GEOTECHNICAL REPORT

NORTH ASH POND AND OLD EAST ASH POND VERMILION SITE EMBANKMENT EVALUATIONS OAKWOOD, ILLINOIS

Prepared for

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URS was tasked by Dynegy Midwest Generation, LLC to evaluate the condition and stability of earthen embankments of the North and Old East Ash Ponds at the Vermilion Site. The ash ponds have been out of operation for decades. The embankments lie on the right-descending bank of the Middle Fork of the Vermilion River near river mile 37.0. The Middle Fork of the Vermilion River is designated a National Wild and Scenic River.

A geotechnical investigation was conducted in August 2013. Soil samples for laboratory testing were collected at 17 borings using a conventional auger drill rig. A cone penetration test rig pushed a piezocone probe through the ash ponds at five locations to obtain strength, pore water pressure, and stratigraphy data from within the ponds. Four piezometers were installed within the embankments to monitor the static groundwater levels for one month after the geotechnical investigation was completed.

The slopes of both the North Ash and Old East Ponds were evaluated for slope stability. The evaluation was performed for existing, high water (river flood), and seismic (earthquake) conditions. The evaluation found that the slopes currently meet or exceed the requirements by the Illinois Department of Natural Resources for the slope stability of dams. Recommendations were made for the eventual construction of closure caps for both ash ponds. These recommendations include regrading the pond slopes to promote drainage, placement of a clay cap, and establishment of vegetation on the clay cap.

To address post-closure integrity issues, the impact of erosion of the Middle Fork of the Vermilion River to the ash ponds was analyzed. The minimum distance from each ash pond embankment toe to the crest of the riverbank, required to maintain acceptable slope stability per Illinois Department of Natural Resources criteria for dams, was estimated. The distance from the ash pond embankment toe to the crest of the riverbank at which failure of the ash ponds is likely to occur was also estimated. The time required for erosion to reach these distances, referenced from present-day (November 2013) was estimated.

The evaluation for both the North Ash Pond and Old East Ash Pond found that slope stability will remain acceptable as long as at least 16 feet separates the toe of the ash pond embankments from crest of the riverbank. Currently, approximately 35 feet separates the ash pond toe from the crest of the riverbank for both ponds. It is estimated that the river take approximately 60 years to erode this distance (19 feet) for the North Ash Pond and 50 years to erode this distance for the Old East Ash Pond. Failure of the North Ash Pond is estimated to occur when 10 feet separates the toe of the ash pond from the crest of the riverbank. Failure of the Old East Ash Pond is estimated to occur when 8 feet separates the toe of the ash pond from the crest of riverbank. It is estimated that the river will take approximately 80 years to erode to the failure condition for the North Ash Pond and 100 years to erode to the failure condition for the Old East Ash Pond.

Various alternatives to maintain the stability of the ash pond embankments are as follows: pulling back the fly ash from the embankments to allow for more distance from the river, flattening the embankment slopes along the river side, reinforcing the slopes using soil nails or other reinforcement, installing a sheet pile wall, strengthen using insitu soil stabilization, install a robust gabion wall or rip rap along the slope, and construct a diversion channel for the Vermilion River. The recommended alternative is the installation of a robust gabion wall and/or rip rap along the slope and riverbank.

This report summarizes URS Corporation's (URS) evaluation of the earthen embankments on the right descending bank of the Middle Fork of the Vermilion River at the North and Old East Ash Ponds at the Dynegy Midwest Generation, LLC (Dynegy) Vermilion Site, located at approximate river mile 37.0.

1.1 SCOPE OF WORK

The geotechnical engineering evaluation scope of work is as follows:

- Characterize the current geotechnical condition of the North and Old East Ash Ponds.
- Assess the slope stability of the deposited ash and earthen/rock embankments.
- Provide preliminary recommendations for the preparation of the ash ponds to receive an eventual cap with appropriate storm water runoff controls.
- Determine if "pulling back" deposited ash from the northern edge of the Old East Ash Pond a distance of 100 to 200 feet from the centerline of the Middle Fork of the Vermilion River is necessary and/or feasible.
- Identify and evaluate various alternatives to protect the post-closure integrity of the ponds against potential future erosion by the Middle Fork of the Vermilion River.
- Determine the distance of erosion necessary to destabilize the berm slopes adjacent to the Middle Fork of the Vermilion River. Also, estimate the time it would take for this amount of erosion to take place. The berms are considered to become unstable when the calculated factor of safety becomes 1.0. For reference only, the distance of erosion necessary to obtain the required regulated factor of safety is also calculated, and shown.

2.1 LOCAL GEOLOGIC CONDITIONS

The site is situated in the Bloomington Ridged Plain which exhibits a prominent southward-trending, generally flat to gently rolling upland glacial topography characteristic of underlying Wisconsinian Age glacial deposition, the last age of the glacial advances occurring within the past approximately 11,000 years. The site is located in the Vermilion River watershed and is immediately adjacent to the Middle Fork of the Vermilion River. The Vermilion River flows to the east into the Wabash River.

The underlying structure of Illinois is described as a complex, generally spoon-shaped basin, called the Illinois Basin. It is oriented NNW to SSE with the tip of the spoon in Kentucky and Tennessee and its eastern edge largely in Indiana. The study area is located atop or within the eastern rim of the Basin which reaches a maximum depth of about 15,000 feet in its center.

Published fault locations are documented neither within the study area, nor within Vermilion County.

Pennsylvanian System bedrock units underlie the site. The Modesto Formation of the Desmoinesian Series of the McLeansboro Group is indicated below the study area. It includes the Number 7 coal and consists mostly of interbedded limestones, shales, and sandstones. In general, the geologic subsurface profile includes a non-uniform surficial fill resting upon glacial till which blankets the bedrock. Based upon an examination of stream cuts at the site, the glacial till lies irregularly and directly on the Farmington Shale Member of the Modesto Formation or a residual clay developed directly on top of the Farmington. The Danville No. 7 Coal lies directly below the Farmington Shale. The glacial till deposit is classified as the Batestown Member of the Wedron Formation of the Woodfordian Substage of the Wisconsin Stage of the Pleistocene Series of the Quaternary System.

2.2 SITE CONDITIONS

The North and Old East Ash Ponds are coal ash impoundments formed by perimeter earthen embankments along the north and east sides. The Old East Ash Pond was removed from service for ash disposal in the early 1970's, and the North Ash Pond was removed from service for ash disposal in the late 1980's. The ash ponds are within a few hundred feet west of the Middle Fork of the Vermilion River. A site location map is provided as Figure 1. The south and west interior slopes of the impoundments are generally in cut. The height of the perimeter embankment ranges from approximately 20 feet to 50 feet with a crest elevation of approximately El. 606 feet for the North Ash Pond and a crest elevation along the river ranging from El. 626 to 635 feet for the Old East Ash Pond. There is no information available to provide details of the embankment construction and it is unknown if seepage reduction and control features such as drains and filters were built into these structures. No seepage was observed at the time of the explorations. In the 1980's, gabion baskets (gabions) were installed to reduce/eliminate erosion primarily along the north side of the old East Pond. There is a minimal length of gabions that could be considered along the southern portion of the east side of the North Ash Pond, but the majority of the gabions are protecting the Old East Ash Pond Embankment.

2.3 SUBSURFACE CONDITIONS

Subsurface conditions are generally based on the 22 explorations, including 17 conventional auger borings (auger borings) and 5 Cone Penetration Test (CPT) soundings made at the site. Locations of the explorations are as shown in Figure 2. The dikes appear to have been constructed out of a combination of compacted ash and compacted clay. The base of the embankment and impoundment was placed on alluvium. The alluvium consists of sands and low plasticity clays. Glacial till consisting of mainly silty clay with sand was encountered below the alluvium. The borings were drilled to auger refusal. It is believed that auger refusal was bedrock (either shale or limestone). Stick logs from the borings are included in Figure 3.

3.1 FIELD INVESTIGATION

URS' field investigation consisted of drilling and sampling 17 auger borings and advancing 5 CPT soundings at the locations shown in Figure 2. The drilling was subcontracted to Midwest Engineering and Testing, Inc. of Champaign, Illinois. The CPT soundings were subcontracted to Stratigraphics, Inc. of Chicago, Illinois. The field investigation occurred between July 23rd and August 9th, 2013.

The CPT soundings were advanced by using an all-terrain drill rig (ATV rig) with a minimum dead load of 10 tons. Pore pressure dissipations tests were performed at selected locations. Details about the CPT testing program including the logs are located in Appendix A.

The auger borings were advanced through soils using hollow stem augers. Soil samples were obtained using either a split spoon sampler in conjunction with Standard Penetration Tests (SPT: ASTM D1586) or a 3-inch O.D. thin-walled Shelby Tube (ASTM D1587). The auger borings were advanced to auger refusal which was presumed to be bedrock based on drill actions. Total boring depths ranged from 15 to 86 feet. Appendix B provides the detailed boring logs from this investigation. Graphic boring logs are shown in Figure 3.

During the field investigation, four vibrating wire piezometers were installed, with one piezometer each installed in Borings B-13-3, B-13-6, B-13-9, and B-13-16. A total of four readings were made in August and September of 2013 to determine the piezometric water levels during that time. Details of the piezometers are included in Appendix C.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected samples of soil recovered during the field investigation. The laboratory tests were used to characterize the subsurface materials and to provide engineering parameters for use in calculations. Selected samples were sent to subcontracted laboratory TerraSense, LLC of Totowa, New Jersey. Selected index tests were performed in the URS laboratory in St. Louis, Missouri.

Shear strength of the soils were determined using triaxial compression tests consisting of both consolidated-undrained (CIU) with pore pressure measurements and consolidated-drained (CD) conditions. The predominate difference between CD (drained) and CIU (undrained) tests is the time element and the effect of pore water pressures, which are water pressure acting within the voids of the soil matrix. The drained strength properties from the CD tests were in general agreement with the CIU testing.

Both soil strength properties and slope stability analyses are commonly performed using either drained or undrained conditions. Drained soil properties are typically used in existing-condition or steady-seepage slope stability analyses, where it is assumed that the pore pressures within the soil have fully reached equilibrium. Undrained soil properties are typically used in end-of-construction of seismic slope stability analyses, where the rate of loading is much quicker than the soil's rate of drainage, and equilibrium of the pore pressures within the soil has not been reached.

Duncan and Wright (2005) describe the difference between drained and undrained conditions as follows:

- ***Drained*** *is the condition under which water is able to flow into or out of a mass of soil in the length of time that the soil is subjected to some change in load. Under drained conditions, changes in the loads on the soil do not cause changes in the water pressure in the voids of the soil, because the water can move in or out of the soil freely when the volume of voids increases or decreases in response to the changing loads.*
- ***Undrained*** *is the condition under which there is no flow of water into or out of a mass of soil in the length of time that the soil is subjected to some change in load. Changes in the loads on the soil cause changes in the water pressure in the voids, because the water cannot move in or out in response to the tendency for the volume of voids to change.*

CIU triaxial tests are performed by shearing the soil specimen without allowing pore water to flow out of the soil. Pore water pressures are measured, which can be used to develop both drained, or "steady-seepage" soil strength properties (IDNR, 2003) and undrained soil strength properties. CD triaxial tests are performed by shearing the soil at a very slow rate and allowing pore water to flow out of the soil. The rate of shear is controlled to prevent the buildup of pore water pressures within the specimen. Only drained soil strength properties can be developed from the CD triaxial test.

Appendix D provides the results of the laboratory testing.

4.1 SLOPE STABILITY ANALYSES FOR EXISITNG CONDITIONS

The computer program package GeoStudio (SLOPE/W Version 8.12, 2012) using the Spencer Method was utilized for the slope stability analyses. Two cross sections of the Old East Ash Pond (shown as A-A' and B-B' on Figure 2) and one cross section of the North Ash Pond were analyzed. Three analyses were performed for the existing-condition slopes: drained, normal river level conditions; drained high-water level (river flood conditions); and seismic (earthquake) conditions.

Failure surfaces were optimized in the analysis, in order to aid in finding the most critical failure surfaces. Results from optimized cases are presented. Water-filled tension cracks were included in the stability analysis as-needed to remove tensile forces. The optimization of failure surfaces and inclusion of water-filled tension cracks are conservative assumptions, and typically result in lower factors of safety relative to an analysis without optimization or tension cracks.

The slopes were analyzed only for drained conditions for the existing and high water cases. Analyses modeling undrained conditions, also referred to as the end of construction case, were not performed since the ponds were constructed decades ago and have not been operated for many years. Therefore, pore water pressures within the ponds have had ample time to come to equilibrium. Slope stability was analyzed for drained conditions based on piezometric data indicating that the groundwater table through the berm was near the current river elevation (El. 580 feet). A second static case was added to evaluate the slope stability should there be an increase in the groundwater table caused by a high-water (river flood conditions). This water level was assumed to be EL. 589 feet, based on data provided by Dynegy.

Soil properties were based on the test borings and related laboratory test data. For the riprap gabion wall, no current data exists; therefore, properties were assigned based on prior experience and engineering judgment.

The seismic analysis was performed using the peak ground acceleration (PGA) based on parameters set forth in the 2012 International Building Code and the 2008 U.S. Geological Survey (USGS) Geohazards Mapping Project. The selected PGA for the site, based on a 2,475 year return period, is 0.08 g. This PGA was used in conjunction with data from the field exploration to estimate the liquefaction potential of the site. The liquefaction analysis found that the site is not susceptible to liquefaction. The seismic slope stability analysis was performed using the pseudo-static approach in SLOPE/W, with the full PGA applied as the horizontal seismic acceleration coefficient, which is a conservative assumption. The slope stability analysis was performed using undrained soil strengths, because the rate of seismic loading is expected to be much faster than the time required for pore pressures within the ponds to reach equilibrium (return to drained conditions).

Plots from the slope stability analyses are included in Appendix E. Summarized results of the slope stability analyses can be found in Table 4.1.

Table 4.1. Slope Stability Factor of Safety Results for Existing Conditions

Analysis	**Minimum IDNR Factor of Safety**	**Facility**		
		North Ash Pond	**Old East Ash Pond (Section A-A')**	**Old East Ash Pond (Section B-B')**
Drained (Water Level Based on Piezometers)	1.5	2.0	1.6	1.9
Drained (High River and Groundwater Level, based on river flood)	1.5	2.2	1.5	1.6
Seismic (Undrained Soil Strengths, Water Level Based on Piezometers	1.0	2.4	1.6	1.6

Note:

1. The North Ash Pond Section and Old East Ash Pond Section A-A' and B-'B are shown in Figure 2.

The Old East Ash Pond at Cross-Section A-A' had the lowest factor of safety (FoS) of 1.5 for the Drained, High River and Groundwater Level case. All FoS values meet or exceed the factor of safety requirements for dams given by the Illinois Department of Natural Resources (IDNR, 2003). The requirements are as follows:

- Drained case requirement minimum FoS = 1.5
- Seismic case requirement minimum FoS = 1.0

4.2 PRELIMINARY RECOMMENDATIONS TO PREPARE PONDS TO BE CAPPED

In order to prepare the site to be capped, URS recommends grading the ash pond surface to promote drainage and prevent standing water from accumulating. The grading should slope the pond surface to approximately 2 percent or greater to direct stormwater. To minimize earthwork, the site should slope from north to south. Collection ditches and discharges should be made to direct stormwater flow. A minimum thickness of 1 foot of vegetated clay should be present above the ash, as temporary cover. Additional material will be needed when the final cap is installed over the ponds. The actual shape of the final surface will be determined when the cap is designed.

The North Ash Pond consists of two cells. The secondary cell is believed to be for decant purposes and contains limited ash. URS recommends that this pond be drained and ash removed from the bottom. The removed ash should be placed in the primary cell. This will prepare the secondary cell for clean closure. If it becomes apparent that the depth of ash is sufficient to make removal impractical, then the ash may be left in place and capped along with the primary cell. The berms of the secondary cell should be left in place. It is anticipated that the secondary cell of the North Ash Pond will be used to form a stormwater detention pond for both the Old East and North Ash Ponds after the cells are capped.

4.3 POST-CLOSURE INTEGRITY OF THE PONDS

4.3.1 Feasibility of Pulling Back the Ash Pond River-Side Slopes

A review of the boring data indicates that it should be possible to "pull back" deposited ash from the northern edge of the Old East Ash Pond a distance of 100 to 200 feet from the centerline of the Middle Fork of the Vermilion River, if necessary. This is based on the piezometric data (groundwater table) which indicated that the water level within the ponds was approximately equal to that of the river. Based on the Standard Penetration Test (SPT) blow count data, the density of the ash encountered ranges from very loose to dense and is typically medium dense (SPT N-values between 10 and 30 blows per foot). In general, this density should be sufficient to limit the flow of ash into an excavation. Localized areas may contain flowing ground (ash), but it is believed that these areas are limited and could be dealt with during construction while pulling back the ash. It should be noted that ponded water has been observed at the ground surface in the past, so some constructability issues related to water should be anticipated. Open excavation below the groundwater table would be problematic so the elevation for the depth of excavation will need to be designed with this in mind. In addition, the excavation exposing a large face of ash by pulling back the slope back will create stormwater management and erosion control issues that will need to be addressed.

The exploration data at the berms for the North Ash Pond encountered similar conditions within the ash, but the explorations within the pond indicated higher water levels and very loose ash. (The North Ash Pond currently has water ponded on a portion of the top. The Old East Ash Pond does not currently pond water.) If a pull back of the North Ash Pond is attempted, we would anticipate significant problems with flowing ground (ash).

4.3.2 Alternatives to Protect Post-Closure Integrity

Alternatives to protect the post-closure integrity of the ponds against potential future erosion by the Middle Fork of the Vermilion River are as follows:

- Pull back the ash in each pond from the pond's side adjacent to the river. This would require excavating part of the embankments to flatten the slope and would result in ash being farther from the river bank.
- Flatten the river side slopes of the ash ponds.
- Reinforcement of the existing slope by using soil nails or reconstructing the slope using geosynthetic reinforcement.
- Install a sheet pile wall at the river to protect against erosion. (Could install other types of walls such as a concrete slurry wall, secant pile walls [overlapping drilled shafts] or tangent pile walls [tangent drilled shafts].) These could be installed at the riverbank or at some location within the slope. There is a limit to how far upslope from the river to install sheet piling. The preference would be to install the wall as a cantilever and not use tiebacks.
- The use of in-situ soil stabilization to increase the strength of the ash and soil. This is generally performed by chemically stabilizing the earth by introducing cementitious material to the ash and soil. Installation would involve methods such as jet grouting or soil mixing.
- Install a newer more robust gabion wall or rip rap at the river.
- Install a diversion within the river (new channel to the east of its current location).

These alternatives involve differing benefits and drawbacks. Based on our professional judgment and a cursory review of the alternatives, we recommend the installation of gabions and/or rip rap to protect the river bank from erosion. Gabions are a low-cost, effective solution to minimizing river bank erosion. The installation of gabions is less invasive than what would be required by the other alternatives referenced herein. Also, gabions have proven to be effective at the Vermilion site already. Providing effective armoring along the river bank would eliminate ash pull back as an alternative for protecting post-closure integrity of the ponds against potential future erosion by the river.

4.4 EROSION FROM THE MIDDLE FORK OF THE VERMILION RIVER

In a letter from Illinois Environmental Protection Agency (IEPA) to Dynegy, dated May 29, 2013, IEPA stated:

> *…the Agency requests that the study include two additional calculations to determine (1) the critical distance from the ash impoundments to the Middle Fork River bank which would cause the embankments to become unstable; and (2) the*

estimated time it would take to reach the critical distance. These calculations should be conducted with and without design standard safety factors. This will allow the Agency to consider a time estimate and determine how far the river can move before any immediate threat of failure may occur.

These calculations were performed using both drained and undrained conditions. The drained analyses are intended to model a condition where the riverbank is slowly eroded away, and sufficient time exists between periods of erosion to allow for pore pressures to equalize and drained conditions to develop in the slope. The undrained analyses are intended to model a condition where the riverbank is rapidly eroded, such as in a large flood, and pore pressures have not yet equalized and drained conditions have not yet developed. IDNR regulations refer to the drained and undrained conditions as the Steady State Seepage and End of Construction cases, respectively.

To determine the distance of erosion necessary to destabilize the berm slopes adjacent to the Middle Fork of the Vermilion River, slope stability analyses were performed using an iterative process within SLOPE/W. Portions of the ground beyond the toe of slope were removed in the analysis to reflect erosion. A vertical cut bank was assumed in the analysis, which is conservative because the buttressing and/or stabilizing effects of sloughed soil at the toe of the cut bank is not included in the analysis. More of the ground beyond the toe of slope was incrementally removed in the analysis until the desired factor of safety (FoS) was reached. A FoS value of 1.5 for drained analysis (steady seepage) represents the minimum FoS required by IDNR for a permitted dam. Likewise, a FoS value of 1.3 is the minimum FoS required by IDNR for the undrained analysis (end of construction) for a permitted dam. A FoS value of 1.0 would be considered imminent failure. At a FoS of 1.0, the forces resisting a slope slide or failure surface would equal the forces driving a slope slide or failure surface, resulting in failure of the slope.

As shown in Figure 4, the erosive distance (D_E) is defined as the horizontal distance from the existing riverbank (E. 580 feet, location of the normal river level on the riverbank) to the crest of the cut bank required to achieve the target FoS for either drained or undrained conditions. The critical distance (D_C) is defined as the horizontal distance from the toe of the impoundment dike to the crest of cut bank. Using the toe as a zero reference datum, erosion into the ash impoundment dike constitutes a negative critical distance. Erosion leaving material between the toe of the impoundment and the river bank yields a positive critical distance.

Plots of the slope stability results are included in Appendix E and are summarized in the tables at the end of this section. For estimating the time it would take for this amount of erosion to take place, an evaluation of historical aerial photographs of the site from 1940, 1966, 1998, 2005, and

2012 was made. The 1940 photograph was prior to plant construction, which occurred in the 1950's. An estimation of the rate of erosion was made for two time frames, 1940 to 2012 and 1966 to 2012. This provides an estimated rate of erosion for the longest duration possible as well as an erosion rate since the plant was constructed. Figures 5 and 6 show the river location over the various years. The edge of the river is plotted for each year. Judgment was used for the river location for each year. The data was then input into Geographic Information System software (GIS) to allow an overlay of the multiple years.

There was a meander in the river which was cut off between 1940 and 1998. There are no other meanders, which when cut off would encroach upon the North or Old East Ash Ponds. Therefore, when erosion rates were estimated, they were based upon direct erosion of the riverbank. An average of the distance of erosion was estimated for both the North and Old East Ash Ponds. The estimated rates of erosion are included in Table 4.2.

Table 4.2 – Estimated Erosion Rates

Pond	Timeframe	Estimated Erosion Rate (feet/year)
North Ash Pond	1940-2012 (72 years)	0.3
	1966-2012 (46 years)	1.3 *
Old East Ash Pond	1940-2012 (72 years)	0.4
	1966-2012 (46 years)	0.0

* The river migrated away from the pond from 1940 to 1966. After 1966, the river eroded back towards the pond. Therefore, this value is not appropriate to use for evaluations. (The erosion rate includes erosion to the west after 1966 over the same ground where the river migrated east from 1940 to 1966; e.g. this is not erosion of the riverbank)

Based on this evaluation, URS recommends using an average erosion rate of 0.4 feet/year for the Old East Ash Pond site and 0.3 feet/year for the North Ash Pond site. For the Old East Ash Pond, there has essentially not been erosion of the bank in the last 46 years. A gabion wall (wire baskets containing rock) was installed around 1980 to help control erosion. It is URS's opinion that the average erosion rate of 0.4 feet/year would be an appropriate conservative value to use for evaluation purposes.

The estimated length of time for erosion to reduce FoS values for various analysis conditions are shown in Tables 4.3 through 4.5. Drained conditions are the controlling failure mode for every cross-section. Because the critical distances for undrained failures are greater than the critical distances for drained failures, only distances and times for the drained failures are discussed further.

Table 4.3 – Slope Stability Results for Erosion Conditions – North Ash Pond[5]

Analysis	Factor of Safety	Existing Distance from Ash Impoundment Toe to River Bank (ft)	Critical Distance from Ash Impoundment Toe to River Bank to Achieve Factor of Safety, D_C (ft)	Erosive Distance to Achieve Factor of Safety, D_E (ft)	Estimated Time to Achieve Factor of Safety[1,3] (years)
Drained	1.5	35	16	19	63
	1.0		10	25	83
Undrained	1.3		-32 (4)	66	220
	1.0		-40 (4)	74	247

Table 4.4 – Slope Stability Results for Erosion Conditions – Old East Ash Pond Section A-A'[5]

Analysis	Factor of Safety	Existing Distance from Ash Impoundment Toe to Crest of River Bank (ft)	Critical Distance from Ash Impoundment Toe to Crest of River Bank, D_c (ft)	Erosive Distance to Achieve Factor of Safety, D_E (ft)	Estimated Time to Achieve Factor of Safety[2,3] (years)
Drained	1.5	35	16	19	48
	1.0		-4 (4)	39	98
Undrained	1.3		-4 (4)	39	98
	1.0		-12 (4)	47	118

Table 4.5 – Slope Stability Results for Erosion Conditions – Old East Ash Pond Section B-B'[5]

Analysis	Factor of Safety	Existing Distance from Ash Impoundment Toe to Crest of River Bank (ft)	Critical Distance from Ash Impoundment Toe to Crest of River Bank, D_c (ft)	Erosive Distance to Achieve Factor of Safety, D_E (ft)	Estimated Time to Achieve Factor of Safety[2,3] (years)
Drained	1.5	60	24	36	90
	1.0		8	52	130
Undrained	1.3		-12 (4)	72	180
	1.0		-40 (4)	100	250

NOTES:
1. Erosive rate for North Ash Pond is assumed to be 0.3 feet per year
2. Erosive rate for Old East Ash Pond is assumed to be 0.4 feet per year (conservative, stabilizing effects of gabions are not considered)
3. Both erosive rates are calculated assuming the existing rip-rap gabion slope protection has been washed away.
4. Negative erosion values refer to riverbank erosion that has progressed inward from the toe of the existing ash pond. Note that the toe of the impoundment and riverbank are at different locations. See Figure 4.
5. See Figure 4 for a schematic cross section of the embankment and river.

For the North Ash Pond, an estimate of the length of time until erosion would cause failure of the berm would be 83 years. This is based on the shortest distance using drained and undrained analyses at a factor of safety of 1.0 and an erosion rate of 0.3 feet/year. The Old East Ash Pond would be anticipated to reach failure in 98 years using a factor of safety of 1.0 and erosion rate of 0.4 feet/year. For the North Ash Pond, an estimate of the length of time until acceptable factors of safety are no longer maintained is 63 years. The Old East Ash Pond would be anticipated to maintain acceptable factors of safety for 48 years. All times are referenced from present-day (November 2013).

The interpretations and assessments contained in this report are based upon the limited available information and our judgment and experience. While we believe that our exploration program has been detailed enough to identify key subsurface conditions, it is possible that unknown conditions exist. Changes in groundwater conditions can also occur over time.

The boring logs depict subsurface conditions for the indicated locations and dates. The recommendations and observations presented in the report assume that significant variations in subsurface conditions do not occur. Non-uniform conditions, however, often cannot be determined by the procedures described.

Duncan, J.M. and Wright, S.G.. *Soil Strength and Slope Stability*, J. Wiley and Sons, 2005.

Google Earth Pro (image saved and georeferenced), Google, Inc., 2012.

Illinois Data Clearinghouse (georeferenced after download), aerial photograph, 1940.

Illinois Data Clearinghouse (downloaded, no georeferencing needed), aerial photograph, 1998.

Illinois Department of Natural Resources, Procedural Guidelines for Preparation of Technical Data to be Included in Applications for Permits for Construction and Maintenance of Dams, pg. 19, January 2003.

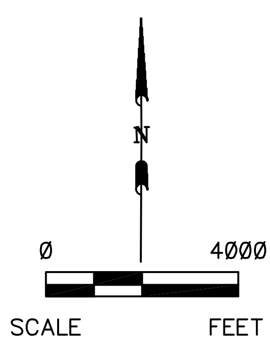
Illinois Environmental Protection Agency Letter to Dynegy dated May 29, 2013. Re: Dynegy Midwest Generation – Vermilion Power Station, Proposed Geotechnical Study of the North and Old East Ash Pond Sites.

International Code Council, 2012 International Building Code.

National Agriculture Imagery Program (downloaded, no georeferencing needed),aerial photograph, 2005

USDA Office in Vermilion County, Illinois (scanned by USDA, e-mailed, then georeferenced), aerial photograph, 1966.

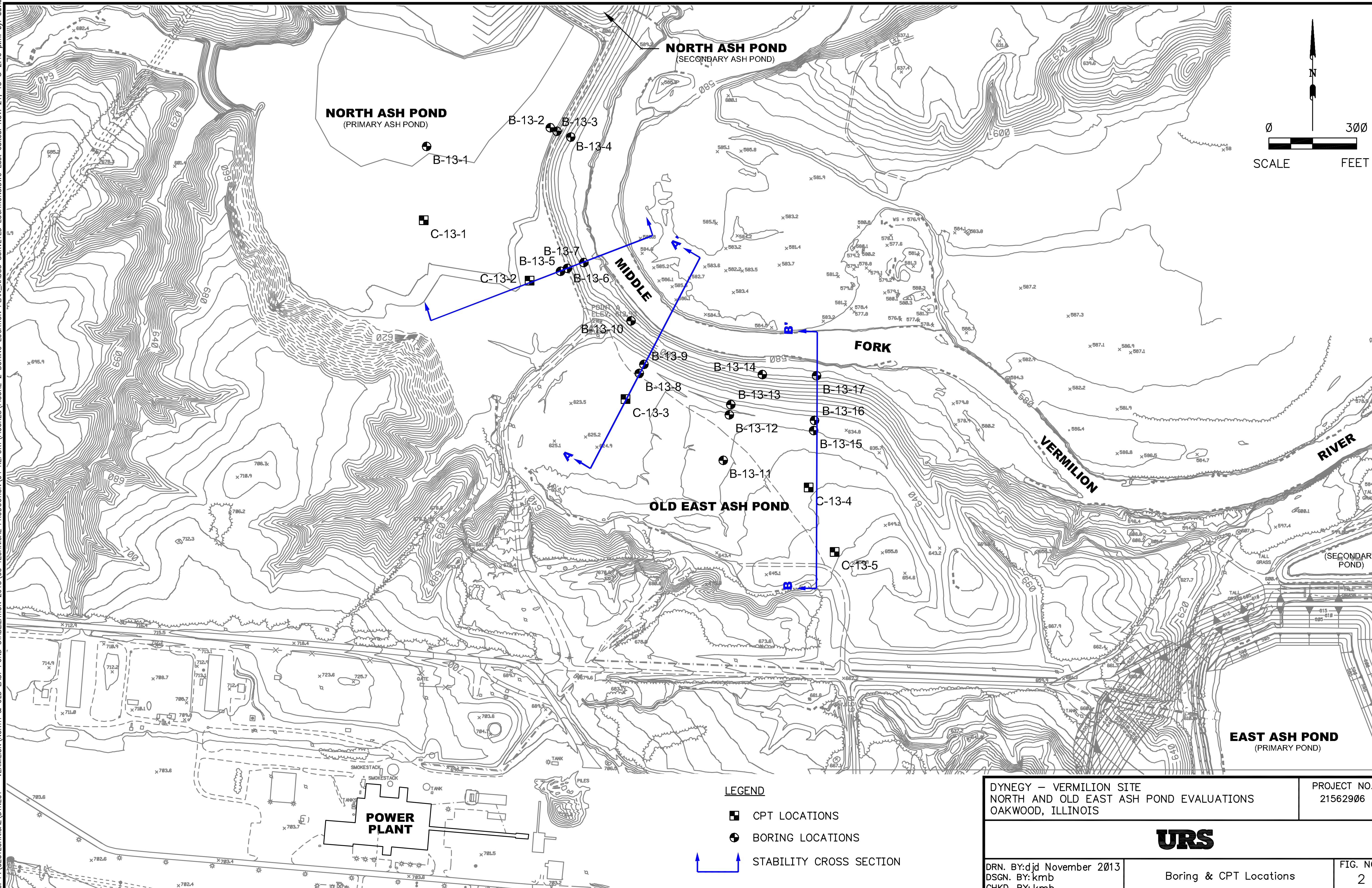
SOURCE: MAP PROVIDED BY GOOGLE EARTH PRO.



DYNEGY – VERMILION SITE NORTH AND OLD EAST ASH POND EVALUATIONS OAKWOOD, ILLINOIS	PROJECT NO. 215629Ø6

URS

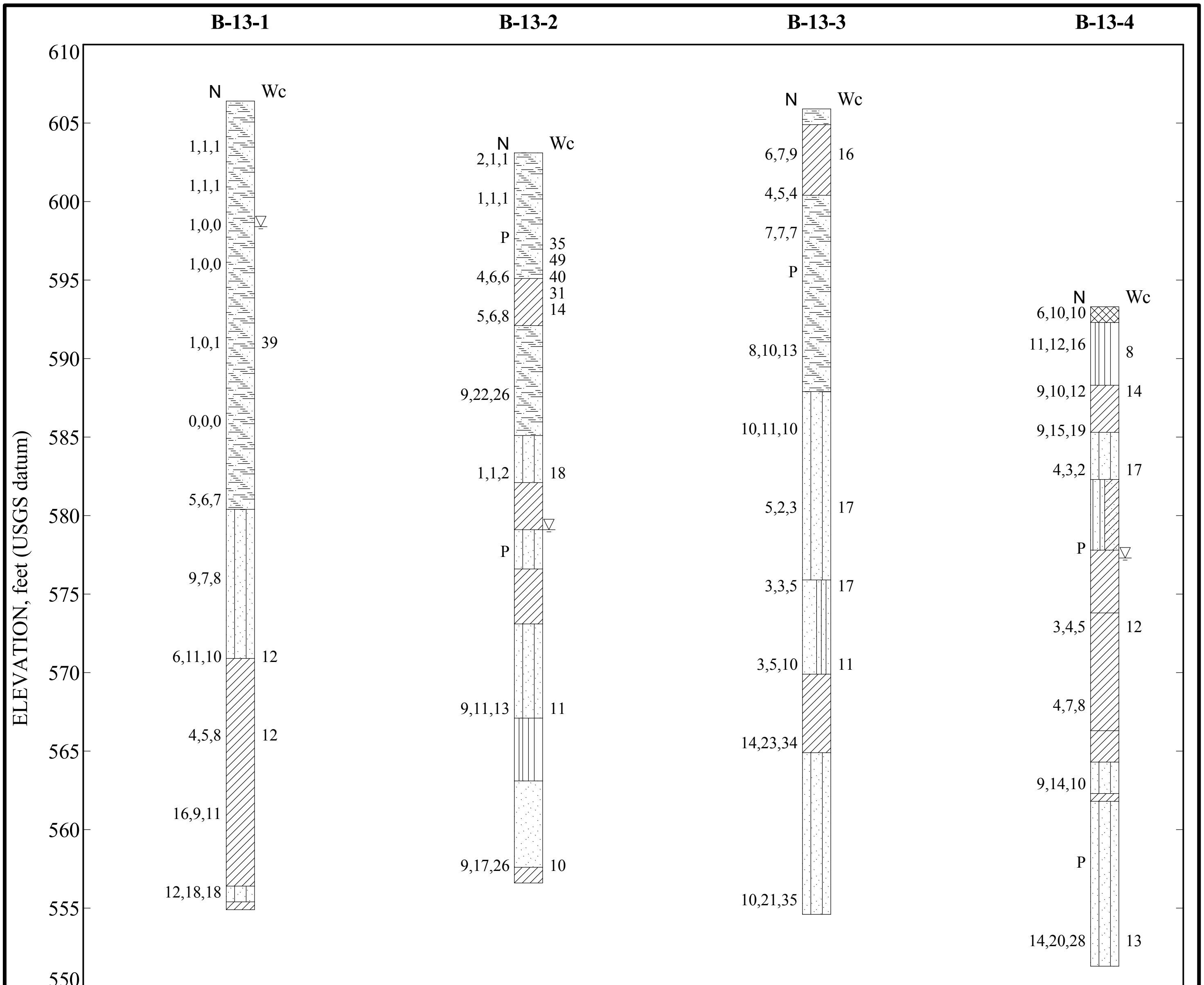
DRN. BY:djd August 2Ø13 DSGN. BY:djd CHKD. BY:kmb	Site Location Map	FIG. NO. 1



LEGEND

- CPT LOCATIONS
- BORING LOCATIONS
- STABILITY CROSS SECTION

DYNEGY – VERMILION SITE NORTH AND OLD EAST ASH POND EVALUATIONS OAKWOOD, ILLINOIS	PROJECT NO. 21562906
URS	
DRN. BY: djd November 2013 DSGN. BY: kmb CHKD. BY: kmb	Boring & CPT Locations — FIG. NO. 2



▽	Water level entry at time of drilling
▼	Water level at completion of drilling
Wc	Natural moisture content %
P	Hydraulically pushed sample
WH	Weight of Hammer
RQD	Rock Quality Designation
7,10,15	Blows/6" penetration of sampler unless indicated otherwise
N	N-values equal sum of blows for last 12 inches
50/2	50 blows for 2 inches of penetration with split spoon sampler

Note:
These graphic logs depict generalized soil conditions.
Refer to individual logs for details

Legend:

- FLY ASH/BOTTOM ASH
- Silty SAND (SM)
- Low to Medium Plasticity CLAY (CL)
- Low plasticity SILT (ML)
- Poorly-graded SAND (SP)
- FILL
- Poorly-graded SAND to silty SAND (SP-SM)
- Topsoil
- Silty, Clayey SAND (SC-SM)

Drawn by: bth	Checked by: kmb	Date: 11/11/13

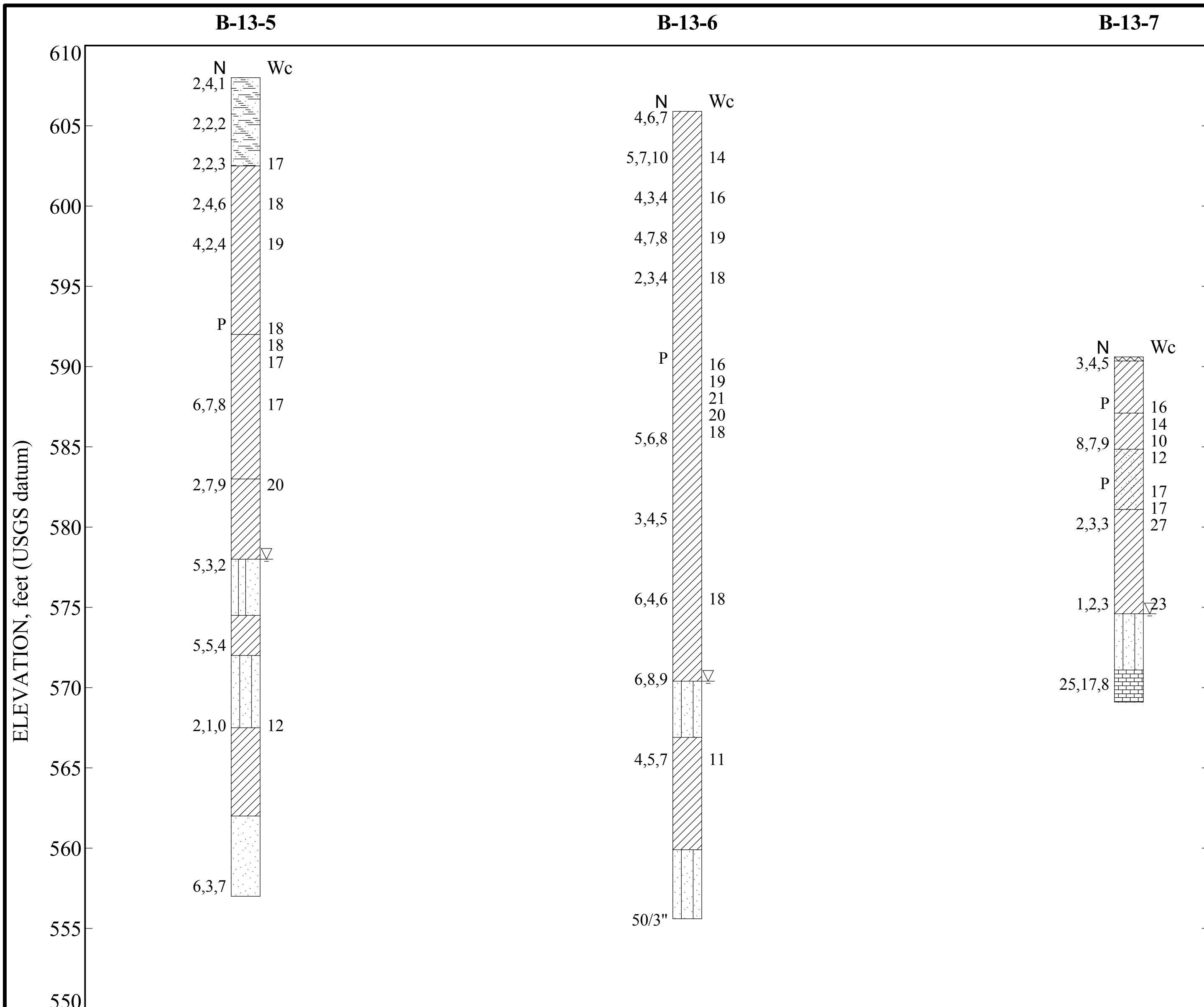
Dynergy- Vermilion, Danville, IL

Project No. 21562906

URS

Graphic Boring Logs

Figure No. 3A



▽	Water level entry at time of drilling
▼	Water level at completion of drilling
Wc	Natural moisture content %
P	Hydraulically pushed sample
WH	Weight of Hammer
RQD	Rock Quality Designation
7,10,15	Blows/6" penetration of sampler unless indicated otherwise
N	N-values equal sum of blows for last 12 inches
50/2	50 blows for 2 inches of penetration with split spoon sampler

Note:
These graphic logs depict generalized soil conditions.
Refer to individual logs for details

Legend:

- FLY ASH/BOTTOM ASH
- Low to Medium Plasticity CLAY (CL)
- Silty SAND to Poorly-graded SAND (SM-SP)
- Silty SAND (SM)
- Poorly-graded SAND (SP)
- Topsoil
- Clayey SAND (SC)
- Limestone

Drawn by: bth	Checked by: kmb	Date: 11/11/13

Dynergy- Vermilion, Danville, IL

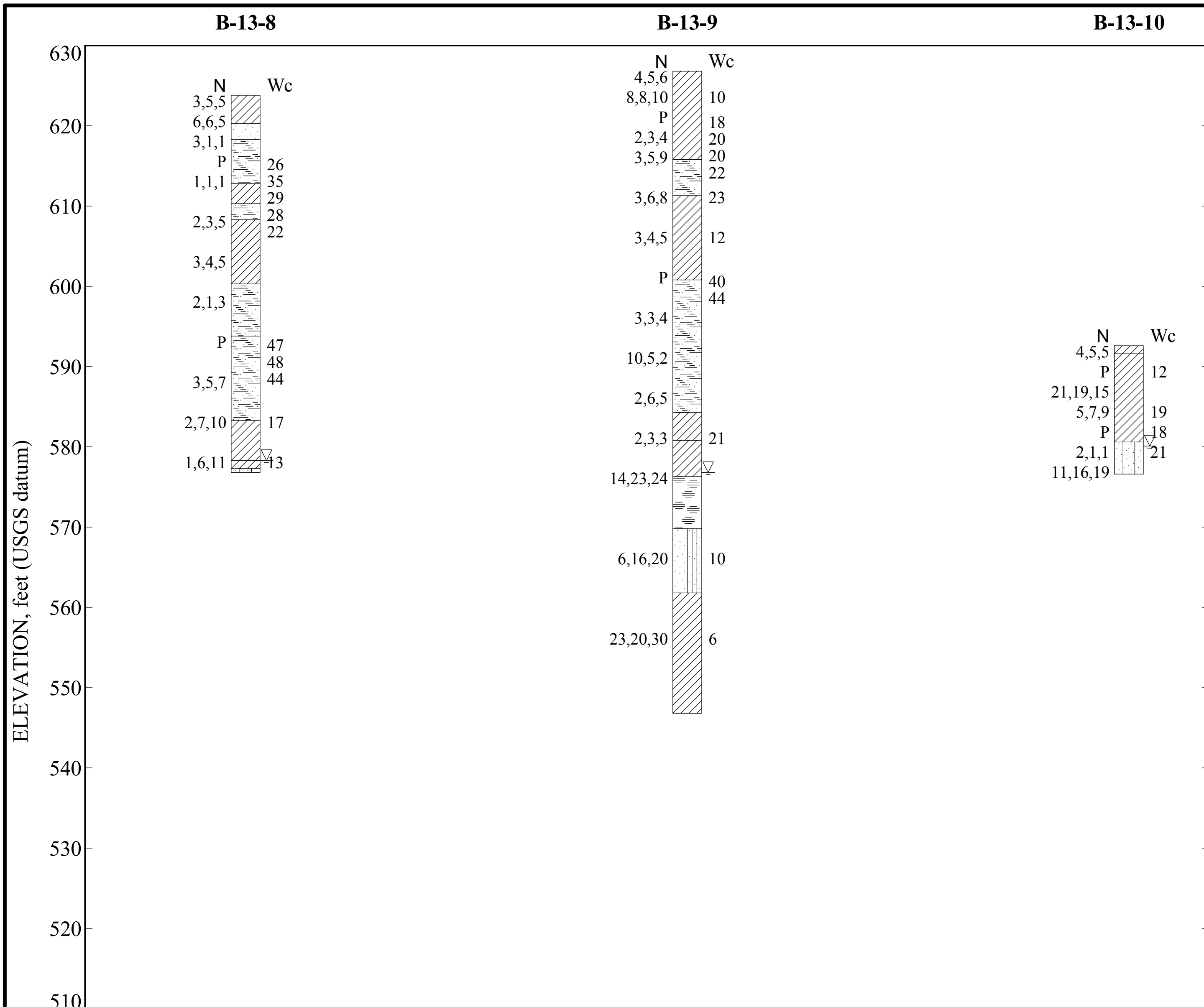
Project No. 21562906

URS

Graphic Boring Logs

Figure No. 3B

Template: URS GRAPHIC LOG; Proj ID: Y:\GINT\PROJECTS\DYNERG-VERMILLION_21562906.GPJ; Printed: 11/21/13



Water level entry at time of drilling

Water level at completion of drilling

Wc Natural moisture content %

P Hydraulically pushed sample

WH Weight of Hammer

RQD Rock Quality Designation

7,10,15 Blows/6" penetration of sampler unless indicated otherwise

N N-values equal sum of blows for last 12 inches

50/2 50 blows for 2 inches of penetration with split spoon sampler

Note:
These graphic logs depict generalized soil conditions.
Refer to individual logs for details

Legend:

- Low to Medium Plasticity CLAY (CL)
- Silty SAND (SM)
- Poorly-graded SAND (SP)
- FLY ASH/BOTTOM ASH
- Poorly-graded GRAVEL (GP)
- Poorly-graded SAND to silty SAND (SP-SM)

Drawn by: bth	Checked by: kmb	Date: 11/11/13

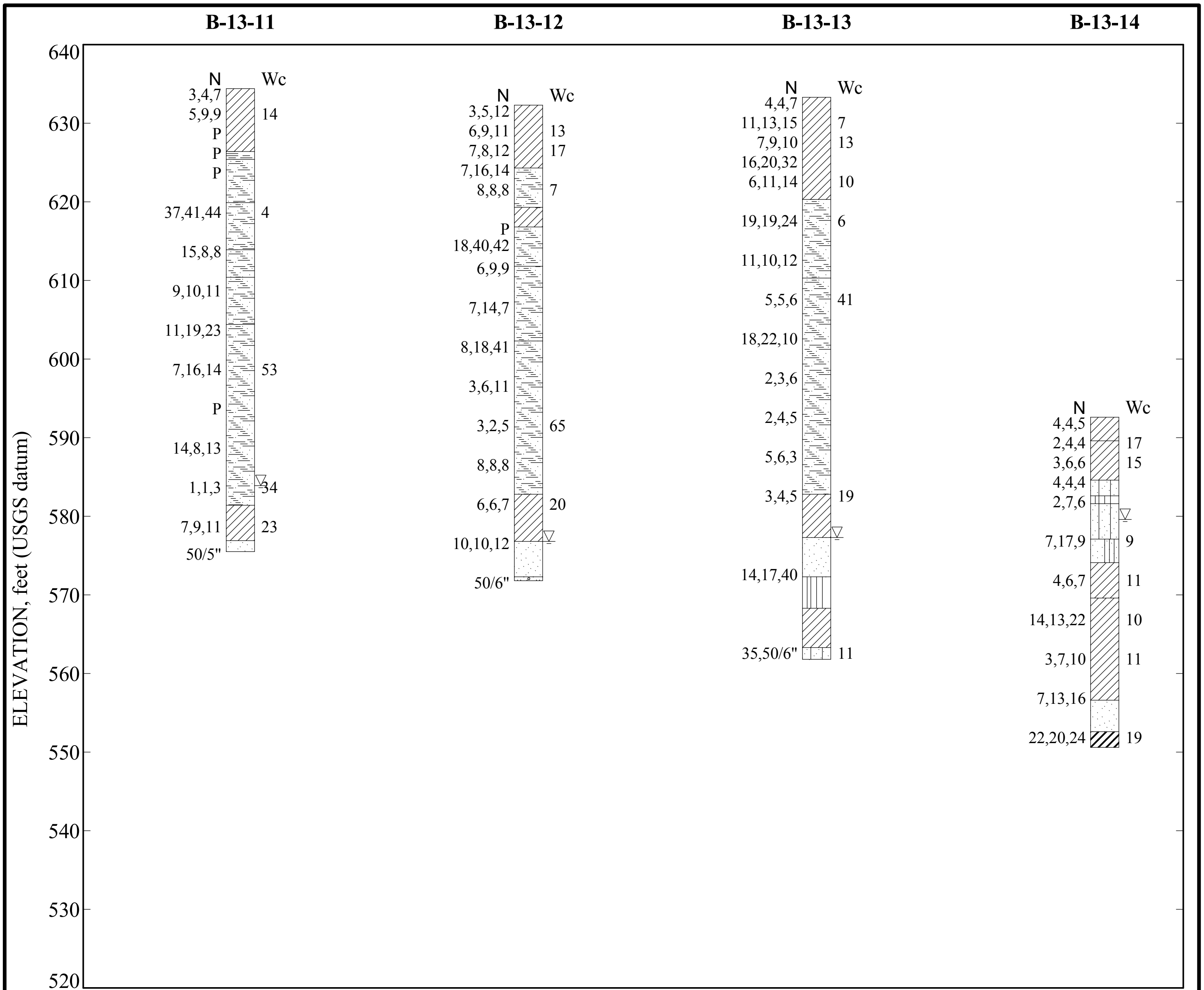
Dynergy- Vermilion, Danville, IL

Project No. 21562906

URS

Graphic Boring Logs

Figure No. 3C



▽	Water level entry at time of drilling
▼	Water level at completion of drilling
Wc	Natural moisture content %
P	Hydraulically pushed sample
WH	Weight of Hammer
RQD	Rock Quality Designation
7,10,15	Blows/6" penetration of sampler unless indicated otherwise
N	N-values equal sum of blows for last 12 inches
50/2	50 blows for 2 inches of penetration with split spoon sampler

Note:
These graphic logs depict generalized soil conditions.
Refer to individual logs for details

Legend:

- Low to Medium Plasticity CLAY (CL)
- Poorly-graded GRAVEL (GP)
- FLY ASH/BOTTOM ASH
- Poorly-graded SAND (SP)
- Poorly graded SAND to Poorly-graded GRAVEL (SP-GP)
- Low plasticity SILT (ML)
- Silty SAND (SM)
- Poorly-graded SAND to silty SAND (SP-SM)
- High plasticity CLAY (CH)

Drawn by: bth	Checked by: kmb	Date: 11/11/13

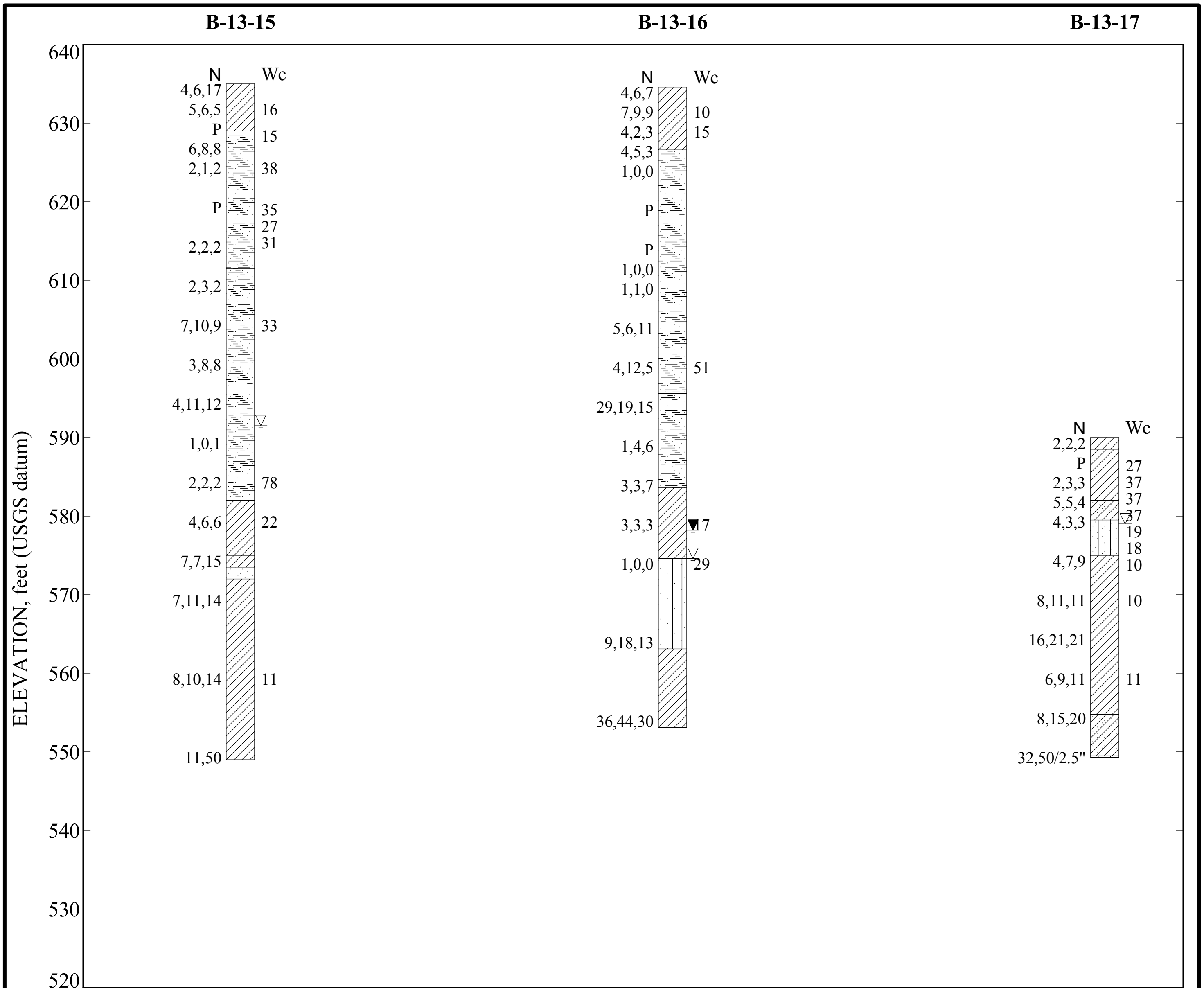
Dynergy- Vermilion, Danville, IL

Project No. 21562906

URS

Graphic Boring Logs

Figure No. 3D



▽	Water level entry at time of drilling
▼	Water level at completion of drilling
Wc	Natural moisture content %
P	Hydraulically pushed sample
WH	Weight of Hammer
RQD	Rock Quality Designation
7,10,15	Blows/6" penetration of sampler unless indicated otherwise
N	N-values equal sum of blows for last 12 inches
50/2	50 blows for 2 inches of penetration with split spoon sampler

Note:
These graphic logs depict generalized soil conditions.
Refer to individual logs for details

Legend:

- Low to Medium Plasticity CLAY (CL)
- FLY ASH/BOTTOM ASH
- Poorly-graded SAND (SP)
- Sandy SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)

Drawn by: bth	Checked by: kmb	Date: 11/11/13

Dynergy- Vermilion, Danville, IL

Project No. 21562906

URS

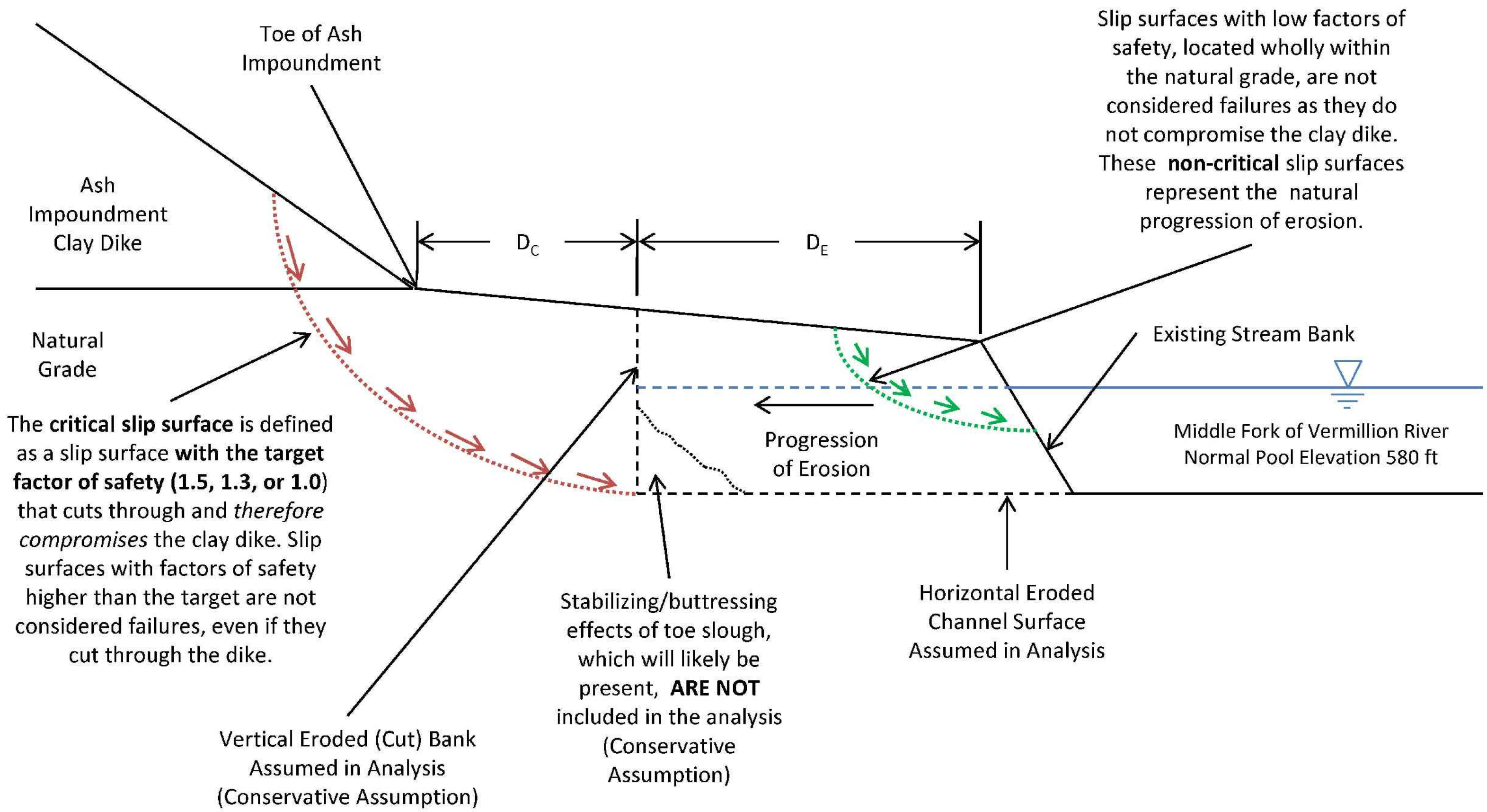
Graphic Boring Logs

Figure No. 3E

File: P:\GEOTECHNICAL\DYNEGY – VERMILION\NORTH & OLD EAST POND STABLIZATION 2013\05 TECHNICAL PRODUCTION\04 REPORT\FIGURES\FIGURE 4 SCHEMATIC RIVER BANK EROSION ANALYSIS.DWG Last edited: NOV. 21, 13 @ 2:48 p.m. by: david_deguire

Schematic for River Bank Erosion Analyses

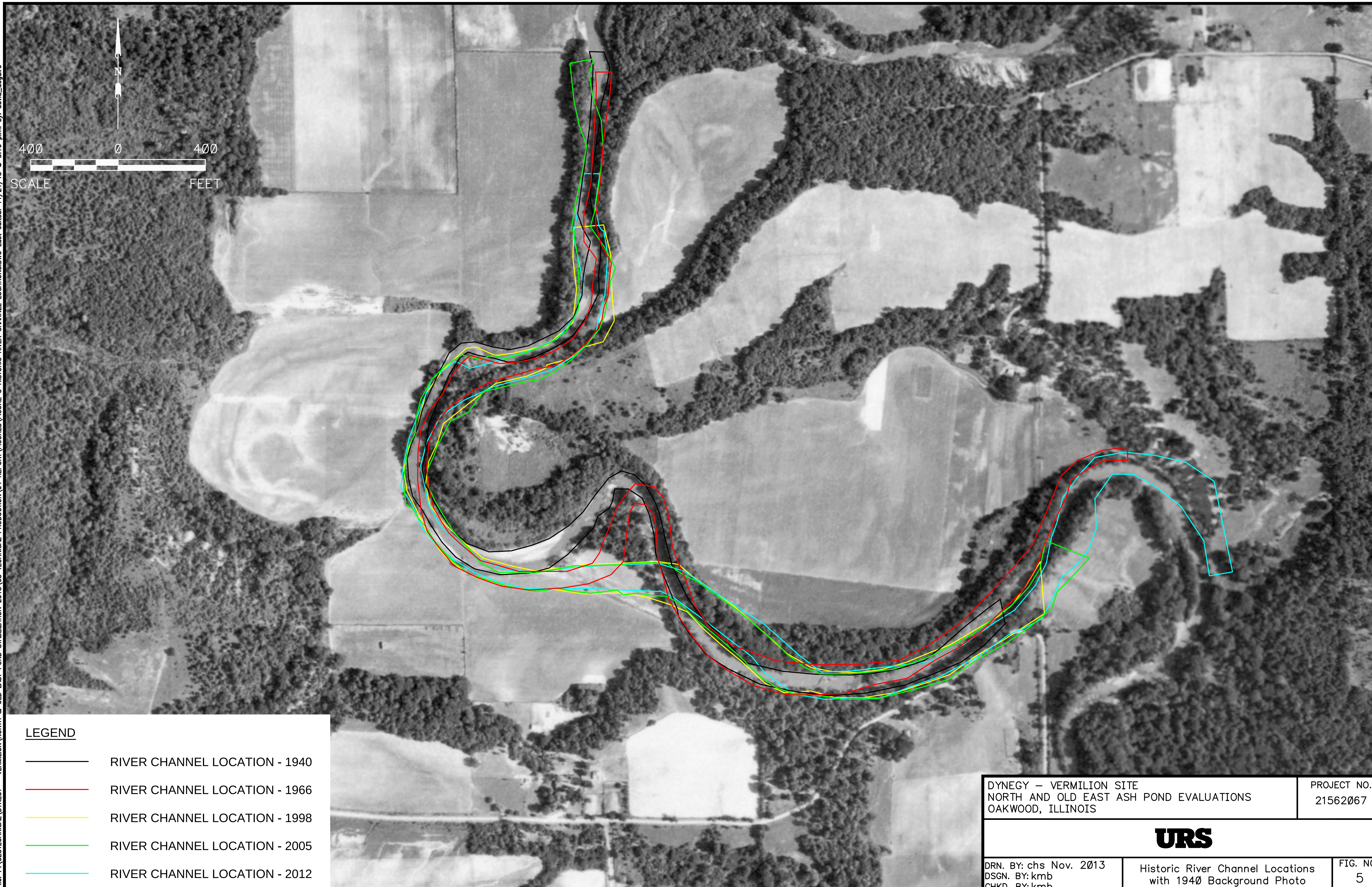
Not to Scale



D_C = Critical distance from ash impoundment toe to Middle Fork of Vermillion River bank required to achieve target factor of safety (1.5, 1.3, or 1.0)
(Note: Negative D_C values refer to erosion of the riverbank into and beyond the toe of the ash impoundment)
D_E = Erosive distance from existing Middle Fork of Vermillion River bank required to achieve target factor of safety (1.5, 1.3, or 1.0)

NOT TO SCALE

DYNEGY – VERMILION NORTH AND OLD EAST ASH POND EVALUATIONS OAKWOOD, ILLINOIS	PROJECT NO. 21562906
URS	
DRN. BY:djd August 2013 DSGN. BY:djd CHKD. BY:lc	Schematic for River Bank Erosion Analysis — FIG. NO. 4



DYNEGY – VERMILION SITE
NORTH AND OLD EAST ASH POND EVALUATIONS
OAKWOOD, ILLINOIS

PROJECT NO. 21562067

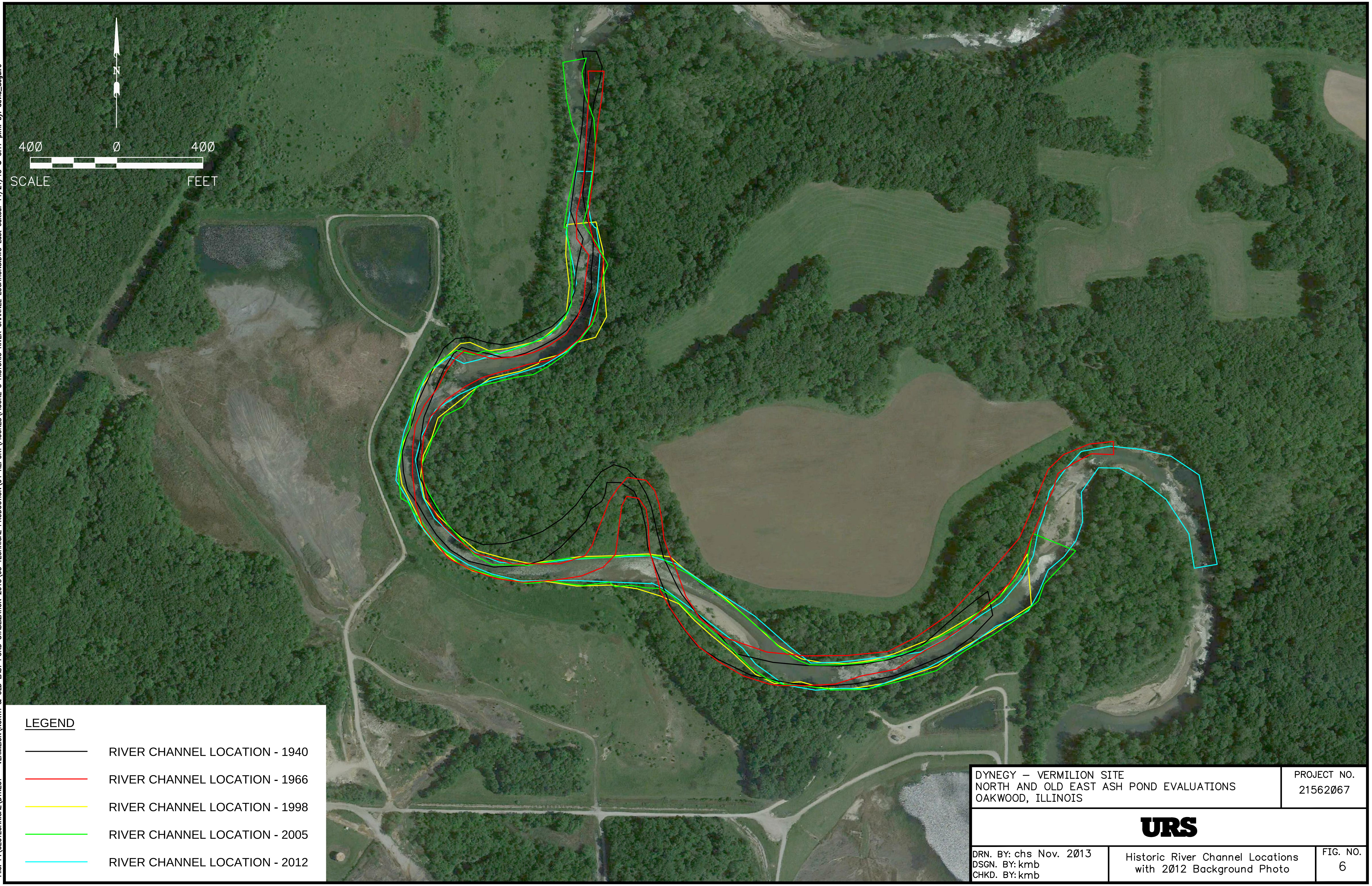
URS

DRN. BY: chs Nov. 2013
DSGN. BY: kmb
CHKD. BY: kmb

Historic River Channel Locations with 1940 Background Photo

FIG. NO. 5

File: P:\GEOTECHNICAL\DYNEGY – VERMILION\NORTH & OLD EAST POND STABLIZATION 2013\05 TECHNICAL PRODUCTION\04 REPORT\FIGURES\FIGURE 5 HISTORIC RIVER CHANNEL LOCATIONS.DWG Last edited: 11/21/13 @ 3:16 p.m. by: david_deguire



LEGEND

Black line	RIVER CHANNEL LOCATION - 1940
Red line	RIVER CHANNEL LOCATION - 1966
Yellow line	RIVER CHANNEL LOCATION - 1998
Green line	RIVER CHANNEL LOCATION - 2005
Cyan line	RIVER CHANNEL LOCATION - 2012

DYNEGY – VERMILION SITE NORTH AND OLD EAST ASH POND EVALUATIONS OAKWOOD, ILLINOIS	PROJECT NO. 21562067
URS	
DRN. BY: chs Nov. 2013 DSGN. BY: kmb CHKD. BY: kmb	Historic River Channel Locations with 2012 Background Photo — FIG. NO. 6

File: P:\GEOTECHNICAL\DYNEGY – VERMILION\NORTH & OLD EAST POND STABLIZATION 2013\05 TECHNICAL PRODUCTION\04 REPORT\FIGURES\FIGURE 5 HISTORIC RIVER CHANNEL LOCATIONS.DWG Last edited: 11/21/13 @ 3:17 p.m. by: david_deguire

PIEZOMETRIC CONE PENETRATION TESTING
Dynegy Vermillion Power Plant Ash Ponds
Danville, Illinois

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July, 2013
13-130-070

TABLE OF CONTENTS

FIGURES AND TABULATIONS

1.0 EXPLORATION PROGRAM SUMMARY

STRATIGRAPHICS, The Geotechnical Data Acquisition Corporation, performed geotechnical cone penetrometer exploration for URS Corporation at the Dynegy Vermillion Power Plant Ash Pond site near Danville, Illinois. The purpose of the exploration was to provide supplemental data on subsurface soil foundation conditions at the site. Our rubber tracked ATV CPT rig was used to perform the testing due to access consideration. This ATV CPT rig has a deadweight push capacity of about 10-11 tons, depending on amounts of equipment and water ballast carried on the rig.

The exploration work was performed on July 24, 2013 and consisted of Piezometric Cone Penetration Test (CPTU) soundings at 5 locations. Shallow refusals were encountered at 2 of the 5 locations - CP1301 and CP1304. A second attempt was successful at Location CP1301 with an offset of about 3 ft. Three attempts were made at Location CP1304, with refusal depths at 11.9 ft, 23.9 ft and 24.3 ft. No further attempts were made at this location per the URS representative at the site. All attempts at Location CP1304 were made within an area of about 25 ft of the staked location.

The total CPT exploration footage was 241.6 ft. A total of seventeen CPTU dissipation tests were performed, three in CP-1301a and 14 in CP1302. These two soundings evidenced the best pore pressure response at the site, and had the thickest sequences of saturated fine grained soils.

This electronic report is presented as a PDF document, including CPT sounding logs, summary tables and report text. Numerical data tabulation files are also embedded within the PDF document. The tabulated data are presented in ASCII *.txt and MS Excel *.xls formats. Details of penetrometer exploration techniques are included in the main body of the report. Additional details of CPT data evaluation are presented in the report appendices.

We have also included a copy of our STRATIGRAPHICS Graphical CPT Data Viewer utility. This utility is a greatly simplified version of our powerful, in-house CPT software program STRATIGRAPHER V8.3. The viewer utility allows viewing the CPT soundings on screen, and to look at features in numerical detail through cursor controls. The utility does not support editing or printing sounding logs. If you need such changes, please contact us.

The viewer requires no installation or setup, and will not change your system configuration. To launch the Viewer utility, open the "STRATIGRAPHICS [ProjectName] Graphical CPT Data Viewer" folder and double click on 'STRATIGRAPHICS CPT Data Viewer version 1.5 beta.exe'. Follow the on screen prompts to get it up and running. Use the File Open command to select the CPT sounding you wish to view. Please disregard the contact information on the viewer utility screen. If you have any questions, please contact us via e-mail at stratigraphics@stratigraphics.com or at 888-790-2788.

2.0 PENETROMETER EQUIPMENT AND DATA ACQUISITION

2.1 Procedure The Cone Penetration Test (CPT) consists of smoothly and continuously pushing an instrumented probe (penetrometer) deep into the ground while recording the soil response to penetration (Figure 1). The CPT penetrometer models a foundation pile under plunging failure load conditions. CPT data are used to develop continuous, high resolution profiles of in situ soil conditions rapidly, accurately and economically.

The soil resistance to penetration acting on the tip and along the sides of the penetrometer is measured during CPT. CPT soil resistance measurements are accurate and highly repeatable. The measurements are used for the evaluation of stratigraphy and various geotechnical parameters. Performance of CPT is specified by ASTM Standard D5778. A fluid pressure transducer is added to acquire hydrogeologic data (Saines and others, 1989) and is called a Piezometric Cone Penetration Test (CPTU). A soil electrical conductivity sensor is added to the penetrometer (CPTU-EC) to acquire qualitative moisture information in vadose zone soils and general groundwater quality data (Strutynsky and others, 1991, 1998). Penetrometer groundwater, soil, and soil gas samplers are used for direct sampling (Strutynsky and Sainey, 1990, Strutynsky and others, 1998). Other sensors, described in the report text, are often included during CPT.

The penetrometer is mounted at the tip of a string of sounding rods. A hydraulic ram is used to push the rod string into the ground at a constant rate of 4 ft per minute. Electronic signals from downhole sensors are transmitted to a data acquisition system for display and recording. Heavy trucks or other deployment systems are used to perform CPT. Truck weight and ballast serve to counteract the thrust of the hydraulic ram. Enclosed truck rig work areas allow all-weather operations. Computers, samplers, electrical power, lighting, compressed air, pressure washer, grout pump, and water tank are included on truck mounted rigs, providing for self-contained operations. Onboard GPS receivers are used to record location positions.

No borehole is required during CPT because penetrometers are directly thrust into the soil. Pressures of over 3 million pounds per square foot can be applied to the tip of the penetrometer for penetration of most soils finer than medium gravel. Asphalt pavements up to 6 inches thick can often be penetrated by penetrometer methods without pre drilling. Site disturbance is reduced since no borehole cuttings or drilling fluids are generated during penetrometer operations. Personnel exposure to contaminated soil is less than exposures during drilling and sampling operations. CPT equipment can be decontaminated during retrieval.

Four to thirteen hundred feet of CPT can be performed in a day, depending on site access. Depths of more than 200 ft can be achieved depending on stratigraphy. Where soils are exceptionally dense, gravelly or rubble filled, an uninstrumented prepunch tool can be used for probing. Information obtained using the prepunch tool can be similar to mechanical (Dutch) cone data, and are indicative of subsurface conditions.

2.1.1 Signal Conditioning and Recording CPT data are acquired using a high channel count, 16 bit (resolution of 1 part in 32,768) industrial data logger and an MS Windows computer. Data are recorded on multiple hard and solid state disks for backup, data processing and archiving. Data are graphically displayed during field testing using commercially available Labview software. CPT data processing is performed using a proprietary software package STRATIGRAPHER (tm) developed by STRATIGRAPHICS.

2.2 Soil Shear Resistance Measurements The soil penetration resistance is measured on the tip and along the sides of the CPT penetrometer using strain gage loadcells (Figure 1, Strutynsky and others, 1985). The conical tip of the penetrometer has a projected cross-sectional area of 15 square centimeters (2.3 sq. in.) and a diameter of 1.7 inches. The cone tip resistance reflects the deep bearing capacity of a soil. Soil friction is measured along a cylindrical sleeve mounted behind the cone tip. The friction sleeve has a surface area of 200 square centimeters (31.0 sq. in.), a length of 5.8 inches, and a diameter slightly larger than the cone tip. The cone tip measurement has a layer resolution of about 2 to 4 inches, while the friction sleeve resolution is about 6 inches.

2.3 Piezometric Measurements A fluid pressure transducer is mounted inside the CPTU penetrometer to measure the soil pore water pressure response to penetration. The advance of the penetrometer causes local, intense volumetric distortion of surrounding soil. This generates a localized pore water pressure field in saturated soils. These generated pressures dissipate almost instantaneously (drained loading) in soils of high permeability, so equilibrium water pressures are typically measured during CPTU in coarse sand and gravel. In medium or low permeability soils, the generated pore water pressure field is sustained for a substantial period of time (partially drained to undrained loading) and can be either negative (dilative) or positive (compressive) relative to the equilibrium (hydrostatic) water pressure field existing before penetration.

The dissipation of generated pore water pressures is recorded during pauses in penetration. The rate of dissipation can be used to estimate soil hydraulic conductivity and consolidation characteristics. If the pauses are long enough for all of the generated water pressures to dissipate, equilibrium potentiometric surface measurements can be obtained at multiple depths in a single CPTU sounding. The CPTU piezometric measurement has a layer resolution of about 1 inch.

2.3.1 Piezometer Saturation The CPTU piezometric measurement system is saturated fully assembled in a 15-50 micron Hg vacuum chamber using silicon oil. This procedure is used to remove as much air as practically possible from the piezometric assembly, to provide as near to an incompressible condition as possible so that near instantaneous responses (zero lag time) to rapidly changing generated pore water pressures are measured during CPTU. High piezometric system saturation levels are indicated by sharp responses at soil interfaces and immediate regeneration of piezometric pressures after pauses in penetration.

Low piezometric measurement system saturation levels leading to poor (lagging) measurements can be caused by inadequate system preparation. Soil suction above the water table, cavitation in highly dilative soils, filter clogging in fine grained soils and filter damage on coarse soil particles or pavement can also occur and cause less than ideal measurements. These problems are beyond the control of the operator and occur with some frequency when testing soils on land. Overwater work provides a more benign environment for CPTU measurements. CPTU piezometric measurements are often less repeatable than CPT tip and friction sleeve resistance measurements.

2.4 Electrical Conductivity and Thermal Measurements A CPTU-EC penetrometer including tip, sleeve, piezometric, temperature, and electrical conductivity (EC) sensors can be used to simultaneously acquire geotechnical, hydrogeological and qualitative geochemical information. Soil EC is measured using a two electrode array, energized with a 3 kHz signal, mounted on the penetrometer tip. The EC measurement has a resolution of about 1 inch. The CPT thermal sensor is used to acquire soil thermal properties.

2.5 Natural Gamma Measurements A CPTU-EC-G penetrometer incorporating cone, friction, piezometric, soil electrical conductivity and natural gamma (G) sensors can be used to simultaneously acquire geotechnical, hydrogeological, qualitative geochemical and radiological information. Gamma measurements can be used to detect radionuclide contamination and to enhance lithologic evaluation.

2.6 UV Fluorescence A CPTU-EC-UVF penetrometer incorporating cone, friction, piezometric, soil electrical conductivity, and Ultraviolet Fluorescence (UVF) sensors can be used to simultaneously acquire geotechnical, hydrogeological, and qualitative geochemical information. The UVF system consists of a sapphire window in the penetrometer, a monochromatic LED UV excitation light source, and photodiode light detectors. UV light is transmitted through the window into the adjacent soil. If the soil contains compounds such as petroleum hydrocarbons that fluoresce, the photodiodes are used to detect the resulting light. The UV excitation has a wavelength of 250 nm. The photodiode sensors are longpass filtered to monitor resulting fluorescent light emissions above 280 nm.

2.7 CPT Seismic Wave Velocity Measurements A vibration receiver module is attached to the penetrometer to acquire seismic (vibration) wave velocity data. CPT vibration sensors have exceptionally good coupling to the surrounding soil resulting in good reception of the high amplitude S-wave arrival. Sensor coupling using packers in cemented and cased boreholes, in contrast, is typically much poorer than that using CPT deployment methods.

The STRATIGRAPHICS CPT seismic wave measurement system consists of downhole vibration sensors, an uphole manual or autohammer wave source with timing trigger, industrial multi-channel, high speed analog to digital converter, and PC signal acquisition and analysis software.

The seismic test procedure is as follows: 1) the CPT and vibration sensor module is pushed to a test depth while acquiring the continuous CPT data; 2) a repeatable shear source wave is generated at the surface; 3) vibration sensor output is recorded as a function of time after source wave triggering; and 4) a consistent reference point on the recorded wave form is picked to indicate wave arrival. The procedure is repeated at multiple depths during the penetration process to allow calculation of pseudo-interval wave velocities between adjacent tests.

Two types of vibration sensors can be used for CPT seismic testing. A low frequency response geophone can be used to acquire data at sites where background environmental noise levels are high. Triaxial accelerometer sensors can be used to acquire multi-channel S-wave data at quiet sites. The accelerometers have a much wider frequency response as compared to the geophones, and are much more sensitive to vibrations. This sensitivity can result in noisy recordings which can preclude good picks of wave arrivals at some industrial sites.

2.8 CPT-EMOD Measurements The standard CPT procedure is conducted as a constant rate of strain test, resulting in a continuous measurement of soil ultimate bearing and frictional strength. By conducting CPT under monotonically increasing stress conditions, soil deformation properties can be evaluated. The CPT-EMOD test is conducted during short pauses in the continuous push process. Load/settlement data are analyzed using elastic theory, as is done for a plate load test for evaluation of Young's Modulus at various stress levels.

2.9 MIP Testing A MIP (Membrane Interface Probe) adapter can be added to the CPT rod string to allow geochemical testing of penetrated soils. The MIP consists of a permeable membrane, heater block with thermocouple and gas carrier tubing. The heater block is set to a temperature of 120-130 degrees C, which heats up the surrounding soil, and volatilizes contaminants in the soil. The volatiles pass through the permeable membrane, and are swept up to the surface by a carrier gas, typically nitrogen, which passes across the back of the membrane.

Once the carrier gas brings the volatiles to the surface, various detectors can be used to characterize the contaminants. A simple photoionization detector (PID) sensor suite is available for rapid screening studies. Two PID sensors, one with a lamp of 10.6 eV energy, and the second with a 9.6 eV lamp, are included in this simple screening suite. More sophisticated analytical equipment, such as GC-MS, can also be used to analyze the volatiles swept up by the carrier gas.

2.10 Penetrometer Geometry The CPT penetrometer external geometry is specified by ASTM standards. Differences in penetrometer internal design can lead to some variability in response between penetrometers of different manufacture, especially in very soft clays. STRATIGRAPHICS uses a cone with a 15 sq cm tip and a 200 sq cm sleeve. The CPTU measurement of generated water pressure depends on external filter geometry. Measurements of equilibrium water pressures after pauses in the penetration process are not sensitive to geometry, and reflect undisturbed conditions.

CPTU piezometric filters are typically mounted on either the cone tip (U1 position) or just ahead of the friction sleeve (U2 position). Each position has advantages and disadvantages. Measurements taken with the cone tip U1 filter are at a maximum and show high resolution of thin soil seams. The cone tip U1 filter is prone to damage on coarse soil particles. Negative pressures are often measured in dense, silty or clayey sands and hard clays when using the U2 friction sleeve filter. These low pressures are probably caused by soil elastic rebound (expansion) as the soil moves from the intensely loaded region beneath the cone tip to the less loaded region next to the friction sleeve. Soil expansion can induce large suction forces on the U2 friction sleeve filter, which can result in decreased filter saturation levels.

Site characteristics and data usage determine which piezometric filter geometry is appropriate. The piezometric filter is placed at the U2 friction sleeve position on the STRATIGRAPHICS CPTU-EC penetrometer. The filter housing is internal to the cone tip. Generally good results can be obtained using this geometry when proper filter preparation techniques are followed.

2.11 Equipment Decontamination and Grouting The rod string is retrieved through a rodwasher mounted on the hydraulic ram assembly. A pressure washer is used to spray water from internal nozzles within the rod washer to clean the rod string. Wash water (about ½ gallon per 10 ft of rod) can be captured for disposal.

The STRATIGRAPHICS grouting system can be used to seal open hole. As penetrometers are being advanced, bentonite grout (about ¼ to ¾ gallon per 10 ft of open hole) is pumped into the annular space formed between the smaller diameter sounding rods and the larger diameter penetrometer. A bypass is opened and additional grout is pumped to seal the hole during rod string retrieval. Pressure grouting during sounding advance can control cross-contamination between different strata. The grout decreases the contact of downhole equipment with contaminated soil. The grout also can decrease rod friction which may allow deeper penetration. Grout levels are checked after sounding completion, and more grout is added to account for penetration of grout into permeable strata.

3.0 PENETROMETER SAMPLING EQUIPMENT

Groundwater, soil gas, and soil samplers are deployed in the same manner as CPT penetrometers. Good sample isolation is achieved because no open hole exists during penetrometer operations.

3.1 Groundwater Sampler The STRATIGRAPHICS groundwater sampler is a shielded wellpoint sampler of heavy construction. The shield controls cross contamination of the sampler while penetrating soils above the sampling depth. Where LNAPL or DNAPL is expected, the sampler and rod string can be prefilled with distilled water during deployment, to provide positive pressure within the sampler, which prevents any product from entering the sampler prior to sampler opening. The DI water is pumped out immediately before opening the sampler. After shield retraction and sampler opening, groundwater flows under in situ pressure conditions, through a 20 inch long screen, into the 350 ml sample barrel, and up the rod string. Small diameter pumps can be used with the sampler to acquire large volumes of sample. This sampler can be deployed in most soils capable of being penetrated by the CPTU-EC penetrometer (Strutynsky and others, 1998).

For the best isolation of samples, the groundwater sampler is first deployed to the shallowest sampling interval, opened, and sample is acquired. The sampler is retrieved to pour off the sample and for decontamination. This process is repeated at each subsequently deeper sampling interval (top/down sampling).

A less expensive method of groundwater sampling is to use a “bottom/up” deployment mode. The groundwater sampler is deployed to the deepest interval, opened, and sample is pumped to the surface. The sampler is then pulled up to the next shallower interval, purged, and sample is pumped again. This procedure is repeated until the shallowest sample has been obtained. If the sampler screen clogs due to fines in the sampled formations, the sampler must be tripped out, deconned, and re-deployed. Bottom/up sampling is most often used at sites with very dense sands and gravels where deep deployment is a problem. The sampler is typically deployed down the same pathway created by the CPTU-EC stratigraphy tool. Since sands cannot maintain an open hole below the water table, good isolation of sampling intervals can be achieved using the bottom/up method.

A pressure transducer can be placed inside the groundwater sampler barrel. This allows the measurement of sample inflow rate. Analysis of inflow data using rising head slug test methods can provide a means of estimating soil hydraulic conductivities. If equilibrium conditions are reached, a measurement of the static water pressure head is obtained during groundwater sampling.

3.2 Soil Gas Sampler The STRATIGRAPHICS soil gas sampler is a shielded screen sampler, similar to the groundwater sampler. The shield is opened by pulling back the rod string during sampling, and soil gases are then purged and extracted. The shield can be closed, and the rod string advanced to another depth, allowing multiple samples during a single rod trip. A vacuum box can be used to inflate Tedlar bags for off site analysis. Portable analytical equipment can be used to allow immediate soil gas profiling.

3.3 Soil Samplers Fixed piston samplers are used to obtain soil samples during penetrometer exploration. A piston, locked into the tip of the barrel to prevent soil from entering the sampler prematurely, is released at the sampling depth. The barrel is then advanced to the bottom of the sampling interval. The soil enters the 1.25 inch diameter, 14 inch long barrel and is retained by a core catcher. The sampler is retrieved to remove the sample and for sampler decontamination. The sampler can be pushed into soils as dense as about 350-400 TSF cone tip resistance, or about 50 to 80 blows per foot SPT.

