SOILS AND FOUNDATION INVESTIGATION

DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
WEST OF INTERSTATE 25 AND CRYSTAL VALLEY PARKWAY
CASTLE ROCK, COLORADO

Prepared for:

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Attention:

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Project No. DN52,431.000-120-R1

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SCOPE

This report presents the results of our Soils and Foundation Investigation for the Dawson Trails Multi-Family Townhomes project located west of Interstate 25 and Crystal Valley Parkway in Castle Rock, Colorado (Fig. 1). The project is planned to consist of construction of 28 townhome buildings with paved roadways and associated infrastructure. The purpose of our investigation was to evaluate the subsurface conditions in order to provide geotechnical design and construction recommendations for the project. The scope was described in our Contract Modification No. 1R (DN-24-0389-CM1R) dated December 9, 2024; Revised December 11, 2024. Evaluation of the property for the presence of potentially hazardous materials (Phase I ESA) was provided under separate cover (Project No. DN52,431.000-200-R1; report dated November 11, 2024).

This report is based on subsurface conditions found in our exploratory borings, results of field and laboratory tests, engineering analysis of field and laboratory data, and our experience. It includes our opinions and recommendations for design criteria and construction details for site development, foundations, floor systems, slabs-on-grade, pavements, and drainage precautions. The report was prepared for the exclusive use of Brightland Homes and your team in design and construction of the proposed development. Other types of construction may require revision of this report and the recommended design criteria. A summary of our conclusions and recommendations follows, with more detailed discussion and design criteria provided within the report.

SUMMARY

1. Strata encountered in our exploratory borings consisted of nil to 29 feet of sandy clay or clean to clayey, silty sand underlain by weathered and comparatively unweathered claystone, sandstone, and interbedded claystone/sandstone bedrock to the maximum depth explored of 35 feet. The clay and claystone are expansive and the sand and sandstone are judged to be non-expansive.

2. Groundwater was encountered in six borings during drilling at depths of 22 to 27 feet. When borings were checked after drilling on March 21, 2025, water was measured in twenty borings at depths of 11 to 30 feet below existing grade. The other holes were either dry or had been destroyed by construction traffic before delayed measurements could be obtained. Groundwater

will likely fluctuate seasonally and rise in response to development, precipitation, landscape irrigation, and changes in land use.

3. Our investigation revealed expansive materials present at depths likely to influence proposed construction. The presence of expansive soils and bedrock constitutes a geologic hazard. There is risk slabs-on-grade, pavements and foundations may experience heave or settlement and be damaged. We believe the recommendations presented in this report will help to control risk of damage; they will not eliminate that risk. Slabs-on-grade and, in some instances, foundations may be damaged by soil movements. Sub-excavation is a ground improvement technique that can reduce potential movements, as discussed in this report.

4. We estimate up to about 9 inches of potential ground heave with post-construction wetting. Sub-excavation is recommended to reduce potential heave by providing a uniform layer of low swelling fill below improvements. To reduce potential movements and provide more uniform support conditions for footings and post-tensioned slab (PTS) foundations, we recommend performing sub-excavation to a depth 5 feet below lowest foundation element. We estimate potential movements will be reduced to about 2 inches or less. Design criteria for footings with minimum deadload and PTS foundations are presented in the report. Drilled piers bottomed in bedrock and structurally-supported floors can be considered in lieu of sub-excavation; we can provide design criteria for drilled piers at your request.

5. Slab-on-grade floors are suitable after sub-excavation provided potential movements of up to about 2 inches is acceptable. Slabs should be isolated from foundations, framing and finishes to avoid transmitting movements. For PTS, the foundations are structurally integral with the floor and should perform better than a conventional slab-on-grade floor. Structurally supported floors should be used if movements and heave-related damage are not tolerable. If structural floors are used above crawl spaces, we recommend foundation drains around the crawl space perimeters.

6. The expansive clayey surficial soils present risk of damaging heave to pavements and exterior flatwork. We recommend at least 3 feet of sub-excavation below pavements and exterior flatwork to reduce potential movements and enhance performance.

7. Control of surface and subsurface drainage will be critical to the performance of foundations, slabs-on-grade, pavements and other improvements. Overall surface drainage should be designed, constructed, and maintained to provide rapid removal of runoff away from the buildings and off pavements and flatwork. Water should not be allowed to pond adjacent to the buildings or in pavement or flatwork areas. Conservative irrigation practices should be employed to reduce the risk of subsurface wetting.

8. The design and construction criteria for foundations and floor system alternatives in this report were compiled with the expectation that all other recommendations presented related to surface drainage, landscaping irrigation,

etc. will be incorporated into the project and that the owner will maintain the structure, use prudent irrigation practices and maintain surface drainage. It is critical that all recommendations in this report are followed.

SITE CONDITIONS

The proposed development is planned west of Interstate 25 and Crystal Valley Parkway in Castle Rock, Colorado (Fig. 1 and Photo 1). The parcel is currently vacant, and the ground surface is barren due to recent site grading. Based on review of historical aerial images, the site has remained vacant dating back to at least 1937 and has remained unchanged until site grading began adjacent to the site sometime in 1993. The site is bordered by vacant land planned for development to the south, Quandry Peak Drive to the west, Dawson Ridge Boulevard to the east and Gamble Ridge Drive to the north. The topography generally slopes to the southeast with a total vertical relief of about 20 feet.

Photo 1: Aerial Image, Google Earth©, September 2023.

PROPOSED DEVELOPMENT

Conceptual plans prepared by Norris Design dated October 2024 indicate the site is being considered for residential development of 28 townhomes planned on an 8.39-acre parcel. The buildings will be served by paved private access drives, buried utilities, and associated infrastructure. We anticipate the buildings will be two to three-story, wood-framed structures with attached garages and no below grade areas. Comparatively low to moderate foundation loads are expected. We assume minor grading of 5 feet or less will be required to achieve final grades. <u>We should review finished floor elevations once available to verify our assumptions and recommendations.</u>

SITE GEOLOGY

A geologic map[1] indicates that the site soils consist of the Late and Middle Pleistocene, Louviers and Slocum Alluviums (Qs) consisting of alluvial sand, silt, clay and gravel. The soils are believed to be underlain by sedimentary claystone and sandstone bedrock of the Denver Formation (Paleocene and Upper Cretaceous) (TKd). The soils found in our borings are consistent with the mapping. The primary geologic hazards are judged to be expansive soils and bedrock.

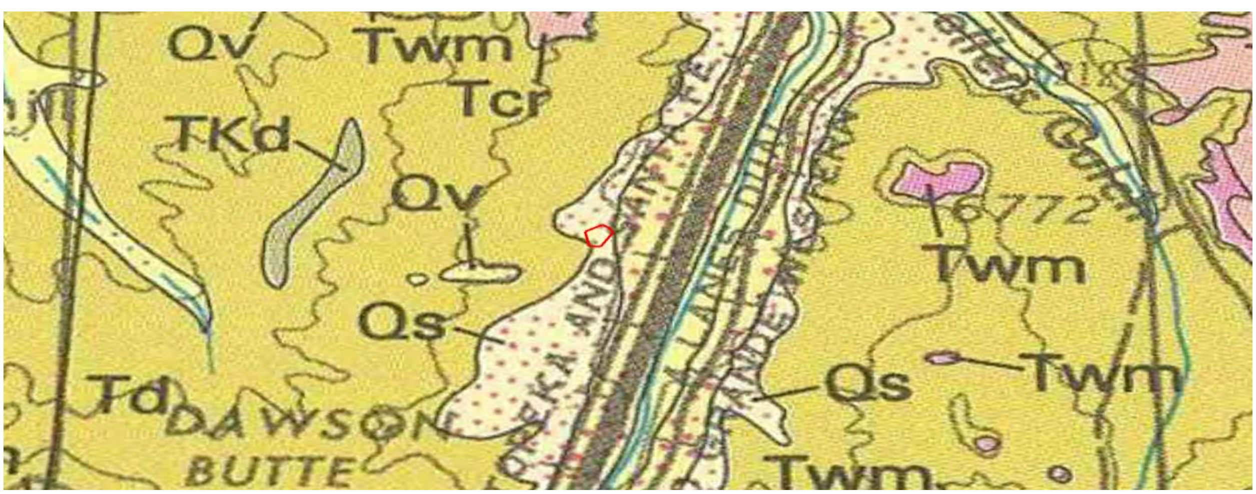

Photo 2: Referenced Geological Map, Site Region Outlined in Red

[1]Geologic map of the Denver 1 degree x 2 degrees quadrangle, north-central Colorado; Bryant, Bruce, McGrew, L.W., and Wobus, R.A..; Miscellaneous Investigations Series Map I-1163; 1981

INVESTIGATION

Subsurface conditions were investigated between February 11 and March 18, 2025, by drilling and sampling 50 exploratory borings in the building footprints and 6 exploratory borings in the pavement areas, at the approximate locations shown on Fig. 1. Prior to drilling, we contacted the Utility Notification Center of Colorado and local sewer and water districts to clear boring locations for conflicts with buried utilities. Boring locations were staked and surveyed by others.

The borings were drilled to depths of 5 to 35 feet using 4-inch diameter, continuous-flight auger powered by a truck-mounted CME-45 and CME-55 drill rigs. We obtained samples at approximate 1 to 5 feet intervals using 2.5-inch diameter (O.D.) a modified California barrel samplers driven by blows of a 140-pound hammer falling 30 inches. Bulk samples were collected in the upper 5 feet of the pavement borings. Our field representatives observed drilling, logged the strata encountered in the borings, and obtained samples. We returned to the site several days after drilling to measure the depth to groundwater in each boring. Graphical logs of the borings, including results of field penetration resistance tests and some laboratory test data, are presented in Appendix A.

Samples obtained during drilling were returned to our laboratory where they were examined and assigned testing. Laboratory testing included moisture content and dry density, swell/consolidation, total suction, Atterberg limits, percent silt and clay-sized particles (passing No. 200 sieve), standard Proctor, CBR, hydrometer, and water-soluble sulfate concentrations. Swell tests were performed by wetting samples under approximate overburden pressures (i.e., the pressure exerted by the overlying soil and bedrock). Load-back analysis was performed on select samples to help estimate swell pressures. Results of the laboratory tests are summarized in Appendix B and summarized on Table B-I.

SUBSURFACE CONDITIONS

Strata encountered in our exploratory borings consisted of nil to 29 feet of sandy clay or clean to clayey, silty sand underlain by weathered and comparatively unweathered claystone, sandstone, and interbedded claystone/sandstone bedrock to the maximum depth explored of 35 feet. Pertinent engineering characteristics of the soil and bedrock are presented in the following paragraphs.

Clay and Sand

Sandy clay and clean to clayey, silty sand was encountered at the ground surface to depths of up to about 29 feet in 41 borings. The clay was medium stiff to very stiff and the sand was loose to dense based on results of field penetration results. Thirteen clay samples compressed 0.1 to 2.7 percent and forty-one swelled 0.1 to 10.4 percent when wetted. Five sand samples compressed 0.2 to 2.5 percent and one swelled 1.0 percent when wetted. Fifteen clay samples had total suction values of 2.78 to 4.11 pF and nine samples had load-back swell pressures of 1,000 to 4,400 psf. One sand sample had a total suction value of 3.41 pF. Eleven clay samples contained 55 to 82 percent silt- and clay-sized particles (passing No. 200 sieve) and nine exhibited moderate to high plasticity. Ten sand samples contained 7 to 48 percent fines and five exhibited moderate to high plasticity. The clay is expansive and the sand is judged to be non-expansive.

Bedrock

Weathered and comparatively unweathered claystone, sandstone and interbedded claystone/sandstone bedrock were encountered at the ground surface or below the clay and sand in 49 of the building borings and 3 of the pavement borings. Bedrock was comparatively shallow in most of the borings. The comparatively unweathered bedrock was medium hard to very hard. Nine claystone samples compressed 0.1 to 1.5 percent and twenty-five swelled 0.1 to 4.4 percent when wetted. One interbedded claystone/sandstone sample compressed 0.8 percent, three did not swell, and three swelled 0.2 to 0.7 percent when wetted. One sandstone sample compressed 0.7 percent when wetted. Bedrock samples exhibiting compression were likely disturbed during sampling or laboratory test setup. Eighteen claystone samples had total suction values of 2.84 to 4.12 pF and twelve samples developed load-back swell pressures of 900 to 12,400 psf. Six claystone samples contained 51 to 99 percent fines and exhibited moderate to high plasticity. Ten interbedded claystone/sandstone samples contained 18 to 53 percent fines and four samples exhibited moderate to high plasticity. Twenty-two sandstone samples contained 11 to 37 percent fines and one exhibited moderate plasticity. The claystone is expansive and the sandstone is judged to be non-expansive.

Groundwater

Groundwater was encountered in six borings during drilling at depths of 22 to 27 feet. When borings were checked after drilling on March 21, 2025, water was measured in twenty borings at depths of 11 to 30 feet below existing grade. The other holes were either dry or had been destroyed by construction traffic before delayed measurements could be obtained. Groundwater will likely fluctuate seasonally and rise in response to development, precipitation, landscape irrigation, and changes in land use.

Seismicity

According to the USGS, Colorado's Front Range and eastern plains are considered low seismic hazard zones. The earthquake hazard exhibits higher risk in western Colorado compared to other parts of the state. The Denver Metropolitan area has experienced earthquakes within the past 100 years, shown to be related to deep drilling, liquid injection, and oil/gas extraction. Naturally occurring earthquakes along faults due to tectonic shifts are rare in this area.

The soil and bedrock at this site are not expected to respond unusually to seismic activity. The 2021 International Building Code (Section 1613.2.2) defers the estimation of Seismic Site Classification to ASCE 7-16, as outlined in the table below.

ASCE 7-16 SITE CLASSIFICATION CRITERIA

Seismic Site Class	$\bar{s}_u$, Average Undrained Shear Strength (lb/ft^2)	$\bar{N}$, Average Standard Penetration Resistance (blows/ft)	$\bar{v}_s$, Average Shear Wave Velocity (ft/s)
A. Hard Rock	N/A	N/A	>5,000
B. Rock	N/A	N/A	2,500 to 5,000
C. Very Dense Soil and Soft Rock	>2,000	>50 blows/ft	1,200 to 2,500
D. Stiff Soil	1,000 to 2,000	15 to 50 blows/ft	600 to 1,200
E. Very Loose Sand or Soft Clay Soil	<1,000	<15 blows/ft	<600
F. Soils requiring Site Response Analysis	See Section 20.3.1	See Section 20.3.1	See Section 20.3.1

Based on the results of our investigation, we judge [a Seismic Site Classification of C. The subsurface conditions indicate low susceptibility to liquefaction from a materials and groundwater perspective.

GEOLOGIC HAZARDS

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry, and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations tend to react to changes in moisture content. Some of the soils and bedrock swell as they increase in moisture and are collectively referred to as expansive soils. Other soils can compress significantly upon wetting and are identified as compressible soils. Much of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit compressible behavior are more likely west of the Continental Divide; however, both types of soils occur throughout the state.

Covering the ground with buildings, streets, driveways, parking lots, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement is inevitable. It is critical that all recommendations in this report are followed to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. Owners and/or property managers must assume responsibility for maintaining structures and use appropriate practices regarding drainage and landscaping.

Based on our investigation, expansive and compressible soils and expansive bedrock are present at this site at depths likely to influence performance of shallow foundations, floor slabs, pavement, and other surface improvements. The presence of expansive and compressible soils and expansive bedrock constitutes a geologic hazard. There is risk that ground heave or settlement will damage slabs-on-grade and foundations. The risks can be mitigated, but not eliminated, by proper design, construction, and maintenance procedures. We believe the recommendations in this report will help reduce risk of foundation and/or slab damage; they will not eliminate risk. The owner(s) should understand that improvements may be affected by movement of the subsoils. Slab-on-grade and, in some instances, foundations may be affected. Maintenance and prudent irrigation practices will be required to reduce risk.

Estimated Potential Heave

Based on the subsurface profiles, swell-consolidation test results and our experience, we calculated the potential heave at the existing ground surface for each building boring, as shown in the table below. The analysis involves dividing the soil and bedrock profile into layers and modeling the heave of each layer from representative swell tests. We estimated potential ground heave of less than ½-inch to about 9 inches at the building boring locations. A depth of wetting of 24 feet below existing grades was considered for the analysis. It is not certain whether the estimated heave will occur, and variations from our estimates should be anticipated.

