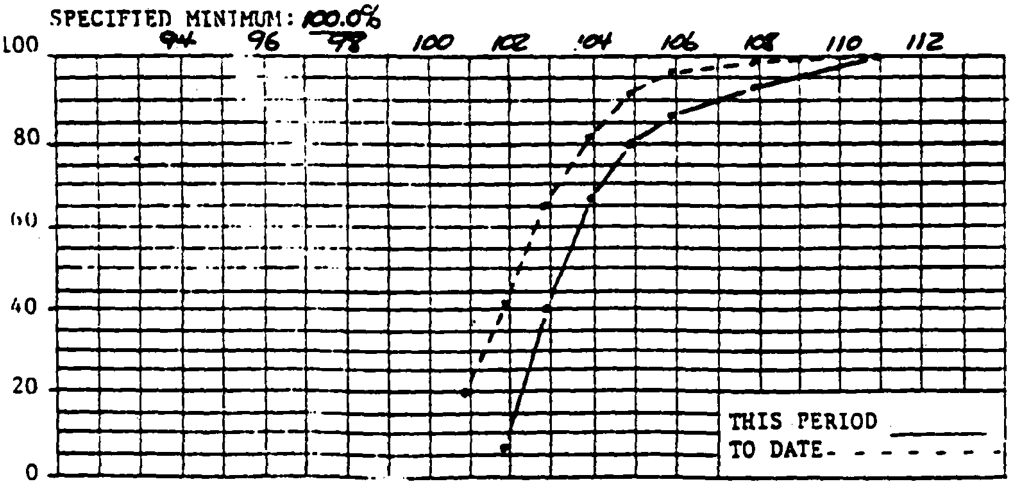
PERCENT COMPACTION ($\gamma_{df}$ - $\gamma_{dL}$) x 100

| | PLOT THIS COL | PREV CUM F | THIS PERIOD FREQUENCY (F) | THIS PERIOD F | THIS PERIOD CUM F | THIS PERIOD CUM % | TO DATE F | TO DATE CUM F | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|
| 95.0 | 95.9 | | | | | | | | |
| 96.0 | 96.9 | | | | | | | | |
| 97.0 | 97.9 | | | | | | | | |
| 98.0 | 98.9 | | | | | | | | |
| 99.0 | 99.9 | | | | | | | | |
| 100.0 | 100.9 | 16 | | | | | 16 | 16 | 20.0 |
| 101.0 | 101.9 | 32 | I | 1 | 1 | 6.7 | 17 | 33 | 41.3 |
| 102.0 | 102.9 | 46 | IIII (5) | 5 | 6 | 40.0 | 19 | 52 | 65.0 |
| 103.0 | 103.9 | 55 | IIII | 4 | 10 | 66.7 | 13 | 65 | 81.3 |
| 104.0 | 104.9 | 61 | II | 2 | 12 | 80.0 | 8 | 73 | 91.3 |
| 105.0 | 105.9 | 64 | I | 1 | 13 | 86.7 | 4 | 77 | 96.3 |
| 106.0 | 106.9 | | | | | | | | |
| 107.0 | 107.9 | 65 | I | 1 | 14 | 93.3 | 2 | 79 | 98.8 |
| 108.0 | 108.9 | | | | | | | | |
| 109.0 | 110.9 | | I | 1 | 15 | 100.0 | 1 | 80 | 100.0 |
| TOTALS | | 65 | -- | -- | 15 | -- | -- | 80 | -- |

SPECIFICATION SOURCE: DWG.#10N213-2 R2

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL DRY DENSITY, $\gamma_{df}$, pcf | 104.4 | 105.2 | 104.6 |
| AVG MAXIMUM DRY DENSITY, $\gamma_{dL}$, pcf | 102.1 | 101.2 | 101.9 |
| MEAN VARIATION $\gamma_{df}$ - $\gamma_{dL}$, pcf | +2.3 | +4.0 | +2.7 |

SPECIFIED MINIMUM: 100.0%




SW 11-1-83

REMARKS: THIS IS THE FINAL ANALYSIS FOR TYPE A1 FILL COMPACTION. SW
INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH REV 4 OF WBNP-QCP-2.01.

W. Scott Woodlee 11-5-83
INSPECTOR Date

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SUMMARY OF EARTHFILL**
**TEST DATA - MOISTURE CONTENT**
**FIGURE 2.5-601**