4.0 PIEZOMETER INSTALLATION TECHNIQUES

Penetrometer methods can be used to install piezometers for water level measurements, slug testing, groundwater sampling, and for remediation activities, such as sparging and soil vapor extraction (SVE). Various installation techniques are available (Saines and others, 1989). Proprietary, low volume change piezometers also can be installed using penetrometer equipment. These piezometers are often used for long term water pressure measurements during geotechnical projects. PVC piezometers are installed using a steel casing pushed to depth. The casing is sealed with an expendable tip which prevents soil from entering the casing during deployment. The PVC screen and risers are lowered into the casing, the casing is then withdrawn, leaving the PVC in place.

5.0 DATA REDUCTION

Test data are monitored as the soundings are performed. Data are recorded on hard disk and may consist of: depth, time, tip and sleeve resistance, generated water pressure, EC, UVF, temperature and natural gamma. Data are processed in-house and undergo quality control review prior to final reporting.

Several parameters can be computed to enhance data correlation:

friction ratio, FR (in %):

FR = fs/qc * 100 (Eq. 1); and

pore pressure ratio, Bq (dimensionless):

Bq = (U-Ue)/(qc-Sv) (Eq. 2);

where: *fs* is the measured friction sleeve resistance, in TSF;
qc is the measured cone end bearing resistance, in TSF;
U is the measured generated pore water pressure, in TSF;
Ue is the measured or estimated equilibrium pore water pressure, in TSF; and
Sv is the total soil overburden pressure, in TSF.

Measured data, computed and correlated parameters are presented in a graphical sounding log format for each sounding; numerical data are typically tabulated at 0.5 ft intervals. Digital data are also included on disk.

CPTU dissipation test data are recorded as a function of time during pauses in the penetration process. Dissipation data are normalized using the following equation:

normalized dissipation level, U* (dimensionless):

(Ut - Ue) / (U0 - Ue) (Eq. 3);

where: *Ut* is the excess pore water pressure at time t, in TSF;
Ue is the measured or estimated equilibrium, undisturbed pore water pressure (in situ pore water pressure before penetrometer insertion), in TSF; and
U0 is the excess pore water pressure at time equal to zero, at the start of the dissipation test, in TSF

The normalized dissipation level is plotted versus log time. In uniform soils, the plot takes the shape of a reverse S-curve, beginning at one at zero time (at the instant the penetration process is stopped) and falling to zero when equilibrium pressures are achieved. Boundary effects in interbedded deposits can cause deviation from this ideal.

An estimate of the horizontal coefficient of soil consolidation can be calculated (Baligh and Levadoux, 1980) using: Ch (in cm**2/sec) = (r**2*T)/t (Eq. 4a).

Estimates of soil hydraulic conductivity in the horizontal direction can be calculated using:

kh (in cm/s) = ((r**2*T)/t)*RR*(Gw/(2.3*Sv')) (Eq. 4b);

where: *r* is the penetrometer radial dimension at the plane of the piezometric filter, equal to 2.2 cm for the U2 friction sleeve filter and 1.9 cm for the U1 cone tip filter;
T is a dimensionless time factor at the 50% normalized dissipation level, equal to 5.5 for the U2 friction sleeve filter and 3.8 for the U1 cone tip filter;
t is the measured time, in seconds, at which the normalized dissipation level is 50%;
RR is a dimensionless soil compressibility parameter;
Gw is the unit weight of water, in kg/cm***3; and
Sv' is the effective soil vertical overburden pressure, in kg/cm**2.

Dissipation test data can be presented in graphical plots and are summarized in tabular form.

6.0 GENERAL DATA EVALUATION

6.1 Sounding Log The CPT sounding logs provide high resolution information on subsurface conditions. Soil layering is often highly apparent. Soil relative strength and saturation levels can also be evaluated. Zones of anomalous soil electrical conductivity can be identified. Apparent lateral continuity of conditions can be evaluated by comparing adjacent soundings. Digital CPT data files can be used in two and three dimensional data visualization, CAD or GIS software programs.

6.2 Soil Type Classification Correlations between penetrometer data and soil classification have been developed from geotechnical bearing capacity theory and a relational database on adjacent CPT soundings and drilled boreholes (Douglas and Olsen, 1981). A CPT soil type chart based on cone tip resistance and friction ratio is presented in Appendix A.

The CPT tip resistance increases exponentially with soil grain size. For example, tip resistance in dense sands ranges from about 100 to 400 tons per square foot (TSF), while tip resistance in a stiff clay ranges from about 5 to 15 TSF. The friction ratio (Section 5.0) is also used for indication of soil type. The friction ratio increases with the fines content and compressibility of a soil. The friction ratio is less than about 1% in a sand and greater than about 3% in a clay. CPT soil types reflect the soil shear resistance to penetration. Soil shear resistance is not entirely controlled by grain size distribution. However, CPT soil types generally agree with classifications based on grain size distribution methods, such as the Unified Soil Classification System (USCS).

The generated pore water pressure measurement is also useful for evaluation of saturated soils. Penetration of coarse sand and gravel occurs under drained loading conditions, and thus equilibrium pressures are measured during CPTU. The pore pressure ratio (Section 5.0) is zero in high permeability soils. For saturated soils of permeability less than about 1*10E-2 cm/sec, undrained loading with significant excess water pressure generation occurs during CPTU. Positive excess water pressures are generally measured during penetration of silt or clay soils when using either the U1 cone tip or U2 friction sleeve filter penetrometer (Section 2.7). Pore pressure ratios of fine grained soils typically range from about 0.4 to 1.0.

Positive excess water pressures are also usually measured in dense, silty or clayey sands when using the U1 filter penetrometer, with pore pressure ratios from about 0 to 0.3. Due to geometric effects (Section 2.7), negative pressures are usually measured in dense, silty or clayey sands, sandy silts, or hard sandy clays with the U2 filter penetrometer. Thus, it is important to note the type of piezometer filter in use. The CPTU-EC penetrometer uses a U2 friction sleeve piezometric filter.

6.3 Potentiometric Surfaces Equilibrium water pressures are measured during penetrometer advance in saturated, coarse sand and gravel. Measurements of equilibrium water pressures can be obtained during CPTU in lower permeability soils by pausing during penetration and allowing generated water pressures to dissipate.

6.4 Soil Saturation Soil saturation often can be evaluated using the CPTU sounding log. Atmospheric (zero) pressure is measured during CPTU in unsaturated soils. Hydrostatic pressures are measured in saturated, high permeability soils. Significant water pressures are generated in saturated, low permeability soils due to penetrometer advance. Decreased levels of water pressure generation can be indicative of partially saturated soils. Decreased water pressure generation also may occur in organic soils due to the high compressibility of organic soil particles and the presence of biogenic gases, such as methane and hydrogen sulfide.

6.5 Soil Hydraulic Conductivity Excess water pressures are generated by penetrometer advance in saturated soils with permeability of less than about 1*10E-2 cm/sec. These generated pressures can be allowed to dissipate during pauses in the penetration process. The CPTU dissipation test is similar to a slug test and can be used to estimate soil hydraulic conductivity in the horizontal direction. Very high water pressures are typically generated in low permeability soils by penetrometer advance, so soil compressibility (storage) effects must be included in analyses. The CPTU tip resistance provides an index of soil compressibility for these computations.

6.6 Soil Electrical Conductivity Behavior Soil electrical conductivity (EC) is controlled by the conductance of both the soil particles and soil pore fluids. The ratio between pore fluid and soil-pore fluid electrical conductivity is termed the formation factor (Archie, 1942). Clays can be electrically conductive due to adsorbed water and ionic electrical charges on the clay platelets. Thus, clay EC depends on mineralogy, porosity and pore fluid characteristics. Sand grains are typically non-conductive, so granular soil conductance is primarily dependent on the conductance of pore fluids and the sand's porosity.

Pore fluids play a major role in sand EC. A dry sand has low EC since both the sand grains and the air in the pore space have very low conductance. Sands saturated with conductive liquids, such as brine or landfill leachates, have high EC. Hydrocarbons typically decrease EC because of their low conductance. **Soil saturation** has a pronounced effect on sand EC, as conductance increases with water saturation. Low saturation is typically associated with low EC. The low **porosity** of a dense sand results in less pore fluid available for electrical conductance and thus lower EC; the high porosity of a loose sand is often associated with higher EC. Formation factors vary as an inverse function of porosity, from about 3 at high porosity to about 4.5 at low porosity. The addition of as little as 5% clay to a sand can increase soil EC (Windle, 1977).

The high resolution of the STRATIGRAPHICS CPTU-EC electrode array makes measurements sensitive to gravel content. Two behaviors can occur when penetrating gravelly soils. One can occur when a large particle is crushed against an electrode, masking it from the pore fluids, which results in low EC values. An opposite behavior is observed in gravel deposits which contain few fine grained intersticial soils. The high resolution EC measurement can result in electrical conductance paths within the soil pore space. In this situation, high EC measurements more closely reflect pore fluid EC, rather than soil EC.

<u>6.7 EC Evaluation</u> EC data are evaluated in conjunction with CPTU-EC piezometric data and soil types for qualitative geochemical characteristics. Anomalous zones possibly indicative of contaminants can be directly sampled for quantitative chemical analysis.

Vadose Zone Low or zero EC values are typically measured in dry sandy soils. Increased EC in vadose zone sands may indicate moisture infiltration. Low EC data in vadose zone silty or clayey soils can be anomalous as fine grained soils often retain significant amounts of moisture within their pore spaces due to capillarity. Elevated EC values in the vadose zone may be associated with road deicing salts, buried metals and rusted metal objects, flyash and cinders, among others.

Saturated Soils Low EC values in saturated soils can be indicative of anomalous geochemistry. In particular, depressed EC zones immediately at the water table may be associated with floating (LNAPL) compounds. Very low EC zones at interfaces between aquifers and aquitards may be associated with either LNAPL or DNAPL compounds. Gravel interference must be considered when evaluating depressed EC zones in saturated soils.

Elevated EC values in saturated soils can be due to increased soil clay content or to increased dissolved salts in the ground water. Increased clay contents are evaluated based on the CPTU-EC piezometric data and soil type information. Zones of elevated EC immediately above an aquiclude may be associated with brines or landfill leachates (Strutynsky and others, 1998).

<u>6.8 UV Fluorescence Behavior</u> Fluorimetry (measurement of fluorescence) has been used for many years for the detection and identification of various compounds and minerals. An excitation light of short wavelength is used to expose the specimen. If fluorescent compounds or minerals are present, light of longer wavelength, as compared to the excitation wavelength, will be emitted from the specimen. This resulting light can be monitored for intensity and spectral distribution.

Compounds that fluoresce include a wide range of hydrocarbon and other organic compounds. Heavy hydrocarbons (e.g. fuel oil and coal tars) fluoresce at relatively long wavelength excitation. As excitation wavelength decreases below about 300 nm, fluorescence from lighter hydrocarbons (e.g. jet fuel and gasoline) is observed. In addition to hydrocarbons, other compounds and minerals, such as fluorites and other carbonates, also exhibit fluorescence. Compounds that fluoresce include dyes and optical brighteners, used in paints, detergents, antifreeze compounds, some food additives and cosmetics, among others. UVF response will be affected by the presence of any such compounds.

<u>6.9 CPT-SPT Correlation</u> Since most geoscientists are familiar with drilling and split spoon sampling, CPT data have been correlated with SPT blowcount N-values. The SPT N-value is defined by ASTM to be the number of blows of a 140 lb hammer, dropped 30 inches, required to drive a 2 inch outside diameter sampler 12 inches into the bottom of the borehole, after an initial seating drive of 6 inches. Correlations of CPT to the crude SPT have been based on numerical modeling of the two penetration processes and on side by side comparisons (Douglas and others, 1981). Additional details on CPT-SPT correlations are included in Appendix A.

7.0 GEOTECHNICAL DATA CORRELATION

CPT data have been correlated with soil type, drained friction angle, undrained shear strength, relative density and SPT blowcounts, among others. A correlation scheme including tip resistance and friction ratio has generally proved most useful for evaluating CPT data. Correlation of CPT data with other parameters has been developed using: 1) comparisons between CPT data and results of other in situ and laboratory tests in adjacent boreholes; 2) CPT testing on large scale soil samples of known composition; and 3) geotechnical bearing capacity and cavity expansion theory. Site specific information can be used to fine tune correlations. Additional information on correlation techniques, including overburden pressure normalization, test drainage conditions and recommended practices, is presented in Appendix A.

8.0 PROGRAM RESULTS

Acquired data are presented following the report text and consist of: 1) sounding logs with lithologic evaluation; 2) data presentation sounding logs; and 3) tabulations of correlated geotechnical parameters, including soil classifications. Digital data are presented on the attached disk, and include statistical summaries of evaluated strata for each sounding, among other data presentations. It should be noted that the computerized evaluations of soil types and other geotechnical properties were generated using a global rather than site specific data base. Use of site specific data was beyond the scope of this study.

9.0 STATEMENT OF LIMITATIONS

Subsurface information was gathered only at the sounding locations. Extrapolation of sounding data to develop stratigraphic continuity is conjectural. Actual site conditions between sounding locations may differ. Evaluation of soil saturation and potentiometric surfaces is only representative of conditions encountered during the field program. Seasonal variation must be expected.

Correlation of penetrometer data with other parameters was performed using generalized, global charts rather than on site specific information. Site specific correlation work based on results of detailed, complementary laboratory testing was beyond the scope of this study.

Data gathering for this study was attempted to be performed in general accordance with accepted procedures and practices. Correlation of penetrometer data with other parameters is empirical and should not be considered as the exact equivalent of laboratory testing. STRATIGRAPHICS shall not be responsible for another's interpretation of the information obtained for this study.

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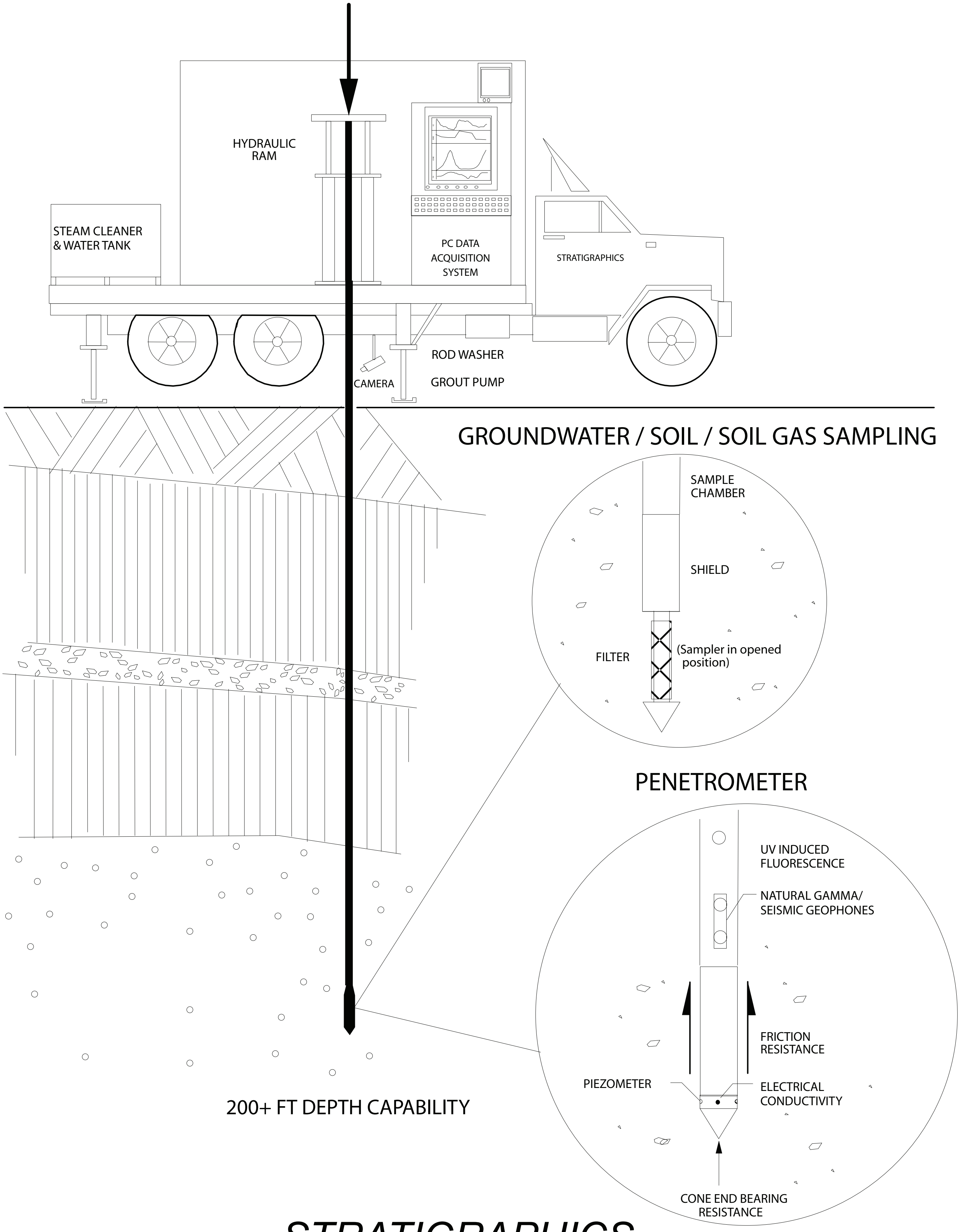

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Figure 1

APPENDIX A
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1.0 EVALUATION OF GEOTECHNICAL PARAMETERS

CPT data have been correlated with soil type, drained friction angle, undrained shear strength, relative density, and equivalent SPT blowcounts, among others. Correlations have been developed by comparing CPT results to laboratory tests on drilled samples and to other in situ tests, such as vane and pressuremeter. Laboratory CPT testing on large scale samples of known composition and classical bearing capacity and cavity expansion theory have also been used. Site specific information, where available, can be used to fine tune correlations.

A two parameter correlation scheme has proved useful for CPT data evaluation. Geotechnical properties often exhibit well defined trends when plotted against the logarithm of the CPT cone end bearing resistance and friction ratio. For instance, increased grain size increases cone end bearing resistance, while increased plasticity and compressibility increase friction ratio. A chart illustrating these and other trends is presented in Figure A1. A discussion of CPT data evaluation is presented in Douglas and Olsen, 1981.

<u>A1.1 CPT Soil Behavior Types</u> CPT soil behavior type correlations (Figure A2) have been developed from geotechnical theory and comparisons of borehole data with CPT data (Douglas and Olsen, 1981). The CPT soil type tabulations are indicative of the response of the soil to the large shear deformations imposed on the soil during penetrometer advance. Soil shear response is not entirely controlled by grain size distribution. However, it has been found that CPT soil types generally agree with classifications based on soil grain size distribution methods such as the Unified Soil Classification System (USCS).

<u>A1.2 CPT Relative Density</u> Relative densities of granular soils are correlated with CPT data (Figure A3) on the basis of laboratory CPT on large scale samples of known composition (Schmertmann, 1978, and Villet and Mitchell, 1981). The effect of soil fines content has been empirically accounted for by extrapolating trends in the two parameter correlation model (Douglas and Strutynsky, 1984).

<u>A1.3 CPT Drained Static Strength</u> Drained friction angles have been correlated with CPT data (Figure A3) on the basis of CPT soundings and laboratory tests on drilled samples, and on theoretical analyses of the cone end bearing capacity problem (Schmertmann, 1978, Durgunoglu and Mitchell, 1974, and Villet and Mitchell, 1981). The effect of soil fines content on friction angles has been accounted for by extrapolating trends in the two parameter correlation model, as was done for the relative density correlation.

<u>A1.4 CPT Undrained Static Strength</u> The correlation between CPT data and undrained shear strength has been extensively studied (Douglas and others, 1984, Lunne and others, 1976, Sanglerat, 1972, and Schmertmann, 1978). The following bearing capacity equation can be used for computing undrained shear strength from CPT data: qu = (Su * Nc) + Sv (Eq. A1); where: qu = ultimate bearing capacity; Su = undrained shear strength; Nc = a dimensionless bearing capacity factor; and Sv = the estimated total vertical stress. By setting qu equal to the cone end bearing resistance, qc, and rearranging the equation, a value of the undrained shear strength can be computed as: Su = (qc - Sv) / Nk (Nk is equivalent to Nc in Eq. A1) (Eq. A2).

The primary difficulty in using this equation has been the selection of Nk applicable to cone penetration in a particular soil. Bearing capacity and cavity expansion theory and other in situ and laboratory test results performed adjacent to CPT soundings have been used to calculate Nk values. These Nk values have ranged from 5 to over 25, but are most often between about 12 and 20. Higher Nk values are typically associated with overconsolidated clays and lower plasticity clays and clayey silts.

A compilation of Nk values as a function of cone end bearing resistance and friction ratio is presented in Figure A4. This figure was developed from comparisons of CPT to results of laboratory consolidated-undrained (CU) strength tests. This is important to note as undrained shear strength is not a unique property of a soil - it is test type and stress path dependent.

Many design methodologies are based on a particular strength test on a particular type of sample. These semi-empirical design methods are successfully used by experienced designers. Engineering judgment must be applied in using the results of any type of testing to assure both adequate safety and design economy.

High Strain, Remolded Strength Another measure of the in situ undrained shear strength is provided by the CPT friction sleeve resistance. The friction sleeve interacts with soil that has already undergone bearing capacity failure induced by the tip of the penetrometer. Thus, the friction sleeve resistance is a measure of soil large strain, remolded strength. The ratio between strengths calculated from the cone end bearing and from the friction sleeve is indicative of soil sensitivity.

In moderately to highly overconsolidated, non-sensitive clays, friction sleeve resistances can indicate higher strengths than those calculated using the cone end bearing resistance. This often reflects the dilative (strain hardening) nature of shear failure in overconsolidated soils. Engineering judgment must be applied in deciding which strain level, and thus which strength, is representative for the design problem to be solved.

A1.5 Evaluation of Soil Stress History The results of penetrometer testing can often be evaluated for indication of clay soil stress history or pre-consolidation pressure. Several methods are available for this evaluation. The first method consists of computing a normally consolidated cone end bearing resistance profile, based on estimated soil unit weights, water table information, cohesion at the ground surface, and an assumed c/p ratio and cone factor Nk for the clay strata in question. This normally consolidated profile is then compared to the measured profile, and differences between the two can be assumed to be due to past stress history events (Schmertmann, 1977). A back calculation is then performed on the difference, using the assumed c/p ratio and Nk, and a pre-consolidation pressure is calculated. OCR’s can then be calculated based on estimated existing stress conditions. SHANSEP procedures used during triaxial testing of clay soils may be useful in this method, especially for definition of c/p ratios.

Other methods for estimating stress history from CPT data are summarized in Mayne (1991 and 1993). These include approaches based on cavity expansion theory and critical state soil mechanics or on empirical methods based on data sets, primarily from sites in offshore oil fields. Results from each method should be compared, and engineering judgment should be used to decide which method gives the most appropriate result for the design at hand.

A1.6 Equivalent SPT Blowcount N-Values An equivalent SPT blowcount can be correlated with CPT data by using an analytical model of the SPT procedure (Douglas and Olsen, 1981). This procedure has been checked by comparison to SPT results at various sites throughout the world (Douglas and others, 1981, Douglas and Strutynsky, 1984, and Olsen and Farr, 1986) with generally good results.

The particular SPT equipment used to develop the CPT-SPT correlation chart (Figure A5) consisted of a SPT trip hammer system. This SPT hammer is characterized by reasonably repeatable, measured hammer input energy efficiencies of about 60 to 70% (Douglas and Strutynsky, 1984). This hammer input energy level is similar to that recommended (Seed and others, 1984) as the "standard" Standard Penetration Test input energy.

SPT results are both equipment and operator dependent. SPT hammer efficiencies have been measured to range from 35 to over 90% of the theoretical 4200 in-lbs (30 inch fall, 140 lbs hammer) SPT input energy. Variable SPT input energy results in variable blowcounts (Douglas and Strutynsky, 1984, Seed and others, 1984). Non-uniform SPT input energy is a limitation for use of SPT for quantitative design purposes.

The approach of using the extensive SPT data base by performing CPT and then deriving equivalent SPT blowcount N-values, can result in better site characterization. This is because CPT is continuous, has higher resolution, is less expensive, and is much more consistent and repeatable than SPT. The chart that was used for correlating CPT to SPT for this study is presented in Figure A5. After determining the overburden normalized equivalent SPT N'-value, the equivalent SPT blowcount N-value was calculated by dividing the overburden normalized value by the overburden normalization factor CN, as defined in Eq. A3.

The equivalent SPT N-values reflect the higher resolution of the CPT measurements as compared to actual SPT. Performance of actual SPT includes averaging of soil resistance over about a 24 inch interval (18 inch sampler embedment and 2 to 3 sampler diameters ahead of the sampler). Equivalent SPT values have a resolution of about six inches. Rather than coarsen the 6 inch resolution equivalent SPT N-value to fit a 24 inch resolution actual SPT N-value, equivalent values are based on point by point CPT data. These high resolution, equivalent SPT values should be more useful for design purposes, especially in interlayered deposits, where thin, weak soil seams cannot be adequately characterized by actual SPT blowcount methods. The high resolution equivalent SPT values and actual SPT measurements should be similar in thick homogeneous strata.

Discrepancies between CPT equivalent SPT N-values and actual, measured SPT N-values are often due to inconsistencies in the performance of actual SPT. Poor fit of CPT equivalent and actual SPT in weak soils with very low blowcounts (0 to 3) can be due to limited accuracy of high capacity CPT loadcells used at the extreme low end of their range, but are more likely caused by extensive borehole disturbance in easily disturbed soil, and set of the SPT sampler under the self-weight of the hammer and drillrods. Discrepancies between equivalent and actual SPT values in very dense or hard soils with high blowcounts, especially in gravelly soils, can be due to both erratic penetrometer or SPT sampler interaction with large soil particles, and basic differences in modes of penetration of the two techniques.
Indications of weak soils, using any method, should strongly encourage additional testing, including undisturbed sampling and sophisticated laboratory testing.

A2.0 OVERBURDEN PRESSURE NORMALIZATION

Overburden normalization of CPT data for correlation purposes is necessary in order to remove the effects of increasing overburden pressure with depth on measured results. Cone tip resistances can be normalized to an effective vertical overburden pressure of 1 TSF by using the following equations: qc1 = qc * CN (Eq. A3); and CN = 1.0 - 0.5 * log (Sv') (Eq. A4); where: qc1 is the overburden normalized cone tip resistance, in TSF; qc is the measured cone tip resistance, in TSF; CN is the overburden normalization factor; and Sv' is the effective vertical overburden stress in TSF.

Overburden normalization curves are variable (Douglas and Martin, 1980) and were developed using laboratory CPT and SPT on large samples of clean sands. Application of these laboratory results to natural soils may be limited. The CN presented in Equation A4 is similar to that proposed (Seed and others, 1977) for the effect of overburden on SPT blowcounts.

The friction ratio is not normalized based on the assumption that overburden pressure affects friction sleeve and cone tip resistance similarly. Since the quantities are divided by each other to compute friction ratio, overburden effects should cancel. Some experience (Olsen and Farr, 1986) indicates that this assumption may oversimplify actual conditions for deep soundings. The friction resistance may be less sensitive to overburden pressure than the cone tip resistance. Thus, in soundings deeper than about 100 ft, the friction ratio may gradually decrease with increased penetration, independent of any changes in soil conditions, other than overburden pressure. Due to the variability in overburden normalization curves, no specific correction for overburden pressure on friction ratio has been recommended or used for this study. For this study, effective stresses in Equation A4 were computed using assumed water tables and soil unit weights.

A3.0 TEST DRAINAGE CONDITION

The CPT loading rate is such that drained and undrained conditions exist during testing of sands and clays, respectively. Partial drainage may occur in mixed (granular and fine grained) soils. CPTU piezometric data indicate that minor differences in cone tip and friction ratio response can correspond with major changes in pore water pressure response (Douglas and others, 1985). The complex volumetric strain field around the penetrometer (Davidson and Boghrat, 1983) precludes reliable geotechnical effective stress analysis of CPTU results in partially drained soil.

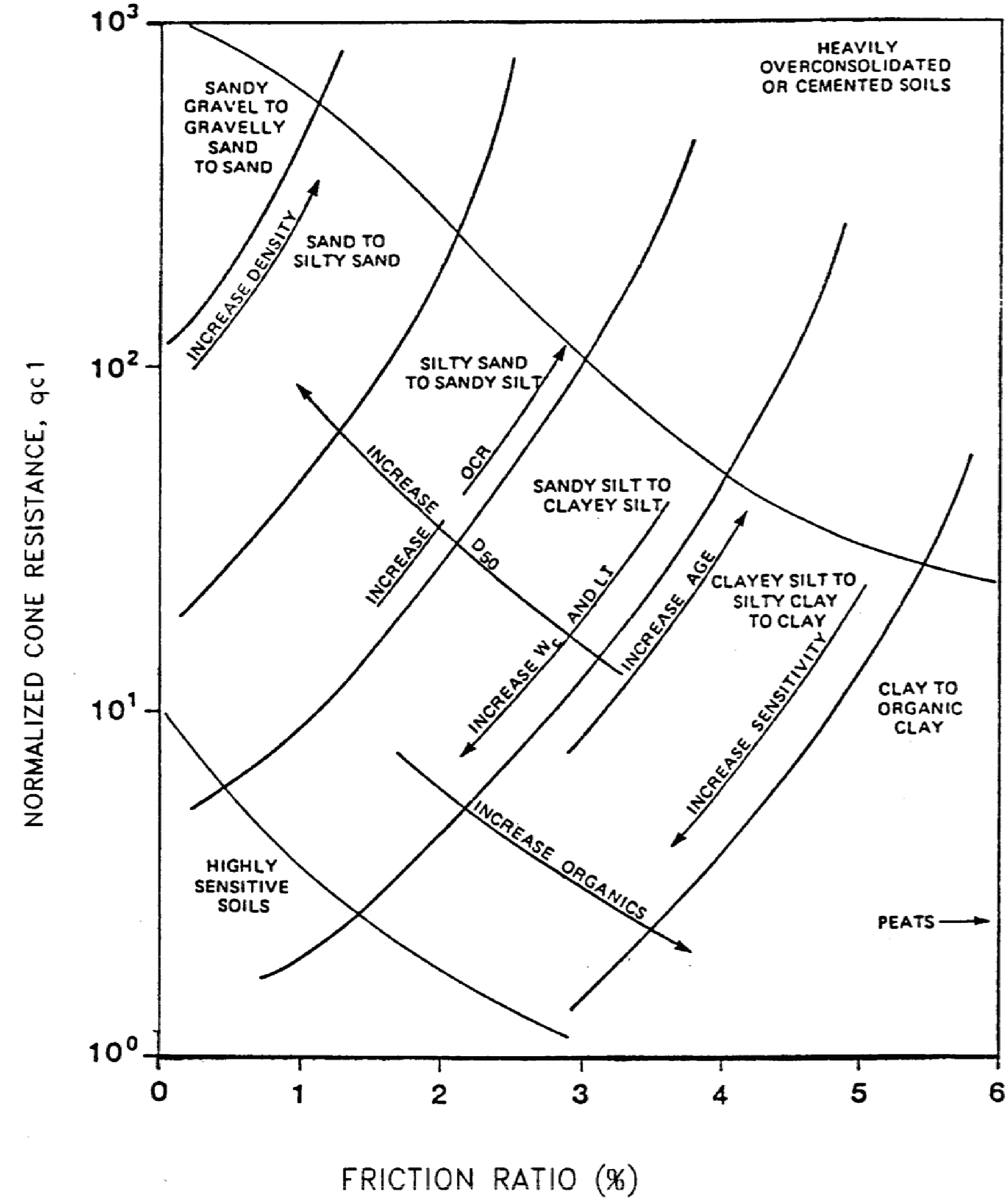
Empirical estimates of either drained or undrained parameters can be made in mixed soils. These parameters must not be combined and must be used alternatively. Combination of drained and undrained parameters will result in significant overestimation of in situ shear strength. Structure rate of loading will help determine whether drained or undrained parameters should be appropriate for design use. Depending on project needs and site conditions, geotechnical laboratory testing including consolidation and CU tests with pore pressure measurements will also be useful in assigning appropriate design parameters. Field instrumentation during construction using low volume change piezometers may be appropriate for some projects.

A4.0 RECOMMENDED PRACTICES

The STRATIGRAPHICS data evaluation program uses a series of global correlation charts, Figures A1 through A5. Parameters are computer evaluated and tabulated at discrete intervals. Stratigraphic units should be defined on the basis of the continuous sounding logs and project requirements. The correlations are then used in evaluation of layer properties. Use of the tabulations without the review of the CPT sounding logs can lead to the choice of non-representative parameters, especially in interlayered deposits. It should be noted that taking discontinuous borehole soil samples also often provides a poor representation of subsurface conditions.

CPT correlations have been developed using empiricism. The data base is world-wide and includes decades of CPT experience. However, local conditions may differ from those in the global data base. Thus, the evaluated parameters should be viewed as indicating trends rather than as the exact equivalent of specific laboratory tests performed under boundary and drainage controlled conditions. The derived parameters are not intended to replace appropriate drilling and undisturbed sampling, other in situ and laboratory testing, and use of engineering judgment.

Review of CPT results and project requirements is used to define the need for additional information. Zones delineated by CPT (or, in fact, any other test) providing low factors of safety should be further explored. For example, high quality undisturbed sampling followed by geotechnical triaxial and consolidation testing may be indicated for low strength cohesive or partially drained mixed soil strata. Monitoring wells may be installed or groundwater samples taken in high hydraulic conductivity strata during geo-environmental exploration. Non-CPT test results can often be extrapolated across the site based on CPT evaluated stratigraphy.



SOIL BEHAVIOR TYPE CLASSIFICATION CHART

After Douglas and Olsen, 1981

STRATIGRAPHICS

Figure A1

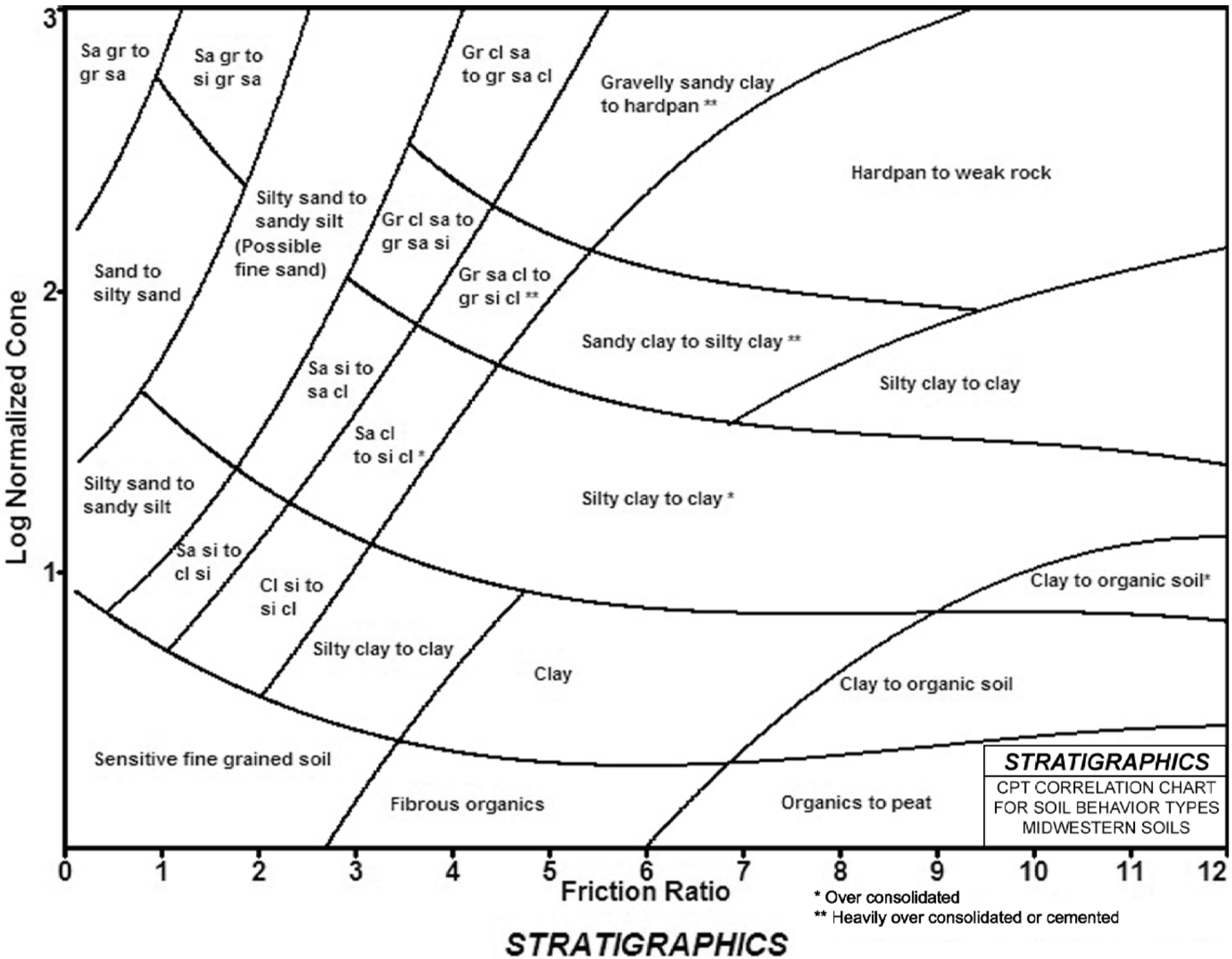
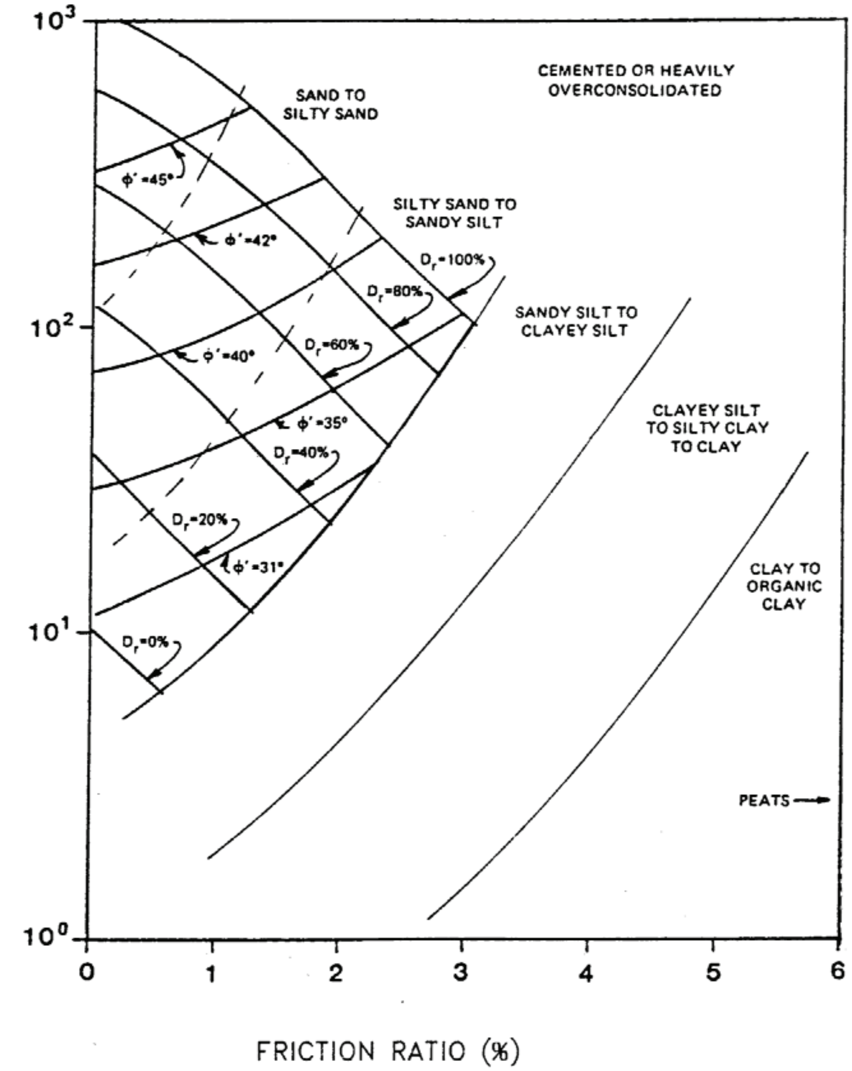

Sa gr to gr sa
Sa gr to si gr sa
Gr cl sa to gr sa cl
Gravelly sandy clay to hardpan **
Hardpan to weak rock
Silty sand to sandy silt (Possible fine sand)
Gr cl sa to gr sa si
Gr sa cl to gr si cl **
Sand to silty sand
Sandy clay to silty clay **
Silty clay to clay
Sa si to sa cl
Sa cl to si cl *
Silty sand to sandy silt
Silty clay to clay *
Sa si to cl si
Cl si to si cl
Clay to organic soil*
Silty clay to clay
Clay
Clay to organic soil
Sensitive fine grained soil
Fibrous organics
Organics to peat
STRATIGRAPHICS
CPT CORRELATION CHART
FOR SOIL BEHAVIOR TYPES
MIDWESTERN SOILS
Log Normalized Cone
0
1
2
3
4
5
6
7
8
9
10
11
12
Friction Ratio
* Over consolidated
** Heavily over consolidated or cemented
STRATIGRAPHICS

Figure A2

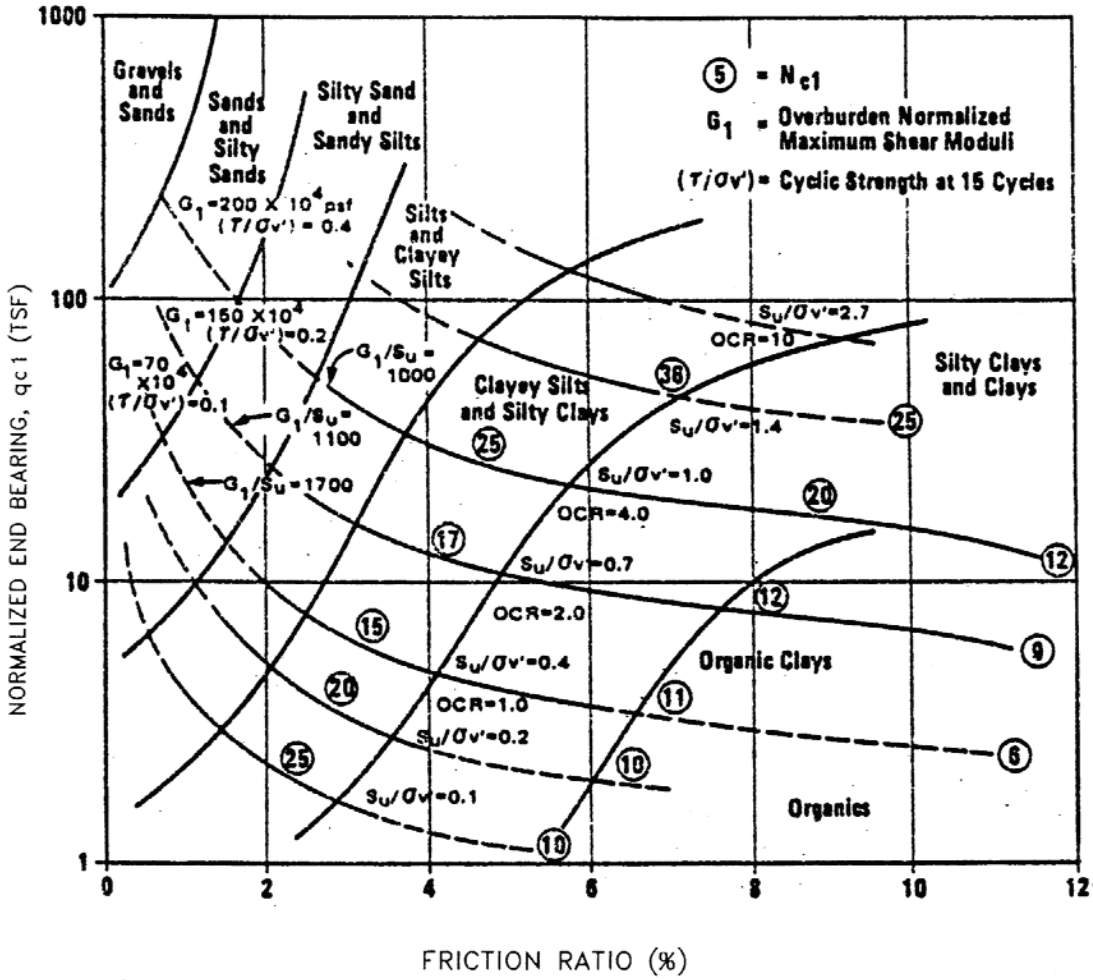


EXPANDED SOIL BEHAVIOR TYPE CLASSIFICATION CHART WITH EQUIVALENT OVERBURDEN NORMALIZED FRICTION ANGLE AND RELATIVE DENSITY TRENDS

After Douglas and Strutynsky, 1984

STRATIGRAPHICS

Figure A3

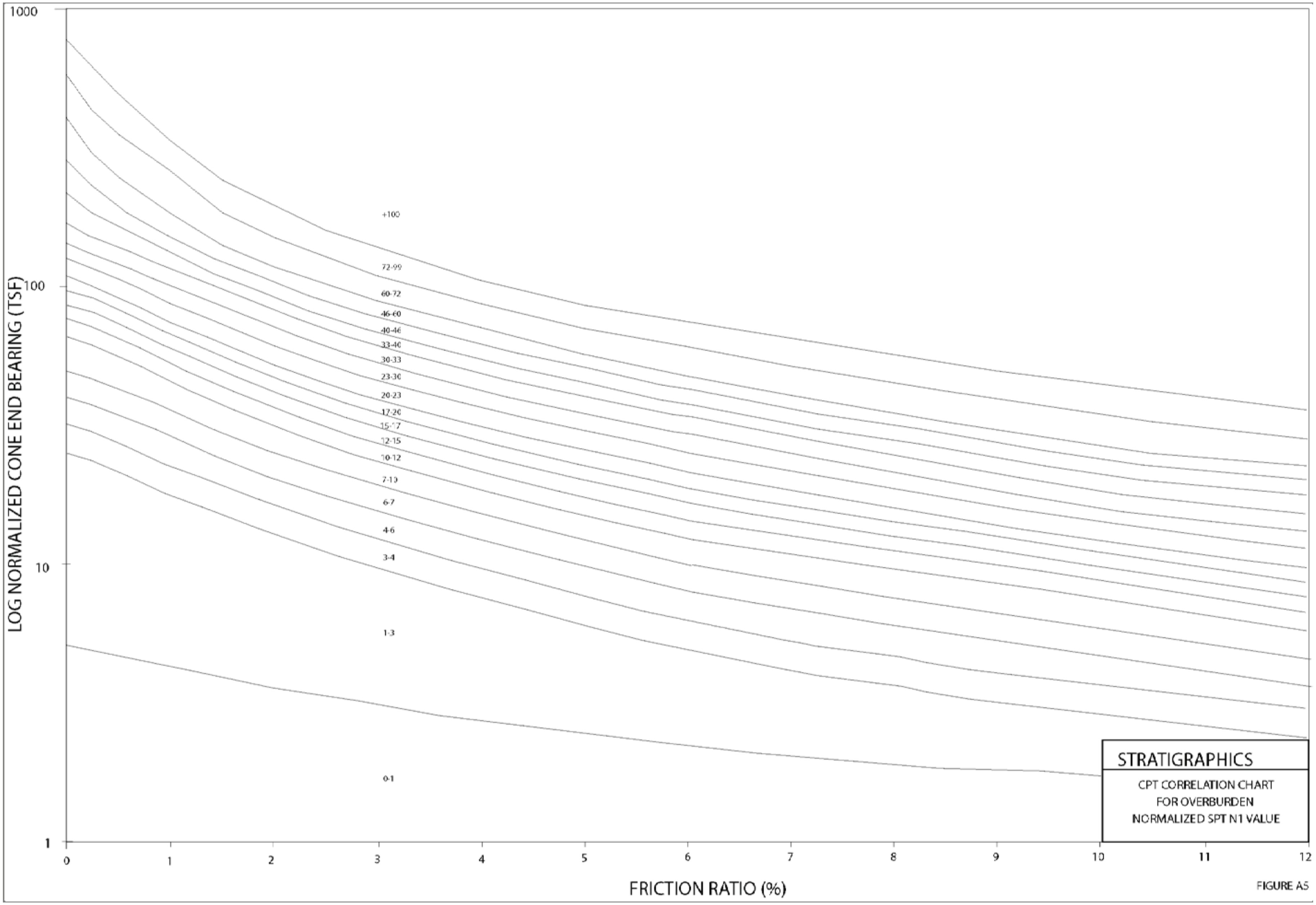


COMPOSITE TRENDS IN UNDRAINED SOIL PROPERTIES

After Douglas, Strutynsky, et. al., 1985

STRATIGRAPHICS

Figure A4


LOG NORMALIZED CONE END BEARING (TSF)
1000
100
10
1
+100
72-99
60-72
46-60
40-46
33-40
30-33
23-30
20-23
17-20
15-17
12-15
10-12
7-10
6-7
4-6
3-4
1-3
0-1
0
1
2
3
4
5
6
7
8
9
10
11
12
FRICTION RATIO (%)
STRATIGRAPHICS
CPT CORRELATION CHART
FOR OVERBURDEN
NORMALIZED SPT N1 VALUE
FIGURE A5

APPENDIX B

from Baligh, M.M. and J. Levadoux, "Pore Pressure Dissipation After Cone Penetration," Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1980.

6.2.4 Evaluation of c_h (probe)

At a given degree of consolidation, the predicted horizontal coefficient of consolidation c_h (probe) is obtained from the expression: c_h (probe) $= R^2T/t$
(6.2)
where R is the radius of the cone shaft, t is the measured time to reach this degree of consolidation; and T is the time factor. Table 5.1 provides values of T for different probe types at various degrees of consolidation.

An analytical method {equivalent to the graphical method described in Section 6.2.3} to check the validity of the prediction method consists of determining c_h at different dissipation stages, i.e., different u. Large differences between c_h at various degrees of consolidation indicate an inadequate initial distribution of excess pore pressure or significant coupling, or creep behavior.

The estimated values of c_h (probe) at 50% dissipation can be used in foundation problems involving horizontal water flow due to unloading or reloading of clays above the maximum past pressure. For problems involving vertical water flow in the overconsolidated range, the vertical coefficient of consolidation, c_v(probe), can be estimated from the expression: c_v (probe) = (k_v/k_h) c_h (probe)
(6.3)
where k_v and k_h are the vertical and horizontal coefficients of permeability, respectively. Reliable estimates of the in situ anisotropy of clays as expressed by the ratio k_h/k_v is difficult to determine in the laboratory because of the effects of sample size, sample disturbance, ... etc. and is the subject of controversy (Rowe, 1972; Casagrande and Poulos, 1969). In situ tests to determine k_h/k_v are almost nonexistent. Table 6.2 provides rough estimates of k_h/k_v for different clays.

6.2.5 Prediction of k_h (probe)

Approximate estimates of the horizontal coefficient of permeability, k_h (probe), can be obtained from the expression: k_h (probe) = $(g_w/2.3s_{vo})$ * RR(probe) * c_h (probe) (6.4)
where s_{vo} is the initial vertical effective stress (kg/cm^2); g_w is the unit weight of water (=10^{-3} kg/cm^3); and RR(probe) is the recompression ratio during early stages of consolidation (50% dissipation, say). Results in both the upper and lower Boston Blue Clays indicate that: the average RR(probe) =10^{-2}
(6.5)
and generally $0.5 * 10^{-2} < \text{RR(probe)} < 2 * 10^{-2}$ (6.6)

6.2.6 Prediction of c_v(NC)

For foundation clays consolidated in the normally consolidated range, estimates of the coefficients of consolidation can be obtained from c_h (probe) by means of the expressions:

c_h(NC) = (RR(probe)/CR) * c_h (probe) (6.7)

for horizontal water flow, and c_v(NC) = (RR(probe)/CR) * (k_v/k_h) * c_h(probe) (6.8)
for vertical water flow.

The compression of ratio CR is the average slope of the strain vs. log effective stress plot in the appropriate effective stress range expected during consolidation of the foundation clay. Values of CR should be obtained from good quality samples carefully tested in the laboratory. Table 6.2 provides rough estimates of CR based on empirical correlation with index properties of various clays.

Table 6.2 Empirical Correlation and Typical Properties of Clays

1. Compression Ratio CR (from Ladd, 1973)

$CR = C_c/1+e_o$ = slope of the strain vs. log stress curve
e_o = initial void ratio
c_c = virgin compression index = slope of e vs. log stress
w_L = liquid limit
w_N = natural water content

$c_c = 0.009 (w_L\% - 10\%)$	Terzaghi and Peck (1967)
$C_c = 0.54 (e_o - 0.35)$	Nishida (1958)
$C_c = 0.01$ to $0.15 (w_N\%)$	MPMR (1958)
$C_c = 0.6 (e_o - 1)$ for $e_o < 6$	
$C_c = 0.85 (e_o - 2)$ for $6 < e_o < 14$	Kapp, (1966)

2. Anisotropic Permeability of Clays (from Ladd, 1976)

Nature of Clay	k_h/k_v
1. No evidence of layering	1.2 +- 0.2
2. Slight layering, e.g., sedimentary clays with occasional silt dustings to random lenses	2 to 5
3. Varved clays in northeastern U.S.	10 +/-5

APPENDIX C
APPLICATIONS OF SEISMIC WAVE VELOCITIES

Shear modulus G = (Vs**2)*d/g;
where: Vs is the measured shear wave velocity;
d is the soil unit weight; and
g is the acceleration of gravity.

Shear modulus G = E/(2*(1+u));
where: E is Young's modulus, and
u is Poisson's ratio.

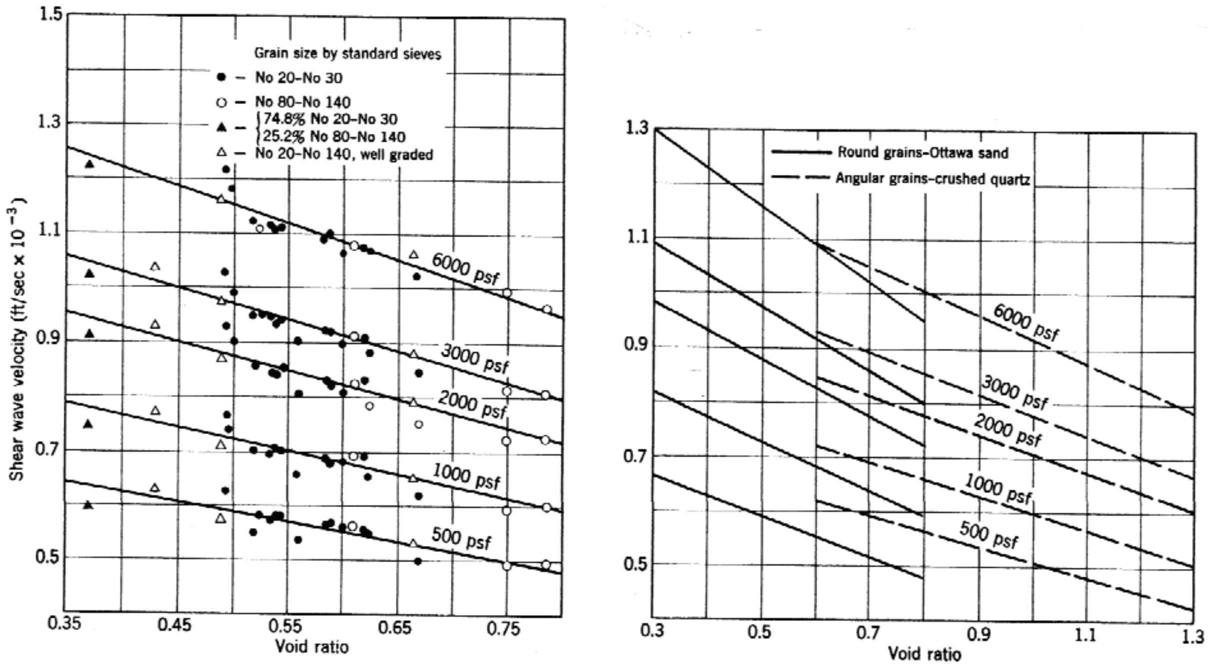


Fig. 12.10 Shear wave velocities through quartz sands (From Hardin and Richart, 1963).

μ	Soil type
0.4–0.5	Most clay soils
0.45–0.50	Saturated clay soils
0.3–0.4	Cohesionless—medium and dense
0.2–0.35	Cohesionless—loose to medium

Appendix C (continued)
from Mayne, P.W. And J.A. Schneider, "Evaluating Axial Drilled Shaft Response by Seismic Cone," Foundations & Ground Improvement, GSP 113, ASCE, Reston, VA, pp 655-669.

Small-Strain Modulus

Recent research outside of the U.S. has found that the small-strain stiffness from shear wave velocity (V_s) measurements applies to the initial static monotonic loading, as well as the dynamic loading of geomaterials (Burland, 1989; Tatsuoka & Shibuya, 1992; LoPresti et al., 1993). Thus, the original dynamic shear modulus (G_{dyn}) has been re-termed the maximum shear modulus, designated G_{max} or G_0, that provides an upper limit stiffness given by: $G_0 = \rho_T V_s^2$ where ρ_T = total mass density of the soil. This is a fundamental stiffness of all solids in civil engineering and can be measured in all soil types from colloids, clays, silts, sands, gravels, to boulders and fractured rocks. The corresponding equivalent elastic modulus is found from: $E_0 = 2G_0(1+\nu)$ where $\nu = 0.2$ is the approximate value of Poisson's ratio of geomaterials at small strains.

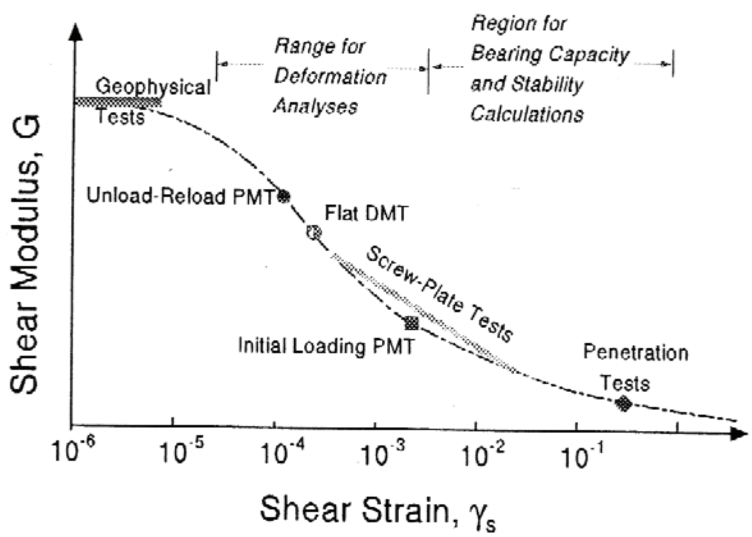


Figure 2. Variation of Shear Modulus with Strain Level and Relevance to In-Situ Tests.

The shear wave data are processed to obtain the initial stiffness using the following relationship for saturated soil mass density (Mayne, et al., 1999a).

$$\rho_{sat} \approx 1 + \frac{1}{0.614 + 58.7(\log z + 1.095)/V_s} \tag{9}$$

where ρ_{sat} is in g/cc, depth z is in meters, and V_s in m/s. Note that dry density (and dry unit weights) can be evaluated from the saturated value from:

$$\rho_{dry} = \frac{G_s(\rho_{sat} - 1)}{G_s - 1} \tag{10}$$

In the vadose zone with partial saturation, the total unit weight would fall between these two extremes. The derived parameters of mass density and initial elastic modulus with depth are presented in Figure 9.

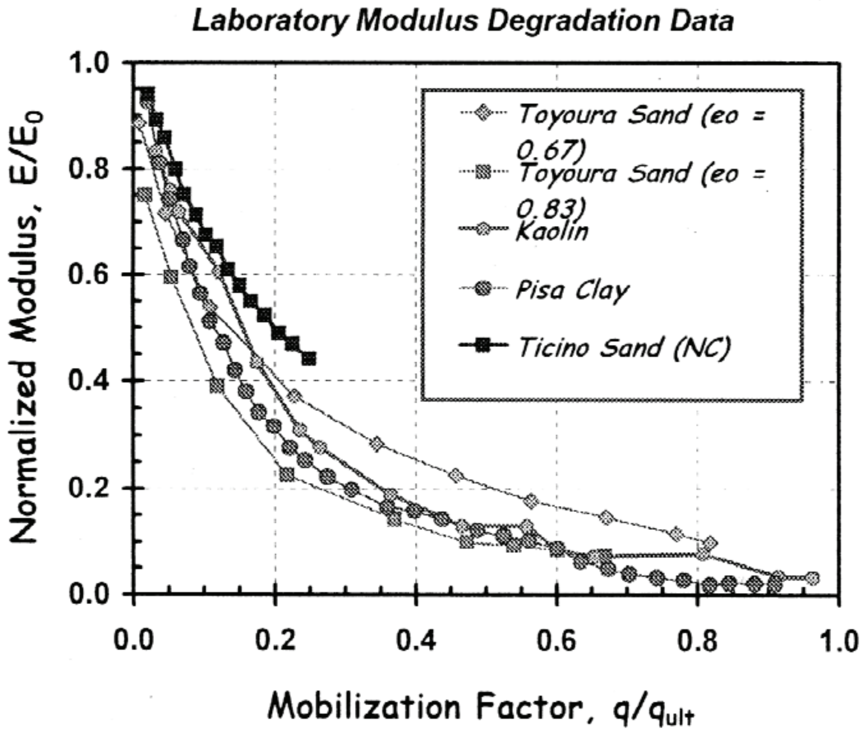


Figure 4. Modulus Degradation from Instrumented Laboratory Tests on Uncemented and Unstructured Geomaterials.

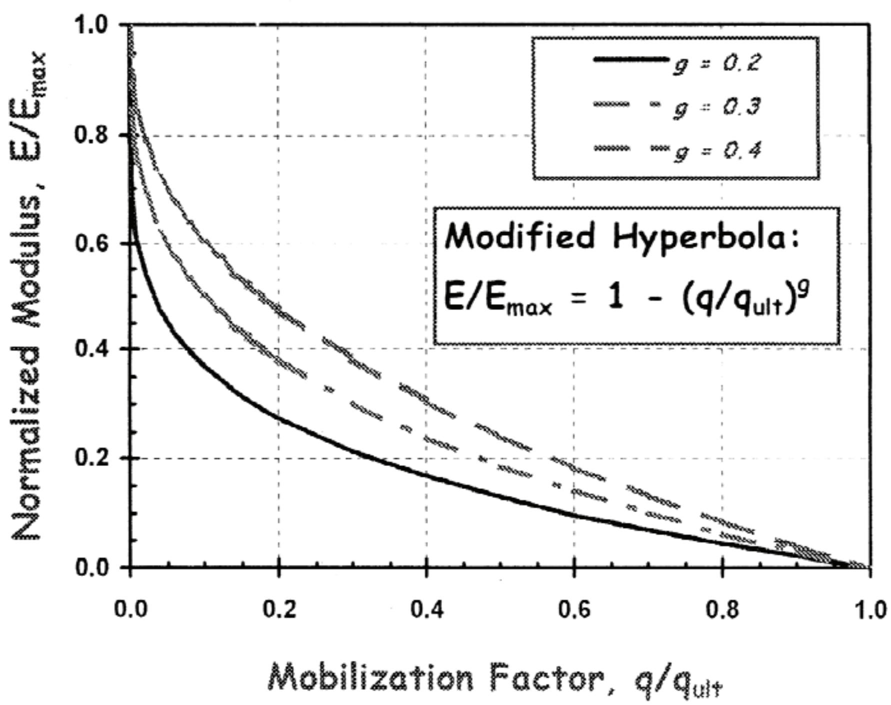


Figure 5. Modified Hyperbolas with g= 0.2, 0.3, and 0.4 to Illustrate Modulus Degradation Curves. Note: Mobilized stress level q/q_u = 1/FS.

Axial Capacity Determinations

The assessment of axial pile capacity ($Q_{ult} = Q_s + Q_b$) from CPT results is well-recognized (e.g., Robertson, et al. 1988; Poulos, 1989; Eslami & Fellenius, 1997). Of recent, Takesue, et al. (1998) offer a versatile direct CPT approach for side resistance of both drilled shafts and driven piles to obtain the pile side friction (f_p) in both clays and sands in terms of the measured f_s and excess porewater pressures (Δu_b) during piezocone penetration. Using measurements with a porous filter located at the cone shoulder:

For $\Delta u_b < 300$ kPa: then $f_p = f_s \cdot [(\Delta u_b/1250) + 0.76]$ (6a)

For $\Delta u_b > 300$ kPa: then $f_p = f_s \cdot [(\Delta u_b/200) - 0.50]$ (6b)

In clays, the pile tip or pier base resistance (q_b) will be fully mobilized and can be evaluated from the effective cone resistance (Eslami & Fellenius, 1997):

Clays: $q_b = q_t - u_b$ (7)

In sands, however, full mobilization of the base develops fairly slowly, depending on the relative movement (s) with respect to pile width (B). Recent work by Lee & Salgado (1999) gives:

Sands: $q_b \approx q_t \cdot [1.90 + \{0.62/(s/B)\}]^{-1}$ (8)

STRATIGRAPHICS

TABLE 1

SUMMARY OF CPT SOUNDINGS

Dynegy Vermillion Power Plant Ash Ponds

13-130-070

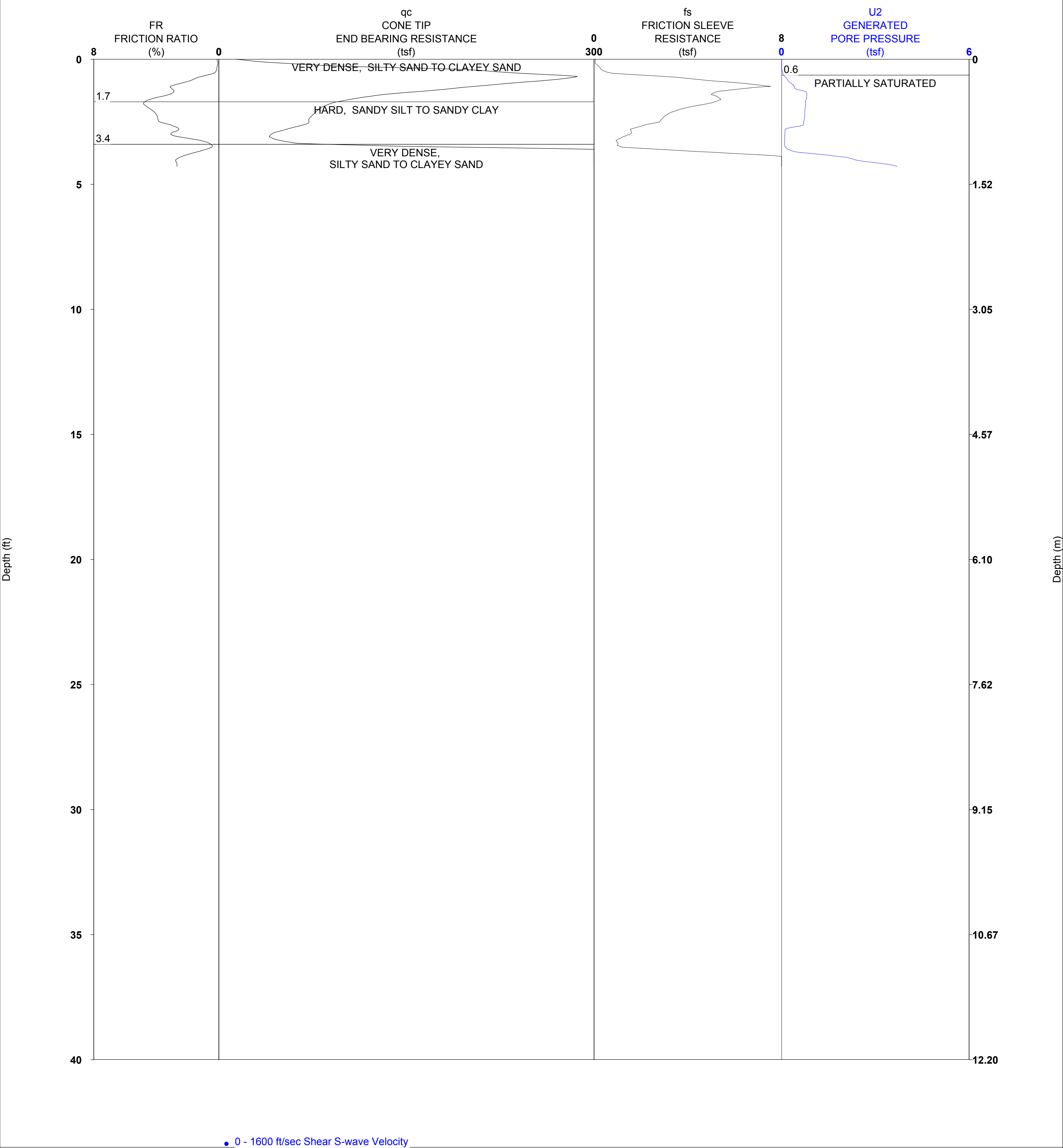
SOUNDING NUMBER	DATE PERFORMED	SOUNDING TYPE	SOUNDING DEPTH (feet)	COMMENTS	COORDINATES LATITUDE (dec. deg)	LONGITUDE (dec. deg)
CP-1301	07/24/13	CPTU	4.3	Lift ATV rig		
CP-1301a	07/24/13	CPTU	38.6	Offset 4 ft, coarse gravel at refusal		
CP-1302	07/24/13	CPTU	33.6	Coarse gravel at refusal		
CP-1303	07/24/13	CPTU	47.4	Coarse gravel at refusal		
CP-1304	07/24/13	CPTU	11.9	Lift ATV rig		
CP-1304a	07/24/13	CPTU	23.9	Lift ATV rig		
CP-1304b	07/24/13	CPTU	24.3	Lift ATV rig		
CP-1305	07/24/13	CPTU	57.7	Significant rod spring, extreme pullout force		
			241.7			

STRATIGRAPHICS

TABLE 2
SUMMARY OF CPTU DISSIPATION TESTS
Dynegy Vermillion Plant
13-130-070

SOUNDING NUMBER	DEPTH (ft)	EVALUATED SOIL TYPE AT DISSIPATION DEPTH	t50 (sec)	ESTIMATED SOIL HORIZONTAL HYDRAULIC CONDUCTIVITY kh (cm/sec)	ESTIMATED HORIZONTAL COEFFICIENT OF CONSOLIDATION IN OVERCONSOLIDATED RANGE* Ch(oc) (cm**2/sec)	MEASURED OR ESTIMATED POTENTIOMETRIC SURFACE AT TEST DEPTH (ft)	ESTIMATED EFFECTIVE STRESS (tsf)	EVALUATED RR PARAMETER
cp1301a	14.0	Silty clay to clay	40	4E-06	6E-01	11	0.75	0.01
cp1301a	15.6	Clayey silt to silty clay	9	2E-05	3E+00	11	0.79	0.01
cp1301a	18.9	Silty clay to clay	47	3E-06	5E-01	11	0.89	0.01
cp1301a	26.8	Sensitive fine grained soil	5.5	2E-05	5E+00	8	1.02	0.01
cp1301a	28.8	Sensitive fine grained soil	11	1E-05	2E+00	7.5	1.06	0.01
cp1301a	30.4	Sensitive fine grained soil	8.5	1E-05	3E+00	6.5	1.08	0.01
cp1302	9.2	Sandy clay to silty clay *	15	2E-04	2E+00	7.5	0.50	0.10
cp1302	10.8	Sandy clay to silty clay *	24	9E-05	1E+00	7.5	0.55	0.10
cp1302	12.4	Silty sand to sandy silt	24	1E-04	1E+00	7.5	0.59	0.15
cp1302	15.6	Sensitive fine grained soil	9	2E-05	3E+00	8	0.70	0.01
cp1302	18.8	Silty clay to clay	4.5	3E-05	6E+00	9	0.82	0.01
cp1302	19.9	Silty clay to clay	8	2E-05	3E+00	9	0.85	0.01
cp1302	22.4	Silty clay to clay	7.5	2E-05	3E+00	9	0.93	0.01
cp1302	23.3	Sensitive fine grained soil	8	2E-05	3E+00	9	0.95	0.01
cp1302	24.9	Silty clay to clay	5.5	2E-05	5E+00	9	1.00	0.01
cp1302	26.6	Sensitive fine grained soil	5.5	2E-05	5E+00	9	1.05	0.01
cp1302	28.2	Sensitive fine grained soil	25	4E-06	1E+00	9	1.09	0.01
cp1302	28.9	Silty clay to clay	131	8E-07	2E-01	9	1.11	0.01
cp1302	31.3	Silty clay to clay *	816	9E-08	3E-02	22	1.59	0.01
cp1302	33.1	Silty sand to sandy silt	7	2E-04	4E+00	22	1.64	0.20

CPTU LOG WITH LITHOLOGIC EVALUATION cp1301

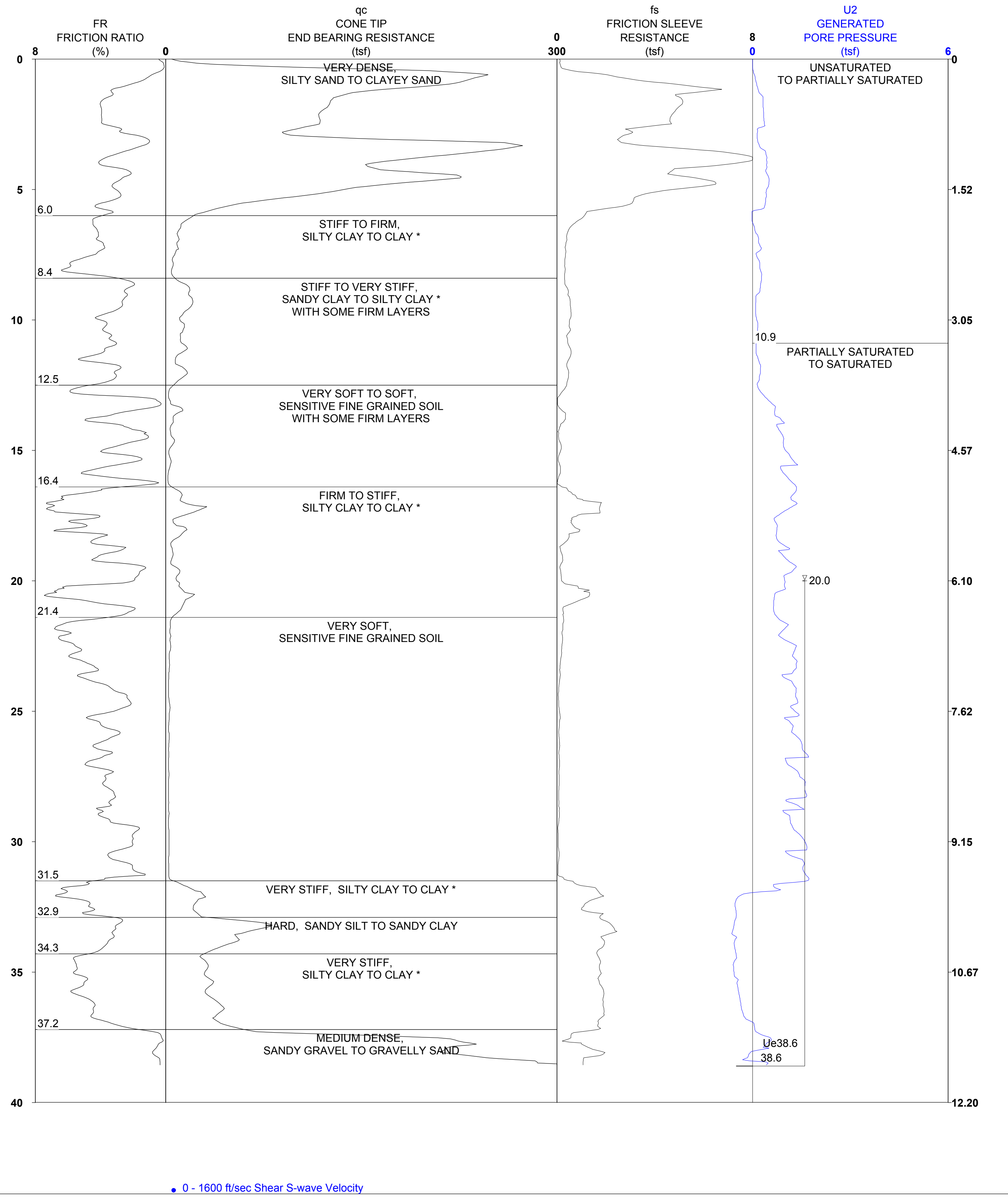


PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

STRATIGRAPHICS

R1 DATE:7/24/2013 TIME:8:24 AM
SOUNDING NUMBER:CP-13-01 (CPTU)

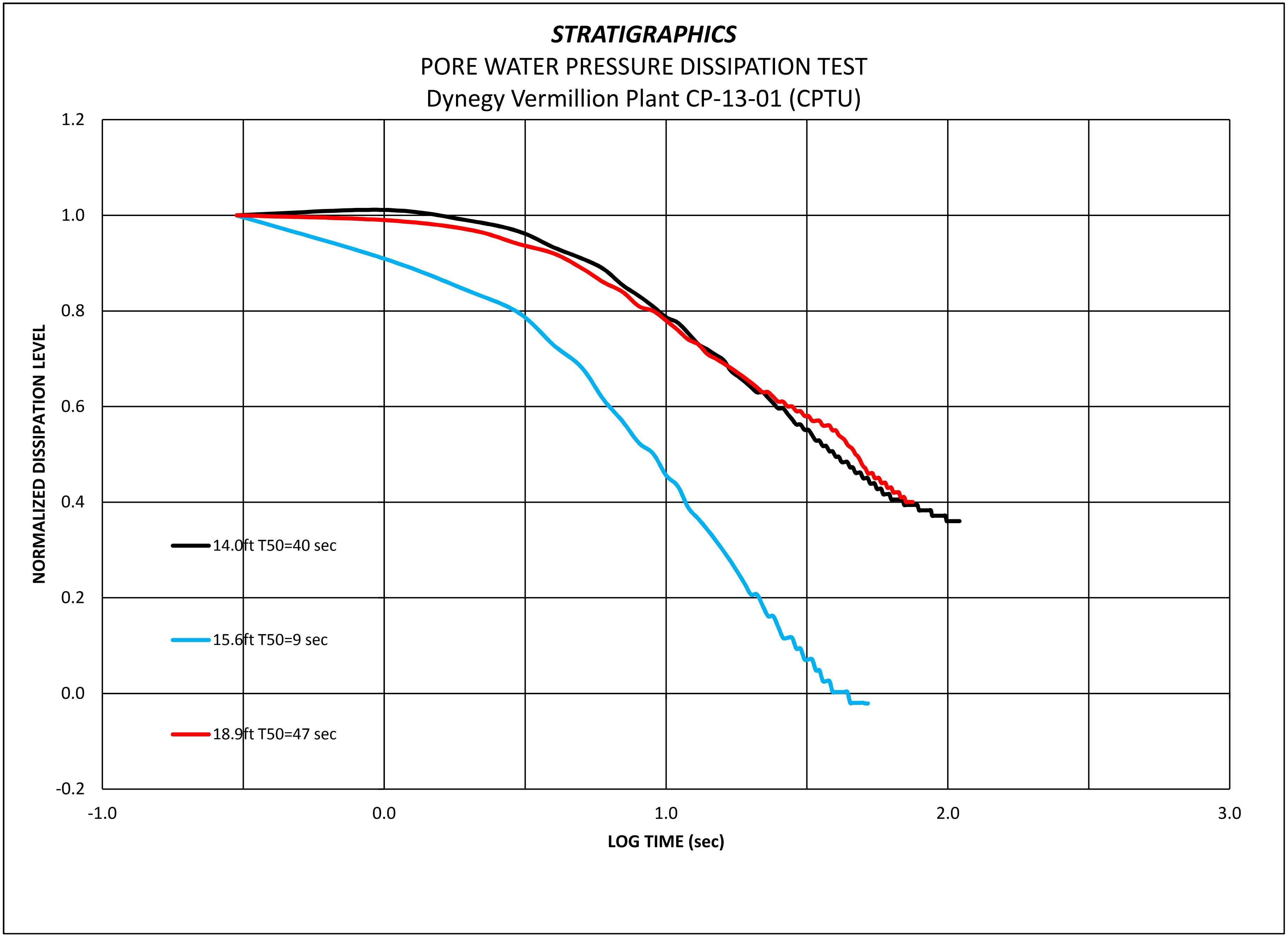
CPTU LOG WITH LITHOLOGIC EVALUATION cp1301a



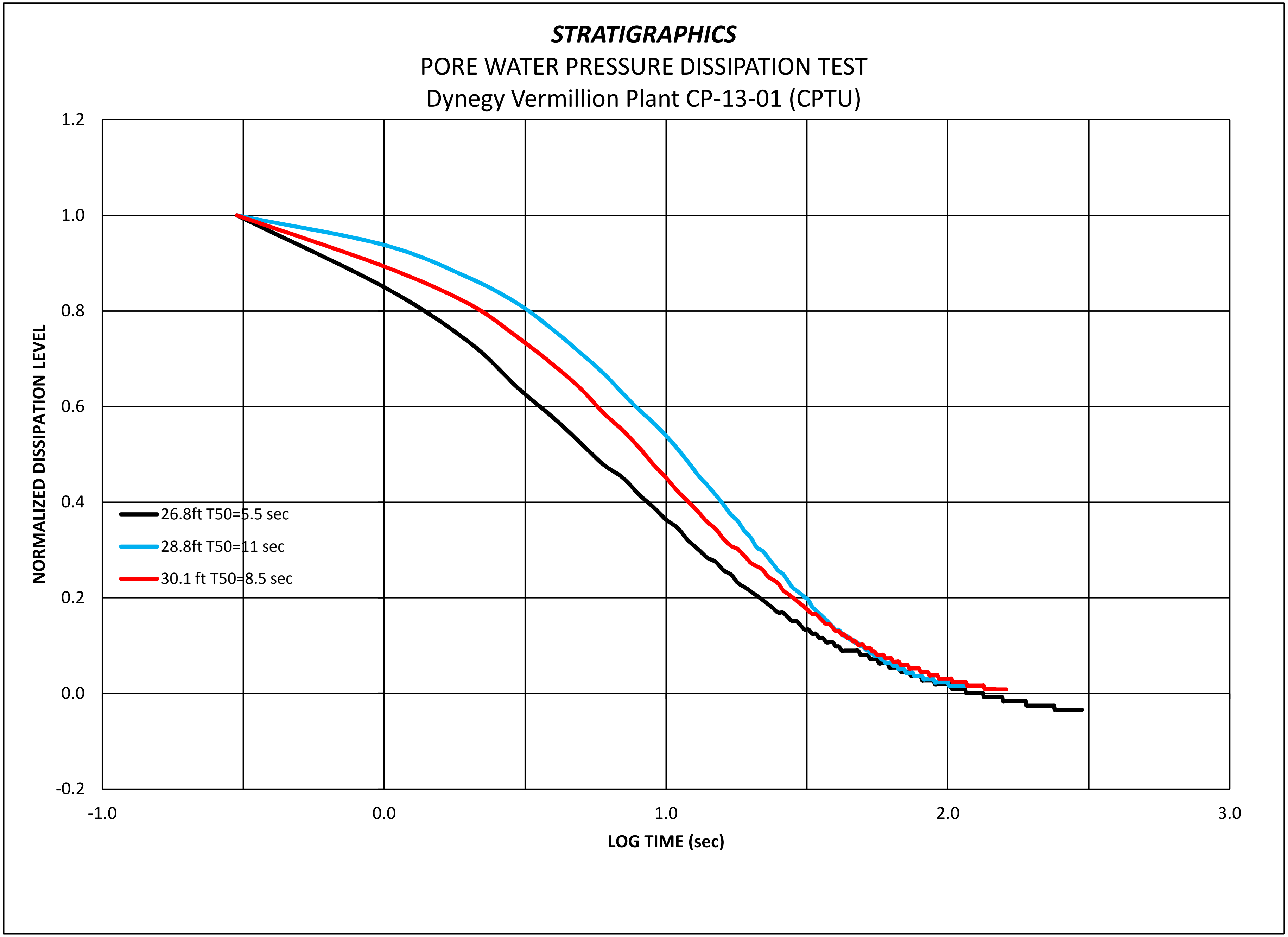
PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

STRATIGRAPHICS

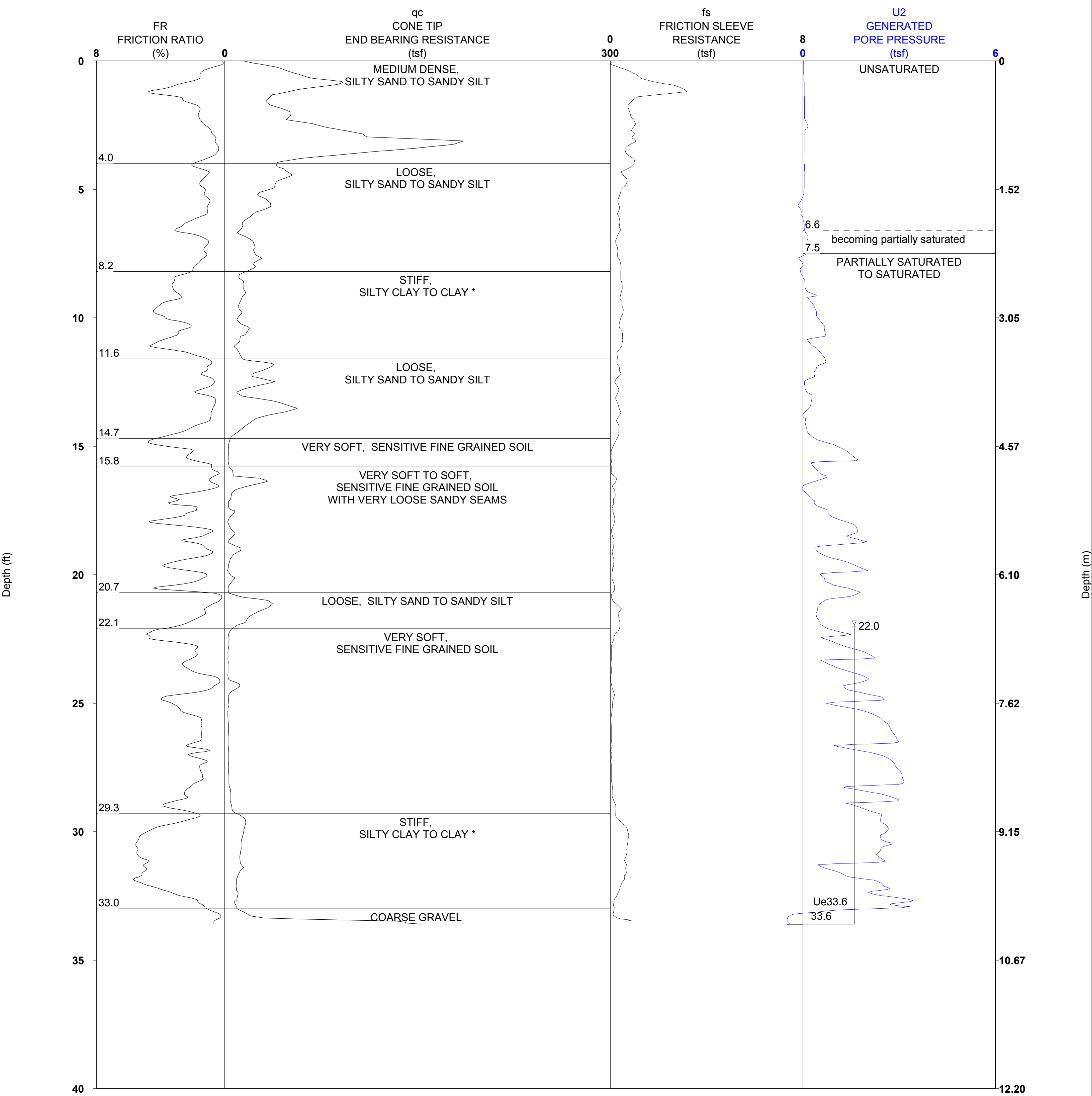
R1 DATE:7/24/2013 TIME:8:51 AM
SOUNDING NUMBER:CP-13-01 (CPTU)