ESTIMATED TOTAL POTENTIAL GROUND HEAVE
BASED ON 24 FOOT DEPTH OF WETTING

Boring	Estimated Potential Heave at Existing Ground Surface (inches)	Boring	Estimated Potential Heave at Existing Ground Surface (inches)
TH-1	<½	TH-26	<½
TH-2	½	TH-27	½
TH-3	3	TH-28	<½
TH-4	1	TH-29	<½
TH-5	6	TH-30	<½
TH-6	6	TH-31	<½
TH-7	2	TH-32	<½
TH-8	2	TH-33	½
TH-9	2	TH-34	3½
TH-10	½	TH-35	3½
TH-11	1	TH-36	3
TH-12	1	TH-37	2
TH-13	9	TH-38	7
TH-14	2	TH-39	5
TH-15	<½	TH-40	1
TH-16	2	TH-41	½
TH-17	1	TH-42	4
TH-18	1½	TH-43	2
TH-19	3½	TH-44	1½
TH-20	1½	TH-45	7½
TH-21	3½	TH-46	3
TH-22	<½	TH-47	1
TH-23	½	TH-48	<½
TH-24	1	TH-49	<½
TH-25	<½	TH-50	<½

SITE DEVELOPMENT

The primary geotechnical concerns that we believe will influence development is the presence of expansive clay and claystone. This concern can be mitigated, but not eliminated, with proper planning, engineering, design and construction. We believe there are no geologic or geotechnical constraints that would preclude development. The following sections provide site development recommendations.

Excavation

We believe the soils penetrated by our exploratory borings can be excavated with typical heavy-duty equipment. Hard to very hard bedrock was encountered in our borings. Deep excavation for utility installation, if any, may require use of more robust excavation techniques, such as heavy ripping with bulldozer equipment.

We recommend the owner and the contractor become familiar with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Based on our investigation and OSHA standards, we anticipate the clay and claystone will classify as Type B and the sand and sandstone as Type C soils based on OSHA Standards governing excavations published in 29 CFR, Part 1926. Type B soil requires 1H:1V (horizontal:vertical) and Type C requires 1.5H:1V for temporary excavations in dry conditions. Permanent un-retained slopes should be designed no steeper than about 3:1 (horizontal to vertical) and should be re-vegetated as soon as practical to control erosion; use of 4:1 maximum slopes is preferable to control erosion. Excavation slopes specified by OSHA are dependent upon soil types and groundwater conditions encountered. The contractor’s “competent person” is required to identify the soils encountered in the excavations and refer to OSHA standards to determine appropriate slopes. Stockpiles of soils and equipment should not be placed within a horizontal distance equal to one-half the excavation depth, from the edge of the excavation. A professional engineer should design excavations deeper than 20 feet, if any.

Site Grading

Prior to fill placement, the ground surface in areas to be filled should be stripped of debris, vegetation/organics and other deleterious materials, scarified and moisture conditioned to between 1 and 4 percent above optimum for clay or within 2 percent of optimum for sand, and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). If imported fill is necessary, it should ideally consist of soil containing between 20 and 60 percent fines (passing the No. 200 sieve), a liquid limit less than 40 and a plasticity index of less than 20. Import material with similar characteristics as the on-site soils may also be considered. Potential fill materials should be submitted to our office for approval prior to importing to the site.

The properties of fill will affect the performance of foundations, slabs-on-grade, utilities, pavements, flatwork and other improvements. The on-site soils are suitable for use as new fill provided they are substantially free of debris, vegetation/organics and other deleterious materials. Fill should be placed in thin loose lifts, moisture conditioned and compacted prior to placement of the next lift in accordance with criteria presented in the previous paragraph. The placement and compaction of new fill should be observed and tested by our representative during construction.

Our experience indicates fill can settle under its own weight. We estimate potential settlement of about 1 to 2 percent of the fill thickness even if the fill is compacted to the specified criteria. Most of this settlement usually occurs during and soon after construction; for clayey fill, it may continue for a longer period of time. Additional heave and settlement may occur after development as landscape irrigation increases the moisture of the soils. If fill will be placed on slopes of 20 percent or steeper, such as improvements near the existing drainage, they should be benched prior to placing fill. <u>We recommend additional review of these conditions as grading and sub-excavation plans are formalized.</u>

Sub-Excavation

Comparatively high swelling clay materials predominate the upper soils. Potential ground heave could be as much as 9 inches with typical post-construction wetting, as shown in the table in **Estimated Potential Heave**. Without mitigation, drilled pier foundations and structurally supported floors would be merited. If shallow foundations are desired for the buildings, we recommend sub-excavation to a depth 5 feet below lowest foundation element to reduce potential heave to acceptable levels and provide more uniform support conditions.

The existing soils are suitable for re-use as new fill from a geotechnical standpoint, provided they are free of debris, organics/vegetation, and other deleterious materials, and are thoroughly moisture conditioned and compacted. Sub-excavation should extend at least 5 feet outside the lateral extent of foundations. A conceptual sub-excavation profile is shown on Fig. 4. We estimate potential movements of about 2 inches or less after sub-excavation provided excessive wetting does not occur after construction. Differential movements should also be substantially reduced, as the fill is expected to act as a buffer or cushion, and distribute heave more evenly, should it occur from the claystone underlying the fill.

In order for the sub-excavation procedure to be performed properly, close control of fill placement to specifications is required. Sub-excavation fill should be placed in loose lifts no thicker than 8 inches, moisture conditioned and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). Clay fill should be moisture conditioned to between 1 and 4 percent above optimum moisture content and sand fill should be moistened to within 2 percent of optimum and compacted to at least 95 percent of standard proctor maximum dry density. Our field representative should observe and test compaction of fill during placement.

Sub-excavation has been used in the Denver Metropolitan area with satisfactory performance for the large majority of the sites where this ground modification method has been completed. A civil plan should be prepared to delineate extent and elevation of sub-excavation. A plan should be developed by the contractor detailing the “as-built” survey of the sub-excavation during construction. We have seen isolated instances where settlement of sub-excavation fill has led to damage to buildings supported on shallow foundations. In most cases, the settlement was caused by wetting associated with poor surface drainage and/or poorly compacted fill placed at the horizontal limits of the sub-excavation. Special precautions should be taken for compaction of fill at corners, access ramps and edges of the sub-excavation due to equipment access constraints. The contractor should have the appropriate equipment to reach and compact these areas.

The excavation contractor should be chosen based on experience with sub-excavation and processing high moisture content clay fills and have the necessary mixing and compaction equipment. The contractor should provide a construction disc to break down fill materials. The operation will be relatively slow. Soil and bedrock clods should be broken down to about 3 inches or less. The excavation slopes should meet OSHA, state, and local safety standards.

We recommend at least 3 feet of sub-excavation, moisture-conditioning and re-compaction below pavements to reduce potential heave and improve performance. The sub-excavation can be extended beneath the adjacent sidewalks and improvements, if desired. Deeper sub-excavation to 5 feet below pavements can be considered for marginally better performance.

Utility Construction

Water and sewer lines are usually constructed beneath paved roads. Compaction of trench backfill can have a significant effect on the life and serviceability of pavements. Utility trench backfill should be compacted to Douglas County specifications. Trench backfill should be placed in thin (8 inches or less) loose lifts. The placement and compaction of utility trench backfill should be observed and tested by a representative of our firm during construction.

Utility trench backfill compaction by a sheepsfoot wheel attachment on a backhoe or trackhoe has been found to be generally less successful than using self-propelled roller compactors. Special attention should be paid to backfill placed adjacent to manholes as we have seen instances where settlement in excess of 2 percent has occurred. Any improvements placed over backfill should be designed to accommodate movement.

FOUNDATIONS

Our investigation indicates expansive clay and claystone are present at depths likely to influence the performance of shallow foundations. Based on 24 feet depth of wetting, we estimate total potential ground heave may range from less than ½-inch to about 9 inches. The expansive clayey materials should be mitigated as discussed in **Sub-Excavation**. We believe footings or PTS foundations can be used provided sub-excavation is performed as recommended. Drilled piers bottomed in bedrock (and structurally supported floors) can be considered in lieu of sub-excavation. Design and construction criteria for footings and PTS are presented below. We can provide design criteria for drilled piers at your request.

Footings with Minimum Deadload

1. The footings should be constructed on new, moisture-conditioned and compacted fill. If soft/loose soils are exposed in footing excavations or are the result of the excavation/forming process, these soils should be removed and recompacted as recommended in **SITE DEVELOPMENT**.

2. Footings should be designed for a maximum allowable soil pressure of 2,500 psf and a minimum deadload pressure of 800 psf, where practical.

3. Lateral earth pressures can be calculated based on equivalent fluid density using at least 50 pcf for the active case. Walls which can deflect less than 1 percent of height can be designed using 60 pcf. For the at-rest case, where essentially no lateral movement is allowed, we recommend using at least 70 pcf. Footing translation can be resisted using an equivalent fluid density of 275 pcf for the passive case, providing backfill is similar to the site soils, is well compacted and remains in-place. The coefficient of friction for sliding may be taken as 0.3. These values have not been factored. The structural engineer should apply appropriate factors of safety in design.

4. Footings should have a minimum width of 16 inches. Foundations for isolated columns should have minimum dimensions of 18 inches by 18 inches. Larger sizes may be required depending upon the loads and structural system used, and design performed by the structural engineer.

5. If interrupted footings are necessary to maintain deadload, a 4-inch (minimum) continuous void should be constructed below grade beams or foundation walls, between the pads. Void should also be used if interior drains are planned in crawl space areas (if any). We should be contacted if this condition exists to provide drain figures.

6. Foundation walls and grade beams should be well-reinforced. We recommend reinforcement sufficient to span an unsupported distance of at least 10 feet or the distance between pads, whichever is greater. Reinforcement should be designed by the structural engineer considering lateral earth pressure on wall performance.

7. Exterior footings must be protected from frost action. Normally, 3 feet of frost cover is assumed in the area.

8. The completed foundation excavation should be observed by a representative of our firm to confirm subsurface conditions are as anticipated from our borings. Our representative should observe and test moisture and compaction of the fill.

9. Excessive wetting of foundation soils during and after construction can cause heave and/or softening and settlement of foundation soils and result in footing movements. Proper surface drainage around the buildings and pavements is critical to control wetting. The utility service trenches should be

braced or adequately sloped away from the footings to reduce the risk of undermining the footings. Any voids should be backfilled with compacted on-site soils, squeegee, or “flowable fill” to reduce settlements.

Post-Tensioned Slab-On-Grade (PTS)

PTS foundation design is based on a method developed by the Post-Tensioning Institute (PTI) and is outlined in PTI’s third edition of Standard Requirements for Design and Analysis of Shallowed Post-Tensioned Concrete Foundations on Expansive and Stable Soils (December 2024). Various climate and relevant soil factors are required to evaluate the PTI design criteria. These include the Thornthwaite Moisture Index (I_m), suction compression index (γ_h), unsaturated diffusion coefficient (α), depth of probable moisture variation, initial and final soil suction profiles, and percent clay fraction and predominant clay mineral. In the Denver Metro area, I_m is about -25.

The PTI foundation design method is based on the potential differential movement of the slabs due to both settlement and heave of the subsoils that is primarily controlled by climate. In the 2024 design manual, PTI estimates movements for a depth of wetting of 9 feet below the ground surface. Based on our experience and field and laboratory test results, the depth of wetting can vary from about 15 to 20 feet or more below the ground surface. It is possible wetting will not penetrate this deep; however, we believe it is a reasonable design assumption. PTI design method does not predict soil movement caused by site conditions such as irrigation or poor surface drainage that may lead to deeper wetting. If deeper wetting occurs, the foundation movement may exceed the design movements estimated in the PTI design method.

In the PTI design method, two mechanisms of soil movement (edge lift and center lift) are evaluated based on assumptions that wetting and drying of the foundation soils are primarily affected by the climate. Our experience indicates the foundation soils will normally undergo an increase in moisture due to covering the ground surface with buildings and flatwork, coupled with the introduction of landscape irrigation. Considering the limitations of the current PTI design method, we believe a conservative approach with reasonable engineering judgment is merited in PTS foundation design.

Design criteria for post-tensioned slab-on-grade foundations are presented below. Criteria were developed from analysis of field and laboratory data, PTI's third edition of Standard Requirements for Design and Analysis of Shallow *Post-Tensioned Concrete Foundations on Expansive and Stable Soils* (First Printing, December 2024), and our experience. The builder and structural engineer should also consider design and construction details established by the structural warrantor (if any) that may impose additional design and installation requirements.

1. PTS foundations should be constructed on new, moisture-conditioned and compacted fill. If soft/loose soils are exposed in footing excavations or are the result of the excavation/forming process, these soils should be removed and recompacted as recommended in **SITE DEVELOPMENT**.

2. PTS foundations should be designed for a maximum allowable soil pressure of 2,500 psf.

3. We recommend a differential soil movement (y_m) of 2 inches for edge lift and 1.5 inches for center lift conditions. An edge moisture variation distance (e_m) of 4 feet should be used in design for edge lift conditions and 8 feet for center lift conditions.

4. We understand the PTI design method assumes the slab is somewhat flexible. The above-grade construction, such as framing, drywall, brick, and stucco are not as flexible. We are aware of situations where minor differential slab movement has caused distress to finish materials. One way to enhance performance would be to place reinforcing steel in the bottoms of stiffening beams. The structural engineer should evaluate the merits of this approach, as well as other potential alternatives to reduce damage to finish materials.

5. Stiffening beams may be poured "neat" into excavated trenches. Soil may cave or slough during trench excavation for the stiffening beams. Disturbed soil should be removed from trench bottoms prior to placement of concrete. Formwork or other methods may be required for proper stiffening beam installation.

6. Exterior stiffening beams should be protected from frost action. We recommend three feet of frost cover be used and is common practice in this area. If exterior patios are incorporated into PTS, we believe the stiffening beams around the patios should be as deep as those around the building exterior to increase the likelihood the patios will perform similarly to the rest of the PTS.

7. For slab tensioning design, a coefficient of friction value of 0.75 or 1.0 can be assumed for slabs on polyethylene sheeting or a sand layer, respectively. A coefficient of friction of 2.0 should be used for slabs on clay or clay fill. We

believe use of polyethylene is preferable because it serves as a vapor retarder which helps to control moisture migration up through the slabs.

8. A representative of our firm should observe the completed excavations. A representative of the structural engineer or our firm should observe the placement of the reinforcing tendons and any mild reinforcement prior to placing the slabs and beams.

FLOOR SYSTEMS

Slabs-On-Grade

We estimate potential movement of about 2 inches or less for slab-on-grade floors after sub-excavation to 5 feet below lowest foundation element. If floor movements cannot be tolerated, a structurally supported floor system should be used.

Conventional slab-on-grade floors are suitable provided risk of heave and distress is acceptable to the owner. There may be distress to sensitive finishes. It is imperative that foundations, finishes and other items are isolated from slab floors to prevent transferring slab movements to the structure. For PTS, the foundations are structurally integral with the floor and should perform better than a conventional slab-on-grade floor.

Where conventional slabs-on-grade are used and the owner(s) accepts risk, we recommend the following design and construction criteria. These recommendations will not prevent movement. Rather, they tend to reduce damage if movement occurs.

1. Slabs that are not part of a PTS foundation system should be separated from foundations, exterior walls and interior bearing members with a slip joint that allows free vertical movement of the slabs. This detail can reduce cracking if movement of the slab occurs.

2. Slabs should be placed directly on exposed subsoils or properly moisture conditioned, compacted fill. The 2021 International Building Code (IBC) requires a vapor retarder be placed between the base course or subgrade soils and the concrete slab-on-grade floor. The merits of installation of a vapor retarder below floor slabs depend on the sensitivity of floor coverings and building use to moisture. A properly installed vapor retarder (6 mil minimum, 10 mil for increased durability) is more beneficial below concrete slab-on-grade floors where floor coverings, painted floor surfaces or products stored on the floor will be sensitive to moisture. The vapor retarder is most

effective when concrete is placed directly on top of it, rather than placing a sand or gravel leveling course between the vapor retarder and the floor slab. The placement of concrete on the vapor retarder may increase the risk of shrinkage cracking and curling. Use of concrete with reduced shrinkage characteristics including minimized water content, maximized coarse aggregate content, and reasonably low slump will reduce the risk of shrinkage cracking and curling. Considerations and recommendations for the installation of vapor retarders below concrete slabs are outlined in Section 5.2.3.2 of the 2015 report of American Concrete Institute (ACI) Committee 302, "Guide for Concrete Floor and Slab Construction (ACI 302.1R-15)".

3. Use of slab-supported partition walls should be minimized. If slab-bearing partitions are used, they should be designed and constructed with a minimum 2 inches space to allow for slab movement. Differential slab movements may cause cracking of partition walls. If the void is provided at the top of partitions, the connection between slab-supported partitions and foundation-supported walls should be detailed to allow differential movement. Doorways, wall partitions perpendicular to the exterior wall or walls supported by foundations should be detailed to allow for vertical movement. Interior perimeter framing and finishing should not extend onto slabs-on-grade, or if necessary, should be detailed to allow for movement.

