SOIL ENGINEERING & GEOLOGIC INVESTIGATIONS

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FOR

JIM BRIDGER POWER PLANT

Near Rock Springs, Wyoming

VOLUME I

OWNERS

PACIFIC POWER AND LIGHT COMPANY

AND

IDAHO POWER COMPANY

ENGINEER

BECHTEL CORPORATION

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SOIL ENGINEERING & GEOLOGIC INVESTIGATIONS FOR JIM BRIDGER POWER PLANT NEAR ROCK SPRINGS, WYOMING

VOLUME I

Prepared For

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San Francisco, California

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NEAR ROCK SPRINGS, WYOMING

SCOPE

This report presents results of subsurface investigations at the site of the proposed Jim Bridger Power Plant to be located in Section 3, Township 20 North, Range 101 West in Sweetwater County, about 31 miles northeast of Rock Springs, Wyoming. The study was made to assist in determination of the best types and depths of foundations for the various structures and design criteria for them.

Data gathered during the field and laboratory investigations are summarized on Figures 1 through 16 and in Appendices A through J in Volumes II and III. Our opinions, based on the results of our investigations, our understanding of project requirements, and our experience in the area are briefly summarized below.

SUMMARY OF CONCLUSIONS

(1) We believe the major power plant facilities should be founded with spread footings or mat foundations on the sandstone bedrock.

(2) Light power plant structures, such as the warehouse, should be founded with spread footings on the structural fill, compacted to high density.

(3) Coal handling structures should be founded on the claystone bedrock with spread footings or drilled piers, designed to resist upward forces generated by the swelling claystone.

(4) Ground water must be considered in design and construction of some of the deeper, coal handling structures.

(5) Conveyors can be founded with spread footings on the sandstone, structural fill, the claystone and the natural soils, or with piers drilled into the bedrock.

(6) The Induced draft fans deserve special consideration in design and further field investigations because of potential vibration problems.

PROPOSED CONSTRUCTION

As currently planned, the Jim Bridger Power Plant will ultimately have five units, of which three 500-megawatt units will be completed between 1974 and 1979. The power units will be high-pressure steam turbine generators. They will consume approximately 250 tons per hour of coal and 5 cfs of water per unit. The coal will be transported to the plant from a mine 3± miles to the north-east in 120-ton coal trucks. Water will be conveyed to the plant in a 36-inch pipeline from the town of Green River approximately 42 miles southwest of the site and stored in a reservoir near the site. Three 345-KV transmission lines will be constructed from a switchyard west of the power plant building, 250 miles west to Pocatello and American Falls, Idaho. A 230-KV line will provide construction power to the site, and a new heavy-duty road and a railroad spur will be constructed to the site from Point of Rocks approximately five miles south of the site.

The proposed construction will include the power plant and coal handling facilities. The power plant facilities will include the turbine generator building which will house the turbine generators, coal silos, coal mills, boilers, fans and other equipment; precipitators; induced draft fans; chimneys; transformers; cooling towers with connecting piping; and ash ponds which had not been located at the time of our investigations and are not discussed in this report. Coal handling facilities will include a coal truck dump, primary and secondary crushers, reclaim hopper-feeder, live and dead coal storage facilities and connecting conveyors. Miscellaneous facilities will include an office building; warehouse; an oil storage tank; and plant area roads. There will also be a substation, a water storage reservoir, roads and railroad beyond the site, a water pipeline to the site and transmission lines, all beyond the scope of our investigations.

SITE CONDITIONS

The ground surface at the site is generally undulating and slopes down to the northeast from a northwest-southeast trending ridge near the western side of the site, dropping about 100 feet to the wide, flat alluvial plain of Deadman Wash which occupies the easterly portion of the site. There are sandstone bedrock exposures on the flanks of the ridge which is generally overlain by a thin mantle of dune sand. Vegetation consists primarily of sage and wild grass. The site is vacant and is used for winter sheep pasture.

DESCRIPTION OF INVESTIGATIONS

A reconnaissance of several sites then under consideration was made on April 3, 1970 by the undersigned, in company with your Messrs. Fletcher and Content and Mr. Condit of Idaho Power Company, at which time the logs and cores of test holes drilled by others in November and December 1969 and March of 1970 were reviewed. Waxed core samples from these test holes previously selected by your personnel, were sent to us for testing. Part of the results of these tests, assigned by your personnel, were submitted with our report of the site reconnaissance dated April 14, 1970 and the remainder by letter dated April 16, 1970.

Subsequently, we supervised the drilling of 66 test holes and the excavation of 9 test pits at the selected site between May 5 and August 4, 1970. The location of the structures was shifted about 600 feet to the north subsequent to our preliminary report dated May 31, 1970, and thence was shifted to the location shown on Figure 1 in the latter part of June 1970 in order to minimize potential problems associated with the Lewis Shale Formation. Rigs provided by the Boyles Bros. Drilling Company completed 24 NX core holes, 6 continuous Pitcher sample holes, 16 alternating Pitcher sample and drive sample holes, and 20 air rotary drive sample holes on July 28, 1970. Nine test pits were excavated with a rubber tired Michigan 180 Loader dozer and a D-8-H Caterpillar tractor with a hydraulic dozer blade and a hydraulic, single-tooth ripper. Pit excavation rates were recorded, the pits were logged, in-place density tests were taken in the pits, and hand-cut, undisturbed samples were taken. The locations of test holes and test pits are shown on Figure 1, summary logs on Figures 7 through 12, detailed logs in Appendix K, and core logs in Appendix L.

Laboratory testing was performed on representative drive samples, waxed core and Pitcher samples of the overburden soil, claystone from the Lewis Shale formation and the Almond sandstone. The testing included moisture content, unit weight, gradation, Atterberg limits, compaction, swell-consolidation, unconfined compression, triaxial shear, specific gravity, and shear modulus tests. In addition, petrographic studies were made by Mr. V. E. Wolkodoff, Consulting Petrographer, on samples of the Lewis Shale and the Almond sandstone which included X-ray diffraction, differential thermal analysis and thin-section analysis. The test results are presented in Appendices A through J.

GEOLOGY

The plant is located on the eastern flank of the "Rock Springs Uplift" near the contact between the Lewis Shale and the underlying Almond sandstone, the upper member of the Mesa Verde Formation. A study of the outcrops, the test pits, cores from the test holes, and the contact of the sandstone and shale found in the test holes indicate that these Cretaceous-age beds dip gently down to the northeast on a 5±° slope undulating from about 0° to 10°. Bedrock is mantled by soils across almost the entire plant site. Sandstone of the Almond formation crops out only in short sectors of the ridge along the western boundary of the site. These relationships are shown on Figure 4.

The soils across the western half of the site are mainly silty sands derived as slopewash and residual debris from the Almond sandstone. Locally these are thinly capped by, and inter-lensed with wind-deposited sands. These soils grade eastward, across the sector of the plant underlain by the Lewis Shale, to inter-lensed silts, sands and clays. Surficial sand dunes are better developed in this sector of the plant site.

The western edge of the alluvial plain of Deadman Wash encroaches across the eastern end of the plant site in a narrow, irregular shaped band. Deadman Creek, in past geologic history, has eroded its bed to a depth of 75 feet or more below the present level of the Wash, and then has regraded the valley to its present floor level with lenticular-bedded sands, silts, and clays.

A geologic map of the site prepared from visible rock outcrops, test holes and test pits is shown on Figure 2. A geologic profile along the centerline of the coal handling conveyor, is shown on Figure 3. These and other data were combined to prepare the geologic isometric sketch shown in Figure 4 to show the relative position of the formations and the power plant structures. The formations are discussed in more detail under "Subsoils" below.

SUBSOILS

Overburden

The dune sands and silts (SM to ML by the Unified Classification System) in the vicinity of the turbine-generator building to the west are generally of low density, 103± pcf. Locally, they are calcareously cemented to form a hard "caliche-like" layer, exhibiting high, but misleading, blow counts of over 50 blows for 12 inch penetration. The silts (ML) here are porous and tend to settle on wetting under low to moderate footing pressures. These soils will carry relatively high loads if they are not wetted, consolidation of 1% or less under loads up to 8 ksf, but settle markedly upon wetting even under low loads, 3% at 1 ksf and 13% at 5 ksf. To the east the silts (ML) are also of low density (94 to 100 pcf) and will settle on wetting even under low loads. Most of the overburden soils are non-plastic with some clays (CL) exhibiting low plasticity, PI less than 10.

The alluvial soils at the easterly edge of the site, below the low density surface silt, are denser (103 to 109 pcf) and are predominately sands (SM & SC) containing interlayered silts (ML) and clays (CL) and a few thin layers of fine coal dust. This material is generally medium dense with standard penetration blow counts in excess of 20 blows per foot, consolidation of the order of 3% at 5 ksf, and triaxial shear deviator stresses of 12 and 20 ksf at confining pressures of 2 and 5 ksf, respectively. These alluvial soils are, in our opinion, capable of supporting moderate footing pressures with normally tolerable settlements.

Almond Sandstone

The thin overburden in the western part of the site is underlain by the Almond Sandstone, as is the Lewis Shale in the eastern part of the site. The sandstone generally has a hard cap layer 3± feet thick. Where the cap is exposed,it is generally highly fractured and frequently underlain by highly altered, very weakly cemented, thin-bedded, somewhat porous sandstone. This very weakly cemented zone is up to 10 feet in thickness and contains some harder layers. It is underlain by variably, but generally moderately cemented, hard sandstone which contains layers of weakly cemented and strongly cemented sandstone and pockets and lenses of very weakly cemented to uncemented sandstone, as well as occasional layers of very hard, limy, fossiliferous sandstone and claystone. Photographs showing the relationship of the "cap" rock to the overlying Lewis Shale and underlying sandstone, as well as the upper thinly bedded and deeper, more massive sandstone are shown on Fig. 17.

We have utilized the following definitions to describe the degree of cementation of the sandstone throughout this investigation:

<u>Strongly Cemented</u> - particles firmly held in bond by a cementing agent, impossible to break by hand.

<u>Moderately Cemented</u> - particles moderately held in bond by cementing agent and sample can be crushed or broken by hand with some difficulty.

<u>Weakly Cemented</u> - particles are weakly bonded together by a cementing agent and sample can be crushed or broken by fingers with very little difficulty.

<u>Uncemented</u> - no cementing agent present in sample.

Classification tests show that when broken down to their constituent grains, the sandstone is non-plastic, fine sand, generally contains between 10 and 20% -#200 sizes and classifies as a silty sand (SM). The sandstone is composed of about 80% quartz particles, 1 to 2% kaolinite or halloysite clay, up to 10% dolomite, as well as small quantities of other minerals. The cementing mechanism is absent in some of the sandstone. The cementation is that of point-to-point contact of quartz particles in some of the sandstone and is chalcedony in other sandstones. The laboratory dry densities of the sandstones range from 92 to 140, averaging 109 pcf as summarized in Table III. Field densities taken in the test pits range from 95 to 138 pcf, averaging 108 pcf, and are reported on Table IV.

These tests represent a total of approximately 160 tests performed in the laboratory and field, of which 9 tests were below 100 pcf and 3 were above 130 pcf.

We have performed many penetration resistance tests on the sandstone in the drill holes, as well as consolidation, unconfined and triaxial compression tests, in the laboratory. We believe the blow counts from the standard penetration tests are an important indicator of the in-situ behavior of the sandstone if taken in sufficient number to enable statistical analysis. We have performed 270 penetration tests in the sandstone in the plant area. The blow counts ranged from 10/12 inches to 50/0 inches with an average of 50/2 inches. Of the total, 75% were in excess of 100 blows per foot and less than 5% were below 30 blows per foot, and these were at shallow depth in the sandstone.

Laboratory tests show consolidation averaging about 1½% at 10 ksf, about 2% at 25 ksf, and up to 5% at 80 ksf. The tests indicated the effect of wetting was negligible. Compression tests, both unconfined and triaxial, show high strengths. A summary of representative compression test results are tabulated below.

CONFINING PRESSURE (KSF)	NUMBER OF TESTS	COMPRESSIVE STRENGTH (KSF) (DEVIATOR STRESS)		
		MINIMUM	MAXIMUM	AVERAGE
0	40	0.9	78	34
0.7	4	9.0	63	33
1.4	5	7.3	98	37
2.9	5	5.9	67	48
4.3	4	7.6	128	80
5.8	6	4.9	138	62

Seventy-five percent of the unconfined compression tests indicated breaking strengths in excess of 18 ksf. Most (6 of 9) of those below 18 ksf were very weakly cemented sandstones which were difficult to sample and test and were below 3 ksf strength. Seventy-five percent of the triaxial shear tests indicated deviator stresses above 15 ksf.

Core and Pitcher sample recovery was generally very good, but there were zones where no samples were recovered. Such zones could reflect weaker phases of the sandstone; however, very little difference was noted in the standard penetration test blow counts of the in-situ material in the low recovery areas, as compared to the high recovery areas. We do not feel that the lack of recovery is indicative of material substantially weaker than those sampled and tested.

We believe, based on the results of field and laboratory tests, as well as observation of the samples and materials exposed in the test pits, that footings on the sandstone should be designed for maximum soil pressures of 10 to 15 ksf. We believe these values are conservative and reflect the possible existence of pockets or lenses of very weakly cemented sandstone within the loaded depth beneath the foundation. We suggest the use of the higher value for small footings, and the lower value for large footings, to reduce differential settlements, as shown on Figure 15. We estimate that the total settlement experienced by the footings, designed in accordance with this criteria will be of the order of 3/4 inch. Settlement due to the deadload should occur essentially concurrent with construction and that due to live load on first application of that load.

Tests were performed in the laboratory to provide preliminary data on the shear modulus of the sandstone for consideration of the effects of vibratory loads. The results, discussed below under "Induced Draft Fans", and in Appendix G, showed moderately high, but highly variable shear moduli, indicating the desirability of field investigations to provide data for dynamic design of the induced draft fan foundations.

Lewis Shale

The overburden in the eastern part of the site is up to 78 feet thick and is underlain by claystone of the Lewis Shale Formation. The upper stratum of the claystone, up to 50 feet thick, ranges erratically from firm to hard and contains many fractures filled with clay and selenite, a water-soluble form of gypsum (calcium sulfate). Photographs illustrating the undulating beds, the blocky fractured condition of the shale and clay seams, are shown on Figure 18. The deeper claystone is generally hard to very hard, thicker bedded, sometimes limy, and no evidence of gypsum filled fractures was found.

The total thickness of gypsum in the upper part of the Lewis Shale, based on a study of drive samples, cores and test pits is estimated to be as much as 2 inches in 50 feet. A continuous flow of water through this horizon of the claystone could cause settlement due to resolution of the gypsum. Such settlement would be more likely in situations where excavations for structures have increased the access of water to the formations.

The claystone is composed of and alters to a silty clay, primarily minus #200 sizes. It has plasticity ranging from a PI 17 to 50. Petrographic studies show that the predominate minerals, in order of decreasing abundance are muscovite, sericite, quartz, montmorillonite, feldspar and kaolinite. The predominating clay mineral is montmorillonite, and the predominating cation is sodium Na_2O, both indicative of a material that will slake when exposed to the air and swell when wetted. Laboratory tests of the upper firm to hard claystone indicate swell of 1% to 8% under a 1 ksf load, and 0.2% under a load of 10 ksf when wetted. Samples of the deeper very hard claystone swelled up to 2% under a load of 20 ksf.

The upper medium hard claystone is moderately compressible with laboratory test consolidation of 0% to 6% under a load of 1 ksf, 1% to 9% at 4 ksf, and 2% to 12% at 10 ksf. The deeper claystones are denser, less fractured and less compressible with laboratory consolidation ranging from 0% for the siltier phases to 5% for the clayier phases under a load of 50 ksf.

Unconfined and triaxial compression tests show a wide range of strength for the upper claystone. The strengths of the deeper, very hard claystone are greater and more uniform. Representative compressive strengths are tabulated below:

UPPER FIRM TO HARD CLAYSTONE

CONFINING PRESSURE (KSF)	NUMBER OF TESTS	COMPRESSIVE STRENGTH - KSF (DEVIATOR STRESS)		
		MINIMUM	MAXIMUM	AVERAGE
0	12	0.9	57	13
4.3	4	7.6	21	12

VERY HARD CLAYSTONE

CONFINING PRESSURE (KSF)	NUMBER OF TESTS	COMPRESSIVE STRENGTH - KSF (DEVIATOR STRESS)		
		MINIMUM	MAXIMUM	AVERAGE
0	2	3.8	23	13
7.2	4	21	68	39

The density of the firm to hard claystone ranged from 95 to 128 pcf, averaging 111 pcf with only 4 tests being below 105 pcf, and the moisture contents ranged from 6% to 24%, averaging 16%. The density of the very hard claystone, excluding the siltstone phase, ranged from 107 to 132 pcf, averaging 123 pcf, and the moisture content ranged from 10% to 19%, and averaged 13%.

Over 100 penetration resistance tests were taken during drilling in the firm to hard gypsiferous claystone stratum. Of these, 3 were less than 30 blows per foot and 28 were less than 50 blow per foot. The mean value for the lower 25% was approximately 35 blows per foot. Sixty penetration resistance tests were performed in the very hard claystone. Of these, all were above 100 blows per foot and the average blow count was about 200 blows per foot. The mean blow count for the lower 25% was approximately 150 blows per foot.

Our experience indicates that laboratory tests generally lead to unrealistically low design values for foundations on clay-shale materials and that more realistic, performance proven criteria can be established utilizing standard penetration blow count data. We believe that the upper claystone is capable of supporting moderately high loads, of the order of 10 ksf, and the deeper, very hard claystone high loads, of the order of 50 ksf with normally tolerable settlements. These values are based on the standard penetration blow count data, as well as the data from laboratory tests with greater weight given to the blow count data, in view of our experience, discussed above. High minimum dead loads will also be desirable because of the swell potential of the claystone. Detailed design criteria are given below for individual structures.

Ground Water

Free water level measurements were made periodically in the test holes, facilitated by installation of slotted plastic pipe in the test holes. Many of these plastic pipes were left in the test holes so additional water level measurements can be made. Measured free water levels are shown on the summary logs of the test holes, Figures 5 through 10.

Free water was found 33 to 65 feet below the proposed plant grade in the westerly, power plant-cooling tower portion of the site, and 22 to 88 feet below finished grade along the coal handling conveyor in the eastern part of the site, and at depth 18 to 50 feet beneath the dead coal storage area. We do not believe that ground water will present a problem with respect to the proposed construction with the exception of the deeper structures in the coal handling area. Dewatering and design for uplift or installation of subsurface drainage systems may be required for some of the coal handling structures, depending on the finally selected structure locations and bottom elevations.

We found no data on the fluctuation of ground water levels. This should be checked. In our opinion, a rise in water level of at least 5 feet above the levels measured in our test holes should be assumed during wetter years or wetter seasons, unless reliable data is found.

Casagrande-type piezometers were installed near the bottom of Holes JB-6, JB-28, and JB-39. These were installed to explore the possibility that artesian pressures were present in the sandstone at depth, particularly where the sandstone is overlain by the Lewis Shale. The water level rose about 4 feet in Hole JB-28 and 14 feet in Hole JB-6 after installation of the piezometers, indicating the possibility of a slight artesian pressure. You may wish to consider converting some of these into permanent piezometers to provide data on water levels in the future.

FOUNDATIONS

General

As currently planned, the power plant facilities will be located in the westerly part of the site, as shown on Figure 1, where the Almond sandstone is overlain by a thin mantle of overburden soils, as shown on the geologic profile on Figure 3. The coal handling facilities are located in the easterly part of the site where the overburden soils are underlain by the Lewis Shale (claystone) and thence by the Almond sandstone. Site grading will create a three-level plant area, stepping down to the east with most of the upper level in excavation, the easterly part of the upper level and the intermediate level created by compacted, structural fill, and the lower level probably mostly in excavation. Sandstone bedrock will be exposed in the excavated portion of the upper level. Overburden soils and claystone will be removed and the structural fill placed directly on the sandstone in the easterly part of the upper level and in the intermediate level. Claystone will be exposed only in the western part of the lower level. Overburden soils will be exposed in the eastern portion of the lower level.

Power plant facility foundations will generally involve the sandstone bedrock and structural fill with only the chimneys, warehouse and fuel oil storage tank close to the sandstone-claystone contact. The coal handling facility foundations will be influenced by overburden soils and the claystone bedrock.

We have considered several types of foundations for the various facilities, as discussed in detail below. Generally, we believe the best type foundations for power plant facilities will be spread footings or mat foundations, placed on the sandstone bedrock where heavy loads or movement-sensitive facilities are involved, and placed on compacted structural fill where loads are light and the facilities less sensitive to foundation movement. I.D. fan foundations and, possibly, the coal mill foundations, deserve special consideration because of vibrations. The best type foundation for the coal handling facilities will be high-pressure spread footings placed on the claystone or piers drilled into the claystone, designed in both cases to concentrate foundation loads to resist the upward forces that will be generated if the claystone becomes wetted.

Power Plant Facilities

Turbine-Generator Building. The steel frame, metal-clad, turbine-generator building will enclose the turbine generator, overhead heaters, coal silos, coal mills, boilers and forced draft fans. The building columns will support much of the equipment and equipment connections vital to the operation of the power unit. There will be a 75-ton crane supported by building columns over the turbine-generator for installation and maintenance of this unit. Each unit of the building will be 110 to 220 feet wide by 300 feet long and the heights will range from 100 feet high on the west to 250 feet high on the east. Building column loads will range up to 850 kips plus low seismic and wind loadings in the western part of the building. Loads of up to 1,660 kips plus much higher seismic loads(1,115 kips vertical)and wind loadings,(300 kips horizontal and 800 kips uplift)will occur in the eastern end of the building. The column-supported boilers in the east end of the building will involve maximum column loads of 3,800 kips plus 300 kips seismic load. These are the most heavily loaded columns in the building.

Sandstone bedrock will be exposed at grade over most of the building, but the eastern end will be overlain by up to 12± feet of compacted structural fill.

We believe the best type foundation for this building and interior equipment, exclusive of the turbine-generator, coal silos and coal mills, and the forced draft fans will be spread footings placed on the sandstone bedrock below frost depth. Footings are normally placed about $3\frac{1}{2}$ feet below finished grade for frost protection in this area. Footings should be placed below the thin ($3\pm$ feet) upper, highly fractured sandstone cap which may be found in excavations in the easterly part of the building and below the underlying, highly altered, thin-bedded, weakly cemented sandstone which will be found under the highly fractured layer in some parts of the area. The moderately cemented sandstone found beneath these materials is generally hard and will support relatively high footing pressures. Our test holes and test pits indicate that pockets or lenses of uncemented sandstone may be found in the footing excavations. Where such pockets are found, based on inspection of the completed excavations by a competent soil specialist, they should be removed and replaced with lean concrete or footings placed beneath them.

Footings placed on the sandstone should be designed for maximum, total soil pressures (dead load and live load) of 10,000 to 15,000 psf, controlled by the weakly cemented sandstone, with the design pressure varied with the column load, and footing size, determined in accordance with criteria given on Figure 15, to minimize differential settlement. Where several heavy columns are located close together, a reduced value should be assumed based on combining the several footings involved.

We estimate that the maximum settlement experienced by footings designed in accordance with this criteria will be of the order of 3/4 inch. Settlement due to dead load will occur essentially concurrent with construction and that due to live load upon the first application of that load. The design pressures should not be increased for wind or seismic loadings.

Resistance to lateral loads will be mobilized by friction between the footings and the underlying sandstone, as well as lateral earth pressure against the footing and foundation wall. We suggest a friction factor of 0.5 between the footing and the underlying sandstone and a lateral resisting pressure of 150 pounds per cubic foot equivalent fluid pressure, plus surcharge where applicable, where structural fill or backfill compacted to 95% density (ASTM D1557) is involved, or 200 pcf equivalent fluid pressure, plus surcharge where applicable when foundations are poured "neat" against the sandstone bedrock.

Resistance to uplift loads will be mobilized by the weight of the foundation and the weight of the backfill soil above the footing and within a 30° angle up and out from the outer top edge of the footing. We suggest that backfill unit weight of 100 pcf be utilized in computing resistance to uplift forces.

You have asked our opinion concerning the use of expanding rock anchors or grouted-in reinforcing bars to resist the uplift loads. Such anchors would be an excellent means of resisting uplift loads if the sandstone were uniformly, well cemented. We do not believe they are appropriate here because of the variable degree of cementation which ranges from weakly to well cemented.

Turbine-Generator. We understand the turbine-generators will be located in the westerly part of the turbine-generator building and will rest on 30 to 40 feet wide by 135 feet long, reinforced concrete mats, that the pressure exerted on the underlying material will be of the order of 3.7 ksf, and that vibrations will be negligible. We believe the mat should be placed on the sandstone bedrock below the caprock and highly altered sandstone, and estimate that post-construction settlement of the mat foundation will be small, probably less than 1/2 inch.

Coal Silos and Mills. Each power unit will have 6 coal silos 23 feet in diameter and 65 feet high, each with a coal mill beneath it, supported by a 42 by 160-foot reinforced concrete mat located in the central part of the turbine-generator building. The silos will exert column loads of the order of 1,790 kips, plus 750 kips maximum seismic load, and the coal mills a load of 270 kips. We understand the vibrations from these units will be negligible. The mat will exert a pressure of 3 ksf on the underlying materials.

We believe the mat should be placed on the sandstone bedrock below the caprock and underlying highly altered sandstone, if found, and estimate that post-construction settlement will be small, of the order of 1/2 inch, or less. Settlement due to dead load will occur essentially concurrent with construction and that due to live, coal loads on the first filling of the silos.

Forced Draft Fans. The forced draft fans will be located in the easterly end of the turbine-generator building. We understand the forced draft (F.D.) fans will be small units placed on 15 by 25-foot footings that will exert a maximum pressure of 0.3 ksf on the underlying materials and will not involve significant vibrations.

Sandstone bedrock will be overlain by 5 to 12 feet of compacted structural fill beneath this part of the building.

In our opinion, the F.D. fans can be founded on the sandstone bedrock or considering the low load exerted on the underlying materials, placed on structural fill compacted to 95% density (ASTM D1557). We estimate that settlement will be negligible if founded on the sandstone and will not exceed 1/2 inch if placed on uniformly compacted structural fill.

Precipitators. As currently planned, the precipitators will be located between the turbine-generator building and the chimneys and will be column-supported. The precipitator type, size, and actual loads were not available at this writing, but we understand maximum anticipated column loads are of the order of 2,250 kips.

Sandstone bedrock in this area will be overlain by 7 to 15 feet of compacted structural fill.

We believe the best type foundation involving the least risk of foundation movement will be to found the precipitators with spread footings on the sandstone bedrock, designed in accordance with criteria given above for the turbine-generator building, particularly since the turbine-generator building on the west and the chimneys on the east will also be founded on the sandstone.

An alternative that involves more risk of foundation movement, but may be acceptable if these units are not movement-sensitive, would be to found them with spread footings below frost depth on the structural fill. Footings placed on structural fill constructed of the granular materials from required excavation and compacted to 95% density (ASTM D1557) should be designed for a maximum soil pressure of 5,000 psf.

We estimate that settlement of footings designed in accordance with this criteria will experience.total settlement of the order of 3/4 inch if founded on the sandstone, and 2 inches if founded on the structural fill, with settlement due to dead load occurring concurrent with construction and that due to live load on first application of that load.

<u>Induced Draft (I.D.) Fans</u>. As currently planned, the I.D. fans will be located between the precipitators and the chimneys. The rotor will be on a horizontal shaft 14 feet above the ground surface supported by a reinforced concrete column, will weigh

approximately 70 kips and will rotate at frequencies of the order of 590 to 710 rpm. The total weight of the fan assembly will be about 170 kips and we understand it will be placed on a 40 by 40-foot, 6-foot thick, reinforced concrete mat that will exert a maximum soil pressure of 1 kip per square foot on the underlying material.

Structural fill 5 to 10 feet thick will overlie sandstone bedrock in the area of the I.D. Fans.

Laboratory tests were performed using the "Hardin Device" (equipment, procedures and results presented in Appendix G) to obtain preliminary data on the shear moduli of the sandstone bedrock. The results indicate moderately high but variable shear moduli and do not, in our opinion, provide a firm basis for design.

This type structure often causes large dynamic responses from three causes: (1) resonance or near resonance of machine foundation system; (2) wave reflection from hard layers under the foundation, and less frequently (3) imbalance due to malfunctions of the machinery which is not considered.

In our opinion, the mat supporting the fans should be placed on the sandstone bedrock to minimize potential wave reflection problems. It may be possible to use smaller footings at depth and provide equal or better damping. We believe Rayleigh wave tests should be performed in the field on the structural fill and the sandstone bedrock after completion of site grading and determination of the type of equipment which will be used. We also suggest monitoring the dynamic response of a concrete block constructed at the site. The stress excursions inherent in these field tests would be of the same magnitude as that of the preliminary laboratory tests performed for this study.

An effective dynamic design for the I.D. fans should include a study of the following items:

(1) Both operating and beat frequencies should be considered in all response calculations.

(2) The acoustic impedence of the relatively hard sandstone should be reviewed with respect to the overlying soil to assess the reflection potential. The interface between cut and fill should be included in this study.

(3) A check should be made to determine if the frequency of the reflected vibrations coincides with the operating frequencies to enable a design change, if necessary, to prevent destructive resonance.

(4) Careful consideration should be given anticipated dynamic loads.

(5) After adequate determinations of the areal dynamic soil properties and dynamic loads are made, the dynamic response of the machine-foundation soil system should be

determined so that modifications can be made, if necessary, to reduce excessive response.

(6) It is important that the foundation be made substantially stiffer than the soil-structure-foundation system and that the natural frequency of the structure be as far from that of the soil-structure-foundation as practical. As a guide to the stiffness requirement, we believe the foundation slab alone should have adequate stiffness transverse to the rotor shaft so that its natural frequency calculated in bending for free support conditions is at least five times that of the maximum operating frequency of the fan.

Present indications are that the natural frequencies in the translation modes will be closer than that of the rocking mode to the fan's operating frequency. The damping associated with rocking mode, however, will be much lower than those with translation modes. Based on our experience with similar facilities and our familiarity with this project, we believe the rocking mode will be more critical.

Chimneys. The chimneys will be about 550 feet high, located 300 feet east of the turbine-generator building, as shown on Figure 1. We understand that an 80-foot diameter mat foundation supporting a chimney would exert pressures on the underlying materials of the order of 7 ksf for dead load and 10 ksf for dead and wind load.

Our test holes indicate that sandstone bedrock will be beneath the chimneys.

The chimneys should, in our opinion, be founded with mat foundations on the hard sandstone bedrock. The mat should be placed below the upper, highly fractured "cap layer" of sandstone and the underlying thin, highly altered, thin-bedded sandstone, if these materials are found in the excavation.

We estimate that maximum total settlement of a mat placed on the hard sandstone, subjected to the loads given above, will be of the order of 1 to 2 inches. Settlement due to dead load should occur essentially concurrent with construction and that due to live load on first application of that load. Differential settlement should not exceed 1/3 of the total settlement.

Main Transformers. The main transformers will be located west of the turbine-generator building and supported by mat foundations that will exert a maximum pressure of 2 ksf on the underlying materials.

The mats should, in our opinion, be placed below frost depth on the sandstone bedrock which will be exposed at plant grade here. The sandstone is easily capable of supporting mats exerting these low pressures and settlement should be negligible.

<u>Office Building</u>. As currently planned, the one-story high, steel frame, metal-clad, non-basement office building will be located near the southwest corner of the turbine-generator building, as shown on Figure 1. Maximum column and wall loads were not available at this writing, but we assume they will be light, typical of this type and height construction. In our opinion, the building should be founded with spread footings below frost depth on the sandstone that will be exposed at plant grade in this area. Footings should be designed for the maximum pressures given above for the turbine-generator building. Foundation walls for continuous footings should be well reinforced. We suggest a minimum amount of steel equivalent to that for a simply supported span of 15 feet.

<u>Warehouse</u>. We understand the one-story high, steel frame, metal-clad, non-basement warehouse will be located southeast of the turbine-generator building, as shown on Figure 1.

Site grading here will involve removal of the thin overburden soils overlying the sandstone bedrock and placement of 15± feet of compacted structural fill to achieve plant grade. In our opinion, the warehouse should be founded with spread footings below frost depth on structural fill compacted to 95% density (ASTM D1557). Footings should be designed for a maximum soil pressure of 5,000 psf. Foundation walls for continuous footings should be well reinforced. We suggest a minimum amount of steel equal to that for a simply supported span of 15 feet.

We believe settlement of the fill itself will occur essentially concurrent with construction, as will settlement of the footings placed thereon because of the granular nature of the fill soils. Post-construction settlement of the fill and the warehouse foundations, designed in accordance with these criteria, should be negligible unless the fill becomes wetted. The fill might settle as much as 1% of it's thickness upon being wetted, but this should not involve significant differential settlement.

Fuel Oil Storage Tank. A steel fuel oil storage tank will be located southeast of the warehouse, as shown on Figure 1, and will be 31 feet in diameter, about 20 feet high and will exert 1 ksf maximum soil pressure on the underlying materials. As currently planned, the tank will be placed on a 2-foot thick oil-sand fill.

Site grading at the tank site will involve removal of the thin overburden soils and placement of 20± feet of structural fill to achieve plant grade.

In our opinion, structural fill compacted to 95% density (ASTM D1557) will easily support the planned storage tank. We estimate settlement of the tank with respect to the fill will be small, of the order of 1/2 inch, and will occur essentially concurrent with filling of the tank.

Cooling Towers. As currently planned, three cooling towers approximately 50 feet by 400 feet in plan dimension will be constructed at the locations shown on Figure 1, on shallow concrete basins with thin concrete mat bottoms. Basin depth will be of the order of 5 feet over most of the length, sloping down to 17 foot deep collection sumps at the west ends. We understand maximum soil pressures exerted on the materials beneath the mats are not expected to exceed about 1 ksf.

Our test holes indicate that sandstone bedrock is overlain by a thin mantle of overburden soils in the cooling tower area. As currently planned, the sandstone bedrock will be exposed by site grading in most of the cooling tower area and 5 to 15 feet of structural fill will be required, after removal of the thin overburden soils, to achieve plant grade at the extreme easterly end of the cooling towers.

The cooling towers can be founded with a mat foundation on a combination of the sandstone and structural fill, compacted to 95% density (ASTM D1557). Settlement of the fill itself should occur essentially concurrent with construction, as will settlement of the basin because of the granular nature of the sandstone and the fill soils. We estimate that "load induced" settlement will be small, probably not exceeding 1 inch where placed on fill and 1/2 inch where placed on sandstone. However, our experience indicates that basin leakage will occur, despite the best precautions, wetting the foundation soils. Settlement of the sandstone on wetting should be negligible, but we believe some settlement of the fill will occur on wetting, probably of the order of 1% of the thickness of the fill. If this amount of settlement is not tolerable, the structures should be founded entirely on the sandstone bedrock. You may wish to consider the alternate of founding the cooling towers on compacted Portland cement stabilized fill (soil cement).

Coal Handling Facilities

General. The coal handling facilities will be founded in an area entirely underlain by varying thicknesses of claystone. The upper claystone, up to about 50 feet thick, is predominately firm to hard claystone which has been subjected to alteration in widely varying amounts. It has been fractured and the fractures are filled with selenite (soluble crystalline gypsum). The claystone is capable of supporting moderate loads but the possibility of resolution of the selenite seams, which we estimate have an aggregate thickness of the order of 2 inches, should be considered since there is always a possibility of flow of water from the man-made facilities uphill and upstream of the site of the coal handling structures. The deeper claystone and the underlying sandstone is harder, does not contain gypsum seams, and is capable of supporting heavy loads. The claystone will swell on wetting.

The location and details of the various coal handling structures have not been firmly established at this writing. Two schemes, Scheme A and Scheme B are currently under consideration. The locations of the structures for these two schemes are shown on Figure 1. Proposed bottom levels for the various structures are shown on Figures 9 and 10 for both schemes.

The coal handling facilities will include a coal truck dump structure, primary and secondary crushers, a reclaim hopper-feeder, live coal and dead coal storage, possibly an A-Frame coal handling structure and connecting conveyors. These structures, subsurface conditions at each location, and our recommendations are discussed in detail below.

Coal Truck Dump. The coal truck dump structure will be 50 by 50 feet in plan dimension and 50 feet deep, of reinforced concrete construction and will be located east of the primary crusher, somewhere in the vicinity of Test Holes JB-24 and JB-64, depending on whether Scheme A or Shceme B is chosen. It will contain a hopper into which 120-ton coal trucks will dump, and a feed system down onto a conveyor which will convey the coal up to the west through a tunnel to the ground surface and thence to the top of the primary crusher.

If Scheme A is used, the structure will be underlain directly by the upper, firm to hard claystone. If Scheme B is chosen, the structure will be further to the east and will be underlain by approximately 5 feet of alluvial sands which in turn are underlain by firm to hard claystone. The claystone is capable of supporting moderately high loads, but will swell on being wetted and could experience settlement due to resolution of the gypsum seams,if they are subjected to continuous flow of water.

Free water was found about 10 feet below the bottom level of the structure in Test Hole JB-64 near the Scheme B location, 43 feet below the bottom of the structure in JB-24, the next hole to the west, and 8± feet above the bottom level in JB-28, 225 feet further west. We are unable to.explain the low water level in Hole JB-24, and suggest for design purposes that the water level be assumed to vary on a straight line basis between Holes JB-28 and JB-64. This would place the free water level in the vicinity of the bottom of the Scheme A structure.

In our opinion, the structure should be founded with spread footings on the claystone bedrock. The footings should be designed for a maximum soil pressure of 10,000 psf and a minimum dead load pressure of 5,000 psf, or as high as practical to resist the upward forces generated by the swelling claystone on being wetted. A 6-inch minimum air space should be provided beneath the grade beams between the footings to enable effective concentration of loads on the footings. Obtainable structure dead load can be supplemented by extending footings beyond the outer wall of the structure and mobilizing the weight of backfill above the footings and within a 30° angle from the vertical up and out from the top, outer edge of the footing.

An alternative that would involve less risk of foundation movement would be straight-shaft piers drilled into the claystone bedrock. The piers would enable more effective resistance to upward forces by reinforcing them full length to function as anchors to supplement available dead load. Access for pier drilling rigs into small, deep excavations is difficult and the cost of enlarging the excavation may be prohibitive. Generally, in such cases, piers are drilled from a higher elevation and concrete is placed in the pier up to foundation level prior to completion of the excavation.

Piers should be drilled a minimum of 5 feet into the claystone bedrock. Piers bottoming in the upper firm to hard gypsiferous claystone should be designed for a maximum end pressure of 10,000 psf, a maximum side shear of 1,000 psf (exclusive of the top 5 feet of pier) and a minimum dead load pressure of 25,000 psf, based on pier cross-sectional area at the top to resist the upward forces generated by the swelling clays and claystone. Piers bottoming in the deeper, very hard claystone should be designed for a maximum end pressure of 50,000 psf and a maximum side shear of 1,000 psf for the portion of the pier in the firm to hard claystone, and of

5,000 psf for that portion of the pier in the very hard claystone. The sides of pier holes in the very hard claystone should be grooved to assure development of side shear. The grooves are normally cut with a retractable tooth mounted on the auger, are spaced 18 inches to 2 feet apart, extend at least 2 inches beyond the sides of the pier hole, and are 3 to 6 inches wide. Piers bottoming in this phase of the claystone should also be designed for a minimum dead load pressure of 25,000 psf. A 6-inch minimum air space should be provided beneath grade beams between the piers to concentrate the loads on the piers.

Where the minimum dead load requirement cannot be met on lightly loaded piers, we suggest the piers be reinforced with sufficient steel to take the difference between the "desired" and "obtainable" dead load in tension. The uplift resistance required to mobilize the strength of the tensile steel can be developed by side shear between the pier and the claystone, using the same side shear values as for downloads, provided the sides of the pier hole are grooved or otherwise artificially roughened. The top 5 feet of the pier should not be grooved and no credit should be taken for side shear resistance in this portion of the pier.

Belled piers may also be used, but we prefer the straight-shaft since a large part of the load is taken in side shear and a large portion of the bearing stratum can be inspected during construction. Only the top of the bearing stratum can be inspected where "end-bearing" belled piers are used. Belled piers should be designed for the same maximum end pressures and minimum dead load pressures given above for straight-shaft piers. No credit should be taken for side shear on the shaft above the bell. Uplift resistance will be provided by the weight of bedrock and soil in a 45-degree truncated cone above the bottom of the bell. We suggest a unit weight of soil and bedrock of 100 pcf. Pier reinforcement should be carried to the bottom of the bells to develop the uplift resistance. Belling piers in the very hard claystone may be difficult and may require hand excavation, which is costly in this area.

Pier holes should be dewatered prior to placement of concrete to permit hand cleaning and inspection. Temporary casing will be required in overburden soils for the safety of personnel and to facilitate dewatering and cleaning prior to placing concrete. We suggest a minimum pier shaft diameter of 30 inches.

Our test holes indicate that free water will be at or close to the bottom of the Scheme A structure. The structure should be designed for hydrostatic uplift compatible with a 5-foot rise in water level above measured levels, or a subsurface drainage system provided. Such a system could consist of 6 inches minimum of clean, free-draining gravel connected to a peripheral drain consisting of a 6-inch minimum perforated or open-joint tile laid in a gravel filled trench, placed 2 feet minimum below the bottom slab and graded to drain to a pumped sump. Clean, free-draining gravel should be used for backfill around the structure up to at least 5 feet above free water level and should also be connected to the peripheral drain. If a structural bottom slab is used, as discussed below under "FLOOR SLABS",the surface of the air space beneath it should be graded to drain to a pumped sump.

Dewatering could be required to permit construction of the Scheme A structure, depending om the finally selected location and the water level at the time of construction. We believe such dewatering can be done by sump pumping from within the excavation.

The structure should be designed for the lateral earth pressures discussed below under "Lateral Earth Pressures".

<u>Crushers</u>. These structures will be similar to the coal truck dump, containing hoppers, crusher and conveyor facilities. We believe these structures should be founded in accordance with criteria given above for the coal truck dump structure. Details of each of these structures are set forth below.

The primary crusher will be 35 feet by 60 feet by 55 feet deep, and its foundation will be approximately 5 feet above the top of the very hard claystone for Scheme A, and about 15 feet above the top of the very hard claystone for Scheme B. Ground water will be close to the bottom of this structure and should be handled as discussed above for the coal truck dump structure.

The secondary crusher will be 50 by 50 feet by 22 feet deep, and will be at the same location for Schemes A and B. The bottom will be in the firm to hard claystone bedrock. Ground water in this vicinity is indicated to be of the order of 10 feet below bottom of structure and subsurface drainage should not be necessary.

Reclaim Hopper-Feeder. The Scheme B reclaim hopper-feeder will be approximately 700 feet south of the secondary crusher, connected to the crusher by a conveyor. The structure will be approximately 35 by 60 feet by 55 feet deep. The bottom of the structure will be at or near the top of the Almond sandstone. Our test holes indicate free water 25± feet above the bottom of the structure.

In our opinion, the structure should be founded with spread footings on the sandstone, designed in accordance with criteria given above for the turbine-generator building. Shallow ground water will require dewatering during construction, which we believe can be done by pumping from within the excavation, and design of the bottom slab for uplift or provision of subsurface drainage as discussed above for the coal truck dump structure.

"A-Frame" Coal Handling Structure. This structure will be approximately 100 feet by 300 feet in plan dimension, consisting of a long, buried, 20 foot bottom width, trough-shaped hopper bottoming 48 feet below grade, with reinforced concrete walls sloping up and out from the bottom at an angle of 55 degrees above horizontal to the ground surface. Above ground surface the coal will be supported by 33-foot high retaining walls along each side of the hopper with compacted backfill placed outside them. The coal will reach a maximum height of approximately 68 feet midway between the two retaining walls.

At its current location the bottom of the structure will be in or just above the very hard claystone and the sloping underground hopper walls would be supported by a firm to hard gypsiferous claystone. The retaining walls will extend upward from the top of the firm to hard claystone.

In our opinion, the retaining walls should be founded with spread footings on the firm to hard claystone, or with less risk of foundation movement, with piers drilled into the claystone bedrock. Footings or piers should be designed in accordance with criteria given above for the coal truck dump structure. We believe the potential for movement of the sloping hopper walls is quite high due to the swelling properties of the claystone, although such movement may be partially restrained by the stored coal. Ground water at this site is from 10 to 20 feet above the bottom of proposed structure and subsurface drainage will have to be provided, or the side walls and bottom slab designed for hydrostatic uplift. Such drainage should consist of 8 inches minimum of clean, free-draining gravel placed beneath the sloping walls and bottom slab, graded to drain to perforated or open-joint collector pipes placed in a clean gravel filled trench on either side of and 2 feet minimum below the bottom slab, which are, in turn, graded to drain to a pumped sump.

We understand consideration is being given to restricting the lateral movement of the retaining walls with cross-walls. If lateral movement is restricted, we believe the walls should be designed for earth pressure "at rest", in accordance with criteria given under "Lateral Earth Pressures"below. If lateral movement of the retaining walls is not restricted, they may be designed for "active" earth pressure.

Conveyors. The Scheme A conveyor will exit at the bottom of the 50± foot deep coal dump structure, rise to the ground surface in a tunnel, continue upward to the top of the primary crusher, exit near the bottom of the 55-foot deep primary crusher, rising to the ground surface in a tunnel, continue upward to the top of the conical live coal storage facility, rise from beneath the storage pile in a tunnel to the ground surface, continue upward to the top of the secondary crusher, exit in a tunnel from the bottom of the 22-foot deep secondary crusher and continue on above ground to the power plant. Another conveyor will transport coal from a stacker-reclaimer between two parallel live coal storage piles at the location shown on Figure 1 to the secondary crusher.

The Scheme B conveyor will be similar to that for Scheme A, except that it will go from primary crusher to the "A-Frame" coal handling structure and thence to the conical live coal storage pile, etc. A second conveyor will exit in a tunnel beneath a 55-foot deep relcaim hopper-feeder, rising to the top of the secondary crusher.

We understand that movement of conveyor supports is not particularly critical, except at junctions of the conveyors with major structures where heave or settlement of the tunnels or supports could cause binding of the conveyors.

We suggest that connections of conveyor tunnels and major structures be made as flexible as practical in view of the possibility of upward movement of structures because of wetting of the swelling claystone. Longitudinal adjustments of the conveyors would also be desirable. Subsurface drainage should be provided beneath conveyor tunnels where they will be at or below ground water, connected to the subsurface drainage system provided for adjacent structures, where applicable.

Foundations for the conveyor can be either spread footings or drilled piers. We understand that the conveyor is somewhat flexible and adjustments can be made in its support to allow for some settlement or heave of the foundations. In the power plant area we suggest that the conveyors be founded with spread footings on the sandstone or structural fill, designed in accordance with criteria given for the turbine-generator building and equipment. East of the chimneys, where the plant grade drops onto the claystone, the conveyor supports can either be founded with (1) spread footings on the firm to hard claystone designed for a maximum soil pressure of 10,000 psf and a minimum dead load pressure of 5,000 psf (or as high as practical), or (2) with straight-shaft piers drilled into the claystone bedrock, designed in accordance with criteria given above for the coal truck dump structure. The piers would involve less risk of foundation movement as the conveyor proceeds easterly,spread footings on the natural overburden soils below frost depth may be appropriate. We suggest that spread footings on these soils be designed for a maximum soil pressure of 2,000 psf if the claystone is 5 feet or more below the footing level. If the claystone is within 5 feet of the footing level, we suggest that the footings be carried down to the top of claystone and designed for pressures discussed above, or that the conveyor be founded with drilled piers. The deeper, dense alluvium will support footings with pressures of 5,000 psf.

If the conveyor is founded with drilled piers, a single pier should be used for each column. If the columns are tied together at the top with a cap or tie-beam, 6-inch minimum air space should be provided beneath this part of the structure to enable concentration of pier dead loads.

There are some very hard layers in the claystone, especially at the contact between the claystone and the underlying sandstone. Penetration of these layers will require heavy pier drilling rigs, such as a Williams LDH or LLDH, and may require coring.

Lateral Earth Pressures. The lateral earth pressures on the vertical walls of the coal handling structures or retaining walls will depend on the height of the wall, the tolerable movement of the wall, the type of soil used for backfill, and the density to which it is compacted. In our opinion, the walls of the coal truck dump, crushers and reclaim hopper-feeder structures should be designed for "at rest" earth pressures as these walls will probably not be able to tolerate the magnitude of movement necessary to develop the shear strength of the soil behind the wall. In our opinion, an "at rest" pressure of 70 pcf equivalent fluid pressure, plus hydrostatic pressure and surcharge, where applicable, should be used if the on-site soils are used to construct the backfill and it is compacted to 95% density (ASTM D1557). If the clayier of the on-site soils are used for backfill they should be placed at a moisture content between the optimum and 4% above the optimum to minimize the potential swelling of these soils if wetted. The lateral pressure could be reduced to 60 pcf equivalent fluid pressure, plus surcharge where applicable, if clean, free-draining sand and gravel, compacted to 95% density, is used for backfill and the backfill is drained.

Where normal retaining wall movements are tolerable, enabling mobilization of the shear strength of the soil, as may be the case for the "A-Frame" coal handling structure, "active" earth pressure may be used. We suggest the use of 35 pcf equivalent fluid pressure plus hydrostatic pressure and surcharge, where applicable, if on-site soils, compacted to 95% density are used for backfill. The pressure may be reduced to 30 pcf equivalent fluid pressure plus surcharge where applicable if clean, free-draining sand and gravel compacted to 95% density is used for backfill and the backfill is drained.

Excavation Slopes. We believe temporary excavation slopes in the overburden soils, as well as slopes higher than 10 feet in the claystone should be 1:1, or flatter. The claystone will probably stand vertically for short periods of time for heights up to about 10 feet. However, safety of the slopes would be questionable for heights greater than 10 feet. In our opinion, the claystone will also stand on temporary 1:1 slopes below the water table.

FLOOR SLABS

Power Plant Facilities

As currently planned, lower power plant facility floors will be underlain by sandstone bedrock or fill or backfill constructed of sandstone from required excavation compacted to 95% density (ASTM D1557). The sandstone will support heavy floor slab loads with negligible movement. Structural sand fill compacted to 95% density (ASTM D1557) will support normal, lightly loaded floor slabs but we recommend that 6 inches minimum of high quality base course compacted to 100% density (ASTM D1557) be placed beneath heavily loaded slabs or slabs that will be subjected to wheel loads. Some settlement of the structural fill will occur if it becomes wetted. The risk of this occurring is probably low but we believe it should be considered in design and suggest that settlement equal to 1% of this thickness of the fill be assumed.

Coal Handling Facilities

"Bottom slab" in the various coal handling structures will be underlain by swelling claystone bedrock. The claystone is stable at its natural moisture content, but will swell on wetting, causing heave of slabs which cannot be economically controlled by concentration of slab loads. The most positive solution, to our knowledge, is the use of a structural floor supported by the walls, with an air space beneath. This is quite expensive, but we believe the expense is warranted where slab movement is critical. Where floor slab movement is not critical and the owner decides to accept the substantial risk of movement and damage involved in any other alternative, we suggest the following handling of slab-on-grade floors:

(1) Eliminate the usual gravel layer beneath the slab, except as necessary for subsurface drainage.

(2) Separate the slabs from bearing members and provide moderate reinforcement, continuous through interior slab joints.

(3) Avoid underslab plumbing where practical. Where such plumbing is unavoidable, it should be pressure tested during construction to minimize the possibility of leaks with resultant wetting of foundation soils. Backfill of underslab plumbing trenches should be constructed of carefully compacted, impervious soils.

(4) Provide a 3-inch minimum air space above or below interior, non-load bearing partitions.

The above will not prevent movement in the event the subsoils become wetted. However, damage from this movement, if it occurs, will be materially reduced for a relatively small investment. Fill placed beneath floor slabs should be compacted to 95% density (ASTM D1557) at a moisture content at or above the optimum.

ON-SITE ROADS

We understand that there will be a network of bituminous surfaced roads around the power plant building and along conveyor lines, designed for an H20-S16 loading.

The sandstone bedrock and structural "sand" fill compacted to 95% density (ASTM D1557) will provide good subgrade support. We suggest that standard Wyoming Highway Department design practices be used in design of these pavements.

Where roads are located in claystone areas, the claystone will swell upon wetting, causing heave and cracking of pavements. In such areas, we suggest that consideration be given to overexcavating a minimum of 5 feet below subgrade level and backfilling the over-excavation with on-site silty sands compacted to 95% density (ASTM D1557) in order to minimize abrupt differential movements. A pavement section similar to that for pavement in the structural "sand" fill areas could then be used in these areas. Similar treatment would be desirable where roads are constructed in the low parts of the site as the upper 3 to 5 feet of the natural soils are of low density and will probably settle upon wetting.

SITE GRADING

We understand site grading will start soon in the power plant area and the grades will be approximately as shown on Figures 3 through 7. Excavation in this area will involve mostly sandstone with lesser amounts of overburden soils. We have no knowledge of site grading planned in the easterly coal handling portion of the site, but our present understanding of finished grade at the various structures is shown on Figures 10 through 12.

Excavation of the overburden soils will, in our opinion, be relatively easy and can be done with normal earthwork equipment. Some of the soils are very hard, dry and calcareous and ripping may be expedient but we do not believe it will be required. Excavation of the underlying sandstones will be somewhat more difficult. The softer sandstones can probably be excavated without ripping, but the hard, highly fractured "cap" layer we found at the surface of the sandstone, especially in Test Pits 3 and 8, as well as some of the deeper moderately to strongly cemented sandstone, will require ripping. A photograph of ripping the "cap" sandstone is shown on Figure 19. Our explorations indicate that the sandstone can be excavated by a D-9 tractor equipped with a hydraulic, single-tooth ripper. Pit excavation rates were recorded and are shown on the detailed logs in Appendix K. The test pits were excavated with a 180 Michigan loader-dozer with an eleven foot blade or a D-8 Caterpillar tractor with a hydraulic single-tooth ripper.

We believe the overburden soils and the upper, highly weathered sandstone will stand on temporary excavation slopes of 1:1 and the deeper, less altered sandstone on near-vertical temporary slopes. Permanently exposed excavation slopes should, in our opinion, be 2:1 (horizontal to vertical), or flatter. Surface water should be diverted around excavation slopes by ditching or some other means.

In our opinion, with the exception of the harder sandstone cap, the sandstones will break down sufficiently during excavation, hauling, placement and compaction operations to be suitable for fill as will the overburden materials after removal of vegetation. A photograph of the spoil pile from Test Pit 2 is shown on Figure 19. The very hard sandstone "cap" materials or other very hard sandstone layers that won't readily break down could be used as temporary road surfacing materials during construction or placed on exterior fill slopes as erosion protection.

The thin, 2 to 3 foot average, overburden soils are low density and will settle on wetting. We believe the overburden soils should be removed beneath compacted fill. The overburden materials removed will be satisfactory for construction of compacted fill.

A small amount of claystone (shale) will be removed in site grading excavation. We believe it can be easily mixed with the sands and sandstone and spread over large areas of the embankment.

In our opinion, compacted fill should be placed in 8-inch maximum, loose lifts and compacted to 95% density (ASTM D1557-66T). The fill materials should be readily compactable with heavy (50-ton) rubber-tired rollers or heavy, high input vibratory rollers for the more granular soils. A loose surface layer often develops during construction of fine sand fills where the materials are allowed to dry before placement of the next lift. Drying of the surface soils will be rapid here because of the arid, windy climate. This permits the soils to loosen under the influence of traffic. Where this occurs, wetting and recompaction should be required prior to placement of subsequent lifts.

The soils are generally quite dry and will require substantial quantities of water before compaction. Water is somewhat scarce in the area. We believe a separate payment item may be advisable for water in this case. Since the soils are relatively pervious, we believe watering on the fill will be more effective and probably more economical than pre-irrigation of the excavation areas.

Permanent fill slopes should, in our opinion, be 2:1, or flatter. A 3:1 slope would require less maintenance. Consideration should be given to providing erosion protection on fill slopes as the soils will be highly erodable. Diversion of water away from the fill slopes would also be desirable.

CONSTRUCTION PROBLEMS

Although our investigations indicate that the sandstone can be ripped with heavy equipment, light blasting or air spades may be necessary or expedient to excavate the harder phases of the sandstone in confined quarters, inaccessible to heavy equipment. In our opinion, blasting should be minimized as it will tend to damage the foundation soils and air spades used wherever practical. If blasting is used, shots should be small and all material loosened either by fracturing or by gas pressure should be removed prior to placement of foundations.

WETTING OF FOUNDATION SOILS

Wetting of foundation soils always causes some degree of volume change in the soils and should be prevented during and after construction. Normal methods of doing this include placement and compaction of impervious backfill around structures, provision of a good grade for rapid runoff of surface water away from the structures and discharge of roof downspouts and other water collection systems well beyond the backfill, in addition to other usual precautions which may be indicated during design and construction.

SULFATE RESISTANT CEMENT

Laboratory tests on samples of the upper firm to hard claystone selected as representative, indicated high percentages of water soluble sulfates, primarily in the form of selenite gypsum (calcium sulfate). Practically no gypsum was found in the deeper very hard claystone or in the sandstone bedrock, although one thin layer of selenite crystals was found in a lignite seam in the sandstone and the petrographic studies indicated that some of the sandstone contains an estimated 1 to 3% gypsum.

According to standards published by the U. S. Bureau of Reclamation, Type V cement should be used in concrete exposed to foundation soils. A rich mix of Type II cement has often proved satisfactory under similar conditions. We understand there is a local manufacturer of a Type II Modified Portland cement which reportedly is more resistant to sulfate attack than standard Type II. We suggest that local practice govern on this point.

INSPECTION OF CONSTRUCTION

Although test holes and test pits were spaced closely to obtain a reasonably accurate foundation picture, variations in subsurface conditions not indicated by the test holes or pits frequently occur. Soils and rock, by their nature, vary so much it is not possible to cover all eventualities. It is important that foundation excavations be continuously inspected by a competent soil specialist to enable recognition and proper handling of conditions differing from those indicated by our investigations, if exposed, and thus reduction of the risks always present in work involving the underground. Placement and compaction of fill and backfill should be continuously inspected by a qualified soil specialist to assure the use of appropriate soils in the fills as well as proper placement and compaction procedures. Careful records should be kept of the energy input during compaction of the fills, as well as the densities obtained. We will be happy to provide these inspections, if desired.

Investigations and analyses for this report have been made under the supervision of Mr. Guy F. Tabor, Jr., who also prepared the draft of the report. Information on the structures was provided by Messrs. Sotelo, Fletcher, Ellis and Ferris of the Bechtel Corporation. This report has been reviewed and approved by the undersigned Principal of our firm.

If we may be of further service in discussing the contents of this report, or in analyses of structural features from the soil and foundation viewpoint, please feel free to call on us.

By S. T. Thorfinnson

S. T. Thorfinnson
Senior Vice President

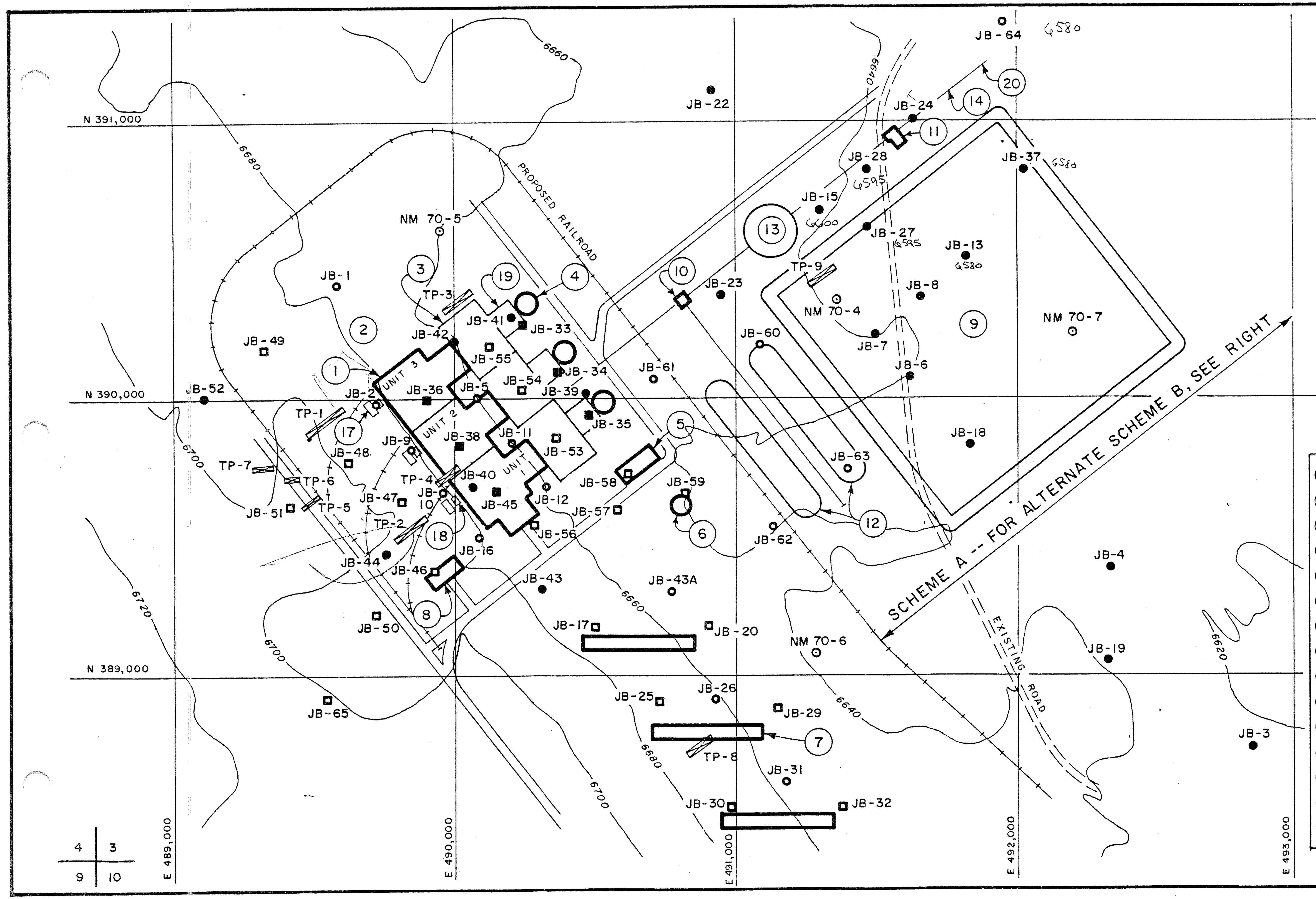
S. T. THORFINNSON
REGISTERED
536
PROFESSIONAL ENGINEER
STATE OF WYOMING

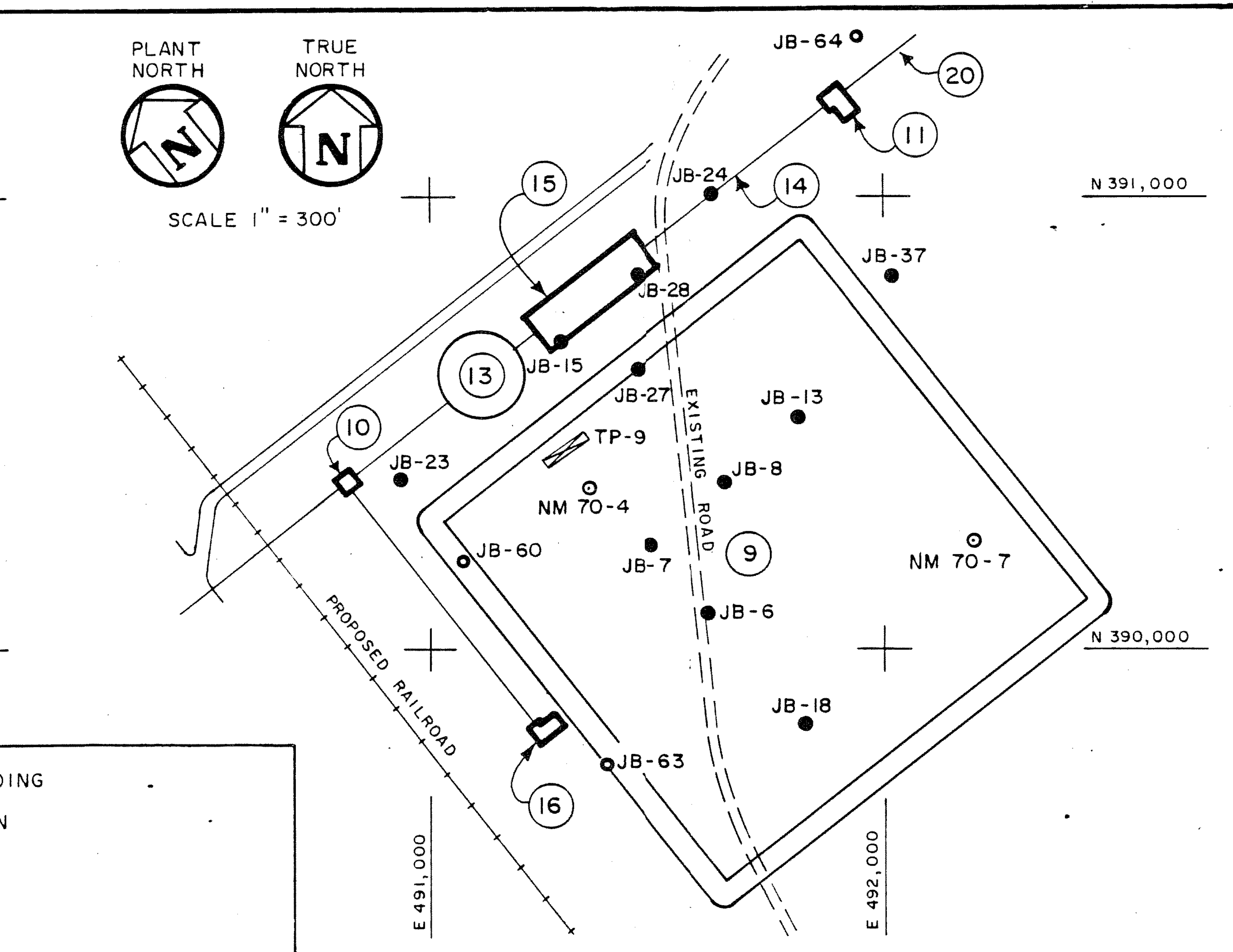
GFT:m

(10 copies sent)

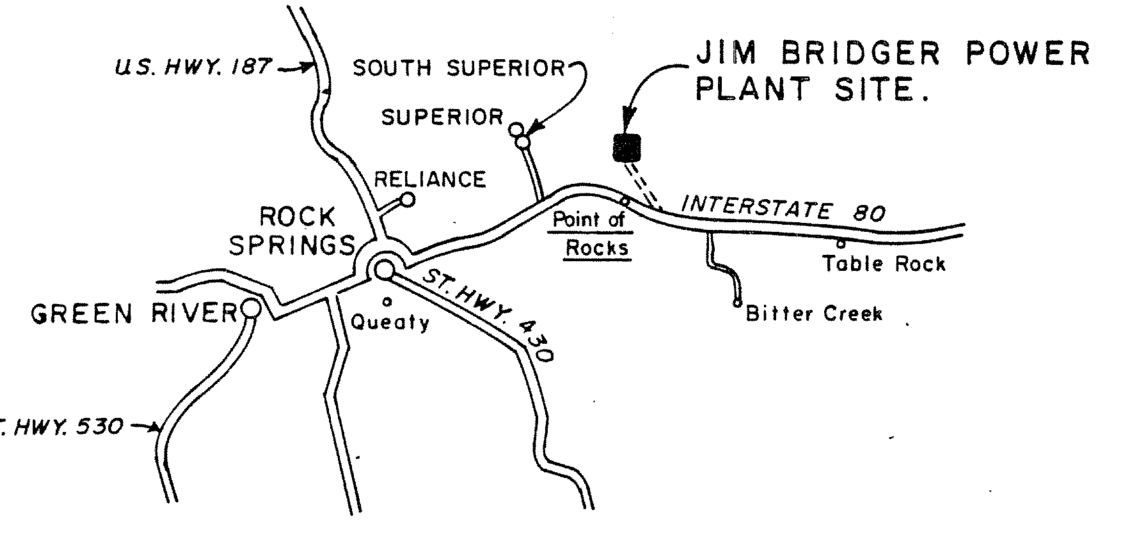
3 cc: Mr. G. J. Hall, Vice President
Idaho Power Company

3 cc: Mr. G. L. Beard, Senior Vice President
Pacific Power & Light Company





SCHEME B



VICINITY MAP

SCALE 1" = 18 MILES

(1) TURB./GEN. BUILDING	(16) RECLAIM HOPPER & FEEDER
(2) FUTURE ADDITION	(17) MAIN TRANSFORMERS
(3) PRECIPITATORS	(18) UNIT AUXILIARY TRANSFORMERS
(4) CHIMNEY	(19) I.D. FANS
(5) WAREHOUSE	(20) COAL DUMP STRUCTURE
(6) FUEL OIL STORAGE	
(7) COOLING TOWERS	
(8) OFFICE BUILDING	
(9) COAL STORAGE (STAND-BY)	
(10) BIN & SECONDARY CRUSHER	
(11) HOPPER & PRIMARY CRUSHER	
(12) COAL STOCKPILE (LIVE)	
(13) COAL STOCKPILE (LIVE)	
(14) CONVEYOR	
(15) 'A-FRAME' COAL HANDLING STRUCTURE	

LEGEND

NM 70-4 ○ CORE HOLES DRILLED MARCH 1970.

JB-7 ● CORE HOLES DRILLED MAY 7 THRU JULY 16, 1970. OVERBURDEN DRILLED BY AIR OR MUD ROTARY MEANS. NO CORE IN HOLES JB-14 OR JB-21.

JB-17 □ DRIVE SAMPLE HOLES DRILLED JULY 6 THROUGH JULY 16, 1970.

JB-26 ○ ALTERNATING DRIVE SAMPLE AND PITCHER SAMPLE HOLES DRILLED JULY 8 THROUGH JULY 28, 1970.

JB-36 ■ PITCHER SAMPLE HOLES DRILLED JULY 8 THROUGH JULY 27, 1970.

TP-7 ⊠ TEST PITS EXCAVATED WITH BULLDOZER JULY 10 THROUGH JULY 30, 1970. DRAWN APPROXIMATELY TO SCALE.

NOTES:

HOLES ARE LOCATED APPROXIMATELY TO SCALE. COORDINATES WERE FURNISHED BY IDAHO POWER COMPANY.

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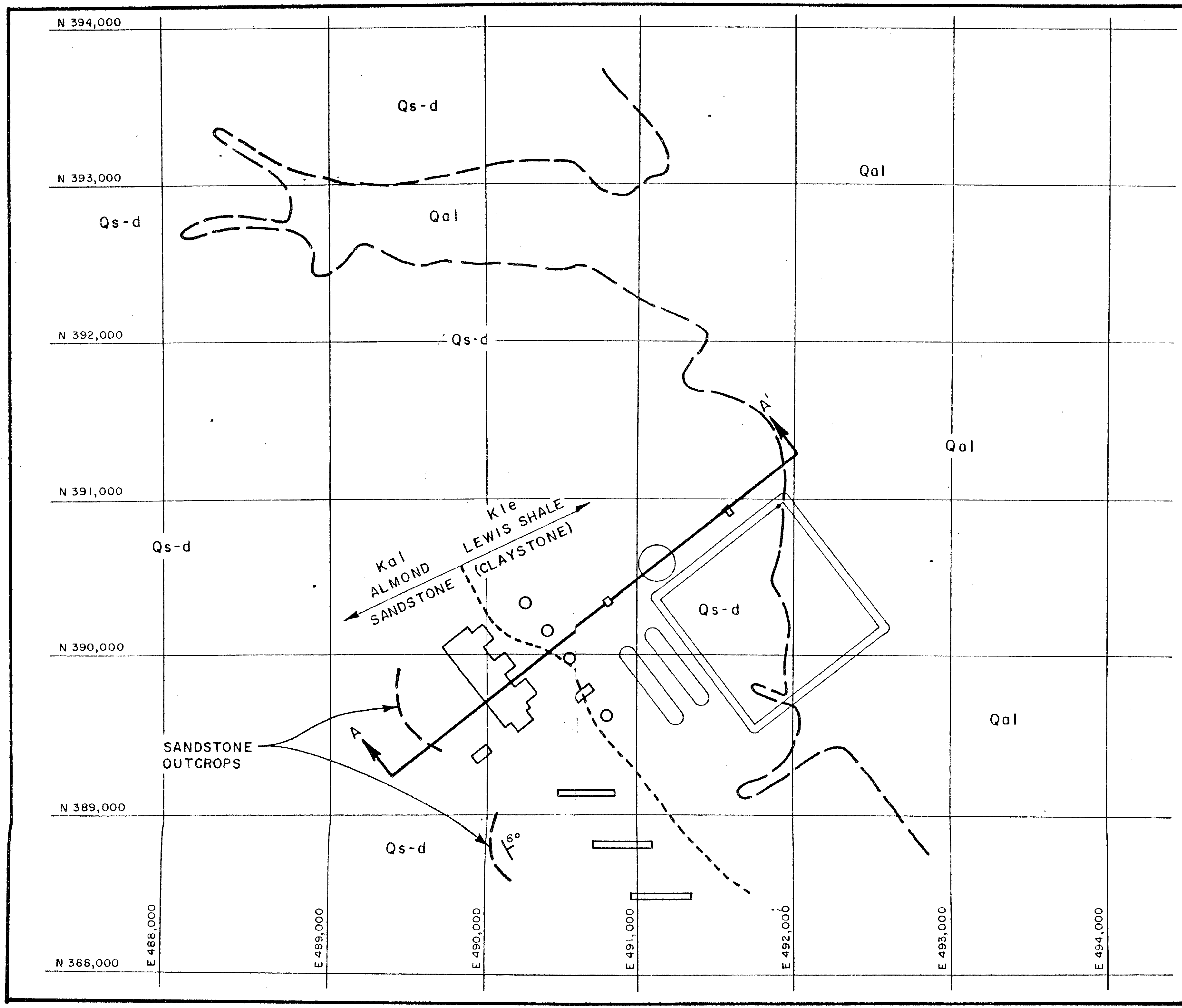
Denver, Colorado

LOCATION OF TEST HOLES

JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. 1



N

SCALE 1" = 600'

LEGEND

SURFACE

Qal	ALLUVIUM: SAND WITH INTERBEDDED SILT, CLAY; LOOSE TO MEDIUM DENSE; SAND MAINLY FINE-GRAINED, QUARTZOSE; POORLY STRATIFIED, LENSITIC, TAN, GRAY.
Qs-d	SLOPEWASH AND SAND DUNES, UNDIFFERENTIATED: SLOPEWASH MAINLY FINE-GRAINED SILTY SAND AND SANDY CLAY, LOOSE TO MEDIUM DENSE, TAN, BROWN, GRAY; SAND DUNES OF LOOSE QUARTZOSE SAND.

SUBSURFACE

Kle	LEWIS SHALE (CLAYSTONE): FISSILE TO THIN-BEDDED, CLOSELY FRACTURED AND JOINTED, FINE SANDY, SCRATCHES WITH A FINGERNAIL, BREAKS ACROSS BEDDING WITH STRONG HAND PRESSURE; INCLUDES GYPSUM CRYSTALS AND VEINLETS ALONG JOINT, FRACTURE AND BEDDING SURFACES; INCLUDES A FEW THIN LIMESTONE AND CARBONACEOUS SHALE SEAMS; DARK GRAY, BROWNISH GRAY.
Kal	ALMOND SANDSTONE: FINE-GRAINED, QUARTZOSE, THIN BEDDED, IN PART CROSS-BEDDED; WEAKLY TO STRONGLY CEMENTED, VARIABLY MASSIVELY TO CLOSELY JOINTED; GRAY, BROWN.
6°	DIP AND STRIKE, MEASURED ON OUTCROP.
	SKETCHED, ESTIMATED SURFACE CONTACT BETWEEN GEOLOGIC MATERIALS.
	SUBSURFACE GEOLOGIC CONTACT, BASED ON EXPLORATORY HOLES AND GEOMORPHIC EVIDENCE, ESTIMATED TO BE WITHIN 100 FEET.

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RECONNAISSANCE GEOLOGY MAP

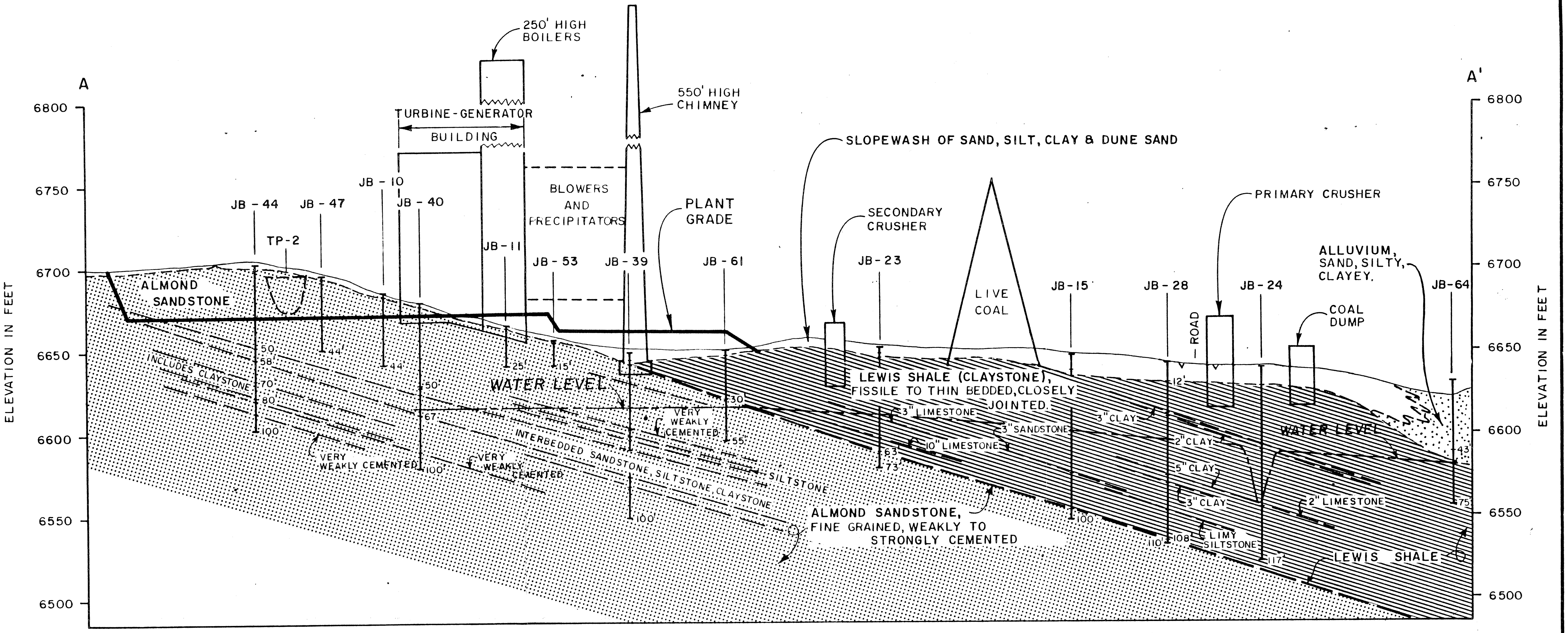
JIM BRIDGER POWER PLANT

NEAR ROCK SPRINGS, WYOMING

Prepared by: RJI | Checked by: GFT

Job No. 12819 - 12578

FIG. 2



NOTES:

1. VERTICAL SCALE DISTORTION 4:1
2. GROUND LINE BASED MAINLY ON EXPLORATORY HOLE GROUND ELEVATIONS SUPPLIED BY OWNER.
3. PROFILE LOCATION SHOWN ON FIGURE 2.

SCALE HORIZONTAL 1" = 200'
VERTICAL 1" = 50'

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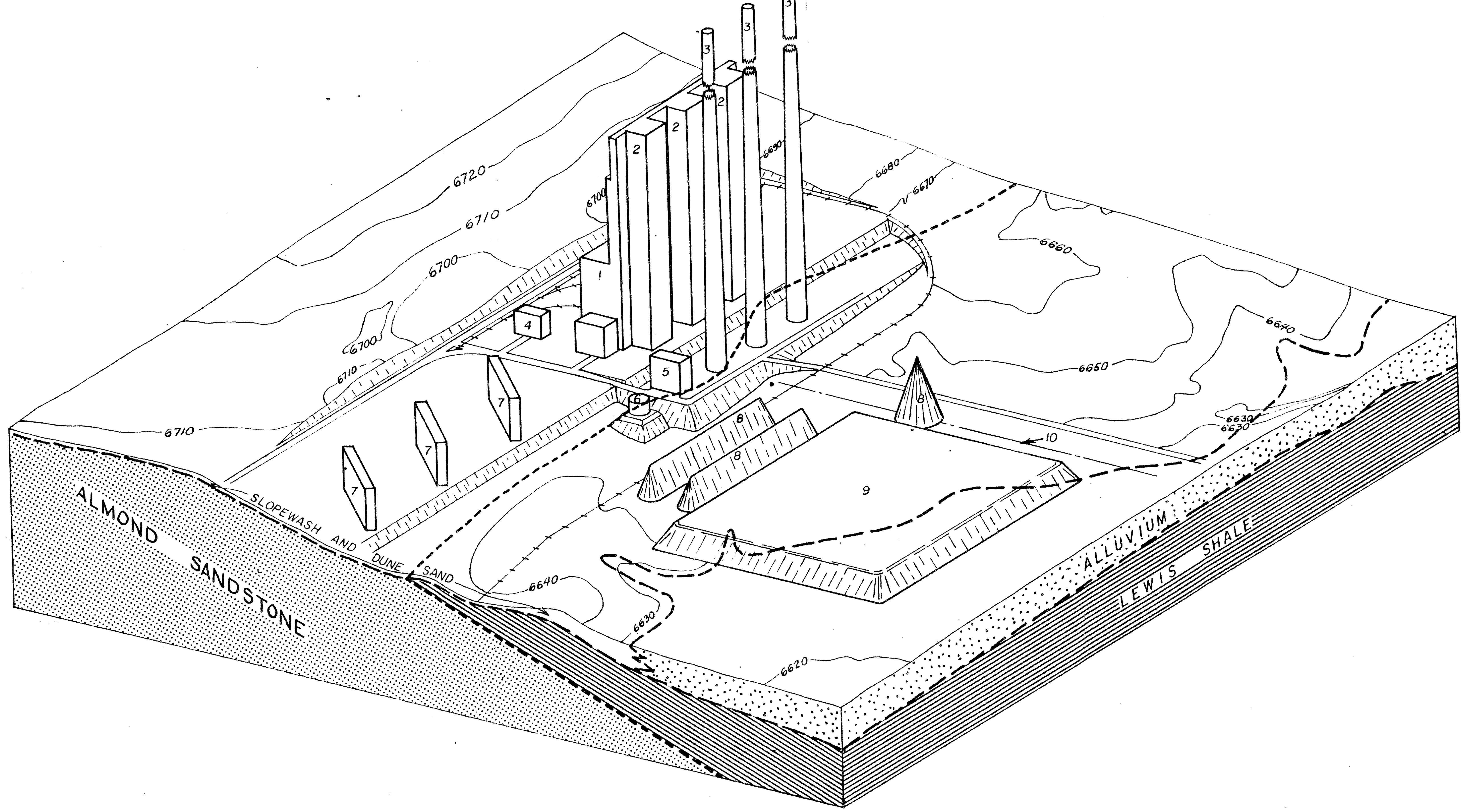
GEOLOGIC PROFILE A - A'

JIM BRIDGER POWER PLANT

NEAR ROCK SPRINGS, WYOMING

Prepared by: RJI Checked by: GFT
Job No. 12819 - 12578

FIG. 3



LEGEND

NO.	
1	TURBINE GENERATOR BUILDING
2	BOILER
3	CHIMNEY
4	OFFICE
5	WAREHOUSE
6	OIL TANK
7	COOLING TOWERS
8	LIVE COAL
9	DEAD COAL
10	CONVEYOR

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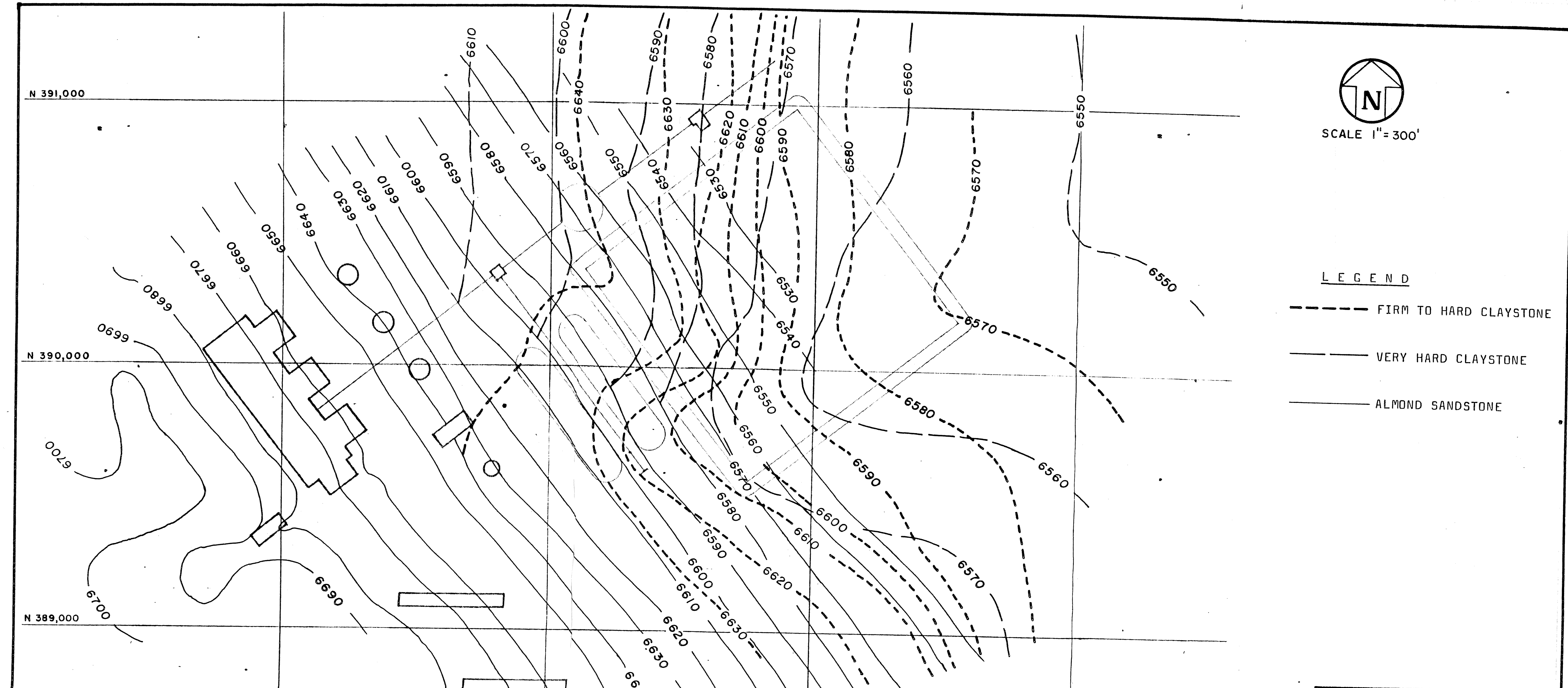
GEOLOGICAL
ISOMETRIC SKETCH
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: RJI | Checked by: GFT
Job No. 12819 - 12578

FIG. 4



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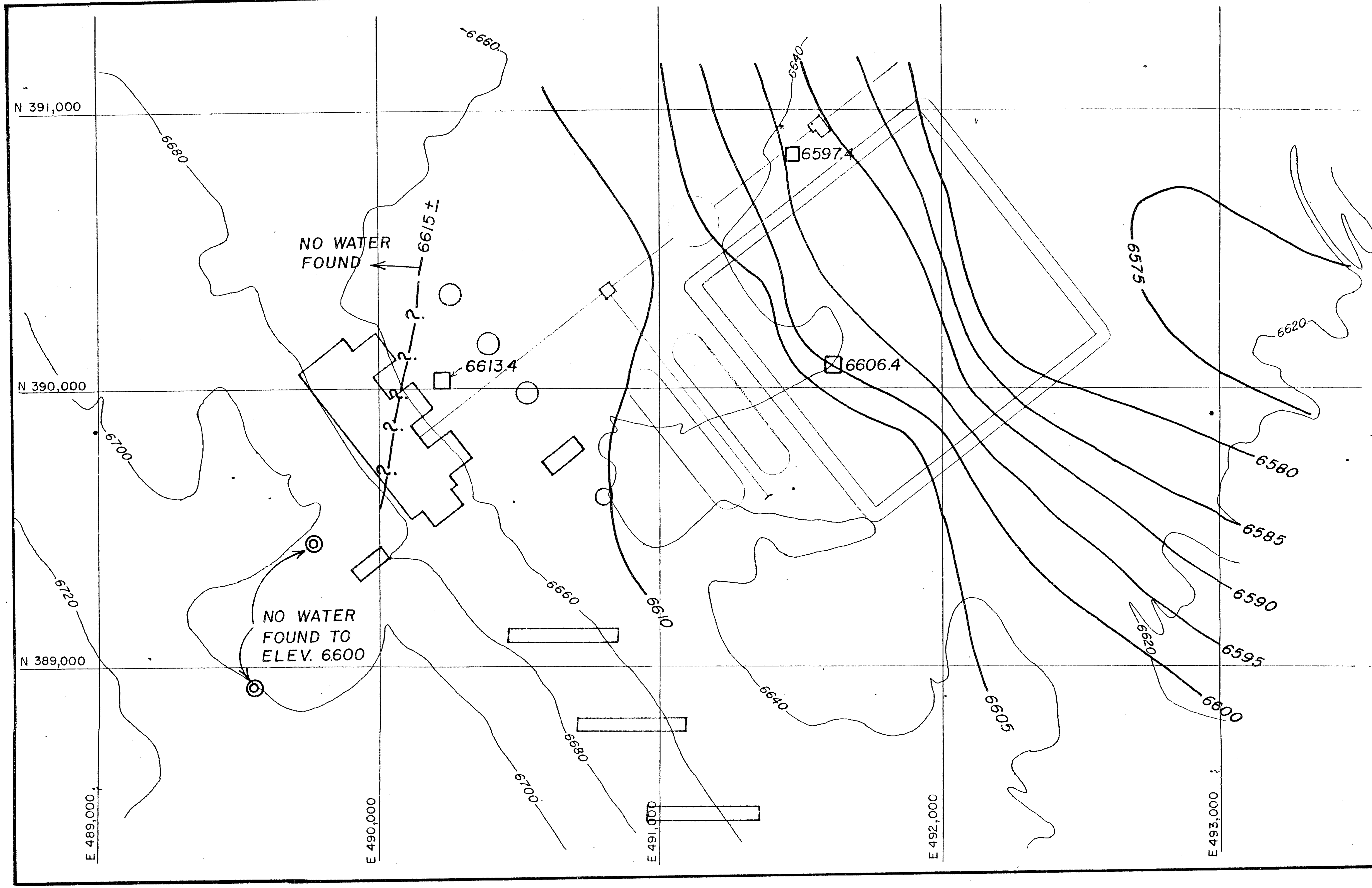
APPROXIMATE
TOP OF BEDROCK CONTOURS
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: TDJ | Checked by: GFT

Job No. 12819-12578

FIG. 5



LEGEND

PRESENT GROUND SURFACE

ELEVATION OF GROUNDWATER SURFACE - 9/15/70

—?— QUESTIONABLE BOUNDARY OF SHALLOW GROUND WATER

□ 6613.4 LOCATION OF CASAGRANDE PIEZOMETER INSTALLED AT DEPTH 100' ± - ELEVATION OF GROUND WATER ON 9/15/70

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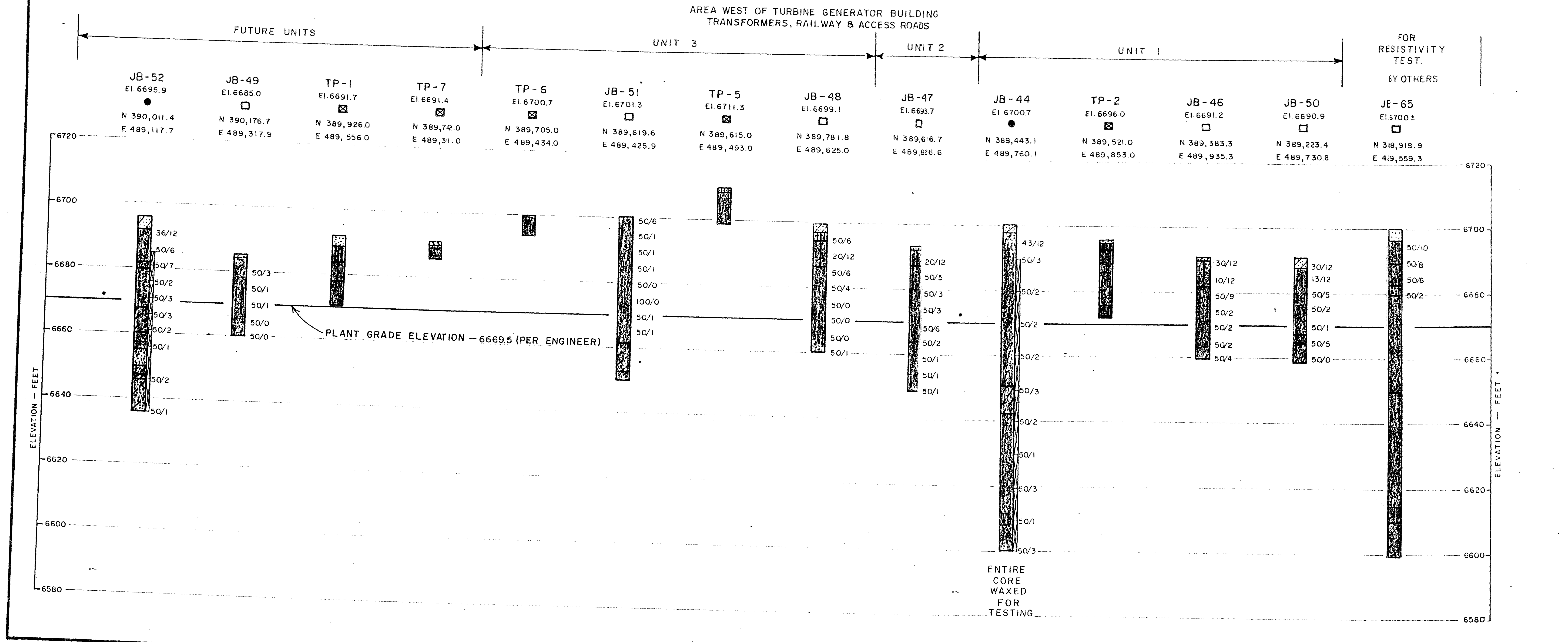
APPROXIMATE
CONTOURS OF GROUNDWATER
SEPTEMBER 1970
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYO.

