2.5 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING

2.5.1 Basic Geologic and Seismic Information

The Beaver Valley Power Station - Unit 2 (BVPS-2) site is located on the south bank of the Ohio River in the borough of Shippingport, Pennsylvania, approximately 25 miles northwest of Pittsburgh. As shown on Figure 2.5.1-1, the site lies near the center of the Appalachian Plateau physiographic province. The plant is located upon a terrace of alluvial gravels about 100 feet thick, deposited by higher stages of the Ohio River during the Pleistocene Epoch. The surrounding topography consists of steep-sided, flat-topped hills separated by narrow stream valleys.

Two flat-lying bedrock formations of Pennsylvanian age outcrop in the site vicinity and form the adjacent hills, which rise to el 1,200 feet, as shown on Figure 2.5.1-2. The rocks are unmetamorphosed and show no evidence of major geologic deformation or tectonic activity. Regionally, the site lies near the center of a basin structure of Permian age (Figure 2.5.1-3). The Upper Freeport coal seam lies at el 900 feet, approximately 150 feet above the plant elevation and has been exploited to some extent in the site area. Several thinner coal seams are believed to exist beneath the site between 0 and 200 feet depth, but are not of sufficient extent or quality for commercial development at this time.

Massive sandstones were utilized locally in the past as dimension blocks for use in nearby bridge abutments, retaining walls, and building construction. None of this activity is carried on presently in the site area.

Minor oil and gas production has been realized within 4 miles of the site, drawing mainly from the Pocono Group of Early Mississippian age. There has been neither mining activity nor hydrocarbon extraction beneath the site which could cause ground settlement or collapse, nor is any anticipated.

The regional geologic history of the site region is discussed in Section 2.5.1.1.4, and reveals that the site area has not been subjected to severe diastrophic events at any time since the Precambrian. The area has remained tectonically stable since the Allegheny orogeny, approximately 250 million years ago, with the exception of epeirogenic uplifts, downwarping, and rebound, due to glacial loading.

The site is located in an area of very low seismicity within the Appalachian Plateau tectonic province as shown on Figure 2.5.1-5.

The nearest earthquake of epicentral Intensity V Modified Mercalli (MM), or greater, took place June 27, 1906, at Fairport, Ohio (near Cleveland), 80 miles northwest of the site. Only one earthquake has been reported within 50 miles of the site, reported at Sharon, Pennsylvania, on August 17, 1873, approximately 40 miles north of the site. Limited details have resulted in an estimated intensity of

III-IV (MM). The largest earthquake in the site region is the intensity VII-VIII (MM) event which occurred March 8, 1937, near Anna, Ohio, approximately 200 miles southwest of the site.

Results of geologic mapping in the site area indicate there is no hazard of surface faulting at or near the site. Additionally, no hazard due to ground subsidence is present which could affect the site.

In general, the founding material at the plant site is glacial outwash, overlain locally by thin deposits of silt, sand, and clay deposited during higher stages of the Ohio River. The founding materials for the plant structures are discussed in detail in Section 2.5.4.

Exploratory borings have shown that the bedrock beneath the site is a hard, black shale, and gray sandstone, probably belonging to the Allegheny Formation of Pennsylvanian age. It is estimated to be 350 feet thick in the plant area and shows no indication of extensive weathering, solution cavities, or other deleterious characteristics.

The work described herein was performed by Stone & Webster Engineering Corporation (SWEC), Boston, Massachusetts, with the following exceptions:

1. Raymond International, Hackensack, New Jersey, performed subsurface test borings, standard penetration tests, and soil, and rock sampling in the site area under the direction of SWEC.

2. Weston Geophysical Engineers, Inc., Westboro, Massachusetts, performed in situ seismic velocity measurements, including seismic refraction profiles and cross-hole, down-hole, and up-hole seismic tests for determining shear moduli of the overburden and bedrock characteristics. They also prepared the original seismicity analysis.

3. Pennsylvania Drilling Company, Inc., Pittsburgh, Pennsylvania, performed subsurface test borings, standard penetration tests, soil and rock sampling, and piezometer installations under the direction of SWEC.

4. Eger Drilling Company, Inc., Bridgeville, Pennsylvania performed subsurface test borings, standard penetration tests, soil sampling and piezometer installations under the direction of SWEC.

2.5.1.1 Regional Geology

2.5.1.1.1 Regional Physiography

The BVPS-2 site lies on the south bank of the Ohio River within the Appalachian Plateau physiographic province (Figure 2.5.1-1) (Fenneman 1938). This province is characterized by relatively undeformed

Paleozoic sediments which have been gently tilted and extensively dissected, producing the appearance of a rejuvenated peneplain. In Beaver County, the flat hill tops lie at approximately el 1,200 feet above narrow valleys cut 200 to 400 feet below the top of the hills.

Alluvial deposits of varying thickness are found at various elevations on the valley walls, and consist mainly of interbedded sands and gravels. These deposits frequently occur as terraces, and are the result of higher stages of rivers carrying large amounts of glacial outwash during the Pleistocene. The limit of glacial ice has been mapped as being approximately 20 miles north of the site (Shepps et al 1959).

Geologically, the province is a broad, gentle basin whose youngest rocks are the Dunkard Group of Early Permian age. The province is bounded on the west by the Central Lowland province, the boundary being an escarpment of Pennylvanian rocks 1,000 feet high in Tennessee and Kentucky, and a lower escarpment of Mississippian rocks in central southern Ohio. The boundary is somewhat indistinct in central Ohio, but generally follows the limit of glacial till plains. To the northwest and north of the site area, the boundary again follows an escarpment, formed by Silurian and Devonian sandstones, limestones, and Ordovician shales, to their contact with the Precambrian rocks of the Adirondacks (Fenneman 1938). The eastern boundary with the Valley and Ridge province occurs 105 miles east of the site and is marked by an abrupt topographic escarpment as much as 1,500 feet high, called the Allegheny Front. The Valley and Ridge province is characterized by a series of narrow, parallel ridges and valleys; the ridges being limbs of folds composed of resistant rock, and the valleys being the crests and troughs.

A portion of the Central Lowland physiographic province also lies within the site region, the boundary occurring 85 miles to the west. This province is characterized by having a Precambrian basement, or craton, with a veneer of nearly horizontal sedimentary rock of varying thicknesses. The structure is generally controlled by several basins and domes formed by Paleozoic epeirogenic activity. This has produced a diversity of geomorphic features, a large part of which has been extensively modified by Pleistocene glaciation (Eardley 1962).

2.5.1.1.2 Regional Stratigraphy

The distribution of the major geologic units within the site region is shown on Figure 2.5.1-3. A generalized cross section and regional stratigraphic column are given on Figures 2.5.1-4 and 2.5.1-6, respectively. The detailed stratigraphy of the Appalachian basin is thoroughly discussed by Colton (1970) and is summarized subsequently.

2.5.1.1.2.1 Precambrian

Rocks of Precambrian age are exposed in the site region, approximately 180 miles to the southeast in the Blue Ridge anticlinorium. These are a sequence of metasediments and

metavolcanics which unconformably overlie what is commonly called Precambrian basement. The basement complex consists of schists, gneisses, and a wide variety of intrusives. The nearly peneplained basement surface has been determined to slope gently to the southeast under the region. Little is known about the stratigraphy of the Precambrian beneath the Appalachian basin.

2.5.1.1.2.2 Cambrian

Lower Cambrian deposition was concentrated in the southeast part of the Appalachian basin and resulted in a thick clastic wedge sequence, which included the sequence of rocks from the Loudoun to Waynesboro Formations. Equivalent rocks were not deposited on the west limb of the basin. Deposition on the western edge began in the Middle Cambrian with the Mt. Simon, Rome, and Conasauga Formations. The clastic sequence was followed in Middle and Late Cambrian time by basinwide deposition of carbonate rocks. These include the Elbrook Dolomite, Conococheague Limestone, the Lower Ordovician Beekmantown and Middle Ordovician Chambersburg, and Trenton Group rocks.

2.5.1.1.2.3 Ordovician

The carbonate sequence gives way abruptly during the Middle Ordovician to marine clastic deposits, beginning with the Martinsburg Shale. A thick clastic wedge about 8,000 feet thick is believed to have apexed in western Virginia and North Carolina during this time (Eardley 1962). Ordovician clastic sedimentation ended with the deposition of the Oswego Sandstone and Queenston Formation. Evidence exists for a diastrophic event affecting the Upper Ordovician along the east side of the basin, with some units missing, and an angular unconformity being developed (Colton 1970).

2.5.1.1.2.4 Silurian

The Upper Ordovician clastic sequence is overlain by a thin sequence of predominantly clastic rocks, mainly of Early Silurian age, that extends throughout most of the Appalachian basin. It is thickest in the northeast part, and thins to the west, southwest, and north, being totally absent in eastern New York. These rocks include some of the major ridge forming rocks of the Valley and Ridge, and include the Tuscarora Sandstone and Clinton Group.

A carbonate sequence began in the Middle Silurian, and continued into Late Silurian, Early Devonian, and even into the Middle Devonian in some areas. Like the underlying sequences, it is wedge-shaped, being thickest on the east and thinning out to the west and south. The sequence begins with the Lockport Dolomite, and includes the Salina and Bass Islands Group of Late Silurian age, deposited in evaporitic basin conditions, and the Helderberg Group. This sequence is overlain in most parts of the basin by the Oriskany Sandstone.

2.5.1.1.2.5 Devonian

Early Devonian carbonate deposition gave way to predominantly clastic sedimentation in the Middle and Late Devonian throughout most of the basin. The contact is conformable in most places and begins with the Needmore Shale. The sequence includes the Olentangy, Chemung, Catskill, and Bedford formations in the site region and ends before deposition of the Berea Sandstone or Pocono Group.

2.5.1.1.2.6 Mississippian

The Mississippian sequence conformably overlies the Devonian clastic sequence in most areas. The sequence is basically wedge-shaped with modifications due to erosion in eastern Ohio-western Pennsylvania, occurring in the Late Mississippian or Early Pennsylvanian time. The sequence includes the Pocono Group, the Greenbrier Group, and the Mauch Chunk Formation.

2.5.1.1.2.7 Pennsylvanian

Pemsylvanian strata are commonly disconformable on the Mississippian and are distinctly clastic. They include thick sequences of alternating beds of sandstone, shale, and siltstone with lesser amounts of coal and limestone. The Pottsville, Allegheny, Conemaugh, and Monongahela Formations were deposited at this time, and include the great coal-bearing formations of the basin. It has been determined that the Pennsylvanian sequence was originally much thicker, and more extensive, than at present, and nearly 75 percent of the sequence has been eroded since the Paleozoic (Colton 1970).

2.5.1.1.2.8 Permian

Overlying the Monongahela Formation in an oval area in West Virginia, southeast Ohio, and southwest Pennsylvania, is the Dunkard Group, of probable Lower Permian age. The Dunkard Group continued the variable deposition sequence started in the Pennsylvanian. The Allegheny orogeny, occurring progressively from the southeast during the Pennsylvanian and Permian, ended the extensive depositional cycle of the Paleozoic and exposed the sediments of the basin to a long period of erosion which is continuing today.

2.5.1.1.2.9 Triassic

The only rocks found in the site region younger than the Dunkard Group are located approximately 165 miles east of the site in the Gettysburg basin. They belong to the Newark Group and are believed to be Late Triassic or perhaps Early Jurassic in age. They are mainly continental sandstones, arkoses, conglomerates, and fanglomerates deposited in long, narrow, fault-bound basins. Numerous mafic sills and dikes are found associated with these deposits, and are believed to be the result of continental rifting during the Late Triassic and Early Jurassic.

2.5.1.1.2.10 Pleistocene

Unconformably overlying the Paleozoic rocks of northern Pennsylvania and Ohio are the unconsolidated deposits of several episodes of Pleistocene glaciation. Although glacial ice never advanced as far as the site area, the effects of its proximity are evident by the presence of high-level gravel terraces along the Ohio River and its major tributaries. These deposits provide the substrata on which the great majority of the cultural and industrial centers are founded.

Erosion since the retreat of the ice has considerably modified and removed much of the original deposits, but three terraces remain in the site area. The plant is situated on the uppermost terrace and is more fully described in Section 2.5.1.2.

2.5.1.1.3 Regional Structural Geology

The site lies on the west limb of the Appalachian sedimentological basin near the axis of the Appalachian coal basin (Rodgers 1970) or the axis of the Pittsburgh-Huntington basin (Wagner et al 1970). This area is just east of the Central Stable Region of North America and west of the Blue Ridge and Piedmont provinces as indicated on Figure 2.5.1-7.

All Carboniferous rocks in this area dip gently (less than 5 degrees) toward the basin axis, a line through Pittsburgh to Huntington, West Virginia. The basin contains the youngest sedimentary rocks in this part of the country, the Dunkard Group of Lower Permian age, exposed in the axial area 26 miles south of the site. The underlying Middle and Lower Paleozoic strata continue to thicken eastward, so that the axis of deposition is displaced somewhat east of Pittsburgh. The Precambrian surface also continues to dip southeastward under the entire Appalachian basin (Rodgers 1970). East of Pittsburgh, the dip of the Carboniferous strata reverses, and the units are deformed into broad gentle folds. This trend continues eastward into the Allegheny Mountains, until the Allegheny Front is reached at the outermost Carboniferous outcrop. Three anticlines form prominent ridges before the Allegheny Front is reached. These are the Chestnut Ridge, Laurel Hill, and Accident Mountain anticlines. Most of the structures found in the site region are the result of the Allegheny orogeny, which culminated in Late Permian time. No diastrophic events have occurred in the site region since the Early Jurassic.

2.5.1.1.3.1 Structures of the Appalachian Plateau

<u>Folding</u>

Major folds within 200 miles of the site are discussed in terms of their history of development, geologic setting, and effects on the geology of the site. The major structural features mentioned herein are shown on Figure 2.5.1-7.

Folds within the site region of the Appalachian Plateau are well displayed southeast of the site between Pittsburgh and the Allegheny

Front. Their wavelengths range from 6 to 12 miles and their structural reliefs vary from 500 to 2,500 feet (Rodgers 1970; Cardwell et al 1968). The three largest of these are the Chestnut Ridge, Laurel Hill, and Accident Mountain anticlines which bring uppermost Devonian rocks to the surface. They are 65, 75, and 85 miles from the site, respectively. Farther east, 150 miles from the site, the higher Deer Park anticline brings to the surface a larger section of Upper Devonian shale. Dips are usually less than 10 degrees and no regularity of plunge of the folds is apparent. Faulting at the surface is rare, but oil and gas drilling has revealed several major faults at depth, mostly in the Devonian section. Evidence indicates that these may be sole thrusts for

westward movement of the overlying Plateau rocks (Gwinn 1964). The trend of the folds closely parallels the trend of the major folds in the Valley and Ridge of central Pennsylvania, swinging from north-northeast near Pittsburgh, to east-northeast in north-central Pennsylvania. Two of the Plateau folds can be traced southwestward into West Virginia, where they steepen significantly and increase in amplitude. The Deer Park anticline and the Briery Mountain anticline, the continuation of the Accident Mountain anticline, converge in West Virginia, 100 miles south of the site, and become the Elkins Valley anticline, whose west flank has a structural relief of 9,000 feet and is locally overturned. Thrust faults have been suggested beneath the anticline from well data (Rodgers 1970). All of the anticlines show westward offset across the west-northwest trending Morgantown-Sang Run and Fairmount-Rowlesburg lines. The nature of these features is not clearly understood at this time but may be related to reactivated basement fracture zones along which strike slip movement has occurred (Rodgers 1970; Cardwell et al 1968).

Of significantly different trend from these folds is the Burning Springs anticline in west-central West Virginia, about 100 miles southwest of the site. It trends nearly north-south across the center of the coal basin with a structural relief of 1,650 feet. The limbs dip very steeply, and the fold structure terminates rather abruptly at either end. Its existence has been interpreted to be due to several repetitions of the Devonian section along imbricate thrust surfaces, possibly facilitated by the presence of Salina Group salt beds (Rodgers 1970).

The folds of the Plateau are so parallel to those in the adjacent Valley and Ridge, that no one doubts their formation at the same time and by the same forces. The difference in complexity and degree of deformation between the two areas indicates that the stress levels were considerably lower in the Plateau, or the rocks responded to the force differently because of an anisotropic property of the rocks. Thin-skinned tectonics, with movement occurring along zones of salt or weak shales, seems to be the best explanation for the origin of structures found in the Appalachian Plateau of the site region (Rodgers 1963, 1970; Gwinn 1964).

Recent seismic reflection profiling in the southern Appalachians appears to confirm large scale decollement movement of rocks in the Appalachian Plateau and Valley and Ridge. Movement was generally to the northwest and occurred mainly during the Allegheny orogeny (Cook et al 1979, 1980).

Other folds of note exist in the Appalachian Plateau section of eastern Ohio. The Parkersburg-Lorain syncline is the westernmost fold of the western Appalachian basin, and can be traced from Parkersburg, West Virginia, to Lorain County on Lake Erie. The syncline is a structural trough trending N10W and is nearly 5 miles wide in the Marietta region, approximately 80 miles west of the site (Lemborn 1951). The Cambridge arch is the anticlinal counterpart of the Parkersburg-Lorain syncline, and parallels it to the east. It

can be traced from the Ohio River in Washington County, Ohio, northwestward into Summit County. The structure has a relief of 450 feet in Washington County, but becomes less well defined northward (Lamborn 1951). Both of these folds are known to affect the Devonian shale sequence above the Onondaga Formation. The folds

are underlain by pinchouts of bedded salt, and their location may be due to movements along this zone during the Allegheny orogeny.

Faults

The Clarendon-Linden fault zone is a major tectonic feature in the Appalachian Plateau and Central Stable Region of western New York. It trends north-south for over 60 miles from near Lake Ontario to northern Allegheny County. The Clarendon-Linden fault is postulated to be not a single fault but instead, a zone consisting of several parallel basement faults which become surface flexures (Van Tyne 1976). Most of the movement is believed to be confined to those formations below the Silurian deposits. Movement is believed to have been downthrown to the east, reversing later to become downthrown to the west. A significant amount of seismic activity has taken place in the area of Attica, New York, in close proximity to the Clarendon-Linden structures (Sbar and Sykes 1977; Pomeroy et al in press). Recent low-level seismic activity has been correlated with high-pressure fluid injection operations in brine fields which are developed in the area, and it is believed to be relieving stress along the fault system. For this reason, the fault must be considered an active feature. The south end of the fault zone is about 160 miles northeast of the BVPS-2 site. The seismicity of the Clarendon-Linden fault zone is discussed in Section 2.5.2. The Intensity VIII (MM) event in 1929 near Attica is the largest event to occur in western New York and has been correlated with the Clarendon-Linden structure.

Recent work in south-central Pennsylvania has resulted in a proposed fault zone near latitude 40°N called the Transylvania fault (Root and Hoskins 1977). This zone is believed by the authors to be a fundamental fracture of the continental plate, end has been traced from the Blue Ridge, across the Appalachian Plateau a few miles south of the BVPS-2 site. The fault is believed to have been active prior to the opening of the Atlantic and was rejuvenated at that time. No seismic activity is now associated with the zone, and it probably has been inactive at least since the Jurassic. The existence of the zone in the Appalachian Plateau is somewhat conjectural, based only on anomalous aeromagnetic patterns (Popenoe et al 1964; Beck and Mattick 1964) and a proximity to one of Wagner and Lytle's (1976) zones of structural discontinuity.

Other investigators have recently proposed the existence of similar geologic features beneath the Appalachian Plateau. Wagner (1976) hypothesizes "growth faults" based on the confined subsurface distribution of certain rock units of Cambrian and Lower Ordovician age. The faults were to have been active during the Cambrian and Ordovician periods. Root (1978) proposes similar down-to-the-east basement faults recurrently active during the Paleozoic and Mesozoic eras. Parrish and Lavin (1982) propose that kimberlite intrusions of Mississippian to mid-Jurassic age were emplaced at the intersection of basement faults along the edge of the Rome Trough with cross-structural lineaments. These cross-structural lineaments were identified from gravity and magnetic anomaly terminations,

pronounced magnetic gradients, changes in gravity patterns, structural discontinuities and satellite imagery. The basement faults are believed to be Triassic to Jurassic in age. Harris (1978) proposes border faults to the Rome Trough in Kentucky and West Virginia as being active during early and middle Paleozoic time.

There appears to be no correlation between the Transylvania faults, Wagner or Root's growth faults, or those faults and lineaments proposed by Parrish and Lavin. All of the features described above are believed to be at least Mesozoic in age, show no history of seismic activity, and pose no threat to the safety of the BVPS-2 site.

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Ver Steeg (1944) describes several minor faults in eastern Ohio. Between Wilkesville and Clarion in Vinton County, there is a north-south striking fault with a throw of 7 feet; in Harrison County, a north-northeasterly striking reverse fault has a throw of 1.5 feet. He also describes a vertical fault with a throw of 15 feet dipping to the west at 45 to 50 degrees. The age of these minor faults is not known, but they may be related to Alleghenian folding. They occur 140 and 42 miles southwest of the site, respectively.

Janssens et al (1976) report overthickened Salina units and folding of the younger sediments in Guernsey County, Ohio, approximately 60 miles from the site. They postulate thrusting above the E salt unit of about 1 mile toward the northwest, with parallel folding of the preceding units. They also postulate a major tear fault in east-central Washington County, Ohio, similar to others found in the Appalachian basin associated with movement along salt beds during the Allegheny orogeny, approximately 95 miles from the site. (Janssen 1977, personal communication)

2.5.1.1.3.2 Structures of the Central Stable Region

Folds

The Cincinnati arch is the dominant basement structure in the Central Stable region of Ohio. This feature marks the change in dip from the easterly component of the Appalachian basin to the westerly component of the Michigan and Illinois basins. It served to divide the basins into separate depositional environments as well as to separate the mobile Appalachian basin from the stable intra-cratonic interior.

The Cincinnati arch is the northern extension of the Nashville-Jessamine dome, located in Tennessee and Kentucky. At its northern end, the arch bifurcates into the northwesterly trending Kankakee arch, and the north-easterly trending Findlay arch. The earliest development of the arch took place near the end of the Early Ordovician, with evidence of erosion of the Lower Ordovician and Upper Cambrian in northern Ohio. A complex sequence of uplift, stability, and subsidence relative to the basins followed, continuing into post-Permian to pre-Late Triassic time when the final uplift occurred (Janssens 1967, 1973). The arches represent Precambrian basement structural highs which have remained inactive since approximately the beginning of the Mesozoic.

The arch system continues into Canada and extends to the Canadian Shield as the Algonquin axis. A cross structure, the Chatham sag, separates the Findlay arch from the Algonquin axis. The feature in Canada is believed to have a similar, related history. The arch system is believed to have served as the anvil during lateral compression of the Paleozoic sediments from the southeast and east during the Allegheny orogeny (Rodgers 1970).

Faults

Ver Steeg (1944) describes a minor fault in Delaware County, Ohio, within the Central Stable Region. It strikes N20E and dips 58 degrees to the east with a displacement of 8.5 feet. Jacoby (1969) reports two minor faults in the International Salt Mine in Cleveland. Both are nearly vertical gravity faults striking N70W, and dipping to the north. The throws on the faults are 4 to 4.5 feet and 47 feet. The origin of the faulting is unknown.

Owens (1967) reports a small displacement, north-south trending, gravity fault, downthrown to the east on the Precambrian surface in Clinton-Fayette-Pickaway Counties, Ohio. The fault is based on an east-west seismic cross section. He also states the feature may be the result of erosion on the Precambrian surface.

Two other faults in Ohio were recognized during site investigations for Perry Nuclear Power Plant - Unit 1 and Unit 2, Lake County, Ohio, approximately 90 miles northwest of the site. The Warners Creek and Hell Hollow faults were found to be relatively small features, probably younger than 35,000 years and related to slumping of rock masses along joint planes or thrust faults which resulted from

loading effects and ice movements during the Pleistocene (Cleveland Electric Illuminating Company 1974). Evidence for deep-seated faulting in the area was not present. The largest fault known in Ohio is the Bowling Green fault, approximately 180 miles from the BVPS-2 site. It is a high angle reverse fault and trends north-northwest across the top of the Cincinnati arch through Hancock, Wood, and Lucas Counties into Michigan. It displaces the Trenton oil horizon some 200 feet. The fault is believed to become a monocline at both ends (Ver Steeg 1944; Janssens 1973). The bedrock surface across the fault was leveled by erosion during the Mesozoic and Cenozoic eras, and it appears that no movement has occurred on the fault since about the end of the Paleozoic (Woodward-Moorhouse and Associates, Inc. 1974). The majority of structural features in northwestern Ohio lie in a northwest-southeast direction paralleling the trends in the Michigan basin, to which they are probably related.

Several faults have been identified in Ontario in the vicinity of the Chatham sag. They include the Electric fault, the Dawn fault, the Clearville fault, the Kimball-Colinville fault, and the Willey fault (Brigham 1972). These faults are 140 miles from the site at their nearest known location and are believed to be Ordovician to Devonian in age, with no evidence of post-Devonian activity.

2.5.1.1.3.3 Structures of the Valley and Ridge Province

Sedimentary strata of the Valley and Ridge have been deformed into a close succession of anticlines and synclines, each several miles across. Most folds are asymmetrical and have been overturned or steepened on the northwest limb. Progressive deformation has resulted in southeast dipping thrust faults developing along the overturned limb in places. Faulting is common in the Valley and Ridge of Virginia and Tennessee, while folding dominates in Pennsylvania. The deformation has been related to thin-skinned tectonics which took place during the Allegheny orogeny (Gwinn 1964, 1970; Rodgers 1963, 1970).

Some of the larger structures closest to the site are the Wills Mountain anticline, Broad Top syncline, and the Nitanny anticline, 110 to 125 miles southeast of the site. All of these structures have been shown to be the result of folding and thrusting along relatively shallow, weak stratigraphic units during the Allegheny orogeny. The Birmingham and Sinking Valley thrusts are exposed 115 miles southeast of the site, and are associated with development of the Nitanny anticlinorium. A major fault, the Little North Mountain thrust, is present 150 miles southeast of the site where it coincides with the mid-province structural front, the zone of vertical and overturned beds (Rodgers 1970). It is just one of several thrusts in the Valley and Ridge of Virginia and Maryland, which developed approximately in the same manner and at the same time.

2.5.1.1.3.4 Structures of the Blue Ridge and Piedmont Provinces

A small part of the Blue Ridge and Piedmont provinces lies within 200 miles of the BVPS-2 site. The history and geologic structures of the two provinces are similar and are discussed together.

The Blue Ridge and Piedmont provinces are characteristically composed of metamorphosed Precambrian and Lower Cambrian eugeosynclinal sediments, which have been intensely folded and faulted. Involvement during two deformations distinguishes these provinces from the Valley and Ridge to the west. Major features of the northern end of the provinces, within 200 miles of the site, are the South Mountain-Blue Ridge anticlinorium and the Catoctin Border fault. The former is the major anticlinal feature of the Blue Ridge, and exposes metamorphosed Precambrian basement rocks in its core with volcanic rocks unconformably overlying them. Plate tectonic theory and interpretation of recent seismic profiling indicate that the Blue Ridge and Piedmont rocks are allochthonous, having been thrust a minimum of 35 miles over Valley and Ridge sedimentary rocks. Deformation and westward transport is believed to have started during the Ordovician Taconic orogeny and culminated in the Pennsylvania to Permian, Allegheny orogeny. Orogenic compressive stresses ceased with the initiation of continental rifting during the Triassic and Jurassic, creating the present Atlantic Ocean basin (Cook 1983; Cook et al 1979; Harris and Bayer 1979; Cook, Brown, and Oliver 1980.)

The Catoctin Border fault forms the western boundary of the Piedmont province in Pennsylvania, Maryland, and northern Virginia. It is a normal fault, downthrown to the east, and borders the Gettysburg-Culpepper basin of Triassic age.

2.5.1.1.3.5 Lineaments Within the Site Region

Several studies have included the identification and analysis of lineaments in the area surrounding the BVPS-2 site (Gwinn 1964; Wagner and Lytle 1976; Kowalik and Gold 1976; Briggs and Kohl 1976; Saunders and Hicks 1976; Bench et al 1977; Colton 1977). Some studies were based on satellite imagery, while others used subsurface geologic information. Several lineaments were identified in the immediate site vicinity, but none are believed to correspond to bedrock fault traces. Most lineaments can be shown to correspond to topographic features and segments of rivers and streams. Many lineaments which represent valley traces are parallel or normal to fold axes. Joint patterns in this area also tend to be parallel or normal to these axes (Briggs and Kohl 1976). Although the relationship between joints and straight stream valleys is still in question, the valley lineaments do suggest some relation to Allegheny orogeny folding. Most, if not all, lineaments identified in Pennsylvania can be shown to have originated before the Cenozoic. The very low level of seismic activity in the area precludes development of any lineaments as a result of recent fault movement.

2.5.1.1.4 Regional Geologic History

The geologic history of the region about the site can best be understood by tracing the history of development of the central Appalachian basin. The Appalachian basin is an elongated sedimentary basin which extends from the Canadian Shield in southern Quebec and Ontario southwestward to central Alabama. It includes here the area of typical Valley and Ridge structures, as well as the rocks of the Appalachian Plateau. Most of the site region (200-mile radius) falls within this area, except for a small section of Blue Ridge and Piedmont rocks to the southeast.

The general configuration and character of the Precambrian basement beneath the basin is fairly well known from oil and gas exploration activities and gravity and aeromagnetic data. Rocks of the Canadian Shield are believed to continue as a peneplain surface beneath the Paleozoic cover, and slope at a very low angle to the south and southeast (Beck and Mattick 1964; King 1977; Kulander and Dean 1978). The depth to the basement is generally equal to the thickness of the overlying sediments and ranges from 2,000 feet over the Cincinnati arch to about 35,000 feet in the geosynclinal portion of the Appalachian basin. The basement surface reflects a long period of erosion which began in Late Precambrian time, and continued into the Middle Cambrian. It resulted in a marked angular unconformity between the metamorphic and igneous complex of the basement, and the sedimentary pile within the basin. Subsidence of the basement in the late Middle Cambrian and Late Cambrian initiated deposition of marine sediments, consisting mostly of sandstone and sandy dolomite, the basal clastic sequence. The sequence is wedge-shaped with the greatest thickness being along the eastern edge of the basin, indicating transgression from the southeast. This sequence was followed by an episode of carbonate deposition during the Late Cambrian and Early Ordovician during a prolonged period of crustal quiescence. Evidence suggests that the carbonate deposits ended abruptly southeastward at a continental shelf bordering the eugeosyncline (Rodgers 1968). This sequence ended after deposition of the Trenton Limestone.

Gentle epeirogenic uplift during the early Middle Ordovician resulted in an erosional disconformity in the upper part of the Cambrian-Ordovician carbonate section in some parts of the basin. Clastic sediments of Late Ordovician to Middle Silurian age conformably overlie the Trenton, although in many areas this episode began in the Middle Ordovician (King 1959). They were derived from erosion of emergent land to the southeast and southwest (Eardley 1962; King 1959). The first part of the later clastic deposits forms the Middle and Upper Ordovician Normanskill and Martinsburg Formations of New York and Pennsylvania, considered to be flysch deposits (King 1977). Evidence exists for a major deformation in Late Ordovician time, mostly from the northeastern part of the basin. The Taconic orogeny left its imprint in central and eastern Pennsylvania as a distinct angular unconformity between highly deformed Upper Ordovician rocks, only slightly deformed Lower Silurian rocks.

A thick wedge of elastic sediments, centered in east-central Pennsylvania, began to accumulate in Late Ordovician time, and continued through the Silurian and Devonian, with the greatest development during the Silurian and Devonian. The source of these sediments is believed to have been an upland to the east which was developing as a result of continental plate convergence (King 1977).

Early Silurian clastics were followed by a thick carbonate and shale sequence during the Middle Silurian. Overlying these are the evaporites of the Salina Group and the Bass Islands carbonates. The top of the Bass Islands is a widespread Early Devonian unconformity, while the top of the overlying Helderberg Formation is a widespread regional unconformity. This unconformity was overlain by the transgressive sequence of the Oriskany and Bois Blanc Formations and was followed by carbonate deposition (Onondaga). This was followed by a thin sequence of clastics with intermittent carbonates up to the end of the Devonian, known as the Catskill Delta. Deposition of the Pocono Sandstone and Mauch Chunk Shale followed conformably on top of the marine Catskill deposits in some areas, but unconformably in most of the basin during the Early Mississippian. They indicate thickening toward the eastern geosynclinal trough which coincided with the Valley and Ridge province.

Another gentle uplift occurred in Late Mississippian or Early Pemsylvanian time in the northwest part of the basin and resulted in an erosional disconformity between the Mississippian and Pennsylvanian (Colton 1970). The Pennsylvanian strata are distinctly clastic, and include the great coal-bearing formations of the Appalachian Plateau and Valley and Ridge provinces, deposited in a restricted basin. The Pottsville, Allegheny, Conemaugh, and Monongahela Formations in the site vicinity were deposited at this time.

Conformably overlying the Monongahela in an oval area of southwest Pennsylvania, eastern Ohio, and West Virginia, is the Dunkard Group of Early Permian age. It is composed of shale, sandstone, and a few thin coal beds.

The age of deformation of this area is not clearly defined, but, presumably, it was later than the youngest rocks present, and before deposition of Late Triassic sediments in the Newark-Gettysburg basin, 165 miles east of the site. The Allegheny orogeny completely changed the character of the Appalachian basin from a predominantly depositional environment into an emergent mountain range and plateau.

The basin can be separated into two structural provinces, the Appalachian foldbelt on the east, and the Appalachian Plateau on the west. The boundary between the two closely coincides with the Allegheny Front. The foldbelt was subjected to intense deformation during the Allegheny orogeny which resulted in folding and faulting and generation of the Valley and Ridge mountains in central Pennsylvania and Virginia. Intensity of deformation decreases rapidly west of the Allegheny Front.

The Appalachian Plateau was also subject to the lateral compressive forces of this orogenic episode, and shows mild deformation within the higher stratigraphic units. The presence of Salina salt beds underlying a large portion of the area apparently had a major effect on controlling the deformation in this area. The salt beds greatly reduced the resistance to the lateral compressive stresses, and facilitated thin-skinned tectonic movements over a large area (Gwinn

1964; Rodgers 1963). In some parts of the Plateau, it can be shown that other weak sedimentary units may have acted in a similar manner (Rodgers 1970). These deposits were the major influence for lateral, northwestern thrusting of the orogenically-disturbed sequences, folding, and faulting of strata above the weak zones, and plastic flow and decollement deformations within the zones. Most of the folds are asymmetrical and steepest on the northwest flank. Thrust faults are the dominant structure in the southern Appalachians, but die out in southern Pennsylvania in a belt of anticlines and synclines.

The tectonic forces which resulted in the Allegheny orogeny are believed by many to be a continuation of earlier Paleozoic continental collision. The forces have been extinct since Late Paleozoic-Early Mesozoic time when, it is believed, the continental plates were rifted apart and generated the present Atlantic Ocean basin. Since that time, the Appalachian basin area has been subjected to moderate epeirogenic movements, which have provided the relief necessary to produce the geomorphologic dissection present today.

Outside the Appalachian basin, but within the site region in eastern Pennsylvania, is an area of Mesozoic deformation and sedimentation. The Newark-Gettysburg-Culpepper basin is a series of long, narrow, fault-bound basins of Late Triassic and Early Jurassic deposits, which developed as a result of continental rifting. The deposits are chiefly clastic, and predominantly red in color, being fanglomerates, conglomerates, sandstones, arkoses, and mudstones. Basalt flows, and diabase dikes and sills are voluminous within the deposits. The total thickness of the deposits is about 20,000 feet, believed to be derived from granitic and gneissic terrain to the southeast (Eardley 1962). The faulting that marked the beginning of the basin deposition indicates the beginning of the Palisades orogeny. It started in late Triassic time, and probably ended before the Early Jurassic (Rodgers 1970).

The final phase in the geologic history of the site region was that of the Pleistocene glaciations, which covered the entire northern half of the region. The tectonic results of the glaciations were down-warping of the area overlain by and adjacent to ice, followed by rebound after removal of the ice load. The low-level seismic activity that still occurs in the northeastern United States and eastern Canada is traditionally attributed to this rebound. Periglacial events, associated with the development of outwash terraces along the Ohio River, are as yet incompletely understood.

2.5.1.2 Site Geology

2.5.1.2.1 Site Physiography

The site is located on the south bank of the Ohio River in the town of Shippingport, 0.5 mile southeast of the town of Midland, Pennsylvania, and adjacent to Beaver Valley Power Station - Unit 1 (BVPS-1). It is situated near the center of the Appalachian Plateau

physiographic province as outlined by Fenneman (1938). As previously described in Section 2.5.1.1.1, this province is characterized as an extensively dissected peneplain underlain by nearly flat-lying, undeformed Paleozoic sediments. The dissected topography has been somewhat subdued beneath several glacial drifts beginning about 20 miles north of the site and extending northward.

The site is situated on the uppermost Pleistocene outwash terrace of the Ohio River, which has an average elevation of approximately 735 feet in the main plant area (Figure 2.5.4-1). A younger terrace exists between the upper terrace and the present flood plain of the Ohio at an elevation of approximately 688 feet. The mean pool elevation of the river at the site is approximately 664 feet 6 inches. The upper terrace rises gently southward for a distance of approximately 1,500 feet before ending abruptly against a series of steep-sided, flat-topped hills with a top elevation of approximately 1,200 feet. The Ohio River is between 1,000 feet to 1,400 feet wide near the site, including the present flood plain.

Figure 2.5.4-50 is a top of rock contour map. As indicated on Figure 2.5.1-2, flat-lying sedimentary rocks of the Allegheny Group of Pennsylvanian age immediately underlie the 100-foot thick terrace. The Allegheny Group consists of a sequence of interbedded shales, sandstones, coal seams, underclays, and a limestone bed. It is estimated to be 350 feet thick in the site area, and contains one minable coal bed, the Upper Freeport coal, which outcrops above plant grade at approximately el 900 feet. No coal seam has been mined in the plant area at elevations below that of the plant, and no seam is considered to have commercial potential beneath the plant (Patterson 1963). The site is drained by a small northwesterly flowing stream, Peggs Run, which enters the Ohio River near the east end of the site. The stream was diverted in conjunction with construction of BVPS-1, and is now culverted or lined for its entire run through the site.

In the immediate area, there are no surface features indicative of actual or potential landsliding, or surface or subsurface subsidence, due to mining or cavernous conditions.

2.5.1.2.2 Site Stratigraphy

The area within 5 miles of the site is underlain by predominantly flat-lying, or gently-dipping sedimentary rocks, varying in age from the Middle Cambrian to the Late Pennsylvanian. Formation descriptions are from Gray (et al 1960), Wagner (et al 1975), and Fettke (1950).

2.5.1.2.2.1 Precambrian

Crystalline Precambrian rock is believed to unconformably lie beneath the thick Paleozoic sequence. Little is known about the rocks which comprise the basement complex as none are exposed within the area, nor have they been encountered in drill holes. From other areas, they have been found to be composed of various metamorphosed sedimentary and igneous materials, which have been intruded by

various other igneous bodies. Beck and Mattick (1964) indicate that the basement may be between 10,000 and 11,000 feet deep in the site area, based on an aeromagnetic survey. The eroded basement surface is believed to dip southeasterly, averaging 85 ft/mile.

2.5.1.2.2.2 Cambrian

Early and Middle Cambrian stratigraphy in the site area is incompletely known from a few deep wells located in adjacent states. Stratigraphic relations indicate a sea transgressing from the southeast during this time which deposited a thick clastic wedge on the Precambrian surface. The westward extent of this wedge is not fully known, and it is somewhat speculative whether Lower and early Middle Cambrian rocks are represented beneath the site. Deposition may have begun in late Middle Cambrian with the Pleasant Hill and Warrior Formations, or even the Potsdam sandstone, but is definitely known to have occurred by the Late Cambrian with the Gatesburg Formation. The Gatesburg is known from a deep well in Butler County, Pennsylvania, to be a fine-grained, crystalline, light brownish gray dolomite, sandy dolomite, or dolomitic sandstone in excess of 350 feet thick (Fettke 1950).

2.5.1.2.2.3 Ordovician

Carbonate sedimentation continued in the Early and Middle Ordovician with deposition of Beekmantown Group rocks, composed of fine- to medium-grained, crystalline, light gray dolomite. The thickness of the Beekmantown varies in western Pennsylvania from 0 to 200 feet. A major unconformity occurs at the base of the Middle Ordovician section and is nearly basinwide in extent with the magnitude increasing to the northwest (Colton 1970). Approximately 4,500 feet of Lower Ordovician strata, present in central Pennsylvania, are missing in western Pennsylvania. It is not known to what extent rocks beneath the site were affected.

A sequence of predominantly noncalcareous clastic sedimentation began in the Middle Ordovician and continued into the Early Silurian. The Utica Formation, Reedsville Shale, Oswego Sandstone, and Queenston Shale are believed to exist beneath the site. The Utica is a black shale 100 to 300 feet thick while the Reedsville is a gray shale between 700 and 800 feet thick in western Pennsylvania. The Oswego Sandstone is a very-fine-grained, gray sandstone 0 to 60 feet thick, and the Queenston is a red shale, in part silty and sandy, and may be between 850 and 1,200 feet thick.

2.5.1.2.2.4 Silurian

Clastic deposition continued through the Early and Middle Silurian with deposition of the Tuscarora and Rose Hill Formations, the Keefer Sandstone, the Rochester Shale and the McKenzie Formation. The Tuscarora is a white-to-gray, fine-grained sandstone, conglomeratic in part, and may be 500 to 700 feet thick. The Rose Hill Formation is a reddish purple-to-greenish gray, fossiliferous shale with some hematitic sandstone lenses, and may be up to 875 feet thick. The

overlying Rochester Shale is dark gray and calcareous and may be from 0 to 60 feet thick. Moderate gas and minor oil production has been realized from the Tuscarora Formation in northwestern Pennsylvania, Ohio, and West Virginia. The McKenzie Formation is a greenish gray shale interbedded with gray, fossiliferous limestone, and may be up to 330 feet thick.

Upper Silurian rocks were also predominantly clastic comprising the Bloomsburg, Wills Creek, and Tonoloway Formations. The Bloomsburg is a red interbedded shale and siltstone with lenses of sandstone and limestone. The unit varies in thickness from a few hundred to over 1,500 feet thick. The Wills Creek Formation is typically a greenish gray, fissile shale with local limestone and sandstone lenses. It may be up to 475 feet thick. The Tonoloway Formation is a gray, laminated, argillaceous limestone up to 575 feet thick. Deposition of the Keyser Formation marked the completion of the shift to carbonate sedimentation. The Keyser is a dark gray, fossiliferous, crystalline to nodular limestone and may be up to 300 feet thick.

2.5.1.2.2.5 Devonian

Carbonate deposition continued into Early Devonian time beginning with the Coeymanns Limestone, New Scotland Formation, and the Mandata Shale. The Coeymanns Limestone is a dark gray, crystalline limestone which may be sandy and shaly in places with some chert nodules. The thickness varies from 0 to 75 feet. The New Scotland Formation is a dark gray, cherty, fossiliferous limestone with some sandstone lenses and may be between 25 and 80 feet thick. The Mandata is a dark gray, calcareous shale between 20 and 150 feet thick. Overlying these are the Shriver Chert and the Ridgeley Sandstone. The Shriver is a dark gray, cherty limestone with some interbeds of shale and sandstone and may be up to 165 feet thick. The Ridgeley Sandstone (Oriskany) is a white to brown, partly calcareous, fossiliferous sandstone from 0 to 110 feet thick. There has been some production of gas in Beaver County from the Ridgeley Sandstone.

Middle Devonian rocks are predominantly clastic, and include the Needmore Shale, Selinsgrove Limestone, Marcellus Formation, and Mahantango Formation. The Needmore Shale is a greenish blue, thin bedded shale, and the Selinsgrove is a blue to black, medium bedded limestone. The Marcellus Formation is a black, carbonaceous shale, while the Mahantango is a brown to olive shale with interbedded sandstones and may be highly fossiliferous. The four units comprise the Hamilton Group, which varies from 140 to 2,000 feet thick in western Pennsylvania.

Late Middle and Upper Devonian rocks are represented by the Tully Limestone, Harrell Shale, Brallier, Chemung, Canadaway, Conneaut, Cattaraugus, and Oswayo Formations. The Tully is an argillaceous limestone 0 to 150 feet thick. The Harrell is a dark gray to black shale, while the Brallier Formation consists of interbeds of gray shale, siltstone, and sandstone. The Chemung is an irregularly-bedded gray siltstone, sandstone, and shale, displaying abundant primary sedimentary features. The Canadaway consists of alternating

gray shales and brown sandstones, and the Conneaut consists of alternating gray, brown, greenish, and purplish shales and siltstones. Red, gray, and brown shales and sandstones make up the Cattaraugus Formation, while the uppermost Devonian Oswayo Formation consists of greenish gray to gray shales, siltstones, and sandstones. The thickness of the Upper Devonian section, from the Harrell Shale through the Oswayo Formation, is between 3,000 and 6,000 feet from northwest to southeast Pennsylvania.

2.5.1.2.2.6 Mississippian

Pocono Group rocks of Early Mississippian age are predominantly gray, massive, cross-bedded sandstones and conglomerates with minor amounts of shale. They are between 570 and 900 feet thick in western Pennsylvania, and are important oil and gas reservoirs. The overlying sandy Loyalhanna Limestone is between 0 and 80 feet thick. The Upper Mississippian Mauch Chunk Formation consists of red shales with brown-to-greenish gray, flaggy sandstones and is 0 to 100 feet thick.

2.5.1.2.2.7 Pennsylvanian

An erosional unconformity separates the Upper Mississippian and Lower Pennsylvanian systems in western Pennsylvania. The Pottsville Group probably rests on the Mauch Chunk in the site area. The Pottsville is typically a light gray-to-white, coarse-grained sandstone and conglomerate with minor shale beds. It is between 120 and 230 feet thick in the site area and contains some minable coal beds. The Middle Pennsylvanian, Allegheny Group, overlies the Pottsville, and is the subsurface bedrock at the site. It is also the dominant rock unit exposed in the site area. The Allegheny consists of cyclic sequences of sandstone, shale, limestone, and coal.

Differentiating the several coal beds has been accomplished by utilizing the distinctive Vanport Limestone. The type locality is approximately 6 miles northeast of the site, in the town of Vanport.

This limestone has been described as having abundant fossils, being very brittle, and breaking into irregular fractures. It is gray to blue in color, and interbedded with calcareous shale. Its total maximum thickness is 19 feet (Woolsey 1905). Above the Vanport Limestone is an interval which includes several coal beds, beginning with the Lower, Middle, and Upper Kittanning. Their respective thicknesses have been reported as 0 to 36 inches, 14 to 24 inches, and generally less then 6 inches (Patterson 1963).

The Lower and Upper Freeport Coal occur above the Upper Kittanning Coal, and have been or are currently mined within the site area. The thickness of the lower Freeport coal seam is 14 to 48 inches, while the upper seam thickness averages 36 inches. They are separated by approximately 45 feet of sandstone and shale.

The Lower Freeport coal is presently being open cut, auger mined, at Kelly Mine No. 1 in a 41-inch bed along Wolf Run in Industry. The

Upper Freeport has been both strip mined and underground mined along Peggs Run in a 48-inch average thickness bed. This coal seam also serves as the boundary between the Allegheny and Conemaugh Groups.

The Upper Pennsylvanian Conemaugh Group outcrops in the site area and continues the cyclic sedimentation sequence begun in the Allegheny. The Conemaugh Group has been divided into two mappable formations in the site area, the Glenshaw and the Casselman Formations (Wagner et al 1975). The Glenshaw contains cyclic sequences of red shales, sandstones, thin coal beds, and several thin marine limestones. The Ames Limestone, which forms the boundary between the two formations, is the most distinctive marker horizon within the Conemaugh Group. The weathered surface, where exposed, is covered with numerous projections of crinoid stems. It is a very persistent bed with an average thickness of 3 feet (Woolsey 1905). Where exposed, it is light brownish gray, being dark bluish gray on a fresh surface.

Between the Ames Limestone and the Morgantown Sandstone (the probable upper limit of rock types found in the site area) are approximately 40 feet of variegated shale or shaly limestone, and a thin coal seam (Woolsey 1905). The Casselman also contains cyclic sequences of red sandstones and shales with thin limestones and coal beds. The Glenshaw is 300 to 350 feet thick in the site vicinity, while the Casselman varies between 200 and 400 feet thick. Rocks younger than the Conemaugh do not outcrop within the site area, but are found 10 miles south of the site. They belong to the Upper Pennsylvanian Monongahela Group and continue the cyclic sedimentation sequences.

2.5.1.2.2.8 Pleistocene

Pleistocene deposits in the site area exist as terraces above the larger streams, and consist of unconsolidated sand and gravel deposits with varying amounts of clay and silt. Thicknesses of greater than 150 feet are known. The terrace on which the plant is situated averages 100 feet in thickness. It resulted from the ancestral Ohio River depositing enormous volumes of glacial outwash which was being carried away from the ice margins during the Late Pleistocene. The terrace at the site has not been correlated with any one of the seven known ice advances into Pennsylvania, but is probably the product of several of them.

Recent alluvial materials exist in the site area as floodplain deposits, primarily adjacent to the present Ohio River, but also mantling the intermediate terrace. The intermediate terrace is the result of flood control projects which lowered the river level during the 1930s.

2.5.1.2.3 Site Structure

The site area geologic investigation consisted of field-checking the existing published geologic literature within approximately 7 miles of the site. The original work, upon which all later information is based, was performed by L. H. Woolsey between 1902 and 1905, and was

published as the Beaver Folio. Coal, oil, and gas explorations since 1905 have only slightly modified Woolsey's original interpretations.

The field verification took place over a 2-week period in the fall of 1978 and relied primarily on recent road cuts, coal mining activities, and cliff exposures. The results of our investigation are presented subsequently, and are in complete agreement with the efforts of Woolsey (1905) and of Wagner (et al 1975) which indicate that the bedrock in the area is relatively flat-lying and undeformed. No offsets of stratigraphic marker beds were detected, based on exposures several miles apart, and no bedrock faults were identified within 5 miles of the site.

2.5.1.2.3.1 Structure as Determined from Coal Mining

The Peggs Run Coal Company Mine No. 2 is located approximately 8,500 feet south of the BVPS-2 site. The mine was operated in the Upper Freeport Coal seam, with an average thickness of 48 inches and ranged in elevation between 939 and 906 feet. The dip of the seam has been calculated from mine elevations to be less than 1 degree (33 /4,000 feet) to the northeast in one area, to less than 0.25 degree (13 /3,000 feet) to the southwest in another area. A strip mine operated by Peggs Run Coal Company, and located 2,600 feet southeast of the site, removed Upper Freeport Coal at an average elevation of 920 feet.

A similar example of the local structural dip variation (deviation from the regional southwest dip) has been extracted from Woolsey (1905). He had reported a 30-foot decrease in elevation of the Upper Freeport between the two adjacent towns of Vanport (el 938 feet) and Beaver (el 908 feet) located at least 10 miles to the northeast of the Peggs Run mine referenced previously. Based on both the absolute value and range of elevations at the two locations, the regional dip is found to be imperceptible over a 10-mile distance.

The Lower Kittanning Coal seam was also observed to maintain a nearly imperceptible dip from one side of the Ohio River to the other at Midland.

2.5.1.2.3.2 Structure as Determined from Limestone Horizons

The Vanport Limestone was verified at Merrill along Fourmile Run at el 720 feet, as reported by Woolsey (1905).

In addition, the Ames Limestone was found both north of the site in Midland, and south of the site near Hookstown. The two exposures of the Ames in Midland were noted as loose, detached blocks, at approximately el 1,200 feet, as indicated by Woolsey's Areal Geology map (1905).

Along U.S. Route 30, 1.4 miles west of the State Route 151 junction, the Ames Limestone outcrops at approximately el 1,200 feet, once again consistent in elevation and location, as reported by Woolsey.

These two limestone marker beds nearly bound the exposure of the Allegheny and Conemaugh Groups in the site area.

2.5.1.2.3.3 Jointing and Bedding

Four joint sets were identified from outcrops within the 5-mile radius of the site; two sets strike roughly northeast and two strike northwest; all are near vertical. This is in fair agreement with the results of Bench (et al 1977) in this area, which indicated the joints are the result of tectonic stresses, and subsequent stress adjustments produced during the erosion and unloading that affected the Plateau. The two dominant joint systems, which strike N76W and N57W, are believed to be the bedrock expression of the principal stress trends, and possibly relate to a structural weakness which resulted from the Allegheny folding and thrusting.

2.5.1.2.3.4 Faulting

No bedrock faulting was identified within 5 miles of the BVPS-2 site. A fault was identified, however, about 0.25 mile outside the radius at the Stewart Hill road cut along U.S. Route 30 in West Virginia. The fault strikes N35E and dips 17 degrees northwest and appears to be a gravity fault. The amount of displacement is indeterminable, as an 18-inch marker coal seam (Elk Lick coal) does not outcrop west of the fault, but presumably occurs beneath the ground surface.

The time of last movement has been determined stratigraphically by an overlying, horizontal sandstone bed, which appears to be continuous across the fault plane at the top of the exposure. Slumping of sediments along the fault plane during deposition resulted in upturned beds being overlain by the horizontal sandstone, as seen at the west end of the exposure. A portion of the fault is shown on Figure 2.5.1-8.

A similar example of deformation during sedimentation is cited by Wagner (et al 1970) and occurs in a railroad cut in the Casselman Formation near McKeesport. Here, a faulted sandstone is overlain by a claystone which is not offset.

The shallow dip angle of the fault in West Virginia is indicative of near-surface failure, probably as a submarine slump of semiconsolidated material. The upper surface of the slumped block was then eroded, leveled, and subsequently overlain by the thick sand layer during the Pennsylvanian.

2.5.1.2.4 Site History

The geologic history of the site area is similar to the history of the Appalachian basin discussed in Section 2.5.1.1.4 and is briefly summarized here.

An extended period of erosion on the Precambrian basement complex, which began during the Late Precambrian, ended during the Middle or Late Cambrian when a sea, transgressing from the southeast, deposited

a basal clastic sequence in the site area. This was followed throughout most of the Paleozoic Era by an alternating sequence of carbonate and clastic sedimentation, punctuated by three orogenic events: 1) the Taconic during the Middle Ordovician, 2) the Acadian during the Middle Devonian, and 3) the Alleghenian during the Permian. The latter had the most significant effect in the site area by producing a series of very gentle folds within the Paleozoic strata, and ended the sedimentation cycle. The site lies on the west limb of a troughlike basin, known as the Pittsburgh-Huntington basin. Dips of strata into the basin are gentle, usually less than 3 degrees, and are nearly imperceptible in the site area. Obviously, diastrophic deformation has not played a major role in the history of the site area. Tectonic forces have been inactive in the site area probably since the end of the Allegheny orogeny, 250 million years ago. Periodic epeirogenic uplifts, isostatic adjustments, and erosion since the Paleozoic have produced the well-dissected plateau present in the site area today.

2.5.1.2.5 Plot Plan

Location plans of borings performed at the site are shown on Figures 2.5.4-10, 2.5.4-13 and 2.5.4-15. Plant structures are superimposed upon these figures.

2.5.1.2.6 Geologic Profiles of Plant Foundations

Geologic profiles are presented in Section 2.5.4.

2.5.1.2.7 Extent of Backfill and Excavation

Excavation end backfill at the site are discussed in Section 2.5.4.5.

2.5.1.2.8 Engineering Geology Evaluation

2.5.1.2.8.1 Dynamic Behavior During Prior Earthquakes

Site investigations show no features or conditions indicative of disturbance during prior earthquakes, such as flow structures, fissures, or slumps in the unconsolidated deposits.

2.5.1.2.8.2 Description and Evaluation of Deformational and Weathered Zones

No zones of severe weathering, structural deformation, or lithologic weakness were identified in the site area based on core borings, seismic velocity measurements, and site area geologic reconnaissance. Seismic refraction studies indicate that hard, intact rock with compressional wave velocities of 12,000 feet per second (fps) underlies the site. No low velocity or anomalous zones were indicated.

The underlying rock is slightly weathered for the first few feet, with weathering effects decreasing rapidly with depth. All

structures are founded on select granular fill or natural soil deposits, with bedrock lying at least 55 feet deep.

Pomeroy (1979) mapped recent and older landslides and identified areas most susceptible to sliding within Beaver County, Pennsylvania. It was noted that most landslides that had been observed occurred in colluvial soils and weathered rock derived from mudstone, claystone, shale, and siltstone. It was further noted that most recent landslides had been generated by construction activities. The site topography is shown on Figure 2.5.4-13. While not specifically identified as an area of potential instability, the steep slopes to the south of the BVPS plant site are colluvial in nature. They are, however, sufficiently removed from the main plant area to present no potential safety problem in the event of a landslide. The stability analysis of the colluvial slopes to the south of the emergency outfall structure (EOS), located at the far western end of the site, is described in a summary report submitted separately (SWEC 1983). It was concluded that although there may be a potential for movement of the upper portion of the colluvial slope above el 780 ft, any slope movements would not affect the EOS.

2.5.1.2.8.3 Unrelieved Residual Stresses in Rock

Unrelieved residual stresses in rock were considered to have no influence on the design and operation of the plant due to the thickness of founding overburden.

2.5.1.2.8.4 Evaluation and Description of Natural Soils

The characteristics of the in situ surficial materials are described in Section 2.5.4.2 and the Soil Densification Program Report (DLC 1976).

2.5.1.2.8.5 Description of Man's Activities at the Site

Some oil and natural gas have been recovered within 5 miles of the site, mostly from the Pocono Group of Mississippian age. No wells have been drilled within the site boundary, nor are any anticipated. Extraction of natural gas or oil is not likely to produce consolidation and subsequent surface subsidence of the well lithified rocks beneath the site. The rocks in the site area are Permian or older and have not been susceptible to consolidation upon withdrawal of fluids from them.

Coal has been recovered at several locations within 5 miles of the site by underground and surface mining methods, mostly from the Upper Freeport coal seam.

No coal mining has taken place beneath the site nor is any anticipated. The limited quantity, low quality, and depth below the surface of the underlying coal seams precludes development during the expected lifetime of the plant. Maps indicating the areas underlain by coal deposits, and oil and gas, are presented on Figures 2.5.1-9 and 2.5.1-10, respectively.

Withdrawal of groundwater in the site area is discussed in Section 2.4.13.

2.5.1.2.9 Site Ground-water Conditions

The ground-water conditions in the site area are discussed in detail in Sections 2.4.13 and 2.5.4.6.

2.5.1.3 References for Section 2.5.1

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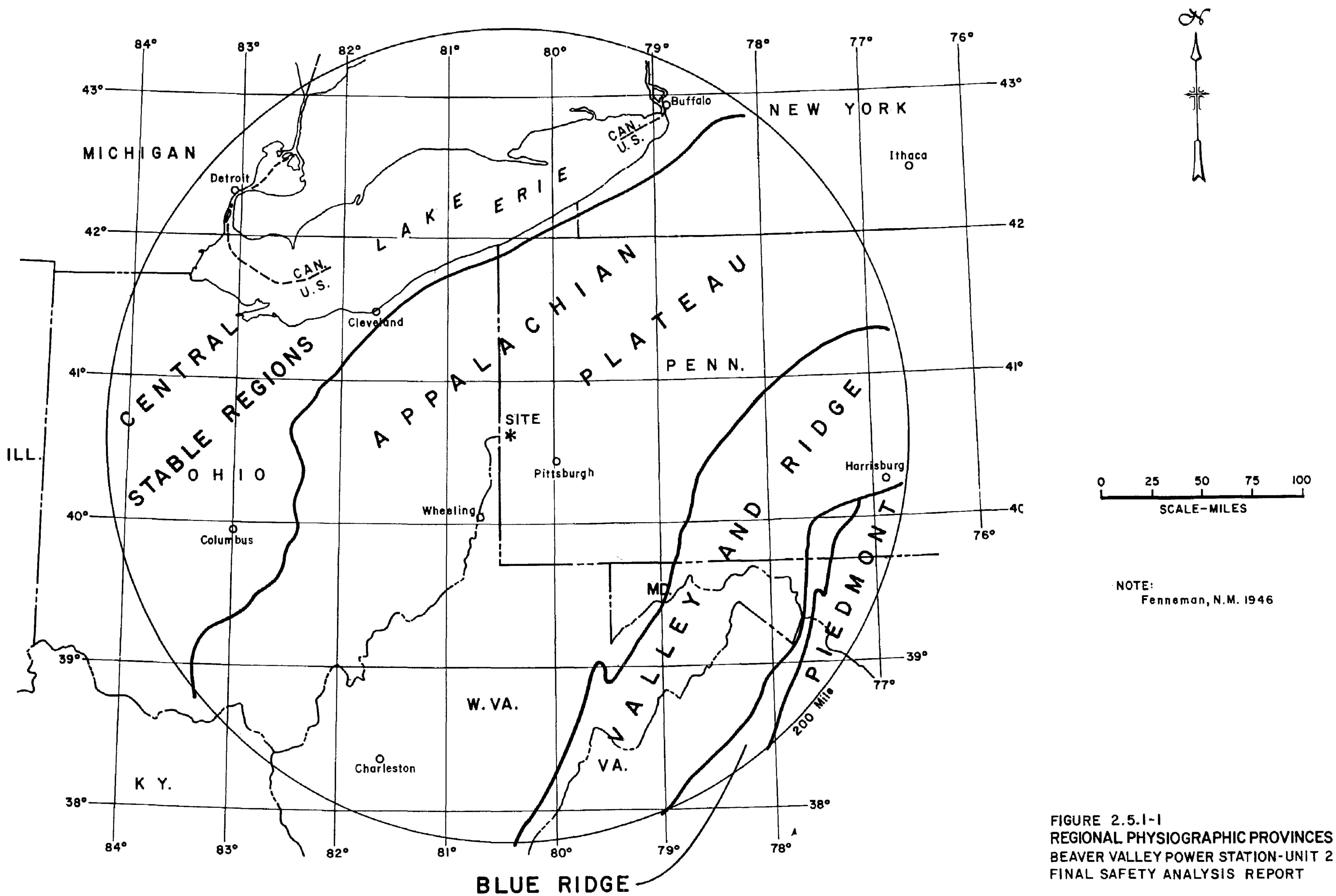
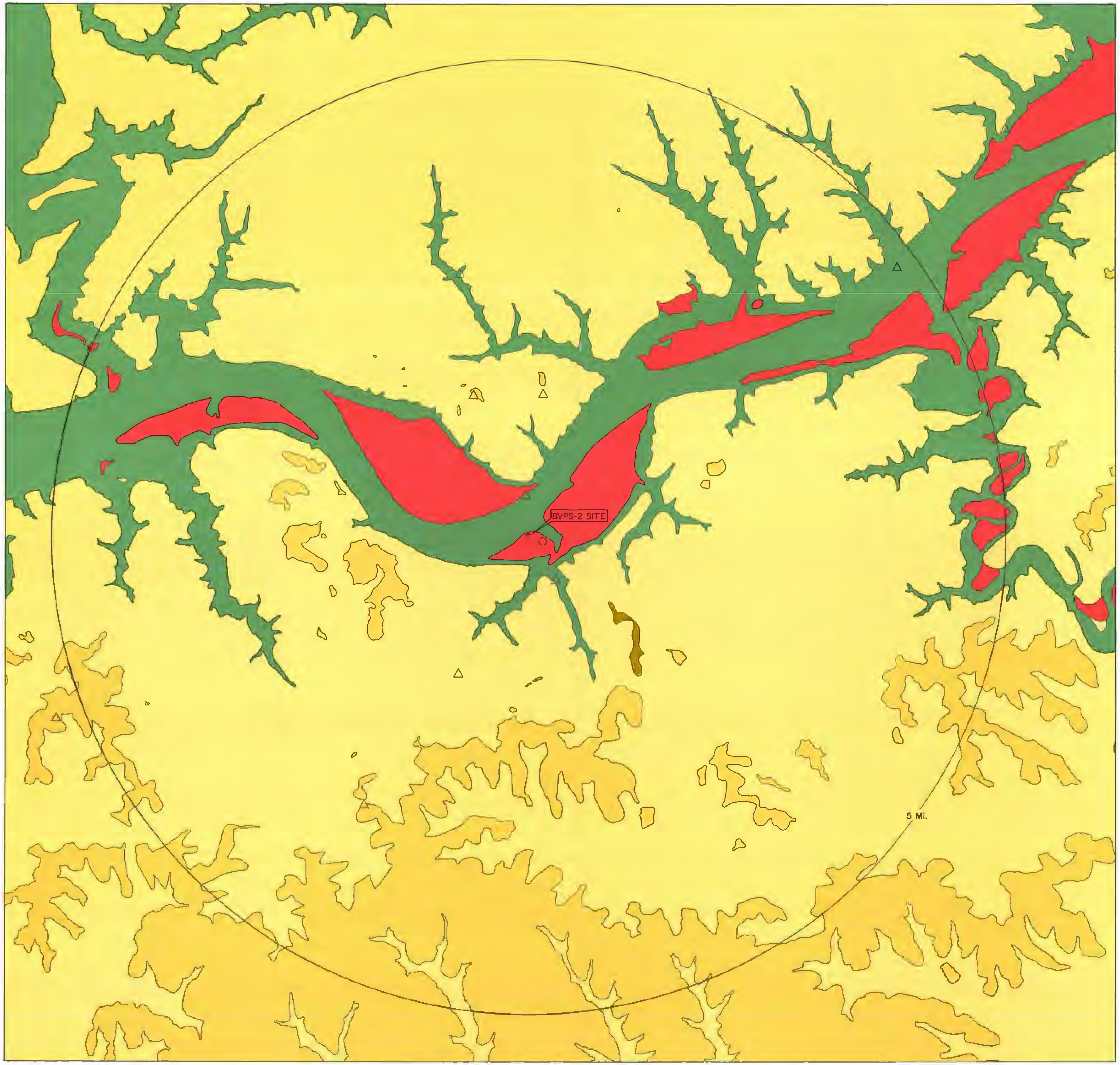


FIGURE 2.5.1-1
REGIONAL PHYSIOGRAPHIC PROVINCES
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



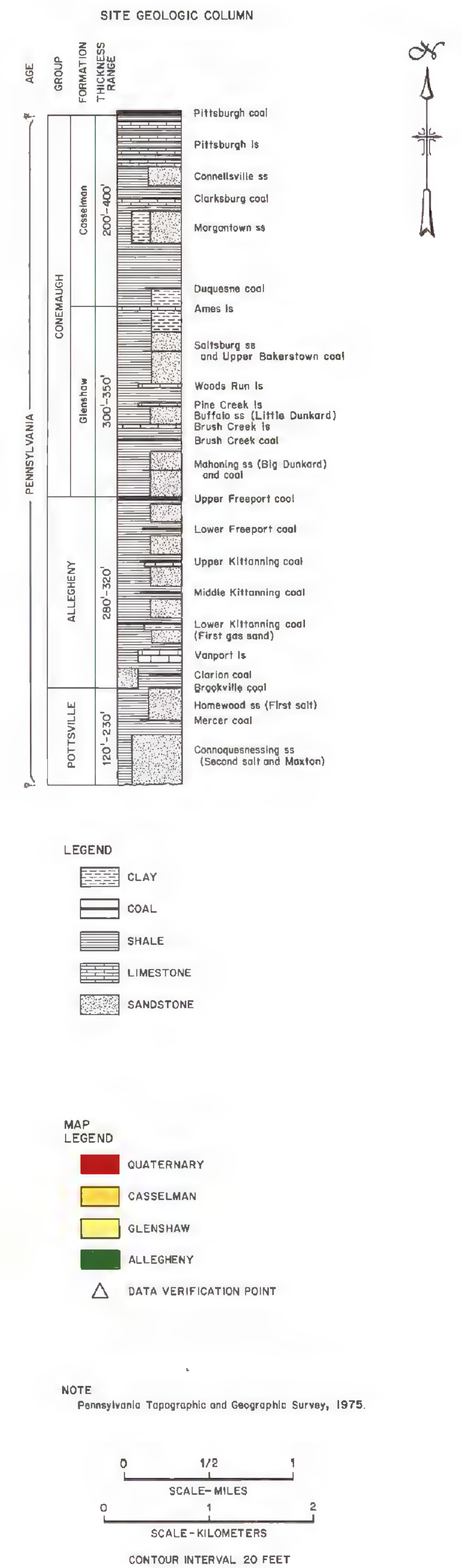


FIGURE 2.5.1-2
SITE AREA GEOLOGIC MAP
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

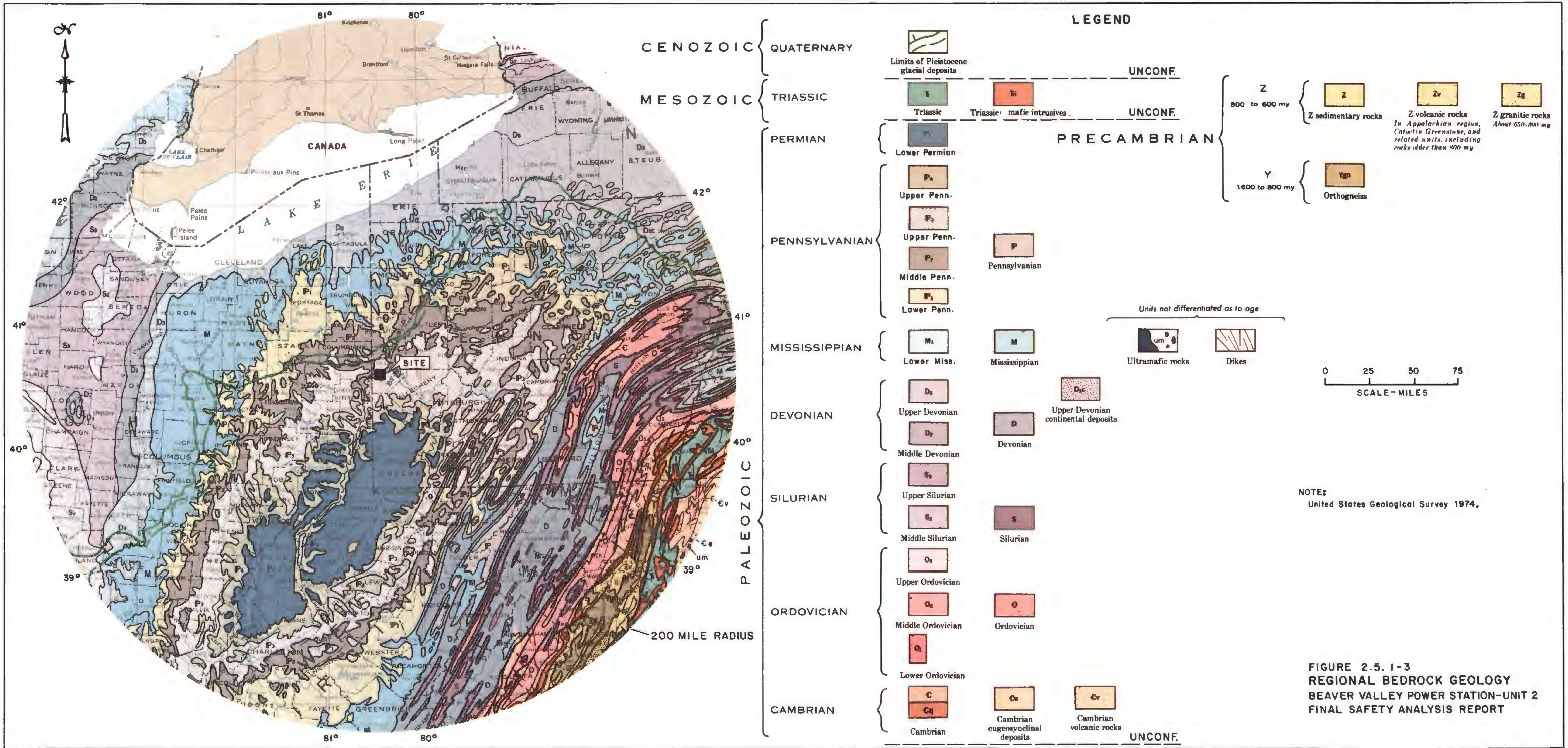
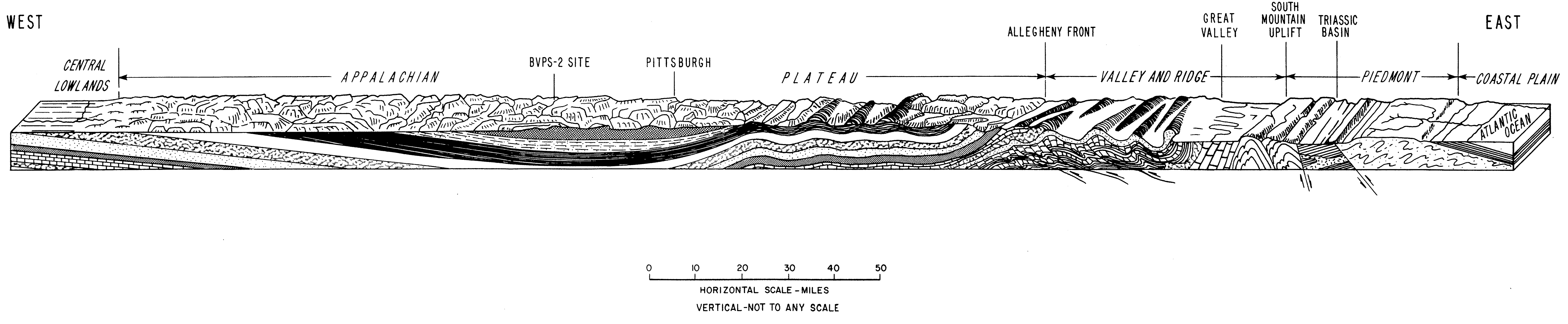


FIGURE 2.5.1-3
REGIONAL BEDROCK GEOLOGY
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTE:
Modified from: Johnson D., 1931.

FIGURE 2.5.1-4
GENERALIZED GEOLOGIC CROSS-SECTION ACROSS PENNSYLVANIA AND EASTERN OHIO
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

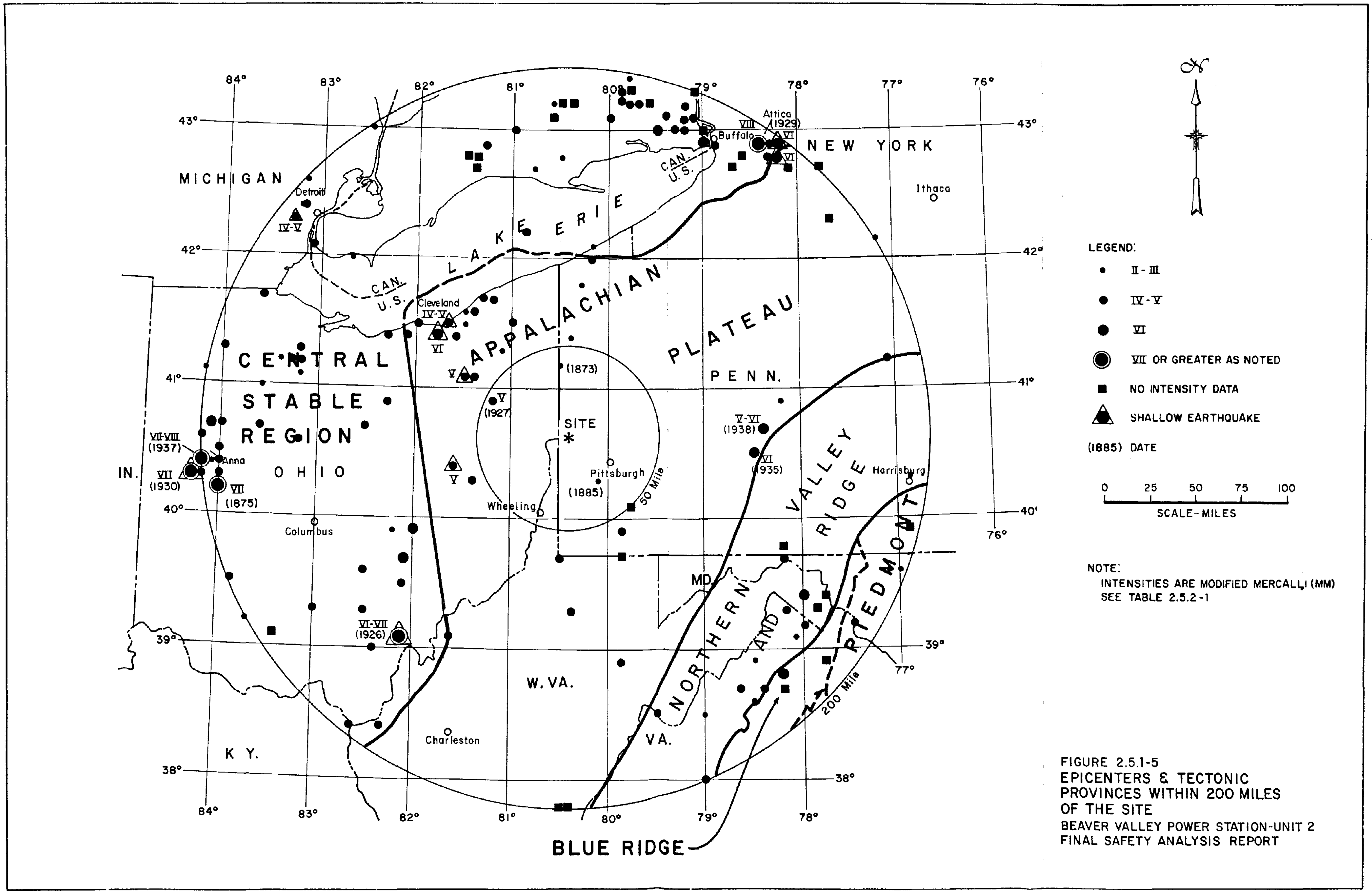
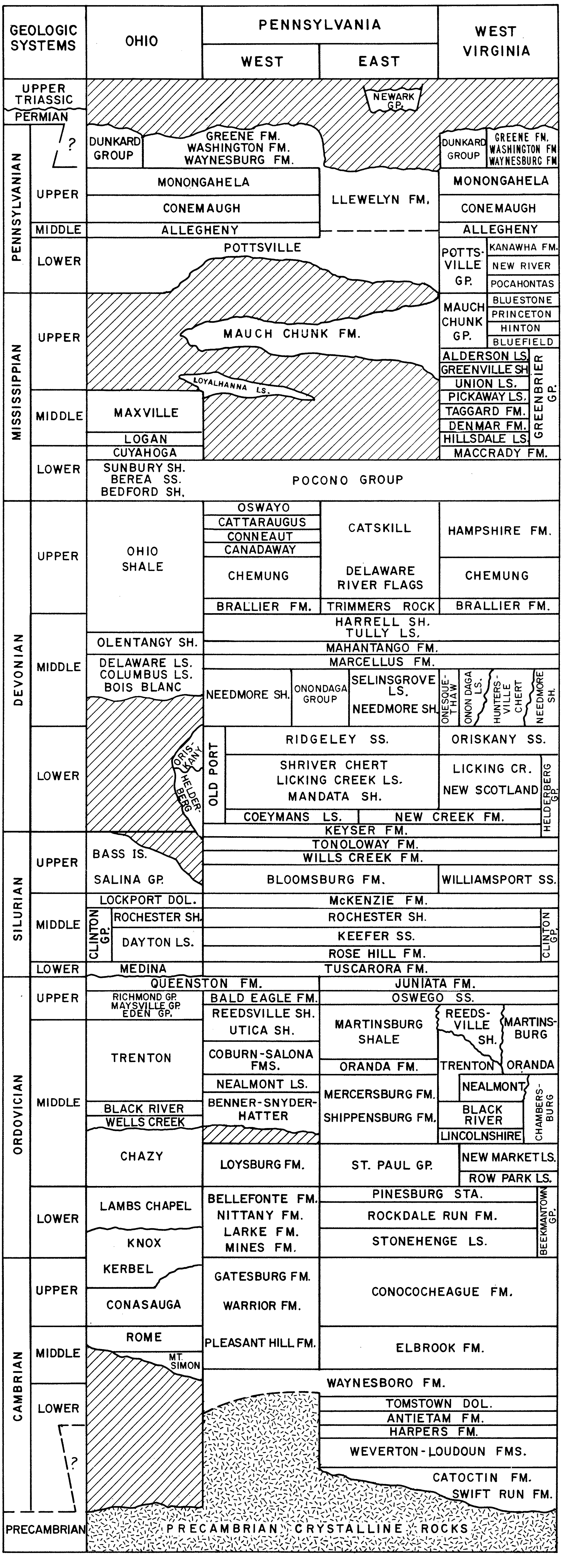


FIGURE 2.5.1-5
EPICENTERS & TECTONIC PROVINCES WITHIN 200 MILES OF THE SITE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES:
1. Cardwell et al 1968
2. Fettke 1950
3. Gray et al 1960

FIGURE 2.5.1-6
REGIONAL STRATIGRAPHIC CORRELATION CHART
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

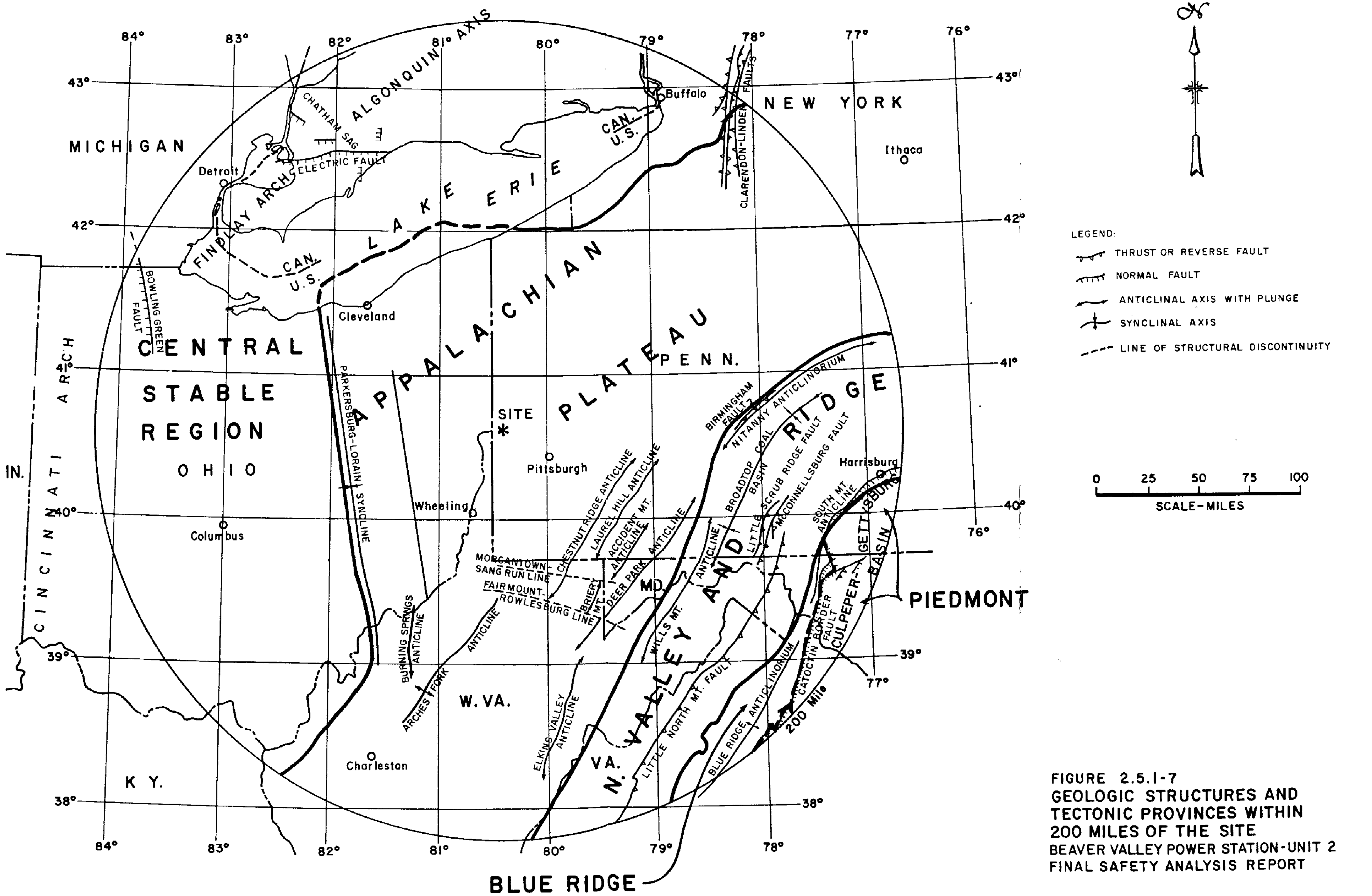
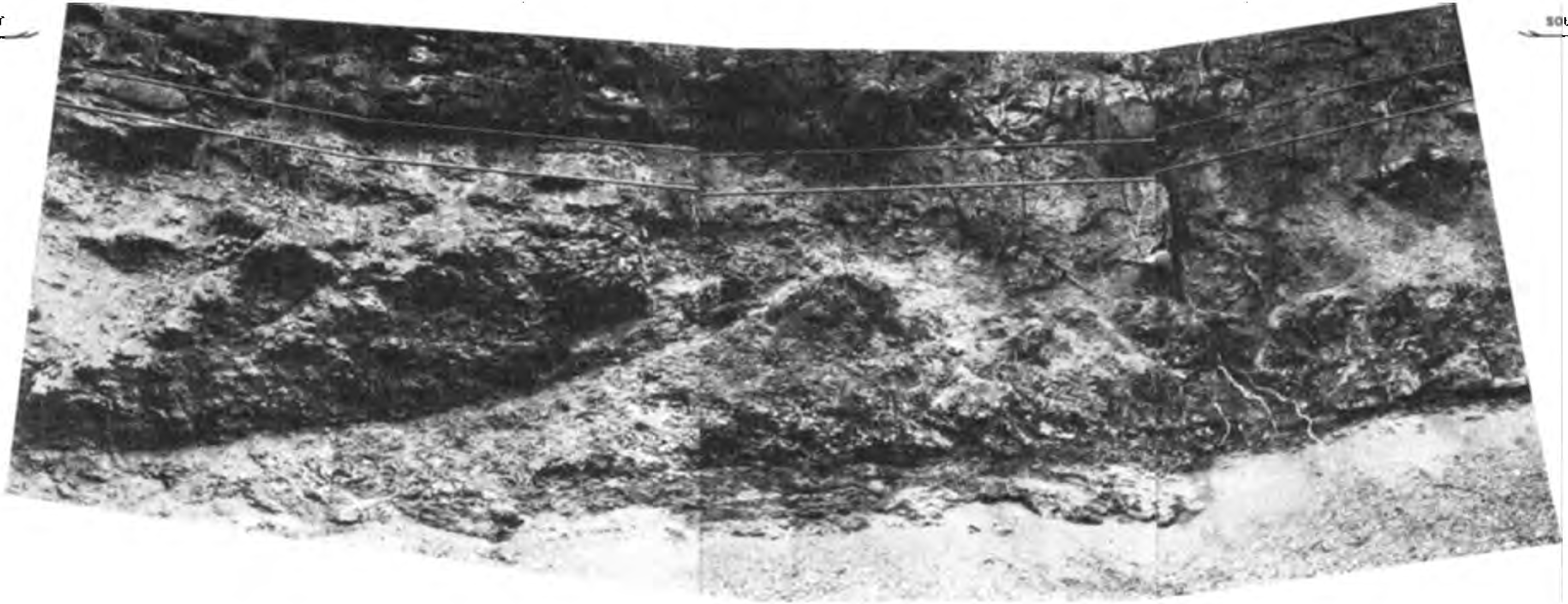


FIGURE 2.5.1-7
GEOLOGIC STRUCTURES AND TECTONIC PROVINCES WITHIN 200 MILES OF THE SITE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

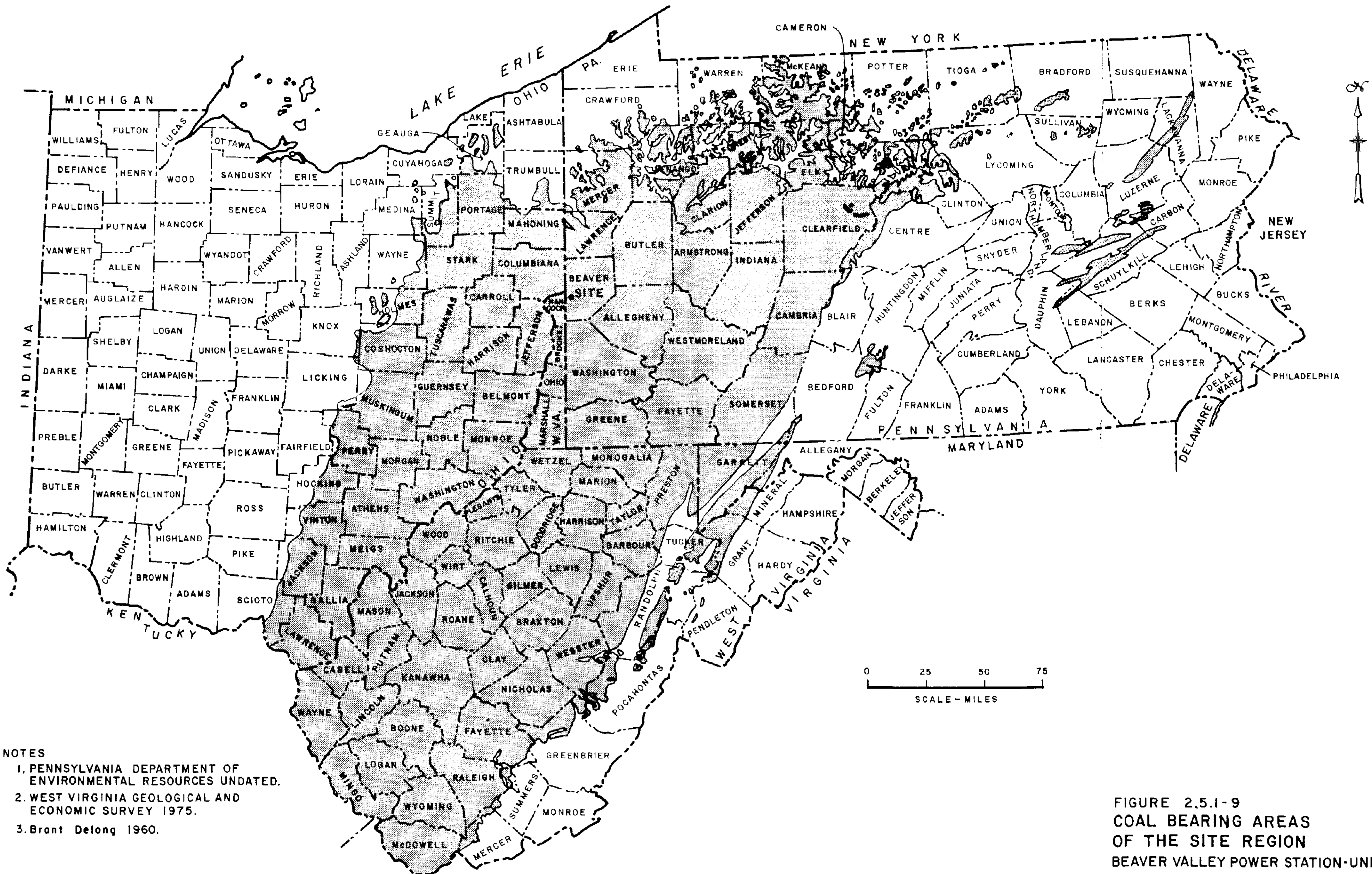
NORTHWEST

SOUTHEAST



NOTE
FAULT IS DISCUSSED IN SECTION 2.5.1.2.3.4

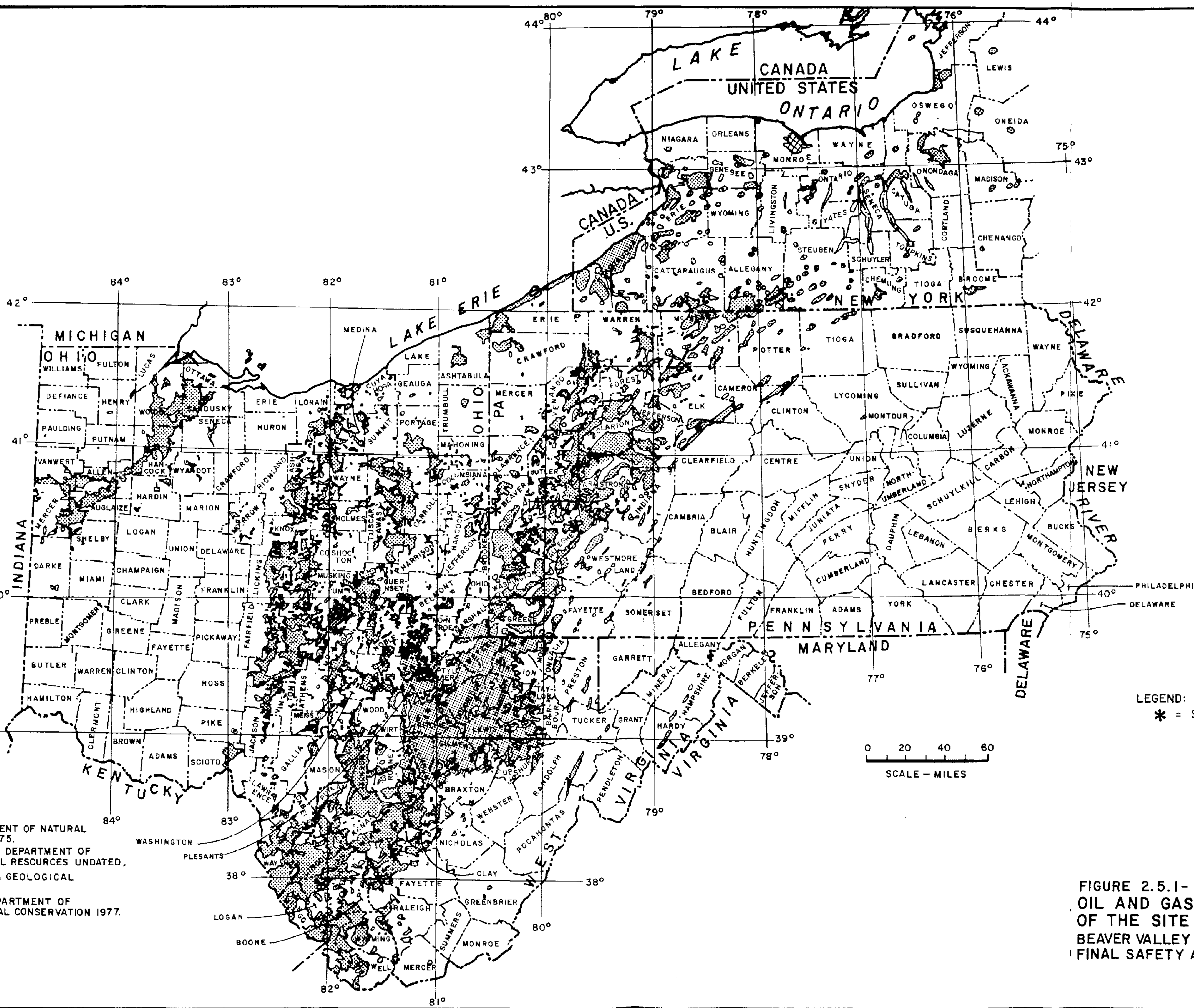
FIGURE 2.5.1-8
STEWART HILL FAULT
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES

1. PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES UNDATED.
2. WEST VIRGINIA GEOLOGICAL AND ECONOMIC SURVEY 1975.
3. Brant Delong 1960.

FIGURE 2.5.1-9
COAL BEARING AREAS
OF THE SITE REGION
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES:

1. OHIO DEPARTMENT OF NATURAL RESOURCES 1975.
2. PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES UNDATED.
3. WEST VIRGINIA GEOLOGICAL SURVEY 1975.
4. NEW YORK DEPARTMENT OF ENVIRONMENTAL CONSERVATION 1977.

LEGEND:
* = SITE

FIGURE 2.5.1-10
OIL AND GAS FIELDS
OF THE SITE REGION
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

2.5.2 Vibratory Ground Motion

The site region is characterized by a low level of earthquake activity. The Ohio River Valley in which the site is located has been well settled since the early 1800's. During the past 180 years, there have been few earthquakes within 200 miles of the site and only three within 50 miles. There are two centers of activity within 200 miles of the site - one near Attica, New York, and one near Anna, Ohio. Moderate size earthquakes have occurred in these centers of activity. The maximum earthquake potential at the site is an earthquake of Modified Mercalli (MM), Intensity VI, occurring near the site, corresponding to a peak horizontal ground acceleration of 0.07g. The safe shutdown earthquake (SSE) has been specified as 0.125g and the operating basis earthquake (OBE) has been specified as 0.06g.

2.5.2.1 Seismicity

Most of the information concerning earthquake activity in the eastern United States is based on historical reports, old diaries, and newspaper accounts. These earthquakes are classified on the basis of intensity corresponding to the Modified Mercalli (MM) scale. This scale, shown in Table 2.5.2-1, is based on observations of effects of earthquakes and damage to structures. The instrumental monitoring of earthquakes in the eastern United States began in the mid 1920's. Since that time, the number of seismograph stations has greatly increased. Historical reports of earthquakes and information obtained from instrumental coverage in recent years form the basis of the examination of the seismicity of the site region.

2.5.2.1.1 Totality and Reliability of Earthquake Catalog

Even though major historical catalogs carry entries dating back almost to the 1800's, the coverage of this long a period is not homogeneous. The completeness and reliability of the data are related to population distribution and to the seismograph network coverage. Therefore, the accuracy of epicentral coordinates and the assigned maximum intensities have to be evaluated carefully.

For the earlier historical events, epicenters near dense settlements are probably located incorrectly due to the absence of felt reports from the true epicentral area. The intensity of an earthquake at a given location depends not only on accurate and complete human observations but also on foundation conditions, structure, design, type, and quality of construction. Construction practices, particularly of chimneys in the earlier centuries, were certainly not those envisaged in the MM scale. Interpretation of historical damage reports, without consideration of construction practices, may result in overestimated intensities. Furthermore, the tendency of early settlers to build structures near rivers, where soil conditions often amplify the ground motion, resulted in a biased sampling of earthquake damage and overestimated intensities.

Seismological information for the instrumental period (post-1900) must also be evaluated carefully. Seismic instrumentation began in the early 1900's in the United States and Canada and progressively improved the quality of earthquake data. Epicentral locations based on felt reports were complemented and somewhat controlled by instrumental data. From the 1900's until the 1960's, only a few seismographs operated in the eastern United States. Most of these stations were part of the regional network operated by the Jesuit Seismological Association. In the early decades, numerous factors were potential sources of errors such as the type of instrumental response, lack of accurate time control, awkward configuration, use of graphical methods and limited knowledge of crustal velocities. These produced large uncertainties in the epicentral coordinates which in many cases, amounted to tens of kilometers. Since the 1960’s, increased interest in understanding local seismicity has resulted in the installation of dense seismographic networks.

2.5.2.1.2 Earthquake History

A chronological list of all earthquakes known to have occurred within 200 miles of the site is provided in Table 2.5.2-2. The basic information for this seismic data base was taken largely from the earthquake catalog developed by Barstow et al (1981) which lists 4289 events which have occurred in the eastern and central United States and portions of Canada between 1534 and April 1978. Several additional events not noted in Barstow et al (1981) were taken from the data bases prepared by Weston Geophysical (1972), Pomeroy and Faukundiny (1976), and Stover et al (1981).

To account for any additional events which may have occurred more recently then 1978, a search was made of the Regional Seismic Network Bulletins prepared by St. Louis University between January 1978 and March 1983 and the Northeastern United States Seismic Network Bulletins for January 1978 through September 1981 (Chiburis et al). Use was also made of a computerized earthquake catalog developed by the National Oceanic and Atmospheric Administration (NOAA) which lists worldwide events for the period between 1900 and the end of 1979 (SWEC 1980).

Figure 2.5.2-1 shows the location of the earthquakes listed in Table 2.5.2-2; Figures 2.5.2-2 and 2.5.1-5 show the location of the earthquakes in relation to geologic structures and tectonic boundaries, respectively. These figures show that BVPS-2, situated within the Appalachian Plateau Tectonic Province, is located in an almost aseismic area.

The cumulative historical seismicity data (Figure 2.5.2-1) reveal the presence of two areas of concentrated seismic activity. They are Attica, New York and Anna, Ohio. These will be addressed in this section in terms of their location, areal extent, and level of historical seismicity. The tectonic frame work of these sources as inferred from current research will be discussed in Section 2.5.2.3.

Activity in Attica, New York

The Attica area has been the site of a significant amount of historical seismic activity and includes the August 12, 1929 event discussed in Section 2.5.2.1.3. Recent low level seismic activity has been correlated with high-pressure

fluid injection operations in brine fields which are developed in the area (Fletcher and Sykes 1977).

Activity in Anna, Ohio Area

A localized concentration of seismic activity exists in Shelby County, Ohio near the town of Anna. Several moderately damaging earthquakes have occurred in the area. These include the earthquakes of June 18, 1875, Modified Mercalli Intensity (VII), September 19, 1884 (VI), September 30, 1930 (VII), March 2, 1937 (VII), and March 9, 1937 (VII-VIII) (Bradley and Bennett 1965). Understanding of the seismicity and tectonics of the Anna, Ohio region will be improved by the data being gathered by the microearthquake network recently installed in the area by the University of Michigan.

The cumulative historical seismicity data, carefully interpreted, can yield valuable information on the spatial and temporal distribution of larger and more significant earthquakes and the location of zones of concentrated activity. In the northeastern United States, several years of operation of the seismographic network have produced a complete record of accurately located events of magnitude 1.8 through 2.0 and larger in the region. Sbar and Sykes (1977) have noted that the spatial distribution of instrumental seismicity closely tracks the distribution of less accurately located historical events, thus reinforcing confidence that older events are fairly well located and that areas of seismic activity are stationary. Although the midwestern United States is not as densely monitored as the northeastern region, we can assume that a similar analogy exists. The site region can then be assumed to exhibit in reality very low levels of seismicity except in the Attica, New York and Anna, Ohio areas.

The low level of seismicity in the site region is also evident in several other comprehensive studies of earthquake hazard in the eastern United States. A portion of the seismic frequency map prepared by Hadley and Devine (1974) is shown in Figure 2.5.2-10. The contours were drawn to differentiate the areal distribution of earthquake epicenters for earthquakes having epicentral intensities ≥ II (MM), on the basis of the total number of earthquakes per 10,000 km^2 during the time period between 1800 and 1972. Hadley and Devine (1974) point out that the contours are considerably generalized and are drawn only as a guide for estimating regional seismicity. Figure 2.5.2-10 shows that BVPS-2 is situated in an area that has experienced less than four earthquakes per 10,000 km^2 during the historical period studied.

A study similar to that of Hadley and Devine (1974) was conducted by Barstow et. al. (1981). They developed an earthquake catalogue for the eastern and central United States covering the period between 1800 and 1977. The beginning date, 1800, was chosen since a more uniform demographic coverage of the study area was achieved. An epicenter map was then computer-plotted which showed the location of

all earthquakes with a Modified Mercalli Intensity ≥ III or with a magnitude ≥ 2.0. A uniform, rectilinear coordinate system with grid points 85 km apart was superimposed on the epicenter map and fixed at 96°W longitude and 39°N latitude. A computer program was used to count and plot the number of earthquake epicenters within a radius of 61 km (11,689 km^2) from each grid point. A seismic frequency contour map was then hand drawn, a portion of which is shown on Figure 2.5.2-11. It shows that BVPS-2 is located in an area with an earthquake frequency less than four per 11,689 km^2 during the historic period used for the study.

Although the contours are drawn somewhat differently in Figures 2.5.2-10 and 2.5.2-11, they do illustrate the extremely low level of seismicity in the vicinity of the site and that BVPS-2 is located in one of the least seismic areas in the eastern United States.

2.5.2.1.3 Earthquakes Felt at the Site

In order to determine earthquake hazard to BVPS-2, it is necessary to examine how severely the site has been affected by large earthquakes in the past. This examination is based on available historical records. A discussion of these earthquakes follows:

New Madrid, Missouri Earthquakes, 1811 and 1812

The New Madrid, Missouri earthquakes of December 16, 1811, January 23, 1812, and February 7, 1812 (location - 36.6°N, 89.6°W - Intensity XI-XII), were felt over most of the eastern two-thirds of the United States, an affected area of at least 2,000,000 mi^2. Topographic changes including uplifts, landslides, and fissures took place over an area of 30,000 to 50,000 mi^2, principally along the Mississippi and Ohio Rivers. The Beaver Valley Power Station (BVPS) site is located 408 miles from the presently accepted Northern limit of the New Madrid fault zone at Vincennes, Indiana (USNRC 1982). The nearest report of significant damage from these earthquakes came from the Cincinnati, Ohio area about 330 miles from the epicenter and 250 miles from the site. In the Cincinnati area, the tops of chimneys were thrown down and some walls were cracked, indicating a probable Intensity VI (MM), perhaps low VII (MM), when considering the type and quality of construction and the foundation conditions. Fuller (1912) reports that "the earthquake was severe at Pittsburgh, being greater than any previously experienced. Many persons left their houses." Eppley (1965) reports that the earthquake was "strongly felt in Butler County, Pennsylvania." Butler, in the center of Butler County, is about 35 miles east-northeast of the site. Nuttli (1973) has re-evaluated ground motion at various locations in the eastern United States and published an isoseismal map of this earthquake which is reproduced on Figure 2.5.2-3. Based on the available data and Nuttli's re-evaluation, the intensity at the site is estimated at low to middle V (MM).

Charleston, S.C. Earthquake August 31, 1886

This earthquake (location - 32.9°N, 80.0°W - Intensity IX-X) was felt over a 2,000,000-mi^2 area of the eastern United States. In the epicentral area, located a few miles north and west of Charleston, South Carolina, chimneys and fireplaces collapsed, railroad tracks were bent and laterally displaced, and fissures occurred in the ground with ejection of some water, sand, and mud. The area within 100 miles of the epicenter was strongly affected with damage to plaster and chimneys. C.E. Dutton (1889) conducted a thorough investigation of the effects of this earthquake in the epicentral area and throughout the eastern United States. Dutton prepared an isoseismal map which showed a Rossi-Forel Intensity of V (MM) in the vicinity of the site. Reports from Pittsburgh and other towns in the site area indicated a similar intensity except along and near the rivers where somewhat stronger effects were noted. In towns located along rivers, dishes were thrown from shelves and clocks were stopped, indicating an approximate intensity of low V (MM). Bollinger (1977) has re-evaluated ground motion at various locations in the eastern United States and published an isoseismal map for this earthquake which is reproduced on Figure 2.5.2-4. The site, located adjacent to the Ohio River, may have experienced Intensity IV-V (MM).

St. Lawrence River Earthquake February 28, 1925

The epicenter was located in the St. Lawrence River Valley (47.6°N, 70.1°W - Intensity IX - Magnitude 7.0) northeast of Quebec City, a distance of 700 miles from the site. The earthquake was felt over an area of approximately 2,000,000 mi^2, extending south to Virginia and west to the Mississippi River. Important damage was confined to a narrow belt along the St. Lawrence River Valley. Isoseismals prepared by the Dominion Observatory and the United States Coast and Geodetic Survey (Figure 2.5.2-5) show that the estimated intensity at the site was II (MM).

Other earthquakes of Intensity IX and X (MM) have originated in the St. Lawrence River Valley near the epicenter of the February 28, 1925 earthquake. Nearly all of these earthquakes took place during colonial times when reporting of earthquake effects may be accurate in some cases and inaccurate and exaggerated in others. Based on attenuation data and the effects of the February 28, 1925 earthquake, it is estimated that some of these historical earthquakes may have had an intensity of III (MM) in the site area.

Attica, N.Y. Earthquake, August 12, 1929

This earthquake was centered near Attica, New York, (location - 42.9°N, 78.3°W - Intensity VIII - Magnitude 5.8) about 180 miles northeast of the site. It was originally assigned an Intensity VIII (MM) by Coffman and Von Hake (1973), but a re-evaluation by Fox and Spiker (1977) suggested that the epicentral intensity was about VII (MM). The earthquake was felt over a

100,000-mi^2 area of the northeastern United States and Ontario, Canada, extending from Cleveland, Ohio and Port Huron, Michigan on the west; to Montreal and the Connecticut River Valley on the east. The maximum intensity was confined to the eastern part of the city of Attica and the immediate area to the east, where many chimneys were thrown down and some buildings were structurally damaged. Intensity VI (MM) or greater was noted at Batavia, Dale, East Bethany, Johnsonburg, Warsaw, and Wyoming, New York. All of these localities are within 10 miles of the epicenter.

In the vicinity of the site, intensities ranged from IV (MM) at New Castle (25 miles north) and Butler (35 miles northeast) where windows rattled, to III (MM) at Pittsburgh (25 miles southeast) where the earthquake was only slightly felt. Similar intensities are estimated for the site (U.S. Geological Survey 1974). Figure 2.5.2-6 shows that the site is near the western boundary of the area affected by this earthquake.

Timiskaming, Quebec Earthquake, November 1, 1935

The epicenter was located approximately 425 miles north of the site, near Timiskaming Station, Quebec, (location - 46.8°N, 79.1°W - Intensity VII - Magnitude 6.25) where some damage was reported. The earthquake was felt over a 1,000,000-mi^2 area of the northeastern United States and eastern Canada. The earthquake was felt as far south as Virginia and Kentucky and as far west as Wisconsin. Damage in the epicentral region was relatively small when compared to the large area affected. Isoseismals prepared by the Dominion Observatory of Canada and the U.S. Coast and Geodetic Survey (1968) (Figure 2.5.2-7) show that the intensity in the vicinity of the site was III (MM).

Anna, Ohio Earthquake, March 8, 1937

This earthquake occurred in western Ohio in the vicinity of Anna (location - 40.6°N, 84.0°W - Intensity VII-VIII) where walls of brick buildings cracked, chimneys were thrown down, and furniture was upset. The earthquake was felt over a 150,000-mi^2 area including all of Ohio, most of Indiana and adjacent areas of Michigan, Kentucky, West Virginia, and southeastern Ontario, Canada. The site is located at the eastern limit of the perceptible area and may possibly have experienced an intensity of II (MM) (Westland and Heinrich 1940) (Figure 2.5.2-8).

Massena, N.Y. Earthquake, September 4, 1944

The epicenter was located in the vicinity of Massena, New York and Cornwall, Ontario (location - 44.95°N, 74.9°W - Intensity VIII - Magnitude 5.9) about 405 miles northeast of the site. Damage was estimated at two million dollars. The earthquake was felt over an estimated area of 175,000 mi^2. Isoseismals prepared by the Dominion Observatory of Canada (Figure 2.5.2-9) show that the area of damage

(Intensity VI (MM) or greater) was elongated along the St. Lawrence River Valley. The isoseismals show that the intensity in the vicinity of the site was II (MM).

The review shows that the site has experienced vibratory ground motion primarily from large, distant earthquakes, most notably the 1811-1812 earthquakes near New Madrid, Missouri and the 1886 Charleston earthquake. The Attica, New York and Anna, Ohio earthquakes were barely perceptible at the site.

2.5.2.2 Geologic Structures and Tectonic Activity

Portions of four tectonic provinces are located within a 200-mile radius of the BVPS-2 site (Figure 2.5.1-7). The provinces have been defined on the basis of the following criteria:

1. Style and degree of deformation,

2. Age of the relationships with the basement rock, and

3. Age of the orogenic or tectonic activity found within the province.

The four provinces, from northwest to southeast are:

1. Central Stable Region,

2. Appalachian Plateau Province,

3. Valley and Ridge Province, and

4. Piedmont-Blue Ridge Province.

They are defined in accordance with 10 CFR 100, Appendix A, which defines a Tectonic Province as "A region of the North American continent characterized by a relative consistency of the geologic structural features contained therein." The conclusions are in general agreement with those of Rodgers (1970), Hadley and Devine (1974), and King (1969). The names for the tectonic provinces are taken from the physiographic provinces with which they generally correspond.

2.5.2.2.1 Appalachian Plateau Province

The BVPS-2 site is located on the Ohio River within the Appalachian Plateau Tectonic Province. Geologically, the province is a broad, gentle synclinal basin whose youngest rocks are the Dunkard Group of probable Early Permian age (Eardley 1962). The basin forms the western part of the former Appalachian geosyncline, with sediments thickening generally southeastward from the Cincinnati-Findlay Arch. Precambrian basement dips beneath the province in the same direction. Deformation in the province occurred primarily during the Permian Allegheny orogeny. The same type of structure exist in both the Appalachian Plateau and Valley and Ridge Provinces, the principal difference being a gradual decrease in intensity of deformation from east to west. "Thin-skinned" tectonics was the dominant mode of deformation in the Appalachian Plateau with movement occurring mainly along sole thrusts in Silurian salt beds and Cambro-Ordovician shales (Rodgers 1964, 1970; Gwinn 1964, 1970). Deep drilling has not as yet delineated the regional extent of thrusting in the Appalachian Plateau. Mild epeirogenic uplift has been the only tectonic event to affect the province since Late Paleozoic time.

Orogenic stresses were persistent and extensive during Permian time and affected all the rocks of the former Appalachian geosyncline. The Valley and Ridge region was the most intensely deformed, with effects diminishing north and west of the Allegheny Front. The Appalachian Plateau region shows only mild deformation and only within the higher stratigraphic units, generally above Silurian evaporites. These effects are recognized in east central Ohio as the Parkersburg-Lorain Syncline and the Cambridge Arch (Figure 2.5.1-7). The syncline can be traced from Parkersburg, West Virginia, north-northwest to Lorain County on Lake Erie. It is a structural trough parallel to the Cambridge Arch to the east and is nearly 5 miles in width with a structural relief of 300 feet (Lamborn 1951). The folds are known to affect the Devonian shale sequence above the Delaware limestone but they have not been investigated at depth (Janssens 1977). These folds are believed to have been formed because of their stratigraphic proximity directly above the low shear resistance zone of Salina salt (Janssens 1977). The thick salt beds are believed to have reduced the resistance to lateral compressive stresses during Permian time, facilitating "thin-skinned" movement of post-Salina rocks (decollement) over a very large area (Gwinn, 1964, 1970; Rodgers 1964, 1970).

Geiser and Engelder (1983) summarize the results of their work on evidence for Allegheny orogenic deformations in New York and eastern Pennsylvania. They believe that the "layer parallel shortening fabrics," which are identified in the rocks of the area "reflect the presence of deeper hidden or blind detachments." The subsurface thrust zones can then be mapped on the basis of the presence of the layer shortening fabrics. Maps showing the limit of the layer parallel shortening fabrics in central and western New York closely

coincide with the limit of Silurian evaporite deposits in the Salina Basin.

Unfortunately, similar fabrics were not developed in the Carboniferous rocks on the surface in western Pennsylvania and eastern Ohio. Ver Steeg (1942), however, has identified a form of cleavage in the coal fields of eastern Ohio which controls mining techniques and direction. A set of perpendicular joints, or coal "cleats", is seen to be arranged in a broad arc from north-central Ohio to southern Ohio. The arc is convex to the west and corresponds to the curve of the Appalachian fold belt in eastern Pennsylvania. Ver Steeg (1942) believes that the joints were formed at the same time as the folds.

In order to include all of the rocks which might have been affected by the Allegheny orogenic events, the western boundary of the Appalachian Plateau province is drawn along the mapped limit of Silurian salt (Clifford 1973; SWEC 1978) except where other Allegheny evidence is known to exist further to the west, such as the Parkersburg - Lorain syncline. The present extent of the salt beneath Lake Erie is unknown but most authors indicate continuous salt across the Findlay Arch into the Michigan Basin. Since Allegheny deformation is not known to exist in the Michigan Basin, the boundary of the Appalachian Plateau Province is inferred where it is drawn beneath Lake Erie. South of Ohio, the limit of salt swings eastward, oulining the southeast edge of the Silurian Salina Basin. The Appalachian Plateau Province boundary, however swings westward to include unnamed, low amplitude anticlines and synclines east of Huntington, West Virginia, which parallel similar Allegheny deformational features further east (Rodgers 1970; Cardwell 1977).

The Appalachian Plateau Province is characterized in general by infrequent earthquakes of low intensity. Figures 2.5.2-10 and 2.5.2-11 show that a large part of the Province in the vicinity of the site has experienced less than four earthquakes per 10,000 to 11,680 km^2. Figure 2.5.2-1 shows that during the entire period of historical reports, only about 18 earthquakes, with epicentral intensities between II and VI (MM), have occurred in the Appalachian Plateau Province, indicating that it is in one of the least seismic areas in the eastern United States.

Barstow, et. al. (1981), using the results of the earthquake frequency study discussed in Section 2.5.2.1.2, developed a contour map of the cumulative strain released by earthquakes that occurred in the eastern United States between 1800 and 1977. A portion of the map is shown on Figure 2.5.2-12. Also shown is a table indicating the amount of strain released by a single event of a given intensity. By comparison with the contours of cumulative strain during the entire historical period, most of the Appalachian Plateau Province has experienced strain release corresponding to an earthquake of Intensity V (MM) or less. Only in the vicinity of Cleveland, Ohio;

northwest of the site, is the cumulative strain equivalent to an earthquake of Intensity VII-VIII (MM).

The largest seismic events to occur in the Appalachian Plateau Province, not associated with tectonic structures (Figure 2.5.2-2), are two Intensity VI (MM) events. One is the April 9, 1900 shallow event near Cleveland, Ohio, and the other is the July 13, 1935 event in Blair County, Pennsylvania.

2.5.2.2.2 Central Stable Region

The Central Stable Region bounds the Appalachian Plateau on the north and west and begins about 85 miles from the site. The northern boundary of the Region is the Canadian Shield. Westward, it extends to the east flank of the Rocky Mountains and includes a wide variety of morphology and structure. The Coastal Plain overlaps the region to the south. The Central Stable Region is made up of a foundation of Precambrian crystalline rock with a veneer of sedimentary cover, which varies widely in thickness. It represents the craton or central stable area of the North American crustal plate. Deformation within the region has been restricted to the development of several broad basins, arches, and similar features, mostly during the Paleozoic. Several of the basins have in excess of 10,000 feet of strata in them, while some of the arches expose Precambrian crystallines. Movements since the Paleozoic have been mostly a series of epeirogenic uplifts and downwarps, followed by long episodes of erosion. The largest earthquakes to occur in this province are the March 9, 1937 event near Anna, Ohio, with Intensity VII-VIII (MM) (Coffman and Von Hake 1973), and the Intensity VIII (MM) event of August 12, 1929 near Attica, New York.

2.5.2.2.3 Valley and Ridge Provinces

The Northern and Southern Valley and Ridge Provinces contain the major portions of the sediments which were deposited in the Appalachian geosyncline, of which they comprise the southeastern part. They are bounded on the north and west by the Appalachian Plateau Province, on the south and east by the Piedmont-Blue Ridge Province, and on the northeast end by the New England Province. The Valley and Ridge Provinces are characterized by unmetamorphosed Paleozoic sediments that were tightly folded and thrust faulted during the Allegheny orogeny, approximately 250 million years ago. Intense pressure from the southeast folded the sediments into large synclines and anticlines, some overturned to the northwest. Thrust faults were commonly developed with the horizontal attitude of the sediments barely disturbed. The division of the Valley and Ridge Province into northern and southern sections is based on the difference in structural styles. The northern section is typified by folding, whereas the southern section is characterized by thrust faulting. The southern section has historically experienced a higher level of seismic activity south of an east-west line through central Virginia (Hadley and Devine 1974). This line is somewhat indistinct, but would fall outside the 200-mile site region.

The largest earthquake to occur in the northern province is the February 21, 1954 event near Wilkes Barre, Pennsylvania, approximately 235 miles from the site. This event was estimated to be Intensity VIII (MM) by Sbar and Sykes (1977), and Intensity VIII (MM) by Barstow et. al (1981) and Stover et. al (1981). Damage was restricted to a five-block area, suggesting that the earthquake resulted from the collapse of an abandoned mine and occurred at very shallow depths.

The Northern Valley and Ridge Province lies approximately 105 miles east of the site at its closest approach.

2.5.2.2.4 Piedmont-Blue Ridge Province

The Piedmont-Blue Ridge Province is characterized by metamorphosed Precambrian and early Paleozoic eugeosynclinal rocks which were deformed during the Taconic and Allegheny orogenies and may have been recrystallized during the Acadian orogeny. It includes the Blue Ridge Anticlinorium, a relatively narrow belt of folded and faulted Upper Precambrian crystalline schists and gneisses, which were thrust westward several kilometers over the rocks of the Valley and Ridge. Terrains of intrusive igneous rocks are notable in the Piedmont of Virginia and North Carolina. The eastern part of the province was also effected by the Allegheny orogeny. Long narrow graben structures filled with continental deposits of Late Triassic age are superimposed intermittently on the crystallines from Pennsylvania to South Carolina. The effects that each orogeny had on the rocks in the Piedmont are not yet fully understood, due to the lack of outcrop, lack of fossils, and the strong recrystallization. The

Piedmont-Blue Ridge Province is bounded on the northwest by the Northern and Southern Valley and Ridge Provinces. The southern and eastern boundary of the province is drawn at the present westward limit of Cretaceous Coastal Plain deposits. Piedmont geology certainly continues beneath the Coastal Plain for some distance, but the line where Coastal Plain becomes dominant is presently not well established. The northern boundary of the Piedmont with the New England Province is hidden beneath the Triassic Newark-Gettysburg Basin.

The largest earthquake to occur in this province is the January 1, 1913, event in Union County, South Carolina. Different sources have assigned Intensity VI-VII (MM) (Coffman and Von Hake 1973) or VII-VIII (NM) (Bollinger 1973, 1975). The most recent reference assigns it Intensity VII (MM) (Barstow et. al., 1981).

2.5.2.3 Correlation of Earthquake Activity With Geologic Structure Or Tectonic Provinces

The relationship between earthquake locations and geologic structures is important in assessing earthquake hazard to a particular site. Figure 2.5.2-2 reveals no direct spatial relationship between earthquake epicenters and known geologic or tectonic structures within 200 miles of the site, except in the area of the Clarendon-Linden fault zone in western New York. No evidence of tectonically induced faulting has been reported or inferred to have displaced Cenozoic age deposits in the Appalachian Plateau Province, and no rupture of the ground surface or man-made structures resulting from tectonic faulting has been recorded anywhere in the eastern United States (York and Oliver 1976).

2.5.2.3.1 Correlation with Geologic Structures

<u>Clarendon-Linden Fault Zone</u>

The Clarendon-Linden fault system has been traced from near Lake Ontario in the Central Stable Region to the northern part of Allegheny County in the Appalachian Plateau Province. A significant amount of seismic activity has taken place along the zone (Sbar and Sykes 1977; Pomeroy et al, In Press). Van Tyne (1975, 1976) reports that the Clarendon-Linden fault is not a single fault but a zone consisting of several parallel basement faults which become surface flexures. Most of the movement is believed to be confined to formations below the Silurian deposits. Movement is believed to have been initially downthrown to the east, reversing later to become now downthrown 100 feet on the west. Recent low-level seismic activity has been correlated with high-pressure fluid injection operations in brine fields which are developed in the area (Fletcher and Sykes 1977), and may be relieving stress along the fault system. These events are small but may be felt locally and number up to 80 per day.

This activity and the occurrence of several small earthquakes near Attica indicate that the Clarendon-Linden structure is active and therefore is considered as a localized source. The Clarendon-Linden fault zone lies approximately 160 miles northeast of the BVPS-2 site at its closest approach.

Anna Fault System

2.5.2.3.2 Correlation with Tectonic Provinces

In accordance with 10 CFR 100, Appendix A, earthquakes in the site region which are not correlated to the Clarendon-Linden fault system are presumed to be associated with the tectonic provinces in which they occur. The seismicity of all tectonic provinces within the site region is discussed in Section 2.5.2.2.

2.5.2.4 Maximum Earthquake Potential

Maximum earthquake potential for the site is evaluated by utilizing maximum earthquakes associated with all nearby tectonic provinces and geologic structure. This analysis is made for two different sets of conditions. First, actual site intensities resulting from the larger historical earthquakes are determined. Second, the maximum potential site intensities resulting from hypothetical events are specified as arising from the largest known earthquakes in each adjoining tectonic province, postulated to occur at the point where the province or structure most closely approaches the site.

2.5.2.4.1 Maximum Historical Site Intensity

As discussed earlier, in the site region there are sources of earthquake activity at Attica, New York and Anna, Ohio. The largest earthquakes in each of these sources are discussed in Section 2.5.2. These earthquakes were barely perceptible at the site. Other than these two sources, Figure 2.5.2-2 shows that the largest earthquake in the site region took place on November 6, 1926 in southeastern Ohio, approximately 130 miles southwest of the site. The epicentral intensity of this earthquake was VI-VII (MM). Chimneys were toppled at Keno and Pomeroy in Meigs County, Ohio, and a stove was overturned in Pomeroy (Von Hake 1976). As indicated in Table 2.5.2-2, this event had a small felt area of only 300 square miles and was probably not felt at the site. Three earthquakes have been reported within 50 miles of the site (Figure 2.5.2-1). One was reported at Sharon, Pennsylvania, approximately 40 miles north of the site, on August 17, 1873. Limited details have resulted in an estimated Intensity III-IV (MM) for this event. Using the attenuation relationship of Gupta and Nuttli (1976) given in Section 2.5.2.4.2, this event would have attenuated to about an Intensity II at the site; it is not likely that it was felt. On September 26, 1885, an Intensity III (MM) earthquake occurred near Pittsburgh, about 30 miles southeast of the site. It was probably not felt. Another was the Intensity V (MM)

event of October 29, 1927, approximately 45 miles northwest of the site. This event would have attenuated to approximately Intensity III-IV at the site and may have been felt at the site.

This examination of ground motion effects of earthquakes within 200 miles of BVPS-2 indicates that the site has not experienced ground motion exceeding Intensity III-IV (MM). It is likely that in the last 180 years, only the October 29, 1927 earthquake may have been felt at the site. This is clearly a reflection of the low intensity of earthquakes which are reported to have occurred within 200 miles of BVPS-2.

The BVPS-2 site has, however, experienced more severe ground motion from larger, but more distant earthquakes. Examination of isoseismal maps of larger earthquakes felt in the eastern United States shows that the New Madrid events of 1811-1812 probably caused a maximum ground motion at the site corresponding to Intensity low to middle V (MM). Therefore, the maximum historical intensity at the site was probably Intensity low to middle V (MM).

2.5.2.4.2 Maximum Earthquake Potential From Tectonic Province Approach

The BVPS-2 site is located near the center of the Appalachian Plateau Tectonic Province. As discussed in Section 2.5.2.2.1, two earthquakes with epicentral Intensity VI (MM) have occurred in the province. No earthquake with epicentral intensity greater than VI (MM) has been reported to have occurred in the province. None of these earthquakes appear to be associated with a particular known geologic or tectonic structure, so that it is assumed that a similar random event of this intensity could occur anywhere within the province. Consequently, if such an earthquake occurred near the site, it would generate ground motion corresponding to Intensity VI (MM). The magnitude of an earthquake can be estimated on the basis of the Nuttli and Herrmann (1978) relationship:

$$I = 2m_b - 3.5$$

where: I = epicentral intensity

m_b = body wave magnitude

Using this relationship, an earthquake of Intensity VI would have a magnitude of 4.75.

The maximum earthquake potential at BVPS-2 from earthquakes in other tectonic provinces is computed by attenuating the largest known earthquake in each province from the point of nearest approach to the site in that province. If the size of the earthquake is specified in terms of epicentral intensity, Io (MM), then the expected intensity at the site can be computed by using the Gupta and Nuttli (1976) attenuation relationship.

$$I(R) = I_o + 3.7 - 0.0011R - 2.7 \log_{10}R$$

where: $I(R)$ = Intensity at site

I_o = Epicentral intensity

R = Epicentral distance (kilometers), for $R \geq 20$ kilometers

If the size of the earthquake is specified in terms of bodywave magnitude, m_b, then ground motion at the site can be computed in terms of peak horizontal acceleration using the Nuttli and Herman (1981) relationship:

$$\log a = 0.57 + 0.50\ m_b - 0.83 \log (R^2 + h^2)^{1/2} - 0.0016R$$

where: a = peak horizontal acceleration, cm/sec^2

m_b = body wave magnitude

R = epicentral distance kilometers

h = focal depth, kilometers.

The largest event to occur in the Central Stable Region was the 1937 Anna, Ohio earthquake which had an epicentral intensity of VII-VIII (MM) and a magnitude, m_b, of 5.3 (Table 2.5.2-2). The minimum distance from the site to the boundary of the Central Stable Region is about 85 miles (136 km). A repeat of the 1937 Anna earthquake at this minimum distance from the site would result in an Intensity V-VI (MM) at the site if the Gupta and Nuttli (1976) attenuation relationship is used. Assuming zero focal depth, an earthquake with a magnitude of 5.3, at a distance of 85 miles, would cause a peak horizontal acceleration of 0.017g at the site according to the Nuttli and Herman (1981) relationship.

The largest earthquake to occur in the Northern Valley and Ridge Province was the February 21, 1954, Wilkes Barre, Pennsylvania event of Intensity VIII (MM) (Coffman and Von Hake 1973). The Northern Valley and Ridge Province lies approximately 105 miles east of the site at its closest approach. This earthquake was felt only within a five block area, suggesting that the earthquake resulted from the collapse of an abandoned mine. Earthquakes with epicentral Intensity VII (MM) occurring in the Northern Valley and Ridge Province at a distance of 105 miles (168 km) will cause ground motions at the site corresponding to Intensity IV-V (MM).

The Piedmont Province is at a minimum distance of 165 miles (264 km) east of the site. The largest earthquake in this province was the January 1, 1913 event with Intensity VII (MM) in Union County, South Carolina. Attenuation of this event to the site results in an Intensity IV (MM) at the site.

If it were assumed that the 1929 Attica, New York event, which had an Intensity VII (MM), reoccurred on the Clarendon-Linden fault zone at its closest approach to the site, it would produce ground motions corresponding to Intensity IV (MM) at the site.

Hence, the maximum earthquake for the BVPS-2 site is equivalent to an Intensity VI event occurring in the Appalachian Plateau Province near the site.

2.5.2.5 Seismic Wave Transmission Characteristics of the Site

The amplification characteristics of the soil at the BVPS-2 site were originally discussed by Whitman (1968), and his results led to the development of the BVPS-1 response spectra and, as later modified, to the BVPS-2 response spectra. The BVPS-2 response spectra for the SSE is shown on Figure 3.7B-1.

2.5.2.6 Safe Shutdown Earthquake

The maximum earthquake expected at the site is described in Section 2.5.2.4 and results in ground motion corresponding to Intensity VI (MM). Trifunac and Brady (1975) developed the following correlation between intensity and acceleration:

$$\log a = 0.30 I_{mm} + 0.014$$

where:

a = Peak horizontal acceleration (cm/sec^2)

I_{mm} = Modified Mercalli intensity

Using this correlation, an Intensity VI (MM) earthquake would produce a horizontal acceleration of 0.07g.

Murphy and O'Brien (1977), using a larger data base, determined the following relationship between acceleration and intensity:

$$\log a = 0.25 I_{mm} + 0.25$$

Using this relationship an Intensity VI (MM) produces an acceleration of 0.06g.

On the basis of these empirical relationships, the peak horizontal ground surface acceleration corresponding to a random Intensity VI (MM) earthquake occurring near the site would be 0.07 g. BVPS-2 has been designed for an SSE corresponding to a peak horizontal ground surface acceleration of 0.125 g, slightly greater than the midpoint acceleration between Intensity VI-VII (MM).

2.5.2.7 Operating Basis Earthquake

An OBE equivalent to one-half the SSE is used. The value of the OBE for BVPS-2 is 0.06.g.

2.5.2.8 References for Section 2.5.2

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Tables for Section 2.5.2

TABLE 2.5.2-1

MODIFIED MERCALLI INTENSITY SCALE OF 1931

I -	Not felt except by a very few under especially favorable circumstances.
II -	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III -	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earth-quake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.
IV -	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building Standing motor cars rocked noticeably.
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.
VI -	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII -	Everyone 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 -	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. Persons driving motor cars disturbed.
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.

TABLE 2.5.2-1 (Cont)

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.

XI - Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII - Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.

TABLE 2.5.2-2

EARTHQUAKE CATALOG
BEAVER VALLEY POWER STATION - UNIT 2
200-MILE RADIUS

Date Year	Date Month	Date Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area ($x10^3$ mi^2)	Location
1776				39.9	82.0	VI				
1796	12	26	1100	42.9	79.0	VI			7.5	
1823	05	30		41.5	81.0	IV		3.8		
1824	07	15	1620	39.7	80.5	IV				
1836	07	08		41.5	81.7	IV		3.8		
1840	09	10		43.2	79.9	V				Hamilton, ON
1845				41.1	84.2	II		3.0		
1846	10	18	2100	39.4	77.8					
1846	10	19	0200	39.3	77.9					
1850	10	01	1001	41.4	82.3	IV		3.8		
1853	01	30		38.9	78.5	II				
1853	03	13	1000	43.1	79.4	V				St. Catharines, ON
1853	05	02	0920	38.5	79.5	V			72.0	
1856	01	16	0300	39.3	78.2	IV				
1857	03	01		41.7	81.2	IV-V		4.0		
1857	12	10	2200	37.8	80.4					
1857	12	11	0300	37.8	80.5					
1858	01	15		43.1	79.1	II				Niagara Falls, ON
1858	04	16	1200	41.7	81.3	IV		3.8		
1867	01	13		41.5	81.7	III		3.4		
1869	04	09		42.7	80.8	III		3.4		

TABLE 2.5.2-2 (Cont)

Date			Origin	Latitude	Longitude	Intensity	Depth		Felt Area	
Year	Month	Day	Time	(°N)	(°W)	(MM)	(km)	Magnitude	($x10^3$ mi^2)	Location
1872	07	23		41.4	82.1	IV		3.8		
1873	04	30	PM	43.3	79.9	IV				Hamilton, ON
1873	08	17	1400	41.2	80.5	III				Sharon, PA
1873	07	06	1430	43.0	79.5	VI				Welland, ON
1875	06	18	1343	40.2	84.0	VII		5.3	38.6	
1876	02	27		42.4	83.2	II		3.0		
1876	06			40.4	84.2	V		4.2		
1877	08	17	1650	42.3	83.3	IV-V*		4.0 (3.2)	0.2	
1879	08	21	0800	43.2	79.2	V				
1881	07	31	0400	39.1	83.4					
1881	08	30	0500	39.2	83.7	III		3.4		
1882	02	09	2000	40.4	84.2	V		4.2	0.1	
1882	04	02		38.6	78.5	II				
1882	11	27	2330	43.0	79.2	IV				Welland, ON
1882	12	04	2330	43.0	79.2	II				Welland, ON
1883	04	01		43.3	79.9	III				Hamilton, ON
1883	05	23	0430	38.4	82.6	IV		3.8		
1884	09	19	2014	40.7	84.1	VI		4.7	123.6	
1884	12	23	2300	40.4	84.2	III		3.4		
1885	01	02	2116	39.2	77.5	V			3.5	
1885	01	18	1030	41.1	81.4	(IV)		(3.8)		
1885	01	18	1130	41.3	81.1	III		3.4		
1885	08	15	0505	41.3	81.1	II		3.2		

TABLE 2.5.2-2 (Cont)

Date Year	Month	Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area ($x10^3$ mi^2)	Location
1886	05	03	0300	39.5	82.1	III-IV		3.6	0.4	
1886	09	02		43.2	79.2	II				St. Catharines, ON
1889	09	00		40.4	84.2	III		3.4		
1885	09	26	2030	40.3	80.1	III				
1896	03	15	0700	40.3	84.2	IV		3.8		
1897	03	07		43.1	79.2	IV				Niagara Falls, ON
1898	10	24		41.5	81.7	III-IV		3.6		
1899	11	12	1400	39.3	83.0	IV		3.8		
1900	04	09	1400	41.4	81.8	VI*		4.7 (3.8)		
1901	05	17	0700	39.3	82.5	V		4.2	9.7	
1902	03	10	1030	39.6	77.1	III				
1902	03	11		39.6	77.1	III				
1902	06	14	0700	40.3	81.4	IV-V		4.0		
1903	01	01	1730	39.6	77.1	II				
1903	01	01	2045	39.6	77.1	I				
1906	04	20	1730	41.5	81.7	(III)		(3.4)		
1906	04	20	1830	41.5	81.7	IV		3.8		
1906	04	23	0712	40.7	83.6	V		4.2		
1906	06	27	1210	40.4	81.6	V*		4.2 (3.4)	0.4	
1906	06	27	2210	41.4	81.6	V				
1907	01	10	1000	41.2	77.1	IV				Williamsport, PA
1907	04	12		41.5	81.7	III		3.0		
1909	04	02	0725	39.4	78.0	VI			2.5	

TABLE 2.5.2-2 (Cont)

Date			Origin	Latitude	Longitude	Intensity	Depth		Felt Area	
Year	Month	Day	Time	(°N)	(°W)	(MM)	(km)	Magnitude	($x10^3$ mi^2)	Location
1910	01	23	2120	39.6	77.0	II				
1910	02	08	0900	38.7	78.7	IV			1.1	
1910	02	25	PM	43.2	79.8	IV				Hamilton, ON
1912	03	27	1252	43.2	79.7	V				Hamilton, ON
1914				40.4	84.2	III		3.4		
1918	04	09	1808	38.5	79.0	II				
1918	04	16	1340	38.6	78.5	II				
1919	09	05	2146	38.8	78.2	VI				
1919	09	06	0246	38.8	78.2	VI				
1920	07	24		38.7	78.4	IV				
1921	09	27	0432	42.1	80.2	III				Erie, PA
1922	03	16	0930	43.0	82.5	III		3.4		
1923	12	31	2400	39.2	78.0	V				
1924	01	01		39.2	78.0	IV				
1924	01	01	0500	39.1	78.1	III				
1925	03	27	0406	39.5	83.9	V		4.2		
1925	10			40.4	84.2	III		3.4		
1926	10	28	0842	41.7	83.6	III		3.6		
1926	10	28	1100	41.7	83.6	IV		3.8		
1926	11	05	1553	39.1	82.1	VI-VII*		4.0 (3.4)	0.3	
1927	01	17	0530	40.7	82.5	IV		3.8		
1927	02	17	0600	40.7	82.5	II		3.0		
1927	06	10	0716	38.0	79.0	V		2.9		

TABLE 2.5.2-2 (Cont)

Date Year	Month	Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area (x10^3 mi^2)	Location
1927	10	29		40.9	81.2	V		4.2		
1927	11	12		43.1	79.1	IV				Niagara Falls, ON
1927	11	13	0050	43.1	79.1	IV				Niagara Falls, ON
1928	09	09	2100	41.5	82.0	V		4.2	1.5	
1928	10	27		40.4	84.1	III		3.4	0.1	
1929	03	08	0906	40.6	84.2	V		4.2	5.0	
1929	08	12	1124	42.9	78.4	VIII		5.8		Attica, NY
1929	09	17	1900	41.5	81.5	III		3.0		
1929	12	02	2214	42.8	78.3	V				Attica, NY
1929	12	03	1250	42.8	78.3	V				
1930	01	17		42.8	78.3	III				
1930	02	16	1217	42.8	80.5	III				Simcoe, ON
1930	06	26	2145	40.5	84.0	IV		3.8		
1930	06	27	0723	40.5	84.0	IV		3.8		
1930	07	11	0015	40.6	83.2	IV		3.8		
1930	09	29	2115	40.4	84.2	III		3.4		
1930	09	29	2250	40.3	84.2	III				
1930	09	30	2040	40.3	84.3	VII*		5.3 (4.2)		
1930	10			40.4	84.2	III-IV		3.6		
1930	11	20		42.6	83.2	III		3.4		
1931	03	21	1548	40.4	84.2	III		3.4		
1931	04	01	0015	40.4	84.0	III		3.4		
1931	04	22		42.9	78.9	IV				Buffalo, NY

TABLE 2.5.2-2 (Cont)

Date			Origin	Latitude	Longitude	Intensity	Depth		Felt Area	
Year	Month	Day	Time	(°N)	(°W)	(MM)	(km)	Magnitude	(x10³ mi²)	Location
1931	06	10	0830	41.3	84.0	V		4.2	1.5	
1931	09	20	2305	40.4	84.2	VII		5.3	46.3	
1931	10			40.4	84.2	III				
1931	10	08	1430	40.4	84.2	III		3.4		
1932	01	22		41.1	81.5	V*		4.2 (3.6)		
1933	02	23	0320	40.3	84.2	IV		3.8	1.9	
1934	10	29	2007	42.0	80.2	V				Erie, PA
1934	11	05	2000	41.8	80.3	III				
1935	07	13		40.5	78.5	VI				Blair Co., PA
1935	11	01	0330	38.9	79.9	V				
1935	11	01	2030	39.9	79.9	V				
1936	01	31	0630	41.1	83.2	III				
1936	01	31	1930	41.2	83.2	IV		3.8		
1936	01	31	2000	41.2	83.2	II		3.0		
1936	08	26	0900	41.4	80.4	III				Greenville, PA
1937	03	02	1447	40.4	84.2	VII		5.3	108.1	
1937	03	03	0950	40.7	84.0	V		4.2	0.2	
1937	03	03	0955	40.7	84.0	III		3.4		
1937	03	09	0544	40.4	84.2	VII-VIII		5.3	193.1	Anna, OH
1937	04	23	1715	40.7	84.0	III		3.4	0.3	
1937	04	27	1700	40.7	84.0	III		3.4	0.3	
1937	05	02	1705	40.7	84.0	IV		3.8		
1938	03	13	1610	42.4	83.2	(IV)		(3.8)		

TABLE 2.5.2-2 (Cont)

Date Year	Month	Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area ($x10^3$ mi^2)	Location
1938	03	16	1000	42.4	83.2	IV		3.8		
1938	07	15	2245	40.7	78.4	V-VI				Blair Co., PA
1939	01	14	0810	43.3	79.9			3.3		Hamilton, ON
1939	02	24	0020	42.9	78.3	III				Attica, NY
1939	03	18		40.4	84.0	II		3.0		
1939	03	18	1403	40.4	84.0	III-IV		3.6	0.5	
1939	06	18	0320	40.3	84.0	IV		3.8	0.4	
1939	07	09	1250	40.3	84.0	II		3.0		
1939	11	26	0520	39.9	76.9					
1940	05	28	2006	40.3	76.9	II				Harrisburg, PA
1940	05	31	1700	41.1	81.5	II		3.0		
1940	06	16	0230	39.9	82.2	III				
1940	06	16	0430	40.9	82.3	IV		3.8		
1940	07	28	0930	40.9	82.3	III		3.4		
1940	08	15	1035	40.9	82.3	III		3.4		
1940	08	19	0330	39.9	82.2	II				
1940	08	20	0330	40.9	82.3	III		3.4		
1943	03	09	0325	42.2	80.9	V		4.7	84.9	
1944	02	26	2058	42.9	78.8	II				Buffalo, NY
1948	01	18		41.7	83.6	III		3.4		
1951	12	03	0200	41.6	81.4	IV		3.8	0.1	
1951	12	03	0702	41.6	81.4	(IV)		(3.2)	(0.1)	
1951	12	07		41.6	81.4	II		3.0		

TABLE 2.5.2-2 (Cont)

Date Year	Month	Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area ($x10^3$ mi^2)	Location
1951	12	21	2100	41.6	81.5	II				
1951	12	22	0400	41.6	81.4	II		3.0		
1952	06	20	0938	39.7	82.1	VI		4.7	5.0	
1953	05	07	2332	39.7	82.1	IV		3.8		
1953	06	12		41.7	83.6	IV		3.8		
1954	04	27	0214	43.1	79.2			4.1		Welland, ON
1955	05	26	1809	41.5	81.7	V (IV-V)*		3.8 (3.6)		
1955	06	29	0116	41.5	81.7	V (IV)*		3.8 (3.6)		
1955	08	16	0735	42.9	78.3	V				Attica, NY
1956	01	27	1203	40.4	84.2	V		4.2	1.9	
1957	06	29		42.9	81.3	IV		3.8		
1958	05	01	2247	41.5	81.7	IV-V		4.0		
1958	07	22	0146	43.0	79.5			4.3		Welland, ON
1958	08	04	2025	43.1	80.0	(IV)		3.9		Caledonia, ON
1958	08	04	2025	43.1	80.0	(IV)		3.9		Caledonia, ON
1958	08	22	1425	43.0	79.0			3.6		Niagara Peninsula, ON
1959	02	09	0200	43.0	81.0			2.4		London, ON
1959	02	09		43.0	81.0	(IV)		3.8		
1961	02	22	0645	41.2	83.3	V		4.2	5.0	
1961	02	22	0844	41.0	83.6	III				
1961	02	22	0945	41.2	83.3	V		(4.0)	(5.0)	
1962	03	27	0635	43.0	79.3	V		3.0		Niagara Falls, NY
1962	03	27	0737	42.9	79.0	V				

TABLE 2.5.2-2 (Cont)

Date Year	Date Month	Date Day	Origin Time	Latitude (°N)	Longitude (°W)	Intensity (MM)	Depth (km)	Magnitude	Felt Area ($x10^3$ mi^2)	Location
1962	09	07	1400	39.7	78.2	IV				
1963	02	27	0600	43.2	79.6			3.0		Grimsby, ON
1963	10	10	1500	39.8	78.2		15.0			
1964	02	13		40.4	78.2	VI		4.6		Blair Co., PA
1964	02	13	1946	40.4	78.2			5.2		Non-tectonic event **
1965	07	16	1100	42.9	78.2	IV		3.5		Attica, NY
1965			0157	42.9	78.2	IV				Attica, NY
1965	08	27		42.9	78.2	IV				Attica, NY
1965	10	08	0217	40.1	79.8			3.3		Southwestern PA
1966	01	01	1030	42.8	78.2					Attica, NY
1966	01	01	1129	42.8	78.3			3.0		Attica, NY
1966	01	01	1323	42.8	78.2	VI*		4.7(4.6)		Attica, NY
1966	09	28	2059	39.3	80.4	IV		(3.8)		
1967	04	08	0541	39.6	82.5	V		4.2	3.9	
1967	06	13	1908	42.9	78.2	VI*		3.9(4.4)		Attica, NY
1968	07	26		40.4	84.2	II-III		3.2		
1969	05	22	1500	39.7	78.2					
1969	08	13		42.9	78.2	IV		2.5		Attica, NY
1970	05	27	1800	39.7	78.2					
1970	08	11	0614	38.4	82.3	IV		3.8		
1970	12	13	0536	42.7	78.7			2.0		SW of Hamburg, NY
1971	02	18	1930	39.7	78.2					
1971	03	05	1719	40.7	78.0					Non-tectonic event**
1972	09	12	1715	39.7	79.9					

TABLE 2.5.2-2 (Cont)

Date			Origin	Latitude	Longitude	Intensity	Depth		Felt Area	
Year	Month	Day	Time	(°N)	(°W)	(MM)	(km)	Magnitude	($x10^3$ mi^2)	Location
1973	02	09	0446	42.8	78.3			2.7		SE of Attica, NY
1974	03	23	0947	38.9	77.8			2.5		
1974	09	29	0226	41.2	83.4	II		3.0		
1974	10	10	2146	42.3	77.7			2.2		Hornell, NY
1974	10	20	1514	39.1	81.6	V		3.4		
1974	11	27	1028	43.3	79.1			3.3		
1975	02	03	1031	41.3	83.2	(IV)		(3.8)		
1975	02	16	2322	39.0	82.4	(IV)		(3.8) 3.3		
1975	06	30	2015	43.4	79.8	III		3.0		
1975	07	01	0010	42.8	78.6			2.4		Lancaster, NY
1975	08	30	0614	42.7	78.1			2.1		S of Warsaw, NY
1975	10	31	0026	42.8	78.2					Attica, NY
1975	11	20	1502	42.9	78.2				1.5	Attica, NY
1975	11	20	1504	42.9	78.2					Attica, NY
1975	11	29	1222	42.8	78.2					Attica, NY
1975	12	01	2341	42.8	78.2					Attica, NY
1976	01	01	2118	42.9	78.2					Attica, NY
1976	01	10	2114	42.8	78.2					Attica, NY
1976	01	14	2008	42.8	78.2					Attica, NY
1976	01	30	1859	39.7	78.2		15	2.8		
1976	02	02	2114	42.0	82.7	(III)		3.4		Leamington, ON
1978	04	26	1930	89.7	78.2		15	3.1		
1978	05	13	2156	42.8	78.3		16	2.8		W of Attica, NY
1978	05	13	2209	42.8	78.3		6	2.6		W of Attica, NY

TABLE 2.5.2-2 (Cont)

Date			Origin	Latitude	Longitude	Intensity	Depth		Felt Area	
Year	Month	Day	Time	(°N)	(°W)	(MM)	(km)	Magnitude	($x10^3$ mi^2)	Location
1978	10	15	2237	43.2	80.5		OR	2.2		Drumbo, ON
1978	10	26	2154	42.7	77.8		6	2.6		Mount Morris, NY
1980	01	21	0616	43.3	79.8		5	2.5		E. Hamilton, ON
1980	08	20	0935	42.1	83.1	V	18R	3.3		Lake Erie, OH
1980	10	14	0059	43.1	80.6	Felt	18R	3.5		ON
1981	01	07	0503	43.2	80.4		6.7	2.8		Near Brantford, ON
1981	03	31	0541	42.9	78.3		4.9	1.4		Attica, NY
1981	03	31	2105	42.9	78.3		6.2	2.8		Attica, NY
1981	08	28	1051	43.2	80.6	III	1R	3.3		ON
1981	09	05	0547	42.7	81.4		9	1.9		15 km, S of DLA, ON
1981	09	05	0549	42.8	81.5		9R			15 km S of DLA, ON
1981	09	05	0549	42.8	81.4		9R	3.1		7 km S of DLA, ON
1981	09	11	1625	43.4	79.8		2.7	2.2		Burglington, ON

NOTES:

*Indicates shallow earthquake per Nuttli (1981).

Data in parentheses taken from Nuttli (1981).

**Stover, Reagor, and Algermission (1981).

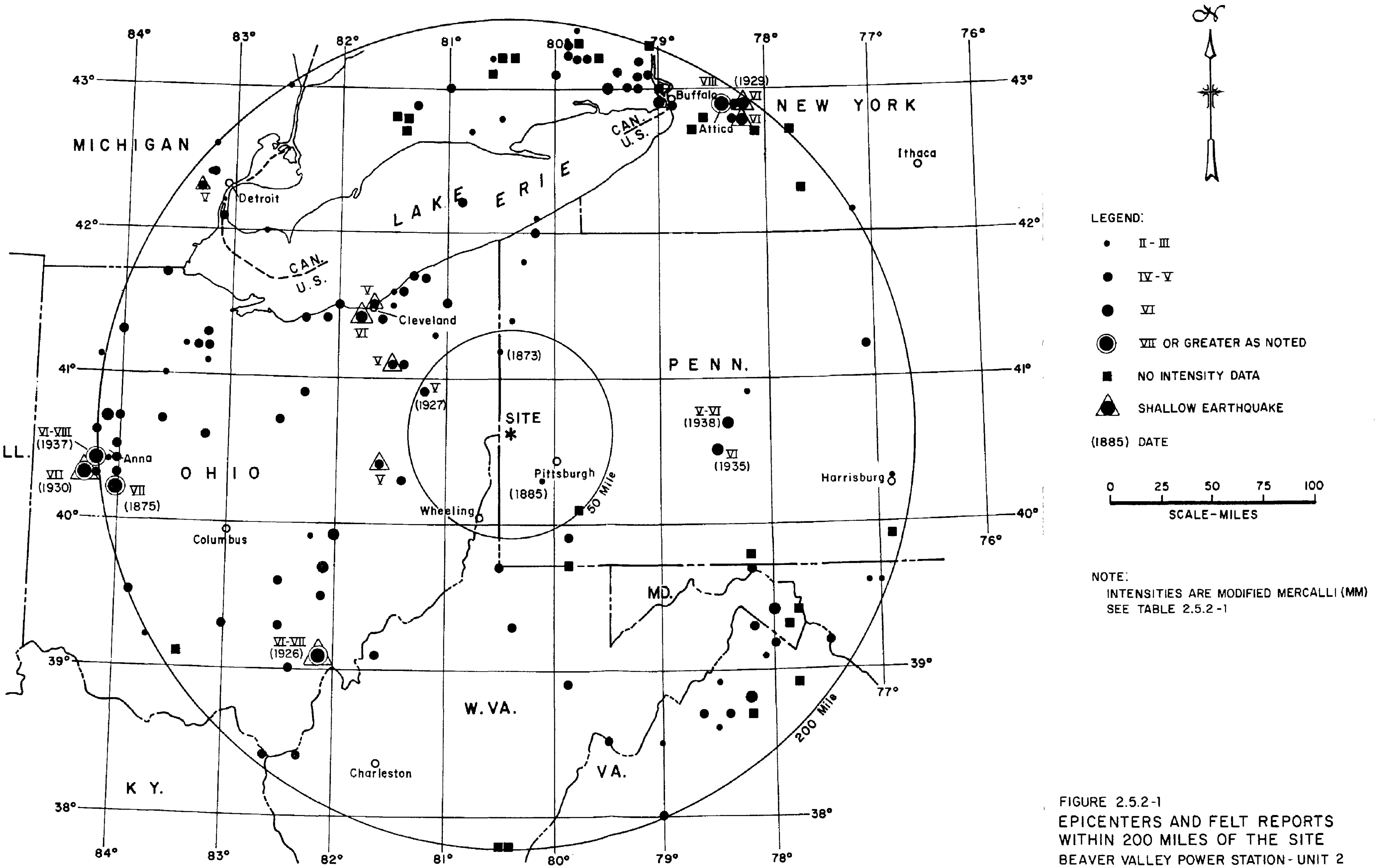


FIGURE 2.5.2-1
EPICENTERS AND FELT REPORTS WITHIN 200 MILES OF THE SITE
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

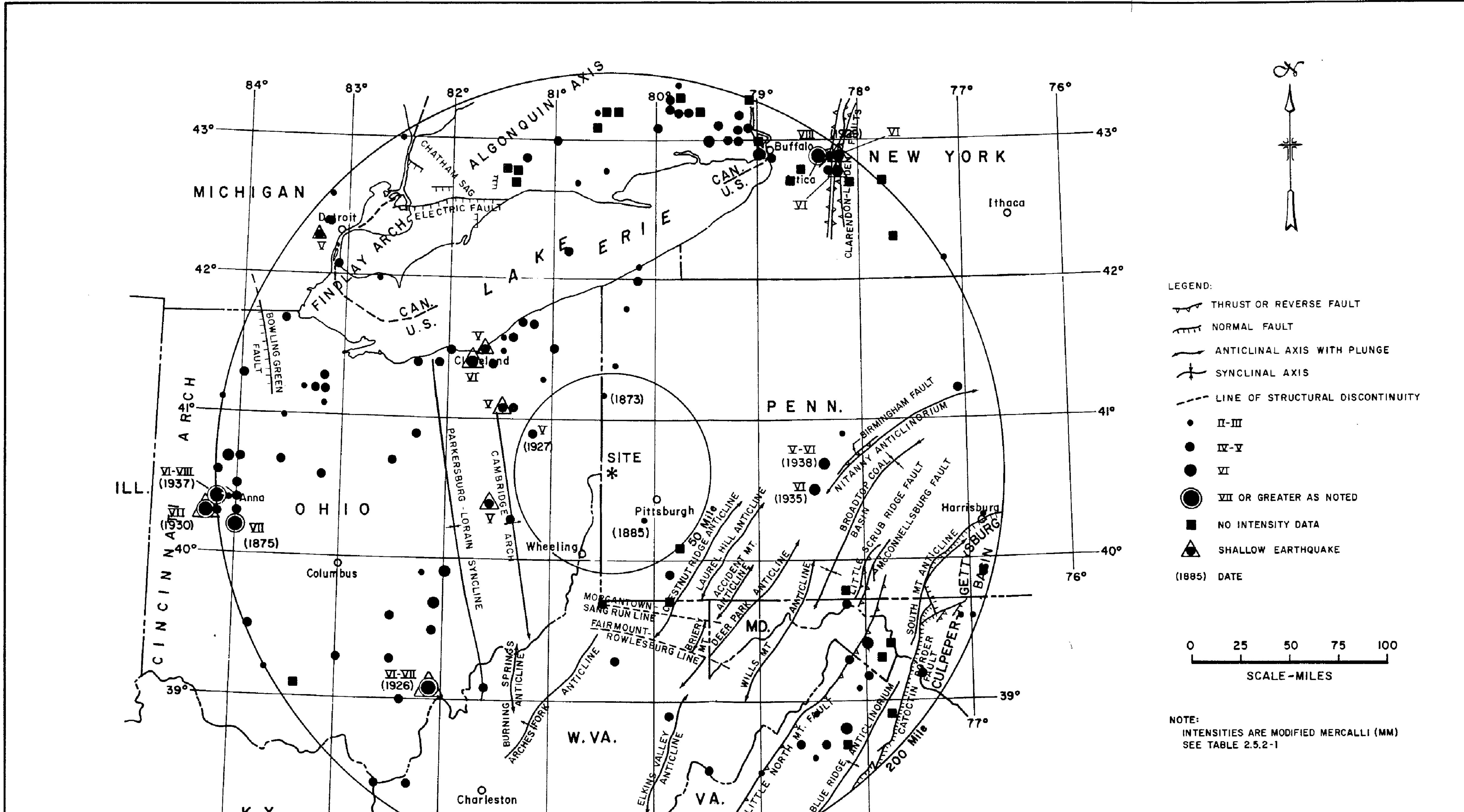
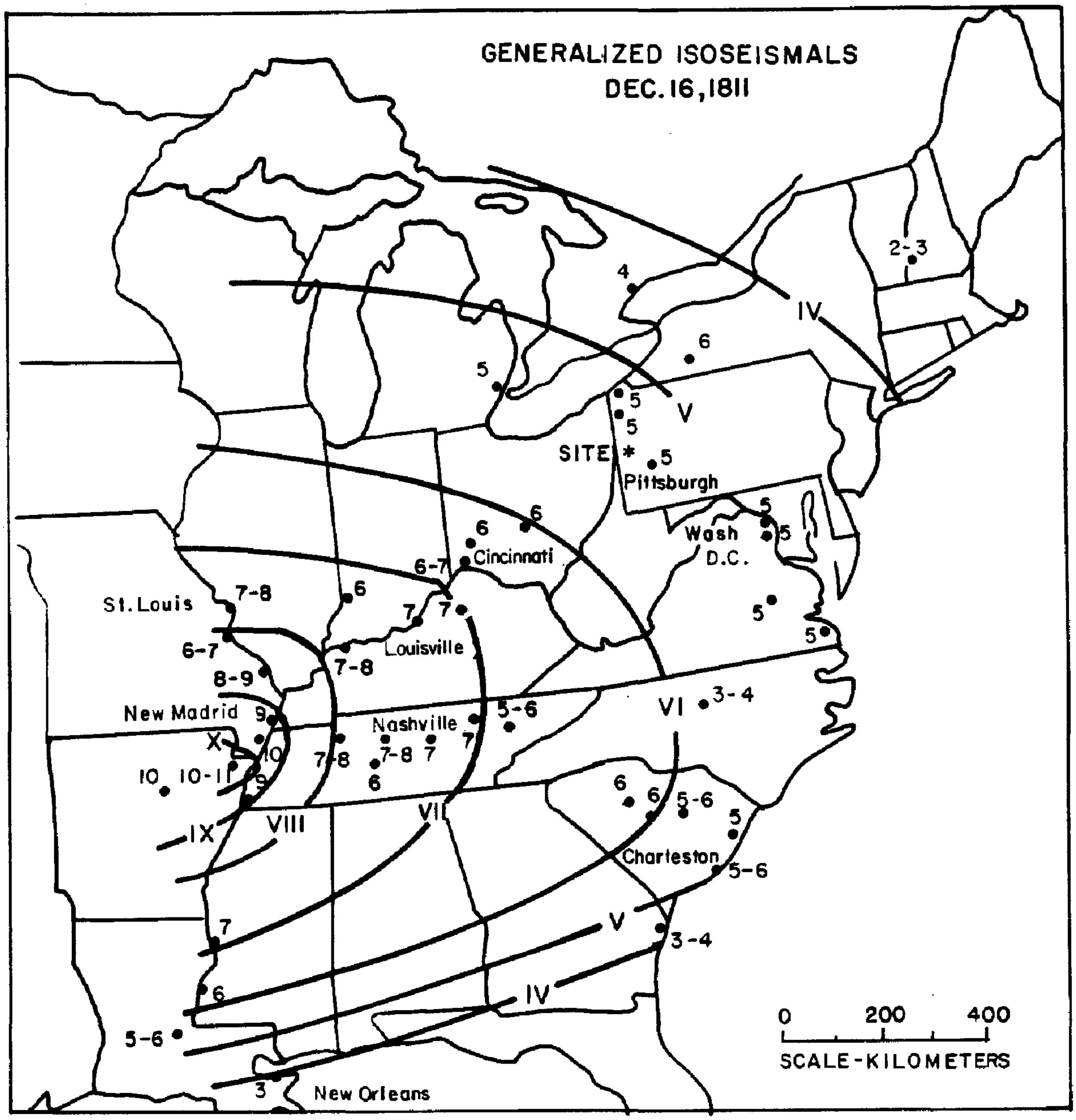
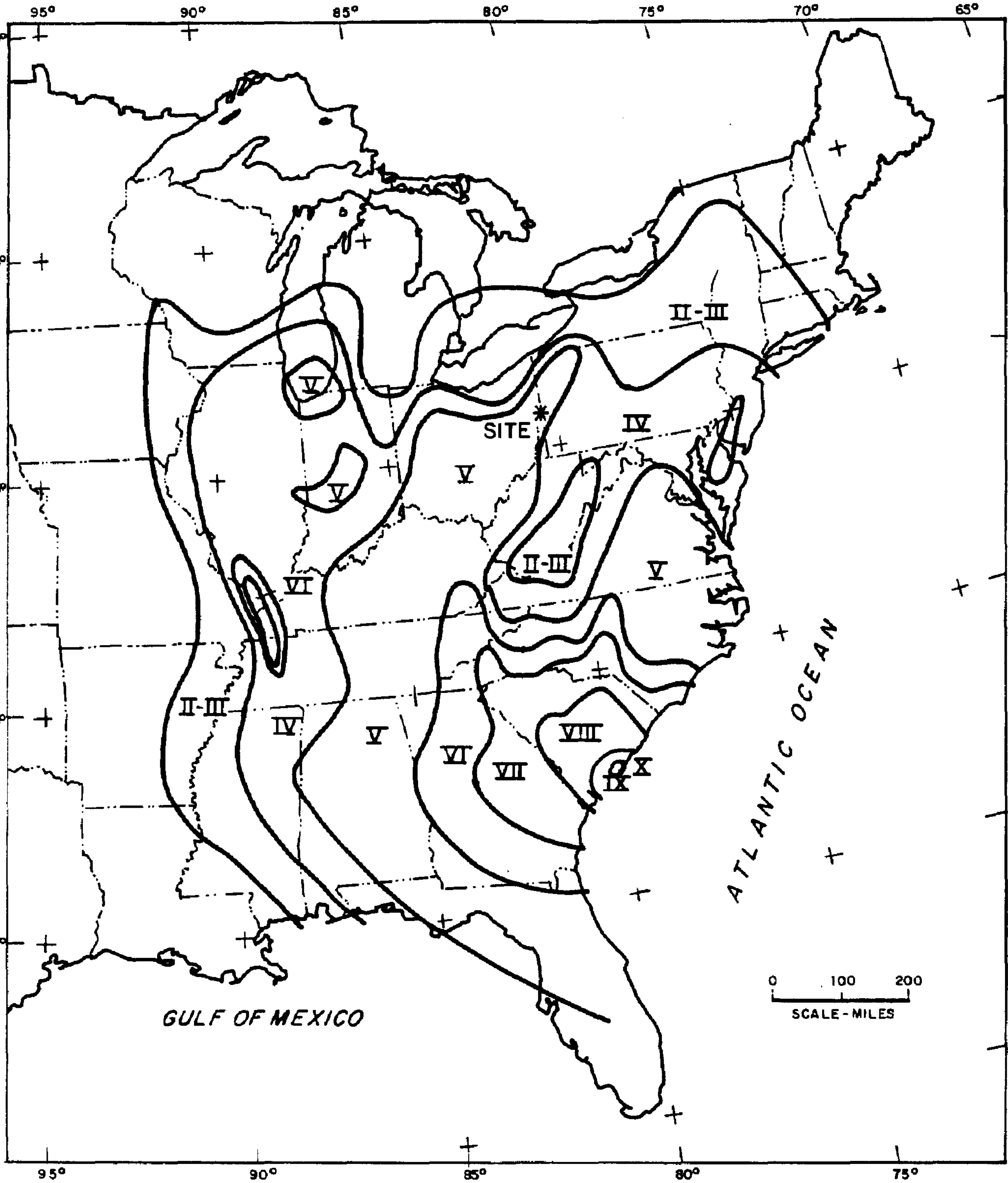


FIGURE 2.5.2-2
EPICENTERS & GEOLOGIC STRUCTURES
WITHIN 200 MILES OF THE SITE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



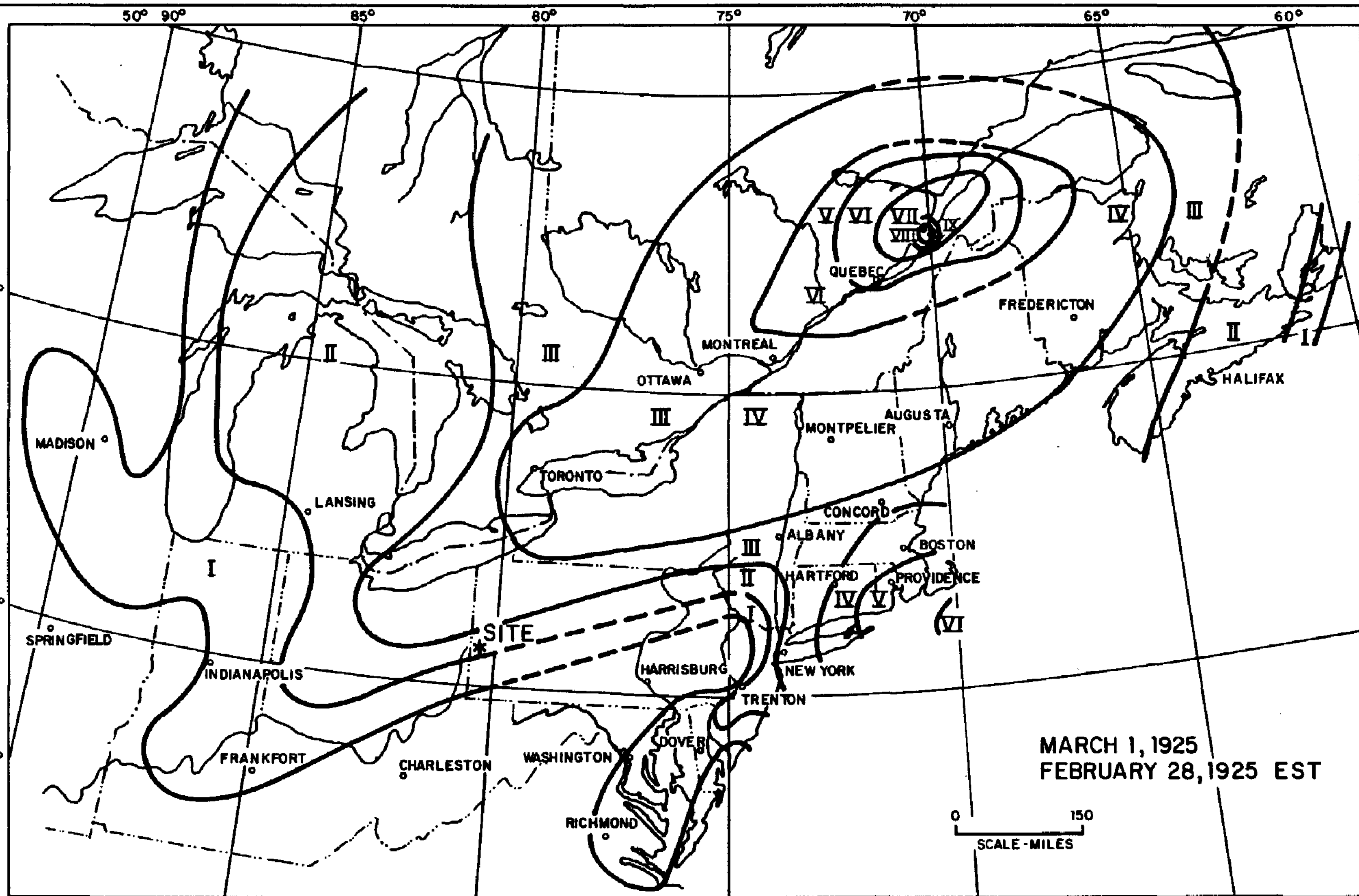
NOTE:
Nuttli 1973

FIGURE 2.5.2-3
ISOSEISMAL MAP
NEW MADRID EARTHQUAKE, 1811
BEAVER VALLEY POWER STATION-UNIT-2
FINAL SAFETY ANALYSIS REPORT



NOTE:
Bollinger, 1977

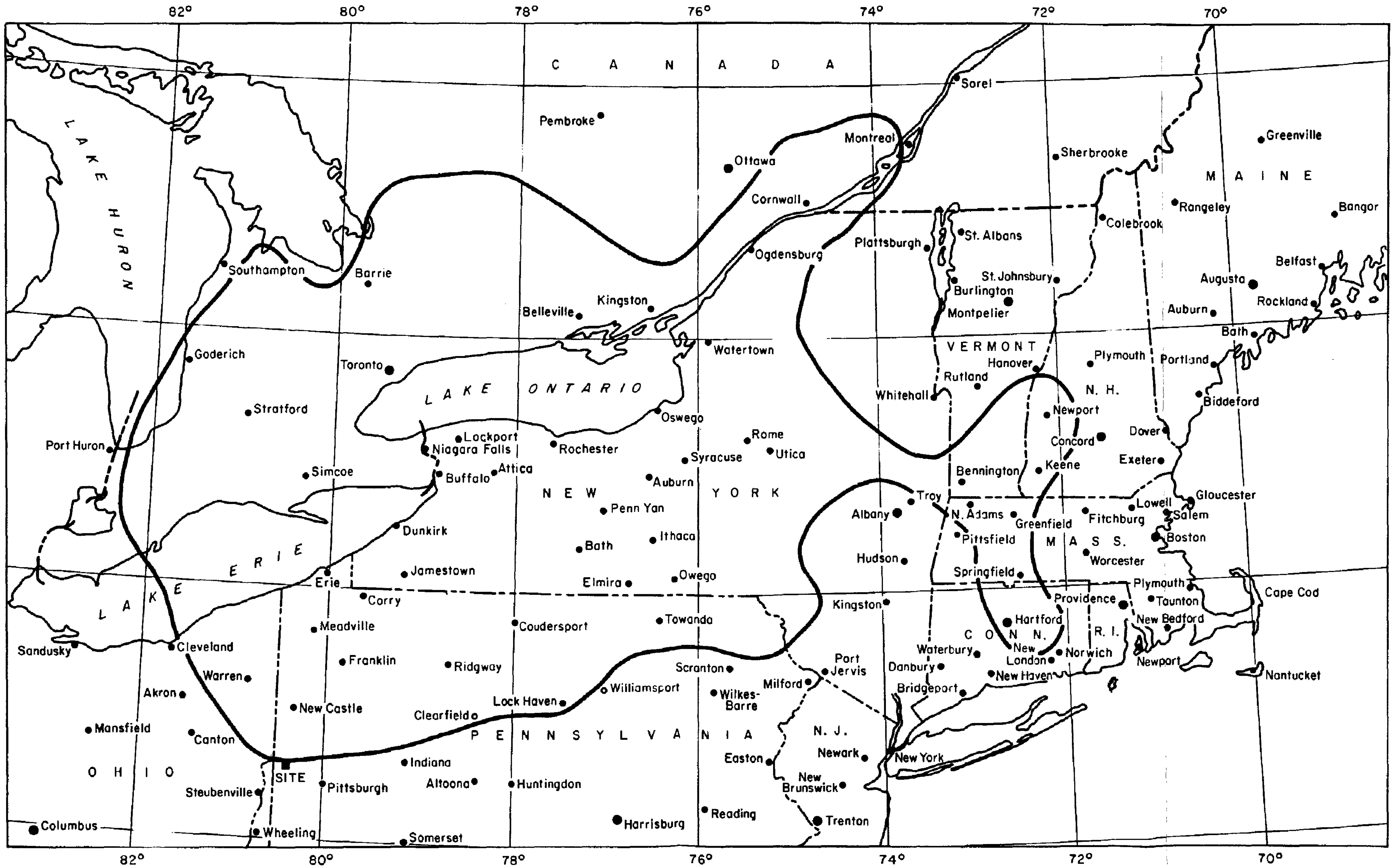
FIGURE 2.5.2-4
ISOSEISMAL MAP
CHARLESTON, S.C. EARTHQUAKE, 1886
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTE:

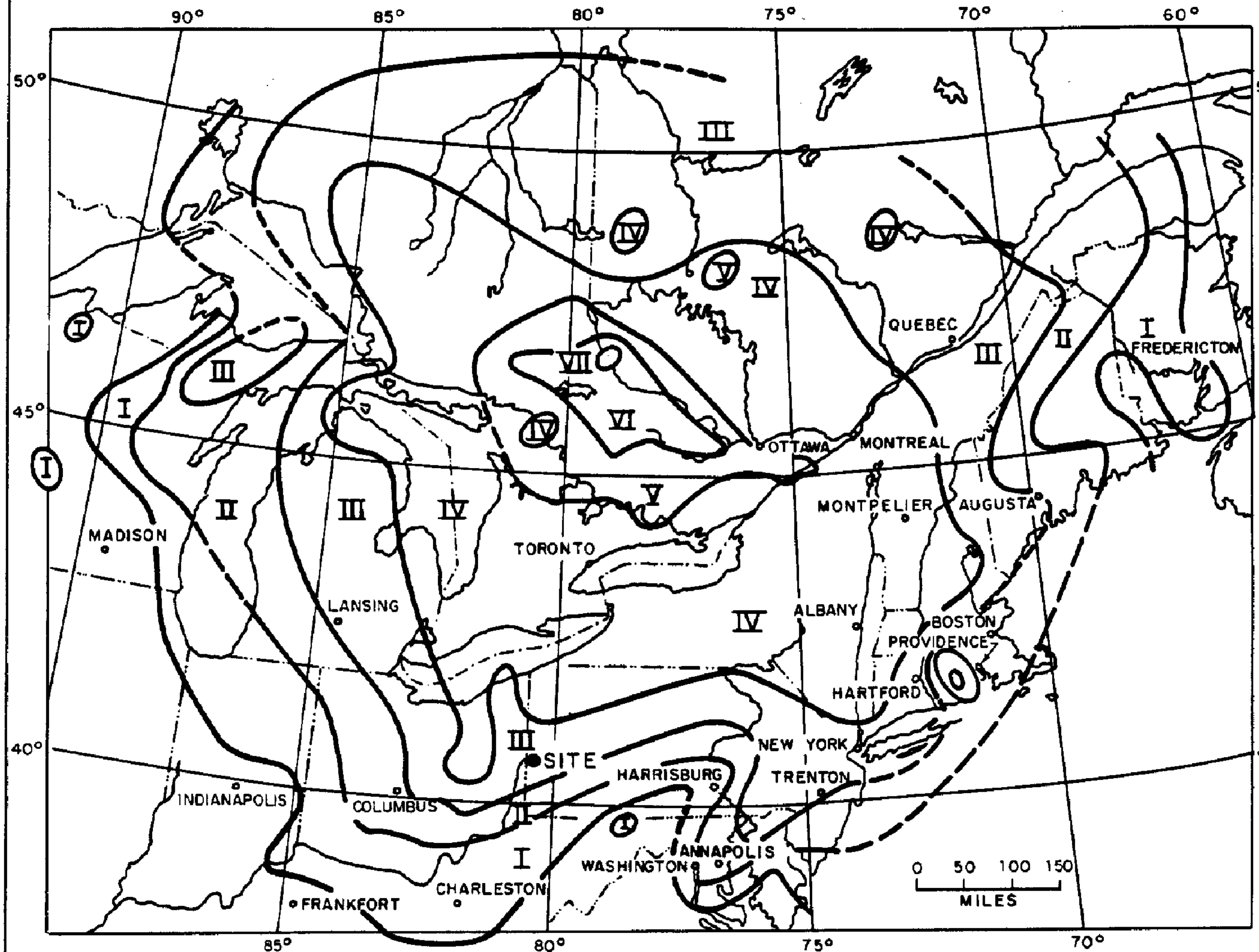
Smith 1966

FIGURE 2.5.2-5
ISOSEISMAL MAP
ST. LAWRENCE RIVER EARTHQUAKE, 1925
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT



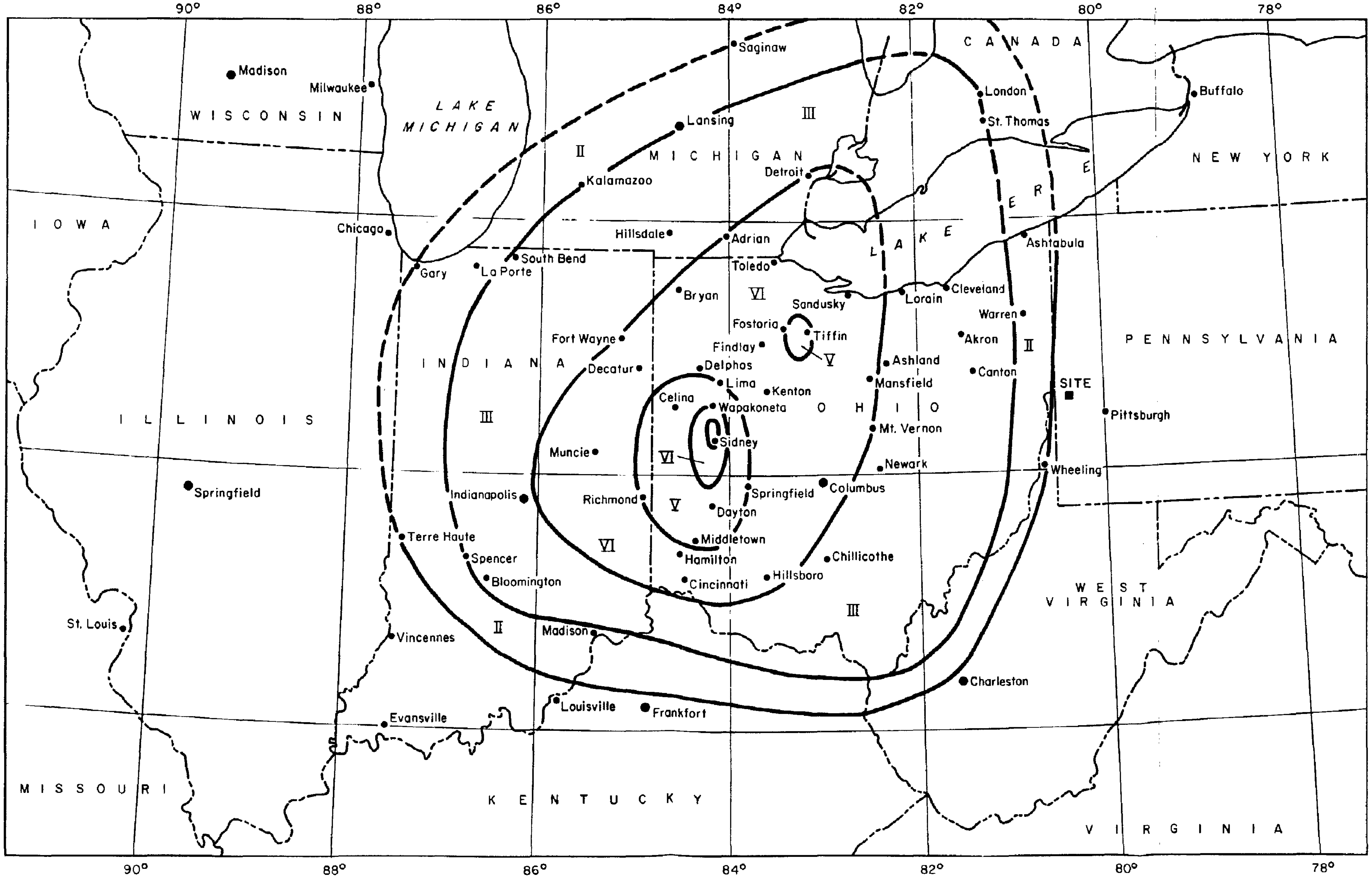
NOTE
UNITED STATES COAST AND GEODETIC SURVEY 1968

FIGURE 2.5.2-6
AREAS AFFECTED BY ATTICA EARTHQUAKE AUGUST 12, 1929.
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



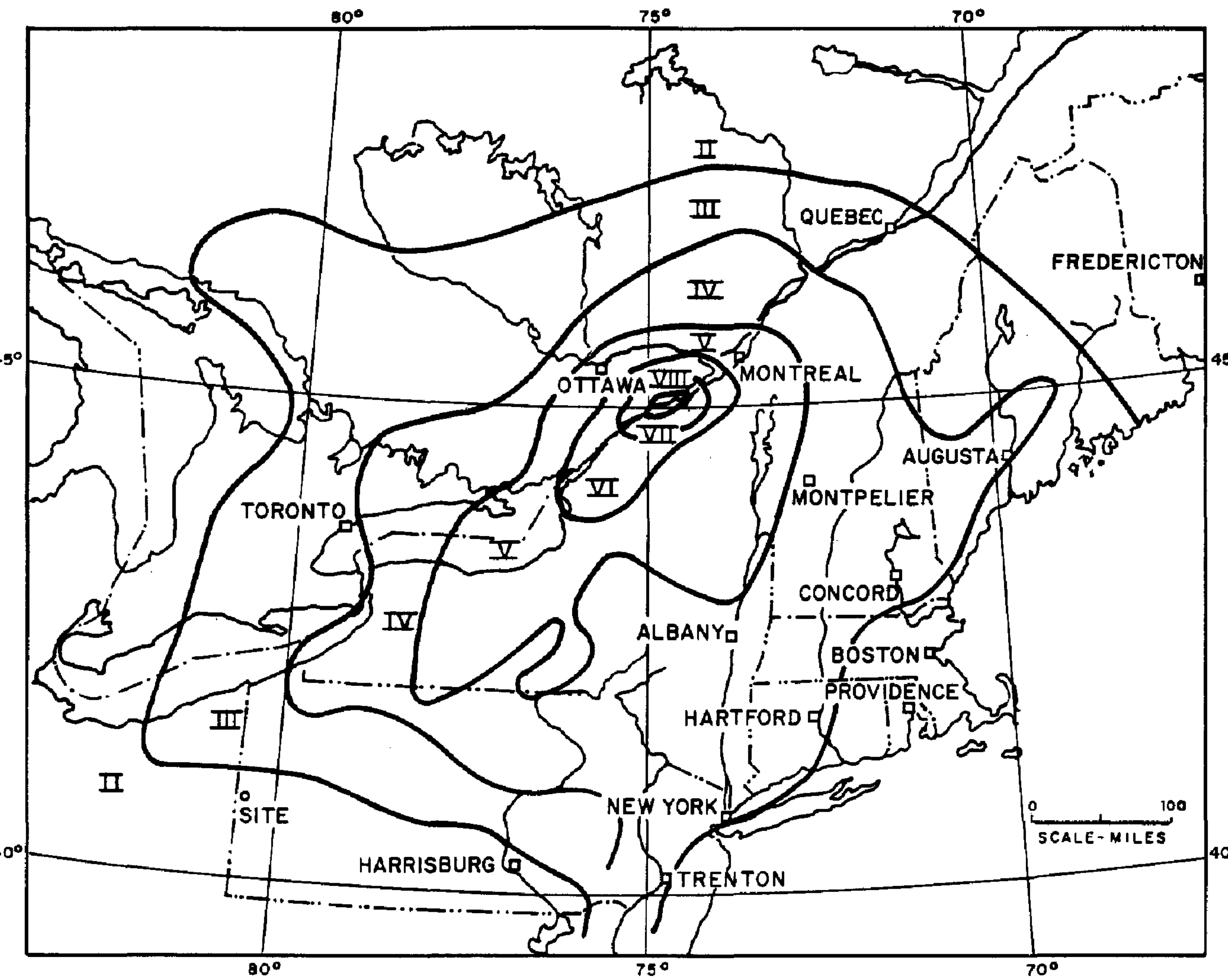
NOTE:
Smith 1966

FIGURE 2.5.2-7
ISOSEISMAL MAP
TIMISKAMING EARTHQUAKE, 1935
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES
1. WESTLAND AND HEINRICH 1940.
2. ROMAN NUMERALS INDICATES INTENSITIES ON THE WOOD-NEUMANN SCALE.

FIGURE 2.5.2-8
ISOSEISMAL MAP
ANNA, OHIO EARTHQUAKE
MARCH 9, 1937
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTE:
Smith 1966

FIGURE 2.5.2-9
ISOSEISMAL MAP
CORNWALL MASSENA EARTHQUAKE
SEPTEMBER 5, 1944

BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

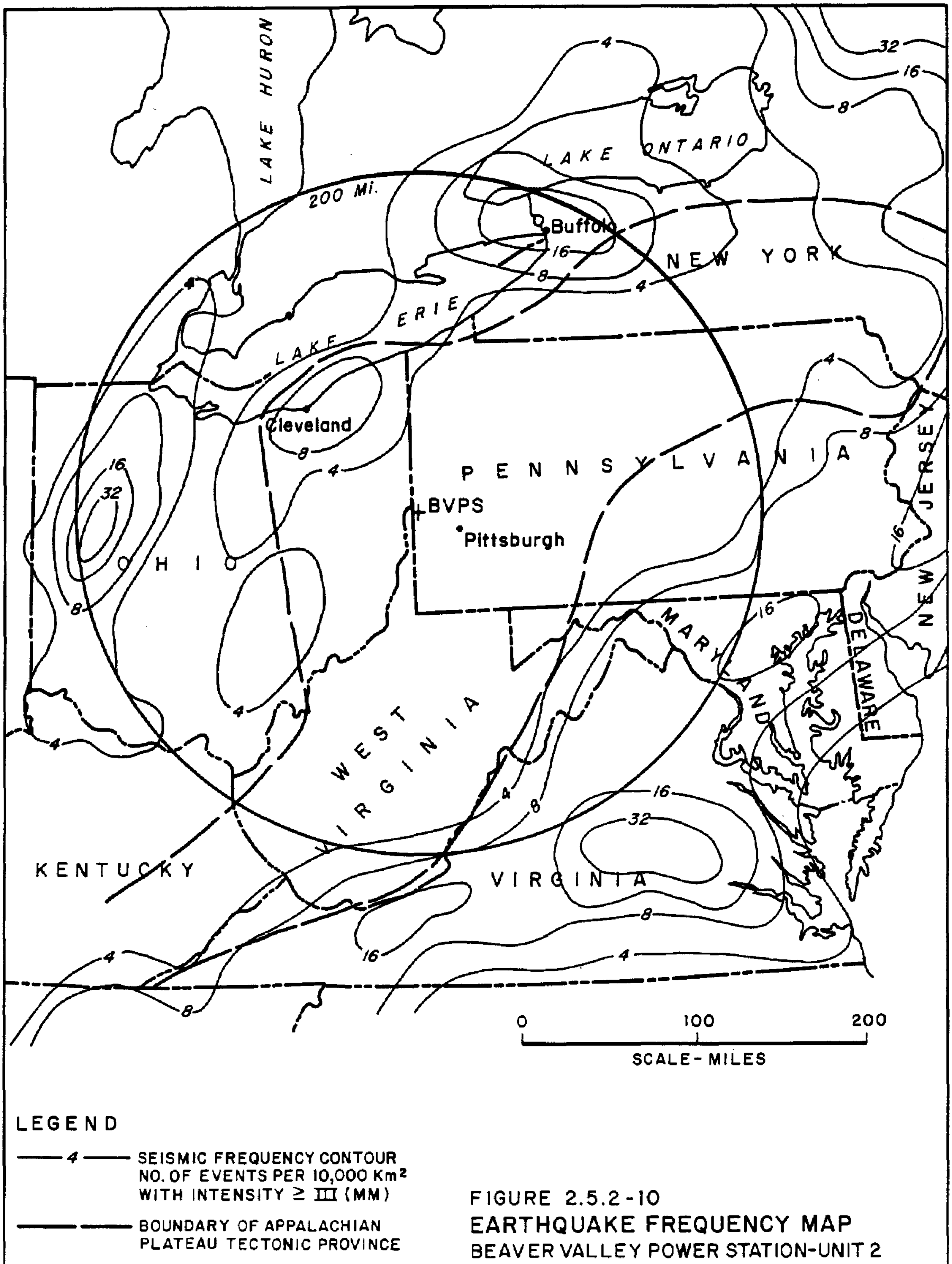
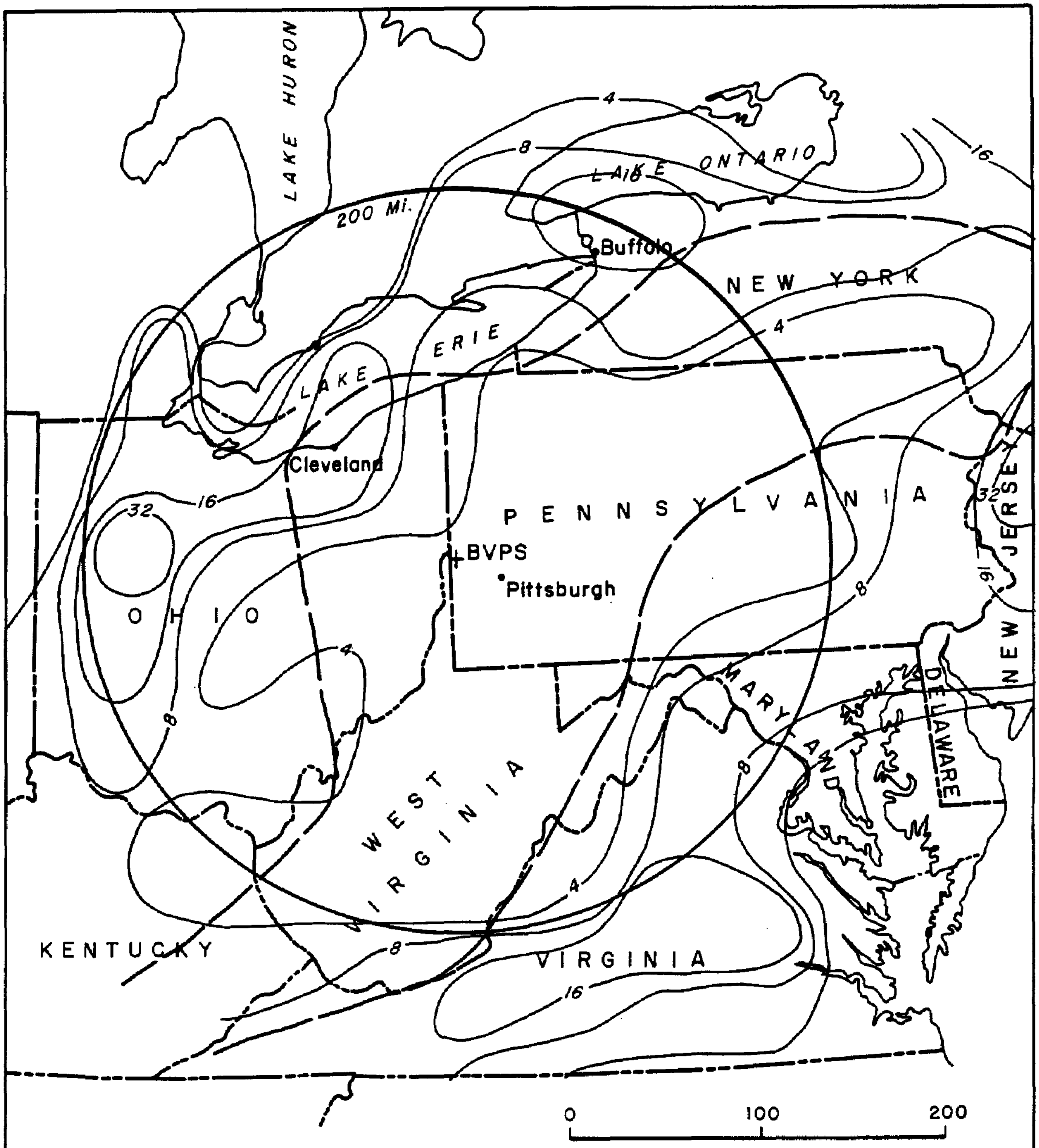


FIGURE 2.5.2-10
EARTHQUAKE FREQUENCY MAP
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

REFERENCE: Hadley & Devine, (1974)



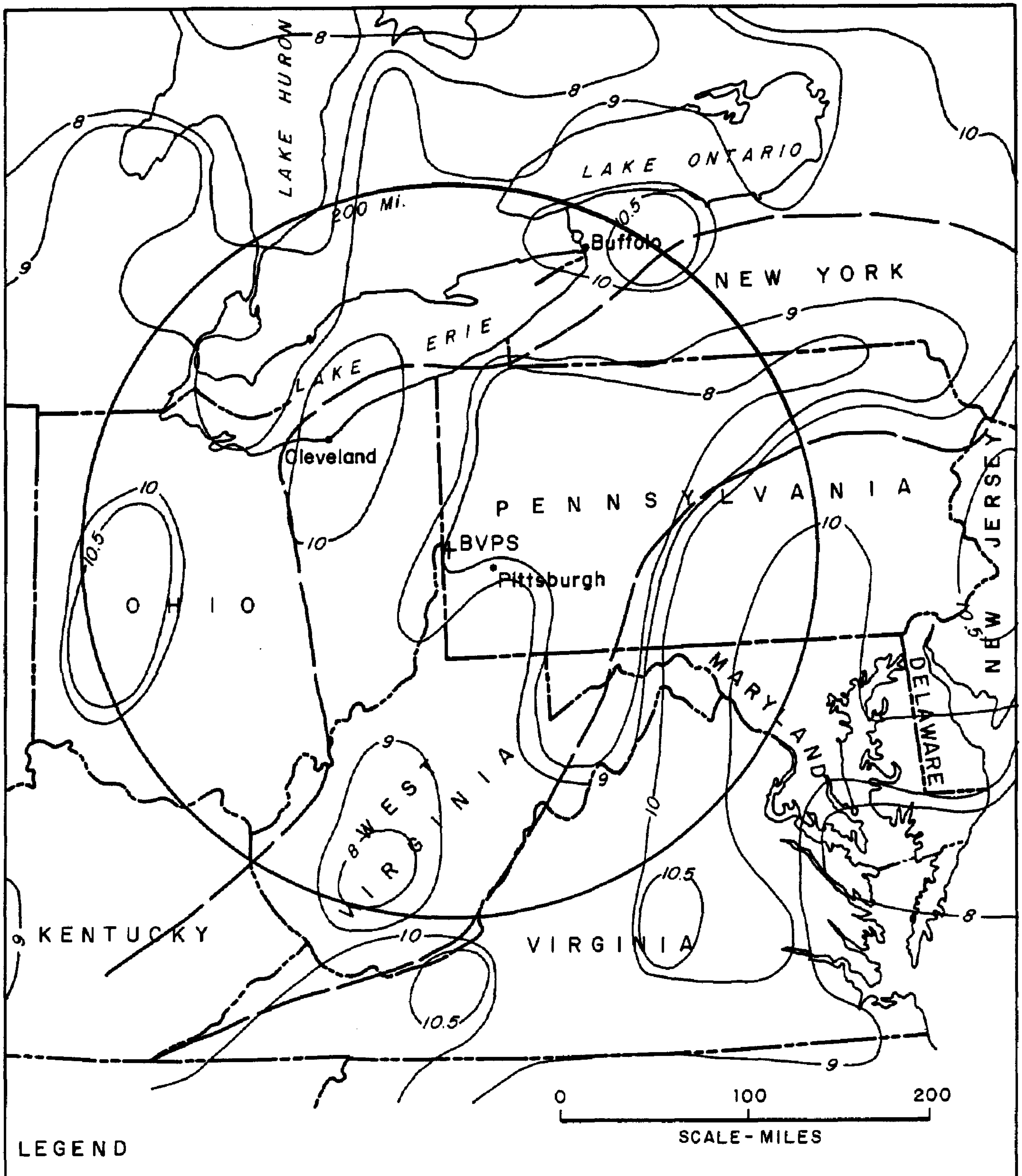
LEGEND

——4—— SIESMIC FREQUENCY CONTOUR NO. OF EVENTS PER 11,680 Km² WITH INTENSITY ≥ III (MM) OR LOCAL MAGNITUDE ≥ 2.0

—— —— BOUNDARY OF APPALACHIAN PLATEAU TECTONIC PROVINCE

FIGURE 2.5.2 - 11
EARTHQUAKE FREQUENCY MAP
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

REFERENCE: Barstow, et. al., (1981)



LEGEND

—— 9 —— STRAIN RELEASE CONTOUR REPRESENTS LOG_{10} FOR CUMULATIVE STRAIN RELEASE PER 11,689 Km^2 FOR EVENTS WITH INTENSITY ≥ III (MM) OR LOCAL MAGNITUDE ≥ 2.0
STRAIN = $10^{0.75 MAG + 5.9}$

—— —— BOUNDARY OF APPALACHIAN PLATEAU TECTONIC PROVINCE

FIGURE 2.5.2 - 12
CUMULATIVE STRAIN RELEASE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

REFERENCE: Barstow et. al., (1981)

2.5.3 Surface Faulting

No surface faulting exists at or near the site. There are no known active or capable faults within 150 miles of the site. There has been no mining, hydrocarbon extraction, or other activity beneath the site which could cause ground rupture at the site.

2.5.3.1 Geologic Conditions of the Site

The geologic conditions in the region and at the site are described in Sections 2.5.1.1 and 2.5.1.2, respectively.

2.5.3.2 Evidence of Fault Offset

There is no evidence of fault offset at the ground surface within 5 miles of the site or in any subsurface boring taken at the site.

2.5.3.3 Earthquakes Associated with Capable Faults

There is no seismic or geologic evidence of capable faulting within 5 miles of the site.

2.5.3.4 Investigation of Capable Faults

There are no known capable faults within 5 miles of the site requiring investigation.

2.5.3.5 Correlation of Epicenters with Capable Faults

There is no seismic evidence to indicate capable faulting within 5 miles of the site to correlate with epicenters.

2.5.3.6 Description of Capable Faults

There are no known capable faults within 5 miles of the site.

2.5.3.7 Zone Requiring Detailed Faulting Investigation

No zone requiring a detailed faulting investigation has been identified within 5 miles of the site.

2.5.3.8 Results of Faulting Investigation

A fault zone requiring a detailed investigation has not been identified in the site area.

2.5.4 Stability of Subsurface Materials and Foundations

This section presents the results of investigations and studies conducted to evaluate the stability of subsurface soils at the site and the foundations which they support. Engineering properties of soils were determined based on detailed field and laboratory investigations described herein. The evaluation of subsurface conditions and soil properties and the results of stability analyses are presented under the following specific headings.

2.5.4.1 Geologic Features

The major structures of Beaver Valley Power Station (BVPS) are located on the highest of three terraces along the south side of the Ohio River. They are composed predominantly of alluvial deposits derived from the cyclic aggradation and degradation of local materials and glacial outwash by the ancestral Ohio River drainage system during the Pleistocene period. Figure 2.5.4-1 is a typical north-south cross section through the site showing the terraces.

The Upper Pleistocene terrace slopes gently toward the Ohio River from about el 760 feet to 735 feet. The soils of this terrace consist predominantly of interbedded sands, gravels, and silty sands and gravels.

A zone of loose granular material from approximately el 640 feet to 660 feet was discovered in the plant area during the excavation for the Beaver Valley Power Station - Unit 2 (BVPS-2) containment foundation. The loose zone was present under approximately the northern portion of the containment and extended east and west beneath most of the Category I structures. The loose zone was successfully densified using the pressure injected footing technique. The extent of the densified area is shown on Figure 2.5.4-15. It has been determined that the densified in situ soil will be stable under all anticipated loading and environmental conditions. The densification program and its evaluation are fully described in the Duquesne Light Company (DLC 1976) Report on Soil Densification Program.

The near surface soils of the intermediate terrace (original ground surface el 685 feet to 700 feet) and the present floodplain (original ground surface el 675 feet) consist of medium stiff to soft clays and silts. These recent river silts and clays extend to approximately el 655 feet where they are underlain by sands and gravels to bedrock. The intermediate terrace is overlain in part by fill placed during the construction of Shippingport Atomic Power Station (SAPS) and Beaver Valley Power Station - Unit 1 (BVPS-1).

The bedrock in the area of the site is Pennsylvanian in age and belongs to the Allegheny group which consists of interbedded sandstones, shales, coal seams, and occasional limestones. The rock underlying the plant site is a dark gray carbonaceous shale which

dips gently southeastward about 15 to 20 ft/mi. The rock is slightly weathered for the first few feet with weathering effects decreasing rapidly with depth. A top of rock contour map is provided on Figure 2.5.4-50. The computer program SURFACE II (Sampson 1975) was used as an aid in developing the map. Input to SURFACE II was the top of rock elevations from the irregularly spaced exploratory borings. SURFACE II establishes a regularly spaced, orthogonal grid and interpolates top of rock elevations at these grid points utilizing a data fitting algorithm specified by the user. The computer develops the contour map from the interpolated grid elevations.

A check was made to verify that the computer-drawn map was an accurate representation of the top of rock elevations from the boring data. It was necessary to manually re-contour the computer-generated 800 to 875-feet contours because the computer-drawn contours did not adequately represent the top of rock elevations in an area of known rock surface geometry. Only the exploratory borings were used to evaluate the top of rock elevation; the verification borings performed for several densification programs in the main plant area provided redundant data and were not used.

As discussed in Section 2.5.1.2, there are no areas of actual or potential subsurface subsidence at the plant site.

The ground-water conditions at the site are discussed in detail in Sections 2.4.13 and 2.5.4.6.

Unrelieved residual stresses in rock were not considered to have an influence on the design and operation of the plant due to the thickness of the founding overburden.

2.5.4.2 Properties of Subsurface Materials

The BVPS is founded on the highest of three alluvial terraces. These terraces are described in more detail in Section 2.5.4.1.

Borings drilled within the main plant area indicate a subsurface profile consisting of about 115 feet of medium dense to dense granular soils underlain by shale bedrock with a top surface at about el 620 feet. A zone of loose granular material between about el 640 feet and 660 feet was discovered in the BVPS-2 plant area and was subsequently densified using the pressure injected footing technique (DLC 1976).

A lens of very stiff, silty clay was uncovered along the northern edge of the reactor containment excavation at about el 679 feet, the presence of which was not noted during the original subsurface investigation. The clay lens was removed from within the containment area and replaced with compacted structural fill. It extends eastward and is present beneath the northern portions of the

safeguards area and the refueling water storage tank (RWST). Its areal extent is discussed further in Section 2.5.4.7.1.

Subsurface profiles are presented on Figures 2.5.4-2, 2.5.4-3, 2.5.4-4, 2.5.4-5, 2.5.4-6, 2.5.4-7, 2.5.4-8 and 2.5.4-9, Figures 2.5.4-51, 2.5.4-52, 2.5.4-53, 2.5.4-54 and 2.5.4-55, and Figure 2.5.4-60, the locations of which are shown on Figures 2.5.4-10 and 2.5.4-13. The profiles are based upon the data from the boring logs which are referenced in Table 2.5.4-1.

An extensive laboratory testing effort was undertaken to establish the engineering and index properties of the intermediate and lower terrace silts and clays. The results are presented and summarized in Appendix 2.5D. Included are grain size analyses performed on samples of the in situ sands and gravels and the results of in place density

tests conducted during the documentation of the soil conditions at the reactor containment founding elevation (Section 2.5.4.5).

Attempts to obtain undisturbed samples of the in situ sands and gravels were unsuccessful. Consequently, the engineering properties of the sands and gravels developed for design purposes were based upon accepted conservative, empirical correlations of engineering properties to subsurface conditions determined by geophysical surveys, test borings, and field testing.

A plot of relative density versus blow count for the in situ sands and gravels is shown on Figure 2.5.4-11 for borings outside of the area densified by the pressure-injected footing technique. (Borings within the densified area are discussed in DLC'S 1976 Report on Soil Densification Program.) The relative density of most of the samples fall within the range of 50-80 percent, classifying the in situ sands and gravels as medium dense to dense (Terzaghi and Peck 1967). Based on a correlation with relative density (U.S. Department of the Navy 1971), the angle of internal friction of the in situ sands and gravels may range between about 33 and 40 degrees; an angle of 30 degrees was conservatively chosen for design purposes.

The dry unit weight of the in situ sands and gravels was taken as 117 pcf, based on an average of in place density tests performed during excavation for plant structures.

The specific gravity was taken as 2.65 and was based upon laboratory determination (Appendix 2.5D).

The void ratio was computed to be 0.4 from the equation:

$$e = \frac{G\gamma_w - \gamma_d}{\gamma_d} \qquad (2.5.4\text{-}1)$$

where:

- e = void ratio
- G = specific gravity
- γ_d = dry unit weight (pcf)
- γ_w = unit weight of water (62.4 pcf)

The saturated unit weight below the ground-water table was taken as 136 pcf from the equation:

$$\gamma_T = \frac{G + Se}{1+e} \bullet \gamma_w \qquad (2.5.4\text{-}2)$$

where:

- γ_T = total unit weight
- S = degree of saturation

Above the ground-water table, the total unit weight was taken as 125 pcf assuming an average water content of 7 percent.

The low strain shear moduli of the in situ sand and gravel, used in the estimation of building settlements, were determined using Equation 2.5.4-3.

$$G_{max} = \frac{1,230\ (2.97 - e)^2\ (\bar{\sigma}_o)\ 0.5}{(1+e)} \qquad (2.5.4\text{-}3)$$

where:

G_{max} = shear modulus (psi)

σ_o = effective octahedral stress (psi)

Shear moduli determined from in situ seismic velocity measurements compared quite well with those computed using this relationship as shown on Figure 2.5.4-12. Section 2.5.4.10.2 provides an in-depth discussion of the determination of elastic properties of the in situ sands and gravels used in the estimation of building settlement.

The following tests, the results of which are presented in Appendix 2.5D, were performed on undisturbed block samples of the stiff silty clay lens which was encountered below the reactor containment excavation:

1. Atterberg limits and natural water contents,

2. Constant rate of strain (CRSC) and incrementally loaded (IC) consolidation tests,

3. Unconsolidated undrained (UU) triaxial compression tests, and

4. Consolidated undrained ($\overline{CIU}$) triaxial compression tests.

Classification tests show that the silty clay has a liquid limit of 50, a plastic limit of 23, and a natural water content of 23 percent. The natural water content being equal to the plastic limit is an indication that the clay has been precompressed. The presence of small fissures with discoloration along their surfaces suggests that the precompression may have been due to dessication.

Consolidation tests show that the clay has been preloaded to a maximum past pressure ranging between 9.5 and 18 ksf. The estimated overburden pressure prior to the excavation for the containment foundation was approximately 7.5 ksf, indicating an overconsolidation ratio (OCR) of 1.3 to 2.4. The recompression ratio (RR) is approximately 0.02 and the compression ratio (CR) is approximately 0.12. The coefficient of consolidation (c_v) varies from approximately $5X10^{-3}$ to $1.8x10^{-2}$ cm^2/sec in the overconsolidated region and is approximately $2.5x10^{-3}$ cm^2/sec in the normally consolidated region. From the incremental consolidation test, the

average coefficient of secondary consolidation (c_{α}) ranges between $5X10^{-4}$ and $2X10^{-3}$ in/in/log cycle of time.

The effective friction angle ($\bar{\phi}$) as determined from the $\overline{CIU}$ triaxial test was 25.7 degrees, assuming that the effective cohesion intercept was zero. The undrained shear strength measured in the UU tests is approximately 4.3 ksf.

In situ shear wave velocity measurements are discussed in Section 2.5.4.4. Field measurements of permeability are discussed in Section 2.5.4.6. Dynamic engineering properties of the soils underlying the site are discussed in Section 2.5.4.7.3.

2.5.4.3 Exploration

Site specific exploration activities at the BVPS site, for the purpose of evaluating subsurface conditions, consisted of drilling exploratory borings, installing piezometers, and performing geophysical surveys.

2.5.4.3.1 Exploratory Borings

A total of 298 exploratory borings were performed under the supervision of Stone & Webster Engineering Corporation (SWEC) at the BVPS site for the construction of SAPS, BVPS-1 and BVPS-2. The locations of the exploratory borings are shown on Figures 2.5.4-10 and 2.5.4-13. A list of borings, along with the dates that they were drilled and the locations of the boring logs for reference purposes, is provided in Table 2.5.4-1. Boring logs which have not been published in previous documents are included in Appendix 2.5B.

The primary functions of the exploratory borings were to establish the nature of the overburden soils and rock, to study the geology of the site area, and to obtain representative samples to develop engineering properties for design purposes.

A series of borings, PL-1 through PL-66, was performed by others in conjunction with the construction of a sludge pipeline system for the Bruce Mansfield Plant. Borings TH-1 through TH-13 were performed by others for the BVPS emergency response facility. The borings are shown on Figure 2.5.4-13 and are referenced in Table 2.5.4-1. Site subsurface profiles within the BVPS-2 area, based on data derived from the borings, are shown on Figures 2.5.4-2, 2.5.4-3, 2.5.4-4, 2.5.4-5, 2.5.4-6, 2.5.4-7, 2.5.4-8 and 2.5.4-9, Figures 2.5.4-51, 2.5.4-52, 2.5.4-53, 2.5.4-54 and 2.5.4-55; and on Figure 2.5.4-60.

Six piezometers were installed, at the locations shown on Figure 2.5.4-14, for the purpose of studying ground-water conditions at the site. Discussion of the data obtained is contained in Section 2.5.4.6.

2.5.4.3.2 Verification Borings

A total of 154 verification borings were performed to evaluate the results of the in situ densification program in the BVPS-2 area described in the Report on Soil Densification Program, (DLC 1976). A boring location plan is given on Figure 2.5.4-15, which also outlines the area densified. Each boring was evaluated on a sample-by-sample basis to verify that the desired degree of densification had been achieved. The logs of the verification borings can be found in Appendix I of the Report on Soil Densification Program, (DLC 1976).

Borings 501 through 562 were performed to verify the effectiveness of a vibroflotation densification program of the soil underlying the river water and service water system pipelines during the construction of BVPS-1. The limits of densification are shown on Figure 2.5.4-16, and Figure 2.5.4-54 presents the subsurface conditions beneath the 30-inch service water system lines from the valve pit to the intake structure. The purpose of the program was to remove the potential for liquefaction of the underlying sands and gravels. This work is described in the Response to USNRC Questions 2.26 and 2.27 of the BVPS-2 PSAR, (DLC 1972e).

Borings 537T through 577T (Figure 2.5.4-13) were performed to verify the effectiveness of the Terra Probe densification program around the main intake structure. It was postulated that the nondensified soils, should they liquefy, could block the intake structure. The Terra Probe densification program was undertaken to prevent such an occurrence. This work is described in Section 2.5.4.12. The boring logs are included in Appendix 2.5B.

2.5.4.4 Geophysical Surveys

Geophysical surveys were conducted at the site by Weston Geophysical Engineers, Inc., to measure the in situ compression and shear wave velocities of the soil and rock. Appendix 2G of the BVPS-2 PSAR, (DLC 1972f) presents the results of measurements taken in 1968 in the area of the reactor containment for BVPS-1. Subsequent to the soil densification program at BVPS-2, additional crosshole seismic velocity measurements were made in the densified area. The results of this study are presented in the Report on Soil Densification Program, (DLC 1976). A summary of the information obtained from the geophysical surveys is given on Figure 2.5.4-17. A comparison of the measured in situ shear wave velocities on Figure 2.5.4-18 shows little difference before and after densification.

The field work involved with the measurement of the post-densification, in-situ, seismic velocities was performed between June 9 and June 22, 1977. From piezometer data presented in Appendix 2.5A, the ground-water levels within the terrace sands and gravels of the main plant area during this period averaged approximately el 665.7 feet. Consequently, the water level of el 652 presented by Weston Geophysical Engineers appears to be incorrect. The soil layer

between approximately el 652 and el 667 with a compressive wave velocity of 3,000 ft per second was mostly below the ground-water table at the time of the seismic survey.

Since water is relatively incompressible, as compared to the soil skeleton, measurements of compressive (P) wave velocities below the ground-water table are more representative of the water than the soil. The compressive wave velocity of water is about 5,000 ft per second; therefore, the reported compressive wave velocity of 3,000 ft per second between el 652 and el 667 is anomolous.

This value of compressive wave velocity from the seismic survey was not used in analyzing the behavior of safety-related plant structures, systems, or components.

2.5.4.5 Excavations and Backfill

A comprehensive onsite quality control program was instituted at BVPS-2 to ensure compliance with excavation, material, and compaction requirements as specified by SWEC. This program was under the control of Duquesne Light Company Site Quality Control (DLC-SQC).

Field inspection and testing, as required, were performed by Dick Corporation Field Quality Control (DC-FQC), which reported directly to DLC-SQC.

2.5.4.5.1 Excavation

Permanent Seismic Category I excavations are not present at the site. All excavations are temporary and are related to the construction of the plant structures. They will be backfilled as required prior to plant operation. The areal extent of excavations in the plant area is shown on Figure 2.5.4-19. Profiles through the plant area are given on Figures 2.5.4-2, 2.5.4-3, 2.5.4-4, 2.5.4-5, 2.5.4-6, 2.5.4-7, 2.5.4-8 and 2.5.4-9.

To ensure the suitability of the excavated foundation levels for Category I structures, buried piping, and duct lines, the DC-FQC inspector verified the following (DLC 1979, SWEC 1978):

1. Excavated areas were within the limits shown on the drawings,

2. All excavated or bedding areas or fill areas, as applicable, were graded to within 0.2 foot of the grades shown on the drawings,

3. Tests were performed on granular excavated material and/or founding elevation, as applicable, as required in Table 2.5.4-2,

4. Any soft spots at the bottom of excavations were removed and backfilled at the direction of the Geotechnical Engineer, and

5. The founding elevations or prepared surfaces, as applicable, were approved by the Geotechnical Engineer.

The excavation for the reactor containment was made within a steel sheetpile cofferdam driven to el 671 feet. Upon completion of the excavation to el 679 feet, a foundation documentation program was conducted which consisted of the following:

1. Establishing a 25-foot square grid over the floor of the containment excavation,

2. Photographing the floor of the containment excavation,

3. Performing in-place density tests at each grid intersection, and

4. Obtaining a bag sample of the founding soil at each grid intersection for classification.

Grain size analyses performed on each bag sample and the results of the in-place density tests are presented in Appendix 2.5D.

The foundation documentation program revealed the presence of a lens of stiff silty clay along the northern perimeter of the containment excavation at el 679 feet; the presence of which was not encountered during the original subsurface investigation. The lens extends eastward beneath roughly the northern half of the safeguards area and the RWST. The areal extent of the clay lens is discussed further in Section 2.5.4.7.1. Soil profiles beneath the safeguards area and the RWST are shown on Figures 2.5.4-8 and 2.5.4-9. Laboratory tests performed on undisturbed block samples recovered from the containment excavation are presented in Appendix 2.5D and are summarized in Section 2.5.4.2.

The clay was removed from within the containment excavation and replaced with compacted structural fill; it was not removed from beneath the safeguards area and the RWST. Estimates of the settlements of the safeguards area and the RWST were found to be within tolerable limits (Figure 2.5.4-20) and the stiff clay was not considered to be a concern to the stability of the structures insofar as a bearing capacity failure was concerned due to the overlying thickness of compacted structural fill. The area beneath the northern portion of the safeguards area and the RWST was excavated to el 690 feet during the soil densification program (Section 2.5.4.12) and then backfilled with compacted structural fill.

Portions of the intermediate terrace and present floodplain (Figure 2.5.4-1) have been overlain by uncontrolled fill and nonstructural fill placed during the construction of SAPS and BVPS-1. The limit of the uncontrolled fill in the plant area was determined from a comparison of the original ground topography that existed prior to the construction of SAPS with the topography after the completion of BVPS-1. The excavation to el 690 feet north and east of the containment shown on Figure 2.5.4-19 was conducted to remove this material. The excavated area was then backfilled with compacted select granular fill.

Measures to control ground-water levels during excavation were not required. The ground-water level reflects the Ohio River water level which has a normal pool elevation of 665 feet. With the exception of a local area within the containment cofferdam, the bottom of all excavations were well above el 665 feet.

2.5.4.5.2 Backfill

Specifications

Structural or select granular fill for use beneath and adjacent to Category I structures consisted of well-graded sand and gravel, which conformed to the following grain size requirements:

Sieve size	Percent passing by dry weight
6 (inches)	100
No. 200	0-15 (nonplastic fines)

Figure 2.5.4-21 shows the upper and lower gradation limits Of 115 grain size analyses on material used for structural fill. Compaction tests performed on these samples according to ASTM 1557, Method D, indicated a mean maximum dry density of 136.9 pcf with a mean optimum water content of 7 percent.

The material was placed in loose lifts of 6 to 12 inches and compacted to a minimum of 95 percent of the maximum dry unit weight obtained from compaction tests performed in accordance with ASTM D1557, Method D, with a minimum required in-place density of 130 pcf.

Material testing requirements were as given in Table 2.5.4-2 (SWEC 1978).

Granular borrow material meeting the gradation requirements for structural/select granular fill was obtained from the suppliers listed in Table 2.5.4-6. Also shown are quantities of backfill provided by each supplier.

In situ soils removed from on-site excavations were not used as structural fill beneath or around Category I structures.

Soil Properties

The dry unit weight of compacted structural fill was taken as 130 pcf, corresponding to 95 percent of the mean maximum dry density from 115 moisture density tests.

The specific gravity was taken as 2.65.

The void ratio was computed to be 0.27.

The saturated unit weight below the ground-water table was taken as 144 pcf from the equation:

$$\gamma_T = \frac{G + Se}{1+e} \bullet \gamma_w \tag{2.5.4-4}$$

where:

γ_T = total unit weight (pcf)
G = specific gravity
S = degree of saturation, decimal (100%)
e = void ratio
γ_w = unit weight of water = 62.4 pcf

Above the ground-water table, the total unit weight was taken as 136 pcf assuming an average water content of 5 percent.

The angle of internal friction of compacted structural fill was conservatively assumed to be 36 degrees.

Low strain shear moduli were estimated using Equation 2.5.4-5 as follows (Hardin and Drenewich 1972):

$$G = \frac{1{,}230\ (2.97 - e)^2\ (\bar{\sigma}_o)^{0.5}}{1+e} \tag{2.5.4-5}$$

where:

G = shear modulus (psi)
$\bar{\sigma}_o$ = effective octahedral stress (psi)

The vertical coefficient of subgrade reaction for buried pipe was computed according to the following equation (Vesie 1961, 1961a):

$$k_v = \frac{0.65^{12}}{D_o} \sqrt{\frac{E_s D_o{}^4}{E_p I_p}} \left(\frac{E_s}{1-\upsilon^2}\right)$$

(2.5.4-5a)

where :

k_v = vertical coefficient of subgrade reaction (lb/in^3)

D_o = outside diameter of pipe (in)

E_s = Young's modulus of soil (lb/in^2)

E_p = Young's modulus of pipe (lb/in^2)

I_p = moment of inertia of pipe section (in^4)

ν = Poisson's ratio of soil

An average, low strain value of shear modulus, G, was estimated using equation 2.5.4-5 for two ranges of pipe embedment depth, H_e:

H_e <15 ft; G = 2250 ksf

15 ft $\leq H_e$ <30 ft; G = 4350 ksf

Using these values of shear modulus, Young's modulus, with a reduction to account for strain, was estimated as:

$$E_s = 2\ (1+\nu)\ \frac{G}{3} \qquad (2.5.4\text{-}5b)$$

Vertical coefficient of subgrade reaction is shown on Figure 2.5.4-62 as a function of depth of embedment and pipe diameter.