WBNP-QCP-2.01 ~~R~~ R4 SW 11-5-83
Attachment C
LOP

Sheet 4 of 4

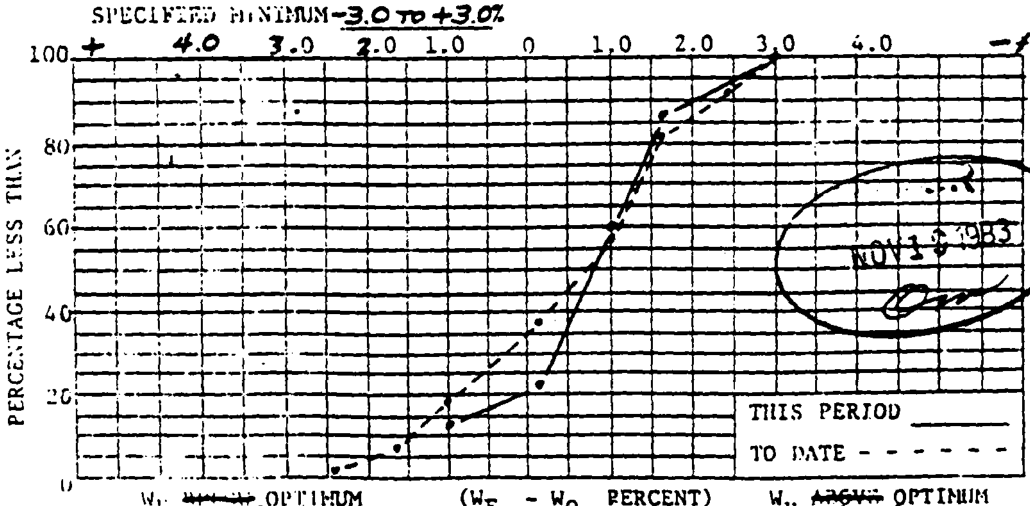
FEATURE: UNDERGROUND BARRIER — TRENCH A - 100% $\gamma_{max}$ FILL
DATE: 9-30-83 TO: 10-9-83 TEST NO.: 1347 TO: 1364
PART: I SECTION: 52A (A1) PREPARED BY: W.S. WOODLEE

| ($W_F$ - $W_O$), PERCENT | | PLOT THIS COL | PREV CUM F | THIS PERIOD: FREQUENCY (F) | THIS PERIOD: F | THIS PERIOD: CUM F | THIS PERIOD: CUM % | TO DATE: F | TO DATE: CUM F | TO DATE: CUM % |
|---|---|---|---|---|---|---|---|---|---|---|
| $W_F$ ABOVE OPT | +4.6 | 5.2 | | | | | | | | |
| | 3.9 | 4.5 | | | | | | | | |
| | 3.1 | 3.8 | | | | | | | | |
| | 2.5 | 3.0 | | | | | | | | |
| | 1.8 | 2.4 | 1 | | | | | 1 | 1 | 1.3 |
| | 1.1 | 1.7 | 6 | | | | | 5 | 6 | 7.5 |
| | 0.4 | 1.0 | 13 | II | 2 | 2 | 13.3 | 9 | 15 | 18.8 |
| PLOT OPT | +0.3 -0.3 | -0.3 | 25 | II | 2 | 4 | 26.7 | 14 | 29 | 36.3 |
| | 0.4 | 1.0 | 38 | ~~IIII~~ | 5 | 9 | 60.0 | 18 | 47 | 58.8 |
| $W_F$ BELOW OPT | 1.1 | 1.7 | 52 | IIII | 4 | 13 | 86.7 | 18 | 65 | 81.3 |
| | 1.8 | 2.4 | 61 | | | | | 9 | 74 | 92.5 |
| | 2.5 | 3.0 | 65 | II | 2 | 15 | 100.0 | 6 | 80 | 100.0 |
| | 3.1 | 3.8 | | | | | | | | |
| | 3.9 | 4.5 | | | | | | | | |
| | -4.6 | 5.2 | | | | | | | | |
| | TOTALS | NA | 65 | -- | -- | 15 | -- | -- | 80 | -- |

SPECIFICATION SOURCE: DWG.#10N213-2 R2

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL MOISTURE CONTENT, $W_F$, % | 19.7 | 19.9 | 19.7 |
| AVG OPTIMUM MOISTURE CONTENT, $W_O$, % | 20.4 | 20.8 | 20.5 |
| MEAN VARIATION ($W_F$ - $W_O$), % | -0.7 | -0.9 | -0.8 |