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. 6



LEGEND

- SAND, MEDIUM DENSE, SILTY, FINE-GRAINED, ROOTS, DRY, TAN (SM).
- SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
- CLAYSTONE-SILTSTONE, VERY HARD, LAYERED, DARK GRAY.
- SANDSTONE, SILTSTONE, CLAYSTONE, LAYERED, FOSSILS, VERY HARD.
- SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY, CALCAREOUS COATING, DRY, TAN, GRAY.
- SANDSTONE, WEAKLY CEMENTED TO UNCEMENTED, MODERATE TO HIGHLY ALTERED, TAN.
- SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).
- 5 — WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING THAT MEASUREMENT WAS TAKEN.
- 50/12 INDICATES THAT 50 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2-INCH DIAMETER SAMPLER 12 INCHES.
- INDICATES 1-INCH PLASTIC PIPE INSTALLED IN HOLE AT TIME OF DRILLING FOR FUTURE WATER LEVEL.
- INDICATES NX WIRE LINE CORING.
- INDICATES WAXED SAMPLE OF NX CORE RETAINED FOR TESTING.
- AIR ROTARY DRILL HOLE DRIVE SAMPLE ONLY.
- CORE HOLE WITH DRILLING MUD, EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR. OVERBURDEN GENERALLY DRILLED WITH AIR.
- BULLDOZER TEST PIT.

FOR NOTES, SEE FIG. 6

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SUMMARY LOGS OF TEST HOLES AND TEST PITS
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT	Checked by: STT
Job No. 12819 - 12578	

FIG. 7

LEGEND

- FILL, LOOSE SAND.
- SILT, TOPSOIL, LOOSE, DRY, ROOTS (ML).
- SAND, LOOSE, FINE-GRAINED, ROOTS, POROUS, DRY, TAN (SP).
- SILT, HARD, DRY, POROUS, LOW DENSITY AT TOP TO DENSE WITH DEPTH, SANDY, BROWN (ML).
- SAND, MEDIUM DENSE, SILTY, FINE-GRAINED, ROOTS, DRY, TAN (SM).
- SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
- CLAYSTONE (LEWIS SHALE) FIRM TO HARD WITH FEW VERY HARD LAYERS, THIN-BEDDED, ALTERED TO CLAY IN PART, FRACTURED IN PART WITH 1/8± INCH THICKNESS, GYPSUM CRYSTALS IN FRACTURES AND JOINTS, OCCASIONAL THIN LIMESTONE LAYERS, MOIST TO VERY MOIST, DARK BROWN, BLACK (BEDROCK).
- SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY, CALCAREOUS COATING, DRY, TAN, GRAY.
- SANDSTONE, WEAKLY CEMENTED TO UNCEMENTED, MODERATE TO HIGHLY ALTERED, TAN.
- SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).
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- □ AIR ROTARY DRILL HOLE DRIVE SAMPLES ONLY.
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- ■ CONTINUOUS PITCHER SAMPLE HOLE WITH DRILLING MUD.
- ● CORE HOLE WITH DRILLING MUD EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR. OVERBURDEN GENERALLY DRILLED WITH AIR.
- ⊠ BULLDOZER TEST PIT.

NOTES:

1. HOLES DRILLED OR TEST PITS EXCAVATED BY METHODS SHOWN IN THE LEGEND MARCH THROUGH JULY, 1970.
2. LOCATIONS AND ELEVATIONS BY IDAHO POWER COMPANY, EXCEPT, WHERE ± SHOWN HAND LEVEL ELEVATIONS ARE BEING USED TEMPORARILY.
3. DRILL LOGS AND TEST PIT LOGS IN THIS REPORT ARE SUBJECT TO LIMITATIONS, EXPLANATIONS AND CONCLUSIONS OF THIS REPORT.

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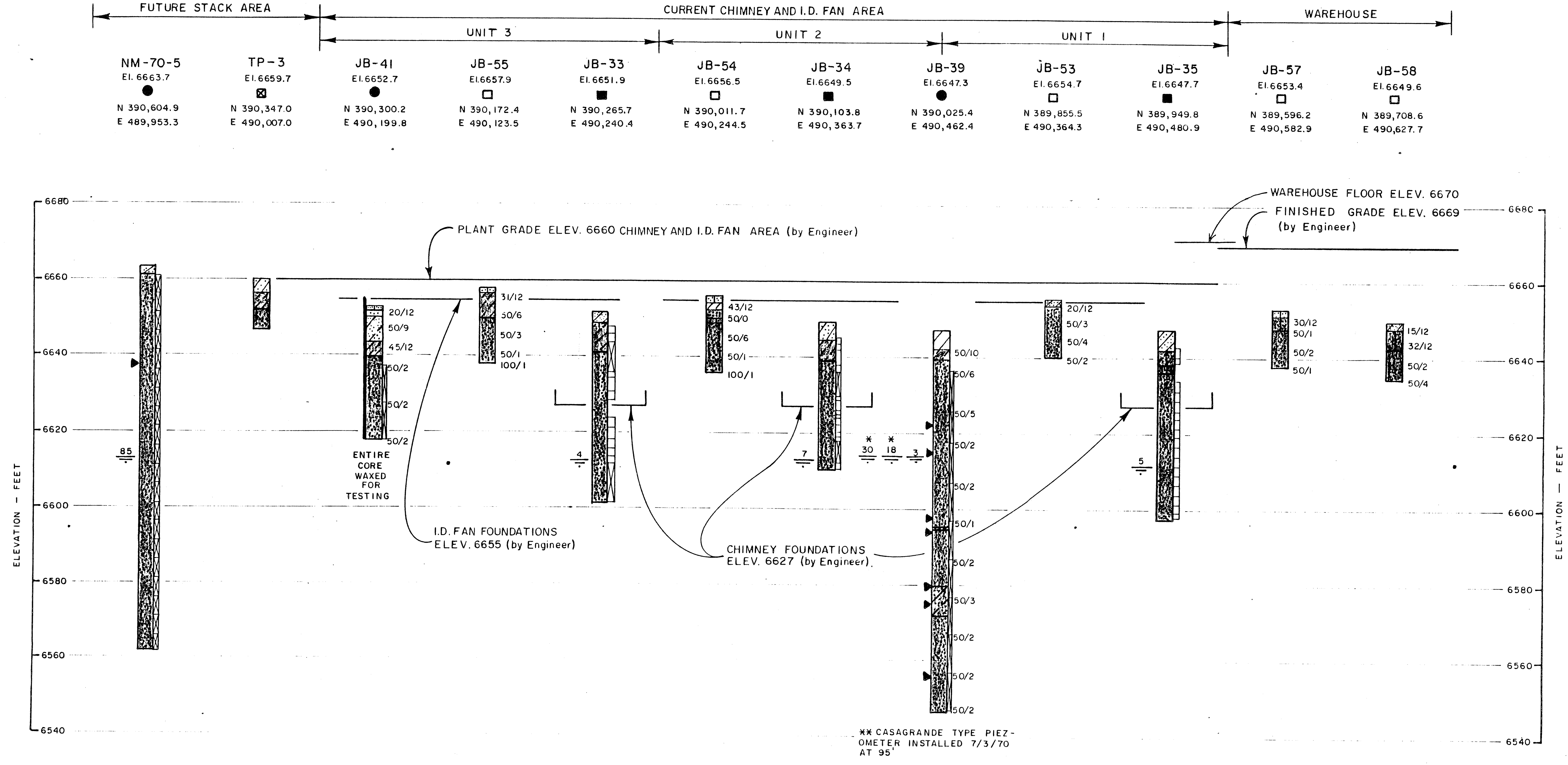
SUMMARY LOGS OF TEST HOLES AND TEST PITS
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 — 12578

FIG. 8



LEGEND

	SILT, TOPSOIL, LOOSE, DRY, ROOTS (ML).
	SAND, LOOSE, FINE-GRAINED, ROOTS, POROUS, DRY, TAN (SP).
	SILT, HARD, DRY, POROUS, LOW DENSITY AT TOP TO DENSE WITH DEPTH, SANDY, BROWN (ML).
	SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
	CLAYSTONE (LEWIS SHALE), FIRM TO HARD WITH FEW VERY HARD LAYERS, THIN-BEDDED, ALTERED TO CLAY IN PART, FRACTURED IN PART WITH 1/8± INCH THICKNESS, GYPSUM CRYSTALS IN FRACTURES AND JOINTS, OCCASIONAL THIN LIMESTONE LAYERS, MOIST TO VERY MOIST, DARK BROWN, BLACK (BEDROCK).
	SANDSTONE, SILTSTONE, CLAYSTONE, LAYERED, FOSSILS, VERY HARD.
	SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY, CALCAREOUS COATING, DRY, TAN, GRAY.
	SANDSTONE, WEAKLY CEMENTED TO UNCEMENTED, MODERATE TO HIGHLY ALTERED, TAN.
	SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).
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	INDICATES NX WIRE LINE CORING.
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□	AIR ROTARY DRILL HOLE DRIVE SAMPLES ONLY.
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●	CORE HOLE WITH DRILLING MUD, EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR. OVERBURDEN GENERALLY DRILLED WITH AIR.
⊠	BULLDOZER TEST PIT.

FOR NOTES, SEE FIG. 6

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SUMMARY LOGS OF TEST HOLES AND TEST PITS

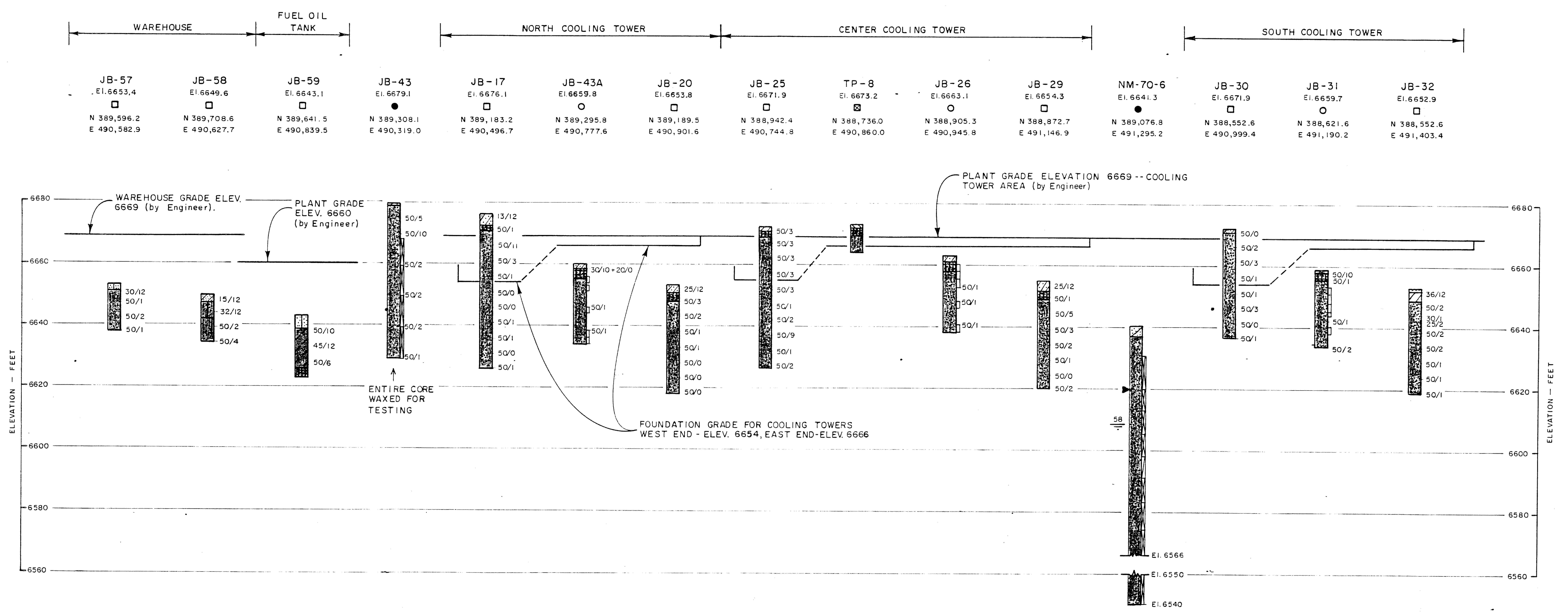
JIM BRIDGER POWER PLANT

NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT

Job No. 12819 — 12578

FIG. 9



LEGEND

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- SAND, LOOSE, FINE-GRAINED, ROOTS, POROUS, DRY, TAN (SP).
- SILT, HARD, DRY, POROUS, LOW DENSITY AT TOP TO DENSE WITH DEPTH, SANDY, BROWN (ML).
- SAND, MEDIUM DENSE, SILTY, FINE-GRAINED, ROOTS, DRY, TAN (SM).
- SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
- CLAYSTONE (LEWIS SHALE) FIRM TO HARD WITH FEW VERY HARD LAYERS, THIN-BEDDED, ALTERED TO CLAY IN PART, FRACTURED IN PART WITH 1/8± INCH THICKNESS, GYPSUM CRYSTALS IN FRACTURES AND JOINTS, OCCASIONAL THIN LIMESTONE LAYERS, MOIST TO VERY MOIST, DARK BROWN, BLACK (BEDROCK).
- SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY CALCAREOUS COATING, DRY, TAN, GRAY.
- SANDSTONE, WEAKLY CEMENTED TO UNCEMENTED, MODERATE TO HIGHLY ALTERED, TAN.
- SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).

58 — WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING THAT MEASUREMENT WAS TAKEN.

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● CORE HOLE WITH DRILLING MUD, EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR. OVERBURDEN GENERALLY DRILLED WITH AIR.

⊠ BULLDOZER TEST PIT.

FOR NOTES, SEE FIG. 6

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SUMMARY LOGS OF TEST HOLES AND TEST PITS
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. 10

LEGEND

- SILT, TOPSOIL, LOOSE, DRY, ROOTS (ML).
- SAND, LOOSE, FINE-GRAINED, ROOTS, POROUS, DRY, TAN (SP).
- SILT, HARD, DRY, POROUS, LOW DENSITY AT TOP TO DENSE WITH DEPTH, SANDY, BROWN (ML).
- GRAVEL (ROUNDED SANDSTONE-LIMESTONE FRAGMENTS), MEDIUM DENSE TO DENSE, SILTY, SANDY, DRY, TAN TO BROWN (CM-GP).
- CLAY, STIFF TO HARD, SLIGHTLY MOIST TO VERY MOIST, SANDY LAYERS, BROWN (CL).
- SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
- SAND, MEDIUM DENSE, LAYERED WITH STIFF SILT AND CLAY, ALLUVIUM, TRACE OF COAL DUST, DRY TO VERY MOIST, TAN TO ORANGE-TAN (SM-ML-CL).
- WEATHERED CLAYSTONE WITH CLAY FILLED FRACTURES TO CLAY WITH CLAYSTONE CHIPS (HIGHLY WEATHERED CLAYSTONE), VERY STIFF, CALCAREOUS, DARK GRAY TO ORANGE-BROWN (CL).
- CLAYSTONE (LEWIS SHALE) FIRM TO HARD WITH FEW VERY HARD LAYERS, THIN-BEDDED, ALTERED TO CLAY IN PART, FRACTURED IN PART WITH 1/8± INCH THICKNESS, GYPSUM CRYSTALS IN FRACTURES AND JOINTS, OCCASIONAL THIN LIMESTONE LAYERS, MOIST TO VERY MOIST, DARK BROWN, BLACK (BEDROCK).
- CLAYSTONE, AS ABOVE, BUT VERY HARD, THICK-BEDDED TO MASSIVE, NO GYPSUM, THIN SANDSTONE, SILTSTONE AND LIMESTONE LAYERS (BEDROCK).
- SAND (SANDSTONE-UNCEMENTED), DENSE, CLAYEY, DRY, BROWN (SC).
- SANDSTONE, SILTSTONE, CLAYSTONE, LAYERED, FOSSILS, VERY HARD.
- SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY, CALCAREOUS COATING, DRY, TAN, GRAY (BEDROCK).
- SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).

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- ■ CONTINUOUS PITCHER SAMPLE HOLE WITH DRILLING MUD.
- ● CORE HOLE WITH DRILLING MUD, EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR. OVERBURDEN GENERALLY DRILLED WITH AIR.
- ⊠ BULLDOZER TEST PIT.
- GRADUAL CHANGE IN MATERIALS. EXACT STRATA CHANGE NOT LOCATED.

FOR NOTES, SEE FIG. 6

WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

SUMMARY LOGS OF TEST HOLES AND TEST PITS
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. 1

LEGEND

- SILT, TOPSOIL, LOOSE, DRY ROOTS, (ML).
- SILT, HARD, DRY, POROUS, LOW DENSITY AT TOP TO DENSE WITH DEPTH, SANDY, BROWN (ML).
- GRAVEL (ROUNDED SANDSTONE-LIMESTONE FRAGMENTS), MEDIUM DENSE TO DENSE, SILTY, SANDY, DRY, TAN TO BROWN (CM-GP).
- SAND, MEDIUM DENSE, SILTY, FINE-GRAINED, ROOTS, DRY, TAN (SM).
- SAND, FINE, SILTY TO SILT, SANDY, LOOSE TO MEDIUM DENSE, ROOTS NEAR GROUND SURFACE, CALCAREOUS, SLIGHTLY POROUS, DRY TO WET, TAN (SM-ML).
- SILT, CLAY AND SAND, LAYERED, MEDIUM DENSE TO DENSE, POROUS & LOW DENSITY NEAR GROUND SURFACE, TAN, BROWN, GRAY (SM-ML-CL).
- CLAY, STIFF TO HARD, SLIGHTLY MOIST TO VERY MOIST, SANDY LAYERS, BROWN (CL).
- SAND, MEDIUM DENSE, LAYERED WITH STIFF SILT AND CLAY, ALLUVIUM, TRACE OF COAL DUST, DRY TO VERY MOIST, TAN TO ORANGE-TAN (SM-ML-CL).
- CLAY, VERY STIFF, CLAYSTONE CHIPS, SAND WITH FEW SAND LAYERS AND SCATTERED GRAVEL, BROWN (CL-SC).
- WEATHERED CLAYSTONE WITH CLAY FILLED FRACTURES TO CLAY WITH CLAYSTONE CHIPS (HIGHLY WEATHERED CLAYSTONE), VERY STIFF, CALCAREOUS, DARK GRAY TO ORANGE-BROWN (CL).
- CLAYSTONE (LEWIS SHALE) FIRM TO HARD WITH FEW VERY HARD LAYERS, THIN-BEDDED, ALTERED TO CLAY IN PART, FRACTURED IN PART WITH 1/8± INCH THICKNESS, GYPSUM CRYSTALS IN FRACTURES AND JOINTS, OCCASIONAL THIN LIMESTONE LAYERS, MOIST TO VERY MOIST, DARK BROWN, BLACK (BEDROCK).
- CLAYSTONE, AS ABOVE, BUT VERY HARD, THICK-BEDDED TO MASSIVE, NO GYPSUM, THIN SANDSTONE, SILTSTONE, AND LIMESTONE LAYERS (BEDROCK).
- SANDSTONE, SILTSTONE, CLAYSTONE, LAYERED, FOSSILS, VERY HARD.
- SANDSTONE, VERY HARD, STRONGLY CEMENTED, HIGHLY FRACTURED, LIMY, CALCAREOUS COATING, DRY, TAN, GRAY.
- SANDSTONE, WEAKLY CEMENTED TO UNCEMENTED, MODERATE TO HIGHLY ALTERED, TAN.
- SANDSTONE (ALMOND FORMATION) HARD TO VERY HARD, STRONGLY TO WEAKLY CEMENTED, OCCASIONAL COAL SEAMS, FRACTURED, MODERATELY TO SLIGHTLY ALTERED, TAN TO GRAY (BEDROCK).
- 2 — WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING THAT MEASUREMENT WAS TAKEN.
- 50/12 INDICATES THAT 50 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2-INCH DIAMETER SAMPLER 12 INCHES.
- GRADUAL CHANGE IN MATERIALS. EXACT STRATA CHANGE NOT LOCATED.
- INDICATES 1-INCH PLASTIC PIPE INSTALLED IN HOLE AT TIME OF DRILLING FOR FUTURE WATER LEVEL.
- INDICATES PITCHER TUBE SAMPLE. DRIVE SAMPLES TAKEN ABOVE OR BELOW PITCHER SAMPLES IN COMBINATION SAMPLE HOLES.
- INDICATES NX WIRELINE CORING.
- INDICATES WAXED SAMPLE OF NX CORE RETAINED FOR TESTING.
- ○ AIR (AIR-MIST) ROTARY DRILL HOLE DRIVE AND PITCHER SAMPLES.
- ● CORE HOLE WITH DRILLING MUD, EXCEPT JB-14 AND JB-21 ROTARY WITH MUD AND AIR.
- ⊠ BULLDOZER TEST PIT.

FOR NOTES, SEE FIG. 6

WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

SUMMARY LOGS OF TEST HOLES AND TEST PITS

JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819-12578

FIG. 12

WOODWARD - CLYDE & ASSOCIATES
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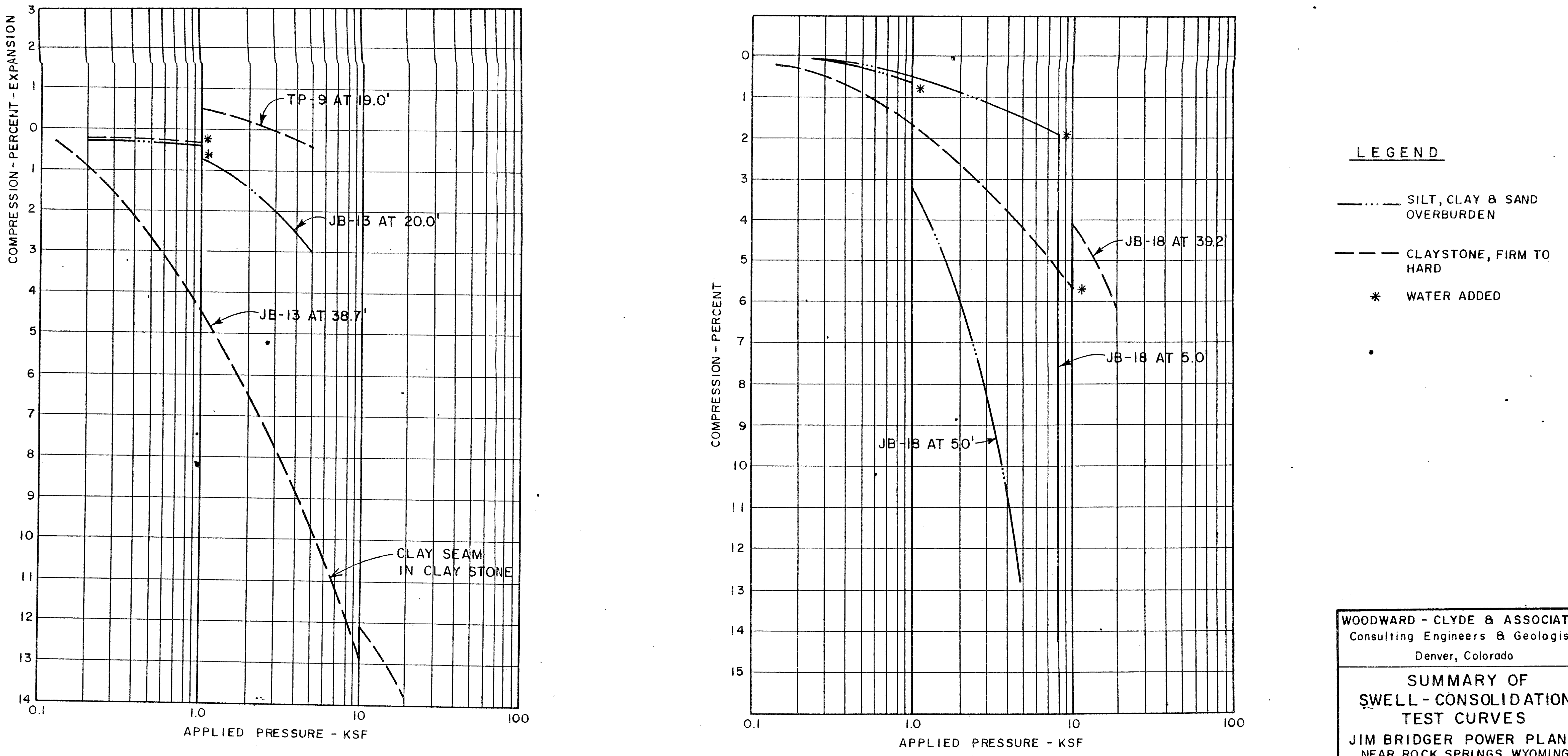
Denver, Colorado

SUMMARY OF
SWELL - CONSOLIDATION
TEST CURVES
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. 13

LIVE COAL STORAGE AREA



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Denver, Colorado

SUMMARY OF SWELL - CONSOLIDATION TEST CURVES

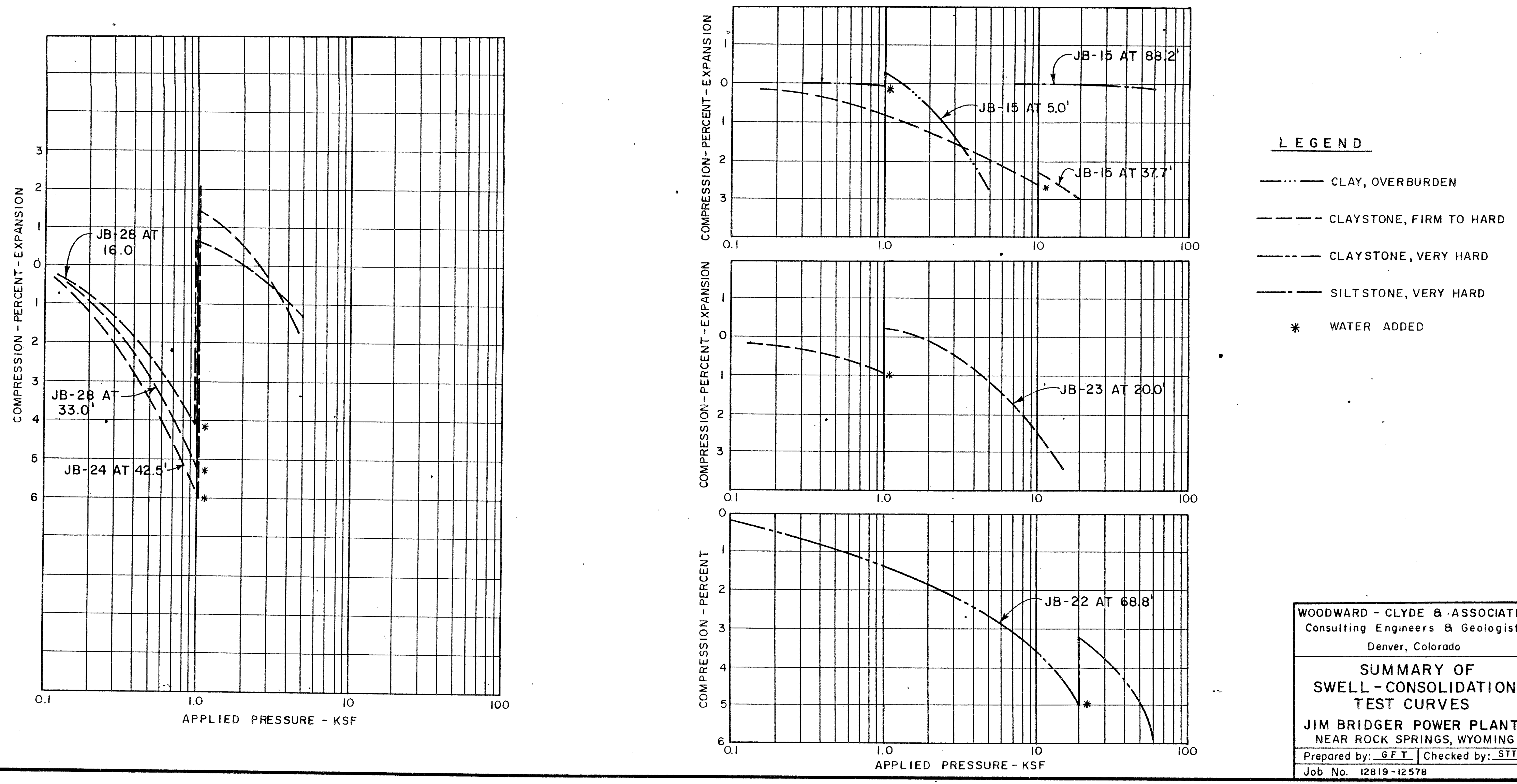
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT

Job No. 12819 - 12578

FIG. 14

CONVEYOR AND COAL HANDLING FACILITIES AREA



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Denver, Colorado

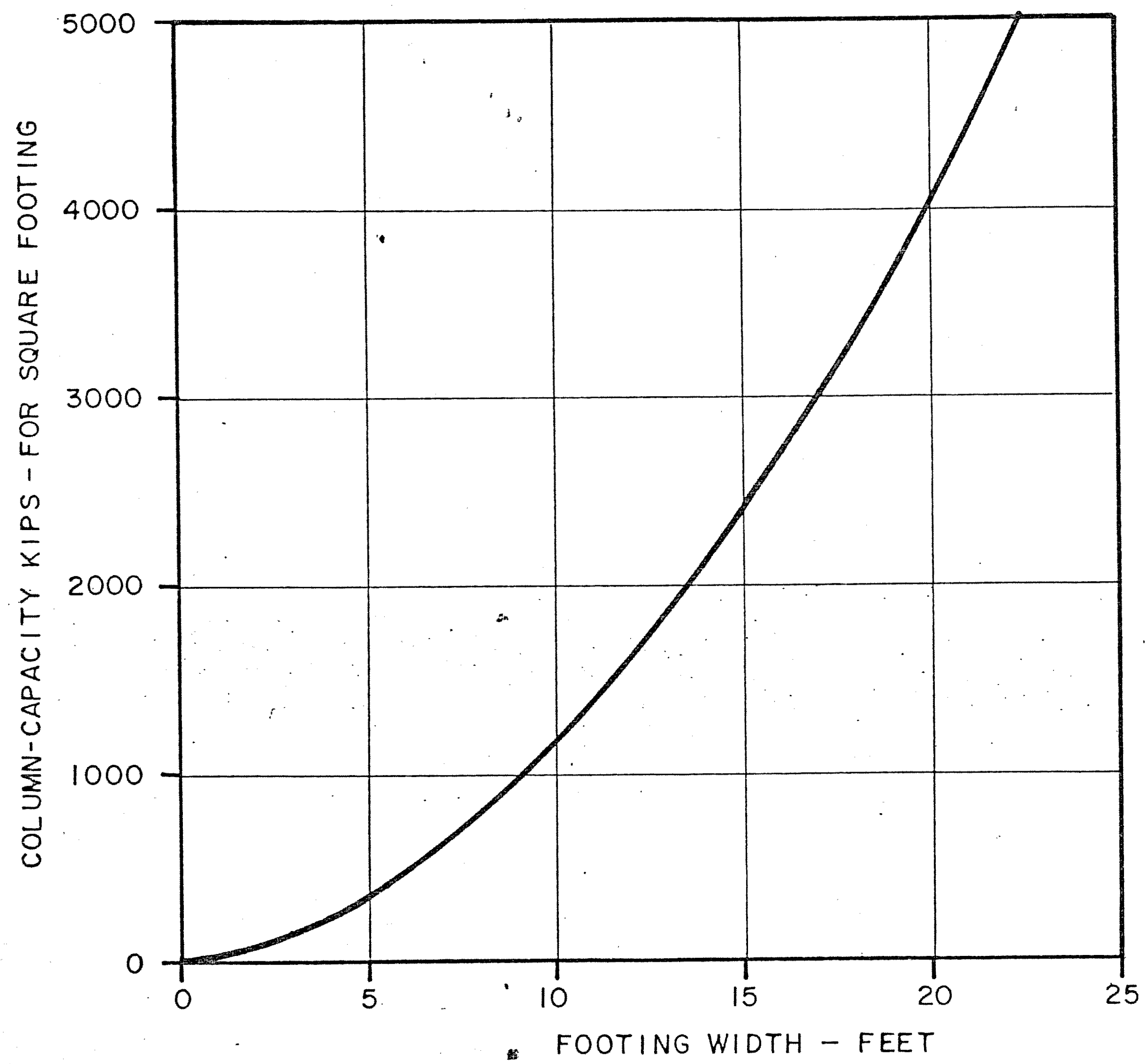
SUMMARY OF SWELL - CONSOLIDATION TEST CURVES

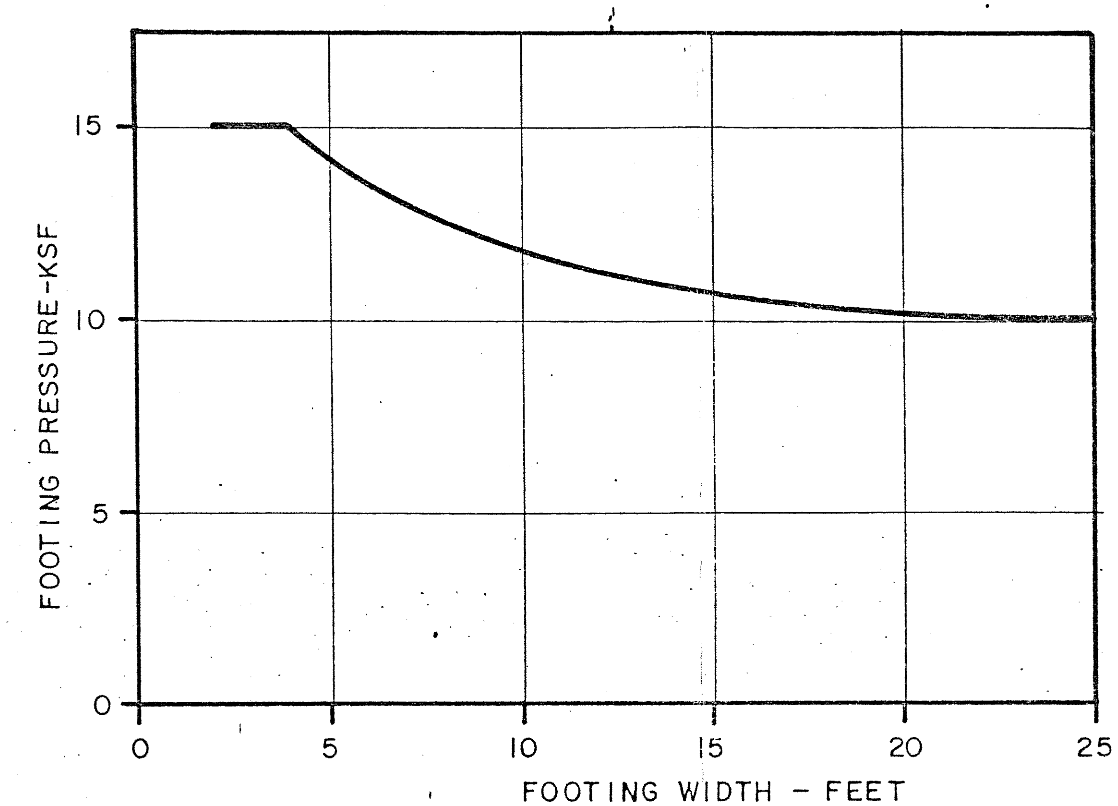
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT

Job No. 12819-12578

FIG. 15





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SUGGESTED DESIGN PRESSURE FOR FOOTINGS ON SANDSTONE

JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

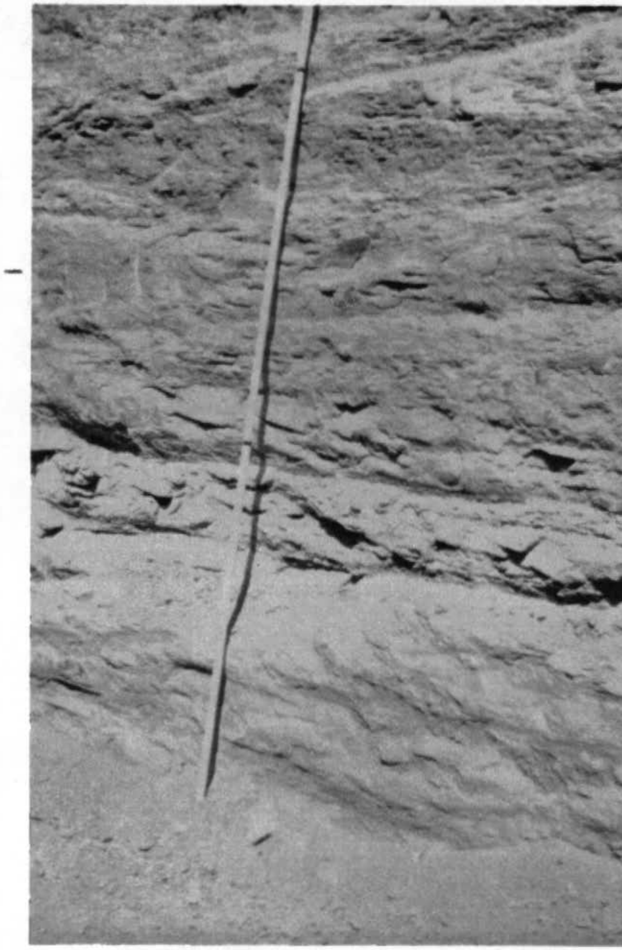
Prepared by: GFT | Checked by: STT

Job No. 12819-12578

FIG. 16

TP-3

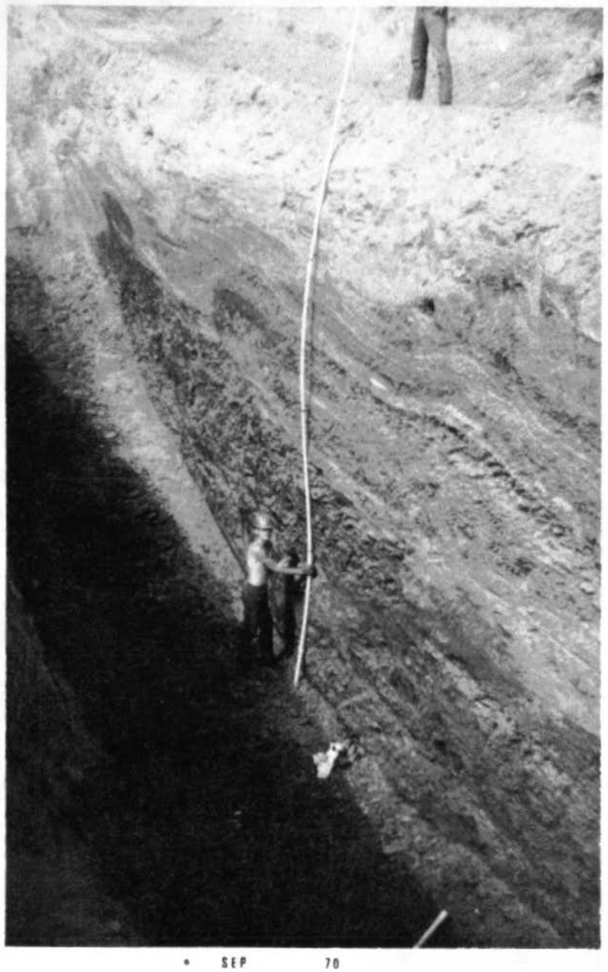
FROM 4.5 TO 8.0 FEET ON ROD, SHOWING FRACTURED SANDSTONE "CAP" ROCK (OPPOSITE LEFT HAND) AND THE BLOCKY WEATHERED CLAYSTONE OF LEWIS SHALE ABOVE AND WEAKLY CEMENTED ALMOND SANDSTONE BELOW IT.



TP-2

SHOWING UPPER, THINLY BEDDED SANDSTONE AND UNDERLYING MORE MASSIVE, HARDER SANDSTONE, LOWER 8 FEET OF ROD (BLACK MARKS AT 5-FOOT SPACING.)

FIG. 17



TP-9
SHOWING UNDULATION OF BEDS
OF GYPSIFEROUS LEWIS SHALE

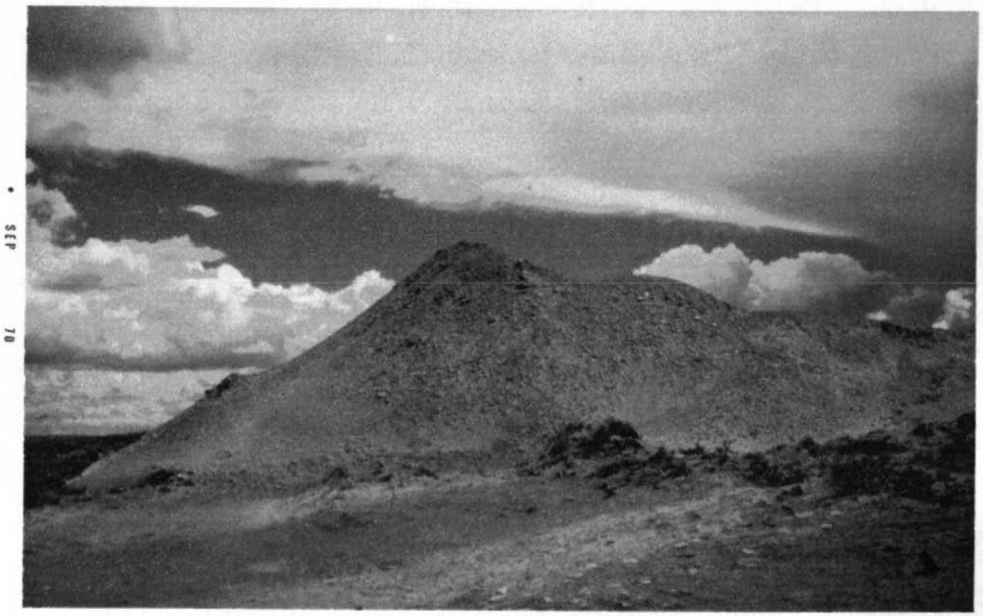
TP-9
SHOWING BLOCKY FRACTURED
CONDITION OF SHALLOW
GYPSIFEROUS LEWIS SHALE

TP-9
SHOWING CLAY SEAMS
(RUST-COLORED ZONES)

FIG. 18

TP-8

CATERPILLAR D-8-H RIPPING "CAP" SANDSTONE



TP-2

WASTE PILE BROKEN DOWN SANDSTONE WITH SANDSTONE FRAGMENTS

FIG. 19

SOIL ENGINEERING & GEOLOGIC INVESTIGATIONS

FOR

JIM BRIDGER POWER PLANT

Near Rock Springs, Wyoming

VOLUME II

OWNERS

PACIFIC POWER AND LIGHT COMPANY

AND

IDAHO POWER COMPANY

ENGINEER

BECHTEL CORPORATION

BY

WOODWARD–CLYDE & ASSOCIATES
Consulting Engineers & Geologists
2909 West Seventh Avenue
Denver, Colorado 80204

SEPTEMBER 1970

WOODWARD-CLYDE & ASSOCIATES
CONSULTING ENGINEERS AND GEOLOGISTS
2909 WEST SEVENTH AVENUE
DENVER, COLORADO 80204
TELEPHONE 222-9434

SOIL ENGINEERING & GEOLOGIC INVESTIGATIONS FOR JIM BRIDGER POWER PLANT NEAR ROCK SPRINGS, WYOMING

VOLUME II

Prepared For

Bechtel Corporation
50 Beale Street
San Francisco, California

Job No. 12880-12578

September 30, 1970

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TABLE OF CONTENTS (CONT'D)

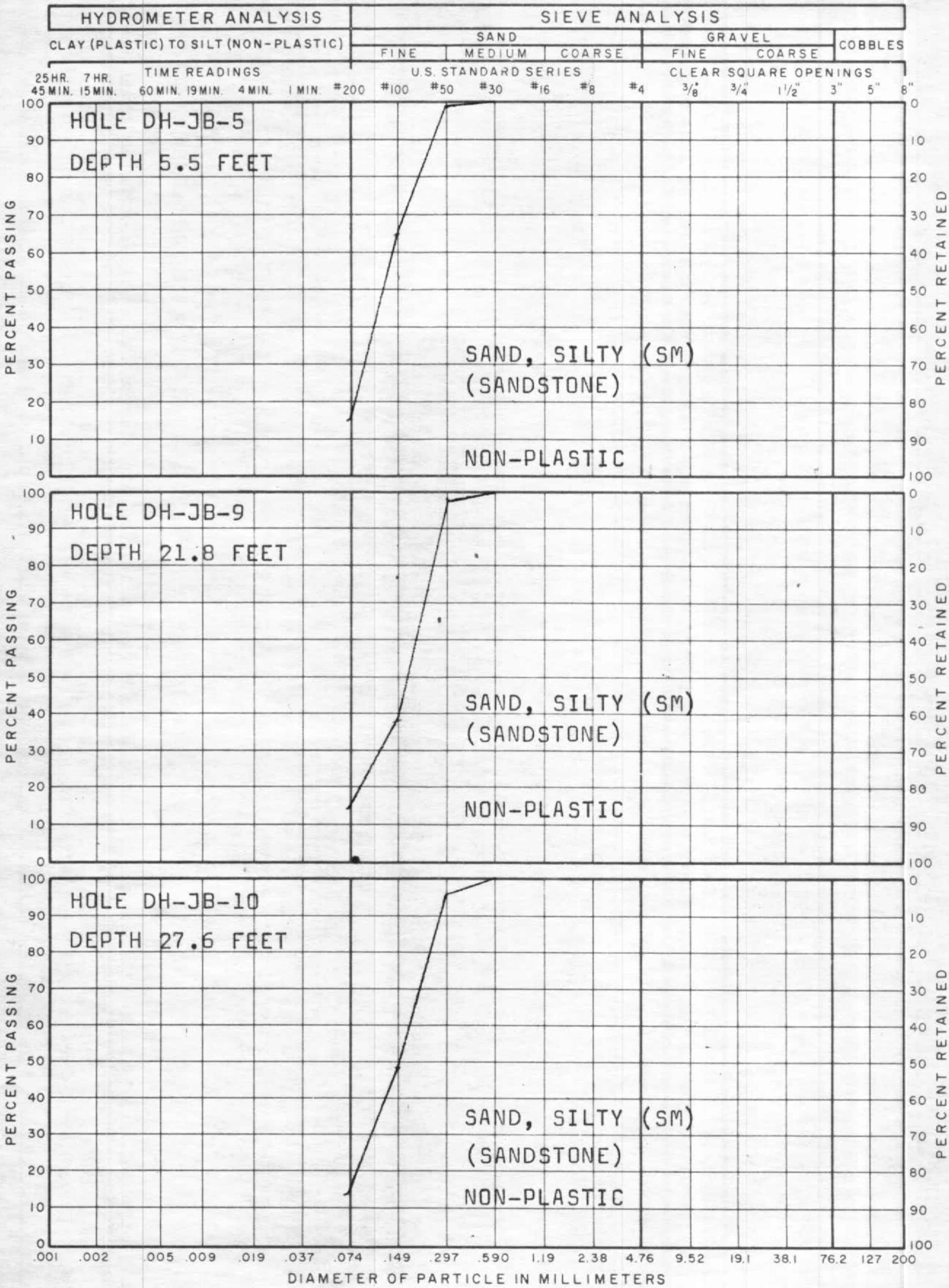
APPENDIX A

GRADATION ANALYSES

FORM NO. WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS



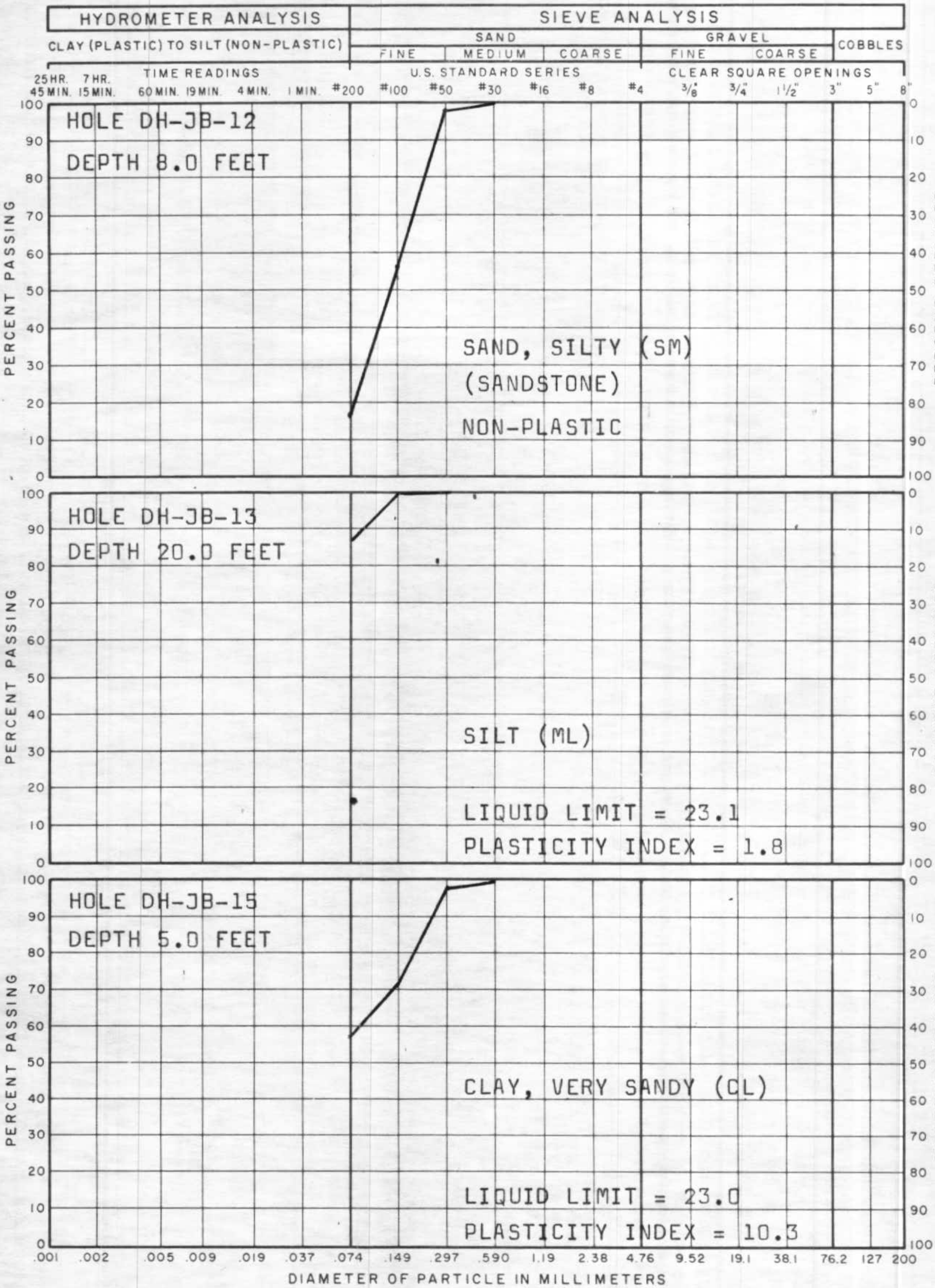
Job No. 12819-12578

FIG. A-1

FORM NO.
WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS



Job No. 12819-12578

FIG. A-2

FORM NO. WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS

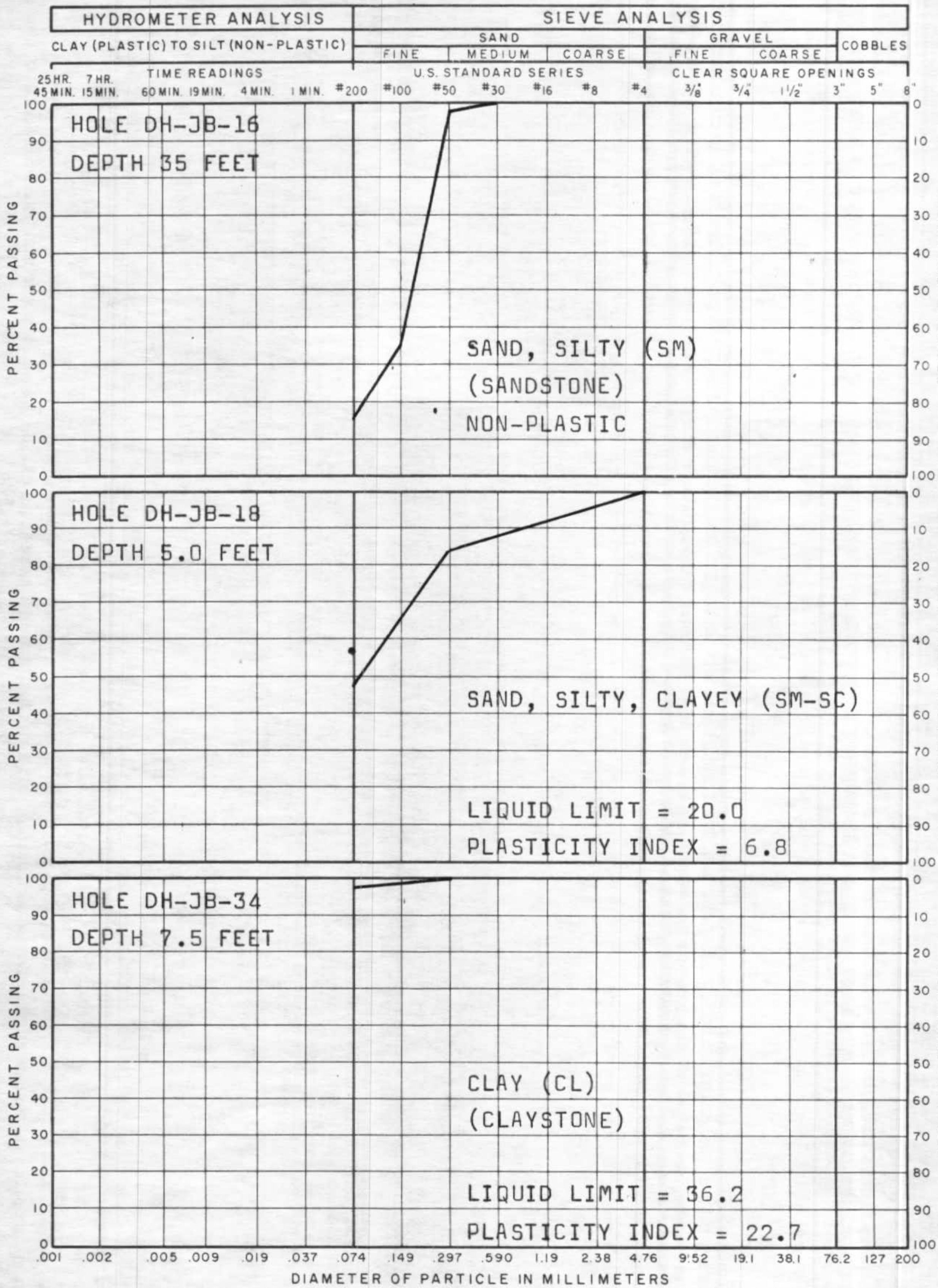


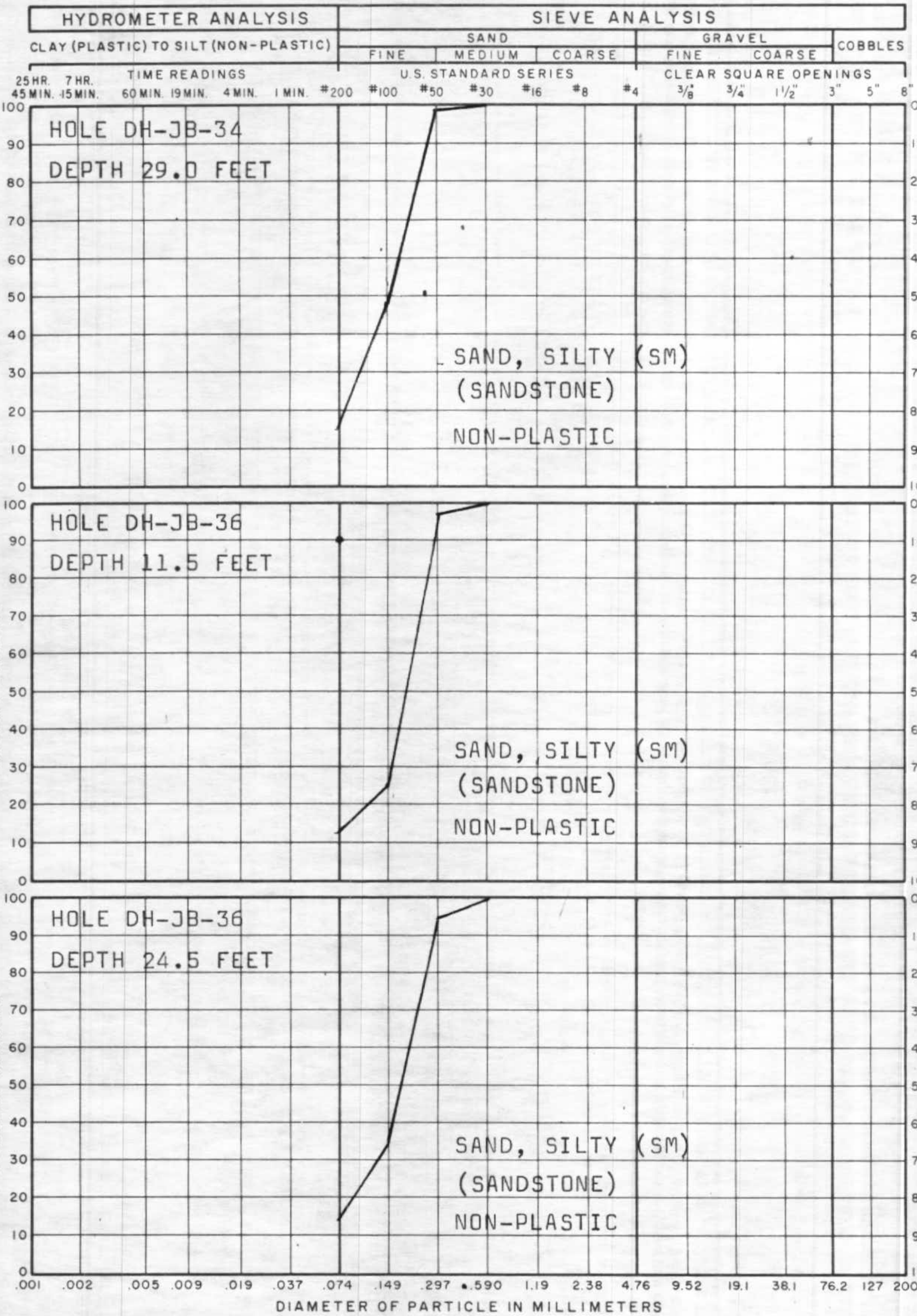
FIG. A-3

Job No. 12819-12578

FORM NO.
WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS



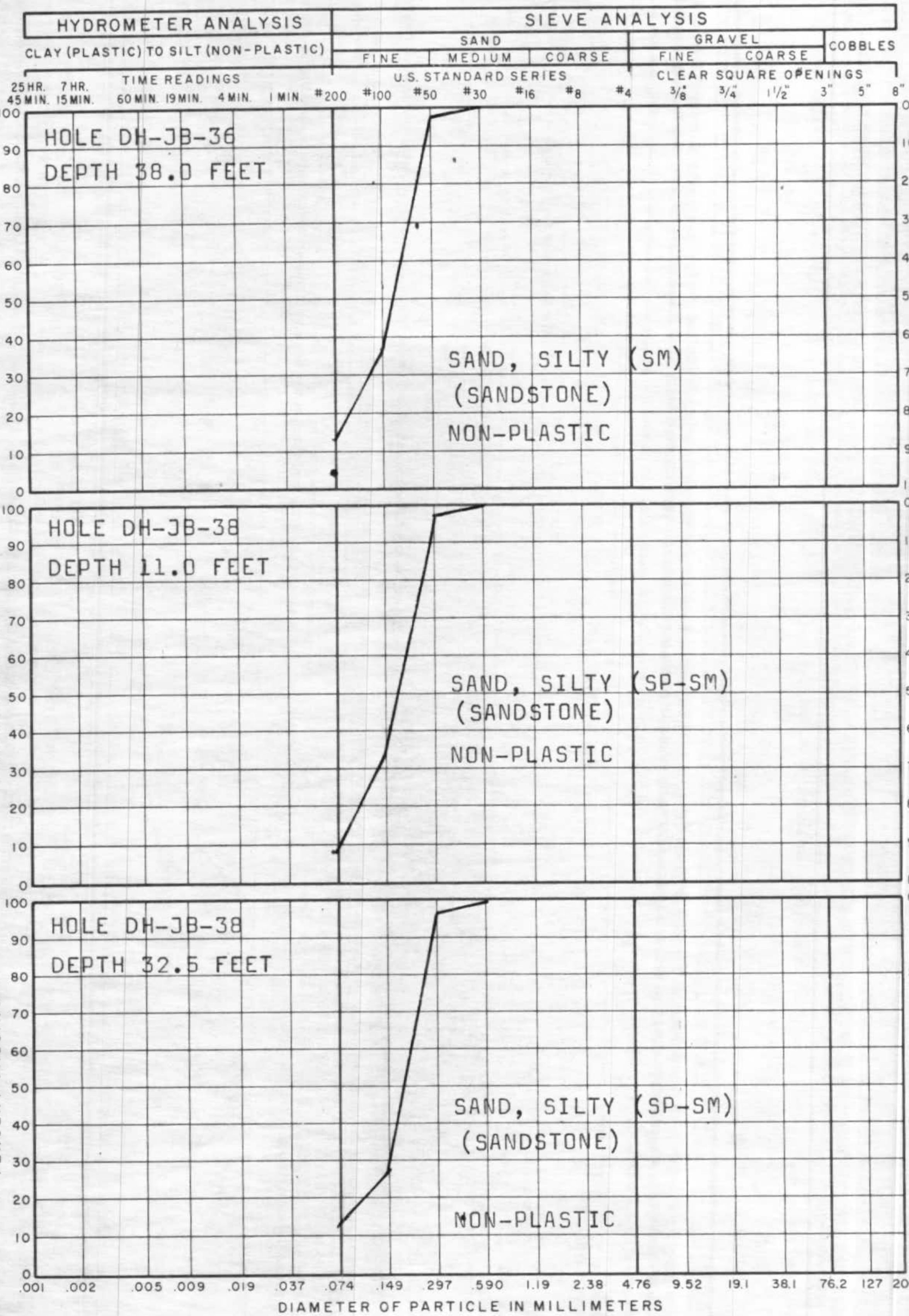
Job No. 12819-12578

FIG. A-4

FORM NO.
WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS



Job No. 12819-12578

FIG. A-5

FORM NO.
WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS

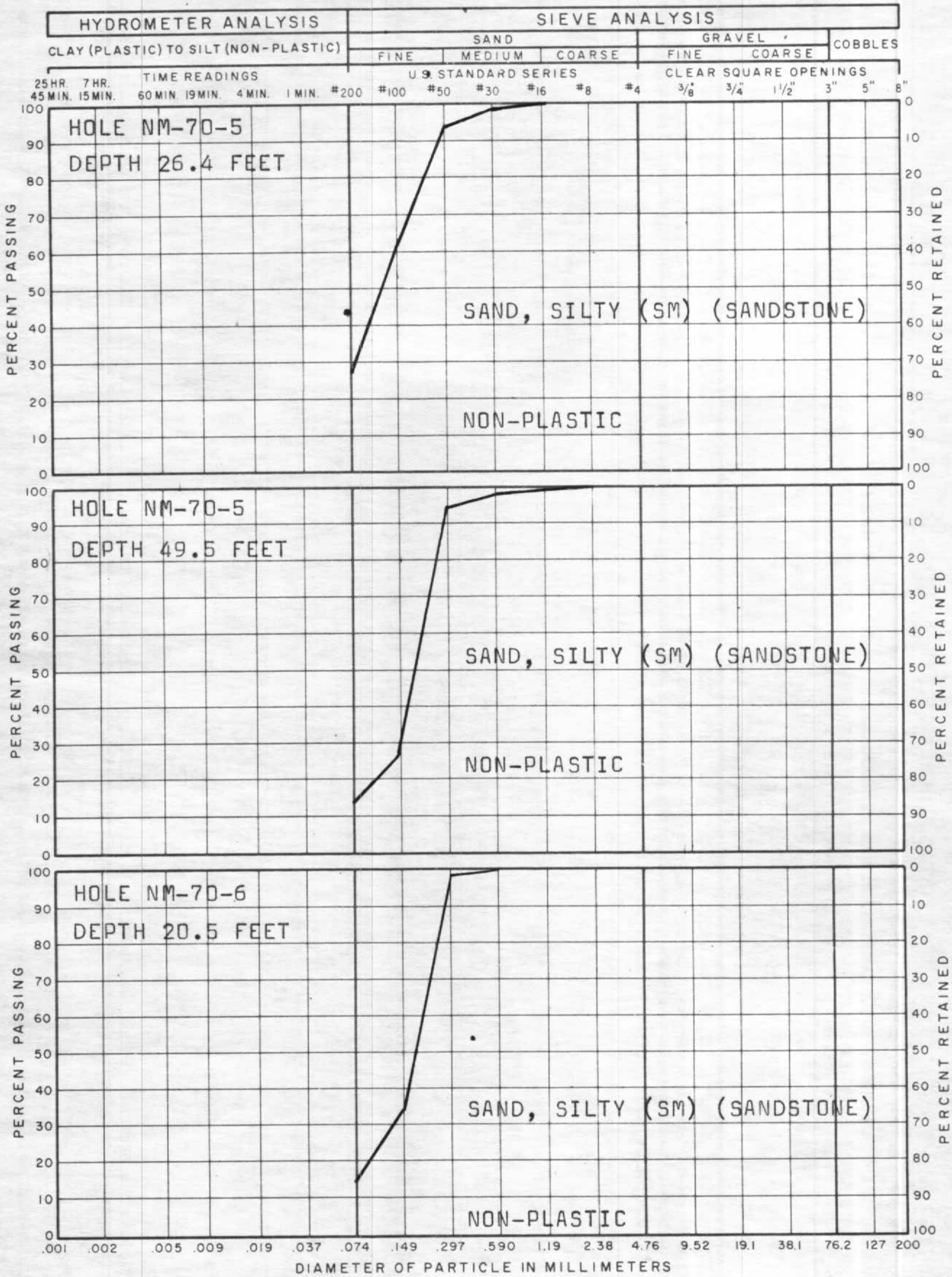


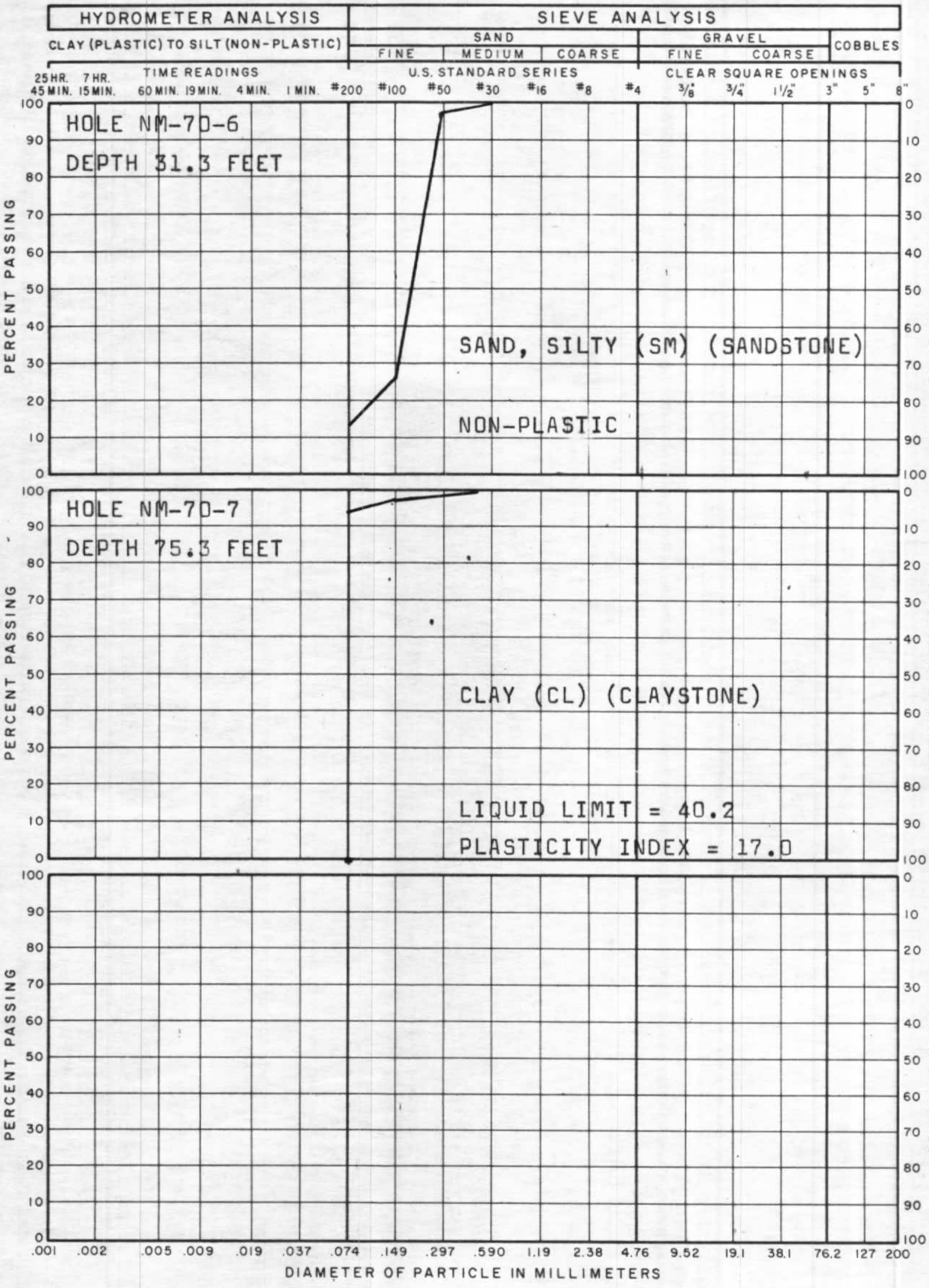
FIG. A-6

Job No. 12819-12578

FORM NO.
WC -4

WOODWARD - CLYDE & ASSOCIATES

GRADATION ANALYSIS



Job No. 12819-12578

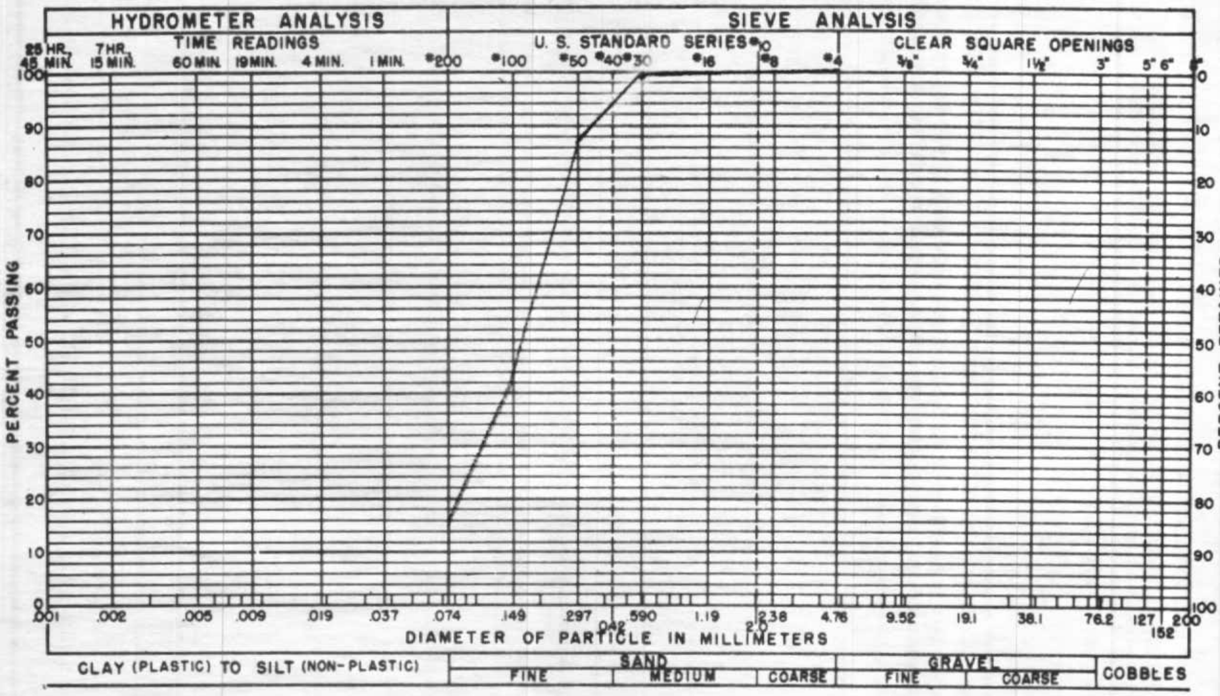
FIG. A-7

APPENDIX B

COMPACTION TEST RESULTS

FORM NO.
WC 1

WOODWARD - CLYDE & ASSOCIATES
CONSULTING SOIL ENGINEERS

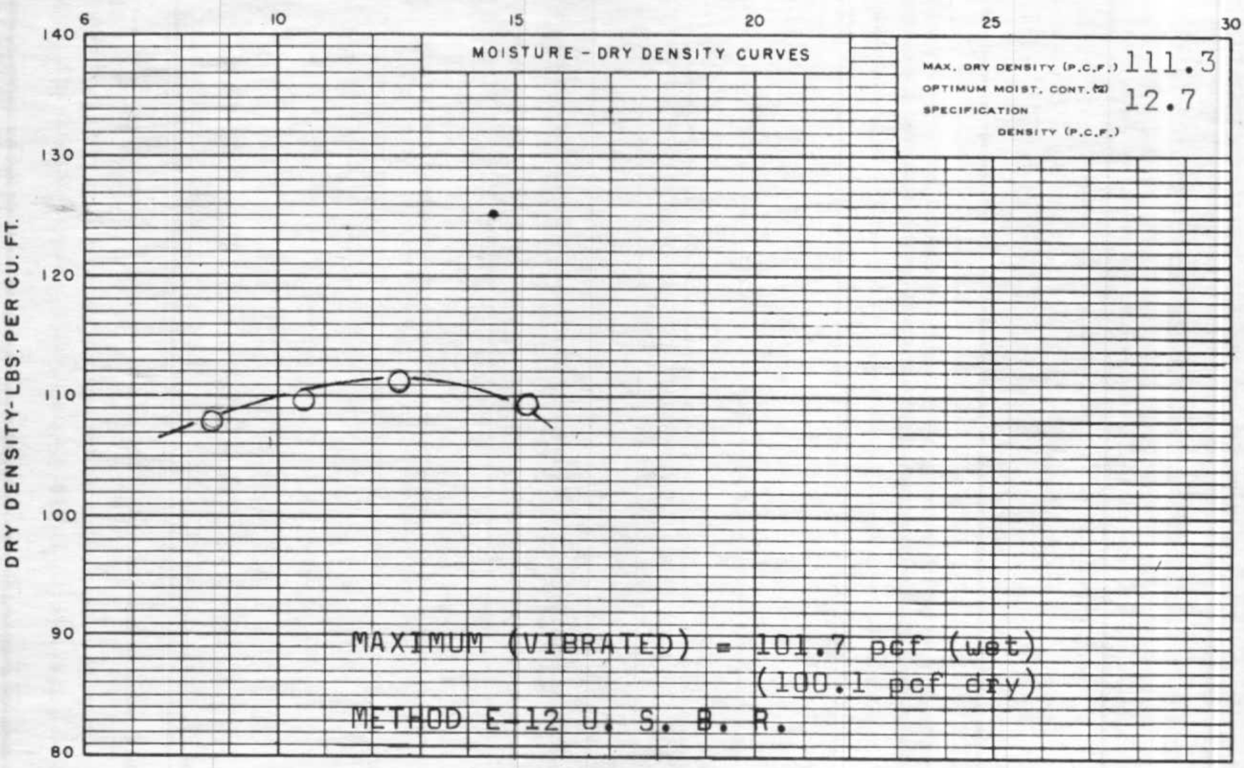


GRADATION TEST RESULTS

GRAVEL 0 % SAND 87.7% SILT AND CLAY 12.3 %

LIQUID LIMIT % PLASTICITY INDEX %

NON-PLASTIC



COMPACTION TEST RESULTS

Job No.
12819-12578

COMPACTION TEST PROCEDURE ASTM D-1557-66T, Method "A"

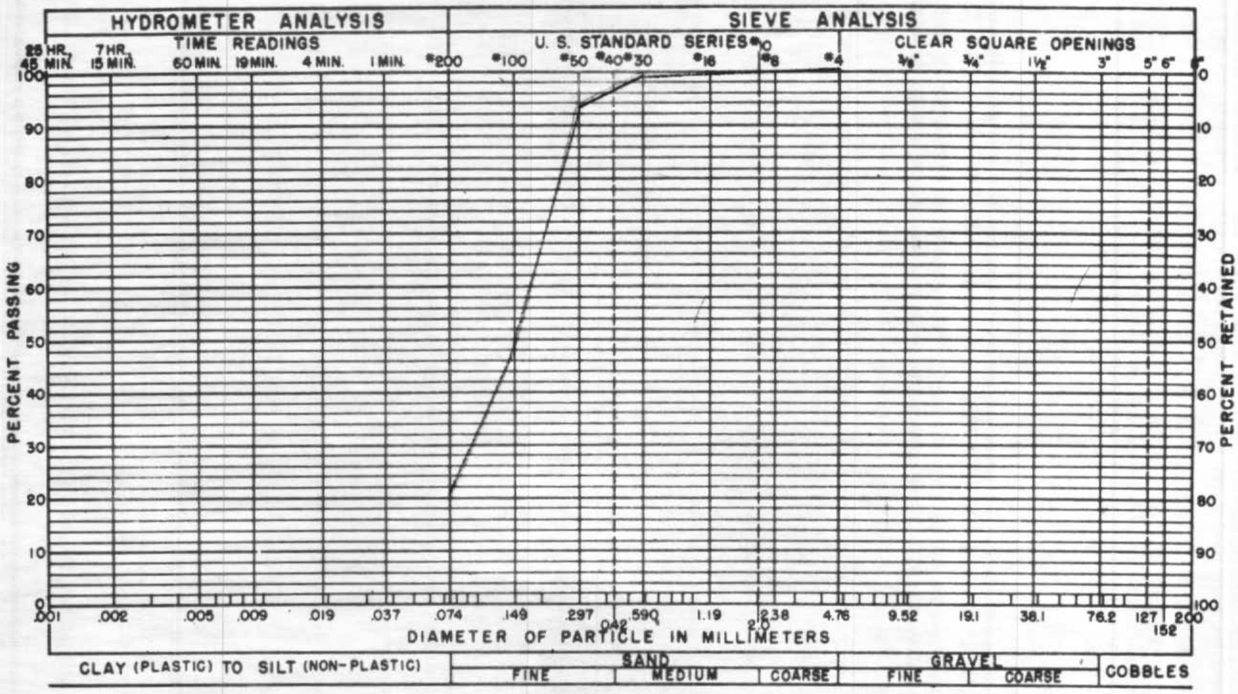
SAMPLE OF Silty Sand

FROM Test Pit 1 DEPTH

FIG. B-1

FORM NO. WC 1

WOODWARD - CLYDE & ASSOCIATES
CONSULTING SOIL ENGINEERS

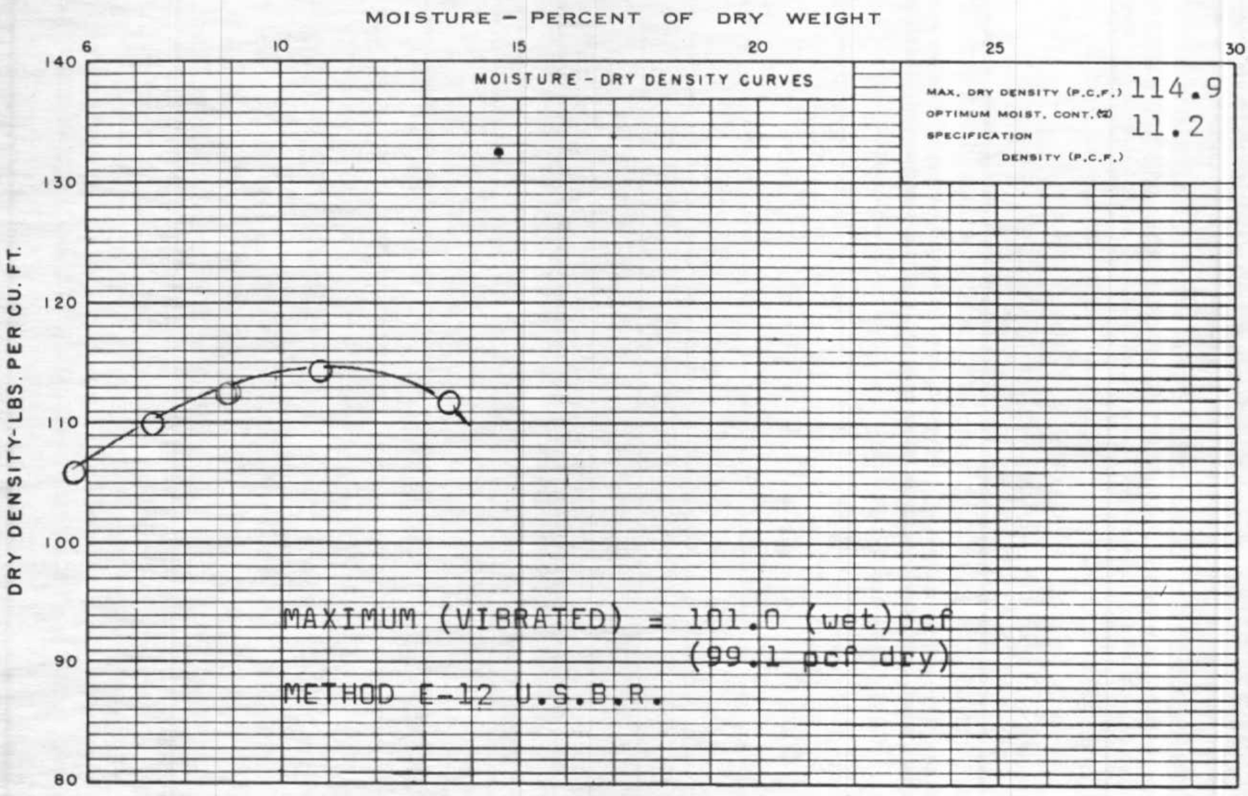


GRADATION TEST RESULTS

GRAVEL 0 % SAND 87.7% SILT AND CLAY 12.3 %

LIQUID LIMIT % PLASTICITY INDEX %

NON-PLASTIC



COMPACTION TEST RESULTS

Job No. 12819-12578

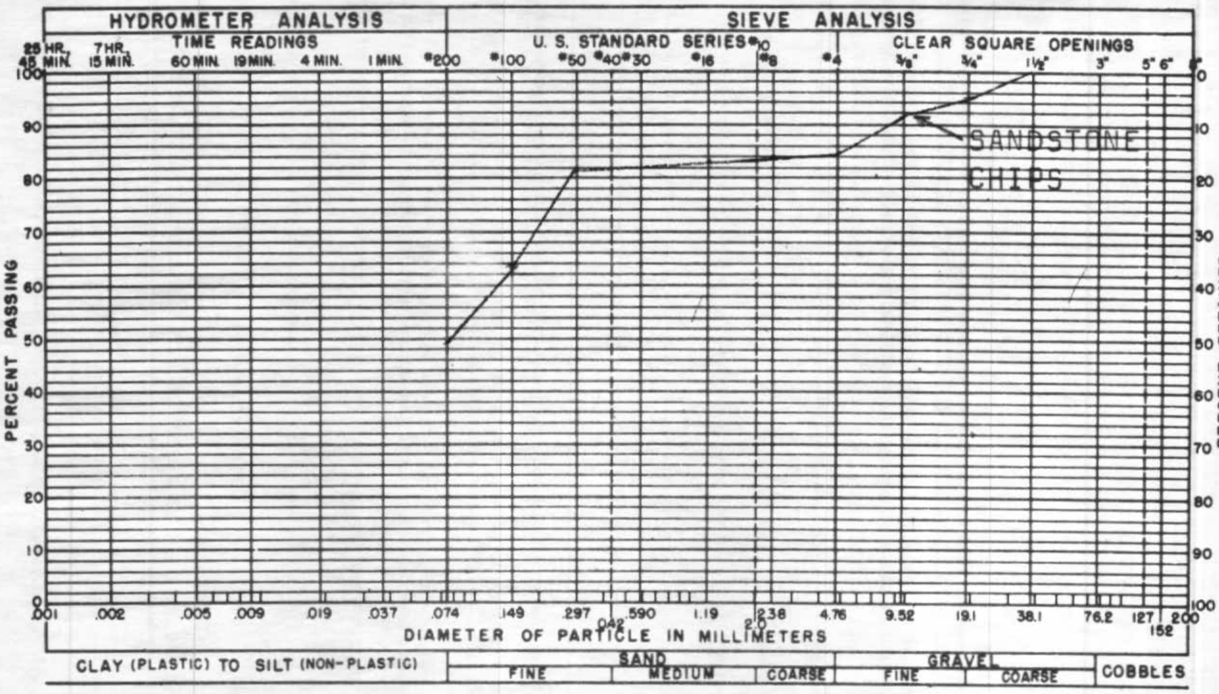
COMPACTION TEST PROCEDURE ASTM D1557-66T, Method "A"