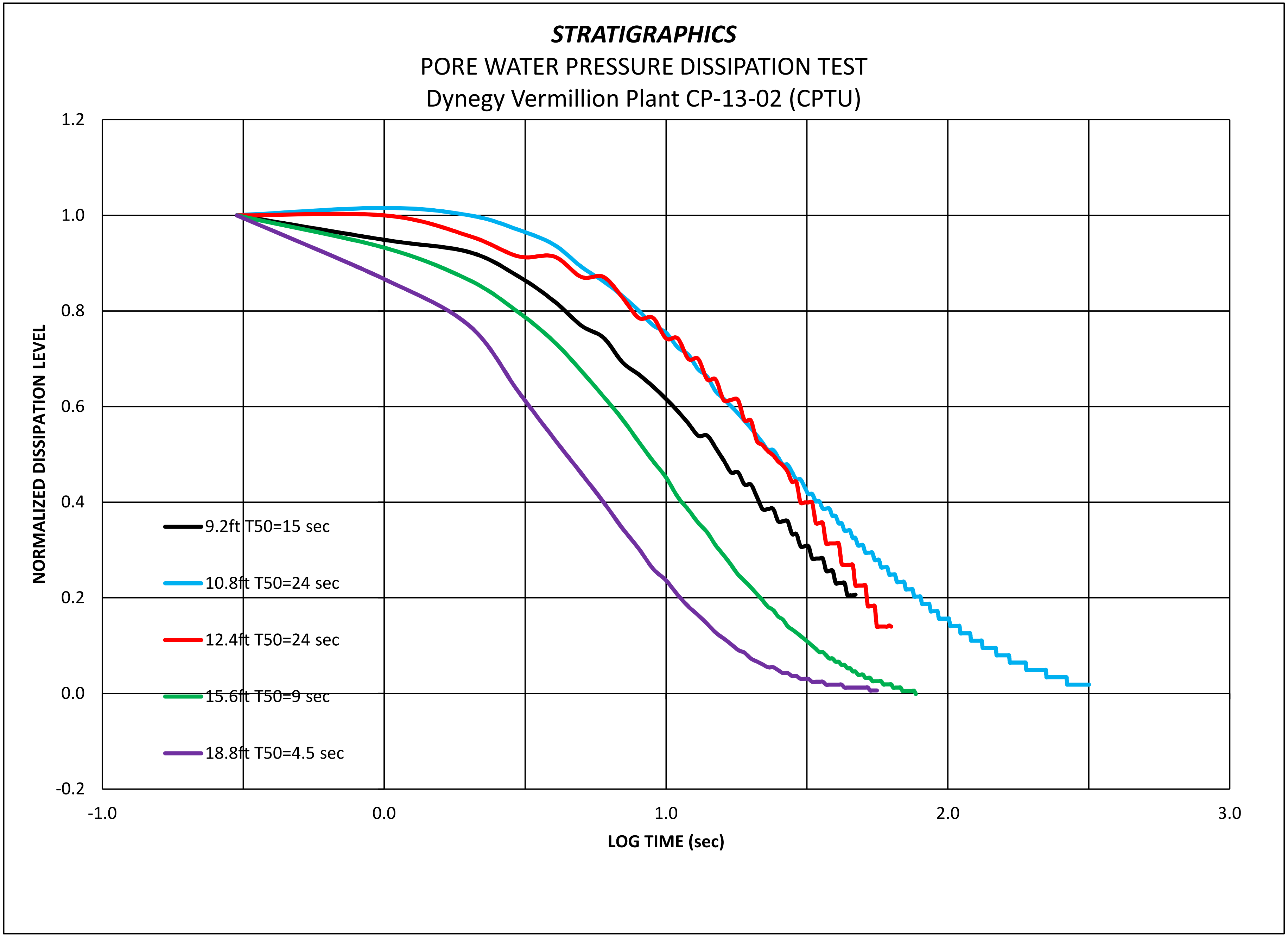
STRATIGRAPHICS
PORE WATER PRESSURE DISSIPATION TEST
Dynegy Vermillion Plant CP-13-01 (CPTU)
NORMALIZED DISSIPATION LEVEL
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-1.0
0.0
1.0
2.0
3.0
LOG TIME (sec)
14.0ft T50=40 sec
15.6ft T50=9 sec
18.9ft T50=47 sec


STRATIGRAPHICS
PORE WATER PRESSURE DISSIPATION TEST
Dynegy Vermillion Plant CP-13-01 (CPTU)
NORMALIZED DISSIPATION LEVEL
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-1.0
0.0
1.0
2.0
3.0
LOG TIME (sec)
26.8ft T50=5.5 sec
28.8ft T50=11 sec
30.1 ft T50=8.5 sec

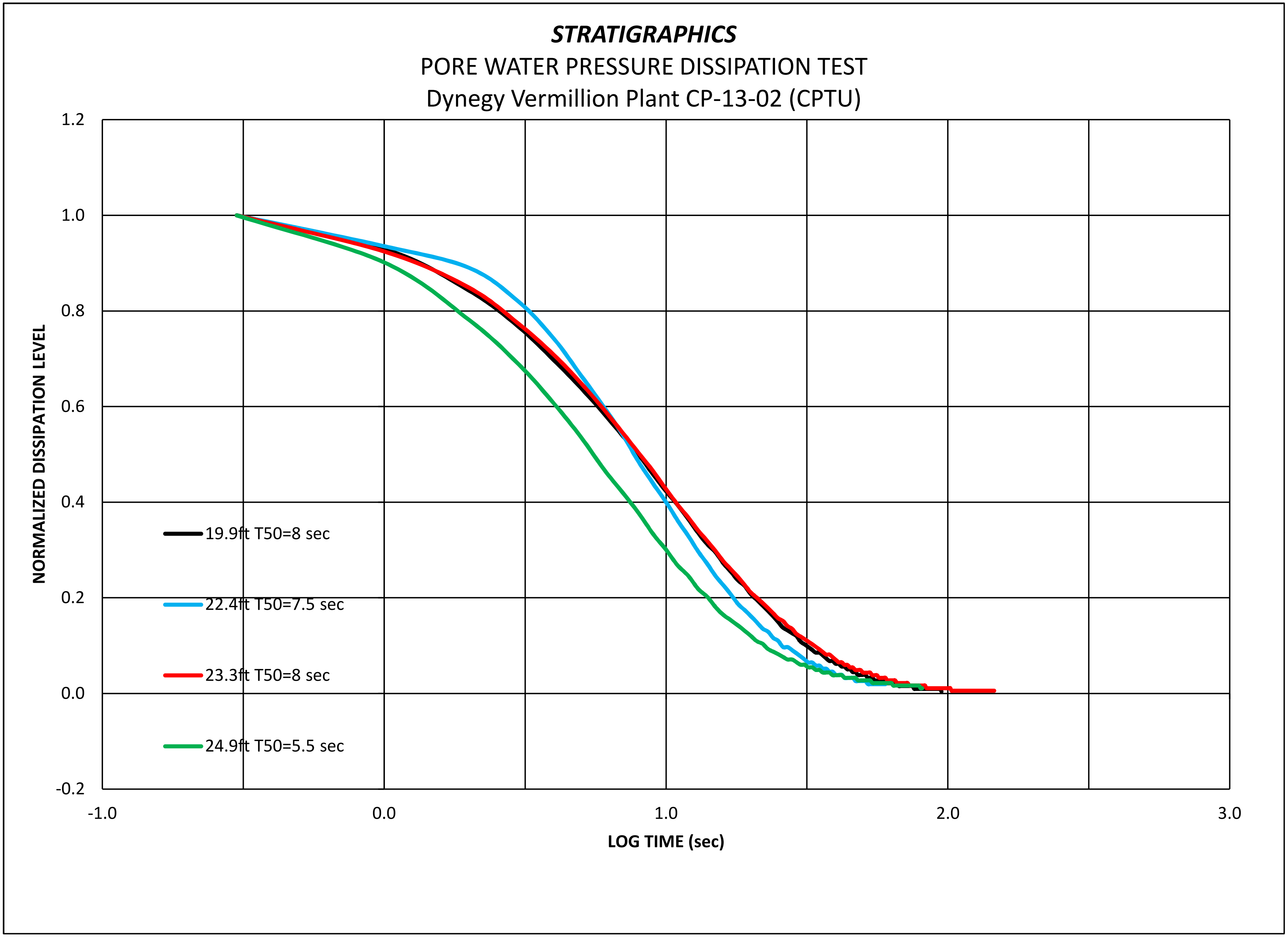
CPTU LOG WITH LITHOLOGIC EVALUATION cp1302

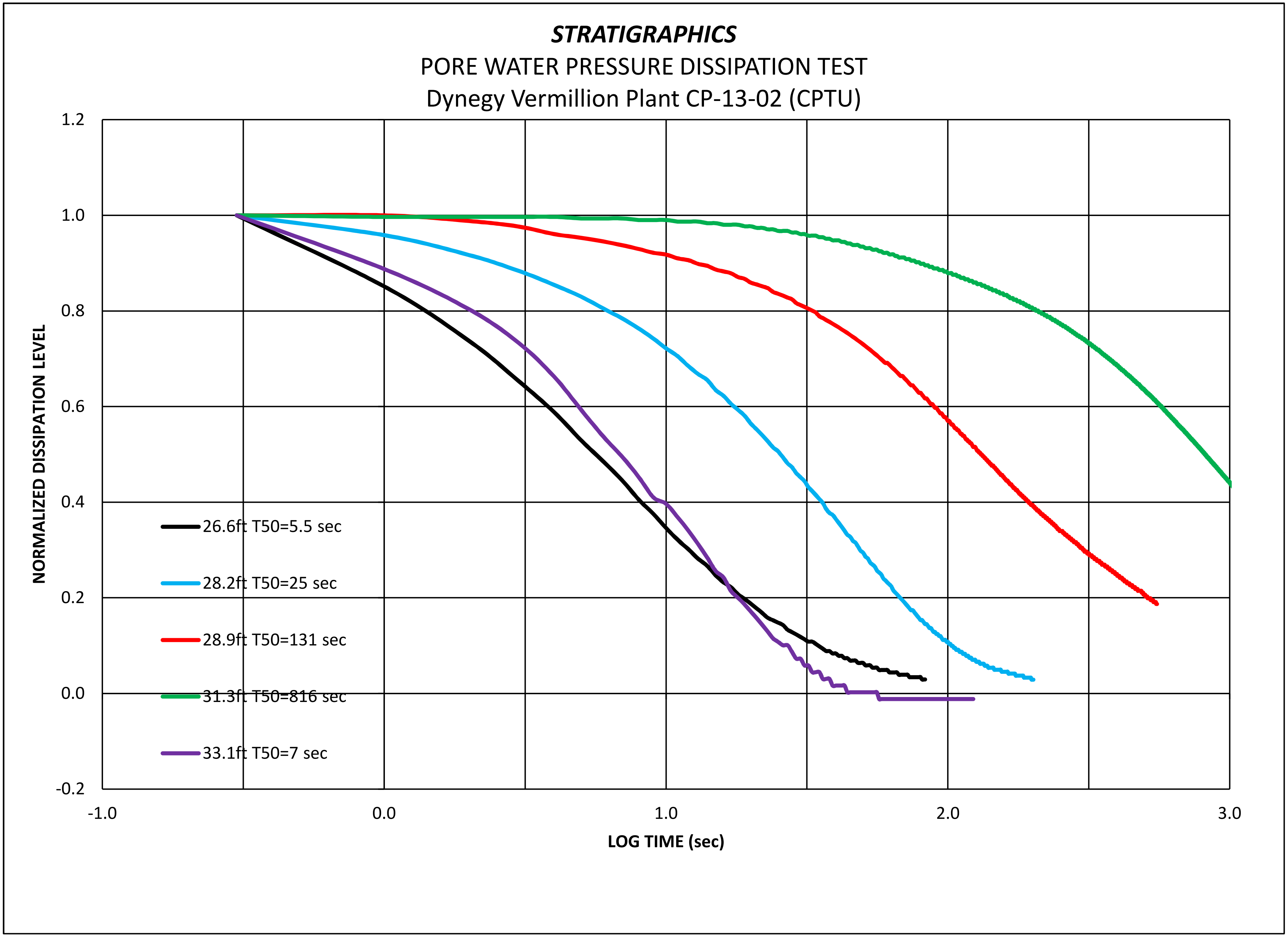


● 0 - 1600 ft/sec Shear S-wave Velocity

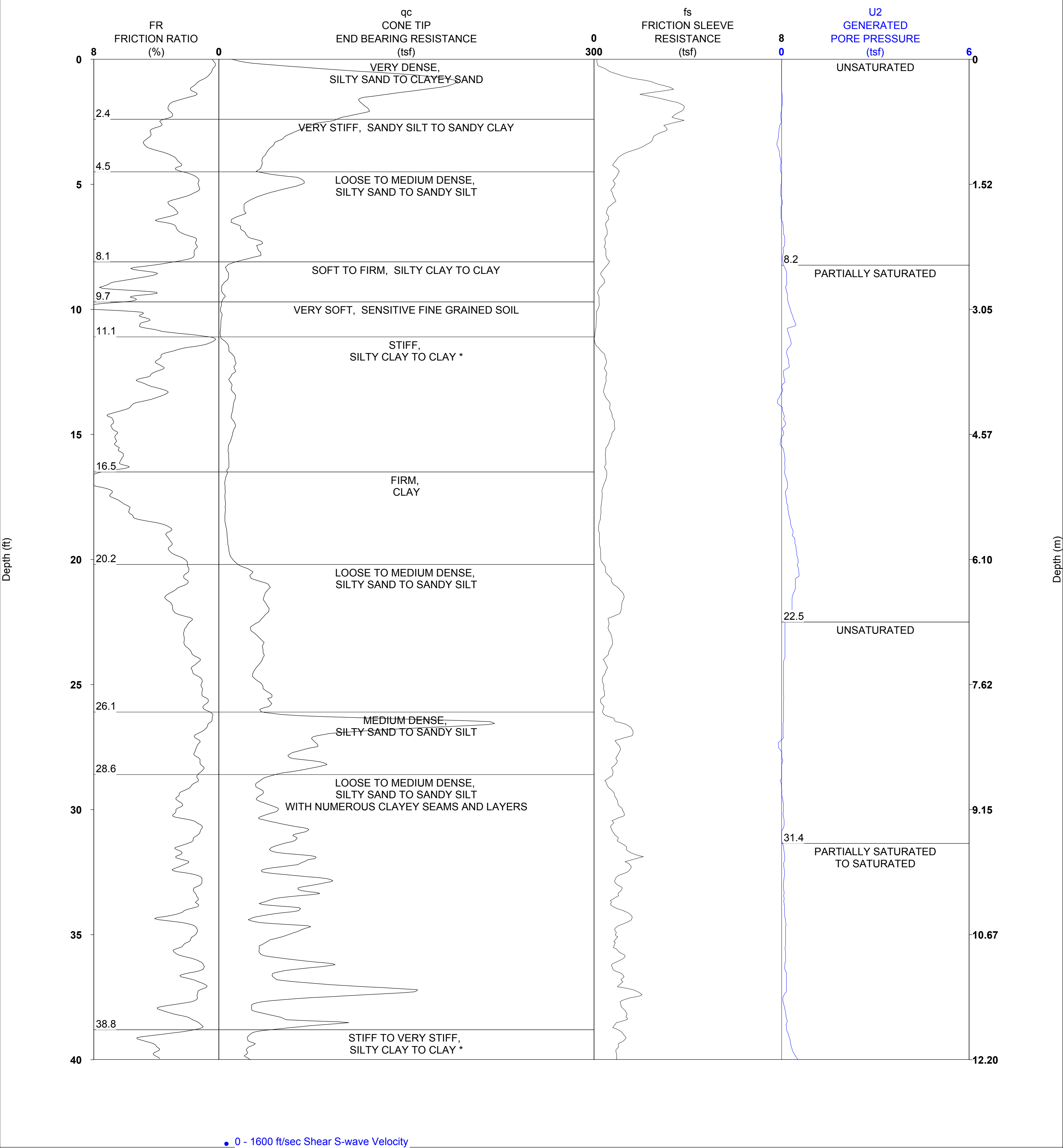


STRATIGRAPHICS
PORE WATER PRESSURE DISSIPATION TEST
Dynegy Vermillion Plant CP-13-02 (CPTU)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
NORMALIZED DISSIPATION LEVEL
9.2ft T50=15 sec
10.8ft T50=24 sec
12.4ft T50=24 sec
15.6ft T50=9 sec
18.8ft T50=4.5 sec
-1.0
0.0
1.0
2.0
3.0
LOG TIME (sec)


STRATIGRAPHICS
PORE WATER PRESSURE DISSIPATION TEST
Dynegy Vermillion Plant CP-13-02 (CPTU)
NORMALIZED DISSIPATION LEVEL
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-1.0
0.0
1.0
2.0
3.0
LOG TIME (sec)
19.9ft T50=8 sec
22.4ft T50=7.5 sec
23.3ft T50=8 sec
24.9ft T50=5.5 sec


STRATIGRAPHICS
PORE WATER PRESSURE DISSIPATION TEST
Dynegy Vermillion Plant CP-13-02 (CPTU)
NORMALIZED DISSIPATION LEVEL
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-1.0
0.0
1.0
2.0
3.0
LOG TIME (sec)
26.6ft T50=5.5 sec
28.2ft T50=25 sec
28.9ft T50=131 sec
31.3ft T50=816 sec
33.1ft T50=7 sec

CPTU LOG WITH LITHOLOGIC EVALUATION cp1303

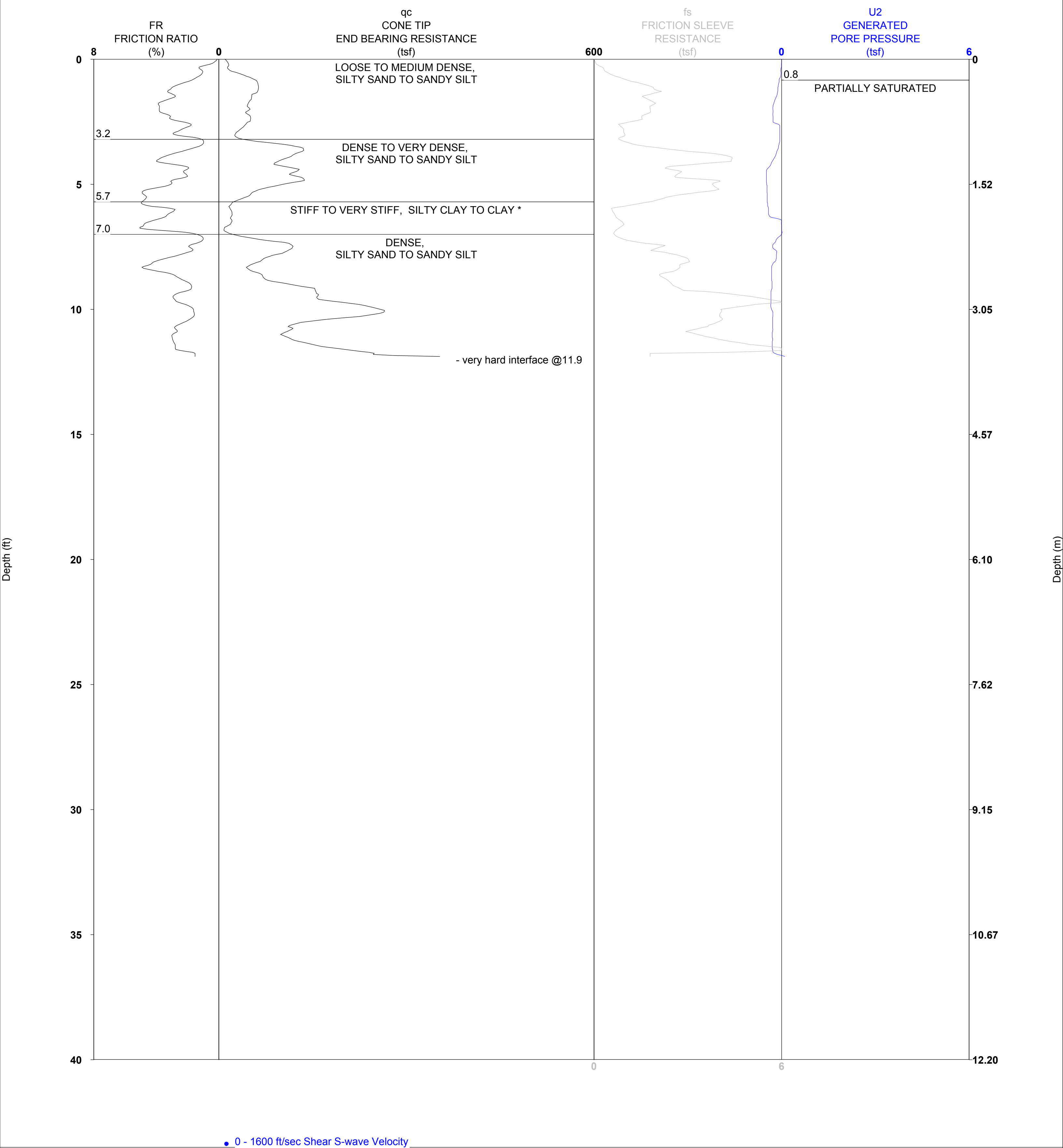


PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

STRATIGRAPHICS

R1 DATE:7/24/2013 TIME:1:34 PM
SOUNDING NUMBER:CP-13-03 (CPTU)

CPTU LOG WITH LITHOLOGIC EVALUATION cp1304

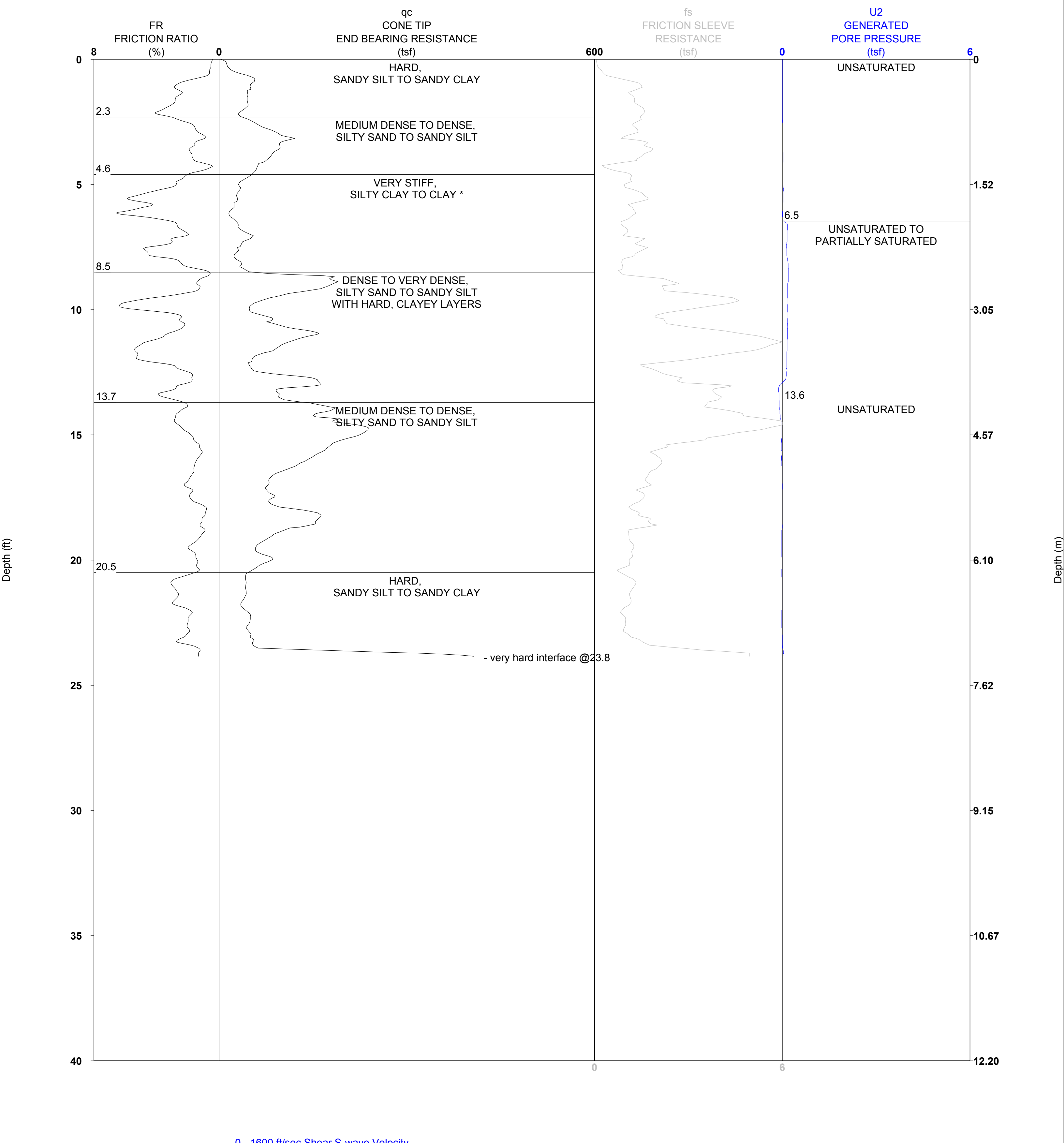


PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

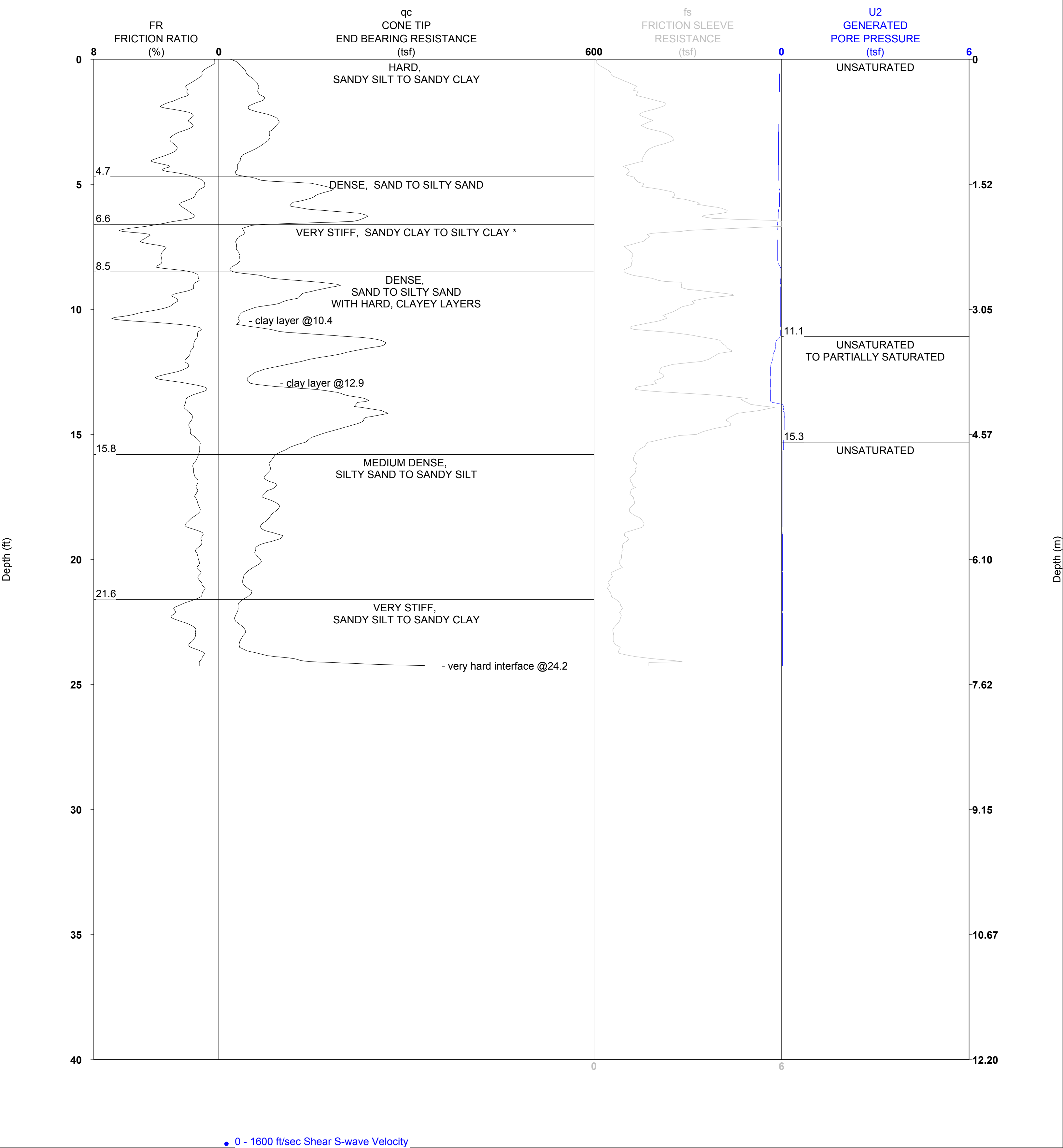
STRATIGRAPHICS

R1 DATE:7/24/2013 TIME:3:00 PM
SOUNDING NUMBER:CP-13-04 (CPTU)

CPTU LOG WITH LITHOLOGIC EVALUATION cp1304a



CPTU LOG WITH LITHOLOGIC EVALUATION cp1304b

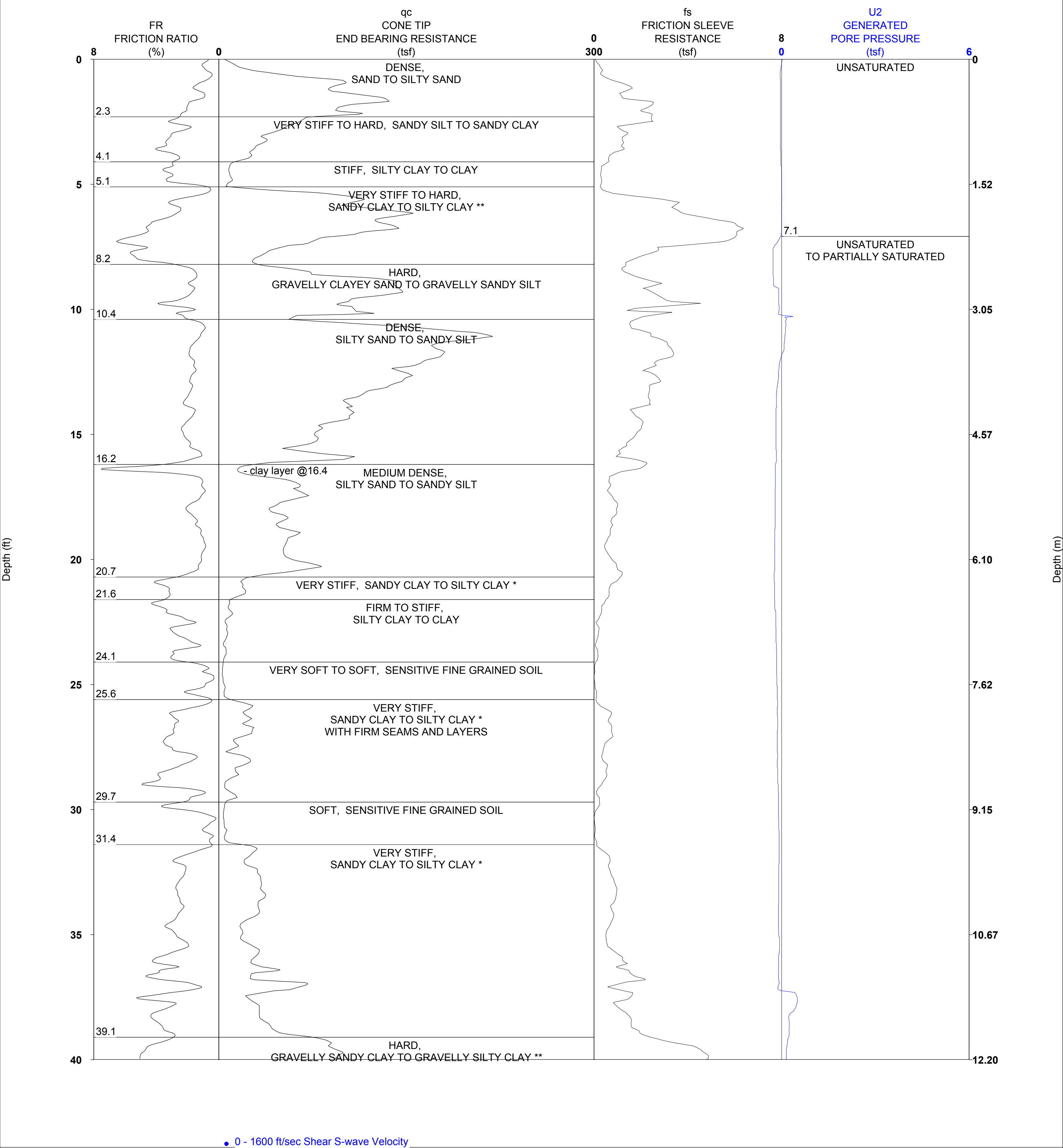


PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

STRATIGRAPHICS

R1 DATE:7/24/2013 TIME:4:36 PM
SOUNDING NUMBER:CP-13-05 (CPTU)

CPTU LOG WITH LITHOLOGIC EVALUATION cp1305



PROJECT NAME:Dynegy Vermillion Plant
PROJECT NUMBER:13-130-070

STRATIGRAPHICS

R1 DATE:7/24/2013 TIME:4:36 PM
SOUNDING NUMBER:CP-13-05 (CPTU)

KEY TO BORING LOGS

Group	Graphic Symbol	Description	USCS Classification
GRAVEL		GRAVEL with little or no fines	GP or GW
GRAVEL		Silty GRAVEL	GM
GRAVEL		Clayey GRAVEL	GC
GRAVEL		SAND and GRAVEL	SP/GP
SAND		SAND poorly graded	SP
SAND		SAND well graded	SW
SAND		Silty SAND	SM
SAND		Clayey SAND	SC
LOW PLASTIC SILTS AND CLAYS		Inorganic low plastic SILT	ML
LOW PLASTIC SILTS AND CLAYS		Inorganic low plastic CLAY	CL
LOW PLASTIC SILTS AND CLAYS		Sandy SILT	ML
LOW PLASTIC SILTS AND CLAYS		Sandy CLAY	CL
LOW PLASTIC SILTS AND CLAYS		Gravelly CLAY	CL
LOW PLASTIC SILTS AND CLAYS		Organic low plastic SILT or CLAY	OL
HIGH PLASTIC SILTS AND CLAYS		Inorganic high plastic SILT	MH
HIGH PLASTIC SILTS AND CLAYS		Inorganic high plastic CLAY	CH
HIGH PLASTIC SILTS AND CLAYS		Sandy Inorganic high plastic CLAY	CH
HIGH PLASTIC SILTS AND CLAYS		Organic high plastic SILT or CLAY	OH
		Peat and other highly organic soils	PT
ROCKS		LIMESTONE	
ROCKS		SHALE	
ROCKS		SANDSTONE	
ROCKS		SILTSTONE	
SURFACE MATERIALS		FLY ASH/BOTTOM ASH	
SURFACE MATERIALS		FILL	
SURFACE MATERIALS		Topsoil	

TERMS DESCRIBING DENSITY OR CONSISTENCY

Coarse grained soils (major portion retained on No. 200 sieve) include gravels and sands. Density is based on the Standard Penetration Test (SPT).

Density	SPT blows per foot
Very loose	0 – 5
Loose	5 – 10
Medium dense	10 – 30
Dense	30 – 50
Very dense	Greater than 50

Fine grained soils (major portion passing No. 200 sieve) include clays and silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Descriptive Term	SPT blows per foot	Estimated undrained shear strength (ksf)	Hand Test
Very soft	0–2	< 0.25	Extrudes between fingers
Soft	2–4	0.25–0.5	Molded by slight pressure
Medium stiff	4–8	0.5–1.0	Molded by strong pressure
Stiff	8–15	1.0–2.0	Indented by thumb
Very stiff	15–30	2.0–4.0	Indented by thumbnail
Hard	> 30	> 4.0	Difficult to indent

LEGEND AND NOMENCLATURE

- Standard penetration test sample
- Grab sample
- Continuous sample
- Undisturbed shelby tube sample
- California modified sample
- NX core.

PP Su	Pocket penetrometer undrained shear strength
TV Su	Torvane undrained shear strength
NMC	Natural Moisture Content, %
LL	Liquid Limit
PI	Plasticity Index
NP	Non–plastic
–#200	(% pass #200 sieve)
SA(%)	Sieve analysis (% passing #200)
LV Su	Lab vane undrained shear strength
UUC Qu	Unconfined undrained compression strength
TXUU Su	Unconsolidated undrained triaxial compression shear strength
CONS	Consolidation test
DSS	Direct simple shear test
RC	Resonant column test
CyTXCIU	Cyclic isotropically consolidated undrained triaxial compression test
CyDSSCKoU	Cyclic Ko–consolidated undrained direct simple shear test
RQD	Rock quality designation
∇	Depth Groundwater enters at time of drilling.
▼	Groundwater Level at some specified time after drilling

SAMPLING RESISTANCE

P	Sample pushed by hydraulic rig action.
3 6 9	Numbers indicate blows per 6 in. of sampler penetration. Standard penetration test sampler, (2–in O.D.) and oversize penetration sample (3–in O.D.) are driven by a 140 lb hammer falling freely 30–in
50/2	Number of blows (50) used to drive a penetration sampler a certain number of inches (2)
WOH	Weight of hammer

ABBREVIATIONS USED UNDER "FIELD NOTES"

HSA = Hollow Stem Auger
CFA = Continuous Flight Auger
ATD = At Time of Drilling
AD = After Drilling
ST = Static

URS

File: P:\GEOTECHNICAL\DYNEGY – VERMILION\NORTH & OLD EAST POND STABLIZATION 2013\FIGURES\GEO KEY (VERMILLION).DWG Last edited: NOV. 12, 13 @ 10:41 a.m. by: david_deguire

KEY TO BORING LOGS

Group	Description	USCS Classification
GRAVEL	GRAVEL with little or no fines	GP or GW
GRAVEL	Silty GRAVEL	GM
GRAVEL	Clayey GRAVEL	GC
GRAVEL	SAND and GRAVEL	SP/GP
SAND	SAND poorly graded	SP
SAND	SAND well graded	SW
SAND	Silty SAND	SM
SAND	Clayey SAND	SC
LOW PLASTIC SILTS AND CLAYS	Inorganic low plastic SILT	ML
LOW PLASTIC SILTS AND CLAYS	Inorganic low plastic CLAY	CL
LOW PLASTIC SILTS AND CLAYS	Sandy SILT	ML
LOW PLASTIC SILTS AND CLAYS	Sandy CLAY	CL
LOW PLASTIC SILTS AND CLAYS	Gravelly CLAY	CL
LOW PLASTIC SILTS AND CLAYS	Organic low plastic SILT or CLAY	OL
HIGH PLASTIC SILTS AND CLAYS	Inorganic high plastic SILT	MH
HIGH PLASTIC SILTS AND CLAYS	Inorganic high plastic CLAY	CH
HIGH PLASTIC SILTS AND CLAYS	Sandy Inorganic high plastic CLAY	CH
HIGH PLASTIC SILTS AND CLAYS	Organic high plastic SILT or CLAY	OH
	Peat and other highly organic soils	PT
ROCKS	LIMESTONE	
ROCKS	SHALE	
ROCKS	SANDSTONE	
ROCKS	SILTSTONE	
SURFACE MATERIALS	FLY ASH/BOTTOM ASH	
SURFACE MATERIALS	FILL	
SURFACE MATERIALS	Topsoil	

TERMS DESCRIBING DENSITY OR CONSISTENCY

Coarse grained soils (major portion retained on No. 200 sieve) include gravels and sands. Density is based on the Standard Penetration Test (SPT).

Density	SPT blows per foot
Very loose	0 – 5
Loose	5 – 10
Medium dense	10 – 30
Dense	30 – 50
Very dense	Greater than 50

Fine grained soils (major portion passing No. 200 sieve) include clays and silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Descriptive Term	SPT blows per foot	Estimated undrained shear strength (ksf)	Hand Test
Very soft	0–2	< 0.25	Extrudes between fingers
Soft	2–4	0.25–0.5	Molded by slight pressure
Medium stiff	4–8	0.5–1.0	Molded by strong pressure
Stiff	8–15	1.0–2.0	Indented by thumb
Very stiff	15–30	2.0–4.0	Indented by thumbnail
Hard	> 30	> 4.0	Difficult to indent

LEGEND AND NOMENCLATURE

- Standard penetration test sample
- Grab sample
- Continuous sample
- Undisturbed shelby tube sample
- California modified sample
- NX core.

PP Su	Pocket penetrometer undrained shear strength
TV Su	Torvane undrained shear strength
NMC	Natural Moisture Content, %
LL	Liquid Limit
PI	Plasticity Index
NP	Non–plastic
–#200	(% pass #200 sieve)
SA(%)	Sieve analysis (% passing #200)
LV Su	Lab vane undrained shear strength
UUC Qu	Unconfined undrained compression strength
TXUU Su	Unconsolidated undrained triaxial compression shear strength
CONS	Consolidation test
DSS	Direct simple shear test
RC	Resonant column test
CyTXCIU	Cyclic isotropically consolidated undrained triaxial compression test
CyDSSCKoU	Cyclic Ko–consolidated undrained direct simple shear test
RQD	Rock quality designation
∇	Depth Groundwater enters at time of drilling.
▼	Groundwater Level at some specified time after drilling

SAMPLING RESISTANCE

P	Sample pushed by hydraulic rig action.
3 6 9	Numbers indicate blows per 6 in. of sampler penetration. Standard penetration test sampler, (2–in O.D.) and oversize penetration sample (3–in O.D.) are driven by a 140 lb hammer falling freely 30–in
50/2	Number of blows (50) used to drive a penetration sampler a certain number of inches (2)
WOH	Weight of hammer

ABBREVIATIONS USED UNDER "FIELD NOTES"

HSA = Hollow Stem Auger
CFA = Continuous Flight Auger
ATD = At Time of Drilling
AD = After Drilling
ST = Static

URS

LOG of BORING No. B-13-1

STARTED 8/8/13
COMPLETED 8/8/13
LOCATION Danville, IL
SURFACE EL., FT 606.4
EL. DATUM NAVD 88
NORTHING 1281636.51
EASTING 1147839.71
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0				Very loose, dry, light gray FLY ASH, trace fine bottom ash.										
		1 1 1	100											
5		1 1 1	100	Becomes moist.										
		1 0 0	100	▽										
				Becomes wet.										
10		1 0 0	100											
15		1 0 1	100	Fly ash - 90% coarse to fine bottom ash - 10%			39							15' : Fines content (%)=97.7
20		0 0 0	100	Saturated										

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 8 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-1

STARTED 8/8/13
COMPLETED 8/8/13
LOCATION Danville, IL
SURFACE EL., FT 606.4
EL. DATUM NAVD 88
NORTHING 1281636.51
EASTING 1147839.71
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		5 6 7	100											
				Medium dense, wet, light brown, coarse to fine silty SAND (SM). [ALLUVIAL]	580.4 26.0									
30		9 7 8	0											
				Becomes poorly graded, medium to fine sand.										
35		6 11 10	100				12				>4.5 2.5			
				Very stiff, moist, gray, low plastic CLAY (CL), trace medium sand. [TILL]	570.9 35.5									
40		4 5 8	100	Becomes stiff, trace coarse to medium sand.			12		24	12	4.0			
45		16 9 11	89	Becomes very stiff.							4.5			
					556.4									

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 8 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-1

STARTED 8/8/13
COMPLETED 8/8/13
LOCATION Danville, IL
SURFACE EL., FT 606.4
EL. DATUM NAVD 88
NORTHING 1281636.51
EASTING 1147839.71
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		12 18 18	100	Medium dense, wet, light brown, medium to fine, silty SAND (SM). [OUTWASH]	50.0 555.4 51.0									
				Hard, moist, gray, low plastic CLAY (CL), trace coarse to medium sand. [TILL]	554.9 51.5									
				Bottom of boring at 51.5'										
55														
60														
65														
70														

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 8 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

11/21/13 URS GEOTECH TEMPLATE (LAB STRENGTH-TXUU) Y:\GINT\PROJECTS\DYNERG-VERMILLION_21562906.GPJ URS_STL.GLB

URS

LOG of BORING No. B-13-2

STARTED 8/6/13
COMPLETED 8/6/13
LOCATION Danville, IL
SURFACE EL., FT 603.1
EL. DATUM NAVD 88
NORTHING 1281700.74
EASTING 1148264.03
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		2 1 1	78	Very loose, moist, gray fly ash. [FILL]										
		1 1 1	100											
5		P	100				35 49 40 31	102 96 98						5.4' : Fines content (%)=87.2 5.4' :TX CD C'= 0 ; phi'=36.8 5.95' :Consol test: Cc=0.277 Cr=0.033
		4 6 6	100				14		22	6	2.0			
				Stiff, moist, light brown, low plastic, fine sandy CLAY (CL). [FILL]	595.1 8.0									
10		5 6 8	100											
				Medium dense, moist, gray, FLYASH, trace fine bottom ash. [FILL]	592.1 11.0									
15		9 22 26	100	Becomes very dense, trace fine sand, no bottom ash.										
				Very loose, wet, light brown, fine silty SAND (SM). [ALLUVIAL]	585.1 18.0									
20		1 1 2					18							20' : Fines content (%)=36.1
				Soft, moist, light brown, low plastic, silty CLAY (CL). [ALLUVIAL]	582.1 21.0									
				▽ Loose, wet, light brown, medium to fine silty SAND (SM). [ALLUVIAL]	579.1 24.0									

Completion Depth: 46.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 24 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-2

STARTED 8/6/13
COMPLETED 8/6/13
LOCATION Danville, IL
SURFACE EL., FT 603.1
EL. DATUM NAVD 88
NORTHING 1281700.74
EASTING 1148264.03
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		P	33											Sample put in jar.
				Soft, moist, gray, low plastic, silty CLAY (CL), trace medium to fine sand. [ALLUVIAL]	576.6 / 26.5									
30				Dense, wet, light brown, poorly graded, coarse to fine silty SAND (SM). [ALLUVIAL]	573.1 / 30.0									
35		9 11 13	100				11				4.5			35' : Fines content (%)=28.8
				Medium dense, wet, gray, sandy SILT (ML). [TILL]	567.1 / 36.0									
40				Dense, wet, coarse to fine SAND (SP), trace silt. [OUTWASH]	563.1 / 40.0									
45		9 17 26	100				10							
				Hard, moist, gray, medium plastic CLAY (CL), trace coarse to fine sand. [TILL]	557.6 / 45.5									
				Bottom of boring at 46.5'	556.6 / 46.5									

Completion Depth: 46.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 24 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-3

STARTED 8/6/13
COMPLETED 8/6/13
LOCATION Danville, IL
SURFACE EL., FT 605.9
EL. DATUM NAVD 88
NORTHING 1281688.64
EASTING 1148286.59
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0				3/4" minus crushed limestone rock. [FILL]										
				Very stiff, moist, light brown, low plastic CLAY (CL). [FILL]	604.9 / 1.0									
		6 7 9	89				16		38	22				
5		4 5 4	100											
				Loose, moist, drak gray, FLYASH, trace clay. [FILL]	600.4 / 5.5									
		7 7 7	100	Becomes medium dense.										
10		P	24	With medium to fine gravel										Bent tube. Put in jar
15		8 10 13	100	Trace medium to fine sand, no gravel.										
				Medium dense, moist, light brown to gray, medium to fine silty SAND (SM). [ALLUVIAL]	587.9 / 18.0									
20		10 11 10	100											

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 26 ft., After ___ hrs.
___ ft., After ___ hrs.
___ ft., After ___ hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-3

STARTED 8/6/13
COMPLETED 8/6/13
LOCATION Danville, IL
SURFACE EL., FT 605.9
EL. DATUM NAVD 88
NORTHING 1281688.64
EASTING 1148286.59
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		5 2 3	100	Becomes loose, wet. (water level ▼)			17							25' : Fines content (%)=25.4
30		3 3 5	67	Loose, wet, light brown, poorly graded, coarse to fine SAND (SP-SM), with silt. [ALLUVIAL]	575.9 30.0		17							30' : Fines content (%)=6.38
35		3 5 10	89				11		23	11				
				Stiff, moist, gray, medium plastic CLAY (CL), trace coarse to fine sand. [TILL]	569.9 36.0									
40		14 23 34	89	Becomes very stiff.							4.5			
				Very dense, wet, light brown, medium to fine, silty SAND (SM). [OUTWASH]	564.9 41.0									
45														

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 26 ft., After ____ hrs.
____ ft., After ____ hrs.
____ ft., After ____ hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-3

STARTED 8/6/13
COMPLETED 8/6/13
LOCATION Danville, IL
SURFACE EL., FT 605.9
EL. DATUM NAVD 88
N, E DATUM IL CS, East Zone
NORTHING 1281688.64
EASTING 1148286.59

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		10 21 35	89	Becomes coarse to fine sand.	554.6 51.3									
				Limestone in sample spoon shoe. Bottom of boring at 51.5'										
55														
60														
65														
70														

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 26 ft., After ____ hrs.
____ ft., After ____ hrs.
____ ft., After ____ hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-4

STARTED: 7/23/13
COMPLETED: 7/23/13
LOCATION: Danville, IL
SURFACE EL., FT: 593.3
EL. DATUM: NAVD 88
NORTHING: 1281668.92
EASTING: 1148334.20
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0	6 10 10	50	Soft, dry, black, TOPSOIL.	592.3 / 1.0								
			Very stiff, dry, light brown, clayey SILT (ML), trace fine sand. [FILL]									
	11 12 16	83			8							
5	9 10 12	83	Very stiff, moist, light brown, fine sandy and silty CLAY (CL). [FILL]	588.3 / 5.0	14				3.5 >4.5			
	9 15 19	83		585.3 / 8.0					3.3			
			Dense, moist, light gray, fine, silty SAND (SM), trace clay. [ALLUVIAL]									
10	4 3 2	92	Becomes loose.	582.3 / 11.0	17							10' : Fines content (%)=40.3
			Increase in clay content									
15	P	38		577.8 / 15.5								
			Soft, wet, gray, sandy CLAY (CL), trace silt. [ALLUVIAL] ▽									
				573.8 / 19.5								
20	3 4 5	100	Stiff, wet, gray, silty CLAY (CL), trace poorly graded sand. [ALLUVIAL]		12		24	12				20' : Fines content (%)=93.41

Completion Depth: 42.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 16 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-4

STARTED 7/23/13
COMPLETED 7/23/13
LOCATION Danville, IL
SURFACE EL., FT 593.3
EL. DATUM NAVD 88
NORTHING 1281668.92
EASTING 1148334.20
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		4 7 8	100	Becomes stiff.							2.0 4.0			
				1/2" Poorly graded sand seam.	566.3 27.0									
				Stiff, wet, gray, silty CLAY (CL), trace poorly graded sand. [ALLUVIAL]	564.3 29.0									
				Loose, wet, light brown, poorly graded, silty SAND (SM). [ALLUVIAL]										
30		9 14 10	100		562.3 31.0									
				6" : Stiff, wet, gray, silty CLAY (CL), trace sand.	561.8 31.5									
				Loose, wet, light brown, poorly graded silty SAND (SM). [ALLUVIAL]										
35		P	0											10 ft of blow back. Added water. No sample spoon collected
40		14 20 28	100				13							40' : Fines content (%)=15.2
				Bottom of boring at 42'	551.3 42.0									Auger refusal at 42.0'. SHALE in spoon shoe.
45														

Completion Depth: 42.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 16 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-5

STARTED 8/7/13
COMPLETED 8/7/13
LOCATION Danville, IL
SURFACE EL., FT 608.0
EL. DATUM NAVD 88
NORTHING 1281208.71
EASTING 1148299.28
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		2 4 1	89	Loose, moist, gray, FLYASH, trace fine bottom ash and clay. [FILL]										
		2 2 2	100	Becomes wet.										
5		2 2 3	78		602.5 / 5.5		17		35	18	1.0			
				Medium stiff, moist, gray, medium plastic CLAY (CL). [FILL]										
		2 4 6	89	Becomes stiff, tace medium to fine sand.			18				3.0 3.25			
10		4 2 4	44				19				2.3			
15		P	83		592.0 / 16.0		18 18 17	132 134 135 134	36	20				
				Very stiff to stiff, moist, gray, medium plastic CLAY (CL). [FILL]										16.5' :TX CD C'=0 ; phi'=40.1
20		6 7 8	78				17				4.5			20.5' : Limestone fragments in split spoon shoe.
					583.0									

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 30 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-5

STARTED 8/7/13
COMPLETED 8/7/13
LOCATION Danville, IL
SURFACE EL., FT 608.0
EL. DATUM NAVD 88
NORTHING 1281208.71
EASTING 1148299.28
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		2 7 9	78	Very stiff to stiff, moist, gray,low plastic, silty CLAY (CL). [FILL]	25.0		20				2.5			26.5' : Chunk of wood in shoe.
30		5 3 2	11	Loose, wet, dark gray, silty, medium to fine SAND (SP), trace silt. [ALLUVIAL]	578.0 / 30.0									31.5' : Limestone fragments wedged in spoon shoe
				Medium stiff, moist, dark gray, low plastic, silty CLAY (CL). [ALLUVIAL]	574.5 / 33.5									
35		5 5 4	89								1.0			
				Loose, wet, dark gray, medium to fine silty SAND (SM). [ALLUVIAL]	572.0 / 36.0									
40		2 1 0	67				12		22	11	1.0			
				Very soft, wet, gray, low plastic, sandy CLAY (CL). [ALLUVIAL]	567.5 / 40.5									
45														
				Medium dense, wet, light brown, fine SAND (SP), trace silt (SP). [ALLUVIAL]	562.0 / 46.0									

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 30 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-5

STARTED 8/7/13
COMPLETED 8/7/13
LOCATION Danville, IL
SURFACE EL., FT 608.0
EL. DATUM NAVD 88
NORTHING 1281208.71
EASTING 1148299.28
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		6 3 7	67	Becomes poorly graded, coarse to fine sand.	557.0 / 51.0									
				Bottom of boring at 51.5'										
55														
60														
65														
70														

Completion Depth: 51.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 30 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-6

STARTED: 8/7/13
COMPLETED: 8/7/13
LOCATION: Danville, IL
SURFACE EL., FT: 605.9
EL. DATUM: NAVD 88
NORTHING: 1281218.93
EASTING: 1148322.85
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 6 7	78	Stiff, dry, brown, low plastic CLAY (CL), trace 3/4" minus rock. [FILL]										
		5 7 10	89	Becomes very stiff			14				3.0 +4.5			
5		4 3 4	67	Becomes medium stiff, trace medium to fine sand.			16		32	16	3.5			
		4 7 8	89	Becomes very stiff			19				3.5 2.5 4			
10		2 3 4	78	Becomes medium stiff, moist.			18				3.0 +4 1.5			
15		P	94				16 19 21 20 18	130 134 132 132	36	20				16.5' : TX CU C'=0; phi=37.3; phi'=31.7
20		5 6 8	89	Becomes stiff.							3.5			

Completion Depth: 50.3 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 35.5 ft., After ATD hrs.; 27 ft., After 1 hrs.; ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-6

STARTED 8/7/13
COMPLETED 8/7/13
LOCATION Danville, IL
SURFACE EL., FT 605.9
EL. DATUM NAVD 88
NORTHING 1281218.93
EASTING 1148322.85
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γt, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25	3 4 5	0	With coarse gravel to fine cobbles.									
30	6 4 6	56			18							
35	6 8 9	0	Medium dense, wet, medium to fine silty SAND (SM). [ALLUVIAL]	570.4 / 35.5								
			Stiff, moist, gray, low plastic, CLAY (CL), trace medium sand. [TILL]	566.9 / 39.0								
40	4 5 7	78	1" medium to fine, silty sand lens.		11				2.0 3.0			
45			Dense, wet, gray medium to fine, silty sand (SM). [OUTWASH]	559.9 / 46.0								

Completion Depth: 50.3 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 35.5 ft., After ATD hrs.
27 ft., After 1 hrs.
ft., After hrs.
Logged by: Tim Hicks

11/21/13 URS GEOTECH TEMPLATE (LAB STRENGTH-TXUU) Y:\GINT\PROJECTS\DYNERG-VERMILLION_21562906.GPJ URS_STL.GLB

URS

LOG of BORING No. B-13-6

STARTED 8/7/13
COMPLETED 8/7/13
LOCATION Danville, IL
SURFACE EL., FT 605.9
EL. DATUM NAVD 88
NORTHING 1281218.93
EASTING 1148322.85
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		50/3"		LIMESTONE: Weathered.	555.6 50.3									50.25' : Auger refusal.
				Bottom of boring at 50.25'										
55														
60														
65														
70														

Completion Depth: 50.3 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 35.5 ft., After ATD hrs.
27 ft., After 1 hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-7

STARTED 7/24/13
COMPLETED 7/24/13
LOCATION Danville, IL
SURFACE EL., FT 590.6 EL. DATUM NAVD 88 N, E DATUM IL CS, East Zone
NORTHING 1281238.89
EASTING 1148378.49

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0	3 4 5	83	3" soft, dry, black, silty CLAY (CL). [TOPSOIL]	590.4 / 0.3					4.0			
			Stiff, dry, tan, silty CLAY (CL). [FILL]									
	P	75			16 14 10	126 131 129 130	28	14				
			Stiff, moist, gray, fine sandy CLAY (CL). [FILL]	587.1 / 3.5								3.5' : TX CIU C=99; phi=49.4 ; C'=382 psf; phi'=23.7
5	8 7 9	83			12							
			3" medium dense, brown, fine silty sand seam.	584.9 / 5.8								
			Very stiff, moist, dark gray, poorly graded, sandy clay (CL). [ALLUVIAL]									
	P	50			17 17	118 126	27	12			0.68	
			Medium stiff, moist, dark gray, silty CLAY (CL), trace fine sand. [ALLUVIAL]	581.1 / 9.5								
10	2 3 3	100			27				2.0 2.5			
15	1 2 3	94			23				2.0			15' : Fines content (%)=42.8
			Loose, wet , dark gray, fine, silty SAND (SM), trace clay. [ALLUVIAL]	▽ 574.6 / 16.0								
			LIMESTONE: weathered, fractured, with chert fine sand lenses.	571.1 / 19.5								
20	25 17 8	44										20' : Auger refusal.
			Bottom of boring at 21.5'	569.1 / 21.5								

Completion Depth: 21.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 16 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-8

STARTED: 8/2/13
COMPLETED: 8/2/13
LOCATION: Danville, IL
SURFACE EL., FT: 623.8
EL. DATUM: NAVD 88
NORTHING: 1280859.34
EASTING: 1148569.02
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0	3 5 5	78	Stiff, dry, light brown, low plastic CLAY (CL), trace fine sand. [FILL]						2.5			
	6 6 5	78							2.5			
			Medium dense, moist, brown, medium to fine SAND (SP), trace silt. [FILL]	620.3 / 3.5								
5	3 1 1	100										
			Very loose, wet, gray FLY ASH. [FILL]	618.3 / 5.5								
	P	75			26 35 29 28	109 107 114						8.65' : Fines content (%)=78.9 8.65' : TX CD C'=0 ; phi'=37.6
10	1 1 1	100										
			Soft, moist, light brown, low plastic CLAY (CL), with fly ash. [FILL]	612.8 / 11.0								
			Loose, moist, gray FLY ASH. [FILL]	610.3 / 13.5								
15	2 3 5	100			22		39	20				
			Medium stiff, moist, gray to brown, low plastic CLAY (CL), trace fly ash. [FILL]	608.3 / 15.5								
20	3 4 5	100							1.5			
			Loose, wet, gray to light brown, FLY ASH, trace fine bottom ash. [FILL]	600.3 / 23.5								

Completion Depth: 47.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 45.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-8

STARTED	8/2/13	NORTHING	1280859.34
COMPLETED	8/2/13	EASTING	1148569.02
LOCATION	Danville, IL	SURFACE EL., FT 623.8	EL. DATUM NAVD 88 / N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25	2 1 3	89										
30	P	75	Loose to medium dense, moist, gray, FLY ASH, trace fine bottom ash. [FILL]	593.8 / 30.0	47 48 44	104 102 103					1.07	30.95' : Fines content (%)=97.5 30.95' : Consol test Cc=0.275 Cr=0.008
35	3 5 7	100										
40	2 7 10	100	Very stiff, moist, light brown to gray, low plastic CLAY (CL), mottled, trace fine sand. [ALLUVIAL]	583.3 / 40.5	17				3.0 2.5			
45	1 6 11	100	Very stiff, wet, light brown, coarse to fine sandy CLAY (CL). [ALLUVIAL]	578.3 / 45.5	13							
			Medium dense, wet, light brown, coarse to fine, silty SAND (SM), trace coarse gravel to fine cobbles. [ALLUVIAL]	577.3 / 46.5								
			Bottom of boring at 47'	576.8 / 47.0								47: Auger refusal

Completion Depth: 47.0 feet	Drilling Equipment: D-50 ATV	Water Depth: 45.5 ft., After ATD hrs.	
Project No.: 21562906	Drilling Method: HSA (3.25" ID, 7.00" OD)	ft., After hrs.	
Project Name: Dynergy- Vermilion	Hammer Type: Automatic	ft., After hrs.	
Drilling Contractor: MET, Inc.	Driller's Name: Zack Wilcoxen	Logged by: Tim Hicks	

LOG of BORING No. B-13-9

STARTED 8/1/13
COMPLETED 8/1/13
LOCATION Danville, IL
SURFACE EL., FT 626.8
EL. DATUM NAVD 88
NORTHING 1280889.90
EASTING 1148585.00
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0	4 5 6	83	Stiff, dry, light brown, low plastic CLAY (CL), trace coarse to medium sand. [FILL]						2.0			
	8 8 10	89	Becomes very stiff.		10				4.0			
5	P	75			18 20 20	129 133 132	33	17				6.15' : Fines content (%)=93.6 6.15' : TX CIU C=0; phi=51; C'= 0; phi'=30.3
	2 3 4	89	Becomes medium stiff to stiff, moist, trace fly ash.		22				1.5 1.75 2.25			
10	3 5 9	100	Becomes stiff.						2.5			
			Medium dense, dry, gray, FLY ASH. [FILL]	615.8 / 11.0								
15	3 6 8	100			23				2.5 2.0 2.25			
			Stiff, moist, brown, low plastic CLAY (CL), trace medium gravel to fine sand. [FILL]	611.3 / 15.5								
20	3 4 5	83	Trace fly ash.		12				2.5 +4.0			

Completion Depth: 80.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 50 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-9

STARTED 8/1/13
COMPLETED 8/1/13
LOCATION Danville, IL
SURFACE EL., FT 626.8
EL. DATUM NAVD 88
NORTHING 1280889.90
EASTING 1148585.00
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		P	63					99						
					600.8 / 26.0		40 44	104					1.10	25.7' : Fines content (%)=98.9 Based on auger cuttings
				Medium dense, moist, gray, FLY ASH and BOTTOM ASH. [FILL]										
30		3 3 4	100	Becomes loose, 90% fly ash, 10% bottom ash.										
35		10 5 2	100	Becomes 100% fly ash, trace fine bottom ash.										
40		2 6 5	100	Becomes medium dense, wet.										
				Medium stiff, moist, gray, low plastic CLAY (CL), trace fine sand. [ALLUVIAL]	584.3 / 42.5									
45		2 3 3	100				21				1.0 1.5			
				Medium stiff,, wet, gray, sandy CLAY (CL). [ALLUVIAL]	580.8 / 46.0									

Completion Depth: 80.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 50 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-9

STARTED	8/1/13	NORTHING	1280889.90
COMPLETED	8/1/13	EASTING	1148585.00
LOCATION	Danville, IL	SURFACE EL., FT	626.8
EL. DATUM	NAVD 88	N, E DATUM	IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		14 23 24	89											
				Dense, wet, brown, coarse to fine sandy GRAVEL (GP). [OUTWASH]	576.3 / 50.5									
55														
				Dense, wet, gray, coarse to fine silty SAND (SP-SM). [OUTWASH]	569.8 / 57.0									
60		6 16 20	100	With clay layers.			10							60' : Fines content (%)=12.8
65				Hard, moist, gray, coarse to fine sandy CLAY (CL). [TILL]	561.8 / 65.0									
70		23 20 30	100				6				4.5			
				Limestone fragments.										

Completion Depth:	80.0 feet	Drilling Equipment:	D-50 ATV
Project No.:	21562906	Drilling Method:	HSA (3.25" ID, 7.00" OD)
Project Name:	Dynergy- Vermilion	Hammer Type:	Automatic
Drilling Contractor:	MET, Inc.	Driller's Name:	Zack Wilcoxen

Water Depth: 50 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.

Logged by: Tim Hicks

LOG of BORING No. B-13-9

STARTED 8/1/13
COMPLETED 8/1/13
LOCATION Danville, IL
SURFACE EL., FT 626.8
EL. DATUM NAVD 88
NORTHING 1280889.90
EASTING 1148585.00
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
75				Increasing gravel/ limestone fragments.										
80				Bottom of boring at 80'	546.8 80.0									
85														
90														
95														

Completion Depth: 80.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 50 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-10

STARTED 7/24/13
COMPLETED 7/24/13
LOCATION Danville, IL
SURFACE EL., FT 592.6
EL. DATUM NAVD 88
NORTHING 1281038.83
EASTING 1148540.89
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 5 5	89	Stiff, dry, tan, silty CLAY(CL). [FILL]	591.6 / 1.0						4.0			
				Stiff, dry, dark gray, silty CLAY (CL). [ALLUVIAL]										
		P	13				12							
				Trace coarse to fine gravel.										
5		21 19 15	0	Becomes hard.										
		5 7 9	94	Becomes stiff, trace medium to fine sand, no coarse to fine gravel.			19		42	21	4.0			
10		P	4	Trace coarse to fine gravel, coarse to fine sand.	580.6 / 12.0		18							
		2 1 1	100	Very loose, wet, tan, poorly graded, medium to fine silty SAND (SM). ▽			21							12.5' : Fines content (%)=35.7
15		11 16 19	56	LIMESTONE: Fractured, weathered.	576.6 / 16.0									15.5' : Auger refusal.
				Bottom of boring at 15.5'										
20														

Completion Depth: 15.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 12.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

11/21/13 URS GEOTECH TEMPLATE (LAB STRENGTH-TXUU) Y:\GINT\PROJECTS\DYNERG-VERMILLION_21562906.GPJ URS_STL.GLB

URS

LOG of BORING No. B-13-11

STARTED 7/24/13
COMPLETED 7/25/13
LOCATION Danville, IL
SURFACE EL., FT 634.4
EL. DATUM NAVD 88
NORTHING 1280560.90
EASTING 1148856.98
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		3 4 7	100	Stiff, dry, tan, low plastic,silty CLAY (CL). [FILL]							>4			
		5 9 9	89	Becomes very stiff.			14				4.0			
				Trace coarse sand to fine gravel.										
5		P	0											Bent tube. No recovery.
		P	0											
				Gravel layer.	626.4 / 8.0									
				Dense, black, 50% FLY ASH and 50% BOTTOM ASH.	625.4 / 9.0									
10		P	21											
				Some slag.										
				Very dense, moist, black, 50% BOTTOM ASH, 25% slag, 25% fly ash.	619.9 / 14.5									
15		37 41 44	89				4							15' : Fines content (%)=13.7
20		15 8 8	100											
				Medium dense, moist, gray, 95% FLY ASH, 5% bottom ash.	613.9 / 20.5									
				Medium dense, moist, dark gray, 75% BOTTOM ASH, 20% fly ash, 5% unburnt coal and slag.	610.4 / 24.0									

Completion Depth: 58.9 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 50.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.

Logged by: Tim Hicks

LOG of BORING No. B-13-11

STARTED 7/24/13
COMPLETED 7/25/13
LOCATION Danville, IL
SURFACE EL., FT 634.4
EL. DATUM NAVD 88
NORTHING 1280560.90
EASTING 1148856.98
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		9 10 11	100											
30		11 19 23	100	Dense, moist, dark gray, FLY ASH, trace bottom ash.	604.4 / 30.0									
35		7 16 14	100				53							35' : Fines content (%)=81.8
				Becomes dry.										
40		P	60											Only able to push 10". Piston sampler not in yet. Put in jar.
				Becomes moist.										
45		14 8 13	100	Becomes medium dense, 5% to 10% bottom ash.										

Completion Depth: 58.9 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 50.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-11

STARTED 7/24/13
COMPLETED 7/25/13
LOCATION Danville, IL
SURFACE EL., FT 634.4
EL. DATUM NAVD 88
NORTHING 1280560.90
EASTING 1148856.98
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		1 1 3	100	Becomes very loose, wet, no bottom ash. ▽			34							50' : Fines content (%)=90.4
				Very stiff, moist, gray, silty CLAY (CL), trace fine sand. [ALLUVIAL]	581.4 / 53.0									
55		7 9 11	100				23				4.5 >4.0			
				Dense, wet, gray to brown, poorly graded SAND (SP), trace silt. [ALLUVIAL]	576.9 / 57.5									
		50/5"		Weathered limestone/chert.										58.5' : Auger refusal.
				Bottom of boring at 58.9'	575.5 / 58.9									
60														
65														
70														

Completion Depth: 58.9 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 50.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-12

STARTED: 8/5/13
COMPLETED: 8/5/13
LOCATION: Danville, IL
SURFACE EL., FT: 632.3
EL. DATUM: NAVD 88
NORTHING: 1280716.74
EASTING: 1148877.46
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γt, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		3 5 12	67	Very stiff, dry, light brown, low plastic CLAY (CL). [FILL]										
		6 9 11	89				13				>4.0			
5		7 8 12	94				17				>4.0			
		7 16 14	39											
				Dense, dry, dark gray, coarse to fine BOTTOM ASH, trace fly ash. [FILL]	624.3 / 8.0									
10		8 8 8	89				7							10' : Fines content (%)=17.9
				Stiff, moist, light brown, low plastic CLAY (CL), trace sand. [FILL]	619.3 / 13.0									
15		P	100											
		18 40 42	100	Very dense, moist, dark gray, coarse to fine BOTTOM ASH, trace fly ash. [FILL]	616.8 / 15.5									
20		6 9 9	100											
				Medium dense, moist, gray, FLY ASH, trace clay. [FILL]	611.8 / 20.5									

Completion Depth: 60.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 55.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

STARTED	8/5/13			NORTHING	1280716.74
COMPLETED	8/5/13			EASTING	1148877.46
LOCATION	Danville, IL	SURFACE EL., FT	632.3	EL. DATUM	NAVD 88
				N, E DATUM	IL CS, East Zone

LOG of BORING No. B-13-12

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		7 14 7	89											
30		8 18 41	100	Very dense, dry, gray, FLY ASH, trace medium to fine bottom ash. [FILL]	602.3 30.0									
35		3 6 11	100	Becomes medium dense. Becomes wet.										
40		3 2 5	100	Becomes loose.			65							40' : Fines content (%)=89.5
45		8 8 8	100	Becomes medium dense. Becomes wet.										
				Stiff, moist, light brown to gray, low plastic	582.8 49.5									

Completion Depth: 60.5 feet	Drilling Equipment: D-50 ATV	Water Depth:	55.5	ft., After	ATD hrs.
Project No.: 21562906	Drilling Method: HSA (3.25" ID, 7.00" OD)			ft., After	hrs.
Project Name: Dynergy- Vermilion	Hammer Type: Automatic			ft., After	hrs.
Drilling Contractor: MET, Inc.	Driller's Name: Zack Wilcoxen	Logged by:	Tim Hicks		

LOG of BORING No. B-13-12

STARTED: 8/5/13
COMPLETED: 8/5/13
LOCATION: Danville, IL
NORTHING: 1280716.74
EASTING: 1148877.46
SURFACE EL., FT: 632.3
EL. DATUM: NAVD 88
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		6 6 7	100	CLAY (CL), trace silt.			20				2.5 1.75 2.25			
55		10 10 12	100	▽	576.8 55.5									
				Medium dense, wet, light brown, coarse to fine SAND (SP), trace silt.										
60		50/6"	0		572.3 60.0									
				Very dense, wet, coarse SAND to coarse GRAVEL (SP-GP).	571.8 60.5									
				Bottom of boring at 60.5'										
65														
70														

Completion Depth: 60.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 55.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-13

STARTED 8/5/13
COMPLETED 8/5/13
LOCATION Danville, IL
SURFACE EL., FT 633.3
EL. DATUM NAVD 88
NORTHING 1280751.58
EASTING 1148882.38
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 4 7	89	Stiff, dry, light brown, low plastic CLAY (CL), trace medium to fine sand. [FILL]							3.0			
		11 13 15	100	Becomes very stiff.			7		24	10	3.5			
5		7 9 10	89	Trace fly ash.			13				3.0 >4.0			
		16 20 32	0	Becomes hard.										7.5' to 12' : Driving through limestone gravel.
10		6 11 14	28	Becomes very stiff.			10							
				Dense, dry, dark gray, BOTTOM ASH and FLYASH, with limestone gravel. [FILL]	620.3 13.0									
15		19 19 24	56				6							15' : Fines content (%)=17.9
20		11 10 12	0											
				Medium dense, moist, gray, FLY ASH, trace fine bottom ash. [FILL]	610.3 23.0									

Completion Depth: 71.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 56 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-13

STARTED 8/5/13
COMPLETED 8/5/13
LOCATION Danville, IL
SURFACE EL., FT 633.3
EL. DATUM NAVD 88
N, E DATUM IL CS, East Zone
NORTHING 1280751.58
EASTING 1148882.38

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		5 5 6	94				41							25' : Fines content (%)=79.3
30		18 22 10	100	Becomes dense.										
				Becomes medium dense, wet.										
35		2 3 6	100	Becomes loose.										
40		2 4 5	94	Becomes moist, trace coarse to fine bottom ash.										
45		5 6 3	100											

Completion Depth: 71.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 56 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-13

STARTED: 8/5/13
COMPLETED: 8/5/13
LOCATION: Danville, IL
SURFACE EL., FT: 633.3
EL. DATUM: NAVD 88
N, E DATUM: IL CS, East Zone
NORTHING: 1280751.58
EASTING: 1148882.38

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		3 4 5	100		582.8		19				2.5 2.0			
				Medium stiff, moist, gray, low plastic, silty CLAY (CL). [ALLUVIAL]	50.5									
55					577.3									
				▽ Dense, wet, light brown, poorly graded, coarse to fine SAND (SP). [ALLUVIAL]	56.0									
60		14 17 40	100		572.3									
				Hard, moist, light gray, SILT (ML), trace fine sand. [OUTWASH]	61.0									
65					568.3									
				Very stiff, moist, light gray, medium plastic CLAY (CL), trace coarse to medium sand. [TILL]	65.0									
					563.3									
70		35 50/6"		Very dense, wet, light gray, gravelly, silty, fine SAND (SM), trace clay.	70.0		11							70' : Fines content (%)=23.6
					561.8									
				Bottom of boring at 71.5'	71.5									70' : Auger refusal.

Completion Depth: 71.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 56 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-14

STARTED 7/24/13
COMPLETED 7/24/13
LOCATION Danville, IL
SURFACE EL., FT 592.6
EL. DATUM NAVD 88
NORTHING 1280854.70
EASTING 1148991.34
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 4 5	100	Medium stiff to stif, dry, silty CLAY (CL). [FILL]							2.0			
		2 4 4	89		589.6 / 3.0		17				2.0 4.0			
				Medium stiff to stiff, moist, silty CLAY (CL), trace medium to fine sand.										
5		3 6 6	100	Becomes stiff, dark gray. [ALLUVIAL]			15				3.0 >4.0			
		4 4 4	100		584.6 / 8.0									
				Loose, light brown, moist, fine, silty SAND (SM). [ALLUVIAL]										
10		2 7 6	100	Medium dense, moist, brown, fine sandy SILT (ML). [ALLUVIAL]	582.6 / 10.0									
				Medium dense, moist, brown, poorly graded, medium to fine, silty SAND (SM). [ALLUVIAL] ▽	581.6 / 11.0									
15		7 17 9	67		577.1 / 15.5		9							15' : Fines content (%)=8.5
				Medium dense, wet, brown, poorly graded, coarse to fine SAND with SILT (SP-SM).										
				Stiff, wet, gray, low plastic CLAY (CL), coarse to fine sand trace. [ALLUVIAL]	574.1 / 18.5									
20		4 6 7	100				11		23	11				
				Hard, moist, gray, coarse to fine sandy CLAY (CL). [TILL]	569.6 / 23.0									

Completion Depth: 42.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 13 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-14

STARTED 7/24/13
COMPLETED 7/24/13
LOCATION Danville, IL
SURFACE EL., FT 592.6
EL. DATUM NAVD 88
NORTHING 1280854.70
EASTING 1148991.34
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		14 13 22	100				10				>4.0			
30		3 7 10	100	Becomes very stiff.			11		24	11				
35		7 13 16	100											
				Dense, wet, light brown, poorly graded, medium to fine SAND (SP), trace silt. [OUTWASH]	556.6 36.0									
40		22 20 24		Hard, moist, gray, high plastic CLAY (CH). [TILL]	552.6 40.0		19				>4.0			
				Bottom of boring at 42'	550.6 42.0									42' : Auger refusal in shale.
45														

Completion Depth: 42.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 13 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-15

STARTED 7/29/13
COMPLETED 7/29/13
LOCATION Danville, IL
SURFACE EL., FT 635.0
EL. DATUM NAVD 88
NORTHING 1280663.39
EASTING 1149166.89
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 6 17	72	Very stiff, dry, brown to gray, low plastic, silty CLAY (CL), trace fine gravel. [FILL]							4.0			
		5 6 5	89	Becomes stiff.			16				4.0			0-5' : cap
5		P	83					124						
				Medium dense, dry, gray, FLY ASH. [FILL]	629.0 6.0		15	133	33	17				6.15' : TX CID C'=0; phi'=42
		6 8 8	100											
10		2 1 2	100	Becomes very loose			38							10' : Fines content (%)=96.7
15		P	100				35 27 31	89 105 106						15.6' : TX CID C'=39 psf; phi'=35.3 15.9' : Fines content (%)=94.0
20		2 2 2	100	Becomes loose, 1" coarse to fine bottom ash seams.										
				Loose, moist, gray, 75 % FLY ASH, 25% coarse to fine bottom ash. [FILL]	611.5 23.5									

Completion Depth: 86.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 43.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-15

STARTED 7/29/13
COMPLETED 7/29/13
LOCATION Danville, IL
SURFACE EL., FT 635.0 EL. DATUM NAVD 88 N, E DATUM IL CS, East Zone
NORTHING 1280663.39
EASTING 1149166.89

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		2 3 2	100											
30		7 10 9	100	Becomes medium dense. 75% to 80% fly ash 25% to 20% bottom ash			33							30' : Fines content (%)=71.6
35		3 8 8	100	Trace medium to fine bottom ash .										
40		4 11 12	100	2" wet zone.										41' : Perched water level.
				Becomes wet, very loose. ▽										
45		1 0 1	100											

Completion Depth: 86.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 43.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-15

STARTED 7/29/13
COMPLETED 7/29/13
LOCATION Danville, IL
SURFACE EL., FT 635.0 EL. DATUM NAVD 88 N, E DATUM IL CS, East Zone
NORTHING 1280663.39
EASTING 1149166.89

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		2 2 2	100	Very loose to loose.			78							50' : Fines content (%)=93.4
				Stiff, moist, mottled brown to gray, medium plastic CLAY (CL), trace silt. [ALLUVIUM]	582.0 53.0									
55		4 6 6	100				22				4 2.5 3.5			
60		7 7 15	100	Stiff to very stiff, moist, medium plastic CLAY (CL), trace medium to fine sand. [TILL] 2" coarse sand to medium gravel layer.	575.0 60.0						4.0			
				Medium dense, wet, gray, fine to medium SAND (SP), trace silt. [OUTWASH]	573.5 61.5									
				Very stiff, moist, gray, medium plastic CLAY (CL), trace silt and medium to coarse sand. [TILL]	572.0 63.0									
65		7 11 14	100								4.5			
70														

Completion Depth: 86.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 43.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-15

STARTED 7/29/13
COMPLETED 7/29/13
LOCATION Danville, IL
SURFACE EL., FT 635.0
EL. DATUM NAVD 88
NORTHING 1280663.39
EASTING 1149166.89
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
75		8 10 14	89				11				4.5			
80														
85		11 50	83	SHALE: Weathered, gray.	549.0 86.0									
				Bottom of boring at 86'										86' : Auger refusal.
90														
95														

Completion Depth: 86.0 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 43.5 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

URS

LOG of BORING No. B-13-16

STARTED 7/30/13
COMPLETED 7/31/13
LOCATION Danville, IL
SURFACE EL., FT 634.6
EL. DATUM NAVD 88
NORTHING 1280698.03
EASTING 1149169.68
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		4 6 7	89	Stiff, dry, light brown, low plastic CLAY (CL), trace coarse to fine sand. [FILL]							3.5			
		7 9 9	89				10				3.0			
5		4 2 3	78	Becomes medium stiff, moist.			15				1.5			
		4 5 3	100	Loose, moist, gray FLY ASH, trace bottom ash. [FILL]	626.6 / 8.0									
10		1 0 0	100	Becomes very loose, wet.										
15		P	13	Trace clay.										Sample put in jar.
20		P	33	No trace clay.										
		1 0 0	100	Becomes saturated.										23' : Perched water

Completion Depth: 81.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 60 ft., After ATD hrs.; 56.4 ft., After 1 hr. hrs.; ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-16

STARTED 7/30/13
COMPLETED 7/31/13
LOCATION Danville, IL
SURFACE EL., FT 634.6
EL. DATUM NAVD 88
NORTHING 1280698.03
EASTING 1149169.68
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25		1 1 0	100											
30		5 6 11	100	Medium dense, moist, dark gray, 75% FLY ASH; 25% medium to fine bottom ash. [FILL]	604.6 / 30.0									
35		4 12 5	100	90% fly ash; 10% medium to fine bottom ash.			51							35' : Fines content (%)=96.1
				Dense, dry, dark gray FLY ASH, trace fine bottom ash. [FILL]	595.6 / 39.0									
40		29 19 15	100											
				Becomes medium dense, moist with wet seams.										
45		1 4 6	100											

Completion Depth: 81.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 60 ft., After ATD hrs.
56.4 ft., After 1 hr. hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-16

STARTED 7/30/13
COMPLETED 7/31/13
LOCATION Danville, IL
SURFACE EL., FT 634.6
EL. DATUM NAVD 88
NORTHING 1280698.03
EASTING 1149169.68
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
50		3 3 7	100								2.0			
				Medium stiff, moist, gray, low plastic CLAY (CL). [ALLUVIAL]	583.6 / 51.0									
55		3 3 3	100	Becomes loose, mottled, light gray to brown.			17		29	12	2.0 1.0			
60		1 0 0	56	Very loose, saturated, coarse to fine sandy SILT (ML).	574.6 / 60.0		29							60' : Fines content (%)=17.4 Added water into the augers.
65														
70		9 18 13	89	Becomes medium dense.										
				Hard, moist, gray low plastic CLAY (CL), trace coarse to fine sand. [TILL]	563.1 / 71.5									

Completion Depth: 81.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.

Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen

Water Depth: 60 ft., After ATD hrs.
56.4 ft., After 1 hr. hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-16

STARTED 7/30/13
COMPLETED 7/31/13
LOCATION Danville, IL
SURFACE EL., FT 634.6
EL. DATUM NAVD 88
NORTHING 1280698.03
EASTING 1149169.68
N, E DATUM IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
75														
80		36 44 30	0											80' : Auger refusal. 80.5' : Dark gray, weathered shale in SPT shoe.
				Bottom of boring at 81.5'	553.1 81.5									
85														
90														
95														

Completion Depth: 81.5 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 60 ft., After ATD hrs.
56.4 ft., After 1 hr. hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-17

STARTED: 7/29/13
COMPLETED: 7/29/13
LOCATION: Danville, IL
SURFACE EL., FT: 590.0
EL. DATUM: NAVD 88
NORTHING: 1280850.61
EASTING: 1149176.76
N, E DATUM: IL CS, East Zone

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
0		2 2 2	67	Soft, moist, light brown, low plastic, silty CLAY (CL). [FILL]										
				Soft, moist, gray to light brown, low plastic, sIlty CLAY (CL), trace medium to fine sand. [ALLUVIUM]	588.5 1.5									
		P	83				27 37 37 37	95 108 93 98	44	9	1.0			6.15' : TX CD C=0; phi=41.3
5		2 3 3	78	Becomes medium dense.			19				1.0			
		5 5 4	100											
				Loose, moist, brown, fine, clayey SAND (SC), trace silt. [ALLUVIAL]	582.0 8.0									
10		4 3 3	100				18							10' : Fines content (%)=17.2
				Loose, wet, brown, medium to fine, silty SAND (SM). ▽	579.5 10.5									
15		4 7 9	94	Stiff to very stiff, moist, dark gray, silty CLAY (CL), trace medium sand. [TILL]	575.0 15.0		10				4.0 >4.0			
20		8 11 11	100	1" thick coarse to medium sand seam. Becomes very stiff.			10				>4.5 >4.0			

Completion Depth: 40.7 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 11 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

LOG of BORING No. B-13-17

STARTED 7/29/13
COMPLETED 7/29/13
LOCATION Danville, IL
SURFACE EL., FT 590.0
EL. DATUM NAVD 88
NORTHING 1280850.61
EASTING 1149176.76
N, E DATUM IL CS, East Zone

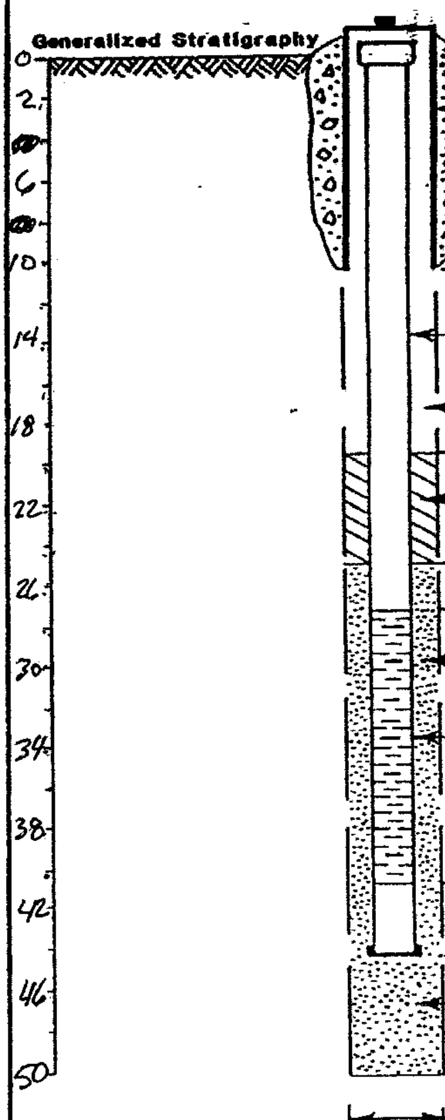
DEPTH, ft.	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	NMC, %	γ_t, PCF	LL	PI	PP Su, KSF	TV Su, KSF	TXUU Su, KSF	NOTES
25	16 21 21	0	Becomes hard.									
30	6 9 11	100	Coarse to fine sand.		11				4.0 >4.0			
35	8 15 20	89	Dense, wet, dark gray, medium to fine clayey SAND (SC). [TILL]	554.8 / 35.3								
40	32 50/2.5"	82	Very dense, wet, brown, medium to fine, silty SAND (SM). [OUTWASH]	549.5 / 40.5								40.5' : Auger refusal.
			Gray SHALE.	549.3 / 40.7								
			Bottom of boring at 40.7'									
45												

Completion Depth: 40.7 feet
Project No.: 21562906
Project Name: Dynergy- Vermilion
Drilling Contractor: MET, Inc.
Drilling Equipment: D-50 ATV
Drilling Method: HSA (3.25" ID, 7.00" OD)
Hammer Type: Automatic
Driller's Name: Zack Wilcoxen
Water Depth: 11 ft., After ATD hrs.
ft., After hrs.
ft., After hrs.
Logged by: Tim Hicks

GROUND WATER OBSERVATION WELL REPORT

Project Name: DYNEGY VERMILLION
Location: DANVILLE, IL
Installed by: ZACH WILCOXEN (MET)
Inspected by: TIM HICKS
Method of Installation: HSA BOREHOLE
Remarks: ______

Piez./Well No.: B-13-3
Project No.: 21562906
Date: 8-6-13
Time: 1440



Ground Elevation: 0
I.D./Type of surface casing: —
Type of surface seal: —
Depth of surface seal: —
I.D./Type of riser pipe: —
Type of backfill: ______
Elev./Depth of top of seal: —
Type of seal: BENTONITE PLUG
Elev./Depth of top of filter pack: 20ft
Elev./Depth of top of screen: —
Type of filter pack: SAND
I.D./Type of screen: —
Screen slot size: —
Elev./Depth of bottom of ~~screen~~ PIEZO: 42ft
Elev./Depth of bottom of plugged blank section: —
Type of backfill below observation well: SAND
Elev./Depth of bottom of boring: 50ft
Diameter of boring: 7 3/4"

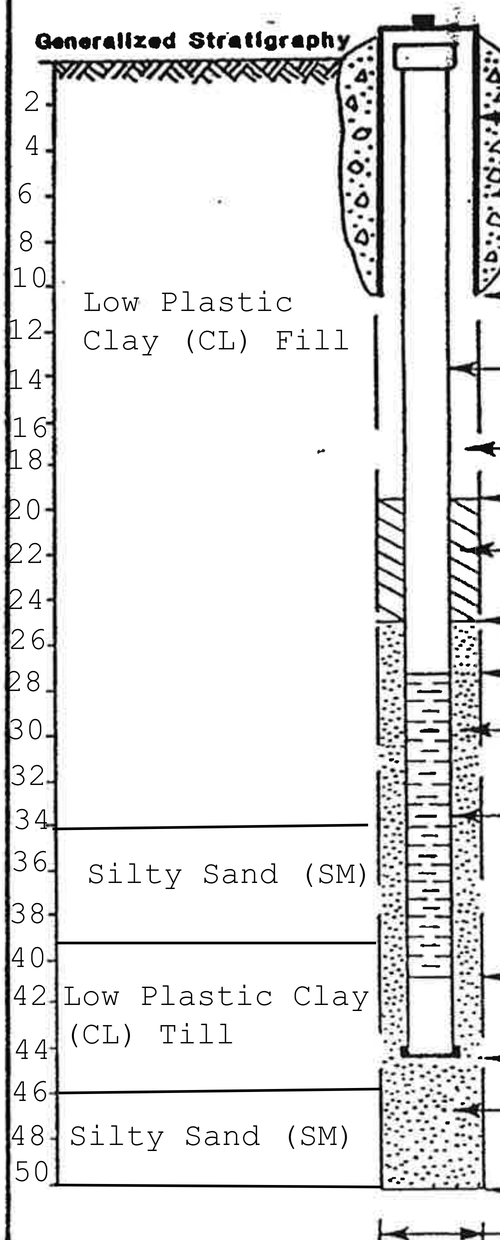
Woodward-Clyde Consultants

Fig. ______

GROUND WATER OBSERVATION WELL REPORT

Project Name: Dynegy - Vermillion
Location: Danville, IL
Installed by: Zach Wilcoxen (MET)
Inspected by: Tim Hicks (URS)
Method of Installation: HSA Borehole
Remarks: Vibrating Wire Piezometer

Piez./Well No.: B-13-06
Project No.: 21562906
Date: 8/7/2013
Time: 1332 to 1350



Ground Elevation: 0
I.D./Type of surface casing: ----
Type of surface seal: Grout
Depth of surface seal: ----
I.D./Type of riser pipe: ----
Type of backfill: Grout
Elev./Depth of top of seal: 10ft
Type of seal: Bentonite
Elev./Depth of top of filter pack: 20 ft
Elev./Depth of top of screen: ----
Type of filter pack: Sand
I.D./Type of screen: ----
Screen slot size: ----
Elev./Depth of bottom of ~~screen~~ - Piezo.: 40 ft
Elev./Depth of bottom of plugged blank section: ----
Type of backfill below observation well: Sand
Elev./Depth of bottom of boring: 50.25ft
Diameter of boring: 7 3/4 in

Woodward-Clyde Consultants

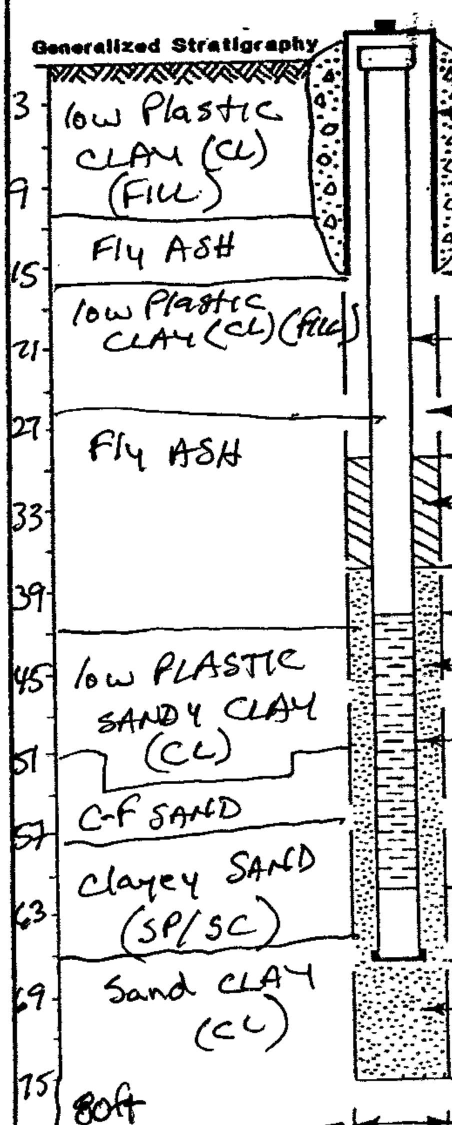
Fig. ____

GROUND WATER OBSERVATION WELL REPORT

Project Name: DYNEGY – VERMILLION
Location: DANVILLE, IL
Installed by: ZACH WILCAKEN (MET)
Inspected by: TIM HICKS (URS)
Method of Installation: HSA BOREHOLE
Remarks: VIBRATING WIRE PIEZOMETER

Piez./Well No. B-13-9
Project No. 21562906
Date 8-1-13
Time 1345 TO 1600 HRS

Generalized Stratigraphy



- Ground Elevation: 0
- I.D./Type of surface casing: —
- Type of surface seal: GROUT
- Depth of surface seal: ~~GROUT~~
- I.D./Type of riser pipe: —
- Type of backfill: GROUT
- Elev./Depth of top of seal: 40ft
- Type of seal: BENTONITE
- Elev./Depth of top of filter pack: 50ft
- Elev./Depth of top of screen: —
- Type of filter pack: SAND
- I.D./Type of screen: —
- Screen slot size: —
- Elev./Depth of bottom ~~of screen~~ OF PIEZO: 70ft
- Elev./Depth of bottom of plugged blank section: —
- Type of backfill below observation well: SAND
- Elev./Depth of bottom of boring: 80ft
- Diameter of boring: 7 3/4"

Woodward-Clyde Consultants

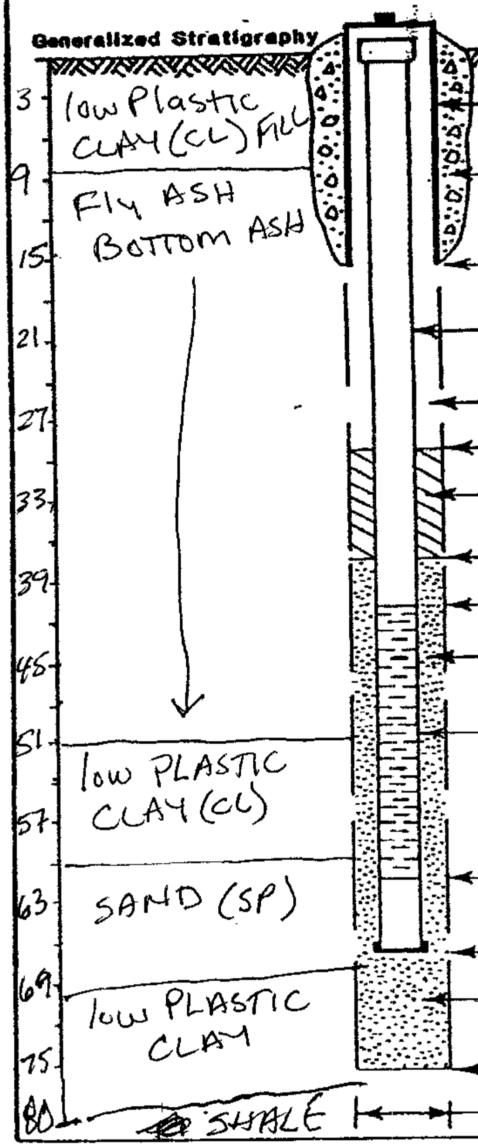
Fig. ______

GROUND WATER OBSERVATION WELL REPORT

Project Name: DYNEGY VERMILLION
Location: DANVILLE, IL
Installed by: Z. WILCOXEN (MET)
Inspected by: TIM HICKS
Method of Installation: VIBRATING WIRE PIEZOMETER
Remarks:

Piez./Well No. B-13-16
Project No. 21562906
Date 7/31/13
Time 10:00AM – 6:40pm

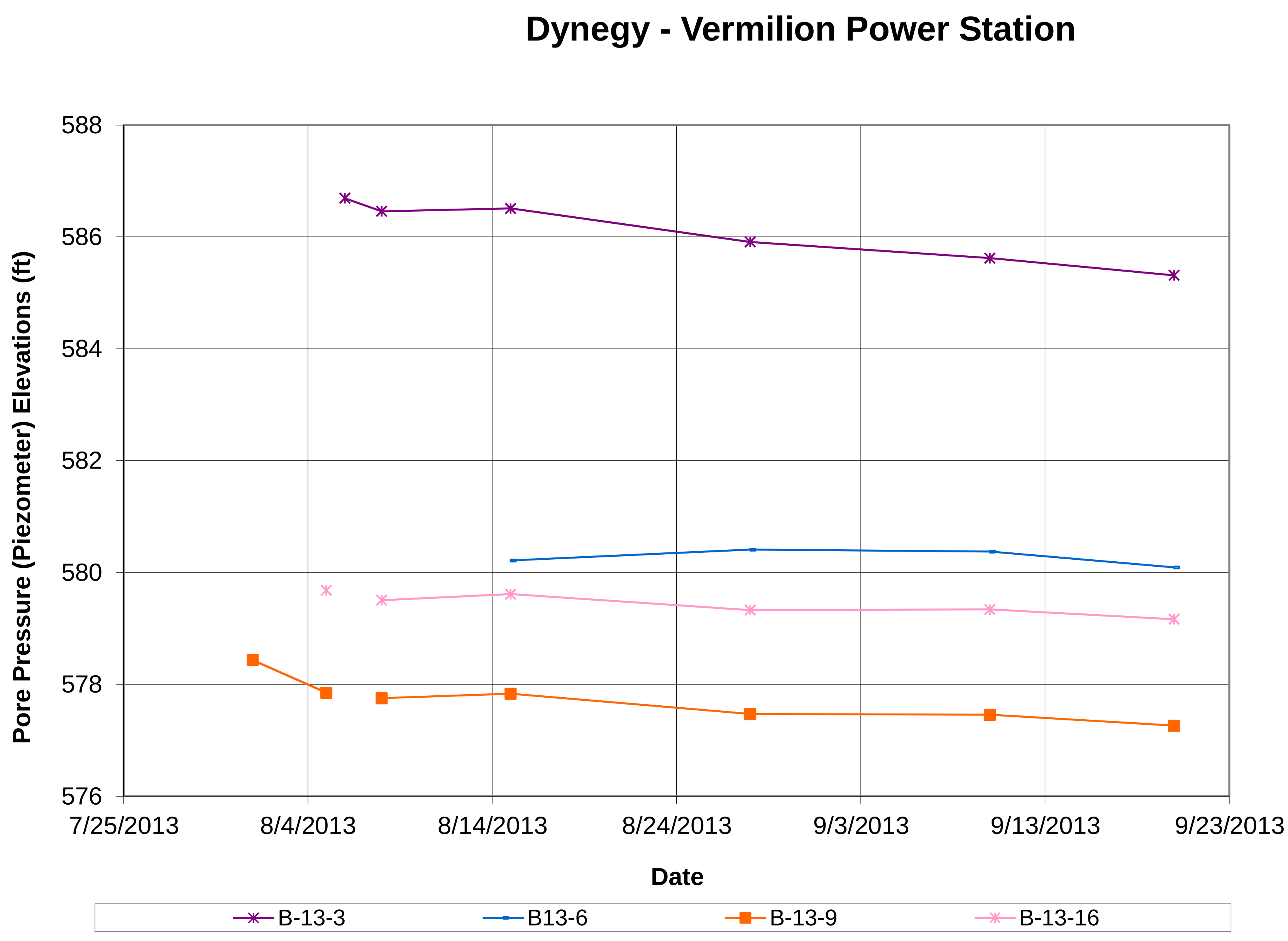
Generalized Stratigraphy



- Ground Elevation ____
- I.D./Type of surface casing —
- Type of surface seal —
- Depth of surface seal 0
- I.D./Type of riser pipe —
- Type of backfill QUICK-GROUT
- Elev./Depth of top of seal 37.0 FT
- Type of seal BENTONITE PELLETS
- Elev./Depth of top of filter pack 45.0 FT
- Elev./Depth of top of screen —
- Type of filter pack SAND
- I.D./Type of screen —
- Screen slot size —
- Elev./Depth of bottom of screen —
- Elev./Depth of bottom of ~~plugged blank section~~ PIEZOMETER 68.2 Ft
- Type of backfill below observation well SAND
- Elev./Depth of bottom of boring 80.0 Ft
- Diameter of boring 7 3/4"

Woodward-Clyde Consultants

Fig. ____


Dynegy - Vermilion Power Station
Pore Pressure (Piezometer) Elevations (ft)
588
586
584
582
580
578
576
7/25/2013
8/4/2013
8/14/2013
8/24/2013
9/3/2013
9/13/2013
9/23/2013
Date
B-13-3
B13-6
B-13-9
B-13-16

B-13-3

Input data into the red columns and copy the formulas to the next rows.

Geokon Serial #	(G) Linear Gage Factor	(R0) Zero Reading	(K) Thermal Factor	(T0) Zero Reading	(S0) Barometer Zero	Sensor Elevation	Ground Surface	Groundwater Depth At Time of Drilling
1316841	-0.01187	6409.8	0.01704	29.5		563.9	605.9	26

Date & Time	Ri (Digits)	Ti (C)	PSI	FT	Elevation	Depth to Water (ft)
8/6/13 4:35 PM	5558.8	16.2	9.87	22.79	586.69	19.2
8/8/13 11:30 AM	5561.7	12.3	9.77	22.56	586.46	19.4
8/15/13 9:50 AM	5559.6	12.1	9.80	22.61	586.51	19.4
8/28/13 9:56 AM	5581.3	12	9.54	22.01	585.91	20.0
9/10/13 9:30 AM	5591.9	12	9.41	21.72	585.62	20.3
9/20/13 9:15 AM	5603.1	12	9.28	21.41	585.31	20.6

B-13-6

Input data into the red columns and copy the formulas to the next rows.

Geokon Serial #	(G) Linear Gage Factor	(R0) Zero Reading	(K) Thermal Factor	(T0) Zero Reading	(S0) Barometer Zero	Sensor Elevaton	Ground Surface	Groundwater Depth At Time of Drilling
1316840	-0.01169	7886	0.002497	23		562.8	605.9	27

Date & Time	Ri (Digits)	Ti (C)	PSI	FT	Elevation	Depth to Water (ft)
8/15/13 9:57 AM	7238.3	12.6	7.55	17.42	580.22	25.7
8/28/13 10:06 AM	7231.1	12.6	7.63	17.61	580.41	25.5
9/10/13 9:35 AM	7232.4	12.5	7.61	17.57	580.37	25.5
9/20/13 9:20 AM	7242.9	12.5	7.49	17.29	580.09	25.8

B-13-9

Input data into the red columns and copy the formulas to the next rows.

Geokon Ser	(G) Linear	(R0) Zero I	(K) Therma	(T0) Zero F	(S0) Baron	Sensor Ele	Ground Surface	Groundwater Depth At Time of Drilling
1243747	-0.01166	7411.1	0.005213	22.6		556.8	626.8	50

Date & Time	Ri (Digits)	Ti (C)	PSI	FT	Elevation	Depth to Water (ft)
8/1/13 3:20 PM	6604.5	16.7	9.37	21.64	578.44	48.4
8/5/13 3:20 PM	6624.6	13	9.12	21.05	577.85	48.9
8/8/13 11:45 AM	6628.2	12.9	9.08	20.95	577.75	49.0
8/15/13 12:00 AM	6625.2	12.9	9.11	21.03	577.83	49.0
8/28/13 10:14 AM	6638.7	12.9	8.96	20.67	577.47	49.3
9/10/13 9:41 AM	6639.2	12.9	8.95	20.66	577.46	49.3
9/20/13 9:28 AM	6646.4	12.9	8.87	20.46	577.26	49.5

B-13-16

Input data into the red columns and copy the formulas to the next rows.

Geokon Ser	(G) Linear	(R0) Zero I	(K) Therma	(T0) Zero I	(S0) Baron	Sensor Ele	Ground Surface	Groundwater Depth At Time of Drilling
1243745	-0.01147	8070.3	0.00743	24		566.6	634.6	56.4

Date & Time	Ri (Digits)	Ti (C)	PSI	FT	Elevation	Depth to Water (ft)
7/31/13 6:05 PM	7117.2	15.7	10.87	25.09	591.69	42.9
8/5/13 3:15 PM	7570	14.5	5.67	13.08	579.68	54.9
8/8/13 12:00 AM	7576.7	14.5	5.59	12.90	579.50	55.1
8/15/13 10:10 AM	7572.5	14.4	5.64	13.01	579.61	55.0
8/28/13 10:23 AM	7583.3	14.4	5.51	12.73	579.33	55.3
9/10/13 9:35 AM	7582.9	14.4	5.52	12.74	579.34	55.3
9/20/13 9:40 AM	7589.5	14.4	5.44	12.56	579.16	55.4

Compiled Piezometer Data

	8/1/2013	8/5/2013	8/6/2013	8/8/2013	8/15/2013	8/28/2013	9/10/2013	9/20/2013
B-13-3			586.69	586.46	586.51	585.91	585.62	585.31
B13-6					580.22	580.41	580.37	580.09
B-13-9	578.44	577.85		577.75	577.83	577.47	577.46	577.26
B-13-16		579.68		579.50	579.61	579.33	579.34	579.16

Laboratory Test Results
URS-St. Louis

URS Corporation #215629006
Dynegy Vermilion 2013
LABORATORY TEST DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS						
			WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTIC INDEX (%)	USCS SYMB. (1)	SIEVE MINUS NO. 200	HYDRO. % MINUS 2µm
B-13-1	S-10	35.0-36.5	11.6						
B-13-1	S-11	40.0-41.5	12.2	24	12	12	CL		
B-13-2	S-4	7.5-9.0	14.4	22	16	6	CL-ML		
B-13-2	S-9	35.0-36.5	10.8					28.8	
B-13-2	S-10	45.0-46.5	9.6						
B-13-3	S-2	2.5-4.0	15.9	38	16	22	CL		
B-13-3	S-8	25.0-26.5	16.9					25.4	
B-13-3	S-9	30.0-31.5	17.0					6.4	
B-13-3	S-10	35.0-36.5	10.7	23	12	11	CL		
B-13-4	S-2	2.5-4.5	7.7						
B-13-4	S-3	5.0-7.0	13.7						
B-13-4	S-7	20.0-22.0	11.7	24	12	12	CL		
B-13-4	S-10	40.0-42.0	13.0					15.2	
B-13-5	S-3	5.0-6.5	17.2	35	17	18	CL		
B-13-5	S-4	7.5-9.0	17.6						
B-13-5	S-5	10.0-11.5	19.2						
B-13-5	S-7	20-21.5	17.5						
B-13-5	S-8	25.0-26.5	20.2						
B-13-5	S-11	40.0-41.5	12.4	22	11	11	CL		
B-13-6	S-2	2.5-4.0	13.7						
B-13-6	S-4	7.5-9.0	19.3						
B-13-6	S-3	5.0-6.5	16.5	33	16	16	CL		
B-13-6	S-5	10.0-11.5	17.6						
B-13-6	S-9	30.0-31.5	17.9						
B-13-6	S-11	40.0-41.5	11.4						
B-13-7	S-3	5.0-6.5	12.3						
B-13-7	S-5	10-11.5	27.0						
B-13-7	S-6	15.0-16.5	23.3					42.8	
B-13-8	S-6	15.0-16.5	21.5	39	18	20	CL		
B-13-8	S-11	40-41.5	17.3						
B-13-8	S-12	45.0-46.5	13.0						
B-13-9	S-2	2.5-4.0	9.6						
B-13-9	S-4	7.5-9.0	22.4						
B-13-9	S-6	15-16.5	22.7						
B-13-9	S-7	20.0-21.5	11.8						
B-13-9	S-12	45.0-46.5	20.9						
B-13-9	S-15	70-71.5	6.3						

Prepared by: BTH
Reviewed by: SAV
Date: 11/05/13

URS COrporation
1001 Highlands Plaza Drive West, Suite # 300
St. Louis, MO 63110

URS Corporation #215629006

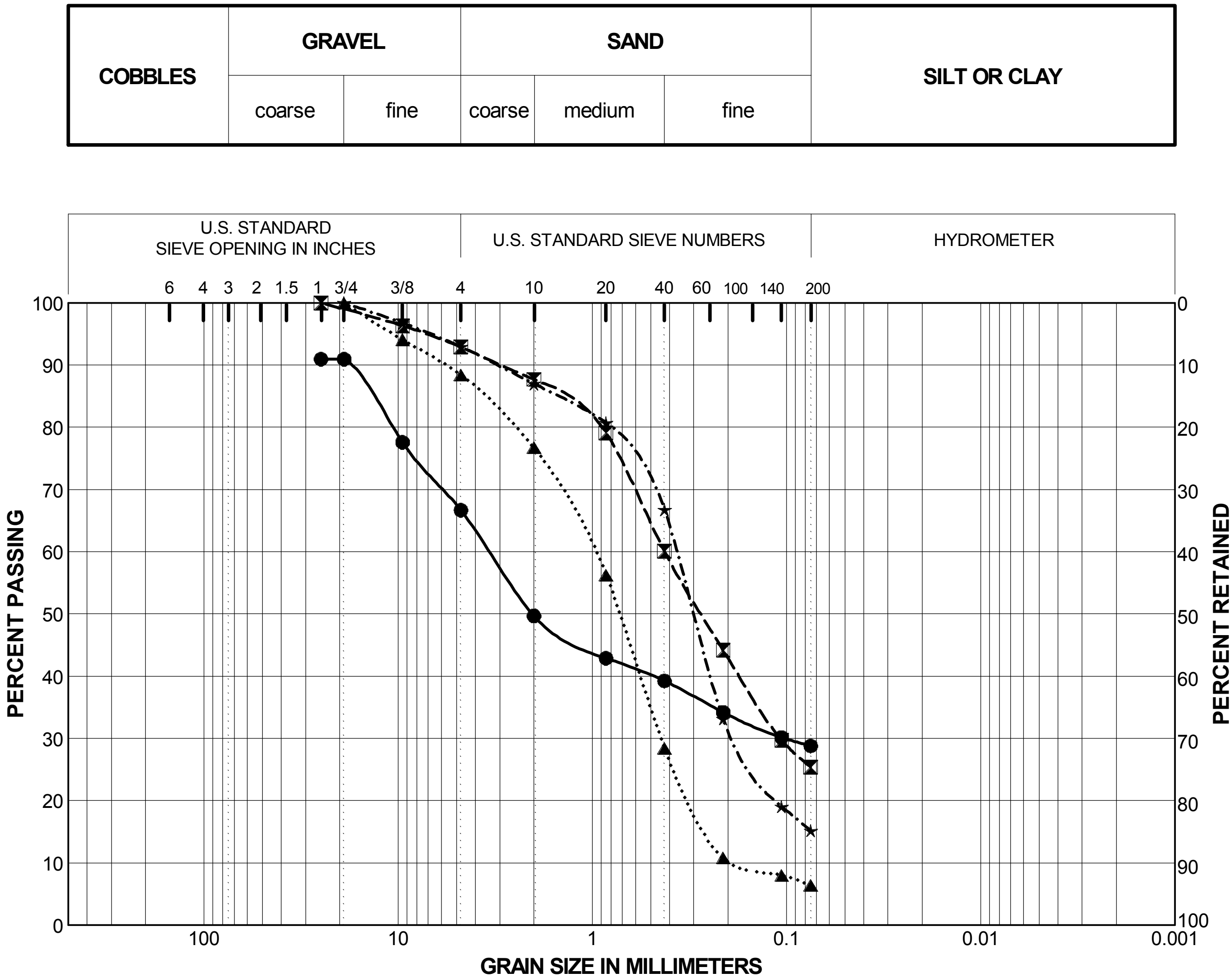
Dynegy Vermilion 2013

LABORATORY TEST DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS						
			WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTIC INDEX (%)	USCS SYMB. (1)	SIEVE MINUS NO. 200	HYDRO. % MINUS 2µm
B-13-10	S-2	2.5-4.5	12.4						
B-13-10	S-4	7.5-9.0	19.5	42	21	21	CL		
B-13-10	S-5	10.0-12.0	17.8						
B-13-10	S-6	12.5-14.0	21.1					35.7	
B-13-11	S-2	2.5-4.0	13.9						
B-13-11	S-14	55-56.5	22.8						
B-13-12	S-2	2.5-4.0	13.3						
B-13-12	S-3	5.0-6.5	17.5						
B-13-12	S-12	40.0-41.5	64.8					89.5	
B-13-12	S-14	50.0-51.5	19.7						
B-13-13	S-2	2.5-4.0	6.8	24	14	10	CL		
B-13-13	S-3	5.0-6.5	13.0						
B-13-13	S-5	10.0-11.5	10.4						
B-13-13	S-6	15.0-16.5	5.6					17.9	
B-13-13	S-13	50.0-51.5	19.1						
B-13-13	S-15	70.0-71.0	11.0					23.6	
B-13-14	S-2	2.5-4.0	16.8						
B-13-14	S-3	5.0-6.5	15.1						
B-13-14	S-6	15.0-16.5	8.9					8.5	
B-13-14	S-9	30.0-31.5	11.1	24	13	11	CL		
B-13-14	S-7	20.0-21.5	11.3	24	12	11	CL		
B-13-14	S-8	25.0-26.5	9.6						
B-13-14	S-11	40.0-41.5	19.0						
B-13-15	S-2	2.5-4.0	16.0						
B-13-15	S-5	10.0-11.5	38.3					96.7	
B-13-15	S-9	30.0-31.5	32.7					71.6	
B-13-15	S-13	50-51.5	78.5					93.4	
B-13-15	S-14	55.0-56.5	21.9						
B-13-15	S-17	75.0-76.5	11.3						
B-13-16	S-2	2.5-4.0	10.2						
B-13-16	S-3	5.0-6.5	14.8						
B-13-16	S-11	35-36.5	50.6					96.1	
B-13-16	S-15	55.0-56.5	17.3	29	17	12	CL		
B-13-17	S-3	5.0-6.5	19.4						
B-13-17	S-6	15.0-16.5	9.9						
B-13-17	S-7	20-21.5	10.0						
B-13-17	S-9	30.0-31.5	10.9						

Prepared by: BTH
Reviewed by: SAV
Date: 11/05/13

URS COrporation
1001 Highlands Plaza Drive West, Suite # 300
St. Louis, MO 63110



Boring Number	Depth (feet)	Symbol	LL	PI	Classification
B-13-2	35.0	●			Brown and dark gray, Clayey Gravel
B-13-3	25.0	⧗			Brown, Silty Sand
B-13-3	30.0	▲			Brown, Sand with trace to some silt
B-13-4	40.0	★			Brown, Sand with trace silt

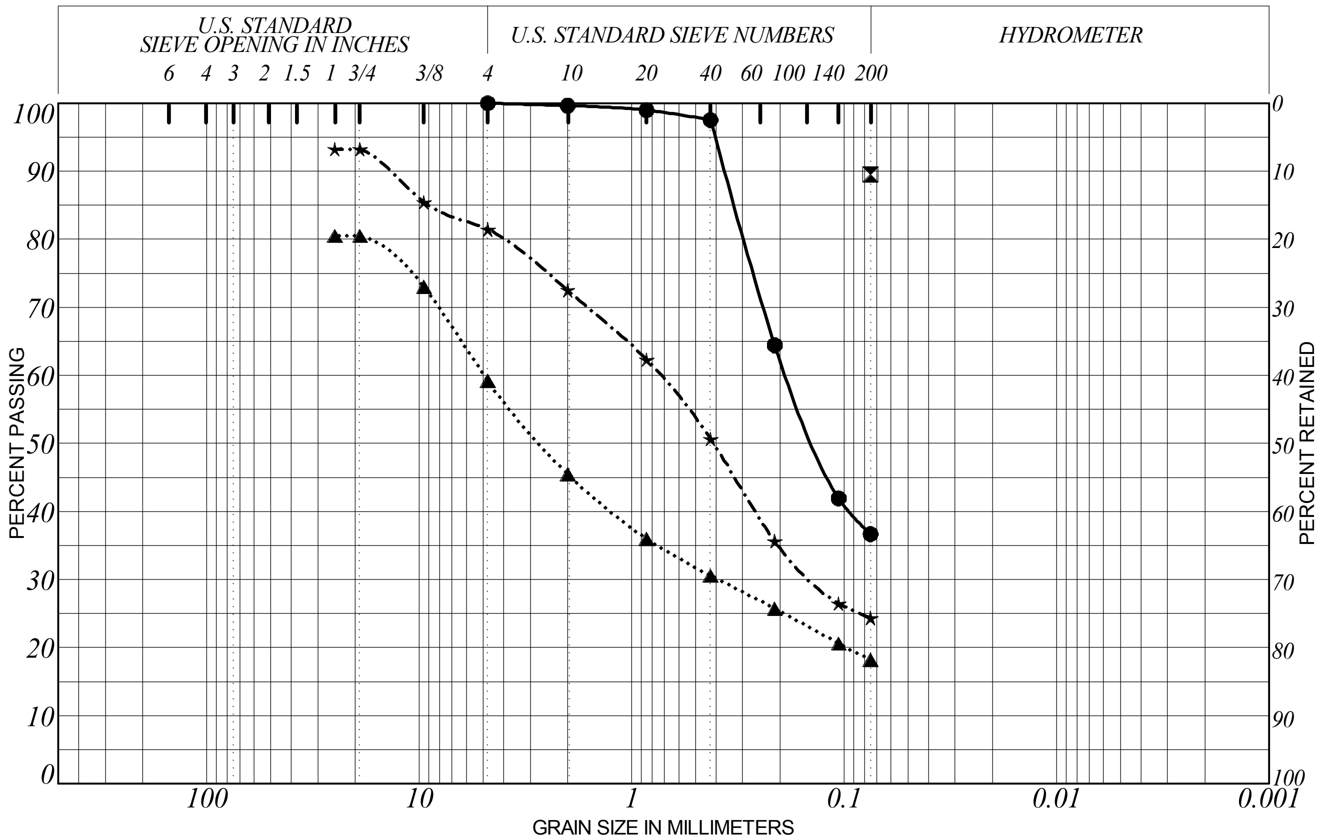
Project: Dynegy-Vermilion
Location: Danville, IL
Project Number: 21562906

GRAIN SIZE DISTRIBUTION CURVES

Figure 1

URS

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	



Boring Number	Depth (feet)	Symbol	LL	PI	Classification
B-13-10	12.5	●			Brown, Silty Sand
B-13-12	40.0	⧗			Brown and dark gray, Sandy Silt
B-13-13	15.0	▲			Ash with trace gravel
B-13-13	70.0	★			Silty Sand with trace gravel

Project: Dynegy-Vermilion
Project Number: *21562906*

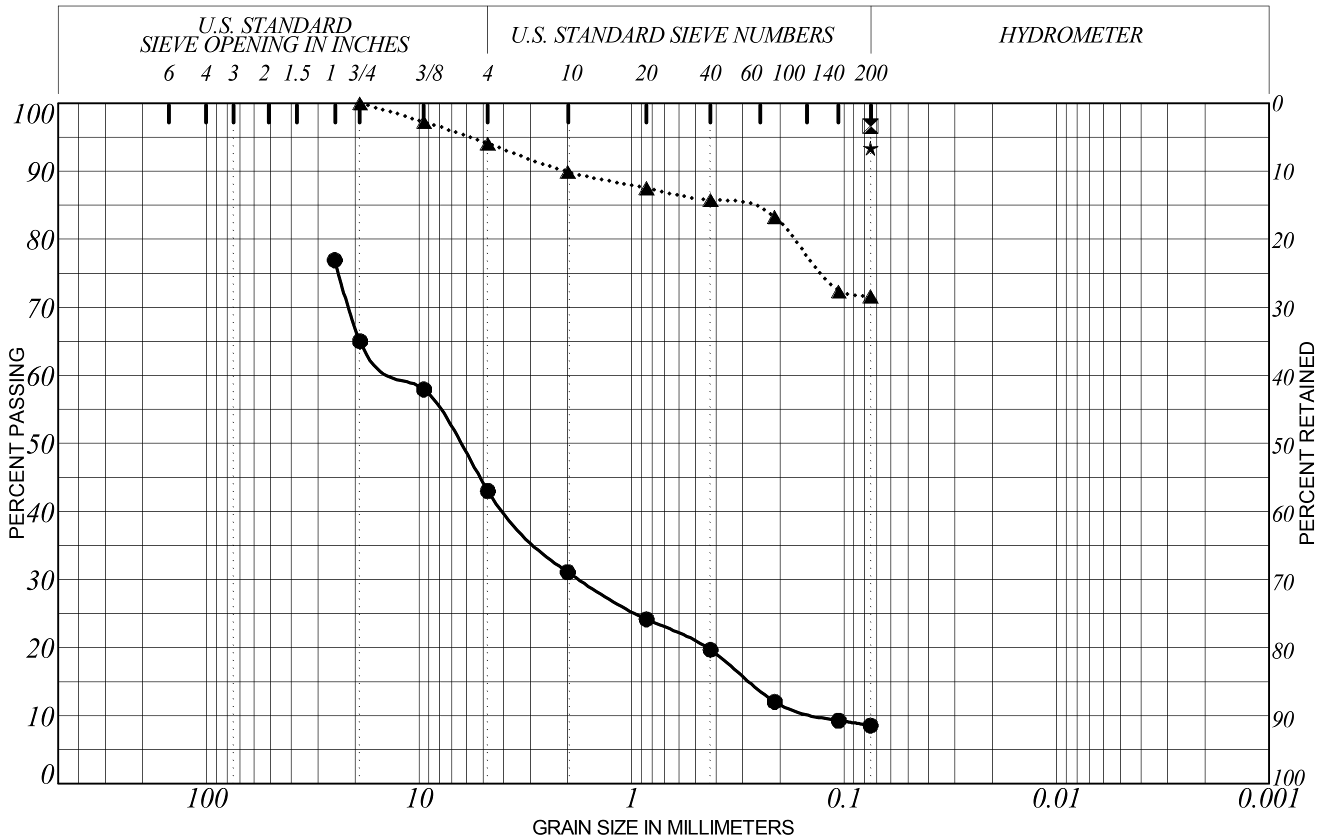
GRAIN SIZE DISTRIBUTION CURVES

Figure 1

11/7/13 SLSIEVE DYNERG-VERMILLION.GPJ

URS

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

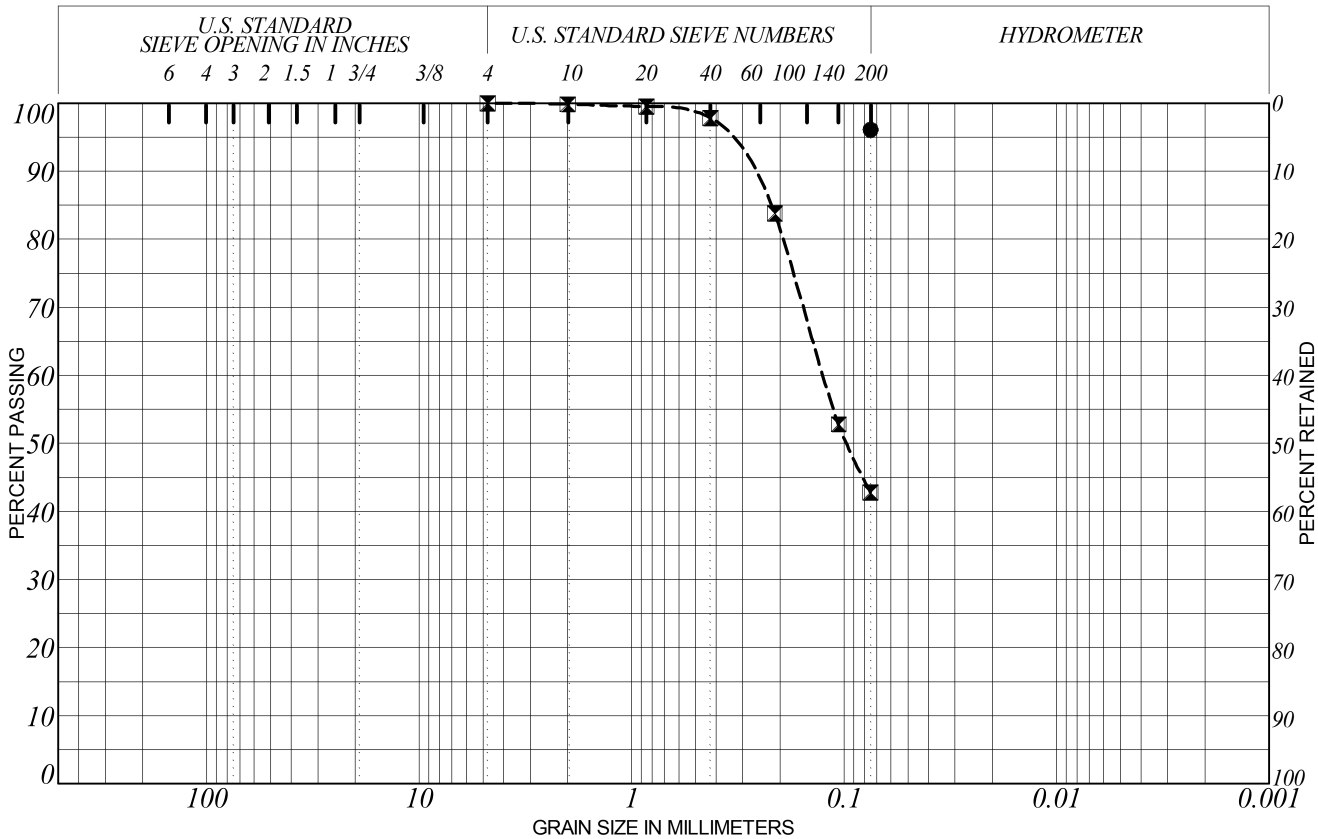


Boring Number	Depth (feet)	Symbol	LL	PI	Classification
B-13-14	15.0	●			Brown, Gravel with sand and trace silt
B-13-15	10.0	⧗			Dark brown gray, Silt with trace to some sand
B-13-15	30.0	▲			Dark gray, Silt with trace to some sand
B-13-15	50.0	★			Dark brown gray, Silt with trace to some sand

Project: Dynegy-Vermilion **Project Number:** 21562906	GRAIN SIZE DISTRIBUTION CURVES	*Figure 2*

URS

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	



Boring Number	Depth (feet)	Symbol	LL	PI	Classification
B-13-16	**35.0**	●			**Dark brown gray, Silt with trace to some sand**
B-13-7	**15.0**	⧗			**Brown, Sity Sand**

Project: Dynegy-Vermilion	GRAIN SIZE	*Figure 3*
Project Number: *21562906*	DISTRIBUTION CURVES	

URS

Laboratory Test Results
Terrasense

URS Corporation #21562906
Dynegy Vermillion 2013
LABORATORY TESTING DATA SUMMARY

BORING	SAMPLE	DEPTH	IDENTIFICATION TESTS									STRENGTH			CONSOLIDATION		REMARKS
															INITIAL CONDITIONS		
NO.	NO.	(ft)	WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDRO. % MINUS 2 µm (%)	TOTAL UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	Type Test @ STRESS (psi)	PEAK SHEAR STRESS (psi)	STRAIN @ PEAK STRESS (%)	VOID RATIO (-)	SATUR-ATION (%)	/ Test ID
B-13-1	SS-6	15-16.5	38.8				CL	97.7	8								
B-13-2	SS-7	20-21.5	17.8				SC	36.1	10								
B-13-2	SH-3	5-7								101.5							
B-13-2	SH-3A	5.4	34.9				FA	87.2	6	96.2	71.3	CID@5	7.5	7.9			TD409
B-13-2	SH-3	5.7	48.6														
B-13-2	SH-3B	5.95	39.7				FA			98.4	70.4				1.038	88	C13192
B-13-2	SH-3	6.25	31.0														
B-13-4	SS-5	10-12	17.1				SC	40.3	9								
B-13-5	SS-6	15-17								132.1							
B-13-5	SS-6A	15.25	17.8				CL			134.2	113.9	CID@5	11.2	15.7			TD410
B-13-5	SS-6B	15.75	17.5	36	16	20	CL			134.3	114.3	CID@10	14.4	15.5			TD411
B-13-5	SS-6C	16.25	16.5				CL			133.9	114.9	CID@15	28.4	14.3			TD412
B-13-6	SS-6	15-17								130.0							
B-13-6	SS-6A	15.4	16.3				CL			133.6	114.9	CIU@5	12.7	20.4			T3521
B-13-6	SS-6	15.7	18.6														
B-13-6	SS-6B	15.95	21.0	36	16	20	CL			132.4	109.5	CIU@10	9.0	20.2			T3522
B-13-6	SS-6	16.25	19.8														
B-13-6	SS-6C	16.5	18.4				CL			132.4	111.9	CIU@15	24.0	20.0			T3523
B-13-7	SS-2	2.5-4.5								125.5							
B-13-7	SS-2A	2.75	16.4				CL			130.8	112.4	CIU@2	8.2	20.2			T3524
B-13-7	SS-2B	3.25	14.1	28	14	14	CL			129.4	113.4	CIU@3	11.3	21.1			T3525
B-13-7	SS-2C	3.75	10.3				SM			130.3	118.1	CIU@4	69.5	14.5			T3526

URS Corporation #21562906
Dynegy Vermillion 2013
LABORATORY TESTING DATA SUMMARY

BORING	SAMPLE	DEPTH	IDENTIFICATION TESTS									STRENGTH			CONSOLIDATION		REMARKS
			WATER	LIQUID	PLASTIC	PLAS.	USCS	SIEVE	HYDRO.	TOTAL	DRY	Type Test	PEAK	STRAIN	INITIAL CONDITIONS		/
NO.	NO.		CONTENT	LIMIT	LIMIT	INDEX	SYMB.	MINUS	% MINUS	UNIT	UNIT	@	SHEAR	@ PEAK	VOID	SATUR-	Test ID
							(1)	NO. 200	2 µm	WEIGHT	WEIGHT	STRESS	STRESS	STRESS	RATIO	ATION	
		(ft)	(%)	(-)	(-)	(-)		(%)	(%)	(pcf)	(pcf)	(psi)	(psi)	(%)	(-)	(%)	
B-13-7	SS-4	7.5-9								117.8							
B-13-7	SS-4	8.0	16.8				FA										
B-13-7	SS-4B	8.25	16.7	27	15	12	CL/FA			125.9	107.9	UU@6	4.7	14.0			UU234b
B-13-8	SS-4	7.5-9.5								108.7							
B-13-8	SS-4	7.85	26.3														
B-13-8	SS-4A	8.1	34.8				FA			107.3	79.6	CID@5	6.8	8.8			TD413
B-13-8	SS-4	8.4	28.5														
B-13-8	SS-4B	8.65	28.0				CL/FA	78.9	6	114.3	89.3	CID@6	10.1	3.1			TD414
B-13-8	SS-9	30-32								103.9							
B-13-8	SS-9A	30.4	47.4				FA			102.1	69.3	UU@20	7.3	7.4			UU234c
B-13-8	SS-9	30.7	47.6														
B-13-8	SS-9B	30.95	44.2				FA	97.5	7	102.5	71.0				1.118	95	C13193
B-13-9	SS-3	5-7								128.5							
B-13-9	SS-3A	5.6	17.5				CL			132.6	112.9	CIU@4	12.5	20.4			T3527
B-13-9	SS-3	5.9	19.5														
B-13-9	SS-3B	6.15	19.6				CL	93.6	24	131.5	110.0	CIU@5	18.5	20.7			T3528
B-13-9	SS-8	25-27								99.0							
B-13-9	SS-8	25.45	40.3														
B-13-9	SS-8B	25.7	43.5				FA	98.9	8	103.5	72.1	UU@20	7.7	10.8			UU234a
B-13-9	SS-14	60-61.5	10.1				SM	12.8	1								

URS Corporation #21562906
Dynegy Vermillion 2013
LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDRO. % MINUS 2 µm (%)	TOTAL UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	STRENGTH Type Test @ STRESS (psi)	PEAK SHEAR STRESS (psi)	STRAIN @ PEAK STRESS (%)	CONSOLIDATION INITIAL CONDITIONS VOID RATIO (-)	SATUR-ATION (%)	REMARKS / Test ID
B-13-11	SS-6	15-16.5	3.8				GM	13.7	2								
B-13-11	SS-10	35-36.5	53.3				MH	81.8	6								
B-13-11	SS-13	50-51.5	33.6				CL	90.4	5								
B-13-12	SS-5	10-11.5	6.7				GM	17.9	2								
B-13-13	SS-8	25-26.5	41.4				ML	79.3	5								
B-13-15	SS-3	5-7								124.4							
B-13-15	SS-3	5.9	14.9	33	16	17	SM/CL			133.2	115.9	CID@4	8.3	11.0			TD416
B-13-15	SS-6	15-17								88.6							
B-13-15	SS-6A	15.3	34.7				FA			105.0	77.9	CID@5	7.4	5.9			TD415
B-13-15	SS-6	15.65	27.4														
B-13-15	SS-6B	15.9	31.3				FA	94.0	3	105.9	80.6	CID@10	14.2	4.4			TD417
B-13-16	SS-16	60-61.5	29.1				SM	17.4	1								
B-13-17	SS-2	2.5-4.5								95.3							
B-13-17	SS-2A	2.85	27.1				SC/FA			107.8	84.8	CID@2	3.1	12.9			TD418
B-13-17	SS-2B	3.35	37.2	44	35	9	FA			93.3	68.0	CID@3	4.6	4.0			TD419
B-13-17	SS-2	3.65	36.8														
B-13-17	SS-2	3.9	36.6				FA			97.6	71.5	CID@4	8.8	2.1			TD420
B-13-17	SS-5	10-11.5	17.7				SM	17.2	3								

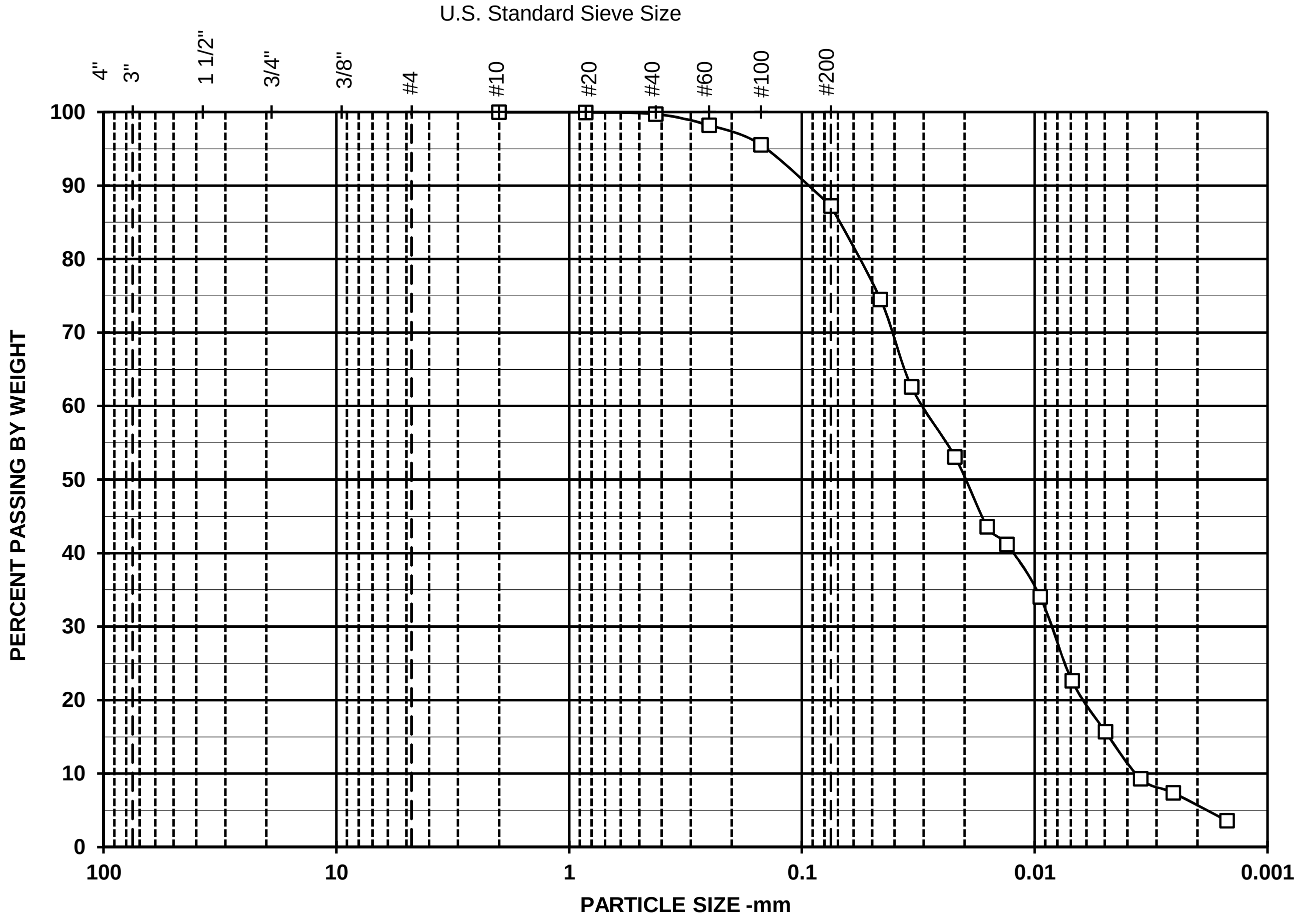
Note: (1) USCS symbol based on visual observation and Sieve and Atterberg limits reported. "FA" reported for Fly-Ash samples

Prepared by: JR
Reviewed by: GET
Date: 9/20/2013

TerraSense, LLC
45H Commerce Way
Totowa, NJ 07512

Project No.: T21562906
File: IndxAll.xls

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	B-13-2		
Sample	SH-3A		
Depth	5.4		
% +3"	0.0		
% Gravel	0.0		
% SAND	12.8		
%C SAND	0.0		
%M SAND	0.2		
%F SAND	12.5		
% FINES	87.2		
% -2μ	6		
D_{100} (mm)	4.75		
D_{60} (mm)	0.03		
D_{30} (mm)	0.01		
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4			
10	100.0		
20	99.9		
40	99.7		
60	98.2		
100	95.5		
200	87.2		

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□					FA	Gray, Fly-Ash	8/26/2013
■							
○							

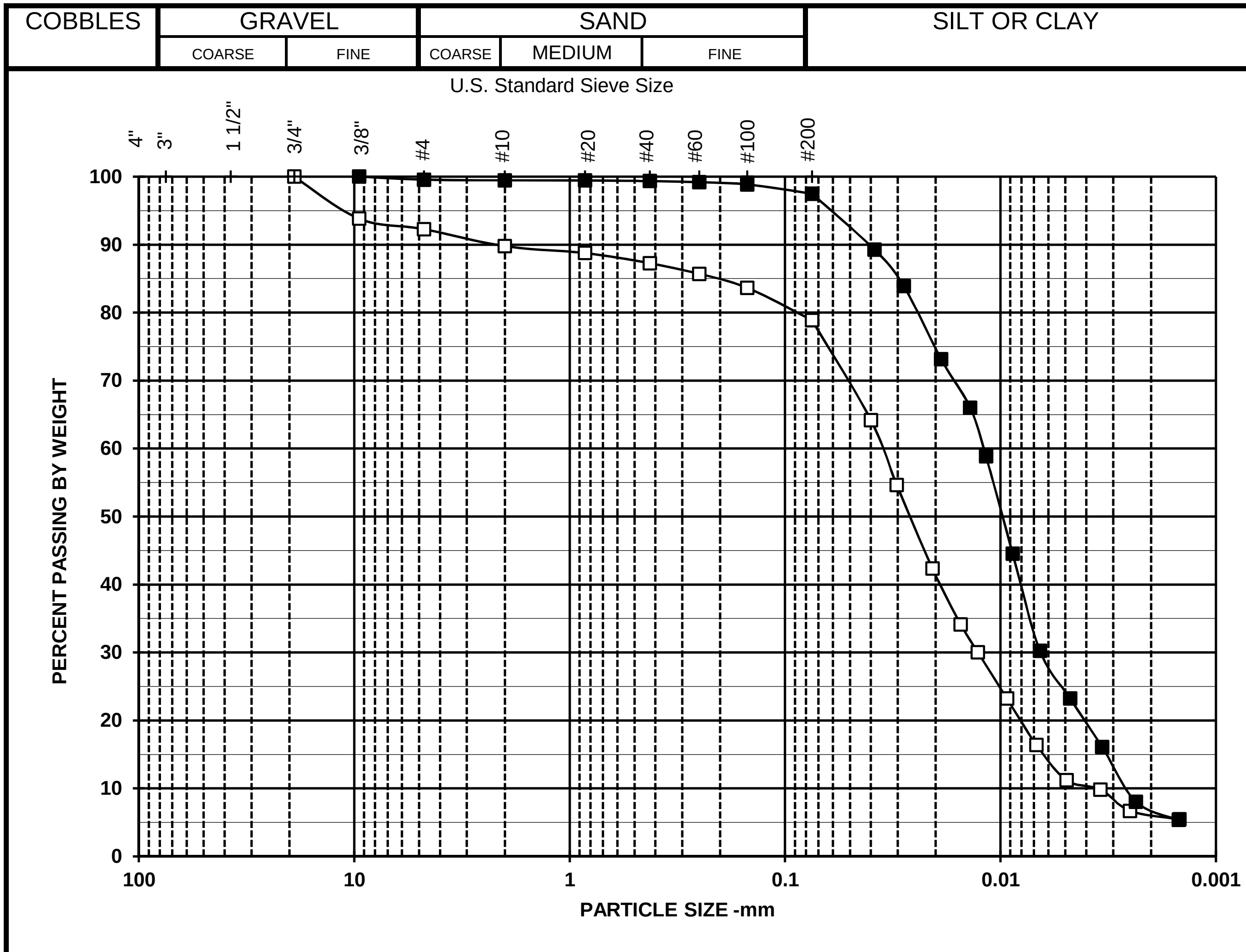
TerraSense, LLC	URS Corporation
T21562906	21562906

PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev13-02.xls 9/20/2013



Symbol	□	■	○
Boring	B-13-8	B-13-8	
Sample	SS-4	SS-9B	
Depth	8.65	30.95	
% +3"	0.0	0.0	
% Gravel	7.7	0.4	
% SAND	13.4	2.1	
%C SAND	2.5	0.1	
%M SAND	2.5	0.1	
%F SAND	8.4	1.9	
% FINES	78.9	97.5	
% -2μ	6	7	
D_{100} (mm)	19.00	9.50	
D_{60} (mm)	0.04	0.01	
D_{30} (mm)	0.01	0.01	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"	100.0		
3/8"	93.8	100.0	
4	92.3	99.6	
10	89.8	99.5	
20	88.8	99.4	
40	87.3	99.4	
60	85.7	99.2	
100	83.6	98.9	
200	78.9	97.5	

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□					FA	Gray, Fly-Ash with clay	9/4/2013
■					FA	Gray, Fly-Ash	8/22/2013
○							

TerraSense, LLC	URS
T21562906	21562906

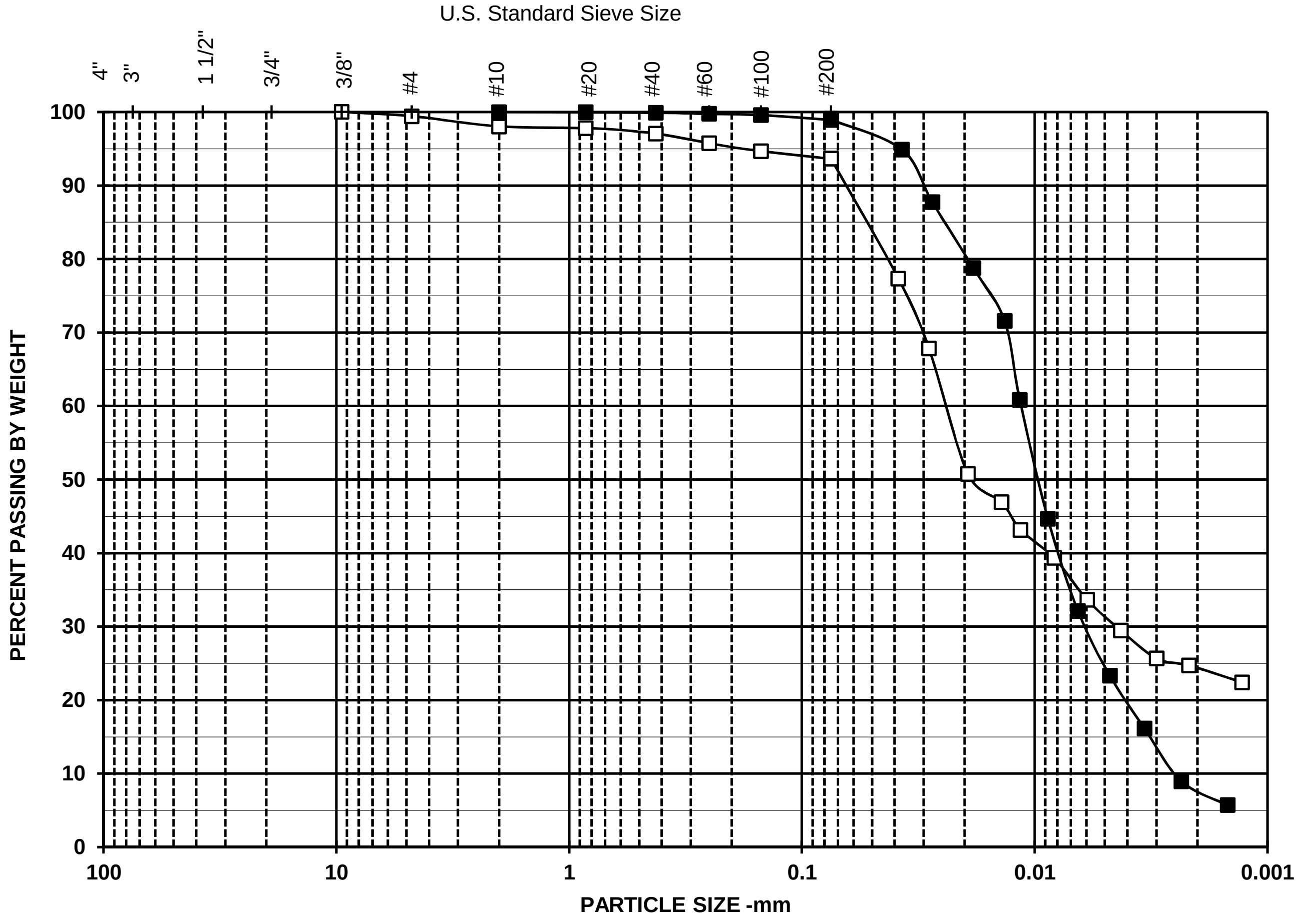
PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev13-08.xls 9/20/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□					CL	Brown, Lean clay	8/26/2013
■					FA	Gray, Fly-Ash	8/22/2013
○							

Symbol	□	■	○
Boring	B-13-9	B-13-9	
Sample	SH-3B	SS-8B	
Depth	6.15	25.7	
% +3"	0.0	0.0	
% Gravel	0.6	0.0	
% SAND	5.8	1.1	
%C SAND	1.4	0.0	
%M SAND	1.0	0.1	
%F SAND	3.4	1.0	
% FINES	93.6	98.9	
% -2μ	24	8	
D_{100} (mm)	9.50	4.75	
D_{60} (mm)	0.02	0.01	
D_{30} (mm)	0.00	0.01	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0		
4	99.4		
10	98.0	100.0	
20	97.8	100.0	
40	97.1	99.9	
60	95.7	99.8	
100	94.7	99.6	
200	93.6	98.9	

TerraSense, LLC	**URS**
T21562906	21562906

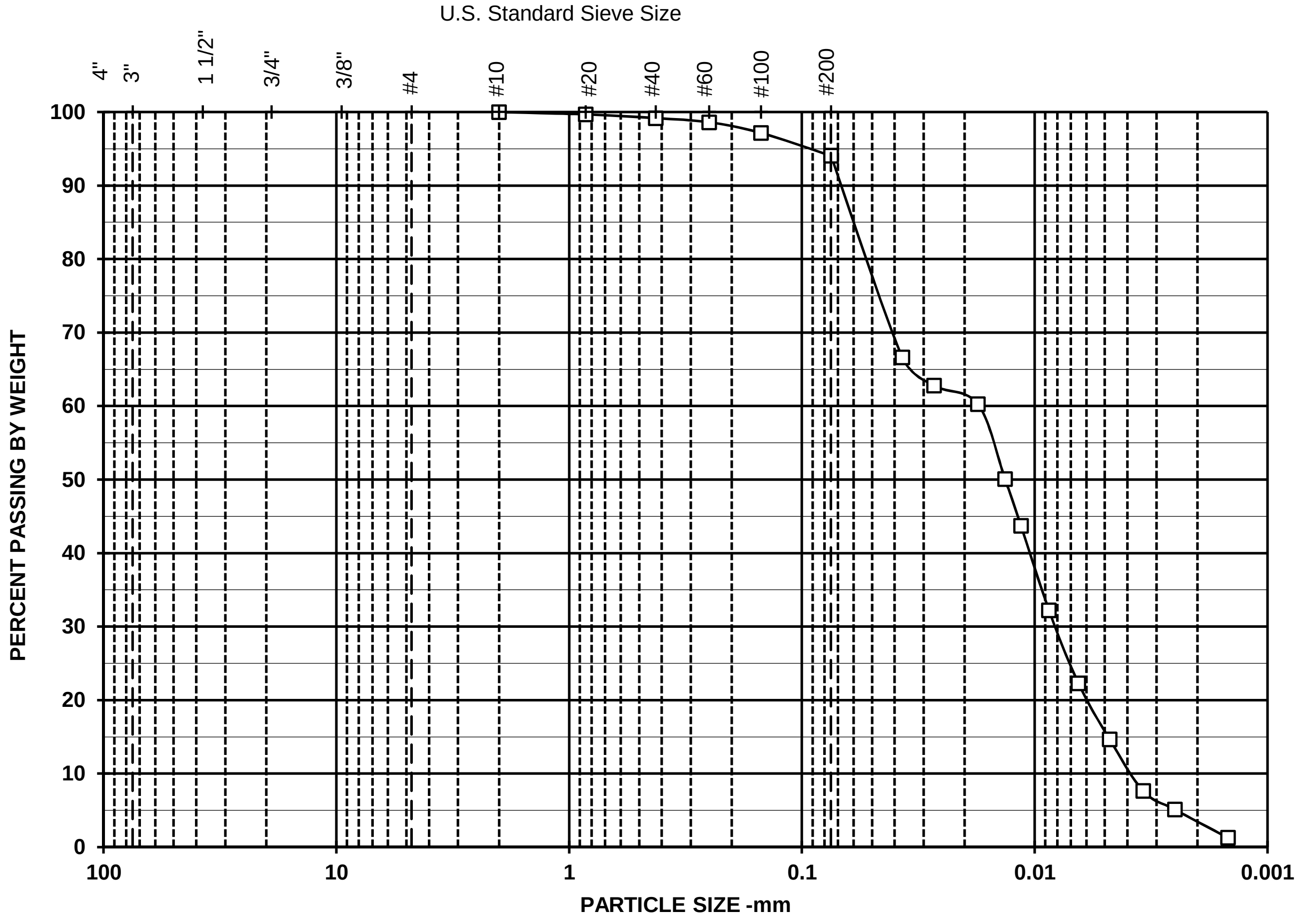
PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev13-09.xls 9/20/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	B-13-15		
Sample	SS-6B		
Depth	15.9		
% +3"	0.0		
% Gravel	0.0		
% SAND	6.0		
%C SAND	0.0		
%M SAND	0.8		
%F SAND	5.1		
% FINES	94.0		
% -2μ	3		
D_{100} (mm)	4.75		
D_{60} (mm)	0.02		
D_{30} (mm)	0.01		
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4			
10	100.0		
20	99.7		
40	99.2		
60	98.6		
100	97.2		
200	94.0		

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□					FA	Gray, Fly-Ash	9/4/2013
■							
○							

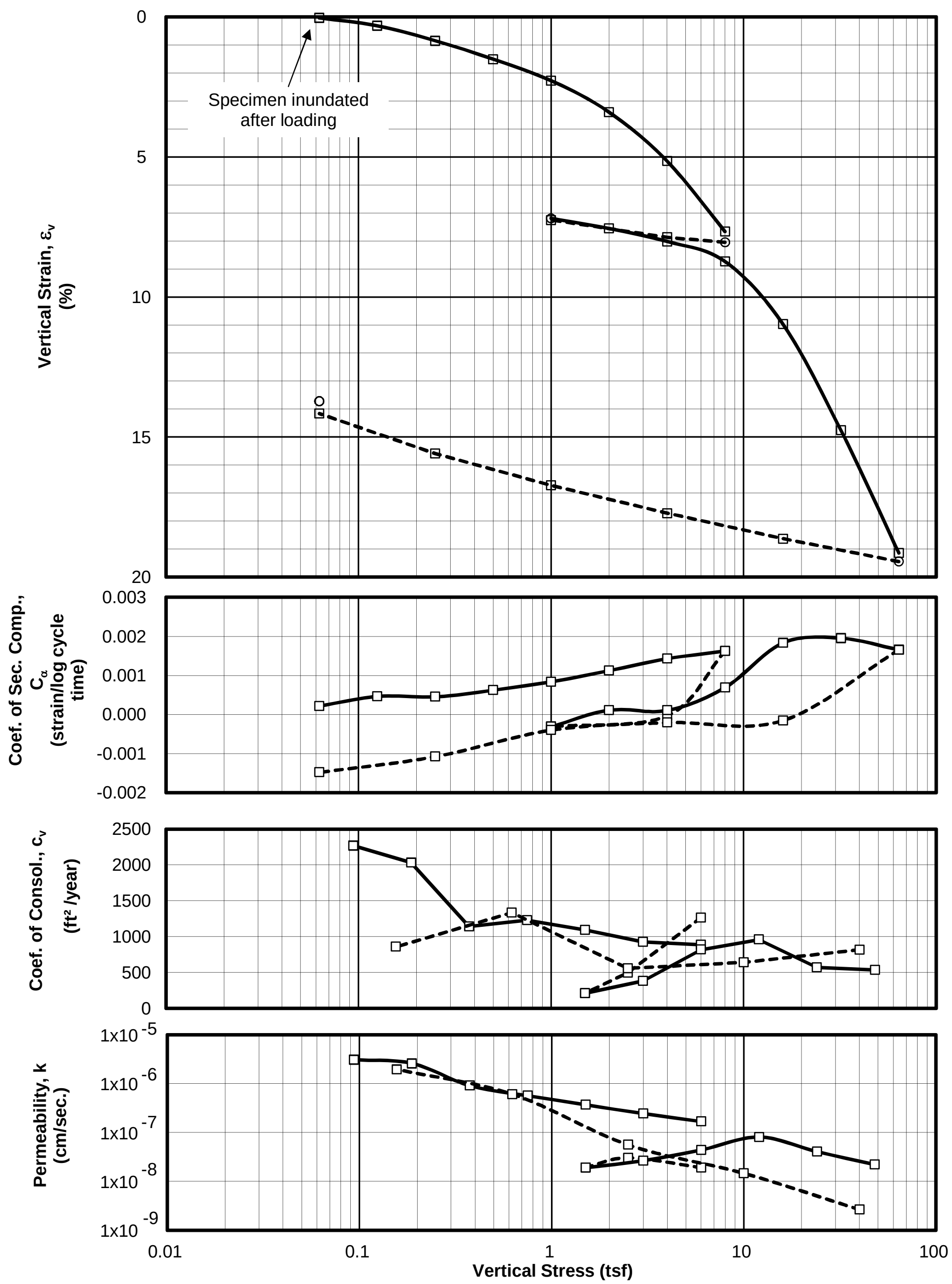
TerraSense, LLC	URS Corporation
T21562906	21562906

PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev13-15.xls 9/20/2013



SAMPLE INFORMATION

Boring:	B-13-2
Sample:	SH-3B
Depth:	5.95 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	FA, gray silt with sand (flyash)

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.61	inch
Diameter:	2.50	inch

Initial water content:	39.7	%
Initial total unit weight:	98.4	pcf
Initial dry unit weight:	70.4	pcf
Initial void ratio:	1.038	
Initial degree of saturation:	88	%
Final water content:	37.8	%
Final total unit weight:	105.7	pcf
Final dry unit weight:	76.7	pcf
Final void ratio:	0.873	
Final degree of saturation:	100	% (assumed specific gravity = 2.30)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	5.5 (Range: 5.2 to 7.9)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.136
Compression Index (void ratio per log cycle stress):	0.277
Swell Ratio (strain per log cycle stress):	0.010
Swell Index (void ratio per log cycle stress):	0.020
Recompression Ratio (strain per log cycle stress):	0.016
Recompression Index (void ratio per log cycle stress):	0.033
Remarks:	

LEGEND: □ End of primary o End of Stage ———— Loading - - - - - - Unloading

Test Date: 8/21/13 Tested By: CMJ Checked By: GET

URS Project No. 21562906	Dynegy Vermillion 2013	ONE DIMENSIONAL CONSOLIDATION TEST Boring: B-13-2 Depth: 5.95 feet
TerraSense, LLC	Project No. 21562906	September 2013

PROJECT:	Dynegy Vermillion 2013			
PROJECT NO.:	21562906	Initial height: 0.606 inch		Final height: 0.557 inch
BORING:	B-13-2	Initial water content: 39.7 %		Final water content: 37.8 %
SAMPLE:	SH-3B	Initial dry density: 70.4 pcf		Final dry density: 76.7 pcf
TEST:	C13192	Initial total density: 98.4 pcf		Final total density: 105.7 pcf
DEPTH, feet:	5.95	Initial saturation: 88 %		Final saturation: 100 %
BY:	CMJ	Initial void ratio: 1.038		Final void ratio: 0.873
TEST DATE:	8/21/2013			Final strain: 8.1 %

EQUIPMENT:

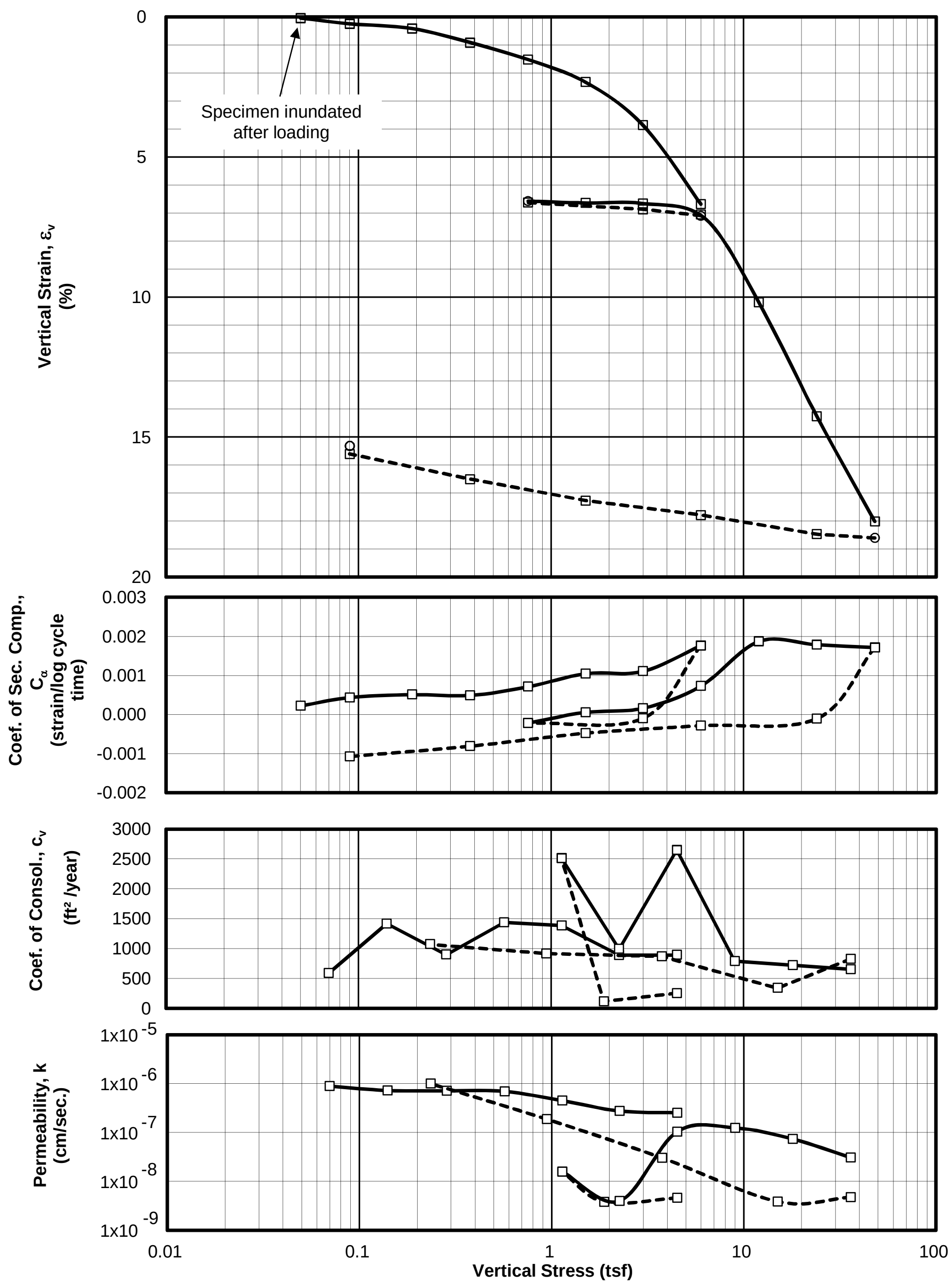
Load Frame No.: 2

Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: FA, gray silt with sand (flyash)

G	LL	PL	PI
2.3			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft²/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0002	0.039	1.038	0.056	1.037	71.12	0.0002	161.65	1.33E-08
2	0.125	0.0019	0.322	1.032	0.566	1.027	2268.70	0.0005	22.09	3.10E-06
3	0.250	0.0052	0.853	1.021	0.984	1.018	2031.30	0.0005	23.53	2.60E-06
4	0.500	0.0092	1.515	1.008	1.669	1.004	1140.89	0.0006	37.78	9.11E-07
5	1.00	0.0138	2.279	0.992	2.495	0.988	1228.54	0.0008	65.37	5.67E-07
6	2.00	0.0206	3.402	0.969	3.673	0.964	1092.02	0.0011	89.07	3.70E-07
7	4.00	0.0312	5.148	0.933	5.487	0.927	924.99	0.0014	114.53	2.44E-07
8	8.00	0.0465	7.665	0.882	8.048	0.874	884.12	0.0016	158.94	1.68E-07
9	4.00	0.0477	7.866	0.878	7.869	0.878	1264.84	0.0000	1992.83	1.91E-08
10	1.00	0.0440	7.257	0.890	7.194	0.892	495.27	-0.0003	492.97	3.03E-08
11	2.00	0.0458	7.558	0.884	7.567	0.884	209.88	0.0001	332.58	1.90E-08
12	4.00	0.0486	8.019	0.875	8.039	0.875	379.97	0.0001	433.21	2.65E-08
13	8.00	0.0529	8.732	0.860	8.892	0.857	817.36	0.0007	561.08	4.39E-08
14	16.0	0.0665	10.964	0.815	11.410	0.806	957.65	0.0018	358.52	8.06E-08
15	32.0	0.0894	14.755	0.738	15.167	0.729	569.16	0.0020	422.07	4.07E-08
16	64.0	0.1160	19.140	0.648	19.441	0.642	534.89	0.0017	729.68	2.21E-08
17	16.0	0.1129	18.626	0.659	18.515	0.661	815.98	-0.0002	9330.56	2.64E-09
18	4.00	0.1074	17.719	0.677	17.680	0.678	641.06	-0.0002	1324.11	1.46E-08
19	1.00	0.1014	16.721	0.698	16.635	0.699	557.32	-0.0004	300.53	5.59E-08
20	0.250	0.0945	15.590	0.721	15.262	0.727	1332.08	-0.0011	66.27	6.06E-07
21	0.063	0.0859	14.164	0.750	13.724	0.759	856.56	-0.0015	13.15	1.96E-06



SAMPLE INFORMATION

Boring:	B-13-8
Sample:	SS-9B
Depth:	30.95 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	FA, light gray silt (flyash); crystalized formation noted

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.61	inch
Diameter:	2.50	inch

Initial water content:	44.2	%
Initial total unit weight:	102.5	pcf
Initial dry unit weight:	71.0	pcf
Initial void ratio:	1.118	
Initial degree of saturation:	95	%
Final water content:	34.5	%
Final total unit weight:	110.6	pcf
Final dry unit weight:	82.2	pcf
Final void ratio:	0.831	
Final degree of saturation:	100	% (assumed specific gravity = 2.41)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	3.9 (Range: 3.4 to 4.1)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.130
Compression Index (void ratio per log cycle stress):	0.275
Swell Ratio (strain per log cycle stress):	0.004
Swell Index (void ratio per log cycle stress):	0.008
Recompression Ratio (strain per log cycle stress):	0.004
Recompression Index (void ratio per log cycle stress):	0.008
Remarks:	

LEGEND: □ End of primary o End of Stage ———— Loading - - - - - - Unloading

Test Date: 8/22/13 Tested By: CMJ Checked By: GET

URS Project No. 21562906	Dynegy Vermillion 2013	ONE DIMENSIONAL CONSOLIDATION TEST Boring: B-13-8 Depth: 30.95 feet
TerraSense, LLC	Project No. T21562906	September 2013

PROJECT:	Dynegy Vermillion 2013				
PROJECT NO.:	T21562906	Initial height:	0.613 inch	Final height:	0.530 inch
BORING:	B-13-8	Initial water content:	44.2 %	Final water content:	34.5 %
SAMPLE:	SS-9B	Initial dry density:	71.0 pcf	Final dry density:	82.2 pcf
TEST:	C13193	Initial total density:	102.5 pcf	Final total density:	110.6 pcf
DEPTH, feet:	30.95	Initial saturation:	95 %	Final saturation:	100 %
BY:	CMJ	Initial void ratio:	1.118	Final void ratio:	0.831
TEST DATE:	8/22/2013			Final strain:	13.6 %

EQUIPMENT:

Load Frame No.: 1

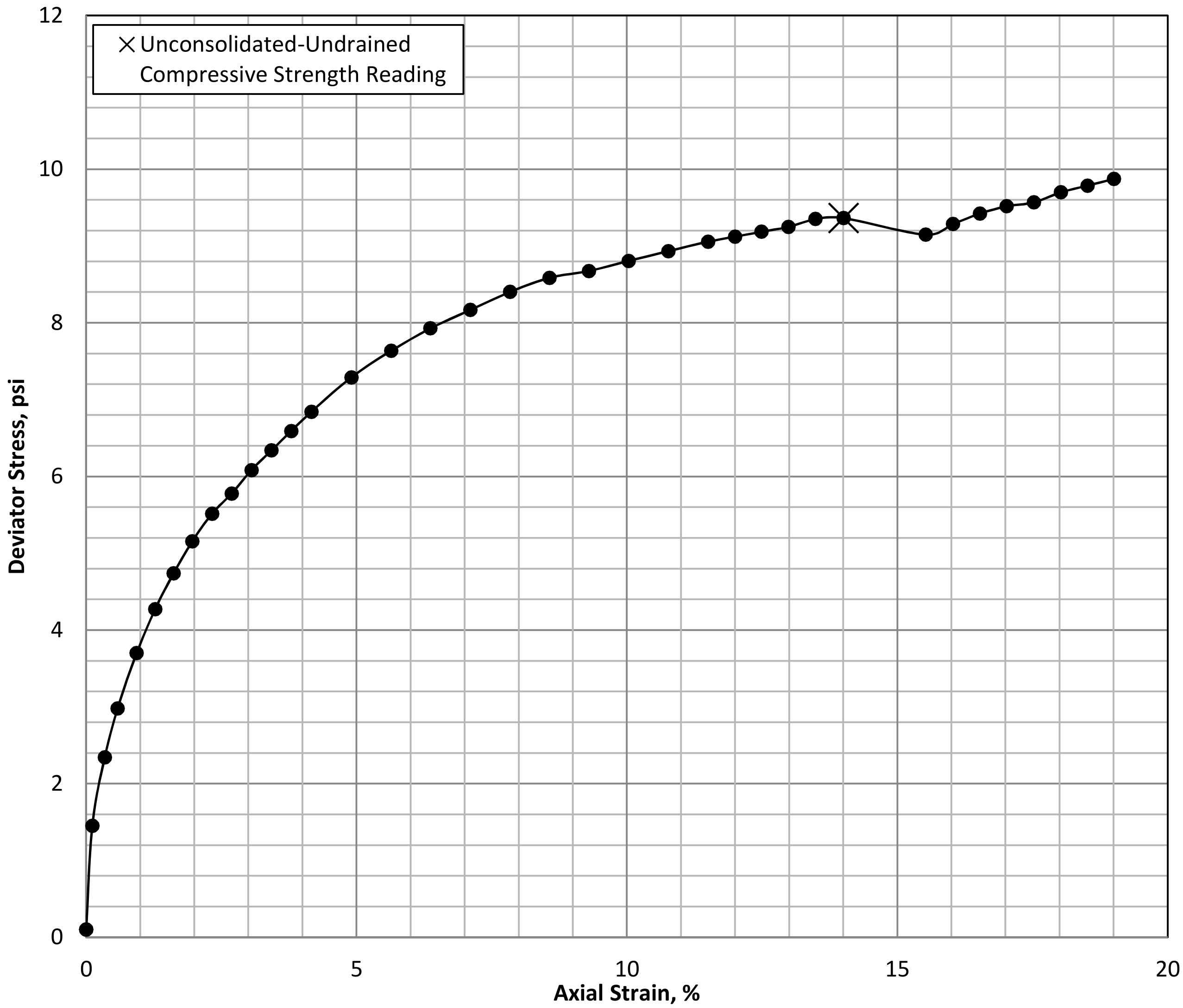
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: FA, light gray silt (flyash); crystalized formation noted

G	LL	PL	PI
2.41			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft²/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.050	0.0003	0.046	1.117	0.308	1.111	767.56	0.0002	109.73	2.11E-07
2	0.090	0.0015	0.247	1.113	0.342	1.111	588.72	0.0004	19.81	8.97E-07
3	0.190	0.0026	0.417	1.109	0.605	1.105	1414.53	0.0005	59.04	7.23E-07
4	0.380	0.0056	0.920	1.098	1.034	1.096	896.39	0.0005	37.78	7.16E-07
5	0.760	0.0094	1.529	1.085	1.708	1.082	1437.38	0.0007	62.38	6.95E-07
6	1.51	0.0143	2.334	1.068	2.599	1.063	1385.83	0.0010	93.22	4.49E-07
7	3.00	0.0237	3.866	1.036	4.115	1.031	889.31	0.0011	97.26	2.76E-07
8	6.00	0.0410	6.691	0.976	7.098	0.968	891.48	0.0018	106.17	2.53E-07
9	3.00	0.0422	6.874	0.972	6.859	0.973	249.61	-0.0001	1639.59	4.59E-09
10	0.760	0.0407	6.631	0.977	6.576	0.979	114.50	-0.0002	919.47	3.76E-09
11	1.51	0.0408	6.646	0.977	6.659	0.977	2513.85	0.0001	4812.91	1.58E-08
12	3.00	0.0409	6.666	0.977	6.706	0.976	991.67	0.0002	7581.65	3.95E-09
13	6.00	0.0433	7.054	0.968	7.284	0.964	2649.83	0.0007	772.21	1.04E-07
14	12.0	0.0625	10.194	0.902	10.626	0.893	788.30	0.0019	191.09	1.24E-07
15	24.0	0.0875	14.257	0.816	14.676	0.807	719.80	0.0018	295.36	7.35E-08
16	48.0	0.1105	18.010	0.736	18.600	0.724	650.19	0.0017	639.46	3.07E-08
17	24.0	0.1133	18.467	0.727	18.443	0.727	824.20	-0.0001	5250.70	4.74E-09
18	6.00	0.1091	17.787	0.741	17.732	0.742	337.70	-0.0003	2644.09	3.85E-09
19	1.51	0.1059	17.270	0.752	17.155	0.755	869.51	-0.0005	869.12	3.02E-08
20	0.380	0.1012	16.503	0.768	16.308	0.772	914.78	-0.0008	147.40	1.87E-07
21	0.090	0.0957	15.607	0.787	15.321	0.793	1070.47	-0.0011	32.36	9.98E-07

UNCONSOLIDATED-UNDRAINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2850



Specimen and Material Property Information

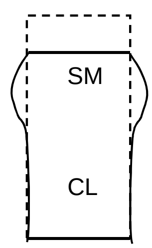
Sample Type: Intact tube sample

Description and/or Classification: CL, gray CLAY with gray silty sand Fly-Ash at top

Cell Pressure (psi)	Water Content (%) (1)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf) (1)	Void Ratio (-)	Saturation (%) (2)	Length (inch)	Diameter (inch)	L/D (-)	LL/PL (-)	PI (-)	Specific Gravity (-) (2)
0 (Initial)	16.7	125.9	107.9	0.45	93.5	6.059	2.866	2.1	27	12	2.50
6.0	16.7	127.1	108.9	0.43	96.5	6.039	2.857	2.1	15		

Failure Summary

U-U Compressive Strength (psi)	U-U Shear Strength, s_u (psi)	Strain to to Peak (%)	Strain Rate (%/min)
9.36	4.68	14.0	0.72



FAILURE SKETCH

Remarks and Notes:

(1) Water Content determined after shear from partial specimen.

(2) Assumed specific gravity

Tested by: DT

Reviewed by: GET

Test Date: 8/22/2013

URS Corporation
Project # 21562906

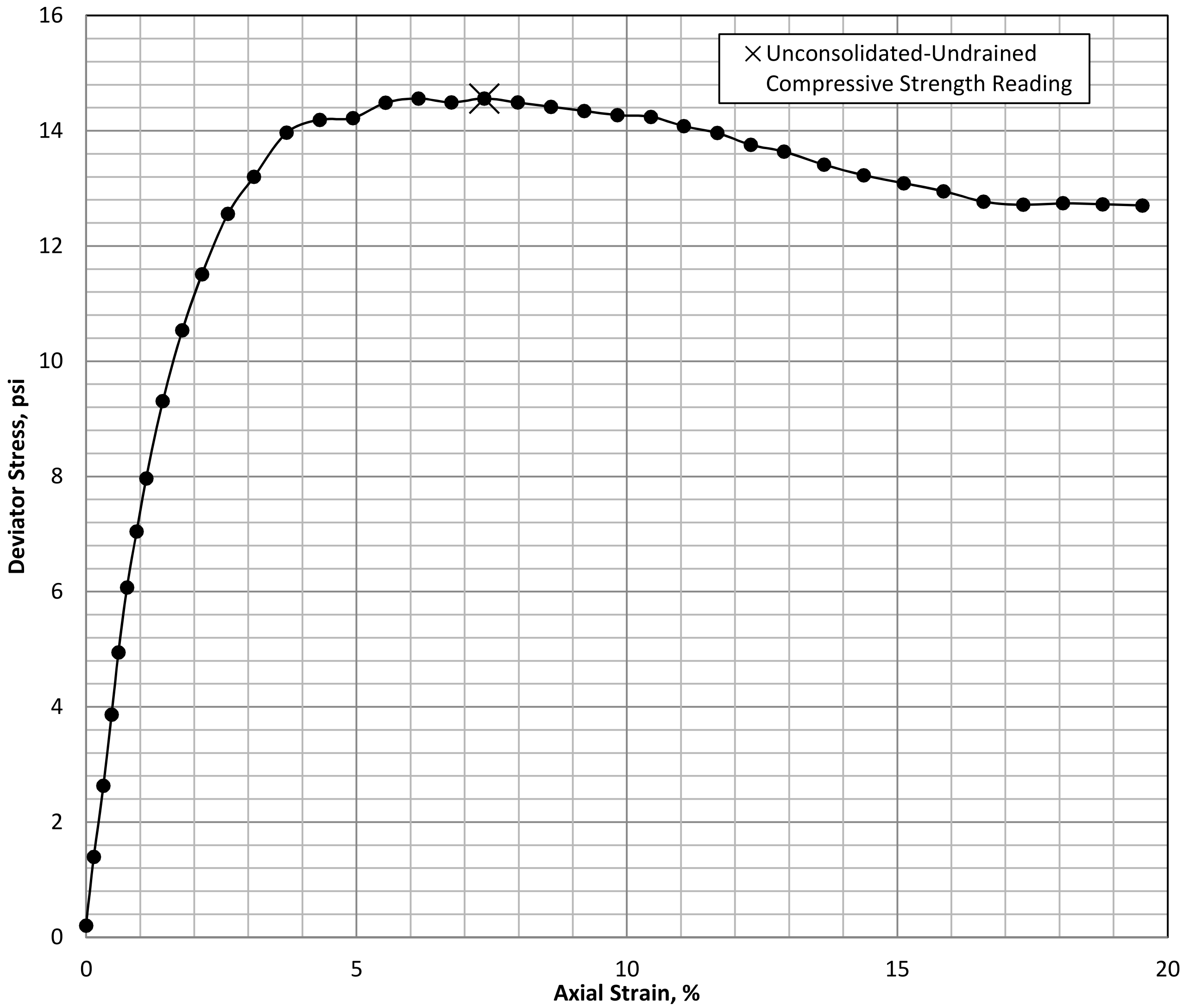
TerraSense, LLC
Project # T21562906

Dynegy Vermillion 2013

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

Boring: B-13-7 Sample: SS-4
Section: B Depth: 8.25 ft.