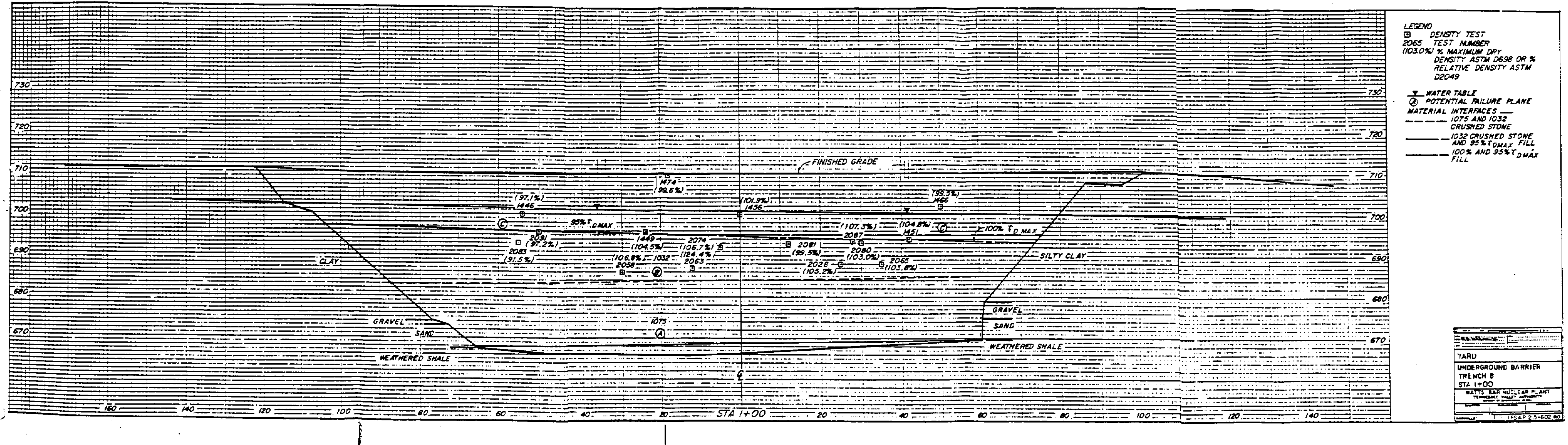
SPECIFIED MINIMUM -3.0 TO +3.0%



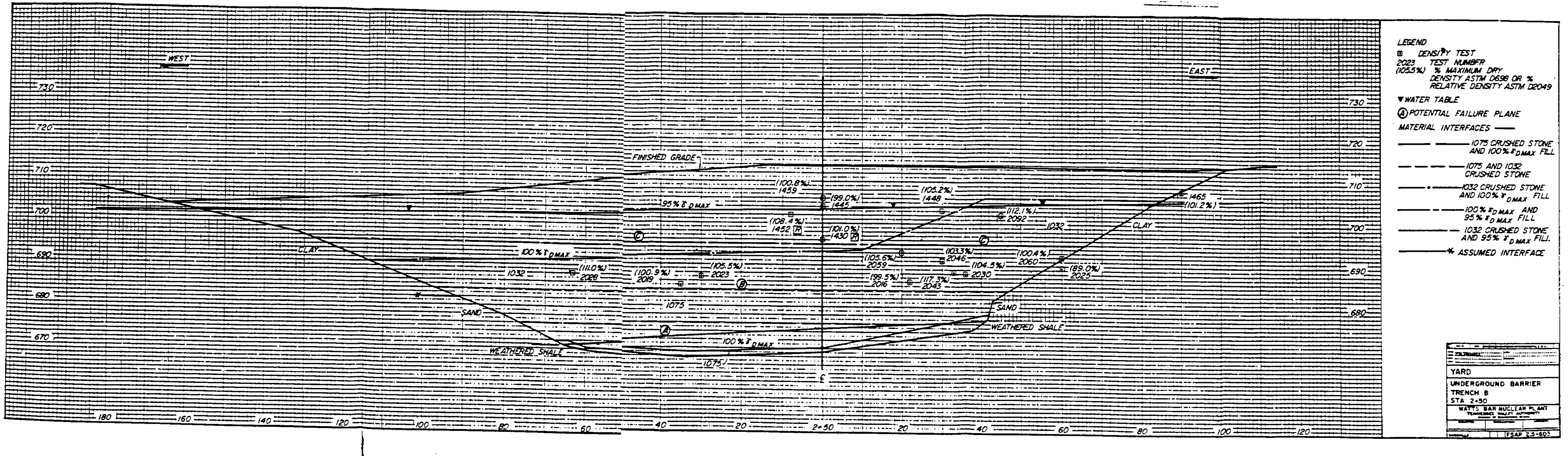

SW 11-5-83

REMARKS: THIS IS THE FINAL ANALYSIS FOR TYPE A1 FILL COMPACTION. SW
INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH R 4 OF WBNP-QCP-2.01.

