KERR-McGEE CORPORATION

See Revised Report

APPLICANTS ENVIRONMENTAL REPORT

USAEC

Docket No. 40-8027

For Div. of Compliance

Uranium Hexafluoride Plant

NOVEMBER 1971

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ENVIRONMENTAL REPORT

SEQUOYAH FACILITY

KERR-McGEE CORPORATION

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ENVIRONMENTAL REPORT

SEQUOYAH FACILITY

KERR-McGEE CORPORATION

I. General

On February 20, 1970, the AEC issued License No. SUB-1010 to Kerr-McGee Corporation for the operation of a Uranium Hexafluoride Production Plant located in Sequoyah County, Oklahoma. This environmental report is submitted in accordance with the requirements of Appendix D, 10CFR Part 50, effective September 9, 1971.

II. Description of Site and Area

A. Location

The plant is located in a 2100-acre tract on the western edge of Sequoyah County. The site is bounded on the north by U.S. Highway 64, on the west by the Illinois River and the Arkansas River, on the south by Interstate Highway 40, and on the east by the eastern section line of Section 22. The plant area is located in Section 21, T12N-R21E, Sequoyah County, Oklahoma. Drawing 110-C-151 Rev. 4, attached, shows the site layout and its location in relation to nearby population centers. The site is approximately 2.5 miles southeast of Gore, Oklahoma, 19 miles west of Sallisaw, Oklahoma, and 20 miles north of Stigler, Oklahoma. The immediate plant area is a fenced-in restricted area of about 75 acres with access to Oklahoma Highway 10 adjacent to the eastern boundary.

B. Physical Description

The Sequoyah Facility was designed and built by Bechtel Corporation based upon design criteria furnished by Kerr-McGee. The plant consists of about 53,000 square feet of manufacturing, warehousing and office floor space in three separate buildings. The main process and administration building contains offices, laboratory, fluorine generation, sampling, and main process areas. A separate solvent extraction building contains only the solvent extraction system. A separate warehouse building was provided for storage of mechanical parts. In addition, to the west of the plant are located retention ponds for sanitary sewage, fluoride treatment and clarification and raffinate retention. The plant employs approximately 100 people of whom 75 are production and maintenance workers.

The Sequoyah Facility manufactures purified UF_6 from feed material consisting primarily of uranium concentrates received from mills located in the western United States and Canada. These concentrates are received in 55 gallon drums, weighed, sampled and digested in nitric acid solution. The uranium values in the solution are removed by a solvent extraction system and re-extracted into water. The re-extracted solution is concentrated and denitrated by heating. The resultant UO_3 is reduced to UO_2 with dissociated ammonia and hydrofluorinated to UF_4 with hydrofluoric acid. The UF_4 is fluorinated by elemental fluorine to UF_6. The UF_6 is removed from the process as a liquid, packaged into shipping cylinders containing 10 tons of UF_6 for shipment to USAEC diffusion plants.

This process is performed in a closed system consisting of a series of vessels, tanks, towers, evaporators and reactors employing a series of auxiliary equipment to provide: conveying, removal of impurities, effluent control, heating and cooling. The process is performed in the main process area and the solvent extraction building described above.

The process uses in sequence: 60% nitric acid, aluminum hydroxide, ammonia, hydrofluoric acid, potassium hydrogen fluoride, sodium carbonate, tribuytl phosphate and liquid hexane with natural gas as fuel for steam producing boilers. An oil inventory serves as standby fuel for the boilers.

Each of the raw materials listed above is stored and handled by methods recommended by the Manufacturing Chemists Association. The utility area containing boilers, nitric acid absorber, offgas burners and scrubber is located immediately behind the main process building. The storage area for chemicals is located across the driveway from this utility area. The area immediately surrounding the plant is covered with either concrete or asphalt paving. The area around the solvent extraction building for 100 feet distant is covered with noncombustible gravel in order to meet insurance requirements for flammable material.

A storage yard capable of containing 100 shipping cylinders for UF_6 is located adjacent to the northeast corner of the main process building. A switch yard for the necessary breakers and transformers to control incoming electrical power is located immediately east of the UF_6 storage yard and surrounded by a six-foot chain-link fence.

The process effluents are treated appropriately to avoid release to the environment.

1. A solution of impurities originating with the concentrates in the form of ammonium nitrate solution containing nitric acid, radium 226, thorium 234 and 230 and normal uranium.

2. A weak hydrofluoric acid solution (.31%) containing less than MPC amounts of normal uranium.

3. Flue gases from the combustion of natural gas in the boiler and the burning of excess cracked ammonia in the reduction process.

4. A weak hydrofluoric acid solution (approximately 25%) which is recovered and returned to the hydrofluoric acid suppliers.

5. Noncondensable fumes consisting of nitrogen, water vapor, HF, nitrogen oxide, sulphur oxide and negligible amounts of UF_6 in the offgas from the boiler stacks and the scrubber vent stacks.

6. Ambient air used in pneumatic transfer systems and dust control systems is emitted to the air after particulate filtration in high efficiency filters.

Waste materials from the plant are either buried on site or burned. Burnable wastes contaminated with uranium are burned in an incinerator close to the boiler house and its stack discharge is combined with the flue gas of the boiler. The burnable noncontaminated wastes are burned in a state approved open pit incinerator.

The plant auxiliary systems were started in January, 1970, and uranium charged in late February, 1970. Production operations have continued since then without interruption.

C. Area Description

The plant site was located after a preliminary study of ten comparable sites of the Arkansas River Valley. The specific site was selected after consideration of transportation, water supply, land availability, absence of other industrial installations, the quality and skill of available labor and recognition of the current and chronic depressed state of the eastern Oklahoma economic activity.

The topography in the vicinity of the site is gently rolling from a rather high ridge to the north of Highway 64 to the bottom land along the Arkansas and Illinois Rivers. As a result of ample rainfall, all the surface is densely covered by grasses, tree or shrub growth. The area

along the Illinois River was being used as a soybean field at the time of the site acquisition. Generally, other parts were used as pasture or are covered with profusely growing native oak. No large-scale agricultural enterprise existed except use of the pasture for cattle and the soybean field mentioned above. Since the area of the soybean field is partially under high-water levels set for the Robert S. Kerr Reservoir, the land has been acquired for the reservoir by the Corps of Engineers to the 470' elevation.

Naturally occurring wildlife has not been displaced by these original activities. Many species of birds and small animals exist in the area. A deer herd of significant size is increasing as more and more land is returned to pasture. Primary recreational use of the wildlife in the area is the hunting of quail and deer with some small amount of trapping of fur-bearing animals along the waterways. No significant lumbering activities exist in the area.

D. Population

This area of eastern Oklahoma is relatively sparsely populated and almost completely devoid of industrial activity. Population growth has been approximately 3% in the period 1960 to 1970. The plant site is located approximately 150 miles east of Oklahoma City on Interstate Highway 40 and approximately 40 miles west of Ft. Smith, Arkansas, and 25 miles to the southeast of Muskogee, Oklahoma. Nearby cities in the area are listed below.

County or City	Direction	Distance Miles	Population
Sequoyah County			23,370
Vian	E	4	1,131
Sallisaw	E	19	4,888
Muskogee County			59,542
Muskogee	NW	25	37,331
Warner	W	15	1,217
Webbers Falls	W	3	485
Gore	NW	2	478
Other			
Fort Smith, Arkansas	E	40	62,802

Main economic activity in this area at the time of plant construction consisted of farming. Since the selection of the site in 1967, completion of interstate routes and the Arkansas Riverway has considerably increased the amount of east-west traffic and will probably considerably increase the recreational use of the entire area. In Sequoyah County is located the Robert S. Kerr Reservoir of the Arkansas Riverway and the Webbers Falls Reservoir is immediately west of the plant site in Muskogee County. It is expected that these two impoundments, after further commercial development, will form an important recreational resource.

The climate in the area is characterized by hot summers and moderate winters. The normal annual rain fall is approximately 40 inches and the mean temperature is 62°. The extreme high temperature during a 62-year period of records was 115° and the extreme low was -15° below zero. Some strong winds are experienced in the area. Sequoyah County lies in a zone of approximately 1.66×10^{-3} probability of experiencing a tornado in any given year. Until the purchase of the site for the plant, one family had lived on this ground for a period of 100 years and have no record or recall of a tornado ever damaging the plant area.

This area was a part of the land given to the Cherokee Nation after their move from the southeastern United States. The Carlile house, on the property, at one time served as a station for a stage running from Ft. Smith to Ft. Gibson. The ford of the Illinois River was known as Carlile Ford but has since been flooded by the completion of the Robert S. Kerr Reservoir.

E. Geography and Geology

The Arkansas River in this area flows through a mountainous section on the southwest flank of the Ozark Uplift and is characterized by level-topped parallel east-west ridges rising as much as 400 feet above the adjacent valley floor. These uplands are drained by several rivers and numerous creeks which flow into the Arkansas along the area. The maximum change of elevation across the site is from 450 feet at the Illinois River to 700 feet in the southeast corner of Section 22.

Exposed surface geology consists of sandstone and shale sequence of the lower Atoka structure. The outcropping Atoka rocks are approximately 100 feet thick and are capped by approximately 15 feet of thick terrace gravel in the immediate area of the plant. Much of the structure was determined as a result of core hole data gathered to explore the size and extent of the normal fault which surfaces on Highway 64 at the Carlile School. Twenty-one cores were drilled in

the area in order to examine the characteristics of this fault zone. The core holes exhibited alternating beds of sandstone and black shale. Three separate sandstone beds can be recognized in the deeper holes of Section 21 and correlated with outcrops above the Illinois River. The Atoka sandstone and shales were deposited on a stable shelf. In post Atoka time the region was affected by a major deformation which formed a number of northeast to southwest trending folds and normal faults. The faulting ended in middle-Des Moinesian time and the region has been structurally stable since the middle Pennsylvanian period, approximately 250 million years ago.

Exploration of the area has demonstrated no deposits of oil, gas or other valuable minerals. Dry holes are located approximately two miles east and three miles south of the plant site. These two wells were plugged and capped with concrete after completion of drilling to 2000 feet and 4600 feet, respectively. All of the dry holes abandoned in the 16 township area surrounding the site were abandoned by leaving the surface casing in the hole and placing one or more cement plugs on top.

F. Waterways

As described above, the plant site is bounded on the west by the Illinois and Arkansas Rivers and, as can be seen on Drawing 151, the Arkansas River lays a short distance to the south of the site. All natural drainage of the plant area flows to the west into the Illinois River.

The Arkansas River has undergone significant development in recent years, primarily as a commercial waterway for the movement of freight. With completion in 1970 of the Robert S. Kerr and Webbers Falls Reservoirs and installations in the north on the Verdigris River near Tulsa, Oklahoma, this waterway now has become a working commercial trafficway. Barge traffic has not thus far developed significantly but is expected to grow at a steady rate for the next decade.