SAMPLE OF Silty Sand

FROM Test Pit 2 DEPTH FIG. B-2

FORM NO.
WC 1

WOODWARD - CLYDE & ASSOCIATES
CONSULTING SOIL ENGINEERS

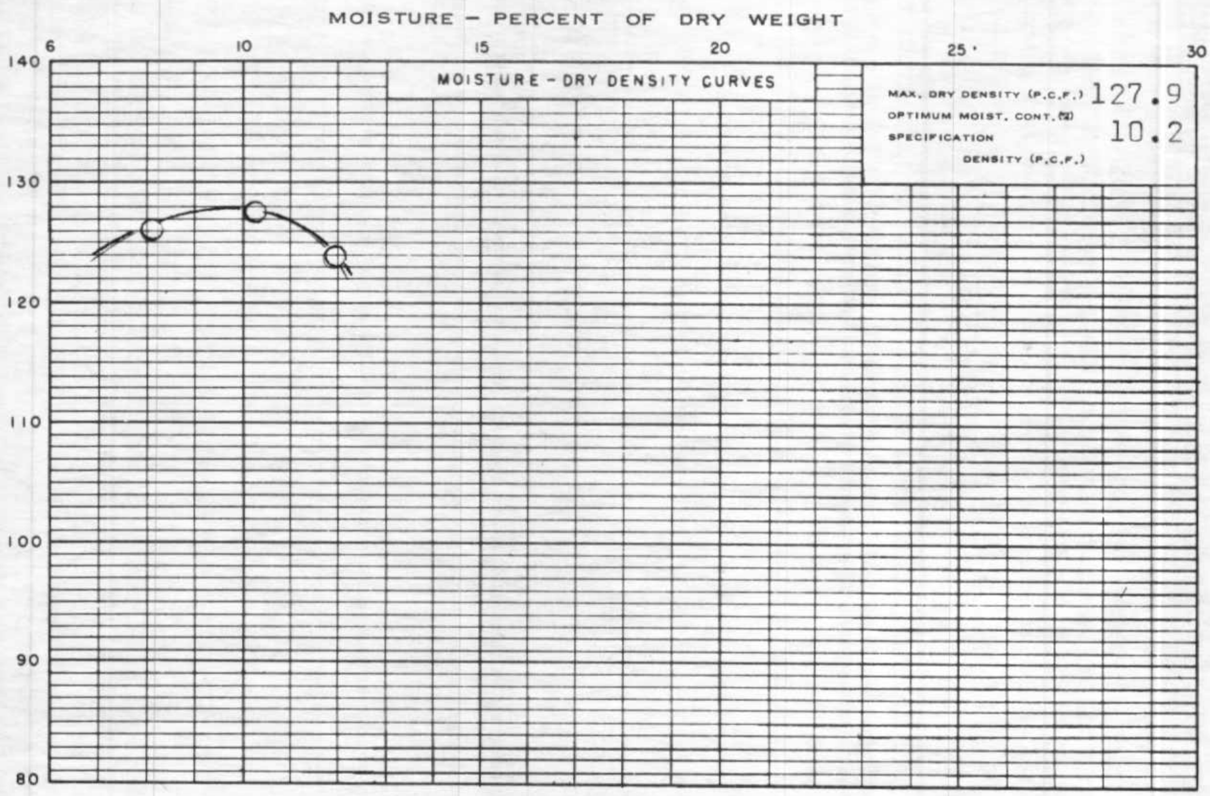


GRADATION TEST RESULTS

Sandstone 15.9 % SAND 34.6% SILT AND CLAY 49.5 %

LIQUID LIMIT % PLASTICITY INDEX %

NON-PLASTIC



COMPACTION TEST RESULTS

COMPACTION TEST PROCEDURE ASTM D1557-66T, Method "A"

Job No.
12819-
12578

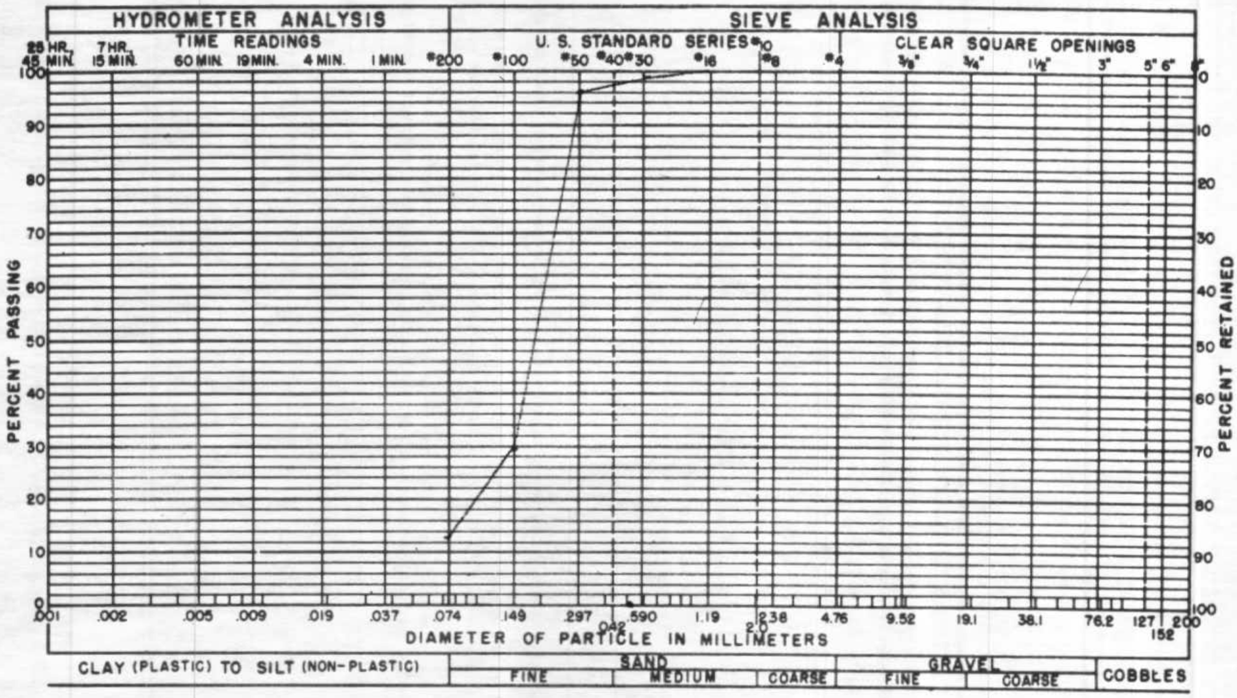
SAMPLE OF Silt and Sand

FROM Test Pit 3 DEPTH

FIG. B-3

FORM NO.
WC 1

WOODWARD - CLYDE & ASSOCIATES
CONSULTING SOIL ENGINEERS

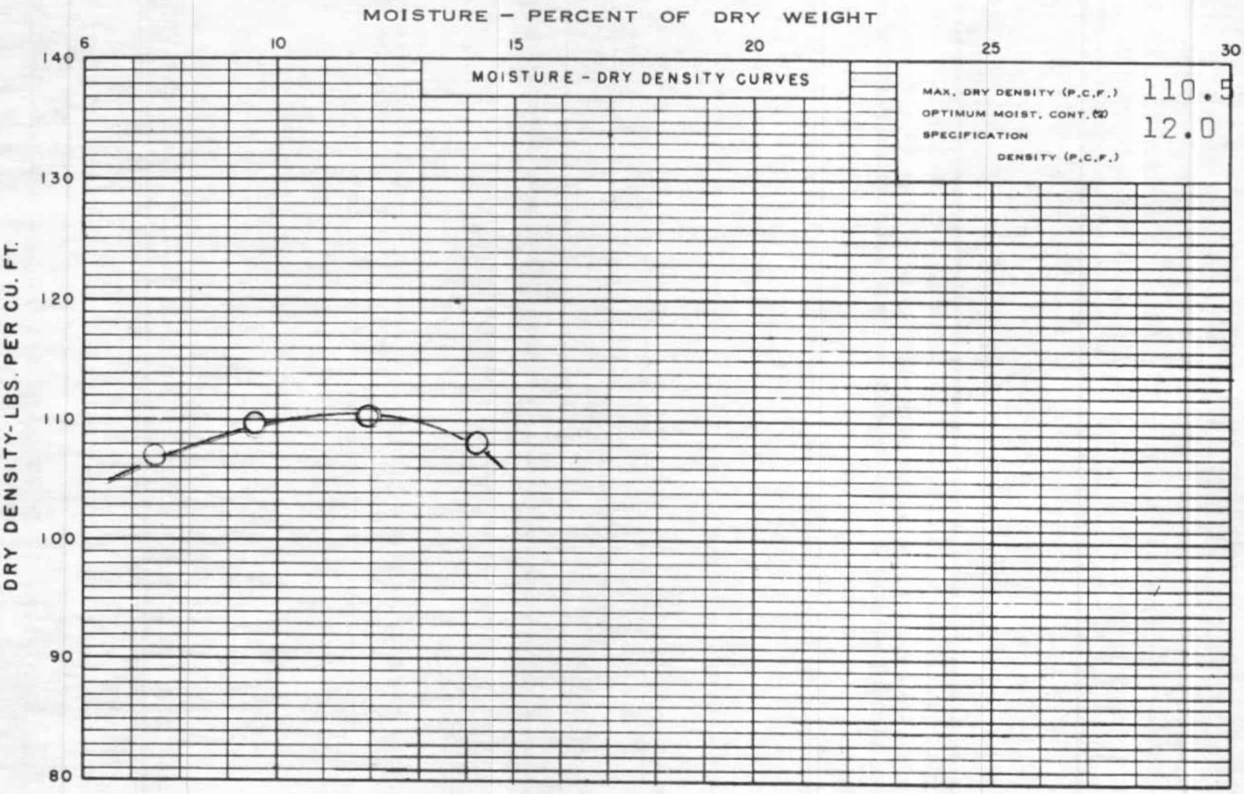


GRADATION TEST RESULTS

GRAVEL 0 % SAND 87.2% SILT AND CLAY 12.8 %

LIQUID LIMIT % PLASTICITY INDEX %

NON-PLASTIC



COMPACTION TEST RESULTS

COMPACTION TEST PROCEDURE ASTM D-1557-66T, Method "A"

Job No.
12819-
12578

SAMPLE OF Silty Sand

FROM Composite of Hole No. 45 DEPTH

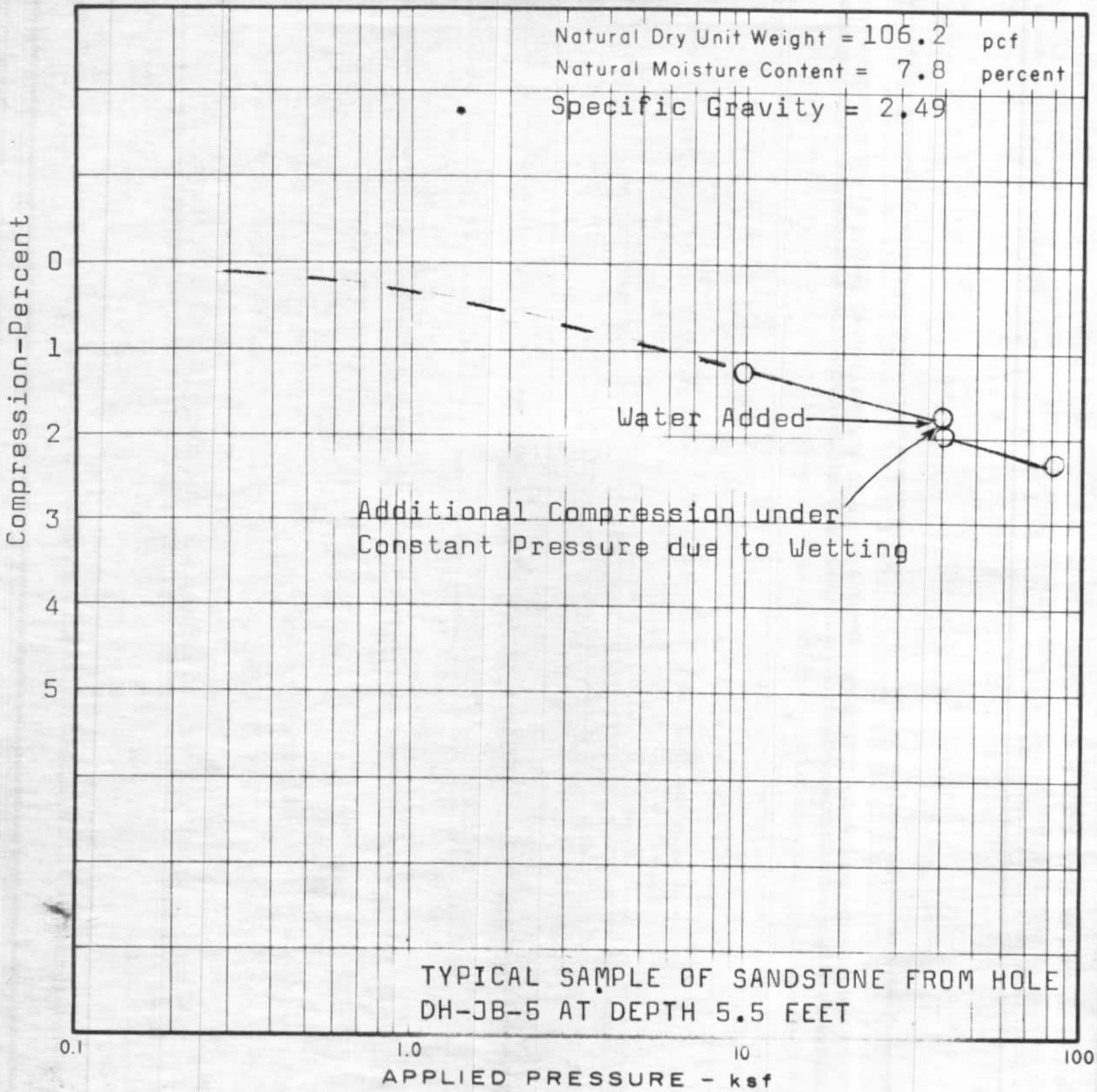
FIG. B-4

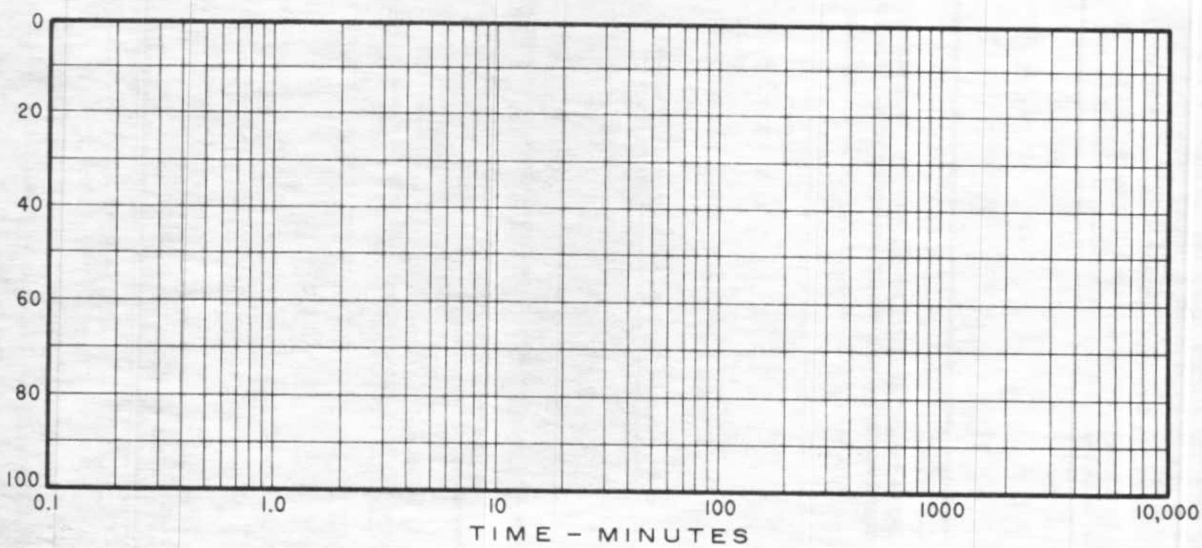
APPENDIX C

SWELL-CONSOLIDATION TEST RESULTS

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





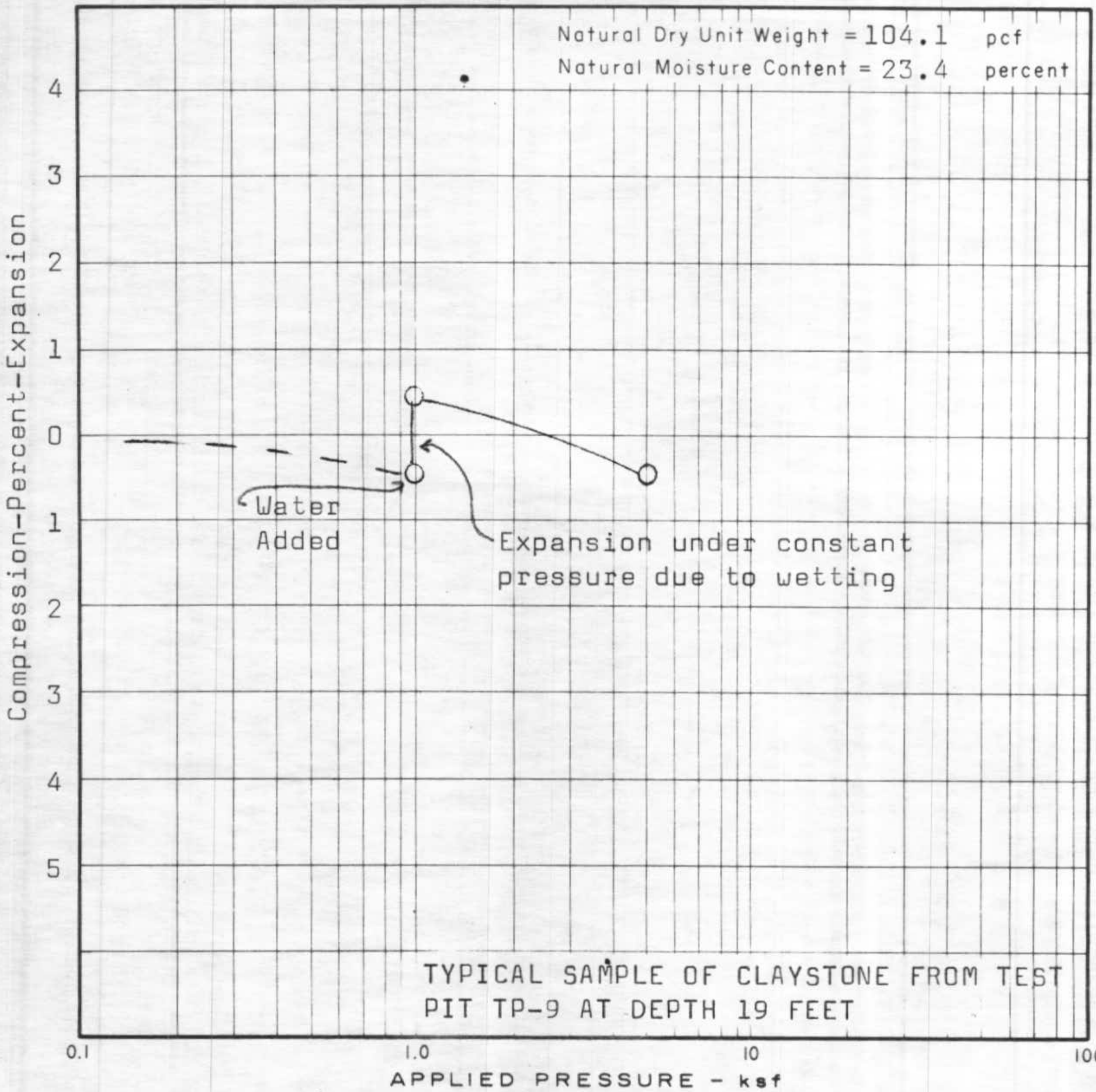
Job No.
12819-12578

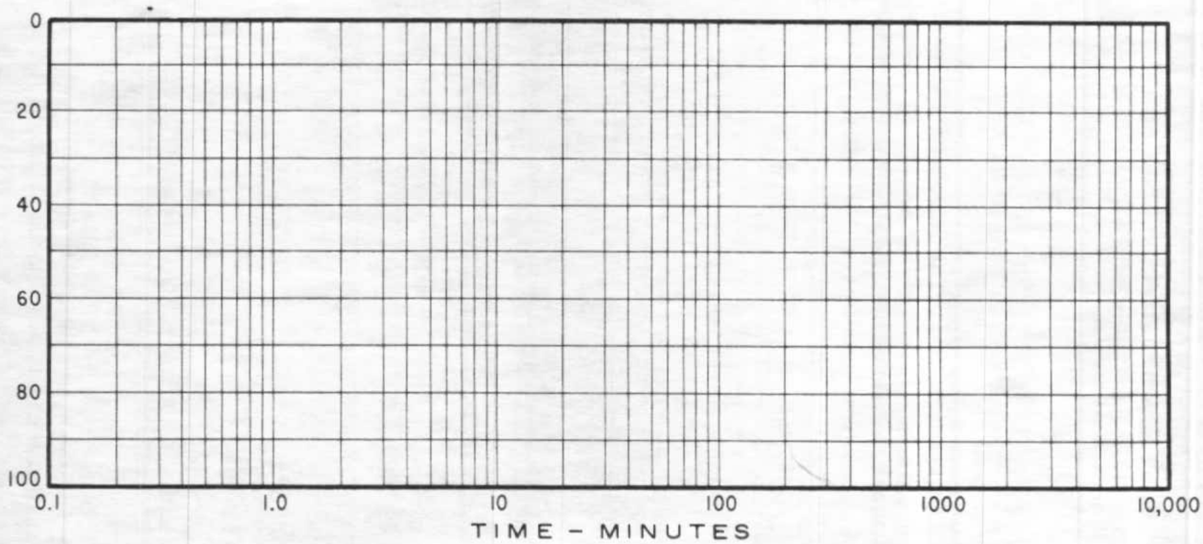
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-1

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





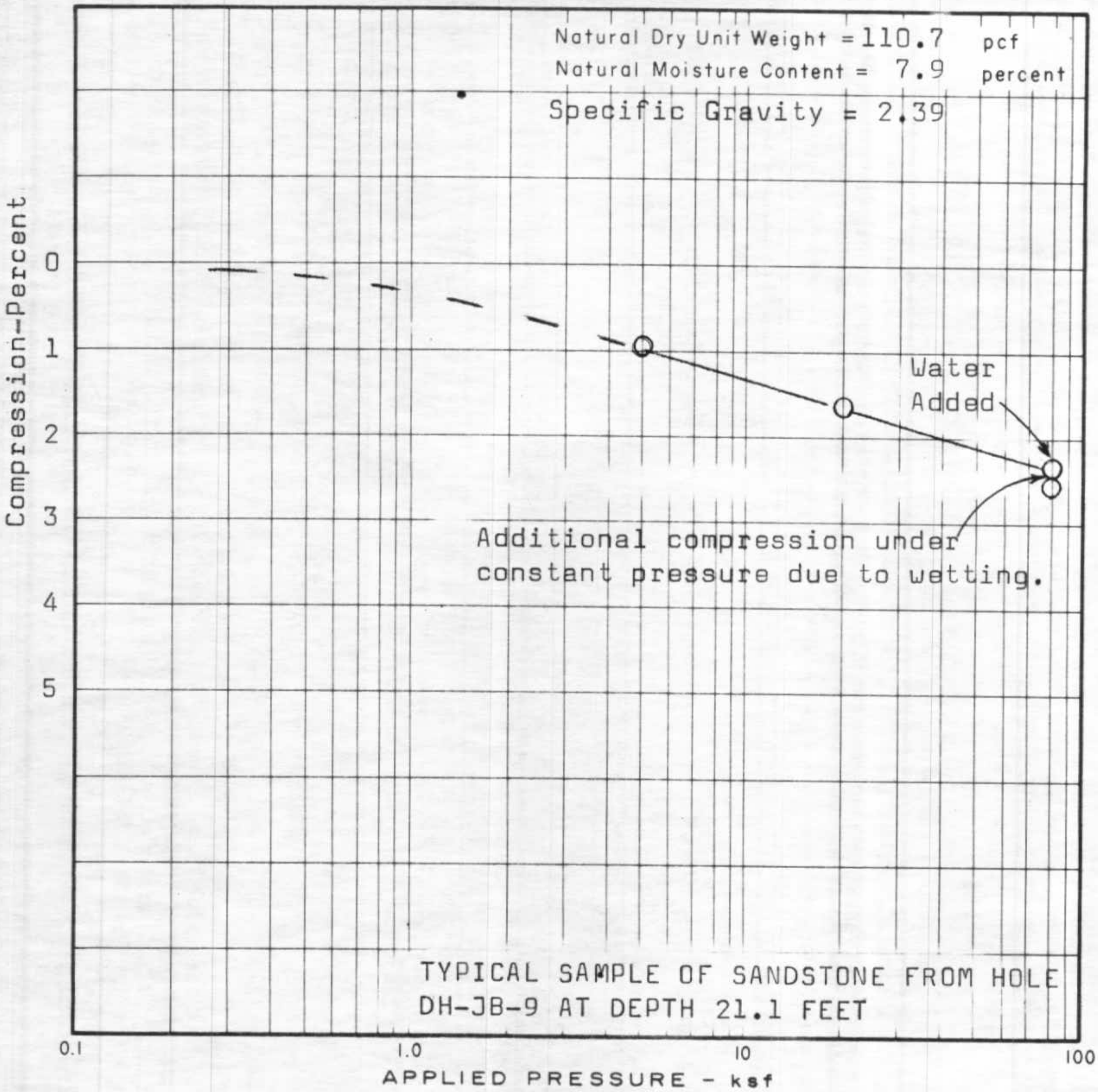
Job No.
12819-12578

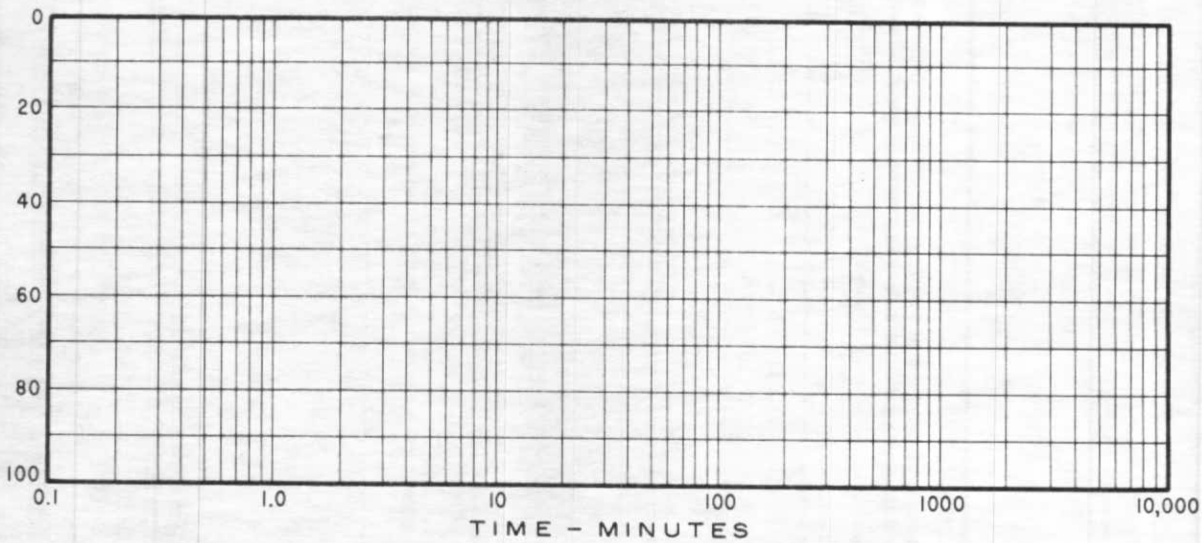
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-2

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





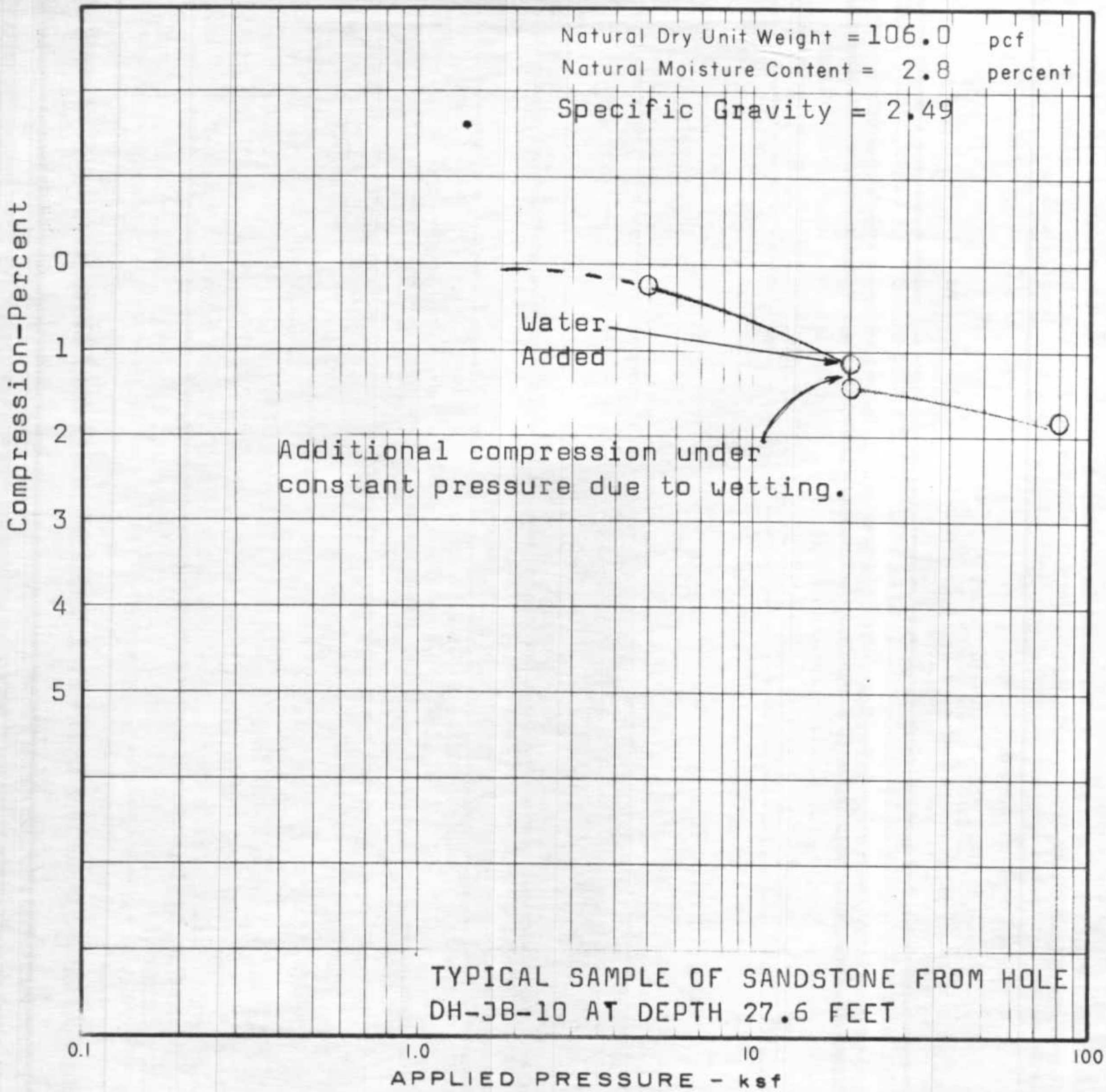
Job No.
12819-12578

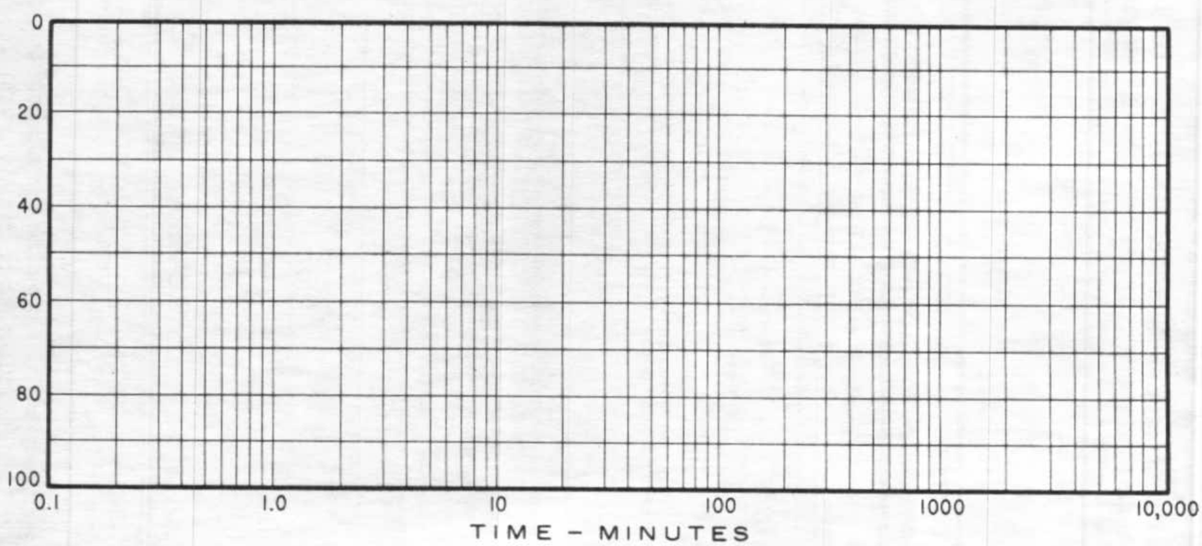
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-3

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





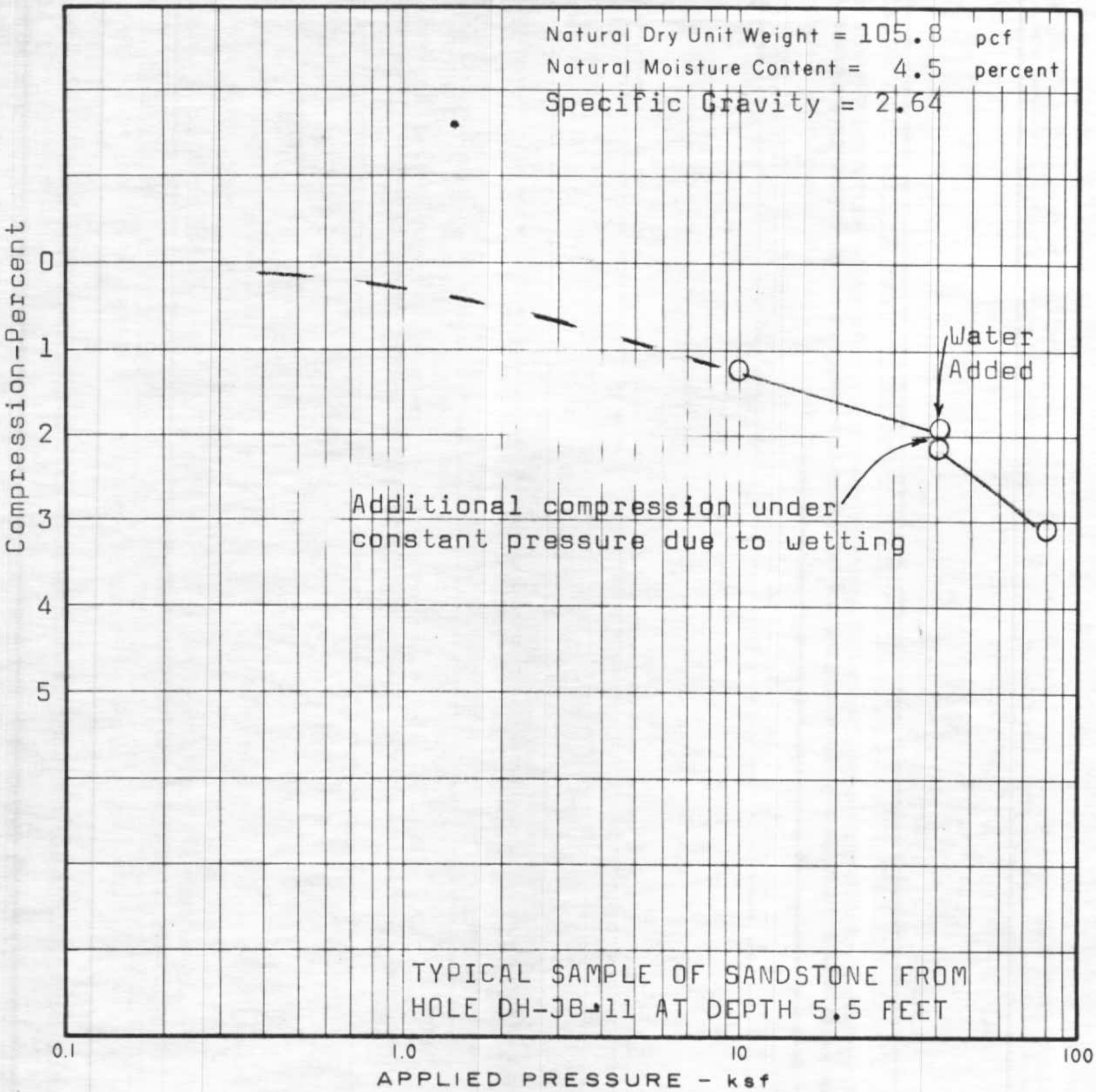
Job No.
12819-12578

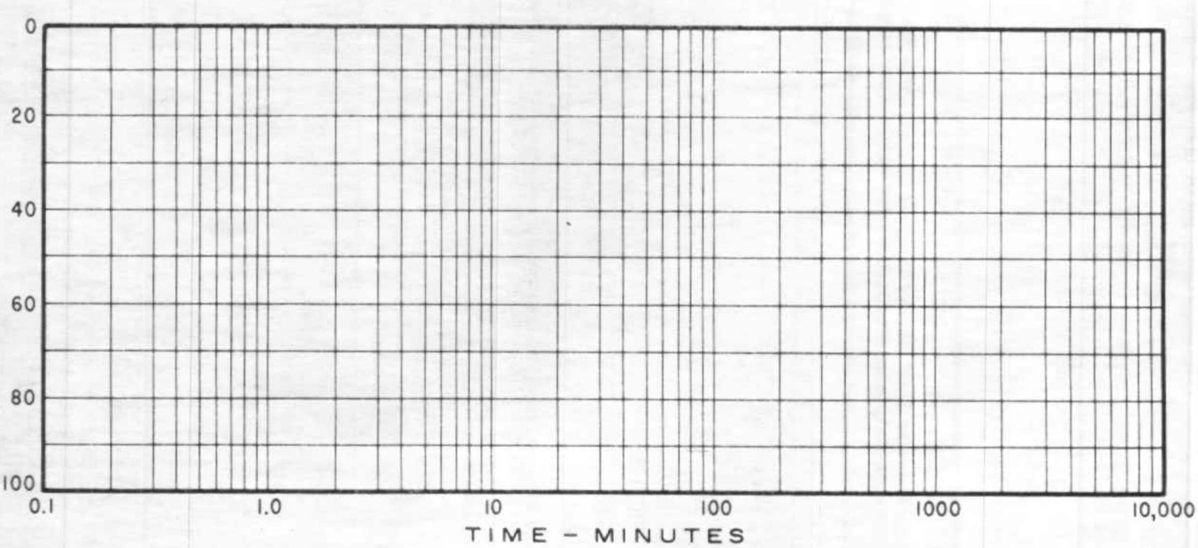
SWELL-CONSOLIDATION REST RESULTS

FIG. C-4

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





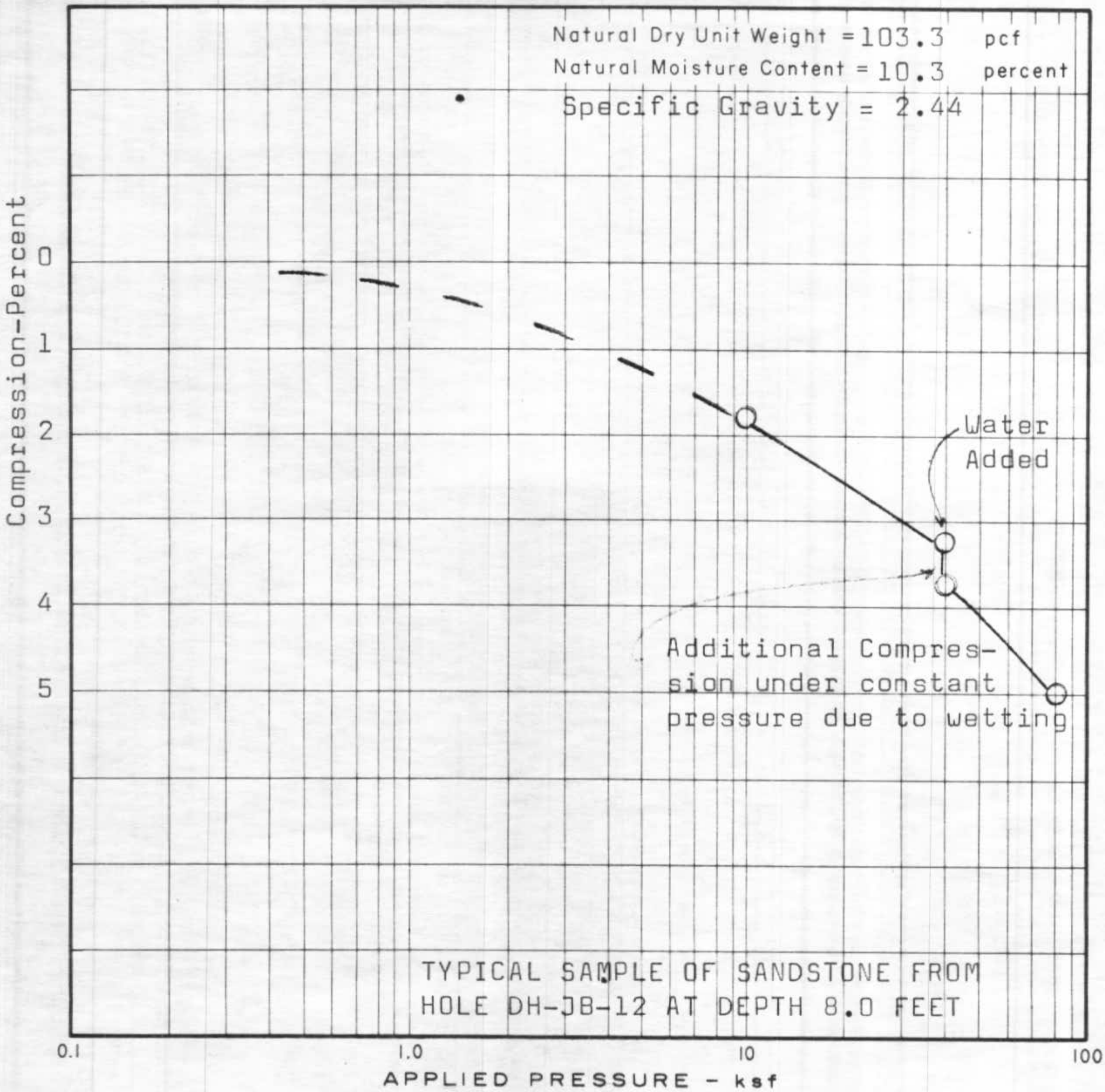
SWELL-CONSOLIDATION TEST RESULTS

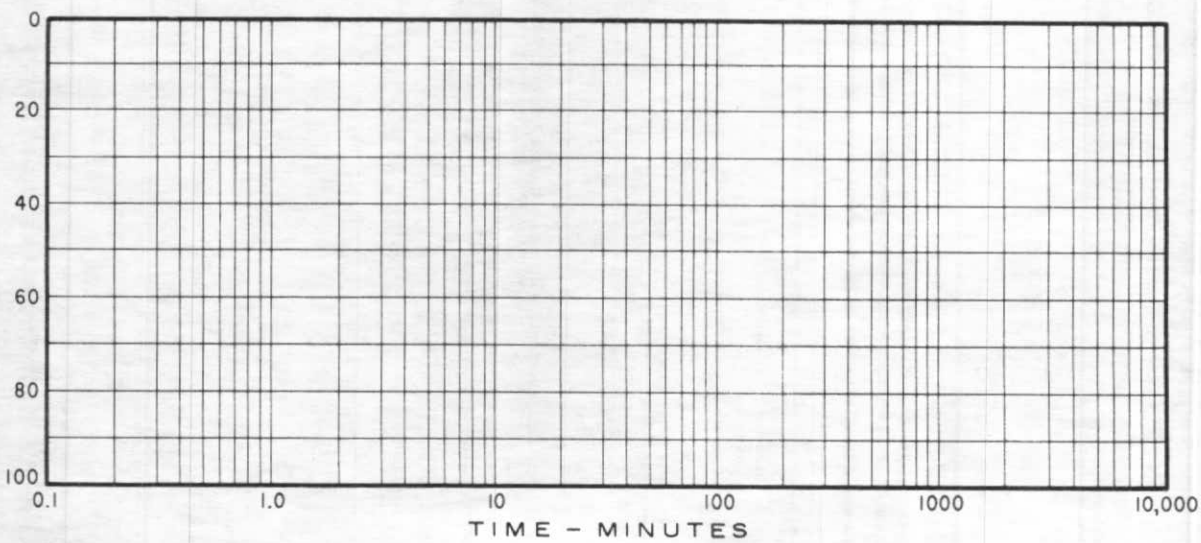
FIG. C-5

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





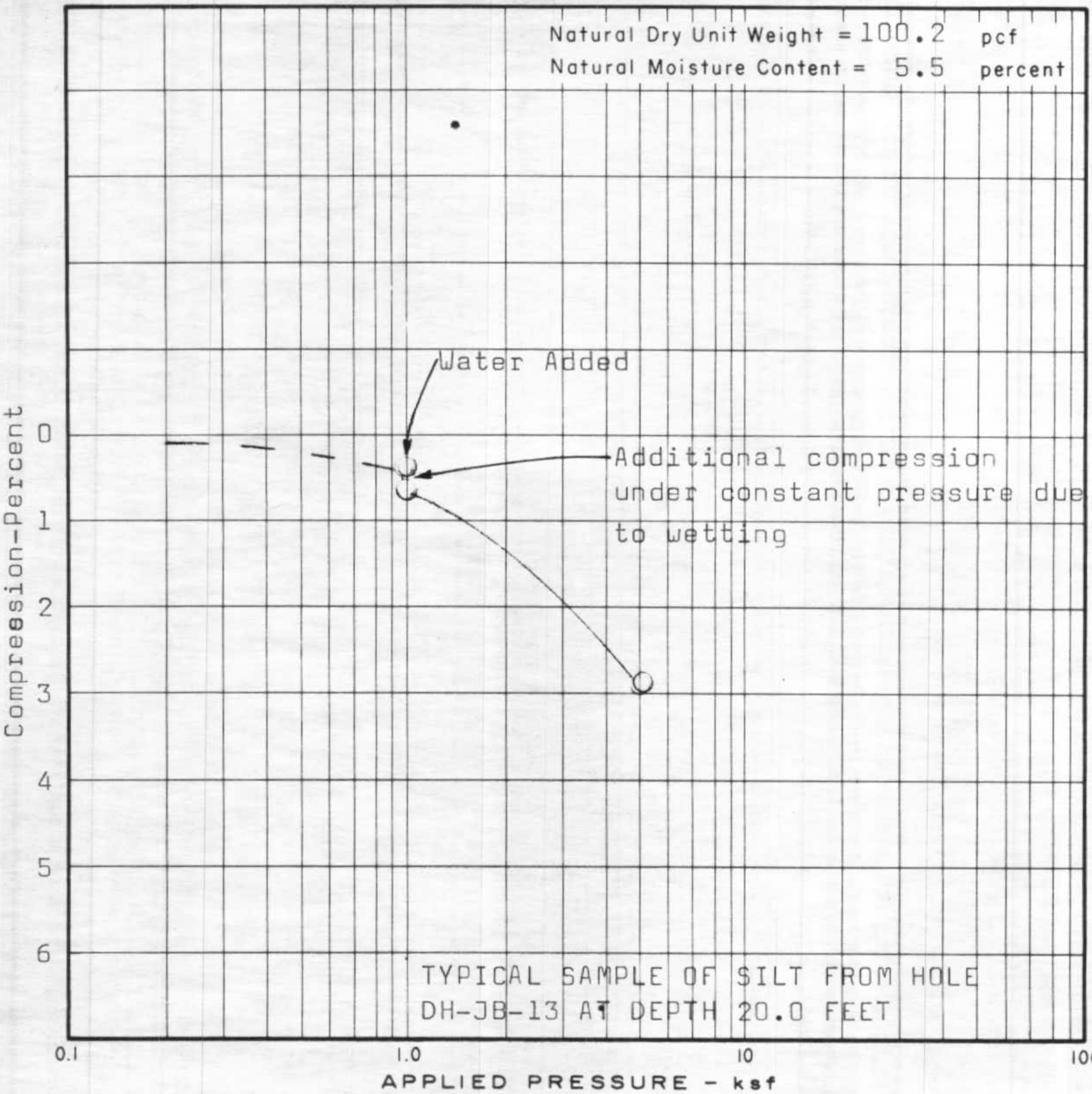
SWELL-CONSOLIDATION TEST RESULTS

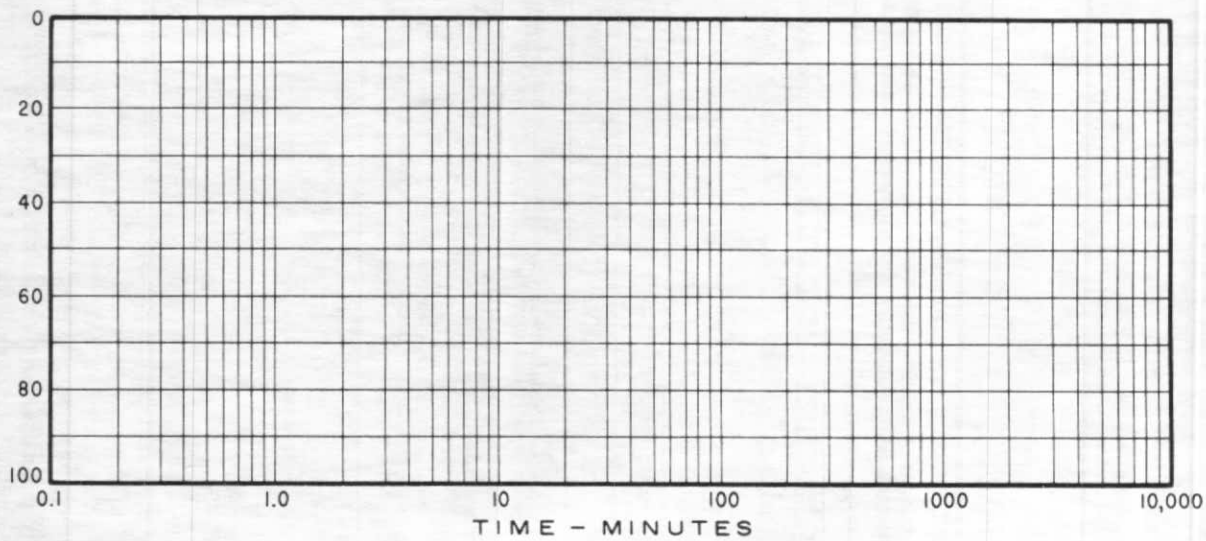
FIG. C-6

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





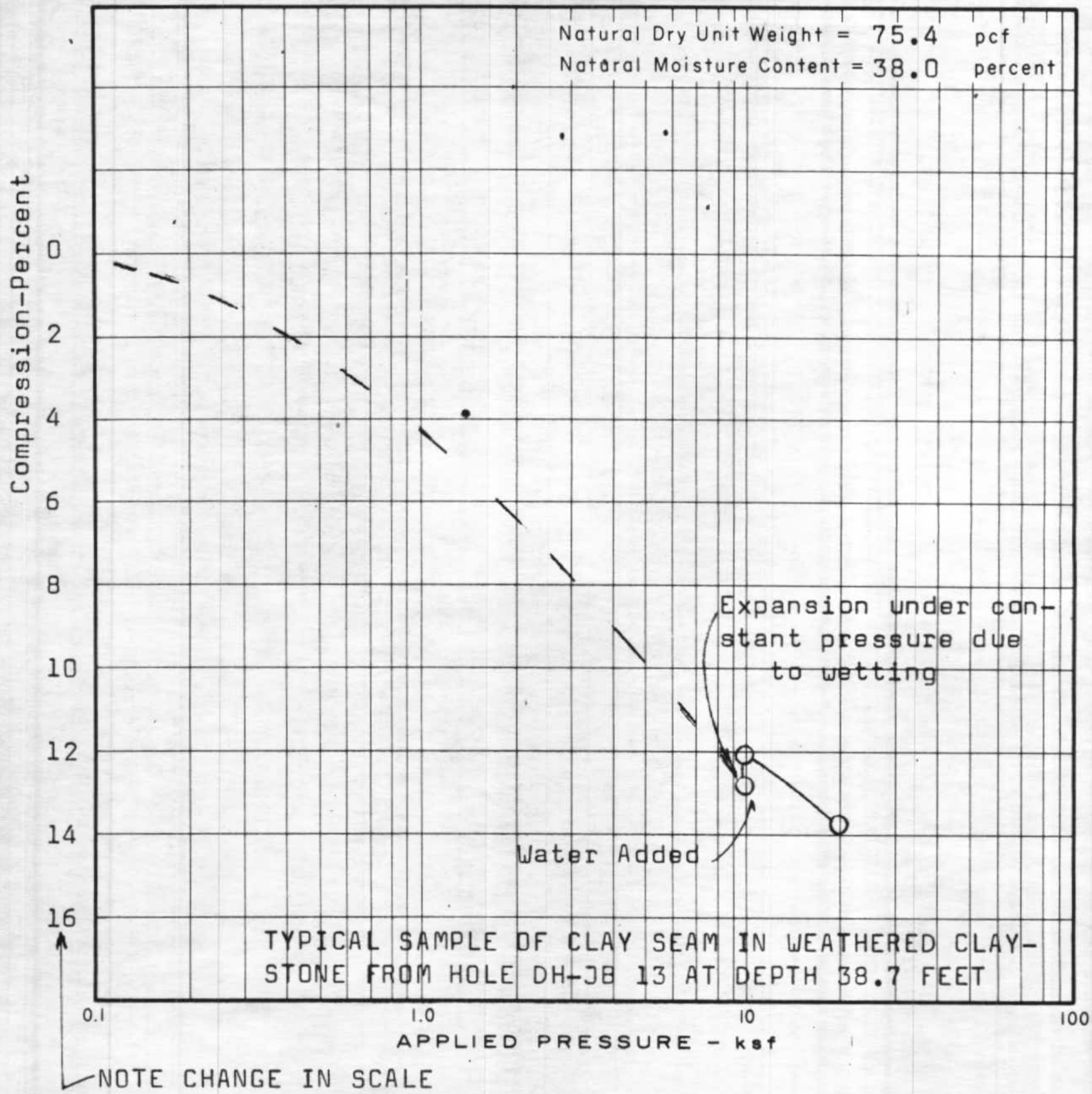
SWELL-CONSOLIDATION TEST RESULTS

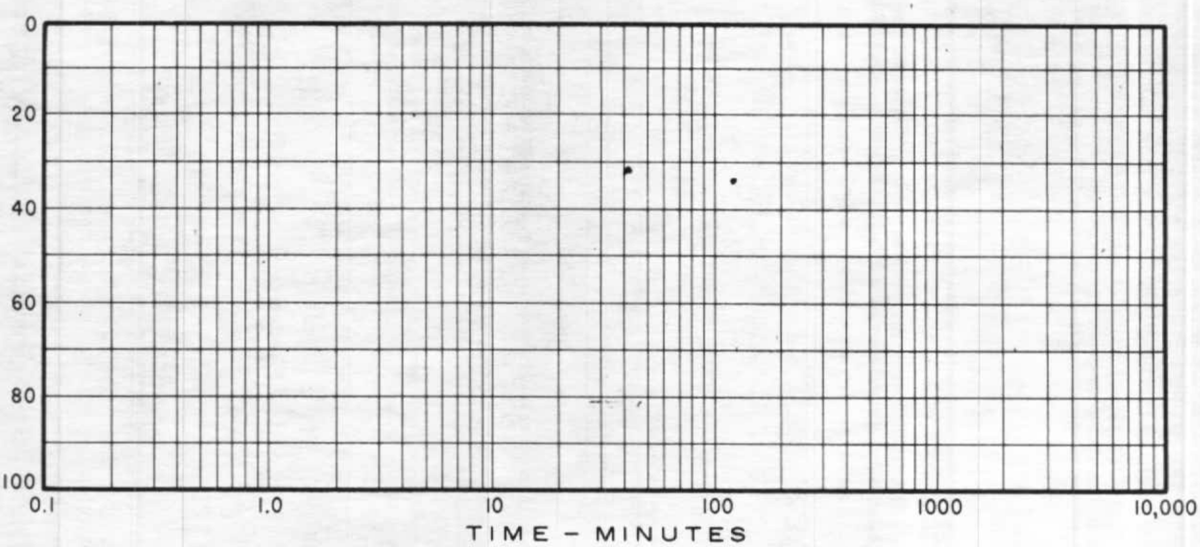
FIG. C-7

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





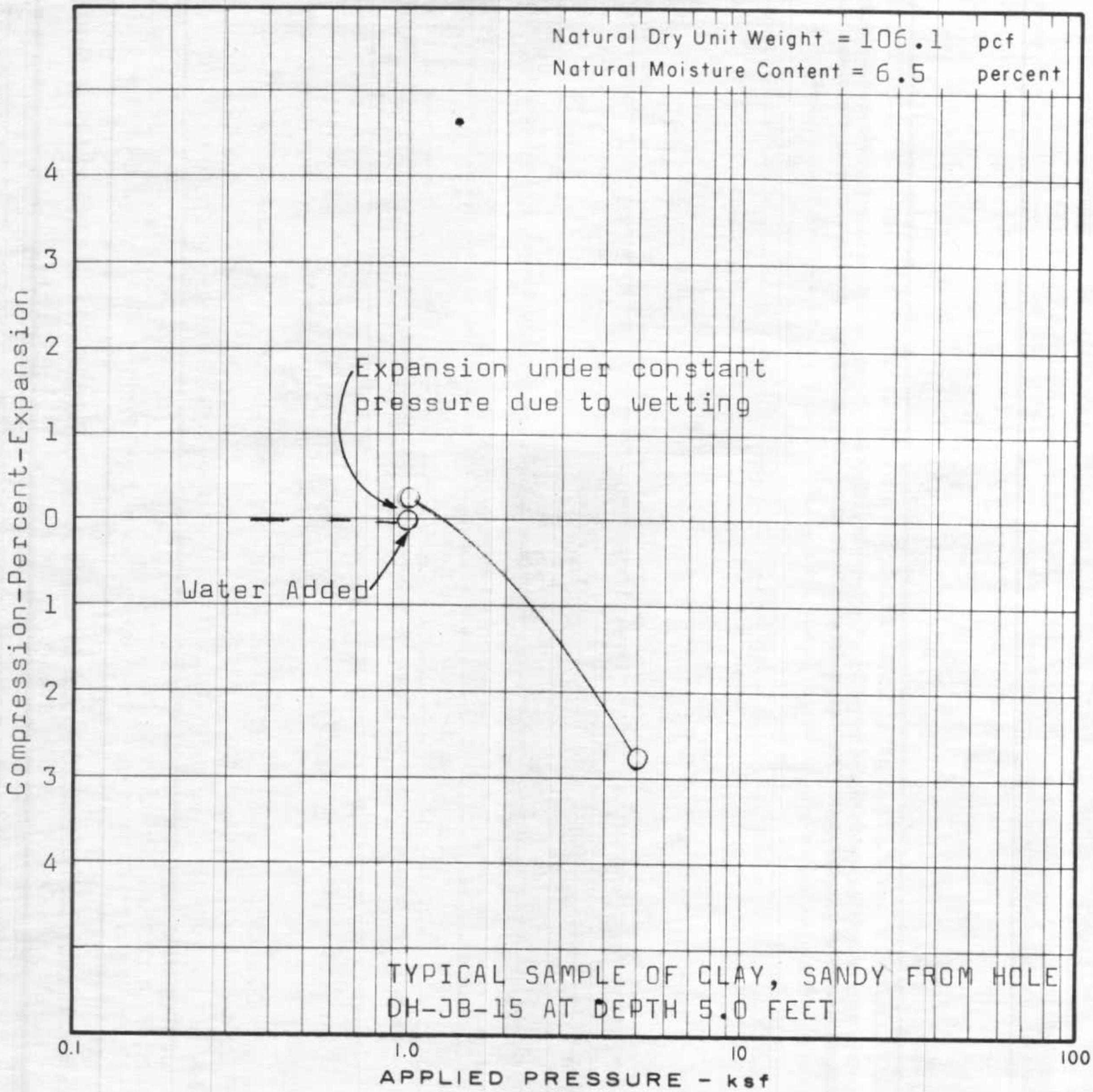
SWELL-CONSOLIDATION TEST RESULTS

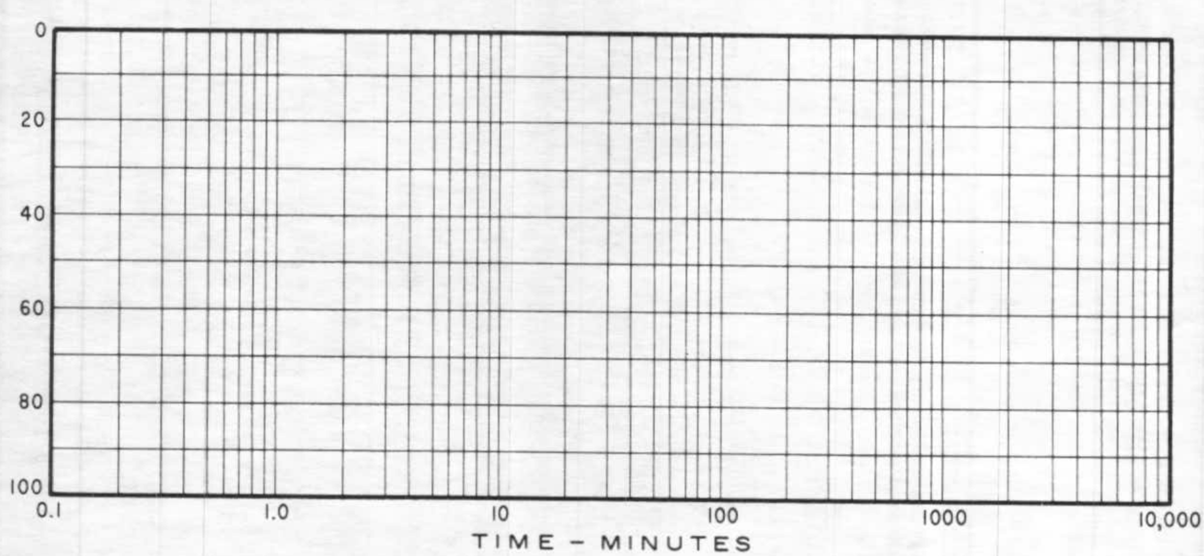
Job No. 12819 -12578

FIG. C-8

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





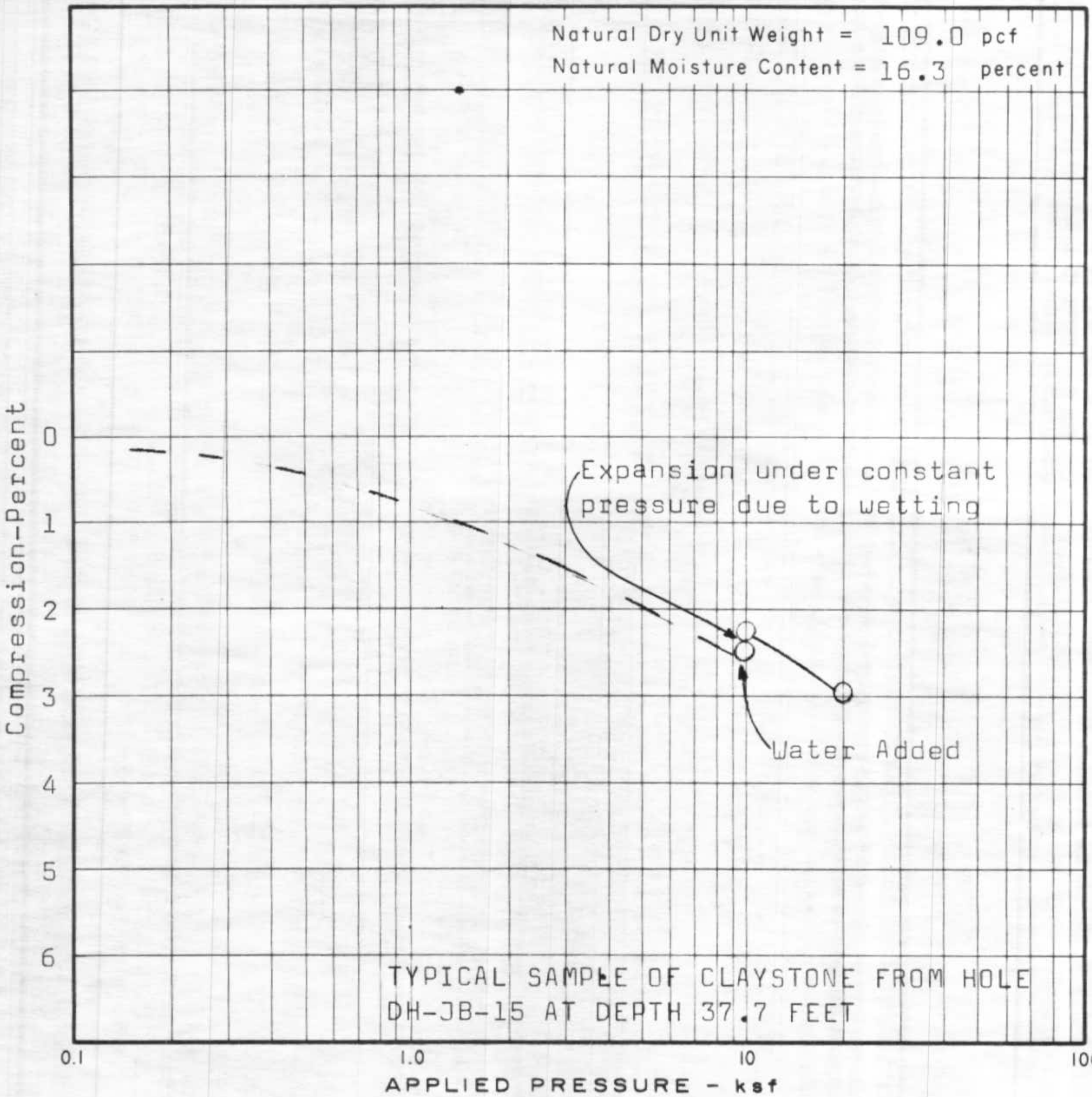
SWELL-CONSOLIDATION TEST RESULTS

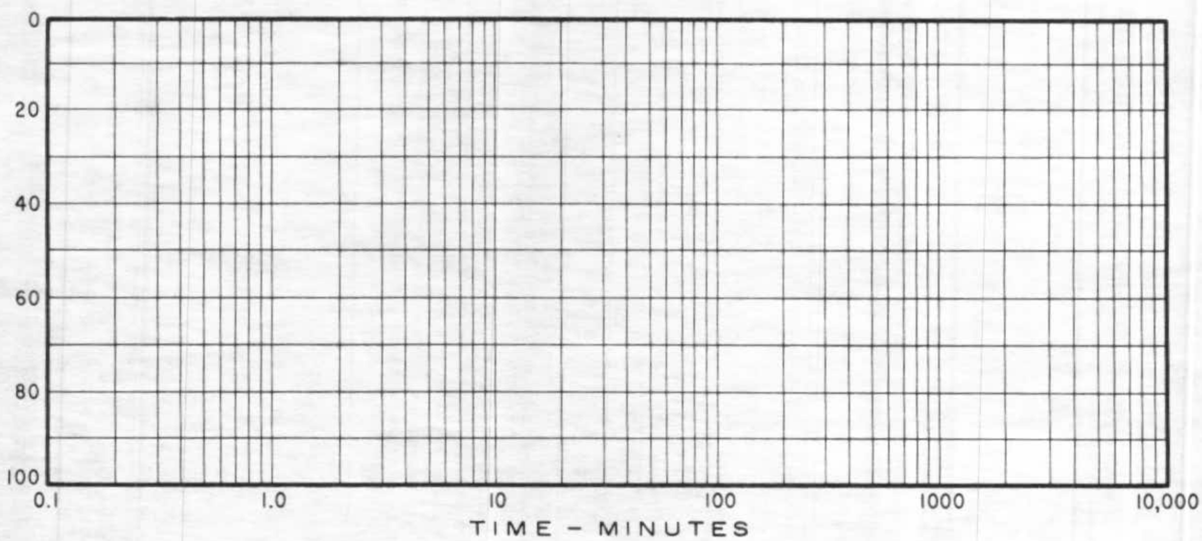
FIG. C-9

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





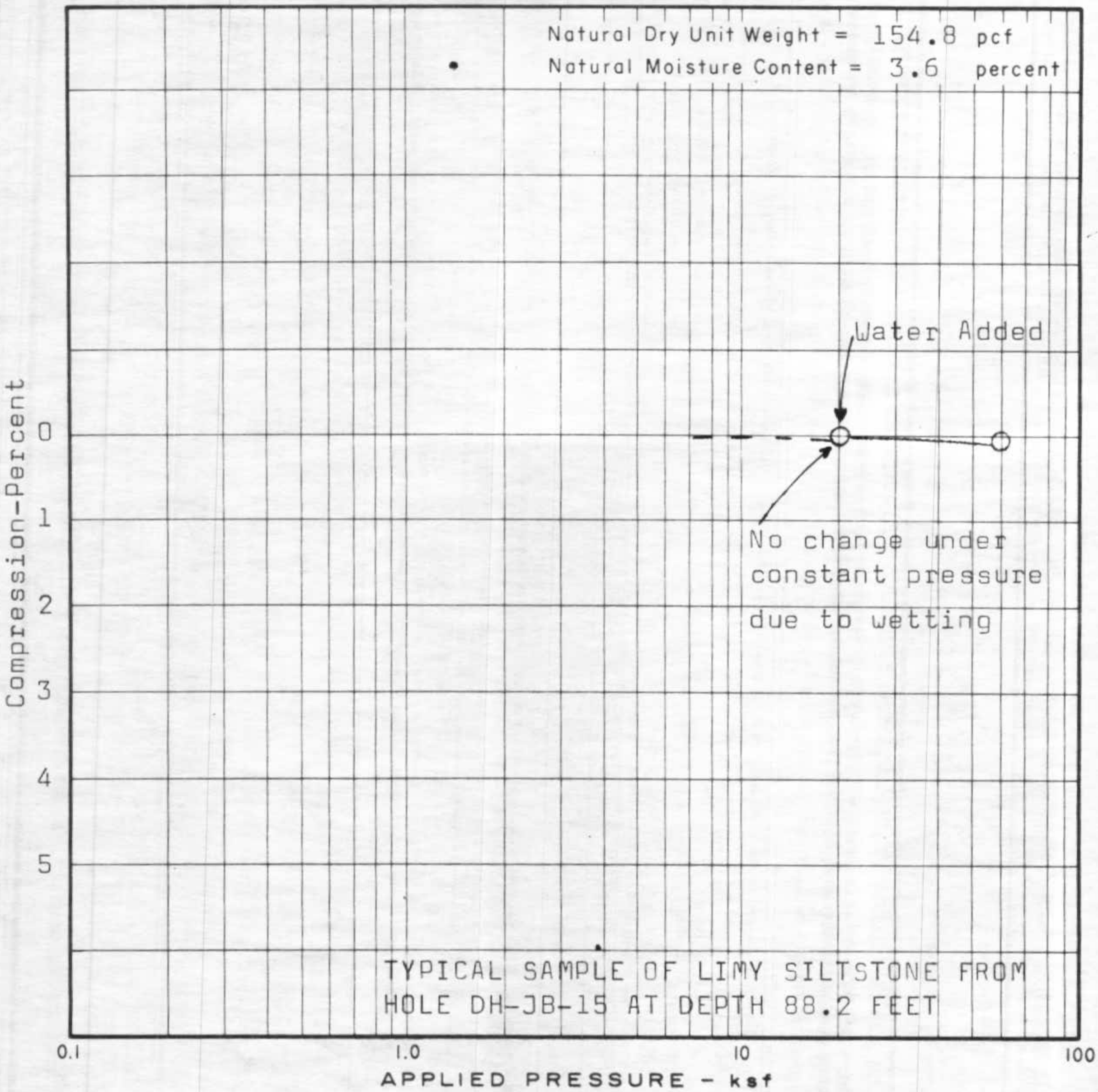
SWELL-CONSOLIDATION TEST RESULTS

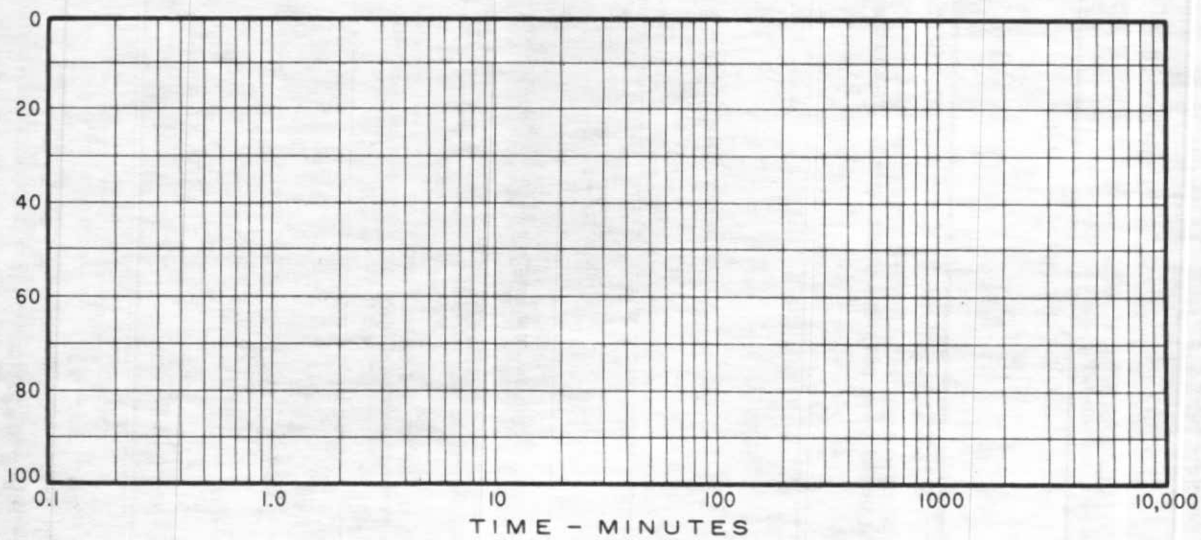
FIG. C-10

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





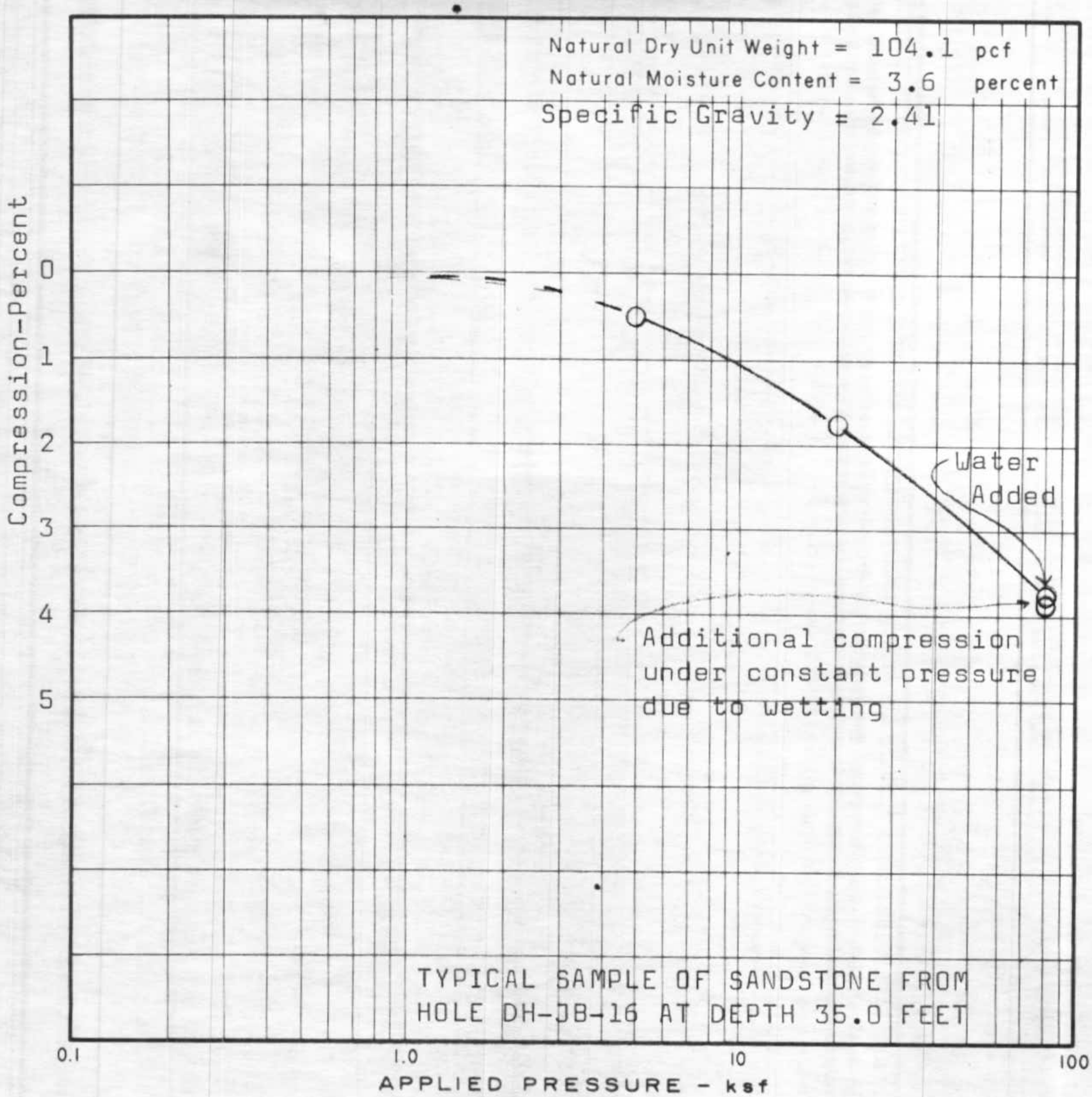
SWELL-CONSOLIDATION TEST RESULTS

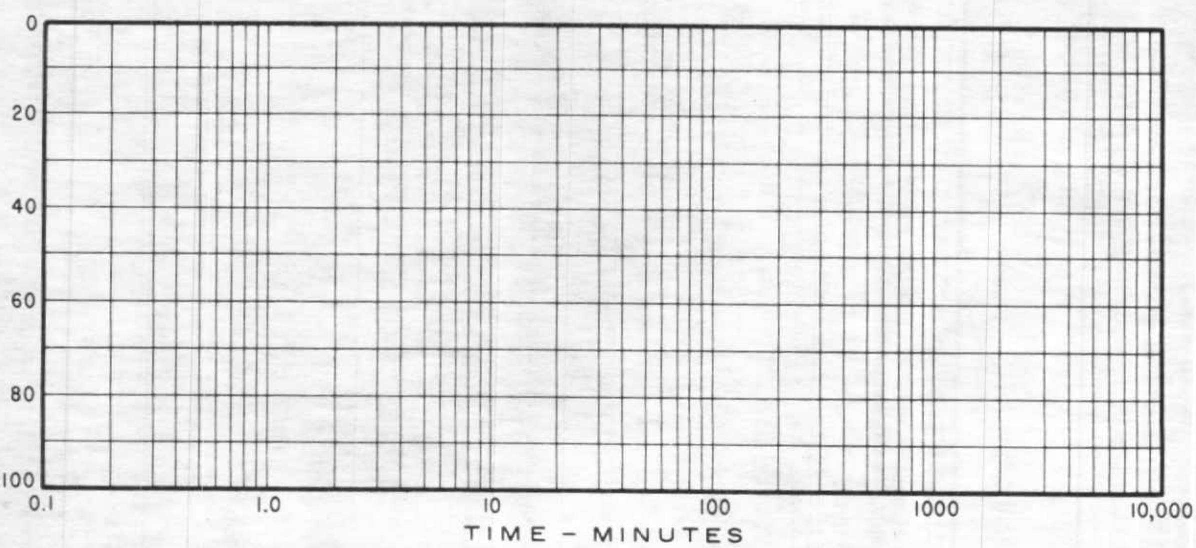
Job No. 12819-12578

FIG. C-11

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





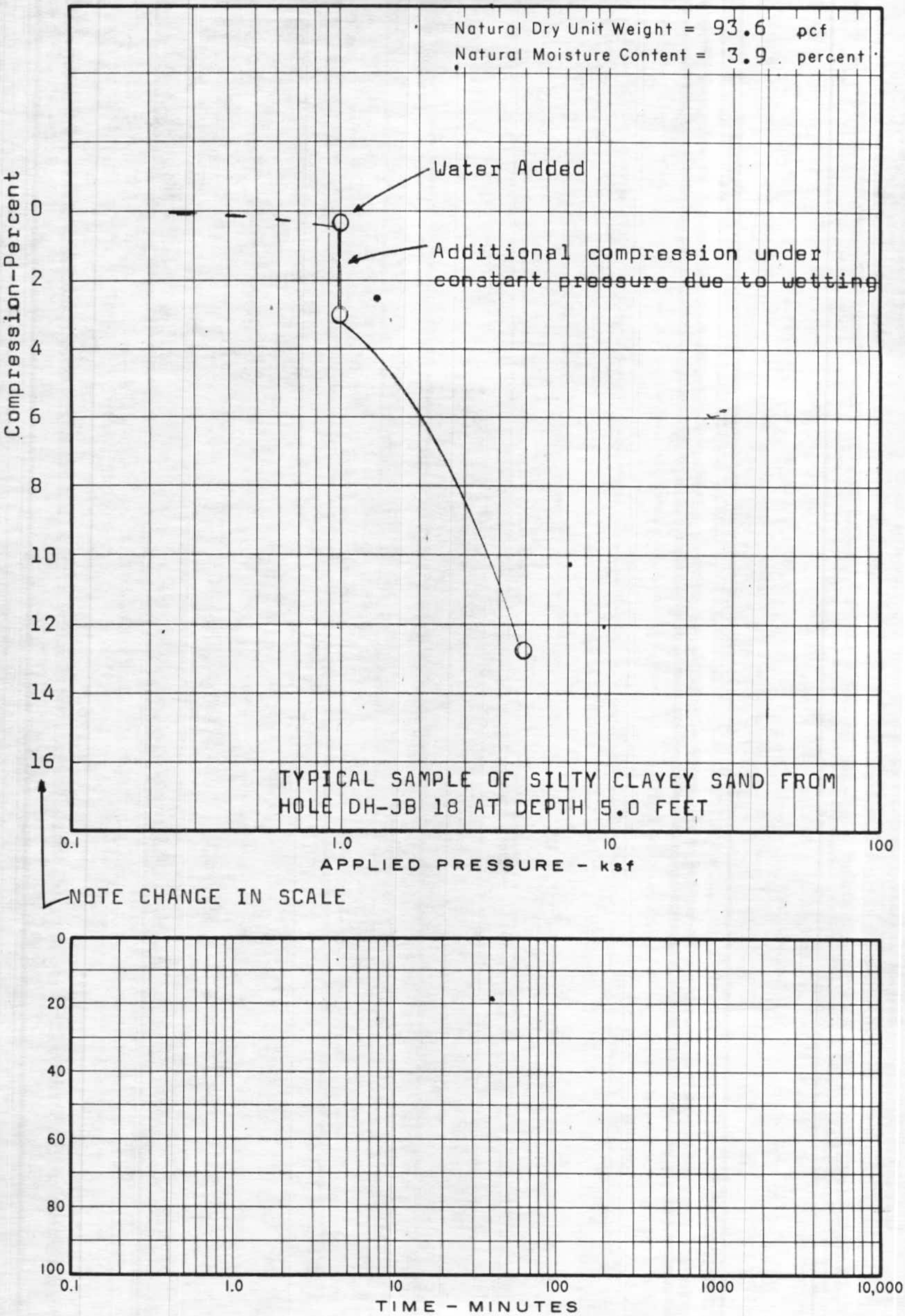
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-12