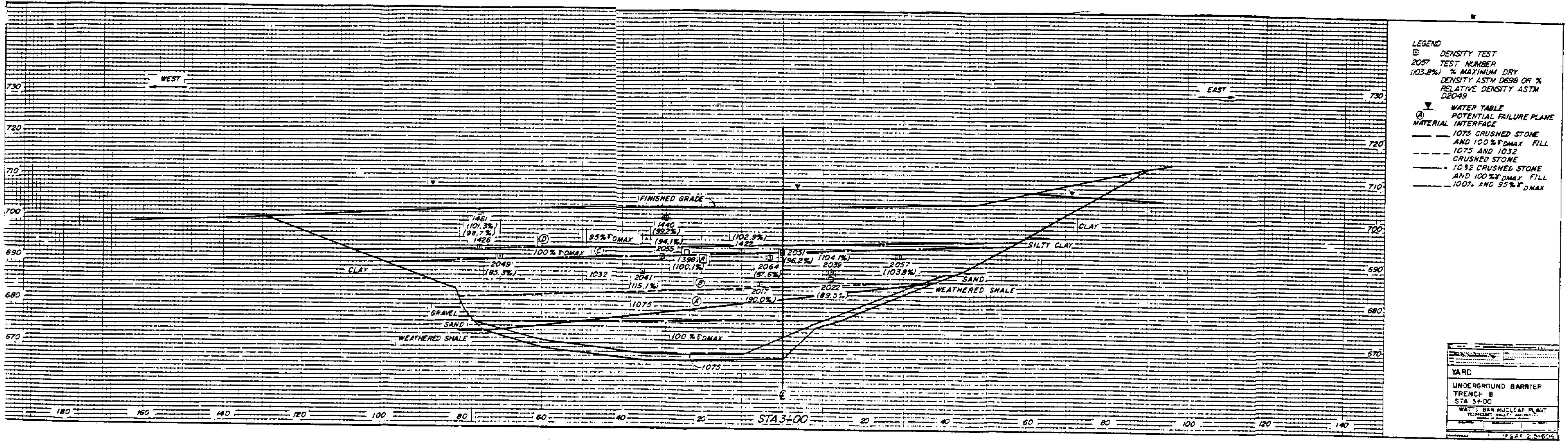
/s/ Scott Woodlee 11-5-83



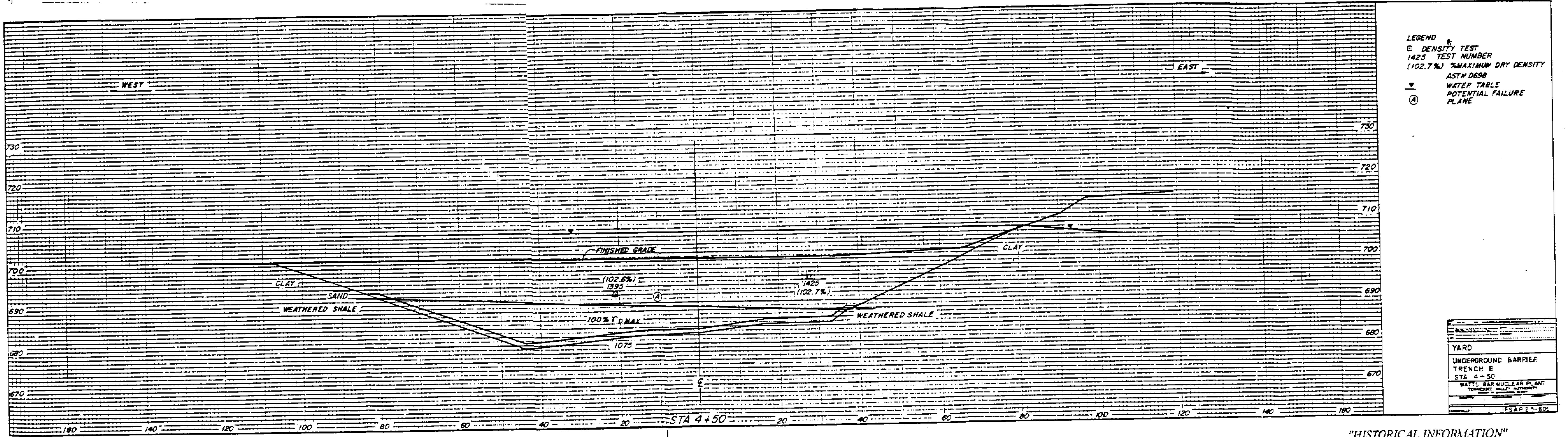

"HISTORICAL INFORMATION"




"HISTORICAL INFORMATION"




"HISTORICAL INFORMATION"




"HISTORICAL INFORMATION"