The Illinois River is primarily noted as the only spring-fed cold water river in Oklahoma. Tenkiller Ferry Reservoir was completed and opened for recreation in 1953 approximately seven miles up river from the site. It has proven very popular with Oklahoma residents and has several commercial installations serving the recreational market. With the completion of the dam for Tenkiller Reservoir and the decrease in water temperature below the reservoir, the Illinois River from the dam to its junction with the Arkansas became one of two artificially stocked trout streams in Oklahoma. Most of the stocking and trout fishing is done between the Highway 64 bridge north to the dam. Very little fishing is done in the area below the Highway 64 bridge for artificially

stocked trout. With completion of the Robert S. Kerr Reservoir in 1970, the headwater of the reservoir normal pool level now extends upstream in the Illinois to the Highway 64 bridge. As a result, the Illinois, from the Highway 64 bridge to the Arkansas proper, is classified as a part of the reservoir. Since the reservoir filled in December, 1970, it appears that water from the Arkansas has flowed up the Illinois past the outfall discharge point. This area has not become commercialized for recreational purposes but, since the Corps of Engineers has designated the west bank of the Illinois immediately north of U.S. 64 as a public access area for the reservoir, it is expected that eventually it will develop as a recreational area.

With the establishment of the reservoir, the area on the shoreline of the reservoir from the I-40 bridge to Vian Creek is being studied as a possible wildlife refuge. This area will be partially reserved for wildlife with limited waterfowl hunting permitted.

As mentioned previously, the Corps of Engineers has control of the Illinois River at Tenkiller Reservoir, the downstream water to the Arkansas and the area reserved for the flood level (470') of the Robert S. Kerr Reservoir. The only government installations on the river occur at the dams and their lock mechanism. No other government installations occur in the area.

III. Environmental Approval

When this site was selected for the location of the plant, extensive consultation was held with the Oklahoma Water Resources Board and the Corps of Engineers as to the preferred method of diverting Illinois water for use in plant cooling and potable water. Agreement was reached with the Oklahoma Water Resources Board on January 9, 1968, with the issuance of a "Permit to Appropriate Surface Water No. P67-765" covering 30,000 acre feet of water per year to be diverted from the outlet works of the Tenkiller Reservoir.

Subsequently, Contract No. DACW 56-70-C-0083 for water storage space in Tenkiller Ferry Reservoir was completed with the Department of the Army Corps of Engineers. These agreements permitted the diversion system to be designed and installed to remove water from the reservoir dam and pipe it to the site.

No state, local or regional planning organizations have been authorized to consider regional economic development in this area.

The State of Oklahoma is proceeding in an orderly fashion to evolve a set of environmental control regulations

without unnecessary conflict with the U.S. Government authorized regulatory activities. Currently, Oklahoma requires a permit for the disposal of waste to riverways. This permit has been granted by the State for the Sequoyah Facility, No. IW-70-011, for waste disposal and a sanitary waste treatment permit dated 8-21-69.

As described above, as this plant processes nuclear source materials, it was necessary to obtain from the USAEC an operating license. License SUB-1010 was granted February 20, 1970, based upon application submitted on September 25, 1969.

In accordance with applicable regulations, an application for a permit to discharge waste into navigable waters was filed with the Corps of Engineers on June 21, 1971, and supplemented on October 4, 1971. The Discharge Permit Application OK-076-0Y1-2-000111 is currently being processed.

IV. Environmental Impact

As described in paragraph I. B. above, plant construction was completed in early 1970 and production operations started immediately. Production operations have since continued without interruption. From these operations we measure no adverse effect on the environment as a result of the surveillance program described in paragraph V below.

A. Land Use

The immediate plant area was used for the cultivation of wheat and the balance was pasture. Grading for the building site and its auxiliaries changed the original contours to provide for the settling basins and treatment and storage ponds as shown on the attached Drawing 151. All graded land not covered by noneroding materials was subsequently seeded with fescue and rye to provide soil stability.

Currently, no plans have been made to provide public access or use of any of the 2100 acre site.

With the completion of the Arkansas Riverway and the extensive interstate highway system, it is expected that land along the Arkansas River will be developed in many places for industrial and commercial use. Since the land chosen for the Sequoyah Plant is not uniquely suitable for other beneficial use, it is believed that erecting this plant in this location provided an overall benefit to the human environment in the area.

The plant site does not intrude into any site of historical significance nor is it listed in the National Register of Historic Places.

B. Water Use

In accordance with the contracts as described under paragraph III above, water for the Sequoyah site is withdrawn from the Tenkiller Reservoir Dam and conducted through a 16-inch water main to the site. Appropriate valving and metering is provided prior to the water entering a stilling basin. This water main was designed to provide sufficient cooling and potable water for the expanded capacity of the plant.

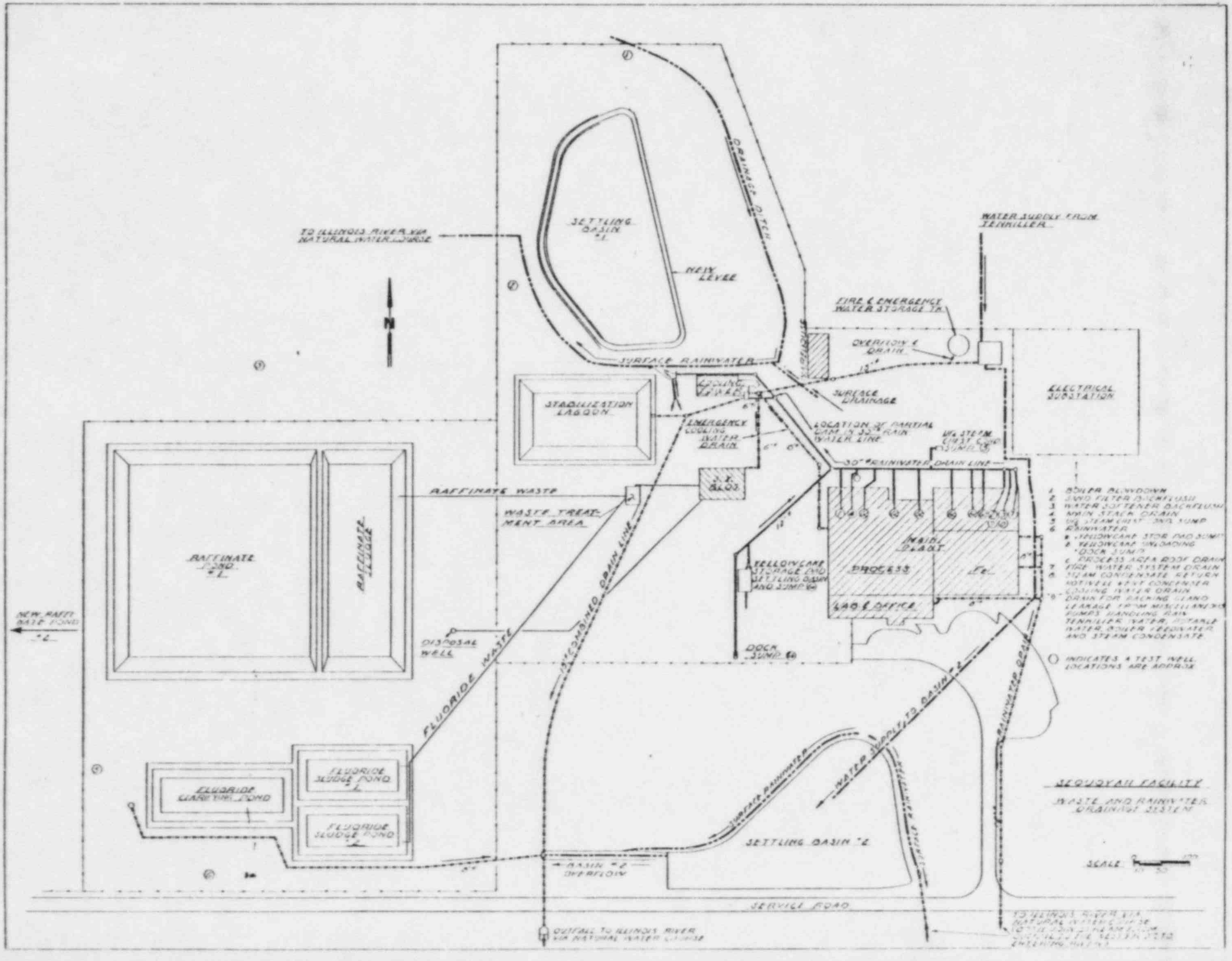
A portion of the water flowing to the plant site is permitted to bypass the treatment system and join the overflow from the cooling tower. This water combines with the overflow from the sanitary lagoon and fluoride clarification pond and flows through a natural watercourse to enter the Illinois River approximately 1000 yards above its junction with the Arkansas River. As a part of our environmental surveillance system, the quality of the outfall water is routinely measured as described under paragraph V. The drawing on the following page, "Waste and Rainwater Drainage System", shows the flow of water through the plant.

C. Heat Dissipation

Heat removal from the facility is provided for by the use of either cooling water or ambient air. Water received from Lake Tenkiller is sufficiently cold to use directly for cooling process heat sources. Certain points are extremely important and critical from the viewpoint of controlling the unplanned release of process material, protection of processing equipment, or the control of certain reactions. Water is piped directly to coolers and condensers for these critical points and thence discharged to the cooling water system. Other, less critical, heat release points are cooled by using the water in a cooling water system which circulates through cooling towers. In this manner critical points are provided with low temperature cooling water under sufficient gravity-induced pressure to protect the environs, personnel and equipment, while less critical points are cooled with recycle water.

Little water is used in the process except for makeup of neutralization solution, the absorption of noxious gases and for potable or sanitary purposes. Water used for these purposes is discharged through treatment systems to a common outfall on the plant site prior to discharge to the Illinois River.

The heat dissipated from the plant results in a negligible increase in the temperature of the water discharged to the outfall system and minor increases in ambient air temperature returned to the atmosphere.


SETTLING BASIN #1
NEW LEVEE
DRAINAGE DITCH
TO ILLINOIS RIVER VIA NATURAL WATER COURSE
WATER SUPPLY FROM TENKILLER
FIRE & EMERGENCY WATER STORAGE TK.
OVERFLOW & DRAIN
SURFACE RAINWATER
SURFACE DRAINAGE
ELECTRICAL SUBSTATION
STABILIZATION LAGOON
EMERGENCY COOLING WATER DRAIN
LOCATION OF PARTIAL DAM IN 30" RAIN WATER LINE
30" RAINWATER DRAIN LINE
RAFFINATE WASTE
WASTE TREATMENT AREA
RAFFINATE POND #1
RAFFINATE SLUDGE
NEW RAFF. BASE POND #2
DISPOSAL WELL
COMBINED DRAIN LINE
FLUORIDE WASTE
YELLOWCAKE STORAGE AND SETTLING BASIN AND SUMP
MAIN PLANT
PROCESS
LAB & OFFICE
DOCK SUMP
1 BOILER BLOWDOWN
2 SAND FILTER BACKFLUSH
3 WATER SOFTENER BACKFLUSH
4 MAIN STACK DRAIN
6 RAINWATER
7 FIRE WATER SYSTEM DRAIN
8 STEAM CONDENSATE RETURN
INDICATES A TEST WELL LOCATIONS ARE APPROX.
FLUORIDE CLARIFYING POND
FLUORIDE SLUDGE POND #1
FLUORIDE SLUDGE POND #2
SETTLING BASIN #2
BASIN #2 OVERFLOW
SURFACE RAINWATER
WATER SUPPLY TO BASIN #2
RAINWATER DRAIN
SERVICE ROAD
OUTFALL TO ILLINOIS RIVER VIA NATURAL WATER COURSE
SEQUOYAH FACILITY
WASTE AND RAINWATER DRAINAGE SYSTEM
SCALE
N

D. Chemical Discharge

Original plant design criteria provided that chemical waste originating from the solvent extraction building as an ammonium nitrate solution known as "raffinate" and the scrubber solution containing small quantities of fluoride and uranium would be discharged as generated into a deep well disposal system. This deep well had been drilled to the depth of approximately 3700 feet into a porous Arbuckle limestone formation saturated with low-quality water unfit for agricultural, industrial or potable use due to the high quantities of soluble salts. However, the AEC source material License SUB-1010 did not approve the use of this well as planned because of the need for additional data as to the extent and capacity of the underground reservoir, the permeability of the formation and the uniform distribution of waste within the formation. Subsequently, Kerr-McGee has employed a consultant firm experienced in the delineation of such underground reservoirs, H. J. Gruy & Associates, Inc., to conduct a development program to determine the extent and capacity of this underground reservoir. This development program involves the measurement of injection rates and dissipation of injection pressures over time periods at various depths in the reservoir permitting the consultant to correlate the actual reservoir data with mathematical models of similar reservoirs. It is expected that these lengthy and expensive tests and the subsequent correlation will permit definition of the reservoir capacity and confirm the absence of risk of communication of waste fluids to potable and surface water. Currently, Kerr-McGee's geological and engineering review of these tests is proceeding and an AEC license amendment application will propose the authorization of the use of this deep disposal well upon completion of AEC and geological review.