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES



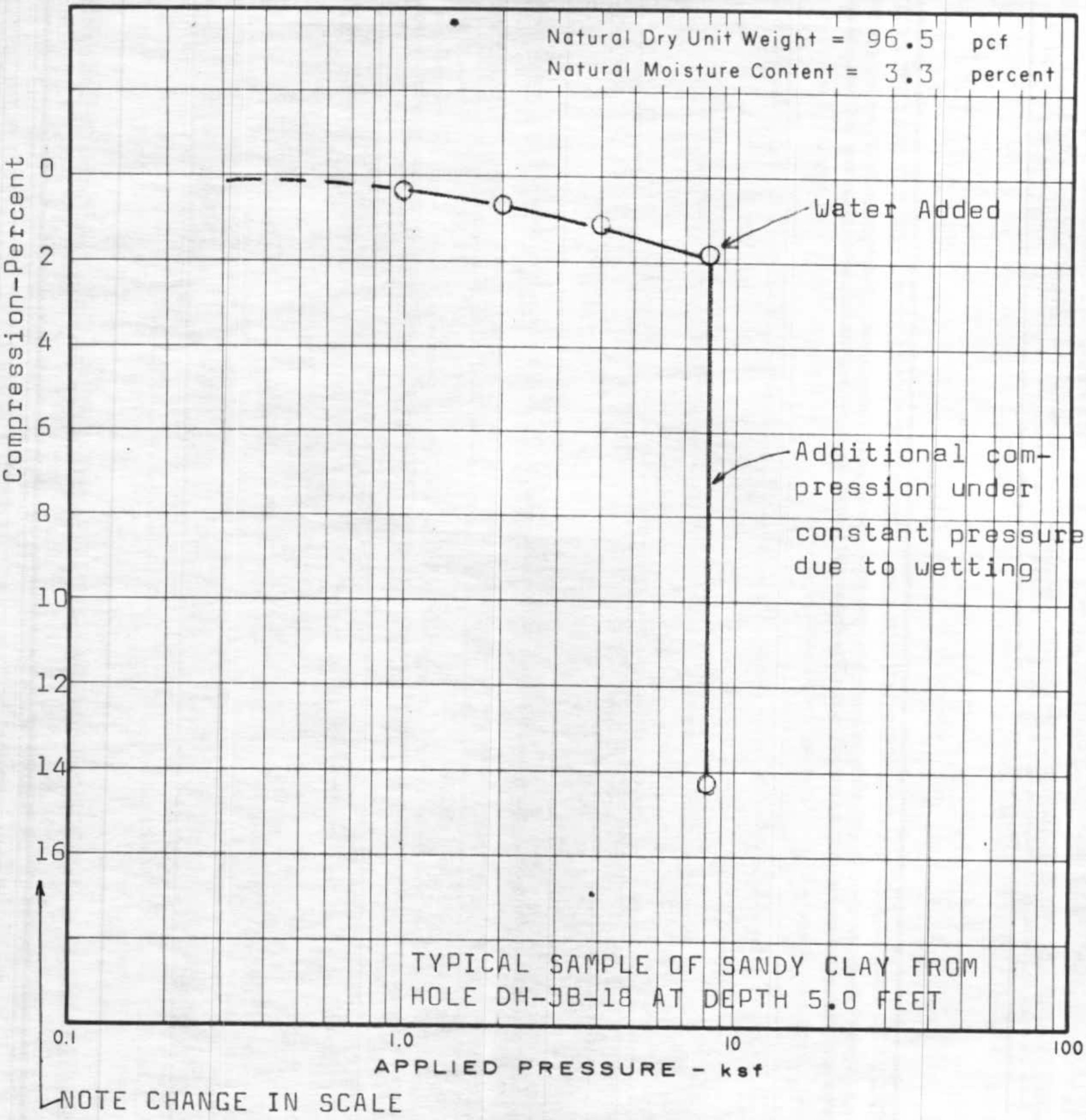
SWELL-CONSOLIDATION TEST RESULTS

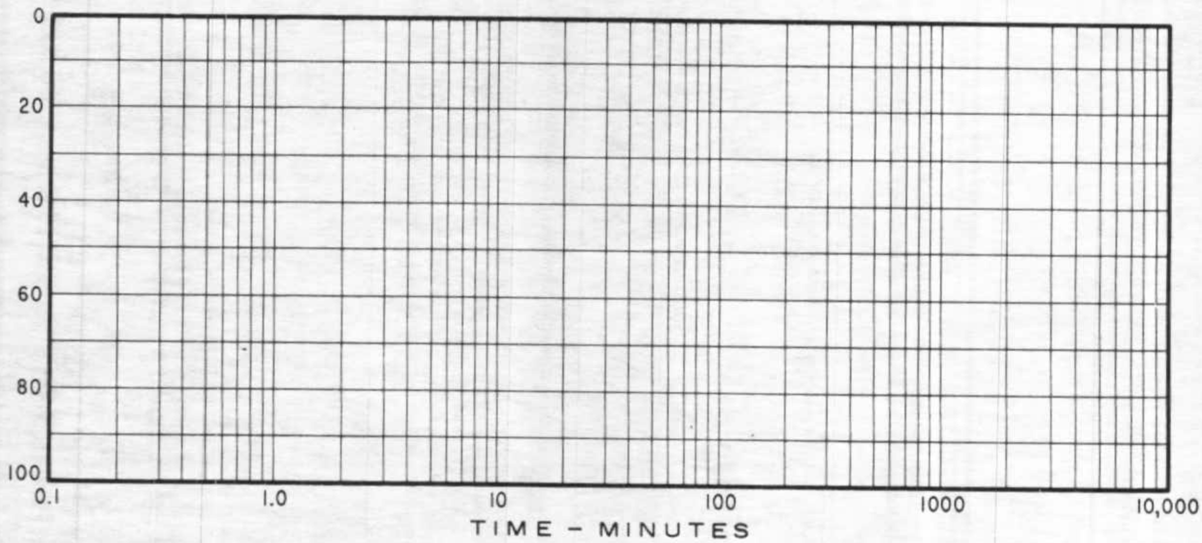
Job No. 12819 -12578

FIG. C-13

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





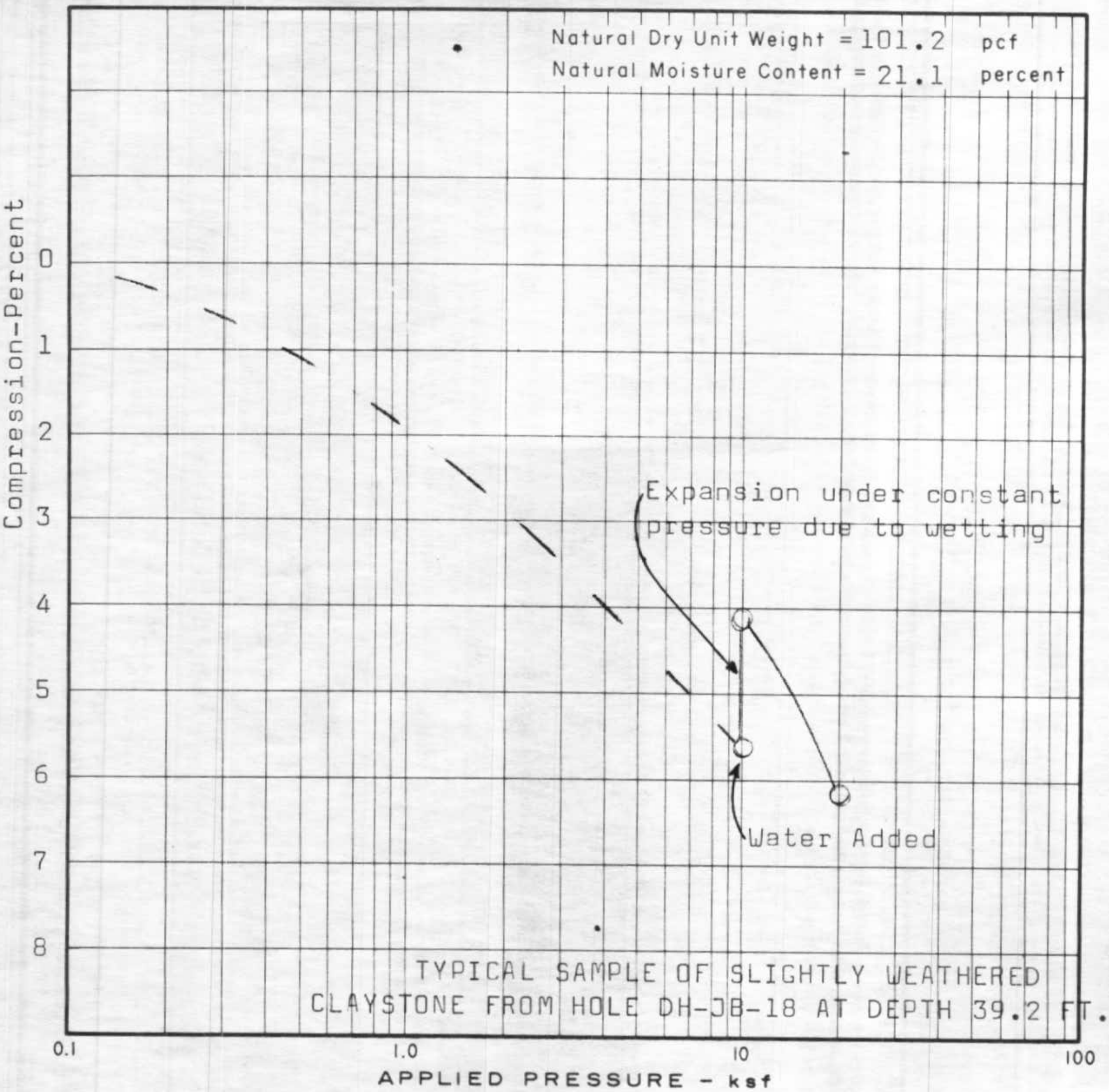
SWELL-CONSOLIDATION TEST RESULTS

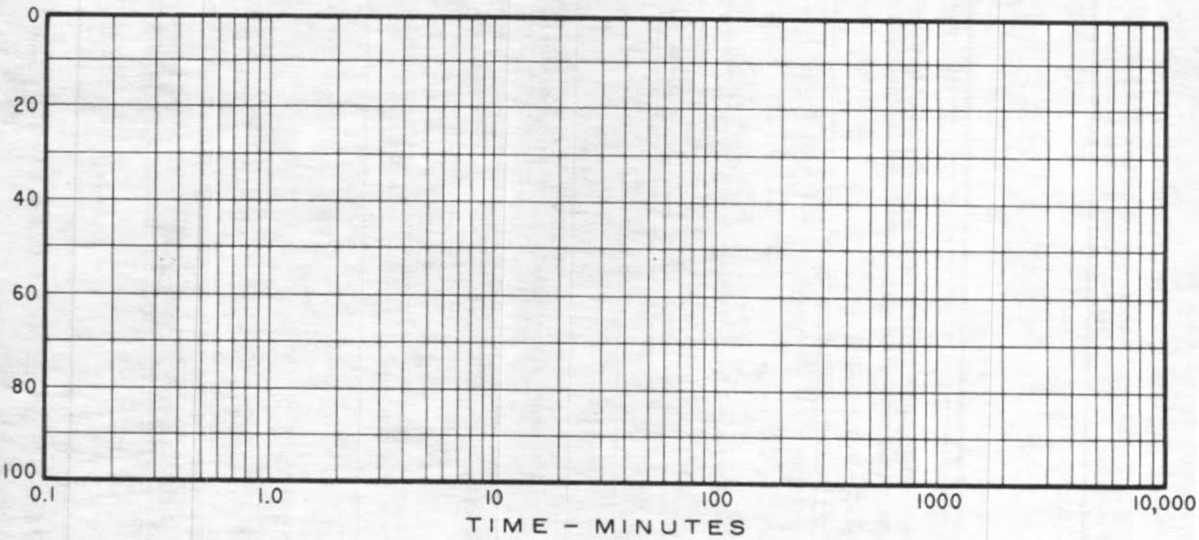
FIG. C-14

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





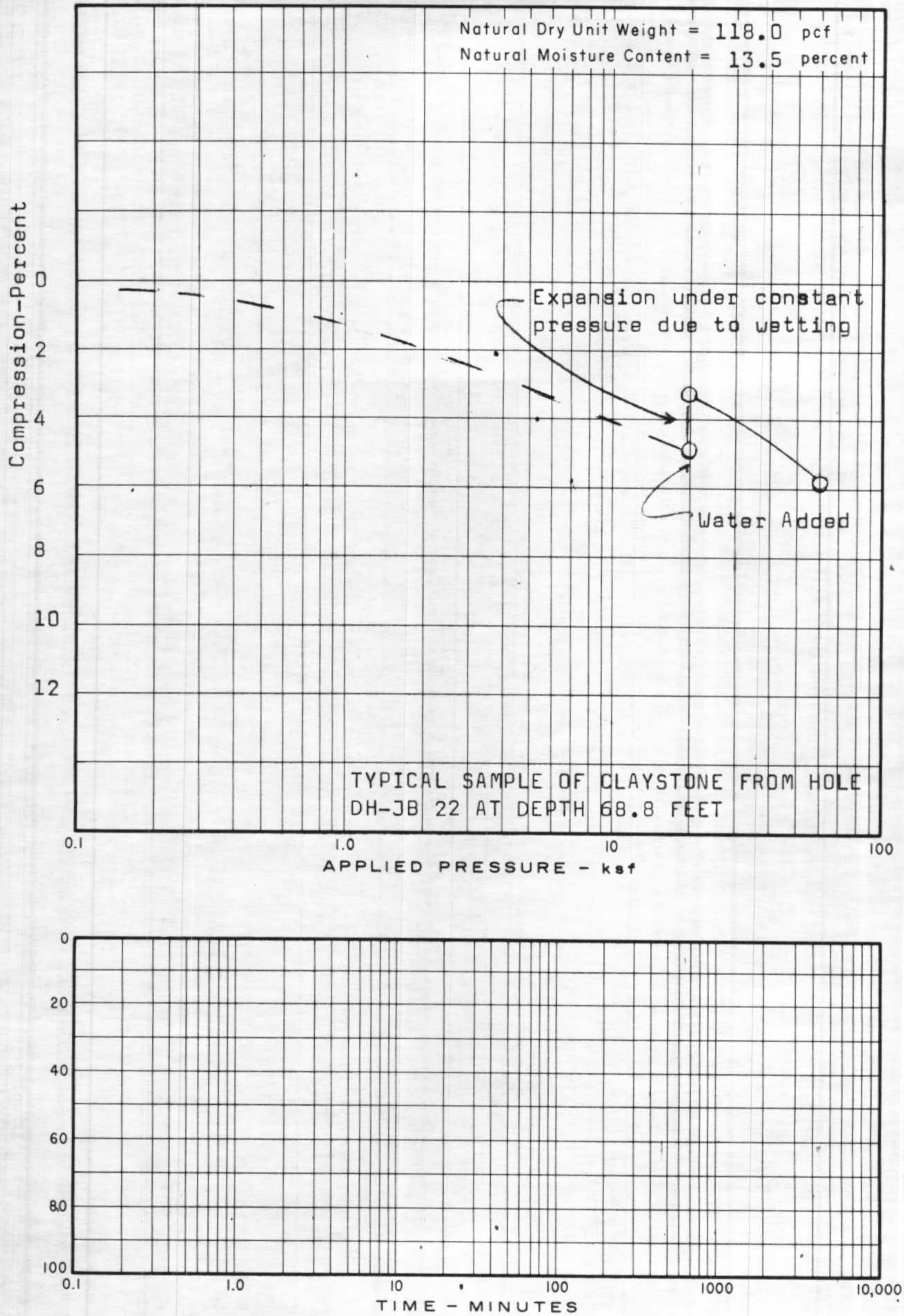
SWELL-CONSOLIDATION TEST RESULTS

Job No. 12819-12578

FIG. C-15

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES



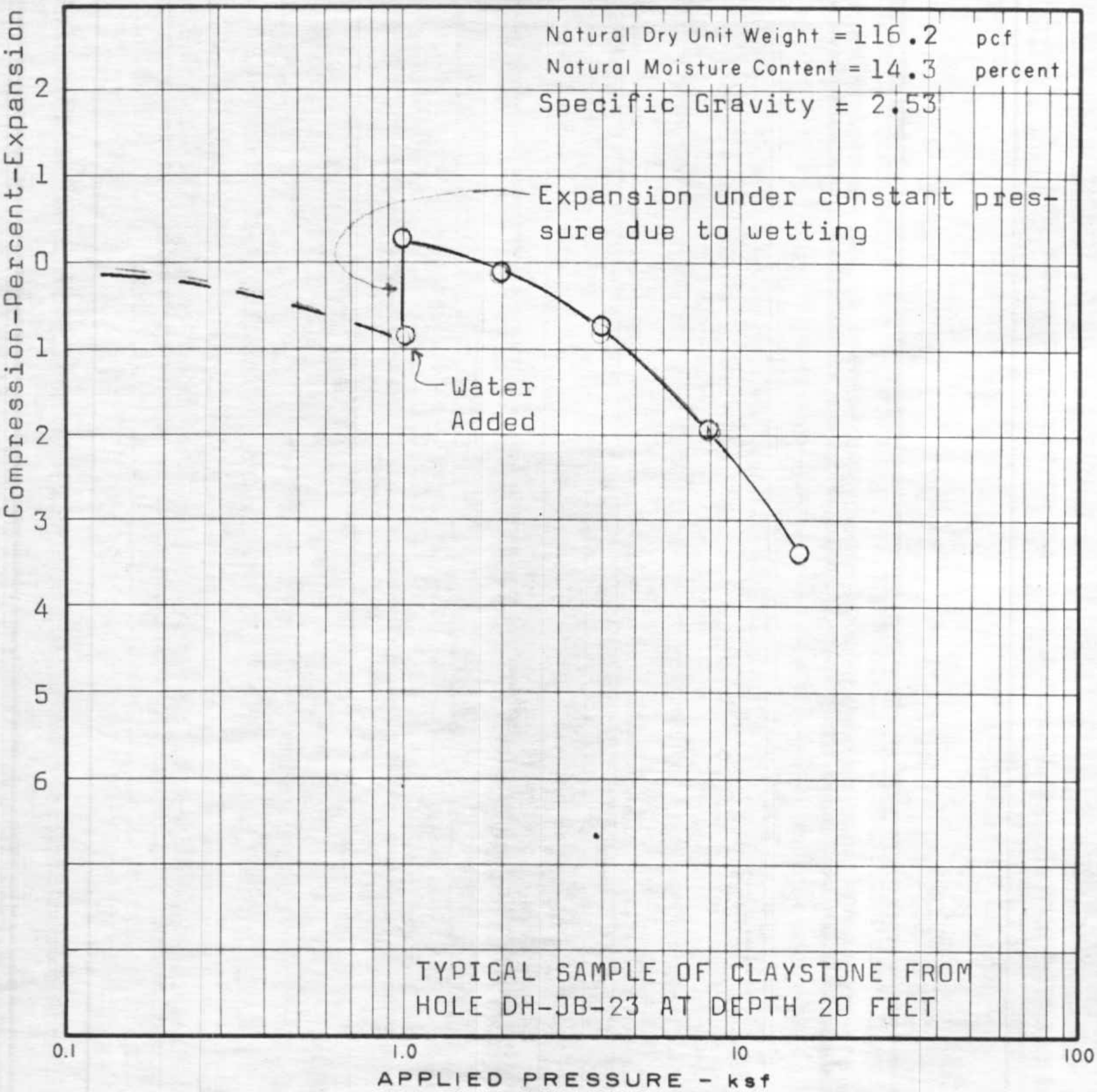
SWELL-CONSOLIDATION TEST RESULTS

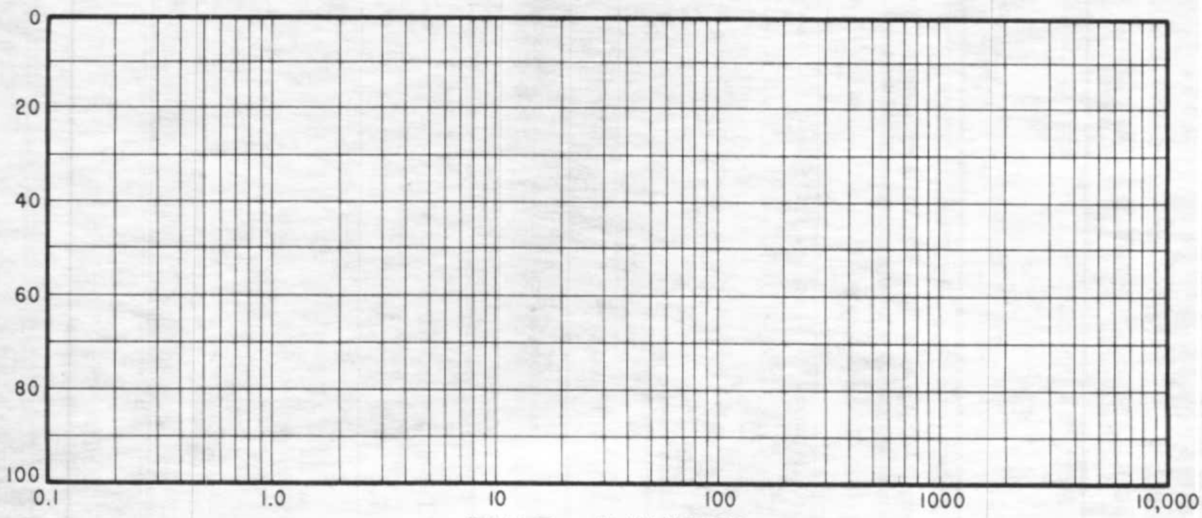
Job No. 12819 -12578

FIG. C-16

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





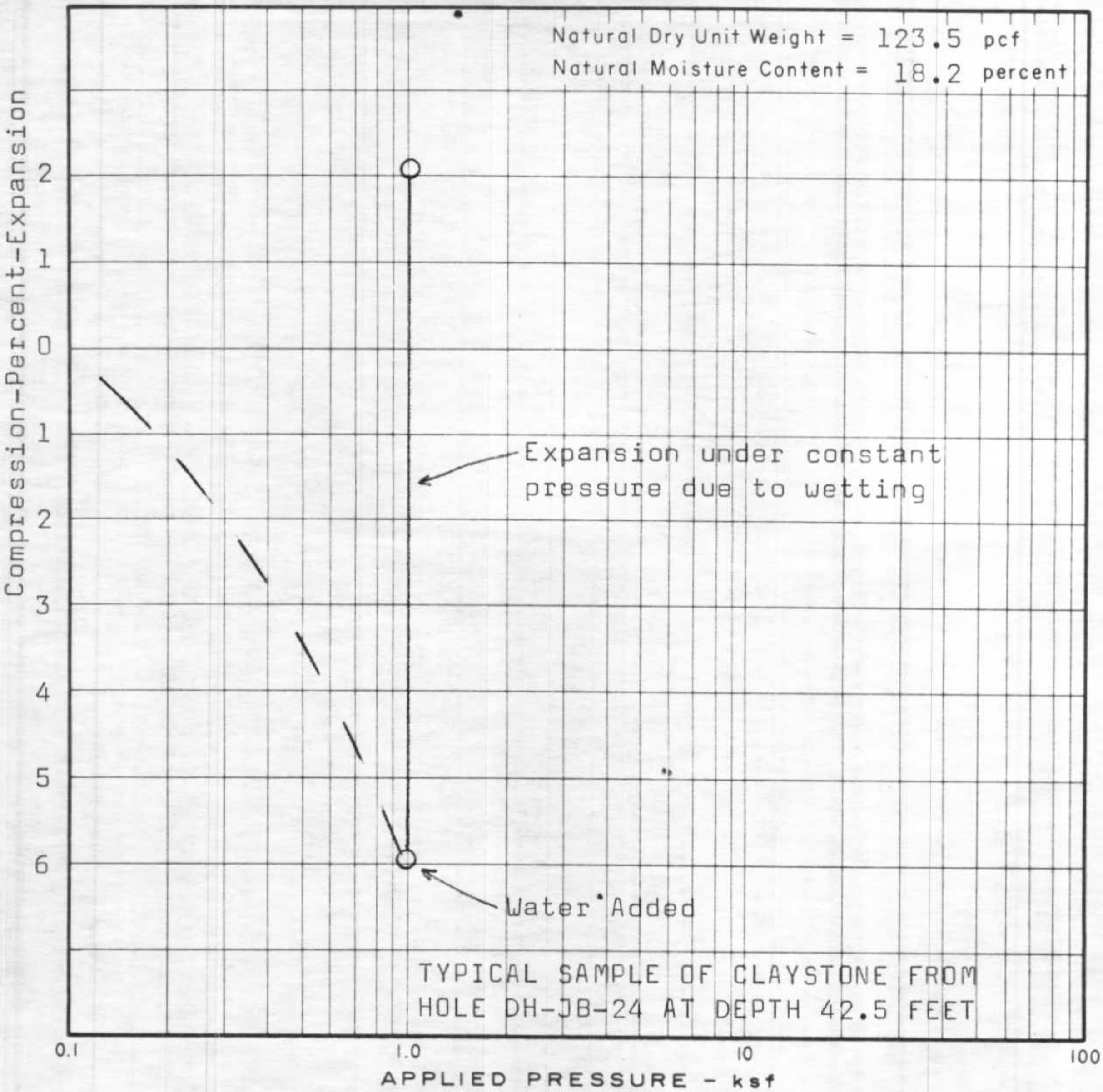
SWELL-CONSOLIDATION TEST RESULTS

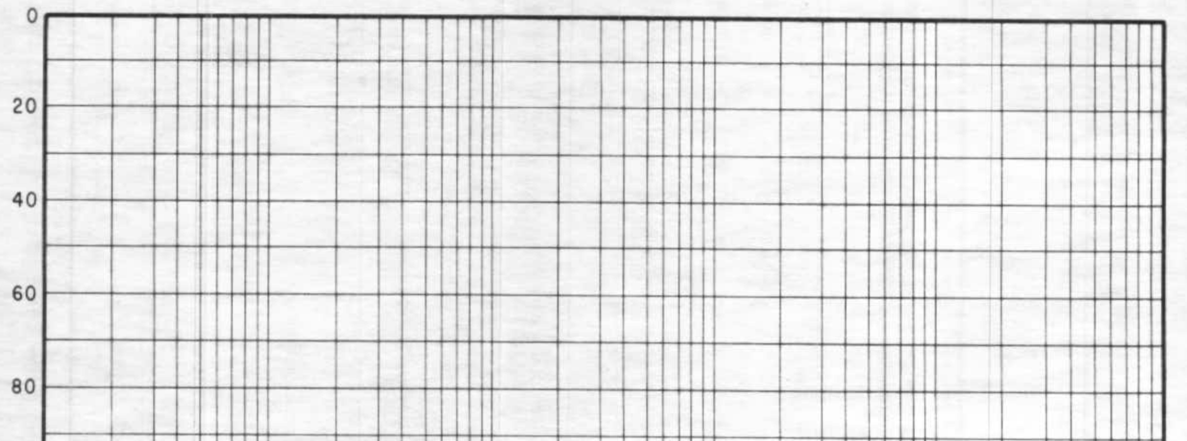
Job No. 12819-12578

FIG. C-17

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





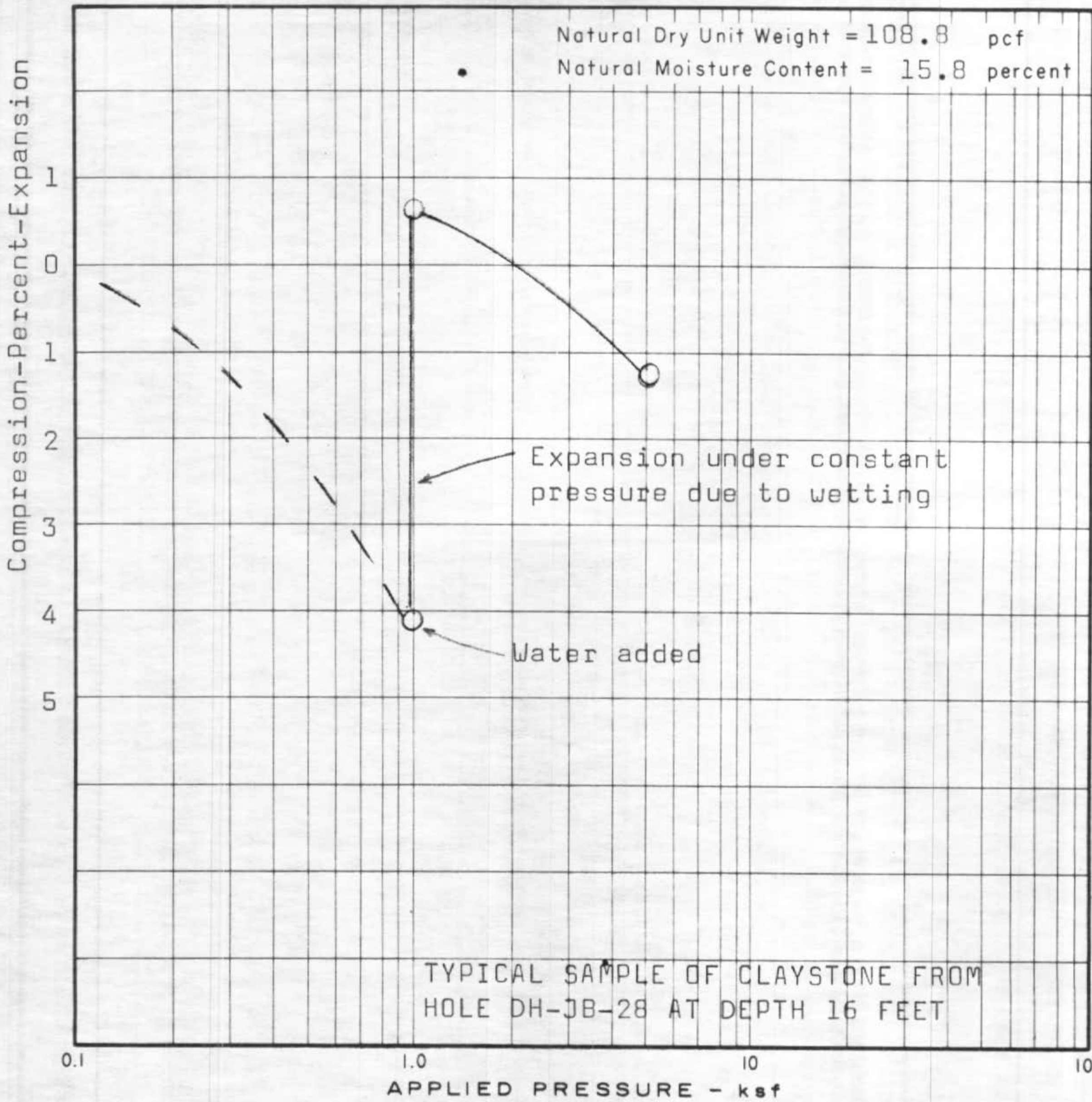
SWELL-CONSOLIDATION TEST RESULTS

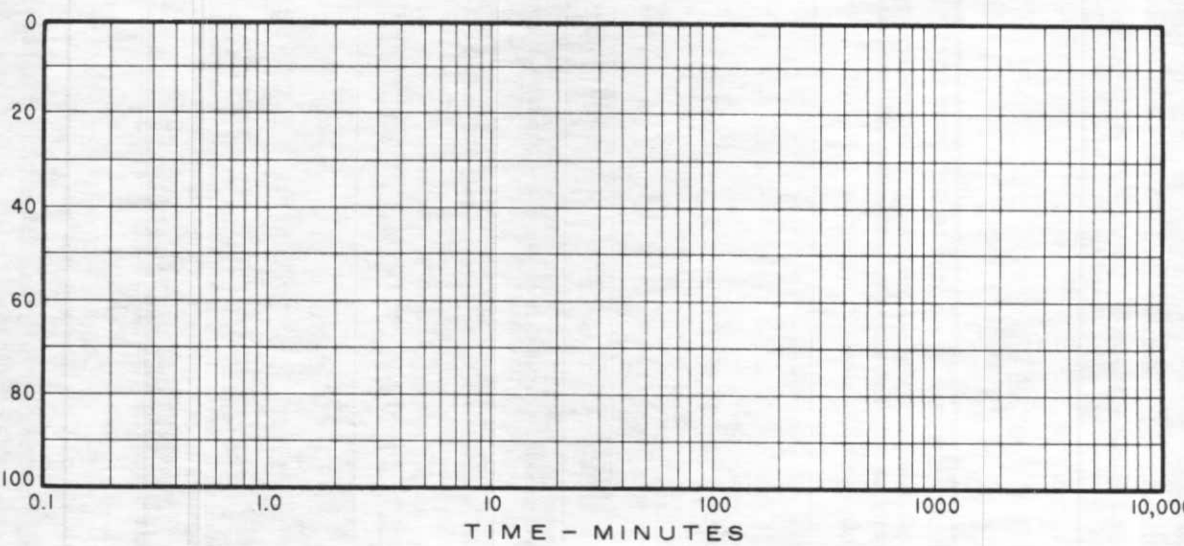
FIG. C-18

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





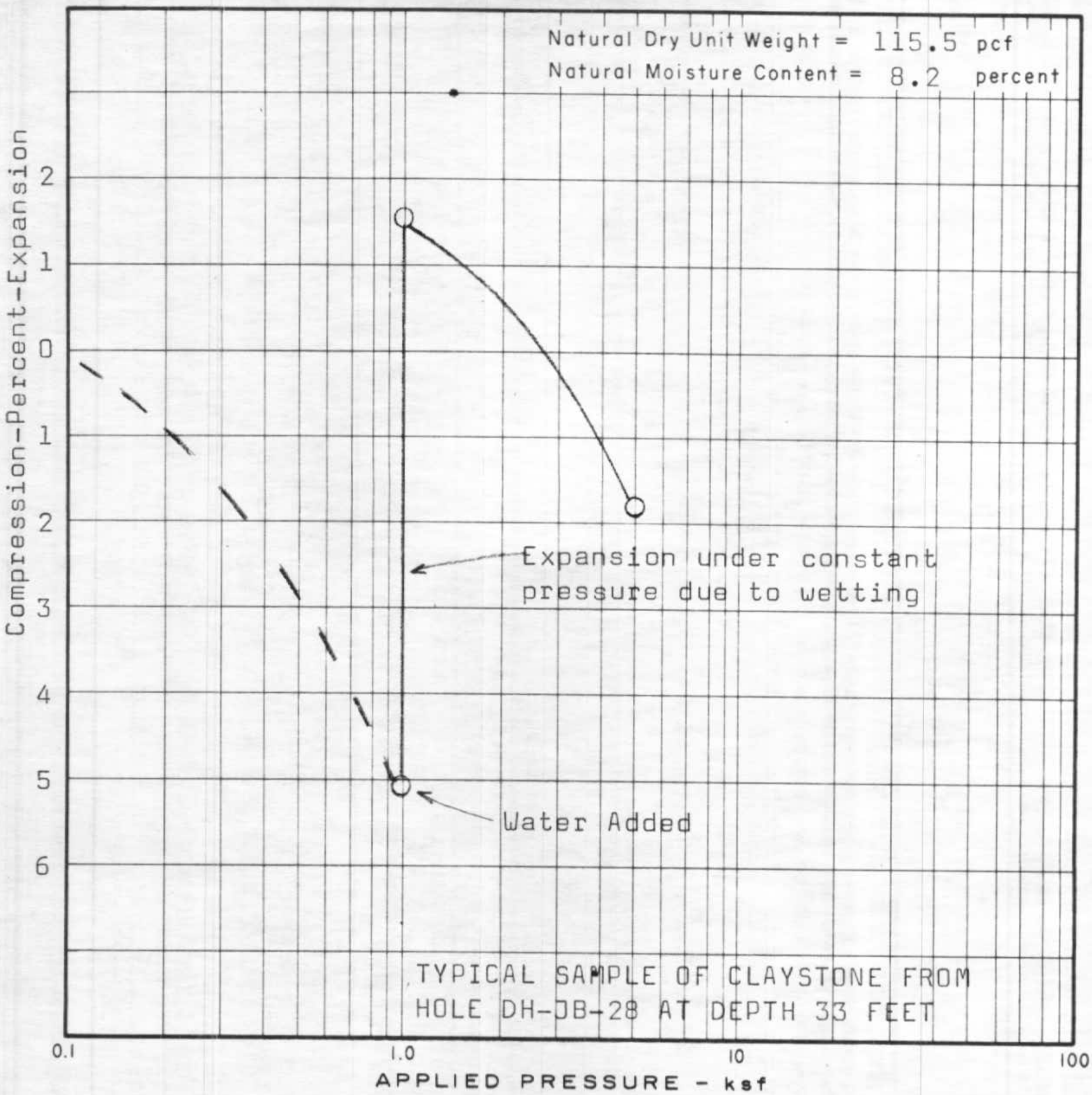
SWELL-CONSOLIDATION TEST RESULTS

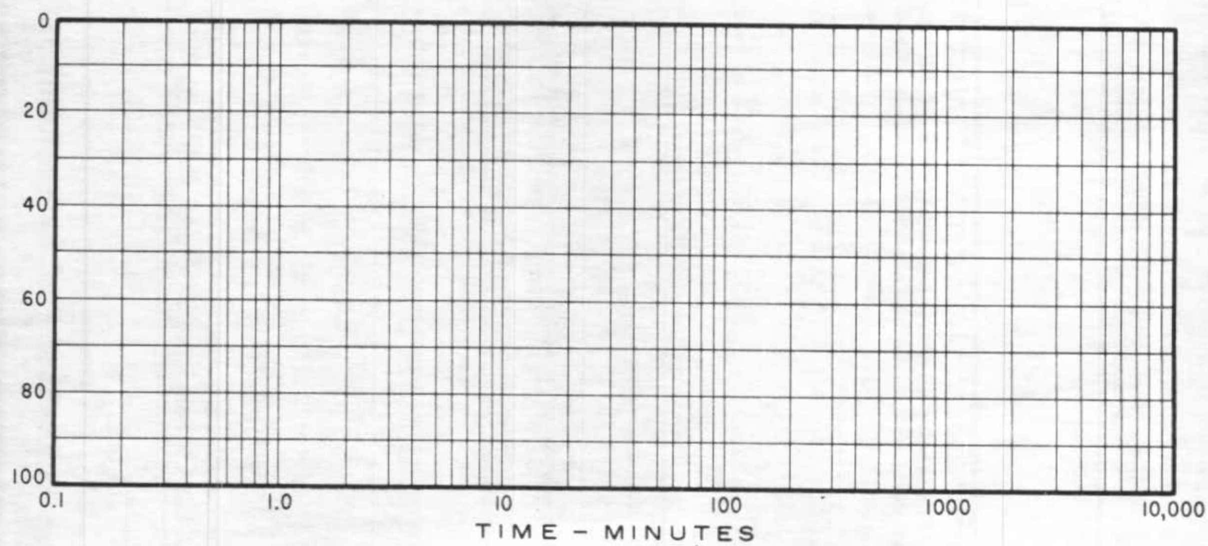
FIG. C-19

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES



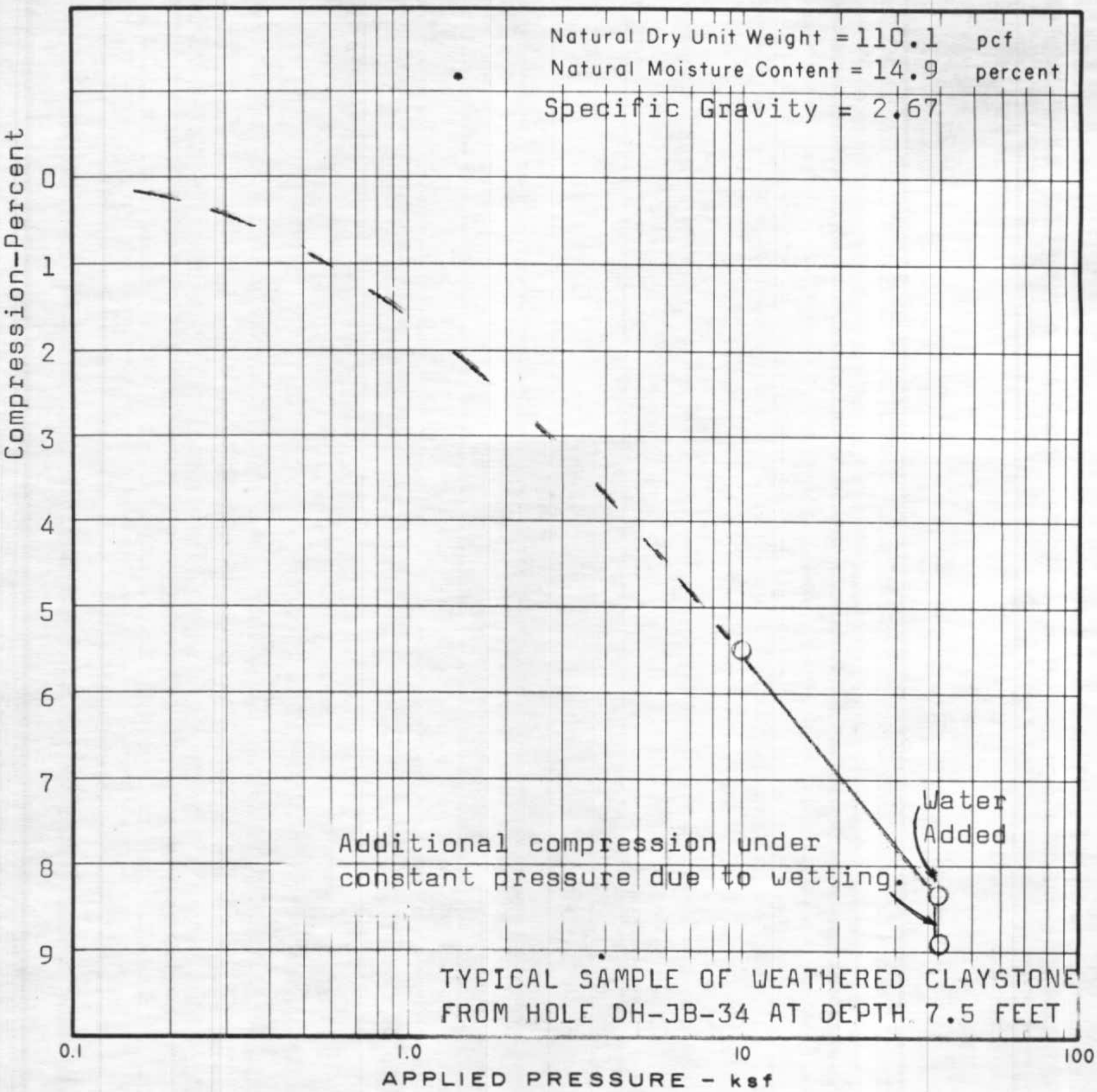


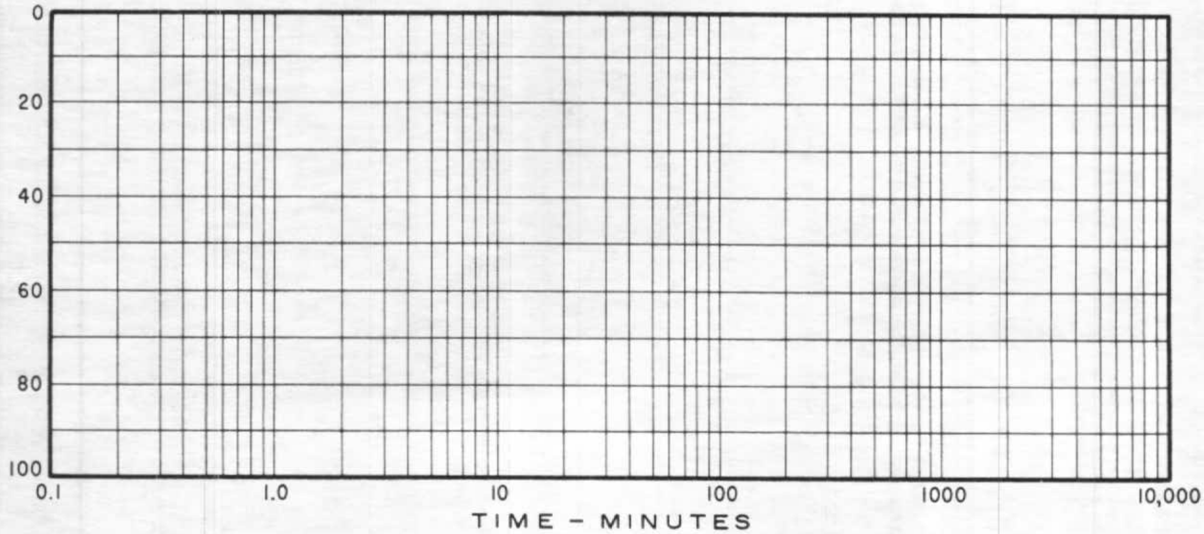
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-20

Job No. 12819-12578

WOODWARD - CLYDE & ASSOCIATES





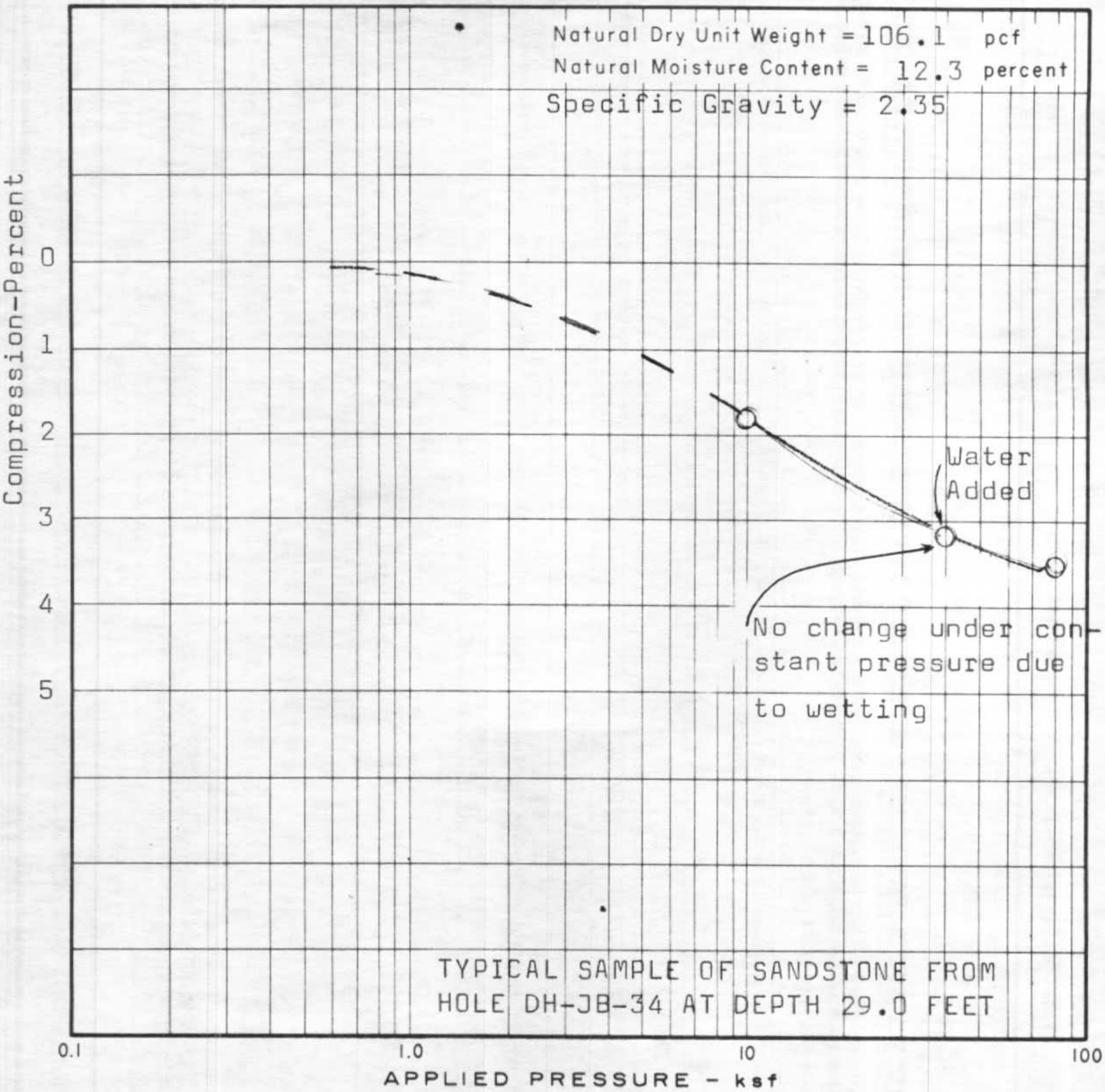
Job No.
12819-12578

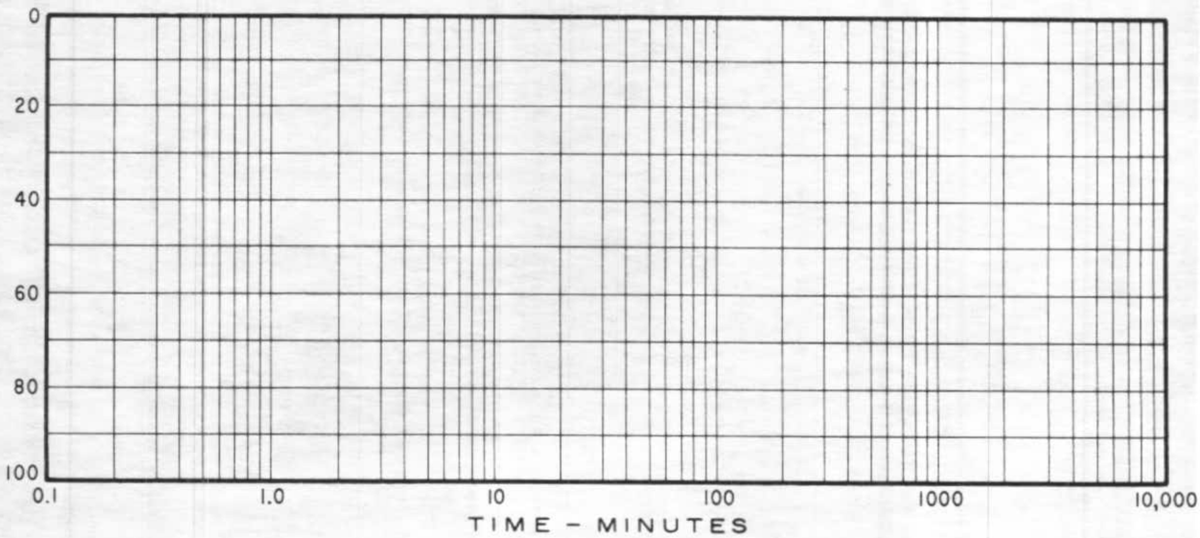
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-21

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





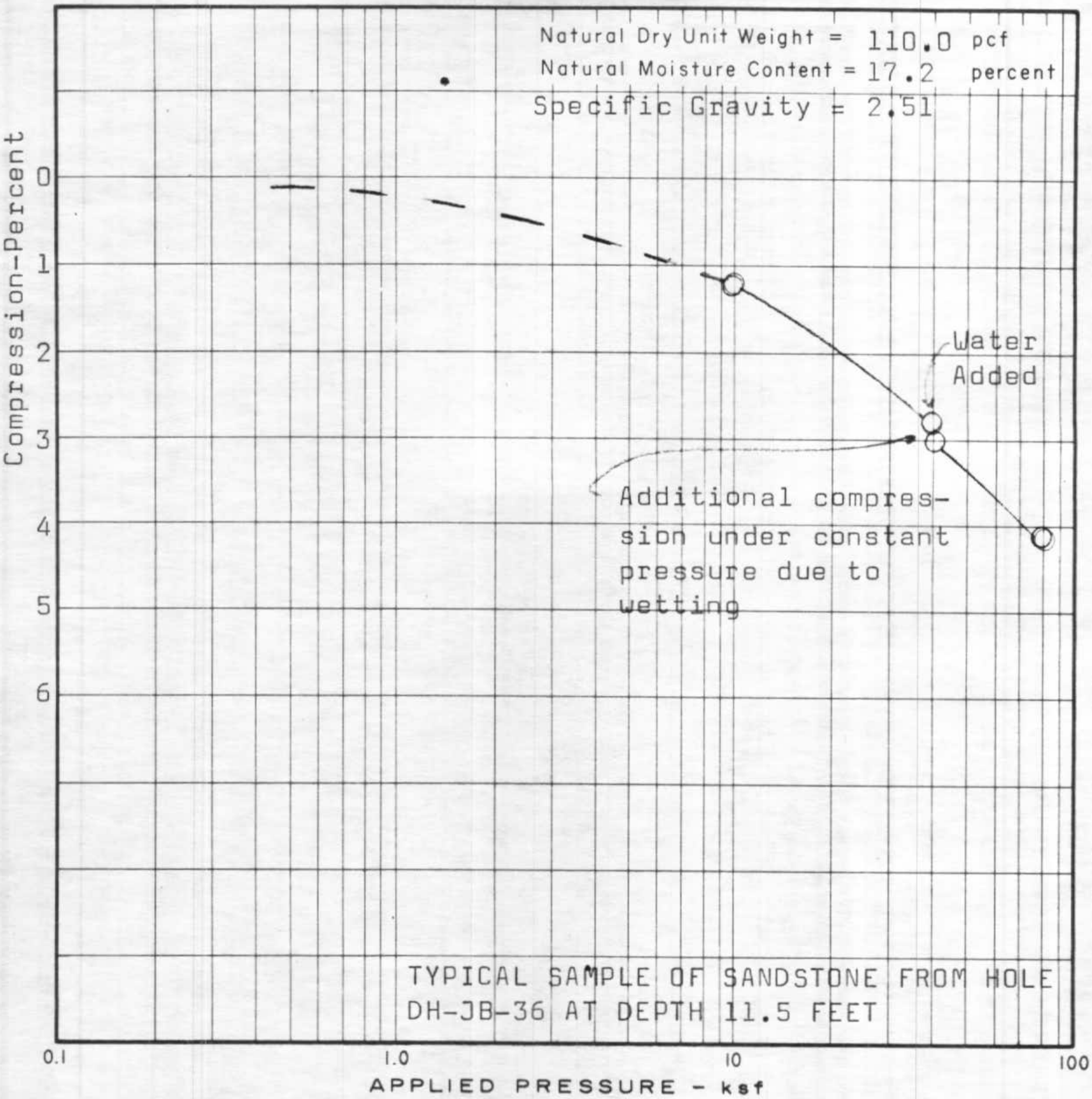
SWELL-CONSOLIDATION TEST RESULTS

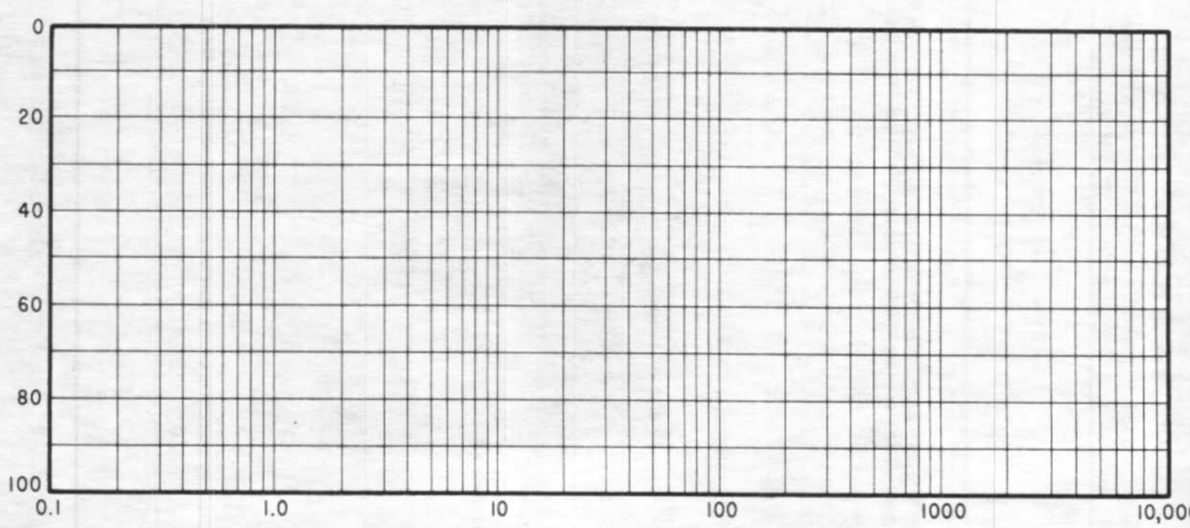
FIG. C -22

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





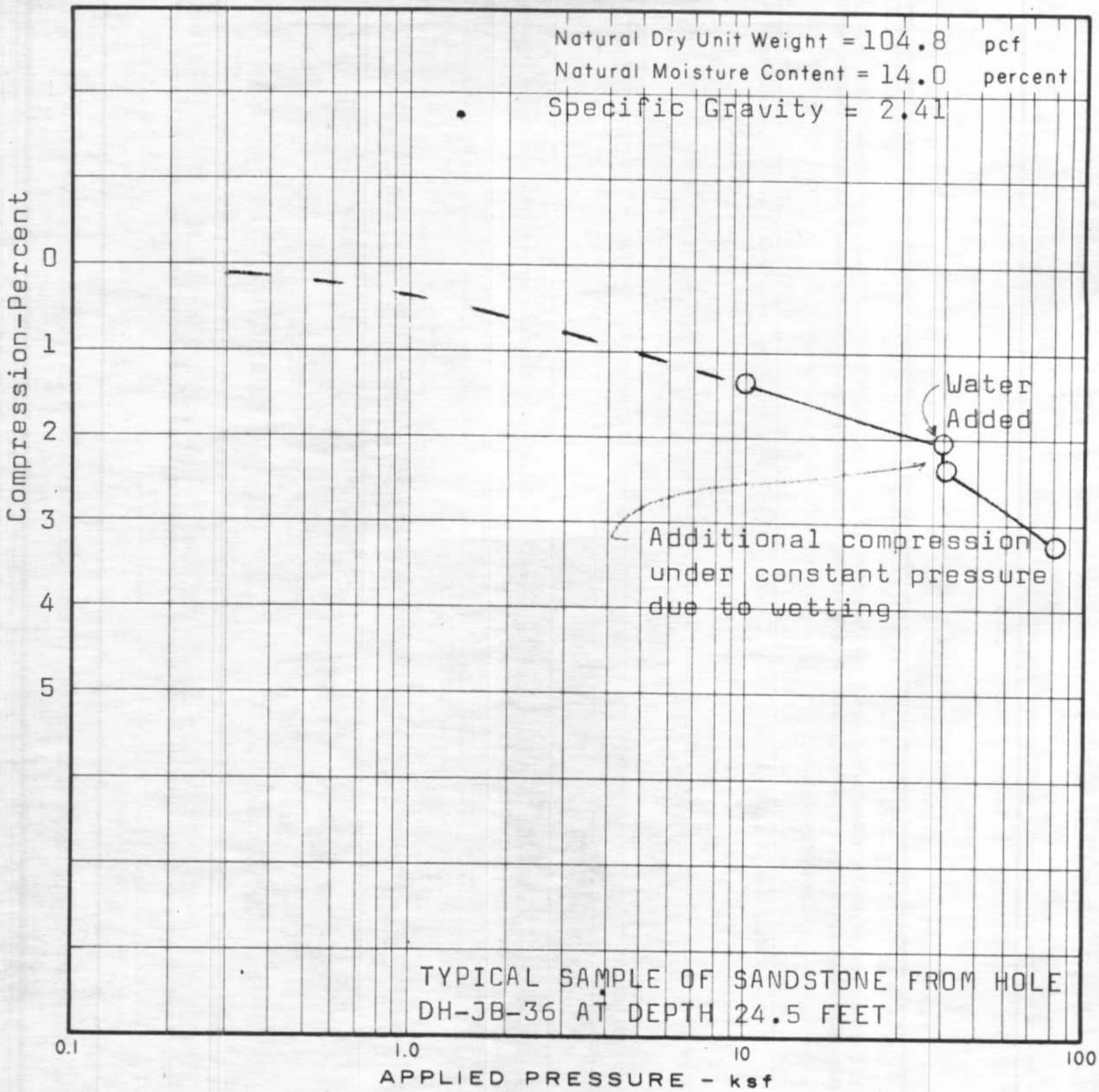
SWELL-CONSOLIDATION TEST RESULTS

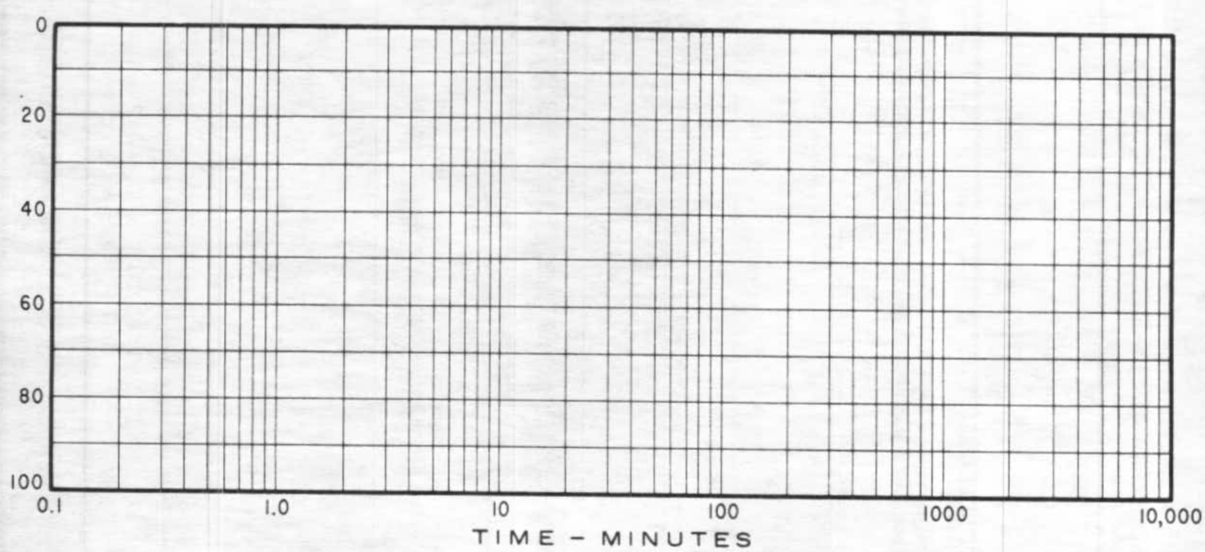
Job No. 12819-12578

FIG. C-23

FORM NO. WC -11

WOODWARD - CLYDE & ASSOCIATES





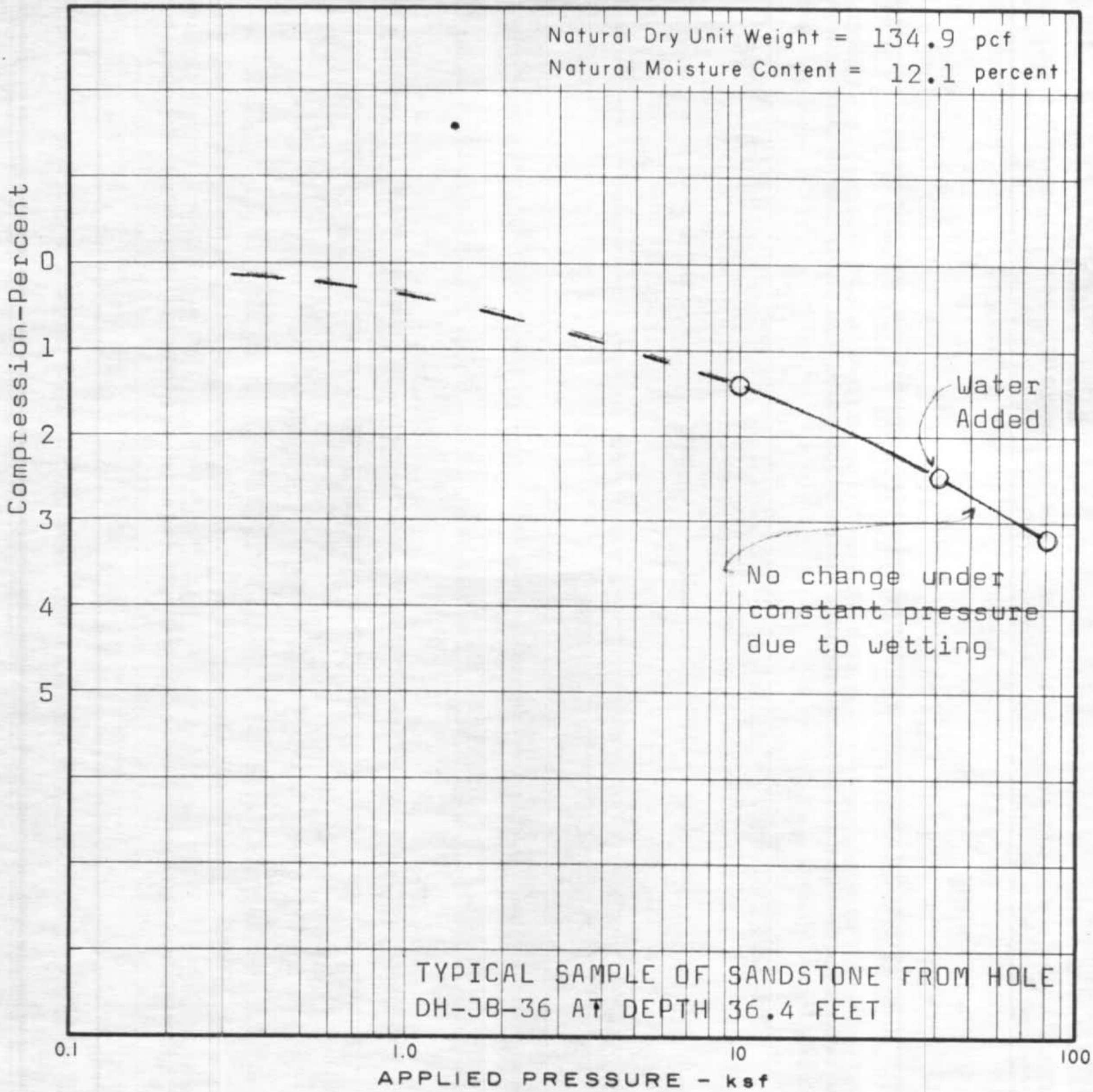
SWELL-CONSOLIDATION TEST RESULTS

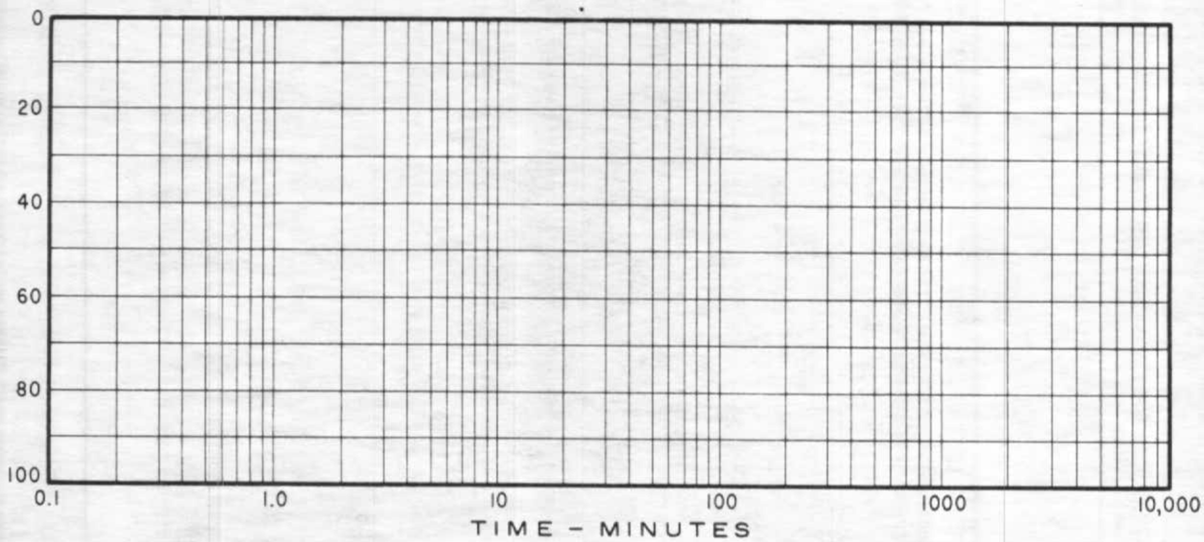
FIG. C-24

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





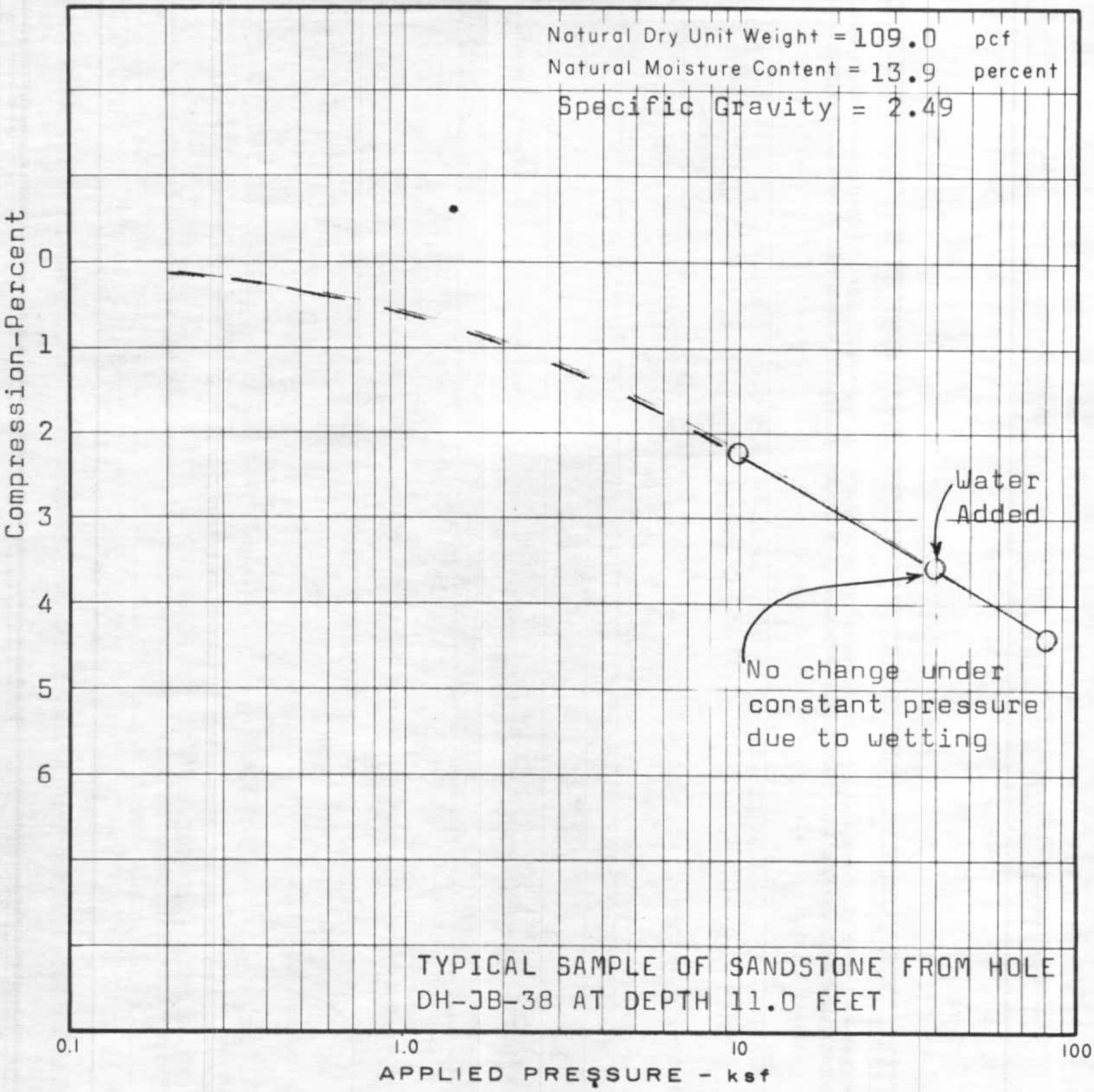
SWELL-CONSOLIDATION TEST RESULTS

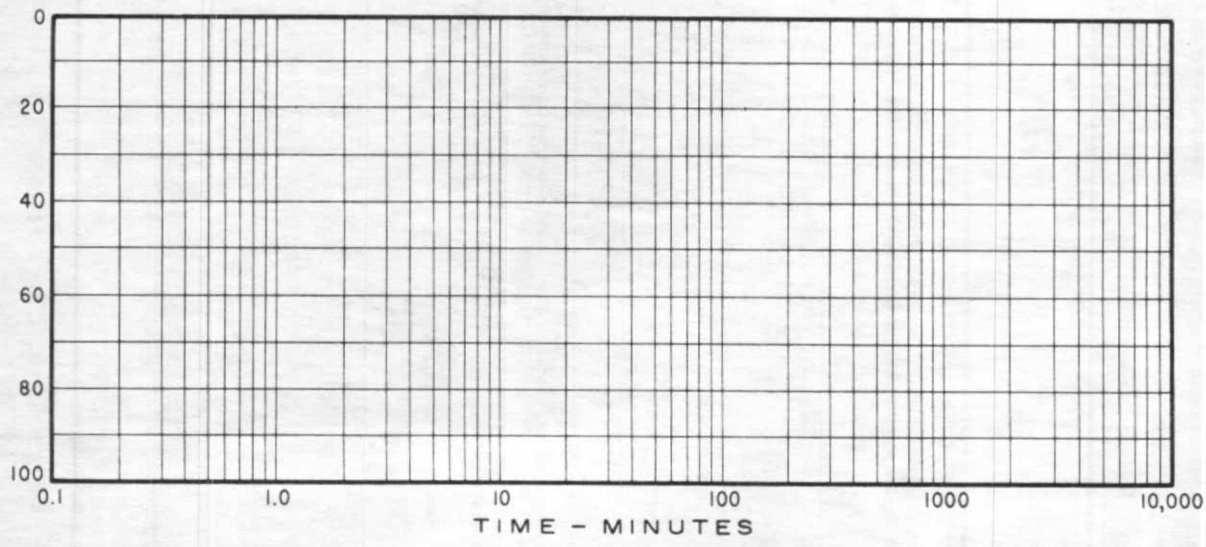
FIG. C-25

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





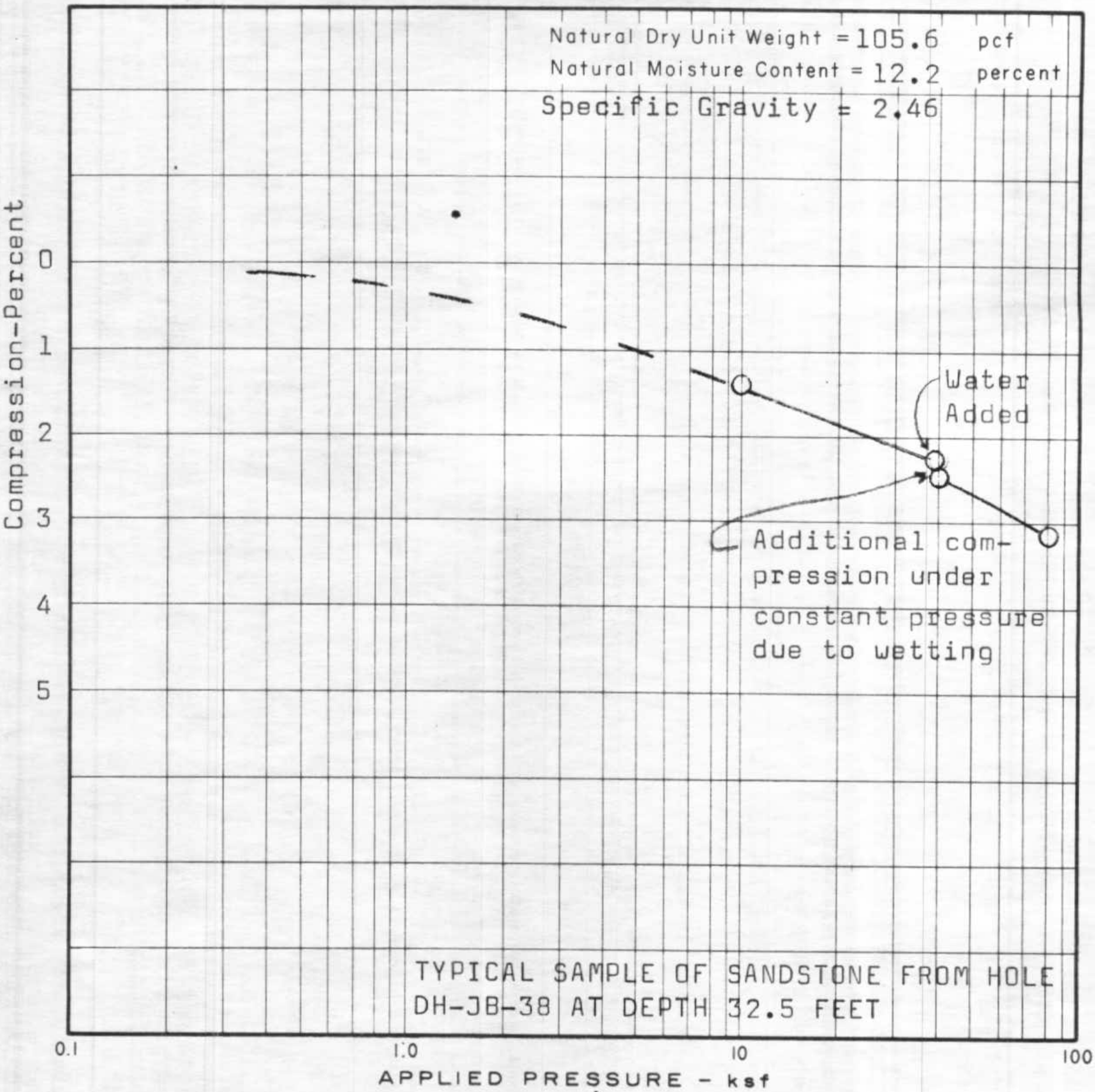
SWELL-CONSOLIDATION TEST RESULTS

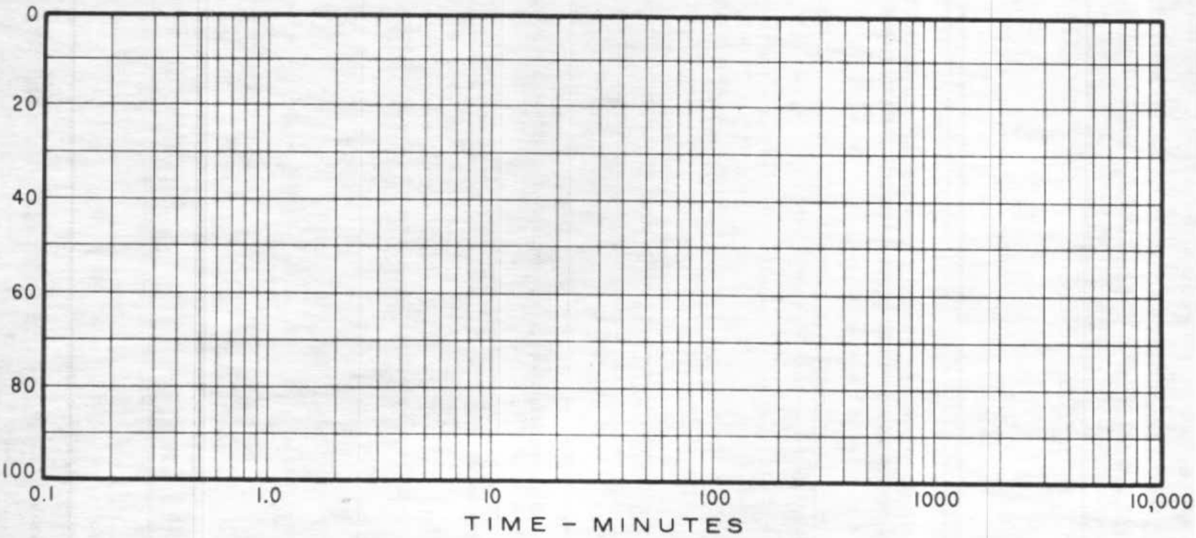
FIG. C-26

Job No. 12819-12578

FORM NO
WC -11

WOODWARD - CLYDE & ASSOCIATES





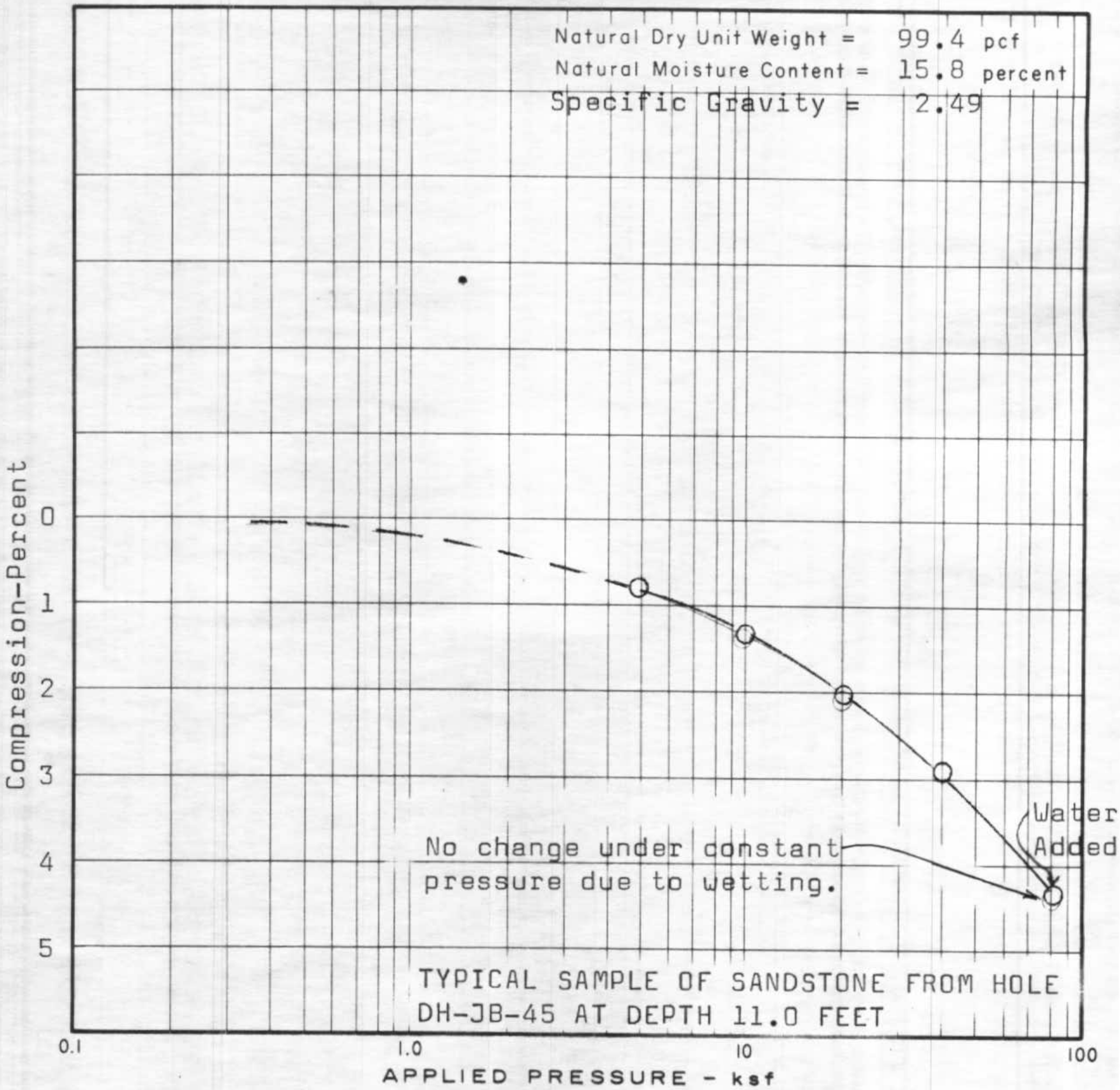
SWELL-CONSOLIDATION TEST RESULTS

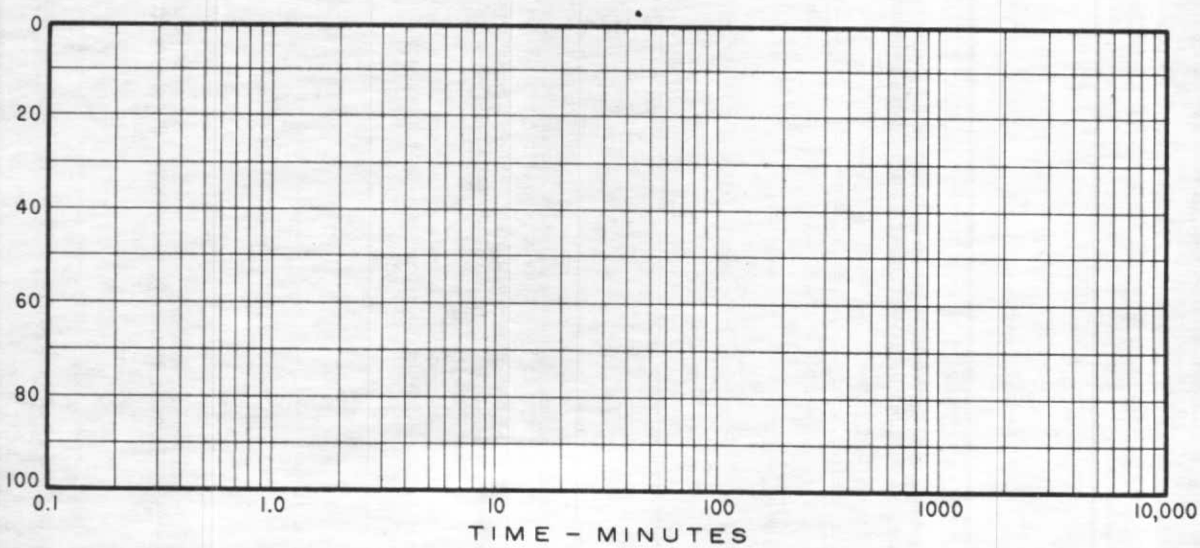
Job No. 12819-12578

FIG. C-27

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





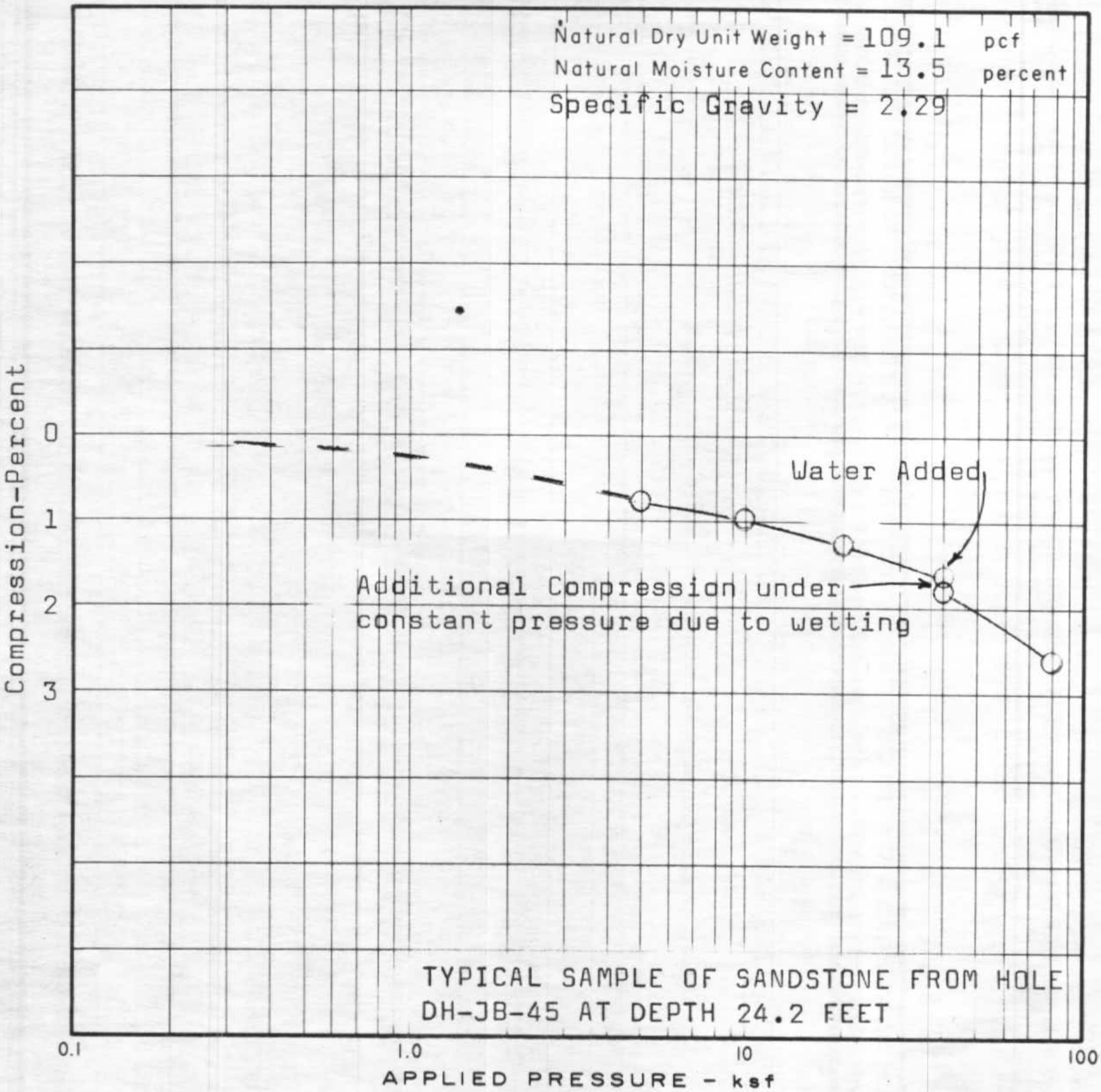
Job No.
12819-12578

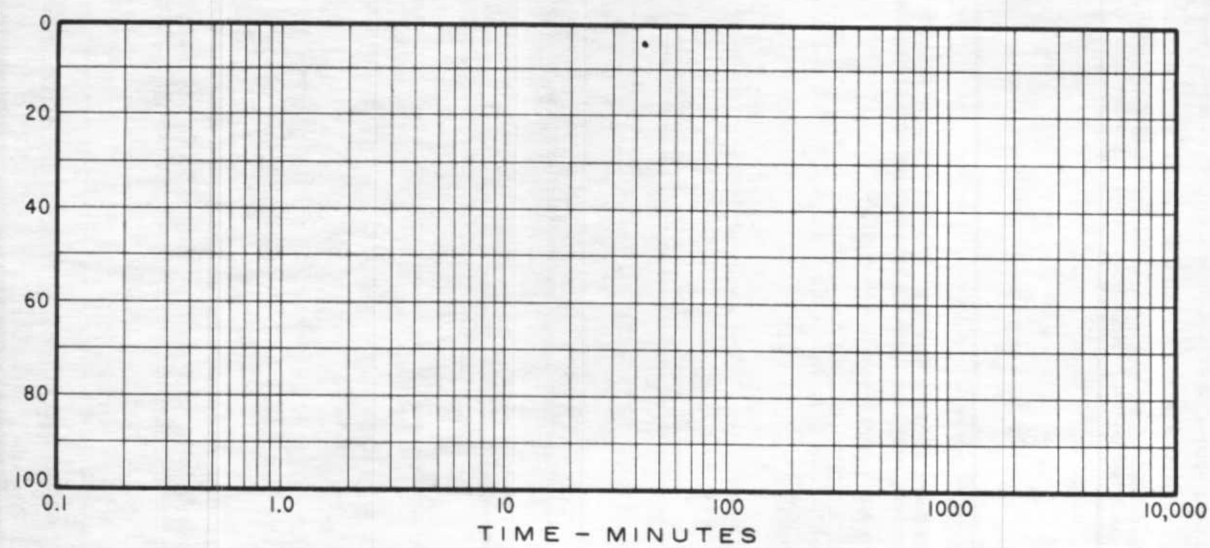
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-28

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





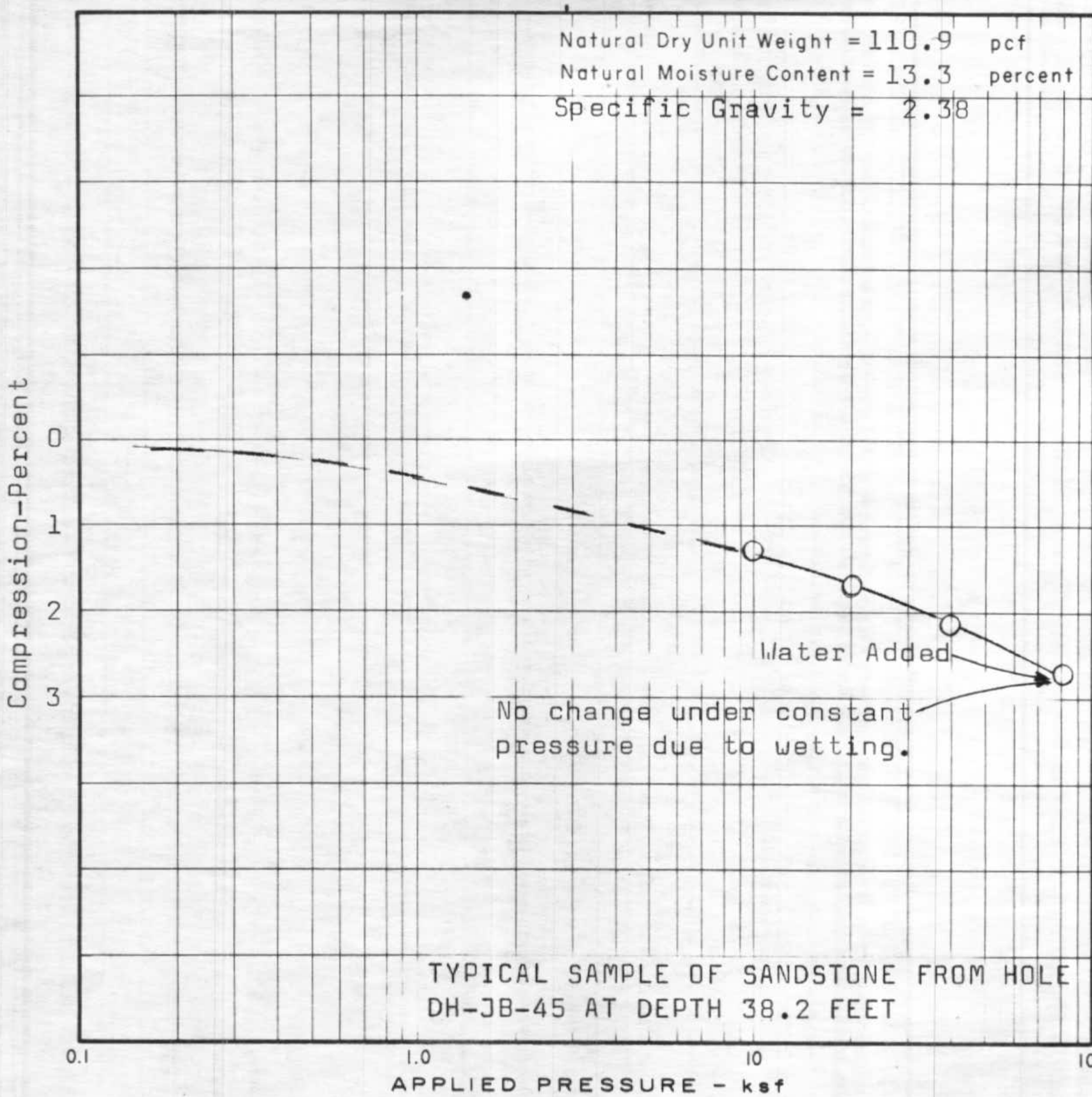
Job No.
12819-12578

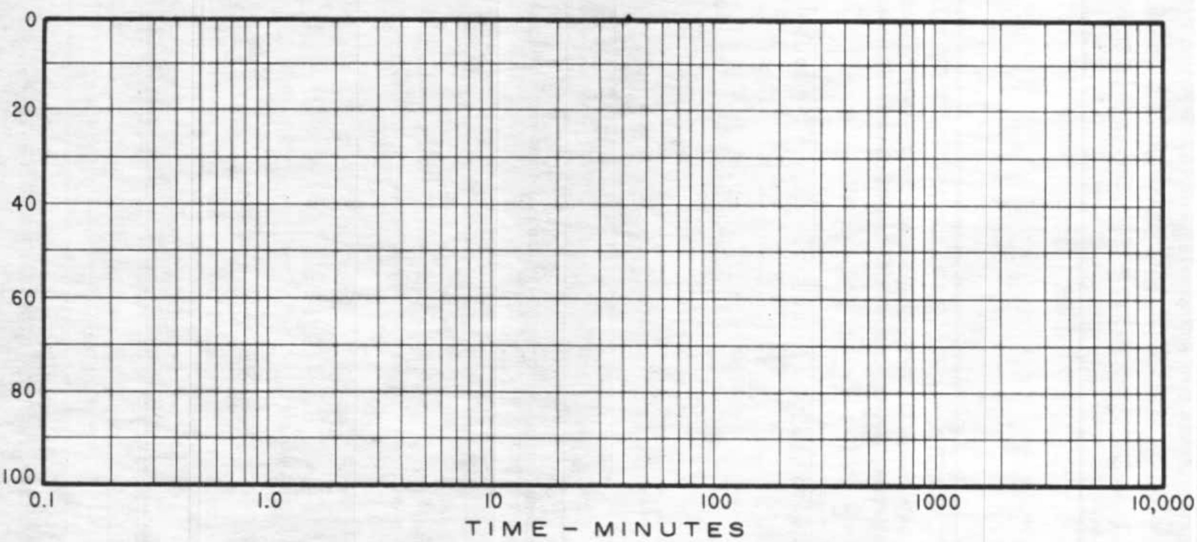
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-29

