GEOTECHNICAL STUDY

PRELIMINARY GEOTECHNICAL STUDY FOR

CASTLE VALLEY RANCH
WEST OF CASTLE VALLEY BOULEVARD
AND CLUBHOUSE DRIVE
NEW CASTLE, COLORADO

PREPARED FOR

VILLAGE HOMES OF COLORADO, INC.
100 INVERNESS TERRACE EAST, SUITE 200
ENGLEWOOD, COLORADO 80112

JUNE 12, 2006
PROJECT NUMBER 90114

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June 12, 2006

Village Homes of Colorado, Inc.
100 Inverness Terrace East, Suite 200
Englewood, Colorado 80112

Attention: Mr. Ron Hettinger

Subject: Preliminary Geotechnical Study
Castle Valley Ranch
West of Castle Valley Boulevard and Clubhouse Drive
New Castle, Colorado
Project Number 90114

Dear Mr. Hettinger:

We have conducted a preliminary geotechnical study for the proposed development at the subject site. Our summary of the data collected during our field and laboratory work and our analysis, opinions, and conclusions are presented in the attached report. The purpose of our study is to provide geotechnical design criteria for planning and site development, and preliminary design concepts for foundation systems, interior floor support, and drainage for the proposed development. Preliminary pavement thickness recommendations are also included.

In general, the subsurface materials encountered consist of topsoil, fill, sandy clay, silty to clayey sand and sand and gravel overlying bedrock. Claystone and/or sandstone bedrock was encountered at depths of four and one-half (4½) to 26 feet below the ground surface in 15 of the 22 test borings. Ground water was not encountered during this study. Six (6) of the 22 test borings caved at depths of 13 to 27½ feet one (1) to two (2) days after drilling.

Site development considerations should include provisions related to the presence of expansive clays and bedrock. Consideration should be given to the placement of a thick layer of moisture treated fill to mitigate the expansive materials. Well cemented, hard to very hard sandstone bedrock was found in five (5) borings which may cause construction difficulties.

Based upon the results of this preliminary study, we expect that the structures at the site will be founded on straight shaft piers drilled into competent bedrock or footings or footing pads. Preliminary foundation design concepts are given in the report.

Slabs-on-grade will require some special consideration because of the moderate to high swelling potential of some of the clay and the claystone. Where the structures are founded upon straight shaft piers, structural floors can be anticipated. Where footings are constructed, slabs-on-grade may be appropriate.

Perimeter subdrains will be necessary for all below grade areas.

Sulfate test results indicate that concrete in contact with the soils should be designed for very severe sulfate conditions.

Preliminary pavement sections are given in the following report. Overexcavation and placement of moisture treated fill in the streets during site grading may be advantageous in areas where claystone is found in the cut areas prior to pavement construction.

Additional recommendations are presented in the following report.

If you have any questions regarding the contents of this report or our analyses of the subsurface conditions which will influence the proposed development, please call us. We have appreciated the opportunity to provide this service for you.

Sincerely,

A. G. WASSENAAR, INC.

COLORADO REGISTERED PROFESSIONAL ENGINEER KATHLEEN ANN NOONAN NUMBER 32156 6-12-06

Kathleen A. Noonan, P.E.
Project Engineer

Reviewed by:

Keith D. Seaton, P.E.
Senior Engineer

KAN/KDS/kan/meg

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ATTACHMENTS

PRELIMINARY GEOTECHNICAL STUDY

Castle Valley Ranch
West of Castle Valley Boulevard and Clubhouse Drive
New Castle, Colorado
June 12, 2006

PURPOSE

This report presents results of a geotechnical study for a proposed development located along Castle Valley Boulevard to the west of Clubhouse Drive in New Castle, Colorado. This study was conducted for the purpose of generating geotechnical data to assist in determining geotechnical design criteria for planning, site evaluation, and development considerations. Preliminary geotechnical design concepts are also presented for foundations, interior floor support, drainage, and street construction. Factual data gathered during the field and laboratory work is summarized on Figures 1 through 27 and Table I attached. Our opinions and recommendations presented in this report are based on the data generated during this field exploration, associated laboratory testing, our experience with similar type projects, and our understanding of the proposed project.

This report was not intended to provide design criteria for individual foundations or street construction. Additional geotechnical studies will be required to develop these types of final design criteria and construction recommendations.

PROPOSED CONSTRUCTION

We understand the proposed 157 acre development will consist of single family and/or multi-family residential structures and the associated infrastructure. No details of structure construction are available at this time. Preliminary overlot grading plans were not available at the time of this study. We have assumed maximum cut/fill depths will not exceed 10 feet across the site.

SITE CONDITIONS

The site is located to the north and south [redacted] New Castle, Colorado (see Figure 1). The [redacted] a total relief of approximately 330 feet. Ve [redacted] It appears that the level areas of the parc [redacted] runs along the southern boundary of the [redacted] northern, eastern, and southern boundari [redacted]

FIELD EXPLORATIONS

Subsurface conditions were explored by [redacted] indicated on Figure 1. The boring location [redacted] typographic features on the site. The borin [redacted] flight auger powered by a truck-mounted, [redacted] the subsurface materials were taken using [redacted] soil by dropping a 140-pound hammer thr [redacted] sampler is a 2.5-inch outside diameter by [redacted] required for the sampler to penetrate 12 in [redacted] density of the soils encountered. Results [redacted] presented on the "Exploratory Boring Log [redacted] logging each boring for material types, gr [redacted] drilling and again one (1) and two (2) days [redacted]

LABORATORY TESTING

Samples were returned to the laboratory [redacted] engineer. Testing was then assigned to spe [redacted]

The laboratory tests included 34 settlement-swell tests to evaluate the effect of wetting and loading on the selected soils samples. The results of the settlement-swell tests are presented on Figures 6 through 22. Nine (9) gradation analysis tests and Atterberg limits tests were conducted to evaluate grain size distribution and plasticity. These results are presented on Figures 23 through 27. In addition, representative samples were tested for water soluble sulfates, pH, resistivity, and chlorides. These results are discussed under the heading "Site Concrete and Corrosivity". The test results are summarized on Figures 2 through 5 and Table I.

SUBSURFACE CONDITIONS

The subsurface materials encountered in our test borings consisted of topsoil, fill, sandy clays, silty to clayey sands and sand and gravel over sedimentary bedrock. Claystone and/or sandstone bedrock was encountered at depths of four and one-half (4½) to 26 feet below the ground surface in 15 of the 22 test borings. Ground water was not encountered during this study. Six (6) of the 22 test borings had caved at depths of 13 to 27½ feet when checked one (1) to two (2) days after drilling. A graphical depiction of the subsurface materials and ground water encountered is shown on Figures 2 through 5.

Topsoil was found in 19 of the 22 test borings. The topsoil encountered consisted of sandy clay, up to one-half (½) foot thick, was organic and moist, and dark brown in color. The topsoil is not considered capable of supporting the structures and should be removed. Construction on topsoil is at the sole risk of the Owner.

Fill was found in one (1) test boring (Boring 22). The fill material encountered consisted of sandy clay and was 16 feet thick. It was compact in consistency and moist. It was mottled brown in color. It exhibited in-situ dry densities ranging from 102 to 119 pounds per cubic foot (pcf) at in-situ moisture contents ranging from 10 to 12 percent (%). The samples tested were of low plasticity. These soils exhibited consolidation (-1.9% to -0.3%) upon wetting and under a load of 1,000 pounds per square foot (psf). This fill was placed prior to A. G. Wassenaar, Inc.'s involvement at this site. Therefore, it is not known if this fill was placed with the proper compactive effort and density compaction testing. Unless documentation is available for the fill which verifies proper placement and compaction, this fill is not considered capable of supporting the structures. Construction on undocumented fill is at the sole risk of the Owner.

Sandy clay was found in 19 of the 22 borings. The clay was generally stiff to very stiff, slightly moist to moist, and brown to red brown in color. It exhibited in-situ dry densities ranging from 78 to 120 pcf at in-situ moisture contents ranging from 6 to 18%. The samples tested were of low to moderate plasticity. These soils exhibited compression to high swell (+4.3%) upon wetting and under a load of 1,000 psf. Some samples from the southern portion of the site exhibited collapse. This soil is assessed to possess a low to high expansion potential.

Silty to clayey sand was encountered in 11 of the 22 test borings. The sand was dense to medium dense, slightly moist to moist, with some silt layers and scattered gravel and cobble and sandstone, and brown to light brown to red brown to gray in color. It exhibited in-situ dry densities of 87 to 123 pcf at an in-situ moisture contents of 2 to 8%. The samples tested were non-plastic or of low plasticity. The samples tested exhibited consolidation (-0.5%) to low swell (+1.7%) when wetted under a 1,000 psf surcharge load. The sands are considered to possess no to low expansion potential.

Claystone bedrock was encountered in 11 of the 22 borings. It was medium hard to very hard, silty to very silty, slightly sandy to sandy, iron stained, with sulfur and sulfate crystals, slightly moist to moist, and olive to rust in color. It exhibited in-situ dry densities of 94 to 124 pcf at in-situ moisture contents of 6 to 16%. The samples tested were of moderate plasticity. The claystone exhibited consolidation (-7.5%) to very high swell (+6.0%) upon wetting and under a loading of 1,000 psf. It is considered to possess a high expansion potential.

Sandstone bedrock was encountered in five (5) of the 22 borings. The sandstone encountered was clean to silty to clayey, moderately to well cemented, firm to very hard, slightly moist to moist, and rust to brown in color. The sandstone tested exhibited an in-situ dry density of 120 pcf at an in-situ moisture content of 5%. The samples observed were visually of low plasticity. The sandstone exhibited low swell (+0.8%) upon wetting and under a loading of 1,000 psf. It is considered to possess a low expansion potential. A map showing the estimated depths to bedrock is shown on Figure 28.

GEOTECHNICAL CONCERNS

Expansive clays and claystone bedrock were encountered across the site. The clays exhibited no to high swell when tested. The claystone exhibited no to very high swell when tested. In our opinion, the expansive properties of the soil and bedrock can be reduced with proper fill placement, drainage, future irrigation controls, and with the use of proper design and construction techniques. To eliminate use of deep foundations for expansive and collapse prone soils, overexcavation may be performed.

Hard to very hard sandstone bedrock was encountered in the test borings. Very hard, well cemented bedrock may cause construction difficulties during the various excavations to be made during development. It may become especially evident if cuts encounter the sandstone bedrock.

The sandstone may require light blasting or special equipment. The sandstone may require crushing in order to be re-used as fill.

Collapsing clays were encountered in Test Borings 19 and 21. The final concern is the presence of the collapse prone sandy clay. In the presence of moisture, these soils will consolidate, sometimes suddenly. This could cause significant settlements to structures (residence, pavements, etc.) supported by these soils. If left in-place, pier type foundations would be needed in these areas to prevent settlement of the structures. Due to the wide spacing of the test borings, the extent of the collapsing soils could not be accurately determined. We recommend a more in-depth study in the vicinity of these test borings be conducted in order to adequately delineate the areas of collapse potential.

Fill was encountered in Test Boring 22. The fill is approximately 16 feet thick and was placed prior to our involvement with this site. Construction on undocumented fill is the sole risk of the Owner. We recommend the removal of this fill.

SITE DEVELOPMENT

OVERLOT GRADING

We assume the fill materials to be used at the site will be from on-site cut areas. In general, suitable inorganic on-site or off-site soils may be used for structural fill. Any topsoil, or soil containing vegetation or other deleterious material, should also be removed prior to placement of structural fill. Any materials that have been chemically contaminated should be removed from the site for proper disposal. Off-site material considered for structural fill should be evaluated by our office prior to hauling to the site.

Construction of the fill embankments throughout the site will consist of proper foundation preparation, constructing embankment benching where necessary, disposition of strippings, proper fill placement and compaction, and designing and vegetating slopes in accordance with the analysis performed and the applicable governing regulations. Following are general site grading recommendations:

1. It is recommended that we be called to observe and test the fill placement so that a uniform, compacted fill will be placed.
2. Based upon the subsurface information contained in this report, and our assumption that the near surface soils will be used as fill, we have provided general specifications for the project in the Appendix.
3. All vegetation and topsoil beneath planned fill areas should be thoroughly stripped and removed prior to fill placement. These soils should be removed from the site or stockpiled for future use in revegetating exposed slopes. In no case should these materials be used in the structural areas or where the stability of slopes will be affected by their low shear strength. If these materials are used in non-structural areas, they should only be placed in fills where the embankment section does not exceed five feet in height.
4. Any existing fill should be entirely removed prior to new fill placement.
5. Soft soils are anticipated near the existing drainage. Soft soils may need to be stabilized prior to fill placement where encountered. This may be accomplished by drying, addition of angular rock or with manufactured products such as geogrids or stabilization fabric. These areas will need to be field identified at the time of grading. Once the extent of these areas is identified, a stabilization method may be chosen.

6. Where natural slopes exceed an existing slope of 5:1 (horizontal to vertical), benching will be required for structural integrity of any fills. Benches should be constructed as shown on Figure 29.
7. After the foundation has been properly prepared, the natural foundation soils should be scarified to a minimum depth of 6 inches, brought to the proper moisture content and then compacted according to the Appendix.
8. The compaction and moisture control of the soils will be dependent upon material types. The specifications outlined in the Appendix are based upon providing a fill with sufficient shear strength to support structures and controlling residual swell of expansive soil used in fill sections.
9. Particular attention should be paid to compaction of the exterior faces of slopes (i.e., slopes should be compacted to the minimum specification to the surface of the fill embankment).
10. Other specifications outlined in the Appendix of this report should be followed.

MOISTURE TREATED FILL

An option to reduce the amount of swell of the expansive clays and claystone and potential for collapse of the clays would be to remove them from beneath the foundation and pavement areas and then to replace them as a moisture treated fill. This procedure generally results in a fill that is either able to support footing type foundations or reduces the swell of the materials sufficiently to allow the construction of minimum pier lengths. This procedure involves excavating to a depth below the foundations and pavements as determined by the amount of potential swell. The excavated soil is then wetted to above the optimum moisture content and then recompacted into the excavations. If this procedure is desired, it will be necessary to perform a more detailed study of the proposed residential areas to better define the characteristics of the existing soil and bedrock. We are available to discuss this with you.

SLOPES

A slope stability analysis was not conducted as part of this study. Based upon preliminary site specific observation, it appears that most of the existing slopes appear stable. The only instabilities noted were the result of erosion of banks along the various gullies and intermittent stream channels on the site. These areas will need to be laid back or removed during construction. Where natural slopes exceed 5 to 1, horizontal to vertical, benching to maintain structural integrity will be required. Planned excavations into the steeper natural slopes should be reviewed by this office when grading plans become available. Construction of conventional fill slopes should be limited to 2 to 1 or flatter. Cut slopes steeper than 2 to 1 should be evaluated for stability.

CONSTRUCTION EXCAVATIONS

In our opinion, the site grading and utility excavations may be constructed using conventional earth-moving equipment for the area. The excavations in areas where bedrock is present at or near the surface will require additional effort where moderately to well cemented sandstone is encountered. The use of a large dozer (CAT D8 or D9) with a single shank ripper tooth will be required. In addition, some of the sandstone may require light blasting where well cemented. Excavations deeper than three feet should be properly sloped or braced to prevent collapse because of caving soils. Local, city, county, state, and federal (OSHA) regulations should be followed.

SITE DRAINAGE

We recommend that provision be made to divert surface runoff away from foundation areas. This may reduce potential problems associated with excess water in the foundation bearing soils. The site should be designed such that a 10% slope can be established at the residences after foundation construction. Slopes of at least 2% should then be planned in landscaped areas once the water is away from the foundation.

SUBSURFACE DRAINAGE

The ground water encountered is not anticipated to cause significant problems across most of the site during development except near the existing drainages. It may be necessary to construct blanket drains in the existing drainages if they are to be filled to significant depths.

The types of materials encountered across the site have a relatively low permeability, and are, therefore, susceptible to the creation of a perched water condition. Perched water, in conditions such as these, forms after construction has taken place, when extensive irrigation is introduced to the property.

For these reasons, we recommend an overall area drain be considered during site development. In addition, the overall area drain can also provide for a discharge and collection point for individual foundation drains. Because the sanitary sewer trench excavation is typically the deepest excavated trench area, underdrains can be designed and constructed with installation of the sanitary sewer system. The civil engineering company contracted to design the infrastructure should be able to provide this design. We are available to assist in drain design. For the system to work, the area drain must be graded to a positive discharge point. Given the topography of the site, it should be possible to lead the area drain to a gravity "daylight" outfall on the lower topographic portions of the site. **If a permanent outfall for an area drain cannot be determined, the area drain should not be constructed.** If an area drain is not constructed, it would be advantageous to provide a gravity outfall for the sewer bedding material.

UTILITY CONSTRUCTION

Excavations into the overburden soils will encounter primarily sands, clays and some bedrock. The bedrock may be considered a "Type A" soil, where intact. The overburden clay above the ground water level may be considered a "Type B" soil, and the sands and any soil influenced by the ground water should be considered as a "Type C" soil. Final determination of the soil types must be made by the contractor's "competent person" at the time of construction. All excavations should be sloped or shored in the interest of safety, following local and federal (OSHA) regulations.

The bedrock, when encountered, may stand vertically unsupported, except where fractured or inundated with water. In the interest of safety, bedrock excavations should be sloped as outlined above. In our opinion, most of the utility excavations may be constructed using conventional earth-moving equipment for the area. Difficulty will be experienced where moderately to well cemented sandstone is found. Excavation with rock buckets or trenchers designed for the cemented rock should be anticipated. In addition, some light blasting may be required.

Trench backfill should be well compacted to prevent future settlement. Trenches, as a minimum, should be compacted to the same specifications as required for overlot grading. Trenches in streets should be compacted to Town of New Castle specifications. Density-compaction testing must be performed during trench backfilling.

SITE CONCRETE AND CORROSIVITY

Testing performed on selected soil samples indicates a water soluble sulfate content ranging from less than 50 ppm to 20,000 ppm. This is considered to be a negligible to very severe concentration relative to potential corrosive attack on concrete. Therefore, all concrete in contact with the soils on the site should be designed for very severe sulfate exposure in accordance with the American Concrete Institute (ACI) Design Manual, Section 318, Chapter 4.3, 2004 Edition.

The pH testing exhibited levels of 7.32 to 8.31. Resistivity testing at in-situ moistures resulted in levels from 516 to 3,984 Ohms/cm. Chloride test results indicated less than 0.0001% to 0.0068%. These results are summarized on Figures 2 through 5, and in Table I. The results of this testing should be used as an aid in choosing the construction materials in contact with these soils and will be resistant to the various corrosive forces. Manufacturer's representatives should be contacted regarding the specific corrosivity resistance to the stated levels of pH, resistivity, and chlorides for their particular product. In addition, local district specifications should be consulted when selecting pipe materials.

PRELIMINARY FOUNDATION DESIGN CONCEPTS

The foundation recommendations for each structure are dependent upon the subsurface profile and engineering properties of the materials encountered at and near to the depth of the proposed foundation. These are dependent upon the final configuration and construction methods used during overlot grading at the site and the type of structure to be constructed. Therefore, foundation design recommendations for each structure cannot be presented until site grading is complete. **The information presented in the following sections presents preliminary foundation concepts which must be finalized for each building site upon completion of the overlot grading operations.** We should be retained to provide an additional soil and foundation exploration after completion of site grading to provide specific foundation design recommendations for each site.

PIERS

A suitable foundation system for structures founded where claystone bedrock, moderate to highly expansive clay soils or collapse prone soils are found at or near to the bottom of the final excavations would be straight shaft piers drilled into bedrock. The piers will likely be designed for an end bearing pressure in the range of 15,000 to 30,000 pounds per square foot (psf), a minimum dead load pressure in the range of 15,000 to 20,000 psf, and a side shear in the range of 1,500 to 3,000 psf. The side shear would be applied for that portion of the pier in undisturbed bedrock with the exception of the upper 10 feet of each pier beneath the grade beam or foundation wall. Pier lengths on the order of 20 to 30 feet with bedrock penetration from eight (8) to 15 feet can be anticipated.

As an alternative, helical steel piers may be considered. These piers will need to be drilled to depths of 15 to 20 feet below the bottom of the foundation and bear into materials capable of supporting their design pressures. Due to the hardness of the bedrock, pre-drilling of the pier locations will likely be necessary. Heavy duty piers may be necessary. Additionally, refusal of the piers may occur in the well cemented sandstone.

FOOTINGS

It is likely that some of the structures could be supported by spread footings or pad-type footings bearing on the natural sands, sandstone, and clays or thick, low expansive fill materials. If the expansive and collapse prone materials are overexcavated and replaced as moisture treated fill, most of the structures could likely be supported by footings. The footings must be founded below frost depth. Some densification may be required for footing support in areas where loose sand is encountered at foundation level. The footings will likely be designed for a maximum soil pressure ranging from 1,000 to 3,000 pounds per square foot (psf). A minimum dead load pressure may be required where clays are present.

Lateral Earth Pressures

Foundation walls with fill on only one side and any retaining walls will need to be designed for lateral earth pressures. For this site, lateral equivalent fluid pressures on the order of 45 to 60 pounds per cubic foot should be anticipated dependent upon the type of soil used to backfill the walls.

Interior Floor Construction

Where straight shaft piers are used for foundation support, the sites will be assessed with a moderate to very high slab risk performance evaluation. Where footing type foundations are constructed, it is likely that the sites will be assessed with a low or moderate slab risk performance evaluation. For structures constructed on piers, it is likely that it will be necessary to construct a structural basement floor where moderate or higher risk is present. Where structures are supported on footings, low to moderate basement slab risk assessments can be anticipated. If the risk tolerance for slab movement is zero, structural floors should be considered in all areas.

Drain Systems

Due to the relatively impermeable nature of the soils encountered on the site, drain systems will be required where below grade spaces are planned. Either interior or exterior drains may be used. The drains must be led to a positive gravity outfall or sump.

BACKFILL AND SURFACE DRAINAGE

Backfill should be moistened and compacted to reduce future settlement. The site grading should consider a slope of 10% away from the foundations at the completion of construction. All other drainage swales in landscaped areas should slope at a minimum of 2%.

PRELIMINARY STREET PAVEMENT DESIGN

Pavement design procedures are based on strength properties of the subgrade and pavement materials, along with the assumed design traffic conditions. Subgrade materials, such as the clay materials encountered on this site, are potentially expansive and require additional precautions be taken to provide for adequate pavement performance. The pavement design procedures outlined address expansive subgrade materials primarily by modifying the subgrade materials in such a manner as to reduce the swell potential and then by attempting to minimize subgrade wetting after construction.

Based upon our preliminary analysis, it appears the proposed pavement subgrade materials will be the sandy clays and clayey sands. These soils are summarized below according to their AASHTO Soil Classification System and Group Index Method.

Soil	AASHTO	
	Classification	Group Index
Silty, gravelly sand, clayey sand, sandstone	A-1-b, A-2-4, A-4	0
Sandy clay	A-6	9-14

From these soil classifications, we have estimated R-Values in order to determine the preliminary pavement thicknesses. Based on this information and utilizing thickness as determined from the CDOT Design Nomograph, as accepted by the Town of New Castle, the alternatives presented below were calculated.

PAVEMENT ALTERNATIVES FOR INTERIOR STREETS

A-1-b, A-2-4, A-4 Soils		
Traffic Category	**HBP**	**HBP/ABC**
Local	5.5" - 6.5"	3.5" - 4.5" / 7.5" - 9.0"
Minor Collector (Residential)	7.0" - 8.5"	4.0" - 5.0" / 8.0" - 9.5"

A-6 Soils		
Traffic Category	**HBP**	**HBP/ABC**
Local	6.0" - 7.0"	3.5" - 4.5" / 7.5" - 9.0"
Minor Collector (Residential)	8.0" - 9.5"	4.5" - 5.5" / 8.0" - 9.5"

HBP = Hot Bituminous Pavement ABC = Aggregate Base Course

Note: Composite sections are only allowed in private streets and parking lots.

DTNs of 5 were used for the local streets and a DTN of 30 was used for the residential minor collector. A design life of 20 years was assumed. It should be emphasized that the design alternatives provided above are preliminary for interior local residential streets and collectors. The final design thickness could be more or less than indicated.

Proper surface and subsurface drainage is essential for adequate performance of pavements constructed on these types of subgrade materials. It has been our experience that water from landscaped areas will infiltrate pavement subgrade soils and result in loss of subgrade integrity followed by pavement damage. Therefore, provisions should be made to maintain adequate drainage and/or contain runoff from such areas. In addition, water and irrigation lines should be thoroughly pressure tested for leaks prior to placement of pavement materials.

It must be reiterated that the information contained in this section is preliminary in nature. More detailed information will be required by the Town of New Castle prior to issuance of a paving permit. **Therefore, when overlot grading is complete at the site, a final pavement evaluation must be performed.**

FINAL DESIGN CONSULTATION AND CONSTRUCTION OBSERVATION

This report has been prepared for the exclusive use of Village Homes of Colorado, Inc. for the purpose of providing geotechnical criteria for the proposed project. The data gathered and the conclusions and recommendations presented herein are based upon the consideration of many factors including, but not limited to, the type of structures proposed, the configuration of the structures, the proposed usage of the site, the configuration of surrounding structures, the geologic setting, the materials encountered, and our understanding of the level of risk acceptable to the client. Therefore, the conclusions and recommendations contained in this report shall not be considered valid for use by others unless accompanied by written authorization from A. G. Wassenaar, Inc.

It is recommended that A. G. Wassenaar, Inc. be retained to provide general review of the final design and specifications in order that the recommendations presented may be properly interpreted and implemented. Our firm should also be retained to provide geotechnical engineering and material testing services during construction of the site grading, utilities, and drainage features. The purpose is to observe the construction with respect to the geotechnical design concepts, specifications or recommendations, and to facilitate design changes in the event that subsurface conditions differ from those anticipated prior to start of construction. It is also recommended that our firm be retained to perform a final pavement design for the streets and parking lots in the development and to perform a final foundation design report for each structure in the development after site grading is complete.