4. Underslab plumbing (if any) should be pressure tested for leaks prior to slab construction and be provided with flexible couplings. Pressurized water supply lines should be brought above the floors as quickly as possible.

5. Plumbing and utilities that pass through the slabs should be isolated from the slabs and constructed with flexible couplings. Utilities, as well as electrical and mechanical equipment should be constructed with sufficient flexibility to allow for movement.

6. Mechanical systems supported by the slabs should be provided with flexible connections capable of at least 2 inches of movement.

7. Exterior flatwork and sidewalks should be separated from the structures, or made part of the PTS foundation. These slabs should be detailed to function as independent units. Movement of these slabs should not be transmitted to the foundations of the structures.

8. The American Concrete Institute (ACI) recommends frequent control joints be provided in slabs to reduce problems associated with shrinkage cracking and curling. To reduce curling, the concrete mix should have a high aggregate content and a low slump. If desired, a shrinkage compensating admixture could be added to the concrete to reduce the risk of shrinkage cracking. We can perform a mix design or assist the design team in selecting a pre-existing mix.

Structurally Supported Floors

To our knowledge, there are no soil treatments combined with slab-on-grade floors that will result in the same reduction in risk of floor movement (relative to the risk inherent for a floor slab placed directly on the natural soils), as would be provided by a structurally supported floor.

A structural floor is supported by the foundation system. Design and construction issues associated with structural floors include ventilation and lateral loads. Where structurally supported floors are installed over a crawl space, the required air space depends on the materials used to construct the floor and the potential expansion of the underlying soils. Building codes require a clear space of 18 inches between exposed earth and untreated wood floor components. For non-organic floor systems, we recommend a minimum clear space of 12 inches. This minimum clear space should be maintained between any point on the underside of the floor system (including beams and floor drain traps) and the soils.

A slab-on-void system may also be considered. Void form should be chosen to break down quickly after the slab is placed. A sand or gravel leveling base below the void form should not be used. We recommend against the use of wax or plastic-coated boxes unless provisions are made to allow water vapor to penetrate the boxes, resulting in softening. The voids should not transfer heave to the floor system.

Where structurally supported floors are used, utility connections including water, gas, air duct, and exhaust stack connections to floor supported appliances should be capable of absorbing some deflection of the floor. Plumbing that passes through the floor should ideally be hung from the underside of the structural floor and not lain on the bottom of the excavation. It is prudent to maintain the minimum clear space below all plumbing lines. This configuration may not be achievable for some parts of the installation.

Control of humidity in crawl spaces is important for indoor air quality and performance of wood floor systems. We believe the best current practices to control humidity involve the use of a vapor retarder or vapor barrier (6 mil) placed on the soils below accessible subfloor areas. The vapor retarder/barrier should be sealed at joints and attached to concrete foundation elements.

Exterior Flatwork

We recommend exterior flatwork and sidewalks (which are not part of the PTS foundation) be isolated from foundations to reduce the risk of transferring heave, settlement or freeze-thaw movement to the structure. One alternative would be to construct the inner edges of the flatwork on haunches or steel angles bolted to the foundation walls and detailing the connections such that movement will cause less distress to the building, rather than tying the slabs directly into the building foundation. Construction on haunches or steel angles and reinforcing the sidewalks and other exterior flatwork will reduce the potential for differential settlement and better allow them to span across wall backfill. Frequent control joints should be provided to reduce problems associated with shrinkage. Panels that are approximately square perform better than rectangular areas.

PAVEMENTS

Paved automobile parking, access drives and truck/fire lanes and private streets/drives are planned. Truck lanes will likely be subjected to heavy equipment traffic. We investigated subsurface conditions by obtaining shallow drive samples at depths of 1, 4 and 9 feet and bulk samples from the auger cuttings within the upper 5 feet in all pavement borings (S-1 through S-6).

The samples were tested to classify the pavement subgrade and evaluate index properties for the soils that will influence pavement design. Six drive samples swelled 0.7 to 5.5 percent when wetted under an applied pressure of 200 psf. Six samples contained 42 to 64 percent silt and clay-sized particles (passing No. 200 sieve) and exhibited moderate to high plasticity. The bulk samples classify as A-6 and A-7-6 soils based on criteria established by the American Association of State Highway and Transportation Officials (AASHTO).

A composite sample consisting of material from S-1, 4, and 5 was subjected to standard Proctor test (ASTM D 698) compaction test procedures, a remolded swell-consolidation test, and a California Bearing Ratio (CBR) test (ASTM D 1883) to determine a design support value for the subgrade soils. Based on the Proctor results, a maximum dry density of 106.3 pcf was determined at an optimum moisture content of 18.5 percent. A remolded composite sample swelled 1.9 percent when wetted under an applied pressure of 200 psf at 95% maximum dry density and optimum moisture content. The design CBR value was determined to be 3.9. These results are shown in Appendix B.

Our investigation indicates pavement subgrade will likely consist of moderate to high-plasticity sandy clay and clayey sand material, which is considered relatively poor subgrade. Pavements can experience heave due to expansive clay and claystone, or settlement due to compression of clay or utility trench backfill. For the private parking lots, access drives, and private streets/drives we advocate sub-excavation of 3 feet or more below pavements to reduce risk of distress caused by swelling subgrade. Five feet of sub-excavation would likely result in marginally better performance. The pavement subgrade should be proof-rolled to disclose soft areas. Soft areas should be stabilized.

Using the Doulgas County Roadway Design and Technical Criteria Manual, the minimum Equivalent Axle Load (ESAL) value for private street/drives, automobile parking, and fire lane/access drives are as follows: Automobile Parking (ESAL = 60,000), Private Street/Drive (ESAL = 75,000), Access Drives/Fire Lane (ESAL = 75,000). We have provided pavement alternatives for full depth Portland cement concrete, and composite sections consisting of asphalt over aggregate base course below.

SUMMARY OF RECOMMENDED MINIMUM PAVEMENT ALTERNATIVES

Traffic Type	Hot-Mix Asphalt + Aggregate Base Course (HMA +ABC)	Portland Cement Concrete (PCC)
Automobile Parking, Private Street/Drive, Access Drives and Fire/Truck Lanes	4” HMA + 6” ABC	6” PCC

The effects of expansive subgrade can be controlled by constructing a thicker total pavement “section” (pavement and moisture treated fill zone). The goal is to achieve more uniform movement and lower potential differential movement. To create a moisture conditioned soil zone will require sub-excavation to a depth of at least 3 feet below subgrade level and placing the material as moistened, properly compacted fill. Use of sub-excavation can produce a softer subgrade than the same soil in a drier state. Stabilizing agents may be considered to increase strength.

The design of a pavement system is as much a function of paving materials as support characteristics of the subgrade. If the pavement system is constructed of inferior material, then the life and serviceability of the pavement will be substantially reduced. Materials and placement methods should conform to the requirements of Castle Rock and Douglas County. All materials planned for construction should be tested to confirm their compliance with project specifications.

Control joints should separate concrete pavements into panels with patterns and spacing as recommended by ACI. No de-icing salts should be used on paving concrete for at least one year after placement. Routine maintenance, such as sealing and repair of cracks and overlays at 5 to 7-year intervals, are necessary to achieve long-term performance of an asphalt system. We recommend application of a rejuvenating sealant such as fog seal after the first year. Deferring maintenance usually results in accelerated deterioration of pavements leading to higher future maintenance costs.

A primary cause of early pavement deterioration is water infiltration into the pavement system. The addition of moisture usually results in softening of the subgrade and eventual failure of the pavement. We recommend drainage be designed for rapid removal of surface runoff. Curb and gutter should be backfilled and the backfill compacted to reduce ponding adjacent to the pavements. Final grading of the subgrade should be carefully controlled so that design cross-slope is maintained and low spots in the subgrade which could trap water are eliminated. A seal should be provided between curb and pavement and at all joints to reduce moisture infiltration. Landscaped areas and detention ponds in pavements should be avoided.

Recommended material properties and construction criteria for pavements are provided in Appendix C. These criteria were developed from analysis of the field and laboratory data and our experience. If the materials cannot meet these recommendations, then the pavement design should be re-evaluated based upon available materials. All material and construction requirements of Castle Rock and Douglas County should be followed. All materials planned for construction should be submitted and the applicable laboratory tests performed to verify compliance with the specifications.

CONCRETE

Concrete in contact with soil can be subject to sulfate attack. We measured water-soluble sulfate concentrations in five samples at less than 0.01 to 0.10 percent. As indicated in our tests and ACI 332-20, the sulfate exposure class is *Not Applicable* or *RS0.*

SULFATE EXPOSURE CLASSES PER ACI 332-20

Exposure Classes		Water-Soluble Sulfate (SO_4) in Soil [A] (%)
Not Applicable	RS0	< 0.10
Moderate	RS1	0.10 to 0.20
Severe	RS2	0.20 to 2.00
Very Severe	RS3	> 2.00

A) Percent sulfate by mass in soil determined by ASTM C1580

For this level of sulfate concentration, ACI 332-20 *Code Requirements for Residential Concrete* indicates there are no cement type requirements for sulfate resistance as indicated in the table below.

CONCRETE DESIGN REQUIREMENTS FOR SULFATE EXPOSURE PER ACI 332-20

Exposure Class	Maximum Water/Cement Ratio	Minimum Compressive Strength[A] (psi)	Cementitious Material Types[B]			Calcium Chloride Admixtures
			ASTM C150/C150M	ASTM C595/C595M	ASTM C1157/C1157M	
RS0	N/A	2500	No Type Restrictions	No Type Restrictions	No Type Restrictions	No Restrictions
RS1	0.50	2500	II	Type with (MS) Designation	MS	No Restrictions
RS2	0.45	3000	V[C]	Type with (HS) Designation	HS	Not Permitted
RS3	0.45	3000	V + Pozzolan or Slag Cement[D]	Type with (HS) Designation plus Pozzolan or Slag Cement[E]	HS + Pozzolan or Slag Cement[E]	Not Permitted

A) Concrete compressive strength specified shall be based on 28-day tests per ASTM C39/C39M
B) Alternate combinations of cementitious materials of those listed in ACI 332-20 Table 5.4.2 shall be permitted when tested for sulfate resistance meeting the criteria in section 5.5.
C) Other available types of cement such as Type III or Type I are permitted in Exposure Classes RS1 or RS2 if the C3A contents are less than 8 or 5 percent, respectively.
D) The amount of the specific source of pozzolan or slag to be used shall not be less than the amount that has been determined by service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slab to be used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the criteria in section 5.5.1 of ACI 332-20.
E) Water-soluble chloride ion content that is contributed from the ingredients including water aggregates, cementitious materials, and admixtures shall be determined on the concrete mixture ASTM C1218/C1218M between 29 and 42 days.

Superficial damage may occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are relatively low. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious materials ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or high-water tables. Concrete should have a total air content of 6 percent ± 1.5 percent. We advocate damp-proofing of all foundation walls and grade beams in contact with the subsoils (including the inside and outside faces of garage and crawl space grade beams).

SUBSURFACE DRAINAGE

Water from surface irrigation landscaping frequently flows through relatively permeable backfill placed adjacent to buildings and collects on the surface of less permeable soils occurring at the bottom of foundation excavations. This process can cause wet or moist crawl space conditions after construction.

Foundation drains are typically not installed for buildings where no below-grade construction is planned. Installation of these drains can help control accumulation of moisture around footings and help to control excessive wetting. Drains do not eliminate wetting. Installation of drains would be a benefit in areas where the ground surface next to the buildings will not be paved. If a structural floor and crawl space floor system is selected, a drain system should be considered around the perimeter (Figs. 5 & 6).

SURFACE DRAINAGE

Performance of foundations and flatwork is influenced by the moisture conditions existing within the foundation or subgrade soils. Overall surface drainage should be designed, constructed, and maintained to provide rapid removal of surface water runoff away from the buildings and off pavements and flatwork. We recommend the following precautions be observed during construction and maintained at all times after construction is completed.

1. Wetting or drying of open foundations and utility excavations should be avoided.

2. Positive drainage should be provided away from the buildings. We recommend a minimum slope of at least 5 percent in the first 5 to 10 feet away from the foundations in landscaped areas. Paved surfaces should be positively sloped to drain away from the buildings at a minimum slope of 2 percent. More slope is desirable. Concrete curbs and sidewalks may “dam” surface runoff adjacent to the buildings and disrupt proper flow. Use of “chase” drains or weep holes at low points in the curb should be considered to promote proper drainage. Final grading should be controlled so that the designed cross slopes are maintained and low spots in the subgrade that could trap water are eliminated.

3. Backfill around foundations should be moistened and compacted according to criteria presented in this report. Areas behind curb and gutter should be backfilled and well compacted to reduce ponding of surface water. The joint between curb and pavement should be sealed to reduce infiltration.

4. Landscaping should be designed to minimize irrigation. Plants used close to foundation walls should be limited to those with low moisture requirements. Irrigation should be limited to the minimum amount sufficient to maintain vegetation. Application of more water will increase the likelihood of slab and foundation movements and associated damage. Landscaped areas should be adequately sloped to direct flow away from the buildings and improvements. Use of area drains can be considered for areas where adequate slope cannot be provided.

5. Impervious plastic membranes should not be used to cover the ground surface immediately surrounding foundations. These membranes tend to trap moisture and prevent normal evaporation from occurring. Geotextile fabrics can be used to control weed growth and allow evaporation.

6. Roof drains should be directed away from the buildings and discharge beyond backfill zones or into appropriate storm sewer or detention area. Downspout extensions and splash blocks should be provided at all discharge points. Roof drains can also be connected to buried, solid pipe outlets. Roof drains should not be directed below slab-on-grade floors. Roof drain outlets and their flow direction should be maintained.

CONSTRUCTION OBSERVATIONS

This report has been prepared for the exclusive use of Brightland Homes and your design team for the purpose of providing geotechnical design and construction criteria for the proposed project. The information, conclusions, and recommendations presented herein are based upon consideration of many factors including, but not limited to, the type of structure proposed, the geologic setting, and the subsurface conditions encountered. The conclusions and recommendations contained in the report are not valid for use by others.

Standards of practice evolve in geotechnical engineering. The recommendations provided are appropriate for about three years. If the project is not constructed within about three years, we should be contacted to determine if we should update this report.

We recommend that CTL|Thompson, Inc. provide construction observation services to allow us the opportunity to verify whether soil conditions are consistent with those found during this investigation. If others perform these observations, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation, primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience. Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free. Our recommendations represent our judgment of those measures that are necessary to increase the chances that the structures and improvements will perform satisfactorily. It is critical that all recommendations in this report are followed during construction. Owners or property managers must assume responsibility for maintaining the structures and use appropriate practices regarding drainage and landscaping. Improvements after construction should be completed in accordance with recommendations provided in this report and may require additional soil investigation and consultation.

LIMITATIONS

Our borings were spaced to obtain a reasonably accurate picture of subsurface conditions at this site. The borings are representative of conditions encountered only at the locations drilled. Subsurface variations not indicated by the borings are possible.

We believe this investigation was conducted in a manner consistent with the level of care and skill ordinarily used by geotechnical engineers practicing under similar conditions. No warranty, express or implied, is made. If we can be of further service in discussing the contents of this report, or in the analysis of the influence of the subsurface conditions on the design of the buildings or any other aspect of the proposed construction, please call.

CTL | THOMPSON, INC.