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





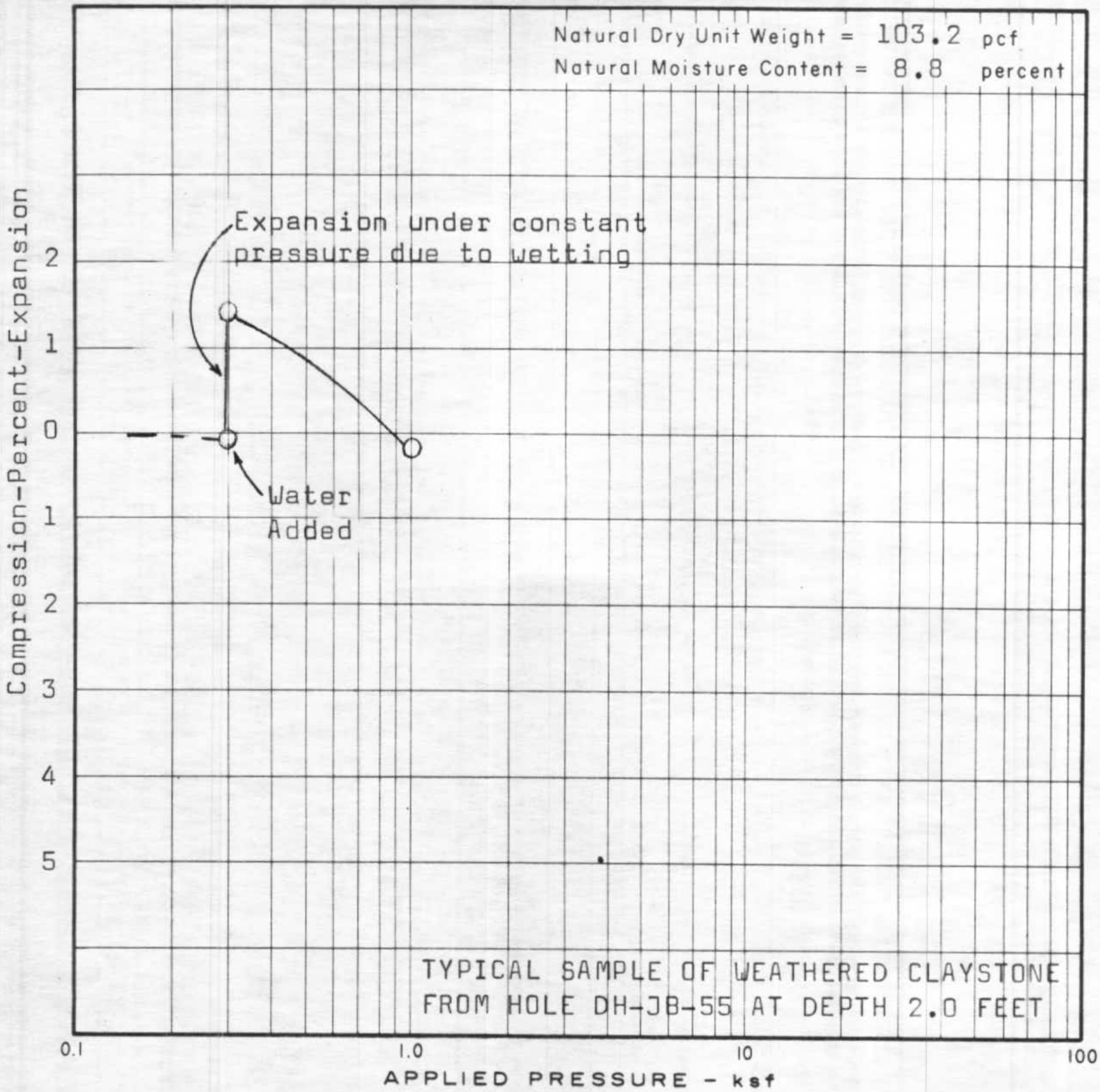
Job No.
12819-12578

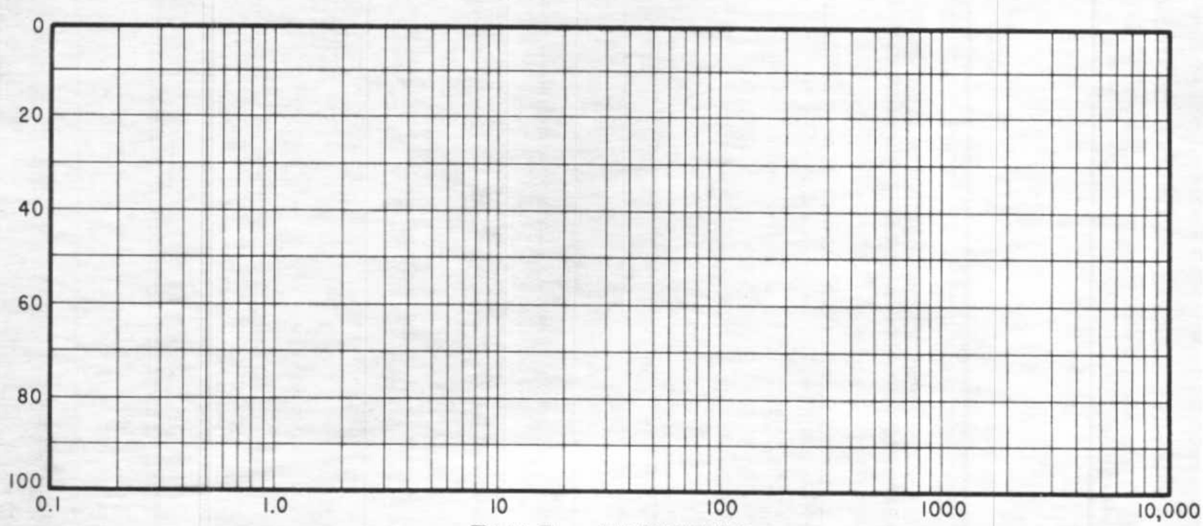
SWELL-CONSOLIDATION TEST RESULTS

FIG. C-30

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





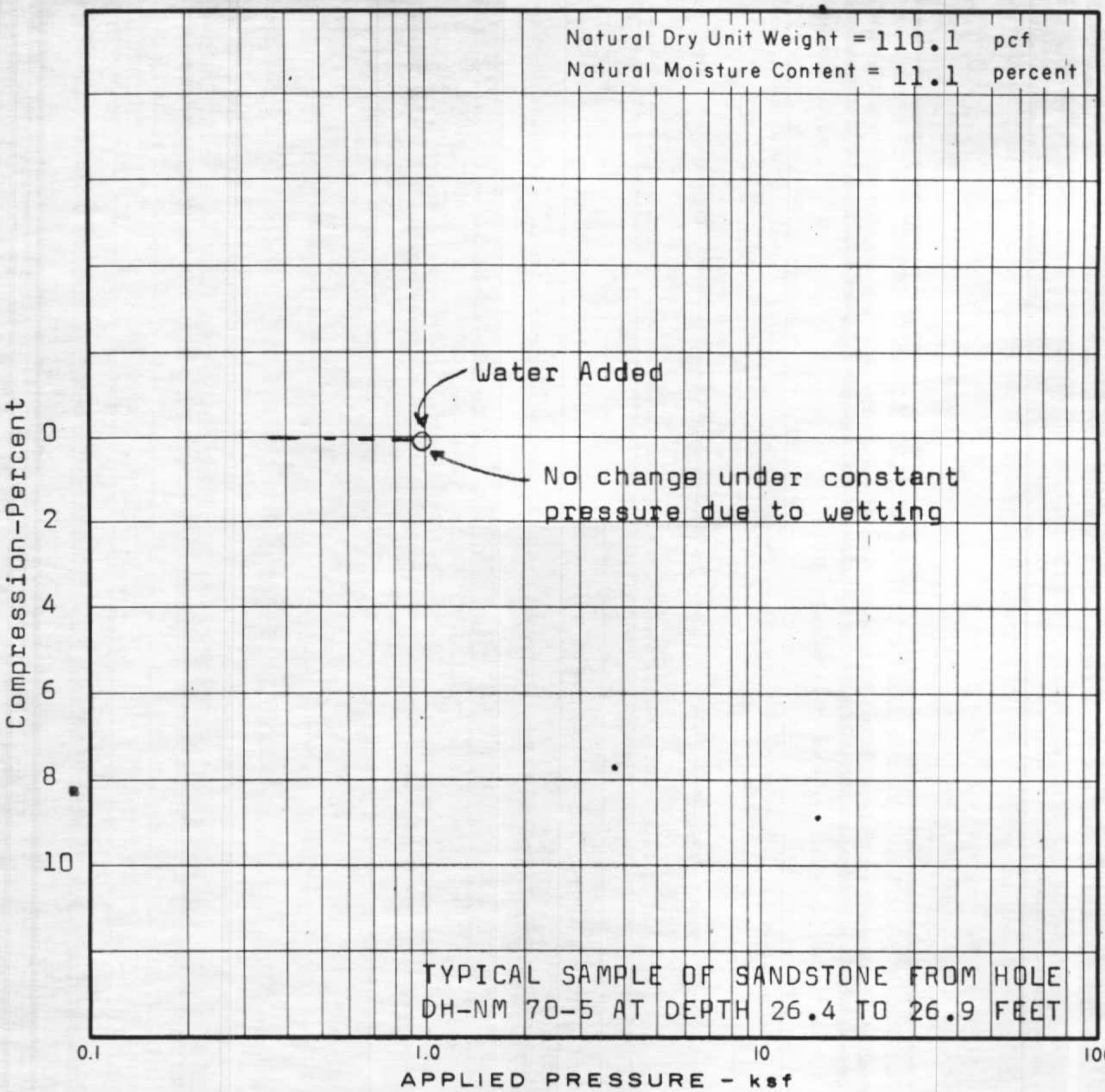
SWELL-CONSOLIDATION TEST RESULTS

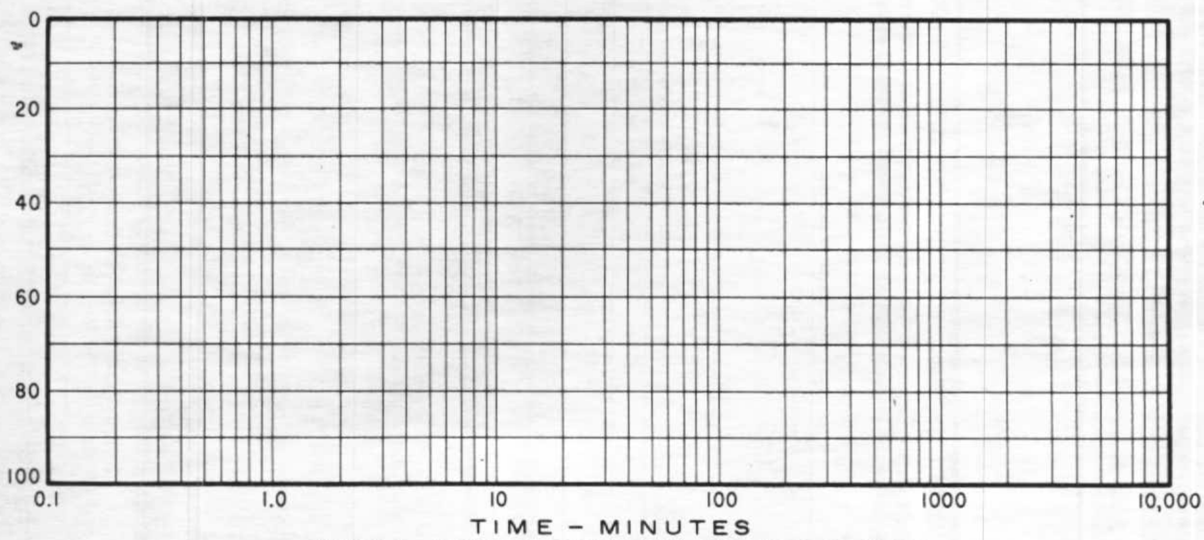
FIG. C-31

Job No. 12819-12578

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





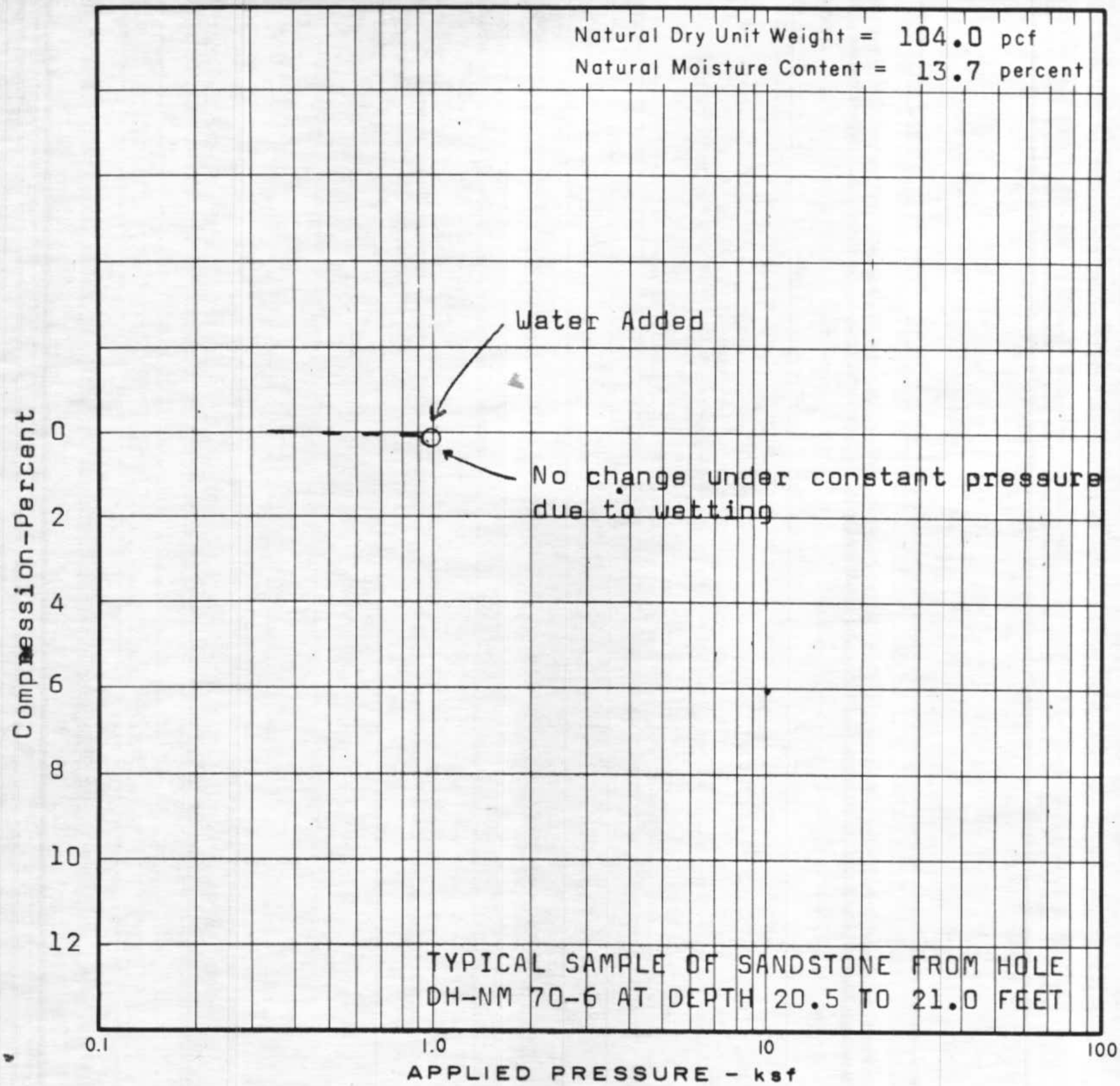
SWELL-CONSOLIDATION TEST RESULTS

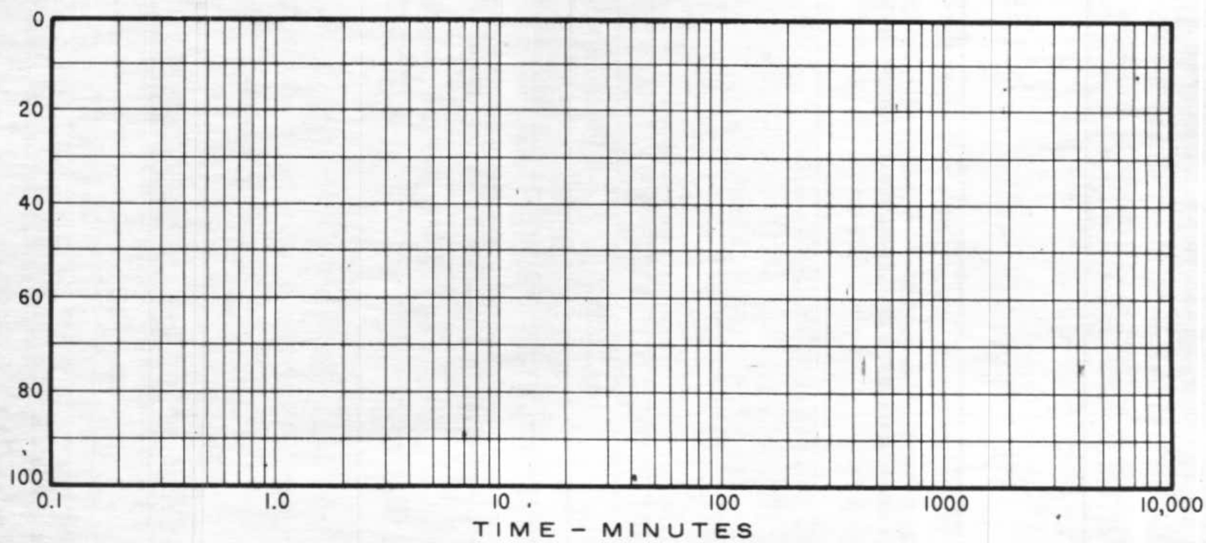
Job No. 12819-12578

FIG. C-32

FORM NO.
WC -11

WOODWARD - CLYDE & ASSOCIATES





SWELL-CONSOLIDATION TEST RESULTS

Job No. 12819-12578

FIG. C-33

APPENDIX D

UNCONFINED-COMPRESSION TESTS

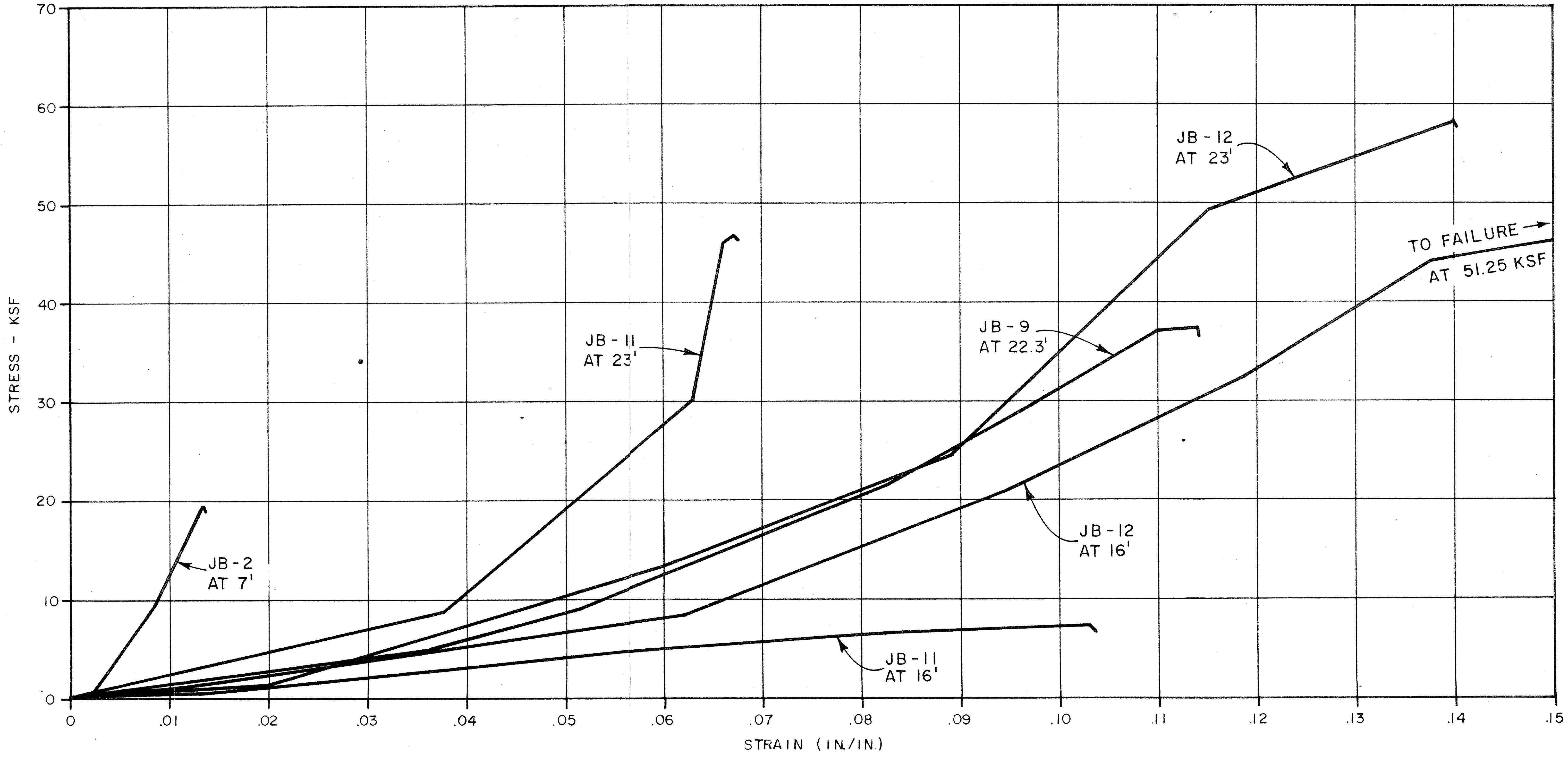
STRESS-STRAIN CURVES

APPENDIX E

TRIAXIAL COMPRESSION TEST REPORTS

TURBINE - GENERATOR BUILDING

HOLES DH-JB-2, 9, 11 & 12



LEGEND

SANDSTONE, WEAKLY TO MODERATELY CEMENTED

ALL PITCHER SAMPLES

WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

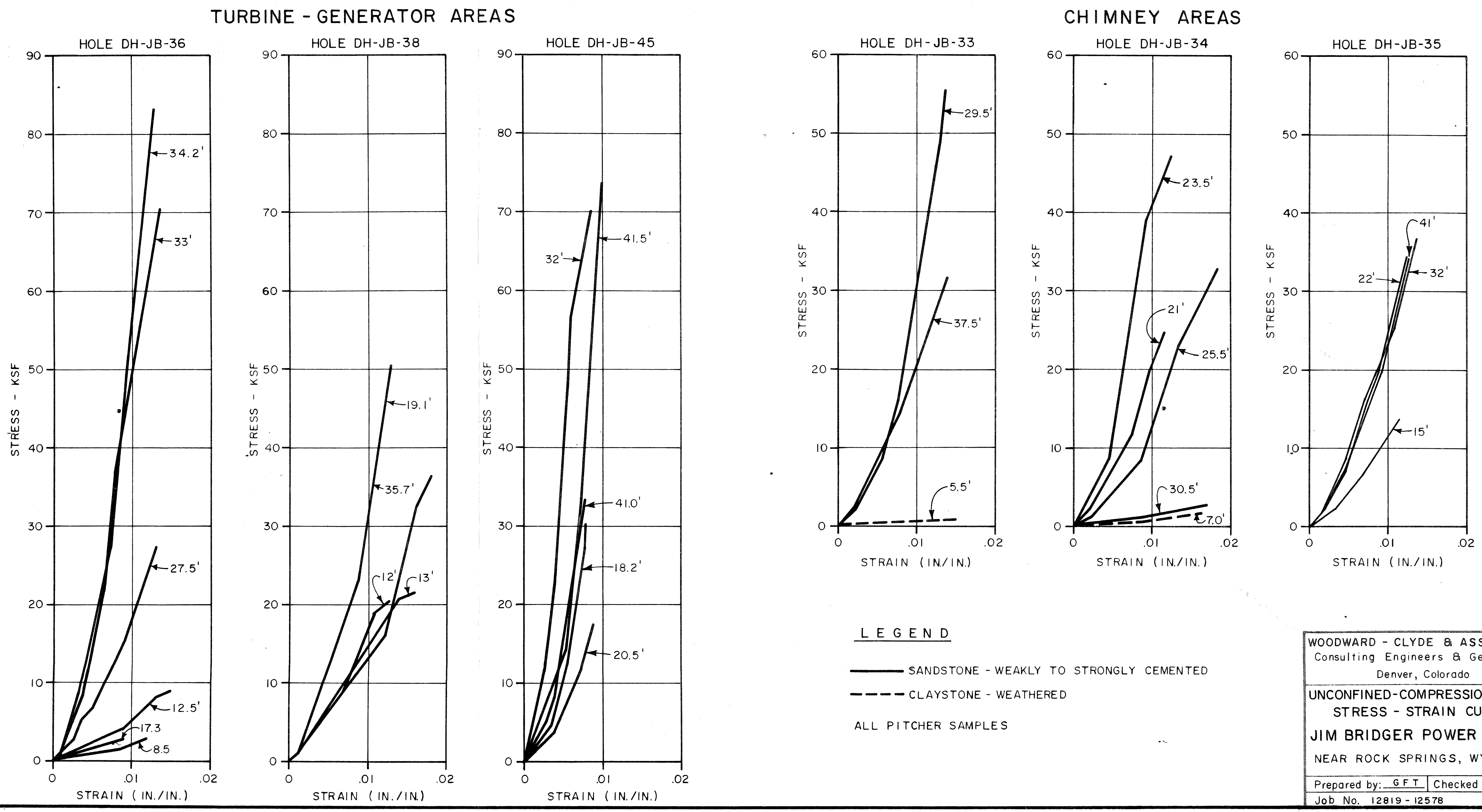
UNCONFINED-COMPRESSION TESTS
STRESS-STRAIN CURVES

JIM BRIDGER POWER PLANT

NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT	Checked by: STT
Job No. 12819-12578	

FIG. D-1



WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

UNCONFINED-COMPRESSION TESTS
STRESS - STRAIN CURVES

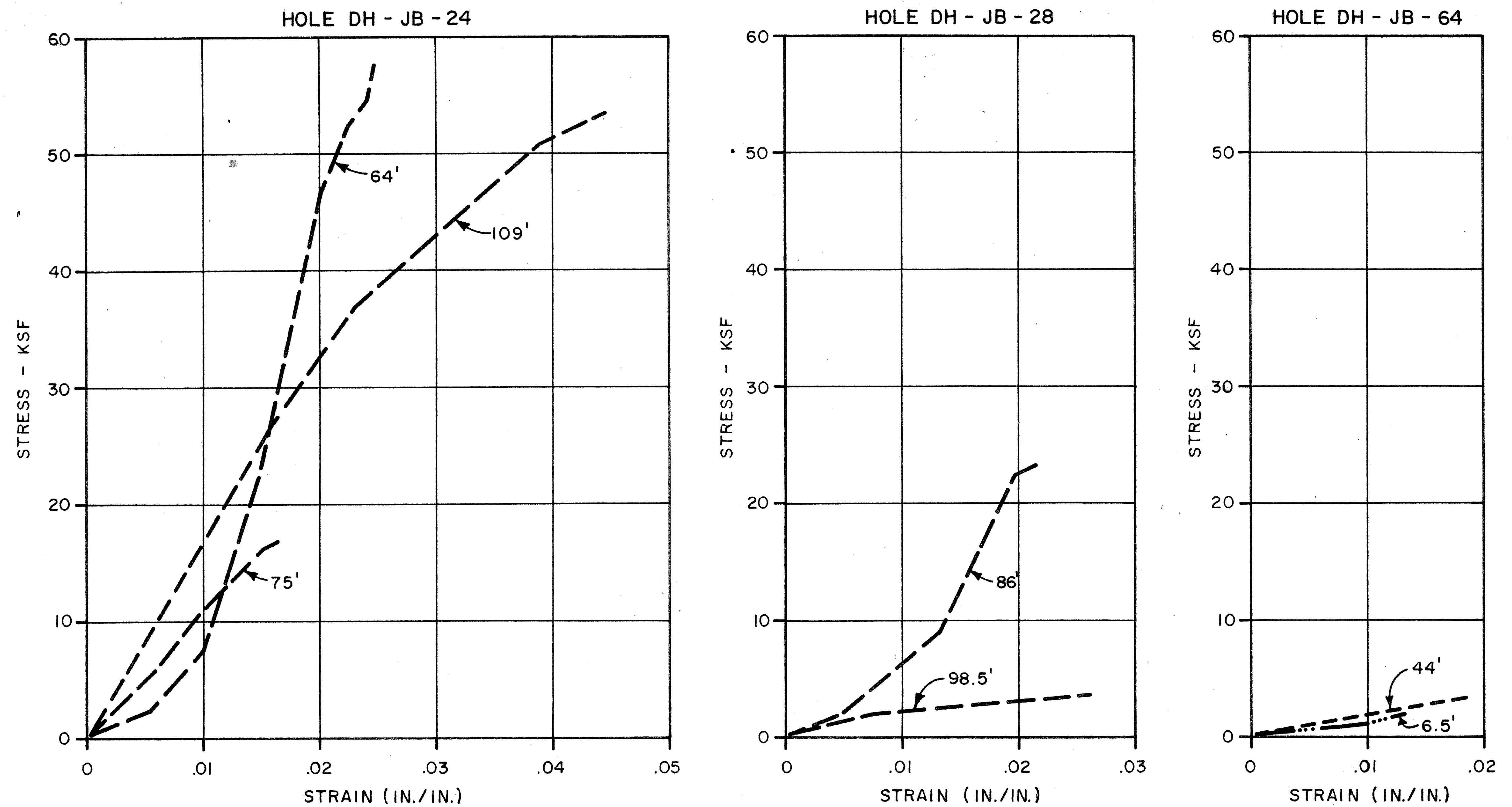
JIM BRIDGER POWER PLANT

NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

FIG. D-2

CONVEYOR AND COAL HANDLING FACILITIES AREA



LEGEND

— — — — CLAYSTONE

—···— SAND, SILTY

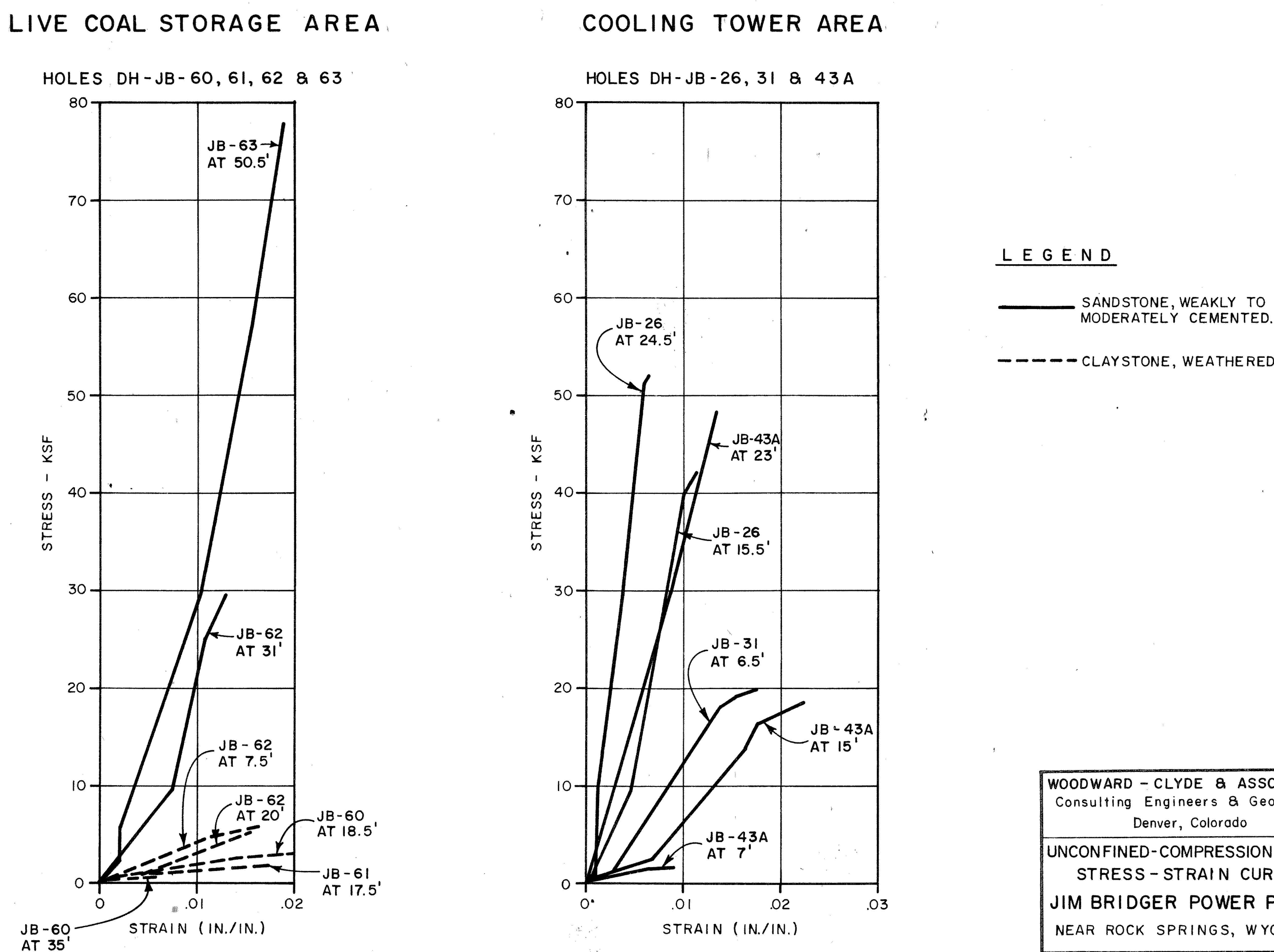
WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

UNCONFINED-COMPRESSION TESTS
STRESS - STRAIN CURVES

JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT	Checked by: STT
Job No. 12819 - 12578	

FIG. D-3



WOODWARD - CLYDE & ASSOCIATES
Consulting Engineers & Geologists
Denver, Colorado

UNCONFINED-COMPRESSION TESTS
STRESS-STRAIN CURVES
JIM BRIDGER POWER PLANT
NEAR ROCK SPRINGS, WYOMING

Prepared by: GFT | Checked by: STT
Job No. 12819 - 12578

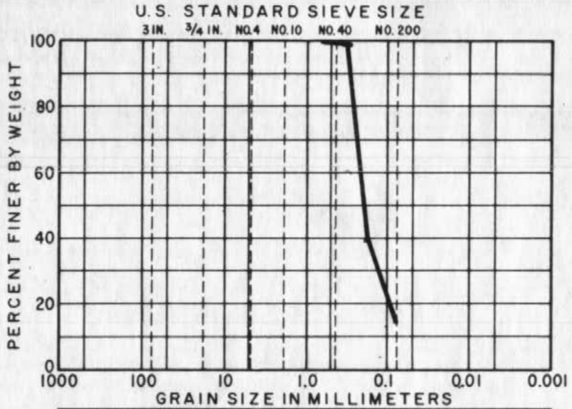
FIG. D-4

APPENDIX E

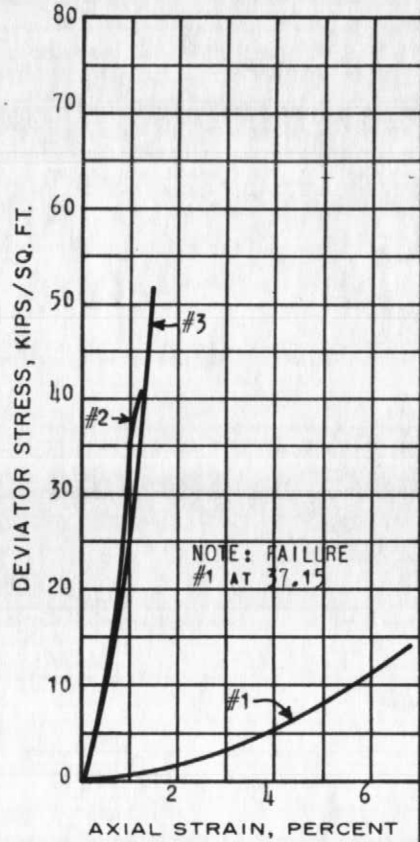
TRIAXIAL COMPRESSION TEST REPORTS

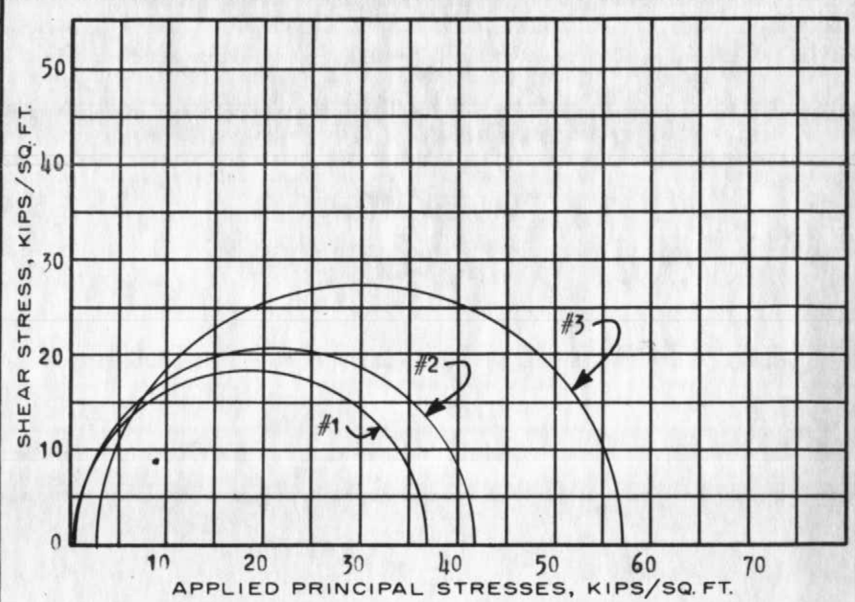
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY





	Test No.	1	2	3
INITIAL	Water Content, W_o %	6.3	8.3	8.3
	Dry Density Lbs/Cu.Ft.	112.9	111.8	116.8
	Void Ratio, e_o			
	Saturation, S_o %			
BEFORE TEST	W.C. after Saturation, W_s %			
	Saturation, S %			
	Consol Pressure K/Sq.Ft.			
	W.C. after Consol, W_c %			
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft	37.15	42.02	54.78
	Min. Prin. Stress, σ_{III} K/Sq.Ft	0	.72	2.88
	Water Content, W_F %			
	Void Ratio, e_F			
	Specimen Diameter Inches	2.82	2.81	2.81
	Initial Height Inches	5.34	5.60	5.07
	Test Time to Failure Min.	46	1.1	1.4

Remarks: #1 QU TEST - CONFINING PRESSURE 0 PSI
#2 QU TEST - CONFINING PRESSURE 5 PSI
#3 QU TEST - CONFINING PRESSURE 20 PSI

Type of Test
#1 Constant RATE OF STRESS Control
#2&#3 CONSTANT RATE OF STRAIN
UNConsolidated UNDrained

Type of Specimen PITCHER

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC	G 2.39
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-9 DEPTH 20.0 TO 22.3'

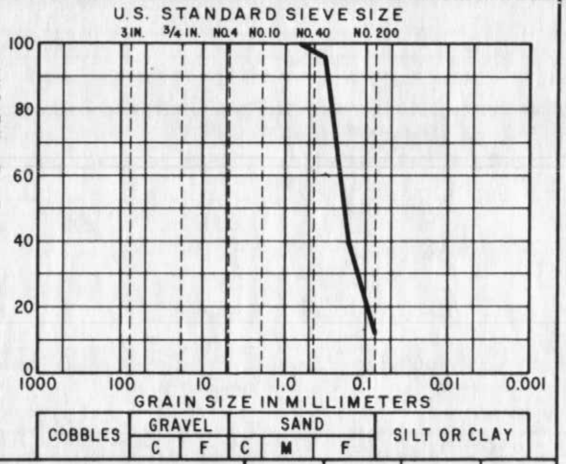
DATE 8/14/70

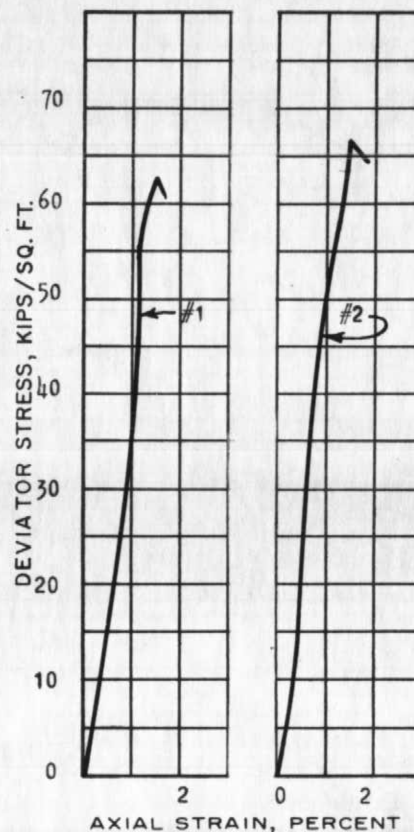
TRIAXIAL COMPRESSION TEST REPORT

FIG. E-1

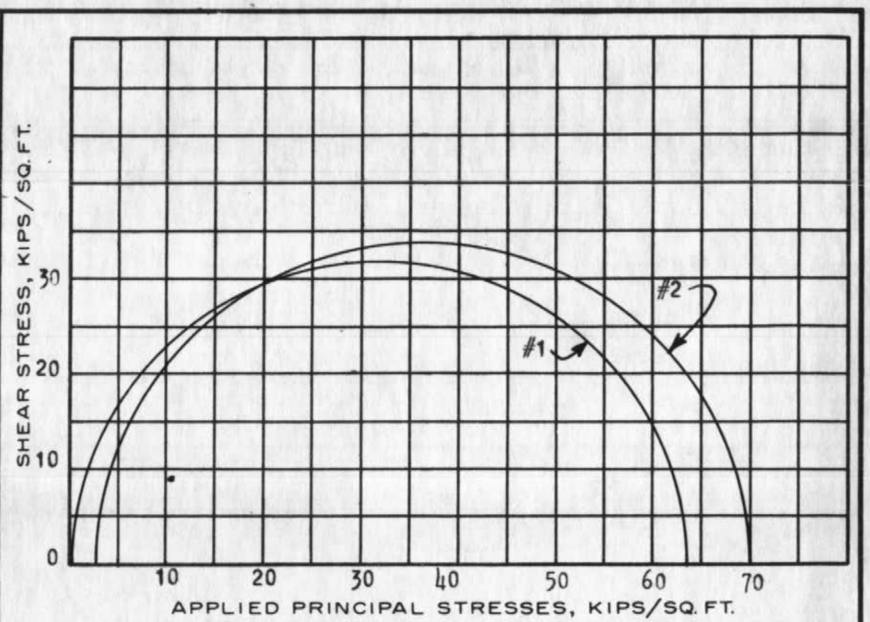
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES





*NOTE CHANGE OF SCALE



Remarks: #1 QU TEST - CONFINING PRESSURE 5 PSI
#2 QU TEST - CONFINING PRESSURE 20 PSI

	Test No.	1	2				
INITIAL	Water Content, W_o %	4.4	2.5				
	Dry Density Lbs/Cu.Ft.	110.0	110.4				
	Void Ratio, e_o						
	Saturation, S_o %						
BEFORE TEST	W.C. after Saturation, W_s %						
	Saturation, S %						
	Consol Pressure K/Sq.Ft.						
	W.C. after Consol, W_c %						
	Void Ratio after Consol, e_c						
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	63.5	69.8				
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	.72	2.88				
	Water Content, W_F %						
	Void Ratio, e_F						
	Specimen Diameter Inches	2.81	2.82				
	Initial Height Inches	5.60	5.60				
	Test Time to Failure Min.	32	37				

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC G 2.49

PL D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-10 DEPTH 20.5 & 29.0'

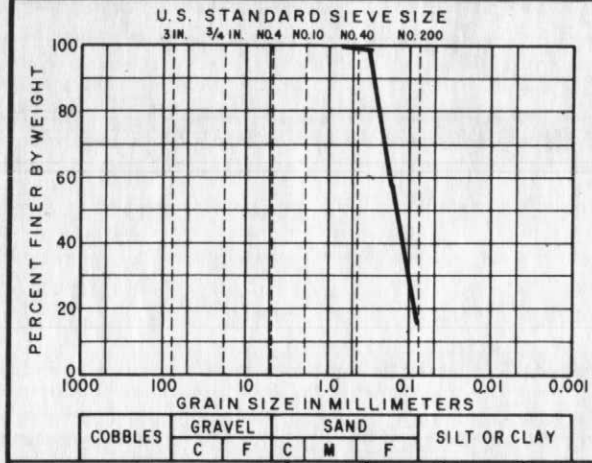
DATE 8/1/70

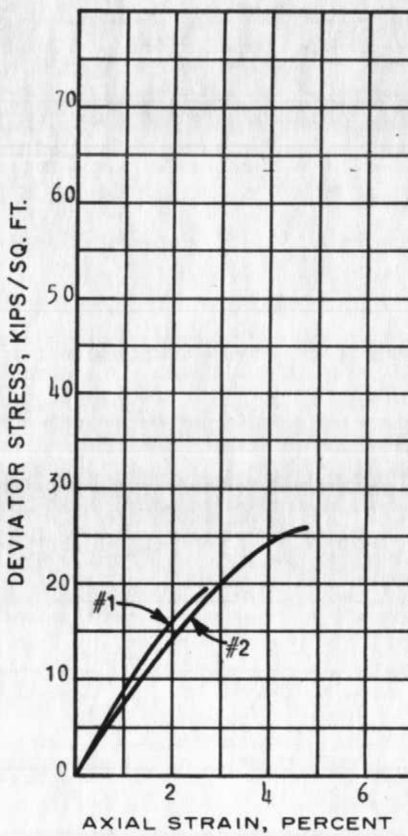
TRIAXIAL COMPRESSION TEST REPORT

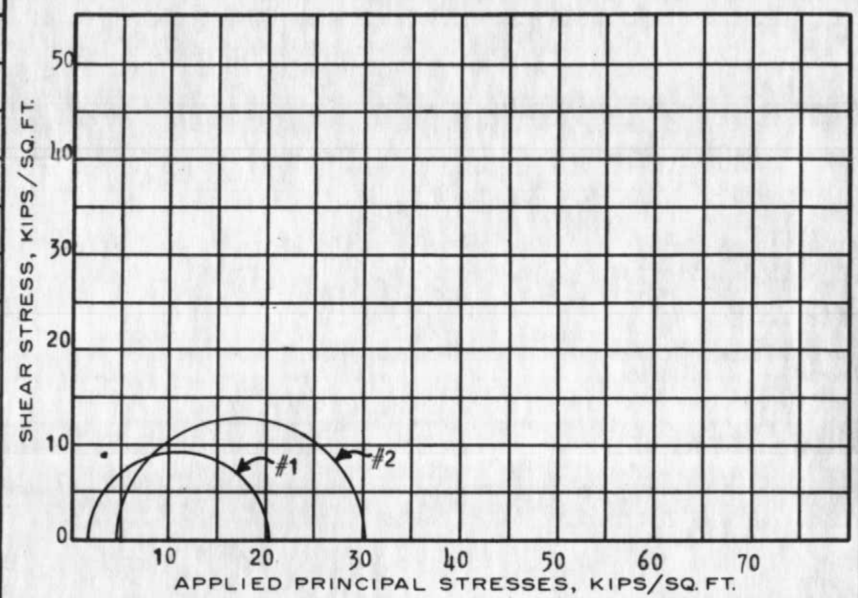
FIG. E-2

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







		Test No.	1	2
INITIAL	Water Content, W_o	%	10.3	10.3
	Dry Density	Lbs/Cu.Ft.	103.6	99.6
	Void Ratio, e_o			
	Saturation, S_o	%		
BEFORE TEST	W.C. after Saturation, W_s	%		
	Saturation, S	%		
	Consol Pressure	K/Sq.Ft.		
	W.C. after Consol, W_c	%		
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_1	K/Sq.Ft.	20.4	30.9
	Min. Prin. Stress, σ_{III}	K/Sq.Ft.	1.44	4.32
	Water Content, W_F	%		
	Void Ratio, e_F			
Specimen Diameter		Inches	2.81	2.81
Initial Height		Inches	5.35	5.60
Test Time to Failure		Min.	11	15

Remarks: #1 QU TEST - CONFINING PRESSURE 10 PSI
#2 QU TEST - CONFINING PRESSURE 30 PSI

Type of Test
Constant RATE OF STRESS Control
UNConsolidated UN Drained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC	G 2.44
PL	D_{10}

PROJECT NO. 12819-12578
PROJECT NAME JIM BRIDGER PROJECT

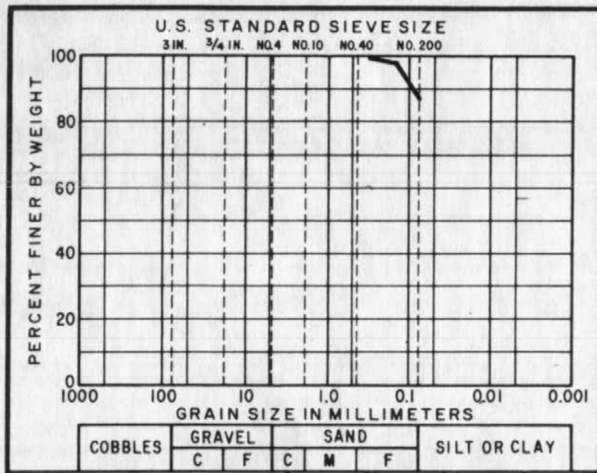
BORING NO. DH-JB-12 DEPTH 8.5 TO 9.0'
DATE 8/1/70

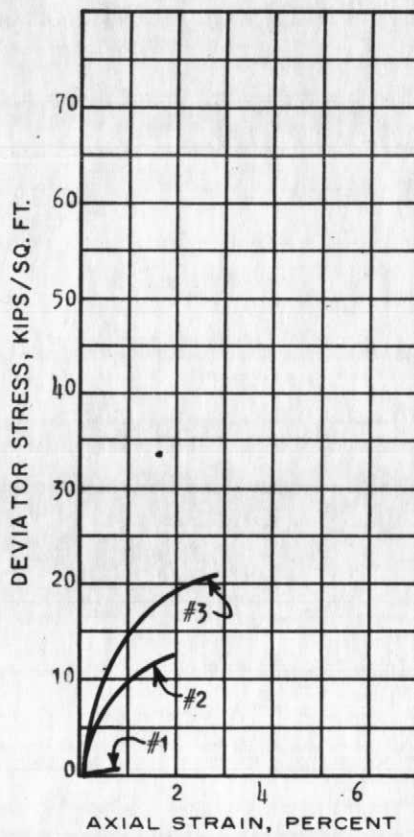
TRIAXIAL COMPRESSION TEST REPORT

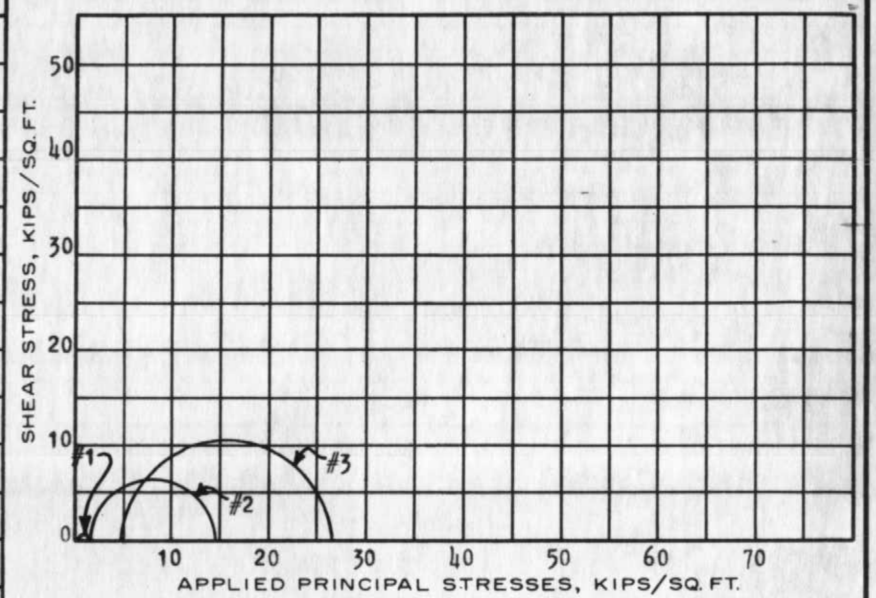
FIG. E-3

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







			1	2	3
	Test No.		1	2	3
INITIAL	Water Content, W_o	%	5.8	7.4	4.2
	Dry Density Lbs/Cu.Ft.		99.5	109.0	103.1
	Void Ratio, e_o				
	Saturation, S_o	%			
BEFORE TEST	W.C. after Saturation, W_S	%			
	Saturation, S	%			
	Consol Pressure	K/Sq.Ft.			
	W.C. after Consol, W_C	%			
	Void Ratio after Consol, e_c				
AT FAILURE	Maj.Prin.Stress, σ_I	K/Sq.Ft.	2.035	14.5	26.3
	Min.Prin.Stress, σ_{III}	K/Sq.Ft.	1.44	2.0	5.0
	Water Content, W_F	%			
	Void Ratio, e_F				
Specimen Diameter		Inches	1.94	1.94	1.94
Initial Height		Inches	3.91	3.90	3.88
Test Time to Failure		Min.	3	9	12.5

Remarks:
#1 CONFINING PRESSURE 10 PSI
#2 CONFINING PRESSURE 13.9 PSI
#3 CONFINING PRESSURE 34.7 PSI

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen CALIFORNIA DRIVE SAMPLE

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification SAND, SILTY

LL 20.0	G NONE TAKEN
PL 6.8	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-18

DEPTH 5.0 - 10.0 - 15.0'

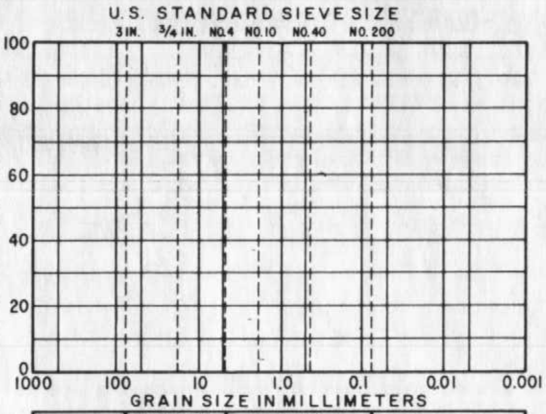
DATE 7/9/70

TRIAXIAL COMPRESSION TEST REPORT

FIG. E-4

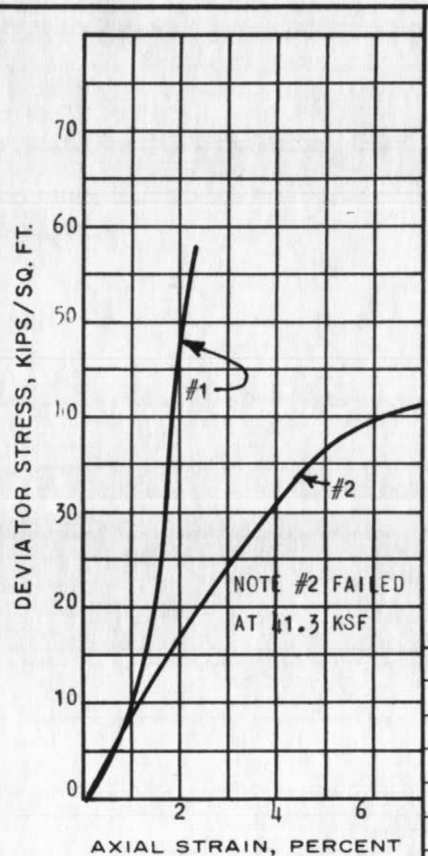
FORM NO. WC 3

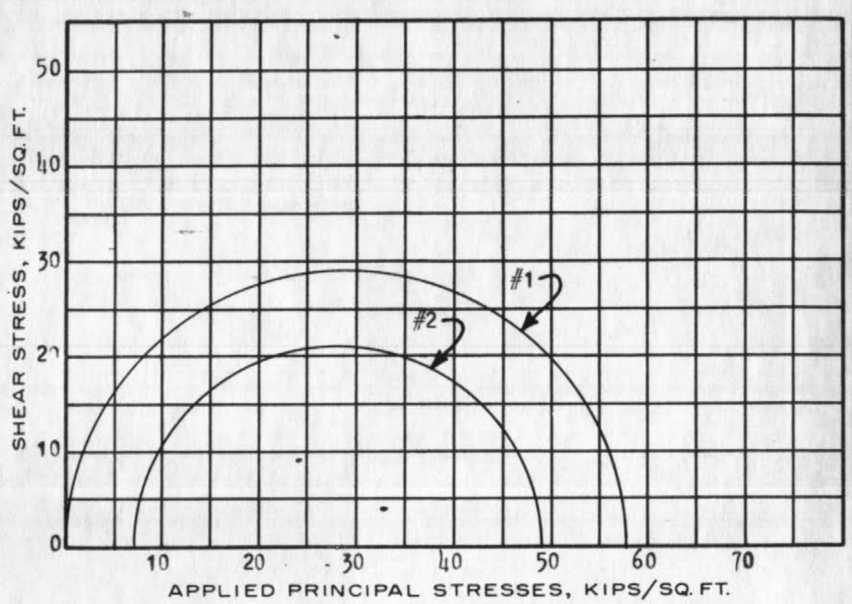
WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	

		1	2
	Test No.	1	2
INITIAL	Water Content, W_o %	10.8	16.1
	Dry Density Lbs/Cu.Ft.	125.5	127.0
	Void Ratio, e_o		
	Saturation, S_o %		
BEFORE TEST	W.C. after Saturation, W_s %		
	Saturation, S %		
	Consol Pressure K/Sq.Ft.		
	W.C. after Consol, W_c %		
	Void Ratio after Consol, e_c		
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	57.2	48.5
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	7.2
	Water Content, W_F %		
	Void Ratio, e_F		
	Specimen Diameter Inches	1.82	1.80
	Initial Height Inches	3.9	3.98
	Test Time to Failure Min.	27	20





Remarks: #1 CONFINED PRESSURE 0 PSI
#2 CONFINED PRESSURE 50 PSI

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen NX CORE

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification CLAYSTONE, SILTY

LL G 2.54
PL D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-24 DEPTH 64 TO 64.5'

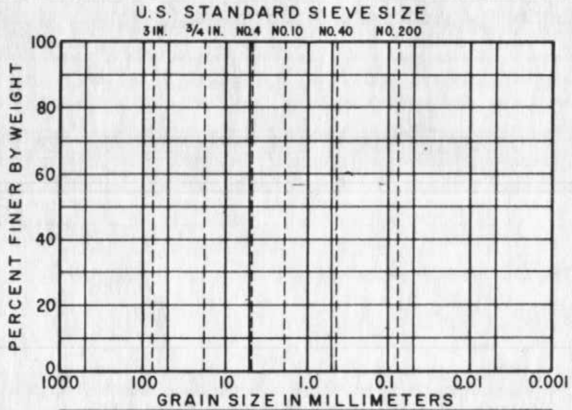
DATE

TRIAXIAL COMPRESSION TEST REPORT

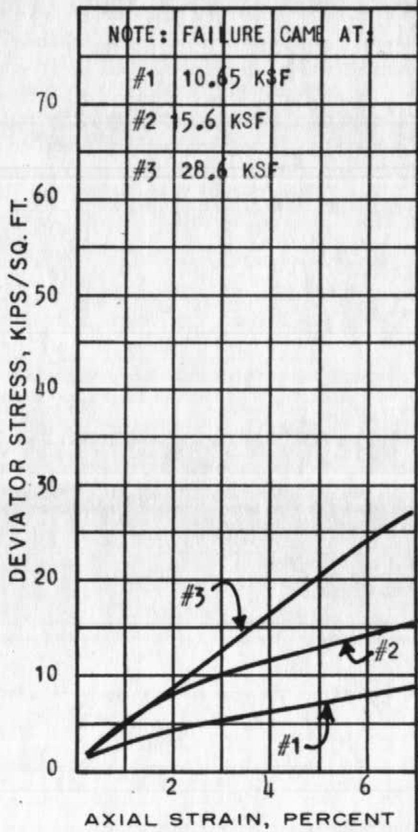
FIG. E-6

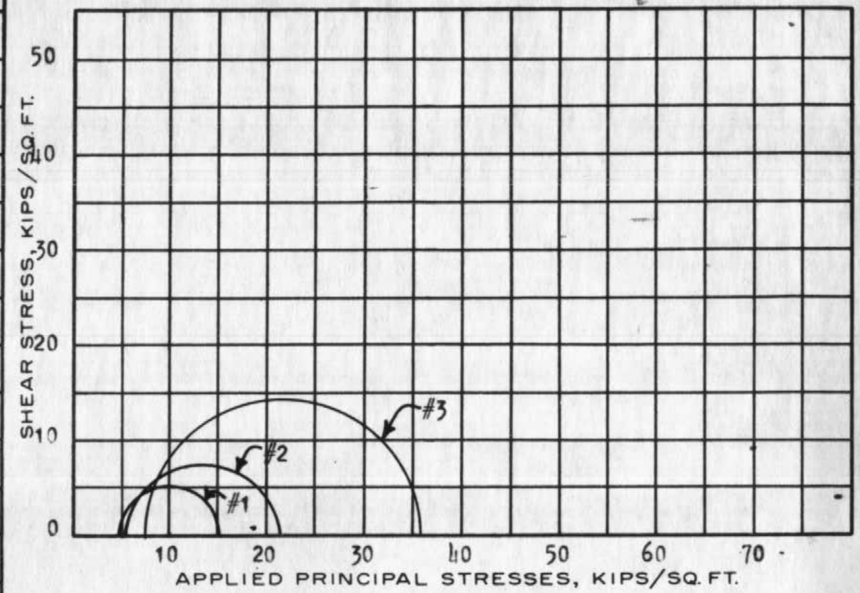
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY





	Test No.	1	2	3
INITIAL	Water Content, W_o %	16.9	14.4	11.1
INITIAL	Dry Density Lbs/Cu.Ft.	106	114.5	126.7
INITIAL	Void Ratio, e_o			
INITIAL	Saturation, S_o %			
BEFORE TEST	W.C. after Saturation, W_s %			
BEFORE TEST	Saturation, S %			
BEFORE TEST	Consol Pressure K/Sq.Ft.			
BEFORE TEST	W.C. after Consol, W_c %			
BEFORE TEST	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	15.0	21.4	35.8
AT FAILURE	Min. Prin. Stress, σ_{III} K/Sq.Ft.	4.32	5.76	7.2
AT FAILURE	Water Content, W_F %			
AT FAILURE	Void Ratio, e_F			
	Specimen Diameter Inches	1.98	1.90	1.95
	Initial Height Inches	3.92	3.98	3.9
	Test Time to Failure Min.	3.5	4	8

Remarks:
#1 QU TEST - CONFINING PRESSURE 30 PSI
#2 QU TEST - CONFINING PRESSURE 40 PSI
#3 QU TEST - CONFINING PRESSURE 50 PSI

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen NX CORE

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification CLAYSTONE

LL	G
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-23 DEPTH 35.0 TO 53.0'

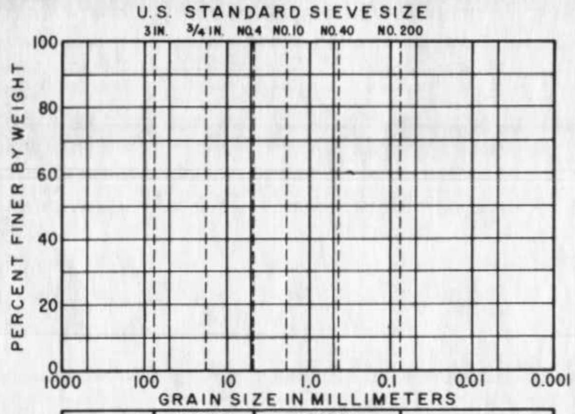
DATE 7/6/70

TRIAXIAL COMPRESSION TEST REPORT

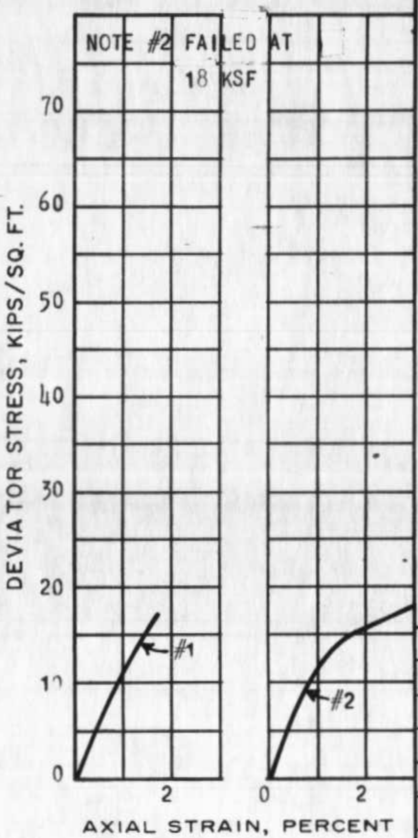
FIG. E-5

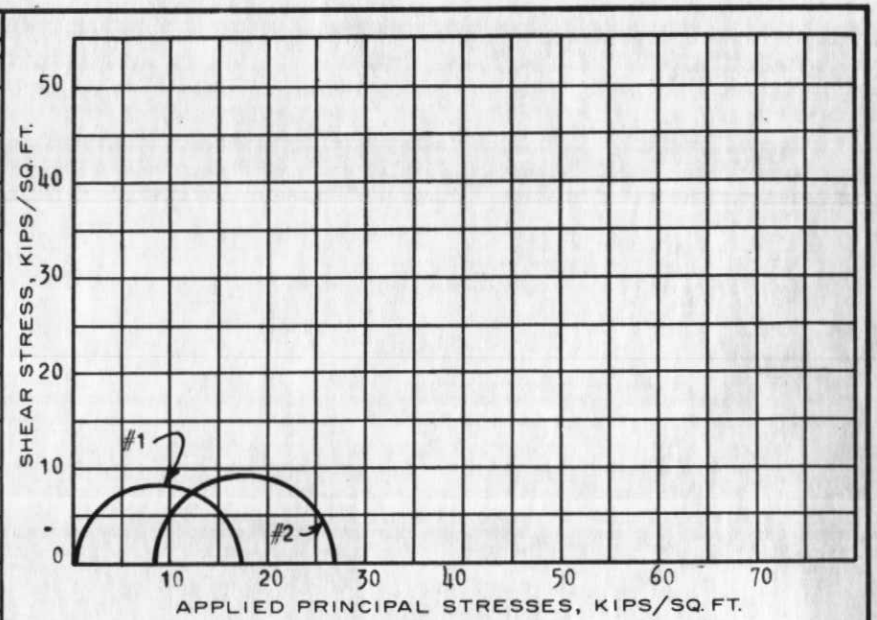
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	





Remarks: #1 QU TEST - UNCONFINED COMPRESSION
#2 QU TEST - CONFINING PRESSURE 60 PSI

	Test No.	1	2			
INITIAL	Water Content, W_o %	10.8	11.5			
	Dry Density Lbs/Cu.Ft.	128	118.8			
	Void Ratio, e_o					
	Saturation, S_o %					
BEFORE TEST	W.C. after Saturation, W_s %					
	Saturation, S %					
	Consol Pressure K/Sq.Ft.					
	W.C. after Consol, W_c %					
	Void Ratio after Consol, e_c					
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	17.0	26.6			
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	8.64			
	Water Content, W_F %					
	Void Ratio, e_F					
Specimen Diameter Inches		1.90	1.98			
Initial Height Inches		3.9	3.94			
Test Time to Failure Min.		8.5	10			

Type of Test
Constant RATE OF STRESS Control
UNConsolidated UN Drained

Type of Specimen

ϕ = °	Tan ϕ =	c = K/Sq.Ft.
Classification CLAYSTONE		
LL	G 2.57	
PL	D_{10}	

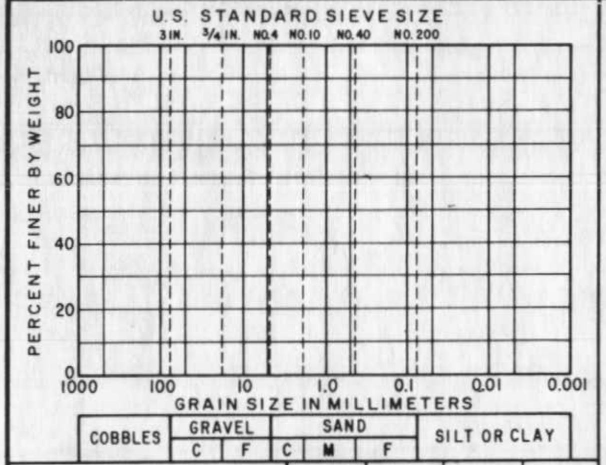
PROJECT NO. 12819-12578	
PROJECT NAME JIM BRIDGER PROJECT	
BORING NO. DH-JB-24	DEPTH 75 TO 75.5'
	DATE 7/3/70

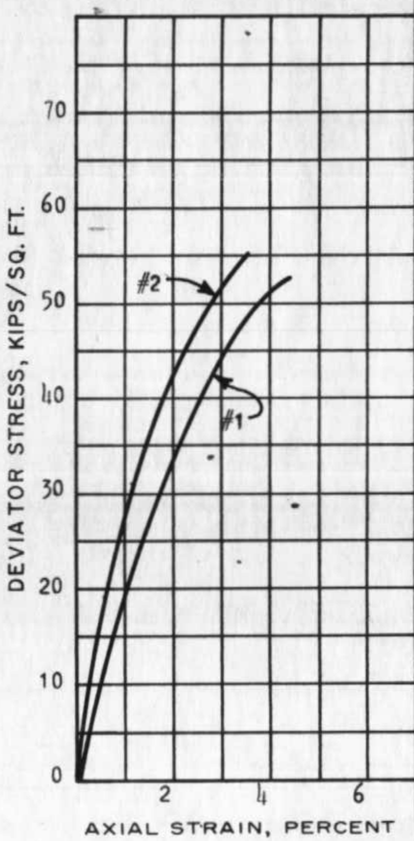
TRIAXIAL COMPRESSION TEST REPORT

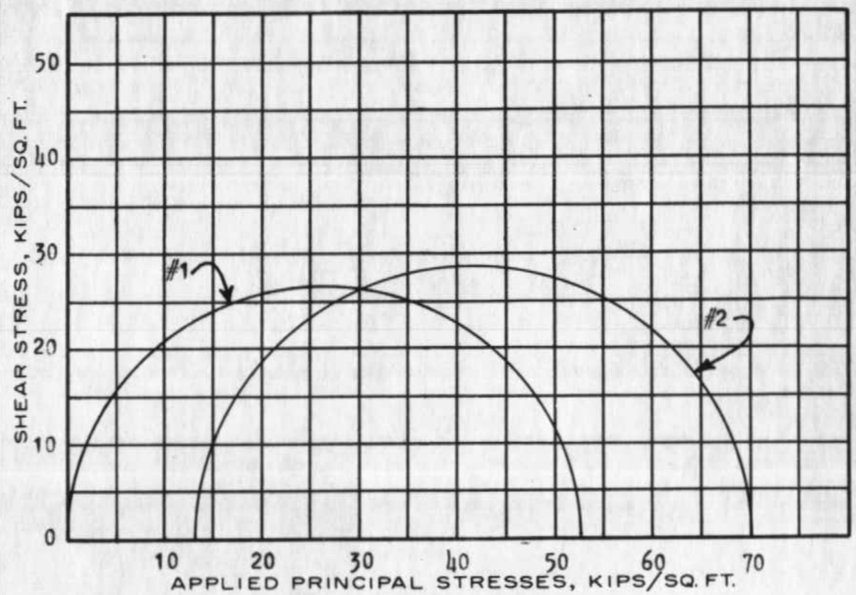
FIG. E-7

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







Remarks: #1 CONFINING PRESSURE 0 PSI
#2 CONFINING PRESSURE 90 PSI

		Test No.	1	2
INITIAL	Water Content, W_o	%	9.5	10.3
	Dry Density Lbs/Cu.Ft.			132.2
	Void Ratio, e_o			
	Saturation, S_o	%		
BEFORE TEST	W.C. after Saturation, W_s	%		
	Saturation, S	%		
	Consol Pressure	K/Sq.Ft.		
	W.C. after Consol, W_c	%		
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I	K/Sq.Ft.	53.0	69.96
	Min. Prin. Stress, σ_{III}	K/Sq.Ft.	0	12.96
	Water Content, W_F	%		
	Void Ratio, e_F			
Specimen Diameter		Inches	1.80	1.76
Initial Height		Inches	1.78	3.98
Test Time to Failure		Min.	24.5	24.5

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen NX CORE

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification CLAYSTONE

LL	G NONE GIVEN
PL	D_{10}

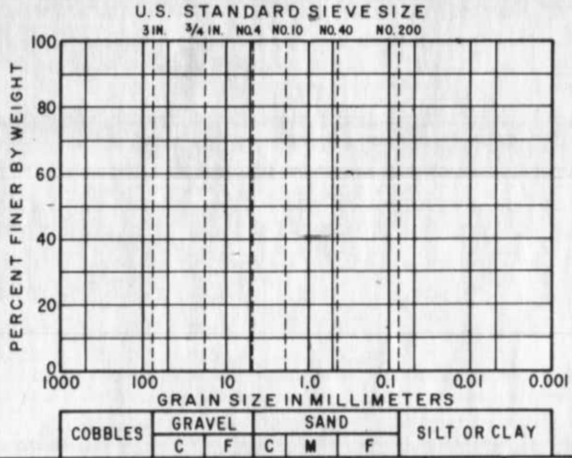
PROJECT NO. 12819-12578

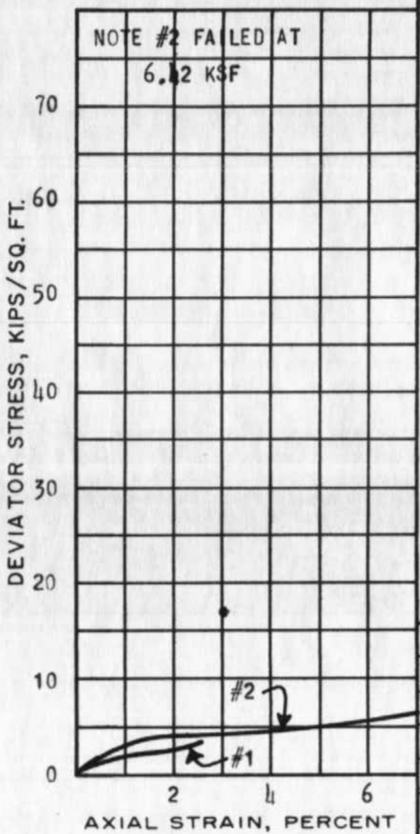
PROJECT NAME JIM BRIDGER PROJECT

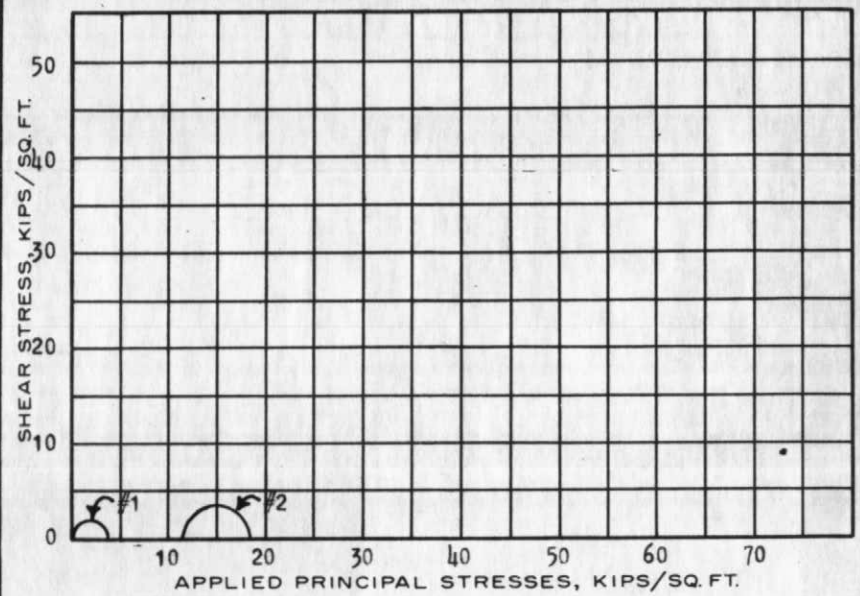
BORING NO. DH-JB-24	DEPTH 109.0 TO 109.5'
	DATE

TRIAXIAL COMPRESSION TEST REPORT

WOODWARD - CLYDE & ASSOCIATES







Remarks: #1 QU TEST - UNCONFINED COMPRESSION
#2 QU TEST - CONFINING PRESSURE

		1	2			
	Test No.	1	2			
INITIAL	Water Content, W_o %	16.7	19.4			
	Dry Density Lbs/Cu.Ft.	109	107			
	Void Ratio, e_o					
	Saturation, S_o %					
BEFORE TEST	W.C. after Saturation, W_s %					
	Saturation, S %					
	Consol Pressure K/Sq.Ft.					
	W.C. after Consol, W_c %					
	Void Ratio after Consol, e_c					
AT FAILURE	Maj.Prin.Stress, σ_I K/Sq.Ft.	3.79	17.92			
	Min.Prin.Stress, σ_{III} K/Sq.Ft.	0	11.5			
	Water Content, W_F %					
	Void Ratio, e_F					
Specimen Diameter	Inches	2.0	1.97			
Initial Height	Inches	3.98	3.97			
Test Time to Failure	Min.	2	4.5			

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen NX CORE

ϕ = °	Tan ϕ =	c = K/Sq.Ft.
Classification CLAYSTONE		
LL	G 2.46	
PL	D_{10}	

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

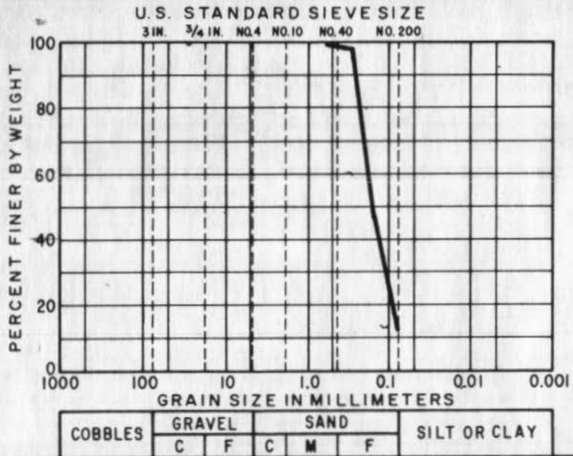
BORING NO. DH-JB-28 DEPTH 98.0 TO 98.5'

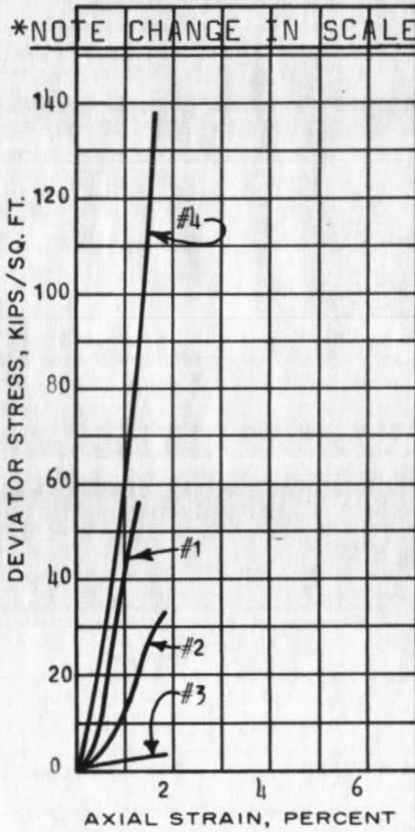
DATE 7/3/70

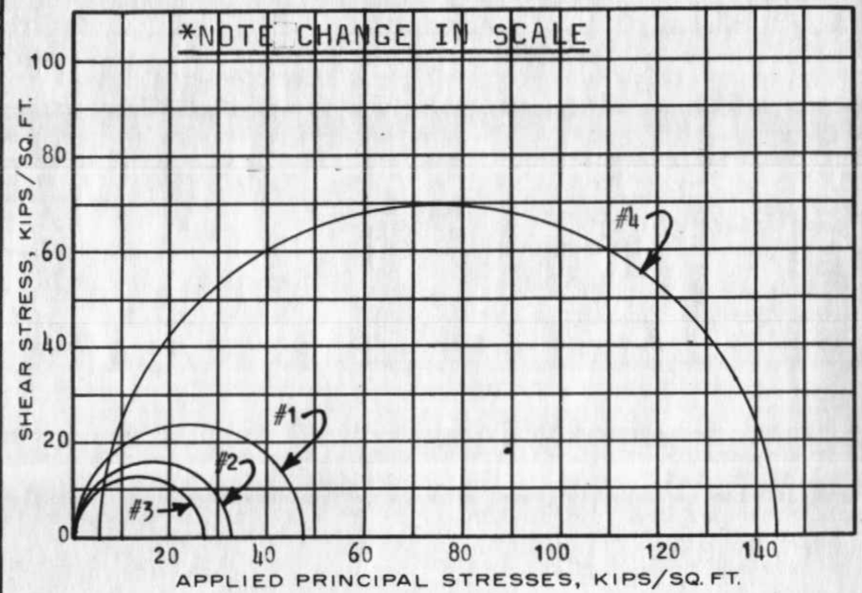
TRIAXIAL COMPRESSION TEST REPORT

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







	Test No.	1	2	3	4
INITIAL	Water Content, W_o %	1	2	3	4
	Dry Density Lbs/Cu.Ft.	11.0	11.1	13.6	11.3
	Void Ratio, e_o	115.8	109.2	112.9	116.2
	Saturation, S_o %				
BEFORE TEST	W.C. after Saturation, W_s %				
	Saturation, S %				
	Consol Pressure K/Sq.Ft.				
	W.C. after Consol, W_c %				
	Void Ratio after Consol, e_c				
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	47.5	32.8	2.74	144.26
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	0	0	5.76
	Water Content, W_F %				
	Void Ratio, e_F				
	Specimen Diameter Inches	2.83	2.83	2.82	2.83
	Initial Height Inches	5.60	5.60	5.10	5.60
	Test Time to Failure Min.	1.5	37	3	3.8

Remarks:
- #1 CONFINING PRESSURE 0 PSI
- #2 CONFINING PRESSURE 0 PSI
- #3 CONFINING PRESSURE 0 PSI
- #4 CONFINING PRESSURE 40 PSI

Type of Test
#1, 2 & 3 Constant RATE OF STRESS Control
#4 CONSTANT RATE OF STRAIN
UNConsolidated UNDrained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC G 2.35

PL D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-34 DEPTH 23.5 TO 30.5'

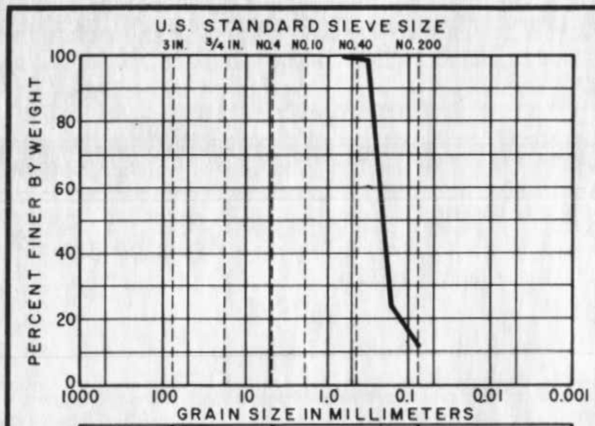
DATE

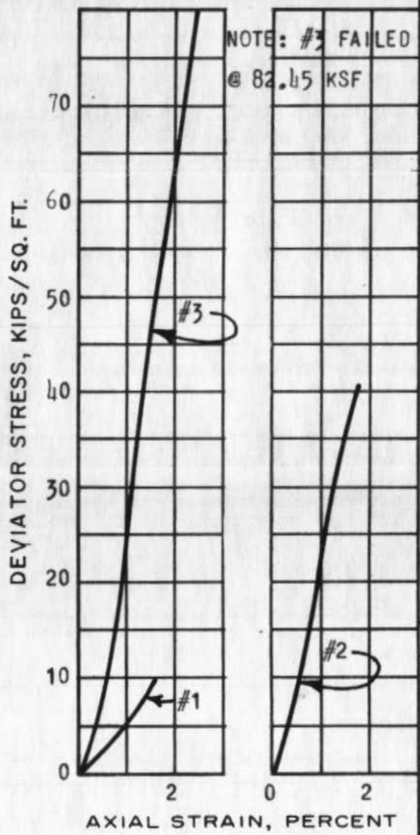
TRIAXIAL COMPRESSION TEST REPORT

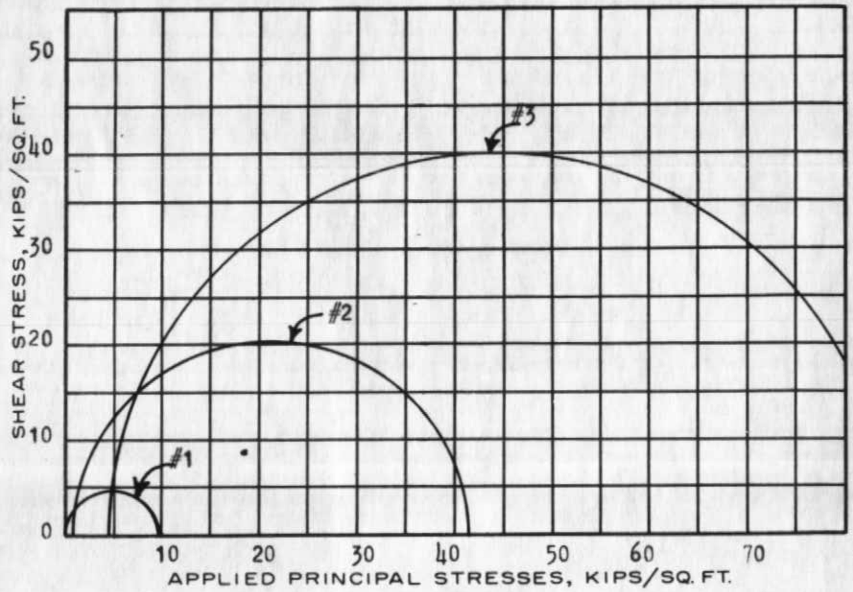
FIG. E-10

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







			1	2	3
	Test No.		1	2	3
INITIAL	Water Content, W_o	%	16.3	17.2	14.8
INITIAL	Dry Density Lbs / Cu.Ft.		108	110	109
INITIAL	Void Ratio, e_o				
INITIAL	Saturation, S_o	%			
BEFORE TEST	W.C. after Saturation, W_S	%			
BEFORE TEST	Saturation, S	%			
BEFORE TEST	Consol Pressure K/Sq.Ft.				
BEFORE TEST	W.C. after Consol, W_C	%			
BEFORE TEST	Void Ratio after Consol, e_C				
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.		9.16	41.6	86.8
AT FAILURE	Min. Prin. Stress, σ_{III} K/Sq.Ft.		0	1.44	4.32
AT FAILURE	Water Content, W_F	%			
AT FAILURE	Void Ratio, e_F				
	Specimen Diameter	Inches	2.81	2.81	2.81
	Initial Height	Inches	5.35	5.60	4.87
	Test Time to Failure	Min.	5	22.5	45.5

Remarks:
#1 QU TEST - UNCONFINED COMPRESSION
#2 QU TEST - CONFINING PRESSURE 10 PSI
#3 QU TEST - CONFINING PRESSURE 30 PSI

Type of Test: Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen: PITCHER

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification: SANDSTONE

LL NON-PLASTIC	G 2.51
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-36 DEPTH 11.5 TO 14.0'

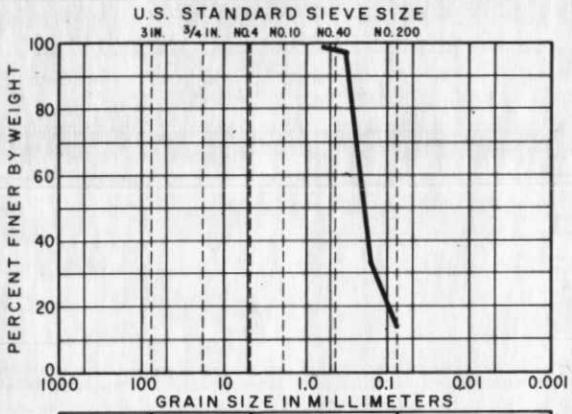
DATE 8/1/70

TRIAXIAL COMPRESSION TEST REPORT

FIG. E-11

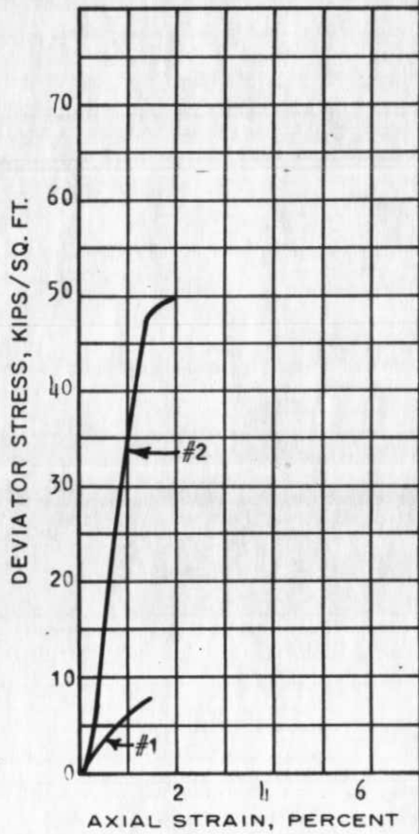
FORM NO. WC 3

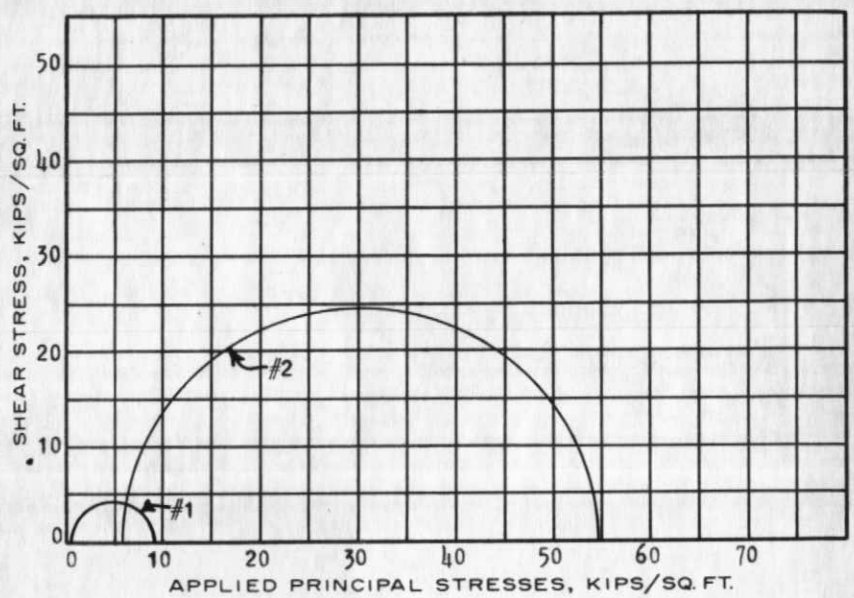
WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	