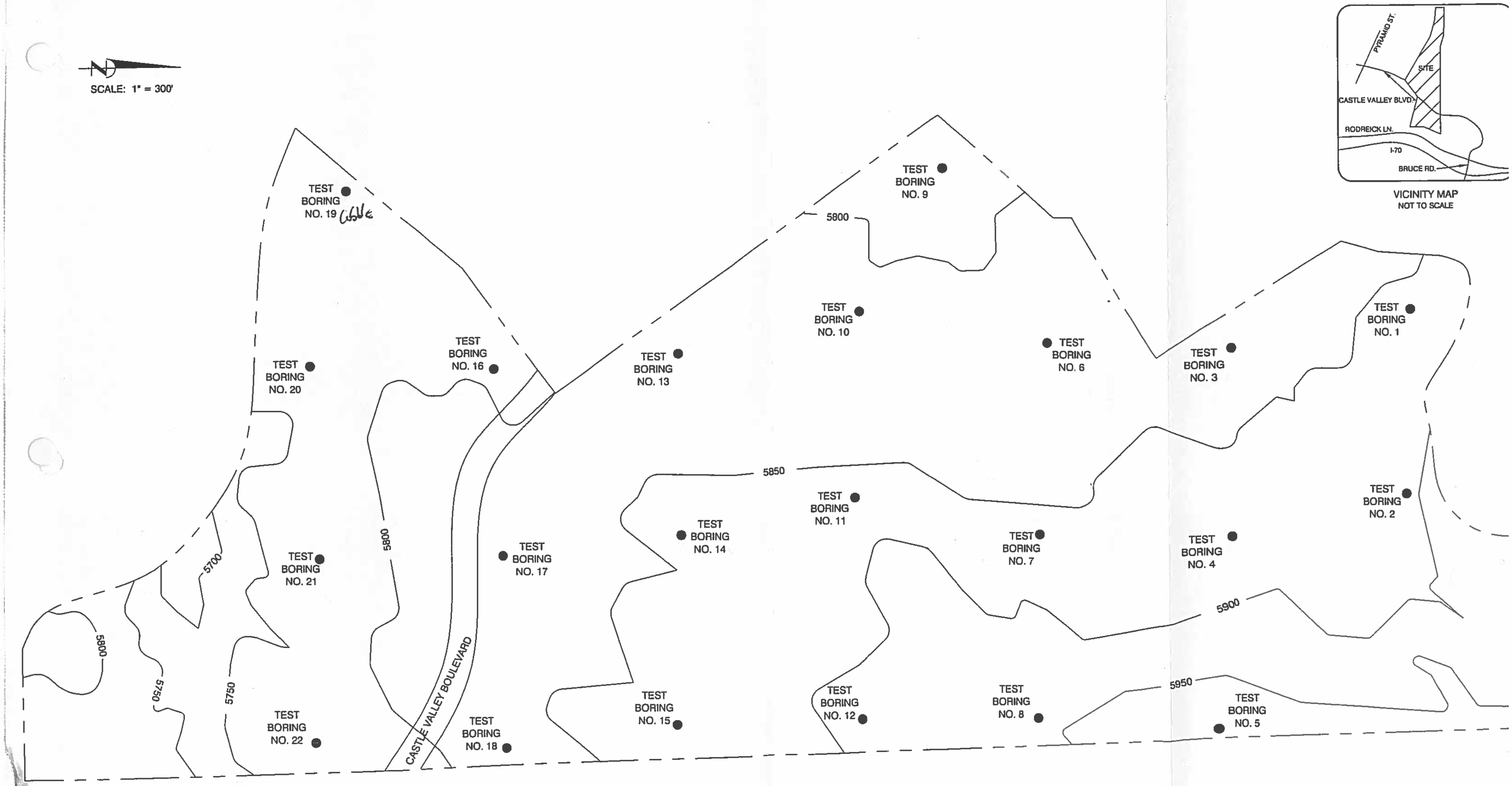
GEOTECHNICAL RISK

The concept of risk is an important aspect of any geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be tempered by engineering judgment and experience. Therefore, the solutions or recommendations presented in any geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as desired or intended. What the engineering recommendations presented in the preceding sections do constitute is our best estimate, based on the information generated during this and previous evaluations and our experience in working with these conditions, of those measures that are necessary to help the development perform in a satisfactory manner. The Developer, Builder, and future Owners must understand this concept of risk, as it is they who must decide what is an acceptable level of risk for the proposed development of the site.

LIMITATIONS

The professional judgments expressed in this report meet the standard care of our profession in this area at this time. The test borings drilled for this study were spaced to obtain a reasonably accurate picture of underground conditions for design purposes. Variations frequently occur from these conditions which are not indicated by the test borings. These variations are sometimes sufficient to necessitate modifications in the designs. For this reason, we should be retained to observe the site during construction.

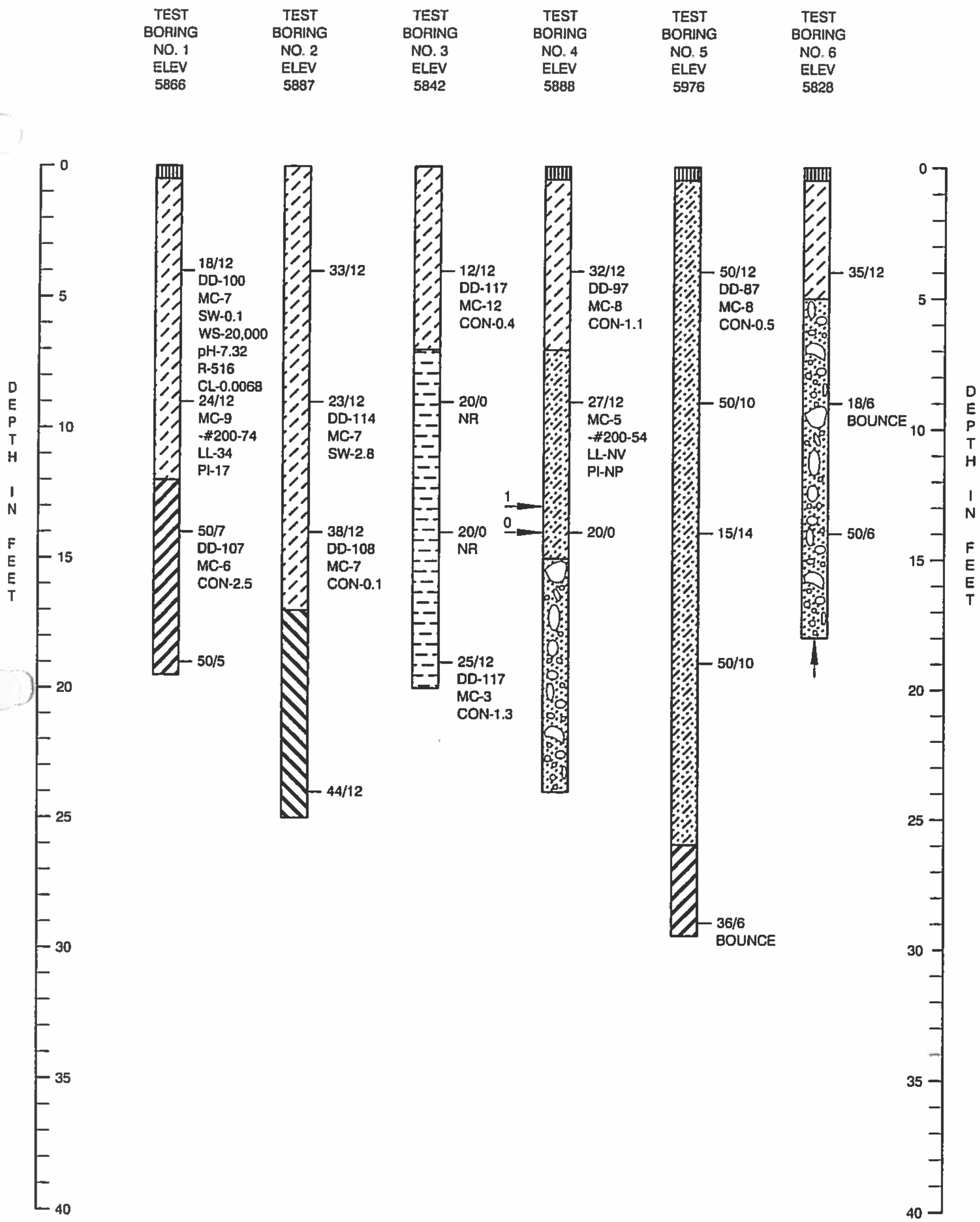
Our scope of services for this project did not include any research, testing, or assessment relative to past or present contamination of the site by any source. If such contamination were present, it is likely that the exploration and testing conducted for this report would not reveal its existence. If the Client is concerned about the potential for such contamination, additional studies should be undertaken. We are available to discuss the scope of such studies with you.



— 5850 — APPROXIMATE 5850-FOOT CONTOUR LINE

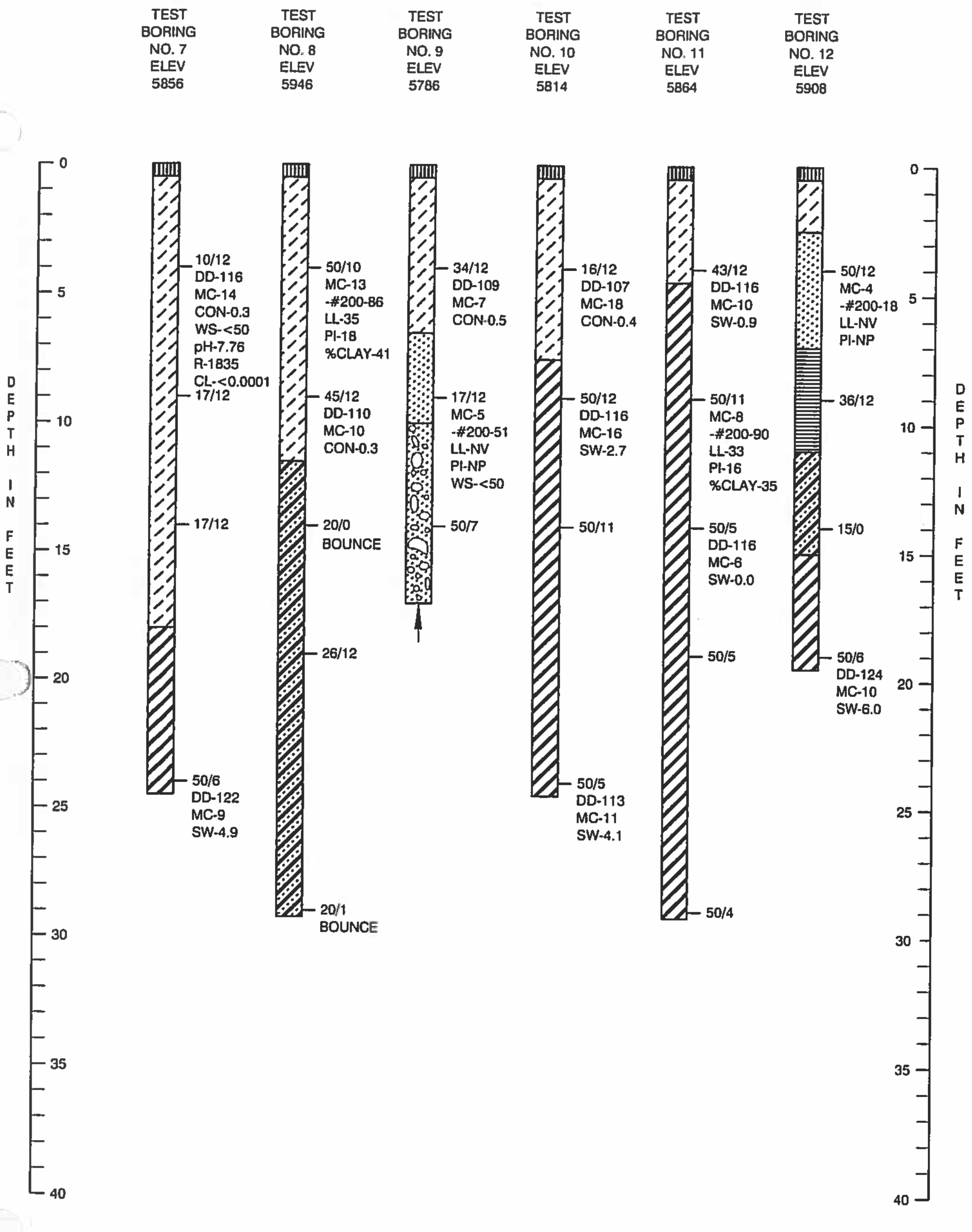
NOTE: ALL LOCATIONS ARE APPROXIMATE

A.G. Wassenaar Inc. Geotechnical and Environmental Consultants	
SITE PLAN AND VICINITY MAP	PROJECT NO. 90114 FIGURE 1



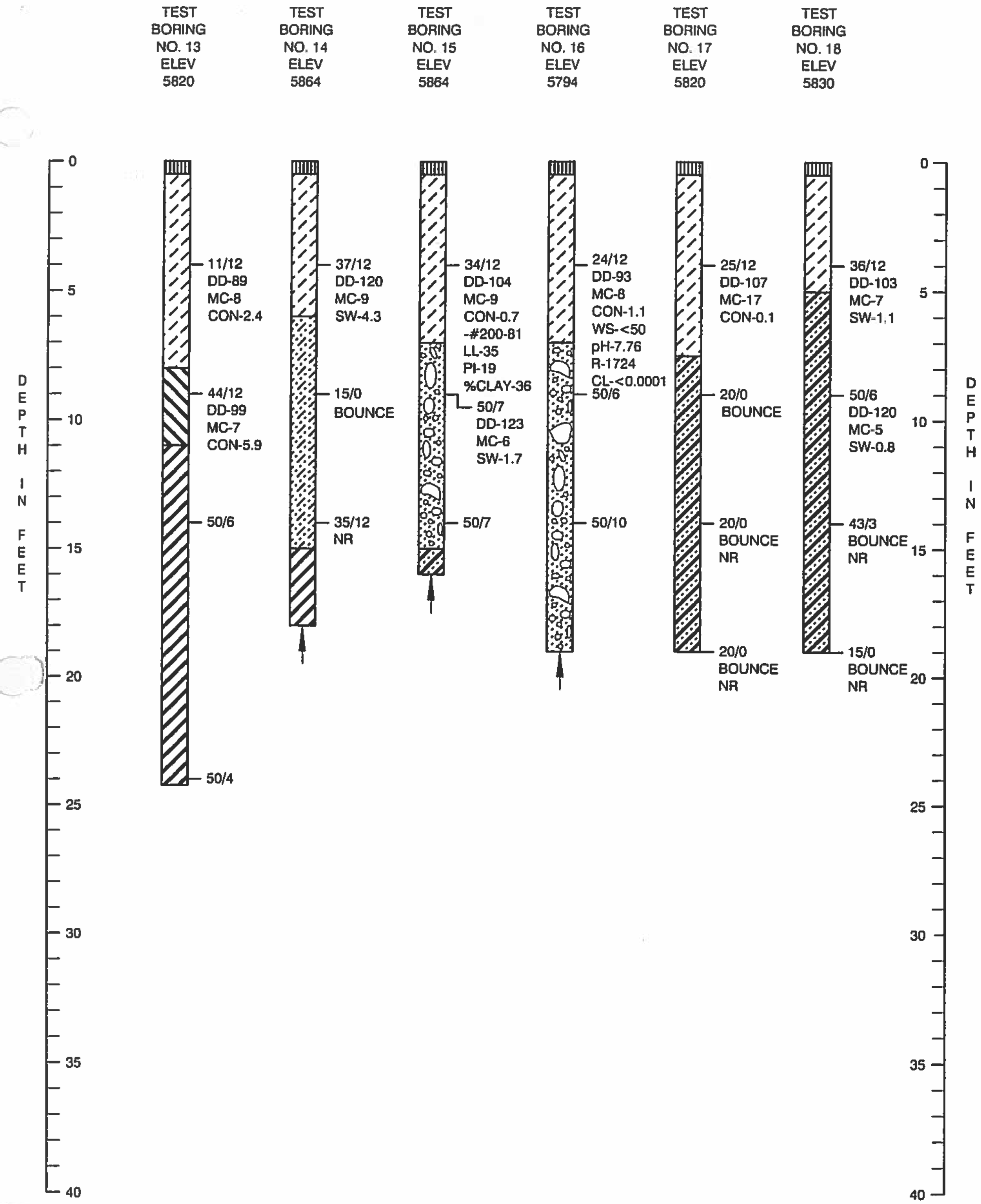
SEE FIGURE 5 FOR LEGEND AND NOTES TO EXPLORATORY BORINGS

EXPLORATORY BORING LOGS
FIGURE 2



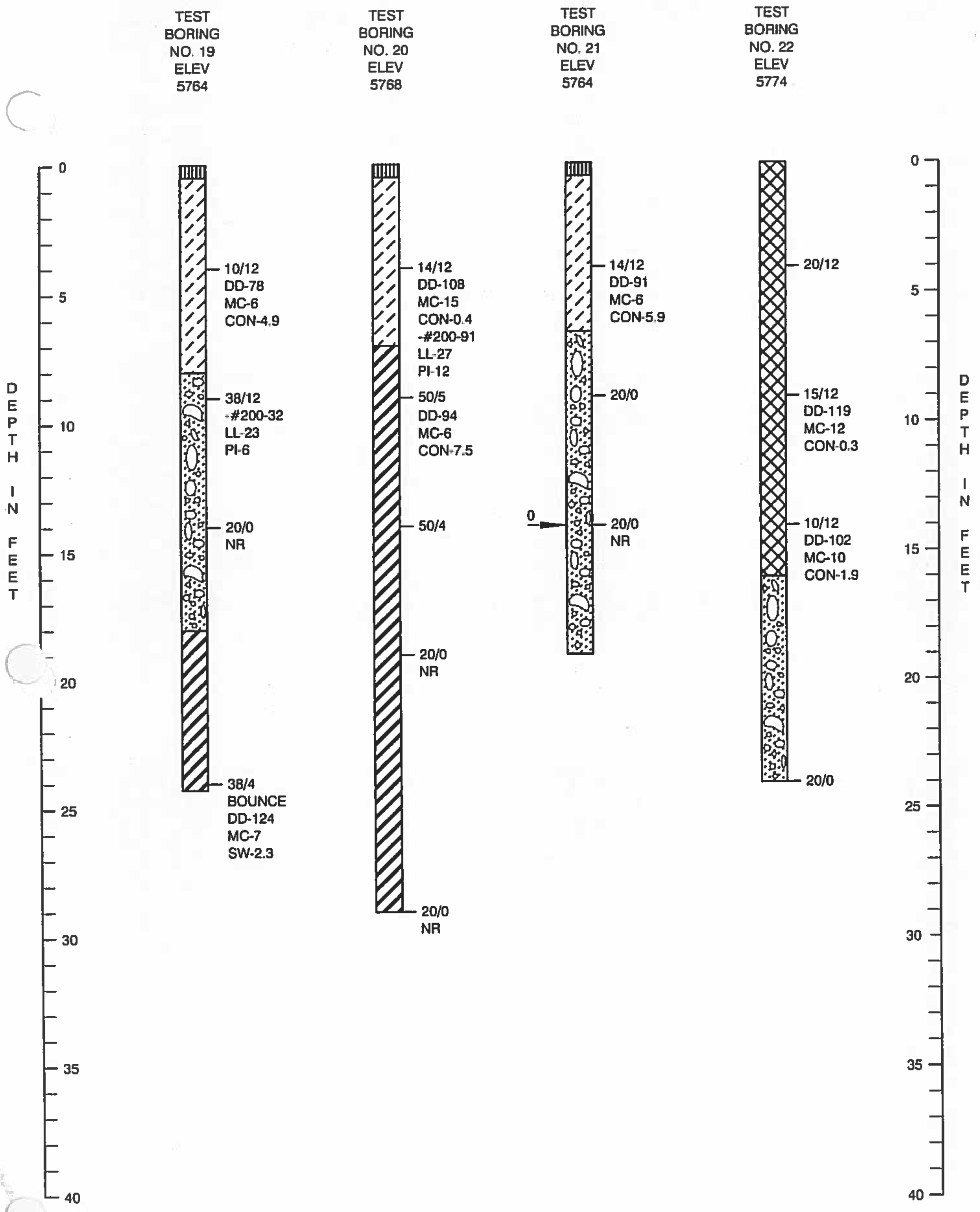
SEE FIGURE 5 FOR LEGEND AND NOTES TO EXPLORATORY BORINGS

EXPLORATORY BORING LOGS
FIGURE 3



SEE FIGURE 5 FOR LEGEND AND NOTES TO EXPLORATORY BORINGS

EXPLORATORY BORING LOGS
FIGURE 4



LEGEND

- TOPSOIL, CLAY, SANDY, ORGANIC, MOIST, DARK BROWN
- FILL (MAN-MADE), CLAY, COMPACT, SANDY, MOIST, MOTTLED BROWN (AF)
- CLAY, STIFF TO VERY STIFF, SILTY, SANDY, WITH SCATTERED GRAVEL, CALCAREOUS, SLIGHTLY MOIST, BROWN TO RED BROWN (CL)
- CLAY, VERY STIFF TO HARD, SILTY, SANDY, WITH COBBLES, SLIGHTLY MOIST, BROWN
- SAND, MEDIUM DENSE, SILTY, WITH VERY SAND SILT AND VERY SANDY GRAVEL LENSES, SLIGHTLY MOIST, RED BROWN (SM)
- SAND, MEDIUM DENSE TO DENSE, SILTY, CLAYEY, WITH VERY SANDY SILT LENSES, SCATTERED GRAVEL, SLIGHTLY MOIST TO MOIST, RED BROWN (SC)
- SAND AND GRAVELS, DENSE, WITH COBBLES, SLIGHTLY MOIST, RED BROWN
- SAND / CLAY, INTERBEDDED, DENSE / VERY STIFF,VERY SILTY, WITH SCATTERED GRAVEL, SLIGHTLY MOIST, RED BROWN
- CLAYSTONE (BEDROCK), MEDIUM HARD, SILTY TO VERY SILTY, SLIGHTLY SANDY, WITH GYPSUM, MOIST, OLIVE
- CLAYSTONE (BEDROCK), HARD TO VERY HARD, SILTY TO VERY SILTY, IRON STAINED, WITH SULFUR CRYSTALS, SLIGHTLY MOIST, OLIVE TO RUST
- SANDSTONE (BEDROCK), VERY HARD, MODERATELY TO WELL CEMENTED, SILTY, SLIGHTLY MOIST, RED BROWN

18/12	INDICATES THAT18 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH OUTSIDE DIAMETER SAMPLER 12 INCHES.
18/12*	INDICATES THAT18 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2-INCH OUTSIDE DIAMETER SAMPLER 12 INCHES.
NR	INDICATES NO SAMPLE RECOVERED
BOUNCE	INDICATES THAT THE SAMPLER BOUNCED WHEN DRIVEN WITH A 140-POUND HAMMER FALLING 30 INCHES
0	INDICATES THE DEPTH TO THE FREE WATER TABLE AND THE NUMBER OF DAYS AFTER DRILLING WHEN THE MEASUREMENT WAS TAKEN.
	INDICATES DEPTH AT WHICH PRACTICAL DRILLING REFUSAL WAS ENCOUNTERED.
0	INDICATES THE DEPTH AT WHICH THE TEST BORING CAVED AND THE NUMBER OF DAYS AFTER DRILLING WHEN THE MEASUREMENT WAS TAKEN.
DD	INDICATES DRY WEIGHT OF SAMPLE IN POUNDS PER CUBIC FOOT.
MC	INDICATES MOISTURE CONTENT AS A PERCENTAGE OF DRY WEIGHT OF SOIL.
SW	INDICATES PERCENT SWELL UNDER A SURCHARGE OF 1000 PSF UPON WETTING.
CON	INDICATES PERCENT CONSOLIDATION UNDER A SURCHARGE OF 1000 PSF UPON WETTING
-#200	INDICATES PERCENT PASSING THE NO. 200 SIEVE.
% CLAY	INDICATES PERCENTAGE OF CLAY SIZES (<0.002mm)
LL	INDICATES LIQUID LIMIT.
PI	INDICATES PLASTICITY INDEX.
NP	INDICATES NON-PLASTIC.
NV	INDICATES NO VALUE.
WS	INDICATES WATER SOLUBLE SULFATES IN PARTS PER MILLION.
pH	INDICATES ACIDITY OR ALKALINITY OF SAMPLE IN pH UNITS.
CL	INDICATES CHLORIDES IN PERCENT.
R	INDICATES RESISTIVITY IN OHMS-CM.

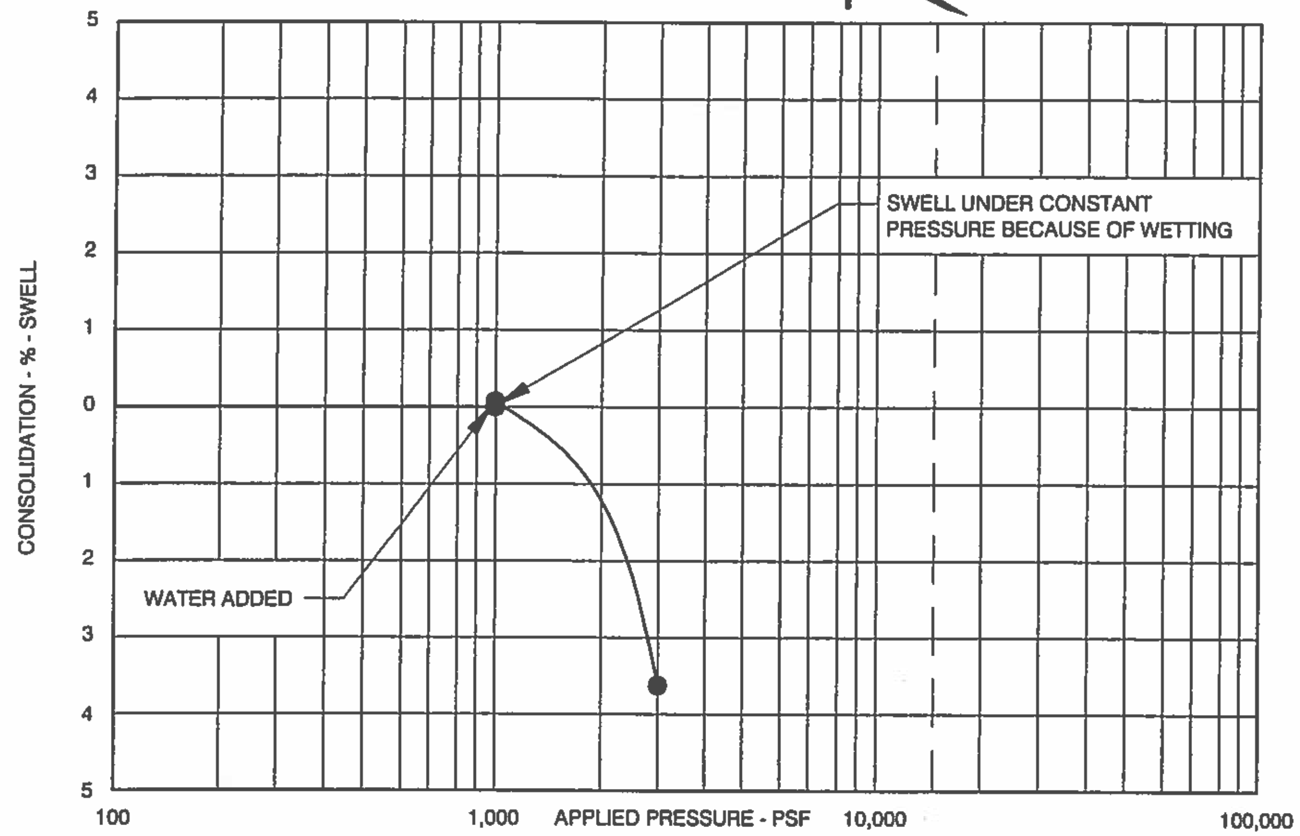
NOTES

1. TEST BORINGS WERE DRILLED MAY 17 & 18, 2006 WITH A 4-INCH DIAMETER, CONTINUOUS FLIGHT POWER AUGER.
2. NO FREE WATER WAS OBSERVED AT THE TIME OF DRILLING.
3. LOCATIONS OF TEST BORINGS WERE DETERMINED BY RECONNOITERING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED BY OTHERS.
4. ELEVATIONS ARE APPROXIMATE AND REFER TO THE TOPOGRAPHIC SITE PLAN PROVIDED BY OTHERS.
5. THE HORIZONTAL LINES SHOWN ON THE LOGS ARE TO DIFFERENTIATE MATERIALS AND REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIALS. THE TRANSITIONS BETWEEN MATERIALS MAY BE GRADUAL.
6. DRILL LOGS SHOWN IN THIS REPORT ARE SUBJECT TO THE LIMITATIONS, EXPLANATIONS, AND CONCLUSIONS OF THIS REPORT.