Sharone Richards

Sharone Richards
Staff Engineer

Reviewed by:

COLORADO LICENSED
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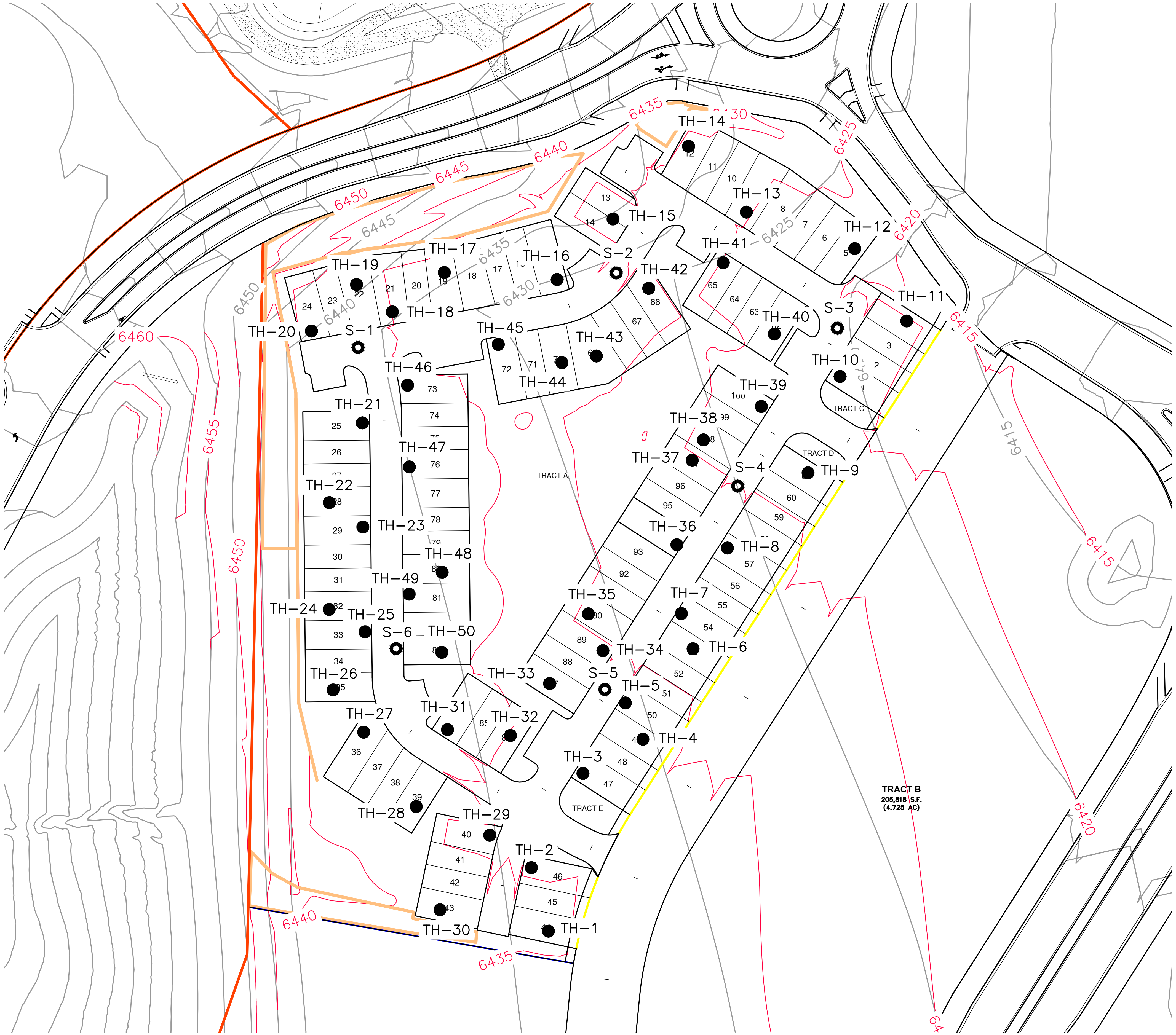
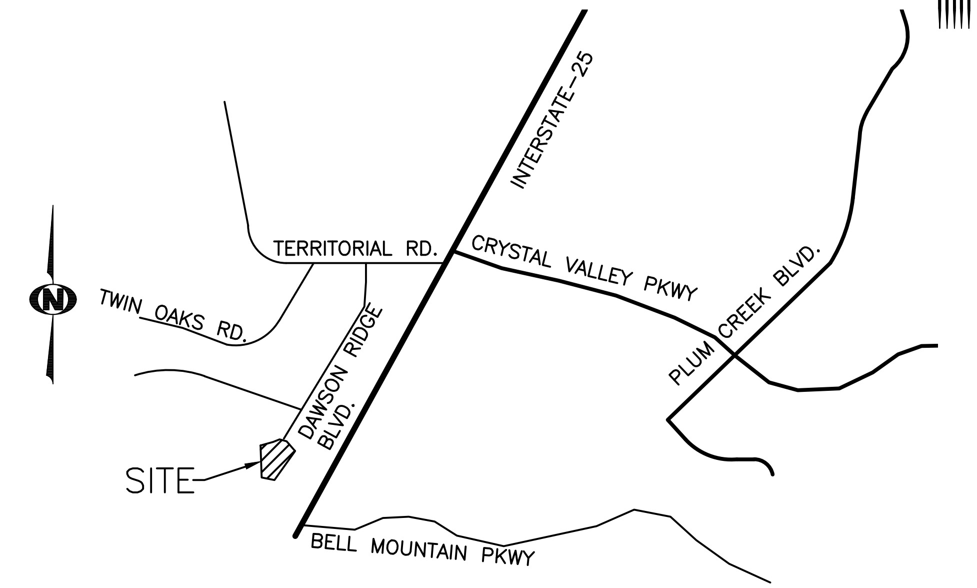
Ryan Lickteig

Ryan Lickteig, P.E.
Senior Associate Engineer

4/21/2025

Via e-mail: ghart@brightlandhomes.com
nlozano@brightlandhomes.com





VICINITY MAP
NOT TO SCALE

LEGEND:

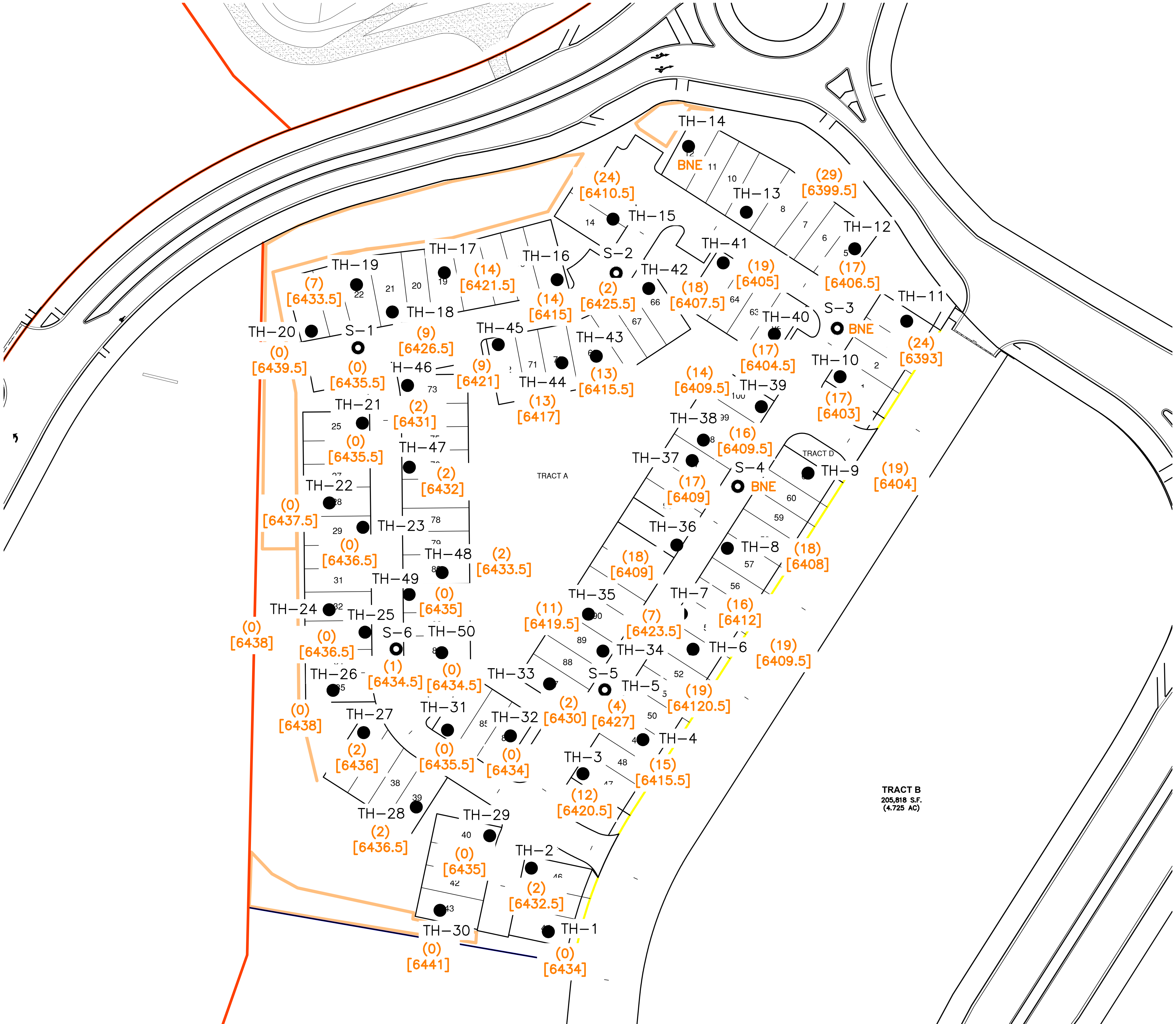
TH-1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
S-1 ○	APPROXIMATE LOCATION OF PAVEMENT BORING
(grey line)	INDICATES EXISTING GROUND SURFACE ELEVATION
(red line)	INDICATES PROPOSED GROUND SURFACE ELEVATION

0 50' 100'
SCALE: 1" = 100'

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T Project No. DN52,431-120-R1

Locations of Exploratory Borings

Fig. 1



LEGEND:

TH-1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
S-1 ○	APPROXIMATE LOCATION OF PAVEMENT BORING
(2)	INDICATES ESTIMATED DEPTH TO BEDROCK (FEET)
[6432.5]	INDICATES ESTIMATED BEDROCK ELEVATION (FEET)
BNE	BEDROCK NOT ENCOUNTERED
NOTE:	THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS.

0 50' 100'

SCALE: 1" = 100'

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T Project No. DN52,431-120-R1

Depth and Elevation of Bedrock

Fig. 2

LEGEND:

TH-1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
S-1 ○	APPROXIMATE LOCATION OF PAVEMENT BORING
(14)	INDICATES APPROXIMATE DEPTH TO GROUNDWATER (FEET)
[6420]	INDICATES APPROXIMATE GROUNDWATER ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS AND SEASONAL FLUCTUATIONS.

N

0 50' 100'

SCALE: 1" = 100'

BRIGHTLAND HOMES
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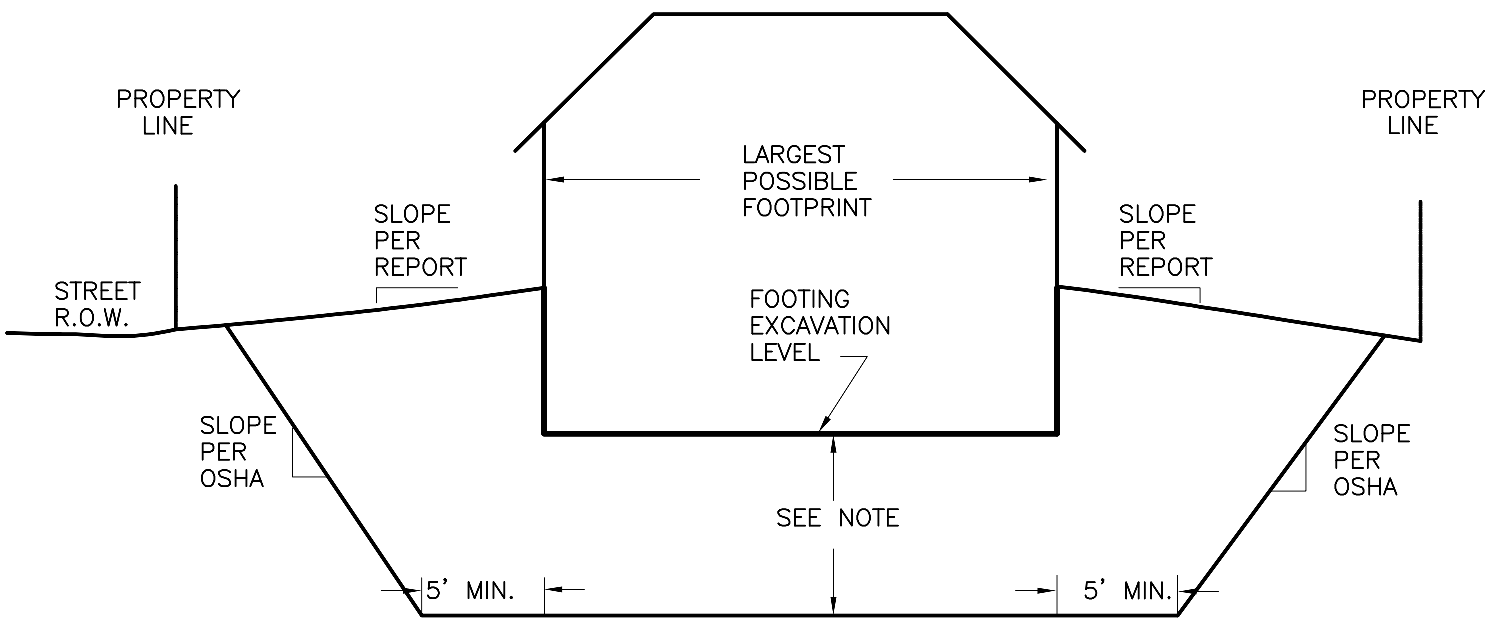
CTL|T Project No. DN52,431-120-R1

Depth and Elevation of Groundwater

Fig. 3

95-SUB-EXCAVATION_01



NOT TO SCALE

NOTE: SUB-EXCAVATION TO AT LEAST 5 FEET BELOW LOWEST FOUNDATION ELEMENT.

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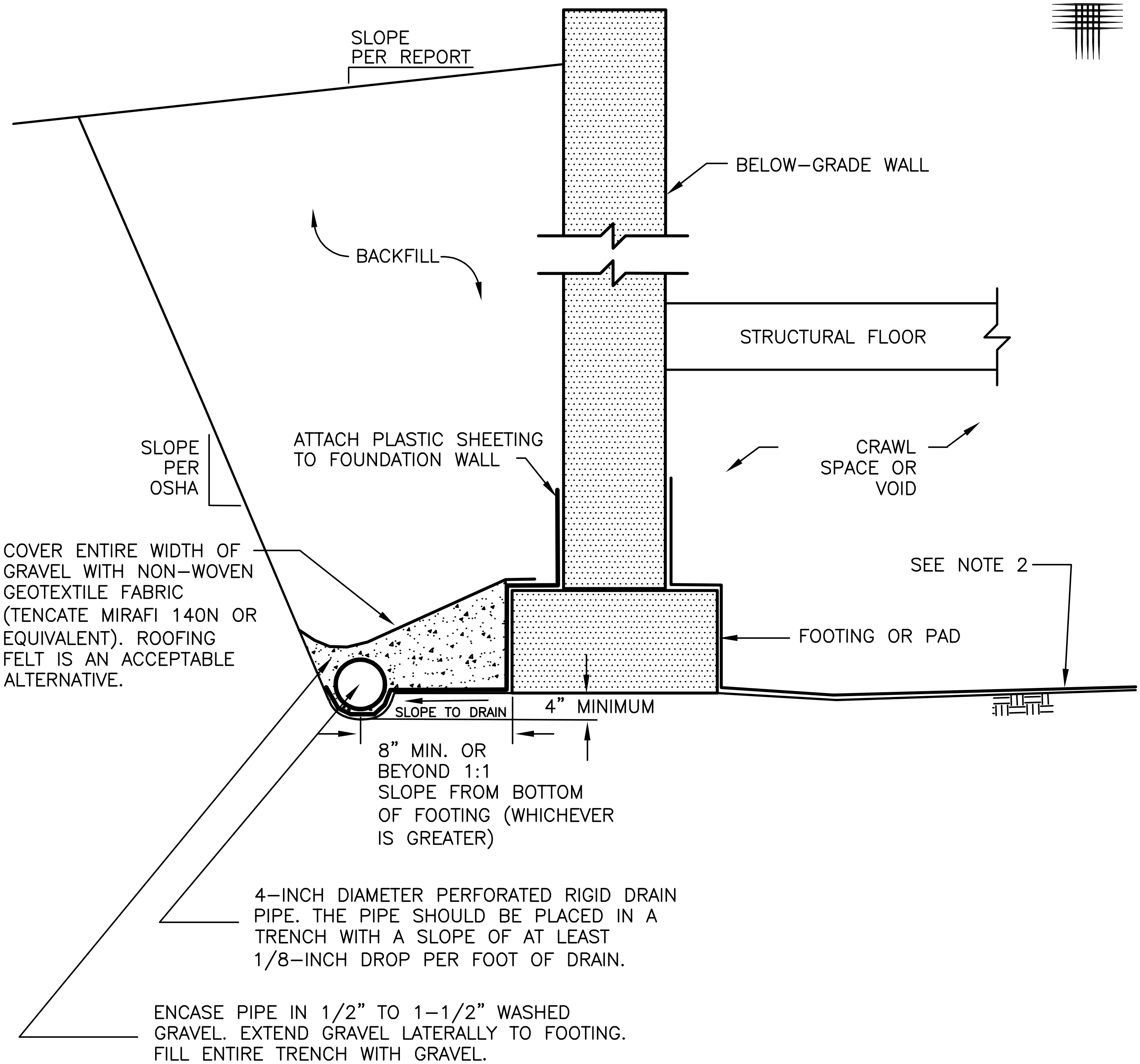
Conceptual Sub-excavation Profile

Fig. 4



NOTES:

1) THE BOTTOM OF THE DRAIN SHOULD BE AT LEAST 4 INCHES BELOW BOTTOM OF FOOTING AT THE HIGHEST POINT AND SLOPE DOWNWARD TO A POSITIVE GRAVITY OUTLET OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING.