As a consequence of the inability to license the deep disposal well, provision was made to subdivide the chemical waste into two types; with permanent storage of one, and treatment of the other to meet applicable Oklahoma discharge criteria.

1. Nitrate Waste. The primary chemical waste of the uranium hexafluoride production process is a nitrate solution of ammonia containing the impurities removed from the feed material and approximately one molar nitric acid concentration. These impurities contain quantities of radium 226, thorium 230 and thorium 234 as daughter products in equilibrium with the original uranium content. No practical method is known for the beneficial recovery, concentration or reduction to solid of these heterogeneous wastes. Consequently, holding ponds with carefully sealed bottoms were constructed in accordance with AEC criteria. A lime system to neutralize the excess nitric acid was installed and all

such waste was treated with lime and pumped to the pond for storage. No nitrate chemical wastes have been discharged to the environment and all those generated are currently being held in disposal ponds in the plant area.

2. Fluoride Waste. The second portion of the chemical waste generated by the process is a weak solution of hydrofluoric acid (.3%) resulting from the operation of the offgas scrubber in connection with the hydrofluorination and fluorination processes. It was known that the treatment of this material with calcium hydroxide would precipitate calcium fluoride and further treatment with sulphuric acid would precipitate excess calcium and neutralize effluent solutions to acceptable disposal levels. As a consequence, a pond system with a carefully sealed bottom meeting AEC standards was constructed and the solution neutralized with lime and then pumped to an initial pond for settling. The effluent from this first pond is then treated with sulphuric acid to adjust the pH and to precipitate excess calcium and allowed to settle further. The effluent supernatant liquid is combined with other effluents at the plant outfall. The combined stream meets accepted levels (USPHS drinking water standards) of fluoride ion.

3. Sanitary Wastes. Sanitary wastes are collected, piped to a stabilization lagoon approved by the State Department of Health of Oklahoma. Discharge of liquid effluent from this system has been tested and conforms to the State requirements. This stream is added to the combined stream and flows to the Illinois River.

F. Biological Impact

Installation of the plant and its operation has caused minimum biological impact on the area. The construction work resulted in the removal of a small wheat field from production and a few native trees, none of them of special or marked value. All slopes affected by the preparation of the area for construction were reseeded upon completion with a mixture of fescue and rye that rapidly became established, thus preventing erosion.

Small numbers of indigenous birds and animals were forced to relocate. A large amount of natural cover and feed sources remain to maintain native bird and game populations. There has been no noticeable reduction of the nearby population of deer and small animals or quail and other species of birds. It has been observed that many of the native animals are feeding upon the fresher grasses in the reseeded areas as a result of the water used in periods of dry weather.

G. Radioactivity Discharge

Processing results in radioactive contamination of the following plant discard streams: (1) small amount of uranium and daughter products contained in raffinate from the solvent extraction plant which is described above under chemical discharges, (2) a small amount of normal uranium contained in the hydrofluoric acid solution described above, (3) ambient air passed through vacuum transfer and cleaning systems which is discharged to the atmosphere after filtering containing finely divided uranium salts, and (4) gaseous effluent resulting from noncondensable gas release from the UF_6 condensing system which is piped to the top of the flue gas stacks from the boiler house.

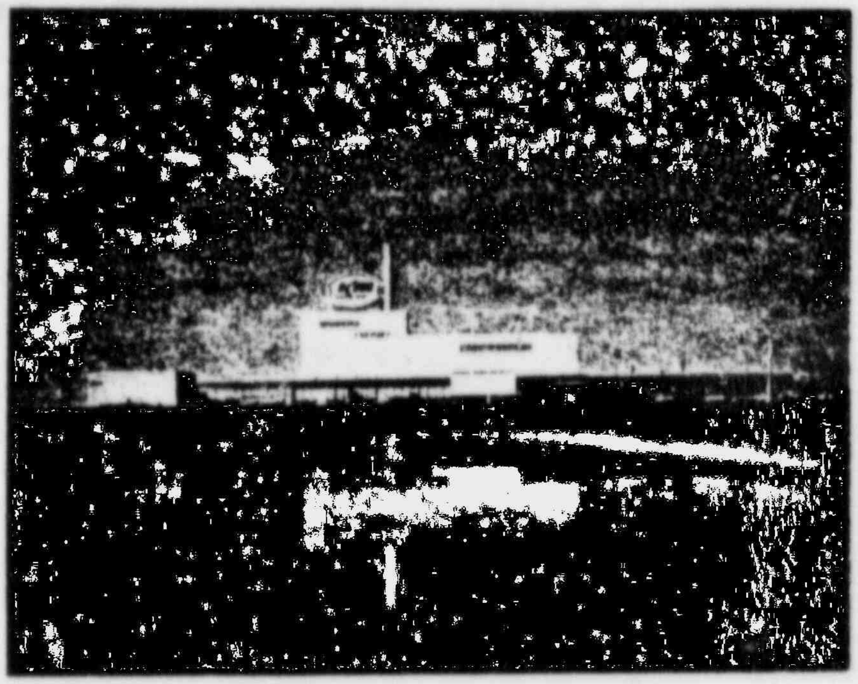
All sources of discharge of radioactive substance are controlled either by permanent storage, treatment or filtration to keep effluents well within limits set by 10CFR20.

H. Aesthetics

The land chosen for the Sequoyah site, as described earlier, had been previously occupied by a small wheat field and the balance in uncultivated pasture. Efforts were made to design the facility in a manner so that land would be conserved and the resulting view would be enhanced rather than harmed. The view was unremarkable and similar to many others in the area and it is believed that design criteria have succeeded in enhancing the appearance of the area. Pictures of the plant from ground level and from the air are on the following page.

V. Environmental Surveillance Program

The design criteria of the Sequoyah Facility included criteria for the quality of release of noxious gases, fumes and radioactive materials as a guide to the architectural engineering firm in establishing equipment design and specifications. Concurrently, it was realized that meeting these criteria could not be entirely determined by on-site measurements and an Environmental Surveillance Program was initiated. The purpose of the program is to demonstrate that effluent control equipment and procedures are limiting gaseous and liquid discharges of radioactive and chemical pollutants to the environment to acceptable levels. This program was initiated prior to the operation of the plant so that a base line could be established. The program covers all possible effluents from the plant and provides for monitoring of the holding ponds through the installation of several wells at their periphery to insure that no unforeseen leakage from the retention system occurs.



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The following samples are taken at locations shown on Drawing 110C-151 and analyzed for radioactivity, fluoride and nitrate contents as monitors for all other chemical releases.

1. The liquid effluent stream after the combination of the fluoride treatment effluent, the sanitary effluent, water bypassed around the water treatment facility, overflow from the cooling tower plant is sampled at the point where it leaves the immediate plant control area south of the road. The stream is sampled once each shift and samples are composited on a weekly and monthly basis for analysis.

2. Air samplers are located at the fence perimeter and at a radius of 1000 feet in four directions. Continuous samples are taken for a week and analyzed.

3. The Illinois and Arkansas Rivers are sampled upstream and downstream of the outfall discharge once each week and analyzed in a monthly composite.

4. Soil and vegetation samples are taken near the location of the four air samplers quarterly. Vegetation is protected by cages and entirely collected at the time scheduled. Soil is taken from a four-square-foot area one-inch deep near the cages. All samples are analyzed for radioactivity, uranium, radium, fluoride and nitrate.

5. Samples are removed from the monitoring wells near the storage ponds and from water wells on the site once each week and analyzed on a monthly composite.

6. Surface ponds on the site are sampled weekly and analyzed on a monthly composite.

All environmental samples are analyzed by an independent laboratory. Results of these analyses are given on Tables I to VI immediately following. We conclude from these data that no measurable impact on the environment has been detected.

VI. Results of Plant Use

The conversion of impure uranium concentrates to purified uranium hexafluoride is a central and necessary step in the complete nuclear fuel cycle. Nuclear power production promises a number of environmental advantages including the absence of release of significant amounts of combustion products to the atmosphere, the possibility of attractive architectural design, the significantly reduced flow of fuel materials and waste products and a reduction of associated noise and land commitment. Nuclear power is regarded as essential to meet the growing energy needs of the United

TABLE I

COMBINED LIQUID DISCHARGES AT PLANT OUTFALL

(1971 TO OCT. 1 - 8 SAMPLES)

	Combined Liquid Discharges			Limit	Ratio-Conc/Limit		
	High	Low	Ave.		High	Low	Ave.
1. Gross Alpha Activity (μCi/mℓ)	$1.6x10^{-6}$	$4.0x10^{-8}$	$.7x10^{-6}$	$2x10^{-5}$(a)	.08	.002	.035
2. Gross Beta Activity (μCi/mℓ)	$2.4x10^{-6}$	$.7x10^{-7}$	$.6x10^{-6}$	$1x10^{-5}$(a)	.24	.007	.06
3. Total Uranium (ppm)	8.0	.2	2.82	60.0(a)	.13	.003	.05
4. Nitrate (as N) (ppm)	22.0	.2	6.8 (e)	3.9(d)	5.60	.05	1.75(e)
5. Fluoride (as F) (ppm)	2.5	.2	1.34	1.5(c)	1.61	.14	.81
6. Radium - 226 (μCi/mℓx10^{-8})	2.62	.054	.65	3(d)	.86	.018	.22

(a) 10 CFR 20.106 - Assuming Natural Uranium and Thorium Release Limits

10 CFR 20.5(c) - 1 μCi = $4.44x10^{-6}$ dpm - Specific activity - 33μCi/gram Uranium

(b) USPHS Drinking Water Standards - 1962 - Publication 956

(c) 10 CFR 20.106 - Assuming Soluable Radium - 226 Release Limits

(d) Oklahoma Water Quality Standards - 1968

All Samples Analyzed by Controls for Environmental Pollution, Inc., Santa Fe, New Mexico.

(e) This high average due to accidental release early in the year.