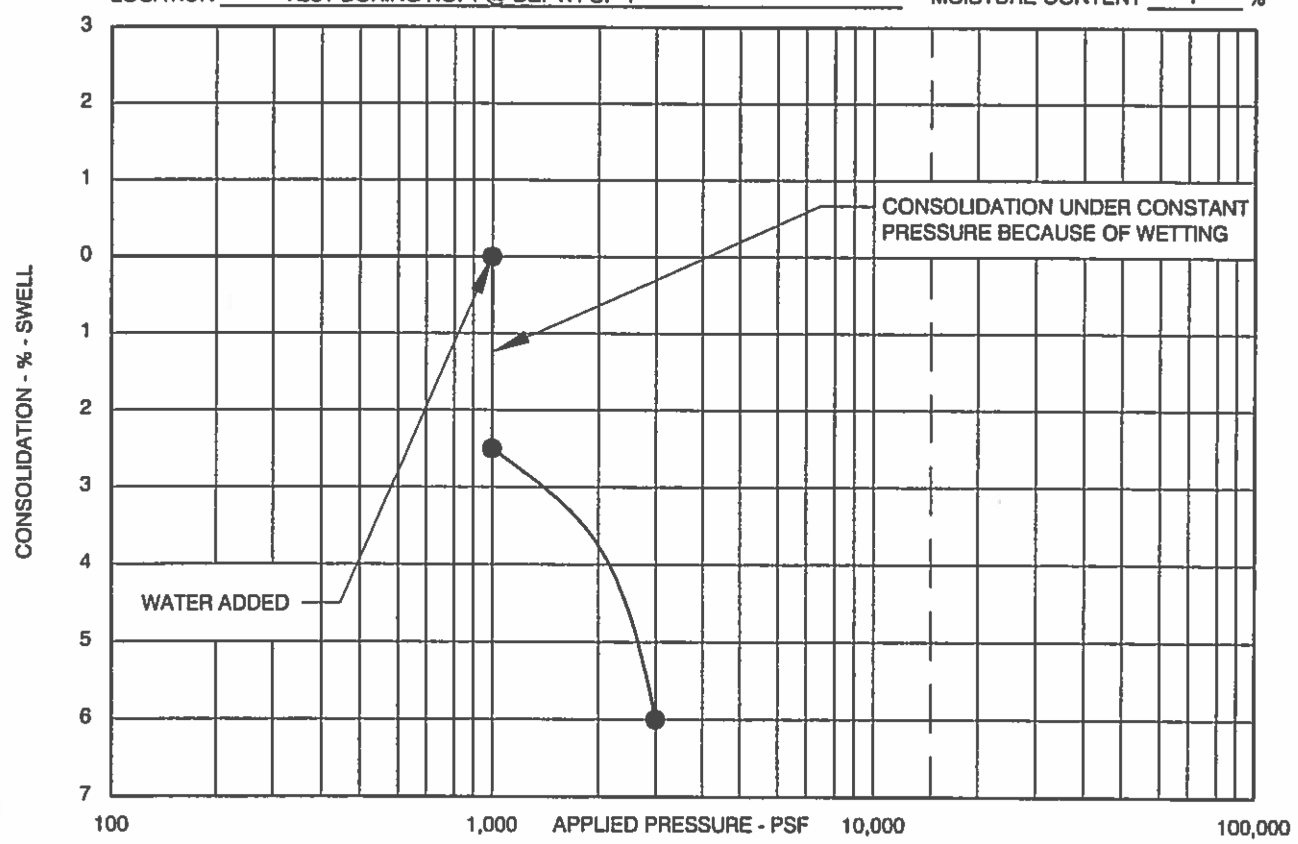
A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants

EXPLORATORY BORING LOGS	PROJECT NO. 90114 FIGURE 5

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 1 @ DEPTH OF 4'
DRY UNIT WT. 100 PCF
MOISTURE CONTENT 7 %

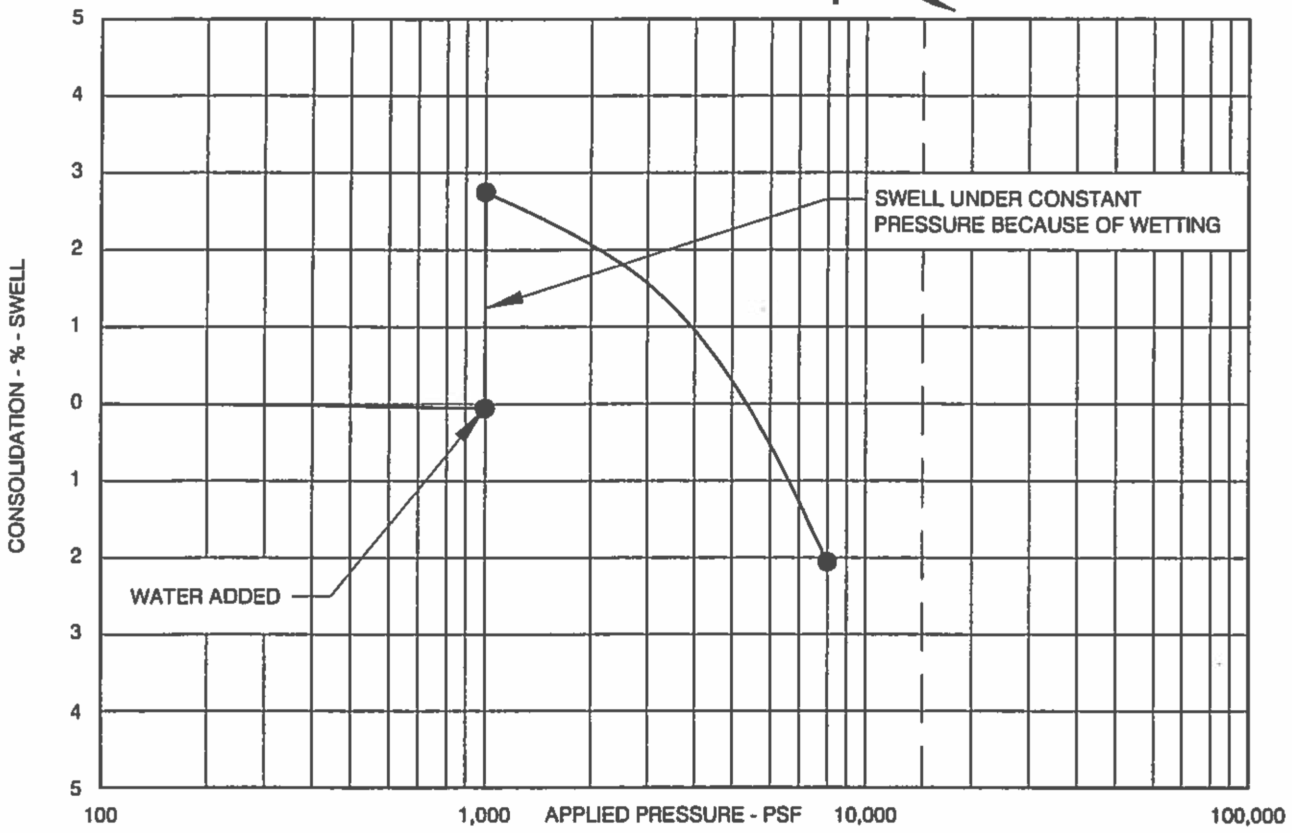


SAMPLE DESCRIPTION CLAYSTONE, SILTY (DISTURBED)
LOCATION TEST BORING NO. 1 @ DEPTH OF 14'
DRY UNIT WT. 107 PCF
MOISTURE CONTENT 6 %

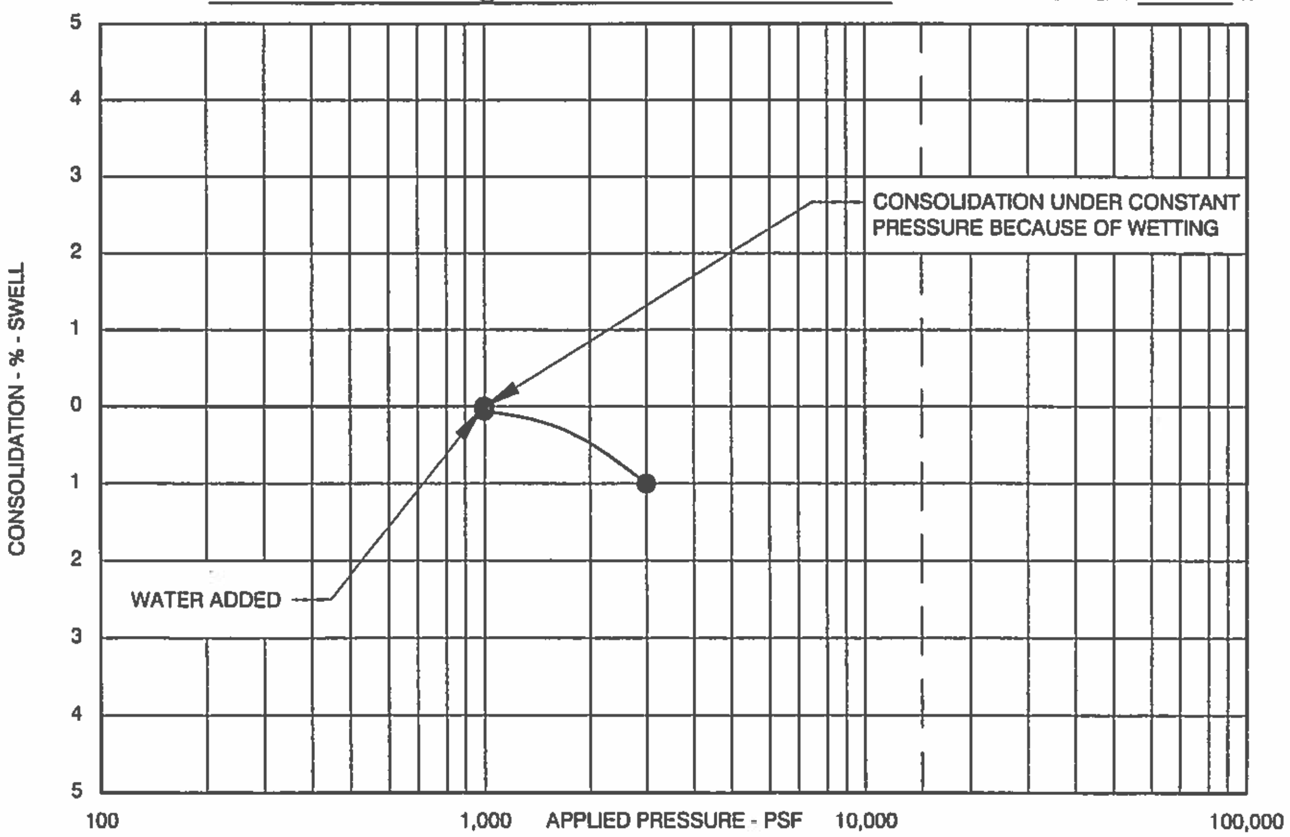
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 6

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 2 @ DEPTH OF 9'
DRY UNIT WT. 114 PCF
MOISTURE CONTENT 7 %



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 2 @ DEPTH OF 14'
DRY UNIT WT. 108 PCF
MOISTURE CONTENT 7 %

SWELL - CONSOLIDATION TEST RESULTS

FIGURE 7

A.G. Wassenaar Inc.
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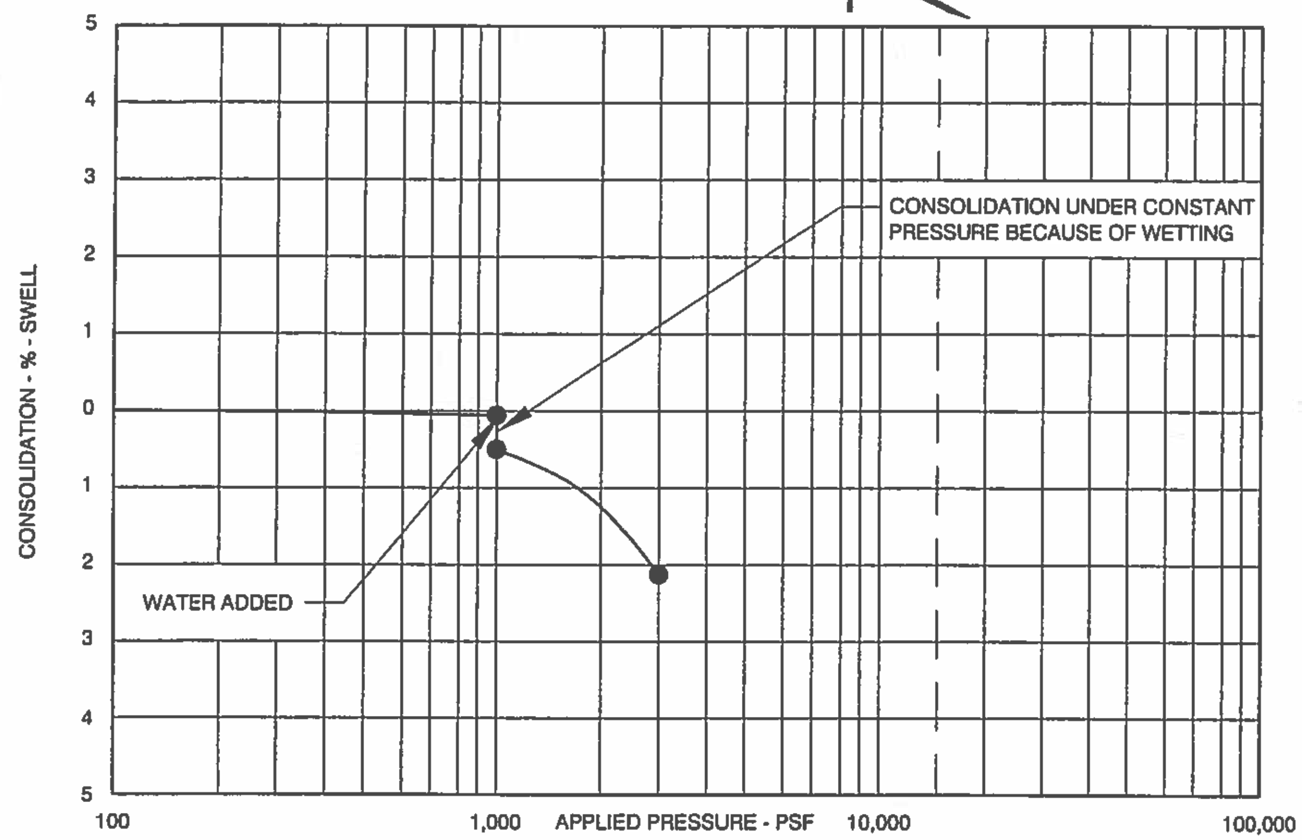
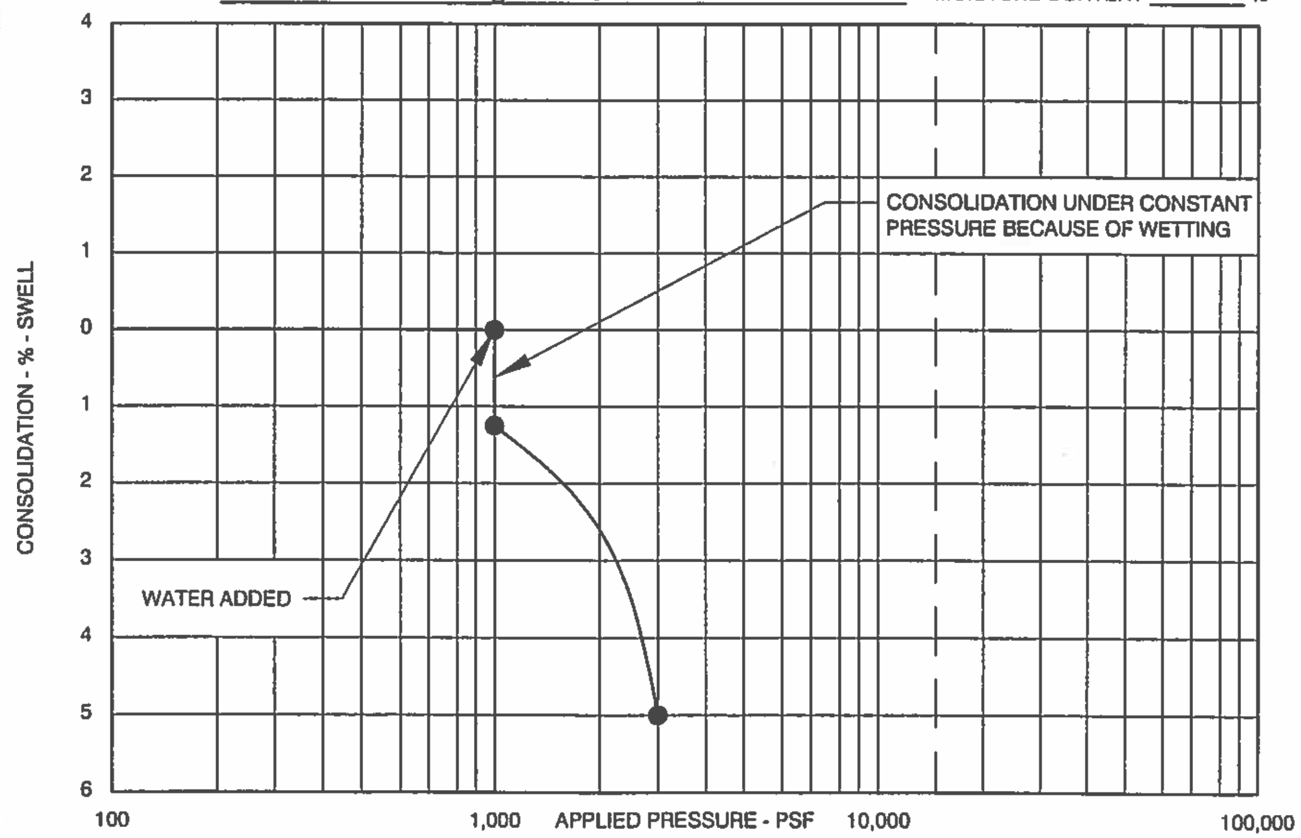


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 3 @ DEPTH OF 4'
DRY UNIT WT. 117 PCF
MOISTURE CONTENT 12 %

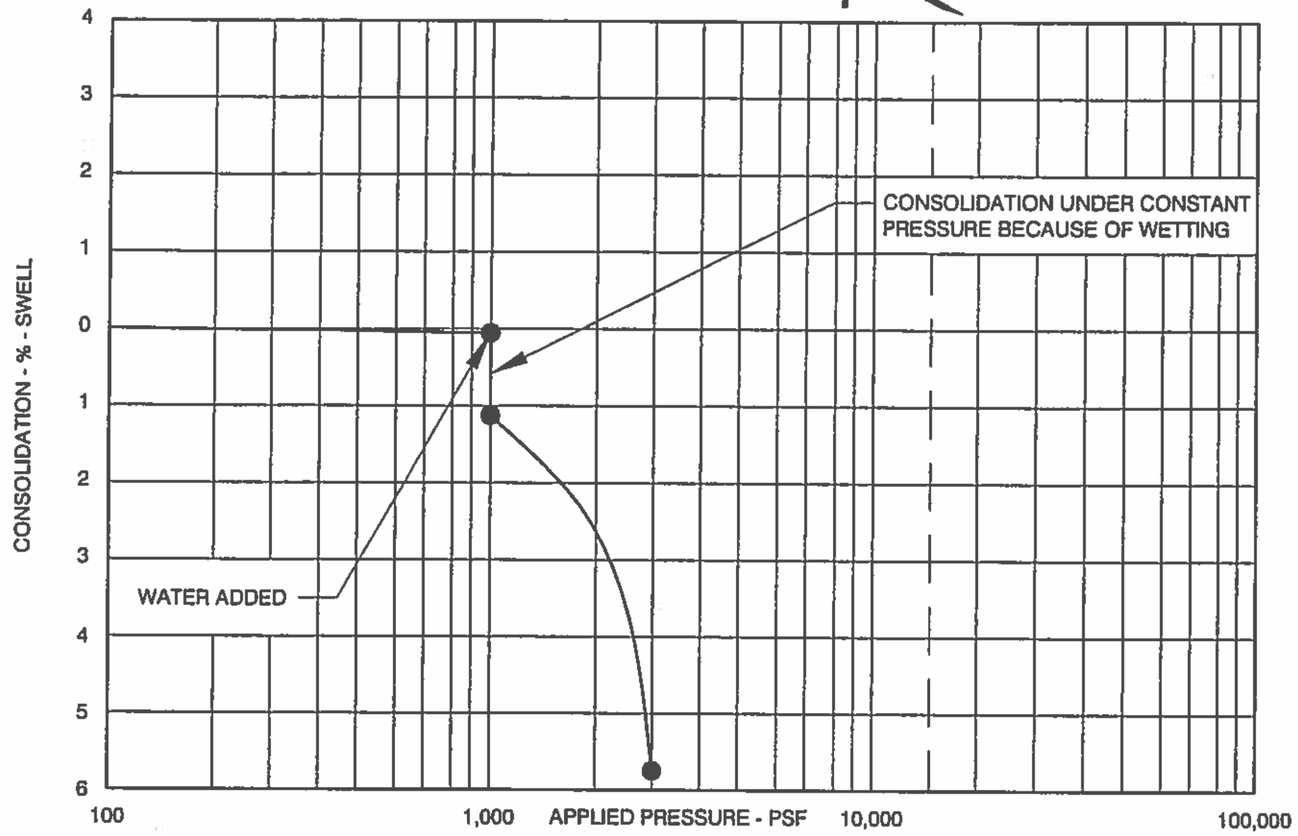


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 3 @ DEPTH OF 19'
DRY UNIT WT. 117 PCF
MOISTURE CONTENT 3 %

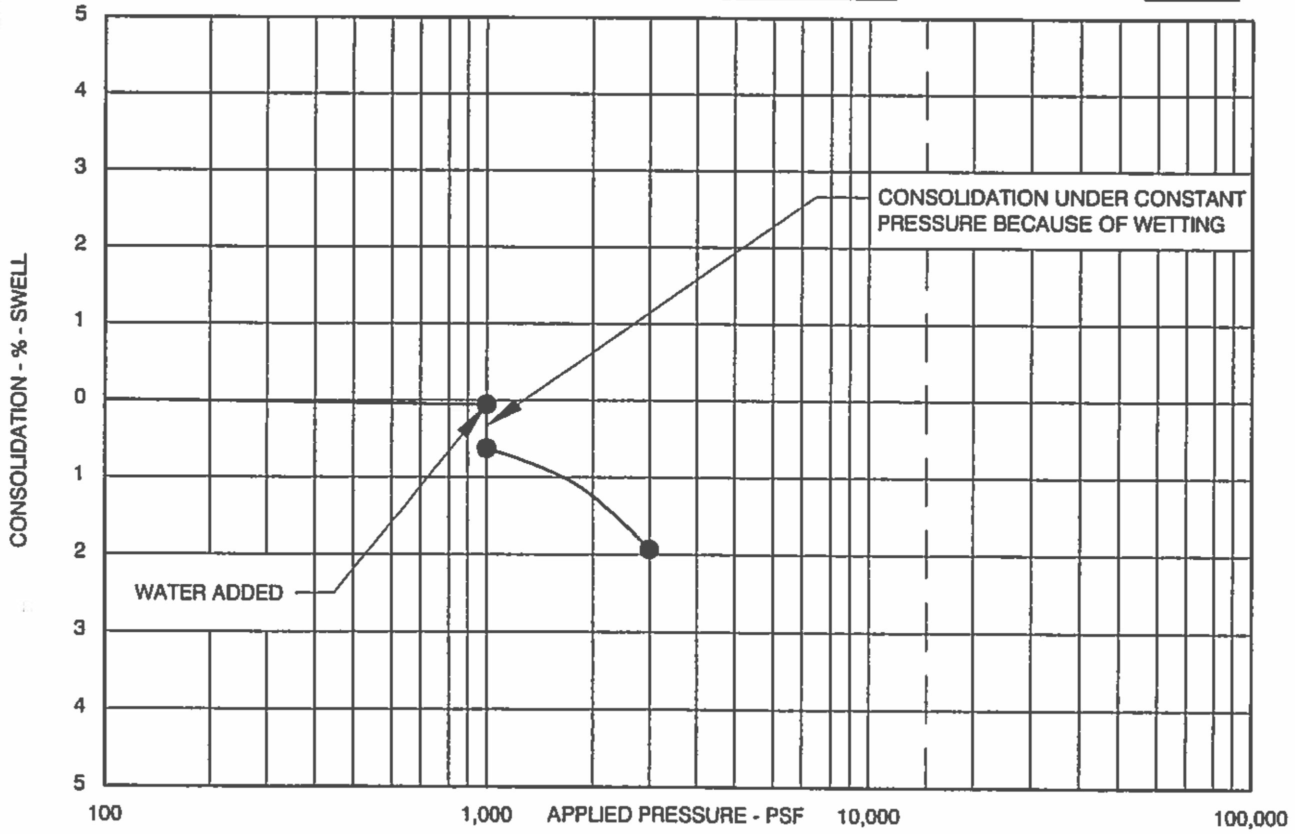
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 8

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 4 @ DEPTH OF 4'
DRY UNIT WT. 97 PCF
MOISTURE CONTENT 8 %