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

**SUMMARY OF FILL TEST DATA - DENSITY**
**FIGURE 2.5-606**

NP-QCP-2.01 R6
tachment F
P

Sheet 1 of ___

FEATURE: UNDERGROUND BARRIER – TRENCH B-95% $\gamma_{DMAX}$ FILL

DATE: 11-2-83 TO: 6-28-84 TEST NO.: 1397 TO: 1475

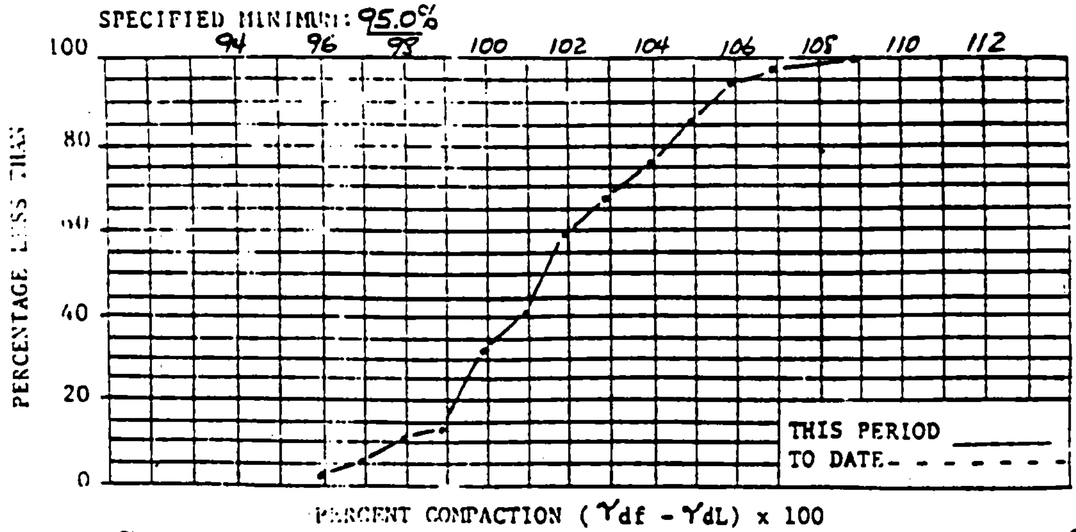
PART: I SECTION: 52B (A) PREPARED BY: W.S. WOODLEE

| PERCENT COMPACTION ($\gamma_{df}$ - $\gamma_{dL}$) x 100 | PLOT THIS COL | PREV CUM F | THIS PERIOD FREQUENCY (F) | THIS PERIOD F | THIS PERIOD CUM F | THIS PERIOD CUM % | TO DATE F | TO DATE CUM F | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|
| 95.0 | 95.9 | | I | 1 | 1 | 2.7 | | | |
| 96.0 | 96.9 | | I | 1 | 2 | 5.4 | | | |
| 97.0 | 97.9 | | II | 2 | 4 | 10.8 | | | |
| 98.0 | 98.9 | | I | 1 | 5 | 13.5 | | | |
| 99.0 | 99.9 | | ~~IIII~~-II | 7 | 12 | 32.4 | | | |
| 100.0 | 100.9 | | III | 3 | 15 | 40.5 | | | |
| 101.0 | 101.9 | | ~~IIII~~-II | 7 | 22 | 59.5 | | | |
| 102.0 | 102.9 | NA | III | 3 | 25 | 67.6 | NA | NA | NA |
| 103.0 | 103.9 | | III | 3 | 28 | 75.7 | | | |
| 104.0 | 104.9 | | IIII | 4 | 32 | 86.5 | | | |
| 105.0 | 105.9 | | III | 3 | 35 | 94.6 | | | |
| 106.0 | 106.9 | | I | 1 | 36 | 97.3 | | | |
| 107.0 | 107.9 | | | | | | | | |
| 108.0 | 108.9 | | I | 1 | 37 | 100.0 | | | |
| 109.0 | 110.9 | | | | | | | | |
| TOTALS | | | -- | -- | 37 | -- | -- | | |

SPECIFICATION SOURCE: DWG. #10N213-2 R4

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL DRY DENSITY, $\gamma_{df}$, pcf | NA | 107.0 | 107.0 |
| AVG MAXIMUM DRY DENSITY, $\gamma_{dL}$, pcf | NA | 105.3 | 105.3 |
| MEAN VARIATION $\gamma_{df}$ - $\gamma_{dL}$, pcf | NA | +1.7 | +1.7 |

SPECIFIED MINIMUM: 95.0%




SW 7-3-84

REMARKS: FAILED TESTS NOT INCLUDED IN THIS ANALYSIS. SW

INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH REV 6 OF WBNP-QCP-2.01.

W. Scott Woodlee — INSPECTOR

7-3-84 — Date

**SUMMARY OF EARTHFILL TEST DATA - MOISTURE CONTENT**
**FIGURE 2.5-607**

:P-QCP-2.01 R6
achment C

heet 1 of ____

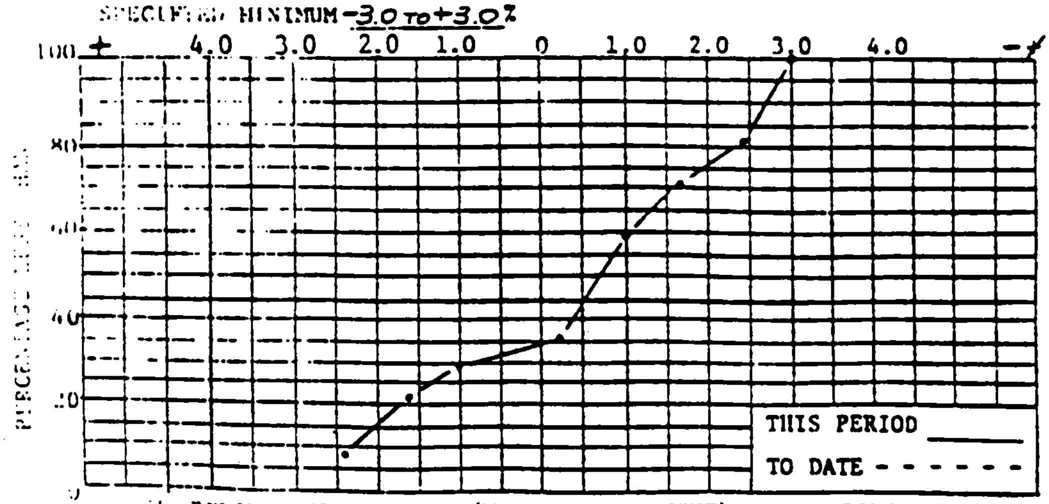
FEATURE: UNDERGROUND BARRIER - TRENCH B - 95% $\gamma_{D}$MAX FILL
DATE: 11-2-83 TO: 6-28-84 TEST NO.: 1397 TO: 1475
PART: I SECTION: 528 (A) PREPARED BY: W.S. WOODLEE