TABLE II

GASEOUS DISCHARGES

MONTHLY AVERAGE CONCENTRATIONS AT SAMPLING POINTS

(1971 TO OCT. 1 - 8 Samples)

	GROSS ALPHA				FLUORIDES (as F^-)			
	Limit μCi/mℓ	Ratio-Conc/Limit High	Low	Ave.	Limit ppm	Ratio-Conc/Limit High	Low	Ave.
Fence Line Sampling								
1. North	$2x10^{-12}$ [a]	.81	.16	.42		NOT SAMPLED		
2. South	$2x10^{-12}$	1.00	<.1	.47		NOT SAMPLED		
Environmental Sampling (at 1000 ft)								
1. South	$2x10^{-12}$ [a]	.029	<.002	.015	.01 [b]	.20	<.01	<.01
2. East	$2x10^{-12}$	.053	<.002	.029	.01	.20	<.01	<.01
3. West	$2x10^{-12}$	.026	.014	.018	.01	.50	<.01	.04

a. 10 CFR 20.106

b. K. M. Criteria - 10 ppb (as F_2) Maximum Ground Level Concentration Beyond Site Fence

TABLE III
1971 ARKANSAS AND ILLINOIS RIVER SAMPLING
MONTHLY AVERAGE CONCENTRATIONS
8 SAMPLES
(1971 TO OCT. 1)

Arkansas River	Upstream			Downstream			Okla Water Resources Board Standards
	High	Low	Ave.	High	Low	Ave.	
1. Gross Alpha Activity ($\mu Ci/m\ell x10^{-8}$)(a)	.17	<.005	.07	1.44	< .005	.24	2000
2. Gross Beta Activity ($\mu Ci/m\ell x10^{-8}$)(a)	.71	.16	.42	1.84	< .005	.59	1000
3. Total Uranium (ppm)	.014	.005	.003	.014	< .005	.004	60
4. Nitrate as N (ppm)	1.3	.1	.63	1.8	<.1	.57	4.9
5. Fluoride as F (ppm)	2.0	.2	.57	1.3	.2	.40	1.5 - 2.4
6. Radium 226 ($\mu Ci/m\ell x10^{-8}$)	.69	.002	.16	.42	.002	.115	3.0
Illinois River							
1. Gross Alpha Activity ($\mu Ci/m\ell x10^{-8}$)	.30	< .05	.09	8.8	< .05	2.55	2000
2. Gross Beta Activity ($\mu Ci/m\ell x10^{-8}$)(a)	.45	.05	.25	10.0	.17	2.99	1000
3. Total Uranium (ppm)	.013	<.005	.002	.50	< .005	.115	60
4. Nitrate as N (ppm)	2.6	< .1	.92	1.8	< .1	.8	3.9
5. Fluoride as F (ppm)	.5	< .1	.1	.4	.1	.2	1.5-2.4
6. Radium - 226 ($\mu Ci/m\ell x10^{-8}$)	.35	.001	.084	.45	< .001	.10	3

(a) Assuming all activity due to natural uranium or thorium

TABLE IV
1971 SEQUOYAH FACILITY SOIL AND VEGETATION SAMPLING QUARTERLY CONCENTRATIONS (1971 TO OCT. 1)

	No. Samples	Total Uranium ppm			Fluoride (F) ppm		
		High	Low	Ave.	High	Low	Ave.
Soil							
1. South 1000 ft.	2	3.0	.30	1.7	3.4	1.0	2.2
2. West 1000 ft.	2	8.0	.72	4.4	4.1	.1	2.1
3. North 1000 ft.	2	15.0	.84	7.9	5.8	3.9	4.8
4. East 1000 ft.	2	3.7	3.00	3.4	2.7	2.0	2.4
Pre-Operational Soil*							
Vegetation							
1. South 1000 ft.	1	32.0	32.0	32.0	3.0	3.0	3.0
2. West 1000 ft.	1	75.0	75.0	75.0	2.0	2.0	2.0
3. North 1000 ft.	1	13.0	13.0	13.0	4.0	4.0	4.0
4. East 1000 ft.	1	11.0	11.0	11.0	1.0	1.0	1.0
Pre-Operational Vegetation*	8	38.1	13.2	25.6	Not Analyzed		

*Based on Beta Analysis from 1965 Pre-Operational Survey

TABLE V
1971 SEQUOYAH FACILITY POND SAMPLING
MONTHLY AVERAGE CONCENTRATIONS
7 SAMPLES
(1971 TO. OCT. 1)

	Pond #1 (1/4 mi. south)				Pond #2 (1/4 mi. east)			
	High	Low	Ave.	Pre-operational[b] Ave.	High	Low	Ave.	Pre-operational[b] Ave.
1. Gross Alpha Activity (μCi/mℓ x10^{-8})[(a)]	3.31	.20	1.02	.23	.44	.005	.27	.18
2. Gross Beta Activity (μCi/mℓ x10^{-8})[(a)]	2.15	.63	1.16	.71	1.20	.36	.77	.39
3. Total Uranium (ppm)	.027	.005	.008		.007	.005	.003	
4. Nitrate as N (ppm)	1.7	.1	.81	.05	1.4	.2	.58	.02
5. Fluoride as F (ppm)	2.7	.1	1.05	.38	.30	.10	.16	.23
6. Radium - 226 (μCi/mℓx10^{-8})	.18	.001	.08		.30	.001	.10	

(a) Assuming all Activity Due to Natural Uranium or Thorum

(b) From 1969 Pre-Operational Survey

TABLE VI
1971 SEQUOYAH FACILITY MONITOR WELL SAMPLING
MONTHLY AVERAGE CONCENTRATIONS
8 SAMPLES
(1971 TO OCT. 1)

	Seepage Wells (6)				Fault Well (1)				Residence Wells (2)			
	High	Low	Ave.	Preop. Ave.	High	Low	Ave.	Preop Ave.	High	Low	Ave.	Preop. Ave.
1. Gross Alpha Activity[a] ($\mu Ci/ml \times 10^{-8}$)	12.6	.07	2.3	Installed after Pre-operational Testing.	1.1	.07	.52	.4	.46	.01	.14	.14
2. Gross Beta Activity[a] ($\mu Ci/ml \times 10^{-8}$)	9.7	.11	3.2		1.7	.17	1.0	3.9	.98	.11	.32	.72
3. Total Uranium (ppm)	.95	.005	.081		.036	.005	.014	1.0	.032	.005	.008	NA
4. Nitrate as N (ppm)	44.3	.2	9.0		6.6	.10	1.8	9.2	25.5	.1	3.6	.27
5. Fluoride as F (ppm)	6.3	.1	1.3		3.0	1.8	2.6	.7	1.8	.1	.35	.42
6. Radium - 226 ($\mu Ci/ml \times 10^{-8}$)	6.2	.01	.37		.35	.01	.11	.3	.30	.01	.07	NA

(a) Assuming all Alpha and Beta Activity to be Natural Uranium and/or Thorium

States in the coming decades. The availability of abundant and reliable supplies of electrical power contributes in many ways to an enhanced human environment.

As stated above, Kerr-McGee does not believe that any adverse effect on the environment results from the past or continuing operation of the Sequoyah Facility.

VII. Alternatives

The site for the plant was chosen for its relative isolation, access to transportation and other favorable characteristics enumerated above. Alternate locations were evaluated and rejected on the basis of these criteria. These alternate locations, in view of the absence of any adverse environmental impact, would not currently be evaluated differently than they were at the initial consideration in 1967.

Alternate conversion processes were not available in the public domain at the time of initial planning without significant additional development work so we have duplicated the AEC process. The one other commercial process available is understood to produce no liquid effluent similar to the raffinate effluent generated at Sequoyah. Some technologists would view this as an advantage. However, since the process was proprietary and very little was known of its economics, the current process was chosen. The alternate process should offer no advantage in terms of gaseous effluents.

Kerr-McGee does not believe that a more favorable alternate site or process exists as confirmed by the environment surveillance program now in effect at the Sequoyah Facility.

VIII. Commitments of Resources

The Sequoyah Facility requires commitment of a certain amount of land, water and various chemicals to the production activity. The use of water is temporary and is returned to the river. Its use, permitted by the authorizations cited in paragraph II, does not interfere with alternate constructive use such as potable water or irrigation.

The land commitment is not irretrievable since it could be restored to its initial condition at the end of the plant's useful life.

Chemicals used in the processes are all common items of commerce produced for such purposes and are not in limited supply. The uranium materials processed are not consumed but

leave the plant in an enhanced physical form for further use by an economically important segment of industry.

IX. Cost Benefit Analysis

A. Benefits

The benefits of the Sequoyah Facility will primarily accrue to the commerce and the residents of Sequoyah and Muskogee Counties, Oklahoma, as well as the overall nuclear industry.

1. Nuclear industry will gain the benefit of having a second domestic supplier of conversion service through the use of a different process and accommodating a different set of specifications for the mining and milling segment of the uranium undustry. The second supplier provides a degree of competition to insure an equitable price structure and assure the continuing availability of this important phase of the nuclear fuel cycle.

2. Of the approximately 100 employees at the Sequoyah site, 90 were hired from the immediate area resulting in a payroll of approximately $1 million per year. It has been estimated that for every direct factory employee, three times as many service personnel are required, thus resulting in a total infusion of payroll of approximatey $3 million.

3. Sequoyah County activities will benefit due to the additional taxes paid on the industrial installation as compared to those paid on the unimproved land.

B. Penalties of Environmental Impact

This has been discussed above and it is concluded that no measurable adverse effect results from this installation.

1. Water Use. Since the water discharged is approximately the quality of the Illinois and somewhat above the quality of the Arkansas, into which it immediately flows, no measurable penalty is assessed upon downstream uses of water for industry, agriculture or potable service.

2. Land Use. Temporary removal of about 75 acres of land at an average cost of $400 an acre must be balanced by the value of a multimillion dollar industrial installation. Land not needed for the immediate plant area is continuing to be leased for agriculture. It is our belief that no penalty should be assessed for the change in land use or deterioration of appearance of the area.