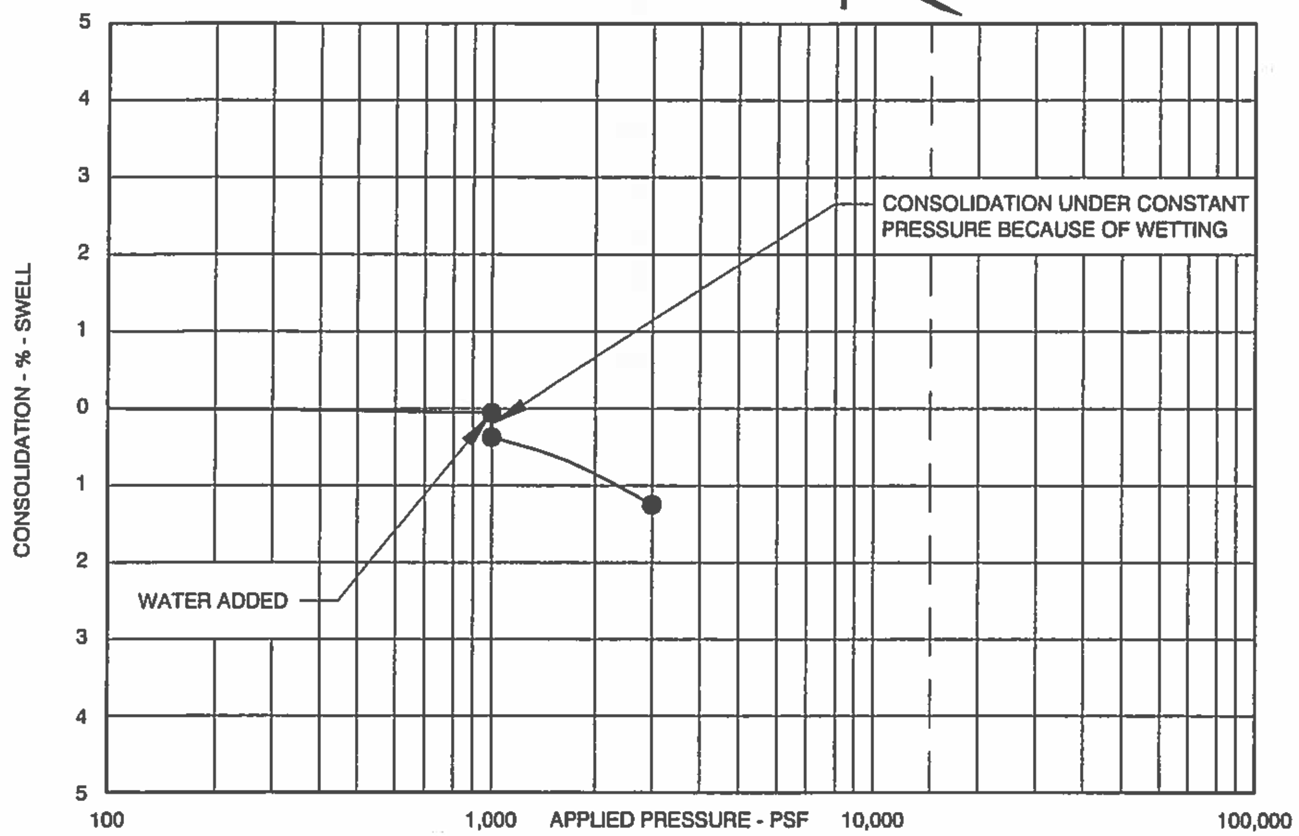


SAMPLE DESCRIPTION SAND, CLAYEY
LOCATION TEST BORING NO. 5 @ DEPTH OF 4'
DRY UNIT WT. 87 PCF
MOISTURE CONTENT 8 %

SWELL - CONSOLIDATION TEST RESULTS

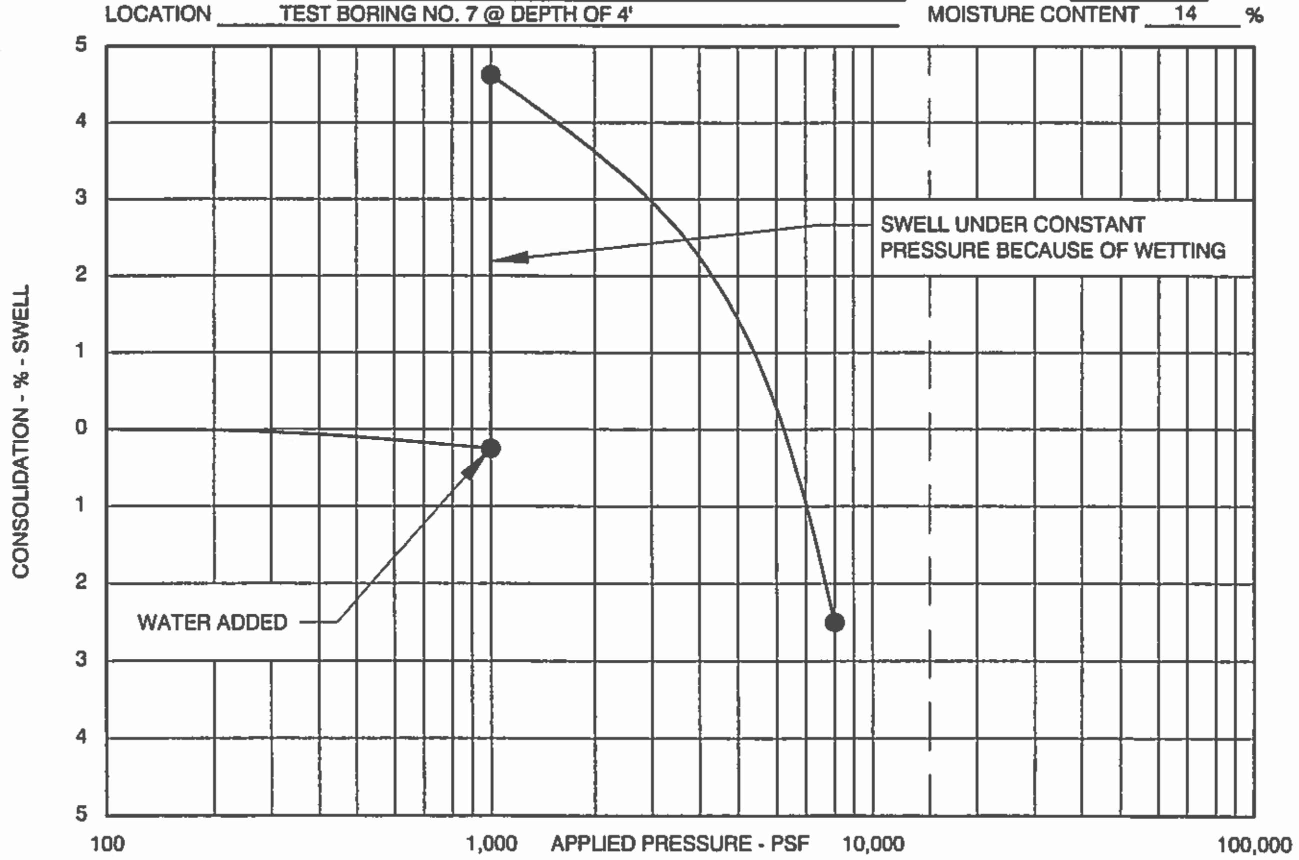
FIGURE 9

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 7 @ DEPTH OF 4'

DRY UNIT WT. 116 PCF
MOISTURE CONTENT 14 %



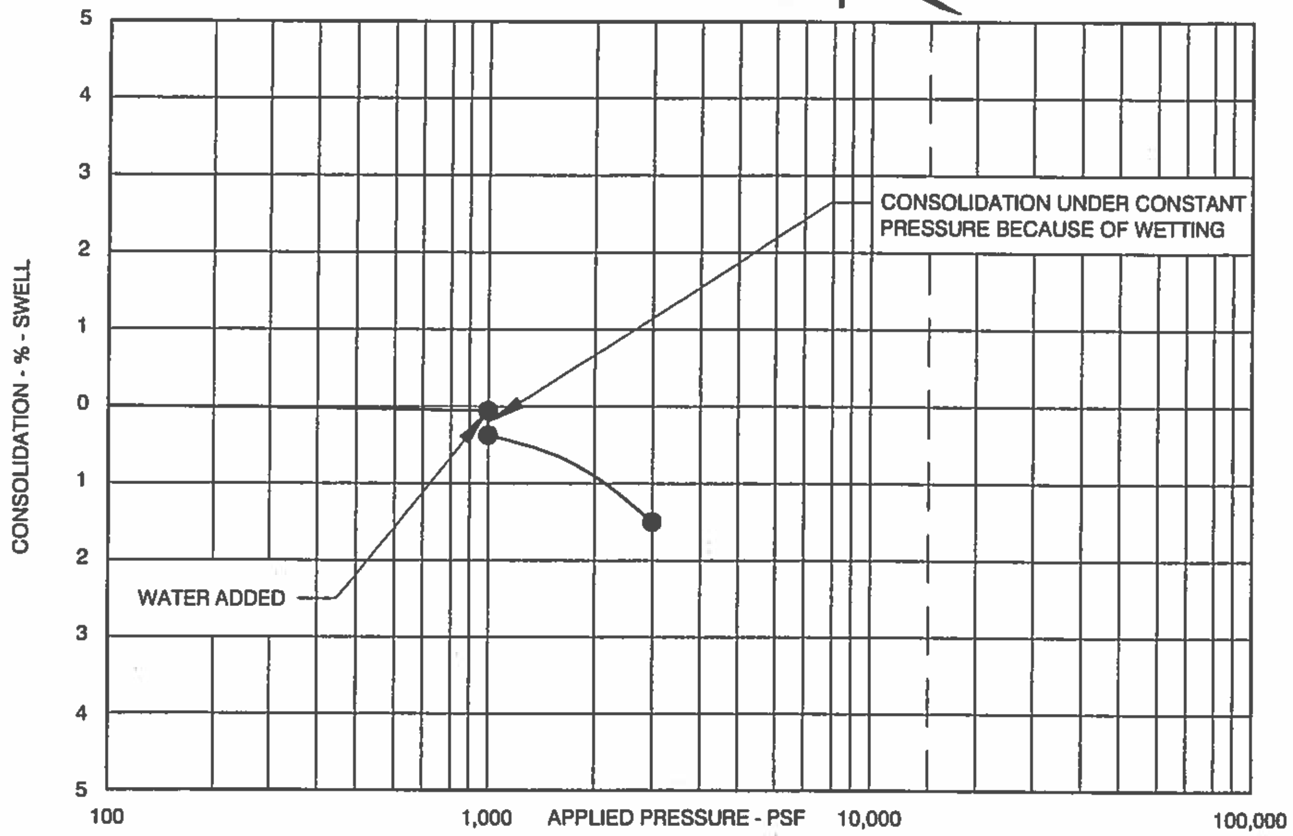
SAMPLE DESCRIPTION CLAYSTONE, SILTY
LOCATION TEST BORING NO. 7 @ DEPTH OF 24'

DRY UNIT WT. 122 PCF
MOISTURE CONTENT 9 %

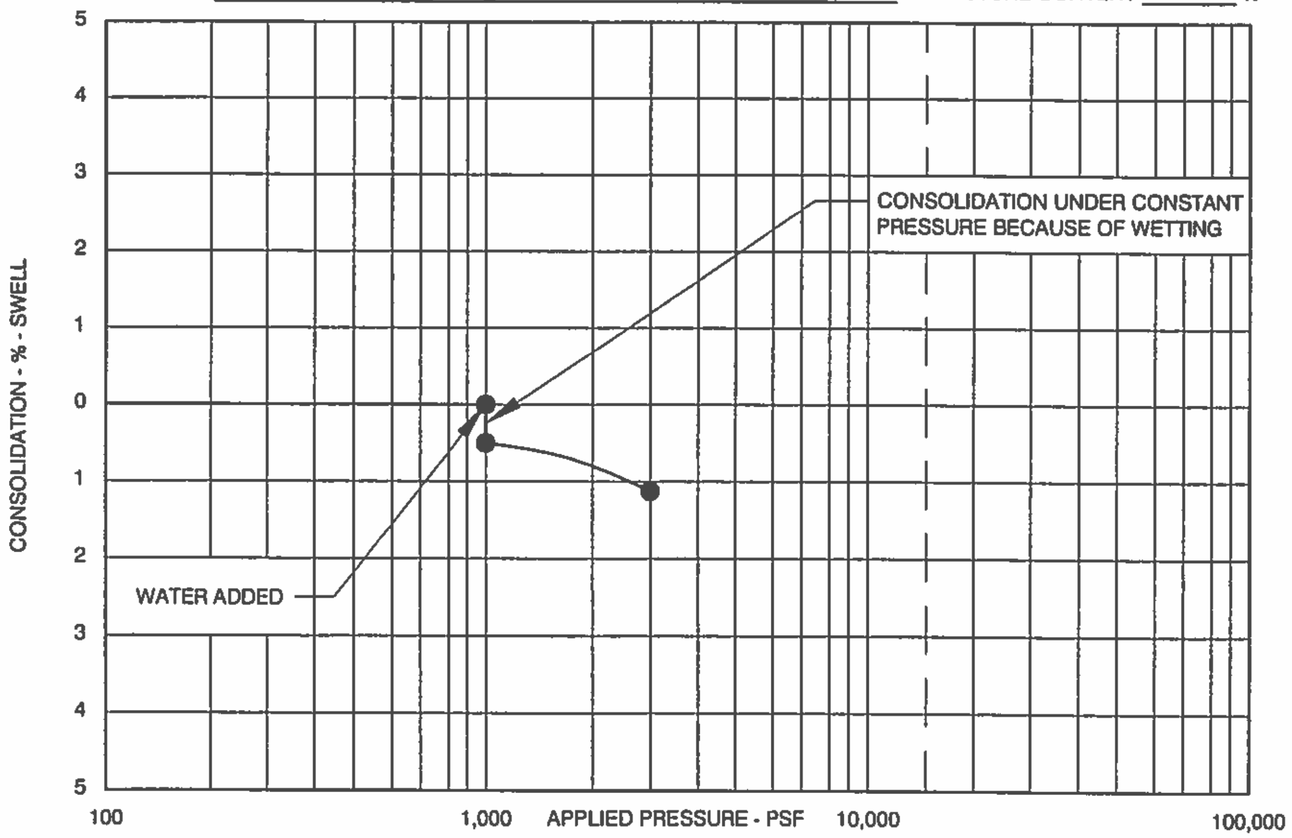
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 10

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 8 @ DEPTH OF 9'
DRY UNIT WT. 110 PCF
MOISTURE CONTENT 10 %

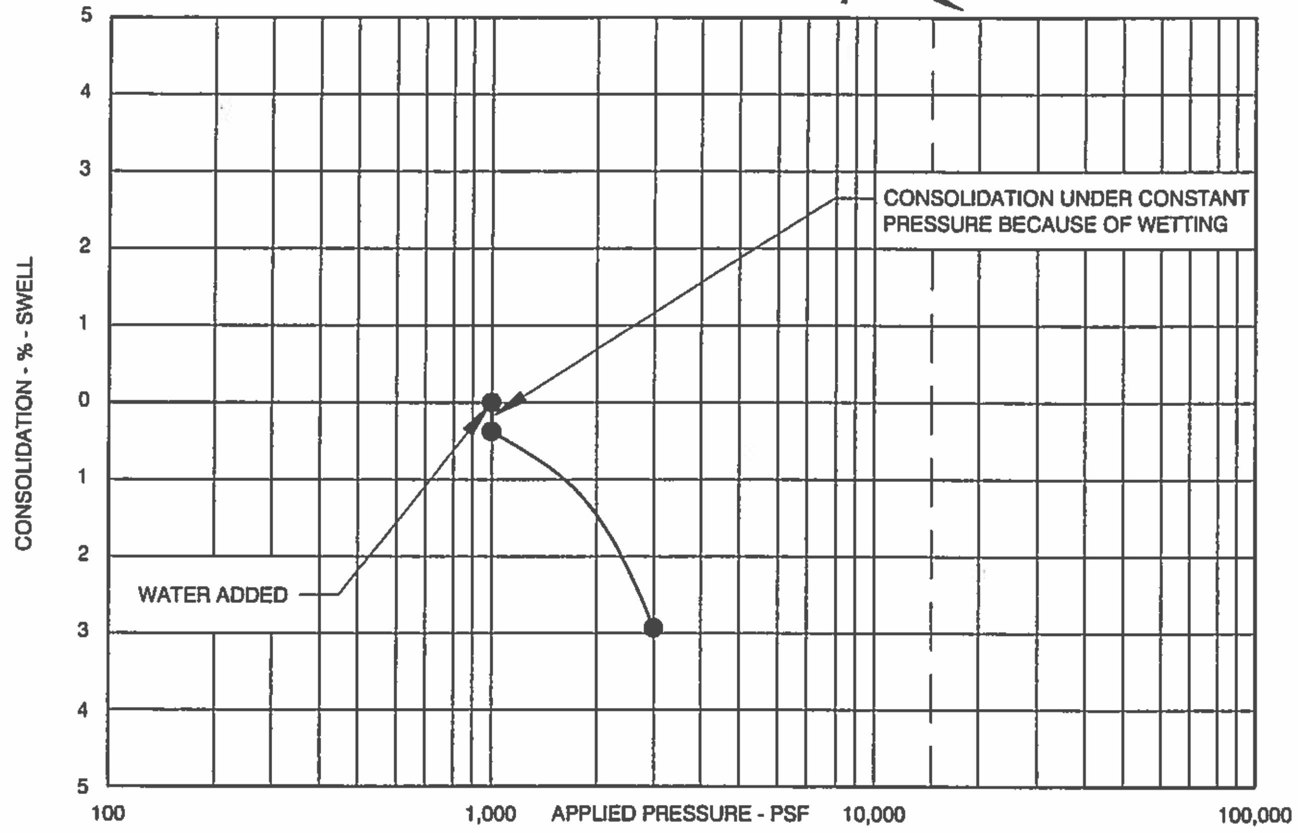


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 9 @ DEPTH OF 4'
DRY UNIT WT. 109 PCF
MOISTURE CONTENT 7 %

SWELL - CONSOLIDATION TEST RESULTS

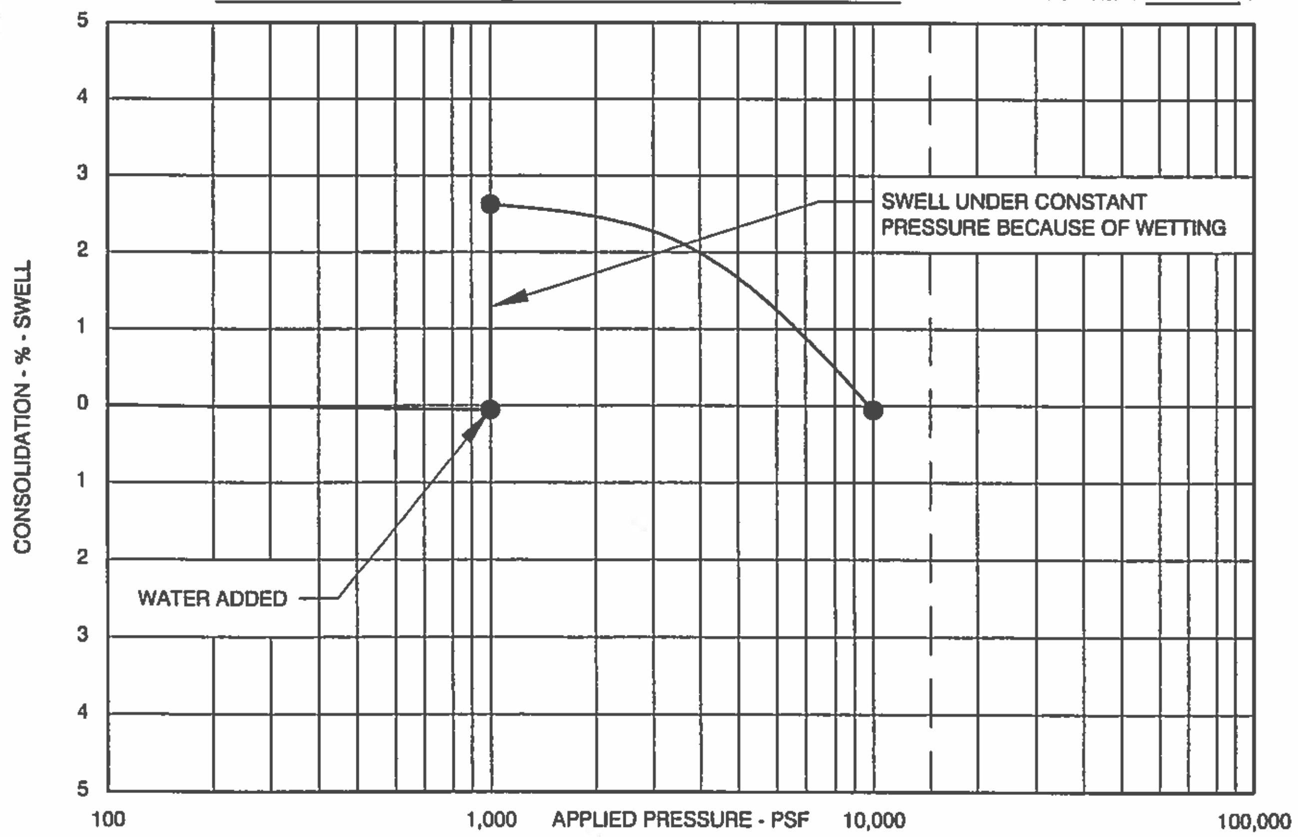
FIGURE 11

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 10 @ DEPTH OF 4'

DRY UNIT WT. 107 PCF
MOISTURE CONTENT 18 %



SAMPLE DESCRIPTION CLAYSTONE, SILTY
LOCATION TEST BORING NO. 10 @ DEPTH OF 9'

DRY UNIT WT. 116 PCF
MOISTURE CONTENT 16 %

SWELL - CONSOLIDATION TEST RESULTS

FIGURE 12

A.G. Wassenaar Inc.
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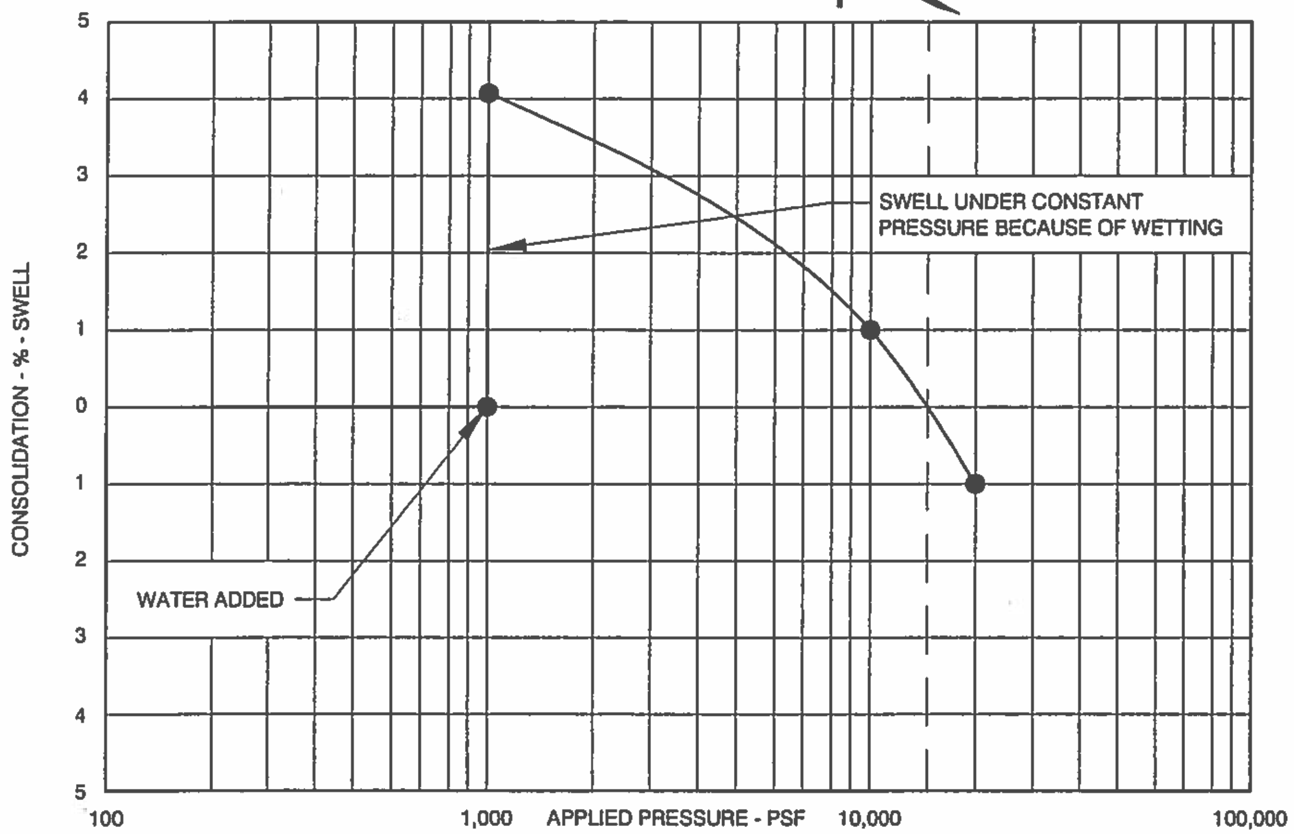
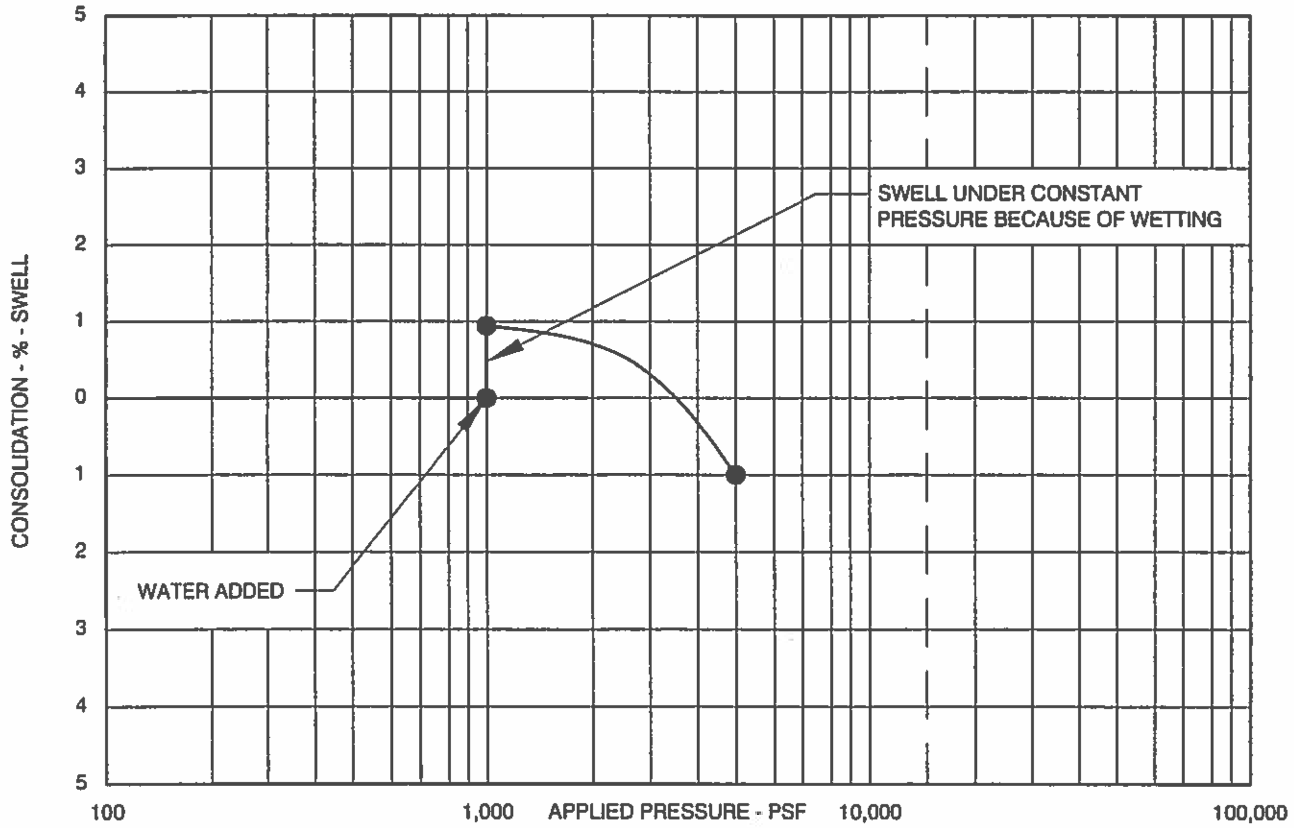


SAMPLE DESCRIPTION CLAYSTONE, SILTY DRY UNIT WT. 113 PCF
LOCATION TEST BORING NO. 10 @ DEPTH OF 24' MOISTURE CONTENT 11 %