| $(W_F - W_O)$, PERCENT | | PLOT THIS COL | PREV CUM F | THIS PERIOD FREQUENCY (F) | F | CUM F | CUM % | TO DATE F | CUM F | CUM % |
|---|---|---|---|---|---|---|---|---|---|---|
| $W_F$ ABOVE OPT | +4.6 | 5.2 | | | | | | | | |
| | 3.9 | 4.5 | | | | | | | | |
| | 3.1 | 3.8 | | | | | | | | |
| | 2.5 | 3.0 | | | | | | | | |
| | 1.8 | 2.4 | | III | 3 | 3 | 8.1 | | | |
| | 1.1 | 1.7 | | ~~IIII~~ | 5 | 8 | 21.6 | | | |
| | 0.4 | 1.0 | | III | 3 | 11 | 29.7 | | | |
| PLOT | +0.3 | -0.3 | NA | II | 2 | 13 | 35.1 | NA | NA | NA |
| | 0.4 | 1.0 | | ~~IIII~~-IIII | 9 | 22 | 59.5 | | | |
| | 1.1 | 1.7 | | IIII | 4 | 26 | 70.3 | | | |
| $W_F$ BELOW OPT | 1.8 | 2.4 | | IIII | 4 | 30 | 81.1 | | | |
| | 2.5 | 3.0 | | ~~IIII~~-II | 7 | 37 | 100.0 | | | |
| | 3.1 | 3.8 | | | | | | | | |
| | 3.9 | 4.5 | | | | | | | | |
| | -4.6 | 5.2 | | | | | | | | |
| | TOTALS | NA | | -- | — | 37 | -- | -- | | -- |

SPECIFICATION SOURCE: DWG.# 10N213-2 R4

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL MOISTURE CONTENT, $W_F$, % | NA | 18.4 | 18.4 |
| AVG OPTIMUM MOISTURE CONTENT, $W_O$, % | NA | 19.0 | 19.0 |
| MEAN VARIATION $(W_F - W_O)$, % | NA | -0.6 | -0.6 |

SPECIFIED MINIMUM -3.0 TO +3.0%




$W_F$ ~~BELOW~~ ABOVE OPTIMUM $(W_F - W_O$, PERCENT) $W_F$ ~~ABOVE~~ BELOW OPTIMUM

REMARKS: FAILED TESTS NOT INCLUDED IN THIS ANALYSIS. SW

INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH R 6 OF WBNP-QCP-2.01

Scott Woodlee 7-3-84
INSPECTOR

WBNP-QCP-2.01 R6
Attachment F
LOF

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
SUMMARY OF FILL TEST DATA - DENSITY

Sheet 2 of 2

FEATURE: UNDERGROUND BARRIER – TRENCH A – 100% [illegible] FILL.
DATE: 11-25-83 TO: 5-31-84 TEST NO.: 1408 TO: 1438
PART: I SECTION: 52B (A1) PREPARED BY: W.S WOODLEE

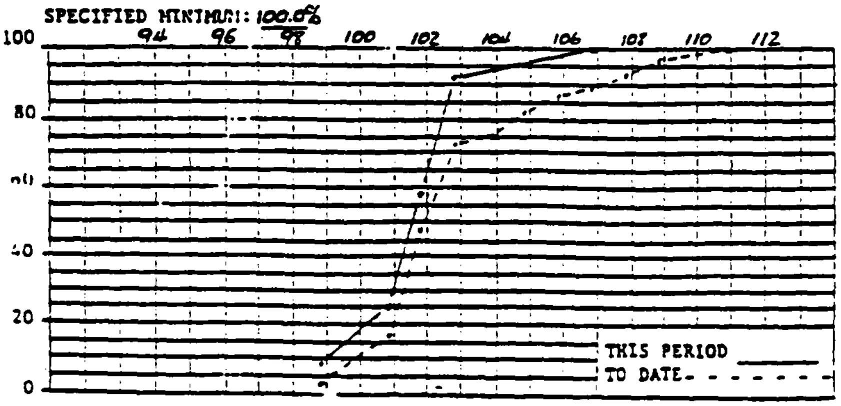
| PERCENT COMPACTION $(\gamma_{df} - \gamma_{dL}) \times 100$ | PLOT THIS COL | PREV CUM F | THIS PERIOD FREQUENCY (F) | THIS PERIOD F | THIS PERIOD CUM F | THIS PERIOD CUM % | TO DATE F | TO DATE CUM F | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|
| 95.0 | 95.9 | | | | | | | | |
| 96.0 | 96.9 | | | | | | | | |
| 97.0 | 97.9 | | | | | | | | |
| 98.0 | 98.9 | | I | 1 | 1 | 8.3 | 1 | 1 | 3.4 |
| 99.0 | 99.9 | | | | | | | | |
| 100.0 | 100.9 | 2 | III | 2 | 3 | 25.0 | 4 | 5 | 17.2 |
| 101.0 | 101.9 | 7 | IIII | 4 | 7 | 58.3 | 9 | 14 | 48.3 |
| 102.0 | 102.9 | 10 | IIII | 4 | 11 | 91.7 | 7 | 21 | 72.4 |
| 103.0 | 103.9 | 11 | | | | | 1 | 22 | 75.9 |
| 104.0 | 104.9 | 13 | | | | | 2 | 24 | 82.8 |
| 105.0 | 105.9 | 14 | | | | | 1 | 25 | 86.2 |
| 106.0 | 106.9 | | II | 1 | 12 | 100.0 | 1 | 26 | 89.7 |
| 107.0 | 107.9 | 15 | | | | | 1 | 27 | 93.1 |
| 108.0 | 108.9 | 16 | | | | | 1 | 28 | 96.6 |
| 109.0 | 110.9 | 17 | | | | | 1 | 29 | 100.0 |
| TOTALS | | 17 | – – | – – | 12 | – – | – – | 29 | – – |