		Test No.	1	2
INITIAL	Water Content, W_o	%	15.6	14.0
	Dry Density Lbs/Cu.Ft.		111.0	109.2
	Void Ratio, e_o			
	Saturation, S_o	%		
BEFORE TEST	W.C. after Saturation, W_s	%		
	Saturation, S	%		
	Consol Pressure	K/Sq.Ft.		
	W.C. after Consol, W_c	%		
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I	K/Sq.Ft.	8.78	10.68
	Min. Prin. Stress, σ_{III}	K/Sq.Ft.	1.44	5.76
	Water Content, W_F	%		
	Void Ratio, e_F			
Specimen Diameter		Inches	2.83	2.83
Initial Height		Inches	5.60	5.60
Test Time to Failure		Min.	8	27





Remarks: #1 CONFINING PRESSURE 10 PSI

#2 CONFINING PRESSURE 40 PSI

Type of Test

Constant RATE OF STRESS Control

UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC	G 2.41
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-36 DEPTH 25.0 TO 26.0'

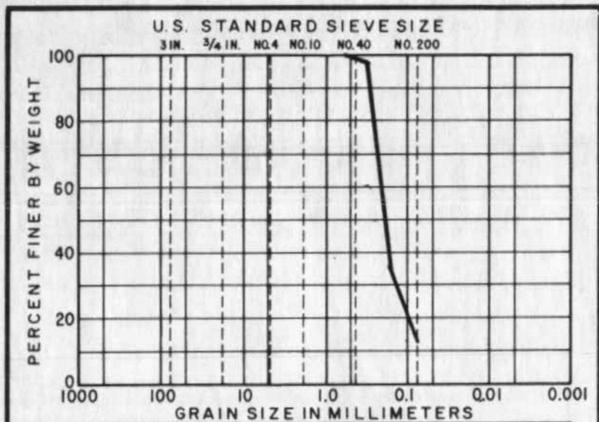
DATE

TRIAXIAL COMPRESSION TEST REPORT

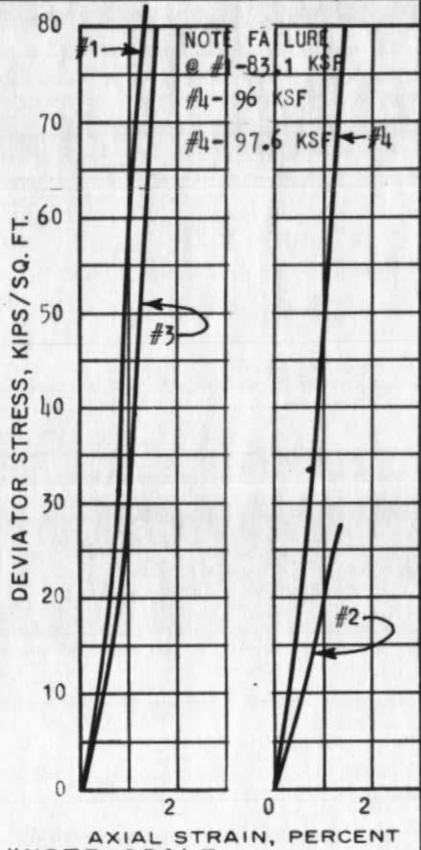
FIG. E-12

FORM NO. WC 3

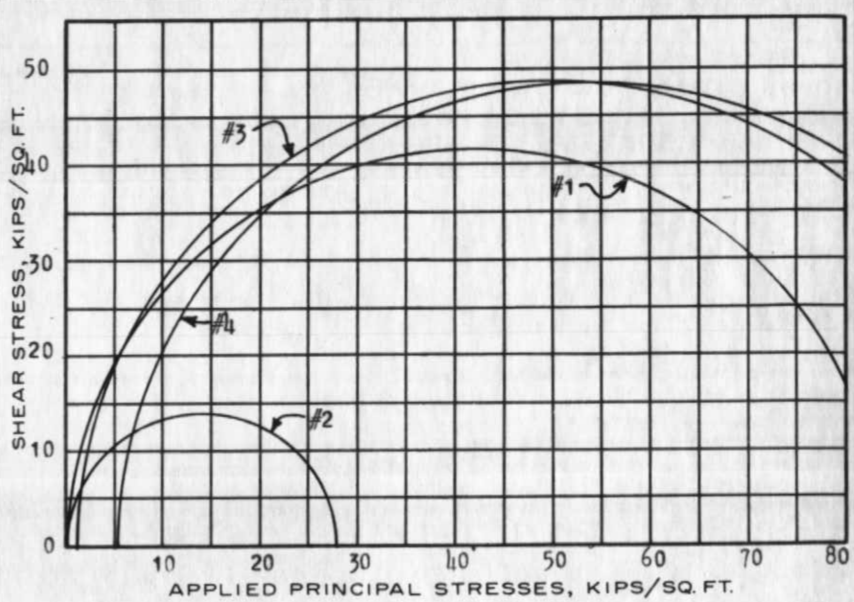
WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	



*NOTE SCALE



Remarks: #1 QU TEST - UNCONFINED COMPRESSION
#2 QU TEST - UNCONFINED COMPRESSION
#3 QU TEST - CONFINING PRESSUE 10 PSI
#4 QU EST - CONFINING PRESSURE 40 PSI

	Test No.	1	2	3	4
INITIAL	Water Content, W_o %	11.9	9.8	13.6	13.8
	Dry Density Lbs/Cu.Ft.	123	114	112	113
	Void Ratio, e_o				
	Saturation, S_o %				
BEFORE TEST	W.C. after Saturation, W_s %				
	Saturation, S %				
	Consol Pressure K/Sq.Ft.				
	W.C. after Consol, W_c %				
	Void Ratio after Consol, e_c				
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	83.1	27.5	99.0	102
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	0	1.44	5.76
	Water Content, W_F %				
	Void Ratio, e_F				
	Specimen Diameter Inches	2.82	2.82	2.83	2.81
	Initial Height Inches	5.10	5.60	5.60	5.60
	Test Time to Failure Min.	47.5	3	3.6	3.6

Type of Test
#1&2 Constant RATE OF STRESS
#3&4 CONSTANT RATE OF STRAIN
Control

UN Consolidated UNDrained

Type of Specimen PITCHER

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC	G 2.41
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-36 DEPTH 34.2 TO 38.0'

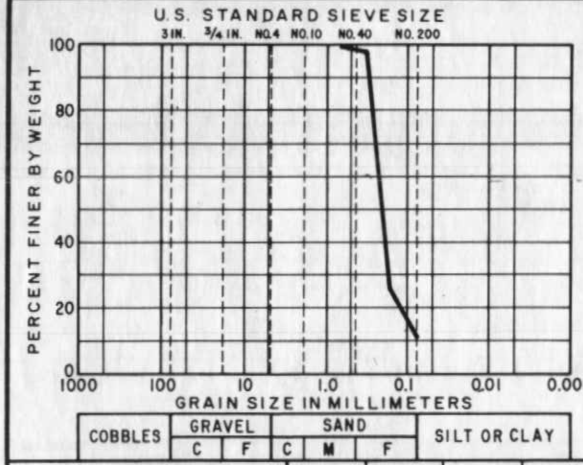
DATE 8/11/70

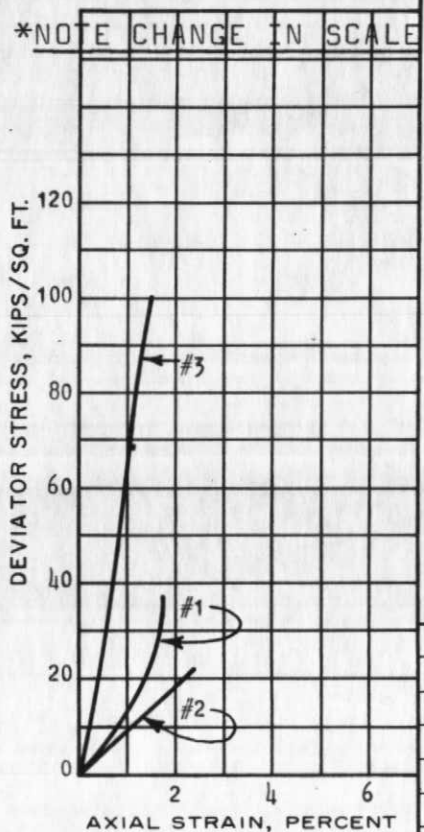
TRIAXIAL COMPRESSION TEST REPORT

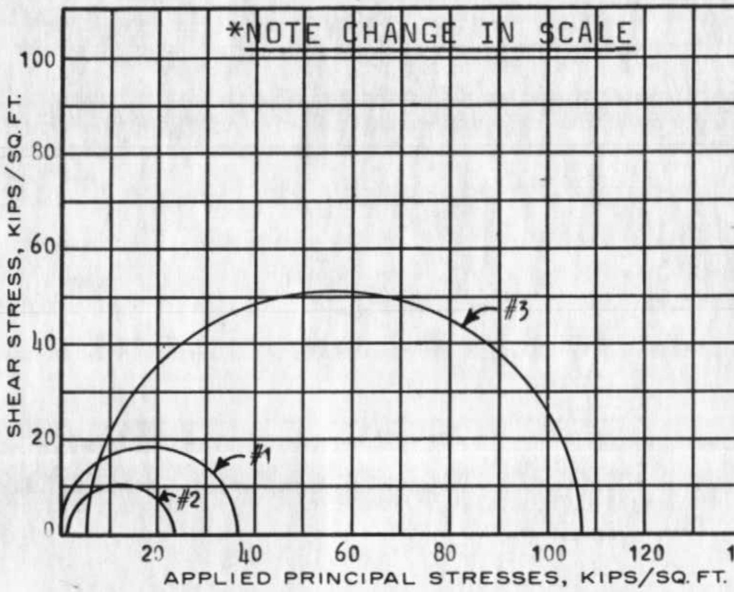
FIG. E-13

FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES







	Test No.	1	2	3
INITIAL	Water Content, W_o %	11.7	15.9	13.9
	Dry Density Lbs/Cu.Ft.	114.0	108.9	114.1
	Void Ratio, e_o			
	Saturation, S_o %			
BEFORE TEST	W.C. after Saturation, W_s %			
	Saturation, S %			
	Consol Pressure K/Sq.Ft.			
	W.C. after Consol, W_c %			
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	36.5	22.9	106.56
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	1.44	5.76
	Water Content, W_F %			
	Void Ratio, e_F			
Specimen Diameter	Inches	2.82	2.81	2.81
Initial Height	Inches	5.60	5.60	5.60
Test Time to Failure	Min.	8	12.5	55

Remarks: #1 CONFINING PRESSURE 0 PSI
#2 CONFINING PRESSURE 10 PSI
#3 CONFINING PRESSURE 40 PSI

Type of Test
Constant RATE OF STRESS Control
UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = ° | Tan ϕ = | c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC | G 2.46

PL | D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

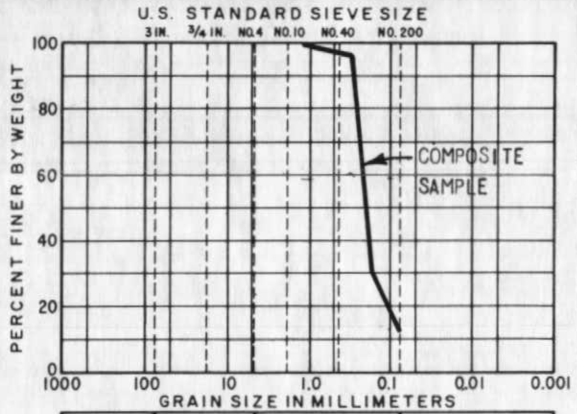
BORING NO. DH-JB-38 | DEPTH 32.3 TO 35.7'

DATE

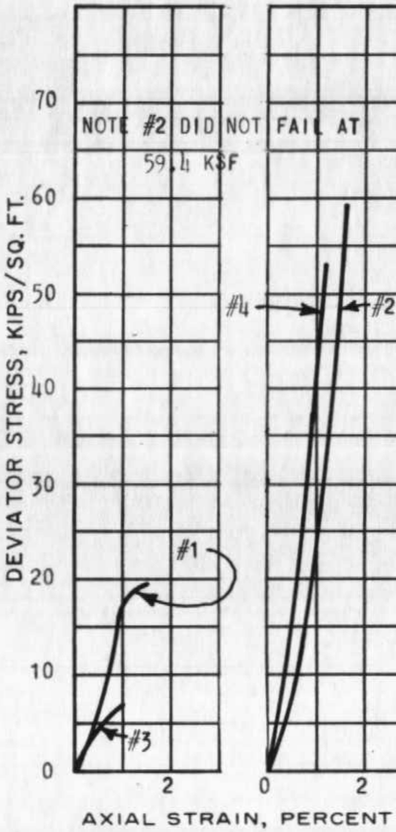
TRIAXIAL COMPRESSION TEST REPORT

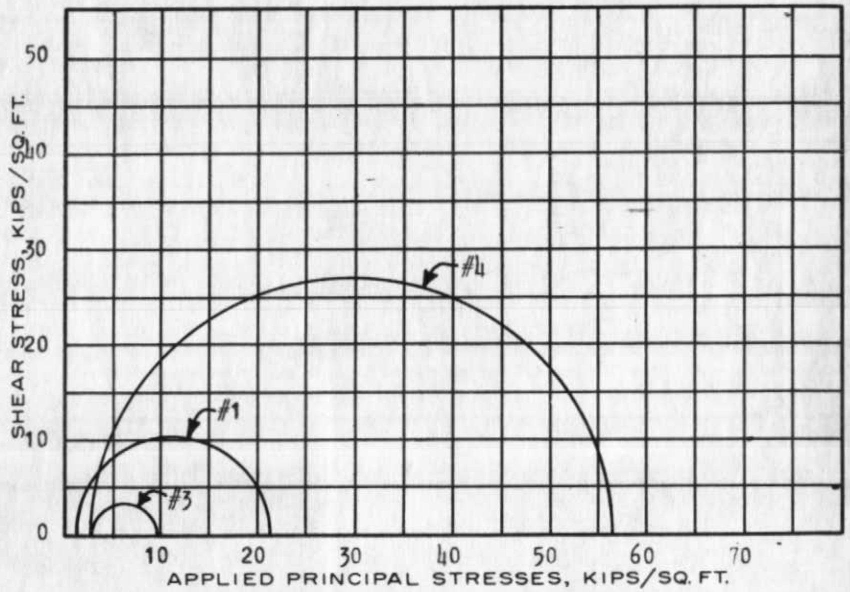
FIG. E-14

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	





	Test No.	1	2	3	4
INITIAL	Water Content, W_o %	14.5	16.2	14.3	12.7
	Dry Density Lbs/Cu.Ft.	112.2	110.0	111.1	114.2
	Void Ratio, e_o				
	Saturation, S_o %				
BEFORE TEST	W.C. after Saturation, W_S %				
	Saturation, S %				
	Consol Pressure K/Sq.Ft.				
	W.C. after Consol, W_C %				
	Void Ratio after Consol, e_C				
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	20.12	62.28	8.77	56.28
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	.72	2.88	2.88	2.88
	Water Content, W_F %				
	Void Ratio, e_F				
	Specimen Diameter Inches	2.83	2.83	2.83	2.81
	Initial Height Inches	5.40	4.74	5.60	5.60
	Test Time to Failure Min.	21.5	66	0.2	1.5

Remarks: #1 CONFINING PRESSURE 5 PSI
#2 CONFINING PRESSURE 20 PSI
#3 CONFINING PRESSURE 20 PSI
#4 CONFINING PRESSURE 20 PSI

NOTE #2 WAS NOT STRESSED TO FAILURE

Type of Test
#1 & #2 Constant RATE OF STRESS
#3 & 4 CONSTANT RATE OF STRAIN Control
UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC G 2.49
PL D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

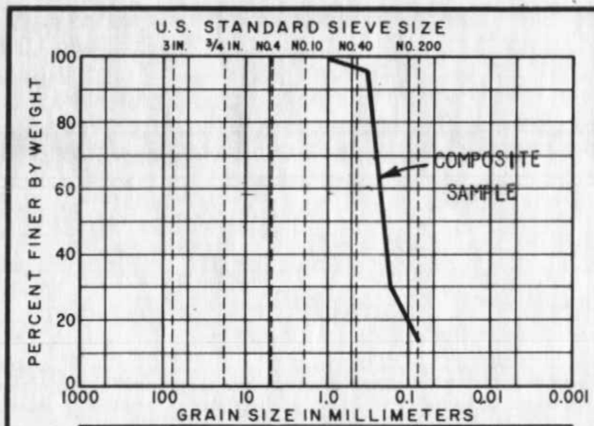
BORING NO. DH-JB-45 DEPTH 11.5 TO 16.1'

DATE 7/23/70

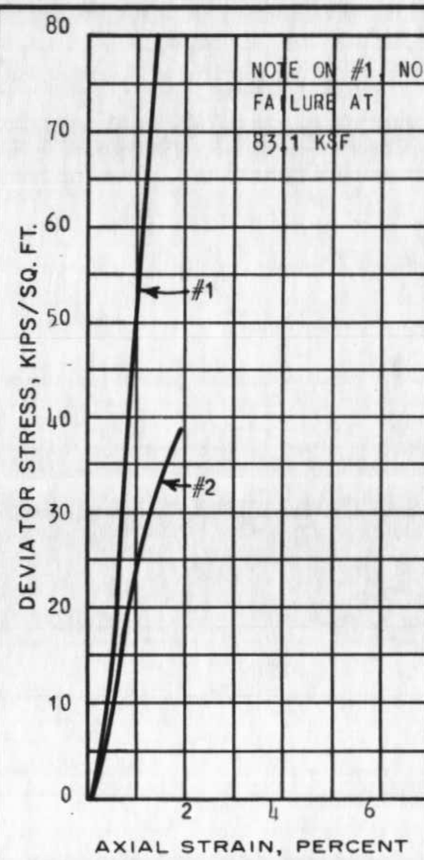
TRIAXIAL COMPRESSION TEST REPORT

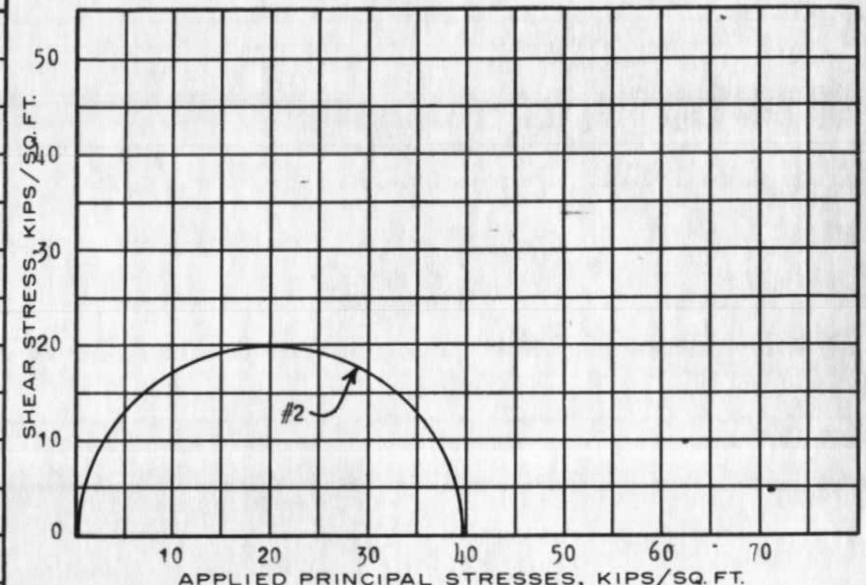
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY





		Test No.	1	2		
INITIAL	Water Content, W_o	%	13.1	13.5		
	Dry Density Lbs/Cu.Ft.		100	113		
	Void Ratio, e_o					
	Saturation, S_o	%				
BEFORE TEST	W.C. after Saturation, W_S	%				
	Saturation, S	%				
	Consol Pressure K/Sq.Ft.					
	W.C. after Consol, W_C	%				
	Void Ratio after Consol, e_c					
AT FAILURE	Maj.Prin.Stress, σ_I K/Sq.Ft.		83+	38.6		
	Min.Prin.Stress, σ_{III} K/Sq.Ft.		0	.72		
	Water Content, W_F	%				
	Void Ratio, e_F					
Specimen Diameter		Inches	2.81	2.82		
Initial Height		Inches	5.30	3.59		
Test Time to Failure		Min.		41.5		

Remarks: #1 QU TEST - UNCONFINED COMPRESSION

#2 QU TEST - CONFINING PRESSURE 5 PSI

Type of Test
Constant RATE OF STRESS Control
UNConsolidated UN Drained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC | G 2.29

PL | D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-45 DEPTH 25.1 & 25.6

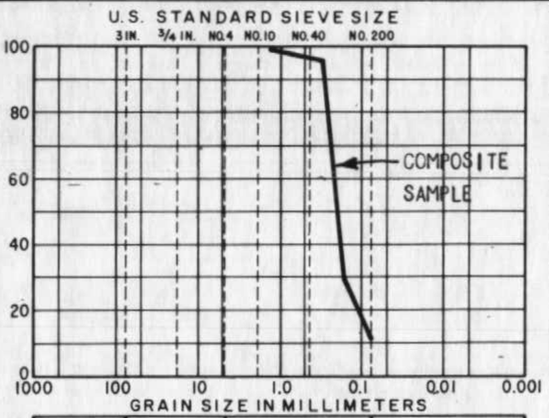
DATE 7/21/70

TRIAXIAL COMPRESSION TEST REPORT

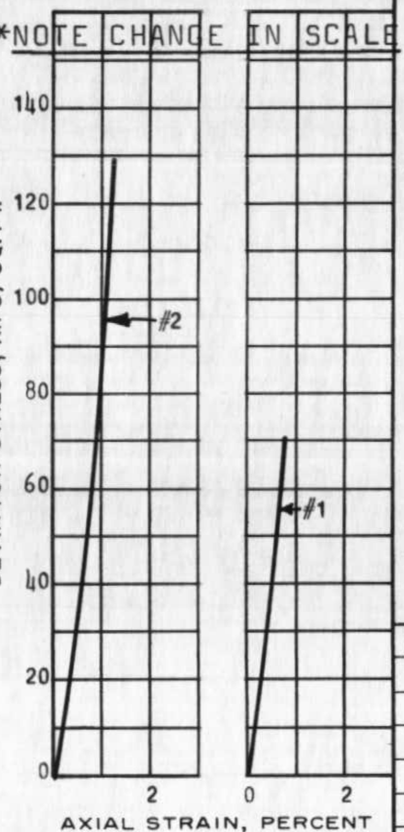
FIG. E-16

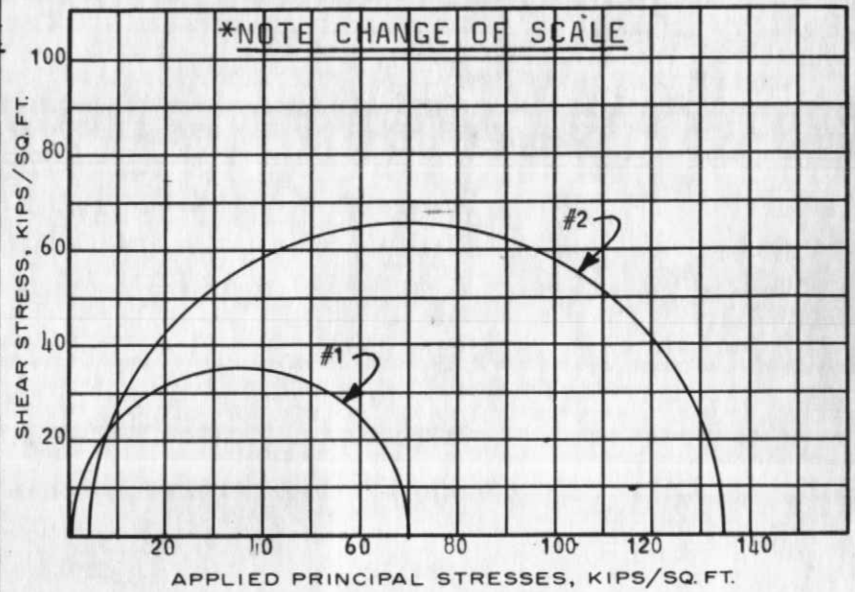
FORM NO. WC 3

WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	C	F	C	M	F	





	Test No.	1	2	
INITIAL	Water Content, W_o %	12.8	15.0	
	Dry Density Lbs/Cu.Ft.	113.0	110.8	
	Void Ratio, e_o			
	Saturation, S_o %			
BEFORE TEST	W.C. after Saturation, W_s %			
	Saturation, S %			
	Consol Pressure K/Sq.Ft.			
	W.C. after Consol, W_c %			
	Void Ratio after Consol, e_c			
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	70.2	132.82	
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	0	4.32	
	Water Content, W_F %			
	Void Ratio, e_F			
	Specimen Diameter Inches	2.81	2.84	
	Initial Height Inches	4.80	5.60	
	Test Time to Failure Min.	38	3.6	

Type of Test

#1 Constant RATE OF STRESS
#2 CONSTANT RATE OF STRAIN
Control

UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = ° Tan ϕ = c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC G NONE GIVEN

PL D_{10}

Remarks: #1 CONFINING PRESSURE 0 PSI
#2 CONFINING PRESSURE 30 PSI

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-45 DEPTH 29.3 & 32.0

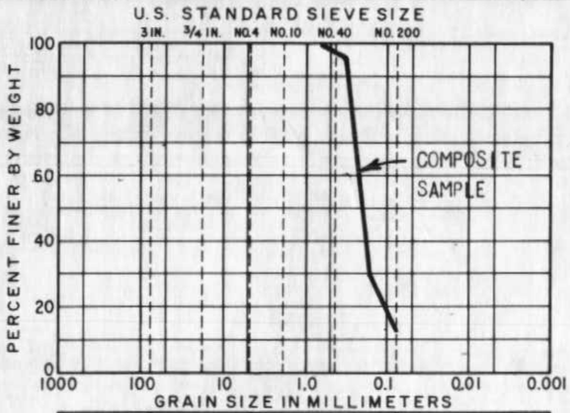
DATE 7/23/70

TRIAXIAL COMPRESSION TEST REPORT

FIG. E-17

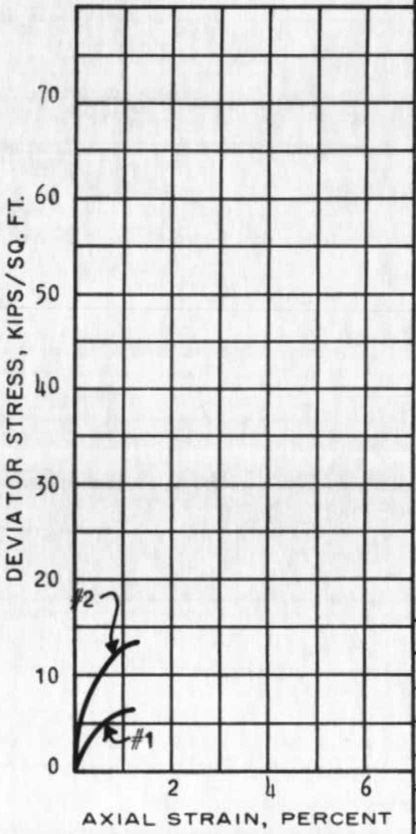
FORM NO. WC 3

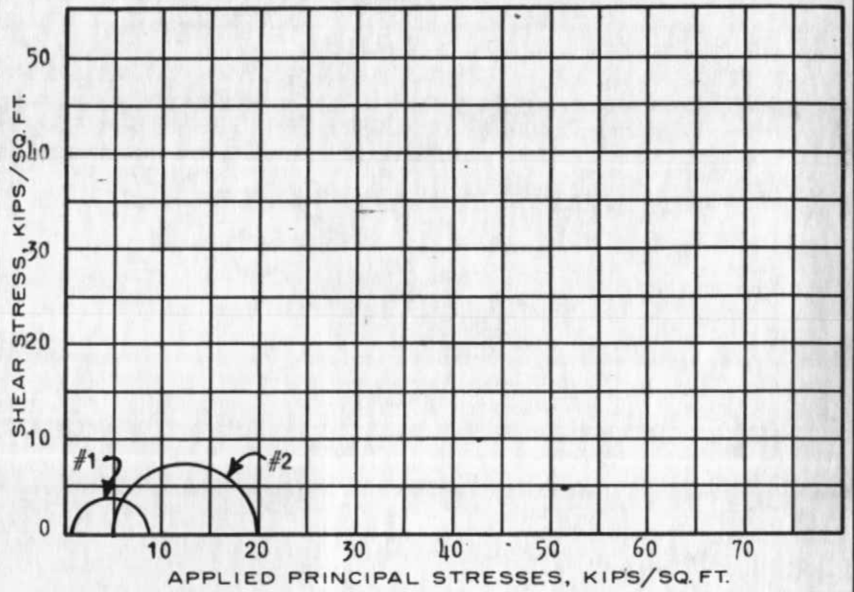
WOODWARD - CLYDE & ASSOCIATES



COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY

		Test No.	1	2		
INITIAL	Water Content, W_o %	15.2	15.2			
	Dry Density Lbs/Cu.Ft.	123	111			
	Void Ratio, e_o					
	Saturation, S_o %					
BEFORE TEST	W.C. after Saturation, W_s %					
	Saturation, S %					
	Consol Pressure K/Sq.Ft.					
	W.C. after Consol, W_c %					
	Void Ratio after Consol, e_c					
AT FAILURE	Maj. Prin. Stress, σ_I K/Sq.Ft.	8.07	19.3			
	Min. Prin. Stress, σ_{III} K/Sq.Ft.	1.44	5.76			
	Water Content, W_F %					
	Void Ratio, e_F					
Specimen Diameter	Inches	2.84	2.81			
Initial Height	Inches	5.60	5.60			
Test Time to Failure	Min.	0.2	0.4			





Remarks: #1 QU TEST - CONFINING PRESSURE 10 PSI
#2 QU TEST - CONFINING PRESSURE 40 PSI

Type of Test
Constant RATE OF STRAIN Control
UN Consolidated UN Drained

Type of Specimen PITCHER

ϕ = °	Tan ϕ =	c = K/Sq.Ft.

Classification SANDSTONE

LL NON-PLASTIC	G 2.38
PL	D_{10}

PROJECT NO. 12819-12578

PROJECT NAME JIM BRIDGER PROJECT

BORING NO. DH-JB-45 DEPTH 36.0 TO 36.5'

DATE 7/23/70

TRIAXIAL COMPRESSION TEST REPORT

FIG. E-18

APPENDIX F

TABLE I - SUMMARY OF SPECIFIC GRAVITY TESTS

TABLE I

SUMMARY OF SPECIFIC GRAVITY TESTS

HOLE NO.	DEPTH (FEET)	SPECIFIC GRAVITY
5	5.5	2.40
9	21.1	2.39
10	27.6	2.49
11	5.5	2.64
12	8.0	2.44
16	35.0	2.41
23	20.0	2.53
24	63.5	2.54
24	75.0	2.57
28	57.0	2.61
28	73.0	2.51
28	86.0	2.56
28	98.0	2.46
34	7.5	2.67
34	29.0	2.35
36	11.5	2.51
36	24.5	2.41
36	38.0	2.41
38	11.0	2.49
38	32.5	2.46
45	11.0	2.49
45	24.2	2.29
45	38.2	2.38

APPENDIX G

TABLE II - SHEAR MODULUS TEST RESULTS

TABLE II

SHEAR MODULUS TEST RESULTS

Sample Identification	ksf σ_3	ksf σ_D	ksf σ_1	cps f	ksi G	Remarks
DH-JB-38 #9 depth 22.8-25.0	4.0	0	4.0	380	94.6	Moisture content = 13.2%
Sandstone, fine, light yellow brown, moderately to well cemented	6.0	0	6.0	400	106.8	Wet Density = 121.8 pcf
	10.0	0	10.0	415	115.7	Dry Density = 107.6 pcf
DH-JB-38 #2 depth 6.3'-8.6'	4.0	0	4.0	210	12.2	Moisture content = 17.7%
middle 1/3 of specimen. Sandstone, fine, light grey	6.0	0	6.0	225	16.6	Wet Density = 121.8 pcf
brown, friable, horizontally stratified	10.0	0	10.0	245	23.4	Dry Density = 103.5 pcf
DH-JB-38 #8 depth 21.3'-22.8'	4.0	0	4.0	240	22.4	Moisture content = 15.0%
Sandstone, fine, light grey, moderately to well	6.0	0	6.0	270	33.3	Wet Density = 134.5 pcf
cemented, horizontal bedding	10.0	0	10.0	310	49.7	Dry Density = 117.0 pcf
	14.6	0	14.6	330	59.6	
DH-JB-38 #1 depth 4.0'-6.3'	4.0	0	4.0	230	17.6	Moisture content = 15.4%
Sandstone, fine, light brown to yellow brown, moder-	6.0	0	6.0	255	27.4	Wet Density = 124.6 pcf
ately cemented, horizontally stratified	10.0	0	10.0	270	32.8	Dry Density = 108.0 pcf

DYNAMIC TESTING PROGRAM

Description of Cores and Sample Preparation

A total of four Shelby tube samples were tested. The tube dimensions were approximately 2 7/8-inch inside diameter by 36 inches in length, both ends were sealed with wax. The tubes were cut into three equal lengths with a tube cutter and relabeled with the appropriate identification as top, middle, and bottom. Each of these sections were cut along the longitudinal axis with an electric saw. The specimens were then removed from the steel tube sections and trimmed down to approximately 1.4 inches in diameter by 3 inches in length to accommodate the testing apparatus. The sample preparation was performed in a humid room to minimize the loss of moisture. The geometry and weight of each specimen were measured so that density values could be determined.

Description of Testing Apparatus

The basic equipment includes the Hardin oscillator fixed-spring model consisting of four leaf springs coupled to a central mass with upper load platen attached. Also included are: an accelerometer; electromagnetic coils; 200 lbs. load cell; and a triaxial cell pressure chamber with pneumatic counterbalance and loading actuator.

Description of Electronic Equipment

The basic electronic components include a sinusoidal wave form oscillator; power amplifier, cathode follower, dual-beam oscillosceop, D. C. constant voltage power supply and amplifier, and a digital volt meter.

Description of Test Procedures

The details of the equipment and the step by step test procedure have been previously published by Hardin and Musie (STP 392 ASTM Symposium on Testing of Soils and Rock, June 1965). Basically, each of the four specimens was sealed in a rubber membrane, placed in the triaxial cell and subjected initially to various confining pressures. The range of initial minor principle stress, σ_3, was from 4.0 ksf to 14.6 ksf, with the state of stress isotropic.

Using the Hardin shaker, each specimen was then subjected to a range of torsional vibratory oscillations varying from 50 to 500 Hz at the various stress conditions until a resonant column condition was obtained. For each confining pressure, the frequency of maximum torsional response (resonance) was obtained; the resonant frequencies, f, ranged from 175 Hz to 415 Hz for the isotropic state of stress.

APPENDIX H

TABLE III - SUMMARY OF LABORATORY TEST RESULTS

FORM NO.
WC -6

JOB NO. 12819-12578

WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS			SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-2	6.0	4.4	92.5							SANDSTONE, weakly cemented, brown.
	7.0	6.7	108.8			19,100				SANDSTONE, brown
DH JB-5	3.0	9.6								SANDSTONE, moderatly cemented, brown
	5.5	7.8	106.2	Non-Plastic						SANDSTONE, weakly to moderately cemented, brown-gray.
	8.0	6.9	108.3				9020	720		SANDSTONE, weakly to moderately cemented, brown-gray.
	15.0	5.0	112.8							SANDSTONE, weakly cemented, gray.
	22.5	9.1								SANDSTONE, weakly cemented, gray.
	26.0	6.5	140.0							SANDSTONE, weakly cemented, gray.

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JOB NO. 12819-12578

WOODWARD-CLYDE & ASSOCIATES

TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-9	0.0								0.86	FILL, loose sand,
	2.5								0.97	SANDSTONE, tan.
	3.5	1.7							1.39	SANDSTONE, well cemented.
	6.0	0.4							1.67	SANDSTONE, brown.
	7.5	4.6								SANDSTONE, weakly cemented, brown-gray.
	19.0								2.0	SANDSTONE, hard, tan-gray.
	20.0	8.3	111.8				41,300	720		SANDSTONE, gray.
	21.1	7.9	110.7						<0.001	SANDSTONE, weak, brown.
	21.8	8.3	116.8	Non-Plastic			51,900	2880		SANDSTONE, gray.
	22.3	6.3	112.9			37,150				SANDSTONE, weak, gray to brown-gray.
	30.0	10.0	109.6							SANDSTONE, weak, gray.
	30.5	8.3	109.4							SANDSTONE, weak, gray.
	37.5	9.2	113.2						0.006	SANDSTONE, weak, brown-gray.

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WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-10	5.0	3.3								SAND, fine, silty, brown.
	20.5	2.5	110.4				66,950	2880		SANDSTONE, weakly cemented, light gray.
	25	3.9							<0.001	SANDSTONE, weakly cemented, gray-brown.
	27.6	2.7	106.0	Non-Plastic						SANDSTONE, moderately cemented, gray
	29.0	4.4	110.0				62,800	720		SANDSTONE, moderately cemented, gray.
	41.8	4.4	116.2						1.19	SANDSTONE, weakly to moderately cemented, brown-gray.
DH JB-11	3.0	3.2								SANDSTONE, weakly to moderately cemented, brown-gray.

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TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-11	5.5	4.5	105.8						0.019	SANDSTONE, weakly to moderately cemented, brown-gray.
	10.0								<0.001	SANDSTONE, weakly to moderately cemented, brown-gray.
	16.0	14.4	99.7			7500.				SANDSTONE, weakly cemented, gray.
	22.5								<0.001	SANDSTONE, weakly cemented, gray.
	23.0	9.8	110.0			46,150				SANDSTONE, weakly cemented, gray.
DH JB-12	3	5.2							<0.001	SANDSTONE, moderately cemented, brown.
	5.5	9.2								SANDSTONE, weakly cemented, brown-gray.
	8.0	10.3	103.3	Non-Plastic						SANDSTONE, weakly cemented, brown-gray.

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WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-12	8.5	10.3	99.6				26,550	4320		SANDSTONE, weakly to moderately cemented, brown-gray.
	9	10.3	103.6				19,000	1440		SANDSTONE, weakly to moderately cemented, brown-gray.
	15.0	4.2	121.0							SANDSTONE, moderately cemented, brown-gray.
	16.0	4.2	113.6			51,250				SANDSTONE, moderately cemented, brown-gray.
	23.0	4.5	113.2			58,200				SANDSTONE, moderately cemented, brown-gray.
DH JB-13	20.0	5.5	100.2	23.1	1.8					SILT, brown.
	38.7	38.0	75.4	81.5	50.0					CLAY SEAM in weathered claystone, gray.

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WOODWARD-CLYDE & ASSOCIATES

TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-13	40.0	23.8	107.0				7620	4320		CLAYSTONE, weathered, gray.
DH JB-15	5.0	6.5	106.1	23.0	10.3					CLAY, sandy, brown.
	35.5								9.3	CLAYSTONE, gray
	37.7	16.3	109.0	50.2	27.9					CLAYSTONE, gray
	38.0	13.9	115.7				20,800	4320		CLAYSTONE, gray
	88.2	3.6	154.8	Non-Plastic						SILTSTONE, limy, gray.
	88.5	3.7	161.8							
							104,000+	10,080		SILTSTONE, limy, gray.
DH JB-16	20.0	2.4	113.7							SANDSTONE, weakly cemented, gray.
	22.2	2.9								SANDSTONE, weak to very hard cementation.
	24.5	5.0	113.2							SANDSTONE, weakly cemented.
	26.7	1.6								SANDSTONE, weakly cemented.

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WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-16	35.0	3.6	104.1							SANDSTONE, hard, cemented.
	36.0	3.0	139.2							SANDSTONE, moderately to highly cemented, brown.
	37.0	3.0	111.0							SANDSTONE, moderately to highly cemented, brown.
	42.5	4.1	140.5							SANDSTONE, brown-gray.
DH JB-18	5.0	3.3	96.5							CLAY, sandy, porous.
	5.0	3.9	93.6	20.0	6.8					SAND, silty, clayey.
	5.0	5.8	99.5				585	1440		SAND, silty.
	10.0	4.2	103.1				21,300	5000		SAND, silty.
	15.0	7.4	109.0				12,500	2000		SAND, silty.
	39.2	21.1	101.2	58.8	36.0					CLAYSTONE, gray.
	39.5	19.3	108.4				9,050	4320		CLAYSTONE, gray.

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TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-22	68.8	13.5	118.0	42.6	20.8					CLAYSTONE, gray.
	69.0	13.8	119.2				20,800	7200		CLAYSTONE, gray.
DH JB-23	20.0	14.3	116.2							CLAYSTONE, gray.
	35.0	16.9	105.8				10,650	4320		CLAYSTONE, gray.
	49.0	14.4	114.5				15,600	5760		CLAYSTONE, gray.
	53.0	11.1	126.7				28,600	7200		CLAYSTONE, gray.
DH JB-24	42.5	18.2	123.5							CLAYSTONE, gray.
	63.5	10.4	129.8							CLAYSTONE, gray.
	64.5	16.1	127.0				41,300	7200		CLAYSTONE, silty.
	64	10.8	125.5			57,200				CLAYSTONE, silty
	75.0	10.8	128.0			17,000				CLAYSTONE, silty.
	75.5	11.5	118.8				18,000	8640		CLAYSTONE, gray, silty.
	95.0	13.3	115.5							CLAYSTONE, gray.
	109	9.5				53,000				CLAYSTONE, gray.
	109.5	10.3	132.2				57,000	12,960		CLAYSTONE, gray.

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TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-26	4.0	16.8	116.9							SANDSTONE, brown.
	7.6	7.8	127.8							SANDSTONE, weak to very hard, brown.
	10.0	12.9	118							SANDSTONE, weakly cemented, gray to brown-gray.
	15.5	5.2	111.3			41,750				SANDSTONE, moderately cemented, gray.
	24.5	4.7	112.3			51,750				SANDSTONE, moderately cemented, gray.
	32.0	6.3								SANDSTONE, brown.
DH JB-28	16.0	15.8	108.8							CLAYSTONE, gray.
	33.0	8.2	115.5							CLAYSTONE, gray-brown.
	41.0	19.8	107.5				19,280	5040		CLAYSTONE, gray-brown.
	57.0	11.7	129.4							CLAYSTONE, silty, gray.
	64.0	10.9	131.2				66,900	7200		CLAYSTONE, silty.

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TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-28	73.0	13.3	120.8							CLAYSTONE, gray.
	86.0	10.3	131.5			23,100				CLAYSTONE, gray.
	98	19.4	107.2				6420	11,520		CLAYSTONE, gray.
	98.5	16.7	109.0			3,790				CLAYSTONE, gray.
DH JB-31	5.5	2.6								SANDSTONE, brown.
	6.5	10.2	112.9			19,850				SANDSTONE, weak, brown.
	8.0	8.0								SANDSTONE, weak, gray.
	12.8	8.7								SANDSTONE, weak, gray.
	20	7.5	110.3							SANDSTONE, light brown.
DH JB-33	5.5	17.5	101.2			910				CLAYSTONE, weathered, dark brown.
	17.0	11.9	114.5							SANDSTONE, weakly cemented.
	29.5	11.1	113.9			55,200				SANDSTONE, brown.
	37.5	13.9	118			31,830				SANDSTONE, brown.

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TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-34	5.0	13.1	112			< 915				CLAYSTONE, weathered.
	5.5	15.1	113.5			< 1830				CLAYSTONE, weathered.
	7.0	14.0	120.2			1820				CLAYSTONE, weathered.
	7.5			36.2	22.7					CLAYSTONE, weathered.
	8.0	10.9	123.9				10,600	720		CLAYSTONE, gray-brown.
	8.5	10.9	128.9				12,350	2880		CLAYSTONE, gray-brown.
	20.2	11.4								SANDSTONE, well cemented, gray.
	21.0	15.1	112.9			24,950				SANDSTONE, well cemented, gray.
	23.5	11.0	115.8			47,500				SANDSTONE, well cemented, gray.
	24.5	9.9	109.0							SANDSTONE, gray.
	25.5	11.1	109.2			32,800				SANDSTONE, weak, gray.
	28.0	11.3	116.2				138,500	5760		SANDSTONE, hard, gray.
	29.0	12.3		Non-Plastic						SANDSTONE, hard, gray.

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SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-34	30.0	14.3	100.0							SANDSTONE, hard, gray.
	30.5	13.6	112.9			2740				SANDSTONE, light brown.
	36.3	18.3	108.1							SANDSTONE, gray.
DH JB-35	6.0	17.3	115.2			3630				CLAYSTONE, brown, weathered.
	6.5	9.1	104.1							CLAYSTONE, brown.
	15.0	7.4	110.9			13,750				SANDSTONE, brown.
	22.0	9.1	113.3			34,400				SANDSTONE, brown.
	32.0	9.4	110.2			36,800				SANDSTONE, brown.
	41.0	11.4	111.8			34,160				SANDSTONE, brown.
DH JB-36	8.5	15.6	108.5			2,720				SANDSTONE, weak, brown.
	9.5	10.0	112.1			<917				SANDSTONE, weak, brown.
	11.5	17.2	110.0	Non-Plastic			40,110	1440		SANDSTONE, weak, gray.
	12.5	16.3	107.6			9,160				SANDSTONE, weak, gray.

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SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-36	14.0	14.8	109.1				82,450	4320		SANDSTONE, weak, gray with rust mottling.
	17.3	12.4	109.2			2,725				SANDSTONE, weak, light brown.
	18.0	15.8	113.2							SANDSTONE, weak, light brown.
	21.0	12.6	113.1							SANDSTONE, weak, brown.
	24.5	14.0	104.8	Non-Plastic						SANDSTONE, weak, gray.
	25.0	15.6	111.0				7,340	1440		SANDSTONE, weak, gray.
	26.0	14.0	109.2				4,925	5760		SANDSTONE, brown.
	26.6	12.6	113.0							SANDSTONE, brown.
	27.5	15.6	106.4							SANDSTONE, gray.
	31.5	14.9	110.8							SANDSTONE, gray-brown.
	33.0	15.8	122.1			70,500				SANDSTONE, brown.
	34.2	11.9	123.0			83,100				SANDSTONE, brown.
	35.0	9.8	113.5			27,500				SANDSTONE, light brown.
	36.0								0.038	SANDSTONE, hard, weak.

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TABLE III
SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-36	36.3	2.4	112.9							SANDSTONE, light gray.
	36.4	12.1	134.9							SANDSTONE, gray-brown
	36.5	13.6	112.3				97,600	1440		SANDSTONE, gray-brown
	38.0	13.8	113.0	Non-Plastic						SANDSTONE, gray-brown
	39.2	9.2	129.0							SANDSTONE, brown.
	40.5	13.2	107.3							SANDSTONE, brown.
	41.7	7.5	122.0							SANDSTONE, brown.
DH JB-38	10.0	18.3	102.3						<0.001	SANDSTONE, weak, brown.
	11.0	13.9		Non-Plastic						SANDSTONE, weak, brown.
	12.0	13.9	113.8			20,650				SANDSTONE, weak, brown.
	13.0	13.9	115.2			21,500				SANDSTONE, weak, brown.
	19.1	15.4	111.3			50,500				SANDSTONE, hard, gray.
	19.5	15.0	116.7							SANDSTONE, weak to moderately cemented, gray.
	25.8	9.3	127.8							SANDSTONE, hard, light brown.

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SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-38	27.0	15.9	110.3			1,840			0.70	SANDSTONE, weak, brown.
	27.6	15.3								SANDSTONE, light brown, hard.
	28.5	11.6	111.5							SANDSTONE, Claystone blebs with selenite crystals.
	30.0	13.7	113.3							SANDSTONE, brown.
	32.3	15.9	108.9				20,850	1440		SANDSTONE, moderately cemented, gray.
	32.5	12.2		Non-Plastic						SANDSTONE, moderately cemented, gray.
	33.6	13.9	114.1				100,800	5760		SANDSTONE, moderately cemented, gray.
	35.0	15.3	113.0							SANDSTONE, gray.
	35.7	11.7	114.0			36,500				SANDSTONE, hard, brown.
	38.5	18.6	108.0							SANDSTONE, hard, brown.

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SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTICITY INDEX (%)	UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS DEVIATOR STRESS (PSF)	TRIAXIAL SHEAR TESTS CONFINING PRESSURE (PSF)	Water Soluble Sulfate %	SOIL TYPE
DH JB-43A	4.5	11.5	99.6							SANDSTONE, weakly cemented, brown.
	7	7.3	112.8			1,840				SANDSTONE, light brown.
	15	4.4	112.9			18,150				SANDSTONE, hard, brown.
	23	3.7	114.7			48,100				SANDSTONE, hard, brown.
DH JB-45	11.0	15.8	99.4						0.007	SANDSTONE, gray.
	11.5	14.5	112.2				19,400	720		SANDSTONE, gray.
	12.0	16.2	110.0				59,400	2880		SANDSTONE, gray.
	13.0	15.5	110.0							SANDSTONE, gray.
	14.3	14.3	111.1				5,890	2880		SANDSTONE, gray.
	16.1	12.7	114.2				53,400	2880		SANDSTONE, gray.
	17.1	18.6	97.2							SANDSTONE, gray.
	18.2	15.5	112.6			30,500			0.006	SANDSTONE, gray.
	19.2	16.1	109.2							SANDSTONE, gray.
	20.5	14.5	112.1			17,500				SANDSTONE, gray
	21.2	14.0	109.2							SANDSTONE, gray.
	24.0	16.3	109.6							SANDSTONE, gray.
	24.2	13.5	109.1						0.36	SANDSTONE, gray.
	25.1	13.5	112.8				37,900	720		SANDSTONE, gray.

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TABLE III
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HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTICITY INDEX (%)	UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS DEVIATOR STRESS (PSF)	TRIAXIAL SHEAR TESTS CONFINING PRESSURE (PSF)	Water Soluble Sulfate %	SOIL TYPE
DH JB-45	25.6	13.1	100.2				83,100	4320		SANDSTONE, gray.
	26.5	13.6	111.2							SANDSTONE, gray.
	29.3	15.0	110.8				128,500	4320		SANDSTONE, gray.
	31.1	16.0	108.8							SANDSTONE, gray.
	32.0	12.8	113.0			70,200			0.30	SANDSTONE, gray.
	33.4	17.5	106.2							SANDSTONE, gray.
	36.0	15.2	123.3				6,630	1440		SANDSTONE, gray.
	36.5	15.2	110.7				13,560	5760		SANDSTONE, gray.
	38.2	13.3	110.9						0.18	SANDSTONE, gray.
	41.0	16.2	113.2			33,600				SANDSTONE, gray.
	41.5	11.9	114.8			73,800				SANDSTONE, gray.
	40.3	17.7	108.3							SANDSTONE, gray.
	43.0	13.0	112.2							SANDSTONE, gray.
DH JB-55	2.0	8.1							<0.001	CLAYSTONE, brown, weathered.
DH JB-60	18.5	17.9	109.6			2,721				CLAYSTONE, brown, weathered.
	35.0	20.3	104.8			870				CLAYSTONE
	67.0	11.1	123.1							SANDSTONE, gray, brown.

FORM NO.
WC -6

JOB NO. 12819-12578

WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS		Water Soluble Sulfate %	SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
DH JB-61	17.5	18.5	108.1			1,827				CLAYSTONE, weathered.
DH JB-62	6.3	6.3								CLAYSTONE, dark brown.
	7.5	16.9	114.6			5,490				CLAYSTONE, brown, weathered.
	14.4	12.1				5,490				CLAYSTONE, brown, weathered.
	20.0	11.7	123.2			5,480				CLAYSTONE, brown, weathered.
	31.0	8.2	114.5			29,600				SANDSTONE, brown.
DH JB-63	7.5	9.7								SILT, sandy, brown.
	20.0	9.9	94.6							CLAYSTONE, brown.
	50.5	11.1	120.0			77,600				SANDSTONE, brown.

FORM NO. WC -6

JOB NO. 12819-12578

WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTICITY INDEX (%)	UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS DEVIATOR STRESS (PSF)	TRIAXIAL SHEAR TESTS CONFINING PRESSURE (PSF)	Water Soluble Sulfate %	SOIL TYPE
DH JB-64	6.5	8.4	102.9			1,838				SAND, silty, porous.
	44.0	20.6	106.6			3,190				CLAYSTONE, weathered.
NM 70-5	26.4	11.1	110.1	Non-Plastic						SANDSTONE, brown.
	49.5	13.8	116.5	Non-Plastic						SANDSTONE, brown.
NM-70-6	20.5	13.7	104.0	Non-Plastic						SANDSTONE, brown.
	31.3	15.3	117.0	Non-Plastic						SANDSTONE, brown.
NM 70-7	75.3	12.3	129.9	40.2	17.0					CLAYSTONE, gray.

WOODWARD-CLYDE & ASSOCIATES

TABLE III

SUMMARY OF LABORATORY TEST RESULTS

TEST PIT	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS: DEVIATOR STRESS (PSF)	TRIAXIAL SHEAR TESTS: CONFINING PRESSURE (PSF)		SOIL TYPE
TP-9	18' (28' E of reference stake)	17.0								CLAYSTONE, very hard, gypsum, gray to black.
	19' (14.5' W. of reference stake)	23.4	104.1							CLAYSTONE, very hard, gypsum, gray to black.
	20.5' (24' E of reference stake)	15.6	106.8							CLAYSTONE, very hard, gypsum, gray to black.
	21.5' (14' W of reference stake)	13.2	111.0							CLAYSTONE, very hard, gypsum, gray to black.
	24' (2.5' E of reference stake)	12.9	111.8							CLAYSTONE, very hard, gypsum, gray to black.

APPENDIX I

TABLE IV - SUMMARY OF FIELD DENSITY TESTS

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
1	D-1	19.5	3' W	125	0.3	125	19.8
	D-2	14.5	10' W	121	1.5	119	20.5
	D-2A	19.5	10.5' W	121	0.4	121	20.5
	D-3	15.5	15.5' W	115	0.2	115	17.0
	D-4	15.5	19' W	119	1.5	117	17.4
	D-5	11.5	36' W	118	1.9	116	15.1
	D-6	11.5	39' W	116	3.6	112	15.4
	D-7	9.5	50' W	112	2.3	110	14.5
	D-8	9.5	54' W	100	2.4	98	14.9
	D-9	17.5	19' E	119	0.4	118	17.2
	D-10	16.5	23' E	121	0.6	120	14.2
	D-11	13.5	32' E	102	1.0	101	10.3
	D-12	13.5	33' E	100	1.2	99	10.2
	S-1	21.5	0	134	2.0±	131	21.5
	S-2	11.5	0	124	1.0±	123	11.5

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
2	D-1	23	1' W	130	0.4	129	23.1
	D-1A	23	1.5' W	122	0.6	121	23.1
	D-2	23	4.5' W	123	0.6±	122	23.4
	D-3	20	7' W	122	0.8	121	20.7
	D-4	19	11' W	120	1.5	118	20.1
	D-5	17	12.5' W	121	0.5	120	18.2
	D-6	17	21' W	121	0.6	120	19.1
	D-7	11.5	34' W	115	1.3	113	14.9
	D-8	11.5	38.5' W	113	1.6	111	15.3
	D-9	5	57.5' W	87	2.6	95	10.8
	D-10	4	56.0' W	103	3.8	99	9.6
	D-11	4	15.5' W	104	2.5	101	5.6
	D-12	4	12' W	108	3.2	100	5.2
	S-2	8.5	30' E	135	3.2	131	15
	S-3	24	0	138	1.0	136	24

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
3	D-1	11.5	15' W	114	0.2	114	13
	D-1A	10.5	17.5' W	130	2.9	126	12.3
	D-2	11	19.5' W	120	1.5	118	13
	D-3	7	22' W	Rock 1/	---	---	9.2
	D-4	10.5	18.5' W	125	0.4	124	12.3
	D-4A	10.5	15' W	133	2.3	130	12.0
	D-5	11	10' W	130	1.2	128	12.0
	D-6	8.5	17' E	134	3.9	129	6.8
	D-7	8.5	18.5' E	140	5.1	133	6.7
	S-1	13	0	133	2.0	130	13
	S-2	13	0	131	0.8	130	13

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E
1/Rock Sample of Very Strongly Cemented Rock Taken

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
4	D-1	8	0	101	0.5	100	8
	D-2	8	0	104	2.0	102	8
	D-3	7	0	114	0.9	113	7
	D-4	7	0	117	0.7	116	7
	D-5	8	0	103	2.2	101	8
	D-6	7	0	115	1.6	113	7
	D-7	7	0	122	0.6	121	7
	D-8	9	0	102	1.7	100	9
	D-9	9	0	107	1.6	105	9
	D-10	10	0	105	1.6	103	10
	D-11	10	0	108	2.9	105	10
	S-2			129	1.2	127	9 - 11
	S-3			124	1±	123	9 - 11
	S-4			128	2.4	125	5 - 6

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
5	D-1	9.2	27.5' W	120	1.9	118	11.9
	D-2	9.2	26' W	118	1.6	116	11.8
	D-3	7.6	25' W	109	6.0	103	10.1
	D-4	7.6	23.5'W	117	8.6	107	9.9
	D-5	7.0	8' W	107	1.2	105	7.8
	D-6	7.0	5' W	107	3.1	104	7.5
	D-7	3.5	13.5' E	114	1.5	112	2.2
	D-8	3.5	18' E	117	2.0±	115	1.7
	S-1	10.7		122	0.6	121	11.2
	S-2	10.7		120	0.5	119	13.2

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
6	D-1	5.5	22.5' W	133	1.7	130	7.7
	D-2	5.5	20.5' W	123	2.0	120	7.5
	D-3	5.5	10' W	120	2.7	117	6.5
	D-5	4.0	4' E	125	3.1	121	3.6
	D-6	3.5	6' E	110	1.7	109	2.9
	D-7	1.0	14.5' E	114	1.1	112	Above Top of Log (-0.4
	8	1.0	16.5' E	109	3.5	105	(-0.6
	S-1	6.5	18' W	138	0.3	138	8.3
	S-2	6.5	5' W	130	0.9	129	7.0

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E

TABLE IV

SUMMARY OF FIELD DENSITY TESTS

TEST PIT	TEST NO.	DEPTH (FEET)	LOCATION ALONG DIP	WET DENSITY (PCF)	WATER CONTENT (%)	DRY DENSITY (PCF)	EQUIV. LOG* DEPTH (FEET)
7	D-1	2.7	5' E	120	0.8	119	2.2
	D-2	3.7	2.5' E	119	0.8	118	3.5
	D-3	4.2	3.5' W	117	1.1	116	4.6
	D-4	3.2	7.0' W	119	0.6	118	3.9
	D-5	3.2	11' W	124	0.6	123	4.3
	D-6	3.7	19' W	111	0.3	111	5.6
	D-7	2.2	4' E	Rock1/	---	---	1.8

D-1 - Indicates Drilled Density Test
S-1 - Indicates Sand Density Test
*Compensated for 10%± (5°) Dip Down to E
1/Rock Sample of Very Strongly Cemented Rock Taken

APPENDIX J

PETROGRAPHIC ANALYSES

COPY COPY

August 11, 1970

Woodward-Clyde and Associates
2909 West 7th Avenue
Denver, Colorado 80204

Subject: Job No. 12756. Three core samples. Determine extent of alteration of cementing agent and constituent minerals of sandstones employing petrographic methods including thin sections and X-ray diffraction studies.

The samples are identified as follows:

Sample No. 1 - Hole 38, depth 10 feet.
Sample No. 2 - Hole 38, depth 19.5 feet.
Sample No. 3 - Hole 38, depth 38.5 feet.

ANALYSES

Sample No. 1 - Brownish and loose earthy material with some lumps of higher integrity but still friable. Thin section of an individual lump is shown in Figure No. 1. Predominant constituent is subangular to subrounded quartz including some smoky quartz. Other constituents in very minor amounts are plagioclase fledspar, diopside, augite, volcanic glass particles with quartz, trace of iron oxide minerals, and kalonite. Kalonite clay constitutes less than 1% of the material. A few of the quartz particles are weakly bonded by a point-to-point contact. Cementing agent or evidence of former cementing agent is absent. About 80% of the quartz particles average about 210 microns in diameter whereas the remainder are considerably finer with an average size of 20 to 25 microns. A very small percentage of the quartz is as small as 10 microns or less. The finer fractions are distinctly angular in shape. Most of the feldspar, diopside, augite, and volcanic glass particles are equal in size to the coarsest fraction of the quartz.

Classification - Earthy quartzose material. (Weakly cemented sandstone).

Sample No. 2 - Speckled gray and black, fair physical integrity, but highly porous. Very similar to Sample No. 1 in that quartz (angular to subrounded) predominates and also contains very small amounts of plagioclase feldspar, augite, diopside, volcanic glass with quartz, and about 2% kaolinite clay. The dark specks represent smoky quartz usually associated with dark colored augite and diopside. Cementing mechanism is that of point-to-point contact of the quartz particles but enough contacts are made to give rock fair strength. Cementing agents are absent. Again, about 80% of the quartz particles are relatively coarse with some as large as 750 microns but the average size is about 300 microns. Most of the feldspar, diopside, augite, and volcanic glass particles are equal to the average size of the coarse quartz particles. Thin section is presented in Figure No. 2.

Classification - Quartzose sandstone.

Sample No. 3 - Tan color, fairly strong when dry but small splinters or chunks can be broken between the fingers if enough pressure is applied. This sample is distinctly different from Sample Nos. 1 and 2 even though predominant constituent is quartz (subangular to subrounded). There is less plagioclase feldspar, augite, and diopside than in samples described above. The 7 Angstrom "d" spacing characteristic of kaolinite is well defined and sharp in Sample Nos. 1 and 2, whereas in this sample the "d" spacing is diffuse suggesting halloysite clay; however, the amount is less than 1%. About 10% of the rock is composed of dolomite (magnesium-calcium carbonate) generally in the form of well defined rhombs. The distinguishing characteristic of this rock is the presence of a well developed chalcedonic (cryptocrystalline quartz) cementing agent. Refer to the thin section presented in Figure No. 3. In the thin section you will note "fibrous" or very fine-grained chalcedony cementing the particles. Some dolomite is believed to be present in the cementing agent. The relatively large, black, and rhomb-like crystal in the photomicrograph represents a typical dolomite crystal scattered throughout the rock. The constituent grains are well sorted (narrow size classification) in that they range from 90 to 150 microns with the average being 120 microns.

Data shows that gypsum (calcium sulfate) is present in the amount from 1 to 3% (Note: By Addendum).

Classification - Chalcedonic quartzose sandstone.

CONCLUSIONS

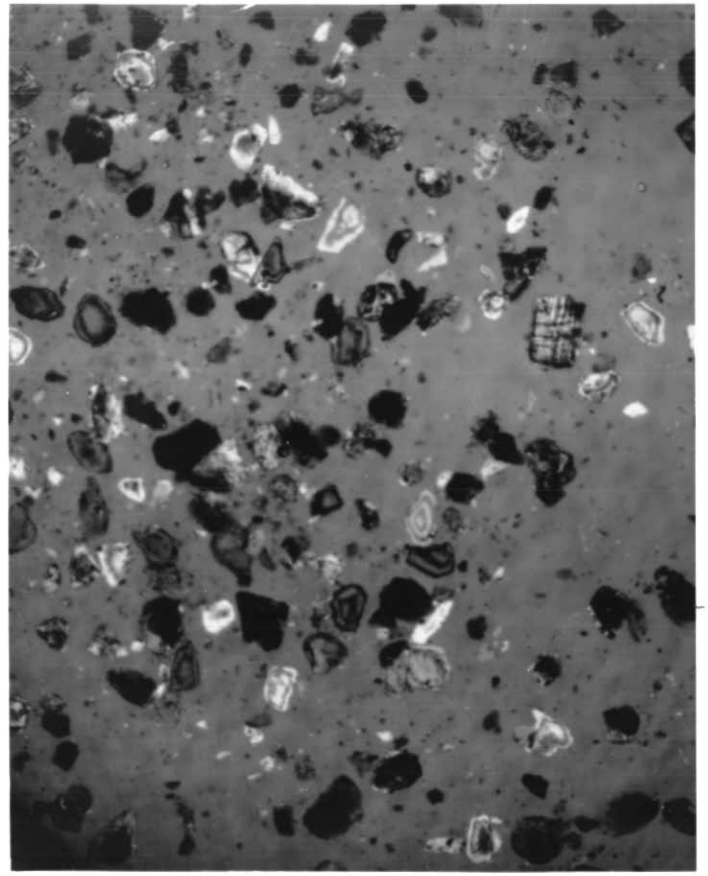
The chalcedonic cemented sandstone (Sample No. 3) is quite different from the sandstones above it in that it is finer grained, well cemented with chalcedony, and contains a carbonate. No chalcedony or carbonate could be detected in Samples Nos. 1 and 2. If these were present originally, they apparently were removed by thorough leaching. I have not seen the cores but it is also quite possible that Sample No. 3 represents one distinct stratum, and a hiatus exists between this rock stratum and those strata above it.

Very truly yours,

/S/ Vladimir E. Wolkodoff, P.E.
Consulting Petrographer

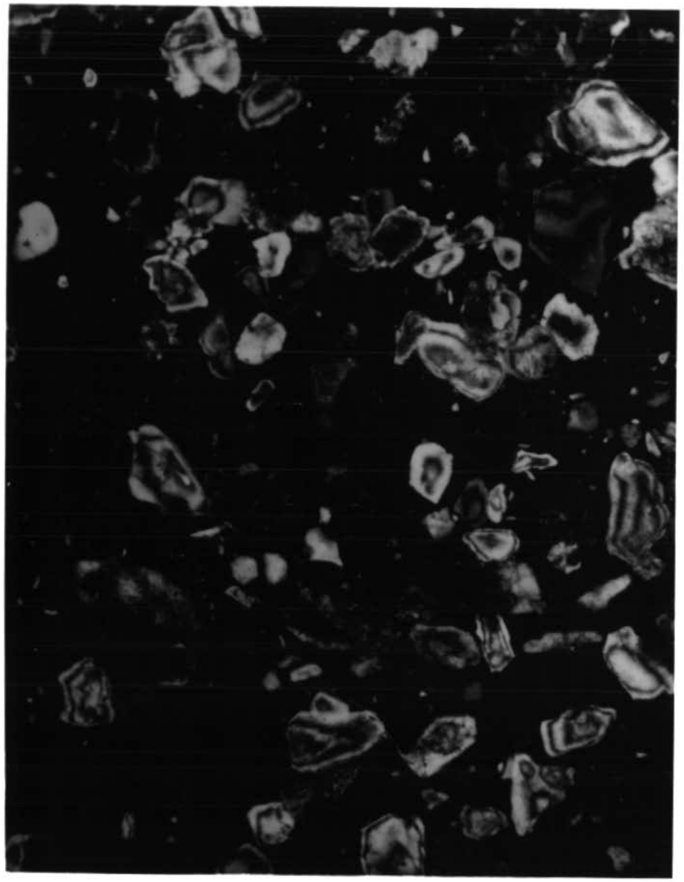
VEW/hpw

A. Fully Polarized Light

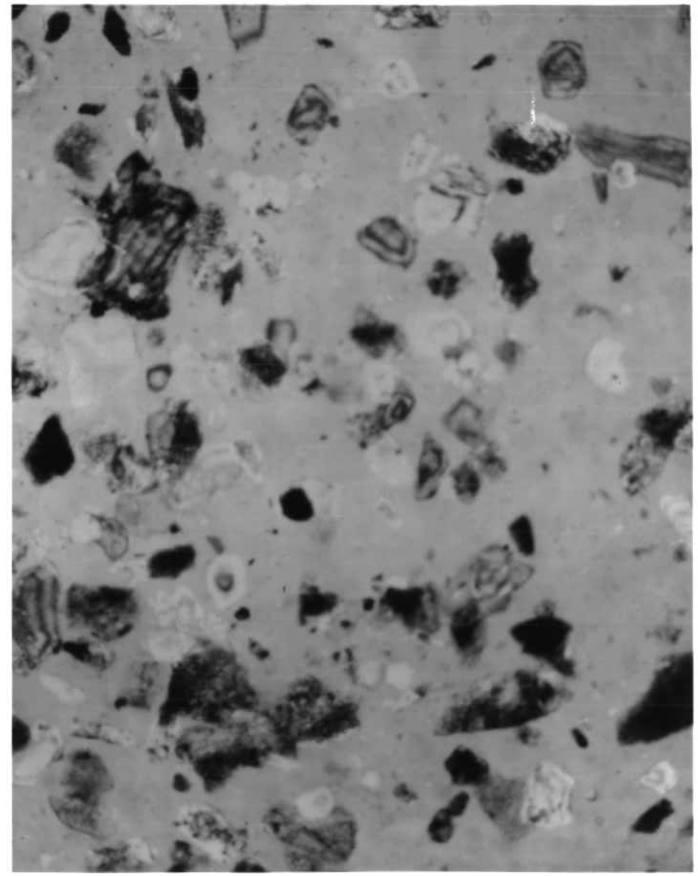


B. Partially Polarized Light

Figure No. 1 Photomicrographs of thin section. Sample 1, Hole 38, Depth 10 feet. Magnification 30X.



A. Fully Polarized Light



B. Partially Polarized Light

Figure No. 2 Photomicrographs of thin section. Sample No. 2, Hole 38, Depth 19.5 feet. Magnification 30X.

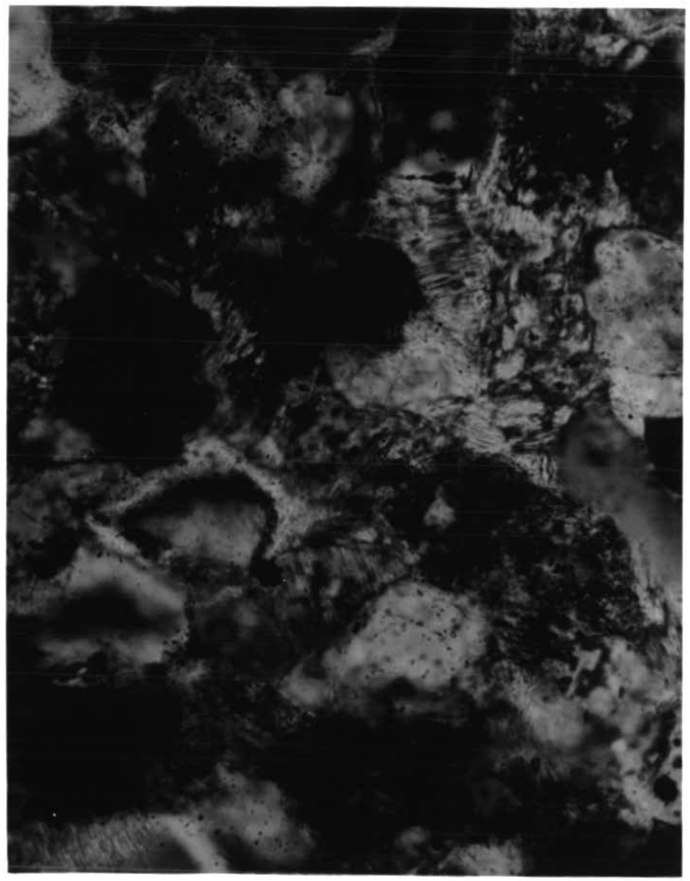


Figure No. 3 Photomicrograph of thin section. Sample No. 3, Hole 38, Depth 38.5 feet. Polarized light. Crossed Nicols. Magnification 160X. Fibrous or fine-grained material among grains is chalcedony.

C O P Y C O P Y

Woodward - Clyde Associates
2909 West 7th Avenue
Denver, Colorado 80204 Ref: Project #12578

Three samples of cored shale were analyzed by X-ray diffraction (film technique) and DTA (Differential Thermal Analysis). The samples are identified as follows:

No. 1 - NM 69-6, 33.7 - 34.3'
No. 2 - NM 70-1, 90.3 - 90.8'
No. 3 - NM 70-1, 39.2 - 39.8'

All materials are classified as Micaceous Clayey Shales and are fairly uniform in content. The predominant minerals in each, listed in order of decreasing abundance, are muscovite, sericite (weathered or hydrated mica), quartz, montmorillonite, feldspar, and kaolinite. When allowed to dry at room temperature for 60 hours, the samples slake or disintegrate upon immersion in water. Sample No. 2 disintegrates the fastest.

Kaolinite clay content of each sample is estimated to be approximately 3 percent but of more engineering significance is the presence of montmorillonite clay in the amount of 7 ± 1% in each. However, each montmorillonite differs in "d" spacing (Angstrom Units) and the cations calcia and soda can be estimated.

	Spacing	CaO%	Na_2O%
No. 1	14.14 Å	50	50
No. 2	12.73 Å	18	82
No. 3	13.71 Å	43	57

These findings are supported by DTA analysis but the essential make-up of the montmorillonite is dictated by "d" spacing values listed above.

Sample No. 2 will show the greatest potential for swelling, if dried and rewetted again, whereas Sample No. 1 will show the least.

The amount and type of montmorillonite in each sample is sufficient and significant enough to be of engineering concern.

Very truly yours,
(SEAL) /S/ Vladmir E. Wolkodoff, P.E.
Consulting Geological Engineer
and Mineralogist

INEERING & GEOLOGIC INVESTIGATIONS

FOR

JIM BRIDGER POWER PLANT

Near Rock Springs, Wyoming

VOLUME III

OWNERS

PACIFIC POWER AND LIGHT COMPANY

AND

IDAHO POWER COMPANY

ENGINEER

BECHTEL CORPORATION

BY

WOODWARD-CLYDE & ASSOCIATES
Consulting Engineers & Geologists
2909 West Seventh Avenue
Denver, Colorado 80204

SEPTEMBER 1970

WOODWARD-CLYDE & ASSOCIATES
CONSULTING ENGINEERS AND GEOLOGISTS
2909 WEST SEVENTH AVENUE
DENVER, COLORADO 80204
TELEPHONE 222-9434

SOIL ENGINEERING & GEOLOGIC INVESTIGATIONS FOR JIM BRIDGER POWER PLANT NEAR ROCK SPRINGS, WYOMING

VOLUME III

Prepared For

Bechtel Corporation
50 Beale Street
San Francisco, California

Job No. 12880-12578

September 30, 1970

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TABLE OF CONTENTS (CONT'D)

APPENDIX K

DETAILED DRILLING LOGS

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,394, E 489,591
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-1
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	$2\frac{1}{2}$'
8. DEPTH DRILLED INTO ROCK	$37\frac{1}{2}$'
9. TOTAL DEPTH OF HOLE	40'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 6 (CAL); Undisturbed 7 (PITCHER)
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	None
16. DATE HOLE	Started 7/21/70; Completed 7/21/70
17. ELEV. TOP OF HOLE	6676.3
18. TOTAL CORE RECOVERY FOR BORING (%)	---
19. SIGNATURE OF INSPECTOR	EDW BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense, silty, fine, roots, dry, tan.			0'
						3'-CAL-50/10 - No recovery ST = 2 min.
			SILT, medium dense, sandy, roots dry, light brown (ML).	0.8/2.5	1	5.5'
				2.1/2.5	2	8'
	10					10'-CAL-50/2 - No recovery
			SANDSTONE, hard to very hard, weakly cemented, fine, dry, tan to gray. Occasional coal seams.	2.3/2.5	3	11.5' ST = 2 min.
				2.3/2.5	4	14' ST = 2 min.
				2.1/2.5	5	16.5' ST = 2 min
	20					19'-CAL-50/2 (no recovery)
						24'-CAL-50/1 - No recovery
				2.4/2.5	6	ST = 2 min. 26.5'
	30					31.5'-CAL-50/2 - No recovery
				2.3/2.5	7	ST = 2 min 34'
						39'-CAL-50/9
	40		CLAYSTONE, hard, sandy, fractured, fractures filled with gypsum and clay, slightly moist, dark brown.			
	50					4 3/4" Tri-Cone rock bit with air except for Pitcher samples. Pitcher sampling with air-water mist.
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I. D. CALIFORNIA SAMPLER ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG. K-1

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
   PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station) N 389,980, E 489,723
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-2
5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 1'
8. DEPTH DRILLED INTO ROCK 44'
9. TOTAL DEPTH OF HOLE 45'
10. SIZE AND TYPE OF BIT SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 7 (CAL) Undisturbed 6 (PITCHER)
14. TOTAL NO. CORE BOXES --
15. ELEV. GROUND WATER None
16. DATE HOLE Started 7/17/70 Completed 7/17/70
17. ELEV. TOP OF HOLE 6685.4
18. TOTAL CORE RECOVERY FOR BORING (%) ---
19. SIGNATURE OF INSPECTOR EDW BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					0'
			SILT-SAND, medium dense, fine roots, dry, tan (ML-SM).			1'-CAL-50/11
						5' ST = 2 min.
			SANDSTONE, hard to very hard, (upper 1.5±' weathered, fractured, well cemented), fine, silty, weakly to moderately cemented, dry, tan to gray. Clay seams approximately 1/8" thick at 10' to 15'. Occasional thin coal seams.	1.9/2.3	1	7.3'
	10					10'-CAL-50/2 - No recovery Cuttings sample 10' to 15'
						15'-CAL-50/1 - No recovery Cuttings sample 15' to 20'
	20			1.8/2.3	2	20'-CAL-50/2 - No recovery 22.3' ST = 2 min
				2.3/2.3	3	24.5' ST = 2 min.
				2.2/2.3	4	26.8' ST = 3 min. Cuttings sample 26.8' to 30'
	30			1.9/2.3	5	30.0'-CAL-50/0 - No recovery 32.3' ST = 3 min. Cuttings sample 32.3 to 37.5'
	40			0.8/2.7	6	37.5'-CAL-50/3 - No recovery 40.2' ST = 11 min. Cuttings sample 40.2 to 45.2'
						45.2-CAL-50/0 - No recovery
	50					
	60					4 3/4" Tri-Cone rock bit with air, except for Pitcher samples. Pitcher sampling with air-water mist.
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC & A 29

FIG. K-2

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGER POWER PLANT

2. LOCATION (Coodinates or Station) (BY IDAHO POWER COMPANY)
N 388,765 - E 492,835

3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY

4. HOLE NO. DH-JB-3

5. NAME OF DRILLER
FOREMAN-MARLIN STURTZ; P.M. - GARY JOHNSON

6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL

7. THICKNESS OF OVERBURDEN 39'

8. DEPTH DRILLED INTO ROCK 56'

9. TOTAL DEPTH OF HOLE 95'

10. SIZE AND TYPE OF BIT SEE REMARKS

11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL

12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 6; Undisturbed 8 (CAL)

14. TOTAL NO. CORE BOXES 2

15. ELEV. GROUND WATER 6604

16. DATE HOLE: Started 5/21/70; Completed 5/22/70

17. ELEV. TOP OF HOLE 6621.2

18. TOTAL CORE RECOVERY FOR BORING (%) 60

19. SIGNATURE OF INSPECTOR
GUY F. TABOR, JR., AND E. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						4" Hawthorne with air
6620	0		SILT, topsoil, loose, dry (ML).			0'
			SILT, dry, hard, porous, low density at top to dense with depth, brown, sandy (ML).			5'-CAL-37/12 *
	10					10'-CAL-50/10
						15'-CAL-50/9
WL 5/25/70 & 6/8/70			GRAVEL AND SILT, layered (gravel = rock fragments, subangular limestone and sandstone), dry, dense, brown (GM-ML).			
	20					20'-CAL-50/10
			CLAY, very stiff, silty; sand, dense, clayey to clean; and coal dust; in matrix, mottled in color, clay brown to light gray, sand tan to rust, moist to very moist with depth (CL-SC). Much gypsum interspersed.			25'-CAL-42/12
	30					30'-CAL-26/12 Getting very moist
						35'-CAL-36/12
	40		CLAYSTONE, firm to very hard, thin bedded, fractured and altered, thin, 1/16" to 1/8", selenite gypsum in fractures, est. total thickness 1/2" from 39 to 67 feet, dark brown to black.	90		40'-CAL-50/10 Coring with NXWL bit 4/CT Dia. water type with "Quiktrol" & Condet.
				65		45'-AX-SS-50/8 *
	50		No gypsum noted below 50 feet, and harder.	100	BOX 1	50'-AX-SS-50/9
				90		55'
	60		4-inch limestone	100		60'-AX-SS-50/6
						65'
			Very hard - layered, dark gray to gray Claystone Siltstone-Limestone Sandstone	100		
	70			100		70'-AX-SS-50/4
			SANDSTONE, very hard, strongly to very weakly cemented, indistinct bedding, fine to medium grained, light gray. (ALMOND FORMATION)	100	BOX 2	75' Bit plugged
				0		78'
	80			60		80'-AX-SS-50/1
						83' lost circulation
				10		85'
	90			15		90'-AX-SS-50/4 (Drive taken in sand believed loosened by water pressure-believe blow count should be higher)
			TOTAL DEPTH 95 FEET			95'
	100					

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4 INCH O.D. SPLIT SPOON SAMPLER
WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-3

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) (BY IDAHO POWER COMPANY) N 389,395 - E 492,345 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-4	5. NAME OF DRILLER FOREMAN-MARLIN STURTZ; P.M. - GARY JOHNSON

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	39'	60'	99'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN		14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE	
Disturbed 7 AX-SS	Undisturbed 8 (CAL)	3	6600 *	Started 5/20/70	Completed 5/21/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6629.8	75	GUY F. TABOR, JR., AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6630	0	SILT, sandy, roots, (ML).			0'
		GRAVEL, sandy, silty (rock fragments), dense, dry, brown (GP).			* 5'-CAL-30/8
	10	SILT-SAND-CLAY, thin bedded, medium dense to dense, dry to slightly moist, cemented in part, tan-brown (ML-SM-CL).			10'-CAL-50/9 15'-CAL-31/12
	20	CLAY, silty, similar to above but indistinct bedding, scattered gravel, very stiff, slightly moist to moist with gypsum, brown (CL).			20'-CAL-32/12 24.5'-CAL-30/12
WL 5/25/70 6/19/70 7/31/70	30	3-Inch coal and sand layer.			30'-CAL-20/10 15/2
		SAND, CLAY, CLAYSTONE, coal dust and gypsum in matrix, very stiff, moist to very moist, rust-black-tan & brown (SC-CC).			35'-CAL-24/12 Gypsum
	40	CLAYSTONE, firm to very hard, fractured, thin bedded and altered in part, clay and 1/16" to 1/8" selenite gypsum filling in fractures, dark brown to black. Moderately weathered to 55 feet. Estimated total gypsum = 1"± thickness 40 to 60 feet.	40 80 90 50		40'-CAL-50/7 * 45'-AX-SS-50/11 40'-AX-SS-50/7 55'
	50				
	60	Very hard below 60 feet.	60	BOX 1	60'-AX-SS-50/3 65'
		1-inch sandstone	100		
	70	7-inch sandstone-siltstone	100 95		70'-AX-SS-50/4 75'
	80		100		80;-AX-SS-50/4
		SANDSTONE, very hard, strong to weak cementation, indistinct bedding, gray. (ALMOND FORMATION)	85 10 100		85' 90'-AX-SS-50/1 Lost core and recovered bottom 0.5' 95' 99'-AX-SS-50/1
	90				
	100	TOTAL DEPTH 99 FEET			

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER WL = WATER LEVEL
AX-SS = 1 3/4 INCH O.D. SPLIT SPOON SAMPLER

FORM NO. WC&A 29

FIG. K-4

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,009, E 490,081
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-5
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	2'
8. DEPTH DRILLED INTO ROCK	23'
9. TOTAL DEPTH OF HOLE	25'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 4 (CAL); Undisturbed 6 (PITCHER)
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	None
16. DATE HOLE	Started 7/20/70; Completed 7/20/70
17. ELEV. TOP OF HOLE	6663.9
18. TOTAL CORE RECOVERY FOR BORING (%)	--
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		FILL, loose, sand.			0'
			SILT, medium dense, sandy, roots, calcareous, slightly porous, dry, tan.			3'-CAL-50/2 - No recovery
				1.7/2.5	1	5.5' ST = 6 min
				2.3/2.5	2	8' ST = 4 min.
	10			2.3/2.5	3	10.5' ST = 1 min.
			SANDSTONE, very hard, fine, some silt, weakly to moderately cemented, dry to very slightly moist, tan to gray.			15'-CAL-50/4 ST = 1 min
				2.4/2.5	4	17.5'
	20					Cuttings sample 17.5 to 22.5'
						22.5'-CAL-50/1 - No recovery
				1.5/2.5	5	25.0' ST = 1 min
				2.3/2.5	6	27.5'-CAL-50/3 ST = 1 min

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

REMARKS: 4 3/4" Tri-Cone rock bit with air, except for Pitcher samples. Pitcher sampling with air-water mist.