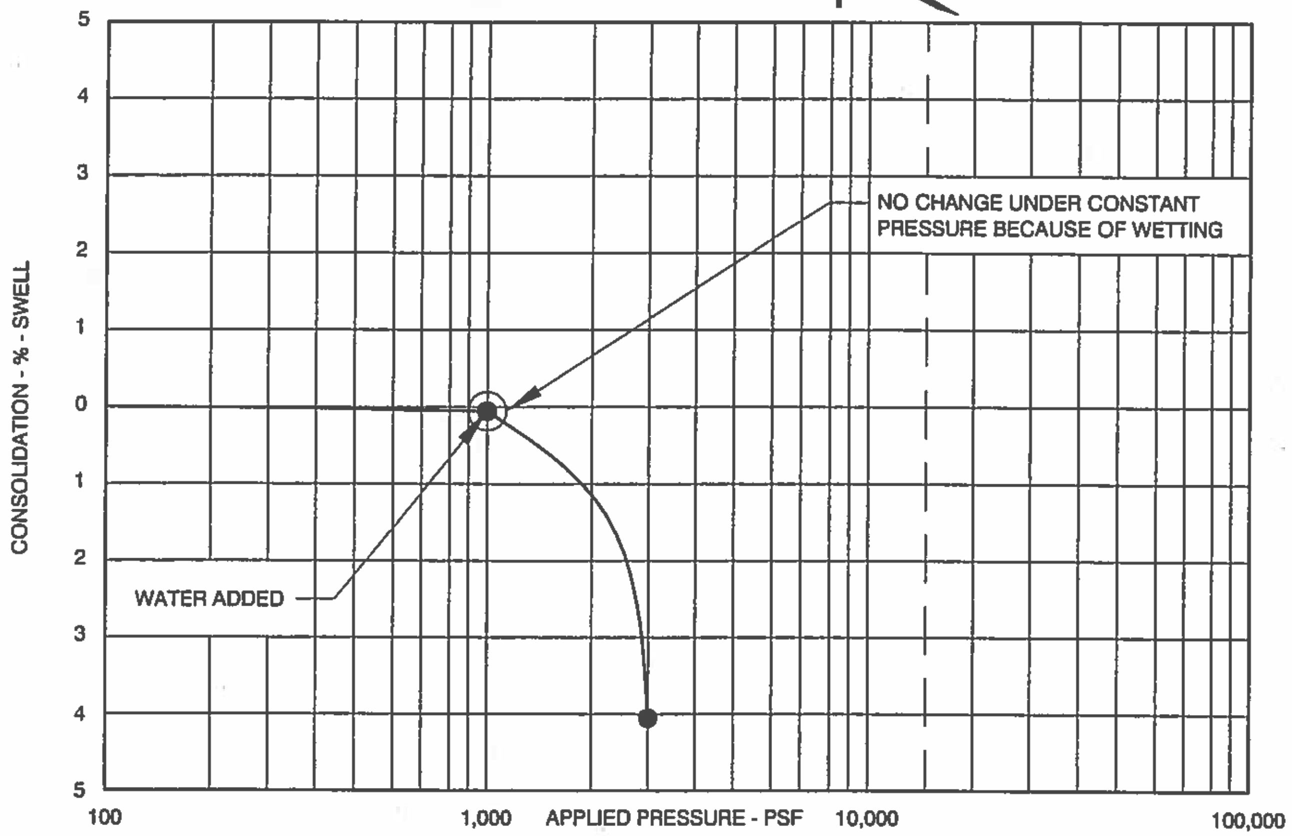


SAMPLE DESCRIPTION CLAYSTONE, SILTY DRY UNIT WT. 116 PCF
LOCATION TEST BORING NO. 11 @ DEPTH OF 4' MOISTURE CONTENT 10 %

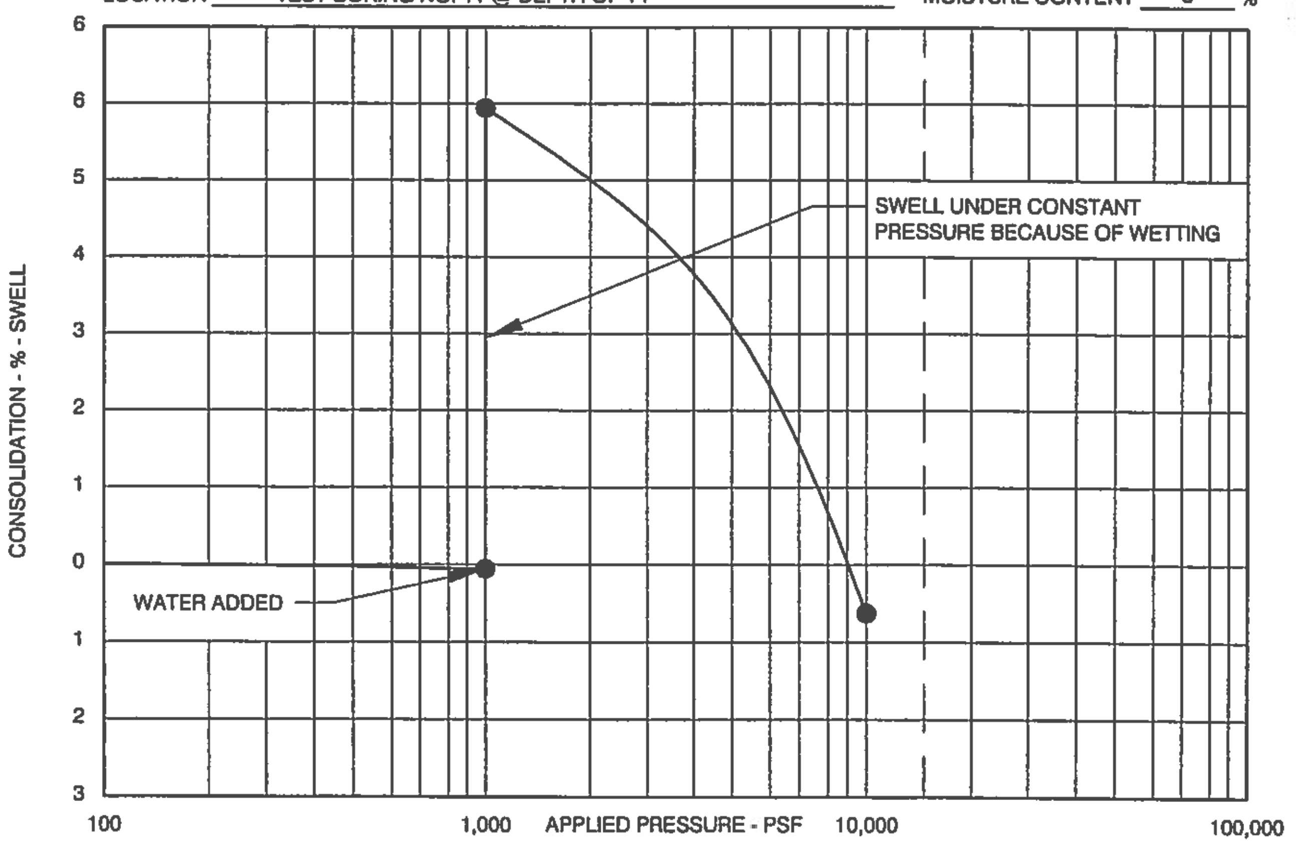
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 13

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAYSTONE, SILTY
LOCATION TEST BORING NO. 11 @ DEPTH OF 14'
DRY UNIT WT. 116 PCF
MOISTURE CONTENT 6 %

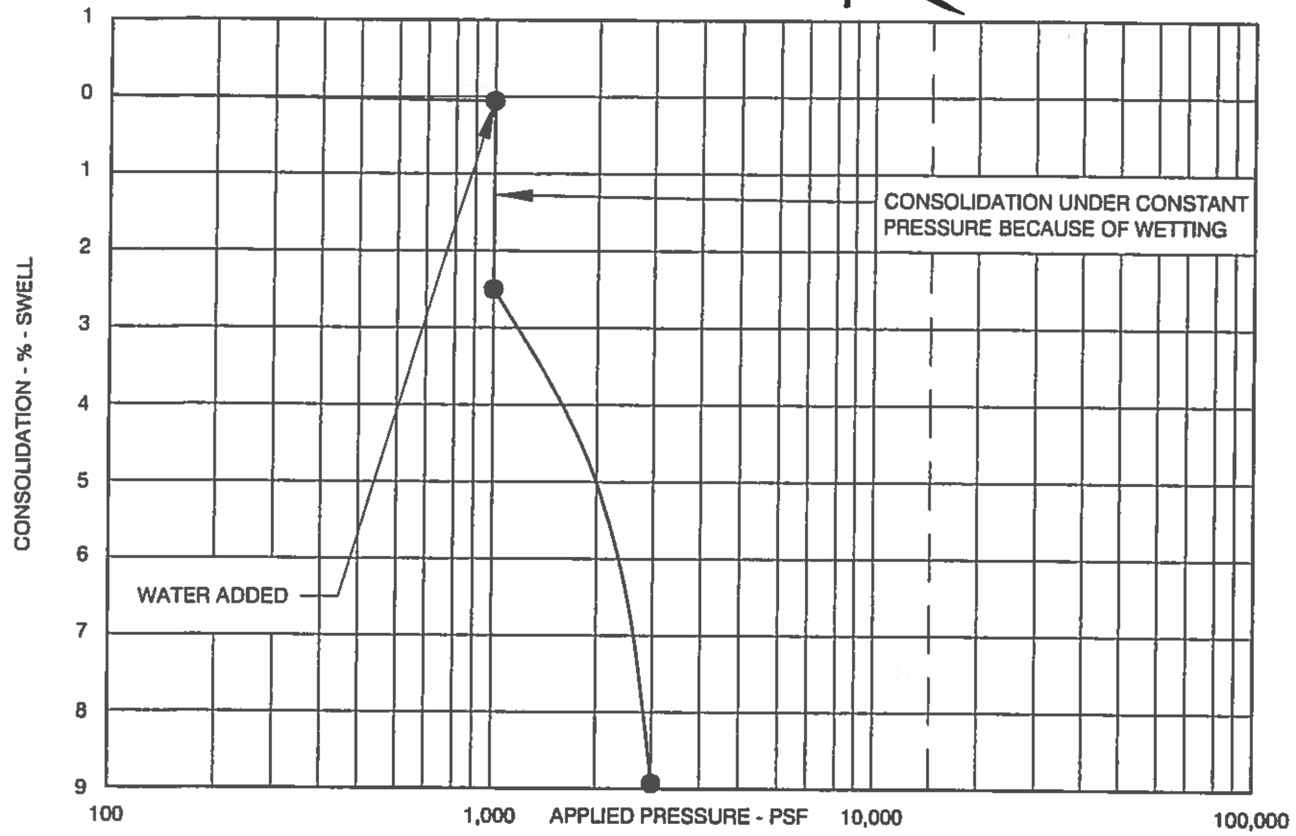


SAMPLE DESCRIPTION CLAYSTONE, SILTY
LOCATION TEST BORING NO. 12 @ DEPTH OF 19'
DRY UNIT WT. 124 PCF
MOISTURE CONTENT 10 %

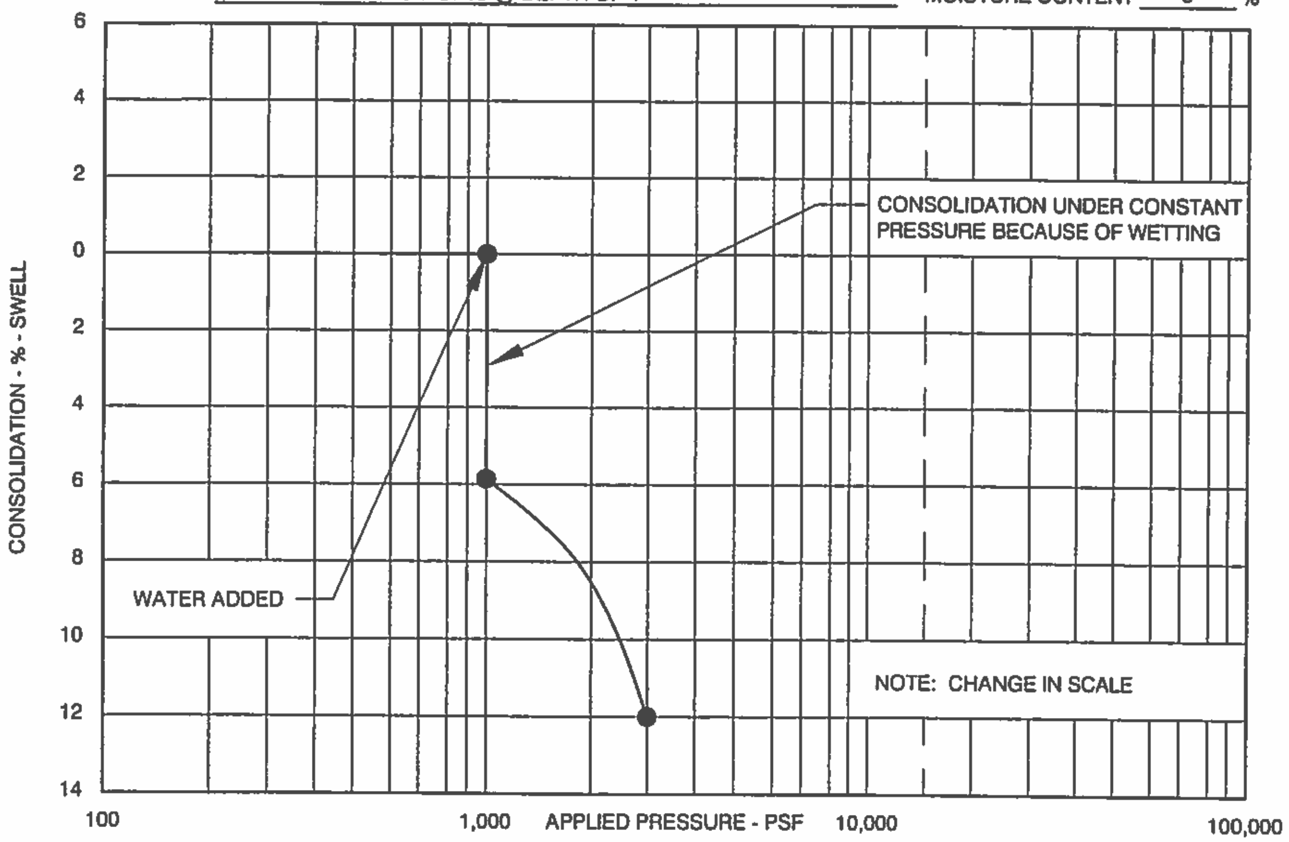
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 14

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 13 @ DEPTH OF 4'
DRY UNIT WT. 89 PCF
MOISTURE CONTENT 8 %

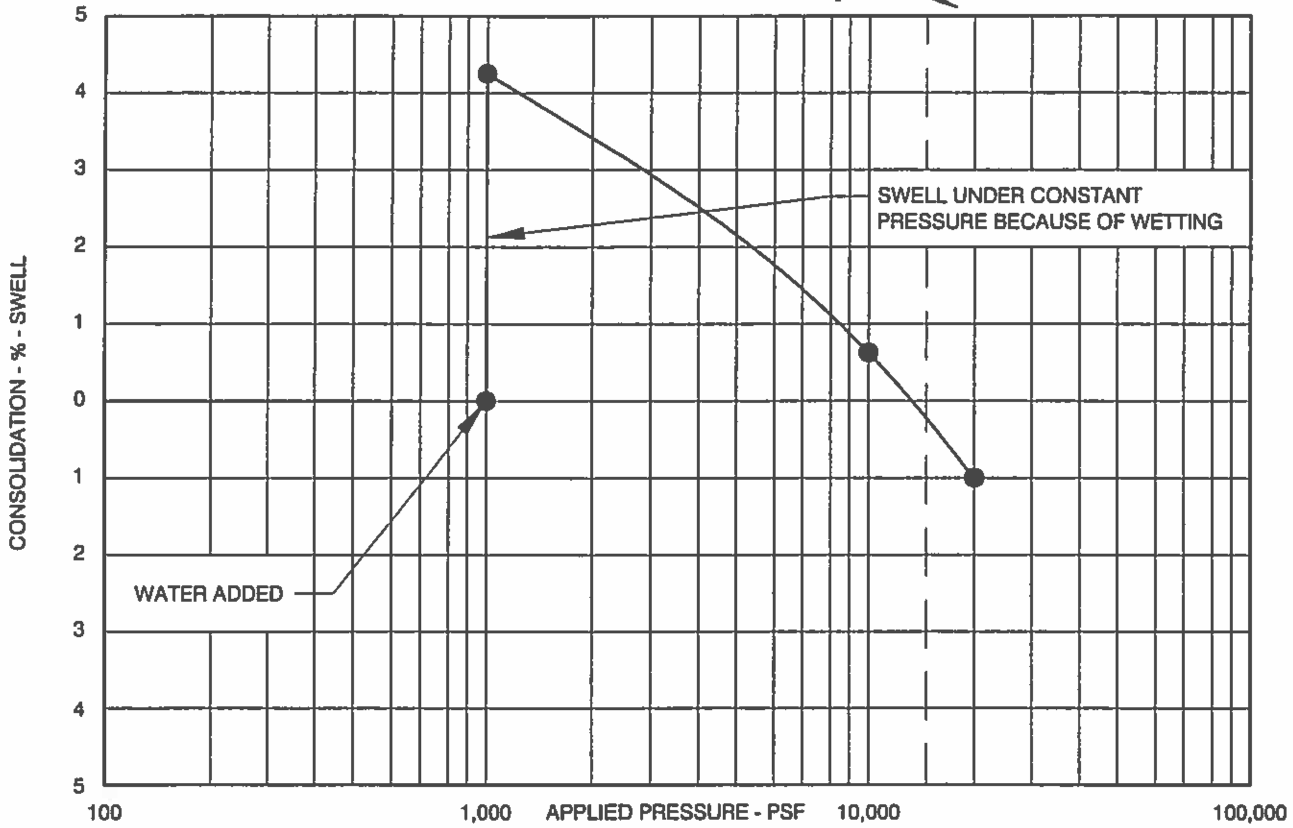


SAMPLE DESCRIPTION CLAYSTONE, SILTY (DISTURBED)
LOCATION TEST BORING NO. 13 @ DEPTH OF 9'
DRY UNIT WT. 99 PCF
MOISTURE CONTENT 7 %

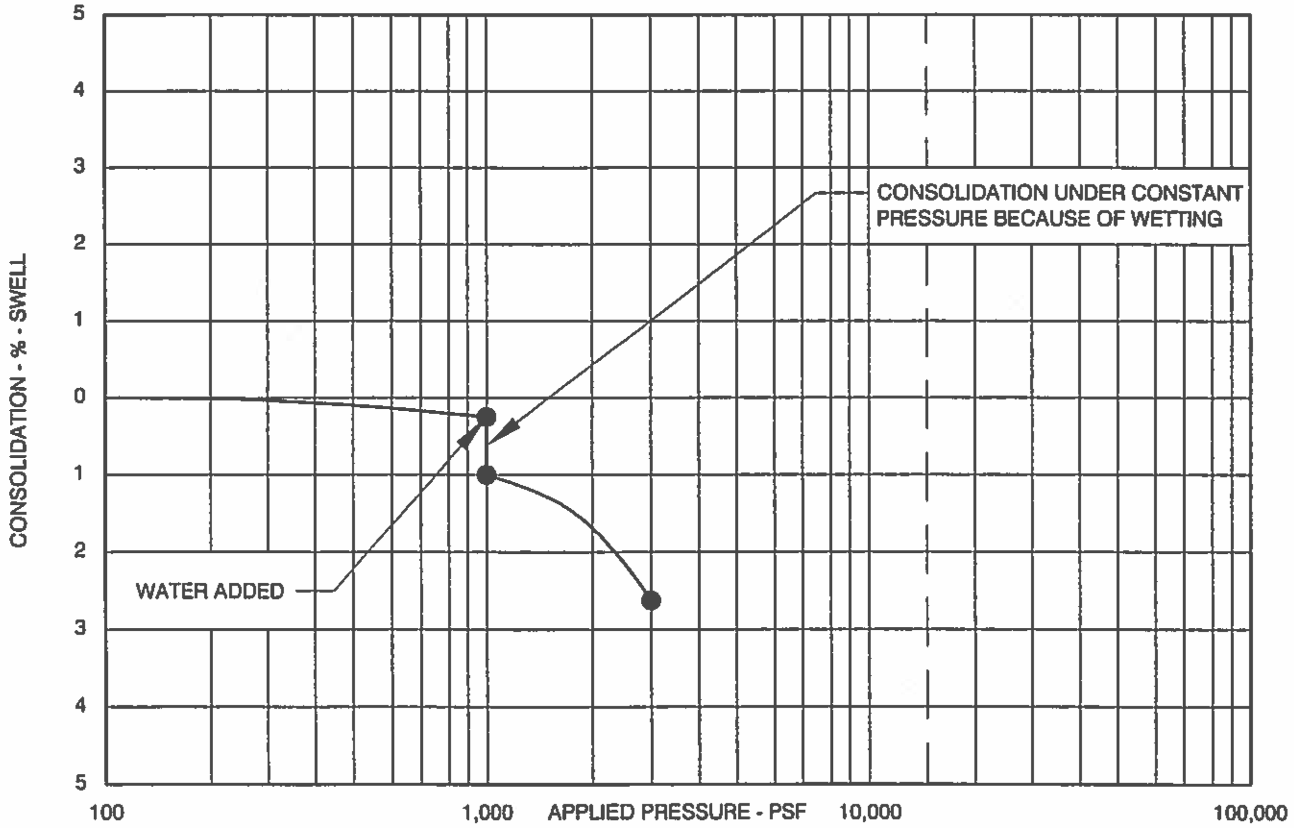
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 15

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 14 @ DEPTH OF 4'
DRY UNIT WT. 120 PCF
MOISTURE CONTENT 9 %

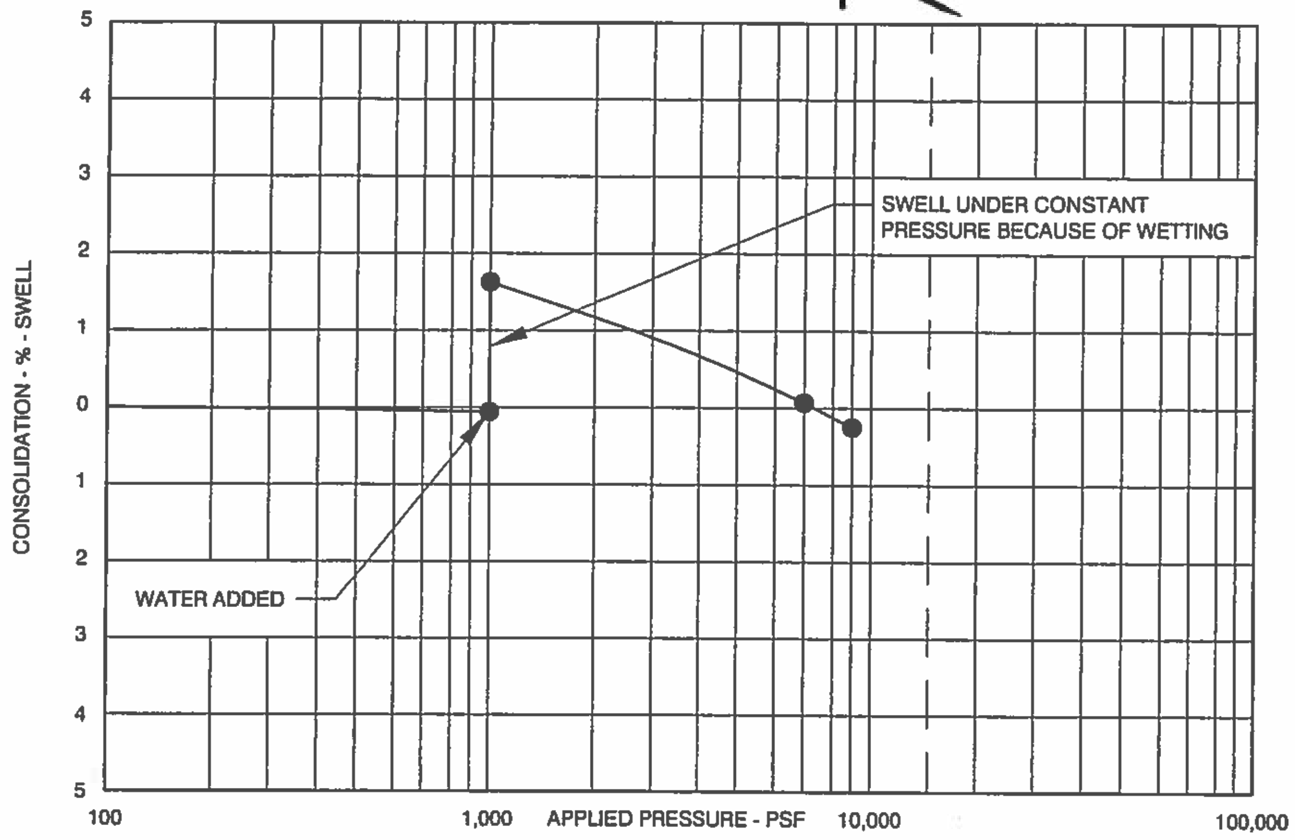


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 15 @ DEPTH OF 4'
DRY UNIT WT. 104 PCF
MOISTURE CONTENT 9 %

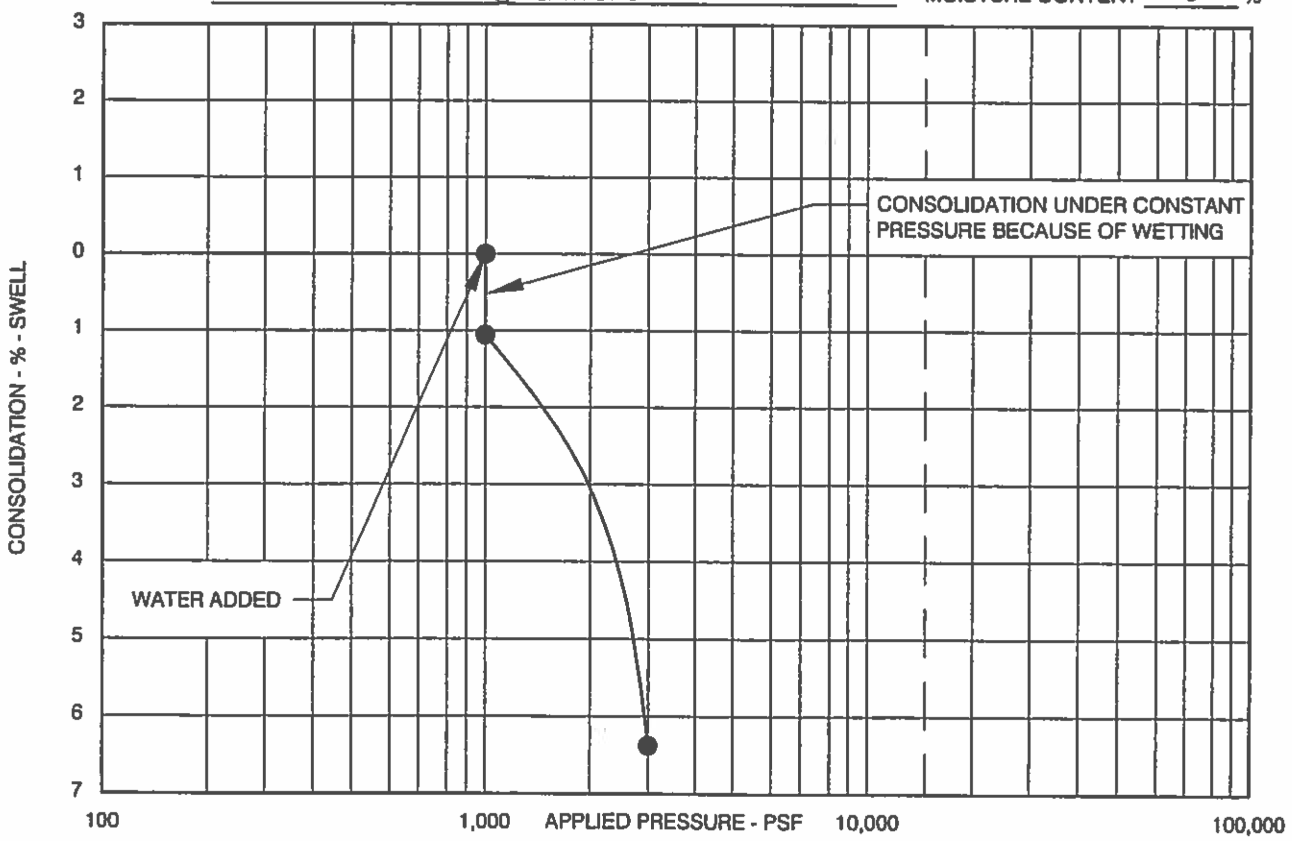
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 16