2) TO HELP CONTROL THE HUMIDITY IN THE CRAWL SPACE, A MINIMUM 10–MIL POLYETHYLENE VAPOR RETARDER SHOULD BE PLACED OVER THE CRAWL SPACE SOILS. THE RETARDER SHOULD BE ATTACHED TO CONCRETE FOUNDATION ELEMENTS AND EXTEND UP FOUNDATION WALLS AT LEAST 8 INCHES ABOVE TOP OF FOOTING. OVERLAP JOINTS 3 FEET AND SEAL.

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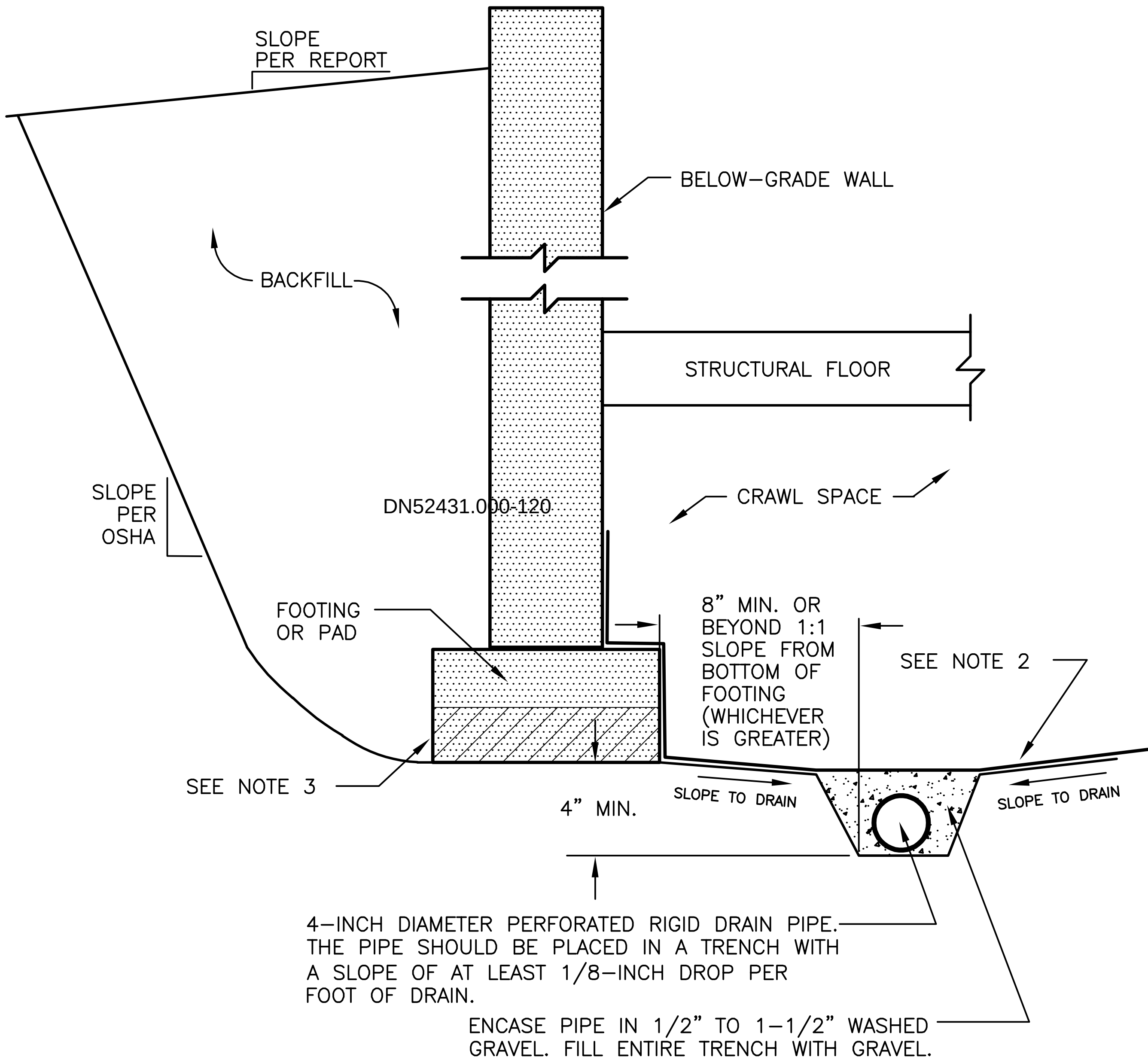
Exterior Foundation Wall Drain

Fig. 5



NOTES:

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2) TO HELP CONTROL THE HUMIDITY IN THE CRAWL SPACE, A MINIMUM 10–MIL POLYETHYLENE VAPOR RETARDER SHOULD BE PLACED OVER THE CRAWL SPACE SOILS. THE RETARDER SHOULD BE ATTACHED TO CONCRETE FOUNDATION ELEMENTS AND EXTEND UP FOUNDATION WALLS AT LEAST 8 INCHES ABOVE TOP OF FOOTING. OVERLAP JOINTS 3 FEET AND SEAL.

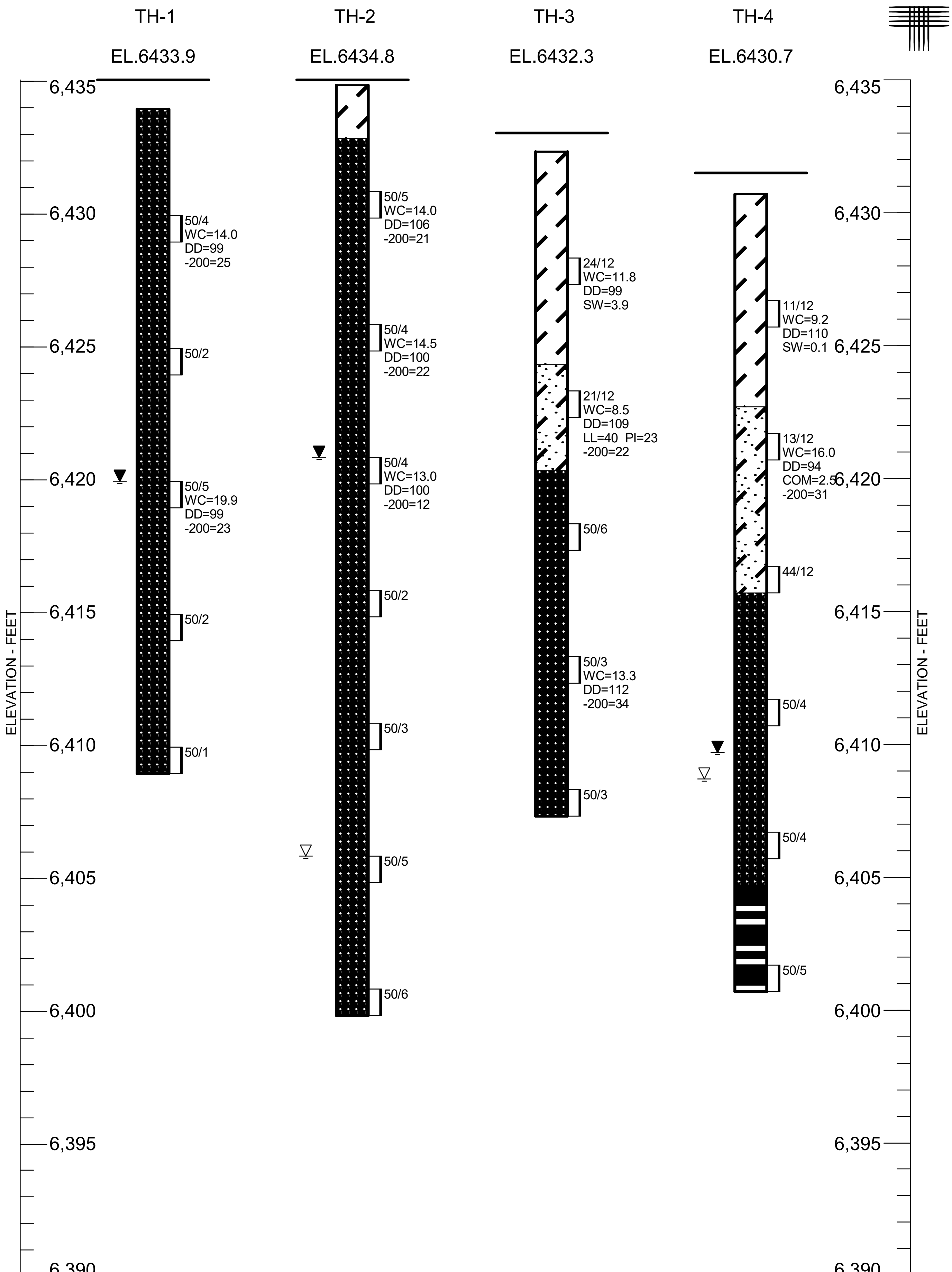
3) FOR FOOTINGS IN BASEMENT AREAS, WE RECOMMEND PLACING A 4–INCH THICK, 8–INCH WIDE SECTION OF VOID FORM PERPENDICULAR TO FOOTING ABOUT EVERY 10 TO 15 FEET AND AT WINDOW WELLS, TO ALLOW WATER IN WALL BACKFILL TO PASS BENEATH THE FOOTING INTO THE INTERIOR DRAIN. THIS CAN ALSO BE ACCOMPLISHED BY "TUNNELING" UNDER FOOTINGS AT THE TIME OF DRAIN INSTALLATION. THIS DETAIL SHOULD BE REVIEWED BY THE STRUCTURAL ENGINEER DURING FOUNDATION DESIGN AND INCORPORATED INTO THE FOUNDATION PLAN. ALTERNATIVELY, AN EXTERIOR FOUNDATION DRAIN CAN BE USED.

Interior Foundation Wall Drain

Fig. 6

APPENDIX A

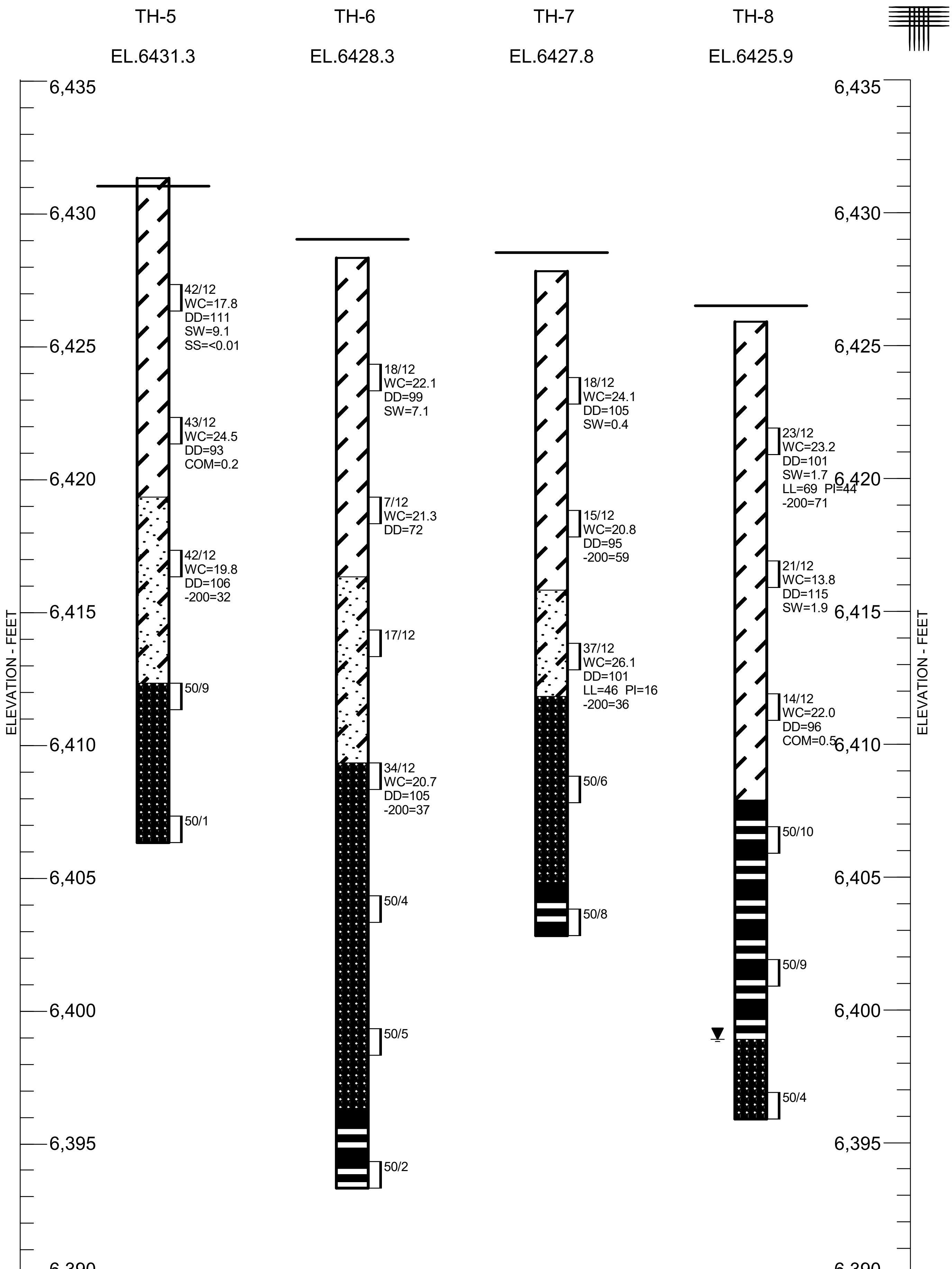
SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