SPECIFICATION SOURCE: DWG # 10NZ13-2 R4

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL DRY DENSITY $\gamma_{df}$, pcf | 104.7 | 105.6 | 105.1 |
| AVG MAXIMUM DRY DENSITY $\gamma_{dL}$, pcf | 101.0 | 103.6 | 102.1 |
| MEAN VARIATION $\gamma_{df} - \gamma_{dL}$, pcf | +3.7 | +2.0 | +3.0 |

SPECIFIED MINIMUM: 100.0%

SW
8-29-84




REMARKS: ANALYSIS ISSUED TO REFLECT CHANGE DUE TO MISTAKE ON SANDCONE TEST # 1426.
INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH REV 6 OF WBNP-QCP-2.01.

W. Scott Woodlee — INSPECTOR
8-29-84 — Date
NCR #5804

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY ANALYSIS REPORT**

SUMMARY OF FILL TEST DATA DENSITY

Figure 2.5-608

WBNP-QCP-2.01 R6
Attachment C
LOP

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
SUMMARY OF EARTHFILL TEST DATA - MOISTURE CONTENT Sheet 2 of 2

FEATURE: UNDERGROUND BARRIER - TRENCH A - 100% Ymax FILL
DATE: 11-25-83 TO: 5-31-84 TEST NO.: 1408 TO: 1438
PART: I SECTION: 52B (A1) PREPARED BY: W.S WOODLEE

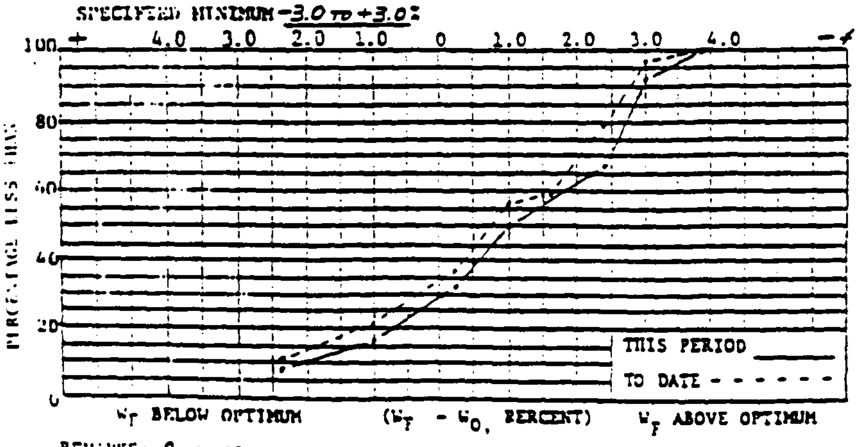
| $(W_F - W_O)$, PERCENT | | PLOT THIS | PREV CUM f | THIS PERIOD FREQUENCY (f) | THIS PERIOD f | THIS PERIOD CUM f | THIS PERIOD CUM % | TO DATE f | TO DATE CUM f | TO DATE CUM % |
|---|---|---|---|---|---|---|---|---|---|---|
| $W_F$ ABOVE OPT | +4.6 | 5.2 | | | | | | | | |
| | 3.9 | 4.5 | | | | | | | | |
| | 3.1 | 3.8 | | | | | | | | |
| | 2.5 | 3.0 | | | | | | | | |
| | 1.8 | 2.4 | 2 | II | 1 | 1 | 8.3 | 3 | 3 | 10.3 |
| | 1.1 | 1.7 | | | | | | | | |
| | 0.4 | 1.0 | 4 | II | 1 | 2 | 16.7 | 3 | 6 | 20.7 |
| OPT | +0.3 | -0.3 | 7 | III | 2 | 4 | 33.3 | 5 | 11 | 37.9 |
| | 0.4 | 1.0 | 10 | III | 2 | 6 | 50.0 | 5 | 16 | 55.2 |
| $W_F$ BELOW OPT | 1.1 | 1.7 | 11 | | | | | 1 | 17 | 58.6 |
| | 1.8 | 2.4 | 15 | III | 2 | 8 | 66.7 | 6 | 23 | 79.3 |
| | 2.5 | 3.0 | 17 | IIII | 3 | 11 | 91.7 | 5 | 28 | 96.6 |
| | 3.1 | 3.8 | | II | 1 | 12 | 100.0 | 1 | 29 | 100.0 |
| | 3.9 | 4.5 | | | | | | | | |
| | -4.6 | 5.2 | | | | | | | | |
| TOTALS | | NA | 17 | -- | — | 12 | — | — | 29 | — |

SPECIFICATION SOURCE: DWG #10N213-2 R4

| | PREV | THIS PERIOD | TO DATE |
|---|---|---|---|
| AVG FILL MOISTURE CONTENT, $W_F$, % | 20.2 | 18.7 | 19.6 |
| AVG OPTIMUM MOISTURE CONTENT, $W_O$, % | 21.1 | 20.2 | 20.7 |
| MEAN VARIATION $(W_F - W_O)$, % | -0.9 | -1.5 | -1.1 |