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAY, VERY SANDY
LOCATION TEST BORING NO. 15 @ DEPTH OF 9'
DRY UNIT WT. 123 PCF
MOISTURE CONTENT 6 %



SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 16 @ DEPTH OF 4'
DRY UNIT WT. 93 PCF
MOISTURE CONTENT 8 %

SWELL - CONSOLIDATION TEST RESULTS

FIGURE 17

A.G. Wassenaar Inc.
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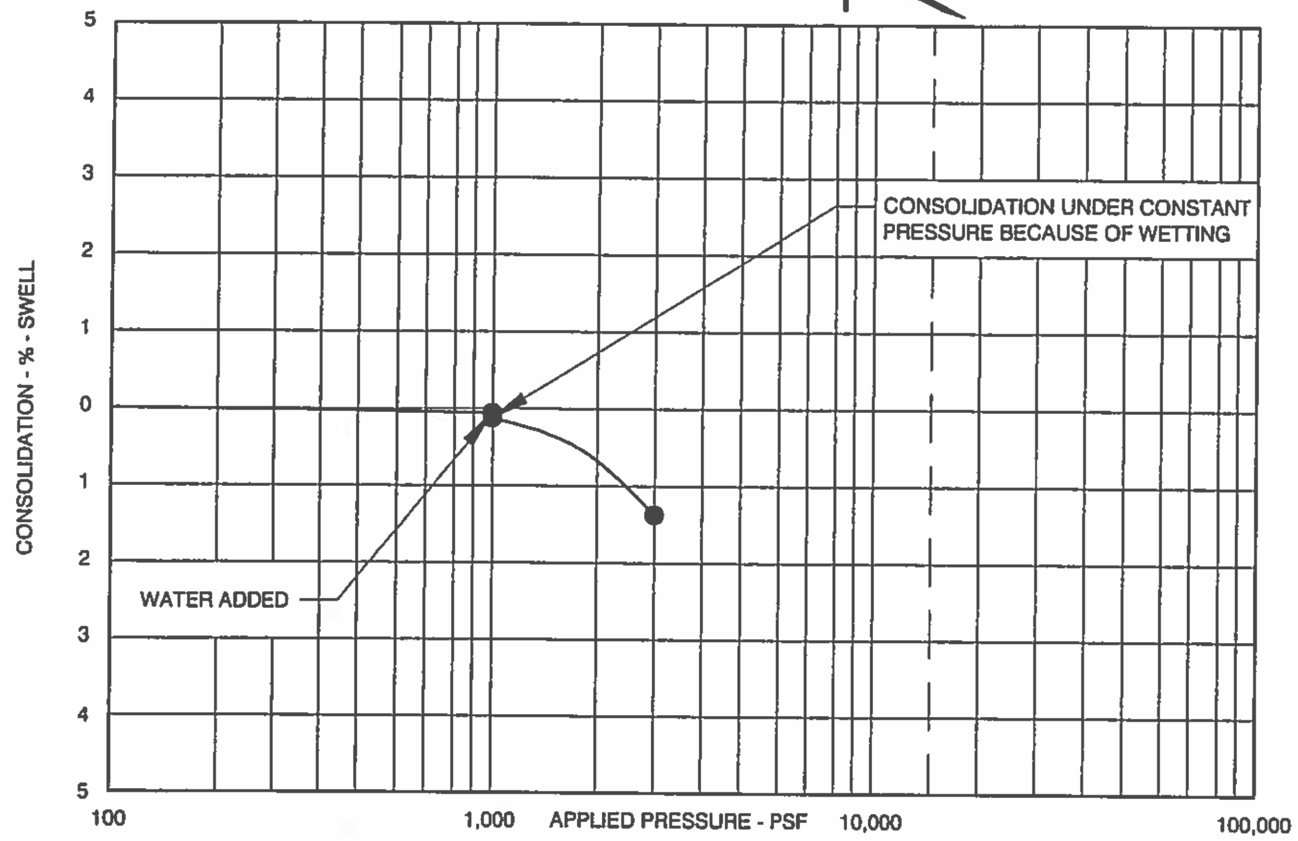
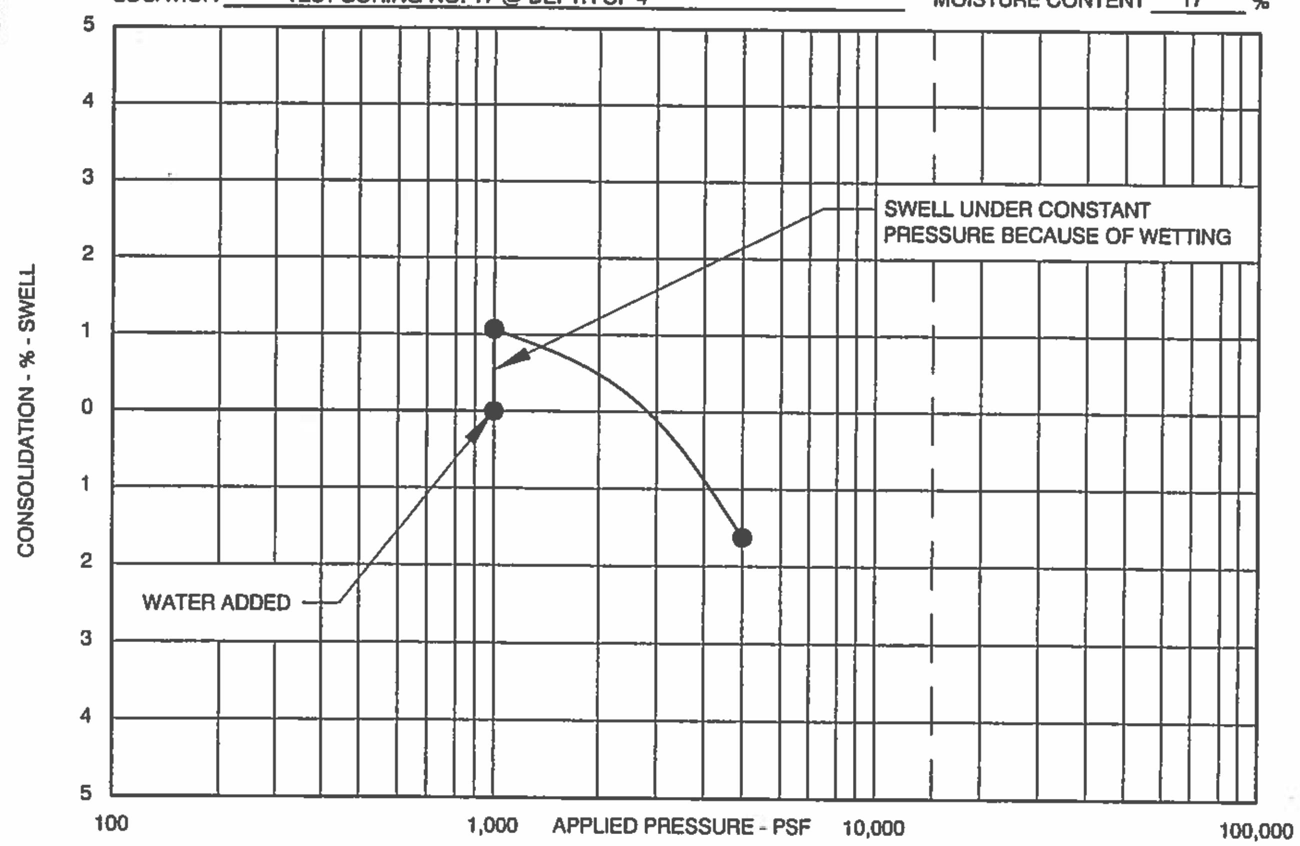


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 17 @ DEPTH OF 4'

DRY UNIT WT. 107 PCF
MOISTURE CONTENT 17 %



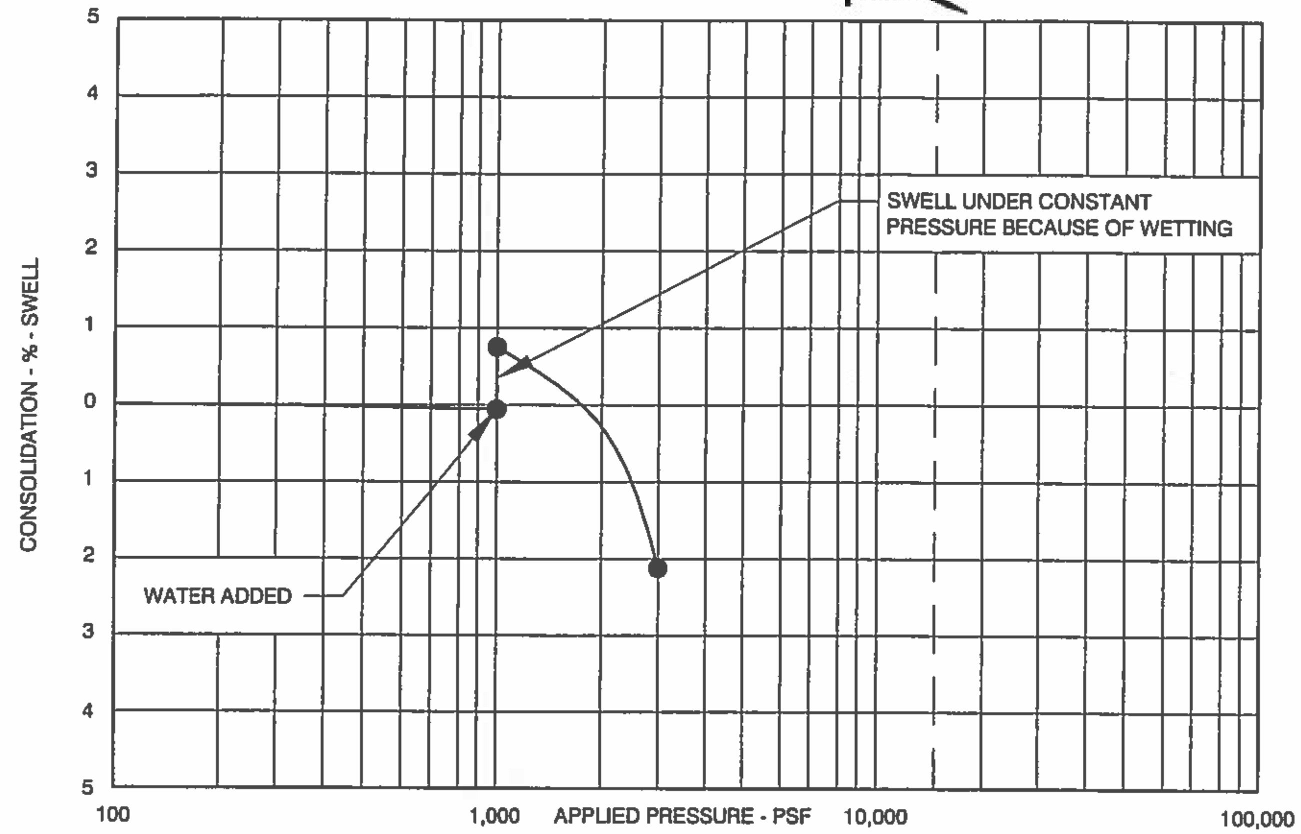
SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 18 @ DEPTH OF 4'

DRY UNIT WT. 103 PCF
MOISTURE CONTENT 7 %

SWELL - CONSOLIDATION TEST RESULTS

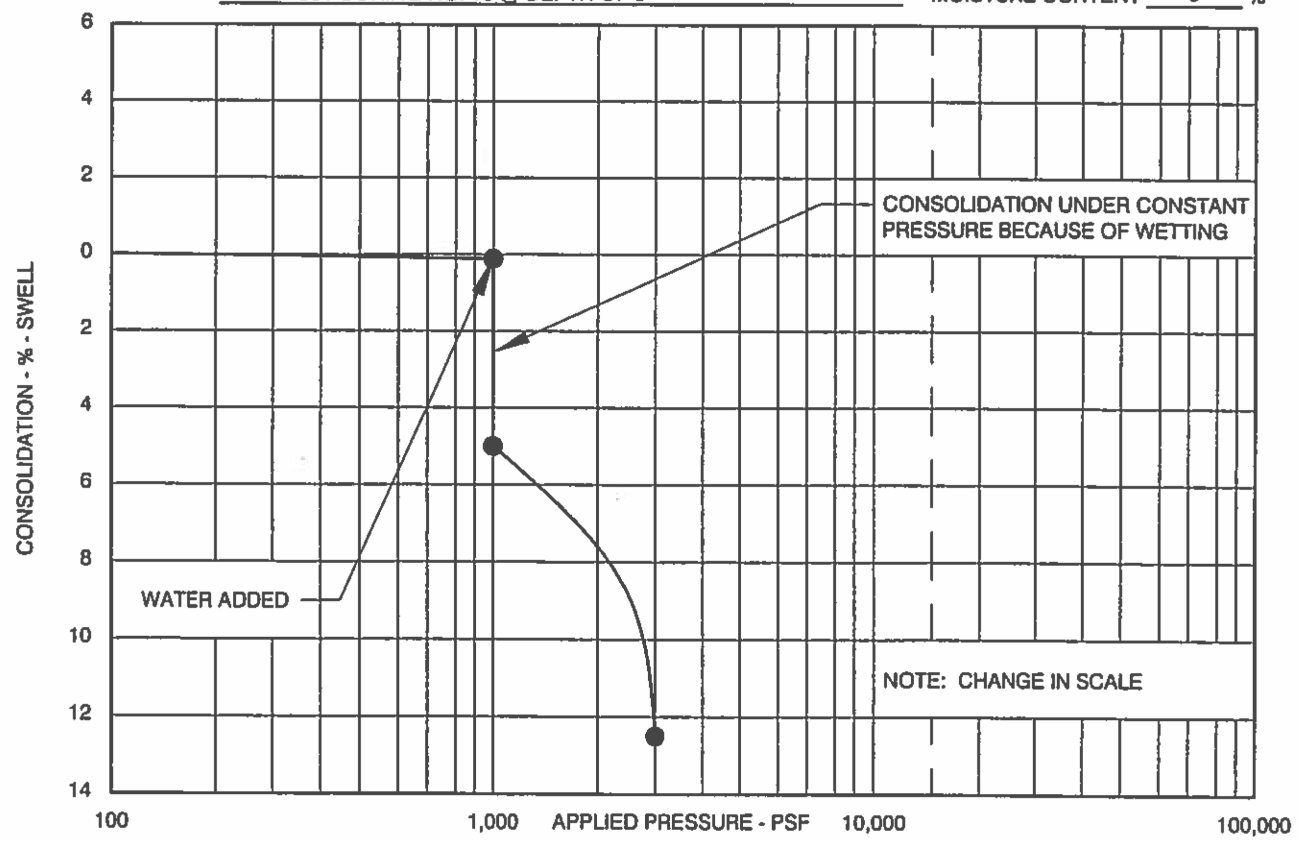
FIGURE 18

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION SANDSTONE, SLIGHTLY CLAYEY
LOCATION TEST BORING NO. 18 @ DEPTH OF 9'

DRY UNIT WT. 120 PCF
MOISTURE CONTENT 5 %



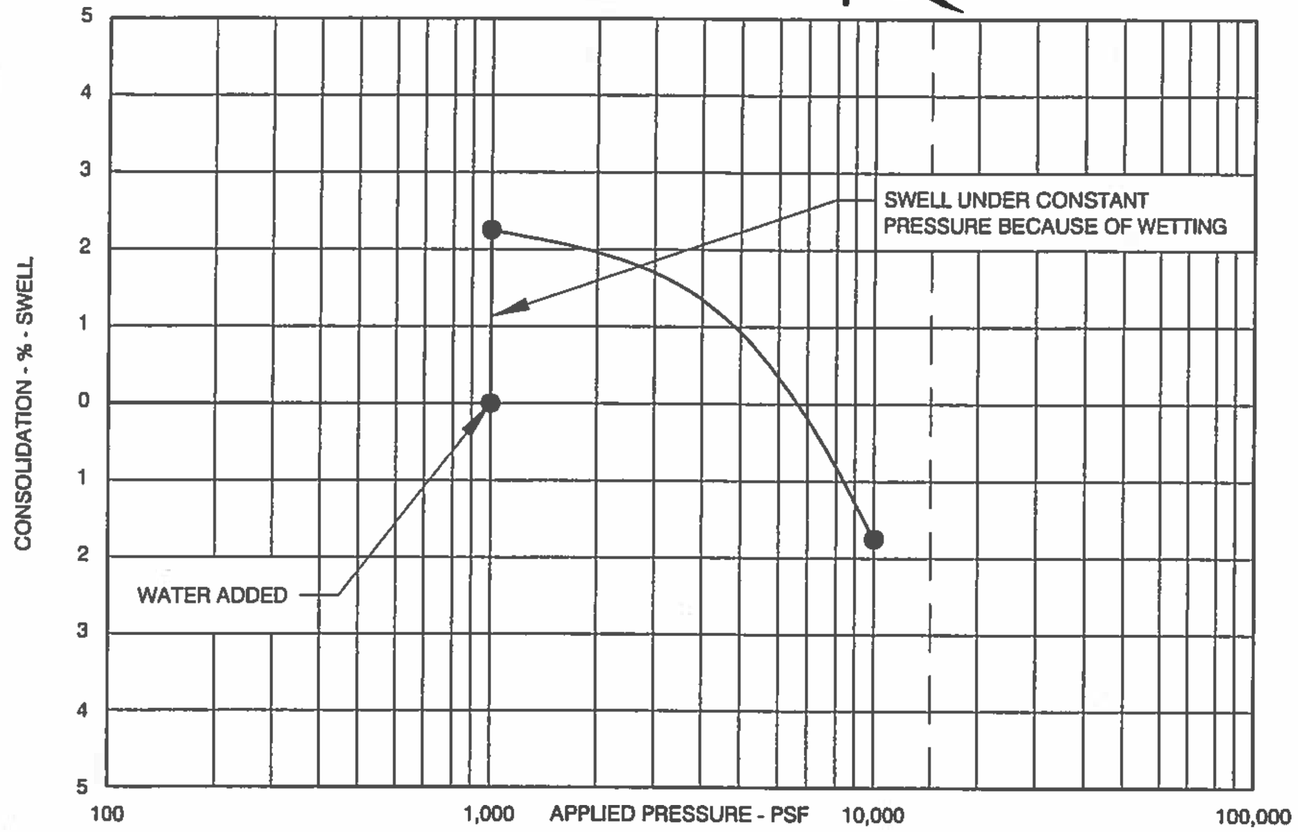
SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 19 @ DEPTH OF 4'

DRY UNIT WT. 78 PCF
MOISTURE CONTENT 6 %

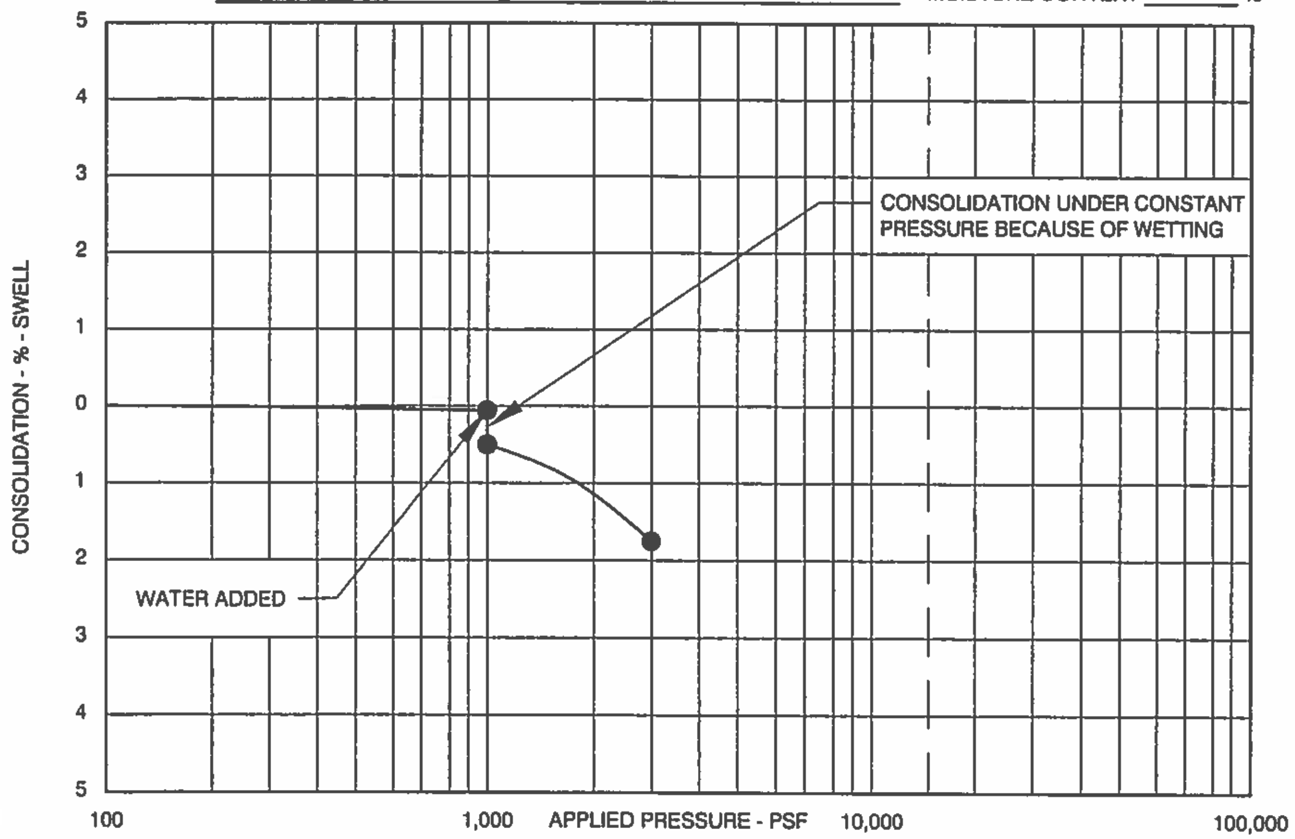
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 19

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAYSTONE, SILTY
LOCATION TEST BORING NO. 19 @ DEPTH OF 24'
DRY UNIT WT. 124 PCF
MOISTURE CONTENT 7 %

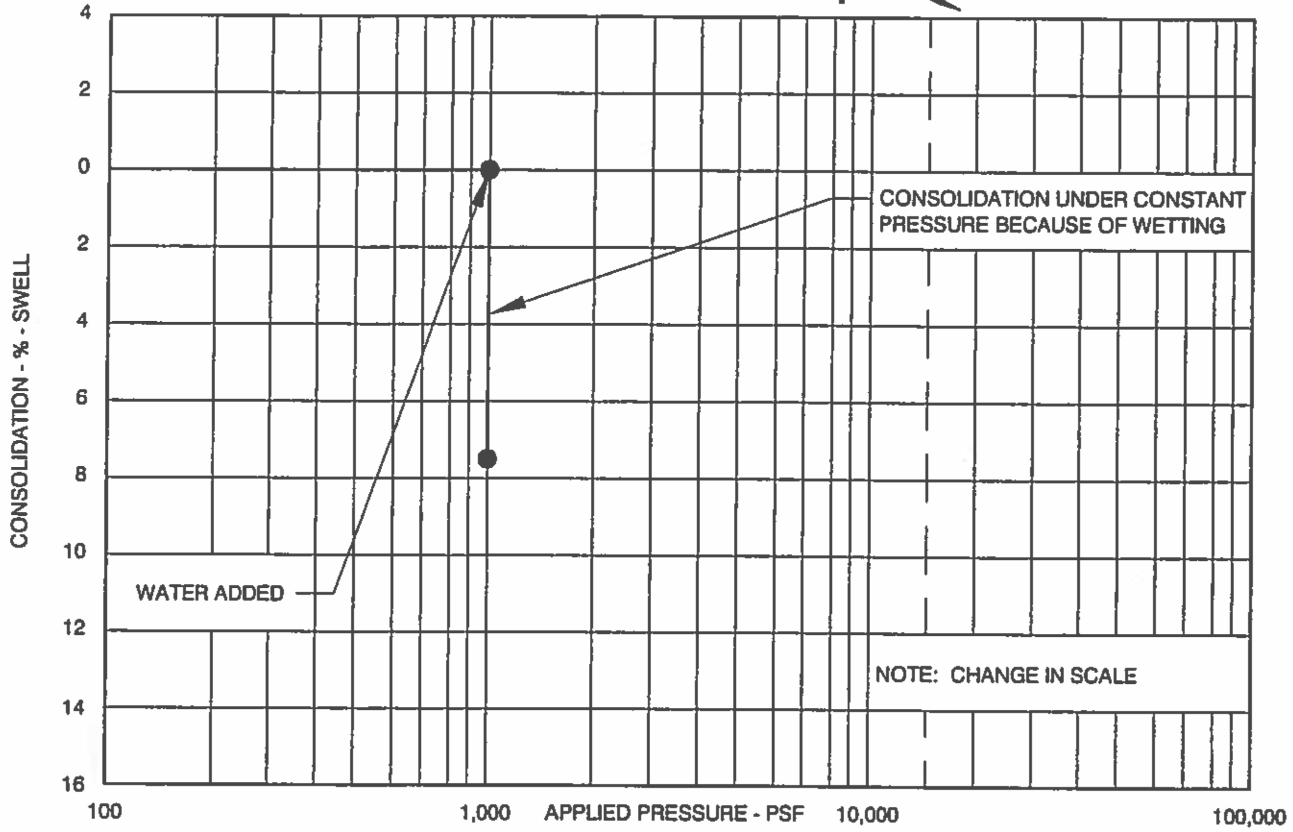


SAMPLE DESCRIPTION CLAY, SLIGHTLY SANDY
LOCATION TEST BORING NO. 20 @ DEPTH OF 4'
DRY UNIT WT. 108 PCF
MOISTURE CONTENT 15 %