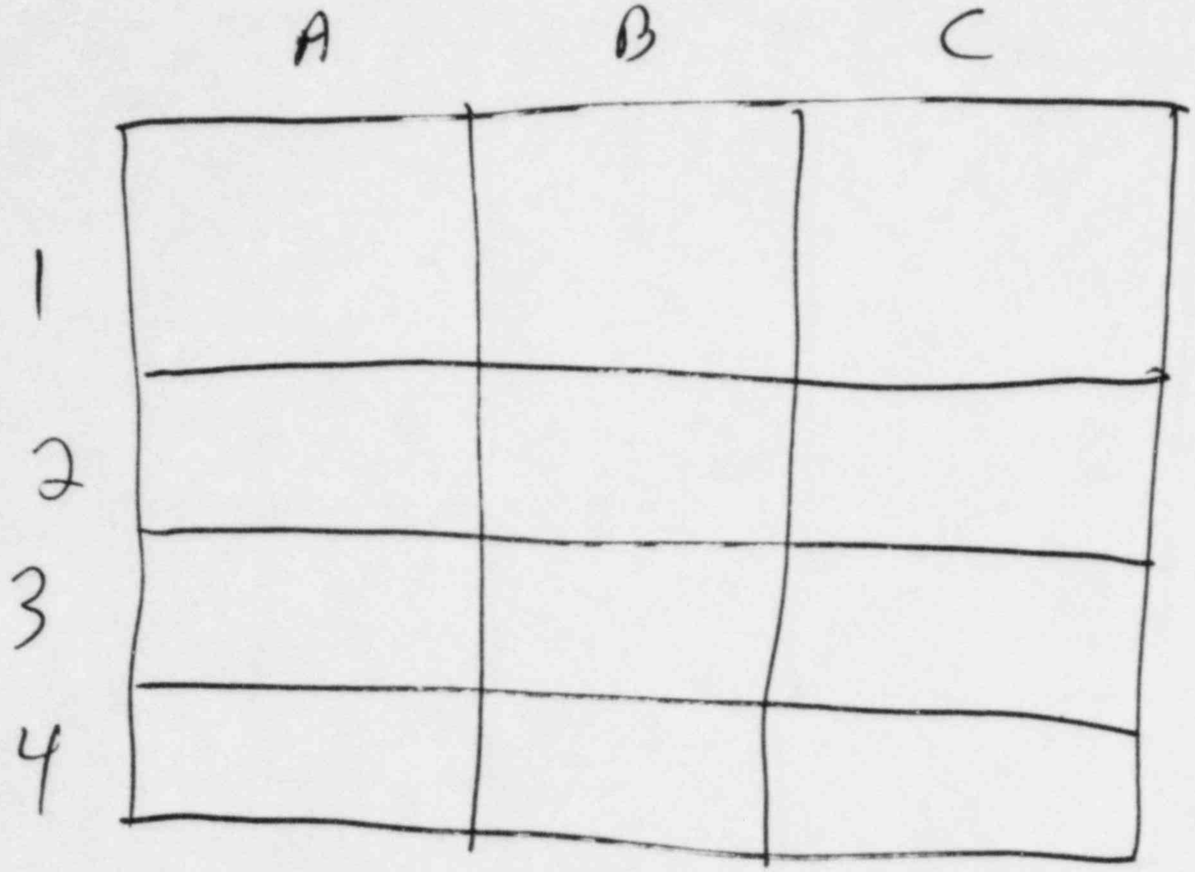
3. Biological Impact. No irreplaceable loss of wildlife or air quality has occurred and, as a consequence,

it is concluded that no cost penalty can be assessed for this effect.

C. Conclusion

Based upon the above, it is our conclusion that the enhancement of environmental values to the population of Sequoyah and Muskogee Counties by the addition of a viable industrial site far outweighs in benefits the nonmeasurable impact upon the environment.

THIS BLUE PRINT IS DIVIDED INTO 12 SECTIONS



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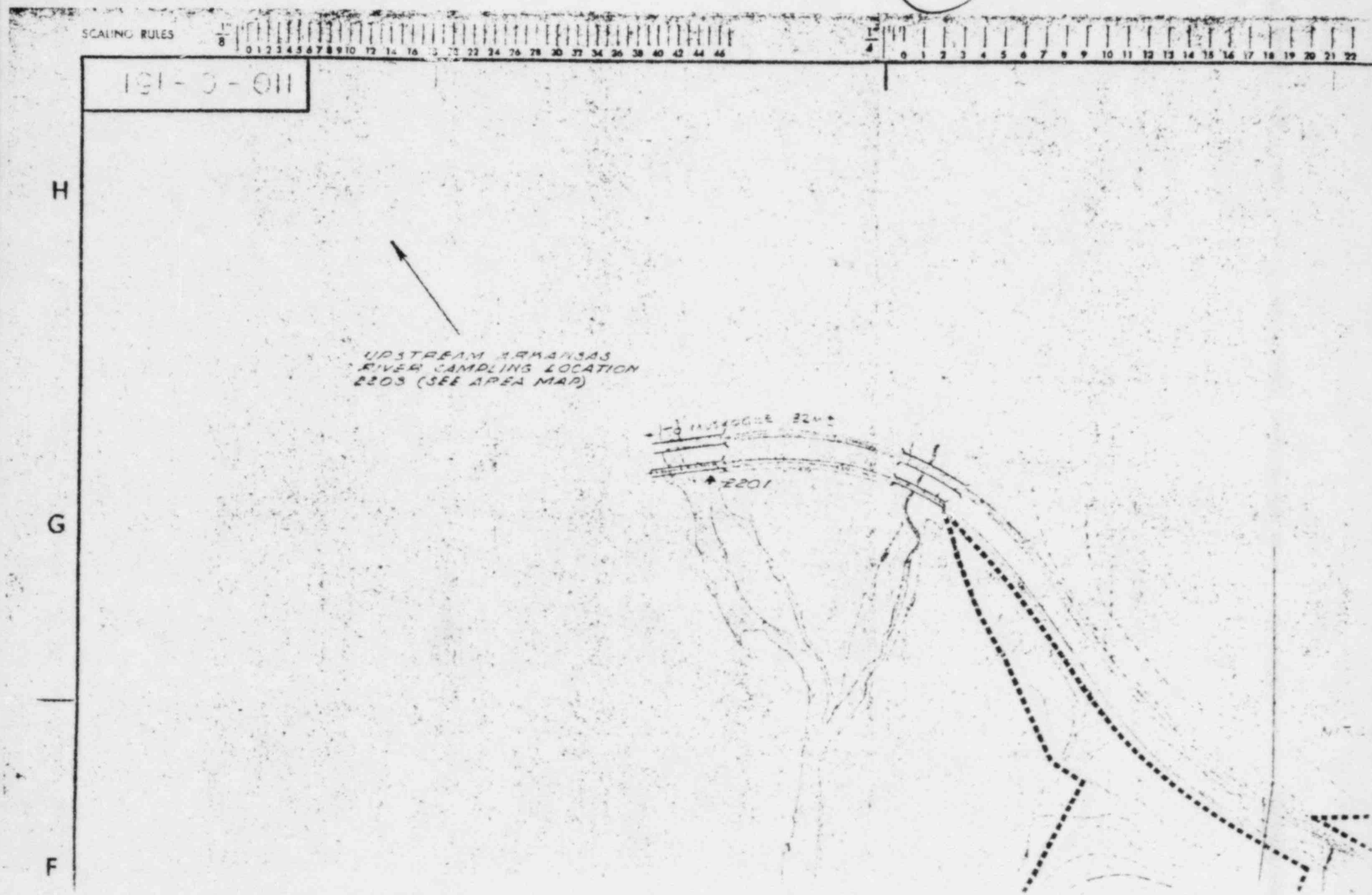
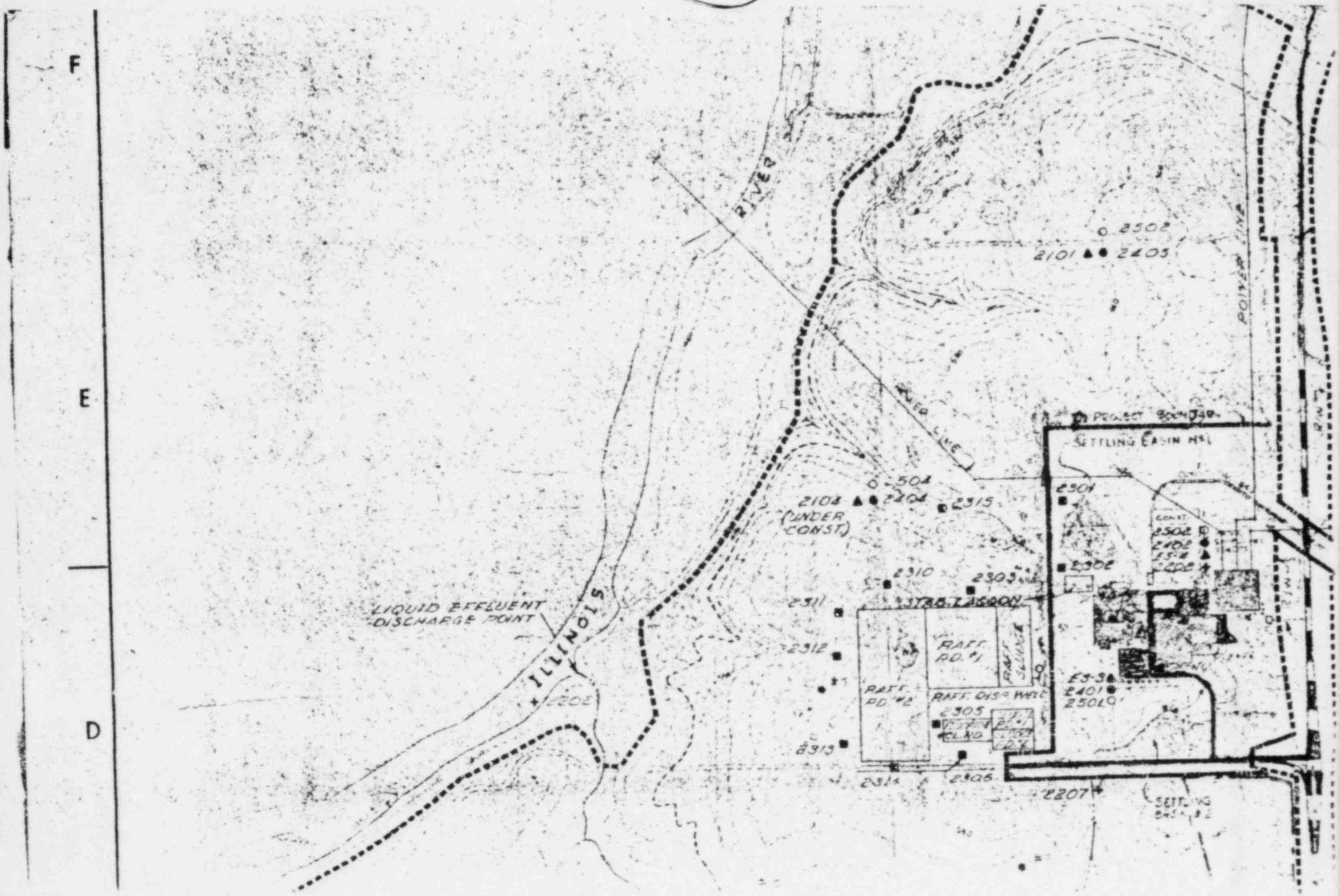