UNCONSOLIDATED-UNDRAINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2850



Specimen and Material Property Information

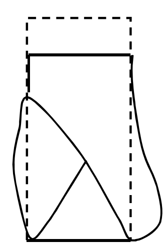
Sample Type: Intact tube sample

Description and/or Classification: FA, gray layered silty and sandy Fly-Ash

Cell Pressure (psi)	Water [1] Content (%)	Wet Unit Weight (pcf)	Dry Unit [1] Weight (pcf)	Void Ratio (-)	Saturation[2] (%)	Length (inch)	Diameter (inch)	L/D (-)	LL/PL (-)	PI (-)	Specific [2] Gravity (-)
0 (Initial)	47.4	102.1	69.3	1.16	97.9	6.013	2.872	2.1			2.40
20.0	47.4	102.7	69.7	1.15	99.0	6.001	2.866	2.1			

Failure Summary

U-U Compressive Strength (psi)	U-U Shear Strength, s_u (psi)	Strain to to Peak (%)	Strain Rate (%/min)
14.6	7.3	7.4	0.73



FAILURE SKETCH

Remarks and Notes:

(1) Water Content determined after shear from partial specimen.

(2) Assumed specific gravity

Tested by: DT

Test Date: 8/22/2013

Reviewed by: GET

URS Corporation
Project # 21562906

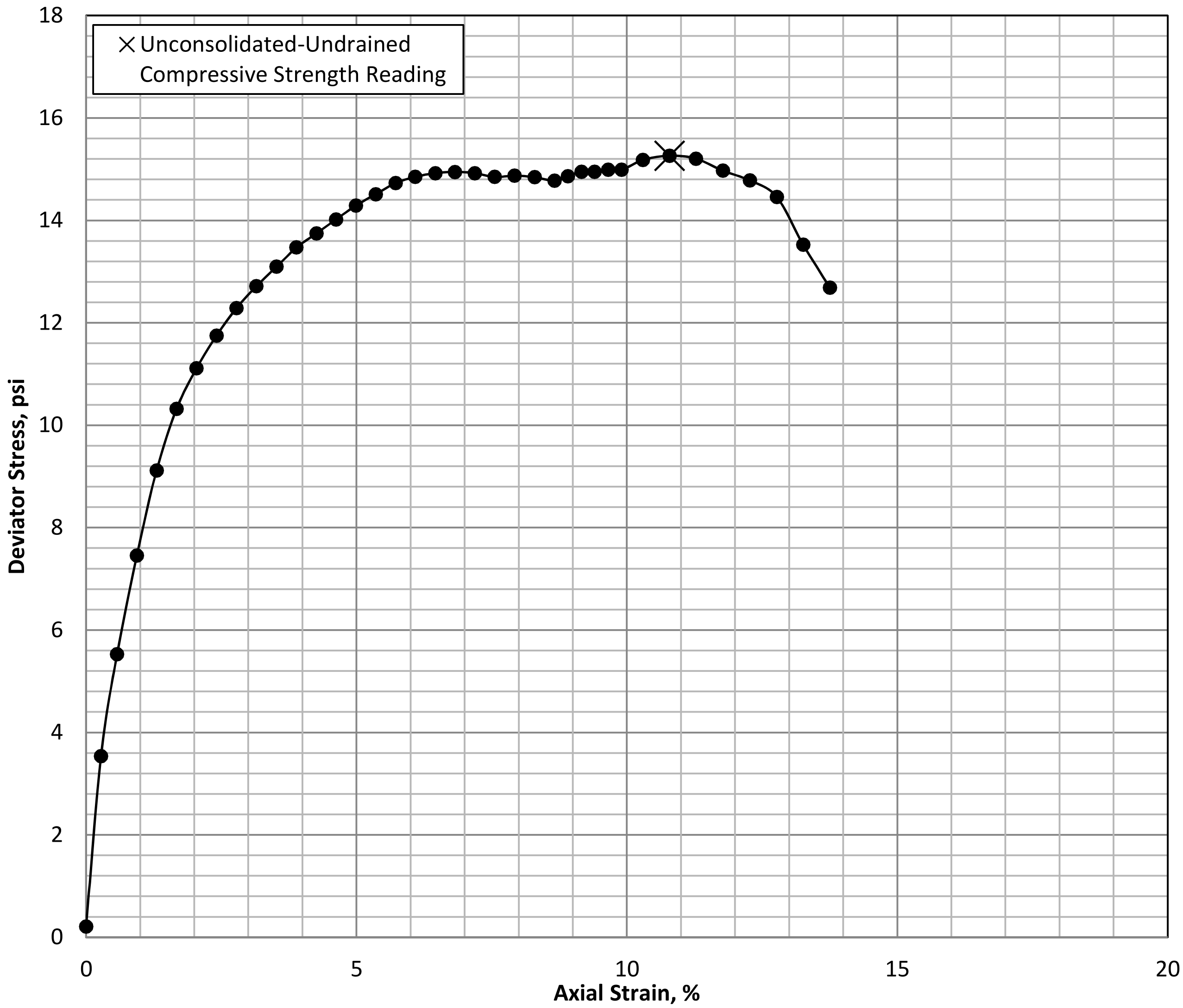
TerraSense, LLC
Project # T21562906

Dynegy Vermillion 2013

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

Boring: B-13-8 Sample: SS-9
Section: A Depth: 30.4 ft.

UNCONSOLIDATED-UNDRAINED COMPRESSIVE STRENGTH TEST, ASTM METHOD D2850



Specimen and Material Property Information

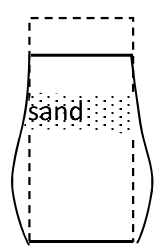
Sample Type: Intact tube sample

Description and/or Classification: FA, light gray silty Fly-Ash with sandy layers

Cell Pressure (psi)	Water Content [1] (%)	Wet Unit Weight (pcf)	Dry Unit Weight [1] (pcf)	Void Ratio (-)	Saturation [2] (%)	Length (inch)	Diameter (inch)	L/D (-)	LL/PL (-)	PI (-)	Specific Gravity [2] (-)
0 (Initial)	43.5	103.5	72.1	1.08	97.0	6.001	2.859	2.1			2.40
20.0	43.5	105.1	73.2	1.05	100.0	5.969	2.843	2.1			

Failure Summary

U-U Compressive Strength (psi)	U-U Shear Strength, s_u (psi)	Strain to to Peak (%)	Strain Rate (%/min)
15.3	7.65	10.8	0.73



FAILURE SKETCH

Remarks and Notes:

(1) Water Content determined after shear from partial specimen.

(2) Assumed specific gravity

Tested by: DT

Reviewed by: GET

Test Date: 8/22/2013

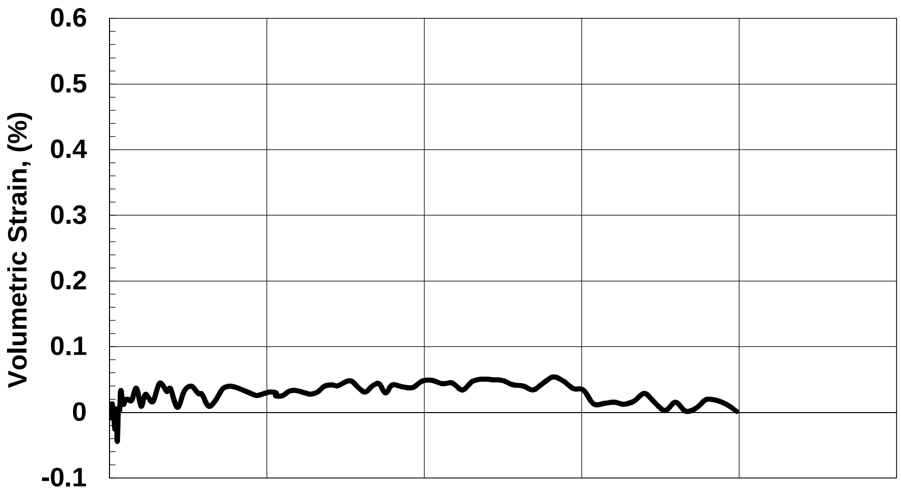
URS Corporation
Project # 21562906

TerraSense, LLC
Project # T21562906

Dynegy Vermillion 2013

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

Boring: B-13-9 Sample: SS-8
Section: B Depth: 25.7 ft.

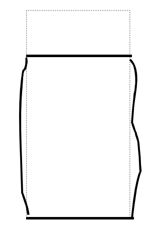


SAMPLE INFORMATION
Boring: B-13-2 Sample: SH-3A Depth: 5.4 ft
Type: Intact tube sample
Description: FA, light gray silt with sand (flyash), roots present

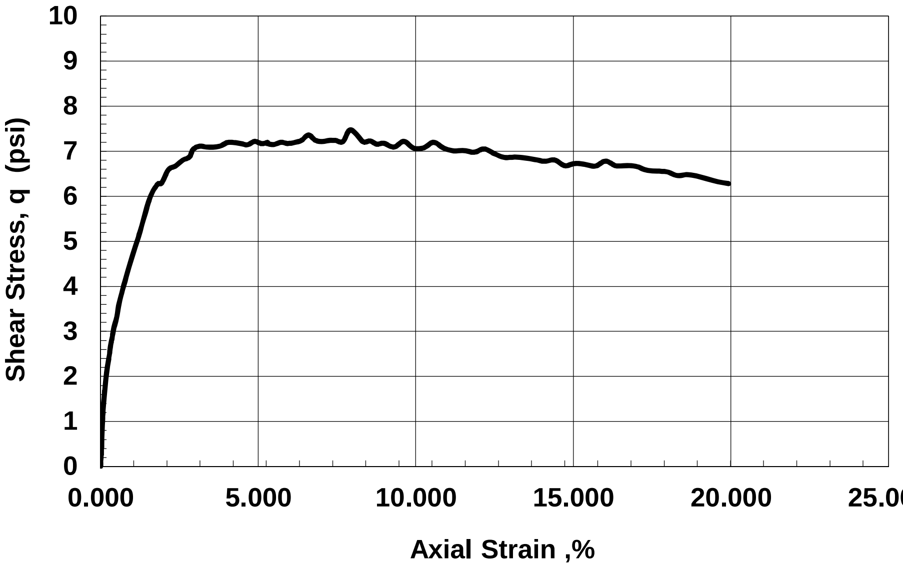
SPECIMEN INFORMATION (Initial)
Height: 6.03 inch Diameter: 2.87 inch Area: 6.49 in²
Water Content: 34.9 % Total Unit Weight: 96.2 pcf

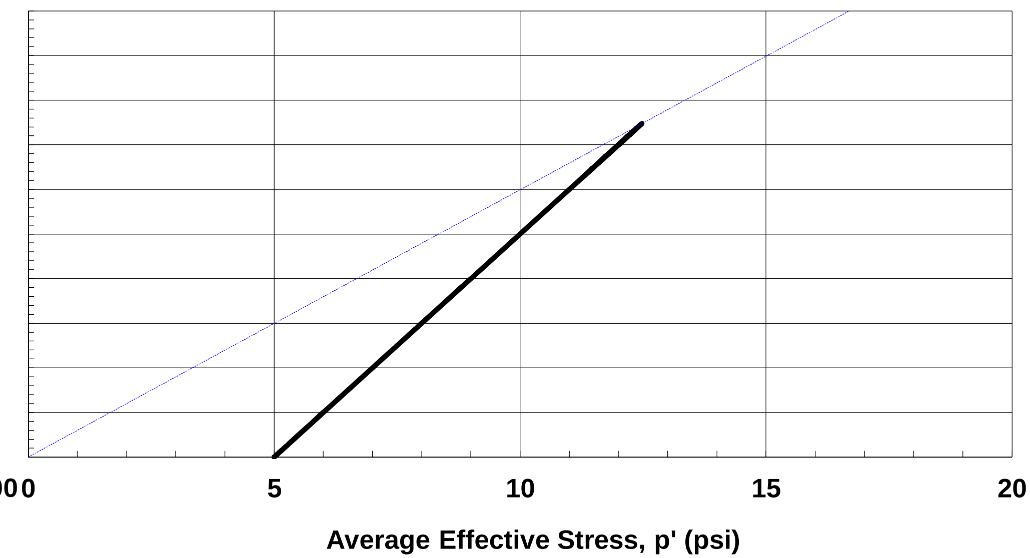
TEST SUMMARY
Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 41.5 % Total Unit Weight: 104.0 pcf
B Coefficient: 99.4 Strain Rate: 0.018 %/min
Peak Shear Strength: 7.47 psi @ 7.9 % Strain
Peak Effective Friction Angle: 36.8°

REMARKS: Compression positive



Failure Sketch





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-2 Sample: SH-3A Depth: 5.4ft	September-13

SUMMARY OF TRIAXIAL CID-C TESTS ON UNDISTURBED SPECIMENS

Series Test No	Boring No / Sample No.	Depth (ft)	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	σ'_c (ksf) / OCR $\frac{\sigma'_{v,c}}{\sigma'_{v,max}}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/min)	at Peak Deviator Stress / at Large Strain: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	Vol. Strain ε_{vol} (%)	ϕ' for c'=0
TD410	B-13-5	15.25	17.8	134.2	113.9	5.0	0.8	0.0	15.7	11.2	16.2	5.46	-0.34	43.7
	SS-6A		17.9	135.6	115.0	1.0	0.9	0.02	18.8	11.0	16.0	5.38	-0.58	43.4
TD411	B-13-5	15.75	17.5	134.3	114.3	10.0	0.4	99.2	15.5	14.4	24.4	3.87	0.32	36.1
	SS-6B		16.9	137.0	117.2	1.0	2.4	0.02	19.1	14.1	24.1	3.81	0.15	35.8
TD412	B-13-5	16.25	16.5	133.9	114.9	15.0	0.7	98.0	14.3	28.4	43.4	4.79	0.29	40.9
	SS-6C		16.9	137.0	117.3	1.0	2.0	0.02	19.8	27.3	42.3	4.65	0.04	40.2

Test No	Description of Material Tested and Remarks
TD410	CL, brown lean clay
TD411	CL, brown lean clay
TD412	CL, gray clay

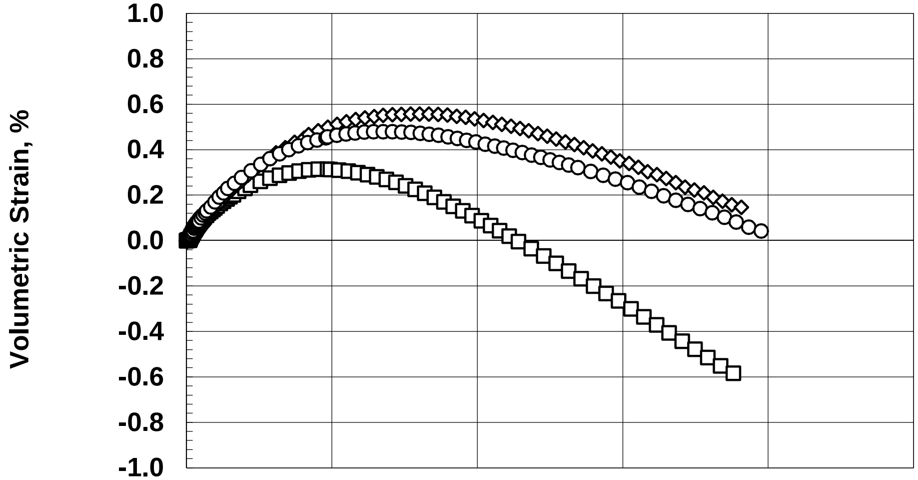
Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	40.1	0.000	32.8	0.000	--
	2	39.5	0.000	32.5	0.000	--

Failure Criteria: 1 - Peak Deviator Stress; 2 - Large Strain

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION B-13-5 SS-6 SUMMARY	September 2013

TerraSense, LLC

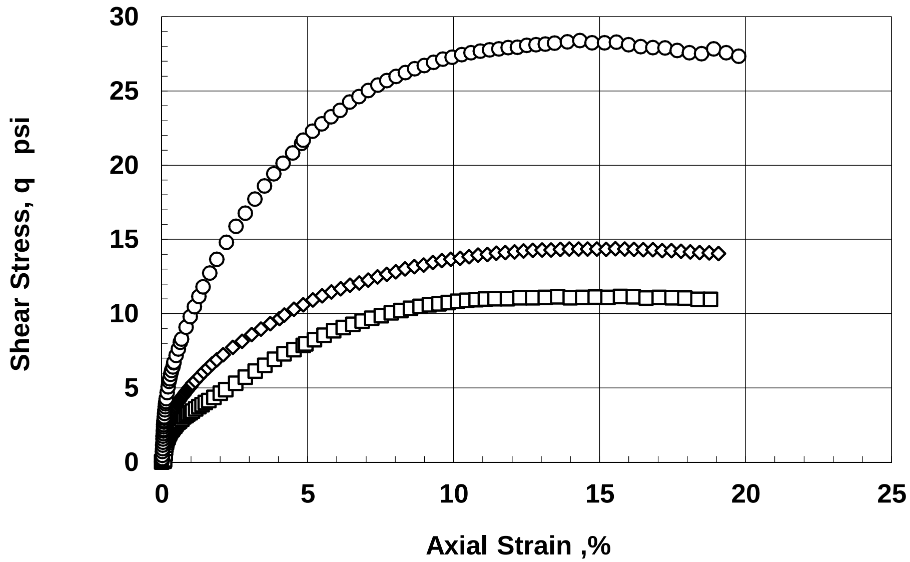


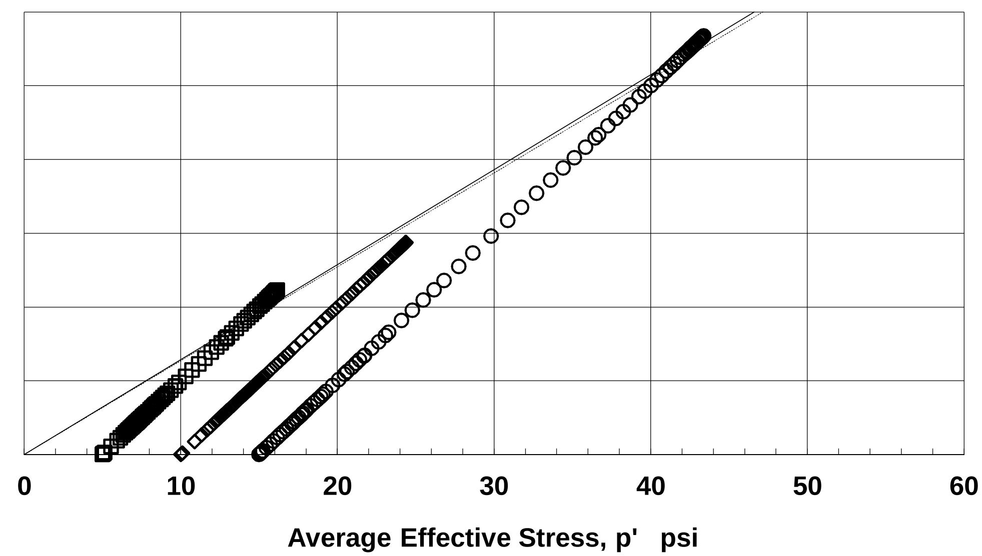
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	σ'c (ksf)	wc (%)	γtc (pcf)
□	TD410	B-13-5	15.25	5.0	17.9	135.6
◊	TD411	B-13-5	15.75	10.0	16.9	137.0
○	TD412	B-13-5	16.25	15.0	16.9	137.0

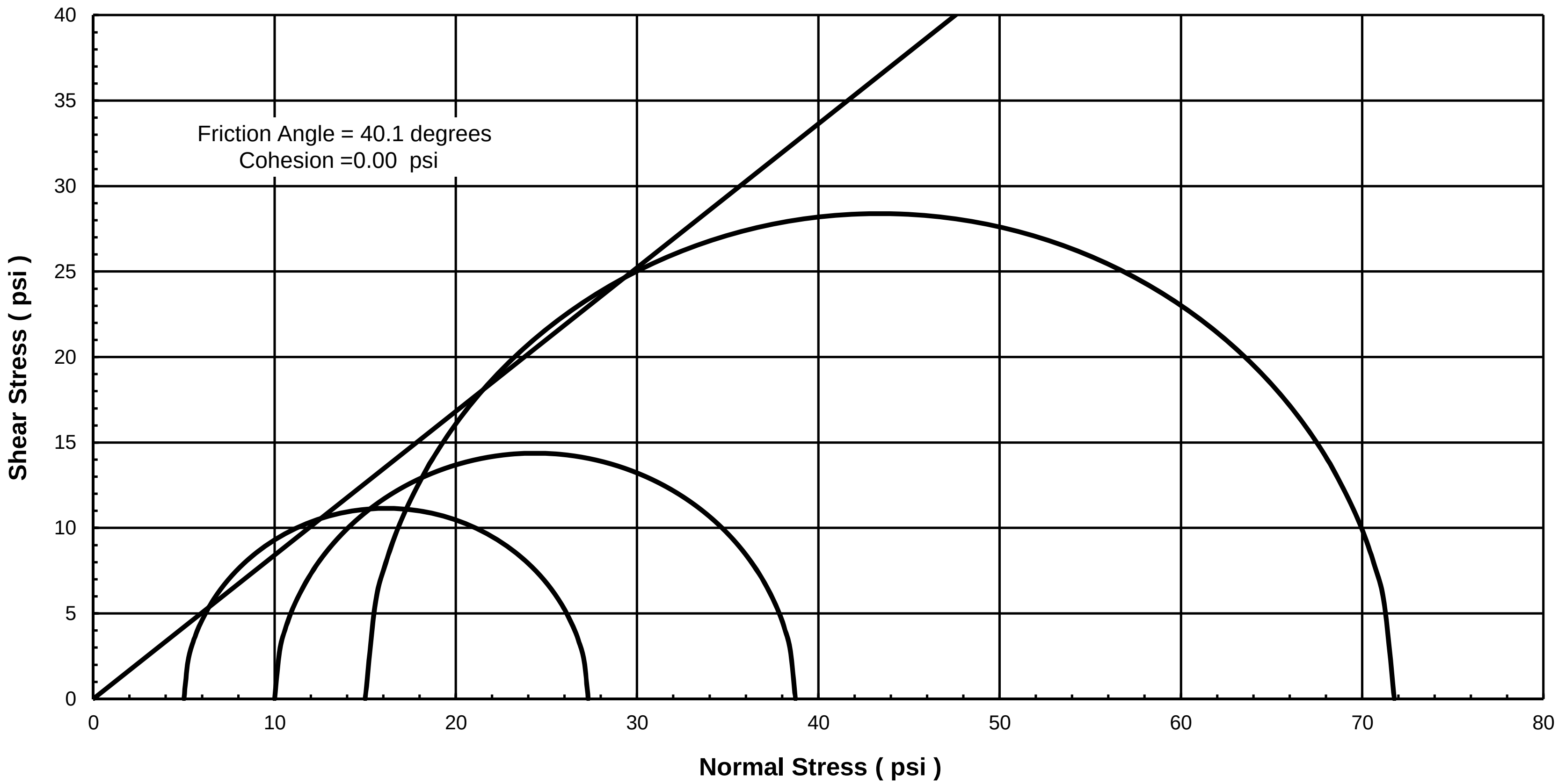
SERIES SUMMARY

Notation	Failure Criteria	c' psi	Φ' (degrees)
———	Peak Deviator Stress	0.00	40.1
-----------	Large Strain	0.00	39.5

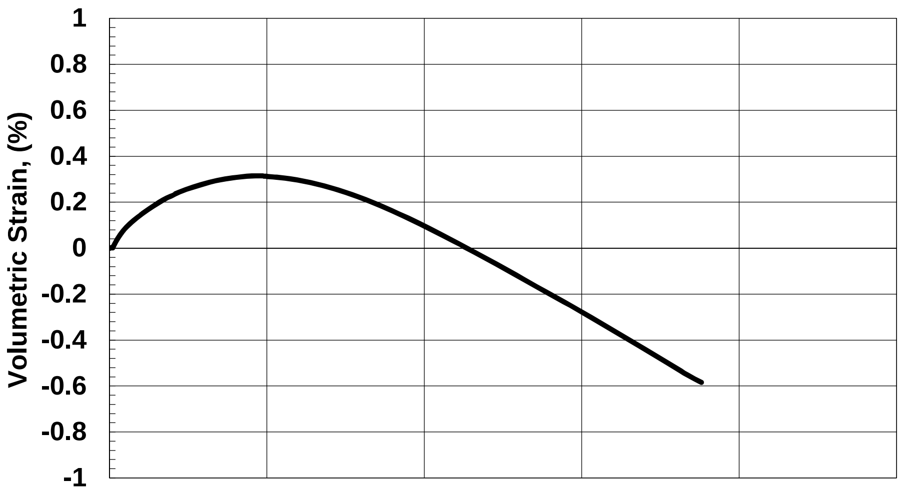




Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	Figure 1
Prepared by: CMJ Checked by: G. Thomas	**TerraSense, LLC**	B-13-5 SS-6 SUMMARY	September 2013



Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circle at Peak CD Triaxial Tests	Figure 2
TerraSense, LLC		B-13-5 SS-6 SUMMARY	September 2013



SAMPLE INFORMATION

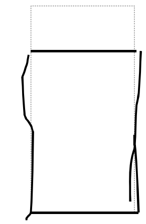
Boring: B-13-5 Sample: SS-6A Depth: 15.25 ft
Type: Intact tube sample
Description: CL, brown lean clay

SPECIMEN INFORMATION (Initial)

Height: 6.03 inch Diameter: 2.85 inch Area: 6.39 in²
Water Content: 17.8 % Total Unit Weight: 134.2 pcf

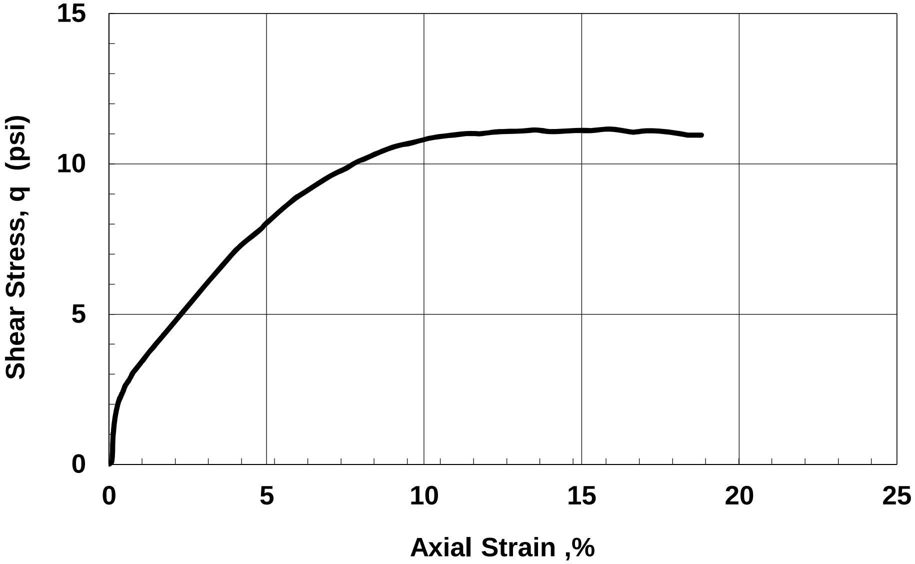
TEST SUMMARY

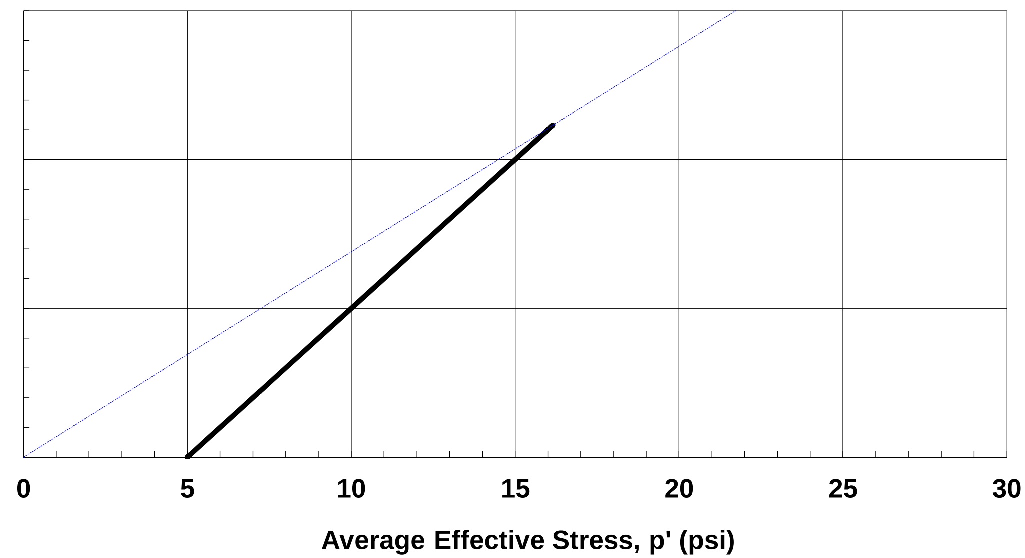
Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 17.9 % Total Unit Weight: 135.6 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 11.15 psi @ 15.7 % Strain
Peak Effective Friction Angle: 43.7°



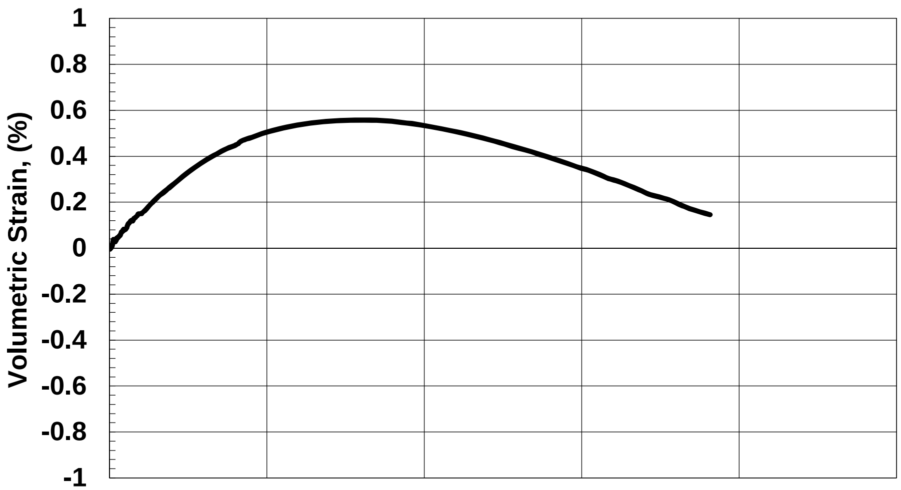
Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-5 Sample: SS-6A Depth: 15.25ft	September-13



SAMPLE INFORMATION

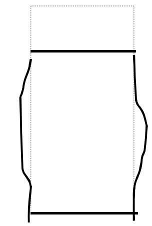
Boring: B-13-5 Sample: SS-6B Depth: 15.75 ft
Type: Intact tube sample
Description: CL, brown lean clay
LL = 36 PL = 16 PI = 20

SPECIMEN INFORMATION (Initial)

Height: 6.04 inch Diameter: 2.87 inch Area: 6.45 in²
Water Content: 17.5 % Total Unit Weight: 134.3 pcf

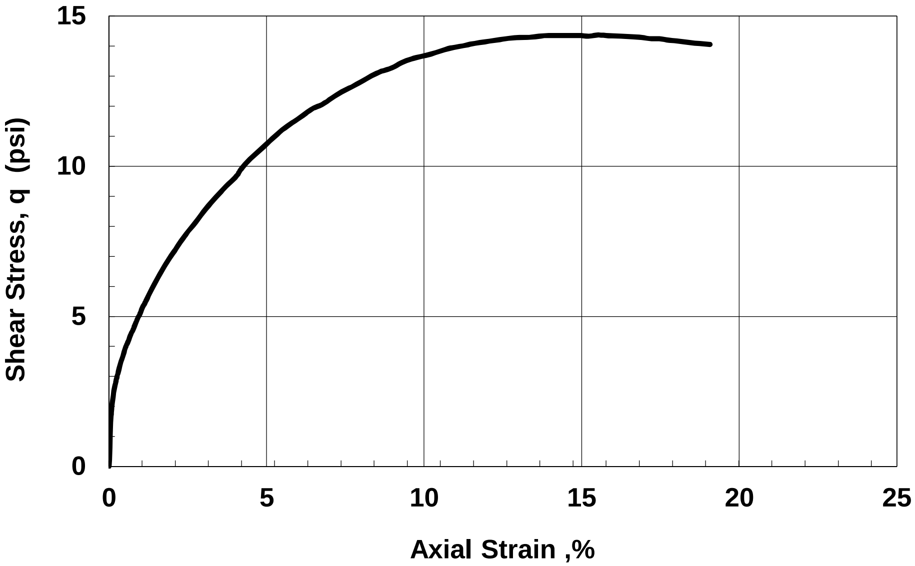
TEST SUMMARY

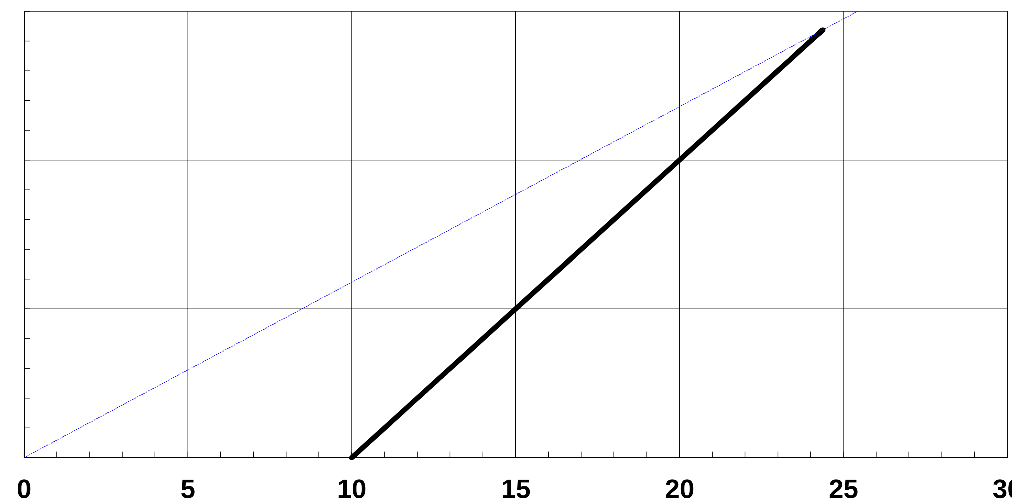
Consolidation Stresses: 10.00 psi vertical, 10.00 psi lateral
Water Content: 16.9 % Total Unit Weight: 137.0 pcf
B Coefficient: 99.2 Strain Rate: 0.018 %/min
Peak Shear Strength: 14.37 psi @ 15.5 % Strain
Peak Effective Friction Angle: 36.1°



Failure Sketch

REMARKS: Compression positive



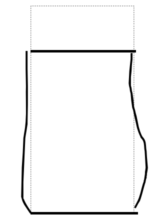


Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-5 Sample: SS-6B Depth: 15.75ft	September-13

SAMPLE INFORMATION
Boring: B-13-5 Sample: SS-6C Depth: 16.25 ft
Type: Intact tube sample
Description: CL, gray clay

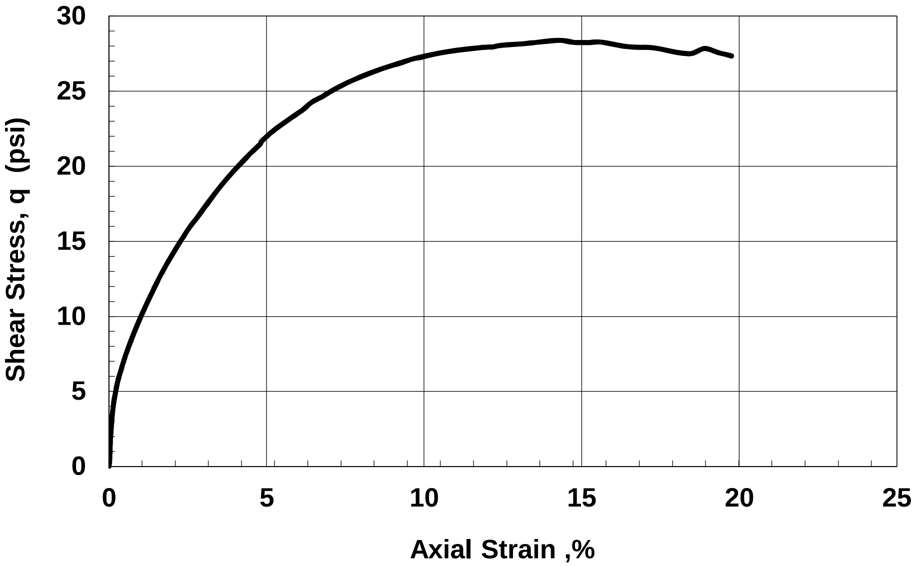
SPECIMEN INFORMATION (Initial)
Height: 6.03 inch Diameter: 2.85 inch Area: 6.39 in²
Water Content: 16.5 % Total Unit Weight: 133.9 pcf

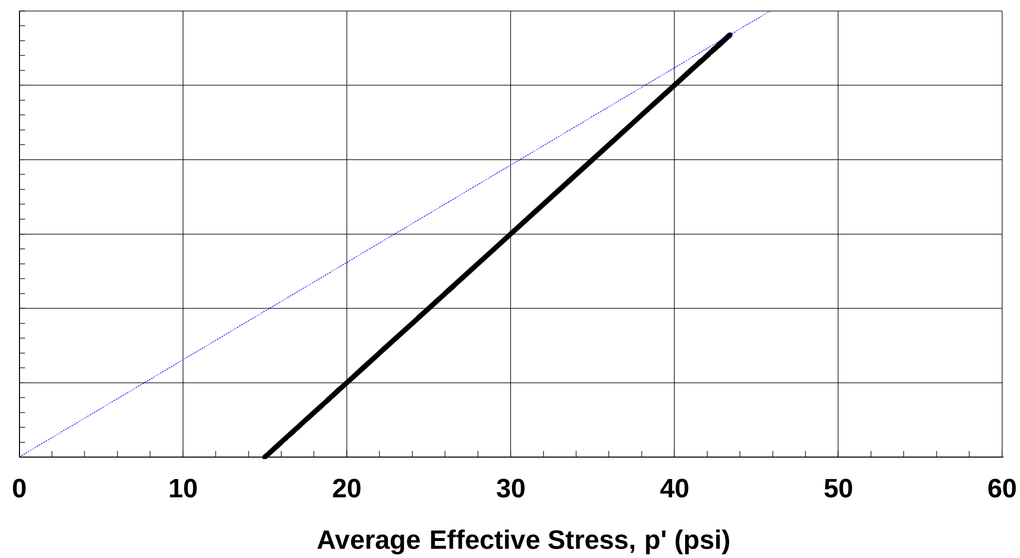
TEST SUMMARY
Consolidation Stresses: 15.00 psi vertical, 15.00 psi lateral
Water Content: 16.9 % Total Unit Weight: 137.0 pcf
B Coefficient: 98 Strain Rate: 0.018 %/min
Peak Shear Strength: 28.39 psi @ 14.3 % Strain
Peak Effective Friction Angle: 40.9°



Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-5 Sample: SS-6C Depth: 16.25ft	September-13

SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth / Elev (ft)	USCS Group Symbol / Gs	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	$\sigma'_{c,max}$ (psi) / OCR	$\sigma'_{v,c}$ (psi) / $K_c = \sigma'_{v,c} / \sigma'_{h,c}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/hr)	at Peak Deviator Stress / at Peak Obliquity: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	A factor	ϕ' for c'=0
T3521	B-13-6	SS-6A	15.4	CL	16.3	133.6	114.9	5.00	5.00	1.0	97	20.4	12.65	23.73	3.28	-0.240	32.2
				(2.80)	17.0	138.5	118.3	1.0	1.00	2.9	1.1	3.7	5.41	8.21	4.85	0.203	41.2
T3522	B-13-6	SS-6B	15.95	CL	21.0	132.4	109.5	10.0	10.0	0.7	98.5	20.2	8.96	17.46	3.11	0.083	30.9
				(2.80)	20.4	133.9	111.2	1.0	1.00	1.6	1.1	3.1	5.94	9.89	4.01	0.510	36.9
T3523	B-13-6	SS-6C	16.5	CL	18.4	132.4	111.9	15.0	15.0	0.8	99.2	20.0	23.99	45.59	3.22	-0.138	31.8
				(2.78)	18.5	135.8	114.6	1.0	1.00	2.4	1.1	2.0	10.95	16.96	4.64	0.411	40.2

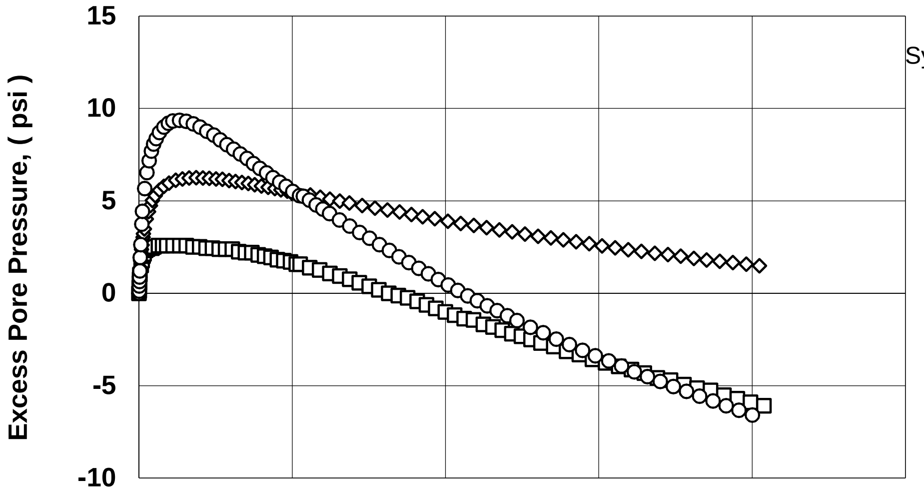
Test No	Description of Material Tested and Remarks
T3521	CL, brown lean clay
T3522	CL, brown lean clay
T3523	CL, brown lean clay; bottom gray silty clay

Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	31.7	0.000	27.8	0.000	--
	2	39.6	0.000	32.5	0.000	--

Failure Criteria: 1 - Peak Deviator Stress; 2 - Peak Obliquity

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-6 SS-6 SUMMARY	
TerraSense, LLC			August 2013

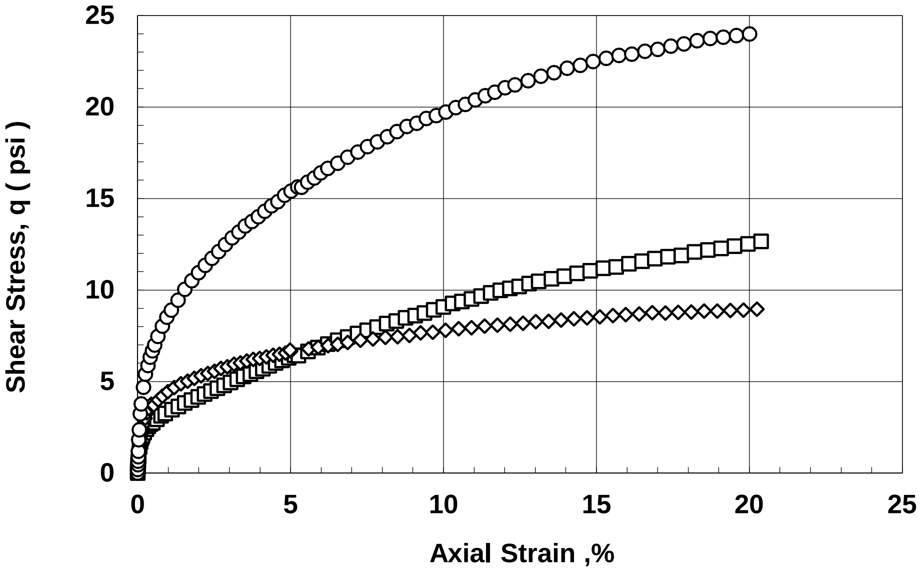


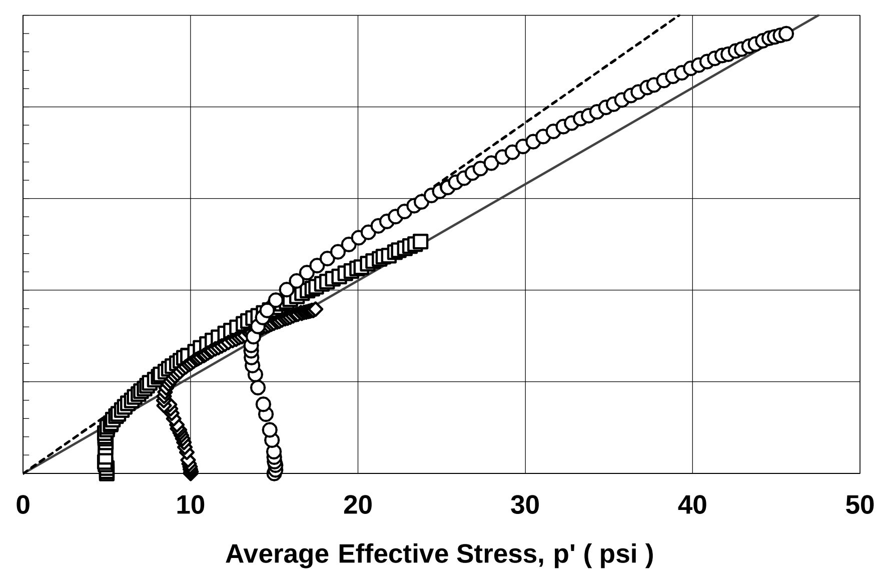
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T3521	B-13-6	SS-6A	15.4	16.3	133.6	5.00
◊	T3522	B-13-6	SS-6B	16.0	21.0	132.4	10.00
○	T3523	B-13-6	SS-6C	16.5	18.4	132.4	15.00

SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
——— (solid)	Peak Deviator Stress	0.00	31.7
······· (dotted)	Peak Obliquity	0.00	39.6





Project No. T21562906	**URS Corporation #21562906 Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-6 SS-6 SUMMARY	Figure 1 August 2013

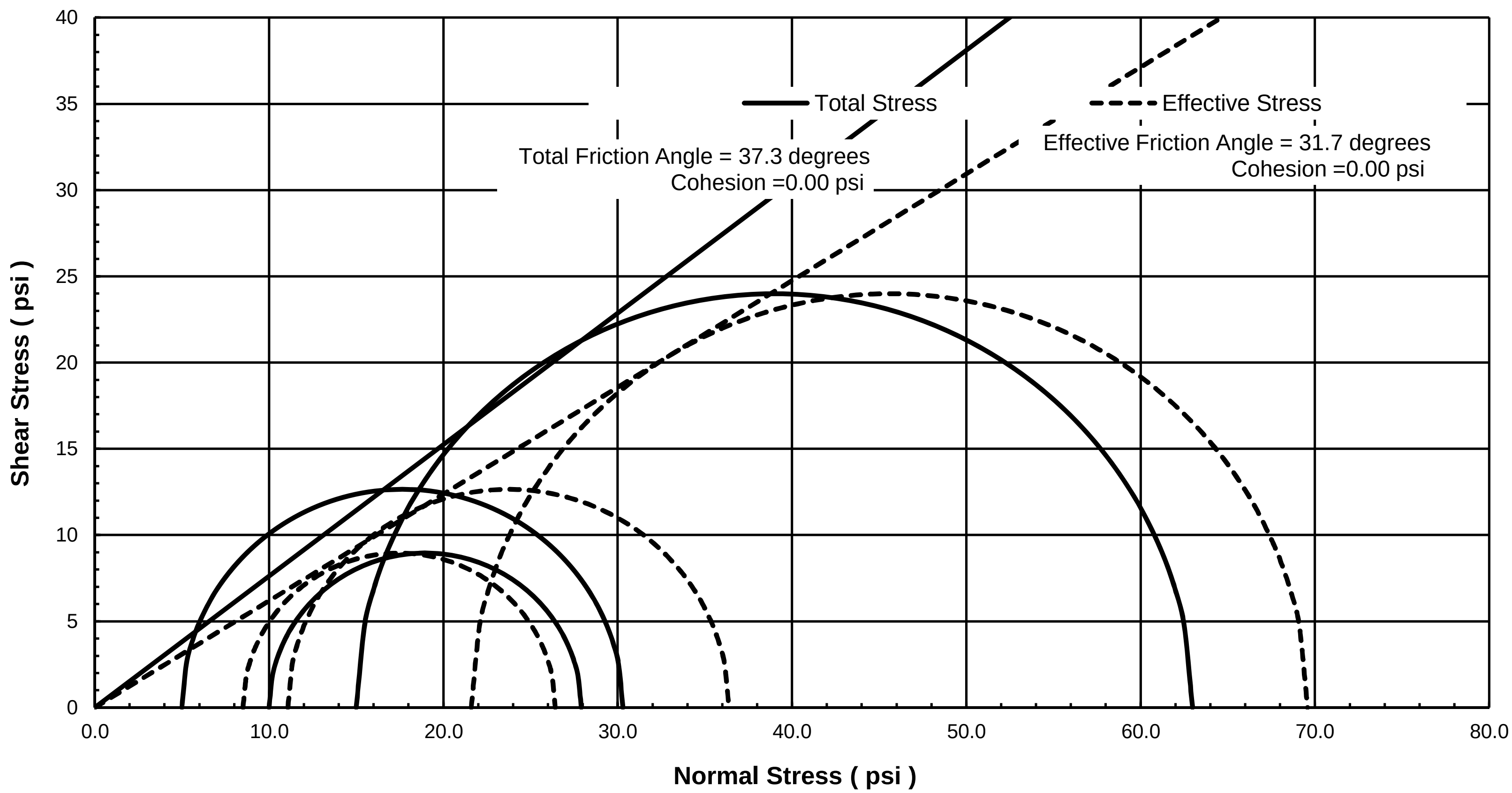
Prepared by: CMJ

Checked by: G. Thomas

TerraSense, LLC

GSI Analysis File: Cu'sum3v4

9/20/2013 Test: Ciu1a.xlsx



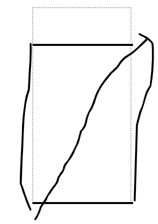
Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
TerraSense, LLC		B-13-6 SS-6 SUMMARY	August 2013

SAMPLE INFORMATION

Boring: B-13-6 Sample: SS-6A Depth: 15.4ft
Type: Intact tube sample
Description: CL, brown lean clay

SPECIMEN INFORMATION (Initial)

Height: 6.03 inch Diameter: 2.88 inch Area: 6.50 in²
Water Content: 16.3 % Total Unit Weight: 133.6 pcf

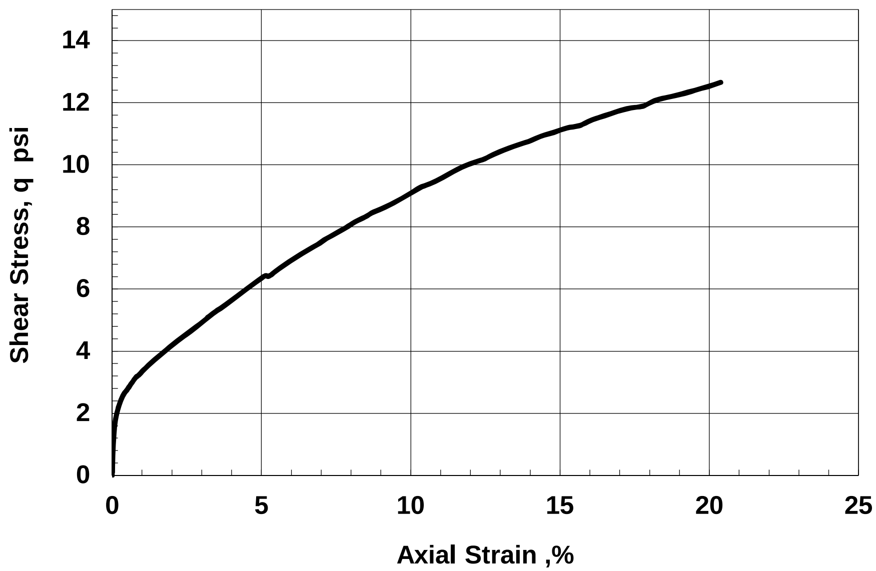


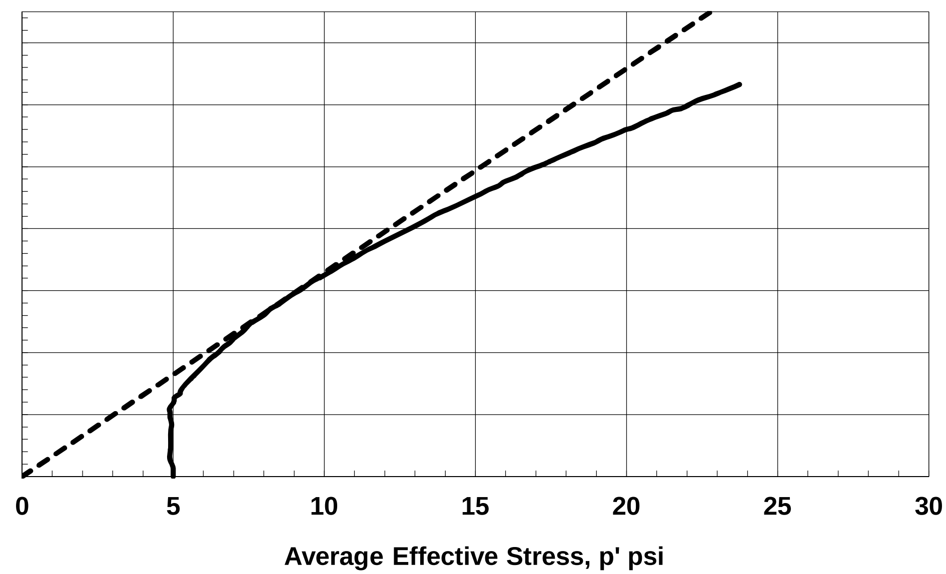
Failure Sketch

TEST SUMMARY

Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 17.0 % Total Unit Weight: 138.5 pcf
B Coefficient: 97 Strain Rate: 0.018 %/min
Peak Shear Strength: 12.65 psi @ 20.4 % Strain
Peak Effective Friction Angle: 41.2°

REMARKS:





Test by: DT

Checked by: GET

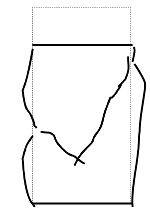
Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Boring: B-13-6 Sample: SS-6A	
TerraSense, LLC			September-13

SAMPLE INFORMATION

Boring: B-13-6 Sample: SS-6B Depth: 15.95ft
Type: Intact tube sample
Description: CL, brown lean clay
LL = 36 PL = 16 PI = 20

SPECIMEN INFORMATION (Initial)

Height: 6.02 inch Diameter: 2.87 inch Area: 6.48 in²
Water Content: 21.0 % Total Unit Weight: 132.4 pcf

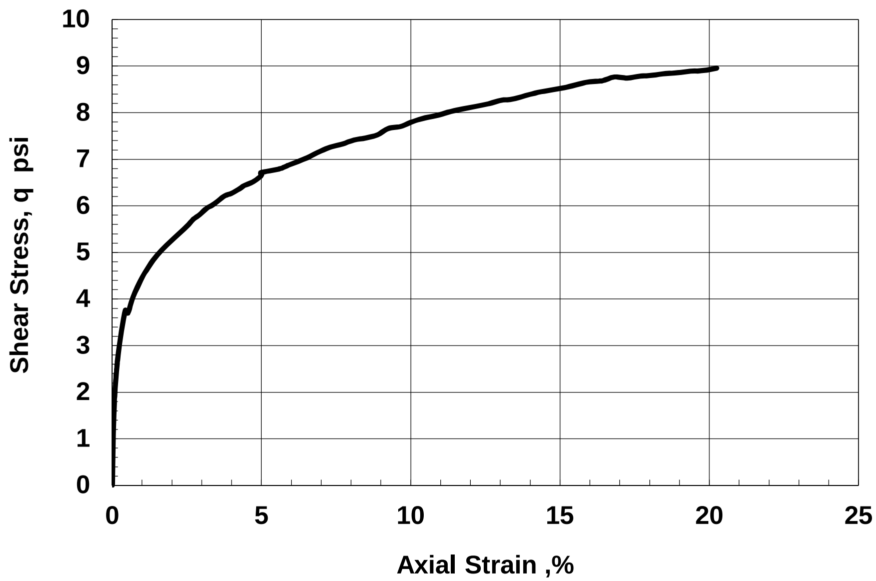


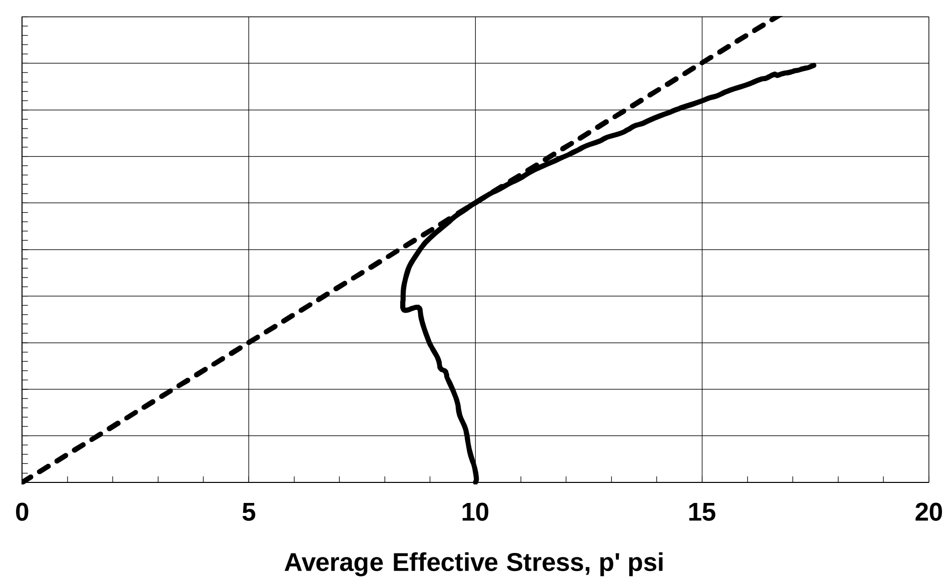
Failure Sketch

TEST SUMMARY

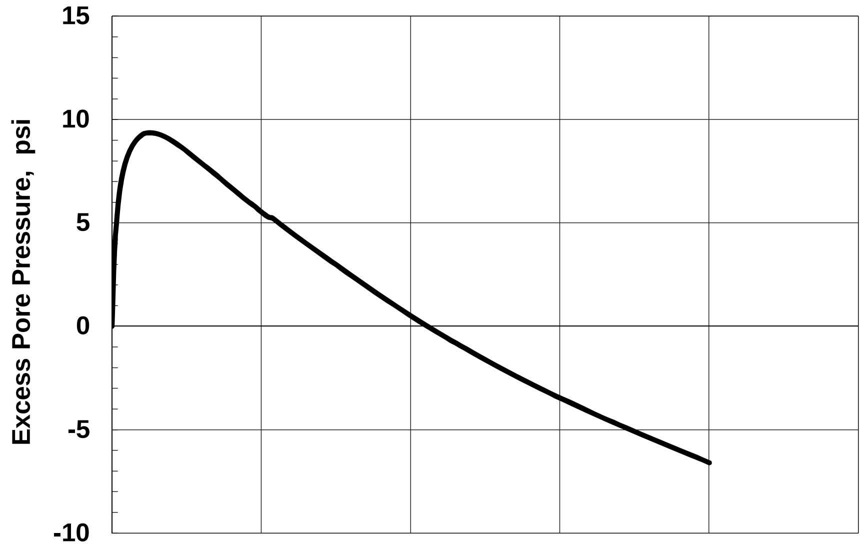
Consolidation Stresses: 10.00 psi vertical, 10.00 psi lateral
Water Content: 20.4 % Total Unit Weight: 133.9 pcf
B Coefficient: 98.5 Strain Rate: 0.018 %/min
Peak Shear Strength: 8.96 psi @ 20.2 % Strain
Peak Effective Friction Angle: 36.9°

REMARKS:



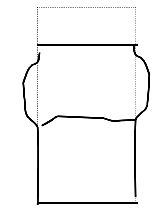


Test by: DT	Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements	
Checked by: GET	TerraSense, LLC		Boring: B-13-6 Sample: SS-6B	September-13



SAMPLE INFORMATION
Boring: B-13-6 Sample: SS-6C Depth: 16.5ft
Type: Intact tube sample
Description: CL, brown lean clay; bottom gray silty clay

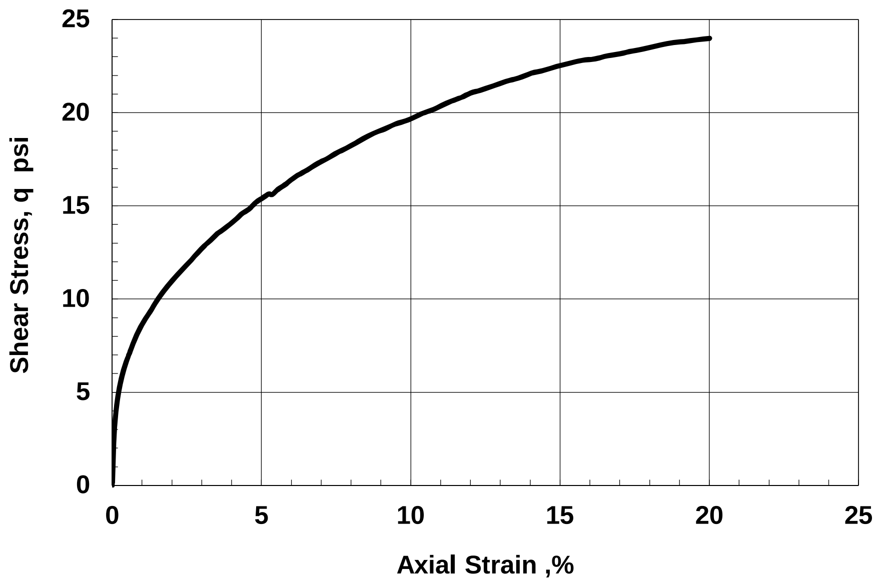
SPECIMEN INFORMATION (Initial)
Height: 6.03 inch Diameter: 2.88 inch Area: 6.51 in²
Water Content: 18.4 % Total Unit Weight: 132.4 pcf

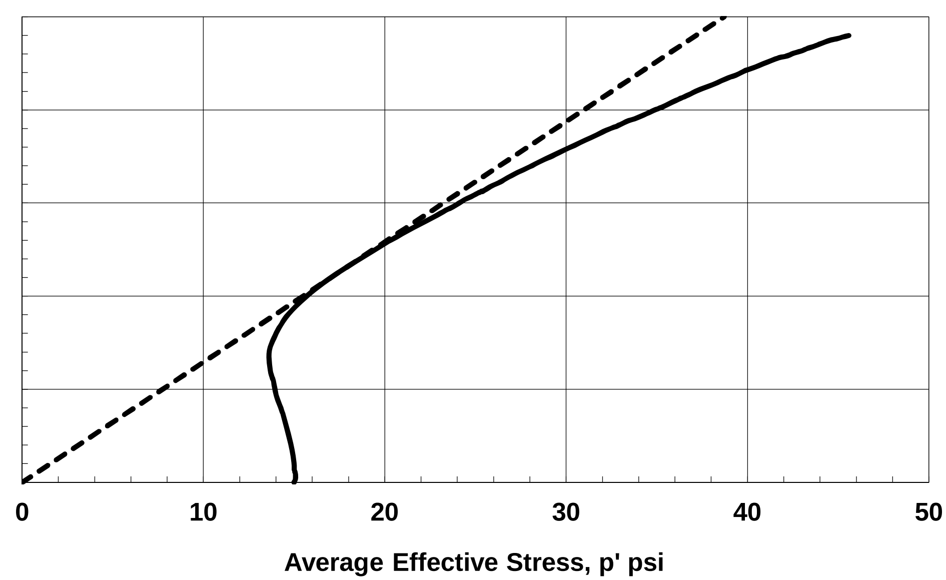


Failure Sketch

TEST SUMMARY
Consolidation Stresses: 15.00 psi vertical, 15.00 psi lateral
Water Content: 18.5 % Total Unit Weight: 135.8 pcf
B Coefficient: 99.2 Strain Rate: 0.018 %/min
Peak Shear Strength: 23.99 psi @ 20.0 % Strain
Peak Effective Friction Angle: 40.2°

REMARKS:





Test by: DT	Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Boring: B-13-6 Sample: SS-6C	September-13
Checked by: GET	TerraSense, LLC			

SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

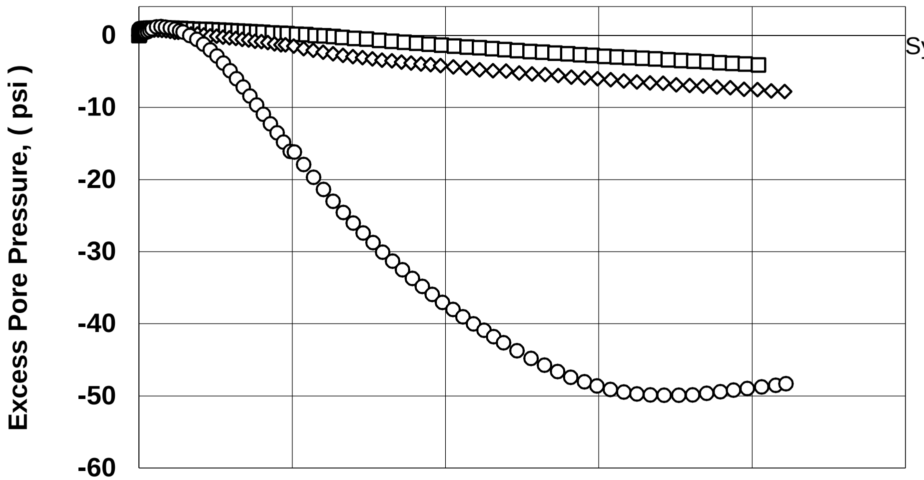
Test No	Boring No	Sample Section No	Depth (ft) / Elev (ft)	USCS Group Symbol / Gs	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	$\sigma'_{c,max}$ (psi) / OCR	$\sigma'_{v,c}$ (psi) / $K_c = \sigma'_{v,c} / \sigma'_{h,c}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/hr)	ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	A factor	ϕ' for c'=0
												at Peak Deviator Stress / at Peak Obliquity					
T3524	B-13-7	SS-2A	2.75	CL	16.4	130.8	112.4	2.00	2.00	0.9		20.2	8.16	14.25	3.68	-0.251	34.9
				(2.75)	17.6	136.1	115.7	1.00	1.00	2.9	1.0	1.8	2.66	3.78	5.78	0.166	44.8
T3525	B-13-7	SS-2B	3.25	CL	14.1	129.4	113.4	3.00	3.00	0.4		21.1	11.31	22.09	3.10	-0.344	30.8
				(2.72)	17.5	135.1	114.9	1.00	1.00	1.3	1.1	3.6	5.24	8.87	3.89	-0.060	36.2
T3526	B-13-7	SS-2C	3.75	SM	10.3	130.3	118.1	4.00	4.00	0.9		14.5	69.47	121.52	3.67	-0.346	34.9
				(2.70)	14.3	139.0	121.6	1.00	1.00	2.9	1.1	2.3	13.26	19.26	5.42	-0.076	43.5

Test No	Description of Material Tested and Remarks
T3524	CL, light gray lean clay
T3525	CL, brown lean clay
T3526	SM, brown silty sand

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	23.7	2.652	21.9	2.428	1.000
	2	30.5	0.868	26.9	0.748	1.000
	Failure Envelope for clay samples only					

Failure Criteria: 1 - Peak Deviator Stress
2 - Peak Obliquity

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-7 SS-2 SUMMARY	August 2013
TerraSense, LLC			



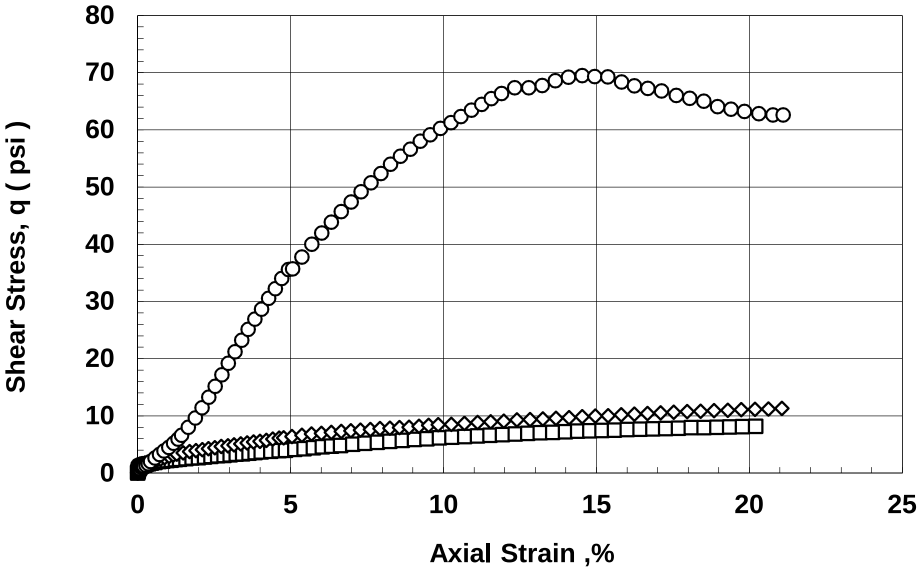
LEGEND AND SUMMARY INFORMATION

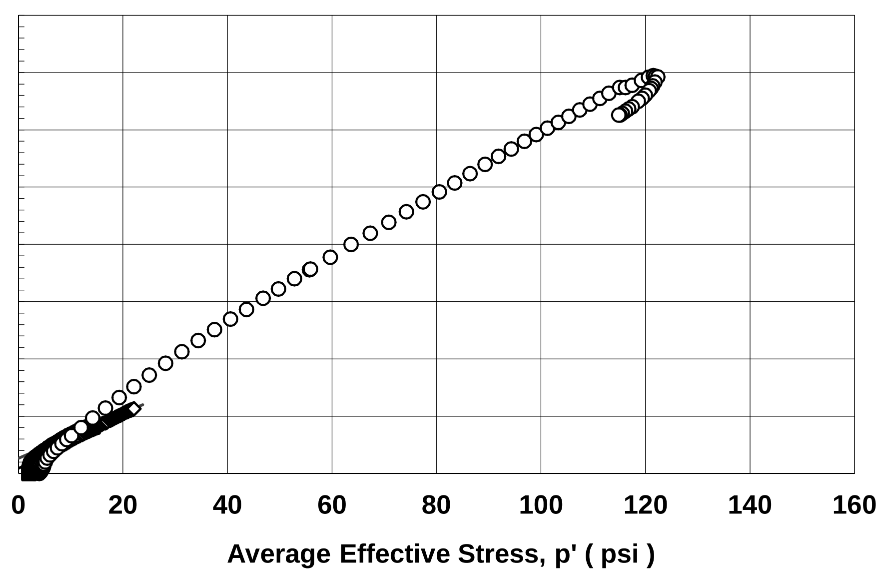
Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T3524	B-13-7	SS-2A	2.8	16.4	130.8	2.00
◊	T3525	B-13-7	SS-2B	3.3	14.1	129.4	3.00
○	T3526	B-13-7	SS-2C	3.8	10.3	130.3	4.00

SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
——— (solid line)	Peak Deviator Stress	2.65	23.7
········ (dotted line)	Peak Obliquity	0.87	30.5

Failure Envelope for clay samples only





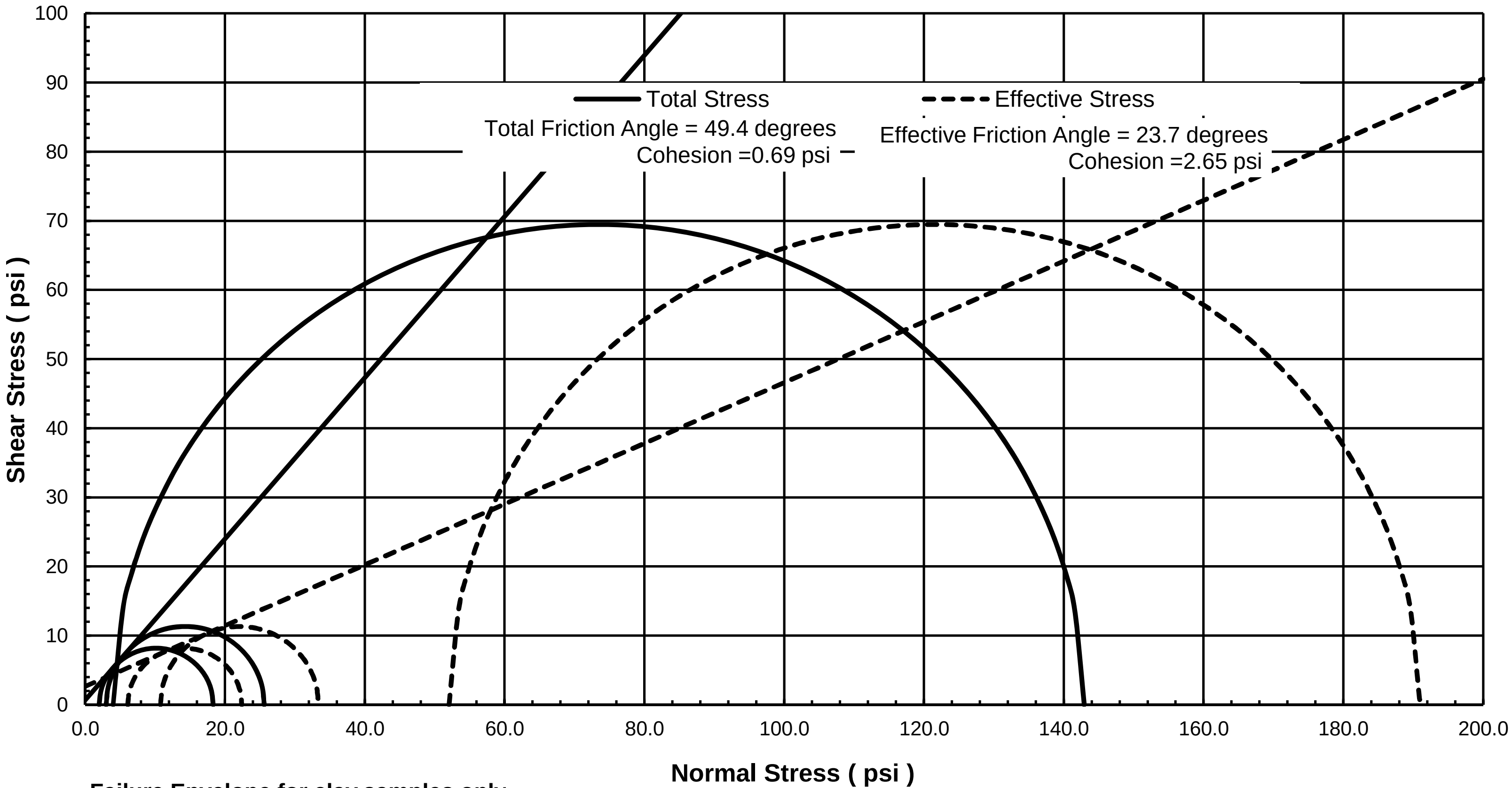
Project No. T21562906	**URS Corporation #21562906 Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-7 SS-2 SUMMARY	Figure 1
	TerraSense, LLC		August 2013

Prepared by: CMJ

Checked by: G. Thomas

GSI Analysis File: Cu'sum3v4

9/20/2013 Test: Ciu1b.xlsx



Failure Envelope for clay samples only

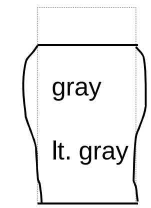
Project No. **T21562906**	**URS Corporation #21562906** **Dynegy Vermillion 2013**	**Mohr Circles of Total and Effective Stresses at Peak** **CIU' Triaxial Test** **B-13-7 SS-2 SUMMARY**	**Figure** **2** **August 2013**
TerraSense, LLC			

SAMPLE INFORMATION

Boring: B-13-7 Sample: SS-2A Depth: 2.75ft
Type: Intact tube sample
Description: CL, light gray lean clay

SPECIMEN INFORMATION (Initial)

Height: 6.04 inch Diameter: 2.87 inch Area: 6.46 in²
Water Content: 16.4 % Total Unit Weight: 130.8 pcf

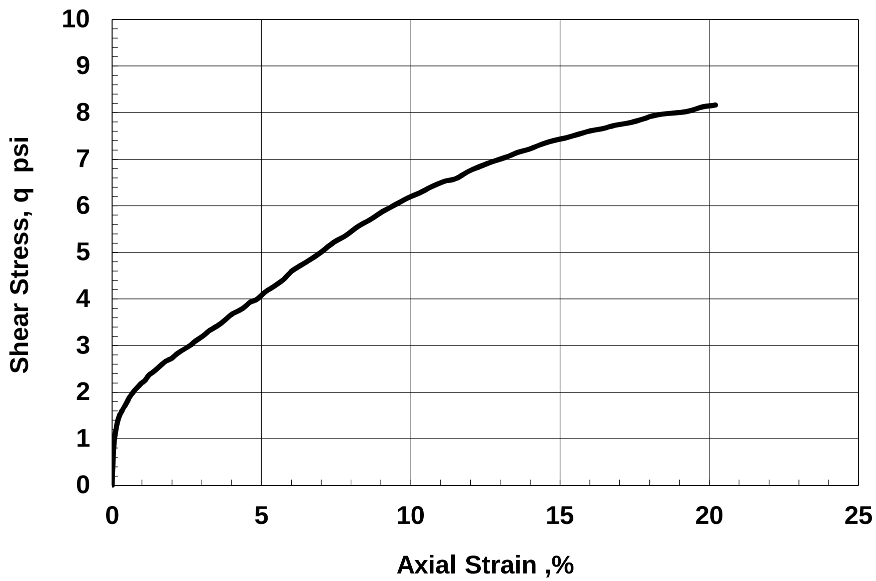


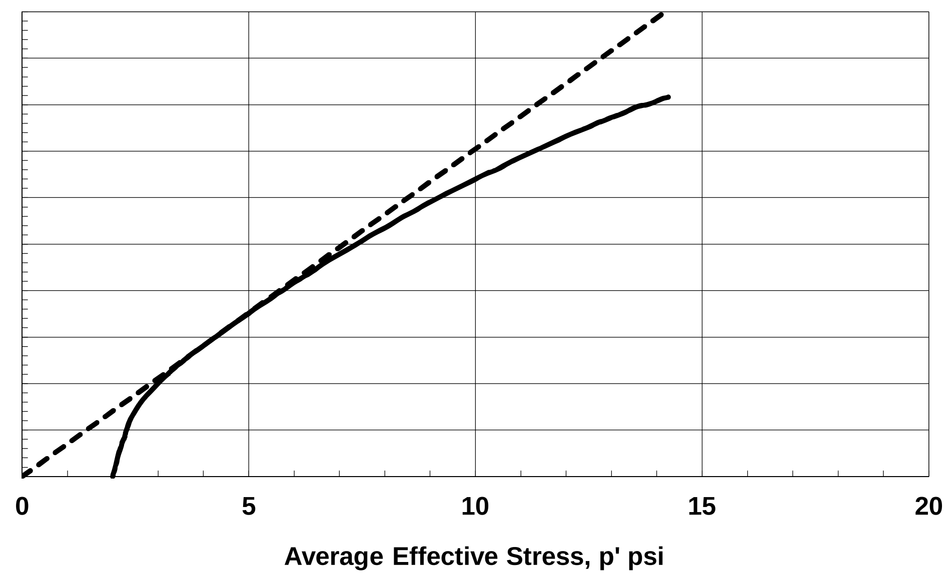
TEST SUMMARY

Consolidation Stresses: 2.00 psi vertical, 2.00 psi lateral
Water Content: 17.6 % Total Unit Weight: 136.1 pcf
B Coefficient: Strain Rate: 0.017 %/min
Peak Shear Strength: 8.16 psi @ 20.2 % Strain
Peak Effective Friction Angle: 44.8°

Failure Sketch

REMARKS:

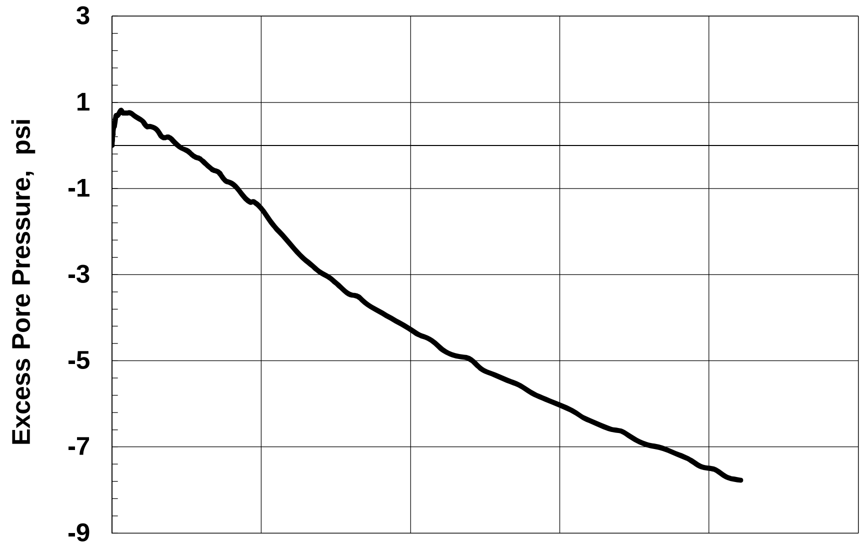




Test by: DT

Checked by: GET

Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Boring: B-13-7 Sample: SS-2A	September-13
TerraSense, LLC			

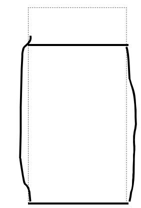


SAMPLE INFORMATION

Boring: B-13-7 Sample: SS-2B Depth: 3.25ft
Type: Intact tube sample
Description: CL, brown lean clay
LL = 28 PL = 14 PI = 14

SPECIMEN INFORMATION (Initial)

Height: 5.79 inch Diameter: 2.87 inch Area: 6.46 in²
Water Content: 14.1 % Total Unit Weight: 129.4 pcf

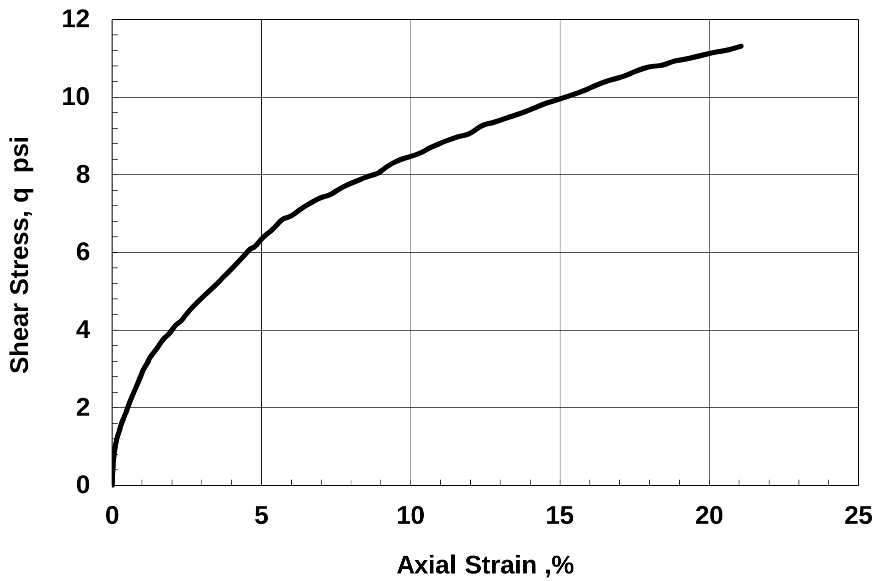


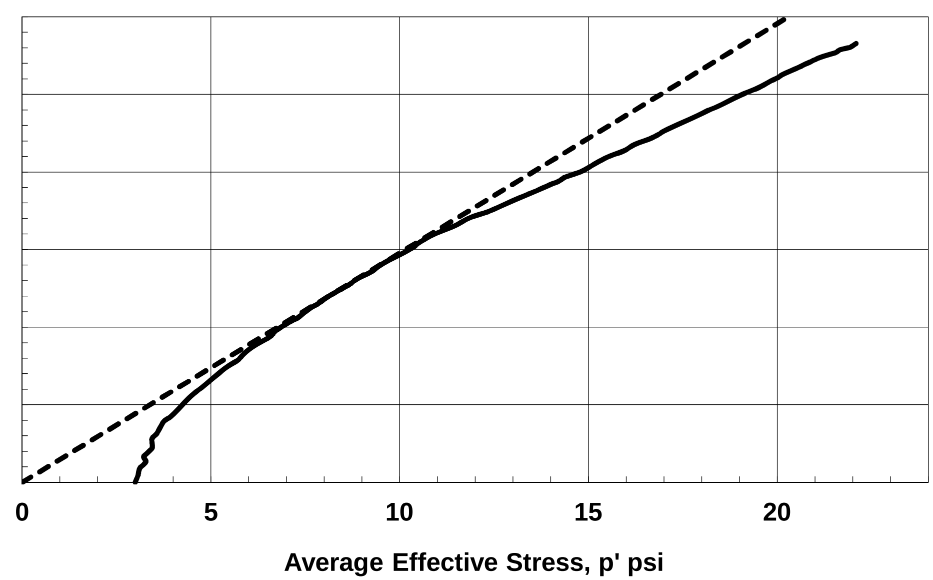
Failure Sketch

TEST SUMMARY

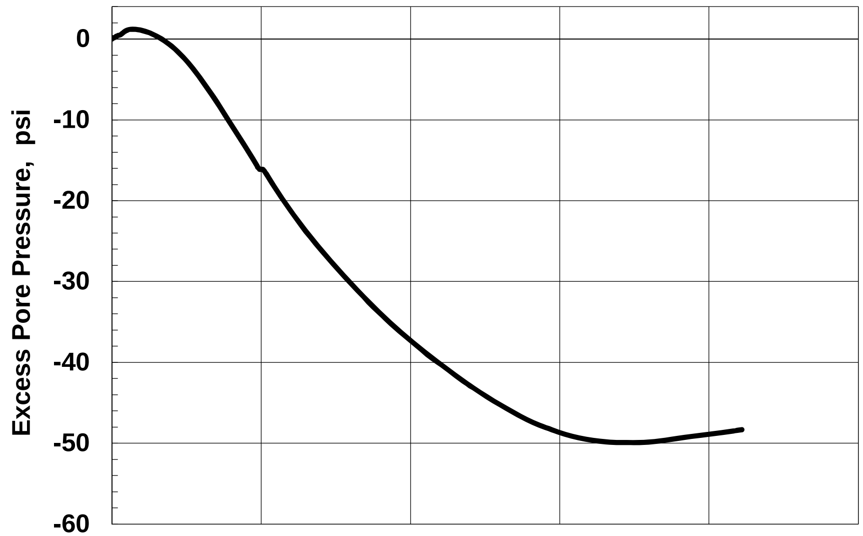
Consolidation Stresses: 3.00 psi vertical, 3.00 psi lateral
Water Content: 17.5 % Total Unit Weight: 135.1 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 11.31 psi @ 21.1 % Strain
Peak Effective Friction Angle: 36.2°