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG.K -5

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station)(BY IDAHO POWER COMPANY) N 390,088 - E 491,644	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-6	5. NAME OF DRILLER FOREMAN-MARLIN STURTZ; P.M. - GARY JOHNSON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 19' — 8. DEPTH DRILLED INTO ROCK 79' — 9. TOTAL DEPTH OF HOLE 98'
10. SIZE AND TYPE OF BIT SEE REMARKS — 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 10; Undisturbed 4 (CAL) — 14. TOTAL NO. CORE BOXES 4	15. ELEV. GROUND WATER 6596 — 16. DATE HOLE Started 5/18/70 Completed 5/19/20
17. ELEV. TOP OF HOLE 6642.9 — 18. TOTAL CORE RECOVERY FOR BORING (%) 75	19. SIGNATURE OF INSPECTOR GUY F. TABOR, JR., AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT, loose, sandy, roots, dry, brown (ML).			4" Hawthorne bit with air to 20' 0'
6640		GRAVEL, silty, sandy, dense, dry (Limestone & sandstone fragments with calcareous coating), brown (GM).			5'-CAL-50/12 *
	10	SILT, CLAY & SAND, thin-bedded, medium dense, to dense, dry, brown (ML-CL).			10'-CAL-35/12 15'-CAL-32/12
	20	SAND, fine, medium dense, silty, dry, brown (SM).	75		20'-CAL-50/12 4/CT Diamond face Disc. Bit using Condet or Oakite & "Quiktrol" mud
WL 6/14/70 & 6/26/70	30 **	CLAYSTONE, firm to very hard, thin bedded, fractured and altered in part to clay, clay and thin, 1/8", selenite gypsum, filling in fractures; estimated total gypsum in fractures $1\frac{1}{2}$" from 19 to 73 feet; dark brown to clak. Moderately to highly weathered 19 to 56 feet. Slightly weathered to 73 feet. Moderately to highly fractured to 68 feet. (LEWIS SHALE).	70 80 95 70 95	box BOX 1	26'-AX-SS-31/12 * 31'-AX-SS-50/12 36'-AX-SS-50/9 41'-AX-SS-50/6 Cored to 46', lost core & redrilled to 46' 46' Hole caved, prevented drive sample
WL 5/25/70 & 6/19/70 6/8/70	40 50	CLAY SEAM 6± inches, stiff, light gray to rust.	5 70 20 100	BOX 2	51'-AX-SS-30/12 56'-AX-SS-50/4 61' 66'-AX-SS-48/12 68'
	60 70	CLAY SEAM 3± inches, stiff, light gray to rust.	100		73'-AX-SS-50/3
		Very hard below 73 feet. No gypsum noted below 73 feet.	95 100	BOX 3	78'
	80	CLAYSTONE/SANDSTONE, very hard, fine grained dry, gray to black.	100		83'-AX-SS-50/1 88'
	90	SANDSTONE, very hard, indistinct bedding, strongly to weakly cemented, gray. (ALMOND FORMATION).	100 50	BOX 4	93'-AX-SS-50/1 No recovery 98'
	100	TOTAL DEPTH 98 FEET			

** CASAGRANDE TYPE PIEZOMETER INSTALLED 7/3/70 @ 95±FOOT DEPTH

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER

AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

WL = WATER LEVEL IN HOLE

FORM NO. WC&A 29

FIG. K-6

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,248 - E 491,512
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH - JB 7
5. NAME OF DRILLER	GARY JOHNSON
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	7'
8. DEPTH DRILLED INTO ROCK	83'
9. TOTAL DEPTH OF HOLE	90'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 13; Undisturbed 0
14. TOTAL NO. CORE BOXES	4
15. ELEV. GROUND WATER	6595
16. DATE HOLE	Started 5/30/70; Completed 6/1/70
17. ELEV. TOP OF HOLE	6639.2
18. TOTAL CORE RECOVERY FOR BORING (%)	85
19. SIGNATURE OF INSPECTOR	TED JOHNSON AND ED BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT, clayey, sandy, roots, slightly moist, tan to brown.			4" Hawthorne bit with air 0' to 20'
		CLAY, stiff, slightly sandy, slightly moist, brown to gray (weathered claystone).			5'-AX-SS-20/12*
	10	CLAYSTONE, firm to hard below 18 feet to very hard below 27 feet, slightly sandy, thin-bedded, gray to dark gray, moist. Bedding dip predom. 0° to 10°. Gypsum crystals (selenite) in joints and fractures 1/8± inch thick, estimated total thickness 1" from 7 feet to 55 feet.			10'-AX-SS-32/12
					15'-AX-SS-25/6
	20		85		3" face discharge carbide bit 20' to 45'
			95	BOX 1	25'-AX-ss-50/11
	30		100		30'-AX-SS-50/7
			95		35'-AX-SS-50/7; "Quiktrol" & "Condet" 20' to 90'
WL 6/2/70	40		100		40'-AX-SS-50/4
WL 6/8/70, 6/19/70 & 7/31/70			85		45'-AX-SS-50/6
		3-inch clay layer @ 48', brown.			
	50		15	BOX 2	50'-AX-SS-50/3; 3" NX (4/w) bit 45' to 90'
		Very hard below 55 feet.	100		
	60	No gypsum noted below 55 feet. 3-inch sandstone layer @ 68 feet, gray.	80		60'-AX-SS-50/3
			100		
	70		75	BOX 3	70'-AX-SS-50/3
			100		
	80		95		80'-AX-SS-50/2
		SANDSTONE, very hard, massive, well cemented to loosely cemented, dry, gray	100		90'± of 1" dia. plastic pipe in hole.
	90			BOX 4	90'-AX-SS-50/2
	100				

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

WL= WATER LEVEL

FORM NO. WC & A 29

FIG. K-7

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 390,359 - E 491,654
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-8
5. NAME OF DRILLER GARY JOHNSON	6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 24'	8. DEPTH DRILLED INTO ROCK 76'
9. TOTAL DEPTH OF HOLE 100'	10. SIZE AND TYPE OF BIT SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING HOLEMASTER 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 15, Undisturbed 0	14. TOTAL NO. CORE BOXES 3
15. ELEV. GROUND WATER 6594±	16. DATE HOLE Started 5/26/70 Completed 5/28/70
17. ELEV. TOP OF HOLE 6634.6	18. TOTAL CORE RECOVERY FOR BORING (%) 77
19. SIGNATURE OF INSPECTOR EDWARD BRYLAWSKI AND T. D. JOHNSON	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	TOPSOIL, CLAY, sandy, roots, light brown (CL)			1'-SS-14/12 — 4" Hawthorne Bit with air to 25 feet.
6630		CLAY, very stiff, sandy to very sandy, dry to slightly moist, tan to olive brown (CL).			5'-SS-30/12
	10				10'-SS-50/12
					15'-SS-50/15
	20				20'-SS-35/12
		CLAYSTONE (LEWIS SHALE) firm to very hard, thin bedded, fractured in part, dark brown, black, gray. Moderately weathered to 35 feet. Gypsum crystals in 1/8" fractures 24 to 49 feet. Estimated total thickness = 3/4" from 24 to 56 feet. Very hard below 40 feet. Bedding predom. 0° to 10°.	25	BOX 1	25' — Water course diamond bit (4/CT) with Quiktrol & Condet to 100'
	30		80		30'-AX-SS-28/12*
WL 7/31/70			40		35'-AX-SS-50/9
WL 6/1/70	40		90		40'-AX-SS-50/6
6/8/70 & 6/19/70			70		45'-AX-SS-50/5 — Bit plugged at 45 feet
	50	No gypsum evident below 56 feet. Very hard below 49 feet.	80		50'-AX-SS-50/2
			100	BOX 2	55'
	60		55		60'-AX-SS-50/1
			100		65'
	70		65		70'-AX-SS-50/2
		3-inch very hard siltstone or limestone	100		75'
	80		55	BOX 3	80'-AX-SS-50/3
		2-inch very hard sandstone-siltstone	100		85'
	90		95		90'-AX-SS-50/2
		SANDSTONE (ALMOND FORMATION) very hard, loosely cemented 95 to 100 feet, light grey, dark grey.	95		95'
	100	TOTAL DEPTH 100.0 FEET			100'-AX-SS-50/1

FORM NO. WC&A 29

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

WL = WATER LEVEL

FIG. K-8

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,824, E 489,845	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-9	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 2' 8. DEPTH DRILLED INTO ROCK 44' 9. TOTAL DEPTH OF HOLE 46'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL 12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 7 (CAL) Undisturbed 7 (PITCHER)	14. TOTAL NO. CORE BOXES 15. ELEV. GROUND WATER None 16. DATE HOLE Started 7/17/70 Completed 7/17/70
17. ELEV. TOP OF HOLE 6683.8	18. TOTAL CORE RECOVERY FOR BORING (%) 19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
					4 3/4" Tri-cone rock bit with air, except where Pitcher sampler used. Part of Pitcher sample #2 fell out of barrel, changed to air mist.
	0	FILL, loose, sand.			0'
		SILT, medium dense, sandy, fine, sandstone chips, roots, dry, tan (ML-SM).	1.6/2.3	1	3' ST=12 min.
			0.3/2.3	2	5.3'-CAL-30/12 ST=2 min.
			2.2/2.3	3	7.5' ST=1 min.
	10	SANDSTONE, firm to medium hard, broken pieces of well cemented sandstone, weakly cemented, fractured, dry, tan.			9.8' -CAL-50/3 Cuttings sample 5.3'-7.5'.
					15'-CAL-50/3 - tip sample
	20	SANDSTONE, very hard, fine, moderately cemented, dry, tan to gray.			20'-CAL-50/1 - No recovery
			2.0/2.3	4	22.3' ST= 2 min.
			2.3/2.3	5	24.5' ST= 3 min.
					Cuttings sample 24.5'-30.0'.
	30				30.0'-CAL-50/1 - No recovery
			2.3/2.3	6	32.3' ST = 3 min.
					Cuttings sample 32.3'-38'.
					37.5-CAL-50/1 - No recovery
	40		2.4/2.3	7	39.8' ST = 3 min.
					Cuttings sample 39.8'-45.8'
					45.8'-CAL-50/1 - No recovery
	50				
	60				
	70				
	80				
	90				
	100				

CAL - 2-INCH I.D. CALIFORNIA SAMPLER ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG. K-9

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,667, E 489,968
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-10	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED, DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 3' / 8. DEPTH DRILLED INTO ROCK 41' / 9. TOTAL DEPTH OF HOLE 44'
10. SIZE AND TYPE OF BIT SEE REMARKS / 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 8 (CAL), Undisturbed 6 (PITCHER) / 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER None / 16. DATE HOLE Started 7/16/70, Completed 7/16/70
17. ELEV. TOP OF HOLE 6684.5 / 18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT-SAND, medium dense, fine, sandstone fragments, roots, dry, tan (ML-SM).			0'
				1.4/2.3	1	5'-CAL-34/12 - No recovery; 7.3' ST=3 min. Cuttings sample 5' to 10'
	10		SANDSTONE, very hard, fine, well cemented, fractured, calcareous, dry, tan.			10'-CAL-50/3 - No recovery; Cuttings sample 10' to 15'
			SANDSTONE, medium hard, fine, silty, weakly cemented, dry, tan.			15'-CAL-50/4 - No recovery; Cuttings sample 15' to 20'
	20		SANDSTONE, very hard, fine, silty, weak to moderately cemented, thin coal seams, dry, tan to gray.	2.1/2.3	2	20'-CAL-50/2 - No recovery; 22.3' ST= 3min. Cuttings sample 22.3'25'
				1.4/2.3	3	25'-CAL-50/2 - No recovery; 27.3' ST = 3 min.
				2.4/2.3	4	29.5' ST = 2 min.
	30					Cuttings sample 29.5 ' 35.0'
				2.5/2.3	5	35'-CAL-50/0 - No recovery; 37.5' ST = 3 min.
	40					Cuttings sample 37.5 - 41.8'
				1.8/2.3	6	41.8'-CAL-42/5 - No recovery; 44.1' ST = 3 min.
	50					
						4 3/4" Tri-Cone rock bit with air, except where Pitcher sampler used. Six Pitcher samples with air as indicated above.
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE

FORM NO. WC&A 29

FIG. K-10

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,850, E 490,203	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-11	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 1½' ; 8. DEPTH DRILLED INTO ROCK 23½' ; 9. TOTAL DEPTH OF HOLE 25'
10. SIZE AND TYPE OF BIT SEE REMARKS ; 11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 3 (CAL); Undisturbed 5 (PITCHER) ; 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER None ; 16. DATE HOLE Started 7/20/70 Completed 7/20/70
17. ELEV. TOP OF HOLE 6663.5 ; 18. TOTAL CORE RECOVERY FOR BORING (%) --	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense, silty, fine, roots, dry, tan (SM-ML).			0'
						3'-CAL-50/7 - Tip sample
			SANDSTONE, very hard, fine, weakly to moderately cemented, dry to moist, tan to gray.	2.0/2.5	1	ST = 2 min
						5.5'
				2.3/2.5	2	ST = 2 min.
						8'
	10			1.6/2.5	3	ST = 2 min.
						10.5'
						Cuttings sample 10.5' to 15'
						15'-CAL-50/3 - No recovery
				2.1/2.5	4	ST = 1/2 min.
						17.5'
	20					Cuttings sample 17.5' to 22.5'
						22.5'-CAL-50/1 - No recovery
				2.3/2.5	5	
						25'
	30					
	40					4 3/4" Tri-cone rock bit with air, except for Pitcher samples. Pitcher sampling with air-water mist.
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-11

CAL = 2-INCH I. D. CALIFORNIA SAMPLER ST = SAMPLE TIME (PITCHER SAMPLE)

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 389,694, E 490,325 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-12	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVERBURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2½'	22½'	25'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN — Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
4 (CAL)	5 (PITCHER)	--	None	7/21/70	7/21/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6662.3	---	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT-SAND, medium dense, roots, slightly calcareous, slightly moist, tan to light brown (ML-SM).			0'
				2.3/2.5	1	3'-CAL-50/2 - No recovery ST = 10 min.
				2.2/2.5	2	5.5' ST = 3 min.
				2.2/2.5	3	8' ST = 2 min.
	10		SANDSTONE, very hard, weakly cemented, fine, dry, tan to gray. (Highly cemented 2.5' to 3.0')			10.5'-CAL-50/5 Cuttings sample 10.5' to 15.0' 15'-CAL-50/1 - No recovery
				1.7/2.5	4	17.5' ST = 2 min. Cuttings sample 17.5' to 22.5'
	20					22.5'-CAL-50/1 - No recovery
				1.9/2.5	5	25' ST = 2 min.
	30					
	40					4 3/4" Tri-Cone rock bit with air, except for Pitcher Samples. Pitcher sampling with air-water mist.
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE

FIG. K-12

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) (BY IDAHO POWER COMPANY) N 390,494 - E 491,827	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-13	5. NAME OF DRILLER FOREMAN-MARLIN STURTZ; P.M. - GARY JOHNSON
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED; DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 30' · 8. DEPTH DRILLED INTO ROCK 75' · 9. TOTAL DEPTH OF HOLE 105'
10. SIZE AND TYPE OF BIT: SEE REMARKS · 11. DATUM FOR ELEV. SHOWN (TBM or MSL): MSL	12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 14 AX-SS; Undisturbed 5 (CAL) · 14. TOTAL NO. CORE BOXES 4	15. ELEV. GROUND WATER 6580 · 16. DATE HOLE: Started 5/11/70; Completed 5/13/70
17. ELEV. TOP OF HOLE 6627.7 · 18. TOTAL CORE RECOVERY FOR BORING (%) 85	19. SIGNATURE OF INSPECTOR: GUY F. TABOR, JR., AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT, TOPSOIL, roots, dry, loose			4" dia. Hawthorne bit with air. 0'-CAL-4/12 *
		SAND, dense, fine, silty, brown (SM).			5'-CAL-45/12
6620	10	GRAVEL (hard sandstone and limestone fragments), sandy, silty, dense, brown (GP).			10'-CAL-34/12 15'-CAL-46/12
	20	SILT, thin bedded with fine sand and clay, dense, slightly cemented (dissolves in water) dry, alluvium, brown to gray (ML).			20'-CAL-50/12 25'-CAL-50/9
	30	CLAYSTONE, highly weathered in part, fractures filled with clay, orange-brown, dry (appears transported slightly).	0		30' to 33' face disc. carbide bit w/air & below 33' with Quiktrol & Condet 33'-AX-SS-28/12
		CLAYSTONE (LEWIS SHALE) firm to very hard, thin bedded, dark blue gray to brown gray. Bedding Predom. 0° to 10° dip.	80	BOX 1	39'-AX-SS-50/12 * NOTE: top of core is reaming from drive sample
	40	1/8" gypsum crystals in fractures & joints, total estimated = 1/2" from 30 to 60'.	100		44.5'-AX-SS-50/11
WL 5/16/70 5/25/70		Highly weathered 30 to 40'. Firmer below 40'.	100		
6/8/70 & 6/19/70	50	Moderate weathering 40 to 55 feet.	100		49.5'-AX-SS-50/7
		Very hard below 55 feet.	100		54.5'-AX-SS-50/5 Lost sand
	60	No gypsum evident below 60 feet.	100	BOX 2	59.5'-AX-SS-50/3
		SANDSTONE layer 3 inches thick, badly fractured. Gray.	100		64.5'-AX-SS-50/3
	70		100		69.5'-AX-SS-50/3
			100		74.5'-AX-SS-50/4
	80		85	BOX 3	79.5'-AX-SS-50/4
		SANDSTONE, 3+ inches thick, gray.	25		84.5'-CAL-50/2 Change to Dia. bit (4/w)
	90	CLAYSTONE, very hard, dark gray.	0		89.5 Change to Dia. Bit, face dis.
			90		Attempted to recover above core 95'-AX-SS-50/1
	100	SANDSTONE (ALMOND FORMATION) very hard, massive, dry, gray.	100		
			100	BOX 4	

TOTAL DEPTH 105 FEET

FORM NO. WC & A 29 WL = WATER LEVEL

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

FIG. K-13

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGE POWER PLANT
2. LOCATION (Coodinates or Station)
N 391,370, E 493,410
3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-14
5. NAME OF DRILLER
GARY JOHNSON AND JOHN MADISON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 77'
8. DEPTH DRILLED INTO ROCK 9'
9. TOTAL DEPTH OF HOLE 86'
10. SIZE AND TYPE OF BIT
4 1/4" Hawthorne
11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL
FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 1(AXSS) Undisturbed 13 (CAL)
14. TOTAL NO. CORE BOXES 0
15. ELEV. GROUND WATER 6586
16. DATE HOLE: Started 6/10/70 Completed 6/14/70
17. ELEV. TOP OF HOLE
6624.6
18. TOTAL CORE RECOVERY FOR BORING (%) None
19. SIGNATURE OF INSPECTOR
GUY F. TABOR AND ED. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6625	0		SILT, very stiff, dry, porous, low density near surface, thin to thick bedded, calcareous, little gypsum, little fine sand, non-plastic, sandier 7' to 12', roots in all samples, tan. (ML).			Air as drill fluid 0' to 65'
	5					5'-CAL-27/12
	10					10'-CAL-19/12
	15					15'-CAL-20/12
	20					20'-CAL-18/12
	25		SAND, medium dense, layered with stiff silt and clay, trace of coal dust, dry, sand, fine to medium grained with depth, sand, dry, silt, moist, silt tan, sand tan to orange tan. (SM-ML-CL).			25'-CAL-15/12
	30					30;-CAL-20/12
	35					35'-CAL-19/12
WL 6/19/70	40		More coal dust at 45'. Moist to very moist at 45' to 46', wet at 47'.			40'-CAL-17/12
	45					45'-CAL-18/12
	50					50'-CAL-19/12 Lost sample
	55					55'-CAL-18/12 Hole squeezing in below 55'
	60					60'-CAL-22/12 Quiktrol and LOloss mud used below 65' Washed hole at 65' and washed to depth 70'
	70		CLAY, very stiff, moderately plastic, wet, brown (CL).			70'-AXSS-23/12
	75		SAND, dense, very silty, clayey, trace of coal dust, wet, brown (SM-SC).			75'-CAL-42/12
	80		CLAYSTONE, very hard, black, moist (Lewis Shale). No gypsum evident.			81'-CAL-50/4
	85					86'-CAL-50/2
	90					
	100					

WL = Water Level CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

FORM NO. WC&A 29

FIG. K-14

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station) (BY IDAHO POWER COMPANY)	N 390,680 - E 491,300
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-15
5. NAME OF DRILLER	FOREMAN-MARLIN STURTZ; P.M. - GARY JOHNSON
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	13'
8. DEPTH DRILLED INTO ROCK	87'
9. TOTAL DEPTH OF HOLE	100'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 12; Undisturbed 4 (CAL)
14. TOTAL NO. CORE BOXES	4
15. ELEV. GROUND WATER	6598
16. DATE HOLE	Started 5/13/70; Completed 5/15/70
17. ELEV. TOP OF HOLE	6646.3
18. TOTAL CORE RECOVERY FOR BORING (%)	85
19. SIGNATURE OF INSPECTOR	GUY F. TABOR, JR. AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	CLAY, sitff, silty, sandy, dry, calcareous, brown (CL).			0'-CAL-13/12* 4" Hawthorne bit with air.
6640	5	CLAYSTONE CHIPS, highly weathered, some fine sand, calcareous, dry, brown (CL).			5'-CAL-50/9
	10	SAND (SANDSTONE-UNCEMENTED), dense, clayey, dry, brown (SC).			10'-CAL-50/10
	15		0		15'-CAL-50/12
	20	CLAYSTONE (LEWIS SHALE) firm to very hard, thin bedded, fractured in part, dark brown, gray to blue gray. Bedding - Predom. 0° to 10°. Gypsum crystals in joints and fractures 1/8" to 1/16" thick, est. total = 1" from 13' to 55 feet. Moderately weathered to 55 feet.	60	BOX 1	20'-AX-SS-50/9* Face disc. dia bit (4/CT) with Quiktrol & Condet
			65		25.8'-AX-SS-50/7 Core sticking in barrel
	30		95		30.5'-AX-SS-50/8
			100		35.7'-AX-SS-50/10
	40		85		40.9-AX-SS-50/7
WL 5/16/70 & 7/31/70			65	BOX 2	44.8'-AX-SS-50/7
	50		100		49.3'-AX-SS-50/8 Change to water (4/CT) Dia. bit.
		No gypsum evident below 55 feet. Occasional weathering below 55 feet. Very hard below 55'±.	100		54.8'
	60		100		60.0'-AX-SS-50/3
			100	BOX 3	65.5'-AX-SS-50/3 Lost Sample
	70	3 inches of very hard fractured sandstone.	100		70.5'
			100		76.0'-AX-SS-50/3
	80		100		81.5'
		Harder.	100	BOX 4	86.5'-AX-SS-50/2
	90		100		91.5'
		CLAYSTONE-SANDSTONE, very hard, dark gray.	100		96.5'-AX-SS-50/0
		SANDSTONE, very hard, dry, gray.			
	100	TOTAL DEPTH 100.0 Feet			100.0'

*CAL = 2-INCH I. D. CALIFORNIA SAMPLER WL = WATER LEVEL

AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

FORM NO. WC&A 29

FIG. K-15

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGER POWER PLANT

2. LOCATION (Coodinates or Station)
N 389,489, E 490,091

3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY

4. HOLE NO.
DH-JB-16

5. NAME OF DRILLER
DON IRVINE

6. DIRECTION OF HOLE
[x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL

7. THICKNESS OF OVER-BURDEN 1'

8. DEPTH DRILLED INTO ROCK 44'

9. TOTAL DEPTH OF HOLE 45'

10. SIZE AND TYPE OF BIT
SEE REMARKS

11. DATUM FOR ELEV. SHOWN (TBM or MSL)
MSL

12. MANUFACTURER'S DESIGNATION OF DRILL
FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN
Disturbed 8 (CAL) — Undisturbed 6 (PITCHER)

14. TOTAL NO. CORE BOXES --

15. ELEV. GROUND WATER None

16. DATE HOLE
Started 7/8/70 — Completed 7/15/70

17. ELEV. TOP OF HOLE
6685.4

18. TOTAL CORE RECOVERY FOR BORING (%)

19. SIGNATURE OF INSPECTOR
EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOV-ERY (FEET)	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						5 5/8" Tri-cone roller bit with air: 0' - 20', 29' - 35', 37.3' - 42.5'. Pitcher Sampler: 20' - 29', 35' - 37.3', 42.5' - 44.8'
	0		FILL, sand, loose.			0'
			SANDSTONE, very hard, fractured, silt in fractures, highly cemented, dry, tan-yellow.			3'-CAL-50/1; 8'-CAL-40/12
	10		SANDSTONE, medium hard, fine, weakly cemented, dry, tan to yellow-brown.			11'-CAL-50/8; 15'-CAL-25/4* and 25/0
	20		SANDSTONE, hard to very hard, interbedded layers, fine, weakly to strongly cemented, with thin clay seams and coal seams, dry, tan and gray.		**	20.0'-CAL-50/2
					1	22.3' ST = 10 min.
					2	24.5' ST = 10 min - dropped sample
					3	26.8' ST = 12 min.
	30				4	29.0' ST = 38 min. (reduced weight on sample)
						30'-CAL-50/2 - No recovery (Cuttings sample 30'-35')
					5	35.0' ST = 15 min.
	40					37.3'-CAL-50/1 - No recovery
						42.5'-CAL-50/2 - No recovery
					6	44.8' ST = 3 min. (Hydraulic jacking pressure in addition to weight of Kelly-bar).
	50					
	60					*Believe 25/0 blow count due to a piece of 2" diameter rock lodging in barrel preventing further entrance of material.
	70					**NOTE: Hole discontinued at this point on 7/8/70 to await arrival of Pitcher Sampler. Resumed 7/15/70.
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER — ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG. K-16

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,183, E 490,497
	3. DRILLING AGENCY BOULES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-17	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	4'	46'	50'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
11 (CAL)	--	--	None	7/7/70	7/7/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6676.1	---	ED. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						4 3/4" Tri-cone with air
	0		SAND, silty, fine, loose to medium dense (dune sand), roots, dry, tan (SM).			0' 1'-CAL-13/12 5'-CAL-50/1
	10		SANDSTONE, strongly cemented top 0.5', moderately to weakly cemented below; gray to tan.			10'-CAL-50/11 15'-CAL-50/3
	20		Harder layer @ 18' - 4" Coal Lense @ 19' - 1"			20'-CAL-50/1
			Coal lenses @ 22 to 23' - 1" Harder layers @ 23 to 25'			25'-CAL-50/0
	30		Coal lense @ 33' - 1"			30'-CAL-50/0 35'-CAL-50/1
	40		Few thin claystone lenses 42' to 49.5', less than 1", dry, tan. Very hard @ 49.5 to 50 Feet			40'-CAL-50/1 45'-CAL-50/0
	50					50'-CAL-50/1
	60					
	70					
	80					
	90					
	100					

FIG. K-17

FORM NO. WC & A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) (BY IDAHO POWER COMPANY) N 389,814 - E 491,850	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-18	5. NAME OF DRILLER FOREMAN-MARLIN STURTZ; P.M.-GARY JOHNSON
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 31' / 8. DEPTH DRILLED INTO ROCK 72' / 9. TOTAL DEPTH OF HOLE 103'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL / 12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 8-AX-SS; Undisturbed 7-CAL	14. TOTAL NO. CORE BOXES 3 / 15. ELEV. GROUND WATER 6606 / 16. DATE HOLE Started 5/7/70 Completed 5/11/70
17. ELEV. TOP OF HOLE 6624.4	18. TOTAL CORE RECOVERY FOR BORING (%) 75 / 19. SIGNATURE OF INSPECTOR GUY F. TABOR, JR. AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6620	0	SILT, loose, few roots, some fine sand, slightly moist, brown (ML).			0'*-CAL-6/12 6 Blows/12" with 140# Hammer x 30" Fall.
	10	SILT-CLAY, very stiff, sandy, thin-bedded, tan (SM). Sandier below 5 feet.			5'-CAL-28/12 0' to 31' 4" Hawthorne Bit with air 10'-CAL-25/12 15'-CAL-19/12 Some air loss 18' to 25'
5/16 & 5/25/70 6/8/70 & 6/19/70	20	SAND, clean to silty, with clayey silt layers, very stiff, red-brown to brown.			20'-CAL-21/12
		SANDSTONE CHIPS in clayey matrix, very stiff, brown.			25'-CAL-32/12
	30	CLAY, very stiff, sandy with chips of claystone, some gypsum crystals, dark gray-brown.	0		30'-CAL-18/12 31' to 32' try coring with air no success
	40 50 60	CLAYSTONE (LEWIS SHALE), firm to very hard, thin-bedded, dark blue to brown-gray. Bedding predom. 0° to 10° dip. Thin, 1/8", gypsum crystals in joints and fractures, est. total = 3/4" from 31 to 63 feet. Moderately weathered 31 to 63 feet. (Highly weathered 38 to 41 feet and 55 to 63(?) feet).	80 90 80 30 60 15	BOX 1	35'-CAL-50/8 below 32' NX Dia. Bit (/w) with "Quiktrol" mud & "Condet" 38.5'-CAL-50/12 46.5'-CAL-50/5 Try Flat Face-Discharge carbide bit below 46.5' 55'*-AX-SS-50/5 Lost core three times
	70	Harder and no gypsum noted below 63 feet.	90 100		63'-AX-SS-50/4 NX Dia. Bit below 63' 68'-AX-SS-50/1
	80 90 100	SANDSTONE (ALMOND FORMATION) very hard. Strongly cemented to uncemented, indistinct bedding (massive or thick bedded), light gray. Very hard layers 75 feet and 102 feet. Fractures - horizontal with few near vertical.	100 100 100 100 100 100	BOX 2 BOX 3	73'-AX-SS-50/1 78'-AX-SS-50/1 83'-AX-SS-50/1 93'-AX-SS-50/1 105' of 1" Dia. Plastic pipe installed 5/12/70
		TOTAL DEPTH 103 FEET			103'-AX-SS-50/1

FORM NO. WC&A 29

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

WL = WATER LEVEL

FIG. K-18

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station) N 389,070, E 492,330	(BY IDAHO POWER COMPANY)
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-19	5. NAME OF DRILLER JOHN MADISON AND GARY JOHNSON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED, DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 28'
8. DEPTH DRILLED INTO ROCK 57'	9. TOTAL DEPTH OF HOLE 85'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 9 (AXSS)	Undisturbed 5 (CAL)
14. TOTAL NO. CORE BOXES 3	15. ELEV. GROUND WATER 6604
16. DATE HOLE Started 6/8/70	Completed 6/9/70
17. ELEV. TOP OF HOLE 6642.6	18. TOTAL CORE RECOVERY FOR BORING (%) 85
19. SIGNATURE OF INSPECTOR	GUY F. TABOR AND ED. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT AND SAND, Topsoil, roots, dry, hard, porous, slightly gravelly, light brown. (ML-SM).			0 - CAL - 13/12 4" Hawthorne with air
					5' - CAL - 50/10
	10	SAND, silty, hard, dry, medium dense, occasional cobbles of sedimentary rock, porous in part, light brown. (SM).			10' - CAL - 33/12 Broke rope
		SILT, Hard, dry, lower density than above, some fine sand and clay layers, thin bedded, tan. (ML).			15' - AXSS - 50/12
	20				20' AXSS - 44/12
		CLAY, SAND & SILT in layers and mixtures - dense, transition zone, contains some gypsum and claystone chips, mottled gray-brown, tan and rust, slightly moist. (CL-SM).			25' CAL - 48/12
	30		25	Box 1	30' - CAL - 50/6 NX Wireline core with mud, low loss mud; Coring time = 47 min (dropped 3±' of core).
WL 7/31/70 & 6/19/70					35' AXSS - 50/4 CT = 30 min.
	40	CLAYSTONE, firm to hard, fractured and altered, thin bedded, clay seams to 4" thick, gypsum filling 1/16" to 1/8" thick, estimated total thickness 28' to 65' = 1" dark brown to black, bedrock (Lewis shale).	80		40'-AXSS-50/9 CT = 33 min.
			80		45'-AXSS-30/3 CT = 31 min.
	50	4" clay seam - light gray to rust (Est. 30/12 hardness).	100		50'-AXSS-50/6 CT = 25 min.
		2" clay seam, rust.	100		55' CT = 28 min.
	60	1" clay seam - rust. Very hard below 60'	100	Box 2	60'-AXSS-50/3 CT = 25 min.
		2" limestone layer at 62±'.	100		65' CT = 30 min.
	70	No gypsum evident below depth 65'.	100		70'-AXSS-50/3 CT = 20 min.
			100		75' CT = 20 min.
	80	SANDSTONE, very hard, massive, weak to strong cementation, light gray (Almond Formation)	100	Box 3	80'-AXSS-50/2 CT = 13 min.
			70		85'
		TOTAL DEPTH 85.0 FEET			
	90				
	100				

CAL= 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME
WL = WATER LEVEL

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGER POWER PLANT

2. LOCATION (Coodinates or Station)
N 389,190, E 490,902

3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY

4. HOLE NO. DH-JB-20

5. NAME OF DRILLER
DON IRVINE

6. DIRECTION OF HOLE
[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL

7. THICKNESS OF OVER-BURDEN 2'

8. DEPTH DRILLED INTO ROCK 33'

9. TOTAL DEPTH OF HOLE 35'

10. SIZE AND TYPE OF BIT
4 3/4" TRI-CONE ROLLER

11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL

12. MANUFACTURER'S DESIGNATION OF DRILL
FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN
Disturbed 8 (CAL) Undisturbed 0

14. TOTAL NO CORE BOXES --

15. ELEV. GROUND WATER None

16. DATE HOLE Started 7/7/70 Completed 7/7/70

17. ELEV. TOP OF HOLE
6653.8

18. TOTAL CORE RECOVERY FOR BORING (%) ---

19. SIGNATURE OF INSPECTOR
ED BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT-SAND, medium dense, calcareous, roots, dry, light brown (ML-SM).			0' 1'-CAL-25/12 4 3/4" Tri-cone with air
						5'-CAL-50/3
	10		SANDSTONE, very hard and strongly cemented top 2.5 feet, very hard and weakly cemented below, dry (slightly moist at 22 feet), tan to gray.			10'-CAL-50/2
						15'-CAL-50/1
	20					20'-CAL-50/1
						25'-CAL-50/0
	30					30'-CAL-50/0
						35'-CAL-50/0
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

FIG. K-20

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 390,110, E 493,310 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-21	5. NAME OF DRILLER JOHN MADISON AND GARY JOHNSON
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 55' / 8. DEPTH DRILLED INTO ROCK 20.5' / 9. TOTAL DEPTH OF HOLE 75.5'
10. SIZE AND TYPE OF BIT SEE REMARKS / 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 0 / Undisturbed 9 (CAL) / 14. TOTAL NO. CORE BOXES 0	15. ELEV. GROUND WATER 6570 / 16. DATE HOLE Started 6/5/70 Completed 6/6/70
17. ELEV. TOP OF HOLE 6620.8 / 18. TOTAL CORE RECOVERY FOR BORING (%) No core taken	19. SIGNATURE OF INSPECTOR TED JOHNSON AND EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6620	0		SILT, topsoil, sandy, clayey, roots, dry, light brown.			4" Hawthorne bit with air
			CLAY, very stiff, silty, dry, light brown (CL) (Some roots and root holes).			8'-CAL-22/12
	10		SILT, medium dense, clayey, fine grained sand, dry, light, slightly porous, brown (ML).			13'-CAL-21/12 18'-CAL-23/12
	20					
	30		CLAY, very stiff, sandy, silty, slightly moist, thin bedded (alluvium) brown (CL).			30'-CAL-18/12 36'-CAL-32/12
	40					41' Hole Caved to 37'
WL 6/19/70 & 6/8/70 & 7/3/70 6/6/70	50		CLAY, very stiff, slightly sandy, moist, brown-gray to gray with brown mottling (CL) (weathered claystone).			47'-CAL-35/12
	60		CLAYSTONE, HARD, thin bedded, gypsum in fractures, brown-gray to gray. (Gypsum is Selenite in 1/8±" fractures). Est. 1/2" gypsum total between 55' and 70'. Very hard below 70'.			57'-CAL-50/8 65'-CAL-50/8
	70					75'-CAL-50/4
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

CT = CORING TIME
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES
DRILLING LOG

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 391,104 - E 490,895±
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-22	5. NAME OF DRILLER MARLIN STURTZ AND GARY JOHNSON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 10' — 8. DEPTH DRILLED INTO ROCK 90' — 9. TOTAL DEPTH OF HOLE 95'
10. SIZE AND TYPE OF BIT: SEE REMARKS — 11. DATUM FOR ELEV. SHOWN (TBM or MSL): MSL	12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 13, Undisturbed 1 (CAL) — 14. TOTAL NO. CORE BOXES 4	15. ELEV. GROUND-WATER 6612± — 16. DATE HOLE Started 5/22/70, Completed 5/25/70
17. ELEV. TOP OF HOLE 6651.5± — 18. TOTAL CORE RECOVERY FOR BORING (%) 60	19. SIGNATURE OF INSPECTOR: GUY F. TABOR, JR. AND E. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6650	0	SILT, topsoil, roots (ML).			0' — 4" Hawthorne Bit with Air to 5 Ft.
		GRAVEL, medium dense, silty, sandy, dry, tan.			5'-CAL-50/12* — (NXWL) bit with Quiktrol mud & Condet
		CLAYSTONE CHIPS, clay, sandstone chips in matrix, brown transition zone.	5	BOX 1	
	10	CLAYSTONE, firm to very hard, thin bedded, moderately to highly weathered 10 feet to 50 feet, slightly weathered below; clay seams, gypsum filling in fractures 1/16" to 1/8" thick. Est. = 1" total thickness of gypsum between 10 feet and 50 feet, dark brown to black. 1-inch thick clay layers, tan very plastic.	40		10' — Hole caved, couldn't drive, cased hole to 13.5 feet
					16'-AX-SS-40/9*
			50		
	20		20		20'-AX-SS-48/12
			70		25'-AX-SS-31/12 — Some softer layers in drive sample
	30		0		30'-AX-SS-50/12
			95		35'-AX-SS-50/9 — change to face disc. bit
WL 5/27/70	40		100		40'-AX-SS-50/6
			100	BOX 2	45'-AX-SS-46/12
	50	Very hard and no gypsum evident below 50 feet.	100		50'-AX-SS-50/2
			90		55'-AX-SS-50/6
	60		100		60'
			100	BOX 3	65'-AX-SS-50/1
	70		100		70'
			70		75'-AX-SS-50/4 — Change to water course bit
	80		100		80'
		CLAYSTONE-SILTSTONE-LIMESTONE very hard, gray.	95	BOX 4	85'-AX-SS-50/5 — NOTE: Piece of the sampler drive shoe broke off in hole @ 95' depth. The hole was redrilled 30'± west.
	90		95		90'
		SANDSTONE, very hard, gray	100		95'-AX-SS-50/1 — See Log of DH-JB-22A
	100	TOTAL DEPTH 95 FEET: SEE DH-JB-22A			

*CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
WL = WATER LEVEL

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 391,104, E 490,925	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-22A	5. NAME OF DRILLER MARLIN STURTZ AND GARY JOHNSON

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	10'	90'	100'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12 MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16 DATE HOLE Started	Completed
				5/25/70	5/26/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6651.5±		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BLOW COUNT	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0–95					4-INCH Rock Bit with air to 95 Feet, then NX Wire-line with Quiktrol mud from 95 feet to 100 feet. NOTE: Piece of the sampler drive shoe broke off in Hole DH-JB-22 at 95-foot depth. This hole was drilled 30± feet West and was found to be the same. See DH-JB-22 for Log 0 feet to 95 feet.
	95–100		SANDSTONE, very hard, gray.			
	100		TOTAL DEPTH 100 FEET			

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

FIG. K-23

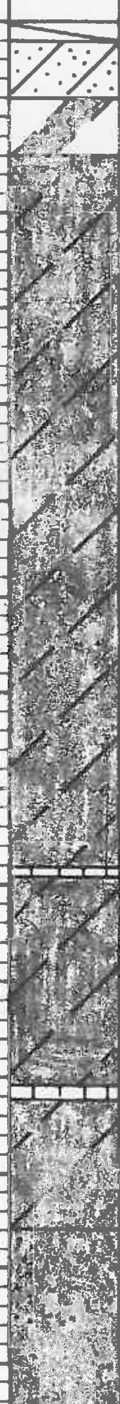
WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12636-12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) (BY IDAHO POWER CO.) N 390,371 - E 490,957 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-23	5. NAME OF DRILLER GARY JOHNSON AND JOHN MADISON

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	7'	66'	73'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING HOLEMASTER 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
10 AX-SS	2 CAL	3	6611±	6/2/70	6/2/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6649.8	77	TED JOHNSON AND ED BRYLAWSKI



ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6650±	0	TOPSOIL, sand, silty, roots, dry brown (SM).			Hawthorne bit 0 to 10' with air
		SAND, medium dense, silty, slightly gravelly, slightly moist, brown (SM).			5' *CAL-50/11
	10				10' CAL-50/9
		CLAY, hard, sandy, slightly gravelly, moist, brown to gray (CL) Weathered claystone.	30	BOX 1	15'*AX-SS-50/12 4/carat water course diam. bit 10 to 73 feet with Condet and Quiktrol
	20	CLAYSTONE, hard highly altered and fractured, clay filling in fractures, gypsum in fractures and joints - 1/8" to 1/16" thick, estimated total = 3/4 inches 7 to 45 feet; 3' brown clay layer at 24 feet; very hard below 45 feet. Dark brown to black.	50		20' AX-SS-50/12
			70		25' AX-SS-50/6
	30		40		30' AX-SS-20/3
			100		35' AX-SS-50/4
WL 6/19/70	40		70		40' AX-SS-50/8
		3' limestone(?) layer at 44.5' no gypsum below 45' evident. Very hard below 45'.	100	BOX 2	46' AX-SS-50/2
	50		95		51' AX-SS-50/3
		10" limestone? Layer at 56', gray.	100		56' --
	60	Claystone harder at 60'. Transition zone 60 to 63', sandy.	100		51' AX-SS-50/3
		SANDSTONE, very hard, very weak cementation 65 to 73 feet, massive, fine to medium grained, light to dark gray.	100	BOX 3	66' -- Dropped $1\frac{1}{2}$' of core, no successful recovery
	70		70		71' --
			0		73' AX-SS-50/10 (Believe this blow count is not representative of hardness of sandstone. Weakly cemented sand loosened by water pressure. Blow count should be higher.
	80				
	90				Ground Water 33' at 7:00 a.m. 6/3/70
	100				

FORM NO. WC&A 29

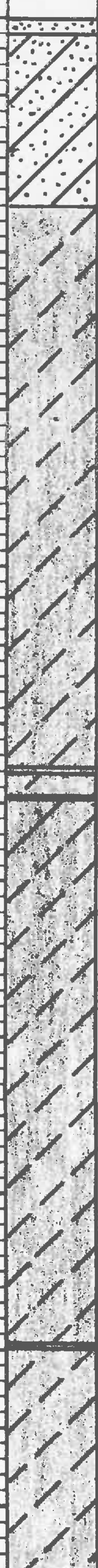
*CAL = 2-INCH I.D. CALIFORNIA SAMPLER   WL = WATER LEVEL
AX-SS = 1 3/4 INCH O.D. SPLIT SPOON SAMPLER

FIG. K-24

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
   PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)
   N 391,005 E 491,633
3. DRILLING AGENCY
   BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-24 SHEET 1 OF 2
5. NAME OF DRILLER
   JOHN MADISON AND GARY JOHNSON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 12'
8. DEPTH DRILLED INTO ROCK 105'
9. TOTAL DEPTH OF HOLE 117'
10. SIZE AND TYPE OF BIT
    SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MLS
12. MANUFACTURER'S DESIGNATION OF DRILL
    FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 10 (AXSS) Undisturbed 5 (CAL)
14. TOTAL NO. CORE BOXES 4
15. ELEV. GROUND WATER 6550
16. DATE HOLE: Started 6/3/70 Completed 6/5/70
17. ELEV. TOP OF HOLE
    6638.7
18. TOTAL CORE RECOVERY FOR BORING (%) 75
19. SIGNATURE OF INSPECTOR
    EDW. BRYLAWSKI AND TED JOHNSON



ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SAND, silty, topsoil, roots, dry loose, brown (SM).			4" Hawthorne bit with air 0' to 30' 0'
		SAND, dense, slightly gravelly, silty, dry to slightly moist, brown (SM).			5'-CAL-50/12
	10				10'-AXSS-38/12
		CLAYSTONE, firm to hard, thin bedded, fractured and altered. Gypsum (Selenite) in fractures 1/8±" thick; Est. total = 2" from 12' to 61', some clay filling in fractures. Dark brown to black.			15'-CAL-30/10
	20				20'-CAL-50/6
					25'-CAL-50/7
	30		80	Box 1	30'-CAL-50/12 NX Wireline Dia. W.C. bit with mud & Quiktrol & Condet 30' to 117'
			75		35'-AXSS-50/7
	40		40		40'-AXSS-50/5 41' 40' to 41' washed out by circulation of mud
			100		46'-AXSS-50/6
	50	3" brown clay layer 2" brown clay layer	45		51'-AXSS-50/4 Lost circulation at 51'
					56' Bit plugged at 56' 57'
	60	No gypsum evident below 61'	85	Box 2	CT = 30 min
			100		62'-AXSS-50/4 CT = 41 min.
	70		60		67' CT = 35 min.
			100		72'-AXSS-50/2 CT = 21 min.
	80		100		77' CT = 24 min.
6/29/70		2" limestone layer	55	Box 3	82'-AXSS-50/2 CT = 27 min.
	90		100		87' CT = 25 min.
			75		92'-AXSS-50/3 CT = 16 min.
	100		25		97' CT = 40 min.

Continued on Sheet 2

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 391,005, E 491,633 3. DRILLING AGENCY BOYLES BROS, DRILLING COMPANY
4. HOLE NO. DH-JB-24 SHEET 2 OF 2	5. NAME OF DRILLER JOHN MADISON AND GARY JOHNSON
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 12' · 8. DEPTH DRILLED INTO ROCK 105' · 9. TOTAL DEPTH OF HOLE 117'
10. SIZE AND TYPE OF BIT SEE REMARKS · 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 10 (AXSS) · Undisturbed 5 (CAL) · 14. TOTAL NO CORE BOXES 4	15. ELEV. GROUND WATER 6550 · 16. DATE HOLE Started 6/3/70 · Completed 6/5/70
17. ELEV. TOP OF HOLE 6638.7 · 18. TOTAL CORE RECOVERY FOR BORING (%) 75	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI AND TED JOHNSON

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
			Continued from Sheet 1			
	100		CLAYSTONE, very hard, dry, black-gray.	70	Box 3	102' CT = 26 min.
				90		107' CT = 58 min.
	110		Harder at 115'	100	Box 4	112'-AXSS-50/4 CT = 27 min.
						117'
	120		TOTAL DEPTH 117 FEET			
	130					
	140					
	150					
	160					
	170					
	180					
	190					
	200					

FORM NO. WC&A 29

FIG. K-25

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 388,942, E 490,745	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-25	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED; DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 1'
8. DEPTH DRILLED INTO ROCK 44'	9. TOTAL DEPTH OF HOLE 45'
10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE	11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 10 (CAL); Undisturbed --	14. TOTAL NO. CORE BOXES ---
15. ELEV. GROUND WATER None	16. DATE HOLE: Started 7/8/70; Completed 7/8/70
17. ELEV. TOP OF HOLE 6671.9	18. TOTAL CORE RECOVERY FOR BORING (%) --
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					4 3/4" Tricone with air 0'
			SILT, roots, sandy, loose, tan.			1'-CAL-50/3
			SANDSTONE, hard to very hard, strongly cemented in top 1' then moderately to weakly cemented, tan to gray.			5'-CAL-50/3
	10					10'-CAL-50/3
			Thin coal seams at 14' to 37'			15'-CAL-50/3
	20					20'-CAL-50/3
						25'-CAL-50/1
	30					30'-CAL-50/2
			Claystone layers 38.5±'			35'-CAL-50/9
	40		Strongly cemented 41' to 45'.			40'-CAL-50/1
						45'-CAL-50/2
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

FORM NO. WC & A 29

FIG. K-26

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 388,905, E 490,946 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-26	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	23'	25'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN		14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE	
Disturbed 3 (CAL)	Undisturbed 5 (PITCHER)	--	None	Started 7/22/70	Completed 7/23/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6663.1	----	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense, silty, fine roots, dry, tan (SM).			Pitcher sample #1 stopped 0' after 1.3'. Rock too hard to penetrate.
				0.7/1.3	1	3' ST = 25 min. 4.3'
			SANDSTONE, very hard, weakly to moderately cemented, fine, dry, tan to gray.	1.8/2.5	2	5.5' ST = 3 min
	10			0.9/2.5	3	8' ST = 2 min.
			(2' to 5'± highly cemented).			10.5'-CAL-50/1 - No recovery
				2.3/2.5	4	15'-CAL-50/1 - No recovery 17.5' ST = 2 min.
	20					
				2.2/2.5	5	22.5'-CAL-50/1 - No recovery 25.0' ST = 1 min.
	30					
	40					4 3/4" Tri-cone rock bit with air, except for Pitcher samples. Pitcher sampling with air-water mist.
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER ST = SAMPLE TIME (PITCHER SAMPLE)

FIG. K-27

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,630, E 491,480
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-27	SHEET 1 OF 2
5. NAME OF DRILLER	GARY JOHNSON AND JOHN MADISON
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	14'
8. DEPTH DRILLED INTO ROCK	91'
9. TOTAL DEPTH OF HOLE	105'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 13 (AX-SS); Undisturbed 3 (CAL)
14. TOTAL NO. CORE BOXES	4
15. ELEV. GROUND WATER	6595
16. DATE HOLE	Started 6/18/70; Completed 6/19/70
17. ELEV. TOP OF HOLE	6641.7
18. TOTAL CORE RECOVERY FOR BORING (%)	75
19. SIGNATURE OF INSPECTOR	GUY F. TABOR, JR. & EDW. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT, topsoil, loose, roots, tan to gray (ML).			0' — 4" Hawthorne with air 0' to 15'
		SILT, hard, dry, porous, gravelly (sandstone chips), sandy, light gray (ML-GM).			5'-CAL-40/12
	10	CLAY MATRIX with claystone chips hard (highly weathered claystone), moist, black, gray (CL).			10'-CAL-22/12 - Some caving
		CLAYSTONE, firm to hard, thin bedded, altered to clay in part, fractured, little clay filling in fractures, highly fractured to 35±', gypsum filling in fractures 1/32 to 1/4" thick, Est. total thickness 2" from 14' to 60'. Few very hard layers. Dark brown to black.	80		15'-CAL-18/6+32/6 CT = 42 min. — Start Coring @ 15' NX (WL) 4/CT WC Bit Loloss Mud
	20		40		20'-AXSS-46/12 CT = 27 min.
			0		25'-AXSS-45/12 — Try air water mist-collaring badly, switch to Quiktrol Mud
			60	Box 1	27' CT = 17 min.
	30		0		32'-AXSS-50/6 CT = 23 min — Dropped core, Couldn't recover
			35		37'-AXSS-30/6 CT = 12 min
	40	Numerous gypsum filled fractures 40' to 45' to 1/4" thick.	80		40'-AXSS-50/6 CT = 29 min
WL 6/29/70 & 7/31/70			70		45'-AXSS-50/3 CT = 36 min
	50		80		50'-AXSS-50/3 CT = 28 min — Dropped 2+ ft. of core, recovered 1 ft.
			55	Box 2	55'-AXSS-50/2 CT = 22 min
	60	No gypsum evident below 60', very hard below 60'.	100		60' CT = 25 min.
			70		65'-AXSS-50/2 CT = 33 min — Dropped core, recovered 3+ ft
	70	1" siltstone layer	75		70' CT = 40 min
			80		75'-AXSS-50/2 CT = 37 min
	80		100	Box 3	80' CT = 43 min
		2" limy siltstone layer	100		85'-AXSS-50/3 CT = 49 min
	90		100		90' CT = 33 min.
		CLAYSTONE-SILTSTONE, very hard layered, dark gray	100	Box4	95'-AXSS-50/1 CT = 32 min.
	100				100'

Continued on Sheet 2

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH. O.D. SPLIT SPOON SAMPLER

CT= CORING TIME
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 390,630, E 491,480
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-27 SHEET 2 OF 2	5. NAME OF DRILLER GARY JOHNSON AND JOHN MADISON

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	14'	91'	105'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
13 (AXSS)	3 (CAL)	4	6595	6/18/70	6/19/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6641.7	75	GUY F. TABOR, JR. AND EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
			Continued from Sheet 1			
	100		See Above			100' CT = 21 min
			SANDSTONE, very hard, well cemented 102 to 104' and weakly to 105', light gray.			105'-AXSS-50/1
	110		TOTAL DEPTH 105 FEET			
	120					
	130					
	140					
	150					
	160					
	170					
	180					
	190					

FIG. K-28

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station) N 390,830, E 491,480	(BY IDAHO POWER CO.)
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-28	SHEET 1 OF 2
5. NAME OF DRILLER	GARY JOHNSON (DAY SHIFT): JOHN MADISON (NIGHT SHIFT)
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVERBURDEN	12.5'
8. DEPTH DRILLED INTO ROCK	97.5'
9. TOTAL DEPTH OF HOLE	110'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 12 (AXSS); Undisturbed 3 (CAL)
14. TOTAL NO. CORE BOXES	5
15. ELEV. GROUND WATER	
16. DATE HOLE	Started 6/16/70; Completed 6/17/70
17. ELEV. TOP OF HOLE	6642.3
18. TOTAL CORE RECOVERY FOR BORING (%)	85
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI AND GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, topsoil, loose, roots, tan, dry (ML).			4" Hauthorne with air 0' to 15'
						0
			SILT, hard, dry, porous, blocky, few claystone chips, tan (ML-CL).			5'-CAL-50/8
	10					10'-CAL-35/12
			CLAY, highly weathered claystone, very stiff, blocky, moist, tan-gray (CL-CH).			15'-CAL-50/12 NX-Wireline 4/CT Dia. Water course bit with Loloss mud 15' to 110'
				75		CT = 35 min.
	20		CLAYSTONE, firm to very hard, thin bedded, highly to slightly fractured with depth, altered to clay in part, some clay filling in fractures. Some gypsum filling in fractures 1/8±" thick, Est. total thickness = 1± ft. from 12.5' to 55'.	70	Box 1	20'-AXSS-50/8 CT = 25 min.
				85		25'-AXSS-50/9 CT = 17 min.
	30		3" clay lense, light brown and gray.	90		30'-AXSS-50/8 CT = 26 min.
				95		35'-AXSS-50/3 CT = 30 min.
WL 7/14/70 & 7/26/70 & ** WL 6/29/70	40		2" clay lense, light brown and gray.	90		40'-AXSS-50/6 CT = 28 min.
				45	Box 2	45' CT = 35 min. Dropped piece of core - unable to recover
	50			95		50'-AXSS-50/6 CT = 35 min.
			No gypsum below 55'.	100		55' CT = 36 min.
	60			100		60'-AXSS-50/4 CT = 37 min.
			5" stiff clay layer, dark gray.	75	Box 3	65' CT = 42 min. Dropped 14" of core
	70		3" hard clay layer, light gray.	100		70'-AXSS-50/6 CT = 37 min Partial loss of circulation 73' to 77'
				100		75' CT = 43 min.
	80			60		80'-AXSS-50/1 - No recovery CT = 73 min. Bit plugging
				100	Box 4	85' CT = 21 min.
	90		2" very hard limy siltstone, light gray.	100		90'-AXSS-50/1 - No recovery CT = 26 min
				75		95' CT = 40 min.
	100					100'-AXSS-50/2 - No recovery

Continued on Sheet 2

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME
*WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-29

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) (BY IDAHO POWER CO.) N 390,830, E 491,480 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-28 SHEET 2 OF 2	5. NAME OF DRILLER GARY JOHNSON (DAY SHIFT); JOHN MADISON (NIGHT SHIFT)

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	12.5'	97.5'	110'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
12 (AXSS)	3 (CAL)	5		6/16/70	6/17/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6642.3	85	EDW. BRYLAWSKI AND GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
			Continued from Sheet 1			
	100		CLAYSTONE, as above.	75		100'-AXSS-50/2 - No recovery CT = 25 min.
			SILTSTONE-CLAYSTONE, few clay lenses, very hard, gray to black.	100		105' CT =
	110		SANDSTONE, very hard, fine, gray			110'-AXSS-50/1
			TOTAL DEPTH 110 FEET			
	120					
	130					
	140					
	150					
	160					
	170					
	180					
	190					
	200					

** CASAGRANDE TYPE PIEZOMETER INSTALLED 7/3/70 AT 105-FOOT DEPTH

FORM NO. WC&A 29

CAL - 2-INCH I.D. CALIFORNIA SAMPLER CT = CORING TIME
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 388,873, E 491,147
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-29
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	3'
8. DEPTH DRILLED INTO ROCK	32'
9. TOTAL DEPTH OF HOLE	35'
10. SIZE AND TYPE OF BIT	4 3/4" TRI-CONE ROLLER
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 8 (CAL); Undisturbed –
14. TOTAL NO. CORE BOXES	–
15. ELEV. GROUND WATER	None
16. DATE HOLE	Started 7/7/70; Completed 7/7/70
17. ELEV. TOP OF HOLE	6654.3
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					Drilled with air
	0–3		SILT, medium dense, very sandy, calcareous, porous, roots, dry, light brown (ML-SM)			1'-CAL-25/12 Weathered 3' to 4' approx.
	3–35		SANDSTONE, very hard, moderately to (highly cemented below 25'), fine, dry, light, gray to tan. (4' to 6' highly cemented).			5'-CAL-50/1
	10					10'-CAL-50/5
	15					15'-CAL-50/3
	20					20'-CAL-50/2
	25					25'-CAL-50/1
	30					30'-CAL-50/0
	35					35'-CAL-50/2

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

FIG. K-30

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 388,553, E 490,999 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-30	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED; DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 1' — 8. DEPTH DRILLED INTO ROCK 34' — 9. TOTAL DEPTH OF HOLE 35'
10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE ROLLER — 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 8 (CAL); Undisturbed — 14. TOTAL NO. CORE BOXES 0	15. ELEV. GROUND WATER None — 16. DATE HOLE Started 7/6/70, Completed 7/6/70
17. ELEV. TOP OF HOLE 6671.9 — 18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose, silty, roots, dry, light brown (SM-ML).			1'-CAL-50/0
			SANDSTONE, very hard, moderately to weakly cemented, fine grained, dry, to very slightly moist below 25', light grey to tan.			5'-CAL-50/2
	10					10'-CAL-50/3
						15'-CAL-50/1
	20					20'-CAL-50/1
			Clay seam at 25±'			25'-CAL-50/3
	30					30'-CAL-50/0
						35'-CAL-50/1
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FIG. K-31

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGER POWER PLANT

2. LOCATION (Coodinates or Station)
N 388,622, E 491, 190

3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY

4. HOLE NO.
DH-JB-31

5. NAME OF DRILLER
DON IRVINE

6. DIRECTION OF HOLE
[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL

7. THICKNESS OF OVER-BURDEN 1'

8. DEPTH DRILLED INTO ROCK 24'

9. TOTAL DEPTH OF HOLE 25'

10. SIZE AND TYPE OF BIT
SEE REMARKS

11. DATUM FOR ELEV. SHOWN (TBM or MSL)
MSL

12. MANUFACTURER'S DESIGNATION OF DRILL
FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN
Disturbed 4 (CAL)
Undisturbed 5 (PITCHER)

14. TOTAL NO. CORE BOXES --

15. ELEV. GROUND WATER None

16. DATE HOLE
Started 7/22/70
Completed 7/22/70

17. ELEV. TOP OF HOLE
6659.7

18. TOTAL CORE RECOVERY FOR BORING (%) --

19. SIGNATURE OF INSPECTOR
EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, silty, medium dense, fine, roots, calcareous, chips of sandstone, dry, tan (SM-ML).			0' 1'-CAL-50/10 - No recovery 2'-CAL-50/1 - No recovery
				0.3/2.5	1	3' ST = 10 min
				2.[illegible]/2.5	2	5.5' ST = 3 min
	10		SANDSTONE, very hard, weakly to moderately cemented, fine, dry, tan to gray.	1.6/2.5	3	8' ST = 3 min
				0.8/2.5	4	10.5' ST = 3 min
						13' Cuttings sample 13'-15' 15'-CAL-50/1 - No recovery
	20		1' to 3±' highly cemented, fractured, weathered.	2.0/2.5	5	18' ST = 2 min. 20.5'
						25'-CAL-50/2 - No recovery
	30					
	40					4 3/4" Tri-cone rock bit with air, except for Pitcher samples. Pitcher sampling with air-water mist.
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC & A 29

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE)

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 388,553, E 491,403
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-32	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED; DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 4'; 8. DEPTH DRILLED INTO ROCK 30'; 9. TOTAL DEPTH OF HOLE 34'
10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE ROLLER; 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 9 (CAL); Undisturbed; 14. TOTAL NO. CORE BOXES 0	15. ELEV. GROUND WATER None; 16. DATE HOLE Started 7/6/70, Completed 7/6/70
17. ELEV. TOP OF HOLE 6652.9; 18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6653	0		SAND, loose, fine, roots, dry, tan (SP).			Drilled with air 1'-CAL-36/12 Top 1' of sandstone weathered
			SILT, dense, fine sand, calcareous, roots, dry, tan (ML).			5'-CAL-50/2 8.5'-CAL-30/1
	10		SANDSTONE, very hard, fine, weakly to highly cemented, occasional trace of coal, 1/16"± dry to very slightly moist, tan, yellowish-brown, light grey.			9'-CAL-25/2 14'-CAL-50/2 19'-CAL-50/2 24'-CAL-50/1 29'-CAL-50/1 34'-CAL-50/1
	20					
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

FIG. K-33

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 390,266, E 490,240	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-33	5. NAME OF DRILLER HOWARD JOSSERAND
6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 3' 8. DEPTH DRILLED INTO ROCK 47' 9. TOTAL DEPTH OF HOLE 50'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL 12. MANUFACTURER'S DESIGNATION OF DRILL CHICAGO PNEUMATIC CP-8
13. TOTAL NO. OF SAMPLES TAKEN Disturbed — Undisturbed 9 (PITCHER)	14. TOTAL NO. CORE BOXES 2 15. ELEV. GROUND WATER -- 16. DATE HOLE Started 7/26/70 Completed 7/27/70
17. ELEV. TOP OF HOLE 6651.9	18. TOTAL CORE RECOVERY FOR BORING (%) 19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0 – 3	SAND, medium dense, silty, dry, tan (SM-ML).			0.0'
			1.5/2.2	1	4.0' ST = 45 min.
		CLAYSTONE, medium hard to hard, gypsum, fractured, sandy, dry, brown to black.	0.0/1.8	2	6.2' ST = 45 min (no tube, no recovery)
			100%	Core Box 1	8.0' ST = 5 min.
			90%		11.0' ST = 5 min.
		SANDSTONE, very hard, fine, moderate to weak cementation, dry, gray, to brown.			16.2' ST = 25 min.
			100%	Box 1.	17.0' ST = 5 min.
			0.0/2.0	4	21.0' ST = 25 min (no tube, no recovery)
					23.0' Rock bit
			2.3/2.8	5	28.0' ST = 10 min.
			2.2/2.7	6	30.8' ST = 10 min.
			1.4/2.2	7	33.5' ST = 8 min.
			2.1/2.2	8	35.7' ST = 8 min.
WL 7/31/70		39' ▽ 4 Da	1.5/2.1	9	37.9' ST = 8 min. Lost all water @ 40' could not get it back
			85%	Core Box 2	40.0' ST = 5 min
			90%		45.0' ST = 5 min.
	50				50.0'

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Pitcher Sampler, 4 3/4" Tri-cone rock bit, and NX wire-line core with 4/c diamond water course bit using Quik-trol Condet, W.O.L.F., Lo-loss, Hy-seal and Palco seal drilling mud additives.

FORM NO. WC&A 29

WL = WATER LEVEL

ST = SAMPLE TIME (PITCHER SAMPLE)

WOODWARD - CLYDE & ASSOCIATES
DRILLING LOG

1. PROJECT NO. 12578
   PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)
   N 390,104, E 490,364
3. DRILLING AGENCY
   BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-34
5. NAME OF DRILLER
   HOWARD JOSSERAND
6. DIRECTION OF HOLE
   [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 4.5'
8. DEPTH DRILLED INTO ROCK 34
9. TOTAL DEPTH OF HOLE 38.5'
10. SIZE AND TYPE OF BIT
    SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL
    CHICAGO PNEUMATIC - CP-8
13. TOTAL NO. OF SAMPLES TAKEN
    Disturbed --
    Undisturbed 12 (PITCHER)
14. TOTAL NO. CORE BOXES
15. ELEV. GROUND WATER 6613
16. DATE HOLE
    Started 7/24/70
    Completed 7/25/70
17. ELEV. TOP OF HOLE
    6649.5
18. TOTAL CORE RECOVERY FOR BORING (%) --
19. SIGNATURE OF INSPECTOR
    GUY F. TABOR, JR.

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)
	0–4.5	SILT, sandy, hard, porous near surface, roots (ML-SM)
	4.5–10	CLAYSTONE, medium hard to hard, blocky, weathered, calcareous, gray brown.
WL 7/31/70 (?) Possible drilling mud left in hole	10–38.5	SANDSTONE, very hard, moderately cemented to weakly cemented (strongly cemented 10' to 15' fractured and jointed) generally stronger cemented with depth. Few very weak zones; thin, 1/2", 8±" total, gray.
		TOTAL DEPTH 38.5 FEET

RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
		0' to 4' 4 3/4" Rock Bit. Below 4' = 3" ID Pitcher with Loloss & Quiktrol mud
1.8/1.9	1	4.0' – 5.9' ST = 35 min
1.1/1.4	2	5.9' – 7.3' ST = 40 min
2.2/1.9	3	7.3' – 9.2' ST = 45 min
0/1.7		9.2' – 10.9'
100+	Core Box 1	10.9' – 14.5' ST = 10 min
100		14.5' – 19.5' ST = 10 min
0.5/1.0	4	19.5' – 20.5' ST = 45 min
1.9/2.5	5	20.5' – 23.0' ST = 45 min.
2.0/1.0	6	23.0' – 24.0' ST = 45 min.
0.9/1.0	7	24.0' – 25.0' ST = 30 min
1.0/2.0	8	25.0' – 27.0' ST = 30 min.
1.0/1.8	9	27.0' – 28.8' ST = 60 min.
1.1/1.0	10	28.8' – 29.8' ST = 40 min
0.9/1.0	11	29.8' – 30.8' ST = 40 min
0	Box 1	30.8' – 36.1' 5 min. Dropped core - few pieces in last Pitcher
1.8/2.4	12	36.1' – 38.5'

Tried Pitcher 9.2' to 10.9' but lost; cored then to 14.5' and recovered part of Pitcher sample.

NW Wireline 10.9' to 19.5'

Lost 80% of circulation at 32'.

FIG. K-35

FORM NO. WC&A 29

ST = SAMPLE TIME (PITCHER SAMPLE)
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,950, E 490,481
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-35
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	5'
8. DEPTH DRILLED INTO ROCK	45'
9. TOTAL DEPTH OF HOLE	50'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed: — Undisturbed: 17 (PITCHER)
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	
16. DATE HOLE	Started 7/26/70 Completed 7/26/70
17. ELEV. TOP OF HOLE	6647.7
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCHER SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense to loose silt, dry, tan.			0.0' Rock bit 0.0' to 5.0'
	5		CLAYSTONE, medium hard to hard, blocky, weathered, brown.	2.3/2.5	1	5.0' ST = 5 min.
						7.5' 8.5' ST = 10 min. Pitcher Sampler stopped after 1.0', no penetration
	10		SANDSTONE, hard to very hard, fractured, highly cemented 8' to 11±', limy, dry, gray.	0.2/1.0	2	Rock bit 8.5' to 14.0'
				2.3/2.5	3	14.0' ST = 3 min.
				2.2/2.5	4	16.5' ST = 3 min.
	20			2.3/2.5	5	19.0' ST = 5 min.
				2.0/2.0	6	21.5' ST = 3 min.
				2.2/2.5	7	23.5' ST = 5 min.
				2.3/2.5	8	26.0' ST = 3 min.
	30			2.1/2.5	9	28.5' ST = 3 min.
				2.3/2.5	10	31.0' ST = 4 min.
WL 7/31/70				2.2/2.5	11	33.5' ST = 3 min.
				2.3/2.5	12	36.0' ST = 4 min.
	40			2.3/2.5	13	38.5' ST = 4 min.
				2.3/2.5	14	41.0' ST = 4 min.
				2.3/2.5	15	43.5' ST = 4 min.
				1.9/2.5	16	46.0' ST = 4 min.
				0.8/1.5	17	48.5' ST = 4 min.
	50					50.0' ST = 8 min.
	60					4 3/4" Tri-cone rock bit and Pitcher sampler with air-water mist.
	70					
	80					
	90		NOTE: WHERE PITCHER SAMPLES WERE TAKEN, IDENTIFICATION WAS MADE FROM ENDS IN THE FIELD. FURTHER IDENTIFICATION WILL BE MADE IN THE LABORATORY WHEN SAMPLES ARE EXTRUDED FROM SHELBY TUBES.			
	100					

WL = WATER LEVEL ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG. K-36

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,995, E 489,901
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-36	5. NAME OF DRILLER WOOD AND JOSSERAND
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 1' — 8. DEPTH DRILLED INTO ROCK 47' — 9. TOTAL DEPTH OF HOLE 48'
10. SIZE AND TYPE OF BIT SEE REMARKS — 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL CHICAGO PNEUMATIC - CP-8
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed -- ; Undisturbed 20 (PITCHER) — 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER 6631 — 16. DATE HOLE Started 7/20/70, Completed 7/22/70
17. ELEV. TOP OF HOLE 6675.3 — 18. TOTAL CORE RECOVERY FOR BORING (%) ---	19. SIGNATURE OF INSPECTOR GUY F. TABOR, JR.

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0–1	SILT, hard, porous, sandy, roots, dry, tan (ML-SM).			0' to 4' 4 3/4" Rock Bit with Loloss & Quik-trol mud. Below 4' = 3" I.D. Pitcher
	1–48	SANDSTONE, hard to very hard, weakly to moderately cemented - more cemented with depth, gray to brown.			
	4'–6.5'		2.3/2.5	1	ST= 8 min.
	6.5'–9'		1.4/2.5	2	ST = 10 min.
	9'–11.5'		2.2/2.5	3	ST = 7 min.
	11.5'–14'		2.3/2.4	4	ST = 8 min.
	14'–16.5'		2.3/2.5	5	ST = 15 min.
	16.5'–19'		2.2/2.5	6	ST = 8 min.
	19'–21.5'		2.0/2.5	7	ST = 8 min.
	21.5'–24'		2.2/2.5	8	ST = 8 min.
	24'–26.5'		2.2/2.5	9	ST = 9 min. Lost circ. @ 26.5';
	26.5'–29'		2.0/2.5	10	ST = 15 min. Got back @ 29.0'.
	29'–31'		1.7/2.0	11	ST = 15 min.
	31'–31.8'		0.9/0.8	12	ST = 20 min.
	31.8'–34.2'		2.4/2.4	13	ST = 25 min.
	34.2'–36.4'		2.1/2.2	14	ST = 30 min.
	36.4'–38.8'		2.3/2.4	15	ST = 8 min.
	38.8'–39.6'	Pitcher Refusal	0.7/0.8	16	ST = 10 min.
	39.6'–41.7'	Pitcher Refusal	0.8/0.9	17	ST = 20 min
	41.7'–41.8'	Pitcher Refusal	0.1/0.1	18	ST = 20 min
	41.8'–42.4'	Pitcher Refusal	0.1/0.6	19	ST = 35 min.
	42.4'–42.5'	Pitcher Refusal	0/0	20	ST = 30 min.
	39–48	Very hard 39±' to 48'. Strongly cemented. Harder @ 47'			
	46.5	2" layer of weakly cemented sand @ 46.5'			
	48	TOTAL DEPTH 48.0 FEET			No. 17 had 4" core sticking out tip. Lost No. 18. Lost circulation at 42.5'. Rock bit to 48'. Still harder. No further attempt to take Pitcher Samples.

ST = SAMPLE TIME (PITCHER SAMPLE) WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-37

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 390,827±, E 492,030±
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB 37	5. NAME OF DRILLER JOHN MADISON (swing shift) GARY JOHNSON (day shift);

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	45.5'	49.5'	95'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
5 (AX-SS)	10 (CAL)	3	6577	6/15/70	6/16/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6627.2	95	GUY F. TABOR AND ED. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						4" Hawthorne bit with air
	0		SILT, hard, dry, porous, little fine sand, tan (ML). Grey-tan with rust and coal layers 8 to 14 feet. "Caliche-like" at 10' with thin beds of coal, slightly clayey, calcareous.			0'; 5'-CAL-50/9; 10'-CAL-50/10
	10–20		SAND, dense, fine, silty to slightly silty, layered with silt, thin bedded, calcareous, coal dust streaks, dry, tan to orange-tan (SM-ML). Silt is porous.			15'-CAL-50/12; 20'-CAL-50/7; 25'-CAL-45/12
	30		SAND, dense, slightly silty, fine, thin clay and coal layers, dry, tan (SM-SP).			30'-CAL-47/12; 35'-CAL-48/12
	40		CLAY-SILT, hard, sandy, coal dust with sand layers, slightly moist, (CL-ML).			40'-CAL-45/12
WL 6/19/70			GRAVEL, clay, claystone chips, dense, in matrix, some sand layers: mostly gravel, 36' to 40'. (CL-GC). Some caving.			45'-CAL-50/8
	50		CLAYSTONE, hard, clay and gypsum filled fractures, Est. 1/16 to 1/4" thick gypsum with total = 3/4±" from 45.5' to 64', thin-bedded, altered to clay in part, Black.	100	Box 1	50'-CAL-50/9 CT = 15 min. NX Wireline core with mud
				95		55'-AXSS-50/8 CT = 24 min. Lost circ. 54', Caved 52'-55'
	60			100		60'-AXSS-50/5 CT = 34 min.
			No gypsum below 64±'; very hard below 64±'.	90		65'- CT = 40 min.
	70			40	Box 2	70'-AXSS-50/2 CT = 35 min. Dropped core - re-recov. = 40%
				100		75' CT = 42 min.
	80			100		80'-AXSS-50/2 CT = 24 min.
				100		85' CT = 30 min.
	90		Limy layers 90' to 95'. 1' clay layer at 94'.	100	Box 3	90'-AXSS-50/2 CT = 22 min.
						95'
	100					

FORM NO. WC&A 29a

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

CT= CORING TIME
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,837, E 490,025	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-38	5. NAME OF DRILLER H. JOSSERAND

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	42.5'	44.5'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	CHICAGO PNEUMATIC - CP-8

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
	18 (PITCHER)		--	7/22/70	7/22/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6672.5	--	GUY F. TABOR, JR.

CLASSIFICATION OF MATERIALS (Description)

- 0' to 4.0': SAND, silty, loose, dry, tan (SM-ML).
- 4.0' to 41±': SANDSTONE, hard to very hard, weakly to moderately cemented, tan to gray.
- Very hard, light gray limy sandstone 41± to 43'.

Depth	Recovery (Feet)	Pitcher Sample No.	Remarks
0'			0' to 4' 4 3/4" Rock bit with Loloss & Quiktrol mud. Below 4' = 3" I.D. Pitcher
4.0'	1.6/2.3	1	ST = 8 min.
6.3'	2.2/2.3	2	ST = 7 min.
8.6'	2.2/2.4	3	ST = 4 min.
11.0'	2.2/2.3	4	ST = 4 min.
13.3'	2.2+/2.4	5	ST = 4 min.
15.7'			
16.7'	2.2+/2.3	6	ST = 10 min.
19.0'	2.2+/2.3	7	ST = 5 min.
21.3'	1.4/1.5	8	ST = 7 min
22.8'	2.5/2.2	9	ST = 7 min.
25.0'	0.8/1.8	10	ST = 10 min.
26.8'	1.4/0.8	11	ST = 15 min.
27.6'	1.6/1.5	12	ST = 12 min.
29.1'	2.0/2.3	13	ST = 10 min.
31.4'	1.9/2.6	14	ST = 11 min.
34.0'	1.7/1.7	15	ST = 11 min.
35.7'	2.5/2.3	16	ST = 15 min.
38.0'	0.7/1.0	17	ST = 16 min.) Blocked
39.0'	0.3/0.5	18	ST = 14 min.) Tube
39.5'	65% Recov	Core Box 1	ST = 17 min.
44.5'			

Slight loss of circulation at 16± feet. Lost 80% circulation at 19 feet. Circulation comes and goes below 19 feet.

ST = SAMPLE TIME (PITCHER SAMPLE) WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-39

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578
PROJECT NAME JIM BRIDGER POWER PLANT

2. LOCATION (Coodinates or Station) (BY IDAHO POWER CO.)
N 390,025, E 490,462

3. DRILLING AGENCY
BOYLES BROS. DRILLING COMPANY

4. HOLE NO.
DH-JB-39

5. NAME OF DRILLER
JOHN MADISON AND ED SNELL

6. DIRECTION OF HOLE
[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL

7. THICKNESS OF OVER-BURDEN 7.5'

8. DEPTH DRILLED INTO ROCK 92.5'

9. TOTAL DEPTH OF HOLE 100'

10. SIZE AND TYPE OF BIT
SEE REMARKS

11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL

12. MANUFACTURER'S DESIGNATION OF DRILL
FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN
Disturbed 9 (AXSS) Undisturbed 2 (CAL)

14. TOTAL NO. CORE BOXES 4

15. ELEV. GROUND - WATER 6614

16. DATE HOLE
Started 6/25/70 Completed 6/26/70

17. ELEV. TOP OF HOLE
6647.3

18. TOTAL CORE RECOVERY FOR BORING (%) 70%

19. SIGNATURE OF INSPECTOR
GUY F. TABOR, JR.

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0				4" Hawthorne with Loloss mud and Wolf
	0–7.5	SAND, loose to medium dense, fine (dune sand), silty, moist, tan (SM).			-5'-CAL-50/10
	7.5–17	CLAY, claystone chips in silt, clay matrix (highly weathered claystone), moist, brown to gray (CL-CH).	45		-11'-CAL-50/6 CT = 40 min. Start NX Wire-line at 10'. Lost circ. @ 19.5' Recovery at 21.5' with Palco Seal. Lost again at 23.5'
	17–68	SANDSTONE, hard to very hard, strongly cemented and limy to very weakly cemented. Few fossils and claystone-siltstone layers, brown to gray, dry to moist. Fractured and altered in part. Highly fractured and altered 11.5 to 50' and 80' to 90'.	75	Box 1	-21.5'-AXSS-50/5 CT = 31 min.
WL 6/29/70	30	Very loose sand 19.5 to 20'.	50		-29.5'-AXSS-50/2 (no recovery) CT = 19 min. Some water in hole below 35' but did not regain circulation.
** WL DATE 33.5' 7/14/70 33.5' 7/25/70	40	General weakly cemented to 50'	50		-40'-AXSS-50/2 - No recovery CT = 8 min.
	50	Very loose sand 46 to 47.5'. Fossils at 49' Siltstone, brown, hard 51 to 52'. Sandstone strongly cemented 50 to 67.5'	90		-50'-AXSS-50/1 - No recovery CT = 40 min.
	60	Fossils at 56±'.	80	Box 2	-60'-AXSS-50/2 - No recovery CT = 65 min.
	68–76	SANDSTONE-SILTSTONE-CLAYSTONE, layered, dark brown to black, few fossils near top, many with depth.	100		-70'-AXSS-50/3 CT = 20 min. 75' CT = 19 min.
	76–100	SANDSTONE, as above, moderately cemented to weakly cemented.	100		
	80	Few fossils and lignite layers 80' to 100'	60	Box 3	-80'-AXSS-50/2 - No recovery CT = 21 min.
	90		70		-87' CT = 11 min. -90'-AXSS-50/2 - No recovery CT = 15 min.
			90		
	100			Box 4	-100'-AXSS-50/2 - No recovery

**(CASAGRANDE TYPE PIEZOMETER INSTALLED JULY 3, 1970 @ 95-FOOT DEPTH).

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME
WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-40

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,697, E 490,067 (BY IDAHO POWER CO.)	
3. DRILLING AGENCY - BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-40	5. NAME OF DRILLER JOHN MADISON AND ED SNELL
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 4'
8. DEPTH DRILLED INTO ROCK 96'	9. TOTAL DEPTH OF HOLE 100'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 9 (AXSS); Undisturbed 2 (CAL)	14. TOTAL NO. CORE BOXES 4
15. ELEV. GROUND WATER 6614	16. DATE HOLE Started 6/26/70 Completed 6/28/70
17. ELEV. TOP OF HOLE 6677.9	18. TOTAL CORE RECOVERY FOR BORING (%) 85
19. SIGNATURE OF INSPECTOR GUY F. TABOR, JR.	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SAND, loose to medium dense, fine, moist (dune sand), tan (SM).			0'
	4–10	SANDSTONE, slightly cemented to uncemented, very hard to very dense, fractured, few thin layers of moderately cemented limy sandstone, slightly clayey below 5±' from weathering of clay forming minerals, tan to light gray.			5'-CAL-50/5
	10		30	Box 1	10'-CAL-50/7 CT = 70 min.
	20		100		20'-AXSS-50/3 - No recovery CT = 35 min.
	30		100		30'-AXSS-50/3 - No recovery CT = 17 min.
	40	Becoming slightly to moderately cemented at 41'.	90	Box 2	40'-AXSS-50/2 CT = 27 min.
	50	Few fossils at 49.5'. Very hard limy layer 50 to 51'. Uncemented 51' to 53'.	95		50'-AXSS-50/2 - No recovery CT = 39 min.
	55	SANDSTONE-SILTSTONE-CLAYSTONE, layered, many fossils, very hard.			
WL 6/29/70 & 7/31/70	60		95	Box 3	60'-AXSS-50/2 CT = 33 min.
	67	SANDSTONE, as above.			
	70	Few thin claystone layers 76' to 78'	90		70'-AXSS-50/2 - No recovery CT = 47 min.
	80	Very slightly to uncemented below 80'.	55	Box 4	80'-AXSS-50/1 - No recovery CT = 41 min. Big plugged @ 89, had to pull out & dropped some core - couldn't recover.
	90	Very loose sand 91.5 to 92'	95		90'-AXSS-50/2 - No recovery CT = 31 min.
	100	TOTAL DEPTH 100 FEET			100'-AXSS-50/2 - No recovery

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME
WL = WATER LEVEL

FIG. K-41

WOODWARD - CLYDE & ASSOCIATES
DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) (BY IDAHO POWER CO.) N 390,300, E 490,200
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-41
5. NAME OF DRILLER JOHN MADISON	6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVERBURDEN 9'	8. DEPTH DRILLED INTO ROCK 26'
9. TOTAL DEPTH OF HOLE 35'	10. SIZE AND TYPE OF BIT SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 4 Undisturbed 2	14. TOTAL NO. CORE BOXES 1
15. ELEV. GROUND WATER None *	16. DATE HOLE Started 6/29/70 Completed 6/29/70
17. ELEV. TOP OF HOLE 6652.7	18. TOTAL CORE RECOVERY FOR BORING (%) 90
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose, fine, roots, porous, dry, tan (SP).			1'-CAL-20/12
			SAND, medium dense, fine, slightly silty, porous, slightly calcareous, slightly moist, light brown (SM-SP).			5'-CAL-50/9
	10					10'-CAL-45/12
			SILT, transition zone, blocky, clayey, dense, occasional hard chips of sandstone, slightly moist, light brown (ML). Lewis Shale.			15'-CAL-50/2 - No recovery. CT = 26 min. 15 to 35' 4/c Diameter Wire-line core bit with Quiktrol, Condet, Loloss and Wolf.
	20		CLAYSTONE, medium hard to hard, blocky, weathered, brown.	85	Box 1	
			SANDSTONE, very hard, moderate to very weakly cemented, massive, thick bedded, fine to medium grained, gry to light brown. Bedding angle (0 to 10°). Occasional thin coal seams 1/16± inches.			25'-AXSS-50/2 - No recovery CT = 30 min.
	30			95		35'-AXSS-50/2
	40					
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME

FORM NO. WC&A 29

FIG. K-42

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 390,204, E 489,989 (BY IDAHO POWER CO.)
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-42
5. NAME OF DRILLER ED SNELL	6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 2'	8. DEPTH DRILLED INTO ROCK 48'
9. TOTAL DEPTH OF HOLE 50'	10. SIZE AND TYPE OF BIT SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 3 (AXSS) Undisturbed 4 (CAL)	14. TOTAL NO. CORE BOXES 1
15. ELEV. GROUND WATER None	16. DATE HOLE Started 6/30/70 Completed 6/30/70
17. ELEV. TOP OF HOLE 6662.1	18. TOTAL CORE RECOVERY FOR BORING (%) 50
19. SIGNATURE OF INSPECTOR GUY F. TABOR, JR.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose, fine to medium grained, dry to moist (dune sand), tan (SM).			4" Hawthorne with Quiktrol 0' to 11' 0' 2'-CAL-50/8 6'-CAL-50/3
	10		SANDSTONE, very hard to very dense, weakly cemented to uncemented with few moderately cemented layers, generally thick bedded, light gray to brown.	20		10'-CAL-50/9 Start NX Wireline core @ 11' (4/c WC bit) CT = 17 min
	20		More moderately cemented below 25'.	65		20'-CAL-50/2 - No recovery. CT = 21 min.
	30			35		30'-AXSS-50/1 - No recovery CT = 44 min. No water return below 30'
	40		Few fossils at 41'. Silstone-Sandstone, thin bedded, hard, brown 44±' to 46±'. Limy layer 46±' to 47.5±', very hard. Fossils 49.5 to 50.0'	70		40'-AXSS-50/1 - No recovery CT = 47 min.
	50					50'-AXSS-50/1 - No recovery
	60					
	70					
	80					
	90					
	100					

FIG. K-43

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AXSS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) (BY IDAHO POWER CO.) N 389,308, E 490,319
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-43	5. NAME OF DRILLER ED SNELL

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	1'	49'	50'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN		14. TOTAL NO CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE	
Disturbed 4 (AXSS)	Undisturbed 2 (CAL)	2	6632	Started 7/2/70	Completed 7/2/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6679.1	80	GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, silty, loose (dune sand), dry, tan (SM).			0' 4" Hawthorne with Quiktrol mud and Condet
			SANDSTONE, hard to very hard or very dense, slightly cemented to uncemented with few moderately cemented zones, altered to clay in part, tan to light gray.			5'-CAL-50/5
	10					10'-CAL-50/10 Started core at 11' using Quiktrol
				45	Box 1	
	20		Clayey and slightly more cemented below 25'.			20'-AXSS-50/2 - No recovery
			Few thin moderately cemented layers 30 to 32'.	100		
	30		Few lignite layers.			30'-AXSS-50/2 - No recovery
			Moderately cemented 40' to 50'.	100		
	40		Very hard limy layer at 48'. Many fossils at 49'.		Box 2	40'-AXSS-50/2 - No recovery
				75		
	50					50'-AXSS-50/1 - No recovery
			TOTAL DEPTH 50 FEET			
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLE
AX-SS = 1 3/4 INCH O. D. SPLIT SPOON SAMPLER
WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-44

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,296, E 490,778
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-43A
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	2.3'
8. DEPTH DRILLED INTO ROCK	23.7'
9. TOTAL DEPTH OF HOLE	26'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN — Disturbed	4 (3 CAL - 1 CUT)
13. TOTAL NO. OF SAMPLES TAKEN — Undisturbed	4 (PITCHER)
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	None
16. DATE HOLE — Started	7/23/70
16. DATE HOLE — Completed	7/23/70
17. ELEV. TOP OF HOLE	6659.8
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium dense to dense, sandy, roots, slightly porous, calcareous, dry, tan.			0' 1.5'-CAL-30/10, 20/0 2.3' Cut
				1.8/2.5	1	4.0' ST = 2 min.
			SANDSTONE, very hard, highly cemented, fine, dry, gray.	2.1/2.5	2	6.5' ST = 2 min. 9.0'
	10		SANDSTONE, very hard, fine, weakly to moderately cemented, occasional clay seams, dry, light, gray, to brown.	2.3/2.5	3	14.0'-CAL-50/1 16.5' ST = 1 min
	20			2.2/2.5	4	21.5'-CAL-50/1 24.0' ST = 4 min. 26'
	30					
	40					
	50					4 3/4" Tri-cone Rock bit with air and 3" I.D. Pitcher sampler with air-mist.
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

ST = SAMPLE TIME (PITCHER SAMPLE)

FORM NO. WC&A 29

FIG. K-45

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,443, E 489,760	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-44	5. NAME OF DRILLER ED. SNELL

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	3'	97'	100'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN		14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE	
Disturbed 9 (AXSS)	Undisturbed 2 (CAL)	4	None	Started 7/1/70	Completed 7/1/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6700.7	80	GUY F. TABOR, JR. AND EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND			4" Hawthorne with Quicktrol mud 0
			SANDSTONE, hard to very hard or very dense, weakly cemented to uncemented, with some moderately cemented layers bedding predominately 0° to 10° dip and generally thick bedded. Light gray to brown.			5'-CAL-43/12
	10			25	Box 1	10'-CAL-50/3 - No recovery CT = 33 min. Start NX Wire-line core, with Quicktrol At 10'.
	20		Trace of lignite Few thin brown siltstone layers at 25±'.	35		20'-AXSS-50/2 - No recovery CT = 50 min. No mud return 20' to 21'
	30			100		30'-AXSS-50/2 - No recovery CT = 45 min.
	40			50		40'-AXSS-50/2 - No recovery CT = 48 min.
	50		CLAYSTONE-SILTSTONE-SANDSTONE, many fossils, very hard, brown. Very hard limy layer 58'to 59'.	85	Box 2	50'-AXSS-50/3 - No recovery CT = 60 min.
	60		Weakly cemented sandstone as above - clayey due to presence of clay layers (1/16") & weathering of clay forming minerals. Very hard or very dense.	100		60'-AXSS-50/2 - No recovery CT = 51 min. 68'
	70		Claystone layers 1/2"± thick from 70' to 80', Est. total thickness = 12"±.	90 95	Box 3	70'-AXSS-50/1 - No recovery
	80		Very loose sand at 81', drill bit dropped 1'.	90		80'-AXSS-50/3 - No recovery Lost all mud return below 81'.
	90		Very loose sand at 90.5', drill bit dropped 6".	95	Box 4	90'-AXSS-50/1 - No recovery
	100		TOTAL DEPTH 100 FEET.			100'-AXSS-50/3 - No recovery.

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4 INCH O.D. SPLIT SPOON SAMPLER

CT = CORING TIME

FIG. K-46

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 389,680, E 490,148 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-45	5. NAME OF DRILLER JOHN MADISON

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	0	45.5'	45.5'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	CHICAGO PNEUMATIC - CP-8

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
--	17 (PITCHER)	--	None	7/8/70	7/9/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6672.1	--	GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SANDSTONE, weakly cemented to moderately cemented with few thin uncemented layers, hard to very hard, tan to gray, moist.			Rock bit to 4.8' with mud and 5.0' to 9.0'
				0.2	1	4.6' – 5.0' Pitcher Tube Blocked after drilling 0.2'
				0.2	2	9.0'
	10			0.2	3	9.2' Pitcher sampler continuing to block due to lack of taper inside bit end.
				2.0	4	9.5'
				1.3	5	11.0'
				2.5	6	13.0'
				2.1	7	14.5'
	20			2.4	8	16.7'
				2.3	9	18.8'
				1.4	10	21.2'
				2.5	11	23.5'
				2.3	12	23.9' Lost circulation @ 26.5±'. Very loose soil 0.5' @ 36.5±'.
	30			2.4	13	26.4'
				2.2	14	28.7'
				2.3	15	31.1'
				2.4	16	33.3'
	40			2.3	17	35.6'
				2.2	18	38.0'
				2.3	19	40.3'
				0.7	20	42.5'
						44.8'
						45.5' Pitcher blocked at 45.5' due to harder sandstone.
	50		TOTAL DEPTH 45.5 FEET			Recovery nearly 100% on all runs.
	60					
	70					
	80					
	90					
	100					

FIG. K-47

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,383, E 489,935
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-46	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	1'	30'	31'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
7 (CAL)	---	---	None	7/9/70	7/9/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6691.2	---	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						4 3/4" Tricone with water
	0		SAND, loose, silty (dune sand), dry, tan (SM)			0' 1'-CAL-30/12
			SANDSTONE, hard to very hard, moderately to weakly cemented, light brown to gray, dry (uncemented 4' to 9').			6'-CAL-10/12
	10					11'-CAL-50/9
						16'-CAL-50/2
	20					21'-CAL-50/2
			Coal seams 1/16" and clay lenses 1/4" at 25±'.			26'-CAL-50/2
	30					31'-CAL-50/4
			TOTAL DEPTH 31 FEET			
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FIG. K-48

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 389,617, E 489,827 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-47	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	1'	43'	44'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14 TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
9 (CAL)		0	None	7/9/70	7/10/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6693.7	---	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose, silty, calcareous, roots, dry, light brown (SM-ML).			0'
						4'-CAL-20/12
	10		SANDSTONE, firm, fine, partial loss of cementation, fractured, highly weathered, dry, orange.			9'-CAL-50/5
			SANDSTONE, very hard, fine, moderately cemented, dry, tan to grey.			14'-CAL-50/3
	20					19'-CAL-50/3
						24'-CAL-50/6
	30					29'-CAL-50/2
						34'-CAL-50/1
	40					39'-CAL-50/1
						44'-CAL-50/1
	50					
	60					
	70					
	80					
	90					
	100					

CAL =2-INCH I. D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,782, E 489,625	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-48	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	37'	39'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
8 (CAL)	---	---	None	7/9/70	7/9/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19 SIGNATURE OF INSPECTOR
6699.1	--	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						4 3/4" Tricone bit with air
	0		SAND, silty, roots, medium dense, dry, tan-orange (SM).			
						4'-CAL-50/6
			SANDSTONE, firm to very hard (firm 4' to 13'), strongly cemented 2' to 4' and moderately to weakly cemented below 4', tan to gray.			
	10					9'-CAL-20/12
						14'-CAL-50/6
						19'-CAL-50/4
	20					24'-CAL-50/0
						29'-CAL-50/0
	30					34'-CAL-50/0
						39'-CAL-50/1
	40		TOTAL DEPTH 39 FEET			
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FIG. K-50

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 390,177, E 489,318
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-49	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	1'	24'	25'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
5 (CAL)	---	---	None	7/10/70	7/10/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6685	---	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense, silty, roots, dry, light brown (SM)			4 3/4" Tricone bit with air
			SANDSTONE, hard to very hard, moderately to weakly cemented, gray to tan.			5'-CAL-50/3
	10					10'-CAL-50/1
						15'-CAL-50/1
	20		3" Clay layer at 23'			20'-CAL-50/0
			Very hard 24' to 25'			25'-CAL-50/0
	30		TOTAL DEPTH 25 FEET			
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FIG. K-51

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,223, E 489,731	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-50	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2.5'	29.5'	32'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
7 (CAL)	---	--	--	7/9/70	7/9/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6690.9	--	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					4 3/4" Tricone bit with air
	0–2.5		SAND, silty, dune sand, medium dense, roots, porous, dry, light brown (SM).			2'-CAL-30/12 6'-CAL-13/12
	10		SANDSTONE, hard to very hard, weakly to moderately cemented, 1/16" coal seams at 23±', tan to gray.			11'-CAL-50/5 16'-CAL-50/2
	20					21'-CAL-50/1
			CLAYSTONE, very hard, fossils, silty, sandy, brown, black.			25'-CAL-50/5
	30		CLAYSTONE, very hard, calcareous some fossils, dry, brown, black.			30'-CAL-50/0
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AXSS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER

CT = CORING TIME

WOODWARD - CLYDE & ASSOCIATES
DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,620, E 489,426
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-51
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	0'
8. DEPTH DRILLED INTO ROCK	50'
9. TOTAL DEPTH OF HOLE	50'
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 8 (CAL); Undisturbed
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	--
16. DATE HOLE	Started 7/10/70; Completed 7/10/70
17. ELEV. TOP OF HOLE	6701.3
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SANDSTONE, very hard, fine grained and silty, weakly cemented, dry, tan to grey, traces of coal, calcareous, roots, discolored, thin clay lenses 0' to 1.5'.			1' - CAL-50/6; 6'-CAL-50/1; 11'-CAL-50/1; 16'-CAL-50/1 — Weathered 0' to 1.5'. Drilled with air
	20		Occasional thin (1/8") discolored lenses, red-brown 18' to 20±'.			21'-CAL-50/0; 26'-CAL-100/0
	30		Siltstone, limy, highly cemented 24' to 25'.			31'-CAL-50/1; 36'-CAL-50/1
	40		CLAYSTONE, very hard, sandy, fractured, gypsum and limy material in fractures, layered, slightly moist, brown-black. Grades to sandstone 45' to 47.5'.			
	50		SANDSTONE, very hard, fine, some silty, dry, gray.			