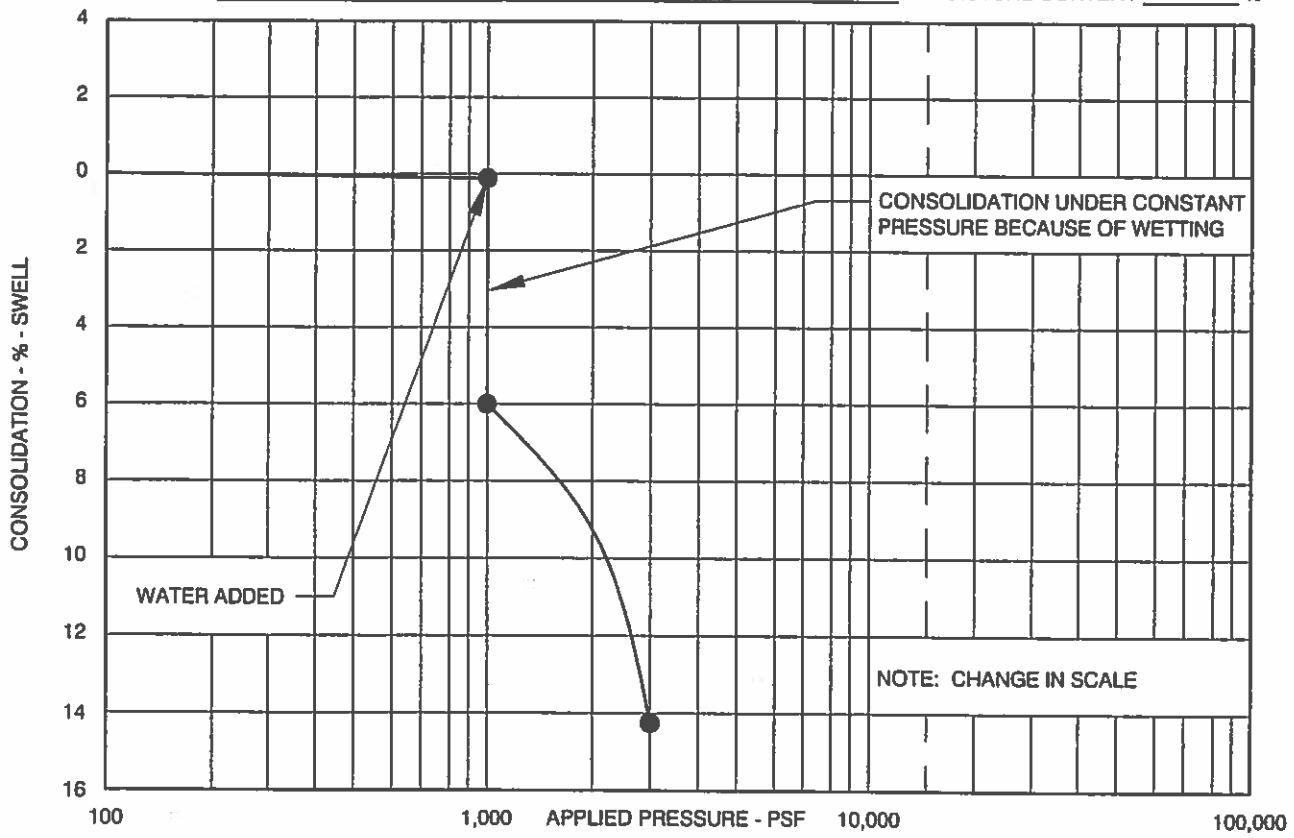
SWELL - CONSOLIDATION TEST RESULTS

FIGURE 20

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION CLAYSTONE, SILTY (DISTURBED)
LOCATION TEST BORING NO. 20 @ DEPTH OF 9'
DRY UNIT WT. 94 PCF
MOISTURE CONTENT 6 %

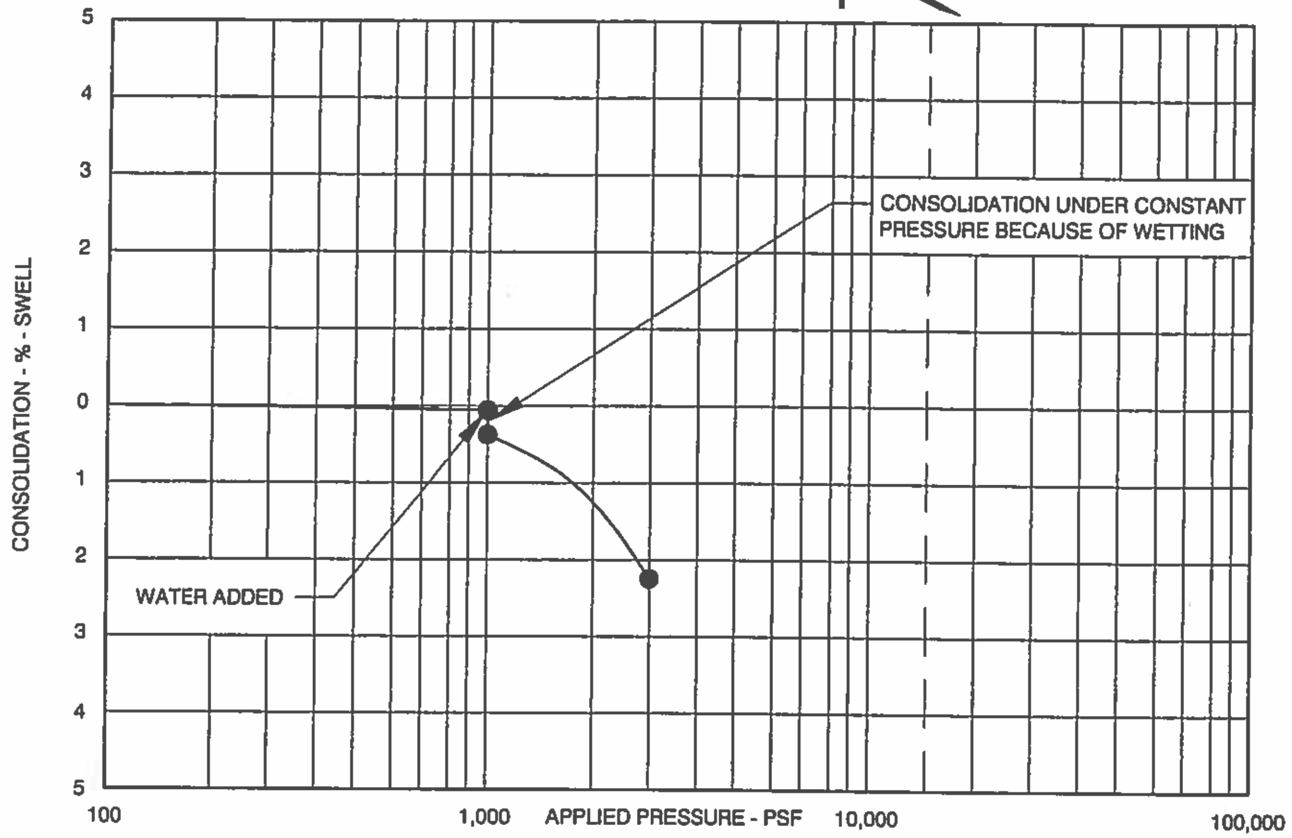


SAMPLE DESCRIPTION CLAY, SANDY
LOCATION TEST BORING NO. 21 @ DEPTH OF 4'
DRY UNIT WT. 91 PCF
MOISTURE CONTENT 6 %

SWELL - CONSOLIDATION TEST RESULTS

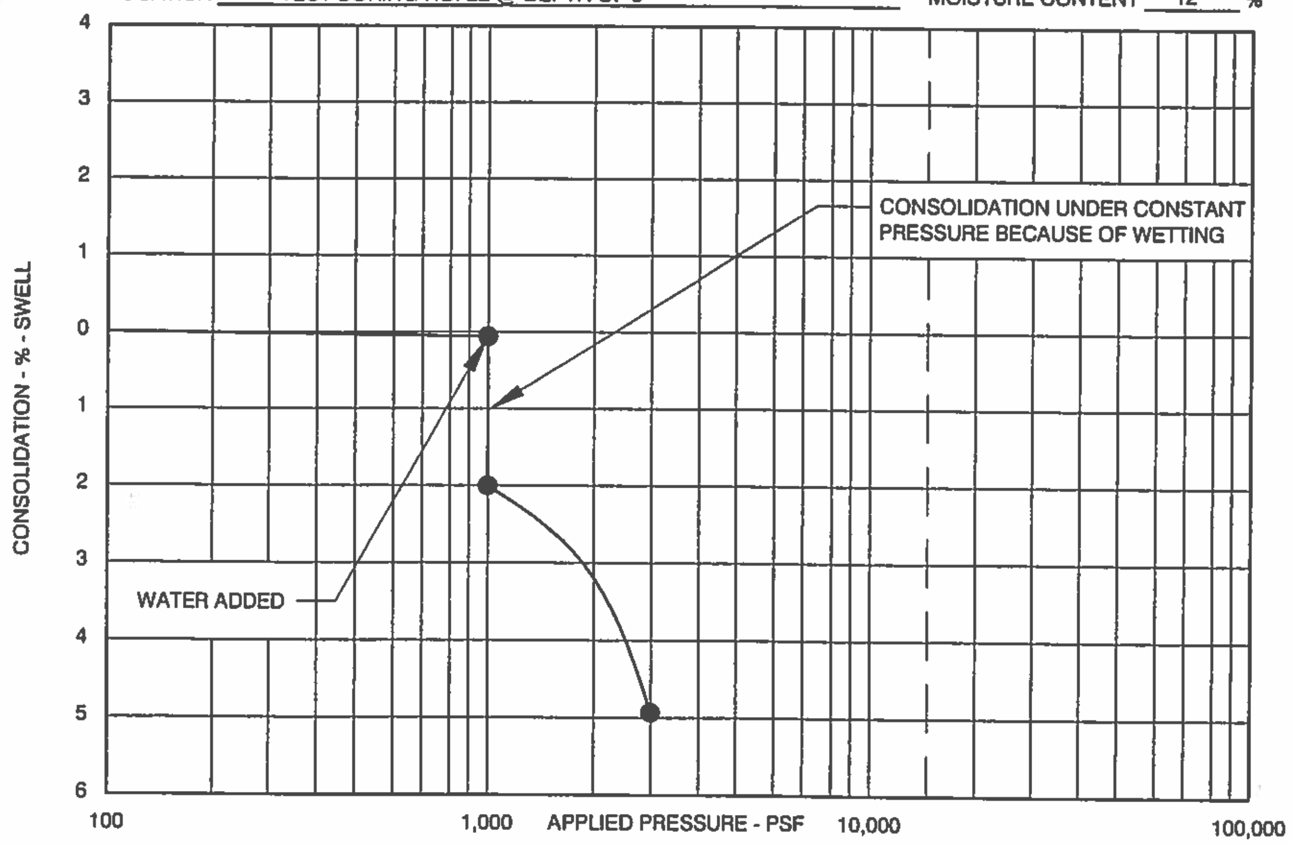
FIGURE 21

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



SAMPLE DESCRIPTION FILL-CLAY, SANDY
LOCATION TEST BORING NO. 22 @ DEPTH OF 9'

DRY UNIT WT. 119 PCF
MOISTURE CONTENT 12 %



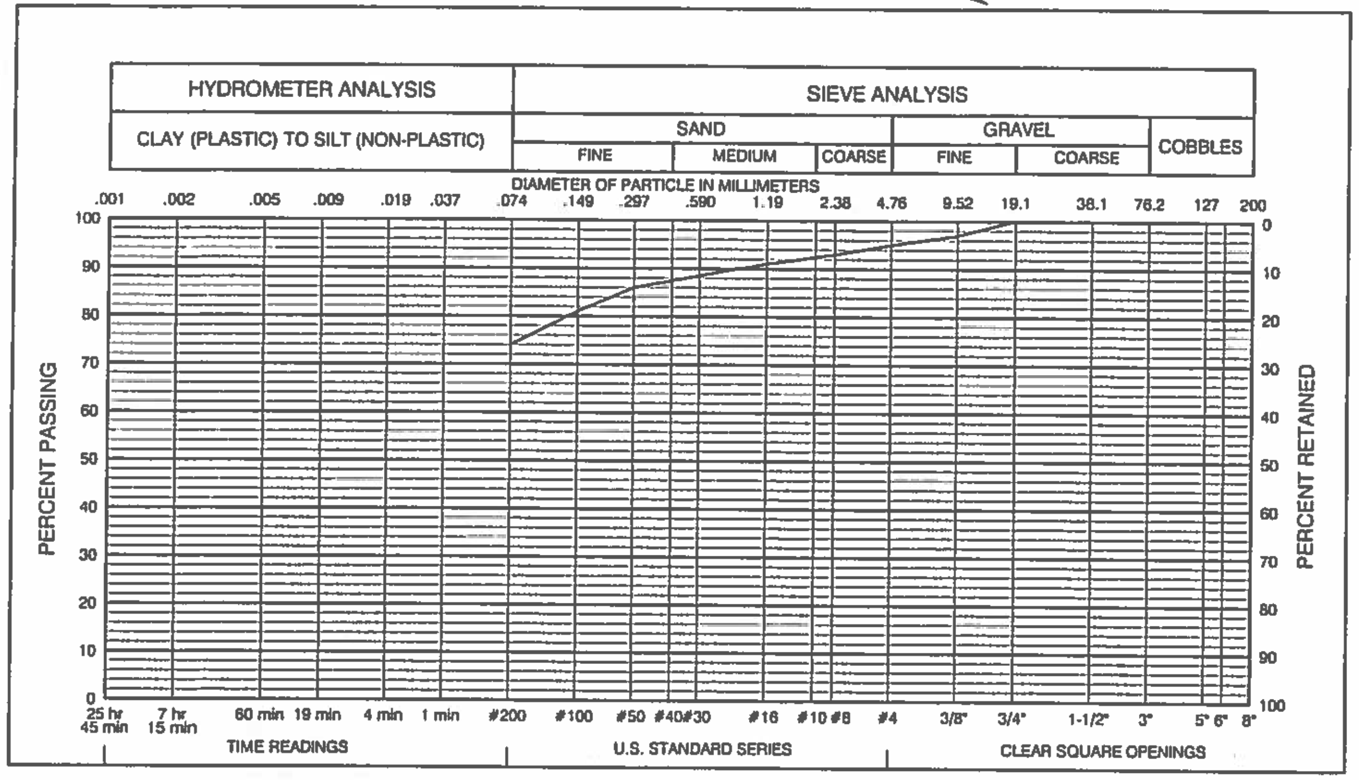
SAMPLE DESCRIPTION FILL-CLAY, SANDY
LOCATION TEST BORING NO. 22 @ DEPTH OF 14'

DRY UNIT WT. 102 PCF
MOISTURE CONTENT 10 %

SWELL - CONSOLIDATION TEST RESULTS

FIGURE 22

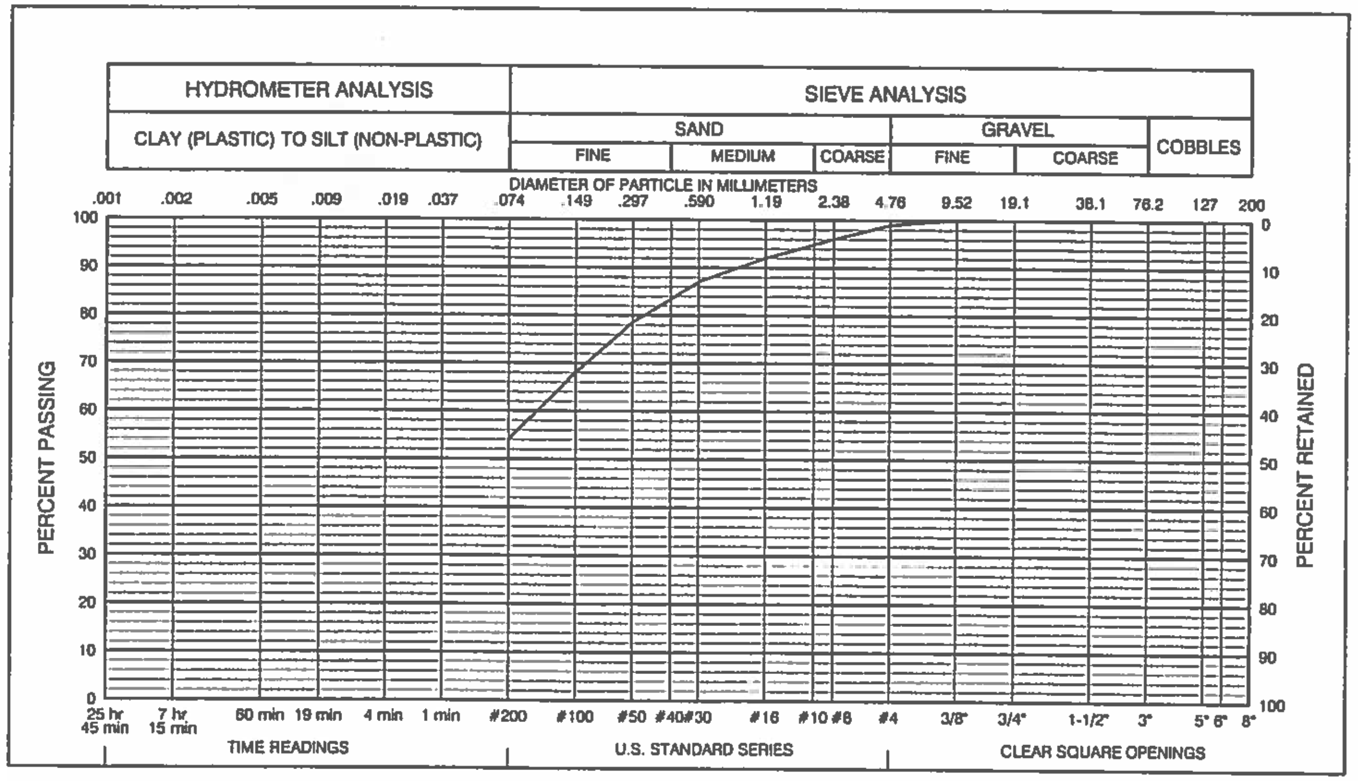
A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



LOCATION TEST BORING NO. 1 @ DEPTH OF 9'
SAMPLE DESCRIPTION CLAY, SANDY, SLIGHTLY GRAVELLY (CL)
CLASSIFICATION AASHTO A-6 (11)

GRAVEL 5 %
SAND 21 %
SILT & CLAY 74 %

LIQUID LIMIT 35
PLASTICITY INDEX 17



LOCATION TEST BORING NO. 4 @ DEPTH OF 9'
SAMPLE DESCRIPTION SILT, VERY SANDY (ML)
CLASSIFICATION AASHTO A-4 (0)

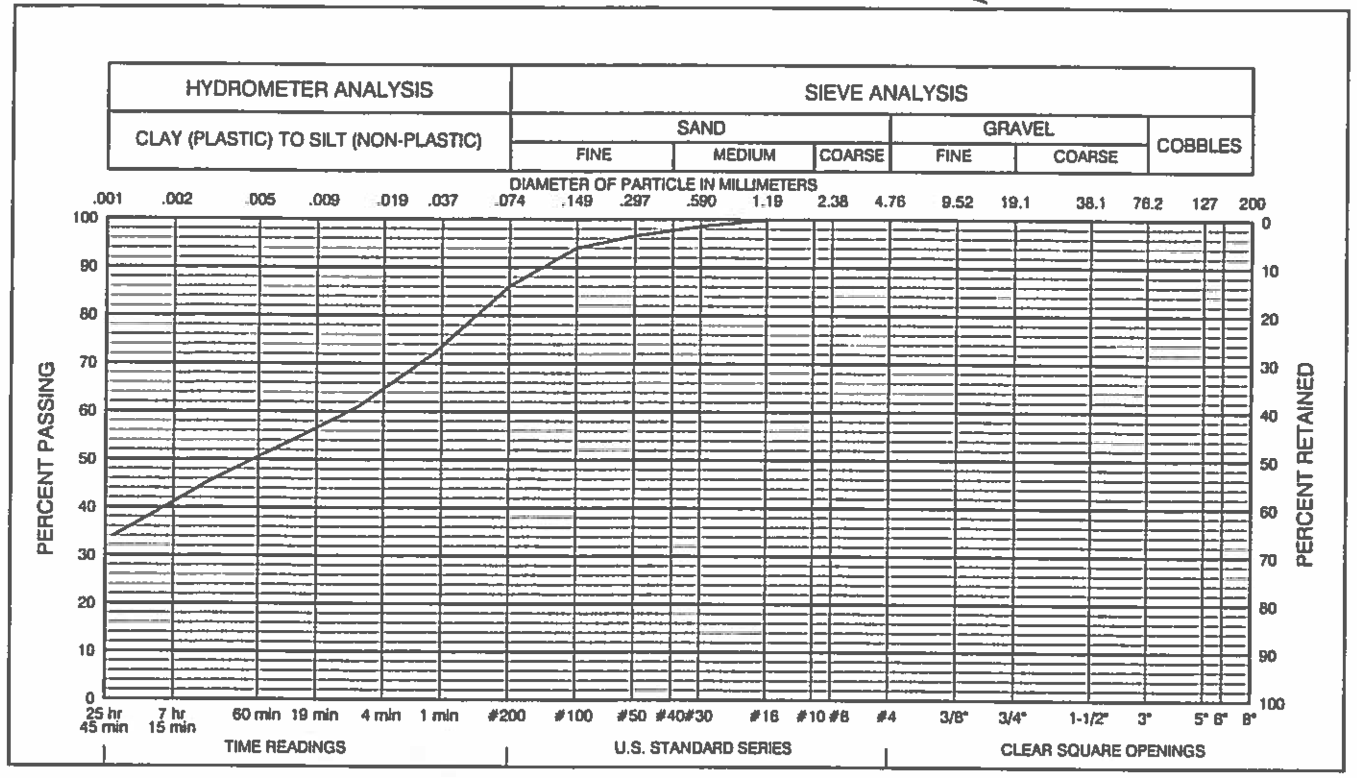
GRAVEL 1 %
SAND 45 %
SILT & CLAY 54 %

LIQUID LIMIT NV
PLASTICITY INDEX NP

GRADATION TEST RESULTS

FIGURE 23

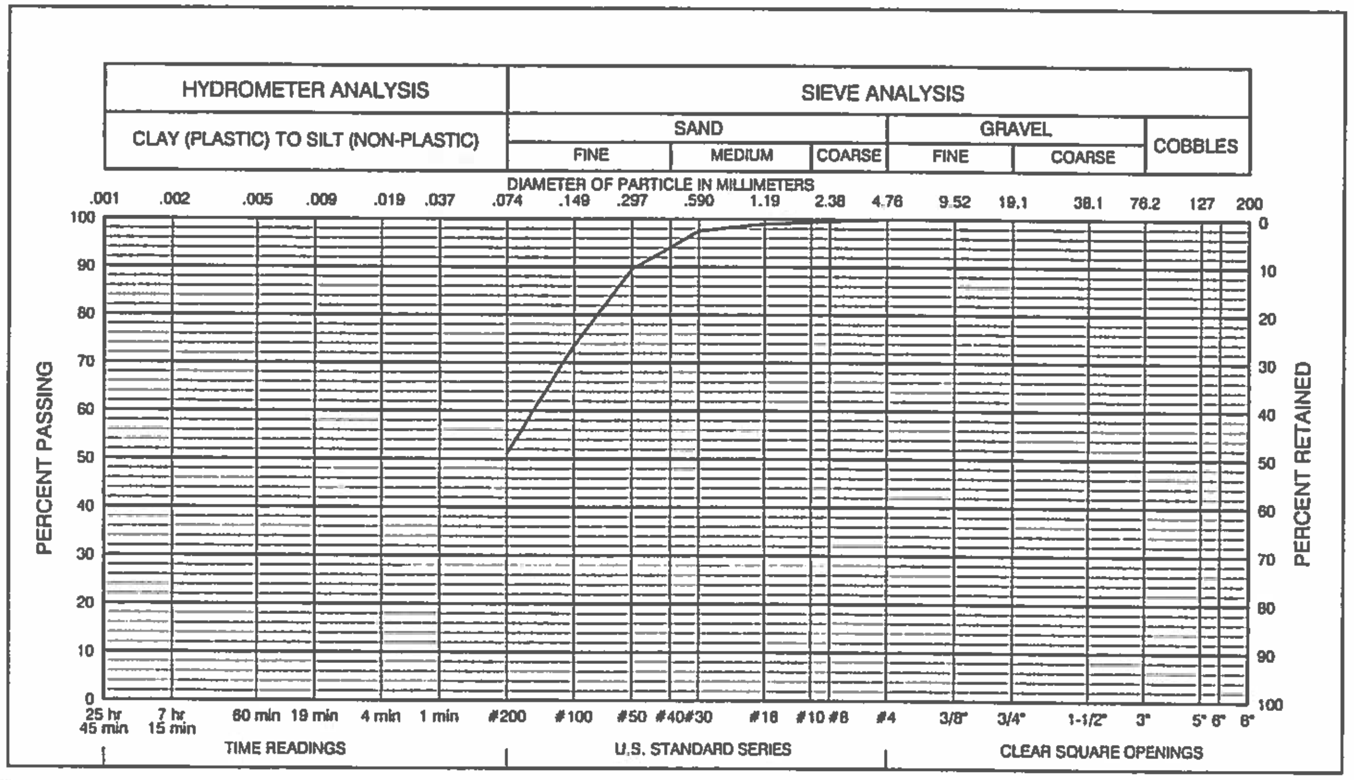
A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants



LOCATION TEST BORING NO. 8 @ DEPTH OF 4'
SAMPLE DESCRIPTION CLAY, SLIGHTLY SANDY (CL)
CLASSIFICATION AASHTO A-6 (13)

GRAVEL 0 %
SAND 14 %
SILT & CLAY 86 %

LIQUID LIMIT 35
PLASTICITY INDEX 18



LOCATION TEST BORING NO. 9 @ DEPTH OF 9'
SAMPLE DESCRIPTION SILT, VERY SANDY (ML)
CLASSIFICATION AASHTO A-4 (0)