The horizontal coefficient of subgrade reaction for buried pipe was determined according to the empirical procedure described by Audibert and Nyman (1977). An analytical procedure was developed to determine the horizontal load-displacement (p-y) curve for any size pipe embedded at any given depth. Considering the horizontal coefficient of subgrade reaction as the amount of soil pressure reaction generated by a given amount of horizontal displacement (that is, as a secant to the p-y curve), the coefficient of horizontal subgrade reaction can be expressed by:

$$k_h = \frac{p}{y} = \frac{1}{A' + B'\,y} \qquad (2.5.4\text{-}5c)$$

where:

k_h = horizontal coefficient of subgrade reaction (lb/in^3)
p = pressure (lb/in^2)
y = displacement (in)

$$A' = \frac{0.145\ yu}{q_u} \quad (in^3/lb)$$

$$B' = \frac{0.855}{q_u} \quad (in^2/lb)$$

y_u = ultimate displacement (in)
q_u = ultimate soil resistance (lb/in^2)

Considering the buried pipe as horizontal footing, the ultimate soil resistance, q_u is computed as:

$$q_u = \gamma\ Z\ N_q \qquad (2.5.4\text{-}5d)$$

where:
q_u = ultimate soil resistance (lb/in^2)
γ = unit weight of soil around pipe (lb/in^3)
Z = depth to center of pipe (in)
N_q = bearing capacity factor

The bearing capacity factor is given on Figure 2.5.4-63. The ultimate displacement, y_u, was evaluated from Figure 2.5.4-63. The iterative procedure used to calculate displacements assumes an initial value of displacement in order to compute an initial value of k_h. Then, using this initial value of k_h, an actual displacement is computed. This procedure continues until the iterative values converge at a final displacement.

2.5.4.6 Ground-water Conditions

Regional and local aquifer characteristics are described in detail in Section 2.4.13.

At the bottom of the excavation for the reactor containment foundation, four temporary observation wells were installed at the locations shown on Figure 2.5.4-22. These observation wells were abandoned when the reactor containment foundation mat was placed. Ground-water level readings as well as the Ohio River elevation were recorded daily from March 19, 1976 until May 21, 1976. The data are shown on Figures 2.5.4-23, 2.5.4-24, 2.5.4-25 and 2.5.4-26 along with installation details of the observation wells. As can be seen from the data, there is essentially no hydrodynamic time lag between the elevation of the Ohio River and the ground-water level in the observation wells.

Falling head permeability tests were conducted in three of the wells in order to estimate the coefficient of permeability. The results were:

Well No.	Coefficient of permeability ($x10^{-3}$ cm/see)
1	1.3-3.9
3	0.9-1.7
4	0.9-3.5

In 1977, as part of the settlement monitoring program that is described in Section 2.5.4.13, six piezometers were installed at the locations shown on Figure 2.5.4-14. A typical piezometer detail is shown on Figure 2.5.4-27 and installation data are given in Appendix 2.5A. Tip elevations range between el 646 feet and 651 feet, and all of the piezometers are located within the in situ sand and gravel.

Piezometer data and Ohio River elevation data were recorded during construction on a weekly basis since mid-1977 and are included in Appendix 2.5A. With the exception of one period during February 1979, the ground-water levels recorded in the piezometers show very good correlation with the Ohio River elevations. During February 1979, the river rose to el 681 feet and the piezometer data indicate an apparent time lag. However, the piezometers were only read weekly during this period and in the interim between readings the water level in the piezometers may have risen higher thereby reducing the apparent elevation difference between the ground-water level and the Ohio River elevation indicated by the data.

For the purpose of design, the ground-water level in the plant site area can be expected to reflect the various stages of the Ohio River as discussed in Section 2.4 and repeated as follows:

River stage	Elevation (feet)
Normal water level	665
Ordinary high water	675
Twenty-five year flood	690
Standard project flood	705
Probable maximum flood	730

The design basis for substructure hydrostatic loading is discussed in Section 2.4.13.5.

As stated in Section 2.5.4.1, dewatering for the control of ground water in the plant area during excavation was not required.

The exterior surfaces of the reactor containment shell and foundation mat are protected from water seepage during flood stages caused by the standard project flood and the probable maximum flood by a continuous waterproof membrane. In the event that leakage should occur through the membrane, a supplementary water relief system is provided in the containment to prevent the buildup of water pressure under and behind the steel liner. This system is described in Section 3.8.1.1.1.

2.5.4.7 Response of Soil and Rock to Dynamic Loading

This section describes the dynamic engineering properties of the soils underlying the site and the method used to determine relative displacement between two structures during a seismic event.

Soil structure interaction analyses and the response of buried pipe to dynamic loading is discussed in Sections 3.7B.2 and 3.7B.3, respectively. A discussion of the liquefaction and dynamic settlement potential of the soils at the site is given in Section 2.5.4.8.

2.5.4.7.1 Subsurface Conditions

Subsurface exploration activities conducted at the site are described in Section 2.5.4.3. Soil profiles through the main plant area with the major structures superimposed are shown on Figures 2.5.4-2, 2.5.4-3, 2.5.4-4, 2.5.4-5, 2.5.4-6, 2.5.4-7, 2.5.4-8 and 2.5.4-9. The geology of the site is described in Sections 2.5.1.2 and 2.5.4.1. Soil profiles under Category I pipelines are shown on Figures 2.5.4-51, 2.5.4-52, 2.5.4-53, 2.5.4-54 and 2.5.4-55.

The major structures of BVPS-2 are located on the highest of three alluvial terraces along the south side of the Ohio River. These terraces are described in more detail in Section 2.5.4.1. Foundation information for Category I structures is given in Table 3.7B-2. Category I structures are founded on compacted select granular fill overlying dense in situ granular soil which extends to rock or directly on the in situ granular soil with one exception. The soil in the vicinity of the safeguards area was excavated to el 690 feet

as shown on Figure 2.5.4-8 to remove uncontrolled fill placed during the construction of SAPS and BVPS-1. Beneath the northern portions of the safeguards area and the RWST, underlying the select granular fill which was placed subsequent to the excavation, is a layer of stiff silty clay with a top surface at approximately el 688 feet. The layer is about 20 feet thick at the northern edge of the safeguards area and about 10 feet thick at the northern edge of the RWST. The layer thins to the south and is no longer present at about the east-west centerline of the safeguards area (Figures 2.5.4-8 and 2.5.4-9).

A zone of loose, in situ granular material located from approximately el 640 feet to 660 feet was discovered in the BVPS-2 plant area during the excavation for the reactor containment. This zone was successfully densified using the pressure-injected footing technique.

Site investigations did not detect evidence of features or conditions indicative of disturbance during prior earthquakes.

2.5.4.7.2 In Situ Seismic Velocity Measurements

The results of geophysical surveys conducted at the site are presented in Section 2.5.4.4.

2.5.4.7.3 Dynamic Soil Properties

Measurements were made of the in-situ shear wave velocity of the terrace sands and gravels by Weston Geophysical (DLC 1976). The results are tabulated on Figure 2.5.4-17 and plotted on Figure 2.5.4-18. The 1968 survey was performed in the vicinity of the BVPS-1 reactor containment building and the 1977 survey was performed after the soil densification program in the vicinity of the BVPS-2 fuel building. The terrace soil conditions at the two locations are very similar. The shear wave velocities in the densified zone are similar to those in the vicinity of the BVPS-1 reactor containment. This suggests that the soil densification program increased the density and modulus of the formerly loose sands and gravels such that they are similar to the density and modulus of the soils outside the densified area.

A finite element, soil-structure interaction analysis was performed to evaluate the effect of the densified zone on the response of the reactor containment structure. The densified zone is present beneath about one-half of the containment mat. A benchmark analysis was performed without the densified layer present and was compared with an analysis of an unsymmetric case which included the densified layer. In the latter analysis, conditions were exaggerated because the shear modulus value assigned to the densified zone was very much greater than that computed from the shear wave velocity measurements. The results indicated very little difference in the computed response of the containment structure for the two cases and it was therefore concluded that assuming properties within

the densified zone consistent with those outside the densified zone was justified.

As discussed in Section 2.5.4.2, and shown on Figure 2.5.4-12, the low strain shear moduli of the in-situ sands and gravels determined from the measured shear wave velocities outside the densified area compare quite well with those determined using the empirical relationship of Hardin and Drenevich (1972).

Shear strains generated by earthquake motions cause a reduction in the low strain value of shear modulus. Using test data presented by Seed (et al 1975), the low strain values of shear modulus were reduced for anticipated strain levels during the safe shutdown earthquake (SSE) as shown on Figure 2.5.4-12.

The low strain shear modulus of compacted structural fill was determined using the empirical relationship of Hardin and Drenevich (1972) as given in Section 2.5.4.5.

Cyclic triaxial tests to investigate the susceptibility of compacted structural fill to liquefaction were not performed. As stated in Section 2.5.4.5.2, structural fill was placed and compacted to 95 percent of the maximum dry density indicated by ASTM 1557 Method D, with a minimum required in-place dry density of 130 pcf, and this, coupled with the gradation of the material, was considered sufficient to preclude liquefaction. Liquefaction analyses are performed assuming, as a minimum, a groundwater level coincident with the 25-year flood, which for BVPS is at el 690 feet. With the exception of an area beneath the northern portion of the reactor containment foundation, as shown on Figure 2.5.4-19, all structural fill within the main plant area was placed above el 690 feet.

Attempts to obtain undisturbed samples of the in situ sands and gravels suitable for dynamic triaxial testing were unsuccessful. The

resistance to liquefaction of the in situ sands and gravels at the site was investigated by two methods:

1. Based on dynamic triaxial tests on sands susceptible to liquefaction and

2. Based on the observed behavior of sand deposits in previous earthquakes (DLC 1976).

The results of dynamic triaxial tests upon Sacramento River sand, considered to be extremely susceptible to liquefaction, are presented on Figure 2.5.4-28, based on the response to USNRC Question 2.26 and 2.27 of the BVPS-2 FSAR. The figure shows the relationship between shearing stresses, expressed as a ratio of shear stress to effective stress, to the number of cycles necessary to cause initial liquefaction for this sand at several relative densities. It was used to evaluate the liquefaction potential of the soils within the main plant area as described in Section 2.6.5.2 of the BVPS-2 PSAR. This approach was conservative since the Sacramento River sand was considered especially susceptible to liquefaction in comparison to the sands and gravels at the site.

After the discovery of the loose zone in the main plant area and its subsequent densification, a liquefaction analysis was performed for soils within the densified zone (DLC 1976). The shear stress required to cause liquefaction of the in situ sands and gravels was evaluated using Figure 2.5.4-29. This figure presents a lower bound envelope for sites where liquefaction has occurred during earthquakes of Richter Magnitude 5.5 or less, correlated with corrected standard penetration resistance, N_1, of the sand deposit. This figure was used to evaluate the resistance to liquefaction of the soils in the vicinity of the intake structure as well. Further discussion is presented in Section 2.5.4.8.

The maximum Rayleigh wave velocity used in the analysis of buried pipe was determined to be 3,000 ft/sec, using the procedure described below.

Ewing et.al. (1957) presented data, reproduced on Figure 2.5.4-31, which showed that Rayleigh wave velocity in a layered system was a complicated function of the depth of soil, the shear wave velocity of soil and rock, and the frequency wave length of the Rayleigh wave.

Using Figure 2.5.4-31, for $C_2/C_1=4.5$, the variation of Rayleigh wave velocity with frequency for the in situ soil conditions in the main plant area was determined and is shown on Figure 2.5.4-64. Rayleigh wave velocity is seen to vary widely depending on frequency. Because an earthquake is likely to produce Rayleigh waves of many frequencies, the selection of a control value of Rayleigh wave velocity was based upon a consideration of the predominant frequency likely to be produced by an earthquake occurring near the site.

The peaks of Fourier spectra for earthquake time histories represent frequencies at which large amounts of energy are released by the earthquake. Housner (1970) compared Fourier spectra with velocity response spectra and found that the peaks occurred at about the same frequencies. Accordingly, a predominant frequency of 2-3 Hz was determined from response spectra presented in SWEC (1984). These response spectra were computed for real earthquake time histories, with magnitudes corresponding to the BVPS-2 SSE, that were amplified through the BVPS-2 soil profile. From Figure 2.5.4-64, a frequency of 2-3 Hz corresponds to a Rayleigh wave velocity of about 3000 ft/sec.

2.5.4.7.4 Relative Displacements

Methods used to evaluate the relative displacement of the closely spaced main plant structures during a seismic event for input to pipe stress analyses are discussed in this section. One method considers the theoretical behavior of surface waves and the effect of site layering on the wave velocities. It uses a simple and conservative model which assumes that the wave motion is propagated horizontally without any change in wave form and with no effect of structure ridigity or other interference. The maximum displacement between two points is enveloped by the first term of a Taylor series expansion of the displacement. The second method, used in only two cases, uses an earthquake acceleration time history to determine a relative displacement time history from which the maximum value is determined. The mass and rigidity of the structures involved and of adjacent structures are not considered in either method. The motion of the ground surface, upon which is founded a massless structure, is estimated. The two methods estimate the magnitude of the relative displacement, but not the direction of movement of the individual structures involved. The earthquake time history method results in smaller estimates of relative displacement, but it represents a more realistic approach, since it is based upon actual recorded ground motions.

SIMPLE MODEL

It is assumed that relative displacement results from the horizontal propagation of seismic waves with little or no change in wave form. It is further assumed that the maximum particle motions produced by each wave occur simultaneously, and that the foundations behave as rigid bodies.

For soil sites such as BVPS, relative displacements are caused by Rayleigh waves and Love waves. The particle motion for the Rayleigh wave occurs in the vertical plane and is elliptical and retrograde with respect to the direction of propagation. By their nature, Rayleigh waves cause horizontal push-pull (R_x) and vertical (R_y) displacements. The particle motion of Love waves is transverse to the direction of propagation and as a result, they are the cause of translational (R_y) displacements.

For wave propagation parallel to the axis between structures under consideration, the horizontal push-pull and translational displacements between two points A, and B, as shown on Figure 2.5.4-30 are given as follows (Christian 1976):

$$R_x = V_m \frac{b}{C_r}$$

$$R_y = V_m \frac{b}{C_L}$$

where :

R_x = push-pull displacement along axis between two points

V_m = peak velocity of design earthquake

b = centroidal distance between structures

C_r = Rayleigh wave velocity

R_y = horizontal displacement perpendicular to the axis between two points

C_L = Love wave velocity

The peak velocity of the design earthquake was determined from the empirical formulation that a V_m of 48 in/sec corresponds to a peak acceleration, a_m of lg; defined by Christian (1976) as:

$$V_m = 48a_m$$

Generally, the vertical ground acceleration is taken as 2/3 of a_h and therefore:

$$R_z = 2/3\ R_x$$

where:

R_z = vertical displacement

For oblique waves, the maximum relative displacement occurs when the direction of propagation is at an angle of 45 degrees to the line between two points. The relative displacement between points A and B (Figure 2.5.4-30) is determined by resolving the relative displacement of points A' and B' into components parallel and perpendicular to line AB. Both the Rayleigh wave and the Love wave contribute to the relative displacement between A and B.

For the Rayleigh wave:

$$R_{xr} = R_{yr} = \left(48a_m \frac{b}{C_r}\right) \sin^2 45° \qquad (2.5.4\text{-}6)$$

For the Love wave:

$$R_{xL} = R_{yL} = \left(48 a_m \frac{b}{C_L}\right) \sin^2 45° \qquad (2.5.4\text{-}7)$$

Symbols are as defined previously.

The vertical displacement R_z is a result of the Rayleigh wave only; therefore:

$$R_z = 2/3 \left(48 a_m \frac{b}{C_r}\right) \sin^2 45° \qquad (2.5.4\text{-}8)$$

Soil sites underlain by stiffer materials such as denser soil or rock will have Rayleigh wave and Love wave velocities that are affected by the wave length, soil and rock characteristics, and depth of overburden to the stiffer layer. The relationship between the parameters already mentioned used to evaluate the Rayleigh wave velocity is given on Figure 2.5.4-31 (Ewing et al 1957). The wavelength was taken as twice the distance between points under consideration. The Love wave velocity was determined from the following expression (Bullen 1963):

$$G_2 \left(1 - \frac{C_L}{C_2^2}\right)^{1/2} - G_1 \left(\frac{C_L^{\,2}}{C_1^{\,2}} - 1\right) \tan\left[\frac{2\pi H}{\lambda}\left(\frac{C_L^{\,2}}{C_1^{\,2}} - 1\right)^{1/2}\right] = 0 \qquad (2.5.4\text{-}9)$$

where:

G_2 = shear modulus of lower denser layer (rock)

C_2 = shear wave velocity of lower denser layer

G_1 = shear modulus of upper layer (in situ sand and gravel)

C_1 = shear wave velocity of upper layer

H = depth of upper layer

λ = wavelength = 2b for parallel waves;
= 2bsin 45° for oblique waves

There is a unique solution for the Rayleigh and Love wave velocities for each value of b.

The shear moduli, G_1, and G_2, of the in situ sand and underlying rock were computed from the measured in situ shear wave velocities (DLC 1976). Average values of 1,250 fps and 5,000 fps were chosen for the soil and rock, respectively.

The relative displacements for parallel waves and for oblique waves determined by this approach for the SSE are shown on Figure 2.5.4-30. For the operating basis earthquake (OBE), the values are one-half those shown for the SSE.

Earthquake Time History Method

The relative displacement of the centroids of two building foundations are computed using the computer program CORD2B, a shortened acronym for "Calculation of Relative Displacements between Two Buildings during an Earthquake" (SWEC 1982). The program does not consider the mass and rigidity of the structures; but rather, computes the displacements of points under massless, rigid buildings caused by the passing of an earthquake wave. It is assumed that each foundation is subjected to the same time history; i.e., that the wave shape is not changed while passing between the centroids. CORD2B filters the acceleration time history, averaging the effect of the accelerations to account for the time required for the earthquake to pass beneath an individual building. This averaging accounts for the fact that different parts of the foundation are subjected to different accelerations as the wave passes, and, in effect, the acceleration time history is smoothed out or filtered. The filtered acceleration time history for each structure is integrated twice to determine a displacement time history. The two displacement time histories are then shifted by the time required for the wave to pass between the centroids, namely:

$$t = b/c$$

where:

t = time lag

b = centroid to centroid distance

c = Rayleigh wave velocity (Figure 2.5.4-31)

Subtracting the time shifted displacement time histories results in a relative displacement time history and identification of the peak relative displacement.

The push-pull and transverse relative displacement is computed as the mean peak horizontal displacement determined from the eighteen horizontal ground surface acceleration time histories listed in Table

2.5.4-9. These time histories were recorded at soil sites for which soil properties and profiles are matched as closely as possible by BVPS-2 (SWEC 1985). They are scaled to the SSE ground surface acceleration of 0.125 g by CORD2B before computing displacements. The vertical relative displacement is assumed to be two-thirds of the horizontal.

The procedure is used to compute the relative motion between the auxiliary building and the main steam and cable vault and between the safeguards area and the main steam and cable vault. The results are summarized in Table 2.5.4-10.

2.5.4.8 Liquefaction Potential and Dynamic Settlement

2.5.4.8.1 Liquefaction Potential

Main Plant Area

A zone of loose, potentially liquefiable, granular soil was identified in the BVPS-2 main plant area during the excavation for the reactor containment foundation. The loose zone was successfully densified and a liquefaction analysis of soils within the densified zone indicated adequate factors of safety (DLC 1976). For further discussion of the densification program, refer to Section 2.5.4.12.

The extent of the loose zone was determined from the exploratory borings as a zone within a given boring containing a significant number of samples with N_1 values less than 10 determined using the data of Gibbs and Holtz (1957). N_1 is the measured standard penetration test resistance, N, corrected to an overburden pressure of 1 ton/ft^2. This criterion was determined from an analysis of liquefaction potential. The analysis was performed with the groundwater table assumed at el 705 feet. A constant value of N_1 was assumed within the free field soil profile of the main plant area and at a number of depths. An allowable shear stress was determined from Figure 2.5.4-29 for this assumed value of N_1. (Further discussion of Figure 2.5.4-29 is provided in the following section concerning the main intake structure.) At the same depths, the applied shear stress was determined from Figure 2.5.4-39 and the factor of safety was determined as the ratio of the allowable shear stress to the applied shear stress. It was determined that an N_1 value of 5 would result in a safety factor against liquefaction of 1.0. As an N_1 of 10 resulted in a factor of safety of about 2, it was conservative to define the loose zone in terms of N_1 values less than 10.

The applied shear stresses given on Figure 2.5.4-39 are based on BVPS-2 PSAR Figure 2.6-6, which shows free field shear stresses for the N69W component of the 1952 Taft accelerogram scaled to an estimate of the SSE bedrock acceleration, and then amplified through a BVPS-2 soil profile by a mass-spring-dashpot computer model (DLC, 1972i). The average stress for the 10 largest peaks has been increased slightly to account for differences between current

building loads and soil unit weights and those used in the original analysis described in DLC (1972i). The peak ground surface acceleration associated with PSAR Figure 2.6-6, and, therefore, Figure 2.5.4-39 is 0.098g. This is lower than the SSE ground surface acceleration of 0.125g, but the shear stresses given by Figure 2.5.4-39 are shown on Figure 2.5.4-39a to represent a very conservative estimate of shear stresses at the site during the SSE.

Figure 2.5.4-39a presents a comparison of the stresses shown on Figure 2.5.4-39 with those computed as an average of those from 28 rock outcrop time histories amplified through a BVPS-2 free field soil model using the computer program SHAKE (Schnabel, et al., 1972). The analysis technique is similar to the soil response analysis described by SWEC (1985), which used the same 28 earthquake records to estimate a BVPS-2 site dependent response spectrum.

The rock outcrop time history is input at the bedrock level of a BVPS-2 free field soil model and scaled to the SSE magnitude, using a procedure described by SWEC (1985). The peak acceleration contained in the record is not considered; magnitude is the design parameter. The scaled time history is then amplified through the soil model by SHAKE to compute peak shear stresses as a function of elevation. An average stress is taken as 65 percent of the peak value as recommended by Seed and Idriss (1971). An average of the responses of the 28 time histories is computed and is shown on Figure 2.5.4-39a. The groundwater table is taken at el 690 ft, the level of the 25 year flood. Shear stress from this analysis technique is seen to be very much lower than the original, but similar analysis based on only one earthquake record. Therefore, use of Figure 2.5.4-39 to evaluate shear stresses in the soil generated by the SSE is very conservative.

Using the criterion of a minimum N_1 of 10, the borings in the main plant area were examined and a thickness contour map of the zone requiring densification was prepared. This map is presented in Appendix Figure B-10 of the Report on the Soil Densification Program (DLC 1976). The extent of the area densified by the pressure-injected footing technique is shown on Figure 2.5.4-15. To the north, east, and west of the main plant area, the densified zone was extended beyond the foundation limits of the plant structures in order to provide continued support to the foundations in the event of the liquefaction of the adjacent, nondensified soil.

N_1 values from borings under the main plant structures outside of the densified zone are presented on Figure 2.5.4-59. From a total of 541 samples, 15 show N values less than 10 and none are less than 5. Figure 2.5.4-11 shows relative density versus standard penetration test N values for the same boring as those on Figure 2.5.4-59. The mean relative density for the sand and gravel is 77.3 percent and the means relative density less one standard deviation is 62.9 percent.

Main Intake Structure

The main intake structure is located as shown on Figure 2.5.4-32 and is common to both BVPS-1 and BVPS-2. The structure is directly adjacent to the Ohio River with founding elevation varying between el 634 feet 6 inches and 640 feet 6 inches. A sheetpile cofferdam driven to rock was used to facilitate the construction of the 85-foot by 88-foot structure. Extending along the river to the east and west of the intake structure are two rows of sheetpile walls that are tied together (Figure 2.5.4-32). The area directly north of the structure was dredged to el 645 feet, with an average side slope of approximately 3.5:1. A simplified north-south section through the intake structure is shown on Figure 2.5.4-66.

The onshore and offshore areas east and west of the intake structure, and the area to the south beneath the BVPS-1 river water lines and the BVPS-2 service water lines were densified. The limits of densification are shown on Figure 2.5.4-16. The purpose of densifying the sands around the intake structure was to prevent the soils from liquefying during the SSE and blocking the intake channel. A detailed discussion of the densification program is presented in Section 2.5.4.12. The areas north of and below the intake structure were not densified. No adverse effects to the structure, slopes, or wingwalls are anticipated. Stability of soils at the intake structure is considered in three parts: a. liquefaction analysis of soils around the intake structure, b. liquefaction analysis of soils below the intake structure and, c. stability of intake channel slopes.

a. Soils Around Intake Structure

Liquefaction analysis of the soils around the intake structure considers three separate areas: 1. the offshore densified area, 2. the onshore densified area, and 3. the intake channel. The factor of safety against liquefaction is taken as the ratio of the shear stress required to cause liquefaction of the soil and the shear stress induced by the design earthquake. The minimum factor of safety is 1.1. Ohio River elevations are assumed coincident with normal river conditions at el 665 ft, and with the 25-year flood at el 690 ft.

The shear stress required to cause liquefaction is evaluated using the relation developed by Seed et al (1975a) that is shown on Figure 2.5.4-29. This curve is described as a lower bound envelope for sites where liquefaction has occurred during earthquakes with Richter magnitudes between 5 and 6, correlated with the corrected penetration resistance, N_1, of the sand deposit involved. N_1 is the measured standard penetration test (SPT) resistance, N, corrected to an overburden pressure of 1 ton/ft^2.

The values of N_1 are computed using the computer program RELDEN (SWEC 1979). The measured SPT resistance, N, is corrected to a maximum N_1 value of 42 by RELDEN, although the actual value could be higher. Since the resistance to liquefaction is related to N_1, the computed factor of safety against liquefaction will be conservative for those samples with an N_1 value greater than 42.

The applied shear stress is calculated from the equation presented by Seed (1976):

$$\tau_{app} = 0.65 \; x \; \frac{\sigma_{vo}}{g} \; x \; a_{\max} \; x \; r_d \qquad (2.5.4\text{-}10)$$

where :

τ_{app} = applied shear stress

σ_{vo} = total overburden pressure on sand layer under consideration

g = acceleration of gravity

a_{max} = maximum acceleration at the ground surface, 0.125g for SSE

r_d = a stress reduction factor varying from a value of 1 at the ground surface to a value of 0.9 at depth of about 30 feet (Seed and Idriss 1971)

Although this equation was developed to predict applied shear stress for a horizontal ground surface, it is used for both horizontal and sloping ground conditions in this analysis. Since the intake channel side slopes are graded to a shallow slope of about 3.5:1, the use of this equation gives a reasonable approximation of the applied shear stresses.

Liquefaction analyses are performed on a sample-by-sample basis, using soil data obtained from the borings shown on Figures 2.5.4-13 and 2.5.4-32. Borings performed after the densification program was completed are used in the analysis of the onshore and offshore densified zones east and west of the intake structure. Borings were not drilled in the channel area immediately north of the structure and since this area was not densified, borings drilled offshore prior to densification are taken as representative of soil conditions in the intake channel.

In the analysis of the onshore areas, the entire soil profile is assumed to be saturated for cases with river level at or above el 665 feet. Therefore, changes in water level from normal to flood conditions do not change the results. Offshore, the total stress at a given sample is computed as the product of saturated weight of the soil and the depth below the river bottom to the soil sample. The total stress is computed neglecting the weight of the overlying water, since the water cannot transmit shear stress. As a result, the computed total stress and therefore the applied shear stress are unaffected by fluctuating river levels. Since the effective stress used to evaluate the allowable shear stress (Figure 2.5.4-29) is likewise not affected, the factor of safety against liquefaction offshore does not change with changes in the Ohio River elevation.

Safety factors for the onshore densified areas and the offshore densified areas are shown on Figures 2.5.4-33 and 2.5.4-35, respectively. The onshore densified areas south of the riverward sheetpile walls have satisfactory factors of safety against liquefaction with all alues at or above 1.6. The offshore densified

soils are not susceptible to liquefaction as shown by the preponderance of samples having factors of safety greater than 1.1. Two samples at a depth of less than 5 feet in two different borings have factors of safety less than 1.1, but this is neither significant nor unusual due to low confining stress at shallow depths.

Safety factors for the undensified intake channel area north of the intake structure are shown on Figure 2.5.4-34. Ten samples between el 645 ft and el 634 ft had factors of safety less than 1.1. Most of these samples occur within the top 5 to 10 feet of the soil profile. One sample at approximately el 623 ft was unsatisfactory. A similar analysis performed for samples above el 645 ft along the intake channel slopes outside the densified area shows that the upper 10 feet of soil is loose and may liquefy. Therefore, in the dynamic slope stability analysis of the intake channel described in Section c., the upper 10 feet along the slopes outside of the densified zone and below the dredge line in front of the intake structure were assumed to be liquefied at the end of the seismic event.

b. Analysis of Soils Beneath Intake Structure

Examination of the soil conditions below the intake structure indicates the possible presence of some low blow count granular soil with an average N_1 of about 7 blows/ft. The liquefaction potential of this granular soil and the underlying more dense soil are evaluated using a different approach than that used for the soils adjacent to the structure. The results indicate that the factor of safety against liquefaction within any low blow count material beneath the intake structure is between 1.2 and 1.6, which is acceptable.

A cross section through the intake structure showing soil conditions that existed prior to the Terra Probe densification program is given on Figure 2.5.4-67. It was developed using data from borings performed in 1954 and 1974 prior to the densification program.

Examination of the corrected blow counts indicates that low blow count materials could have existed below and on either side of the intake structure location between about el 635 ft and 640 ft prior to construction and the subsequent insitu densification by Terra Probe and vibroflotation adjacent to the structure. N_1 values between 4 and 10, with an average N_1 of about 8 are indicated on Figure 2.5.4-67. In contrast, most of the soil has N_1 values between 11 and 50, and averaging about 21. The majority of samples are described as gravelly sand, and the presence of gravel could cause N_1 values to be high. The Report on the Soil Densification Program, BVPS-2 (DLC 1976) indicates that a 13 percent reduction on average to N_1 is appropriate to account for gravel. Applying this correction reduces the average N_1 value for the low blow count material to 7, and to 18 for the deeper material. Using the Marcusson and Bieganouski (1976)

data, N_1 values of 7 and 18 correspond to relative densities of about 40 percent and 60 percent, respectively.

The low blow counts were eliminated on either side of the intake structure within the limits of the Terra Probe densification. Excavation for the intake structure mat was accomplished using a clamshell within the confines of a heavily braced steel sheetpile cofferdam. There were three vertical layers of cross bracing placed in two orthogonal directions. Horizontal spacing of the bracing was at about 17 feet on center. Considering the difficulty involved with using a clamshell in this confined space, it is unlikely that the bottom of the excavation would have conformed to the shape of the mat indicated on Figure 2.5.4-66. It is more likely that the bottom was overexcavated to about el 634.5 feet, corresponding to the bottom of the gravel layer at the south end of the mat, and then backfilled to the required elevation. This would have effectively eliminated the presence of the low blow count material below the structure.

A liquefaction analysis for materials beneath the intake structure is described below for the SSE occurring coincident with the 25-year flood at el 690 ft. Applied shear stresses determined by the computer program SHAKE (Schnabel et al 1972) are compared to shear stresses required to cause liquefaction determined using the two relationships shown on Figure 2.5.4-29a and from cyclic triaxial tests performed on reconstituted samples.

The procedure used to determine the applied shear stresses below the intake structure is shown schematically on Figure 2.5.4-68. It represents an extension of the method used by SWEC (1985) to compute site dependent ground surface response spectra.

A rock outcrop time history is input at the base of a BVPS-2 free field soil profile model. It is amplified through the profile by SHAKE to compute a ground surface time history which is scaled to the SSE magnitude. The scaling procedure, described by SWEC (1985), does not consider the acceleration level of the earthquake; magnitude is the design parameter. The scaled time history is then deconvoluted by SHAKE through the free field profile to compute a site and magnitude consistent bedrock motion, which is input below the intake structure to compute applied shear stresses.

The three rock outcrop records listed in Table 2.5.4-7 are used in this analysis. They were selected from the 28 rock outcrop records used by SWEC (1985). The basis for their selection is that applied shear stresses generated in the free field by these three records approximate the average of the shear stresses from all 28 records. Note, that for the purpose of earthquake record selection, the free field shear stresses are computed by scaling the rock outcrop time histories to the SSE magnitude prior to amplifying them through the free field profile.

The free field soil model is shown on Figure 2.5.4-69. Shear wave velocities are those suggested by Whitman (1968), and are based upon insitu measurements. Soil unit weights are taken from Section 2.5.4.2. The soil model below the intake structure is shown on Figure 2.5.4-70. The structure is represented as a pseudo-soil with a unit weight and shear wave velocity compatible with characteristics of the structure. The shear wave velocity of the pseudo-soil layer is computed from the equation for the first harmonic natural period of the structure as:

$$V_s = \frac{4H_e}{T}$$

where : V_s = equivalent shear wave velocity

H_e = height or thickness of equivalent soil layer

T = natural period of structure

The equivalent height of the pseudo-soil is taken as the ground surface elevation around the structure minus the founding elevation. The liquefaction analysis is performed for the 25-year flood at el 690 ft, which is higher than the ground surface at el 675ft. Since SHAKE cannot handle a free water surface, the ground water table in the model is input at the ground surface. The equivalent unit weight of the pseudo-soil layer is selected so that the effective stress at the bottom of the layer is the same as the effective contact pressure of the structure for a water level at el 690 ft. Shear wave velocities of the soil layers below the structure were calculated from low strain shear moduli determined using equation 2.5.4-3. The void ratio of the low blow count layer estimated to be 0.68, based on data from the loose zone in the main plant area (DLC 1976). The void ratio of the denser layer is taken as 0.4 from Section 2.5.4.2.

SHAKE iterates to compute modulus and damping values compatible with strain levels induced by earthquake ground motions. Strain dependent variations of shear modulus and damping used in the analysis are based on data presented by Seed and Idriss (1970), and are shown on Figure 2.5.4-71.

Using the procedure shown on Figure 2.5.4-68, applied shear stresses are determined for each of the three selected rock outcrop motions and then averaged. Since SHAKE computes peak values of applied shear stress, an equivalent uniform shear stress is taken as 65 percent of the peak value (Seed and Idriss 1971). The results are shown in Table 2.5.4-8.

The resistance to liquefaction of the soils below the intake structure is evaluated using the two relationships shown on Figure 2.5.4-29A. One shows a correlation with N_1, developed by Seed et al (1975a). It is described as a lower bound envelope for sites where liquefaction has occurred during earthquake having magnitudes between 5 and 6. The BVPS-2 SSE is approximately equivalent to a

magnitude 5.0 earthquake, and, therefore, the cyclic stress ratio required to cause liquefaction shown by the Seed (1975a) curve is somewhat low for BVPS. Seed et al (1983), considering more recent earthquake data, discuss a procedure which accounts for the effect of varying magnitude on the cyclic stress ratio. Using this procedure, a curve for a magnitude 5 earthquake was determined and is shown on Figure 2.5.4-29A. It shows a higher cyclic stress ratio required to cause liquefaction for the same value of N_1. The allowable shear stress at the center of the soil layers in the intake structure model, determined using the two relationships shown on Figure 2.5.4-29A, are given in Table 2.5.4-8.

The factor of safety against liquefaction, defined as the ratio of the allowable shear stress to the applied shear stress, is between 1.2 and 1.6 for the low blow count material, and between 3.3 and 4.6 for the higher blow count material. The minimum acceptable factor of safety is 1.1.

The resistance to liquefaction of the low blow count layer is also found to be satisfactory, based on the results of cyclic triaxial testing. The evaluation is described below.

During a study of the liquefaction potential of the soils at BVPS-1, and at the request of the U.S. NRC, a laboratory testing program was conducted to estimate the cyclic shear strength of the soil samples recovered from the freeze hole excavated in the low blow count zone beneath the BVPS-2 containment (SWEC 1977).

Cyclic triaxial testing was performed on eight reconstituted samples that were prepared from material finer than the No. 10 sieve and compacted to dry densities approximating the insitu dry density. The grain size curve of the minus No. 10 fraction is parallel to the grain size curve of the complete sample, indicating that the materials should have essentially the same mechanical properties when compacted to the same dry densities.

Samples were anistropically consolidated and tested isotropically at two confining pressures, one corresponding to the average depth of the loose zone and the other to the deepest level of the loose zone below BVPS-2. From the test results, a cyclic stress ratio was selected to define liquefaction as 2.5 percent double amplitude strain in 8 cycles as:

$$\frac{(\sigma_1 - \sigma_3)\ cy}{2\bar{\sigma}_c} = 0.155$$

where: $(\sigma_1 - \sigma_3)\ cy$ = cyclic deviator stress

$\bar{\sigma}_c$ = effective confining pressure

Seed (1979) contends that the cyclic simple shear test is more representative of actual field stress conditions than the cyclic triaxial test. The results of the two tests are related by a factor, CR, as shown below:

$$\left(\frac{\tau_h}{\bar{\sigma}_v}\right) simpleshear = CR \bullet \frac{(\sigma_1 - \sigma_3)_{cy}}{2\bar{\sigma}_c}$$

where: τ_h = shear stress on horizontal plane

$\bar{\sigma}_v$ = vertical effective stress

From the data presented by Seed (1979) and assuming a K_o of 0.5 for the low blow count soil, CR is 0.74.

Seed (1979) also recommends reducing laboratory simple shear test results an additional 10 percent to account for multidirectional shaking in the field. Therefore, an allowable field shear stress ratio, based on the results of the cyclic triaxial tests is:

$$\left(\frac{\tau_h}{\bar{\sigma}_v}\right)_{field} = (0.74)(0.9)(0.155) = 0.104$$

Based on this relation, the factor of safety of any low blow count material below the intake structure is 1.4.

In summary, low blow count soils may have been present below the intake structure location, but were probably removed during excavation and foundation preparation. Should they still be present, liquefaction analyses based on blow count data and cyclic triaxial test data give satisfactory factors of safety for the soil below the intake structure.

c. Main Intake Structure: Sliding and Slope Stability

Figure 2.5.4-65 presents the loading diagram used to calculate the factor of safety against sliding of the main intake structure. The water level within the intake structure is the same as the river level. During plant operation, a maximum of one bay can be dewatered which would reduce the frictional resisting force along the base of the structure. During a seismic event, undrained shear behavior will govern sliding stability of the intake structure. Changes in vertical stresses at the soil structure interface will cause a

corresponding change in pore pressure. Therefore, the effective contact pressure will remain constant and equal to the effective building weight (total building weight minus static buoyant force). Consequently, only the horizontal component of inertial force is considered in the sliding stability analysis. Under the conservative conditions of the SSE plus standard project flood and one intake bay empty, the factor of safety against sliding is 1.3, which is satisfactory. The dynamic sliding stability analysis of the intake structure was conservatively performed without taking into account the passive resistance of the soil.

Two cross-sections of the intake channel slope at the locations shown on Figure 2.5.4-32 were analyzed for dynamic slope stability using the computer program LEASE II (SWEC 1980). One section was taken adjacent to the intake structure through the densified zone while the other section was taken approximately 100 feet from the intake structure beyond the densified zone.

The upper 10 feet of loose soil along the undensified slope and below the dredge line is susceptible to liquefaction. The pore pressure buildup in the loose zone during the seismic event is accounted for by reducing the friction angle from 25° for the drained case to 17° for the undrained case. This is conservative and assumes the pore pressure parameter equals 1, which is appropriate for loose soils (Lambe & Whitman 1969). A static, post-earthquake slope stability analysis was performed assuming that the liquefied soil would have completely liquefied at the end of a seismic event of short duration and therefore would have weight but not strength (where: $\phi = 0$, $c = 0$). The minimum acceptable factor of safety for the dynamic and post-earthquake cases is 1.1. This is considered adequate since the liquefied soil will regain strength with time due to the dissipation of excess pore pressures generated by earthquake shaking.

The results of the dynamic slope stability analysis of the section through the densified portion of the intake channel slope presented on Figure 2.5.4-57 show satisfactory factors of safety of 1.4 for a failure circle passing behind the tied-back sheetpile wall under normal water conditions, and 1.1 for a shallow failure surface along the slope. The static, post-earthquake case with the water at the 25-year flood level and the upper 10 feet of the river bottom assumed to have liquefied ($\phi = 0$, $c = 0$) resulted in satisfactory factors of safety. Changing the water level from normal water at el 665 feet to the 25-year flood at el 690 feet has no significant effect on the results of the slope stability analysis since the slope is almost totally submerged under normal conditions.

Figure 2.5.4-37 presents the cross-section and soil properties assumed for the stability analysis of the intake channel slope in natural soil outside of the densified area. No borings were performed along the slope outside of the densified area. Therefore, the borings performed before densification, as shown on Figure 2.5.4-32, were used to develop the soil profile used in the analysis. The

static analysis of the slope resulted in a satisfactory minimum factor of safety of 2.

As discussed previously, the upper 10 feet of the river bottom to the north of the intake structure between el 645 feet and el 635 feet, as well as the upper 10 feet along the undensified channel slopes, may liquefy. The dynamic analysis, including earthquake forces, used a reduced friction angle for the loose silty sand of 17° to account for pore pressure buildup prior to liquefaction. The results of the dynamic analysis indicated a family of failure surfaces extending below the loose silty sand layer with factors of safety less than the minimum acceptable value of 1.1. It was hypothesized that the 10-foot layer of loose silty sand along the surface of the intake channel would liquefy and flow downslope until it stabilized at about a 10:1 to 15:1 slope. The denser soils underlying the liquefied soils will remain stable as will the densified zone immediately adjacent to the intake structure, with perhaps some localized sloughing in areas directly adjacent to liquefied soils. These densified areas on either side of the intake structure will serve to prevent liquefied soil from moving directly towards the intake bays.

The intake structure draws water from 646 feet to el 659.5 feet; the pit floor at the pump intakes is at el 640 feet. The New Cumberland Lock and Dam maintains the Ohio River at a normal water elevation of 664.5 feet. A single failure of the dam during minimum river flow conditions would result in an extreme low water level at the intake bays of el 648.6 feet. Even at this water level, there is a water depth of about 9 feet at the pump intakes. The minimum flow requirements for safe plant shutdown following the design basis accident were evaluated and found adequate for this extreme low water condition, (Sections 2.4.11 and 9.2). A proposed Technical Specification discussed in Section 2.4.14 limits the operation of BVPS-2 to a minimum Ohio River level of el 654 feet.

Considering the geometry of the intake structure and adjacent densified areas, and the flow requirements which are adequate for safe shutdown even under extreme low water conditions, it is unlikely that the volume of soil on the intake channel slopes which may flow until stabilized at a very shallow angle would be sufficient to block the intake channel such that the safe shutdown of the plant would be jeopardized.

2.5.4.8.2 Dynamic Settlement

Ground vibrations during an earthquake tend to densify cohesionless soil and thereby cause settlement of structures founded upon them. The dynamic subsidence or settlement potential of the granular soil at the site was evaluated using concepts and data presented by Lee and Albaisa (1974).

The dynamic settlement of saturated sand results from volumetric strain following the dissipation of excess pore pressures developed during cyclic loading. The magnitude of the volumetric strain is a function of several variables, including the peak pore pressure ratio developed during cyclic loading, the grain size distribution, and the relative density of the soil. The peak pore pressure ratio is the ratio of the peak excess pore pressure, Δ_u, to the effective confining pressure, $\bar{\sigma}_c$. From the results of cyclic triaxial tests, it has been found that $\Delta_u/\bar{\sigma}_c$ is primarily a function of the cycle ratio, N_C/N_L, which is the ratio of the number of significant applied cycles of loading, N_C, to the number of cycles required to cause liquefaction of the soil, N_L.

The steps used to compute dynamic settlement are outlined as follows:

1. The soil profile beneath the structures under consideration was divided into layers according to N_1 values, the standard penetration resistance corrected to an overburden pressure of 1 ton/ft^2.

2. An applied shear stress at the center of a given layer was determined from Figure 2.5.4-39 assuming a free field condition and the ratio of applied shear stress to total vertical stress was computed.

3. The applied shear stress at the center of the layer beneath the structure was computed as the applied shear stress ratio determined above for the free field case multiplied by the total vertical stress beneath the structure. Applied shear stresses below the intake structure were taken from Table 2.5.4-8.

4. The number of cycles to cause initial liquefaction, N , was estimated from Figure 2.5.4-38.

5. The volumetric strain for each layer was determined from Figure 2.5.4-40 which is based on test data reported by Lee and Albaisa (1974). A value of eight cycles was used for N for the site SSE as mentioned in Section 2.5.4.9 (DLC 1976).

6. Vertical strain was assumed equal to volumetric strain, implying that dynamic settlement is one-dimensional. The volumetric strain was multiplied by the layer thickness to determine the settlement of an individual layer, and the sum of these settlements for all layers beneath the structure was taken as the total settlement due to earthquake vibration.

This method was applied to soils above and below the ground-water table. It was found that the ground-water table had little effect on the calculated settlements and for the purpose of calculating dynamic settlement, it was taken at el 665 feet, or normal water level.

Considering the free field case, the average applied cyclic stress ratio is approximately 0.07. If an N_1 value within compacted structural fill beneath a given structure was as low as 10, N_1 determined from Figure 2.5.4-38 would be greater than 1,000, resulting in a volumetric strain determined from Figure 2.5.4-40 that is negligibly small. Consequently, the compacted structural fill was not considered as contributing to the dynamic settlement.

A summary of predicted dynamic settlements is given in Table 2.5.4-3.

2.5.4.9 Earthquake Design Basis

The seismicity of the Appalachian Plateau Province, of which the site is a part, is discussed in Section 2.5.2. The maximum earthquake expected at the site is an Intensity VI (MM), with a horizontal ground acceleration of 0.07g. The body-wave magnitude, m_b, of the SSE is 4.75 (SWEC 1985). The plant is designed for an SSE with a horizontal ground acceleration of 0.125g, which is slightly greater than the midpoint acceleration between Intensity VI-VII (MM). The horizontal acceleration for the OBE is 0.06g. Vertical accelerations are two-thirds of the corresponding horizontal accelerations.

The BVPS-2 response spectra for the SSE are shown on Figure 3.7B-1. Analyses described by SWEC (1984) and SWEC (1985) clearly demonstrate that the BVPS-2 design response spectra are appropriate when compared to site dependent response spectra determined by current state-of-the-art methods.

To facilitate the analysis of liquefaction potential and dynamic settlement at the site, eight equivalent uniform stress cycles are used to represent the irregular acceleration-time history of the SSE.

Seed et al (1975) describe a statistical analysis of western United States earthquake time histories that is used to develop a relationship between earthquake magnitude and number of cycles of uniform motion. The BVPS-2 SSE is shown by SWEC (1985) to be equivalent to a western United States earthquake with a local (Richter) magnitude of 4.95. Seed et al (1975) shows that three to four cycles on average are representative of a magnitude 5 earthquake.

2.5.4.10 Static Stability

Foundation analyses related to the static stability of Category I structures included evaluation of bearing capacity, estimate of settlement, and the development of design lateral earth pressure parameters.

2.5.4.10.1 Bearing Capacity

All Category I structures are founded on mat foundations.

The design of mat foundations, particularly those on dense sands and gravels, is generally limited by a consideration of maximum tolerable settlements rather than by ultimate bearing capacity, since the factor of safety against a bearing capacity type failure is typically quite high. Estimated static settlements of plant structures are presented in Section 2.5.4.10.2. However, for completeness, the bearing capacity of the foundations of Category I structures and the factors of safety against a bearing capacity type failure have been computed for both static and dynamic loading conditions and are presented in Table 2.5.4-4.

The ultimate bearing capacity of the supporting soil is a function of the soil properties, the size and shape of the foundation, the depth of embedment and the depth to the ground-water table. The equation used for computing ultimate static bearing capacity is:

Square or rectangular footings:

$$q_{ult} = cN_c \left(1 + 0.3\frac{B}{L}\right) + \gamma D N_q + 0.4\gamma B N_\gamma$$

Circular footings: radius = R

$$q_{ult} = 1.3\ cN_c + \gamma D N_q + 0.6\ \gamma R N_\gamma \qquad (2.5.4\text{-}11)$$

where:

q_{ult} = ultimate bearing capacity
C = cohesion
D = depth to base of mat foundation
γ = unit weight of soil
B = width of foundation
L = length of foundation
N_c, N_q, $N\gamma$ = bearing capacity factors

The following assumptions were made in computing the ultimate static bearing capacity:

1. Each structure was considered individually, ignoring increases in confinement due to adjacent structures.

2. Each structure was assumed to be founded on the in situ sand and gravel with the following properties:

friction angle	=	30°
cohesion	=	0
unit weight	=	125 pcf above ground-water table
	=	136 pcf below ground water table

3. The ground-water table was taken as that corresponding to probable maximum flood conditions at el 730 feet.

As discussed in Section 2.5.4.7, a portion of the safeguards area and the RWST is underlain by a layer of stiff silty clay with a top surface at approximately el 688 feet. Soil profiles depicting the conditions underlying these structures are shown on Figures 2.5.4-8 and 2.5.4-9. This stiff clay was not considered to be a concern to the stability of the structure insofar as a bearing capacity failure is concerned due to the thickness of the overlying compacted structural fill. The bearing capacities given in Table 2.5.4-4 for the safeguards area and the RWST were computed for their respective foundations on compacted fill with the preceding assumptions.

The ultimate static bearing capacity was also used as the ultimate dynamic bearing capacity when computing the factor of safety against a bearing capacity failure for dynamic loading conditions. The ultimate dynamic bearing capacity is conservatively represented by the computed ultimate static bearing capacity. Tests reported by Vesic et al (1965) for both dry and saturated dense sands, performed at various loading rates, showed a slight drop in bearing capacity with increased loading rate, followed by a steady slow increase. The observed minimum dynamic bearing capacities were about 30 percent lower than the static bearing capacities, which corresponds to a 2 degree decrease in the angle of internal friction. The in situ sands and gravels at the BVPS-2 site have an internal friction angle which ranges between 33 and 40 degrees (Section 2.5.4.2), while a 30 degree value was conservatively chosen for design purposes. Since a 2-degree reduction in the actual minimum internal friction angle of the in situ soils would result in a friction angle still higher than that used for design, the actual dynamic bearing capacity is higher than the computed static bearing capacity shown in Table 2.5.4-4. Therefore, the ultimate dynamic bearing capacity is conservatively represented by the computed ultimate static bearing capacity.

2.5.4.10.2 Settlement

This section describes the calculation procedure used to estimate the static settlement of selected points on plant structures. The same procedure is used to estimate a profile of settlement along buried, safety-related piping that extends from the structures out into the yard. The settlement profile is used to evaluate stresses imposed on the piping system using procedures described in Section 3.7B.3.12.3. This section also describes the calculation procedure used to estimate the differential settlements between the closely spaced main plant area structures that are used for pipe stress analysis. Dynamic settlements during a seismic event are discussed in Section 2.5.4.8.2.

A summary of the estimated total static settlements of the plant structures is provided on Figure 2.5.4-20. Observed settlements as of January 1, 1984 are shown on Figure 2.5.4-46.

Foundation soils in the main plant area consist of compacted select granular fill and medium dense to dense in situ granular soils. The northern portions of the safeguards area and RWST are underlain by a layer of stiff silty clay as discussed in Section 2.5.4.7. Site subsurface profiles within the plant area are shown on Figures 2.5.4-2, 2.5.4-3, 2.5.4-4, 2.5.4-5, 2.5.4-6, 2.5.4-7, 2.5.4-8 and 2.5.4-9.

The ground-water level was assumed to coincide with normal river level at el 665 feet.

Total static settlement of the plant structures founded on granular soils was assumed to consist of two components: an elastic component and a time-dependent component which was assumed to be equal in magnitude to the elastic component (Swiger 1974).

The elastic settlement of the structures in the main plant area was calculated using the computer program SETTLE II (Jubenville 1976). This program computes the elastically distributed stress with depth and computes the compression of each layer in the soil profile beneath a selected point on a given structure due to the load imposed on the soil by that structure along with any adjacent structures. The stresses induced by the loaded areas can be calculated using either Boussinesq or Westergaard solutions; the Boussinesq solution was used in this analysis. The foundation configurations, structural loads, and founding elevations of the plant structures are shown on Figure 2.5.4-41.

Certain assumptions accompany the use of SETTLE II in determining settlement. These are: 1) the load imposed by a structure was placed instantaneously, 2) the loads on all structures were placed simultaneously, and 3) settlements occurred simultaneously with load application.

In calculating settlement, the program sums the vertical strains between the founding elevation and the top of the rock according to Equation 2.5.4-12:

$$\rho = \int_o^z \varepsilon_v \, dz = \sum_{i=1}^{n} \frac{\Delta q_i \Delta z_i}{D_i} \qquad (2.5.4\text{-}12)$$

where:

ρ = elastic settlement
z = total thickness of soil
ε_v = vertical strain
n = number of soil layers
Δq_i = stress increase at center of layer i due to foundation loading
Δz_i = thickness of layer i
D_i = constrained modulus of layer i

The constrained modulus was calculated according to the equation:

$$D_i = \frac{E_i \ (1-\mu)}{(1+\mu) \ (1-2\mu)} \qquad (2.5.4\text{-}13)$$

where:

E_i = Young's modulus of layer $_i$

μ = Poisson's ratio = 0.3

To account for the change in constrained modulus that occurs with changes in effective stress as construction continues and additional load is applied, an average value of constrained modulus was used to estimate the elastic settlement. Typically, an initial value of constrained modulus was computed based on the in situ stress conditions after excavation but before the structural loads were applied. SETTLE II was then used to determine the change in stresses at the center of each layer due to structural loads (including loads imposed by adjacent structures). Using these stress changes, values of the final constrained modulus were determined for each layer. Average values of the initial and final constrained moduli were then used in SETTLE II to calculate the settlement of the structures.

Young's modulus was determined by Equation 2.5.4-14:

$$E = 2G(1 + \mu) \qquad (2.5.4\text{-}14)$$

where:

E = Young's modulus

G = Shear modulus

μ = Poisson's ratio

Low strain shear moduli were estimated using the following Hardin and Black equation (Hardin and Drenevich 1972):

$$G = \frac{1{,}230\ (2.97 - e)^2\ (\bar{\sigma}_o)^{0.5}}{(1 + e)} \qquad (2.5.4\text{-}15)$$

where:

G = shear modulus (psi)

e = void ratio

$\bar{\sigma}_o$ = effective octahedral stress (psi)

Shear moduli determined from in situ seismic velocity measurements compared quite favorably with those computed using the Hardin and Black equation as shown on Figure 2.5.4-12. Standard penetration test N values in the densified zone showed a marked increase after densification as compared to before (DLC 1976). However, in situ seismic velocity measurements that were made after densification do not show the same marked increase (Figure 2.5.4-18), suggesting that the elastic properties of the densified zone are similar to those of

the naturally dense in situ soil. Consequently, for the purpose of computing elastic properties for use in the analysis of settlement, no differentiation was made between soils within and outside the densified zone.

The value of low strain shear modulus was reduced by a factor of three to account for the reduction of shear modulus with strain (Swiger 1974).

The settlement of isolated structures outside of the BVPS-2 main plant area were calculated manually using published elastic solutions generally of the form (Poulos and Davis 1974):

$$\rho = \frac{IpB}{E}$$

(2.5.4-16)

where:

ρ = elastic settlement
I = influence factor which accounts for the shape of the loaded area and the position of the point for which settlement is calculated
p = foundation loading
B = characteristic dimension of structure
E = Young's modulus

As with the analysis of settlement using the computer program SETTLE II, the value of moduli used was the average of the moduli determined for the initial and final stress conditions.

The settlement of the clay layer underlying the northern portion of the safeguards and the RWST was analyzed using one-dimensional consolidation theory. The estimated total settlement included both the clay layer consolidation and the elastic settlement of the in situ sand and compacted fill computed using SETTLE II. The properties of the stiff silty clay layer for use in the settlement analysis were developed from consolidation tests presented in Appendix 2.5D.

The active and passive earth pressure coefficients were computed for the case of a vertical wall, horizontal backfill, and no soil/wall friction according to the Rankine equations (Bowles 1977):

$$K = \tan^2 (45 - /2)$$

$$K = \tan^2 (45 + /2)$$

where:

K = coefficient of active earth pressure
K = coefficient of passive earth pressure
= effective friction angle of soil

The lateral earth pressure on a rigid wall, which experiences no appreciable deflections, is governed by the at-rest earth pressure coefficient, K_o, computed as (Bowles 1977):

$$K = 1 - \sin \bar{\phi} \qquad (2.5.4\text{-}17)$$

For in situ sands and gravels with $\bar{\phi}$ = 30°, K_o is 0.5. For compacted select granular fill with $\bar{\phi}$ = 36°, the computed value of K_o is 0.41. From empirical correlations of strength characteristics such as that presented in U.S. Dept. of the Navy (1971), for a well-graded sand and gravel compacted to the density specified in Section 2.5.4.5.2, $\bar{\phi}$ may be in excess of 40°, which corresponds to a K_o of 0.36 or less. A conservative K_o of 0.6 was generally used; however, lateral pressures on the walls of the lower pump cubicles on the east side of reactor containment were evaluated for a K_o of 0.36 ($\bar{\phi}$ = 40°), and for the southwest wall of the control room extension and for the north and south walls of the adjoining electric cable tunnel, a K_o of 0.45 ($\bar{\phi}$ = 33°) was used. These values are consistent with the estimate of $\bar{\phi}$ for the compacted select granular fill.

The active, passive, and at-rest earth pressure coefficients for the in situ sands and the compacted select granular fill are given in Table 2.5.4-5. No safety factors have been applied to the coefficients presented.

Equations for determining the static and dynamic lateral earth and groundwater pressure distributions against unyielding walls are shown on Figure 2.5.4-42. Walls are designed for the combination of static and dynamic lateral earth and groundwater pressures and, in some cases, for compaction-induced lateral earth pressures.

Dynamic lateral earth pressures are those developed by Mononobe-Okabe and described by Seed and Whitman (1970). Hydrodynamic groundwater pressures are taken as 70 percent of the free water pressures determined by Westergaard (1933). Lateral loads on the reactor containment for seismic conditions are determined as described in Section 2.5.5.4 of the BVPS-2 PSAR (DLC 1972g).

Compaction-induced lateral earth pressures are considered for the control room extension and the electrical cable tunnel. The earth pressure diagram shown on Figure 2.5.4-42 is computed using the procedure presented by Broms (1971) for the compaction equipment used at BVPS-2. The compaction-induced lateral earth pressure is added to the static lateral earth pressures computed for $K_o = 0.45$.

Design basis for structure hydrostatic loading is discussed in Section 2.4.13.5.

The differential settlements for safety-related piping that spans the shake spaces between adjacent main plant area structures are estimated by using the settlement data obtained from the settlement monitoring program described in Section 2.5.4.13. The observed settlement data is used to make a prediction of the total settlement of the two adjacent structures that are penetrated by the pipe. An average line is drawn through the log-time plots of observed settlement and extrapolated over an assumed 40-year plant life. The total settlement at the end of 40 years is reduced by the settlement that occurred prior to the date of the final weld connecting the pipe to the structures. Since settlement markers are typically not located at piping penetrations, it is necessary to interpolate between adjacent markers to estimate the total settlement at the penetration. The differential settlement of the pipe is the difference between the total settlements of the two adjacent structures at the piping penetration points subsequent to the final weld. An analysis is made of the stresses imposed on the piping system by this differential movement. For the purpose of pipe stress analysis, a minimum differential settlement of 0.5 inch has been used for initial analysis. If this assumption proves to be too conservative, the predicted differential settlement is used instead.

2.5.4.11 Design Criteria

State-of-the-art methods were used in the analysis of foundation stability of Category I structures. Methods used to evaluate bearing capacity, settlement, and lateral earth pressure are discussed in Section 2.5.4.10. The liquefaction potential and an estimate of the dynamic settlement of the granular soils at the site are discussed in Section 2.5.4.8. Soil properties used in the analyses are provided in Sections 2.5.4.2 and 2.5.4.5.

Minimum design factors of safety are as follows:

Bearing capacity	3.0 for all loading conditions.
Slope stability	1.5 for all permanent loading conditions; 1.1 for SSE loading conditions and for construction slopes.
Hydrostatic uplift	1.1 for maximum water levels.

Sliding	1.5 for all permanent loading conditions; 1.1 for SSE loading conditions.

A discussion of loads and load combinations used in the design of Category I structures is provided in Sections 3.8.1.3 and 3.8.4.3.

2.5.4.12 Techniques to Improve Subsurface Conditions

A zone of loose granular material from approximately el 640 to 660 feet was discovered in the BVPS-2 area during the excavation for the containment foundation. The extent of the loose zone was conservatively defined from exploratory borings as a zone containing a significant number of samples having N_1 values less than 10, as determined by the Gibbs and Holtz (1957) relationship. A discussion of the criteria used to establish the limits of the densified zone is provided in Section 2.5.4.8. Subsequent investigation revealed that the loose zone was present under roughly the northern half of the containment and extended east and west beneath most of the Category I structures. The loose zone was successfully densified using the pressure injected footing technique. The densification program and its evaluation are fully described in the Report on Soil Densification Program (DLC 1976). Plots of N_1 values obtained during the verification program are presented on Figures 3-29, 3-30, and 3-31 of the report. These plots show that all samples of the loose sand and gravel zone have been densified to obtain N_1 values greater than 10. Figure 3-30 shows five data points with N_1 values that are less than 10; however, these samples are not sand.

The removal of uncontrolled fill that was placed during the construction of SAPS and BVPS-1 is discussed in Section 2.5.4.5. The removal of a lens of stiff silty clay found during the containment excavation is also discussed in Section 2.5.4.5.

The approximate limits of densification of the lower terrace sands and gravels beneath the BVPS-1 circulating water lines and river water lines (WR) and the BVPS-2 service water lines (SWS) are shown on Figure 2.5.4-16. This densification program is described in responses to USAEC questions 2.26 and 2.27 in the BVPS-2 PSAR (DLC 1972e).

Initially, BVPS-1 had been designed with a once-through cooling system with an intake structure located near the present location of the BVPS-1 cooling tower. The Category I river water lines for BVPS-1 had been located directly adjacent to the 108-inch circulating water lines leading to this intake structure. Concern had been expressed that in the event of the liquefaction of soils along the circulating water lines leading to this intake structure. Concern had been expressed that in the event of the liquefaction of soils along the circulating water lines, erosion resulting from their possible rupture could disturb the adjacent river water lines and it was decided to densify the sands and gravels beneath the circulating water lines using vibroflotation to preclude this problem.

After completion of the densification program, but before the installation of the circulating water lines, the decision was made to change from a once-through cooling system to closed-cycle cooling towers. Due to space limitations on the site, it was necessary that the intake structure be relocated to its present location as shown on Figure 2.5.4-16.

The soil conditions underlying the service water and river water lines from the point where they cross the circulating water lines to the present location of the intake structure are similar to the previous location and are typical of the low level terrace. The subsurface profile extending from the valve pit to the intake structure is provided on Figure 2.5.4-54. Although the results of a liquefaction analysis of the soils north of the circulating water lines to the intake indicated an adequate factor of safety against liquefaction (Appendix 2H, BVPS-1 PSAR), it was decided to densify the sands and gravels beneath the river water and service water system lines also. A typical section through the densified zone is shown on Figure 2.5.4-58.

The granular soil to the south of the densified zone on the intermediate terrace will not be subject to liquefaction (DLC 1976). If zones of granular material underlying the lower terrace outside of the densified zone were liquefied, flow slides are improbable since the rock surface does not slope toward the river appreciably but remains relatively flat at el 620 feet.

Although some surface subsidence of the soils outside of the densified zone could occur, major movements affecting the support of the service water and river water lines are not likely. The densified area would be constrained against movement towards the river by the densified area adjacent to the intake structure itself.

The limits of densification of the lower terrace sands and gravels beneath the Category II circulating water lines and the Category I service water lines to the intake structure are shown on Figure 2.5.4-16. As shown, the soil was densified to the top of rock using vibroflotation under two of the circulating water lines from just west of the service water lines eastward to near the cooling tower. The soil underlying the service water lines to the intake structure was also densified. The subsurface profile extending from the valve pit to the intake structure is presented on Figure 2.5.4-54. The locations of verification borings 537 through 562 are shown on Figure 2.5.4-13. The results of the verification borings are presented on Figure 2.5.4-56. The minimum allowable relative density for this area was 75 percent. Only two of 178 sand and gravel samples show relative densities less than 75 percent; therefore, the program was successful. The mean relative density indicated by the verification boring data was 97.7 percent and the mean-less-one-standard-deviation relative density was 91.4 percent. The densification under the circulating water lines was done because the intake structure was originally planned for a different location,

near the present BVPS-1 cooling tower, and the service water lines were to run parallel to the circulating water lines. This work is described in the BVPS-2 PSAR response to USNRC Questions 2.26 and 2.27 addressed in Appendix 2A of the BVPS-2 FSAR.

There was a concern that the nondensified granular soils adjacent to the main intake structure, should they liquefy during an SSE, could block the intake channel and/or clog the pumps. To prevent this from occurring, two areas approximately 75 feet by 90 feet on the east and the west side of the main intake structure were densified in 1974 by the L. B. Foster Company of Union, New Jersey using the Terra Probe method. The approximate limits of the densification program are shown on Figure 2.5.4-16.

The Terra Probe consists of a vibratory pile driving hammer to which a 30-inch diameter open-ended tubular probe is attached. The unit is suspended from a crane and vibrated into the soil. Densification occurs as the vibrating probe is withdrawn from the soil.

Forty-six verification borings were performed to evaluate the effectiveness of the densification program, the locations of which are shown on Figure 2.5.4-32. The median relative density at each boring location was required to be not less than 75 percent in the sands and gravels as determined using the Gibbs and Holtz relationship. In any one boring, not more than one sample point within the sands and gravels was allowed a relative density less than 70 percent and none were allowed to be less than 65 percent. If these criteria were not met, the area around the failing boring was redensified.

A test program was conducted to determine the optimum grid spacing for the Terra Probe. Three borings, TH-1 through TH-3, were performed before the test densification and three borings, TH-4 through TH-6, were performed afterwards. It was decided that a 5-foot grid spacing would be adequate to achieve the densification requirements.

Prior to beginning the production densification program, 12 borings were performed to allow a comparison of relative densities before and after densification. (Figure 2.5.4-32). A summary plot of relative densities before and after densification is given on Figure 2.5.4-43. Relative density plots of each individual verification boring are provided in Appendix 2.5C. Boring logs are provided in Appendix 2.5B.

Upon the completion of the initial series of borings, both of the areas were densified using the 5-foot grid spacing. Prior to densification, the material between the sheetpile walls was excavated to expose the tie rods at approximately el 663 feet to facilitate the insertion of the Terra Probe. After densification, backfill material was placed before performing the verification borings. Verification borings performed subsequent to the initial densification revealed that the desired densities were not being achieved in all cases. A second test panel was conducted in which a single Terra Probe was inserted and withdrawn from the soil. Three verification borings were performed, one in the center of the probe location and two at increasing distances from the probe (Borings 559T, 560T, 561T). It was found that in this particular area, densification was occurring within the probe itself and for a distance of about 8 inches outside the probe.

Selected areas offshore were redensified using a 5-foot grid spacing which overlapped the original densification pattern. The onshore areas were redensified using a 2.5-foot grid spacing. Figure 2.5.4-32 shows the approximate areas in which each of the densification patterns were performed.

Eleven borings performed after the final densification program indicated that the densification requirements had been achieved. The boring locations are given on Figure 2.5.4-32 and summary plots of relative density before and after densification are given on Figure 2.5.4-43. The densification program required that the mean relative density at each boring location be not less than 75 percent for the sands and gravels as determined by the Gibbs and Holtz (1957) relationships. In any one boring, not more than one sample within the sands and gravels was allowed a relative density less than 70 percent and none were allowed to be less than 65 percent.

The results of the after-densification borings are summarized on Figure 2.5.4-43. Only three of 93 sand and gravel samples have relative densities less than 65 percent, and of these, two are very close to the soil surface. Thus, it is concluded that adequate densification of the sands and gravels was achieved with a mean relative density of 92.3 percent and a mean-less-one-standard-deviation relative density of 79.8 percent.

2.5.4.13 Surface and Subsurface Instrumentation

In 1977, a comprehensive settlement monitoring program was established for BVPS-2. The settlement of each BVPS-2 Category I structure was monitored during construction, and is monitored through the plant's life until the settlement of a particular structure has been determined to be stable as defined by the settlement monitoring program. For such structures, settlement monitoring is then discontinued.

Differential settlements along buried, safety-related piping that extends from the structures out into the yard and differential settlements of piping that spans the shake spaces between the closely spaced main plant area structures are not monitored as part of the settlement monitoring program. Section 2.5.4.10.2 describes the calculation procedures used to estimate the differential settlements that are used for pipe stress analysis.

During construction, settlement markers are monitored monthly, but, after construction when the structures are fully loaded and their settlement profiles begin to level out, the period between readings will be increased. Permanent bench marks are installed at various locations around the site to provide reliable survey reference points. Several piezometers monitor changes in ground-water elevation to evaluate possible correlations between settlement data and changes in ground-water elevation. In each structure several settlement markers are installed during construction, and are located so that they can be monitored during and after construction. The locations of the bench marks and piezometers are shown on Figure 2.5.4-14 and the locations of the settlement markers installed at present are shown on Figures 2.5.4-44 and 2.5.4-45.

The observed settlements to date (Figure 2.5.4-46) can be compared with the predicted total static settlements shown on Figure 2.5.4-20.

2.5.4.13.1 Bench Marks

Six permanent bench marks were installed at the locations shown on Figure 2.5.4-14. A typical bench mark installation detail is shown on Figure 2.5.4-47. It consists of a 2-inch diameter extra strong steel pipe anchored into bedrock inside of a 3 1/2-inch diameter casing extending to the top of rock. The bench marks are identified by a brass monument inscribed with the bench mark number, elevation, coordinates, and date of initial survey.

The elevations of the bench marks were checked at three-month intervals for the first year after installation and once per year thereafter. In addition, the elevations of bench marks in the

immediate vicinity of construction activities are monitored monthly and any bench mark that is disturbed or is suspected of being disturbed is resurveyed.

Bench marks are checked by running one or a series of leveling loops within the established bench marks. If, by comparison with the elevation measured during the original survey, it has been determined that a bench mark has been disturbed, a new brass monument is installed and the bench mark resurveyed.

All survey work performed in conjunction with checking and reestablishing bench marks is done using first order vertical control.

2.5.4.13.2 Piezometers

Six stand pipe piezometers were installed at the locations shown on Figure 2.5.4-14. Typical piezometer installation details are shown on Figure 2.5.4-27 and specific installation data are given in Appendix 2.5A. Tip elevations range between el 646 and el 651 feet and all of the piezometers are located within the in situ sand and gravel.

Piezometer data and Ohio River elevation data are recorded weekly and are included in Appendix 2.5A. With the exception of one period during February 1979, the ground-water levels recorded in the piezometers show very good correlation with the Ohio River elevations. During February 1979, the river rose to el 681 feet and the piezometer data indicate an apparent time lag. However, the piezometers were only read weekly during the period of high water and in the interim between readings the water level in the piezometers may have continued to rise, thereby reducing the apparent elevation difference between the ground-water levels and the Ohio River elevation.

2.5.4.13.3 Settlement Markers

The locations of the currently installed settlement markers are shown on Figures 2.5.4-44 and 2.5.4-45. Details of the several types of markers are shown on Figure 2.5.4-48. Construction activity in certain structures requires that settlement markers be relocated periodically in order to provide continuing access to the markers. In such structures, temporary markers have been installed instead of permanent markers. Temporary settlement markers have been installed on the reactor containment building, the safeguards area, the fuel and decontamination building, and the cooling tower. When construction activity diminishes to the point that markers are no longer subject to periodic relocation, the temporary settlement markers are replaced with permanent ones.

2.5.4.13.4 Data Processing

Data processing is accomplished using a SWEC computerized data storage system entitled Settlement Monitoring System (IS-233). The settlement marker elevations are input into the computer storage files and a computer printout providing the complete settlement record of each marker is produced. A specimen page of output is given on Figure 2.5.4-49.

For each settlement marker, settlement versus log-time plots have been prepared. These plots are not included herein but are provided in the report on Settlement Monitoring Program (DLC 1980). A summary of the observed settlements to date is shown on Figure 2.5.4-46.

The Ohio River elevation and piezometer data are included in Appendix 2.5A.

2.5.4.14 Construction Notes

The removal of uncontrolled fill placed during the construction of SAPS and BVPS-1 is discussed in Section 2.5.4.5. The removal of a lens of stiff silty clay found during the reactor containment excavation is also discussed in Section 2.5.4.5.

A zone of loose granular material was discovered in the BVPS-2 area during the excavation for the reactor containment excavation. It was densified using the pressure injected footing technique. The densification program and its evaluation are fully described in the Report on Soil Densification Program, (DLC 1976).

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Whitman, R.V. 1968. Effect of Local Soil Conditions on Seismic Threat to Beaver Valley Power Station. Contained in Stone & Webster Engineering Corporation 1968. Preliminary Safety Analysis Report, Beaver Valley Power Station - Unit 1. Docket No. 50-334.

Tables for Section 2.5.4

TABLE 2.5.4-1

BORING LOG INDEX

Project	Boring Number	Date Drilled	Purpose	Boring Log Reference
Shippingport	1 - 23	July 1954	General Site	1
Atomic Power	29 - 33	April 1955	Investigation	1
Station	A - H	April 1955		1
	J - N & P	April 1955		1
Beaver Valley	101 - 117	March/April 1968	General Site Investigation	2
Power Station -	301 - 310	July 1969	General Site Investigation	3
Unit 1	401 - 404	Nov./Dec. 1969	General Site Investigation	3
	501 - 518	June 1970	Vibroflotation Program	4
	519 - 536	Nov./Dec. 1970	Vibroflotation Verification	2
	537 - 562	Jan./Feb. 1973	Vibroflotation Verification	2
	537T - 577T	March/April 1974	Terra Probe Verification	5
	TH1 - TH6	March/April 1974	Terra Probe Verification	5
	601, 602	May 1971	Cooling Tower Location Study	4
	608 - 613	May 1971	Cooling Tower Location Study	2
	650 - 652	May 1971	Cooling Tower Location Study	4
	701 - 718	May 1971	Cooling Tower Location Study	4
	H1 - H5	August 1971	Highway Embankment Stability	6
	AB1 - AB12	Feb./March 1974	Turbine Building Stability	7
Beaver Valley	801 - 843	Nov. 1971 - April 1972	General Site Investigation	2
Power Station -	854, 855	July 1974	General Site Investigation	5
Unit 2	901 - 916	March 1974	Auxiliary Intake Structure	5
	918 - 980	July - Sept. 1976	Loose Zone - Plant Area	8
	1000 - 1030	May - June 1976	Loose Zone - Containment	8
	OF1 - OF6	July 1976	Office Building	8
	RH1	August 1976	General Site Investigation	8
	Z1	November 1976	General Site Investigation	8
	PL1 - PL3	Feb. 1977	Parking Lot	8
	CT1 - CT3	July 1977	Cooling Tower	8
	SWS 1 - SWS 5	August 1977	Service Water System	8
	Figure 2.5.4-15	May 1976 - July 1977	Soil Verification Borings	8
	SEO-1 - SEO-5	October 1981	Office Building	5
	EOS-1 - EOS-10	May - June 1982	Emergency Outfall Structure	5
	TH-1 - TH-13	May - June 1982	Emergency Response Facility	6
Bruce Mansfield Power Plant	PL1 - PL66	May - July 1974	Slurry Pipelines	9

NOTES:
1. Duquesne Light Company 1972a
2. Duquesne Light Company 1972b.
3. Duquesne Light Company 1972c.
4. Duquesne Light Company 1972d.
5. Appendix 2.5B.
6. Not published
7. Duquesne Light Company 1979.
8. Duquesne Light Company 1976.
9. Dravo Corporation 1974.

TABLE 2.5.4-2

MATERIALS TESTING REQUIREMENTS AND FREQUENCY

Materials	Type Of Test	Test Designation	Minimum Frequency Of Testing	Remarks
Excavated material	In-place density	Washington densometer ASTM D2167 and/or Nuclear densometer ASTM D2922	One per 5 ft of depth	Testing to be on excavated material which is to be stockpiled for later use.
	Moisture density	ASTM D1557 Method D	Whenever visual inspection indicates a significant change in material gradation.	
	Sieve analysis	ASTM D422 and ASTM D1140	One per moisture density test.	
Founding elevation material	In-place density	Washington densometer ASTM D2167 and/or Nuclear densometer ASTM D2922	As directed by the Geotechnical Engineer.	
Select granular/ structural fill	In-place density	Washington densometer ASTM D2167 and/or Nuclear densometer ASTM D2922	1. Areas greater than 1,000 ft^2, one per 1,000 yd^3 placed or one per alternate lift, whichever results in a greater frequency. 2. Areas less than 1,000 ft^2, one for every 2.5 ft of compacted fill. 3. For each 200 linear ft of trench, one per alternate lift of compacted fill, or as directed by the Geotechnical Engineer.	
	Moisture density	ASTM D1557 Method D	1. One per new source. 2. One per 5,000 yd^3 placed 3. Whenever visual inspection indicates a significant change in material gradation.	Material for moisture density test shall be taken adjacent to an in-place density test.
	Sieve analysis	ASTM D422 and ASTM D1140	One for each moisture density test	Material for sieve analysis shall be taken from material sampled for the moisture density test

TABLE 2.5.4-2

MATERIALS TESTING REQUIREMENTS AND FREQUENCY

Materials	Type Of Test	Test Designation	Minimum Frequency Of Testing	Remarks
	Specific gravity	ASTM C127	1. One per new source. 2. One per every 50 moisture density tests.	

TABLE 2.5.4-3

SUMMARY OF PREDICTED DYNAMIC SETTLEMENTS

Structure	Dynamic Settlement (in)
Auxiliary building	0.12
Control room extension	0.11
Demineralized water tank	0.16
Diesel generator building	0.13
Fuel building	0.14
Main steam and cable vault	0.14
Reactor containment	0.09
Refueling water tank	0.16
Safeguards area	0.14
Service building	0.16
Valve pit	0.14
Emergency outfall structure	0.03
Main intake structure	0.10

TABLE 2.5.4-4

BEARING CAPACITY - CATEGORY I STRUCTURES

	Approximate Dimensions of Contact Area (ft)	Approximate Foundation Depth (ft)	Ultimate Bearing Capacity (ksf)	Static Approximate* Load (ksf)	Factor of Safety	Dynamic Approximate* Load (ksf)	Factor of Safety
Auxiliary building	120 x 146	32	129	5.7	32	10.6	15
Control room extension	65 x 81	32	97	3.5	54	5.6	25
Decontamination building	33 x 33	5.5	33	6.3	5	11.5	3
Demineralized water tank	38 x 38	4.7	35	3.4	10	10.9	3
Diesel generator building	81 x 83	22	90	3.1	45	5.9	19
Emergency outfall structure	25 x 30	25	60	3.2	10	8.0	9
Fuel building	44 x 110	17.7	61	6.8	10	11.9	5
Main intake structure	84 x 89	39.5	115	8.9	19	6.7**	24**
Main steam and cable vault	90 x 135	22.5	74	3.7	28	7.1	12
Reactor containment	142 dia.	54	157	7.5	36	12.4	17
Refueling water storage tank	57 x 58	4.7	45	3.5	13	8.8	5
Safeguards area	60 x 98	20.5	76	3.2	35	4.7	21
Service building	55 x 186	9.5	54	4.0	15	4.6	13
Valve pit	25 x 37	18.8	50	1.6	31	3.8	17

NOTES:

* Foundation load does not include buoyant effect of water. Bearing capacity calculated assuming ground-water level at el 730 feet corresponding to PMF conditions.

** Dynamic load evaluated for groundwater level at el 665 feet, corresponding to normal water conditions.

TABLE 2.5.4-5

SUMMARY OF
LATERAL EARTH PRESSURE
COEFFICIENTS

Coefficient of Earth Pressure	In Situ Soil	Compacted Select Granular Fill
Active, K_a	0.33	0.26
Passive, K_p	3.0	3.85
At rest, K_o	0.50	0.6
		0.45*
		0.36**

NOTES:

* For control room extension and electric cable tunnel only.
** For lower pump cubicles of the reactor containment only.

TABLE 2.5.4-6

STRUCTURAL FILL
SUPPLIER AND QUANTITIES PROVIDED

Supplier	Quanity (cu yds)
X & L Sand & Gravel Midland, Pennsyvania	287,695
X & L Sand & Gravel Negley, Pennsylvania	192,557
Mahoning Sand & Gravel	306
Georgetown Sand & Gravel Georgetown, Pennsylvania	175,745
Dravo Corporation Georgetown, Pennysylvania	24,855
Dravo/Kabuta Kabuta, Pennsylvania	62,835
	743,993

TABLE 2.5.4-7

LIQUEFACTION ANALYSIS AT INTAKE STRUCTURE
EARTHQUAKE RECORDS

Year	Mo.	Day	Earthquake Name	Local Magnitude	Scaling Factor	Recording Station	Component	Record No.
1935	10	31	Helena, MT	6.0	0.271	Carroll College Helena, MT	EW	B-025
1975	09	27	Oroville, CA Aftershock	4.6	1.452	Oroville, CA CDMG No. 8	SOOE	8-234
1979	08	06	Coyote Lake, CA	5.9	0.307	Coyote Creek San Martin, CA	160°	SM-879

TABLE 2.5.4-8

MAIN INTAKE STRUCTURE
LIQUEFACTION ANALYSIS

Soil Layer*	N_1	$\bar{\sigma}_v$ (psf)	Shear Stress (psf) Applied A	Allowable** B	C	Safety Factor B/A	C/A
3	7	4,210	309	380	491	1.2	1.6
4	18	4,740	339	1,101	1,422	3.3	4.2
5	18	5,280	346	1,226	1,584	3.5	4.6

NOTES:

* Soil model shown on Figure 2.5.4-70

** Allowable shear stress on Figure 2.5.4-29

B τ allow = $0.0129 N_1 \bar{\sigma}_v$ (Seed et al 1975)

C τ allow = $0.01667 N_1 \bar{\sigma}_v$ (Seed et al 1983)

TABLE 2.5.4-9

SITE MATCHED GROUND SURFACE EARTHQUAKE RECORDS*

Date Year	Month	Day	Epicentral Location	Recording Station	Component	CIT Record No. **
1954	12	21	Eureka, CA	Federal Bldg. Eureka, CA	N79E S11E	A-008
1957	03	22	San Francisco, CA	State Bldg. San Francisco, CA	N09E S81W	A-016
				Alexander Bldg. San Francisco, CA	N09W N81E	A-104
1957	03	22	San Francisco, CA	Alexander Bldg. San Francisco, CA	N09W N81E	V-323
				City Hall, Oakland, CA	N26E S64E	A-017
1962	09	04	Northern CA	Federal Bldg. Eureka, CA	N79E S11E	V-330
1965	07	15	Southern CA	Old Ridge Rte. Castaic, CA	E S	V-331
1970	09	12	Lytle Creek, CA	6074 Park Dr. Wrightwood, CA	S65E S25W	W-334
1971	02	09	San Fernando, CA	Old Ridge Rte. Castaic, CA	N21E N69W	D-056

NOTES:

*Per SWEC (1985)
**California Institute of Technology reference number, Trifunae and Lee (1973)

TABLE 2.5.4-10

RELATIVE DISPLACEMENT OF SELECTED STRUCTURES
USING THE EARTHQUAKE TIME-HISTORY METHOD

Structures		Centroid	Relative Displacement (in.)	
From	To	Distance (ft)	Horizontal	Vertical
Main Steam & Cable Vault	Auxiliary Building	115	0.29	0.19
Main Steam & Cable Vault	Safeguards Area	150	0.32	0.21

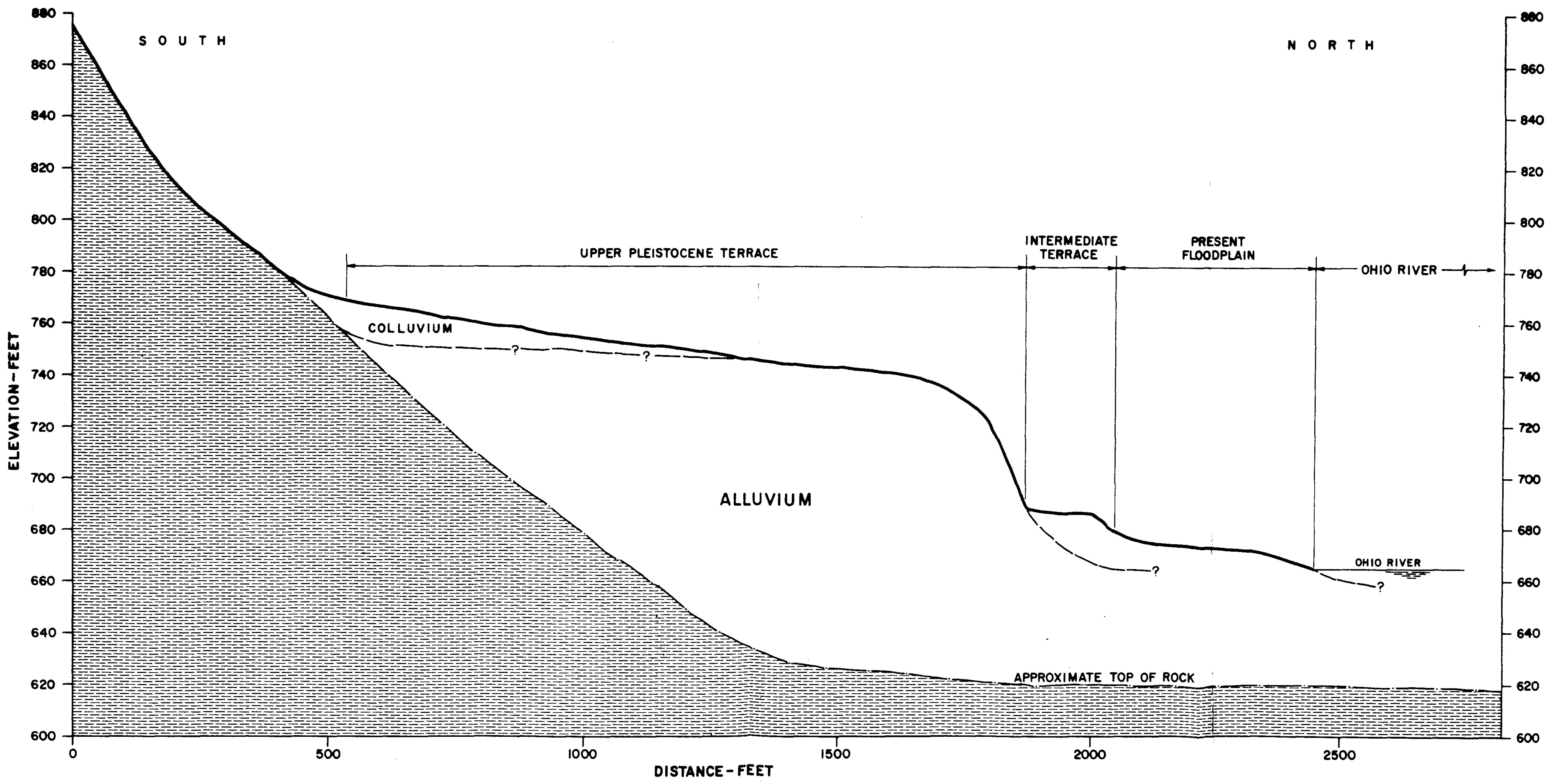


FIGURE 2.5.4-1
TYPICAL TERRACE SECTION
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

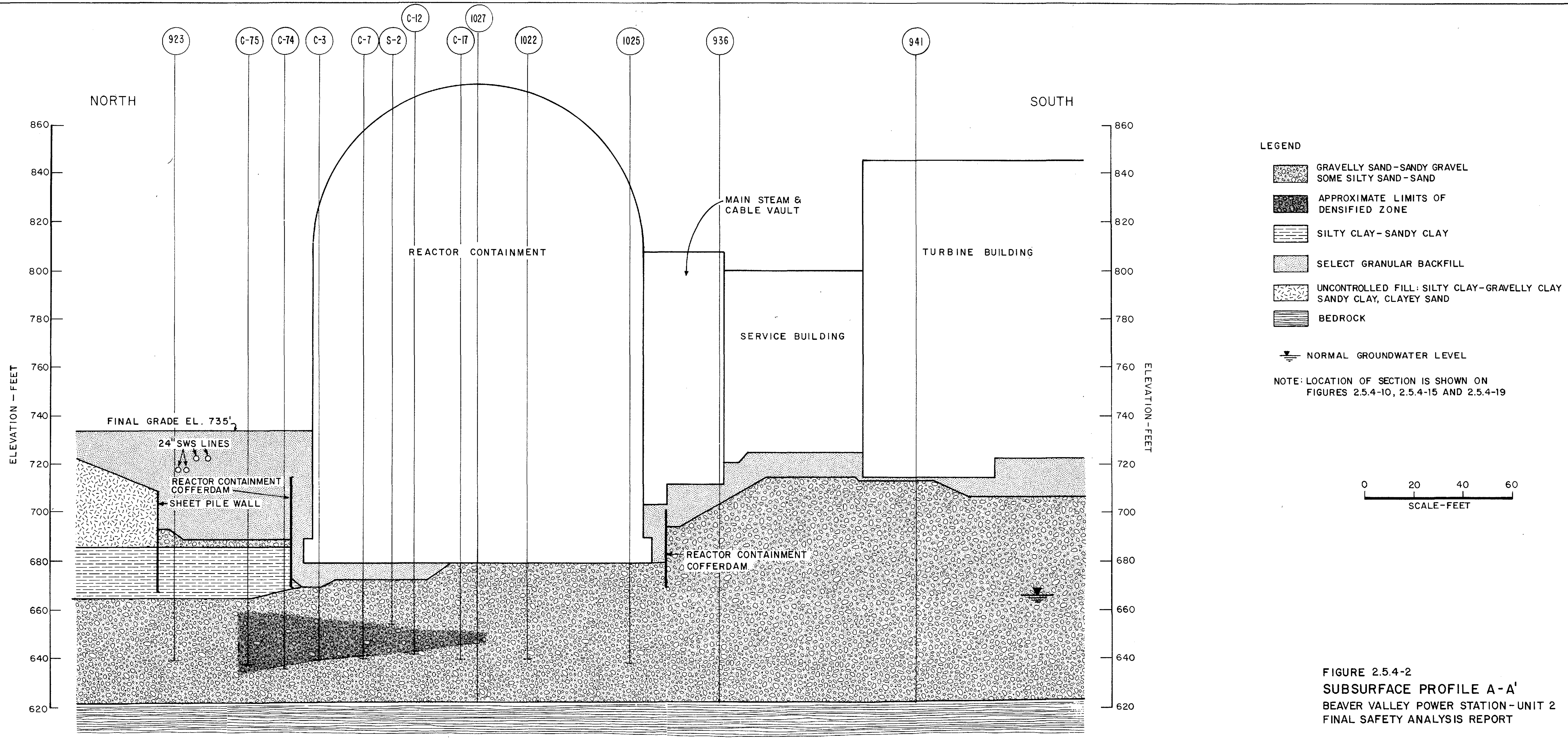


FIGURE 2.5.4-2

SUBSURFACE PROFILE A-A'

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT

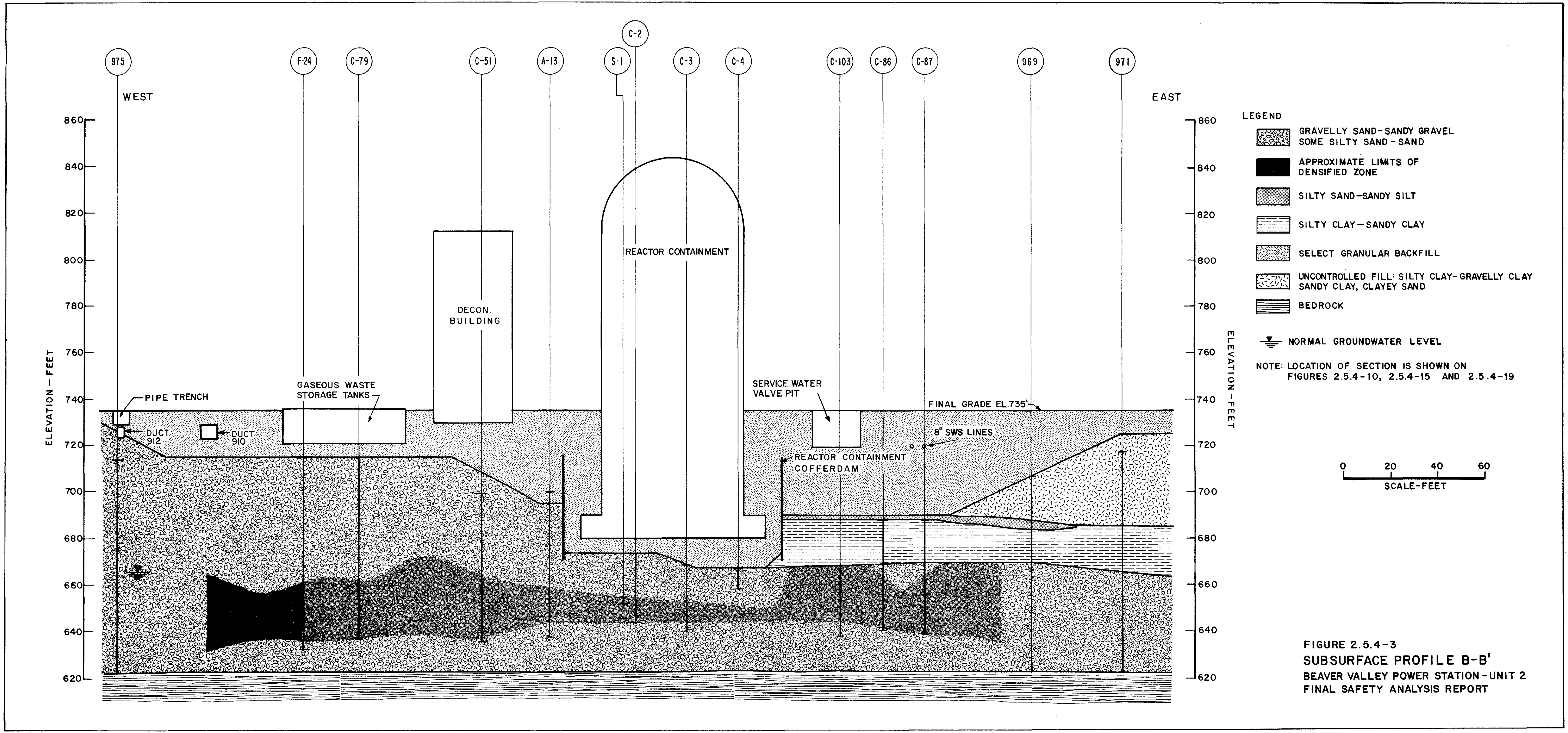


FIGURE 2.5.4-3
SUBSURFACE PROFILE B-B'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

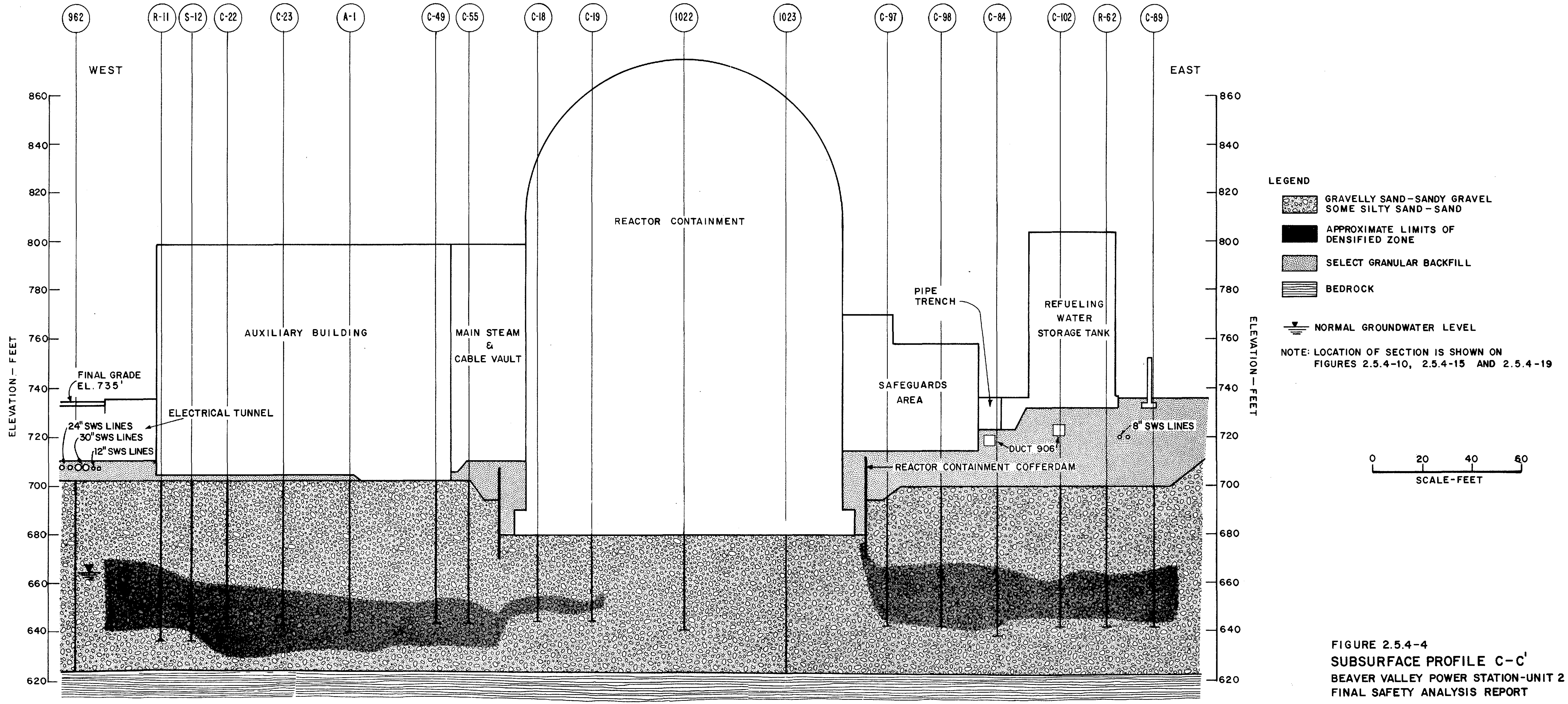


FIGURE 2.5.4-4
SUBSURFACE PROFILE C-C'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

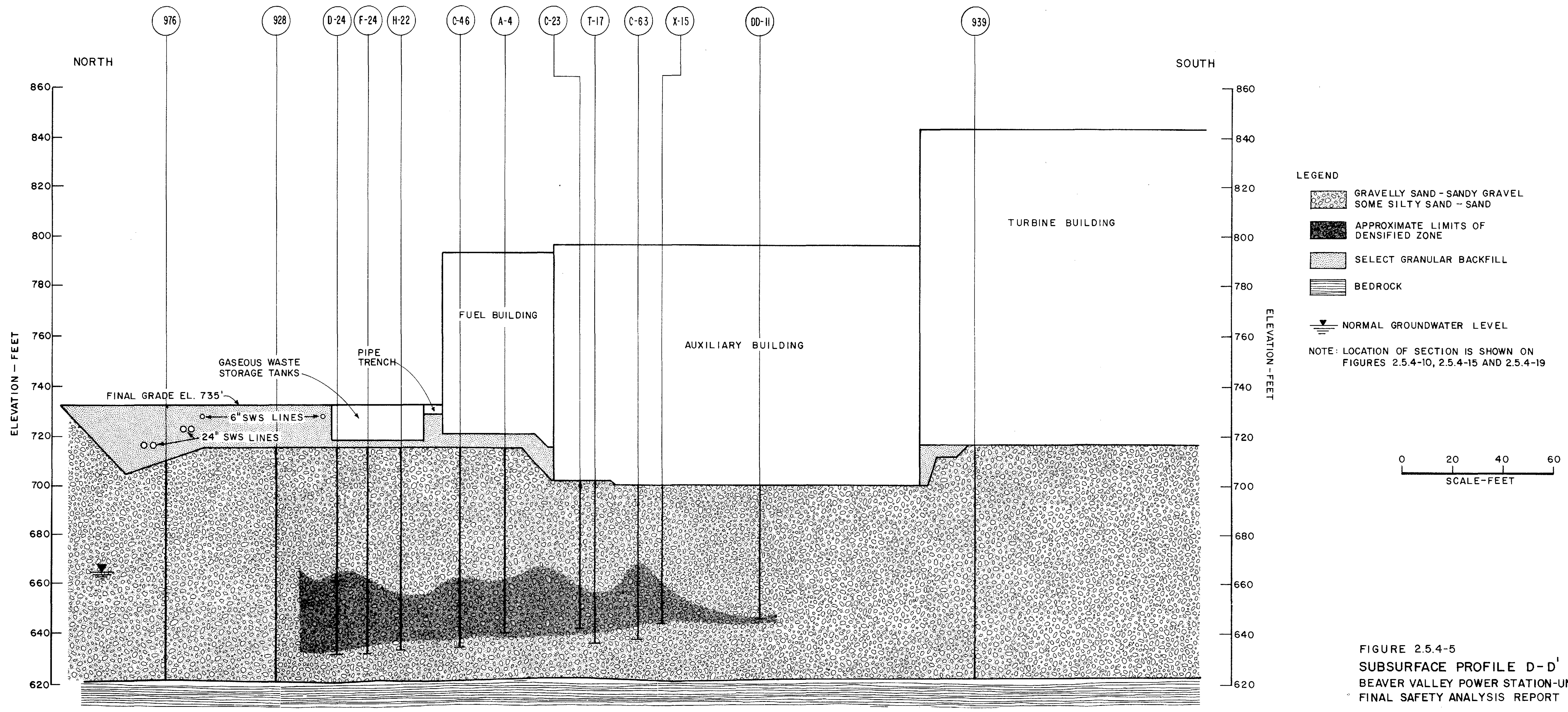


FIGURE 2.5.4-5

SUBSURFACE PROFILE D-D'

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT

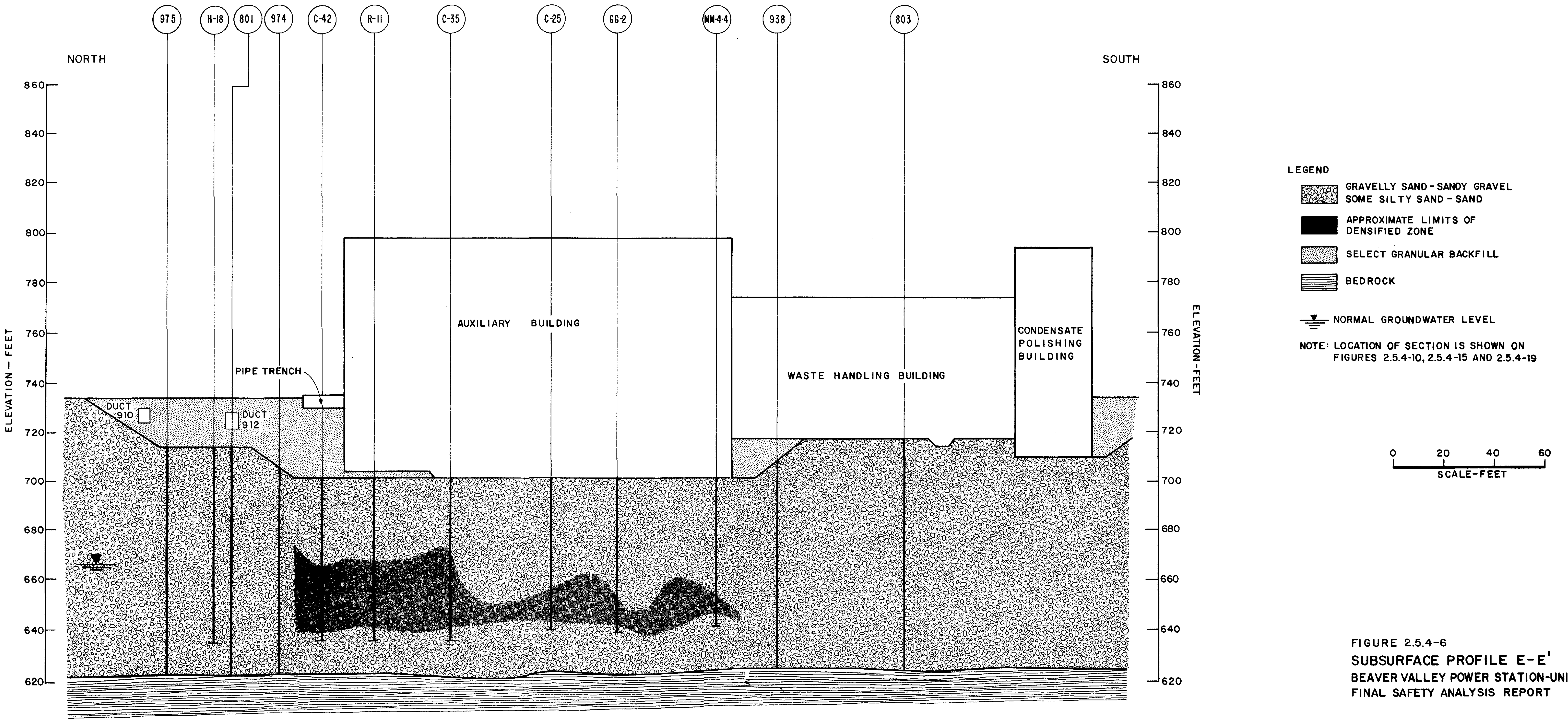


FIGURE 2.5.4-6
SUBSURFACE PROFILE E-E'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

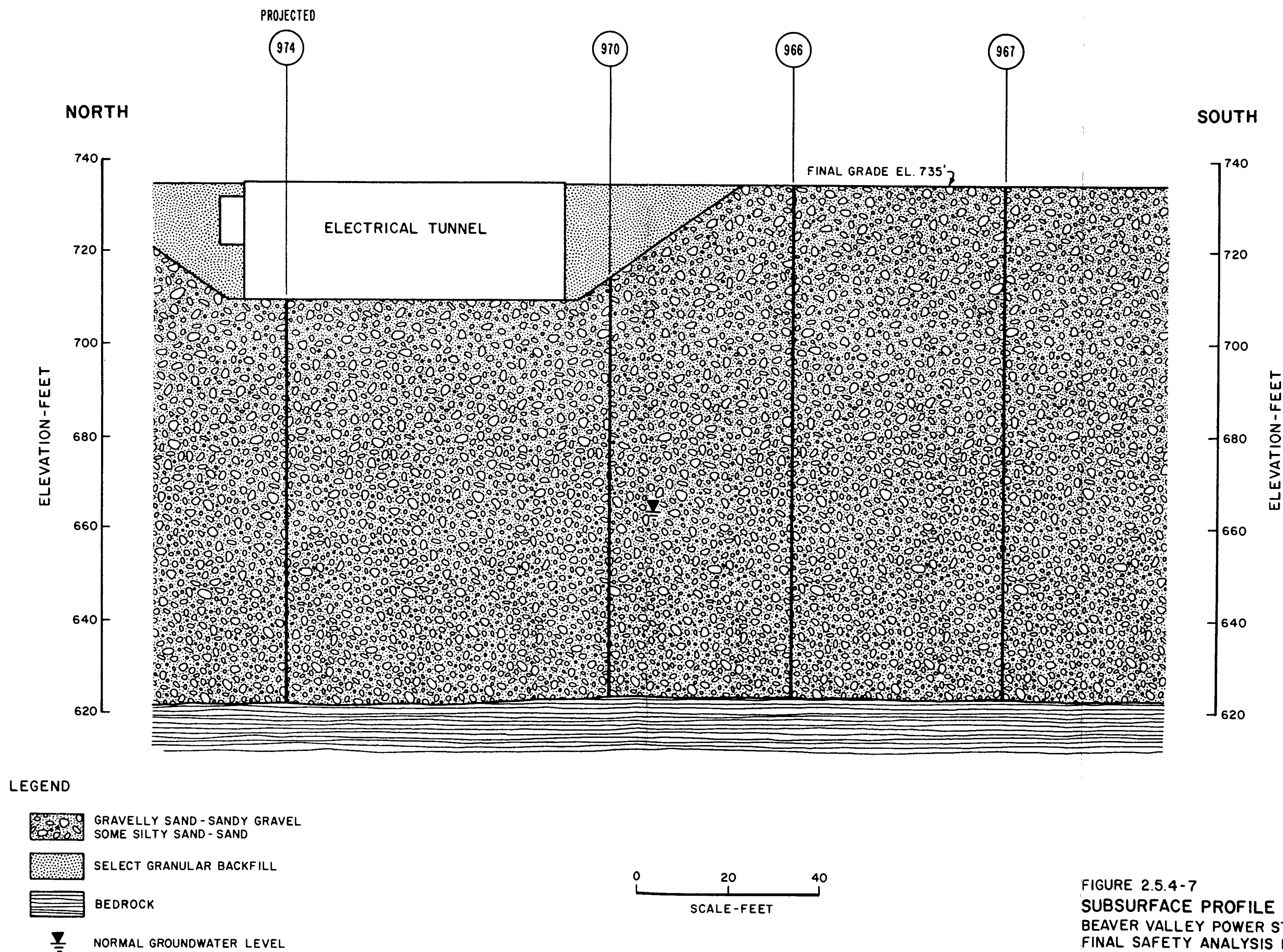


FIGURE 2.5.4-7
SUBSURFACE PROFILE F-F'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

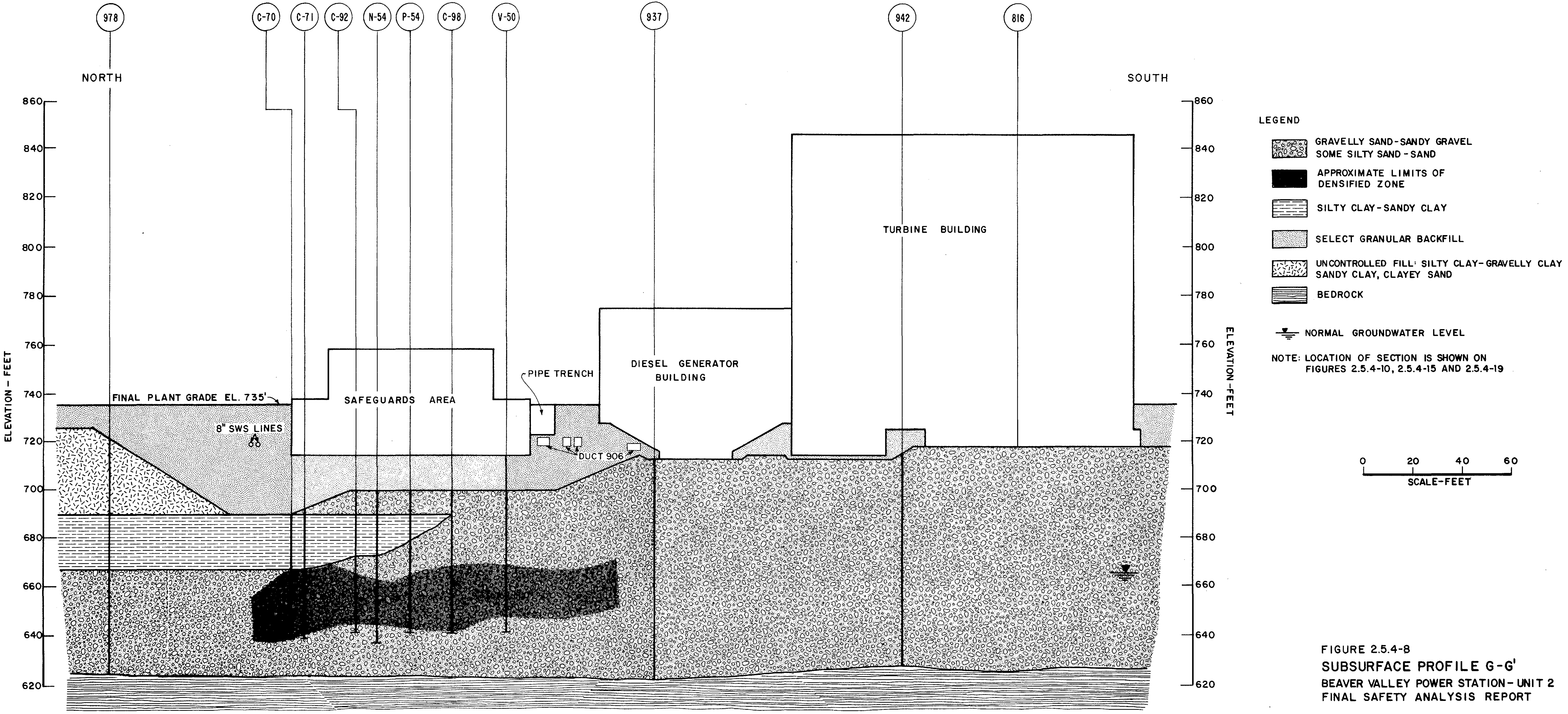
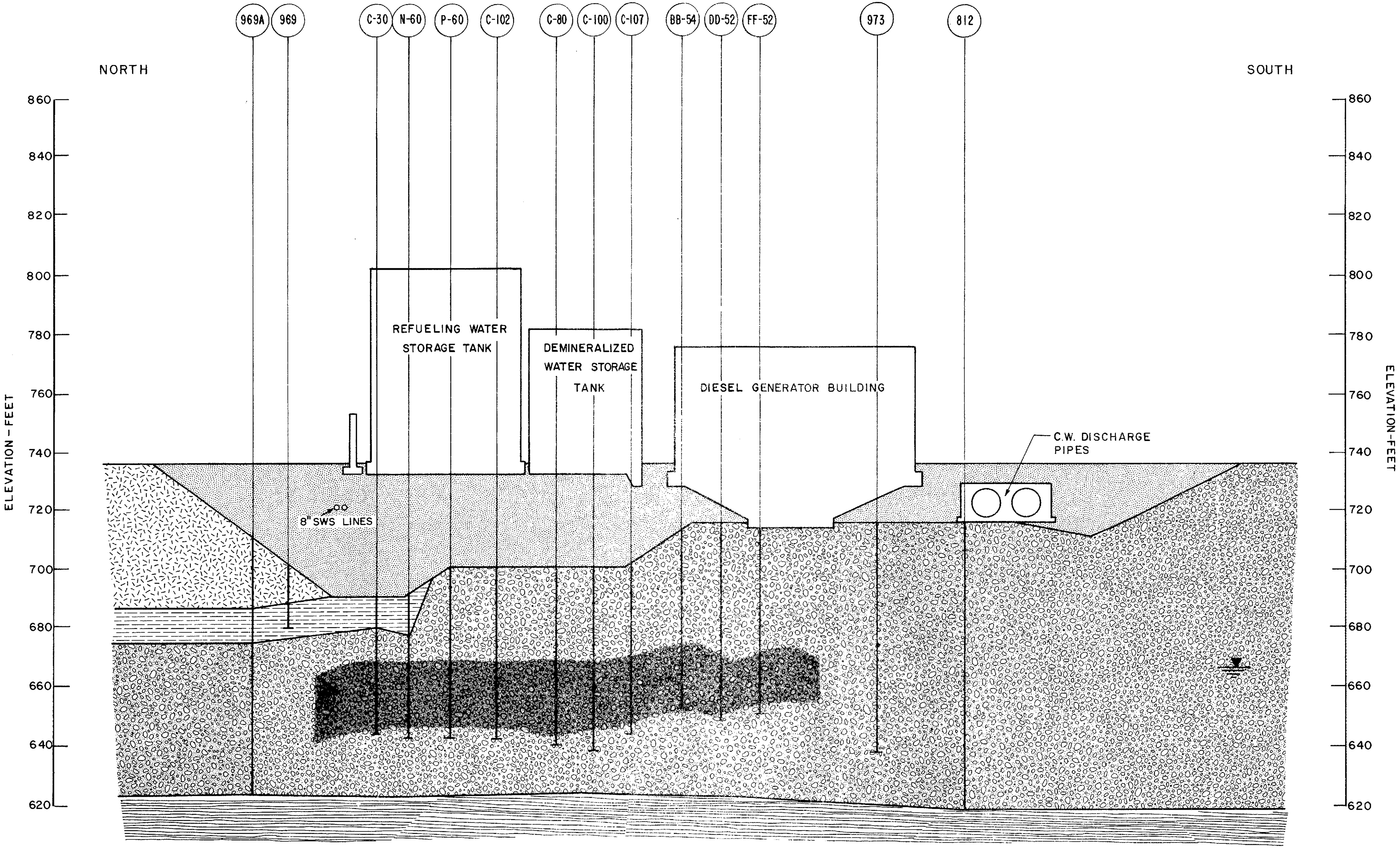


FIGURE 2.5.4-8
SUBSURFACE PROFILE G-G'
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT



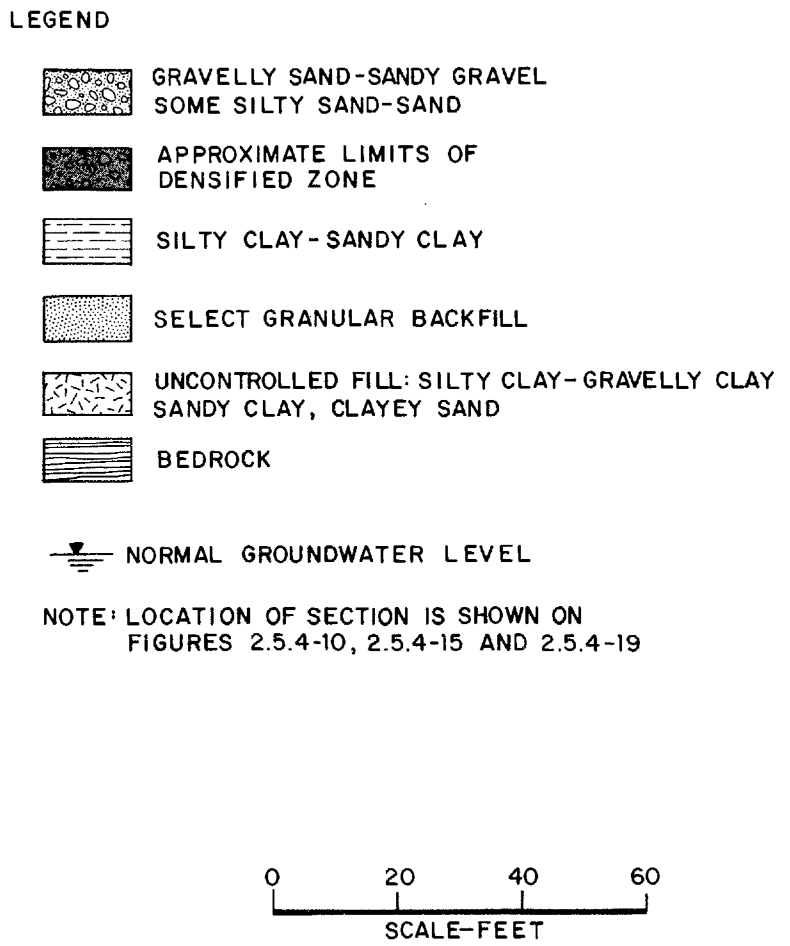


FIGURE 2.5.4-9
SUBSURFACE PROFILE H-H'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

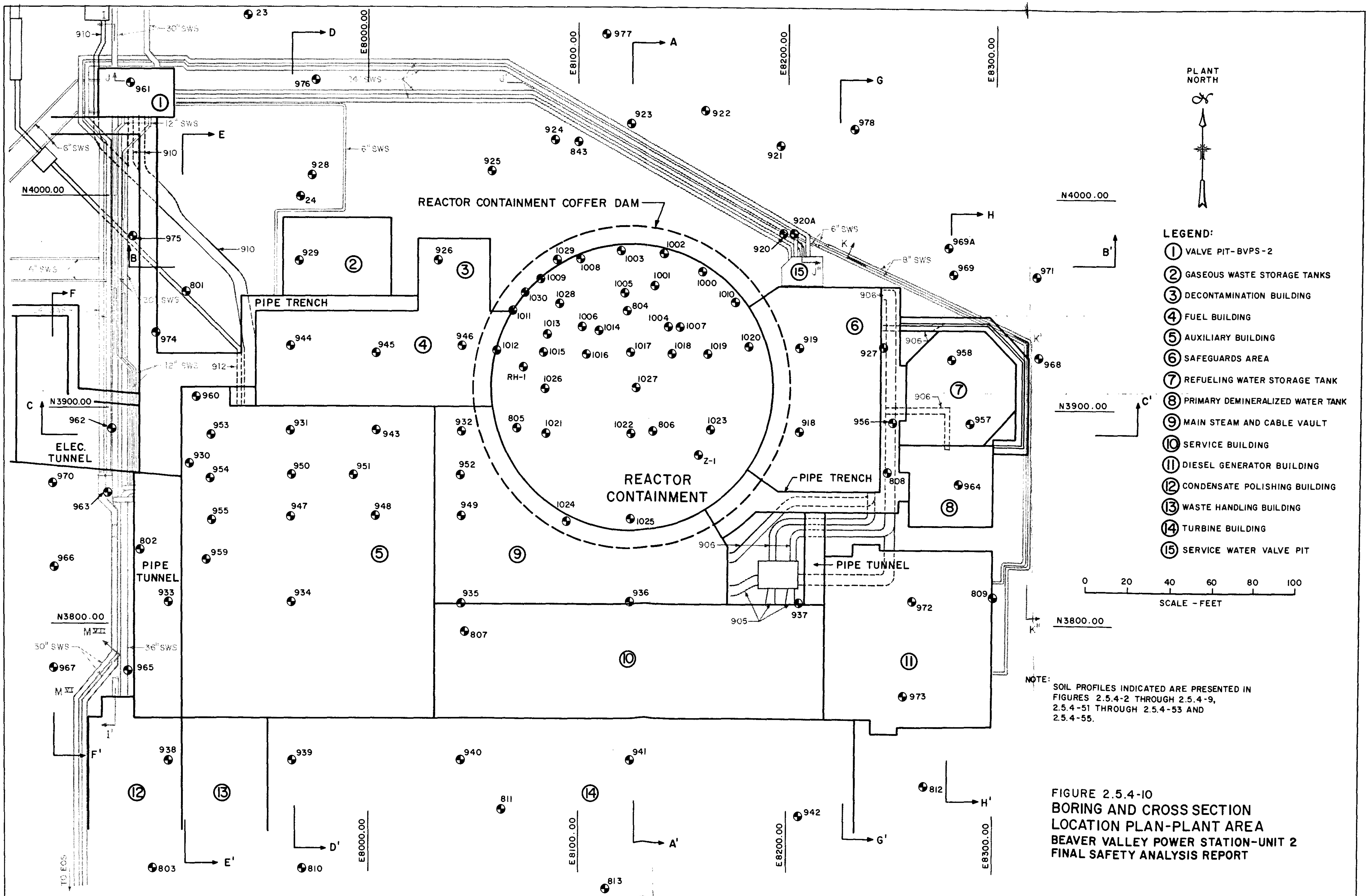
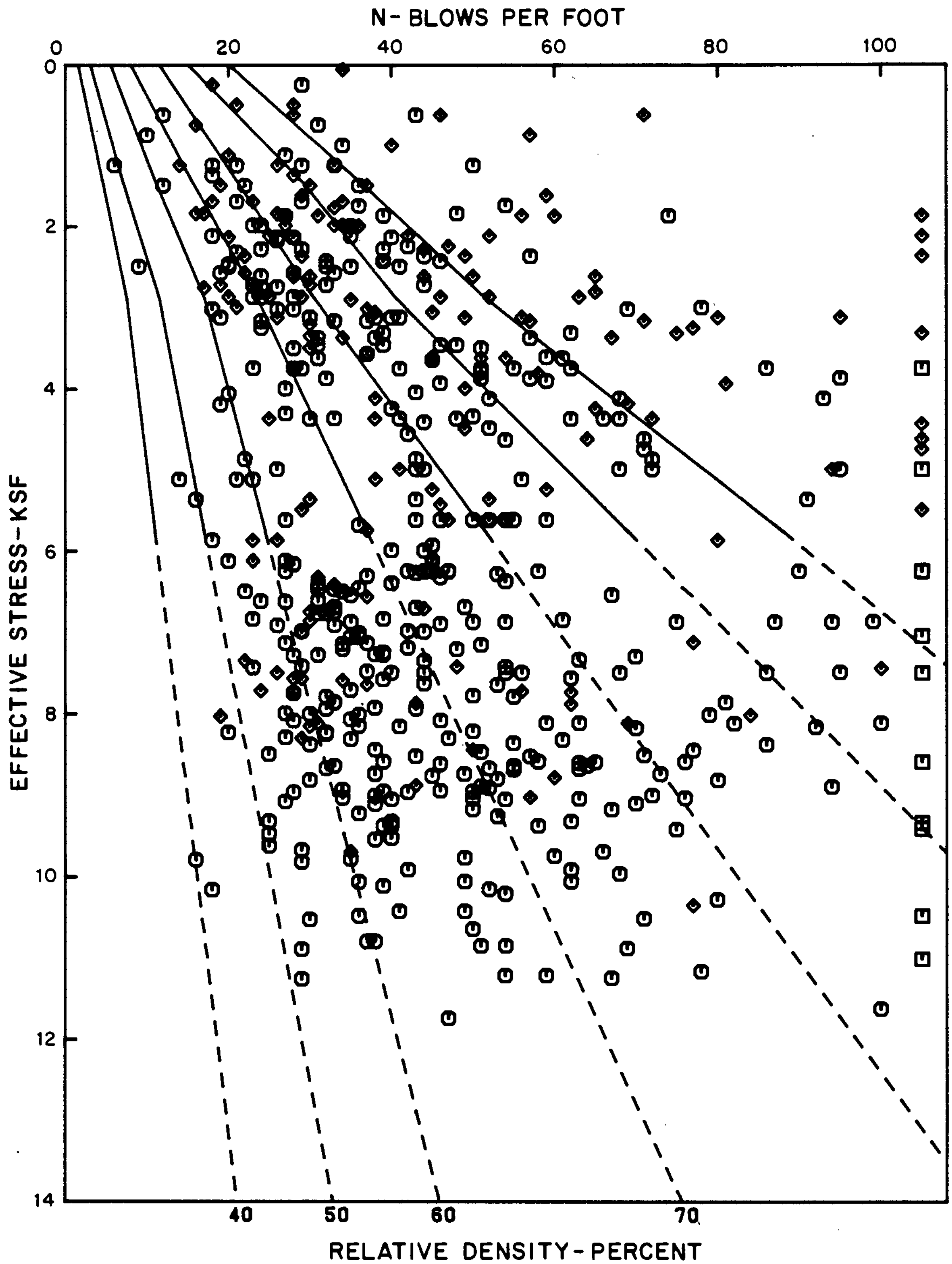


FIGURE 2.5.4-10
BORING AND CROSS SECTION LOCATION PLAN-PLANT AREA
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

O SAND

□ SAND/N>100

◇ OTHER

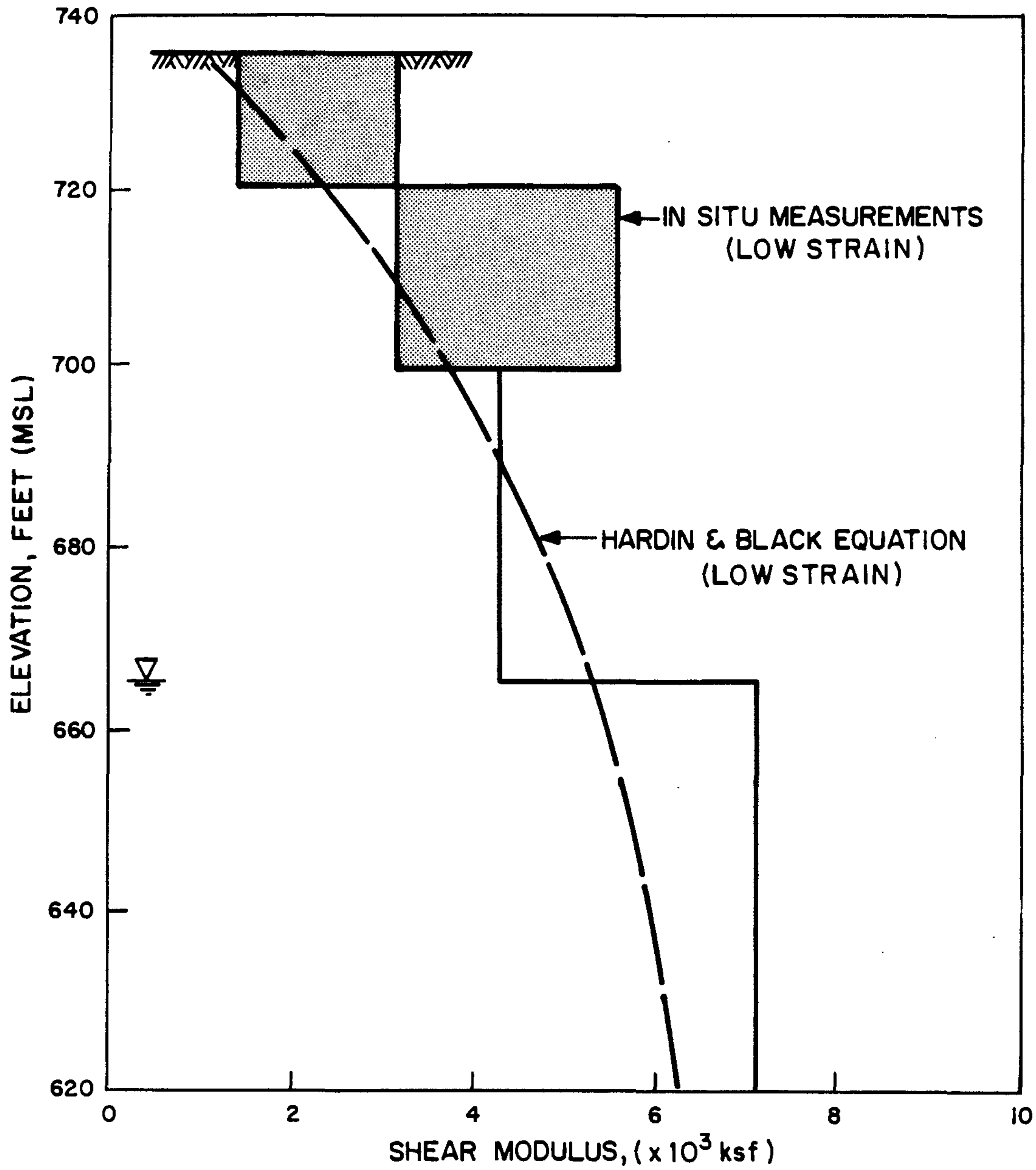
NOTES

1. RELATIONSHIP BETWEEN RELATIVE DENSITY AND SPT N VALUES ACCORDING TO GIBBS AND HOLTZ. (1957)
2. BASED ON BORINGS 803, 806, 807, 810, 811, 813, 816, 935-942, 949, 1019, 1020, 1022-1025.
3. BORING LOCATIONS ARE SHOWN ON FIGURE 2.5.4-10.

FIGURE 2.5.4-11

BORINGS OUTSIDE DENSIFIED ZONE - MAIN PLANT AREA RELATIVE DENSITY PLOT

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



ASSUMED IN SITU SOIL PROPERTIES

UNIT WEIGHT: 125 pcf ABOVE GWT
136 pcf BELOW GWT

VOID RATIO: 0.4

REFERENCE: DLC 1976

FIGURE 2.5.4-12
SHEAR MODULUS VS. DEPTH
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

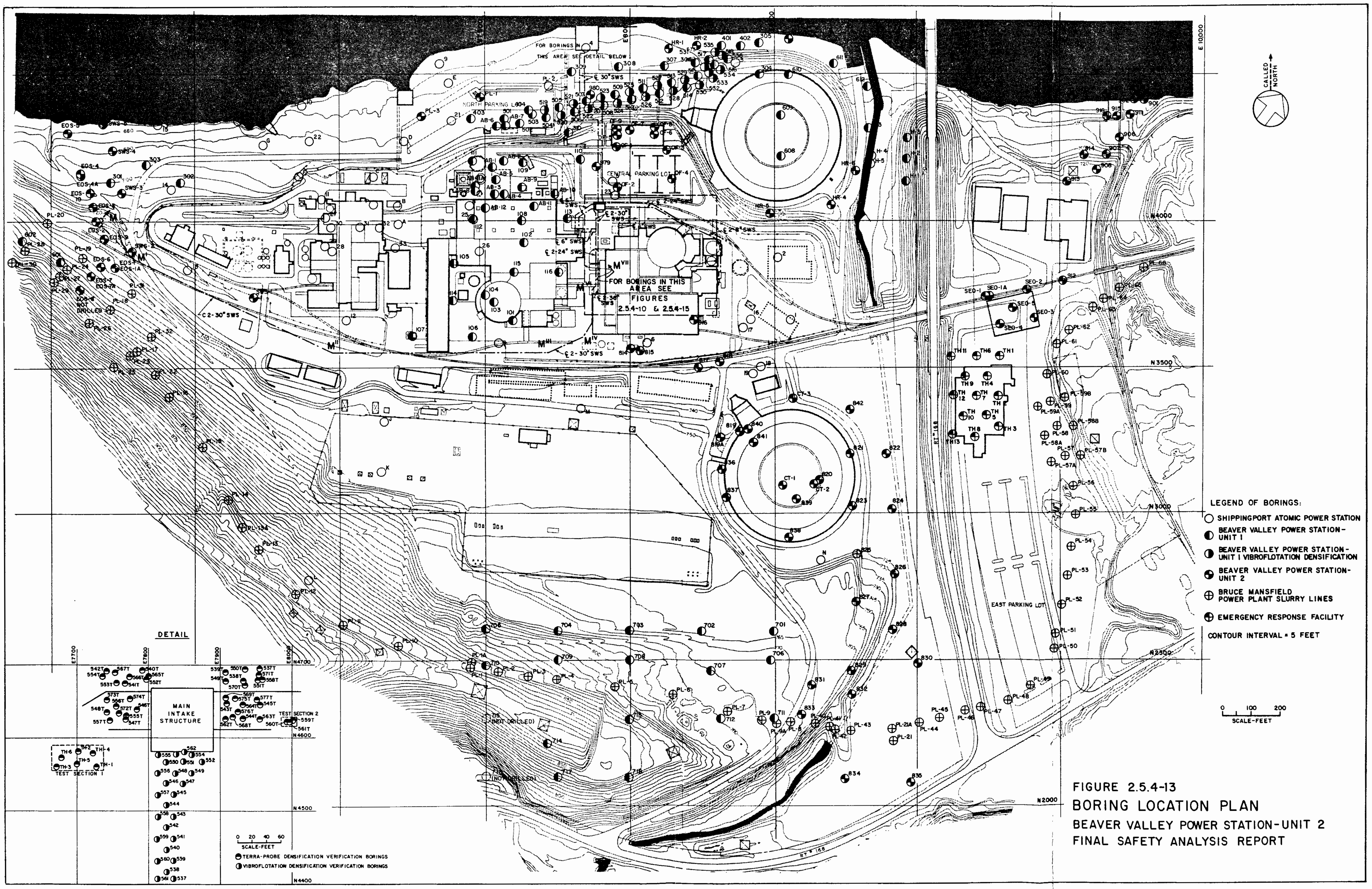


FIGURE 2.5.4-13
BORING LOCATION PLAN
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

Removed in Accordance with RIS 2015-17

FIGURE 2.5.4-14
BENCHMARK AND PIEZOMETER
LOCATION PLAN
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

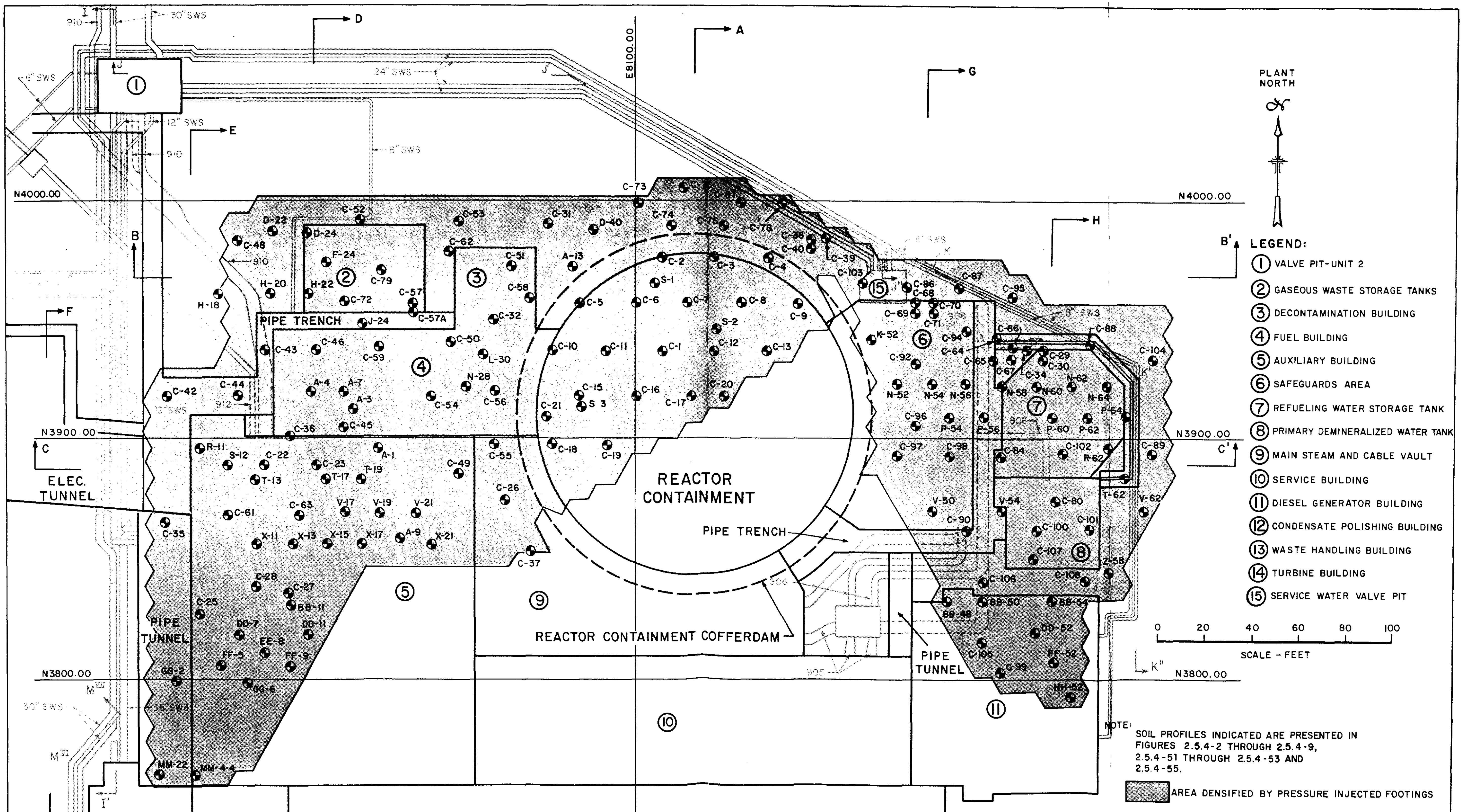
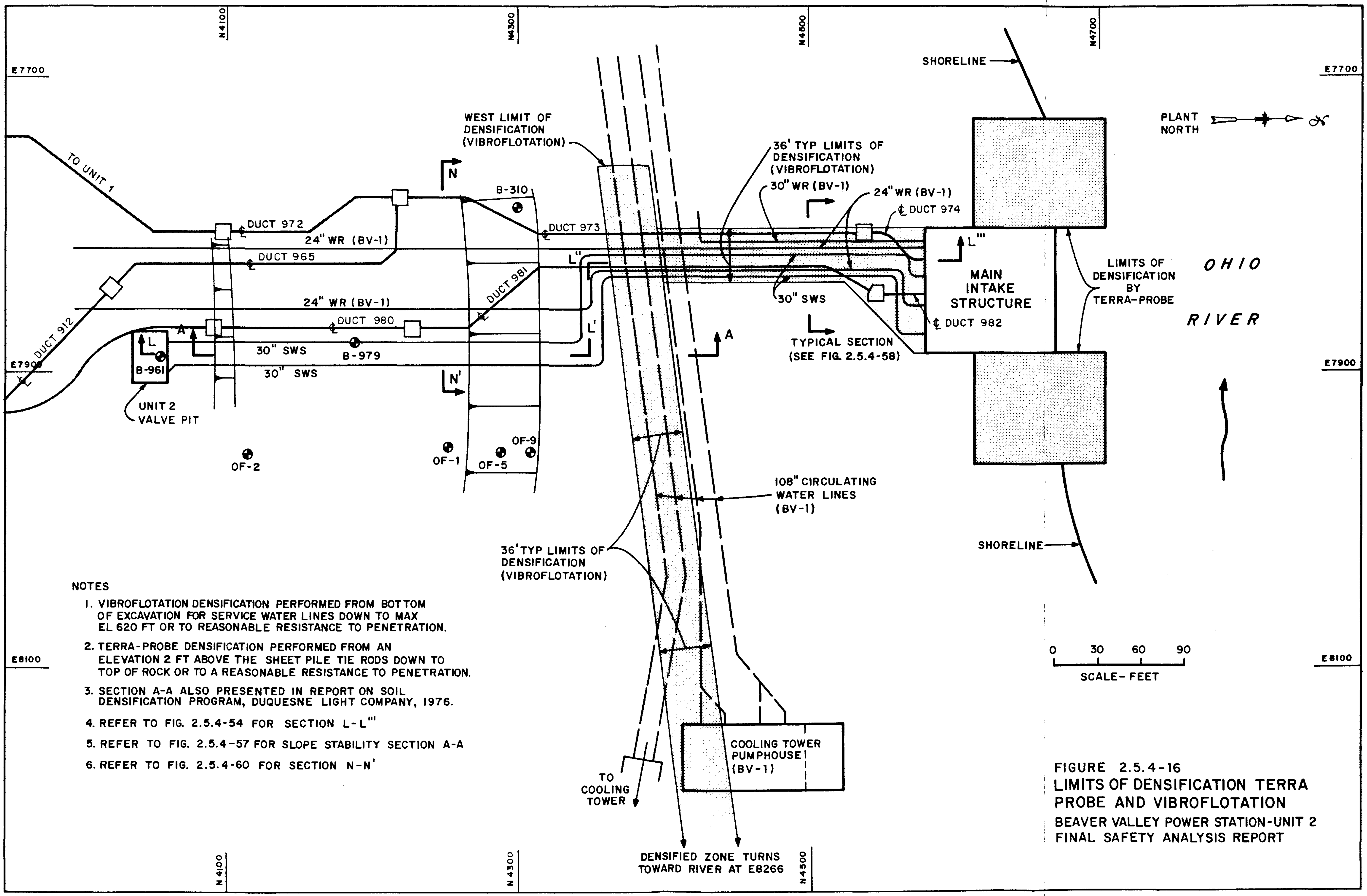


FIGURE 2.5.4-15
IN SITU DENSIFICATION PROGRAM
BORING AND CROSS-SECTION
LOCATION PLAN
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES

1. VIBROFLOTATION DENSIFICATION PERFORMED FROM BOTTOM OF EXCAVATION FOR SERVICE WATER LINES DOWN TO MAX EL 620 FT OR TO REASONABLE RESISTANCE TO PENETRATION.
2. TERRA-PROBE DENSIFICATION PERFORMED FROM AN ELEVATION 2 FT ABOVE THE SHEET PILE TIE RODS DOWN TO TOP OF ROCK OR TO A REASONABLE RESISTANCE TO PENETRATION.
3. SECTION A-A ALSO PRESENTED IN REPORT ON SOIL DENSIFICATION PROGRAM, DUQUESNE LIGHT COMPANY, 1976.
4. REFER TO FIG. 2.5.4-54 FOR SECTION L-L'''
5. REFER TO FIG. 2.5.4-57 FOR SLOPE STABILITY SECTION A-A
6. REFER TO FIG. 2.5.4-60 FOR SECTION N-N'

FIGURE 2.5.4-16
LIMITS OF DENSIFICATION TERRA PROBE AND VIBROFLOTATION
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

	1968 SURVEY UNDISTURBED IN SITU SOIL		1977 SURVEY DENSIFIED IN SITU SOIL		
	"P" WAVE VELOCITY (FPS)	"S" WAVE VELOCITY (FPS)	"P" WAVE VELOCITY (FPS)	"S" WAVE VELOCITY (FPS)	
EL. 740' —					— EL. 740'
APPROX. GROUND SURFACE					
	1,500 (SOME 1,000)	900 - (SOME 600)			
EL. 720' —			APPROX. GROUND SURFACE		— EL. 720'
	2,000	900 - 1,200^{-}			
EL. 700' —			NOTE: NO SEISMIC MEASUREMENTS TAKEN ABOVE EL.685 IN SURVEY		— EL. 700'
	2,000^{-}	1,050 ±	2,000 – 2,500	700 – 800?	
EL. 680' —			? ?	? ?	— EL. 680'
			2,400 – 2,500	1,000	
▽ APPROX. WATER TABLE EL.665 FT.					
EL. 660' —	6,000	1,300^{-}	3,000	1,000 – 1,200	— EL. 660'
			APPROX. WATER TABLE EL. 652 FT.(2)		▽
	6,000	1,300^{-}			
EL. 640' —			6,300 – 6,500	1,500 – 1,800	— EL. 640'
EL. 620' —					— EL. 620'
	12,000	6,000^{-}	12,000	4,400 - 5,800?	
EL. 600' —					— EL. 600'

NOTE:

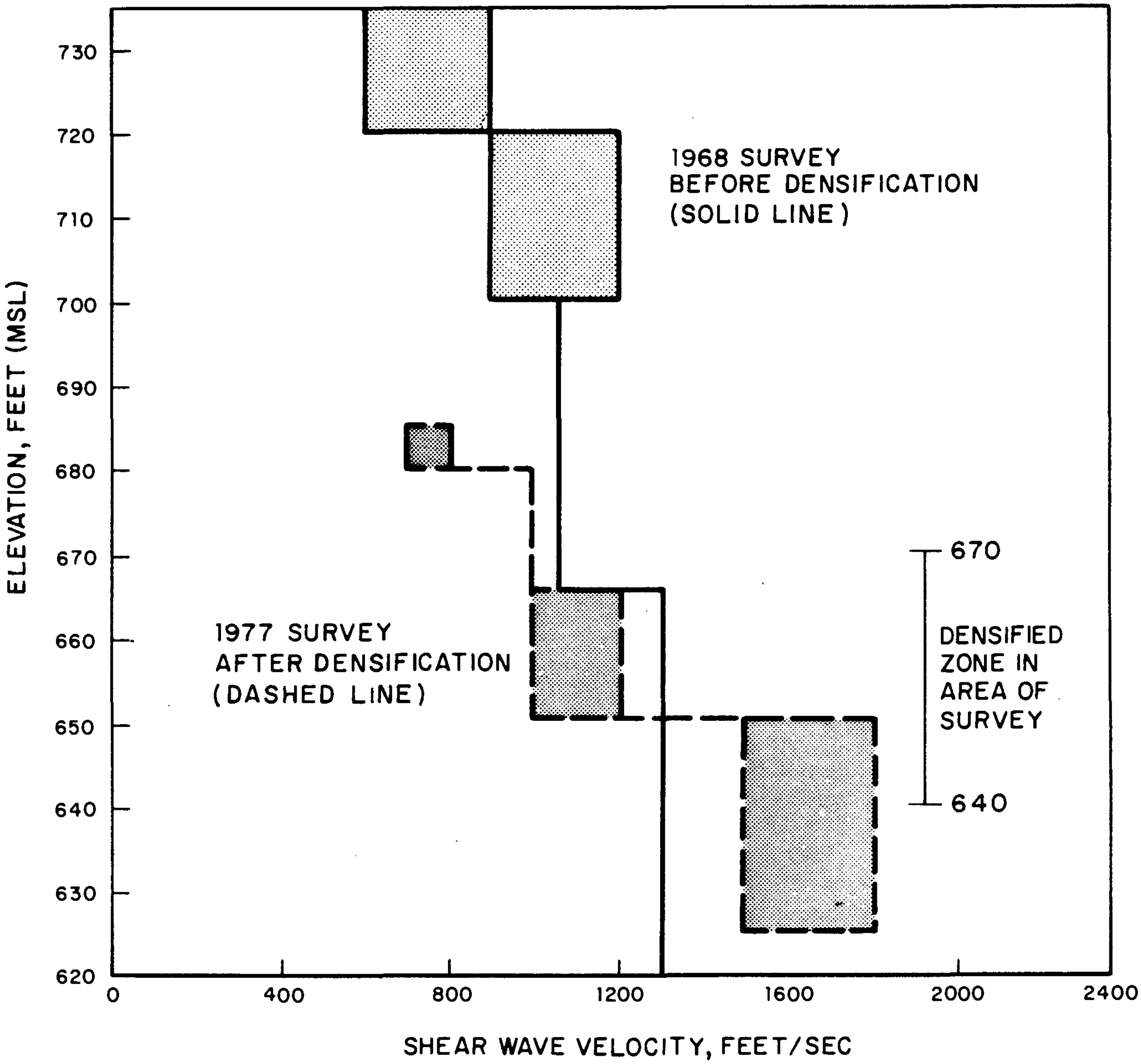
1. DLC 1976
2. REFER TO DISCUSSION IN SECTION 2.5.4-4

FIGURE 2.5.4-17

GENERALIZED "P" AND "S" WAVE VELOCITY VALUES, 1968 AND 1977 SURVEYS

BEAVER VALLEY POWER STATION-UNIT 2

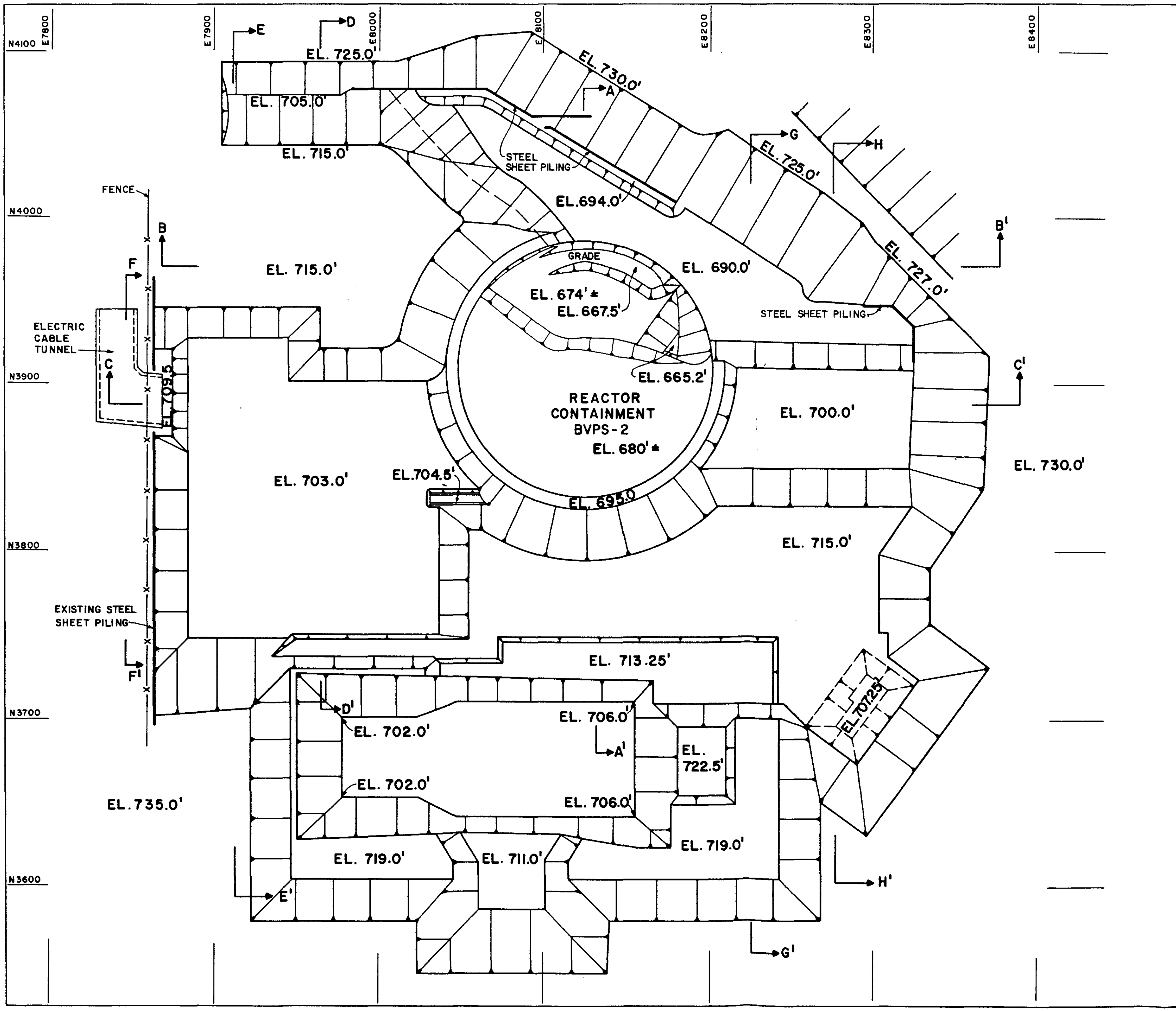
FINAL SAFETY ANALYSIS REPORT



NOTE:
GROUND SURFACE AT EL. 735 FT. FOR 1968 SURVEY AND AT EL. 715 FT. FOR 1977 SURVEY.

DLC 1976

FIGURE 2.5.4-18
COMPARISON OF IN SITU SHEAR WAVE VELOCITIES BEFORE AND AFTER DENSIFICATION
BEAVER VALLEY POWER STATION—UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES:
1. EXCAVATION SLOPES ARE 1.5H:1V UNLESS SHOWN OTHERWISE
2. CROSS SECTIONS INDICATED ARE GIVEN IN FIGURES 2.5.4.1-2 THROUGH 2.5.4.1-9

0 30 60 90 120
SCALE-FEET

FIGURE 2.5.4-19
GENERAL EXCAVATION- PLANT AREA
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

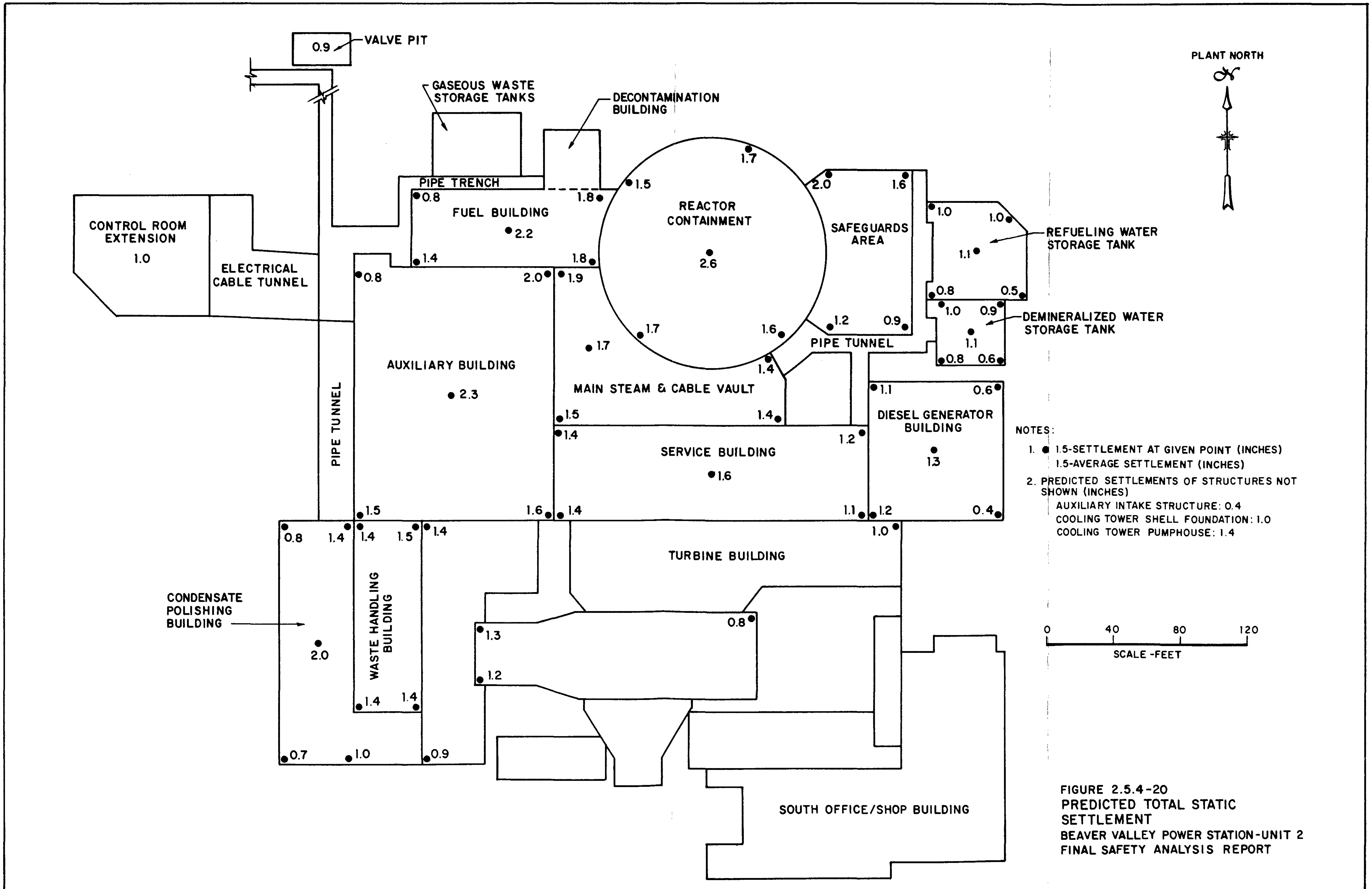
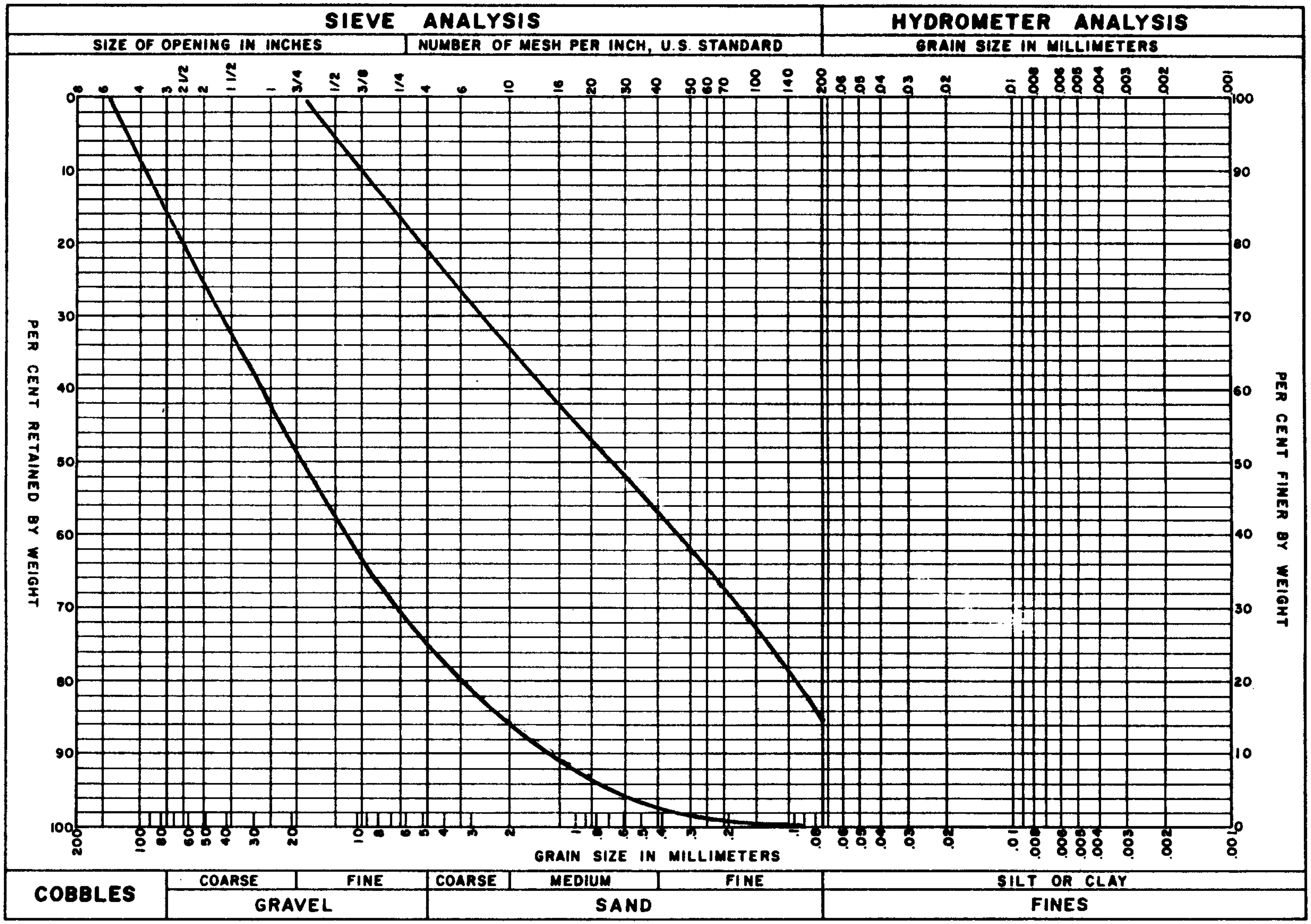


FIGURE 2.5.4-20
PREDICTED TOTAL STATIC SETTLEMENT
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

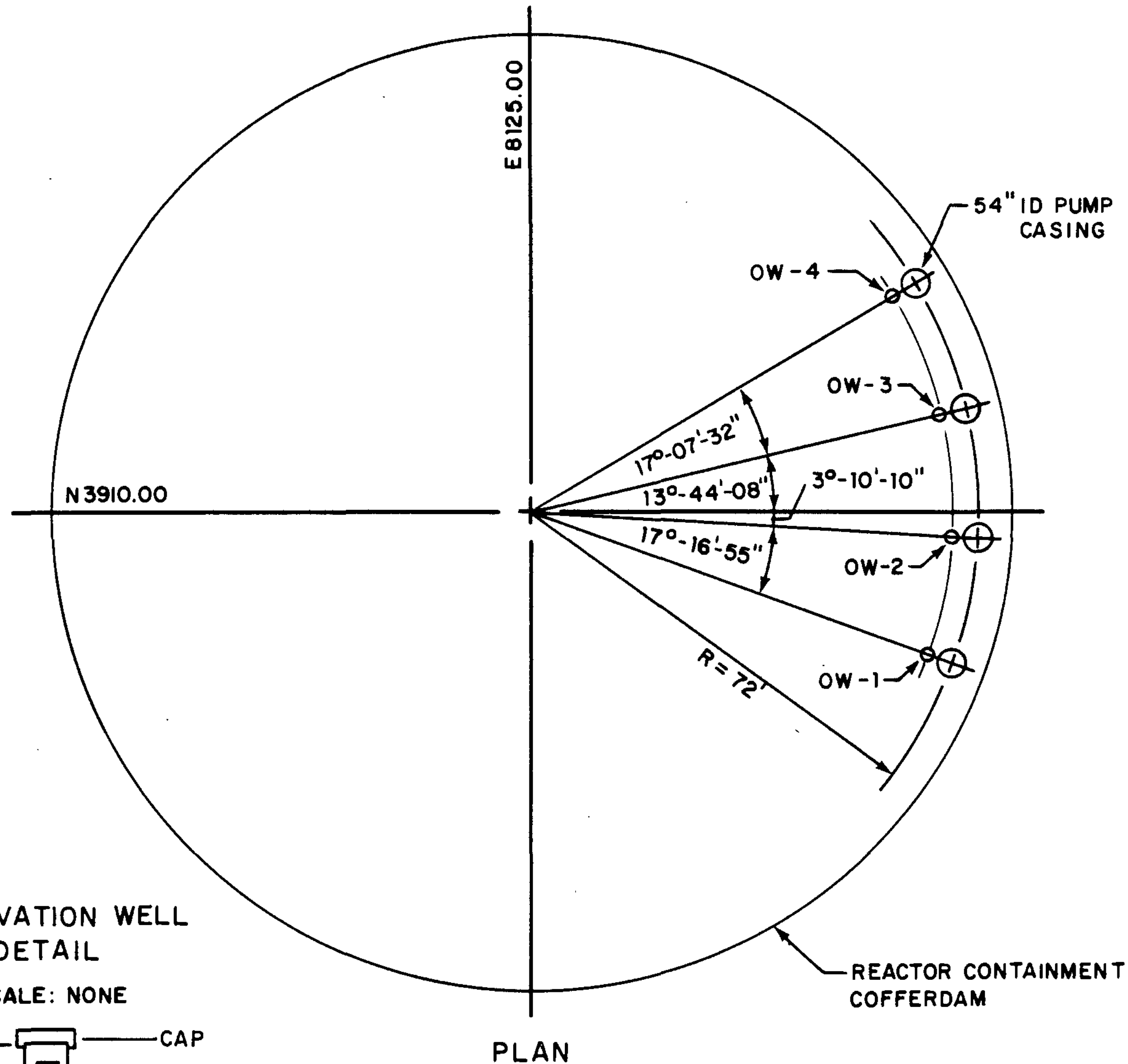


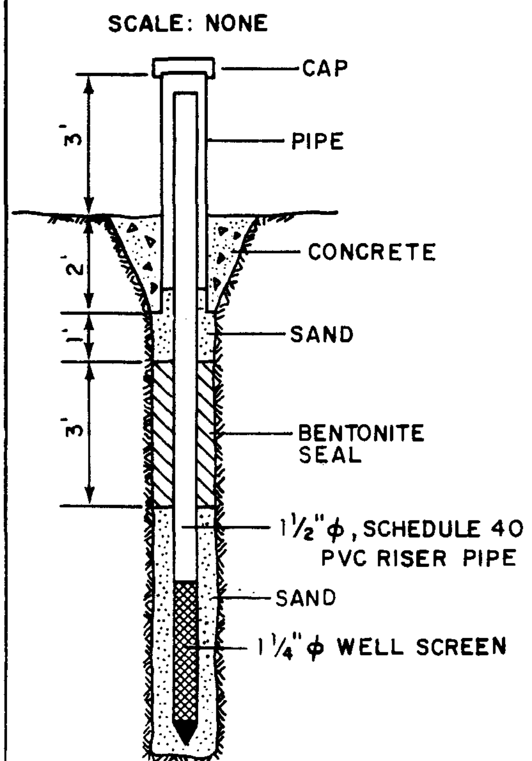
NOTES:

1. FIGURE DEPICTS UPPER AND LOWER LIMITS OF GRAIN SIZE ANALYSES PERFORMED ON 115 SAMPLES TESTED BETWEEN JUNE 1977 AND APRIL, 1980 (TESTS BF 41 - BF 189)
2. MOISTURE DENSITY TESTS (ASTM D1557 METHOD D) PERFORMED ON SAMPLES REVEALED THE FOLLOWING:

	MEAN	STANDARD DEVIATION
MAXIMUM DRY UNIT WEIGHT(PCF)	136.9	1.6
OPTIMUM WATER CONTENT	7.0	1.4

FIGURE 2.5.4-21
GRADATION LIMITS-
STRUCTURAL FILL
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT





NOTE:

OBSERVATION WELLS INSTALLED APPROXIMATELY 2FT. FROM OUTSIDE OF PUMP CASING

FIGURE 2.5.4-22

OBSERVATION WELL LOCATION PLAN

BEAVER VALLEY POWER STATION-UNIT2
FINAL SAFETY ANALYSIS REPORT

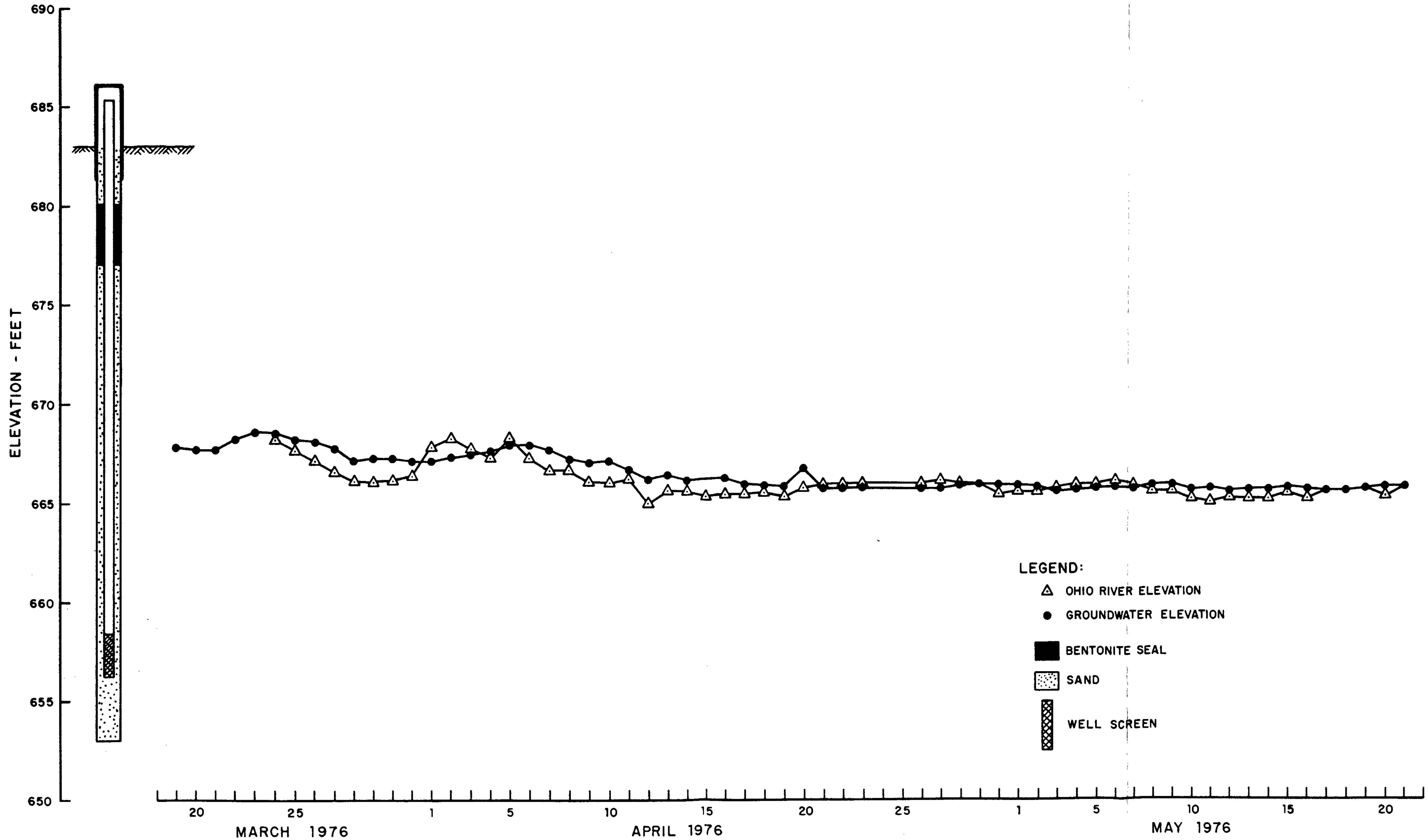


FIGURE 2.5.4-23
OBSERVATION WELL DATA
OW-1
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

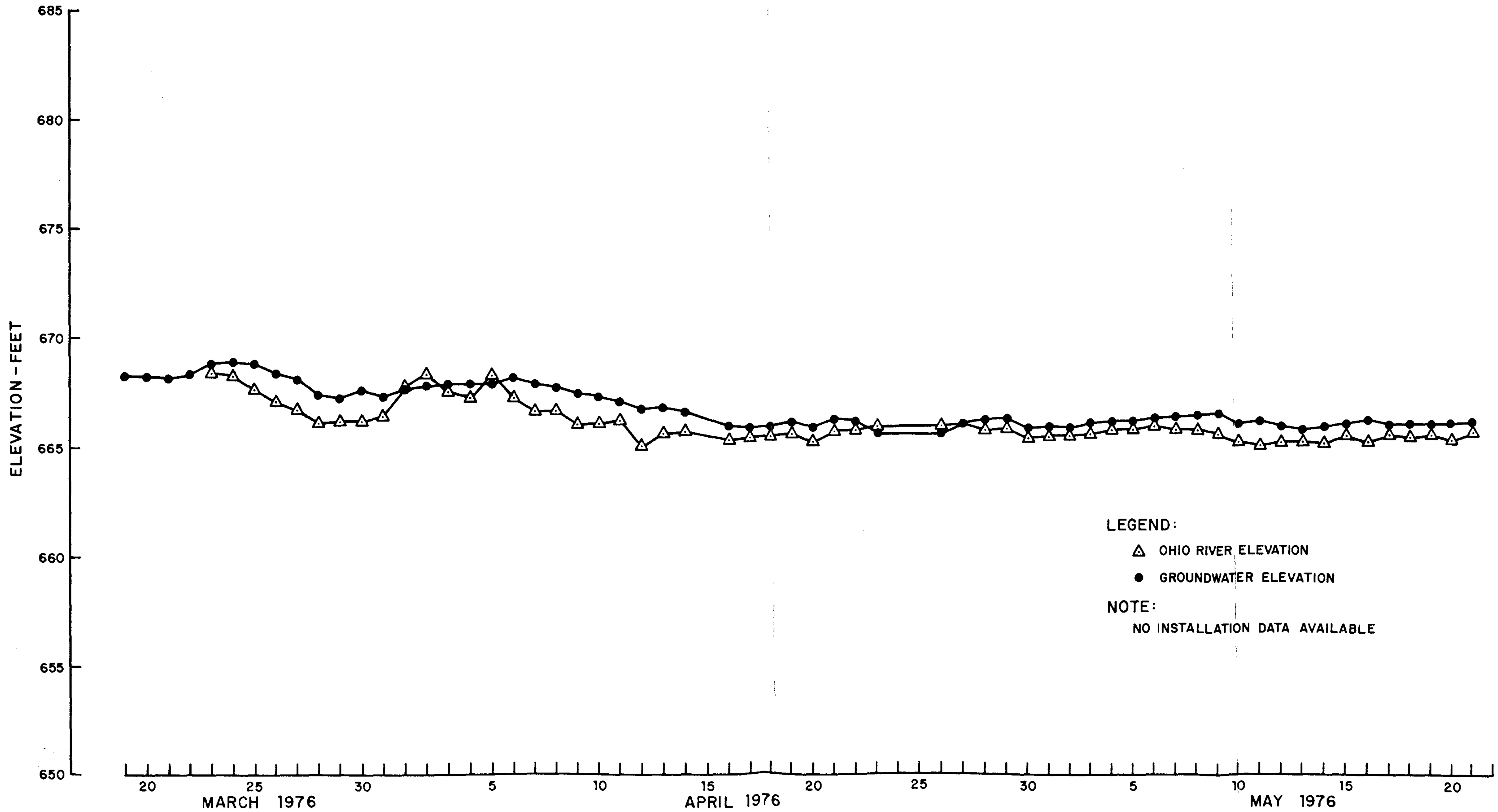


FIGURE 2.5.4-24
OBSERVATION WELL DATA
OW-2
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

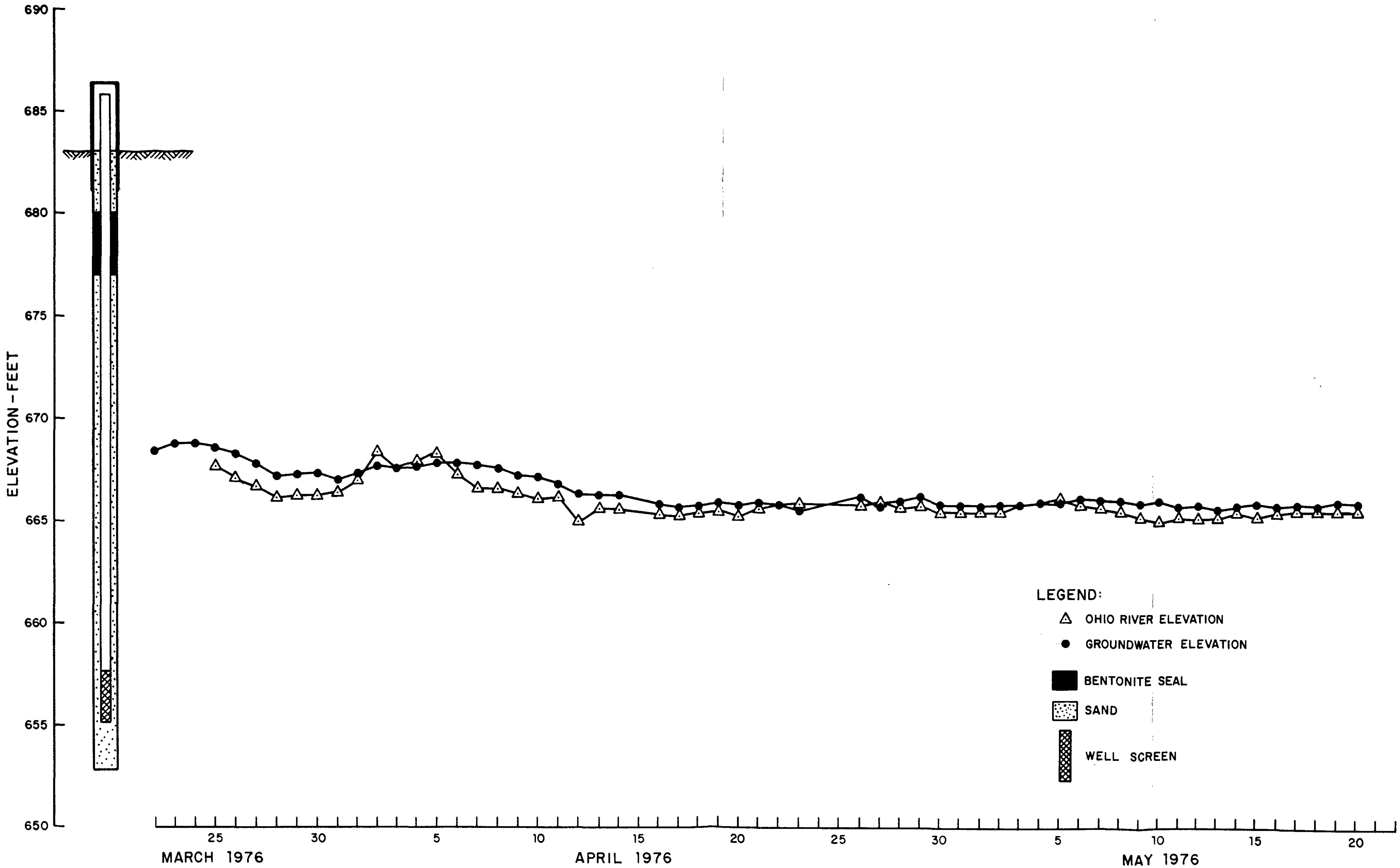


FIGURE 2.5.4-25
OBSERVATION WELL DATA
OW-3
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

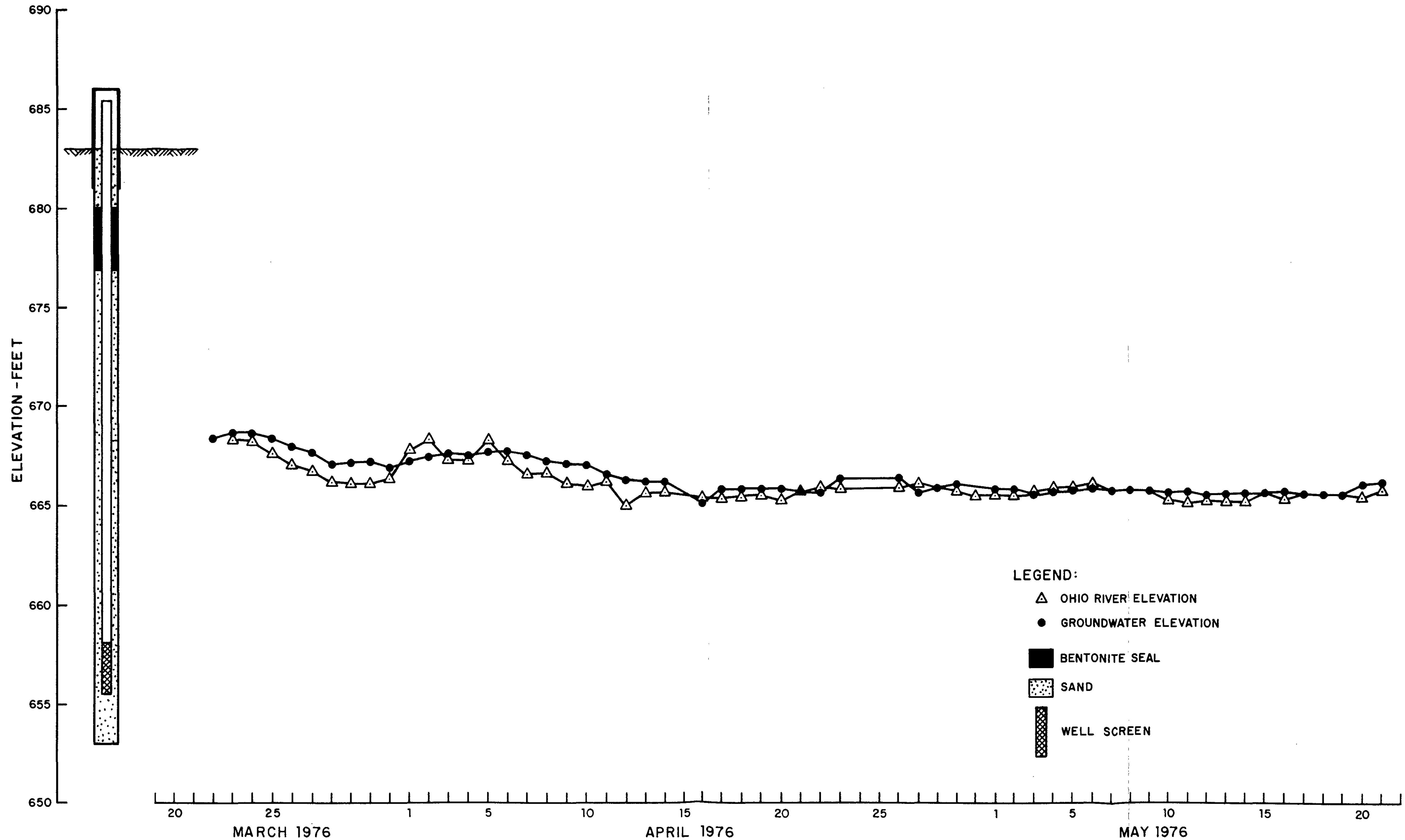


FIGURE 2.5.4-26
OBSERVATION WELL DATA
OW-4
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

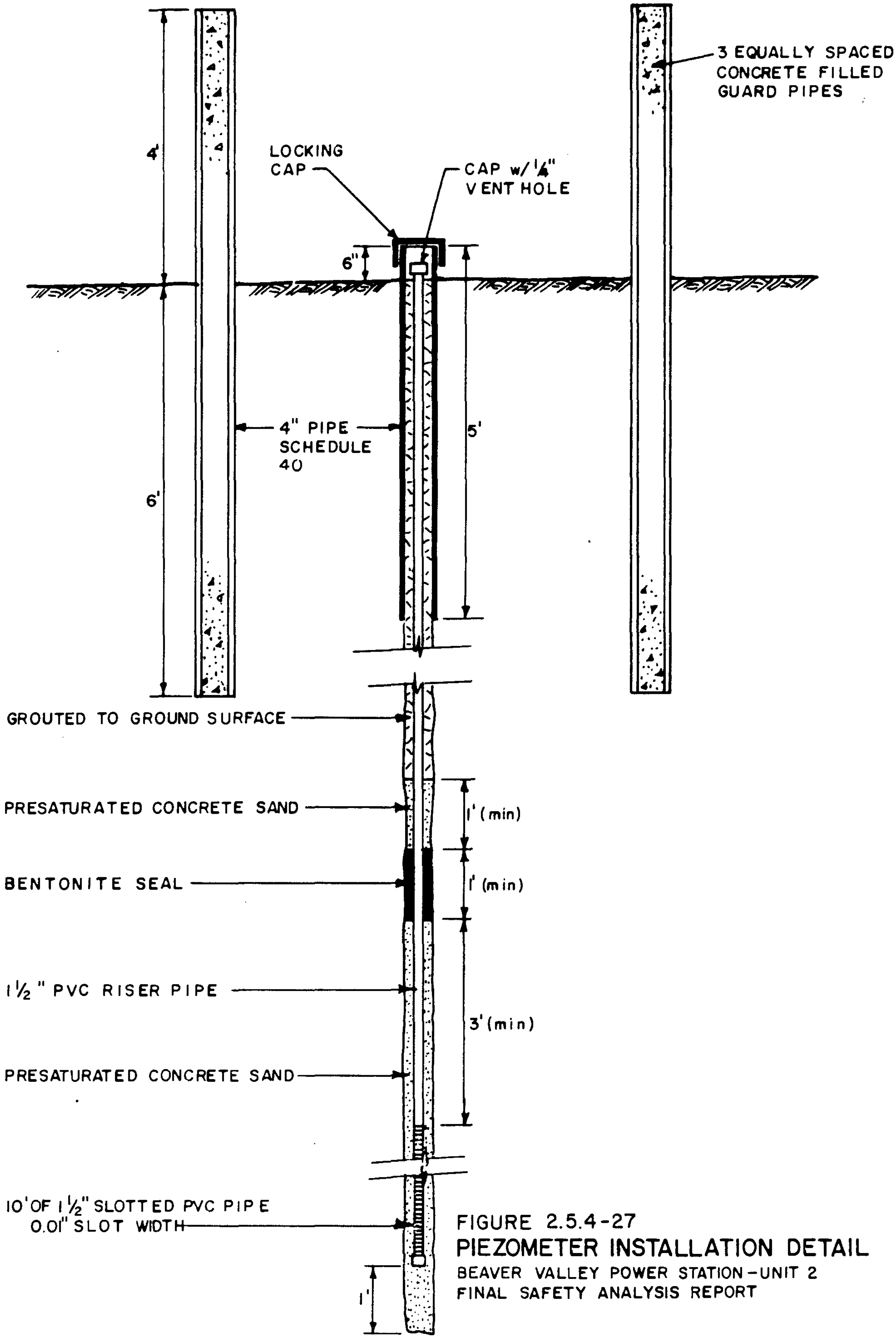
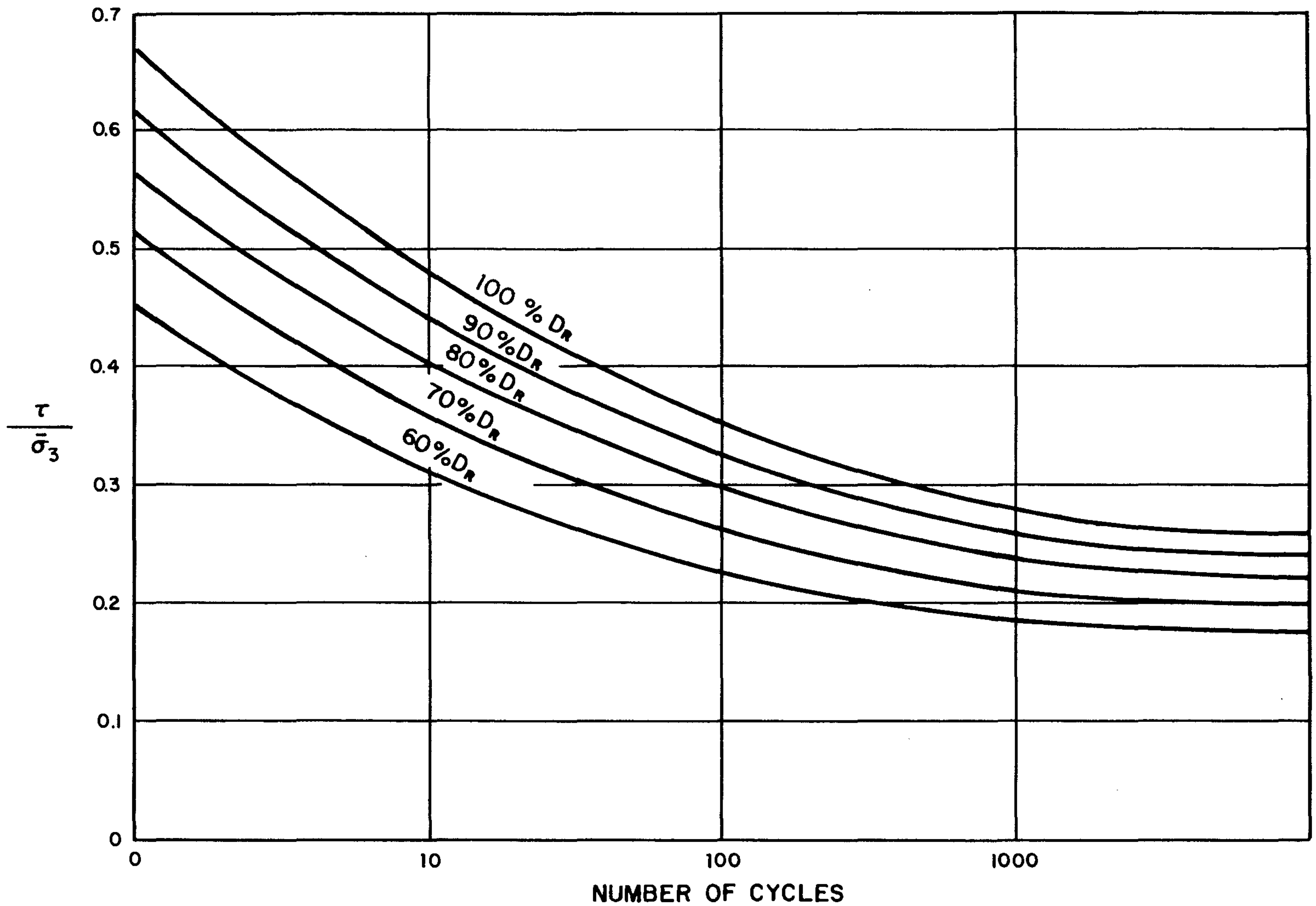
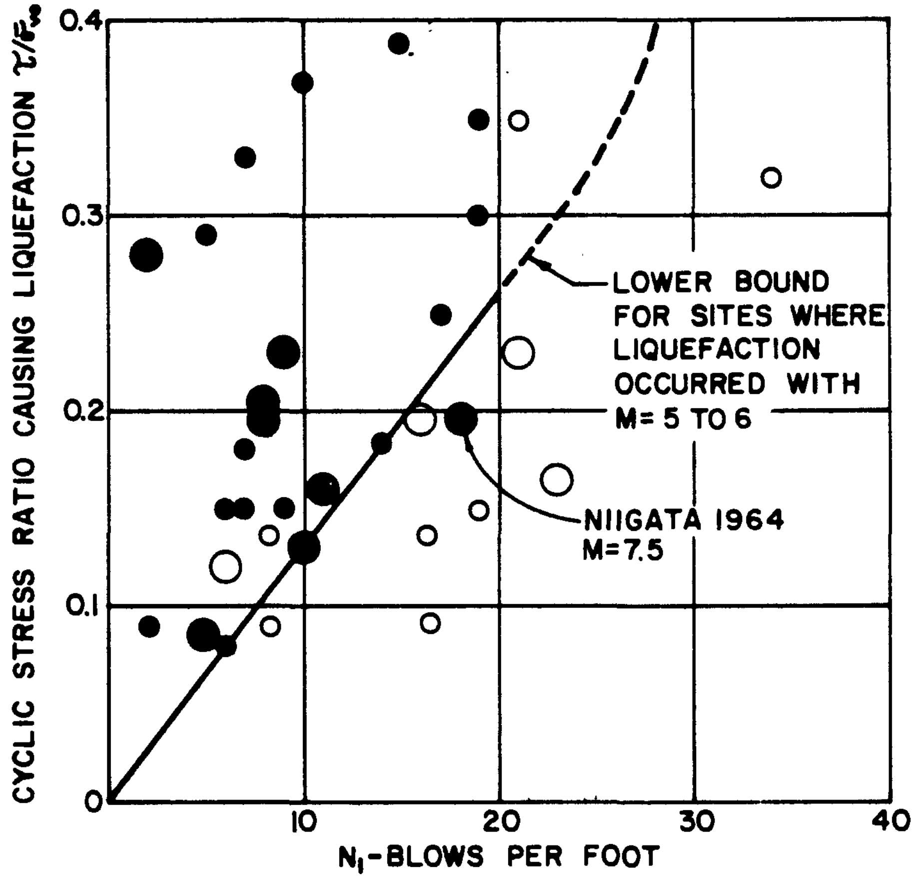


FIGURE 2.5.4-27
PIEZOMETER INSTALLATION DETAIL
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



After Seed for Sacramento River Sand
D_R = Relative Density

FIGURE 2.5.4-28
DYNAMIC TRIAXIAL TEST DATA
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

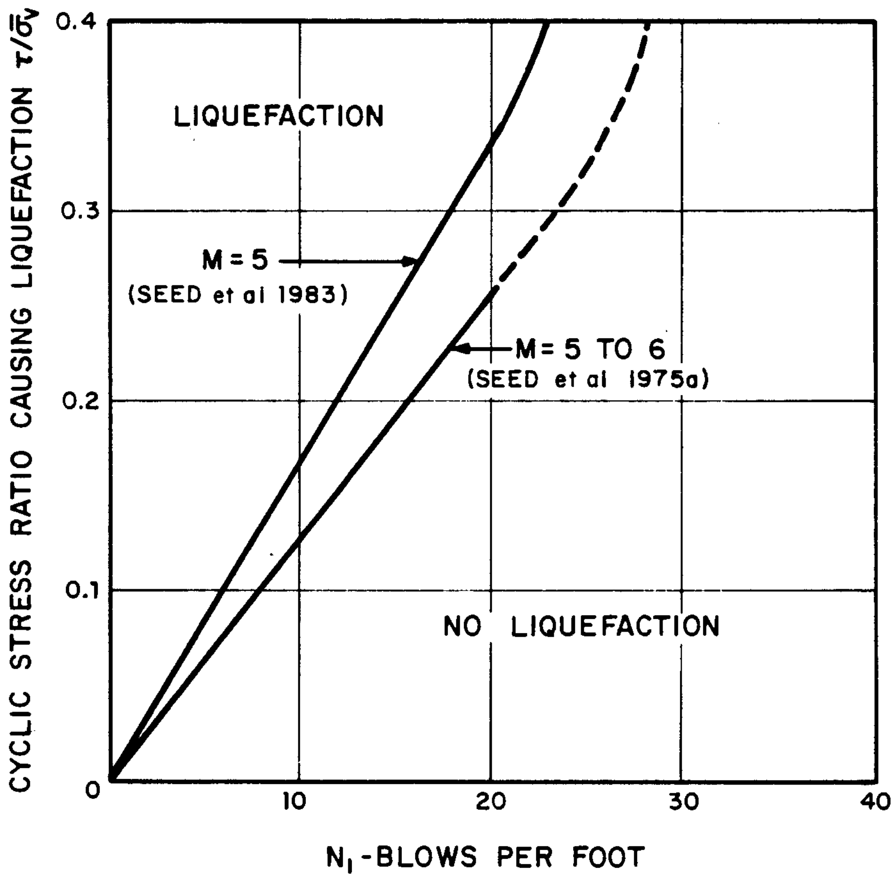


- ● LIQUEFACTION, $\tau/\bar{\sigma}_{vo}$ BASED ON ESTIMATED ACCELERATION
- ⬤ LIQUEFACTION, $\tau/\bar{\sigma}_{vo}$ BASED ON GOOD ACCELERATION DATA
- ○ NO LIQUEFACTION, $\tau/\bar{\sigma}_{vo}$ BASED ON ESTIMATED ACCELERATION
- ◯ NO LIQUEFACTION, $\tau/\bar{\sigma}_{vo}$ BASED ON GOOD ACCELERATION DATA

NOTE:

1. SEED, ARANGO AND CHAN 1975
2. τ = SHEAR STRESS
   $\bar{\sigma}_{vo}$ = VERTICAL EFFECTIVE OVERBURDEN PRESSURE

FIGURE 2.5.4-29
CORRELATION BETWEEN $\tau/\bar{\sigma}_{vo}$ CAUSING LIQUEFACTION AND N_1
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND:

τ = SHEAR STRESS

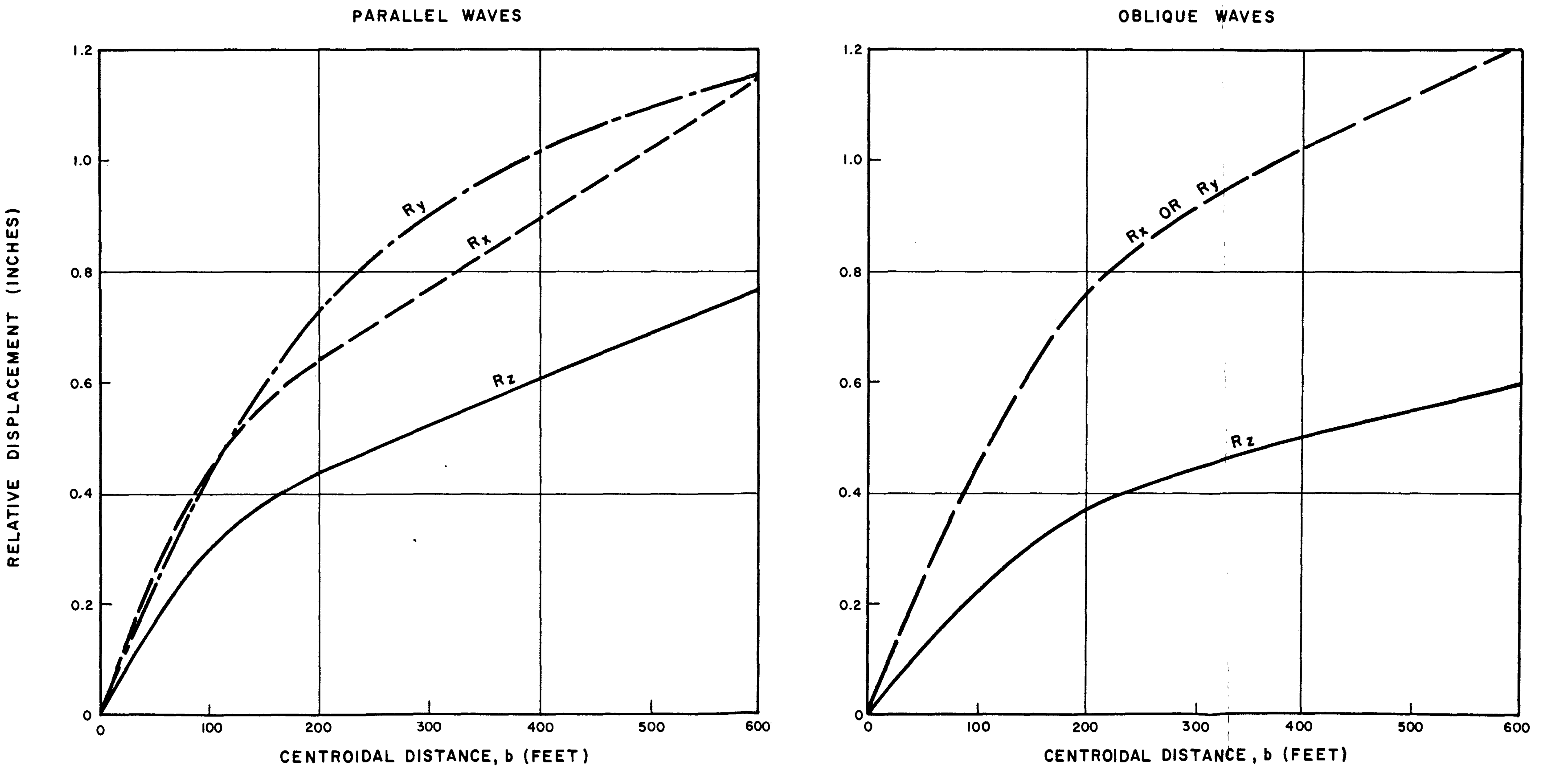
$\bar{\sigma}_v$ = VERTICAL EFFECTIVE STRESS

M = MAGNITUDE

FIGURE 2.5.4-29A

CORRELATION BETWEEN $\tau/\bar{\sigma}_v$ CAUSING LIQUEFACTION AND N_1

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

R_x = PUSH-PULL DISPLACEMENT

R_y = TRANSVERSE DISPLACEMENT

R_z = VERTICAL DISPLACEMENT

SSE = 0.125g

b = CENTROIDAL DISTANCE AB

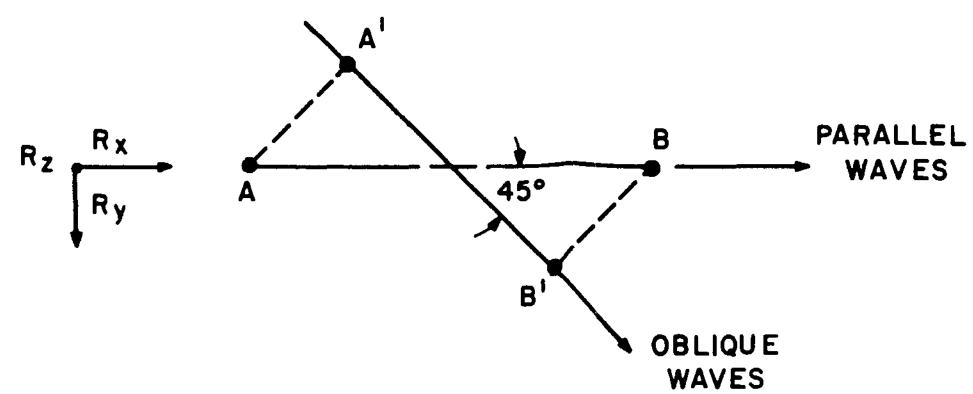
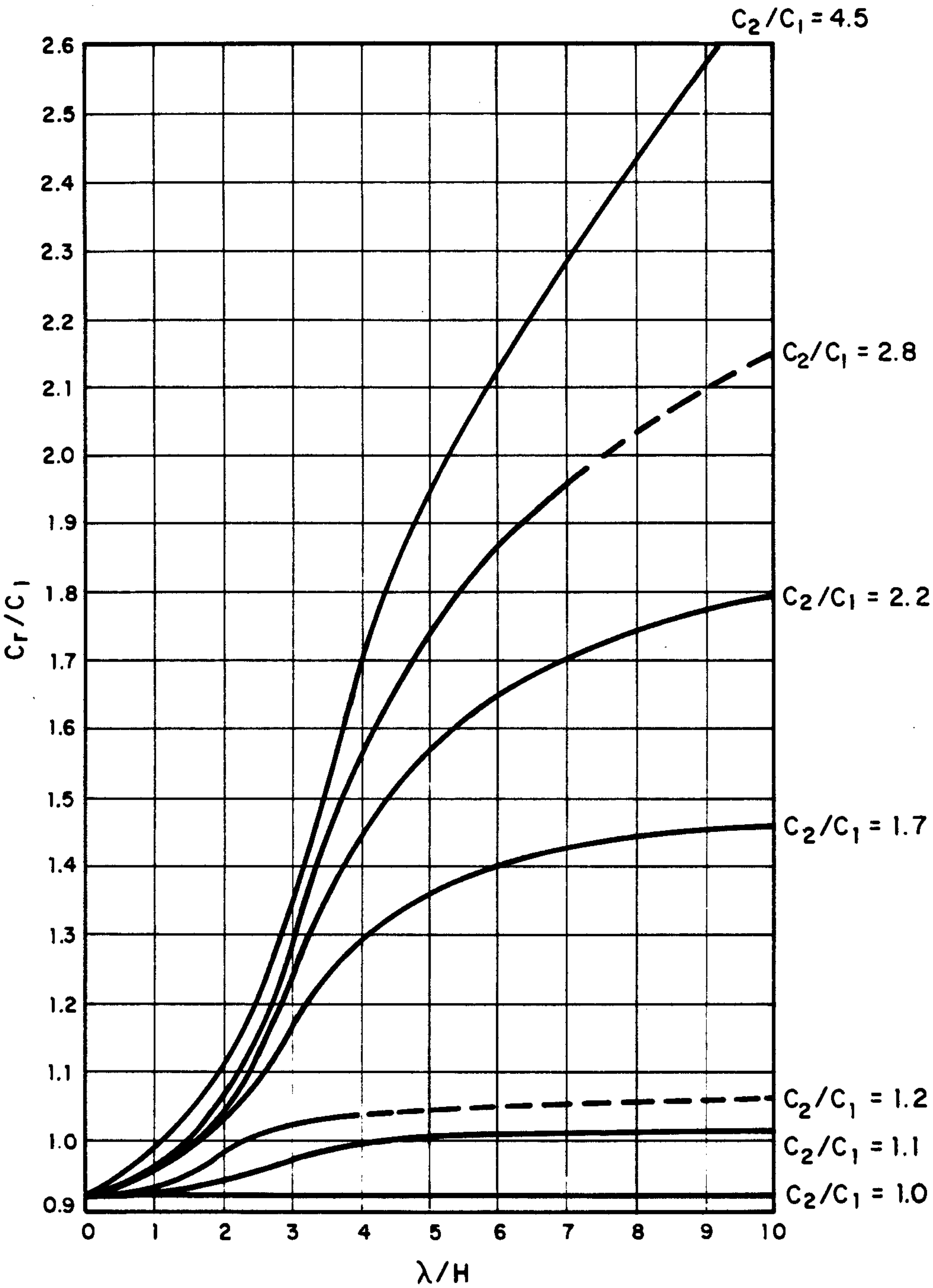


FIGURE 2.5.4-30
RELATIVE DISPLACEMENTS FOR SSE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND:

C_r = RAYLEIGH WAVE VELOCITY

C_1 = SHEAR WAVE VELOCITY OF UPPER LAYER

C_2 = SHEAR WAVE VELOCITY OF LOWER DENSER LAYER

H = THICKNESS OF UPPER LAYER

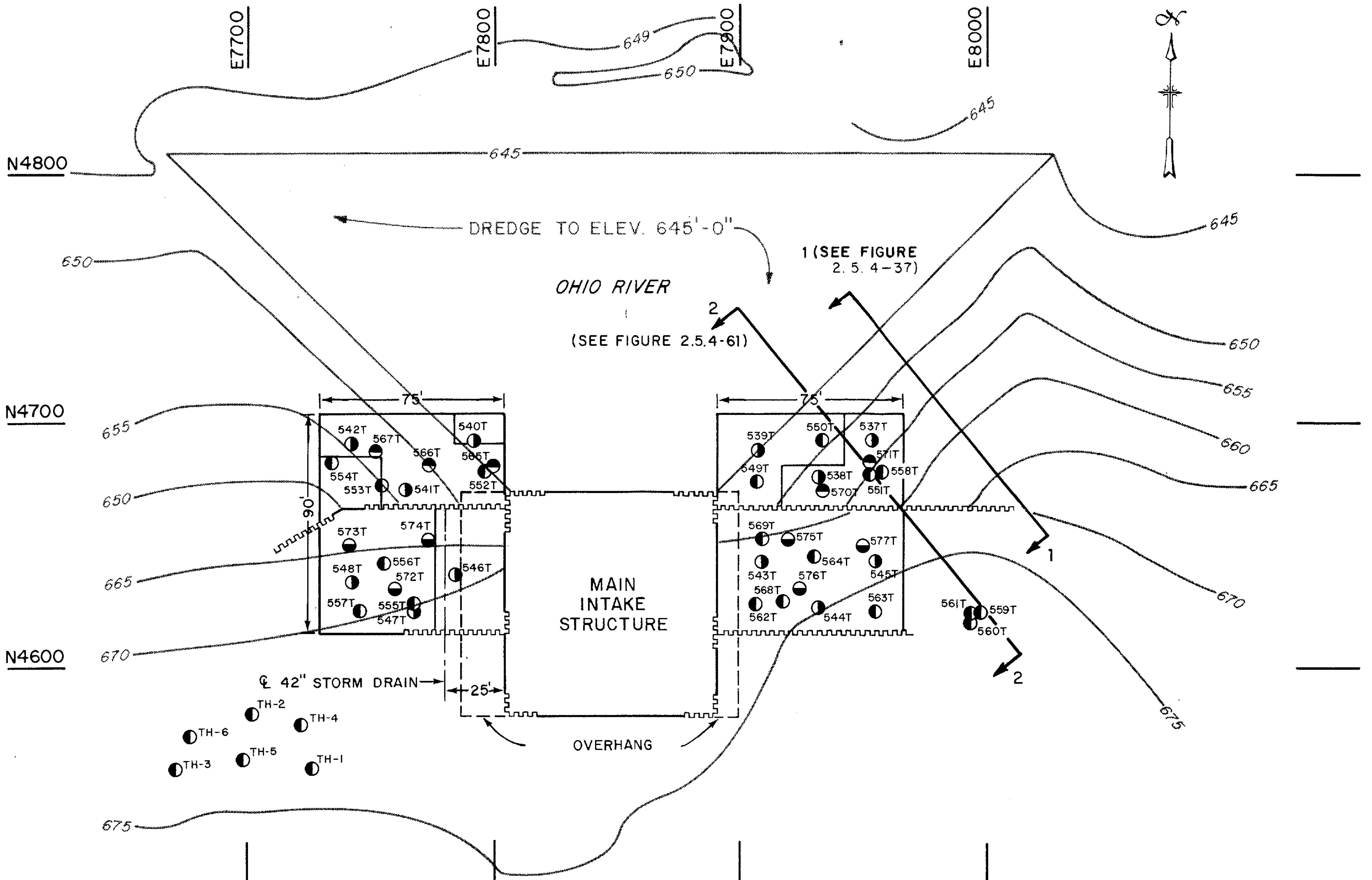
λ = WAVELENGTH

NOTE:
EWING ET AL, 1957.