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

FIG. K-53

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

Field	Entry
1. PROJECT NO.	12578
PROJECT NAME	JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,011, E 489,118
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-52
5. NAME OF DRILLER	JOHN MADISON
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED — DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	4'
8. DEPTH DRILLED INTO ROCK	56'
9. TOTAL DEPTH OF HOLE	60'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CHICAGO PNEUMATIC - CP-8
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 8 (AXSS); Undisturbed 2 (CAL)
14. TOTAL NO. CORE BOXES	2
15. ELEV. GROUND WATER	None
16. DATE HOLE	Started 7/11/70; Completed 7/12/70
17. ELEV. TOP OF HOLE	6695.9
18. TOTAL CORE RECOVERY FOR BORING (%)	70
19. SIGNATURE OF INSPECTOR	GUY F. TABOR, JR. AND ED. BRYLAWSKI

DEPTH	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	SAND, silty, loose to dense (dune sand), dry to slightly moist, tan (SM).			0'; 3 7/8" Tricone with Losloss & Quiktrol mud - with Wolf & Condet.
5				5'-CAL-36/12; NX Wireline core from 10'.
10	SANDSTONE, hard to very hard, weakly to moderately cemented, tan to gray; Limy sandstone, 3" @ 14', Siltstone Claystone, brown to gray, hard 14' to 16'. Limy, very hard sandstone 16' to 17'.	60	Box 1	10'-CAL-50/6 CT = 20 min.; 50% (thick) mud loss 15' to 28'.
15		80		15'-AXSS-50/7 CT = 20 min.
20		70		20'-AXSS-50/2 CT = 15 min.
25		50		25' AXSS-50/3 CT = 15 min.; 80% loss from 28'. Sealed with Celex at 32.5'
28	Limy, fossils, Claystone, brown to gray 28' to 35.5', trace gypsum in joints.			
30		70	32.5	30'-AXSS-50/3 CT = 30 min. 15 + 15 bit blocked.
32.5		10		
35	Limy layer at 37' - 2±". 1/2" thick claystone layers 37.5 and 38.0'. Claystone-Siltstone 38.5 to 40.0'.	90		35'-AXSS-50/2 CT = 15 min.
40		0		40'-AXSS-50/1 CT = 15 min.
45	Many thin claystone lenses 46' to 49'; 2" thick layer at 46.5'.	100	Box 2	45' CT = 15 min.
50	Claystone-Siltstone-Sandstone 49' to 50', predominately claystone, gypsum layers to 3/16" thick interbedded, claystone and sandstone 50' to 55'.	100		50'-AXSS-50/2 CT = 15 min.
55	Few thin claystone layers 55' to 58'. Sandstone 58' to 60', weakly cemented.	95		55' CT = 10 min.
60				60'-AXSS-50/1

TOTAL DEPTH 60 FEET

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER
CT = CORING TIME

FIG. K-54

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 389,856, E 490,364 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-53	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	13'	15'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
4 (CAL)		--	None	7/13/70	7/13/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6654.7	--	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose to medium dense, fine, silty, roots, dry, tan (SM-ML).			0' 1'-CAL-20/12 5'-CAL-50/3
	10		SANDSTONE, very hard, fine, silty, weakly cemented with occasional highly cemented layers, dry, tan to gray. Occasional thin 1/8±" clay lenses.			10'-CAL-50/4 15'-CAL-50/2
	20					
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

FIG. K-55

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 390,012, E 490,245	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-54	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVERBURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	3'	17'	20'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
5 (CAL)		--	None	7/13/70	7/13/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19 SIGNATURE OF INSPECTOR
6656.5	--	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose to medium dense, fine, silty, roots, dry, tan (SM).			0' 2'-CAL-43/12 5'-CAL-50/0
			SILT , dense, sandy, calcareous, porous, roots, dry, tan (ML).			
	10					10'-CAL-50/6
			SANDSTONE, very hard, fine, some silt, weakly cemented, dry, tan to light gray, highly cemented layer 5' to 6'. Occasional traces of clay 13' to 15' and 18±'.			15'-CAL-50/1
	20					20'-CAL-50/1
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

FIG. K-56

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 390,172, E 490,124	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-55	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 1' · 8. DEPTH DRILLED INTO ROCK 19' · 9. TOTAL DEPTH OF HOLE 20'
10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE ROLLER · 11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 5 (CAL) · Undisturbed · 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER None · 16. DATE HOLE Started 7/13/70 · Completed 7/13/70
17. ELEV. TOP OF HOLE 6657.9 · 18. TOTAL CORE RECOVERY FOR BORING (%) ---	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose to medium dense, silty, fine, roots, dry, tan (SM).			2'-CAL-31/12
	10		CLAYSTONE, medium hard, highly weathered, fractured, calcareous, very slightly moist, brown.			7'-CAL-50/6 12'-CAL-50/3
	20		SANDSTONE, very hard, fine, silty, weakly cemented, occasionally thin clay lenses 1/8±", dry, light gray.			17'-CAL-50/1 20'-CAL-100/1
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-57

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 389,544, E 490,287
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-56
5. NAME OF DRILLER DON IRVINE	6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 4'	8. DEPTH DRILLED INTO ROCK 16'
9. TOTAL DEPTH OF HOLE 20'	10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE ROLLER
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 4 (CAL) Undisturbed	14. TOTAL NO. CORE BOXES --
15. ELEV. GROUND WATER None	16. DATE HOLE Started 7/13/70 Completed 7/13/70
17. ELEV. TOP OF HOLE 6668.7	18. TOTAL CORE RECOVERY FOR BORING (%) --
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		FILL, sand, loose Drill platform			0' Weathered 0' to 2'.
			SANDSTONE, firm to medium hard, slightly porous, fractured, weathered, calcareous, weakly cemented, roots, dry, tan.			5'-CAL-30/12 Drilled with air.
	10					10'-CAL-50/12
			SANDSTONE, hard to very hard, fine, silty, weakly cemented, dry, tan. Harder below 13±'.			15'-CAL-50/2
	20					20'-CAL-100/1
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC & A 29

FIG. K-58

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,596, E 490,583	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-57	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	13'	15'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
4 (CAL)	--	----	None	7/13/70	7/13/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6653.4	---	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose to medium dense, fine, silty, roots, dry, tan (SM).			Drilled with air 0' 2'-CAL-30/12 5'-CAL-50/1
	10		SANDSTONE, firm to medium hard, occasional hard thin lenses, dry, tan, claystone lense 2" at 5'.			10'-CAL-50/2 15'-CAL-50/1
	20		SANDSTONE, very hard, fine, silty, weakly cemented with occasional well cemented lenses, dry to very slightly moist, tan. Well cemented layer 5.0' to 5.5'			
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,709, E 490,628
	3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-58	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[x] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	2'	13'	15'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4" TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
4 (CAL)		--	--	7/13/70	7/13/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6649.6	--	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant).
	0					Drilled with air
	0–2		SAND, loose to medium dense, fine, silty, roots, dry, light brown (SM-ML).			1'-CAL-15/12 5'-CAL-32/12
	2–7		SANDSTONE, medium hard, fine, silty, weakly cemented, dry, tan.			10'-CAL-50/2
	7–15		SANDSTONE, very hard, fine, silty, weakly cemented, dry, tan.			15'-CAL-50/4

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

CT = CORING TIME

FORM NO. WC&A 29

FIG. K-60

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 389,642, E 490,840
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-59
5. NAME OF DRILLER DON IRVINE	6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 4.5'	8. DEPTH DRILLED INTO ROCK 15.5'
9. TOTAL DEPTH OF HOLE 20'	10. SIZE AND TYPE OF BIT 4 3/4" TRI-CONE ROLLER
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 3 (CAL) Undisturbed	14. TOTAL NO. CORE BOXES --
15. ELEV. GROUND WATER --	16. DATE HOLE Started 7/13/70 Completed 7/13/70
17. ELEV. TOP OF HOLE 6643.1	18. TOTAL CORE RECOVERY FOR BORING (%) ---
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
						Drilled with air
	0		SAND, loose, fine, silty, roots, dry, tan (SP-SM).			0'
			CLAYSTONE, medium hard, sand, fractured, gypsum in fractures, weathered, dry to slightly moist, brown to black. Claystone-sandstone and very hard 15' to 17'. (Lewis shale).			5'-CAL-50/10 10'-CAL-45/12 15'-CAL-50/6
	20		SANDSTONE, very hard, fine, well cemented, dry, gray.			

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

FIG. K-61

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER CT = CORING TIME
AX-SS = 1 3/4-INCH O.D. SPLIT SPOON SAMPLER WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 390,180, E 491,090
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	4. HOLE NO. DH-JB-60
5. NAME OF DRILLER DON IRVINE	6. DIRECTION OF HOLE [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 15'	8. DEPTH DRILLED INTO ROCK 59.5'
9. TOTAL DEPTH OF HOLE 74.5'	10. SIZE AND TYPE OF BIT SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN Disturbed 6 (CAL) Undisturbed 7 (PITCHER)	14. TOTAL NO. CORE BOXES --
15. ELEV. GROUND WATER 6607	16. DATE HOLE Started 7/26/70 Completed 7/27/70
17. ELEV. TOP OF HOLE 6648.7	18. TOTAL CORE RECOVERY FOR BORING (%)
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium dense, sandy, sandstone chips, fine, dry, tan to gray. (Grades to dirty sand and claystone chips 12' to 15').			0'
				1.2/2.5	1	5' 7.5' ST = 2 min.
	10					12.5'-CAL-47/12
			CLAYSTONE, very hard, gypsum, fractured, moist, black.	2.3/2.5	2	17.5' 20.0' ST = 8 min.
	20					25'-CAL-50/4 No recovery
	30			1.5/2.5	3	30' 32.5' ST = 7 min.
						37.5'-CAL-50/3
WL 7/27/70 & 7/31/70	40			1.1/2.5	4	42.5' 45.0' ST = 10 min. 45' ▽ 0 Hour
	50					50.0'-CAL-50/3
			SANDSTONE, very hard, fine, wet, gray.			55.0' 56.0' ST = 10 min.
				1.0/1.0	5	
	60					61.0'-CAL-50/0 - No recovery
				1.0/1.0	6	66.0' 67.0' ST = 10 min.
	70					72.0'-CAL-50/3 - No recovery
				2.3/2.5	7	74.5' ST = 3 min.
	80					
	90					
	100					

FORM NO. WC&A 29

CAL = 2-INCH I. D. CALIFORNIA SAMPLER

WL = WATER LEVEL

ST = SAMPLE TIME (PITCHER SAMPLE)

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,071, E 490,713
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-61	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 3' / 8. DEPTH DRILLED INTO ROCK 52' / 9. TOTAL DEPTH OF HOLE 55'
10. SIZE AND TYPE OF BIT SEE REMARKS / 11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 4 (CAL), Undisturbed 5 (PITCHER) / 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER 6612 / 16. DATE HOLE Started 7/25/70 Completed 7/25/70
17. ELEV. TOP OF HOLE 6645.9 / 18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, medium dense, silty, roots, dry, tan (SM).			0'
			CLAYSTONE, hard, gypsum fractured, slightly moist, black.	2.3/2.5	1	5.0' – 7.5' ST = 5min
	10					12.5'-CAL-50/8
				2.1/2.5	2	17.5' – 20.0' ST = 6 min.
	20		CLAYSTONE, very hard, sandy, silty, trace of gypsum, dry, brown.			25.0'-CAL-50/5
				0/0.7	3	30.0' – 30.7' ST = 15 min; Drilled 0.7' too hard, changed to rock bit
WL 7/27/70 & 7/31/70	30		SANDSTONE, very hard, fine, highly cemented 30' to 34', weakly cemented 34' to 55', dry to wet, grey 30' to 34', light brown 34' to 55'.			35.0'-CAL-50/2
	40			2.3/2.5	4	40.0' – 42.5' ST =5 min.; 34' ▽ 24 Hr; 38' ▽ 0 Hr
						47.5'-CAL-50/1
	50			2.3/2.5	5	52.5' – 55.0' ST = 5 min.
	60					
	70					
	80					
	90					
	100					

CAL = 2-INCH I.D. CALIFORNIA SAMPLER ST = SAMPLE TIME (PITCHER SAMPLE)
WL = WATER LEVEL

FORM NO. WC&A 29

FIG. K-63

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,550, E 491,130	
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-62	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 0' / 8. DEPTH DRILLED INTO ROCK 50' / 9. TOTAL DEPTH OF HOLE 50'
10. SIZE AND TYPE OF BIT SEE REMARKS / 11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed 5 (CAL) Undisturbed 5 (PITCHER) / 14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER 6609 / 16. DATE HOLE Started 7/23/70 Completed 7/24/70
17. ELEV. TOP OF HOLE 6639.2 / 18. TOTAL CORE RECOVERY FOR BORING (%) ---	19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY (FEET)	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0–12	CLAYSTONE, medium hard, highly weathered, claystone chips, transported soil(?), silt, slightly calcareous, some gypsum, roots, slightly moist, gray to black.			4 3/4" Tricone rock bit with air and 3" I.D. Pitcher Sampler with air mist.
	0'				0'
	1'				1'-CAL-33/12
	4.0'–6.5'		0.5/2.5	1	4.0' ST = 5 min
	6.5'		1.4/2.2	2	6.5' ST = 10 min
	12–24	CLAYSTONE, hard, thin bedded, fractured, gypsum, slightly moist, black to gray to dark brown.			
	14.0				14.0-CAL-50/8
	19.0–21.5'		2.0/2.5	3	19.0 ST = 8 min 21.5'
	24–50	SANDSTONE, very hard, fine, highly cemented, light gray.			
	25.5				25.5-CAL-50/0
WL 7/27/70	30.0'–32.5'		2.3/2.5	4	30.0' ST = 4 min. 32.5'
	37.5'				37.5'-CAL-50/2
	42.5–45.0		2.3/2.5	5	42.5 ST = 4 min. 45.0
	50.0				50.0-CAL-50/2

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
WL = WATER LEVEL
ST = SAMPLE TIME

FIG. K-64

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 389,761, E. 491,410
3. DRILLING AGENCY	BOYLES BROS. DRILLING COMPANY
4. HOLE NO.	DH-JB-63
5. NAME OF DRILLER	DON IRVINE
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	17.5'
8. DEPTH DRILLED INTO ROCK	52.5'
9. TOTAL DEPTH OF HOLE	70.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 6 (CAL); Undisturbed 6 (PITCHER)
14. TOTAL NO. CORE BOXES	--
15. ELEV.	GROUND 6607; WATER
16. DATE HOLE	Started 7/24/70; Completed 7/24/70
17. ELEV. TOP OF HOLE	6630.3
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SILT, medium dense, sand, slightly cemented, calcareous, dry, light brown to tan (ML-SM).			0'
			1.5/2.5	1	5' – 7.5' ST = 4 min.
	10				12.5'-CAL-25/12
	17.5	CLAYSTONE, hard to very hard, thin bedded, gypsum in fractures, slightly moist, black.	1.7/2.5	2	17.5' – 20.0' ST = 1 min.
WL 7/31/70	20				22.7' 24 Hr G.W.
					25.0-CAL-50/12
	30		0.0/2.5	3	30.0 – 32.5' ST = 5 min.
			2.5/2.5	4	32.5' – 35.0' ST = 10 min.
	40				40.0'-CAL-50/3
	44	SANDSTONE, very hard, fine (highly cemented 44' to 46') generally moderately cemented, dry to wet, gray to tan.			45.0'-CAL-50/0 45.0' 0 Hr.
	50		2.3/2.5	5	50.0' – 52.5' ST = 5 min.
					57.5-CAL-50/1
	60			6	62.5' – 65.0' ST = 3 min.
	70				70.0'-CAL-50/1 Increased flow of water @ 70' into hole at time of drilling
	80				4 3/4" Tri-cone rock bit, except where Pitcher samples taken. Pitcher sampler with air-water mist.
	90				
	100				

FORM NO. WC&A 29

CAL = 2-INCH I.D. CALIFORNIA SAMPLER
WL = WATER LEVEL

ST = SAMPLE TIME (PITCHER SAMPLE)

FIG. K-65

WOODWARD - CLYDE & ASSOCIATES
DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 391,344, E 491,951
3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY	
4. HOLE NO. DH-JB-64	5. NAME OF DRILLER DON IRVINE
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN 43'
8. DEPTH DRILLED INTO ROCK 32'	9. TOTAL DEPTH OF HOLE 75'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	13. TOTAL NO. OF SAMPLES TAKEN Disturbed / Undisturbed
14. TOTAL NO. CORE BOXES --	15. ELEV. GROUND WATER 6578
16. DATE HOLE Started 7/27/70	Completed 7/28/70
17. ELEV. TOP OF HOLE 6628.9	18. TOTAL CORE RECOVERY FOR BORING (%)
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	RECOVERY FEET	PITCH. SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SAND, medium dense to hard, silty, fine, dry, tan (SM-ML).			0.0'
			2.3/2.5	1	5.0' – 7.5' ST = 3 min.
	10	SLIGHTLY CALCAREOUS (7.5' to 12'), slightly moist.			12.5'-CAL-50/10
	20		1.8/2.5	2	17.5' – 20.0' ST = 4 min.
		compacted, loosely cemented silt at 25'.			25.0'-CAL-50/8
	30		2.3/2.5	3	30.0' – 32.5' ST = 1 min.
		Moist at 32.5' Dense to hard sandy silt, some clay and claystone chips, altered, transported (37.5' to 42.5')			37.5'-CAL-50/10
	40	CLAYSTONE, very hard, thin bedded, fractured with gypsum in fractures, moist to wet.	2.3/2.5	4	42.5' – 45.0' ST = 3 min.
WL 7/31/70	50				50.0'-CAL-50/4
				5	55.0' – 57.5' ST = 8 min.
	60				62.5'-CAL-50/2
				6	67.5' ST = 10 min.
	70	SANDSTONE-LIMESTONE-CLAYSTONE, very hard, highly cemented, wet, gray.			68.0'-CAL-50/0
					73.0'-CAL-50/0
					75.0'
	80				4 3/4" Tri-cone rock bit with air and Pitcher sampler with air-water mist.
	90				
	100				

FIG. K-66

FORM NO. WC&A 29

CAL = 2-INCH I. D. CALIFORNIA SAMPLER ST= SAMPLE TIME (PITCHER SAMPLE)
WL = WATER LEVEL

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 386,920, E 489,559 3. DRILLING AGENCY BOYLES BROS. DRILLING COMPANY
4. HOLE NO. DH-JB-65	5. NAME OF DRILLER DON IRVINE

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
[X] VERTICAL	[ ] INCLINED	DEGREES WITH VERTICAL	3'	97'	100'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
4 3/4"TRI-CONE ROLLER	MSL	FAILING 1500

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
4 (CAL)		--	None	7/15/70	7/15/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6700±	----	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose to medium dense, fine, silty, dry, tan (dunes) (SP-SM).			Air Rotary 5'-CAL-50/10
	10		SANDSTONE, hard to very hard, fine, some silty, dry, gray.			10'-CAL-50/8
			CLAYSTONE-SANDSTONE, hard, fossiliferous.			15'-CAL-50/6
	20		SANDSTONE, very hard, weak to moderately cemented, fine, silty, dry, gray.			20'-CAL-50/2
	30 40		CLAYSTONE-SANDSTONE, very hard interbedded, dry, brown-gray.			
	50 60 70 80		SANDSTONE, very hard, light gray, dry.			
			CLAYSTONE-SANDSTONE transition zone, dry.			
	90		CLAYSTONE, very hard, fossiliferous, dark gray			
	100		TOTAL DEPTH 100.0 FEET			

CAL = 2-INCH I.D. CALIFORNIA SAMPLER

CT = CORING TIME

FORM NO. WC & A 29

FIG. K-67

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 389,926, E 489,556 (CENTER BOTTOM)	
3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY (SULENTA-SUBCONTR.)	
4. HOLE NO. TP-1	5. NAME OF DRILLER
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED DEGREES WITH VERTICAL	7. THICKNESS OF OVERBURDEN 3'
8. DEPTH DRILLED INTO ROCK 18.5'	9. TOTAL DEPTH OF HOLE 21.5'
10. SIZE AND TYPE OF BIT SEE REMARKS	11. DATUM FOR ELEV SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL CATERPILLAR D-8-H (46A)	
13. TOTAL NO. OF SAMPLES TAKEN: Disturbed / Undisturbed	14. TOTAL NO. CORE BOXES
15. ELEV. GROUND WATER None	16. DATE HOLE Started 7/26/70 Completed 7/26/70
17. ELEV. TOP OF HOLE 6691.7	18. TOTAL CORE RECOVERY FOR BORING (%)
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose to medium dense (dune sand), silty, roots, dry, tan.			0' 12.5' Dozer Blade with Single tooth ripper. 1500 cubic yards excavated in 6 hours, at rate of 250 cubic yards/hour.
	10		SANDSTONE, very hard, weathered, highly fractured, highly cemented, calcareous coating in fractures, silty, roots, dry, tan to light gray.			
	20		SANDSTONE, hard, weakly cemented, fine, rust stains, few roots, thin bedded, occasional uncemented, silty layers 1± inch, dry, tan.			
	30		SANDSTONE, very hard, thin coal seams at 6 inch spacing, 1/16±" thick, rust stained, 1±" bedding upper to thick bedded lower, few small 1" coal lenses and clayey pockets, slight vertical fracturing, dry, gray to tan.			
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-68

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,521, E 489,853 (CENTER BOTTOM)
	3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY (SULENTA-SUBCONTR.
4. HOLE NO. TP-2	5. NAME OF DRILLER

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
VERTICAL	INCLINED	DEGREES WITH VERTICAL	0.5'	23.5'	24.0'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
SEE REMARKS	MSL	CATERPILLAR D-8 (46A)

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
			None	7/25/70	7/25/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6696.0		EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium dense, sandy, sandstone chips, roots, dry, tan (SM-ML).			0' 12.5' Dozer Blade with single-tooth ripper
	10		SANDSTONE, very hard, weathered, fractured, transported, high cementation, roots, silt, slightly moist to dry, calcareous, tan.			
	20		SANDSTONE, hard, thin bedded, weakly cemented, slightly moist, tan, gray.			Excavation time = 12 hours. Excavation rate = 173 cubic yards/hour Volume = 2,080 cubic yards
	30		SANDSTONE, very hard, horizontal bedding on 1-inch fractures, well jointed vertically, moderately cemented, rust stain fractured, dry, tan-gray.			
	40		SANDSTONE, very hard, fine, moderately cemented, horizontal fractures, 1-inch bedding, occasional coal blebs and seams, water rust stained fractures, dry, gray.			
	50		SANDSTONE, very hard, fine, moderately cemented, massive, dry, tan.			
	60					
	70					
	80					
	90					
	100					

FORM NO. WC&A 29

FIG. K-69

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	
2. LOCATION (Coodinates or Station) N 390,347, E 490,007 (CENTER BOTTOM)	
3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY (SULENTA-SUBCONTR.)	
4. HOLE NO. TP-3	5. NAME OF DRILLER

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
VERTICAL	INCLINED	DEGREES WITH VERTICAL	4±'	9±'	13±'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
12.5-FOOT DOZER BLADE		CATERPILLAR D-8 (46A)

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
			None	7/26/70	7/26/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6659.7		GUY F. TABOR AND EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SAND, loose to medium dense, silty, roots, dry, tan (SM-ML).			0' Excavation time = 4 hours Excavation rate = 160 cubic yards/hour. Volume = 650 cubic yards
	10		SILTS, hard, sandy, gypsum, calcareous, caliche, slightly porous, few roots, dry, tan (ML-SM).			
			CLAYSTONE, hard, fractured, blocky, slightly moist, light brown.			
	20					
			SANDSTONE, very hard, well cemented top 2 feet to moderately cemented bottom 3 feet; jointed, fine.			
	30					
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-70

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,710, E 489,973 (CENTER BOTTOM)
	3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY
4. HOLE NO. TP-4	5. NAME OF DRILLER NORMAN HEAVEN

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
VERTICAL	INCLINED	DEGREES WITH VERTICAL	1'	11'	12'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
11-FOOT BLADE	MSL	MICHIGAN 180 Dozer

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE: Started	Completed
--	--	--	--	7/10/70	7/10/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6672.8		EDW. BRYLAWSKI AND GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
6673	0		SAND, silty, roots, dry, light brown (SM).			0'
	10		SANDSTONE, weakly cemented, layered, dips slight, about 5° to northeast, dry, tan to gray.			
	20					
	30					Volume of excavation = 300± cubic yards. Time required to excavate = 2 hours with Michigan 180 rubber-tired loader with 11-foot pusher blade.
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-71

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT	2. LOCATION (Coodinates or Station) N 369,615, E 489,493 (CENTER BOTTOM)
3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY	4. HOLE NO. TP-5
5. NAME OF DRILLER NORMAN HEAVEN	6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN 0'	8. DEPTH DRILLED INTO ROCK 10.7'
9. TOTAL DEPTH OF HOLE 10.7'	10. SIZE AND TYPE OF BIT 11-FOOT BLADE
11. DATUM FOR ELEV. SHOWN (TBM or MSL) MSL	12. MANUFACTURER'S DESIGNATION OF DRILL MICHIGAN 180 WHEEL LOADER
13. TOTAL NO. OF SAMPLES TAKEN Disturbed -- Undisturbed --	14. TOTAL NO. CORE BOXES
15. ELEV. GROUND WATER	16. DATE HOLE Started 7/21/70 Completed 7/21/70
17. ELEV. TOP OF HOLE 6711.3 (Center)	18. TOTAL CORE RECOVERY FOR BORING (%)
19. SIGNATURE OF INSPECTOR EDW. BRYLAWSKI AND GUY F. TABOR, JR.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0–10.7		SANDSTONE, very hard, well cemented, weathered, some roots, silt-filled pockets, slabby, bedding tilted, dry, light tan.			
			SANDSTONE, very hard, fine grained to silty, weakly to moderately cemented, bedding about 1/2" thick, vertical joints, slightly blockey, thin calcareous material along some horizontal joints, occasional silty sand filled pockets in horizontal and vertical directions, dry, tan.			
						Volume = 210 cubic yards. Excavation time with Michigan 180 Wheel type loader = 2 hours, for excavation rate of 105 cubic yards/hour.

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

*FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT 2. LOCATION (Coodinates or Station) N 389,705, E 489,434 (CENTER BOTTOM) 3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY
4. HOLE NO. TP-6	5. NAME OF DRILLER NORMAN HEAVEN

6. DIRECTION OF HOLE: VERTICAL / INCLINED	DEGREES WITH VERTICAL	7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
				6.5'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
11-FOOT BLADE	MSL	MICHIGAN 180 WHEEL LOADER

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
				7/21/70	7/22/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6700.7 (Center)		EDW. BRYLAWSKI AND GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0–6.5		SANDSTONE, hard, moderately cemented, fine, thin bedded 1/2", slightly blocky, occasional thin coal seams, rust stained, about 6" to 2' apart, dry, gray*.			Excavation time 1½ hours. Volume = 150 cubic yards. Rate = 100 cubic yards/hour. NOTE: *East end of pit 14±' higher than west end

Depth scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

FORM NO. WC & A 29

WOODWARD - CLYDE & ASSOCIATES DRILLING LOG	1. PROJECT NO. 12578 PROJECT NAME JIM BRIDGER POWER PLANT
	2. LOCATION (Coodinates or Station) N 389,742, E 489,311 (CENTER BOTTOM)
	3. DRILLING AGENCY MARTIN CONSTRUCTION COMPANY
4. HOLE NO. TP-7	5. NAME OF DRILLER NORMAN HEAVEN

6. DIRECTION OF HOLE			7. THICKNESS OF OVER-BURDEN	8. DEPTH DRILLED INTO ROCK	9. TOTAL DEPTH OF HOLE
VERTICAL	INCLINED	DEGREES WITH VERTICAL	2.0'	3.2'	5.2'

10. SIZE AND TYPE OF BIT	11. DATUM FOR ELEV. SHOWN (TBM or MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL
11-FOOT BLADE	MSL	MICHIGAN 180 Wheel Loader

13. TOTAL NO. OF SAMPLES TAKEN: Disturbed	Undisturbed	14. TOTAL NO. CORE BOXES	15. ELEV. GROUND WATER	16. DATE HOLE Started	Completed
--	--	--	--	7/22/70	7/22/70

17. ELEV. TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING (%)	19. SIGNATURE OF INSPECTOR
6691.4 (Center)		EDW. BRYLAWSKI AND GUY F. TABOR, JR.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium stiff, sandy, porous, roots, dry, light brown (ML-SM).			
			SILT, hard, sandy, slightly porous, some roots, sandstone fragments at contact with sandstone, dry, tan (ML).			
			SANDSTONE, very hard, massive, moderately cemented, calcareous, fine to silt sized grains, calcareous material in horizontal joints, dry, light gray.			
	10					
	20					
	30					Volume = 159 cubic yards. Michigan 180 wheel type loader excavation time: $1\frac{1}{2}$ hours for rate of 106 cubic yards/hour.
	40					
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-74

FORM NO. WC&A 29

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 388,736, E 490,860 (CENTER BOTTOM)
3. DRILLING AGENCY	MARTIN CONSTRUCTION COMPANY (SULENTA CONSTRUCTION COMPANY - SUBCONTRACTOR)
4. HOLE NO.	TP-8
5. NAME OF DRILLER	NORMAN HEAVEN AND PAUL BUCHANAN
6. DIRECTION OF HOLE	☐ VERTICAL ☐ INCLINED DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	0.5'
8. DEPTH DRILLED INTO ROCK	8.7'
9. TOTAL DEPTH OF HOLE	9.2'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEV. SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	MICH. 180 WHEEL LOADER & CAT D-8-H
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed -- Undisturbed --
14. TOTAL NO. CORE BOXES	--
15. ELEV. GROUND WATER	--
16. DATE HOLE	Started 7/23/70 Completed 7/23/70
17. ELEV. TOP OF HOLE	6673.2 (Center)
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium stiff, sandy, calcareous, roots, dry, tan (ML-SM).			
	10		SANDSTONE, very hard, highly cemented, fractured, bedding 3" to 4" thick, jointed parallel to bedding, some vertical jointing, calcareous coatings on upper layer, dry, gray.			
	20		SANDSTONE, very hard, highly cemented, massive, obscure bedding, occasional silty seams 1/8"±, dry, light gray.			
	30		Contact dips East about 5°.			
	40					(1) Mich. 180 wheel loader with 11-foot dozer blade. (2) Cat D-8-H 46A with 14' hydraulically operated blade.
	50					Reference Stake 61±' from end of pit.
	60					Initial volume to 3' depth, 111 cubic yards. Excavated by Mich. 180 wheel loader (1) in 2 hrs. Rate of Excavation: 55.5 cubic yards/hour.
	70					Remainder: 684 cubic yards, excavated by D-8-H tractor (2) in 5 hours. Rate of excavation: 137 cubic yards/hour.
	80					
	90					
	100					

FORM NO. WC&A 29

FIG. K-75

WOODWARD - CLYDE & ASSOCIATES

DRILLING LOG

1. PROJECT NO. 12578	PROJECT NAME JIM BRIDGER POWER PLANT
2. LOCATION (Coodinates or Station)	N 390,419, E 491,286 (CENTER BOTTOM)
3. DRILLING AGENCY	MARTIN CONSTRUCTION COMPANY (SULENTA CONSTRUCTION COMPANY - SUBCONTRACTOR)
4. HOLE NO.	TP-9
5. NAME OF DRILLER	BOYD CURTIS
6. DIRECTION OF HOLE	[x] VERTICAL [ ] INCLINED; DEGREES WITH VERTICAL
7. THICKNESS OF OVER-BURDEN	2'
8. DEPTH DRILLED INTO ROCK	22'
9. TOTAL DEPTH OF HOLE	24'
10. SIZE AND TYPE OF BIT	14-FOOT BLADE
11. DATUM FOR ELEV SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	CATERPILLAR D-8-H Dozer
13. TOTAL NO. OF SAMPLES TAKEN	Disturbed 5 (CAL); Undisturbed 1 (CUBE)
14. TOTAL NO. CORE BOXES	--
15. ELEV GROUND WATER	--
16. DATE HOLE	Started 7/29/70; Completed 7/29/70
17. ELEV. TOP OF HOLE	6644.1(Center)
18. TOTAL CORE RECOVERY FOR BORING (%)	
19. SIGNATURE OF INSPECTOR	EDW. BRYLAWSKI

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	%CORE RECOVERY	BOX or SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0		SILT, medium stiff, calcareous sandy, roots, porous, dry, light brown.			
	10		SANDSTONE, hard, weakly cemented, fine, very slightly moist, tan.			
	20		CLAYSTONE, very hard, fractured gypsum in fractures, thin bedded, 1/8" to 1/2" blocky, indistinct bedding, undulating strata laced with clay seams, rust to gray color at about 2" to 6" intervals throughout, 1" to 2±" thick, thinner bedding near surfaces, moist, gray to black.			
	30					
	40					Volume: 1,470 cubic yards. Excavation time: 7 Hours with a Cat D-8-H 46A with 14 Foot Blade. Excavation Rate: 210 cubic yards per hour. Test pit logged at reference stake.
	50					
	60					
	70					
	80					
	90					
	100					

FIG. K-76

FORM NO. WC&A 29

APPENDIX L

CORE LOGS

BECHTEL CORPORATION

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2
HOLE NO. [illegible]

PROJECT Jim Bridger Project ANGLE FROM HORIZ. 90° BEARING
LOCATION Nine Mile Section 3 BEGUN 3/21/70 COMPLETED 3/24/70
OVERBURDEN 2.0 feet DEPTH DRILLED INTO ROCK 98.1' TOTAL DEPTH OF HOLE 100.1
ELEV. WATER TABLE 6401.5' 4-4-70 NO. CORE BOXES 5 NO. SAMPLES TAKEN --
CORE RECOVERY (%) 95.4 FEET 93.6 MODEL & MAKE OF DRILL CP-8
GROUND ELEV. 6641.0 HOLE LOGGED BY M. M. Forrest DRILLER Boyles Bros.

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
100% water return throughout hole.	0							OVERBURDEN 0.0'-2.0' Weathered shale and sand.
	81							CLAY SHALE 2.0-45.4' Weathered, soft, dark gray to olive, contains gypsum, heavy. 31.3'-36.2'.
					6631.0	10		
	94							
Drilled with loloss mud.	100							
						20		
	100							
	100							
						30		
	100							
	100							
	100							
						40		
	100							
	100							SILTY SHALE 45.4'-71.7' Dark gray to black, massive, moderately hard. No gypsum below 47.7'. 0.2' lime at 63.3'.
						50		
	100							
	100							
						60		
	100							
	100							
						70		

Hole Size NX wireline

HOLE NO. [illegible]
SITE Nine Mile

PROJECT Jim Bridger Project

SHEET 2 OF 2

HOLE NO. NM-70-4

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.,	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
	100					70		SANDSTONE 71.7'-100.1'
No water table readings taken. To be taken later by survey crew.	100							Medium gray, medium to coarse grained, cementing variable, hard to moderately hard, some soft spots. Harder below 75'.
	100					80		
	89							
Water table at 39.5 feet 4-4-70	70					90		
	88							
					6540.9	100		BOTTOM OF HOLE 100.1 feet

Hole Size NX wireline

HOLE NO. NM70-4

SITE Nine Mile

BECHTEL CORPORATION
GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2
HOLE NO. NM70-[illegible]

PROJECT: Jim Bridger Project | ANGLE FROM HORIZ. 90° | BEARING:
LOCATION: Nine Mile Section 3 | BEGUN: 3/26/70 | COMPLETED: 3/2[illegible]/70
OVERBURDEN: 2.0' | DEPTH DRILLED INTO ROCK: 99.2' | TOTAL DEPTH OF HOLE: 101.2'
ELEV. WATER TABLE: 6613.7' 4-4-70 | NO. CORE BOXES: 5 | NO. SAMPLES TAKEN: 1
CORE RECOVERY (%): 91% | FEET: 90.3' | MODEL & MAKE OF DRILL: CP-8
GROUND ELEV. 6663.7 | HOLE LOGGED BY: M. M. Forrest | DRILLER: Boyles Bros.

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
Lost about 50% water return at 21 feet, thicker mud used below 35.8 feet resulted in 90% water return for rest of hole.	0					0		OVERBURDEN 0.0'-2.0' Sand
	87				6653.7	10		CLAY SHALE 2.0'-17.0' Olive, soft, weathered, much gypsum, iron stained.
	92							
	92					20		SILTY SHALE 17.0'-21.0' Dark gray to olive, weathered, flecks of iron stain, much gypsum.
	100							
Drilled with loloss mud.	80					30		SANDSTONE 21.0'-101.2' Medium gray to blue-gray, medium to coarse grained. Moderately hard to hard with soft areas. Harder below 47 feet.
	61							
	100					40		
	100							
	96					50		
	100							
	100					60		
	100							
	96					70		

Hole Size: NX wireline

HOLE NO. NM7[illegible]
SITE: Nine Mile

SHEET 2 OF 2

PROJECT Jim Bridger Project

HOLE NO. NM70-5

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.,	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
No water table readings taken. To be taken later by survey crew.	100					70		Many fossils below 70.6 feet to 85.6 feet, well cemented with lime.
	100					80		
	100							
Water table at 50.0 feet 4-4-70	96					90		
	88							
	96				6562.5	100		
								BOTTOM OF HOLE 101.2 FEET

Hole Size NX wireline

HOLE NO. NM70-5

SITE Nine Mile

BECHTEL CORPORATION

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2
HOLE NO. [illegible]

PROJECT Jim Bridger Project ANGLE FROM HORIZ. 90° BEARING [illegible]
LOCATION Nine Mile Section 3 BEGUN 3/27/70 COMPLETED [illegible]
OVERBURDEN 4.0' DEPTH DRILLED INTO ROCK 96.9' TOTAL DEPTH OF HOLE [illegible]
ELEV. WATER TABLE 6610.3' 4-4-70 NO. CORE BOXES 5 NO. SAMPLES TAKEN [illegible]
CORE RECOVERY (%) 79% FEET 86.3' MODEL & MAKE OF DRILL CP-8
GROUND ELEV. 6641.3 HOLE LOGGED BY M. M. Forrest DRILLER [illegible]

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
Water return 100% to 90% to 46.0', where lost 80% return. About 5%-10% water return below 50.6'. About 20% water return last run in hole.	0							OVERBURDEN 0.0'-4.0' Sand.
	94							SILTY SHALE 4.0'-10.3' Dark gray, soft, gypsum.
	98				6631.3	10		SANDSTONE 10.3'-100.9' Medium gray to blue-gray. Medium to coarse grained, hard to moderately hard with soft areas. Many fossils 50.0' to 70.8'. Solution voids of about 2.0' from 50.6-[illegible] additional small solution voids to 70.8'.
	96							
	96					20		
	98							
	98					30		
	100							
	92					40		
	94							
	80					50		
	70							
	78					60		
	91							
	90					70		

Hole Size NX wireline

HOLE NO. [illegible]
SITE Nine Mile

PROJECT Jim Bridger Project

HOLE NO. NM70-6

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.,	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
No water table readings taken; to be taken later by survey crew.	90					70		SANDSTONE
	94					80		
	86							
Water table at 31 feet 4-4-70	90					90		
	100							
	100				6540.4	100		BOTTOM OF HOLE 100.9 FEET

Hole Size NX wireline

HOLE NO. NM70-6

SITE Nine Mile

BECHTEL CORPORATION

SHEET 1 OF [illegible]

GEOLOGIC LOG OF DRILL HOLE

HOLE NO. [illegible]

PROJECT Jim Bridger Project ANGLE FROM HORIZ. 90° BEARING

LOCATION Nine Mile BEGUN 3/29/70 COMPLETED [illegible]

OVERBURDEN 52.5' DEPTH DRILLED INTO ROCK 38.8 TOTAL DEPTH OF HOLE [illegible]

ELEV. WATER TABLE 6657.2' 4-4-70 NO. CORE BOXES 5 NO. SAMPLES TAKEN [illegible]

CORE RECOVERY (%) FEET MODEL & MAKE OF DRILL CP-8

GROUND ELEV. 6625.2' HOLE LOGGED BY M. M. Forrest DRILLER Boyles Bros.

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
100% water return to 37.0 feet. 50% return for rest of hole.	0							OVERBURDEN 0.0'-52.5' Silt and silty clay to 11.0 feet. Sand, silt with some clay; mostly sand below 45.5'
	100							
	100					10		
	96							
Drilled with lo-loss mud.	100					20		
	100							
	100					30		
	96							
	100					40		
	86							
	4					50		
	85							SILTY SHALE 52.5'-90.3' Black, moderately hard, gypsum in joint at 68 feet.
	40					60		
	77							
	100					70		

Hole Size NX wireline

HOLE NO. [illegible]

SITE Nine Mile

PROJECT Jim Bridger Project

SHEET 2 OF 2

HOLE NO. NM70-7

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.,	% CORE RECOVERY	PRESSURE TESTS: LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MIN.	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
No water table readings taken ; to be taken later by survey crew.	100					70		No gypsum below 68 feet. Massive.
	100							
	98					80		
Water table at 48 feet 4-4-70	100							
						90		BOTTOM OF HOLE 90.3 FEET

Hole Size NX wireline

HOLE NO. NM70-7

SITE Nine Mile

TABLE I
CORE LOG

JOB NO.		NAME JIM BRIDGER POWER PLANT															HOLE NO. DH-JB-3									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
40.0/45.0	90	Claystone		x				X		S/I	0-10 45					GYP 1/8"		X					X			
45.0/50.0	65	Claystone		x				X		S/I	0-10 45					GYP 1/8"		X					X			
50.0/55.0	100	Claystone		x		X				S/I	0-10& 60							X				X				
55.0/60.0	90	Claystone		x		X				S	0-10							X				X				4 inches Limestone @ 59.5
60.0/65.0	100	Claystone		x	X					S	0-10							X				X				
65.0/70.0	100	Claystone		x		X				S	0-10& 30							X				X				With layers of Siltstone-Limestone
70.0/75.0	100	Claystone		x			X			S/I	0-10					Negligible		X			X					"
75.0/78.2	100	Sandstone	x			X				S	0-10					"				Loss of Cement	X					Claystone to 75.5
78.2/80.0	0	Sandstone								LOST		CORE														
80.0/85.0	60	Sandstone	x				X			S	0-10					"				"	X					Lost water circulate @ 83.0'
85.0/90.0	10	Sandstone	x				X			S	0-10					"				"	X					Weakly Cemented or Uncemented
90.0/95.0	15	Sandstone	x				X			S	0-10					"				"	X					"

LEGEND

* RARE = FRAGMENTS 1-2' LONG
SLIGHTLY = FRAGMENTS 6"-1' LONG
MODERATE = FRAGMENTS 2-6" LONG
HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

● S = SMOOTH
I = IRREGULAR
°A = ANGLE TO CORE

GYP = Gypsum
▲ CL = CLAY
H = HEMATITE
CA = CALCITE
Q = QUARTZ

■ C = CHLORITIZED
A = ARGILLIZED
B = BIOTIZED

♦ NON = 0-5%
SLIGHTLY = 5-20%
MODERATE = 20-50%
HIGHLY = 50-95%
TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-4 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE: Coarse	Medium	Fine	* DEGREE OF FRACTURING: R	SL	M	H	VH	● SHAPE OF FRACTURE: S/I	°A	▲ FRACTURE FILLING and THICKNESS: CL	H	CA	Q	OTHER	■ ALTERATION TYPE: C	A	B	OTHER	♦ ALTERATION DEGREE: N	SL	M	H	T	COMMENTS
40.0/45.0	40	Claystone		X				X		S / I	0-30					GYP 1/8"		X						X		
45.0/50.0	80	Claystone		X			X			S / I	0-10 / +60 ±					GYP 1/8"		X					X			
50.0/55.0	90	Claystone		X		X	X			S	0-10 70±					GYP 1/8"		X					X			
55.0/60.0	50	Claystone		X			X			S	0-10 & 30					GYP 1/8"		X				X				
60.0/65.0	60	Claystone		X		X				S	0-10					Negligible		X				X				
65.0/70.0	100	Claystone		X		X				I	0-10 & 75					"		X				X				
70.0/75.0	100	Claystone		X		X				S	0-10 & 30					"		X				X				
75.0/80.0	95	Claystone		X		X				S	0-10					"		X				X				
80.0/83.0	100	Claystone		X	X					S	0-10					"		X				X				
83/085.0	100	Sandstone	X	X		X				S	0-10					"				Loss of Cement		X				
85.0/90.0	85	Sandstone	X	X		X				S	0-10					"				"			X			
90.0/95.0	10	Sandstone	X	X			X			S	0-10					"				"				X		
95.0/99.0	100	Sandstone	X	X			X			S	0-10					"				"		X				Weakly Cemented

LEGEND

* RARE = FRAGMENTS 1-2' LONG
SLIGHTLY = FRAGMENTS 6"-1' LONG
MODERATE = FRAGMENTS 2-6" LONG
HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

● S = SMOOTH
I = IRREGULAR
°A = ANGLE TO CORE

GYP = Gypsum
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H = HEMATITE
CA = CALCITE
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■ C = CHLORITIZED
A = ARGILLIZED
B = BIOTIZED

♦ NON = 0-5%
SLIGHTLY = 5-20%
MODERATE = 20-50%
HIGHLY = 50-95%
TOTALLY = 95-100%

TABLE I

CORE LOG

JOB NO. | NAME: JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-6 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
20.0/26.0	75	Claystone		x			X			I	0-30					GYP 1/8"		X					X			
26.0/31.0	70	Claystone		x				X		I	All					GYP 1/8"		X						X		
31.0/36.0	80	Claystone		x			X			I	0-30					GYP 1/16"		X					X			
36.0/41.0	95	Claystone		x		X				I	0-20					GYP 1/16"		X				X				
41.0/46.0	70	Claystone		x			X			S/I	0-10 & 70±					GYP 1/16"		X					X			
46.0/51.0	95	Claystone		x			X			S/I	0-10 & 70±					GYP 1/16"		X					X			
51.0/56.0	5	Claystone		x	----------	L O S T	C O R E	----------																		
56.0/61.5	70	Claystone		x		X				S	0-10 & 70					GYP 1/8"		X				X				
61.5/66.0	20	Claystone		x			X			S	0-10					GYP 1/16"		X				X				
66.0/68.0	100	Claystone		x			X			S	0-10					GYP 1/16"		X				X				
68.0/73.0	100	Claystone		x		X				S	0-10= & 45					GYP 1/16"		X				X				
73.0/78.0	95	Claystone		x		X				S	0-10					Negligible		X			X					
78.0/83.0	100	Claystone		x		X				S	0-10 & 80±					"		X			X					
83.0/88.0	100	Clayst-Sandst		x	X	X				S	0-10					"		X			X					
88.0/93.0	100	Sandstone	x	x		X				S	0-10					"				Loss of Cement	X					
93.0/98.0	50	Sandstone	x	x		X				S	0-10					"				"			X			

LEGEND

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																									HOLE NO. DH-JB-7	PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE	Coarse	Medium	Fine	* DEGREE OF FRACTURING R	SL	M	H	VH	● SHAPE OF FRACTURE S/I	°A	▲ FRACTURE FILLING and THICKNESS CL	H	CA	Q	OTHER	■ ALTERATION TYPE C	A	B	OTHER	♦ ALTERATION DEGREE N	SL	M	H	T	COMMENTS
20.0/25.0	85	Claystone			x				X	X	I	0-10	X				GYP 1/8"		X					X	X		No waxed sample
25.0/30.0	95	Claystone			x				X	X	S/I	0-10	X				GYP 1/8"		X					X	X		" " "
30.0/35.0	100	Claystone			x				X	X	S/I	0-10	X				GYP 1/8"		X					X			" " "
35.0/40.0	95	Claystone			x				X	X	S/I	0-10	X				GYP 1/8"		X				X	X			" " "
40.0/45.0	100	Claystone			x			X	X		S/I	0-10	X				GYP		X				X	X			
45.0/50.0	85	Claystone			x			X			S	0-10	X				GYP		X				X				3" clay layer @ 48'
50.0/55.0	15	Claystone			x			X			S	0-10					Negligible		X			X	X				No waxed sample
55.0/60.0	100	Claystone			x		X	X			S	0-10					"		X			X	X				
60.0/65.0	80	Claystone			x	X	X				S	0-10					"		X			X					
65.0/70.0	100	Claystone			x	X	X				S/I	0-10 & 80					"		X			X					3" Sandstone layer @ 68'
70.0/75.0	75	Claystone			x	X	X				S/I	0-10 & 30					"		X			X					
75.0/80.0	100	Claystone			x	X	X				S	0-10					"		X			X					
80.0/85.0	95	Claystone		x	x	X	X				S	0-10					"		X			X					Sandstone @ 83'
85.0/90.0	100	Sandstone			x	X					S	0-10					"										

L E G E N D

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																HOLE NO. DH-JB-8									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
25.0/30.0	25	Claystone		X					X	I	All					GYP 1/8"		X						X		
30.0/35.0	80	Claystone		X		X	X			I	0-10 & various					GYP 1/8"		X					X			
35.0/40.0	40	Claystone		X			X			S	0-10					GYP 1/8"		X					X			
40.0/45.0	90	Claystone		X			X			S	0-10					GYP 1/16"		X				X				
45.0/50.0	70	Claystone		X			X			S	0-10	Negligible						X				X				
50.0/55.0	80	Claystone		X			X	X		S	0-10					"		X				X				
55.0/60.0	100	Claystone		X		X	X			S/I	0-5					GYP 1/16"		X			X					1/16" Gypsum seam @ 56'
60.0/65.0	55	Claystone		X	X	X				S	0-5	Negligible						X			X					Lost part of core
65.0/70.0	100	Claystone		X	X	X				S	0-5					"		X			X					
70.0/75.0	65	Claystone		X			X			S	0-10					"		X			X					
75.0/80.0	100	Claystone		X				X		S	0-10					"		X			X					
80.0/85.0	55	Claystone		X	X	X				S	0-10					"		X			X					
85.0/90.0	100	Claystone		X		X				S/I	0-20					"		X			X					Transition zone grey harder claystone.
90.0/95.0	95	Clayst-Sandst	X	X	X					S	0-5					"		X			X					Stong Cementation 93'-95'
95.0/100.0	95	Sandstone	X	X	X	X				S	0-5					"		X			X					Weakly cemented

LEGEND

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T A B L E I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																	HOLE NO. DH-JB-13						PAGE 1 OF 1		
DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
33.0/39.0	80	Claystone		X				X		-	All	X				GYP 1/8"		X						X		
39.0/44.5	100	Claystone		X			X	X		S	0-10 45 & 90	X	T			GYP 1/8"		X					X	X		
44.5/49.5	100	Claystone		X			X			S	0-10 45 & 90	X	T			GYP 1/8"		X					X			
49.5/54.5	100	Claystone		X			X			S	0-10	X	T					X					X			
54.5/59.5	100	Claystone		X		X				S	0-10	X	T			GYP 1/16"		X				X				
59.5/64.5	100	Claystone		X		X				S	0-10	X	T			Sand Trace		X				X				
64.5/69.5	100	Claystone		X	X					S	0-10			Negligible				X					X	X		Some soft zones
69.5/74.5	100	Claystone		X	X					S	0-10					"		X					X	X		" " "
74.5/79.5	100	Claystone		X	X					S	0-10					"		X				X				
79.5/84.5	85	Claystone		X		X				S	0-20					"		X				X				
84.5/89.5	25	Claystone		X	1 piece 16"					S	0-10					"		X				X				3" sandstone @ 90°
89.5/91.0	0	Claystone		X																						
91.0/91.5	90	Claystone		X	X					S	0-10					"		X				X				
95.0/100.0	100	Clystn/silty		X	X					S	0-10					"				None	X					
00.0/103.5	100	Clystn/silty		X	X					S	0-10					"				"	X					
03.5/105.0	100	Sandstone	X	X	X											"				"	X					

LEGEND

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TABLE I

CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. DH-JB-15	PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE				* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Rock Type	Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
15.0/20.0	0	Claystone			X	----	----	----	----	----	----	LOST	CORE	----	----	----	----	----	----	----	----	----	----	----	----	----	
20.0/25.8	60	Claystone			X				X	X	I	All					GYP 1/8"		X						X		
25.8/30.5	65	Claystone			X				X		I	All					GYP 1/8"		X					X			
30.5/35.7	95	Claystone			X			X			I	0-10					GYP 1/8"		X					X			
35.7/40.8	100	Claystone			X			X			I	0-10					GYP 1/8"		X					X			
40.8/44.8	85	Claystone			X			X			S	0-10					GYP 1/8"		X					X			
44.8/49.3	65	Claystone			X			X			S	0-10					GYP 1/8"		X					X			Sample broke apart when forced out of core barrel.
49.3/54.8	100	Claystone			X		X				S	0-10 one 70°		Trace			GYP 1/8"		X				X	X			
54.8/60.0	100	Claystone			X		X				S/I	0-10 70-90		T					X				X				
60.0/65.5	100	Claystone			X		X				S/I	0-10 80±					Negligible		X				X				
65.5/70.5	100	Claystone			X	X					S	0-10					"		X				X				
70.5/76.0	100	Claystone			X	X					S	0-10					"		X				X				
76.0/81.5	100	Claystone			X	X					S	0-10					"		X				X				3 inches of sandston @77.5
81.5/86.5	100	Claystone			X		X				S	0-10					"				None	X					Some softer clay layers.
86.5/91.5	100	Claystone			X	X					S	0-10					"		X				X				
91.5/96.5	100	Clystn-Sndstn		X	X	X					S	0-10					"				None	X					
96.5/100.0	100	Sandstone		X	X		X				S	0-10					"				"	X					

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. DH-JB-18	PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
32.5/35.0	80	Claystone		x		X				S	0-10	X				1/8"		X					X			
35.5/38.5	90	Claystone		x			X			S	0-10	X	T			GYP 1/8"		X					X			
38.5/41.0	80	Claystone		x		X				S	0-10	X						X						X		Soft
41.0/46.5	30	Claystone		x			X			S	0-10	X						X					X			
46.5/55.0	60	Claystone		x				X		S	0-90	X	T			GYP 1/8"		X					X			Few vertical fractur
55.0/63.0	15	Claystone		x			X			S	0-10	X	T			GYP 1/8"		X					X			Core lost twice
63.0/68.0	90	Claystone		x	X					S	0-10					Negligible		X				X				
68.0/73.0	100	Claystone		x	X					S	0-10					"		X			X					
73.0/73.5	100	Sandstone															Loss of Cementation								X	Uncemented
73.5/77.0	100	Sandstone	x	x	X					S	0-10					"					X					Strong Cementation
77.0/78.0	100	Sandstone	x	x					X	S	0-10					"				"				X		
78.0/83.0	100	Sandstone	x	x		X	X			S	0-10					"				"		X	X			
83.0/85.0	100	Sandstone	x	x					X	-	------					"				"				X	X	Very slightly Cemented
85.0/88.0	100	Sandstone	x	x			X			S	0-10					"				"			X			
88.0/93.0	100	Sandstone	x	x			X			S	0-10 few 80±					"				"		X				
93.0/98.0	100	Sandstone	x	x			X			S	0-10 few 80±					"				"		X				
98.0/101.0	100	Sandstone	x	x			X			S	few 80±					"				"		X				
101.0/103.0	100	Sandstone	x	x	X					NONE						"				"	X					Strong Cementation

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																HOLE NO. DH-JB-19									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
30.0/35.0	25	Claystone		X			X	X		S/I	0-10 30±					GYP 1/8"		X					X	X		
35.0/40.0	80	Claystone		X		X	X			S	0-10 40±					GYP 1/8"		X				X	X			
40.0/45.0	80	Claystone		X		X	X			S	0-10 20±					GYP 1/8"		X				X	X			
45.0/50.0	100	Claystone		X		X	X			S	0-10 70±					GYP 1/8"		X				X				
50.0/55.0	100	Claystone		X		X	X			S	0-10 & 50-70±					GYP 1/8"		X				X				
55.0/60.0	100	Claystone		X		X	X			S	0-10°					GYP 1/8"		X				X				
60.0/65.0	100	Claystone		X		X	X			S	0-10 & 60					GYP 1/16"		X			X					
65.0/70.0	100	Claystone		X	X	X				S/I	0-10 & 30					Negligible		X			X					
70.0/75.0	100	Claystone			X	X				S	0-10					"		X			X					
75.0/80.0	100	Claystone			X	X				S	0-10					"		X			X					Sandstone at 79.5
80.0/85.0	70	Sandstone	X		X	X				S	0-10					"					X					

LEGEND

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TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-22 | PAGE 1 OF 2

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
5.0/10.0	5	NO RECOVERY																								Transition zone CS & SS frag. in clay.
10.0/16.0	40	Claystone		x					X	I	All					GYP 1/16"		X						X		None waxed for testing.
16.0/20.0	50	Claystone		x				X		S/I	0 & 30					GYP 1/16"		X					X			" " "
20.0/25.0	20	Claystone		x				X		I	All					GYP 1/16"		X					X			" " "
25.0/30.0	70	Claystone		x		X	X			S/I	0-10 & 300					GYP 1/8"		X					X			Clay lenses 1" thick about 28'-30'
30.0/35.0	0	NO RECOVERY																								
35.0/40.0	95	Claystone		x		X	X			S	0-10 & 35-40					GYP 1/8"		X					X			
40.0/45.0	100	Claystone		x		X	X			S	0-10 50±					GYP 1/8"		X					X			
45.0/50.0	100	Claystone		x		X	X			S/I	0-10 50±					GYP 1/8"		X				X				
50.0/55.0	100	Claystone		x		X				S	0-10					Negligible		X				X				
55.0/60.0	90	Claystone		x		X				S	0-10 80±					"		X				X				
60.0/65.0	100	Claystone		x		X				S	0-10					"		X				X				
65.0/70.0	100	Claystone		x	X	X				S	0-10					"		X				X				
70.0/75.0	100	Claystone		x	X					S	0-10 & 70±					"		X				X				
75.0/80.0	70	Claystone		x		X				S	0-10					"		X			X					Lens 3" limestone or siltstone at 79±
80.0/85.0	100	Claystone		x		X				S/I	0-10					"		X			X					
85.0/90.0	95	Clst-Siltst		x		X				S	0-10 90					"		X			X					Harder siltstone-limestone 86' to 90'
90.0/95.0	95	Siltst-Sndst	x	x	X					S	0-10					"					X					

LEGEND

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HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

● S = SMOOTH
I = IRREGULAR
°A = ANGLE TO CORE

GYP = Gypsum
▲ CL = CLAY
H = HEMATITE
CA = CALCITE
Q = QUARTZ

■ C = CHLORITIZED
A = ARGILLIZED
B = BIOTIZED

♦ NON = 0-5 %
SLIGHTLY = 5-20 %
MODERATE = 20-50 %
HIGHLY = 50-95 %
TOTALLY = 95-100 %

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-22 | PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
95.0/100.0	100	Sandstone	x	x		X				S/I	0-10					Negligible					X					Medium Grained Below 98"

LEGEND

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TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-23 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			*DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
10.0/15.0	30	Claystone		x				X	X	I	0-10					GYP 1/8"±		X					X	X		None waxed for tests.
15.0/20.0	50	Claystone		x				X	X	I	0-10					GYP 1/8"±		X					X	X		
20.0/25.0	70	Claystone		x				X	X	I	0-10					GYP 1/8"±		X					X	X		None waxed for tests. 3" brown.
25.0/30	40	Claystone		x				X	X	I	0-10					GYP 1/16"		X					X	X		Clay layer at 24' None waxed for tests
30.0/35.0	100	Claystone		x				X	X	I	0-10					GYP 1/16"		X					X			
35.0/40.0	70	Claystone		x				X		S/I	0-10					GYP 1/16"		X					X			
40.0/46.0	100	Claystone		x		X	X			S/I	0-10 & 60					GYP Trace		X					X			3" limestone layer at 44.5'±
46.0/51.0	95	Claystone		x			X	X	X	S/I	0-10 & all					Negligible		X					X			
51.0/56.0	100	Claystone		x		X	X			S	0-10 & 40					"		X				X				10" limestone layer at 56'±
56.0/61.0	100	Claystone		x		X	X	X		S	0-10					"		X				X				
61.0/66.0	100	Clayst-Sandst	x	x		X	X		X	S/I	0-10 & all					"					X					63'-64' well cemented light grey sandstone layer.
66.0/71.0	70	Sandstone	x	x		X	X			S	0-10					"					X					Dropped 1½' of core.
		----------------------------------L O S T C O R E----------------------------------																								Drilled 2' attempting to recover lost core unsuccessfully.
71.0/73.0	0																									

L E G E N D

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HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

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GYP=Gypsum
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TABLE I
CORE LOG

JOB NO.	NAME: JIM BRIDGER POWER PLANT																HOLE NO. DH-JB-24									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
30.0/35.0	80	Claystone		X				X	X	I	All					GYP 1/4"		X						X		
35.0/40.0	75	Claystone		X				X		S/I	0-20					GYP 1/8"		X					X			Lost 1' from 45-46' washing hole after drive.
41.0/46.0	40	Claystone		X			X			S	0-20					GYP 1/8"		X					X			
46.0/51.0	100	Claystone		X		X				S	0-10 & 30					GYP 1/8"		X					X			3"clay layer at 48' 2"clay layer at 49'
51.0/56.0	45	Claystone		X			X	X		S	0-10					GYP 1/8"		X					X			
57.0/62.0	85	Claystone		X		X	X			S	0-10					GYP 1/4"		X				X	X			
62.0/67.0	100	Claystone		X		X	X			S	0-10					Negligible		X				X				
67.0/72.0	60	Claystone		X			X	X		S/I	0-10					"		X				X				
72.0/77.0	100	Claystone		X	X	X				S/I	0-10 & 60					"		X				X				
77.0/82.0	100	Claystone		X		X	X			S/I	0-10 & 180-90					"		X				X				
82.0/87.0	55	Claystone		X			X			S/I	0-10					"		X				X				2"limestone & grey clay layer at 84.5'
87.0/92.0	100	Claystone		X		X				S	0-10 & 80					"		X				X				
92.0/97.0	75	Claystone		X			X			S	0-10					"		X				X'				
97.0/102.0	25	Claystone		X			X	X		S/I	0-10					"		X			X	X				
102.0/107.0	70	Claystone		X			X			S	0-10					"		X			X	X				
107.0/112.0	90	Claystone		X	X	X				S	0-10					"		X			X					
112.0/117.0	100	Claystone		X		X	X			S	0-10					"		X			X					

LEGEND

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TABLE. I
CORE LOG

JOB NO.		NAME JIM BRIDGER POWER PLANT																		HOLE NO. DH-JB-27						PAGE 1 OF 2
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
15.0/20.0	80	Claystone		X				X	X	S/I	All					GYP 1/8"		X						X		
20.0/25.0	40	Claystone		X				X	X	S/I	All					GYP 3/16"		X						X		
25.0/27.0	-0-	Claystone		X	NO RECOVERY																					Tried Air Mist Did Not Work
27.0/32.0	60	Claystone		X				X	X	S/I	All					GYP 3/16"		X						X		
32.0/37.0	-0-	Claystone		X	NO RECOVERY																					Lost Circulation
37.0/40.0	35	Claystone		X			X			S/I	0-10 & 20					GYP 1/8"		X					X			
40.0/45.0	80	Claystone		X		X	X			S	0-10 30±					GYP 3/8"		X				X	X			
45.0/50.0	70	Claystone		X		X	X			S	0-10 40±					GYP 1/4"		X				X	X			
50.0/55.0	80	Claystone		X		X	X			S	0-10 40±					GYP 1/8"		X				X	X			Dropped core recovered part
55.0/60.0	55	Claystone		X			X	X		S/I	0-10					GYP 1/8"		X				X	X			Dropped core recovered part
60.0/65.0	100	Claystone		X			X			S/I	0-10 & 90±					Negligible		X				X				
65.0/70.0	70	Claystone		X		X				S	0-10					"		X					X			Dropped core recovered part
70.0/75.0	75	Claystone		X		X				S	0-10					"		X				X				1" hard siltstone layer at 73'
75.0/80.0	80	Claystone		X	X	X				S	0-10					"		X				X				
80.0/85.0	100	Claystone		X		X				S/I	0-10 & 20±					"		X				X				2" very hard limy siltstone layer at 85'
85.0/90.0	100	Claystone		X		X				S/I	10±					"		X				X				
90.0/95.0	100	Claystone		X		X	X			S/I	0-10					"		X			X					Harder at 95'
95.0/100.0	100	Clayst.-Siltst.		X	X		X			S	0-10					"		X			X					Transition Zone

LEGEND

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TOTALLY = 95-100%

TABLE I

CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-27 | PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
100.0/105.0	100	Clayst-Siltst-Sandst.			X	X				S / I	0-10 & 20					Negligible				Loss of cement	X		X			Sandstone at 102' weakly cemented 104' to 105'

L E G E N D

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TOTALLY = 95-100%

TABLE I

CORE LOG

JOB NO. | NAME: JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-28 | PAGE 1 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE: Coarse	Medium	Fine	*DEGREE OF FRACTURING: R	SL	M	H	VH	● SHAPE OF FRACTURE: S/I	°A	▲ FRACTURE FILLING and THICKNESS: CL	H	CA	Q	OTHER	■ ALTERATION TYPE: C	A	B	OTHER	♦ ALTERATION DEGREE: N	SL	M	H	T	COMMENTS
15.0/20.0	75	Claystone		x			X	X		S/I	0-10					GYP 1/8"		X						X		
20.0/25.0	70	Claystone		x			X	X		S/I	0-10 & 20					GYP 1/8"		X					X			
25.0/30.0	85	Claystone		x			X	X		S/I	0-10					GYP 1/8"		X					X			
30.0/35.0	90	Claystone		x			X			S/I	0-10 30 & 70					GYP 1/8"		X					X	X		Grey & tan at 31-32' Clay seams 2-3" thick
35.0/40.0	95	Claystone		x			X			S/I	0-10 20 & 45					GYP 1/8"		X					X	X		
40.0/45.0	90	Claystone		x			X			S	0-10 & 30					GYP 1/8"		X					X			
45.0/50.0	45	Claystone		x			X			S	0-10 & 50					GYP 1/8"		X					X			Dropped core•unable to recover
50.0/55.0	95	Claystone		x		X				S	0-10					GYP 1/8"		X				X				Gypsum fractures less frequent
55.0/60.0	100	Claystone		x		X				S/I	0-10					Negligible		X				X				
60.0/65.0	100	Claystone		x		X	X			S	0-10 & 20 & 40					"		X				X				
65.0/70.0	75	Claystone		x		X	X			S	0-10 & 50 & 80					"		X				X				Dropped 14". 4"clay layer at 68'
70.0/75.0	100	Claystone		x	X	X				S	0-10 & 40					"		X				X				3" clay layer at 73'
75.0/80.0	100	Claystone		x		X	X			S/I	0-10 40±		Trace			"		X				X	X			
80.0/85.0	60	Claystone		x	X		X			S	0-10 & 80±					"		X			X		X			Bit plugging with clay-from altered zone.
85.0/90.0	100	Claystone		x		X	X			S/I	0-10 & all					"		X				X	X			Some highly fractured and partially altered zones.
90.0/95.0	100	Claystone		x		X				S/I	0-10					"		X				X				2" siltstone layer at 91'± (limy)
95.0/100.0	100	Claystone		x		X				S/I	0-10					"		X				X				Some soft altered layers 1-2"

LEGEND

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SLIGHTLY = 5-20 %
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TOTALLY = 95-100 %

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-28 | PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
100.0/105.0	75	Claystone		x		X	X			S/I	0-10					Negligible		X				X				6" siltstone at 100-100.5'
105.0/110.0	100	Clayst.-Siltst.-Sandst.				X				S	0-10					"		X				X				Clay alterations in siltstone-claystone

L E G E N D

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TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-35 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE: Coarse	Medium	Fine	* DEGREE OF FRACTURING: R	SL	M	H	VH	● SHAPE OF FRACTURE: S/I	°A	▲ FRACTURE FILLING and THICKNESS: CL	H	CA	Q	OTHER	■ ALTERATION TYPE: C	A	B	OTHER	♦ ALTERATION DEGREE: N	SL	M	H	T	COMMENTS
8.0/11.0	100	Claystone		X			X			S	0-10					GYP 1/16"		X					X			
11.0/16.0	90	Sandstone	X	X			X	X		S	0-10					Negligible				Partial Loss Cement			X			
16.0/21.0	100	Sandstone	X	X					X	I	All					"				Loss Cement				X	X	
40.0/45.0	85	Sandstone	X	X				X	X	S/I	0-10 All					"				Loss Cement				X		Coal seams
45.0/50.0	90	Sandstone		X		X				S	0-10					"				Loss Cement				X		Coal seams

LEGEND

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MODERATE = FRAGMENTS 2-6" LONG
HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

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SLIGHTLY = 5-20 %
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HIGHLY = 50-95 %
TOTALLY = 95-100 %

TABLE I
CORE LOG

JOB NO.		NAME JIM BRIDGER POWER PLANT														HOLE NO. DH-JB-37									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE				COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
50.0/55.0	100	Claystone		X		X	X			S/I	0-10 & 40					GYP 1/4"		X						X		
55.0/60.0	95	Claystone		X		X	X			S/I	0-10 & 20					GYP 1/8"		X					X	X		
60.0/65.0	100	Claystone					X			S	0-10					GYP 1/8"		X					X	X		
65.0/70.0	90	Claystone					X			S	0-10					Negligible		X					X			
70.0/75.0	40	Claystone				X	X			S	0-10					"		X					X			
75.0/80.0	100	Claystone			X	X				S	0-10 & 60					"		X				X				
80.0/85.0	100	Claystone			X	X				S	0-10 & 60±					"		X				X	X			
85.0/90.0	100	Claystone			X	X				S	0-10 & 45±					"		X			X	X				
90.0/95.0	100	Claystone		X	X	X				S	0-10					"		X			X	X				Limy 94-95' and very hard.

LEGEND

* RARE = FRAGMENTS 1-2' LONG
SLIGHTLY = FRAGMENTS 6"-1' LONG
MODERATE = FRAGMENTS 2-6" LONG
HIGHLY = FRAGMENTS AVERAGE 2" LONG
VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

● S = SMOOTH
I = IRREGULAR
°A = ANGLE TO CORE

GYP=Gypsum
▲ CL = CLAY
H = HEMATITE
CA = CALCITE
Q = QUARTZ

■ C = CHLORITIZED
A = ARGILLIZED
B = BIOTIZED

♦ NON = 0-5%
SLIGHTLY = 5-20%
MODERATE = 20-50%
HIGHLY = 50-95%
TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO.	NAME	JIM BRIDGER POWER PLANT	HOLE NO.	DH-JB-39	PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE: Coarse	Medium	Fine	* DEGREE OF FRACTURING: R	SL	M	H	VH	● SHAPE OF FRACTURE: S/I	°A	▲ FRACTURE FILLING and THICKNESS: CL	H	CA	Q	OTHER	■ ALTERATION TYPE: C	A	B	OTHER	♦ ALTERATION DEGREE: N	SL	M	H	T	COMMENTS
11.5/21.5	45	Sandstone	x	x				X		S	0-10 & 30					GYP Trace				Loss of Cement				X		
21.5/29.5	75	Sandstone	x	x				X		S	0-10 & 30					LIG 1/16"				"				X		
29.5/40.0	50	Sandstone	x	x				X		S	0-10 & 20									"				X		
40.0/50.0	50	Sandstone	x	x				X		S	0-10									"				X		Fossils and Lignite at 49'±
50.0/60.0	90	Sandstone	x	x		X	X			S	0-10 & 30					LIG Trace				"	X					Brown Siltstone 51-52' and Fossils 56'
60.0/70.0	80	Sandst.-Clayst.	x	x		X				S	0-10 20 & 45					LIG Trace		X		"	X					Claystone at 67.5' to 70'
70.0/75.0	100	Sandst/Clayst/Siltst.	x	x		X	X			S/I	0-10					LIG		X		"	X					
75.0/80.0	100	Sandstone	x	x			X			S	0-10 45±									"	X					
80.0/87.0	60	Sandstone	x	x				X		S	0-10 45±									"			X	X		Few Fossils & Lignite
87.0/90.0	70	Sandstone	x	x				X		S	0-10 45±									"			X	X		" " " "
90.0/100.0	90	Sandstone	x	x		X				S	0-10									"	X	X				" " " "

L E G E N D

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MODERATE = FRAGMENTS 2-6" LONG
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SLIGHTLY = 5-20%
MODERATE = 20-50%
HIGHLY = 50-95%
TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																HOLE NO. DH JB-40									PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
10.0/20.0	30	Sandstone	x	x					X	S	0-10 & all					Negligible				Loss of Cement				X		
20.0/30.0	100	Sandstone	x	x			X	X		S	0-10 & 45±					"				"				X		
30.0/40.0	100	Sandstone	x	x			X	X		S	0-10					"		X		"				X		Feldspars alternating to clay below 35'
40.0/50.0	90	Sandstone	x	x			X	X		S	0-10					"		X		"			X	X		Fossils at 49.5'±
50.0/60.0	95	Sandst/Siltst/Clayst	x	x			X	X		S	0-10					"		X		"			X			Fossils 55-67'
60.0/70.0	95	Sandst/Siltst/Clayst	x	x		X	X			S	0-10					"		X		"			X			With some Siltstone and Claystone.
70.0/80.0	90	Sandstone	x	x			X	X		S	0-10 & 20					"		X		"			X			Few thin Claystone layers 76-78'
80.0/90.0	55	Sandstone	x	x			X			S	0-10					"		X		"				X		
90.0/100.0	95	Sandstone	x	x			X			S	0-10					"		X		"				X		

LEGEND

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SLIGHTLY = 5-20%
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HIGHLY = 50-95%
TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-41 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
15.0/25.0	85	Sandstone	x				X	X		S	0-10									Loss of Cement				X		
25.0/35.0	95	Sandstone	x				X	X		S	0-10 & 20									Partial Loss of Cement			X			Thin coal seams 1/16" at 30'±

LEGEND

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MODERATE = FRAGMENTS 2-6" LONG
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TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-42 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE				* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				◆ ALTERATION DEGREE					COMMENTS
		Rock type	Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
11.0/20.0	20	Sandstone		x	x			X	X	X	S	All							X		Loss of Cement					X	
20.0/30.0	65	Sandstone		x	x			X			S	0-10 & 20					LIG 1/32"				"			X	X		Thin Lignite layer
30.0/40.0	35	Sandstone		x	x			X			S	0-10 & 20					LIG 1/32"				"			X	X		
40.0/50.0	70	Sandst/Siltst						X			S	0-10									"			X	X		Little Lignite and some Fossils

LEGEND

* RARE = FRAGMENTS 1-2' LONG
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MODERATE = FRAGMENTS 2-6" LONG
HIGHLY = FRAGMENTS AVERAGE 2" LONG
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I = IRREGULAR
°A = ANGLE TO CORE

LIG=Lignite
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H = HEMATITE
CA = CALCITE
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SLIGHTLY = 5-20%
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TOTALLY = 95-100%

TABLE I
CORE LOG

JOB NO.		NAME JIM BRIDGER POWER PLANT																HOLE NO. DH-JB-43								PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
		Sandstone																								
11.0/20.0	45		X	X	NOT APPLICABLE											Negligible				Loss of Cement					X	Few Lignite layers at 1/8"±
		Sandstone																								
20.0/30.0	100		X	X	TO TOTALLY											"		X		"				X	X	More clayey & slightl more cemented below 25'.
		Sandstone																								
30.0/40.0	100		X	X	ALTERED SANDSTONE											"		X		"					X	Few thin moderately cemented layers.
40.0/50.0	75		X	X			X			S	0-10					"				"			X			Limy at 48' very har Fossils at 49'

L E G E N D

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TABLE I

CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. DH-JB-44 | PAGE 1 OF 1

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
10.0/20.0	25	Sandstone	X	X	NOT APPLICABLE											Negligible				Loss of Cement				X		
20.0/30.0	35	Sandstone	X	X	TO HIGHLY											"				"				X		Trace of Lignite and Siltstone
30.0/40.0	100	Sandstone	X	X	ALTERED SANDSTONE											"		X		"				X		Below 35' some clayey fines
40.0/50.0	50	Sandstone	X	X			X			S	0-10					"		X		"				X		
50.0/60.0	85	Clayst/Siltst/Sandst					X			S/I	0-10					"		X		"			X	X		Many fossils to 58' Limy very hard 58-59
60.0/68.0	100	Sandstone						X		S	0-10					"		X		"				X		Becoming Clayey
68.0/70.0	90	Sandstone						X		S	0-10					"		X		"			X	X		
70.0/80.0	95	Sandstone					X	X	X	S/I	0-10 & All					"		X		"				X	X	Claystone layers 12' total from 70-80'
80.0/90.0	90	Sandstone							X	S/I	0-10 & All					"		X		"					X	
90.0/100.0	95	Sandstone					X			S	0-10					"		X		"				X		Some coal lenses

LEGEND

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HIGHLY = FRAGMENTS AVERAGE 2" LONG
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MODERATE = 20-50 %
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TOTALLY = 95-100 %

TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																								HOLE NO. DH-JB-52	PAGE 1 OF 1
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
10.0/15.0	60	Sandstone	×	×			X	X		S/I	0-10 & 20					Negligible		X		Loss of Cement			X	X		Siltstone-Claystone 14-15'
15.0/20.0	80	Sandstone	×	×			X	X		S	0-10					"		X		"			X			Siltstone-Claystone 15-16' Limy Sandstone 16-17'
20.0/25.0	70	Sandstone	×	×			X			S	0-10					"		X		"			X			
25.0/30.0	50	Sandst/Clayst					X			S/I	0-10 & 20					"		X		"			X			Dropped core-recovered 50% many Fossils and Claystone below 28'
30.0/35.0	40	Clayst/Siltst					X	X		S/I	0-10 & 30					GYP 1/8"		X		"			X	X		
35.0/40.0	90	Clayst/Sandst					X			S	0-10					Negligible		X		"			X			Fossil layer bottoms at 35.5'
40.0/45.0	-0-	LOST CORE																								No recovery
45.0/50.0	100	Sandst/Clayst					X	X		S	0-10					GYP 1/8"		X		"			X	X		Claystone at 49-50' and 2" at 46.3'
50.0/55.0	100	Sandst/Clayst						X		S	0-10					Negligible		X		"			X			
55.0/60.0	95	Sandstone					X	X		S	0-10					"		X		"			X			Few thin Claystone layers

LEGEND

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VERY HIGHLY = FRAGMENTS ARE GRAVELLY (1/4-1/2" DIA.)

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TABLE I

CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT																	HOLE NO. NM-70-4									PAGE 1 OF 2
DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE				* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
			Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
5.0/11.2	100	Claystone			X				X	X	I	0-10 & all					GYP Trace		X						X		
11.2/16.3	100	Claystone			X				X		S/I	0-10 & 20					GYP Trace		X						X		Clay seams at 12.5'± 1/2"±
16.3-21.3	100	Claystone			X					X	I	All					GYP Trace		X						X		
21.3/26.3	100	Claystone			X			X			S	0-10					GYP Trace		X					X			
26.3/31.3	90	Claystone			X			X			S	0-10					GYP 1/8"		X					X			
31.3/36.2	100	Claystone			X			X			S/I	0-10 & 20					GYP 1/8"		X					X			
36.2/38.2	100	Claystone			X			X	X		S	0-10					GYP 1/8"		X					X			
38.2/41.2	100	Claystone			X				X		S	0-10, 60					GYP 1/8"		X					X			
41.2/45.2	90	Claystone			X			X	X		S	0-10					GYP 1/8"		X					X			Clay seams at 42'± 1"
45.2/49.2	100	Claystone			X			X			S	0-10					GYP 1/8"		X					X			
49.2/54.3	100	Claystone			X				X		S/I	0-10 All					Negligible		X				X	X			
54.3/64.3	100	Claystone			X			X			S	0-10					"		X				X				Sandstone layer at 63'±, Limy 3"
64.3/69.2	100	Claystone			X		X	X			S	0-10, 90					"		X				X				
69.2/74.3	100	Claystone			X		X				S	0-10, 60					"		X				X				Fossils at 73'± Limy 72-73'±
74.3/79.4	100	Clayst/Siltst			X		X				S/I	0-10, 80					"		X				X				
79.4/84.5	100	Sandstone		X				X	X		S	0-10, 90					"				Partial Loss of Cement		X				
84.5/90.1	100	Sandstone		X				X	X		S	0-10					"				"		X				
90.1/95.1	70	Sandstone		X				X	X		S	0-10					"				"		X				Coal seams, thin 1/8"±

LEGEND

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. NM-70-4	PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
95.1/100.1	90	Sandstone	x				X	X		S	0-10					Negligible				Partial Loss of Cement		X				Coal seams, thin 1/8"±

LEGEND

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TABLE I
CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. NM-70-5	PAGE 1 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE	Coarse	Medium	Fine	* DEGREE OF FRACTURING R	SL	M	H	VH	● SHAPE OF FRACTURE S/I	°A	▲ FRACTURE FILLING and THICKNESS CL	H	CA	Q	OTHER	■ ALTERATION TYPE C	A	B	OTHER	♦ ALTERATION DEGREE N	SL	M	H	T	COMMENTS
5.0/10.6	87	Claystone			x		X	X	X		S/I	0-10					GYP 1/8"		X					X			Highly fractured at 10'±
10.6/15.6	92	Claystone			x		X	X	X		S/I	0-10 & all					GYP 1/8"		X					X			
15.6/20.6	92	Claystone			x			X			S	0-10 & 45					GYP 1/8"		X					X			
20.6/25.6	100	Sandstone		x				X			S	0-10 & 45					GYP 1/8"							X			Some layers of thin Siltstone & Claysto 1". Gypsum in Claystone at 21'±
25.6/30.6	80	Sandstone		x				X	X		S	0-10					Negligible				Slight loss of Cement			X			
30.6/35.8	61	Sandstone		x				X	X		S	0-10					"				"			X			
35.8/40.5	100	Sandstone		x					X	X	S/I	0-10 & all					"				Loss of Cementation				X	X	
40.5/45.4	100	Sandstone		x					X	X	S/I	0-10 & all					"				"					X	
45.4/50.6	96	Sandstone		x				X	X	X	S/I	0-10 & all					"				"				X	X	Totally altered 45.4-48'±
50.6/55.6	100	Sandstone		x				X			S	0-10					"				Partial Loss of Cement				X		
55.6/60.8	100	Sandstone		x				X			S/I	0-10 & all					"				"				X		Coal seams, thin 59-60.8'
60.8/65.4	100	Sandstone		x			X				S	0-10					"				Slight loss of Cement			X			Loss Cementation 60.8-61.5'±
65.4/70.6	96	Sandstone		x				X			S	0-10 & 20					"				Partial Loss of Cement			X	X		
70.6/75.6	100	Sandst/Siltst		x	x			X			S/I	0-10 & 20					"				Partial to Total Loss of Cementation			X	X	X	Limy blebs, possibly fossils.
75.6/80.5	100	Siltstone			x		X	X			S/I	0-10					"						X				Limy blebs, fossils
80.5/85.6	100	Sandstone		x			X	X			S/I	0-10					"							X			Occasional Limy bleb Fossils, 80.5-81.5'±
85.6/90.8	96	Sandstone		x			X	X			S	0-10					"				Slight loss of Cement			X			Thin claystone layer

LEGEND

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TABLE I

CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. NM-70-5	PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
90.8/95.9	88		Sandstone x					X		S/I	0-10 & 50					Negligible				Loss of Cement				X		Coal seams, thin 93-94'±
95.9/101.2	96		Sandstone x					X	X	S/I	0-10 & all					"				Loss of Cementation				X	X	

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TABLE I

CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. NM-70-6 | PAGE 1 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
5.0/10.3	94	Claystone		X			X			S/I	0-10					GYP 1/8"		X				X	X			
10.3/15.5	98	Sandstone	X	X			X	X		S/I	0-10 & 20					GYP 1/8"				Loss of Cementation		X	X			
15.5/20.5	96	Sandstone	X	X				X		S	0-10					GYP 1/16"				"			X			
20.5/25.5	96	Sandstone	X	X			X			S	0-10		Trace			GYP Trace				"			X			
25.5/30.5	98	Sandstone	X	X			X			S	0-10					Negligible				"			X			
30.5/35.5	98	Sandstone	X	X			X			S	0-10					"				"			X			
35.5/40.5	100	Sandstone	X	X		X	X			S	0-10 & 20					"				"			X			Trace lignite
40.5/45.5	92	Sandstone	X	X			X			S/I	0-10 & 20+			Trace		"				"			X			
45.5/50.6	94	Sandstone	X	X		X	X			S/I	0-10					"		X		"		X	X			Siltstone 45.5-46.5
50.6/55.7	80	Sandstone	X	X			X			S/I	0-10					"				"		X				
55.7/60.8	70	Sandstone	X	X			X	X		S	0-10					"				"				X		Few fossils
60.8/62.6	78	Sandstone	X	X				X		S/I	0-10					"				"		X				Trace of lignite and fossils
62.6/65.9	91	Sandstone	X	X			X			S/I	0-10					"				"			X			" " "
65.9/70.8	90	Sandstone	X	X			X	X		S/I	0-10					"				"		X	X			" " "
70.8/75.8	90	Sandstone	X	X			X	X		S/I	0-10					"				"		X				" " "
75.8/80.9	94	Sandstone	X	X		X	X			S	0-10					"				"			X	X		" " "
80.9/85.9	86	Sandstone	X	X			X			S	0-10					"				"			X			" " "
85.9/90.9	90	Sandstone					X	X		S	0-10					"				"		X	X			Trace of lignite and Claystone

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TABLE I

CORE LOG

JOB NO. | NAME JIM BRIDGER POWER PLANT | HOLE NO. NM-70-6 | PAGE 2 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE			* DEGREE OF FRACTURING					● SHAPE OF FRACTURE		▲ FRACTURE FILLING and THICKNESS					■ ALTERATION TYPE				♦ ALTERATION DEGREE					COMMENTS
		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
90.9/95.9	100	Sandstone	X	X			X			S/I	0-10 & 20					Negligible				Loss of Cementation			X			Trace of lignite and Claystone
95.9/100.9	100	Sandstone	X	X		X	X			S/I	0-10					"							X			Trace of lignite and fossils.

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T A B L E I

CORE LOG

JOB NO.	NAME JIM BRIDGER POWER PLANT	HOLE NO. NM-70-7	PAGE 1 OF 2

DEPTH INTERVAL	CORE RECOVERY %	ROCK TYPE & GRAIN SIZE	Coarse	Medium	Fine	* DEGREE OF FRACTURING R	SL	M	H	VH	● SHAPE OF FRACTURE S/I	°A	▲ FRACTURE FILLING and THICKNESS CL	H	CA	Q	OTHER	■ ALTERATION TYPE C	A	B	OTHER	♦ ALTERATION DEGREE N	SL	M	H	T	COMMENTS
5.0/9.9	100	Siltstone			x					X	I	All					Indistinct				O V E R B U R D E N						
9.9/15.0	100	Siltstone			x				X	X	I	0-10 All	\				Silt			"	"			"			Coal seams, thin 1/16"± at 13'
15.0/20.2	95	Siltstone			x				X	X	I	0-10 All					Silt			"	"			"			Coal seams. thin 1/16"± at 17,18 & 19
20.2/25.2	100	Clayst/Siltst			x				X		S/I	0-10 30,90	\	\						"	"			"			Coal seams thin 1/16" at 23', 1/8"± at 25'
25.2/30.2	100	Siltstone			x			X	X		S/I	0-10	\							"	"			"			Coal seams thin 1/16" generally throughout
30.2/35.3	100	Siltst/Sandst			x				X		S/I	0-10 All	\				GYP Trace			"	"			"			Coal seams thin 1/16" at 33.8-35'
35.3/40.5	95	Sandst/Siltst			x		•	X	X		S	0-10					GYP Trace			"	"			"			Coal seams thin 1/8"± generally from 35.3-37.5'.
40.5/45.5	100	Siltst/Sandst		x	x				X	X	I	0-10 All	\	\			GYP Trace			"	"			"			Coal seams thin 1/16" generally throughout
45.5/50.5	85	Sandstone	x	x	x			X	X		I	0-10 & 30	\				GYP Trace			"	"			"			Coal seams thin 1/16" at 45.5,46,47.5'
50.5/55.5	5																										No Recovery
55.5/60.4	85	Claystone			x			X			S	0-10					GYP 1/8"		X						X		
60.4/62.4	40	Claystone			x				X	X	S/I	0-10 All					GYP 1/16"		X						X		
62.4/65.4	75	Claystone			x					X	S	0-10 & 60					GYP 1/16"		X					X	X		
65.4/70.4	100	Claystone			x				X		S/I	0-10 & 60					Negligible		X					X			
70.4/75.3	100	Claystone			x				X	X	S	0-10					"		X				X	X			
75.3/80.3	100	Claystone			x				X	X	S	0-10					"		X				X	X			
80.3/85.3	100	Claystone			x				X	X	S	0-10					"		X				X	X			

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		Coarse	Medium	Fine	R	SL	M	H	VH	S/I	°A	CL	H	CA	Q	OTHER	C	A	B	OTHER	N	SL	M	H	T	
85.3/90.3	100	Claystone		x				X	X	S	0-10	Negligible					X				X	X				

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