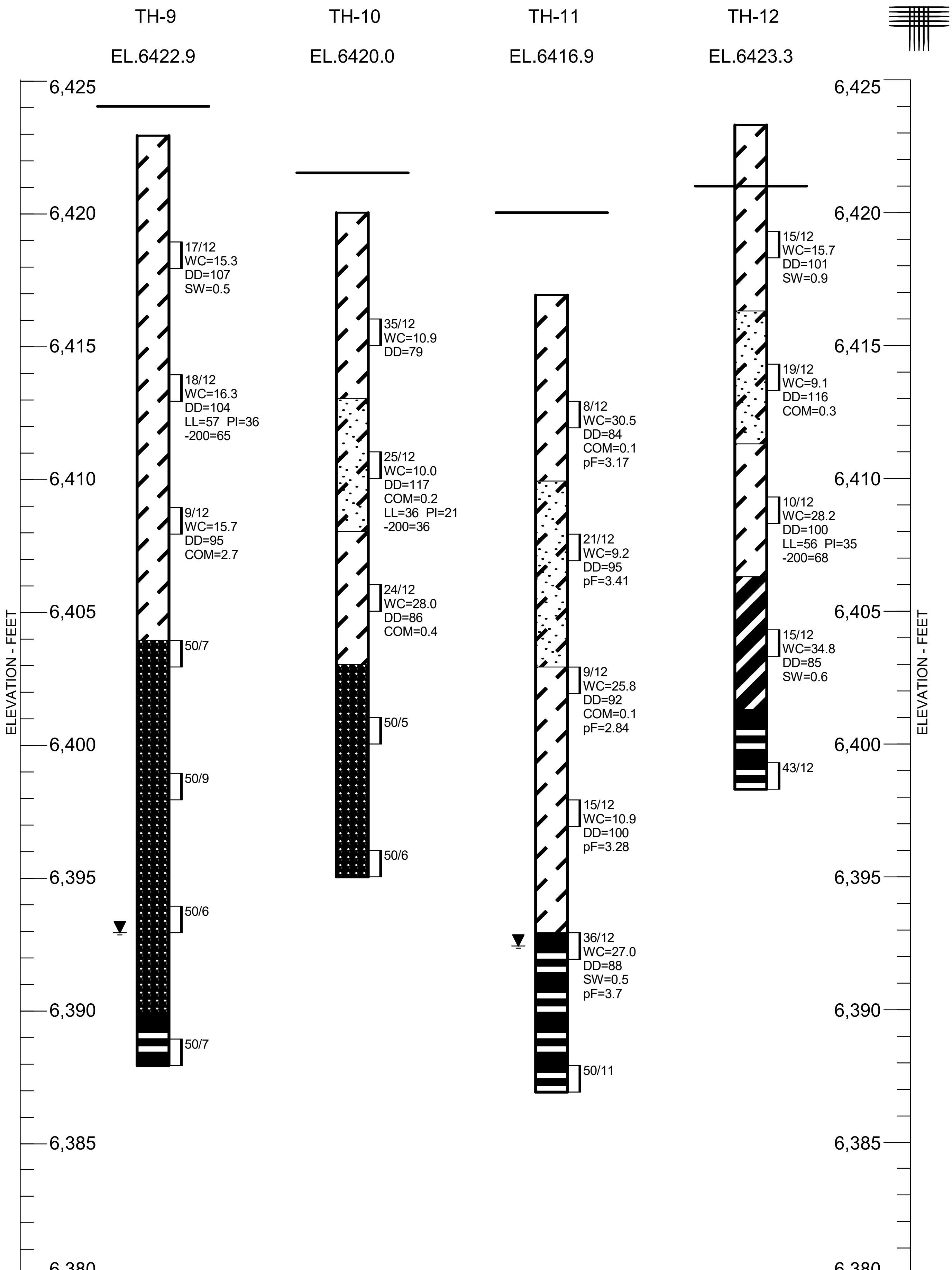
FIG. A-1



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

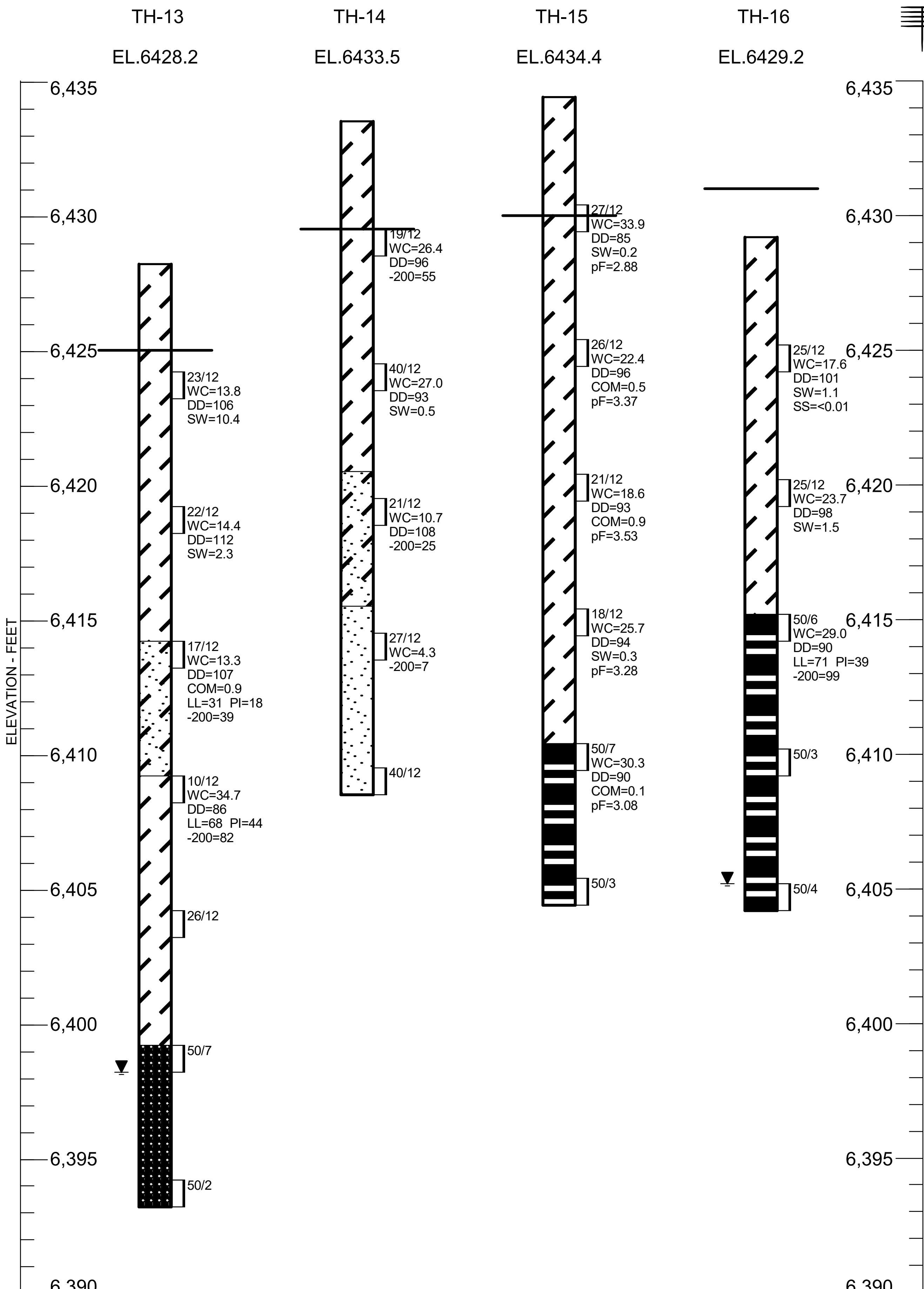
FIG. A-2



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

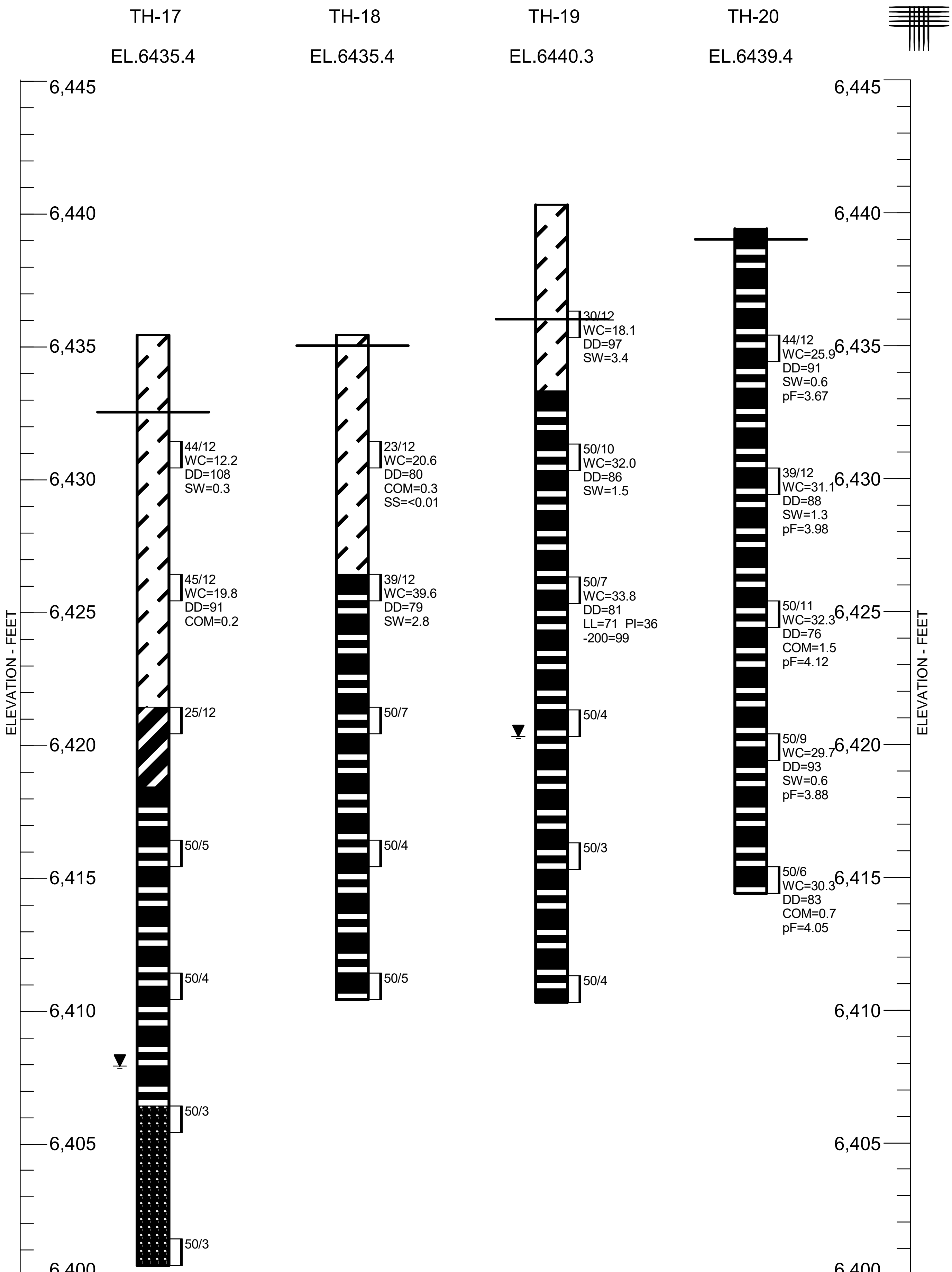
FIG. A-3



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

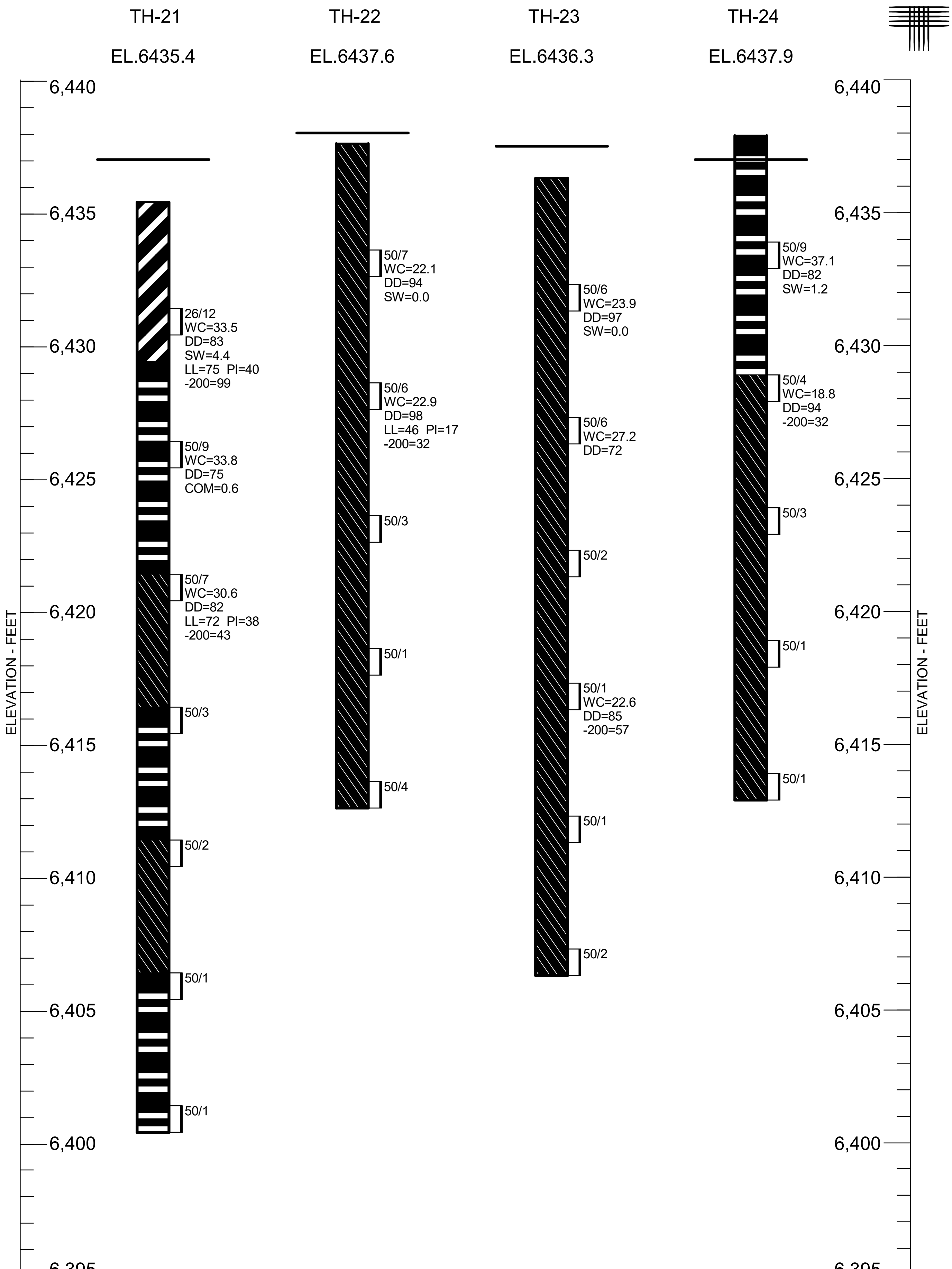
FIG. A-4



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

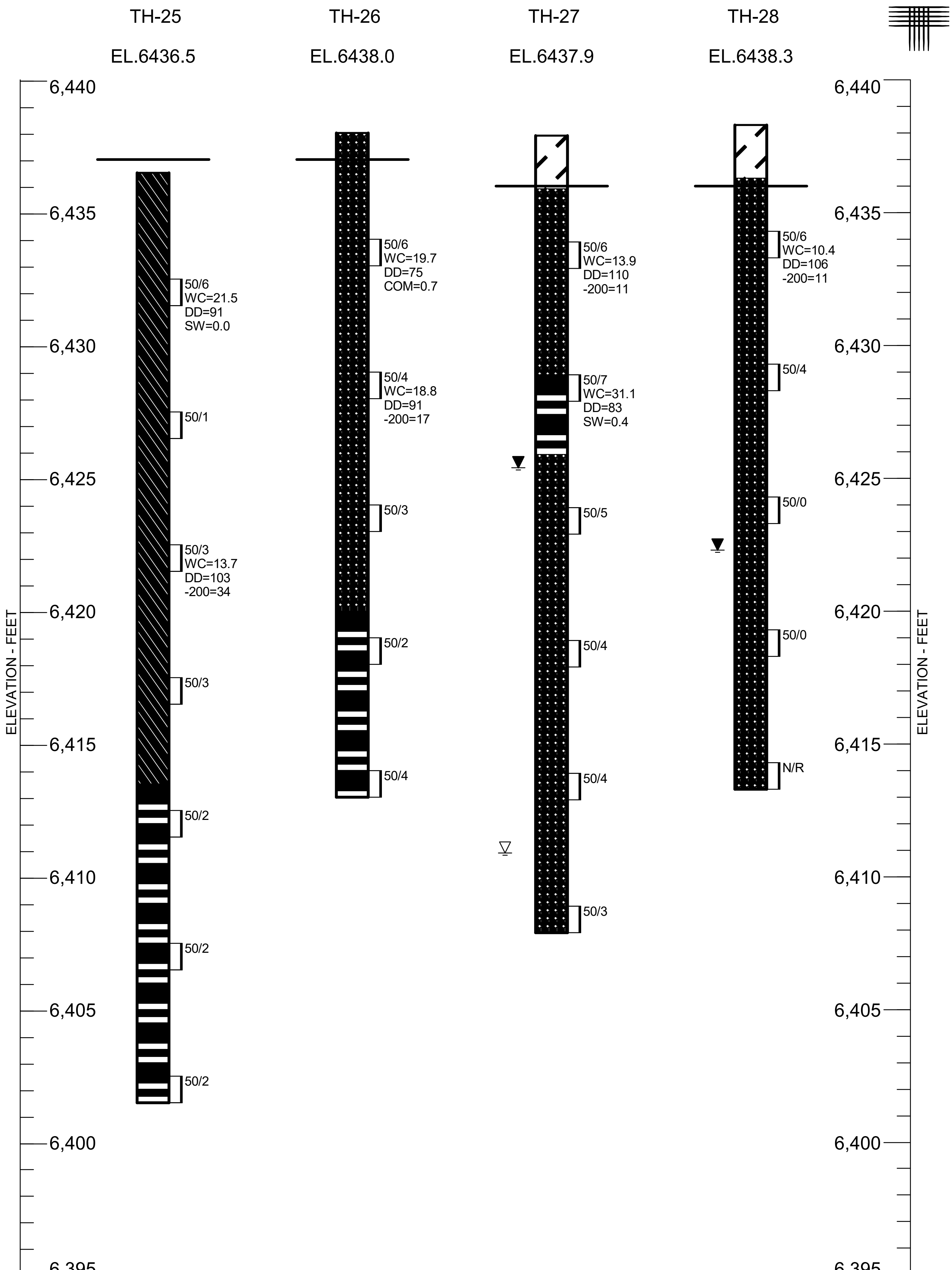
FIG. A-5



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

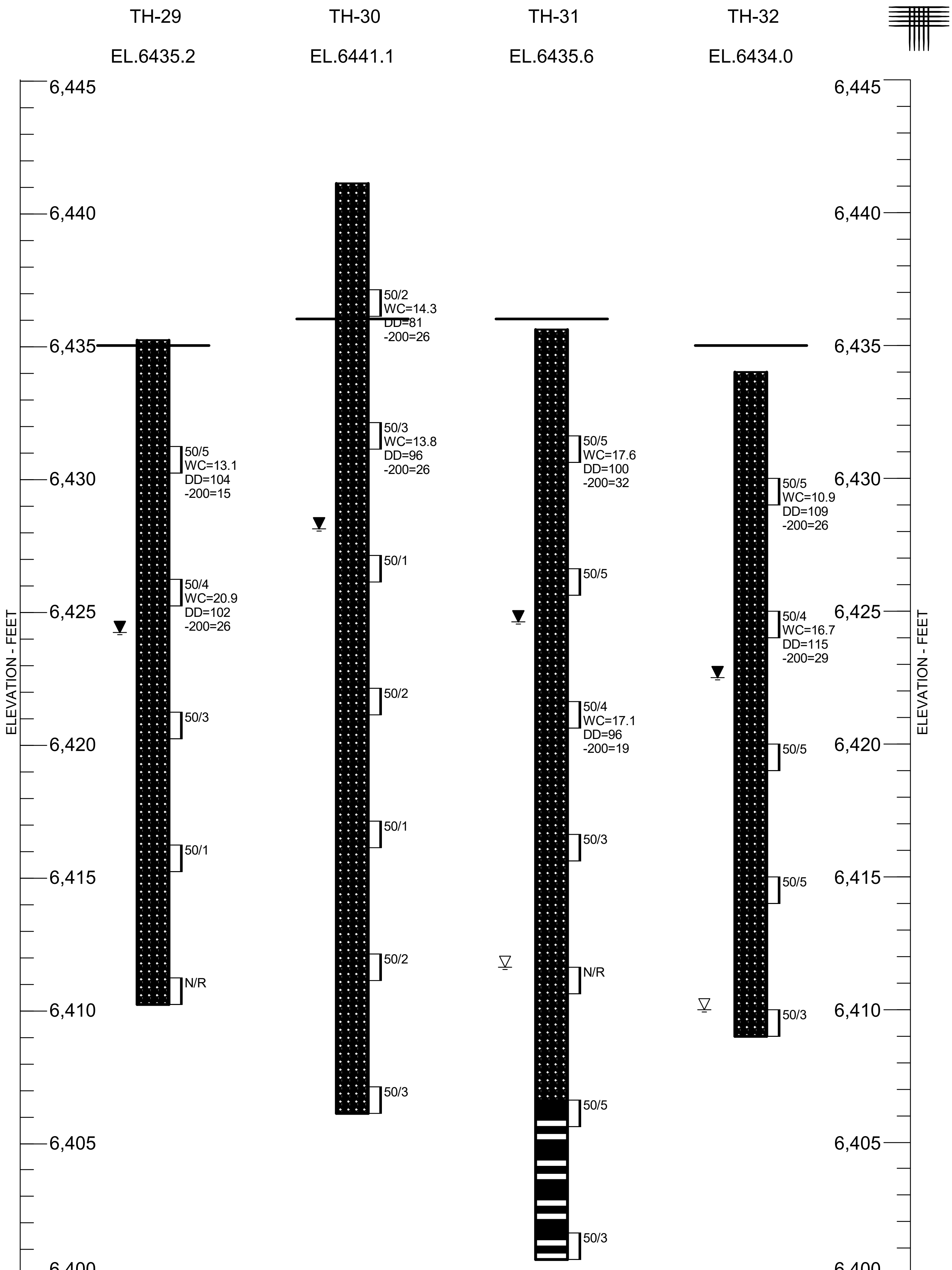
FIG. A-6



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

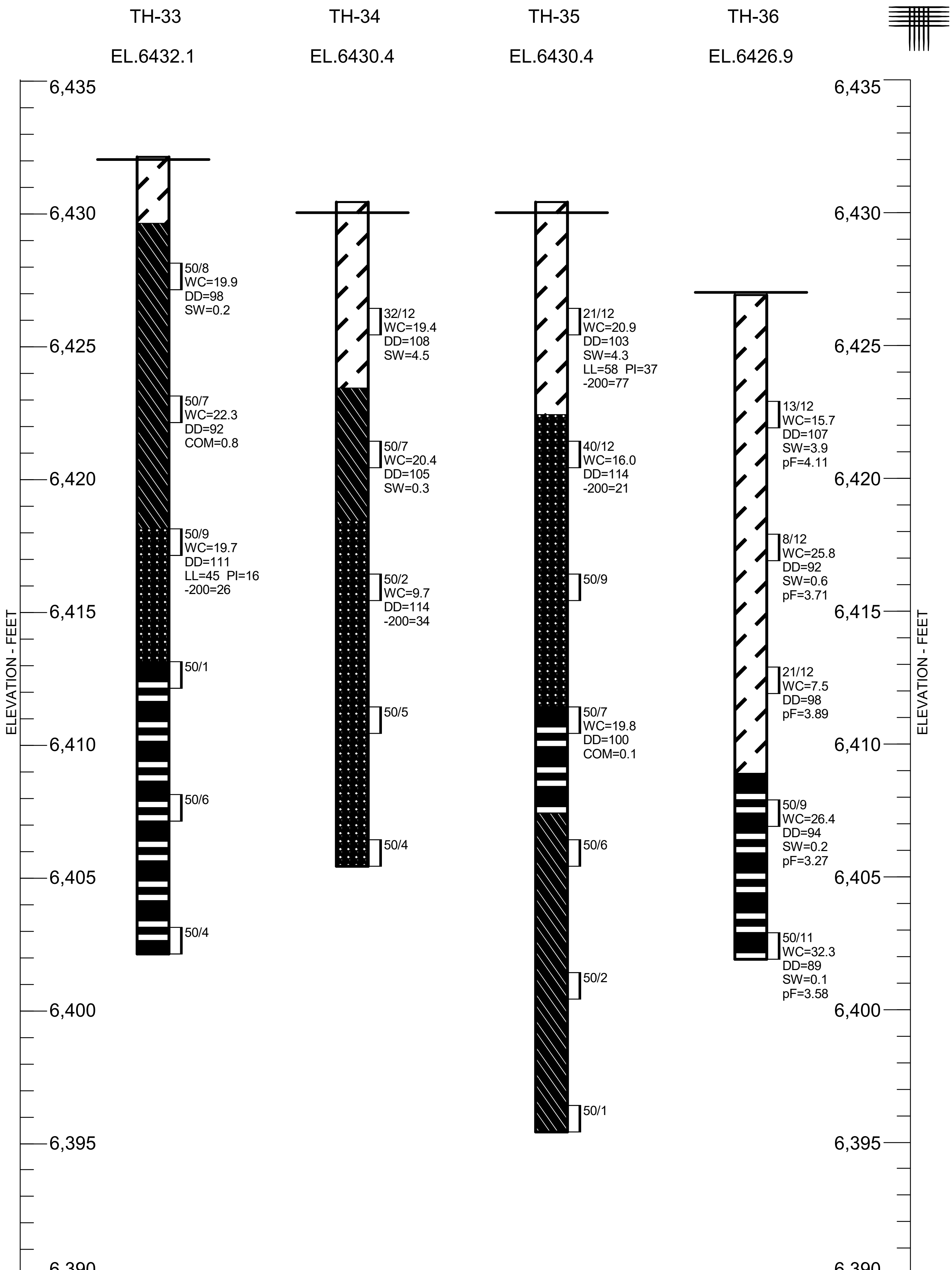
FIG. A-7



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

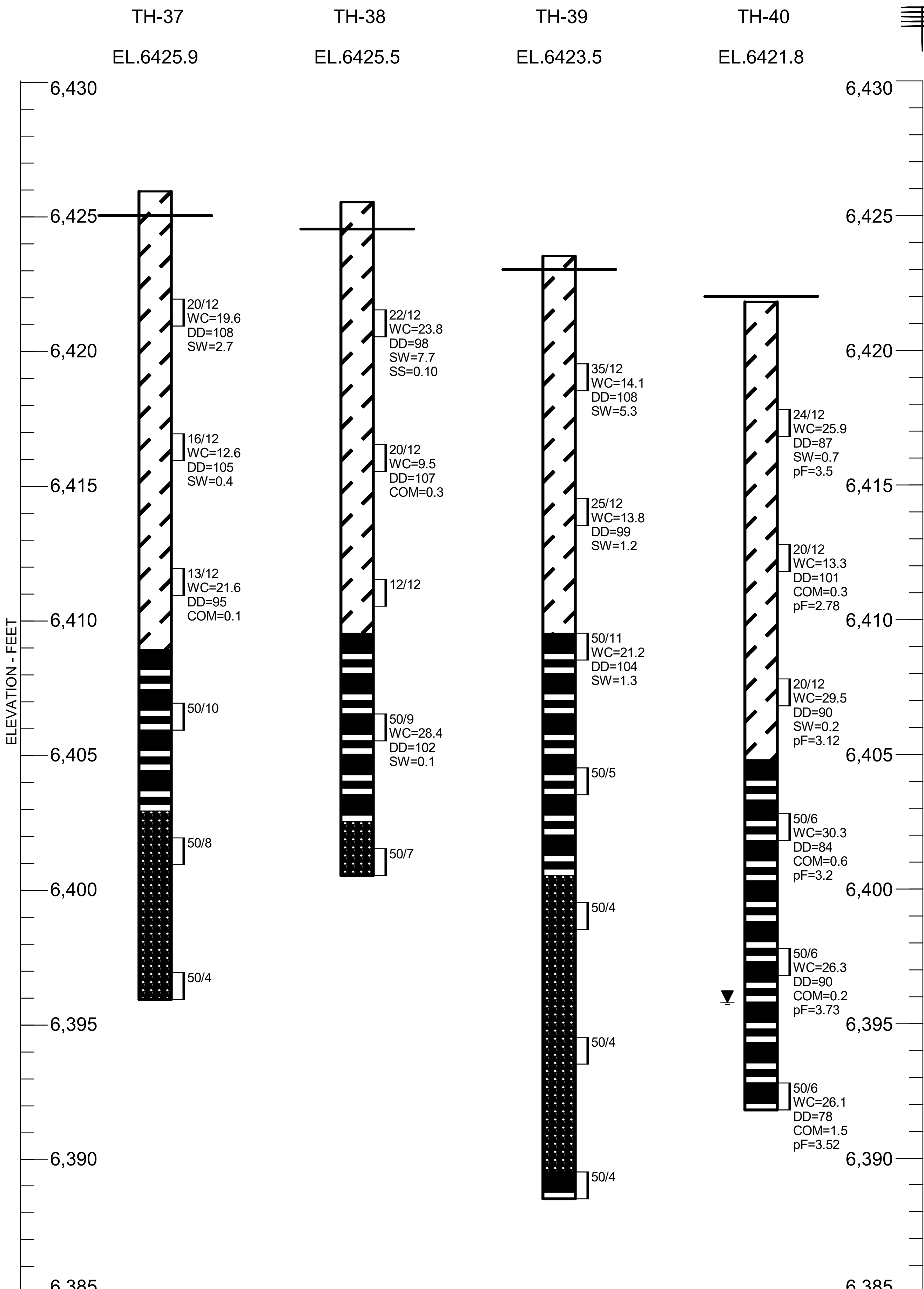
FIG. A-8



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

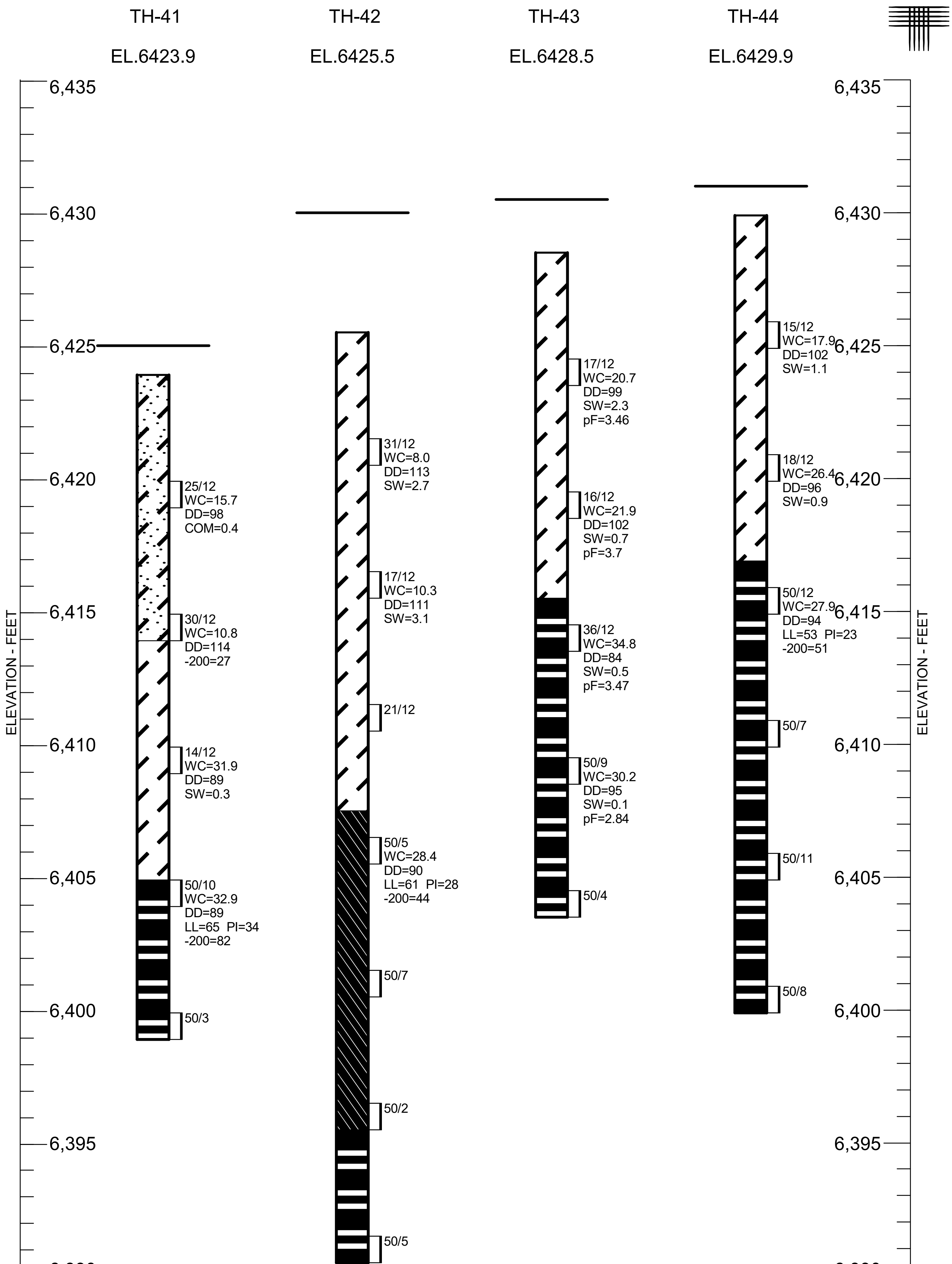
FIG. A-9



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

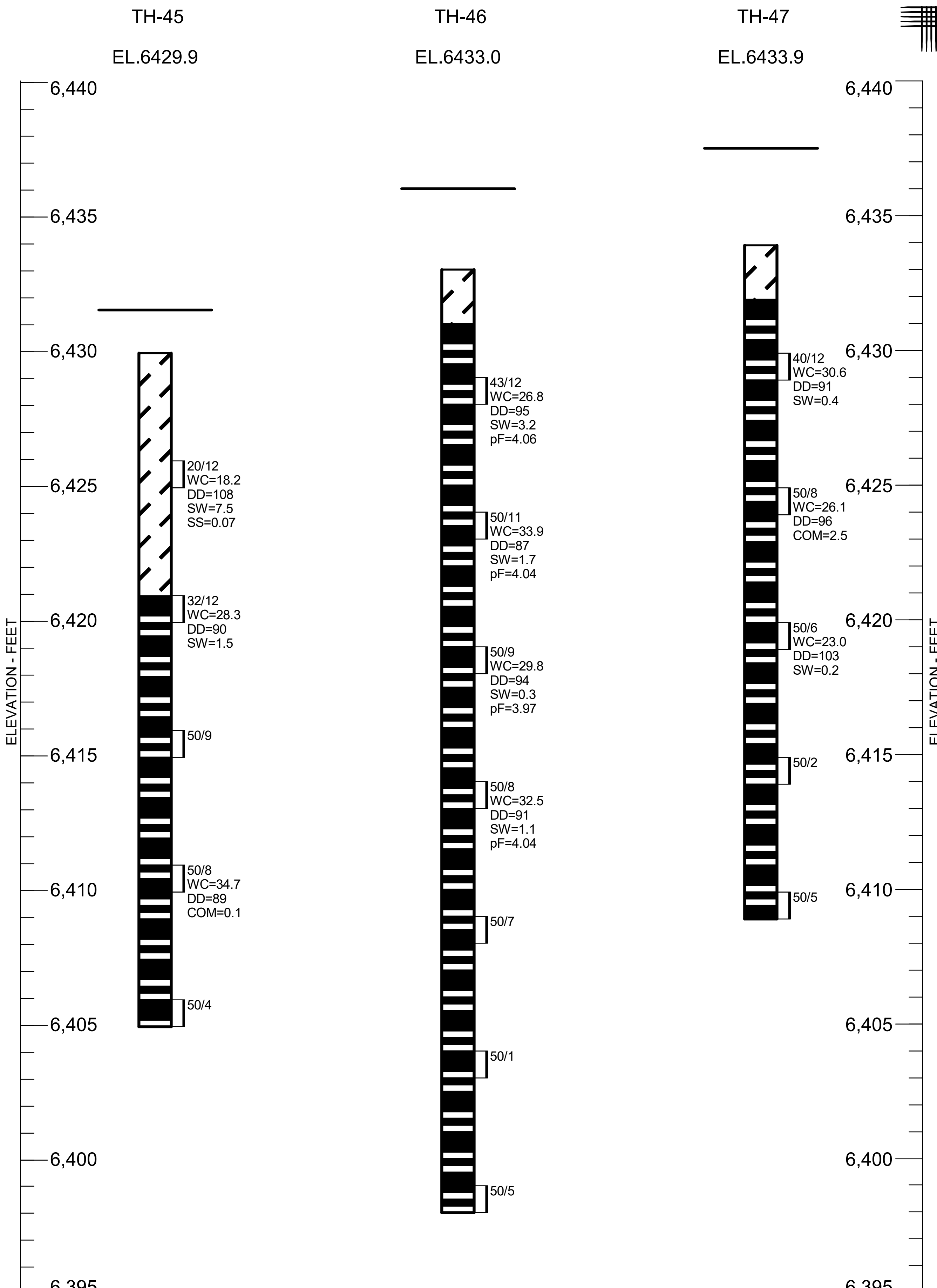