GRAVEL 0 %
SAND 49 %
SILT & CLAY 51 %

LIQUID LIMIT NV
PLASTICITY INDEX NP

GRADATION TEST RESULTS

FIGURE 24

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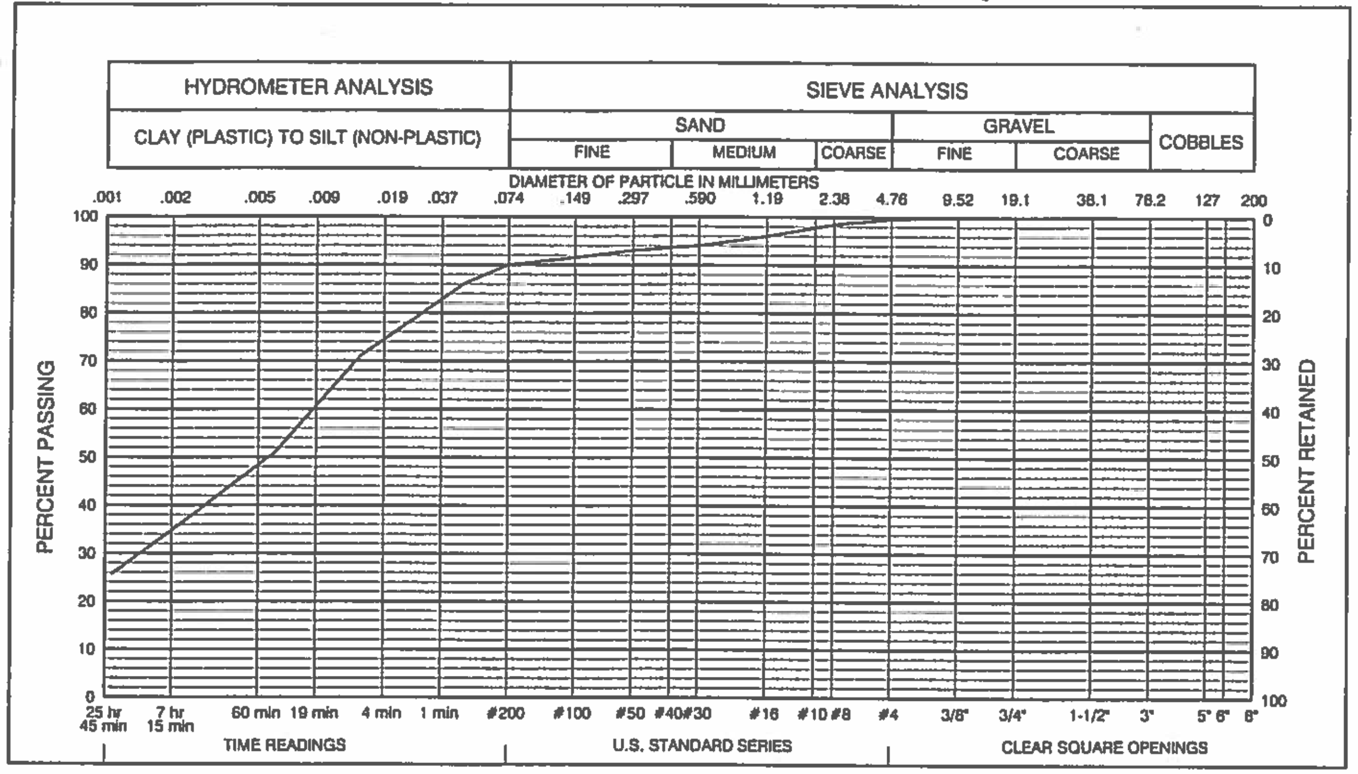
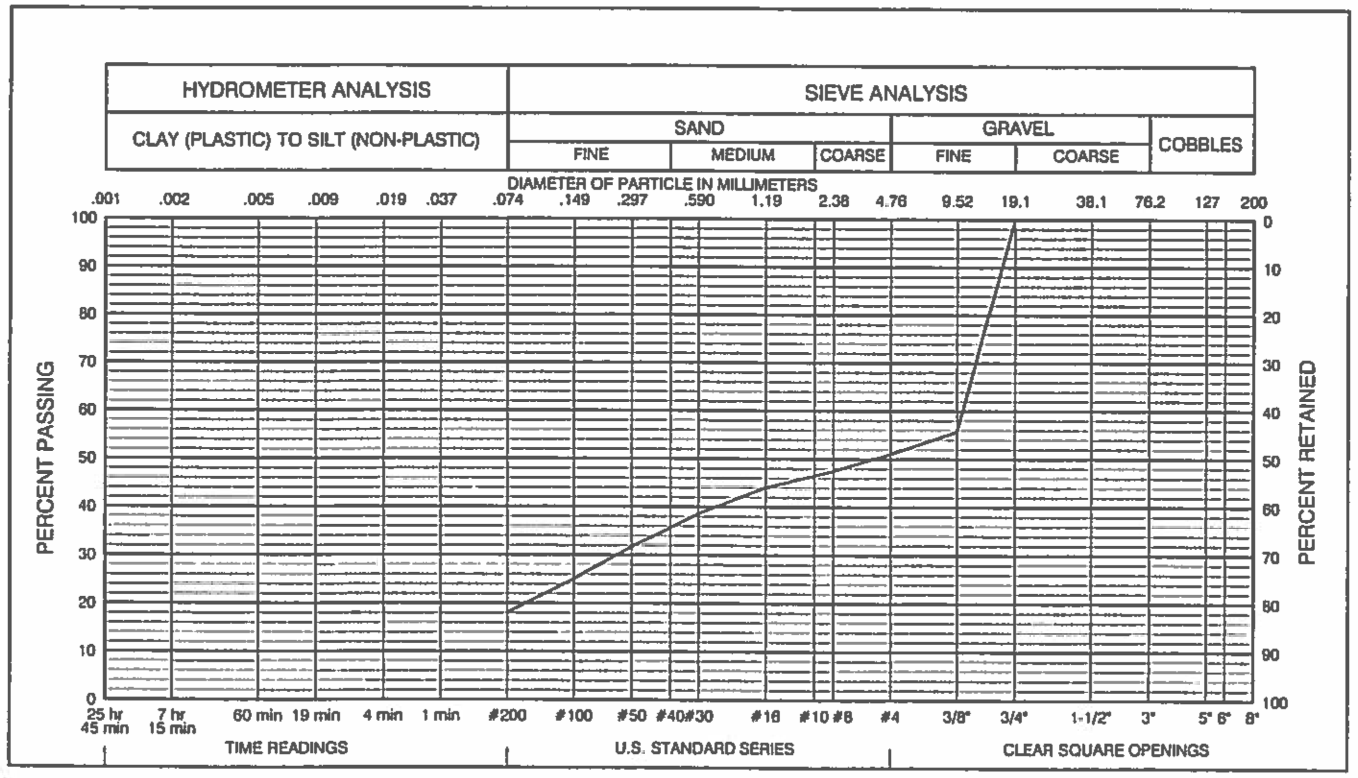


LOCATION TEST BORING NO. 11 @ DEPTH OF 9'
SAMPLE DESCRIPTION CLAY, SLIGHTLY SANDY (CL)
CLASSIFICATION AASHTO A-6 (13)

GRAVEL 0 %
SAND 10 %
SILT & CLAY 90 %
LIQUID LIMIT 33
PLASTICITY INDEX 16



LOCATION TEST BORING NO. 12 @ DEPTH OF 4'
SAMPLE DESCRIPTION GRAVEL, VERY SANDY, SILTY (GM)
CLASSIFICATION AASHTO A-1-b

GRAVEL 49 %
SAND 33 %
SILT & CLAY 18 %
LIQUID LIMIT NV
PLASTICITY INDEX NP

GRADATION TEST RESULTS

FIGURE 25

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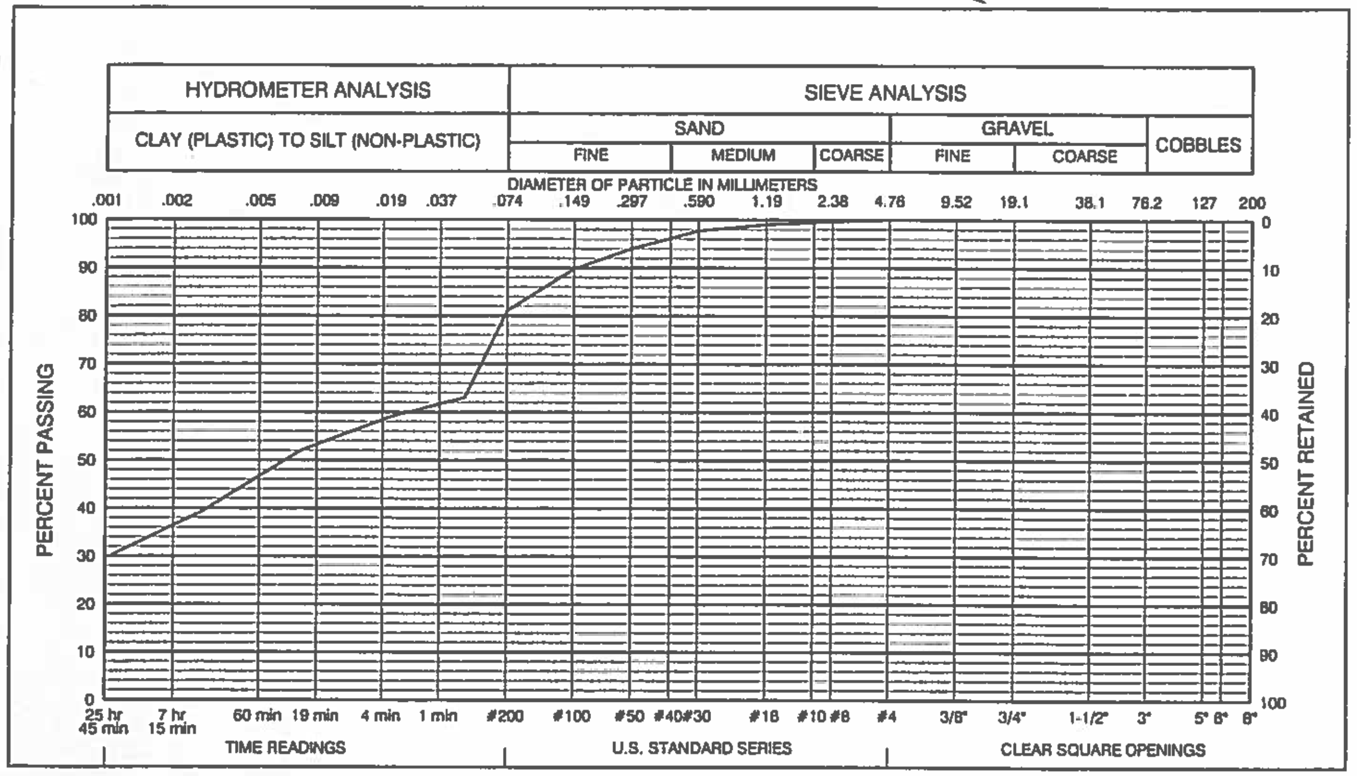
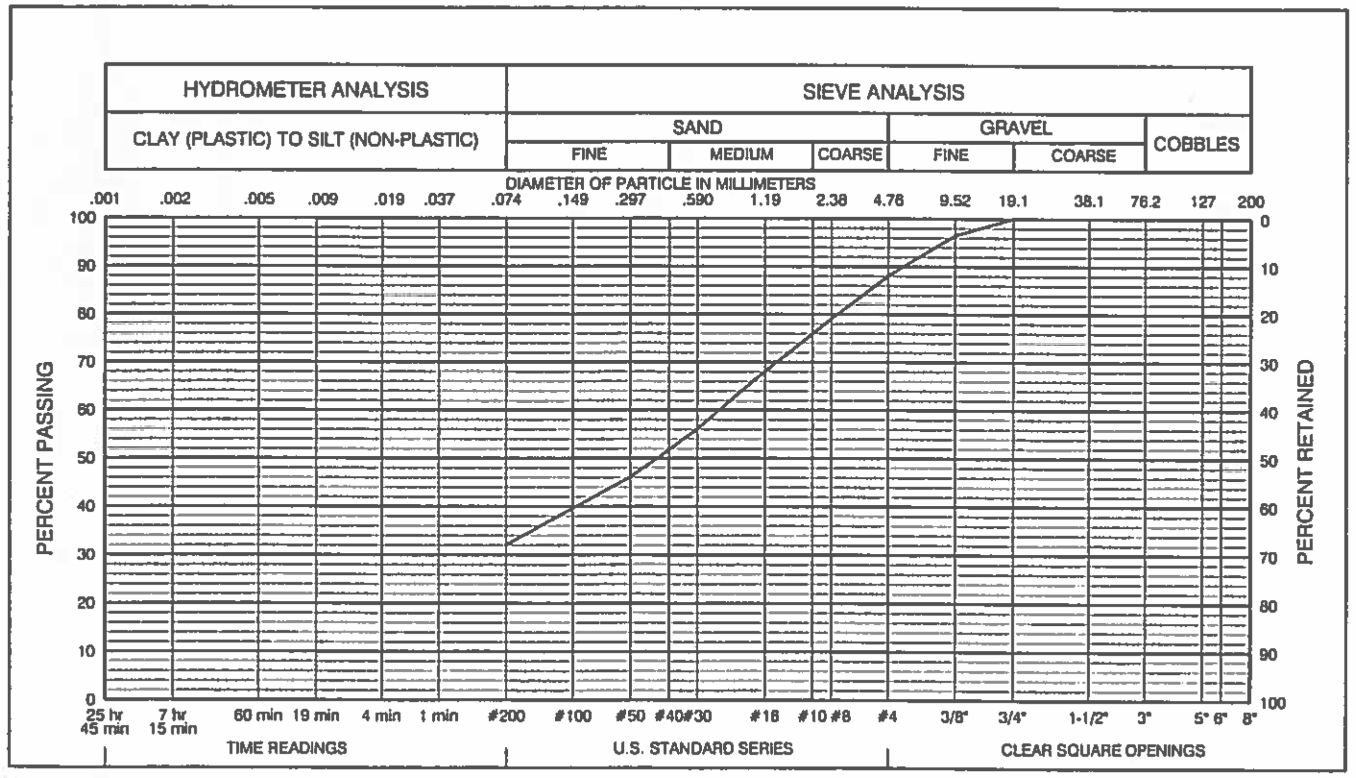


LOCATION TEST BORING NO. 15 @ DEPTH OF 4' GRAVEL 0 % LIQUID LIMIT 35
SAMPLE DESCRIPTION CLAY, SLIGHTLY SANDY (CL) SAND 19 % PLASTICITY INDEX 19
CLASSIFICATION AASHTO A-6 (14) SILT & CLAY 81 %



LOCATION TEST BORING NO. 19 @ DEPTH OF 9' GRAVEL 12 % LIQUID LIMIT 23
SAMPLE DESCRIPTION SAND, VERY CLAYEY TO SILTY, SL. GRAVELLY (SC-SM) SAND 65 % PLASTICITY INDEX 6
CLASSIFICATION AASHTO A-2-4 (0) SILT & CLAY 32 %

GRADATION TEST RESULTS

FIGURE 26

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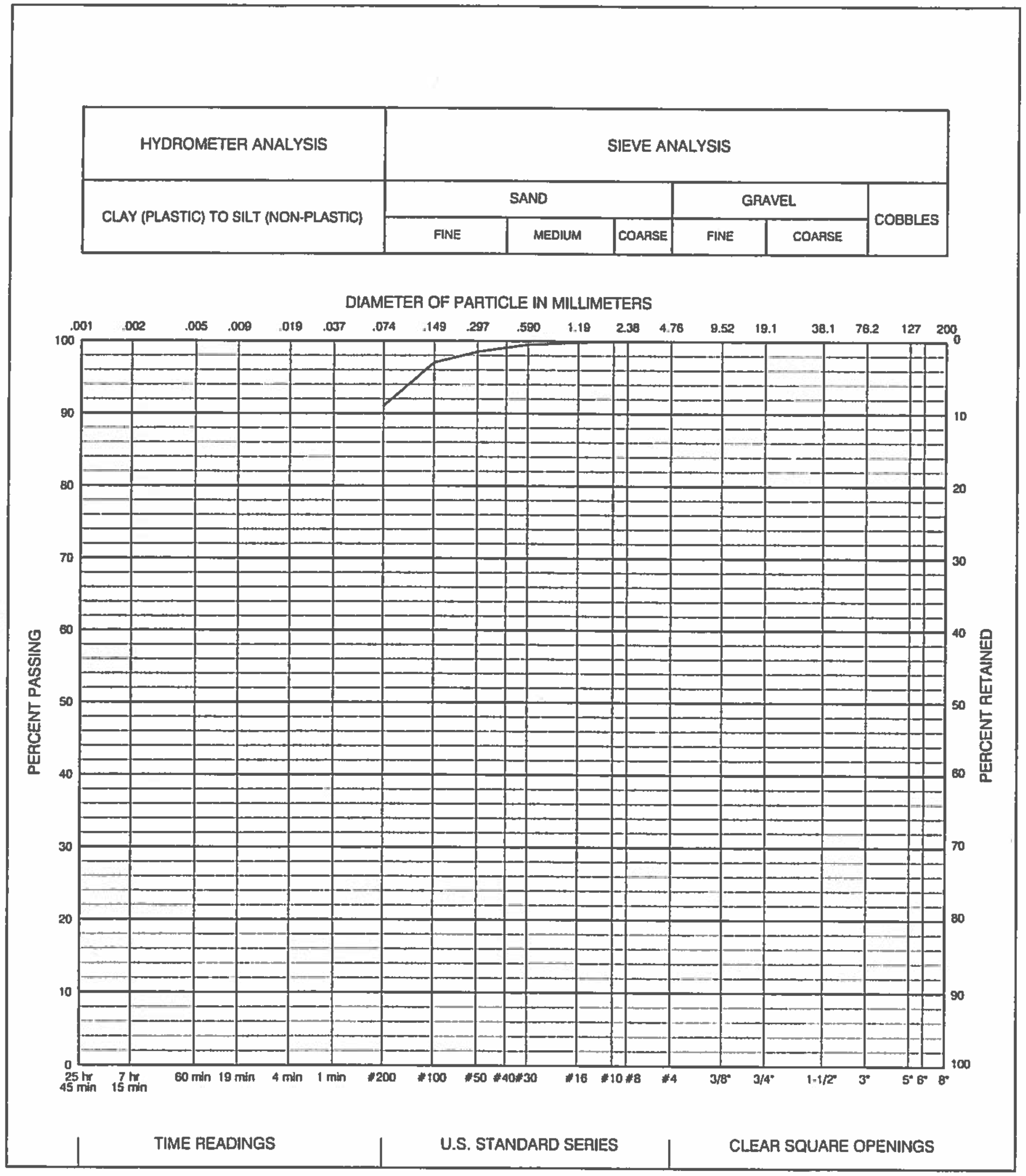

LOCATION TEST BORING NO. 20 @ DEPTH OF 4'
SAMPLE DESCRIPTION CLAY, SLIGHTLY SANDY (CL)
CLASSIFICATION AASHTO A-6 (9)

GRAVEL 0 %
SAND 9 %
SILT & CLAY 91 %

LIQUID LIMIT 27
PLASTICITY INDEX 12

GRADATION TEST RESULTS
FIGURE 27

NOTE: ALL LOCATIONS ARE APPROXIMATE

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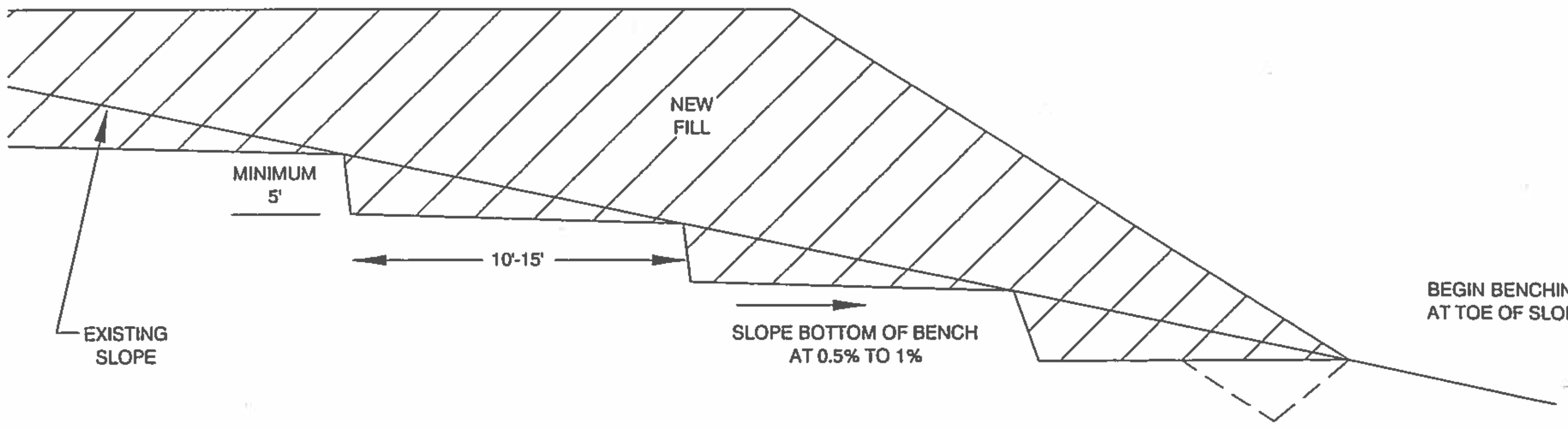
ESTIMATED DEPTH TO BEDROCK MAP	PROJECT NO. 90114 FIGURE 28

CONTINUE BENCHING UNTIL NATURAL SLOPE
FLATTENS OR SLOPE DAYLIGHTS



A KEYWAY MAY BE REQUIRED BY GEOTECHNICAL
ENGINEER DEPENDING UPON SLOPE CONFIGURATION.

BENCHING REQUIRED WHEN EXISTING
SLOPE IS 5 : 1 (HORITONTAL : VERTICAL) OR GREATER

NOTES: DRAINS MAY BE REQUIRED IF GROUND
WATER IS ENCOUNTERED.

ADDITIONAL CUTTING BACK OF SOME SLOPES
MAY BE REQUIRED BY GEOTECHNICAL ENGINEER
IF SLOPE INSTABILITY IS NOTED.

NOT TO SCALE

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GENERALIZED BENCHING DETAIL	PROJECT NO. 90114 FIGURE 29

Test Boring No.	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture (%)	Swell (+) / Consolidation (-) (%)*	Swell Pressure (psf)	% Clay	% Passing #200 Sieve	Atterberg Liquid Limit LL	Atterberg Plasticity Index PI	pH	Resistivity (ohm/cm)	Water Soluble Sulfates (ppm)	Chlorides (%)
1	4	Clay, sandy	100	7	+0.1	1,100					7.32	516	20,000	0.0068
	9	Clay, sandy, slightly gravelly		9				74	35	17				
	14	Claystone, silty (disturbed)	107	6	-2.5	—								
2	9	Clay, sandy	114	7	+2.8	5,400								
	14	Clay, sandy	108	7	-0.1	—								
3	4	Clay, sandy	117	12	-0.4	—								
	19	Clay, sandy	117	3	-1.3	—								
4	4	Clay, sandy	97	8	-1.1	—								
	9	Silt, very sandy		5				54	NV	NP				
5	4	Sand, clayey	87	8	-0.5	—								
7	4	Clay, sandy	116	14	-0.3	—					7.76	1,835	<50	<0.0001
	24	Claystone, silty	122	9	+4.9	6,500								
8	4	Clay, slightly sandy		13			41	86	35	18				
	9	Clay, slightly sandy	110	10	-0.3	—								
9	4	Clay, slightly sandy	109	7	-0.5	—								
	9	Silt, very sandy		5				51	NV	NP			<50	

Notes:
*Indicates Percent Swell (+) or Consolidation (-) when wetted under a 1,000 psf load.

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SUMMARY OF LABORATORY TEST RESULTS

Village Homes of Colorado, Inc.
Castle Valley Ranch
Project Number 90114

TABLE I

Page 1 of 3

Test Boring No.	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture (%)	Swell (+) / Consolidation (-) (%)*	Swell Pressure (psf)	% Clay	% Passing #200 Sieve	Atterberg Liquid Limit LL	Atterberg Plasticity Index PI	pH	Resistivity (ohm/cm)	Water Soluble Sulfates (ppm)	Chlorides (%)
10	4	Clay, sandy	107	18	-0.4	—								
	9	Claystone, silty	116	16	+2.7	10,000					8.31	1,000	<50	0.0003
	24	Claystone, silty	113	11	+4.1	15,000								
11	4	Claystone, silty	116	10	+0.9	3,500								
	9	Clay, slightly sandy		8			35	90	33	16				
	14	Clay, slightly sandy	116	6	0.0	—								
12	4	Gravel, very sandy, silty		4				18	NV	NP				
	19	Claystone, silty	124	10	+6.0	9,200								
13	4	Clay, sandy	89	8	-2.4	—								
	9	Claystone, silty (disturbed)	99	7	-5.9	—								
14	4	Clay, sandy	120	9	+4.3	14,000								
15	4	Clay, slightly sandy	104	9	-0.7	—	36	81	35	19				
	9	Clay, very sandy	123	6	+1.7	7,700								
16	4	Clay, sandy	93	8	-1.1	—					7.76	1,724	<50	<0.0001
17	4	Clay, sandy	107	17	-0.1	—								
18	4	Clay, sandy	103	7	+1.1	2,900								

Notes:
*Indicates Percent Swell (+) or Consolidation (–) when wetted under a 1,000 psf load.

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SUMMARY OF LABORATORY TEST RESULTS
Village Homes of Colorado, Inc.
Castle Valley Ranch
Project Number 90114

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Test Boring No.	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture (%)	Swell (+) / Consolidation (-) (%)*	Swell Pressure (psf)	% Clay	% Passing #200 Sieve	Atterberg Liquid Limit LL	Atterberg Plasticity Index PI	pH	Resistivity (ohm/cm)	Water Soluble Sulfates (ppm)	Chlorides (%)
18	9	Sandstone, slightly clayey	120	5	+0.8									
19	4	Clay, sandy	78	6	-4.9	—								
	9	Sand, very clayey to silty, slightly gravelly		2				32	23	6				
	24	Claystone, silty	124	7	+2.3									
20	4	Clay, slightly sandy	108	15	-0.4	—		91	27	12				
	9	Claystone, silty (disturbed)	94	6	-7.5	—								
21	4	Clay, sandy	91	6	-5.9	—								
22	9	Fill - clay, sandy	119	12	-0.3	—								
	14	Fill - clay, sandy	102	10	-1.9	—					7.82	3,984	<50	0.0007

Notes:
*Indicates Percent Swell (+) or Consolidation (-) when wetted under a 1,000 psf load.

A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants

SUMMARY OF LABORATORY TEST RESULTS
Village Homes of Colorado, Inc.
Castle Valley Ranch
Project Number 90114

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APPENDIX

SPECIFICATIONS FOR PLACEMENT OF FILL

GENERAL

The Soil Engineer, as the Owner's representative, shall conduct tests to determine if the material, method of placement, and compaction are in reasonable compliance with the specifications.

PREPARATION OF NATURAL GROUND

Vegetation, organic topsoil, any existing man-made fill and any other deleterious materials shall be removed from the fill area. The area to be filled shall then be scarified, moistened if necessary, and compacted in the manner specified below prior to placement of subsequent layers of fill.

FILL MATERIAL

Fill material shall consist of on or off-site soils which are relatively free of vegetable matter and rubble. Off-site materials shall be evaluated by the Soil Engineer prior to importation. No organic, frozen, perishable, or other unsuitable material shall be placed in the fill. For the purpose of this specification, cohesive soil shall be defined as a mixture of clay, sand, and silt with more than 35% passing a U. S. Standard #200 sieve and a Plasticity Index of at least 11. These materials will classify as an A-6 or A-7 by the AASHTO Classification system. Granular soils shall be all materials which do not classify as cohesive.

Crushed sandstone should consist of a material of which at least 90% are smaller than 4-inches in dimension and at least 60% passes a U. S. Standard No. 4 sieve.

PLACEMENT OF FILL MATERIAL

The materials shall be delivered to the fill in a manner which will permit a well and uniformly compacted fill. Before compacting, the fill material shall be properly mixed and spread in approximately horizontal layers not greater than 8 inches in loose thickness.

MOISTURE CONTROL

While being compacted, the material shall contain uniformly distributed optimum moisture for compaction. The Contractor shall be required to add moisture to the materials if, in the opinion of the Soil Engineer, proper and uniform moisture is not being obtained for compaction. If the fill materials are too wet for proper compaction, aerating and/or mixing with drier materials may be required.

Moisture content shall be controlled as a percentage deviation from optimum. Optimum moisture content is defined as the moisture content corresponding to the maximum density of a laboratory compacted sample performed according to ASTM D698 for cohesive soils or ASTM D1557 for granular soils. The moisture content specifications for the various areas are as follows:

APPENDIX
SPECIFICATIONS FOR PLACEMENT OF FILL
PAGE TWO

1. Beneath Structural Areas:	Cohesive	-1 to +3 percent
	Granular	-2 to +2 percent
2. Beneath Non-Structural Areas:		-3 to +3 percent
3. Moisture Treated Fill:	Cohesive	0 to +4 percent
	Granular	-2 to +2 percent

COMPACTION

When the moisture content and conditions of each layer spread are satisfactory, it shall then be compacted by an approved method. Moisture-density tests shall be performed on typical fill materials to determine the maximum density. Field density tests must then be made to determine the adequacy of the fill compaction. The compaction standard to be utilized in determining the maximum density is ASTM D698 for cohesive soils or ASTM D1557 for granular soils. The following compaction specifications should be followed for each area:

1. Beneath Structural Areas: 95% of Maximum Dry Density
2. Beneath Non-Structural Areas: 90% of Maximum Dry Density

If Proctor testing is not feasible due to the percentage of +¾ inch material, compaction of the fill should be judged by the methodology for rock fills as described in The Colorado Department of Transportation Standard Specifications.

Note: In areas where fill depths exceed 20 feet, additional compaction considerations will be required to minimize fill settlement. We recommend any fill placed within 20 feet of final subgrade elevation be compacted to a minimum of 95% of the appropriate maximum dry density, and deeper fills be compacted to 100% of the appropriate maximum dry density. The required moisture content for all fills more than 20 feet deep shall be -2 to +2% of optimum moisture content.

If the structural fill contains less than 10% passing the No. 200 sieve, it may be necessary to control compaction based on relative density (ASTM D 2049). If this is the case, then compaction around the structures and beneath slabs shall be to at least 60% relative density, and compaction beneath foundations and pavements shall be to at least 70% relative density.