SCALING RULES
UPSTREAM ARKANSAS
RIVER SAMPLING LOCATION
2203 (SEE AREA MAP)
2201
H
G
F

A2

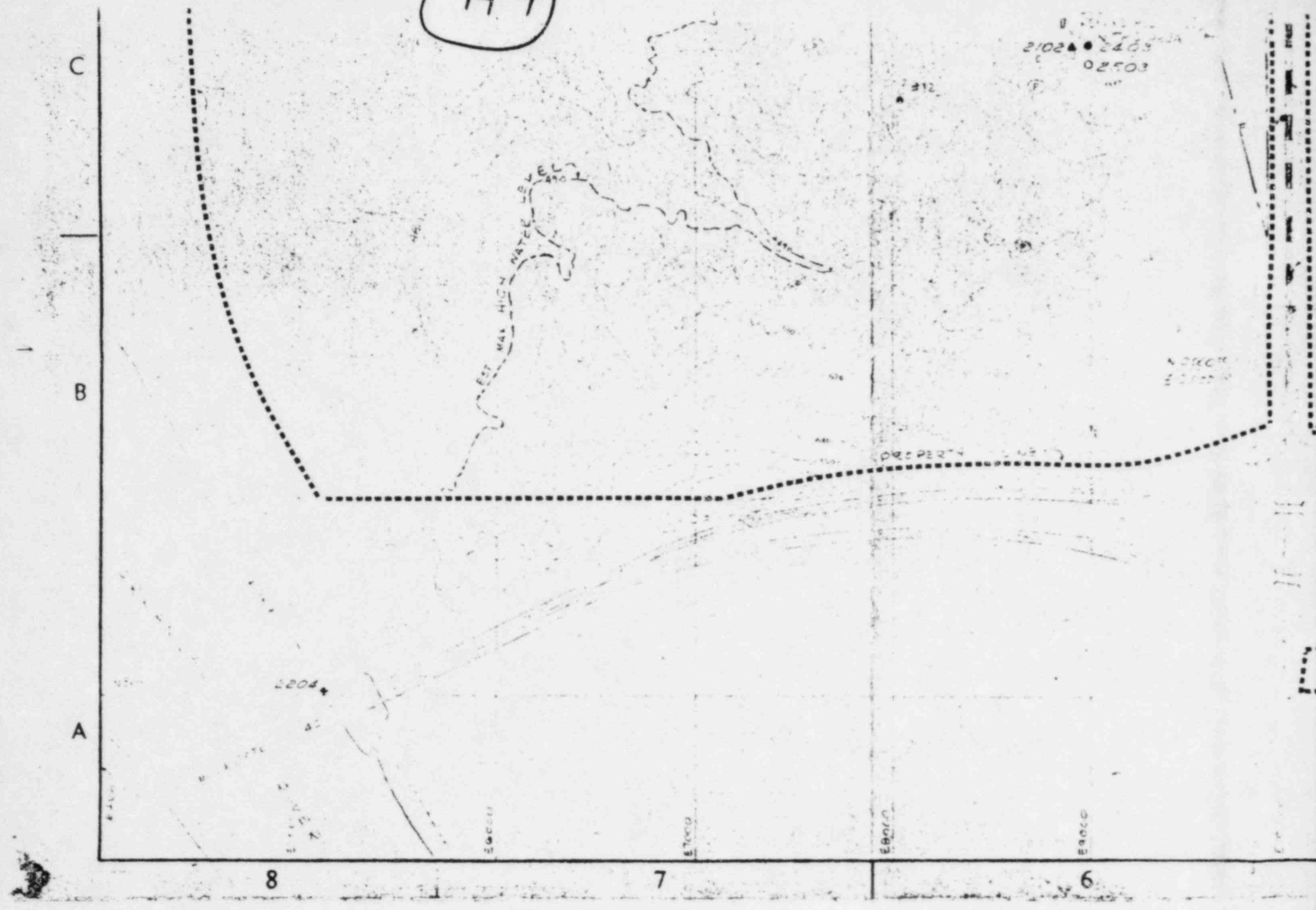


F
E
D
ILLINOIS
RIVER
RIVER LINE
POWER LINE
LIQUID EFFLUENT DISCHARGE POINT
PROJECT BOUNDARY
SETTLING BASIN No 1
SETTLING BASIN No 2
STAB. LAGOON
RAFF. PD. #1
RAFF. PD. #2
RAFF. SLUDGE
RAFF. DISP. WELL
2502
2101
2405
504
2104
2404
2315
(UNDER CONST.)
2301
2302
2310
2303
2311
2312
2313
2305
2306
2314
2207
2202
2401
2501

A3

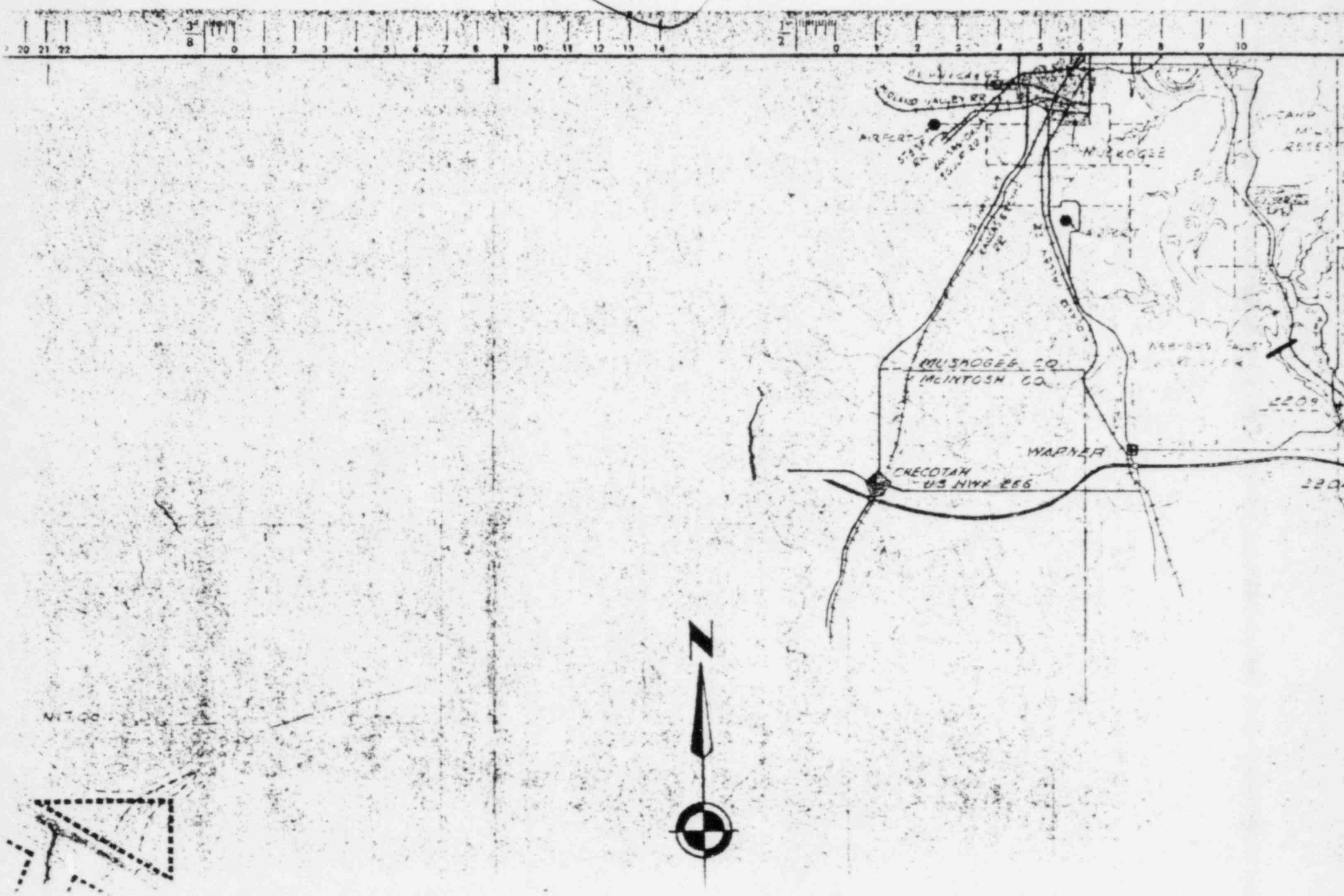
C
B
#10
COMBINED EFFLUENT DISCHARGE
+ 2206
CLEARING LINE
AREA
2102
2403
02503
#12
EST MAX HIGH WATER LEVEL
PROPERTY LINE
2204