FIGURE 2.5.4-31

RELATIONSHIP BETWEEN RAYLEIGH WAVE VELOCITY AND SOIL PARAMETERS

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



PLAN

◑ BORINGS PERFORMED PRIOR TO DENSIFICATION

◐ BORINGS PERFORMED AFTER INITIAL DENSIFICATION

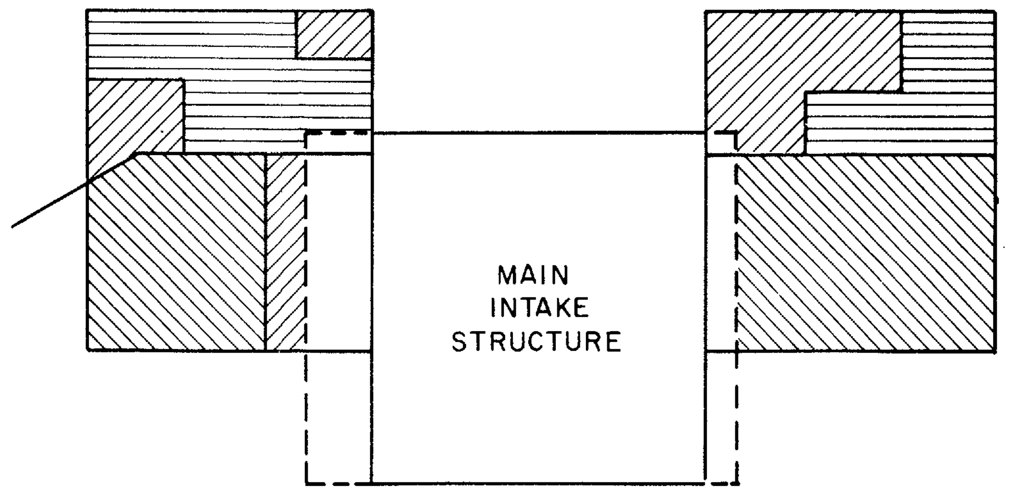
⬒ BORINGS PERFORMED AFTER REDENSIFICATION OFFSHORE

⬓ BORINGS PERFORMED AFTER REDENSIFICATION ONSHORE

NOTES:

1. DENSIFICATION TO WITHIN 5 FT. OF SHEETPILE WALLS AND STORM DRAIN AND TO WITHIN 2 FT. OF OVERHANG.
2. STORM DRAIN NOT IN PLACE AT TIME OF INITIAL COVERAGE

0 20 40 60 80 100
SCALE-FEET



TERRA PROBE DENSIFICATION PATTERNS

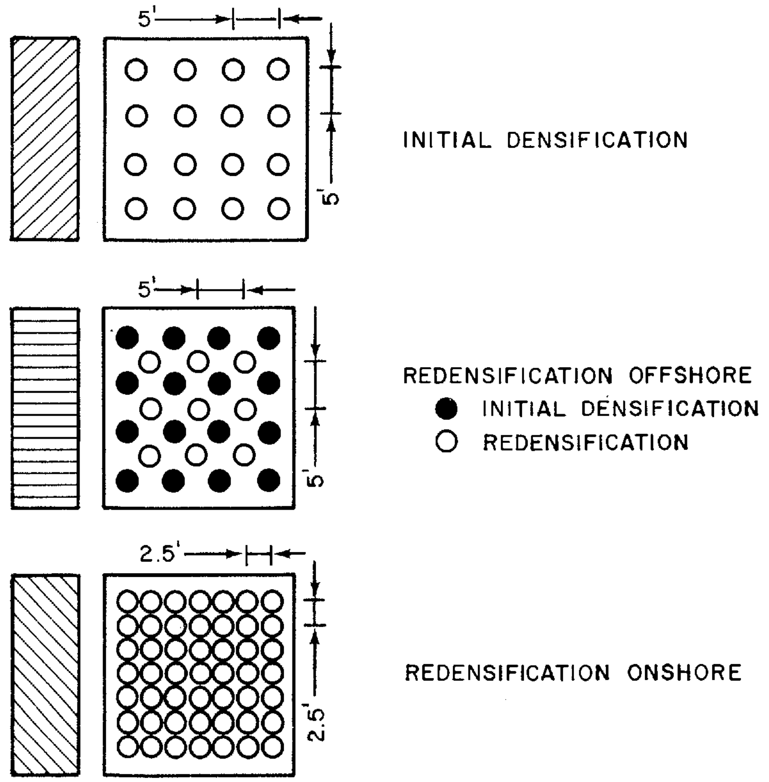
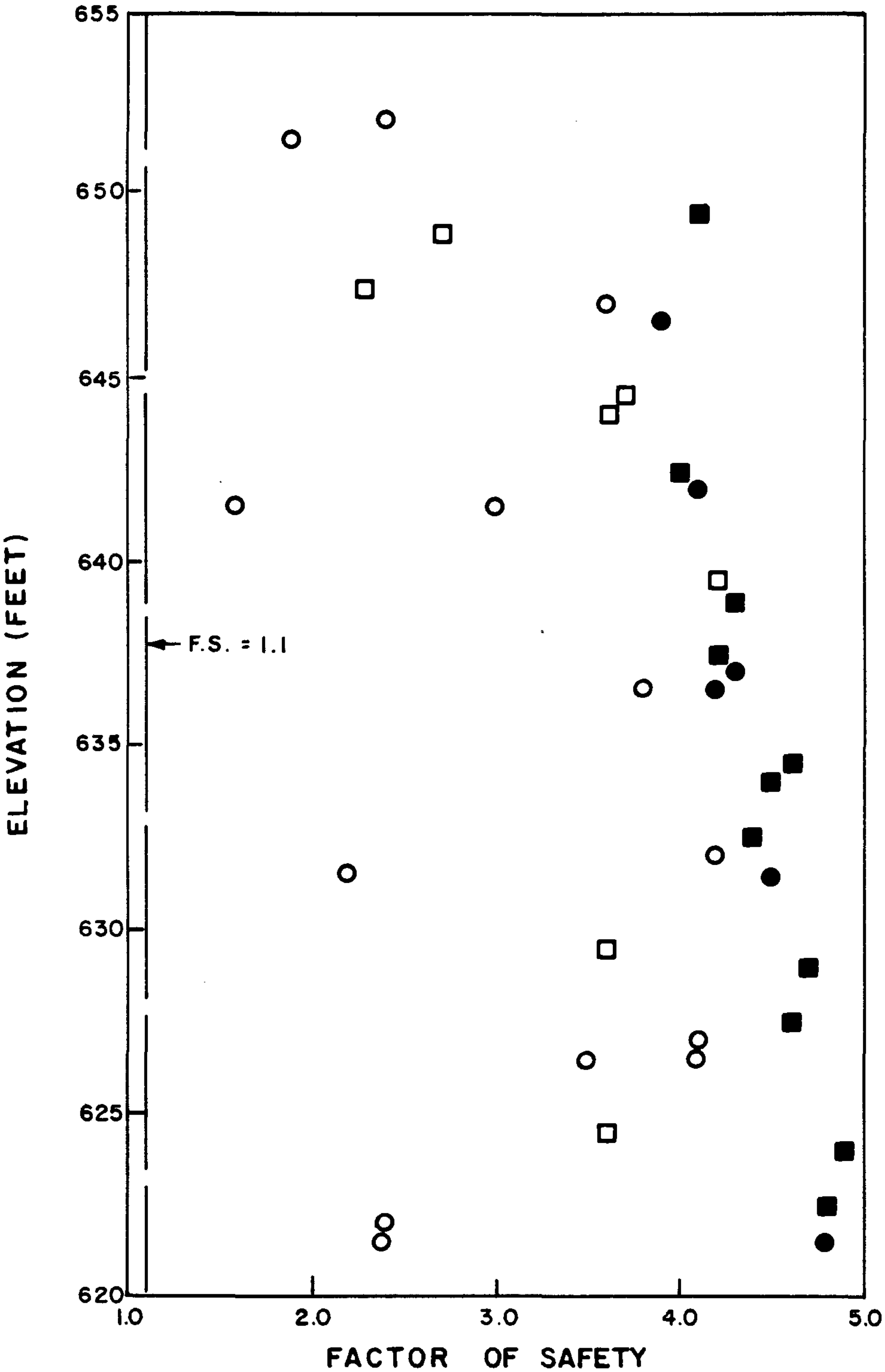


FIGURE 2.5.4-32
TERRA PROBE DENSIFICATION
MAIN INTAKE STRUCTURE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



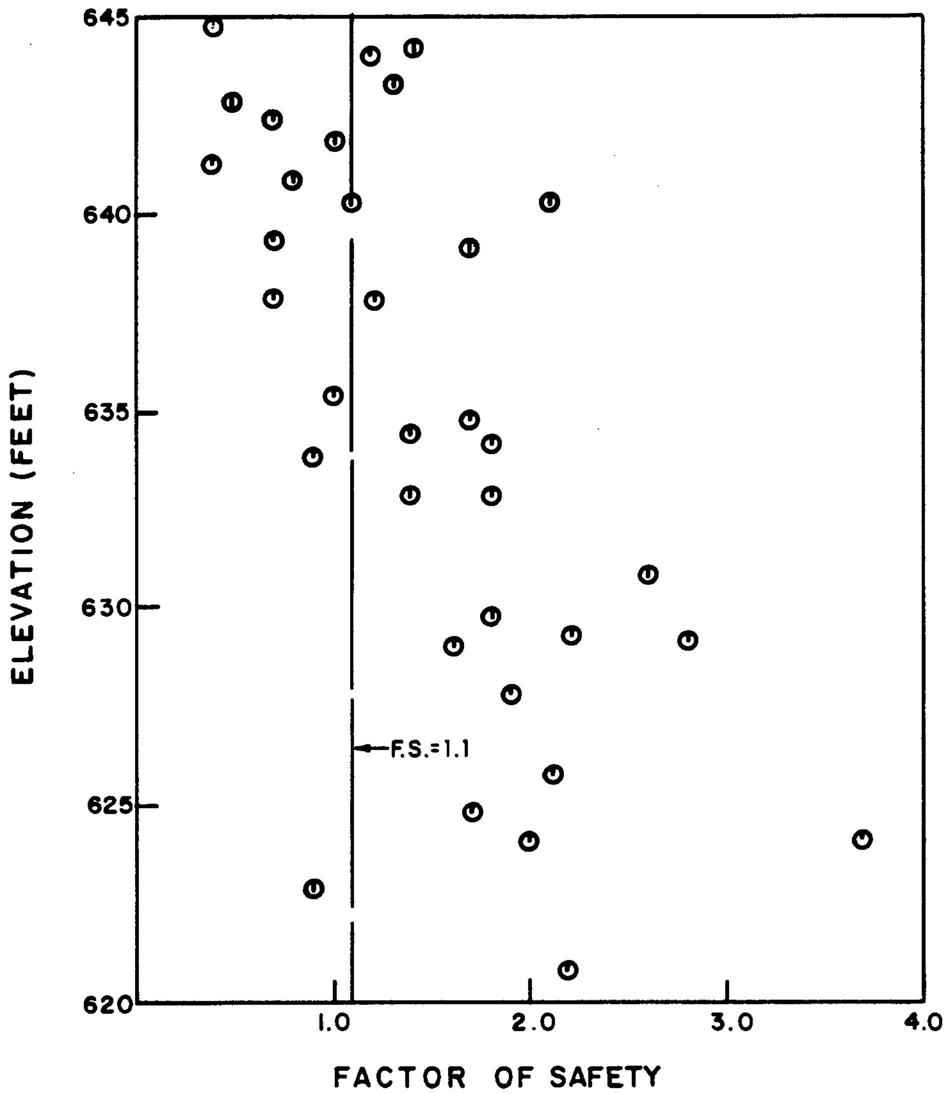
○ WEST OF STRUCTURE
□ EAST OF STRUCTURE

SOLID SYMBOLS INDICATE $N_1 > 42$

SOIL DATA FROM BORINGS AFTER DENSIFICATION:
572T-577T

N_1 DETERMINED USING GIBBS & HOLTZ (1957) DATA

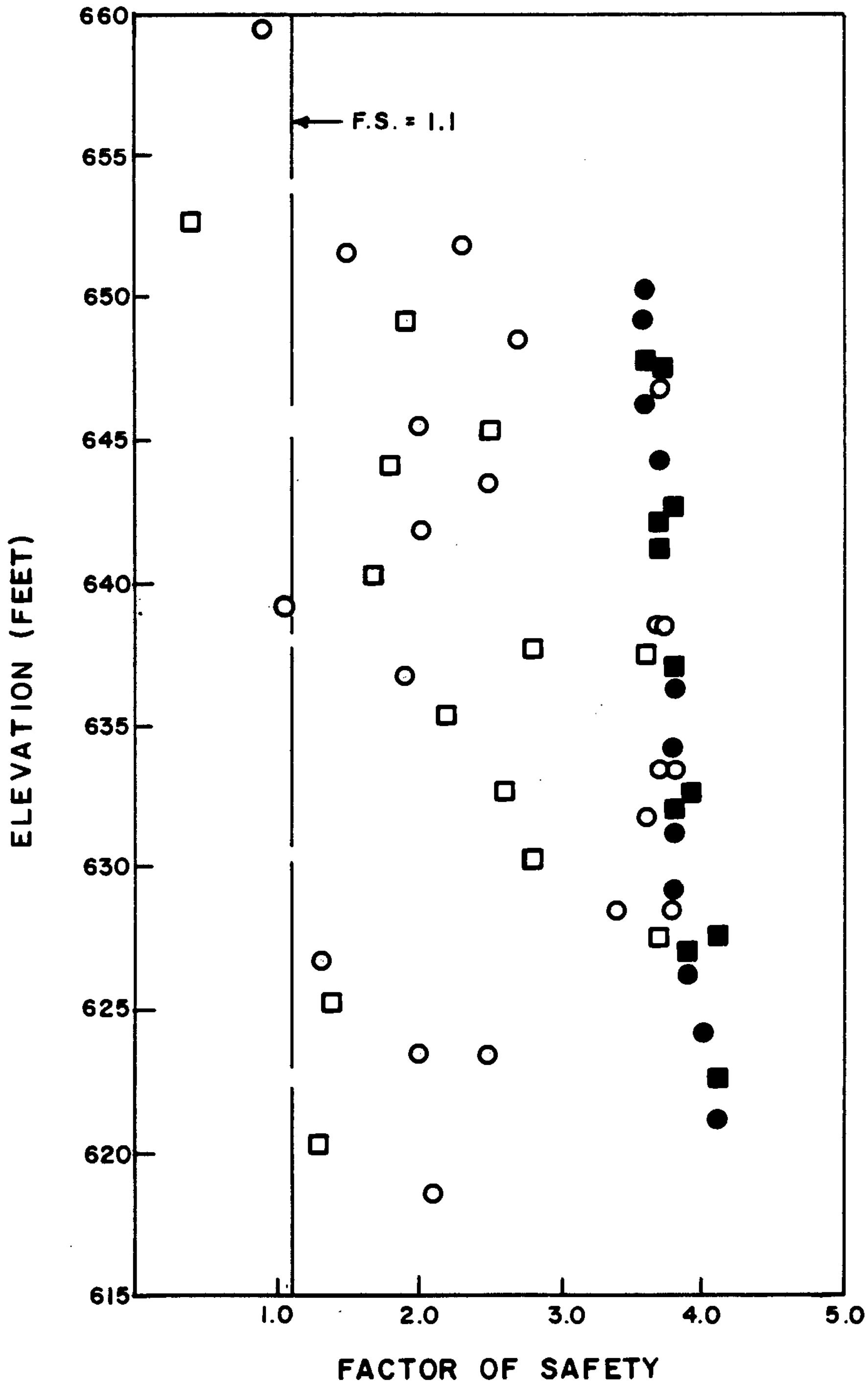
FIGURE 2.5.4-33
LIQUEFACTION ANALYSIS AT MAIN INTAKE STRUCTURE-ONSHORE DENSIFIED AREAS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



SOIL DATA FROM BORINGS PRIOR TO DENSIFICATION: 537T-542T

N_1 DETERMINED USING MARCUSSON & BIEGANOUSKI (1977) DATA

FIGURE 2.5.4-34
LIQUEFACTION ANALYSIS AT MAIN INTAKE STRUCTURE-INTAKE CHANNEL
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



O WEST OF STRUCTURE

□ EAST OF STRUCTURE

SOLID SYMBOLS INDICATE N_1>42

SOIL DATA FROM BORINGS AFTER DENSIFICATION: 549T, 550T, 553T, 554T, 565T-567T, 570T, 571T

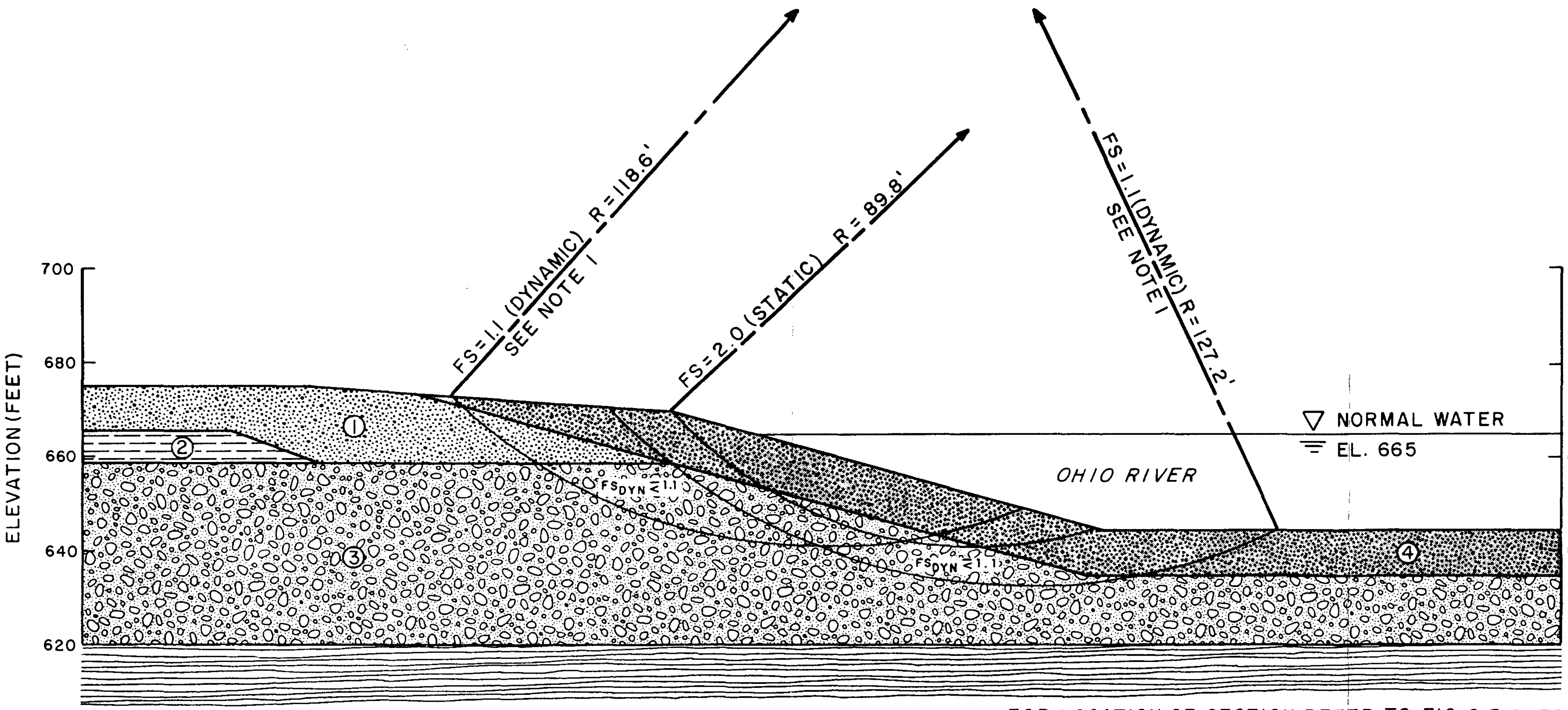
N_1 DETERMINED USING GIBBS & HOLTZ (1957) DATA

FIGURE 2.5.4-35

LIQUEFACTION ANALYSIS AT MAIN INTAKE STRUCTURE - OFFSHORE DENSIFIED AREAS

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT



LEGEND

- SILTY SAND/SANDY SILT
- ORGANIC SILT, CLAY
- SAND, GRAVELLY SAND
- ZONE SUBJECT TO LIQUEFACTION
- BEDROCK

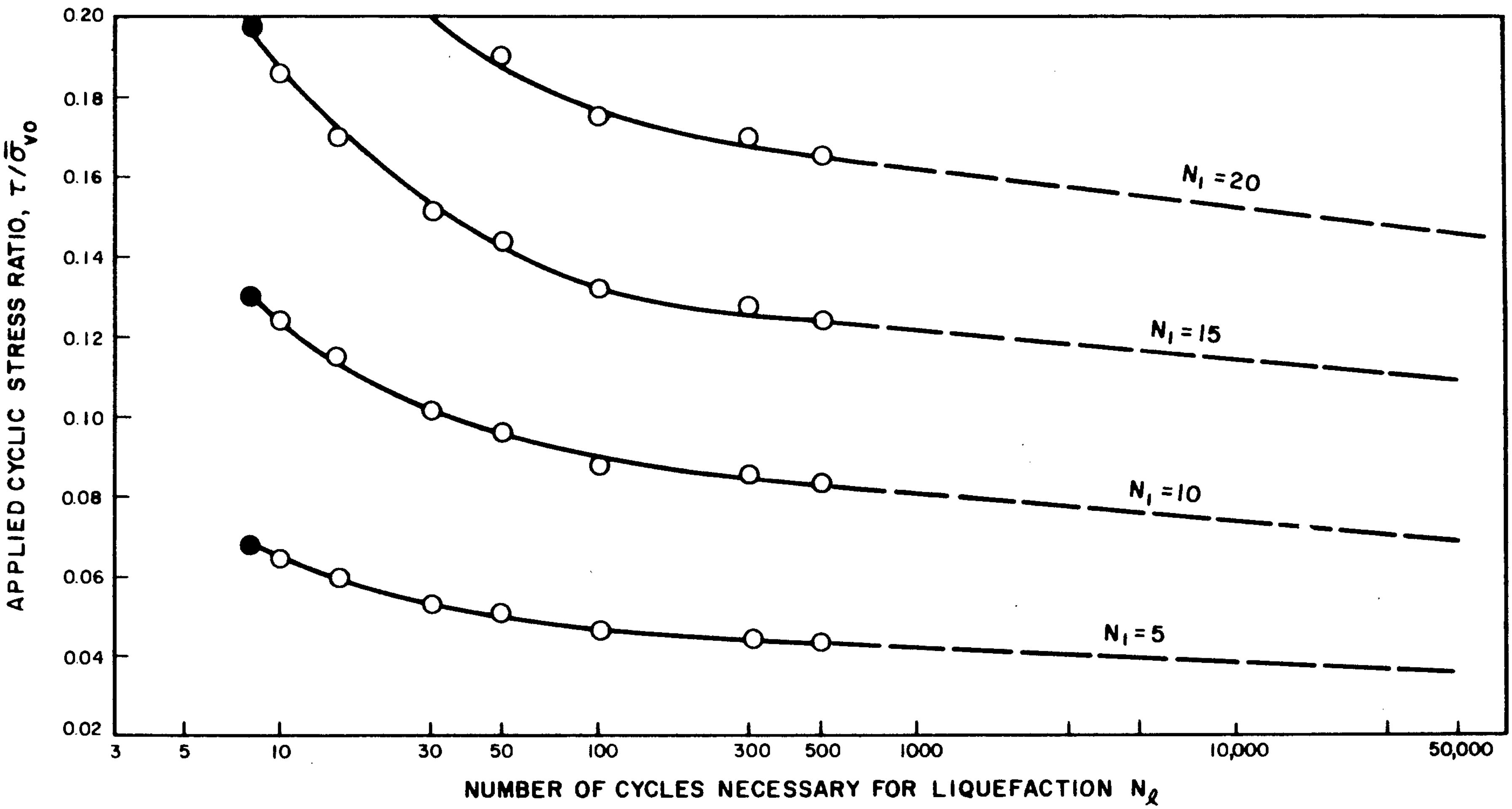
NOTE

(1) FAILURE CIRCLES WITH RADII LESS THAN THOSE SHOWN HAVE DYNAMIC FACTORS OF SAFETY LESS THAN 1.1.

0 20 40
SCALE - FEET

SOIL PROPERTIES					
SOIL UNIT	TOTAL UNIT WEIGHT γ_T, pcf	COHESION C, psf	FRICTION ANGLE UNDRAINED ϕ DEGREES	FRICTION ANGLE DRAINED ϕ DEGREES	SOIL DESCRIPTION
1	120	0	17	25	SILTY SAND
2	110	350	0	0	CLAY
3	136	0	30	30	SAND AND GRAVEL
4	120	0	17	25	LOOSE SILTY SAND

FIGURE 2.5.4-37
MAIN INTAKE CHANNEL
SLOPE STABILITY SECTION 1-1
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

● — DATA FROM LOWER BOUND ENVELOPE,

○ — REDUCED STRESS RATIOS BASED UPON LABORATORY TEST DATA (SEED, ARANGO, CHAN)

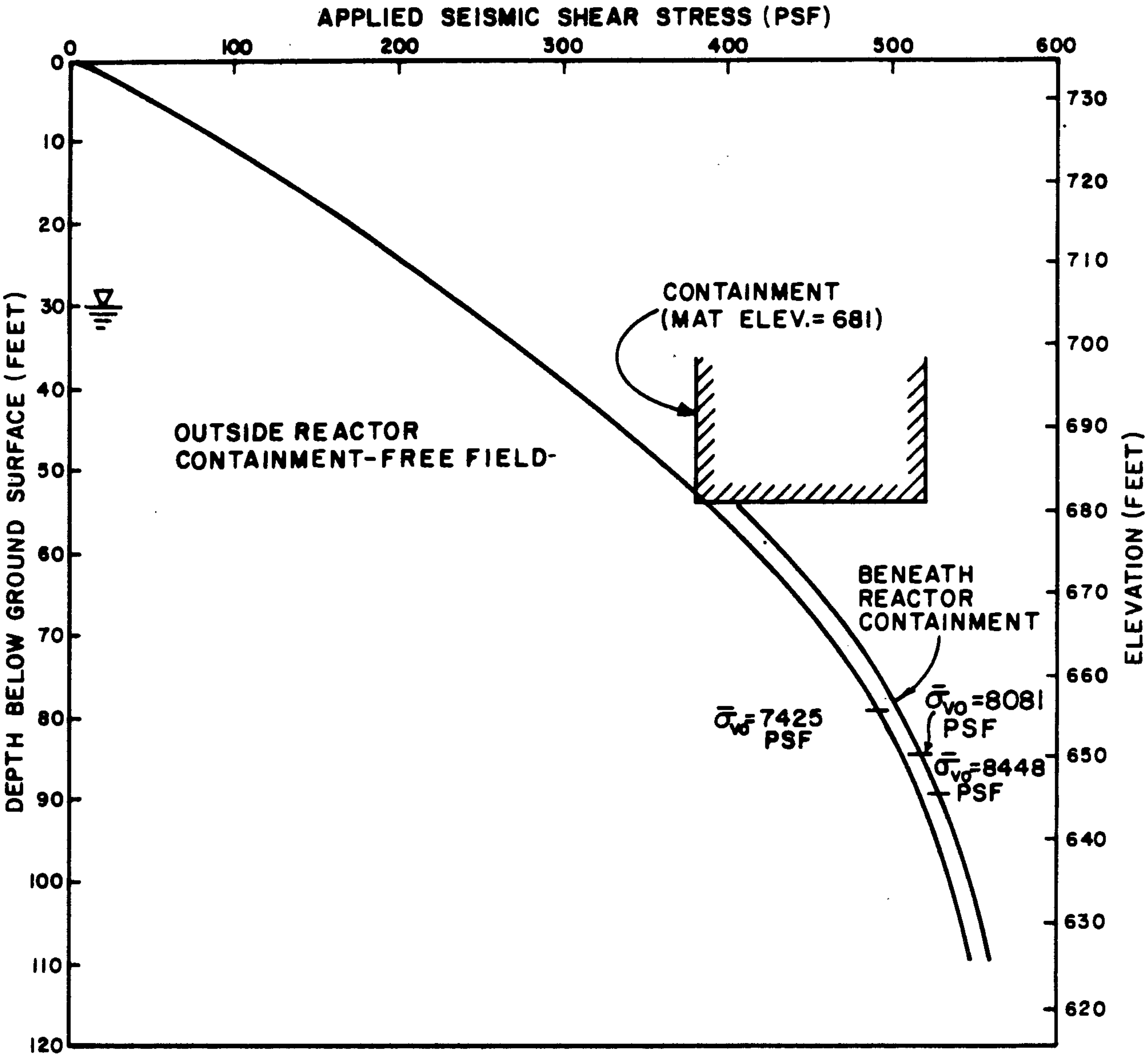
N_1 — STANDARD PENETRATION RESISTANCE CORRECTED TO $\bar{\sigma}_{vo} = 1$ TsF

FIGURE 2.5.4-38

NUMBER OF CYCLES NECESSARY FOR LIQUEFACTION, N_ℓ VS CYCLIC STRESS RATIO

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT



STRESSES REPRESENT AVERAGE OF 10 LARGEST PEAKS, BASED ON PSAR FIGURE 2.6-6, MODIFIED AS DESCRIBED IN DLC 1976.

$\bar{\sigma}_{vo}$ = VERTICAL EFFECTIVE OVERBURDEN PRESSURE.

FIGURE 2.5.4-39
SHEAR STRESS IN SOIL
FOR DESIGN EARTHQUAKE
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

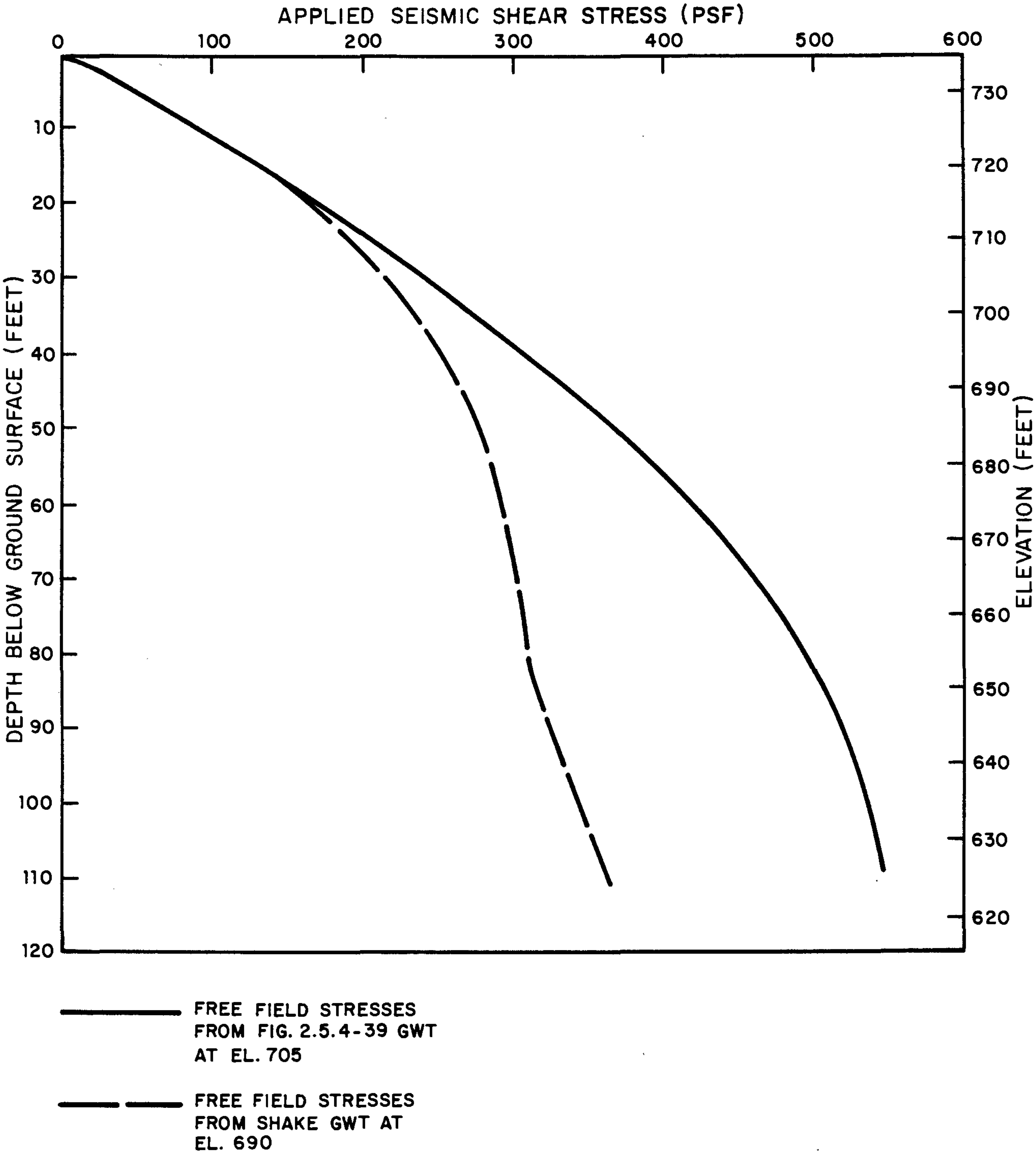
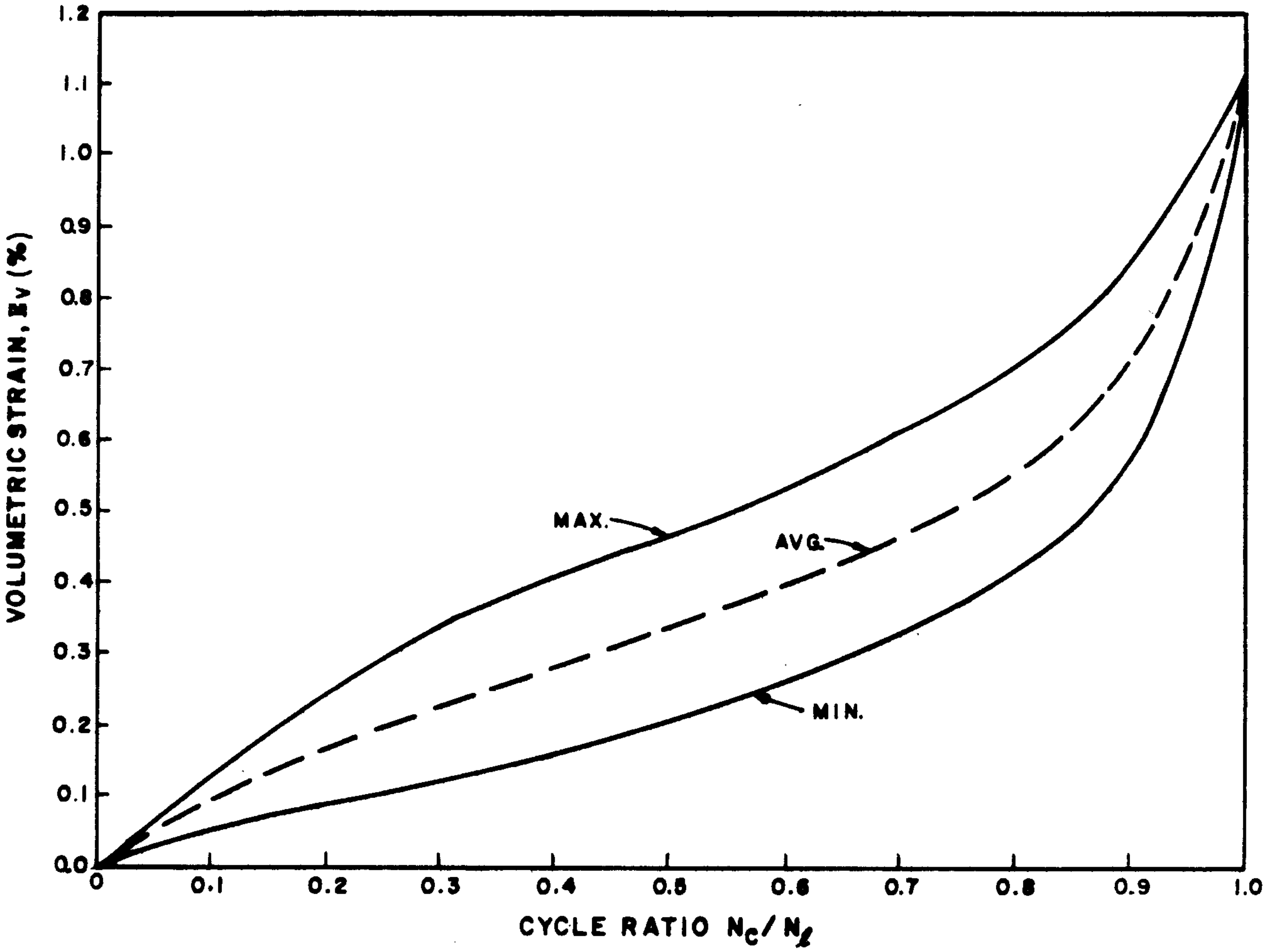


FIGURE 2.5.4-39a
SHEAR STRESS IN SOIL FOR DESIGN EARTHQUAKE
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

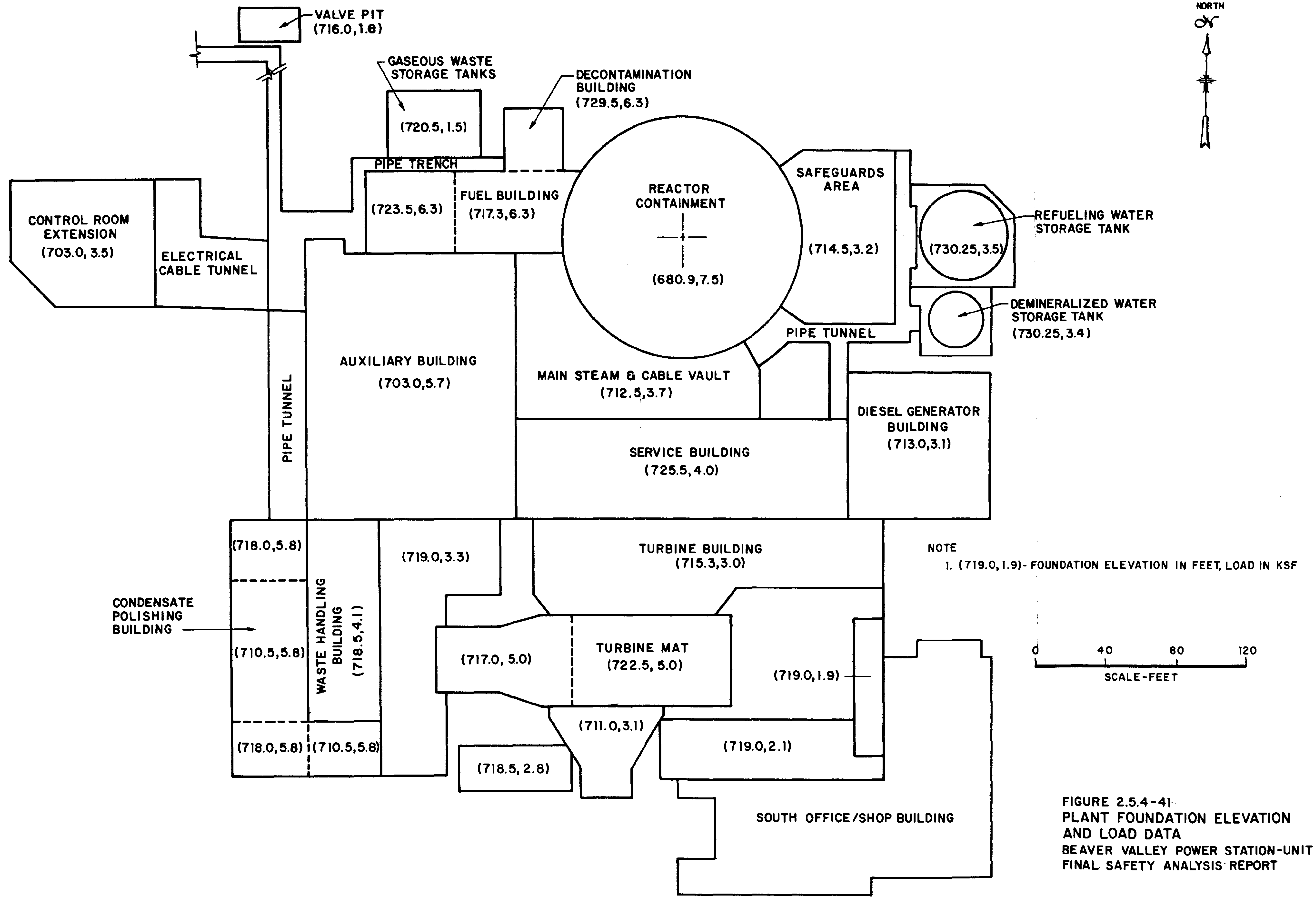


N_c= NUMBER OF LOADING CYCLES

N_ℓ= NUMBER OF LOADING CYCLES NECESSARY FOR INITIAL LIQUEFACTION.

CURVES BASED UPON LABORATORY TESTS BY LEE AND ALBAISA 1974

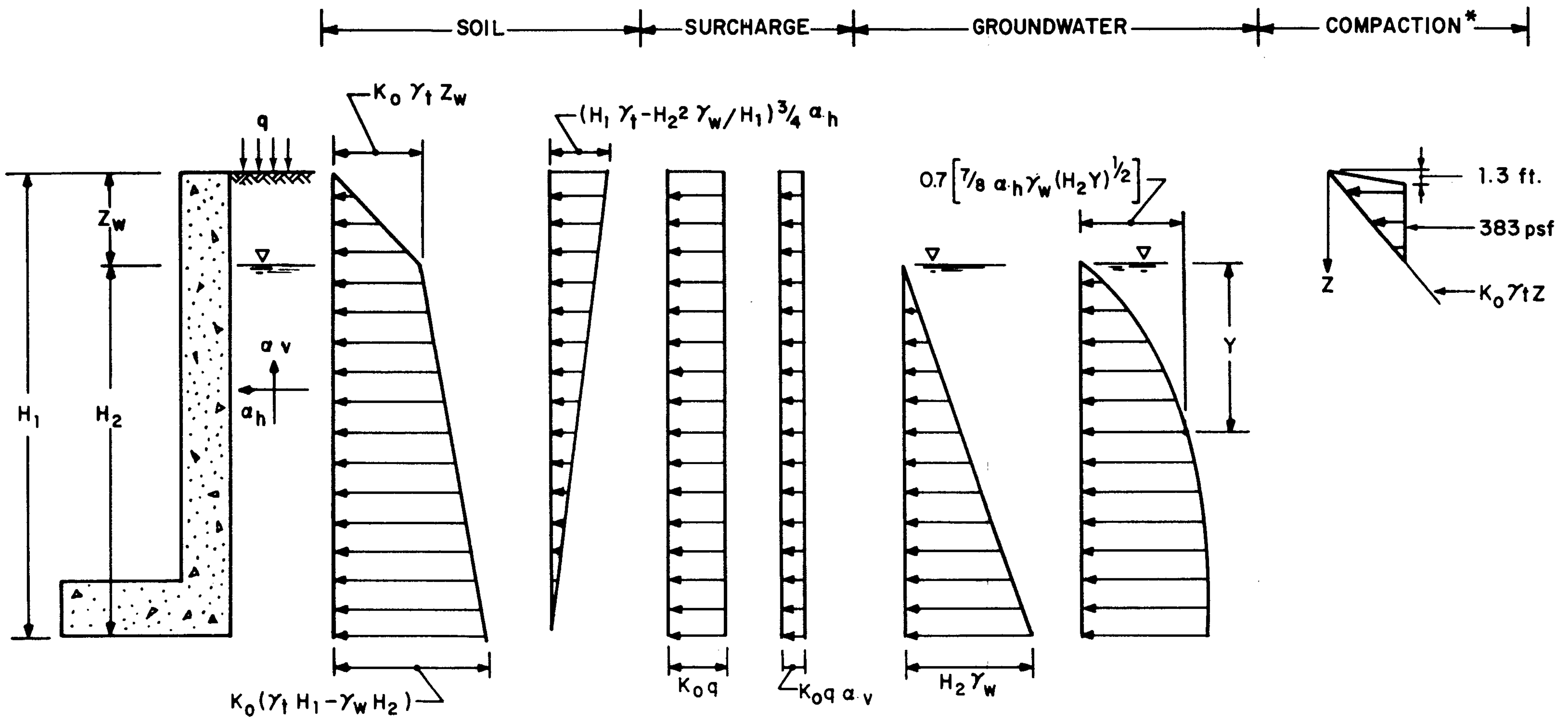
FIGURE 2.5.4-40
VOLUMETRIC STRAIN VS CYCLE RATIO
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTE

1. (719.0,1.9)- FOUNDATION ELEVATION IN FEET, LOAD IN KSF

FIGURE 2.5.4-41
PLANT FOUNDATION ELEVATION AND LOAD DATA
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



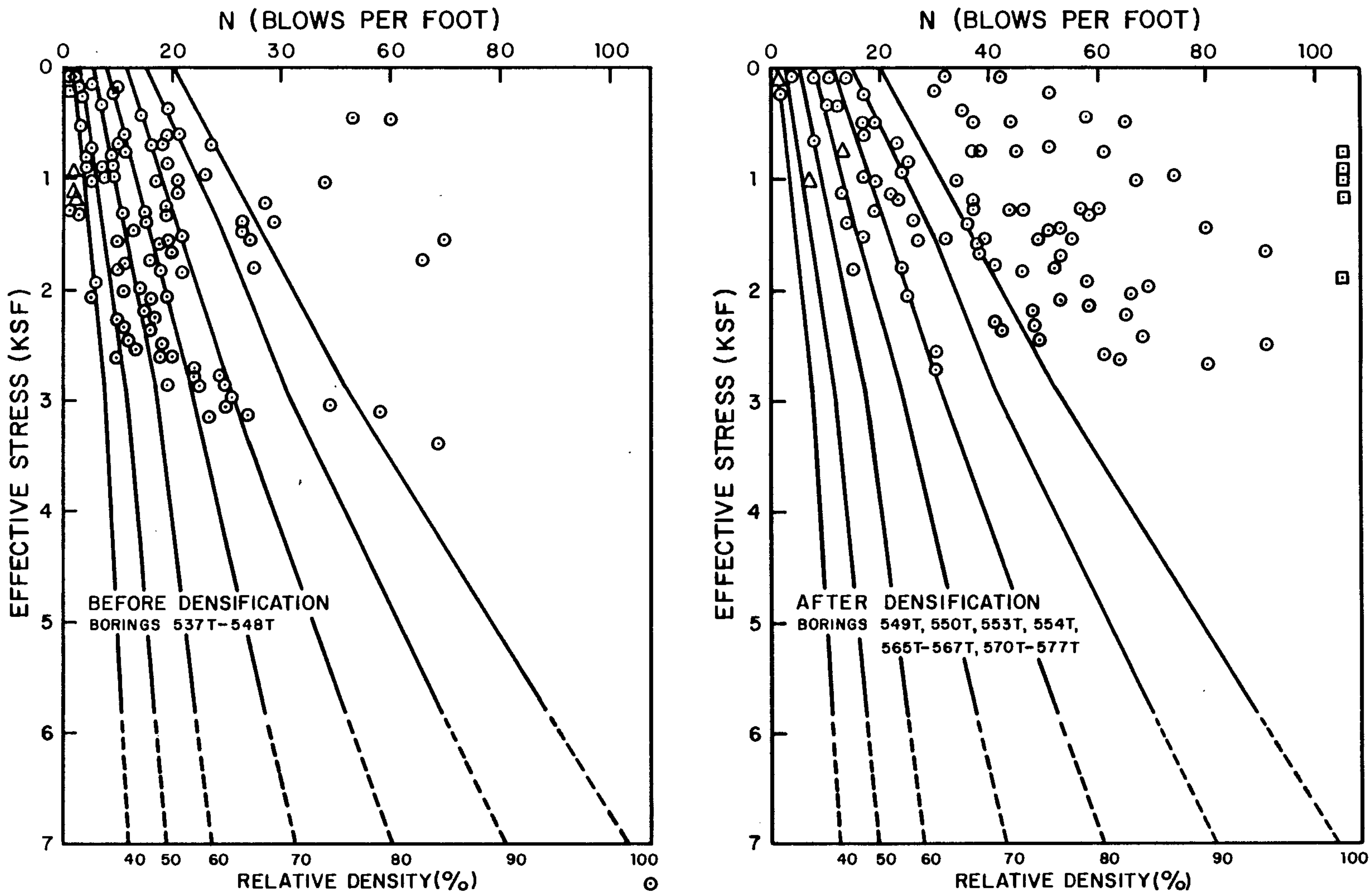
LOAD/LIN. FT OF WALL	SOIL	SURCHARGE	GROUNDWATER
STATIC	$(H_1^2 \gamma_t - H_2^2 \gamma_w) \frac{K_o}{2}$	$K_o q H_1$	$\frac{1}{2} H_2^2 \gamma_w$
DYNAMIC	$(H_1^2 \gamma_t - H_2^2 \gamma_w)(\frac{1}{2})(\frac{3}{4} \alpha_h)$	$K_o \alpha_v q H_1$	$0.7\left[(\frac{7}{12}) \alpha_h \gamma_w H_2^2\right]$
COMBINED	$\frac{1}{2}(H_1^2 \gamma_t - H_2^2 \gamma_w)(K_o + \frac{3}{4} \alpha_h)$	$K_o q(1 + \alpha_v) H_1$	$\frac{\gamma_w H_2^2}{2}(1 + 0.82 \alpha_h)$

LEGEND

- K_o = COEFFICIENT OF LATERAL EARTH PRESSURE AT REST
- γ_t = TOTAL UNIT WEIGHT OF SOIL
- γ_w = UNIT WEIGHT OF WATER
- α_h = HORIZONTAL SEISMIC COEFFICIENT = 0.125g (SSE)
- α_v = VERTICAL SEISMIC COEFFICIENT = $\frac{2}{3} \alpha_h$
- q = UNIFORM SURCHARGE LOAD

* ONLY FOR CONTROL ROOM EXTENSION AND CABLE TUNNEL

FIGURE 2.5.4-42
LATERAL EARTH PRESSURES ON RIGID WALLS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND:

⊙ SAND

⊡ SAND / N>100

Δ OTHER

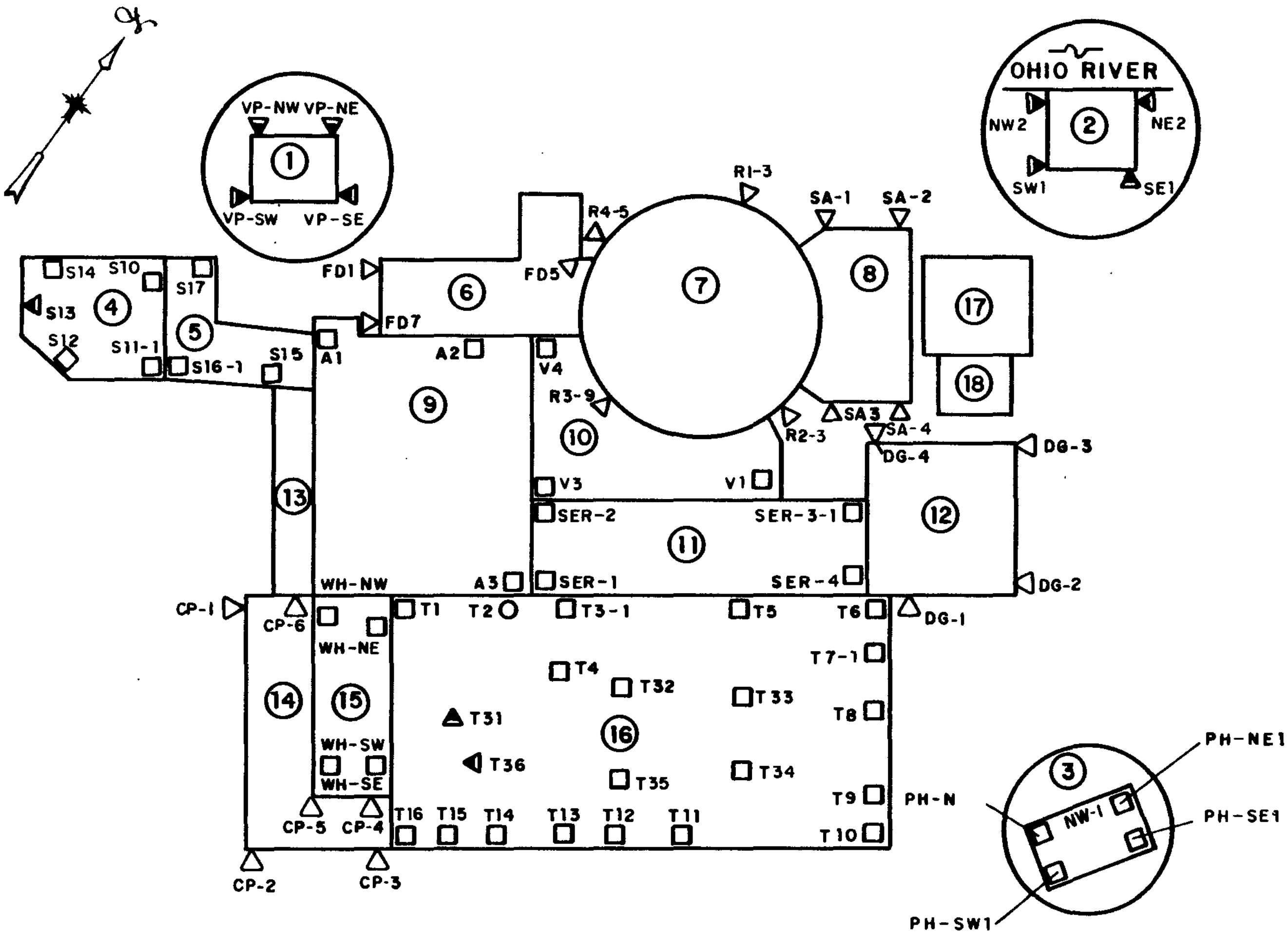
NOTE:

INDIVIDUAL PLOTS CONTAINED IN APPENDIX 2.5C

FIGURE 2.5.4-43

SUMMARY PLOTS-
TERRA PROBE DENSIFICATION
AT MAIN INTAKE STRUCTURE

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



1. VALVE PIT
2. ALTERNATE INTAKE STRUCTURE
3. COOLING TOWER PUMPHOUSE
4. CONTROL ROOM EXTENSION
5. ELECTRIC CABLE TUNNEL
6. FUEL & DECONTAMINATION BUILDING
7. REACTOR CONTAINMENT
8. SAFEGUARDS AREA
9. AUXILIARY BUILDING
10. MAIN STEAM AND CABLE VAULT
11. SERVICE BUILDING
12. DIESEL GENERATOR BUILDING
13. PIPE TUNNEL
14. CONDENSATE POLISHING BUILDING
15. WASTE HANDLING BUILDING
16. TURBINE BUILDING
17. REFUELING WATER TANK
18. DEMINERALIZED WATER TANK

▶ VERTICAL INSTALLATION
▷ VERTICAL INSTALLATION (TEMPORARY)
○ SLEEVE TYPE INSTALLATION
□ HORIZONTAL INSTALLATION

SUMMARY OF OBSERVED SETTLEMENTS SHOWN IN FIGURE 2.5.4-46

INSTALLATION DETAILS SHOWN IN FIGURE 2.5.4-48

FIGURE 2.5.4-44

SETTLEMENT MARKER LOCATION PLAN

BEAVER VALLEY POWER STATION — UNIT 2

FINAL SAFETY ANALYSIS REPORT

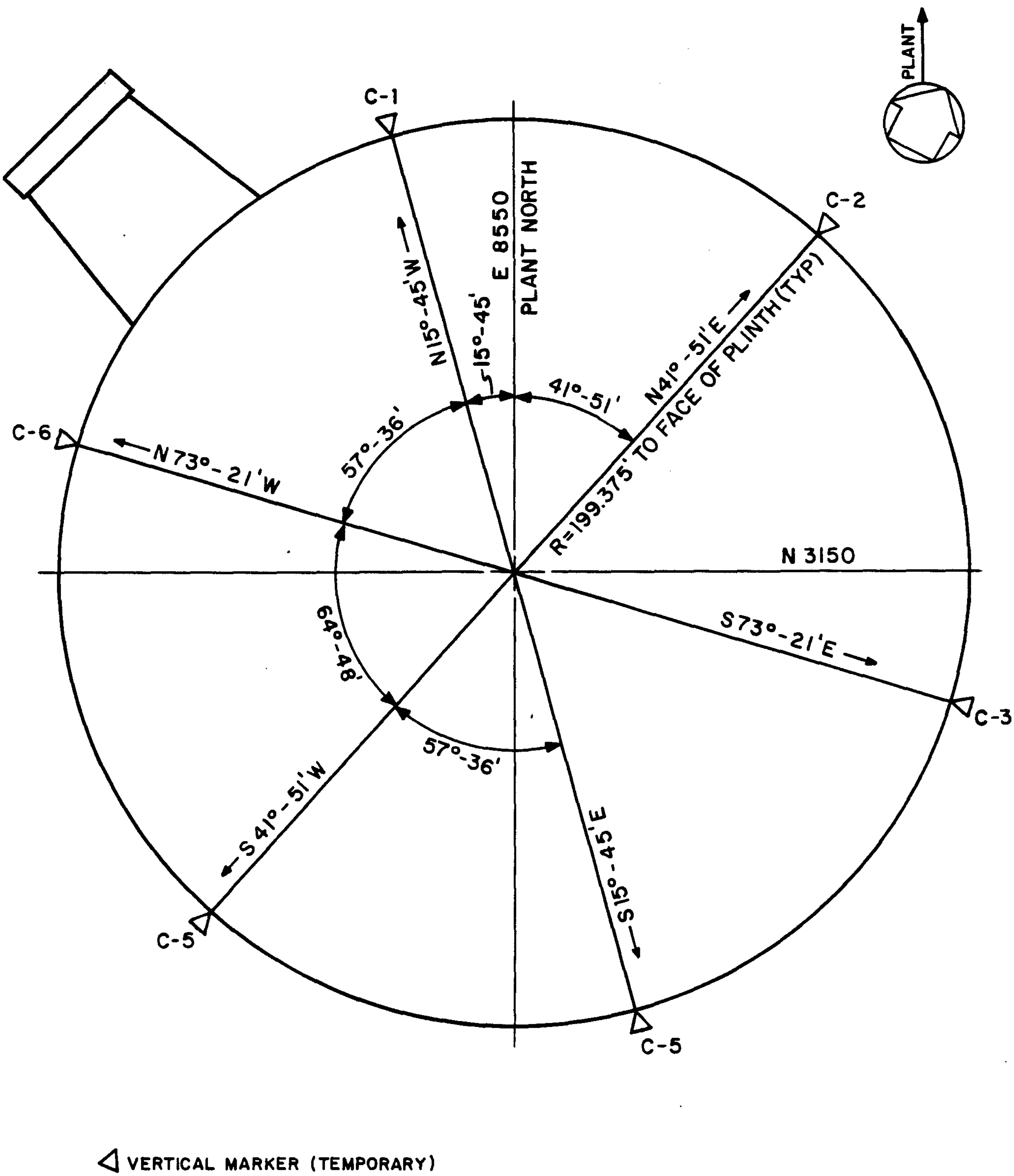
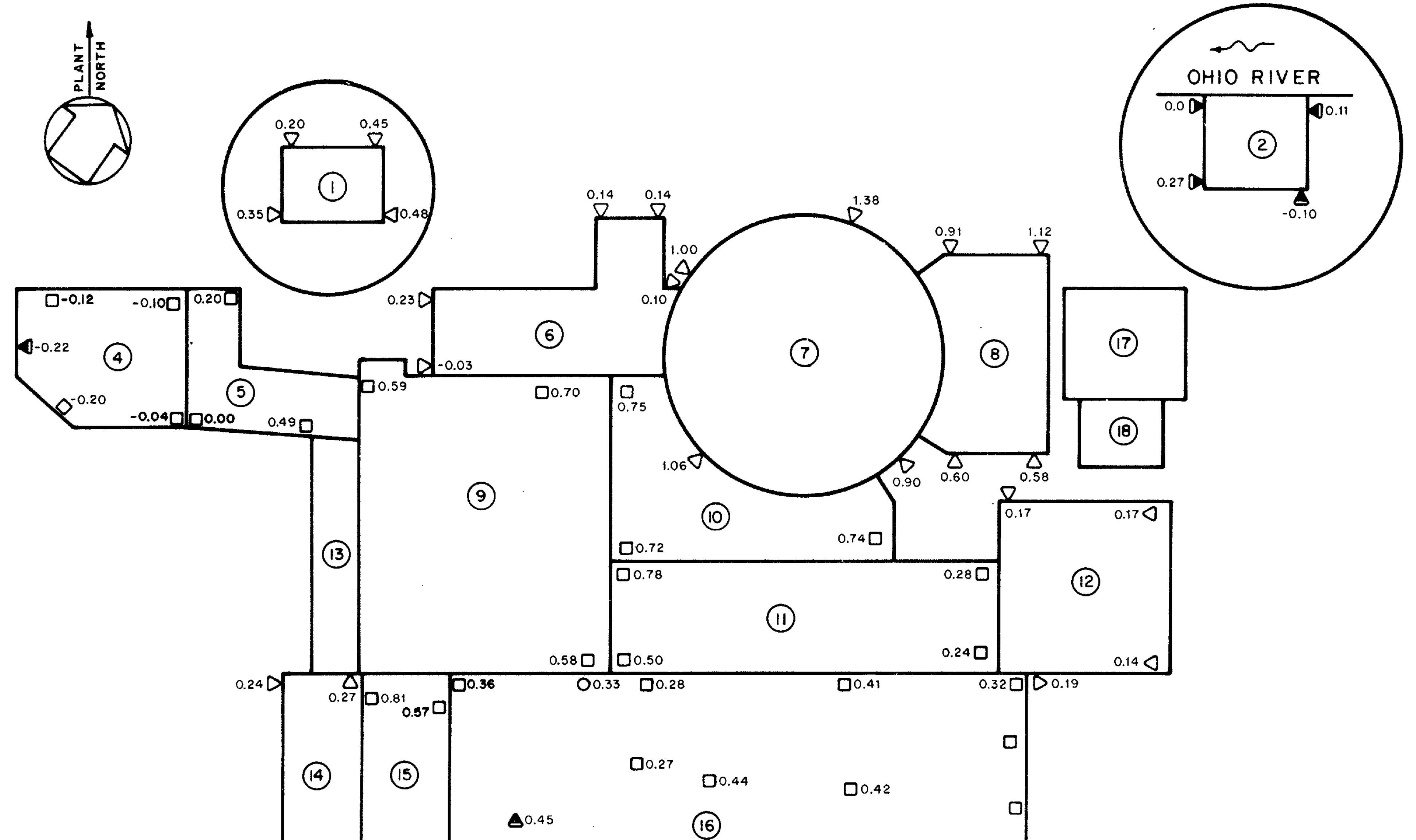
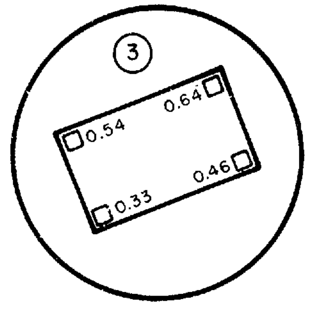


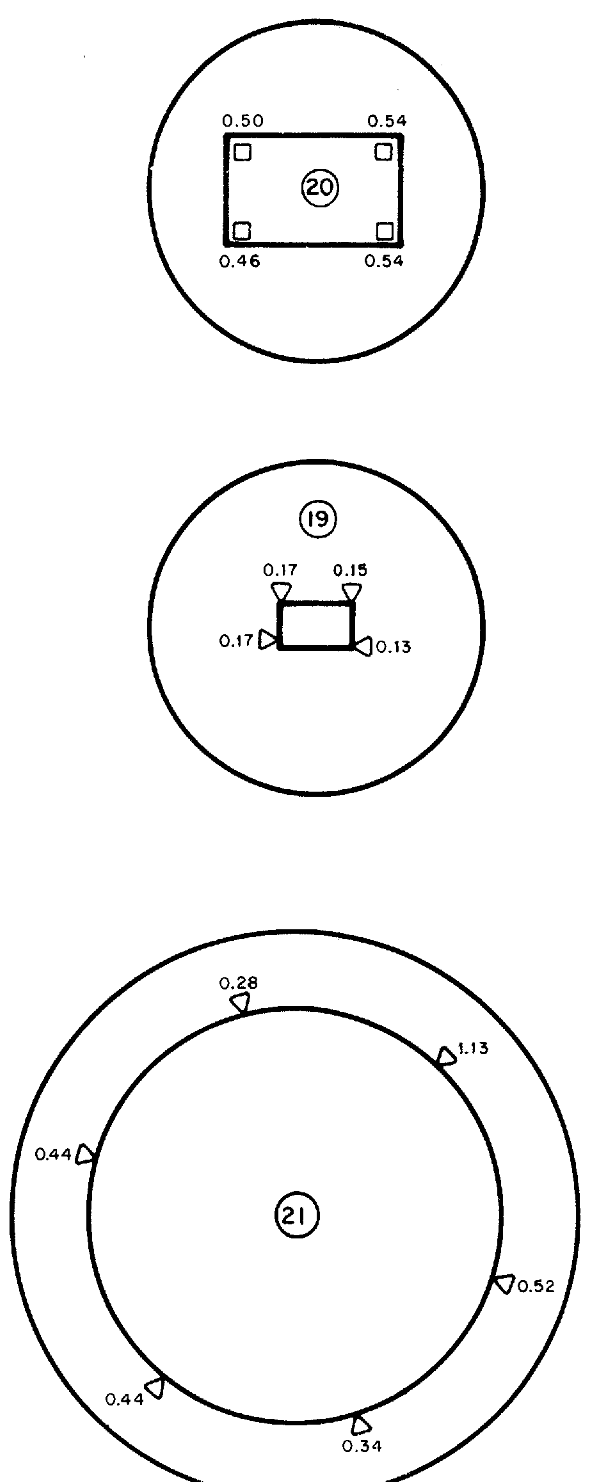
FIGURE 2.5.4-45

SETTLEMENT MARKER LOCATION PLAN
COOLING TOWER

BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT







CONSTRUCTION (4) PROGRESS (%)		
95	1	VALVE PIT
99	2	ALTERNATE INTAKE STRUCTURE
94	3	COOLING TOWER PUMPHOUSE
92	4	CONTROL ROOM EXTENSION
93	5	ELEC. CABLE TUNNEL
95	6	FUEL & DECON. BUILDING
95	7	REACTOR CONTAINMENT
98	8	SAFEGUARDS AREA
97	9	AUXILIARY BUILDING
98	10	MAIN STEAM & CABLE VAULT
93	11	SERVICE BUILDING
93	12	DIESEL GENERATOR
95	13	PIPE TUNNEL
97	14	CONDENSATE POLISHING BUILDING
95	15	WASTE HANDLING BUILDING
91	16	TURBINE BUILDING
80	17	REFUELING WATER TANK
80	18	DEMINERALIZED WATER TANK
100	19	SANITARY TREATMENT BUILDING (BVPS-1)
100	20	ALTERNATE ACCESS FACILITY (BVPS-1)
99	21	COOLING TOWER
	◗	VERTICAL MARKER
	▷	VERTICAL MARKER (TEMPORARY)
	□	HORIZONTAL MARKER
	○	SLEEVE TYPE MARKER

NOTES

1. OBSERVED DATA SHOWN REPRESENTS THE SETTLEMENT (HEAVE) OF A GIVEN SETTLEMENT MARKER ESTIMATED BY AN AVERAGE LINE THROUGH THE SURVEY DATA AS OF JAN. 1, 1984. IF NO DATA IS GIVEN, INSUFFICIENT SURVEY DATA WAS AVAILABLE WITH WHICH TO ESTIMATE SETTLEMENT (HEAVE) OF THE MARKER.
2. LETTERED DESIGNATION OF SETTLEMENT MARKERS GIVEN IN FIGURE 2.5.4-44 AND 2.5.4-45.
3. 0.024 = SETTLEMENT, INCHES; -0.024 = HEAVE, INCHES.
4. APPROXIMATE PERCENTAGE OF TOTAL STRUCTURAL LOAD, INCLUDING MAJOR PIECES OF EQUIPMENT, AS OF JAN. 1, 1984. DOES NOT INCLUDE WEIGHT OF WATER FOR STRUCTURES 17, 18 AND 21.

FIGURE 2.5.4-46
SUMMARY OF OBSERVED SETTLEMENTS
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

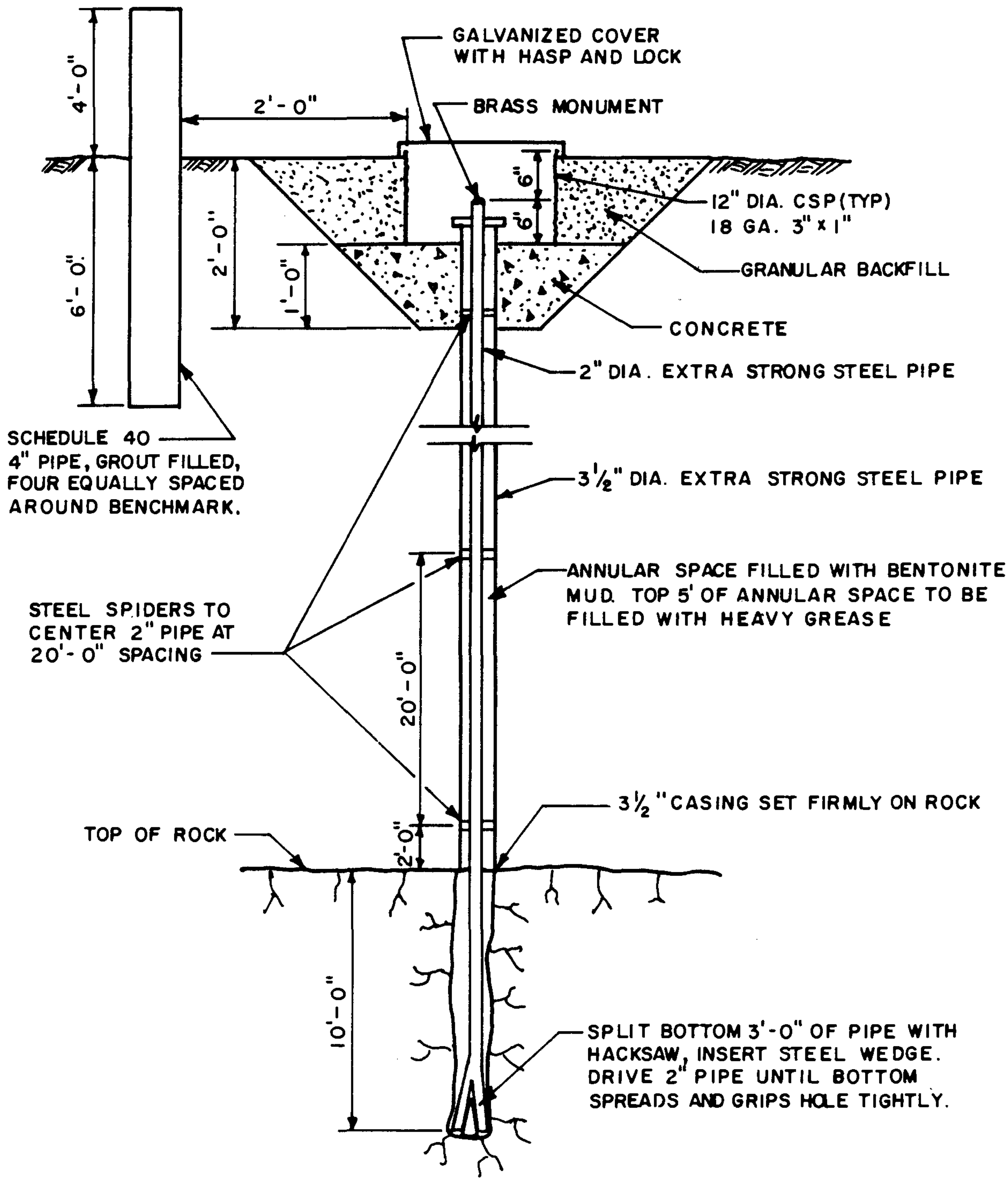


FIGURE 2.5.4-47
BENCHMARK INSTALLATION DETAIL
BEAVER VALLEY POWER STATION – UNIT 2
FINAL SAFETY ANALYSIS REPORT

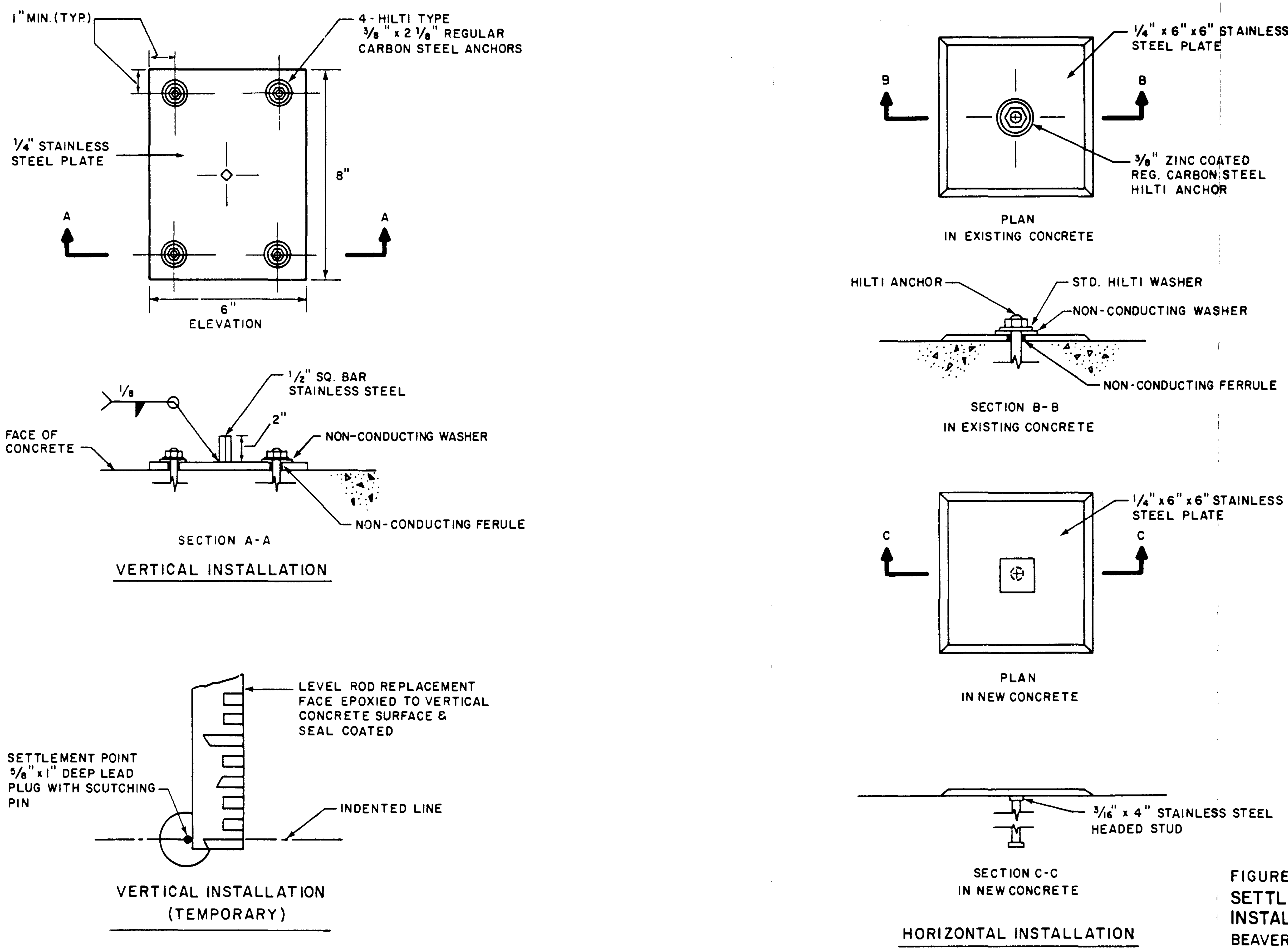


FIGURE 2.5.4-48
SETTLEMENT MARKER
INSTALLATION DETAILS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

JAN 28, 1980 PAGE 1

DETAILED SETTLEMENT REPORT
BEAVER VALLEY 2: 12241

GT-030-100

MARKER NO.	X-COORD	Y-COORD	REFERENCE BENCHMARK	BASE ELEV. (FEET)	SURVEYED ELEV. (FEET)	DATE OF SURVEY	TOTAL SETTLEMENT (INCHES)
T1	.000	.000	B2	730.561	730.561	07/06/77	.000
					730.561	08/02/77	.000
					730.559	09/01/77	.024
					730.565	10/01/77	-.048
					730.565	11/01/77	-.048
					730.567	12/06/77	-.072
					730.569	01/05/78	-.096
					730.572	02/01/78	-.132
					730.570	03/01/78	-.108
					730.556	04/04/78	.060
					730.551	05/04/78	.120
					730.543	06/03/78	.216
					730.540	07/06/78	.252
					730.532	08/03/78	.348
					730.535	09/05/78	.312
					730.536	10/02/78	.300
					730.541	11/07/78	.240
					730.537	12/08/78	.288
					730.537	01/08/79	.288
					730.541	02/01/79	.240
					730.548	03/09/79	.156
					730.546	04/03/79	.180
					730.540	05/03/79	.252
					730.538	06/06/79	.276
					730.516	07/09/79	.540
					730.531	08/08/79	.360
					730.528	09/05/79	.396
					730.532	10/02/79	.348
					730.536	11/07/79	.300
					730.531	12/16/79	.360
					730.537	01/02/80	.288
T2	.000	.000	B2	725.728	725.728	08/02/77	.000
					725.729	09/01/77	-.012
					725.726	10/01/77	.024
					725.727	11/01/77	.012
					725.719	12/06/77	.108
					725.724	01/05/78	.048
					725.716	04/04/78	.144
					725.710	05/04/78	.216
					725.709	06/03/78	.228
					725.708	07/06/78	.240
					725.699	08/03/78	.348
					725.700	09/05/78	.336

FIGURE 2.5.4-49
TYPICAL SETTLEMENT MONITORING DATA REPORT
BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

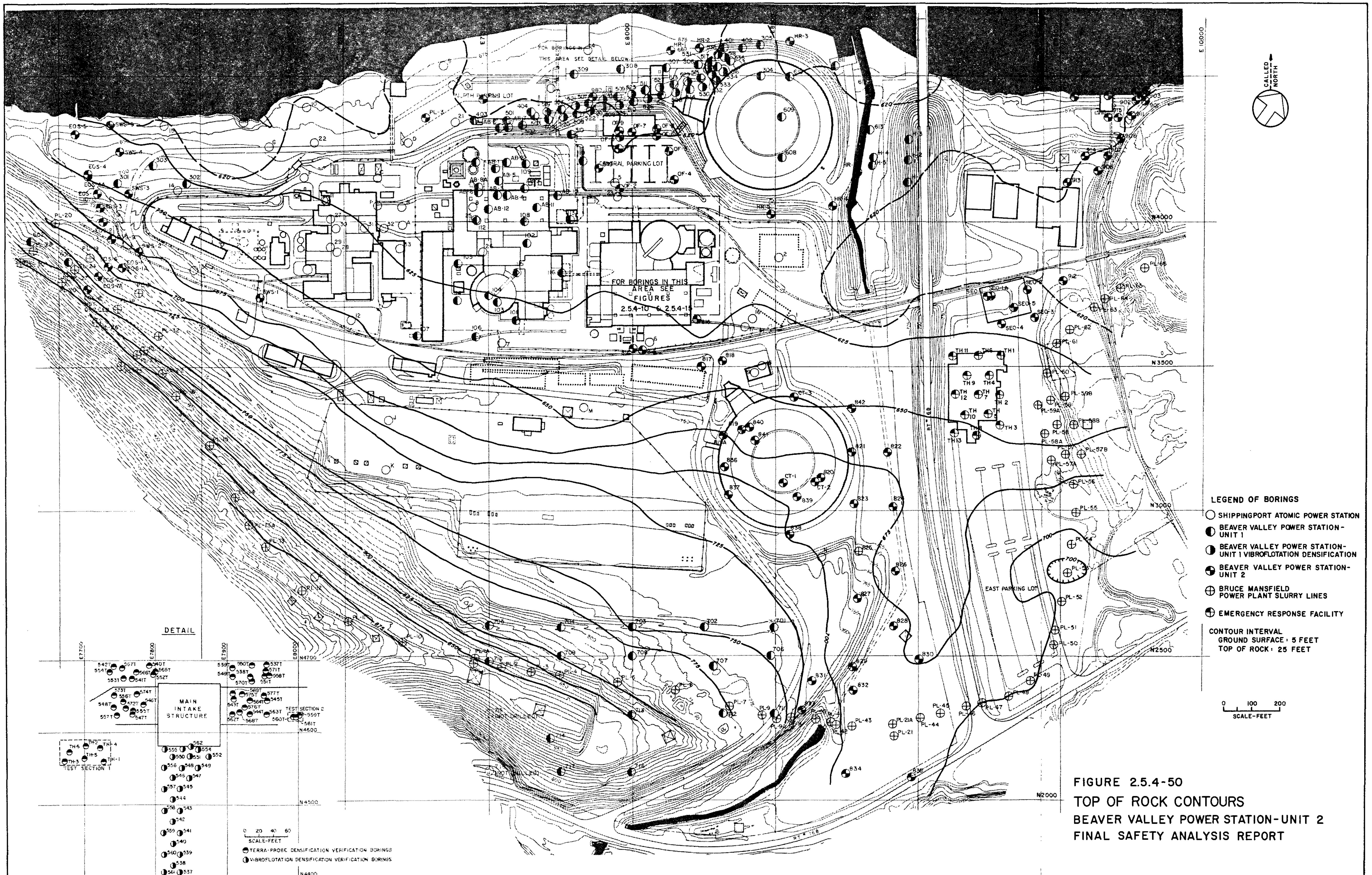
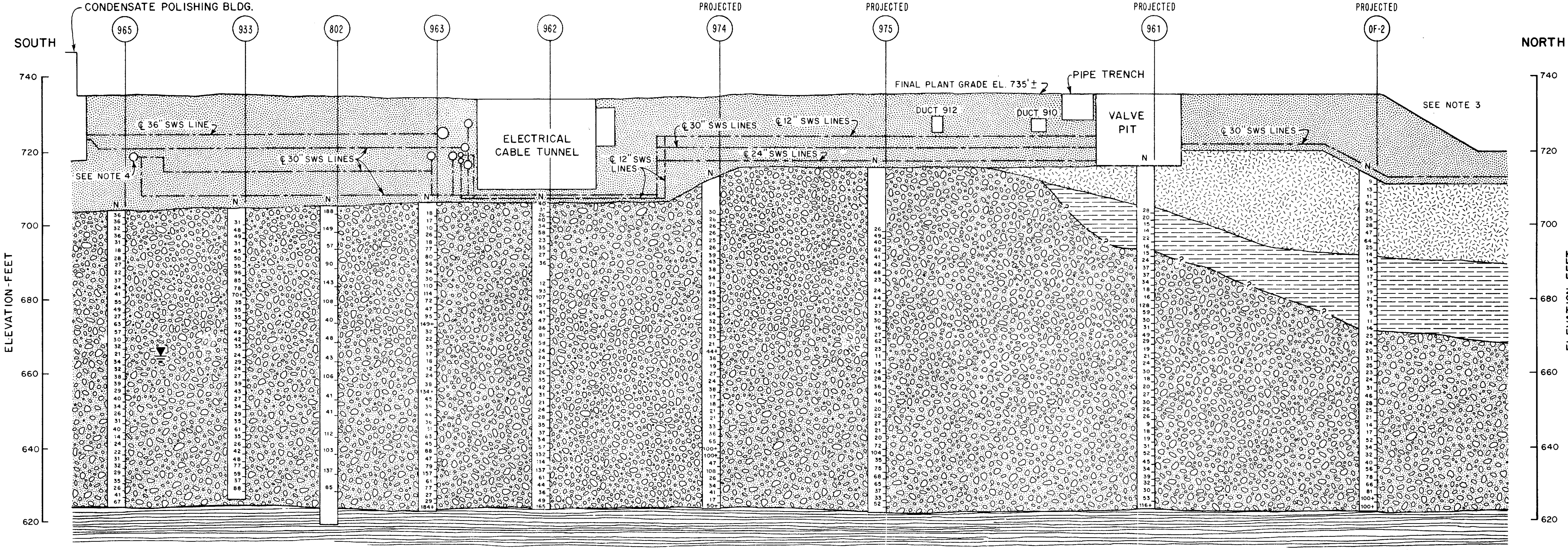


FIGURE 2.5.4-50
TOP OF ROCK CONTOURS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

- GRAVELLY SAND - SANDY GRAVEL SOME SILTY SAND - SAND
- SELECT GRANULAR BACKFILL
- SILTY CLAY - SOME SILTY SAND, SANDY CLAY
- UNCONTROLLED FILL - SILTY CLAY - GRAVELLY CLAY, SANDY CLAY, CLAYEY SAND
- BEDROCK
- NORMAL GROUNDWATER LEVEL

NOTES

1. LOCATION OF SECTION IS SHOWN ON FIGURE 2.5.4-10.
2. N - STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.).
3. PROFILE CONTINUED TO THE NORTH ON SECTION L-L"', FIGURE 2.5.4-54.
4. PROFILE CONTINUED TO EMERGENCY OUTFALL STRUCTURE ON SECTION M-M"', FIGURE 2.5.4-55.

0 20 40
SCALE-FEET

FIGURE 2.5.4-51
SUBSURFACE PROFILE I-I"
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

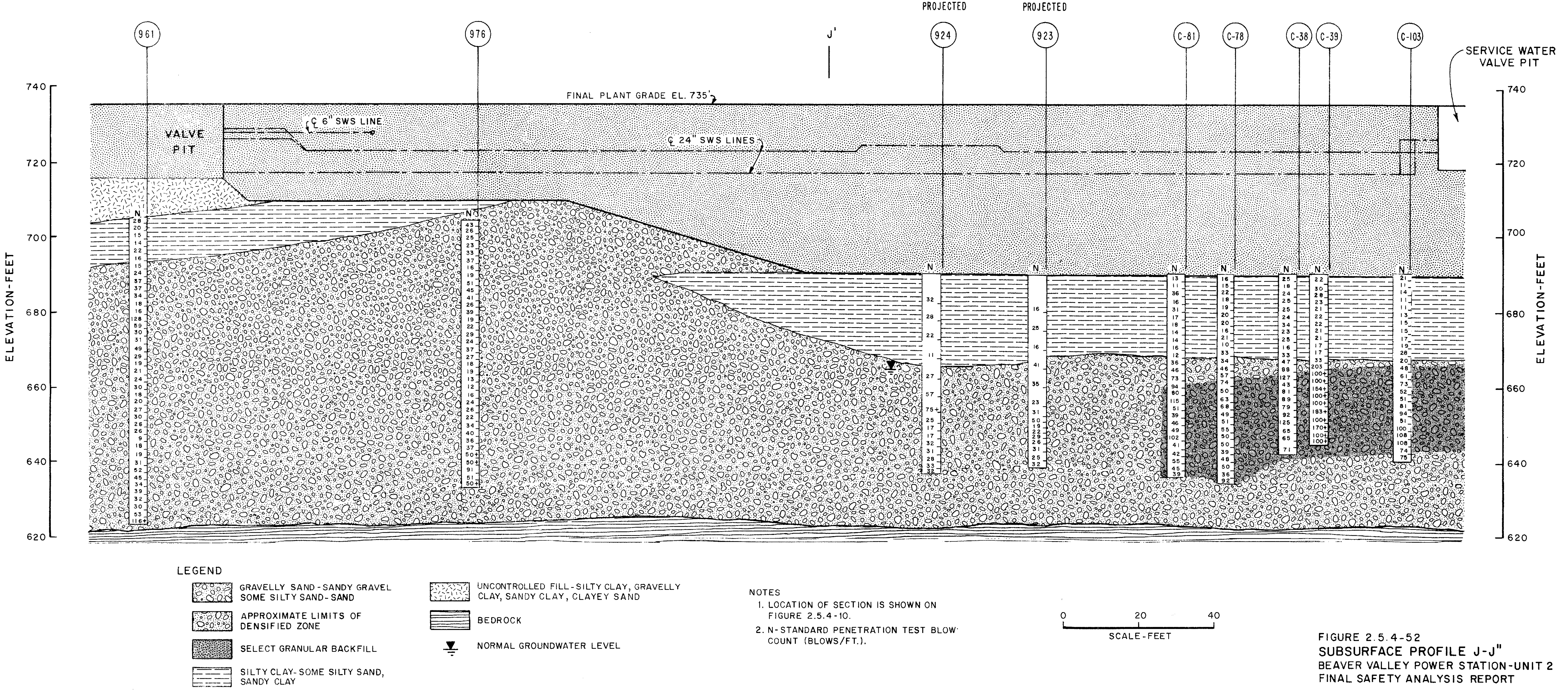
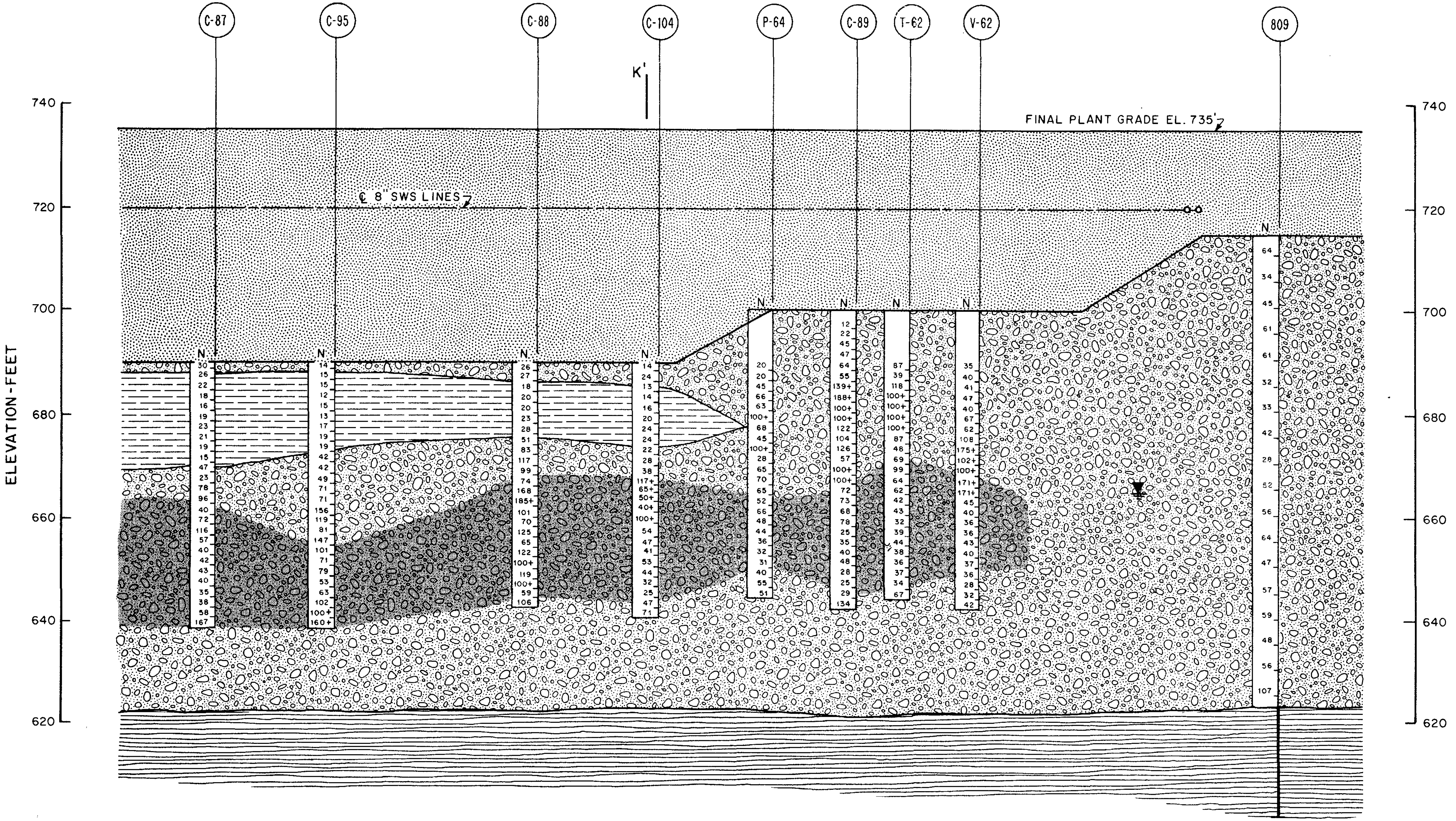


FIGURE 2.5.4-52
SUBSURFACE PROFILE J-J"
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

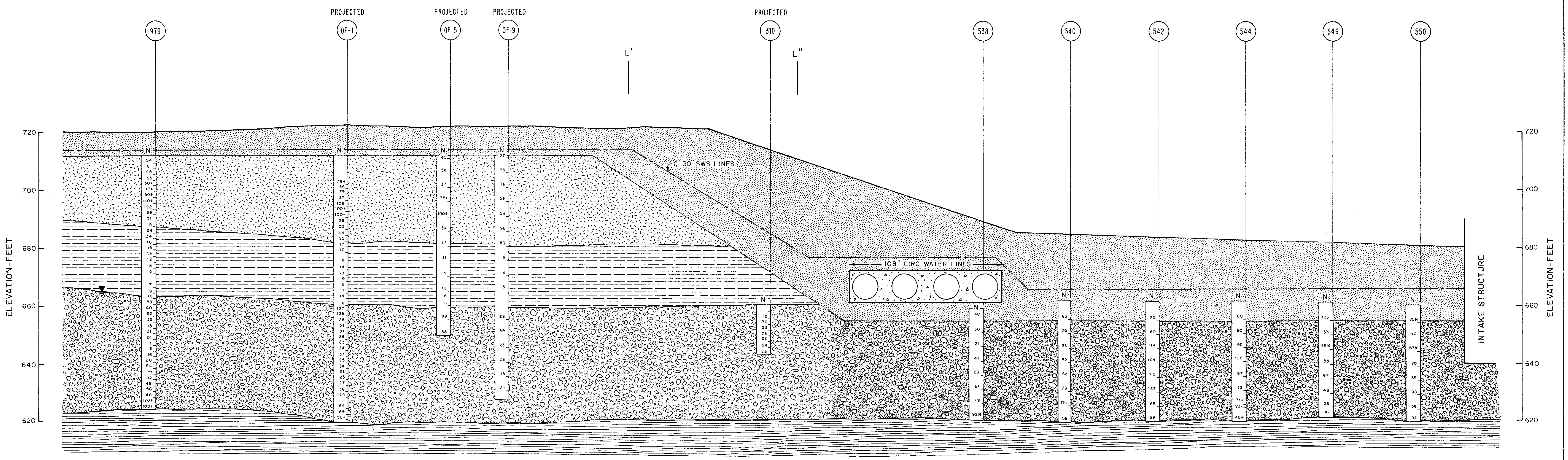
- GRAVELLY SAND - SANDY GRAVEL SOME SILTY SAND - SAND
- APPROXIMATE LIMITS OF DENSIFIED ZONE
- SELECT GRANULAR BACKFILL
- SILTY CLAY - SOME SILTY SAND, SANDY CLAY
- BEDROCK
- NORMAL GROUNDWATER LEVEL

NOTES

1. LOCATION OF SECTION IS SHOWN ON FIGURE 2.5.4-10.
2. N-STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.).

0 20 40
SCALE - FEET

FIGURE 2.5.4-53
SUBSURFACE PROFILE K-K"
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

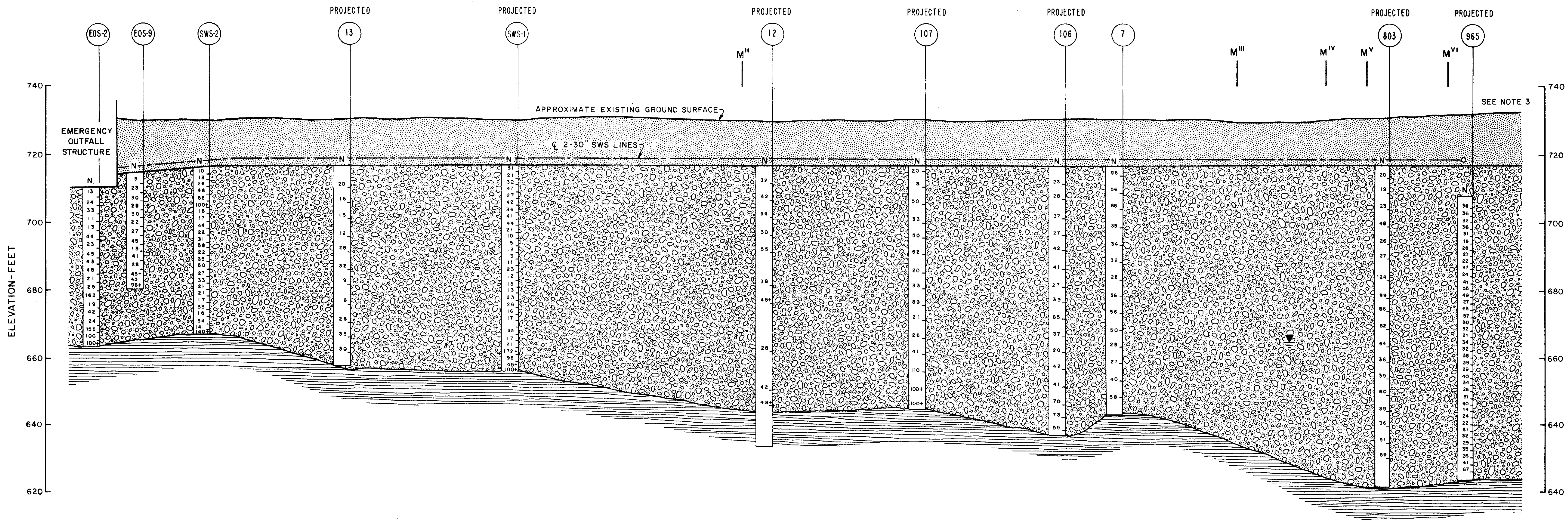
- GRAVELLY SAND-SANDY GRAVEL SOME SILTY SAND - SAND
- APPROXIMATE LIMITS OF DENSIFIED ZONE
- SELECT GRANULAR BACKFILL
- SILTY CLAY-SOME SILTY SAND, SANDY CLAY
- UNCONTROLLED FILL-SILTY CLAY-GRAVELLY CLAY, SANDY CLAY, CLAYEY SAND
- BEDROCK
- NORMAL GROUNDWATER LEVEL

NOTES

1. LOCATION OF SECTION IS SHOWN ON FIGURE 2.5.4-16.
2. N-STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.).
3. ✱ - INDICATES USE OF 300LB. HAMMER.
4. CIRCULATING WATER LINES IN CONCRETE ENCASEMENT AT THIS LOCATION ONLY.

0 20 40
SCALE-FEET

FIGURE 2.5.4-54
SUBSURFACE PROFILE L-L'''
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

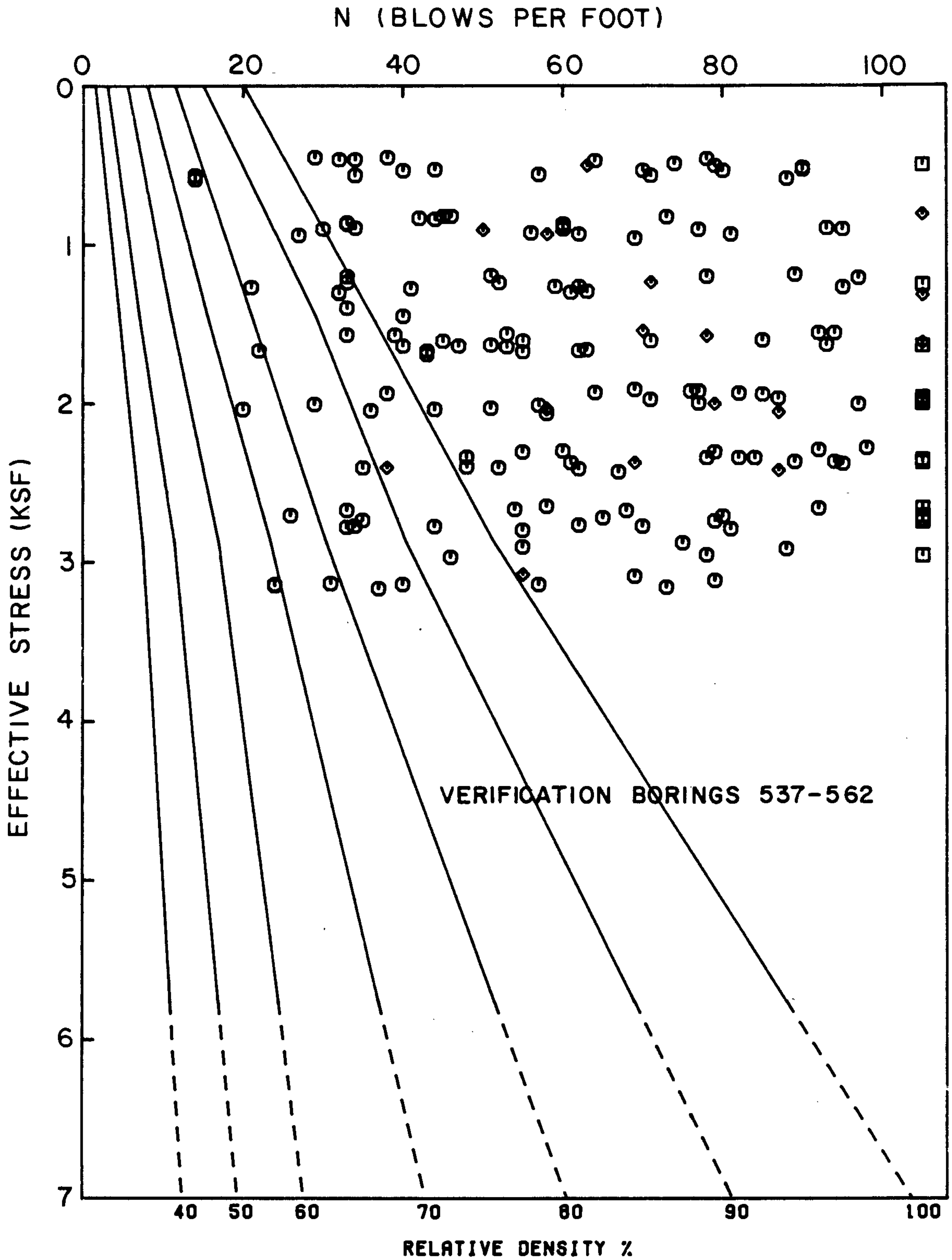
- GRAVELLY SAND-SANDY GRAVEL SOME SILTY SAND-SAND
- SELECT GRANULAR BACKFILL
- BEDROCK
- NORMAL GROUNDWATER LEVEL

NOTES

1. LOCATION OF SECTION IS SHOWN ON FIGURE 2.5.4-13
2. N-STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT)
3. FOR A CONTINUATION OF PROFILE ALONG SWS PIPELINES, SEE SECTION I-I, FIGURE 2.5.4-51.

0 100 200
HORIZONTAL SCALE-FEET

FIGURE 2.5.4-55
SUBSURFACE PROFILE M-M^{VII}
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

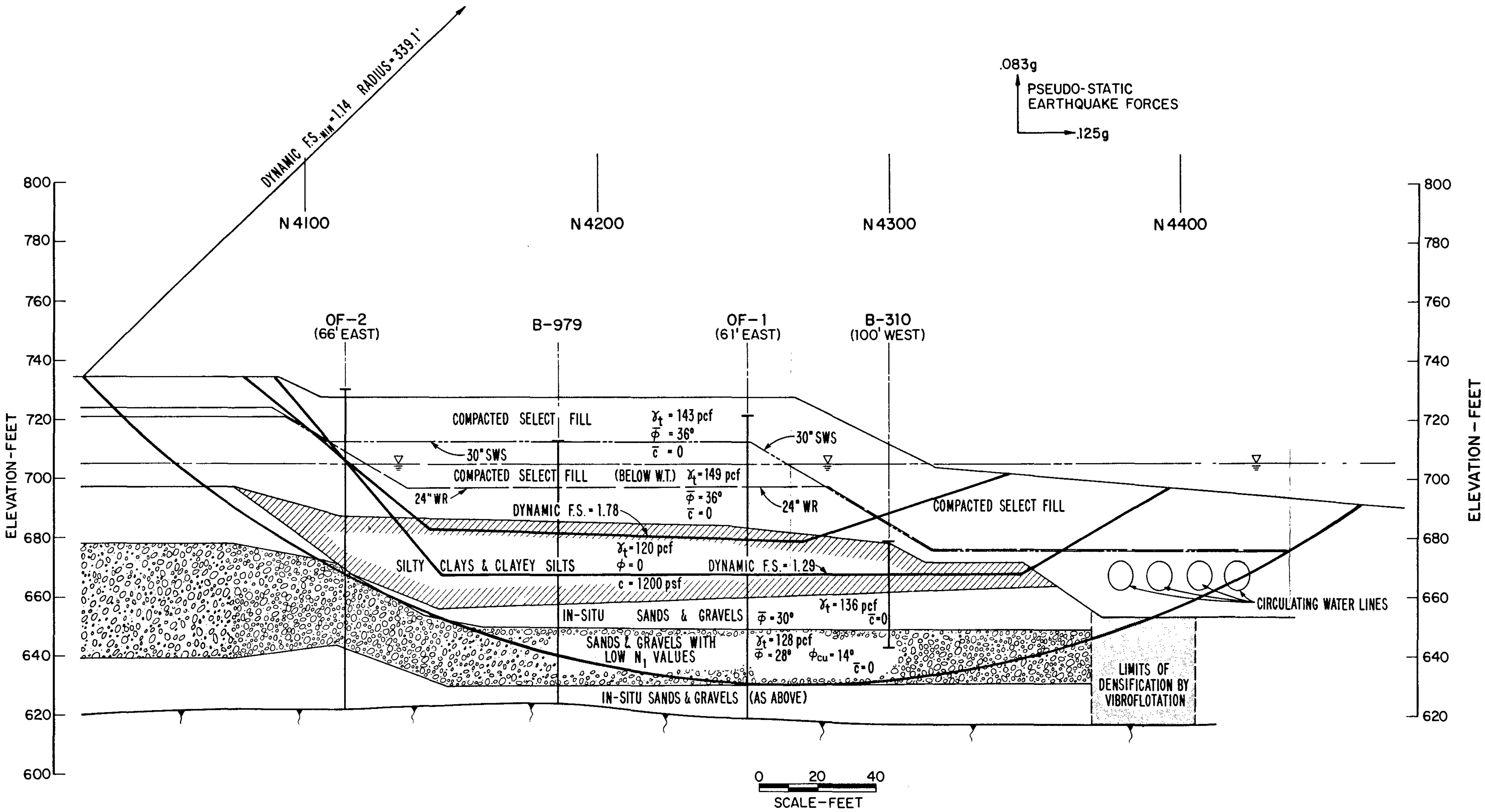


LEGEND:

- SAND
- SAND/N>100
- OTHER

NOTE: FOR LOCATION OF BORINGS REFER TO FIG. 2.5.4-13

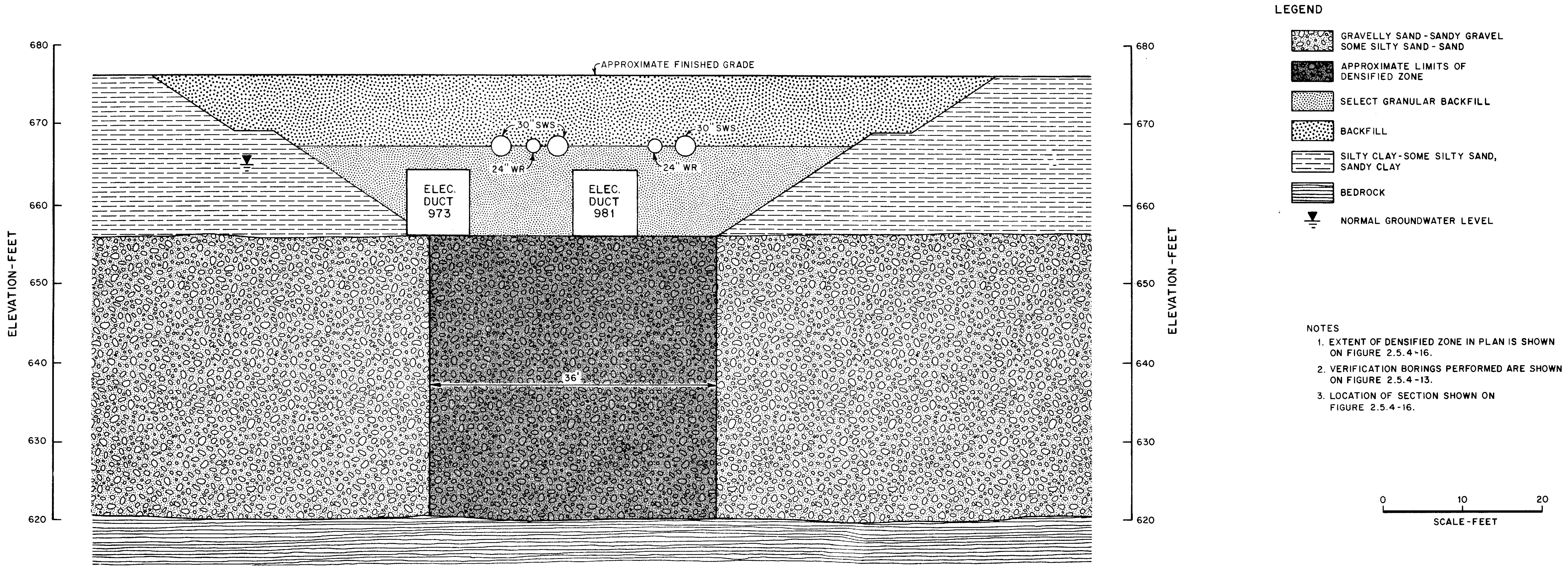
FIGURE 2.5.4-56
SUMMARY PLOT
VIBROFLOTATION-RIVER WATER
INTAKE PIPELINE TRENCH
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES

1. VIBROFLOTATION HAS ALSO BEEN PERFORMED NORTH OF THE CIRCULATING WATER LINES UNDER THE SWS LINES 50 FT WEST OF THIS SECTION.
2. THE CIRCULATING WATER LINES ARE ENCASED BENEATH THE SWS AND WR LINES.
3. THE PRESENCE OF THE CIRCULATING WATER LINES HAS BEEN IGNORED IN THESE ANALYSES.
4. FOR LOCATION OF SECTION REFER TO FIGURE 2.5.4-16

FIGURE 2.5.4-57
SLOPE STABILITY SECTION A-A
RIVERWARD SLOPE ANALYSIS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



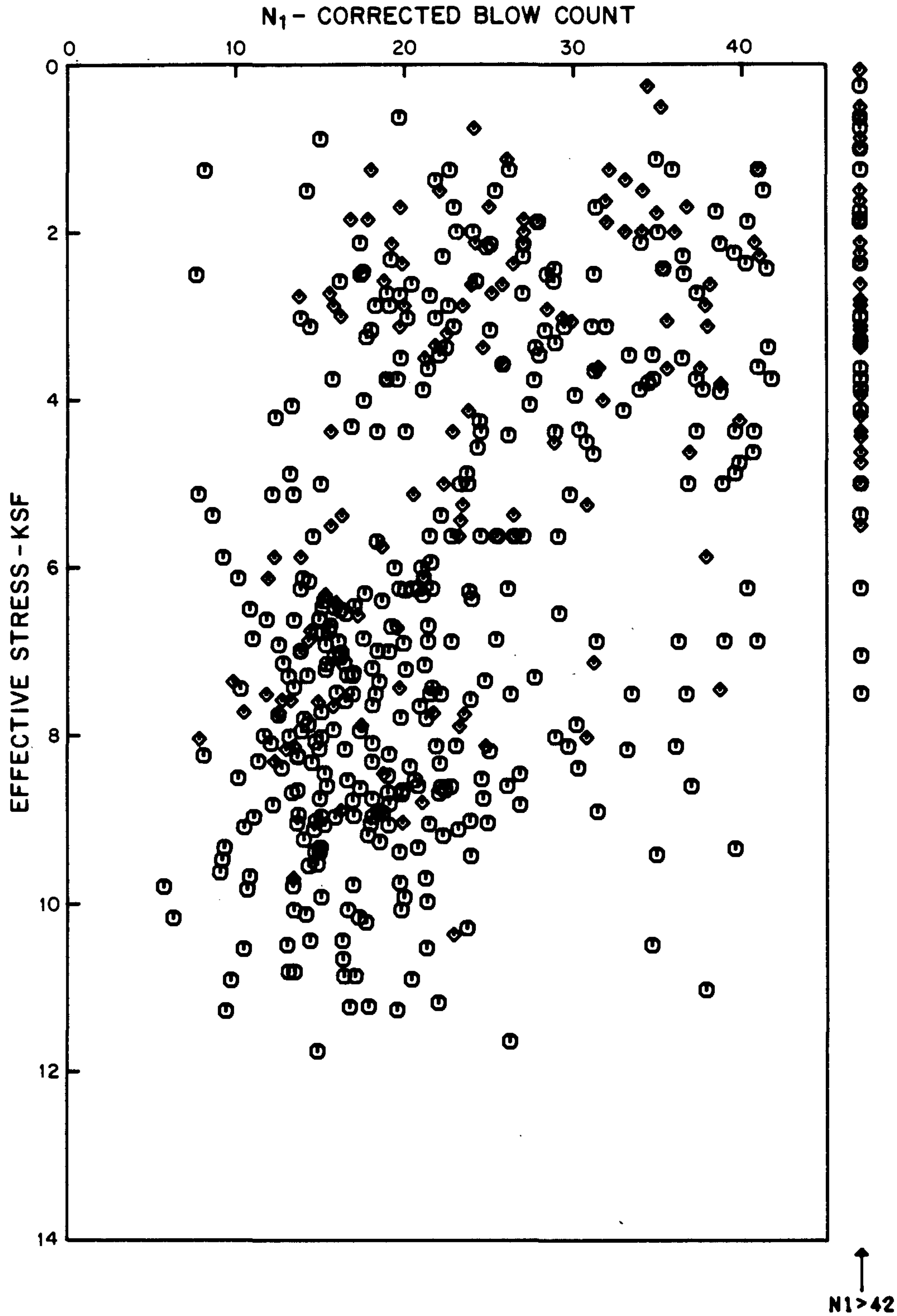
NOTES

1. EXTENT OF DENSIFIED ZONE IN PLAN IS SHOWN ON FIGURE 2.5.4-16.
2. VERIFICATION BORINGS PERFORMED ARE SHOWN ON FIGURE 2.5.4-13.
3. LOCATION OF SECTION SHOWN ON FIGURE 2.5.4-16.

FIGURE 2.5.4-58

TYPICAL SECTION-VIBROFLOTATION DENSIFICATION FOR SERVICE WATER SYSTEM PIPELINES

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND

O SAND

◇ OTHER

NOTES

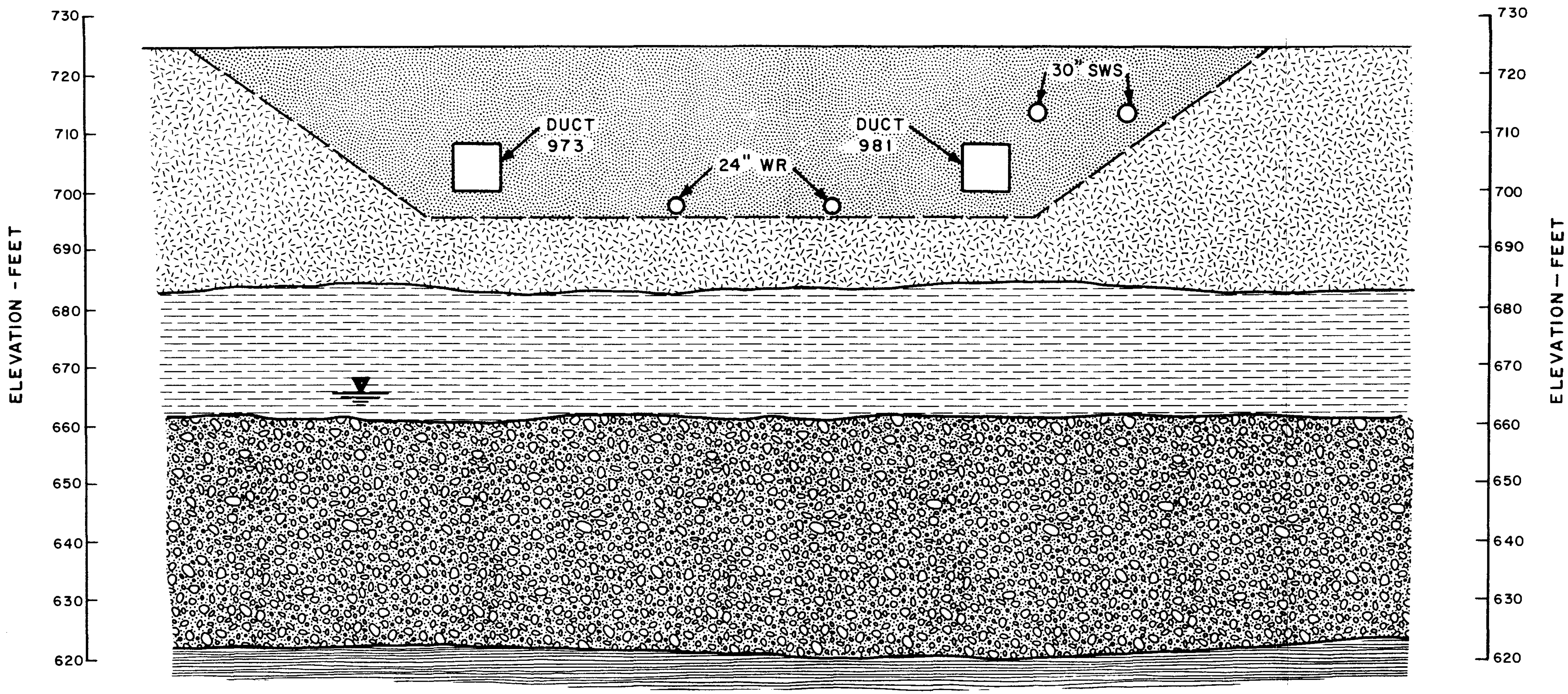
1. BASED ON GIBBS AND HOLTZ. (1957)
2. BASED ON BORINGS 803, 806, 807, 810, 811, 813, 816, 935-942, 949, 1019, 1020, 1022-1025.
3. BORING LOCATIONS ARE SHOWN ON FIGURE 2.5.4-10.

FIGURE 2.5.4-59

BORINGS OUTSIDE DENSIFIED ZONE-MAIN PLANT AREA N_1 VERSUS EFFECTIVE STRESS

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT



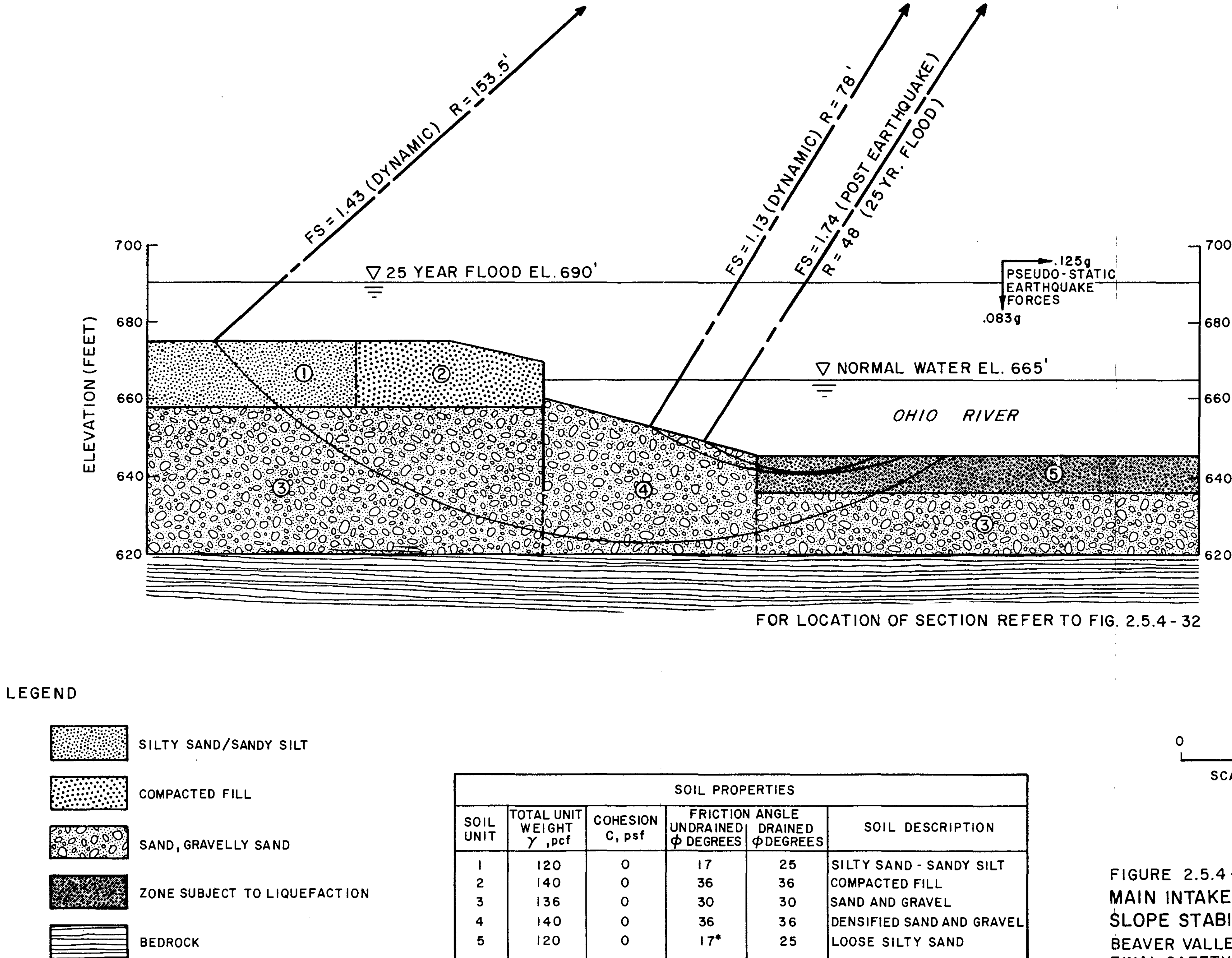
LEGEND:

- GRAVELLY SAND-SANDY GRAVEL SOME SILTY SAND - SAND
- SELECT GRANULAR BACKFILL
- SILTY CLAY-SOME SILTY SAND, SANDY CLAY
- UNCONTROLLED FILL-SILTY CLAY-GRAVELLY CLAY, SANDY CLAY, CLAYEY SAND
- BEDROCK
- NORMAL GROUNDWATER LEVEL

NOTE
LOCATION OF SECTION IS SHOWN ON FIGURE 2.5.4-16

0 20 40
SCALE - FEET

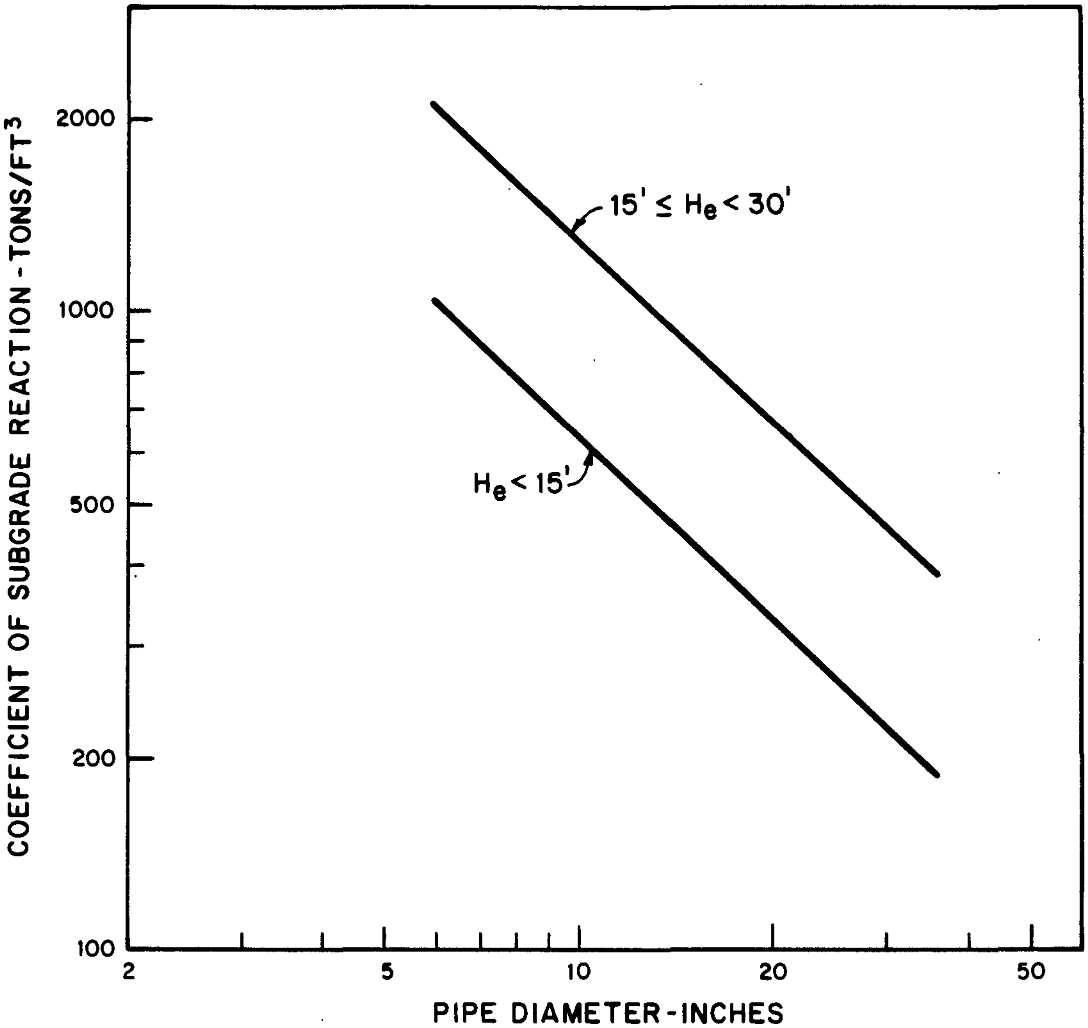
FIGURE 2.5.4-60
SUBSURFACE PROFILE N-N'
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



SOIL PROPERTIES					
SOIL UNIT	TOTAL UNIT WEIGHT γ, pcf	COHESION C, psf	FRICTION ANGLE UNDRAINED ϕ DEGREES	FRICTION ANGLE DRAINED ϕ DEGREES	SOIL DESCRIPTION
1	120	0	17	25	SILTY SAND - SANDY SILT
2	140	0	36	36	COMPACTED FILL
3	136	0	30	30	SAND AND GRAVEL
4	140	0	36	36	DENSIFIED SAND AND GRAVEL
5	120	0	17*	25	LOOSE SILTY SAND

* ϕ EQUALS 0° FOR POST EARTHQUAKE CASE

FIGURE 2.5.4-61
MAIN INTAKE CHANNEL
SLOPE STABILITY SECTION 2-2
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



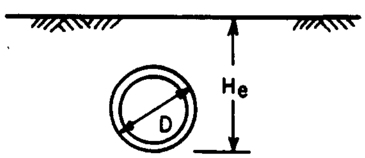


FIGURE 2.5.4-62

VERTICAL COEFFICIENT OF SUBGRADE REACTION FOR BURIED PIPE

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

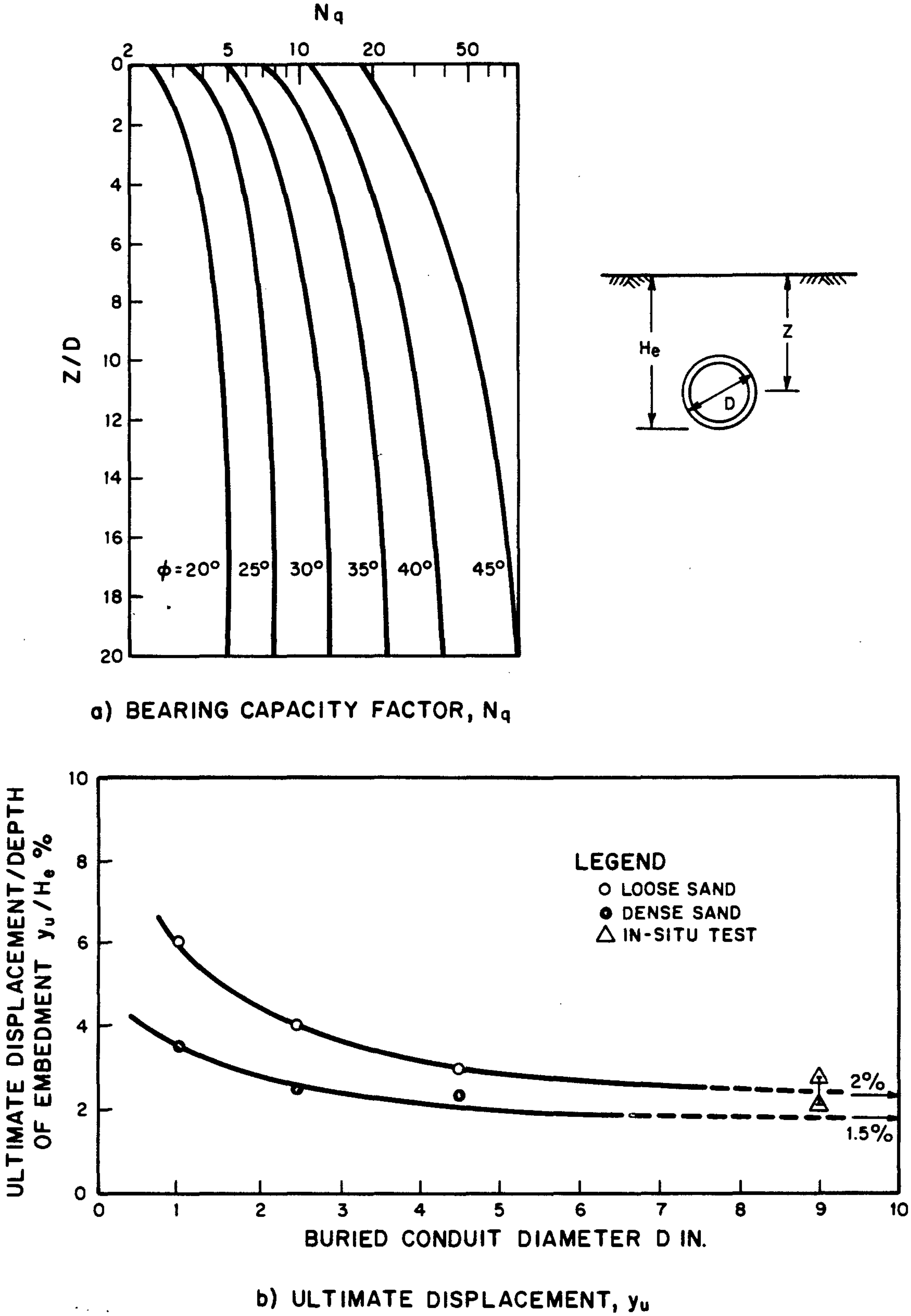


FIGURE 2.5.4-63
HORIZONTAL BEARING CAPACITY FACTOR AND ULTIMATE DISPLACEMENT FOR BURIED PIPE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

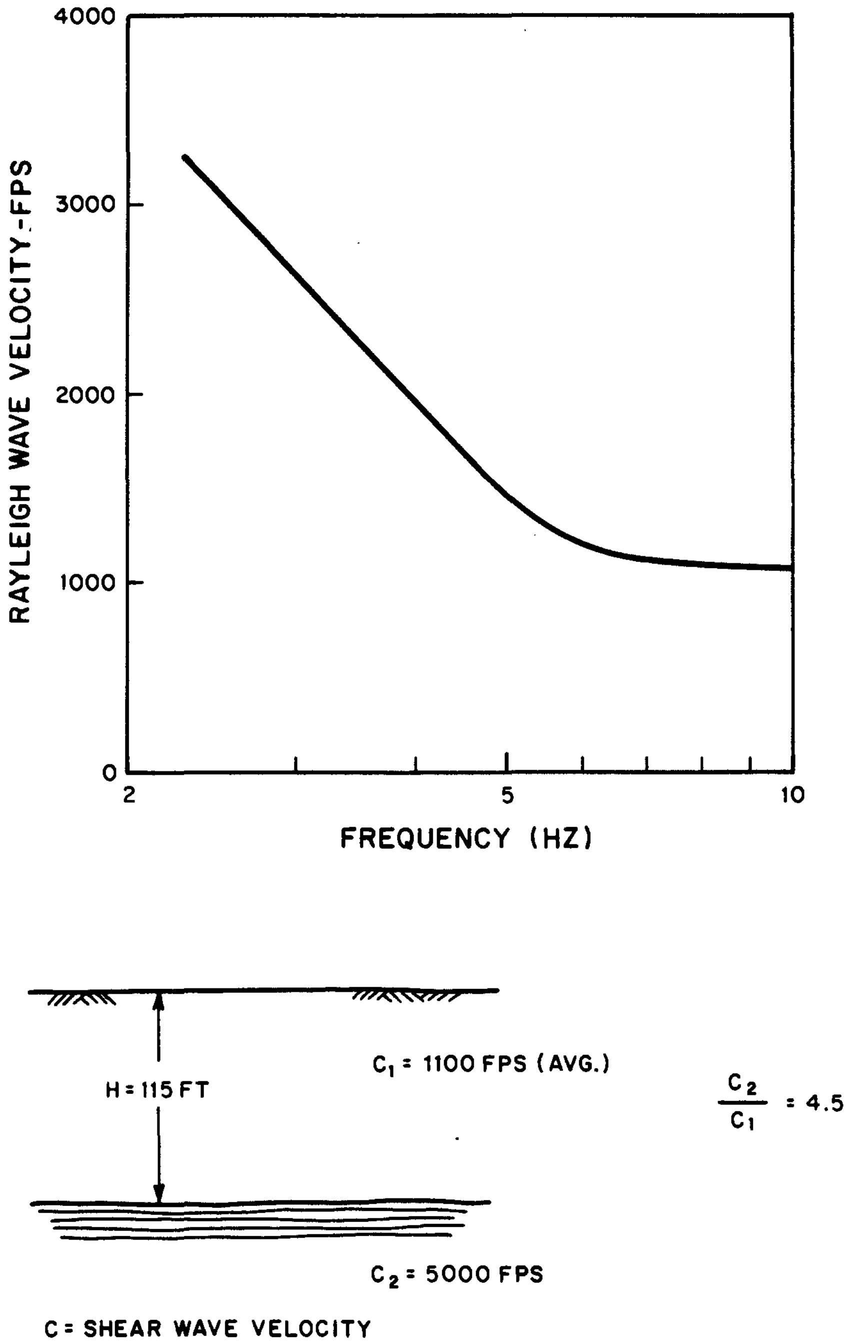
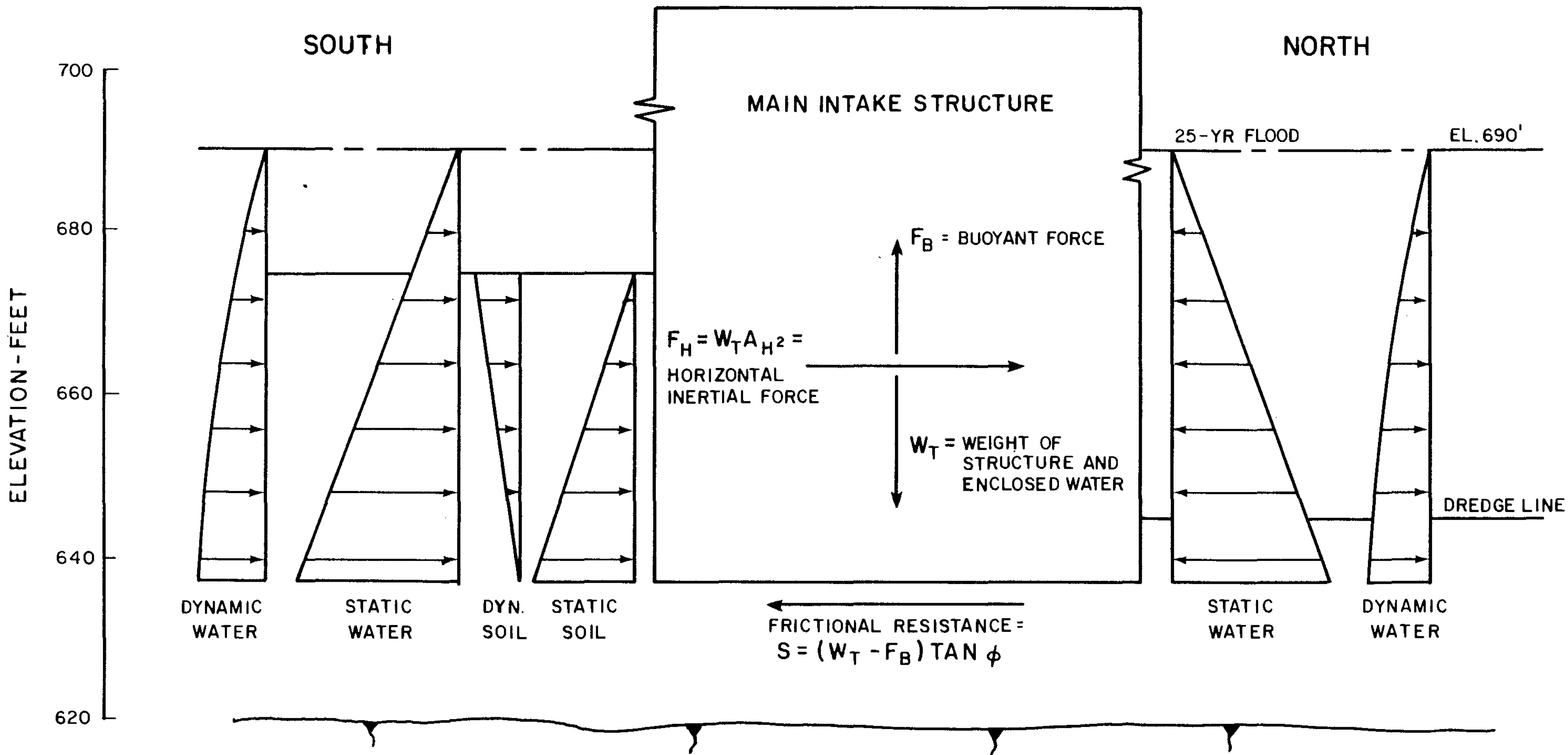


FIGURE 2.5.4-64
RAYLEIGH WAVE VELOCITY
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



$$FS_{SLIDING} = \frac{S}{F_H + \Sigma \text{ LATERAL SOIL FORCES} + \Sigma \text{ LATERAL WATER FORCES}}$$

REFERENCE:

FIGURE 2.5.4-42 FOR METHOD OF CALCULATION OF LATERAL FORCES.

FIGURE 2.5.4-65

MAIN INTAKE STRUCTURE

DYNAMIC SLIDING STABILITY

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT

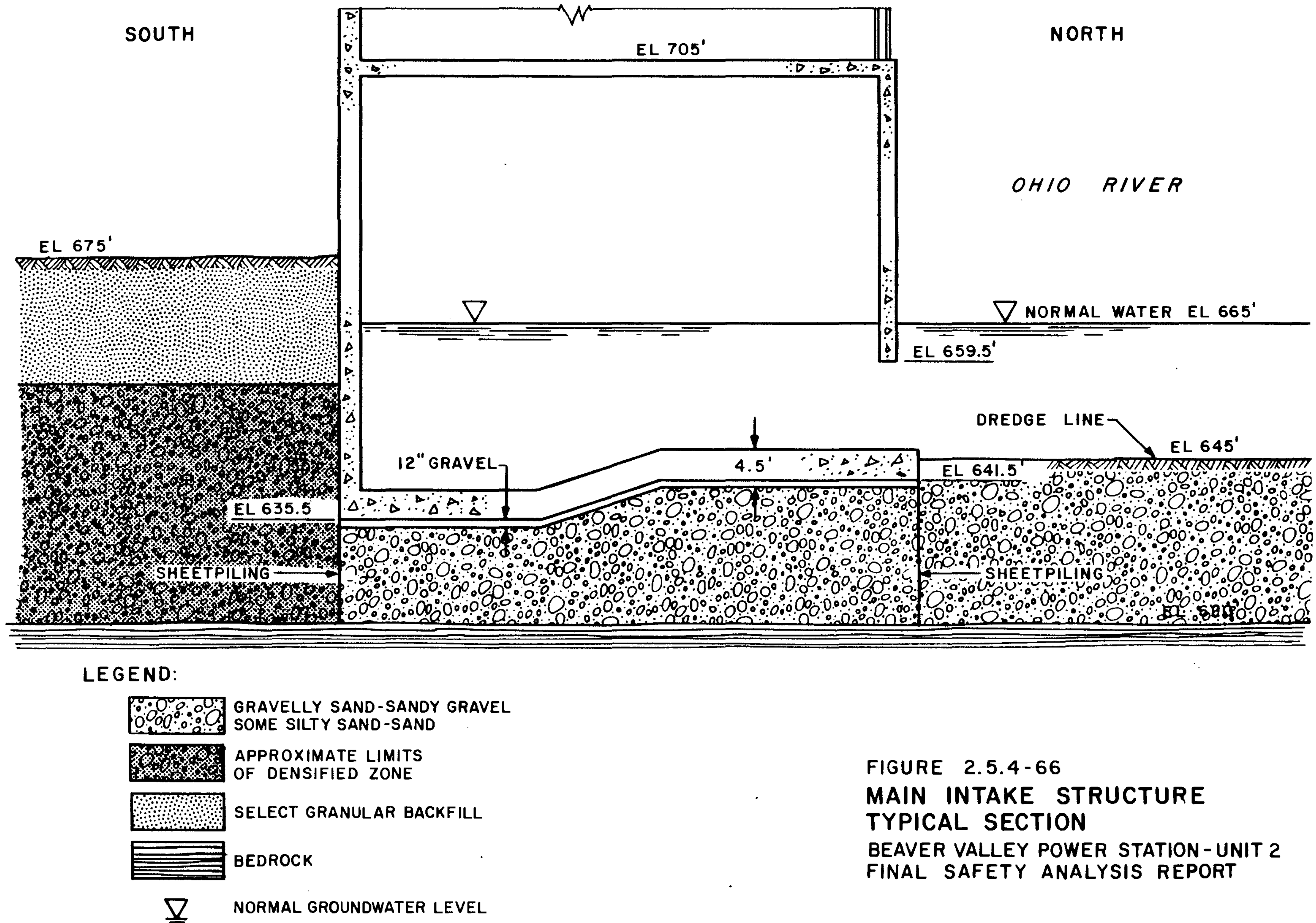
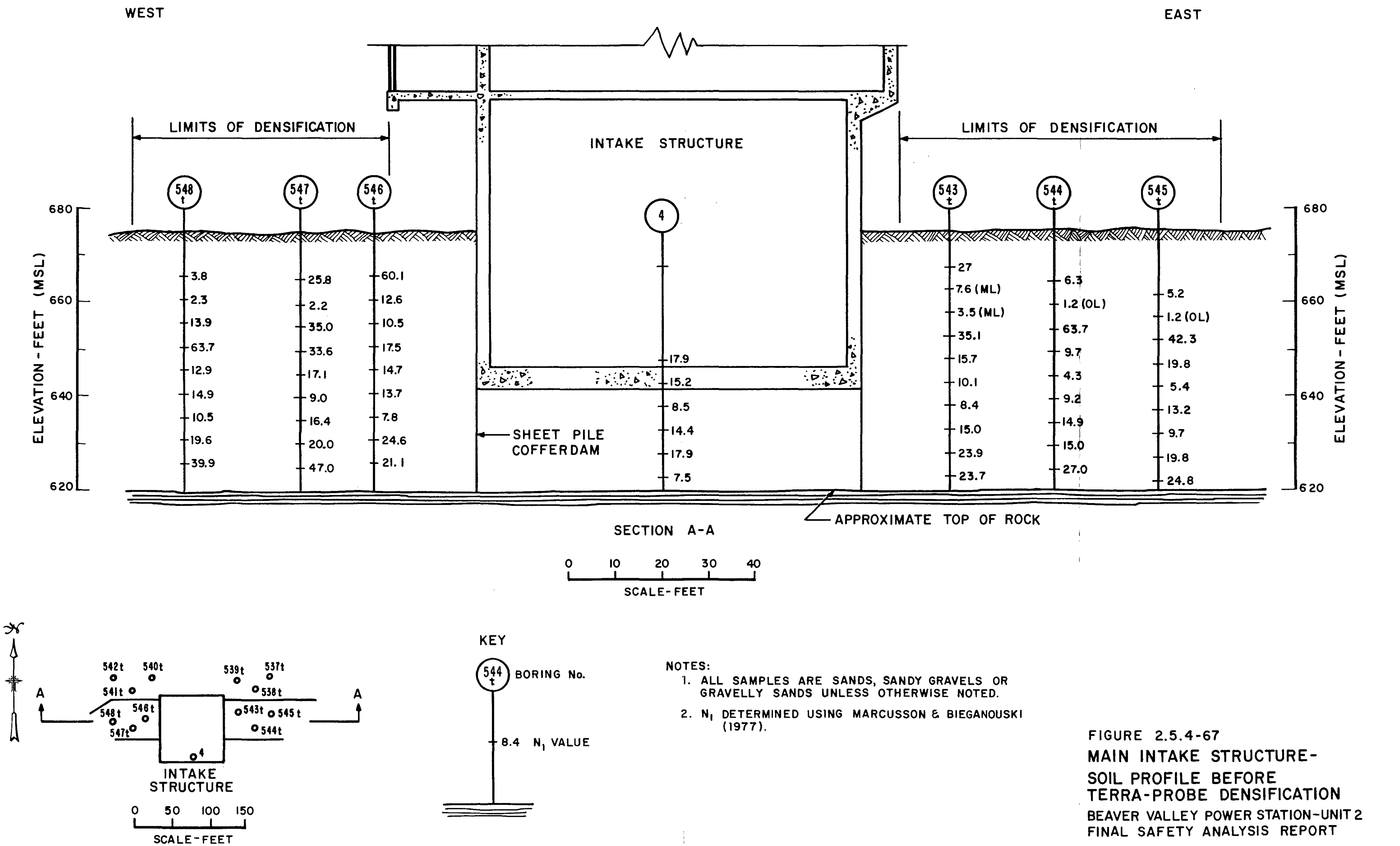


FIGURE 2.5.4-66

MAIN INTAKE STRUCTURE TYPICAL SECTION

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



NOTES:
1. ALL SAMPLES ARE SANDS, SANDY GRAVELS OR GRAVELLY SANDS UNLESS OTHERWISE NOTED.
2. N_1 DETERMINED USING MARCUSSON & BIEGANOUSKI (1977).

FIGURE 2.5.4-67
MAIN INTAKE STRUCTURE-
SOIL PROFILE BEFORE
TERRA-PROBE DENSIFICATION

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

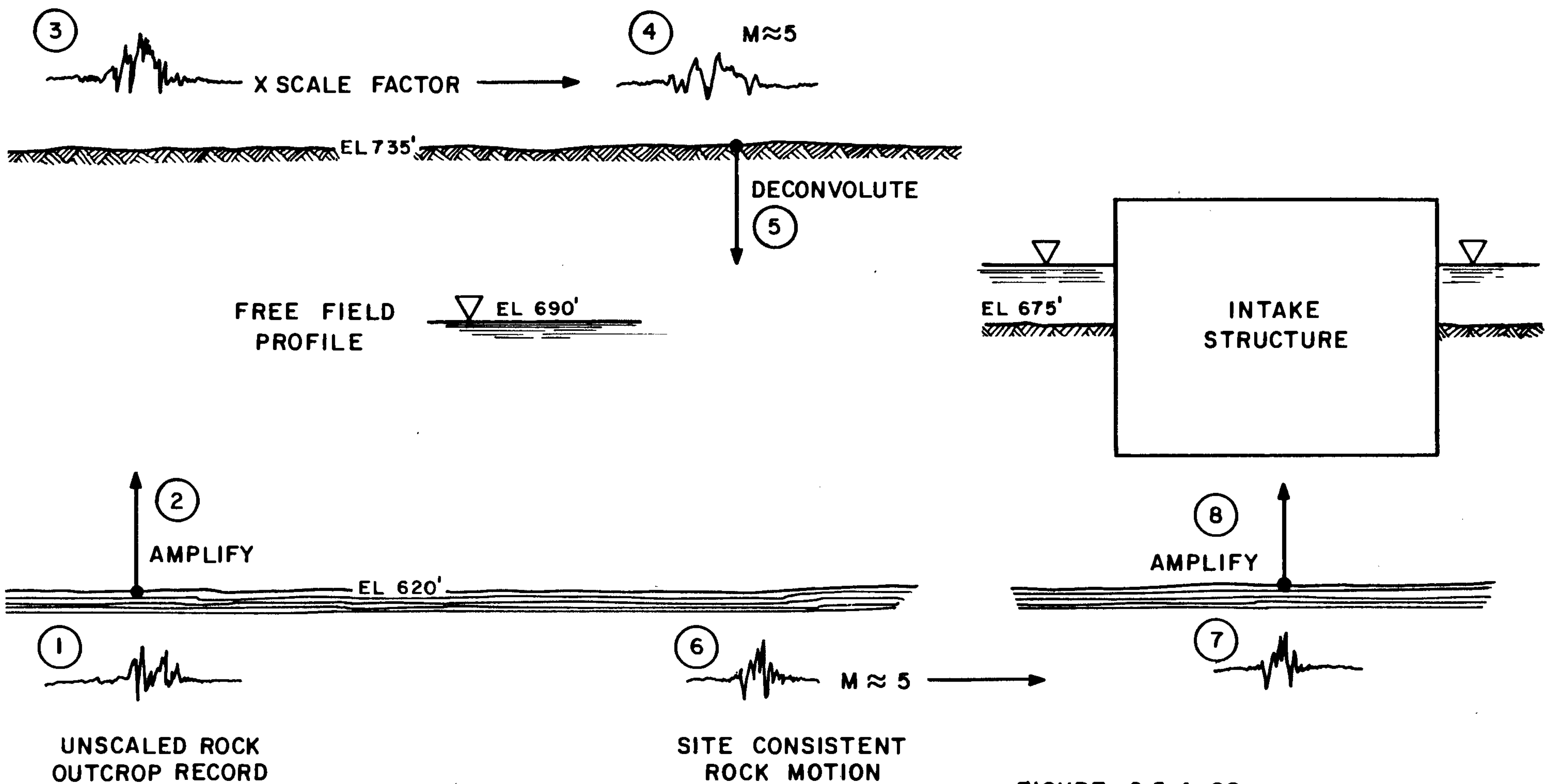


FIGURE 2.5.4-68
LIQUEFACTION ANALYSIS
MAIN INTAKE STRUCTURE
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

LAYER No.	LAYER THICKNESS (FT)	UNIT* WEIGHT (PCF)	SHEAR WAVE VELOCITY ** (FT./SEC)
1	10	125	600
2	10	125	800
3	10	125	950
4	10	125	950
5	5	125	1100
6	5	136	1100
7	10	136	1100
8	10	136	1100
9	7.5	136	1200
10	7.5	136	1200
11	10	136	1200
12	10	136	1200
13	10	136	1200
14	HALF SPACE	160	5000

ELEVATION - FEET: 735, 725, 715, 705, 695, 685, 675, 665, 657.5, 650, 640, 630, 620

DEPTH - FEET: 0, 10, 20, 30, 40, 50, 60, 70, 77.5, 85, 95, 105, 115

SAND & GRAVEL

ROCK

NOTES

* UNIT WEIGHT FROM BVPS-2 FSAR SECTION 2.5.4

** SHEAR WAVE VELOCITY FROM FIGURE 6-2 (SWEC 1984)
IN SITU: NATURAL FREQUENCY = 2.3 Hz

FIGURE 2.5.4-69

SOIL MODEL-FREE FIELD

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

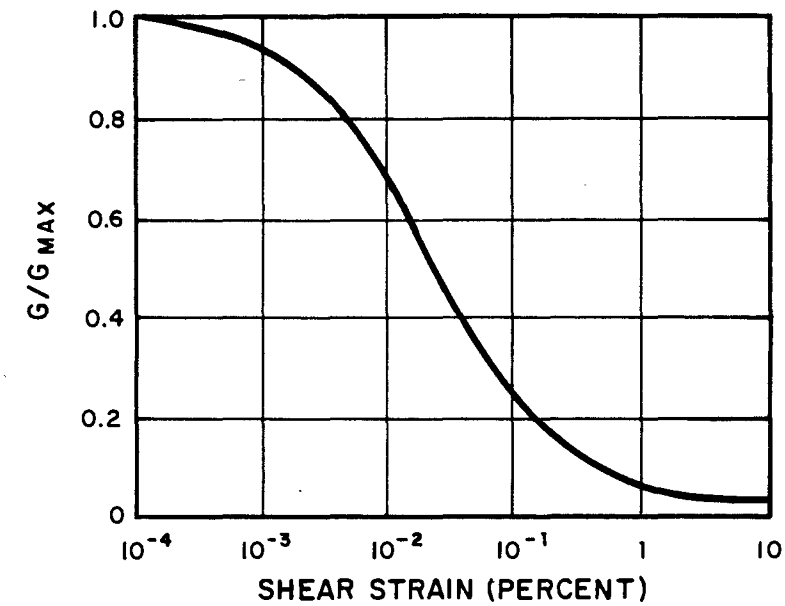
LAYER No.	N_1	LAYER THICKNESS (FT)	UNIT WEIGHT (PCF)	SHEAR WAVE VELOCITY (FT/SEC)
1	—	16.75	181	670
2	—	16.75	181	670
3	7	6.5	136	675
4	18	8	136	879
5	18	7	136	915
6	—	HALF SPACE	160	5000

ELEVATION - FEET	DEPTH - FEET	
675	0	PSEUDO-SOIL
658.25	16.75	
641.5	33.5	SAND & GRAVEL
635	40	
627	48	
620	55	ROCK

FIGURE 2.5.4-70

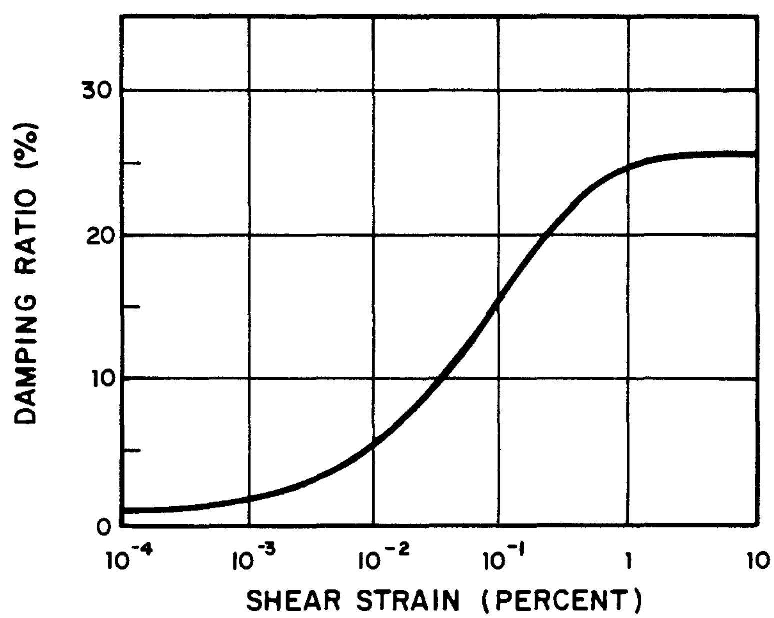
SOIL MODEL - INTAKE STRUCTURE

BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



G = SHEAR MODULUS AT SHEAR STRAIN γ
G_{MAX} = SHEAR STRAIN AT $\gamma = 10^{-4}$ PERCENT

a. VARIATION OF SHEAR MODULUS OF SAND WITH STRAIN



b. VARIATION OF DAMPING RATIO OF SAND WITH STRAIN

FIGURE 2.5.4-71
STRAIN DEPENDENT SOIL PARAMETERS
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

2.5.5 Slope Stability

Both static and dynamic stability analyses of the riverward slope involving the service water pipelines leading to the intake structure were performed and are described in DLC (1976). The factors of safety were found to be acceptable.

The dynamic stability analysis of this slope was supplemented using more conservative seismic coefficients as indicated below. Additional failure surfaces through the silty clay layer in the soil profile were also considered. The results are presented in Figure 2.5.4-57 and were acceptable. (Refer to Figure 2.5.4-16 for location of section.)

Two methods of analysis were employed: the Simplified Bishop method and the Morgenstern-Price method. The Simplied Bishop method assumes a circular arc failure surface while the Morgenstern-Price method allows for an arbitrary shaped failure mass, which, in this case, was assumed to be a sliding wedge with straight line failure surfaces. The stability analyses were performed using the computer program LEASE II (SWEC 1980). LEASE II uses a pseudo-static approach to dynamic stability analysis in which a constant force is applied to each slice and is computed as the weight of the slice multiplied by a seismic coefficient. The horizontal seismic coefficient was taken as 0.125, corresponding to the ground surface acceleration for the SSE; the vertical seismic coefficient was taken as 0.083. This analysis was considered conservative since the applied pseudo-static force was constant and no consideration was given to the variation of acceleration with time, direction, or with depth in the soil profile.

The analysis of the intake channel slopes is discussed in Section 2.5.4.8.

The analysis of the stability of the slopes in the vicinity of the emergency outfall structure is fully described in Appendix 2.5E.

2.5.5.1 Reference for Section 2.5.5

Duquesne Light Company 1976. Report on the Soil Densification Program. Beaver Valley Power Station - Unit 2. Prepared by SWEC, Boston, Mass.

Stone & Webster Engineering Corporation (SWEC) 1980. Slope Stability Analysis (LEASE II), GT-108.

2.5.6 Embankments and Dams

Seismic Category I embankments and dams are not utilized at Beaver Valley Power Station - Unit 2.

APPENDIX 2.5A

OHIO RIVER ELEVATIONS

AND

PIEZOMETER DATA

BEAVER VALLEY POWER STATION

APPENDIX 2.5A-1

LIST OF FIGURES

Tables for Appendix 2.5A

TABLE 2.5A-1

PIEZOMETER INSTALLATION DATA

Piezometer No.	Ground Surface Elevation (ft)	Tip Elevation (ft)	a (ft)	b (ft)
P-1	730.9	646.4	85.5	68.0
P-2	729.6	646.9	83.7	68.7
P-3	728.2	645.2	84.0	70.0
P-4	731.7	651.2	81.5	67.5
P-6	705.8	647.1	59.7	44.2
P-7	733.0	650.0	84.0	71.0

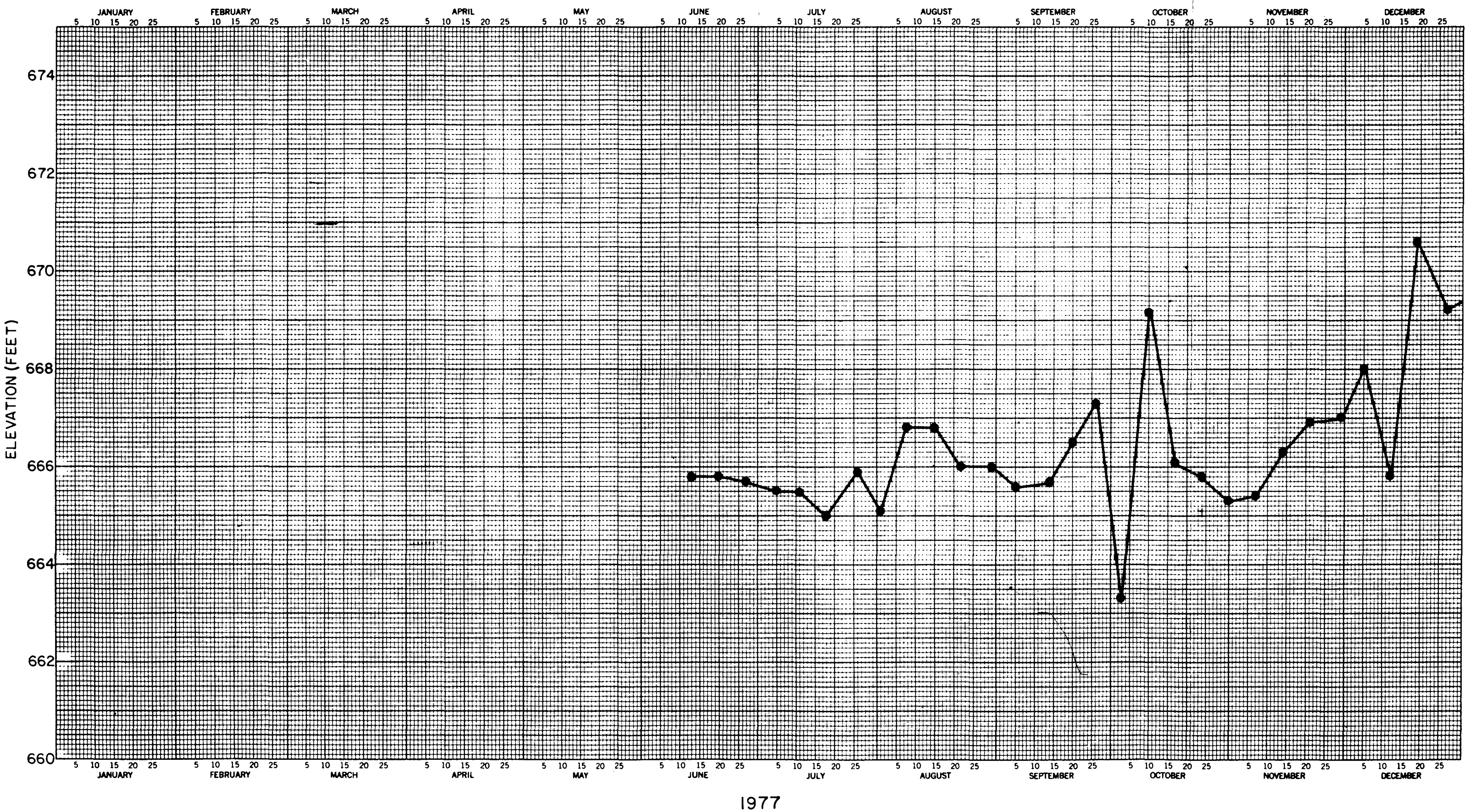


FIGURE 2.5A-1
OHIO RIVER ELEVATION, 1977
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

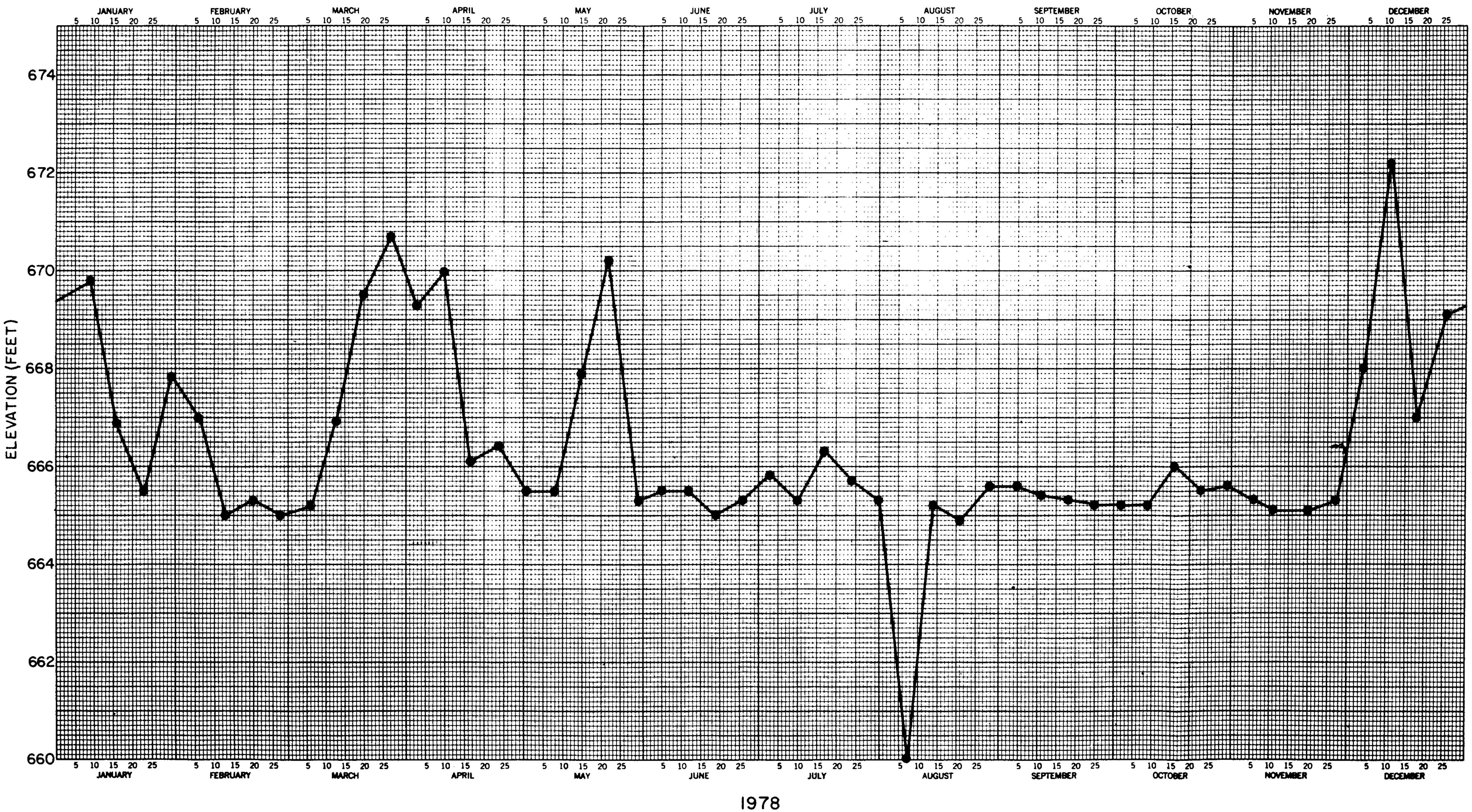


FIGURE 2.5A-2
OHIO RIVER ELEVATION, 1978
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

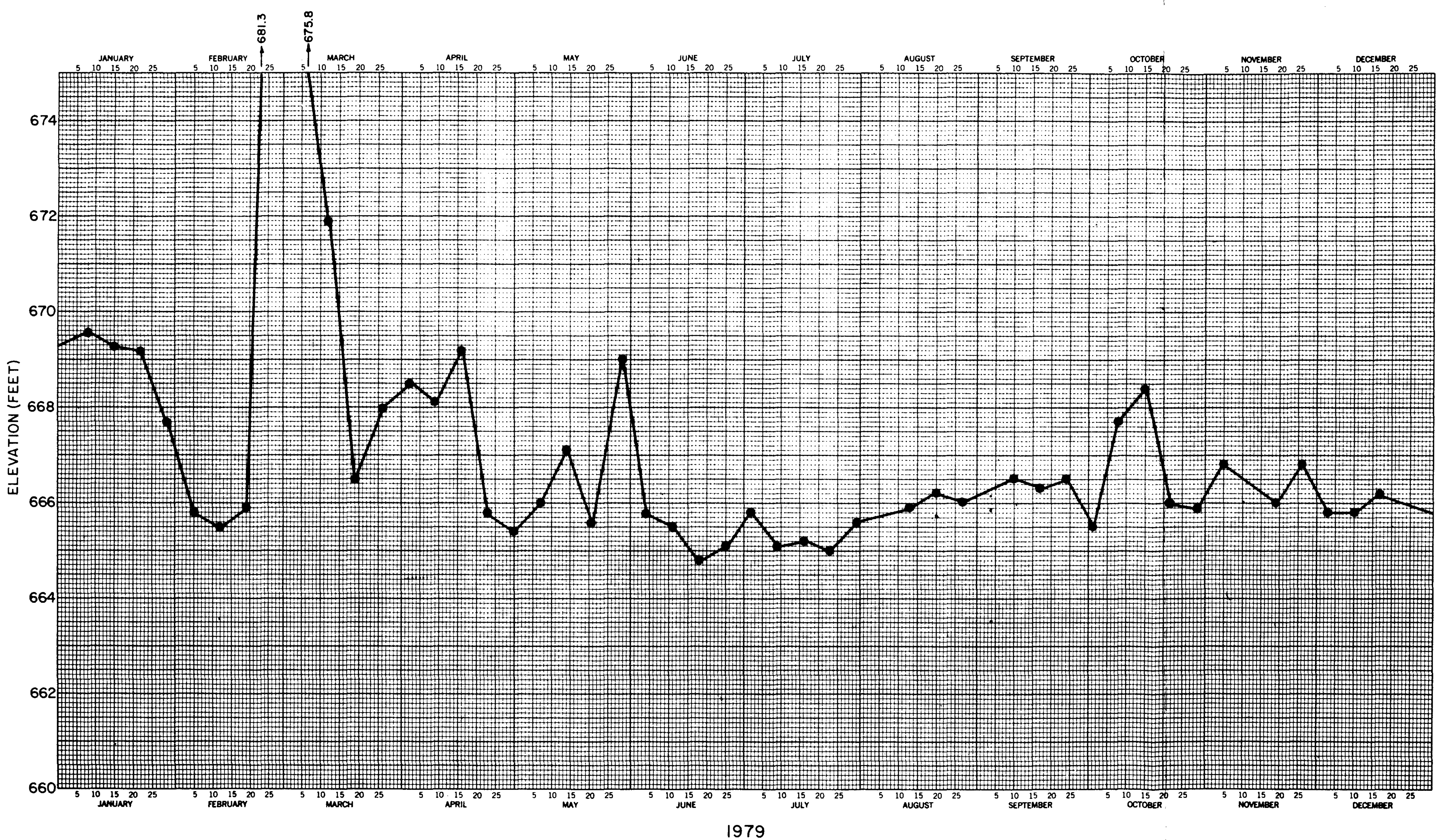


FIGURE 2.5A-3
OHIO RIVER ELEVATION, 1979
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

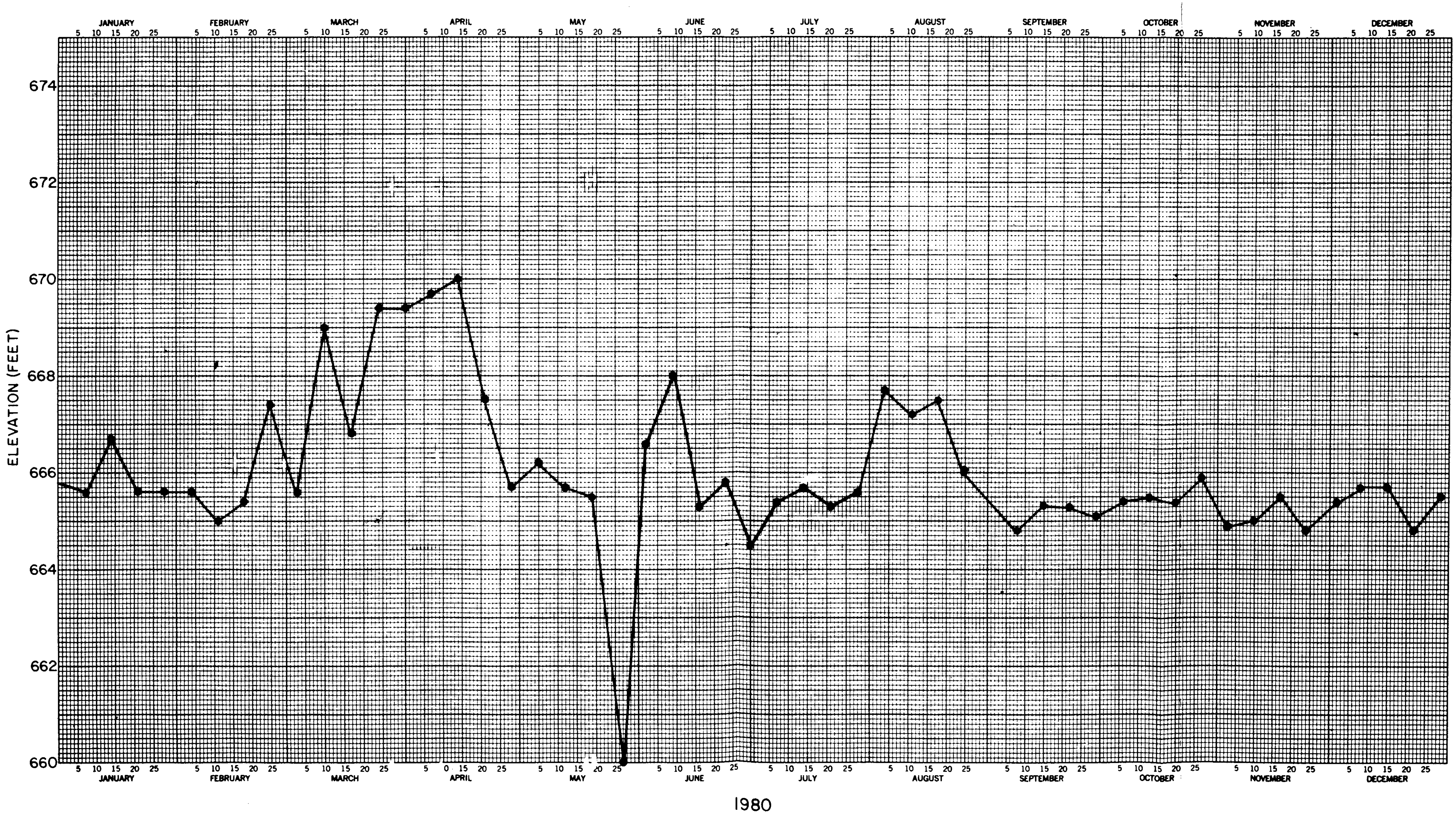


FIGURE 2.5A-4
OHIO RIVER ELEVATION, 1980
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

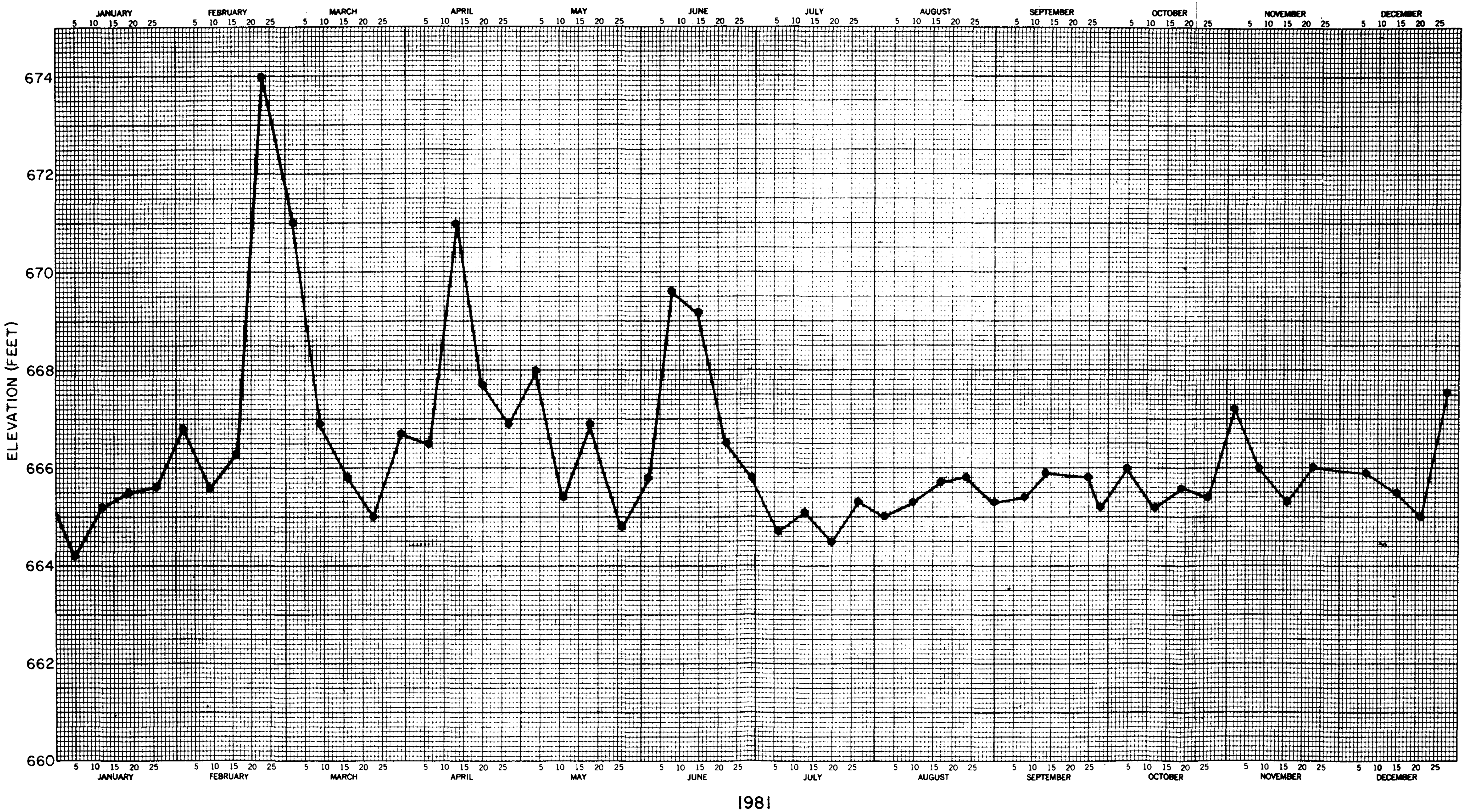


FIGURE 2.5A-5
OHIO RIVER ELEVATION, 1981
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

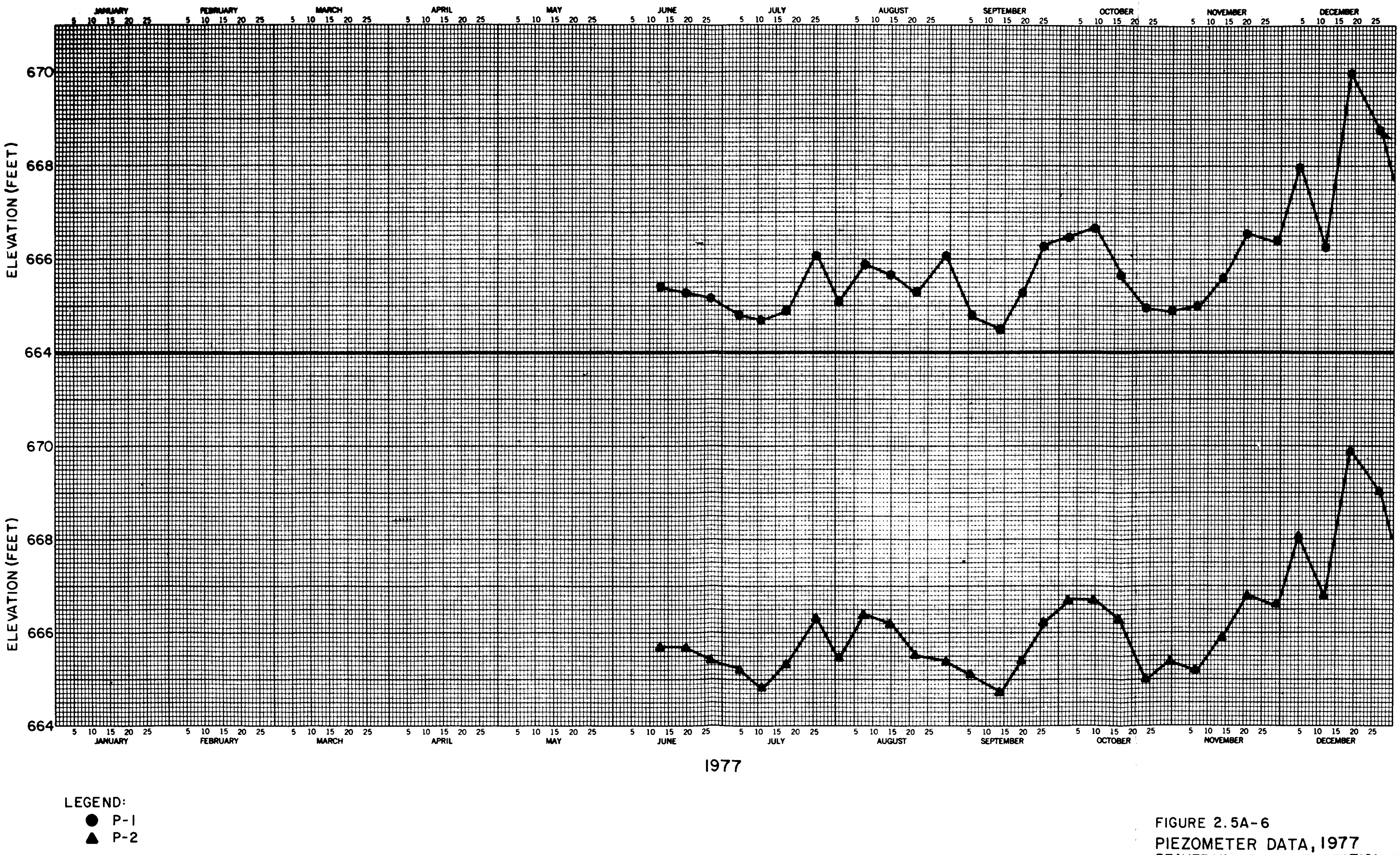


FIGURE 2.5A-6
PIEZOMETER DATA, 1977
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

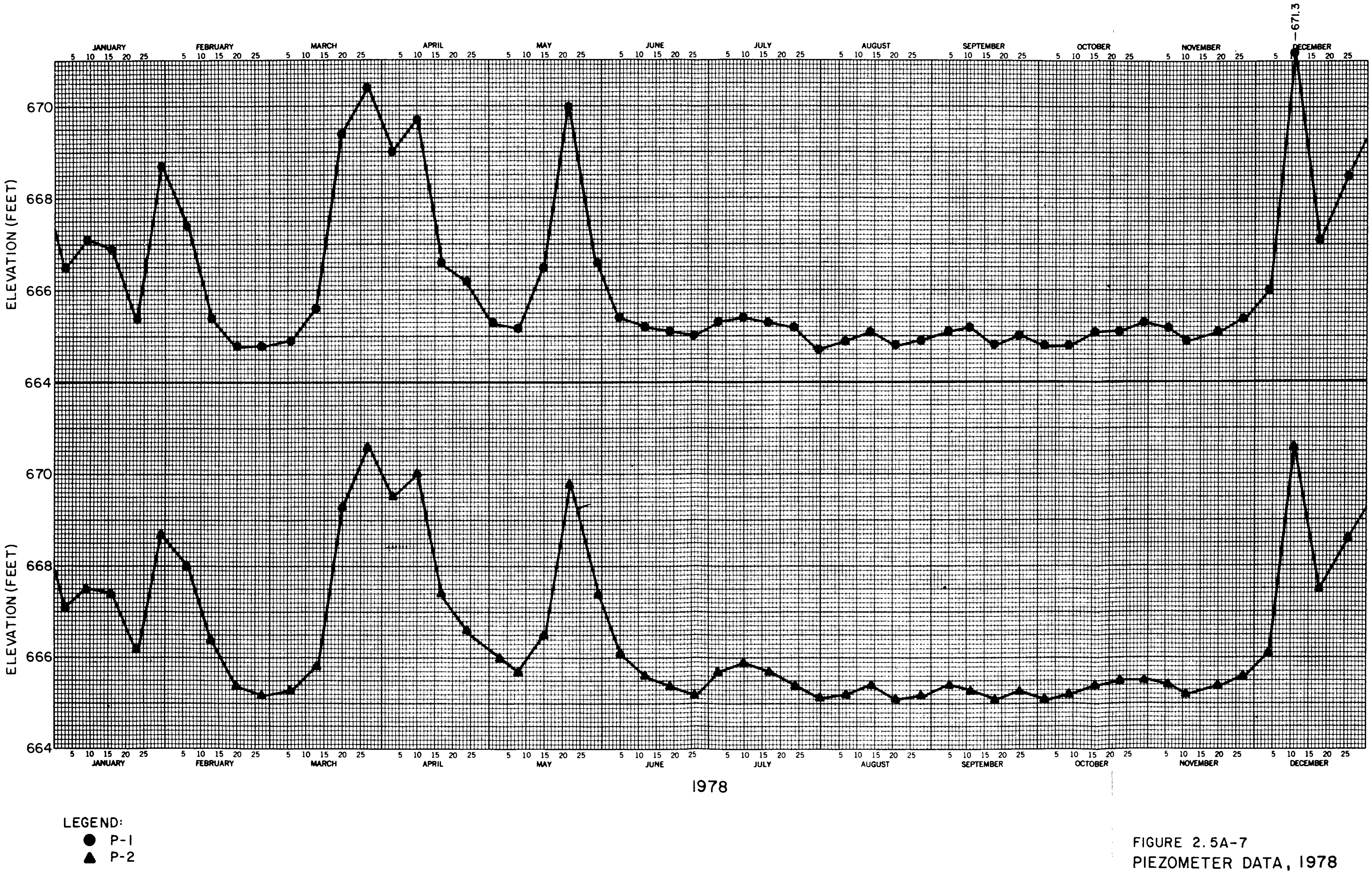


FIGURE 2.5A-7
PIEZOMETER DATA, 1978
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

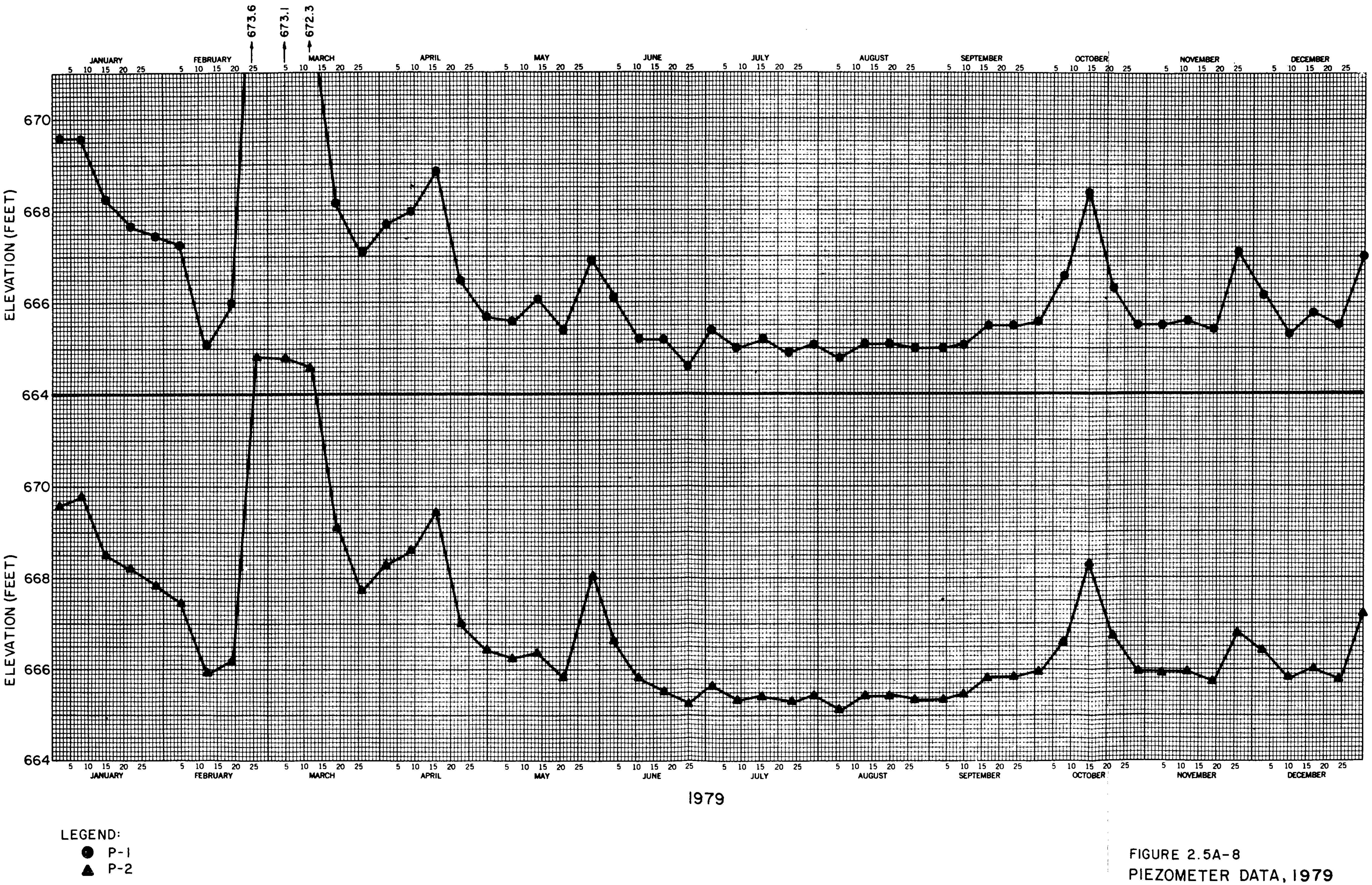


FIGURE 2.5A-8
PIEZOMETER DATA, 1979
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

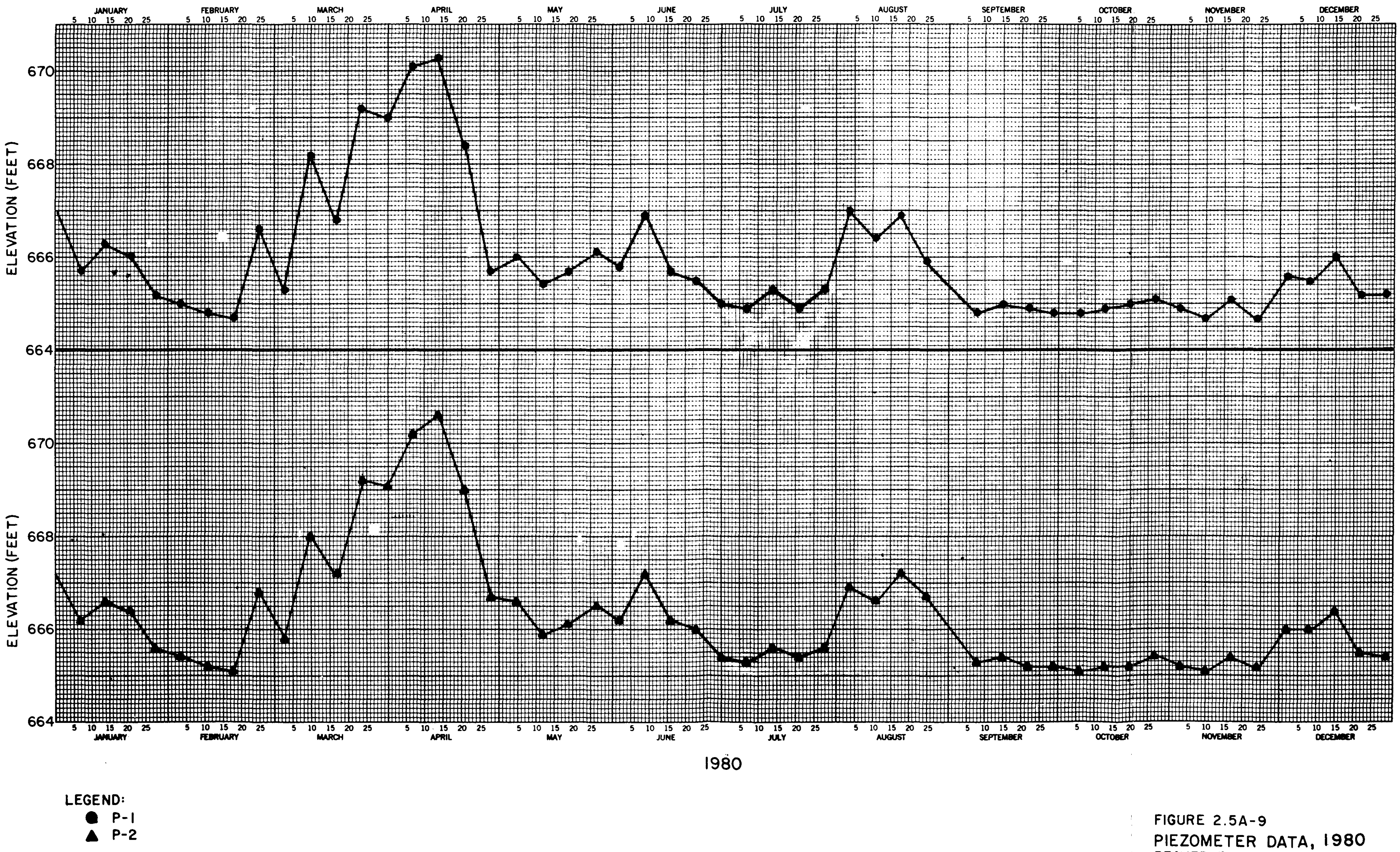
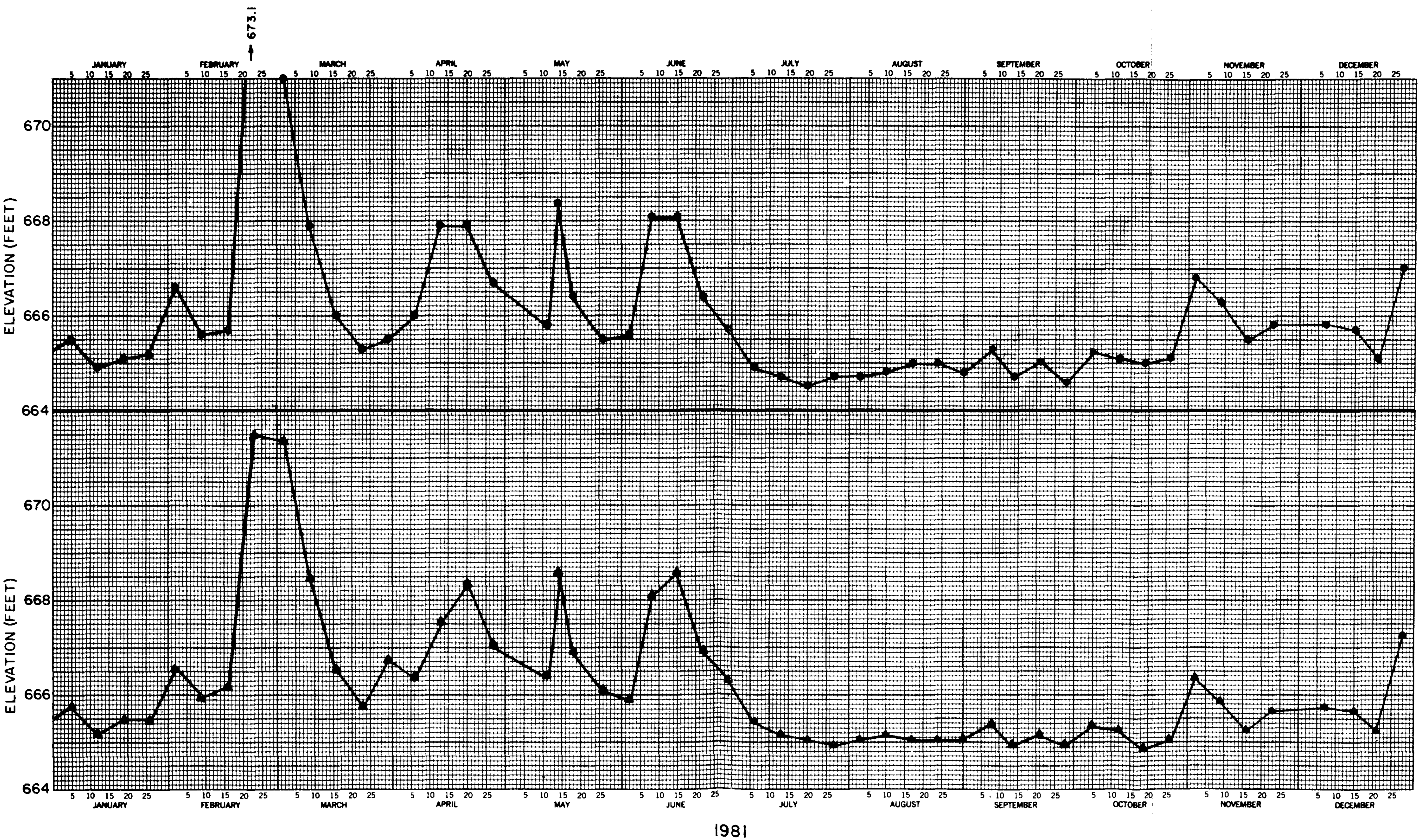


FIGURE 2.5A-9

PIEZOMETER DATA, 1980

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT



LEGEND:
● P-1
▲ P-2

FIGURE 2.5A-10
PIEZOMETER DATA, 1981
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

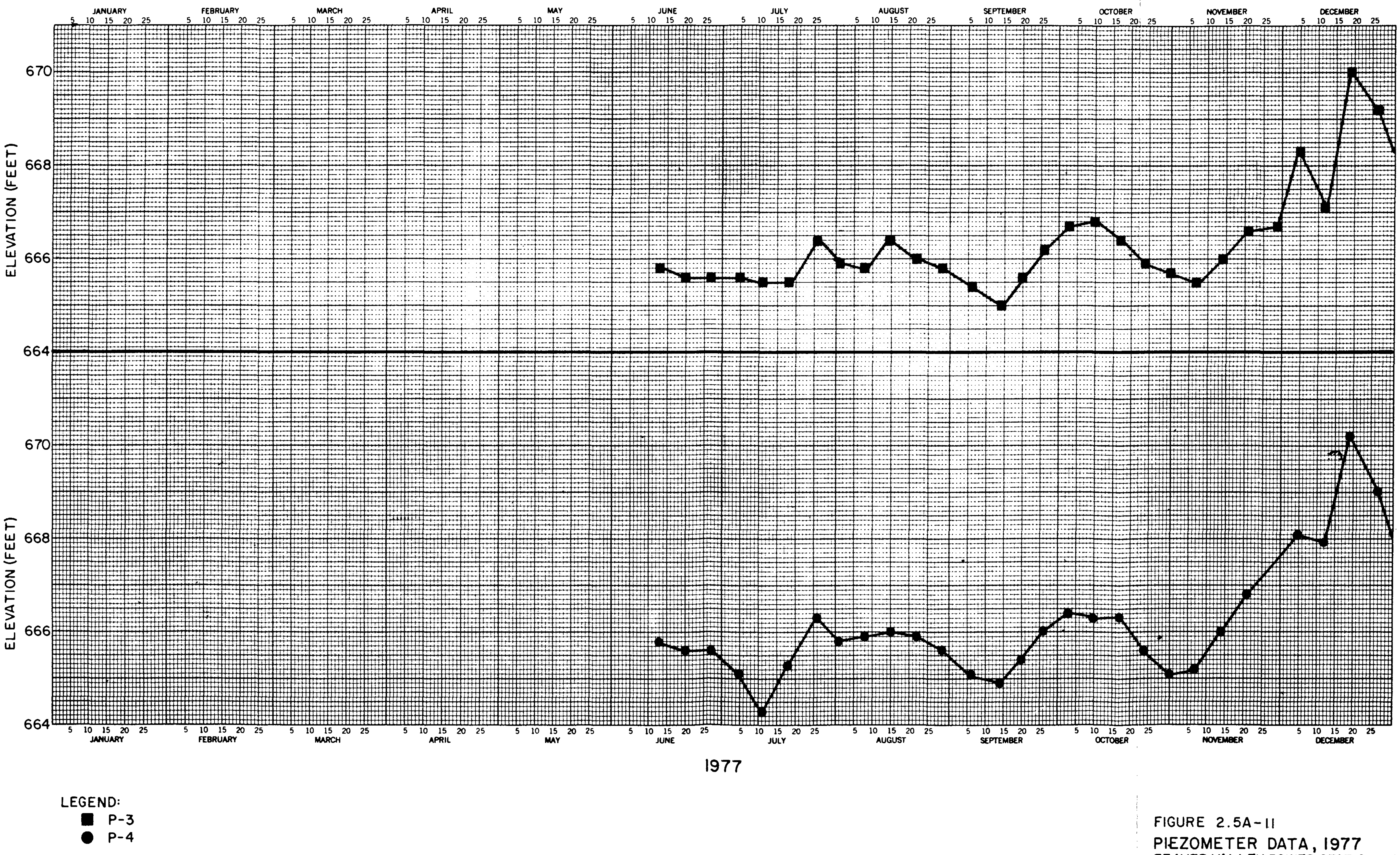


FIGURE 2.5A-11
PIEZOMETER DATA, 1977
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

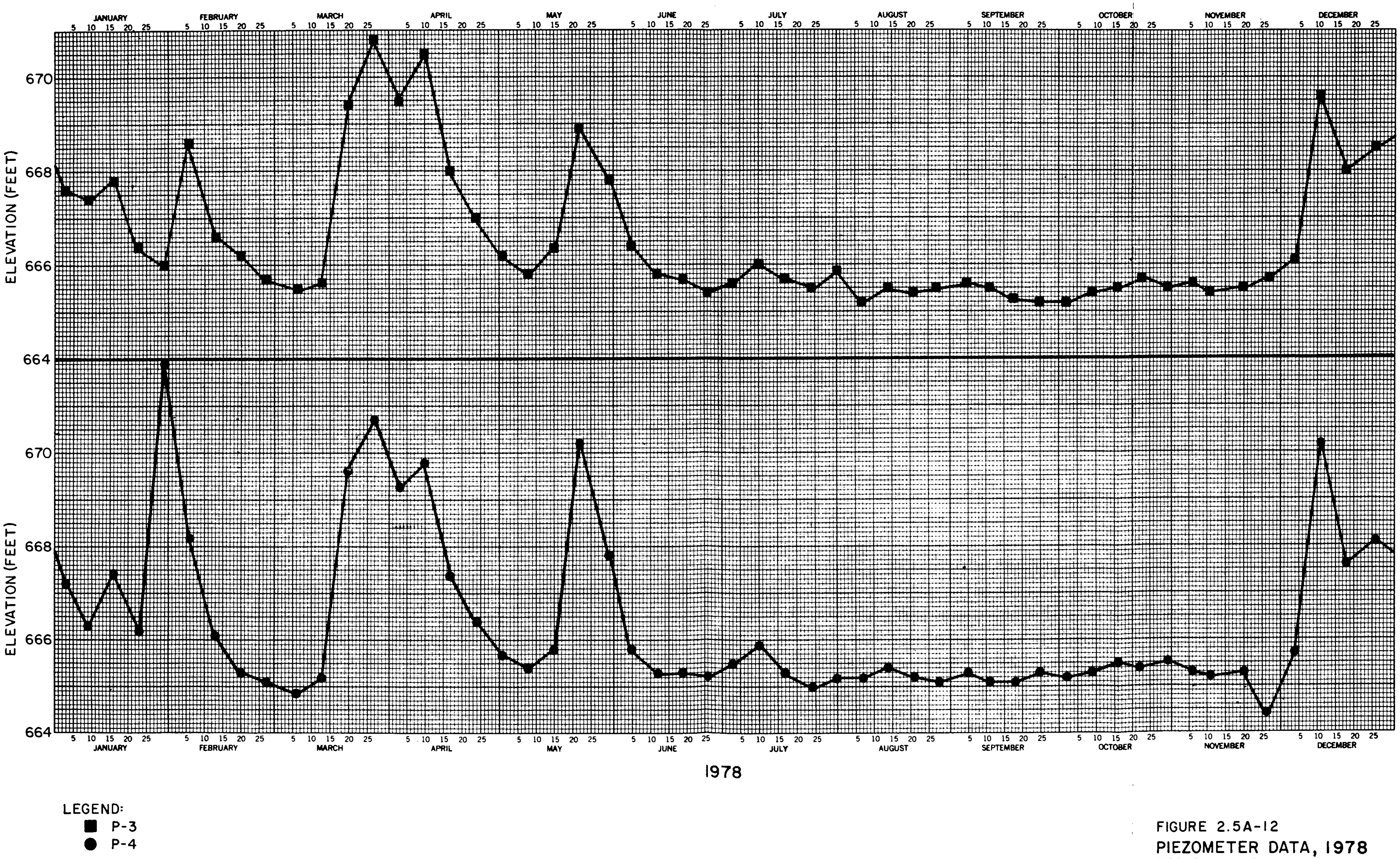


FIGURE 2.5A-12
PIEZOMETER DATA, 1978
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

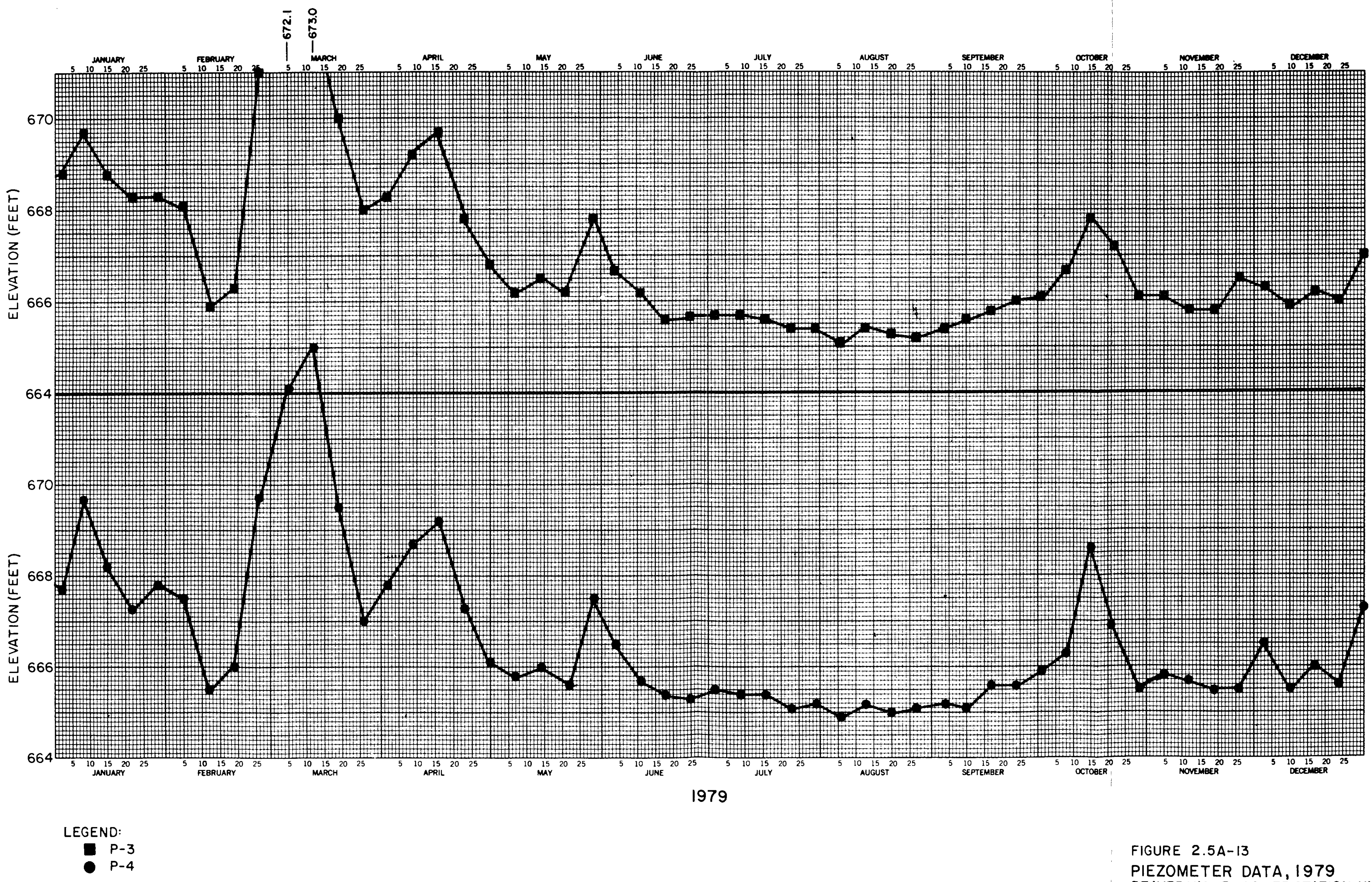
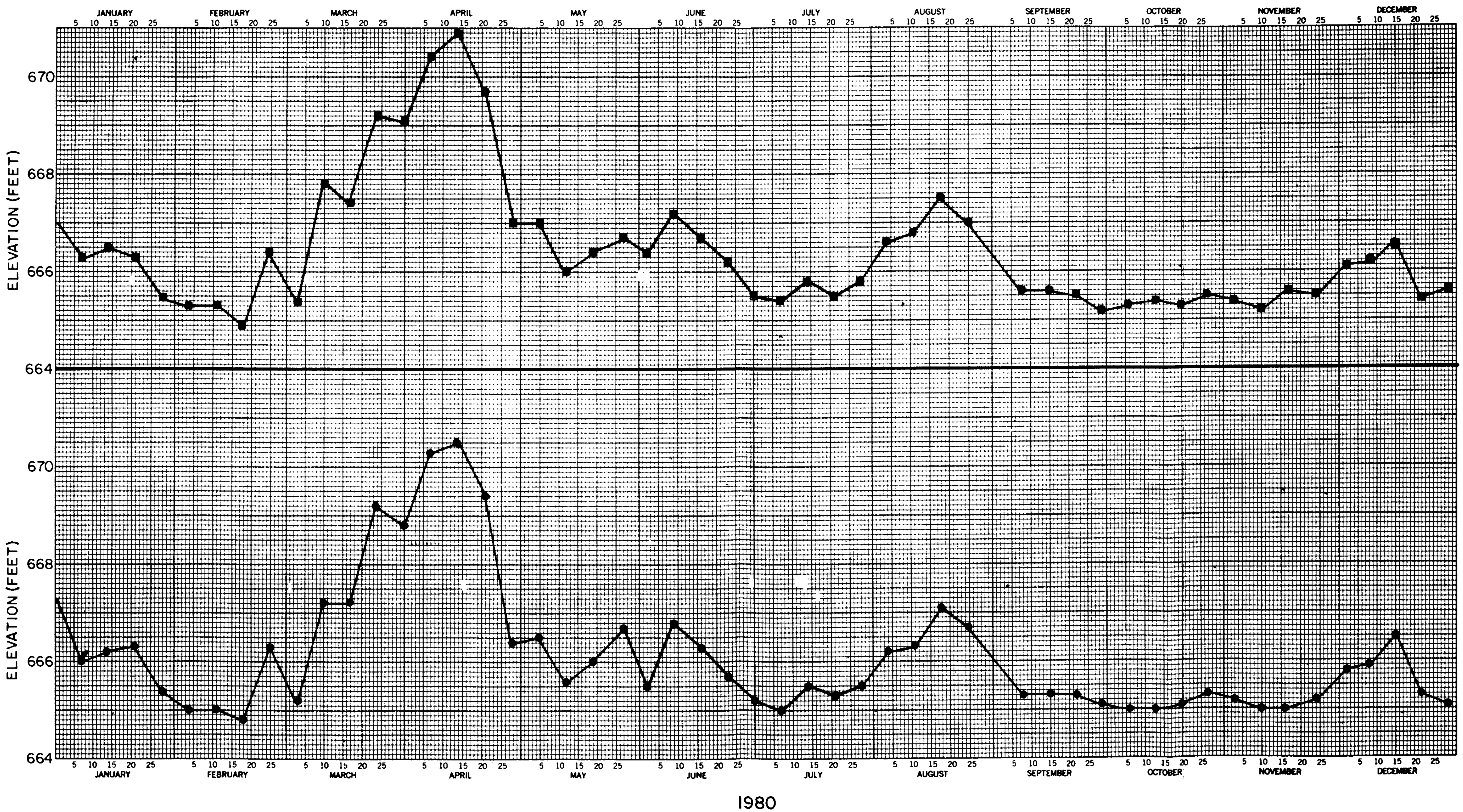
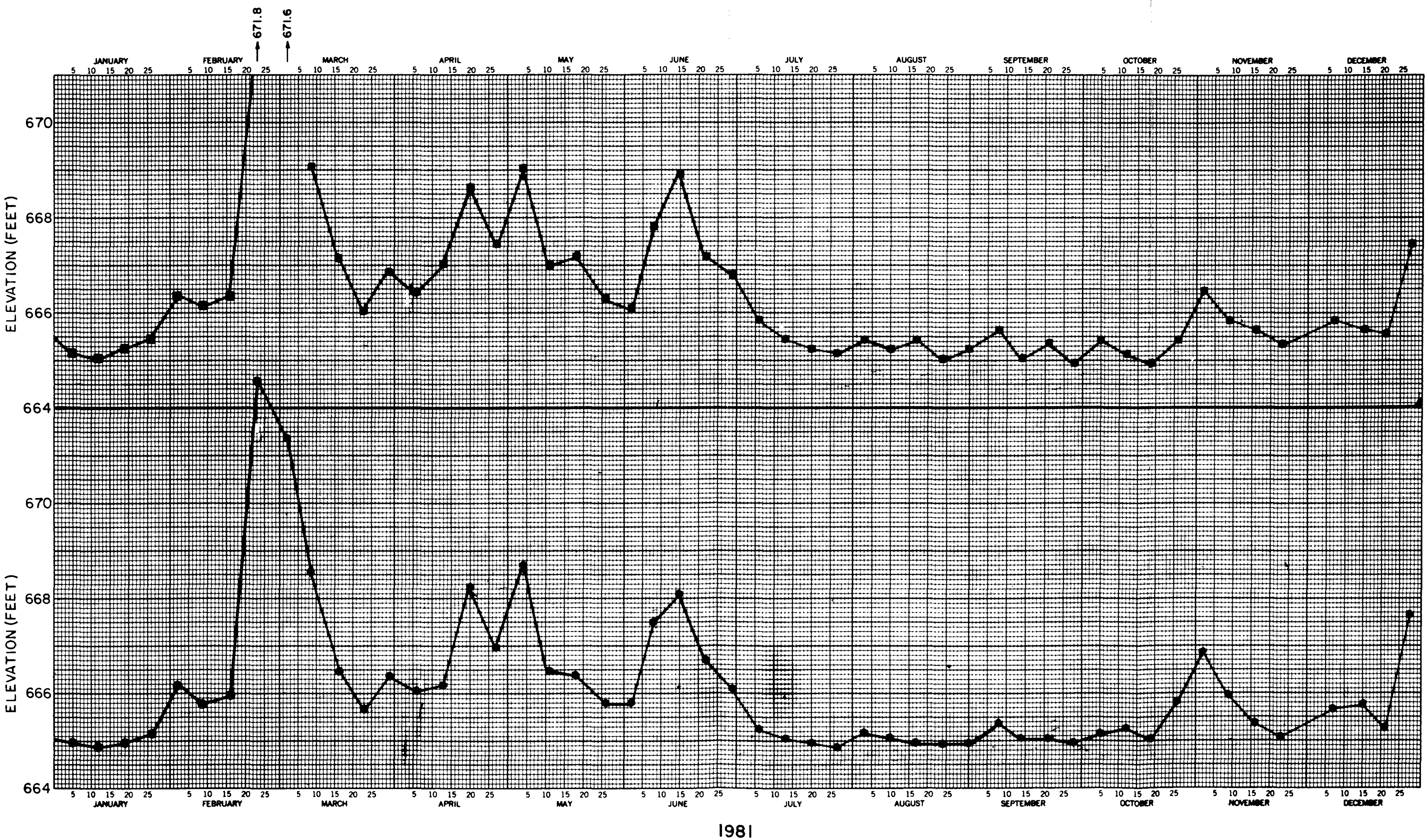


FIGURE 2.5A-13
PIEZOMETER DATA, 1979
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



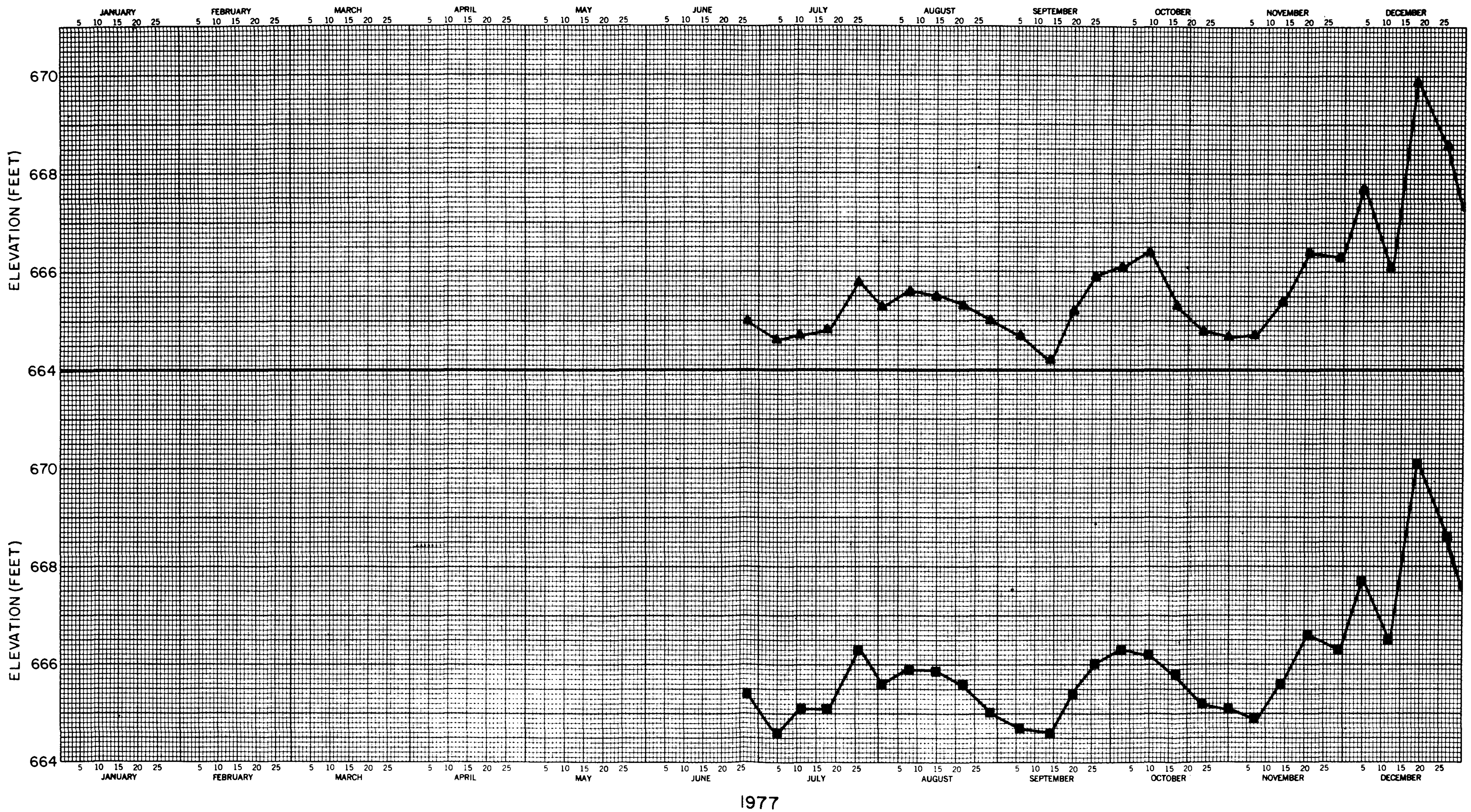
LEGEND:
■ P-3
● P-4

FIGURE 2.5A-14
PIEZOMETER DATA, 1980
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND:
■ P-3
● P-4

FIGURE 2.5A-15
PIEZOMETER DATA, 1981
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT



LEGEND:
▲ P-6
■ P-7

FIGURE 2.5A-16
PIEZOMETER DATA, 1977
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

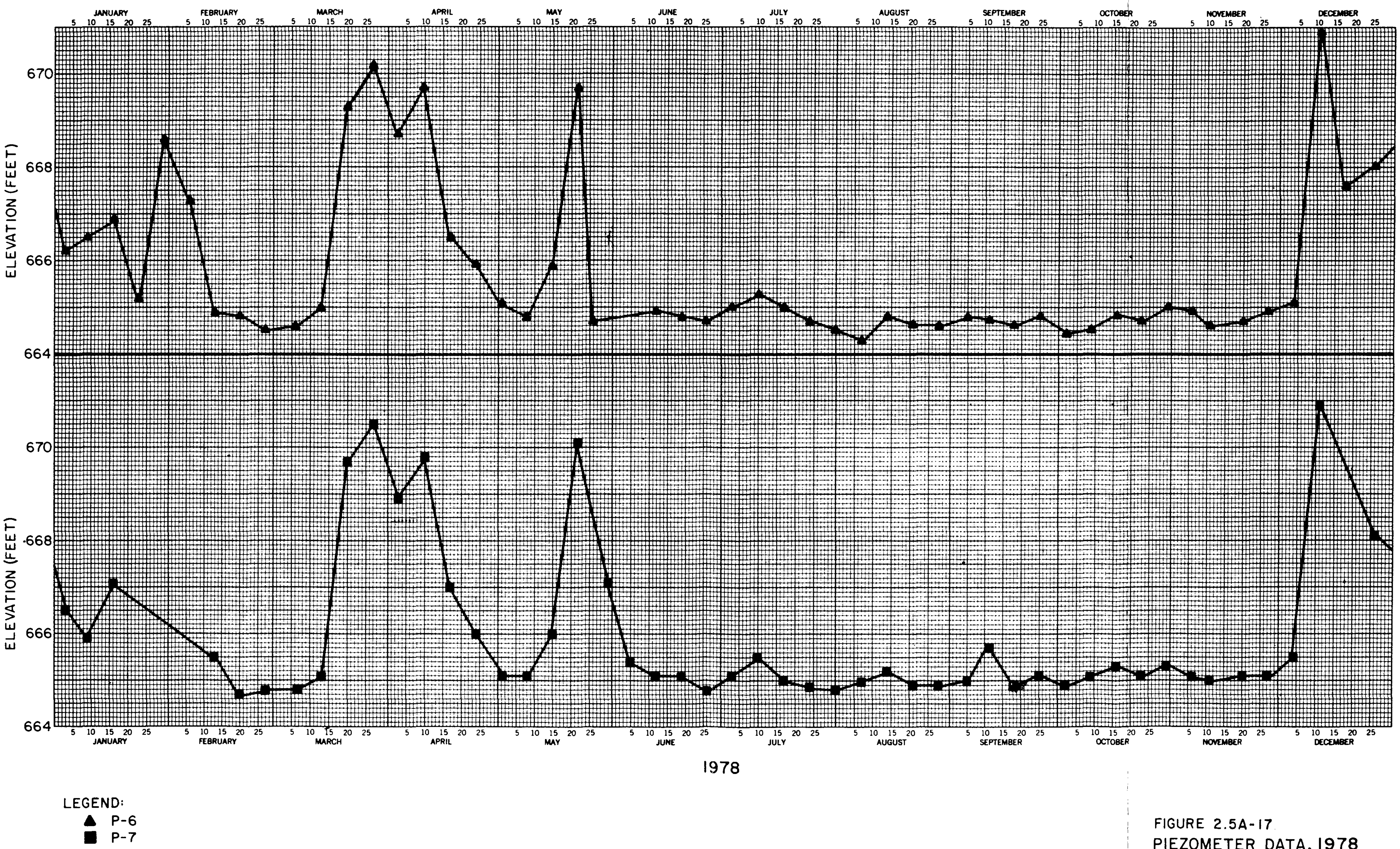


FIGURE 2.5A-17
PIEZOMETER DATA, 1978
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

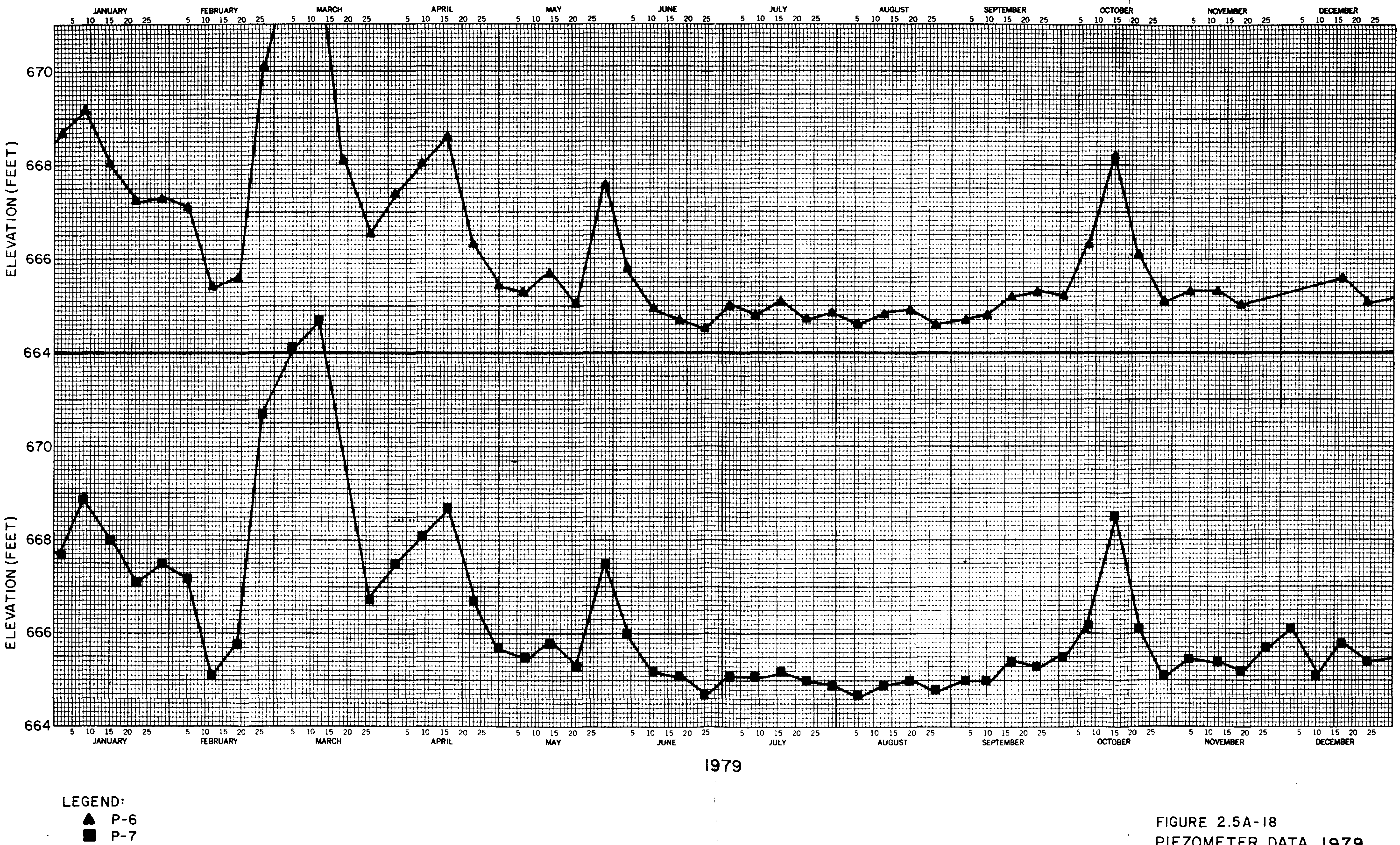


FIGURE 2.5A-18

PIEZOMETER DATA, 1979

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT

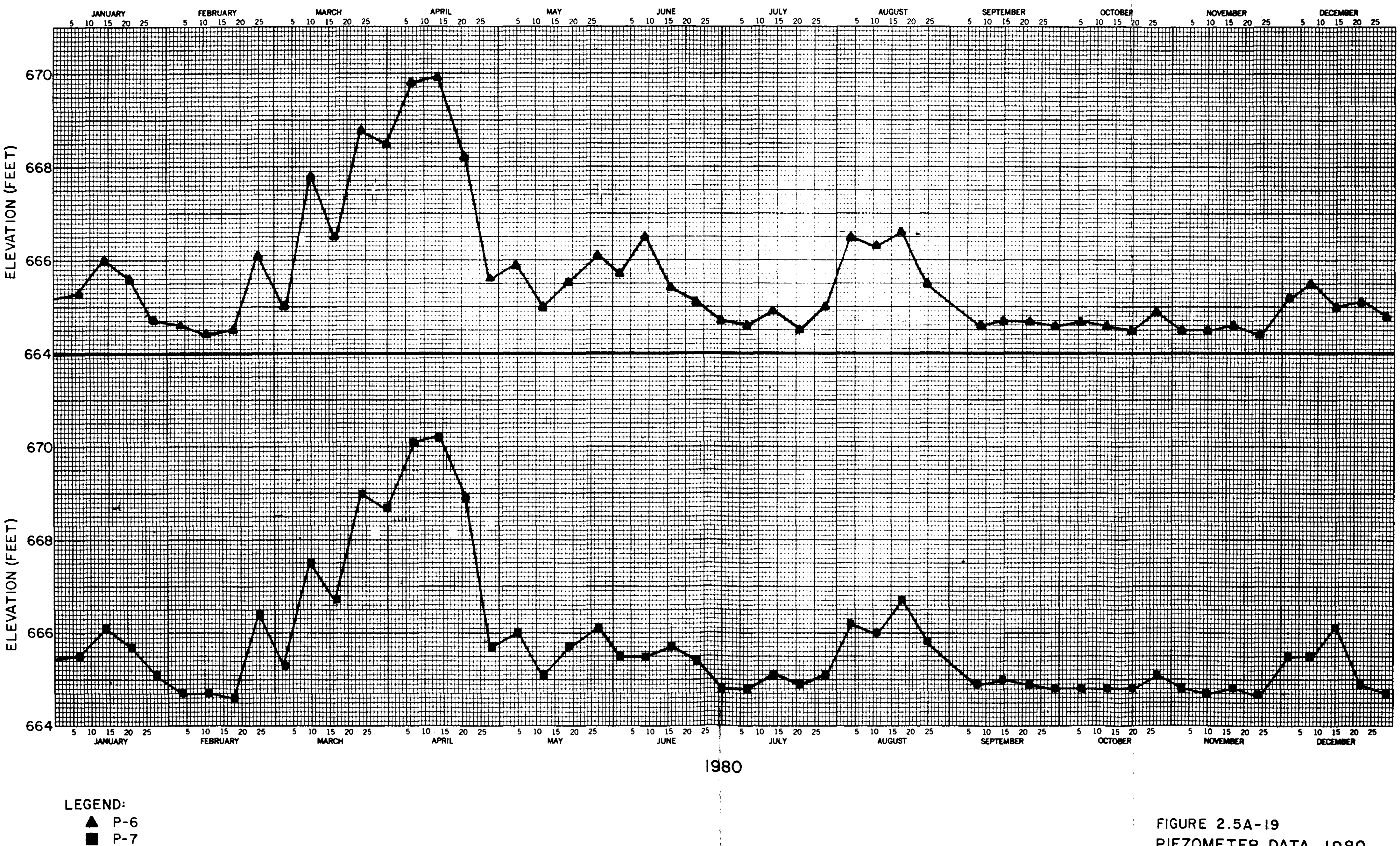


FIGURE 2.5A-19
PIEZOMETER DATA, 1980
BEAVER VALLEY POWER STATION-UNIT 2
FINAL SAFETY ANALYSIS REPORT

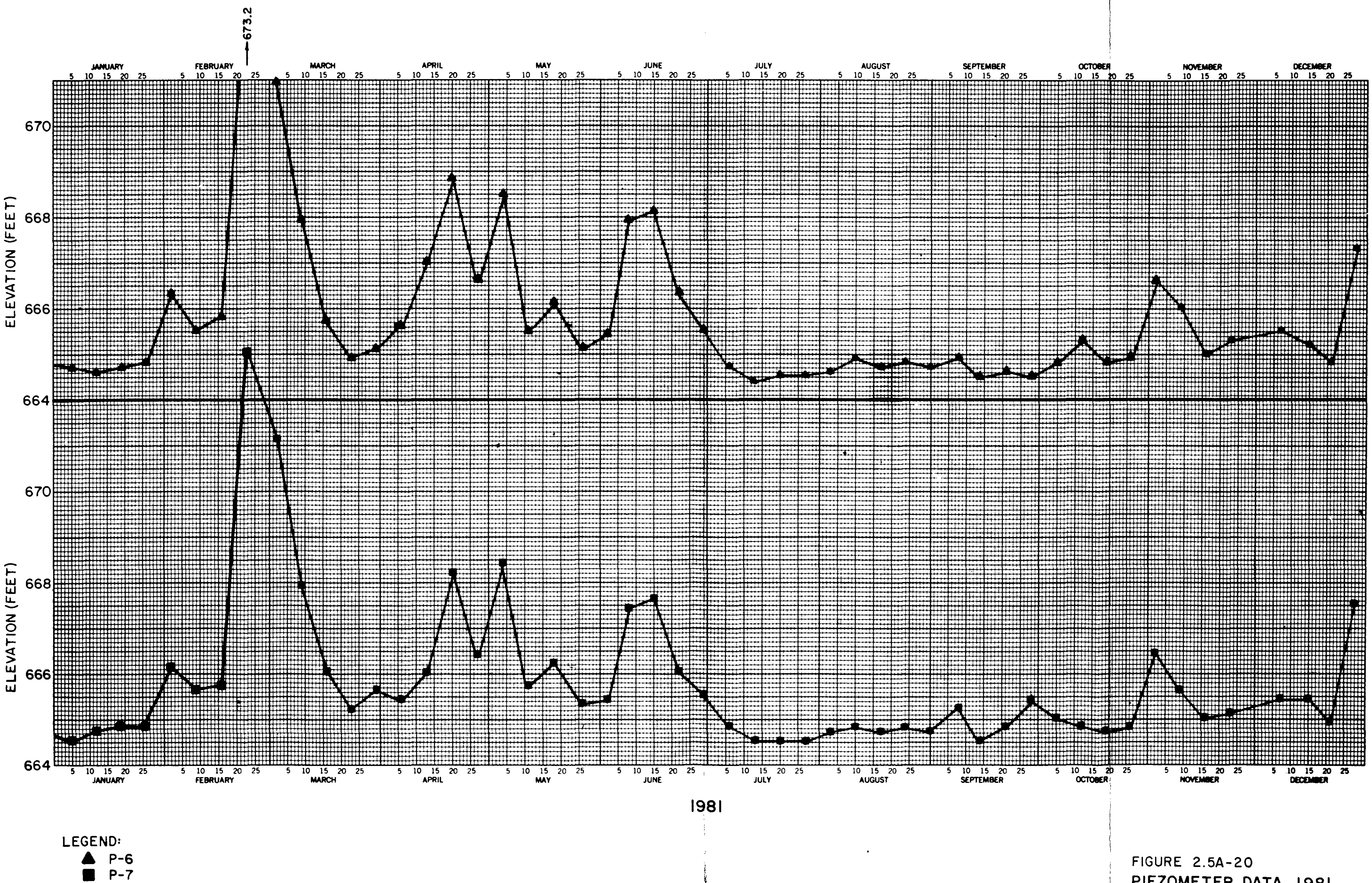


FIGURE 2.5A-20

PIEZOMETER DATA, 1981

BEAVER VALLEY POWER STATION-UNIT 2

FINAL SAFETY ANALYSIS REPORT

APPENDIX 2.5B

BORING LOGS

BEAVER VALLEY POWER STATION

Tables for Appendix 2.5B

TABLE 2.5B-1

LIST OF BORING LOGS

Boring No.	Boring No.	Boring No.	Boring No.	Boring No.
854	TH-1	537T	SEO-1	EOS-1
855	TH-2	538T	SEO-1A	EOS-1A
901	TH-3	539T	SEO-2	EOS-2
902	TH-4	540T	SEO-3	EOS-3
903	TH-5	541T	SEO-4	EOS-4
904	TH-6	542T	SEO-5	EOS-4A
905		543T		EOS-5
906		543AT		EOS-6
907		544T		EOS-7
907		545T		EOS-7A
908		546T		EOS-9
908		547T		EOS-10
909		548T		
910		549T		
911		550T		
912		551T		
913		552T		
914		553T		
915		554T		
916		555T		
		556T		
		557T		
		558T		
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		567T		
		568T		
		569T		
		570T		
		571T		
		572T		
		573T		
		574T		
		575T		
		576T		
		577T		

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 12241 BORING NO. 854

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 715.8'

DATE DRILLED JULY 23, 1974 7-23-74 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
715.8						
			19	1		CLAYEY SILT, MODERATELY TO HIGHLY PLASTIC, 3-7% VERY FINE SAND, WITH ROOTS, DARK BROWN. (SM)
710	5		32	2		SAND, UNIFORM, FINE/VERY FINE, 2-3% MEDIUM SAND, 4-8% SLIGHTLY TO MODERATELY PLASTIC FINES, DARK YELLOWISH BROWN, WITH SMALL LAYERS OF CLAYEY SILT CONTAINING SOME ROOTS.
	10		20	3		SAND, UNIFORM, FINE 5-8% MODERATELY PLASTIC FINES, LIGHT BROWN, LESS THAN 1% GRAVEL TO 0.9 INCH MAXIMUM. (SP)
700	15		23	4		SAND, UNIFORM, FINE, 2-4% FINES, LIGHT BROWN. (SP)
	20		33	5		SAND, POORLY GRADED, FINE TO COARSE, 5-10% MEDIUM AND COARSE SAND 4-6% GRAVEL TO 1.5 INCH MAXIMUM, 3-6% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (SP)
690	25		52	6		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE AND MEDIUM, 5-10% GRAVEL TO 1.0 INCH MAXIMUM, 4-8% SLIGHTLY TO MODERATELY PLASTIC FINES, LIGHT BROWN. (SP)
	30		29	7		NO RECOVERY
	35					END OF BORING AT 36.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◻7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ◻ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	
1	M 10/7/74

BORING LOG 854

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

12241 - GSK - 11

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 12241 BORING NO. 855

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 694.4

DATE DRILLED JULY 25, 1974 DRILLED BY AMERICAN LOGGED BY D.P.F.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
694.4						
690	5		57	1		SAND, UNIFORM, FINE 2-3% MEDIUM AND COARSE SAND, 4-6% SLIGHTLY PLASTIC FINES, DARK BROWN WITH 3-5% GRAVEL TO 1.2 INCH MAXIMUM. (SP)
	10		6	2		SILTY CLAY, MODERATELY PLASTIC, 2-3% VERY FINE SAND, MOTTLED, LIGHT GRAY AND DARK BROWN, CONTAINING A TRACE OF MICA. (CH)
680	15		8	3		SIMILAR TO ABOVE. (CH)
	20		5	4		SIMILAR TO SS #2 (CH)
670	25		3	5		SIMILAR TO SS#2 (CH)
	30		2	6		SIMILAR TO SS#2 (CH)
660	35		5	7		SILTY CLAY, MODERATELY PLASTIC, 3-5% VERY FINE SAND, DARK BROWN. (CH)
						END OF BORING AT 36.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⏚ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	
1	11/7/74

BORING LOG 855

BEAVER VALLEY POWER STATION - UNIT NO.1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

12241 - GSK - 12

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 901

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 677.2'

DATE DRILLED MARCH 13, 1974 DRILLED BY AMERICAN DRILLING LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS & RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
677.2						
			1	1		ORGANIC SILT, MODERATELY PLASTIC, 5-10% FINE SAND, VERY SOFT, DARK BROWN, CONTAINS ROOT OR TWIG FRAGMENTS, DAMP. (OL)
670	5		5	2		SILTY SAND, UNIFORM, FINE TO VERY FINE, 10-15% SLIGHTLY PLASTIC ORGANIC FINES, DAMP, MEDIUM TO DARK BROWN. (SM)
	10		5	3		SILTY SAND, MOSTLY UNIFORM, FINE TO VERY FINE, 10-15% SLIGHTLY PLASTIC ORGANIC FINES, MOIST, MEDIUM TO DARK BROWN, OCCASIONAL PEBBLES TO 0.75 INCHES. (SM)
660	15		2	4		SILTY SAND, UNIFORM, FINE TO VERY FINE, 15-20% SLIGHTLY PLASTIC FINES, MOIST TO WET, MEDIUM BROWN. (SM)
	20		WOH	5		SILTY SAND, UNIFORM, FINE TO VERY FINE, 10-15% NONPLASTIC FINES, WET, MEDIUM GRAY. (SM)
650	25		11	6		SANDY CLAY, SLIGHTLY PLASTIC, 20-30% VERY FINE SAND, FIRM, MEDIUM GRAY, SOME SMALL PEBBLES, WET. (CL)
	30		12	7		NO RECOVERY
640	35		33	8		SILTY SAND, MOSTLY UNIFORM, FINE, 5-10% NONPLASTIC FINES, WET, MEDIUM BROWN, ONE 1 INCH PEBBLE. (SM)
	40		14	9		SAND, UNIFORM, COARSE TO FINE, 1-3% NONPLASTIC FINES, MOIST, MEDIUM BROWN. (SP)
630	45		32	10		SAND, MOSTLY UNIFORM, VERY COARSE TO FINE, 3-5% NONPLASTIC FINES, WET, MEDIUM BROWN TO MEDIUM GRAY. (SP)
	50		25	11		SAND, UNIFORM, VERY COARSE TO FINE, 3-5% NONPLASTIC FINES, SATURATED, MEDIUM TO DARK GRAY. (SP)
620	55		62	12		SAND, SAME AS ABOVE. TOP OF ROCK AT 58.0'
						GRAY SHALE
	60					END OF BORING AT 60.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4		
3		
2	[illegible]	
1	[illegible]	

BORING LOG 901

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -152

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 902

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 678.3'

DATE DRILLED MARCH 15, 1974 DRILLED BY AMERICAN DRILLING LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS or RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
678.3						APPROXIMATELY 3.5' OF FILL PLACED TO LEVEL DRILL. (NO SAMPLE)
	5		6	1		ORGANIC SILT, SLIGHTLY PLASTIC, 10-15% FINE SAND, SOFT, DAMP, DARK BROWN, SOME ROOT FRAGMENTS. (OL)
670	10		7	2		SANDY SILT, MODERATELY PLASTIC, 15-20% FINE SAND, SOFT, WET, DARK BROWN, SOME FINES MAY BE ORGANIC. (ML)
	15		4	3		SILTY SAND, UNIFORM, FINE TO VERY FINE, 20-25% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN. (SM)
660	20		3	4		SILTY SAND, UNIFORM, FINE TO VERY FINE, 20-25% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN WITH TRACES OF MEDIUM GRAY. (SM)
	25		2	5		CLAYEY SAND, UNIFORM, FINE TO VERY FINE, 20-25% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, PIECE OF ROTTED WOOD. (SC)
650	30		12	6		SAND, UNIFORM, COARSE TO FINE, 1-3% NONPLASTIC FINES, WET, MEDIUM BROWN. (SP)
	35		31	7		SAND, UNIFORM, FINE, 1-3% NONPLASTIC FINES, MOIST, MEDIUM BROWN, ONE 0.75 INCH PEBBLE. (SP)
640	40		35	8		SAND, UNIFORM, FINE, 1-3% NONPLASTIC FINES, DAMP, MEDIUM BROWN. (SP)
	45		15	9		SAND, POORLY GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, DAMP TO MOIST, MEDIUM BROWN. (SP)
630	50		20	10		SAND, UNIFORM, COARSE TO FINE, 1-3% NONPLASTIC FINES, SATURATED, MEDIUM GRAY. (SP)
	55		21	11		SANDY GRAVEL, GAP GRADED, VERY COARSE TO FINE, 1% NONPLASTIC FINES, SATURATED, MEDIUM GRAY, SANDSTONE FRAGMENTS TO 1 INCH. (GP) — TOP OF ROCK AT 57.5'
620	60					GRAY SHALE
						END OF BORING AT 60.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	[illegible]
1	10/7/74 [illegible]

BORING LOG 902

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 153

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 903
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 672.8'
DATE DRILLED MARCH 19, 1974 DRILLED BY AMERICAN DRILLING LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
672.8						
670			3	1		SILTY SAND, UNIFORM, FINE TO VERY FINE, 15-20% SLIGHTLY PLASTIC ORGANIC FINES, MEDIUM TO DARK BROWN, SOME ROOT FRAGMENTS. (SM)
	5		2	2		SILTY SAND, POORLY GRADED, COARSE TO FINE, 15-20% SLIGHTLY PLASTIC FINES, SOME FINES ORGANIC, MEDIUM TO DARK BROWN WITH TRACE OF GRAY. (SM)
660	10		7	3		SILTY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 10-15% NONPLASTIC FINES, REDDISH BROWN TO MEDIUM BROWN, FEW PEBBLES TO 1.5 INCHES. (SM)
	15		2	4		CLAYEY SAND, UNIFORM, FINE TO VERY FINE, 25-30% MODERATELY PLASTIC FINES, MEDIUM GRAY WITH SOME REDDISH BROWN. (SC)
650	20		9	5		SILTY SAND, WELL GRADED, COARSE TO FINE, 10-15% SLIGHTLY PLASTIC FINES, MEDIUM GRAY CHANGING TO ORANGE BOTTOM ONE THIRD OF RUN. (SM)
	25		25	6		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, 5-10% NONPLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1.5 INCHES. (SP)
640	30		17	7		SAND, UNIFORM, FINE, 1-3% NONPLASTIC FINES, DAMP, MEDIUM BROWN. (SP)
	35		11	8		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, LESS THAN 1% NONPLASTIC FINES, WET, MEDIUM GRAY-BROWN, SOME PEBBLES TO 0.5 INCHES. (SP)
630	40		19	9		SANDY GRAVEL, POORLY GRADED, COARSE TO FINE, 1% NONPLASTIC FINES, SATURATED, MEDIUM BROWN. (GP)
	45		31	10		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, SOME PEBBLES TO 0.5 INCHES. (SW)
620	50 / 51.5		46 100/0	11		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, LESS THAN 1% FINES, WET, MEDIUM GRAY-BROWN, OCCASIONAL PEBBLES TO 1 INCH, CHANGES TO: GRAY SHALE - BOTTOM 4 INCHES OF RUN. (SP) END OF BORING AT 51.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	[illegible]
1	[illegible]

BORING LOG 903

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -154

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 904

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 669.4'

DATE DRILLED MARCH 19, 1974 DRILLED BY AMERICAN DRILLING LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
669.4						
			1	1		SILTY SAND, MOSTLY UNIFORM, FINE TO VERY FINE, 20-25% SLIGHTLY PLASTIC FINES, SOME FINES ORGANIC, MEDIUM BROWN WITH SOME MEDIUM GRAY, CONTAINS ROTTED WOOD AND ROOT FRAGMENTS, MOIST. (SM)
	5		*16	2		SANDY SILT, SLIGHTLY PLASTIC, 20-25% FINE SAND, SOFT, WET, MEDIUM BROWNISH GRAY, CONTAINS PIECE OF ROTTED WOOD THAT HAD TO BE DRIVEN THROUGH USING 300 LB. HAMMER. (ML)
660	10		8	3		SILTY SAND, POORLY GRADED, COARSE TO FINE, 15-20% NONPLASTIC FINES, WET, MEDIUM BROWN. (SM)
	15		14	4		GRAVELLY SAND, WELL GRADED, VERY COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWNISH GRAY, SOME PEBBLES TO 1 INCH. (SW)
650	20		11	5		SANDY GRAVEL, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, WET, MEDIUM BROWN. (GW)
	25		9	6		SAND, UNIFORM, FINE, 1-3% NONPLASTIC FINES, SATURATED, MEDIUM BROWN. (SP)
640	30		41	7		SAND, POORLY GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, DAMP, MEDIUM BROWN, FEW PEBBLES TO 1 INCH. (SP)
	35		9	8		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NONPLASTIC FINES, SATURATED, MEDIUM BROWN, FEW PEBBLES TO 0.5 INCH. (SP)
630	40		20	9		SILTY SAND, WELL GRADED, COARSE TO VERY FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN CHANGING TO MEDIUM GRAY BOTTOM TWO THIRDS OF RUN. (SW)
	45		45	10		SAND, UNIFORM, FINE, 3-5% SLIGHTLY PLASTIC FINES, DAMP, MEDIUM GRAY, SOME GRAY SANDSTONE FRAGMENTS AT BOTTOM OF RUN. (SP)
	47.5		100/0			
620						END OF BORING AT 47.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≑ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [ ] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

* DENOTES USE OF 300 LB. HAMMER

4	
3	
2	M [illegible]
1	M [illegible]

BORING LOG 904

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -155

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE: BEAVER VALLEY POWER STATION — J.O. NO. 11700 — BORING NO. 905

TYPE OF BORING: SPLIT SPOON — LOCATION: SHIPPINGPORT, PENNSYLVANIA — GROUND ELEV. 670.0

DATE DRILLED: MARCH 20, 1974 — DRILLED BY: AMERICAN — LOGGED BY: F.P.V.