REMARKS:





Test by: DT	Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements	
Checked by: GET	TerraSense, LLC		Boring: B-13-7 Sample: SS-2B	September-13



SAMPLE INFORMATION

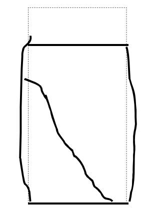
Boring: B-13-7 Sample: SS-2C Depth: 3.75ft
Type: Intact tube sample
Description: SM, brown silty sand

SPECIMEN INFORMATION (Initial)

Height: 5.91 inch Diameter: 2.87 inch Area: 6.47 in²
Water Content: 10.3 % Total Unit Weight: 130.3 pcf

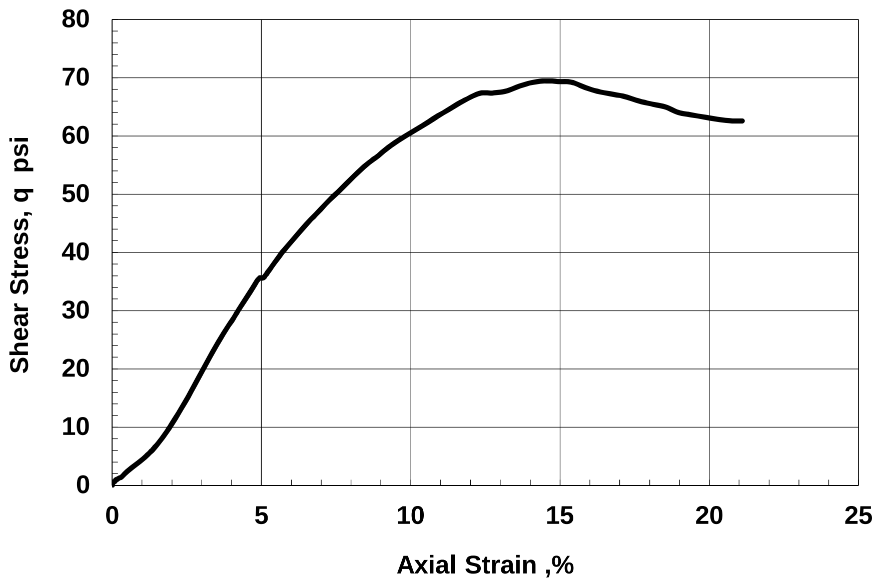
TEST SUMMARY

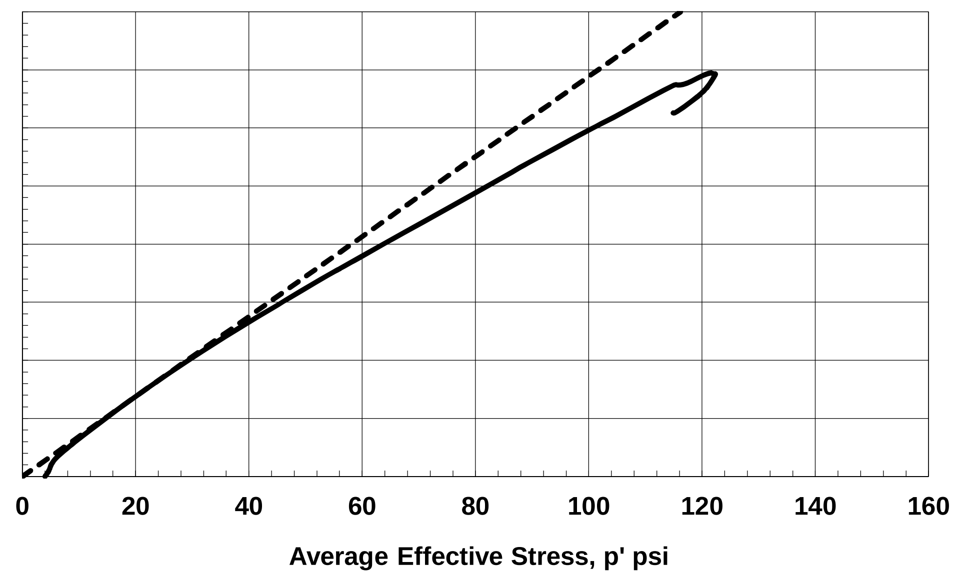
Consolidation Stresses: 4.00 psi vertical, 4.00 psi lateral
Water Content: 14.3 % Total Unit Weight: 139.0 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 69.47 psi @ 14.5 % Strain
Peak Effective Friction Angle: 43.5°



Failure Sketch

REMARKS:





Test by: DT

Checked by: GET

Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Boring: B-13-7 Sample: SS-2C	September-13
TerraSense, LLC			

SUMMARY OF TRIAXIAL CID-C TESTS ON UNDISTURBED SPECIMENS

Series Test No	Boring No / Sample No.	Depth (ft)	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	σ'_c (ksf) / OCR $\frac{\sigma'_{v,c}}{\sigma'_{v,max}}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/min)	at Peak Deviator Stress / at Large Strain: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	Vol. Strain ε_{vol} (%)	ϕ' for c'=0
TD413	B-13-8	8.1	34.8	107.3	79.6	5.0	0.4	0.0	8.8	6.8	11.8	3.72	0.32	35.2
	SS-4A		35.9	117.4	86.4	1.0	7.9	0.02	18.9	6.3	11.3	3.51	0.06	33.8
TD414	B-13-8	8.65	28.0	114.3	89.3	6.0	0.6	0.0	3.1	10.1	16.1	4.38	-0.13	38.9
	SS-4B		29.6	117.8	90.9	1.0	1.8	0.02	20.3	8.4	14.4	3.81	-1.45	35.7

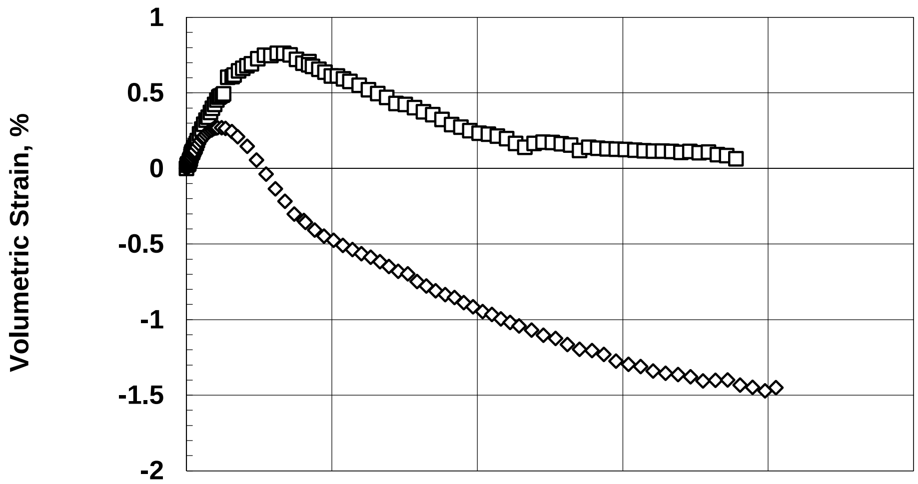
Test No	Description of Material Tested and Remarks
TD413	FA, gray silt with sand (Fly-Ash)
TD414	CL/FA, dark brown clay with silt and sand layer (Fly-Ash layer)

Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	37.6	0.000	31.4	0.000	--
	2	35.0	0.000	29.8	0.000	--

Failure Criteria: 1 - Peak Deviator Stress; 2 - Large Strain

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION B-13-8 SS-4 SUMMARY	September 2013
TerraSense, LLC			

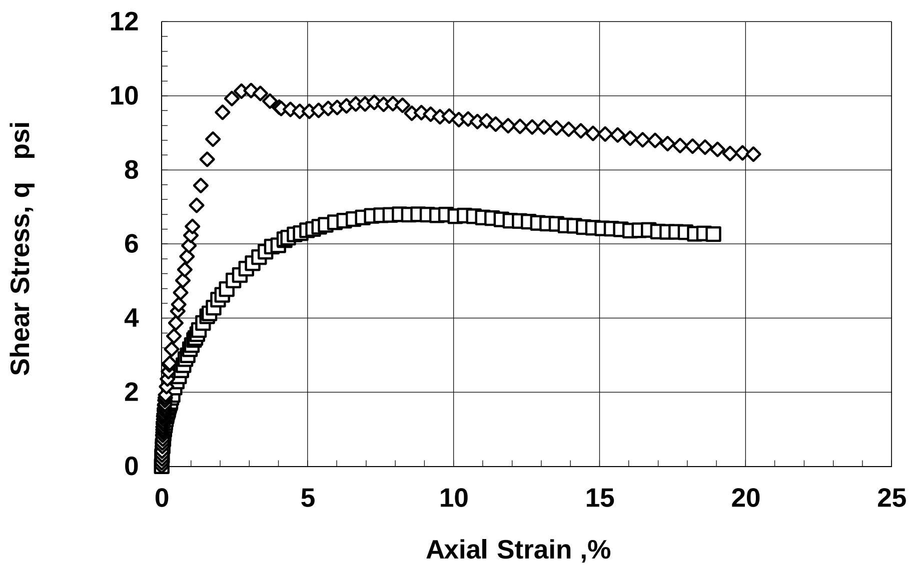


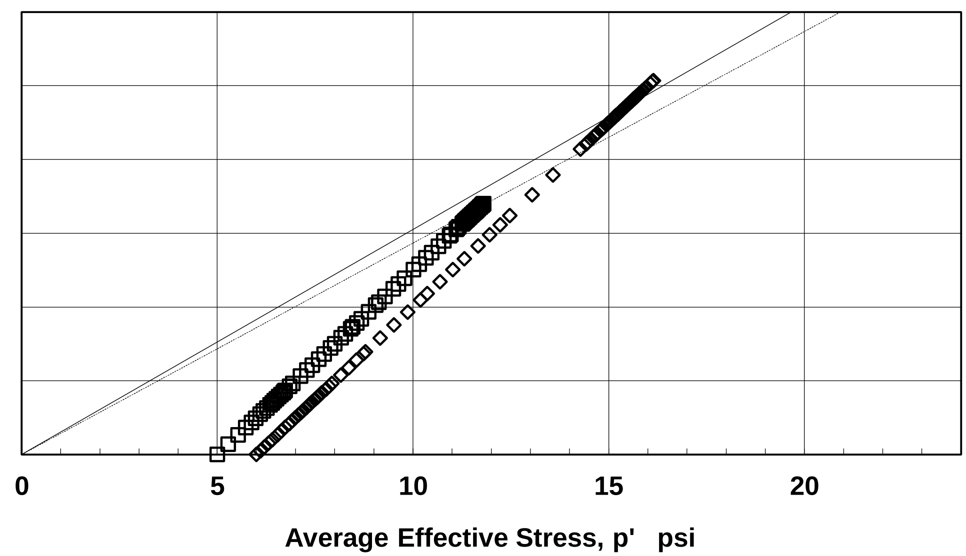
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	σ'c (ksf)	wc (%)	γtc (pcf)
□	TD413	B-13-8	8.1	5.0	35.9	117.4
◊	TD414	B-13-8	8.65	6.0	29.6	117.8
○	0	0	0	0.0	0.0	0.0

SERIES SUMMARY

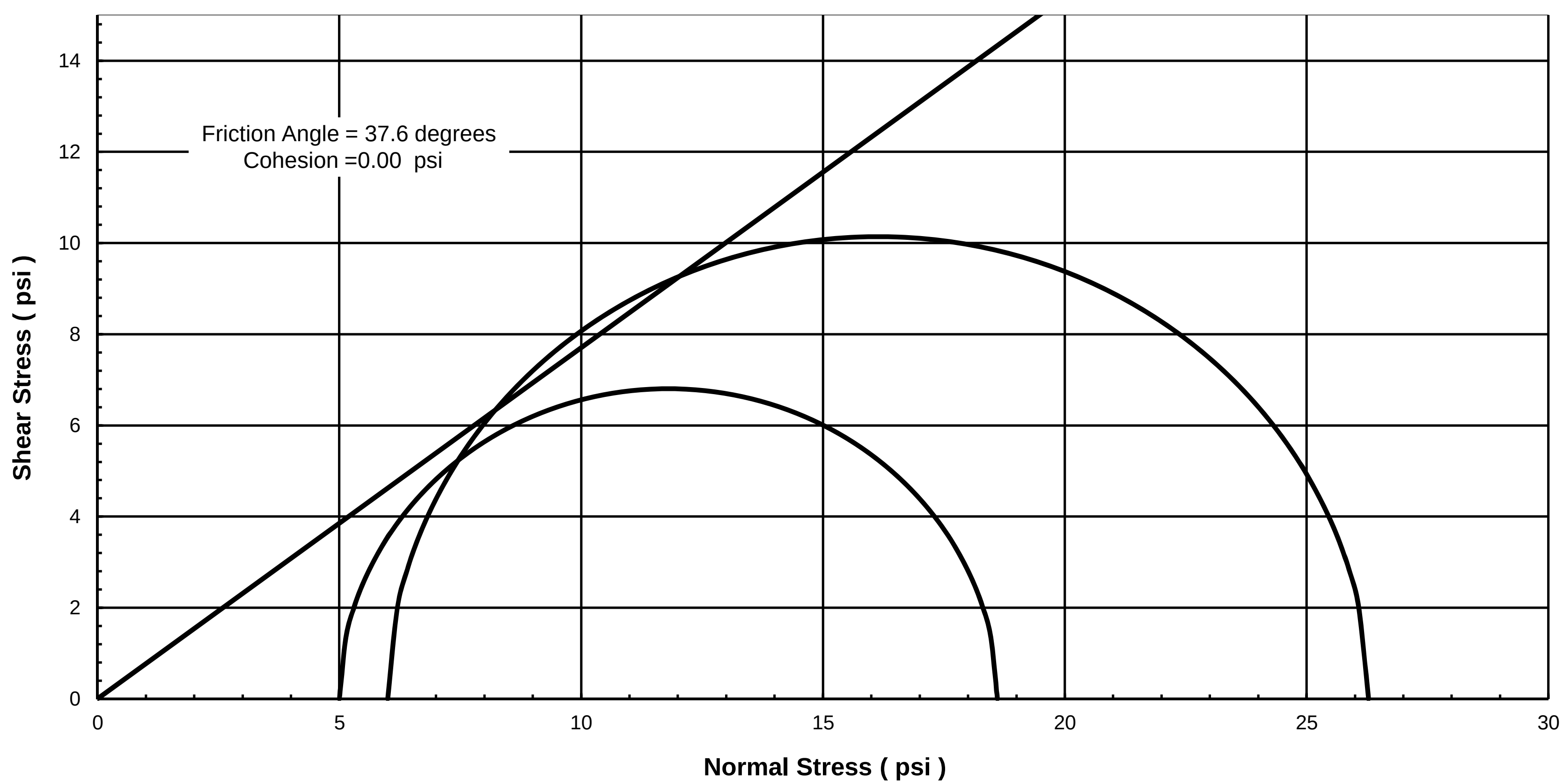
Notation	Failure Criteria	c' psi	Φ' (degrees)
————	Peak Deviator Stress	0.00	37.6
-----------	Large Strain	0.00	35.0



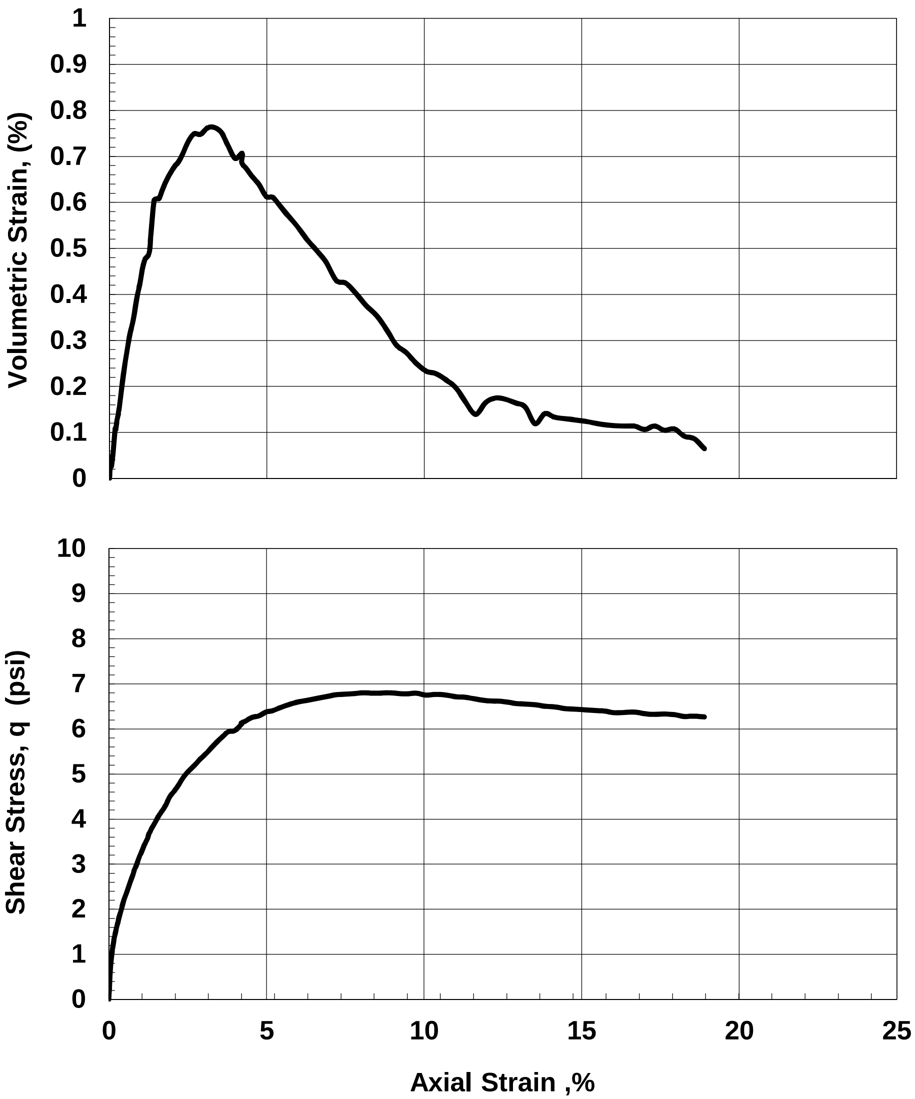


Prepared by: CMJ
Checked by: G. Thomas

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	Figure 1
TerraSense, LLC		B-13-8 SS-4 SUMMARY	September 2013



Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circle at Peak CD Triaxial Tests	Figure 2
TerraSense, LLC		B-13-8 SS-4 SUMMARY	September 2013

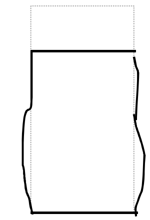


SAMPLE INFORMATION

Boring: B-13-8 Sample: SS-4A Depth: 8.1 ft
Type: Intact tube sample
Description: FA, gray silt with sand (Fly-Ash)

SPECIMEN INFORMATION (Initial)

Height: 6.01 inch Diameter: 2.82 inch Area: 6.26 in²
Water Content: 34.8 % Total Unit Weight: 107.3 pcf

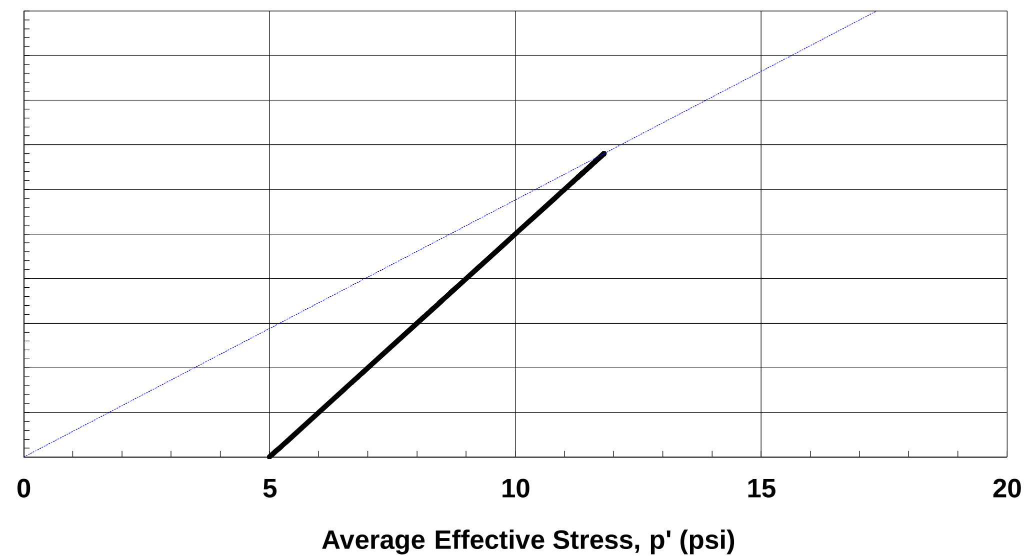


Failure Sketch

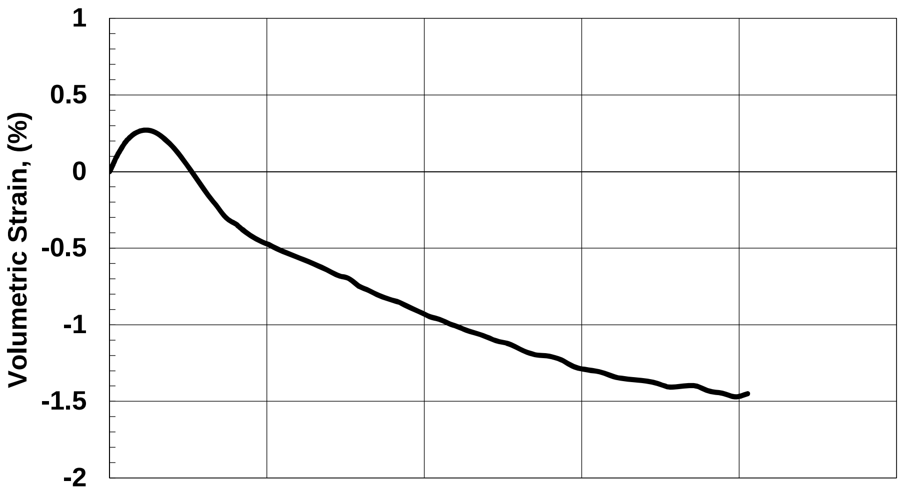
TEST SUMMARY

Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 35.9 % Total Unit Weight: 117.4 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 6.80 psi @ 8.8 % Strain
Peak Effective Friction Angle: 35.2°

REMARKS: Compression positive



Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas		**TerraSense, LLC**	Boring:B-13-8 Sample: SS-4A Depth: 8.1ft	September-13



SAMPLE INFORMATION

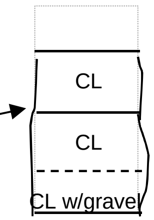
Boring: B-13-8 Sample: SS-4B Depth: 8.65 ft
Type: Intact tube sample
Description: CL/FA, dark brown clay with silt and sand layer (Fly-Ash layer)

SPECIMEN INFORMATION (Initial)

Height: 6.02 inch Diameter: 2.86 inch Area: 6.41 in²
Water Content: 28.0 % Total Unit Weight: 114.3 pcf

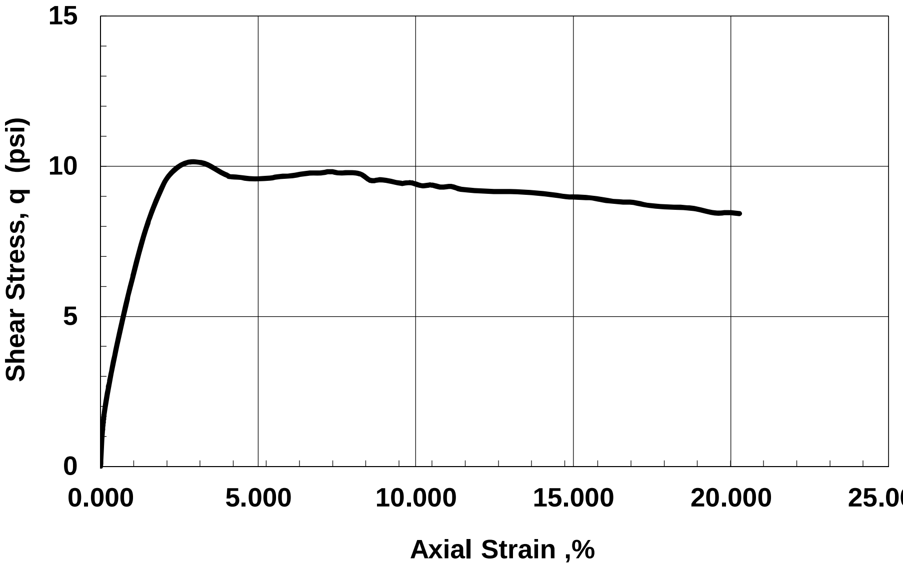
TEST SUMMARY

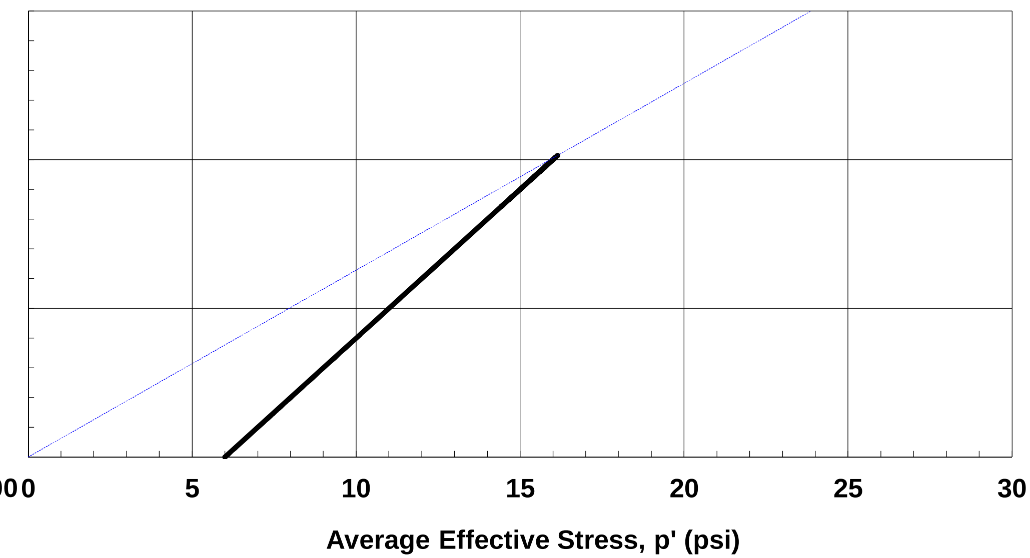
Consolidation Stresses: 6.00 psi vertical, 6.00 psi lateral
Water Content: 29.6 % Total Unit Weight: 117.8 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 10.14 psi @ 3.1 % Strain
Peak Effective Friction Angle: 38.9°



Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-8 Sample: SS-4B Depth: 8.65ft	September-13

SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth / Elev (ft)	USCS Group Symbol / Gs	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	$\sigma'_{c,max}$ (psi) / OCR	$\sigma'_{v,c}$ (psi) / $K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/hr)	at Peak Deviator Stress / at Peak Obliquity: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	A factor	ϕ' for c'=0
T3527	B-13-9	SS-3A	5.6	CL	17.5	132.6	112.9	4.00	4.00	0.5		20.4	12.53	25.81	2.89	-0.370	29.0
				(2.79)	18.6	136.0	114.6	1.0	1.00	1.5	1.1	1.7	5.59	8.71	4.58	0.078	39.9
T3528	B-13-9	SS-3B	6.15	CL	19.6	131.5	110.0	5.00	5.00	0.1		20.7	18.51	36.05	3.11	-0.339	30.9
				(2.79)	20.2	133.9	111.4	1.0	1.00	1.3	1.1	1.3	6.34	8.68	6.41	0.210	46.9

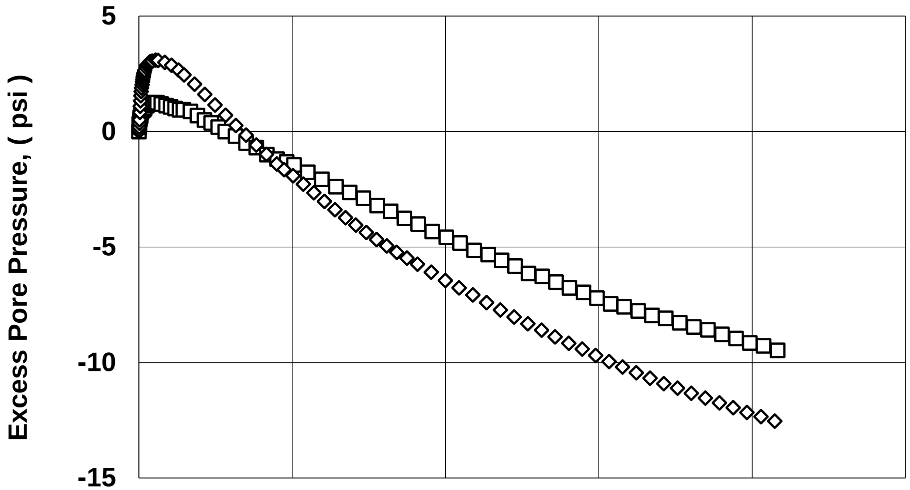
Test No	Description of Material Tested and Remarks
T3527	CL, brown lean clay
T3528	CL, brown lean clay

Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	30.3	0.000	26.8	0.000	--
	2	43.3	0.000	34.4	0.000	--

Failure Criteria: 1 - Peak Deviator Stress; 2 - Peak Obliquity

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-9 SS-3 SUMMARY	
TerraSense, LLC			**September 2013**

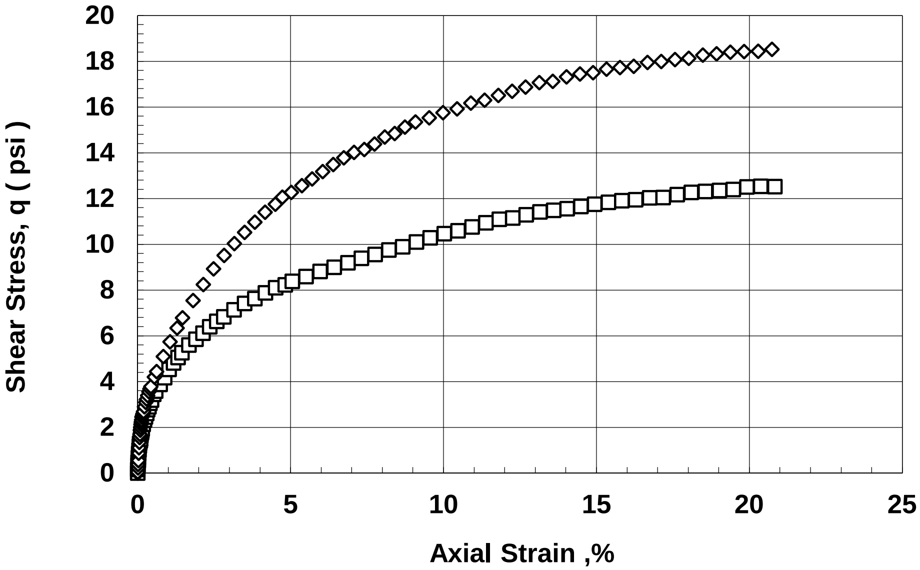


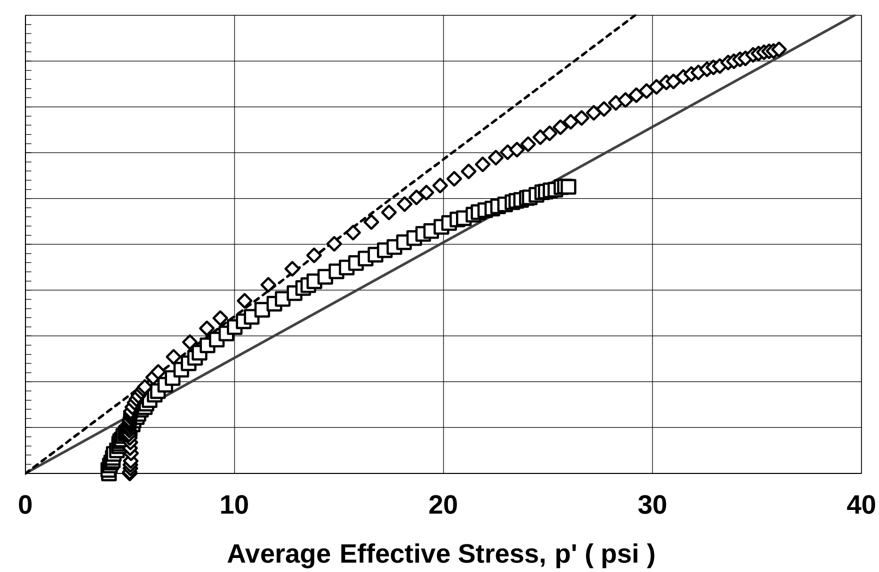
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T3527	B-13-9	SS-3A	5.6	17.5	132.6	4.00
◊	T3528	B-13-9	SS-3B	6.2	19.6	131.5	5.00

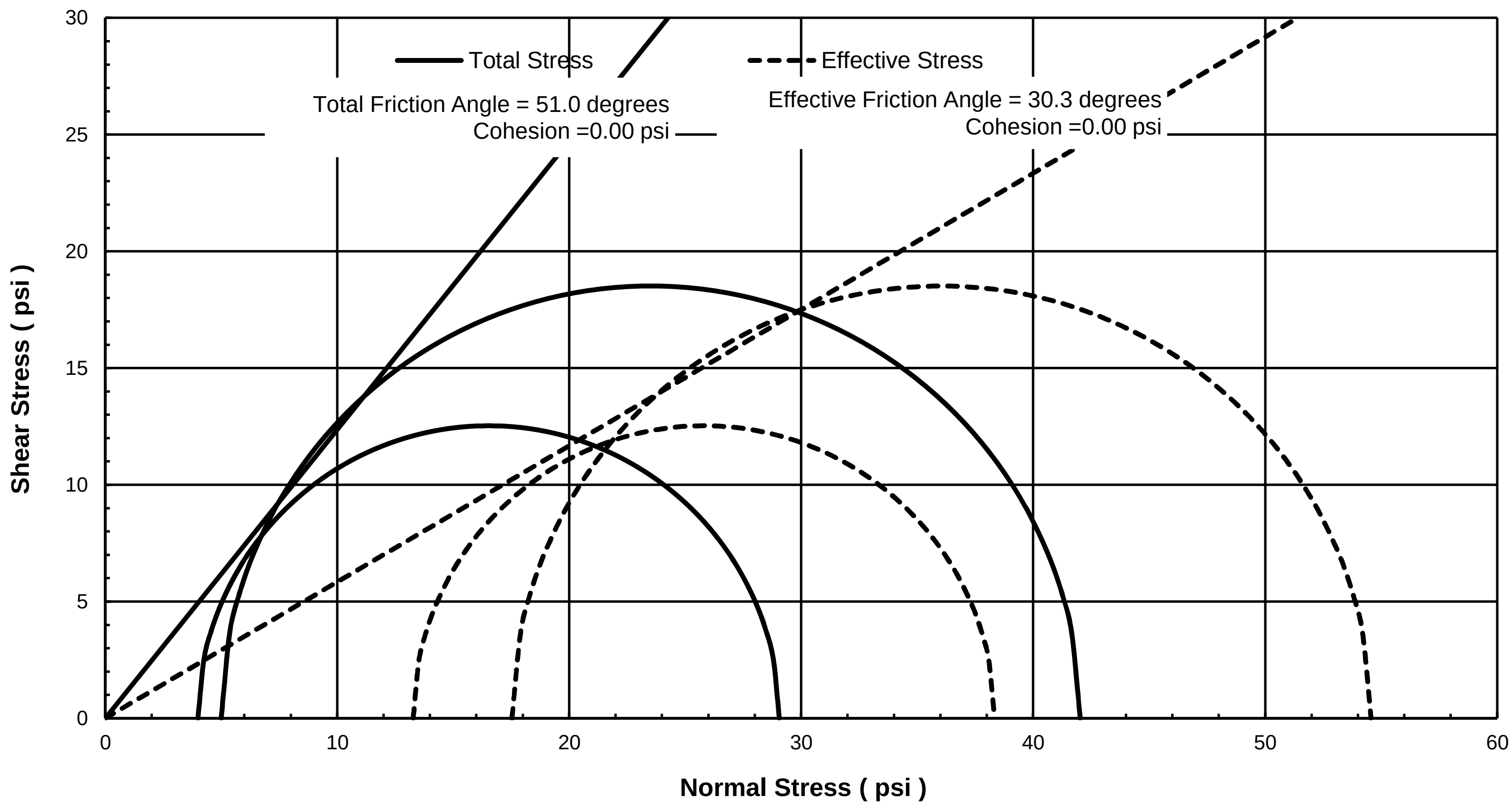
SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
——— (solid line)	Peak Deviator Stress	0.00	30.3
······· (dotted line)	Peak Obliquity	0.00	43.3





Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements B-13-9 SS-3 SUMMARY	Figure 1
Prepared by: C. Jordan Checked by: G. Thomas	**TerraSense, LLC**		September 2013



Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
TerraSense, LLC		B-13-9 SS-3 SUMMARY	September 2013

SAMPLE INFORMATION

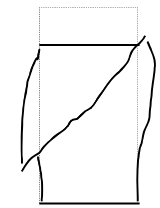
Boring: B-13-9 Sample: SS-3A Depth: 5.6ft
Type: Intact tube sample
Description: CL, brown lean clay

SPECIMEN INFORMATION (Initial)

Height: 6.03 inch Diameter: 2.88 inch Area: 6.50 in²
Water Content: 17.5 % Total Unit Weight: 132.6 pcf

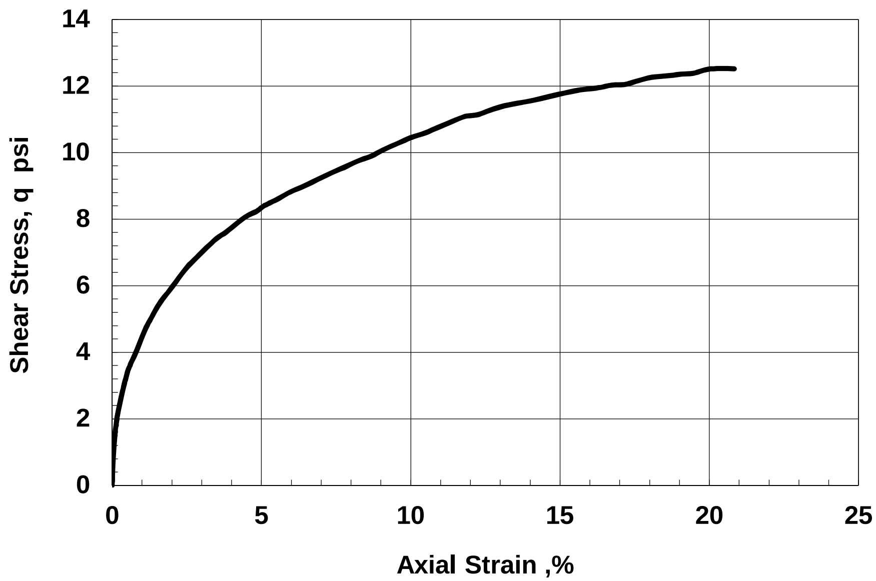
TEST SUMMARY

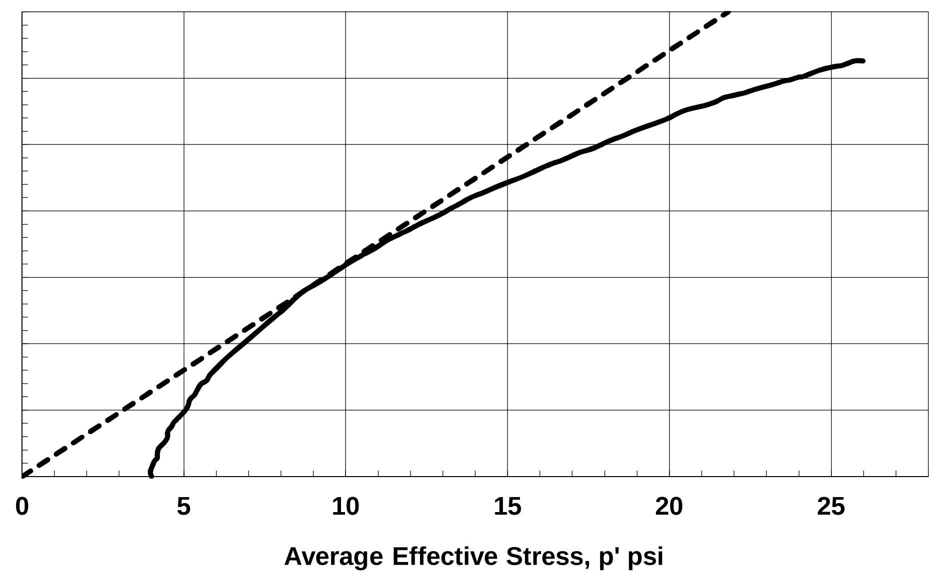
Consolidation Stresses: 4.00 psi vertical, 4.00 psi lateral
Water Content: 18.6 % Total Unit Weight: 136.0 pcf
B Coefficient: Strain Rate: 0.019 %/min
Peak Shear Strength: 12.53 psi @ 20.4 % Strain
Peak Effective Friction Angle: 39.9°



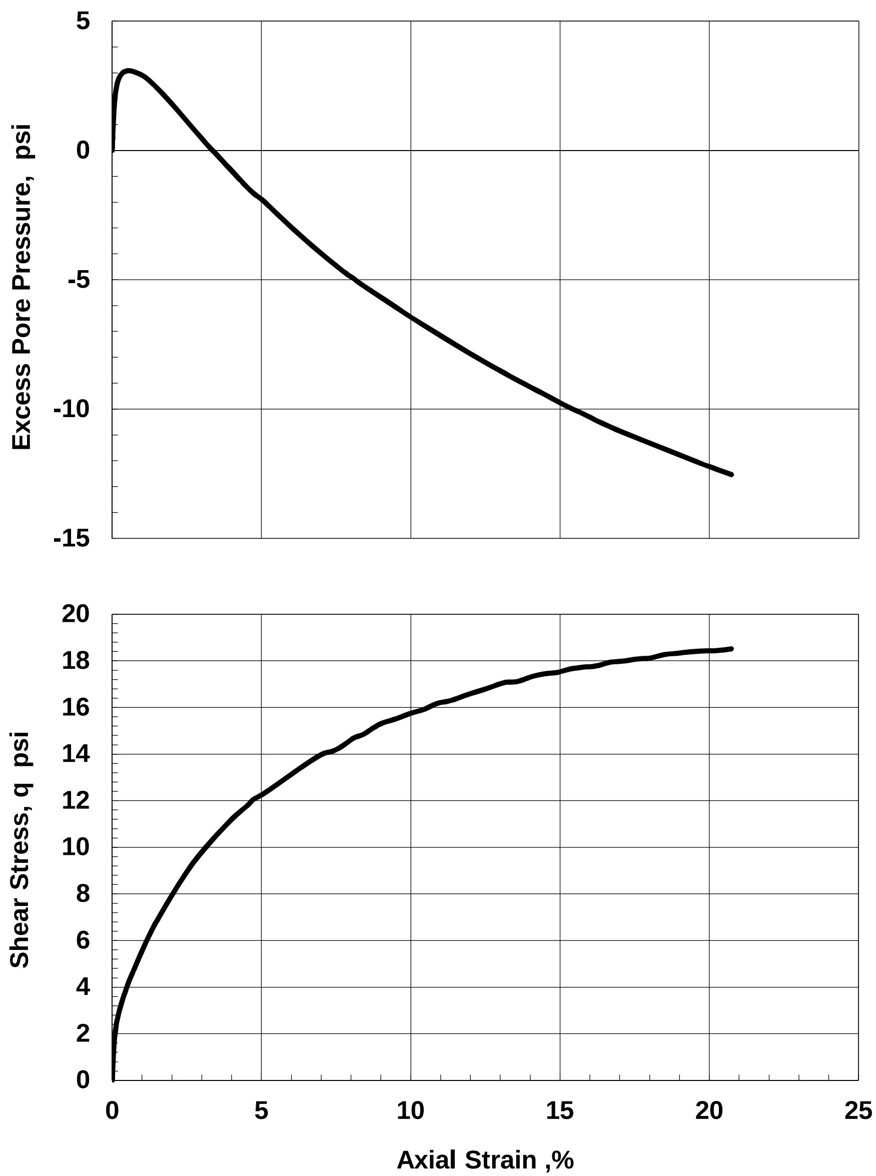
Failure Sketch

REMARKS:





Test by: DT	Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Boring: B-13-9 Sample: SS-3A	
Checked by: GET	TerraSense, LLC			September-13



SAMPLE INFORMATION

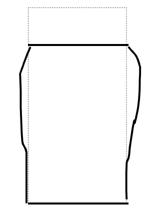
Boring: B-13-9 Sample: SS-3B Depth: 6.15ft
Type: Intact tube sample
Description: CL, brown lean clay

SPECIMEN INFORMATION (Initial)

Height: 6.03 inch Diameter: 2.88 inch Area: 6.51 in²
Water Content: 19.6 % Total Unit Weight: 131.5 pcf

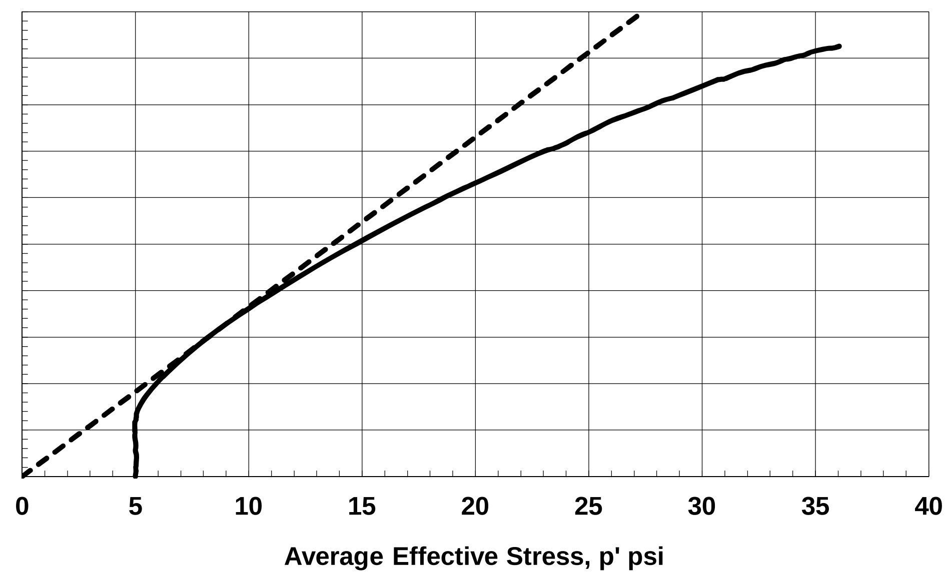
TEST SUMMARY

Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 20.2 % Total Unit Weight: 133.9 pcf
B Coefficient: Strain Rate: 0.019 %/min
Peak Shear Strength: 18.51 psi @ 20.7 % Strain
Peak Effective Friction Angle: 46.9°

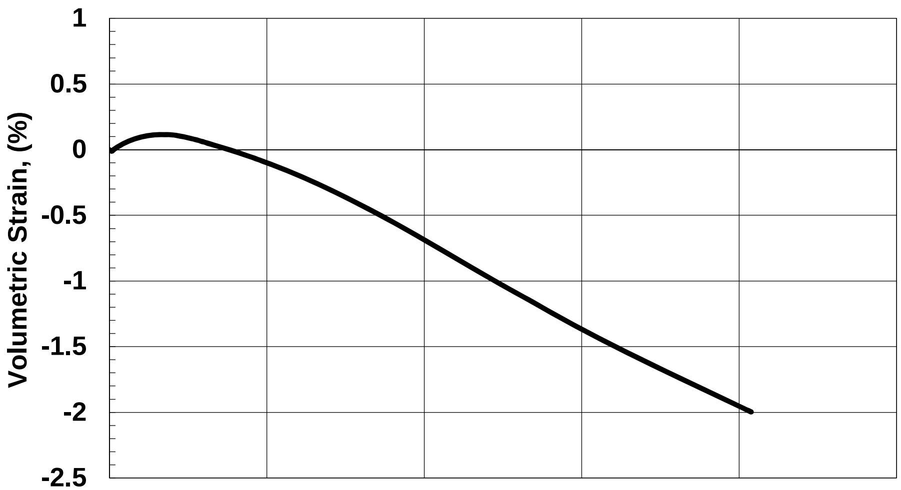


Failure Sketch

REMARKS:



Test by: DT	Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements
Checked by: GET	**TerraSense, LLC**		Boring: B-13-9 Sample: SS-3B
			September-13



SAMPLE INFORMATION

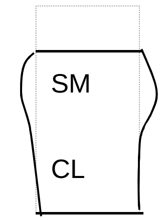
Boring: B-13-15 Sample: SS-3A Depth: 5.9 ft
Type: Intact tube sample
Description: SM/CL, Top: brown silty c-f sand; Bot.: gray clay
LL = 33 PL = 16 PI = 17

SPECIMEN INFORMATION (Initial)

Height: 6.04 inch Diameter: 2.85 inch Area: 6.40 in²
Water Content: 14.9 % Total Unit Weight: 133.2 pcf

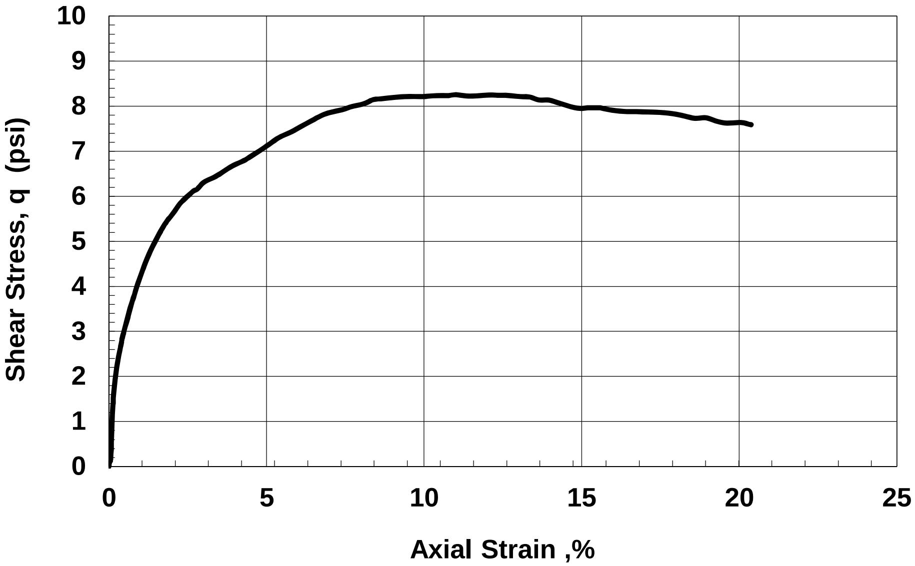
TEST SUMMARY

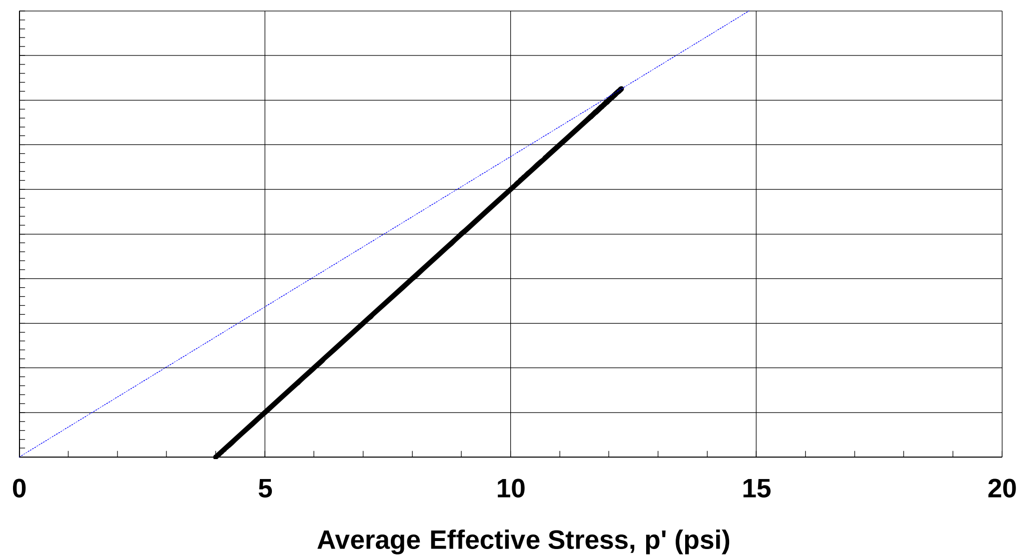
Consolidation Stresses: 4.00 psi vertical, 4.00 psi lateral
Water Content: 16.6 % Total Unit Weight: 137.5 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 8.25 psi @ 11.0 % Strain
Peak Effective Friction Angle: 42.3°



Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-15 Sample: SS-3A Depth: 5.9ft	September-13

SUMMARY OF TRIAXIAL CID-C TESTS ON UNDISTURBED SPECIMENS

Series Test No	Boring No / Sample No.	Depth (ft)	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	σ'_c (ksf) / OCR $\frac{\sigma'_{v,c}}{\sigma'_{v,max}}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/min)	at Peak Deviator Stress / at Large Strain: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	Vol. Strain ε_{vol} (%)	ϕ' for c'=0
TD415	B-13-15	15.3	34.7	105.0	77.9	5.0	0.8	0.0	5.9	7.4	12.4	3.94	-0.03	36.5
	SS-6A		35.7	108.5	79.9	1.0	2.5	0.02	19.2	6.4	11.4	3.54	-0.96	34.0
TD417	B-13-15	15.9	31.3	105.9	80.6	10.0	1.2	98.5	4.4	14.2	24.2	3.84	-0.18	35.9
	SS-6B		33.8	111.4	83.2	1.0	3.1	0.02	19.2	11.1	21.1	3.23	-0.75	31.8

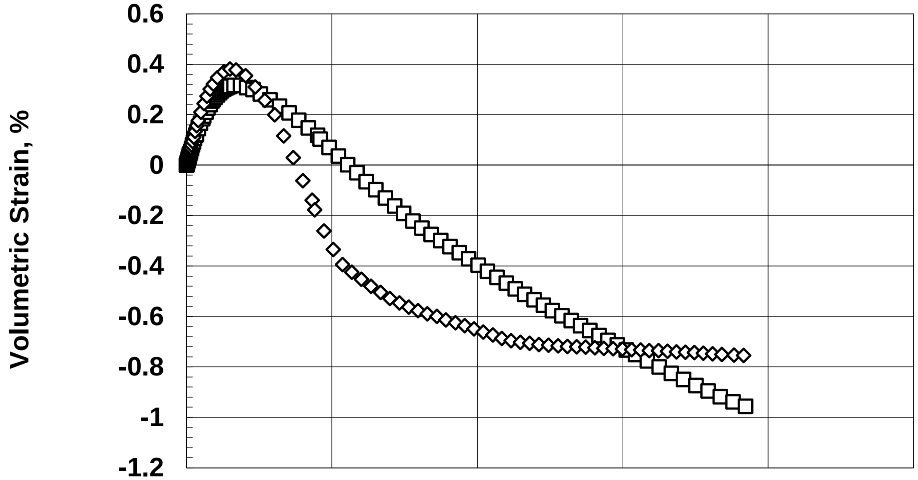
Test No	Description of Material Tested and Remarks
TD415	FA, gray silt with sand (Fly-Ash)
TD417	FA, gray silt with sand (Fly-Ash)

Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	35.3	0.274	30.0	0.224	1.000
	2	29.3	0.131	26.1	0.114	1.000

Failure Criteria: 1 - Peak Deviator Stress; 2 - Large Strain

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
TerraSense, LLC		B-13-15 SS-6 SUMMARY	September 2013

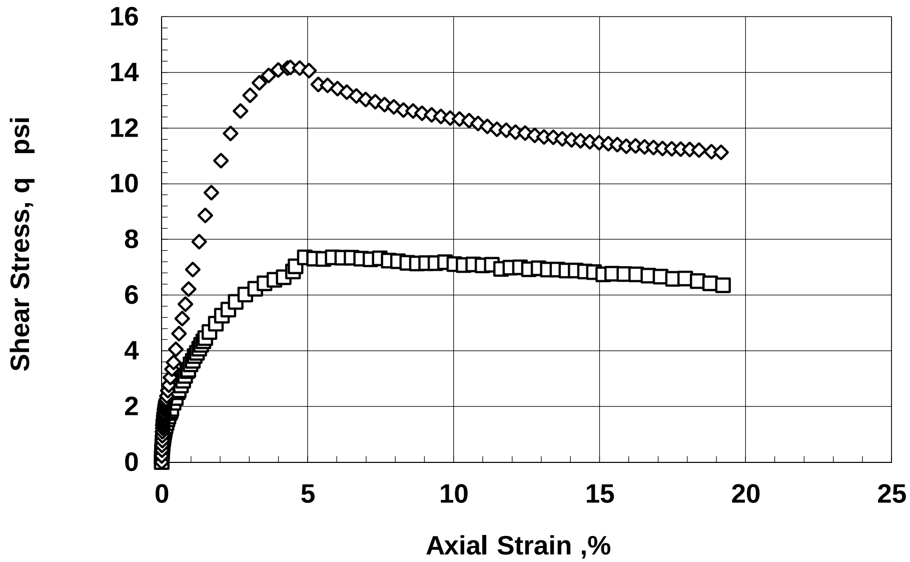


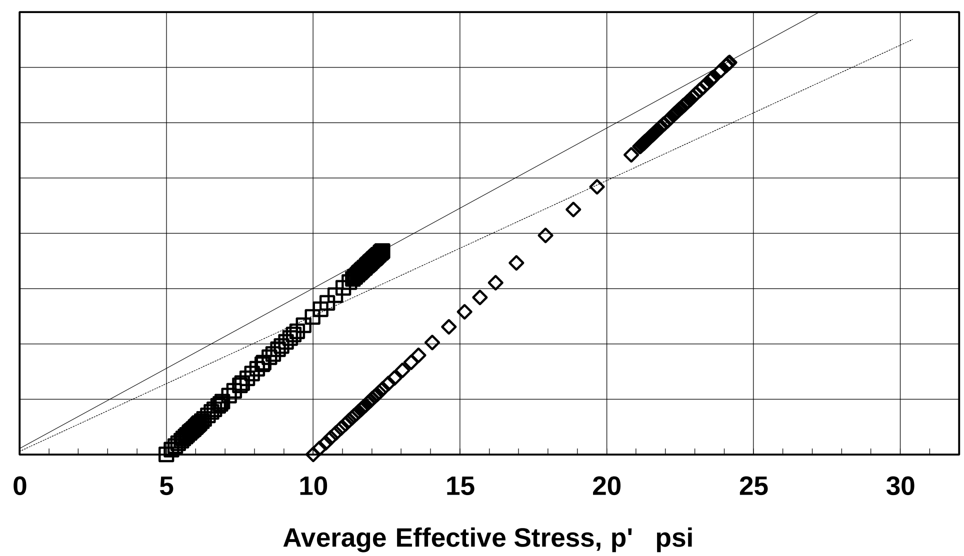
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	σ'_c (ksf)	w_c (%)	γ_{tc} (pcf)
□	TD415	B-13-15	15.3	5.0	35.7	108.5
◊	TD417	B-13-15	15.9	10.0	33.8	111.4
○	0	0	0	0.0	0.0	0.0

SERIES SUMMARY

Notation	Failure Criteria	c' psi	Φ' (degrees)
————	Peak Deviator Stress	0.27	35.3
-----------	Large Strain	0.13	29.3

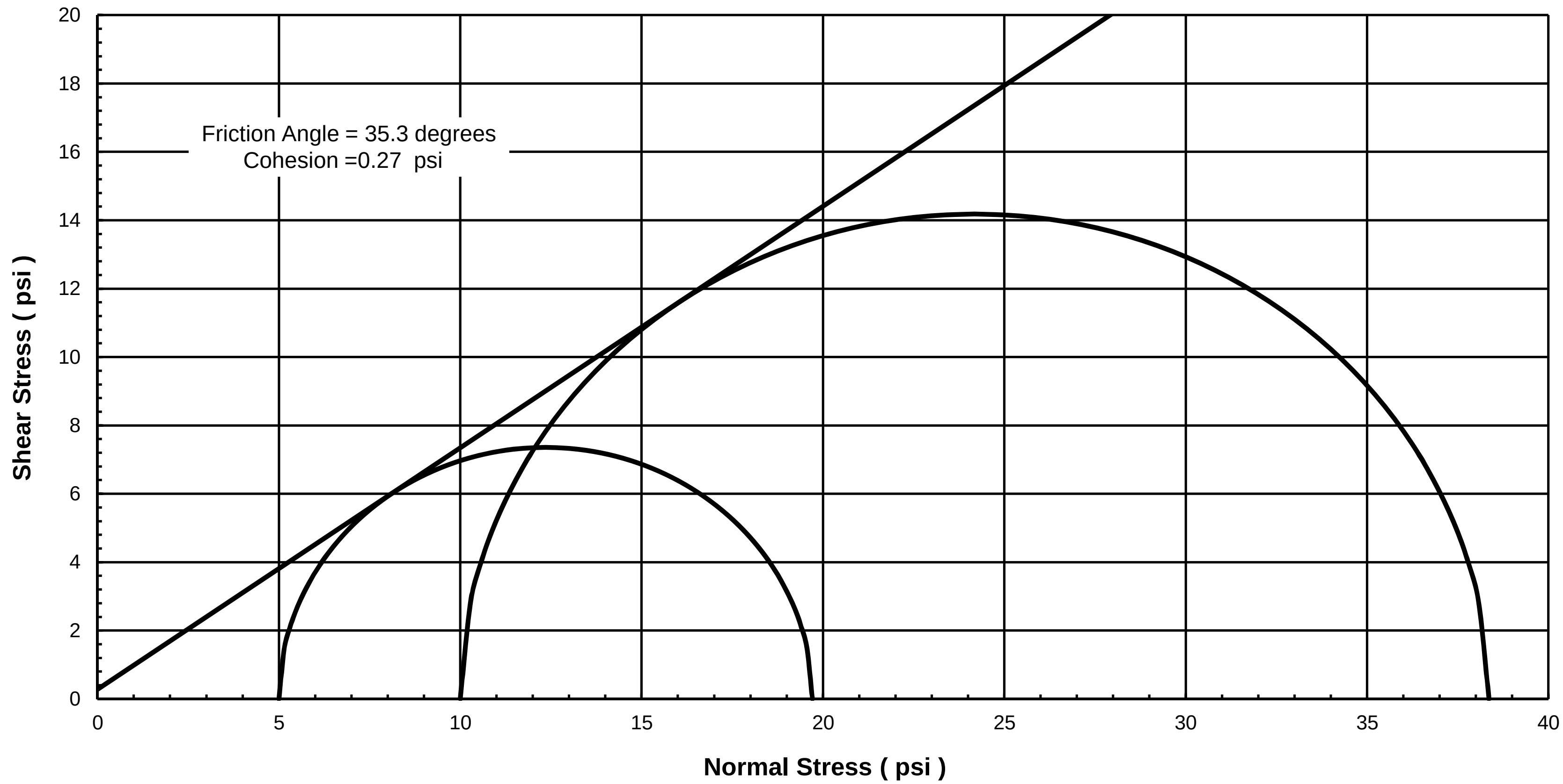




Project No. T21562906	**URS Corporation #21562906 Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	Figure 1
TerraSense, LLC		B-13-15 SS-6 SUMMARY	September 2013

Prepared by: CMJ
Checked by: G. Thomas

Analysis File: CIDsum.xls (9/13) Cdsum1c.xlsx 9/20/2013



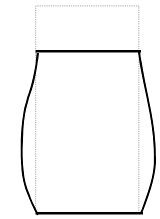
Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circle at Peak CD Triaxial Tests	Figure 2
TerraSense, LLC		B-13-15 SS-6 SUMMARY	September 2013

SAMPLE INFORMATION

Boring: B-13-15 Sample: SS-6A Depth: 15.3 ft
Type: Intact tube sample
Description: FA, gray silt with sand (Fly-Ash)

SPECIMEN INFORMATION (Initial)

Height: 6.01 inch Diameter: 2.82 inch Area: 6.24 in²
Water Content: 34.7 % Total Unit Weight: 105.0 pcf

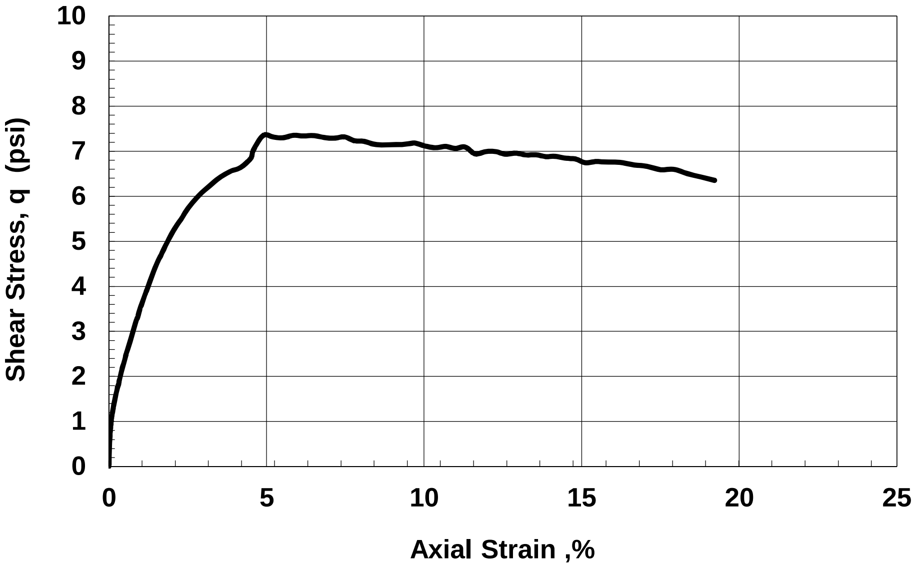


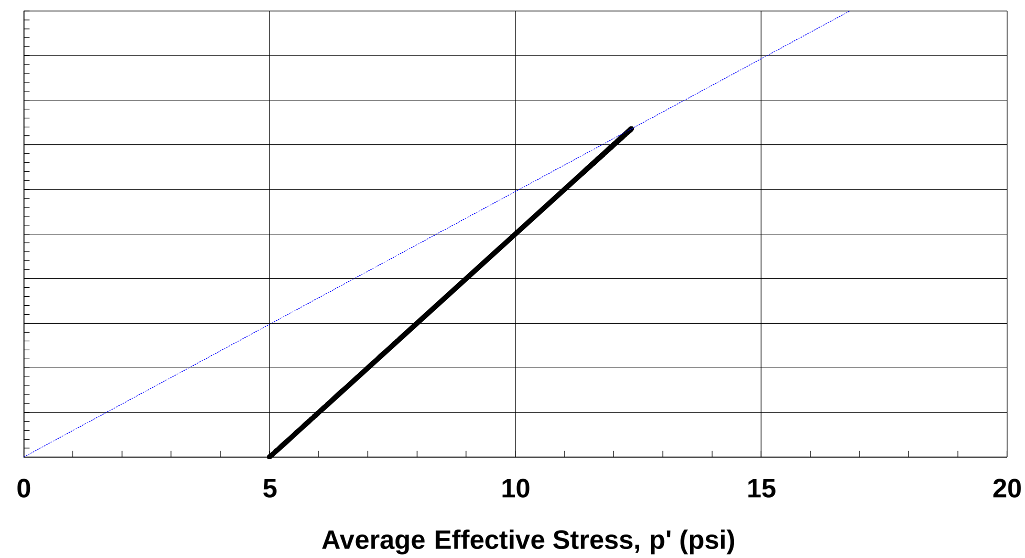
Failure Sketch

TEST SUMMARY

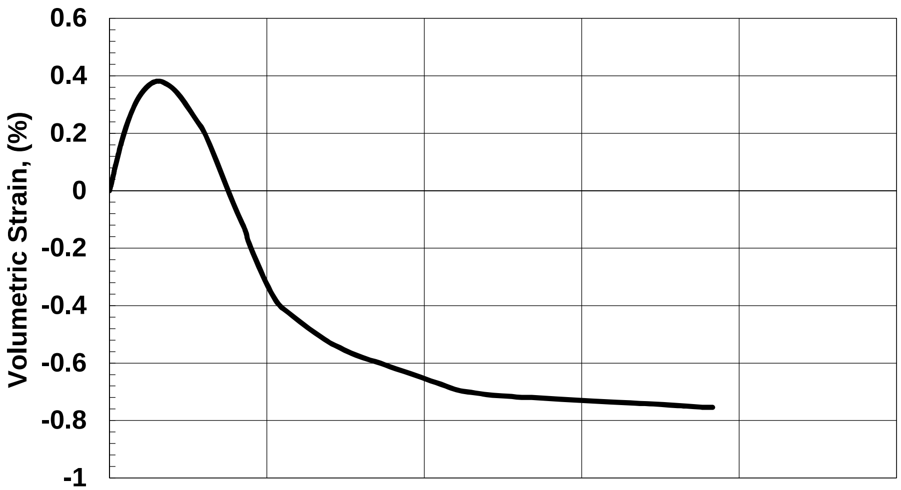
Consolidation Stresses: 5.00 psi vertical, 5.00 psi lateral
Water Content: 35.7 % Total Unit Weight: 108.5 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 7.36 psi @ 5.9 % Strain
Peak Effective Friction Angle: 36.5°

REMARKS: Compression positive





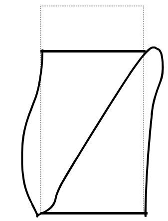
Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas		**TerraSense, LLC**	Boring:B-13-15 Sample: SS-6A Depth: 15.3ft	September-13



SAMPLE INFORMATION
Boring: B-13-15 Sample: SS-6B Depth: 15.9 ft
Type: Intact tube sample
Description: FA, gray silt with sand (Fly-Ash)

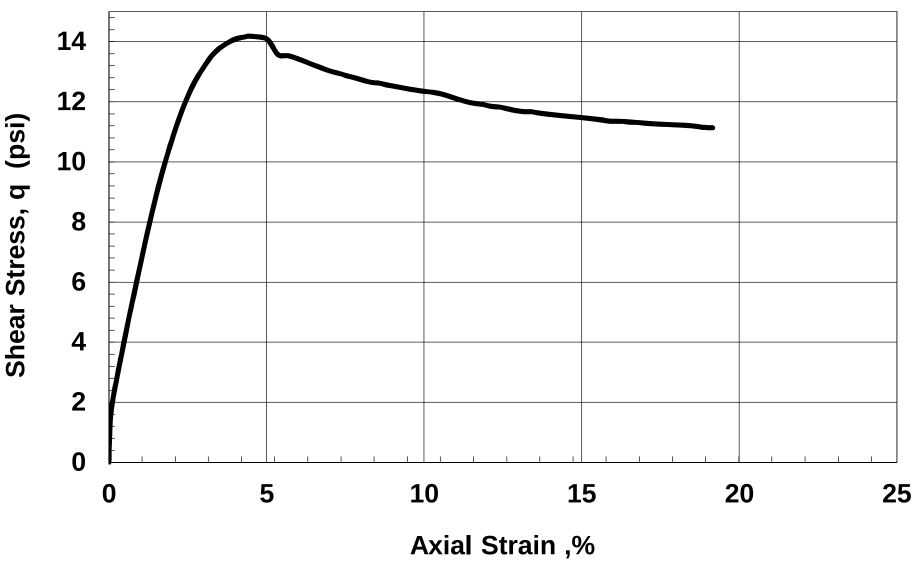
SPECIMEN INFORMATION (Initial)
Height: 5.98 inch Diameter: 2.84 inch Area: 6.33 in²
Water Content: 31.3 % Total Unit Weight: 105.9 pcf

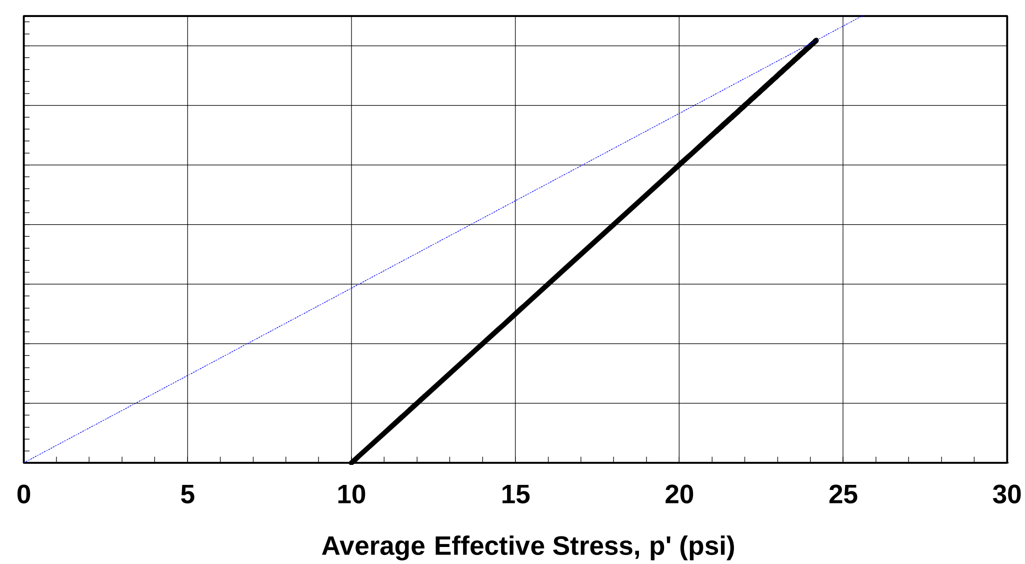
TEST SUMMARY
Consolidation Stresses: 10.00 psi vertical, 10.00 psi lateral
Water Content: 33.8 % Total Unit Weight: 111.4 pcf
B Coefficient: 98.5 Strain Rate: 0.018 %/min
Peak Shear Strength: 14.18 psi @ 4.4 % Strain
Peak Effective Friction Angle: 35.9°



Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-15 Sample: SS-6B Depth: 15.9ft	September-13

SUMMARY OF TRIAXIAL CID-C TESTS ON UNDISTURBED SPECIMENS

Series Test No	Boring No / Sample No.	Depth (ft)	w_o / w_c (%)	$\gamma_{t,o}$ / $\gamma_{t,c}$ (pcf)	$\gamma_{d,o}$ / $\gamma_{d,c}$ (pcf)	σ'_c (ksf) / OCR $\sigma'_{v,c}/\sigma'_{v,max}$	$\varepsilon_{a,c}$ / $\varepsilon_{v,c}$ (%)	B factor (%) / ε_{rate} (%/min)	at Peak Deviator Stress / at Large Strain: ε_a (%)	$\frac{\sigma_1 - \sigma_3}{2}$ (psi)	$\frac{\sigma'_1 + \sigma'_3}{2}$ (psi)	σ'_1 / σ'_3	Vol. Strain ε_{vol} (%)	ϕ' for c'=0
TD418	B-13-17	2.85	27.1	107.8	84.8	2.0	0.3	98.5	12.9	3.1	5.1	4.08	0.24	37.3
	SS-2A		34.8	115.3	85.6	1.0	0.9	0.02	21.4	2.9	4.9	3.89	-0.16	36.2
TD419	B-13-17	3.35	37.2	93.3	68.0	3.0	0.5	0.0	4.0	4.6	7.6	4.05	-0.11	37.1
	SS-2B		49.6	103.3	69.0	1.0	1.4	0.02	20.6	3.9	6.9	3.59	-0.66	34.4
TD420	B-13-17	3.9	36.6	97.6	71.5	4.0	0.7	0.0	2.1	8.8	12.8	5.42	-0.39	43.5
	SS-2C		45.7	106.5	73.1	1.0	2.3	0.02	19.5	6.6	10.6	4.32	-2.38	38.6

Test No	Description of Material Tested and Remarks
TD418	SC/FA, Top: brown clayey f. sand; Bot: gray silt with sand (Fly-Ash)
TD419	FA, gray silt with sand (Fly-Ash)
TD420	FA, gray silt with sand (Fly-Ash)

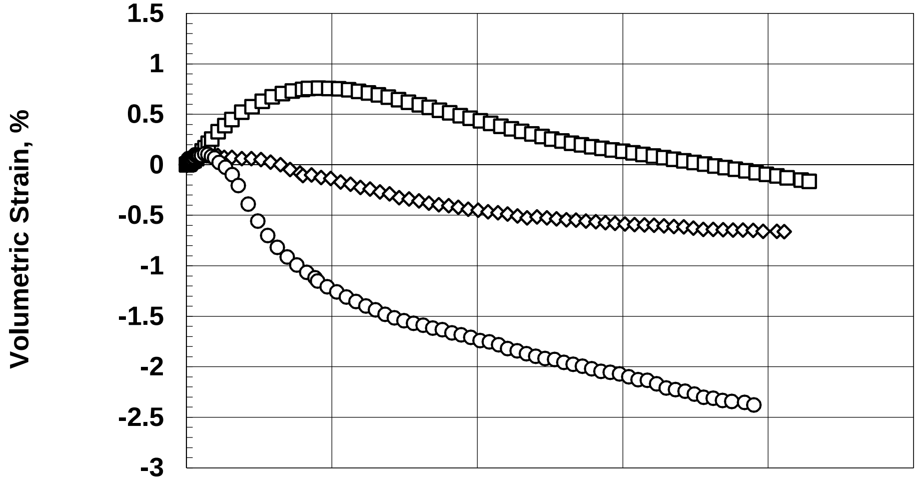
Strength Envelope Summary

Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	41.3	0.000	33.4	0.000	--
	2	37.2	0.000	31.1	0.000	--

Failure Criteria: 1 - Peak Deviator Stress; 2 - Large Strain

Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION B-13-17 SS-2 SUMMARY	September 2013

TerraSense, LLC

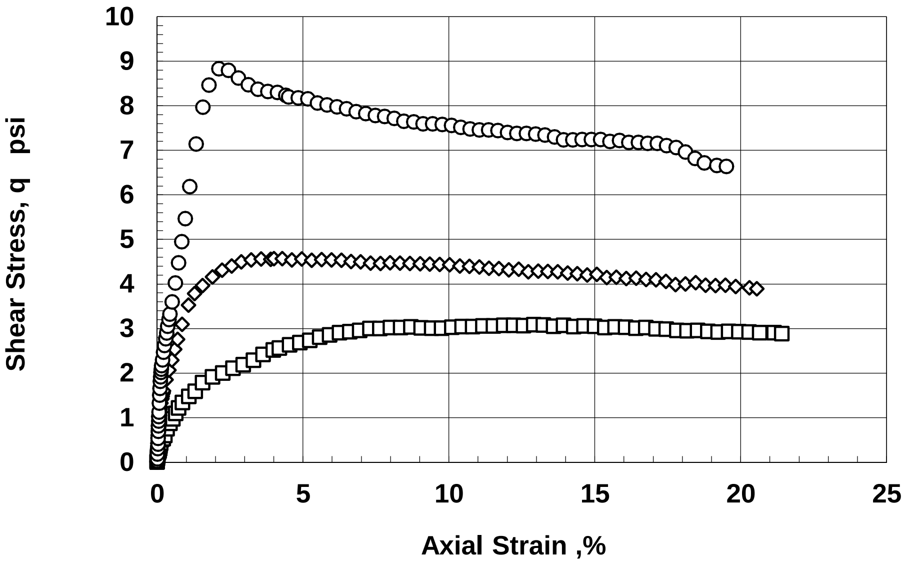


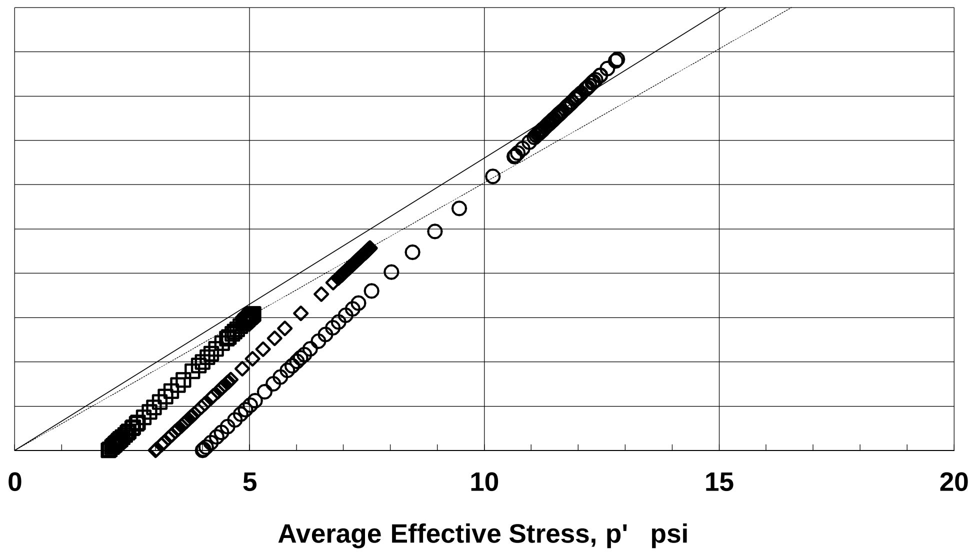
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	σ'c (ksf)	w_c (%)	γ_{tc} (pcf)
□	TD418	B-13-17	2.85	2.0	34.8	115.3
◊	TD419	B-13-17	3.35	3.0	49.6	103.3
○	TD420	B-13-17	3.9	4.0	45.7	106.5

SERIES SUMMARY

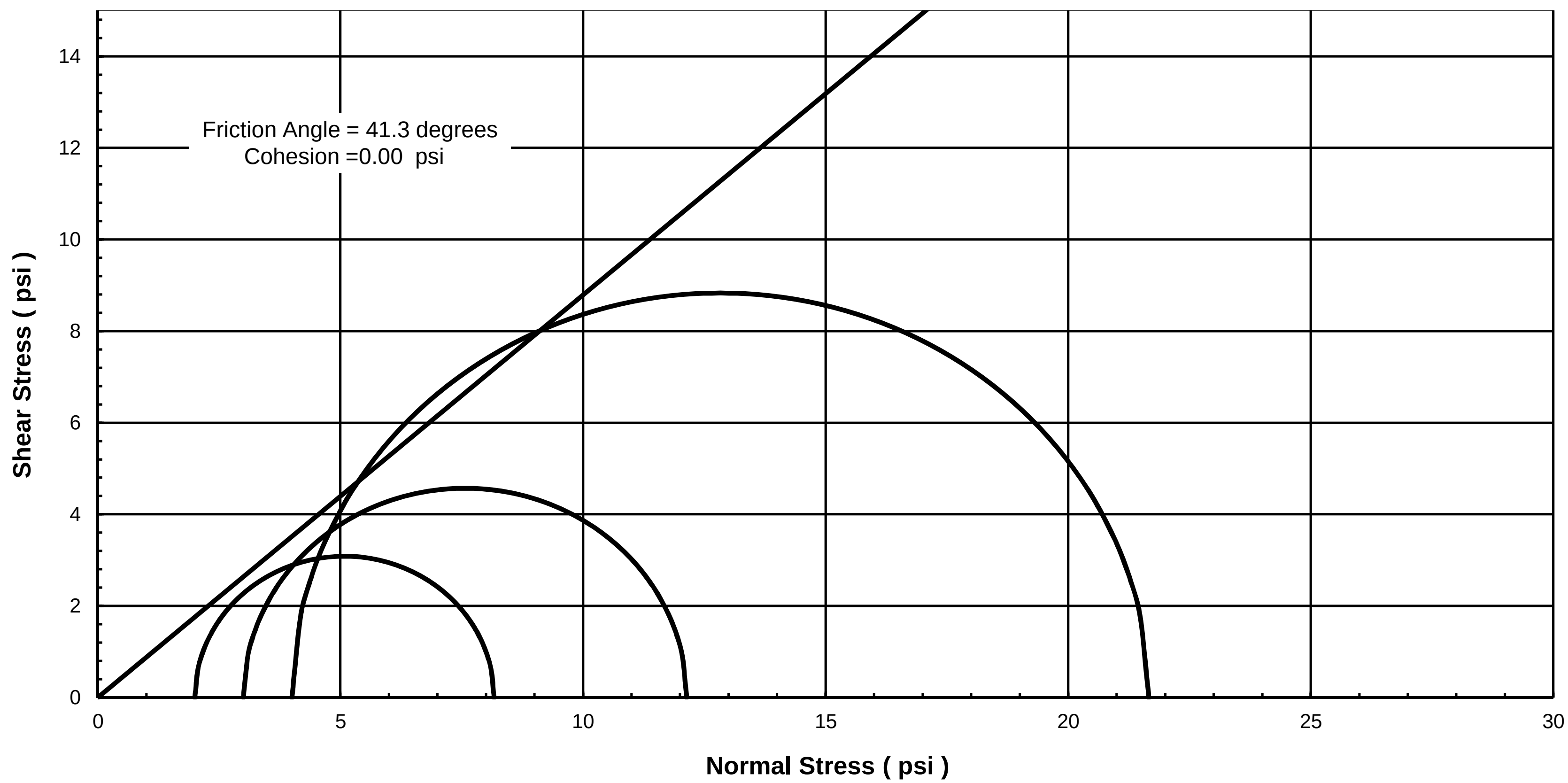
Notation	Failure Criteria	c' psi	Φ' (degrees)
———	Peak Deviator Stress	0.00	41.3
-----------	Large Strain	0.00	37.2



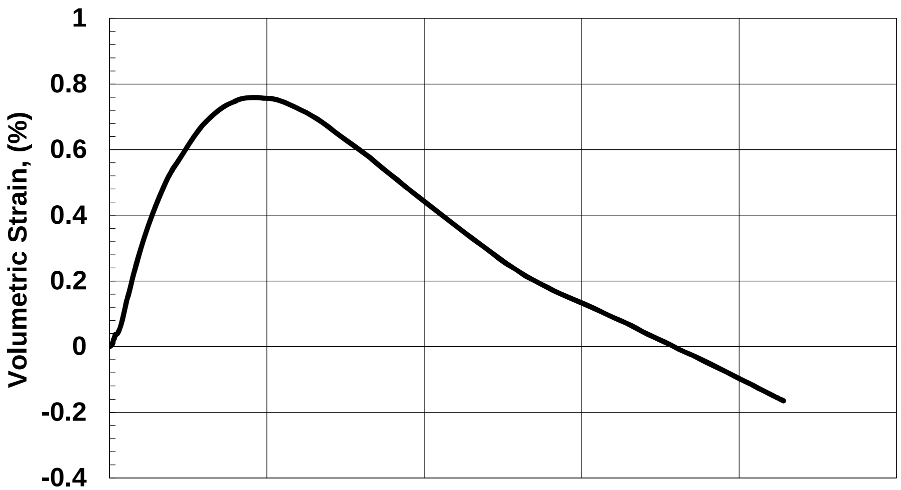


Project No. T21562906	**URS Corporation #21562906** **Dynegy Vermillion 2013**	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	Figure 1
Prepared by: CMJ Checked by: G. Thomas	**TerraSense, LLC**	B-13-17 SS-2 SUMMARY	September 2013

Analysis File: CIDsum.xls (9/13) Cdsum1d.xlsx 9/20/2013



Project No. T21562906	URS Corporation #21562906 Dynegy Vermillion 2013	Mohr Circle at Peak CD Triaxial Tests	Figure 2
TerraSense, LLC		B-13-17 SS-2 SUMMARY	September 2013



SAMPLE INFORMATION

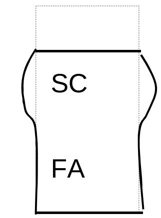
Boring: B-13-17 Sample: SS-2A Depth: 2.85 ft
Type: Intact tube sample
Description: SC/FA, Top: brown clayey f. sand; Bot: gray silt with sand (Fly-Ash)

SPECIMEN INFORMATION (Initial)

Height: 5.76 inch Diameter: 2.86 inch Area: 6.41 in²
Water Content: 27.1 % Total Unit Weight: 107.8 pcf