A4

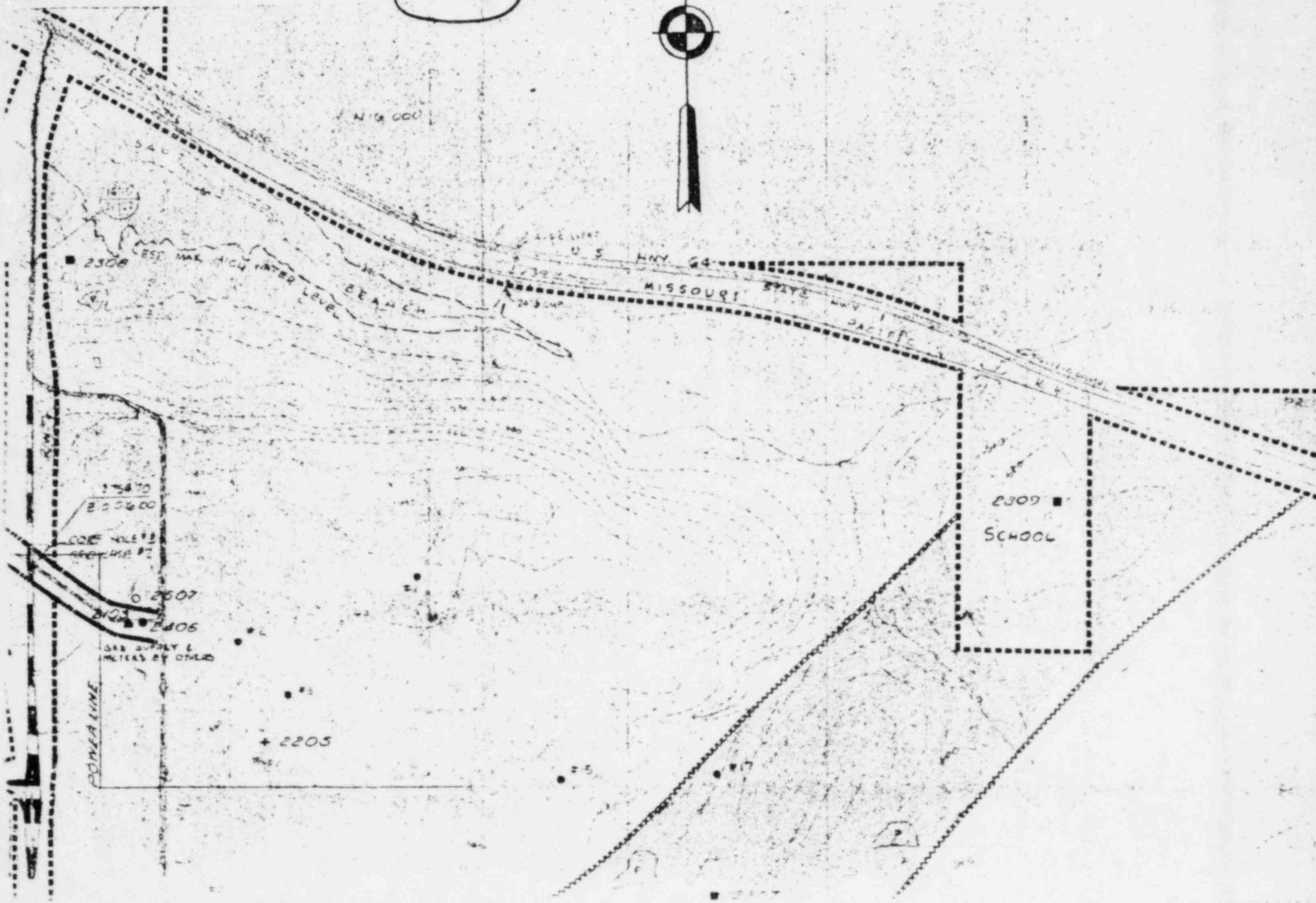


C
B
A
8
7
6
EST MAX HIGH WATER LEVEL
PROPERTY LINE
2102
2403
02503
2204

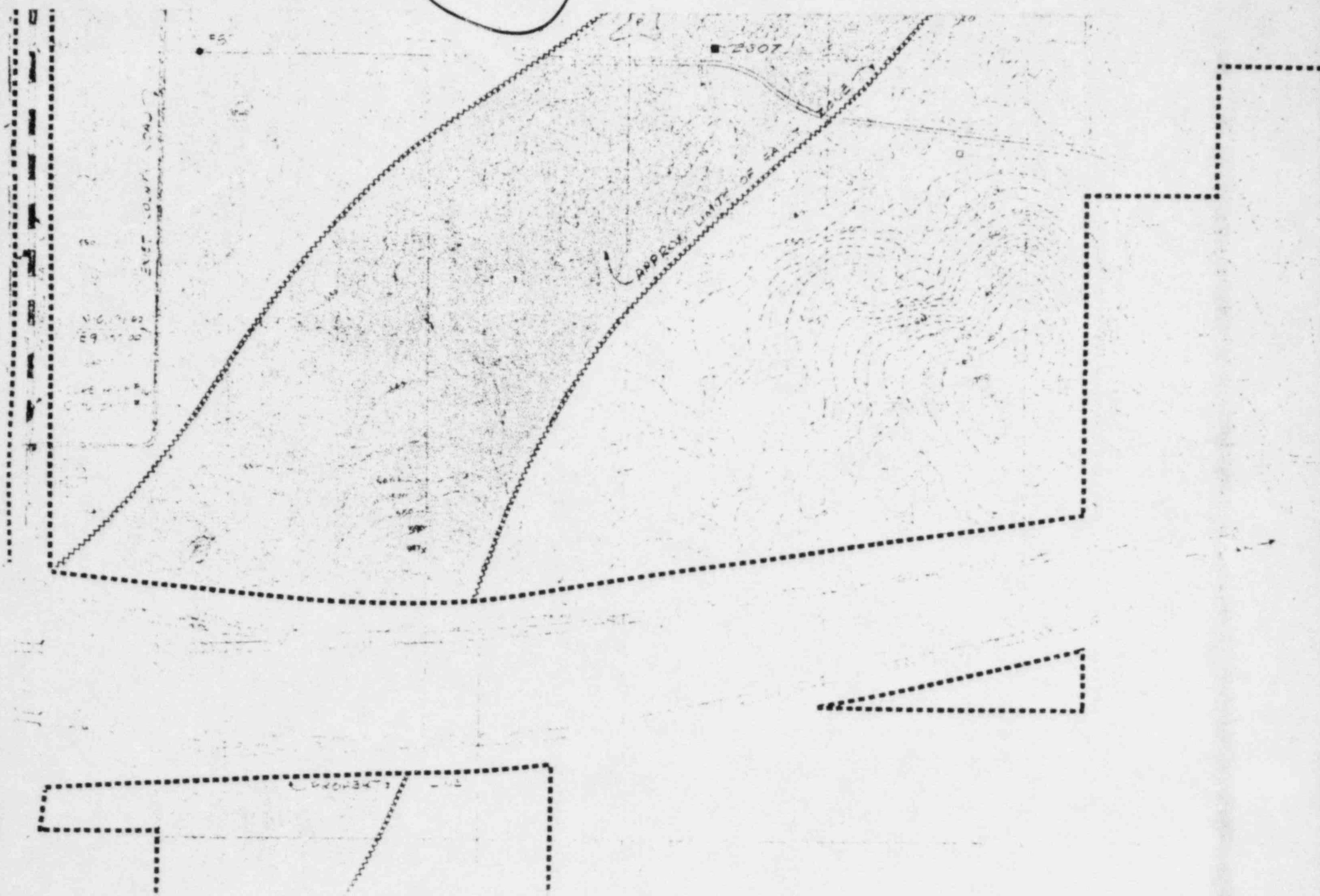
B1


MUSKOGEE CO.
McINTOSH CO.
WARNER
CHECOTAH
US HWY 266
AIRPORT
MUSKOGEE
N

B2


U S HWY 64
MISSOURI STATE HWY
PACIFIC
R R
EST. MAX. HIGH WATER LEVEL
BRANCH
2308
2309
SCHOOL
2307
2406
2205
POWER LINE
CORE HOLE #2

B3



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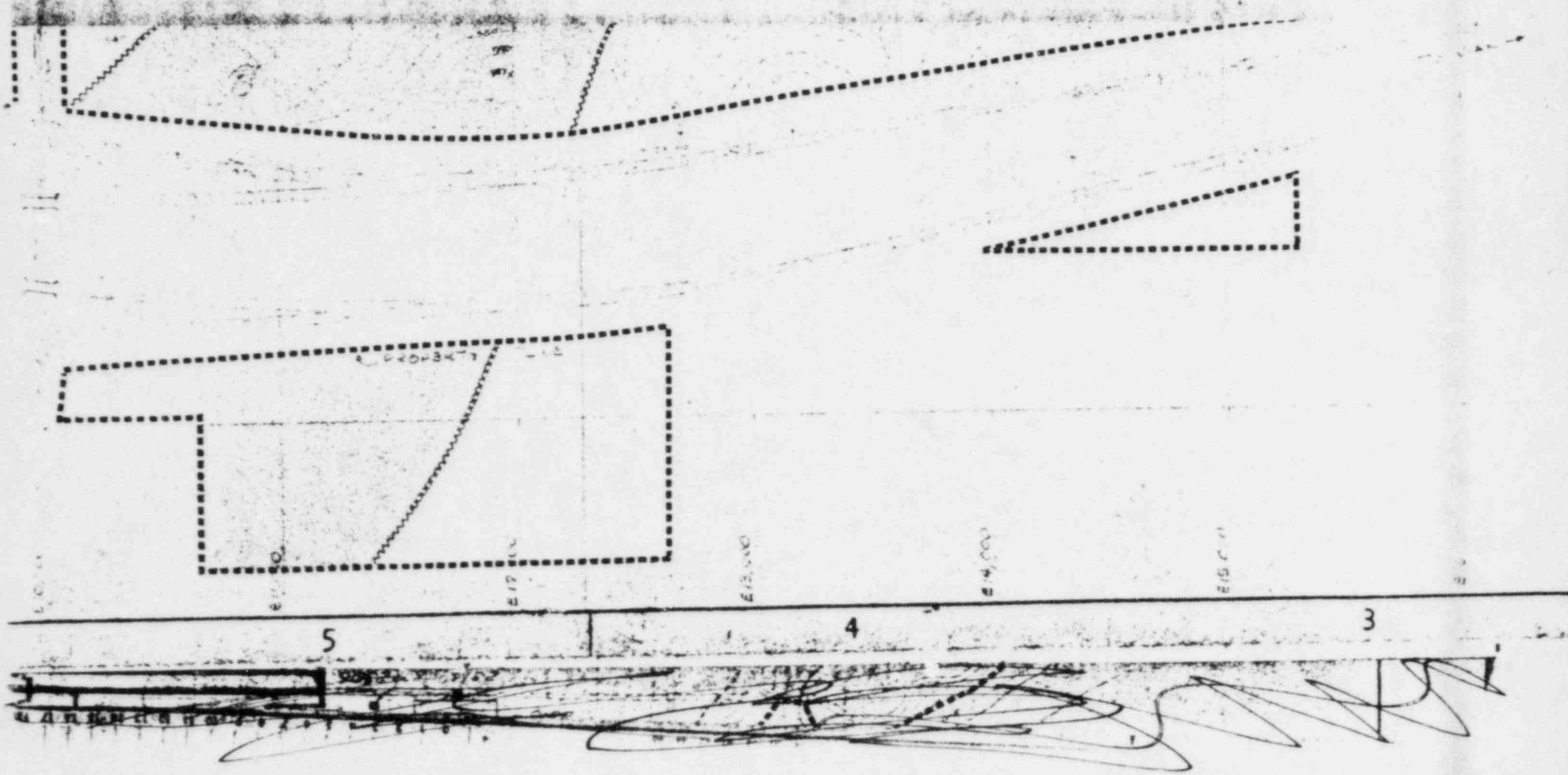
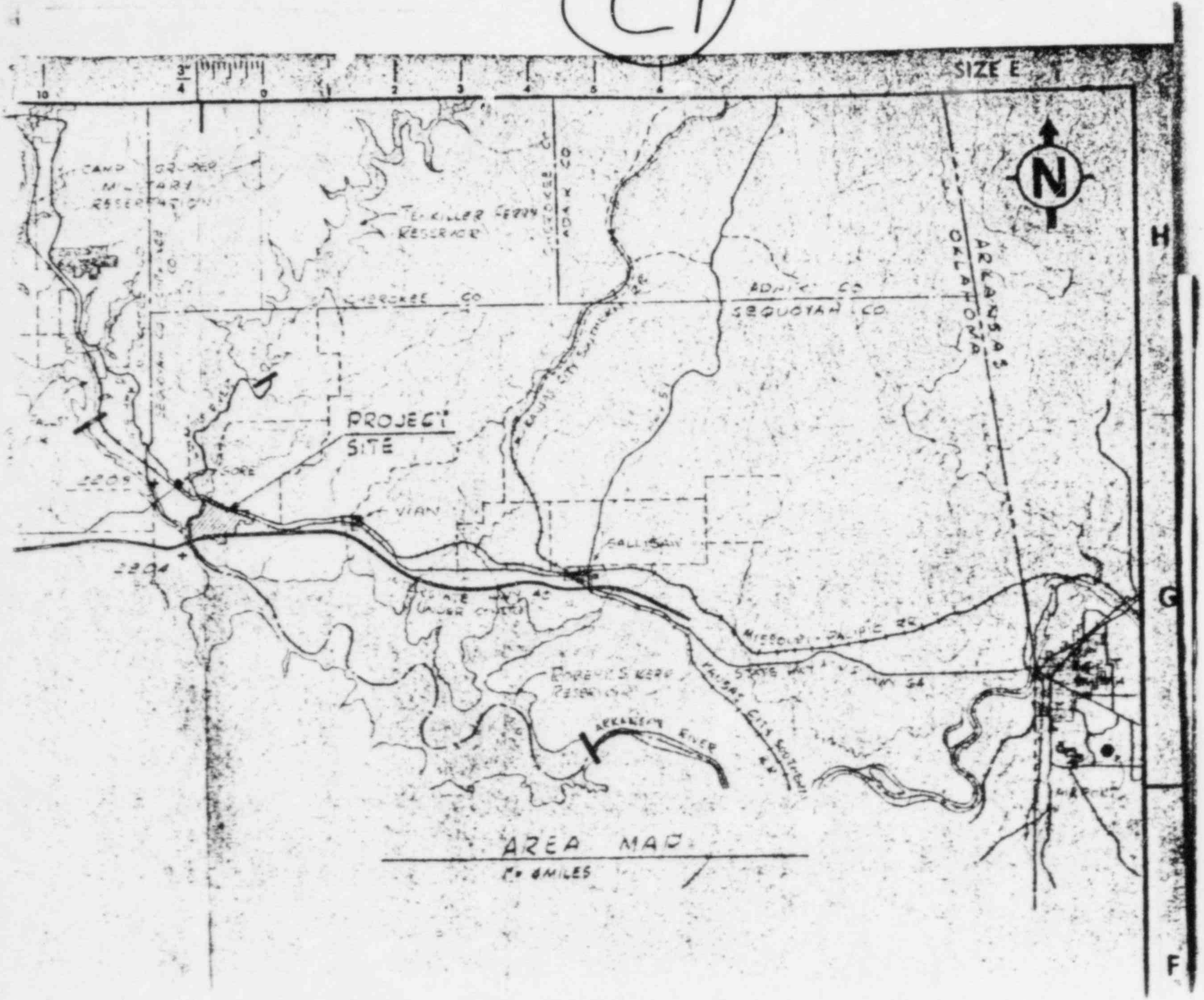
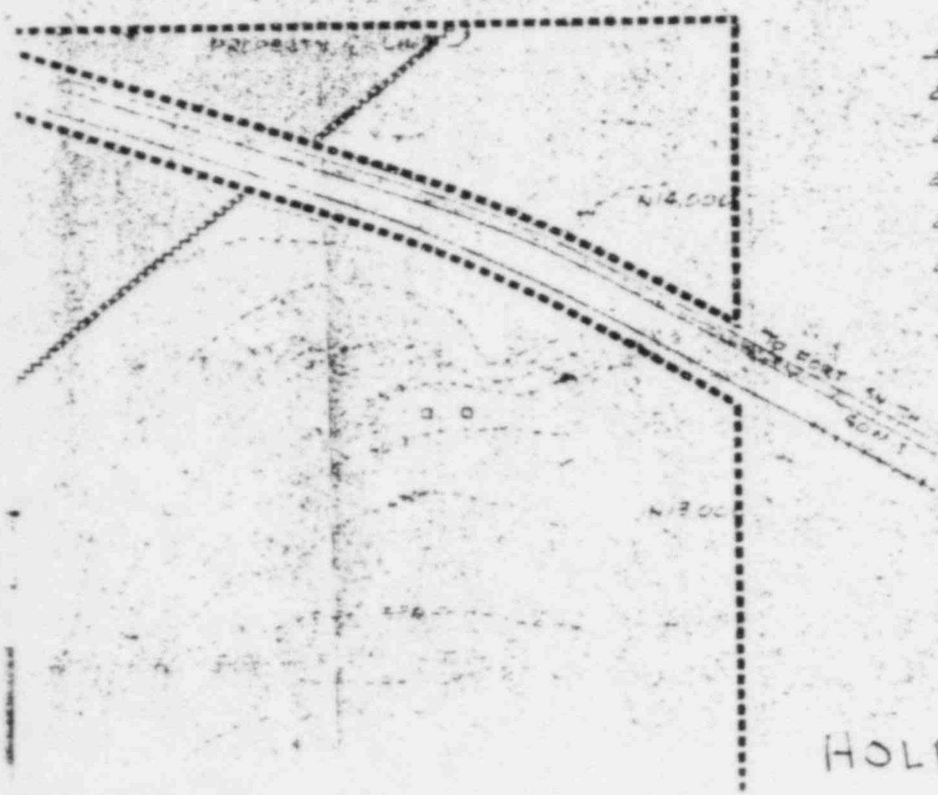