SUMMARY OF BORING:

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
670.0						
			1/12"	1		ORGANIC SILT, MODERATELY PLASTIC, 3-5% FINE SAND, VERY SOFT, DAMP, CONTAINS ROOT FRAGMENTS, DARK GRAY BROWN. (OL)
	5		1/18"	2		ORGANIC SILT, MODERATELY PLASTIC, 20-25% FINE SAND, VERY SOFT, WET, SOME WOOD FRAGMENTS, DARK GRAY BROWN TO BLACK. (OL)
660	10		31	3		SILTY SAND, GAP GRADED, VERY COARSE TO VERY FINE, MOSTLY FINE, 10-15% NON PLASTIC FINES, WET, MEDIUM BROWN, FEW PEBBLES TO 1". (SM)
	15		31	4		GRAVELLY SAND, POORLY GRADED, VERY COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, PEBBLES TO 1 1/2". (SW)
650	20		19	5		GRAVELLY SAND, WELL GRADED, VERY COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MOIST, MEDIUM ORANGE BROWN, PEBBLES TO 1/2". (SW)
	25		18	6		SAND, UNIFORM, FINE, 1-3% NON PLASTIC FINES, DAMP, MEDIUM GRAYISH BROWN. (SP)
640	30		26	7		SAND, MOSTLY UNIFORM, FINE, 1-3% NON PLASTIC FINES, DAMP, MEDIUM GRAYISH BROWN, FEW PEBBLES TO 1/2". (SP)
	35		11	8		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, MOSTLY COARSE, SATURATED, MEDIUM GRAY BROWN, PEBBLES TO 1/2", LESS THAN 1% NON PLASTIC FINES. (SW)
630	40		16	9		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, SATURATED, MEDIUM GRAY, PEBBLES TO 1". (SW)
	45		22	10		SAND, MOSTLY UNIFORM, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MOIST, MEDIUM GRAY, CONTAINS 1/4" GRAY CLAY LAYER. (SP)
			100/0"			NO RECOVERY (REFUSAL)
620	50					END OF BORING @ 49.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

Rev.	
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2	M [illegible]
1	M 10/7/[illegible]

BORING LOG 905

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 156

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 906

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. [illegible].4

DATE DRILLED MARCH 22, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
689.4						
			35	1		SAND, POORLY GRADED, MEDIUM COARSE TO FINE, MOSTLY FINE, 5-10% SLIGHTLY PLASTIC FINES, DAMP, MEDIUM BROWN, ONE 1 INCH PEBBLE. (ROAD FILL) (SP)
	5			1		SILTY SAND, UNIFORM, FINE TO VERY FINE, 20-25% MODERATELY PLASTIC FINES, DAMP, MEDIUM BROWN. (SM)
680	10			2		SILTY SAND, SAME AS ABOVE. (SM)
	15			3		NO RECOVERY
			9	2		SILTY SAND, UNIFORM, FINE TO VERY FINE, 20-25% MODERATELY PLASTIC FINES, WET, MEDIUM BROWN. (SM)
670	20		13	3		SILTY SAND, POORLY GRADED, COARSE TO VERY FINE, MOSTLY FINE, 20-25% MODERATELY PLASTIC FINES, WET, MEDIUM BROWN. (SM)
	25		38	4		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MOIST, MEDIUM BROWN, PEBBLES TO 1 1/4 INCH. (SP)
660	30		23	5		SAND, WELL GRADED, COARSE TO FINE, 3-5% NONPLASTIC FINES, WET, MEDIUM BROWN, FEW PEBBLES TO 3/4 INCH. (SW)
	35		13	6		SANDY GRAVEL, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, WET, PEBBLES TO 1 INCH. (SW)
650	40		45	7		GRAVELLY SAND, GAP GRADED, VERY COARSE TO FINE, WET, MEDIUM BROWN, SEVERAL SANDSTONE FRAGMENTS TO 1 1/2 INCH. (SP)
	45		35	8		SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN, FEW PEBBLES TO 1/2 INCH. (SW)
640	50		36	9		SAND, SAME AS ABOVE. (SW)
	55		48	10		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, PEBBLES TO 1/2 INCH. (SW)
630	60		80	11		SAND, MOSTLY UNIFORM, COARSE TO FINE, LESS THAN 1% SLIGHTLY PLASTIC FINES, DAMP, MEDIUM GRAY, FEW SANDSTONE FRAGMENTS TO 1 1/4 INCH. (SP)
	65		77	12		GRAVELLY SAND, WELL GRADED, VERY COARSE TOOFINE, 1-3% SLIGHTLY PLASTIC FINES, DAMP, MEDIUM GRAY, PEBBLES TO 1 INCH, MOSTLY SANDSTONE FRAGMENTS. (SW)
			100/0"			GRAY SHALE TOP OF ROCK AT 68.5'
620	70					
						END OF BORING AT 71.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [ ] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
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2	[illegible]
1	[illegible]

BORING LOG 906

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 157

SH 1 OF 2

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 907
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 715.0'
DATE DRILLED MARCH 26-27, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
715						
				■ 1		SILTY SAND, UNIFORM, FINE, 20-25% NONPLASTIC FINES, DRY, COMPACT, MEDIUM BROWN. (SM)
	5			■ 2		CLAYEY SAND, SIMILAR TO SH #1, EXCEPT FINES ARE SLIGHTLY PLASTIC, DAMP. (SC)
705	10			■ 3		CLAYEY SAND, SAME AS SH #2. (SC)
	15			■ 4		CLAYEY SAND, WIDELY GRADED, 10-20% ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 20-25% SLIGHTLY PLASTIC FINES, COMPACT, DAMP, MEDIUM BROWN, LARGE PIECE OF WOOD. (SB)
695	20			□ 5		NO RECOVERY
			23	◤ 1		SILTY SAND, WIDELY GRADED, MEDIUM TO FINE, MOSTLY FINE, 10-15% NONPLASTIC FINES, MOIST, COMPACT, MEDIUM GRAY, FEW PIECES SANDSTONE GRAVEL. (SM)
	25		31	◤ 2		SILTY SAND, WIDELY GRADED, 8-12% ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 10-20% NONPLASTIC FINES, STIFF, MOIST, MEDIUM BROWN, TRACE COAL. (SM)
685	30		16	◤ 3		SAND, UNIFORM, FINE, 3-8% NONPLASTIC FINES, COMPACT, MOIST, MEDIUM BROWN. (SP)
	35		18	◤ 4		GRAVELLY SAND, POORLY GRADED, 5-10% ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, COMPACT, MOIST, MEDIUM BROWN. (SP)
675	40		21	◤ 5		GRAVELLY SAND, SIMILAR TO S#4, WITH TRACE OF COAL. (SP)
	45		26	◤ 6		GRAVELLY SAND, SIMILAR TO S #4, EXCEPT SATURATED. (SP)
665	50		22	◤ 7		GRAVELLY SAND, SIMILAR TO S #4, EXCEPT SATURATED. (SP)
	55		32	◤ 8		GRAVELLY SAND, SIMILAR TO S #4, EXCEPT SATURATED AND MANY SILTY SAND LENSES. (SP)
655	60		27	◤ 9		GRAVELLY SAND, POORLY GRADED, 15-20% ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, COMPACT, SATURATED, MEDIUM BROWN. (SP)
	65		27	◤ 10		GRAVELLY SAND, SIMILAR TO S #9, EXCEPT MANY SILTY SAND LENSES. (SP)
	70					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [ ] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	
1	M 4/1/74

BORING LOG 907

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 158

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 907
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 715.0'
DATE DRILLED MARCH 26-27, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
645	70		54	11		SAND, POORLY GRADED, 3-8% ANGULAR GRAVEL TO 0.6 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, VERY DENSE, MEDIUM BROWN. (SP)
	75		58	12		SILTY SAND, WIDELY GRADED, COARSE TO FINE, MOSTLY FINE, 10-15% NON-PLASTIC FINES, VERY DENSE, MEDIUM BROWN. (SM)
635	80		50	13		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, VERY DENSE, MEDIUM BROWN. (SP)
	85		56	14		SAND, SAME AS S #13. (SP)
625	90		147	15		GRAVELLY SAND, WIDELY GRADED, 15-25% SUBROUNDED GRAVEL TO 1.1 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 10-15% NONPLASTIC FINES, VERY DNESE, GREENISH BROWN. (SP)
	95		186	16		GRAVELLY SAND, POORLY GRADED, 15-25% ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, VERY DENSE, GREENISH BROWN. (SP) TOP OF ROCK AT 96.0'
615	100		100 / 0"	17		NO RECOVERY
						END OF BORING AT 100.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [ ] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	
1	

BORING LOG 907

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 158A

DUQUESNE LIGHT COMPANY

SH 1 OF 2

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 908

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 718.5 718.5

DATE DRILLED MARCH 28-29, 1974 DRILLED BY AMERICAN LOGGED BY JEP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
718.5						
			PUSH	■1		CUTTINGS - SILTY SAND, WIDELY GRADED, COARSE TO FINE, MOSTLY FINE, 20-30% NONPLASTIC TO SLIGHTLY PLASTIC FINES, COMPACT, DAMP, MEDIUM BROWN, SOME WOOD AND ROOTS, (SM).
	5		41-38*	1		GRAVELLY SAND, POORLY GRADED, 25-30% ANGULAR GRAVEL TO 1.0 INCH MAXIMUM COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, VERY DENSE, DAMP, LIGHT BROWN, (SP).
710	10		101	2		GRAVELLY SAND, SIMILAR TO S#1 EXCEPT 15-20% SUBANGULAR GRAVEL TO 1.2 INCH MAXIMUM, (SP).
	15		79	3		GRAVELLY SAND, WIDELY GRADED, 10-15% SUBANGULAR GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 5-10% NONPLASTIC FINES, VERY DENSE, MOIST, MEDIUM BROWN, (SP).
700	20		85	4		GRAVELLY SAND, SIMILAR TO S#3 EXCEPT DRY, (SP).
	25		51	5		GRAVELLY SAND, SIMILAR TO S#3 EXCEPT 15-25% ANGULAR GRAVEL TO 1.1 INCH MAXIMUM, (SP).
690	30		59	6		GRAVELLY SAND, WELL GRADED, 10-20% ANGULAR GRAVEL TO 0.9 INCH MAXIMUM, COARSE TO FINE SAND, 3-8% NONPLASTIC FINES, MOIST, VERY DENSE, MEDIUM BROWN, (SW).
	35		59	7		GRAVELLY SAND, POORLY GRADED, 10-15% SUBROUNDED GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, VERY DENSE, MOIST, MEDIUM BROWN, (SP).
680	40		114	8		SANDY GRAVEL, POORLY GRADED, ROUNDED TO 1.2 INCH MAXIMUM, 30-35% COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, VERY DENSE, SATURATED, DARK BROWN, (GP).
	45		15	9		SAND, WELL GRADED, 3-8% ROUNDED GRAVEL TO 0.6 INCH MAXIMUM, COARSE TO FINE, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN, (SW).
670	50		30	10		GRAVELLY SAND, POORLY GRADED, 30-40% ROUNDED GRAVEL TO 1.2 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY COARSE, DENSE, DARK BROWN, POCKETS OF ORGANIC SILT, (SP).
	55		29	11		SILTY SAND, WIDELY GRADED, 1-5% SUBANGULAR GRAVEL TO 0.9 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 15-25% NONPLASTIC FINES, COMPACT, MEDIUM BROWN, (SP).
660	60		30	12		GRAVELLY SAND, POORLY GRADED, 10-15% SUBANGULAR GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 5-10% NONPLASTIC FINES, DENSE, DARK BROWN, (SP).
	65		35	13		SILTY SAND, UNIFORM, FINE, 25-30% NONPLASTIC FINES, DENSE, MEDIUM BROWN, (SM).

* DENOTE USE OF 300 LB HAMMER

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≚ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. □ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	
1	11/7/74

BORING LOG 908

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 159

DUQUESNE LIGHT COMPANY

SH 2 OF 2

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 908

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 718.5 718.5

DATE DRILLED MARCH 28-29, 1974 DRILLED BY AMERICAN LOGGED BY JP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
718.5						
650	70		36	14		SILTY SAND, SAME AS S#13, (SM).
	75		42	15		SAND, SKIP GRADED, COARSE AND FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, 1-5% NONPLASTIC FINES, DENSE, MEDIUM BROWN, (SP).
640	80		40	16		SAND, SAME AS S#15, (SP).
	85		115	17		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, VERY DENSE, DARK BROWN, POCKETS OF SILTY SAND, (SP).
630	90		167	18		SILTY SAND, UNIFORM, FINE, 10-20% NONPLASTIC FINES, VERY DENSE, DARK BROWN, FEW SEVERELY WEATHERED GREEN SANDSTONE FRAGMENTS, (SM).
	95					TOP OF WEATHERED ROCK AT 95.0'
			100/3"	19		SANDY CLAY, MODERATELY PLASTIC, 10-20% FINE SAND, VERY DENSE, MEDIUM GRAY, (CL), WEATHERED SHALE? 95-100' - GRAY SHALE IN WATER RETURN
620	100		100/0"	20		NO RECOVERY. TOP OF ROCK AT 100.0'
						END OF BORING AT 100.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ∇ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

* DENOTE'S USE OF 300 LB HAMMER.

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1	M 4/2/74

BORING LOG 908

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 159A

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 909

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 670.7'

DATE DRILLED APRIL 17, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
670.7						
670			5	1		SILTY SAND, UNIFORM, VERY FINE, 35-40% SLIGHTLY PLASTIC FINES, DAMP, MEDIUM DARK BROWN, SOME FINES ORGANIC, SOME ROOT FRAGMENTS. (SM)
	5		2	2		SANDY SILT, SLIGHTLY PLASTIC, 20-30% VERY FINE SAND, VERY SOFT, MEDIUM BROWN WITH SOME REDDISH BROWN AND GRAY. (ML)
660	10		10	3		SILTY SAND, MOSTLY UNIFORM, FINE TO VERY FINE, 25-30% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN CHANGING TO MEDIUM DARK GRAY, BOTTOM 1/3 OF RUN. (SM)
	15		19	4		SILTY SAND, MOSTLY UNIFORM, FINE, 10-15% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, FEW PEBBLES TO 1/2 INCH. (SM)
650	20		11	5		SAND, UNIFORM, FINE, 1-3% NONPLASTIC FINES, DAMP, MEDIUM BROWN. (SP)
	25		12	6		SAND, SAME AS SS #5. (SP) CHANGING AT APPROXIMATELY 26.0' TO: GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY-BROWN, PEBBLES TO 3/4 INCH. (SW)
640	30		14	7		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, WET, MEDIUM GRAY-BROWN, PEBBLES TO 3/4 INCH. (SW)
	35		16	8		SAND, MOSTLY UNIFORM, FINE, 1-3% NONPLASTIC FINES, SATURATED, MEDIUM GRAY-BROWN. (SP)
630	40		28	9		GRAY SANDSTONE, VERY WEATHERED, 20-25% MEDIUM GRAY SAND.
	45		55	10		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, MOIST, MEDIUM GRAY, PEBBLES TO 1/2 INCH, SOME SANDSTONE FRAGMENTS. (SW)
			100/6"	11		
620	50					END OF BORING AT 49.5'
	55					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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3	
2	M
1	10/7/74

BORING LOG 909

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 160

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 910

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 669.0'

DATE DRILLED APRIL 18, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
669.0						
			2	1		SILTY SAND, UNIFORM, FINE TO VERY FINE, 35-40% SLIGHTLY PLASTIC FINES, SOME ORGANIC, MOIST, MEDIUM DARK BROWN, SOME ROOT FRAGMENTS. (SM)
	5		9	2		SILTY SAND, UNIFORM, FINE TO VERY FINE, 30-35% SLIGHTLY PLASTIC FINES, SOME ORGANIC, MOIST, MEDIUM DARK BROWN, SOME ROOT FRAGMENTS, PIECES OF ROTTED WOOD AT BOTTOM OF RUN. (SM)
660	10		9	3		SILTY SAND, UNIFORM, FINE TO VERY FINE, 15-20% SLIGHTLY PLASTIC FINES, WET, DARK GRAY TO BLACK, SOME COAL. (SM)
	15		22	4		SILTY SAND, MOSTLY UNIFORM, FINE TO VERY FINE, 10-15% NONPLASTIC FINES, WET, MEDIUM BROWN WITH TRACE OF ORANGE BROWN, FEW PEBBLES TO 1 INCH AT BOTTOM OF RUN. (SM)
650	20		10	5		SAND, UNIFORM, FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, MEDIUM BROWN, FEW PEBBLES TO 1/2 INCH AT BOTTOM OF RUN. (SP)
	25		12	6		GRAVELLY SAND, WIDELY GRADED, VERY COARSE TO FINE, 10-15% NONPLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1 1/4 INCH, SOME SANDSTONE FRAGMENTS. (SW)
640	30		22	7		GRAVELLY SAND, SAME AS SS #6. (SW)
	35		23	8		SAND, MOSTLY UNIFORM, FINE, LESS THAN 1% NONPLASTIC FINES, DAMP, MEDIUM GRAY, FEW PEBBLES TO 1/2 INCH. (SP)
630	40		26	9		SAND, SAME AS ABOVE. (SP)
	45		51	10		SAND, SAME AS ABOVE, LAYER OF SILTY SAND AT BOTTOM OF RUN WITH SOME GRAY CLAY. (SP)
[illegible]			100/3"	11		
	50					END OF BORING AT 49.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
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2	[illegible]
1	[illegible]

BORING LOG 910

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 161

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 911

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 683 683

DATE DRILLED APRIL 19, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
683						
			9	1		GRAVELLY SAND, FILL, TOP 1/3 OF RUN. CHANGING TO: SILTY SAND, UNIFORM, FINE TO VERY FINE, 20-25% MODERATELY PLASTIC FINES, SOME ORGANIC, DAMP, MEDIUM BROWN. (SM)
680						
	5		3	2		SANDY SILT, MODERATELY PLASTIC, 15-20% FINE SAND, VERY SOFT, DAMP, MEDIUM BROWN WITH SOME ORANGE BROWN, SOME ORGANIC. (ML)
	10		7	3		SILTY SAND, UNIFORM, FINE TO VERY FINE, 15-20% SLIGHTLY PLASTIC FINES, MOIST, MEDIUM BROWN. (SM)
670						
	15		8	4		SILTY SAND, SAME AS ABOVE. (SM)
	20		2	5		SILTY SAND, SAME AS ABOVE. (SM)
660						
	25		14	6		SILTY SAND, POORLY GRADED, COARSE TO VERY FINE, 15-20% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN, FEW PEBBLES - ONE 1 1/4 INCH. (SM)
	30		22	7		GRAVELLY SAND, WELL GRADED, VERY COARSE TO VERY FINE, 10-15% NONPLASTIC FINES, SATURATED, MEDIUM BROWN. (SW)
650						
	35		23	8		GRAVELLY SAND, GAP GRADED, VERY COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 3/4 INCH. (SW)
	40		34	9		SAND, UNIFORM, FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, MEDIUM GRAYISH BROWN. (SP)
640						
	45		22	10		GRAVELLY SAND, POORLY GRADED, VERY COARSE TO FINE, MOSTLY FINE, 5-10% NONPLASTIC FINES, MOIST, MEDIUM GRAYISH BROWN, PEBBLES TO 1 1/4 INCH. (SW)
	50		29	11		SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY BROWN, FEW PEBBLES TO 3/8 INCH. (SP)
630						
	55		28	12		SAND, WELL GRADED, MEDIUM TO FINE, 3-5% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY. (SP)
	60		49	13		GRAVELLY SAND, POORLY GRADED, VERY COARSE TO VERY FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY, PEBBLES TO 1/2 INCH, MOSTLY SANDSTONE FRAGMENTS. (SW)
620						
	65		100/0"	14		
						END OF BORING AT 65.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	M 10/7/74

BORING LOG 911

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 62

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 912

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 710.9

DATE DRILLED MAY 1, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
710.9						
710			15	1		SILTY SAND, TRACE OF GRAVEL TO 1.25 INCH MAXIMUM, UNIFORM, FINE, SAND, 20-30% NONPLASTIC FINES, COMPACT, DAMP, BROWN MOTTLED WITH YELLOW BROWN, (SM).
	5		7	2		TOP 7" SILTY SAND, POORLY GRADED, MEDIUM TO FINE, MOSTLY FINE, 10-15% NONPLASTIC FINES, LOOSE, DAMP, BROWN, (SM). BOTTOM 7" CLAYEY SAND, 25-35% POORLY GRADED, COARSE TO VERY FINE, MOSTLY VERY FINE SAND, SLIGHTLY TO MODERATELY PLASTIC GRAY TO PINK CLAY, LOOSE, DAMP, GRAY BROWN, (SC) TRACE OF GRAVEL TO 0.50 INCH MAXIMUM IN SAMPLE.
700	10		6	3		CLAYEY SILT, SLIGHTLY PLASTIC, TRACE OF MEDIUM TO FINE SAND, FIRM, BROWN TO GRAY BROWN, (MC).
	15		13	4		SANDY SILT, SLIGHTLY PLASTIC, 10-15% COARSE TO FINE SAND, FIRM, DARK GRAY.
690	20		15	5		SILT, NONPLASTIC, 3-5% COARSE TO FINE SAND, FIRM,BROWN, (ML).
	25		11	6		GRAVELLY SAND, 15-20% SUBROUNDED GRAVEL TO 0.75 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 8-12% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (SP-SM).
680	30		21	7		SANDY GRAVEL, SUBANGULAR GRAVEL TO 1.5 INCH MAXIMUM, 30-40% POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 3-8% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (GP).
	35		17	8		SANDY SILT, NONPLASTIC, 10-15% VERY FINE SAND, FIRM, LIGHT BROWN, (MS-ML).
670	40		9	9		GRAVELLY SAND, 10-15% SUBROUNDED GRAVEL TO 0.50 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 8-12% NONPLASTIC FINES, LOOSE, SATURATED, LIGHT BROWN, (SP-SM).
	45		7	10		GRAVELLY SAND, SIMILAR TO ABOVE.
660	50		28	11		GRAVELLY SAND, SIMILAR TO S#9 EXCEPT 15-20% GRAVEL TO 1.0 INCH MAXIMUM, (SP-SM).
						END OF BORING AT 51.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	[illegible]

BORING LOG 912

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 63

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 913

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 725.6

DATE DRILLED APRIL 30, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
725.6						
			10	1		SILTY SAND, UNIFORM, VERY FINE, SAND, 30-40% NONPLASTIC FINES, LOOSE, DAMP, BROWN, (SM).
720	5		19	2		CLAYEY SAND, POORLY GRADED, COARSE TO VERY FINE, MOSTLY VERY FINE, SAND, 10-15% NONPLASTIC FINES, 15-25% MODERATELY PLASTIC FINES, DAMP, COMPACT, BROWN, (0.1" LAYERS OF YELLOW AND GREEN CLAY, ALTERNATING WITH 0.1'-0.3' SILTY SAND, (SM-SC).
	10		12	3		TOP 4" SILTY SAND UNIFORM, VERY FINE SAND, 25-30% SLIGHTLY PLASTIC FINES, COMPACT, MOIST, BROWN, (SM). BOTTOM 12"- SAND, GAP GRADED MEDIUM AND VERY FINE, MOSTLY VERY FINE, 3-5% NONPLASTIC FINES, COMPACT, DAMP, LIGHT BROWN, (SP) TRACE OF MEDIUM SAND.
710	15		9	4		TOP 7" SILTY SAND, UNIFORM, VERY FINE SAND, 15-20% NONPLASTIC FINES, 8-12% MODERATELY PLASTIC FINES, LOOSE, DAMP BROWN WITH GRAY CLAY, (SM). BOTTOM 11" - SAND, UNIFORM, VERY FINE SAND, 3-8% NONPLASTIC FINES, LOOSE, DAMP, BROWN. TRACE OF BROKEN GRAVEL FRAGMENTS TO 0.75 INCH MAXIMUM IN SHOE, (SP).
	20		68	5		SANDY GRAVEL, ANGULAR GRAVEL TO 1.5 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 3-8% SLIGHTLY PLASTIC FINES, VERY DENSE, MOIST, LIGHT BROWN, (GP).
700	25		50	6		SANDY GRAVEL, SAME AS ABOVE, (GP).
	30		20	7		SANDY GRAVEL, ANGULAR GRAVEL TO 1.25 INCH MAXIMUM, 25-35% POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 3-8% NONPLASTIC FINES, COMPACT, DAMP, LIGHT YELLOW BROWN, (GP).
690	35		25	8		GRAVELLY SAND, 10-15% SUBROUNDED GRAVEL TO 1.0 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 5-8% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (SP).
	40		22	9		1ST ATTEMPT - NO RECOVERY - 1.4' PIECE OF GRAVEL LODGED IN SHOE.
			44	10		GRAVELLY SAND, 10-15% ANGULAR TO SUBROUNDED GRAVEL TO 1.25 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 1-3% NONPLASTIC FINES, DENSE, DAMP, LIGHT BROWN, (SP).
680	45		25	11		NO RECOVERY.
			38	12		GRAVELLY SAND - SAME AS SAMPLE #10 EXCEPT 30-40% GRAVEL TO 1.0 INCH MAXIMUM, (SP).
	50		98	13		SANDY GRAVEL, ANGULAR TO SUBROUNDED GRAVEL TO 0.80 INCH MAXIMUM 30-40% POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 3-8% NONPLASTIC FINES, VERY DENSE, MOIST, GRAY BROWN, MOTTLED WITH BROWN AND ORANGE BROWN, (GP).
						END OF BORING AT 51.5'
	55					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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BORING LOG 913

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 64

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 914
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV.
DATE DRILLED APRIL 30, 1974 DRILLED BY AMERICAN LOGGED BY JDG
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
			14	1		SILTY SAND, MOSTLY UNIFORM, VERY FINE, 20-25% SLIGHTLY PLASTIC FINES, SOME ORGANIC, DAMP, MEDIUM BROWN WITH SOME GRAY, 1 1/4" SLAG PEBBLE, (SM).
	5		22	2		SILTY SAND, MOSTLY UNIFORM, FINE TO VERY FINE, 10-15% NONPLASTIC FINES, DAMP, MEDIUM BROWN WITH SOME BLACK, CONTAINS ROOT AND TWIG FRAGMENTS, (SM).
	10		14	3		SILTY SAND, WELL GRADED, COARSE TO FINE, 10-15% NONPLASTIC FINES, DAMP, MEDIUM BROWN WITH SOME GRAY AND BLACK, (SM).
	15		55	4		GRAVELLY SAND, POORLY GRADED, VERY COARSE TO VERY FINE, 15-20% NONPLASTIC FINES, DAMP, MEDIUM BROWN, LAYERS OF VARIED SILT AT TOP OF RUN, PEBBLES TO 1", (SP-SM).
	20		50	5		SAND, WELL GRADED, COARSE TO FINE, 3-5% NONPLASTIC FINES, SAND LIGHT TO MEDIUM BROWN, FEW PEBBLES TO 3/4", (SP).
	25		31	6		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, DAMP, MEDIUM BROWN, FEW PEBBLES TO 3/4", (SP).
	30		58	7		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, MOIST, MEDIUM TO DARK BROWN, PEBBLES TO 1/2", MOSTLY SANDSTONE FRAGMENTS, PIECE OF WEATHERED GRAY SANDSTONE AT BOTTOM OF RUN, (SP).
	35		53	8		GRAVELLY SAND, SAME AS ABOVE, PEBBLES TO 1 1/4", (SP).
	40		63	9		GRAVELLY SAND: SAME AS ABOVE, (SP)
	45		41	10		SAND, UNIFORM, FINE, 5-10% NONPLASTIC FINES, MOIST, MEDIUM BROWN TOP 1/3 OF RUN, (SP-SM), CHANGING TO SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, MEDIUM BROWN, PEBBLES TO 1/2".
	50		32	11		SAND, UNIFORM, FINE, 5-10% NONPLASTIC FINES, WET, MEDIUM BROWN, (SP).
						END OF BORING AT 50.0'
	55					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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2	
1	4/4/74

BORING LOG 914

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 65

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 915
TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 686.8'
DATE DRILLED JUNE 7, 1974 DRILLED BY AMERICAN LOGGED BY D.F.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
686.8						
680	5		5	1		SILT, MODERATELY PLASTIC, 6-10% VERY FINE SAND, DARK BROWN, (SM)
	10		9	2		SILTY SAND, UNIFORM, VERY FINE, 15-20% MODERATELY PLASTIC FINES, DARK BROWN. (SM)
670	15		11	3		SAND, UNIFORM, FINE, LESS THAN 3% MEDIUM AND COARSE SAND, 5-7% FINES, YELLOWISH BROWN. (SP)
	20		4	4		CLAYEY SAND, UNIFORM, VERY FINE, 8-10% SLIGHTLY TO MODERATELY PLASTIC FINES, YELLOWISH BROWN. (SC)
660	25		6	5		CLAYEY SAND, SIMILAR TO SS #4.
	30		37	6		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 10-15% GRAVEL TO 1.9 INCH MAXIMUM, 4-6% FINES, LIGHT BROWN. (SP)
650	35		27	7		SAND, UNIFORM, FINE, LESS THAN 4% MEDIUM SAND, 3-4% FINES, LIGHT BROWN. (SP)
	40		22	8		SAND, SIMILAR TO ABOVE EXCEPT SAMPLE CONTAINS 8-10% GRAVEL TO 2.0 INCH MAXIMUM.
640	45		21	9		SANDY GRAVEL, POORLY GRADED TO 1.9 INCH MAXIMUM, 10-15% FINE TO COARSE SAND, 4-6% FINES, LIGHT BROWN. (GP)
	50		24	10		SANDY GRAVEL, POORLY GRADED TO 1.75 INCH MAXIMUM, 12-18% FINE TO COARSE SAND, MOSTLY FINE, 3-7% FINES, LIGHT YELLOWISH BROWN. (GP)
630	55		58	11		SAND, UNIFORM, FINE, LESS THAN 4% MEDIUM AND COARSE SAND, 8-12% GRAVEL TO 2.0 INCH MAXIMUM, LESS THAN 5% FINES, BLUEISH GRAY. (SP)
	60		48	12		SAND, UNIFORM, FINE, 4-6% MEDIUM SAND, 6-10% GRAVEL TO 1.75 INCH MAXIMUM, 2-4% FINES, BLUEISH GRAY. (SP)
			100/2.5"	13		BLUE SHALE FRAGMENTS AT BOTTOM OF SHOE
						END OF BORING AT 62.4'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≑ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
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1	10/7/76

BORING LOG 915

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -66

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 916

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 686.2

DATE DRILLED JUNE 7, 1974 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
686.2						
680	5		4	1		SILT, MODERATELY PLASTIC, 8-10% VERY FINE SAND, DARK BROWN. (SM)
	10		3	2		SILTY SAND, UNIFORM, VERY FINE, 10-15% MODERATELY PLASTIC FINES, DARK BROWN. (SM)
670	15		7	3		SAND, UNIFORM, FINE, 3-5% MEDIUM AND COARSE SAND, 4-6% FINES, YELLOWISH BROWN. (SP)
	20		5	4		CLAYEY SAND, UNIFORM, FINE TO VERY FINE, 6-8% MODERATELY PLASTIC FINES, YELLOWISH BROWN. (SC)
660	25		13	5		SANDY GRAVEL, POORLY GRADED TO 2.5 INCH MAXIMUM, 8-10% FINE TO COARSE SAND, MOSTLY FINE, 6-8% SLIGHTLY TO MODERATELY PLASTIC FINES, BROWN. (GP)
	30		27	6		SAND, POORLY GRADED, FINE TO MEDIUM, 10-12% GRAVEL TO 1.9 INCH MAXIMUM, 4-7% FINES, DARK BROWN. (SP)
650	35		28	7		SAND, POORLY GRADED, FINE TO MEDIUM, 6-9% GRAVEL TO 0.9 INCH MAXIMUM, 3-6% FINES, DARK BROWN. (SP)
	40		18	8		NO RECOVERY
640	45		42	9		SAND, UNIFORM, FINE, 4-7% MEDIUM SAND, 5-7% SLIGHTLY PLASTIC FINES, DARK BROWN. (SP)
	50		52	10		SAND, UNIFORM, FINE, 4-6% MEDIUM SAND, LESS THAN 1% GRAVEL TO 2.0 INCH MAXIMUM, LESS THAN 5% FINES, BLUEISH GRAY. (SP)
630	55		52	11		SAND, UNIFORM, FINE, 3-5% MEDIUM AND COARSE SAND, 2-4% FINES, BLUEISH GRAY. (SP)
	60		85	12		SAND, SIMILAR TO SS #11.
			100/2.5"	13		
620	65					END OF BORING AT 64.8'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	10/7/74

BORING LOG 916

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 67

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. TH-1
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 675.9
DATE DRILLED MARCH 29-30, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
675.9						
670	5					
	10		5	1		NO RECOVERY
			7	2		SILTY SAND, WIDELY GRADED, MEDIUM TO FINE, MOSTLY FINE, 10-20% NONPLASTIC FINES, LOOSE, MOIST, DARK BROWN. (SM)
660	15		5	3		SILTY SAND, UNIFORM, FINE, 15-20% NONPLASTIC FINES, LOOSE, DAMP, DARK BROWN. (SM)
	20		135	4		SILTY SAND, WIDELY GRADED, 10-15% ANGULAR GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, VERY DENSE, DAMP, GREENISH BROWN. (SM)
650	25		12	5		GRAVELLY SAND, WIDELY GRADED, 15-25% ANGULAR TO ROUNDED GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 5-10% NONPLASTIC FINES, COMPACT, SATURATED, DARK BROWN. (SP)
	30		14	6		SAND, POORLY GRADED, 3-8% SUBROUNDED GRAVEL TO 0.7 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY MEDIUM, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN. (SP)
640	35		21	7		TOP 14 INCHES: SAND, UNIFORM, MEDIUM, COMPACT, BROWN. (WASH?) (SP) BOTTOM 4 INCHES: SILTY SAND, WIDELY GRADED, 3-8% ROUNDED GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, COMPACT, MEDIUM BROWN. (SM)
	40		28	8		SAND, POORLY GRADED, MEDIUM TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, COMPACT, MEDIUM BROWN. (SP)
630	45		27	9		SAND, SAME AS SS #8. (SP)
	50		23	10		SAND, SAME AS SS #8. (SP)
620	55		164 / 7"	11		TOP 5 INCHES: SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, DENSE, MEDIUM BROWN. (SM) BOTTOM 2 INCHES: LIGHT GRAY SHALE , 0° BEDDING, SEVERELY WEATHERED.
						END OF BORING AT 56.6'
	60					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	[illegible]

BORING LOG TH-1

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 4

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. TH-2

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676.5

DATE DRILLED MARCH 30-APRIL 2,1974 DRILLED BY AMERICAN LOGGED BY J.E.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD 0 25 50 75 100	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.5						
	5		7	1		NO RECOVERY
670			4	2		NO RECOVERY
	10		2	3		SILTY SAND, WIDELY GRADED, MEDIUM TO FINE, MOSTLY FINE, 15-20% NONPLASTIC FINES, VERY LOOSE, SATURATED, DARK BROWN, MANY WOOD PIECES, FEW CLAY POCKETS. (SM)
660	15		2	4		ORGANIC SILT, NONPLASTIC, 20-30% FINE SAND, VERY SOFT, BLACK, OILY SMELL, ROOTS AND FIBERS. (OL)
	20		13	5		SANDY GRAVEL, POORLY GRADED, ANGULAR TO ROUNDED TO 1.1 INCH MAXIMUM 25-35% COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, COMPACT, BLACK AND BROWN, OILY SMELL. (GP)
650	25		19	6		SANDY GRAVEL, SIMILAR TO SS #5, EXCEPT NO BLACK OR OILY SMELL. (GP)
	30		12	7		SAND, POORLY GRADED, 5-10% ROUNDED GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN. (SP)
640	35		7	8		NO RECOVERY
			9	9		GRAVELLY SAND, SIMILAR TO SS #7, EXCEPT 10-20% ROUNDED GRAVEL TO 0.9 INCH MAXIMUM. (SP)
	40		17	10		SILTY SAND, UNIFORM, FINE, 15-20% NONPLASTIC FINES, COMPACT, LIGHT BROWN. (SM)
630	45		25	11		SAND, WELL GRADED, COARSE TO FINE, 3-8% NONPLASTIC FINES, COMPACT, DARK BROWN. (SW)
	50		30	12		SAND, SAME AS SS #11. (SW)
620	55		129 / 10"	13		TOP 8 INCHES: SAND, SAME AS SS #11. (SW) BOTTOM 2 INCHES: LIGHT GRAY SHALE, HIGHLY WEATHERED.
						END OF BORING AT 56.7'
	60					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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BORING LOG TH-2

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 5

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE: BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. TH-3
TYPE OF BORING: SPLIT SPOON LOCATION: SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676.7
DATE DRILLED: MARCH 30, 1974 DRILLED BY: AMERICAN LOGGED BY: F.P.V.
SUMMARY OF BORING:

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.7						
			104	1		GRAVELLY SAND, POORLY GRADED, COARSE TO VERY FINE, DAMP, MEDIUM BROWN, PEBBLES TO 1 1/2 INCH (FILL), 3-5% NONPLASTIC FINES. (SP)
670	5		18	2		GRAVELLY SAND, POORLY GRADED, COARSE TO VERY FINE, 5-10% NONPLASTIC FINES, WET, MEDIUM BROWN, FEW PEBBLES TO 1 INCH. (SP)
	10		2	3		SILTY SAND, UNIFORM, FINE TO VERY FINE, 10-15% NONPLASTIC FINES, MEDIUM BROWN, TRACE OF COAL. (SM)
660	15		1	4		SANDY SILT, MODERATELY PLASTIC, 15-20% VERY FINE SAND, VERY SOFT, WET, DARK GRAY TO BLACK, HIGH COAL CONTENT. (ML)
	20		7	5		NO RECOVERY.
			20	6		SILTY SAND, WIDELY GRADED, COARSE TO VERY FINE, 10-15% SLIGHTLY TO MODERATELY PLASTIC FINES, WET, DARK GRAY CHANGING TO MEDIUM GRAY. (SM)
650	25		32	7		SANDY GRAVEL, WIDELY GRADED, COARSE TO VERY FINE, 5-10% SLIGHTLY TO PLASTIC FINES, WET, MEDIUM GRAY-BROWN, PEBBLES TO 1 1/4 INCH. (GP)
	30		10	8		SANDY GRAVEL, GAP GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1 INCH. (GP)
	35		15	9		NO RECOVERY.
640			[illegible]	10		SAND, UNIFORM, MEDIUM TO FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, MEDIUM BROWN. (SP)
	40		15	11		GRAVELLY SAND, UNIFORM, COARSE TO MEDIUM, LESS THAN 1% NONPLASTIC FINES, WET, MEDIUM GRAY-BROWN. (SP)
630	45		31	12		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NONPLASTIC FINES, SATURATED, MEDIUM BROWN, FEW PEBBLES TO 1/2 INCH. (SP)
	50		23	13		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1/2 INCH. (SW)
620	55		44	14		SAND, UNIFORM, MEDIUM TO FINE, LESS THAN 1% NONPLASTIC FINES, WET, MEDIUM BROWN, 1/2 INCH GRAY CLAY SEAM NEAR BOTTOM OF RUN. TOP OF ROCK AT 57.0'
			100/0"			
	60					END OF BORING AT 58.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	M 10/7/74

BORING LOG TH-3

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 6

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. TH-4
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676.0
DATE DRILLED APRIL 10-11, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D./F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.0						
670	5		7	1		SILTY SAND, WIDELY GRADED, COARSE TO FINE, 6-8% GRAVEL TO 7/8 INCH ANGULAR, 15-20% COARSE SAND, SUB-ROUNDED, 30-40% SLIGHTLY PLASTIC, DARK BROWN SILT WITH BLACK ORGANIC STREAKS, DAMP TO MOIST. (SP)
	10		3	2		CLAYEY SILT, SLIGHTLY PLASTIC, 10-20% FINE AND MEDIUM SAND, VERY SOFT, 20-30% MODERATELY PLASTIC CLAY WITH SOME BLACK ORGANIC, BLACK TO BROWN. (MH)
660	15		1/18"	3		NO RECOVERY
			1/18"	4		NO RECOVERY
	20		1/18"	5		SANDY CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, 15-20% FINE SAND, 15-20% SLIGHTLY PLASTIC CLAY, ROOTS, VERY SOFT, BLACK ORGANIC STREAKS, BLACK TO BROWN. (ML)
			WOH 18"	6		SANDY CLAYEY SILT, SAME AS ABOVE. (ML)
650	25		42	7		SAND, WELL GRADED, COARSE TO FINE, 5-10% NONPLASTIC FINES, MOIST, MEDIUM GRAY BROWN, FEW PEBBLES TO 1/2 INCH. (SW)
	30		37	8		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, MEDIUM BROWN, FEW PEBBLES TO 1 INCH. (SP)
640	35		53	9		GRAVELLY SAND, WELL GRADED, VERY COARSE TO FINE, 5-10% NONPLASTIC FINES, WET, MEDIUM BROWN TO GRAY, PEBBLES TO 3/4 INCH. (SW)
	40		47	10		GRAVELLY SAND, WELL GRADED, VERY COARSE TO FINE, 3-5% NONPLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1 INCH, SOME SANDSTONE FRAGMENTS. (SW)
630	45		31	11		GRAVELLY SAND, POORLY GRADED, VERY COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NONPLASTIC FINES, MOIST, LIGHT TO MEDIUM GRAY-BROWN, PEBBLES TO 1 INCH. (SP)
	50		57	12		SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, WET, MEDIUM GRAY-BROWN. (SW)
620	55		200 6"	13		SAND, MOSTLY UNIFORM, MEDIUM TO FINE, LESS THAN 1% NONPLASTIC FINES, WET, MEDIUM BROWN. (SP) GRAY SHALE ; BOTTOM 1 INCH OF SAMPLE.
						END OF BORING AT 57.0'
	60					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
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1	[illegible handwritten initials]

BORING LOG TH-4

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
11700 - GSK - 7

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. TH-5

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676.0

DATE DRILLED APRIL 15, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.0						
670	5		14	1		PUSHED COBBLE (FROM 5'-10')
			25	2		
			4	3		
	10		2	4		SANDY SILT, SLIGHTLY PLASTIC, 8-12% GRAVEL TO 1.75 INCH MAXIMUM DIAMETER, SUB-ROUNDED, 10-20% FINE SAND, VERY SOFT, DARK BROWN, LESS THAN 5% REDDISH CLAYEY MATERIAL, TRACE OF ORGANIC MATTER THROUGHOUT, SMALL ROOTS. (W.O.H. - KEPT SINKING) (ML)
660	15		2	5		TOP 12 INCHES: SANDY SILT, SAME AS ABOVE, NO GRAVEL. (ML) BOTTOM 6 INCHES: BLACK ORGANIC SANDY SILT, SLIGHTLY PLASTIC, 20-30% FINE SAND, VERY SOFT, BLACK, SMALL ROOTS, ORGANIC OILY SMELL. (OH)
	20		28	6		ORGANIC SAND, WIDELY GRADED SAND, COARSE TO FINE, 8-12% GRAVEL TO 1.6 INCH MAXIMUM DIAMETER, SUB-ROUNDED, 20-30% SLIGHTLY PLASTIC FINES, MOIST, BROWN BLACK, ORGANIC MATERIAL THROUGHOUT. (SP-OL)
650	25		25	7		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 10-15% GRAVEL TO 1.4 INCH MAXIMUM DIAMETER, SUB-ANGULAR, 20-25% COARSE SAND, SUB-ANGULAR, 10-15% NONPLASTIC FINES, COMPACT, MOIST TO SATURATED, SEPARATE DARK YELLOW AND DARK GREEN COLORS, OILY SMELL. (SP-SW)
	30		33	8		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 15-20% GRAVEL TO 1.4 INCH MAXIMUM DIAMETER, SUB-ROUNDED TO ANGULAR, 15-20% FINE UNIFORM SAND, 8-12% NONPLASTIC FINES, MOIST, DENSE, MEDIUM BROWN, OILY SMELL. (SP-SW)
640	35		48	9		PUSHED BOULDER -HAD TO TRI-CONE THROUGH
	40		40	10		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 15-20% GRAVEL TO 7/8 INCH MAXIMUM DIAMETER, SUB-ROUNDED TO ANGULAR, 20% COARSE SAND, ANGULAR, ANGULAR FINE TO MEDIUM SAND, LESS THAN 5% NONPLASTIC FINES, DAMP, DENSE, LIGHT BROWN, OILY SMELL. (SP-SW)
630	45		101	11		SAND, POORLY GRADED, COARSE TO FINE, 1 PIECE OF GRAVEL, 1.4 INCH DIAMETER, SUB-ROUNDED, 15-25% COARSE TO MEDIUM SAND, FINE UNIFORM, SUB-ROUNDED SAND, LESS THAN 5% NONPLASTIC FINES, DAMP, VERY DENSE, LIGHT BROWN, OILY SMELL. (SP)
	50		70	12		SAND, WIDELY GRADED, COARSE TO FINE, 1 PIECE OF GRAVEL, 1 7/8 INCH DIAMETER, ANGULAR, 10% COARSE SAND, DAMP, VERY DENSE, LESS THAN 5% NONPLASTIC FINES, ROUNDED AND SUB-ANGULAR MEDIUM SAND, MEDIUM BROWN, OILY SMELL. (SP-SW)
620	55		78	13		SAND, UNIFORMLY GRADED, FINE SAND, LESS THAN 5% MEDIUM SAND, DAMP, VERY DENSE, LESS THAN 3% NONPLASTIC FINES, LIGHT BROWN, TRACE OF COAL, OILY SMELL. (SP)
	60					END OF BORING AT 57.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≡ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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BORING LOG TH-5

BEAVER VALLEY POWER STATION--UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 8

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. TH-6

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676.0

DATE DRILLED APRIL 16, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.0						
670	5		11	1		SAND, WIDELY GRADED, COARSE TO FINE, 20-30% COARSE SAND, SUB-ROUNDED, 50-60% MEDIUM TO FINE SAND, SUBROUNDED AND ANGULAR, 8-12% SLIGHTLY PLASTIC FINES, MOIST, COMPACT, MEDIUM BROWN, OILY SMELL. (SP-SW)
	10		2	2		SANDY SILT, SLIGHTLY PLASTIC, 20-30% FINE TO MEDIUM SAND, GREEN BROWN, ROOTS AND ORGANIC MATERIAL THROUGHOUT IN SMALL AMOUNT, LESS THAN 5% COARSE SAND IN SAMPLE, OILY SMELL. (ML)
	15		1/18"	3		
660			WOH	4		
	20		2	5		SANDY ORGANIC SILT, MODERATELY PLASTIC, 10-15% SMALL GRAVEL, SUB-ROUNDED, COARSE TO FINE SAND, MOSTLY FINE SAND, BROWN BLACK, ORGANIC SMELL, TRACE OF ROOTS THROUGHOUT. (OL)
650	25		68	6		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, GRAVEL TO 1.75 INCH MAXIMUM DIAMETER, SUB-ROUNDED TO ANGULAR, 15-20% COARSE SAND, 8-12% SLIGHTLY PLASTIC FINES, VERY DENSE, DAMP, GREEN BROWN. (SP-SW)
	30		14	7		SILTY SAND, POORLY GRADED, COARSE TO FINE, 1 PIECE OF GRAVEL TO 1.25 INCH DIAMETER, SUB-ROUNDED, 20-30% GRAVEL, 10% COARSE SAND, 30% FINE SAND, 14-18% NONPLASTIC FINES, SATURATED, COMPACT, LIGHT BROWN. (SP)
640	35		15	8		SILTY SAND, COARSE TO FINE SAND, WIDELY GRADED, 1 PIECE OF GRAVEL TO 1.25 INCH MAXIMUM DIAMETER, ANGULAR, 20-25% GRAVEL, 25-30% COARSE SAND, 14-18% NONPLASTIC FINES, SATURATED, COMPACT, LIGHT BROWN. (SP)
	40		19	9		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 20-30% GRAVEL TO 1.0 INCH MAXIMUM DIAMETER, SUB-ROUNDED, 10-15% COARSE SAND, SUB-ROUNDED, 8-12% NONPLASTIC FINES, COMPACT, MOIST, LIGHT BROWN. (SP)
630	45		23	10		GRAVELLY SILTY SAND, WIDELY GRADED, COARSE TO FINE, 10-15% GRAVEL TO 1 3/8 INCH MAXIMUM DIAMETER, SUB-ANGULAR, MOSTLY FINE TO MEDIUM SAND, 12-15% NONPLASTIC FINES, MOIST, COMPACT, LIGHT BROWN. (SM-SP)
	50		59	11		SAND, WELL GRADED, COARSE TO FINE, 8-12% GRAVEL TO 1.25 INCH MAXIMUM DIAMETER, SUB-ROUNDED TO ANGULAR, MOIST, VERY DENSE, 8-12% NONPLASTIC FINES, MEDIUM BROWN. (SW)
620	55		44	12		SAND, FINE UNIFORM SAND, 8-12% GRAVEL TO 1 3/8 INCH MAXIMUM DIAMETER, SUB-ANGULAR, LESS THAN 5% NONPLASTIC FINES, DAMP, LIGHT BROWN. (SP)
						END OF BORING AT 56.5'
	60					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ◻ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	[signature]

BORING LOG TH-6

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 9

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 537 C
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 657.8
DATE DRILLED MARCH 18, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
657.8						
			2	1		SILTY SAND, UNIFORMLY GRADED, FINE, SUB-ROUNDED PARTICLES, 30% SLIGHTLY PLASTIC FINES, VERY LOOSE, SATURATED, GRAY BROWN. (SM)
	5					
650			53	2		GRAVELLY SAND, GAP-GRADED, FINE AND COARSE SAND, COARSE ANGULAR AND SUB-ROUNDED FINE PARTICLES, 30% GRAVEL TO 1 1/4" DIAMETER, SUB-ANGULAR, MOIST, 8% SLIGHTLY PLASTIC FINES, COMPACT, MEDIUM BROWN. (SP)
	10					
			9	3		NO RECOVERY
	15		7	4		NO RECOVERY
640			8	5		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE PARTICLES, SUB-ROUNDED, 5% NONPLASTIC FINES, SATURATED, VERY LOOSE, BROWN, TWO PIECES OF ANGULAR GRAVEL IN SHOE, 1 1/4" DIAMETER. (SW)
	20					
			15	6		GRAVELLY SAND, POORLY GRADED, FINE TO MEDIUM SAND, ANGULAR AND SUB-ROUNDED, 3 PIECES OF GRAVEL TO 1" DIAMETER, ANGULAR, LESS THAN 3% FINES, MOIST, COMPACT, GRAY BROWN. (SP)
	25		15	7		6" - SAND, POORLY GRADED, FINE SAND PARTICLES, 15% MEDIUM SAND SIZES, SUB-ROUNDED, 10% NONPLASTIC FINES, MOIST, COMPACT, LIGHT BROWN.. (SM) 12" - SAND, WELL GRADED FROM FINE TO MEDIUM SAND PARTICLES, SUB-ROUNDED AND ANGULAR PARTICLES, 50% MEDIUM SAND, 40% FINE SAND, 10% NONPLASTIC FINES, MOIST, COMPACT, BROWN. (SW)
630	30		18	8		SAND, WELL GRADED FROM FINE TO MEDIUM SIZE PARTICLES, 50% MEDIUM SAND, SUB-ROUNDED AND ANGULAR, 40% FINE SAND, SUB-ROUNDED, 10% NONPLASTIC FINES, MOIST, LIGHT BROWN, LOOSE. (SW)
	35		22	9		SAND, SAME AS ABOVE, EXCEPT LESS THAN 10% MEDIUM SAND, MORE THAN 10% FINE SAND. (SP)
620			116/7"	10		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE SAND, 10% NONPLASTIC FINES, PARTICLES ROUNDED AND ANGULAR, MOIST, COMPACT, MEDIUM BROWN, 15% SMALL GRAVEL. (SP)
	40					END OF BORING AT 39.4'
	45					
	50					
	55					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
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1	[illegible]

BORING LOG 537 C

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 10

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 538 T

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 655.3

DATE DRILLED MARCH 20, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
655.3						
			1	1		GRAVELLY SAND, GAP GRADED, COARSE TO FINE SAND, ROUNDED TO ANGULAR, 40% ANGULAR, GRAVEL TO 1 3/4 INCH DIAMETER, 20% COARSE SAND, ANGULAR, 30% FINE SAND, SUB-ROUNDED, 10% NONPLASTIC FINES, SATURATED, VERY LOOSE, DARK GREEN. (SP)
650	5					
			60	2		GRAVELLY SAND, GAP GRADED, COARSE TO FINE SAND, 1 LARGE PIECE OF GRAVEL, ANGULAR, 2 INCH DIAMETER, 15% SMALLER GRAVEL, 50% COARSE SUB-ROUNDED SAND, 30% FINE SAND, 5% NONPLASTIC FINES, MOIST, COMPACT, GRAY GREEN. (SP)
	10					
			5	3		NO RECOVERY
640	15		4	4		SAND, WIDELY GRADED, COARSE TO FINE, SUB-ROUNDED, 30% COARSE, 30% MEDIUM, 30% FINE SAND, 5% NONPLASTIC FINES, DAMP, VERY LOOSE, LIGHT BROWN. (SP-SW)
			7	5		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE SAND, GRAVEL TO 1 INCH DIAMETER, 15% GRAVEL, 20% COARSE SAND, 20% MEDIUM SAND, 30% FINE SAND, 5% NONPLASTIC FINES, MOIST, VERY LOOSE, BROWN. (SP-SW)
	20					
			19	6		GRAVELLY SAND, SAME AS ABOVE EXCEPT 10% NONPLASTIC FINES, AND GRAVEL ONLY TO 3/4 INCH DIAMETER. (SP-SW)
630	25					
			22	7		GRAVELLY SAND, SAME AS SAMPLE #6. (SP-SW)
	30					
			11	8		FIRST 3 INCHES: SAND, SAME AS SAMPLE #4. (SP-SW) LAST 4 INCHES: GRAVELLY SAND, WIDELY GRADED, FROM FINE TO COARSE SAND SIZES, GRAVEL TO 1 1/2 INCHES, 25% GRAVEL, ANGULAR, 30% MEDIUM AND COARSE SAND, 10% NONPLASTIC FINES, 35% FINE SAND, DAMP, COMPACT, LIGHT BROWN. (SP)
620	35					
			100/3"	9		TOP 2.5 INCHES: GRAVELLY SAND, SAME AS ABOVE. (SP) BOTTOM 2.5 INCHES: DECOMPOSED CLAYEY SHALE, HIGHLY PLASTIC, DAMP, DARK GRAY, HARD. (CH)
	40					END OF BORING AT 39.3'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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BORING LOG 538 T

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 11

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 539 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 640.75

DATE DRILLED MARCH 22, 1974 DRILLED BY LOGGED BY J.P.D.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
640.75						
			PUSH	1		
			5	2		
	5		9	3		GRAVELLY SAND, UNIFORMLY GRADED, FINE SAND, SUBROUNDED; 25% GRAVEL, SUBROUNDED, TO 1½" DIA., 15% NONPLASTIC FINES, SATURATED, LOOSE TO VERY LOOSE, GRAY BROWN. (SP)
630	10		21	4		TOP 4"-SAND, WIDELY GRADED, FINE TO MEDIUM SAND, SUBROUNDED ANGULAR PARTICLES, 5% FINES, NONPLASTIC, DAMP, LOOSE BROWN (SP); BOTTOM 8"-SAND, WELL GRADED, EVEN DISTRIBUTION OF PARTICLE SIZE AND SHAPE, 10% GRAVEL TO 3/4" DIA., ANGULAR; 10% NONPLASTIC FINES, SATURATED, LOOSE BROWN. (SW)
			18	5		
	15		19	6		SAME AS ABOVE EXCEPT ALL DAMP.
620	20		21	7		SAME AS ABOVE, WIDELY GRADED. (SP) BOTTOM 3"-SAND, WIDELY GRADED, MEDIUM TO COARSE SAND, SUBROUNDED, 10% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (SM)
	25		33	8		TOP 3"-SAND, WIDELY GRADED, SUBROUNDED AND ANGULAR, MOIST, BROWN. MIDDLE 12" - SAND, UNIFORMLY GRADED,COARSE SAND, 5% NONPLASTIC FINES ANGULAR, MOIST, BROWN. (SP) BOTTOM 3" - GRAVELLY SAND, WIDELY GRADED, 15% GRAVEL TO 1" DIAMETER, 15% SLIGHTLY PLASTIC FINES, BROWN, MOIST. (SP)
			100/2"	9		NO RECCOVERY
						END OF BORING AT 28.3'
	30					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	(initials)

BORING LOG 539 t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 12

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 540 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 646.1

DATE DRILLED MARCH 25, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
646.1						
			WOH	1		NO RECOVERY.
			10	2		SILTY SAND, WIDELY GRADED, 8-12% SUBROUNDED GRAVEL TO 1.0 IN. MAX., COARSE TO FINE, MOSTLY COARSE AND FINE, 15-20% NONPLASTIC FINES, LOOSE, SATURATED, DARK BROWN. (SM)
640	5					
			14	3		SAND, POORLY GRADED, MEDIUM AND FINE, MOSTLY MEDIUM, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN. (SP)
	10					
			16	4		GRAVELLY SAND, POORLY GRADED, 5-10% ROUNDED GRAVEL TO 1.2 IN. MAX., COARSE AND MEDIUM SAND, COMPACT, DARK BROWN. (SP)
630	15					
			26	5		GRAVELLY SAND, SIMILAR TO S #4, EXCEPT POCKET OF LIGHT BROWN SILTY SAND IN MIDDLE SAMPLE. (SP)
	20					
			37	6		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY MEDIUM, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN, POCKET OF LIGHT BROWN SILTY SAND AT BOTTOM OF SAMPLE. (SP)
620	25					
			100/2"	7		NO RECOVERY.
						END OF BORING AT 27.7'
	30					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≡ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5.][INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 540 t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 13

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 541C

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 650.9'

DATE DRILLED MARCH 26, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
650.9						
650			WOH	1		NO RECOVERY
			2	2		NO RECOVERY
	5		3	3		GRAVELLY SAND, POORLY GRADED, 15-20% SUBANGULAR GRAVEL TO 1.2 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, LOOSE, SATURATED, DARK BROWN. (SP)
			19	4		GRAVELLY SAND, SIMILAR TO SS #3, EXCEPT COMPACT, 2 INCH POCKET DARK GRAY SILTY SAND. (SP)
640	10		19	5		SILTY SAND, WIDELY GRADED, 5-10% ANGULAR GRAVEL TO 0.8 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY FINE, 15-25% NONPLASTIC FINES, COMPACT, DARK AND LIGHT BROWN. (SM)
	15		9	6		NO RECOVERY
			9	7		SILTY SAND, WIDELY GRADED, 5-10% ANGULAR GRAVEL TO 1.2 INCH MAXIMUM COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, COMPACT, DARK BROWN. (SM)
	20		100/2"	8		NO RECOVERY
						END OF BORING AT 21.0'
	25					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	M 10/1/74

BORING LOG 541C

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 14

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 542 C
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 653.3
DATE DRILLED MARCH 27, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
653.3						
			WOH	1		NO RECOVERY
650			2	2		NO RECOVERY
			3	3		NO RECOVERY
	5		7	4		GRAVELLY SAND, POORLY GRADED, 10-20% ANGULAR GRAVEL TO 1.0 INCH MAXIMUM, COARSE TO FINE SAND, MOSTLY COARSE, 1-5% NONPLASTIC FINES, SATURATED, LOOSE, DARK BROWN. (SP)
			3	5		NO RECOVERY
	10		11	6		NO RECOVERY
			10	7		SAND, WELL GRADED, COARSE TO FINE, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN. (SW)
640			11	8		SILTY SAND, WIDELY GRADED, COARSE TO FINE, MOSTLY FINE, 5-10% NONPLASTIC FINES, COMPACT, DARK BROWN. (SM-SP)
	15					
	20		17	9		SILTY SAND, SAME AS SS #8. (SM-SP)
630	25		19	10		SILTY SAND, POORLY GRADED, MEDIUM AND FINE, MOSTLY FINE, 10-15% NONPLASTIC FINES, COMPACT, DARK BROWN. (SM)
	30		19	11		SILTY SAND, SIMILAR EXCEPT 15-20% NONPLASTIC FINES, (SM)
			100/6"	12		DARK GREEN SANDSTONE.
	35					END OF BORING AT 33.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	6/17/75

BORING LOG 542 C

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 15

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 543 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 672.84

DATE DRILLED MARCH 26-27, 1974 DRILLED BY LOGGED BY J.E.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
672.84						
670			31	1		SILTY SAND, WIDELY GRADED, 8-12% SUBROUNDED GRAVEL TO 1.0 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, DRY, DENSE, MEDIUM BROWN AND BLACK, MUCH COAL. (SM)
	5		12	2		SANDY GRAVEL, POORLY GRADED, ANGULAR TO 1.0 IN. MAX., COARSE TO FINE SAND, MOSTLY COARSE, 1-5% NONPLASTIC FINES, SATURATED, COMPACT, DARK BROWN. (GP)
	10		7	3		SANDY SILT, NONPLASTIC, 20-30% COARSE TO FINE SAND, MOSTLY FINE, FIRM, DARK BROWN, 1.2 IN. GRAVEL AT TOP. (ML)
660	15					END OF BORING AT 12.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	M 4/7/74

BORING LOG 543 T

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

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DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE: BEAVER VALLEY POWER STATION   J.O. No. 11700   BORING NO. 543 A t

TYPE OF BORING: SPLIT SPOON   LOCATION: SHIPPINGPORT, PENNSYLVANIA   GROUND ELEV. 672.8

DATE DRILLED: MARCH 27-29, 1974   DRILLED BY: AMERICAN   LOGGED BY: J.E.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
672.8						
670						
	5		27	1		SILTY SAND, WIDELY GRADED, 10-15% ANGULAR GRAVEL TO 1.0 IN. MAX., COARSE TO FINE SAND, 15-20% NONPLASTIC FINES, SATURATED, COMPACT, DARK BROWN. (SM)
	10		6	2		SANDY SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 25-35% MEDIUM TO FINE SAND, MOSTLY FINE, FIRM, DARK BROWN, TRACE COAL. (ML)
660						
	15		3	3		SANDY SILT, NONPLASTIC, 20-30% FINE SAND, SOFT, BLACK AND BROWN, OILY SMELL. (ML)
	20		33	4		GRAVELLY SAND, WIDELY GRADED, 10-20% ANGULAR GRAVEL TO 1.0 IN. MAX., COARSE TO FINE, MOSTLY FINE, 5-10% NONPLASTIC FINES, DENSE BLACK AND GRAY. (SP)
650						
	25		16	5		SILTY SAND, WIDELY GRADED, COARSE TO FINE SAND, MOSTLY FINE, 10-20% NONPLASTIC FINES, COMPACT, MEDIUM BROWN. (SM)
	30		11	6		GRAVELLY SAND, WELL GRADED, 5-10% ROUNDED GRAVEL TO 1.0 IN. MAX., COARSE TO FINE SAND, 1-5% NONPLASTIC FINES, COMPACT, DARK BROWN. (SW)
640						
	35		10	7		SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, LOOSE, LIGHT BROWN. (SM)
	40		18	8		GRAVELLY SAND, WELL GRADED, 10-15% ROUNDED GRAVEL TO 1.0 IN. MAX., COARSE TO FINE, 3-8% NONPLASTIC FINES, VERY DENSE, MEDIUM BROWN. (SW)
630						
	45		29	9		GRAVELLY SAND, SAME AS S #8. (SW)
	50		30	10		SAND, WELL GRADED, 3-8% SUBANGULAR GRAVEL TO 0.7 IN. MAX., COARSE TO FINE SAND, 3-8% NONPLASTIC FINES, COMPACT, DARK BROWN. (SW)
620						
	55		100/3"			NO RECOVERY.
						TOP OF ROCK AT 55.0'
						END OF BORING AT 55.3'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	4/7/74

BORING LOG 543 A t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 17

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 544 t

TYPE OF BORING ______ LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 674.17

DATE DRILLED MARCH 30-APRIL 1, 1974 DRILLED BY AMERICAN LOGGED BY J.E.P.

SUMMARY OF BORING

Column headings: ELEV. FEET | DEPTH FEET | OVERALL WEATHERING AND RQD (0 25 50 75 100) | SAMPLE (BLOWS OR RECOV., TYPE) | GRAPHIC LOG | SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS — SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)

Elevation scale: 674.17, 670, 660, 650, 640, 630, 620

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

BLOWS OR RECOV.	TYPE	SOIL OR ROCK DESCRIPTION
5	1	SILTY SAND, WIDELY GRADED, 8-12% ANGULAR GRAVEL TO 0.7 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 20-30% NONPLASTIC FINES, LOOSE, MOIST DARK BROWN AND BLACK, ORGANIC. (SM)
1	2	ORGANIC SILT, NONPLASTIC, 25-35% FINE SAND, VERY LOOSE, SATURATED, BLACK. (OL)
70	3	SILTY SAND, WIDELY GRADED, 5-10% ANGULAR GRAVEL TO 1.0 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, VERY DENSE, LIGHT GRAY AND DARK BROWN. (SM)
10	4	GRAVELLY SAND, POORLY GRADED, 8-12% SUBANGULAR TO 1.1 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, LOOSE, DARK BROWN. (SP)
5	5	SILTY SAND, WIDELY GRADED, MEDIUM TO FINE, MOSTLY FINE, 8-12% NON-PLASTIC FINES, LOOSE, MEDIUM BROWN. (SM-SP)
11	6	GRAVELLY SAND, POORLY GRADED, 10-20% ROUNDED GRAVEL TO 1.1 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 3-8% NONPLASTIC FINES, COMPACT, MEDIUM BROWN. (SP)
18	7	GRAVELLY SAND, SIMILAR TO S #6 EXCEPT 20-30% ROUNDED GRAVEL TO 0.9 IN. MAX. (SP)
19	8	GRAVELLY SAND, SAME AS S #7. (SP)
34	9	SILTY SAND, WIDELY GRADED, 3-8% ROUNDED GRAVEL TO 0.7 IN. MAX., COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, DENSE, DARK BROWN. (SM)
100/5"		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-5% NONPLASTIC FINES, VERY DENSE, DARK BROWN. (SP)

TOP OF ROCK AT 55.4'

END OF BORING AT 55.4'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 544 Z

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 18

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 545 [illegible]
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 671.5'
DATE DRILLED APRIL 1, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS — SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
671.5						
	0–10					NO SAMPLES FIRST 10'
660	10		4	1		NO RECOVERY
			2	2		TOP 8 INCHES: CLAYEY ORGANIC SILT, SLIGHTLY TO MODERATELY PLASTIC, 8-12% FINE SAND, VERY SOFT, MOIST, BROWN. LAST 10 INCHES: SAME AS ABOVE, EXCEPT BLACK. (OL)
	15		2	3		CLAYEY ORGANIC SILT, SIMILAR TO ABOVE, EXCEPT SATURATED. (OL)
650	20		39	4		SAND, POORLY GRADED, FINE SUB-ROUNDED SAND, LESS THAN 5% COARSE SAND, LESS THAN 5% SLIGHTLY PLASTIC FINES, DAMP, COMPACT, DRY POCKET OF BLUE-GREEN FINE SAND, BLUE BROWN. (SP)
	25		20	5		SANDY GRAVEL, POORLY GRADED, 60% GRAVEL TO 1.75 INCH DIAMETER, 15% COARSE SAND, 18-22% FINE SAND, 5% NONPLASTIC FINES, BLUE-BROWN, DAMP, 1/2 INCH ON BOTTOM SATURATED GRAVELLY SAND, 40% GRAVEL, 60% FINE SAND. (GP)
640	30		6	6		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 40% GRAVEL TO 1.75 INCH DIAMETER, 30% COARSE SAND, 25% MEDIUM TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, VERY LOOSE, DAMP, MEDIUM BROWN. (SP)
	35		15	7		SAND, WIDELY GRADED, COARSE TO FINE, EVENLY DISTRIBUTED, 10% NONPLASTIC FINES, DAMP, MEDIUM BROWN. (SP-SW)
630	40		12	8		GRAVELLY SAND, UNIFORM, FINE, SAND, 20% GRAVEL TO 1.5 INCH DIAMETER, 10% NONPLASTIC FINES, DAMP, LOOSE, BROWN. (SP)
	45		24	9		GRAVELLY SAND, WIDELY GRADED, 15-25% GRAVEL TO 3/4 INCH DIAMETER, SAND EVENLY DISTRIBUTED, 5-8% NONPLASTIC FINES, DAMP, COMPACT, BLUE-BROWN. (SP)
620	50		31	10		GRAVELLY SAND, SIMILAR TO ABOVE. (SP)
			100/1"	11		NO RECOVERY.
	55					END OF BORING AT 55.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ∇ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [ ] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

BORING LOG 545 [illegible]

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 19

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 546 Ȼ
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 675.9'
DATE DRILLED APRIL 2, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
675.9						
	5					NO SAMPLES FIRST 10'
665	10		48	1		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, SUB-ROUNDED TO ANGULAR, 25% GRAVEL TO 1.5 INCH DIAMETER, ANGULAR, 20% COARSE TO MEDIUM SAND, 5% NONPLASTIC FINES, DAMP, COMPACT, BLUE-BROWN. (SP)
	15		11	2		SANDY GRAVEL, POORLY GRADED, SMALL GRAVEL TO 1.3 INCH DIAMETER, ANGULAR, 25-35% SAND, 8-12% MEDIUM SAND, SUB-ANGULAR, 5% NONPLASTIC FINES, DAMP, LOOSE, BROWN. (GP)
655	20		10	3		3 INCHES: GRAVELLY SAND, POORLY GRADED, COARSE TO FINE SAND, 25% ANGULAR GRAVEL TO 1.3 INCH DIAMETER, LITTLE OR NO FINES, DAMP, LOOSE, BROWN. (SP) 3 INCH LAYER OF FINE BLACK SAND, UNIFORM, VERY BLACK, ORGANIC SMELL, 5-10% NONPLASTIC FINES, DAMP. (SM) 4 INCHES: GRAVELLY SAND, SAME AS TOP 3 INCHES. (SP)
	25		18	4		GRAVELLY SAND, UNIFORM, FINE, ROUNDED SAND, GRAVEL TO 1.2 INCH DIAMETER, ANGULAR, 5% NONPLASTIC FINES, LOOSE, DAMP, BLUE-GRAY, POCKETS OF VERY DENSE, LIGHT BLUE UNIFORM SAND. (SP) LAST 2 INCHES: SANDY GRAVEL, 25% FINE SAND, BLUE-GREEN. (GP)
645	30		16	5		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE SAND, 25-35% GRAVEL, SUB-ROUNDED, TO 1.25 INCH DIAMETER, MOSTLY FINE SAND, 5% NONPLASTIC FINES, DAMP, LOOSE, BLUE-BROWN. (SP)
	35		16	6		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE SAND, 25-35% ANGULAR GRAVEL TO 1.6 INCH DIAMETER, MOSTLY FINE SAND, 5% NONPLASTIC FINES, DAMP, LOOSE, BLUE-BROWN. (SP)
635	40		10	7		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE SAND, 25-35% GRAVEL TO 1.25 INCH DIAMETER, ANGULAR, MOSTLY FINE SAND, 5% NONPLASTIC FINES, SATURATED, LOOSE, BLUE-BROWN. (SP)
	45		30	8		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, 10-20% COARSE TO MEDIUM SAND, 10-20% ANUGLAR GRAVEL TO 1 INCH DIAMETER, 5-10% NONPLASTIC FINES, DAMP, COMPACT, MEDIUM BROWN. (SP)
625	50		27	9		SAND, POORLY GRADED, MEDIUM TO FINE SAND, 5-10% ANGULAR GRAVEL 5% OF COARSE, ANGULAR SAND, DAMP, COMPACT, 5% NONPLASTIC FINES, LIGHT BROWN. (SP)
	55					END OF BORING AT 55.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ‡ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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M 1	8/7/74 RW

BORING LOG 546 Ȼ

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 20

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 547 ℄
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 676'
DATE DRILLED APRIL 3-4, 1974 DRILLED BY AMERICAN LOGGED BY J.P.D.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676						
	5					
665	10		21	1		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 35-40% GRAVEL TO 1.5 INCH DAIMETER, SUB-ROUNDED AND ANGULAR, 15-20% COARSE SAND, 5-10% SLIGHTLY PLASTIC FINES, MOIST, COMPACT, LIGHT BROWN. (SP)
	15		2	2		SAND, POORLY GRADED, COARSE TO FINE, 15-20% COARSE SAND, ANGULAR, VERY ANGULAR FINE SAND, 5-10% NONPLASTIC FINES, MOIST TO ALMOST SATURATED, VERY LOOSE, BLUE-BROWN. (SP)
655	20		34	3		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 25-35% GRAVEL TO 1.6 INCH DIAMETER, SUB-ROUNDED TO ANGULAR, 15-20% COARSE SAND, 8-12% SLIGHTLY TO MODERATELY PLASTIC FINES, DAMP, DENSE, GREEN BROWN, SAMPLE HAD 1 INCH LAYER OF DENSE, FINE, LIGHT BLUE SAND IN MIDDLE OF SPOON. (GP)
	25		35	4		SANDY GRAVEL, POORLY GRADED, WIDELY GRADED SAND, GRAVEL TO 1.5 INCH DIAMETER, ANGULAR AND SUB-ROUNDED, 35-40% COARSE TO FINE SAND, 8-12% SLIGHTLY PLASTIC FINES, 15% COARSE SAND, MOIST TO SATURATED, DENSE, BLUE-GREEN. (GP)
645	30		19	5		GRAVELLY SAND, POORLY GRADED, MEDIUM TO FINE SAND, 30-40% GRAVEL TO 1.4 INCH DIAMETER, ANGULAR AND SUB-ANGULAR, 15-20% MEDIUM SAND, SUB-ROUNDED, 6-9% NONPLASTIC FINES, DAMP, COMPACT, MEDIUM BROWN. (COBBLE IN PATH OF SPOON, SMALL RECOVERY). (SP)
	35		11	6		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE SAND, LESS THAN 10% COARSE AND MEDIUM SAND, 15-20% GRAVEL TO 1.5 INCH DIAMETER, ANGULAR 50-60% UNIFORM FINE SAND, ROUNDED, 8-12% NONPLASTIC FINES, SATURATED COMPACT, LIGHT BROWN. (SP)
635	40		20	7		SAND, WELL GRADED FROM FINE TO MEDIUM GRAIN SIZE, ROUNDED TO SUB-ANGULAR, MOIST TO SATURATED, COMPACT, 5-10% NONPLASTIC FINES, LIGHT BROWN, LAST 1 INCH IN SHOE, 1 PIECE OF GRAVEL TO 1.4 INCH DIAMETER, ANGULAR, 5-8% SLIGHTLY PLASTIC FINES, SOME FINE SAND, (SP)
	45		25	8		GRAVELLY SAND, WIDELY GRADED, COARSE TO FINE, 18-23% GRAVEL TO 1.1 INCH DIAMETER, SUB-ROUNDED, 35-45% FINE SAND, ROUNDED, 8-12% NON-PLASTIC FINES, COMPACT, MOIST, MEDIUM BROWN. (SP)
625	50		58	9		SAND, POORLY GRADED, FINE TO MEDIUM, 15% NONPLASTIC FINES. MIDDLE 3 INCHES: SAND, UNIFORMLY FINE SAND, CLEAN, 1 PIECE OF GRAVEL TO 1.2 INCH DIAMETER, ANGULAR. SAND, SAME AS TOP, EXCEPT BLACK STAIN THROUGHOUT-APPEARS AS DE-COMPOSED COAL, SLIGHTLY PLASTIC. (SP)
	55		69	10		SILTY SAND, UNIFORM FINE SAND, COARSE TO FINE SAND, 5-10% COARSE SAND, SUB-ROUNDED TO ANGULAR, 5-8% MEDIUM SAND, 15-20% NONPLASTIC FINES, DAMP TO SATURATED, VERY DENSE, LIGHT BROWN. (SP)
615						END OF BORING AT 57.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
◻7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ₹ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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1	M 10/2/74

BORING LOG 547 ℄

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 21

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 548 C

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 675.3

DATE DRILLED APRIL 4, 1974 DRILLED BY AMERICAN LOGGED BY JPD

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
675.3			3	1		GRAVELLY SANDY SILT, SLIGHTLY TO MODERATELY PLASTIC; 10-15% GRAVEL TO 1.6" DIAMETER, ANGULAR, 15-20% FINE TO MEDIUM SAND; SMALL STREAKS OF BLACK FINE MATERIAL, PROBABLY ORGANIC. (ML)
670	5		2	2		ORGANIC SANDY SILT, NONPLASTIC, 10-15% FINE UNIFORM SAND, VERY SOFT, MOIST, OILY ORGANIC SMELL; DARK BLUE GRAY; STREAKS OF BLACK ORGANIC MATERIAL THROUGHOUT. (OL)
	10		13	3		SANDY GRAVEL; POORLY GRADED, GRAVEL TO 1.5 DIAMETER, ANGULAR AND SUBROUNDED, 6-8% FINE SAND, 3% NONPLASTIC FINES, COMPACT, DAMP; BLUE BROWN. (GP)
660	15		66	4		SANDY GRAVEL, POORLY GRADED; GRAVEL TO 1.75" DIAMETER, ANGULAR 30-35% WIDELY GRADED SAND, COARSE TO FINE; 6-8% NONPLASTIC FINES, VERY DENSE; MOIST, BLUE GRAY. (GP)
	20		14	5		SAND, MOSTLY UNIFORM, FINE, LESS THAN 1% NONPLASTIC FINES, DAMP, MEDIUM GRAYISH BROWN, FEW PEBBLES TO 1/2", (SP).
650	25		17	6		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MOIST, MEDIUM ORANGE BROWN, PEBBLES TO 1", (SW).
	30		13	7		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, LESS THAN 1% NONPLASTIC FINES, WET, MEDIUM GRAYISH BROWN, PEBBLES TO 1 1/4", (SW).
640	35		24	8		SAND, WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, SATURATED, MEDIUM GRAYISH BROWN, FEW PEBBLES TO 1/2", (SW).
	40		49	9		SAND, UNIFORM, MEDIUM TO FINE, LESS THAN 1% NONPLESTIC FINES, WET, MEDIUM BROWN, (SP).
630	45		100/6"	10		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 3-5% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN WITH SOME REDDISH BROWN, FEW PEBBLES TO 1/2", (SP).
						END OF BORING AT 56.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

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BORING LOG 548 C

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 22

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 549 Σ

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 646.9'

DATE DRILLED MAY 2, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
646.9						
			14	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM TO DARK GRAY, PEBBLES TO 1". (SW)
	5					
640			11	2		SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM GRAY, BEW PEBBLES TO 3/4". (SW)
	10					
			17	3		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% NON PLASTIC FINES, MEDIUM GRAY BROWN, PEBBLES TO 1 1/4". (SW)
	15					
630			25	4		GRAVELLY SAND, AS ABOVE, MEDIUM BROWN. (SW)
	20					
			13	5		SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1/2". (SW)
	25					
620			14	6		SAND, AS ABOVE, PEBBLES TO 3/4". (SW)
						SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM BROWN. (SW)
	30		100/5"			GRAY SHALE, BOTTOM 2".
						END OF BORING @ 29.9'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 549 Σ

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 _ GSK - 23

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE: BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 550 t

TYPE OF BORING: SPLIT SPOON LOCATION: SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 650.6

DATE DRILLED: MAY 7, 1974 DRILLED BY: AMERICAN LOGGED BY: F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
650.6						
650			11	1		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 5-10% SLIGHTLY PLASTIC FINES, SOME ORGANIC, MEDIUM GRAY, PEBBLES TO 1", SLIGHT OIL SMELL. (SP)
	5		12	2		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM GRAY, PEBBLES TO 1". (SW)
640	10					
			23	3		GRAVELLY SAND, AS ABOVE, MEDIUM BROWN. (SW)
	15					
			24	4		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN. (SP)
630	20					
			37	5		SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN. (SW)
	25					
			51	6		SAND, AS ABOVE. (SW)
620	30		100 / 1"	7		NO RECOVERY (REFUSAL)
						END OF BORING @ 30.3'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. □ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	M 10/2/76

BORING LOG 550 t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 24

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 551 T
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 661.0
DATE DRILLED MAY 7, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
661.0						
660			WOR	1		SILTY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 10-15% MODERATELY PLASTIC FINES, SOME ORGANIC, DARK GRAY. (SM)
	5		1	2		NO RECOVERY.
			18	3		SILTY SAND, MOSTLY UNIFORM, FINE, 20-25% SLIGHTLY PLASTIC FINES, SOME ORGANIC, BLACK, OIL SMELL, 3 PEBBLES TO 1". (SM). SAND, MOSTLY UNIFORM, FINE, 3-5% SLIGHTLY PLASTIC FINES, SOME ORGANIC DARK GRAY TO ORANGE BROWN, FEW PEBBLES TO 1" (SP).
650	10		17	4		NO RECOVERY.
			7	5		SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM GRAY, FEW PEBBLES TO 3/8". (SW)
	15		11	6		SANDY GRAVEL, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/4", 15-20% FINE SAND. (GW)
640	20		15	7		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/8". (SW)
	25		20	8		GRAVELLY SAND, AS ABOVE. (SW)
630	30		12	9		SAND, WELL GRADED, COARSE TO FINE, 3-5% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1/2". (SW)
	35		19	10		SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 3/4".
620	40		100/3.5"	11		GRAY SHALE, WEATHERED.
						END OF BORING @ 41.8'
	45					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ◻ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 551T

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 25

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING NO. 552 ₵

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 651.2

DATE DRILLED MAY 8, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION
651.3						
650			4	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, SOME ORGANIC, MEDIUM TO DARK GRAY, SLIGHT OIL SMELL, PEBBLES TO 3/4". (SW)
	5		9	2		SAND, UNIFORM, FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM GRAY. (SP) CHANGING TO: GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/4". (SW)
640	10		6	3		NO RECOVERY.
			6	4		NO RECOVERY.
	15		12	5		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1". (SP)
630	20		16	6		GRAVELLY SAND, AS ABOVE, LESS THAN 1% NON PLASTIC FINES. (SP)
	25		33	7		SAND, UNIFORM, FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN. (SP)
			100/0"			NO RECOVERY (REFUSAL).
	30					END OF BORING @ 29.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	M 10/7/74

BORING LOG 552 ₵

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 26

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 553 ℄
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 653.0
DATE DRILLED MAY 8, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
653.0						
650			8	1		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 3/4". (SP)
	5		17	2		GRAVELLY SAND, AS ABOVE. (SP)
	10		19	3		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/8". (SW)
640	15		38	4		SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM GRAYISH BROWN, WITH SOME BLACK, FEW PEBBLES TO 1". (SW)
	20		123	5		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% NON PLASTIC FINES, MEDIUM BROWN,PPEBBLES TO 1/2". (SW) NOTE: SPOON BENT WHILE DRIVING. MARKS ON SIDE INDICATE STRIKING METALLIC OBJECT.
630	25		37	6		GRAVELLY SAND, AS ABOVE, PEBBLES TO 1". (SW)
	30		27	7		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN. (SP)
620	35		24	8		SAND, UNIFORM, FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN. (SP)
			100/1	9		END OF BORING @ 37.1'
	40					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 553 ℄

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 27

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 554-E
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 661.32
DATE DRILLED MAY 10, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
661.32						
			4	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MEDIUM GRAYISH BROWN, PEBBLES TO 3/4". (SW)
	5					
	10		17	2		GRAVELLY SAND, AS ABOVE, MEDIUM BROWN. (SW)
650						
	15		45	3		SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM GRAYISH BROWN, FEW PEBBLES TO 1/2". (SW)
	20		19	4		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/4". (SW)
640						
	25		19	5		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM GRAYISH BROWN, PEBBLES TO 3/4". (SW)
	30		39	6		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1/2". (SW)
630						
	35		15	7		SAND, UNIFORM, FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN. (SP)
			100/1"	8		END OF BORING @ 37.5'
	40					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG NO. 554 E

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 28

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 555 C

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 675.3

DATE DRILLED MAY 8, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
675.3						
670	5		28	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% NON PLASTIC FINES, MEDIUM BROWN, DAMP, PEBBLES TO 1/2" (FILL). (SW)
	10		12	2		GRAVELLY SAND, AS ABOVE, PEBBLES TO 1".(FILL). (SW)
	15		8	3		NO RECOVERY.
660			6	4		GRAVELLY SAND, SAME AS SAMPLE #2, LAYER OF DARK GRAY SILT AT BOTTOM OF RUN. (SW)
	20		52	5		GRAVELLY SAND, POORLY GRADED, COARSE TO MEDIUM, TRACE OF FINES, GRAY, PEBBLES TO 3/4". (SP)
650	25		37	6		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MEDIUM GRAY, PEBBLES TO 1". (SW)
	30		28	7		GRAVELLY SAND, AS ABOVE, WITH SOME BLACK FINES. (SW)
640	35		28	8		GRAVELLY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 10-13% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1". (SP)
	40		14	9		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1". (SW)
630	45		31	10		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN. (SP)
	50		42	11		SAND, MOSTLY UNIFORM, FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1/2". (SP)
620	55		38	12		SAND, AS ABOVE, TRACE OF BLACK FINES. (SP)
	60		100/0"			END OF BORING @ 57.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ∓ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	M 2/7/76

BORING LOG 555 C

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 29

DUQUESNE LIGHT COMPANY

SH __ OF __

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 556 t
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 675.5
DATE DRILLED MAY 15, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS; SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
675.5						
670	5		15	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1 1/8" (FILL). (SW)
	10		6	2		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1 1/4" (FILL), WET. (SW)
660	15		6	3		SILTY SAND, UNIFORM, FINE TO VERY FINE, 15-20% MODERATELY PLASTIC FINES, WET, DARK GRAY TO BLACK, SOME ORGANIC. (SM)
	20		12	4		SAND, UNIFORM, FINE, 3-5% MODERATELY PLASTIC FINES, WET, MEDIUM GRAY TO BLACK, SOME ORGANIC. (SP)
650	25		32	5		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1". (SW)
	30		13	6		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NON PLASTIC FINES, MEDIUM GRAY, FEW PEBBLES TO 3/4". (SP)
640	35		34	7		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 3/4". (SW)
	40		35	8		SAND, WELL GRADED, COARSE TO FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM BROWN.
630	45		74	9		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1". (SP)
	50		93	10		SAND AS ABOVE. (SP)
620	55		82	11		SAND, AS ABOVE, FEW PEBBLES TO 1/2". (SP)
			100/0"			END OF BORING @ 56.0'
	60					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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1	10/7/74

BORING LOG 556 t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 30

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE: BEAVER VALLEY POWER STATION — J.O. NO. 11700 — BORING NO. 557

TYPE OF BORING: SPLIT SPOON — LOCATION: SHIPPINGPORT, PENNSYLVANIA — GROUND ELEV. 676.1

DATE DRILLED: MAY 8, 1974 — DRILLED BY: AMERICAN — LOGGED BY: F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.1						
670	5		4	1		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% NON PLASTIC FINES, DAMP, MEDIUM TO DARK BROWN, PEBBLES TO 1 1/8". (FILL) (SW)
	10		25	2		GRAVELLY SAND, AS ABOVE, PEBBLES TO 1/2". (SW)
660	15		11	3		GRAVELLY SAND, SAME AS ABOVE, PEBBLES TO 1", WET. (SW)
	20		22	4		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% MODERATELY PLASTIC FINES, MEDIUM GRAYISH BROWN WITH SOME BLACK FINES, PEBBLES TO 1". (SW)
650	25		30	5		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, CONTAINS BROKEN GRAY SANDSTONE FRAGMENTS TO 1 1/4". (SW)
	30		15	6		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 5-10% MODERATELY PLASTIC FINES, MEDIUM BROWN WITH SOME GRAY, PEBBLES TO 1". (SW)
640	35		50	7		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1". (SP)
	40		34	8		SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM GRAYISH BROWN, FEW PEBBLES TO 1/2". (SP)
630	45		28	9		SAND, SAME AS SAMPLE 7. (SP)
	50		26	10		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM BROWN WITH SOME BLACK, FEW PEBBLES TO 1/2". (SP)
	55		29	11		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN. (SP)
620			ROLLER BIT			TOP OF ROCK @ 56.0' GRAY SHALE CUTTINGS.
	60					END OF BORING @ 58.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

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BORING LOG 557

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 31

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 558C
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 662.1
DATE DRILLED MAY 9, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
662.1						
660			PUSHED BY HAND	1		SILTY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 20-25% MODERATELY PLASTIC FINES, MEDIUM TO DARK BROWN, FEW PEBBLES TO 3/4". (SM)
	5					
	10		2	2		SILTY SAND, AS ABOVE, FEW PEBBLES TO 1 1/8". (SM)
650						
	15		11	3		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 10-15% MODERATELY PLASTIC FINES, MEDIUM GRAY WITH TRACE OF BLACK, PEBBLES TO 1 1/4". (SW)
	20		13	4		SAND, UNIFORM, FINE, 1-3% SLIGHTLY PLASTIC FINES, MEDIUM BROWN. (SP)
640						
	25		14	5		GRAVELLY SAND, WELL GRADED, COARSE TO FINE, 3-5% SLIGHTLY PLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1". (SW)
	30		18	6		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1". (SP)
630						
	35		16	7		SAND, WELL GRADED, COARSE TO FINE, 1-3% NON PLASTIC FINES, MEDIUM BROWN. (SW)
	40		11	8		SAND, AS ABOVE. (SW)
			100/0"			
620						END OF BORING @ 41.7'
	45					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL.

Rev.	Date / By
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BORING LOG 558 C

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 32

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 559 t
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLAVANIA GROUND ELEV. 673.3
DATE DRILLED MAY 9, 1974 DRILLED BY AMERICAN LOGGED BY FPV
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
673.3						
			5	1		SILTY SAND: POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 15-20% SLIGHTLY PLASTIC FINES, MOIST, MEDIUM BROWN WITH LAYERS OF BLACK SILT, (SM)
			5	2		NO RECOVERY.
			PUSHED BY HAND	3		SANDY SILT; VERY LOOSE, MODERATELY PLASTIC, 10-15% MEDIUM TO FINE SAND, DARK GRAYISH BROWN WITH SOME BLACK, WET. (ML)
			18	4		NO RECOVERY.
			16	5		GRAVELLY SAND: WIDELY GRADED COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, VARIOUS COLORS - BROWN, GRAY, BLACK, PEBBLES TO 1 1/8". (SP)
			21	6		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 3-5% NONPLASTIC FINES, MEDIUM BROWN, PEBBLES TO 3/4". (SW)
			41	7		GRAVELLY SAND; AS ABOVE. (SW)
			29	8		SAND: POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NONPLASTIC FINES, MEDIUM GRAYISH BROWN. (SP)
			39	9		GRAVELLY SAND: POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 1-3% NONPLASTIC FINES, MEDIUM GRAYISH BROWN, PEBBLES TO 1". (SP)
			100/0"	10		NO RECOVERY. (REFUSAL).
620						
						END OF BORING AT 53.5'

Elevation scale: 670, 660, 650, 640, 630, 620. Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60.

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
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2	12/2/76 Rdd
1	11/7/74 Rdd

BORING LOG 559t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 133

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 560 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 673.9

DATE DRILLED MAY 10, 1974 DRILLED BY AMERICAN LOGGED BY F.P.V.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
673.9						
670	5					
	10		6	1		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 3-5% NONPLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1/2". (SW)
660	15		W.O.H.	2		SILTY SAND,: UNIFORM, FINE TO VERY FINE, 20-25% MODERATELY PLASTIC FINES, WET, DARK GRAY TO BLACK. (SM)
	20		25	3		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN WITH SOME GRAY AND BLACK, PEBBLES TO 1". (SW)
650	25		15	4		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 3-5% NONPLASTIC FINES, MEDIUM BROWN, PEBBLES TO 3/4". (SW)
	30		5	5		SAND: MOSTLY UNIFORM, FINE, 1-3% NONPLASTIC FINES, MEDIUM GRAYISH BROWN WITH TRACE OF BLACK, FEW PEBBLES TO 1". (SP)
640	35		7	6		GRAVELLY SAND:WELL GRADED,COARSE TO FINE, LESS THAN 1% NONPLASTIC FINES, MEDIUM GRAY, FEW PEBBLES TO 1". (SP)
	40		14	7		SAND: UNIFORM. MEDIUM TO FINE, LESS THAN 1% NONPLASTIC FINES, MEDIUM GRAY, FEW PEBBLES TO 1". (SP)
630	45		13	8		SAND: AS ABOVE. (SP)
	50		13	9		NO RECOVERY. SAND: WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1/2". (SW) TRACE OF GRAY SHALE AT BOTTOM OF RUN
620			100/2"	10		
	55					END OF BORING AT 54.2'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	Date	By
4		
3		
2	4/2/76	[signature]
1	10/7/74	[signature]

BORING LOG 560t

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 134

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 561 ₺

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 673.6

DATE DRILLED MAY 10, 1974 DRILLED BY AMERICAN LOGGED BY FPV

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
673.6						
670	5					
	10		5	1		SILTY SAND: POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 15-20% MODERATELY PLASTIC FINES, MOIST, MEDIUM DARK GRAYISH BROWN, FEW PEBBLES TO 1/2". (SM)
660	15		W.O.H.	2		SANDY SILT: HIGHLY PLASTIC, 15-20% FINE SAND, VERY SOFT, MOIST, DARK GRAY TO BLACK. (ML)
	20		29	3		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 5-10% SLIGHTLY PLASTIC FINES, WET, MEDIUM BROWN, PEBBLES TO 1". (SW)
650	25		15	4		NO RECOVERY.
	30		13	5		GRAVELLY SAND: WELL GRADED, COARSE TO FINE, 1-3% NONPLASTIC FINES, MEDIUM BROWN, PEBBLES TO 1". (SW)
640	35		17	6		GRAVELLY SAND: AS ABOVE. (SW) SAND; POORLY GRADED, COARSE TO FINE, MOSTLY FINE, LESS THAN 1% NONPLASTIC FINES, MEDIUM BROWN, FEW PEBBLES TO 1". (SP)
	40		19	7		
						END OF BORING AT 40.0'
						NOTE: HOLE TERMINATED AT 40.0' DUE TO RISING WATER IN OHIO RIVER

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	[illegible]
1	[illegible]

BORING LOG 561₺

BEAVER VALLEY POWER STATION - UNIT NO. 1
SHIPPINGPORT, PENNSYLVANIA
DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 135

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 562⊄

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 674.1

DATE DRILLED MAY 16, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
674.1						
670	5		21	1		SANDY GRAVEL, GRAVEL TO 1.25 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 3-5% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (GP).
	10		4	2		NO RECOVERY.
660	15		3	3		SANDY SILT, SLIGHTLY PLASTIC, 3-5% UNIFORM FINE, SAND, SOFT, BLACK, FEW PIECES OF COARSE SAND, (ML).
	20		1/18"	4		TOP 12" - ORGANIC MATERIAL, HIGHLY PLASTIC, SOFT, BLACK, (CH). BOTTOM 6" - SILT, MODERATELY PLASTIC, FIRM, GRAY BLACK.
			26	5		GRAVELLY SAND, 15-25% SUBROUNDED GRAVEL TO 0.75 INCH MAXIMUM, COARSE TO FINE, MOSTLY FINE, SAND, 1-3% NONPLASTIC FINES, COMPACT, MOIST, YELLOW GRAY, (SP).
650	25		21	6		GRAVELLY SAND, SIMILAR TO ABOVE EXCEPT GRAVEL TO 1.5 INCH MAXIMUM, (SP)
	30		11	7		SAND, TRACE OF GRAVEL TO 0.25 INCH MAXIMUM, UNIFORM, FINE, LESS THAN 3% NONPLASTIC FINES, COMPACT, SATURATED, GRAY GREEN, (SP) **2 DISTINCT BLACK STRATA APPROXIMATELY 0.2" THICK OBVIOUSLY UNDEFORMED**
640	35		37	8		SANDY GRAVEL, WASHED OUT GRAVEL TO 1.0 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, DENSE, SATURATED, LIGHT BROWN, (GP) (PIECES OF GRAVEL LODGED IN SHOE)
	40		30	9		GRAVELLY SAND, 15-20% SUBROUNDED TO ANGULAR GRAVEL, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 3-5% NONPLASTIC FINES, COMPACT, SATURATED, BROWN, (SP).
630	45		25	10		SAND, TRACE OF GRAVEL TO 0.75 INCH MAXIMUM, POORLY GRADED, COARSE TO VERY FINE, MOSTLY UNIFORM, FINE, SAND, LESS THAN 2% NONPLASTIC FINES, COMPACT, SATURATED, GRAY BROWN, (SP).
	50		13	11		GRAVELLY SAND, 10-15% SUBROUNDED GRAVEL TO 0.30 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 3-5% NONPLASTIC FINES, COMPACT, SATURATED, GRAY BROWN, (SP).
620	55		60/6"	12		SILTY SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 10-15% NONPLASTIC FINES, DENSE, SATURATED, LIGHT BROWN, (SM) (SHALE CHIPS IN SHOE).
						END OF BORING AT 54.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊥ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4		
3		
2	M 4/2/76	[illegible]
1	M 10/7/76	[illegible]

BORING LOG 562⊄

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 136

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 563 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 674.4

DATE DRILLED MAY 16, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
674.4						
670	5					
	10					(WASHED TO 13.5' - CASING SANK 1.5' WHILE CLEANING OUT.
660	15		1/12"	1		ORGANIC SILT, MODERATELY TO HIGHLY PLASTIC, 2-5% UNIFORM, VERY FINE SAND, BLACK (MH-OH)? (COAL DUST?)
	20		PUSH	2		ORGANIC SILT, SAME AS ABOVE (MH-OH?)
650	25		27	3		GRAVELLY SAND, 35-45% SUBANGULAR GRAVEL TO 1.5 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 3-8% NONPLASTIC FINES, COMPACT, SATURATED, YELLOW BROWN, (SP).
	30		19	4		TOP 10" - SAND, UNIFORM, FINE, LESS THAN 2% NONPLASTIC FINES, COMPACT, SATURATED, LAYERS OF LIGHT BROWN, ORANGE, BROWN AND BLACK, (LAYERS UNDEFORMED), (SP). BOTTOM 2" - GRAVELLY SAND, SUBROUNDED GRAVEL TO 0.30 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 8-12% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (SP-SM).
640	35		34	5		GRAVELLY SAND, ONE PIECE OF GRAVEL TO 0.60 INCH MAXIMUM, AND A FEW GRAINS OF COARSE SAND, (SP).
	40		39	6		SAND, TRACE OF SUBROUNDED GRAVEL TO 0.50 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, LESS THAN 3% NONPLASTIC FINES, DENSE, SATURATED, LIGHT BROWN, (SP).
630	45		39	7		SAND, SAME AS ABOVE EXCEPT TRACE OF GRAVEL TO 0.60 INCH MAXIMUM, (SP).
	50		38	8		TOP 5" - SAND - UNIFORM, FINE, LESS THAN 3% NONPLASTIC FINES, DENSE SATURATED, LIGHT BROWN, (SP). BOTTOM 8" - GRAVELLY SAND, 35-45% SUBANGULAR TO SUBROUNDED GRAVEL TO 0.60 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, LESS THAN 3% NONPLASTIC FINES, DENSE, SATURATED, LIGHT BROWN, (SP).
620	55		33-100 2"	9		GRAVELLY SAND, 5-10% GRAVEL TO 1.0 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, LESS THAN 3% NONPLASTIC, VERY DENSE, SATURATED, GRAY BROWN, (SP) (PIECES OF SHALE IN SHOE).
						END OF BORING AT 54.6'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	M 4/2/76
1	M 10/7/74

BORING LOG 563 t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 137

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 564 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 673.6 673.6

DATE DRILLED MAY 17, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
673.6						
670	5					
	10		6	1		GRAVELLY SAND, FEW PIECES OF GRAVEL AND COARSE SAND, (SP).
660	15		2	2		ORGANIC MATERIAL, HIGHLY PLASTIC, VERY SOFT, BLACK, A FEW FIBERS, (OH).
	20		1/18"	3		SILTY SAND, UNIFORM, FINE, SAND, 25%-35% MODERATELY PLASTIC FINES, VERY LOOSE, SATURATED, BLACK, (HIGHLY ORGANIC), (SM).
650	25		15	4		GRAVELLY SAND, 10-15% SUBANGULAR TO SUBROUNDED GRAVEL TO 1.0 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, LOOSE, SATURATED, GRAY, (SP-SM).
	30		28	5		GRAVELLY SAND, 5-10% SUBROUNDED GRAVEL TO 0.50 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 3-8% NONPLASTIC FINES, COMPACT, SATURATED, LIGHT BROWN, (SP), (ORGANIC MATERIAL).
640	35		36	6		GRAVELLY SAND, 10-20% SUBROUNDED GRAVEL TO 1.0 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, 2-5% NONPLASTIC FINES, DENSE, SATURATED, LIGHT BROWN, (SP) (A 2.0" LAYER OF ORGANIC MATERIAL)
	40		61	7		GRAVELLY SAND, 5-10% SUBROUNDED GRAVEL TO 0.60 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, LESS THAN 3% NONPLASTIC FINES, VERY DENSE, SATURATED, LIGHT BROWN, (SP).
630	45		52	8		TOP 7" - GRAVELLY SAND, 5-10% SUBROUNDED GRAVEL TO 0.80 INCH MAXIMUM, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, SAND, LESS THAN 5% NONPLASTIC FINES, VERY DENSE, SATURATED, LIGHT BROWN, (SP). BOTTOM 8" - SAND, UNIFORM, FINE, LESS THAN 3% NONPLASTIC FINES, DENSE, SATURATED, BROWN, (SP).
	50		51	9		SAND, UNIFORM, FINE, LESS THAN 3% NONPLASTIC FINES, VERY DENSE, SATURATED, LIGHT BROWN, (SP).
620						TOP OF ROCK AT 53.5'
						END OF BORING AT 54.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ≑ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	4/2/76 [initials]
1	4/7/76 [initials]

BORING LOG 564 t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 138

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 565t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 647.0 647.0

DATE DRILLED MAY 23, 1974 DRILLED BY AMERICAN LOGGED BY JDG

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS — SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
647.0						
			11	1		GRAVELLY SAND, 15-20% SUBROUNDED GRAVEL TO 0.75 IN. MAX., UNIFORM, FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, COMPACT, SATURATED, BLACK. (SP-SM) (SOME COARSE SAND.)
	5					
640			58	2		GRAVELLY SAND, 15-20% FLAT TO SUBROUNDED GRAVEL TO 0.50 IN. MAX., POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 5-8% NONPLASTIC FINES, VERY DENSE, SATURATED, GRAY BROWN WITH GREEN STAINS. (SP)
	10					
			51	3		SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 5-10% NON-PLASTIC FINES, VERY DENSE, MOIST, BROWN. (SP)
	15					
630			74	4		GRAVELLY SAND, 5-10% SUBANGULAR GRAVEL TO 1.0 IN. MAX., POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 3-8% NONPLASTIC FINES, VERY DENSE, SATURATED, LIGHT BROWN. (SP)
	20					
			37	5		SAND, TRACE OF GRAVEL TO 0.25 IN. MAX., POORLY GRADED, COARSE TO FINE, MOSTLY FINE SAND, 1-3% NONPLASTIC FINES, DENSE, SATURATED, BROWN. (SP)
	25					
620			100/4"	6		SHALE.
						END OF BORING @ 27.8'.

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	M 12/2/74
1	M 10/7/74

BORING LOG 565t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 139

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING NO. 566 t
TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 650.8 650.8
DATE DRILLED JUNE 4, 1974 DRILLED BY AMERICAN LOGGED BY DFP
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE BLOWS OR RECOV.	SAMPLE TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
650.8						
650			42	1		GRAVELLY SAND, 10-15% GRAVEL TO 0.8 IN. MAX., UNIFORM, FINE SAND, 8-10% SLIGHTLY PLASTIC FINES, BROWN. (SP)
	5		51	2		SANDY GRAVEL, POORLY GRADED TO 2.5 IN. MAX., 10-15% FINE TO MEDIUM SAND, MOSTLY FINE, 8-12% FINES, BROWN. (GP)
640	10		65	3		SAND, POORLY GRADED, FINE TO COARSE, 5-8% MEDIUM AND COARSE SAND, 8-10% GRAVEL TO 2.0 IN. MAX., 5-8% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (SP)
	15		108	4		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE AND MEDIUM, 5-7% GRAVEL TO 1.0 IN. MAX., 4-7% FINES, LIGHT BROWN. (SP) NOTE: DRILLER BELIEVED TO BE PUSHING COBBLE.
630	20		67	5		SAND, POORLY GRADED FINE TO COARSE, MOSTLY FINE AND MEDIUM, 2-5% GRAVEL TO 0.9 IN. MAX., 3-5% FINES, LIGHT BROWN. (SP)
	25		57	6		SAND, UNIFORM, FINE, 3-5% FINES, LIGHT BROWN WITH A 2" LAYER OF MEDIUM AND COARSE SAND.
620	30		55	7		SAND, POORLY GRADED FINE TO COARSE, MOSTLY FINE AND MEDIUM, 3-5% GRAVEL TO 1.0 IN. MAX., LESS THAN 5% FINES, LIGHT BROWN. (SP)
	35					END OF BORING @ 31.25'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	[illegible]
1	[illegible]

BORING LOG 566t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 140

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING NO. 567 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 651.7 651.7

DATE DRILLED JUNE 5, 1974 DRILLED BY AMERICAN LOGGED BY DFP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
651.7						
650			22	1		SAND, POORLY GRADED, FINE TO COARSE MOSTLY FINE, LESS THAN 2% GRAVEL TO 0.8 INCH MAXIMUM, 6-12% SLIGHTLY PLASTIC FINES, DARK BROWN, (SP-SM).
	5		35	2		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE AND MEDIUM, 10-18% GRAVEL TO 1.75 INCH MAXIMUM, 8-10% SLIGHTLY PLASTIC FINES, DARK BROWN, CONTAINING A 1/8" THICK LAYER OF LIGHT YELLOW CEMENTED SAND, (SP).
640	10		8	3		SILTY SAND, UNIFORM, FINE, VERY FINE, 12-15% MODERATELY PLASTIC FINES, DARK GRAY WITH ONE PIECE OF GRAVEL 1.5 INCH IN SIZE AND LESS THAN 2% MEDIUM AND COARSE SAND. (SM) (SM)
	15		112	4		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 12-15% GRAVEL TO 1.5 INCH MAXIMUM, LESS THAN 5% FINES, LIGHT BROWN, (SP).
630	20		102	5		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 8-10% GRAVEL TO 0.9 INCH MAXIMUM, LESS THAN 5% FINES, YELLOWISH GRAY, (SP).
	25		80	6		SAND, UNIFORM, FINE, 2-4% FINES, YELLOWISH BROWN, (SP).
	30		1 100 / 2 1/2	7		SAND, POORLY GRADED FINE TO COARSE, MOSTLY MEDIUM 6-12% GRAVEL TO 0.7 INCH MAXIMUM, 3-6% FINES YELLOWISH BROWN, (SP).
620						END OF BORING AT 31.31'
	35					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	M 10/26
1	M 10/5/76

BORING LOG 567t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -141

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 568 t

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 676.6

DATE DRILLED JUNE 12, 1974 DRILLED BY AMERICAN LOGGED BY DFP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
676.6						
670	5		27	1		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 10-15% GRAVEL TO 1.4 INCH MAXIMUM, 4-6% MODERATELY PLASTIC FINES, LIGHT BROWN, (SP).
	10		16	2		SANDY GRAVEL, POORLY GRADED TO 2.0 INCH MAXIMUM, 5-10% FINE TO COARSE SAND, LIGHT BROWN, (GP).
660	15		2	3		SANDY SILT, MODERATELY PLASTIC, 10-15% VERY FINE SAND, BLACK, (SM).
	20		3	4		SIMILAR TO SS 3.
650	25		18	5		SIMILAR TO SS 3 EXCEPT SAMPLE CONTAINS 4-6% GRAVEL TO 1.9 INCH MAXIMUM.
	30		20	6		SANDY GRAVEL, POORLY GRADED TO 2.1 INCH MAXIMUM, 10-15% FINE TO COARSE SAND, 4-8% SLIGHTLY TO MODERATELY PLASTIC FINES, LIGHT BROWN, (GP).
640	35		28	7		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM, 6-8% GRAVEL TO 1.8 INCH MAXIMUM, 3-6% FINES, LIGHT BROWN, (SP).
	40		37	8		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE, 8-12% GRAVEL TO 1.75 INCH MAXIMUM, 3-7% FINES, LIGHT BROWN. (SP)
630	45		29	9		SAND, UNIFORM, FINE, 5-8% MEDIUM AND COARSE SAND, 2-4% FINES, LIGHT BROWN, 1-2% GRAVEL TO 1.1 INCH MAXIMUM. (SP)
	50		32	10		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM, 2-4% GRAVEL TO 0.9 INCH MAXIMUM, 2-3% FINES, BROWN. (SP)
	55		100/1"			NO RECOVERY REFUSAL AT 55.1'
620						END OF BORING AT 56.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	Date	By
4		
3		
2	12/6/76	DLS
1	11/1/76	DLS

BORING LOG 568 t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 1.42

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 569 t

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 671.0'

DATE DRILLED JUNE 12, 1974 6-12 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
671.0						
670						
	5		8	1		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, 10-15% GRAVEL TO 2.5 INCHES MAXIMUM, 5-7% FINES, LIGHT BROWN. (SP)
660	10		3	2		SANDY SILT, MODERATELY PLASTIC, 15-18% VERY FINE SAND, BLACK. (SM)
	15		2	3		SIMILAR TO SS#2.
650	20		29	4		SAND, UNIFORM, FINE, 4-8% SLIGHTLY TO MODERATELY PLASTIC FINES, LIGHT BLUEISH GRAY, CONTAINING 5-8% GRAVEL TO 1.7 INCH MAXIMUM. (SP)
	25		14	5		SAND, UNIFORM, FINE CLEAN 1-2% FINES, 2-4% MEDIUM SAND, PALE BROWN. (SP)
640	30		16	6		SIMILAR TO SS #5
	35		20	7		SAND, UNIFORM, FINE, CLEAN, 1-2% FINES, LIGHT BROWN. (SP)
630	40		18	8		SAND, UNIFORM, FINE, 3-5% MEDIUM AND COARSE, CLEAN, LESS THAN 2% FINES, LIGHT BROWN. (SP)
	45		20	9		SAND, UNIFORM FINE, 3-5% MEDIUM SAND, 1-3% FINES, BROWN, WITH LESS THAN 1% GRAVEL TO 0.6 INCH MAXIMUM. (SP)
620	50		29	10		SAND, UNIFORM, FINE, 4-6% MEDIUM AND COARSE SAND, LESS THAN 3% GRAVEL TO 1.1 INCH MAXIMUM, 3-5% FINES BROWN. (SP)
						END OF BORING AT 52.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	M 4/22
1	M 10/7/74

BORING LOG NO. 569 t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 143

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 570t

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 651.6

DATE DRILLED JULY 13, 1974 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
651.6						
	5		30	1		SAND, POORLY GRADED, FINE TO MEDIUM, MOSTLY FINE, LESS THAN 3% GRAVEL TO 0.6 INCH MAXIMUM, 3-7% SLIGHTLY PLASTIC FINES, DARK GRAY. (SP)
640	10		44	2		GRAVELLY SAND, POORLY GRADED, FINE TO MEDIUM, MOSTLY FINE, 12-15% GRAVEL TO 2.0 INCH MAXIMUM, 3-5% FINES, DARK GRAY. (SP)
	15		61	3		SANDY GRAVEL, POORLY GRADED TO 1.9 INCH MAXIMUM, 10-15% FINE TO COARSE SAND, MOSTLY MEDIUM AND COARSE, 4-7% FINES, DARK BROWN. (GP)
630	20		67	4		SANDY GRAVEL, POORLY GRADED TO 2.0 INCH MAXIMUM, 8-12% FINE TO COARSE SAND, MOSTLY MEDIUM AND COARSE, 5-7% FINES, DARK BROWN. (GP)
	25		60	5		SAND, WELL GRADED, FINE TO MEDIUM, CLEAN 1-2% FINES, LIGHT BROWN. (SW)
			100/1"	6		NO RECOVERY
						END OF BORING AT 28.1'
	30					

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊻ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	M 4/2/76 [initials]
1	M 4/7/76 [initials]

BORING LOG 570t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -144

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 571 t

TYPE OF BORING SPLIT SPOON LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 657.1

DATE DRILLED JUNE 13, 1974 DRILLED BY AMERICAN LOGGED BY DFP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
657.1						WEIGHT OF RODS SANK SPOON
			PUSH	1		TOP 11" SANDY SILT, MODERATELY PLASTIC, 10-15% VERY FINE SAND, BLACK, (SM). BOTTOM 7" SAND, UNIFORM, FINE, 5-10% MEDIUM SAND, 6-8% SLIGHTLY PLASTIC FINES, DARK GRAY, (SP).
			2	2		
	5					
650						
			37	3		SAND, UNIFORM, FINE, 3-4% MEDIUM SAND, 5-8% SLIGHTLY PLASTIC FINES, LIGHT GRAY WITH LESS THAN 5% GRAVEL TO 1.0 INCH MAXIMUM, (SP).
	10					
			37	4		SANDY GRAVEL, POORLY GRADED TO 1.8 INCH MAXIMUM, 8-10% FINE TO COARSE SAND, MOSTLY FINE, 4-8% FINES, DARK GRAY, (GP).
	15					
640						
			34	5		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 10-12% GRAVEL TO 0.9 INCH MAXIMUM, 6-8% FINES, LIGHT BROWN, (SP).
	20					
			44	6		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM, 6-10% GRAVEL TO 0.8 INCH MAXIMUM, CLEAN, 1-2% FINES, LIGHT BROWN, (SP).
	25					
630						
			49	7		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 8-12% GRAVEL TO 1.2 INCH MAXIMUM, CLEAN 1-2% FINES, BROWN, (SP).
	30					
						END OF BORING AT 32.5'
						REFUSAL AT 32-6"

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. □ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	[illegible]
1	[illegible]

BORING LOG 571 t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 145

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 572 t

TYPE OF BORING SPLIT SPOON LOCATION ______ GROUND ELEV. 668.5'

DATE DRILLED JULY 12, 1974 DRILLED BY AMERICAN LOGGED BY DFP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
668.5						
	5					WEIGHT OF HAMMER AND RODS ADVANCED SPOON 15'
660	10					
	15		22	◤1		SANDY GRAVEL, POORLY GRADED TO 2.0 INCH MAXIMUM, 5-7% FINE AND MEDIUM SAND, 8-10% FINES, DARK GRAY.
650	20		36	◤2		SAND, UNIFORM, FINE, 4-6% GRAVEL TO 1.75 INCH MAXIMUM, 8-10% SLIGHTLY PLASTIC FINES, DARK GRAY.
	25		91	◤3		GRAVELLY SAND, UNIFORM, FINE, 4-6% MEDIUM AND COARSE SAND, 8-10% GRAVEL TO 1.5 INCH MAXIMUM, 4-6% FINES, DARK BROWN.
640	30		58	◤4		SAND, UNIFORM, FINE, 3-7% MEDIUM AND COARSE SAND, 5-8% GRAVEL TO 0.7 INCH MAXIMUM, 2-4% FINES, DARK BROWN.
	35		48	◤5		SAND, POORLY GRADED, FINE TO MEDIUM, CLEAN, LESS THAN 2% FINES, LIGHT BROWN.
630	40		49	◤6		SAND, POORLY GRADED, VERY FINE TO COARSE, MOSTLY MEDIUM AND FINE, 3-5% GRAVEL TO 0.6 INCH MAXIMUM, LESS THAN 2% FINES, LIGHT BROWN.
	45		30	◤7		SAND, UNIFORM, FINE, CLEAN, 1-2% FINES, LIGHT BROWN.
620						BOTTOM OF BORING AT 46.5'
	50					REFUSAL AT 49.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. □◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ⊽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌷ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4		
3		
2	M 4/4/76	RLL
1	M 10/7/74	RLL

BORING LOG 572t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -146

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 573 t
TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 668.0
DATE DRILLED JUNE 12, 1974 DRILLED BY AMERICAN LOGGED BY DFP
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
668.0						
	5					
660						
	10		13	1		SILT HIGHLY PLASTIC, (ODOROUS), 2-3% VERY FINE SAND, BLACK.
	15		7	2		SIMILAR TO SS-1.
650						
	20		46	3		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE, 7-12% GRAVEL TO 1.0 INCH MAXIMUM, 8-10% SLIGHTLY PLASTIC FINES, DARK GRAY.
	25		32	4		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE, 10-15% GRAVEL TO 1.3 INCH MAXIMUM, 3-7% SLIGHTLY PLASTIC FINES, LIGHT BROWN.
640						
	30		52	5		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM, 4-5% GRAVEL TO 0.5 INCH MAXIMUM, 3-5% FINES, LIGHT GRAY.
	35		25	6		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 5-9% GRAVEL TO 0.9 INCHES MAXIMUM, 3-5% FINES, DARK BROWN.
630						
	40		48	7		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 8-12% GRAVEL TO 0.7 INCH MAXIMUM, 3-5% FINES, DARK BROWN.
	45		61	8		SAND, UNIFORM, FINE, CLEAN, LESS THAN 2% FINES, LIGHT BROWN.
620			100/5"			
	50					END OF BORING AT 48.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   ▯◸ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	[illegible]
1	10/2/74 [illegible]

BORING LOG 573t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -147

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 574t

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 668.'

DATE DRILLED JULY 13, 1974 DRILLED BY AMERICAN LOGGED BY DFP

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
668.0						
	5					
660	10					
	15		17	1		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY MEDIUM AND COARSE, 4-7% GRAVEL TO 0.6 INCH MAXIMUM, CLEAN, 1-2% FINES, LIGHT GRAY.
650	20		19	2		SANDY SILT, MODERATELY TO HIGHLY PLASTIC, 8-10% FINE SAND, BLACK, WITH 1-2% GRAVEL TO 1.5 INCH MAXIMUM.
	25		17	3		GRAVELLY SAND, POORLY GRADED, MEDIUM AND COARSE, MOSTLY MEDIUM, 7-10% GRAVEL TO 0.6 INCH MAXIMUM, 5-7% SLIGHTLY PLASTIC FINES, LIGHT BROWN WITH A 1/4" LAYER OF SILT AT TOP.
640	30		41	4		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE, 8-10% GRAVEL TO 0.5 INCH MAXIMUM, 3-5% SLIGHTLY PLASTIC FINES, LIGHT BROWN.
	35		66	5		SAND, POORLY GRADED FINE AND MEDIUM, MOSTLY MEDIUM, 3-4% GRAVEL TO 0.5 INCH MAXIMUM, 3-5% FINES, LIGHT BROWN.
630	40		41	6		SAND, UNIFORM, FINE, 3-4% FINES, LIGHT BROWN.
	45		30 100/1"	7		SAND, UNIFORM, FINE, CLEAN, LESS THAN 2% FINES, LIGHT BROWN.
620	50					END OF BORING AT 47.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ▯7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ▯ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.	
4	
3	
2	M 12/6/76 [signature]
1	M 10/7/76 [signature]

BORING LOG 574t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK -148

SH 1 OF 1

DUQUESNE LIGHT COMPANY

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING No. 575t
TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 670.5'
DATE DRILLED JUNE 18, 1974 6-18-74 DRILLED BY AMERICAN LOGGED BY D.F.P.
SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
670.5						
670						DROVE CASING THROUGH 6.0' OF FILL: WEIGHT OF HAMMER AND RODS ADVANCED SPOON 13.5'.
	5					
660	10					
	15					
650	20		26	1		SAND, UNIFORM, FINE, 4-6% MEDIUM SAND, 3-7% FINES, LIGHT BROWN WITH LESS THAN 1% GRAVEL TO 0.8 INCH MAXIMUM. (SP)
	25		38	2		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE, 8-10% GRAVEL TO 1.5 INCH MAXIMUM, 5-7% SLIGHTLY PLASTIC FINES, DARK BROWN. (SP)
640	30		104	3		SAND, UNIFORM, FINE, CLEAN, 1-2% FINES, LIGHT BROWN. (SP)
	35		58	4		SAND, UNIFORM, FINE, 5-8% MEDIUM AND COARSE SAND, 1-3% FINES, LIGHT BROWN, WITH LESS THAN 5% GRAVEL TO 0.5 INCH MAXIMUM. (SP)
630	40		68	5		SAND, WELL GRADED, FINE TO MEDIUM, 1-3% FINES, LIGHT BROWN, WITH 2-4% GRAVEL TO 0.5 INCH MAXIMUM. (SW)
	45		80	6		SAND, UNIFORM, FINE, 3-5% MEDIUM AND COARSE, 4-7% GRAVEL TO 0.5 INCH MAXIMUM, 2-3% FINES, BROWN. (SP)
	50					END OF BORING 47.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
□7 INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	[illegible]
1	[illegible]

BORING LOG 575t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 149

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. NO. 11700 BORING NO. 576 t

TYPE OF BORING SPLIT SPOON LOCATION GROUND ELEV. 671.0

DATE DRILLED June 19, 1974 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS or RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
671.0						
670						(DROVE CASING THROUGH 7' OF FILL. WEIGHT OF RODS AND HAMMER ADVANCED SPOON 12'(SILT).
	5					
660	10					
	15					
650	20		58	1		SAND, UNIFORM FINE, CLEAN, LESS THAN 2% FINES, LIGHT GRAY. (SP)
	25		38	2		SIMILAR TO SS #1 EXCEPT SAMPLE CONTAINS 3-5% GRAVEL TO 1.1.INCH MAXIMUM, LIGHT BROWN. (SP)
640	30		46	3		SANDY GRAVEL, POORLY GRADED TO 1.5 INCH MAXIMUM, 12-15% FINE TO COARSE SAND, 3-6% SLIGHTLY PLASTIC FINES, DARK BROWN. (GP)
	35		53	4		SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE AND MEDIUM, 8-12% GRAVEL TO 1.0 INCH MAXIMUM, 3-5% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (SP)
630	40		42	5		GRAVELLY SAND, POORLY GRADED, FINE TO COARSE, 10-12% GRAVEL TO 0.9 INCH MAXIMUM, 3-5% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (SP)
	45		64	6		SAND, UNIFORM FINE, 4-8% GRAVEL TO 0.75 INCH MAXIMUM, CLEAN, LESS THAN 2% FINES, LIGHT BROWN. (SP)
						END OF BORING AT 48.0'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE.
   ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE.
   □/ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY.
   SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ∓ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. [] INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

Rev.		
4		
3		
2	M	[illegible]
1	M 4/7/76	[illegible]

BORING JOB 576t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 150

DUQUESNE LIGHT COMPANY

SH 1 OF 1

SITE BEAVER VALLEY POWER STATION J.O. No. 11700 BORING NO. 577 t

TYPE OF BORING SPLIT SPOON LOCATION ______ GROUND ELEV. 669.0'

DATE DRILLED JULY 19, 1974 DRILLED BY AMERICAN LOGGED BY D.F.P.

SUMMARY OF BORING

ELEV. FEET	DEPTH FEET	OVERALL WEATHERING AND RQD (0 25 50 75 100)	SAMPLE: BLOWS OR RECOV.	SAMPLE: TYPE	GRAPHIC LOG	SOIL OR ROCK DESCRIPTION (FIELD AND LABORATORY TEST RESULTS; OR JOINTING, BEDDING AND FAULTING DESCRIPTIONS / SOIL STRATA DESCRIPTION; LITHOLOGY AND TEXTURE)
669.0						
	5					
660	10					
	15					
650	20		23	1		SANDY GRAVEL, POORLY GRADED TO 1.7 INCH MAXIMUM, 6-10% FINE SAND, 5-8% SLIGHTLY PLASTIC FINES, LIGHT GRAY. (GP)
	25		53	2		SAND, UNIFORM, FINE, CLEAN, 1-2% FINES LIGHT BROWN. (SP)
640	30		53	3		SANDY GRAVEL, POORLY GRADED TO 1.5 INCH MAXIMUM, 10-15% FINE TO COARSE SAND, 3-5% SLIGHTLY PLASTIC FINES, LIGHT BROWN. (GP)
	35		69	4		SAND, UNIFORM, FINE, 4-6% GRAVEL TO 0.7 INCH MAXIMUM, CLEAN, 1-2% FINES, LIGHT BROWN. (SP)
630	40		65	5		SAND, UNIFORM, FINE 3-5% MEDIUM AND COARSE SAND, 2-4% GRAVEL TO 0.6 INCH MAXIMUM, CLEAN, 1-2% FINES, LIGHT BROWN. (SP)
	45		91	6		SAND, UNIFORM, FINE; 2-4% MEDIUM SAND, CLEAN 1-2% FINES, LIGHT BROWN. (SP)
620	50					END OF BORING AT 49.5'

1. FIGURES IN BLOW OR RECOVERY COLUMN OPPOSITE SOIL SAMPLE DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE PERCENT OF CORE RECOVERED.
2. ■2 INDICATES LOCATION OF UNDISTURBED SAMPLE. ◤6 INDICATES LOCATION OF SPLIT-SPOON SAMPLE. ◻ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY. SUBSCRIPT NEXT TO SYMBOL INDICATES SAMPLE NUMBER.
3. ▽ INDICATES LOCATION OF NATURAL GROUND WATER TABLE.
4. RQD - ROCK QUALITY DESIGNATION.
5. ⌶ INDICATES DEPTH & LENGTH OF NX CORING RUN.
6. DATUM IS MEAN SEA LEVEL

4	
3	
2	[illegible]
1	[illegible]

BORING LOG 577t

BEAVER VALLEY POWER STATION - UNIT NO. 1

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700 - GSK - 151

SITE BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO. 12241
BORING NO. SEO-1	SHEET 1 OF 3

COORDINATES N3724.5 E9230.0 GROUND ELEV. (1) 727.3

INCLINATION ______ BEARING ______ INSPECTOR J. W. McCOY

DATE : START / FINISH 10/6/81 / 10/8/81 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE 52.2 (FT) / 10/9/81 DRILL RIG TYPE ______

DEPTH TO BEDROCK 104.3 (FT) TOTAL DEPTH DRILLED 104.5 (FT)

METHODS :

DRILLING SOIL AW RODS, 3 IN ROLLER BIT, DRILLING MUD AND CASING

SAMPLING SOIL 2.0 IN O.D. SPLIT BARREL

DRILLING ROCK N/A

SPECIAL TESTING OR INSTRUMENTATION ______

COMMENTS GROUNDWATER AT 51.3 FT ON 10/12/81

FILL TO APPROXIMATELY 45 FT

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
727.3							
		S	1	37-31-21 (10")	52	GW	SANDY GRAVEL, FEW ROUNDED TO ANGULAR SANDSTONE AND SILTSONE FRAGMENTS TO 1 IN, 40% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
	5	S	2	16-9-7 (3")	16	SP	GRAVELLY SAND, 30% ROUNDED TO SUBANGULAR GRAVEL TO 3/4 IN, LARGE 1¼ IN GRAVEL AT BOTTOM, 60-70% FINE TO MEDIUM SAND, MOSTLY FINE. 5% NONPLASTIC FINES, BROWN.
720.0		S	3	7-6-5 (4½")	11	GP	SANDY GRAVEL, MOSTLY MEDIUM TO FINE GRAVEL, 30-40% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, FEW FRAGMENTS TO 1 IN, 10% NONPLASTIC FINES, BROWN.
	10	S	4	3-3-5 (5½")	8	GP SP	TOP 3 IN - SAME AS ABOVE. ½ IN, COARSE SAND-SIZED SLAG, GRAY. 2 IN - FINE SAND, 5-10% NONPLASTIC FINES, RUSTY BROWN. TRACE OF ORGANICS AT BOTTOM.
		S	5	8-4-5 (6½")	9	GM	SILTY SANDY GRAVEL, WELL-GRADED COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, FEW LARGE GRAVEL SIZES, 30% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 15% NONPLASTIC FINES, BROWN.
	15	S VOID	6	3-1-1 (0")	2	SP	BOTTOM 2 IN - FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE OF FINE GRAVEL, WOOD FRAGMENTS NEAR BOTTOM, RUSTY BROWN.
710.0		S	7	WOH (3")		SP	GRAVELLY SAND, 30% COARSE TO FINE GRAVEL TO 3/4 IN, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10% NONPLASTIC FINES, BROWN. (WASH?).
	20	S	8	3-0-1 (0")	1		
		S	9	5-4-5 (1¼")	9	SP	1¼ IN GRAVEL AT TOP. FINE SAND, 5-10% NONPLASTIC FINES, TRACE OF FINE GRAVEL, BROWN.
		S	10	5-3-4 (4")	7	SP	SAME AS ABOVE.
	25	S	11	6-6-5 (9")	11	SM SP	SILTY SAND, 10-15% FINE TO COARSE GRAVEL, MOSTLY FINE, MEDIUM TO FINE SAND 10-15% NONPLASTIC FINES, TRACE OF BLACK ORGANICS AT BOTTOM TOP 6 IN, FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
700.0		S	12	12-10-7 (12")	17	GM	BOTTOM: GRAVELLY SILT, 20-30% FINE TO MEDIUM GRAVEL SIZED SANDSTONE FRAGMENTS, 10% PLASTIC FINES, BROWN.
	30	S	13	6-7-7 (10")	14	SM	SILTY SAND, 10% COARSE TO FINE WEATHERED ROCK FRAGMENTS AND GRAVEL, 10-15% PLASTIC FINES, COARSE TO FINE SAND.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION

UNIT 2

DUQUESNE LIGHT COMPANY

SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

SKETCH No. 12241-GSK-234A

APPROVED	DATE	BORING NO.	SHEET
DJGN	1/12/82	SEO-1	1 OF 3

BORING NO. SEO-1

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	14	7-9-8 (10")	17	SM	SILTY SAND, 10-15% MEDIUM TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE SAND, 10-20% SLIGHTLY PLASTIC FINES, BROWN.
	35	S	15	11-11-10 (10")	21	SM	SAME AS ABOVE, FRAGMENTS, BROWN, RUST, GRAY.
690.0		S	16	15-15-16 (14")	31	SM	SIMILAR TO ABOVE, SILTY SAND, 10-15% COARSE TO FINE GRAVEL SIZED TO 1 IN ROCK FRAGMENTS, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 15-20% SLIGHTLY TO MODERATELY PLASTIC FINES, GRAY AND BROWN.
	40	S	17	17-18-14 (14")	32	SM	SAME AS ABOVE.
		S	18	8-8-7 (14")	15	SM	TOP 6 IN, SAME AS ABOVE. BOTTOM 8 IN, SILTY SAND, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 10-15% NONPLASTIC FINES, TRACE OF FINE GRAVEL, STRONG OIL SMELL, GRAY.
	45	S	19	5-10-12 (18")	22	CL	TOP 5 IN, SAME AS ABOVE. BOTTOM 13 IN, STIFF SILTY CLAY, MODERATELY PLASTIC, TRACE OF ROCK FRAGMENTS, TRACE OF ROOTS, GRAY. (1.75 tsf)
680.0		S	20	15-22-19 (14")	41	CL SM	TOP 6 IN, SAME AS ABOVE. MIDDLE 2 IN, LARGE SANDSTONE FRAGMENTS WITH COARSE TO MEDIUM SAND, BROWN. BOTTOM 6 IN, SILTY SAND, WITH WEATHERED SANDSTONE AND SHALE, COARSE TO FINE GRAVEL SIZED, 10% SLIGHTLY PLASTIC FINES, GRAY, OIL SMELL
	50	S	21	8-7-13 (8")	20	CL	VERY STIFF SILTY CLAY, MODERATELY PLASTIC, 20-30% SILT, MOTTLED BROWN AND GRAY, TRACE OF SHALE FRAGMENTS, FINE GRAVEL SIZED, TRACE OF OIL SMELL.
		S	22	18-11-13 (9")	24	CL SM	TOP 4½ IN, SIMILAR TO ABOVE, MORE WEATHERED SHALE FRAGMENTS. MIDDLE 1½ IN, SILTY SAND, WITH SANDSTONE FRAGMENTS TO 3/4 IN, GRAY. BOTTOM 3 IN, SANDSTONE FRAGMENTS, SHALE FRAGMENTS TO 1½IN, GRAY.
	55	S	23	14-11-11 (5")	22	SM	SANDY SILT, 10-20% MEDIUM TO FINE SAND,15-20% SLIGHTLY PLASTIC FINES,10-15% SANDSTONE AND SHALE FRAGMENTS, TRACE OF MICA, GRAY, LARGE SANDSTONE FRAGMENT IN BOTTOM.
670.0		S	24	10-17-16 (14")	33	SM	SILTY SAND, WITH SANDSTONE AND SHALE FRAGMENTS TO 1 IN, 10-15% SLIGHTLY PLASTIC FINES, COARSE TO FINE SAND, TRACE OF MICA, TRACE OF BLACK ORGANICS, MOTTLED BROWN AND GRAY.
	60	S	25	10-9-11 (12")	20	SM	SILTY SAND, SIMILAR TO ABOVE, 20-30% SLIGHTLY PLASTIC FINES.
		S	26	7-8-7 (9")	15	SM	SILTY FINE SAND, 20-30% NONPLASTIC FINES, ZONES OF WEATHERED SANDSTONE AND SHALE FRAGMENTS, TRACE OF MICA, BROWN.
	65	S	27	13-10-10 (12")	20	SM	SIMILAR TO ABOVE, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, COARSE TO FINE SAND, ZONES OF WEATHERED SANDSTONE AND SHALE FRAGMENTS,BROWN AND GRAY.
660.0		S	28	15-16-10 (12")	26	SM	TOP 7 IN, SIMILAR TO ABOVE, 10-20% NONPLASTIC SLIGHTLY PLASTIC FINES,BROWN. MIDDLE 3 IN, SILTY SAND, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 10-15% NONPLASTIC FINES, TRACE OF FINE GRAVEL SIZE SANDSTONE FRAGMENTS, ORANGE. BOTTOM 2 IN, SAME AS TOP.
	70	S	29	10-14-14 (13")	28	SW	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, FEW SHALE FRAGMENTS TO 1 IN, COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, BROWN.
	75	S	30	9-8-17 (14")	25	SM	SILTY SAND, WELL GRADED,COARSE TO FINE SAND, 5-15% NONPLASTIC FINES, TRACE OF FINE GRAVEL, BROWN.
650.0							
	80	S	31	13-15-14 (14"	29	SM	TOP 4 IN, SAME AS ABOVE. MIDDLE 1 IN, SILTY FINE SAND, 10-15% NONPLASTIC FINES, TRACE OF MICA, DARK BROWN. BOTTOM 9 IN, SILTY SAND, 10-15% WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES.
	85						
640.0		S	32	19-20-21 (12")		SM	SILTY SAND, SIMILAR TO ABOVE, 20-30% WEATHERED SANDSTONE AND SHALE FRAGMENTS, ALL COLORS, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE.
	90						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-234B

APPROVED RDK | DATE 1/12/82 | BORING NO. SEO-1 | SHEET 2 OF 3

BORING NO. SEO-1

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION J.O. NO. 12241

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	33	8-15-14 (10")	29		GRAVELLY SAND, 10-20% COARSE TO FINE GRAVEL, ROUNDED TO ANGULAR, COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, FEW FRAGMENTS WEATHERED SANDSTONE AND SHALE FRAGMENTS. AT 4 IN, SEAM OF DARK BROWN SILTY FINE SAND, TRACE OF MICA (1 IN THICK)
630.0	95	S	34	11-15-14 (10")	29		TOP 5 IN, SAME AS ABOVE (NO SILTY SAND SEAM) BOTTOM 5 IN, SILTY FINE SAND, 10-15% NONPLASTIC FINES, LIGHT BROWN.
	100	S	35	11-12-15 (10")	27		SAND, LESS THAN 5% FINE GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5-7% NONPLASTIC FINES, BROWN.
622.8	105	S	36	105/.2' (0")			TOP OF ROCK.
							END OF BORING AT 104.5 FT.

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-234C | APPROVED DDW | DATE 1/12/82 | BORING NO. SEO-1 | SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

BORING NO. SEO-1A

SHEET 1 OF 1

COORDINATES ______ ______ GROUND ELEV (1) 727.3

INCLINATION ______ BEARING ______ INSPECTOR J.W. McCOY

DATE : START / FINISH 10-8/81 / 10/8/81 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE ______ (FT) / ______ DRILL RIG TYPE ______

DEPTH TO BEDROCK ______ (FT) TOTAL DEPTH DRILLED 17.5 (FT)

METHODS :

DRILLING SOIL AW RODS, 3 IN ROLLER BIT

SAMPLING SOIL 2.0 IN O.D. SPLIT BARREL

DRILLING ROCK N/A

SPECIAL TESTING OR INSTRUMENTATION ______

COMMENTS 4 FT EAST OF SEO-1

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
727.3							
	5						
720.0							AUGERED TO 14.5 FT - NO SAMPLES
	10						
	15	S	1	4-4-3 (18")	7		SANDY SILT, 10-15% FINE SAND, 5% MEDIUM TO FINE GRAVEL, FEW SANDSTONE AND SHALE FRAGMENTS, BROWN.
710.0		S	2	4-3-3 (0")	6		SANDSTONE FRAGMENT IN BOTTOM OF SAMPLER.
	20						END OF BORING AT 17.5 FT.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION
UNIT 2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-235

APPROVED	DATE	BORING NO.	SHEET
DBK	1/12/82	SEO-1A	1 OF 1

SITE	BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO.	12241
BORING NO.	SEO-2	SHEET	1 OF 3
COORDINATES	N3743.24 E9373.28	GROUND ELEV (1)	728.7
INCLINATION		BEARING	
INSPECTOR	J.W. McCOY		
DATE : START / FINISH	10/8/81 / 10/9/81	CONTRACTOR / DRILLER	EGER DRILLING/JARVIS
STATIC GROUNDWATER DEPTH / DATE	42 (FT) / 10/10/81	DRILL RIG TYPE	
DEPTH TO BEDROCK	105.0 (FT)	TOTAL DEPTH DRILLED	105.8 (FT)

METHODS :

DRILLING SOIL: AW RODS, 3 IN ROLLER BIT, DRILLING MUD AND CASING

SAMPLING SOIL: 2.0 INCH O.D. SPLIT BARREL

DRILLING ROCK: N/A

SPECIAL TESTING OR INSTRUMENTATION:

COMMENTS: GROUNDWATER AT 39.3 FT ON 10/12/81
FILL TO APPROXIMATELY 42 FT

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
728.7		S	1	29-24/5" (9")	24/5"		FILL, LARGE SANDSTONE FRAGMENTS, SILTY SAND, CONCRETE. (HARD AUGERING TO 3 FT).
		S	2	18-9-7 (11")	16	SM	SILTY SAND, 10-20% COARSE TO FINE GRAVEL, ROUNDED TO ANGULAR, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, DARK BROWN.
	5	S	3	1-1-3 (11")	4	SM	SANDY SILT, 5-10% COARSE TO FINE GRAVEL, 10-20% COARSE TO FINE SAND, MOSTLY FINE, PAPER, GRAY. (HIT REBAR)
720.0		S	4	3-4-2 (18")	6		SAME AS ABOVE.
	10	S	5	2-2-2 (18")	4	SM	SIMILAR TO ABOVE, SANDY SILT, 4-6% COARSE TO FINE GRAVEL, TRACE OF ROOTS, DARK GRAY.
	15	S	6	3-1-3 (16")	4	SM	SILTY SAND, LESS THAN 5% COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1 IN, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, GRAY.
		S	7	2-3-4 (18")	7	SM	SANDY SILT, 10-15% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, NONPLASTIC TO SLIGHTLY PLASTIC, TRACE OF GRAVEL, DARK GRAY.
710.0		S	8	3-2-3 (18")	5	SM	SIMILAR TO ABOVE, FEW BROWN SANDSTONE FRAGMENTS TO 1 IN, TRACE OF ROOTS.
	20	S	9	3-3-4 (18")	7	SM	SAME AS ABOVE.
	25	S	10	3-6-8 (18")	14	SM SP	TOP 11 IN, SAME AS ABOVE. BOTTOM 7 IN, SAND, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 5-10% NONPLASTIC FINES, BROWN.
		S	11	3-3-4 (15")	7	SM	SILTY SAND, 5% FINE GRAVEL, COARSE TO FINE SAND, 10-15% NONPLASTIC FINES, BROWN.
700.0	30	S	12	3-4-5 (18")	9	SM	SAME AS ABOVE, 1 LARGE SANDSTONE FRAGMENT.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION
UNIT 2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-236A

APPROVED	DATE	BORING NO.	SHEET
DJW	1/12/82	SEO-2	1 OF 3

			BORING NO. SEO-2
			SHEET 2 **OF** 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 **J.O. NO.** 12241

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	13	4-4-5 (18")	9	SM	SILTY SAND, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-20% NONPLASTIC FINES, TRACE OF BLACK ORGANICS, ORANGE BROWN.
		S	14	8-6-7 (14")	13	SM	TOP 7 IN, SANDY SILT, 10% COARSE TO FINE GRAVEL, 10-20% COARSE TO FINE SAND, NONPLASTIC, GRAY. BOTTOM 7 IN, SILTY SAND, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-20% NONPLASTIC FINES, TRACE OF GRAVEL, GRAY.
	35						
		S	15	4-3-5 (18")	8	SM	SAME AS ABOVE, STRONG OIL SMELL.
690.0		S	16	5-5-3 (18")	8	SM	SILTY SAND, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, TRACE OF FINE GRAVEL, OIL SMELL, GRAY.
	40						
		S	17	3-4-12 (14")	16	SM	TOP 8 IN, SAME AS ABOVE. BOTTOM 6 IN, LARGE SANDSTONE FRAGMENTS TO 1½ IN WITH GRAY SILTY CLAY.
		S	18	3-5-8 (18")	13	ML	CLAYEY SILT, 5% FINE SAND, 7-12% SLIGHTLY PLASTIC TO NONPLASTIC FINES, TRACE OF FINE GRAVEL, TRACE OF ROOTS, OIL SMELL, BROWNISH GRAY. (1 tsf)
	45						
		S	19	12-10-9 (18")	19	SM SW	TOP 5 IN, SANDY SILT, 10% FINE SAND, GRAY. BOTTOM 13 IN, WEATHERED BROKEN SANDSTONE FRAGMENTS TO 1½ IN, WITH SILTY COARSE TO FINE SAND, GRAY, BROWN, ORANGE
680.0		S	20	11-10-8 (10")	18	SM	SANDY SILT, WITH WEATHERED SANDSTONE AND SHALE FRAGMENTS, 10-15% COARSE TO FINE SAND, NONPLASTIC TO SLIGHTLY PLASTIC, GRAY AND BROWN.
	50						
	55	S	21	9-6-18 (18")	24	SM	TOP 2 IN, SAME AS ABOVE. MIDDLE 2 IN, SILT, 5% FINE SAND, NONPLASTIC, BROWN. BOTTOM 14 IN, SAME AS TOP.
670.0							
	60	S	22	8-9-8 (12")	17	SM	SAME AS ABOVE, SANDY SILT AND WEATHERED SANDSTONE AND SHALE FRAGMENTS.
	65	S	23	10-9-6 (8")	15	SM	TOP 6 IN, SAME AS ABOVE. BOTTOM 2 IN, SILTY FINE SAND, 10-15% NONPLASTIC FINES, BROWN.
660.0							
	70	S	24	11-11-7 (3")	18	SW	SAND, WELL-GRADED COARSE TO FINE, LESS THAN 5% COARSE TO FINE GRAVEL, FEW LARGE PIECES, 5% NONPLASTIC FINES, BROWN.
	75	S	25	14-11-13 (12")	24	SW	SIMILAR TO ABOVE AT 75.3 FT SAND, OILY(?), NO SMELL, 2 IN THICK, BLACK STAINS
650.0							
	80	S	26	14-20-12 (16")	32	GM	SILTY GRAVEL, 5% COARSE TO FINE SAND, MOSTLY FINE, 10-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, ANGULAR TO SUBROUNDED WEATHERED SANDSTONE AND SHALE FRAGMENTS, FEW SANDSTONE FRAGMENTS TO 1 IN.
	85	S	27	2-10-21 (18")	31	SM	TOP 12 IN, SILTY FINE SAND, 10-20% NONPLASTIC FINES, BROWN. BOTTOM 6 IN, SAME AS S-26.
640.0	90						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241- GSK-236B	APPROVED DDK	DATE 1/12/82	BORING NO. SEO-2	SHEET 2 OF 3

BORING NO. SEO-2

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	28	20-20-24 (11")	44	GM	SILTY SANDY GRAVEL, SIMILAR TO ABOVE.
	95	S	29	14-15-11 (6½")	26	SW	GRAVELLY SAND, 10-20% COARSE TO FINE ROUNDED TO SUBANGULAR GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5% NONPLASTIC FINES, BROWN.
630.0	100	S	30	15-14-15 (7")	29	SW	SAME AS ABOVE, ONE SANDSTONE FRAGMENT TO 1½ IN.
622.9	105	S	31	26-100/.3' (2")	100/.3'		GRAY, SOFT CLAYEY SHALE.

END OF BORING AT 105.8 FT.

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-236C | APPROVED 1/12/82 | DATE M DDW | BORING NO. SEO-2 | SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

BORING NO. SEO-3

SHEET 1 OF 3

COORDINATES N3649.42 E9393.59 GROUND ELEV. (1) 727.2

INCLINATION ______ BEARING ______ INSPECTOR J.W. McCOY

DATE : START / FINISH 10/13/81 / 10/13/81 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE ____ (FT) / ____ DRILL RIG TYPE ______

DEPTH TO BEDROCK 105.0 (FT) TOTAL DEPTH DRILLED 105.2 (FT)

METHODS :

DRILLING SOIL AW RODS, 3 IN ROLLER BIT, DRILLING MUD AND CASING

SAMPLING SOIL 2.0 IN O.D. SPLIT BARREL

DRILLING ROCK N/A

SPECIAL TESTING OR INSTRUMENTATION ______

COMMENTS FILL TO APPROXIMATELY 40 FT

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
727.2							
		S	1	37-34-35 (16")	69		ROAD FILL, SANDY COARSE TO FINE SLAG, GRAVEL TO 1 IN, GRAY AND BROWN.
	5	S	2	7-5-3 (12")	8	SW	TOP 5 IN, GRAVELLY SAND, 15-20% COARSE TO FINE GRAVEL AND SLAG, COARSE TO FINE SAND, GRAY. BOTTOM 7 IN, GRAVELLY SAND, 10-15% COARSE TO FINE GRAVEL, COARSE TO FINE SAND, BROWN.
720.0		S	3	1-2-1 (15")	3	SM	SANDY SILT, 15-20% FINE SAND, NONPLASTIC TO SLIGHTLY PLASTIC, TRACE OF GRAVEL, TRACE OF ROOTS, GRAY.
	10	S	4	1-1-2 (15")	3	SM	SAME AS ABOVE
		S	5	1-1-2 (17")	3	SM	SIMILAR TO ABOVE, GRASS, ROOTS, FEW SANDSTONE FRAGMENTS.
	15	S	6	1-2-1 (13")	3	SM	SAME AS ABOVE.
710.0		S	7	1-1-2 (13")	3	SM	SILTY SAND, 3-5% COARSE TO FINE GRAVEL, 20-25% SLIGHTLY PLASTIC FINES, COARSE TO FINE SAND, MOSTLY FINE, TRACE OF ROOTS AND WOOD, GRAY.
	20	S	8	3-3-3 (9")	6	SM	SAME AS ABOVE, SANDSTONE FRAGMENTS AT BOTTOM.
		S	9	1-2-3 (18")	5	SM	SILTY FINE SAND, 5-7% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, TRACE OF ROOTS, GRAYISH BROWN.
	25	S	10	3-2-3 (16")	5	SM	SIMILAR TO ABOVE, 20-25% NONPLASTIC TO SLIGHTLY PLASTIC FINES, ORGANIC SMELL, GRAY.
700.0		S	11	3-5-7 (18")	12	SM	SIMILAR TO ABOVE, TRACE OF ROOTS AND WOOD, BROWN
	30	S	12	4-4-6 (18")	10	SM	SIMILAR TO ABOVE, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, ROOTS, TRACE OF BLACK CINDERS, GRAY. (1 tsf).

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2

DUQUESNE LIGHT COMPANY

SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK- 237A

APPROVED	DATE	BORING NO.	SHEET
DBX	1/12/82	SEO-3	1 OF 3

BORING NO. SEO-3

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	13	3-3-4 (18")	7	SM	SANDY SILT, 5-7% COARSE TO FINE GRAVEL, 20-30% FINE SAND, NONPLASTIC TO SLIGHTLY PLASTIC, TRACE OF ROOTS, BROWN.
	35	S	14	3-4-4 (18")	8	SM	SIMILAR TO ABOVE, 10-15% FINE SAND.
690.0		S	15	3-4-5 (16")	9	SM	SILTY FINE SAND, 5-7% COARSE TO FINE GRAVEL, LARGE SLAG PIECE NEAR BOTTOM, SULFUR SMELL, 20-30% SLIGHTLY PLASTIC FINES, TRACE OF RED CLAY SEAM, BROWN.
	40	S	16	5-5-8 (18")	13	SM	SILTY FINE SAND, ORGANIC, 5-7% COARSE TO FINE GRAVEL, 15-20% NONPLASTIC FINES, WOOD AT BOTTOM AND SANDSTONE FRAGMENTS.
		S	17	100/5"	100/5"		WOOD
		S	18	4-3-3 (9")	6	OH	WOOD ON TOP ORGANIC CLAYEY SILT, MODERATELY PLASTIC TO VERY PLASTIC, 5-10% FINE SAND, TRACE OF COARSE TO FINE GRAVEL, GRAY.
	45	S	19	5-6-8 (11")	14	GM	SILTY SANDY GRAVEL, COARSE TO FINE GRAVEL AND WEATHERED SANDSTONE AND SHALE FRAGMENTS, FEW FRAGMENTS TO 1½ IN, 6-12% COARSE TO FINE SAND, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, TRACE OF COAL FRAGMENTS, BROWN.
680.0		S	20	9-7-9 (11")	16		
	50	S	21	6-5-5 (18")	10	SW	(NO RECOVERY FIRST ATTEMPT). SAND, COARSE TO FINE, 5-7% COARSE TO FINE GRAVEL, 5-7% NON-PLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 1½ IN, BROWN.
						GM	SILTY GRAVEL, SOME SAND, COARSE TO FINE GRAVEL AND WEATHERED SANDSTONE AND SHALE, ANGULAR, 5-;0% COARSE TO FINE SAND, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, GRAY.
	55	S	22	7-13-14 (12")	27	GM	SIMILAR TO ABOVE, SLIGHT OIL SMELL, RED AND BROWN SHALE FRAGMENTS.
670.0							
	60	S	23	6-7-8 (11")	15	GM SW	SAME AS ABOVE, (NO OIL SMELL) BOTTOM 1 IN, SAND, COARSE TO FINE, 5-7% NONPLASTIC FINES, TRACE OF GRAVEL, GRAY.
	65	S	24	8-7-7 (11")	14	GW SP	TOP 2 IN, SANDY GRAVEL, 20-30% COARSE TO FINE SAND, BROWN. BOTTOM 9 IN, FINE SAND, 5-7% COARSE TO FINE GRAVEL, 5-7% NONPLASTIC FINES, FEW SANDSTONE FRAGMENTS, BROWN.
660.0							
	70	S	25	11-13-13 ((11")	26	SW SW	TOP 5 IN, GRAVELLY SAND, 10-15% COARSE TO FINE GRAVEL, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN. MIDDLE 5 IN, BROKEN SOFT SANDSTONE FRAGMENTS WITH COARSE SAND, GRAY. BOTTOM 1 IN, SAME AS TOP.
	75	S	26	10-12-13 (13")	25	SW GW	TOP 5 IN, GRAVELLY SAND, 10-15% COARSE TO FINE GRAVEL, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN. BOTTOM 8 IN, SANDY GRAVEL, COARSE TO FINE GRAVEL-SIZED WEATHERED SANDSTONE AND SHALE, ANGULAR TO SUBROUNDED, 20-25% COARSE TO FINE SAND, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN.
650.0							
	80	S	27	16-18-21 (15")	39	GW	SAME AS ABOVE, SANDY GRAVEL.
	85	S	28	21-15-21 (12")	37	SW	TOP 5 IN, BROKEN SANDSTONE FRAGMENTS AND SAND, GRAY. BOTTOM, SAME AS S-27.
640.0	90						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-237B | APPROVED DDN. | DATE 1/2/82 | BORING NO. SEO-3 | SHEET 2 OF 3

BORING NO. SEO-3

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	29	12-10-12 (10")	22	GW	SAME AS ABOVE, SANDY GRAVEL.
630.0	95	S	30	18-15-18 (11")	33	SP	GRAVELLY SAND, 20-30% COARSE TO FINE ROUNDED TO ANGULAR GRAVEL AND SOFT COAL FRAGMENTS, FEW SANDSTONE FRAGMENTS TO 1½ IN, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN AND BLACK.
	100	S	31	16-14-19 (10")	33	SP	SAND, 5-10% COARSE TO FINE GRAVEL, SANDSTONE AND SHALE, ROUNDED TO ANGULAR, TRACE OF COAL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, BROWN TO ORANGE BROWN.
	105	S	32	100/.2'	100/.2'		SOFT WEATHERED THINLY BEDDED GRAY SILTSTONE.

END OF BORING AT 105.2 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-237C	APPROVED	DATE 1/2/[illegible]	BORING NO. SEO-3	SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

BORING NO. SEO-4

SHEET 1 OF 3

COORDINATES N3629.89 E9275.04 GROUND ELEV. (1) 726.4

INCLINATION ______ BEARING ______ INSPECTOR JMcCOY

DATE : START / FINISH 10/11/81 / 10/11/81 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE 36 (FT) / 10/12/81 DRILL RIG TYPE ______

DEPTH TO BEDROCK 103 (FT) TOTAL DEPTH DRILLED 103.1 (FT)

METHODS :

DRILLING SOIL AW RODS, 3 IN ROLLER BIT, DRILLING MUD AND CASING

SAMPLING SOIL 2.0 IN O.D. SPLIT BARREL

DRILLING ROCK N/A

SPECIAL TESTING OR INSTRUMENTATION ______

COMMENTS FILL TO APPROXIMATELY 45 FT

ELEVATION (FEET)(1E2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
726.4		S	1	6-14-16 (12")	30	SM	TOP 3 IN SLAG FILL. BOTTOM 9 IN, SILTY FINE SAND, 10-15% NONPLASTIC FINES, TRACE OF GRAVEL, BROWN.
	5	S	2	6-4-4 (18")	8	SM	SILTY FINE SAND, 5-10% NONPLASTIC FINES, FEW ROCK FRAGMENTS, TRACE OF ROCK FRAGMENTS, TRACE OF GRAVEL, TRACE OF BLACK CINDERS, BROWN.
720.0		S	3	5-3-3 (13")	6	SM	SILTY SAND, 10-12% COARSE TO FINE GRAVEL, FEW ROCK FRAGMENTS, COAL AND SLAG, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-15% NONPLASTIC FINES, BROWN.
	10	S	4	1-1-2 (12")	3	SM	SAME AS ABOVE, FEW LARGE SANDSTONE FRAGMENTS TO 1 IN.
		S	5	1-2-1 (8")	3	SM	SAME AS ABOVE.
	15	S	6	2-1-3 (10")	4	SM	SIMILAR TO ABOVE, SILTY FINE SAND, 10-12% COARSE TO FINE GRAVEL, FEW SANDSTONE AND SLAG FRAGMENTS, 20-25% NONPLASTIC FINES, BROWN.
710.0		S	7	8-9-8 (18")	17	GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SLAG, FEW FRAGMENTS TO 1½ IN, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5-7% NONPLASTIC FINES, TRACE OF COAL CINDERS, BROWN.
	20	S	8	4-4-2 (9")	6	SM	SILTY FINE SAND, 5-7% COARSE TO FINE GRAVEL AND SLAG, 15-20% NONPLASTIC FINES, BROWN.
		S	9	3-4-7 (9")	11	SM	SAND, 5-7% COARSE TO FINE GRAVEL, SANDSTONE FRAGMENT AT BOTTOM, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 8-10% NONPLASTIC FINES, TRACE OF SLAG, BROWN.
	25	S	10	3-4-3 (7")	7	SP	SAME AS ABOVE.
700.0		S	11	4-3-4 (16")	7	SP	GRAVELLY SAND, 15-20% COARSE TO FINE ROUNDED GRAVEL, FEW FRAGMENTS TO 1 IN, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5% NONPLASTIC FINES, BROWN.
	30	S	12	4-3-3 (10")	6	SP	SAME AS ABOVE.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2

DUQUESNE LIGHT COMPANY

SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-238A

APPROVED	DATE	BORING NO.	SHEET
DDW	1/12/82	SEO-4	1 OF 3

BORING NO. SEO-4
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	13	4-3-3 (11")	6	SP	SIMILAR TO ABOVE, 20-30% COARSE TO FINE ROUNDED GRAVEL, FEW FRAGMENTS TO 1½ IN, 5-10% NONPLASTIC FINES.
	35	S	14	6-7-6 (10")	13	GM	GRAVELLY SILTY FINE SAND, 10-15% COARSE TO FINE ROUNDED TO SUBANGULAR GRAVEL, 15-20% NONPLASTIC FINES, BROWN.
690.0		S	15	2-3-2 (9")	5	SM	SILTY FINE SAND AND LARGE SANDSTONE FRAGMENTS TO 1½ IN, 20-25% NONPLASTIC TO SLIGHTLY PLASTIC FINES, 5-7% COARSE TO FINE GRAVEL, BROWN.
	40	S	16	4-4-6 (5")	10	SM	SAME AS ABOVE.
		S	17	2-5-8	13	GP	LARGE GRAVEL, SOME SAND AND SILT, WET. (POSSIBLE WASH).
680.0	45	S	18	15-11-13 (10")	23	GM	TOP 4 IN, GRAVELLY SANDY SILT, 10-15% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, 10-15% COARSE TO FINE SAND, SLIGHTLY PLASTIC TO MODERATELY PLASTIC, ORGANICS, ROOTS, GRAY AND BROWN. BOTTOM 6 IN, BROKEN SANDSTONE FRAGMENTS AND COARSE TO FINE SAND, GRAY AND BROWN.
	50	S	19	10-10-23 (10")	33	GW	SANDY GRAVEL, COARSE TO FINE ANGULAR GRAVEL AND SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, 20-25% COARSE TO FINE SAND, 5-10% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN AND GRAY.
670.0	55	S	20	7-7-9 (14")	16	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE, FEW LARGE FRAGMENTS, 7-10% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, GRAY (FEW RED AND BROWN SHALE).
	60	S	21	9-12-9 (13")	21	GM	GRAVELLY SILTY SAND, 20-25% COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE, FEW FRAGMENTS TO 1½ IN, COARSE TO FINE SAND, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, GRAY (BROWN SANDSTONE).
660.0	65	S	22	9-9-9 (14")	18	GM	SAME AS ABOVE.
	70	S	23	10-9-15 (13")	24	GW	SANDY GRAVEL, COARSE TO FINE ANGULAR SANDSTONE AND SHALE FRAGMENTS, FEW TO 1½ IN, 15-20% COARSE TO FINE SAND, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, TRACE OF CARBON, SHALE, BROWN.
650.0	75	S	24	11-10-9 (12")	19	GW	SAME AS ABOVE.
	80	S	25	10-9-11 (14")	20	SM GW SP	TOP 4 IN, SILTY FINE SAND, 20-30% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN. MIDDLE 5 IN, SAME AS S24. BOTTOM 5 IN, SAND, LARGE SANDSTONE FRAGMENT AT BOTTOM, 5-7% NONPLASTIC FINES, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, TRACE OF GRAVEL, BROWN.
640.0	85	S	26	27-23-22 (14")	55		WEATHERED SANDSTONE FRAGMENTS TO 1½ IN, WITH COARSE TO FINE SAND, BROWN AND LIGHT GRAY, (TRACE OF NONPLASTIC FINES).
	90						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-238B | APPROVED DDN | DATE 1/12/82 | BORING NO. SEO-4 | SHEET 2 OF 3

BORING NO.	SE0-4
SHEET	3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	27	18-13-12 (11")	25	SW	TOP 3 IN, GRAVELLY SAND, 15-20% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS TO 1½ IN, COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
						SP	BOTTOM 8 IN, SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, LESS THAN 5% FINE GRAVEL, LESS THAN 5% NONPLASTIC FINES, GRAY.
	95						
630.0		S	28	12-12-11 (9")	23	SP	GRAVELLY SAND, 30-40% COARSE TO FINE ROUNDED TO ANGULAR GRAVEL, FEW SANDSTONE FRAGMENTS TO 1½ IN, COARSE TO FINE SAND MOSTLY COARSE TO MEDIUM. GRAY.
	100						
		S	29	15-18-32 (12")	50	SP	SAND, 5-7% COARSE TO FINE GRAVEL, FEW SANDSTONE AND COAL FRAGMENTS, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, BLACK AND GRAY.
623.3		S	30	50/.1'	50/.1'		SOFT THINLY BEDDED GRAY SILTSTONE.
	105						END OF BORING AT 103.1 FT.

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-238C	APPROVED	DATE	BORING NO.	SHEET
	DDH	1/12/82	SE0-4	3 OF 3

BORING NO.	SEO-5
SHEET	1 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 1 J.O. NO. 12241

COORDINATES N3682.79 E9320.89 GROUND ELEV (1) 727.2

INCLINATION BEARING INSPECTOR JWMcCoy

DATE : START / FINISH 10/10/81 / 10/10/81 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE (FT) / DRILL RIG TYPE

DEPTH TO BEDROCK 104.0 (FT) TOTAL DEPTH DRILLED 104.5 (FT)

METHODS :

DRILLING SOIL AW RODS, 3 IN ROLLER BIT, DRILLING MUD AND CASING

SAMPLING SOIL 2.0 IN O.D. SPLIT BARREL

DRILLING ROCK N/A

SPECIAL TESTING OR INSTRUMENTATION

COMMENTS HOLE CAVED, UNABLE TO OBTAIN GROUNDWATER LEVEL
FILL TO APPROXIMATELY 40 FT

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
727.2							ASPHALT
		S	1	26-22-20 (11")	42		ROAD FILL, SILTY SAND, 10% GRAVEL, SLAG AND SANDSTONE FRAGMENTS, BROWN AND GRAY.
		S	2	11-7-5 (13")	12	GM	TOP 7 IN, GRAVELLY SILT, 20-30% COARSE TO FINE GRAVEL, 5% FINE SAND, LIGHT GRAY.
	5					SP	BOTTOM 6 IN, GRAVELLY SAND, 10-20% COARSE TO FINE GRAVEL, FEW LARGE FRAGMENTS, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5% SILT, BROWN.
720.0		S	3	2-1-2 (18")	3	GM	GRAVELLY SILT, 20-25% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, FEW FRAGMENTS TO 1 IN, 5-7% FINE SAND, NONPLASTIC TO SLIGHTLY PLASTIC, BROWN.
	10	S	4	3-4-4 (10")	8	GW	SANDY GRAVEL, COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, FEW FRAGMENTS TO 1½ IN, 20-30% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN.
		S	5	1-2-3 (11")	5	SP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 7-10% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN.
	15	S	6	5-4-2 (14")	6	SP	SAME AS ABOVE.
710.0		S	7	3-4-2 (8")	6	SM	SANDY SILT, 20-30% COARSE TO FINE SAND, 5% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS TO 1½ IN, NONPLASTIC TO SLIGHTLY PLASTIC, BROWN.
	20	S	8	2-4-6 (11")	10	SM	SILTY FINE SAND, 5-7% COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1½IN, 15-20% SLIGHTLY PLASTIC FINES, WOOD FRAGMENTS, GRAYISH BROWN.
		S	9	2-2-2 (18")	4	SM	SAME AS ABOVE, GRAY.
	25	S	10	2-2-2 (5")	4	SM	SAME AS ABOVE.
700.0		S	11	2-3-3 (10")	6	SM	SAME AS ABOVE.
	30	S	12	3-5-7 (6")		SM	SIMILAR TO ABOVE, SILTY FINE SAND, WOOD, ROOTS, PLASTIC, TRACE OF GRAVEL, GRAY.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30". * INDICATES USE OF 300lb. HAMMER. ( ) INCHES OF SAMPLE RECOVERY.
4. % ROCK CORE RECOVERY/ ROCK QUALITY DESIGNATION.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. S-SPLIT BARREL SAMPLE

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2

DUQUESNE LIGHT COMPANY

SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-239A

APPROVED	DATE	BORING NO.	SHEET
DDN	1/12/82 JM	SEO-5	1 OF 3

BORING NO. SEO-5

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 1 J.O. NO. 12241

ELEVATION (FEET) (IE2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	13	5-5-4 (10")	9	SM GW	TOP 4 IN, SAME AS ABOVE. BOTTOM 6 IN, SANDY GRAVEL, COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, FEW FRAGMENTS TO 1 IN, 20-30% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5% NONPLASTIC FINES, BROWN.
	35	S	14	7-7-5 (9")	12	SM	TOP 4 IN, SILTY FINE SAND, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, WOOD FRAGMENTS.
690.0		S	15	5-7-11 (11")	18	SW	BOTTOM 5 IN, GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS TO 1 IN, COARSE TO FINE SAND, 5% NONPLASTIC FINES, BROWN
	40	S	16	5-6-11 (15")	17	SM	SILTY FINE SAND, 15-20% NONPLASTIC TO SLIGHTLY PLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 3/4 IN, TRACE OF GRAVEL, TRACE OF ROOTS, BROWN.
		S	17	14-25-20 (16")	45	SM	SILTY FINE SAND, 5-7% COARSE TO FINE GRAVEL AND COAL FRAGMENTS, FEW SANDSTONE FRAGMENTS TO 1½ IN, 10-15% NONPLASTIC TO SLIGHTLY PLASTIC FINES, GRAY AND BROWN.
	45	S	18	6-8-9 (9")	17	SM	SILTY FINE SAND, 5% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, SHALED SANDSTONE FRAGMENTS, 15-20% NONPLASTIC FINES, TRACE OF COAL AND WOOD FRAGMENTS, BROWN AND GRAY.
680.0		S	19	6-10-15 (15")	25	SM	SIMILAR TO ABOVE, ROOTS AND WOOD, DARK GRAY.
						SM	SIMILAR TO ABOVE, 5-10% COARSE TO FINE GRAVEL, BROWN.
	50	S	20	8-7-8 (13")	15	SM	SANDY SILT, 5% COARSE TO FINE GRAVEL, 10-15% FINE SAND, NONPLASTIC TO SLIGHTLY PLASTIC, TRACE OF COAL FRAGMENTS (CINDERS?) OIL SMELL, GRAY.
		S	21	11-10-8 (5")	18	GM	GRAVELLY SILT, 20-25% COARSE TO FINE GRAVEL, LARGE SANDSTONE FRAGMENT AT BOTTOM, 5-7% COARSE TO FINE SAND, SLIGHTLY PLASTIC, GRAY.
	55	S	22	7-11-10 (14")	21	GM	GRAVELLY SILTY SAND, 10-15% COARSE TO FINE GRAVEL, ANGULAR SANDSTONE AND SHALE FRAGMENTS, 20-20% SLIGHTLY PLASTIC FINES, SLIGHT OIL SMELL, GRAY.
670.0		S	23	9-6-9 (9")	15	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL, FEW LARGE FRAGMENTS, 10-13% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, BROWN.
	60	S	24	7-6-8 (13")	14	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL-SIZED SANDSTONE AND SHALE FRAGMENTS, ALL COLORS, RED, BROWN, GRAY, 5-10% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC TO MODERATELY PLASTIC FINES, GRAY.
		S	25	12-11-8 (12")	19	GW	SANDY GRAVEL, WEATHERED SANDSTONE AND SHALE, 8-10% NONPLASTIC TO SLIGHTLY PLASTIC FINES, 15-20% COARSE TO FINE SAND, BROWN.
	65	S	26	9-7-9 (9")	16	GW	SAND, 5-7% COARSE TO FINE GRAVEL, ROUNDED TO ANGULAR, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, BROWN.
660.0							
	70	S	27	9-10-10 (12")	20	GW	SANDY GRAVEL, COARSE TO FINE GRAVEL-SIZED SANDSTONE AND SHALE FRAGMENTS, SOME TO 1½ IN, ANGULAR TO SUBANGULAR, 20-25% COARSE TO FINE SAND, 5-8% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN. (FEW SHALE FRAGMENTS, RED AND ORANGE).
	75	S	28	14-14-10 (15")	24	SP	GRAVELLY SAND, 20-25% COARSE TO FINE GRAVEL-SIZED SANDSTONE AND SHALE FRAGMENTS, ALL COLORS, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-7% NONPLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 1 IN, BROWN.
650.0							
	80	S	29	8-10-15 (14")	25	SP	TOP 5 IN, SAND, 5% COARSE TO FINE GRAVEL, 5-7% NONPLASTIC SILT, COARSE TO FINE SAND, MOSTLY FINE, BROWN.
						GW	BOTTOM 9 IN, SANDY GRAVEL, COARSE TO FINE GRAVEL-SIZED SANDSTONE AND SHALE FRAGMENTS, 15-20% COARSE TO FINE SAND, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 1 IN, BROWN.
	85	S	30	19-15-18 (9")	33	GW	SIMILAR TO ABOVE, SANDY GRAVEL.
640.0	90						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-239B | APPROVED DDH | DATE 1/12/82 M | BORING NO. SEO-5 | SHEET 3 OF 3

BORING NO. SEO-5

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION - UNIT 1 J.O. NO. 12241

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
		S	31	13-10-12 (12")	22	SW	GRAVELLY SAND, 15-25% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR FEW PIECES TO 3/4 IN, COARSE TO FINE SAND, 5-7% NONPLASTIC TO SLIGHTLY PLASTIC FINES, BROWN.
	95	S	32	8-9-14 0-1ST 2"- 2ND	23	SW	NO RECOVERY FIRST ATTEMPT.
630.0							SAME AS ABOVE
	100	S	33	12-11-1 (10")	22	SW	SAME AS ABOVE.
622.7		S	34	50/.1'	50/.1'		SOFT THINLY BEDDED GRAY SILTSTONE.
							END OF BORING 104.5 FT.

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-239C | APPROVED DDH | DATE 1/12/82 | BORING NO. SEO-5 | SHEET 3 OF 3

BORING NO. EOS-1
SHEET 1 **OF** 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 **J.O. NO.** 12241
COORDINATES N3843 E6223 **GROUND ELEV. (1)** 741.0 FT
INCLINATION VERTICAL **BEARING** NA **INSPECTOR** J.W. MCCOY
DATE : START / FINISH 6-4-82 / 6-7-82 **CONTRACTOR / DRILLER** EGER/JARVIS
STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / **DRILL RIG TYPE** CME 45
DEPTH TO BEDROCK 52.0 (FT) **TOTAL DEPTH DRILLED** 52.0 (FT)
METHODS :
DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, WATER
SAMPLING SOIL 2 IN O.D. SPLIT SPOON
DRILLING ROCK NONE
SPECIAL TESTING OR INSTRUMENTATION 2 FT POROUS STONE PIEZOMETER INSTALLED WITH TIP AT EL 718

COMMENTS NONE

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
741.0	0	S	1	1-3-5 (12")	8	ML	TOP 6 IN: SANDY SILT, DENSE, 10% FINE GRAVEL TO 3/8 IN, ANGULAR, 15-20% COARSE TO FINE SAND, CONTAINS ROOTS AND ORGANIC MATTER, VERY SLIGHTLY MOIST, DARK BROWN AND BLACK.
						CL	BOTTOM 6 IN: SANDY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL FINE GRAVEL, 12-15% COARSE TO FINE SAND, ANGULAR, VERY SLIGHTLY MOIST, LIGHT BROWN.
		S	2	4-13-9 (12")	22	CL	SIMILAR TO S-1, BOTTOM 6 IN.
		S	3	1-5-6 (12")	11	CL	SIMILAR TO S-1, BOTTOM 6 IN, GRAY BROWN.
	5						
		S	4	5-6-8 (18")	14	CL	SILTY CLAY, MODERATELY PLASTIC, STIFF, 2% FINE SAND, SLIGHTLY MOIST, BROWN, MOTTLED WITH YELLOW AND SOME GRAY, SMALL POCKETS OF LIGNITE, CONTAINS POCKETS OF SANDY CLAY WITH SOME COARSE AND MEDIUM SAND, TRACE SUBANGULAR GRAVEL TO 0.5 IN MAXIMUM.
		S	5	4-5-6 (16")	11	CL-ML	SILTY CLAY-CLAYEY SILT, SLIGHTLY PLASTIC, MEDIUM STIFF, MOIST, BROWN.
		S	6	6-6-5 (18")	11	ML	SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 5% VERY FINE SAND, MOIST, BROWN.
731.0	10	S	7	2-3-6 (13")	9	ML	SIMILAR TO S-6.
		S	8	4-5-5 (17")	10	ML	SIMILAR TO S-6, CONTAINS OCCASIONAL 5mm FINE SAND LENS.
		S	9	6-7-9 (15")	16	ML	TOP 7 IN: SANDY SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 30-40% FINE SAND, MOIST, BROWN.
						SM	BOTTOM 8 IN: SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, BROWN.
	15	S	10				

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-241A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-1	1 OF 3

BORING NO. EOS-1
SHEET 2 **OF** 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. **J.O. NO.** 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	10	6-5-7 (18")	12	ML-SM	LAYERED SILT AND SILTY FINE SAND, SLIGHTLY PLASTIC FINES, CLAYEY SILT CONTAINING COARSE TO FINE GRAVEL SIZED ROCK FRAGMENTS AT BOTTOM.
		S	11	5-5-7 (14")	12	SM ML	TOP 2 IN: SILTY SAND, FINE, FEW FINE GRAVEL. BOTTOM 12 IN: SILT, NONPLASTIC TO VERY SLIGHTLY PLASTIC, MOIST, BROWN.
		S	12	3-5-5 (14")	10	ML	SIMILAR TO S-11, BOTTOM 12 IN. CONTAINS FINE SAND LENSES ABOUT 2 mm THICK.
		S	13	4-2-3 (12")	5	SM ML	TOP 10 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, BROWN. BOTTOM 2 IN: SILT, SLIGHTLY PLASTIC, BROWN.
721.0	20						
		S	14	3-1-6 (17")	7	SM ML	TOP 8 IN AND BOTTOM 1 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, WET ORANGE-BROWN. MIDDLE 8 IN: SILT, SLIGHTLY PLASTIC, GRAY-BROWN.
		S	15	3-4-4 (17")	8	ML-SM	TOP 8 IN: LAYERED SANDY SILT AND SILTY FINE SAND, NONPLASTIC FINES, BROWN. BOTTOM 9 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, BROWN.
		S	16	3-2-3 (17")	5	SP	SAND, UNIFORM, FINE, 5-10% NONPLASTIC FINES, BROWN.
	25	S	17	2-2-2 (15")	4	SP	SIMILAR TO S-16.
		S	18	1-5-6 (18")	11	SM GP SP	TOP 12 IN: SIMILAR TO S-16. MIDDLE 2 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SHALE FRAGMENTS, ANGULAR. BOTTOM 4 IN: SAND, UNIFORM, FINE, MOIST, BROWN.
		S	19	3-4-3 (13")	7	SP GP-GW	TOP 6 IN: SAND, FINE, TRACE SILT, BROWN. BOTTOM 7 IN: SANDY GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, BROWN.
711.0	30	S	20	2-2-3 (9")	5	SM GP	TOP 5 IN: SILTY SAND, FINE, 10-15% COARSE TO FINE GRAVEL, ROUNDED, 5-7% NONPLASTIC FINES. BOTTOM 4 IN: GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, ANGULAR TO ROUNDED, TRACE SAND, WET, GRAY AND BROWN, ORGANIC OILY SMELL AND FEEL.
		S	21	5-3-3 (5")	6	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1.5 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, TRACE IRON STAINING, BROWN, GRAY ORANGE.
		S	22	4-3-5 (6")	8	GP-GW	SIMILAR TO S-21.
	35	S	23	5-5-5 (4")	10	GP-GW	SIMILAR TO S-21.
		S	24	7-4-5 (13")	9	GP GP-GW	TOP 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 10-15% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, GRAY. BOTTOM 8 IN: SANDY GRAVEL, COARSE TO FINE, ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINS, BROWN.
		S	25	9-8-13 (0")	21		NO RECOVERY.
		S	26	8-9-8	17	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN, ANGULAR, SOME ROUNDED GRAVEL, 15-20% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, IRON STAINS AND COAL, GRAY.
701.0	40						
		S	27	13-19-22 (14")	41	GP	SIMILAR TO S-26. BLOWS/INCH: 2-2-3-2-2-2/3-3-3-3-4-3/4-3-4-4-3-4
		S	28	9-11-20 (13")	31	SP	SAND, POORLY GRADED, MEDIUM TO FINE, 5-10% COARSE TO FINE GRAVEL, SUBANGULAR TO ROUNDED, 1.5 IN SANDSTONE FRAGMENT AT TOP, TRACE NONPLASTIC FINES, BROWN.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-241B	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-1	SHEET 2 OF 3

BORING NO. EOS-1
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	29	12-25-31 (16")	56	GP	SANDY GRAVEL, BROKEN COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, ANGULAR, FEW ROUNDED, 10-15% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN AND GRAY. BLOWS/INCH: 2-1-2-2-2-3/4-5-3-5-4-4/5-5-7-5-3-6
		S	30	23-34-111 (12")	145	GP	SANDY GRAVEL, BROKEN COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, ANGULAR, 30-40% COARSE TO FINE SAND, 10-13% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 2-2-3-4-5-7/5-5-5-8-6-5/13-20-18-18-17-25
		S	31	47-50-113 (18")	163	SP	TOP 2 IN: SAND, FINE, TRACE FINE GRAVEL, 5-10% NONPLASTIC FINES, ORANGE-BROWN.
691.0	50					GP	BOTTOM 16 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN, 20-30% COARSE TO FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE-BROWN. BLOWS/INCH: 3-4-6-4-5-25/18-14-5-5-3-5/20-27-15-17-13-21
		S	32	37-105/3"	105/3"		
						GM	SILTY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.0 IN MAXIMUM, ANGULAR, 5-10% FINE SAND, 5-20% SLIGHTLY PLASTIC FINES, TRACE COAL, IRON STAINS, ORANGE, BROWN, GRAY.
		S	33	50/½"	50/½"		
							REFUSAL
							BOTTOM OF BORING AT 52 FT 1/2 IN ELEVATION 688.96 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-241C	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-1	SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 — J.O. NO. 12241

BORING NO. EOS-1A — SHEET 1 OF 2

COORDINATES 6.5 FT SOUTH OF EOS-1 — GROUND ELEV. (1) 741.0 FT

INCLINATION VERTICAL — BEARING NA — INSPECTOR J.W. MCCOY

DATE: START / FINISH 6/7/82 / 6/7/82 — CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE (FT) / — DRILL RIG TYPE CME 45

DEPTH TO BEDROCK NA (FT) — TOTAL DEPTH DRILLED 22.0 FT (FT)

METHODS:

DRILLING SOIL 3-1/8 IN O.D. AUGER TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON USED TO CLEAN OUT HOLE.

SAMPLING SOIL SHELBY TUBE

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
741.0	0						NO SAMPLES TO 10 FT
	5						
731.0	10						
		US	1	(28")			SILTY CLAY - CLAYEY SILT, SLIGHTLY PLASTIC, 4% FINE SAND, LIGHT BROWN, (SOMEWHAT DILATIVE ON HANDLING).
		US	2	(0")			
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ∇ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-242A

APPROVED	DATE	BORING NO.	SHEET
DDW.	9/1/82	EOS-1A	1 OF 2

BORING NO. EOS-1A

SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	US	3				
721.0	20	US	4	(23)			
							BOTTOM OF BORING AT 22.0 FT ELEVATION 719.0 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-242B

APPROVED DDH

DATE 9/1/82

BORING NO. EOS-1A

SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION -UNIT 2 **J.O. NO.** 12241 **BORING NO.** EOS-2 **SHEET** 1 **OF** 3

COORDINATES N4000 E6165 **GROUND ELEV (1)** 723.9

INCLINATION VERTICAL **BEARING** NA **INSPECTOR** J. W. MCCOY

DATE : START / FINISH 5/21/82 / 5/24/82 **CONTRACTOR / DRILLER** EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE 40'10" (FT) / 5/27/82 **DRILL RIG TYPE** CME 45

DEPTH TO BEDROCK 60.0 (FT) **TOTAL DEPTH DRILLED** 60.3 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
723.9		S	1	4-5-3	8	GP	SLAG, COARSE TO FINE GRAVEL SIZED, 10-20% COARSE TO FINE SAND, BROWN, (FILL).
		S	2	2-3-2 (13")	5	SW	SAND, WELL GRADED, COARSE TO FINE, 10-15% COARSE TO FINE GRAVEL, ROUNDED, LESS THAN 5% NONPLASTIC FINES, BROWN.
	5	S	3	2-2-3 (14")	5	SP SP GP	TOP 4 IN: SAND, UNIFORM, FINE, 2-5% NONPLASTIC FINES, TRACE GRAVEL, BROWN. MIDDLE 5 IN: SAND, FINE, 5-7% FINE GRAVEL, LESS THAN 5% NONPLASTIC FINES, VERY MOIST, LIGHT BROWN. BOTTOM 5 IN: COAL, FINE GRAVEL SIZED FRAGMENTS.
		S	4	5-5-4 (11")	9	GW	SANDY GRAVEL, COARSE TO FINE, FEW TO 1 IN MAXIMUM, ROUNDED TO ANGULAR, 20-30% COARSE TO FINE SAND, MOSTLY COARSE, 2-5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, MOIST, GRAY AND BROWN.
713.9	10	S	5	4-11-6 (18")	17	GP GP	TOP 8 IN: SANDY GRAVEL, COARSE TO FINE, SUBANGULAR TO ROUNDED, 30-40% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, TRACE COAL, GRAY. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, SOME WEATHERED SHALE FRAGMENTS, 25-30% COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE IRON STAINING, BROWN. BLOWS/INCH: 1/2-1/2-1-1/3-1-2-2-2-1/1-1-1-1-1-1
		S	6	7-12-11 (9")	23	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1½ IN, 30-40% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, GRAY AND BROWN. BLOWS/INCH: 7/2-2-3-2-2-1/3-2-1-2-1-2
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-243A

APPROVED	DATE	BORING NO.	SHEET
DDA	9/1/82	EOS-2	1 OF 3

BORING NO.	EOS-2
SHEET 2 OF	3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	7-7-6 (9")	13	GM	TOP 5 IN: SILTY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, BROWN.
						GP	BOTTOM 4 IN: WEATHERED SANDSTONE FRAGMENTS, 1½ IN MAXIMUM, 10-15% COARSE SAND, BROWN. BLOWS/INCH: 2-1-1-1-1-1/1-1-1-1-1-2/1-1-1-1-1-1
		S	8	8-13-11 (8")	24	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZE SANDSTONE FRAGMENTS, SOME SHALE TO 1½ IN MAXIMUM, ANGULAR TO SUBROUNDED, 20-30% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE IRON STAINS, BROWN. BLOWS/INCH: 1-1-1-1-2-2/2-2-2-3-2-2/2-1-2-2-2-2
703.9	20	S	9	17-21-12 (11")	33	GW-GP	SANDY GRAVEL, COARSE TO FINE, ROUNDED TO ANGULAR, SOME SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, LARGE SANDSTONE FRAGMENT AT BOTTOM, 20-30% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, BROWN. BLOWS/INCH: 3-3-2-3-3-3/4-4-4-3-3-3/3-2-3-2-1-1
		S	10	4-5-6 (13")	11	SP	SAND, POORLY GRADED, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 2-6% COARSE TO FINE ROUNDED GRAVEL, 2-5% NONPLASTIC FINES, MOIST, BROWN.
	25	S	11	4-6-7 (14")	13	SP	SAND, SIMILAR TO ABOVE, MOSTLY COARSE TO MEDIUM.
		S	12	53/4"	53/4"	-	NO RECOVERY: BLOWS/INCH: 8-9-17-19
		S	13	13-24-20 (1")	44	-	BROKEN, ROUNDED GRAVEL TO 1½ IN (WASH?) BLOWS/INCH: 2-2-2-2-2-3/5-5-3-3-4-4/3-3-4-3-4-3
693.9	30	S	14	10-10-13 (5")	23	-	SANDSTONE FRAGMENTS, 5-15% COARSE TO FINE GRAVEL, 10-15% COARSE TO FINE SAND.
		S	15	16-19-26 (7")	45	SP	TOP 4 IN: SAND, FINE, LESS THAN 5% NONPLASTIC FINES, BROWN.
						GW	BOTTOM 3 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1½" MAXIMUM, 10-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-3-4-3/3-3-2-3-4-4/4-5-4-4-5-4
	35	S	16	14-16-27 (7")	43	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, ANGULAR, 15-20% COARSE TO FINE SAND, 15-20% SLIGHTLY TO MEDIUM PLASTIC FINES, BROWN, GRAY AND ORANGE. BLOWS/INCH: 2-3-2-2-3-2/2-3-3-2-3-3/5-5-4-2-5-6
		S	17	28-24-21 (11")	45	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, ANGULAR, 20-25% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINS, BROWN AND GRAY. BLOWS/INCH: 4-5-8-4-4-3/4-5-4-4-4-3/4-4-3-4-3-3
683.9	40	S	18	11-11-10 (8")	21	SP	SAND, POORLY GRADED, LESS THAN 5% COARSE TO FINE GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-1-2-2/2-1-2-2-2-2/1-2-2-2-1-2
		S	19	9-11-14 (8")	25	SP	SAND, SIMILAR TO ABOVE, SOFT, BLACK, CARBONACEOUS SHALE FRAGMENT AT BOTTOM. BLOWS/INCH: 1-2-1-2-2-1/1-2-2-2-2-2/2-2-2-3-2-3

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245B	APPROVED DDH.	DATE 9/1/82	BORING NO. EOS-2	SHEET 2 OF 3

BORING NO. EOS-2
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	20	14-108-55 (7")	163	GP-GW	SANDY GRAVEL, WEATHERED SANDSTONE AND SHALE FRAGMENTS, 30-40% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE. BLOWS/INCH: 2-1-2-3-3-3/ 5-5-27-38-19-14/16-12-8-7-7-5
		S	21	9-8-11 (7")	19	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1 IN, ANGULAR TO ROUNDED, 15-25% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, FEW WEATHERED SANDSTONE AND SHALE FRAGMENTS, BROWN. BLOWS/INCH: 2-1-1-1-2-2/1-1-2-1-2-1/1-2-1-2-3-2
673.9	50	S	22	12-14-28 (6")	42	GW-GP	TOP 3 IN: SIMILAR TO ABOVE. BOTTOM 3 IN: SAND, POORLY GRADED, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-2-2-2/3-3-2-2-2-2/2-6-4-5-5-6
		S	23	14-13-11 (5")	24	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS, LARGE SANDSTONE FRAGMENT AT TOP, ANGULAR TO SUBROUNDED, 30-40% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, ORANGE AND GRAY.
	55	S	24	19-56-99 (11")	155	-	WEATHERED SANDSTONE AND SHALE, SOFT, SOME SOFT CLAYSTONE, TACE MICA, GRAY
		S	25	16-30-70 (15")	100	GW GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, SOFT, 20-30% COARSE TO FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, GRAY.
663.9	60	S	26	100/4"	100/4"		CLAYSTONE, WEATHERED, SOFT, DARK GRAY.

BOTTOM OF BORING AT 60 FT 4 IN
ELEVATION 663.6 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-243C | APPROVED JDH | DATE 9/1/82 | BORING NO. EOS-2 | SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-3
SHEET 1 OF 3

COORDINATES N4050 E6147 GROUND ELEV (1) 722.1 FT

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5/24/82 / 5/25/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 65.5 (FT) TOTAL DEPTH DRILLED 63 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
722.1	0	S	1	6-22-9 (9")	31	GP SP-SW	TOP 5 IN: SANDY SLAG AND SANDSTONE FRAGMENTS, GRAY. BOTTOM 4 IN: GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW TO 1 IN, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN.
		S	2	9-16-13 (16")	29	SP-SW GM	TOP 4 IN: SIMILAR TO ABOVE. BOTTOM 12 IN: SILTY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 10-20% COARSE TO FINE SAND, 20-30% SLIGHTLY PLASTIC FINES, BROWN AND GRAY.
	5	S	3	4-7-7 (18")	14	GM ML	TOP 3 IN: SIMILAR TO ABOVE. BOTTOM 15 IN: GRAVELLY SILT, 20-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, ORANGE-BROWN.
		S	4	7-4-4 (18")	8	ML	GRAVELLY SILT, SLIGHTLY PLASTIC, 10-15% COARSE TO FINE GRAVEL, ROUNDED, 5-10% FINE SAND, TRACE COAL, BROWN AND ORANGE.
712.1	10	S	5	3-4-10 (15")	14	ML	SIMILAR TO ABOVE, 2 IN THICK COARSE SAND LAYER AT 8 IN FROM TOP OF SAMPLE.
		S	6	4-7-6 (18")	13	SM	SILTY SAND, UNIFORM, LESS THAN 5% FINE GRAVEL, ROUNDED, FINE SAND, 20-30% NONPLASTIC FINES, BROWN.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-244A

APPROVED	DATE	BORING NO.	SHEET
DDW	9/1/82	EOS-3	1 OF 3

BORING NO. EOS-3

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	3-4-5 (18")	9	SM	SILTY SAND, WIDELY GRADED, 20-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 15-20% NONPLASTIC FINES, TRACE ROOTS AND IRON STAINS, DARK BROWN.
		S	8	3-17-20 (10")	37	SM	SIMILAR TO ABOVE. BLOWS/INCH: 3/2-1-1-3-5-5/4-4-4-2-4-2
702.1	20	S	9	3-3-3 (13")	6	SP	SAND, POORLY GRADED, LESS THAN 5% FINE GRAVEL, ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, BROWN.
		S	10	2-3-6 (18")	9	SW	SAND, WELL GRADED, LESS THAN 5% FINE GRAVEL, ROUNDED, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE COAL, BROWN.
	25	S	11	8-7-10 (18")	17	SW GP-GW	TOP 8 IN: SIMILAR TO ABOVE. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO SUBROUNDED, 30-40% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINS, BROWN. BLOWS/INCH: 1-1-2-1-1-2/2-1-1-1-1-1/1-2-2-1-2-2
		S	12	6-11-13 (11")	24	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, 15-25% COARSE TO FINE SAND, 10-15% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 6/2-2-2-2-2-1/3-2-2-1-2-3
692.1	30	S	13	14-11-14 (8")	25	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 1-1/2 IN MAXIMUM, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-3-3-2-2/1-2-2-2-2-2/2-2-3-2-3-2
		S	14	8-10-11 (10")	21	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1-1/2 IN, 15-20% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, RED, LIGHT GRAY AND BROWN, CONTAINED 1 IN THICK COARSE TO FINE SAND SIZED COAL LENS AT 5 IN FROM TOP. BLOWS/INCH: 2-2-1-1-1-1/1-1-2-2-2-2/2-2-2-1-2-2
	35	S	15	10-16-20 (9")	36	SP GP-GW	TOP 5 IN: SAND, POORLY GRADED, TRACE FINE GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BOTTOM 4 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-2-2-1-1/1-2-2-3-5-3/4-5-4-2-3-2
		S	16	10-8-7 (5")	15	- GW	TOP 3 IN: GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1-1/2 IN, WASH. BOTTOM 2 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, BROWN. BLOWS/INCH: 2-2-1-2-1-2/2-1-2-1-1-1/2-1-1-1-1-1
682.1	40	S	17	11-10-15 (2")	25	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, LARGE ANGULAR SANDSTONE FRAGMENT AT BOTTOM, 20-25% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 2-2-1-2-2-2/1-2-2-1-2-2/2-3-3-3-2-2
		S	18	12-8-8 (10")	16	GP-GW SW	TOP 4 IN: SIMILAR TO ABOVE. BOTTOM 6 IN: SAND, WELL GRADED, TRACE FINE GRAVEL, COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-2-2-2-2/1-2-1-1-1-2/1-2-1-1-1-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-244B | APPROVED DDW | DATE 9/1/82 | BORING NO. EOS-3 | SHEET 2 OF 3

BORING NO. EOS-3
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(E2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	19	18-15-11 (5")	26	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-4-3-4-3/2-3-3-3-2-2/2-3-2-1-2-1
		S	20	9-13-11 (9")	24	GP-GW	SIMILAR TO ABOVE, FEW FRAGMENTS TO 1-1/2 IN. BLOWS/INCH: 1-2-1-2-1-2/2-2-2-2-3-2/2-1-2-2-2-2
672.1	50	S	21	6-6-12 (5")	18	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 1-1-1-1-1-1/1-1-1-1-1-1/2-2-1-3-2-2
		S	22	12-13-14 (7")	27	GP	SANDY GRAVEL, BROKEN, WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE GRAVEL SIZED, TO 1-1/2 IN MAXIMUM, FEW COAL FRAGMENTS, 15-20% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE MICA, ORANGE, BROWN, GRAY, BLACK. BLOWS/INCH: 2-2-2-2-2-2/3-2-3-1-2-2/2-3-2-3-2-2
	55	S	23	30-30-36 (14")	66	GP	SANDY GRAVEL, BROKEN, WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE GRAVEL SIZED TO 1-1/2 IN MAXIMUM, MOSTLY COARSE, 20-30% MEDIUM TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINS, ORANGE, RED, BROWN, GRAY. BLOWS/INCH: 5-3-7-5-5-5/6-8-5-4-4-3/4-3-6-6-10-7
		S	24	25-13-15 (14")	28	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1-1/2 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE IRON STAINS, ORANGE BROWN. BLOWS/INCH: 4-6-5-5-2-3/2-3-2-2-2-2/2-2-3-2-3-3
662.1	60	S	25	18-30-80 (12")	110	-	SHALE, COARSE TO FINE GRAVEL SIZED FRAGMENTS, SOFT, WEATHERED, 5-10% FINE FINE SAND, 25-35% SLIGHTLY PLASTIC FINES, TRACE COAL, GRAY AND BROWN. BLOWS/INCH: 3-4-3-2-3-3/3-4-4-4-7-8/15-20-13-13-10-9
		S	26	105/6" (4")	105/6"		SHALE, SOFT, WEATHERED, GRAY.

BOTTOM OF BORING AT 63.0 FT
ELEVATION 659.1 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-244C | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-3 | SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-4

SHEET 1 OF 3

COORDINATES N4164.41 E6101.98 GROUND ELEV. (1) 720.1 FT

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5/26/82 / 5/26/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED(FT) / NA DRILL RIG TYPE CME 45

DEPTH TO BEDROCK (FT) TOTAL DEPTH DRILLED 53.0 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN O.D. ROLLER BIT, 3-1/4 IN ID CASING, DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS NONE

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
720.1	0	S	1	3-6-11 (10")	17	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1½ IN MAXIMUM, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE ROOTS, IRON STAINING, BROWN.
		S	2	11-17-12 (10")	29	GP-GW	SANDY GRAVEL, SIMILAR TO ABOVE, 30-40% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, DARK BROWN.
	5	S	3	10-13-10 (12")	23	SW	GRAVELLY SAND, WELL-GRADED, 20-30% COARSE TO FINE GRAVEL, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, DARK BROWN. BLOWS/INCH 1-1-2-2-2-2/3-2-2-2-2-2/1-2-2-2-2-1
		S	4	9-7-7 (7")	14	SP	GRAVELLY SAND, POORLY GRADED, 20-30% COARSE TO FINE GRAVEL, MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON STAINS, DARK BROWN.
710.1	10	S	5	4-13-11 (12")	24	SP GP	TOP 7 IN: SIMILAR TO ABOVE. BOTTOM 5 IN: SANDY BROKEN GRAY SANDSTONE, 30-40% COARSE TO MEDIUM SAND, TRACE IRON STAINING. BLOWS/INCH: 4/2-1-2-3-3-2/2-1-2-2-2-2
		S	6	4-17-11 (12")	28	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW SANDSTONE FRAGMENTS TO 1½ IN MAXIMUM, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% NONPLASTIC FINES, TRACE IRON STAINING, GRAY AND DARK BROWN. BLOWS/INCH: 4/1-4-3-3-3-3/3-1-2-2-2-1
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-245A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-4	1 OF 3

BORING NO. EOS-4

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	9-11-10 (14")	21	SP-SW	GRAVELLY SAND, 30-40% COARSE TO FINE GRAVEL TO 1½ IN MAXIMUM, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, TRACE IRON, BROWN. BLOWS/INCH: 9/2-2-3-1-2-1/2-2-2-1-1-2
		S	8	6-8-12 (8")	20	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
700.1	20	S	9	14-12-10 (13")	22	GM	SILTY GRAVEL, COARSE TO FINE, MOSTLY MEDIUM TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS, 10-15% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, TRACE COAL AND MICA, TRACE IRON STAINING, BROWN, GRAY, IRON AND BLACK. BLOWS/INCH: 2-2-2-3-2-3/2-3-2-2-2-1/1-2-2-1-2-2
		S	10	11-63-74 (14")	137	SM --	TOP 9 IN: SILTY SAND, POORLY GRADED, MEDIUM TO FINE SAND, 10-12% NONPLASTIC FINES, TRACE FINE GRAVEL, BROWN. BOTTOM 5 IN: SLAG, GRAY. BLOWS/INCH: 1-1-1-1-3-4/7-11-16-10-10-9/20-23-8-11-6-6
	25	S	11	10-11-17 (0")	28	--	NO RECOVERY BLOWS/INCH: 1-2-1-2-2-2/2-1-2-2-2-2/2-3-3-4-3-2
		S	12	10-9-6 (1")	15	SP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-1-1-2/1-2-2-2-1-1/1-1-1-1-1-1
690.1	30	S	13	4-5-6 (11")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, OCCASIONAL FINE GRAVEL TO ¼ IN, ROUNDED, 5-7% FINE SAND, MOIST, MOTTLED BROWN, GRAY BROWN WITH POCKETS OF GRAY. q_u (pp):2.5TSF
		S	14	18-15-19 (13")	34	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW TO 1.5 IN MAXIMUM, 30-40% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 1-2-4-3-4-4/2-3-3-2-2-3/3-3-4-3-3-3
	35	S	15	3-4-4 (15")	8	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, TRACE FINE GRAVEL, MOIST, GRAY. q_u (pp): 2.0TSF.
		US	1	(23.5")		CL	SANDY CLAY, MODERATELY PLASTIC, 10-15% MEDIUM TO FINE SAND, FEW PIECES COAL UP TO 3/8 IN, DARK GRAYISH BROWN.
		S	16	4-4-5 (12")	9	CL	SILTY CLAY, MEDIUM STIFF TO STIFF, MODERATELY PLASTIC, LESS THAN 5% FINE SAND, BROWN. q_u (pp): 2.0TSF
680.1	40	US	2	(23")			SIMILAR TO S16 (TUBE TRIMMINGS).
		S	17	4-4-4 (12")	8	CL	SILTY CLAY, MEDIUM STIFF TO STIFF, SLIGHTLY TO MODERATELY PLASTIC, LESS THAN 5% FINE SAND, BROWN WITH GRAY MOTTLING. q_u (pp): 2.25TSF
		US	3	(0")			NO RECOVERY.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245B | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-4 | SHEET 2 OF 3

BORING NO. EOS-4
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	18	0-4-4 (18")	8	CL	SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, 10% VERY FINE SAND, BROWN. q_u (pp): 1.75, 0.75, 1.25TSF
		US	4	(16")			
		S	19	4-6-5 (18")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, SOFT TO MEDIUM STIFF, MOIST BROWN. q_u (pp): 0.5TSF
670.1	50						
		US	5	(0")		CL	NO RECOVERY. PUSHED SPLIT SPOON (S-20) - RECOVERED SILTY CLAY SIMILAR TO S-19.

BOTTOM OF BORING AT 53.0 FT
ELEVATION 667.1

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245C	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-4	3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 | J.O. NO. 12241 | BORING NO. EOS-4A | SHEET 1 OF 2

COORDINATES N4158.7 E6105.3 GROUND ELEV. (1) 720.4

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5/27/82 / 5-28-82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / NA DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 72.5 (FT) TOTAL DEPTH DRILLED 72.8 (FT)

METHODS :

DRILLING SOIL 3-7/8 IN ROLLER BIT, 4 IN I.D. CASING, DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. OSTERBERG

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
							NO SAMPLES TO 35.5 FT
	35						
		UO	1	(30.5")	-	-	
		S	1	5-4-5 (14")	9	CL	SILTY CLAY, MODERATELY PLASTIC, STIFF, LESS THAN 5% FINE SAND, TRACE ORGANICS, BROWN WITH SOME MOTTLED GRAY. q_u (pp): 2.25, 2.0, 2.5TSF
680.4	40						
		UO	2				NO RECOVERY.
		UO	3	(30")	-	CL	SIMILAR TO S-1 (TRIMMINGS)
	45	S	2				

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-246A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/1/82	EOS-4A	1 OF 2

BORING NO. EOS-4A
SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	2	3-3-4	7	CL	SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF, TRACE FINE SAND, MOIST, BROWN WITH GRAY MOTTLING. q_u (pp): 1.25, 1.75TSF
		UO	4	(29.8")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	3	3-4-6 (18")	10	CL	SIMILAR TO S-2. TRACE ORGANIC MATERIAL. q_u (pp): 1.25TSF
670.4	50						
		UO	5	(30")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	4	3-4-5	9	CL	SANDY CLAY, MODERATELY PLASTIC, STIFF, 23% VERY FINE SAND, BROWN.
	55	UO	6	(30")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	5	3-5-4 (18")	9	CL CL	TOP 8 IN: SIMILAR TO S-2. BOTTOM 10 IN: SILTY CLAY, MODERATELY PLASTIC, SOFT, CONTAINS FINE SAND LENSES LESS THAN 1 mm THICK, GRAY. q_u (pp): 0.75TSF
		UO	7	(30.5")			
660.4	60						
		S	6	2-2-4 (18")	6	CL	SANDY CLAY, SLIGHTLY PLASTIC, 20-25% VERY FINE SAND, MEDIUM STIFF, SOME VERY FINE SAND LENSES, 5 mm THICK, GRAY. q_u (pp) 1.0, 0.75TSF
		UO	8	(29.3")			
	65	S	7	3-3-6 (16")	9	CL/ML	SANDY CLAY - SANDY SILT, SLIGHTLY PLASTIC, 15-20% VERY FINE SAND, CONTAINS FINE SAND LENSES LESS THAN 1-2 mm THICK, NUMEROUS SMALL WHITE DEPOSITS, 1 mm DIAMETER, MOIST, DARK GRAY.
		S	8	29-28-19 (10")	47	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, WEATHERED, MAXIMUM SIZE 1-1/2 IN.
650.4	70						
		S	9	13-15-101/4"	116/10"		TOP 10 IN: BROKEN SANDSTONE AND SHALE, SOFT, WEATHERED. BOTTOM 4 IN: SHALE, SOFT, GRAY. BLOWS/IN: 3-2-3-1-3-1/3-2-2-2-3-3/6-10-40-45
							BOTTOM OF BORING AT 72 FT 10 IN ELEVATION 647.6 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-246B | APPROVED DDH | DATE 9/1/81 | BORING NO. EOS-4A | SHEET 2 OF 2

BORING NO.	EOS-5
SHEET	1 OF 3

SITE: BEAVER VALLEY POWER STATION - UNIT 2 — J.O. NO.: 12241

COORDINATES: N4300 E6057 — GROUND ELEV. (1): 683.0

INCLINATION: VERTICAL — BEARING: NA — INSPECTOR: JWMCCOY

DATE: START / FINISH: 6/1/82 / 6/2/82 — CONTRACTOR / DRILLER: EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE: NOT RECORDED (FT) / -- — DRILL RIG TYPE: CME 45

DEPTH TO BEDROCK: 51.0 (FT) — TOTAL DEPTH DRILLED: 51.25 (FT)

METHODS:

DRILLING SOIL: 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD.