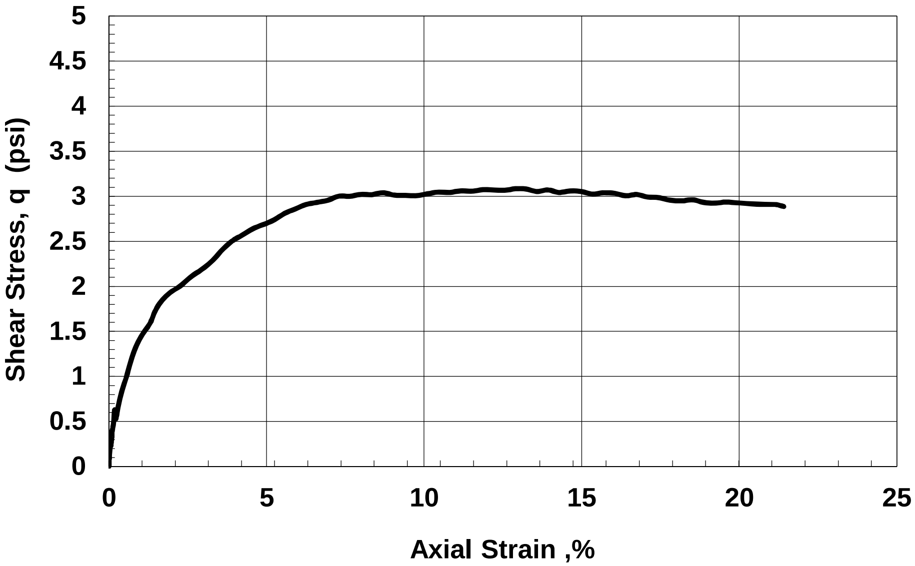
TEST SUMMARY

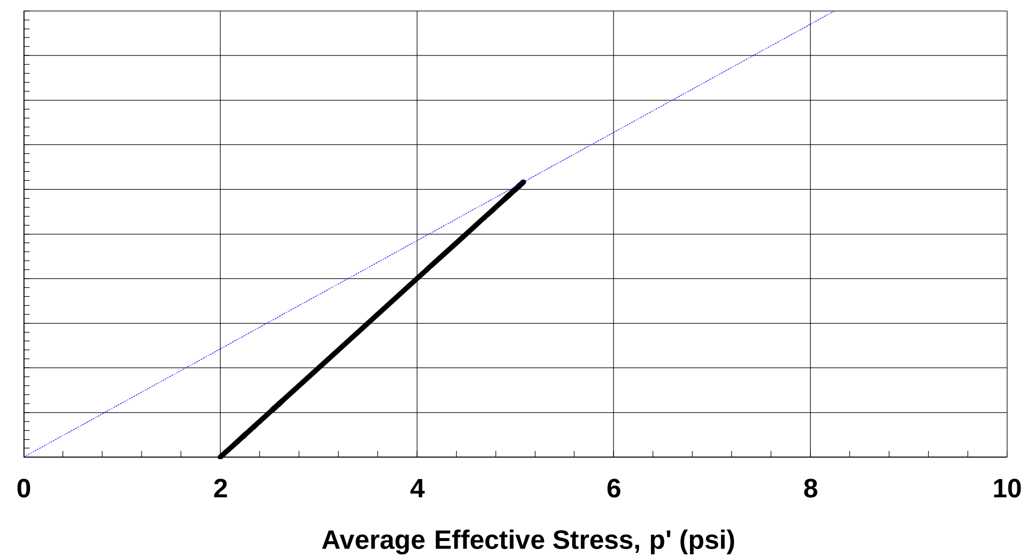
Consolidation Stresses: 2.00 psi vertical, 2.00 psi lateral
Water Content: 34.8 % Total Unit Weight: 115.3 pcf
B Coefficient: 98.5 Strain Rate: 0.019 %/min
Peak Shear Strength: 3.08 psi @ 12.9 % Strain
Peak Effective Friction Angle: 37.3°



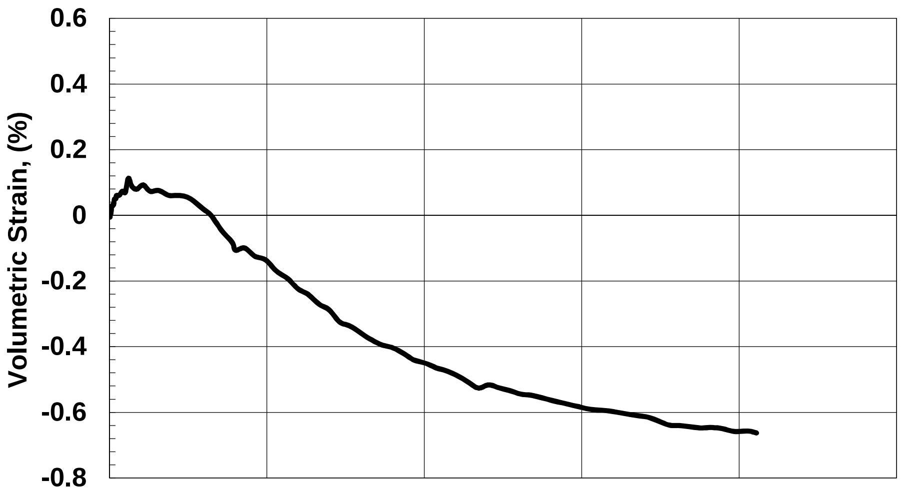
Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	TerraSense, LLC		Boring:B-13-17 Sample: SS-2A Depth: 2.85ft	September-13



SAMPLE INFORMATION

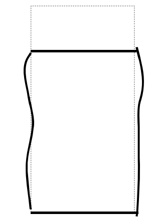
Boring: B-13-17 Sample: SS-2B Depth: 3.35 ft
Type: Intact tube sample
Description: FA, gray silt with sand (Fly-Ash)
LL = 44 PL = 35 PI = 9

SPECIMEN INFORMATION (Initial)

Height: 6.00 inch Diameter: 2.87 inch Area: 6.47 in²
Water Content: 37.2 % Total Unit Weight: 93.3 pcf

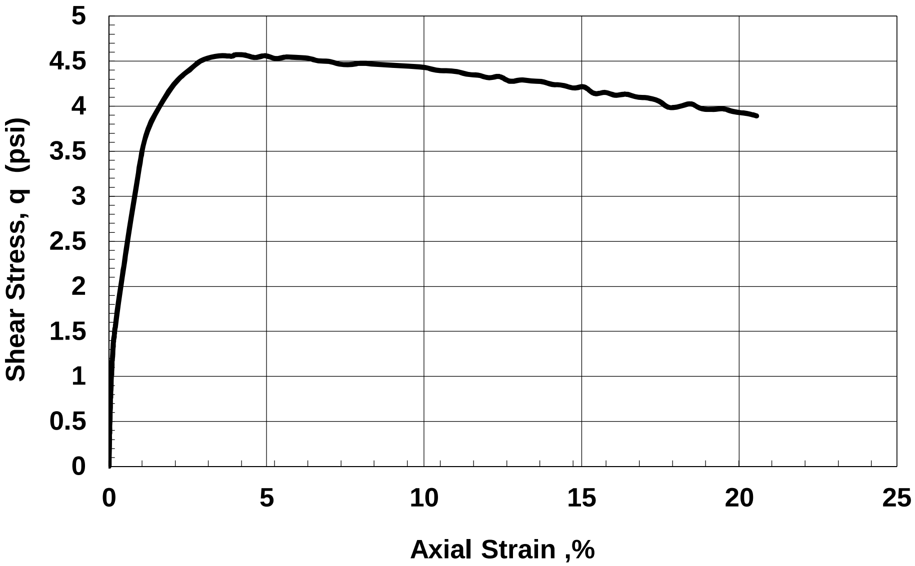
TEST SUMMARY

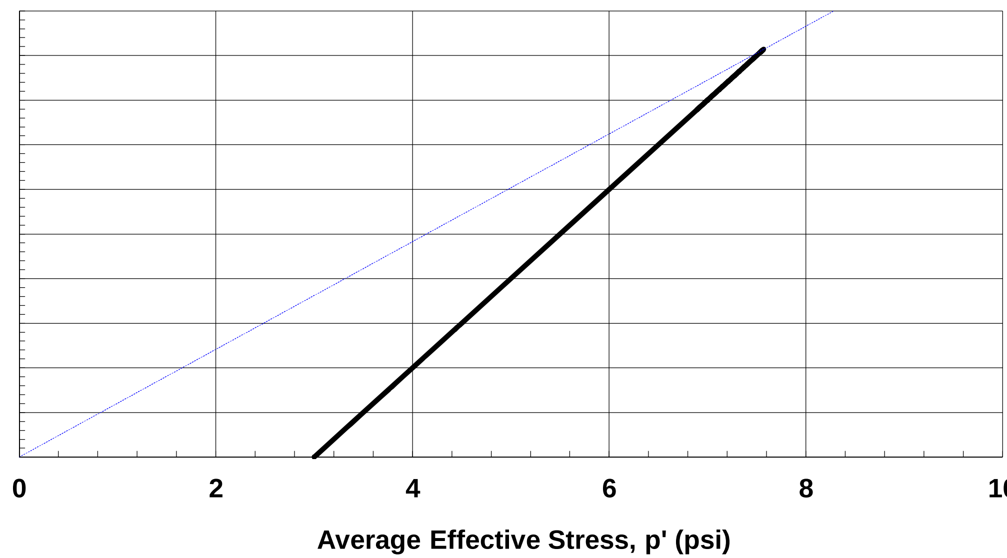
Consolidation Stresses: 3.00 psi vertical, 3.00 psi lateral
Water Content: 49.6 % Total Unit Weight: 103.3 pcf
B Coefficient: Strain Rate: 0.019 %/min
Peak Shear Strength: 4.57 psi @ 4.0 % Strain
Peak Effective Friction Angle: 37.1°



Failure Sketch

REMARKS: Compression positive

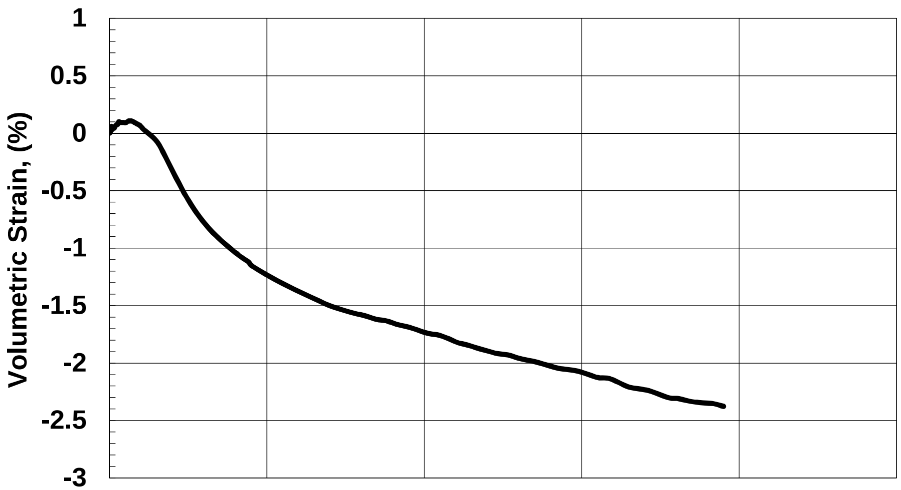




Test by: D. Tso

Checked by: G. Thomas

Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
	TerraSense, LLC	Boring:B-13-17 Sample: SS-2B Depth: 3.35ft	September-13



SAMPLE INFORMATION

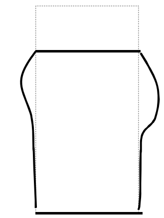
Boring: B-13-17 Sample: SS-2C Depth: 3.9 ft
Type: Intact tube sample
Description: FA, gray silt with sand (Fly-Ash)

SPECIMEN INFORMATION (Initial)

Height: 5.90 inch Diameter: 2.87 inch Area: 6.48 in²
Water Content: 36.6 % Total Unit Weight: 97.6 pcf

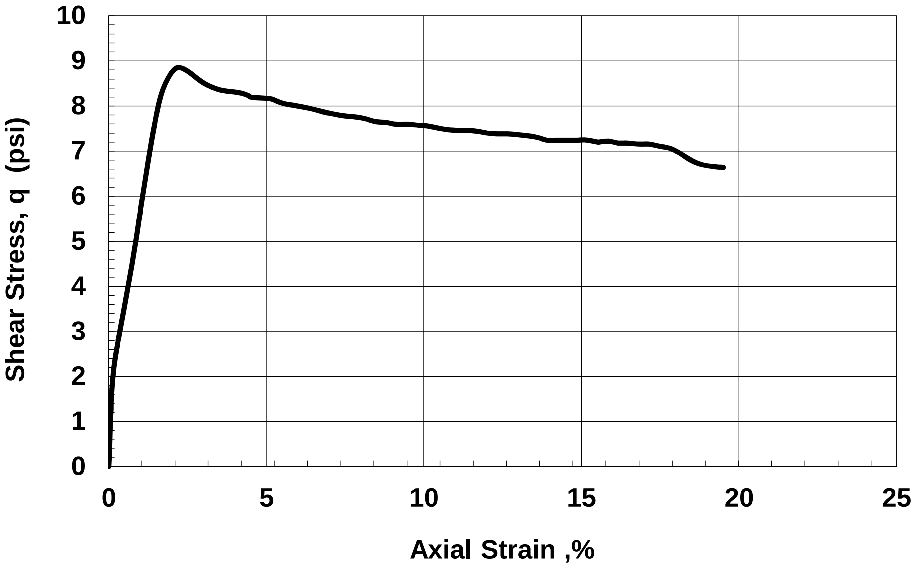
TEST SUMMARY

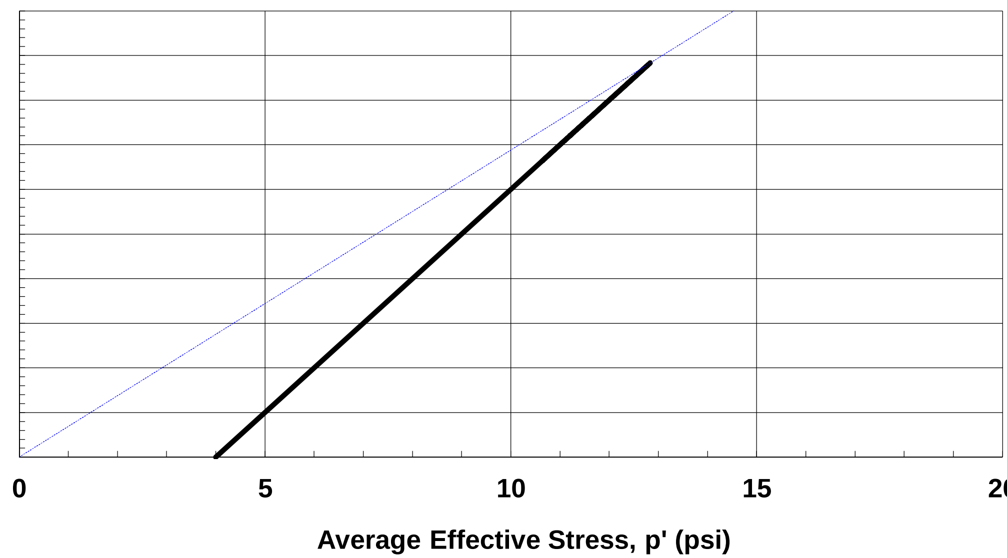
Consolidation Stresses: 4.00 psi vertical, 4.00 psi lateral
Water Content: 45.7 % Total Unit Weight: 106.5 pcf
B Coefficient: Strain Rate: 0.018 %/min
Peak Shear Strength: 8.83 psi @ 2.1 % Strain
Peak Effective Friction Angle: 43.5°



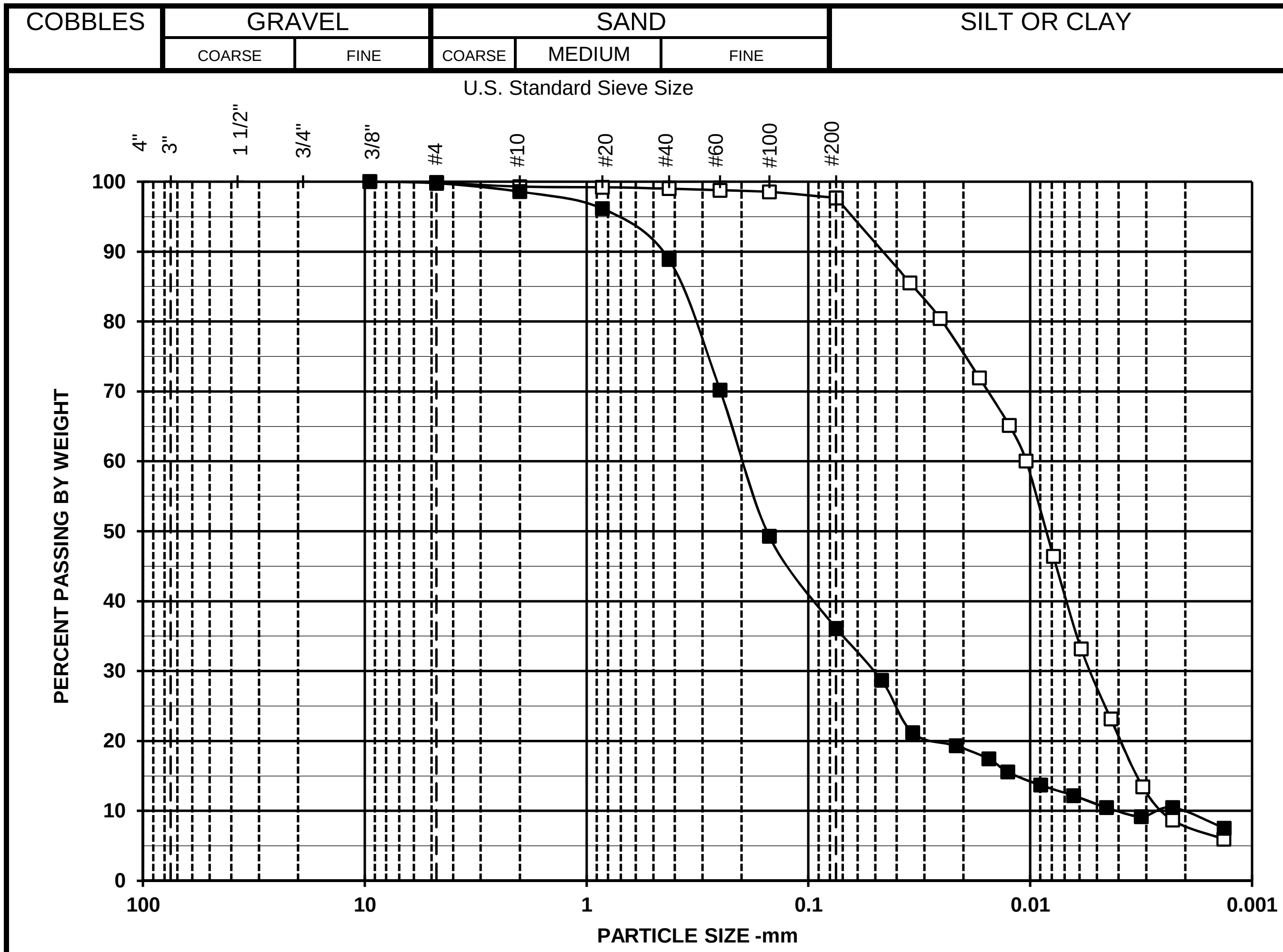
Failure Sketch

REMARKS: Compression positive





Test by: D. Tso	Project No. T21562906	URS #21562906 Dynegy Vermillion 2013	CONSOLIDATED DRAINED TRIAXIAL COMPRESSION	
Checked by: G. Thomas	**TerraSense, LLC**		Boring:B-13-17 Sample: SS-2C Depth: 3.9ft	September-13



SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	38.8				CL	Gray, Lean clay	8/26/2013
■	17.8				SC	Gray, Clayey sand	8/26/2013
○							

Symbol	□	■	○
Boring	B-13-1	B-13-2	
Sample	SS-6	SS-7	
Depth	15-16.5	20-21.5	
% +3"	0.0	0.0	
% Gravel	0.1	0.2	
% SAND	2.2	63.7	
%C SAND	0.6	1.2	
%M SAND	0.3	9.7	
%F SAND	1.3	52.8	
% FINES	97.7	36.1	
% -2μ	8	10	
D_{100} (mm)	9.50	9.50	
D_{60} (mm)	0.01	0.20	
D_{30} (mm)	0.01	0.05	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0	100.0	
4	99.9	99.8	
10	99.3	98.6	
20	99.2	96.2	
40	99.0	88.9	
60	98.8	70.2	
100	98.5	49.3	
200	97.7	36.1	

TerraSense, LLC	**URS**
T21562906	21562906

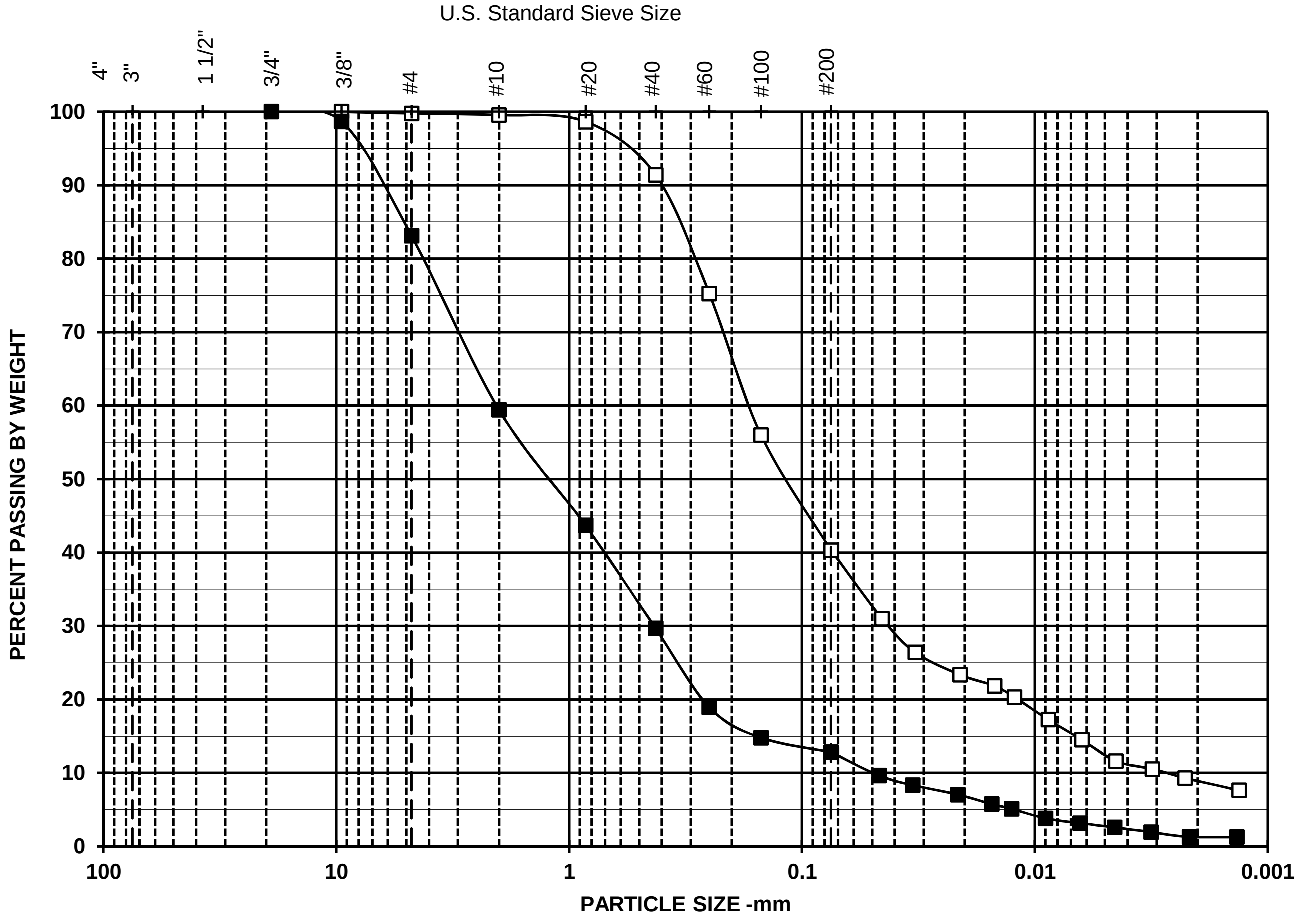
PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev2a.xls 9/20/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	17.1				SC	Brown, Clayey sand	8/26/2013
■	10.1				SM	Brown, Silty sand with gravel	8/25/2013
○							

Symbol	□	■	○
Boring	B-13-4	B-13-9	
Sample	SS-5	SS-14	
Depth	10-12	60-61.5	
% +3"	0.0	0.0	
% Gravel	0.2	16.9	
% SAND	59.5	70.3	
%C SAND	0.2	23.7	
%M SAND	8.2	29.7	
%F SAND	51.1	16.8	
% FINES	40.3	12.8	
% -2µ	9	1	
D_{100} (mm)	9.50	19.00	
D_{60} (mm)	0.17	2.07	
D_{30} (mm)	0.04	0.43	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"		100.0	
3/8"	100.0	98.7	
4	99.8	83.1	
10	99.6	59.4	
20	98.6	43.7	
40	91.4	29.7	
60	75.2	18.9	
100	56.0	14.8	
200	40.3	12.8	

TerraSense, LLC	**URS**
T21562906	21562906

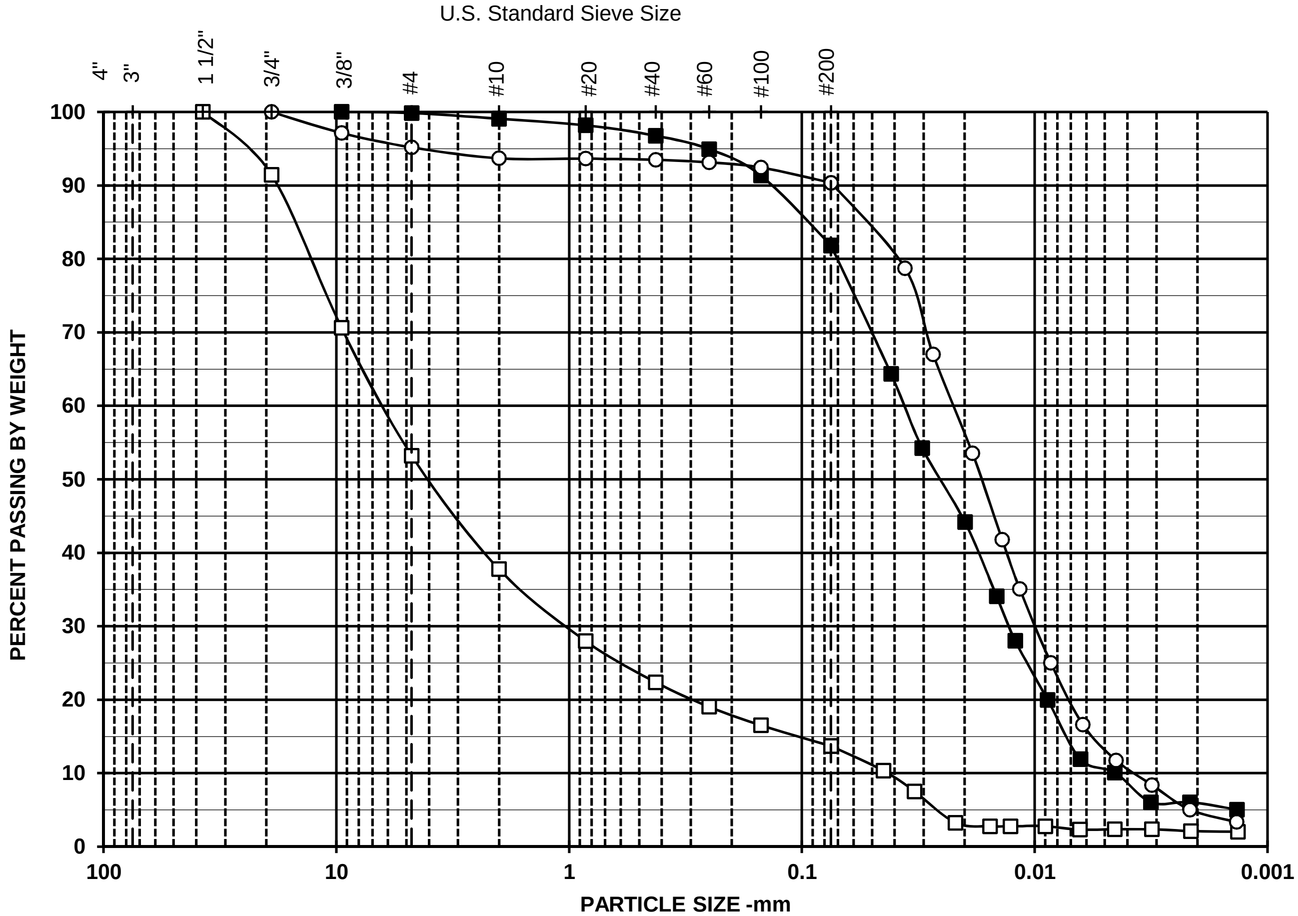
PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev2b.xls 9/20/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	B-13-11	B-13-11	B-13-11
Sample	SS-6	SS-10	SS-13
Depth	15-16.5	35-36.5	50-51.5
% +3"	0.0	0.0	0.0
% Gravel	46.8	0.1	4.8
% SAND	39.5	18.1	4.8
%C SAND	15.5	0.8	1.5
%M SAND	15.4	2.3	0.2
%F SAND	8.7	14.9	3.1
% FINES	13.7	81.8	90.4
% -2μ	2	6	5
D_{100} (mm)	37.50	9.50	19.00
D_{60} (mm)	6.60	0.04	0.02
D_{30} (mm)	1.09	0.01	0.01
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	PERCENT FINER ■	PERCENT FINER ○
4"			
3"			
1 1/2"	100.0		
3/4"	91.4		100.0
3/8"	70.6	100.0	97.1
4	53.2	99.9	95.2
10	37.8	99.1	93.7
20	28.0	98.2	93.6
40	22.4	96.8	93.5
60	19.0	94.9	93.1
100	16.5	91.3	92.4
200	13.7	81.8	90.4

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	3.8				GM	Black, Silty gravel with sand	8/25/2013
■	53.3				MH	Gray, Elastic silt with sand	8/25/2013
○	33.6				CL	Black, Lean clay	8/25/2013

TerraSense, LLC	**URS**
T21562906	21562906

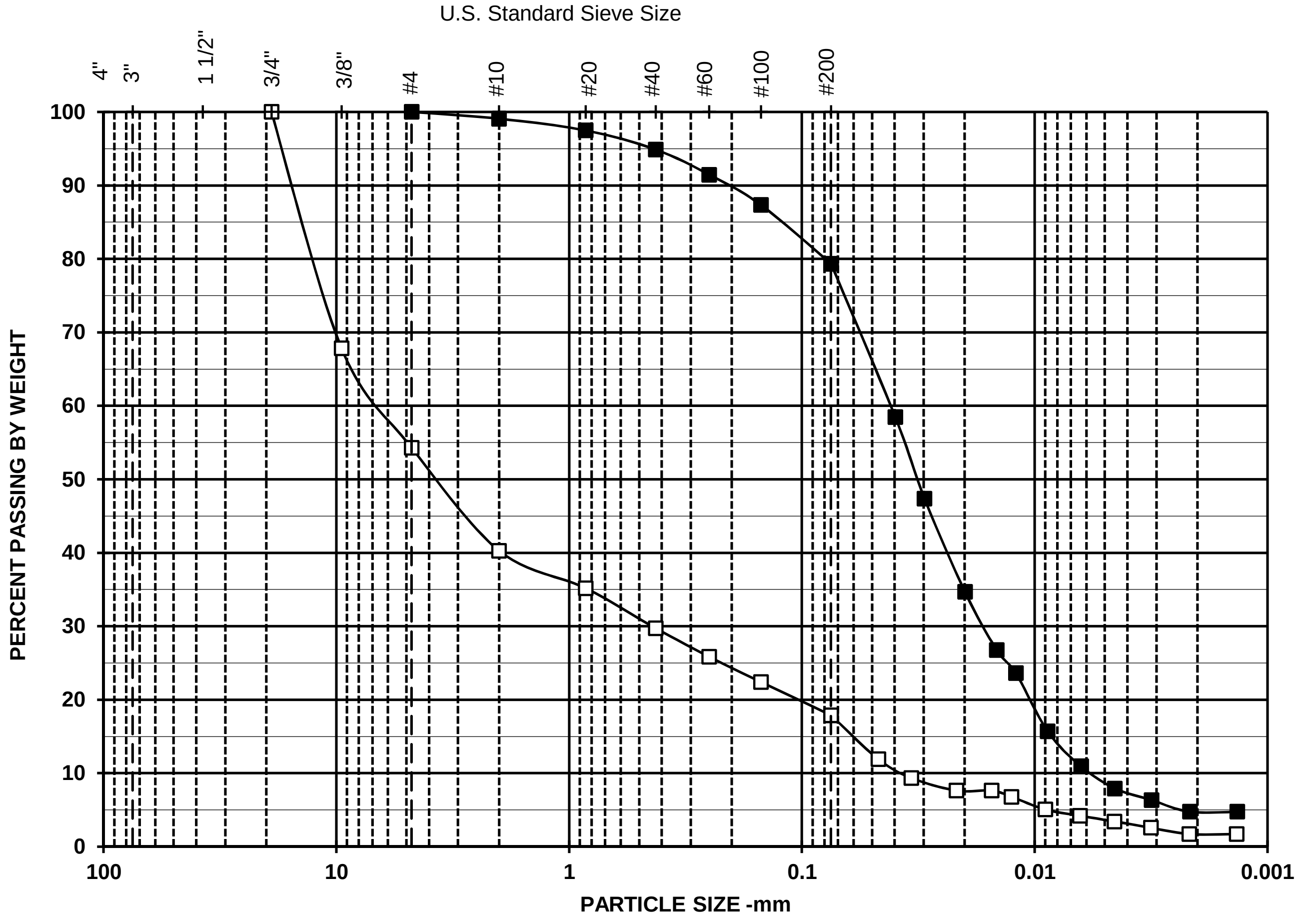
PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev2c.xls 9/20/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	B-13-12	B-13-13	
Sample	SS-5	SS-8	
Depth	10-11.5	25-26.5	
% +3"	0.0	0.0	
% Gravel	45.7	0.0	
% SAND	36.4	20.7	
%C SAND	14.0	0.9	
%M SAND	10.5	4.2	
%F SAND	11.8	15.5	
% FINES	17.9	79.3	
% -2μ	2	5	
D_{100} (mm)	19.00	4.75	
D_{60} (mm)	6.75	0.04	
D_{30} (mm)	0.45	0.02	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"	100.0		
3/8"	67.9		
4	54.3	100.0	
10	40.3	99.1	
20	35.2	97.5	
40	29.7	94.9	
60	25.8	91.5	
100	22.4	87.3	
200	17.9	79.3	

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	6.7				GM	Black, Silty gravel with sand	8/25/2013
■	41.4				ML	Gray, Silt with sand	8/25/2013
○							

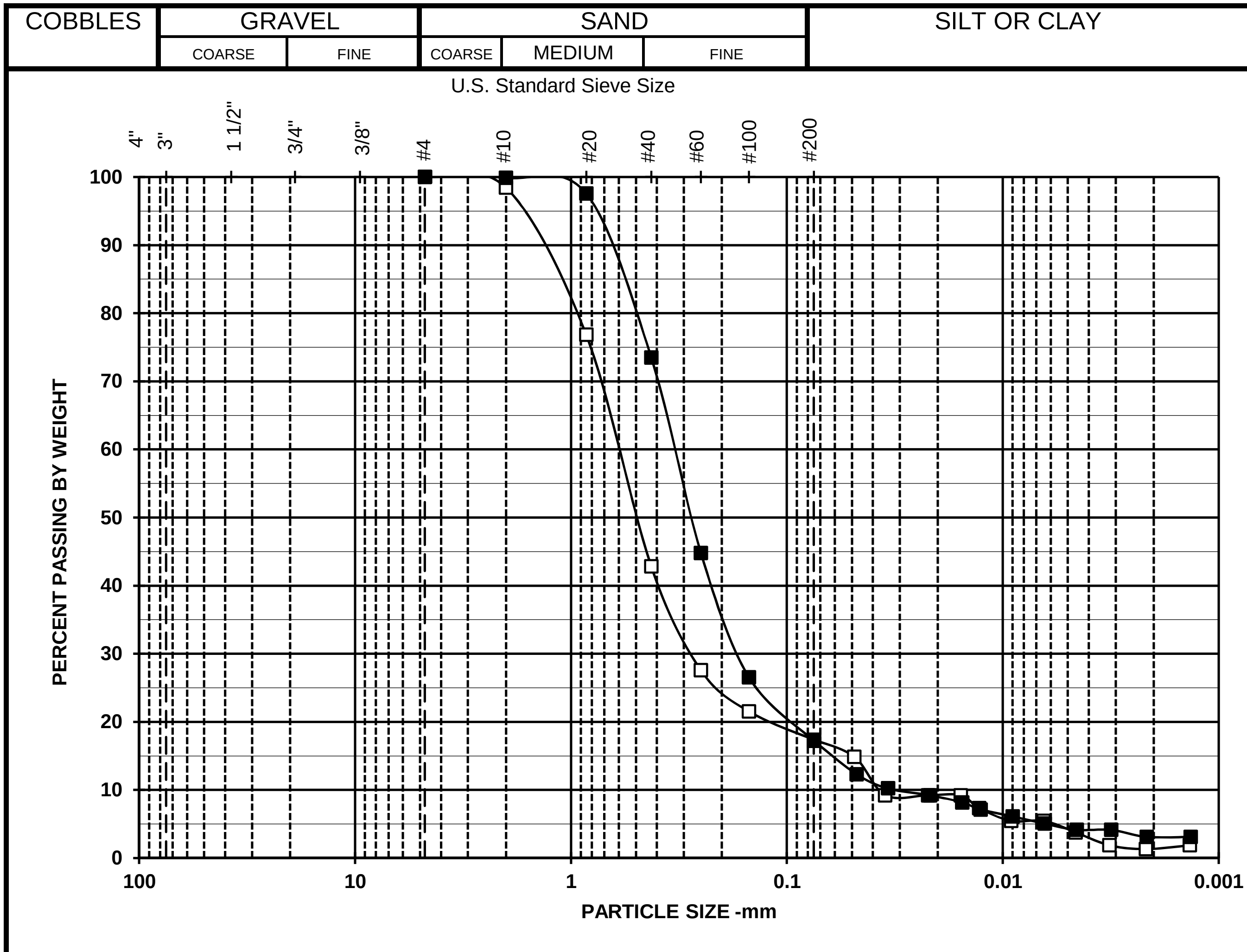
TerraSense, LLC	**URS**
T21562906	21562906

PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev2d.xls 9/20/2013



Symbol	□	■	○
Boring	B-13-16	B-13-17	
Sample	SS-16	SS-5	
Depth	60-61.5	10-11.5	
% +3"	0.0	0.0	
% Gravel	0.0	0.0	
% SAND	82.6	82.8	
%C SAND	1.6	0.1	
%M SAND	55.6	26.4	
%F SAND	25.5	56.3	
% FINES	17.4	17.2	
% -2µ	1	3	
D_{100} (mm)	4.75	4.75	
D_{60} (mm)	0.64	0.34	
D_{30} (mm)	0.28	0.17	
D_{10} (mm)			
Cc			
Cu			

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4	100.0	100.0	
10	98.4	99.9	
20	76.8	97.6	
40	42.8	73.5	
60	27.6	44.8	
100	21.5	26.6	
200	17.4	17.2	

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	29.1				SM	Brown, Silty sand	8/28/2013
■	17.7				SM	Gray, Silty sand	8/25/2013
○							

TerraSense, LLC	**URS**
T21562906	21562906

PARTICLE SIZE DISTRIBUTION

Dynegy Vermillion 2013

Analysis File: 3SV-MasterRev3

siev2e.xls 9/20/2013

North Ash Pond
Global Stability

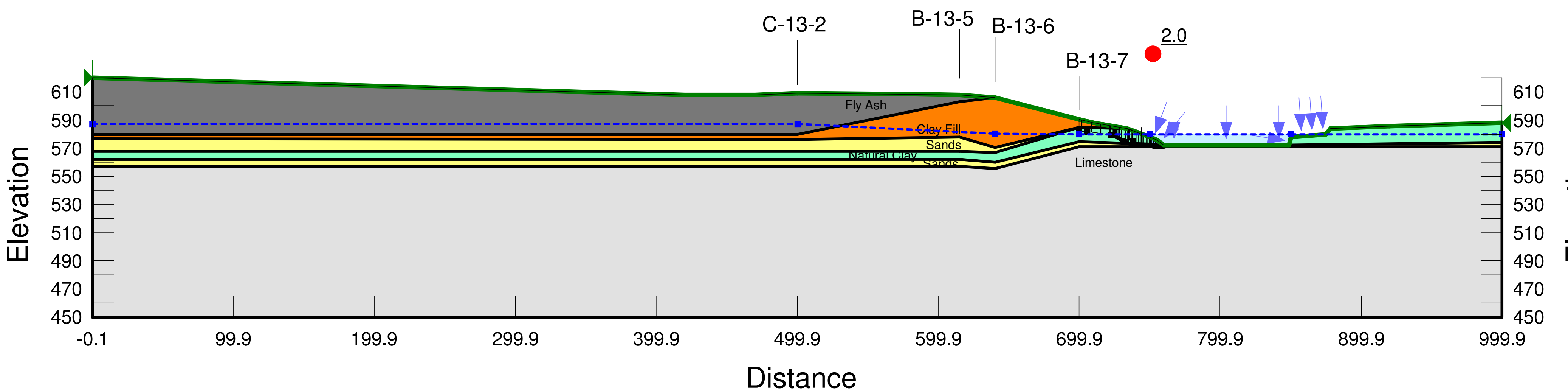
- Drained Case using Piezometer Water Levels
- Drained Case at High Water Level
- Seismic

Dynegy Vermilion
North Ash Pond
Cross-Section
Name: Drained Case using Piezometers
Method: Spencer
Kind: SLOPE/W
F of S: 2.0

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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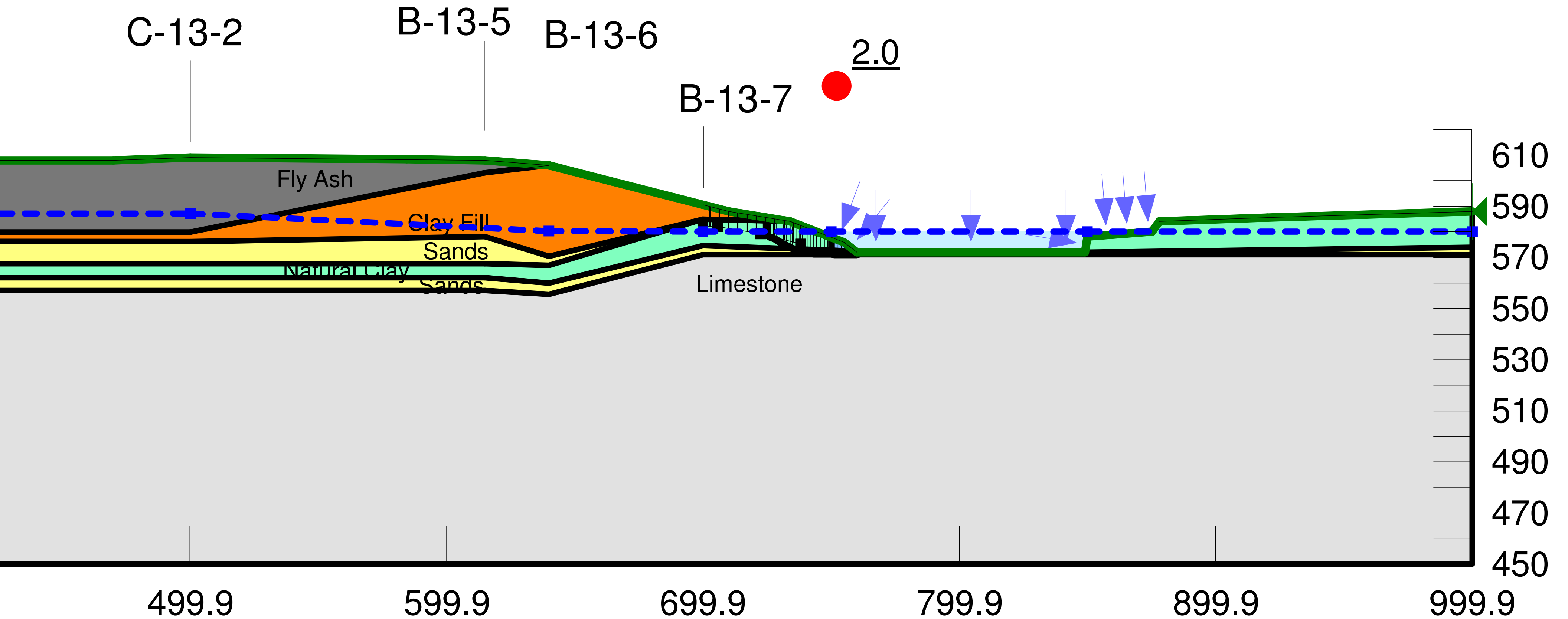


C-13-2
B-13-5
B-13-6
B-13-7
2.0
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone
610
590
570
550
530
510
490
470
450
499.9
599.9
699.9
799.9
899.9
999.9

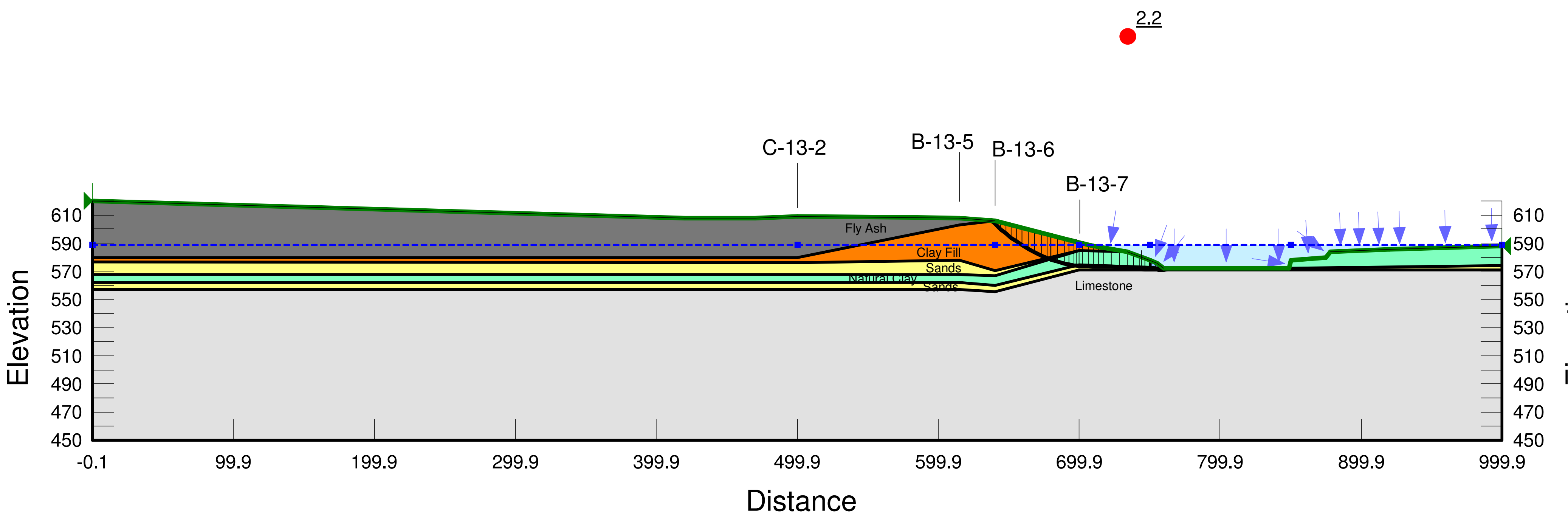
Dynegy Vermilion

North Ash Pond
Cross-Section
Name: Drained Case at High Water Level
Method: Spencer
Kind: SLOPE/W
F of S: 2.2

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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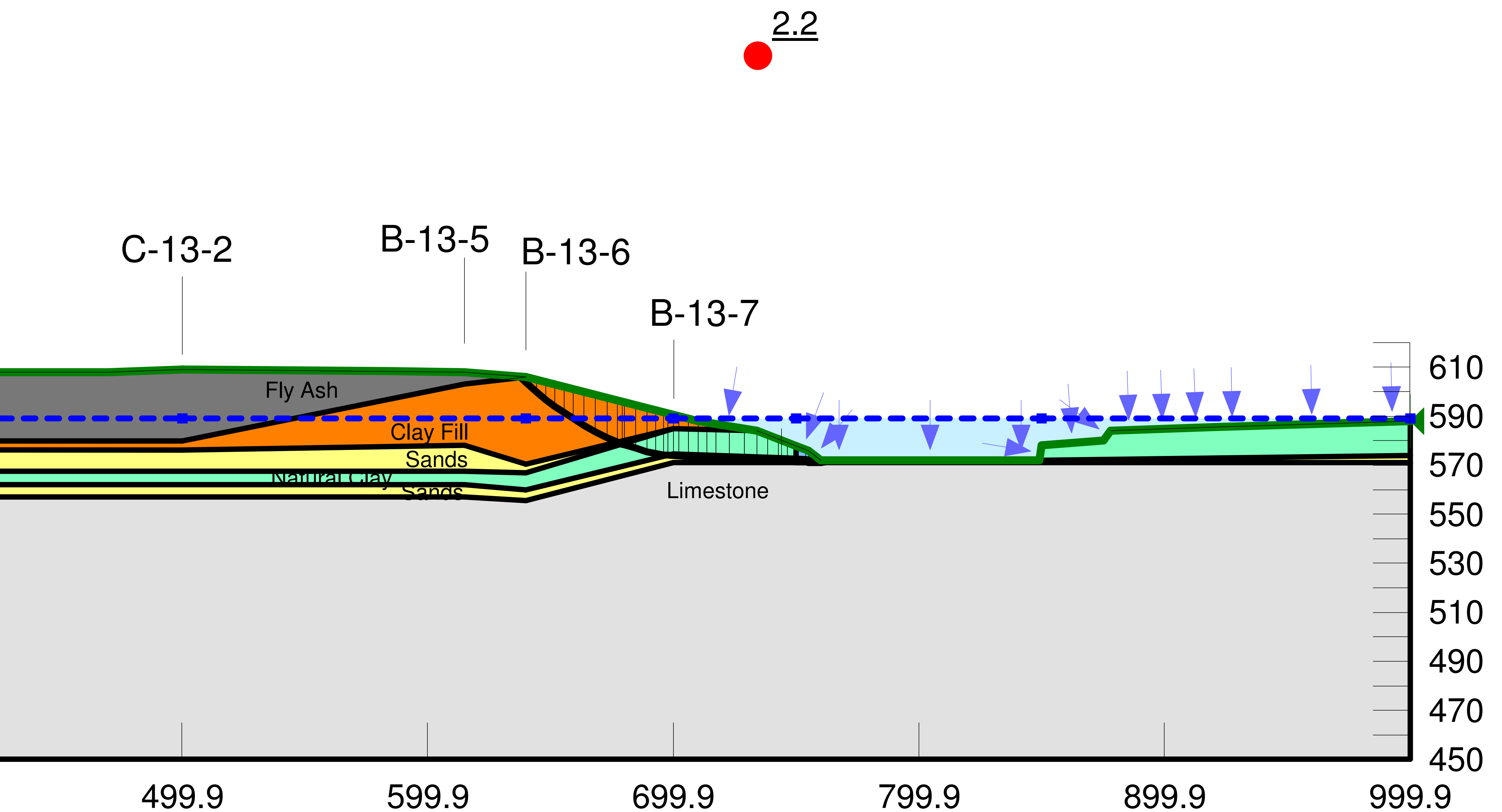


2.2
C-13-2
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone
610
590
570
550
530
510
490
470
450
499.9
599.9
699.9
799.9
899.9
999.9

Dynegy Vermilion

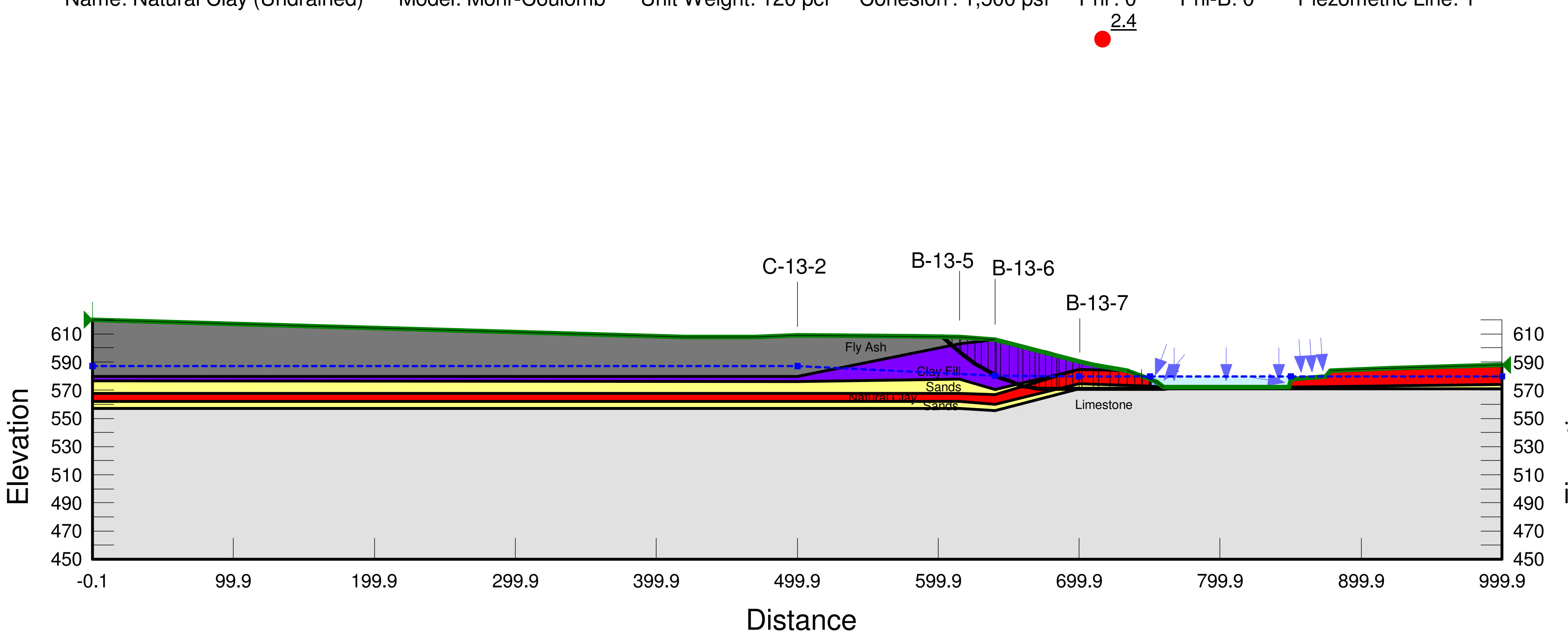
North Ash Pond
Cross-Section
Name: Seismic Case
Method: Spencer
Kind: SLOPE/W
F of S: 2.4

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Seismic Coefficient = 0.05 g

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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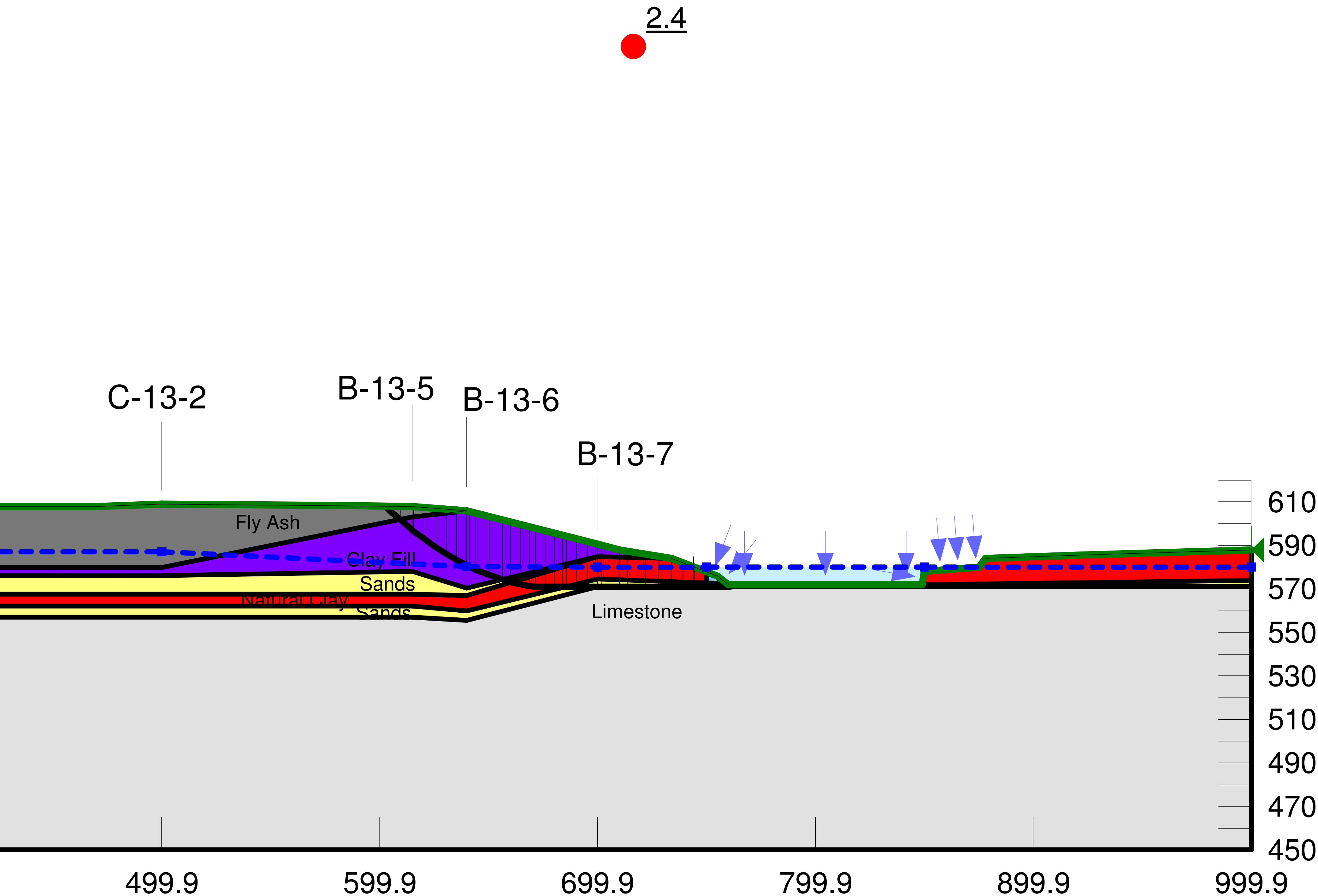

2.4
C-13-2
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone
610
590
570
550
530
510
490
470
450
499.9
599.9
699.9
799.9
899.9
999.9

Old East Ash Pond
Cross-Section A-A'
Global Stability

- Drained Case at High Water Level
- Drained Case using Piezometer Water Levels
- Seismic

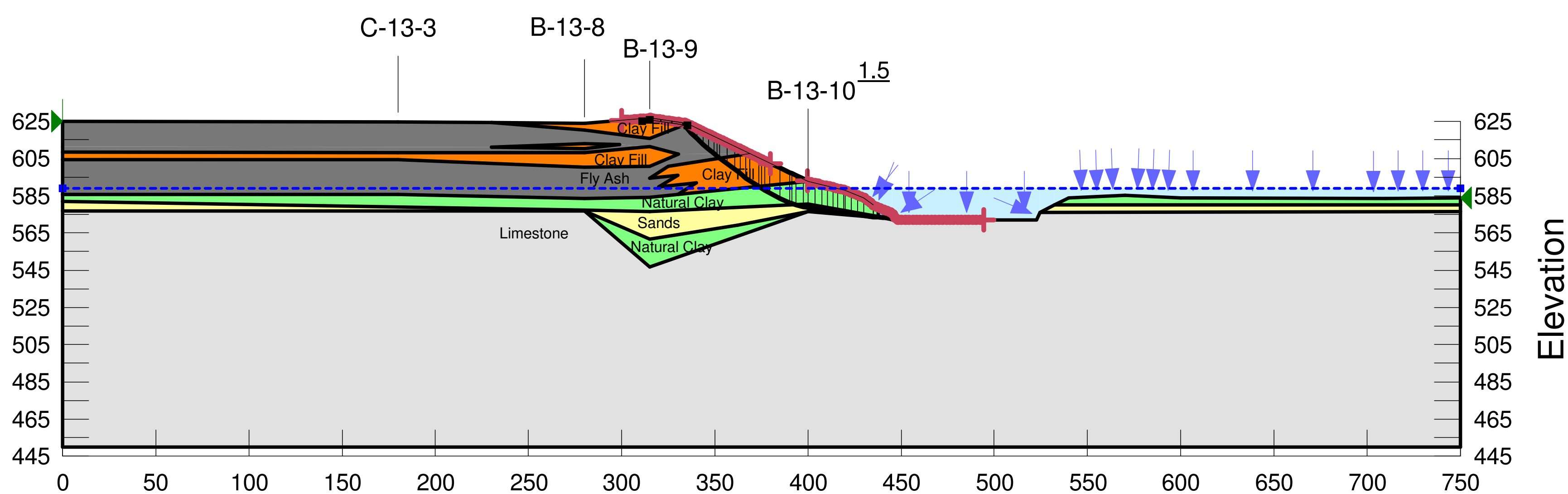
Dynegy Vermilion
Old East Ash Pond
Cross-Section A-A'

Created By: Stefanie Voss
Date: 10/28/2013

Checked By:
Date:

Name: Drained Case at High Water Level Entry Exit
Kind: SLOPE/W
Method: Spencer
F of S: 1.5

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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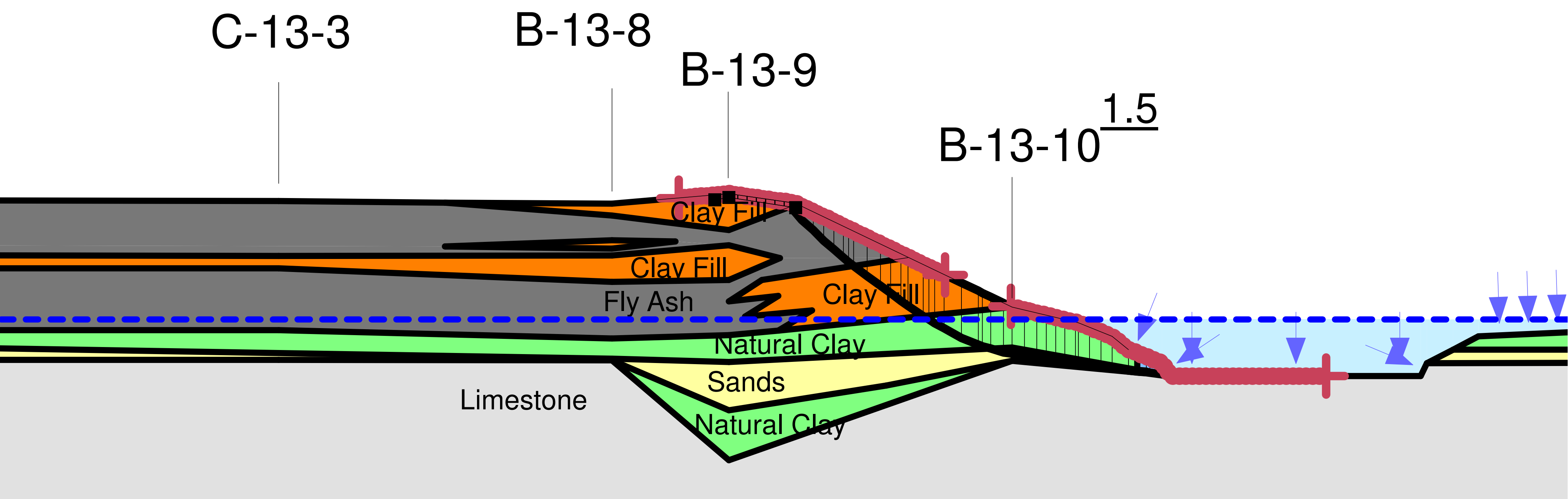

C-13-3
B-13-8
B-13-9
B-13-10
1.5
Clay Fill
Clay Fill
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

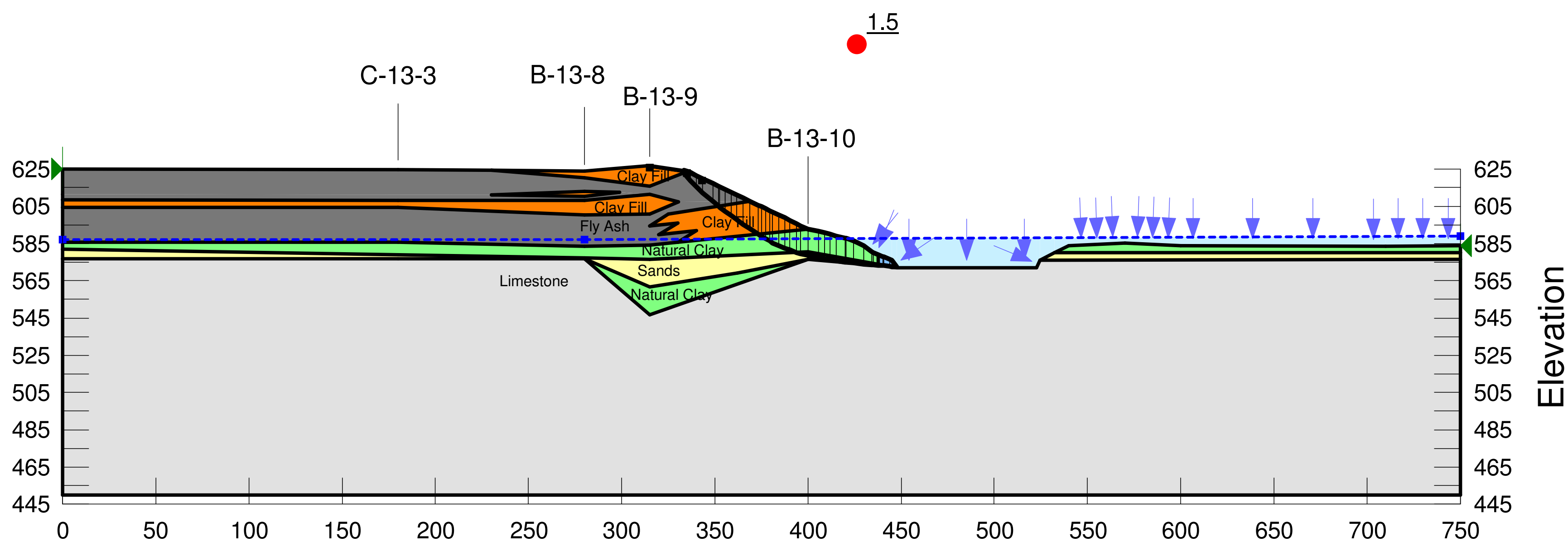
Dynegy Vermilion
Old East Ash Pond
Cross-Section A-A'

Created By: Stefanie Voss
Date: 11/6/2013

Checked By:
Date:

Name: Drained Case at High Water Level Grid & Radius
Kind: SLOPE/W
Method: Spencer
F of S: 1.5

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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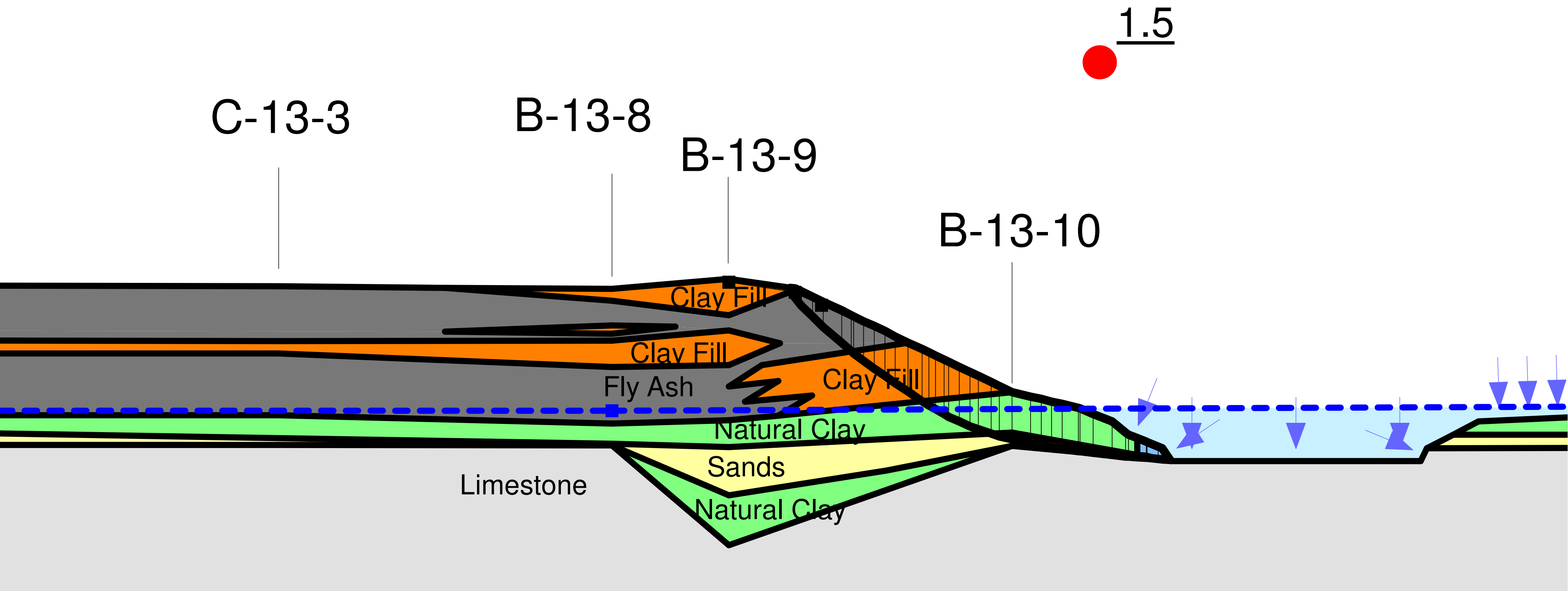

1.5
C-13-3
B-13-8
B-13-9
B-13-10
Clay Fill
Clay Fill
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

Dynegy Vermilion
Old East Ash Pond
Cross-Section A-A'

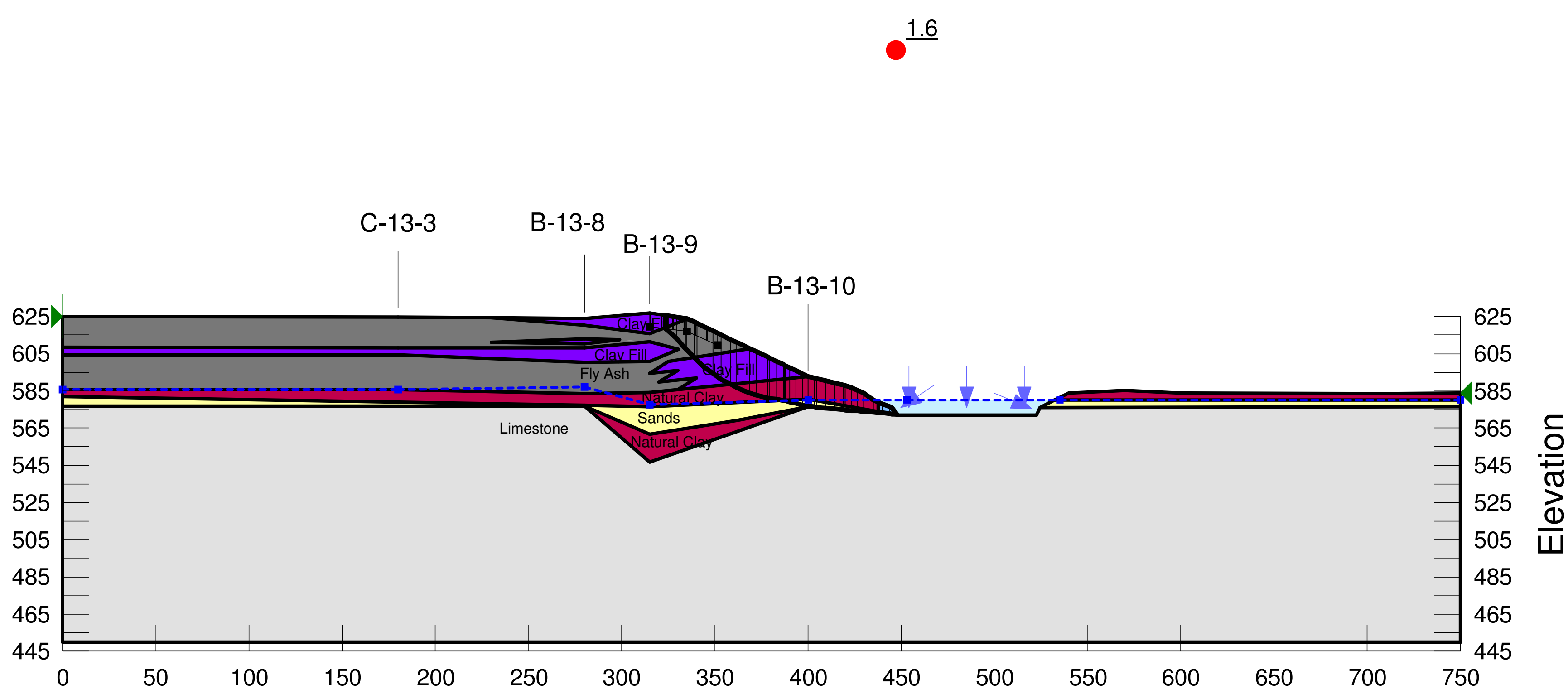
Name: Seismic Case Grid & Radius
Kind: SLOPE/W
Method: Spencer
F of S: 1.6

Created By: Stefanie Voss
Date: 11/6/2013

Checked By:
Date:

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1

Seismic Coefficient = 0.05 g



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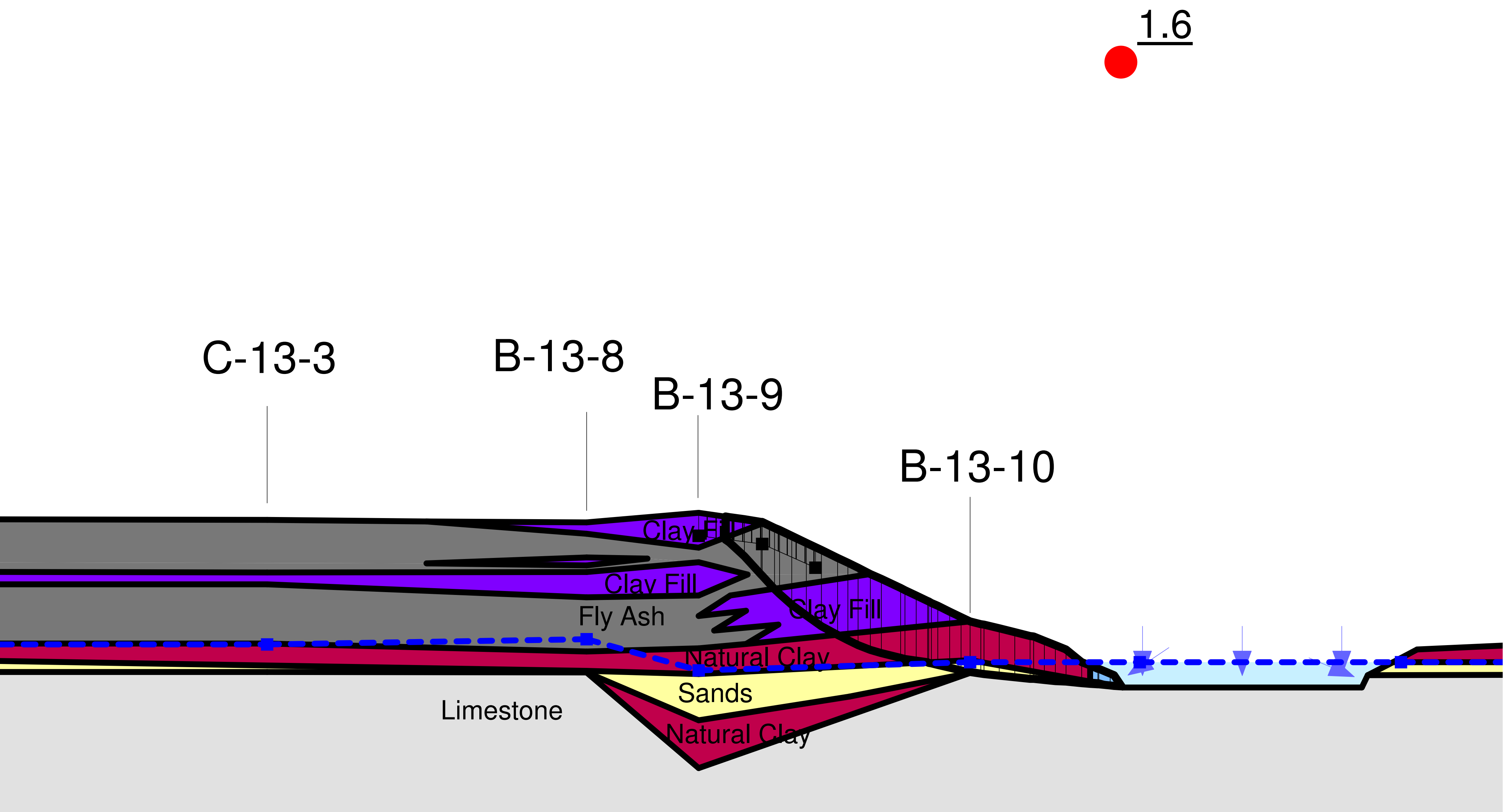

1.6
C-13-3
B-13-8
B-13-9
B-13-10
Clay Fill
Clay Fill
Clay Fill
Fly Ash
Natural Clay
Sands
Limestone
Natural Clay

Old East Ash Pond
Cross-Section B-B'
Global Stability

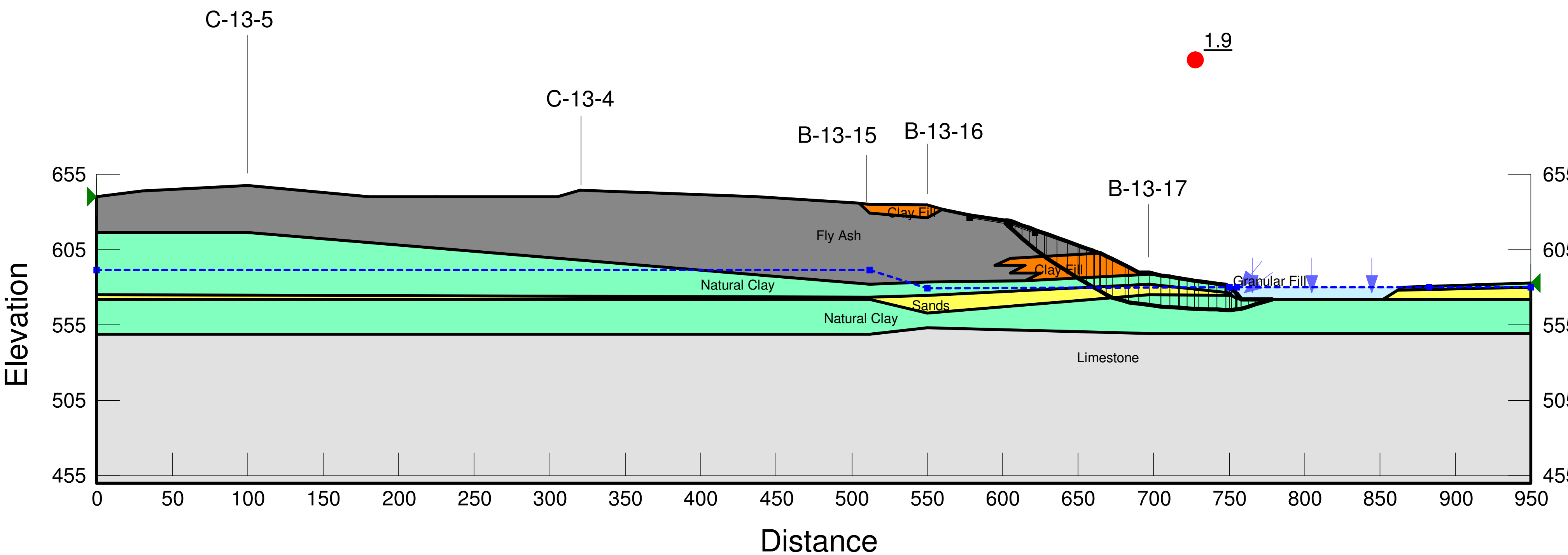
- Drained Case using High Water Level
- Drained Case using Piezometer Water Levels
- Seismic Case

Dynegy Vermilion
Old East Ash Pond
Cross-section B-B'
Name: Drained Case Using Piezometer Levels Grid & Radius
Kind: SLOPE/W
Method: Spencer
F of S: 1.9

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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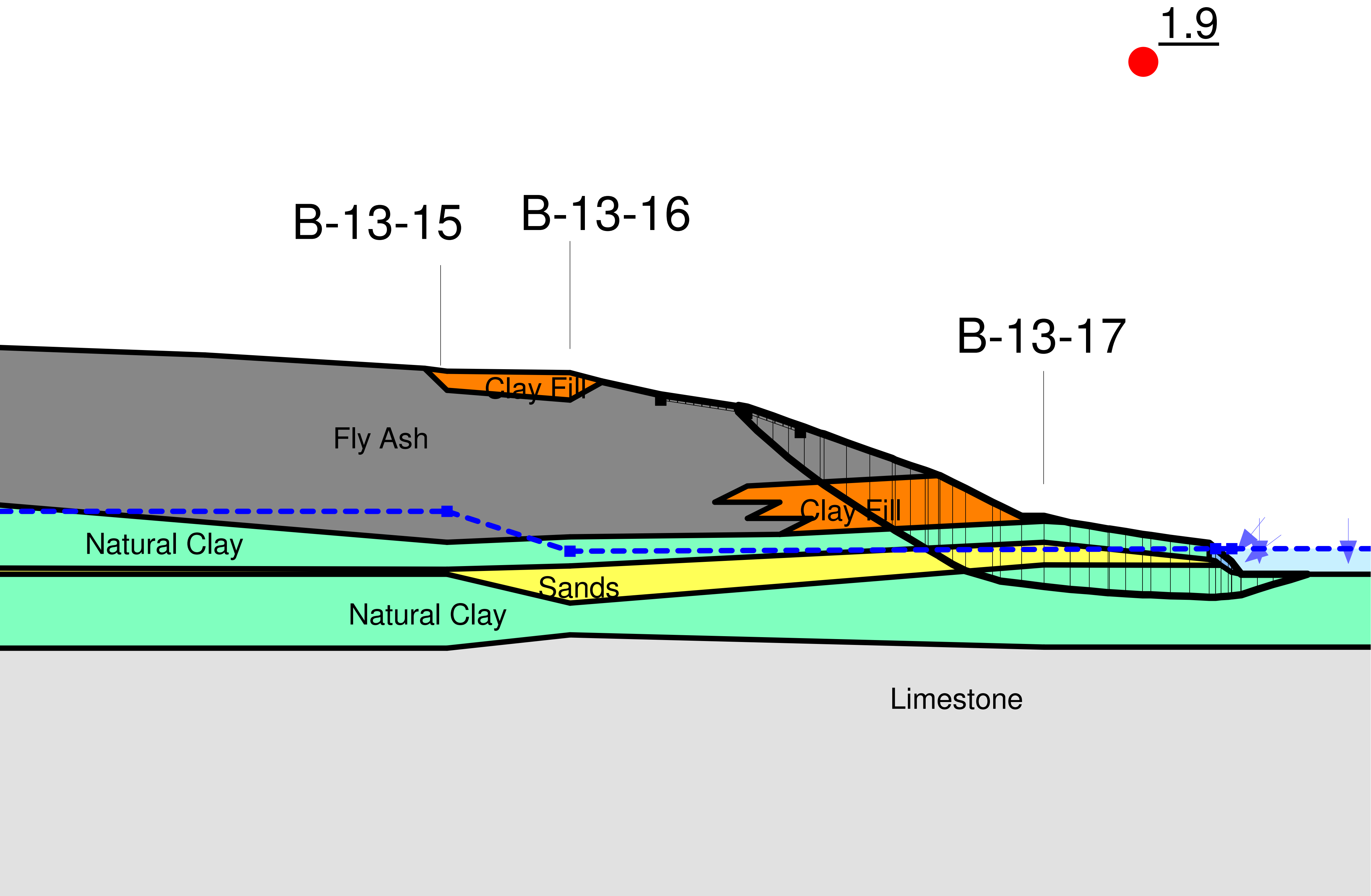
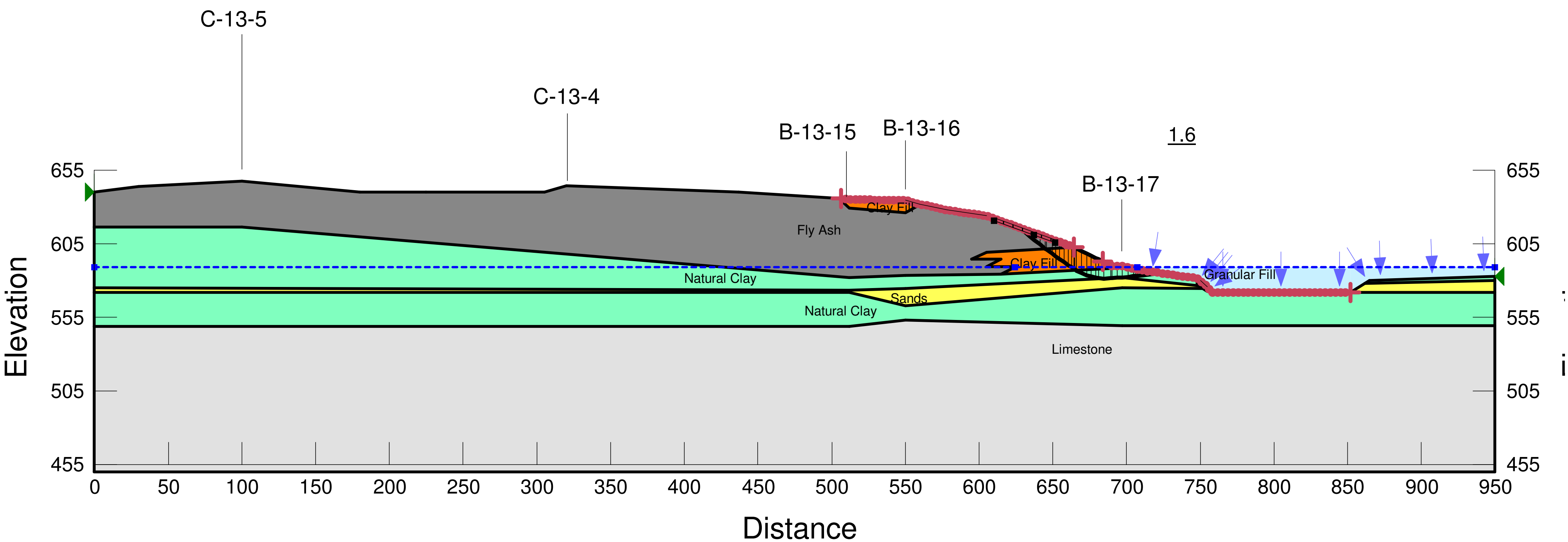

1.9
B-13-15
B-13-16
B-13-17
Clay Fill
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone

Dynegy Vermilion
Old East Ash Pond
Cross-section B-B'
Name: Drained Case At High Water Level EL 589 Entry Exit
Kind: SLOPE/W
Method: Spencer
F of S: 1.6

Created By: Stefanie Voss
Date: 10/28/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1