C1



SIZE E
N
H
G
F
ARKANSAS
OKLAHOMA
CAMP GRUBER MILITARY RESERVATION
TENKILLER FERRY RESERVOIR
CHEROKEE CO
ADAIR CO
SEQUOYAH CO
PROJECT SITE
GORE
VIAN
SALLISAW
MISSOURI PACIFIC RR
KANSAS CITY SOUTHERN RR
ROBERT S. KERR RESERVOIR
ARKANSAS RIVER
2209
2204
AREA MAP

(C2)



GENERAL NOTES

1. GRID SYSTEM BASED ON COORDINATES SHOWN FOR CORE HOLES #3 & #16 ON MAP OF PORTIONS OF SECTIONS 21 & 28, T12N - R21E SEQUOYAH COUNTY OKLAHOMA, COMPILED BY AERIAL DATA SERVICE, TULSA OKLA. DATED OCT. 2, 1967.
2. TOPOGRAPHIC FEATURES REPRODUCED FROM AERIAL DATA SERVICE MAPS
3. GEOLOGICAL FEATURES TAKEN FROM KERR-McGEE EXPLORATION & RESEARCH DIVISION REPORT DATED NOV. 28, 1967.
4. ● #Y REPRESENT CORE HOLES DRILLED FOR STUDY UNDER NOTE #3.

ENVIRONMENTAL SURVEILLANCE KEYS

2100 ▲ ENVIRONMENTAL AIR SAMPLING STATION

2200 + SURFACE WATER SAMPLING LOCATION

2300 ■ WELL SAMPLING LOCATION

2400 ● ENVIRONMENTAL SOIL SAMPLING LOG

2500 ○ ENVIRONMENTAL VEGETATION SAMPLING LOCATION

ALL LOCATIONS ARE APPROX.

REFERENCE DRAWINGS

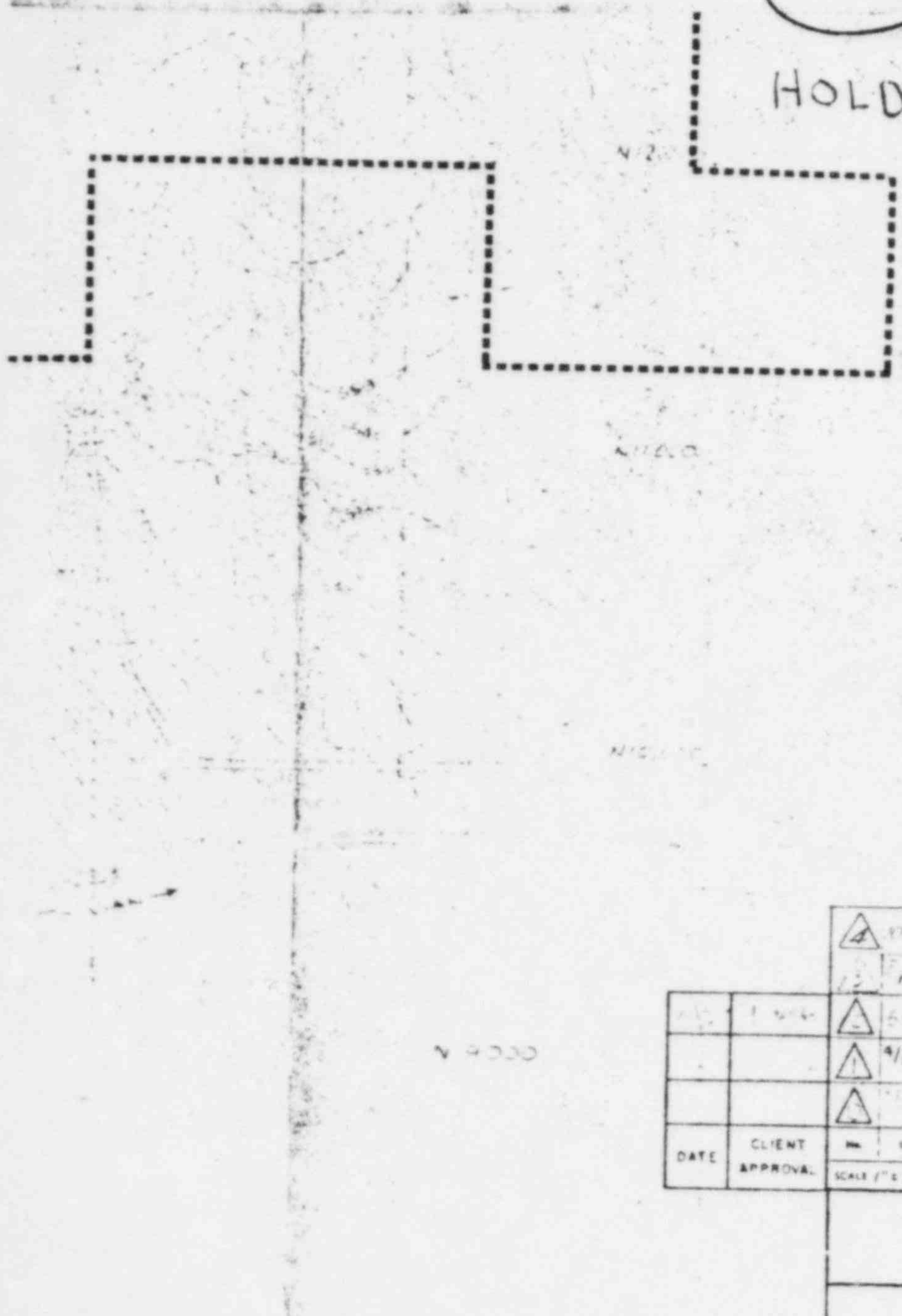
8752-000-C-31	CONSTRUCTION FACILITIES LAYOUT		
110-C-152	GENERAL PLOT PLAN		
" " 170	ROUGH GRADING PLAN		
" " 171	GRADING & PAVING PLAN	SH.1	
" " 172	"	SH.2	
" " 173	"	SH.3	
" " 174	"	SH.4	
175	"	SH.5	
176	GRADING & PAVING PLAN	SH.6	
6752 110-C-153	YARD & LANDSCAPING PLAN	SH.1	HOLD
154		SH.2	HOLD
"		SH.3	HOLD

F

E

D

(C3)



HOLD

	176	GRADING & PAVING PLAN	SH.6
6752 110-C-153		YARD & LANDSCAPING PLAN	SH.1
"	154	"	SH.2
"	155	"	SH.3
"	156	"	SH.4
"	157	YARD & LANDSCAPING PLAN	SH.5
6752 110-C-161		BORING LOGS	SH.1
"	162	BORING LOGS	SH.2
"	163	FOUNDATION SOILS PROFILE	
"	182	GRADING, PAVING & DRAINAGE DETAILS	
"	183	SERVICE ROAD PROFILE & SECTIONS	
"	184	ACCESS ROAD PROFILE & SECTIONS	
"	190	UNDERGROUND PIPING PLAN	SH1
"	191	"	SH.2
"	192	"	SH.3
"	193	"	SH.4
"	196	PIPING PROFILES	SH.1
"	197	PIPING PROFILES	SH.2
6752 110-C-198		PIPING DETAILS	
" 50-C-5		SETTLING BASIN No1	
" 50-C-2[illegible]		" DETAILS	
70-C-101		STABILIZATION LAGOON	
110-C-199		PIPING PROFILES SH. 3	
[illegible]-C-22		[illegible] CONC DETAILS	SH 1
110-C-252		"	SH 2
160-C-201		WATER SUPPLY TANK	

DATE	CLIENT APPROVAL	No.	DATE	REVISIONS	BY	CHK	DFTG SUPVR	ENGR	RESP ENGR	CHIEF ENGR
		4	[illegible]	UPDATED & REV FOR ENVIRONMENTAL REPORT	[illegible]					
			[illegible] 1968	[illegible]	[illegible]					
		3	6/2/[illegible]	COOLING TOWER ADDED	[illegible]					
		1	4/1/66	REVISED & REISSUED FOR CONSTRUCTION	NA					
			[illegible]	ISSUED FOR CONSTRUCTION	A					

SCALE 1" = 400 | DESIGNED BARNETT | DRAWN GARRETT

BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION

SEQUOYAH FACILITY

C4.

N 4000

E 18,000

No.	DATE	REVISIONS	BY	CHK'D	DFTG SUPVR	ENG'R	ENGR ENG'R	CHIEF ENG'R
4	10/23/??	UPDATED & REV. FOR ENVIRONMENTAL REPORT	[illegible]					
3	1968	[illegible]	SEA					
2	6/13/68	COOLING TOWER ADDED	NA					
1	4/1/68	REVISED & REISSUED FOR CONSTRUCTION	A.					
0	[illegible]	ISSUED FOR CONSTRUCTION						

DATE	CLIENT APPROVAL

SCALE 1" = 400

DESIGNED BARNETT

DRAWN GARRETT

BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

SITE PLAN
AND AREA MAP

JOB No.	DRAWING No.	REV.
6752	110-C-151	4

BECHTEL

B

A

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