SAMPLING SOIL: 2 IN O.D. SPLIT SPOON, 3 IN O.D. SHELBY TUBE AND OSTERBERG.

DRILLING ROCK:

SPECIAL TESTING OR INSTRUMENTATION: NONE

COMMENTS:

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
683.0	0	S	1	2-2-1 (0")	3		NO RECOVERY
		S	2	1-1-1 (7")	2	ML	SILT, SLIGHTLY TO MODERATELY PLASTIC, SOFT, TRACE FINE SAND AND ROOTS, BROWN WITH ORANGE MOTTLING.
	5						
		S	3	1-1-1	2	ML	SANDY SILT, SLIGHTLY PLASTIC, SOFT, 15-20% FINE SAND, SOME ORGANIC MATERIAL.
		S	4	1-1-2	3	ML	SIMILAR TO ABOVE.
673.0	10						
		S	5	1-1-1 (7")	2	ML	SANDY SILT, SLIGHTLY TO MODERATELY PLASTIC, 15-20% FINE SAND, TRACE ORGANIC MATERIAL, BROWN.
		US	1	(0")			NO RECOVERY.
	15	S	6	1-2-2 (5")	4	CL/ML	SANDY CLAY - SANDY SILT, MODERATELY PLASTIC, SOFT, 15-20% FINE SAND, BROWN.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-247A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/4/82	EOS-5	1 OF 3

BORING NO. EOS-5
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15						
		S	7	2-2-2 (15")	4	CL/ML	SANDY CLAY-SANDY SILT, SLIGHTLY PLASTIC, SOFT, 20-25% FINE SAND, BROWN.
		UO	2	(30")		CL	SANDY CLAY, MODERATELY PLASTIC, 30-40% MEDIUM TO FINE SAND, MOSTLY FINE, MOTTLED LIGHT BROWN, GRAYISH BROWN AND YELLOW BROWN.
663.0	20	S	8	2-2-3 (18")	5	CL	SANDY CLAY, SLIGHTLY PLASTIC, 30% FINE SAND, BROWN AND GRAY WITH ORANGE MOTTLING. qu(pp) = 0.75, 1.0 TSF
		UO	3	(28")			
	25	S	9	3-2-2 (18")	4	CL ML-MH	TOP 13 IN: SIMILAR TO S-8. BOTTOM 5 IN: ORGANIC CLAYEY SILT, MODERATELY TO HIGHLY PLASTIC, TRACE FINE SAND, GRAY.
		US	4	(27")			SANDY CLAY, MODERATELY PLASTIC, 12-20% VERY FINE SAND, GRAY. (TUBE TRIMMINGS)
		S	10	2-2-11 (18")	13	SM-CL	LAYERED SILTY SAND AND SANDY CLAY, LAYER THICKNESS 1/4 IN TO 3/4 IN, SAND IS FINE, CLAY IS MODERATELY PLASTIC, SOFT, GRAY.
653.0	30	S	11	17-19-16 (6")	35	SP	GRAVELLY SAND, FINE TO COARSE GRAVEL TO 1 IN, COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, CONTAINS SEVERAL PIECES OF FRACTURED SANDSTONE INDICATING SPOON SAMPLED COBBLE. BLOWS/INCH: 2-3-3-3-3-3/4-3-3-4-2-3/2-3-3-3-2-3
		S	12	10-20-14 (7")	34	GP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 2-2-2-2-2-2/1-3-3-3-5-5/3-4-2-2-1-2
	35	S	13	19-18-12 (4")	30	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED, MOSTLY COARSE WEATHERED SANDSTONE AND SHALE, 1½ IN MAXIMUM, ANGULAR (SOME ROUNDED), 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 4-4-2-4-2-3/4-3-2-3-3-3/2-2-2-2-2-2
		S	14	21-10-6 (8")	16	GP	SANDY GRAVEL, COARSE TO FINE, ROUNDED, CONTAINS SOME WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, GRAY. BLOWS/INCH: 4-3-5-3-3-3/2-2-2-1-2-1/1-1-1-1-1-1
643.0	40	S	15	9-11-9 (9")	20	GW	GRAVEL, WELL GRADED, COARSE TO FINE, FEW FRAGMENTS TO 1½ IN, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, GRAY. BLOWS/INCH: 2-2-1-1-2-1/2-2-1-2-2-2/2-1-1-2-1-2
		S	16	25-10-9 (11")	19	GW SP	TOP 6 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR, CONTAINS SANDSTONE FRAGMENTS TO 1½ IN MAXIMUM, 30-35% COARSE TO FINE SAND, GRAY. BOTTOM 5 IN: SAND, POORLY GRADED, 5-10% COARSE TO FINE GRAVEL, ROUNDED, COARSE SAND, GRAY. BLOWS/INCH: 5-4-7-4-2-3/2-2-2-2-1-1/2-1-2-1-1-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-247B | APPROVED DA | DATE 9/9/82 | BORING NO. EOS-5 | SHEET 2 OF 3

BORING NO.	EOS-5
SHEET 3 OF 3	

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	17	30-15-7 (9")	22	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, FEW TO 1-1/2 IN MAXIMUM, WEATHERED, SOFT, 30-40% COARSE TO FINE SAND, TRACE IRON STAINING, BROWN AND GRAY.
		S	18	60/1" (0")	60/1"	--	NO RECOVERY.
		S	19	69-26-90 (14")	116	GP	SIMILAR TO S-17, DARK GRAY SHALE AT BOTTOM, SOFT.
633.0	50						
		S	20	100/3"	100/3"	--	SHALE, SOFT, DARK GRAY.
							BOTTOM OF BORING AT 51 FT 3 IN ELEVATION 631.75

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-247C	APPROVED DD	DATE 9/9/82	BORING NO. EOS-5	SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-6
SHEET 1 OF 3

COORDINATES N3848 E6173 GROUND ELEV (1) 745.1

INCLINATION VERTICAL BEARING ______ INSPECTOR J.W. MCCOY

DATE : START / FINISH 6/8/82 / 6/8/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / NA DRILL RIG TYPE CME-45

DEPTH TO BEDROCK 48.1 (FT) TOTAL DEPTH DRILLED 48.1 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT, 4 IN I.D. CASING, WATER.

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK ______

SPECIAL TESTING OR INSTRUMENTATION 2 FT NORTON POROUS PIEZOMETER INSTALLED WITH TIP AT EL 710.1

COMMENTS ______

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
745.1	0	S	1	1-3-3 (6")	6	-	TOPSOIL, SILT, LESS THAN 5% FINE SAND, 1.5 IN SANDSTONE FRAGMENT AT TIP, DARK BROWN.
		S	2	4-4-6 (18")	10	CL	SANDY CLAY, MODERATELY PLASTIC, STIFF, 12% COARSE TO FINE GRAVEL SIZED SANDSTONE, SHALE AND COAL FRAGMENTS, ANGULAR, 22% COARSE TO FINE SAND, BROWN, MOTTLED WITH YELLOW BROWN AND GRAY.
		S	3	4-7-8 (18")	15	CL	SIMILAR TO S-2.
	5						
		S	4	6-8-8 (18")	16	CL	SIMILAR TO S-2.
		S	5	6-6-8 (11")	14	CL	SIMILAR TO S-2.
735.1	10						
		S	6	4-5-5 (18")	10	CL	SILTY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL COARSE SAND AND COAL FRAGMENTS, MOIST, BROWN.
						CL/ML	SILTY CLAY, SLIGHTLY PLASTIC, 4% VERY FINE SAND, BROWN.
		S	7	3-2-3 (14")	5	ML	TOP 4 IN: SANDY SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 15-20% FINE SAND, WET, BROWN.
						GP	MIDDLE 6 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, BROWN, GRAY.
		S	8	6-8-5 (14")	13	SP	BOTTOM 4 IN: SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, BROWN.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-248A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-6	1 OF 3

BORING NO. EOS-6
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1E2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	8				
		S	9	3-4-5 (17")	9	SP SP	TOP 6 IN: SIMILAR TO S-8, BOTTOM 4 IN. BOTTOM 11 IN: SAND, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 7-8% NONPLASTIC FINES, BROWN, CONTAINS OCCASIONAL POCKET OF SILTY CLAY, MODERATELY PLASTIC, BROWN.
		S	10	5-6-7 (15")	13	SP	SAND, POORLY GRADED, 5-7% FINE GRAVEL, ROUNDED, MEDIUM TO FINE SAND, 7-12 % NONPLASTIC FINES, MOIST, BROWN.
725.1	20	S	11	4-3-5 (15")	8	SP ML	TOP 2 IN: SIMILAR TO S-10. BOTTOM 13 IN: SILT, NONPLASTIC, TRACE FINE GRAVEL SIZED SANDSTONE AND COAL, SOME LENSES OF SANDY SILT, MOIST, BROWN.
		S	12	4-6-9 (18")	15	ML	SILT, NONPLASTIC, TRACE FINE SAND, WET, BROWN.
	25	S	13	4-3-4 (18")	7	ML-SM	LAYERED SILT AND SILTY FINE SAND, TRACE FINE GRAVEL SIZED ROCK FRAGMENTS, NONPLASTIC FINES, WET, BROWN.
		S	14	2-3-4 (18")	7	CL	SILTY CLAY-CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, 1% VERY FINE SAND, BROWN.
		S	15	2-2-2 (10")	4	SM	SILTY SAND, UNIFORMLY GRADED, FINE, TRACE COARSE SAND, 20-25% NONPLASTIC TO SLIGHTLY PLASTIC FINES, WET, BROWN.
715.1	30	S	16	3-7-5 (18")	12	SP GP	TOP 11 IN: SAND, UNIFORMLY GRADED, FINE, 5-7% NONPLASTIC FINES, WET, BROWN. BOTTOM 7 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1.5 IN, SOME COAL, 20-30% COARSE TO FINE SAND, 5% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, BROWN, ORANGE.
		S	17	5-4-4 (18")	8	SM GP-GW	TOP 10 IN: SILTY SAND, 5-10% COARSE TO FINE GRAVEL SIZED COAL FRAGMENTS TO 1 IN, FINE SAND, 15-20% NONPLASTIC FINES. BOTTOM 8 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1 IN, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
		S	18	4-5-5 (18")	10	SP-SM	SILTY SAND, FINE, TRACE FINE GRAVEL AND COAL FRAGMENTS, 10-15% NONPLASTIC FINES, SANDSTONE FRAGMENTS AT BOTTOM.
	35	S	19	7-8-11 (18")	19	SP-SM GP	TOP 13 IN: SIMILAR TO S-18. BOTTOM 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, TRACE IRON STAINING, BROWN, GRAY, BLACK.
		S	20	49-81/2"	81/2"	SP	GRAVELLY SAND, 25-35% COARSE TO FINE GRAVEL SIZED SANDSTONE SHALE AND COAL, ANGULAR TO ROUNDED, MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON, BROWN, GRAY.
705.1	40	S	21	26-34-17 (18")	51	GP GP	TOP 13 IN: SANDY GRAVEL, COARSE TO FINE, ROUNDED, SOME BROKEN SANDSTONE AND SHALE, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE BROWN. BOTTOM 5 IN: GRAVEL, BROWN SANDSTONE FRAGMENTS TO 1.5 IN, SAMPLED COBBLE, GRAY.
		S	22	20-16-103 (18")	119	GM GP	TOP 12 IN: SILTY GRAVEL, COARSE TO FINE GRAVEL, MOSTLY COARSE TO 1 IN, ANGULAR, 25-30% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, WET, BROWN. BOTTOM 6 IN: SANDSTONE FRAGMENTS, SAMPLED COBBLE. BLOWS/INCH: 3-3-2-4-4-4/2-2-1-2-3-6/5-4-30-34-18-12
		S	23	33-107-33 (11")	140	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, SOME COAL, 1.5 IN MAXIMUM, 20-25% COARSE TO MEDIUM SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE MICA, TRACE IRON STAINS, BROWN, GRAY, ORANGE.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-2483	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-6	2 OF 3

BORING NO. EOS-6
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	24	36-28-41 (13")	69	GP	SIMILAR TO S-22, TOP.
		S	25	21-71-103/15" (11")	174/75"	GP	TOP 5 IN: SIMILAR TO S-22, TOP. MIDDLE 2 IN: SANDSTONE FRAGMENTS, SOFT, GRAY. BOTTOM 4 IN: COAL FRAGMENTS.
							BOTTOM OF BORING AT 48.1 FT ELEVATION 697.0 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-248C	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-6	SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-7

SHEET 1 OF 2

COORDINATES N3812 E6140 GROUND ELEV. (1) 759.9

INCLINATION VERTICAL BEARING NA INSPECTOR JW McCOY

DATE : START / FINISH 6/3/82 / 6/3/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / — DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 44.5 (FT) TOTAL DEPTH DRILLED 45.0 (FT)

METHODS :

DRILLING SOIL 3 1/8 IN ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION 2 FT POROUS STONE PIEZOMETER, INSTALLED WITH TIP AT EL. 716.9

COMMENTS BORING ADVANCED WITHOUT WATER. DID NOT ENCOUNTER ANY GROUNDWATER.

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
759.9	0	S	1	4-7-9 (5")	16	-	FILL, SLAG AND SILTY GRAVEL, COARSE TO FINE, TRACE ROOTS AND IRON STAINS, GRAY.
		S	2	4-7-6 (11")	13	ML	GRAVELLY SILT, SLIGHTLY PLASTIC, 10-15% COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE, ROUNDED TO SUBANGULAR, 15-20% COARSE TO FINE SAND, SOME ROOTS SLIGHTLY MOIST, GRAY.
	5	S	3	6-5-6 (18")	11	CL/ML -	TOP 8 IN: GRAVELLY SILT-GRAVELLY CLAY, SLIGHTLY TO MODERATELY PLASTIC, 20-30% COARSE TO FINE GRAVEL, SOME WOOD FRAGMENTS, GRAY AND BROWN. BOTTOM 10: COAL AND SHALE FRAGMENTS, WIDELY GRADED, COARSE TO FINE GRAVEL AND SAND SIZED FRAGMENTS, TRACE IRON STAINING.
		S	4	7-6-5 (16")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, CONTAINS FEW LAYERS OF COAL FRAGMENTS AND SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, FEW RED SHALE FRAGEMENTS, 7-10% COARSE TO FINE SAND, VERY SLIGHTLY MOIST, BROWN.
		S	5	4-7-6 (16")	13	CL	SIMILAR TO S-4, MOTTLED BROWN AND ORANGE.
749.9	10	S	6	3-5-8 (13")	13	CL	SIMILAR TO S-4, CONTAINED 1 IN THICK LAYER OF SILTY CLAY WITHOUT COARSE FRACTION, MOTTLED GRAY AND BROWN.
		S	7	7-8-8 (16")	16	CL	SANDY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL FINE GRAVEL SIZED SANDSTONE PARTICLE, 15-20% COARSE TO FINE SAND, SOME MINOR IRON STAINING, SLIGHTLY MOIST, BROWN.
	15	S	8	4-7-7 (13")	14	CL	SANDY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 10-15% FINE GRAVEL TO 3/4 IN MAXIMUM, ANGULAR, 15-20% COARSE TO FINE SAND, BROWN.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

8. SAMPLE CONTAINS PIECES OF SANDSTONE 1.5 IN DIAMETER AND 1/8 IN THICK, INDICATING SAMPLER PENETRATED COBBLE OR BOULDER. TYPICAL OF THIS MATERIAL.

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-249A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/1/82	EOS-7	1 OF 2

BORING NO. EOS-7

SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	8				
		S	9	6-6-6 (14")	12	CL	TOP 10 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 15-20% COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, FEW COAL FRAGMENTS, ORANGE, BROWN AND GRAY.
						CL	BOTTOM 4 IN: SILTY CLAY, MEDIUM STIFF, MODERATELY PLASTIC, TRACE FINE SAND, MOIST, BROWN. (SIMILAR TO ABOVE BUT WITHOUT COARSE FRACTION).
		S	10	19-17-12 (7")	29	GP	SANDY GRAVEL, POORLY GRADED, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS, MOSTLY 1.5 IN, 20-25% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5% NONPLASTIC FINES, BROWN. (CONTAINED LAYER OF SOFT CLAYEY SILT AT TOP OF SAMPLE). (SEE NOTE 8).
739.9	20						
		S	11	4-15-17 (14")	32	SP	TOP 10 IN: SILTY SAND, SLIGHTLY PLASTIC, 15-20% COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, FEW TO 1 IN MAXIMUM, ANGULAR, 15-20% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN.
						GP	BOTTOM 4: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, 30-40% COARSE TO FINE SAND, 5% NONPLASTIC FINES, LIGHT GRAY.
		S	12	99-10-8 (10")	18	SP	TOP 5 IN: SIMILAR TO S-11, TOP.
						GP	BOTTOM 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, 5% NONPLASTIC FINES, TAN. (SAMPLED COBBLE?).
		S	13	9-59-26 (10")	85	GP	LAYERED SANDY GRAVEL AND SANDY CLAYEY SILT, SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN, ANGULAR, 30-40% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TAN (SAMPLED COBBLE).
	25					ML	CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, SOFT, 10-15% COARSE TO FINE GRAVEL, ANGULAR, BROWN.
		S	14	6-7-10 (14")	17	GP	TOP 6 IN: SANDY GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 20-25% COARSE TO FINE SAND, LIGHT GRAY.
						ML	BOTTOM 8 IN: GRAVELLY SILT, SLIGHTLY PLASTIC, 12-15% COARSE TO FINE GRAVEL SIZED SANDSTONE, SHALE AND COAL FRAGMENTS, 1.5 IN FRAGMENT AT TIP, LESS THAN 5% FINE SAND, TRACE IRON STAINS, BROWN.
		S	15	9-9-11 (12")	20	GP	SANDY GRAVEL, WIDELY GRADED, COARSE TO FINE GRAVEL, MOSTLY COARSE TO 1 IN, ANGULAR TO SUBROUNDED SANDSTONE, 20% COARSE TO FINE SAND, 15-20% NONSLIGHTLY PLASTIC FINES, BROWN.
729.9	30	S	16	8-9-8 (12")	17	GP	SIMILAR TO S-15.
		S	17	7-14-14 (12")	28	GP	SIMILAR TO S-15, SAMPLED COBBLE, SOME FRAGMENTS ROUGHLY THE DIAMETER OF SAMPLER. BLOWS/INCH: 1-1-1-1-1-2/1-1-2-1-4-5/4-1-3-2-2-2
		S	18	12-14-11 (14")	25	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 15-20% COARSE TO FINE SAND, 7% NONPLASTIC FINES, GRAY. SOME POCKETS OF SILTY FINE SAND, BROWN. BLOWS/INCH: 2-1-2-3-2-2/1-3-3-3-2-2/2-2-2-2-2-1
	35						
		S	19	10-9-13 (12")	22	SP	GRAVELLY SAND, 15-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1.5 IN, FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-2-1-2-2/1-2-1-2-2-1/2-1-2-4-2-2
						SP	TOP 3 IN: SAND, UNIFORM, FINE, LESS THAN 5% NONPLASTIC FINES, BROWN.
		S	20	4-7-25 (14")	32	SP	MIDDLE 10 IN: SAND, UNIFORM, MEDIUM TO FINE, TRACE FINE GRAVEL, COAL FRAGMENTS, IRON STAINING, BROWN.
						GP	BOTTOM 1 IN: SANDSTONE FRAGMENTS.
719.9	40	S	21	32-24-24 (14")	48	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, 20-25% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, LIGHT GRAY AND BROWN. SANDSTONE FRAGMENT AT TIP. BLOWS/INCH: 3-7-3-5-4-10/6-3-4-5-3-3/3-4-3-4-5-5
		S	22	100/5"	100/5"	SP	GRAVELLY SAND, POORLY GRADED, 15-20% COARSE TO FINE GRAVEL TO 1 IN MAXIMUM, ANGULAR, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-12% NON TO SLIGHTLY PLASTIC FINES, MOIST, BROWN.
		S	23	47-22-30 (17")	52		SANDY GRAVEL, SIMILAR TO S-15, AT 7 IN. FROM TOP - 2 IN. THICK SEAM OF FINE SAND, 15-20% NONPLASTIC FINES, MOIST, BROWN.
	45	S	24	27-135 (0")	135/6"		REFUSAL/NO RECOVERY. END OF BORING AT 45 FT. EL. 714.9

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-249B | APPROVED [signature] | DATE 9/[illegible] | BORING NO. EOS-7 | SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-7A
SHEET 1 OF 2

COORDINATES N3814.6 E6136.2 GROUND ELEV. (1) 759.6 FT.

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. McCOY

DATE : START / FINISH 6/3/82 / 6/3/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NA (FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK NA (FT) TOTAL DEPTH DRILLED 24.5 (FT)

METHODS :

DRILLING SOIL 3 1/8 IN O.D. ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION 2 FT NORTON POROUS PIEZOMETER INSTALLED WITH TIP AT EL. 738.1

COMMENTS DRILLED 5 FT NORTHWEST OF EOS-7

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
759.6	0						
							NO SAMPLES TO 7 FT.
	5						
		US	1	(15")			
749.6	10	US	2	(25.5")			
		S	1	10-7-6 (13")	13	CL/ML	SANDY CLAY-SANDY SILT, SLIGHTLY PLASTIC, STIFF, 20-25% COARSE TO FINE SAND, 10% FINE GRAVEL TO 1/4 IN, MOIST, BROWN.
		S	2	5-7-7 (10")	14	CL	SANDY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 10% FINE GRAVEL, OCCASIONAL COARSE GRAVEL TO 1 IN, 20% COARSE TO FINE SAND, MOIST, BROWN.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-250A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-7A	1 OF 2

BORING NO.	EOS-7A
SHEET 2 OF 2	

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	3	5-6-9 (13")	15	CL	SIMILAR TO S-2, 20-30% COARSE TO FINE GRAVEL TO 1 IN.
		S	4	4-6-6 (16")	12	CL ML	TOP 13 IN: SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF, MOTTLED GRAY AND BROWN. BOTTOM 3 IN: SILT, LOOSE, TRACE FINE SAND, WET, BROWN.
739.6	20	S	5	11-15-14 (13")	29	GP	SANDY GRAVEL, WEATHERED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 25-30% COARSE TO FINE SAND, MOSTLY MEDIUM FINE, 5-10% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN AND GRAY.
		S	6	20-20-8 (18")	28	GP	GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, LIGHT GRAY. CONTAINS POCKETS OF SANDY SILT, 10-15% FINE SAND, VERY MOIST, BROWN.
		S	7	8-11-18 (13")	29	GP	SIMILAR TO S-6.
							BOTTOM OF BORING AT 24.5 FT ELEVATION 735.1 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-250B	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-7A	2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2	J.O. NO. 12241
BORING NO. EOS-9	SHEET 1 OF 3

COORDINATES N3944 E6185 GROUND ELEV. (1) 732.7

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5-19-82 / 5/20/82 CONTRACTOR / DRILLER EGER DRILLING/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 52.0 (FT) TOTAL DEPTH DRILLED 52.0 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD

SAMPLING SOIL 2.0 IN O.D. SPLIT SPOON

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS LOST DRILLING FLUID AT 35.0 AND 40.0 FT

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
732.7	0	S	1	2-5-3 (14")	8	ML/ SM	SANDY SILT, DENSE, SLIGHTLY MOIST, FEW SANDSTONE FRAGMENTS AND ROOTS, GRADING TO SILTY SAND, TRACE FINE GRAVEL, 30-40% NONPLASTIC FINES, BROWN.
		S	2	4-4-6 (18")	10	ML	SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 0-5% FINE SAND, TRACE ORGANICS, FEW SMALL SAND SEAMS, WET, BROWN.
	5	S	3	3-4-5 (16")	9	ML SP	TOP 13 IN: SIMILAR TO ABOVE. BOTTOM 3 IN: SAND, FINE, FEW FINE GRAVEL AND WEATHERED SANDSTONE FRAGMENTS TO 0.5 IN, 0-5% NONPLASTIC FINES, BROWN.
		S	4	4-4-4 (16")	8	SP ML	TOP 13 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, 2-5% FINE GRAVEL, 0-5% NONPLASTIC FINES, BROWN. BOTTOM 3 IN: SILT, NONPLASTIC TO SLIGHTLY PLASTIC, BROWN. BLOWS/INCH: 1-1-1/2-1/2//1-1/2-1/2-1//1/2-1/2-1-1
722.7	10	S	5	3-3-4 (14")	7	SP SP	TOP 4 IN: SILTY SAND, FINE, TRACE COARSE-MEDIUM SAND, 15-20% NONPLASTIC FINES, MOIST, BROWN. BOTTOM 10 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, TRACE FINE GRAVEL, 5% NONPLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 1-1/2-1/3//1/2-1/2-1/2//1-1/2-1/2-1
		S	6	6-4-3 (18")	7	GW	GRAVELLY SAND, WELL GRADED, 20-30% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, SUBANGULAR TO ROUNDED, COARSE TO FINE SAND, TRACE NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 1-1-1-1-1-1//4//1/2-1/2-1/2
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-251A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-9	1 OF 3

BORING NO. EOS-9
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	4-3-3 (18")	6	SM SP	TOP 9 IN: SILTY SAND, 10-15% COARSE TO FINE GRAVEL, SUBANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES. BOTTOM 9 IN: SAND, FINE, 2-6% FINE GRAVEL, 0-5% NONPLASTIC FINES, TRACE COARSE SAND SIZED COAL FRAGMENTS, BROWN. BLOWS/INCH: 1-1/2-1/2-1//1/2-1/2-1/2//1/2-1/2-1/2
		S	8	9-11-10 (18")	21	GW	SANDY GRAVEL, WIDELY GRADED, SUBANGULAR TO ANGULAR WEATHERED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 25-35% COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE COAL, FEW IRON STAINS, BROWN.
712.7	20	S	9	4-3-2 (16")	5	SP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, MAXIMUM SIZE 1 IN, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY FINE, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL FRAGMENTS, IRON STAINS AT BOTTOM, WET AT BOTTOM, BROWN.
		S	10	9-10-13 (16")	23	GW	SANDY GRAVEL, WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, ANGULAR, 15-25% COARSE TO FINE SAND, 2-5% NONPLASTIC FINES, IRON STAINS, MOIST, BROWN AND GRAY. BLOWS/INCH: 2-2-1-2-1-1/1-1-2-2-2-2/3-2-2-2-2-2
	25	S	11	27-17-13 (12")	30	GP	GRAVEL, WEATHERED SANDSTONE AND LIMESTONE(?) FRAGMENTS TO 1-1/2 IN, ANGULAR TO SUBANGULAR, SOME IRON STAINING, 5-10% NONPLASTIC FINES, TRACE SHALE FRAGMENTS, DRY, BROWN. BLOWS/INCH: 2-3-5-4-5-3/3-3-3-3-2-3/3-2-3-2-2-1
		S	12	5-9-19 (13")	28	SP SP SP	TOP 3 IN: SAND, UNIFORM, FINE, TRACE FINE GRAVEL, TRACE NONPLASTIC FINES, BROWN. MIDDLE 1 IN: SAME AS ABOVE, DARK BROWN. BOTTOM 9 IN: SAND, UNIFORM, FINE, TRACE FINE GRAVEL, ROCK FRAGMENT AT BOTTOM, LIGHT BROWN. BLOWS/INCH: 1-2-1/2-1/2//1-1-1-2-2-2//3-4-3-3-3-3
702.7	30	S	13	11-15-15 (13")	30	SM SW	TOP 4 IN: SILTY SAND, 10-15% FINE GRAVEL TO 1/2 IN, ANGULAR TO SUBROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 25-30% NONPLASTIC FINES, DRY, BROWN, DENSE AND HARD IN NATURAL STATE, PARTICLES APPEAR WATER-BORNE. BOTTOM 9 IN: SAND, WELL GRADED, COARSE TO FINE, 0-5% FINE GRAVEL, 0-5% NONPLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, IRON STAINING, BROWN. BLOWS/INCH: 2-2-2-1-2-2/3-2-3-3-2-2/3-1-3-3-3-2
		S	14	9-7-14 (18")	22	SM SP	TOP 15 IN: SIMILAR TO S-13, TOP 4 IN. BOTTOM 3 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, TRACE FINE GRAVEL, MOIST, BROWN. BLOWS/INCH: 1-2-2-1-2-1/1-1-1-1-1-2/1-2-2-3-3-3
	35	S	15	11-12-15 (18")	27	SM GP	TOP 8 IN: SIMILAR TO S-13, TOP 4 IN BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-3-2-2/2-2-3-2-2-2/3-2-3-3-2-2
		S	16	16-20-25	45	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL, FEW TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 1 IN SANDSTONE FRAGMENTS AT BOTTOM, 10-15% COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, DRY, BROWN (SIMILAR TO S-13, TOP 4 IN). BLOWS/INCH: 2-2-3-3-3-3/4-3-2-3-3-5/4-3-2-2-7-7
692.7	40	S	17	5-5-8 (8")	13	GW	SANDY GRAVEL, COARSE TO FINE GRAVEL, FEW TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 0-5% SLIGHTLY PLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 1/2-1-1-1-1-1//1-1-1/2-1-1//1-1-2-2-1-1
		S	18	12-19-22 (16")	41	GP	SANDY GRAVEL, MOSTLY LARGE, WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1-1/2 IN, SOME SHALE FRAGMENTS, 15-20% COARSE TO FINE SAND, 2-5% NONPLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 3-2-2-2-2-1/2-2-2-4-4-5/7-3-3-4-3-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-251B	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-9	SHEET 2 OF 3

BORING NO. EOS-9

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	19	13-9-19 (11")	28	GP	TOP 4 IN: GRAVEL, SANDSTONE FRAGMENTS TO 1-1/2 IN, SOME SHALE FRAGMENTS, 5-10% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, GRAY AND ORANGE.
						SP	MIDDLE 3 IN: SAND, UNIFORM, FINE, 0-5% NONPLASTIC FINES, WET, BROWN.
						GP	BOTTOM 4 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 5-10% SLIGHTLY PLASTIC FINES, WET, BROWN. BLOWS/INCH: 4-2-2-2-1-2/1-2-2-1-1-2/2-5-2-5-3-2
		S	20	45/6" (5")	45/6"	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, ROUNDED TO ANGULAR, LARGE SANDSTONE FRAGMENT AT BOTTOM, 10-15% COARSE TO FINE SAND, 2-5% SLIGHTLY PLASTIC FINES, MOIST, ORANGE, BLACK AND BROWN. BLOWS/INCH: 8-4-9-6-11-7
		S	21	30-23-20 (10")	43	GP	SANDY GRAVEL, SIMILAR TO ABOVE, MAXIMUM PARTICLE SIZE 1-1/2 IN, 5-7% SLIGHTLY PLASTIC FINES, BROWN. BLOWS/INCH: 3-4-4-7-7-5/6-3-5-4-3-2/4-3-2-3-3-5
682.7	50	S	22	15-98/3" (6")	98/3"	-	WEATHERED SHALE, 10-15% FINE SAND, 10-15% SLIGHTLY PLASTIC TO MEDIUM PLASTIC FINES, ORANGE, BLACK, GRAY BROWN.
		S	23	30/0"			REFUSAL

BOTTOM OF BORING AT 52.0 FT
ELEVATION 680.7 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-251C

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-9	3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-10

SHEET 1 OF 3

COORDINATES N4097.3 E6137.4 GROUND ELEV. (1) 720.7

INCLINATION VERTICAL BEARING NA INSPECTOR J. W. MCCOY

DATE : START / FINISH 6/10/82 / 6/11/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK NA (FT) TOTAL DEPTH DRILLED 66.5 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN O.D. ROLLER BIT, 4 IN I.D. CASING AND DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS NONE

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
720.7	0	S	1	11-21-21 (13")	42	GP-GW	SANDY GRAVEL, COARSE TO FINE TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, BROWN, GRAY AND ORANGE.
		S	2	6-5-3 (11")	8	SP-SW	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1.5 IN, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 5-10% SLIGHTLY PLASTIC FINES, BROWN.
	5						
		S	3	2-1-1 (10")	2	SP-SW	GRAVELLY SAND, 30-35% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% SLIGHTLY PLASTIC FINES, GRAY.
710.7	10						
		S	4	5-5-5 (15")	10	SP-SW	GRAVELLY SAND, 15-25% COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% NONPLASTIC FINES, GRAY.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-252A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-10	1 OF 3

BORING NO. EOS-10

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15						
		S	5	4-2-3 (9")	5	SP	SAND, TRACE FINE GRAVEL, MOSTLY MEDIUM TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
700.7	20						
		S	6	10-14-26 (12")	40	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL TO 1.5 IN, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, TRACE IRON STAINING, BROWN, BOTTOM 3 IN: BROKEN LIGHT GRAY SANDSTONE FRAGMENTS TO 1.5 IN. BLOWS/INCH: 2-1-1-2-2-2/1-1-1-2-5-4/4-3-6-4-3-6
	25						
		S	7	18-23-36 (17")	59	ML GP-GW	TOP 7 IN: GRAVELLY SILT, 15-20% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, ANGULAR TO SUBANGULAR, 5-10% FINE SAND, VERY DRY, BROWN. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1.5 IN, ANGULAR, SOME BROKEN SANDSTONE, 25-35% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, COAL AND IRON STAINING, BROWN. BLOWS/INCH: 1-4-3-3-4-3/4-3-4-5-3-4/9-7-6-5-4-5
690.7	30						
		S	8	2-4-5 (15")	9	SM CL	TOP 5 IN: SILTY SAND, 10-15% COARSE TO FINE GRAVEL, SUBANGULAR, FINE SAND, SOME MEDIUM AND COARSE, 10-15% NONPLASTIC FINES, BROWN. BOTTOM 10 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 5-7% COARSE TO FINE GRAVEL, SOME ROOTS, POCKETS OF COAL FRAGMENTS, MOIST, DARK GRAYISH BROWN.
	35						
		S	9	3-5-6 (17")	11	ML	CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, TRACE FINE GRAVEL SIZED SANDSTONE AND COAL FRAGMENTS, FEW SANDSTONE FRAGMENTS TO 1 IN NEAR TOP, TRACE ROOTS, GRAY. q_u (pp): 1.25, 1.75TSF
		S	10	3-4-6 (13")	10	CL-ML CL	TOP 4 IN: CLAYEY SILT-SILTY CLAY, SIMILAR TO S-9. BOTTOM 9 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF, MOIST, GRAY BROWN. q_u (pp): 1.5, 1.75TSF
		US	1	(23.5")		CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, OCCASIONAL GRAVEL TO 1 IN, MOIST, BROWN. (TUBE TRIMMINGS)
680.7	40						
		S	11	4-3-3 (18")	6	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF, OCCASIONAL FINE GRAVEL TO 1/2 IN, SOME FINE SAND, MOIST, BROWN. q_u (pp): 1.75, 2.00 TSF
		US	2	(23")			SIMILAR TO S-11. (TUBE TRIMMINGS)
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-252B	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-10	2 OF 3

BORING NO. EOS-10
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	12	4-9-11 (6")	20	SP-SW	GRAVELLY SAND, 15-20% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, 3-5% NONPLASTIC FINES, BROWN
		S	13	8-7-9 (8")	16	SP-SW	GRAVELLY SAND, 10-15% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-2-1-1-1/1-1-1-1-2-1/2-2-1-2-1-1
		S	14	5-5-6 (8")	11	GP	SANDY GRAVEL, MEDIUM TO FINE, SUBANGULAR TO ROUNDED, 25-30% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM.
670.7	50						
		S	15	12-9-8 (8")	17	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1.5 IN MAXIMUM, MOSTLY BROKEN SANDSTONE FRAGMENTS, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, TRACE NONPLASTIC FINES AND COAL, BROWN. BLOWS/INCH: 2-2-3-2-2-1/2-1-2-1-1-2/2-1-1-1-2-1
		S	16	10-14-8 (9")	22	GP-GW	SIMILAR TO S-15, 5-7% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-1-2-1-3/3-3-2-2-2-2/1-1-2-1-1-2
		S	17	9-7-7	14	GP-GW	SIMILAR TO S-15, 7-10% NONPLASTIC FINES, BROWN.
660.7	60						
	65						
		S	18	41-42-34 (14")	76	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED GRAY SHALE AND ORANGE BROWN SANDSTONE FRAGMENTS, TRACE SLIGHTLY PLASTIC FINES, COAL AND IRON STAINING.
							BOTTOM OF BORING AT 66.5 FT ELEVATION 654.2 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-252C	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-10	SHEET 3 OF 3

APPENDIX 2.5C

RELATIVE DENSITY PLOTS FOR VERIFICATION BORINGS

TERRA PROBE DENSIFICATION MAIN INTAKE STRUCTURE

Tables for Appendix 2.5C

Table 2.5C-1

TERRA PROBE DENSIFICATION
AT MAIN INTAKE STRUCTURE
VERIFICATION BORINGS

Description	Boring Number
Test Panel 1	TH-1 through TH-6
Summary Plot - Terra Probe before initial densification	537T through 548T
Summary Plot - Terra Probe after densification	549T, 550T, 553T, 554T, 565T, 566T, 567T, 570T through 577T
Borings performed before initial densification	537T through 548T
Borings performed after initial densification	549T through 558T 562T through 564T 568T and 569T
Test Panel 2	559T through 561T
Borings performed after redensification offshore	565T through 567T 570T and 571T
Borings performed after redensification onshore	572T through 577T

STONE & WEBSTER ENGINEERING CORPORATION
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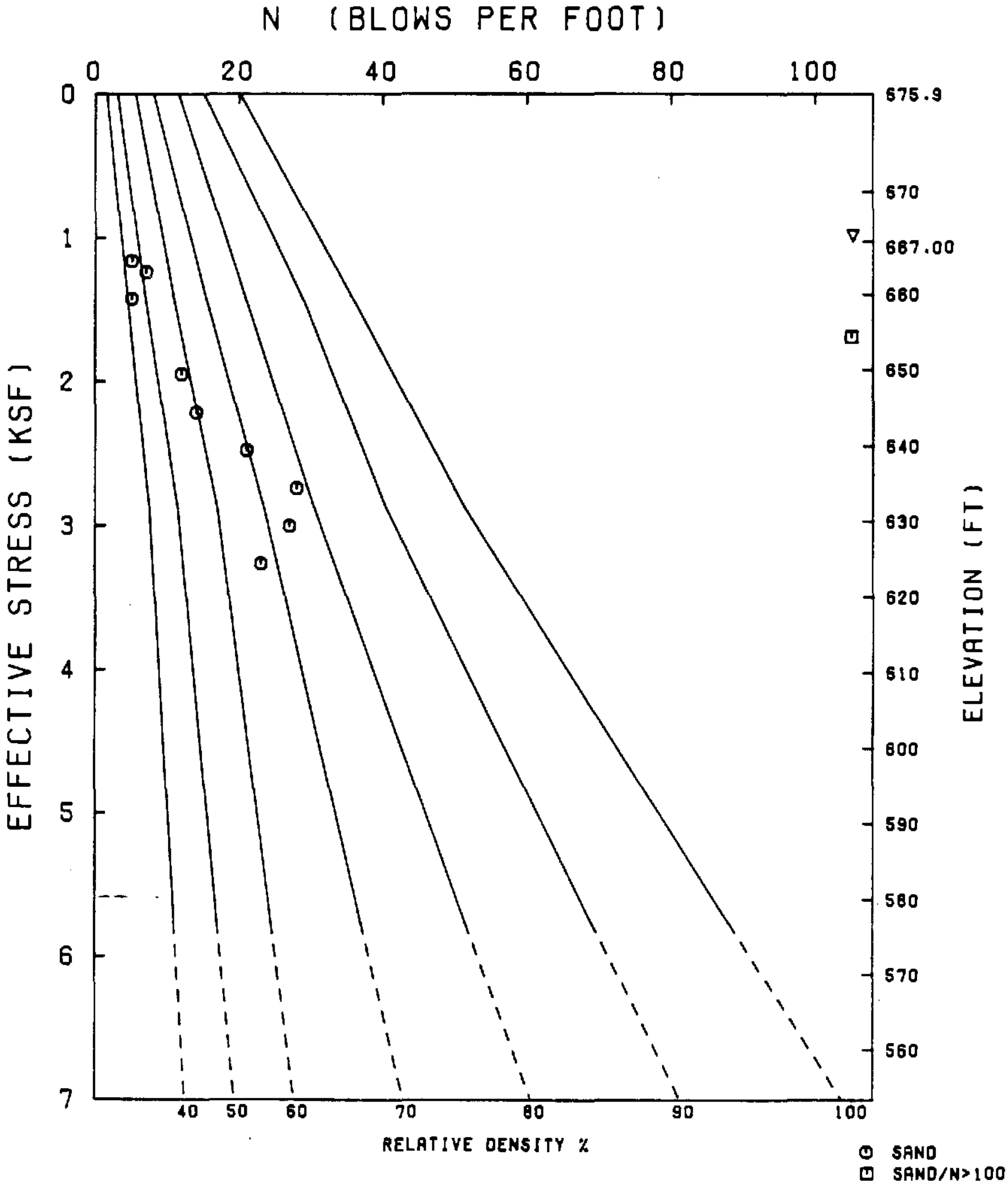
CLIENT DUQUESNE LIGHT CO.-BVPS-2 — J.O. NO. 12241.00

SUBJECT TERRA PROBE-TEST PANEL-BEFORE — DATE 9/3/81 BY DDH

BORING TH-1 — CHECKED 9/3/81 BY JFP

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-D04 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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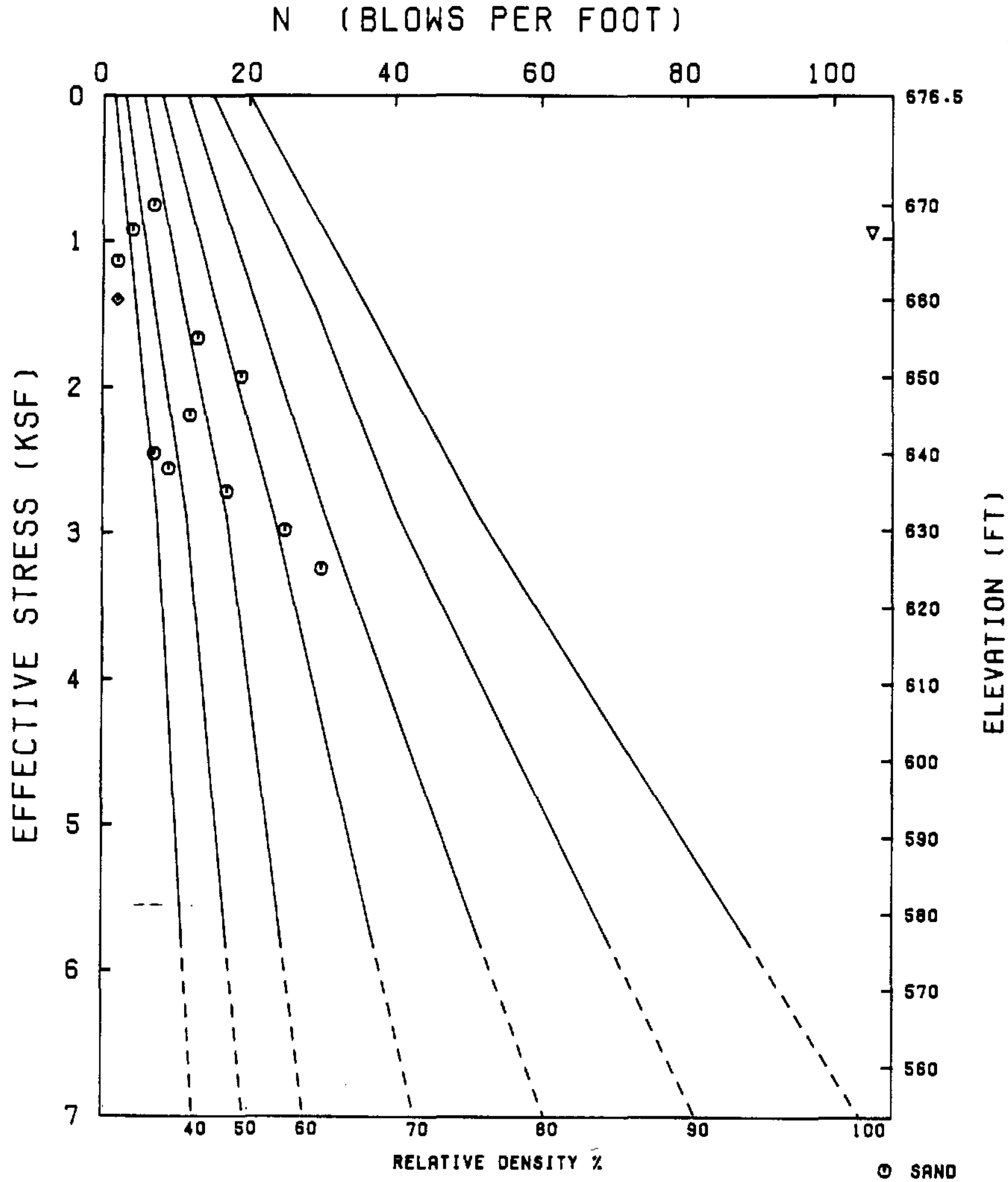
CLIENT DUQUESNE LIGHT CO.-BVPS-2 J.O. NO. 12241.00

SUBJECT TERRA PROBE-TEST PANEL-BEFORE DATE 9/3/81 BY DDH

BORING TH-2 CHECKED 9/3/81 BY JFP

BASED ON COMPUTER RUN J5B64002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



⊙ SAND
◇ OTHER

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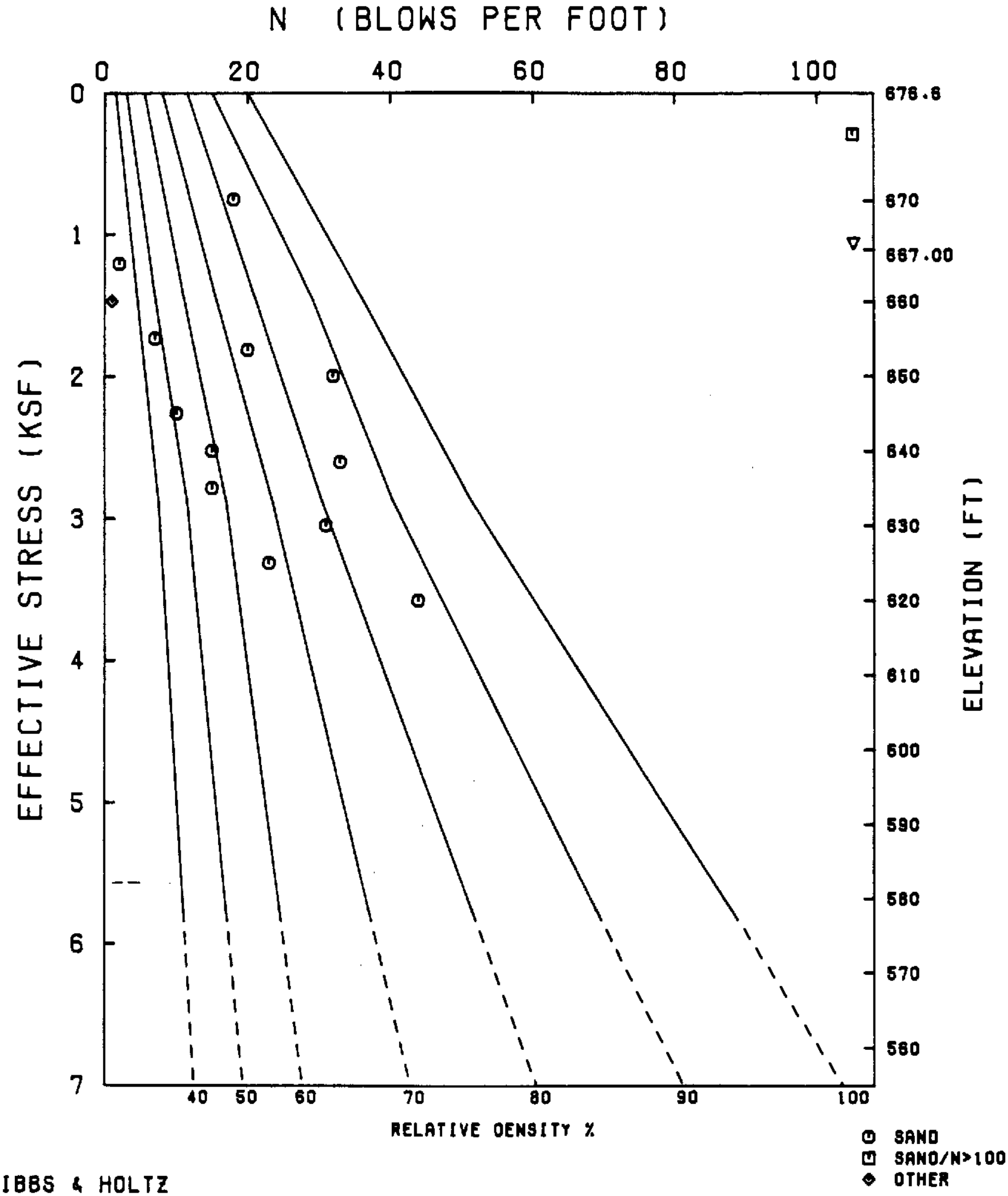
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-TEST PANEL-BEFORE	DATE 9/3/81	BY DDH
	BORING TH-3	CHECKED 9/3/81	BY L.F.P

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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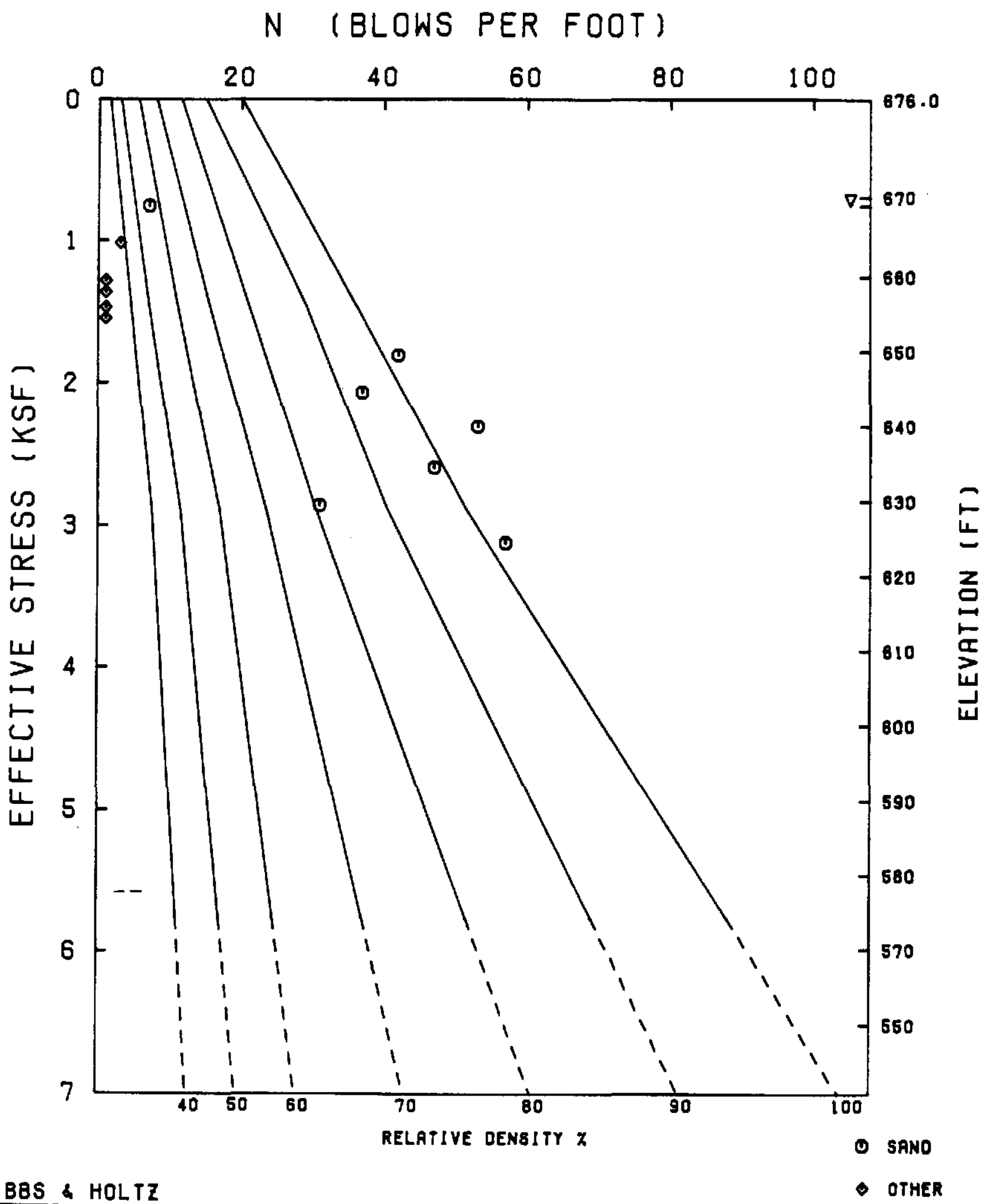
CLIENT DUQUESNE LIGHT CO.-BVPS-2		J.O. NO. 12241.00	
SUBJECT TERRA PROBE-TEST PANEL-AFTER		DATE 9/3/81	BY DDH
BORING TH-4		CHECKED 9/3/81	BY L.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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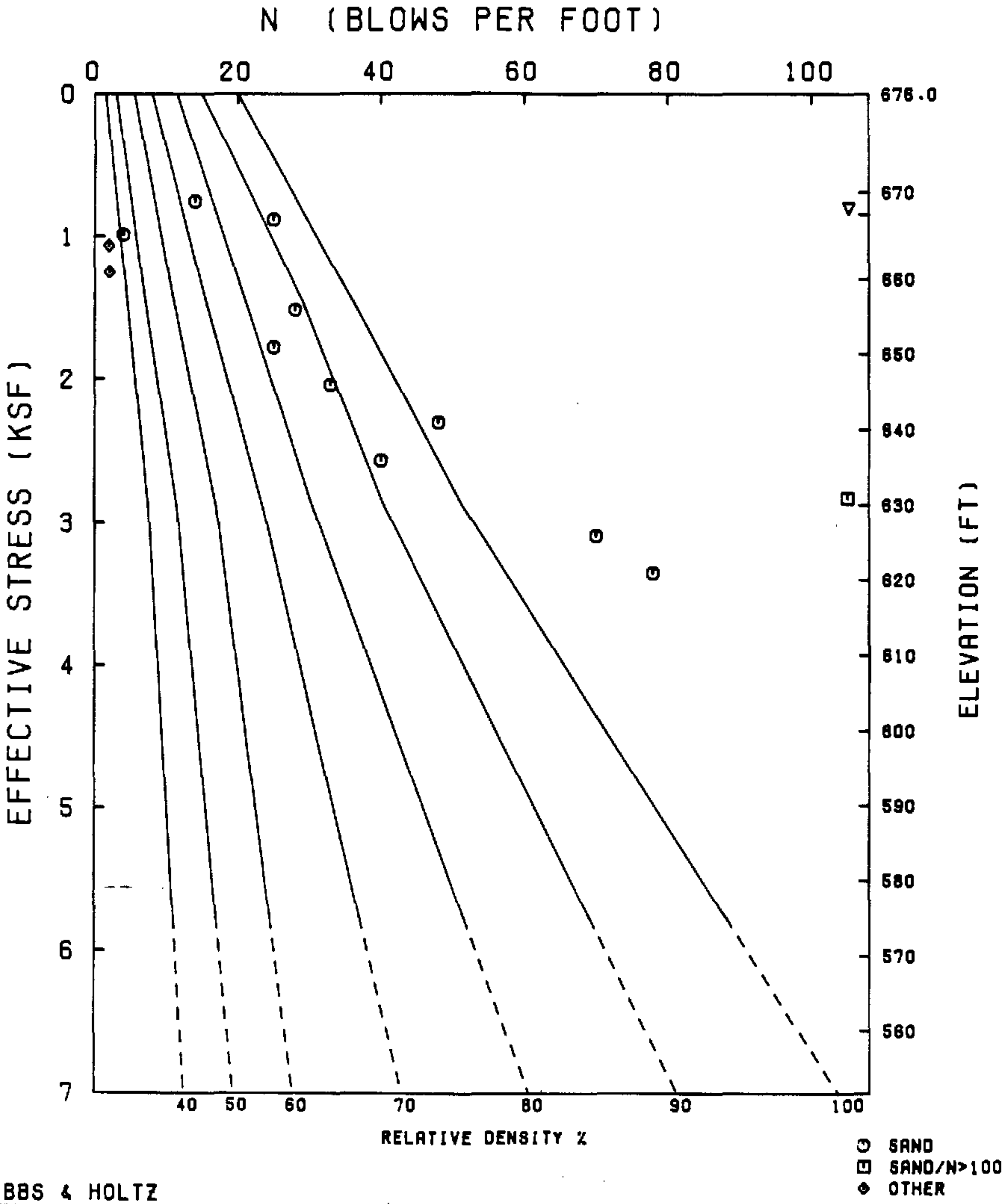
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-TEST PANEL-AFTER	DATE 9/3/81	BY DDH
	BORING TH-5	CHECKED 9/3/81	BY LKP

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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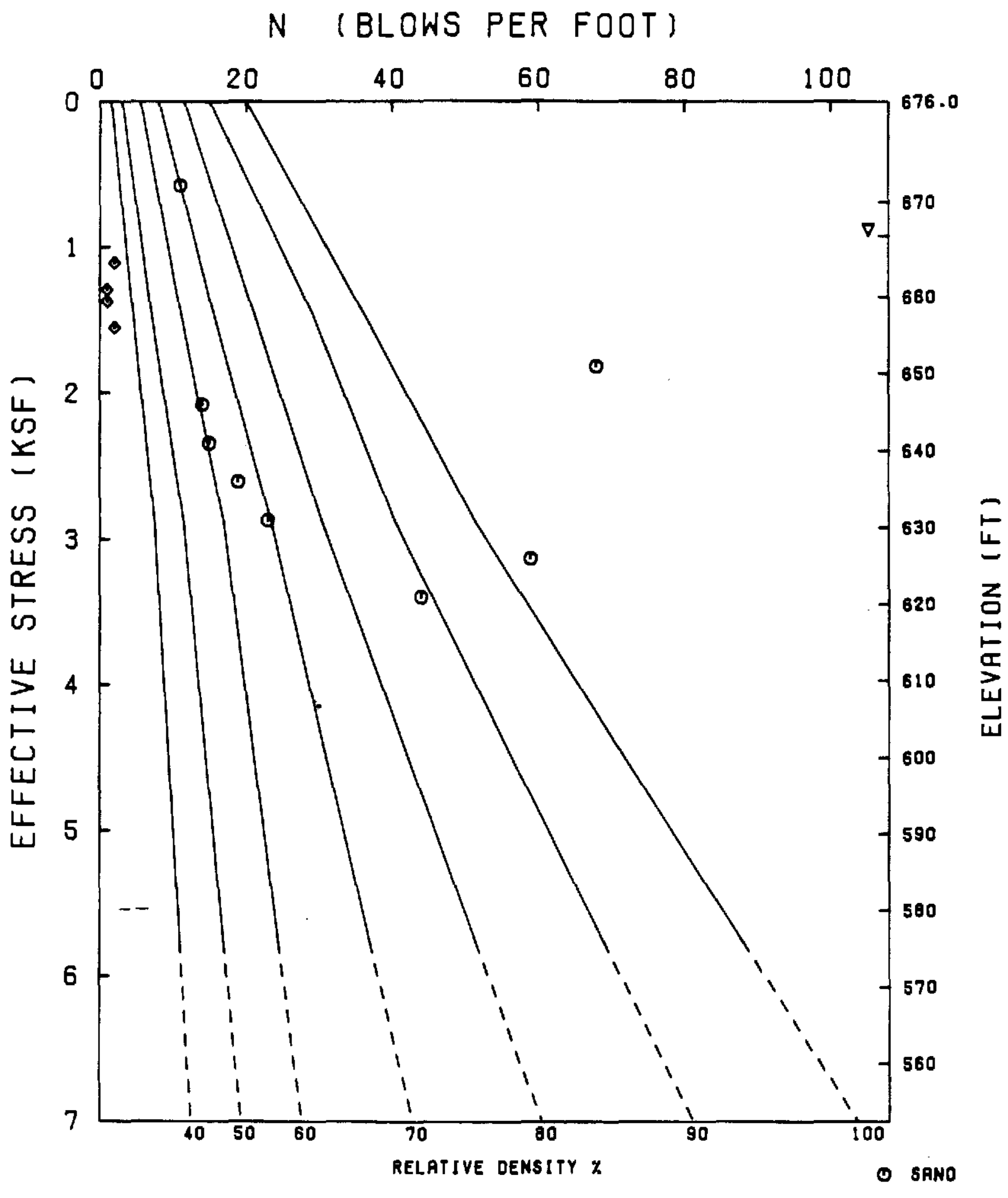
CLIENT DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00		
SUBJECT TERRA PROBE-TEST PANEL-AFTER	DATE 9/3/81	BY DDH	
BORING TH-6	CHECKED 9/3/81	BY LFP	

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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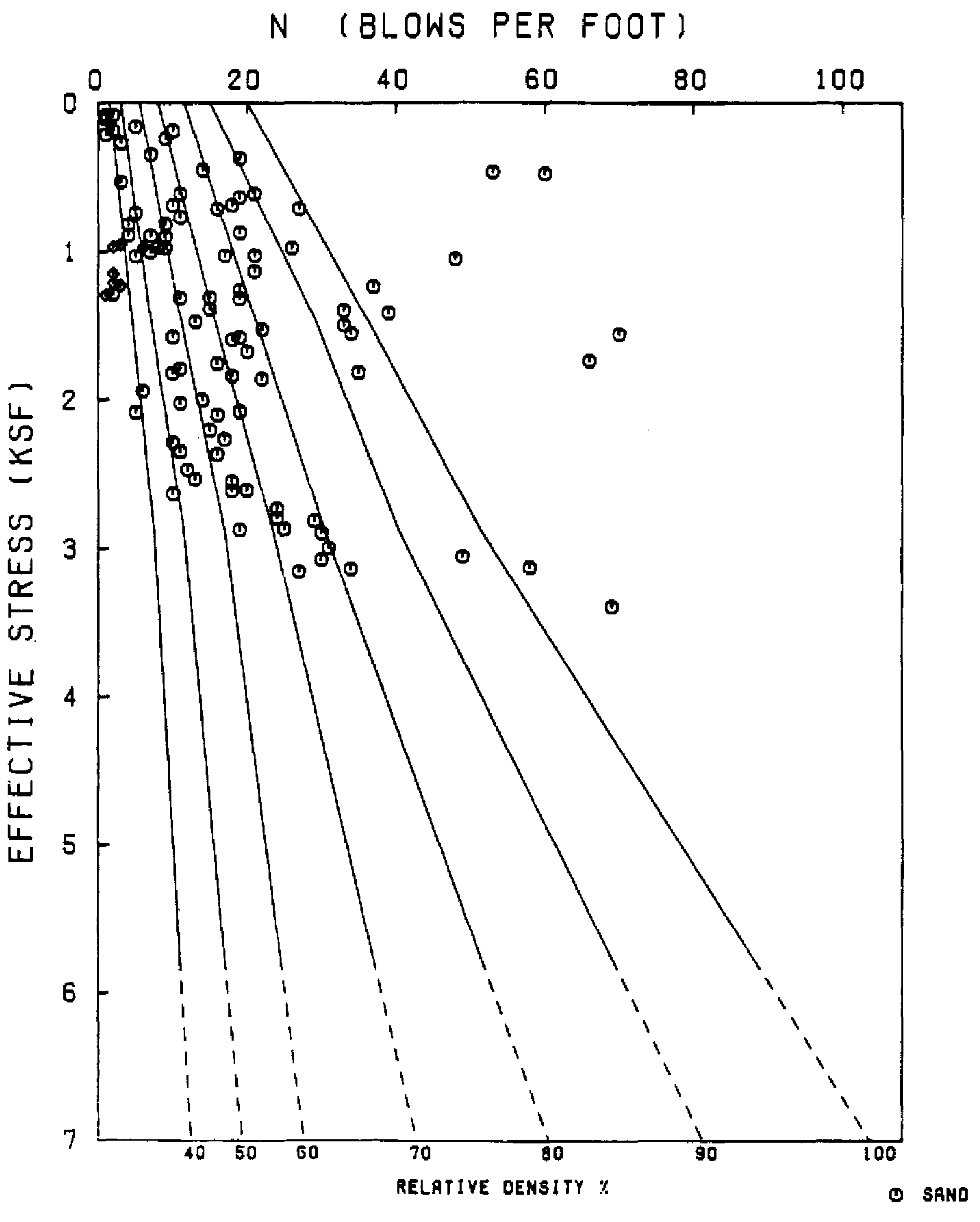
CLIENT DUQUESNE LIGHT CO.-BVPS-2 J.O. NO. 12241.00

SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION DATE 9/15/81 BY DDN

BORINGS 537T-548T CHECKED 9/16/81 BY [illegible]

BASED ON COMPUTER RUN J5864201 ON 09/15/81 AT 14.23.31
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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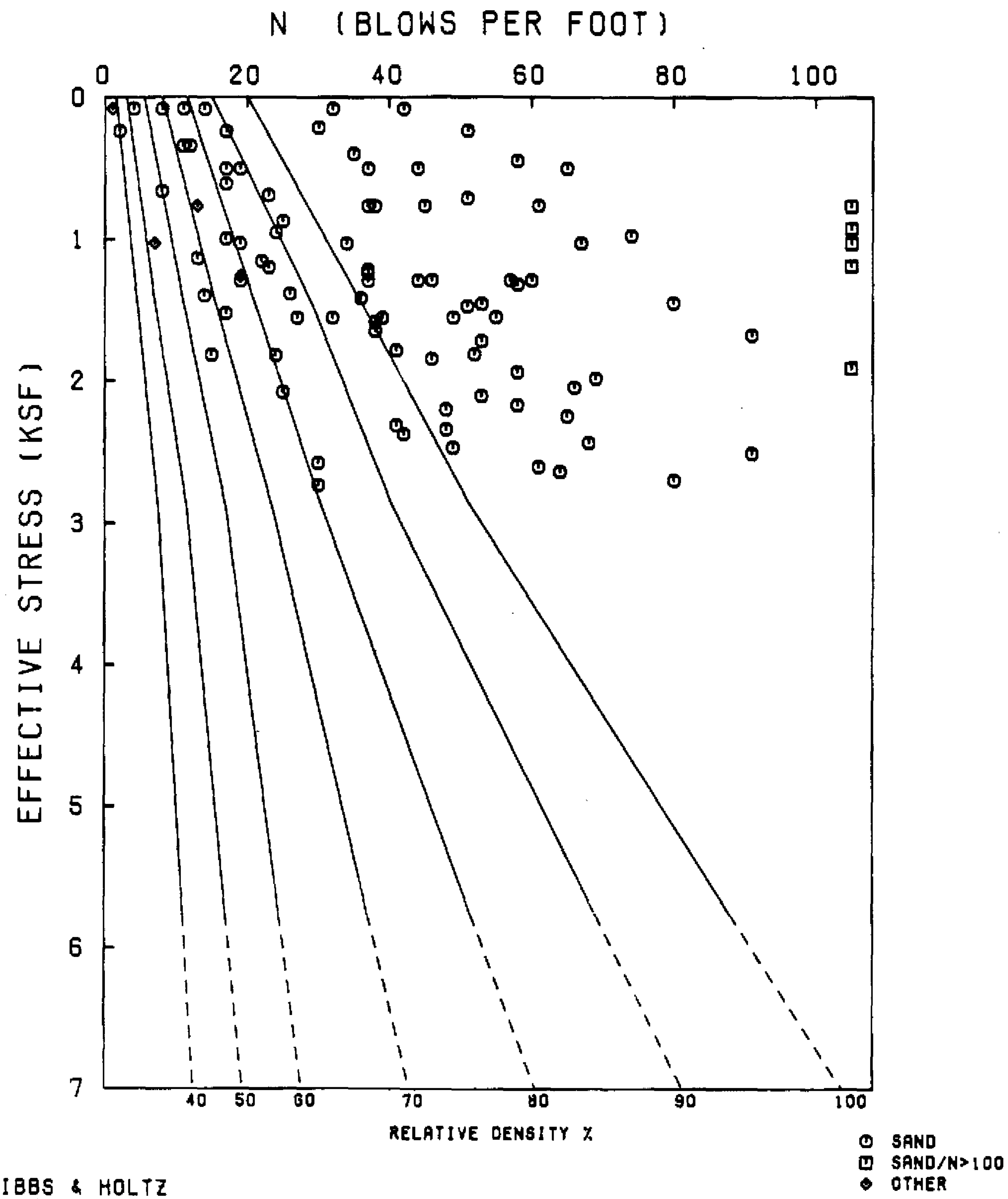
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-AFTER DENSIFICATION	DATE 9/15/81	BY DDH
	549T,550T,553T,554T,565T-567T,570T-577T	CHECKED 9/15/81	BY S.F.P.

BASED ON COMPUTER RUN J5864300 ON 09/15/81 AT 18.52.36
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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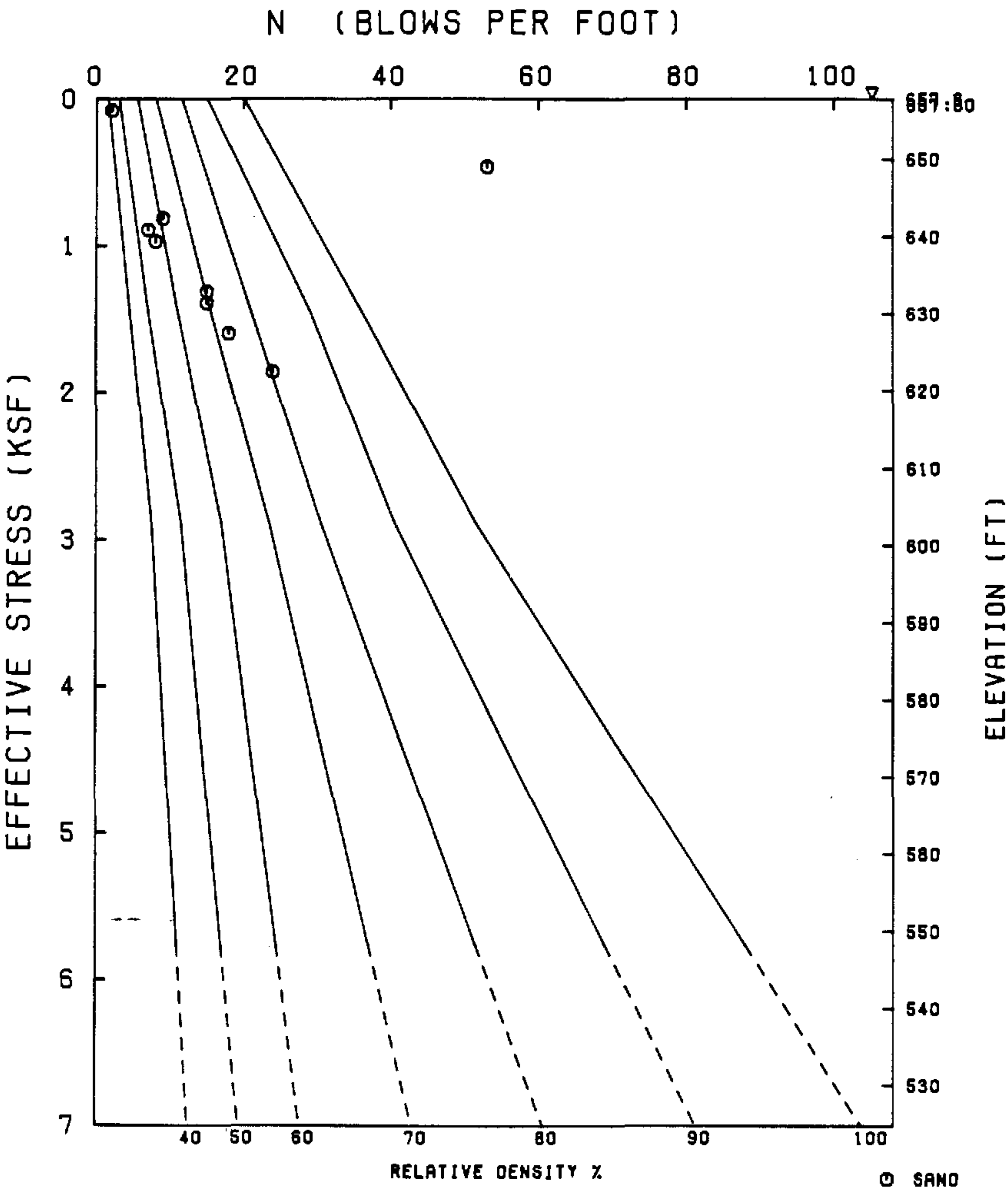
CLIENT DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDH
BORING 537T	CHECKED 9/3/81	BY F.E.P.

BASED ON COMPUTER RUN J5B64002 ON 09/03/81 AT 09.56.41
PROGRAM GT-D04 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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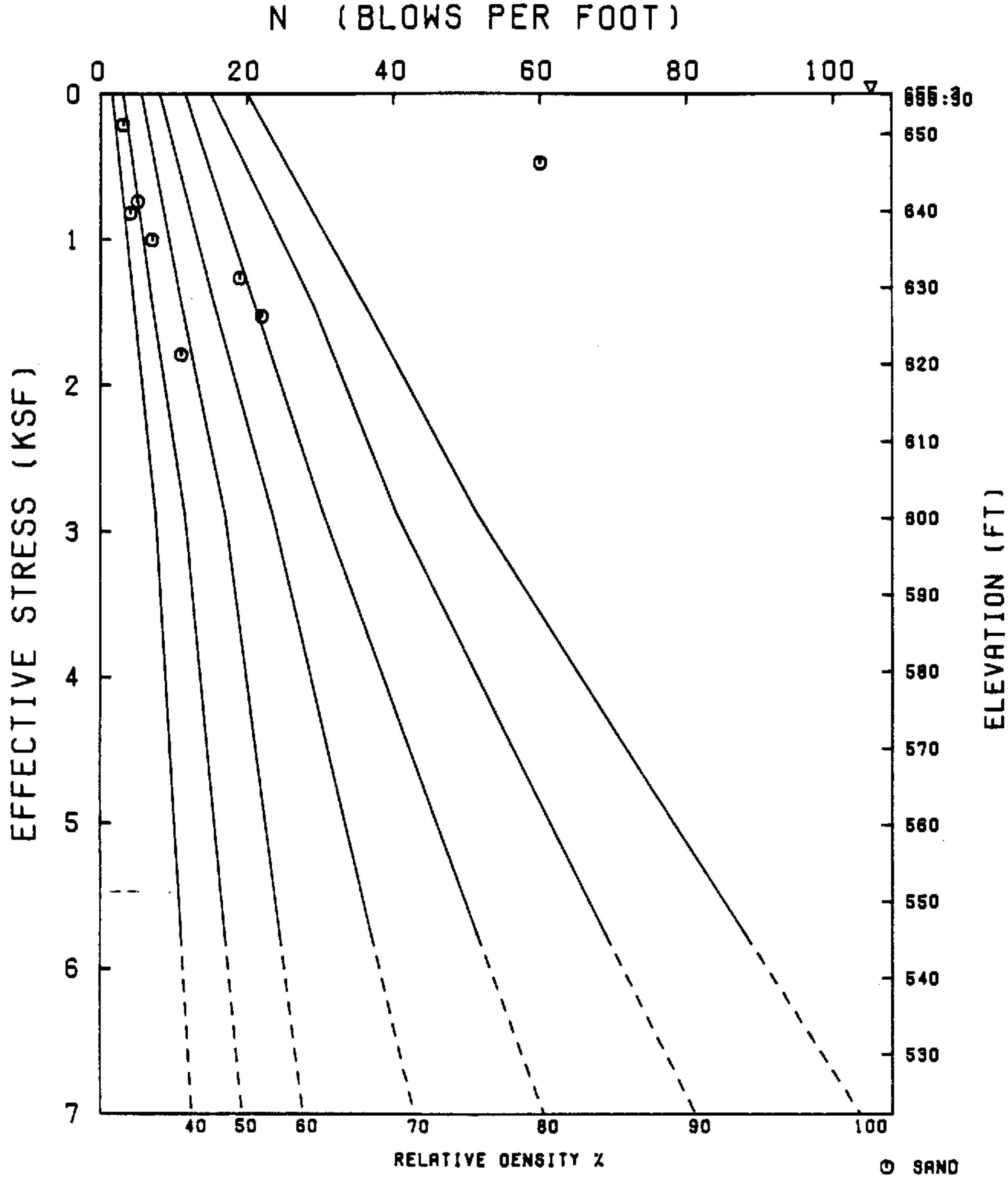
CLIENT DUQUESNE LIGHT CO.-BVPS-2 J.O. NO. 12241.00

SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION DATE 9/3/81 BY DDH

BORING 538T CHECKED 9/3/81 BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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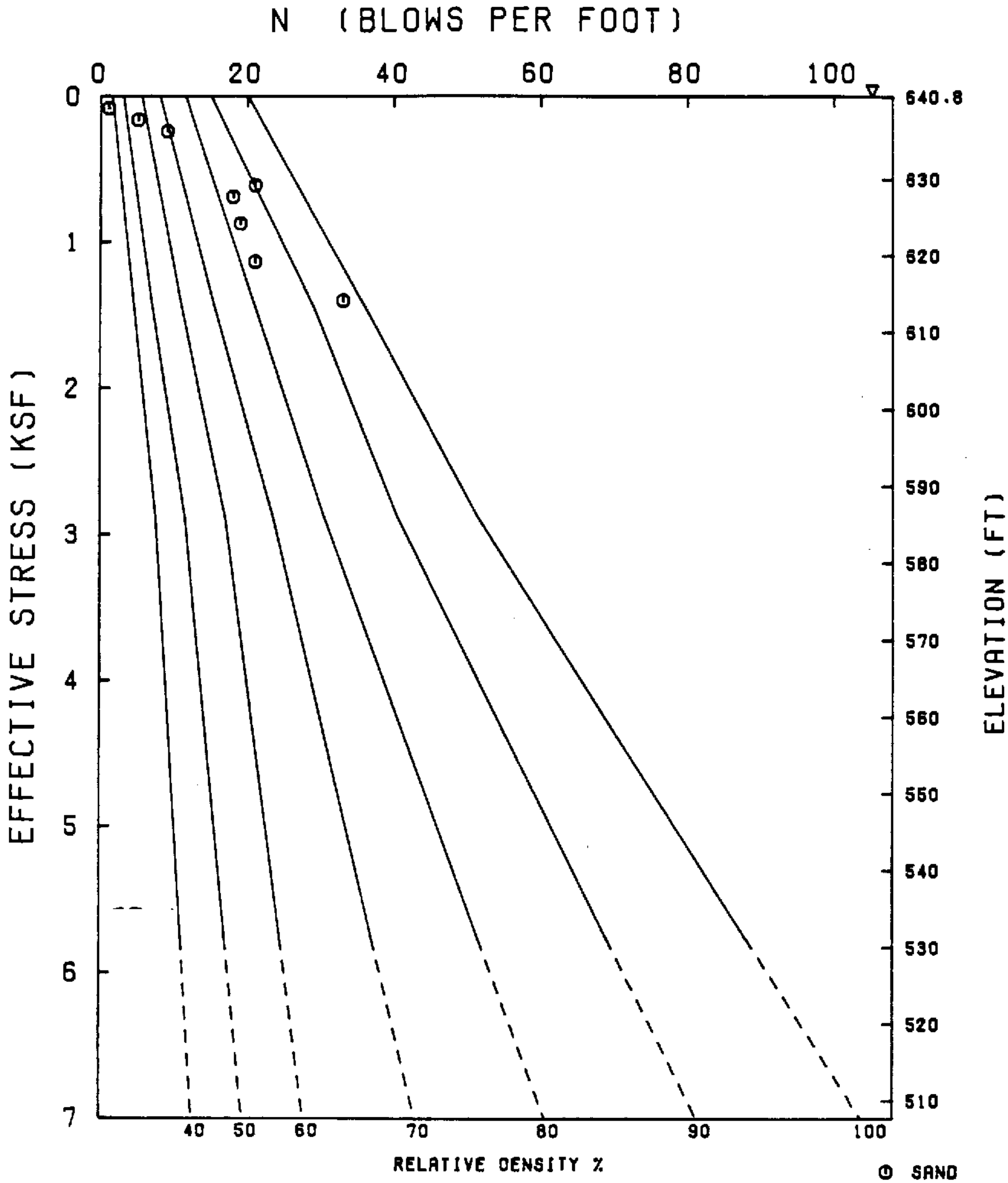
SUBJECT	TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDH
	BORING 539T	CHECKED 9/3/81	BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41

PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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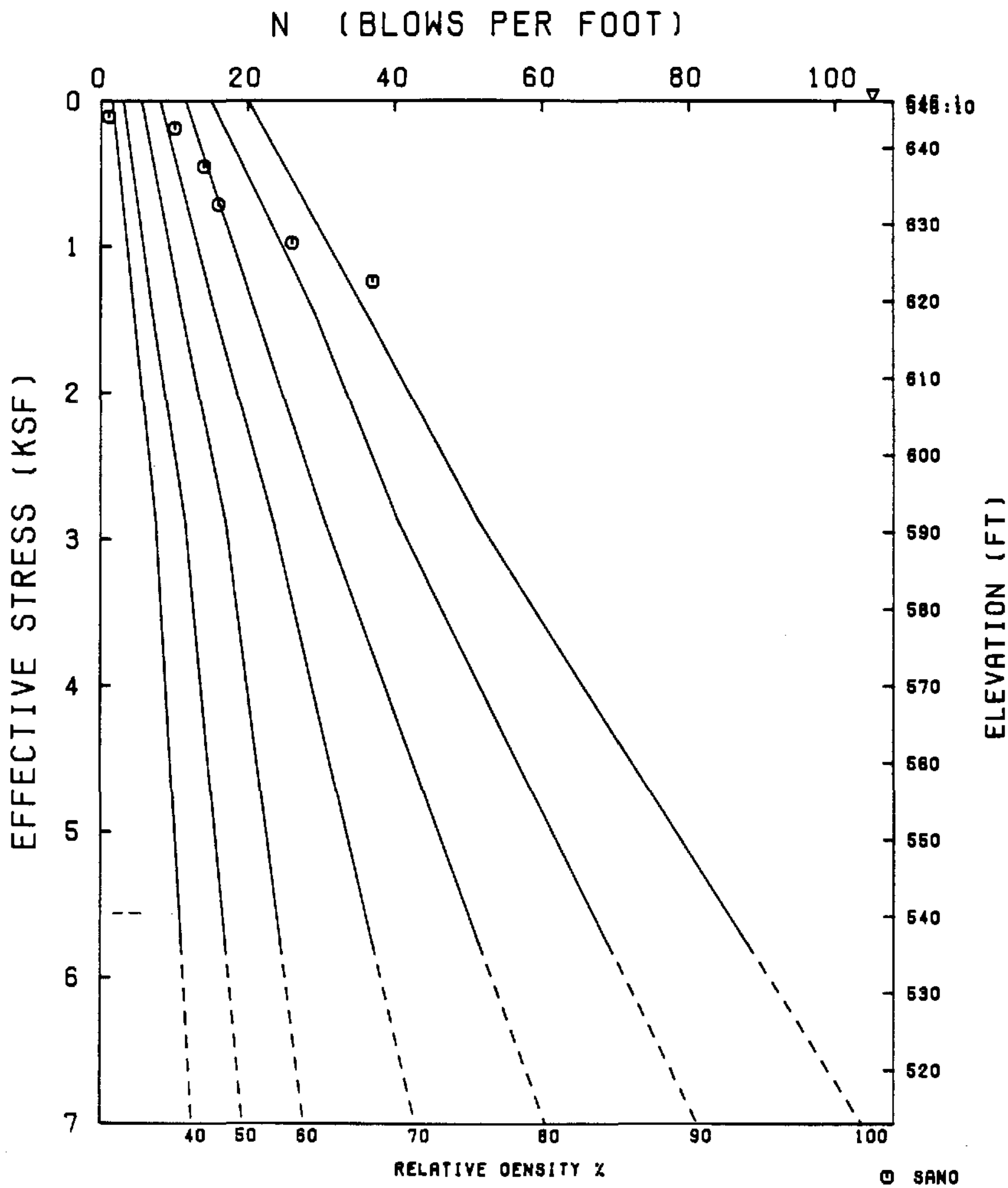
CLIENT DUQUESNE LIGHT CO.-BVPS-2		J.O. NO. 12241.00	
SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION		DATE 9/3/81	BY DDH
BORING 540T		CHECKED 9/3/81	BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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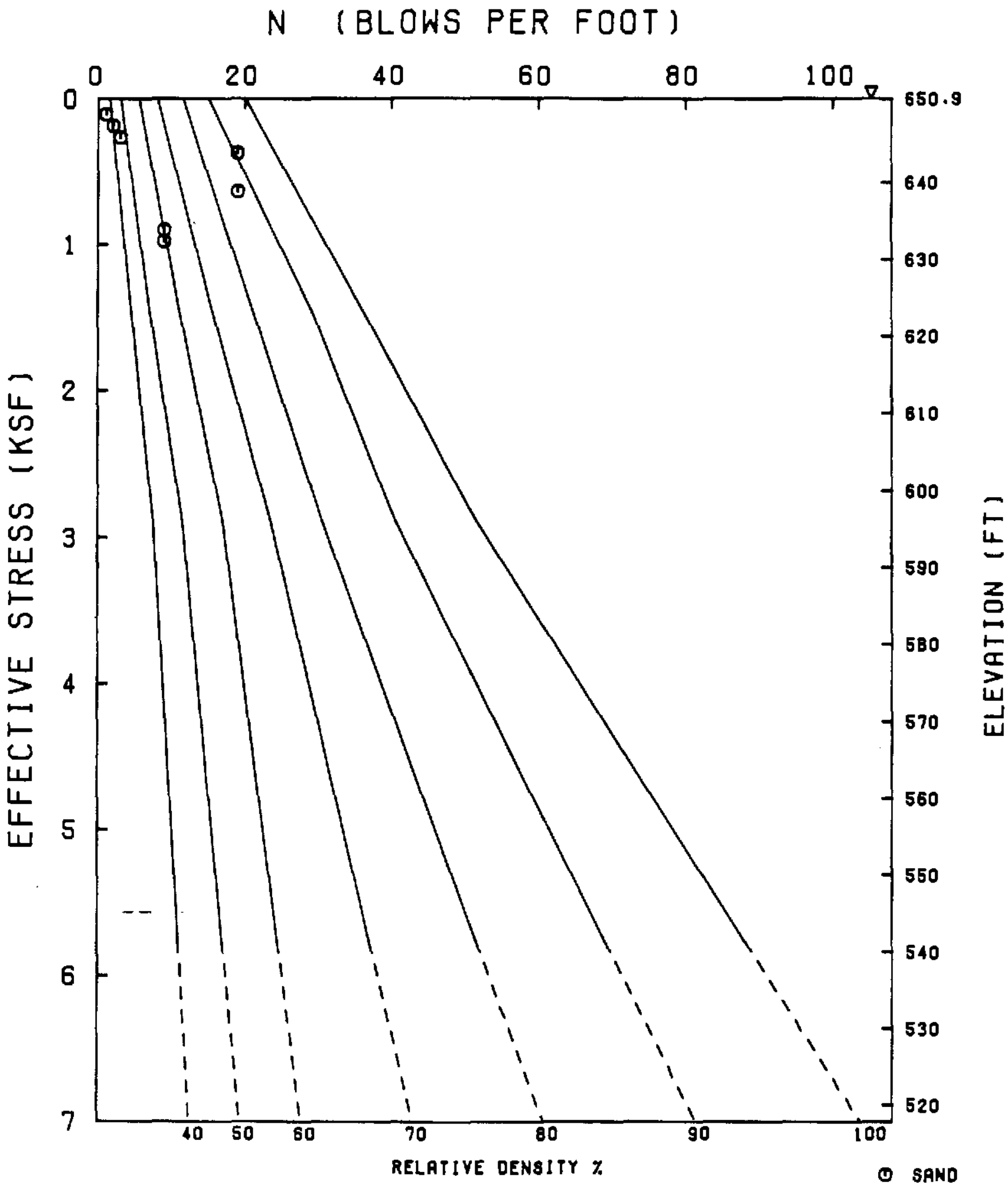
CLIENT DUQUESNE LIGHT CO.-BVPS-2 J.O. NO. 12241.00

SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION DATE 9/3/81 BY DDH

BORING 541T CHECKED 9/3/81 BY R.F.P

BASED ON COMPUTER RUN JSB64002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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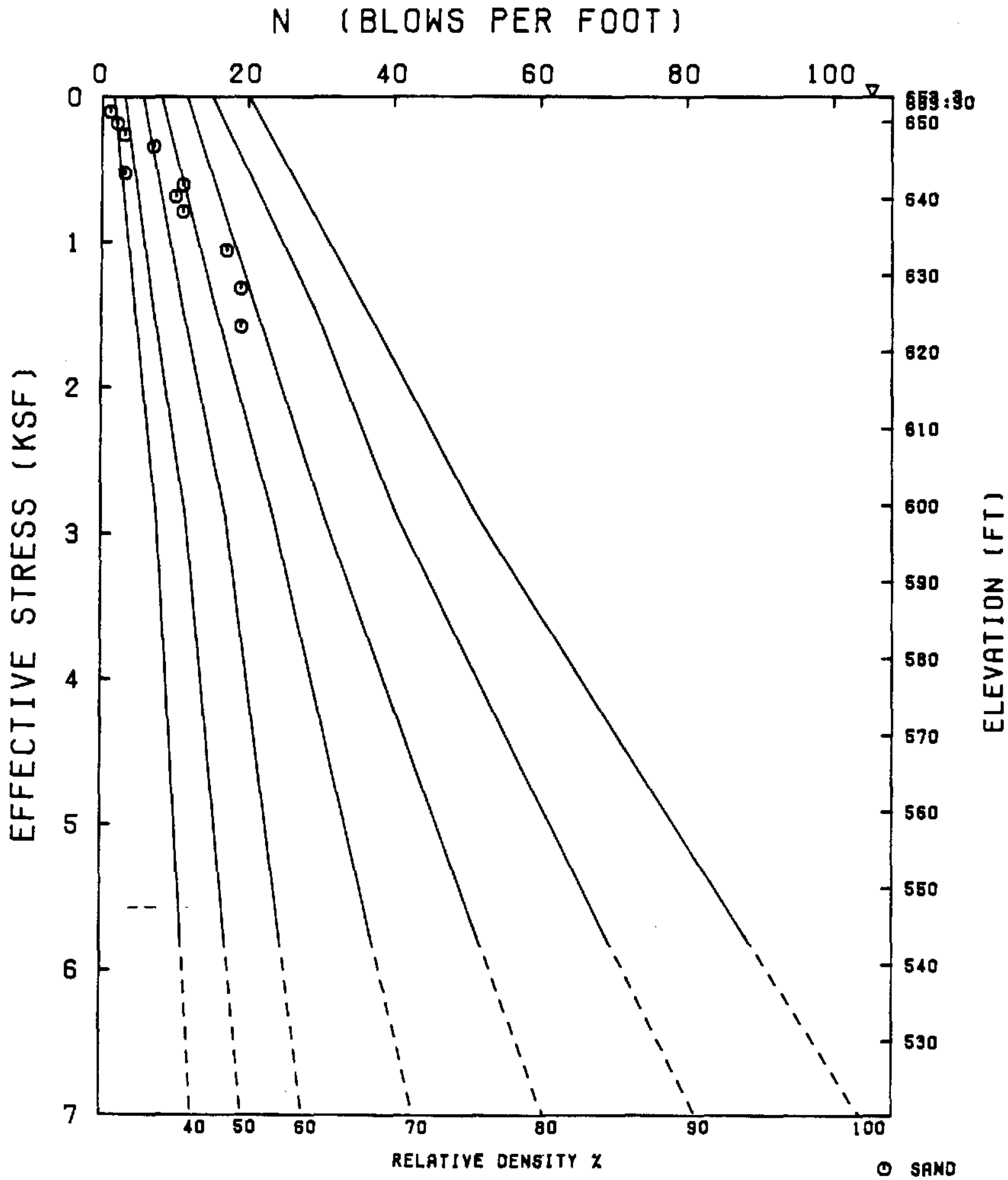
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO.	12241.00
SUBJECT	TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDN
	BORING542T	CHECKED 9/3/81	BY S.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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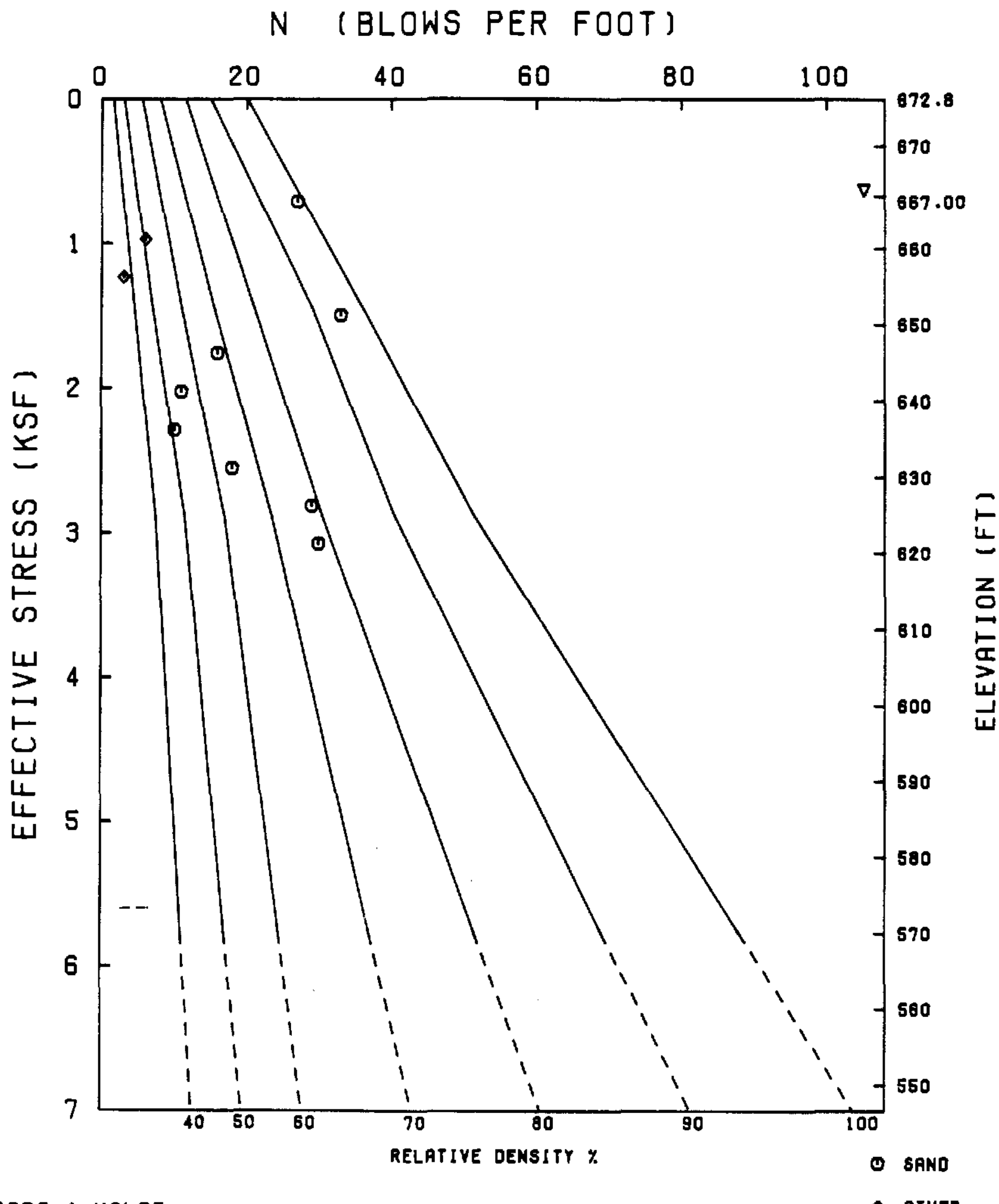
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDH
	BORING 543T(A)	CHECKED 9/3/81	BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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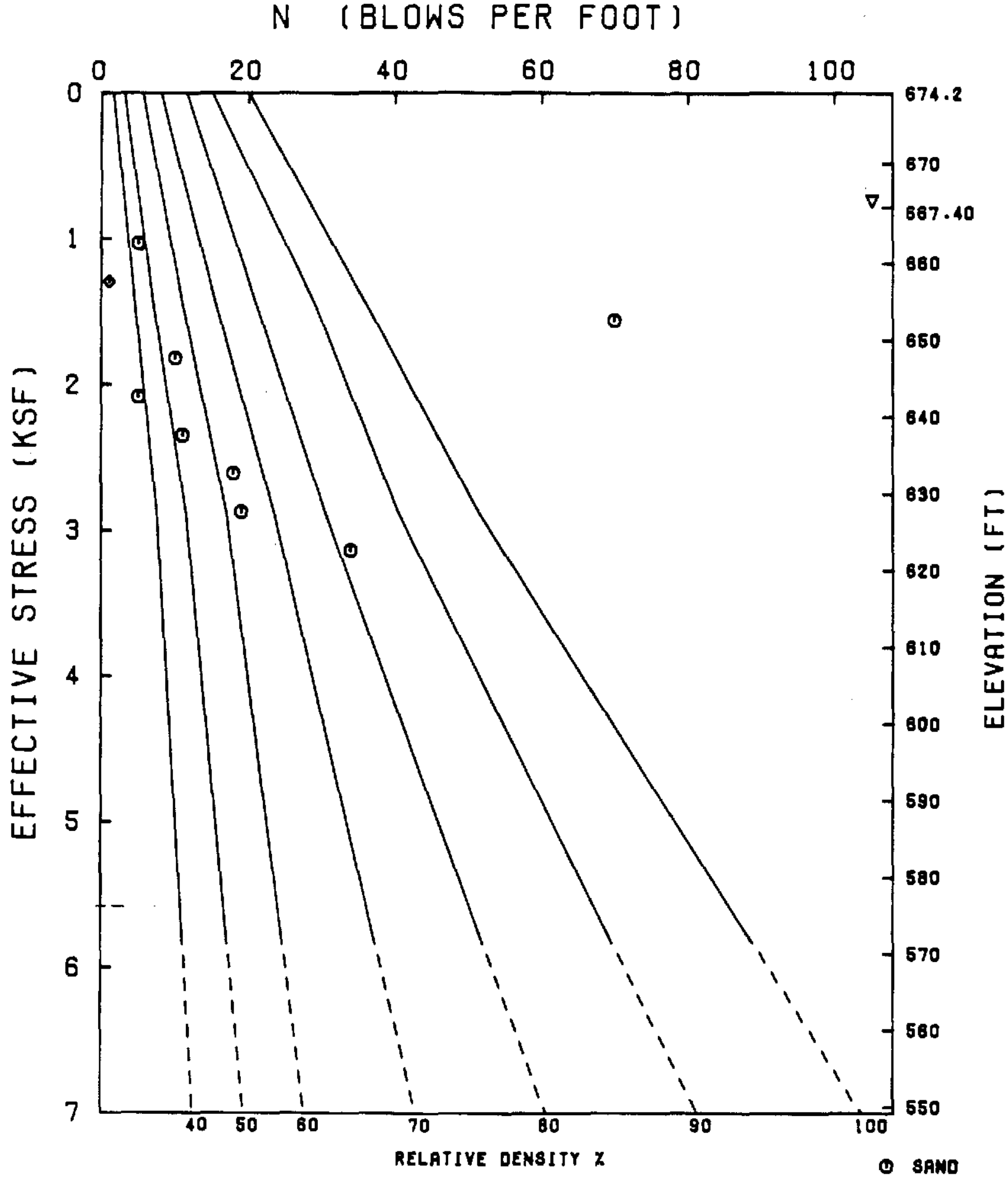
	BORING 544T	CHECKED 9/3/81	BY JFP.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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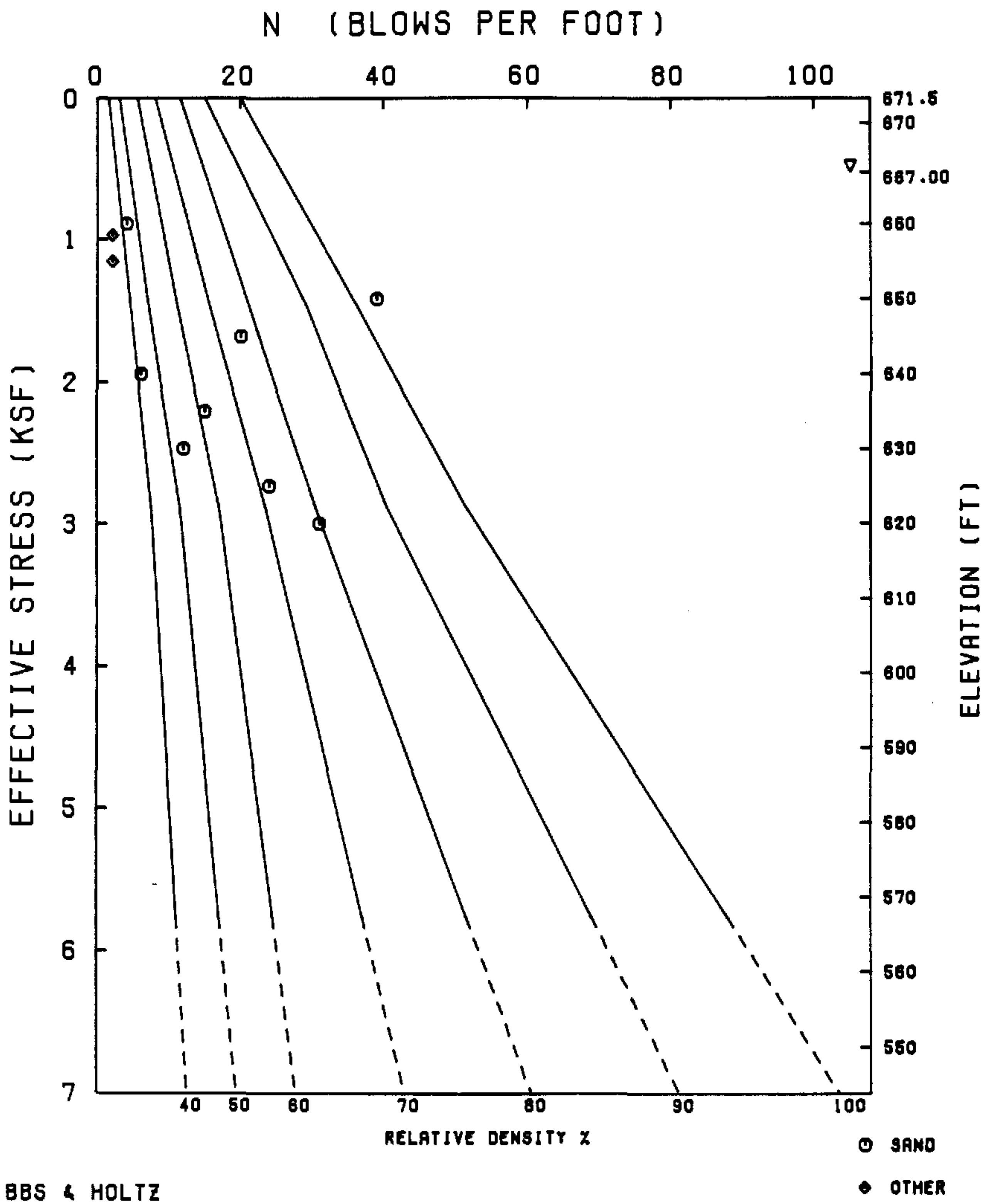
CLIENT DUQUESNE LIGHT CO.-BVPS-2		J.O. NO. 12241.00	
SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION		DATE 9/3/81	BY DDH
BORING 545T		CHECKED 9/3/81	BY S.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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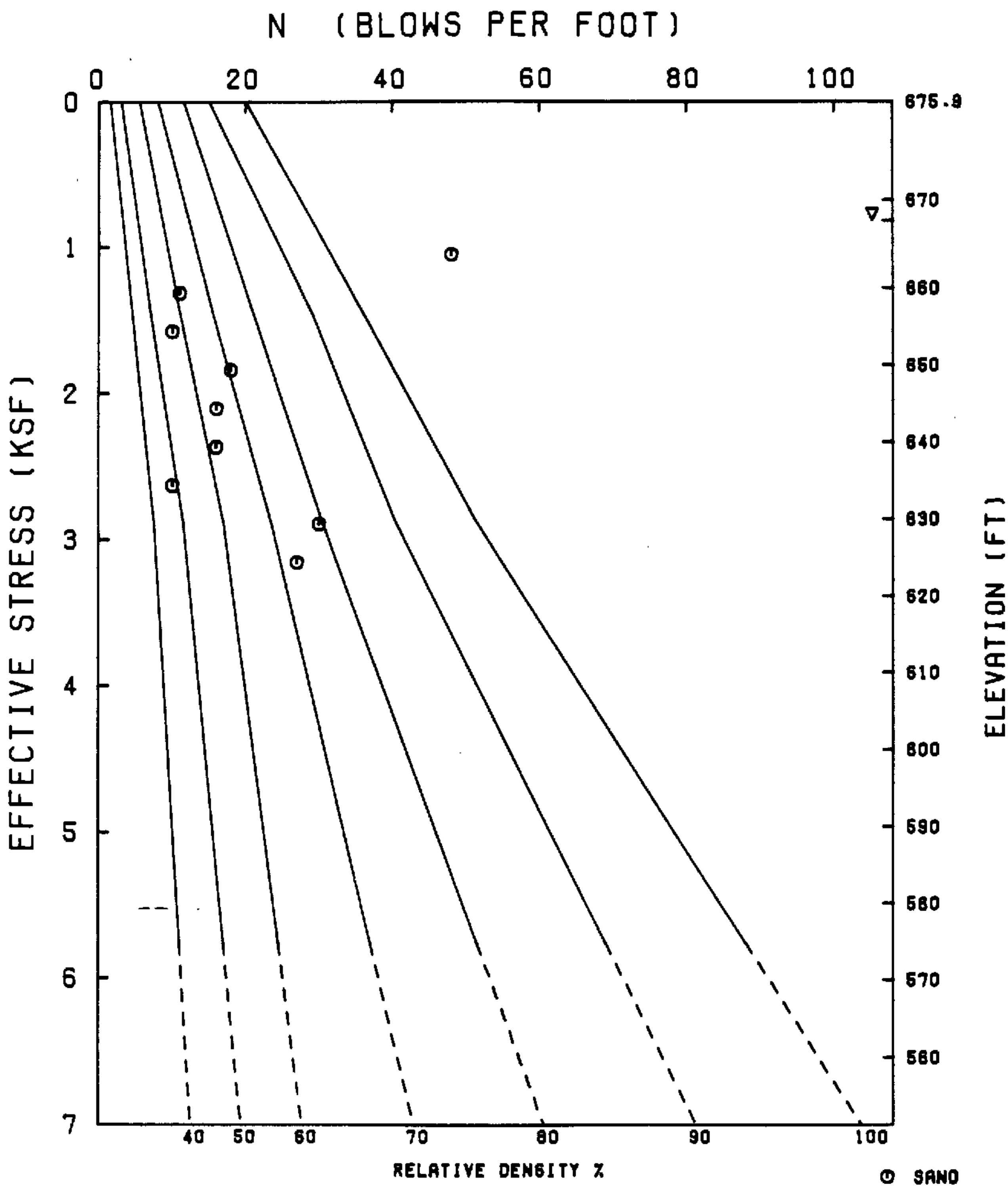
CLIENT DUQUESNE LIGHT CO.-BVPS-2		J.O. NO. 12241.00	
SUBJECT TERRA PROBE-BEFORE INITIAL DENSIFICATION		DATE 9/3/81	BY DDN
BORING 546T		CHECKED 9/3/81	BY L.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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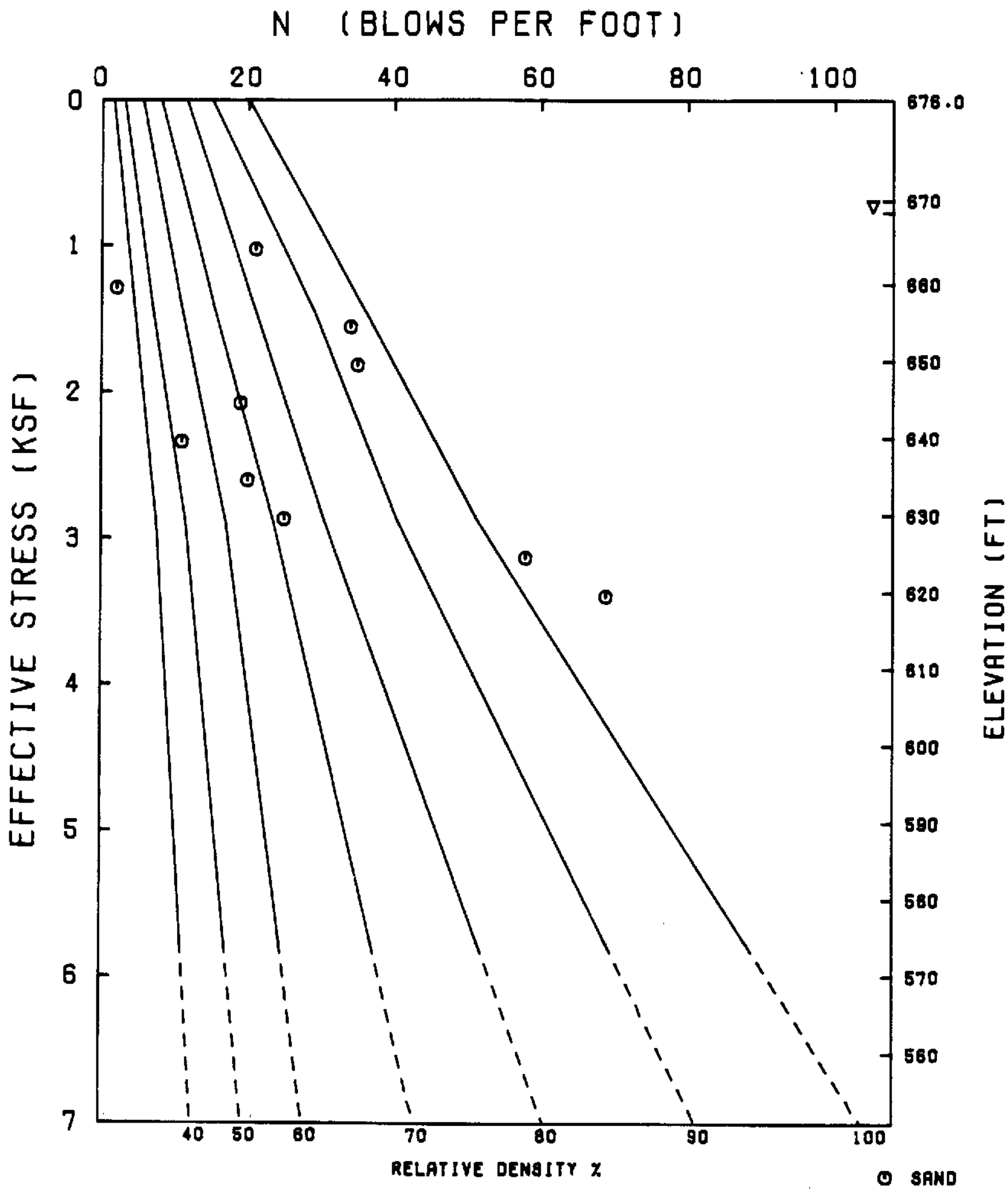
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDW
	BORING 547T	CHECKED 9/3/81	BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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PRELIMINARY ______
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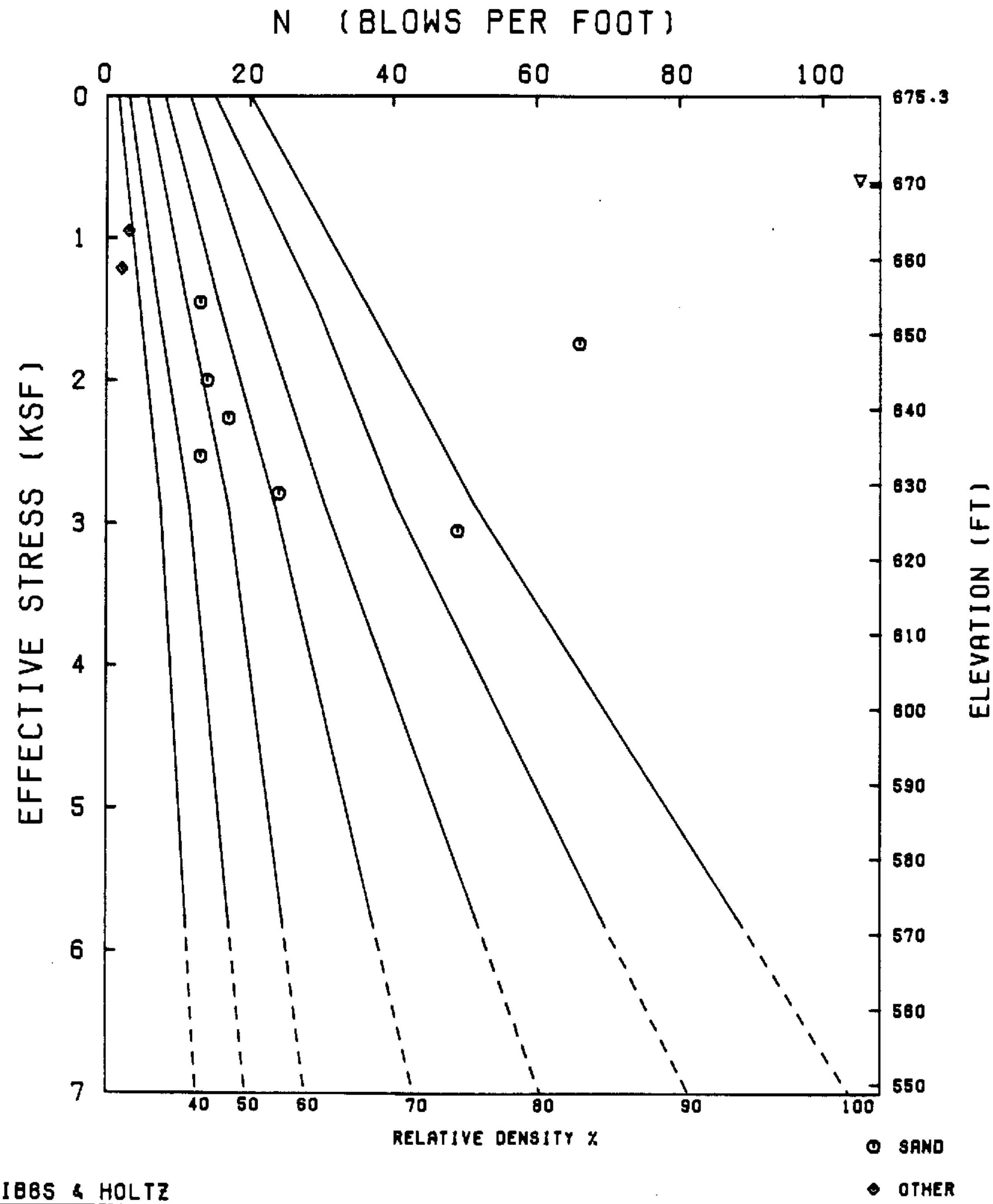
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-BEFORE INITIAL DENSIFICATION	DATE 9/3/81	BY DDN
	BORING 548T	CHECKED 9/3/81	BY J.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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PRELIMINARY ______
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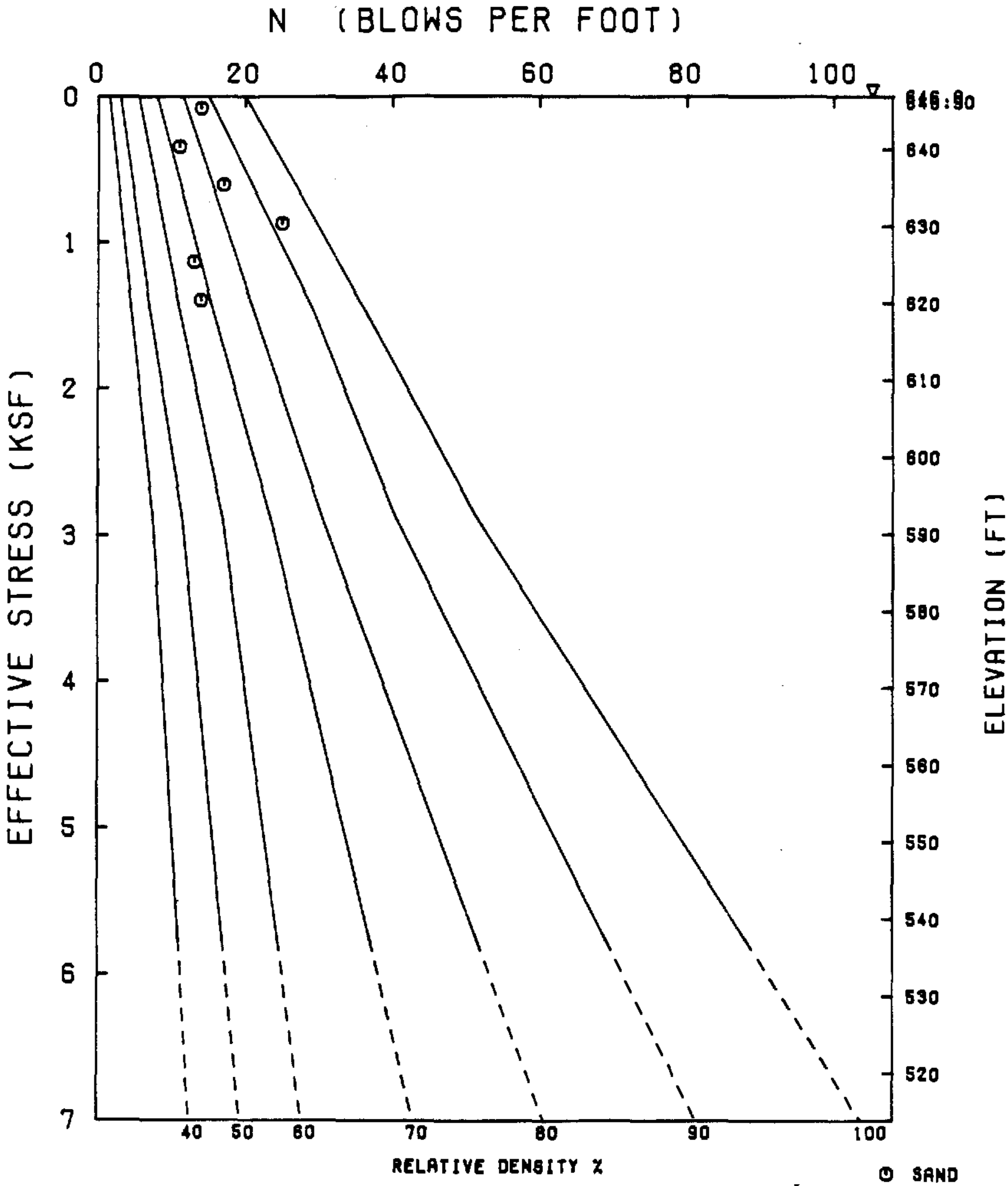
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-AFTER INITIAL DENSIFICATION	DATE 9/3/81	BY DDH
	BORING 549T	CHECKED 9/3/81	BY LEP

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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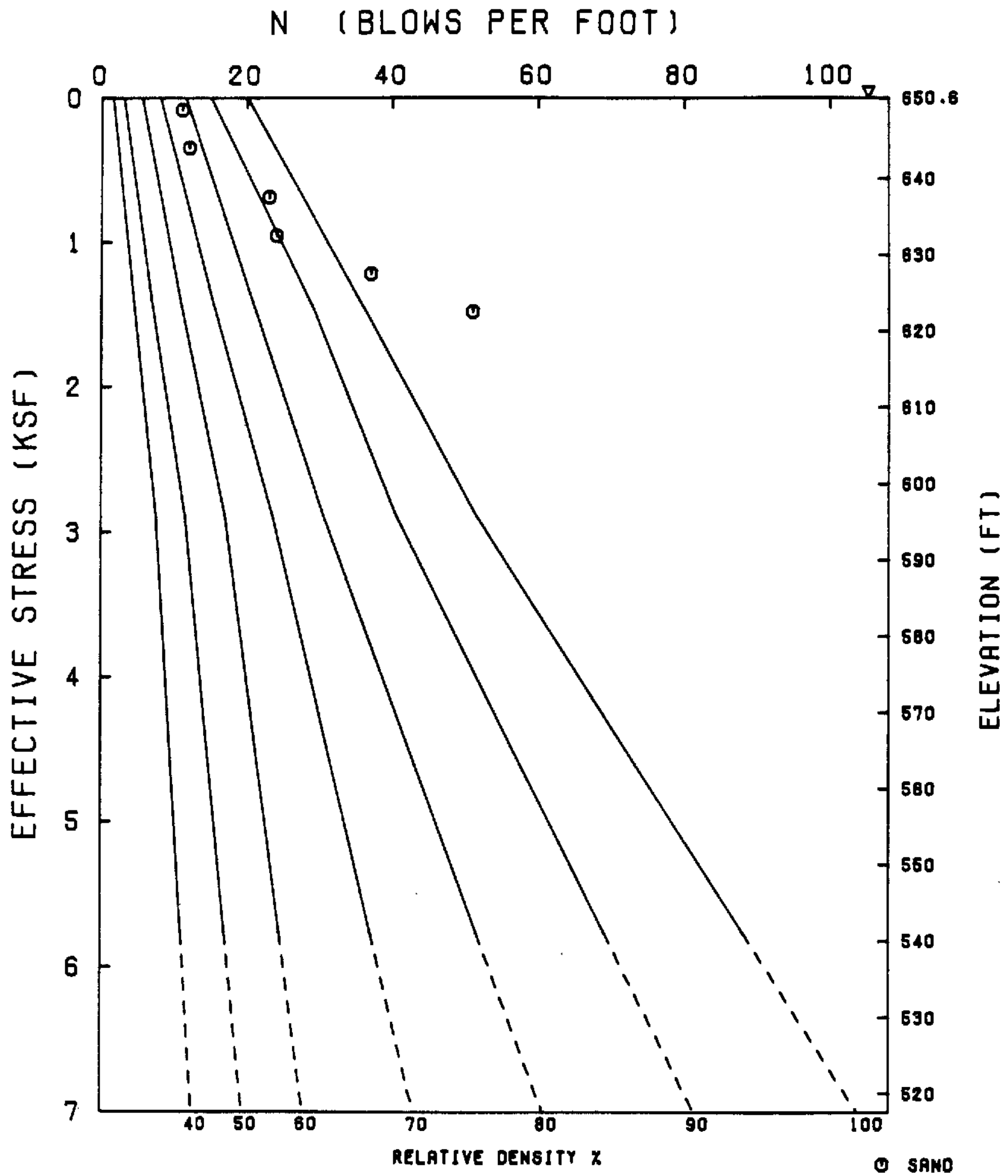
CLIENT DUQUESNE LIGHT CO.-BVPS-2		J.O. NO. 12241.00	
SUBJECT TERRA PROBE-AFTER INITIAL DENSIFICATION		DATE 9/3/81	BY DDN
BORING 550T		CHECKED 9/3/81	BY S.F.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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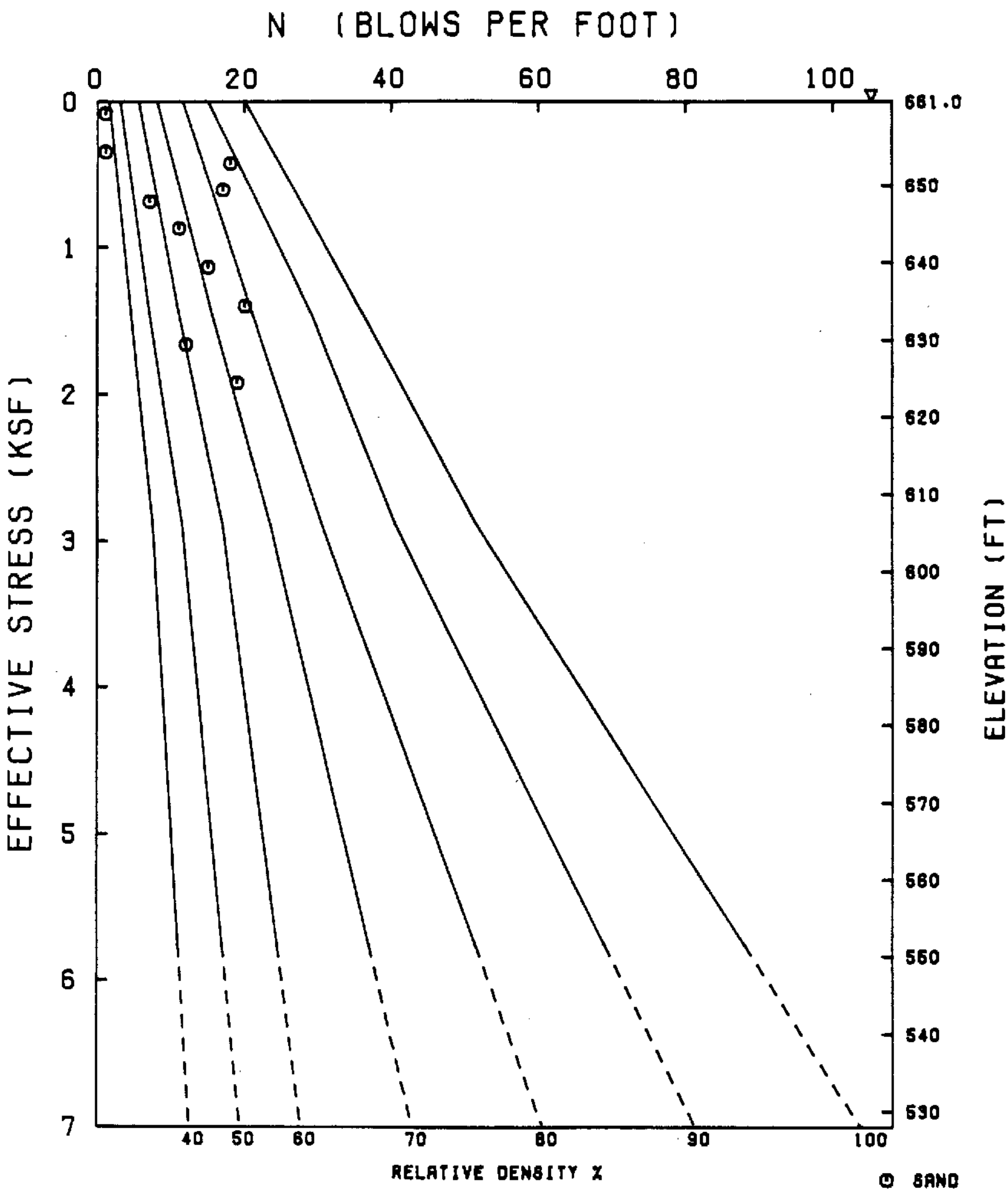
CLIENT	DUQUESNE LIGHT CO.-BVPS-2	J.O. NO. 12241.00	
SUBJECT	TERRA PROBE-AFTER INITIAL DENSIFICATION	DATE 9/3/81	BY DDH
	BORING 551T	CHECKED 9/3/81	BY S.E.P.

BASED ON COMPUTER RUN J5864002 ON 09/03/81 AT 09.56.41
PROGRAM GT-004 RELDEN VER 04 LEV 01 - COMPILED ON 78.219 AT 14.12.34



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CLIENT DUQUESNE LIGHT CO.-BVPS-2 J.O. NO. 12241.00

SUBJECT TERRA PROBE-AFTER INITIAL DENSIFICATION DATE 9/3/81 BY DDW

BORING 552T CHECKED 9/3/81 BY J.F.P.

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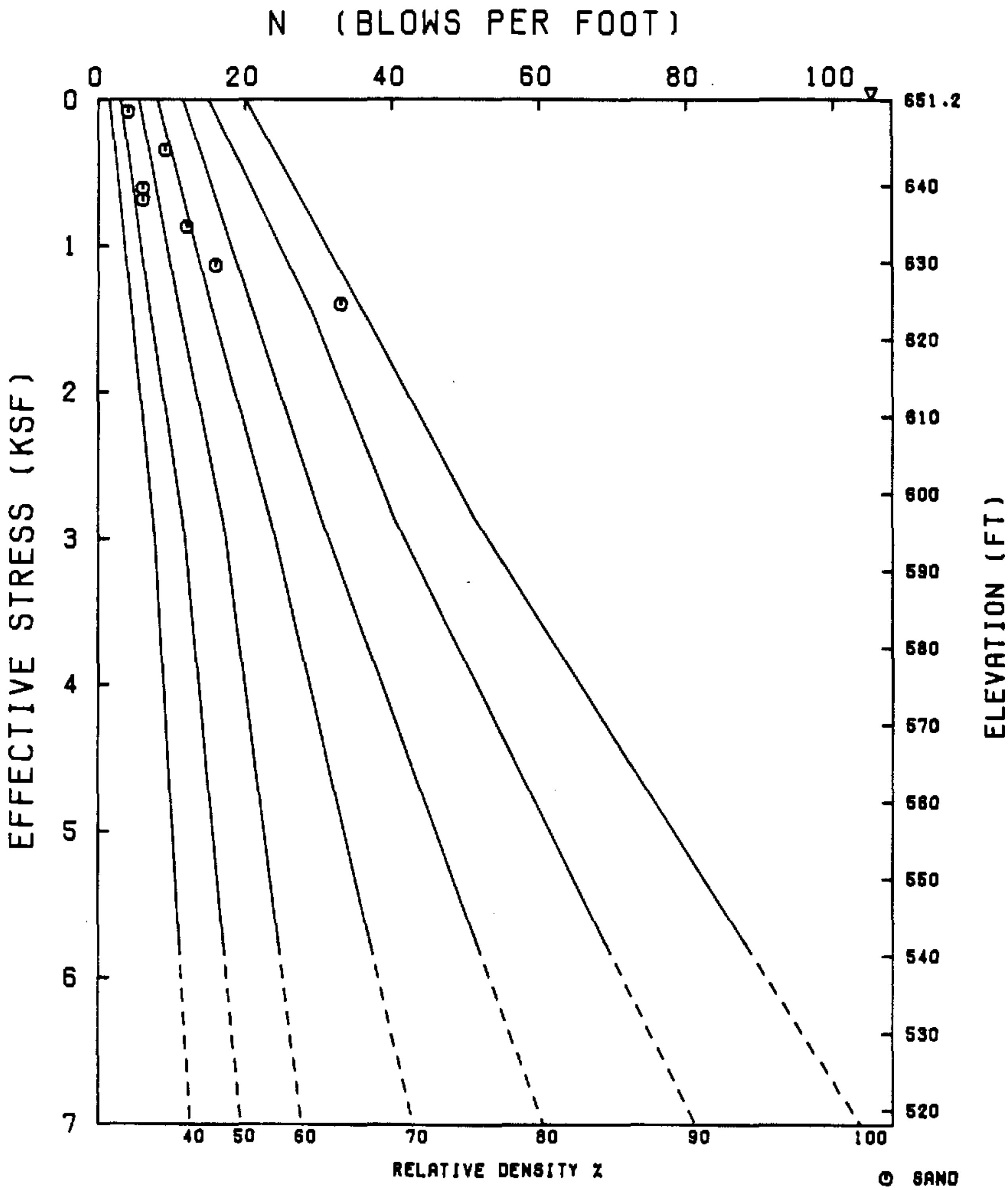

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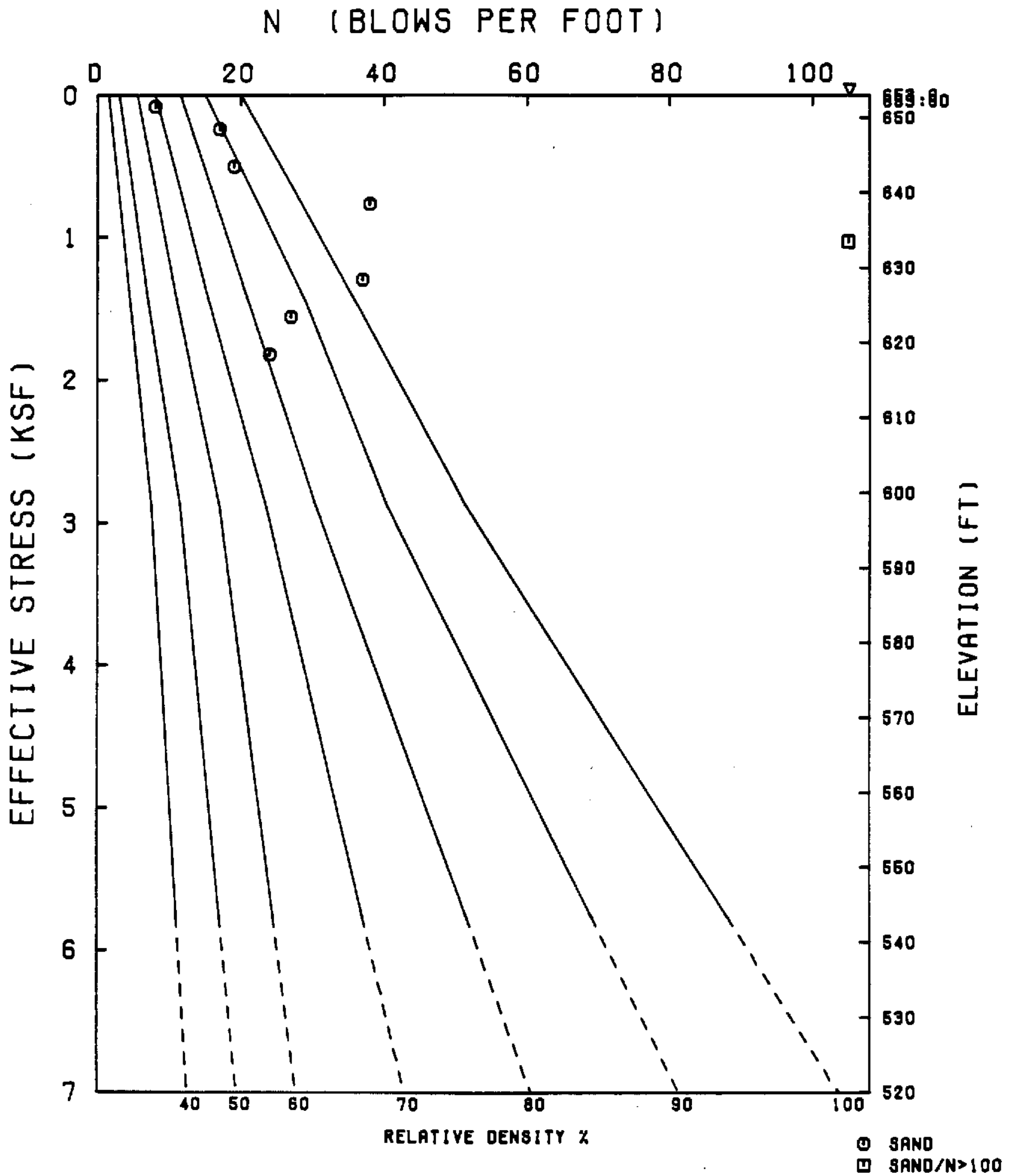

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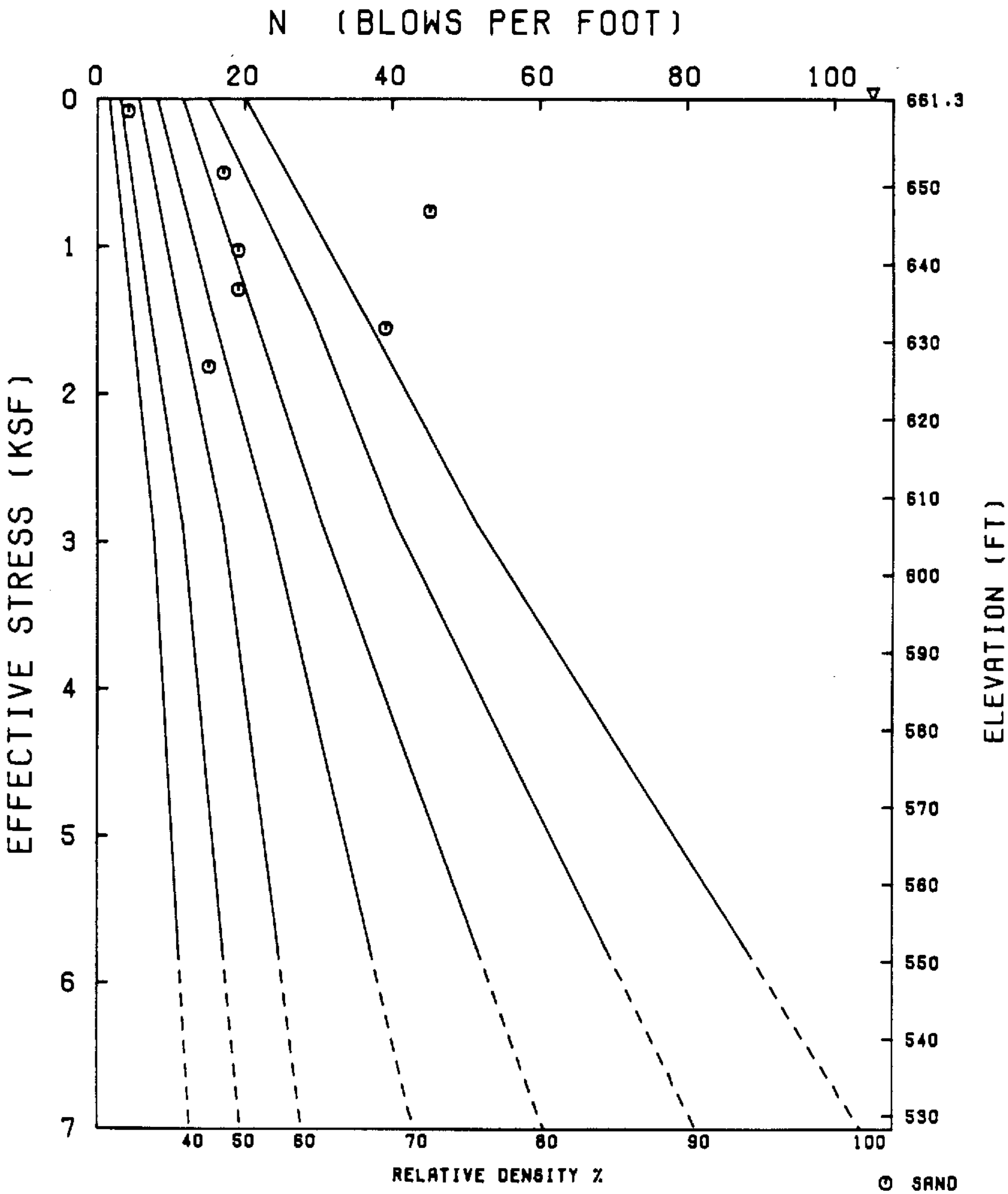

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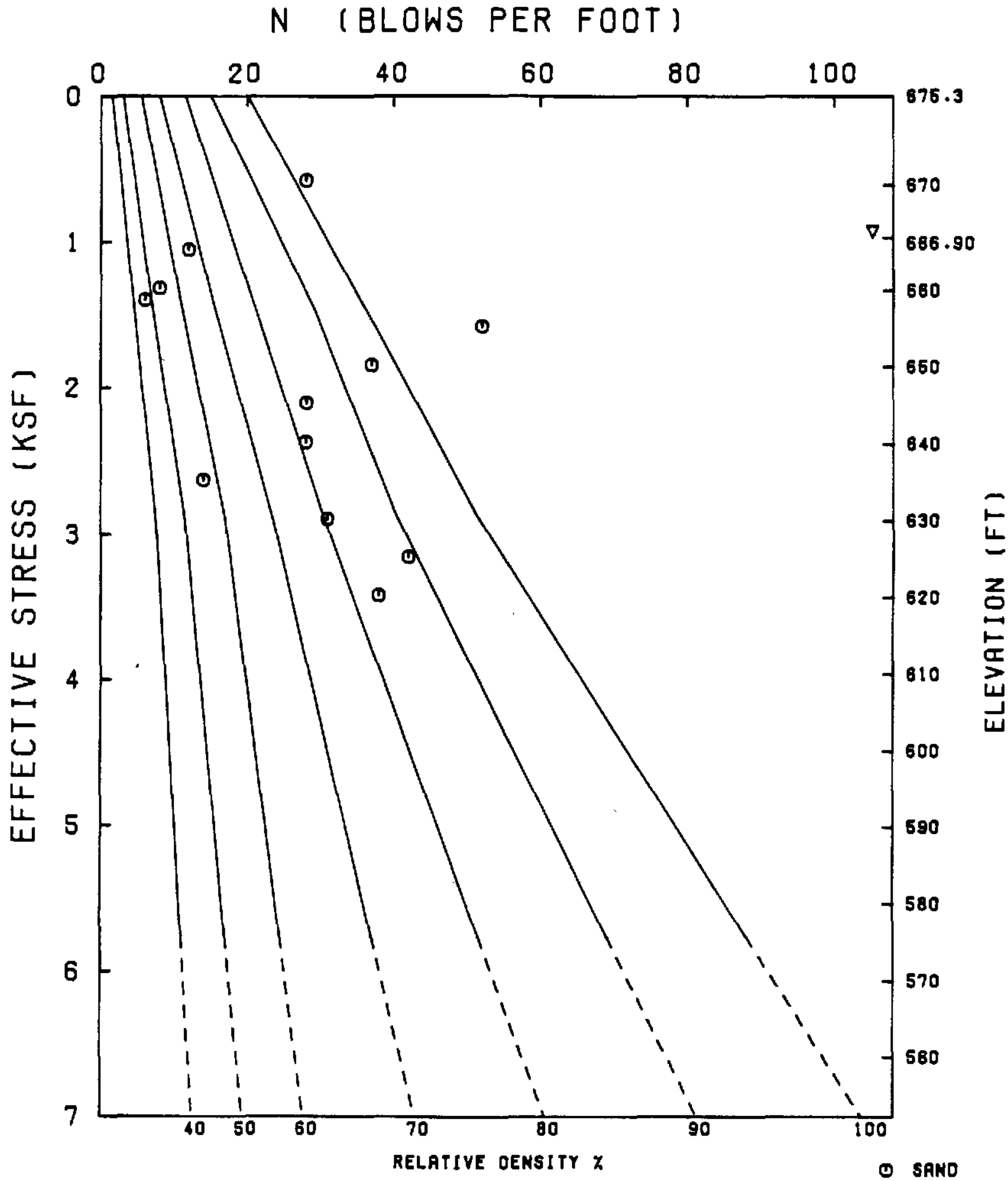

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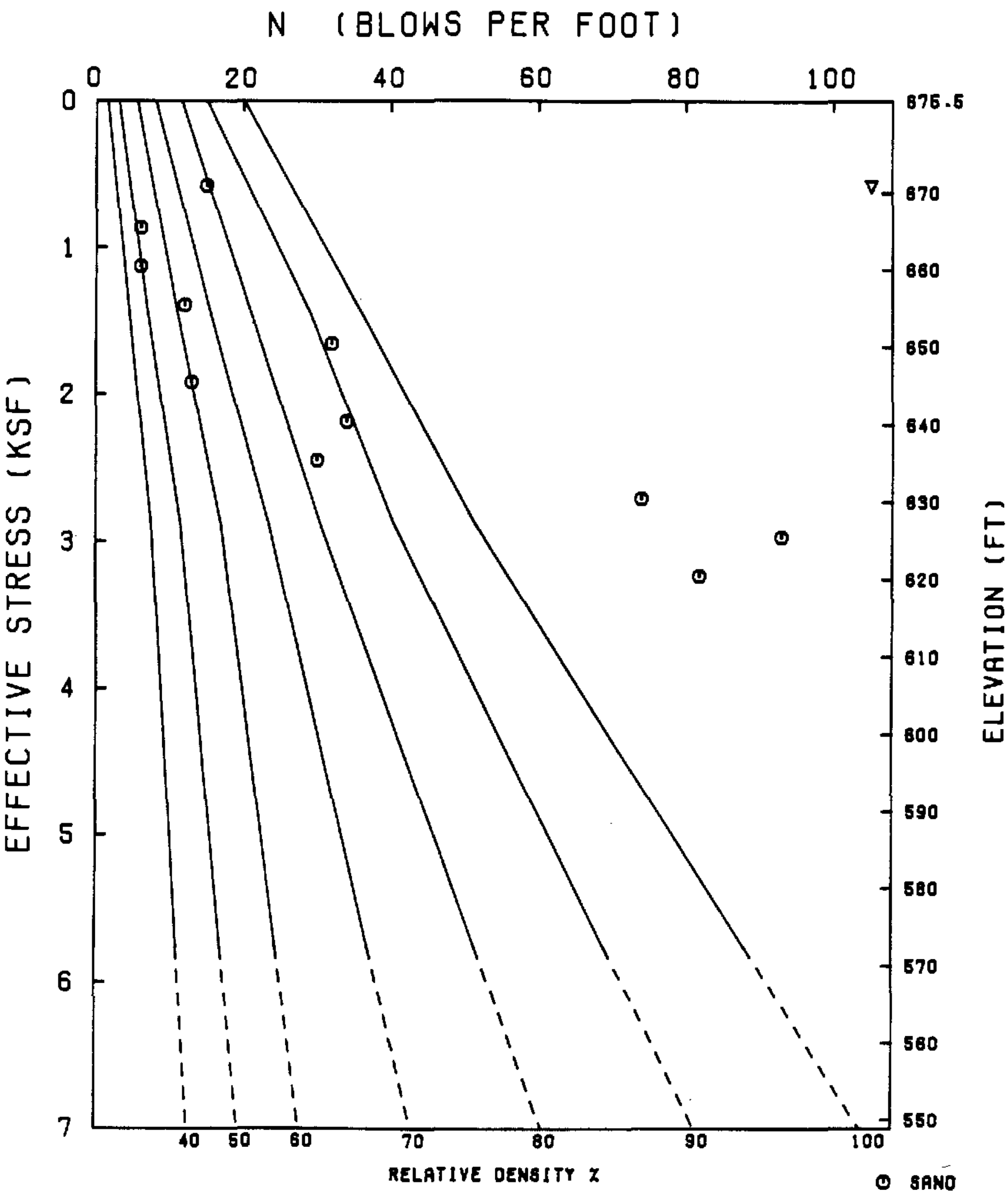

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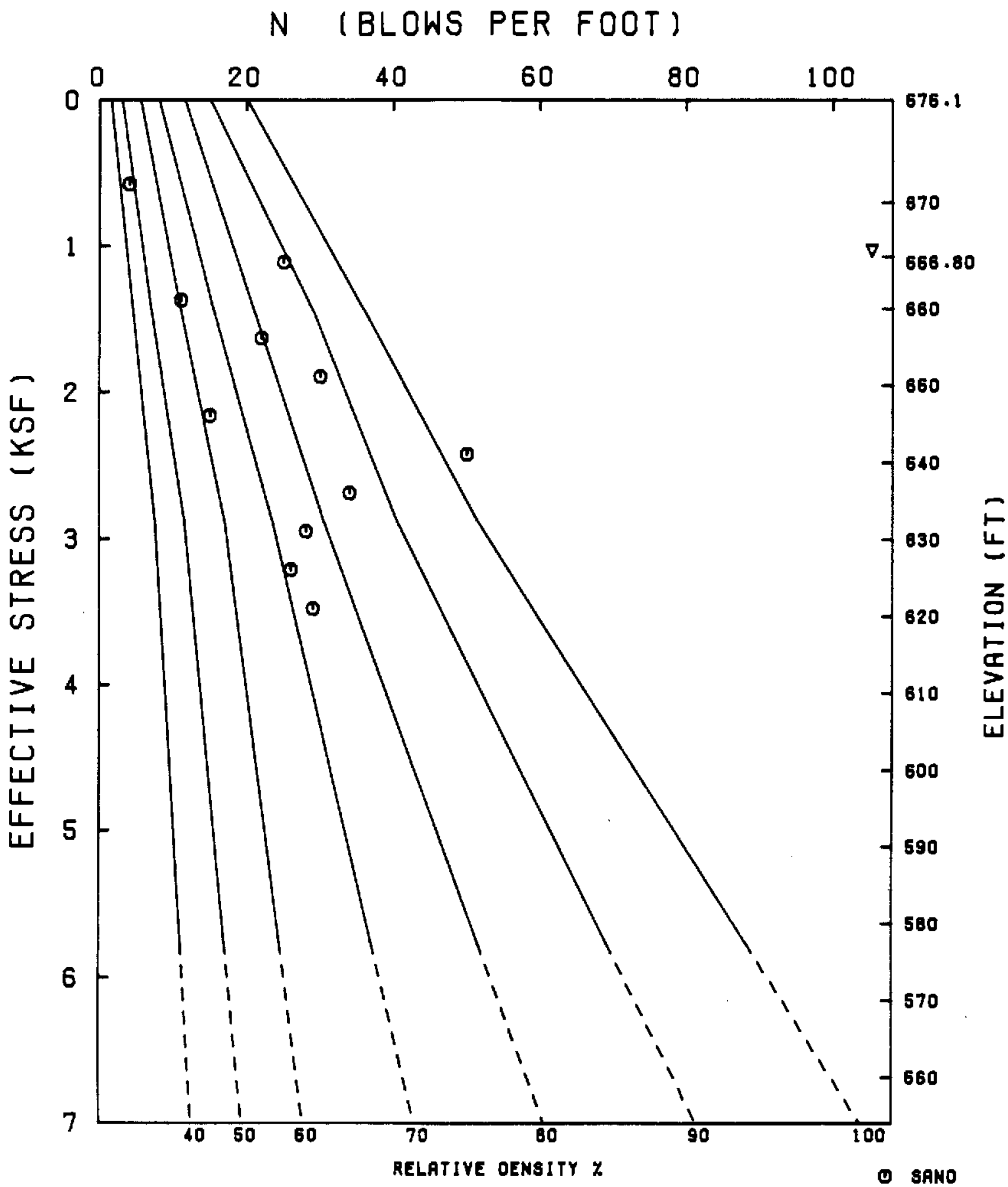

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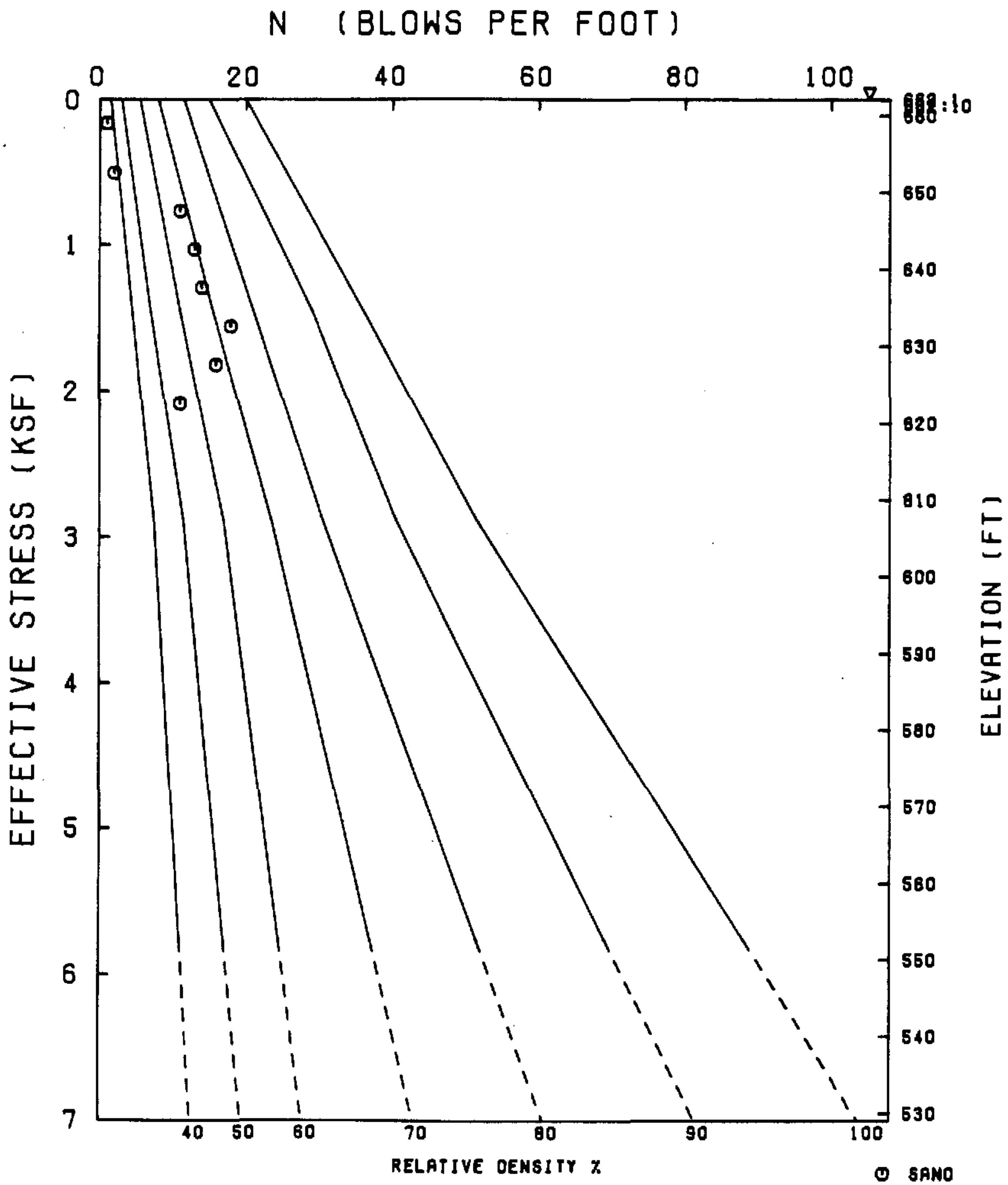

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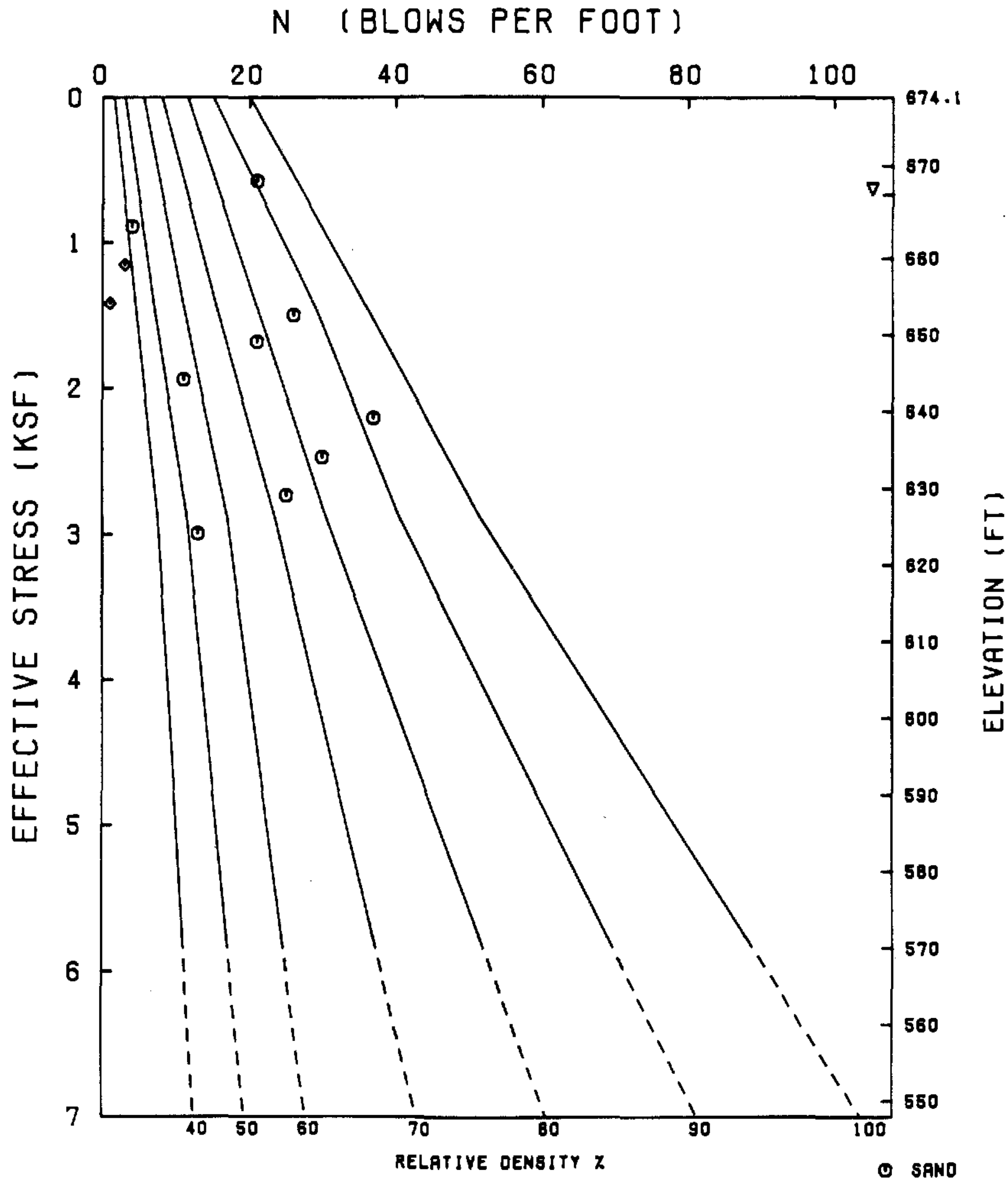

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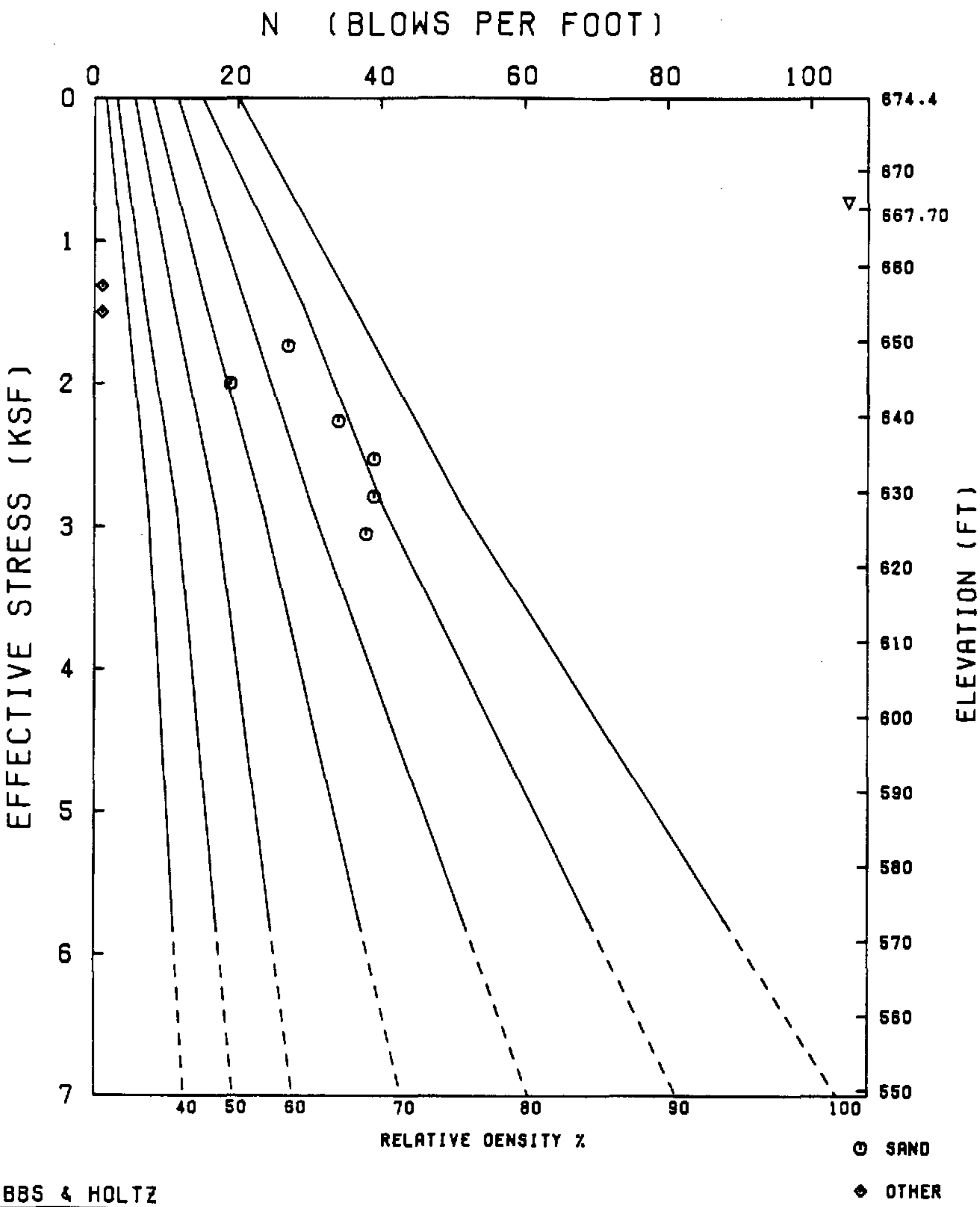

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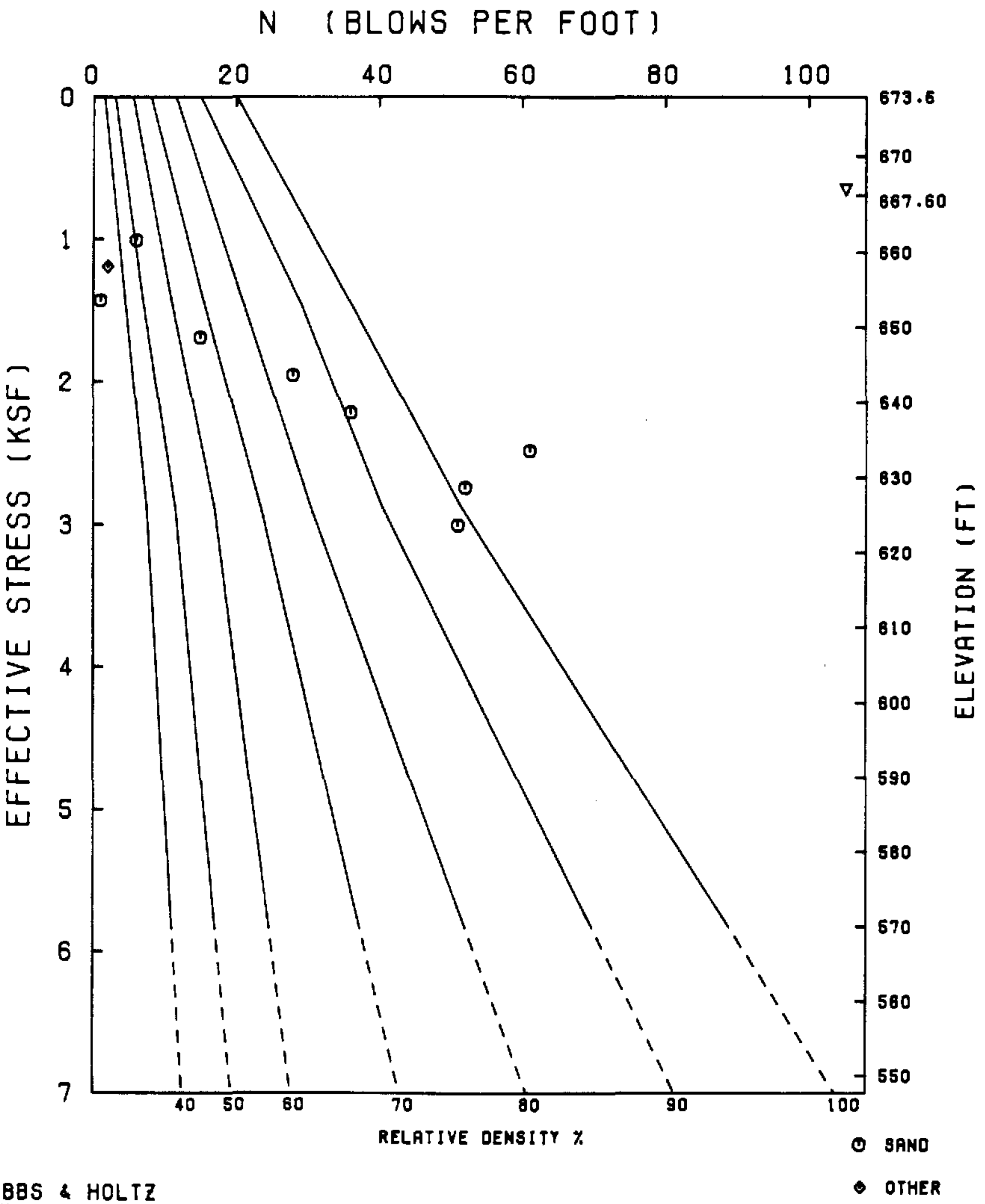

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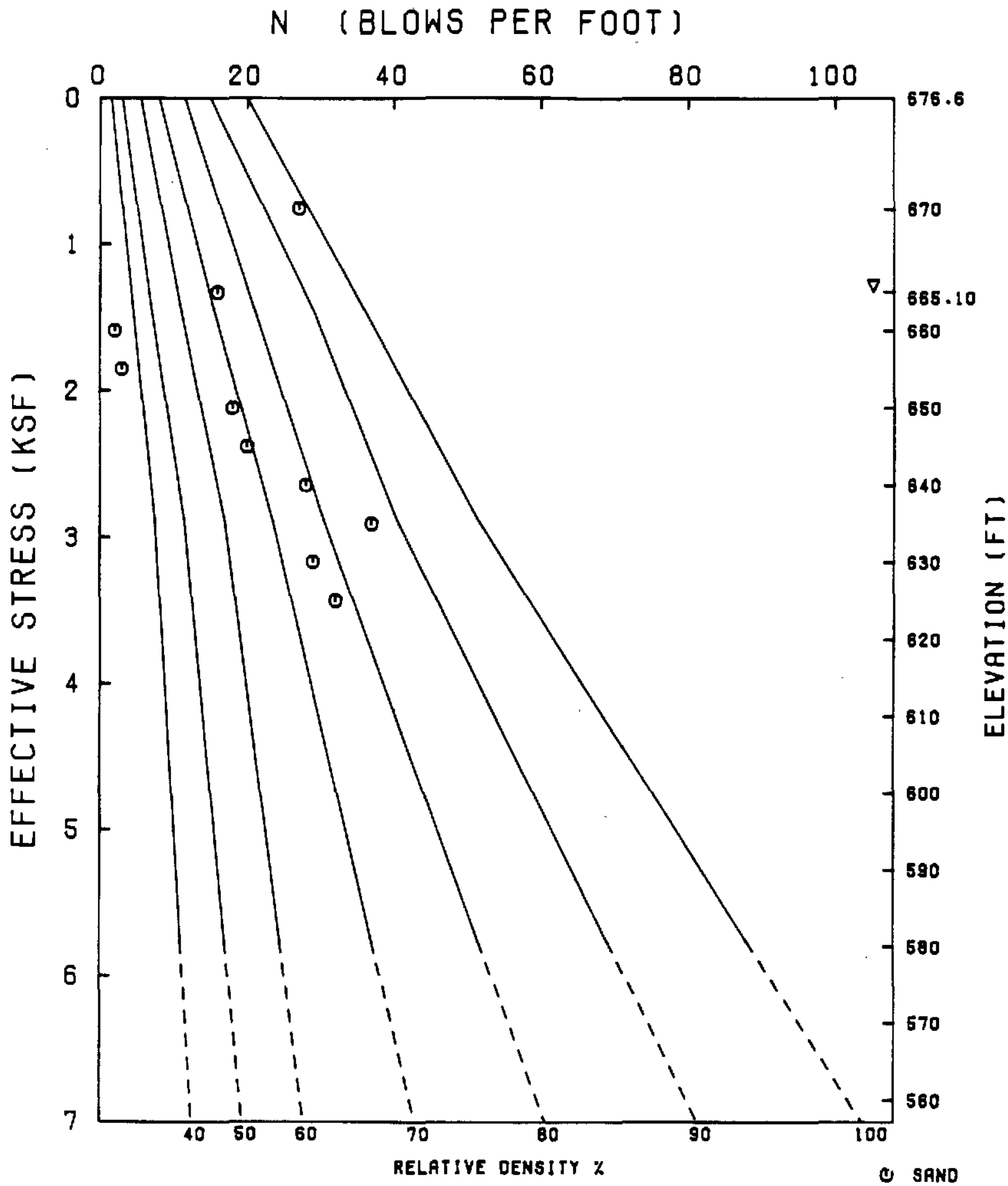

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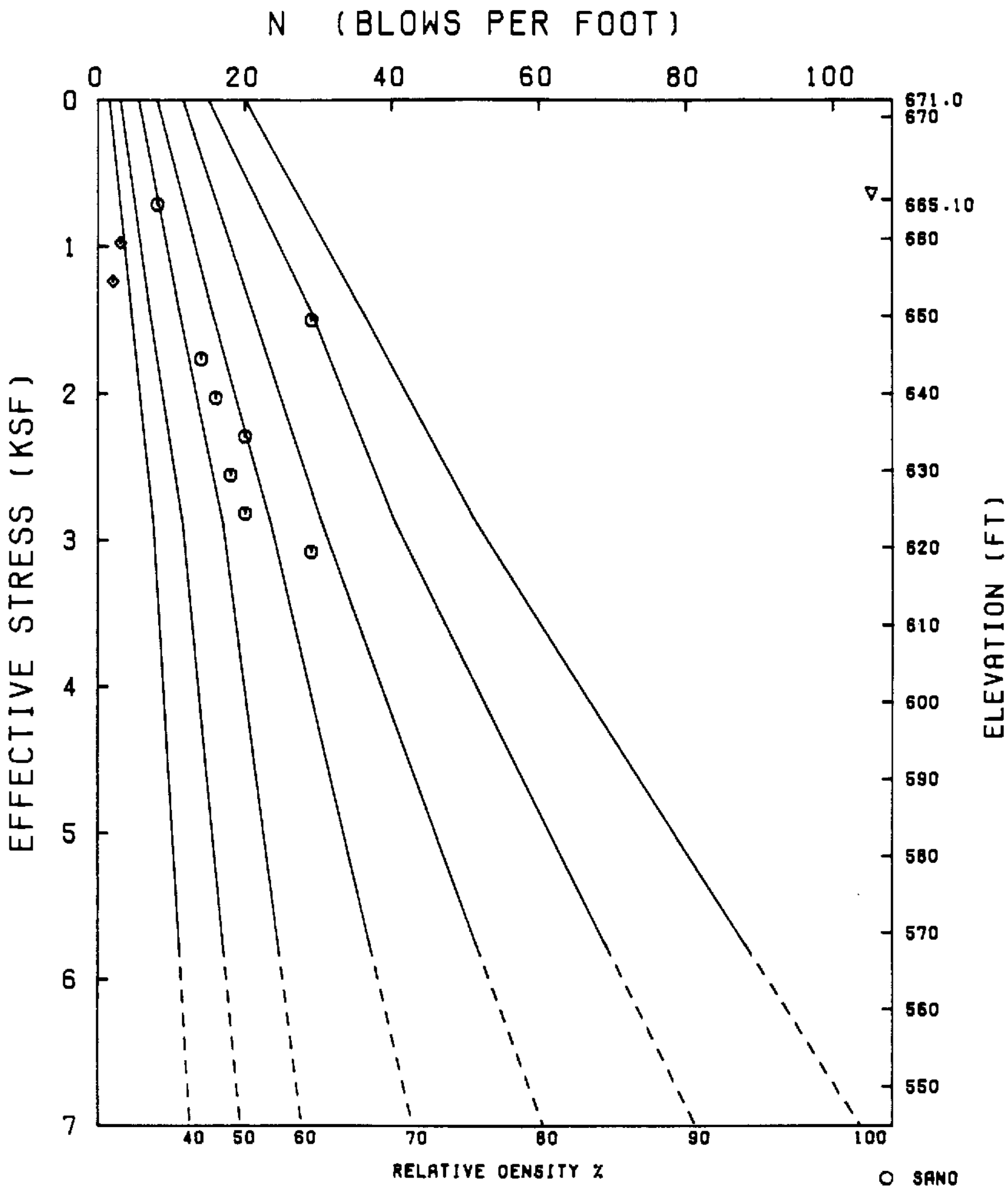

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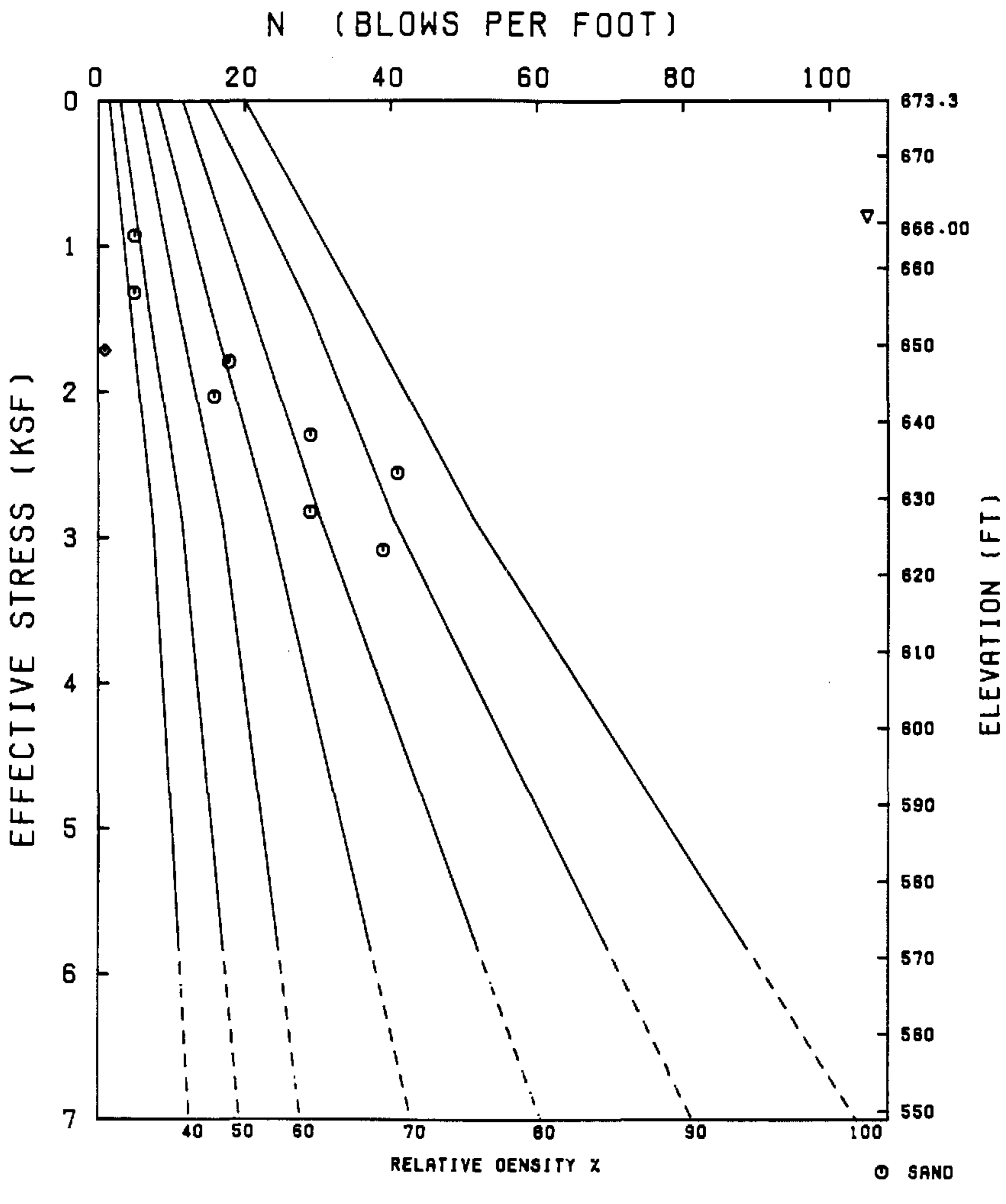

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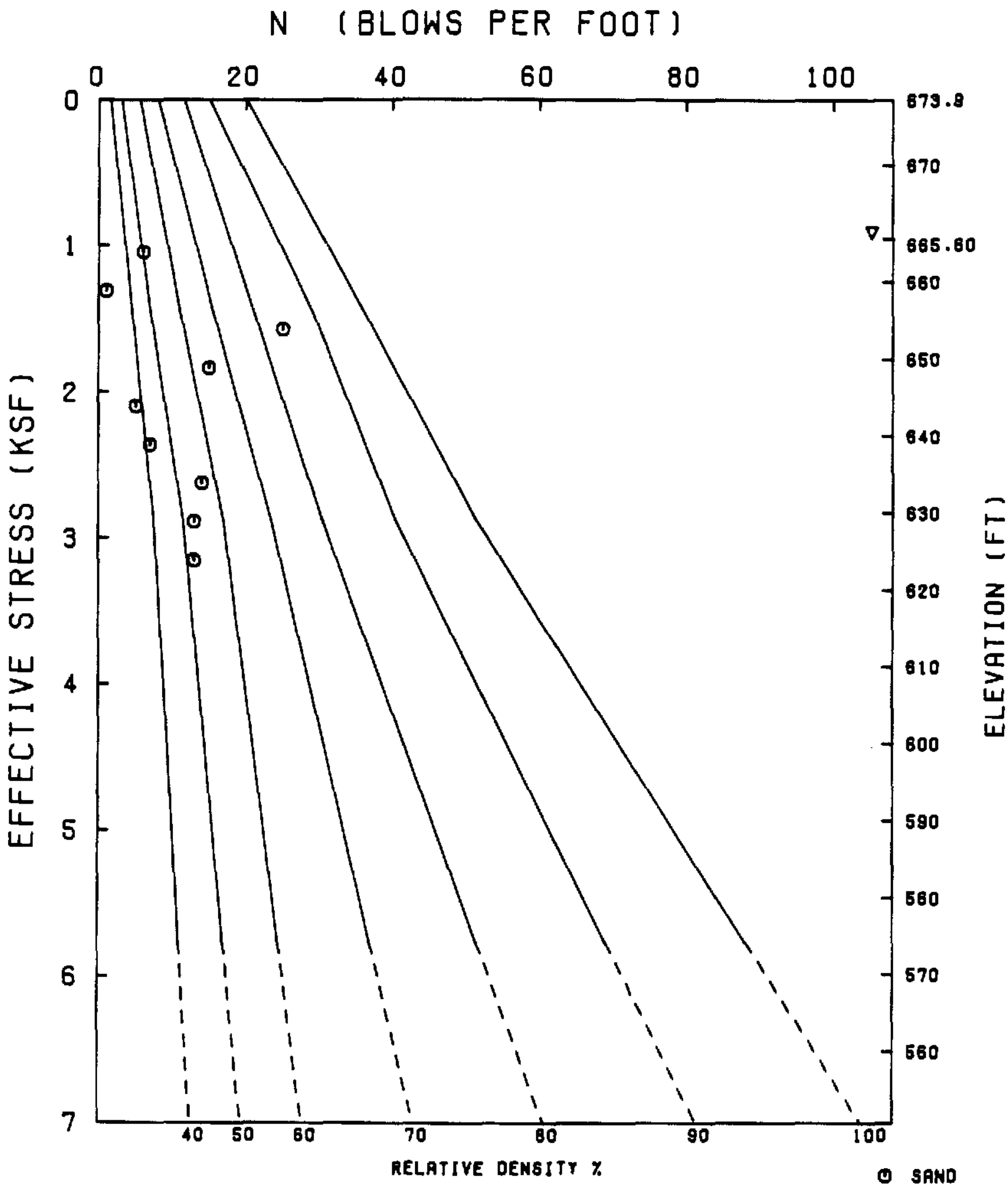

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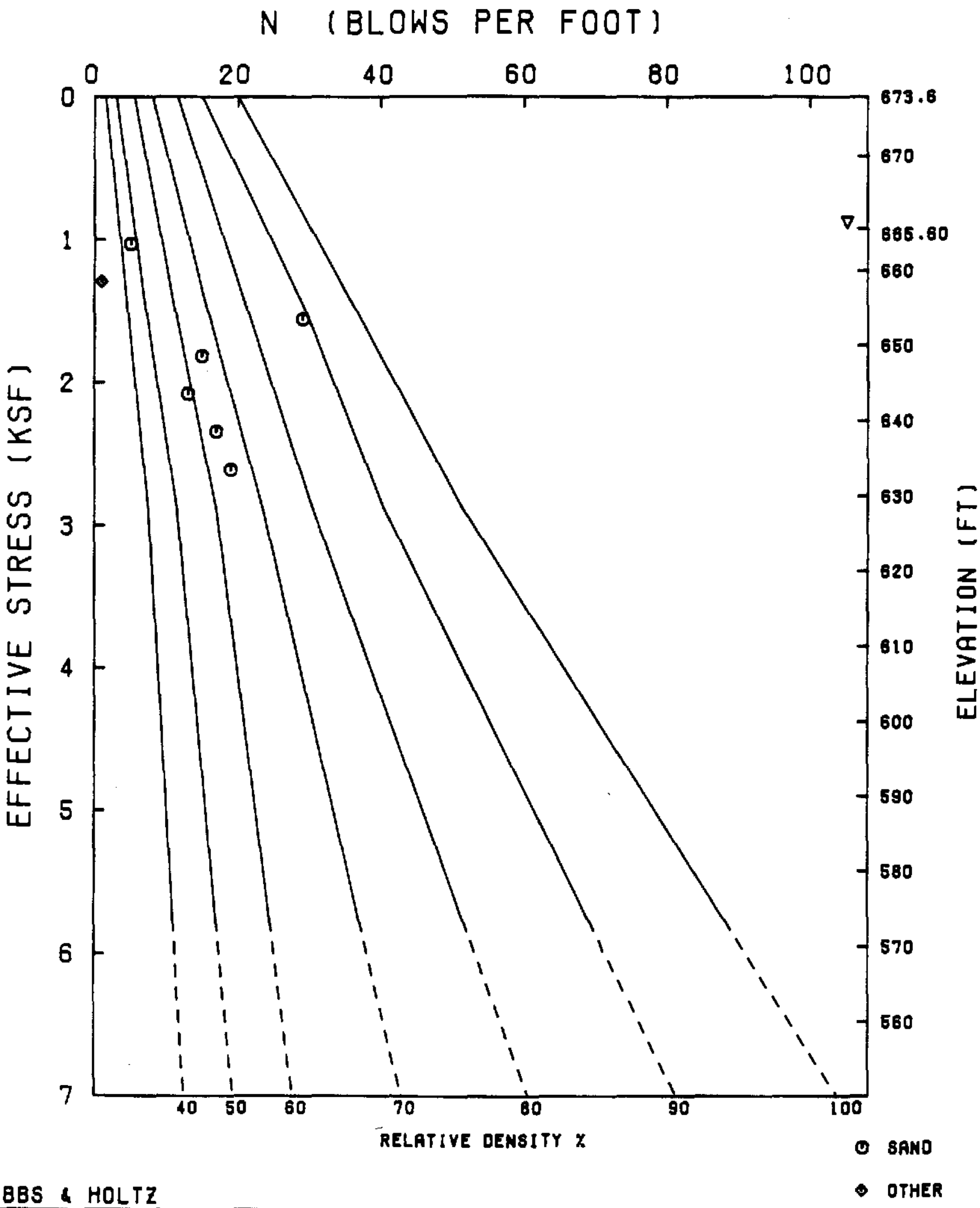

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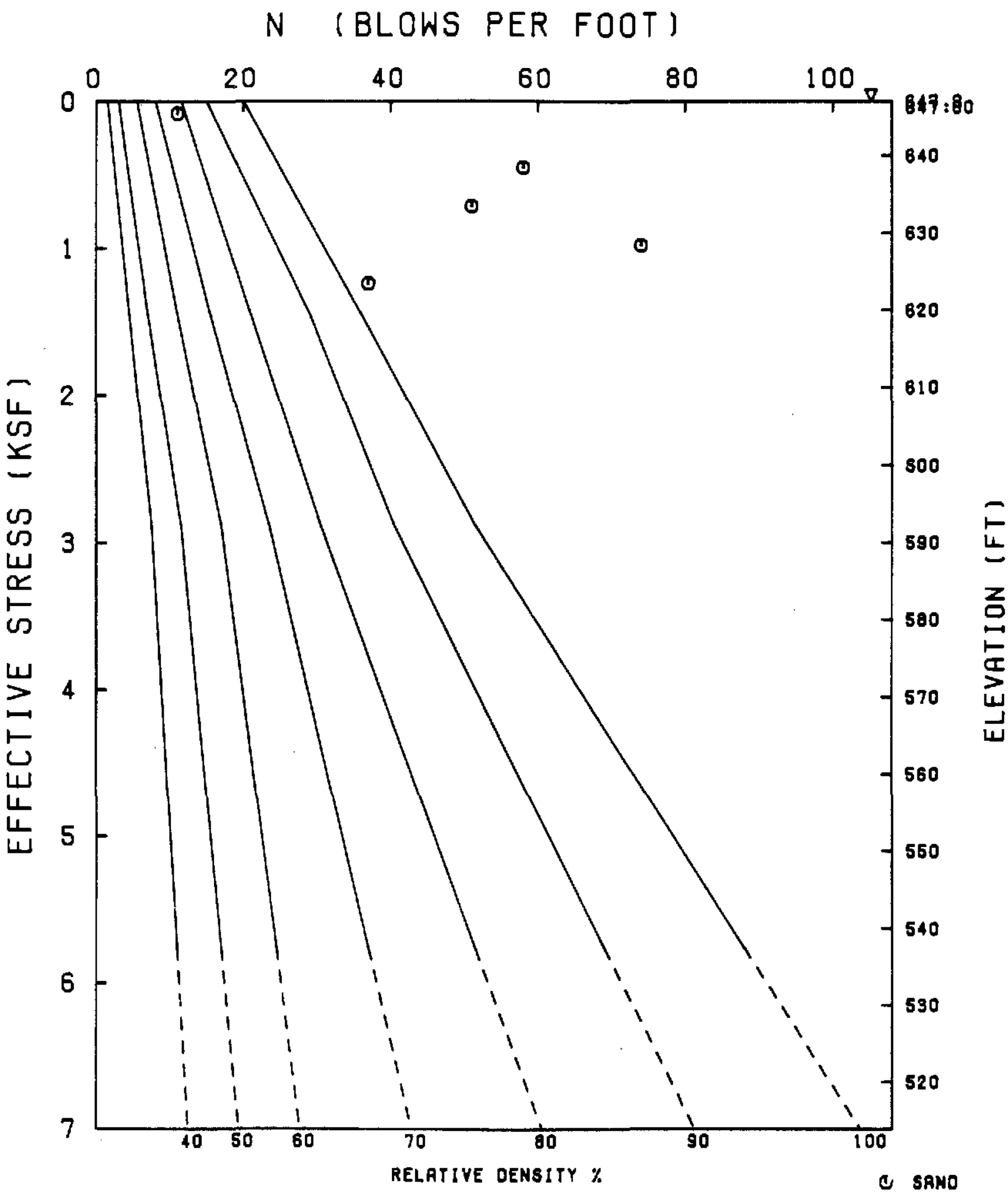

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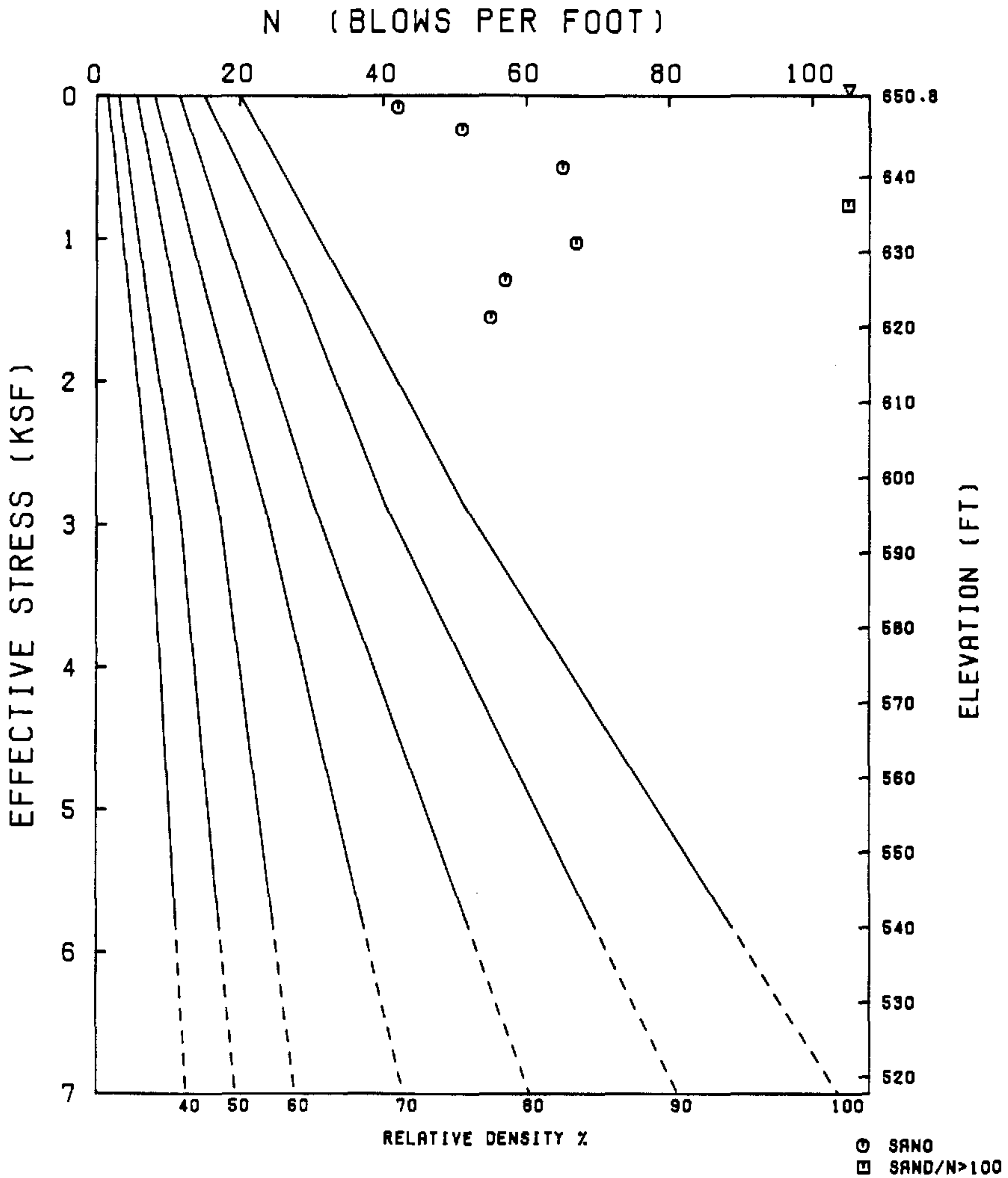

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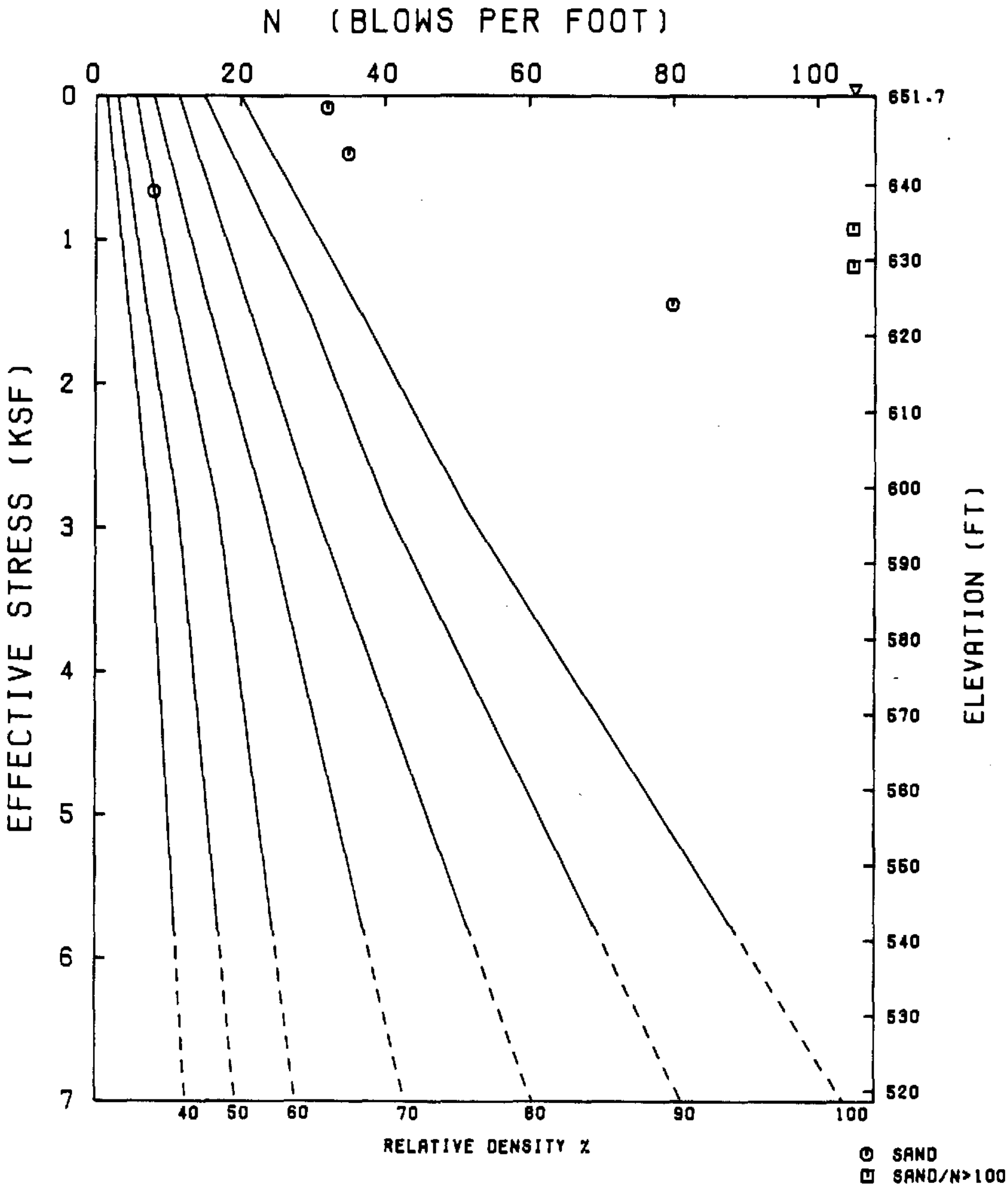

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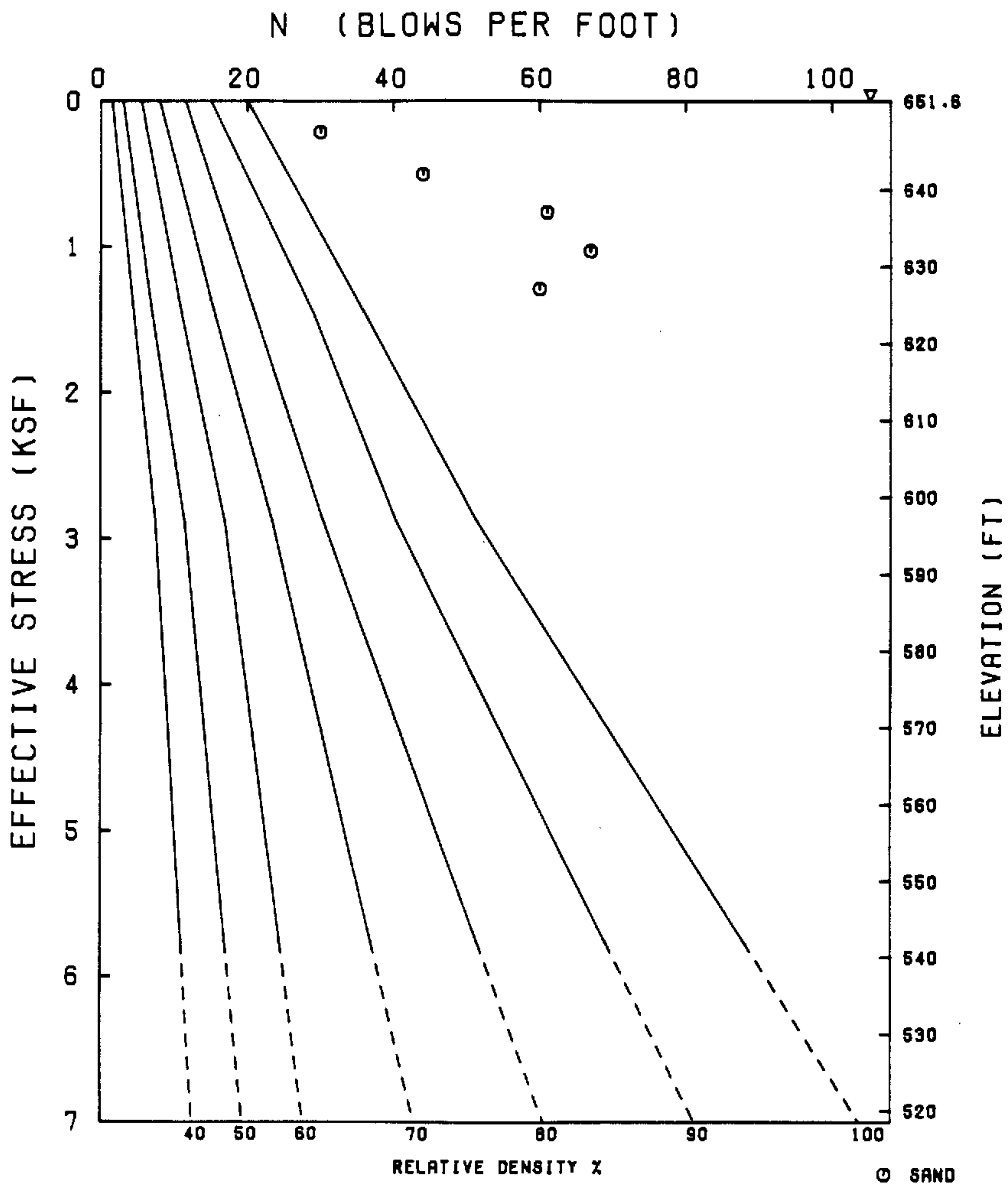

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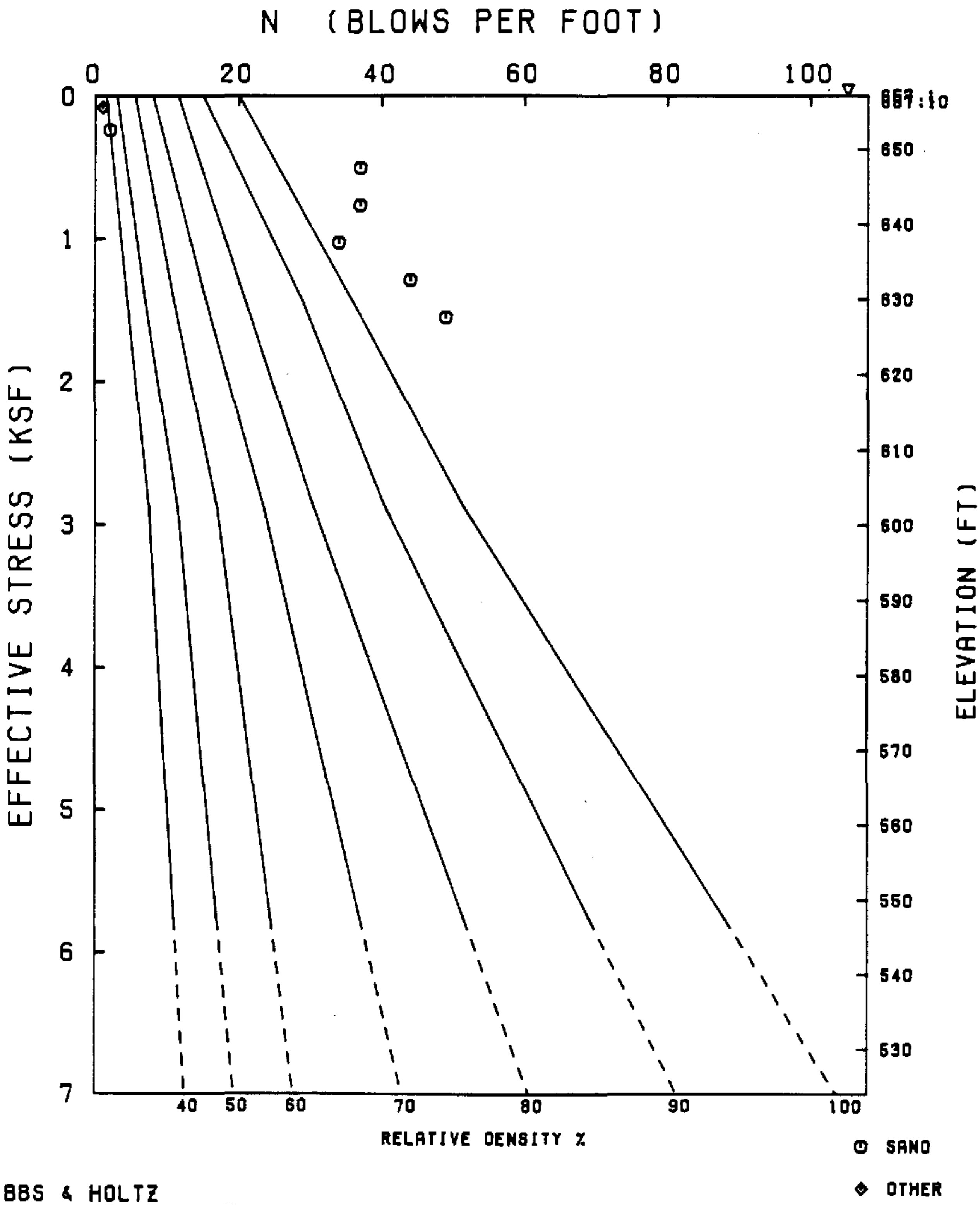

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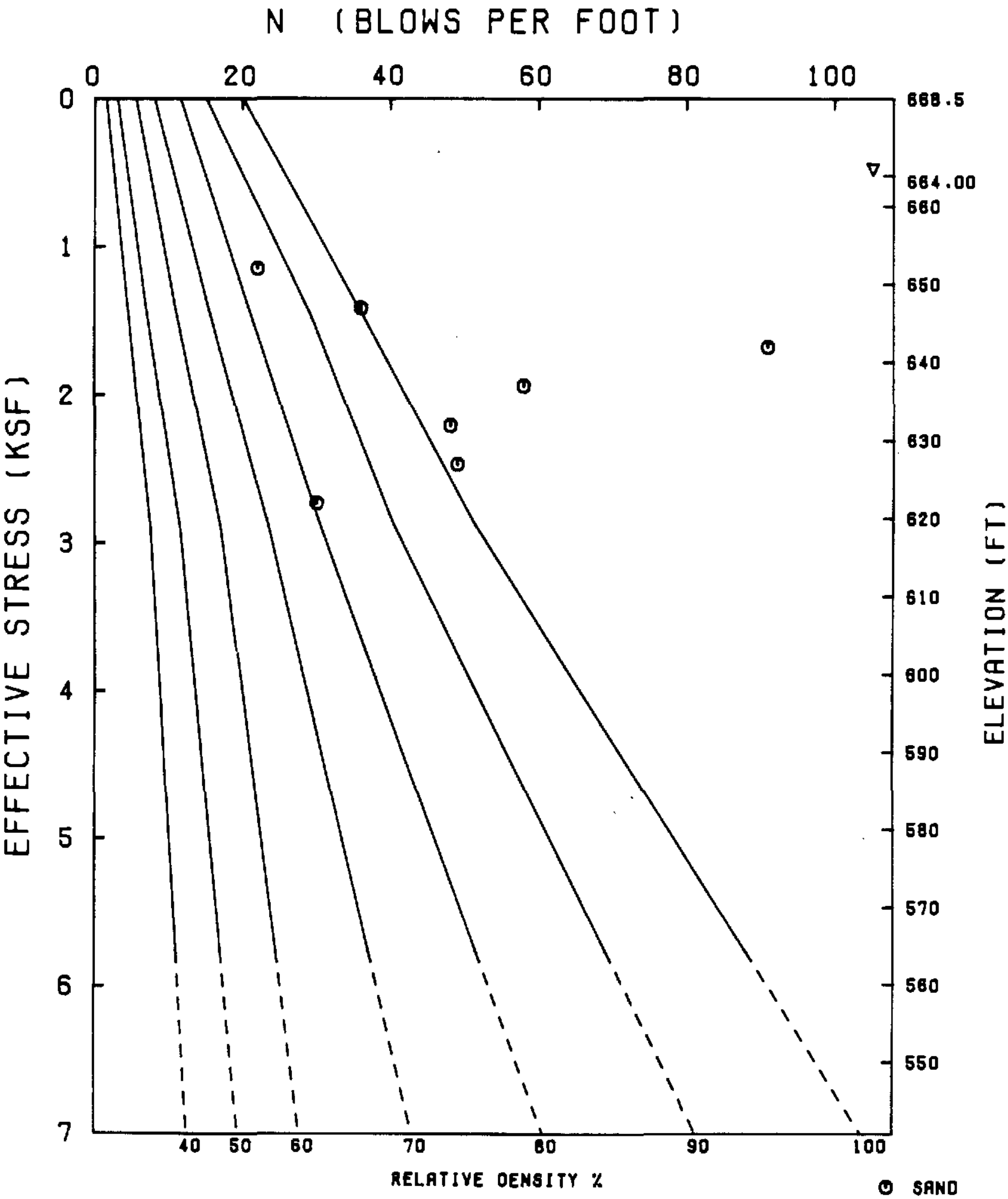

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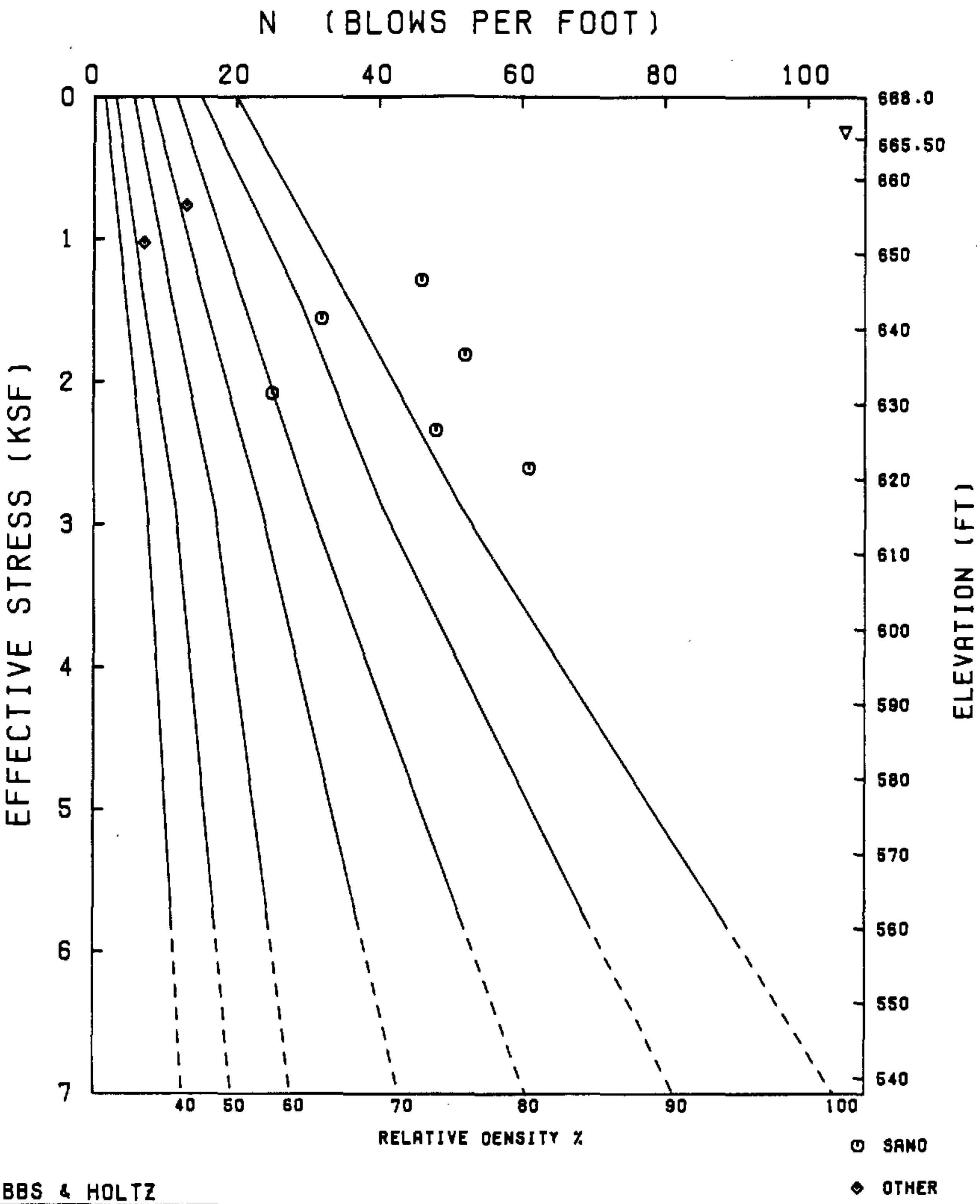

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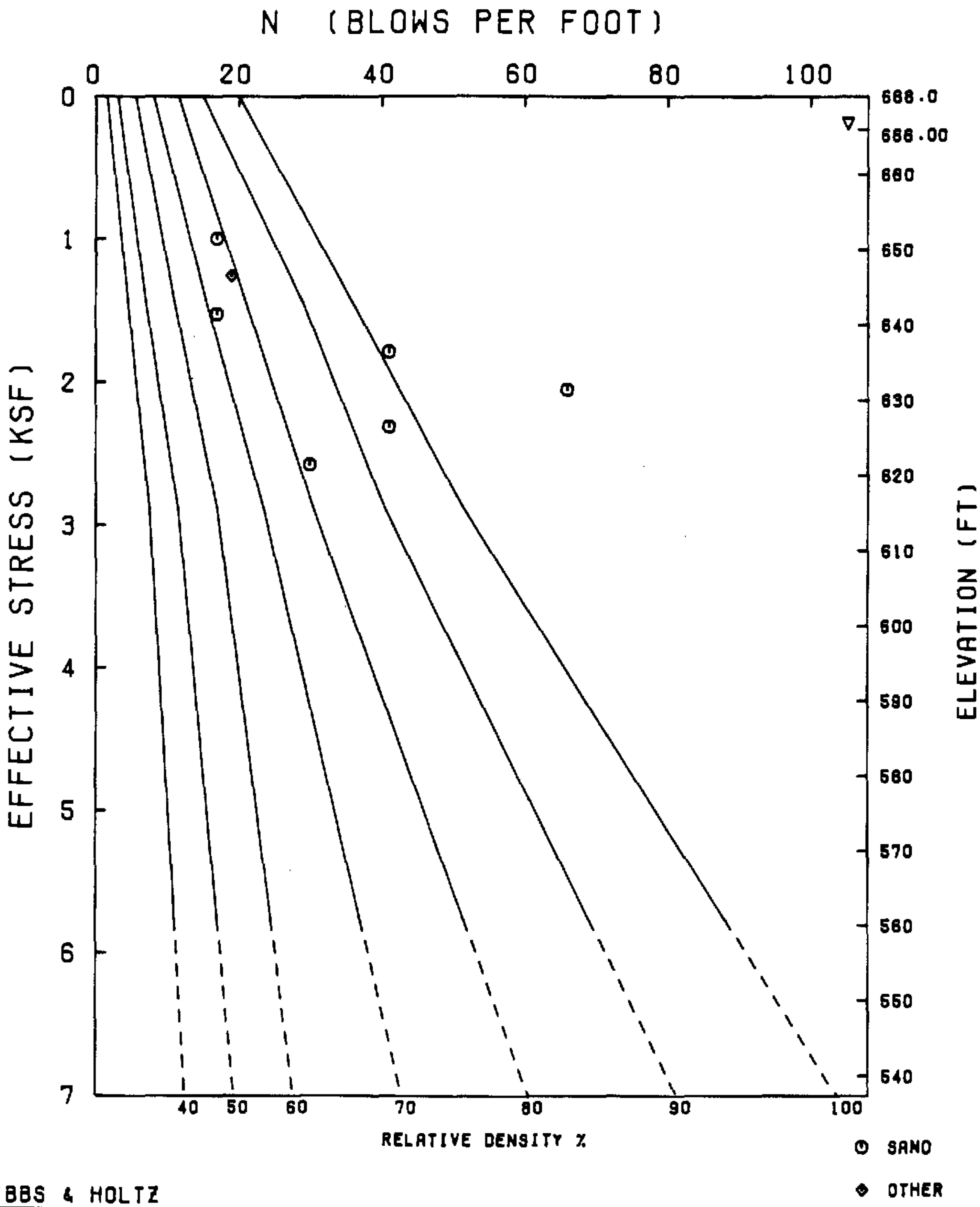

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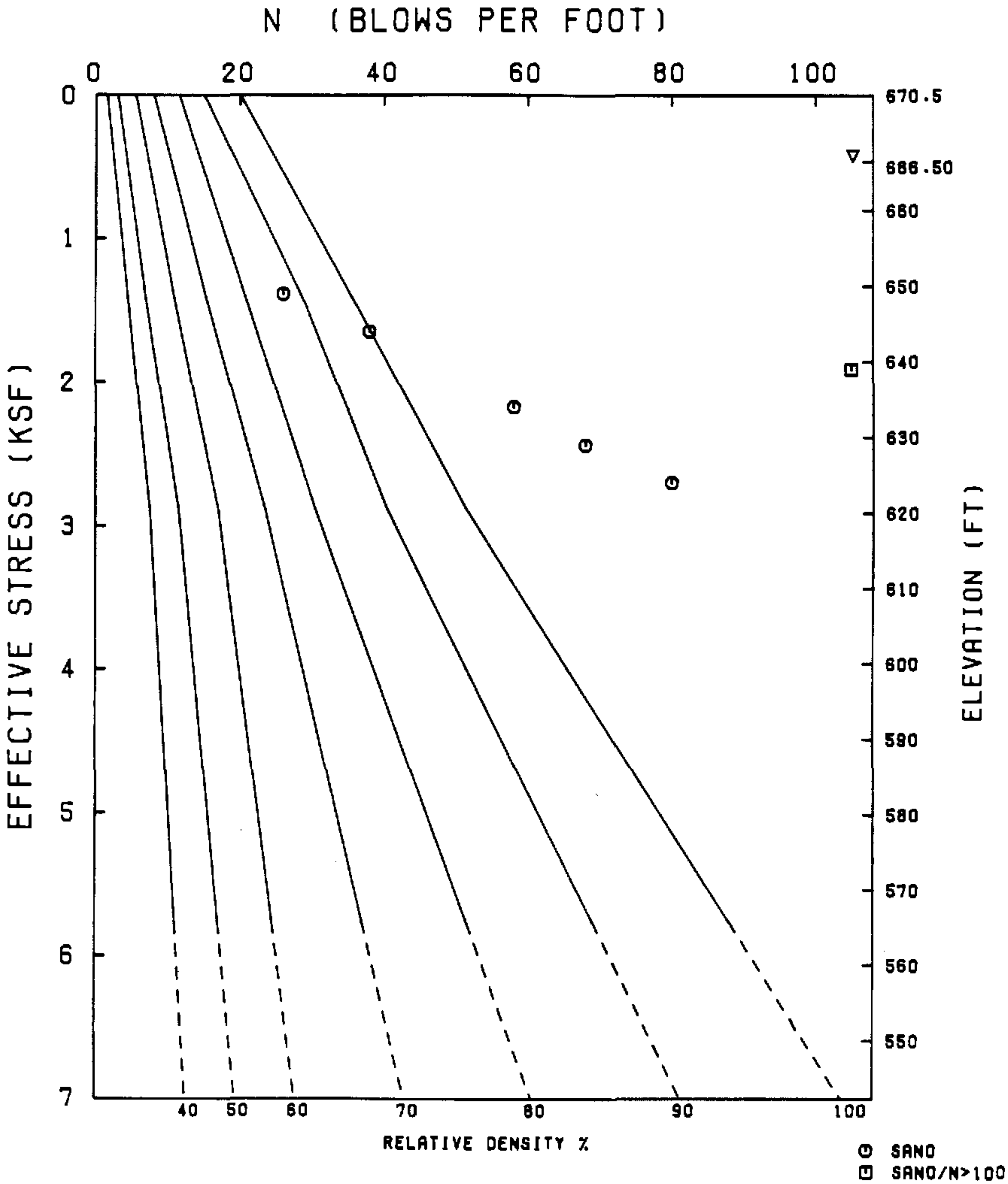

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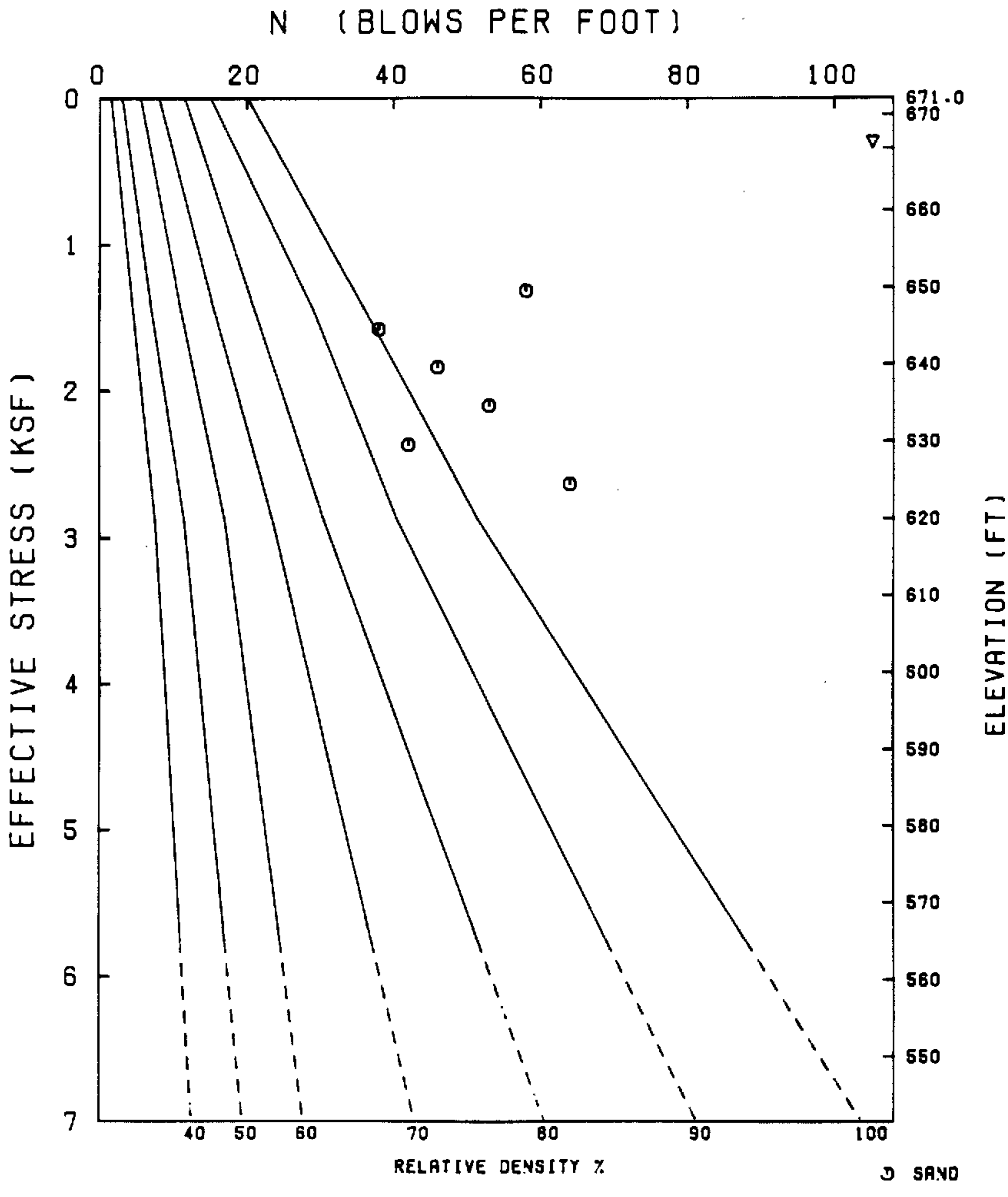

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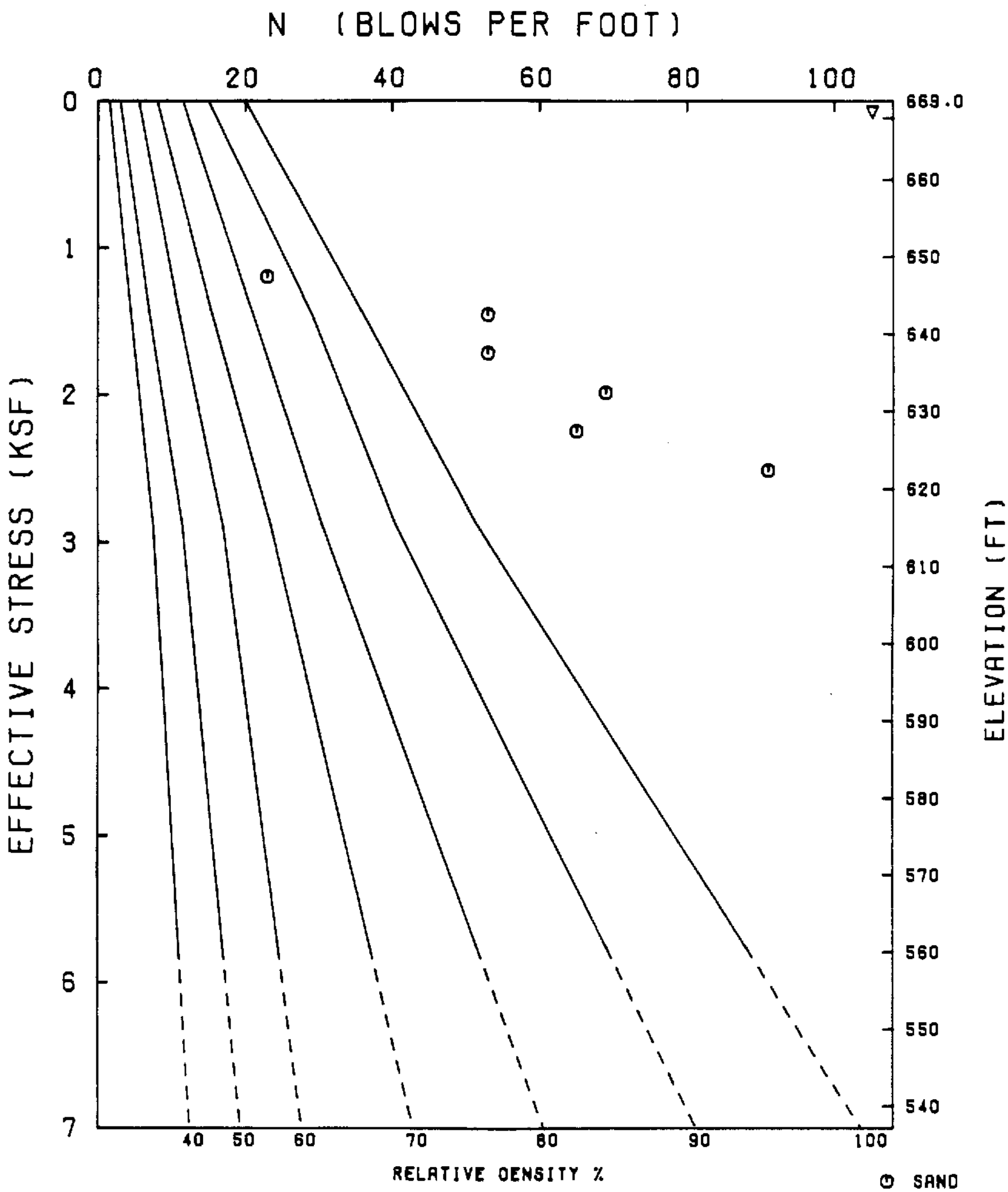

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APPENDIX 2.5D

LABORATORY TEST DATA
IN SITU SOILS

BEAVER VALLEY POWER STATION

APPENDIX 2.5D

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2.5D.1 INTRODUCTION

The purpose of this report is to summarize and present the data obtained from tests performed to evaluate the index and engineering properties of the in situ soils at the Beaver Valley Power Station (BVPS) site.