SPECIFIED MINIMUM -3.0 TO +3.0%

SW 8-29-84




REMARKS: ANALYSIS ISSUED TO REFLECT CHANGE DUE TO MISTAKE ON SANDCONE TEST #1426.
INSPECTED/CHECKED/VERIFIED IN ACCORDANCE WITH R 6 OF WBNP-QCP-2.01. NCR#5604

W. Scott Woodlee 8-29-84

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

SUMMARY OF EARTHILL TEST DATA
MOISTURE CONTENT

Figuure 2.5-609

**WATTS BAR NUCLEAR PLANT**
**FINAL SAFETY**
**ANALYSIS REPORT**

**SUMMARY OF GRANULAR FILL TEST DATA - RELATIVE DENSITY**
**FIGURE 2.5-610**

WBNP-QCP-2.06 R4
Attachment F
LOP
Sheet 2 of ___

Summary o

*Feature: UNDERGROUND BARRIER – TRENCH B - 1032 CRUSHED STONE
Period: 4-27-84 to 5-31-84 Test No. 2046 to 2092
Part II Section 29 Prepared by W.S. WOODLEE

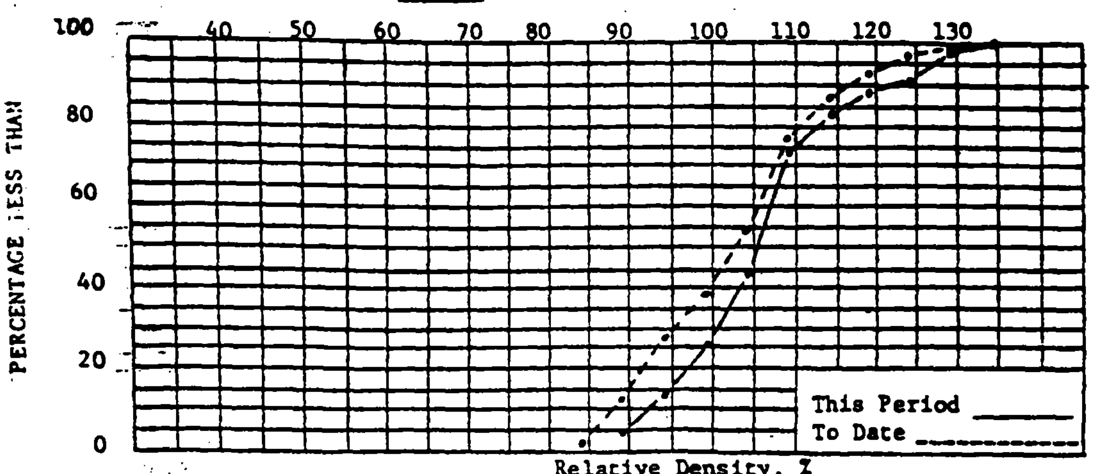
RELATIVE DENSITY, %

| | PLOT THIS COLUMN | PREV. CUM. F | THIS PERIOD | | | | TO DATE | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | FREQUENCY (F) | F | CUM F | CUM % | F | CUM F | CUM % |
| 60.0 | 64.9 | | | | | | | | |
| 65.0 | 69.9 | | | | | | | | |
| 70.0 | 74.9 | | | | | | | | |
| 75.0 | 79.9 | | | | | | | | |
| 80.0 | 84.9 | 2 | | | | | 2 | 2 | 2.7 |
| 85.0 | 89.9 | 7 | II | 2 | 2 | 4.7 | 7 | 9 | 12.3 |
| 90.0 | 94.9 | 14 | IIII | 4 | 6 | 14.0 | 11 | 20 | 27.4 |
| 95.0 | 99.9 | 17 | 卌 | 5 | 11 | 25.6 | 8 | 28 | 38.4 |
| 100.0 | 104.9 | 21 | 卌-III | 8 | 19 | 44.2 | 12 | 40 | 54.8 |
| 105.0 | 109.9 | 24 | 卌-卌-III | 13 | 32 | 74.4 | 16 | 56 | 76.7 |
| 110.0 | 114.9 | 27 | IIII | 4 | 36 | 83.7 | 7 | 63 | 86.3 |
| 115.0 | 119.9 | 30 | II | 2 | 38 | 88.4 | 5 | 68 | 93.2 |
| 120.0 | 124.9 | | III | 3 | 41 | 95.3 | 3 | 71 | 97.3 |
| 125.0 | 129.9 | | I | 1 | 42 | 97.7 | 1 | 72 | 98.6 |
| 130.0 | 134.9 | | I | 1 | 43 | 100.0 | 1 | 73 | 100.0 |
| TOTALS | | 30 | - - | - - | 43 | - - | - - | 73 | - - |

Specification Source DWG.*10N213-2 R4

| | PREV. | THIS PERIOD | TO DATE |
|---|---|---|---|
| Avg. Relative Density | 98.5 | 106.3 | 103.1 |

Specified Min. 80 min. / 85 avg. %




*Remarks 1032 GRANULAR FILL SUBSTITUTED FOR EARTHFILL IN TRENCH B

Inspected/checked/verified in accordance with R4 of WBNP-QCP-2.06

W. Scott Woodlee — Inspector

6-11-84 — Date