FIG. A-10



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

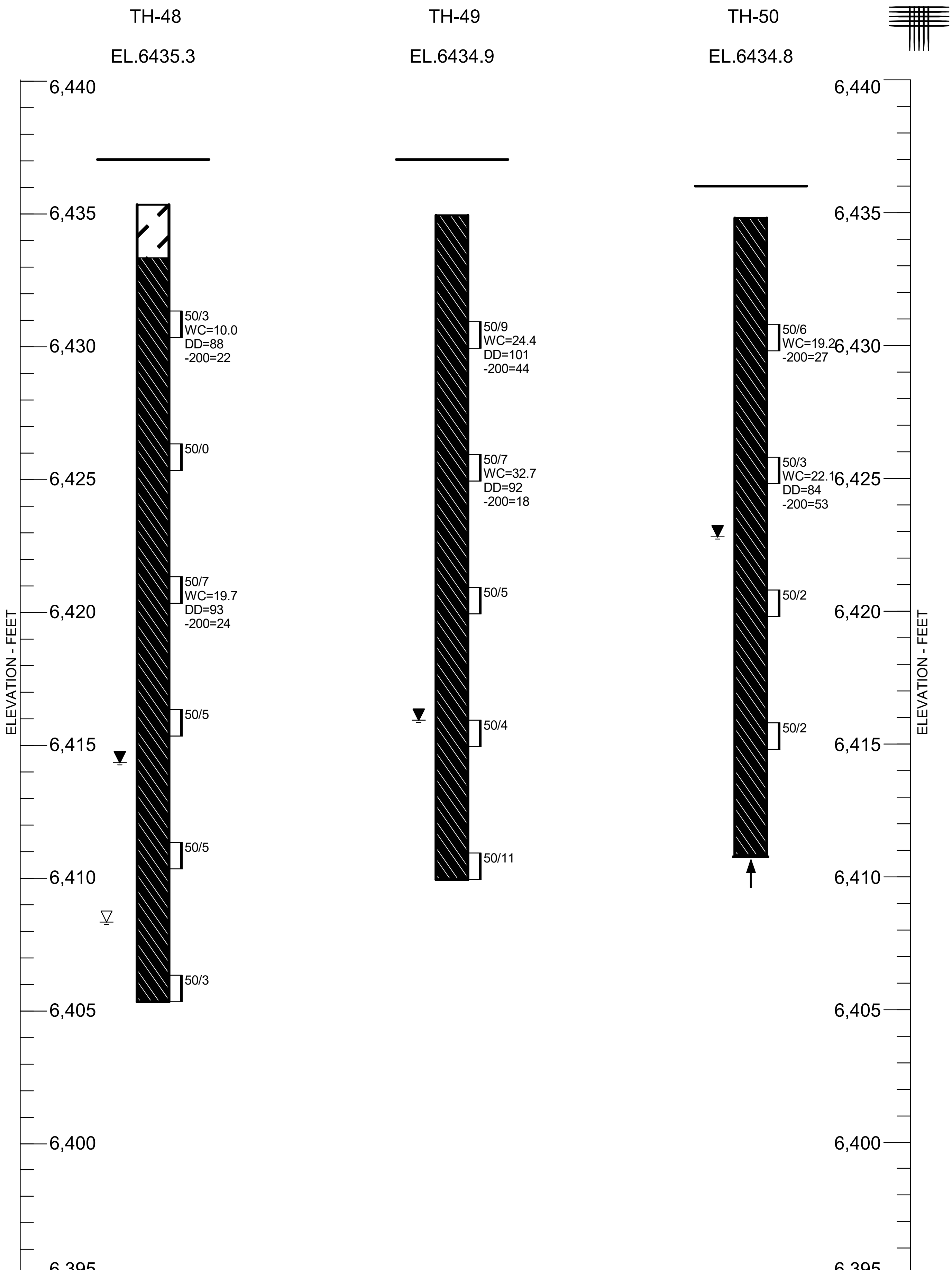
FIG. A-11



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

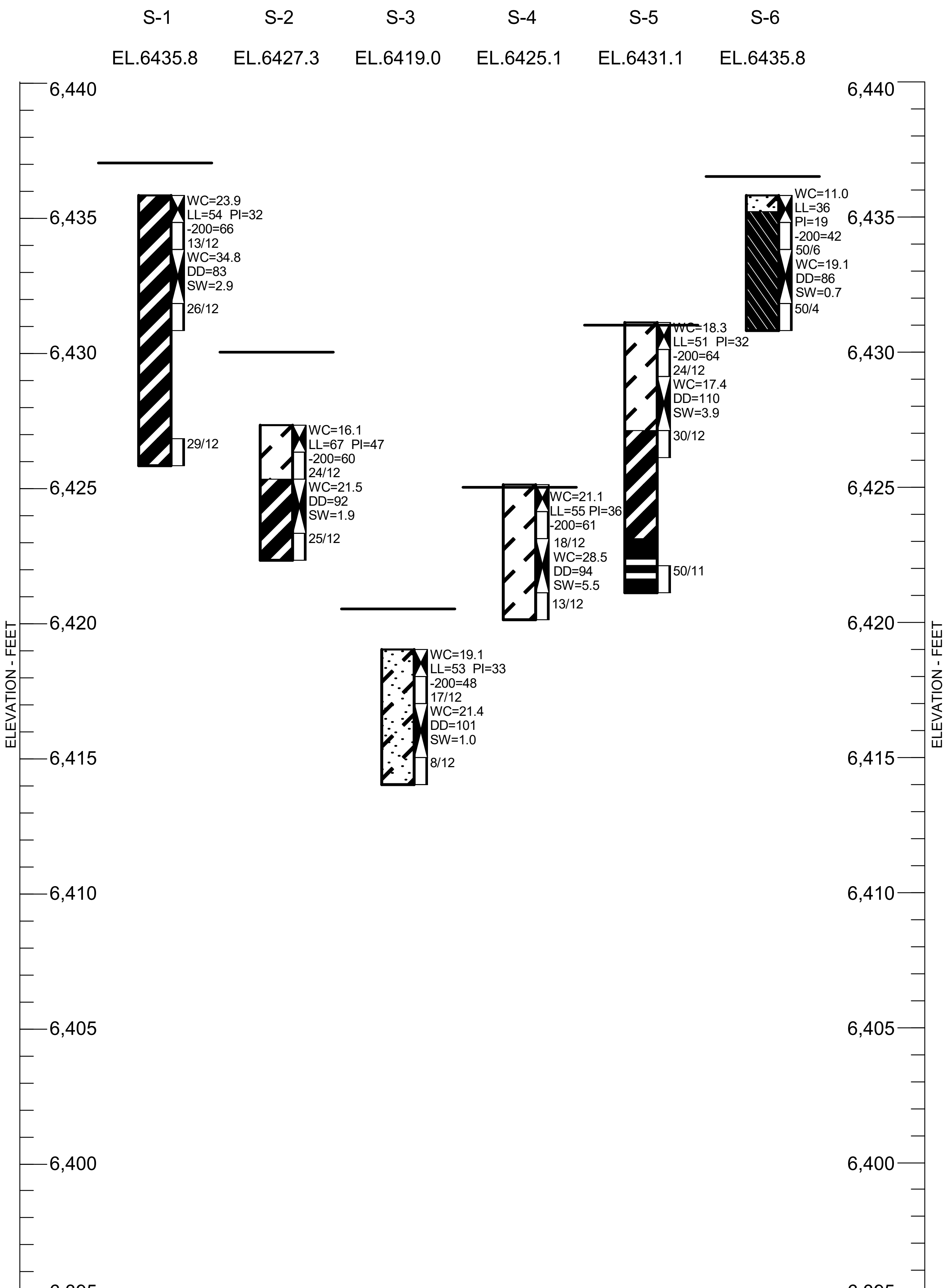
FIG. A-12



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

FIG. A-13



SUMMARY LOGS OF EXPLORATORY BORINGS

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

LEGEND:

CLAY, SANDY, MEDIUM STIFF TO VERY STIFF, MOIST, BROWN, CALCAREOUS (CL).

SAND, CLAYEY, LOOSE TO DENSE, MOIST, BROWN (SC).

SAND, CLEAN TO SLIGHTLY SILTY, MEDIUM DENSE TO DENSE, MOIST, BROWN, LIGHT BROWN (SP-SM).

WEATHERED CLAYSTONE, MOIST, BROWN, RUST, GRAY.

BEDROCK CLAYSTONE, MEDIUM HARD TO VERY HARD, MOIST, BROWN, RUST, GRAY.

BEDROCK SANDSTONE, MEDIUM HARD TO VERY HARD, MOIST, BROWN, TAN, GRAY, RUST.

BEDROCK INTERBEDDED CLAYSTONE/SANDSTONE, HARD TO VERY HARD, MOIST, BROWN, GRAY, RUST.

DRIVE SAMPLE. THE SYMBOL 13/12 INDICATES 13 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.