Attempts to obtain undisturbed samples of the in situ sands and gravels were unsuccessful. Consequently, laboratory testing of undisturbed samples was only performed on the intermediate and lower terrace silts and clays. Grain size analyses on the terrace sands and gravels are discussed in Section 2.5D.2.1, and in situ density tests performed at the foundation elevation of the reactor containment are given in Section 2.5D.2.4.

2.5D.2 Index Tests

2.5D.2.1 Grain Size Analyses

Sixty-two grain size analyses were performed on soil samples obtained from exploratory borings for Beaver Valley Power Station - Unit 1 (BVPS-1). Grain size analyses, predominantly of the upper terrace sands and gravels, performed on samples from the 100 series borings can be found in Appendix 2F of BVPS-1 FSAR (Duquesne Light Company (DLC) 1972a). Grain size analyses performed on the 300 series borings can be found in Appendix 2H of BVPS-1 FSAR (DLC 1972b).

Fourteen additional grain size analyses were performed on samples obtained from exploratory borings for Beaver Valley Power Station - Unit 2 (BVPS-2). They are presented on Figures 2.5D-1, 2.5D-2, 2.5D-3, 2.5D-4, 2.5D-5, 2.5D-6, 2.5D-7 and 2.5D-8.

To document the soils at the foundation grade of the BVPS-2 reactor containment, in-place density tests were performed at the locations shown on Figure 2.5D-9. At each of the test locations, a bag sample was obtained and a grain size analysis was performed. The in-place density tests are described in Section 2.5D.2.4. The grain size analyses performed on the bag samples are shown on Figures 2.5D-10, 2.5D-11, 2.5D-12, 2.5D-13, 2.5D-14, 2.5D-15, 2.5D-16, 2.5D-17, 2.5D-18, 2.5D-19 and 2.5D-20.

2.5D.2.2 Specific Gravity

Four specific gravity determinations were made on samples of the in situ soils from the BVPS site in accordance with the procedures given in Appendix IV (Department of the Army 1965). The results are summarized in Table 2.5D-1.

2.5D.2.3 Atterberg Limits and Natural Water Contents

Atterberg limits and natural water contents were performed on samples of the clays and silts of the intermediate and lower terraces as an index of their variability across the site.

Natural water contents were performed in accordance with ASTM D2216 (Standard Methods of Laboratory Determination of Moisture Content of Soil). Atterberg limits were determined in accordance with the methods presented in Appendix III (Department of the Army 1965). The grooving tool was as specified in ASTM D423 (Liquid Limit of Soils).

Table 2.5D-2 summarizes the Atterberg limit and water content data. Additional natural water contents can be found by referring to the various test summary tables presented herein. Data from the 300 series borings were prepared by others and are included for completeness (DLC 1972a). The plasticity chart shown on Figure 2.5D-21 indicates that the in situ silts and clays are in general slightly to moderately plastic. The points plot roughly parallel to the A line indicating a similar mineralogy across the site.

2.5D.2.4 Unit Weights

Dry unit weights were determined for each sample tested. These data are presented in the various test summary tables. At the completion of the reactor containment excavation to approximately el 679 feet, a series of the in-place density tests were performed in accordance with ASTM D1556 (Test for Density of Soil in Place by the Sand Cone Method) at the locations shown on Figure 2.5D-9. A summary of the tests is presented in Table 2.5D-3. Bag samples were recovered and grain size analyses were performed. The grain size analyses are shown on Figures 2.5D-10, 2.5D-11, 2.5D-12, 2.5D-13, 2.5D-14, 2.5D-15, 2.5D-16, 2.5D-17, 2.5D-18, 2.5D-19 and 2.5D-20.

As a result of this program, a lens of stiff silty clay was discovered beneath the northern portion of the excavation, which was later removed end replaced with compacted fill. A more detailed discussion is given in Section 2.5.4.5.

2.5D.3 Constant Rate of Strain Consolidation Tests

2.5D.3.1 Procedure

Four constant rate of strain consolidation (CRSC) tests were performed on 2.5-inch diameter specimens of in situ clay soils trimmed from undisturbed samples. Specimen preparation was in accordance with Appendix VIII (Department of the Army 1965). Tests were performed according to the procedures described in Wissa and Heilburg (1969). The maximum past consolidation pressure was calculated by the Schmertmann method (Ladd 1971).

2.5D.3.2 Results

Table 2.5D-4 summarizes the results of all CRSC tests performed. Individual test results are presented on Figures 2.5D-22, 2.5D-23, 2.5D-24, 2.5D-25, 2.5D-26, 2.5D-27, 2.5D-28 and 2.5D-29.

Three tests were performed on undisturbed block and bag samples recovered from a stiff silty clay layer that was discovered beneath the northern portion of the reactor containment excavation. The clay was removed from beneath the containment foundation. The clay layer extends beneath the northern portion of the safeguards area and refueling water storage tank.

Classification tests indicate that the clay has a liquid limit of 50, a plastic limit of 23, and a natural water content of about 23 percent. A natural water content equal to the plastic limit indicates that the clay has been overconsolidated. The presence of small fissures and discoloration along the fissure surfaces suggests that the precompression may be due to desiccation. The maximum past pressure ranged between about 13 and 18 ksf. The estimated overburden pressure prior to excavation for the containment foundation was about 7.5 ksf, resulting in an overconsolidation ratio (OCR) of between 1.7 and 2.4.

Incremental consolidation tests, unconsolidated undrained (UU) triaxial compression tests, and consolidated isotropically undrained (CIU) triaxial compression tests performed on this material are described in subsequent sections.

2.5D.4 Incremental Consolidation Tests

2.5D.4.1 Procedure

Four incremental consolidation tests were performed: three on clay samples from the lower terrace and one on the stiff silty clay recovered from the reactor containment excavation. Tests were performed on 2.5-inch diameter specimens in accordance with the method given in Appendix VIII (Department of the Army 1965). The maximum past consolidation pressure was determined by the Schmertmann method (Ladd 1971).

2.5D.4.2 Results

Table 2.5D-5 summarizes the results of the tests performed. Individual test results are presented on Figures 2.5D-30, 2.5D-31, 2.5D-32, 2.5D-33, 2.5D-34, 2.5D-35, 2.5D-36, 2.5D-37, 2.5D-38, 2.5D-39, 2.5D-40, 2.5D-41, 2.5D-42, 2.5D-43, 2.5D-44, 2.5D-45, 2.5D-46, 2.5D-47, 2.5D-48, 2.5D-49, 2.5D-50, 2.5D-51, 2.5D-52, 2.5D-53, 2.5D-54, 2.5D-55, 2.5D-56, 2.5D-57, 2.5D-58, 2.5D-59, 2.5D-60, 2.5D-61, 2.5D-62, 2.5D-63, 2.5D-64, 2.5D-65, 2.5D-66, 2.5D-67 and 2.5D-68.

2.5D.5 Unconfined Compression Tests

Forty-one unconfined compression tests were performed on undisturbed and remolded specimens for the site investigations of BVPS-1 (DLC 1972a, 1972b, 1979). A summary of the test results is presented in Table 2.5D-6. Individual test plots are presented for the AB series borings on Figures 2.5D-69, 2.5D-70, 2.5D-71, 2.5D-72, 2.5D-73, 2.5D-74 and 2.5D-75. The remaining test figures can be found in the references indicated.

2.5D.6 Unconsolidated Undrained Triaxial Compression Tests

2.5D.6.1 Procedure

Six unconsolidated undrained triaxial compression tests were performed on undisturbed tube and block samples in accordance with the procedures given in Appendix X (Department of the Army 1965). No membrane correction was considered necessary.

2.5D.6.2 Results

Curves of deviator stress versus axial strain are presented for each test on Figures 2.5D-76, 2.5D-77, 2.5D-78, 2.5D-79, 2.5D-80 and 2.5D-81. A summary of the test data is presented in Table 2.5D-7.

The block samples were recovered from a stiff silty clay layer beneath the reactor containment excavation as described in DLC's Report on Soil Densification (DLC 1976). The undrained shear strength of this material is about 4.3 ksf. Constant rate of strain and incremental consolidation tests were performed on this material and are described in Sections 2.5D.3 and 2.5D.4, respectively. Consolidated undrained isotropically triaxial compression tests on this material are presented in Section 2.5D.7.

2.5D.7 Consolidated Isotropically Undrained Triaxial Compression Tests

2.5D.7.1 Procedure

Two consolidated isotropically undrained (CIU) triaxial compression tests were performed during the site investigation for BVPS-2; one from boring OF6 and one from a block sample recovered from the stiff silty clay layer beneath the reactor containment excavation. Four additional tests were performed on undisturbed samples from the AB series borings for BVPS-1 (DLC 1979). These tests were performed in accordance with Department of the Army (1965) Appendix X.

Fifteen additional CIU tests were performed by Goldberg-Zoino and Associates, Inc. (DLC 1972a) on samples from the 300 series borings.

2.5D.7.2 Results

Table 2.5D-8 summarizes the CIU test results for all of the CIU tests performed by Stone & Webster Engineering Corporation (SWEC). Table 2.5D-9 summarizes the test results for the 300 series borings. Individual test results for the tests given in Table 2.5D-8 are shown on Figures 2.5D-82, 2.5D-83, 2.5D-84, 2.5D-85, 2.5D-86, 2.5D-87, 2.5D-88, 2.5D-89, 2.5D-90, 2.5D-91, 2.5D-92, 2.5D-93, 2.5D-94, 2.5D-95, 2.5D-96, 2.5D-97, 2.5D-98, 2.5D-99, 2.5D-100, 2.5D-101 and 2.5D-102. Individual test results from the 300 series borings are given in the BVPS-1 FSAR (DLC 1972a).

2.5D.8 Consolidated Drained Direct Shear Tests

2.5D.8.1 Procedure

Five drained direct shear tests were performed on specimens of sandy clay from sample 1 of boring 906 in accordance with the procedures given in Appendix IX (Department of the Army 1965). Two different rates of displacement were used: 1.5 mm/hr and 40 mm/hr.

2.5D.8.2 Results

The test results are shown on Figure 2.5D-103 and are summarized on Figure 2.5D-104. The drained friction angle is approximately 29.5 degrees with a cohesion intercept of about 0.15 tsf. The rate of strain has little effect on the test results for the materials tested.

2.5D.9 References for Appendix 2.5D

Department of the Army 1965. Engineer Manual 1110-2-1906, Laboratory Soil Testing: Appendix III, Liquid and Plastic Limits; Appendix IV, Specific Gravity; Appendix V, Grain Size Analysis; Appendix VIII, Consolidation Test; Appendix IX, Drained Direct Shear Test; Appendix X, Triaxial Compression Test. Office of the Chief Engineers.

Duquesne Light Company (DLC) 1972a. Appendix 2F, Final Safety Analysis Report - Beaver Valley Power Station - Unit 1. Prepared by Stone & Webster Engineering Corporation, Boston, Mass.

Duquesne Light Company 1972b. Appendix 2H, Final Safety Analysis Report - Beaver Valley Power Station - Unit 1. Prepared by Stone & Webster Engineering Corporation, Boston, Mass.

Duquesne Light Company 1976. Report on Soil Densification Program - Beaver Valley Power Station - Unit 2. Prepared by Stone & Webster Engineering Corporation, Boston, Mass.

Duquesne Light Company 1979. Soil Analysis of Turbine Building and Northern Yard Area, Beaver Valley Power Station - Unit 1. Prepared by Stone & Webster Engineering Corporation, Boston, Mass.

Ladd, C.C. 1971. Strength Parameters and Stress-Strain Behavior of Clays. Prepared by Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, Mass.

Wissa, A. and Heilberg, S. 1969. Analysis of Turbine Building and A New One Dimensional Consolidation Test. Beaver Valley Power Station - Unit 1. Prepared by Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, Mass.

Tables for Appendix 2.5D

Table 2.5D-1

SUMMARY OF SPECIFIC GRAVITY DETERMINATIONS

Boring	Sample and Section	Depth (ft)	Elev (ft)	Specific Gravity (G)	Material
802	6, 8, 9	20-31.5	715.0-703.5	2.65	Gravelly sand
PL1	1B2	14.0	666.0	2.67	Sandy silt
PL2	2B1	16.5	664.4	2.67	Clayey silt
PL3	5G	23.0	659.5	2.74	Sandy clay

TABLE 2.5D-2

ATTERBERG LIMITS AND NATURAL WATER CONTENTS

Boring No.	Sample and Section	Depth (ft)	Elevation (ft)	Natural Water Content	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
AB2	SS17	37.5-39.0	667.7-666.2	25.7	34.4	20.2	14.2
				23.4	24.8	18.5	6.3
	SS18	40.0-41.5	665.2-663.7	31.9	26.2	19.2	7.0
	SS19	42.5-44.0	662.7-661.2	26.0	23.4	18.8	4.6
AB10	SS16	35.0-36.5	670.8-669.3	24.1	28.4	19.1	9.3
C30	SS3	14.0-15.5	686.0-684.5	27.1	47.1	24.7	22.4
OF7	US1G	49.3-49.5	671.7-671.5	45.8	67.5	37.7	29.8
	US4B	60.2-60.4	660.8-660.6	24.0	30.1	18.1	12.0
OF8	SS11	55-56.5	666.0-664.5	44.2	58.6	31.7	26.9
				39.8	34.3	26.9	7.4
	SS12	60-61.5	661.0-659.5	42.1	50.4	28.0	22.4
OF9	US1F	48.0-48.2	673.0-672.8	43.2	55.6	31.6	24.0
	US2G	53.4-54.0	667.6-667.0	35.9	56.8	29.2	27.6
	US4A	59.5-59.7	661.5-661.3	30.5	30.7	19.7	11.0
	US4G	60.9-61.0	660.1-660.0	36.7	38.6	22.0	16.6
PL-1	ST1/1B2	14.0-14.3	666.0-665.7	46.6	55.0	30.0	25.0
PL-2	ST2/2B1	16.5-16.6	664.4-664.3	49.3	60.5	32.8	27.7
PL-3	ST1G	7.5-7.7	675.0-674.8	26.2	44.2	21.7	22.5
	ST2G	11.4-11.5	671.1-671.0	24.6	41.2	21.7	19.5
	ST3G	13.8-14.0	668.7-668.5	26.7	45.0	21.9	23.1
	ST4G	17.3-17.5	665.2-665.0	30.1	43.7	24.8	18.9
	ST5F	23.2-23.4	659.3-659.1	30.3	38.6	23.4	15.2
	ST6G	28.2-28.4	654.3-654.1	39.0	45.3	27.8	17.5
301	ST3	11.8-12.5	668.1-668.1	23.1	43	24	19
305	ST3	5.2-5.5	666.0-665.7	47.5	51	39	12
		5.5-5.9	665.7-665.3	47.9	46	38	8
306	ST5	9.4-9.6	665.4-665.2	73.0	83	44	39
308	ST4	6.8-6.9	668.1-668.0	69.0	76	42	34
		7.2-7.5	667.7-667.4	62.8	57	34	23
310	ST13	25.3-25.7	654.2-653.8	25.2	28	18	10
906	ST1	5.0-7.0	684.4-682.2	16.7	24.3	16.8	7.5
919	SS18	35-36.5	681.0-679.5	21.9	46.5	23.6	22.9

TABLE 2.5D-2 (Cont)

Boring No.	Sample and Section	Depth (ft)	Elevation (ft)	Natural Water Content	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
920	SS3	24-25.5	712.0-710.5	21.3	36.5	19.9	16.6
	SS19	56-57.5	680.0-678.5	24.8	43.7	22.6	21.1
	Bag 1*		679.0	23.6	50.1	23.0	27.1
	Bag 2*		679.0	22.8	47.4	23.2	24.2
	Bag 3*		679.0	22.5	46.3	23.3	23.0

NOTE:

*Recovered from stiff silty clay lens beneath reactor containment excavation.

Table 2.5D-3

SUMMARY OF IN-PLACE DENSITY TESTS AT
REACTOR CONTAINMENT FOUNDATION GRADE

Test No.	Test Location*	Elevation (ft)	Dry Unit Weight (pcf)**	Moisture Content (%)	Field Description
A2	1'E, 1'S of A2	679.5	132.2	8.6	Layered sandy clay and sand
A3	1.5'E, 2'S of A3	679.5	101.8	20.2	Clay
A3A	1'E, 1'S of A3	673.5	127.8	9.7	Sand and gravel with clay
A4	1'E, 1'S of A4	679.5	109.8	18.4	Clay
A4A	2.5'W, 1'N of A4	673.7	110.3	12.8	Sand and clay
A5	4'W, 0.5'N of A5	674.6	103.4	22.1	Clay
B1	3'E, 1'S of B1	679.5	126.1	7.1	Sand and gravel with clay
B2	2.5'E, 1'S of B2	679.5	132.0	5.7	Sand and gravel and clay
B3	2.5'E, 3.5'S of B3	679.5	134.2	9.9	Sand and gravel with clay
B4	2.5'E, 3'S of B4	679.5	131.4	8.4	Clay and sand
B5	1.5'W, 3'S of B5	679.5	113.9	8.0	Sandy clay
C1	2'E, 2'N of C1	679.5	129.8	5.8	Sand and gravel with clay
C2	1'E, 1'S of C2	679.5	140.4	5.5	Sand and gravel
C3	3'W, 2'N of C3	679.5	125.8	9.5	Sand and gravel
C4	2.5'E, 1'N of C4	679.5	136.0	6.3	Sand and gravel
C5	2.5'W, 3'S of C5	679.5	127.4	6.9	Sand and gravel
D1	2.5'E, 2'N of D1	679.5	129.8	5.1	Sand and gravel
D2	2'W, 1.5'S of D2	679.5	125.4	4.5	Sand and gravel
D3	4'W, 5'N of D3	679.0	128.0	5.8	Sand and gravel
D3B	1'E, 1.5'S of D3	679.5	127.5	5.1	Sand and gravel
D4	1.5'E, 1.5'S of D4	679.5	135.7	5.0	Sand and gravel
D5	1'W, 2'N of D5	679.0	128.1	5.9	Sand and gravel
E2	1.5'E, 1.5'N of E2	679.5	134.6	4.0	Sand and gravel
E3	1.5'E, 2.5'N of E3	679.0	129.2	4.9	Sand and gravel
E4	2'E, 1'N of E4	679.0	114.6	6.7	Sand and gravel

NOTES:

*Location plan shown on Figure 2.5D-21.
**Grain size analyses at test locations given on Figures 2.5D-9 through 2.5D-19.

TABLE 2.5D-4

SUMMARY OF
CONSTANT RATE OF STRAIN (CRSC) CONSOLIDATION TESTS

Boring No.	Sample No.	Depth (ft)	Elevation (ft)	Specimen Diameter (in)	Specimen Height (in)	Initial Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Dry Unit Weight (pcf)	Initial Void Ratio	Rate of Strain (%/min)	*** Maximum Past Pressure (ksf)	Compression Ratio ** Lab	Compression Ratio *** Field	Recom-pression Ratio**	Material Description
AB6	US7D	16.0	673.7	2.5	1.00	24.2	-	-	97.6	0.727	0.080	3.8	0.114	0.122	0.010	Silty clay (CL)
	US9F	21.7		2.5	1.00	28.1	-	-	94.8	0.777	0.060	4.0	0.117	0.125	0.011	Sandy clay (CL)
OF6	US13F	54.4	666.6	2.5	0.75	35.0	29.6	18.9	84.3	1.00	0.033	6.7	0.124	0.172	0.020	Silty clay (CL)
OF9	US1F	48.0	673.0	2.5	0.75	43.2	55.6	31.6	74.6	1.26	0.044	6.0	0.165	0.208	0.019	Silt (MH)
-	US2F	53.2	667.8	2.5	0.75	44.9	-	-	74.8	1.27	0.027	6.5	0.178	0.212	0.020	Silty clay (CL)
-	Bag 1	-	678.0*	2.5	1.00	23.6	50.1	23.0	102.0	0.64	0.039	13.0	0.126	0.140	0.022	Silty clay (CH)
-	Bag 2	-	678.0*	2.5	0.75	22.8	47.4	23.2	102.6	0.63	0.040	18.0	0.126	-	0.018	Silty clay (CL)
-	Block 1-F	-	679.0*	2.5	1.00	22.0	-	-	105.0	0.60	0.029	18.0	0.118	0.160	0.021	Silty clay (CL)

NOTES:

*Recovered from silty clay lens at base of containment excavation.
**From laboratory curve.
***From Schmertman Construction except for test on Bag 2 which used Casegrande Construction.

TABLE 2.5D-5

SUMMARY OF
INCREMENTAL CONSOLIDATION TESTS

Boring No.	Sample and Section No.	Depth (ft)	Elevation (ft)	Specimen Diameter (in)	Specimen Height (in)	Initial Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Dry Unit Weight (pcf)	Initial Void Ratio	*** Maximum Past Pressure (ksf)	Compression Ratio ** Lab	Compression Ratio *** Field	Recom-pression Ratio**	Material Description
OF7	US1F	49.1	671.9	2.5	0.75	44.3	-	-	73.0	1.301	8.6	0.200	0.240	0.022	Sandy silt (MH)
	US4B	60.2	660.8	2.5	0.75	24.0	30.1	18.1	102.3	0.642	7.1	0.095	0.118	0.010	Sandy clay (CL)
	ST1/1B2	14.0	666.0	2.5	0.75	45.9	55.0	30.0	25.0	1.39	2.6	0.181	0.215	0.017	Sandy silt (MH)
PL2	ST2/2B1	16.5	664.4	2.5	0.75	49.9	60.5	32.8	27.7	1.39	2.0	0.138	0.160	0.014	Clayey silt (MH)
PL3	ST5/5F	23.2	659.3	2.5	1.00	33.1	38.6	23.4	89.6	0.873	5.0	0.101	0.115	0.021	Sandy clay (CL)
-	Block 1	-	679*	2.5	0.75	23.0	-	-	103.0	0.6	9.5	0.103	0.120	0.020	Silty clay (CL)

NOTES:

*Recovered from silty clay lens at base of containment excavation.
**From laboratory curve.
***From Schmertman Construction.

TABLE 2.5D-6

SUMMARY OF
UNCONFINED COMPRESSION TESTS

Boring No.	Sample No.	Test No.	Depth (ft)	Elevation (ft)	Specimen Diameter (in)	Specimen Height (in)	Average Water Content (%)	Rate of Strain (%/min)	$(\sigma_1 - \sigma_3)_{max}$ (ksf)	Axial Strain at $(\sigma_1 - \sigma_3)_{max}$ (%)	Material Description	Test* Reference
109	ST3	109-3N	7	683.6	1.4	2.8	19.8	7.1	2.0	5.0	Brown silty clay	5
	ST6	109-6N	13-15	677.6-675.6	2.8	5.6	23.3	1.4	5.0	6.0	Brown silty clay	5
		109-6R			2.8	5.6	22.6	1.6	2.8	11.5		
	ST7	109-7N	18-20	672.6-670.6	2.8	5.6	26.4	1.68	1.1	16.0	Brown silty clay	5
		109-7R			1.4	2.8	24.8	2.99	1.8	72.8		
	ST9	109-9N	22-24	668.6-666.6	2.8	5.6	23.5	1.79	0.7	8.0	Brown silty fine sand	5
110	ST2	110-2N	7-9	682.1-680.1	2.8	5.6	19.1	1.96	3.9	3.2	Brown clayey silt	5
		110-2R			2.8	5.6	-	1.45	2.5	4.0		
	ST6	110-6N	15-17	674.1-672.1	2.8	5.6	21.7	1.61	4.3	7.5	Brown silty clay	5
		110-6R			2.8	5.6	22.4	2.09	3.0	16.0		
	ST9	110-9N	21-22	668.1-666.1	2.8	5.6	23.8	2.65	1.3	5.0	Brown sandy clayey silt	5
		110-9R			2.8	5.6	26.8	2.92	0.5	14.0		
	ST11	110-11N	28-28.5	661.1-660.6	2.8	5.6	23.0	1.83	1.3	4.5	Brown silty sand	5
111	ST1	111-1N	7	683.0	2.8	5.6	23.5	1.73	1.5	13.0	Brown silty clay	5
		111-1R			2.8	5.6	22.2	1.68	1.7	16.0		
	ST2	111-2N	14	676.0	2.8	5.6	24.4	1.77	3.5	12.0	Brown silty clay	5
		111-2R			2.8	5.6	23.6	1.77	2.3	17.5		
	ST2A	111-2AN	15	675.0	1.4	2.8	23.0	8.21	5.1	15.0	Brown silty clay	5
		111-2AR			1.4	2.8	22.5	8.57	4.0	21.0		
117	ST2	117-2N	11.5	680.5	2.8	5.6	22.3	3.74	5.4	13.0	Brown silty clay	5
	ST5	117-5N	17.5	674.6	2.8	5.6	26.0	4.05	2.4	5.0	Brown silty clay	5
	ST10	117-10N	28	664.1	2.8	5.6	33.4	3.12	2.7	14.0	Brown clay	5

TABLE 2.5D-6 (Cont)

Boring No.	Sample No.	Test No.	Depth (ft)	Elevation (ft)	Specimen Diameter (in)	Specimen Height (in)	Average Water Content (%)	Rate of Strain (%/min)	$(\sigma_1 - \sigma_3)_{max}$ (ksf)	Axial Strain at $(\sigma_1 - \sigma_3)_{max}$ (%)	Material Description	Test* Reference
301	ST2	301-2N	9-11	691.6-689.5	2.8	5.6	23.4	2.03	2.5	6.0	Brown silty clay, some sand lenses	6
		301-2R			2.8	5.6	18.2	2.42	3.0	13.0		
	ST5	301-5N	15-17	685.6-683.6	2.8	5.6	26.7	2.21	2.8	14.0	Gray, clayey organic silt	6
		301-5R			2.8	5.6	28.2	2.35	2.1	16.0		
302	ST3	302-3N	15-17	688.2-686.2	2.8	5.6	14.7	1.71	0.6	7.0	Brown silty sand	
	ST5	302-5N	19-21	684.2-682.2	2.8	5.6	15.4	1.79	0.5	8.0	Brown silty sand	6
303	ST5	303-5N	8-10	688.0-686.0	2.8	5.6	16.7	1.58	0.7	8.0	Brown silty sand	6
	ST12	303-12N	22-24	674.0-672.0	2.8	5.6	26.3	1.87	1.79	16.0	Brown silty clay	6
305	ST5	305-5N	8-10	663.2-661.2	2.8	5.6	43.2	2.32	0.5	6.0	Organic sandy silt, trace clay	6
306	ST2	306-2N	2-4	672.8-670.8	2.8	5.6	62.0	1.67	0.4	5.0	Brown silty sand w/organics	6
307	ST3	307-3N	4-6	671.0-669.0	2.8	5.6	78.6	1.33	0.9	2.5	Brown clayey silt	6
	ST7	307-7N	12-14	663.0-661.0	2.8	5.6	37.6	2.17	0.3	4.8	Organic silty sand	6
AB1	13F	-	29.5	675.5	2.8	6.5	24.8	0.23	3.1	9.0	Silty clay	7
	15E	-	32.2	672.8	2.8	6.5	24.9	0.23	2.75	5.3	Silty clay	7
AB2	15E	-	33.8	671.4	2.9	6.5	27.3	0.25	1.0	11.8	Sandy clay	7
AB5	12E	-	24.1	681.3	2.9	6.5	23.7	0.28	5.2	5.0	Silty clay	7
AB6	7E	-	16.2	673.5	2.9	6.5	25.2	0.31	0.6	1.5	Silty clay	7
	9E	-	21.1	668.6	2.9	6.5	26.8	0.31	0.3	1.8	Sandy clay	7
AB10	10E	-	24.1	681.7	2.9	6.5	23.4	0.28	4.2	5.2	Silty clay	7

NOTES:

*Refers to reference (Section 2.5D.9) in which test results can be found.

TABLE 2.5D-7

SUMMARY OF
UNCONSOLIDATED UNDRAINED (UU) TRIAXIAL COMPRESSION TESTS

Boring No.	Sample and Section	Depth* (ft)	Elevation (ft)	Specimen Diameter (in)	Specimen Height (in)	Water Content (%)	Dry Unit Weight (pcf)	Rate of Strain (%/min)	Confining Pressure (ksf)	$(\sigma_1 - \sigma_3)_{max}$ (ksf)	Axial Strain at $(\sigma_1 - \sigma_3)_{max}$	Material Description
PL3	1F	6.9	675.6	2.87	7.15	24.3	100.3	0.28	1.00	4.4**	15	Silty clay
	3F	13.2	669.3	2.90	7.06	23.5	100.9	0.28	2.00	4.4**	15	Silty clay
	5E	22.6	659.9	2.89	7.08	21.2	93.3	0.28	2.50	3.4**	15	Silty clay
Block I***	IC	-	679	2.59	6.05	22.5	100.8	0.33	28.8	8.3**	19	Silty clay
	IA	-	679	2.58	5.93	22.1	101.3	0.33	14.4	8.7**	20.5	Silty clay
	IB	-	679	2.57	5.42	22.3	101.0	0.31	7.2	8.6**	20	Silty clay

NOTES:

*Depth to top of section cut for testing.
**No defined peak observed in stress-strain curve.
***Recovered from stiff silty clay lens at bottom of containment foundation.

TABLE 2.5D-8

SUMMARY OF
CONSOLIDATED ISOTROPICALLY - UNDRAINED ($\overline{CIUC}$) TRIAXIAL
COMPRESSION TESTS

				Specimen		Specimen Properties: Initial			Specimen Properties: After Consolidation							
Boring No.	Sample and Section No.	Depth (ft)	Elevation (ft)	Diameter (in)	Height (in)	Water Content (%)	Dry Unit Weight (pcf)	Void Ratio	Water Content (%)	Dry Unit Weight (pcf)	Void Ratio	Effective Confining Pressure (ksf)	Back Pressure (ksf)	$(\sigma_1 - \sigma_3)_{max}$ (ksf)	Axial Strain at $(\sigma_1 - \sigma_3)_{max}$ (%)	Material Description
AB1	15F	32.7	672.3	2.8	6.5	23.2	104.2	0.617	24.1	106.7	0.579	3.0	6.5	5.9	13.5	Silty clay
AB5	12D	27.0	678.4	2.8	6.5	22.4	104.4	0.614	23.1	106.1	0.589	2.5	10.0	7.2	13.0	Silty clay
AB6	7F	16.0	673.7	2.8	6.5	28.5	95.4	0.766	28.7	96.4	0.748	1.0	6.5	1.8	13.7	Silty clay
AB10	10D	23.6	682.2	2.8	6.5	22.4	105.9	0.592	22.8	107.6	0.566	3.0	9.4	6.7	12.4	Silty clay
OF6	13E	54.0	667.0	1.4	3.5	33.2	83.2	1.019	31.9	88.2	0.905	7.6	6.9	6.1	11.1	Clay
OF7	1E	48.7	672.3	1.4	3.4	49.8	68.3	1.467	48.0	72.1	1.338	6.0	10.1	6.7	8.0	Sandy silt
OF9	1B	46.7	674.3	1.4	3.4	49.0	66.5	1.524	41.3	75.8	1.215	12.0	5.0	7.3	5.3	Sandy silt
	1C	47.0	674.0	1.4	3.1	31.0	73.7	1.278	38.4	76.6	1.192	9.0	11.4	6.6	4.0	Sandy silt
	1D	47.3	673.7	1.4	3.3	46.2	69.3	1.424	43.8	74.0	1.268	6.0	5.8	5.4	5.1	Sandy silt
	1E	47.7	673.3	1.4	3.4	49.3	68.6	1.449	49.1	70.9	1.369	2.6	8.6	3.0	6.6	Sandy silt
	4D	60.3	660.7	1.4	3.3	25.6	93.2	0.803	26.7	96.9	0.732	8.4	8.6	9.9	7.3	Sandy clay
Block I*	IE	--	$679^{\pm}$	2.7	5.8	22.2	93.4	0.805	20.6	96.4	0.748	7.2	8.7	8.8	15.1	Silty clay

NOTE:

*Recovered from stiff silty clay lens beneath reactor containment excavation.

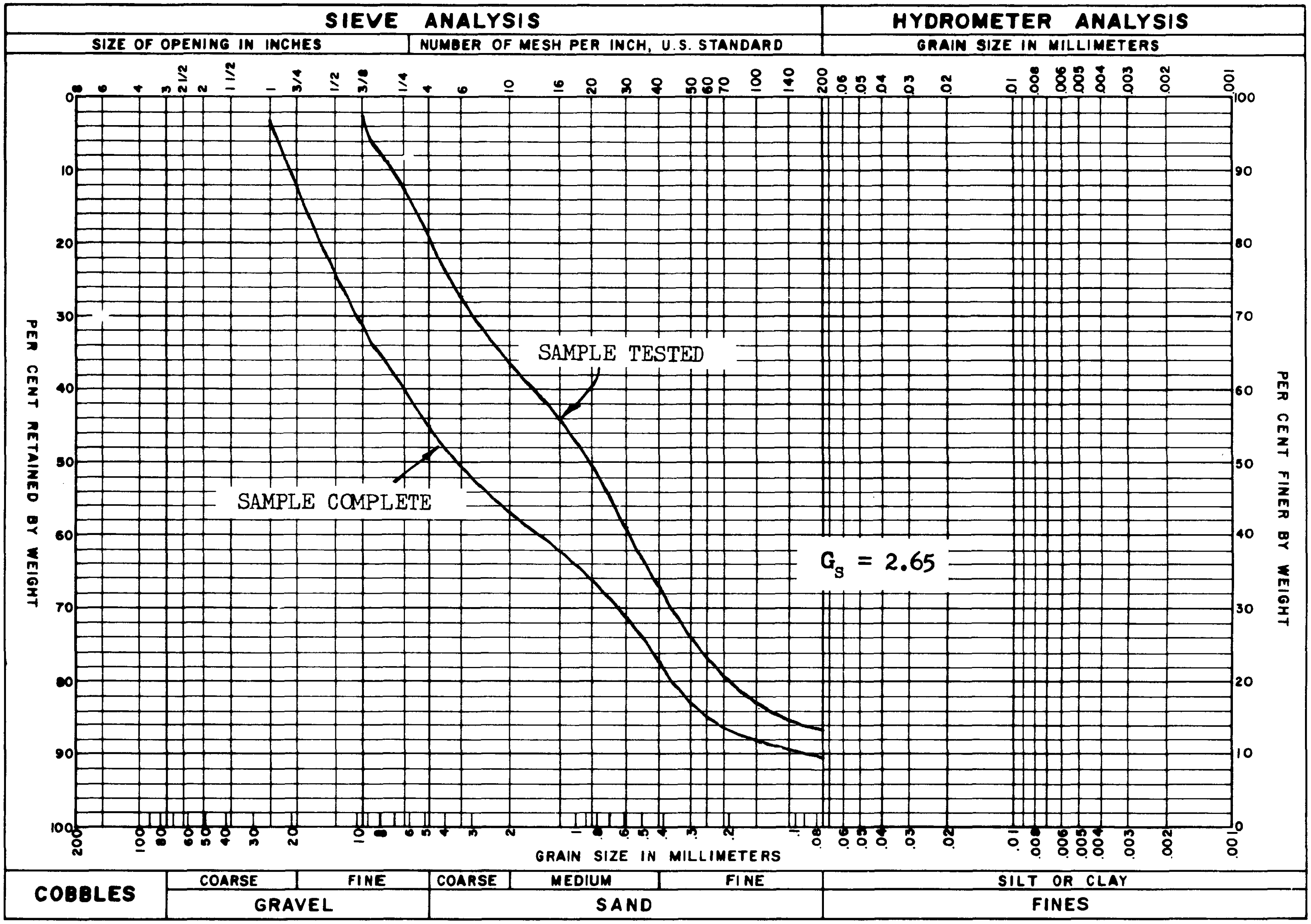
TABLE 2.5D-9

SUMMARY OF
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS*,**
BY OTHERS

Boring No.	Sample No.**	Depth (ft)	Elevation (ft)	Initial Water Content*** (%)	Unit Weight (pcf)	Effective Confining Pressure σ_c (psi)	Back Pressure μ_6 (psi)	$(\sigma_1 - \sigma_3)_{max}$ (psi)	Axial Strain at $(\sigma_1 - \sigma_3)_{max}$ (%)	Material Description
305	3	4.0-4.5	667.2-666.7	71.4	83	7.6	77.4	12.0	8.0	Gray to black organic silty sand
		5.2-5.5	666.0-665.7	47.4	94	14.3	92.6	14.5	5.5	Gray silty sand and organic clayey silt
		5.5-5.9	665.7-665.3	49.8	99	43.5	82.4	41.0	10.0	Gray sandy clayey silt
306	5	8.0-8.4	666.8-666.4	67.0	88	7.2	66.5	11.8	6.0	Mottled brown silty clay
		8.4-8.7	666.4-666.1	76.6	88	14.2	72.8	15.0	5.0	Mottled brown silty clay
		9.0-9.4	665.8-665.4	69.2	94	42.2	63.3	29.5	5.0	Mottled brown silty clay
301	3	11.8-12.1	668.8-668.5	23.5	126	7.2	61.7	28.0	14.0	Mottled brown sandy, clayey silt
		11.8-12.1	668.8-668.5	23.6	126	13.6	73.2	48.0	16.0	Mottled brown sandy, clayey silt
		12.1-12.5	668.5-668.0	22.3	128	41.5	62.6	62.0	12.0	Mottled brown sandy, clayey silt
308	4	6.8-7.2	668.1-667.7	74.5	89	7.0	64.7	11.8	6.0	Mottled brown silty clay
		7.5-7.9	667.4-667.0	77.5	100	14.2	72.8	17.9	10.0	Mottled brown silty clay
		7.5-7.9	667.4-667.0	79.3	98	43.1	91.8	35.0	6.0	Mottled Brown silty clay
310		24.3-24.7	655.2-654.8	26.9	130	6.7	57.0	40	720	Brown clayey sand
		24.7-25.0	654.8-654.5	25.1	128	14.2	62.8	43.0	13.0	Brown clayey sand
		25.0-25.3	654.5-654.2	24.6	128	42.2	61.2	61	720	Brown clayey sand

NOTES:

*Test procedure found in Appendix 2H of BVPS-1 FSAR, Figure 2H-39.
**Soil test specimens approximately 1.4 in diameter and 3.5 in high.
***Atterberg limits of sections of tube sample given in Figure 2H-37 and 2H-38 of above reference.



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
6,8,9								
COMPLETE	20.0 - 31.5	31.7	9.2	6.2	0.09	68.9	0.83	GRAVELLY SAND (SP-SM)
TESTED	" "	19.2	13.4	1.7	--	-	-	SILTY SAND (SM)

FIGURE 2.5D-1

STONE & WEBSTER ENGINEERING CORPORATION

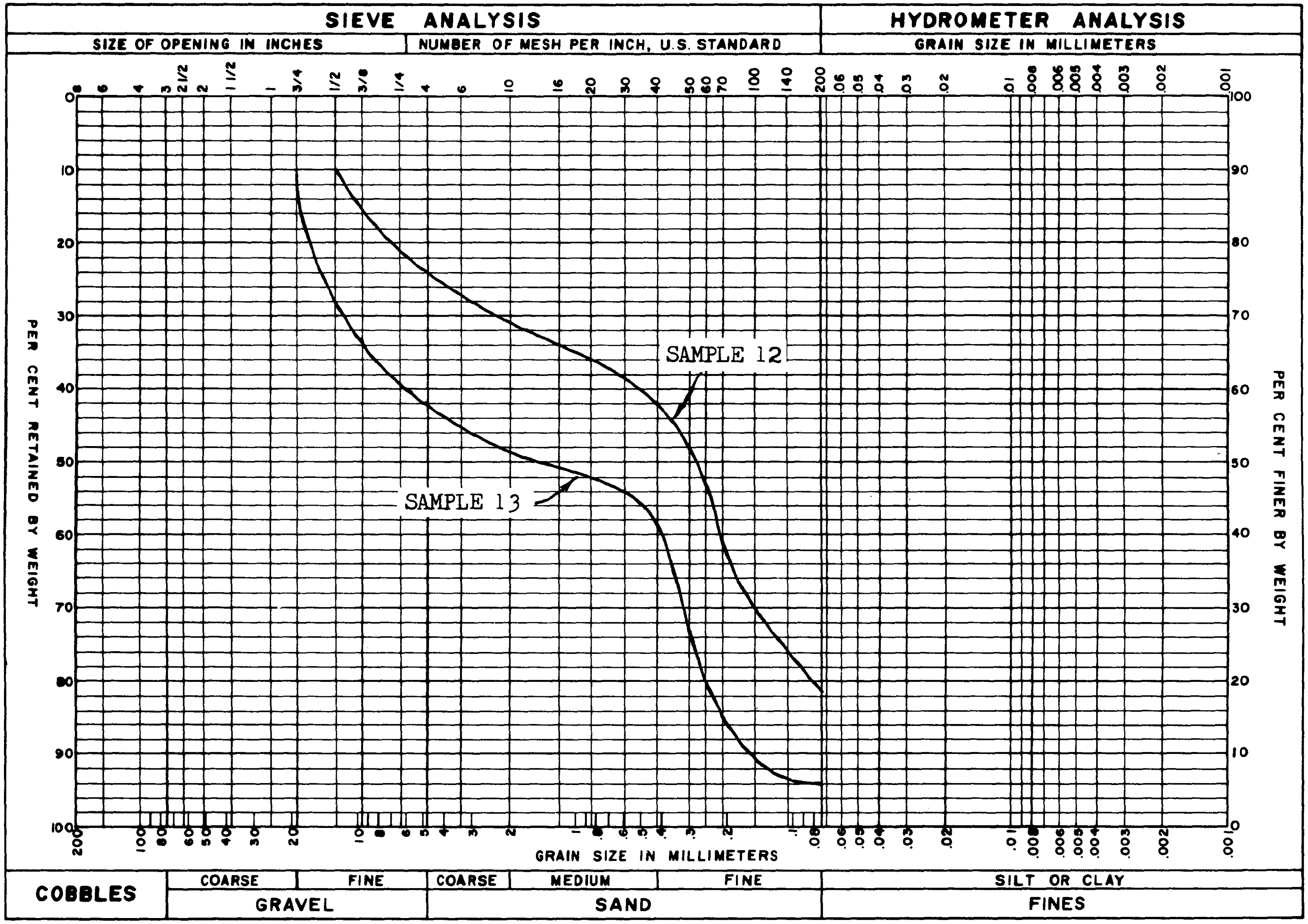
GRADATION CURVES

CLIENT: DUQUESNE LIGHTING COMPANY
SITE: BEAVER VALLEY POWER STATION UNIT 2
J.O. NUMBER: 12241
DATE: 17 MAR 76
EXPLORATION TYPE AND NUMBER: BORING 802
SAMPLE NUMBERS: 6,8,9 (combined)

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

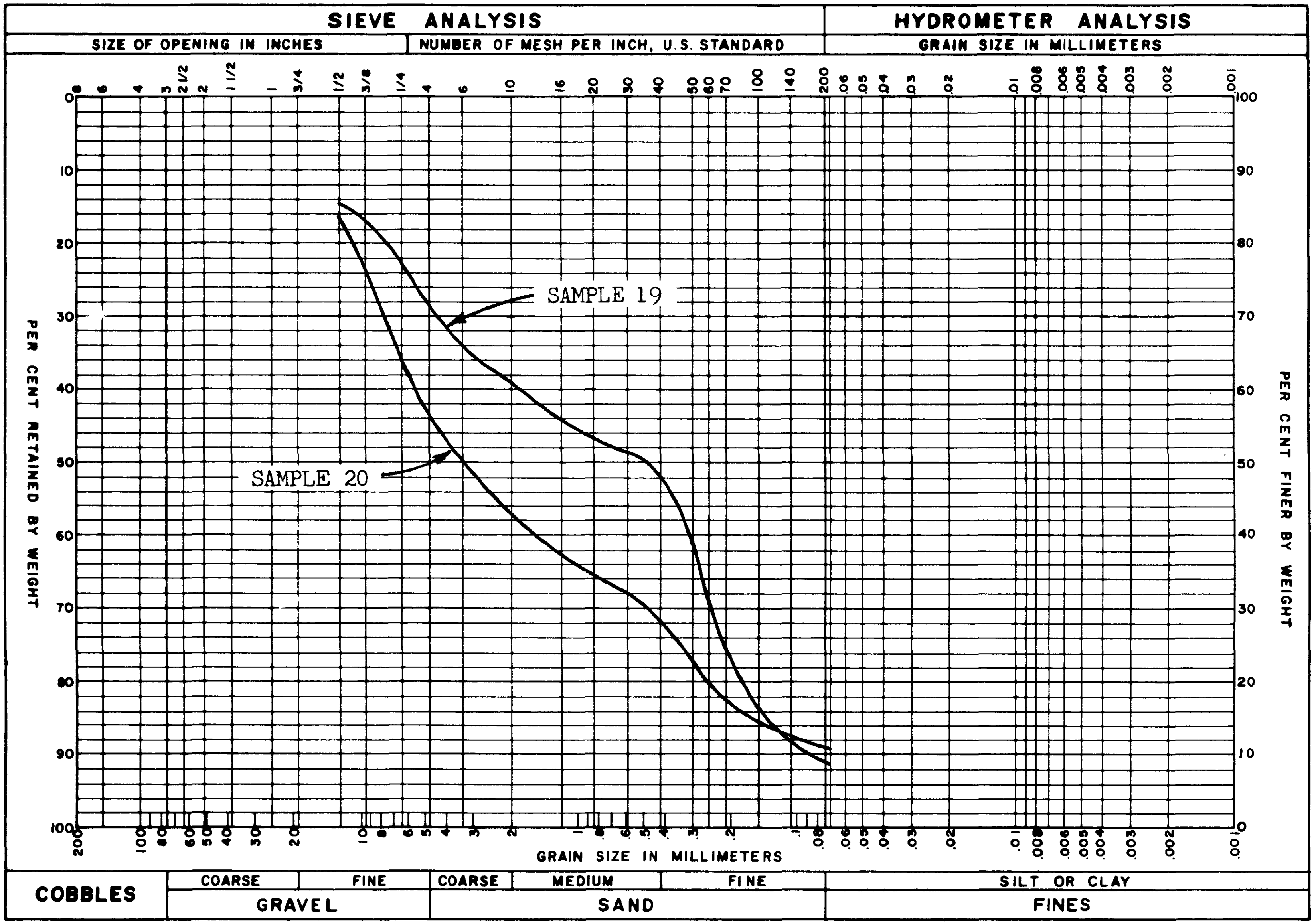
CLIENT	DUQUESNE LIGHTING COMPANY
J.O. NUMBER	12241
EXPLORATION TYPE AND NUMBER	BORING 802
SITE	BEAVER VALLEY POWER STATION UNIT 2
DATE	17 MAR. 76
SAMPLE NUMBERS	12 & 13



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
12	50.0 - 51.5	24.4	18.7	0.5	-	-	-	SILTY SAND (SM)
13	55.0 - 56.5	41.7	6.2	5.9	0.18	32.7	0.11	GRAVELLY SAND (SP-SM)

FIGURE 2.5D-2

)   )   )



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
19	34.0-35.5	29.0	9.0	1.9	0.09	21.1	0.34	GRAVELLY SAND (SP-SM)
20	35.5-37.5	43.8	11.0	5.5	-	-	-	GRAVELLY SAND (SP-SM)

CLIENT: DUQUESNE LIGHT COMPANY

SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 22 JUN 76

EXPLORATION TYPE AND NUMBER: BORING 1005

SAMPLE NUMBERS: 19 AND 20

STONE & WEBSTER ENGINEERING CORPORATION

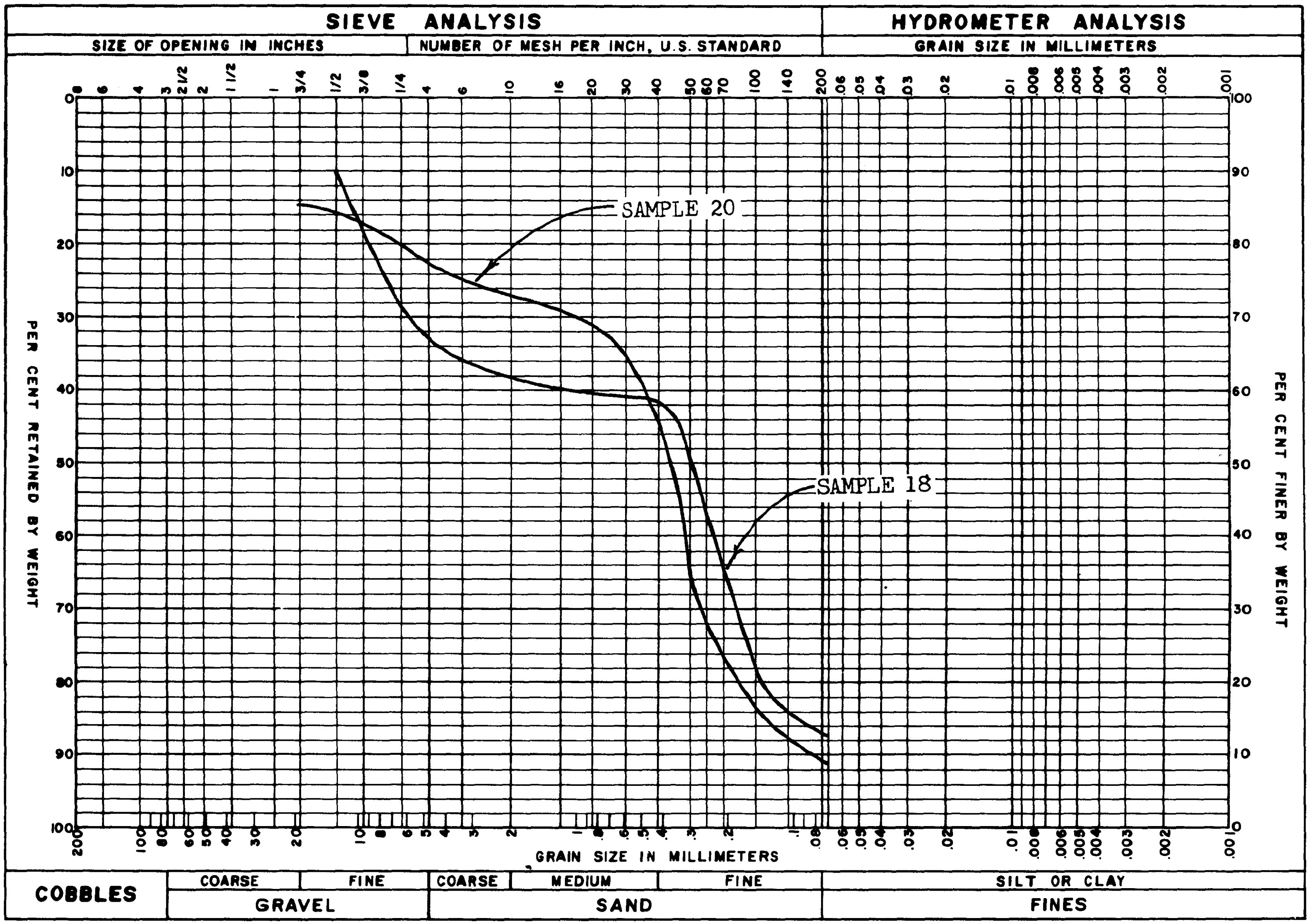
GRADATION CURVES

FIGURE 2.5D-3

STONE & WEBSTER ENGINEERING CORPORATION

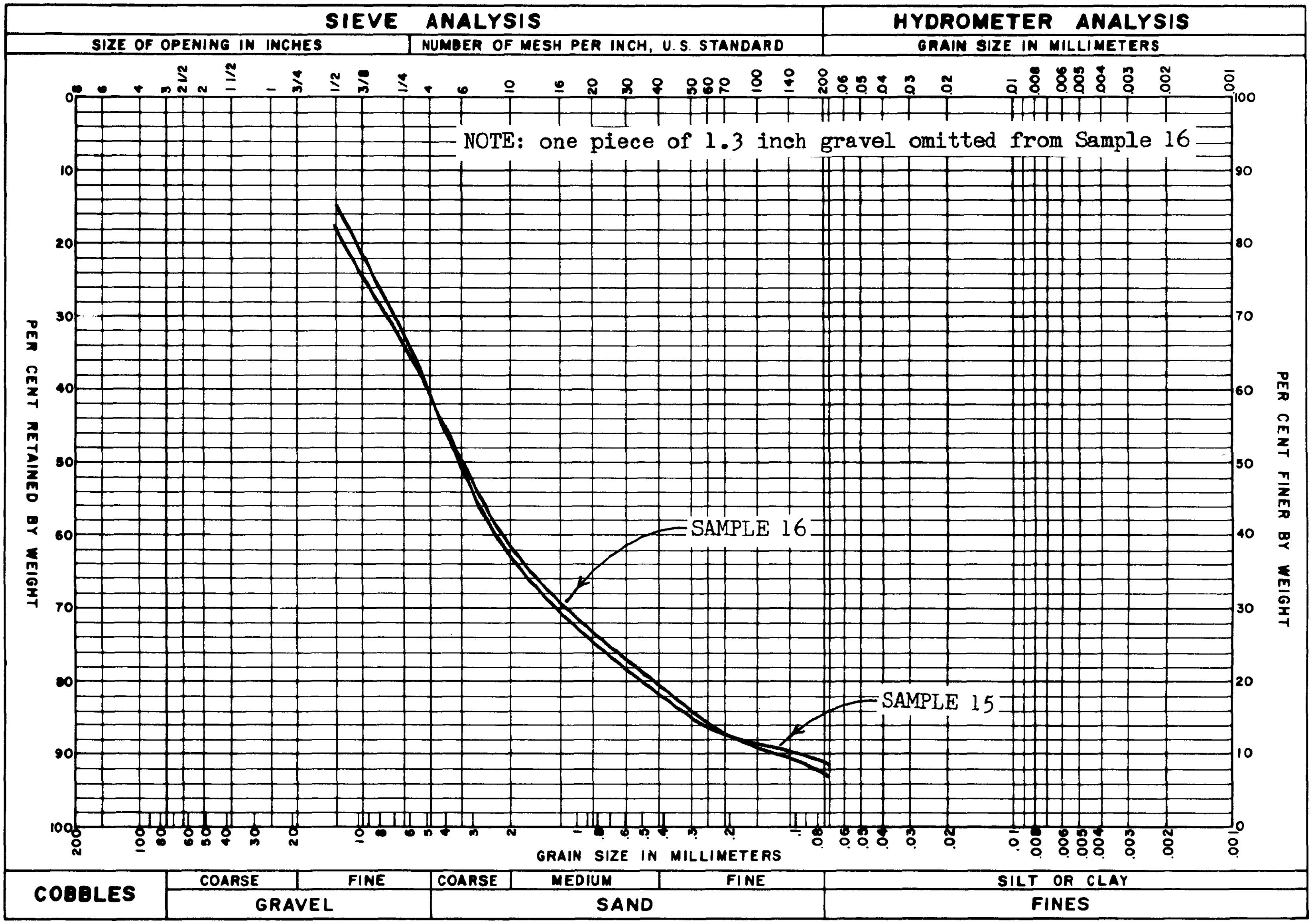
GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY
SITE: BEAVER VALLEY UNIT 2
J.O. NUMBER: 12241
DATE: 22 JUN 76
EXPLORATION TYPE AND NUMBER: BORING 1008
SAMPLE NUMBERS: 18 AND 20



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
18	29.5-31.0	33.1	12.9	1.1	-	-	-	SILTY SAND (SM)
20	32.5-34.0	22.3	9.3	0.48	0.08	6.0	1.76	GRAVELLY SAND (SP-SM)

FIGURE 2.5D-4



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
15	26.0-27.5	40.3	8.9	5.0	0.10	50	2.9	GRAVELLY SAND (SW-SM)
16	28.0-29.5	41.0	7.5	5.1	0.12	42.5	2.0	GRAVELLY SAND (SW-SM)

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 23 JUN 76

EXPLORATION TYPE AND NUMBER: BORING 1009

SAMPLE NUMBERS: 15 AND 16

FIGURE 2.5D-5

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

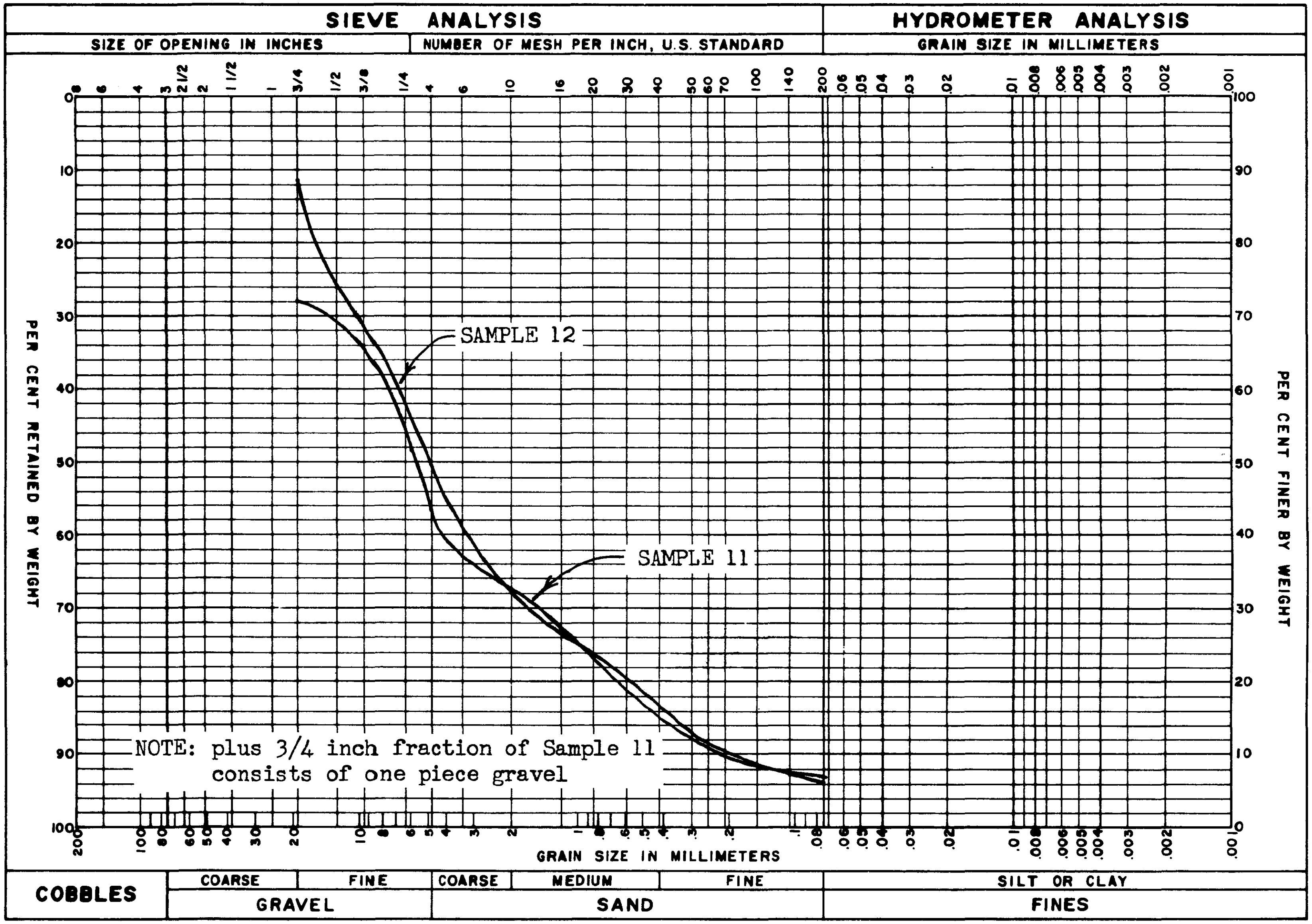
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 18 JUN 76

EXPLORATION TYPE AND NUMBER: BORING 1012

SAMPLE NUMBERS: 11 AND 12



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
11	30.0-31.5	56.4	7.3	7.5	0.22	34.1	1.19	SANDY GRAVEL (GW-GM)
12	32.0-33.5	51.3	6.3	6.8	0.19	35.8	2.51	SANDY GRAVEL (GW-GM)

FIGRUE 2.5D-6

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

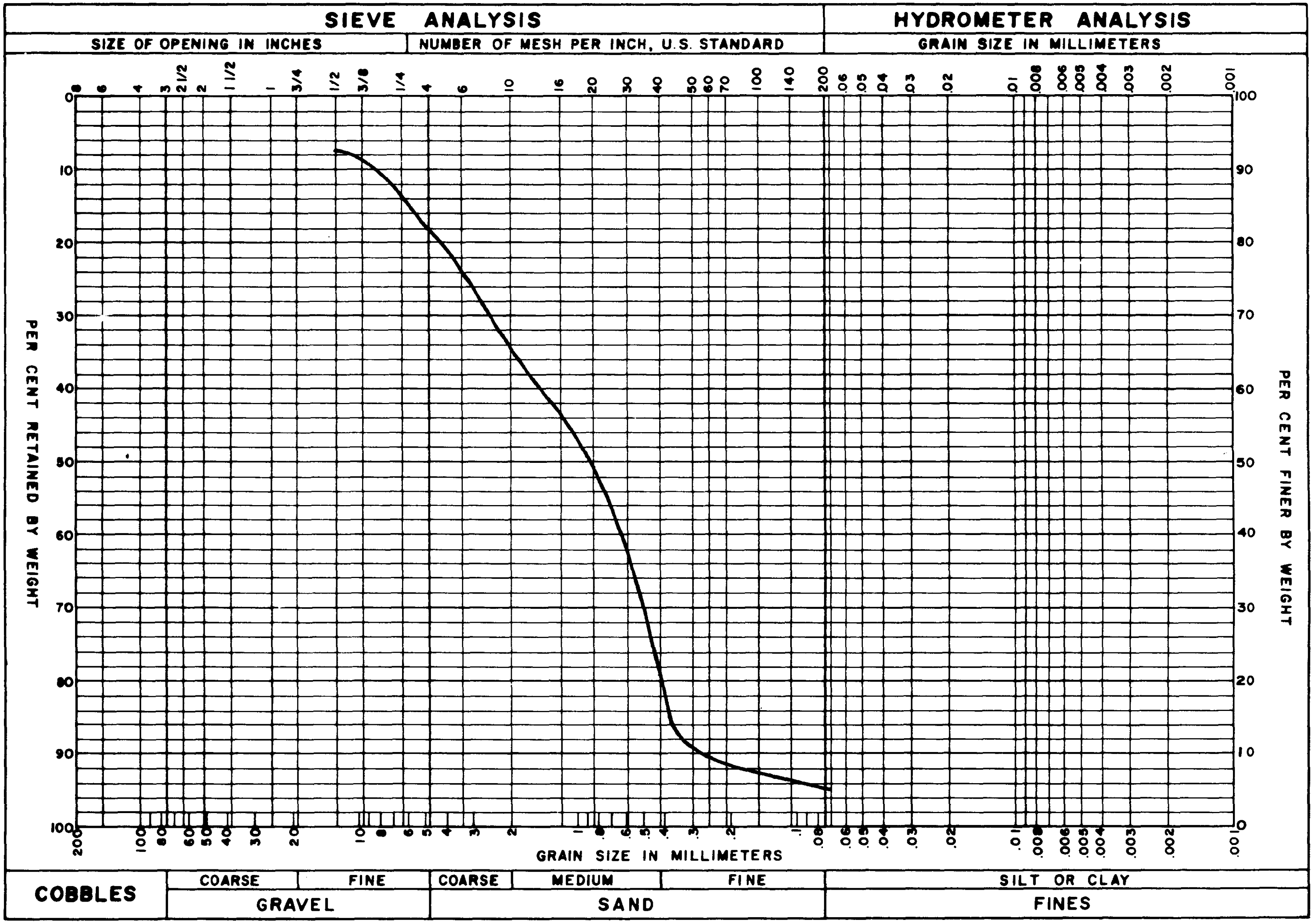
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 22 JUN 76

EXPLORATION TYPE AND NUMBER: BORING 1013

SAMPLE NUMBERS: 12



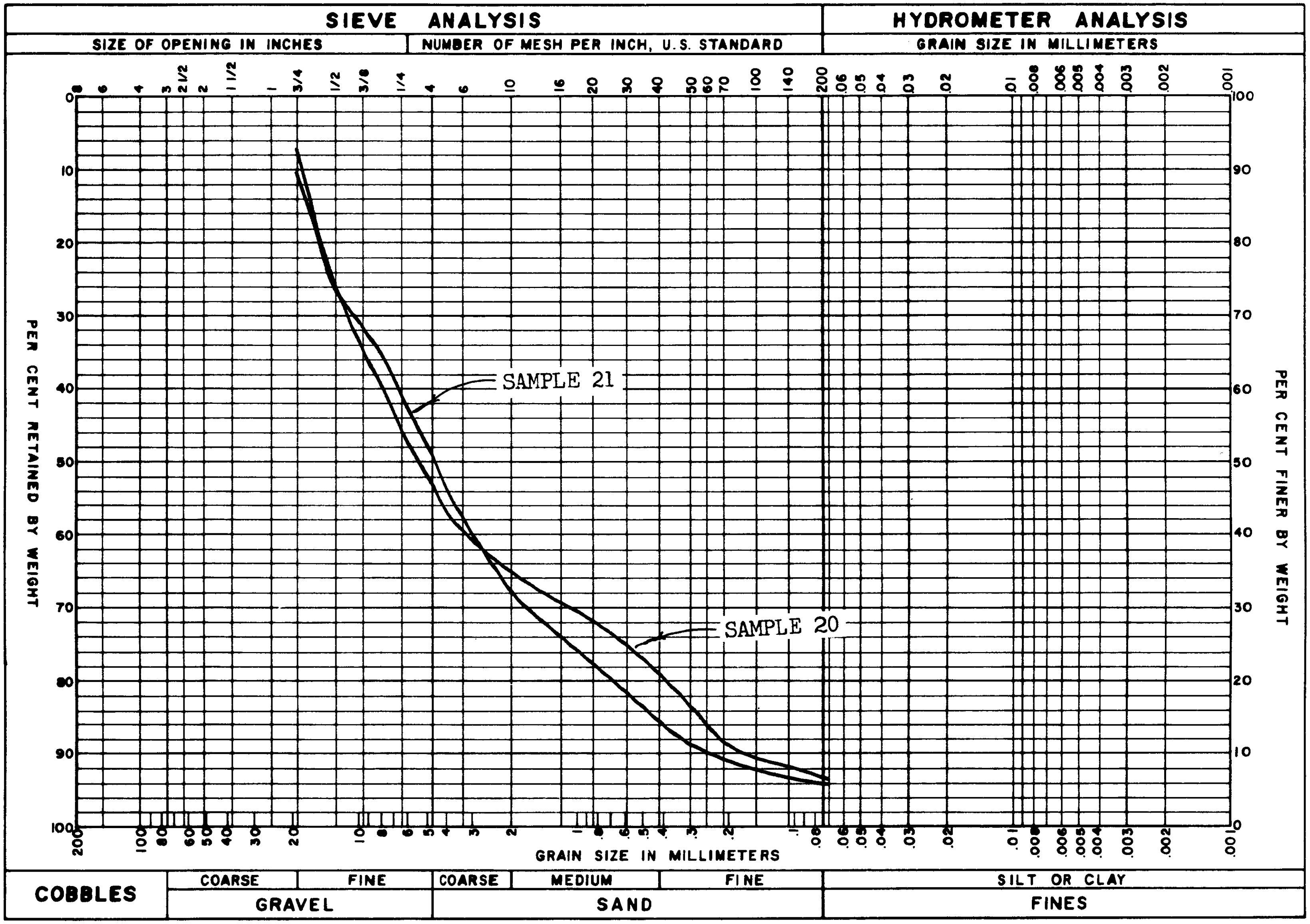
SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
12	32.0-33.5	18.4	5.4	1.4	0.27	5.2	0.66	SAND (SP-SM)

FIGURE 2.5D-7

STONE & WEBSTER ENGINEERING CORPORATION

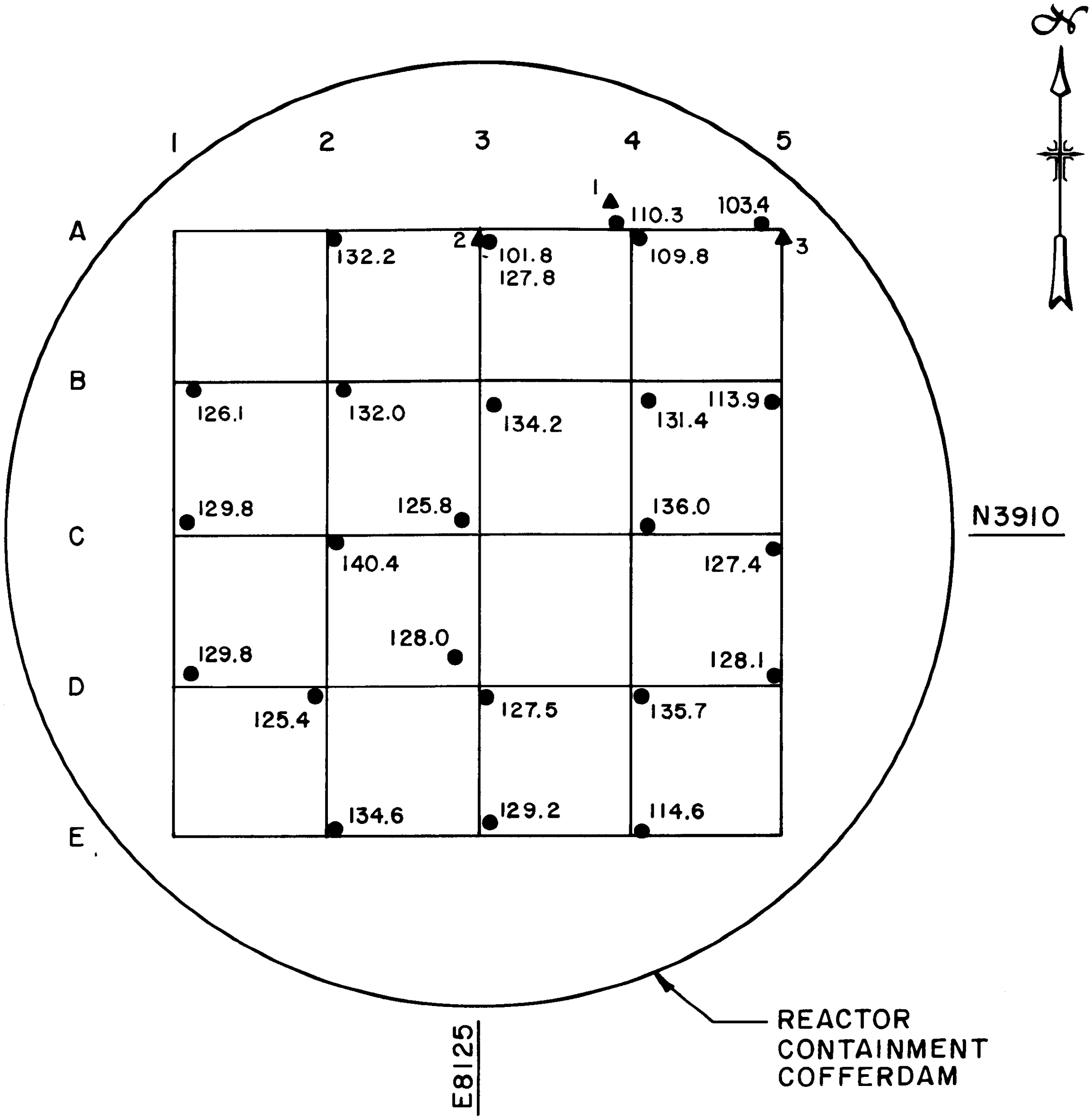
GRADATION CURVES

CLIENT	DUQUESNE LIGHT COMPANY
SITE	BEAVER VALLEY UNIT 2
J.O. NUMBER	12241
DATE	22 JUN 76
EXPLORATION TYPE AND NUMBER	BORING 1014
SAMPLE NUMBERS	20 AND 21



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
20	29.0-30.5	53.4	7.0	7.9	0.17	46.5	0.9	SANDY GRAVEL (GP-GM)
21	30.5-32.0	49.3	6.0	6.7	0.24	27.9	2.0	SANDY GRAVEL (GW-GM)

FIGURE 2.5D-8



NOTES

1. GROUND ELEVATION INSIDE COFFERDAM - 679.5 FT.
2. ● 129.8 - TEST LOCATION AND IN PLACE DRY DENSITY (PCF).
3. BAG SAMPLES OF SILTYCLAY RECOVERED FOR TESTING.

FIGURE 2.5D-9

IN PLACE DENSITY TESTS
REACTOR CONTAINMENT

BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

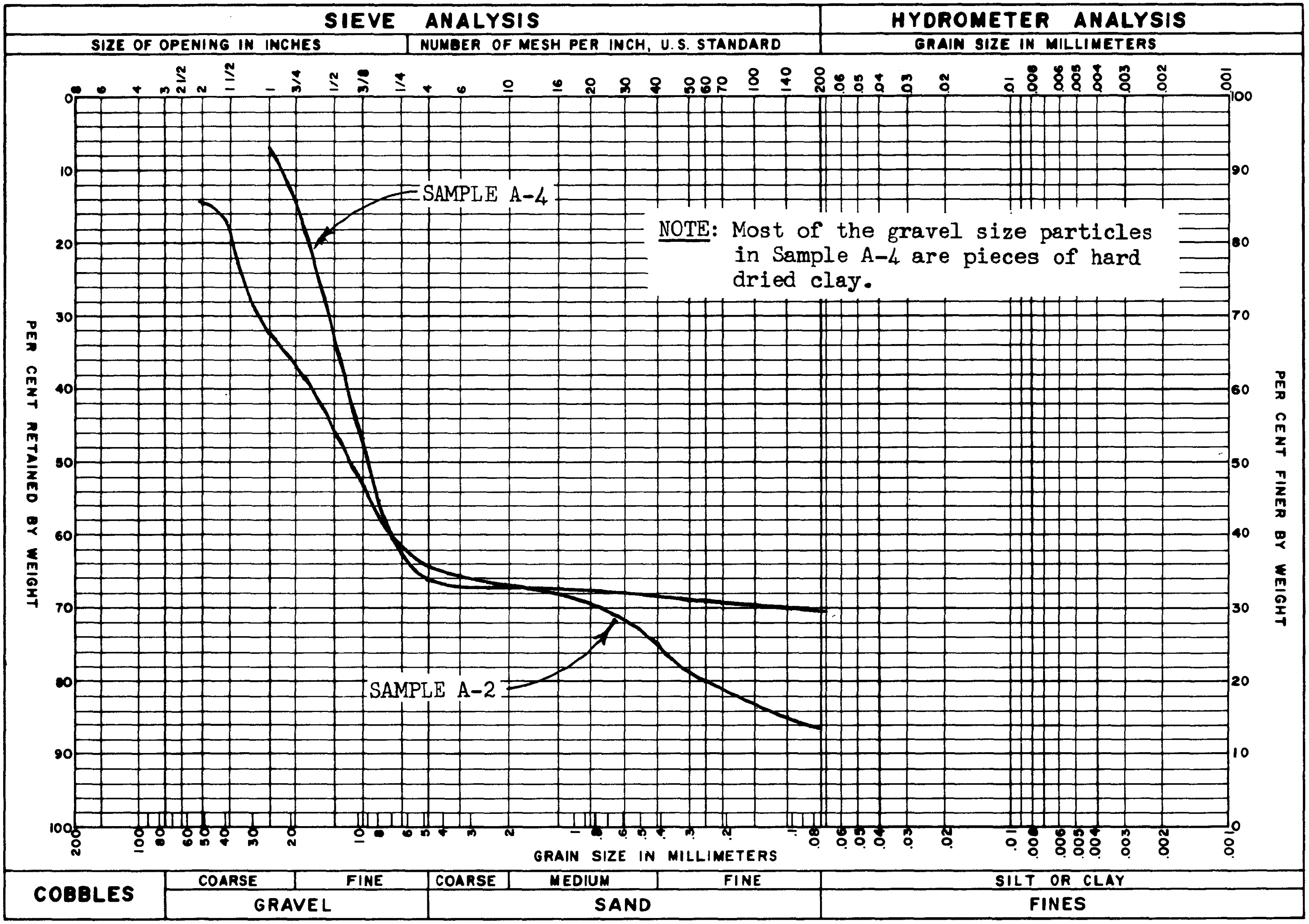
J.O. NUMBER: 12241

EXPLORATION TYPE AND NUMBER: BAG SAMPLE

SITE: BEAVER VALLEY UNIT 2

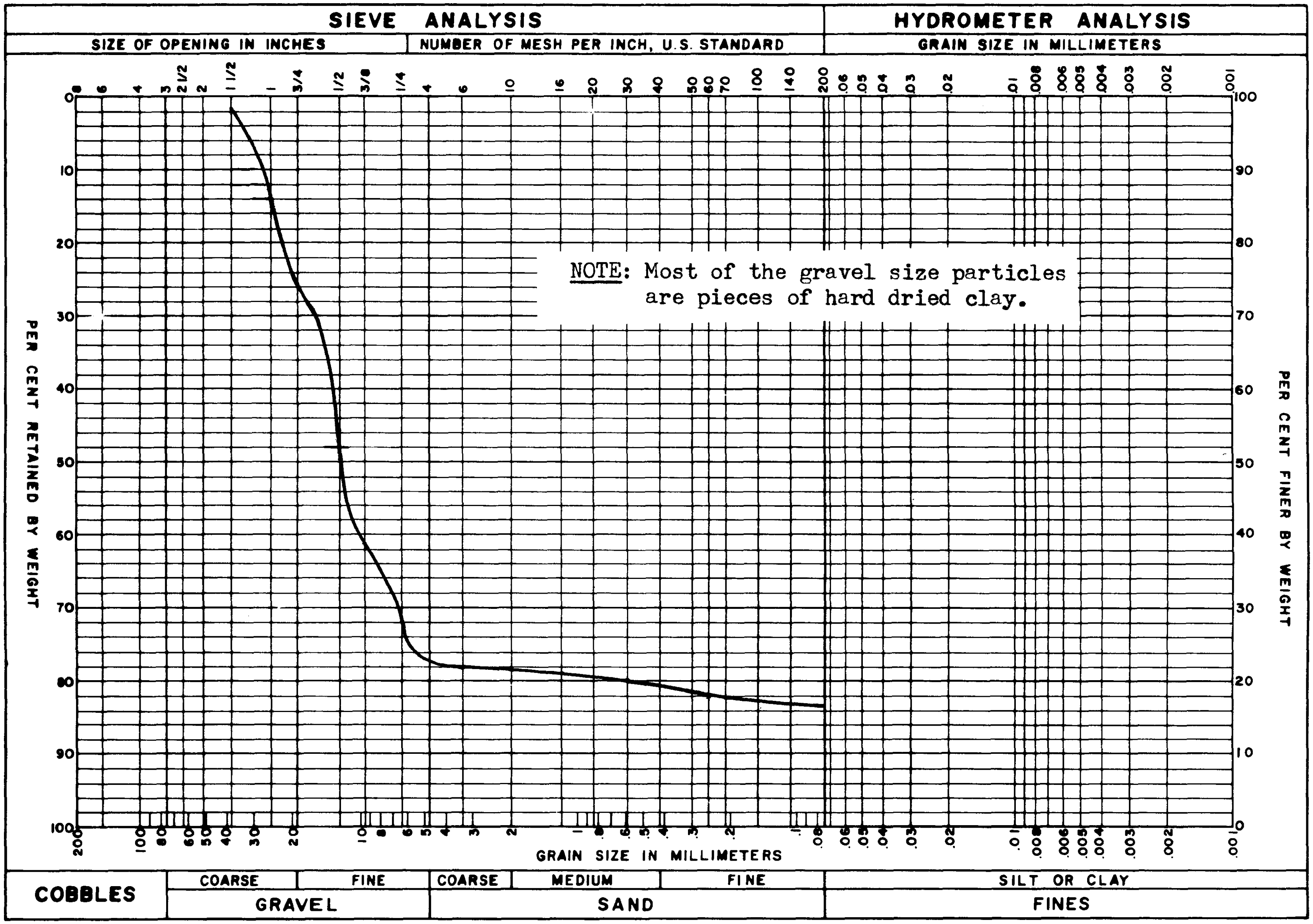
DATE: 3 JUN 76

SAMPLE NUMBERS: A-2 AND A-4



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
A-2	---	64.3	13.8	15	-	-	-	SILTY GRAVEL (GM)
A-4	---	66.3	29.5	11	-	-	-	CLAYEY GRAVEL (GC)

FIGURE 2.5D-10



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
A-3	---	77.7	16.7	13	-	-	-	CLAYEY GRAVEL (GC)

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

SITE: BEAVER VALLEY UNIT 2

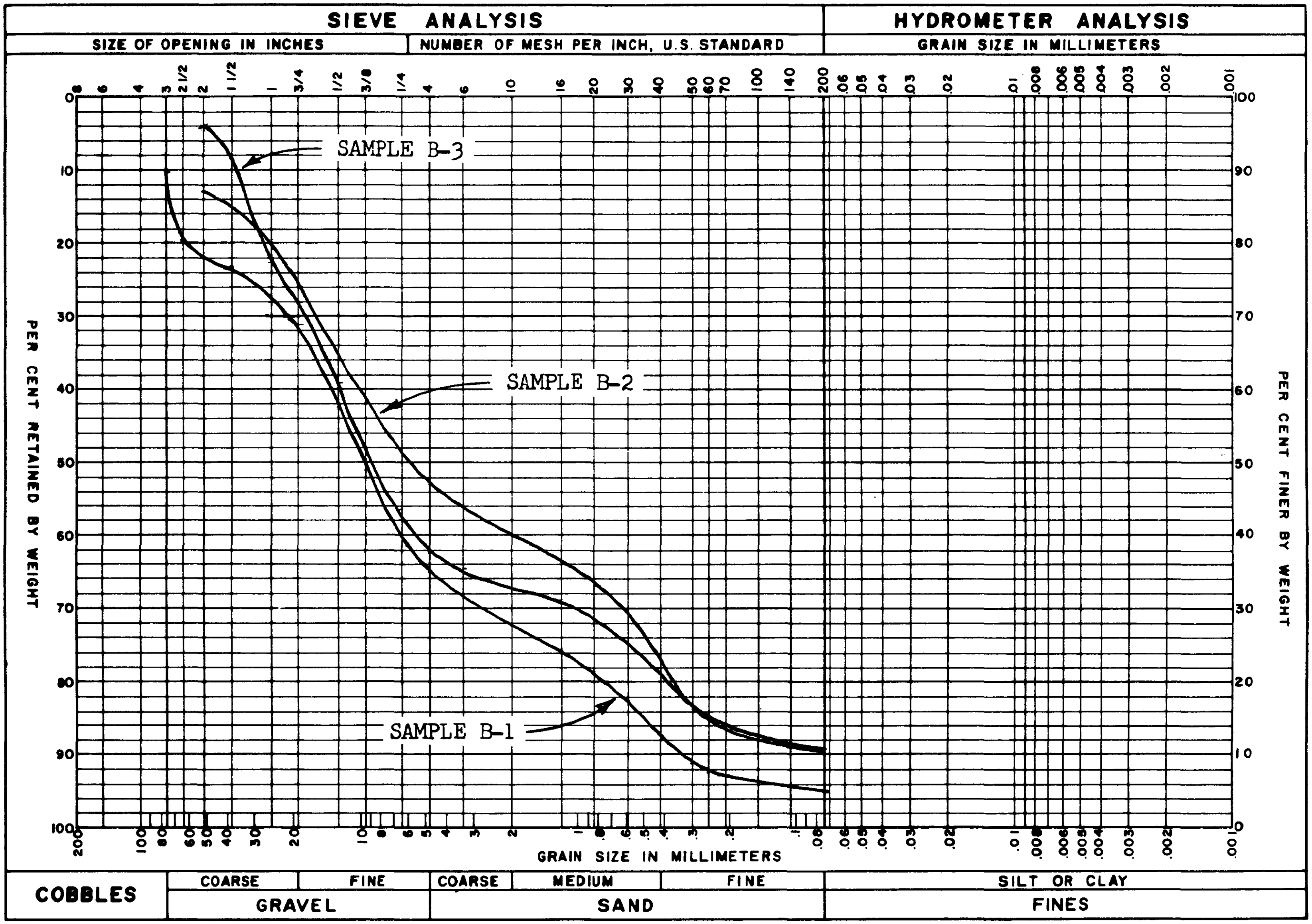
J.O. NUMBER: 12241

DATE: 12 MAY 76

EXPLORATION TYPE AND NUMBER: BAG SAMPLE

SAMPLE NUMBERS: A-3

FIGURE 2.5D-11



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
B-1	--	54.9	5.3	11.3*	0.31*	36.5*	0.73*	SANDY GRAVEL (GP-GM)
B-2	--	53.0	10.2	10.1	--	--	--	SANDY GRAVEL (GP-GM)
B-3	--	62.2	10.6	12.0	--	--	--	SANDY GRAVEL (GP-GM)

* Based on sand and gravel fractions only

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT
DUQUESNE LIGHT COMPANY

SITE
BEAVER VALLEY UNIT 2

J.O. NUMBER
12241

DATE
6 MAY 76

EXPLORATION TYPE AND NUMBER
BAG SAMPLE

SAMPLE NUMBERS
B-1, B-2 AND B-3

FIGURE 2.5D-12

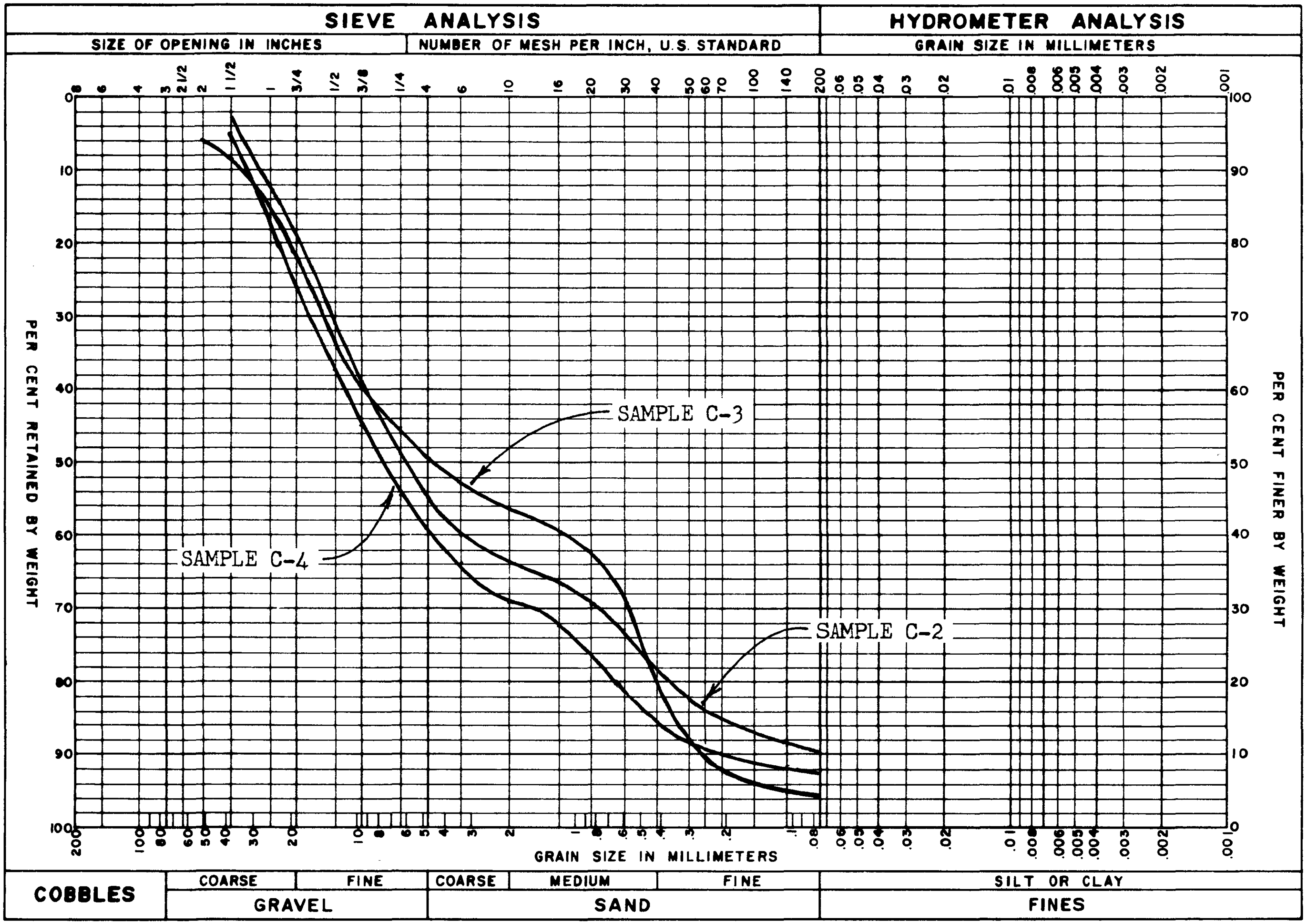
STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY
J.O. NUMBER: 12241
EXPLORATION TYPE AND NUMBER: BAG SAMPLES
SITE: BEAVER VALLEY UNIT 2
DATE: 21 MAY 76
SAMPLE NUMBERS: B-4 AND B-5

SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
B-4	---	67.5	12.9	17.0	-	-	-	SILTY GRAVEL (GM)
B-5	---	53.3	23.8	8.3	-	-	-	SILTY GRAVEL (GM)

FIGURE 2.5D-13



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
C-2	---	55.7	10.1	8.4	-	-	-	SANDY GRAVEL (GP)
C-3	---	49.4	4.5	9.3	0.25	37.2	1.40	GRAVELLY SAND (SP)
C-4	---	59.2	7.7	11.0	0.21	52.4	0.97	SANDY GRAVEL (GW - GP)

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 12 MAY 76

EXPLORATION TYPE AND NUMBER: BAG SAMPLE

SAMPLE NUMBERS: C-2, C-3 AND C-4

FIGURE 2.5D-14

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

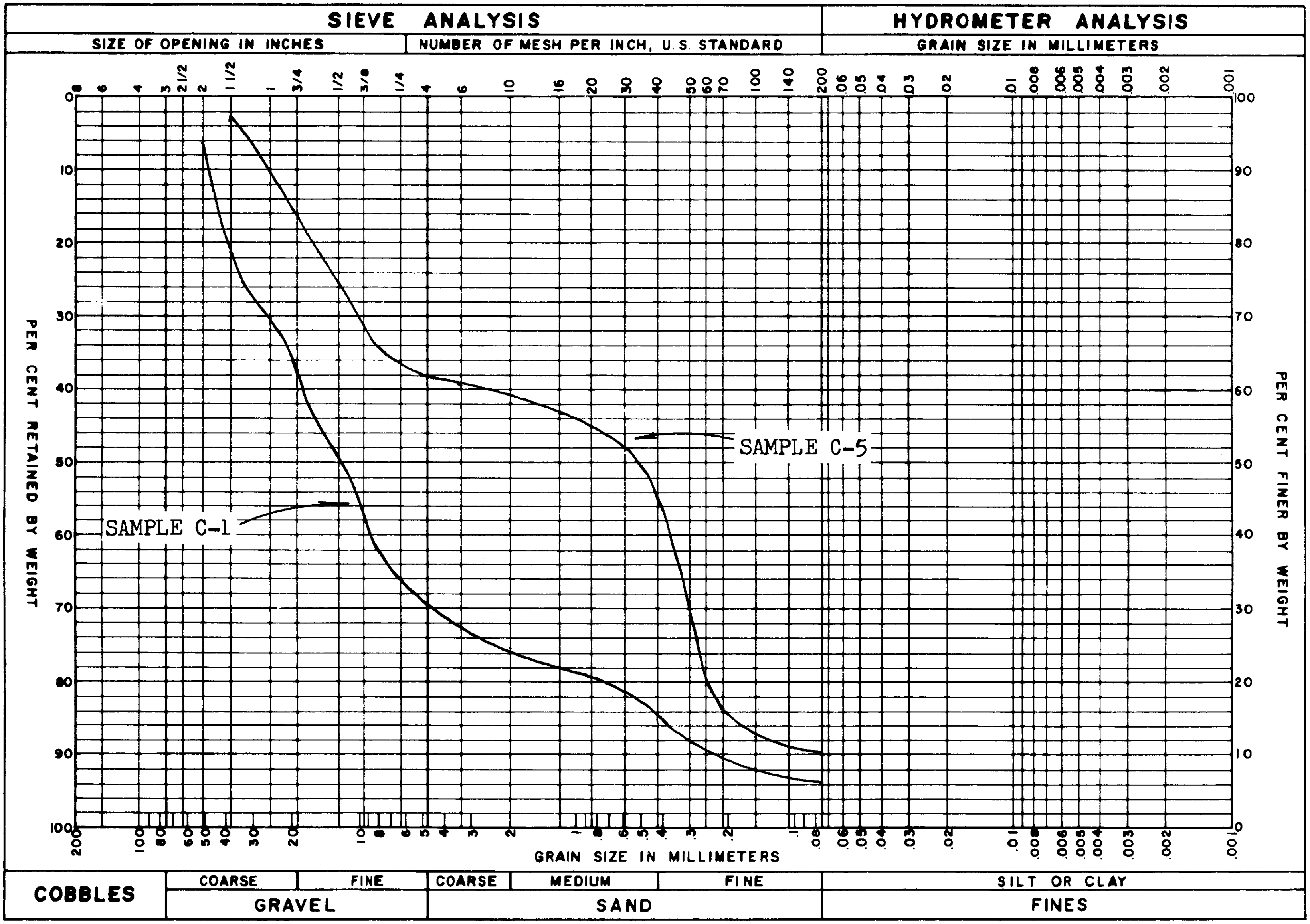
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 6 MAY 76

EXPLORATION TYPE AND NUMBER: BAG SAMPLES

SAMPLE NUMBERS: C-1 AND C-5



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
C-1	--	69.7	6.3	18.0	0.22	81.8	5.34	SANDY GRAVEL (GP-GM)
C-5	--	38.2	10.0	2.4	0.075	32.0	0.50	GRAVELLY SAND (SP-SM)

FIGURE 2.5D-15

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

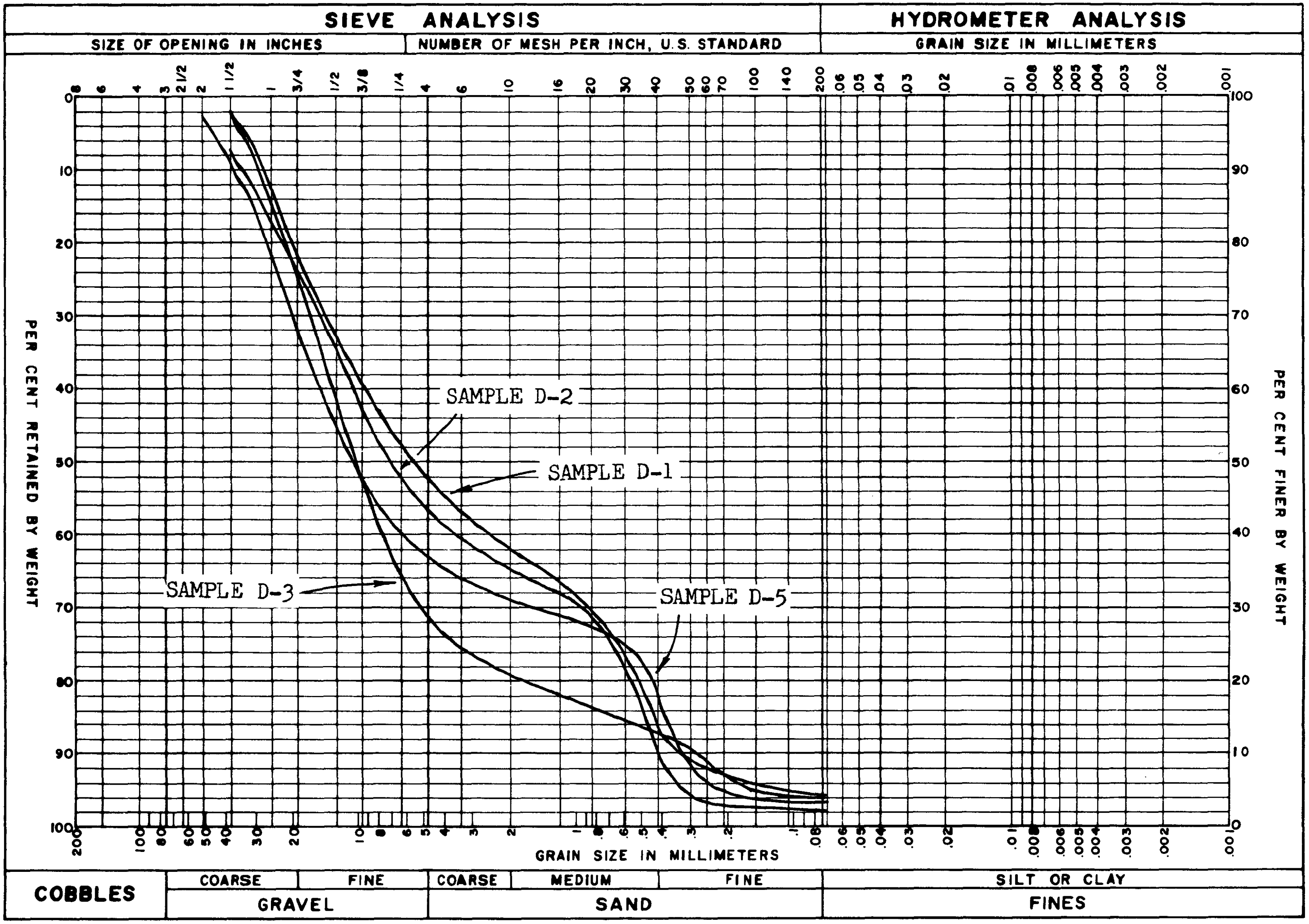
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 6 MAY 76

EXPLORATION TYPE AND NUMBER: BAG SAMPLE

SAMPLE NUMBERS: D-1, D-2, D-3 AND D-5



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
D-1	--	52.9	4.5	9.3	0.34	27.4	0.23	SANDY GRAVEL (GP)
D-2	--	56.9	2.5	11.0	0.42	26.2	0.19	SANDY GRAVEL (GP)
D-3	--	71.8	4.2	13.0	0.27	48.1	7.70	SANDY GRAVEL (GP)
D-5	--	62.8	3.5	15.0	0.33	45.5	0.52	SANDY GRAVEL (GP)

FIGURE 2.5D-16

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

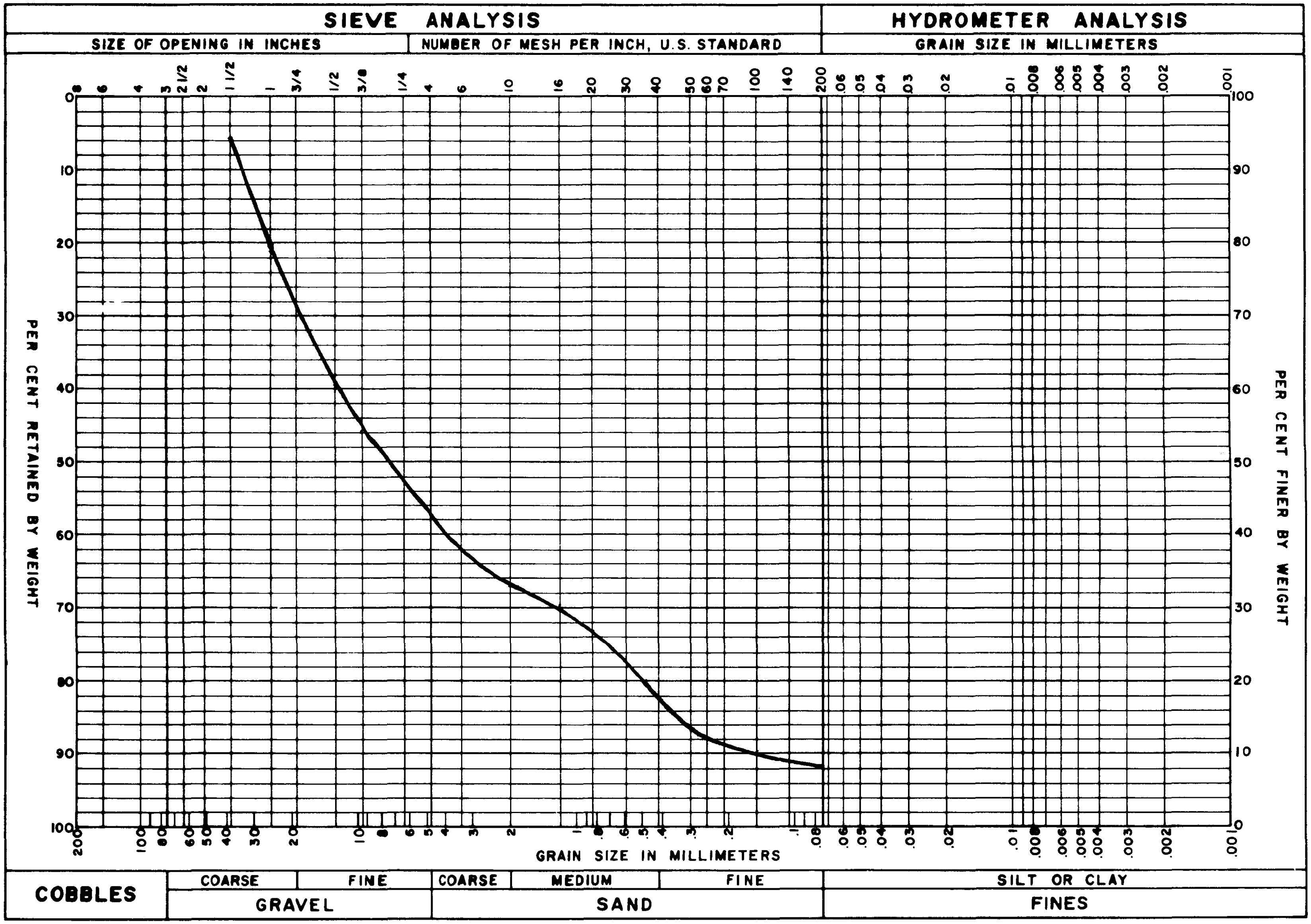
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 3 JUN 76

EXPLORATION TYPE AND NUMBER: BAG SAMPLE

SAMPLE NUMBERS: D-3B



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
D-3B	---	57.1	8.3	12.0	0.15	80.0	0.80	SANDY GRAVEL (GP-GM)

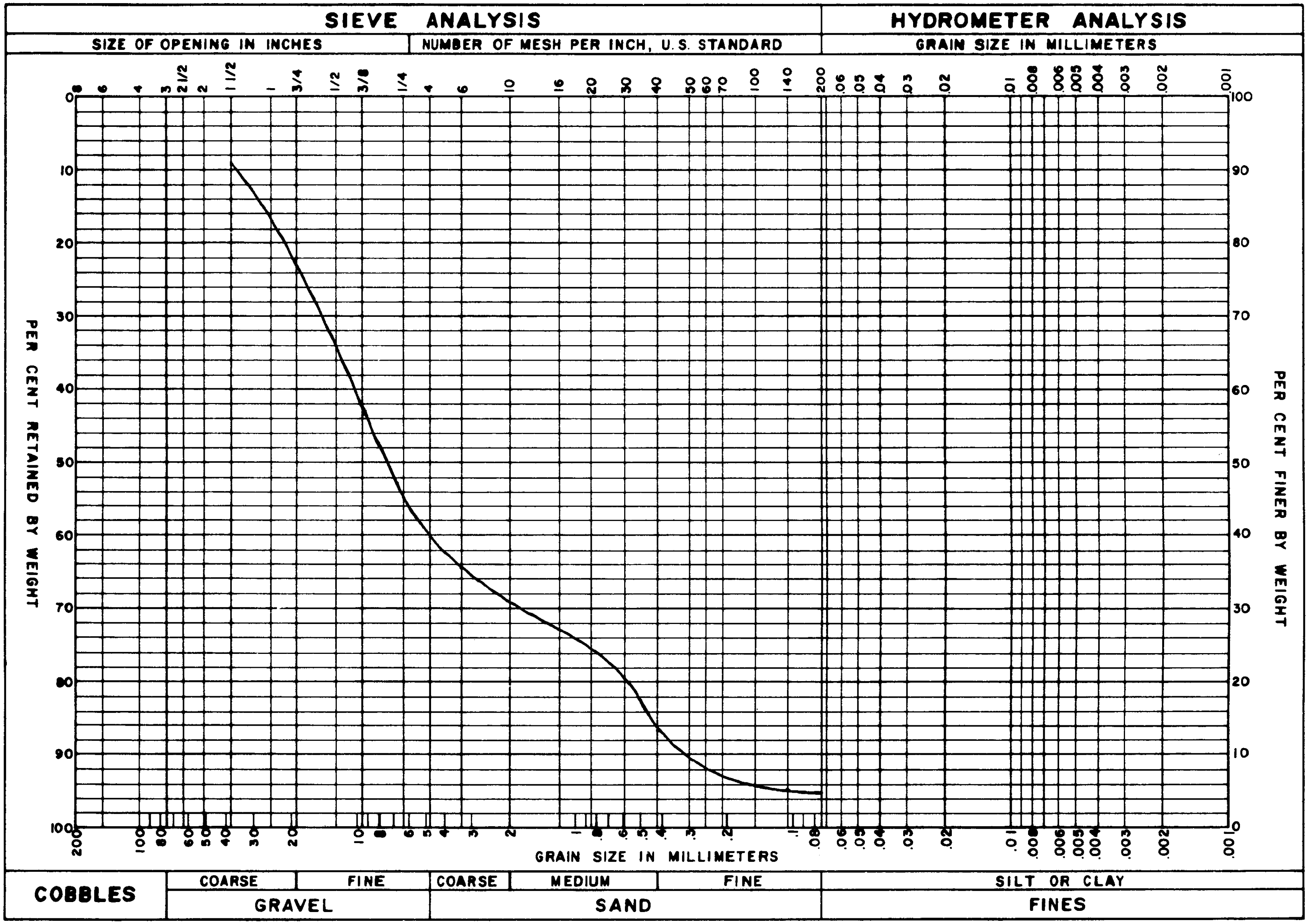
FIGURE 2.5D-17

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12241	BAG SAMPLES

SITE	DATE	SAMPLE NUMBERS
BEAVER VALLEY UNIT 2	10 MAY 76	D-4



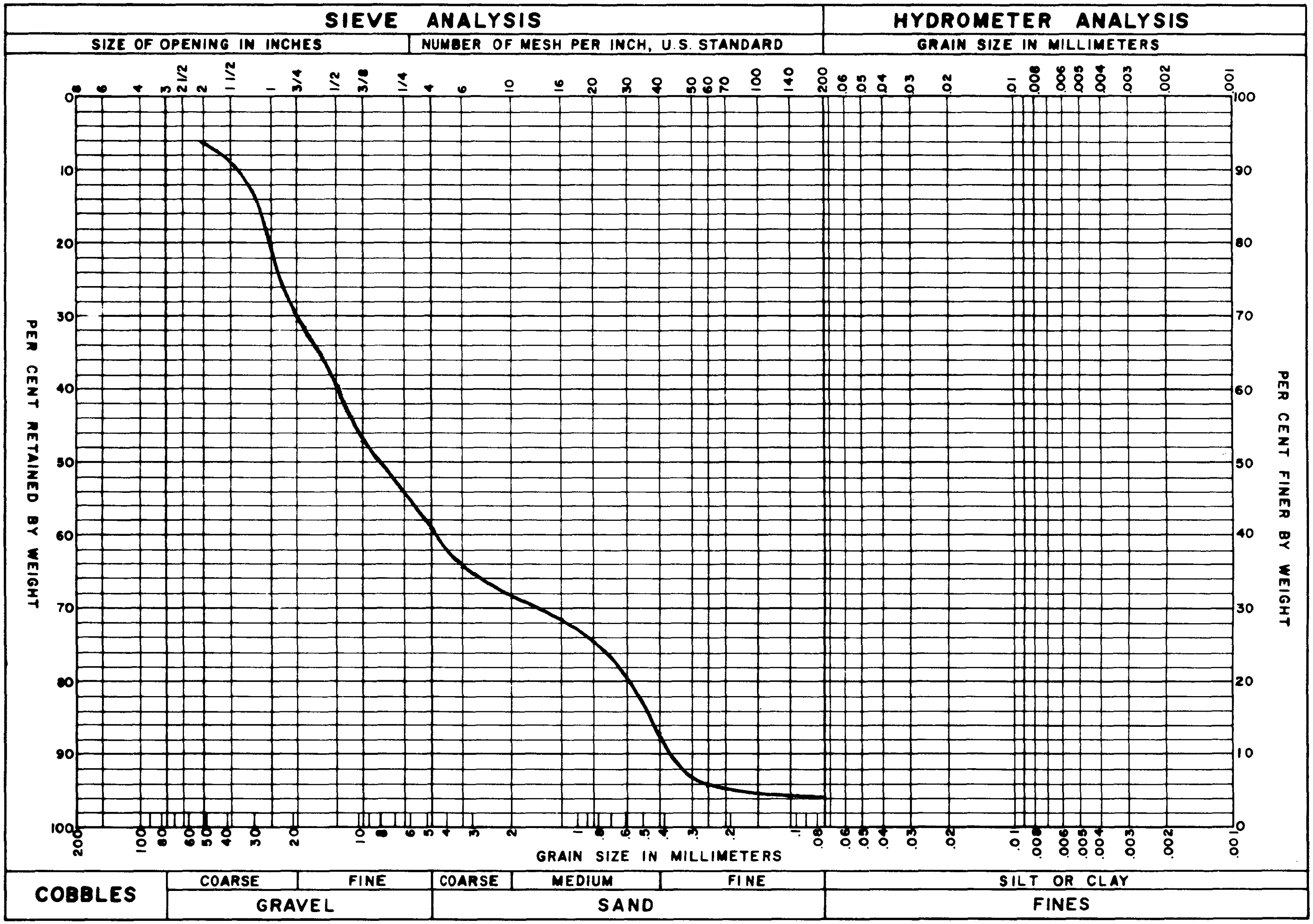
SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
D-4	--	59.9	5.1	10.5	0.31	33.9	1.0	SANDY GRAVEL (GW - GP)

FIGURE 2.5D-18

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12241	BAG SAMPLE
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	12 MAY 76	E-2



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
E-2	----	59.3	4.1	12.0	0.37	32.4	0.51	SANDY GRAVEL (GP)

FIGURE 2.5D-19

STONE & WEBSTER ENGINEERING CORPORATION

GRADATION CURVES

CLIENT: DUQUESNE LIGHT COMPANY

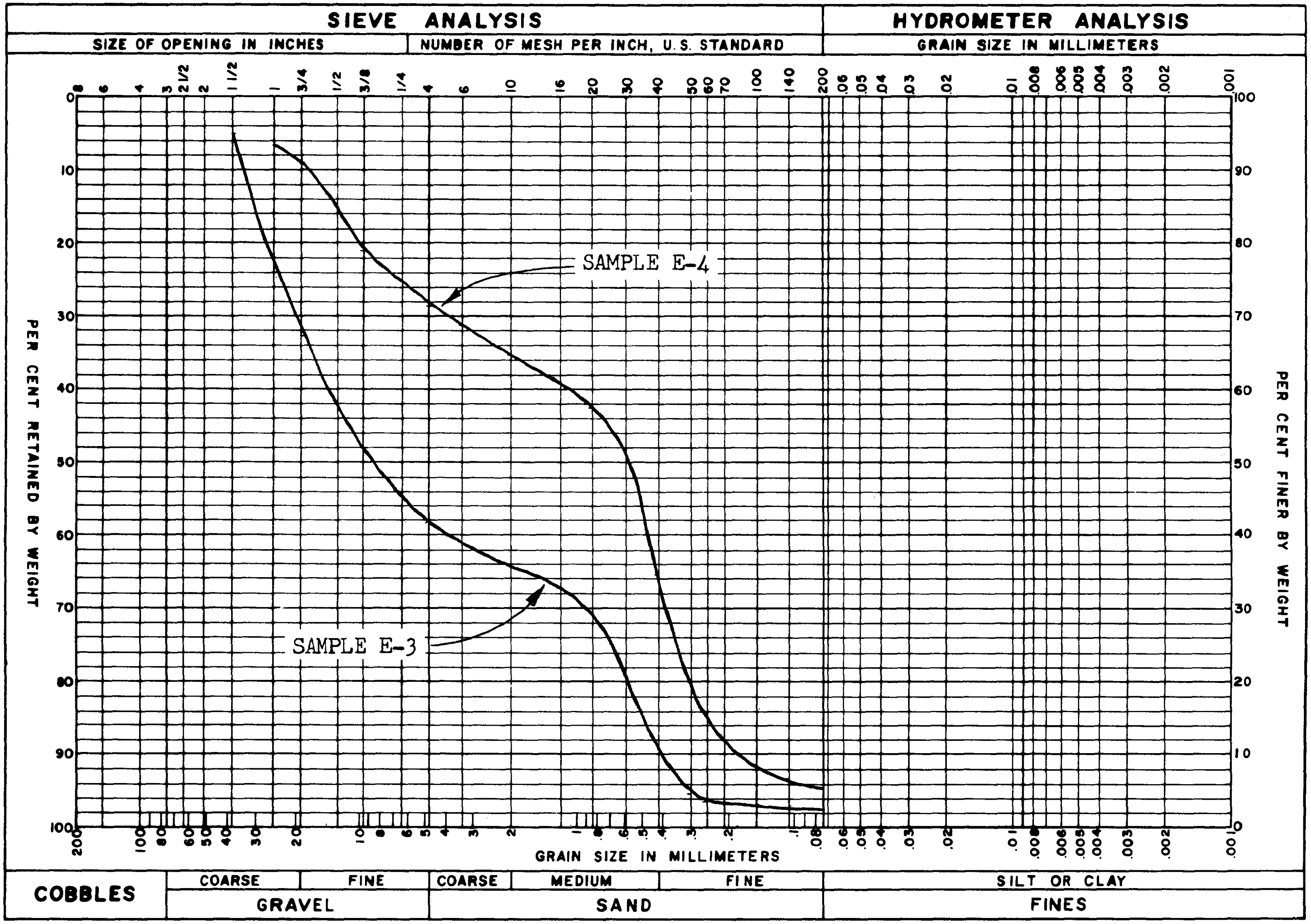
SITE: BEAVER VALLEY UNIT 2

J.O. NUMBER: 12241

DATE: 6 MAY 76

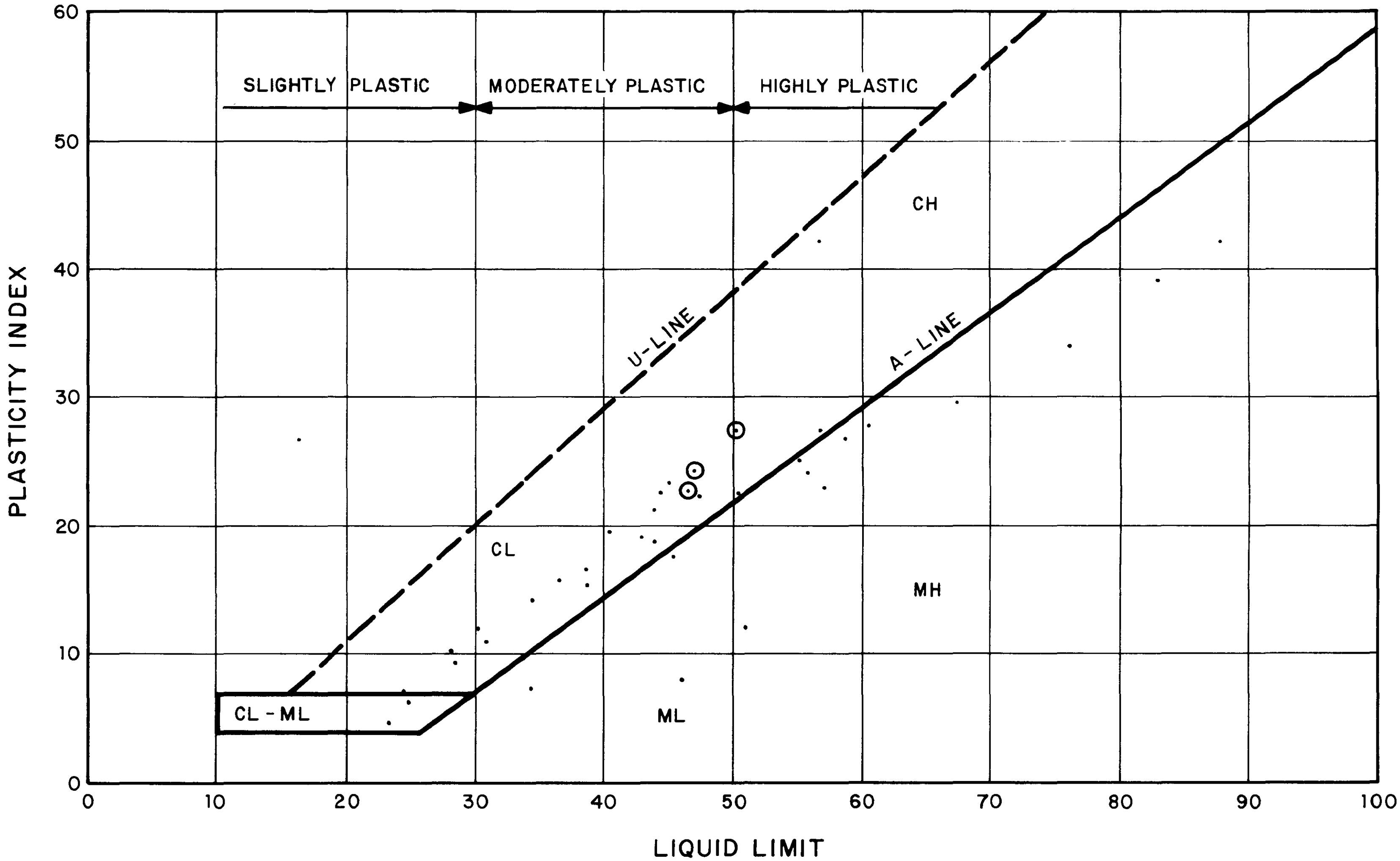
EXPLORATION TYPE AND NUMBER: BAG SAMPLES

SAMPLE NUMBERS: E-3 AND E-4



SAMPLE	DEPTH (FT)	% GRAVEL	% FINES	D_{60}	D_{10}	C_u	C_z	CLASSIFICATION
E-3	---	58.1	2.6	13.0	0.40	32.5	0.16	SANDY GRAVEL (GP)
E-4	---	28.6	5.5	1.05	0.19	5.53	0.76	GRAVELLY SAND (GP-GM)

FIGURE 2.5D-20



LEGEND

⊙ BAG SAMPLES-STIFF SILTY CLAY FROM REACTOR CONTAINMENT EXCAVATION.

FIGURE 2.5D-21

PLASTICITY CHART

BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

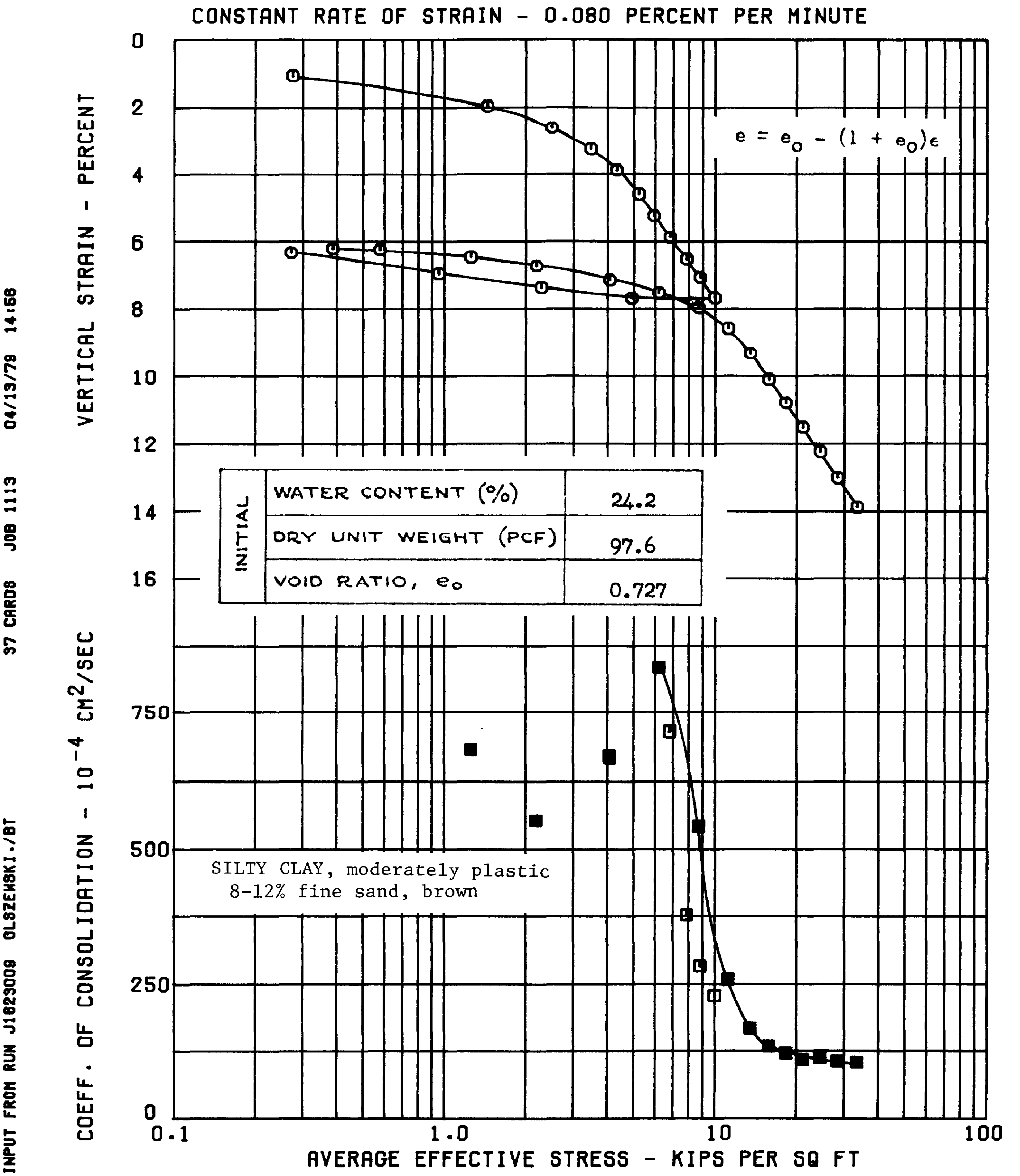
PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT DUQUESNE LIGHT COMPANY — J.O. NO. 12690.46

SITE BEAVER VALLEY - UNIT 1 — DATE 17 APR 79 BY W Olszewski

BORING AB6 SAMPLE 7D DEPTH 16.0 FT — CHECKED 18 APR 79 BY RKW

BASED ON COMPUTER RUN J1623010 ON 04/17/79 AT 11.14.39 BY OLSZEWSKI.
PROGRAM GT-024 OEDPLOT VER 03 LEV 01 - COMPILED ON 78.249 AT 13.51.55



INITIAL		
	WATER CONTENT (%)	24.2
	DRY UNIT WEIGHT (PCF)	97.6
	VOID RATIO, e_o	0.727

FIGURE 2.5D-22

STONE & WEBSTER ENGINEERING CORPORATION

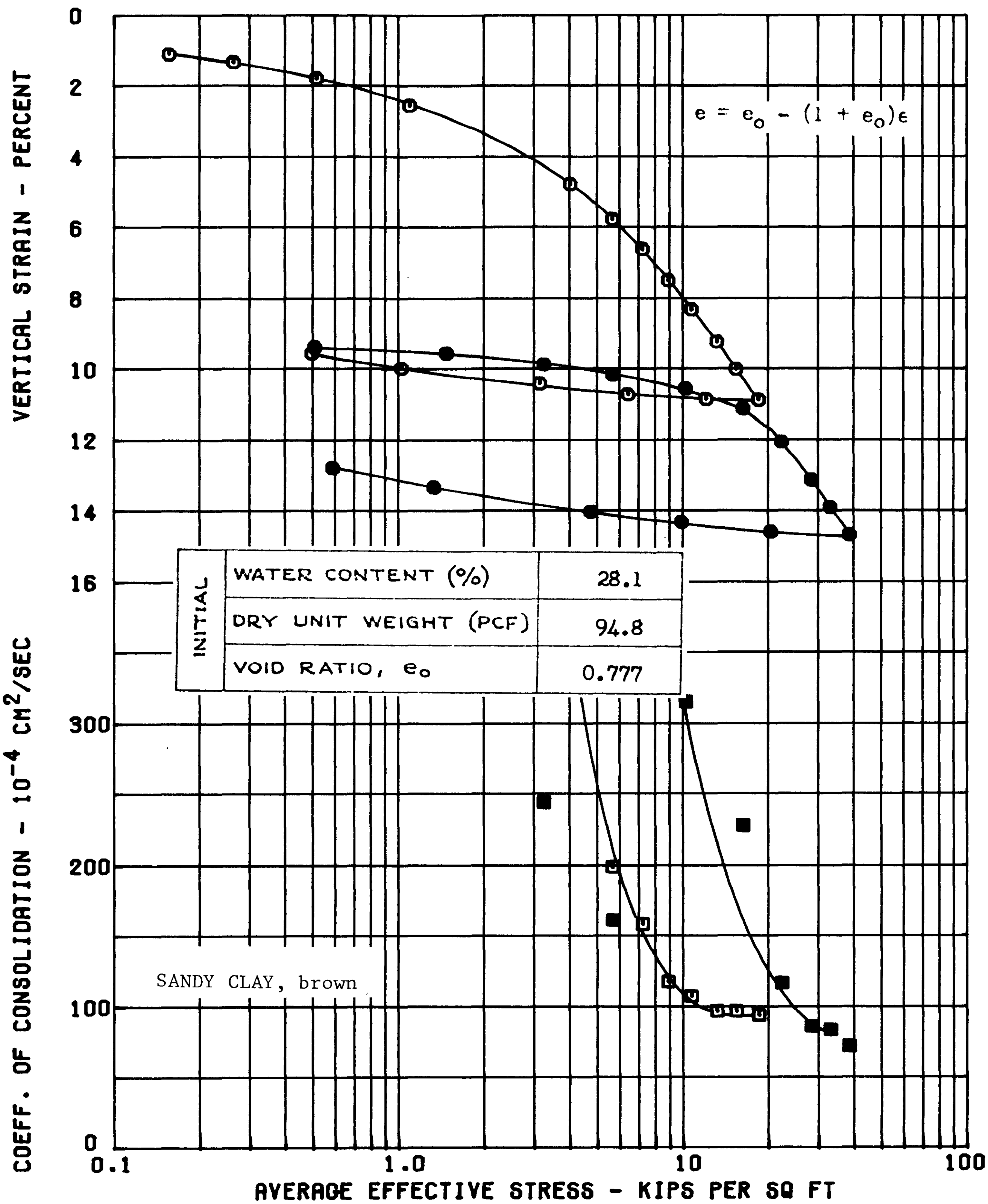
CONSOLIDATION TEST REPORT

PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT	DUQUESNE LIGHT COMPANY	J.O. NO.	12690.46
SITE	BEAVER VALLEY - UNIT 1	DATE 6 APR 79	BY (signature)
BORING AB6	SAMPLE US9F DEPTH	CHECKED 6 APR 79	BY (signature)

BASED ON COMPUTER RUN J1623002 ON 04/06/79 AT 11.18.15 BY OLSZEWSKI.
PROGRAM GT-024 OEDPLOT VER 03 LEV 01 - COMPILED ON 78.249 AT 13.51.55

CONSTANT RATE OF STRAIN - 0.060 PERCENT PER MINUTE



INITIAL		
	WATER CONTENT (%)	28.1
	DRY UNIT WEIGHT (PCF)	94.8
	VOID RATIO, e_o	0.777

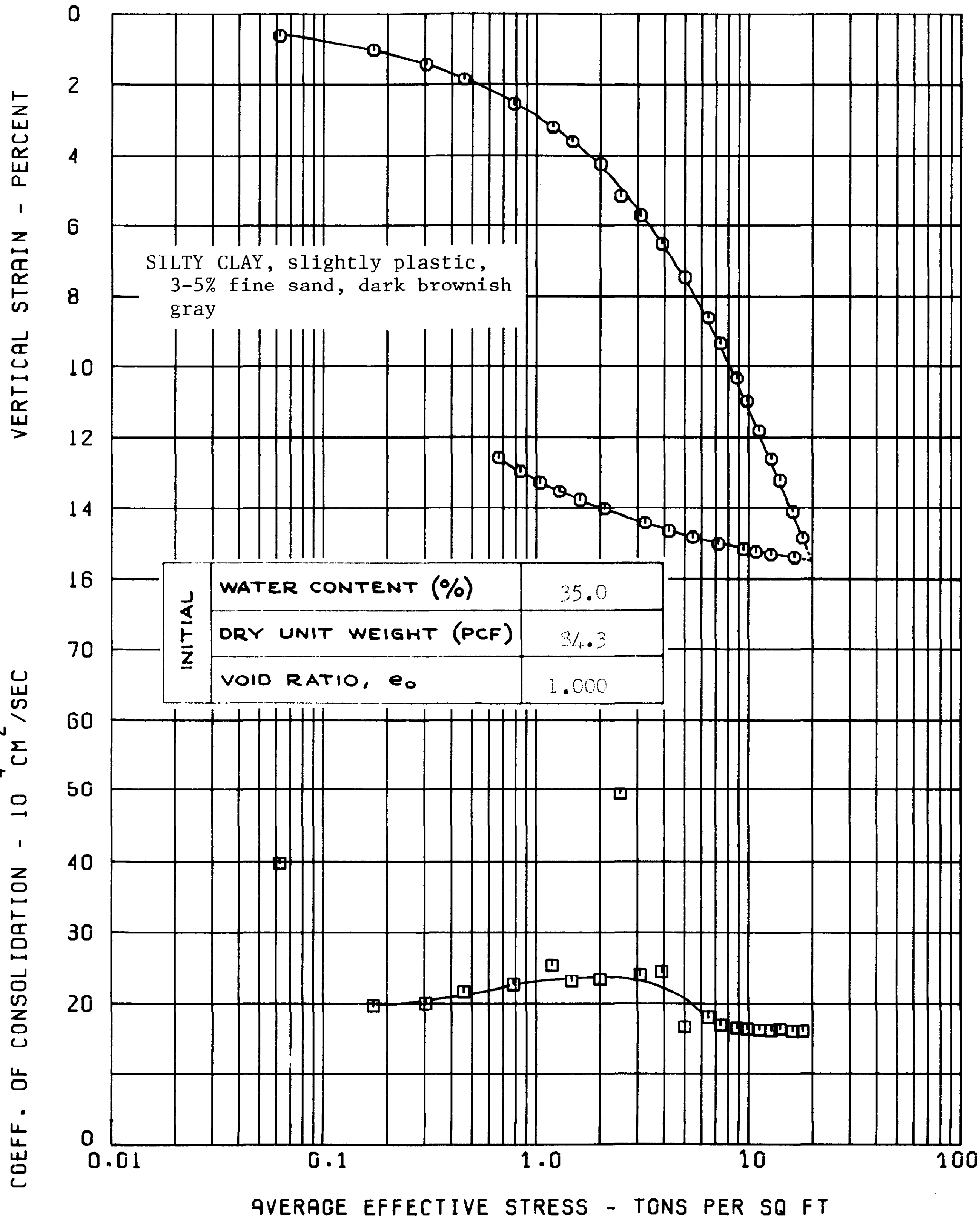
INPUT FROM RUN J1623001 OLSZEWSKI./BT 39 CARDS JOB 340 04/06/79 9:40

FIGURE 2.5D-23

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF 6
SITE BEAVER VALLEY UNIT 2	DATE 29 MAR 77	SAMPLE NUMBER 13F
CONSTANT RATE OF STRAIN - 0.033 PERCENT PER MINUTE		DEPTH 54.4 FT



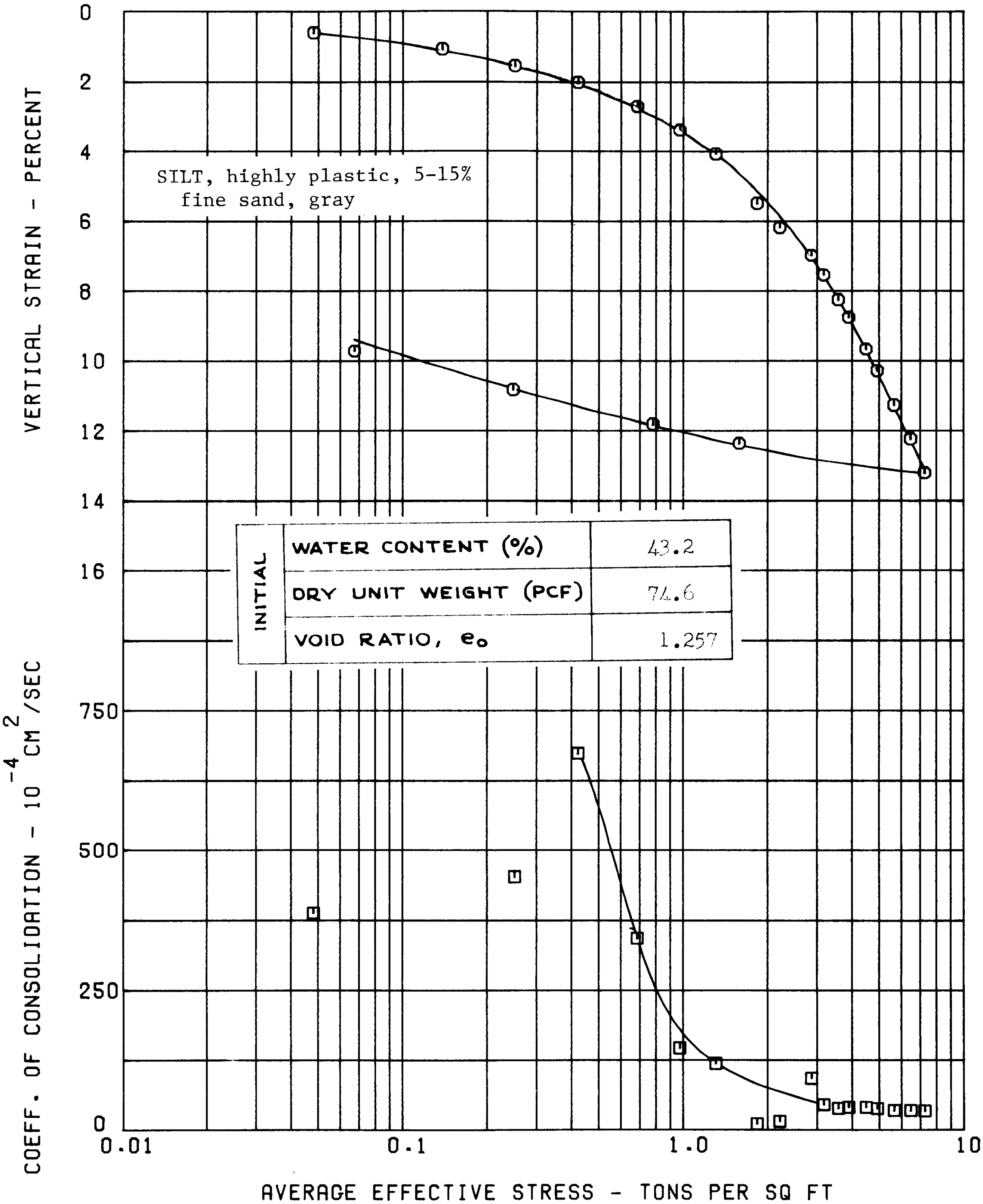
INITIAL		
	WATER CONTENT (%)	35.0
	DRY UNIT WEIGHT (PCF)	84.3
	VOID RATIO, e_o	1.000

FIGURE 2.5D-24

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY - UNIT 2	DATE 7 APR 77	SAMPLE NUMBER 1F
CONSTANT RATE OF STRAIN - 0.044 PERCENT PER MINUTE		DEPTH 48.0 FT



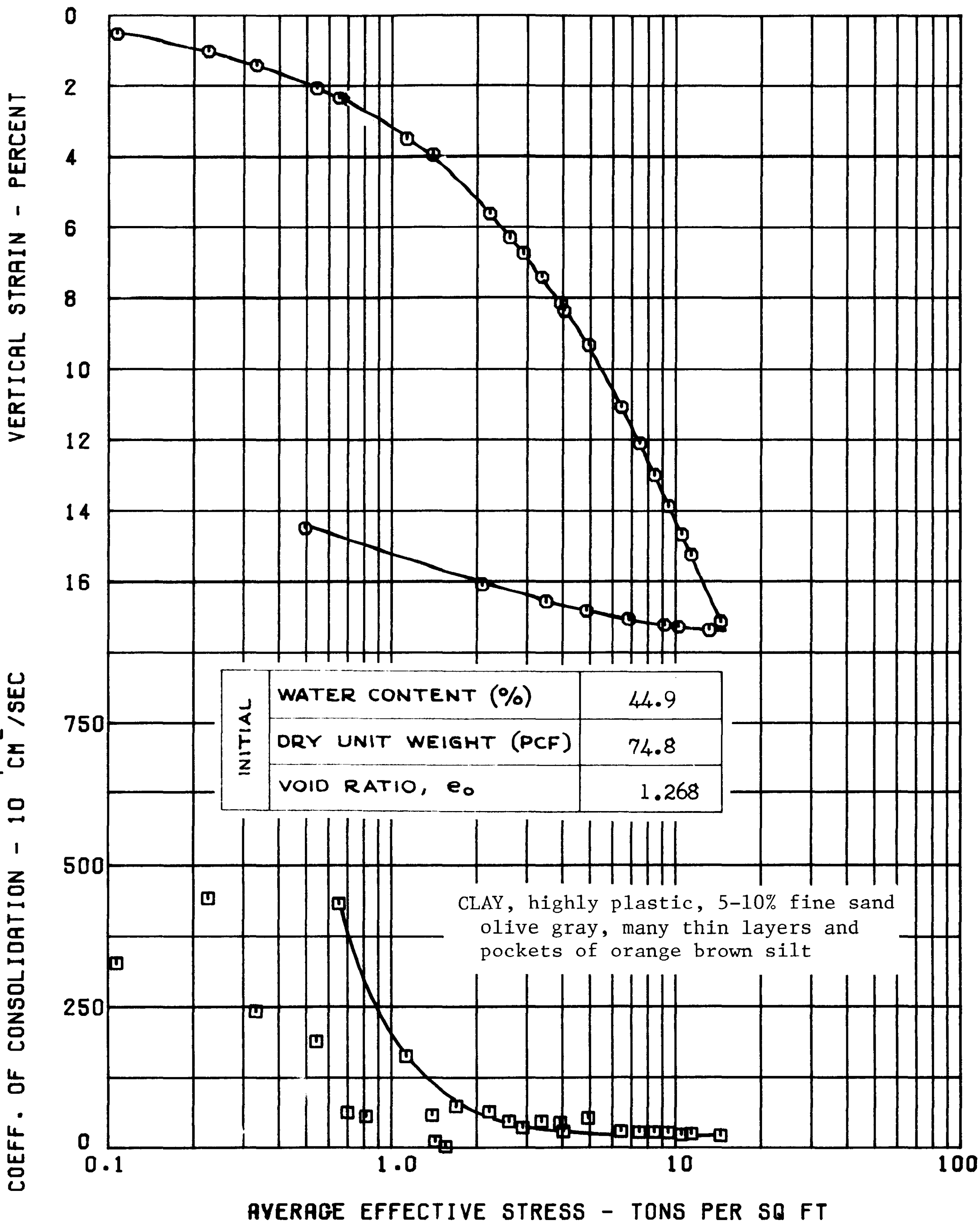
INITIAL		
	WATER CONTENT (%)	43.2
	DRY UNIT WEIGHT (PCF)	74.6
	VOID RATIO, e_o	1.257

FIGURE 2.5D-25

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY - UNIT 2	DATE 14 APR 77	SAMPLE NUMBER 2F
CONSTANT RATE OF STRAIN - 0.027 PERCENT PER MINUTE		DEPTH 53.2 FT



INITIAL		
	WATER CONTENT (%)	44.9
	DRY UNIT WEIGHT (PCF)	74.8
	VOID RATIO, e_o	1.268

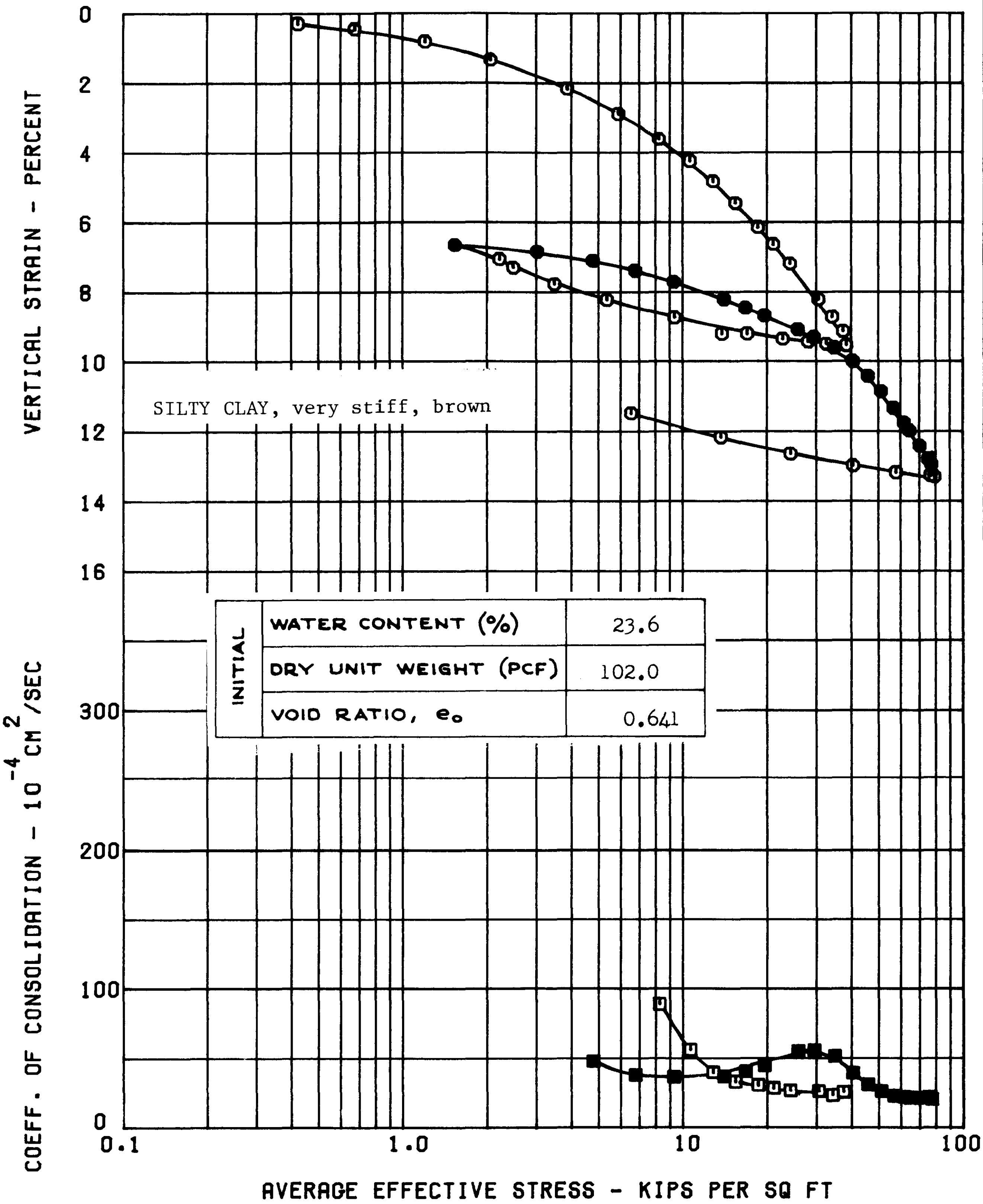
CLAY, highly plastic, 5-10% fine sand olive gray, many thin layers and pockets of orange brown silt

FIGURE 2.5D-26

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	--
SITE: BEAVER VALLEY UNIT 2	DATE: 28 APR 76	SAMPLE NUMBER: BAG 1
CONSTANT RATE OF STRAIN - 0.039 PERCENT PER MINUTE		DEPTH: --- FT



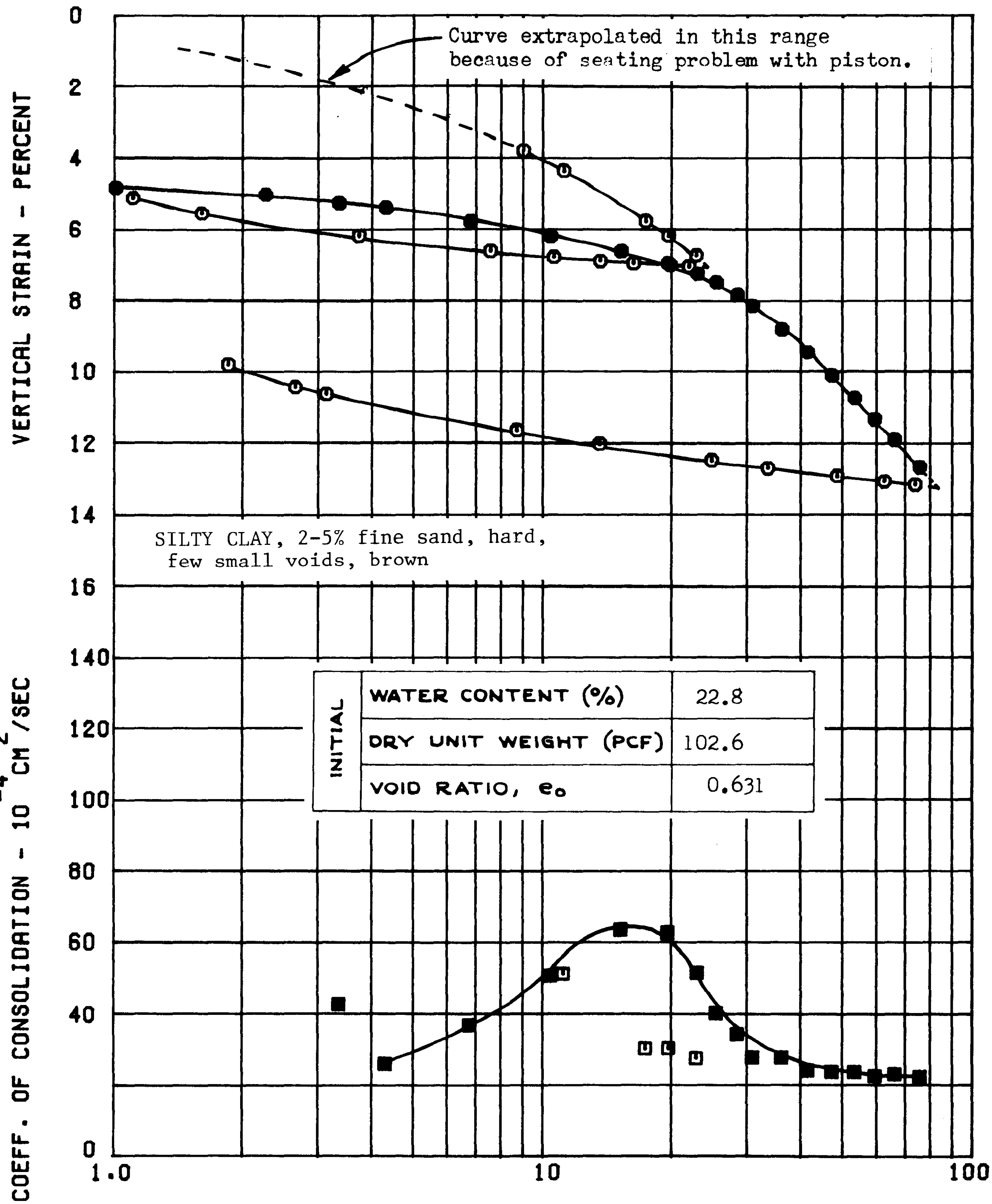
INITIAL		
	WATER CONTENT (%)	23.6
	DRY UNIT WEIGHT (PCF)	102.0
	VOID RATIO, e_o	0.641

FIGURE 2.5D-27

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	--
SITE BEAVER VALLEY UNIT 2	DATE 28 APR 76	SAMPLE NUMBER BAG 2
CONSTANT RATE OF STRAIN - 0.040 PERCENT PER MINUTE		DEPTH ---



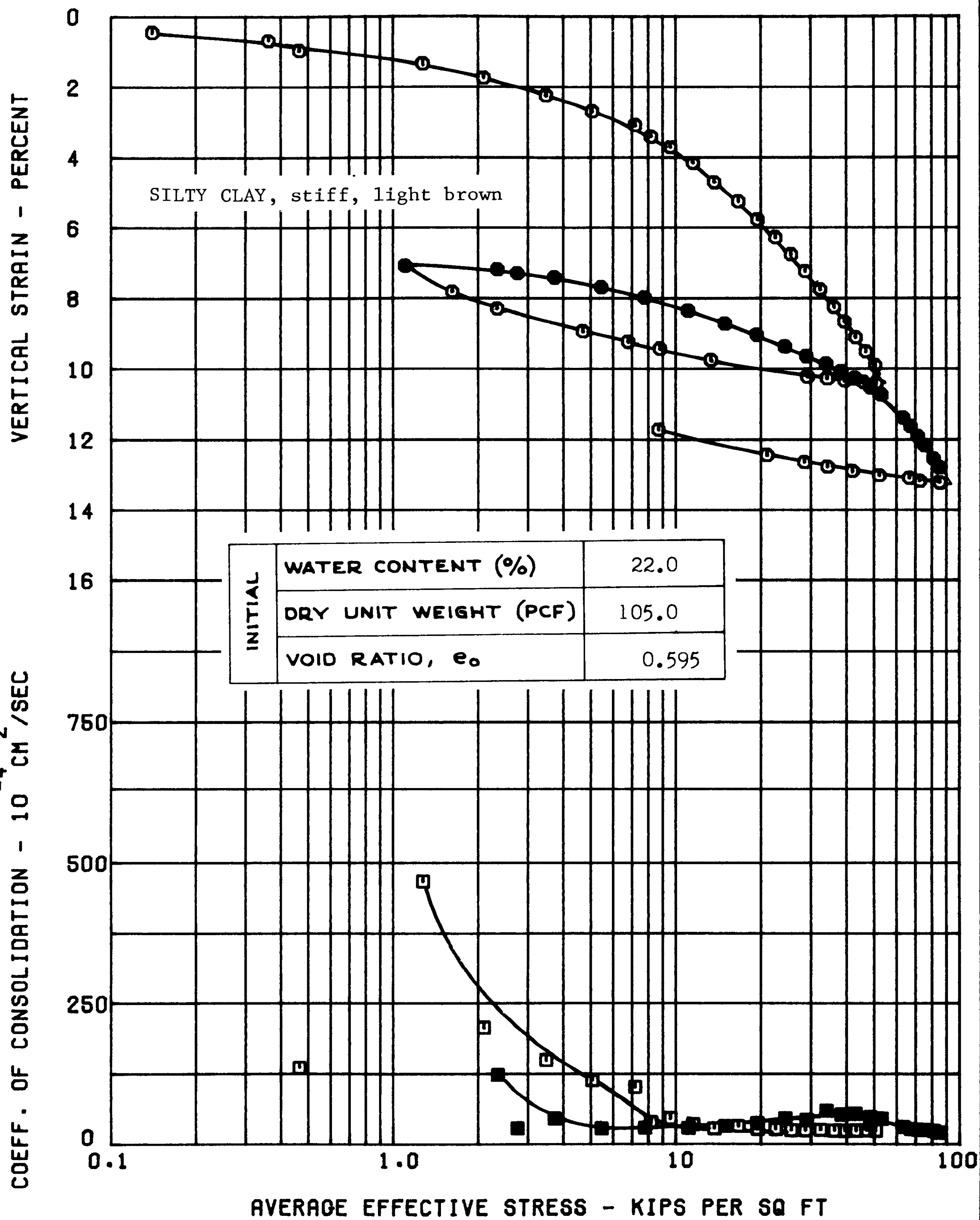
INITIAL		
	WATER CONTENT (%)	22.8
	DRY UNIT WEIGHT (PCF)	102.6
	VOID RATIO, e_o	0.631

FIGURE 2.5D-28

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12241	BORING NUMBER BLOCK I
SITE BEAVER VALLEY UNIT 2	DATE 19 MAY 76	SAMPLE NUMBER IF
CONSTANT RATE OF STRAIN - 0.029 PERCENT PER MINUTE		DEPTH



INITIAL		
	WATER CONTENT (%)	22.0
	DRY UNIT WEIGHT (PCF)	105.0
	VOID RATIO, e_0	0.595

FIGURE 2.5D-29

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	13 APR 77	1F
		DEPTH
		49.1 FT.

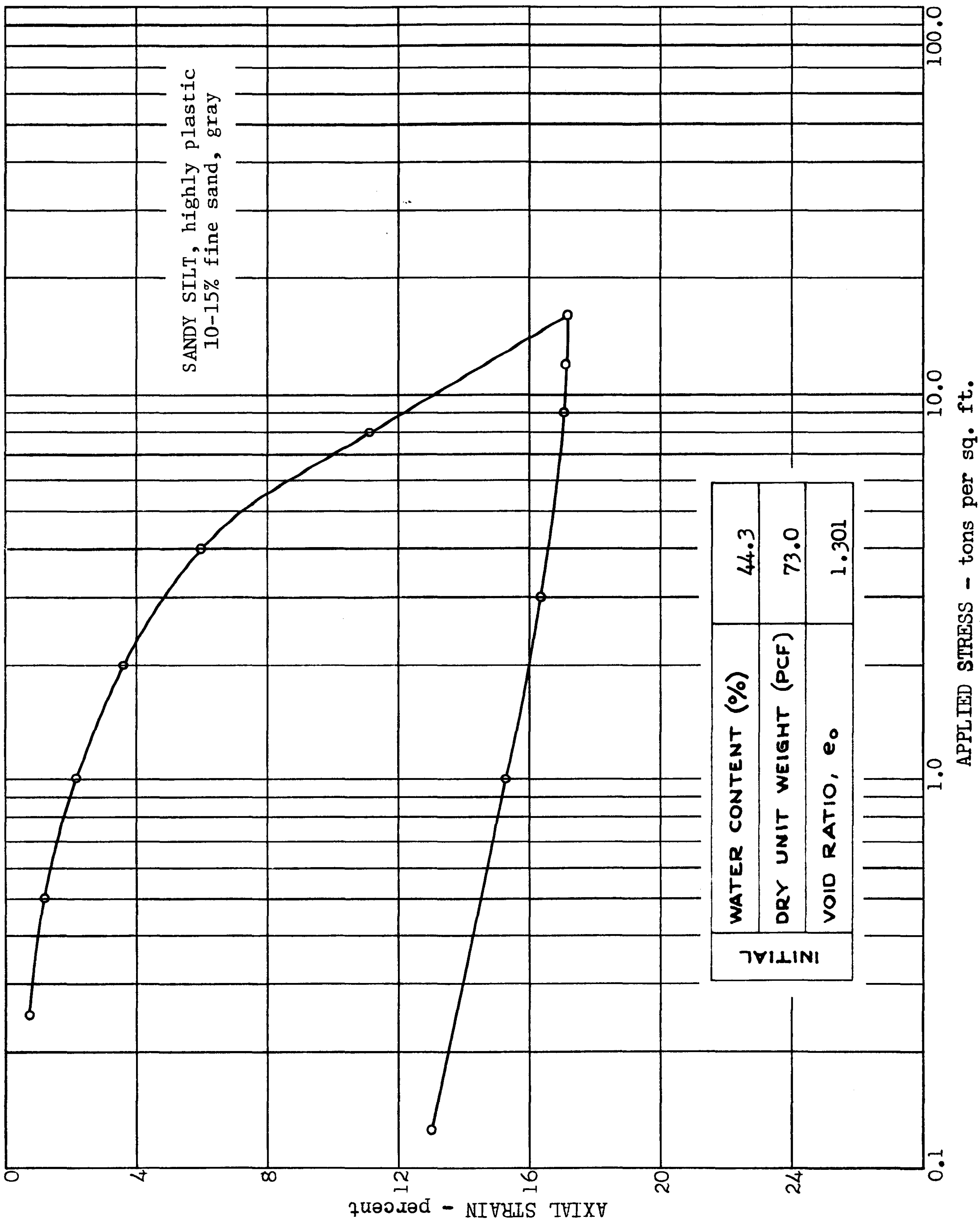


FIGURE 2.5D-30

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 2	1 APR 77	1F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 49.1 FT.

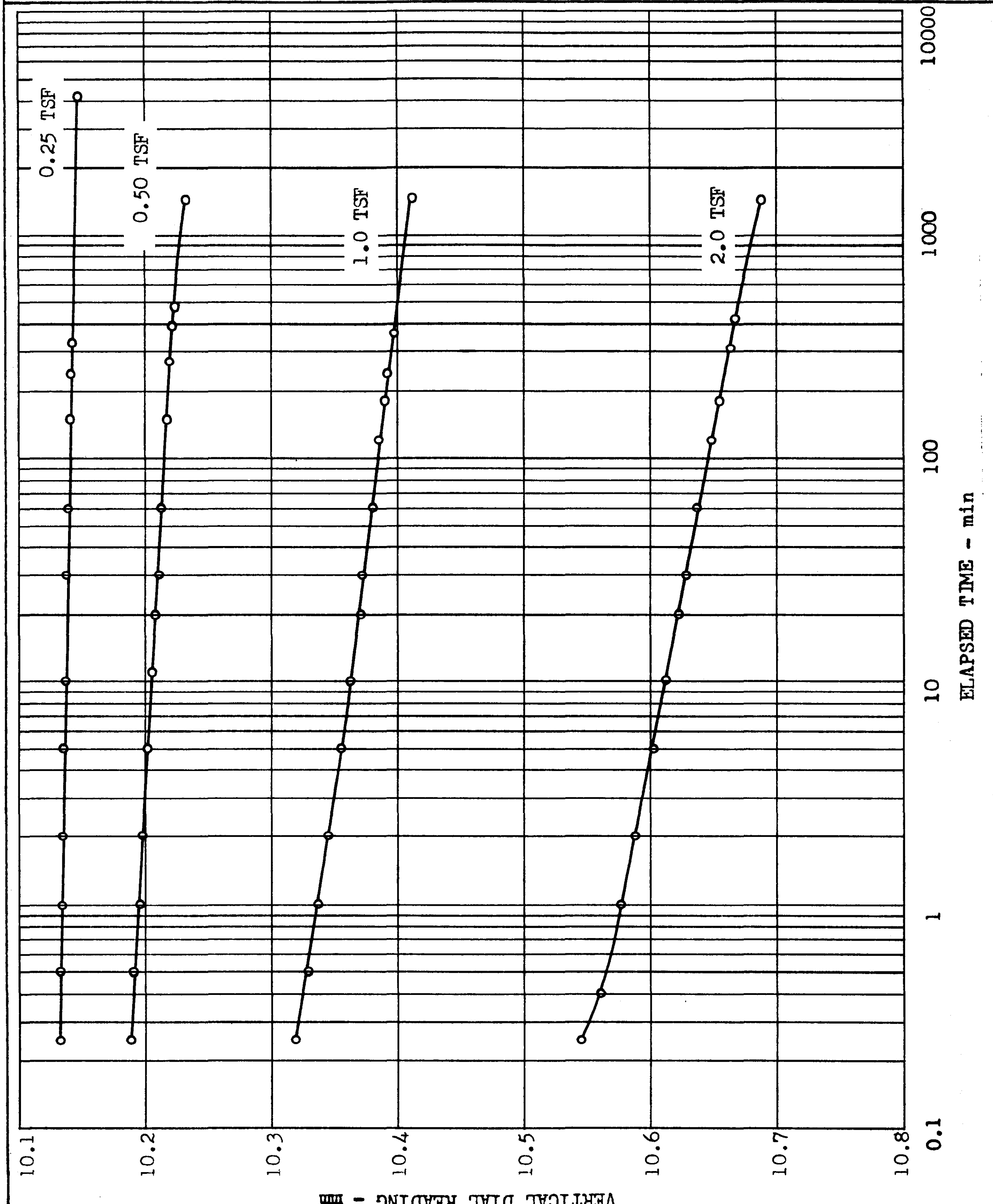
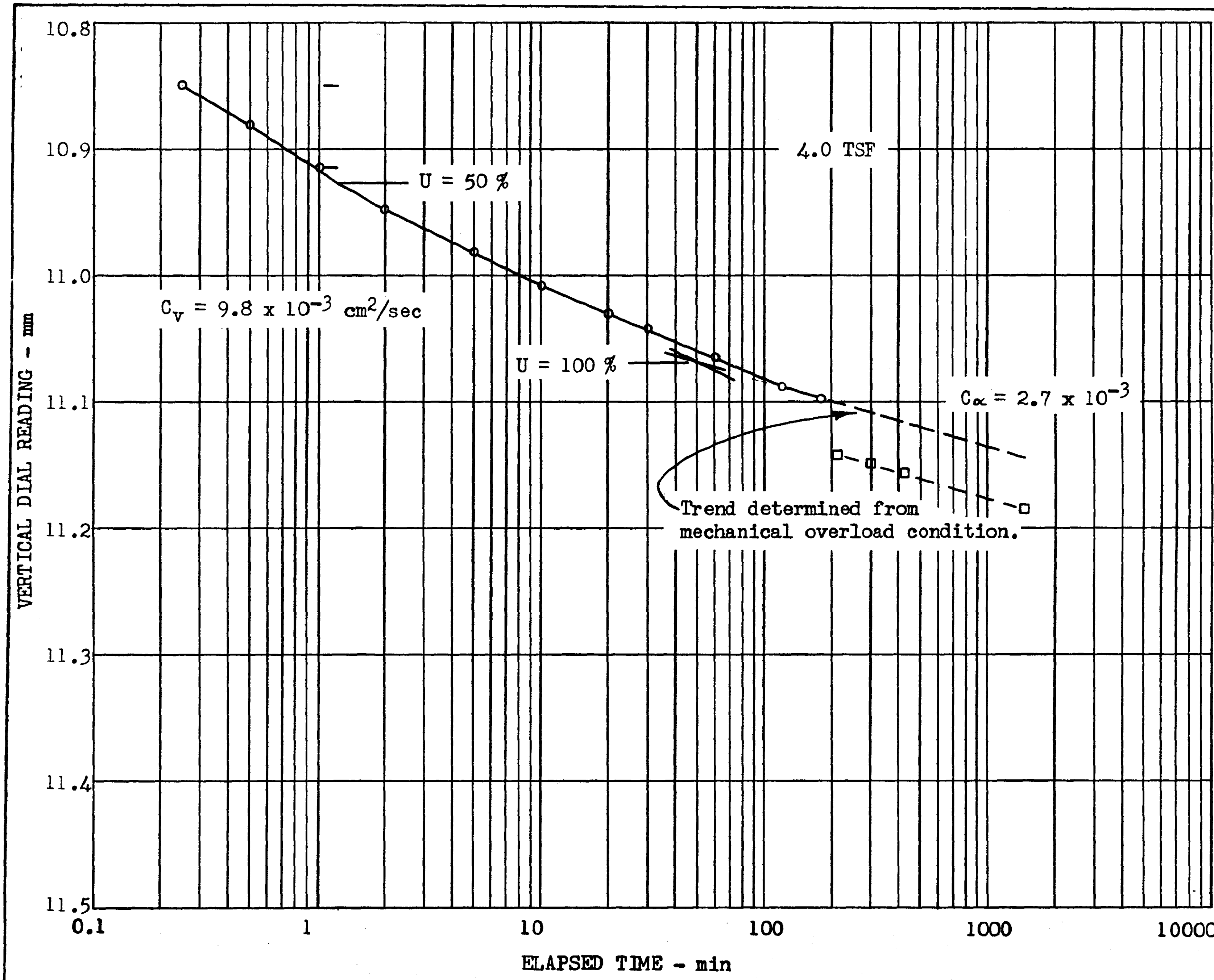


FIGURE 2.5D-31



STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	DUQUESNE LIGHT COMPANY
SITE	BEAVER VALLEY UNIT 2
	DISPLACEMENT vs. LOG TIME PLOT
J.O. NUMBER	12859.01
DATE	2 APR 77
BORING NUMBER	OF7
SAMPLE NUMBER	1F
DEPTH	49.1 FT.

FIGURE 2.5D-32

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF7
SITE BEAVER VALLEY UNIT 2	DATE 4 APR 77	SAMPLE NUMBER 1F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 49.1 FT.

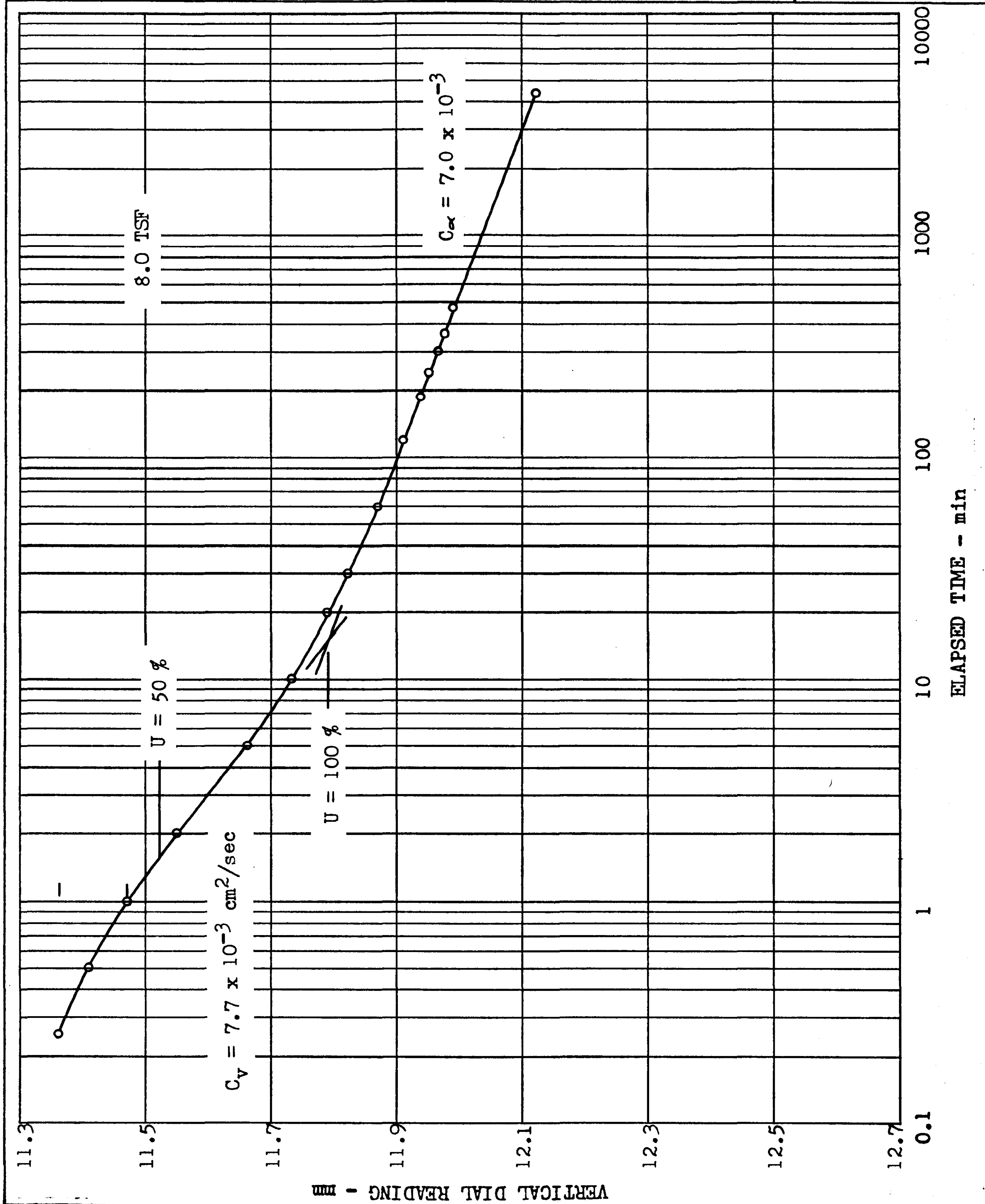


FIGURE 2.5D-33

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	5 APR 77	1F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 49.1 FT.

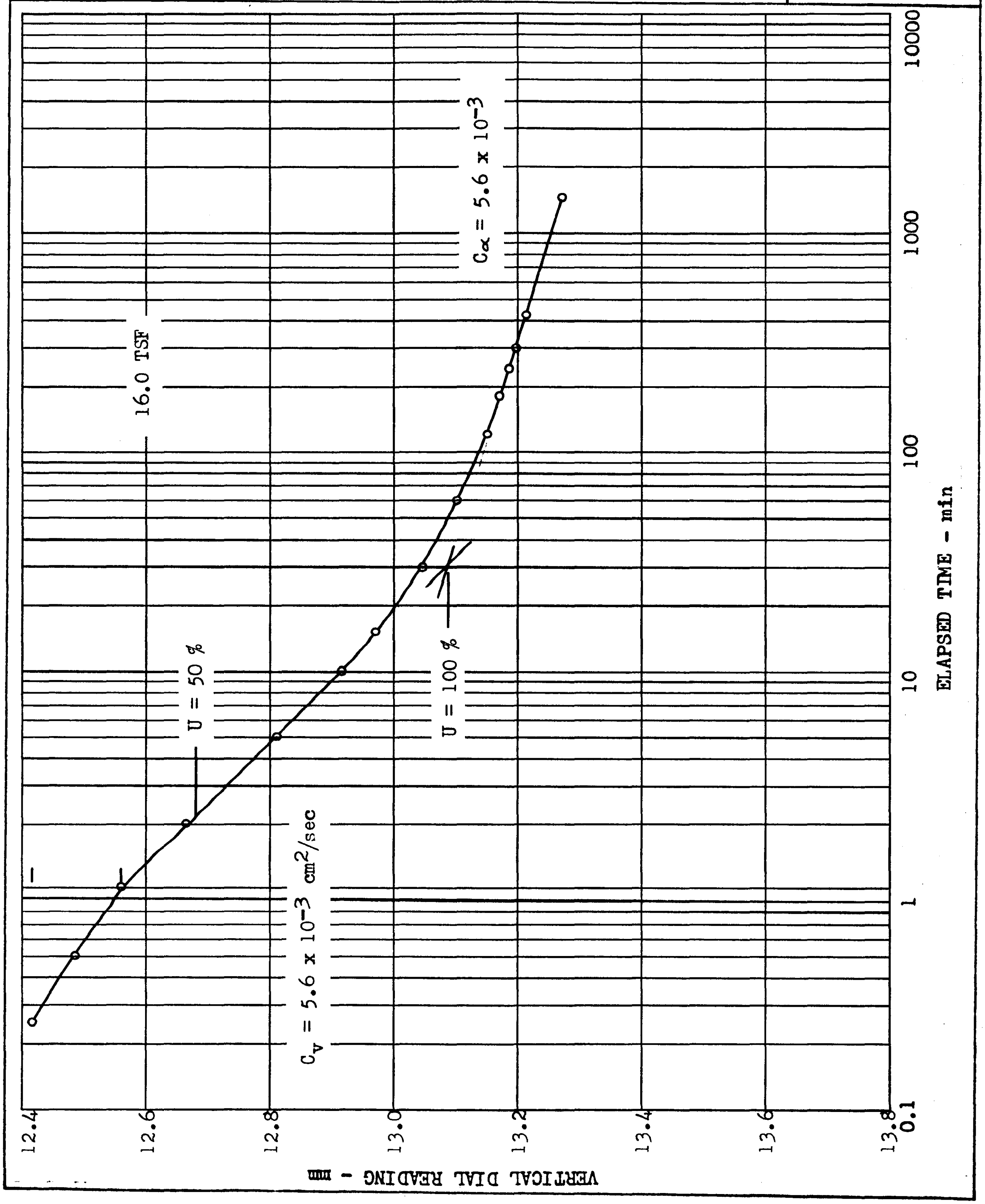


FIGURE 2.5-34

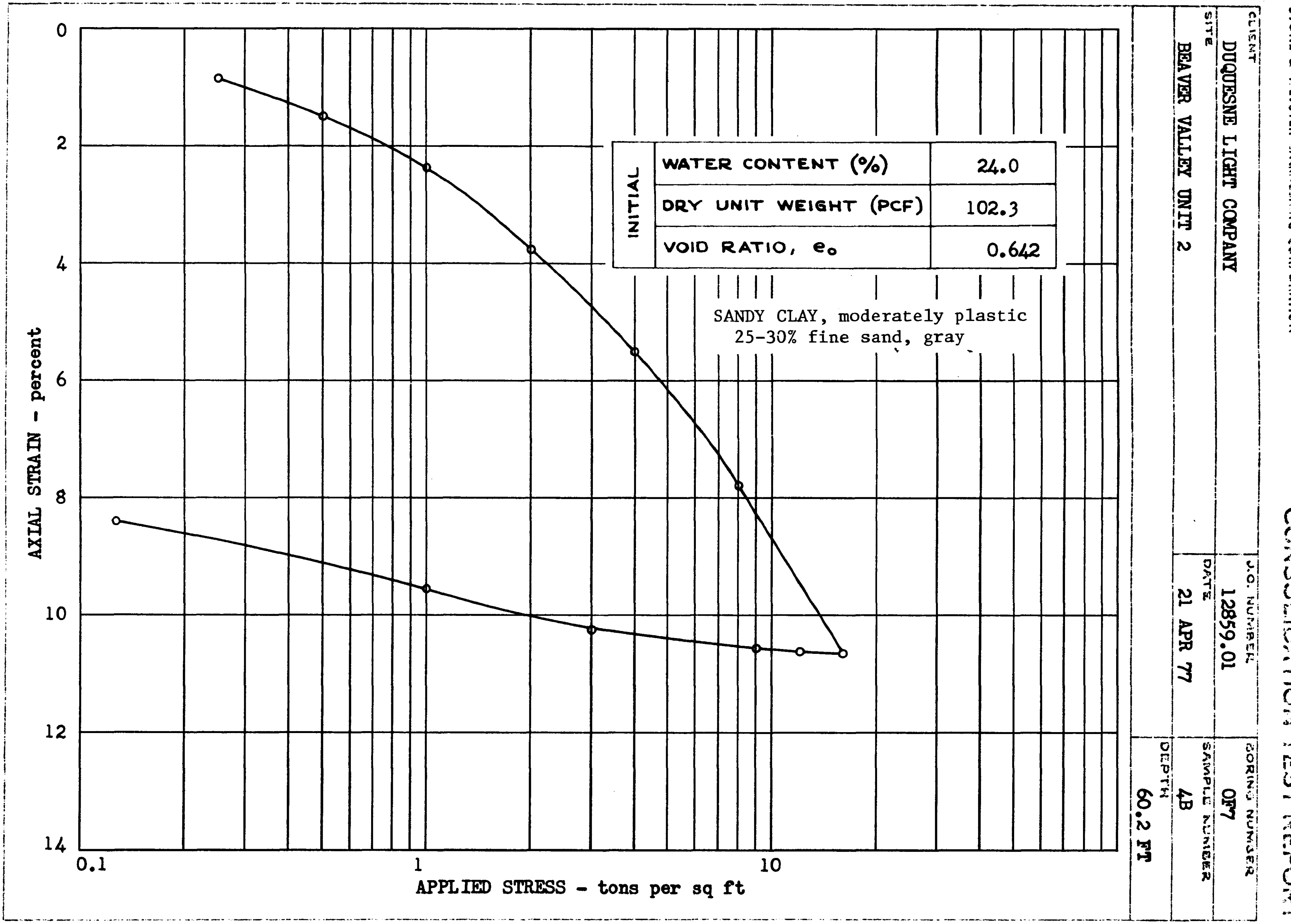
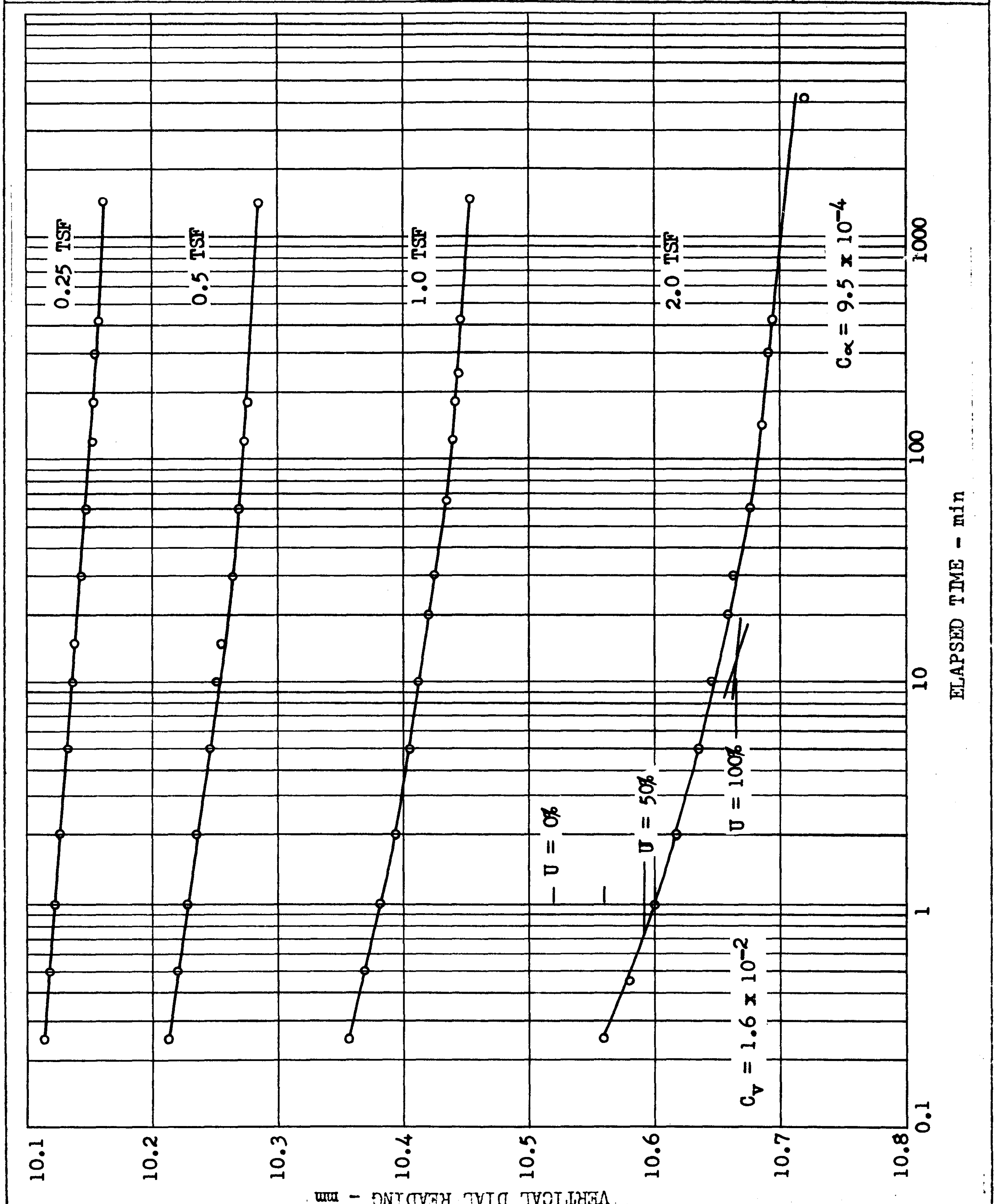


FIGURE 2.5D-35

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF 7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	21 APR 77	4B
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 60.2 FT



STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	21 APR 77	4B
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 60.2 FT

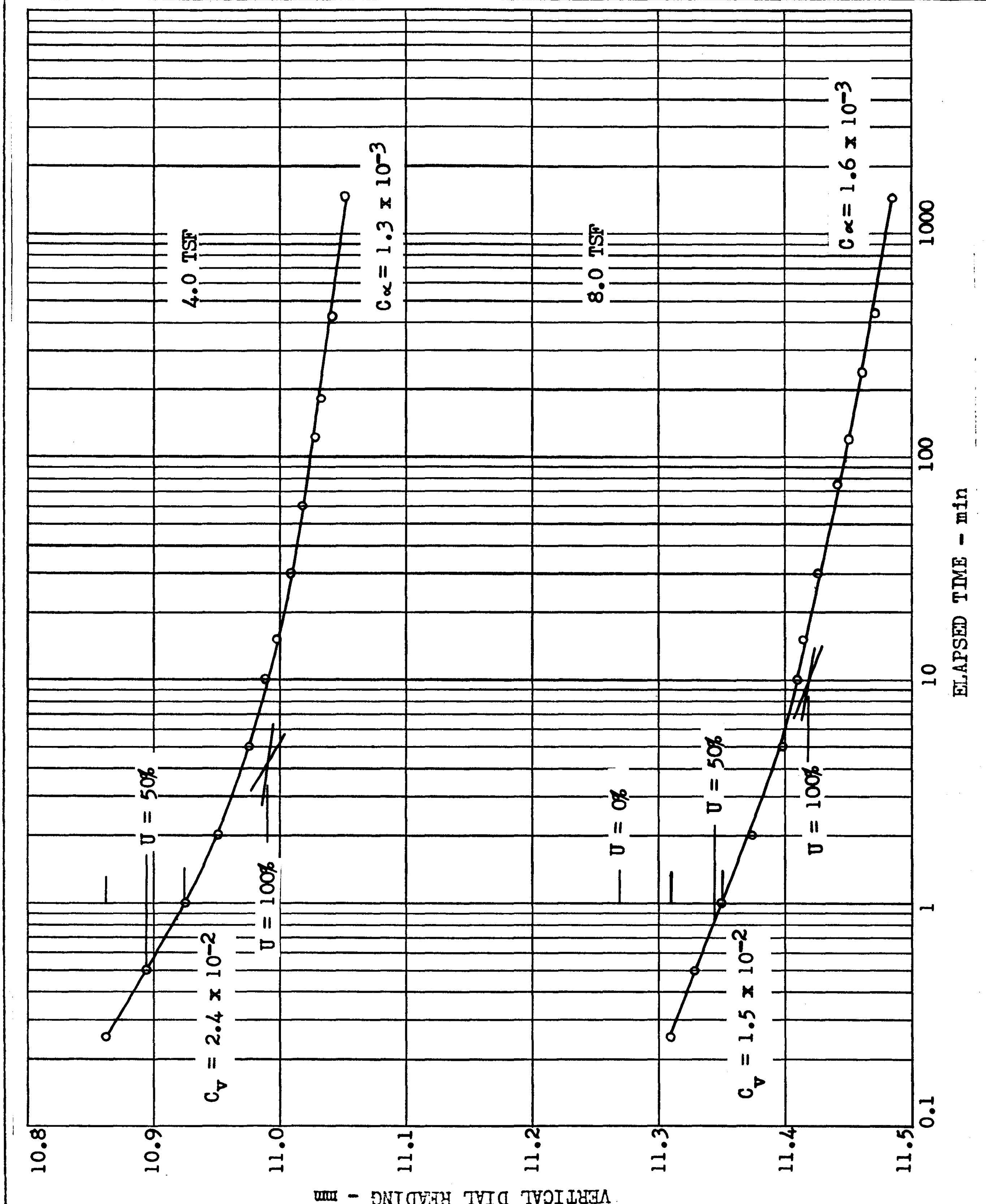


FIGURE 2.5D-37

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12859.01	OF 7
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	21 APR 77	4B
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 60.2 FT

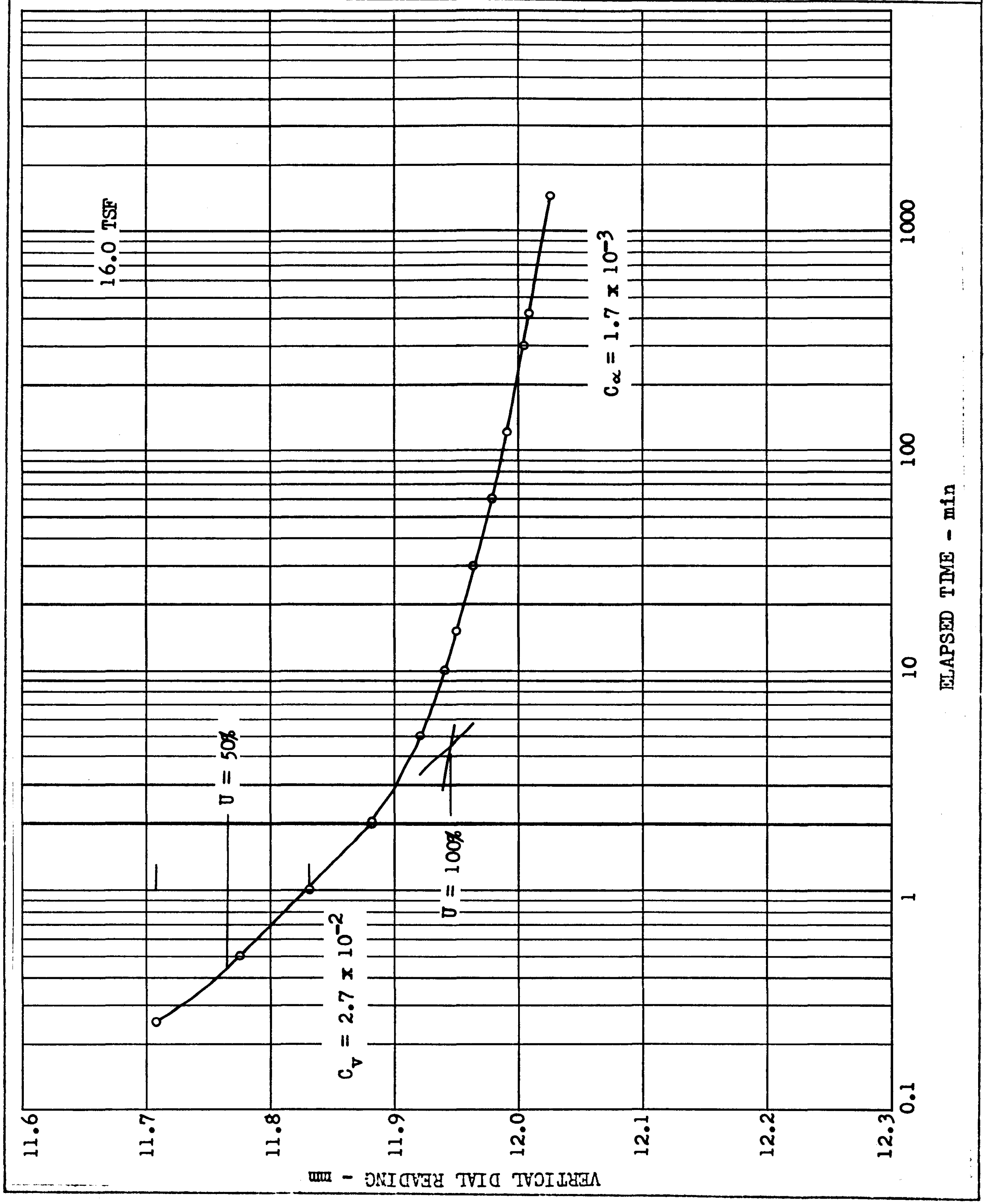


FIGURE 2.5D-38

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE: BEAVER VALLEY UNIT 2	DATE: 29 MAR 77	SAMPLE NUMBER: 1B2
		DEPTH: 14.0 FT

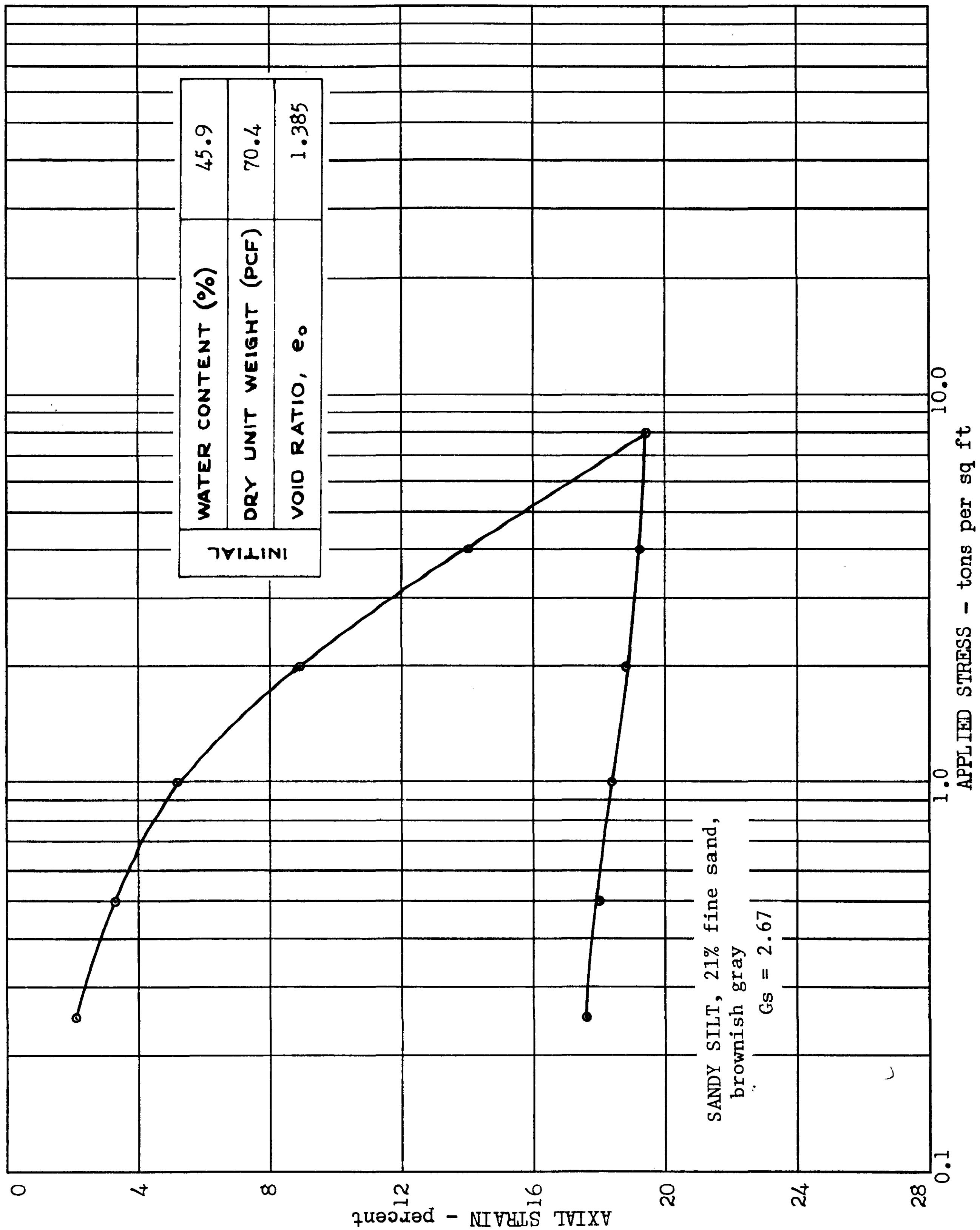


FIGURE 2.5D-39

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 2	8 MAR 77	1B2
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 14.0 FT

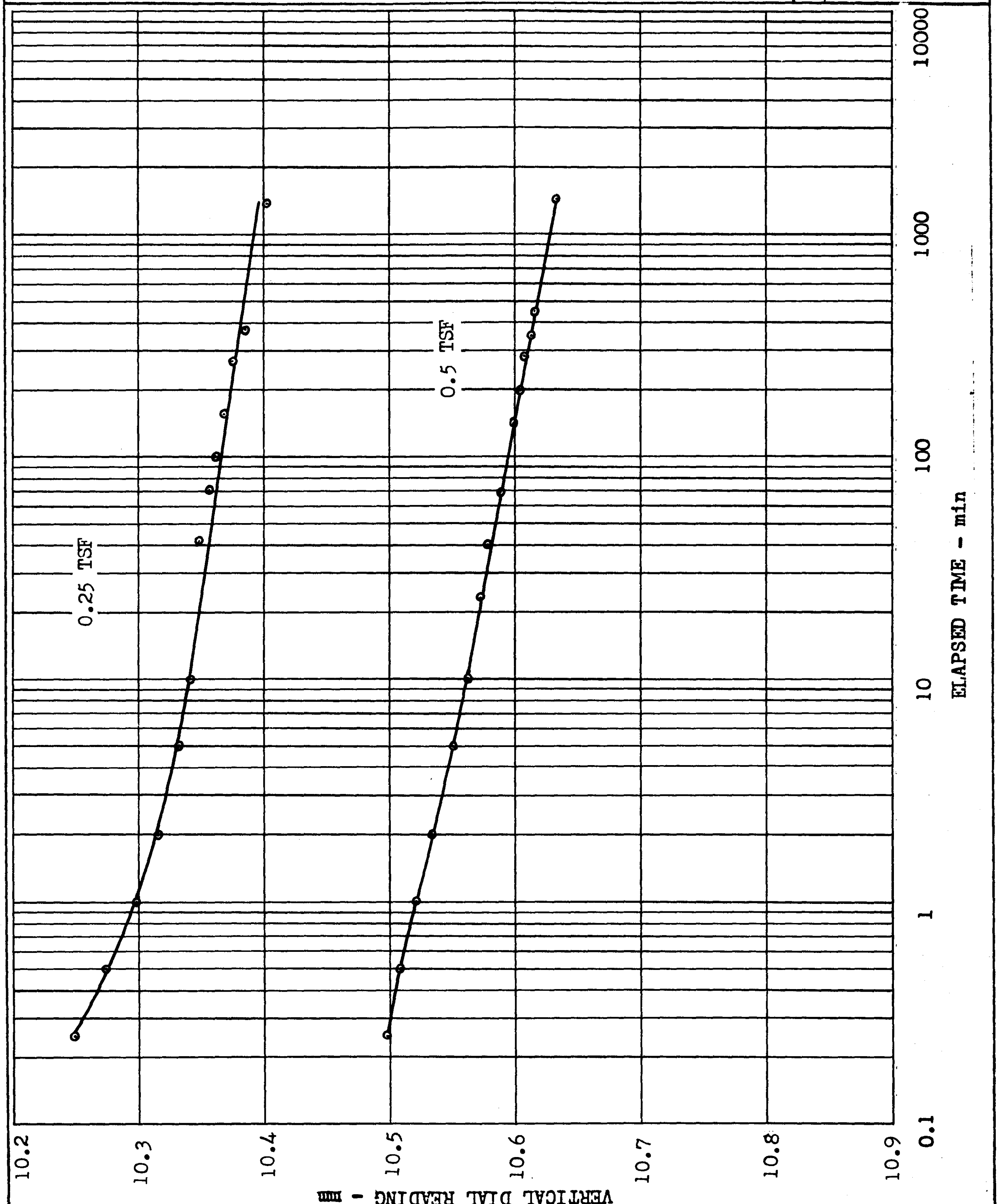


FIGURE 2.5D-40

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 2	8 MAR 77	1B2
DISPLACEMENT vs. LOG TIME PLOT		DEPTH
		14.0 FT

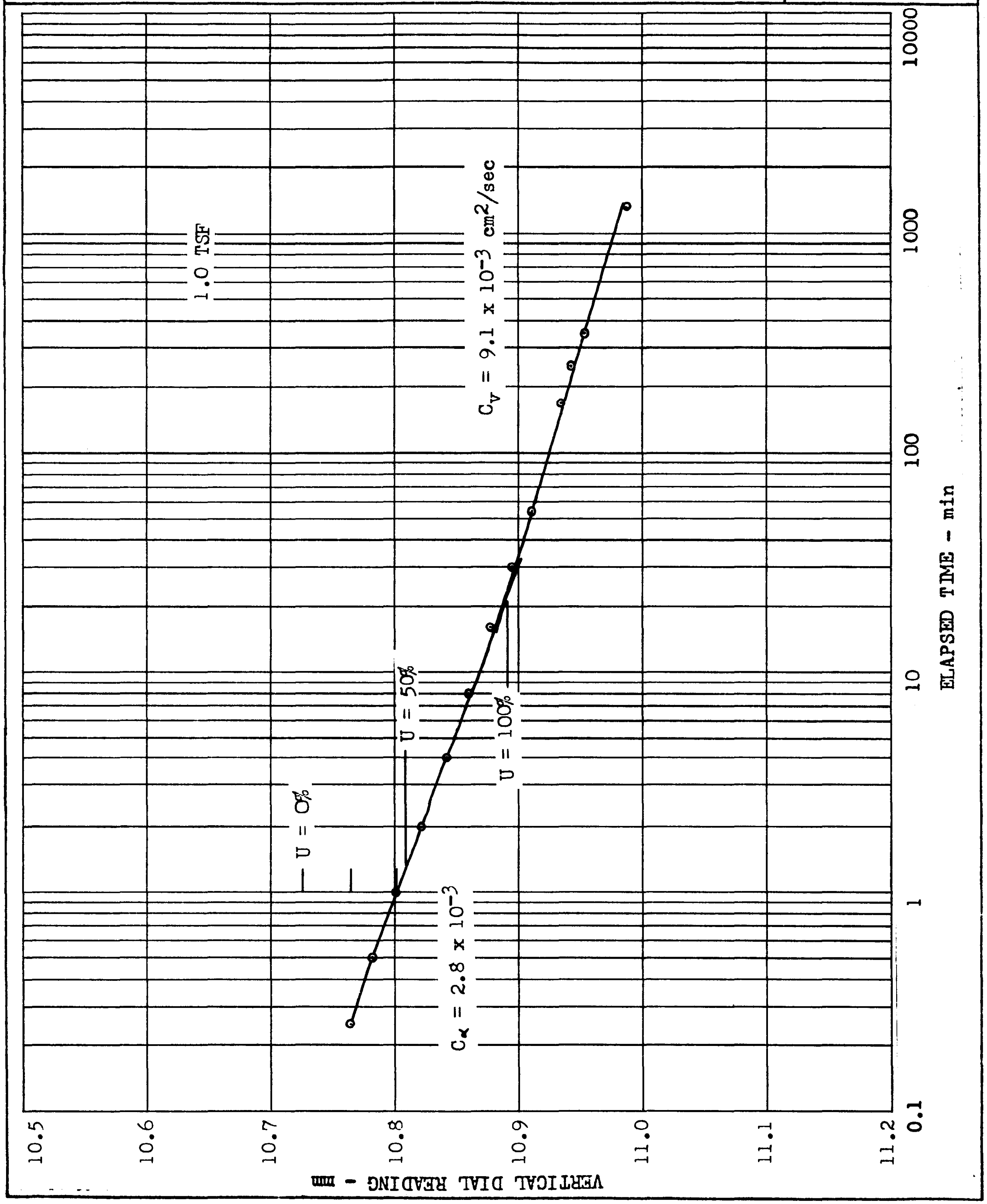


FIGURE 2.5D-41

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 2	8 MAR 77	1B2
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 14.0 FT

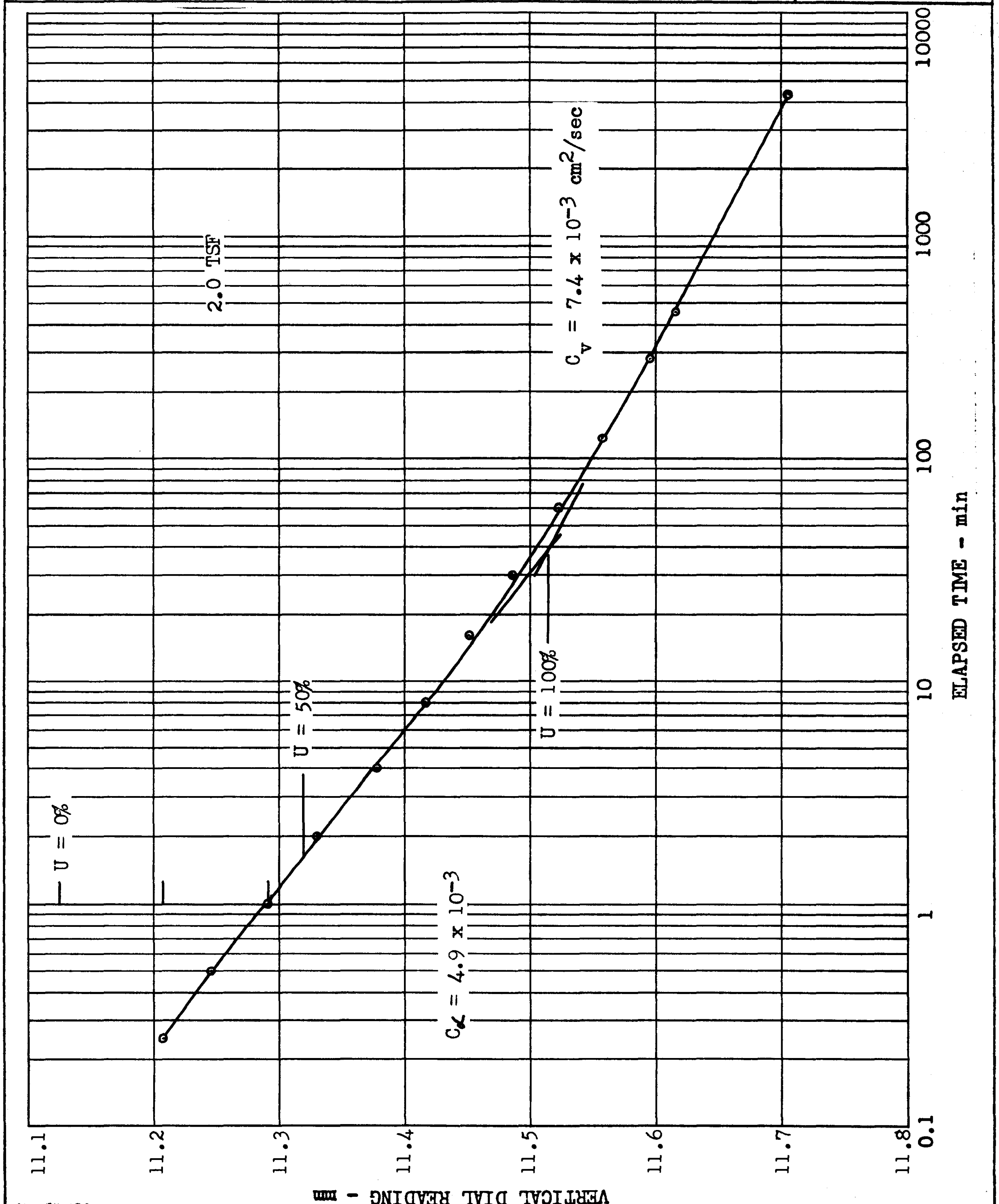


FIGURE 2.5D-42

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY - UNIT 2	8 MAR 77	1B2
DISPLACEMENT vs. LOG TIME PLOT		**DEPTH** 14.0 FT

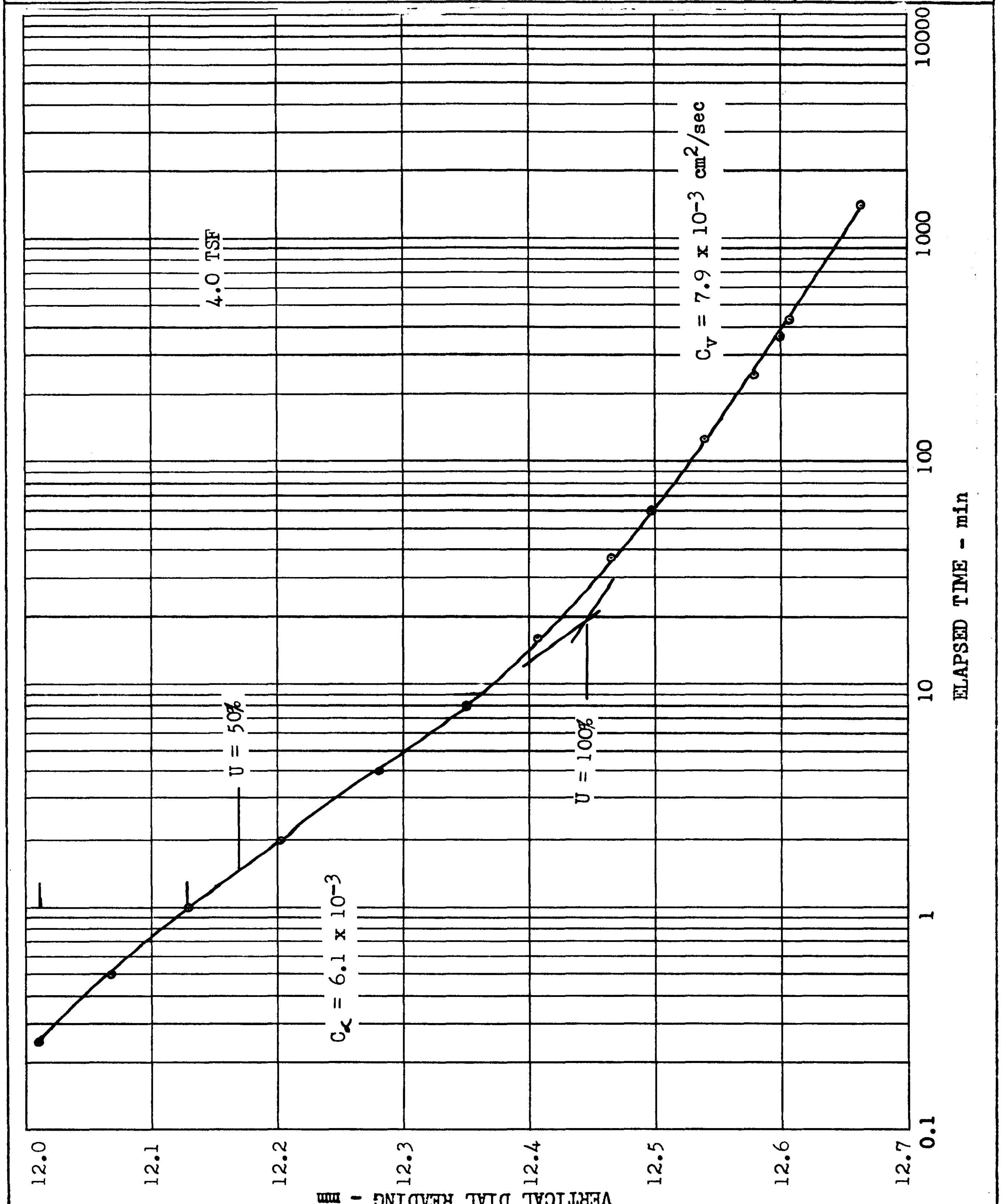


FIGURE 2.5D-43

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL1
SITE BEAVER VALLEY - UNIT 2	DATE 8 MAR 77	SAMPLE NUMBER 1B2
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 14.0 FT

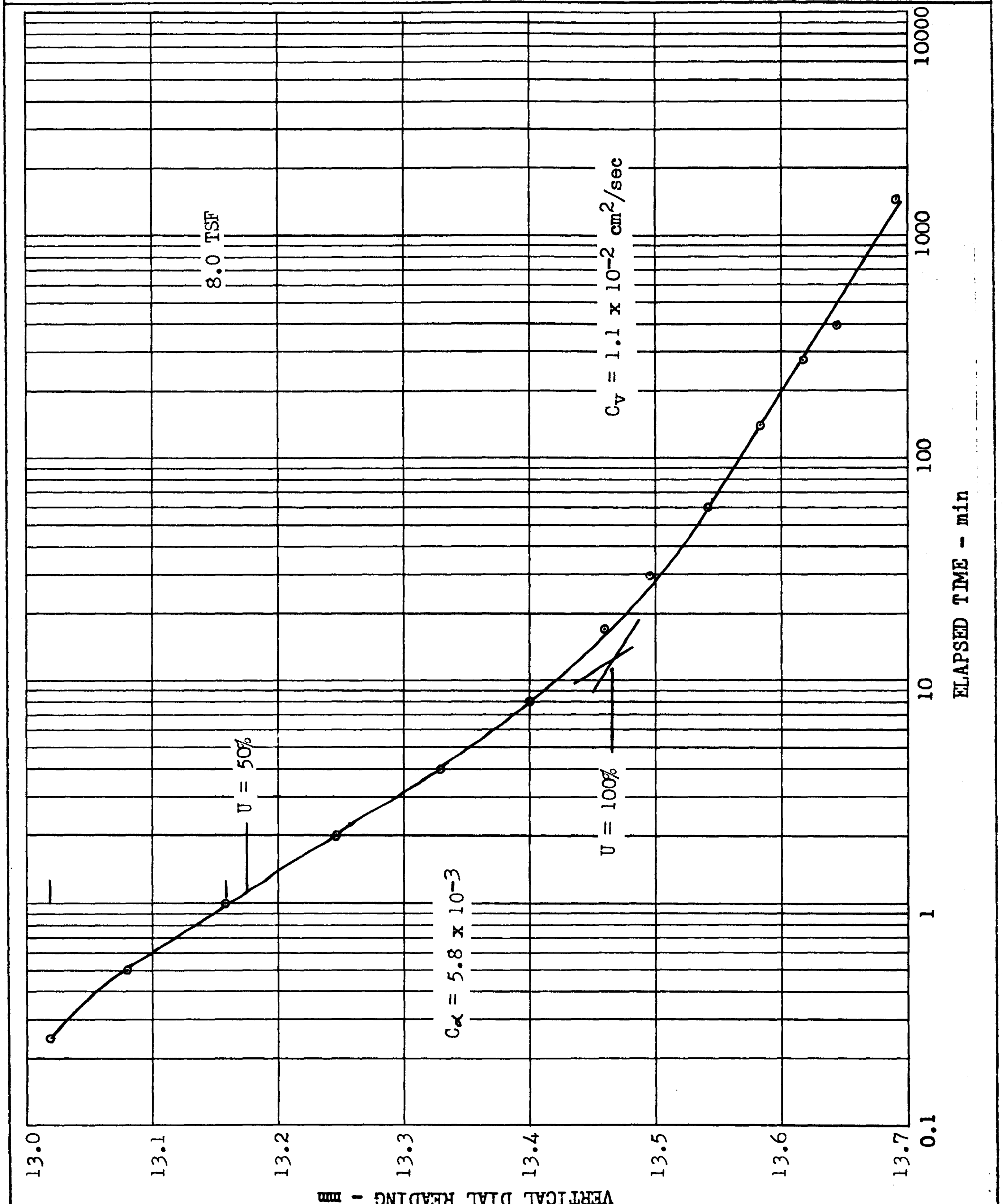


FIGURE 2.5D-44

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
		DEPTH
		16.5 FT

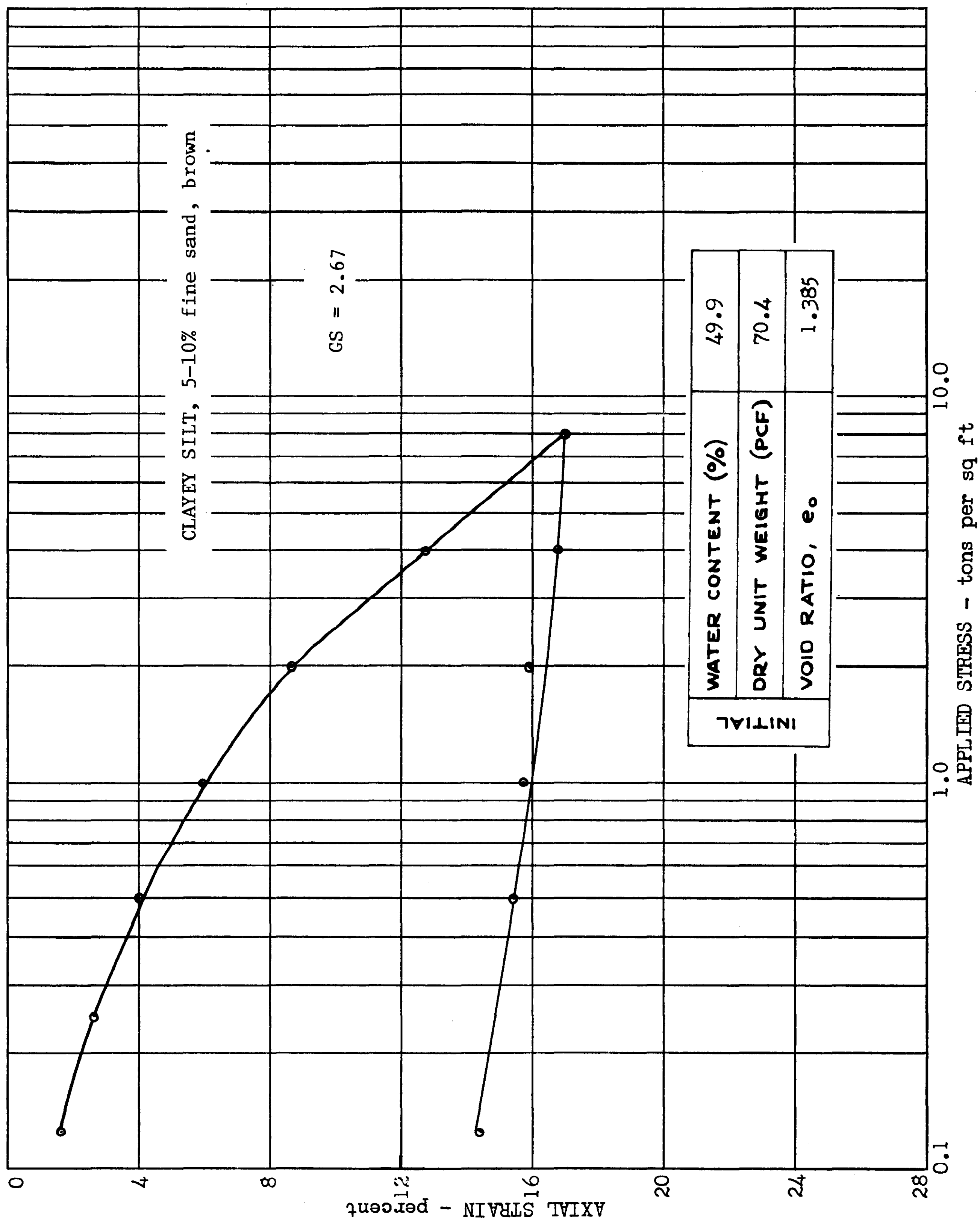


FIGURE 2.5D-45

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
DISPLACEMENT vs. LOG TIME PLOT		**DEPTH** 16.5 FT