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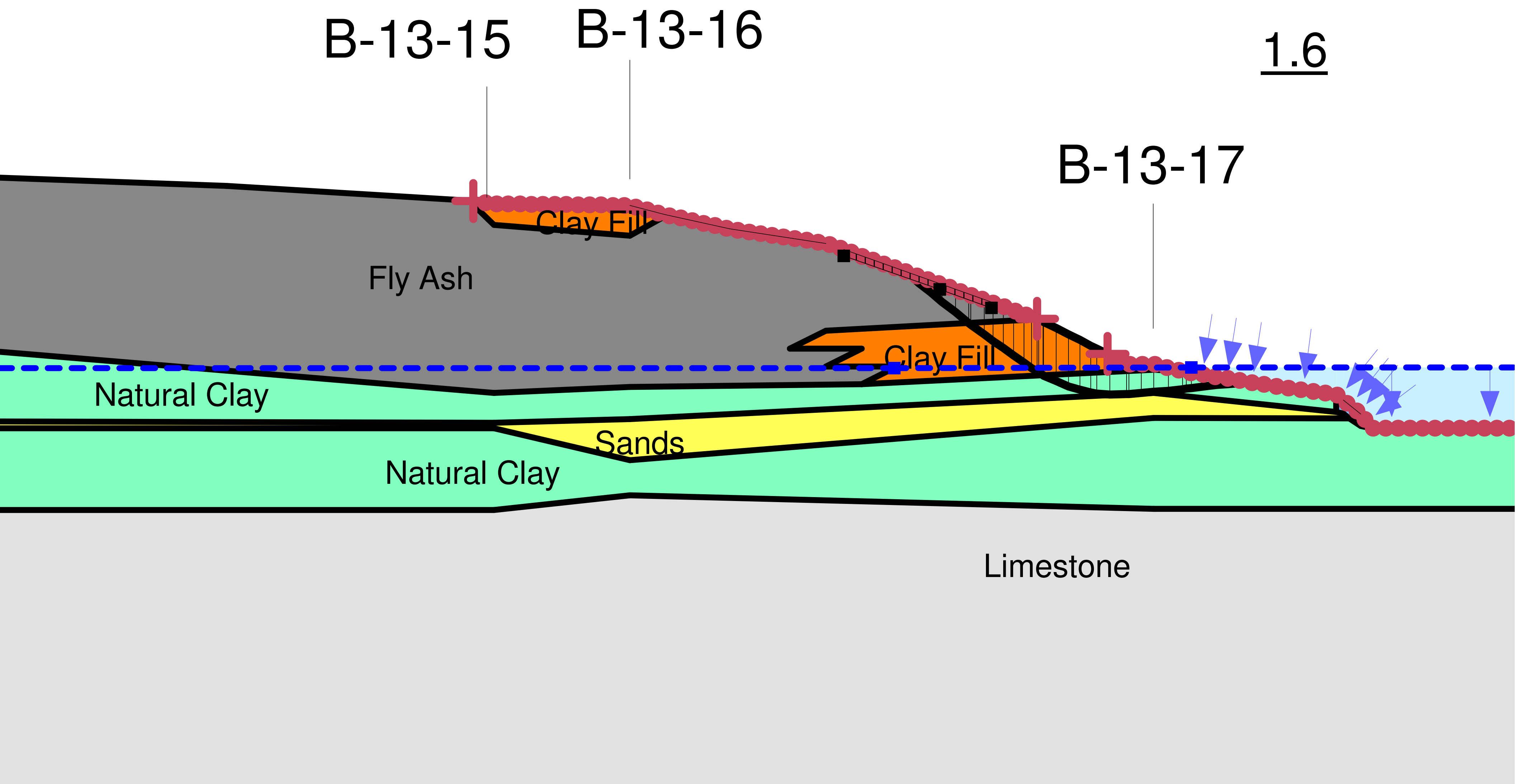


B-13-15
B-13-16
1.6
B-13-17
Clay Fill
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone

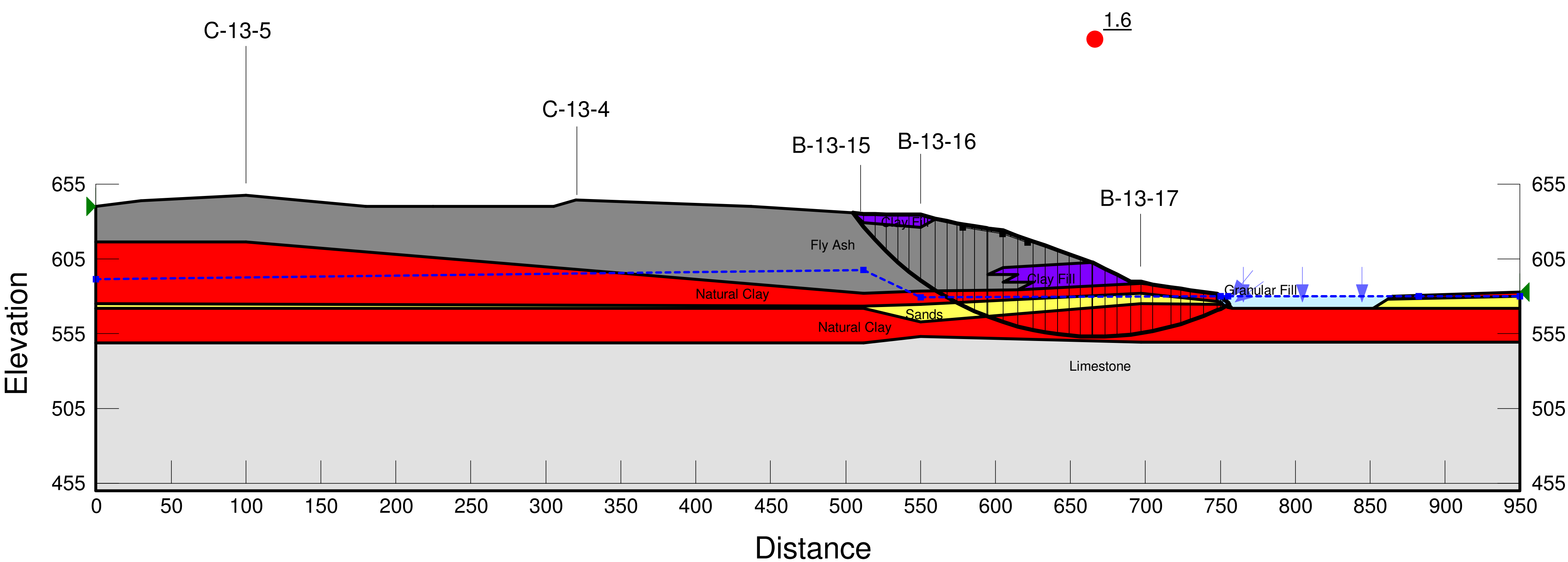
Dynegy Vermilion
Old East Ash Pond
Cross-section B-B'
Name: Seismic Case
Kind: SLOPE/W
Method: Spencer
F of S: 1.6

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Granular Fill Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1

Seismic Coefficient = 0.05 g



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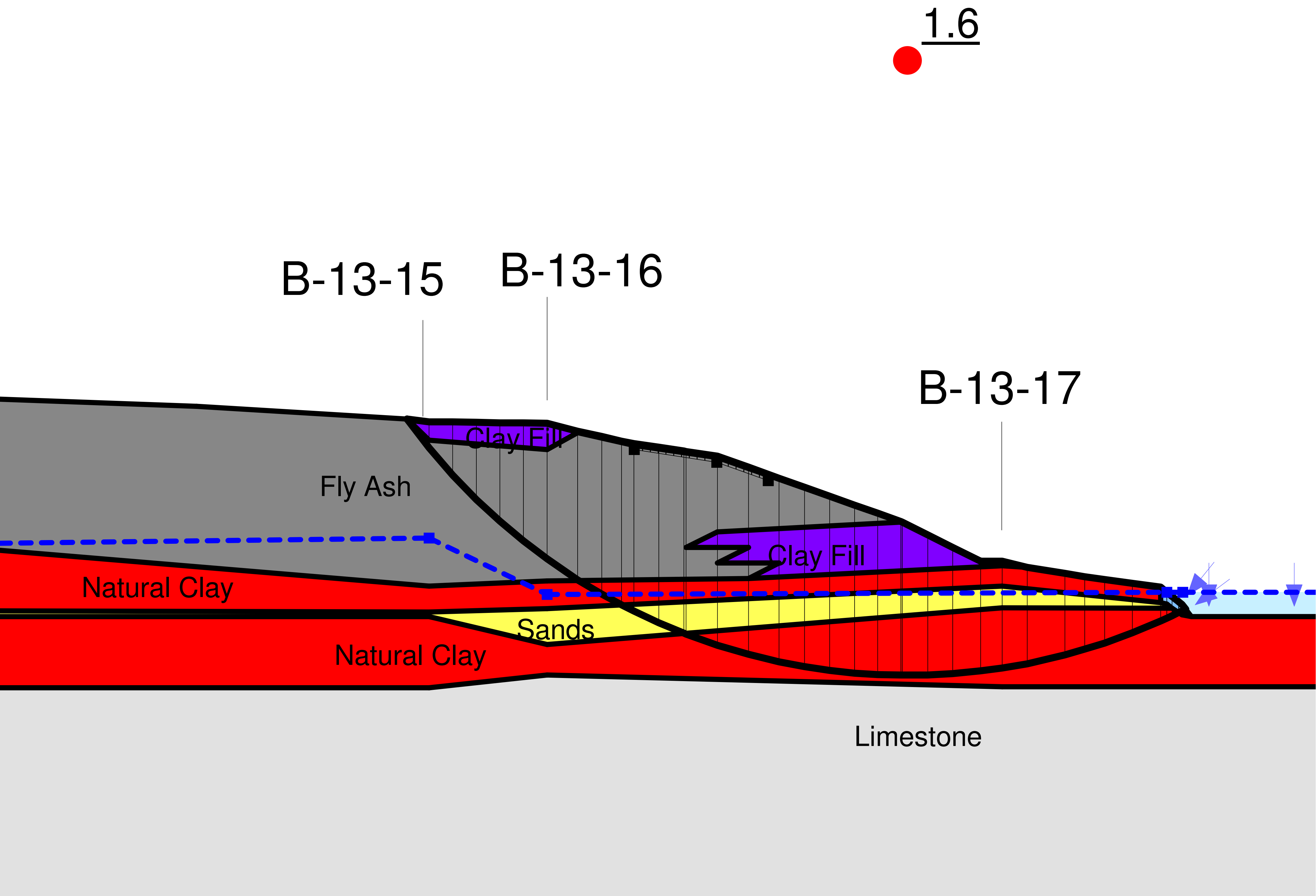

1.6
B-13-15
B-13-16
B-13-17
Clay Fill
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone

North Ash Pond
Erosion Case

-Drained Case at FoS = 1.5
-Drained Case at FoS = 1.0
-Undrained Case at FoS = 1.5
-Undrained Case at FoS = 1.0

Dynegy-Vermilion

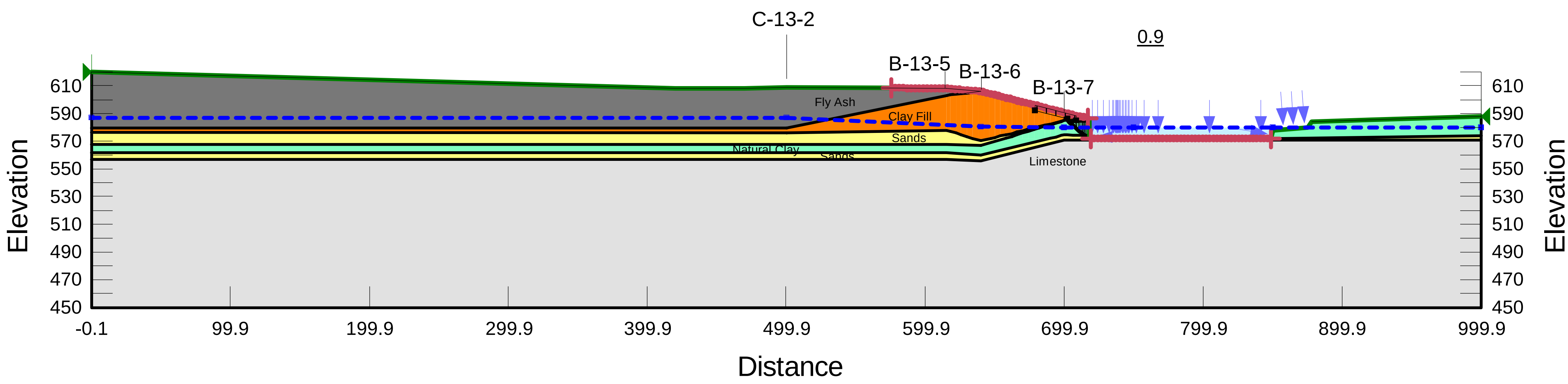
North Ash Pond
Cross-Section

Name: Drained Case Failure (FS=1.0)
Method: Spencer
Kind: SLOPE/W
Water Level Based on Piezometer
F of S: 0.9

Created By: Stefanie Voss
Date: 10/30/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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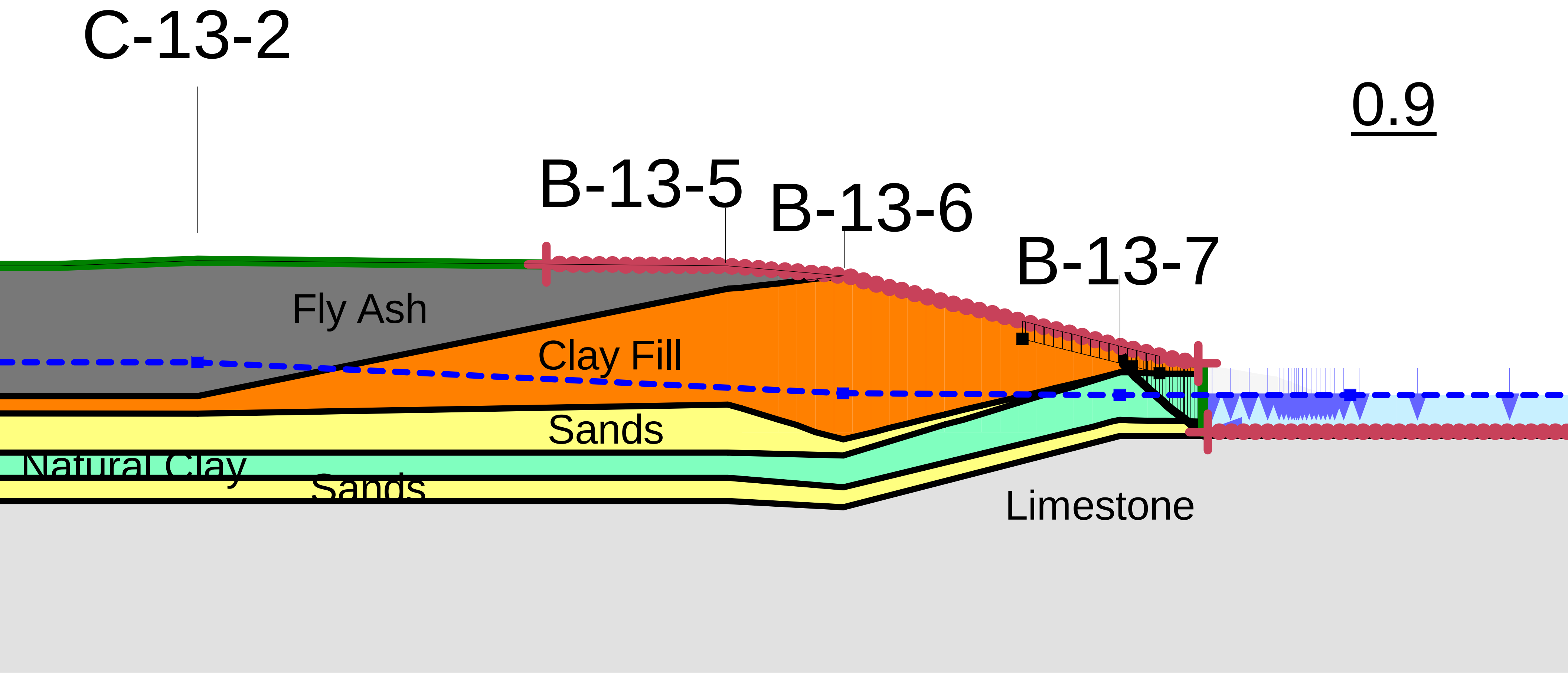
Dynegy - Vermilion North Ash section - Erosion study finalized.gsz



C-13-2
0.9
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone

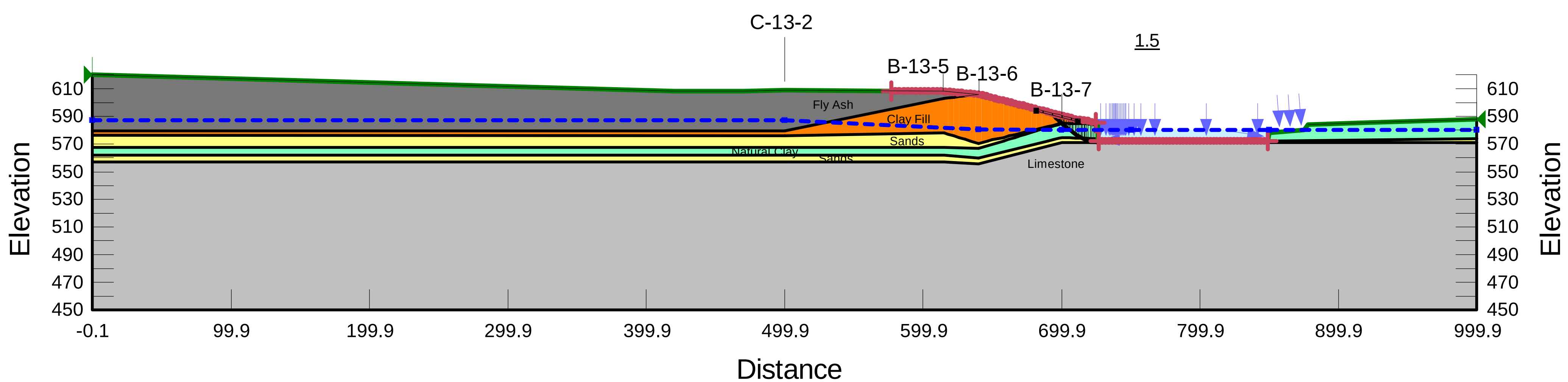
Dynegy-Vermilion
North Ash Pond
Cross-Section

Name: Drained Case FS=1.5
Method: Spencer
Kind: SLOPE/W
Water Level Based on Piezometer
F of S: 1.5

Created By: Stefanie Voss
Date: 10/24/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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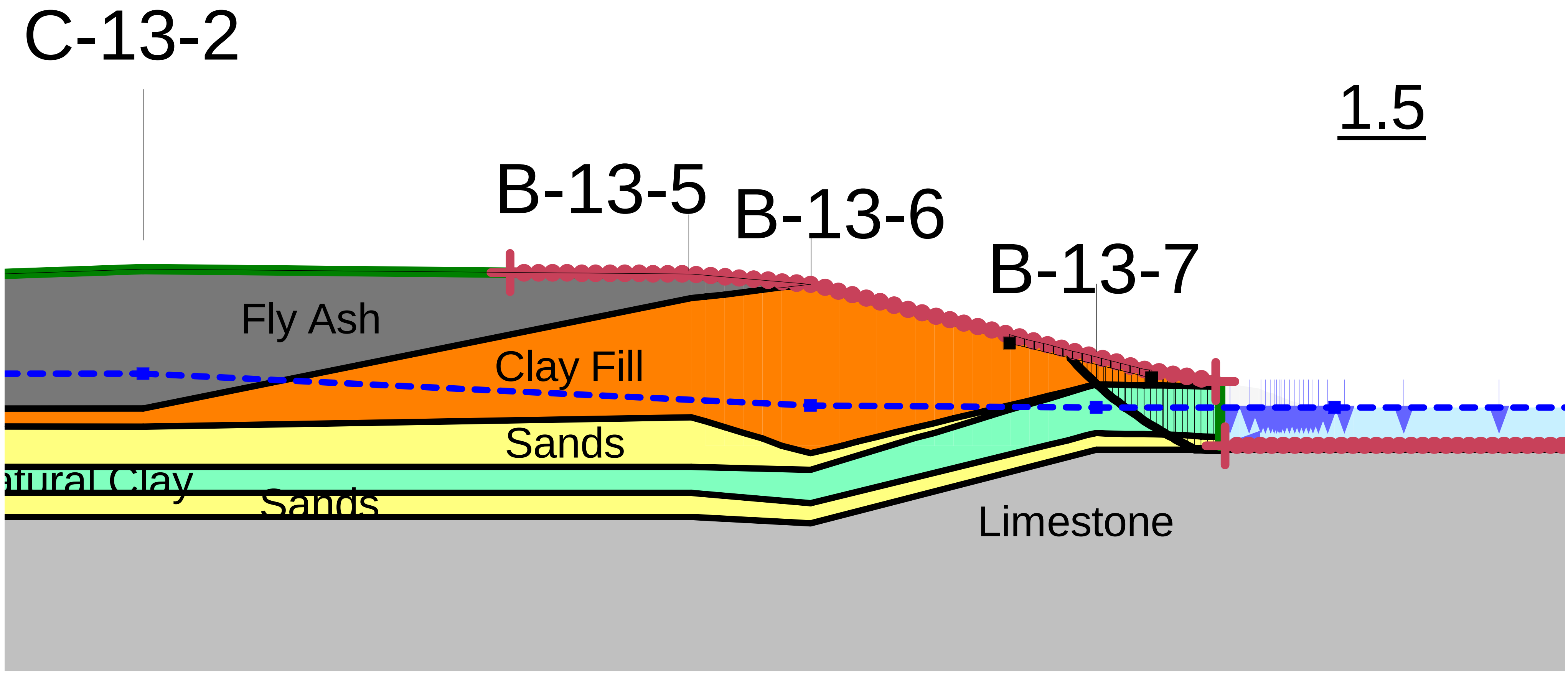
Dynegy - Vermilion North Ash section - Erosion study finalized.gsz


C-13-2
1.5
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Sands
Limestone

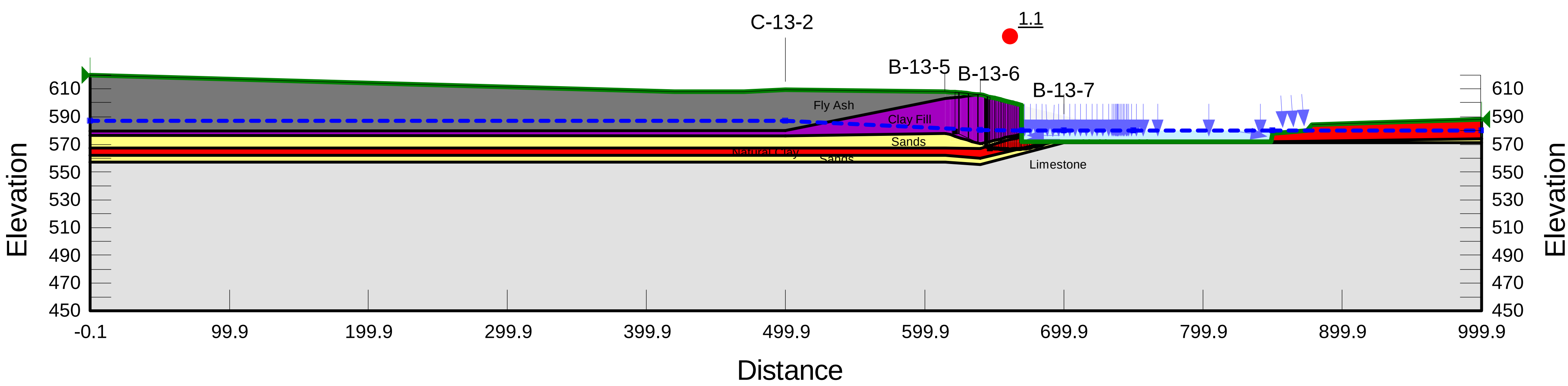
Dynegy-Vermilion
North Ash Pond
Cross-Section

Name: Undrained Case Failure (FS=1.0)
Method: Spencer
Kind: SLOPE/W
Water Level Based on Piezometer
F of S: 1.1

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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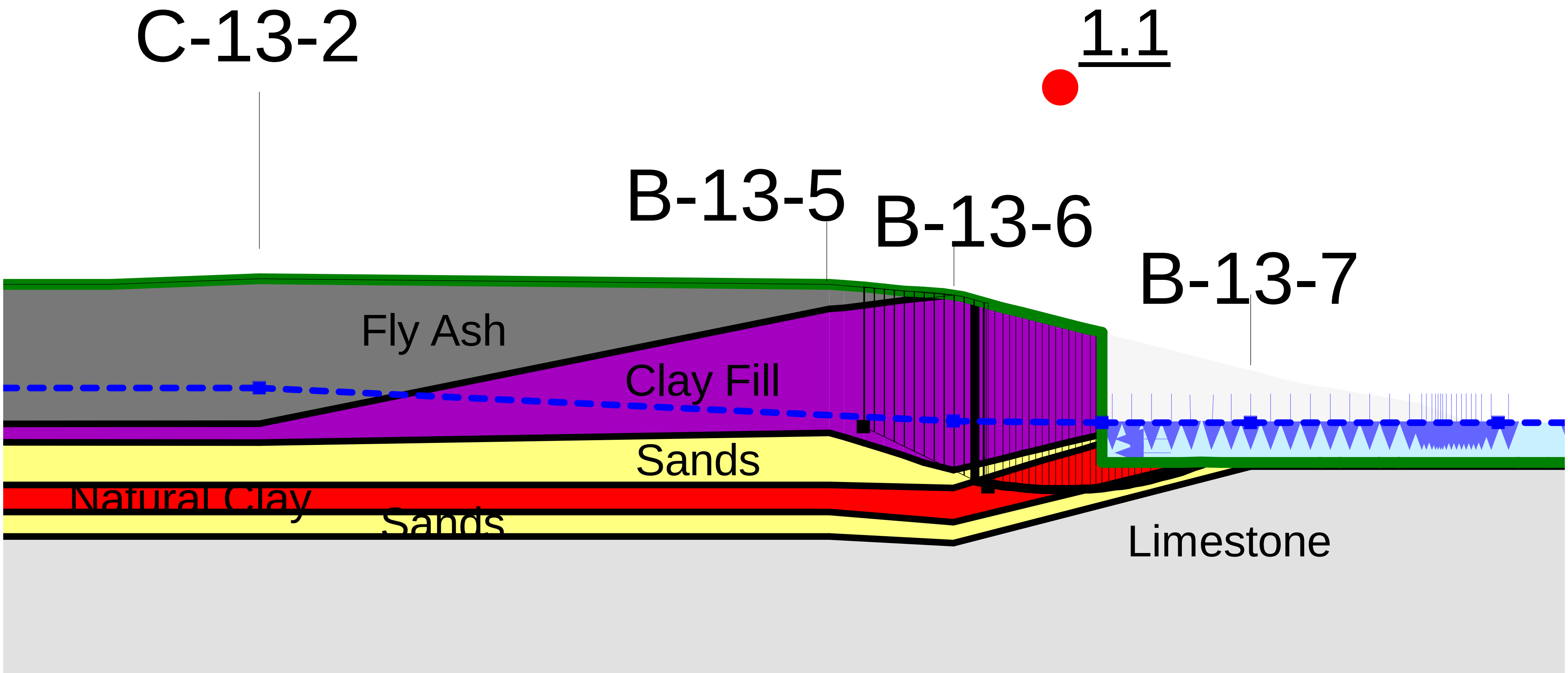
Dynegy - Vermilion North Ash section - Erosion study finalized.gsz



C-13-2
1.1
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone

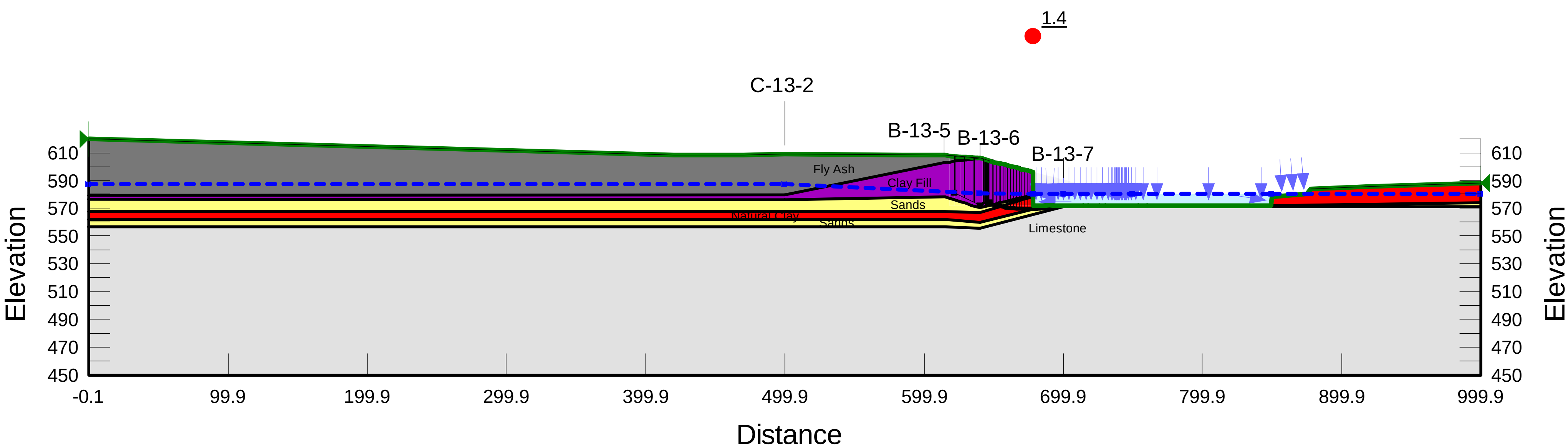
Dynegy-Vermilion
North Ash Pond
Cross-Section

Name: Undrained Case FS=1.3
Method: Spencer
Kind: SLOPE/W
Water Level Based on Piezometer
F of S: 1.4

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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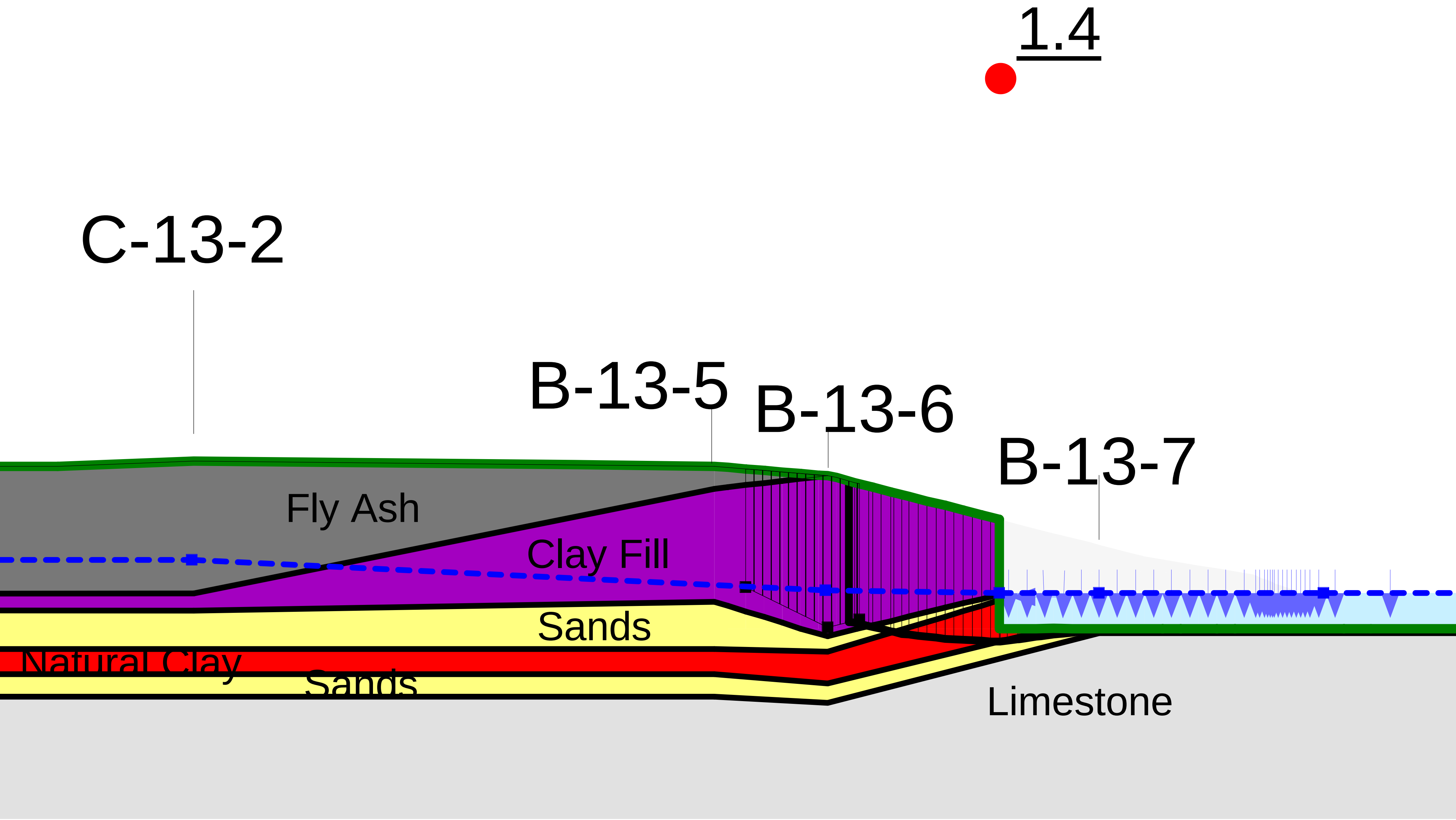

1.4
C-13-2
B-13-5
B-13-6
B-13-7
Fly Ash
Clay Fill
Sands
Natural Clay
Sands
Limestone

Old East Ash Pond
Cross-Section A-A'
Erosion Cases

-Drained Case at FoS = 1.5
-Drained Case at FoS = 1.0
-Undrained Case at FoS = 1.5
-Undrained Case at FoS = 1.0

Dynegy-Vermilion

Old East Ash Pond

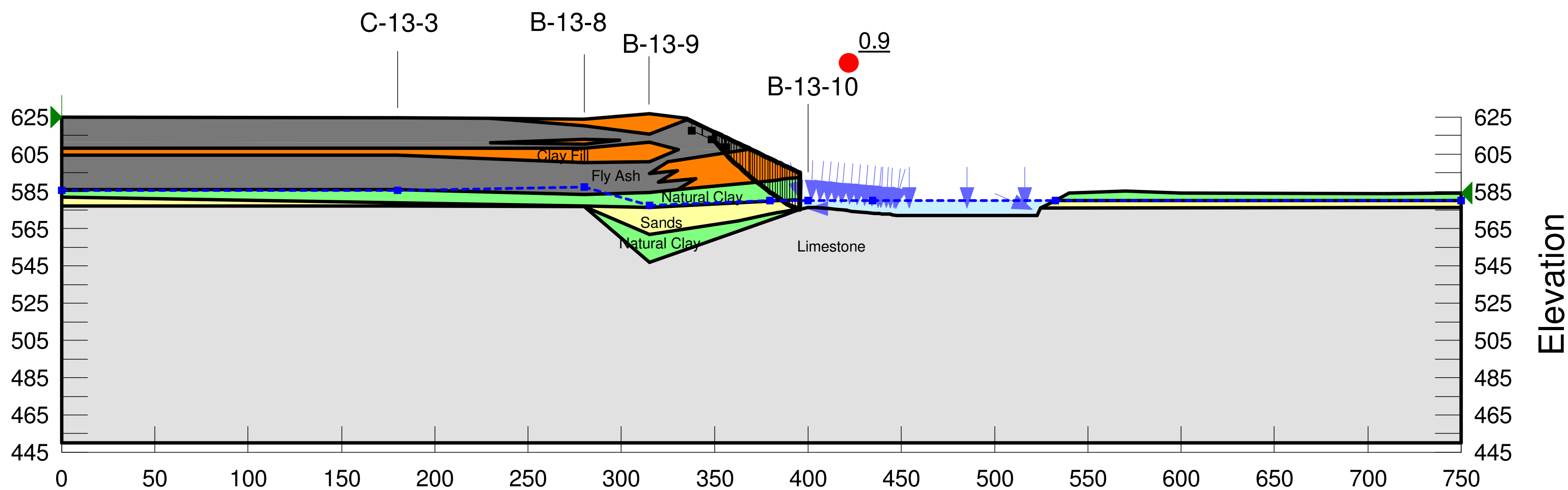
Cross-Section A-A'

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Drained Case Failure (FS=1.0)
Kind: SLOPE/W
Method: Spencer
F of S: 0.9

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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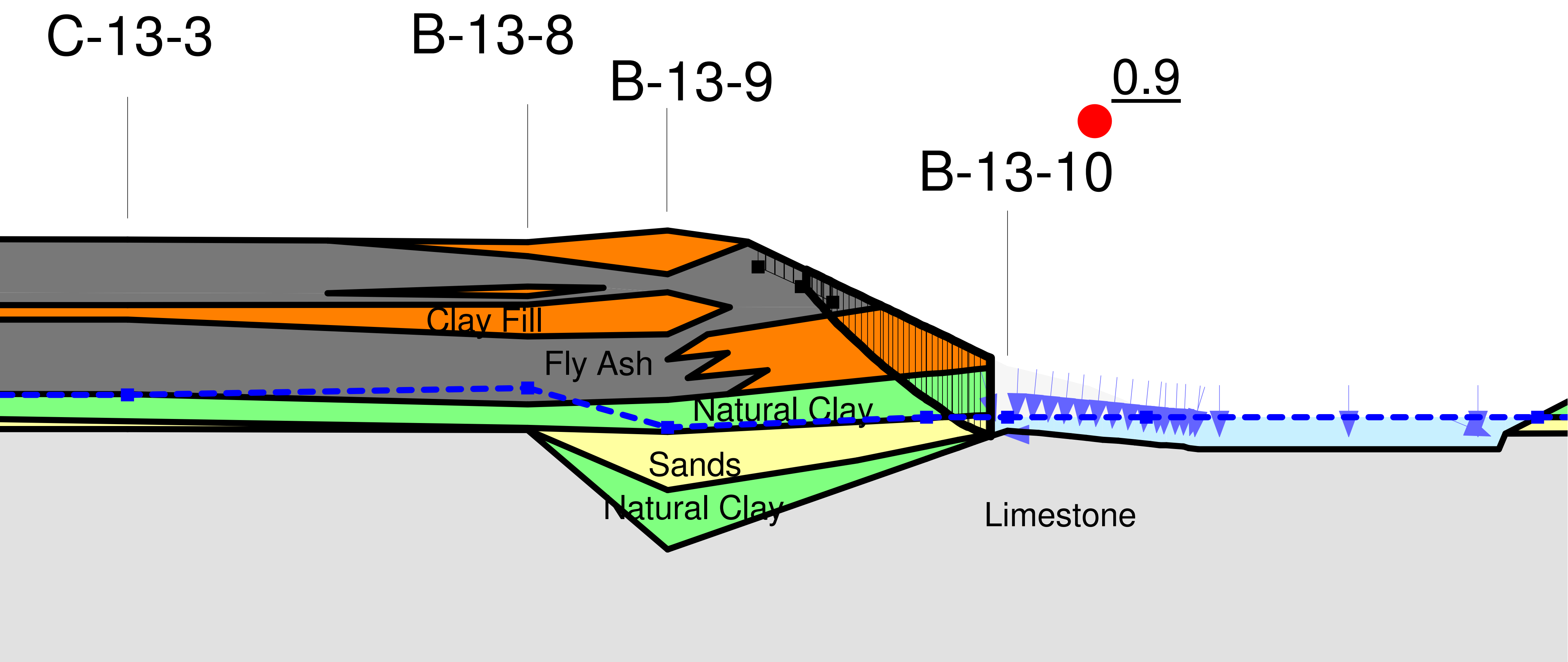

C-13-3
B-13-8
B-13-9
0.9
B-13-10
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

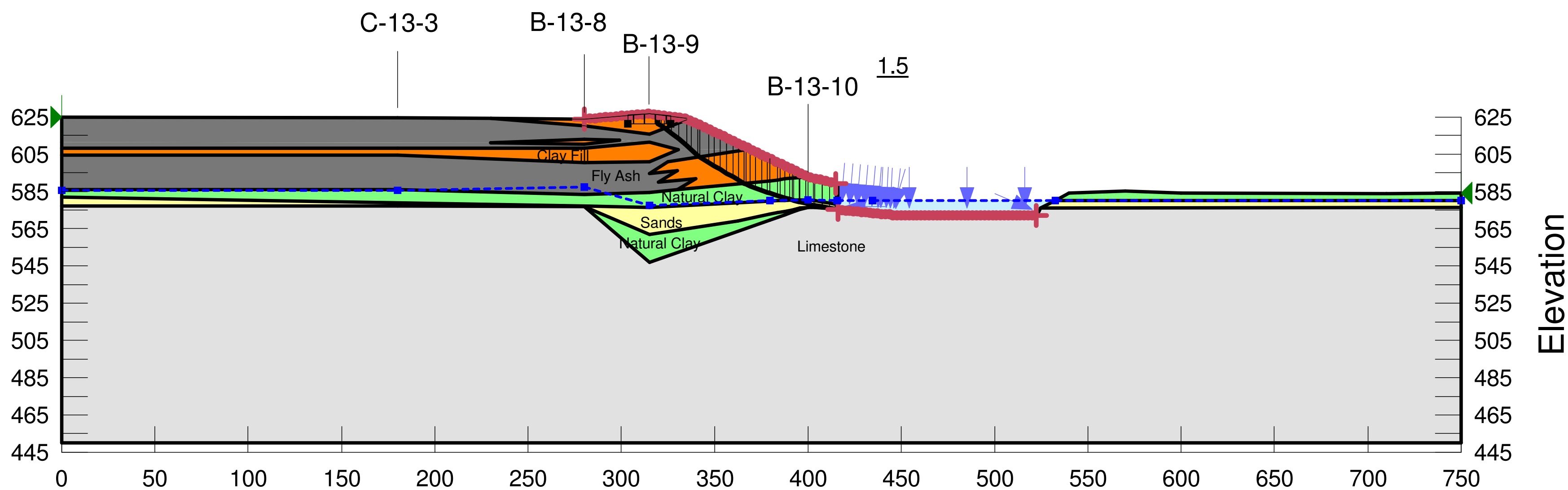
Dynegy-Vermilion
Old East Ash Pond
Cross-Section A-A'

Name: Drained Case FS=1.5
Kind: SLOPE/W
Method: Spencer
F of S: 1.5

Created By: Stefanie Voss
Date: 10/30/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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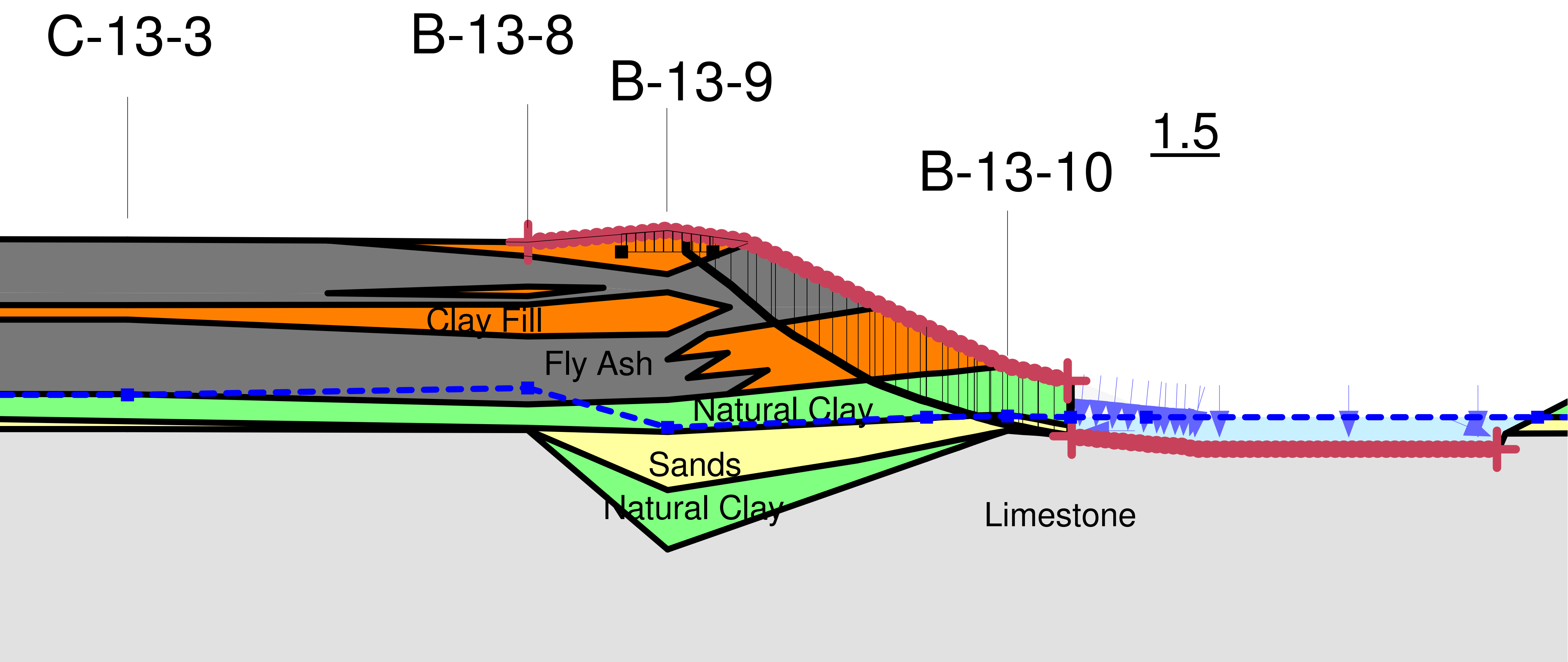


C-13-3
B-13-8
B-13-9
1.5
B-13-10
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

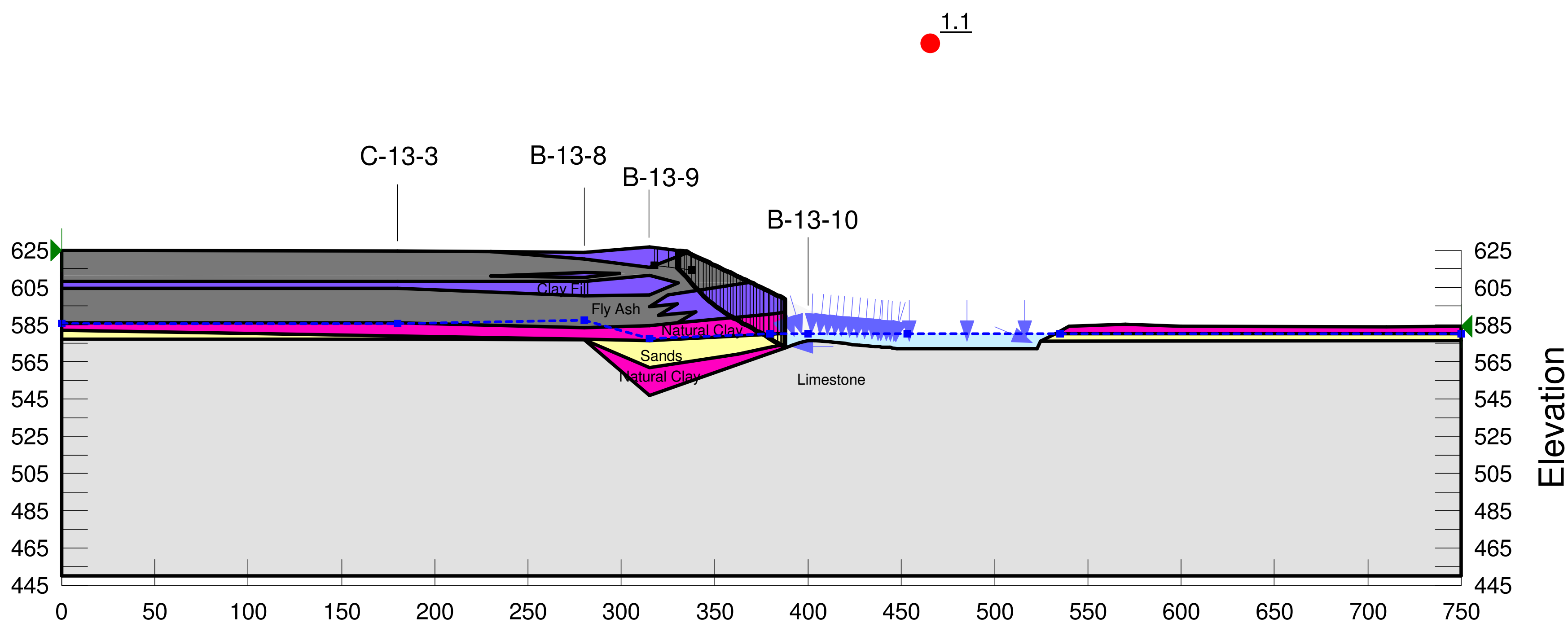
Dynegy-Vermilion
Old East Ash Pond
Cross-Section A-A'

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Undrained Case Failure (FS=1.0)
Kind: SLOPE/W
Method: Spencer
F of S: 1.1

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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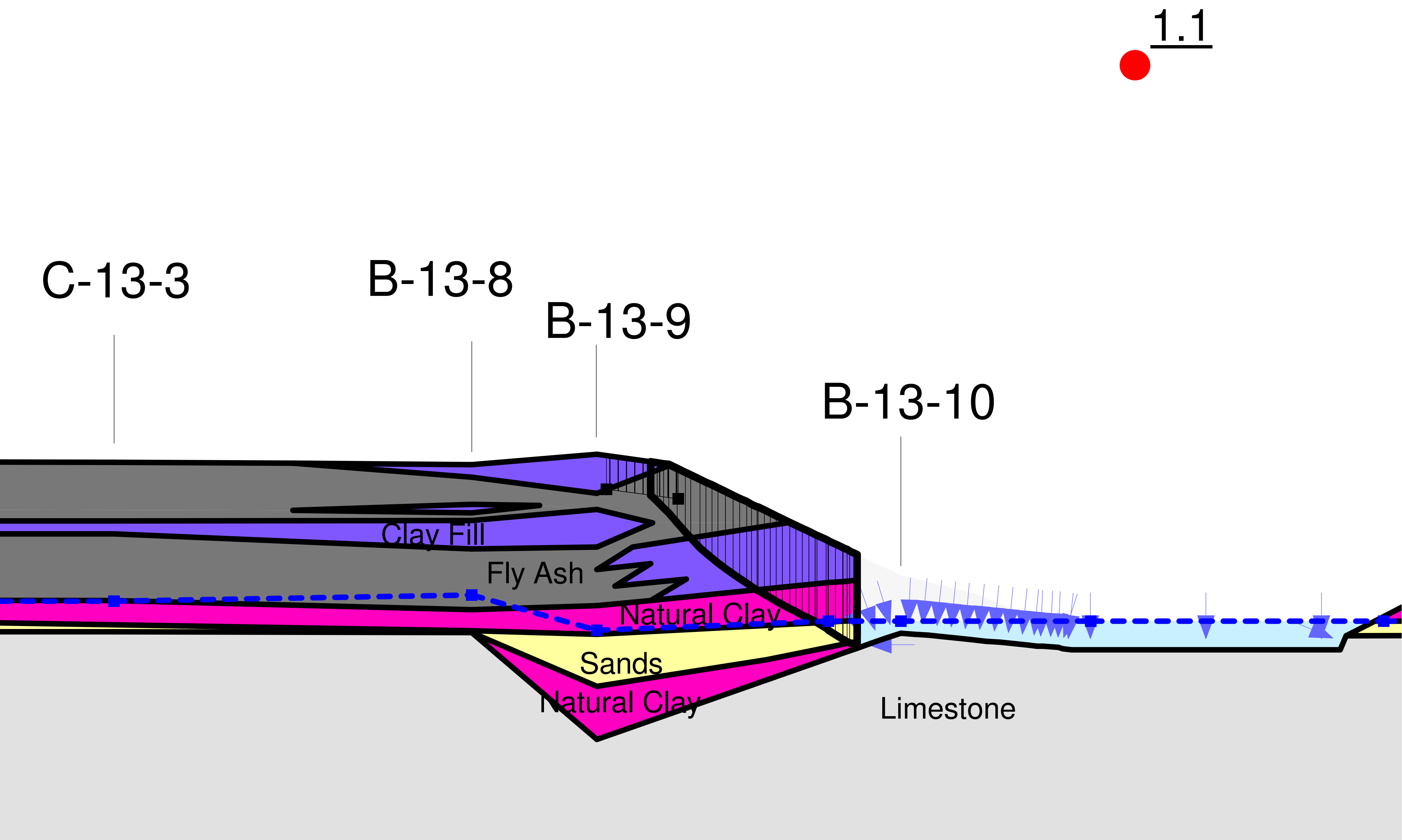

1.1
C-13-3
B-13-8
B-13-9
B-13-10
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

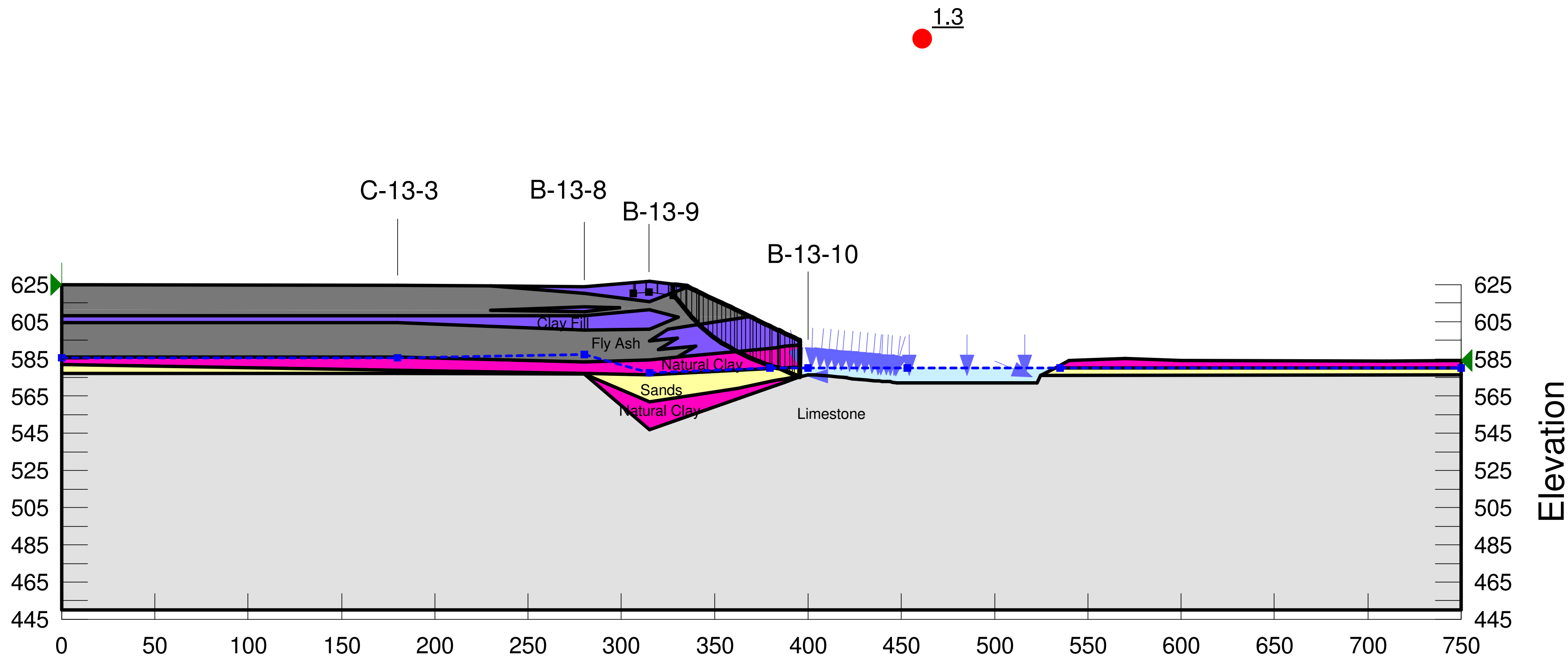
Dynegy-Vermilion
Old East Ash Pond
Cross-Section A-A'

Created By: Stefanie Voss
Date: 11/6/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Undrained Case FS=1.3
Kind: SLOPE/W
Method: Spencer
F of S: 1.3

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 1,500 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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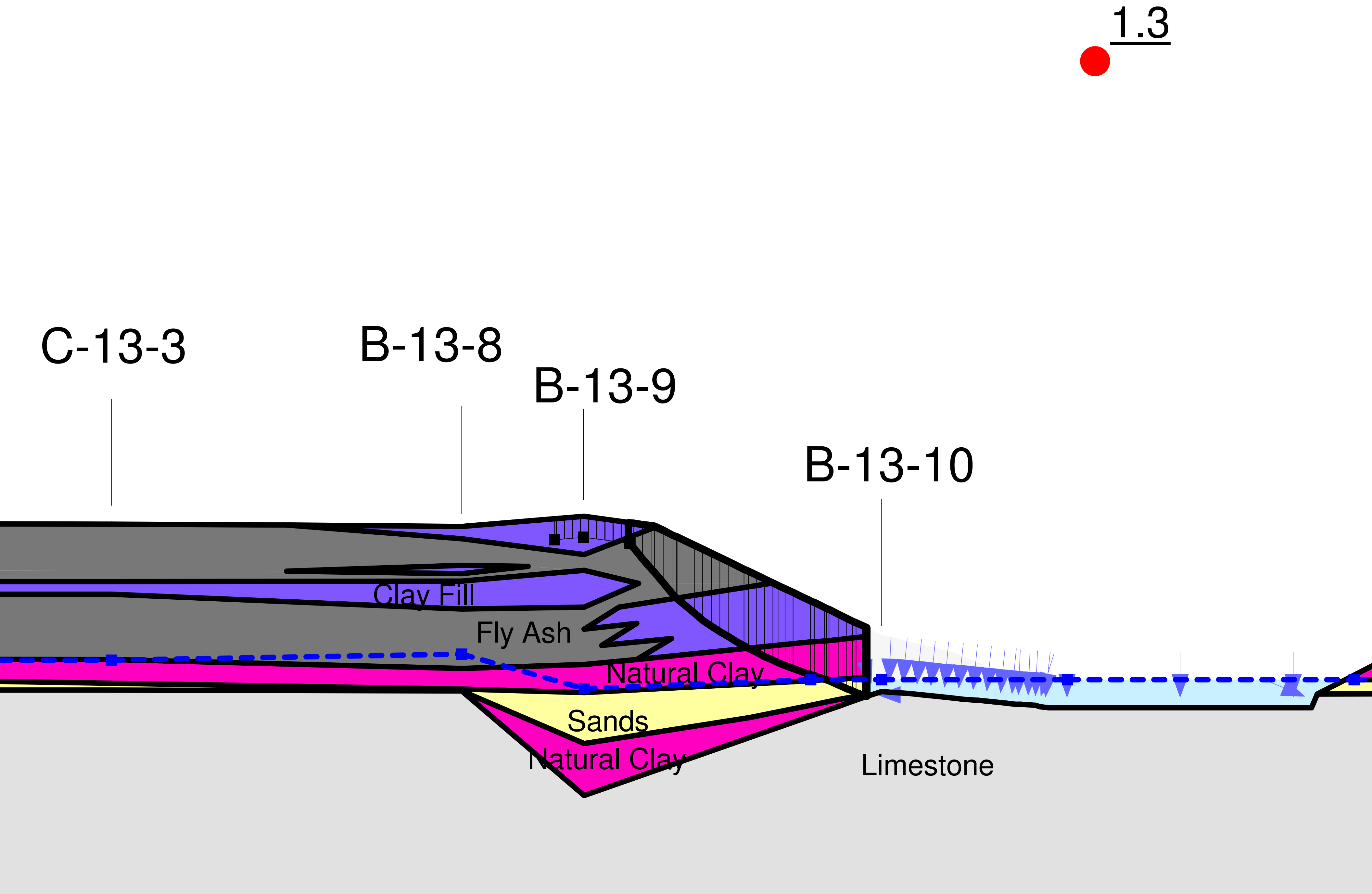


1.3
C-13-3
B-13-8
B-13-9
B-13-10
Clay Fill
Fly Ash
Natural Clay
Sands
Natural Clay
Limestone

Old East Ash Pond
Cross-Section B-B'
Erosion Cases

- -Drained Case at FoS = 1.5
- -Drained Case at FoS = 1.0
- -Undrained Case at FoS = 1.5
- -Undrained Case at FoS = 1.0

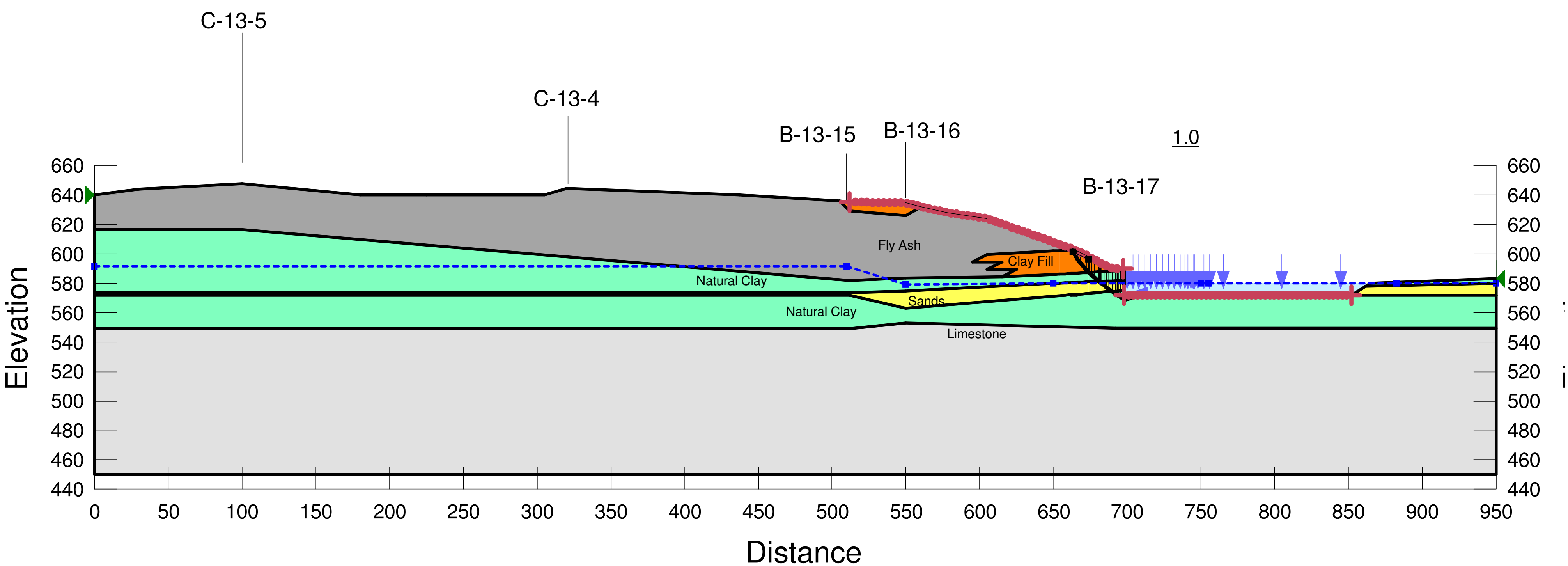
Dynegy-Vermilion
Old East Ash Pond
Cross-section B-B'

Created By: Stefanie Voss
Date: 10/28/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Drained Case Failure (FS=1.0)
Kind: SLOPE/W
Method: Spencer
F of S: 1.0

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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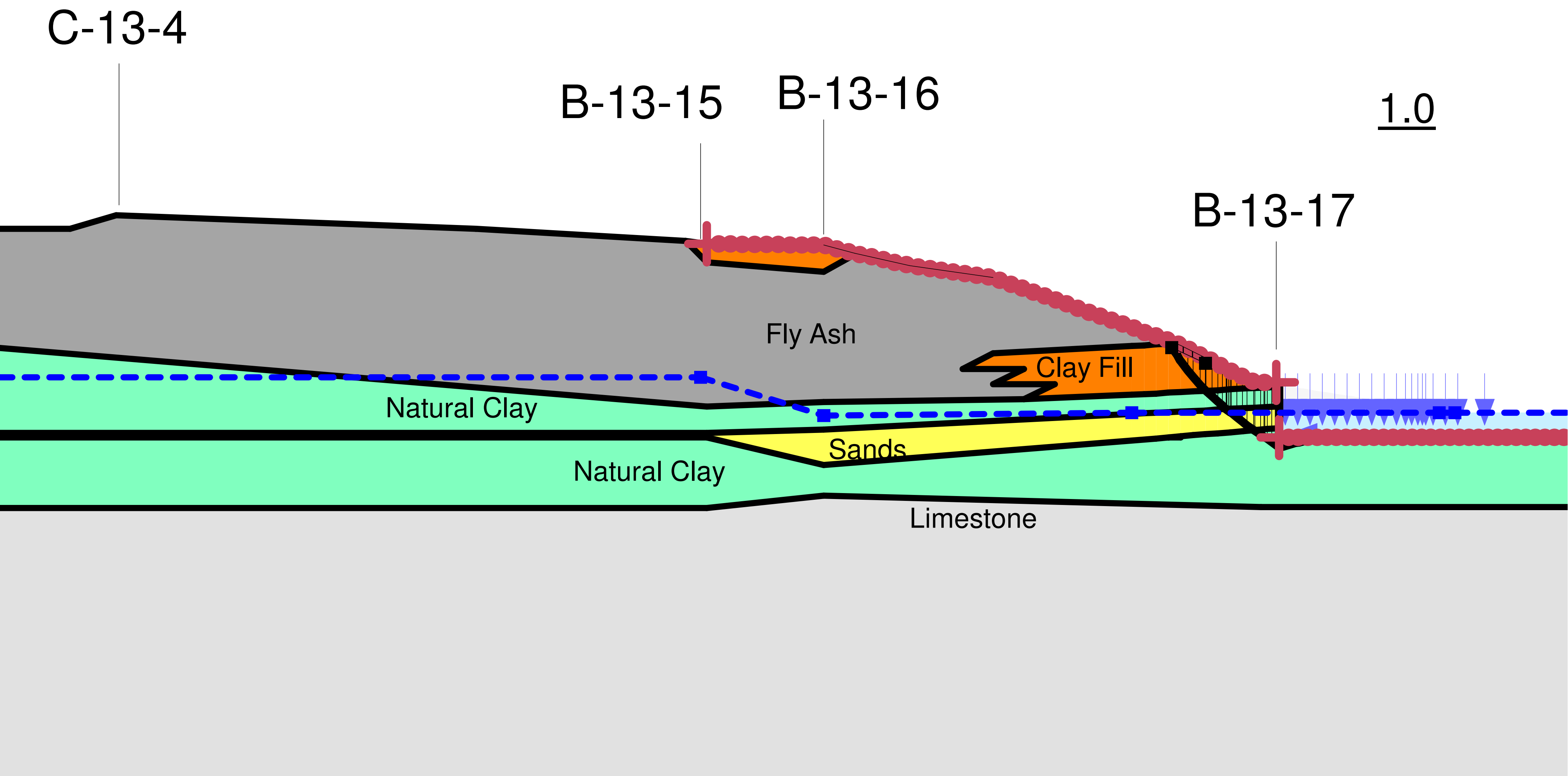


C-13-4
B-13-15
B-13-16
1.0
B-13-17
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone

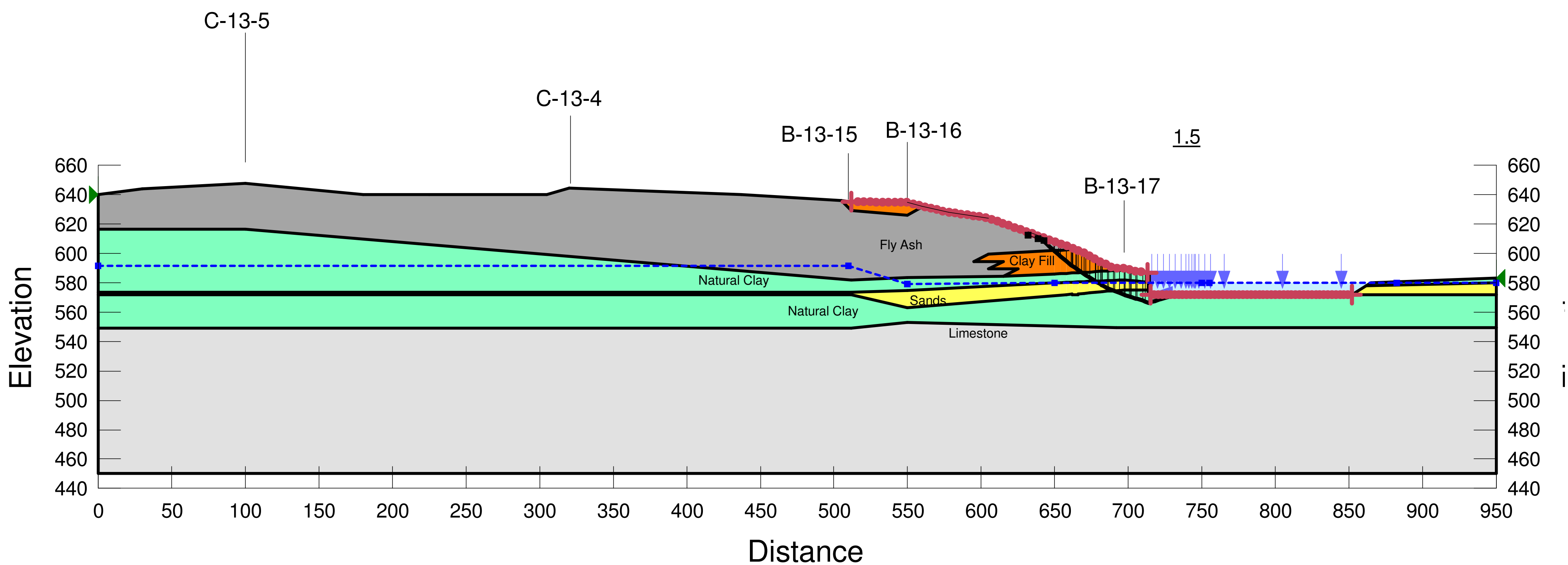
Dynegy-Vermilion
Old East Ash Pond
Cross-section B-B'

Created By: Stefanie Voss
Date: 10/28/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Drained Case FS = 1.5 Entry Exit
Kind: SLOPE/W
Method: Spencer
F of S: 1.5

Name: Clay Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Natural Clay Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1



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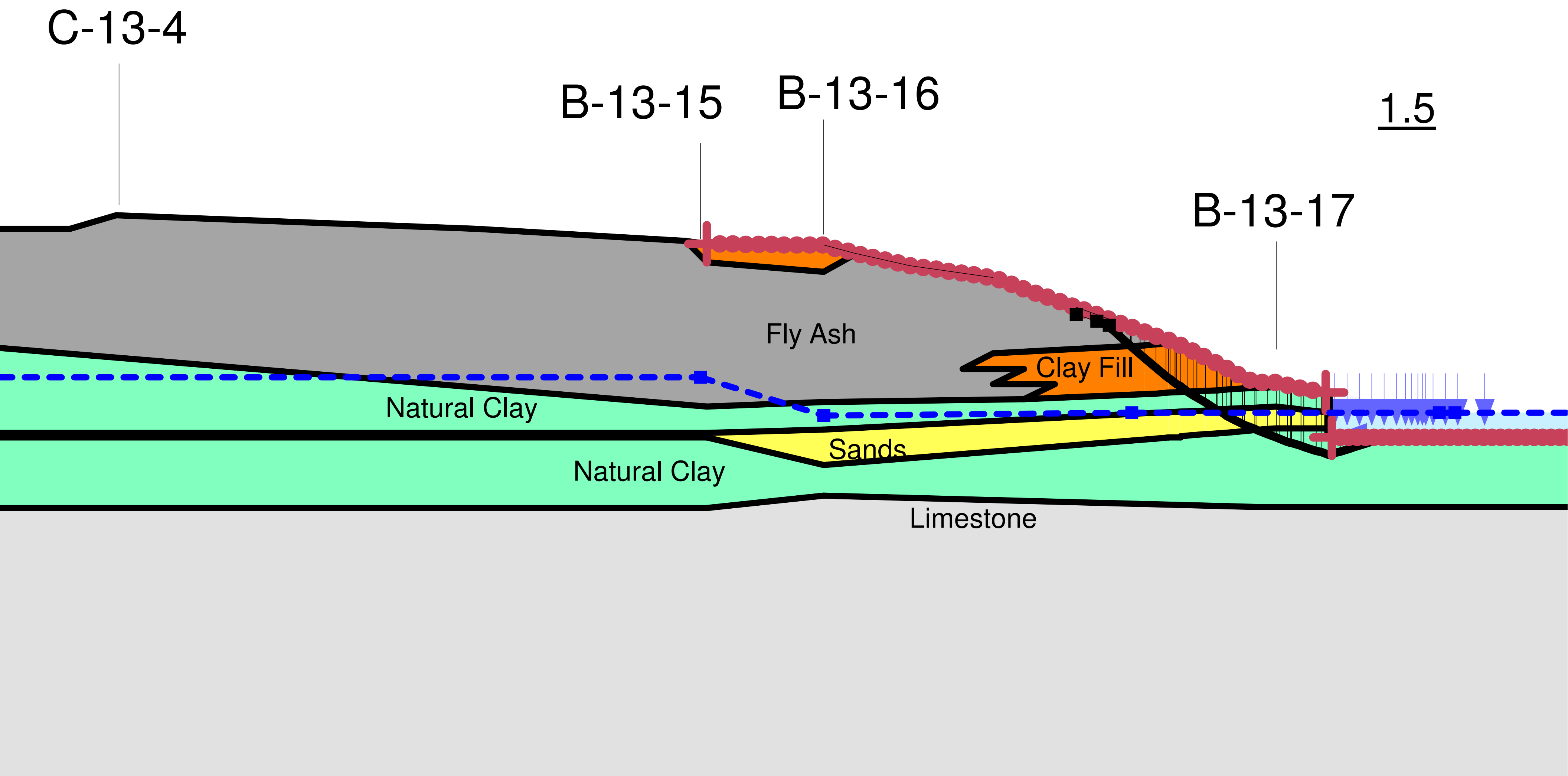

C-13-4
B-13-15
B-13-16
1.5
B-13-17
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone

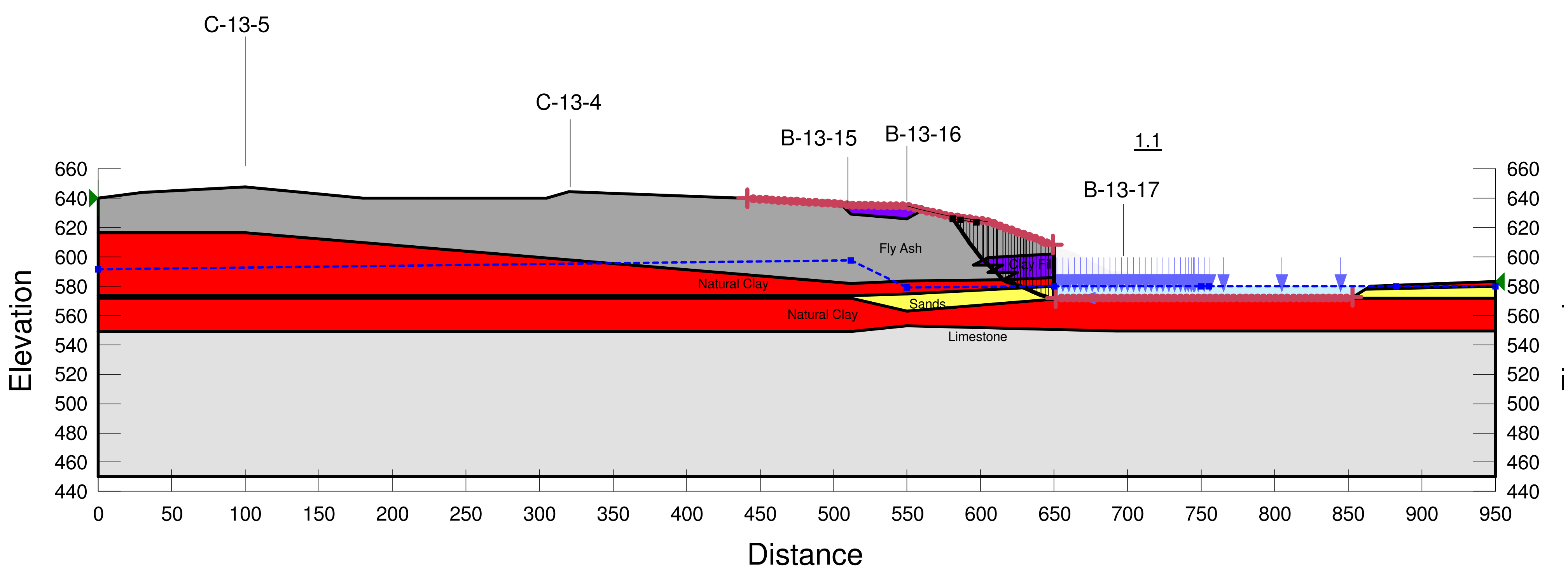
Dynegy-Vermilion
Old East Ash Pond
Cross-section B-B'

Created By: Stefanie Voss
Date: 10/28/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Undrained Case Failure (FS=1.0)
Kind: SLOPE/W
Method: Spencer
F of S: 1.1

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,500 psf Piezometric Line: 1



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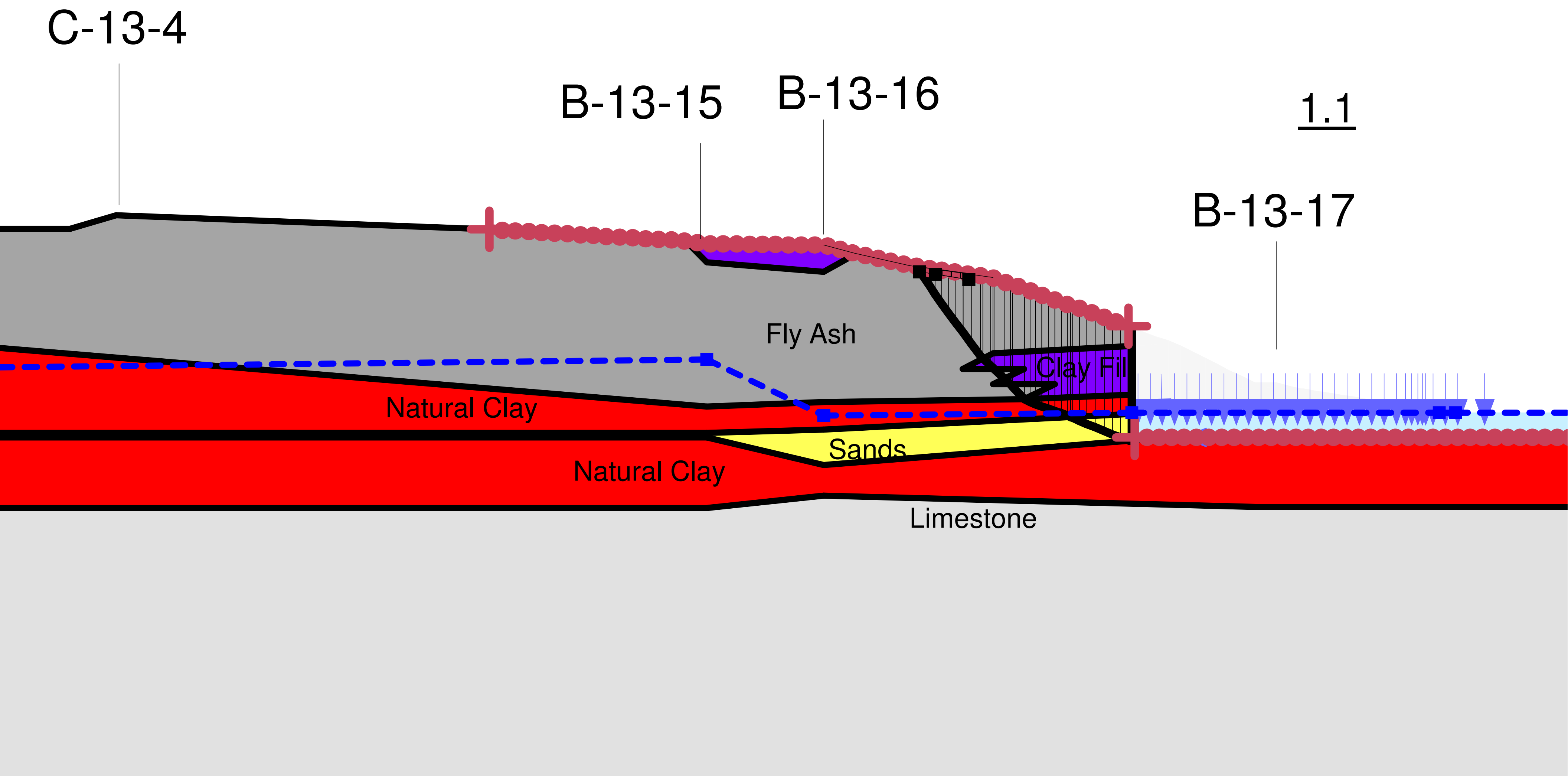


C-13-4
B-13-15
B-13-16
1.1
B-13-17
Fly Ash
Clay Fil
Natural Clay
Sands
Natural Clay
Limestone

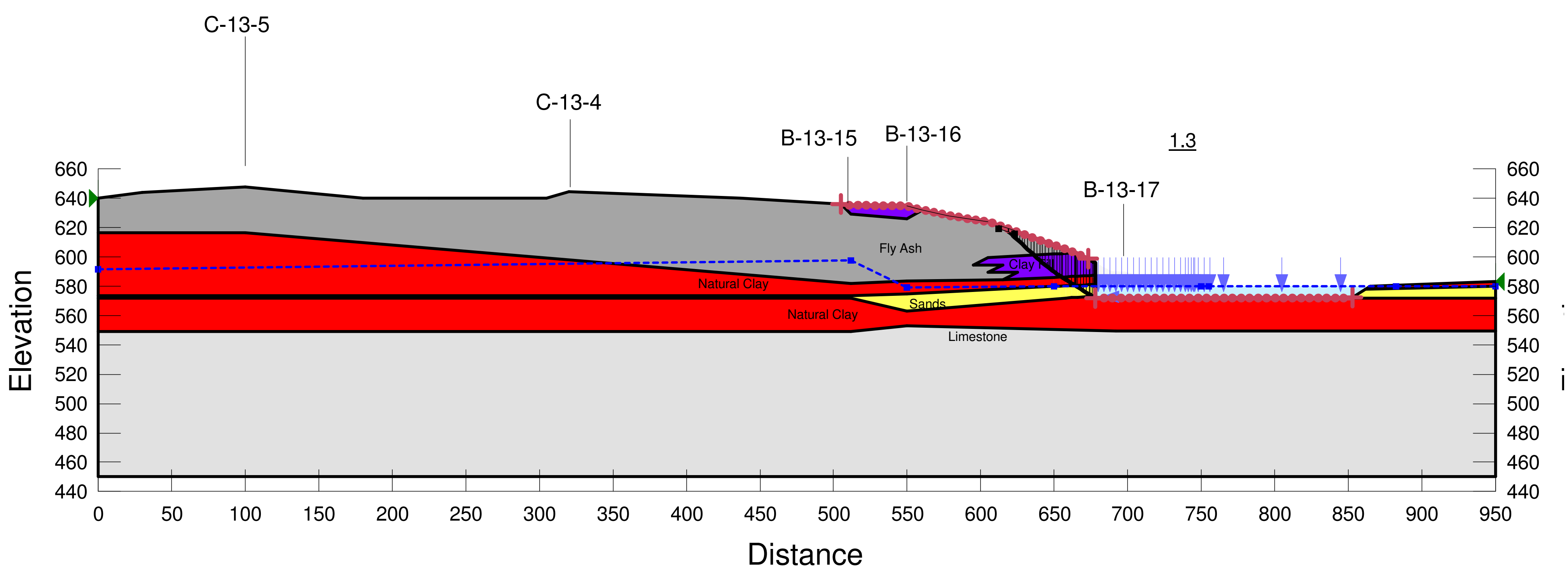
Dynegy-Vermilion
Old East Ash Pond
Cross-section B-B'

Created By: Stefanie Voss
Date: 10/28/2013

Checked By: Lucas Carr
Date: 11/6/2013

Name: Undrained Case FS = 1.3
Kind: SLOPE/W
Method: Spencer
F of S: 1.3

Name: Fly Ash Model: Mohr-Coulomb Unit Weight: 105 pcf Cohesion': 0 psf Phi': 36 ° Phi-B: 0 ° Piezometric Line: 1
Name: Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 ° Phi-B: 0 ° Piezometric Line: 1
Name: Limestone Bedrock Model: Mohr-Coulomb Unit Weight: 165 pcf Cohesion': 100,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: Clay Fill (Undrained) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Natural Clay (Undrained) Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,500 psf Piezometric Line: 1



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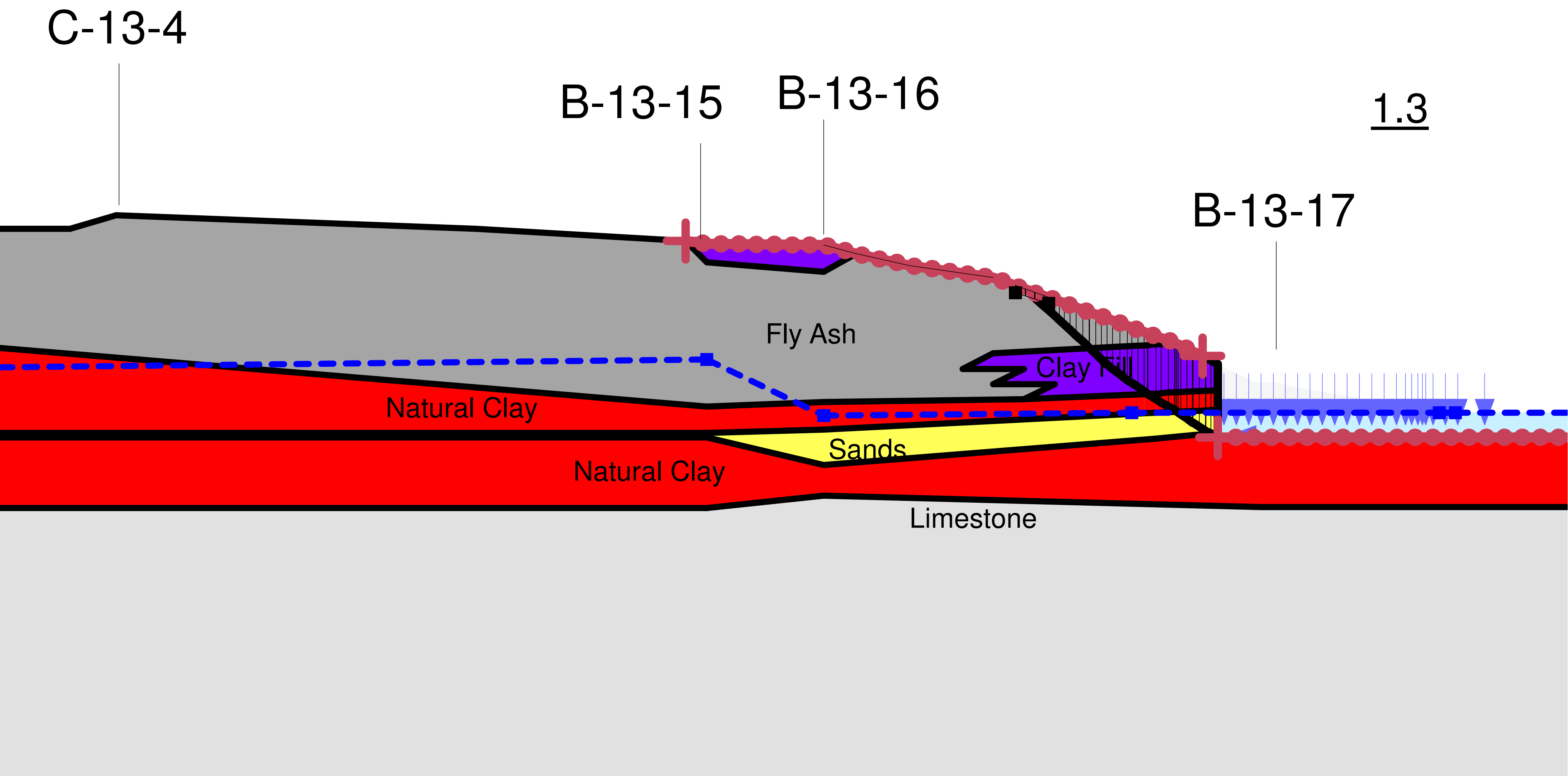

C-13-4
B-13-15
B-13-16
1.3
B-13-17
Fly Ash
Clay Fill
Natural Clay
Sands
Natural Clay
Limestone