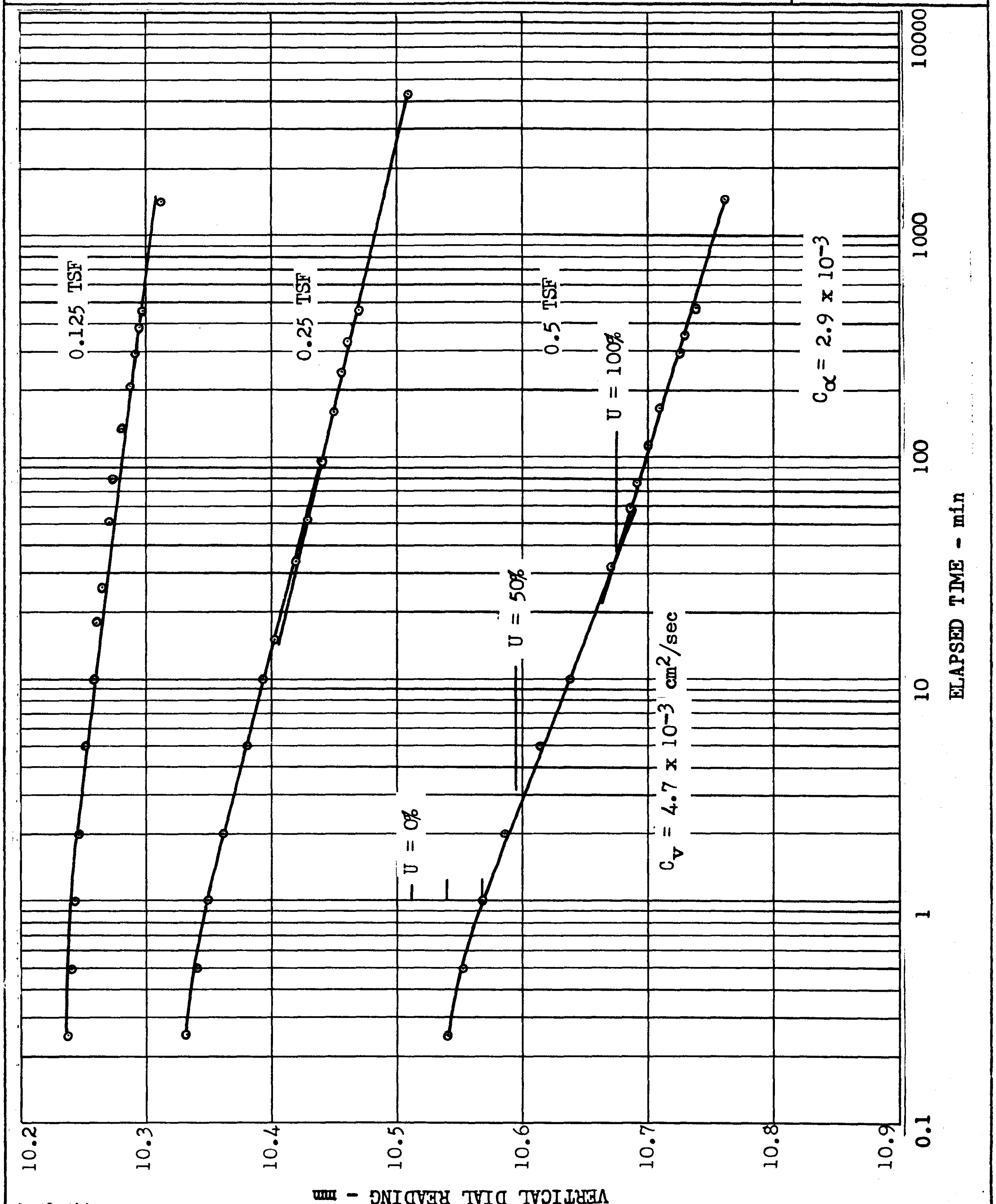


FIGURE 2.5D-46

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 16.5 FT

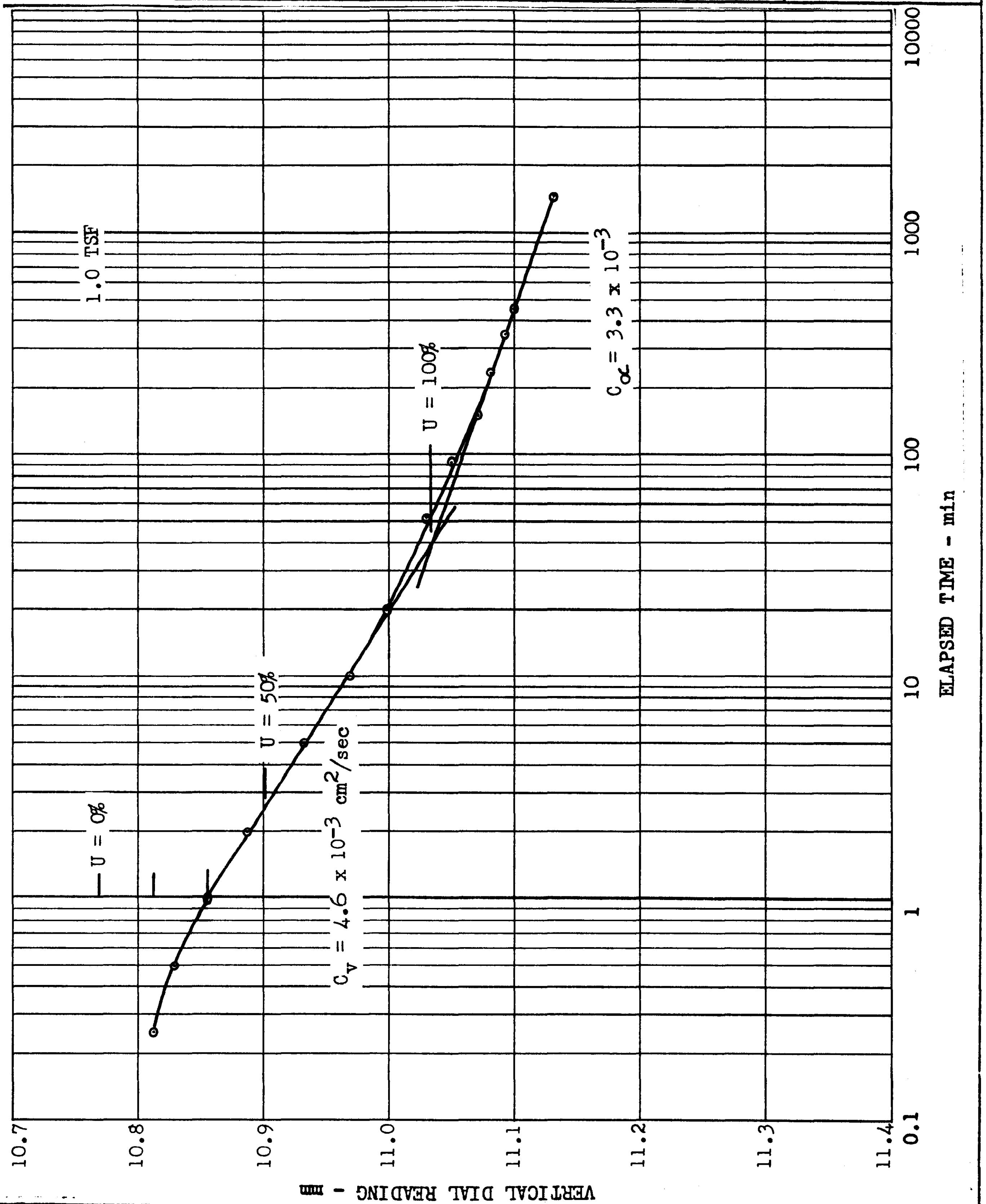


FIGURE 2.5D-47

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
DISPLACEMENT vs. LOG TIME PLOT		**DEPTH** 16.5 FT

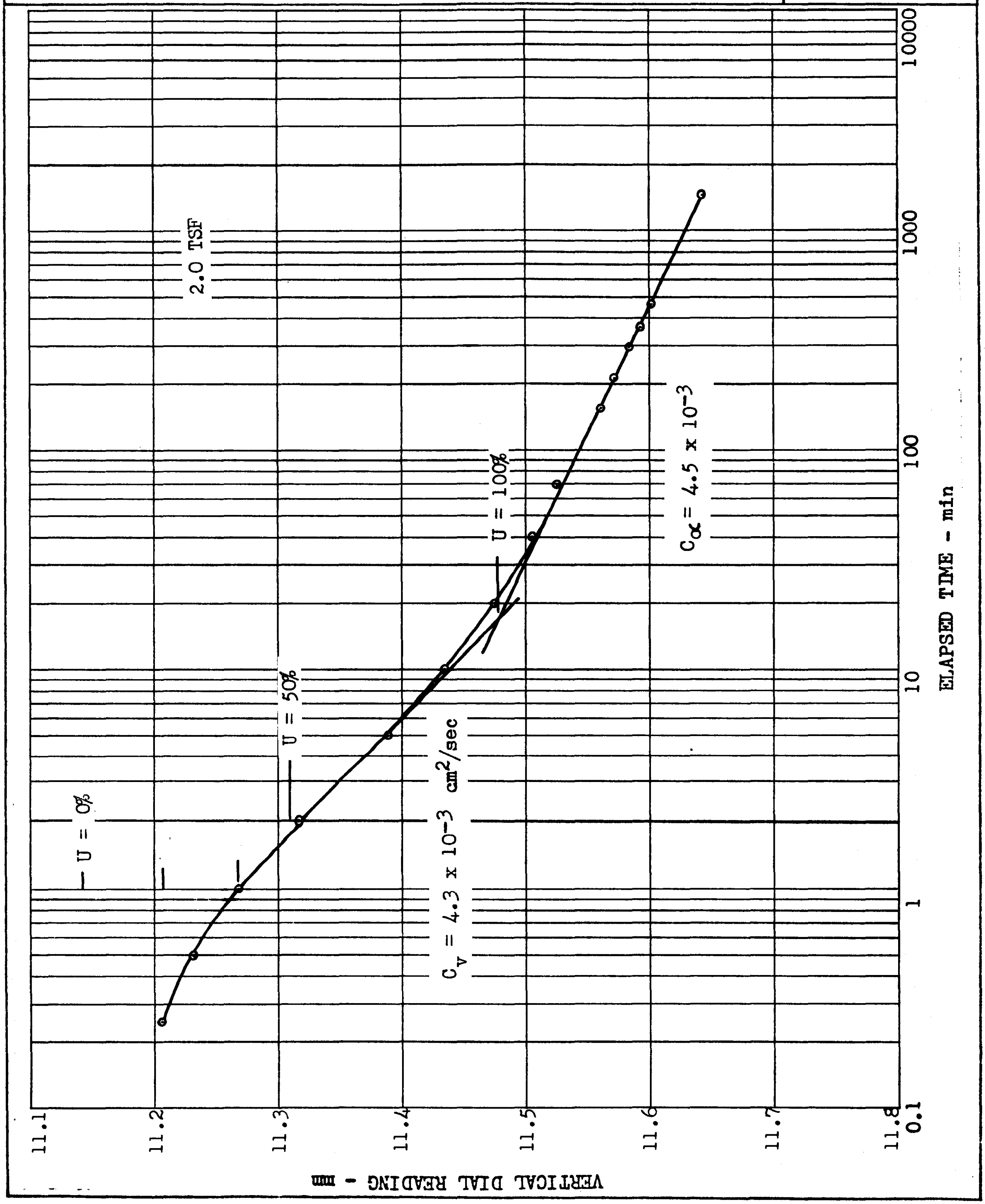


FIGURE 2.5D-48

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
DISPLACEMENT vs. LOG TIME PLOT		**DEPTH** 16.5 FT

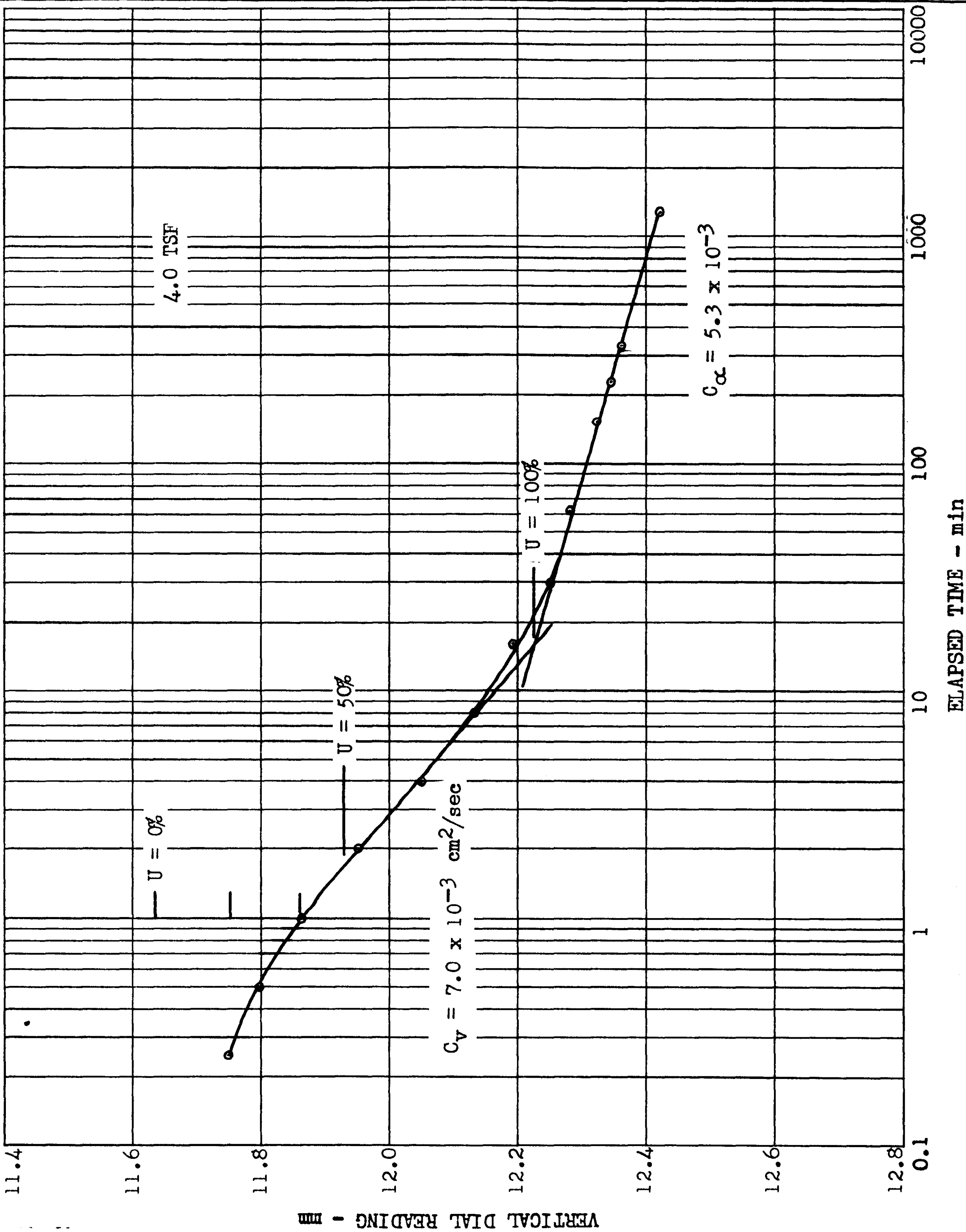


FIGURE 2.5D-49

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL2
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	18 MAR 77	2B1
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 16.5 FT

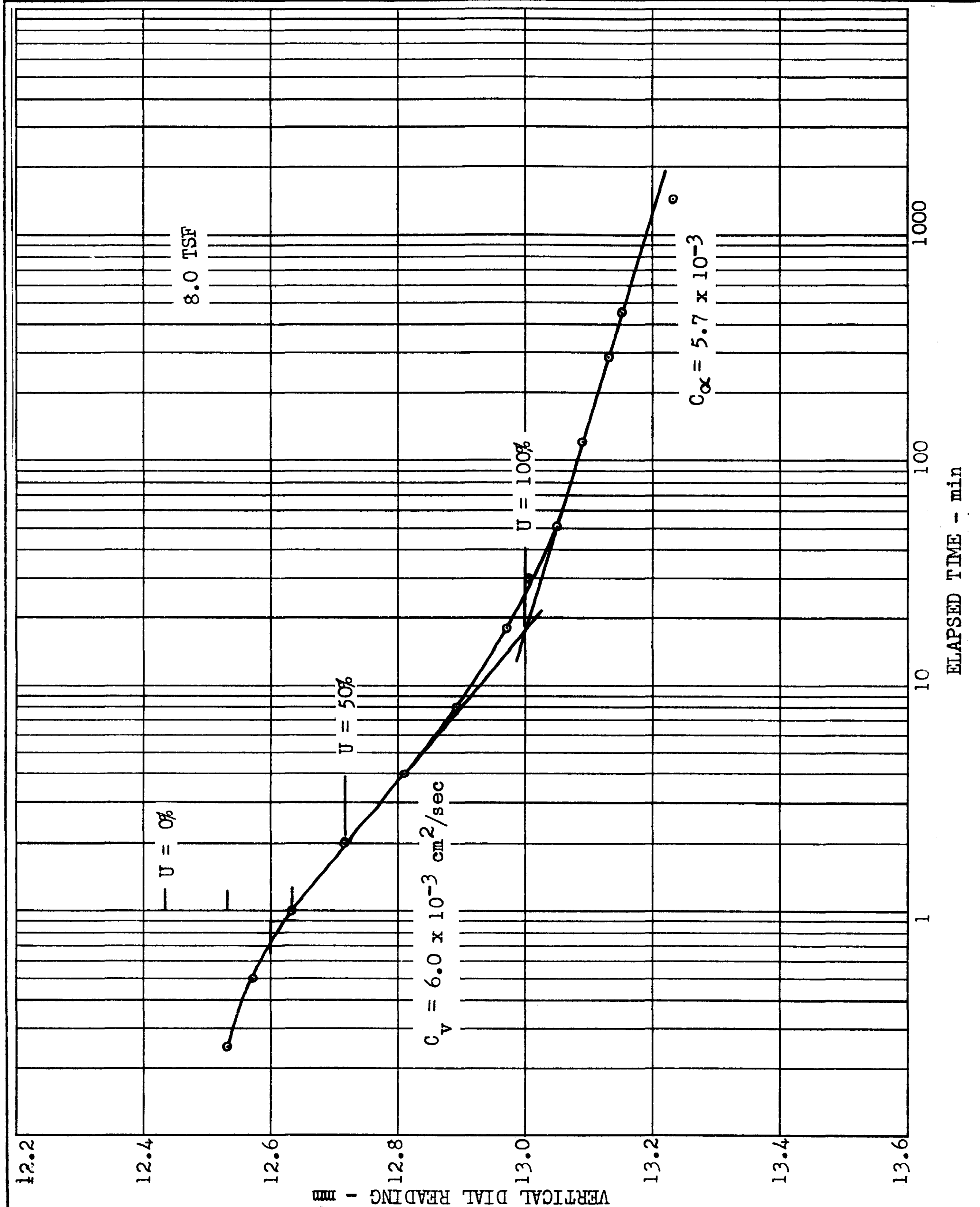


FIGURE 2.5D-50

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	28 MAR 77	5F
		DEPTH
		23.2 FT

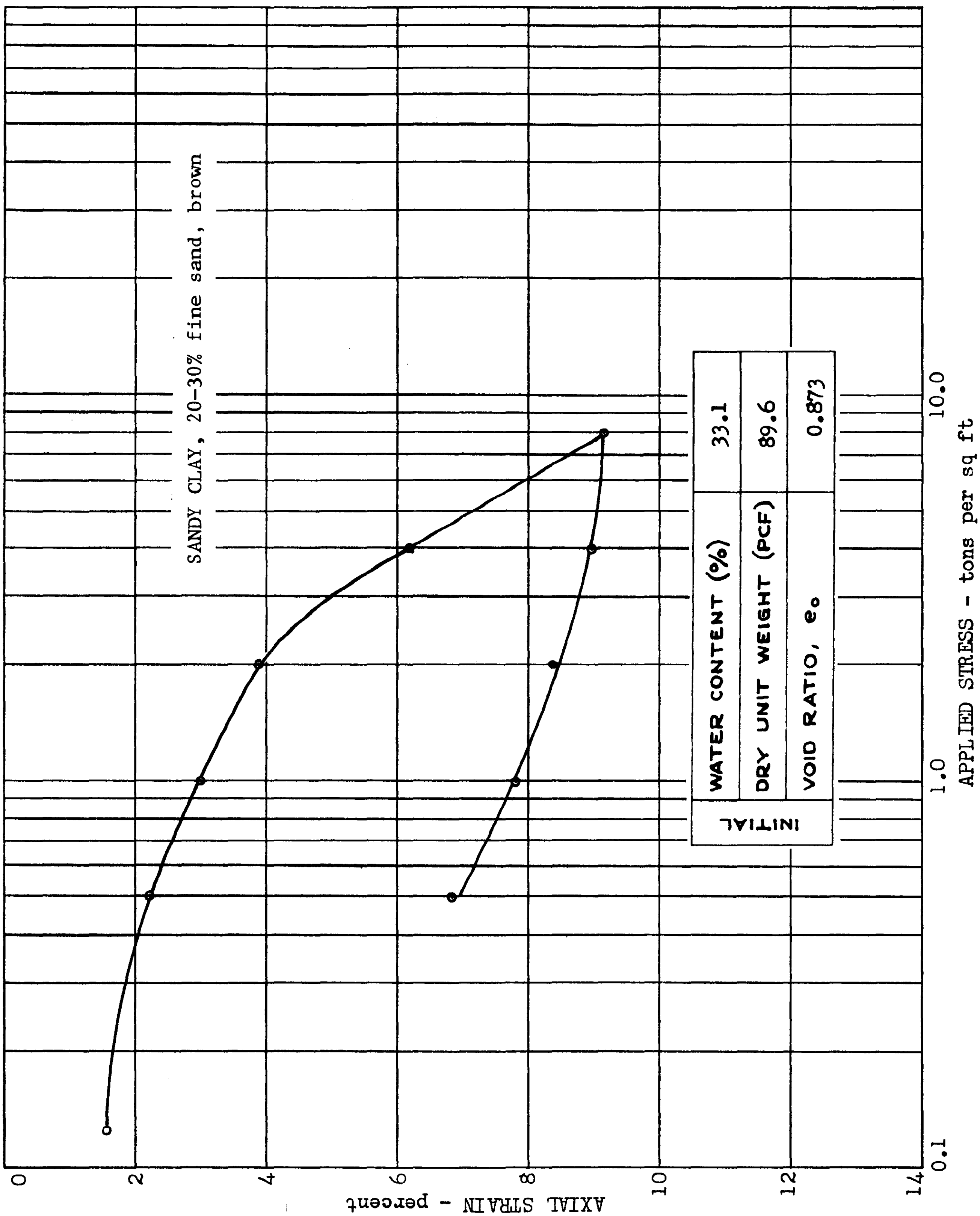


FIGURE 2.5D-51

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	28 MAR 77	5F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 23.2FT

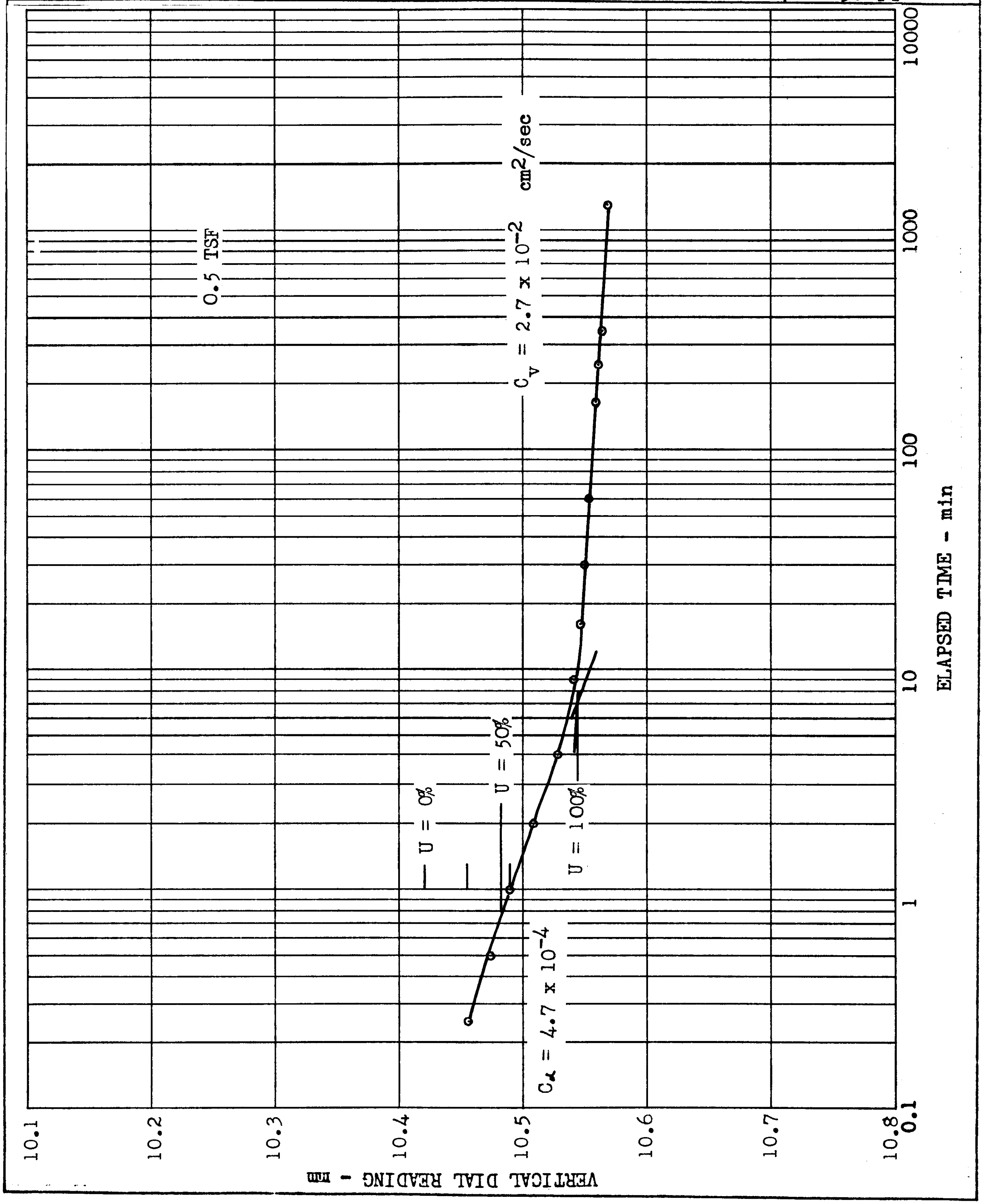


FIGURE 2.5D-52

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	28 MAR 77	5F
DISPLACEMENT vs. LOG TIME PLOT		**DEPTH** 23.2 FT

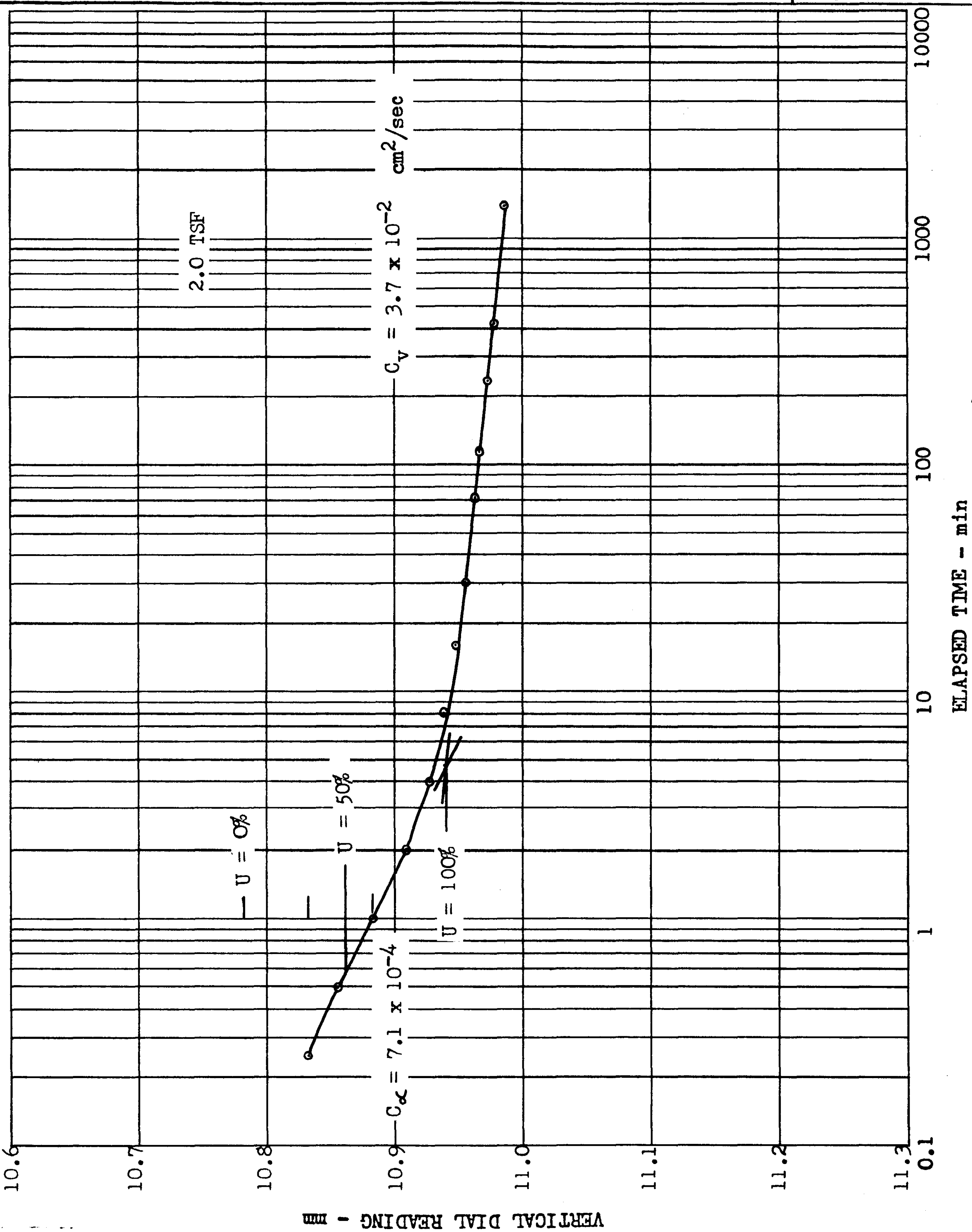


FIGURE 2.5D-53

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	28 MAR 77	5F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 23.2 FT

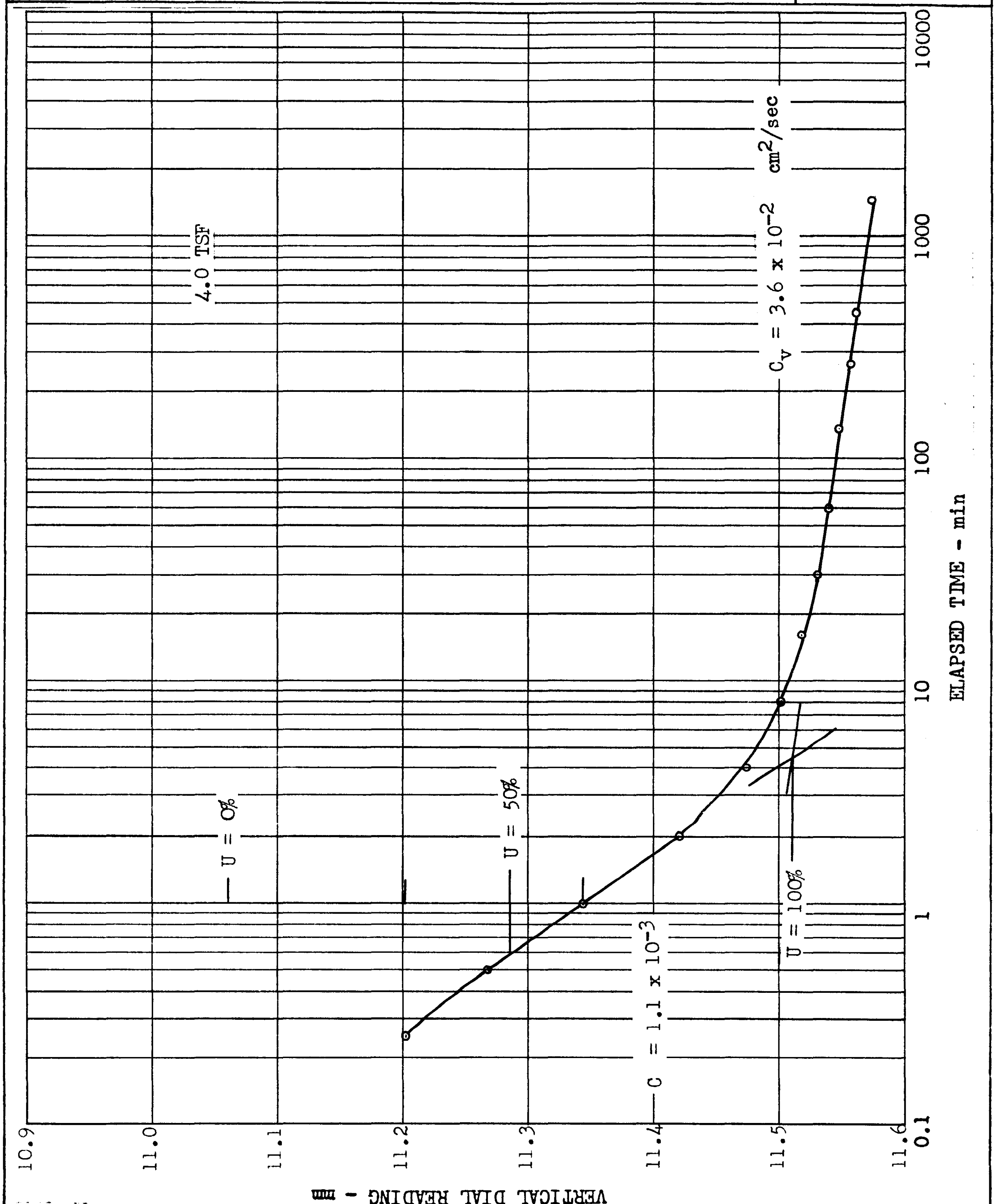


FIGURE 2.5D-54

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	28 MAR 77	5F
DISPLACEMENT vs. LOG TIME PLOT		DEPTH 23.2 FT

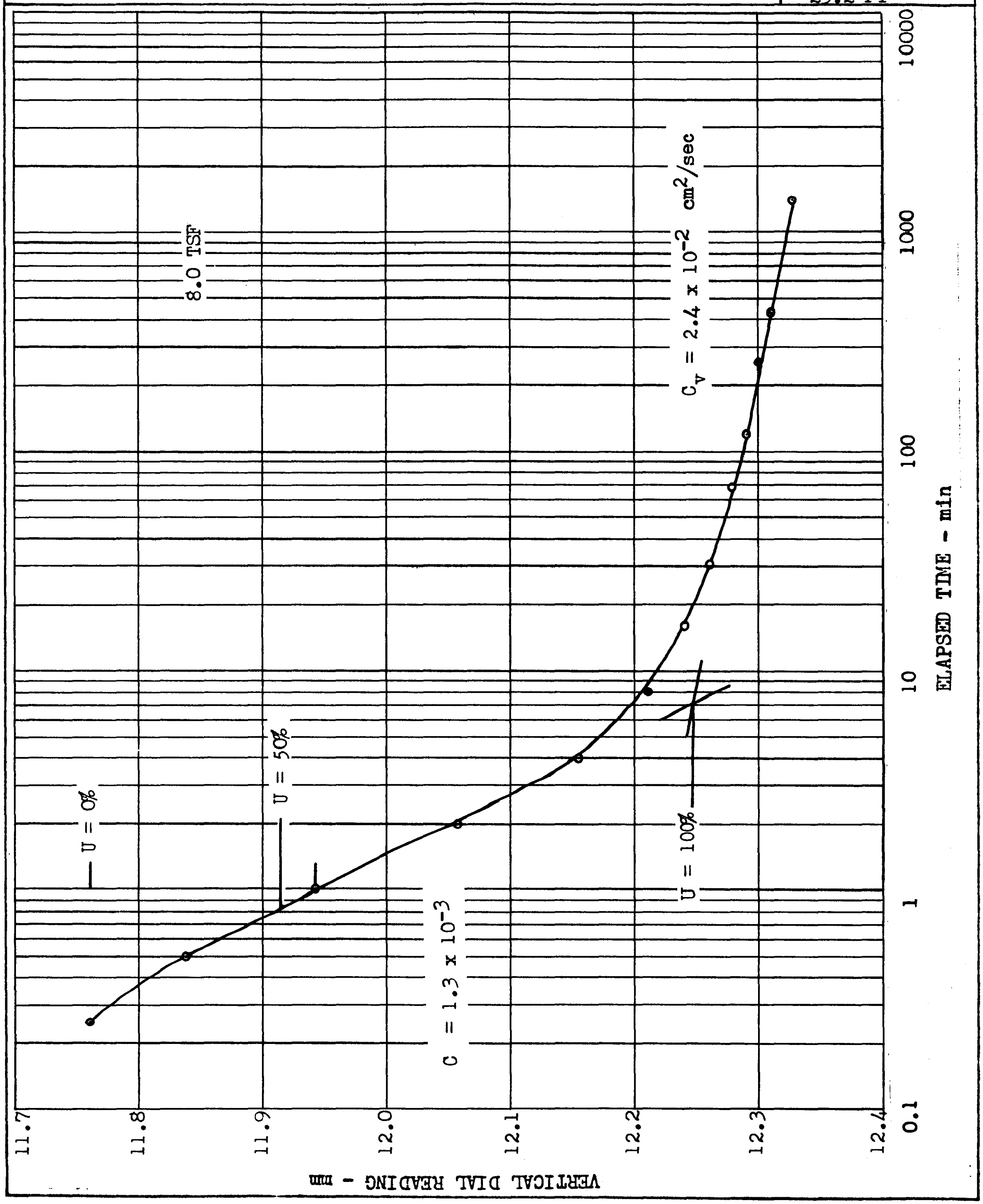


FIGURE 2.5D-55

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	----
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	12 MAY 76	BLOCK SAMPLE I
		DEPTH
INCREMENTAL CONSOLIDATION TEST		---

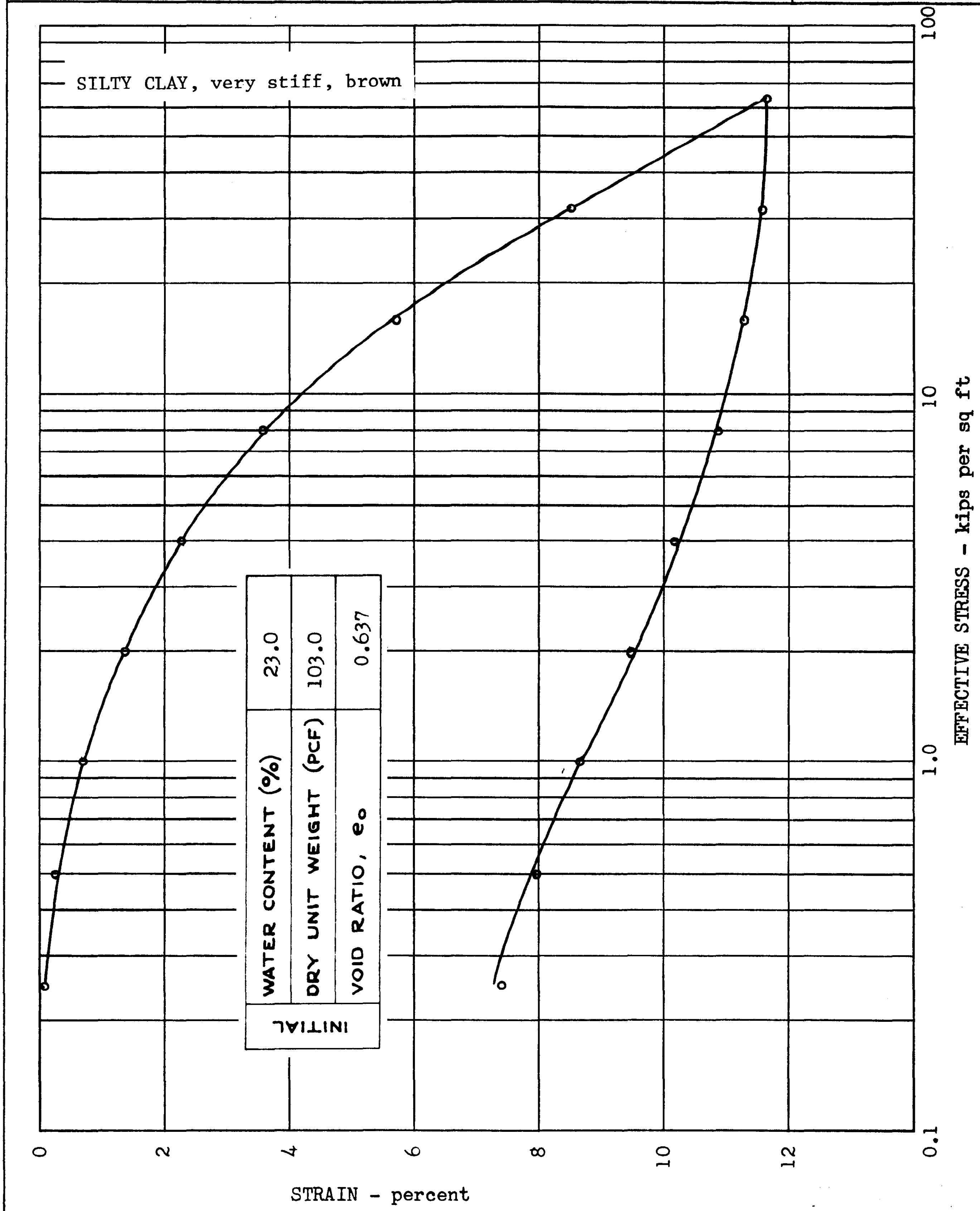


FIGURE 2.5D-56

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	DUQUESNE LIGHT COMPANY
SITE	BEAVER VALLEY UNIT 2
J.O. NUMBER	12241
DATE	4 JUN 76
BORING NUMBER	-
SAMPLE NUMBER	BLOCK SAMPLE I
DEPTH	-

TIME CURVE; 0.25, 0.50, 1.0, 2.0 KSF STRESS INCREMENTS

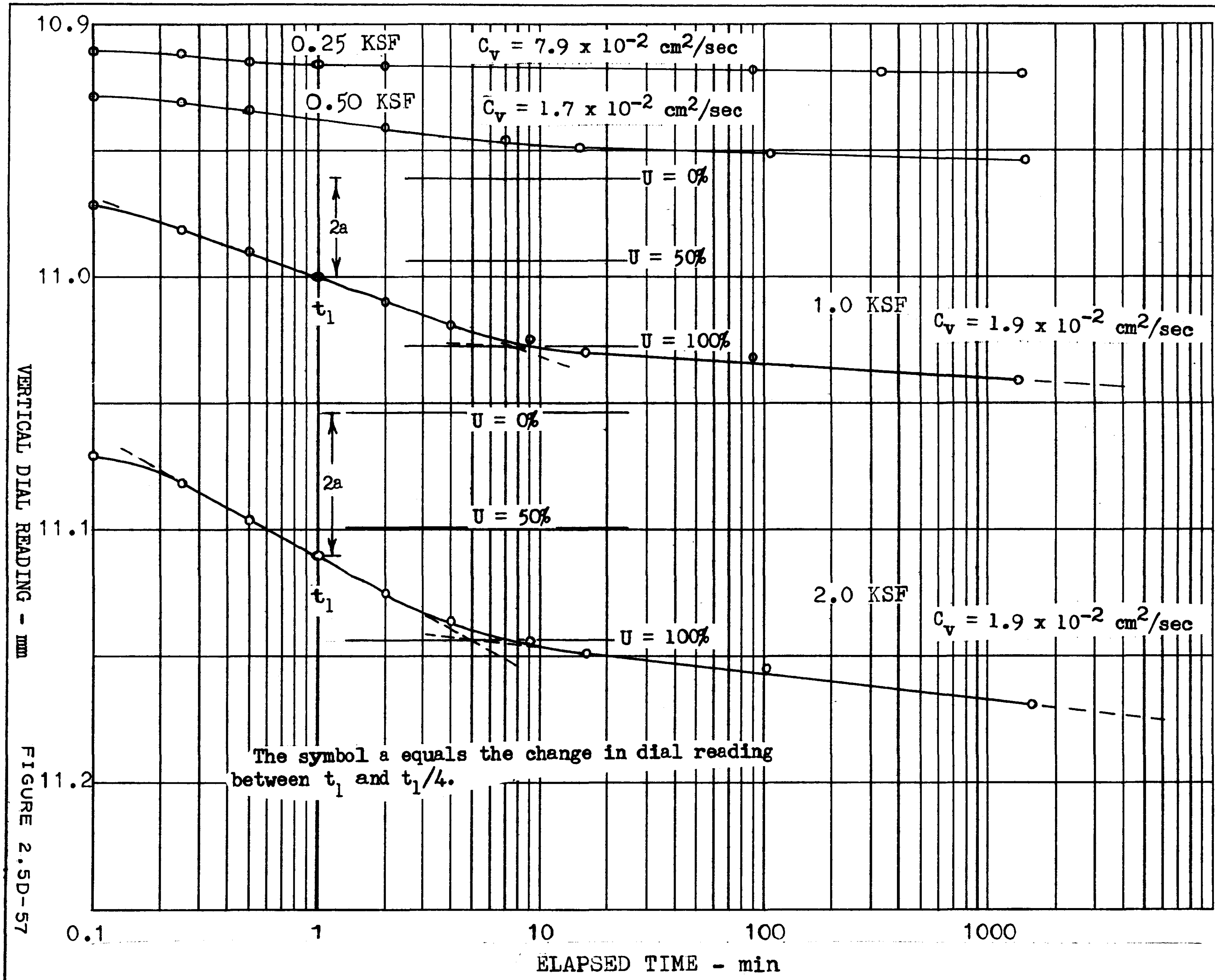


FIGURE 2.5D-57

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	4 JUN 76	BLOCK SAMPLE I
		DEPTH
TIME CURVE: 4.0 KSF STRESS INCREMENT		-

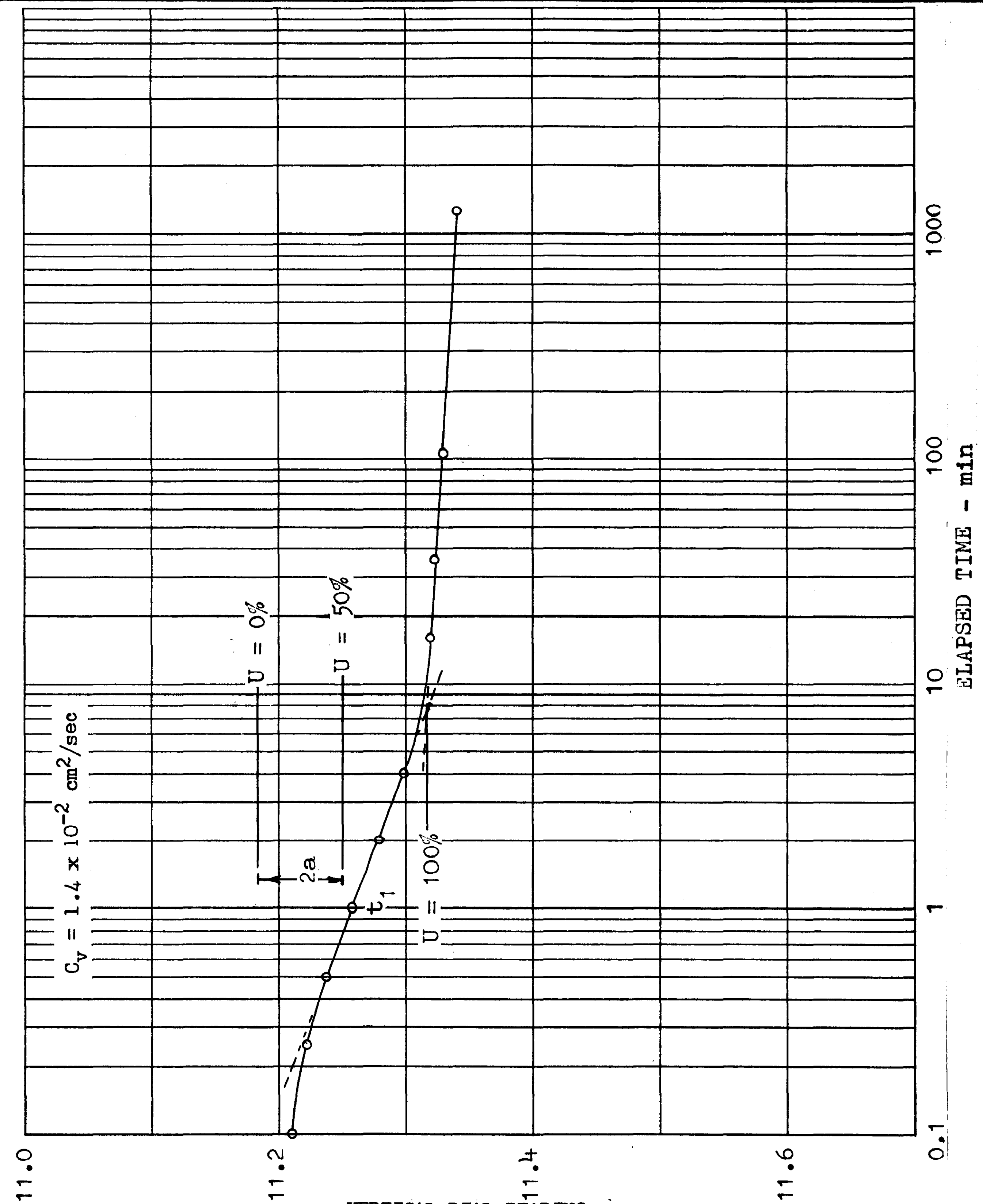


FIGURE 2.5D-58

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	4 JUN 76	BLOCK SAMPLE I
TIME CURVES: 8.0, 16.0 STRESS INCREMENTS		DEPTH: -

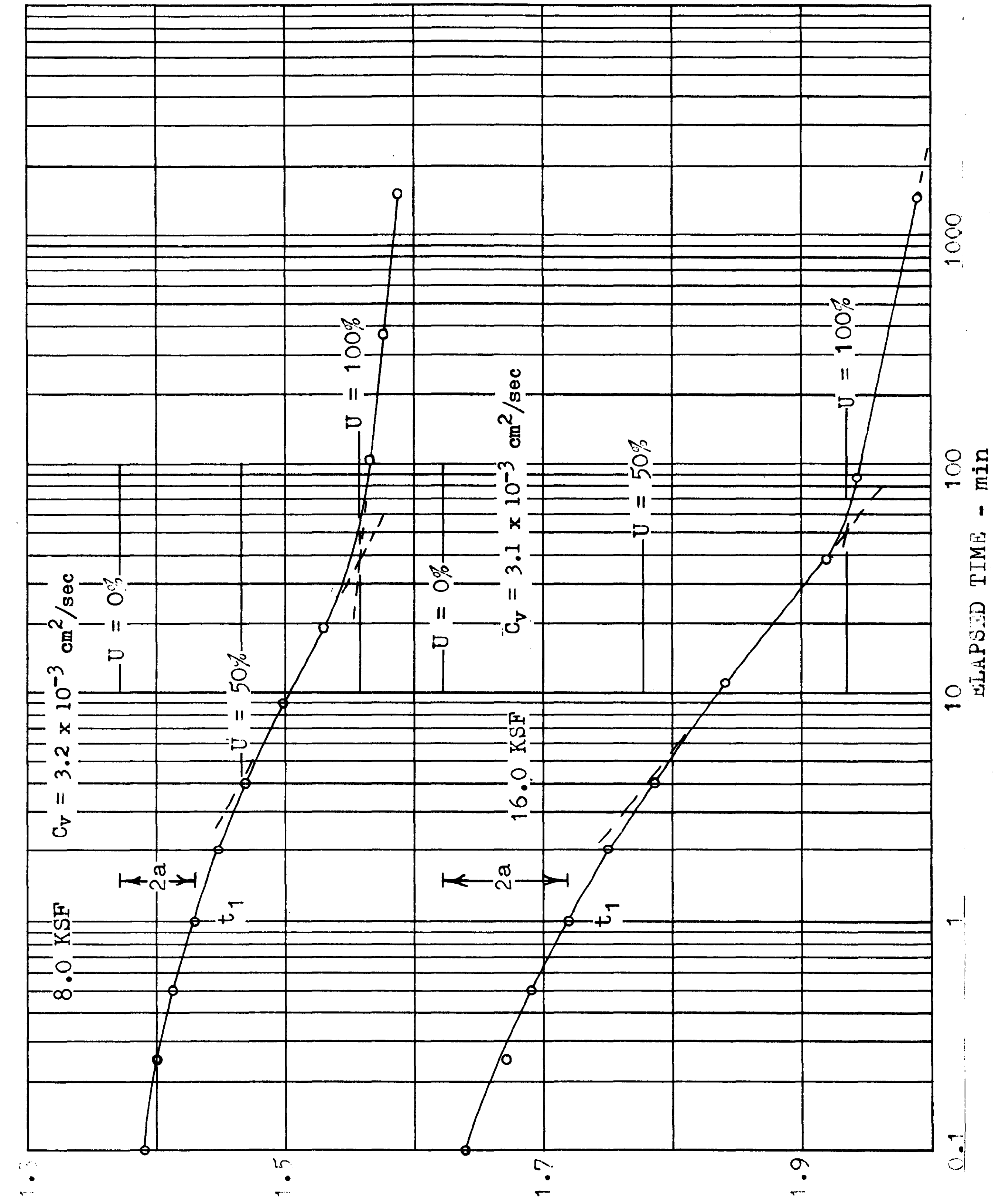


FIGURE 2.5D-59

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	4 JUN 76	BLOCK SAMPLE I
		DEPTH
TIME CURVE: 32.0 KSF STRESS INCREMENT		-

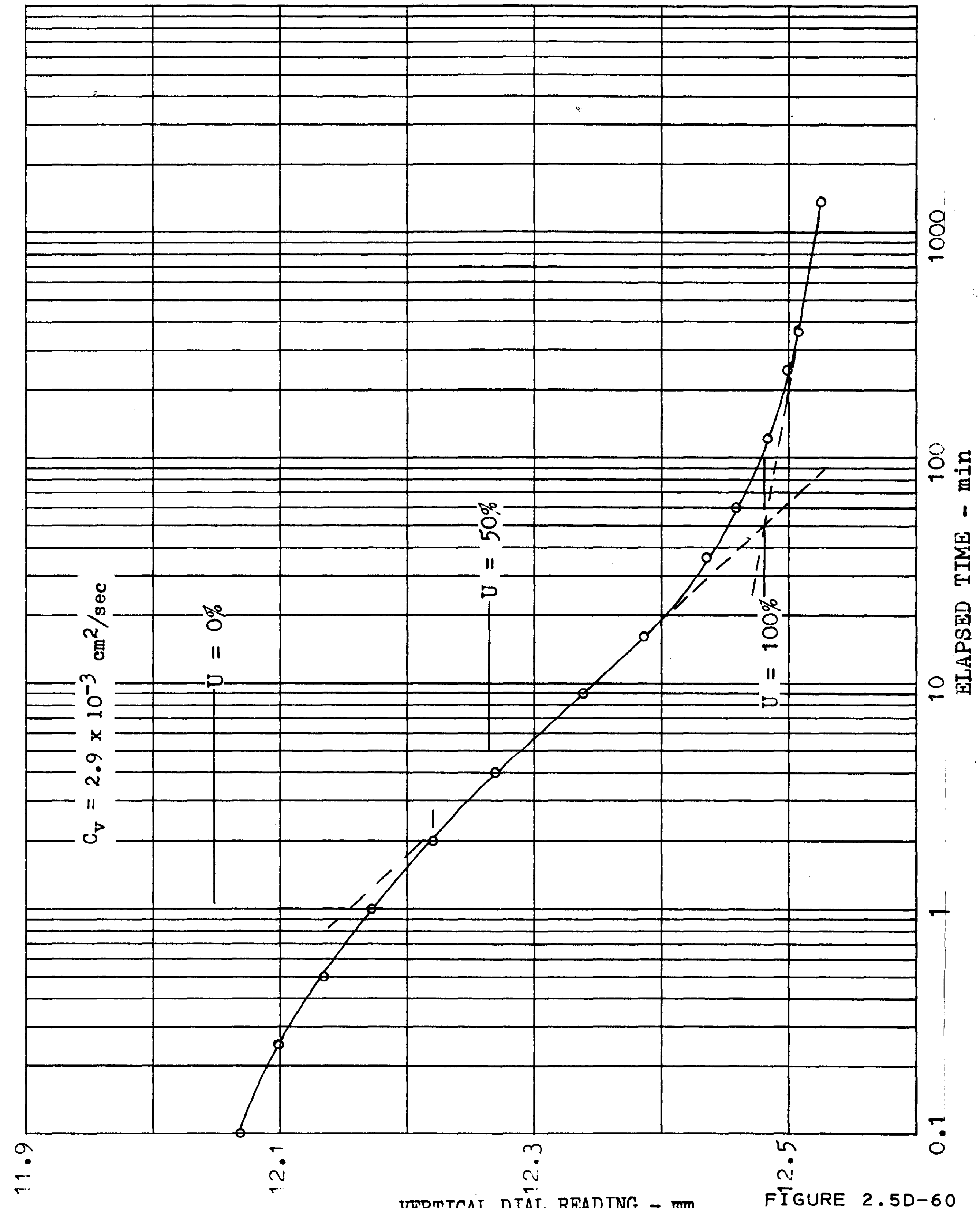


FIGURE 2.5D-60

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	4 JUN 76	BLOCK SAMPLE I
TIME CURVE: 64.0 KSF STRESS INCREMENT		**DEPTH** -

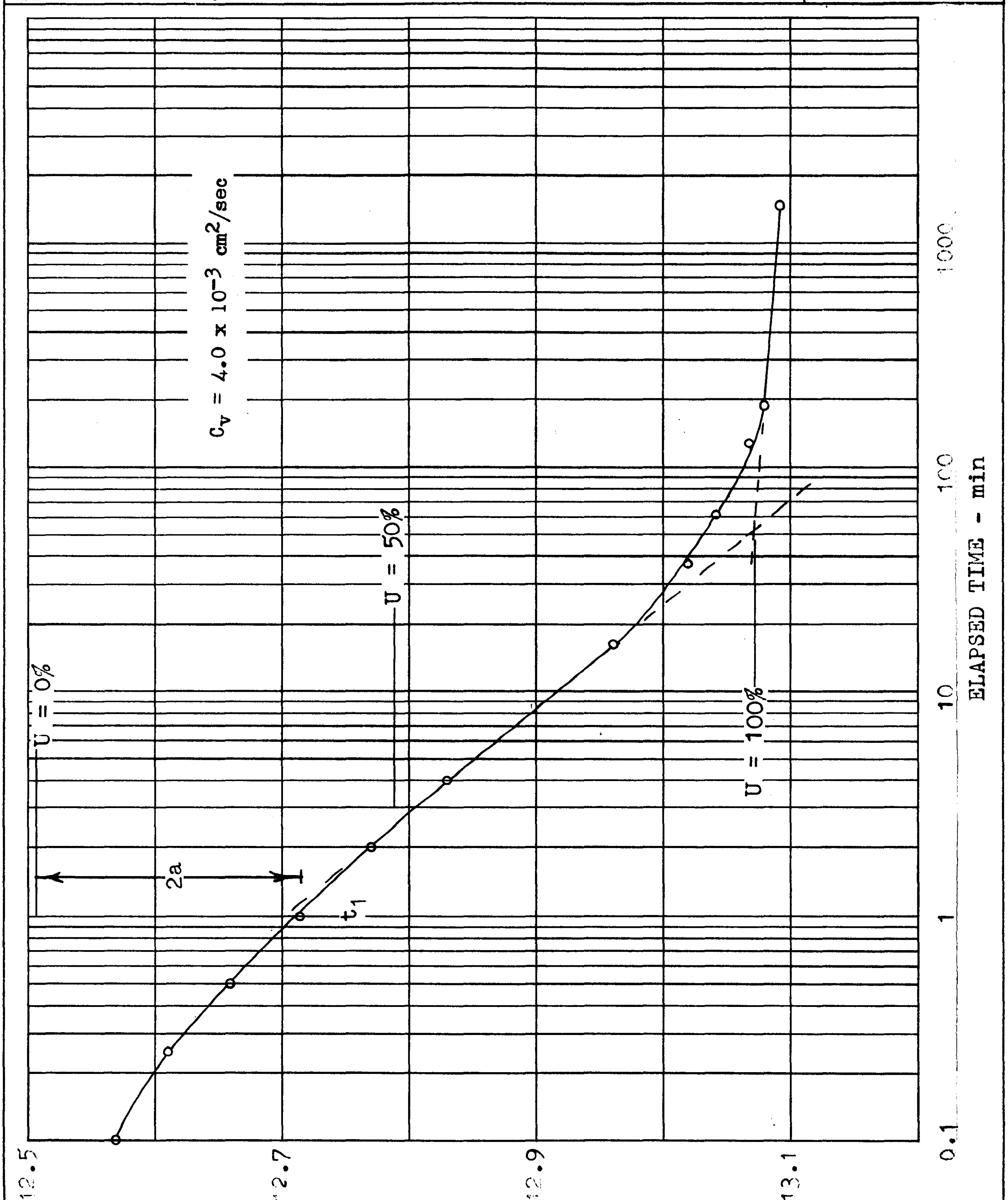


FIGURE 2.5D-61

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	28 JUN 76	BLOCK SAMPLE I
TIME CURVE: 0.25, 0.50, AND 1.0 KSF STRESS INCREMENTS		DEPTH -

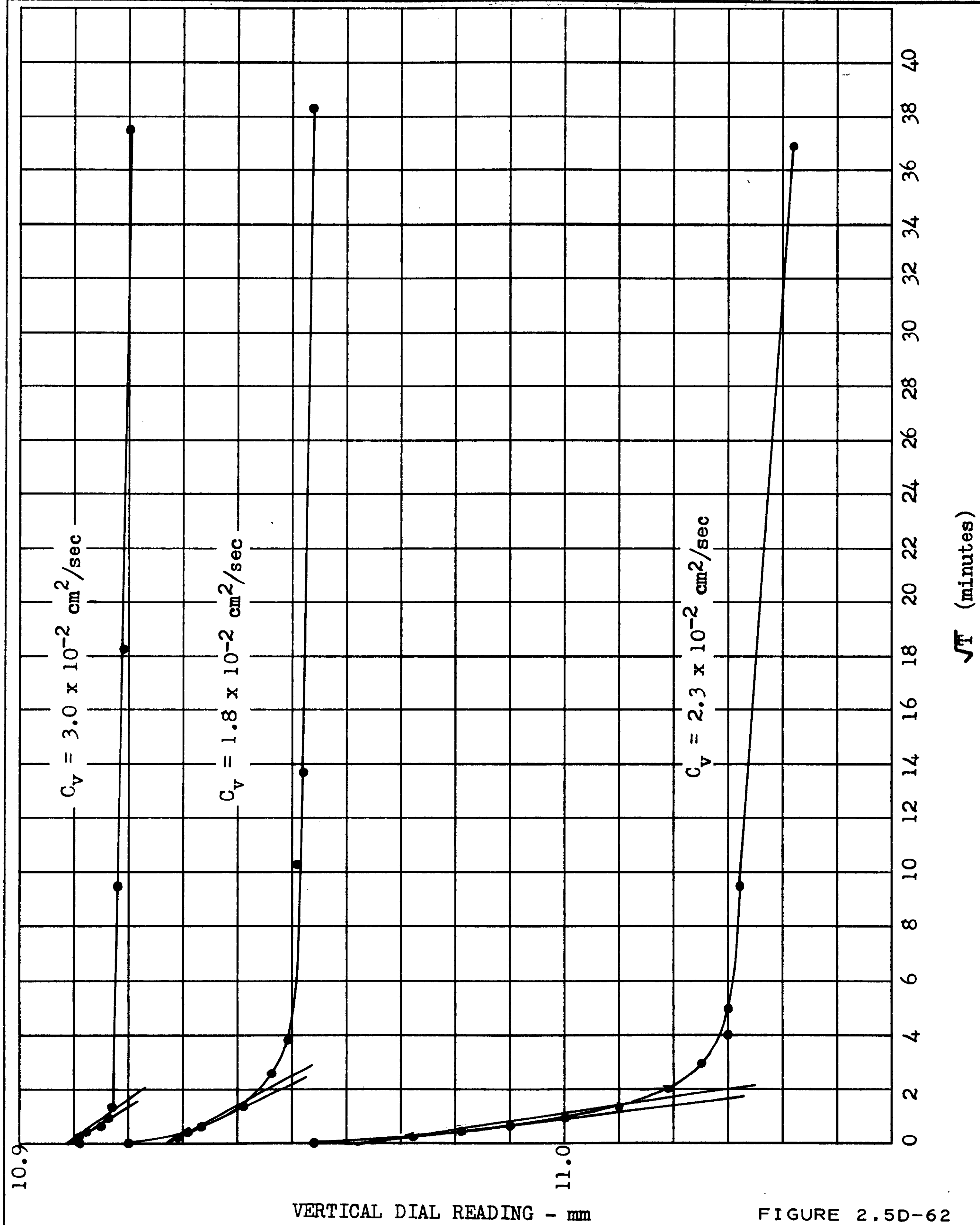


FIGURE 2.5D-62

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	28 JUN 76	BLOCK SAMPLE I
TIME CURVE: 2.0 KSF STRESS INCREMENT		**DEPTH** -

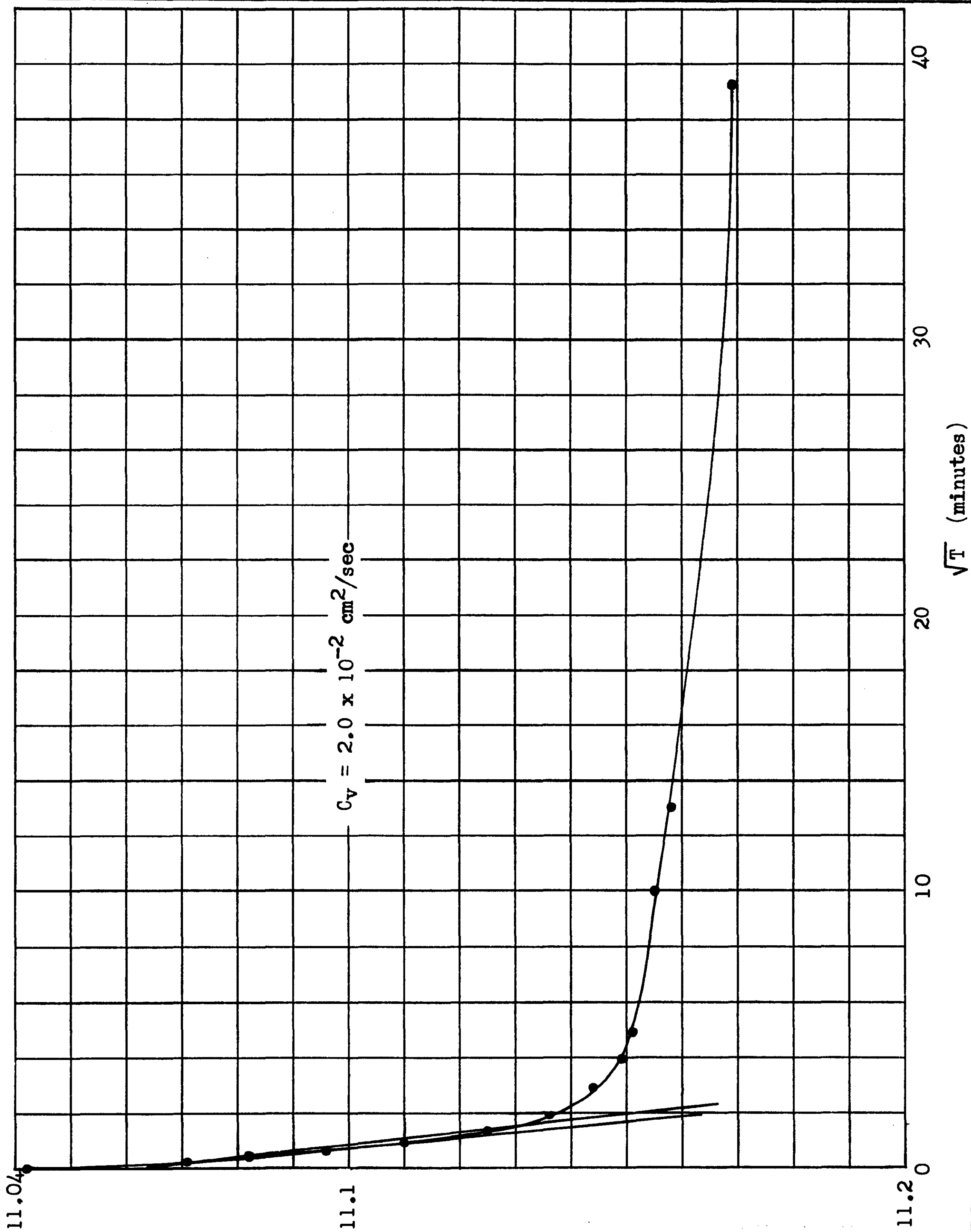


FIGURE 2.5D-63

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	29 JUN 76	BLOCK SAMPLE I
TIME CURVE: 4.0 KSF STRESS INCREMENT		**DEPTH** -

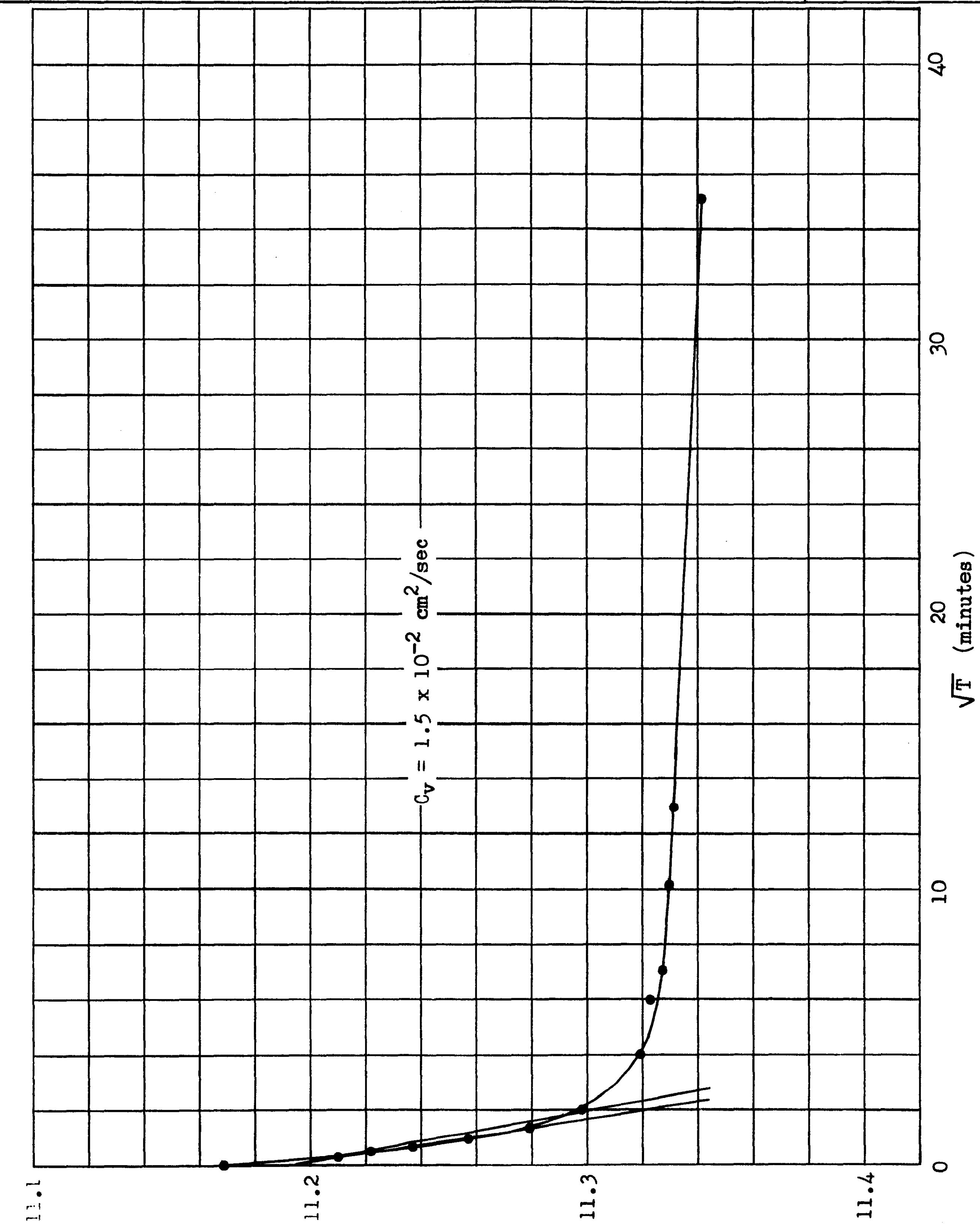


FIGURE 2.5D-64

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	29 JUN 76	BLOCK SAMPLE I
TIME CURVE: 8.0 KSF STRESS INCREMENT		DEPTH -

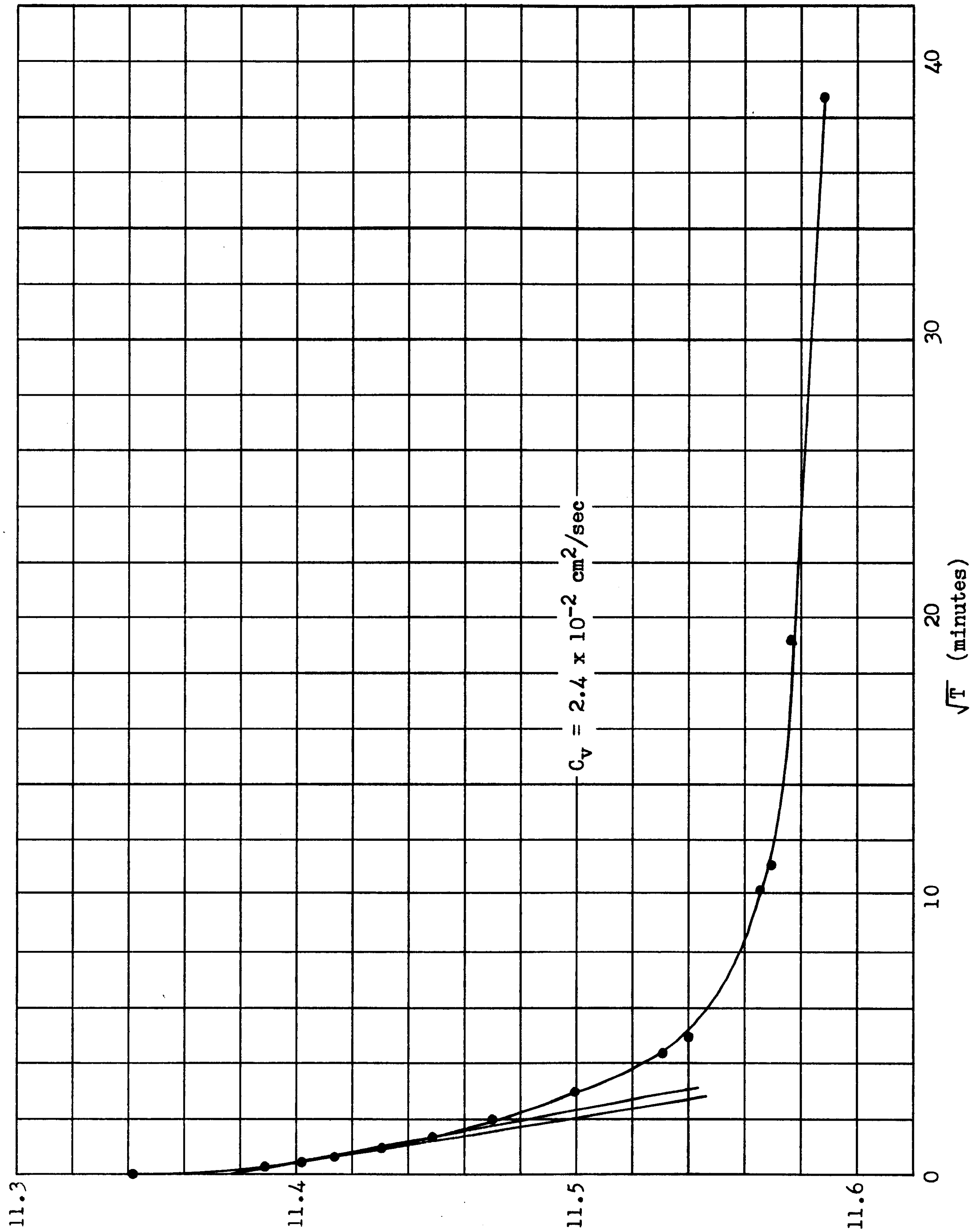


FIGURE 2.5D-65

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	29 JUN 76	BLOCK SAMPLE I
TIME CURVE: 16.0 KSF STRESS INCREMENT		**DEPTH** -

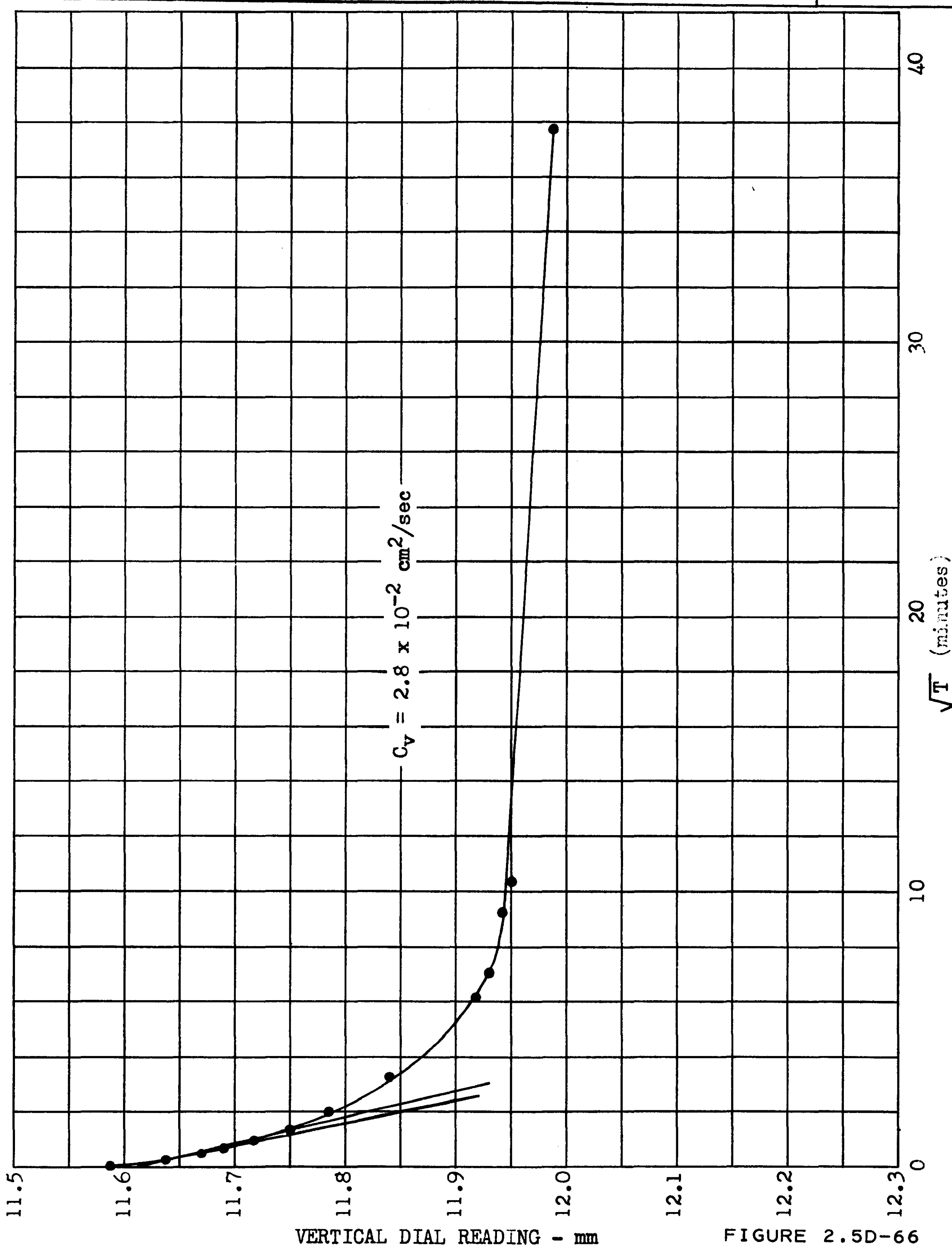


FIGURE 2.5D-66

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	29 JUN 76	BLOCK SAMPLE I
TIME CURVE: 32.0 KSF STRESS INCREMENT		DEPTH -

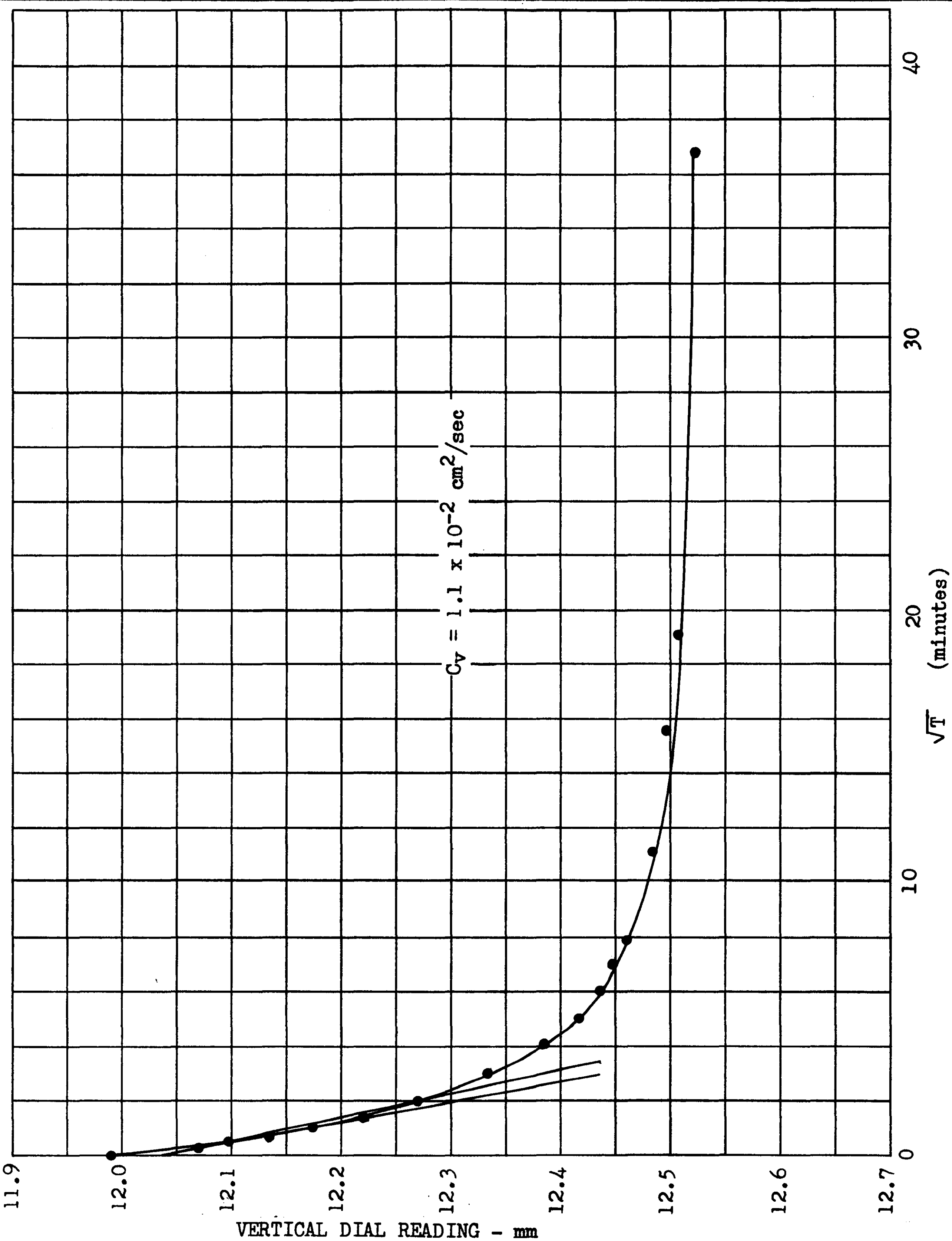


FIGURE 2.5D-67

STONE & WEBSTER ENGINEERING CORPORATION

CONSOLIDATION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	-
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY UNIT 2	30 JUN 76	BLOCK SAMPLE I
		DEPTH
TIME CURVE: 64.0 KSF STRESS INCREMENT		-

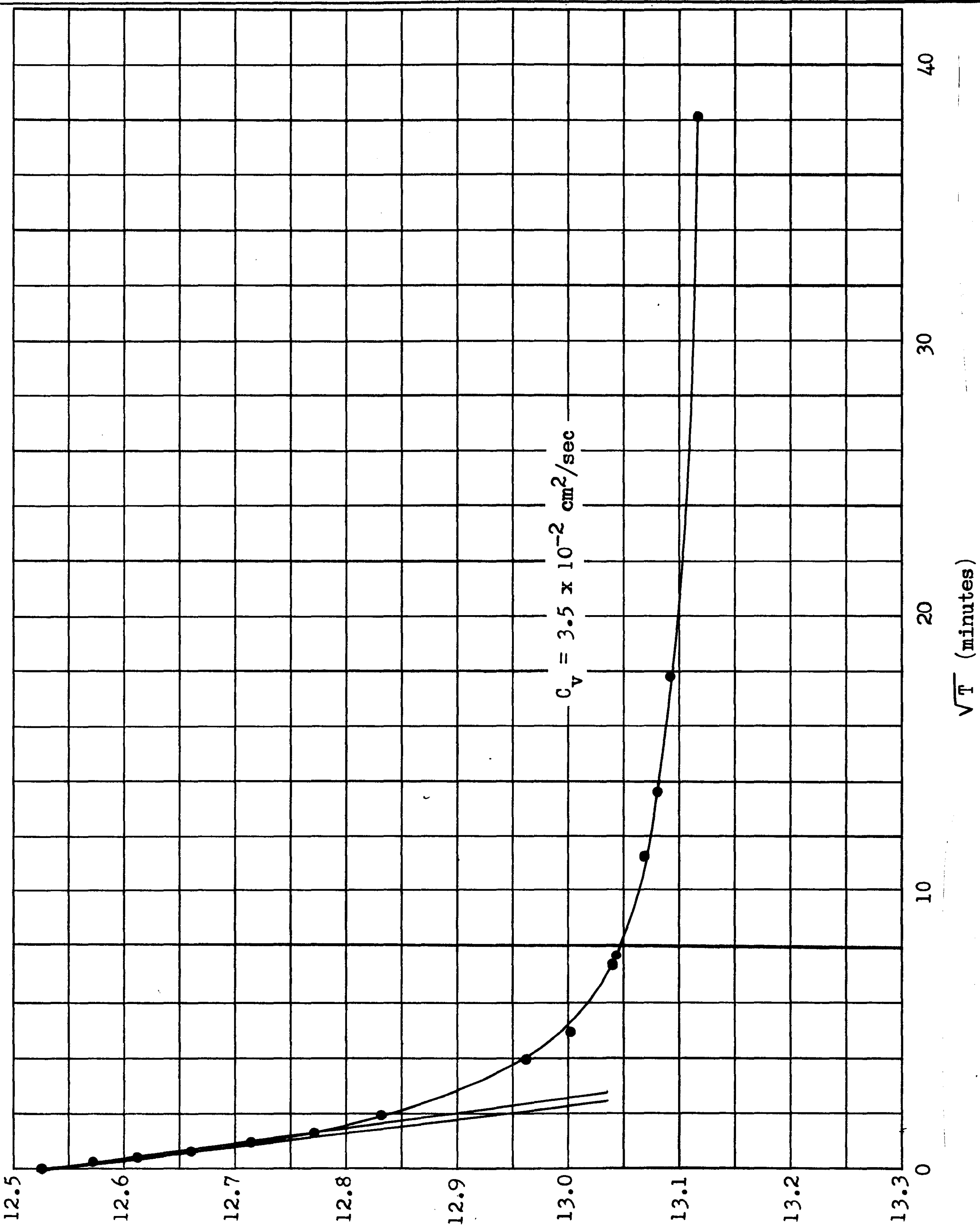


FIGURE 2.5D-68

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12690.46	BORING NUMBER AB1
SITE BEAVER VALLEY - UNIT 1	DATE 13 MAR 79	SAMPLE NUMBER 13F
SOIL DESCRIPTION MODERATELY PLASTIC SILTY CLAY		DEPTH 29.5 FT.

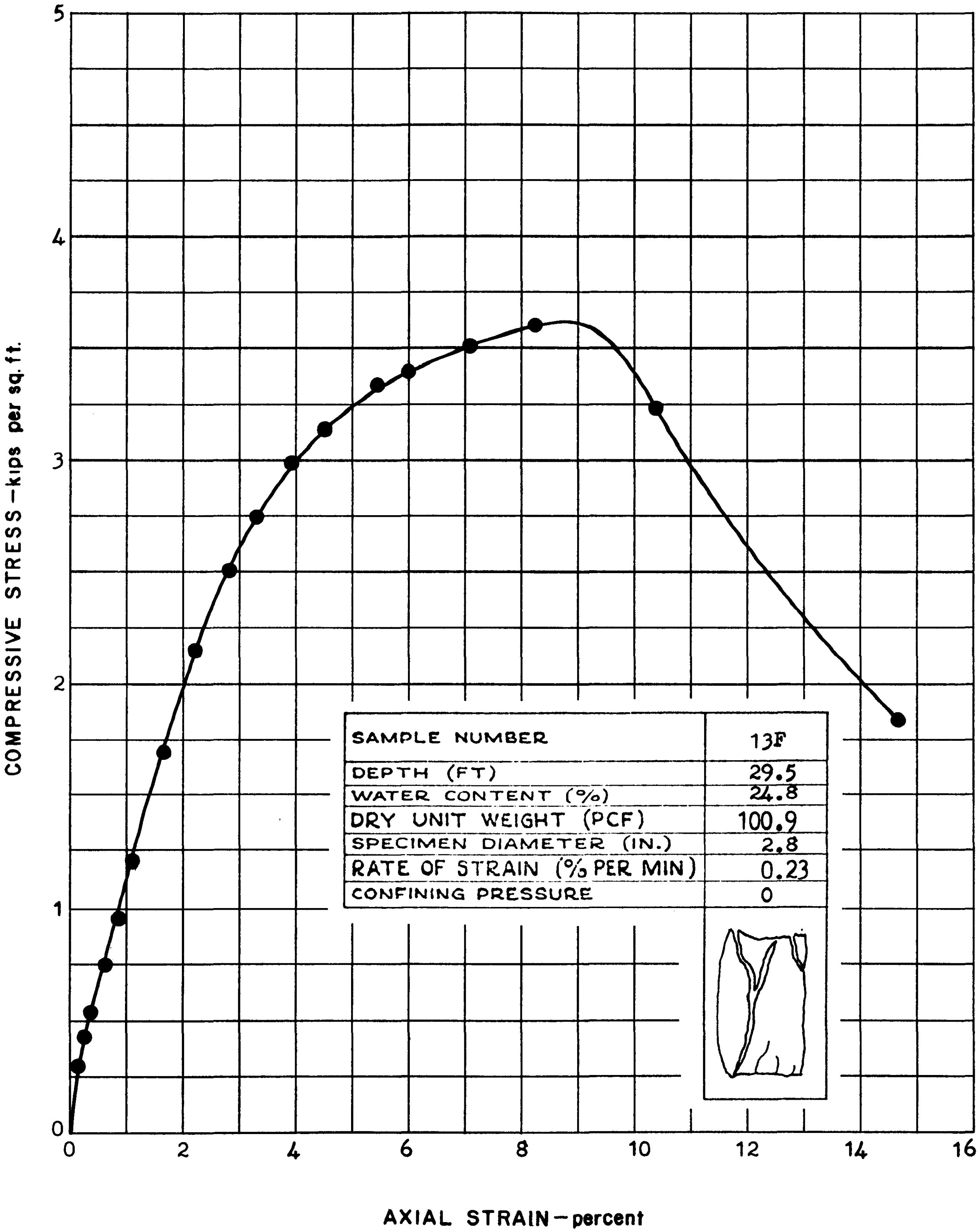
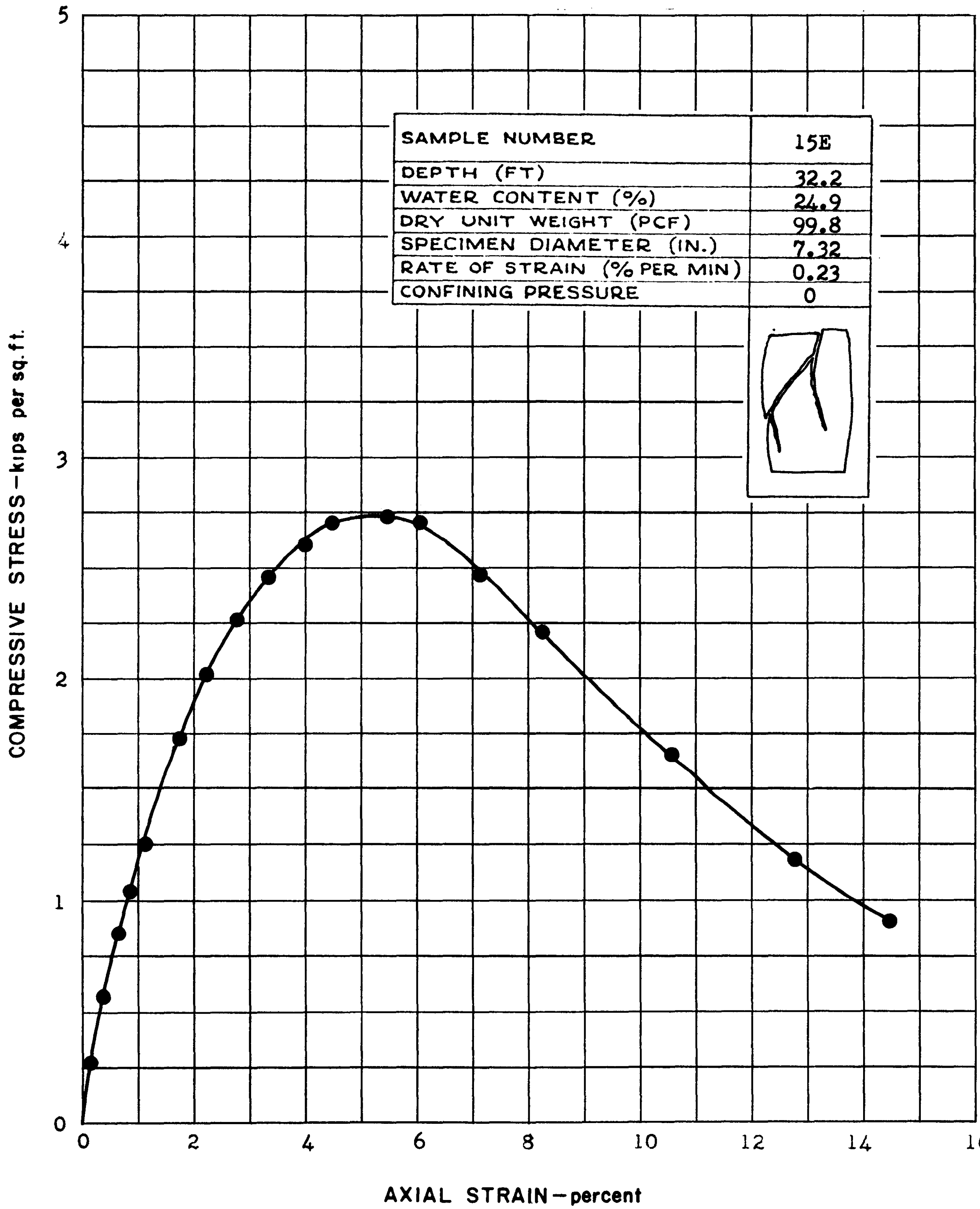


FIGURE 2.5D-69

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12690.46	AB1
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 1	17 APR 79	15E
SOIL DESCRIPTION		DEPTH
SILTY CLAY, MODERATELY PLASTIC, 1-2% FINE SAND, BROWN.		32.2 FT



SAMPLE NUMBER	15E
DEPTH (FT)	32.2
WATER CONTENT (%)	24.9
DRY UNIT WEIGHT (PCF)	99.8
SPECIMEN DIAMETER (IN.)	7.32
RATE OF STRAIN (% PER MIN)	0.23
CONFINING PRESSURE	0

FIGURE 2.5D-70

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12690.46	AB2
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 1	21 MAR 79	15E
SOIL DESCRIPTION		DEPTH
SANDY CLAY, MODERATELY PLASTIC, YELLOWISH BROWN.		33.8

SAMPLE NUMBER	15E
DEPTH (FT)	33.8
WATER CONTENT (%)	27.3
DRY UNIT WEIGHT (PCF)	96.0
SPECIMEN DIAMETER (IN.)	2.89
RATE OF STRAIN (% PER MIN)	0.25
CONFINING PRESSURE	0

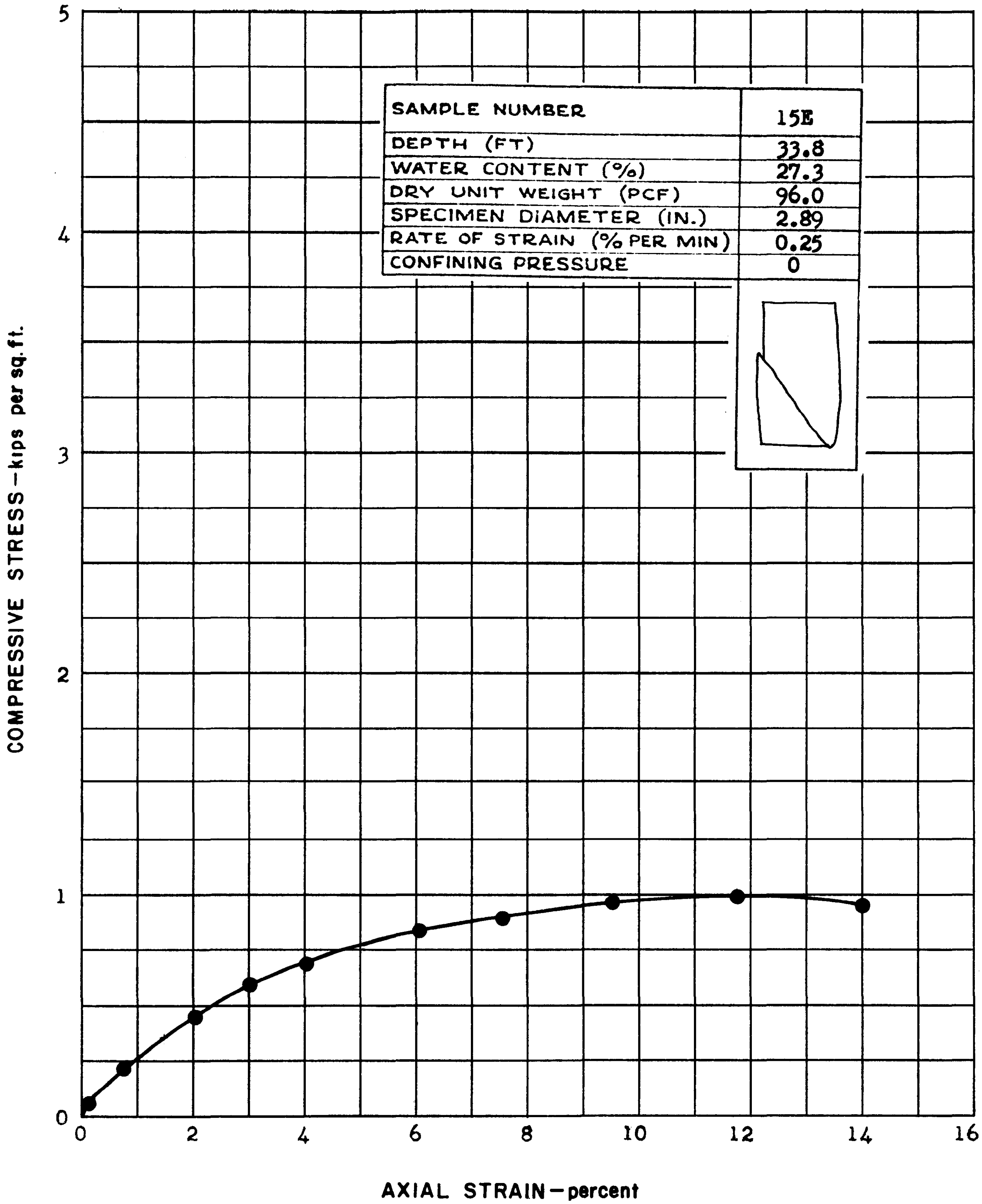
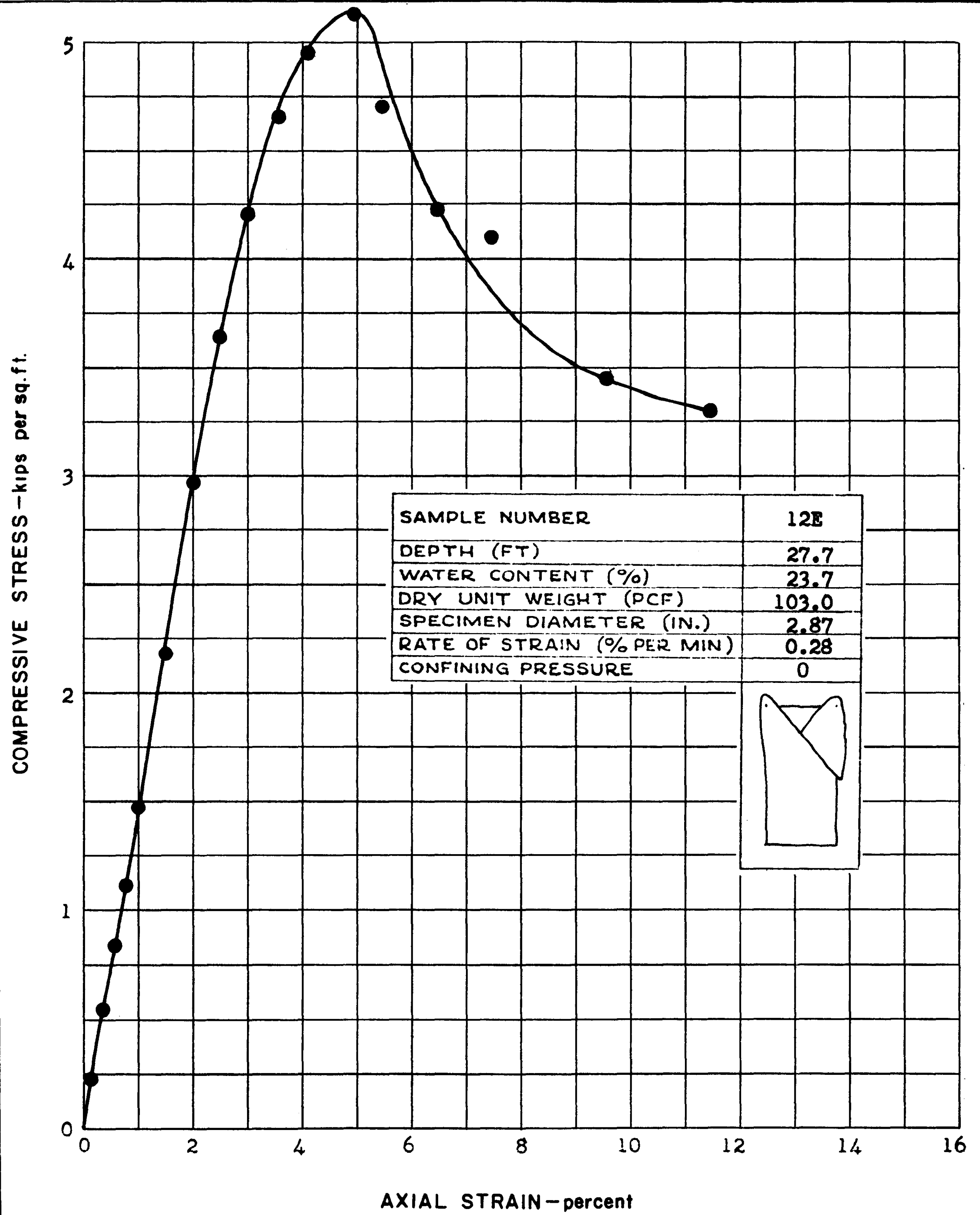


FIGURE 2.5D-71

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12690.46	BORING NUMBER AB5
SITE BEAVER VALLEY - UNIT 1	DATE 21 MAR 79	SAMPLE NUMBER 12E
SOIL DESCRIPTION SILTY CLAY, HIGHLY PLASTIC, LIGHT BROWN.		DEPTH 24.1 FT



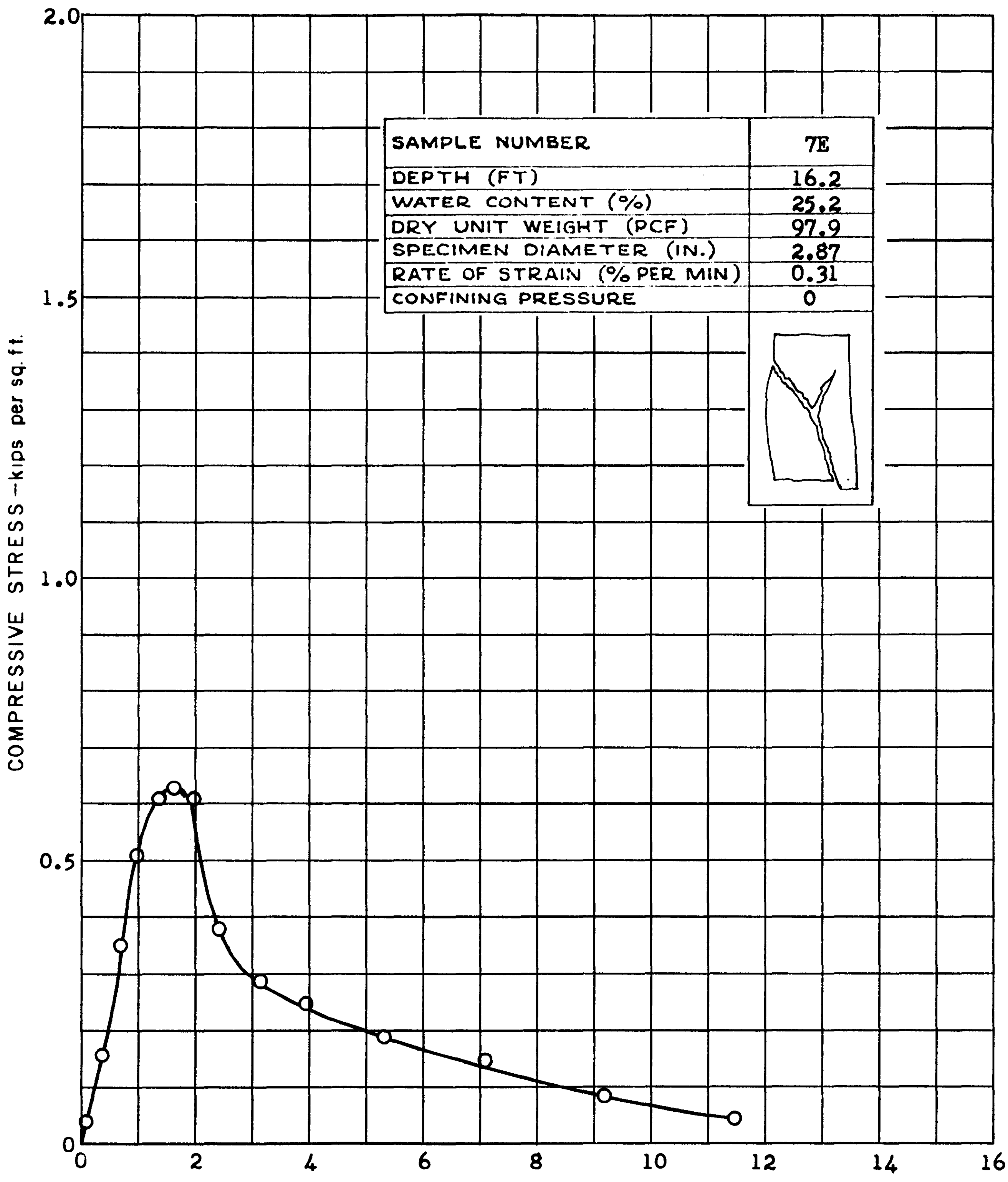
SAMPLE NUMBER	12E
DEPTH (FT)	27.7
WATER CONTENT (%)	23.7
DRY UNIT WEIGHT (PCF)	103.0
SPECIMEN DIAMETER (IN.)	2.87
RATE OF STRAIN (% PER MIN)	0.28
CONFINING PRESSURE	0

FIGURE 2.5D-72

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12690.46	AB6
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 1	5 APR 78	7E
SOIL DESCRIPTION		DEPTH
SILTY CLAY, MODERATELY TO HIGHLY PLASTIC, 5-10% FINE SAND, BROWN.		16.2 FT



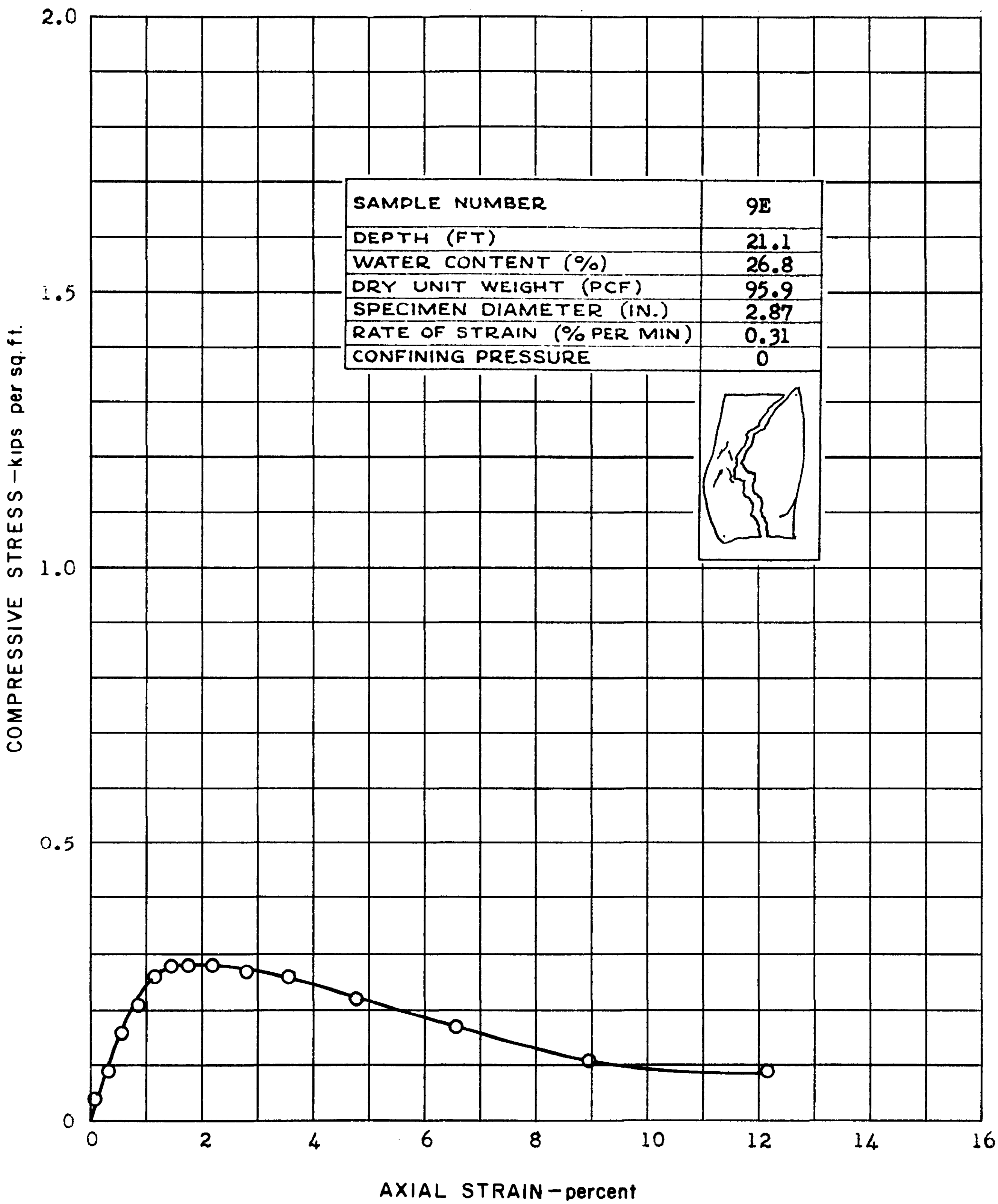
SAMPLE NUMBER	7E
DEPTH (FT)	16.2
WATER CONTENT (%)	25.2
DRY UNIT WEIGHT (PCF)	97.9
SPECIMEN DIAMETER (IN.)	2.87
RATE OF STRAIN (% PER MIN)	0.31
CONFINING PRESSURE	0

FIGURE 2.5D-73

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12690.46	AB6
SITE	**DATE**	**SAMPLE NUMBER**
BEAVER VALLEY - UNIT 1	5 APR 79	9E
SOIL DESCRIPTION		**DEPTH**
SANDY CLAY, MODERATELY PLASTIC, 25-30% FINE SAND, BROWN.		21.1



SAMPLE NUMBER	9E
DEPTH (FT)	21.1
WATER CONTENT (%)	26.8
DRY UNIT WEIGHT (PCF)	95.9
SPECIMEN DIAMETER (IN.)	2.87
RATE OF STRAIN (% PER MIN)	0.31
CONFINING PRESSURE	0

FIGURE 2.5D-74

STONE & WEBSTER ENGINEERING CORPORATION

UNCONFINED COMPRESSION TEST

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12690.46	AB10
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY - UNIT 1	21 MAR 79	10E
SOIL DESCRIPTION		DEPTH
SILTY CLAY,HIGHLY PLASTIC,YELLOWISH BROWN.		24.1 FT

SAMPLE NUMBER	10E
DEPTH (FT)	24.1
WATER CONTENT (%)	23.4
DRY UNIT WEIGHT (PCF)	102.5
SPECIMEN DIAMETER (IN.)	2.86
RATE OF STRAIN (% PER MIN)	0.28
CONFINING PRESSURE	0

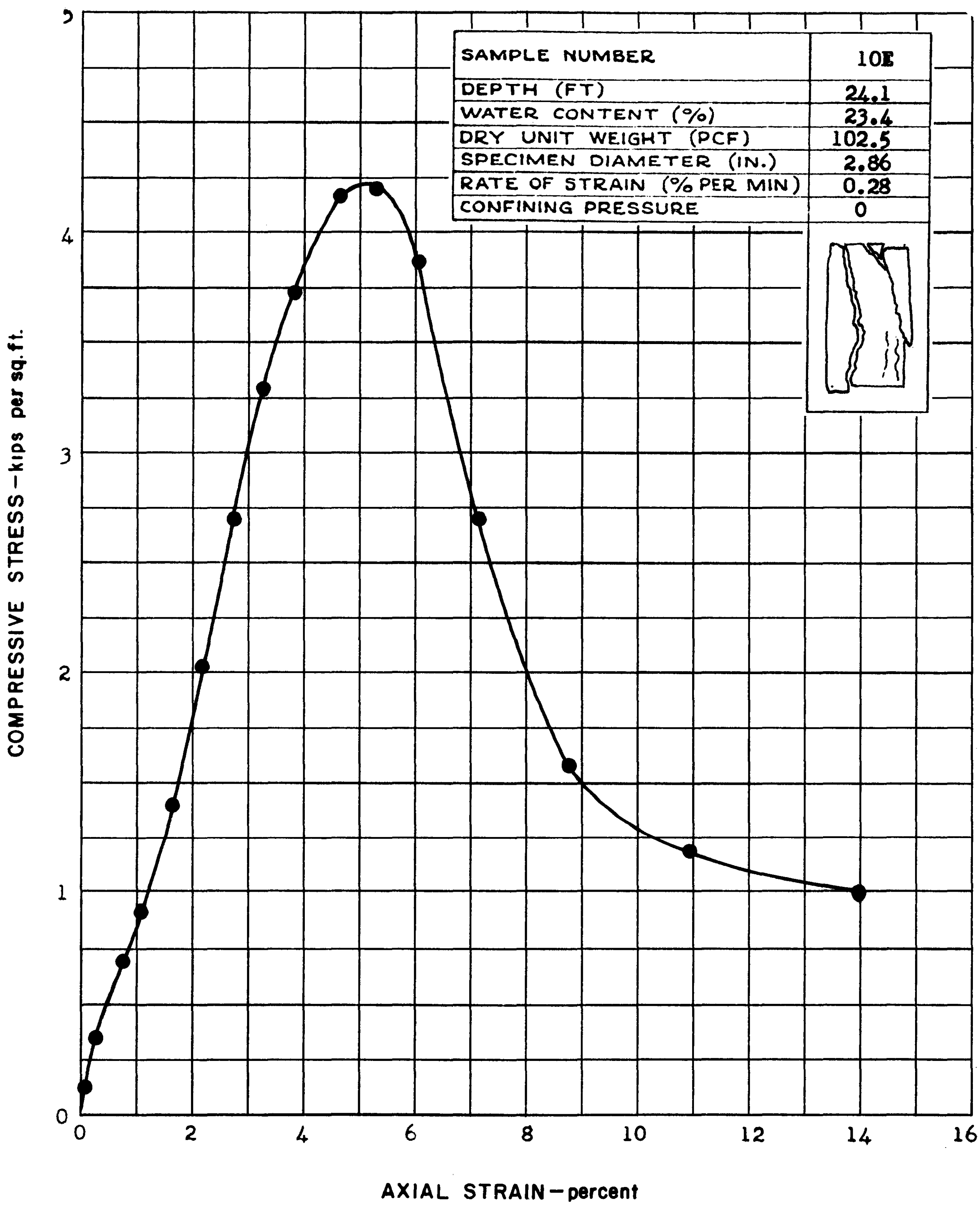


FIGURE 2.5D-75

STONE & WEBSTER ENGINEERING CORPORATION

UNDRAINED COMPRESSION TEST

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	3 MAR 77	1F & 3F
SOIL DESCRIPTION		DEPTH
SILTY CLAY, MODERATELY PLASTIC, LIGHT BROWN, (CL)		SEE BELOW

SAMPLE NUMBER	1F	3F
DEPTH (FT)	6.9	13.2
WATER CONTENT (%)	24.3	23.5
DRY UNIT WEIGHT (PCF)	100.3	100.9
SPECIMEN DIAMETER (IN.)	2.87	2.90
RATE OF STRAIN (% PER MIN)	0.28	0.28
CONFINING PRESSURE (TSF)	0.50	1.0

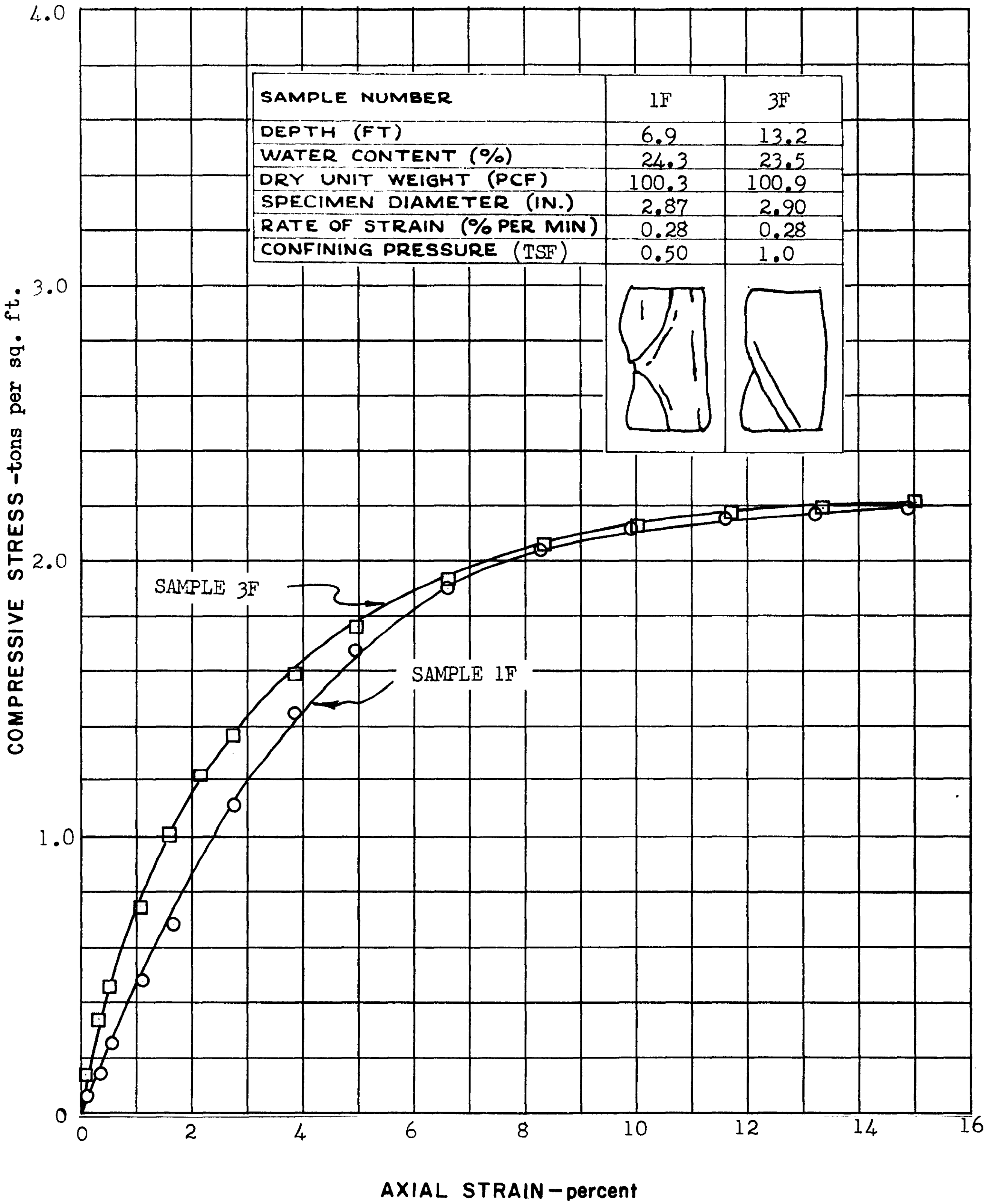
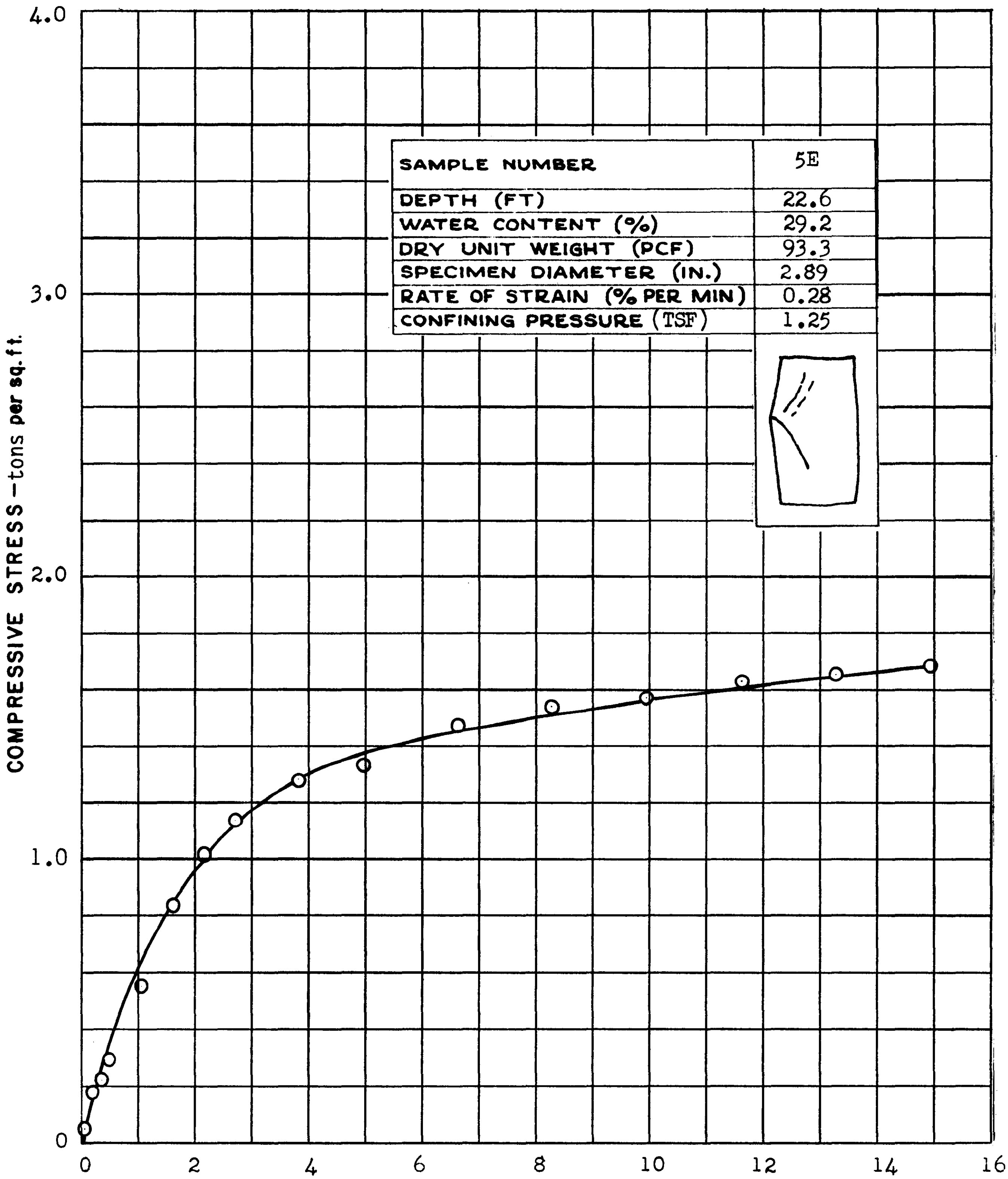


FIGURE 2.5D-76

STONE & WEBSTER ENGINEERING CORPORATION

UNDRAINED COMPRESSION TEST

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	PL3
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	8 MAR 77	5E
SOIL DESCRIPTION		DEPTH
SILTY CLAY, MODERATELY PLASTIC, LIGHT BROWN, (CL)		22.6 FT.



SAMPLE NUMBER	5E
DEPTH (FT)	22.6
WATER CONTENT (%)	29.2
DRY UNIT WEIGHT (PCF)	93.3
SPECIMEN DIAMETER (IN.)	2.89
RATE OF STRAIN (% PER MIN)	0.28
CONFINING PRESSURE (TSF)	1.25

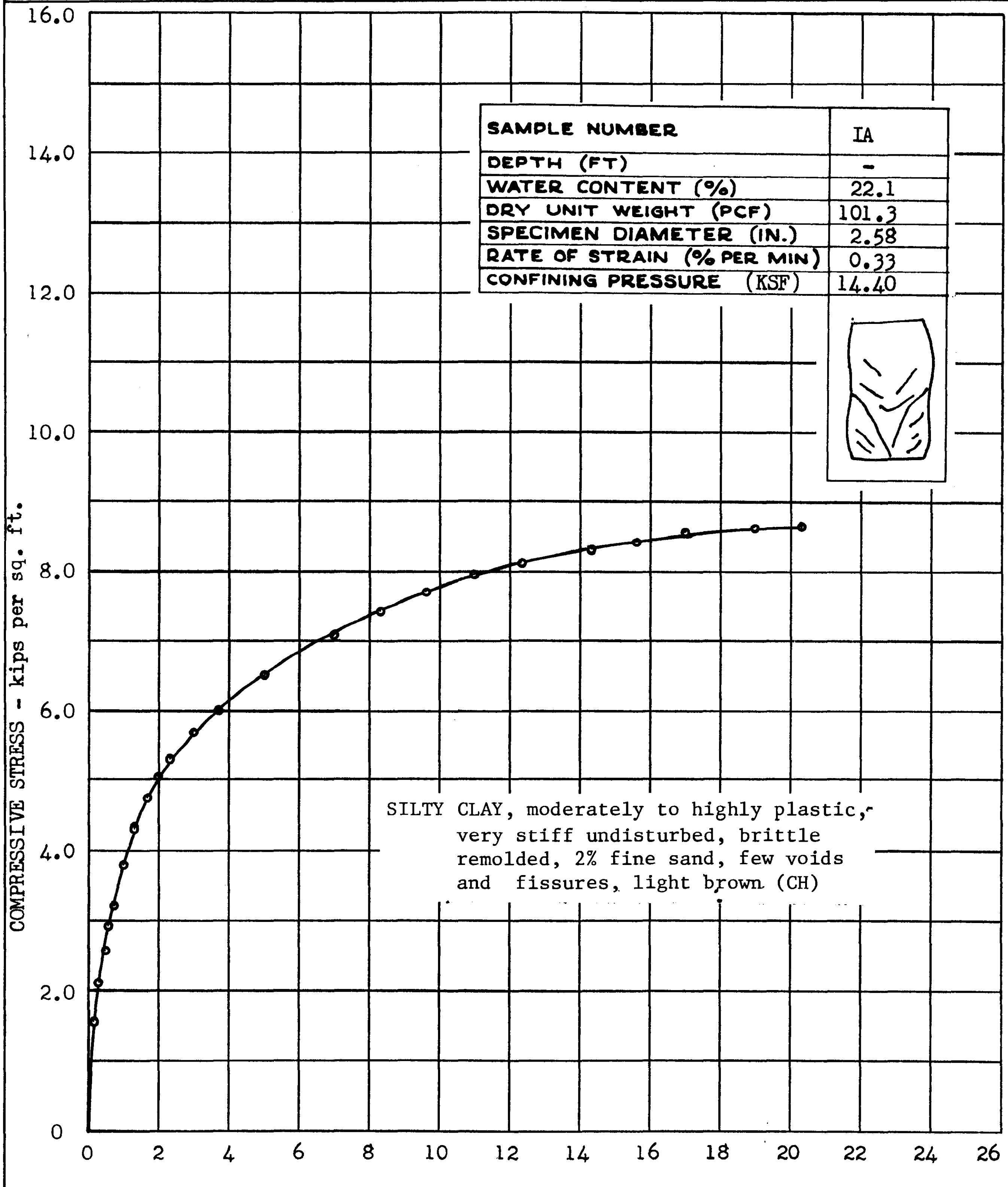
FIGURE 2.5D-77

STONE & WEBSTER ENGINEERING CORPORATION

UNDRAINED COMPRESSION TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12241	BORING NUMBER BLOCK SAMPLE I
SITE BEAVER VALLEY UNIT 2	DATE 18 MAY 76	SAMPLE NUMBER IA
CONFINING PRESSURE: 14.40 KIPS PER SQ. FT. (100.0 PSI)		DEPTH -

SAMPLE NUMBER	IA
DEPTH (FT)	-
WATER CONTENT (%)	22.1
DRY UNIT WEIGHT (PCF)	101.3
SPECIMEN DIAMETER (IN.)	2.58
RATE OF STRAIN (% PER MIN)	0.33
CONFINING PRESSURE (KSF)	14.40



SILTY CLAY, moderately to highly plastic, very stiff undisturbed, brittle remolded, 2% fine sand, few voids and fissures, light brown (CH)

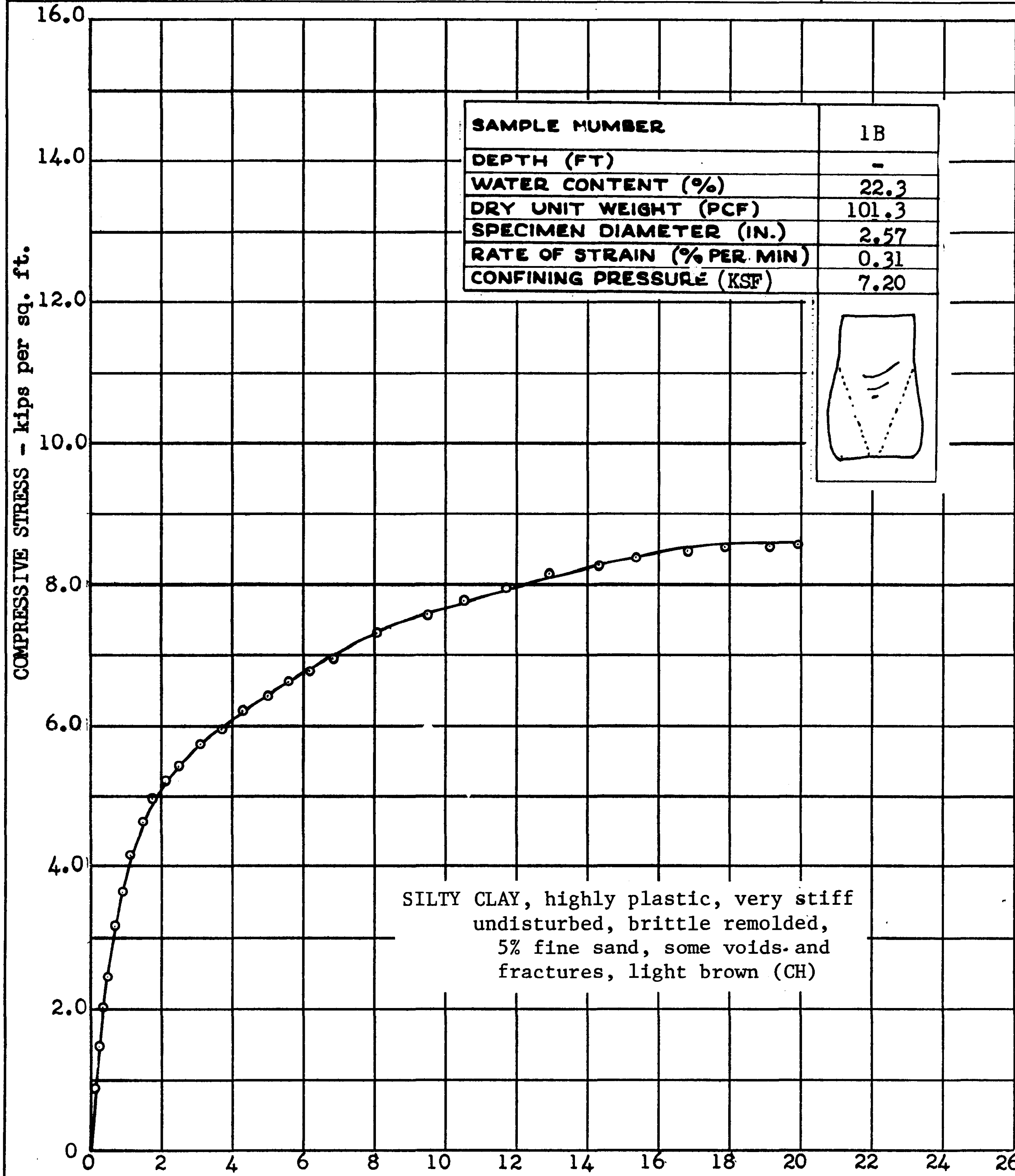
FIGURE 2.5D-78

STONE & WEBSTER ENGINEERING CORPORATION

UNDRAINED COMPRESSION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	BLOCK SAMPLE I
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	13 MAY 76	1B
		DEPTH
CONFINING PRESSURE: 7.20 KIPS PER SQ. FT. (50.0 PSI)		-

SAMPLE NUMBER	1B
DEPTH (FT)	-
WATER CONTENT (%)	22.3
DRY UNIT WEIGHT (PCF)	101.3
SPECIMEN DIAMETER (IN.)	2.57
RATE OF STRAIN (% PER MIN)	0.31
CONFINING PRESSURE (KSF)	7.20



SILTY CLAY, highly plastic, very stiff undisturbed, brittle remolded, 5% fine sand, some voids and fractures, light brown (CH)

FIGURE 2.5D-79

STONE & WEBSTER ENGINEERING CORPORATION

UNDRAINED COMPRESSION TEST REPORT

CLIENT	J.O. NUMBER	BORING NUMBER
DUQUESNE LIGHT COMPANY	12241	BLOCK SAMPLE I
SITE	DATE	SAMPLE NUMBER
BEAVER VALLEY UNIT 2	21 MAY 76	IC
CONFINING PRESSURE: 28.8 KIPS PER SQ. FT. (200.0 PSI)		DEPTH: -

SAMPLE NUMBER	IC
DEPTH (FT)	-
WATER CONTENT (%)	22.5
DRY UNIT WEIGHT (PCF)	100.8
SPECIMEN DIAMETER (IN.)	2.59
RATE OF STRAIN (% PER MIN)	0.33
CONFINING PRESSURE (KSF)	28.8

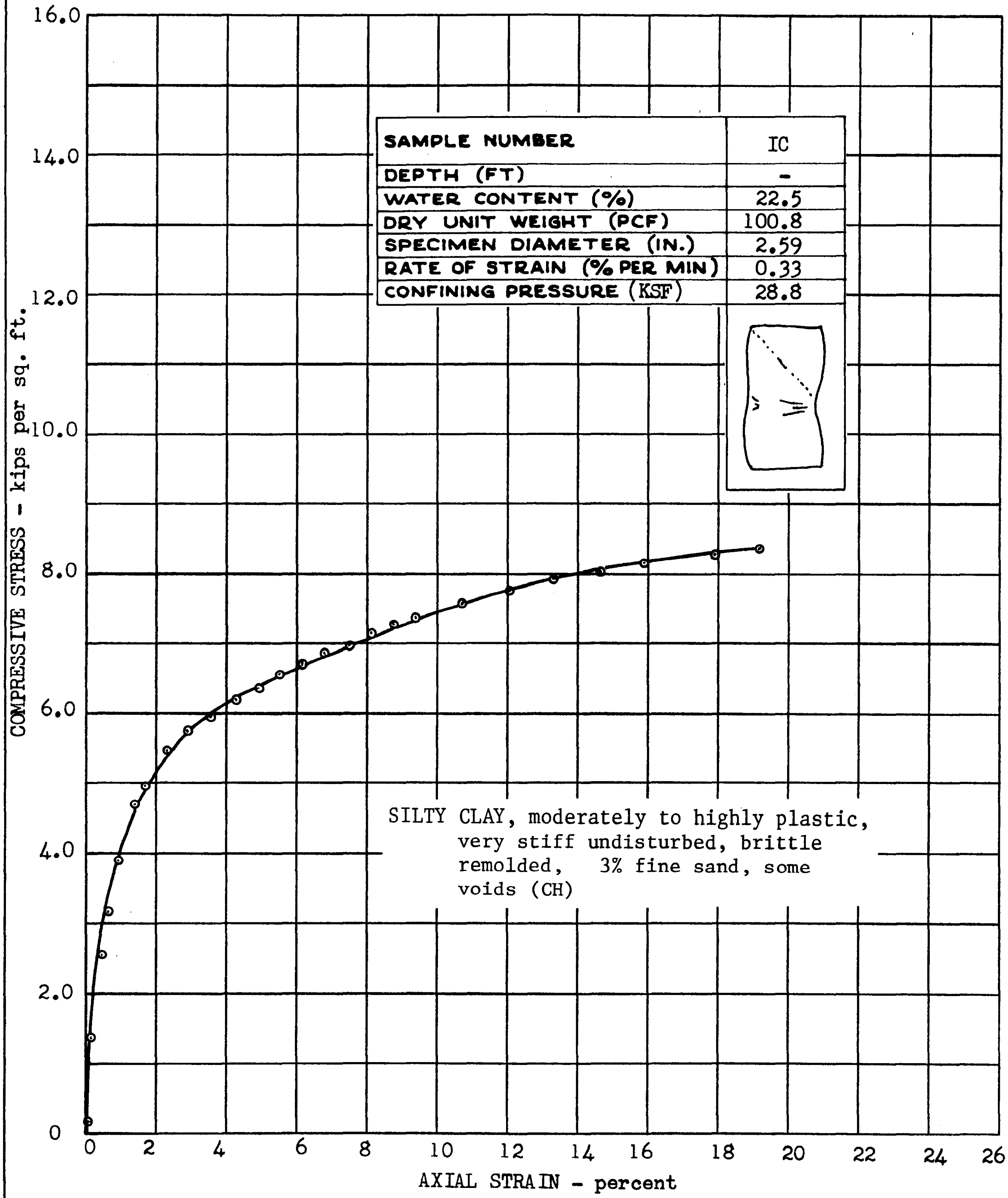


FIGURE 2.5D-80

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12241	BLOCK SAMPLE I
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	25 MAY 76	IA, IB AND IC

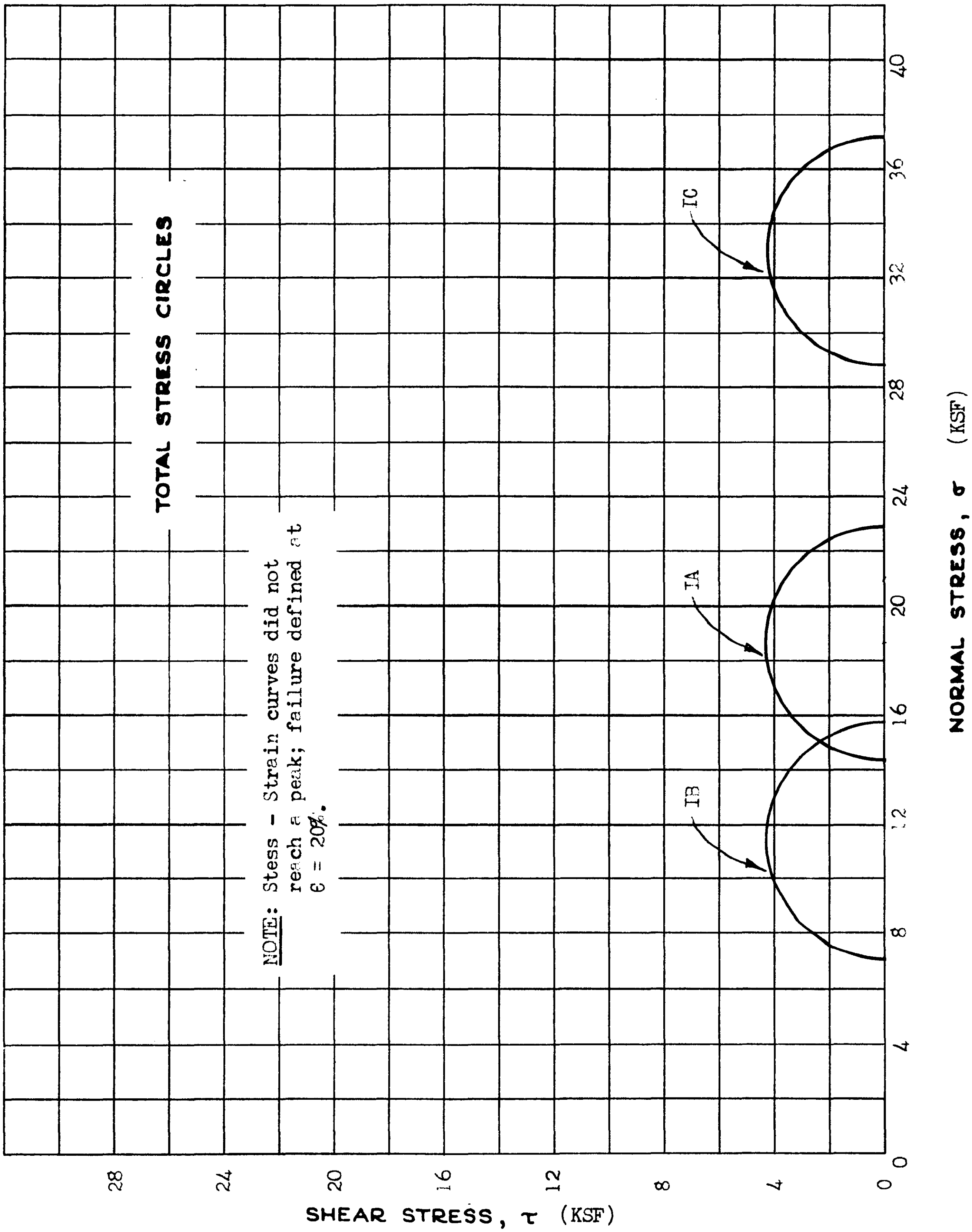


FIGURE 2.5D-81

STONE & WEBSTER ENGINEERING CORPORATION

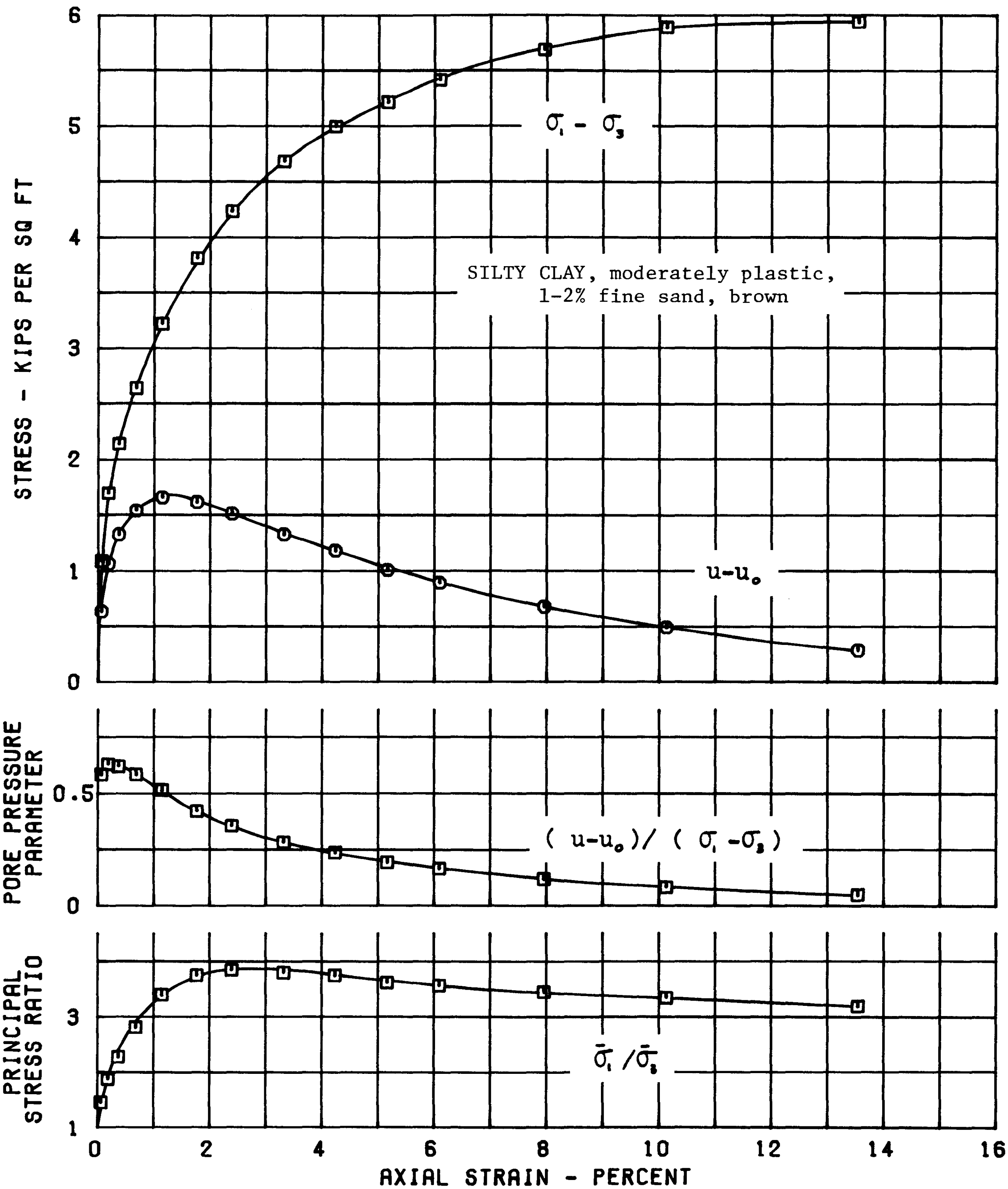
TRIAXIAL TEST REPORT

PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT DUQUESNE LIGHT COMPANY		J.O. NO.	12690.46
SITE BEAVER VALLEY - UNIT 1		DATE 9 April 79	BY GJZ
BORING AB1	SAMPLE 15F DEPTH 32.7 FT	CHECKED 10 APR 79	BY WJO

BASED ON COMPUTER RUN J1623004 ON 04/12/79 AT 09.20.30 BY OLSZEWSKI.
PROGRAM GT-023 TRXPLOT VER 06 LEV 01 - COMPILED ON 78.086 AT 16.13.17

EFFECTIVE CONSOLIDATION PRESSURE 3.00 KIPS PER SQ FT



INPUT FROM RUN J1623003 OLSZEWSKI./BT 34 CARDS JOB 1431 04/11/79 15:45

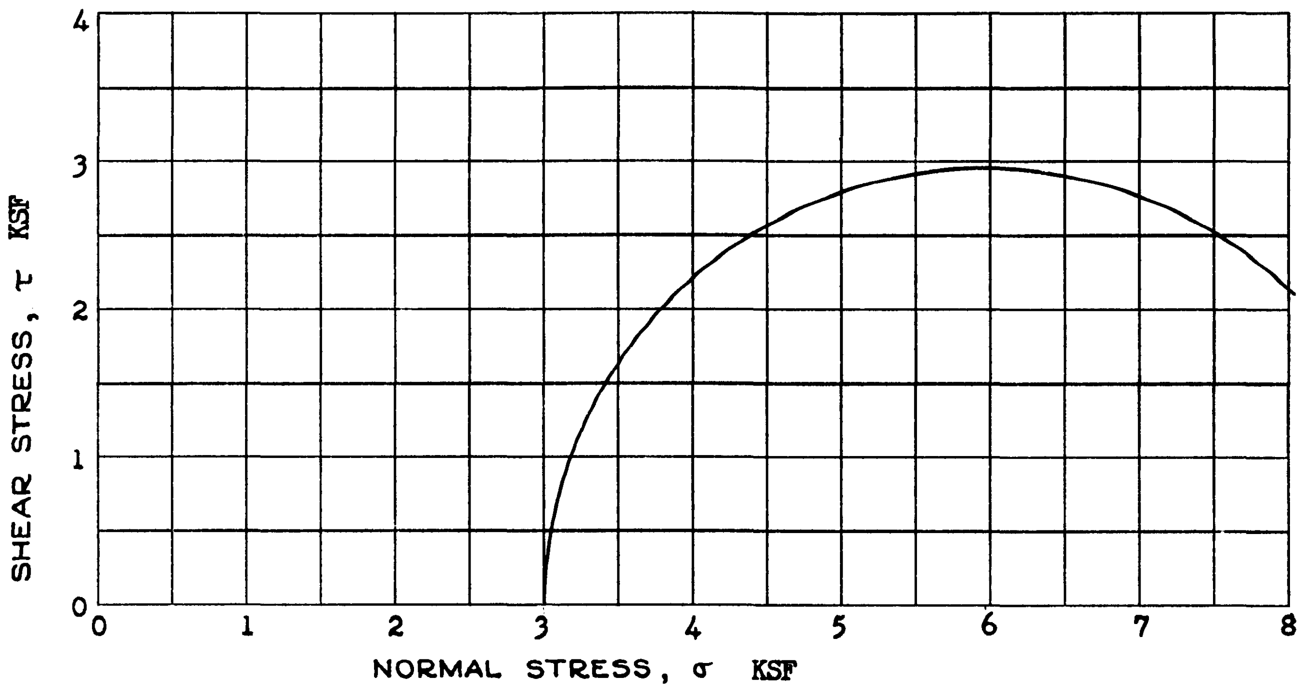
FIGURE 2.5D-82

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12690.46	BORING AB1
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY	11 APR 79	15F

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

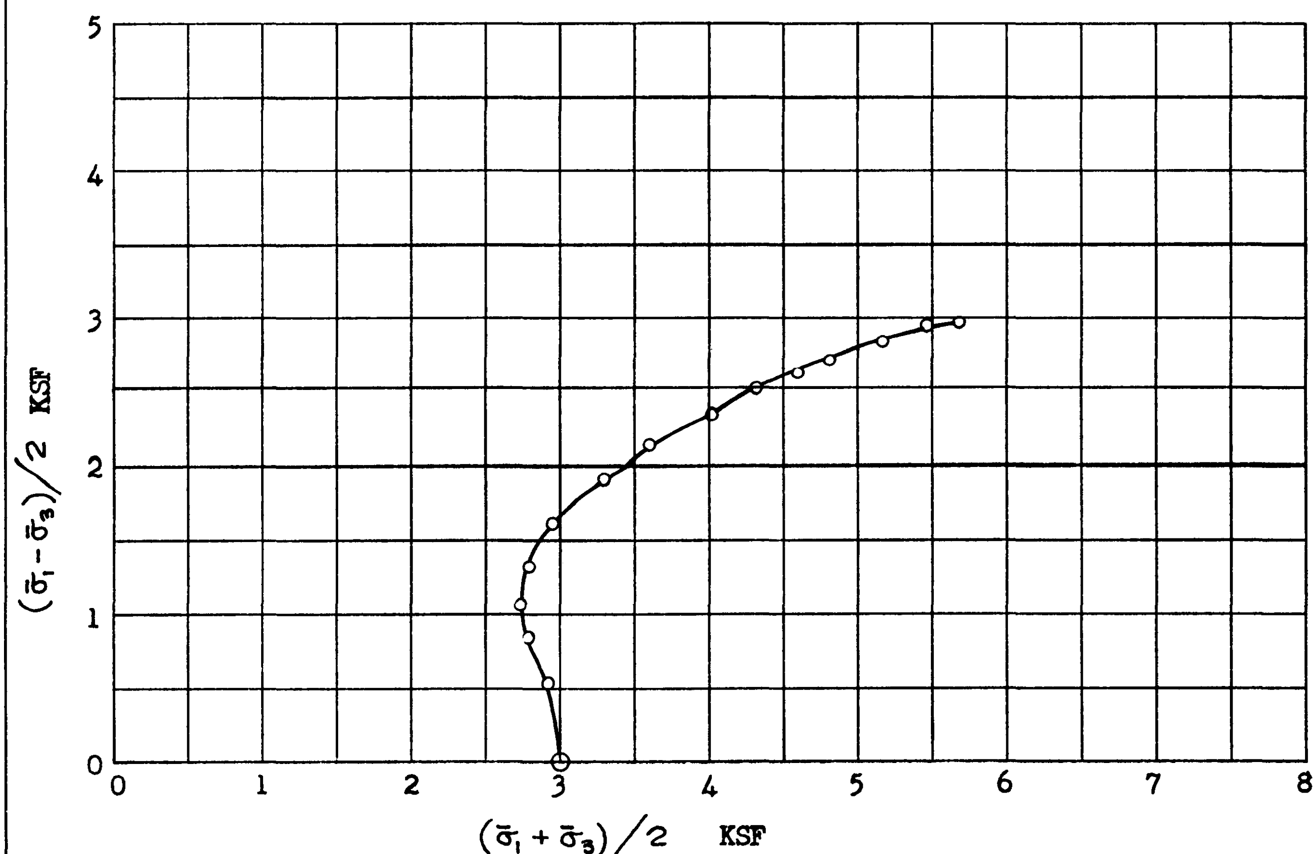


FIGURE 2.5D-83

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT DUQUESNE LIGHT COMPANY J.O. NO. 12690.46

SITE BEAVER VALLEY UNIY - 1 DATE 2 APR 79 BY [signature]

BORING AB 5 SAMPLE 12D DEPTH 27.0 FT CHECKED BY

BASED ON COMPUTER RUN J1623017 ON 04/02/79 AT 12.59.47 BY OLSZEWSKI.
PROGRAM GT-023 TRXPLOT VER 06 LEV 01 - COMPILED ON 78.086 AT 16.13.17

EFFECTIVE CONSOLIDATION PRESSURE 2.50 KIPS PER SQ FT

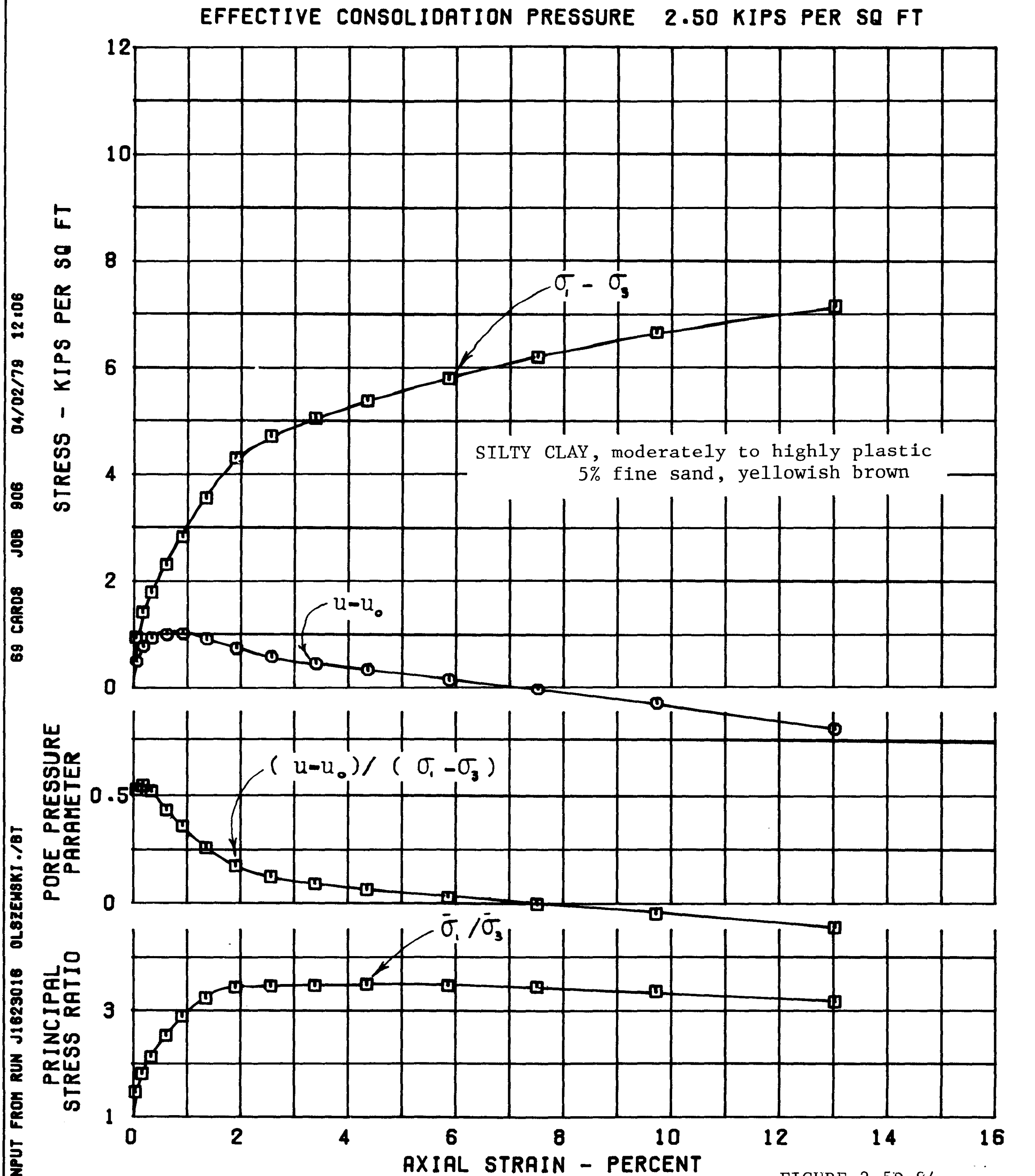


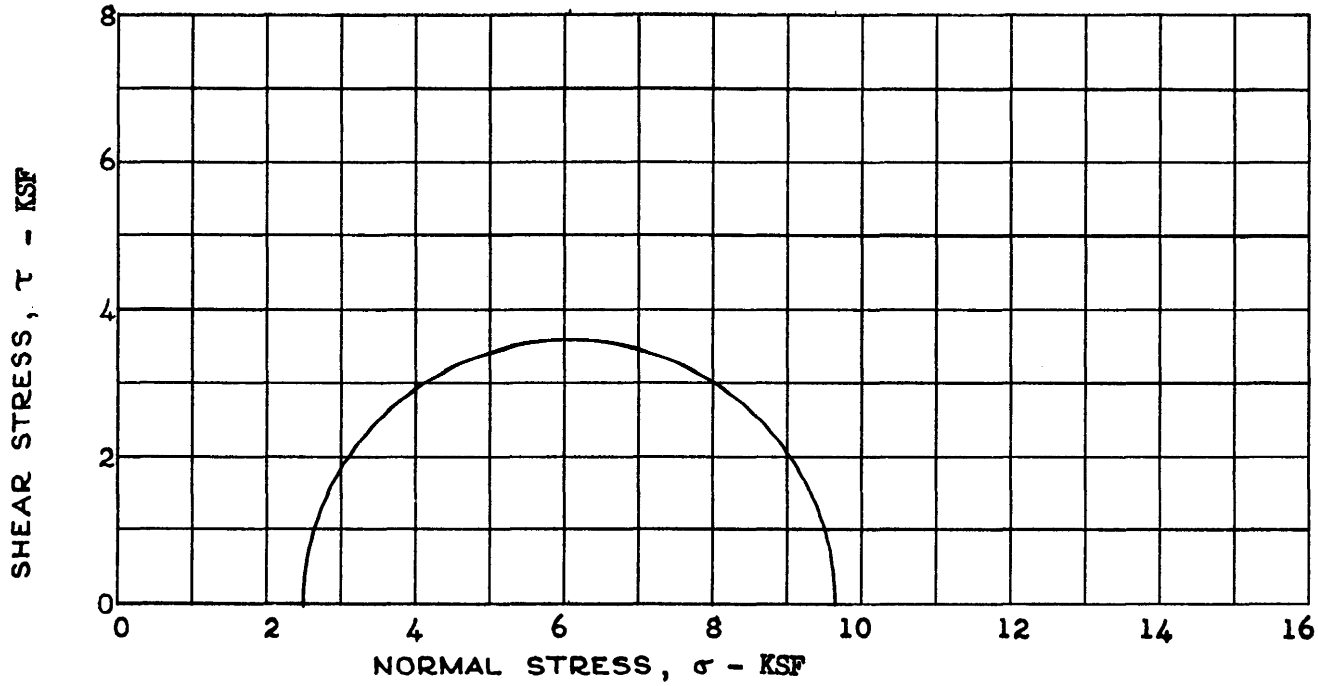
FIGURE 2.5D-84

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12690.46	BORING AB5
SITE	DATE	SAMPLE NUMBERS
BEAVER VALLEY UNIT - 1	2 APR 79	12D

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

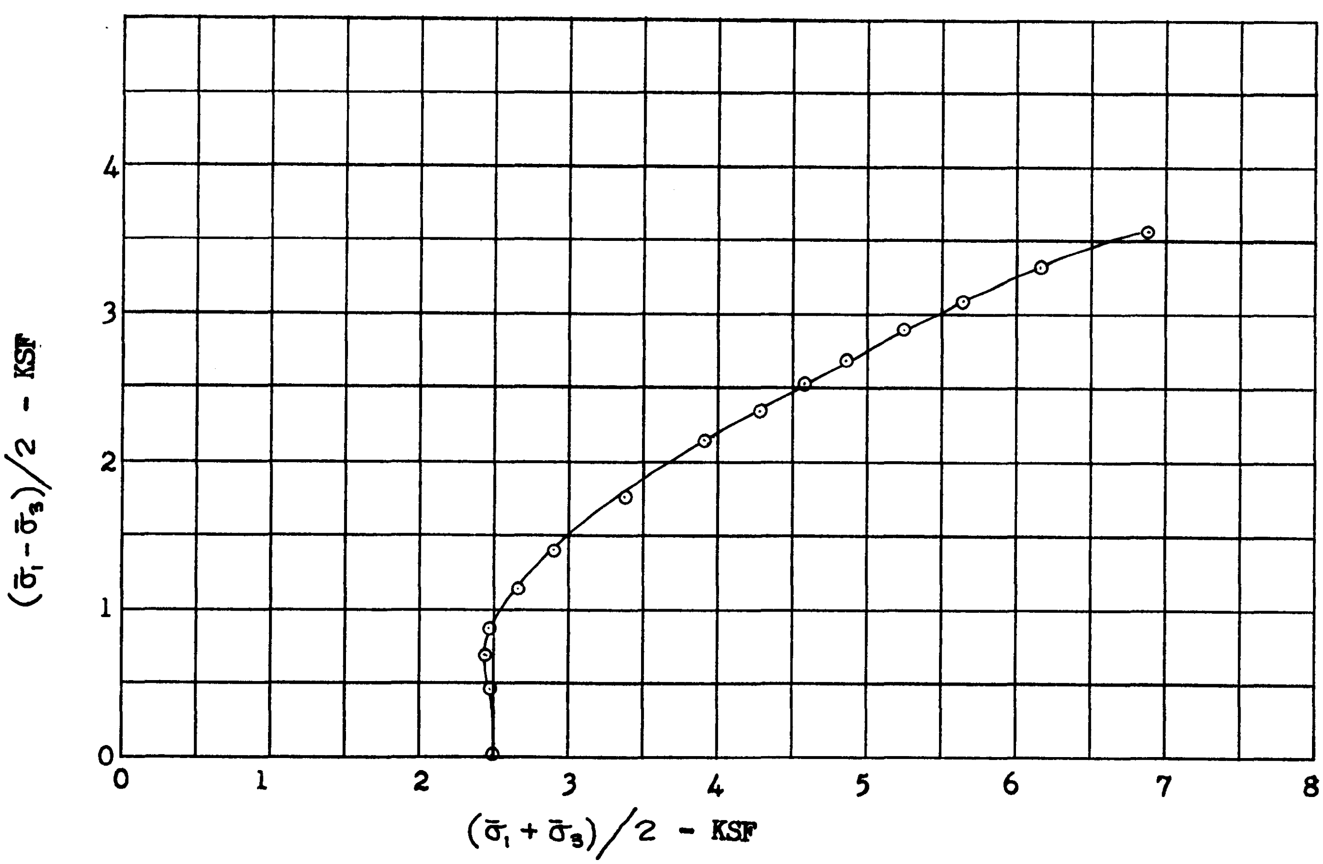


FIGURE 2.5D-85

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT	DUQUESNE LIGHT COMPANY	J.O. NO.	12690.46
SITE	BEAVER VALLEY - UNIT 1	DATE 3 APR 79	BY M. Olszewski
BORING AB6	SAMPLE 7F DEPTH	CHECKED 4 APR 79	BY RKW

BASED ON COMPUTER RUN J1623020 ON 04/03/79 AT 15.42.36 BY OLSZEWSKI.
PROGRAM GT-023 TRXPLOT VER 06 LEV 01 - COMPILED ON 78.086 AT 16.13.17

EFFECTIVE CONSOLIDATION PRESSURE 1.00 KIPS PER SQ FT

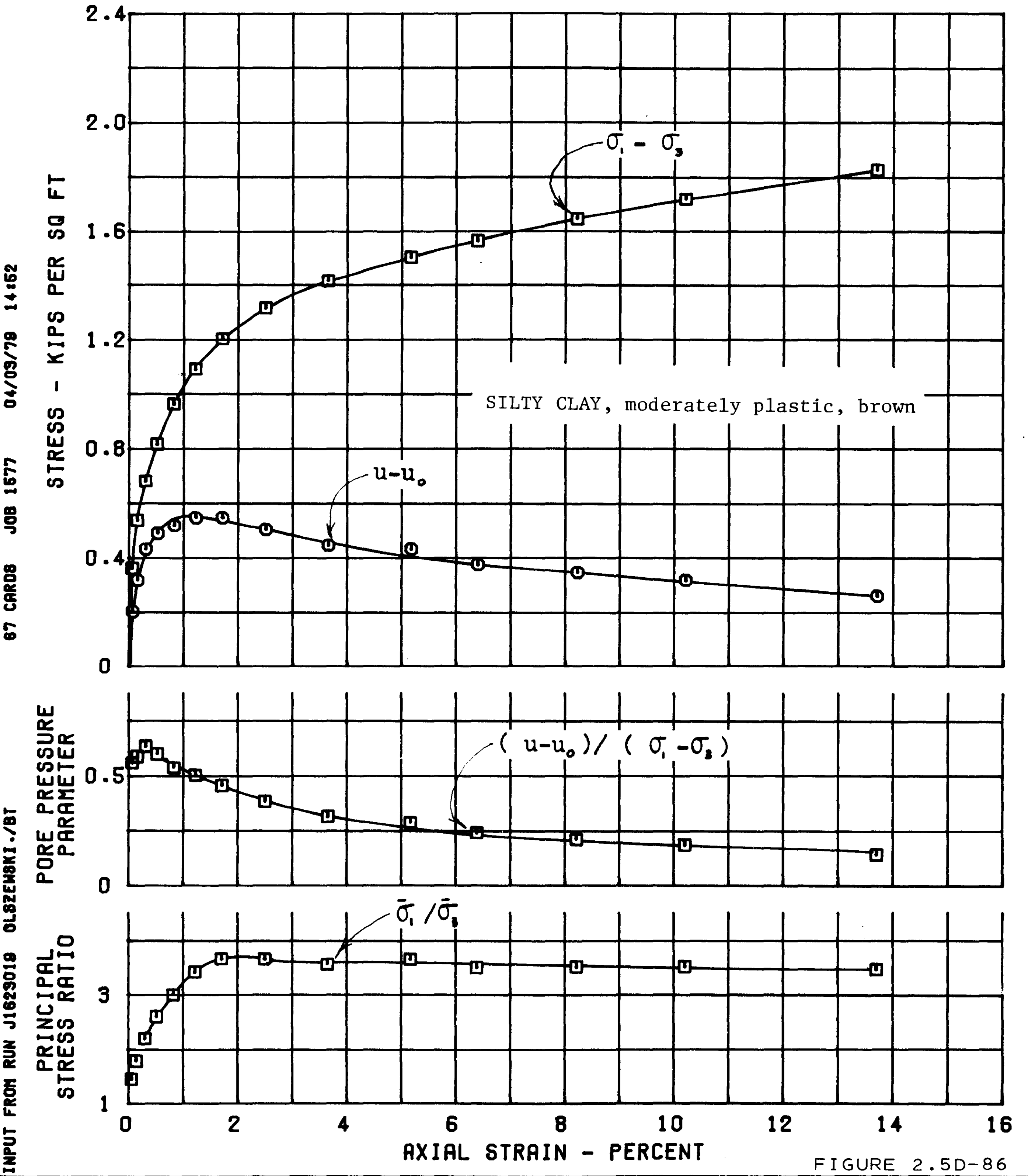


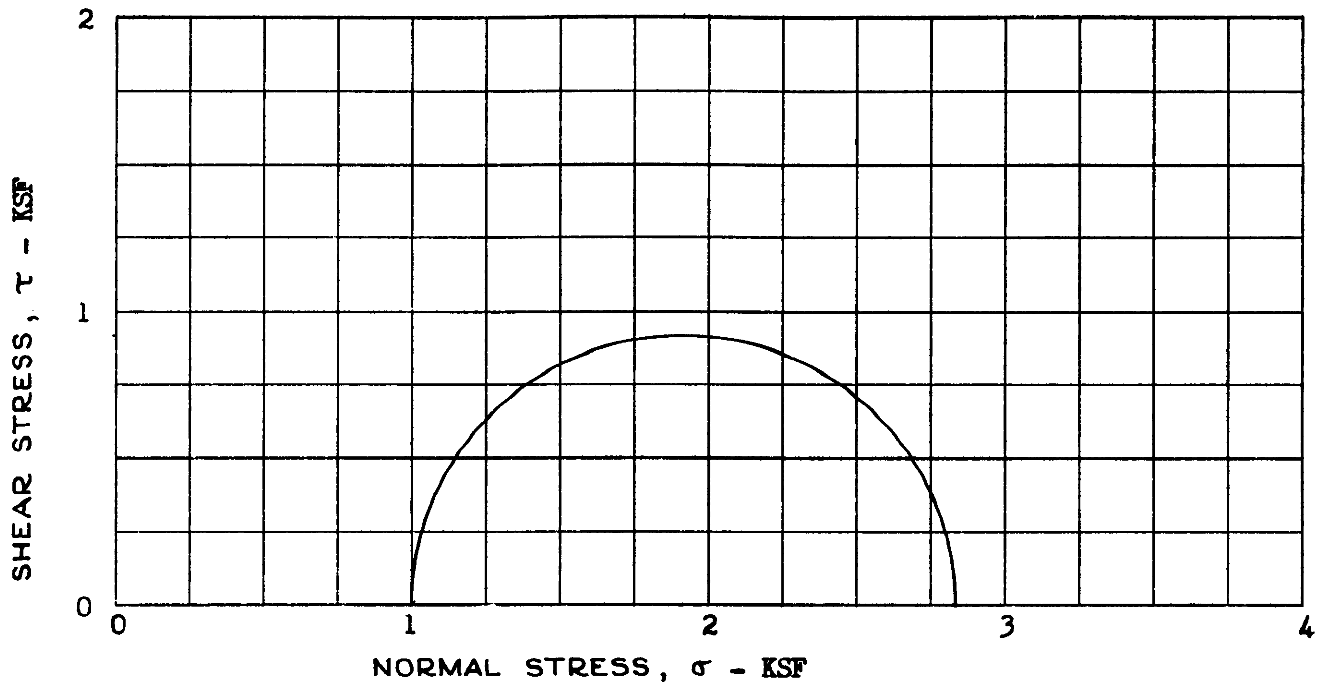
FIGURE 2.5D-86

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12690.46	BORING AB6
SITE	DATE	SAMPLE NUMBERS
BEAVER VALLEY UNIT - 1	3 APR 79	7F

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

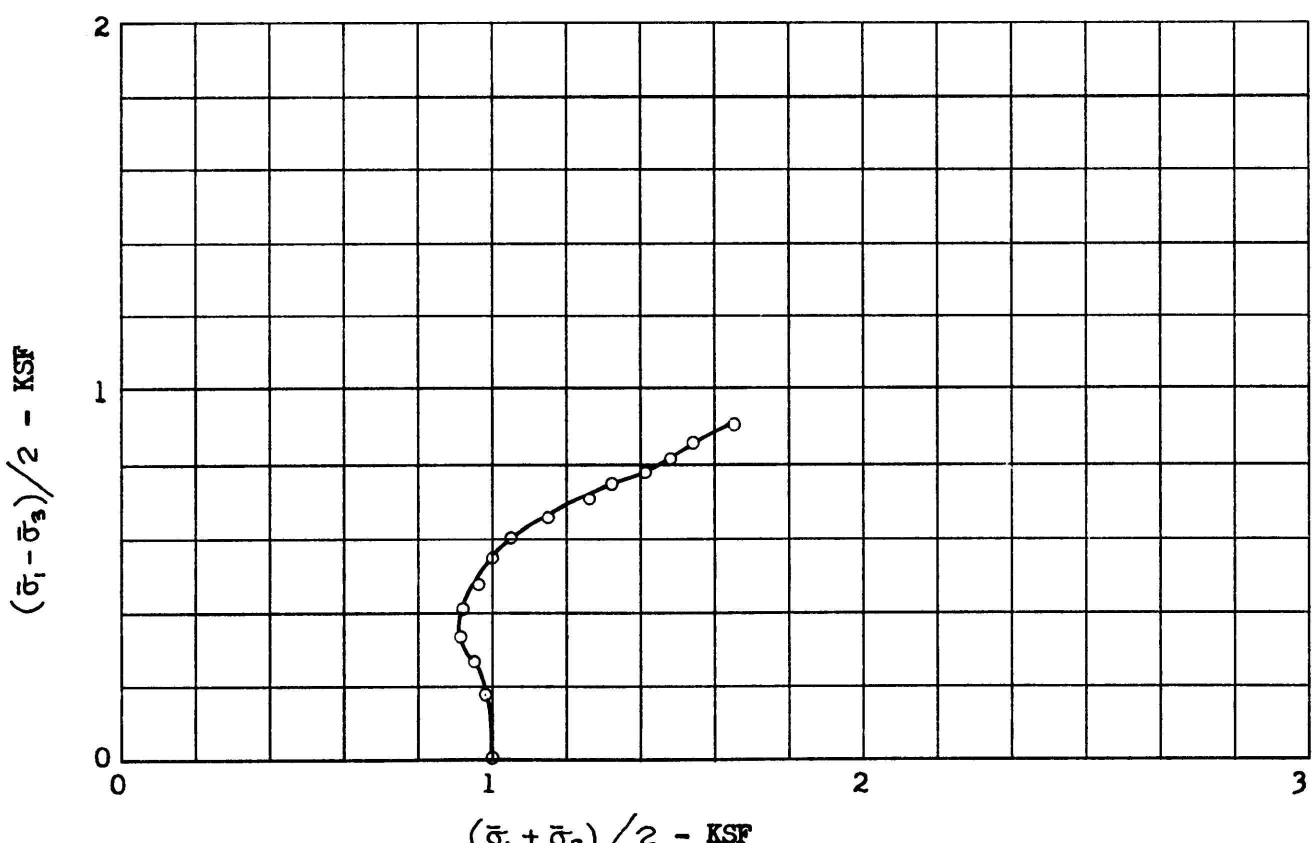


FIGURE 2.5D-87

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

PAGE NO. ______
PRELIMINARY ______
ITEM ______

CLIENT DUQUESNE LIGHT COMPANY J.O. NO. 12690.46

SITE BEAVER VALLEY UNIT - 1 DATE 3 APR 79 BY [signature]

BORING AB10 SAMPLE 10D DEPTH 23.6 FT CHECKED 4 APR 79 BY [signature]

BASED ON COMPUTER RUN J1623020 ON 04/03/79 AT 15.42.36 BY OLSZEWSKI.
PROGRAM GT-023 TRXPLOT VER 06 LEV 01 - COMPILED ON 78.086 AT 16.13.17

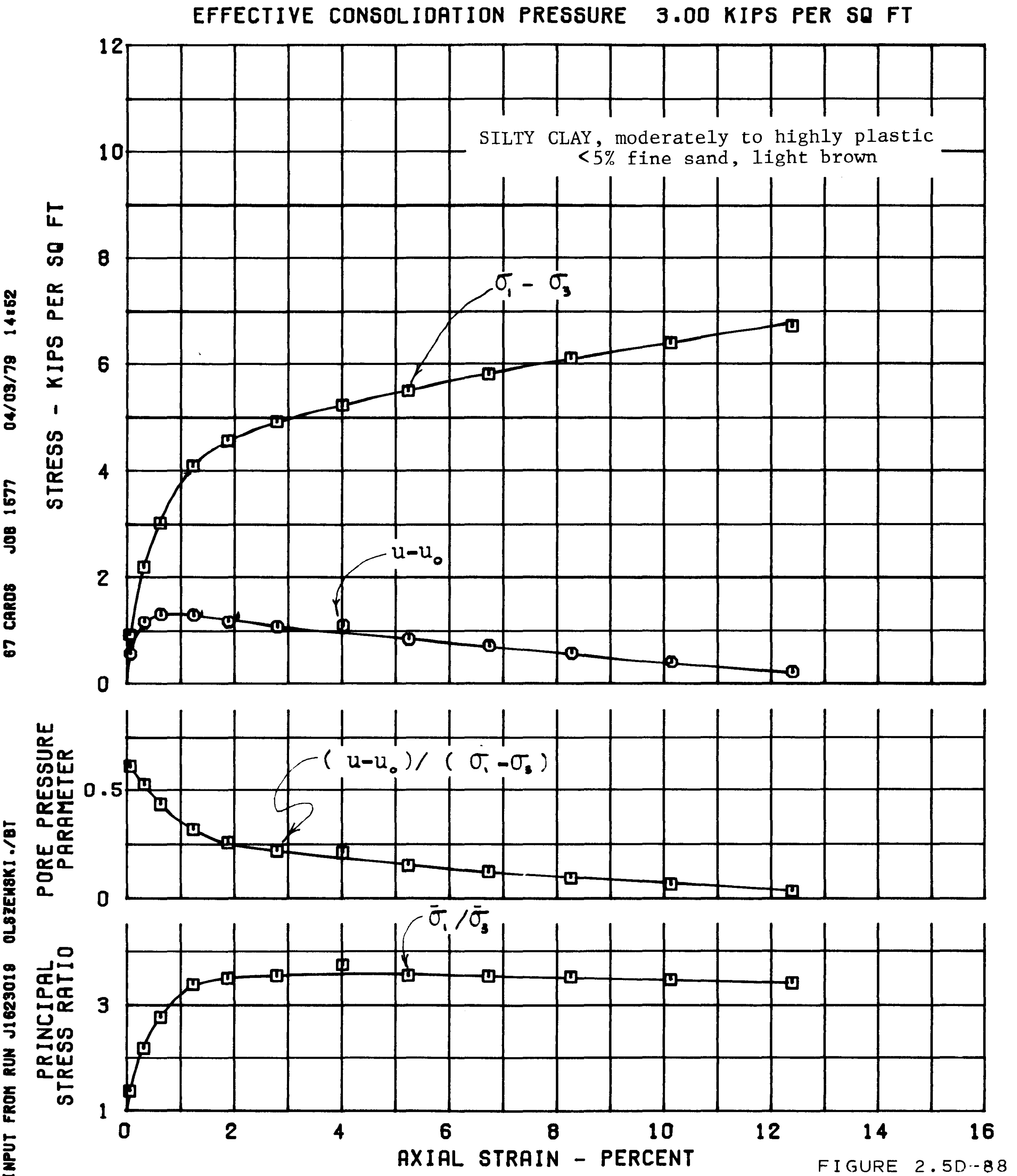


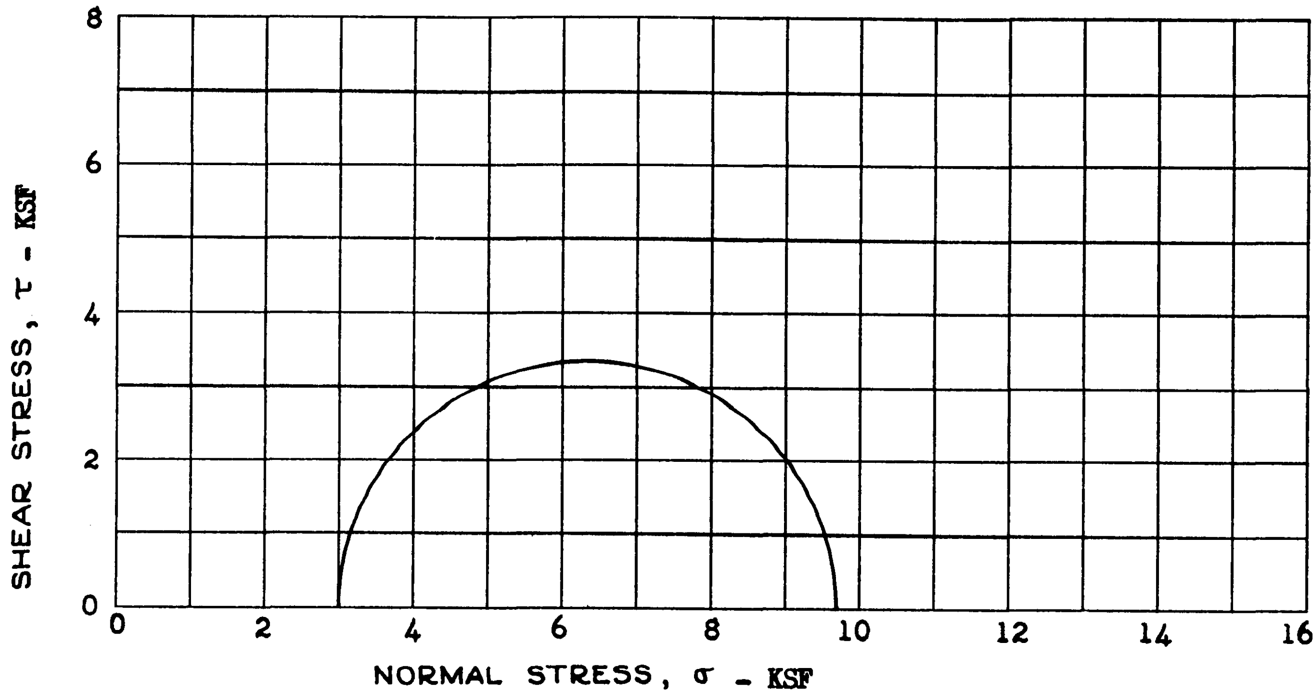
FIGURE 2.5D-88

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12690.46	BORING AB10
SITE	DATE	SAMPLE NUMBERS
BEAVER VALLEY UNIT - 1	3 APR 79	10D

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

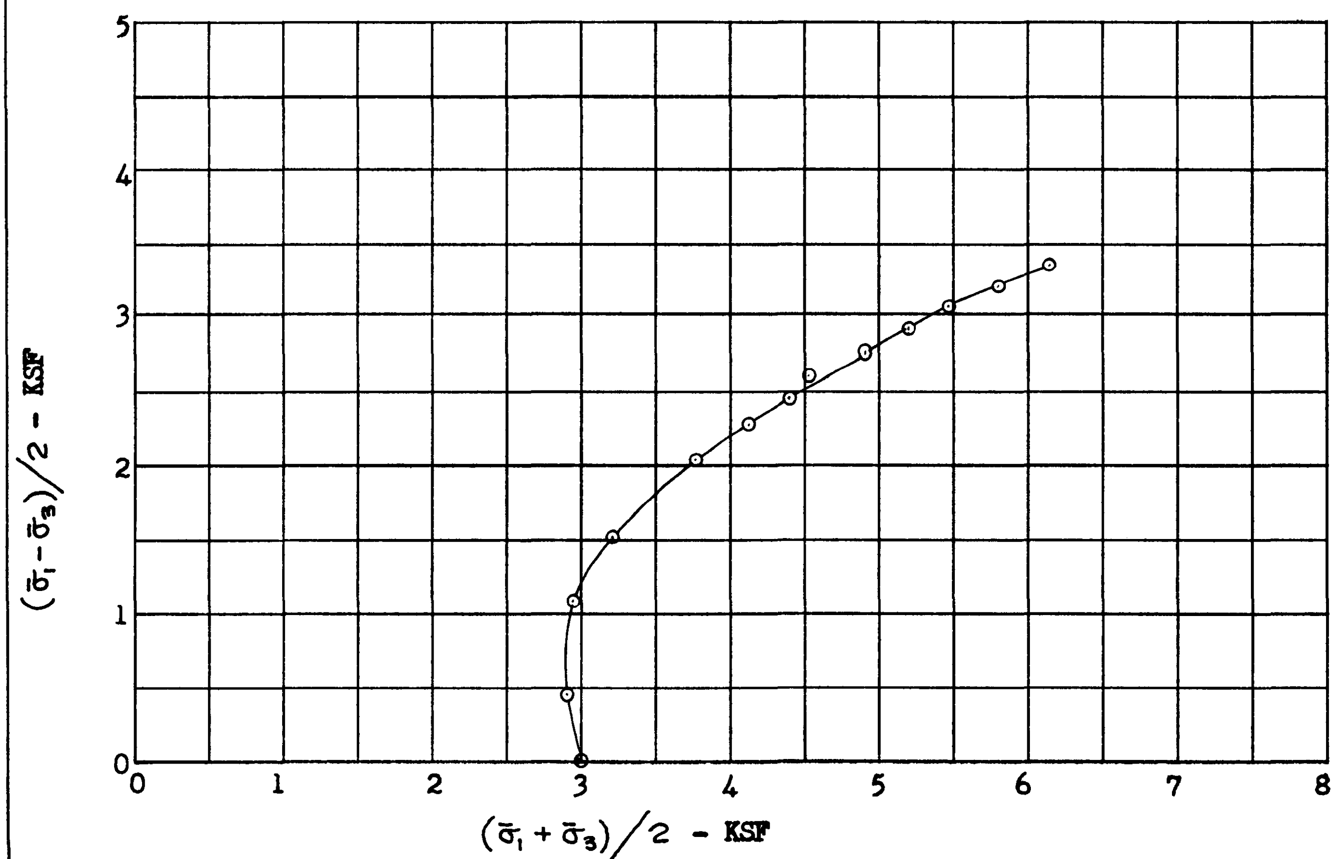


FIGURE 2.5D-89

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF6
SITE BEAVER VALLEY - UNIT 2	DATE 31 MAR 77	SAMPLE NUMBER 13E
EFFECTIVE CONSOLIDATION PRESSURE: 3.80 TONS PER SQ FT		DEPTH 54.0 FT

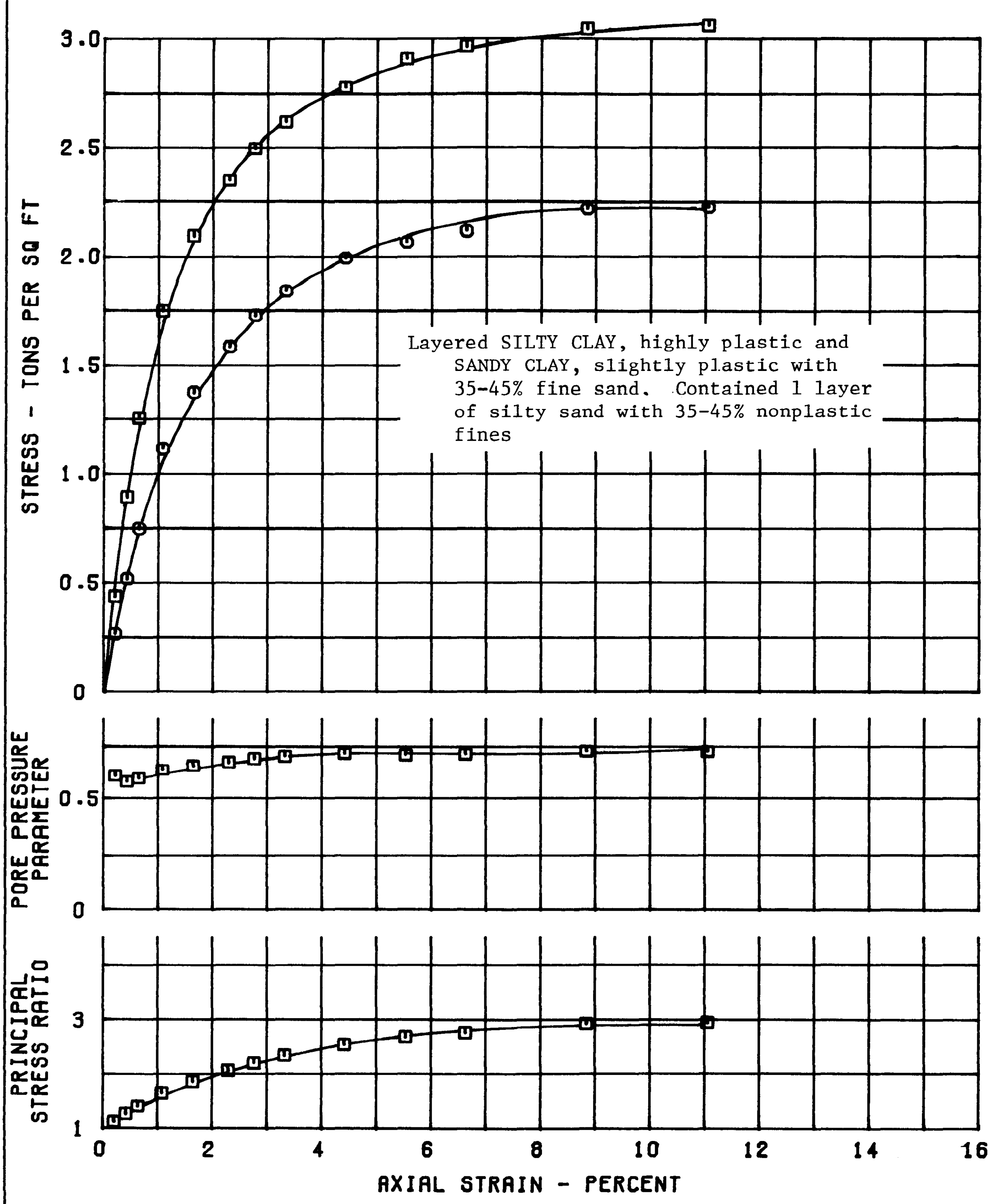


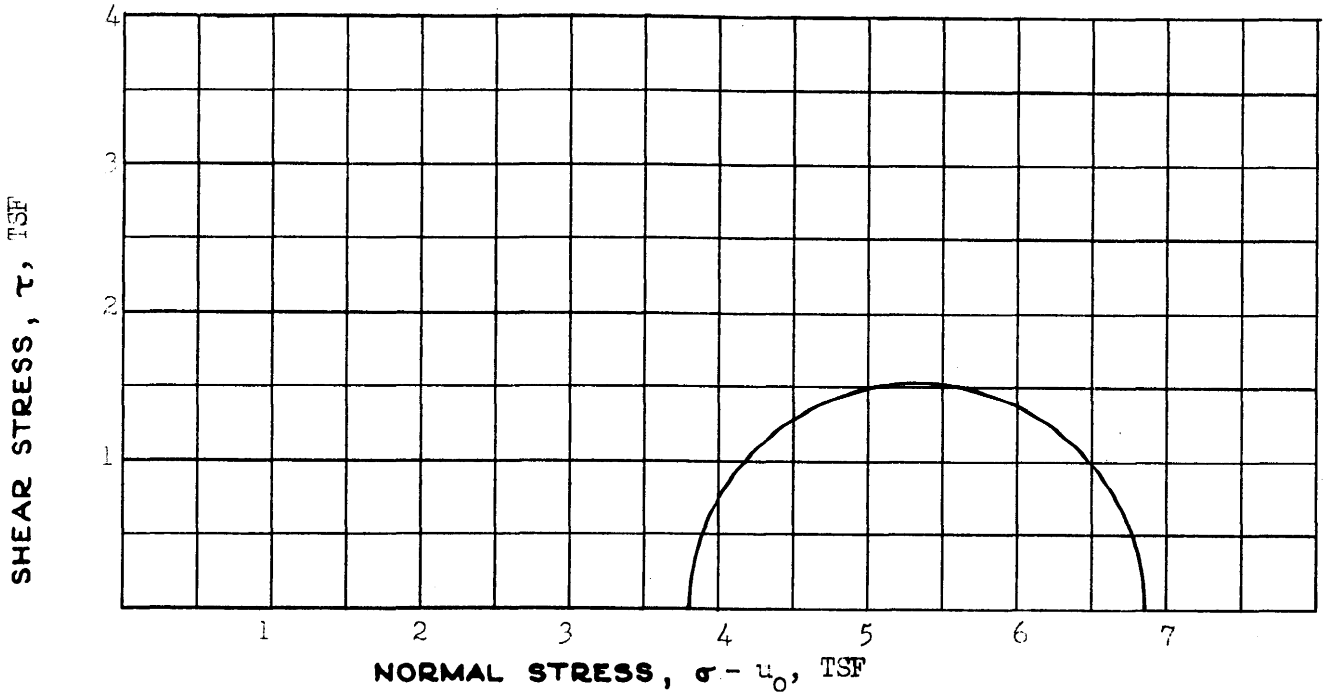
FIGURE 2.5D-90

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12859.01	BORING OF6
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	8 APR 77	SAMPLE 13E

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

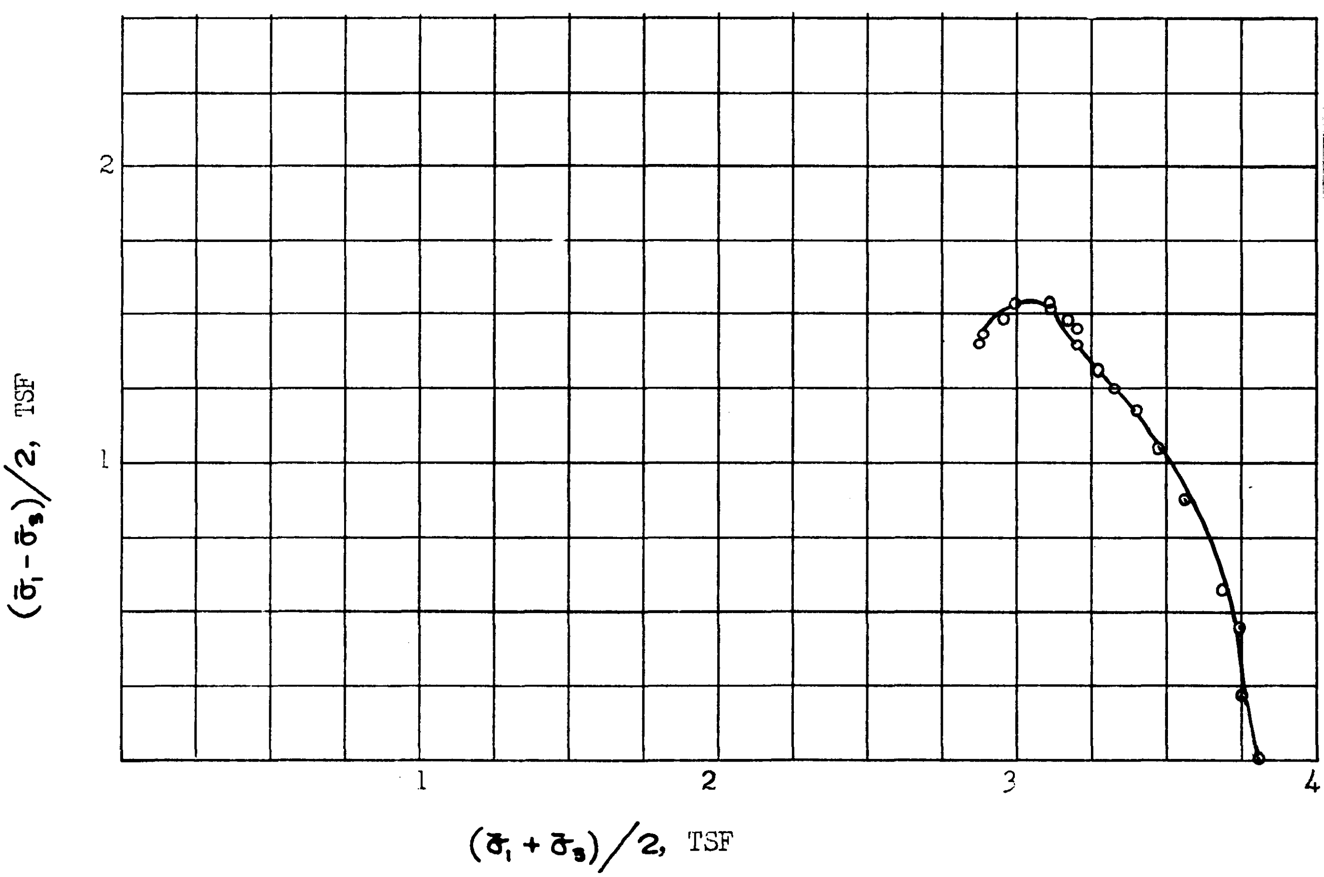


FIGURE 2.5D-91

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12869.01	BORING NUMBER OF7
SITE BEAVER VALLEY - UNIT 2	DATE 14 APR 77	SAMPLE NUMBER 1E
EFFECTIVE CONSOLIDATION PRESSURE: 3.00 TONS PER SQ FT		DEPTH 48.7 FT

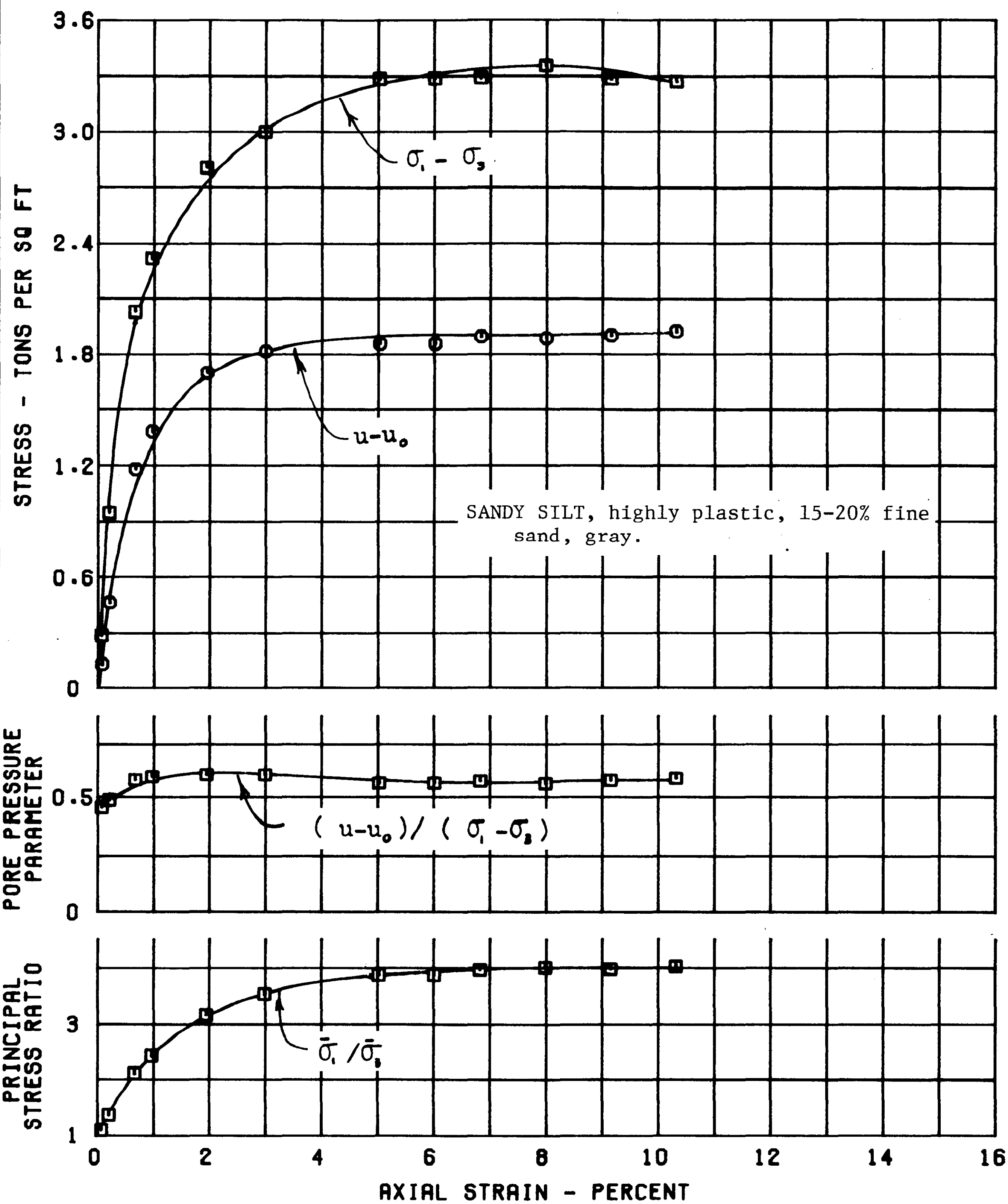


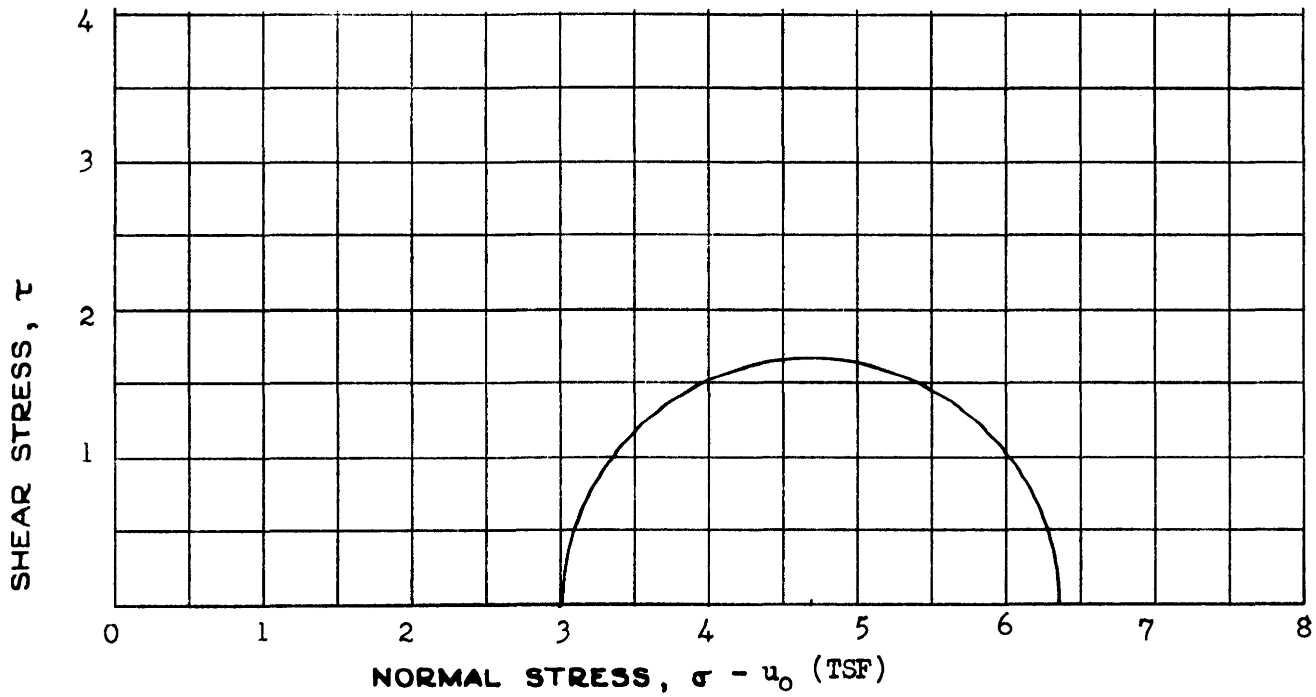
FIGURE 2.5D-92

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12859.01	BORING OF 7
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	19 APR 77	1E

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

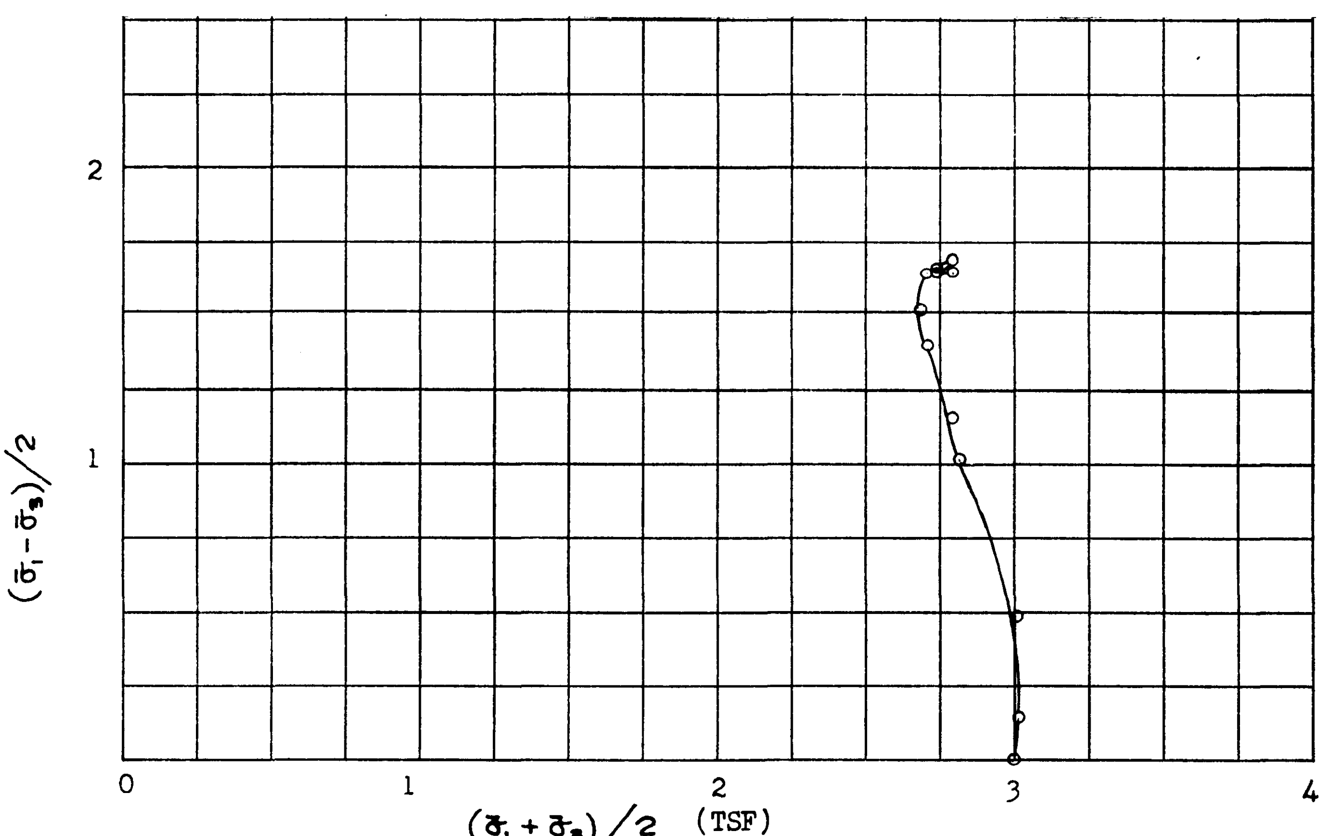


FIGURE 2.5D-93

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY UNIT 2	DATE 26 APR 77	SAMPLE NUMBER 1B
EFFECTIVE CONSOLIDATION PRESSURE: 6.00 TONS PER SQ FT		DEPTH 46.7

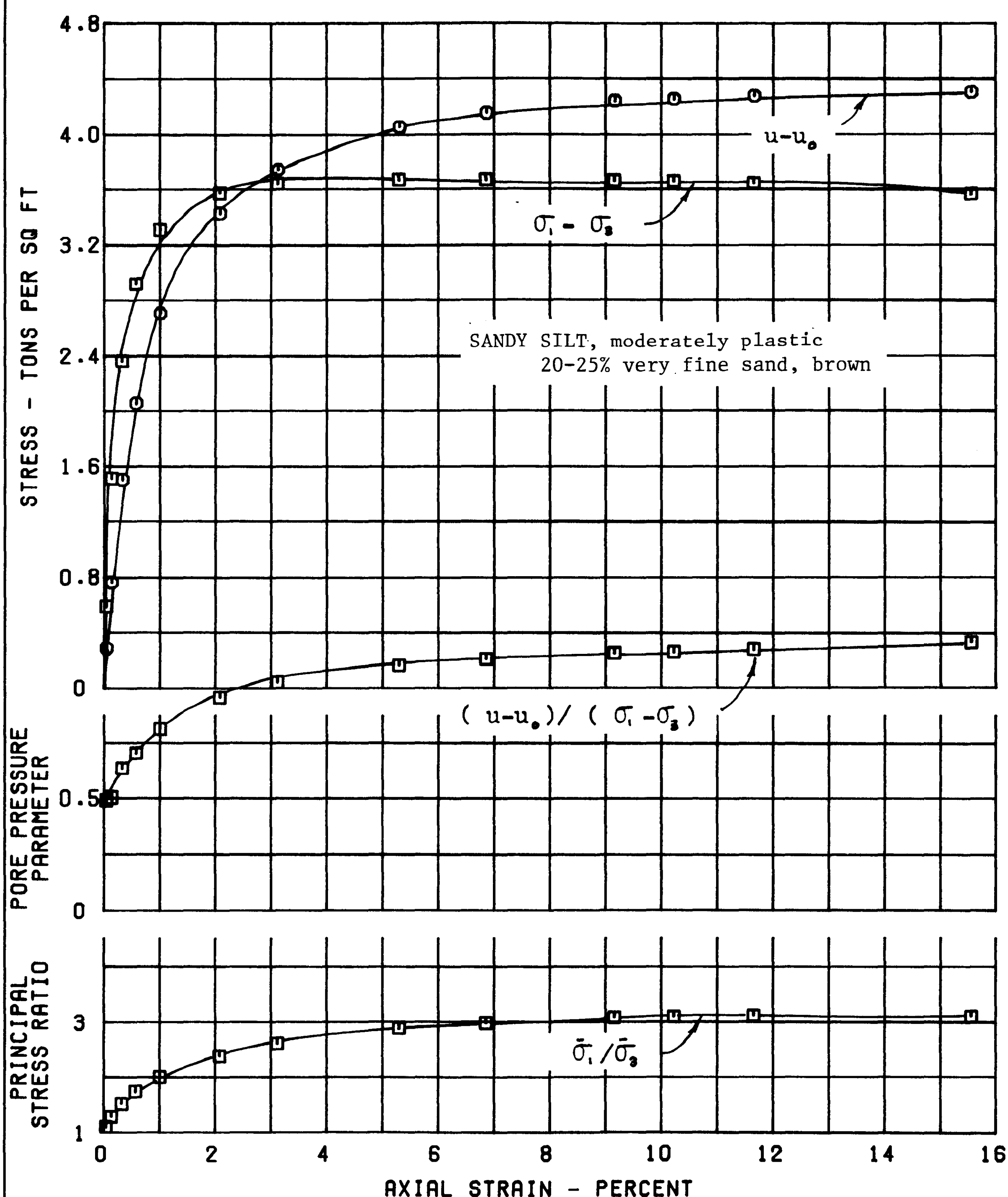


FIGURE 2.5D-94

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER 0F9
SITE BEAVER VALLEY UNIT 2	DATE 22 APR 77	SAMPLE NUMBER 1C
EFFECTIVE CONSOLIDATION PRESSURE: 4.50 TONS PER SQ FT		DEPTH 47.0 FT

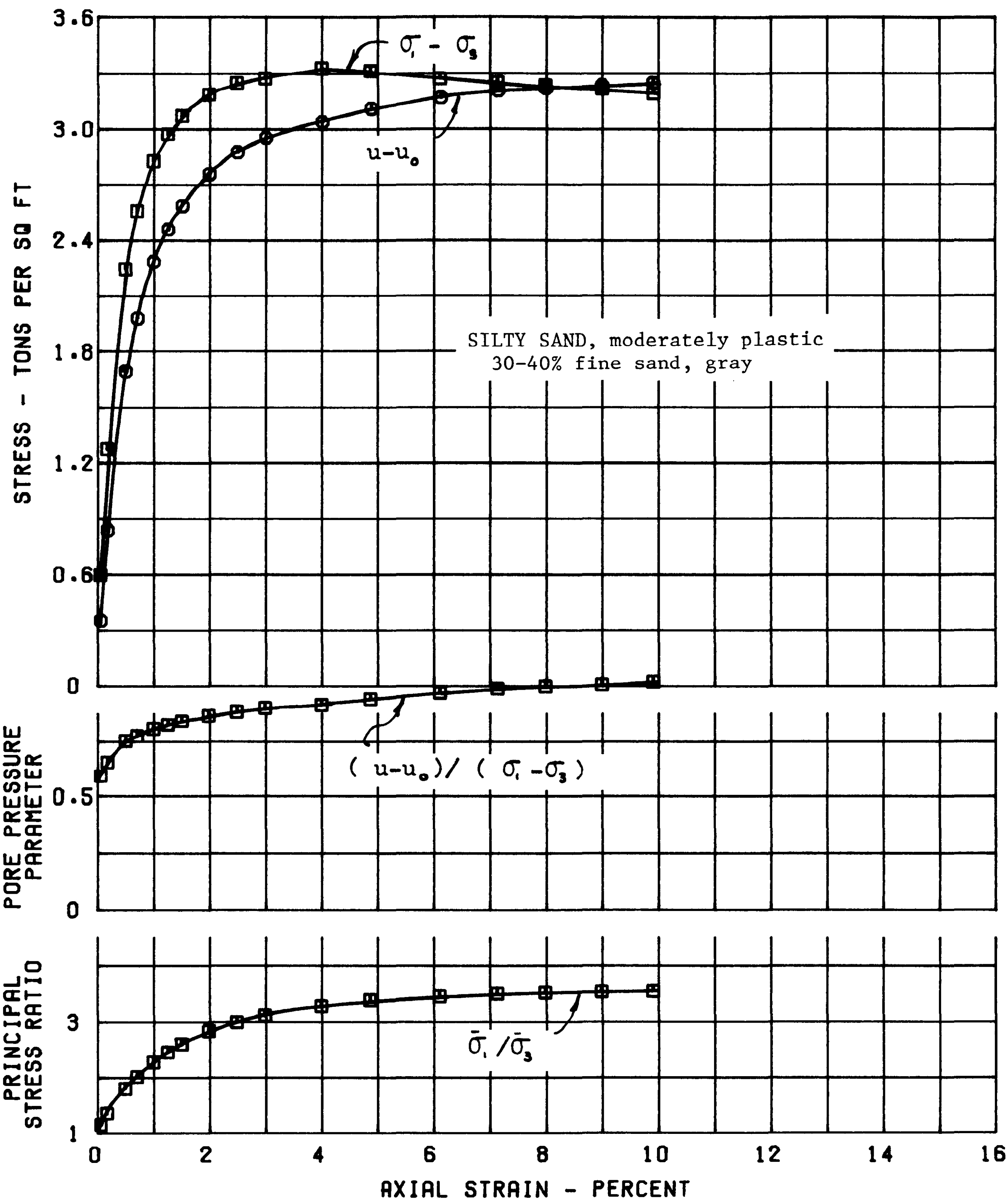


FIGURE 2.5D-95

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY UNIT 2	DATE 21 APR 77	SAMPLE NUMBER 1D
EFFECTIVE CONSOLIDATION PRESSURE: 3.00 TONS PER SQ FT		DEPTH 47.3

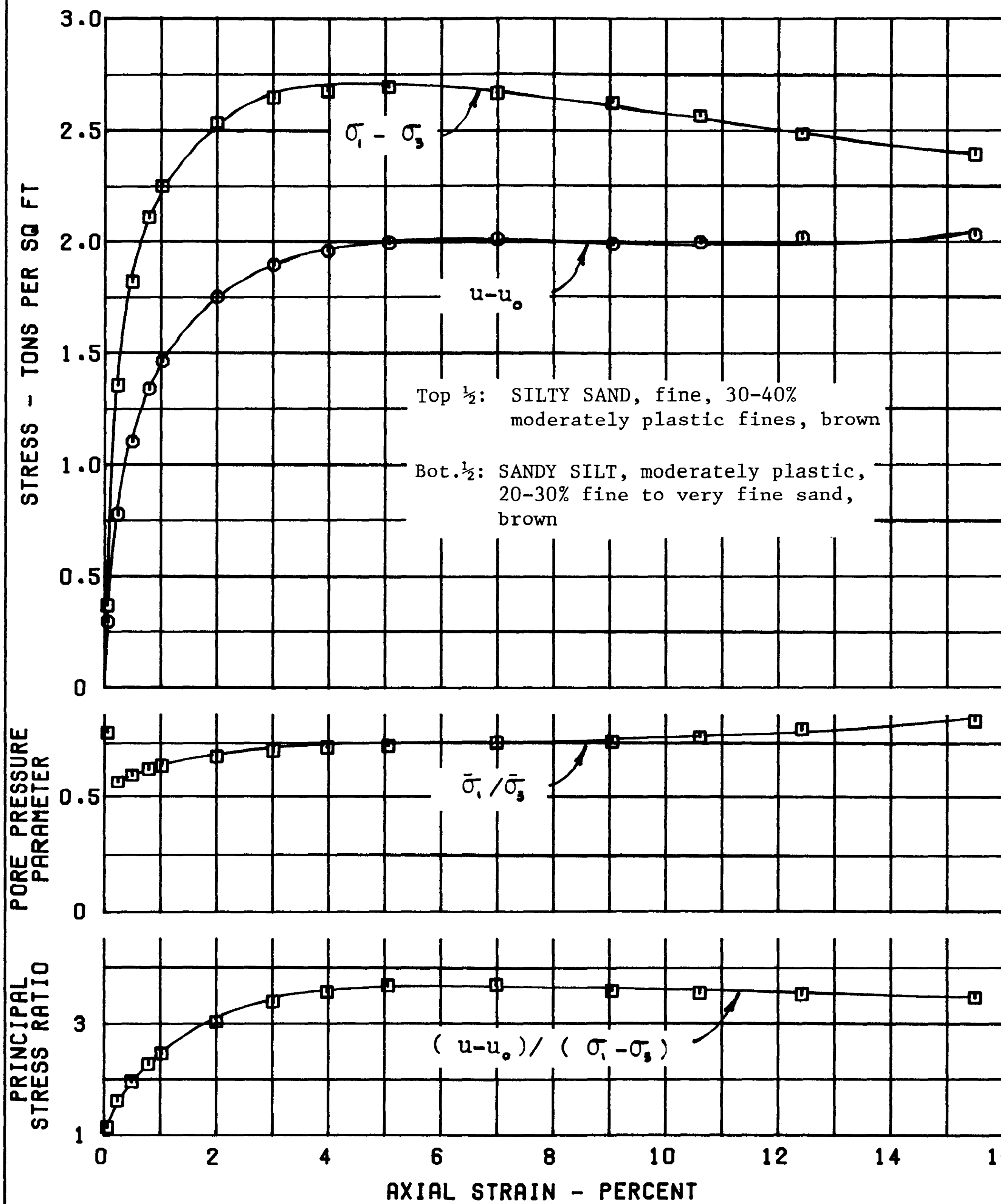


FIGURE 2.5D-96

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY UNIT 2	DATE 14 APR 77	SAMPLE NUMBER 1E
EFFECTIVE CONSOLIDATION PRESSURE: 1.30 TONS PER SQ FT		DEPTH 47.7 FT

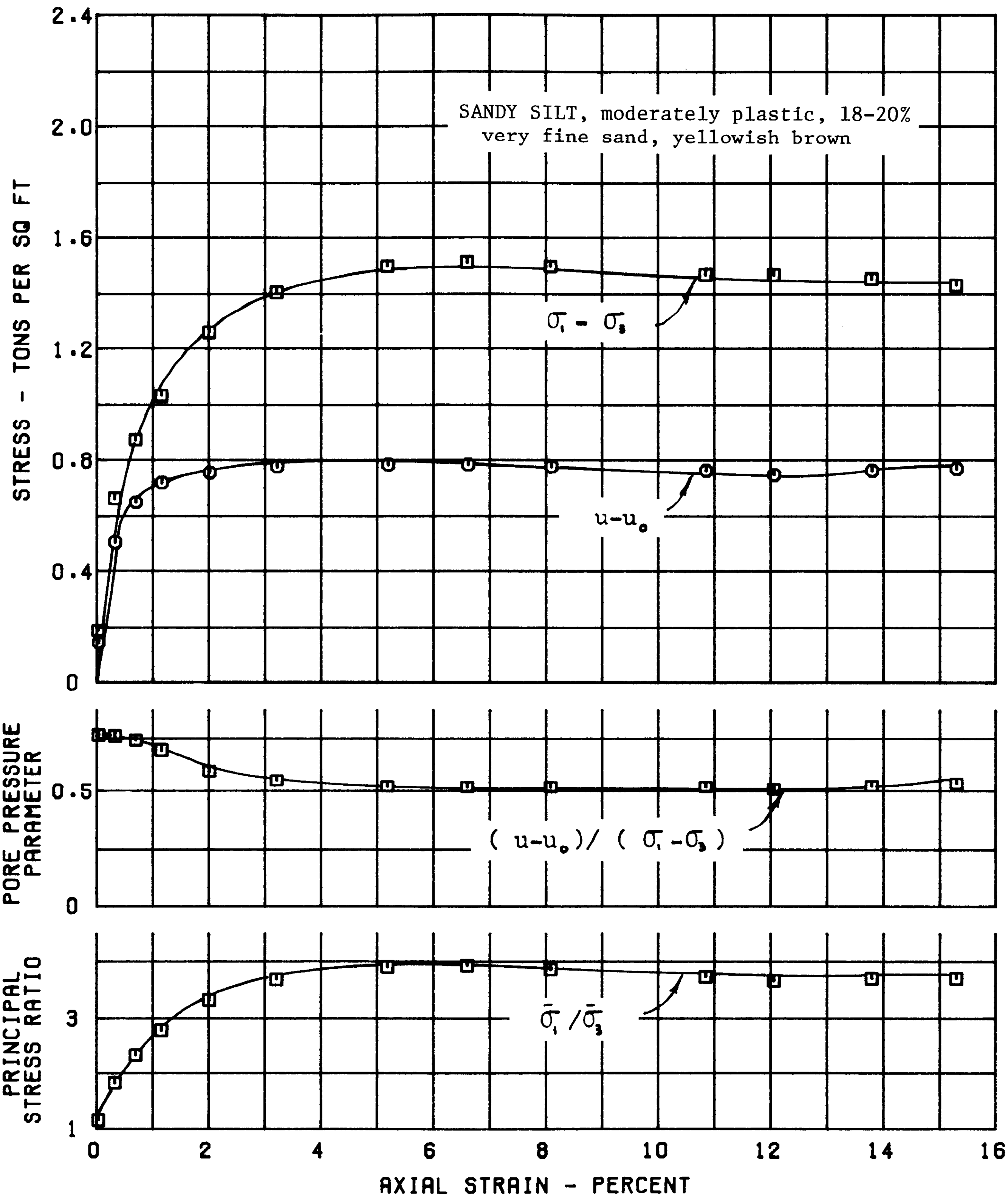


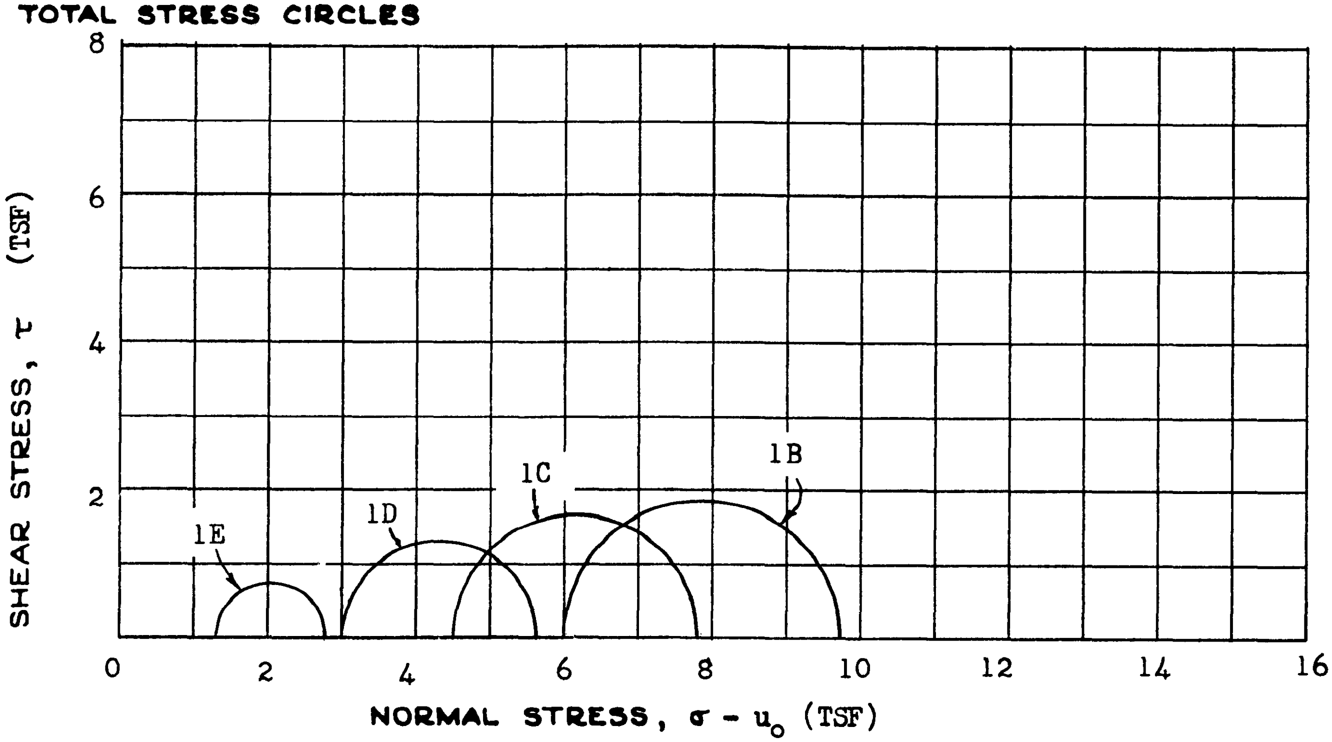
FIGURE 2.5D-97

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12859.01	BORING OF 9
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	22 APR 77	1B,1C,1D,1E

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

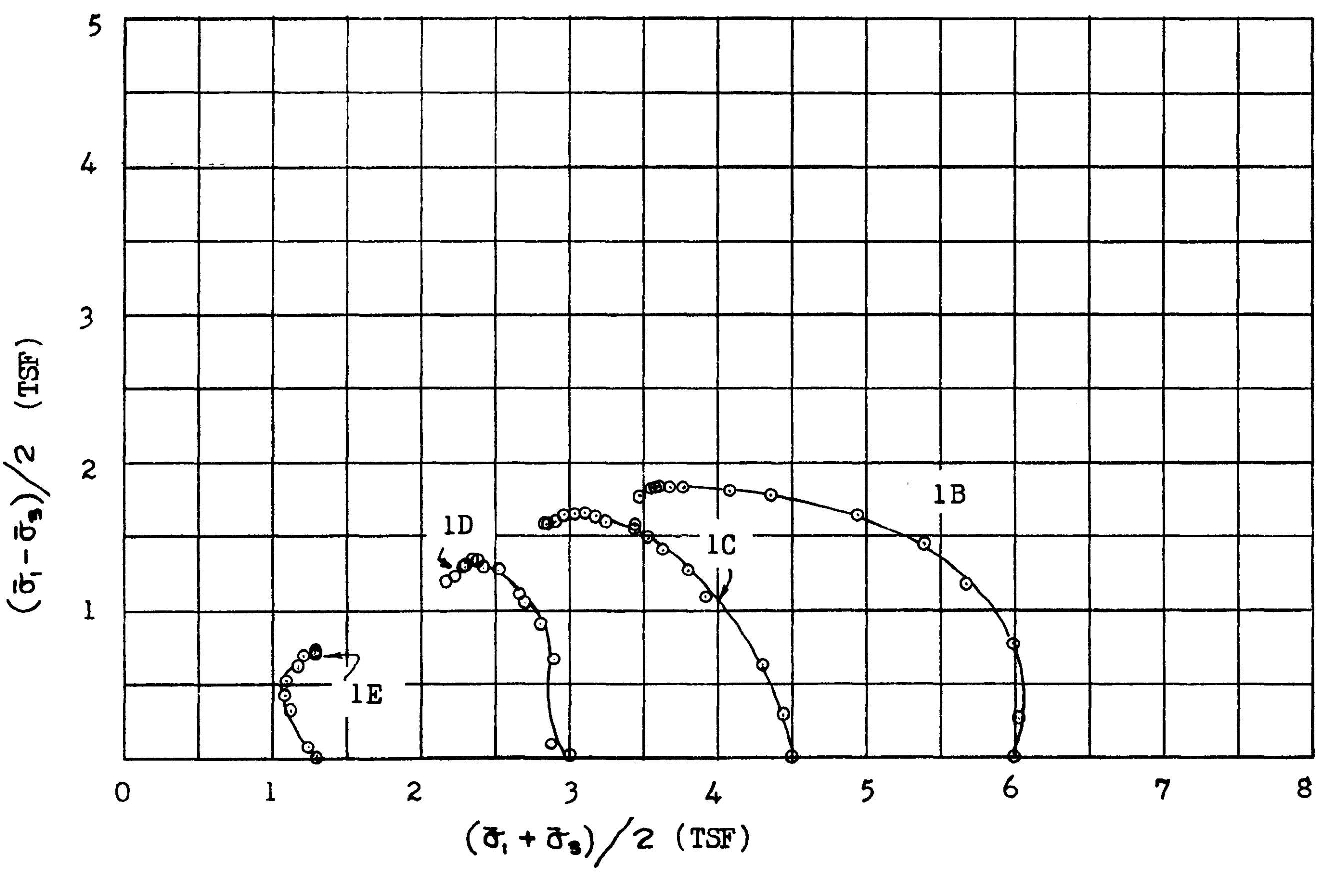


FIGURE 2.5D-98

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12859.01	BORING NUMBER OF9
SITE BEAVER VALLEY UNIT 2	DATE 11 APR 77	SAMPLE NUMBER 4D
EFFECTIVE CONSOLIDATION PRESSURE: 4.20 TONS PER SQ FT		DEPTH 60.3 FT

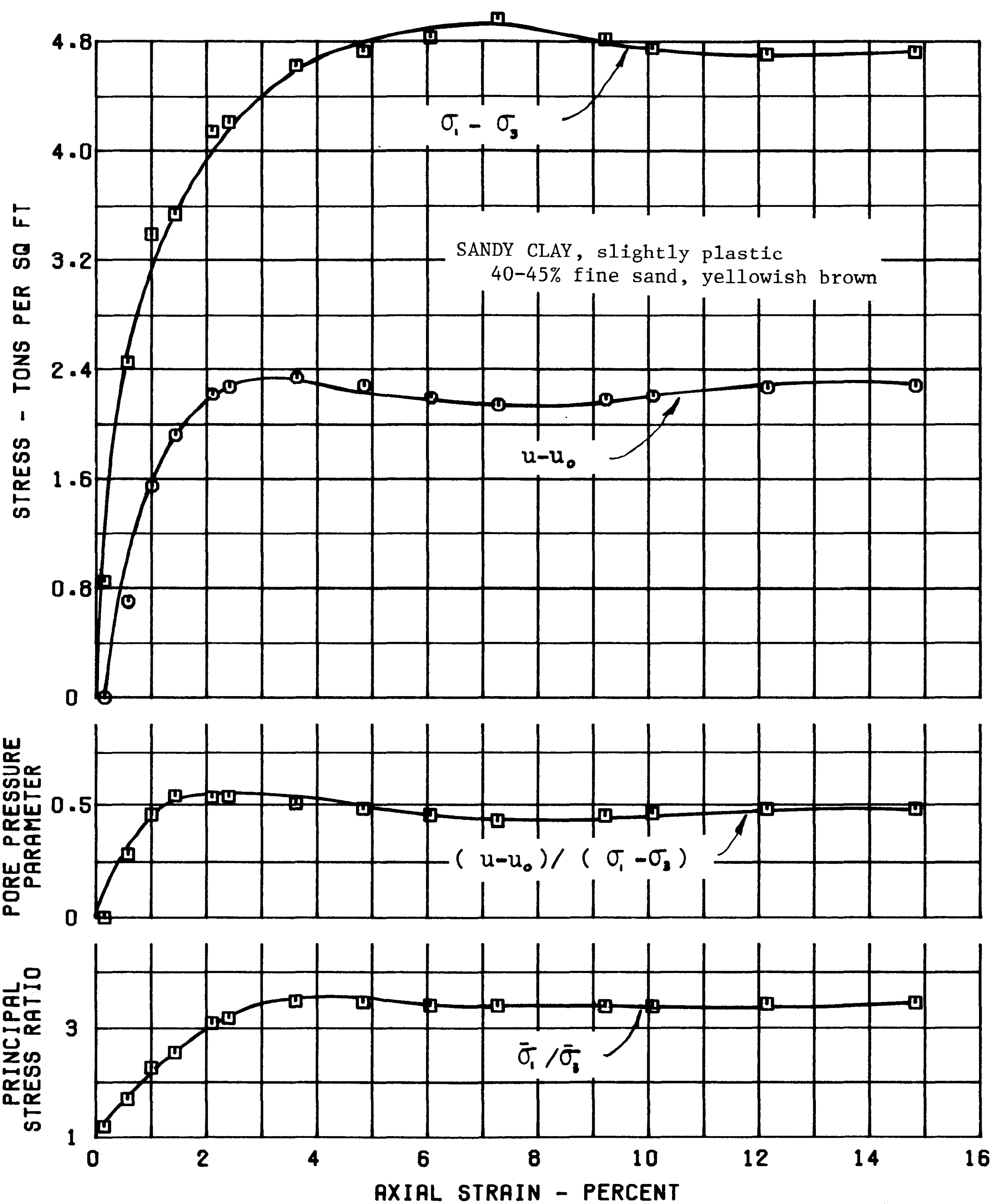


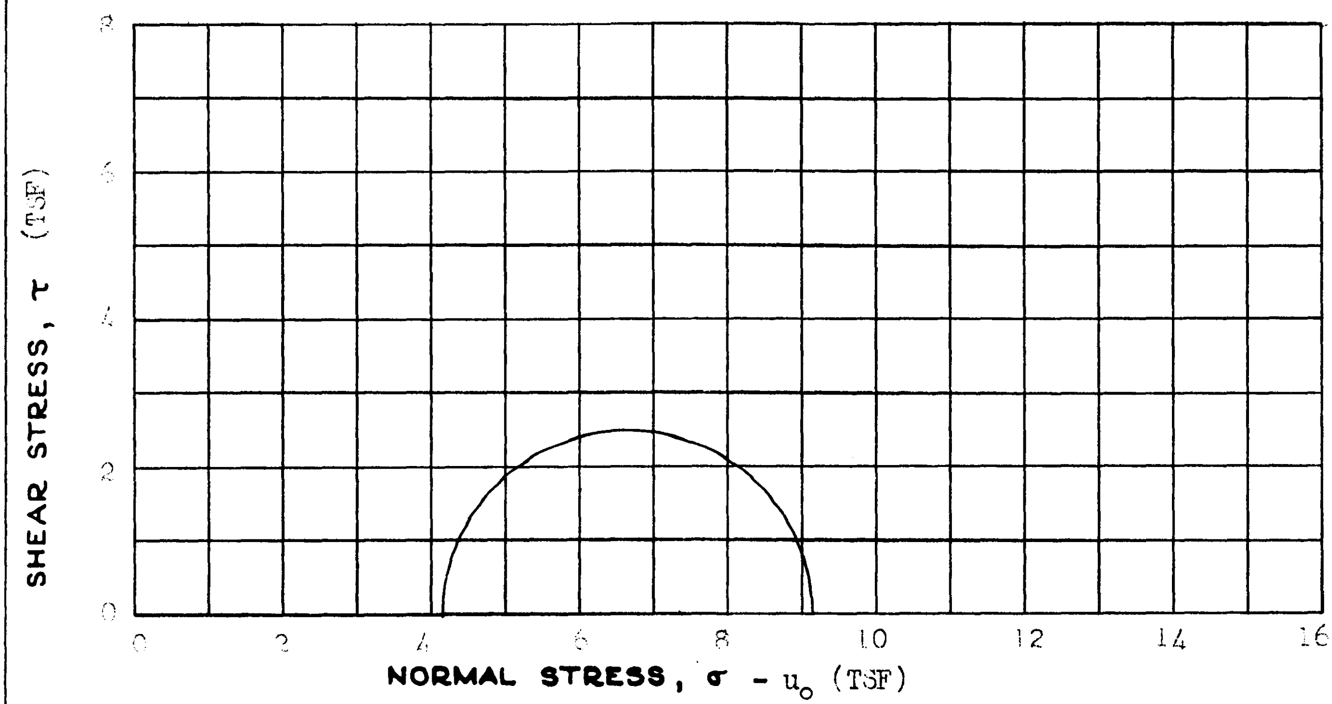
FIGURE 2.5D-99

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST STRENGTH SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	12859.01	BORING OF 9
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY UNIT 2	4 APR 77	4D

TOTAL STRESS CIRCLES



EFFECTIVE STRESS PATHS

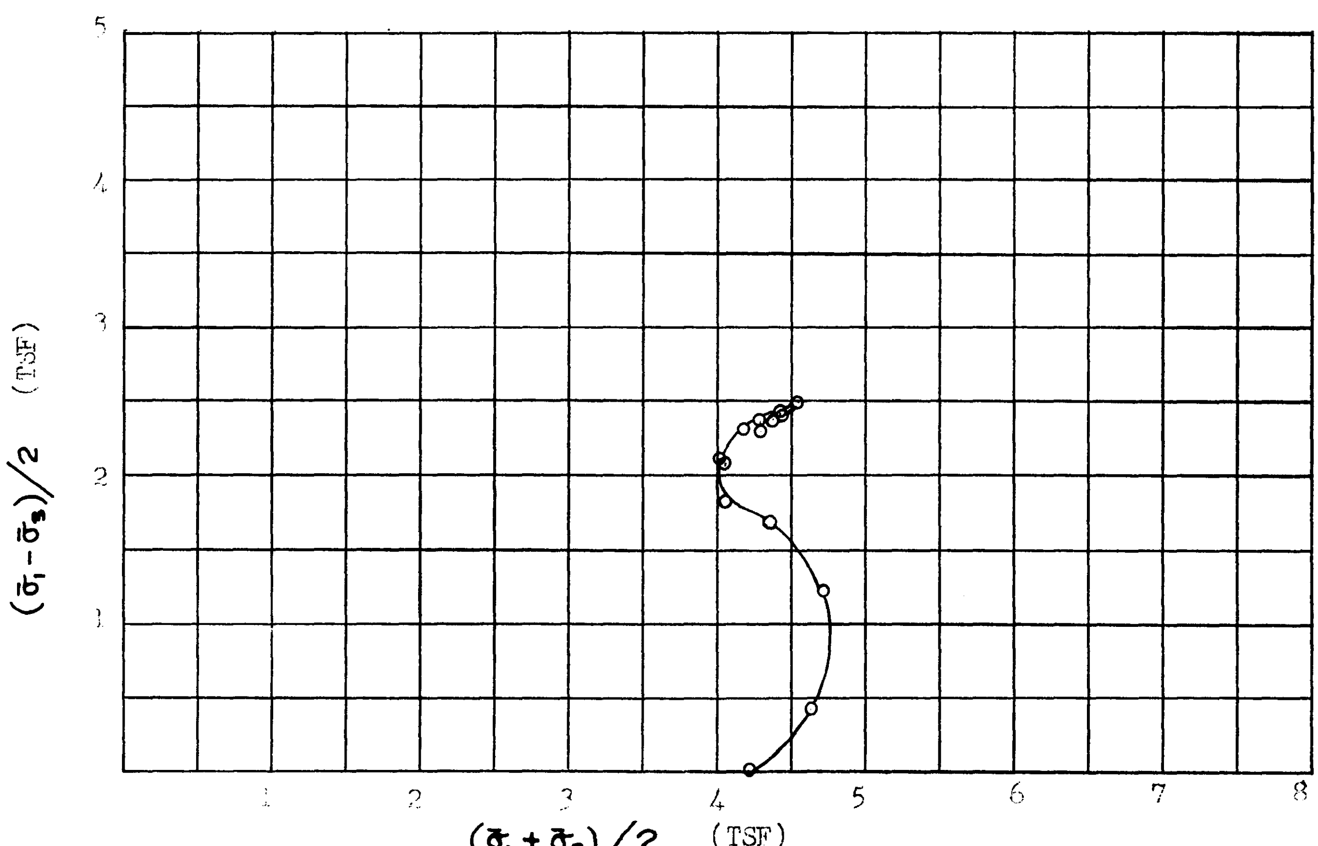


FIGURE 2.5D-100

STONE & WEBSTER ENGINEERING CORPORATION

TRIAXIAL TEST REPORT

CLIENT DUQUESNE LIGHT COMPANY	J.O. NUMBER 12241	BLOCK SAMPLE I
SITE BEAVER VALLEY UNIT 2	DATE 26 MAY 76	SAMPLE NUMBER IE
EFFECTIVE CONSOLIDATION PRESSURE: 7.20 KIPS PER SQ FT		DEPTH

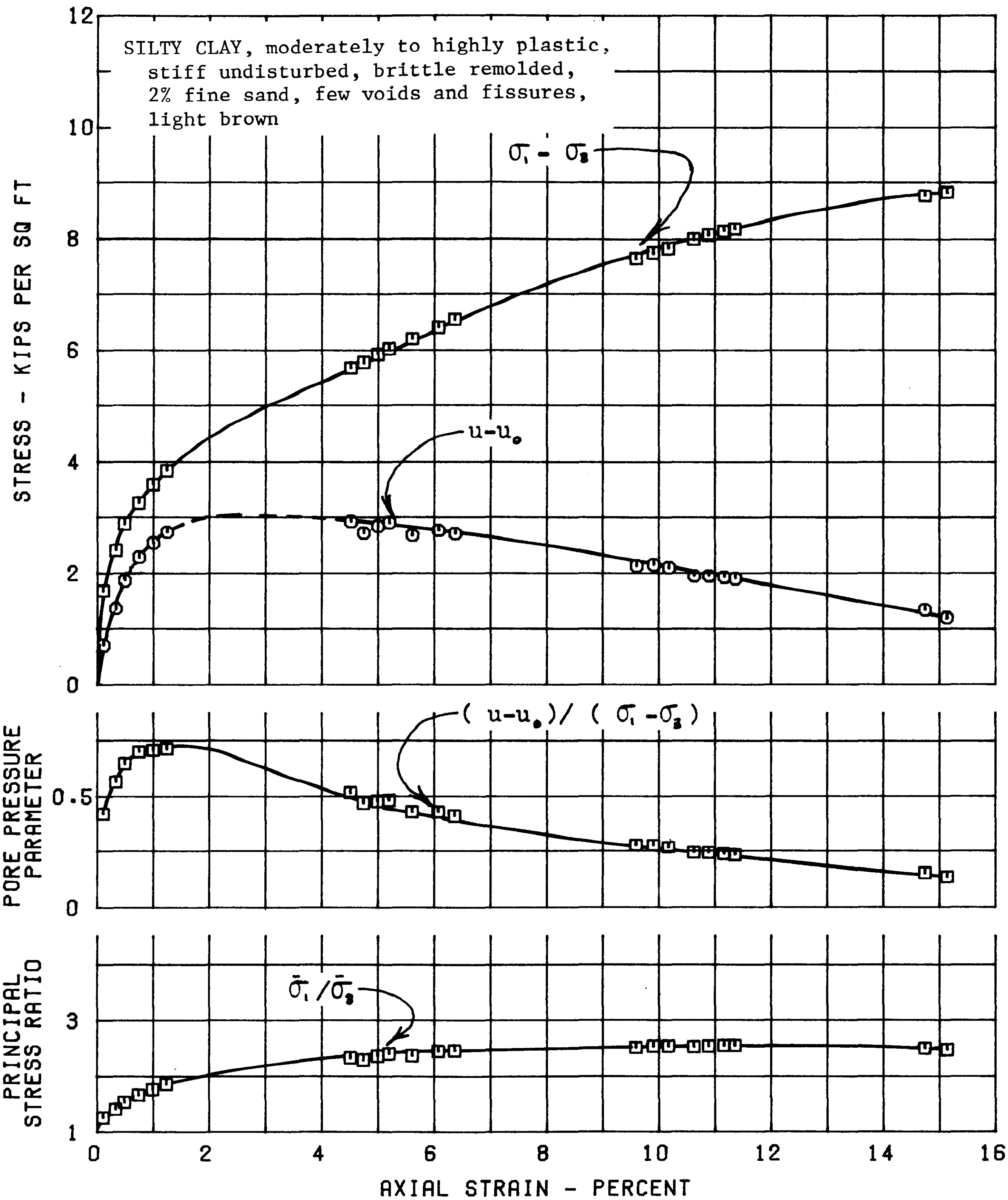
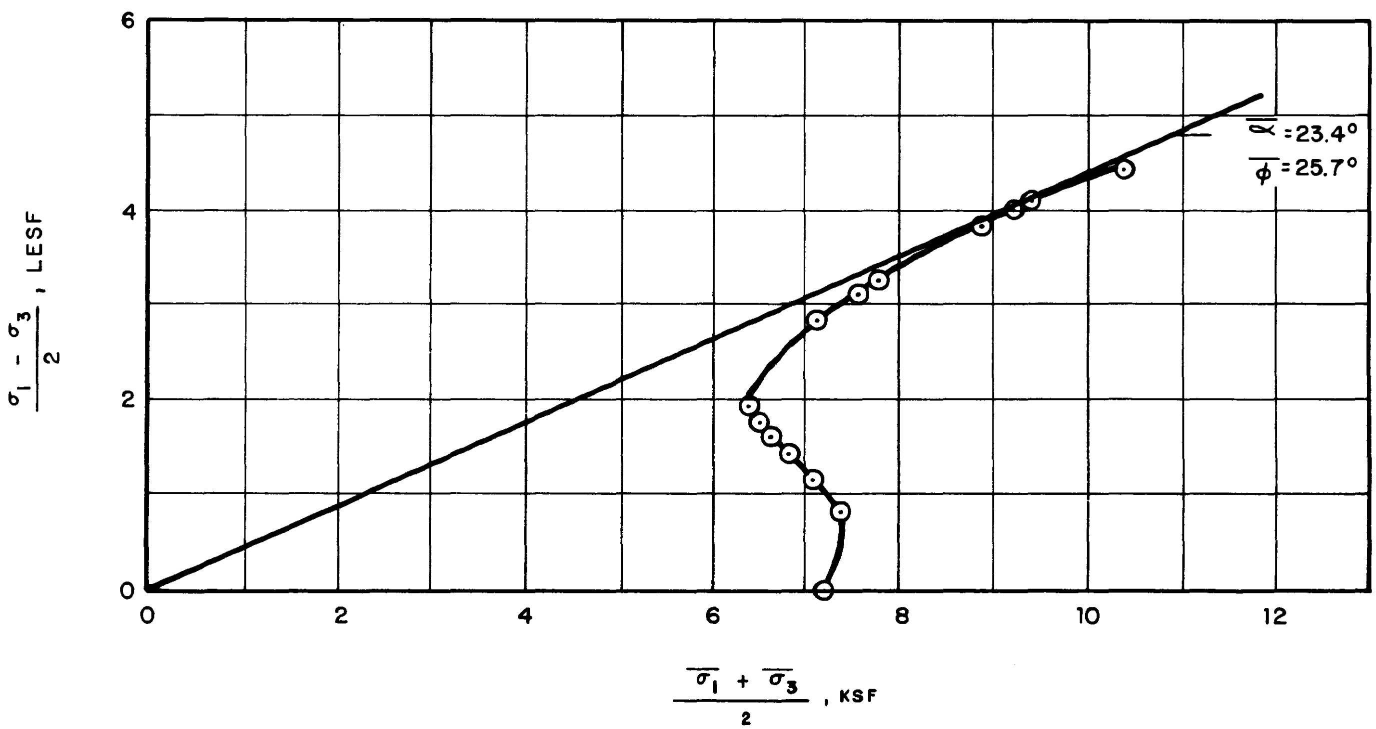


FIGURE 2.5D-101



SIN ϕ = TAN α

FIGURE 2.5D-102

EFFECTIVE STRESS PATH CIUTEST
BLOCK SAMPLE I, SAMPLE IE

BEAVER VALLEY POWER STATION - UNIT 2
FINAL SAFETY ANALYSIS REPORT

STONE & WEBSTER ENGINEERING CORPORATION

DIRECT SHEAR TEST REPORT

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQESNE LIGHT COMPANY	11700	BORING 906
SITE	DATE	SAMPLE NUMBERS
BEAVER VALLEY	21 JUN 74	1

SPECIMENS 2.5 IN. DIAMETER BY 1.0 IN. HIGH

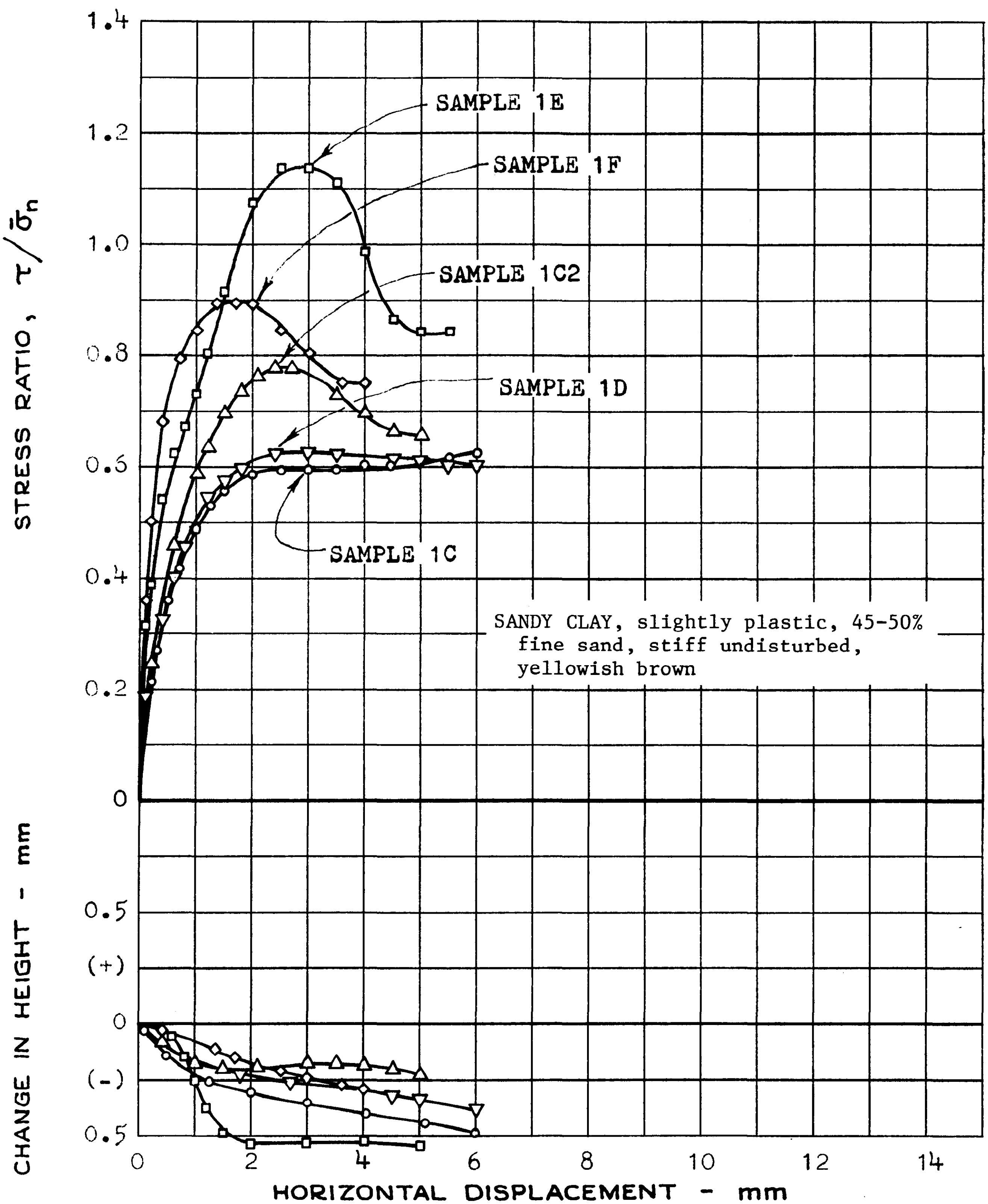


FIGURE 2.5D-103

DIRECT SHEAR TEST SUMMARY

CLIENT	J.O. NUMBER	EXPLORATION TYPE AND NUMBER
DUQUESNE LIGHT COMPANY	11700	BORING 906
SITE	**DATE**	**SAMPLE NUMBERS**
BEAVER VALLEY	21 JUN 74	1

TYPE OF TEST : DRAINED — SPECIMEN SIZE : 2.5 IN. DIAMETER BY 1.0 IN. HIGH

TYPE OF SPECIMEN : UNDISTURBED — RATE OF DISPLACEMENT : SEE BELOW

	SAMPLE NUMBER	1C1	1C2	1D	1E	1F
INITIAL	WATER CONTENT (%)	17.9	18.0	18.2	19.7	18.8
	DRY UNIT WEIGHT, γ_d (PCF)	105.9	108.1	107.8	107.6	109.2
	VOID RATIO, e_o	0.592	0.559	0.565	0.567	0.543
AFTER CONSOL.	NORMAL STRESS, $\bar{\sigma}_n$	2.02	1.09	2.02	0.30	0.30
	VOID RATIO, e_c	0.350	0.441	0.430	0.559	0.540
AT FAILURE	SHEAR STRESS, τ_f (TSF)	1.20	0.848	1.27	0.341	0.268
	STRESS RATIO, $\tau_f / \bar{\sigma}_n$	0.596	0.778	0.628	1.137	0.893
	$\phi' =$ ARC TAN $\tau_f / \bar{\sigma}_n$ (DEG)	30.8	37.9	32.1	48.7	41.8
	VOID RATIO, e_f	0.350	0.430	0.414	0.525	0.533
	RATE OF DISPLACEMENT	1.5mm/hr	40mm/hr	40mm/hr	40mm/hr	1.5mm/hr

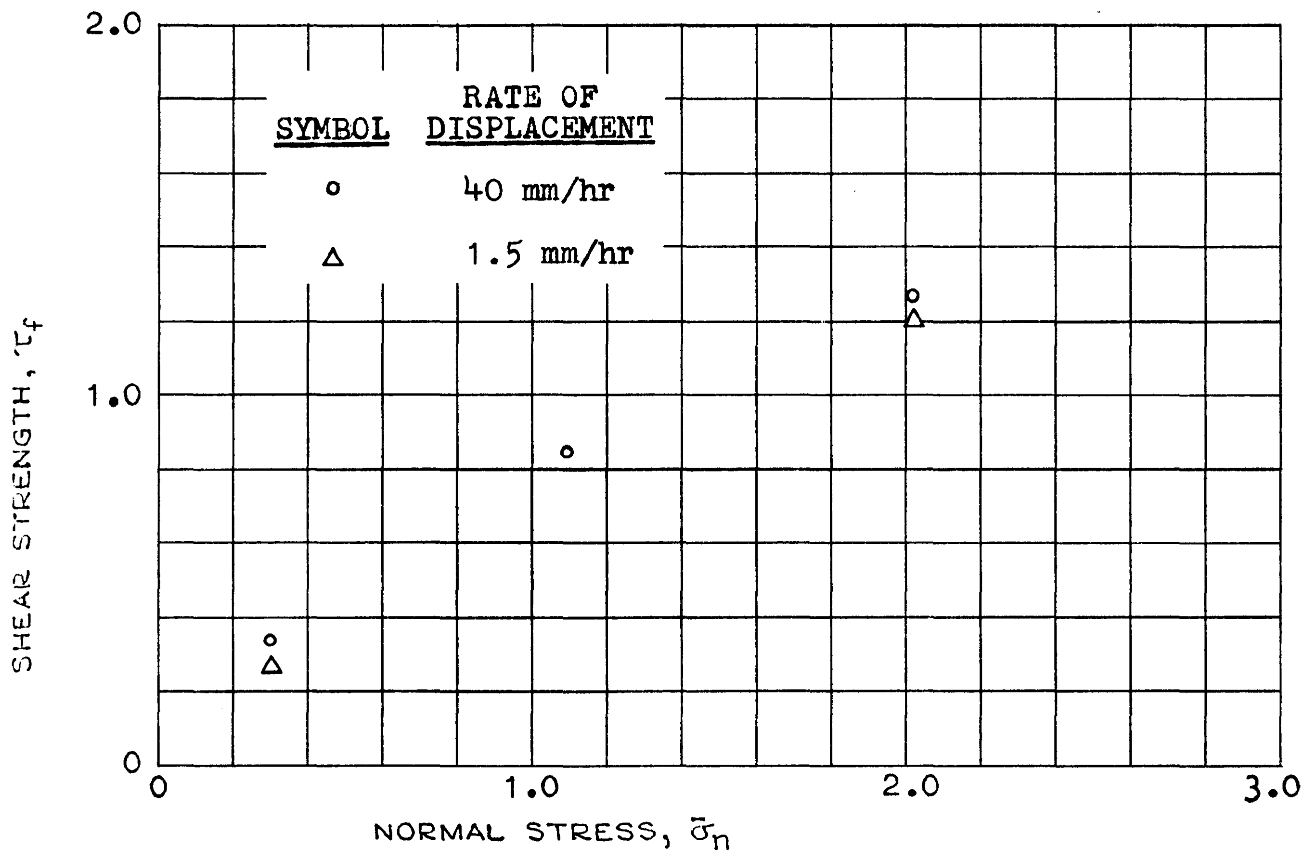


FIGURE 2.5D-104

APPENDIX 2.5E

TECHNICAL REPORT

STABILITY OF SLOPES

AT THE

EMERGENCY OUTFALL STRUCTURE

STABILITY OF SLOPES AT THE EMERGENCY OUTFALL STRUCTURE

Prepared for
BEAVER VALLEY POWER STATION - UNIT 2

DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

by
DONALD D. HUNT

JUNE 1983

Approved by ____________
Project Engineer

____
Division Head

____
Engineering Management

TABLE OF CONTENTS

LIST OF FIGURES

SECTION 1

INTRODUCTION

This report presents the results of an evaluation of the stability of slopes in the vicinity of the Beaver Valley Power Station - Unit 2 (BVPS-2) emergency outfall structure (EOS). The work performed to prepare this report comprised subsurface investigation, laboratory testing and slope stability analyses.

The EOS is a Quality Assurance Category I structure which is to be constructed at the far western end of the site (Figure 1-1). Its intended purpose is to provide missile protection for the emergency discharge point of the service water system and to raise the discharge point above the elevation of the probable maximum flood (el 730 feet). Service water normally flows through the circulating water system to the cooling tower. In the event that this route is blocked, the service water will be rerouted through the EOS to the Ohio River. Piping leading from the EOS to the Ohio River is not classified as Category I.

SECTION 2

SUBSURFACE INVESTIGATION

Eleven borings (EOS series) were drilled in the study area during the months of May and June 1982 by Eger Drilling, Inc. of Bridgeville, Pa. under the supervision of the Stone & Webster Engineering Corporation (SWEC). The locations of these borings and a number of others performed for previous investigations are shown in Figure 1-1. The PL series of borings were performed by others in conjunction with the construction of a sludge transport pipeline for the Bruce Manfield Power Plant (GAI 1976). Logs of borings performed under the supervision of SWEC are contained in Appendix A.

Four piezometers were installed, one each in borings EOS-1, -6, -7 and -7A. Piezometer EOS-6, apparently damaged during installation, is considered inoperable. Installation records for each piezometer can be found in Appendix A.

Along the plant access road, at the base of the valley wall, eight test pits were excavated at the locations shown in Figure 1-1. The test pit logs are given in Appendix A.

SECTION 3

SUBSURFACE CONDITIONS

The Beaver Valley Power Station is founded on a glacial outwash terrace deposited by higher stages of the Ohio River during the Pleistocene age. The study area is at the extreme western end of the terrace where it begins to pinch out against the steep bedrock valley wall. Soil profiles developed from the subsurface investigation data are presented in Figures 3-1 through 3-5. The locations of the sections are shown in Figure 1-1. Due to the complex character of the soil deposits, it was generally not possible to develop a soil profile showing specific continuous soil types between adjacent borings. Instead, at least with the soil data obtained from the EOS borings, soils were categorized according to mode of deposition and roughly by gradation, e.g., coarse and fine colluvium.

Generally, the borings indicate that, on the steep valley walls, the bedrock surface is overlain by what is termed coarse colluvium, derived from the weathering of the parent sandstone bedrock at higher elevations. From the split spoon samples, it can be described as a sandy gravel, largely composed of weathered and decomposed, angular sandstone fragments contained within a matrix of more severely weathered sandstone. The coarse colluvium is, in turn, overlain by fine colluvium derived from the weathering of shales, claystones, and limestones. It is a heterogeneous sandy clay containing fragments of the parent rock. The colluvial soils diminished in thickness with increasing elevation on the valley wall and were found to be absent above el 850 feet (GAI 1976). At the base of the valley and extending northward to the river, there exists an interfingering of the colluvial soils with the outwash and alluvial soils deposited by the Ohio River. Figure 3-2 illustrates in greater detail the complexity of the soil conditions in the vicinity of borings EOS-1 and EOS-6. To the north of boring EOS-10 (Figure 3-1), the terrace has been eroded and portions of the original granular outwash deposits have been replaced with more recent river deposits of silt and clay. This layer is discussed in greater detail in Section 5.3.

SECTION 4

GROUNDWATER

Several piezometers were installed within the granular terrace soils of the main plant area and groundwater levels have been recorded on a regular basis since 1977. Groundwater levels in the terrace have been found to follow quite closely the levels of the Ohio River with little observed time lag (SWEC, 1980). Based on the soil profiles in the study area, there should be good groundwater communication between the granular soils of the terrace and the Ohio River. Consequently, groundwater levels within the terrace can be expected to closely follow the various flood stages of the Ohio River which are as follows:

Normal water level: el 665 feet
Twenty-five year flood: el 690 feet
Probable maximum flood: el 730 feet

Four piezometers were installed within the soils of the colluvial slope, one each in borings EOS-1, -6, -7, and -7A. The piezometer installed in boring EOS-6 was damaged and is considered inoperable. Installation details can be found in Appendix A. The piezometer in boring EOS-7, installed near the top of rock, did not indicate the presence of groundwater, nor did any of other piezometers, even after a heavy rain. The relatively impermeable surface soils and the steepness of the valley walls limit the percolation of runoff into the underlying coarse colluvium and groundwater flow through the bedrock is small; observed groundwater flow from bedrock wells averaged 2 to 4 gpm and surface bedrock seeps along joints were generally less than 1 to 2 gpm (DLC 1983).

Field descriptions indicated that the layered silt/silty sand found in borings EOS1 and EOS6 (Figure 3-2) was somewhat wetter than the surrounding, more coarse grained soil and Hendron (1975) noted what appeared to be a spring at what is approximately the location of boring EOS-1. As mentioned previously, a piezometer was installed in boring EOS-1, but it did not indicate the presence of groundwater. Eight test pits were excavated along the plant access road as shown in Figure 1-1. They should have penetrated this apparent wet zone if it existed beneath the access road; groundwater was not encountered in any of the test pits. It is felt that the condition found in borings EOS-1 and EOS-6 is localized and not extensive.

SECTION 5

PROPERTIES OF SUBSURFACE MATERIALS

A laboratory testing program was conducted to evaluate the properties of the fine grained soils in the study area. Details of the testing program and the results contained in Appendix B are discussed in this section. Properties of the coarse grained soils, for which undisturbed sampling was not possible, were evaluated from correlations with standard penetration test (SPT) blow counts and sample descriptions, such as Terzaghi and Peck (1967) and Department of the Navy (1971).

5.1 COARSE COLLUVIUM

The effective friction angle of the coarse colluvium will be high due to the nature of the material and, for this analysis, a value of 40 degrees was selected. The total unit weight was assumed to be 135 pcf.

5.2 FINE COLLUVIUM

Shales, claystones and limestones have weathered to form the fine colluvium consisting of a heterogeneous sandy clay containing numerous rock fragments. As the material creeps downslope during the weathering process, slickensides (presheared, polished surfaces) may develop which represent inherent planes of weakness along which residual strength properties are considered to apply.

Two direct shear tests were performed on remolded split spoon samples of fine colluvium to evaluate its residual friction angle, details of which are presented in Appendix B. One test was performed on a sandy clay (Appendix B, Figure B-28) from which the coarse material was removed by washing on a No. 40 sieve and the other test was performed on a sample of silty clay (Appendix B, Figure B-25). The measured residual friction angles were 22 and 28 degrees, respectively.

Testing specimens of the fine colluvium which included the coarse grained materials would have resulted in measured residual friction angles which were too high, since there would have been a high probability of including a rock fragment across the relatively small shear plane of the direct shear device. In situ, the residual friction angle will be larger due to the presence of the rock fragments, gravel, and sand within the fine colluvium. Therefore, sufficient conservatism is included in the chosen residual friction angle of 28 degrees for the stability analysis. Also, the heavy vegetation on the slope will act to reinforce the slope and in effect increase the friction angle of the soil cover. The total unit weight of the fine colluvium was assumed to be 125 pcf.

Two additional direct shear tests on remolded split spoon samples of fine colluvium recovered from the PL series of borings were reported by Hendron (1975). They were performed on what was described in the boring logs as sandy clayey silt (liquid limit = 29 percent;

plasticity index = 7.4 percent). The residual friction angles measured were 32 degrees and 33 degrees.

5.3 ALLUVIAL SOILS

Sand, Silty Sand, Sandy Gravel, Gravelly Sand

The derivation of the engineering soil properties of the terrace sands and gravels at the Beaver Valley site, fully described in Section 2.5.4.2 of the BVPS-2 Final Safety Analysis Report (DLC 1983), are summarized below:

Total unit weight:	
above groundwater table:	125 pcf
below groundwater table:	136 pcf
Effective friction angle:	30 degrees

For the purpose of simplifying the computer model, a value of 125 pcf was used for this material, since potential failure surfaces critical to the integrity of the EOS did not pass through the terrace sands and gravels below the groundwater table.

Silty Clay

The properties of the silty clay layer of the riverward slope were evaluated from the results of the laboratory testing program described in Appendix B.

The top surface of the clay (Figure 3-1) is at about el 690 feet. From borings EOS-4 and EOS-4A, the upper 25 feet is described as moderately plastic and medium stiff to stiff, with standard penetration test N values in the range of 8 to 10 blows per foot. As an index test, unconfined compressive strengths measured in the field with a pocket penetrometer were 1 to 2 tons per square foot (tsf). A consolidation test (Appendix B, Figure B-7) performed on an undisturbed specimen of the upper clay indicates it to be slightly overconsolidated to normally unconsolidated under the weight of the recently added uncontrolled fill.

At about el 665 feet there is a color change from brown to gray. The consistency of the lower clay is described as soft to medium stiff with standard penetration test N values of 6 to 9 blows per foot. Field unconfined compressive strengths were 0.75 to 1.0 tsf. Atterberg limits of the upper and lower clays are similar indicating consistent minerology.

The primary differences between the upper and the lower clay appear mainly to be color and consistency, probably as a direct result of a lowering of the groundwater table. This hypothesis is supported by the change in color and consistency at about el 665 feet, corresponding to the present normal water level of the Ohio River.

Two series of consolidated isotropically undrained (CIUC) triaxial compression tests were performed on undisturbed samples from boring

EOS-4A: sample UO-4 from the upper clay and sample UO-7 from the lower clay. The effective friction angle measured for the upper clay was 33.7 degrees (Appendix B, Figure B-14). The effective friction angles measured for the samples of the lower clay were 31 and 33.9 degrees (Appendix B, Figure B-18). Due to some sample disturbance upon extrusion from the sampling tube, it was necessary to trim the test specimens of the lower clay to a smaller diameter. Consequently, the measured effective friction angle may be low as a result of some sample disturbance. Closer to the river, as indicated by samples recovered from boring EOS-5, the soils are softer in consistency and more silty. The upper 12 feet (el 683 feet to el 671 feet) of boring EOS-5 is described as brown sandy silt/silt with standard penetration test N values of 2 to 3 blows per foot. Between el 671 feet and 655 feet, the soil is described as sandy clay/sandy silt with standard penetration test N values of 4 to 5 blows per foot. A series of three CIUC triaxial compression tests was performed on an undisturbed sample of the sandy clay from boring EOS-5 (Appendix B, Figure B-21). An effective friction angle of approximately 35 degrees was measured.

Based on the triaxial test results, for the analysis of the riverward slope for static or long-term conditions, the recent river deposits were considered to be a single layer with an effective friction angle of 32 degrees and a total unit weight of 125 pcf. Failure surfaces critical to the emergency outfall structure were considered to be through the deeper soils and, for this reason, the generalized soil profiles (Figures 6-5 and 6-6) do not include the upper silts found in boring EOS-5.

Undrained strength parameters of the clay were used for the dynamic analysis of the slope. The entire clay layer was assumed to be normally consolidated and was divided into several sublayers. The undrained strength of each sublayer was determined from the ratio of undrained shear strength to effective confining pressure, $s_u/\overline{\sigma}_c$; an average value of 0.4 was determined from the triaxial test results. The friction angle was set equal to zero for the undrained case.

Silt, Sandy Silt, Layered Silt/Silty Sand

As shown in the soil profile detail in Figure 3-2, in the vicinity of borings EOS-1 and EOS-6, there is an upper layer of dense or stiff, somewhat clayey, silt which is underlain by a layered silt/silty fine sand.

A series of three CIUC triaxial compression tests was performed on an undisturbed specimen of the upper material from boring EOS-1A. It was described as a slightly plastic, silty clay/clayey silt and the measured effective friction angle was 34.2 degrees (Appendix B, Figure B-8). Pore pressure response measured during the tests indicate that the soil is dilative during shear; i.e., the pore pressures increased during the early stages of the test and then decreased.

A single CIUC triaxial compression test was performed on the layered silt/silty fine sand (Figure B-12). The effective friction angle was 35.5 degrees, and this test specimen was also dilative during shear.

Soil conditions are complex at the base of the valley where it intersects the terrace. To account for the types of soils shown in Figure 3-2 in the stability analysis, the generalized soil profile discussed in Section 6 includes a trapezoidal zone of soil at the bottom of the valley with an effective friction angle of 30 degrees and a total unit weight of 120 pcf.

5.4 UNCONTROLLED FILL

Uncontrolled fill placed in this area was material removed from onsite excavations. Boring EOS-4 shows the fill material to be sandy gravel and gravelly sand with standard penetration test N values of 14 to 29 blows per foot. The material from boring EOS-10 is similar but blow counts are lower, ranging between 2 and 10 blows per foot. Since the fill was placed without control and with a minimum of compactive effort, in-place densities can be expected to vary widely. Based on the granular materials encountered in the borings,the uncontrolled fill was assumed to have an effective friction angle of 30 degrees and a total unit weight of 120 pcf. In terms of the overall stability analysis of the riverward slope, the soil properties assumed for the uncontrolled fill are not critical since its effect is mostly to add weight to a given slice.

5.5 COMPACTED GRANULAR FILL

Some regrading and filling of the area around the EOS will be required. The evaluation of engineering soil properties for the compacted granular fill used at the site was discussed in Section 2.5.4.5 of the BVPS-2 Final Safety Analysis Report (DLC 1983). The following properties were used in this analysis:

Effective friction angle:	36 degrees
Total unit weight:	136 pcf

SECTION 6

SLOPE STABILITY

Both static and dynamic stability of the slopes in the vicinity of the EOS were examined. The steep valley wall to the south of the EOS is termed the colluvial slope; the terrace to the north of the EOS is termed the riverward slope. The stability analysis of each slope will be discussed under a separate heading.

Two methods of analysis were employed: the simplified Bishop method and the Morgenstern-Price method. The simplified Bishop method assumes a circular arc failure surface and the Morgenstern-Price method allows for an arbitrary shaped failure mass, which, in this analysis, was assumed to be a sliding wedge with straight line boundaries. The stability analyses were performed using the computer program Lease II (SWEC 1980).

The dynamic stability analyses included the effect of earthquake accelerations and the resulting inertial forces applied to the potential sliding mass in the event of the safe shutdown earthquake (SSE). Lease II uses a pseudo-static approach in which a constant force is computed as the weight of a given slice multiplied by a seismic coefficient.

This type of analysis is considered conservative since the applied inertial forces are constant and are related to the peak acceleration of the SSE. No consideration is given to the time variation of acceleration during an actual earthquake event nor is consideration given to the cyclic nature of the direction of acceleration and the resulting seismic forces.

The horizontal ground surface acceleration for the SSE at the site has been determined to be 0.125g and the vertical acceleration is taken as two thirds of the horizontal or 0.08g (DLC 1983). Therefore, the following seismic coefficients were used for both the riverward slope and colluvial slope stability analyses:

horizontal: $\alpha_h = 0.125$

vertical: $\alpha_v = 0.08$

The pseudo-static forces were applied horizontally away from the slope, i.e., downslope, and vertically down.

6.1 COLLUVIAL SLOPE

Profiles representative of soil conditions within the colluvial slope in the immediate vicinity of the EOS are presented in Figures 3-1 and 3-3. As discussed in Section 3, the soil conditions within the slope consist of fine colluvium overlying coarse colluvium which, in turn, overlies bedrock. At the base of the slope, there has been a complex and somewhat unpredictable interfingering of the colluvial soils with alluvial sands and silts deposited by the Ohio River.

On a large scale, the soil and conditions depicted in Figures 3-1 and 3-3 are similar. Since the data obtained from the EOS series of borings are the most recent (1982) and since the engineering soil properties used were developed from soil samples obtained from these borings, more emphasis was placed on the EOS borings when developing the computer model to use in the stability analysis. Section 1-1A (Figure 6-1) depicts the generalized soil profile used in the analysis of the colluvial slope. It was developed from Figure 3-1, but simplified somewhat to facilitate the analysis.

The EOS is shown on the generalized soil profiles at its approximate distance from the toe of the slope so that conclusions can be drawn regarding the impact of any potential sliding of the slope on the structure.

Groundwater levels within the lower portion of the slope were assumed to coincide with the normal level of the Ohio River at el 665 feet for the static case and at the level of the 25-year flood, el 690 feet, for the dynamic case.

6.1.1 Colluvial Slope - Static Case

Results of the analysis indicate that the overall stability of the colluvial slope under static or long-term loading conditions is acceptable. Several typical circular arc failure surfaces examined using the simplified Bishop method of analysis are shown in Figure 6-1. Failure surfaces analyzed using the Morgenstern-Price method are shown in Figure 6-2.

The analysis shows that the fine colluvium is generally stable and that movement of the entire mass of soil downslope is not likely to occur. Safety factors of potential failure surfaces which include the majority of the fine colluvium are greater than 1.5. However, since the residual friction angle of the fine colluvium chosen for the analysis is approximately equal to the angle of the slope above el 780 feet, the analysis did indicate that minor surface sloughing of the upper slope (above el 780 feet) was possible; i.e., shallow circular arcs exhibited safety factors of 1.0. Deeper circular arcs through the upper slope, such as the typical one shown in Figure 6-1, had safety factors of about 1.3 and were considered marginally stable. The distance from the EOS to the toe of this circular arc is about 160 feet and is sufficient to preclude structural damage should movement along the surface actually occur.

6.1.2 Colluvial Slope - Dynamic Case

Results of the analysis, including the effect of pseudo-static forces determined for the peak accelerations of the SSE, indicate that the overall stability of the colluvial slope is acceptable. Failure surfaces examined using the Morgenstern-Price method are shown in Figure 6-2. Several typical circular arcs analyzed using the simplified Bishop method are shown in Figure 6-3.

The analysis shows that movement of the entire mass of fine colluvium downslope is not likely. Safety factors of potential failure

surfaces which include the majority of the fine colluvium are 1.1 or greater. However, the minimum factor of safety for circular arcs within the fine colluvium above the mid-slope region was 0.8. A typical circle is shown in Figure 6-3. A factor of safety less than 1.0 indicates that the fine colluvium in this region may not possess sufficient residual shear strength to resist the additional forces developed by the horizontal and vertical accelerations applied to the soil by the SSE.

Neglecting the fact that the LEASE II pseudo-static analysis is conservative and assuming that some movement of the slope will actually occur in the event of the SSE, the amount of movement that may occur along this typical failure surface was estimated by an approach first suggested by Newmark (Newmark 1965) using the computer program SIDES (SWEC 1980). This analysis is based upon the following:

1. An earthquake acceleration-time history record may be input, normalized to any peak acceleration.

2. No motion will occur within the slope until the strength of the soil is exceeded, i.e., the acceleration is greater than the limiting acceleration producing a safety factor of 1.0. For the typical circle shown in Figure 6-3, the limiting horizontal and vertical accelerations were 0.045g and 0.030g, respectively.

3. When the soil moves, it slides as a rigid mass downslope; movement upslope is conservatively disallowed.

4. Displacements occurring each time the soil strength is exceeded are cumulative throughout the duration of the earthquake.

The time histories from the El Centro 1940 earthquake north-south component and the 1952 Kern County earthquake (S69E component of the Taft record) were used. The El Centro record was chosen because it is representative of the strongest motions available from deep soil sites, whereas Taft was chosen because of its wide frequency range and strong motion characteristics. For these acceleration-time histories, the cumulative displacement of the slope was less than 1 in. This magnitude of movement is considered to be small and, given the distance of the EOS from the potential sliding mass, no damage to the EOS will occur.

Safety factors increase as the circles become larger. A typical circular arc with a safety factor of 1.0 is shown in Figure 6-3 and is considered to be marginally stable. At the limit is the large radius circular arc which includes almost all of the fine colluvium within the sliding mass, its safety factor is 1.1. Sliding wedge stability analyses were performed using the Morgenstern-Price method for failure surfaces which included most of the fine colluvium. The results shown in Figure 6-2 indicate factors of safety of 1.1 to 1.2 which are similar to those obtained using the Bishop method (Figure 6-3) for the large radius circle.

In summary, the overall stability of the colluvial slope for dynamic conditions is acceptable. Failure surfaces which could affect the structure should movement actually occur along them exhibited safety factors which were adequate. Safety factors for extensive failure surfaces encompassing most of the fine colluvial material were about 1.1 for both the simplified Bishop and the Morgenstern-Price methods of analysis. The fine colluvium above about the mid-slope region appears to be unstable. However, failure surfaces within this area will involve limited amounts of material and are of a sufficient distance away from the EOS that any potential movement along the failure surfaces will not affect the structure itself.

6.2 RIVERWARD SLOPE

Generalized soil profiles showing the soil properties used in the stability analysis of the riverward slope are given in Figures 6-4 and 6-5. The soil profiles, based on Section 3-3 (Figure 3-5), are simplified somewhat to facilitate analysis. An amount of compacted granular fill was added to the soil profile in the immediate vicinity of the structure to account for raising the existing grade to el 730 feet. No differentiation was made between granular colluvial and alluvial soils for the purpose of assigning soil properties to the computer model. The soil model used in the dynamic analysis (Figure 6-6) is the same as that for the static case except that undrained soil properties were substituted for the clay layer.

6.2.1 Riverward Slope - Static Case

Results of the analysis (Figure 6-4) indicate that the riverward slope is stable under static loading conditions. The minimum factor of safety was found to be 1.6 for a very shallow circular arc. Potential failure surfaces through the silty clay layer were considered to be the most critical to the structure; two typical circular arcs are shown which exhibit adequate safety factors.

6.2.2 Riverward Slope - Dynamic Case

Results of the analysis indicate that the riverward slope is stable under dynamic loading conditions. The analysis was performed using both the simplified Bishop method and the Morgenstern-Price method. A number of typical failure surfaces is shown in Figure 6-5.

Since the most critical failure surfaces were considered to be through the clay layer, the groundwater level was taken at el 665 feet, the normal Ohio River level. Generally, the dynamic analyses, including the effect of SSE loading, is performed for groundwater levels appropriate to the 25-year flood. As stated in Section 4, the groundwater level within the granular soils of the riverward slope will closely follow the level of the Ohio River. However, given its lower permeability, it is unlikely that groundwater levels in the clay would change substantially during the relatively short duration of the 25-year flood. It was therefore considered acceptable to evaluate failure surfaces through the clay layer with the groundwater level taken at el 665 feet.

A deep circular arc, the majority of which passed through granular soils, was analyzed for both normal water and the 25-year flood as shown in Figure 6-5. The computed safety factors were acceptable.

SECTION 7

CONCLUSIONS

The results of the stability analyses indicate that there is a potential for movement of the upper portions of the colluvial slope; however, these movements will not affect the EOS, should they actually occur. The lower portion of the colluvial slope is stable for both static and dynamic loading conditions.

The riverward slope is stable for both static and dynamic loading conditions.

SECTION 8

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APPENDIX A

BORING LOGS AND TEST PIT LOGS

BORING NO. EOS-1
SHEET 1 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241
COORDINATES N3843 E6223 GROUND ELEV. (1) 741.0 FT
INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY
DATE: START / FINISH 6-4-82 / 6-7-82 CONTRACTOR / DRILLER EGER/JARVIS
STATIC GROUNDWATER DEPTH / DATE NOT RECORDED(FT) / DRILL RIG TYPE CME 45
DEPTH TO BEDROCK 52.0 (FT) TOTAL DEPTH DRILLED 52.0 (FT)
METHODS:
DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, WATER
SAMPLING SOIL 2 IN O.D. SPLIT SPOON
DRILLING ROCK NONE
SPECIAL TESTING OR INSTRUMENTATION 2 FT POROUS STONE PIEZOMETER INSTALLED WITH TIP AT EL 718
COMMENTS NONE

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
741.0	0	S	1	1-3-5 (12")	8	ML	TOP 6 IN: SANDY SILT, DENSE, 10% FINE GRAVEL TO 3/8 IN, ANGULAR, 15-20% COARSE TO FINE SAND, CONTAINS ROOTS AND ORGANIC MATTER, VERY SLIGHTLY MOIST, DARK BROWN AND BLACK.
						CL	BOTTOM 6 IN: SANDY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL FINE GRAVEL, 12-15% COARSE TO FINE SAND, ANGULAR, VERY SLIGHTLY MOIST, LIGHT BROWN.
		S	2	4-13-9 (12")	22	CL	SIMILAR TO S-1, BOTTOM 6 IN.
		S	3	1-5-6 (12")	11	CL	SIMILAR TO S-1, BOTTOM 6 IN, GRAY BROWN.
	5						
		S	4	5-6-8 (18")	14	CL	SILTY CLAY, MODERATELY PLASTIC, STIFF, 2% FINE SAND, SLIGHTLY MOIST, BROWN, MOTTLED WITH YELLOW AND SOME GRAY, SMALL POCKETS OF LIGNITE, CONTAINS POCKETS OF SANDY CLAY WITH SOME COARSE AND MEDIUM SAND, TRACE SUBANGULAR GRAVEL TO 0.5 IN MAXIMUM.
		S	5	4-5-6 (16")	11	CL-ML	SILTY CLAY-CLAYEY SILT, SLIGHTLY PLASTIC, MEDIUM STIFF, MOIST, BROWN.
		S	6	6-6-5 (18")	11	ML	SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 5% VERY FINE SAND, MOIST, BROWN.
731.0	10	S	7	2-3-6 (13")	9	ML	SIMILAR TO S-6.
		S	8	4-5-5 (17")	10	ML	SIMILAR TO S-6, CONTAINS OCCASIONAL 5mm FINE SAND LENS.
		S	9	6-7-9 (15")	16	ML	TOP 7 IN: SANDY SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 30-40% FINE SAND, MOIST, BROWN.
						SM	BOTTOM 8 IN: SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, BROWN.
	15	S	10				

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-241A

APPROVED	DATE	BORING NO.	SHEET
JDH	9/1/82	EOS-1	1 OF 3

BORING NO. EOS-1
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	10	6-5-7 (18")	12	ML-SM	LAYERED SILT AND SILTY FINE SAND, SLIGHTLY PLASTIC FINES, CLAYEY SILT CONTAINING COARSE TO FINE GRAVEL SIZED ROCK FRAGMENTS AT BOTTOM.
		S	11	5-5-7 (14")	12	SM ML	TOP 2 IN: SILTY SAND, FINE, FEW FINE GRAVEL. BOTTOM 12 IN: SILT, NONPLASTIC TO VERY SLIGHTLY PLASTIC, MOIST, BROWN.
		S	12	3-5-5 (14")	10	ML	SIMILAR TO S-11. BOTTOM 12 IN. CONTAINS FINE SAND LENSES ABOUT 2 mm THICK.
		S	13	4-2-3 (12")	5	SM ML	TOP 10 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, BROWN. BOTTOM 2 IN: SILT, SLIGHTLY PLASTIC, BROWN.
721.0	20						
		S	14	3-1-6 (17")	7	SM ML	TOP 8 IN AND BOTTOM 1 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, WET ORANGE-BROWN. MIDDLE 8 IN: SILT, SLIGHTLY PLASTIC, GRAY-BROWN.
		S	15	3-4-4 (17")	8	ML-SM	TOP 8 IN: LAYERED SANDY SILT AND SILTY FINE SAND, NONPLASTIC FINES, BROWN. BOTTOM 9 IN: SILTY SAND, FINE, 10-15% NONPLASTIC FINES, BROWN.
		S	16	3-2-3 (17")	5	SP	SAND, UNIFORM, FINE, 5-10% NONPLASTIC FINES, BROWN.
	25						
		S	17	2-2-2 (15")	4	SP	SIMILAR TO S-16.
		S	18	1-5-6 (18")	11	SM GP SP	TOP 12 IN: SIMILAR TO S-16. MIDDLE 2 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SHALE FRAGMENTS, ANGULAR. BOTTOM 4 IN: SAND, UNIFORM, FINE, MOIST, BROWN.
		S	19	3-4-3 (13")	7	SP GP-GW	TOP 6 IN: SAND, FINE, TRACE SILT, BROWN. BOTTOM 7 IN: SANDY GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, BROWN.
711.0	30	S	20	2-2-3 (9")	5	SM GP	TOP 5 IN: SILTY SAND, FINE, 10-15% COARSE TO FINE GRAVEL, ROUNDED, 5-7% NONPLASTIC FINES. BOTTOM 4 IN: GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, ANGULAR TO ROUNDED, TRACE SAND, WET, GRAY AND BROWN, ORGANIC OILY SMELL AND FEEL.
		S	21	5-3-3 (5")	6	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1.5 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, TRACE IRON STAINING, BROWN, GRAY ORANGE.
		S	22	4-3-5 (6")	8	GP-GW	SIMILAR TO S-21.
		S	23	5-5-5 (4")	10	GP-GW	SIMILAR TO S-21.
	35						
		S	24	7-4-5 (13")	9	GP GP-GW	TOP 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 10-15% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, GRAY. BOTTOM 8 IN: SANDY GRAVEL, COARSE TO FINE, ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINS, BROWN.
		S	25	9-8-13 (0")	21		NO RECOVERY.
		S	26	8-9-8	17	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN, ANGULAR, SOME ROUNDED GRAVEL, 15-20% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, IRON STAINS AND COAL, GRAY.
701.0	40						
		S	27	13-19-22 (14")	41	GP	SIMILAR TO S-26. BLOWS/INCH: 2-2-3-2-2-2/3-3-3-3-4-3/4-3-4-4-3-4
		S	28	9-11-20 (13")	31	SP	SAND, POORLY GRADED, MEDIUM TO FINE, 5-10% COARSE TO FINE GRAVEL, SUBANGULAR TO ROUNDED, 1.5 IN SANDSTONE FRAGMENT AT TOP, TRACE NONPLASTIC FINES, BROWN.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-241B	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-1	2 OF 3

BORING NO. EOS-1

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(6&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	29	12-25-31 (16")	56	GP	SANDY GRAVEL, BROKEN COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, ANGULAR, FEW ROUNDED, 10-15% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN AND GRAY. BLOWS/INCH: 2-1-2-2-2-3/4-5-3-5-4-4/5-5-7-5-3-6
		S	30	23-34-111 (12")	145	GP	SANDY GRAVEL, BROKEN COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, ANGULAR, 30-40% COARSE TO FINE SAND, 10-13% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 2-2-3-4-5-7/5-5-5-8-6-5/13-20-18-18-17-25
		S	31	47-50-113 (18")	163	SP	TOP 2 IN: SAND, FINE, TRACE FINE GRAVEL, 5-10% NONPLASTIC FINES, ORANGE-BROWN.
691.0	50					GP	BOTTOM 16 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN, 20-30% COARSE TO FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE-BROWN. BLOWS/INCH: 3-4-6-4-5-25/18-14-5-5-3-5/20-27-15-17-13-21
		S	32	37-105/3"	105/3"		
						GM	SILTY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.0 IN MAXIMUM, ANGULAR, 5-10% FINE SAND, 5-20% SLIGHTLY PLASTIC FINES, TRACE COAL, IRON STAINS, ORANGE, BROWN, GRAY.
		S	33	50/½"	50/½"		REFUSAL
							BOTTOM OF BORING AT 52 FT 1/2 IN ELEVATION 688.96 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-241C	APPROVED	DATE	BORING NO.	SHEET
		DH	9/1/82	EOS-1	3 OF 3

FORM G-6-O

PIEZOMETER INSTALLATION REPORT
STONE & WEBSTER ENGINEERING CORP.

PIEZOMETER NO. P-EOS-1

SITE: Beaver Valley Power Station-Unit 2

J.O. NO. 12241

DATE 6-7-82 DRILLER Eger/Jarvis INSPECTOR J. W. McCoy

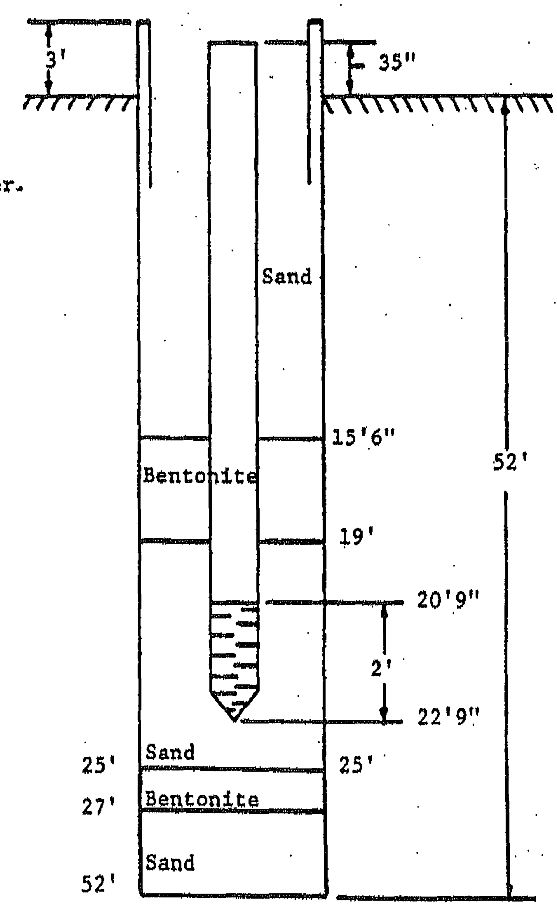
COORDINATES N3843 E6223 GROUND ELEV. 741.0 ft

INSTALLED IN BORING EOS-1 ELEV. TOP OF LEADS. 743.9 ft

RIG & CREW TIME 3 hours

DETAILED INSTALLATION DESCRIPTION :

Hole cleaned to 52.0 ft.
Filled with sand to 27 ft.
Bentonite seal from 27 to 25 ft.
Sand placed from 25 to 22 ft 9 in.
Porous stone - SOILTEST piezometer with centering spider 10 ft from piezometer tip installed.
1 ft 9 in sand placed above piezometer.
3.5 ft Bentonite seal placed.
Sand placed 2 ft from ground surface.
Guard pipe grouted into place.



DESCRIPTION OF PIEZOMETER TIP AND STAND PIPE ASSEMBLY

2 ft section of SOILTEST porous stone piezometer.
Approximately 24 ft 3/4 in I.D. PVC riser pipe.

DESCRIPTION OF SOIL AT TIP ELEVATION :

Silt - wet with sandy silt lenses.

NOTE : SKETCH IN ALL COMPONENTS PERTINENT TO THE INSTALLATION WITH APPLICABLE DIMENSIONS EG : FILTER SAND, SEALS, GROUT, CASING, ETC.

BORING NO. EOS-1A
SHEET 1 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241
COORDINATES 6.5 FT SOUTH OF EOS-1 GROUND ELEV. (1) 741.0 FT
INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY
DATE : START / FINISH 6/7/82 / 6/7/82 CONTRACTOR / DRILLER EGER/JARVIS
STATIC GROUNDWATER DEPTH / DATE (FT) / DRILL RIG TYPE CME 45
DEPTH TO BEDROCK NA (FT) TOTAL DEPTH DRILLED 22.0 FT (FT)
METHODS:
DRILLING SOIL 3-1/8 IN O.D. AUGER TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON USED TO CLEAN OUT HOLE.
SAMPLING SOIL SHELBY TUBE
DRILLING ROCK NONE
SPECIAL TESTING OR INSTRUMENTATION
COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
741.0	0						NO SAMPLES TO 10 FT
	5						
731.0	10						
		US	1	(28")			SILTY CLAY - CLAYEY SILT, SLIGHTLY PLASTIC, 4% FINE SAND, LIGHT BROWN, (SOMEWHAT DILATIVE ON HANDLING).
		US	2	(0")			
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-242A

APPROVED	DATE	BORING NO.	SHEET
DDW	9/1/82	EOS-1A	1 OF 2

BORING NO. EOS-1A
SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(E-2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	US	3				
721.0	20	US	4	(23)			
							BOTTOM OF BORING AT 22.0 FT ELEVATION 719.0 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-242B | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-1A | SHEET 2 OF 2

SITE: BEAVER VALLEY POWER STATION -UNIT 2 J.O. NO. 12241

BORING NO. EOS-2
SHEET 1 OF 3

COORDINATES: N4000 E6165 GROUND ELEV (1): 723.9

INCLINATION: VERTICAL BEARING: NA INSPECTOR: J. W. MCCOY

DATE: START / FINISH: 5/21/82 / 5/24/82 CONTRACTOR / DRILLER: EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE: 40'10" (FT) / 5/27/82 DRILL RIG TYPE: CME 45

DEPTH TO BEDROCK: 60.0 (FT) TOTAL DEPTH DRILLED: 60.3 (FT)

METHODS:

DRILLING SOIL: 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING DRILLING MUD

SAMPLING SOIL: 2 IN O.D. SPLIT SPOON

DRILLING ROCK: NONE

SPECIAL TESTING OR INSTRUMENTATION:

COMMENTS:

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
723.9		S	1	4-5-3	8	GP	SLAG, COARSE TO FINE GRAVEL SIZED, 10-20% COARSE TO FINE SAND, BROWN, (FILL).
		S	2	2-3-2 (13")	5	SW	SAND, WELL GRADED, COARSE TO FINE, 10-15% COARSE TO FINE GRAVEL, ROUNDED, LESS THAN 5% NONPLASTIC FINES, BROWN.
	5	S	3	2-2-3 (14")	5	SP SP GP	TOP 4 IN: SAND, UNIFORM, FINE, 2-5% NONPLASTIC FINES, TRACE GRAVEL, BROWN. MIDDLE 5 IN: SAND, FINE, 5-7% FINE GRAVEL, LESS THAN 5% NONPLASTIC FINES, VERY MOIST, LIGHT BROWN. BOTTOM 5 IN: COAL, FINE GRAVEL SIZED FRAGMENTS.
		S	4	5-5-4 (11")	9	GW	SANDY GRAVEL, COARSE TO FINE, FEW TO 1 IN MAXIMUM, ROUNDED TO ANGULAR, 20-30% COARSE TO FINE SAND, MOSTLY COARSE, 2-5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, MOIST, GRAY AND BROWN.
713.9	10	S	5	4-11-6 (18")	17	GP GP	TOP 8 IN: SANDY GRAVEL, COARSE TO FINE, SUBANGULAR TO ROUNDED, 30-40% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, TRACE COAL, GRAY. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE, 1 IN MAXIMUM, SOME WEATHERED SHALE FRAGMENTS, 25-30% COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE IRON STAINING, BROWN. BLOWS/INCH: 1/2-1/2-1-1/3-1-2-2-2-1/1-1-1-1-1-1
		S	6	7-12-11 (9")	23	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1½ IN, 30-40% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, GRAY AND BROWN. BLOWS/INCH: 7/2-2-3-2-2-1/3-2-1-2-1-2
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
   S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-243A

APPROVED	DATE	BORING NO.	SHEET
DD6	9/1/82	EOS-2	1 OF 3

BORING NO. EOS-2
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	7-7-6 (9")	13	GM GP	TOP 5 IN: SILTY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, BROWN. BOTTOM 4 IN: WEATHERED SANDSTONE FRAGMENTS, 1½ IN MAXIMUM, 10-15% COARSE SAND, BROWN. BLOWS/INCH: 2-1-1-1-1-1/1-1-1-1-1-2/1-1-1-1-1-1
		S	8	8-13-11 (8")	24	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZE SANDSTONE FRAGMENTS, SOME SHALE TO 1½ IN MAXIMUM, ANGULAR TO SUBROUNDED, 20-30% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE IRON STAINS, BROWN. BLOWS/INCH: 1-1-1-1-2-2/2-2-2-3-2-2/2-1-2-2-2-2
703.9	20	S	9	17-21-12 (11")	33	GW-GP	SANDY GRAVEL, COARSE TO FINE, ROUNDED TO ANGULAR. SOME SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, LARGE SANDSTONE FRAGMENT AT BOTTOM, 20-30% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, BROWN. BLOWS/INCH: 3-3-2-3-3-3/4-4-4-3-3-3/3-2-3-2-1-1
		S	10	4-5-6 (13")	11	SP	SAND, POORLY GRADED, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 2-6% COARSE TO FINE ROUNDED GRAVEL, 2-5% NONPLASTIC FINES, MOIST, BROWN.
	25	S	11	4-6-7 (14")	13	SP	SAND, SIMILAR TO ABOVE, MOSTLY COARSE TO MEDIUM.
		S	12	53/4"	53/4"	-	NO RECOVERY: BLOWS/INCH: 8-9-17-19
		S	13	13-24-20 (1")	44	-	BROKEN, ROUNDED GRAVEL TO 1½ IN (WASH?) BLOWS/INCH: 2-2-2-2-2-3/5-5-3-3-4-4/3-3-4-3-4-3
693.9	30	S	14	10-10-13 (5")	23	-	SANDSTONE FRAGMENTS, 5-15% COARSE TO FINE GRAVEL, 10-15% COARSE TO FINE SAND.
		S	15	16-19-26 (7")	45	SP GW	TOP 4 IN: SAND, FINE, LESS THAN 5% NONPLASTIC FINES, BROWN. BOTTOM 3 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1½" MAXIMUM, 10-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-3-4-3/3-3-2-3-4-4/4-5-4-4-5-4
	35	S	16	14-16-27 (7")	43	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, ANGULAR, 15-20% COARSE TO FINE SAND, 15-20% SLIGHTLY TO MEDIUM PLASTIC FINES, BROWN, GRAY AND ORANGE. BLOWS/INCH: 2-3-2-2-3-2/2-3-3-2-3-3/5-5-4-2-5-6
		S	17	28-24-21 (11")	45	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1½ IN, ANGULAR, 20-25% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINS, BROWN AND GRAY. BLOWS/INCH: 4-5-8-4-4-3/4-5-4-4-4-3/4-4-3-4-3-3
683.9	40	S	18	11-11-10 (8")	21	SP	SAND, POORLY GRADED, LESS THAN 5% COARSE TO FINE GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-1-2-2/2-1-2-2-2-2/1-2-2-2-1-2
		S	19	9-11-14 (8")	25	SP	SAND, SIMILAR TO ABOVE, SOFT, BLACK, CARBONACEOUS SHALE FRAGMENT AT BOTTOM. BLOWS/INCH: 1-2-1-2-2-1/1-2-2-2-2-2/2-2-2-3-2-3

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245B	APPROVED	DATE	BORING NO.	SHEET
	DDH.	9/1/82	EOS-2	2 OF 3

BORING NO. EOS-2
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	20	14-108-55 (7")	163	GP-GW	SANDY GRAVEL, WEATHERED SANDSTONE AND SHALE FRAGMENTS, 30-40% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE. BLOWS/INCH: 2-1-2-3-3-3/ 5-5-27-38-19-14/16-12-8-7-7-5
		S	21	9-8-11 (7")	19	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1 IN, ANGULAR TO ROUNDED, 15-25% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, FEW WEATHERED SANDSTONE AND SHALE FRAGMENTS, BROWN. BLOWS/INCH: 2-1-1-1-2-2/1-1-2-1-2-1/1-2-1-2-3-2
673.9	50	S	22	12-14-28 (6")	42	GW-GP	TOP 3 IN: SIMILAR TO ABOVE. BOTTOM 3 IN: SAND, POORLY GRADED, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-2-2-2/3-3-2-2-2-2/2-6-4-5-5-6
		S	23	14-13-11 (5")	24	GW-GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS, LARGE SANDSTONE FRAGMENT AT TOP, ANGULAR TO SUBROUNDED, 30-40% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, ORANGE AND GRAY.
	55	S	24	19-56-99 (11")	155	-	WEATHERED SANDSTONE AND SHALE, SOFT, SOME SOFT CLAYSTONE, TACE MICA, GRAY
		S	25	16-30-70 (15")	100	GW GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1¼ IN, SOFT, 20-30% COARSE TO FINE SAND, 10-15% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, GRAY.
663.9	60	S	26	100/4"	100/4"		CLAYSTONE, WEATHERED, SOFT, DARK GRAY. BOTTOM OF BORING AT 60 FT 4 IN ELEVATION 663.6 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-243C	APPROVED	DATE	BORING NO.	SHEET
	DDd	9/1/82	EOS-2	3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-3
SHEET 1 OF 3

COORDINATES N4050 E6147 GROUND ELEV (1) 722.1 FT

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5/24/82 / 5/25/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED(FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 65.5 (FT) TOTAL DEPTH DRILLED 63 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
722.1	0	S	1	6-22-9 (9")	31	GP SP-SW	TOP 5 IN: SANDY SLAG AND SANDSTONE FRAGMENTS, GRAY. BOTTOM 4 IN: GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW TO 1 IN, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN.
		S	2	9-16-13 (16")	29	SP-SW GM	TOP 4 IN: SIMILAR TO ABOVE. BOTTOM 12 IN: SILTY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 10-20% COARSE TO FINE SAND, 20-30% SLIGHTLY PLASTIC FINES, BROWN AND GRAY.
	5	S	3	4-7-7 (18")	14	GM ML	TOP 3 IN: SIMILAR TO ABOVE. BOTTOM 15 IN: GRAVELLY SILT, 20-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, ORANGE-BROWN.
		S	4	7-4-4 (18")	8	ML	GRAVELLY SILT, SLIGHTLY PLASTIC, 10-15% COARSE TO FINE GRAVEL, ROUNDED, 5-10% FINE SAND, TRACE COAL, BROWN AND ORANGE.
712.1	10	S	5	3-4-10 (15")	14	ML	SIMILAR TO ABOVE, 2 IN THICK COARSE SAND LAYER AT 8 IN FROM TOP OF SAMPLE.
		S	6	4-7-6 (18")	13	SM	SILTY SAND, UNIFORM, LESS THAN 5% FINE GRAVEL, ROUNDED, FINE SAND, 20-30% NONPLASTIC FINES, BROWN.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-244A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-3	1 OF 3

BORING NO. EOS-3
SHEET 2 **OF** 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. **J.O. NO.** 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	3-4-5 (18")	9	SM	SILTY SAND, WIDELY GRADED, 20-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 15-20% NONPLASTIC FINES, TRACE ROOTS AND IRON STAINS, DARK BROWN.
		S	8	3-17-20 (10")	37	SM	SIMILAR TO ABOVE. BLOWS/INCH: 3/2-1-1-3-5-5/4-4-4-2-4-2
702.1	20	S	9	3-3-3 (13")	6	SP	SAND, POORLY GRADED, LESS THAN 5% FINE GRAVEL, ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, BROWN.
		S	10	2-3-6 (18")	9	SW	SAND, WELL GRADED, LESS THAN 5% FINE GRAVEL, ROUNDED, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE COAL, BROWN.
	25	S	11	8-7-10 (18")	17	SW GP-GW	TOP 8 IN: SIMILAR TO ABOVE. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO SUBROUNDED, 30-40% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINS, BROWN. BLOWS/INCH: 1-1-2-1-1-2/2-1-1-1-1-1/1-2-2-1-2-2
		S	12	6-11-13 (11")	24	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, 15-25% COARSE TO FINE SAND, 10-15% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 6/2-2-2-2-2-1/3-2-2-1-2-3
692.1	30	S	13	14-11-14 (8")	25	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 1-1/2 IN MAXIMUM, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-3-3-2-2/1-2-2-2-2-2/2-2-3-2-3-2
		S	14	8-10-11 (10")	21	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1-1/2 IN, 15-20% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, RED, LIGHT GRAY AND BROWN, CONTAINED 1 IN THICK COARSE TO FINE SAND SIZED COAL LENS AT 5 IN FROM TOP. BLOWS/INCH: 2-2-1-1-1-1/1-1-2-2-2-2/2-2-2-1-2-2
	35	S	15	10-16-20 (9")	36	SP GP-GW	TOP 5 IN: SAND, POORLY GRADED, TRACE FINE GRAVEL, COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, BROWN. BOTTOM 4 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-2-2-1-1/1-2-2-3-5-3/4-5-4-2-3-2
		S	16	10-8-7 (5")	15	- GW	TOP 3 IN: GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1-1/2 IN, WASH. BOTTOM 2 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, BROWN. BLOWS/INCH: 2-2-1-2-1-2/2-1-2-1-1-1/2-1-1-1-1-1
682.1	40	S	17	11-10-15 (2")	25	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, LARGE ANGULAR SANDSTONE FRAGMENT AT BOTTOM, 20-25% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN. BLOWS/INCH: 2-2-1-2-2-2/1-2-2-1-2-2/2-3-3-3-2-2
		S	18	12-8-8 (10")	16	GP-GW SW	TOP 4 IN: SIMILAR TO ABOVE. BOTTOM 6 IN: SAND, WELL GRADED, TRACE FINE GRAVEL, COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-2-2-2-2/1-2-1-1-1-2/1-2-1-1-1-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-244B

APPROVED	DATE	BORING NO.	SHEET
DDW.	9/1/82	EOS-3	2 OF 3

BORING NO. EOS-3
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	19	18-15-11 (5")	26	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 2-2-4-3-4-3/2-3-3-3-2-2/2-3-2-1-2-1
		S	20	9-13-11 (9")	24	GP-GW	SIMILAR TO ABOVE, FEW FRAGMENTS TO 1-1/2 IN. BLOWS/INCH: 1-2-1-2-1-2/2-2-2-2-3-2/2-1-2-2-2-2
672.1	50	S	21	6-6-12 (5")	18	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 1-1-1-1-1-1/1-1-1-1-1-1/2-2-1-3-2-2
		S	22	12-13-14 (7")	27	GP	SANDY GRAVEL, BROKEN, WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE GRAVEL SIZED, TO 1-1/2 IN MAXIMUM, FEW COAL FRAGMENTS, 15-20% COARSE TO FINE SAND, 5-7% SLIGHTLY PLASTIC FINES, TRACE MICA, ORANGE, BROWN, GRAY, BLACK. BLOWS/INCH: 2-2-2-2-2-2/3-2-3-1-2-2/2-3-2-3-2-2
	55	S	23	30-30-36 (14")	66	GP	SANDY GRAVEL, BROKEN, WEATHERED SANDSTONE AND SHALE FRAGMENTS, COARSE TO FINE GRAVEL SIZED TO 1-1/2 IN MAXIMUM, MOSTLY COARSE, 20-30% MEDIUM TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL AND IRON STAINS, ORANGE, RED, BROWN, GRAY. BLOWS/INCH: 5-3-7-5-5-5/6-8-5-4-4-3/4-3-6-6-10-7
		S	24	25-13-15 (14")	28	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1-1/2 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE IRON STAINS, ORANGE BROWN. BLOWS/INCH: 4-6-5-5-2-3/2-3-2-2-2-2/2-2-3-2-3-3
662.1	60	S	25	18-30-80 (12")	110	-	SHALE, COARSE TO FINE GRAVEL SIZED FRAGMENTS, SOFT, WEATHERED, 5-10% FINE FINE SAND, 25-35% SLIGHTLY PLASTIC FINES, TRACE COAL, GRAY AND BROWN. BLOWS/INCH: 3-4-3-2-3-3/3-4-4-4-7-8/15-20-13-13-10-9
		S	26	105/6" (4")	105/6"		SHALE, SOFT, WEATHERED, GRAY.
							BOTTOM OF BORING AT 63.0 FT ELEVATION 659.1 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-244C	APPROVED DDH	DATE 9/1/82	BORING NO. EOS-3	SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-4
SHEET 1 OF 3

COORDINATES N4164.41 E6101.98 GROUND ELEV. (1) 720.1 FT

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY

DATE : START / FINISH 5/26/82 / 5/26/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED(FT) / NA DRILL RIG TYPE CME 45

DEPTH TO BEDROCK (FT) TOTAL DEPTH DRILLED 53.0 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN O.D. ROLLER BIT, 3-1/4 IN ID CASING, DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS NONE

ELEVATION (FEET)(1E-2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
720.1	0	S	1	3-6-11 (10")	17	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1½ IN MAXIMUM, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE ROOTS, IRON STAINING, BROWN.
		S	2	11-17-12 (10")	29	GP-GW	SANDY GRAVEL, SIMILAR TO ABOVE, 30-40% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, DARK BROWN.
	5	S	3	10-13-10 (12")	23	SW	GRAVELLY SAND, WELL-GRADED, 20-30% COARSE TO FINE GRAVEL, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, DARK BROWN. BLOWS/INCH 1-1-2-2-2-2/3-2-2-2-2-2/1-2-2-2-2-1
		S	4	9-7-7 (7")	14	SP	GRAVELLY SAND, POORLY GRADED, 20-30% COARSE TO FINE GRAVEL, MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON STAINS, DARK BROWN.
710.1	10	S	5	4-13-11 (12")	24	SP GP	TOP 7 IN: SIMILAR TO ABOVE. BOTTOM 5 IN: SANDY BROKEN GRAY SANDSTONE, 30-40% COARSE TO MEDIUM SAND, TRACE IRON STAINING. BLOWS/INCH: 4/2-1-2-3-3-2/2-1-2-2-2-2
		S	6	4-17-11 (12")	28	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW SANDSTONE FRAGMENTS TO 1½ IN MAXIMUM, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% NONPLASTIC FINES, TRACE IRON STAINING, GRAY AND DARK BROWN. BLOWS/INCH: 4/1-4-3-3-3-3/3-1-2-2-2-1
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-245A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-4	1 OF 3

BORING NO. EOS-4

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	9-11-10 (14")	21	SP-SW	GRAVELLY SAND, 30-40% COARSE TO FINE GRAVEL TO 1½ IN MAXIMUM, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, TRACE IRON, BROWN. BLOWS/INCH: 9/2-2-3-1-2-1/2-2-2-1-1-2
		S	8	6-8-12 (8")	20	GP-GW	SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
700.1	20	S	9	14-12-10 (13")	22	GM	SILTY GRAVEL, COARSE TO FINE, MOSTLY MEDIUM TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE FRAGMENTS, 10-15% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, TRACE COAL AND MICA, TRACE IRON STAINING, BROWN, GRAY, IRON AND BLACK. BLOWS/INCH: 2-2-2-3-2-3/2-3-2-2-2-1/1-2-2-1-2-2
		S	10	11-63-74 (14")	137	SM --	TOP 9 IN: SILTY SAND, POORLY GRADED, MEDIUM TO FINE SAND, 10-12% NON-PLASTIC FINES, TRACE FINE GRAVEL, BROWN. BOTTOM 5 IN: SLAG, GRAY. BLOWS/INCH: 1-1-1-1-3-4/7-11-16-10-10-9/20-23-8-11-6-6
	25	S	11	10-11-17 (0")	28	—	NO RECOVERY BLOWS/INCH: 1-2-1-2-2-2/2-1-2-2-2-2/2-3-3-4-3-2
		S	12	10-9-6 (1")	15	SP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-1-1-2/1-2-2-2-1-1/1-1-1-1-1-1
690.1	30	S	13	4-5-6 (11")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, OCCASIONAL FINE GRAVEL TO ½ IN, ROUNDED, 5-7% FINE SAND, MOIST, MOTTLED BROWN, GRAY BROWN WITH POCKETS OF GRAY. q_u (pp):2.5TSF
		S	14	18-15-19 (13")	34	GP-GW	SANDY GRAVEL, COARSE TO FINE, FEW TO 1.5 IN MAXIMUM, 30-40% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 1-2-4-3-4-4/2-3-3-2-2-3/3-3-4-3-3-3
	35	S	15	3-4-4 (15")	8	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, TRACE FINE GRAVEL, MOIST, GRAY. q_u (pp): 2.0TSF.
		US	1	(23.5")		CL	SANDY CLAY, MODERATELY PLASTIC, 10-15% MEDIUM TO FINE SAND, FEW PIECES COAL UP TO 3/8 IN, DARK GRAYISH BROWN.
		S	16	4-4-5 (12")	9	CL	SILTY CLAY, MEDIUM STIFF TO STIFF, MODERATELY PLASTIC, LESS THAN 5% FINE SAND, BROWN. q_u (pp): 2.0TSF
680.1	40	US	2	(23")			SIMILAR TO S16 (TUBE TRIMMINGS).
		S	17	4-4-4 (12")	8	CL	SILTY CLAY, MEDIUM STIFF TO STIFF, SLIGHTLY TO MODERATELY PLASTIC, LESS THAN 5% FINE SAND, BROWN WITH GRAY MOTTLING. q_u (pp): 2.25TSF
		US	3	(0")			NO RECOVERY.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245B	APPROVED	DATE	BORING NO.	SHEET
		DDW	9/1/82	EOS- 4	2 OF 3

BORING NO. EOS-4

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1E2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	18	0-4-4 (18")	8	CL	SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF TO STIFF, 10% VERY FINE SAND, BROWN. q_u (pp): 1.75, 0.75, 1.25TSF
		US	4	(16")			
		S	19	4-6-5 (18")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, SOFT TO MEDIUM STIFF, MOIST BROWN. q_u (pp): 0.5TSF
670.1	50						
		US	5	(0")		CL	NO RECOVERY. PUSHED SPLIT SPOON (S-20) - RECOVERED SILTY CLAY SIMILAR TO S-19.
							BOTTOM OF BORING AT 53.0 FT ELEVATION 667.1

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-245C	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-4	3 OF 3

BORING NO. EOS-4A
SHEET 1 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241
COORDINATES N4158.7 E6105.3 GROUND ELEV. (1) 720.4
INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY
DATE : START / FINISH 5/27/82 / 5-28-82 CONTRACTOR / DRILLER EGER/JARVIS
STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / NA DRILL RIG TYPE CME 45
DEPTH TO BEDROCK 72.5 (FT) TOTAL DEPTH DRILLED 72.8 (FT)
METHODS :
DRILLING SOIL 3-7/8 IN ROLLER BIT, 4 IN I.D. CASING, DRILLING MUD
SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. OSTERBERG
DRILLING ROCK NONE
SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
							NO SAMPLES TO 35.5 FT
	35						
		UO	1	(30.5")	-	-	
		S	1	5-4-5 (14")	9	CL	SILTY CLAY, MODERATELY PLASTIC, STIFF, LESS THAN 5% FINE SAND, TRACE ORGANICS, BROWN WITH SOME MOTTLED GRAY. q_u (pp): 2.25, 2.0, 2.5TSF
680.4	40						
		UO	2				NO RECOVERY.
		UO	3	(30")	-	CL	SIMILAR TO S-1 (TRIMMINGS)
	45	S	2				

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-246A

APPROVED	DATE	BORING NO.	SHEET
DH	9/1/82	EOS-4A	1 OF 2

BORING NO. EOS-4A
SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	2	3-3-4	7	CL	SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF, TRACE FINE SAND, MOIST, BROWN WITH GRAY MOTTLING. q_u (pp): 1.25, 1.75TSF
		UO	4	(29.8")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	3	3-4-6 (18")	10	CL	SIMILAR TO S-2. TRACE ORGANIC MATERIAL. q_u (pp): 1.25TSF
670.4	50						
		UO	5	(30")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	4	3-4-5	9	CL	SANDY CLAY, MODERATELY PLASTIC, STIFF, 23% VERY FINE SAND, BROWN.
	55	UO	6	(30")		CL	SIMILAR TO S-2. (TRIMMINGS)
		S	5	3-5-4 (18")	9	CL CL	TOP 8 IN: SIMILAR TO S-2. BOTTOM 10 IN: SILTY CLAY, MODERATELY PLASTIC, SOFT, CONTAINS FINE SAND LENSES LESS THAN 1 mm THICK, GRAY. q_u (pp): 0.75TSF
		UO	7	(30.5")			
660.4	60						
		S	6	2-2-4 (18")	6	CL	SANDY CLAY, SLIGHTLY PLASTIC, 20-25% VERY FINE SAND, MEDIUM STIFF, SOME VERY FINE SAND LENSES, 5 mm THICK, GRAY. q_u (pp) 1.0, 0.75TSF
		UO	8	(29.3")			
	65	S	7	3-3-6 (16")	9	CL/ML	SANDY CLAY - SANDY SILT, SLIGHTLY PLASTIC, 15-20% VERY FINE SAND, CONTAINS FINE SAND LENSES LESS THAN 1-2 mm THICK, NUMEROUS SMALL WHITE DEPOSITS, 1 mm DIAMETER, MOIST, DARK GRAY.
		S	8	29-28-19 (10")	47	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, WEATHERED, MAXIMUM SIZE 1-1/2 IN.
650.4	70						
		S	9	13-15-101 4"	116 10"		TOP 10 IN: BROKEN SANDSTONE AND SHALE, SOFT, WEATHERED. BOTTOM 4 IN: SHALE, SOFT, GRAY. BLOWS/IN: 3-2-3-1-3-1/3-2-2-2-3-3/6-10-40-45 .
							BOTTOM OF BORING AT 72 FT 10 IN ELEVATION 647.6 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-246B | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-4A | SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION - UNIT 2 J.O. NO. 12241

BORING NO. EOS-5
SHEET 1 OF 3

COORDINATES N4300 E6057 GROUND ELEV (1) 683.0

INCLINATION VERTICAL BEARING NA INSPECTOR JWMCCOY

DATE : START / FINISH 6/1/82 / 6/2/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED(FT) / -- DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 51.0 (FT) TOTAL DEPTH DRILLED 51.25 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD.

SAMPLING SOIL 2 IN O.D. SPLIT SPOON, 3 IN O.D. SHELBY TUBE AND OSTERBERG.

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
683.0	0	S	1	2-2-1 (0")	3		NO RECOVERY
		S	2	1-1-1 (7")	2	ML	SILT, SLIGHTLY TO MODERATELY PLASTIC, SOFT, TRACE FINE SAND AND ROOTS, BROWN WITH ORANGE MOTTLING.
	5						
		S	3	1-1-1	2	ML	SANDY SILT, SLIGHTLY PLASTIC, SOFT, 15-20% FINE SAND, SOME ORGANIC MATERIAL.
		S	4	1-1-2	3	ML	SIMILAR TO ABOVE.
673.0	10						
		S	5	1-1-1 (7")	2	ML	SANDY SILT, SLIGHTLY TO MODERATELY PLASTIC, 15-20% FINE SAND, TRACE ORGANIC MATERIAL, BROWN.
		US	1	(0")			NO RECOVERY.
	15	S	6	1-2-2 (5")	4	CL/ML	SANDY CLAY - SANDY SILT, MODERATELY PLASTIC, SOFT, 15-20% FINE SAND, BROWN.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-247A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/4/82	EOS-5	1 OF 3

BORING NO. EOS-5
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15						
		S	7	2-2-2 (15")	4	CL/ML	SANDY CLAY-SANDY SILT, SLIGHTLY PLASTIC, SOFT, 20-25% FINE SAND, BROWN.
		UO	2	(30")		CL	SANDY CLAY, MODERATELY PLASTIC, 30-40% MEDIUM TO FINE SAND, MOSTLY FINE, MOTTLED LIGHT BROWN, GRAYISH BROWN AND YELLOW BROWN.
663.0	20	S	8	2-2-3 (18")	5	CL	SANDY CLAY, SLIGHTLY PLASTIC, 30% FINE SAND, BROWN AND GRAY WITH ORANGE MOTTLING. qu(pp) = 0.75, 1.0 TSF
		UO	3	(28")			
	25	S	9	3-2-2 (18")	4	CL ML-MH	TOP 13 IN: SIMILAR TO S-8. BOTTOM 5 IN: ORGANIC CLAYEY SILT, MODERATELY TO HIGHLY PLASTIC, TRACE FINE SAND, GRAY.
		US	4	(27")			SANDY CLAY, MODERATELY PLASTIC, 12-20% VERY FINE SAND, GRAY. (TUBE TRIMMINGS)
		S	10	2-2-11 (18")	13	SM-CL	LAYERED SILTY SAND AND SANDY CLAY, LAYER THICKNESS 1/4 IN TO 3/4 IN, SAND IS FINE, CLAY IS MODERATELY PLASTIC, SOFT, GRAY.
653.0	30	S	11	17-19-16 (6")	35	SP	GRAVELLY SAND, FINE TO COARSE GRAVEL TO 1 IN, COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, CONTAINS SEVERAL PIECES OF FRACTURED SANDSTONE INDICATING SPOON SAMPLED COBBLE. BLOWS/INCH: 2-3-3-3-3-3/4-3-3-4-2-3/2-3-3-3-2-3
		S	12	10-20-14 (7")	34	GP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW SANDSTONE FRAGMENTS TO 1-1/2 IN, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 2-2-2-2-2-2/1-3-3-3-5-5/3-4-2-2-1-2
	35	S	13	19-18-12 (4")	30	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED, MOSTLY COARSE WEATHERED SANDSTONE AND SHALE, 1½ IN MAXIMUM, ANGULAR (SOME ROUNDED), 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE IRON STAINING, GRAY. BLOWS/INCH: 4-4-2-4-2-3/4-3-2-3-3-3/2-2-2-2-2-2
		S	14	21-10-6 (8")	16	GP	SANDY GRAVEL, COARSE TO FINE, ROUNDED, CONTAINS SOME WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, GRAY. BLOWS/INCH: 4-3-5-3-3-3/2-2-2-1-2-1/1-1-1-1-1-1
643.0	40	S	15	9-11-9 (9")	20	GW	GRAVEL, WELL GRADED, COARSE TO FINE, FEW FRAGMENTS TO 1½ IN, ANGULAR TO ROUNDED, 10-15% COARSE TO FINE SAND, GRAY. BLOWS/INCH: 2-2-1-1-2-1/2-2-1-2-2-2/2-1-1-2-1-2
		S	16	25-10-9 (11")	19	GW SP	TOP 6 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR, CONTAINS SANDSTONE FRAGMENTS TO 1½ IN MAXIMUM, 30-35% COARSE TO FINE SAND, GRAY. BOTTOM 5 IN: SAND, POORLY GRADED, 5-10% COARSE TO FINE GRAVEL, ROUNDED, COARSE SAND, GRAY. BLOWS/INCH: 5-4-7-4-2-3/2-2-2-2-1-1/2-1-2-1-1-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-247B | APPROVED: DDA | DATE: 9/9/82 | BORING NO. EOS-5 | SHEET 2 OF 3

BORING NO. EOS-5
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	17	30-15-7 (9")	22	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, FEW TO 1-1/2 IN MAXIMUM, WEATHERED, SOFT, 30-40% COARSE TO FINE SAND, TRACE IRON STAINING, BROWN AND GRAY.
		S	18	60/1" (0")	60/1"	--	NO RECOVERY.
		S	19	69-26-90 (14")	116	GP	SIMILAR TO S-17, DARK GRAY SHALE AT BOTTOM, SOFT.
633.0	50						
		S	20	100/3"	100/3"	--	SHALE, SOFT, DARK GRAY.
							BOTTOM OF BORING AT 51 FT 3 IN ELEVATION 631.75

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-247C | APPROVED DDH | DATE 9/9/81 | BORING NO. EOS-5 | SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 **J.O. NO.** 12241 **BORING NO.** EOS-6

COORDINATES N3848 E6173 **GROUND ELEV. (1)** 745.1 **SHEET** 1 **OF** 3

INCLINATION VERTICAL **BEARING** **INSPECTOR** J.W. MCCOY

DATE : START / FINISH 6/8/82 / 6/8/82 **CONTRACTOR / DRILLER** EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / NA **DRILL RIG TYPE** CME-45

DEPTH TO BEDROCK 48.1 (FT) **TOTAL DEPTH DRILLED** 48.1 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT, 4 IN I.D. CASING, WATER.

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION 2 FT NORTON POROUS PIEZOMETER INSTALLED WITH TIP AT EL 710.1

COMMENTS

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
745.1	0	S	1	1-3-3 (6")	6	-	TOPSOIL, SILT, LESS THAN 5% FINE SAND, 1.5 IN SANDSTONE FRAGMENT AT TIP, DARK BROWN.
		S	2	4-4-6 (18")	10	CL	SANDY CLAY, MODERATELY PLASTIC, STIFF, 12% COARSE TO FINE GRAVEL SIZED SANDSTONE, SHALE AND COAL FRAGMENTS, ANGULAR, 22% COARSE TO FINE SAND, BROWN, MOTTLED WITH YELLOW BROWN AND GRAY.
	5	S	3	4-7-8 (18")	15	CL	SIMILAR TO S-2.
		S	4	6-8-8 (18")	16	CL	SIMILAR TO S-2.
		S	5	6-6-8 (11")	14	CL	SIMILAR TO S-2.
735.1	10	S	6	4-5-5 (18")	10	CL	SILTY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL COARSE SAND AND COAL FRAGMENTS, MOIST, BROWN.
						CL/ML	SILTY CLAY, SLIGHTLY PLASTIC, 4% VERY FINE SAND, BROWN.
		S	7	3-2-3 (14")	5	ML	TOP 4 IN: SANDY SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 15-20% FINE SAND, WET, BROWN.
						GP	MIDDLE 6 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 20-30% COARSE TO FINE SAND, 5-8% NONPLASTIC FINES, BROWN, GRAY.
	15	S	8	6-8-5 (14")	13	SP	BOTTOM 4 IN: SILTY SAND, UNIFORM, FINE, 10-15% NONPLASTIC FINES, BROWN.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-248A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-6	1 OF 3

BORING NO. EOS-6

SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1)(2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	8				
		S	9	3-4-5 (17")	9	SP SP	TOP 6 IN: SIMILAR TO S-8, BOTTOM 4 IN. BOTTOM 11 IN: SAND, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 7-8% NONPLASTIC FINES, BROWN, CONTAINS OCCASIONAL POCKET OF SILTY CLAY, MODERATELY PLASTIC, BROWN.
		S	10	5-6-7 (15")	13	SP	SAND, POORLY GRADED, 5-7% FINE GRAVEL, ROUNDED, MEDIUM TO FINE SAND, 7-12 % NONPLASTIC FINES, MOIST, BROWN.
725.1	20	S	11	4-3-5 (15")	8	SP ML	TOP 2 IN: SIMILAR TO S-10. BOTTOM 13 IN: SILT, NONPLASTIC, TRACE FINE GRAVEL SIZED SANDSTONE AND COAL, SOME LENSES OF SANDY SILT, MOIST, BROWN.
		S	12	4-6-9 (18")	15	ML	SILT, NONPLASTIC, TRACE FINE SAND, WET, BROWN.
	25	S	13	4-3-4 (18")	7	ML-SM	LAYERED SILT AND SILTY FINE SAND, TRACE FINE GRAVEL SIZED ROCK FRAGMENTS, NONPLASTIC FINES, WET, BROWN.
		S	14	2-3-4 (18")	7	CL	SILTY CLAY-CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, 1% VERY FINE SAND, BROWN.
		S	15	2-2-2 (10")	4	SM	SILTY SAND, UNIFORMLY GRADED, FINE, TRACE COARSE SAND, 20-25% NONPLASTIC TO SLIGHTLY PLASTIC FINES, WET, BROWN.
715.1	30	S	16	3-7-5 (18")	12	SP GP	TOP 11 IN: SAND, UNIFORMLY GRADED, FINE, 5-7% NONPLASTIC FINES, WET, BROWN. BOTTOM 7 IN: SANDY GRAVEL, COARSE TO FINE, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1.5 IN, SOME COAL, 20-30% COARSE TO FINE SAND, 5% SLIGHTLY PLASTIC FINES, TRACE IRON STAINING, BROWN, ORANGE.
		S	17	5-4-4 (18")	8	SM GP-GW	TOP 10 IN: SILTY SAND, 5-10% COARSE TO FINE GRAVEL SIZED COAL FRAGMENTS TO 1 IN, FINE SAND, 15-20% NONPLASTIC FINES. BOTTOM 8 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1 IN, 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
	35	S	18	4-5-5 (18")	10	SP-SM	SILTY SAND, FINE, TRACE FINE GRAVEL AND COAL FRAGMENTS, 10-15% NONPLASTIC FINES, SANDSTONE FRAGMENTS AT BOTTOM.
		S	19	7-8-11 (18")	19	SP-SM GP	TOP 13 IN:SIMILAR TO S-18. BOTTOM 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, TRACE IRON STAINING, BROWN, GRAY, BLACK.
						SP	GRAVELLY SAND, 25-35% COARSE TO FINE GRAVEL SIZED SANDSTONE SHALE AND COAL, ANGULAR TO ROUNDED, MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE IRON, BROWN, GRAY.
		S	20	49-81/2"	81/2"		
705.1	40	S	21	26-34-17 (18")	51	GP GP	TOP 13 IN: SANDY GRAVEL, COARSE TO FINE, ROUNDED, SOME BROKEN SANDSTONE AND SHALE, 20-30% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL, BROWN, GRAY, ORANGE BROWN. BOTTOM 5 IN: GRAVEL, BROWN SANDSTONE FRAGMENTS TO 1.5 IN,SAMPLED COBBLE, GRAY.
		S	22	20-16-103 (18")	119	GM GP	TOP 12 IN: SILTY GRAVEL, COARSE TO FINE GRAVEL, MOSTLY COARSE TO 1 IN, ANGULAR, 25-30% COARSE TO FINE SAND, 15-20% SLIGHTLY PLASTIC FINES, WET, BROWN. BOTTOM 6 IN: SANDSTONE FRAGMENTS, SAMPLED COBBLE. BLOWS/INCH: 3-3-2-4-4-4/2-2-1-2-3-6/5-4-30-34-18-12
		S	23	33-107-33 (11")	140	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, SOME COAL, 1.5 IN MAXIMUM, 20-25% COARSE TO MEDIUM SAND, 5-10% SLIGHTLY PLASTIC FINES, TRACE MICA, TRACE IRON STAINS, BROWN, GRAY, ORANGE.
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-2483	APPROVED	DATE 9/1/82	BORING NO. EOS-6	SHEET 2 OF 3

BORING NO. EOS-6
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	24	36-28-41 (13")	69	GP	SIMILAR TO S-22, TOP.
		S	25	21-71-103/15" (11")	174/75"	GP	TOP 5 IN: SIMILAR TO S-22, TOP. MIDDLE 2 IN: SANDSTONE FRAGMENTS, SOFT, GRAY. BOTTOM 4 IN: COAL FRAGMENTS.

BOTTOM OF BORING AT 48.1 FT
ELEVATION 697.0 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-248C | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-6 | SHEET 3 OF 3

FORM 6-6-0

PIEZOMETER INSTALLATION REPORT
STONE & WEBSTER ENGINEERING CORP.

PIEZOMETER NO. P-EOS-6

SITE: Beaver Valley Power Station-Unit 2

J.O. NO. 12241

DATE 6-9-82 DRILLER Eger/Jarvis INSPECTOR J. W. McCoy

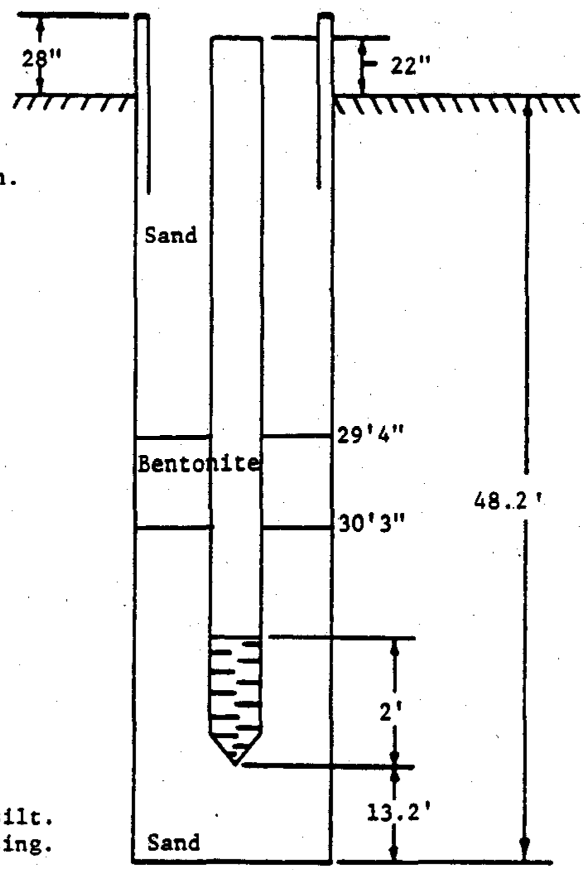
COORDINATES N3848 E6173 GROUND ELEV. 745.1 Ft

INSTALLED IN BORING EOS-6 ELEV. TOP OF LEADS. 746.9 ft

RIG & CREW TIME 5 hours

DETAILED INSTALLATION DESCRIPTION:

Hole cleaned to 48.2 ft.
Filled with sand to 35.0 ft
(Bottom of drill casing).
Install Norton porous tube piezometer centering spider approximately 4.5 ft above piezometer tip.
Sand placed to 30 ft-3 in.
Bentonite pellets placed to 29 ft-4 in.
Difficulty when pulling casing - had to hold piezometer down since it tended to pull out with casing.
Sand to ground surface.
Guard pipe grouted in place.



DESCRIPTION OF PIEZOMETER TIP AND STAND PIPE ASSEMBLY

2 ft Norton porous tube.
Approximately 35 ft-3/4 in I.D. PVC riser pipe with centering spider.

DESCRIPTION OF SOIL AT TIP ELEVATION:

Sand and gravel

NOTE: Piezometer appears clogged with silt. Probe to 31.75 ft from top of casing. Abandon piezometer. 8/11/82

NOTE: SKETCH IN ALL COMPONENTS PERTINENT TO THE INSTALLATION WITH APPLICABLE DIMENSIONS EG: FILTER SAND, SEALS, GROUT, CASING, ETC.

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241 BORING NO. EOS-7 SHEET 1 OF 2

COORDINATES N3812 E6140 GROUND ELEV. (1) 759.9

INCLINATION VERTICAL BEARING NA INSPECTOR JW McCOY

DATE: START/FINISH 6/3/82 / 6/3/82 CONTRACTOR/DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH/DATE NOT RECORDED (FT) / — DRILL RIG TYPE CME 45

DEPTH TO BEDROCK 44.5 (FT) TOTAL DEPTH DRILLED 45.0 (FT)

METHODS:

DRILLING SOIL 3 1/8 IN ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT

SAMPLING SOIL 2 IN O.D. SPLIT SPOON

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION 2 FT POROUS STONE PIEZOMETER, INSTALLED WITH TIP AT EL. 716.9

COMMENTS BORING ADVANCED WITHOUT WATER. DID NOT ENCOUNTER ANY GROUNDWATER.

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
759.9	0	S	1	4-7-9 (5")	16	-	FILL, SLAG AND SILTY GRAVEL, COARSE TO FINE, TRACE ROOTS AND IRON STAINS, GRAY.
		S	2	4-7-6 (11")	13	ML	GRAVELLY SILT, SLIGHTLY PLASTIC, 10-15% COARSE TO FINE GRAVEL SIZED WEATHERED SANDSTONE AND SHALE, ROUNDED TO SUBANGULAR, 15-20% COARSE TO FINE SAND, SOME ROOTS SLIGHTLY MOIST, GRAY.
	5	S	3	6-5-6 (18")	11	CL/ML -	TOP 8 IN: GRAVELLY SILT-GRAVELLY CLAY, SLIGHTLY TO MODERATELY PLASTIC, 20-30% COARSE TO FINE GRAVEL, SOME WOOD FRAGMENTS, GRAY AND BROWN. BOTTOM 10: COAL AND SHALE FRAGMENTS, WIDELY GRADED, COARSE TO FINE GRAVEL AND SAND SIZED FRAGMENTS, TRACE IRON STAINING.
		S	4	7-6-5 (16")	11	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, CONTAINS FEW LAYERS OF COAL FRAGMENTS AND SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, FEW RED SHALE FRAGEMENTS, 7-10% COARSE TO FINE SAND, VERY SLIGHTLY MOIST, BROWN.
		S	5	4-7-6 (16")	13	CL	SIMILAR TO S-4, MOTTLED BROWN AND ORANGE.
749.9	10	S	6	3-5-8 (13")	13	CL	SIMILAR TO S-4, CONTAINED 1 IN THICK LAYER OF SILTY CLAY WITHOUT COARSE FRACTION, MOTTLED GRAY AND BROWN.
		S	7	7-8-8 (16")	16	CL	SANDY CLAY, SLIGHTLY PLASTIC, STIFF, OCCASIONAL FINE GRAVEL SIZED SANDSTONE PARTICLE, 15-20% COARSE TO FINE SAND, SOME MINOR IRON STAINING, SLIGHTLY MOIST, BROWN.
	15	S	8	4-7-7 (13")	14	CL	SANDY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 10-15% FINE GRAVEL TO 3/4 IN MAXIMUM, ANGULAR, 15-20% COARSE TO FINE SAND, BROWN.

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

8. SAMPLE CONTAINS PIECES OF SANDSTONE 1.5 IN DIAMETER AND 1/8 IN THICK, INDICATING SAMPLER PENETRATED COBBLE OR BOULDER. TYPICAL OF THIS MATERIAL.

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-249A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/1/82	EOS-7	1 OF 2

BORING NO. EOS-7
SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	8				
		S	9	6-6-6 (14")	12	CL CL	TOP 10 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 15-20% COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, FEW COAL FRAGMENTS, ORANGE, BROWN AND GRAY. BOTTOM 4 IN: SILTY CLAY, MEDIUM STIFF, MODERATELY PLASTIC, TRACE FINE SAND, MOIST, BROWN. (SIMILAR TO ABOVE BUT WITHOUT COARSE FRACTION).
		S	10	19-17-12 (7")	29	GP	SANDY GRAVEL, POORLY GRADED, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS, MOSTLY 1.5 IN, 20-25% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, 5% NONPLASTIC FINES, BROWN. (CONTAINED LAYER OF SOFT CLAYEY SILT AT TOP OF SAMPLE). (SEE NOTE 8).
739.9	20						
		S	11	4-15-17 (14")	32	SP GP	TOP 10 IN: SILTY SAND, SLIGHTLY PLASTIC, 15-20% COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, FEW TO 1 IN MAXIMUM, ANGULAR, 15-20% SLIGHTLY PLASTIC FINES, TRACE COAL, BROWN. BOTTOM 4: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, 30-40% COARSE TO FINE SAND, 5% NONPLASTIC FINES, LIGHT GRAY.
		S	12	99-10-8 (10")	18	SP GP	TOP 5 IN: SIMILAR TO S-11, TOP. BOTTOM 5 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, 5% NONPLASTIC FINES, TAN. (SAMPLED COBBLE?).
	25	S	13	9-59-26 (10")	85	GP ML	LAYERED SANDY GRAVEL AND SANDY CLAYEY SILT, SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN, ANGULAR, 30-40% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TAN (SAMPLED COBBLE). CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, SOFT, 10-15% COARSE TO FINE GRAVEL, ANGULAR, BROWN.
		S	14	6-7-10 (14")	17	GP ML	TOP 6 IN: SANDY GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 20-25% COARSE TO FINE SAND, LIGHT GRAY. BOTTOM 8 IN: GRAVELLY SILT, SLIGHTLY PLASTIC, 12-15% COARSE TO FINE GRAVEL SIZED SANDSTONE, SHALE AND COAL FRAGMENTS, 1.5 IN FRAGMENT AT TIP, LESS THAN 5% FINE SAND, TRACE IRON STAINS, BROWN.
		S	15	9-9-11 (12")	20	GP	SANDY GRAVEL, WIDELY GRADED, COARSE TO FINE GRAVEL, MOSTLY COARSE TO 1 IN, ANGULAR TO SUBROUNDED SANDSTONE, 20% COARSE TO FINE SAND, 15-20% NONSLIGHTLY PLASTIC FINES, BROWN.
729.9	30	S	16	8-9-8 (12")	17	GP	SIMILAR TO S-15.
		S	17	7-14-14 (12")	28	GP	SIMILAR TO S-15, SAMPLED COBBLE, SOME FRAGMENTS ROUGHLY THE DIAMETER OF SAMPLER. BLOWS/INCH: 1-1-1-1-1-2/1-1-2-1-4-5/4-1-3-2-2-2
	35	S	18	12-14-11 (14")	25	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, 15-20% COARSE TO FINE SAND, 7% NONPLASTIC FINES, GRAY. SOME POCKETS OF SILTY FINE SAND, BROWN. BLOWS/INCH: 2-1-2-3-2-2/1-3-3-3-2-2/2-2-2-2-2-1
		S	19	10-9-13 (12")	22	SP	GRAVELLY SAND, 15-25% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, FEW SANDSTONE FRAGMENTS TO 1.5 IN, FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-2-1-2-2/1-2-1-2-2-1/2-1-2-4-2-2
		S	20	4-7-25 (14")	32	SP SP GP	TOP 3 IN: SAND, UNIFORM, FINE, LESS THAN 5% NONPLASTIC FINES, BROWN. MIDDLE 10 IN: SAND, UNIFORM, MEDIUM TO FINE, TRACE FINE GRAVEL, COAL FRAGMENTS, IRON STAINING, BROWN. BOTTOM 1 IN: SANDSTONE FRAGMENTS.
719.9	40	S	21	32-24-24 (14")	48	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS TO 1.5 IN MAXIMUM, 20-25% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, LIGHT GRAY AND BROWN. SANDSTONE FRAGMENT AT TIP. BLOWS/INCH: 3-7-3-5-4-10/6-3-4-5-3-3/3-4-3-4-5-5
		S	22	100/5"	100/5"	SP	GRAVELLY SAND, POORLY GRADED, 15-20% COARSE TO FINE GRAVEL TO 1 IN MAXIMUM, ANGULAR, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 10-12% NON TO SLIGHTLY PLASTIC FINES, MOIST, BROWN.
		S	23	47-22-30 (17")	52		SANDY GRAVEL, SIMILAR TO S-15, AT 7 IN. FROM TOP - 2 IN. THICK SEAM OF FINE SAND, 15-20% NONPLASTIC FINES, MOIST, BROWN.
	45	S	24	27-135 (0")	135/6"		REFUSAL/NO RECOVERY. END OF BORING AT 45 FT. EL. 714.9

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-249B | APPROVED | DATE 9/1/82 | BORING NO. EOS-7 | SHEET 2 OF 2

FORM G-6-0

PIEZOMETER INSTALLATION REPORT
STONE & WEBSTER ENGINEERING CORP.

PIEZOMETER NO. P-EOS-7

SITE: Beaver Valley Power Station-Unit 2

J.O. NO. 12241

DATE 6-9-82 DRILLER Eger/Jarvis INSPECTOR J. W. McCoy

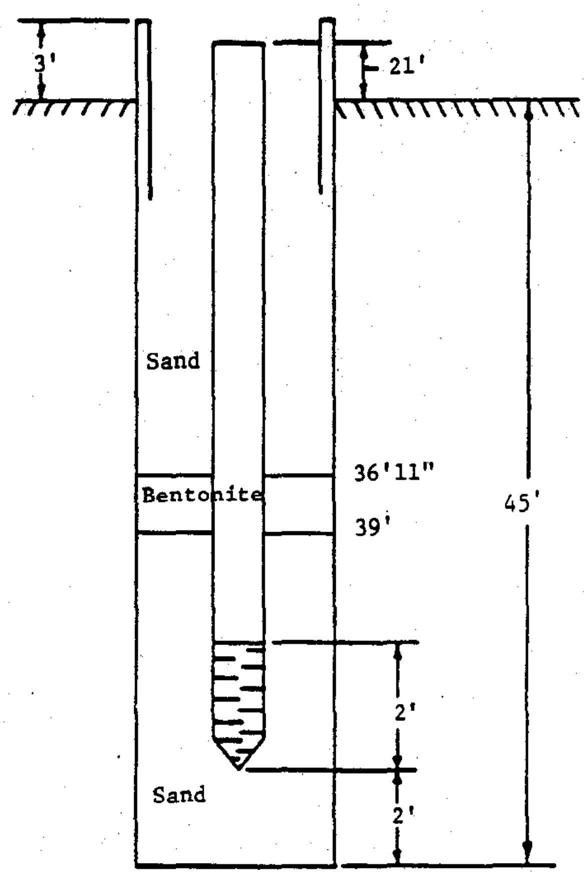
COORDINATES N3812 E6140 GROUND ELEV. 759.9 Ft

INSTALLED IN BORING EOS-7 ELEV. TOP OF LEADS. 761.65 ft

RIG & CREW TIME 4 hours

DETAILED INSTALLATION DESCRIPTION :

Hole cleaned to 45.0 ft.
Sand placed to 43 ft.
Porous stone SOILTEST piezometer placed with centering spider 4 ft above tip.
Sand placed to 39.0 ft.
Bentonite seal between 39.0 and 36 ft-11 in.
Sand to approximately ground surface.
Guard pipe grouted in place.



DESCRIPTION OF PIEZOMETER TIP AND STAND PIPE ASSEMBLY

2 ft section Norton porous tube.
Approximately 43 ft-3/4 in PVC riser pipe with centering spider.

DESCRIPTION OF SOIL AT TIP ELEVATION :

Sandy gravel - rock at 45.0 ft.

NOTE : SKETCH IN ALL COMPONENTS PERTINENT TO THE INSTALLATION WITH APPLICABLE DIMENSIONS EG : FILTER SAND, SEALS, GROUT, CASING, ETC.

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241

BORING NO. EOS-7A
SHEET 1 OF 2

COORDINATES N3814.6 E6136.2 GROUND ELEV (1) 759.6 FT.

INCLINATION VERTICAL BEARING NA INSPECTOR J.W. McCOY

DATE : START / FINISH 6/3/82 / 6/3/82 CONTRACTOR / DRILLER EGER/JARVIS

STATIC GROUNDWATER DEPTH / DATE NA (FT) / DRILL RIG TYPE CME 45

DEPTH TO BEDROCK NA (FT) TOTAL DEPTH DRILLED 24.5 (FT)

METHODS :

DRILLING SOIL 3 1/8 IN O.D. ROLLER BIT TO ADVANCE HOLE, 3 IN O.D. SPLIT SPOON TO CLEAN OUT

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK

SPECIAL TESTING OR INSTRUMENTATION 2 FT NORTON POROUS PIEZOMETER INSTALLED WITH TIP AT EL. 738.1

COMMENTS DRILLED 5 FT NORTHWEST OF EOS-7

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
759.6	0						NO SAMPLES TO 7 FT.
	5						
		US	1	(15")			
749.6	10	US	2	(25.5")			
		S	1	10-7-6 (13")	13	CL/ML	SANDY CLAY-SANDY SILT, SLIGHTLY PLASTIC, STIFF, 20-25% COARSE TO FINE SAND, 10% FINE GRAVEL TO 1/4 IN, MOIST, BROWN.
		S	2	5-7-7 (10")	14	CL	SANDY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 10% FINE GRAVEL, OCCASIONAL COARSE GRAVEL TO 1 IN, 20% COARSE TO FINE SAND, MOIST, BROWN.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ∇ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-250A

APPROVED	DATE	BORING NO.	SHEET
[signature]	9/1/82	EOS-7A	1 OF 2

BORING NO. EOS-7A
SHEET 2 OF 2

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	3	5-6-9 (13")	15	CL	SIMILAR TO S-2, 20-30% COARSE TO FINE GRAVEL TO 1 IN.
		S	4	4-6-6 (16")	12	CL ML	TOP 13 IN: SILTY CLAY, MODERATELY PLASTIC, MEDIUM STIFF, MOTTLED GRAY AND BROWN. BOTTOM 3 IN: SILT, LOOSE, TRACE FINE SAND, WET, BROWN.
739.6	20	S	5	11-15-14 (13")	29	GP	SANDY GRAVEL, WEATHERED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 25-30% COARSE TO FINE SAND, MOSTLY MEDIUM FINE, 5-10% NONPLASTIC FINES, TRACE COAL AND IRON STAINING, BROWN AND GRAY.
		S	6	20-20-8 (18")	28	GP	GRAVEL, COARSE GRAVEL SIZED SANDSTONE FRAGMENTS TO 1.5 IN MAXIMUM, LIGHT GRAY. CONTAINS POCKETS OF SANDY SILT, 10-15% FINE SAND, VERY MOIST, BROWN.
		S	7	8-11-18 (13")	29	GP	SIMILAR TO S-6.
							BOTTOM OF BORING AT 24.5 FT ELEVATION 735.1 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-250B	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-7A	2 OF 2

FORM G-6-0

PIEZOMETER INSTALLATION REPORT
STONE & WEBSTER ENGINEERING CORP.

PIEZOMETER NO. P-EOS-7A

SITE: Beaver Valley Power Station-Unit 2

J.O. NO. 12241

DATE 6-10-82 DRILLER Eger/Jarvis INSPECTOR J. W. McCoy

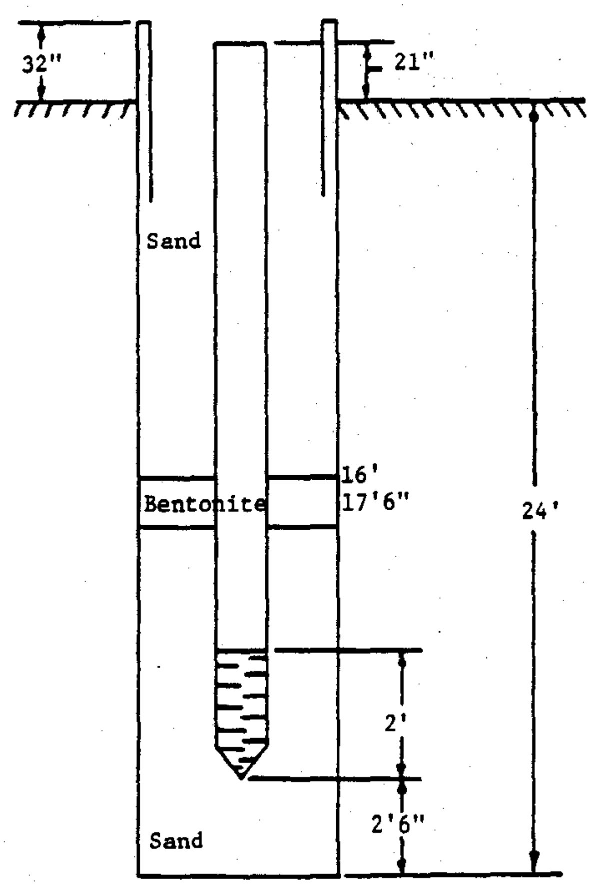
COORDINATES N3814.6 E6136.2 GROUND ELEV. 759.6 ft

INSTALLED IN BORING EOS-7A ELEV. TOP OF LEADS. 761.35 ft

RIG & CREW TIME Approximately 3 hours

DETAILED INSTALLATION DESCRIPTION:

Hole cleaned to 24.0 ft.
Sand placed to 21.5 ft.
Norton porous tube piezometer with centering spider 4 ft above tip installed.
Sand placed to 17.5 ft.
Bentonite seal 17.5 to 16.0 ft.
Sand to near ground surface.
Guard pipe grouted in place.



DESCRIPTION OF PIEZOMETER TIP AND STAND PIPE ASSEMBLY

2 ft section Norton porous tube. Approximately 21.5 ft-3/4 in I.D. PVC riser pipe with centering spider.

DESCRIPTION OF SOIL AT TIP ELEVATION:

Broken sandstone fragments with sandy silt.

NOTE: SKETCH IN ALL COMPONENTS PERTINENT TO THE INSTALLATION WITH APPLICABLE DIMENSIONS EG: FILTER SAND, SEALS, GROUT, CASING, ETC.

BORING NO. EOS-9
SHEET 1 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2 J.O. NO. 12241
COORDINATES N3944 E6185 GROUND ELEV. (1) 732.7
INCLINATION VERTICAL BEARING NA INSPECTOR J.W. MCCOY
DATE : START / FINISH 5-19-82 / 5/20/82 CONTRACTOR / DRILLER EGER DRILLING/JARVIS
STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) / DRILL RIG TYPE CME 45
DEPTH TO BEDROCK 52.0 (FT) TOTAL DEPTH DRILLED 52.0 (FT)
METHODS :
DRILLING SOIL 3-1/8 IN ROLLER BIT, 3-1/4 IN I.D. CASING, DRILLING MUD
SAMPLING SOIL 2.0 IN O.D. SPLIT SPOON
DRILLING ROCK
SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS LOST DRILLING FLUID AT 35.0 AND 40.0 FT

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
732.7	0	S	1	2-5-3 (14")	8	ML/ SM	SANDY SILT, DENSE, SLIGHTLY MOIST, FEW SANDSTONE FRAGMENTS AND ROOTS, GRADING TO SILTY SAND, TRACE FINE GRAVEL, 30-40% NONPLASTIC FINES, BROWN.
		S	2	4-4-6 (18")	10	ML	SILT, NONPLASTIC TO SLIGHTLY PLASTIC, 0-5% FINE SAND, TRACE ORGANICS, FEW SMALL SAND SEAMS, WET, BROWN.
	5	S	3	3-4-5 (16")	9	ML SP	TOP 13 IN: SIMILAR TO ABOVE. BOTTOM 3 IN: SAND, FINE, FEW FINE GRAVEL AND WEATHERED SANDSTONE FRAGMENTS TO 0.5 IN, 0-5% NONPLASTIC FINES, BROWN.
		S	4	4-4-4 (16")	8	SP ML	TOP 13 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, 2-5% FINE GRAVEL, 0-5% NONPLASTIC FINES, BROWN. BOTTOM 3 IN: SILT, NONPLASTIC TO SLIGHTLY PLASTIC, BROWN. BLOWS/INCH: 1-1-1/2-1/2//1-1/2-1/2-1//1/2-1/2-1-1
722.7	10	S	5	3-3-4 (14")	7	SP SP	TOP 4 IN: SILTY SAND, FINE, TRACE COARSE-MEDIUM SAND, 15-20% NONPLASTIC FINES, MOIST, BROWN. BOTTOM 10 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, TRACE FINE GRAVEL, 5% NONPLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 1-1/2-1/3//1/2-1/2-1/2//1-1/2-1/2-1
		S	6	6-4-3 (18")	7	GW	GRAVELLY SAND, WELL GRADED, 20-30% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, SUBANGULAR TO ROUNDED, COARSE TO FINE SAND, TRACE NONPLASTIC FINES, TRACE COAL, BROWN. BLOWS/INCH: 1-1-1-1-1-1//4//1/2-1/2-1/2
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE:
S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-251A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-9	1 OF 3

BORING NO.	EOS-9
SHEET 2	OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15	S	7	4-3-3 (18")	6	SM SP	TOP 9 IN: SILTY SAND, 10-15% COARSE TO FINE GRAVEL, SUBANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES. BOTTOM 9 IN: SAND, FINE, 2-6% FINE GRAVEL, 0-5% NONPLASTIC FINES, TRACE COARSE SAND SIZED COAL FRAGMENTS, BROWN. BLOWS/INCH: 1-1/2-1/2-1//1/2-1/2-1/2//1/2-1/2-1/2
		S	8	9-11-10 (18")	21	GW	SANDY GRAVEL, WIDELY GRADED, SUBANGULAR TO ANGULAR WEATHERED SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, 25-35% COARSE TO FINE SAND, 5-10% NONPLASTIC FINES, TRACE COAL, FEW IRON STAINS, BROWN.
712.7	20	S	9	4-3-2 (16")	5	SP	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL SIZED SANDSTONE FRAGMENTS, MAXIMUM SIZE 1 IN, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY FINE, 5-10% SLIGHTLY PLASTIC FINES, TRACE COAL FRAGMENTS, IRON STAINS AT BOTTOM, WET AT BOTTOM, BROWN.
		S	10	9-10-13 (16")	23	GW	SANDY GRAVEL, WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1 IN MAXIMUM, ANGULAR, 15-25% COARSE TO FINE SAND, 2-5% NONPLASTIC FINES, IRON STAINS, MOIST, BROWN AND GRAY. BLOWS/INCH: 2-2-1-2-1-1/1-1-2-2-2-2/3-2-2-2-2-2
	25	S	11	27-17-13 (12")	30	GP	GRAVEL, WEATHERED SANDSTONE AND LIMESTONE(?) FRAGMENTS TO 1-1/2 IN, ANGULAR TO SUBANGULAR, SOME IRON STAINING, 5-10% NONPLASTIC FINES, TRACE SHALE FRAGMENTS, DRY, BROWN. BLOWS/INCH: 2-3-5-4-5-3/3-3-3-3-2-3/3-2-3-2-2-1
		S	12	5-9-19 (13")	28	SP SP SP	TOP 3 IN: SAND, UNIFORM, FINE, TRACE FINE GRAVEL, TRACE NONPLASTIC FINES, BROWN. MIDDLE 1 IN: SAME AS ABOVE, DARK BROWN. BOTTOM 9 IN: SAND, UNIFORM, FINE, TRACE FINE GRAVEL, ROCK FRAGMENT AT BOTTOM, LIGHT BROWN. BLOWS/INCH: 1-2-1/2-1/2//1-1-1-2-2-2//3-4-3-3-3-3
702.7	30	S	13	11-15-15 (13")	30	SM SW	TOP 4 IN: SILTY SAND, 10-15% FINE GRAVEL TO 1/2 IN, ANGULAR TO SUBROUNDED. COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 25-30% NONPLASTIC FINES, DRY, BROWN, DENSE AND HARD IN NATURAL STATE, PARTICLES APPEAR WATER-BORNE. BOTTOM 9 IN: SAND, WELL GRADED, COARSE TO FINE, 0-5% FINE GRAVEL, 0-5% NONPLASTIC FINES, FEW SANDSTONE FRAGMENTS TO 1 IN MAXIMUM, IRON STAINING, BROWN. BLOWS/INCH: 2-2-2-1-2-2/3-2-3-3-2-2/3-1-3-3-3-2
		S	14	9-7-14 (18")	22	SM SP	TOP 15 IN: SIMILAR TO S-13, TOP 4 IN. BOTTOM 3 IN: SAND, COARSE TO FINE, MOSTLY COARSE TO MEDIUM, TRACE FINE GRAVEL, MOIST, BROWN. BLOWS/INCH: 1-2-2-1-2-1/1-1-1-1-1-2/1-2-2-3-3-3
	35	S	15	11-12-15 (18")	27	SM GP	TOP 8 IN: SIMILAR TO S-13, TOP 4 IN BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, MOSTLY FINE, 10-15% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-2-2-3-2-2/2-2-3-2-2-2/3-2-3-3-2-2
		S	16	16-20-25	45	GM	SILTY GRAVEL, COARSE TO FINE GRAVEL, FEW TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 1 IN SANDSTONE FRAGMENTS AT BOTTOM, 10-15% COARSE TO FINE SAND, MOSTLY FINE, 15-20% NONPLASTIC FINES, DRY, BROWN (SIMILAR TO S-13, TOP 4 IN). BLOWS/INCH: 2-2-3-3-3-3/4-3-2-3-3-5/4-3-2-2-7-7
692.7	40	S	17	5-5-8 (8")	13	GW	SANDY GRAVEL, COARSE TO FINE GRAVEL, FEW TO 1 IN MAXIMUM, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, 0-5% SLIGHTLY PLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 1/2-1-1-1-1//1-1-1/2-1-1//1-1-2-2-1-1
		S	18	12-19-22 (16")	41	GP	SANDY GRAVEL, MOSTLY LARGE, WEATHERED SANDSTONE AND SHALE FRAGMENTS TO 1-1/2 IN, SOME SHALE FRAGMENTS, 15-20% COARSE TO FINE SAND, 2-5% NONPLASTIC FINES, MOIST, BROWN. BLOWS/INCH: 3-2-2-2-2-1/2-2-2-4-4-5/7-3-3-4-3-2
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1	STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-251B	APPROVED	DATE	BORING NO.	SHEET
		DDH	9/1/82	EOS-9	2 OF 3

BORING NO. EOS-9

SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/RQD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	19	13-9-19 (11")	28	GP SP GP	TOP 4 IN: GRAVEL, SANDSTONE FRAGMENTS TO 1-1/2 IN, SOME SHALE FRAGMENTS. 5-10% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, GRAY AND ORANGE. MIDDLE 3 IN: SAND, UNIFORM, FINE, 0-5% NONPLASTIC FINES, WET, BROWN. BOTTOM 4 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, 5-10% SLIGHTLY PLASTIC FINES, WET, BROWN. BLOWS/INCH: 4-2-2-2-1-2/1-2-2-1-1-2/2-5-2-5-3-2
		S	20	45/6" (5")	45/6"	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED SANDSTONE AND SHALE FRAGMENTS, ROUNDED TO ANGULAR, LARGE SANDSTONE FRAGMENT AT BOTTOM, 10-15% COARSE TO FINE SAND, 2-5% SLIGHTLY PLASTIC FINES, MOIST, ORANGE, BLACK AND BROWN. BLOWS/INCH: 8-4-9-6-11-7
		S	21	30-23-20 (10")	43	GP	SANDY GRAVEL, SIMILAR TO ABOVE, MAXIMUM PARTICLE SIZE 1-1/2 IN, 5-7% SLIGHTLY PLASTIC FINES, BROWN.
682.7	50	S	22	15-98/3" (6")	98/3"		BLOWS/INCH: 3-4-4-7-7-5/6-3-5-4-3-2/4-3-2-3-3-5
		S	23	30/0"		-	WEATHERED SHALE, 10-15% FINE SAND, 10-15% SLIGHTLY PLASTIC TO MEDIUM PLASTIC FINES, ORANGE, BLACK, GRAY BROWN. REFUSAL

BOTTOM OF BORING AT 52.0 FT
ELEVATION 680.7 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-251C	APPROVED	DATE	BORING NO.	SHEET
	DDH	9/1/82	EOS-9	3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2	J.O. NO. 12241
BORING NO. EOS-10	SHEET 1 OF 3
COORDINATES N4097.3 E6137.4	GROUND ELEV. (1) 720.7
INCLINATION VERTICAL	BEARING NA
INSPECTOR J. W. MCCOY	
DATE : START / FINISH 6/10/82 / 6/11/82	CONTRACTOR / DRILLER EGER/JARVIS
STATIC GROUNDWATER DEPTH / DATE NOT RECORDED (FT) /	DRILL RIG TYPE CME 45
DEPTH TO BEDROCK NA (FT)	TOTAL DEPTH DRILLED 66.5 (FT)

METHODS :

DRILLING SOIL 3-1/8 IN O.D. ROLLER BIT, 4 IN I.D. CASING AND DRILLING MUD

SAMPLING SOIL 2 IN O.D. SPLIT SPOON AND 3 IN O.D. SHELBY TUBE

DRILLING ROCK NONE

SPECIAL TESTING OR INSTRUMENTATION NONE

COMMENTS NONE

ELEVATION (FEET)(1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) AND/OR RECOVERY (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
720.7	0	S	1	11-21-21 (13")	42	GP-GW	SANDY GRAVEL, COARSE TO FINE TO 1 IN MAXIMUM, 20-30% COARSE TO FINE SAND, 5-10% SLIGHTLY PLASTIC FINES, BROWN, GRAY AND ORANGE.
		S	2	6-5-3 (11")	8	SP-SW	GRAVELLY SAND, 20-30% COARSE TO FINE GRAVEL, FEW FRAGMENTS TO 1.5 IN, COARSE TO FINE, MOSTLY MEDIUM TO FINE, 5-10% SLIGHTLY PLASTIC FINES, BROWN.
	5						
		S	3	2-1-1 (10")	2	SP-SW	GRAVELLY SAND, 30-35% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% SLIGHTLY PLASTIC FINES, GRAY.
710.7	10						
		S	4	5-5-5 (15")	10	SP-SW	GRAVELLY SAND, 15-25% COARSE TO FINE GRAVEL, 1 IN MAXIMUM, ANGULAR TO ROUNDED, COARSE TO FINE SAND, MOSTLY MEDIUM TO FINE, 5-10% NONPLASTIC FINES, GRAY.
	15						

LEGEND / NOTES

1. DATUM IS MEAN SEA LEVEL
2. ▽ GROUND WATER LEVEL
3. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140lb. HAMMER FALLING 30".
4. ( ) INCHES OF SAMPLE RECOVERY.
5. STD. PENETRATION RESISTANCE BLOWS/FT.
6. UNIFIED SOIL CLASSIFICATION SYSTEM.
7. SAMPLE TYPE: S-SPLIT BARREL SAMPLE

UNDISTURBED SAMPLES
US-SHELBY TUBE
UO-OSTERBERG

BORING LOG

BEAVER VALLEY POWER STATION UNIT-2
DUQUESNE LIGHT COMPANY
SHIPPINGPORT, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.
SKETCH No. 12241-GSK-252A

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-10	1 OF 3

BORING NO. EOS-10
SHEET 2 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (EL2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	15						
		S	5	4-2-3 (9")	5	SP	SAND, TRACE FINE GRAVEL, MOSTLY MEDIUM TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.
700.7	20						
		S	6	10-14-26 (12")	40	GP-GW	SANDY GRAVEL, COARSE TO FINE GRAVEL TO 1.5 IN, ANGULAR TO ROUNDED, 25-35% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM, TRACE IRON STAINING, BROWN. BOTTOM 3 IN: BROKEN LIGHT GRAY SANDSTONE FRAGMENTS TO 1.5 IN. BLOWS/INCH: 2-1-1-2-2-2/1-1-1-2-5-4/4-3-6-4-3-6
	25						
		S	7	18-23-36 (17")	59	ML GP-GW	TOP 7 IN: GRAVELLY SILT, 15-20% COARSE TO FINE GRAVEL, MOSTLY MEDIUM TO FINE, ANGULAR TO SUBANGULAR, 5-10% FINE SAND, VERY DRY, BROWN. BOTTOM 10 IN: SANDY GRAVEL, COARSE TO FINE GRAVEL, 1.5 IN, ANGULAR, SOME BROKEN SANDSTONE, 25-35% COARSE TO FINE SAND, TRACE NONPLASTIC FINES, COAL AND IRON STAINING, BROWN. BLOWS/INCH: 1-4-3-3-4-3/4-3-4-5-3-4/9-7-6-5-4-5
690.7	30						
		S	8	2-4-5 (15")	9	SM CL	TOP 5 IN: SILTY SAND, 10-15% COARSE TO FINE GRAVEL, SUBANGULAR, FINE SAND, SOME MEDIUM AND COARSE, 10-15% NONPLASTIC FINES, BROWN. BOTTOM 10 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, 5-7% COARSE TO FINE GRAVEL, SOME ROOTS, POCKETS OF COAL FRAGMENTS, MOIST, DARK GRAYISH BROWN.
	35						
		S	9	3-5-6 (17")	11	ML	CLAYEY SILT, SLIGHTLY TO MODERATELY PLASTIC, TRACE FINE GRAVEL SIZED SANDSTONE AND COAL FRAGMENTS, FEW SANDSTONE FRAGMENTS TO 1 IN NEAR TOP, TRACE ROOTS, GRAY. q_u (pp): 1.25, 1.75TSF
		S	10	3-4-6 (13")	10	CL-ML CL	TOP 4 IN: CLAYEY SILT-SILTY CLAY, SIMILAR TO S-9. BOTTOM 9 IN: SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF, MOIST, GRAY BROWN. q_u (pp): 1.5, 1.75TSF
680.7	40	US	1	(23.5")		CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, OCCASIONAL GRAVEL TO 1 IN, MOIST, BROWN. (TUBE TRIMMINGS)
		S	11	4-3-3 (18")	6	CL	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, MEDIUM STIFF, OCCASIONAL FINE GRAVEL TO 1/2 IN, SOME FINE SAND, MOIST, BROWN. q_u (pp): 1.75, 2.00 TSF
		US	2	(23")			SIMILAR TO S-11. (TUBE TRIMMINGS)
	45						

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-252B | APPROVED DDH | DATE 9/1/82 | BORING NO. EOS-10 | SHEET 2 OF 3

BORING NO. EOS-10
SHEET 3 OF 3

SITE BEAVER VALLEY POWER STATION-UNIT 2, SHIPPINGPORT, PA. J.O. NO. 12241.00

ELEVATION (FEET) (1&2)	DEPTH (FEET)	SAMPLE TYPE (7)	SAMPLE NUMBER	BLOWS (3) OR REC/ROD (4)	SPT N VALUE (5)	GROUP SYMBOL (6)	SAMPLE DESCRIPTION
	45	S	12	4-9-11 (6")	20	SP-SW	GRAVELLY SAND, 15-20% COARSE TO FINE GRAVEL, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, 3-5% NONPLASTIC FINES, BROWN
		S	13	8-7-9 (8")	16	SP-SW	GRAVELLY SAND, 10-15% COARSE TO FINE GRAVEL, ANGULAR TO ROUNDED, COARSE TO FINE SAND, 5-7% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-2-1-1-1/1-1-1-1-2-1/2-2-1-2-1-1
		S	14	5-5-6 (8")	11	GP	SANDY GRAVEL, MEDIUM TO FINE, SUBANGULAR TO ROUNDED, 25-30% COARSE TO FINE SAND, MOSTLY COARSE TO MEDIUM.
670.7	50						
		S	15	12-9-8 (8")	17	GP-GW	SANDY GRAVEL, COARSE TO FINE, 1.5 IN MAXIMUM, MOSTLY BROKEN SANDSTONE FRAGMENTS, ANGULAR TO ROUNDED, 15-20% COARSE TO FINE SAND, TRACE NONPLASTIC FINES AND COAL, BROWN. BLOWS/INCH: 2-2-3-2-2-1/2-1-2-1-1-2/2-1-1-1-2-1
		S	16	10-14-8 (9")	22	GP-GW	SIMILAR TO S-15, 5-7% NONPLASTIC FINES, BROWN. BLOWS/INCH: 2-1-1-2-1-3/3-3-2-2-2-2/1-1-2-1-1-2
		S	17	9-7-7	14	GP-GW	SIMILAR TO S-15, 7-10% NONPLASTIC FINES, BROWN.
660.7	60						
	65						
		S	18	41-42-34 (14")	76	GP	SANDY GRAVEL, COARSE TO FINE GRAVEL SIZED GRAY SHALE AND ORANGE BROWN SANDSTONE FRAGMENTS, TRACE SLIGHTLY PLASTIC FINES, COAL AND IRON STAINING.
							BOTTOM OF BORING AT 66.5 FT ELEVATION 654.2 FT

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.

STONE & WEBSTER ENG. CORP. SKETCH No. 12241-GSK-252C

APPROVED	DATE	BORING NO.	SHEET
DDH	9/1/82	EOS-10	3 OF 3

BORING SWS-1
SHEET 1 OF 4

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241
COORDINATES N 3737 E 6700 GROUND ELEV (1) 734.6
INCLINATION ______ BEARING ______ LOGGED BY D. MACNEILL
DATE : START / FINISH 8-10-77 / 8-11-77 CONTRACTOR / DRILLER RAYMOND/KODITEK
STATIC GROUNDWATER DEPTH / DATE ______ / ______ DRILL RIG TYPE ______
DEPTH TO BEDROCK 77.0' TOTAL DEPTH DRILLED 78.5'
METHODS :
DRILLING SOIL 4" CASING, 3 7/8" ROLLER BIT, AW RODS, MUD
SAMPLING SOIL 2" O.D. SPLIT SPOON
DRILLING ROCK ______
SPECIAL TESTING OR INSTRUMENTATION ______
REMARKS ______

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS(2) OR U.D.S. PENETRATION(3)	SPT N VALUES OR U.D.S. REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
730	5	S	1	5-5-7	12	SM	SILTY SAND, UNIFORM, FINE, 35-45% NONPLASTIC FINES, LIGHT BROWN. 1 INCH LAYER OF UNIFORM FINE SAND, LESS THAN 5% FINES.	
		S	2	4-5-6	11	SM	SILTY SAND, SIMILAR TO ABOVE.	
		S	3	7-8-8	16	SM	SILTY SAND, WIDELY GRADED, 20-25% SUBROUNDED GRAVEL TO 0.7 INCH MAXIMUM, MOSTLY FINE SAND, 15-20% NONPLASTIC FINES, BROWN.	
725	10	S	4	5-7-8	15	SP-SM	GRAVELLY SAND, POORLY GRADED, 25-30% SUBROUNDED GRAVEL TO 0.6 INCH MAXIMUM, MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
		S	5	15-20-20	40	GP-GM	SANDY GRAVEL, POORLY GRADED, ANGULAR TO SUBANGULAR TO 1.0 INCH MAXIMUM, 30-35% MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
720	15	S	6	13-16-12	28	GP-GM	SANDY GRAVEL, SIMILAR TO ABOVE.	

LEGEND / NOTES

S_ SPLIT BARREL SAMPLE
UNDISTURBED SAMPLES (U.D.S.)
US_ SHELBY TUBE
UF_ FIXED PISTON
UO_ OSTERBERG
UD_ DENISON
UP_ PITCHER
N_STD. PENETRATION RESISTANCE BLOWS/FT
GROUNDWATER

1. DATUM IS MEAN SEA LEVEL UNLESS OTHERWISE INDICATED
2. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb HAMMER FALLING 30". * INDICATES USE OF 300 lb HAMMER
3. DENOTES INCHES OF PENETR. OF UNDISTURBED SAMPLER
4. DENOTES INCHES OF UNDISTURBED SAMPLE RECOVERY
5. UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG
BEAVER VALLEY POWER STATION UNIT 2
DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[illegible]	9/7/77	SWS-1	1 OF 4

BORING SWS-1

SHEET 2 OF 4

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
		S	7	6-7-13	20	SP-SM	SAND, POORLY GRADED, 3-8% GRAVEL TO 0.6 INCH MAXIMUM, MOSTLY MEDIUM TO FINE SAND, 5-8% NONPLASTIC FINES, BROWN.	
715		S	8	11-15-16	31	SP-SM	GRAVELLY SAND, POORLY GRADED, 25-35% SUBROUNDED TO SUBANGULAR GRAVEL TO 0.7 INCH MAXIMUM, MOSTLY MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
	20	S	9	9-9-12	21	SP-SM	SAND, UNIFORM, FINE, 5-8% NONPLASTIC FINES, LIGHT BROWN.	
		S	10	8-13-19	32	SP-SM GP	TOP 3 INCHES: SAND, SIMILAR TO ABOVE. BOTTOM: SANDY GRAVEL, POORLY GRADED, MOSTLY COARSE ANGULAR TO 1.0 INCH MAXIMUM, 20-30% COARSE TO FINE SAND, LESS THAN 5% FINES, BROWN.	
710	25	S	11	9-27-20	47	GP	SANDY GRAVEL, SIMILAR TO ABOVE.	
		S	12	8-12-15	27	GP	SANDY GRAVEL, SIMILAR TO ABOVE EXCEPT ONLY 20-25% SAND.	
705		S	13	10-22-20	42	GP	SANDY GRAVEL, SIMILAR TO # 12.	
	30	S	14	13-16-20	36	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBANGULAR TO 0.8 INCH MAXIMUM, 30-35% MOSTLY MEDIUM TO FINE SAND, 5-8% NONPLASTIC FINES, DARK BROWN.	
		S	15	18-21-20	41	GP-GM	SANDY GRAVEL, SIMILAR TO ABOVE.	
700	35	S	16	16-24-20	44	SP-SM	TOP SAND, POORLY GRADED, COARSE TO FINE, MOSTLY FINE, 5-8% NONPLASTIC FINES BROWN. BOTTOM 3 INCHES: GRAVEL.	
		S	17	9-11-10	21	SP-SM	SANDY GRAVEL, POORLY GRADED,SUBANGULAR TO 1.2 INCH MAXIMUM, 25-35% MOSTLY FINE SAND, 5-8% NONPLASTIC FINES, BROWN.	
695		S	18	7-5-5	10	GM	SILTY GRAVEL, WIDELY GRADED, ANGULAR TO SUBANGULAR TO 0.6 INCH MAXIMUM, 25-35% COARSE TO FINE SAND, 12-15% NONPLASTIC FINES, BROWN AND GRAY.	
	40	S	19	8-8-7	15	SM	SILTY SAND, WIDELY GRADED, 35-40% SUBROUNDED TO 0.7 INCH MAXIMUM, MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
		S	20	7-6-7	13	SM	SILTY SAND, SIMILAR TO ABOVE.	
690	45	S	21	7-5-7	13	GM	SILTY GRAVEL, WIDELY GRADED, SUBANGULAR TO 0.8 INCH MAXIMUM, 30-35% MOSTLY MEDIUM TO FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1.

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[illegible signature]	3/7/77	SWS-1	2 OF 4

BORING SWS-1

SHEET 3 OF 4

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS. PENETRATION(3)	SPT N VALUES OR UDS. REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
		S	22	7-5-6	11	GP	SANDY GRAVEL, POORLY GRADED, MOSTLY COARSE SUBROUNDED TO 1.1 INCH MAXIMUM, 25-30% MOSTLY COARSE AND MEDIUM SAND, LESS THAN 5% FINES, BROWN.	
685		S	23	4-8-15	23		NO RECOVERY	
	50	S	24	7-6-6	12		NO RECOVERY	
		S	25	11-8-7	15	SP-SM	SAND, UNIFORM, FINE, 5-60% NONPLASTIC FINES, BROWN.	
680	55	S	26	7-6-7	13	GP	SANDY GRAVEL, POORLY GRADED, MOSTLY COARSE SUBROUNDED TO 1.2 INCH MAXIMUM, 25-35% MOSTLY COARSE AND MEDIUM SAND, LESS THAN 5% FINES, BROWN.	
		S	27	11-13-10	23	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBROUNDED TO 1.1 INCH MAXIMUM, 30-35% MOSTLY MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
675		S	28	10-10-16	26		NOT ENOUTH SAMPLE FOR ACCURATE CLASSIFICATION (APPEARS TO BE SIMILAR TO # 27)	
	60	S	29	6-8-8	16	GP-GM	SANDY GRAVEL, POORLY GRADED, MOSTLY COARSE, SUBROUNDED TO 1.0 INCH MAXIMUM 25-30% COARSE TO FINE SAND, 8-12% NONPLASTIC FINES, BROWN.	
		S	30	8-9-8	17	GP GM	SANDY GRAVEL, SIMILAR TO ABOVE.	
670	65	S	31				DRILLER OVER DRILLED A FOOT AND WENT TO NEXT SAMPLE	
		S	32	17-16-17	33		NO RECOVERY - 2 ATTEMPTS	
665		S	33	8-9-8	17	GP-GM	SANDY GRAVEL, POORLY GRADED, ANGULAR TO 1.0 INCH MAXIMUM, 25-35% MOSTLY COARSE SAND, 5-10% NONPLASTIC FINES, BROWN.	
	70	S	34	10-9-12	21	GP-GM	SANDY GRAVEL, SIMILAR TO ABOVE.	
		S	35	9-72-100/3"	172+	SP-SM	SAND, UNIFORM, FINE, 5-8% NONPLASTIC FINES, BROWN.	
660	75	S	36	13-52-46	98	GP-GM	TOP SANDY GRAVEL, POORLY GRADED, SUBANGULAR TO 0.8 INCH MAXIMUM, 35-40% MOSTLY FINE SAND, 8-12% NONPLASTIC FINES, BROWN. BOTTOM 7 INCHES:	

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1. | STONE & WEBSTER ENG. CORP. | ISSUED BY [signature] | DATE 9/7/77 | BORING NO. SWS-1 | SHEET 3 OF 4

BORING SWS-1

SHEET 4 OF 4

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
							GRAVEL.	
		S	37	45/1"	45+		NO RECOVERY	
							VERY HARD DRILLING AT 77.0', TOP OF ROCK INDICATED BY CUTTINGS.	
		S	38	100/6"	100+		SHALE, BADLY DECOMPOSED, SEVERELY WEATHERED.	
655								
	80						END OF BORING AT 78.5'	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1

STONE & WEBSTER ENG. CORP. | ISSUED BY | DATE 9/7/77 | BORING NO. SWS-1 | SHEET 4 OF 4

12241 - GA(B) - 159D

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

BORING SWS-2

SHEET 1 OF 3

COORDINATES N 3900.0 E 6280.0 GROUND ELEV. (1) 729.7

INCLINATION ____ BEARING ____ LOGGED BY D. MACNEILL

DATE : START / FINISH 8-9-77 / 8-10-77 CONTRACTOR / DRILLER RAYMOND/KODITEK

STATIC GROUNDWATER DEPTH / DATE ____ / ____ DRILL RIG TYPE ____

DEPTH TO BEDROCK 62.0 TOTAL DEPTH DRILLED 62.4'

METHODS :

DRILLING SOIL 4" CASING, 3 7/8" ROLLER BIT, AW RODS, MUD

SAMPLING SOIL 2" O.D. SPLIT SPOON

DRILLING ROCK ____

SPECIAL TESTING OR INSTRUMENTATION ____

REMARKS ____

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS(2) OR U.D.S. PENETRATION(3)	SPT N VALUES OR U.D.S. REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
							0-6' PLACED FILL TO LEVEL AREA FOR DRILLING.	
	5							
		S	1	3-3-4	7	CL	TOP 4 INCHES: SANDY CLAY, SLIGHTLY PLASTIC, 15-20% MOSTLY FINE SAND, BROWN. BOTTOM: SILTY CLAY, SLIGHTLY PLASTIC, BROWN.	
		S	2	2-2-4	6	SP-SM	SAND, POORLY GRADED, TRACE OF 0.4 INCH GRAVEL, MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
720	10							
		S	3	2-3-3	6	SP-SM	SAND, POORLY GRADED, 8-12% GRAVEL TO 0.5 INCH MAXIMUM, MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
		S	4	4-5-7	12	SC	TOP 4 INCHES: SAND, UNIFORM, FINE, 5-10% NONPLASTIC FINES, BROWN. BOTTOM: CLAYEY SAND, UNIFORM, FINE, 20-25% SLIGHTLY PLASTIC FINES, BROWN.	
715	15	S	5	3-5-5	10	CL SM	TOP 1 INCH: SILTY CLAY, SLIGHTLY PLASTIC, BROWN. BOTTOM 3 INCHES: SILTY SAND, UNIFORM, FINE, 12-15% NONPLASTIC FINES, BROWN. FOLLOWED BY 3 INCH	

LEGEND / NOTES

S_ SPLIT BARREL SAMPLE
UNDISTURBED SAMPLES (U.D.S.)
US_ SHELBY TUBE
UF_ FIXED PISTON
UO_ OSTERBERG
UD_ DENISON
UP_ PITCHER
N_STD. PENETRATION RESISTANCE BLOWS/FT
GROUNDWATER

1. DATUM IS MEAN SEA LEVEL UNLESS OTHERWISE INDICATED
2. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb. HAMMER FALLING 30". * INDICATES USE OF 300 lb HAMMER
3. DENOTES INCHES OF PENETR. OF UNDISTURBED SAMPLER
4. DENOTES INCHES OF UNDISTURBED SAMPLE RECOVERY
5. UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2
DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[signature]	9/19/77	SWS-2	1 OF 3

BORING SWS-2

SHEET 2 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
							TO 0.7 INCH MAXIMUM, COARSE TO FINE SAND, 20-25% SLIGHTLY PLASTIC FINES, BROWN.	
		S	6	6-7-6	13	SM	SILTY SAND, WIDELY GRADED, 35-40% SUBROUNDED GRAVEL TO 0.7 INCH MAXIMUM, MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
		S	7	8-11-15	26	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBANGULAR TO 1.0 INCH MAXIMUM, 30-40% MOSTLY COARSE AND MEDIUM SAND, 8-12% NONPLASTIC FINES, BROWN.	
710	20							
		S	8	13-22-24	46	GP-GM	SANDY GRAVEL, POORLY GRADED, ANGULAR TO 1.0 INCH MAXIMUM, 25-30% MOSTLY MEDIUM TO FINE SAND, 5-10% NONPLASTIC FINES, DARK BROWN.	
		S	9	26-30-35	65	GP-GM	SANDY GRAVEL, SIMILAR TO ABOVE.	
		S	10	56-100/4"	100+		NO RECOVERY	
705	25							
		S	11	7-7-11	18	SP	SAND, UNIFORM, MEDIUM TO FINE, MOSTLY MEDIUM LESS THAN 5% FINES, BROWN.	
		S	12	6-7-10	17	SP-SM	SAND, UNIFORM, MEDIUM TO FINE, TRACE OF GRAVEL TO 5-10% NONPLASTIC FINES, BROWN.	
700	30							
		S	13	28-23-21	44		NO RECOVERY	
		S	14	9-8-14	22	GP	SANDY GRAVEL, POORLY GRADED, ANGULAR (FRESHLY FRACTURED) TO 0.9 INCH MAXIMUM, 20-30% MOSTLY FINE SAND, LESS THAN 5% FINES, BROWN.	
695	35	S	15	14-16-15	31	GP	SANDY GRAVEL, SIMILAR TO ABOVE.	
		S	16	21-31-27	58	GP-GM	SANDY GRAVEL, POORLY GRADED, ANGULAR TO 1.2 INCH MAXIMUM, 30-35% MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
		S	17	14-10-12	22	GP-GM	SANDY GRAVEL, POORLY GRADED, ANGULAR TO SUBANGULAR TO 1.1 INCH MAXIMUM, 25-30% MOSTLY COARSE AND MEDIUM SAND, 5-8% NONPLASTIC FINES, DARK BROWN.	
690	40							
		S	18	10-14-21	35	GP-GM	SANDY GRAVEL, SIMILAR TO ABOVE.	
		S	19	23-26-24	50	GM	SILTY GRAVEL, WIDELY GRADED, SUBANGULAR TO 1.1 INCH MAXIMUM, 25-30% MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
685	45	S	20	14-14-13	27	GM	SILTY GRAVEL, WIDELY GRADED, ANGULAR TO SUBANGULAR TO 1.0 INCH MAXIMUM, 30-35% MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1	STONE & WEBSTER ENG. CORP.	ISSUED BY [signature]	DATE 9/13/77	BORING NO. SWS-2	SHEET 2 OF 3

BORING SWS-2

SHEET 3 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION(3)	SPT N VALUES OR U.D.S. REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
		S	21	9-11-22	33	GM	SILTY GRAVEL, SIMILAR TO ABOVE.	
		S	22	13-12-9	21	GP	SANDY GRAVEL, POORLY GRADED, SUBANGULAR, MOSTLY COARSE TO 1.2 INCH MAXIMUM 15-20% COARSE TO FINE SAND, LESS THAN 5% NONPLASTIC FINES, BROWN.	
680	50							
		S	23	9-10-11	21	GM	SILTY GRAVEL, WIDELY GRADED, ANGULAR TO SUBANGULAR TO 1.1 INCH MAXIMUM, 20-30% COARSE TO FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
		S	24	11-8-9	17	GM	SILTY GRAVEL, SIMILAR TO ABOVE.	
675	55	S	25	13-16-17	33		NO RECOVERY	
		S	26	10-7-8	15	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBROUNDED TO 0.9 INCH MAXIMUM, 30-35% MOSTLY COARSE AND MEDIUM SAND, 5-8% NONPLASTIC FINES, BROWN. 1 INCH LAYER OF UNIFORM FINE SAND, NEAR BOTTOM.	
		S	27	8-16-38	54	GP-GM	SANDY GRAVEL, POORLY GRADED, MOSTLY ANGULAR TO 1.0 INCH MAXIMUM, 25-35% MOSTLY FINE SAND, 5-10% NONPLASTIC FINES, BROWN.	
670	60							
		S	28	29-41-100/4"	141	GM	SILTY GRAVEL, WIDELY GRADED, ANGULAR TO 1.2 INCH MAXIMUM (CAUGHT IN SHOE) 30-35% COARSE TO FINE SAND, 12-18% NONPLASTIC FINES, BROWN.	
		S	29	140/4"	140+		SHALE, SEVERELY WEATHERED, DECOMPOSED.	
							TOP OF ROCK AT 62.0'	
							END OF BORING AT 62.4'	
665	65							

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1.	STONE & WEBSTER ENG. CORP.	ISSUED BY	DATE 9/19/77	BORING NO. SWS-2	SHEET 3 OF 3

12241 - GA(B)- 160C

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

BORING SWS-3

SHEET 1 OF 3

COORDINATES N 4095.0 E 6245.0 GROUND ELEV. (1) 706.3

INCLINATION ______ BEARING ______ LOGGED BY D.MACNEILL

DATE : START / FINISH 7/27/77 / 7/29/77 CONTRACTOR / DRILLER RAYMOND/KODITEK

STATIC GROUNDWATER DEPTH / DATE ______ / ______ DRILL RIG TYPE ______

DEPTH TO BEDROCK 58.0' TOTAL DEPTH DRILLED 59.5'

METHODS :

DRILLING SOIL 4" CASING, 3 7/8" ROLLER BIT, AW RODS, MUD

SAMPLING SOIL 2" O.D. SPLIT SPOON

DRILLING ROCK ______

SPECIAL TESTING OR INSTRUMENTATION ______

REMARKS ______

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION (3)	SPT N VALUES OR U.D.S. REC (4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
	5	S	1	6-6-7	13		NO RECOVERY	
700		S	2	3-3-4	7	CL	TOP 4 INCHES: SILTY SAND, WIDELY GRADED, 25-30% GRAVEL TO 0.6 INCH MAXIMUM COARSE TO FINE, MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWNISH GRAY. BOTTOM: SILTY CLAY, SLIGHT TO MODERATELY PLASTIC, 8-12% FINE SAND, BROWN.	
		S	3	4-5-5	10	CL	CLAYEY SAND, WIDELY GRADED, 12-18% GRAVEL TO 0.6 INCH MAXIMUM, MOSTLY FINE SAND, 35-40% SLIGHT TO MODERATELY PLASTIC FINES, BROWN, WITH A FEW SMALL POCKETS OF MODERATELY PLASTIC SILTY CLAY, THROUGHOUT.	
	10							
695		S	4	2-3-3	6	CL	SANDY CLAY, SLIGHT TO MODERATELY PLASTIC, 12-18% FINE SAND, BROWN, MOIST.	
		S	5	1-3-2	6	CL	SILTY CLAY, MODERATELY PLASTIC, ONE PIECE OF SUBROUNDED 0.5 INCH GRAVEL, 5-10% FINE SAND, BROWN.	
	15	S	6	2-3-3	6	CL	SILTY CLAY, MODERATELY PLASTIC, 8-12% FINE GRAVEL TO 0.5 INCH MAXIMUM, 5-10% FINE SAND, BROWN.	

LEGEND / NOTES

S_ SPLIT BARREL SAMPLE
UNDISTURBED SAMPLES (U.D.S.)
US_ SHELBY TUBE
UF_ FIXED PISTON
UO_ OSTERBERG
UD_ DENISON
UP_ PITCHER
N_STD PENETRATION RESISTANCE BLOWS/FT
GROUNDWATER

1. DATUM IS MEAN SEA LEVEL UNLESS OTHERWISE INDICATED
2. BLOWS REQUIRED TO DRIVE 2"O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb HAMMER FALLING 30". * INDICATES USE OF 300 lb HAMMER
3. DENOTES INCHES OF PENETR. OF UNDISTURBED SAMPLER
4. DENOTES INCHES OF UNDISTURBED SAMPLE RECOVERY
5. UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2
DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[signature]	9/7/77	SWS-3	1 OF 3

BORING SWS-3

SHEET 2 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB TEST RESULTS / COMMENTS
690		S	7	1-2-3	5	CL	SILTY CLAY, SIMILAR TO ABOVE.	
		S	8	2-4-5	9	CH	SILTY CLAY, MODERTELY TO HIGHLY PLASTIC, LESS THAN 5% MOSTLY FINE SAND, BROWN, MOIST, STIFF, HARD DRY STRENGTH.	
	20	S	9	3-3-5		CL	TOP 4 INCHES: SANDY CLAY, SLIGHT TO MODERATELY PLASTIC, 10-15% SUBROUNDED GRAVEL TO 0.4 INCH MAXIMUM, 12-15% MOSTLY FINE SAND, GRAY, PIECE OF WOOD NEAR BOTTOM. BOTTOM: SILTY CLAY, MODERATELY PLASTIC, 5-10% MOSTLY FINE SAND, GRAY, TRACE OF ORGANIC MATERIAL THROUGHOUT.	
685		S	10	2-2-5	7	CL	SILTY CLAY, MODERATLEY PLASTIC, 8-12% GRAVEL (BLACK COAL) LESS THAN 5% FINE SAND, GRAY.	
	25	S	11	2-3-6	9	CL	SILTY CLAY, MODERATELY PLASTIC, OCCASSIONAL GRAVEL TO 0.5 INCH MAXIMUM, LESS THAN 5% FINE SAND, BROWNISH GRAY. BOTTOM 7 INCHES: SILTY CLAY, MODERATELY PLASTIC, GRAYISH BROWN.	
680		S	12	3-4-7	11	CL	SILTY CLAY, MODERATELY TO HIGHLY PLASTIC, BROWN.	
		S	13	5-7-10	17	CL	SILTY CLAY, SIMILAR TO ABOVE.	
	30	S	14	6-7-7	14	CL	SILTY CLAY, SIMILAR TO ABOVE, EXCEPT OCCASSIONAL GRAVEL TO 0.5 INCH MAXIMUM.	
675		S	15	5-7-8	15	CH	SILTY CLAY, HIGHTLY PLASTIC, TRACE OF SAND, BROWN, STIFF, HIGH DRY STRENGTH.	
	35	S	16	2-3-4	7	CH	SILTY CLAY, HIGHLY PLASTIC TRACE OF FINE SAND, SOFT, BROWN.	
670		S	17	3-5-6	11	CH	SILTY CLAY, SIMILAR TO ABOVE EXCEPT FIRM TO STIFF.	
		S	18	2-5-6	11	CH	SILTY CLAY, HIGHLY PLASTIC, OCCASSIONAL GRAVEL TO 0.5 INCH MAXIMUM, LESS THAN 5% FINE SAND, BROWN, STIFF, HIGH DRY STRENGTH.	
	40	S	19	3-4-7	11	CL	SILTY CLAY, MODERATELY TO HIGHLY PLASTIC, 5-10% GRAVEL TO 0.5 INCH MAXIMUM, 3-8% FINE SAND, BROWN.	
665		S	20	2-3-5	8	CL	SANDY CLAY, MODERATELY PLASTIC, 12-18% FINE SAND, BROWN, FIRM.	
	45	S	21	2-4-4	8	CL	SANDY CLAY, SIMILAR TO ABOVE.	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1.	STONE & WEBSTER ENG. CORP.	ISSUED BY	DATE 9/7/77	BORING NO. SWS-3	SHEET 2 OF 3

BORING SWS-3

SHEET 3 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION(3)	SPT N VALUES OR U.D.S. REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
660		S	22	9-22-17	39	GC	CLAYEY GRAVEL, WIDELY GRADED, ANGULAR TO 1.3 INCH MAXIMUM, 25-30% MOSTLY FINE SAND, 25-30% MODERATELY PLASTIC FINES, BROWN.	
		S	23	12-9-10	19	GM	SILTY GRAVEL, WIDELY GRADED, SUBROUNDED TO 0.8 INCH MAXIMUM, 25-30% MOSTLY FINE SAND, 12-18% NONPLASTIC FINES, BROWN.	
	50	S	24	9-7-11	18	GM	SILTY GRAVEL, WIDELY GRADED, SUBANGULAR TO SUBROUNDED TO 1.0 INCH MAXIMUM, 25-30% COARSE TO FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
655		S	25	8-8-7	15		NO RECOVERY	
	55	S	26	11-11-11	22		SANDY GRAVEL, POORLY GRADED, SUBANGULAR, MOSTLY COARSE TO 1.3 INCH MAXIMUM 20-25% COARSE TO FINE SAND, 8-12% NONPLASTIC FINES, BROWN.	
650		S	27	100/1"	100+		NO RECOVERY	
		S	28	78-65-100/4"	165+		GRAVEL, SEVERELY WEATHERED, DECOMPOSED SHALE; TOP OF ROCK AT 58.0'.	
	60						END OF BORING AT 59.5'	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1.

STONE & WEBSTER ENG. CORP. | ISSUED BY [signature] | DATE 9/7/77 | BORING NO. SWS-3 | SHEET 3 OF 3

12241 - GA(B) - 161C

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

BORING SWS-4

SHEET 1 OF 3

COORDINATES N 4240.0 E 6212.5 GROUND ELEV. (1) 699.8

INCLINATION ______ BEARING ______ LOGGED BY D. MACNEILL

DATE : START / FINISH 8-1-77 / 8-2-77 CONTRACTOR / DRILLER RAYMOND/KODITEK

STATIC GROUNDWATER DEPTH / DATE ______ / ______ DRILL RIG TYPE ______

DEPTH TO BEDROCK 71.3' TOTAL DEPTH DRILLED 71.5'

METHODS :

DRILLING SOIL 4" CASING, 3 7/8" ROLLER BIT, AW RODS, MUD

SAMPLING SOIL 2" O.D. SPLIT SPOON

DRILLING ROCK ______

SPECIAL TESTING OR INSTRUMENTATION ______

REMARKS ______

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION (3)	SPT N VALUES OR U.D.S. REC (4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
695	5	S	1	2-2-2	4	CL	SANDY CLAY, MODERATELY PLASTIC, 8-12% GRAVEL TO 0.6 INCH MAXIMUM, 15-25% COARSE TO FINE SAND, GRAY, SOFT, SATURATED TRACES OF ORGANIC MATERIAL THROUGHOUT.	
		S	2	1-1-1	2	CL	SANDY CLAY, SIMILAR TO ABOVE.	
		S	3	2-3-5	8		NO RECOVERY	
690	10	S	4	8-7-9	16	SM ML CL	TOP 4 INCHES: SILTY SAND, WIDELY GRADED, 20-25% SUBROUNDED GRAVEL TO 0.7 INCH MAXIMUM, COARSE TO FINE SAND, 35-40% NON TO SLIGHTLY PLASTIC FINES, BROWN. FOLLOWED BY 3 INCH LAYER OF SILTY CLAY, SLIGHTLY PLASTIC BROWN, BOTTOM 3 INCHES: SANDY SILT, NONPLASTIC, 20-30% UNIFORM, FINE SAND, DARK BROWN.	
		S	5	4-4-3	7	CL	SANDY CLAY, SLIGHT TO MODERATELY PLASTIC, 10-15% COARSE TO FINE SAND, DARK BROWN, SOFT, SATURATED, TRACE OF ORGANIC MATERIAL.	
685	15	S	6	3-3-3	6	CL	SANDY CLAY, SIMILAR TO ABOVE.	

LEGEND / NOTES

S_ SPLIT BARREL SAMPLE
UNDISTURBED SAMPLES (U.D.S.)
US_ SHELBY TUBE
UF_ FIXED PISTON
UO_ OSTERBERG
UD_ DENISON
UP_ PITCHER
N_ STD. PENETRATION RESISTANCE BLOWS/FT
GROUNDWATER

1. DATUM IS MEAN SEA LEVEL UNLESS OTHERWISE INDICATED
2. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb. HAMMER FALLING 30". * INDICATES USE OF 300 lb HAMMER
3. DENOTES INCHES OF PENETR. OF UNDISTURBED SAMPLER
4. DENOTES INCHES OF UNDISTURBED SAMPLE RECOVERY
5. UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2
DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[signature]	9/19/77	SWS-4	1 OF 3

12241 - GA(B) - 162A

BORING SWS-4

SHEET 2 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB TEST RESULTS / COMMENTS
		S	7	3-3-5	8	CL	SILTY CLAY, MODERATELY PLASTIC, 8-12% FINE SAND, MEDIUM BROWN.	
		S	8	2-2-3	5	CL	SILTY CLAY, SIMILAR TO ABOVE.	
680	20	S	9	2-4-4	8	CL	SILTY CLAY, SIMILAR TO ABOVE.	
		S	10	2-3-4	7	CL	SILTY CLAY, SIMILAR TO ABOVE.	
675	25	S	11	2-2-3	5	CL	SILTY CLAY, SIMILAR TO ABOVE.	
		S	12	1-2-2	4	CL	SILTY CLAY, SIMILAR TO ABOVE.	
		S	13	3-2-3	5	CL	SILTY CLAY, SIMILAR TO ABOVE.	
670	30	S	14	2-3-3	6	CL	SILTY CLAY, SIMILAR TO ABOVE.	
		S	15	1-2-2	4	CL	SILTY CLAY, SIMILAR TO ABOVE.	
665	35	S	16	1-2-2	4	CL	SILTY CLAY, SIMILAR TO ABOVE. BOTTOM 4 INCHES: ORGANIC BROWN.	
		S	17	1/18"	1	CL	SILTY CLAY, MODERATELY PLASTIC, 3-8% FINE SAND, GRAY.	
		S	18	0/18"	0	CL	SILTY CLAY, SIMILAR TO ABOVE, EXCEPT LESS THAN 5% SAND.	
660	40	S	19	1-1-2	3	CL	SILTY CLAY, SIMILAR TO # 18.	
		S	20	3-3-5	8	CL	SILTY CLAY, MODERATELY TO HIGHLY PLASTIC, LESS THAN 5% FINE SAND, GRAY, 2 THIN LAYERS.	
655	45	S	21	2-2-3	5	CL	SANDY CLAY, SLIGHTLY TO MODERATELY PLASTIC, 15-20% FINE SAND, GRAY.	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1

STONE & WEBSTER ENG. CORP. | ISSUED BY [signature] | DATE 9/19/77 | BORING NO. SWS-4 | SHEET 2 OF 3

12241 - G4(B) - 16op

BORING SWS-4

SHEET 3 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION(3)	SPT N VALUES OR U.D.S. REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
		S	22	3-15-11	24	CL	TOP 5 INCHES: SANDY CLAY, SLIGHTLY PLASTIC, 30-35% FINE SAND, GRAY, 1 INCH LAYER OF SILTY CLAY, MODERATELY TO HIGHLY PLASTIC, GRAY. BOTTOM 1 INCH: SANDY GRAVEL, 1.2 INCH GRAVEL CAUGHT IN SHOE.	
		S	23	7-9-10	19	GC	CLAYEY GRAVEL, WIDELY GRADED, SUBROUNDED TO 0.8 INCH MAXIMUM, 20-25% FINE SAND, 35-40% SLIGHTLY PLASTIC FINES, GRAY, 1 INCH LAYER OF HIGHLY PLASTIC SILTY CLAY, AND A THIN LAYER OF BLACKISH BROWN ORGANIC MATERIAL.	
650	50	S	24	6-10-12	22	GM	SILTY GRAVEL, WIDELY GRADED, SUBROUNDED TO SUBANGULAR TO 1.1 INCH MAXIMUM, 25-30% COARSE TO FINE SAND, 12-18% NONPLASTIC FINES, GRAY.	
		S	25	14-7-11	18	GM	SILTY GRAVEL, WIDELY GRADED, ANGULAR (FRACTURED) TO 0.8 INCH MAXIMUM, 25-30% COARSE TO FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
645	55	S	26	20-18-23	41	GM	SILTY GRAVEL, SIMILAR TO ABOVE.	
		S	27	9-8-7	15	GM	SILTY GRAVEL, SIMILAR TO ABOVE.	
		S	28	8-6-6	12	GP	SANDY GRAVEL, POORLY GRADED, SUBROUNDED TO SUBANGULAR TO 1.0 INCH MAXIMUM, 25-35% MOSTLY COARSE SAND, LESS THAN 5% FINES, BROWN.	
640	60	S	29	30-16-18	34	GM	TOP 3 INCHES: SANDY GRAVEL, SIMILAR TO ABOVE. BOTTOM 1 INCH: SILTY GRAVEL, SUBANGULAR TO 1.0 INCH MAXIMUM, 25-35% MOSTLY FINE SAND, 12-15% NONPLASTIC FINES, BROWN.	
		S	30	16-20-19	39	GM	SILTY GRAVEL, SIMILAR TO ABOVE.	
635	65	S	31	17-23-40	63	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBROUNDED TO SUBANGULAR TO 1.0 INCH MAXIMUM, 30-35% MOSTLY MEDIUM SAND, 5-10% NONPLASTIC FINES, BROWN.	
		S	32	22-23-100/5"	132+	GP-GM	SANDY GRAVEL, POORLY GRADED, SUBANGULAR TO 1.2 INCH MAXIMUM, 25-30% MOSTLY FINE SAND, 5-8% NONPLASTIC FINES, BROWN.	
		S	33	39-56-100/3"	156+	SM	TOP 4 INCHES: GRAVEL. BOTTOM: SILTY SAND, WIDELY GRADED, 25-30% SUBROUNDED GRAVEL TO 0.7 INCH MAXIMUM MOSTLY FINE SAND, 25-35% NONPLASTIC FINES, BROWN. SMALL POCKETS OF SANDY SILT, THROUGHOUT.	
630	70	S	34	50-100/5"	100+	GM	TOP 8 INCHES: SILTY GRAVEL, WIDELY GRADED, SUBANGULAR TO 0.8 INCH MAXIMUM 35-40% COARSE TO FINE SAND, 15-20% NON TO SLIGHTLY PLASTIC FINES, BROWN. BOTTOM 2 INCHES: GRAVEL, SEVERLY WEATHERED DECOMPOSED, GRAY, SHALE.	
							TOP OF ROCK AT 71.3'	
							END OF BORING AT 71.5'	

NOTE: FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1

STONE & WEBSTER ENG. CORP. | ISSUED BY O.M. | DATE 9/19/77 | BORING NO. SWS-4 | SHEET 3 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

BORING SWS-5

SHEET 1 OF 3

COORDINATES N 4330.0 E 6180.0 GROUND ELEV. (1) 682.0

INCLINATION ____ BEARING ____ LOGGED BY G. ZAWADA

DATE : START / FINISH 8-13-77 / 8-13-77 CONTRACTOR / DRILLER RAYMOND/KODITEK

STATIC GROUNDWATER DEPTH / DATE ____ / ____ DRILL RIG TYPE ____

DEPTH TO BEDROCK 56.0' TOTAL DEPTH DRILLED 56.4'

METHODS :

DRILLING SOIL 4" CASING, 3 7/8" ROLLER BIT, AW RODS, MUD

SAMPLING SOIL 2" O.D. SPLIT SPOON

DRILLING ROCK ____

SPECIAL TESTING OR INSTRUMENTATION ____

REMARKS ____

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S. PENETRATION (3)	SPT N VALUES OR U.D.S. REC (4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
680								
	5							
675								
	10							
		S	1	1-1-1	2	ML	SANDY SILT, MODERATELY PLASTIC, 10-20% VERY FINE SAND, BROWN.	
670								
		S	2	1/18"	1	ML	SANDY SILT, SIMILAR TO ABOVE.	
		S	3	1/18"	1	ML	SILT, MODERATELY PLASTIC, 5-15% VERY FINE SAND. TRACE OF ORGANICS, BROWN AND GRAY.	

LEGEND / NOTES

S_ SPLIT BARREL SAMPLE
UNDISTURBED SAMPLES (U.D.S.)
US_ SHELBY TUBE
UF_ FIXED PISTON
UO_ OSTERBERG
UD_ DENISON
UP_ PITCHER
N_STD PENETRATION RESISTANCE BLOWS/FT
GROUNDWATER

1. DATUM IS MEAN SEA LEVEL UNLESS OTHERWISE INDICATED
2. BLOWS REQUIRED TO DRIVE 2" O.D. SAMPLE SPOON 6" OR DISTANCE SHOWN USING 140 lb. HAMMER FALLING 30". * INDICATES USE OF 300 lb HAMMER
3. DENOTES INCHES OF PENETR. OF UNDISTURBED SAMPLER
4. DENOTES INCHES OF UNDISTURBED SAMPLE RECOVERY
5. UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG

BEAVER VALLEY POWER STATION UNIT 2
DUQUESNE LIGHT COMPANY
PITTSBURGH, PENNSYLVANIA

STONE & WEBSTER ENG. CORP.

ISSUED BY	DATE	BORING NO.	SHEET
[illegible]	9/13/77	SWS-5	1 OF 3

12241 - GA(B) - 163A

BORING SWS-5

SHEET 2 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR UDS PENETRATION(3)	SPT N VALUES OR UDS REC(4)	GROUP SYMBOL (5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
605		S	4	1/18"	1	ML	SILT, MODERATELY PLASTIC, LESS THAN 5% VERY FINE SAND, GRAY.	
		S	5	2/2/2	4	ML	SANDY SILT, MODERATELY PLASTIC, 15-25% VERY FINE SAND, GRAY.	
	20	S	6	2/1/2	3		NO RECOVERY	
660		S	7	1/18"	1	ML	SILTY SAND, UNIFORM, VERY FINE, 30-40% SLIGHTLY PLASTIC FINES, GRAY.	
	25	S	8	1/5/3	8	CL	CLAYEY SAND, UNIFORM, VERY FINE, 30-40% MODERATELY PLASTIC FINES, GRAY.	
655		S	9	2/4/4	8	SP SM	SAND, TOP 3 INCHES: SIMILAR TO S8;REMAINING - GRADING TO SAND, POORLY GRADED,FINE TO COARSE, MOSTLY FINE & MEDIUM GRAVEL, TRACES OF WOOD, BROWN & GRAY.	
		S	10	8-11-19	30		NO RECOVERY	
	30	S	11	11-13-11	24		NO RECOVERY	
650		S	12	7-10-15	25	SC	CLAYEY SAND, WELL GRADED, PIECE OF GRAVEL CAUGHT IN SHOE.	
	35	S	13	10-9-5	14	SW	GRAVELLY SAND, WELL GRADED, 20-30% GRAVEL TO 1.2 INCH MAXIMUM, FINE TO COARSE SAND, LESS THAN 5% NONPLASTIC FINES, GRAY.	
646		S	14	9-10-9	19		NO RECOVERY	
		S	15	3-3-5	8		NO RECOVERY	
	40	S	16	9-9-7	16	SM	SILTY SAND, FINE TO COARSE, LESS THAN 5% GRAVEL.	
640		S	17	17-20-19	39	SW SM	GRAVELLY SAND, WELL GRADED, FINE TO COARSE, TOP 3 INCHES: 10-15% SLIGHTLY PLASTIC FINES, 30-40% GRAVEL TO 1½ INCH, YELLOW-BROWN. BOTTOM 3 INCHES: LESS THAN 5% FINES, 30-40% GRAVEL FRACTURED, 3/4 INCH PIECES, GRAY.	
	45	S	18	18-13-11	24	SW-SM	GRAVELLY SAND, WELL GRADED, FINE TO COARSE, 5-10% NON-SLIGHTLY PLASTIC FINES, 30-40% GRAVEL TO 1½ INCH, GRAY AND BROWN.	

NOTE FOR BORING SUMMARY AND LEGEND INFO SEE SHEET 1	STONE & WEBSTER ENG. CORP	ISSUED BY	DATE 9/1/77	BORING NO SWS-5	SHEET 2 OF 3

12241 - GA(B) - 163B

BORING SWS-5

SHEET 3 OF 3

SITE / LOCATION BEAVER VALLEY POWER STATION UNIT 2 J.O. NO. 12241

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE	SAMPLE NUMBER	BLOWS (2) OR U.D.S PENETRATION(3)	SPT N VALUES OR U.D.S REC(4)	GROUP SYMBOL(5)	SAMPLE DESCRIPTION	FIELD AND LAB. TEST RESULTS / COMMENTS
635		S	19	11-11-9	20	GW	SANDY GRAVEL, FINE TO COARSE, MOSTLY FINE & MEDIUM (TO 1½ INCH FRACTURED) LESS THAN 10% NON-SLIGHTLY PLASTIC FINES, SOME LENSES OF SLIGHTLY PLASTIC FINES, 30-40% FINE TO COARSE SAND, BROWN.	
		S	20	12-11-11	22		NO RECOVERY	
	50	S	21	12-10-20	30	SW	GRAVELLY SAND, FINE TO COARSE, WELL GRADED, 10-15% NON-SLIGHTLY PLASTIC FINES, 20-30% GRAVEL FRAGMENTS TO 1½ INCH, BROWN.	
		S	22	39-40-40	80	SP-SM	SILTY SAND, POORLY GRADED, FINE TO COARSE, MOSTLY FINE & MEDIUM, 10% NON-SLIGHTLY PLASTIC FINES, 10-15% GRAVEL TO 1 INCH, BROWN.	
630		S	23	50-75	75+	SP-SM	SILTY SAND, SAME AS ABOVE.	
	55	S	24	100/5"	100+		WEATHERED SHALE.	

TOP OF ROCK AT 56.0'

END OF BORING AT 56.4'

NOTE: FOR BORING SUMMARY AND LEGEND INFO. SEE SHEET 1. | STONE & WEBSTER ENG. CORP. | ISSUED BY [signature] | DATE 9/19/77 | BORING NO. SWS-5 | SHEET 3 OF 3

12241 - GA(B) - 163C

DUQUESNE LIGHT COMPANY

SH. 1 OF 1

SITE BEAVER VALLEY POWER STATION - UNIT NO. 1 J.O. No. 11700 BORING No. 301
TYPE OF BORING DRIVE LOCATION SHIPPINGPORT, PENNSYLVANIA GROUND ELEV. 700.6'
DATE DRILLED JULY, 1969 DRILLED BY PENN DRILLING LOGGED BY R.G., K.L.P.
NOTES

GROUND EL. 700.6' BORING NO. 301

ELEV. FEET	DEPTH FEET	STRATA DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE AND NO.	BLOWS OR RECOVERY	R.Q.D.	[illegible]	[illegible]	LABORATORY OR GEOLOGIST'S DESCRIPTION
		DARK BROWN SANDY CLAY WITH SOME GRAVEL, COMPACT, MOIST		ST1	78				SILT - SANDY, FIRM, BROWN
				SS1	25				SAME AS ST1
				SS2	23				SAME AS ST1
				SS3	18				CLAY - FIRM, LEAN, SILTY, TRACE OF SANDSTONE FRAGMENTS, BROWN
				SS4	17				SAME AS SS3
				SS5	11				SAME AS SS3
		DARK BROWN SANDY CLAY, STIFF		ST2	100				SAME AS SS3
690									
				ST3	83				SAME AS SS3
		DARK GRAY CLAY, TRACE OF WOOD, DAMP TO WET		ST4	100				CLAY - FIRM, LEAN, ORGANIC, SILTY, UNIFORM, GRAY
		DARK GRAY CLAY WITH LOOSE GRAVEL, WET		ST5	75				SAME AS ST4
		DARK GRAY SANDY CLAY WITH LOOSE GRAVEL, WET		SS6	23			▽ 1	SAND - MEDIUM, WITH ORGANIC SILT AND GRAVEL, POORLY GRADED, SUBROUNDED, GRAY-BROWN
				SS7	25				SAME AS SS6
680		DARK BROWN SAND AND COARSE GRAVEL, SOME SILT, WET		SS8	36				GRAVEL - FINE AND MEDIUM, WITH SAND, TRACE OF SILT; FAIRLY WELL GRADED, ROUNDED TO SUBROUNDED, BLACK
				SS9	36				SAME AS SS8
		DARK BROWN COARSE SAND, SOME MEDIUM GRAVEL AND SILT, WET		SS10	44				SIMILAR TO SS8, BUR MORE SAND
				SS11	25				SAND - MEDIUM AND COARSE, SILTY, SOME GRAVEL, UNIFORM, ROUNDED, DARK GRAY
				SS12	43				SAME AS SS11
				SS13	56				SAME AS SS11
670									

1. FIGURES IN BLOW OR RECOVERY COLUMN DENOTE THE NUMBER OF BLOWS OF A 140 LB HAMMER FALLING 30" REQUIRED TO DRIVE A 2" OD SAMPLE SPOON 12" OR THE DISTANCE SHOWN. FIGURES SHOWN OPPOSITE ROCK CORES DENOTE THE RECOVERY IN INCHES AND PERCENT.
2. ▮ INDICATES LOCATION OF SAMPLES.
3. ▽ INDICATES LOCATION OF THE NATURAL GROUND WATER TABLE. THE FIGURE INDICATES THE TIME OF READING (HOURS) AFTER COMPLETION OF BORING.
4. W_n - NATURAL MOISTURE CONTENT EXPRESSED AS A PERCENTAGE OF DRY WEIGHT OF SOIL.
5. W_p - PLASTIC LIMIT; W_L - LIQUID LIMIT; I_L - LIQUIDITY INDEX.
6. SS - DENOTES SPLIT SPOON; ST - DENOTES SHELBY TUBE.
7. DATUM IS MEAN SEA LEVEL.
8. R.Q.D. - DENOTES ROCK QUALITY DESIGNATION - % OF RECOVERY 4" OR OVER, DUE TO ROCK STRUCTURE.

BORING LOG 301

BEAVER VALLEY POWER STATION - UNIT NO

SHIPPINGPORT, PENNSYLVANIA

DUQUESNE LIGHT COMPANY

STONE & WEBSTER ENGINEERING CORPORATION

11700-SEK-19

FORM G-13-0

FIELD TEST PIT LOG
STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2		J.O. NO.: 12241.00	TEST PIT NO.: TP-1 SHEET 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N 3885.7, E6204.3		GROUND ELEV.: 733.5
DATE EXCAVATED: AUGUST 11, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY	

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
733.5		CLAYEY SILT/SILT, SLIGHTLY PLASTIC, MOIST, LIGHT BROWN WITH GRAY MOTTLING. (CL/ML).
	5	
		SILTY SAND/SAND, UNIFORM, FINE, BROWN (SM-SP).
	10	SILT, NON TO SLIGHTLY PLASTIC, VERY MOIST, SOME LAYERING, LIGHT BROWN (ML).
		SAND, TRACE FINE GRAVEL, MEDIUM-FINE SAND, FEW NODULES OF SILT, MOIST, BROWN (SP).
	15	BOTTOM OF TEST PIT: 14 FT. GROUNDWATER NOT ENCOUNTERED.

FIELD TEST PIT LOG
STONE & WEBSTER ENGINEERING CORP.

TEST PIT NO. TP-2			
SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO. 12241.00		SHEET 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3949.6, E6167.7		GROUND ELEV. 733.5
DATE EXCAVATED: AUGUST 11, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY	

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
733.5		SANDY SILT, BROWN.
		SILT, NONPLASTIC TO SLIGHTLY PLASTIC, TRACE FINE SAND, VERY MOIST, LIGHT BROWN. (ML).
	5	
		SANDY SILT
		SAND, TRACE FINE GRAVEL, MEDIUM TO FINE SAND, BROWN. (SP).
	10	
		SILT, NONPLASTIC TO SLIGHTLY PLASTIC, VERY MOIST, MODERATELY STIFF TO SOFT, LIGHT BROWN. (ML).
		SAND, 10-15% GRAVEL, ROUNDED TO SUBANGULAR, COARSE TO FINE SAND, TRACE COAL FRAGMENTS, GRAYISH BROWN. (SP).
	15	BOTTOM OF TEST PIT: 13'9" GROUNDWATER NOT ENCOUNTERED.

FORM G-13-0

FIELD TEST PIT LOG

STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO.: 12241	SHEET: 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3949.9, E6112.2	GROUND ELEV.: 733.5
DATE EXCAVATED: AUGUST 11, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY

TEST PIT NO.: TP-3

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
733.5		SAND, SILT, GRAVEL, SLAG GRAY.
		SILT, 5-10% FINE SAND, SLIGHTLY PLASTIC, MODERATELY STIFF TO SOFT, VERY MOIST, LIGHT BROWN, FEW LARGE ROUNDED GRAVEL TO 6 IN. (ML).
	5	
		SAND, 5-7% COARSE TO FINE GRAVEL, MEDIUM TO FINE SAND, MOIST, BROWN. (SP).
	10	
		SILT, NON TO SLIGHTLY PLASTIC, MODERATELY STIFF, VERY MOIST. (ML)
		SAND, 5-7% FINE GRAVEL, COARSE TO FINE SAND, TRACE NONPLASTIC FINES, VERY MOIST. BROWN. (SP-SW).
		BOTTOM OF TEST PIT: 13.5 FT. (CAVING) GROUNDWATER NOT ENCOUNTERED.
	15	

FORM G-13-0

FIELD TEST PIT LOG
STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO.: 12241.00	TEST PIT NO.: TP-4	SHEET: 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3895, E6240		GROUND ELEV.: 733.5
DATE EXCAVATED: SEPTEMBER 21, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY/D. HUNT	

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
733.5		FILL, SLAG, CINDERS, GRAY.
		SANDY CLAY/SILTY CLAY, STIFF, MOIST, COARSE TO FINE GRAVEL SIZED WEATHERED SHALE FRAGMENTS, MOTTLED BROWN AND GRAY. (CL).
	5	CLAYEY SILT/SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, MOIST, SOME FINE GRAVEL SIZED WEATHERED SHALE, 15-20% FINE SAND, BROWN. (CL).
		SIMILAR TO ABOVE, GRAY.
	10	SAND, 10-15% FINE GRAVEL, ROUNDED, MDEIUM TO FINE SAND, 5% NONPLASTIC FINES, DAMP, BROWN, ESTIMATE WATER CONTENT AT 7-8%.(SP).
	15	BOTTOM OF TEST PIT: 15 FT. GROUNDWATER NOT ENCOUNTERED

FORM G-13-0

FIELD TEST PIT LOG
STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO. 12241	TEST PIT NO. TP-5 / SHEET 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3825, E6320	GROUND ELEV. 731.6
DATE EXCAVATED:	CONTRACTOR:	LOGGED BY: J. W. MCCOY/D. HUNT

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
731.6		SANDY SILT, VERY DENSE, OCCASIONAL GRAVEL TO 2 IN., ROUNDED, MOTTLED GRAY AND BROWN. (ML).
		SILTY CLAY/CLAYEY SILT, STIFF TO VERY STIFF, MODERATELY PLASTIC, BROWN. (CL).
		SAND, FINE, 7-10% NONPLASTIC FINES, DAMP, BROWN.
	5	SILTY SAND, FINE, DENSE, WET, GRAY BROWN. (DILATIVE) (SM).
	10	
		SAND, 10-15% FINE GRAVEL, ROUNDED, MEDIUM TO FINE SAND, 5% NONPLASTIC FINES, MOIST, BROWN. (SP).
	15	BOTTOM OF TEST PIT: 13 FT. GROUNDWATER NOT ENCOUNTERED.

FORM G-13-0

FIELD TEST PIT LOG
STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO.: 12241	TEST PIT NO.: TP-6
		SHEET: 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3775, E6400	GROUND ELEV.: 733.4
DATE EXCAVATED: SEPTEMBER 21, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
733.4		FILL, SLAG, CINDERS
		SILTY SAND, TRACE COARSE TO FINE GRAVEL, OCCASIONAL LARGE ROUNDED COBBLE, FINE SAND, 30-40% NONPLASTIC FINES, CONTAINS LAYERED ZONES OF CLAYEY SILT AND FINE SAND, 1/4 TO 1 IN. THICK, DAMP, BROWN.
	5	
	10	
	15	BOTTOM OF TEST PIT: 15 FT. GROUNDWATER NOT ENCOUNTERED.

FORM G-13-0

FIELD TEST PIT LOG

STONE & WEBSTER ENGINEERING CORP.

TEST PIT NO. TP-7		
SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO. 12241	SHEET 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION: N3745, E6375	GROUND ELEV. 734.2
DATE EXCAVATED: SEPTEMBER 21, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY/D. HUNT

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
734.2		CLAYEY SILT, DENSE, 15-20% FINE GRAVEL SIZED SHALE FRAGMENTS, BROWN.
	5	SILTY SAND, FINE, 20-40% NONPLASTIC FINES, OCCASIONAL SILT LAYERS, DAMP, DENSE, BROWN.
	10	SILTY SAND, FINE, 15-20% NONPLASTIC FINES, OCCASIONAL COBBLE, ROUNDED, LIGHT GRAY, GRADING TO SAND, FINE, TRACE COARSE TO FINE GRAVEL AND OCCASIONAL LARGE COBBLE, DAMP (W=6%), MEDIUM DENSE TO DENSE.
	15	BOTTOM OF TEST PIT: 14 FT. GROUNDWATER NOT ENCOUNTERED.

FORM G-13-0

FIELD TEST PIT LOG

STONE & WEBSTER ENGINEERING CORP.

SITE: BEAVER VALLEY POWER STATION - UNIT 2	J.O. NO.: 12241	TEST PIT NO.: TP-8 / SHEET 1 OF 1
EQUIPMENT: BACKHOE - CASE 780B	LOCATION:	GROUND ELEV.:
DATE EXCAVATED: SEPTEMBER 21, 1982	CONTRACTOR: DICK CORPORATION	LOGGED BY: J. W. MCCOY/D. HUNT

ELEV.	DEPTH (FEET)	SAMPLE DESCRIPTION
	0–6.5	STRUCTURAL FILL, FOR SWS PIPELINE.
	6.5–10	SILTY CLAY, SLIGHTLY TO MODERATELY PLASTIC, STIFF, MOIST, MOTTLED GRAY - BROWN.
	10–12	CLAYEY SILT, TRACE COARSE TO FINE GRAVEL, 20-30% FINE SAND, BROWN. (DRIER, LESS PLASTIC MORE CRUMBLY THAN ABOVE).
	12–15	GRAVELLY SAND, 20-25% COARSE TO FINE GRAVEL, 5-10% NONPLASTIC FINES, BROWN.
	15	BOTTOM OF TEST PIT: 15 FT. GROUNDWATER NOT ENCOUNTERED.

APPENDIX B

LABORATORY TESTING

APPENDIX B

TABLE OF CONTENTS

APPENDIX B

LIST OF TABLES

APPENDIX B

LIST OF FIGURES

LIST OF FIGURES (Cont)

B1 INTRODUCTION

The purpose of the laboratory testing program described herein was to evaluate the index and engineering properties of the soil samples recovered from EOS series of borings that are pertinent to the study of the stability of slopes in the vicinity of the emergency outfall structure. The scope of the testing program consisted of the following:

- Atterberg Limits and Grain Size Analyses
- Consolidation Test
- Triaxial Compression Tests
- Direct Shear Tests

B2 INDEX TESTS

B2.1 Grain Size Analyses

Eight grain size analyses were performed on split spoon samples, the results of which are shown in Figures B-1, B-2, B-3, B-4, and B-5. Tests were performed in accordance with Appendix V of WES (1970).

B2.2 Atterberg Limits and Natural Water Contents

Atterberg limits and natural water contents were performed on selected split spoon and undisturbed samples as summarized in Table B-1 and Figure B-6. Natural water content determinations were made in accordance with ASTM D2216. Atterberg limits were determined in accordance with the methods presented in Appendix III of WES (1970); however, the grooving tool used was as specified in ASTM D423.

B3 CONSTANT RATE OF STRAIN CONSOLIDATION TESTS

A single constant rate of strain consolidation (CRSC) test was performed on a 2.5-inch diameter by 1.0-inch high specimen of sandy clay trimmed from an undisturbed sample from boring EOS-4 on the riverward slope. Specimen preparation was in accordance with Appendix VIII of WES (1970). Testing was performed according to the procedures described by Wissa and Heilberg (1969).

The results of the test (Figure B-7) indicate that the clay is only slightly overconsolidated with a maximum past pressure of about 5.6 ksf, compared to an in situ vertical effective stress of about 4.6 ksf.

B4 TRIAXIAL COMPRESSION TESTS

Twelve consolidated isotropically undrained triaxial compression tests were performed on undisturbed samples of the alluvial soils in accordance with the methods described in Appendix X of WES (1970). Table B-2 summarizes the results shown in Figures B-8, B-9, B-10, B-11, B-12, B-13, B-14, B-15, B-16, B-17, B-18, B-19, B-20, B-21, B-22, B-23, and B-24.

B5 DIRECT SHEAR TESTS

Two direct shear tests were performed on 2.5-inch diameter, remolded specimens of the fine colluvial material, the results of which are presented in Figures B-25, B-26, B-27, B-28, B-29, and B-30 and summarized in Table B-3. The tests were performed in accordance with Appendix IX of WES (1970); sample preparation is described in this section.

Since the residual friction angle was desired, tests were performed on remolded split spoon samples, using only the finer fraction of the fine colluvium. Test 3 was performed on a sample of silty clay which did not contain the coarser fractions, and Test 4 was performed on the minus No. 40 sieve fraction of the sample. The remolded samples were tamped into the direct shear box to obtain an initial specimen height of one inch. The specimens were initially consolidated to approximately twice the in situ vertical effective stress. The normal load on the test specimens was then reduced and the specimens reconsolidated to approximately the in situ vertical effective stress. Tests were terminated after about one inch of cumulative horizontal displacement since material was slaking from between the halves of the direct shear box.

The measured residual friction angles were 22 and 28.4 degrees.

B6 REFERENCES

U.S. Army Engineers Waterways Experiment Station (WES). Laboratory Soils Testing. Engineer Manual 1110-2-1906. Department of the Army. 1970.

Wissa, A. and Heilberg, S. New One Dimensional Consolidation Test. Research Report 69-9. Soils Publication No. 229. Prepared by Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, Massachusetts. 1969.

American Society for Testing Materials. Standard Test Method for Liquid Limit of Soils. ASTM D423-66 (Reapproved 1972).

American Society for Testing Materials. Laboratory Determination of Moisture Content of Soil. ASTM D2216-71.

TABLE B-1

ATTERBURG LIMITS AND NATURAL WATER CONTENTS

Boring No.	Sample No.	Depth (ft)	Elevation (ft)	Natural Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Finer than No. 200 (%)	Finer than No. 200 (%)
EOS-1	S4	5.5-7.0	735.5-734.0	22.1	43.7	22.0	21.7	98	CL
	S5	7.0-8.5	734.0-732.5	25.8	31.8	19.2	12.6	--	CL
	S6	8.5-10.0	732.5-731.0	26.7	28.5	21.7	6.8	95	ML
	S7	10-11.5	731.0-729.5	15.9	23.8	17.8	6.0	42	ML-CL
	S8	11.5-13.0	729.5-728.0	19.8	24.6	19.8	4.6	94	ML-CL
	S10	14.5-16.0	726.5-725.0	19.7	21.1	13.7	7.4	--	ML-CL
	S12	17.5-19.0	723.5-722.0	26.8	24.8	22.8	2.0	96	ML
	S13(T)	19.0-20.5	722.0-720.5	22.4	--	--	--	--	SM
	S14	20.5-22.0	720.5-719.0	29.5	--	--	--	--	SM
	S15(T)	22.0-23.5	719.0-717.5	28.4	--	--	--	--	ML
	S15(B)	22.0-23.5	719.0-717.5	13.1	--	--	--	--	SM
	S16	23.5-25.0	717.5-716.0	7.7	--	--	--	--	SP
	S17	25.0-26.5	716.0-714.5	29.6	--	--	--	--	SP
EOS-1A	US1E	11.1-11.6	729.9-729.4	27.6	26.0	21.2	4.8	96	ML-CL
EOS-4	US185	36.9-37.1	683.2-683.0	28.5	42.0	22.5	19.5	88	CL
	S16	38.0-39.5	682.1-680.6	26.2	35.0	22.5	12.5	87	CL
	S18	45.0-46.5	675.1-673.6	27.0	39.9	23.7	16.2	90	CL
EOS-4A	U04E	47.2-47.8	673.2-672.6	26.5	34.5	19.5	15.0	--	CL
	S4	52.5-54.0	667.9-666.4	31.0	34.5	21.6	12.9	77	CL
	U07C	58.8-59.3	661.6-661.1	25.7	30.2	17.1	13.1	--	CL
	U07F	59.9-60.4	660.6-660.0	25.6	30.7	17.5	13.2	--	CL
	S6	60.5-62.0	659.9-658.4	28.6	28.7	20.2	8.5	68	CL
EOS-5	S3	5.0-6.5	678.0-676.5	37.8	52.9	30.5	22.4	82	MH
	S6	13.5-15.0	669.5-668.0	29.2	33.0	22.7	10.3	71	CL
	U02E	18.7-19.3	664.3-663.7	26.7	31.4	19.1	12.3	--	CL
	S8	20.0-21.5	663.0-661.5	24.0	28.4	16.2	12.2	70	CL
	S9	24.0-25.5	659.0-657.5	28.9	31.9	17.8	14.1	76	CL
EOS-6	S2	2.0-3.5	743.1-741.6	19.1	36.3	23.6	12.7	66	CL
	S4	6.0-7.5	739.1-737.6	19.2	42.0	19.5	22.5	--	CL
	S6	10.0-11.5	735.1-733.6	22.3	35.3	19.2	16.1	--	CL
	S7	12.0-13.5	733.1-731.6	27.8	26.2	19.3	6.9	96	CL-ML

TABLE B-1 (Cont)

Boring No.	Sample No.	Depth (ft)	Elevation (ft)	Natural Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Finer than No. 200 (%)	Finer than No. 200 (%)
EOS-6	S11	20.0-21.5	725.1-723.6	25.8	29.2	24.1	5.1	--	ML
(Cont)	S12	22.0-23.5	723.1-721.6	25.4	27.0	20.5	6.5	--	CL-ML
	S13	24.0-25.5	721.5-719.6	27.6	Non-plastic	--	--	--	--
	S14	26.0-27.5	719.1-717.6	30.7	30.5	19.7	10.8	99	CL
	S15	28.0-29.5	717.1-715.6	--	Non-plastic	--	--	--	--
EOS-7	S4	6.0-7.5	753.9-752.4	17.0	34.0	23.4	10.6	54	CL
EOS-7A	S4	17.0-18.5	742.6-741.1	22.8	42.9	18.4	24.5	--	CL
EOS-10	S9	35.5-37.0	685.2-683.7	21.5	36.1	19.8	16.3	75	CL
Test Pit 1	--	0.0-7.0	733.5-726.5	--	--	--	--	98	ML
	--	9.5-10.5	724.0-723.0	--	--	--	--	99	ML
Test Pit 2	--	1.1-7.5	732.4-726.0	--	--	--	--	92	ML

TABLE B-2
SUMMARY OF
CONSOLIDATED ISOTROPICALLY - UNDRAINED (CIUC) TRIAXIAL COMPRESSION TESTS

				SPECIMEN PROPERTIES INITIAL					AFTER CONSOLIDATION									
Boring No.	Sample and Section	Depth (ft)	Elevation (ft)	Diameter (in)	Height (in)	Water Content (%)	Dry Unit Weight (pct)	Void Ratio	Water Content (%)	Dry Unit Weight (pct)	Void Ratio	Liquid Limit (%)	Plastic Limit (%)	Effective Confining Pressure σ_C (ksf)	Back Pressure uo (ksf)	$(\sigma_1 - \sigma_3)_{max}$ (ksf)	Vertical strain at $(\sigma_1 - \sigma_3)_{max}$ (%)	Soil Description
EOS-1A	US1D	10.5	730.5	2.9	6.5	28.2	95.8	0.747	26.3	98.6	0.697	--	--	6.0	6.5	7.2	14.4	Silty Clay-Clayey silt
	US1E	11.1	729.9	2.9	6.5	27.6	96.2	0.740	26.2	98.3	0.702	26.0	21.2	3.0	6.5	6.2	14.8	Silty Clay-Clayey silt
	US1F	11.6	729.4	2.9	6.0	28.1	97.2	0.721	27.5	98.2	0.703	--	--	1.5	5.8	5.8	15.9	Silty Clay-Clayey silt
EOS-1A	US4E	20.8	720.2	2.9	6.0	24.3	91.4	0.829	29.5	92.2	0.814	--	--	3.0	13.0	6.3	13.9	Layered Silt and Silty Fine Sand
EOS-41	UO4D	46.6	673.8	2.9	7.1	26.5	98.5	0.699	24.1	102.9	0.626	--	--	5.5	5.8	5.3	14.9	Sandy Clay
	UO4E	47.2	673.2	2.9	7.0	26.5	98.3	0.702	23.4	103.8	0.612	34.5	19.5	7.0	6.5	5.9	15.0	Sandy Clay
	UO4F	47.8	672.6	2.9	7.0	27.8	96.4	0.735	23.1	104.0	0.608	--	--	10.0	6.5	7.9	15.6	Sandy Clay
EOS-4A	UO7B	58.2	662.2	2.5	6.2	26.0	99.5	0.681	21.2	107.9	0.551	--	--	14.0	9.4	10.7	14.0	Sandy Clay
	UO7C	58.8	661.6	1.4	3.5	25.7	103.3	0.619	22.3	109.6	0.526	30.2	17.1	7.0	10.1	6.1	8.8	Sandy Clay
EOS-5	UO2D	18.1	664.9	2.9	7.0	27.9	97.4	0.718	26.1	99.3	0.685	--	--	2.00	7.2	2.9	14.4	Sandy Clay
	UO2E	18.7	664.3	2.9	7.0	26.7	97.5	0.716	25.0	100.1	0.671	31.4	19.1	4.0	7.2	4.5	12.9	Sandy Clay
	UO2F	19.3	663.7	2.9	7.0	28.5	94.8	0.764	25.7	98.8	0.694	--	--	6.0	9.4	5.3	14.8	Sandy Clay

TABLE B-3

SUMMARY OF DIRECT SHEAR TESTS

Boring No.	Sample No.*	Depth (ft)	Elevation (ft)	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Residual Friction Angle (Degrees)	Symbol
EOS-7A EOS-7	S4 (90%) S9 (10%)	17.0-18.5	742.6-741.1	22.8	42.9	18.4	28.2	CL
EOS-6	S4 (90%) S3 (10%)	6.0-7.5	739.1-737.6	19.2	42.0	19.5	22.0	CL

NOTE:

* Remolded specimen consists of material from split spoon samples in the percentages indicated. Additional data provided only for major constituent of test specimen. Specimen dimensions: 2.5-inch diameter by 1.0-inch height.