INDICATES ESTIMATED PROPOSED GRADE.

INDICATES BULK SAMPLE OBTAINED FROM AUGER CUTTINGS.

WATER LEVEL MEASURED AT TIME OF DRILLING.

WATER LEVEL MEASURED AFTER DRILLING ON MARCH 21, 2025.

INDICATES PRACTICAL DRILL RIG REFUSAL.

N/R NO RECOVERY.

NOTES:

1. THE BORINGS WERE DRILLED BETWEEN FEBRUARY 11, AND MARCH 18, 2025 USING A 4-INCH DIAMETER, CONTINUOUS-FLIGHT SOLID-STEM AUGERAND TRUCK-MOUNTED CME-45 AND CME-55 DRILL RIGS.

2. BORING LOCATIONS AND ELEVATIONS WERE SURVEYED BY OTHERS.

3. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (PCF).
   SW - INDICATES SWELL WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE (%).
   COM - INDICATES COMPRESSION WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE (%).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONTENT (%).
   pF - INDICATES SOIL SUCTION VALUE (PSF).

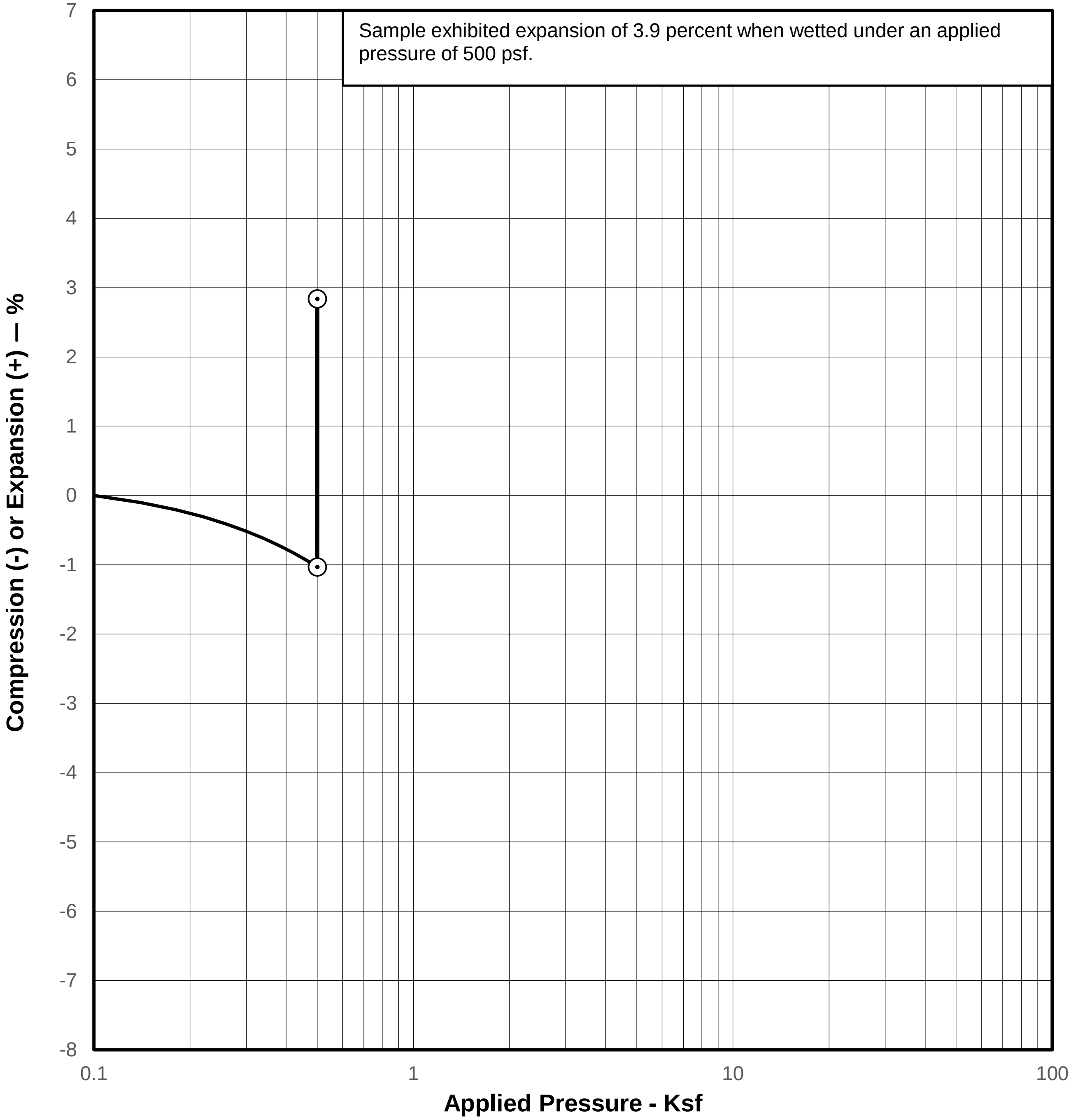
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.

FIG. A-14

APPENDIX B

LABORATORY TEST RESULTS

TABLE B-I – SUMMARY OF LABORATORY TESTING

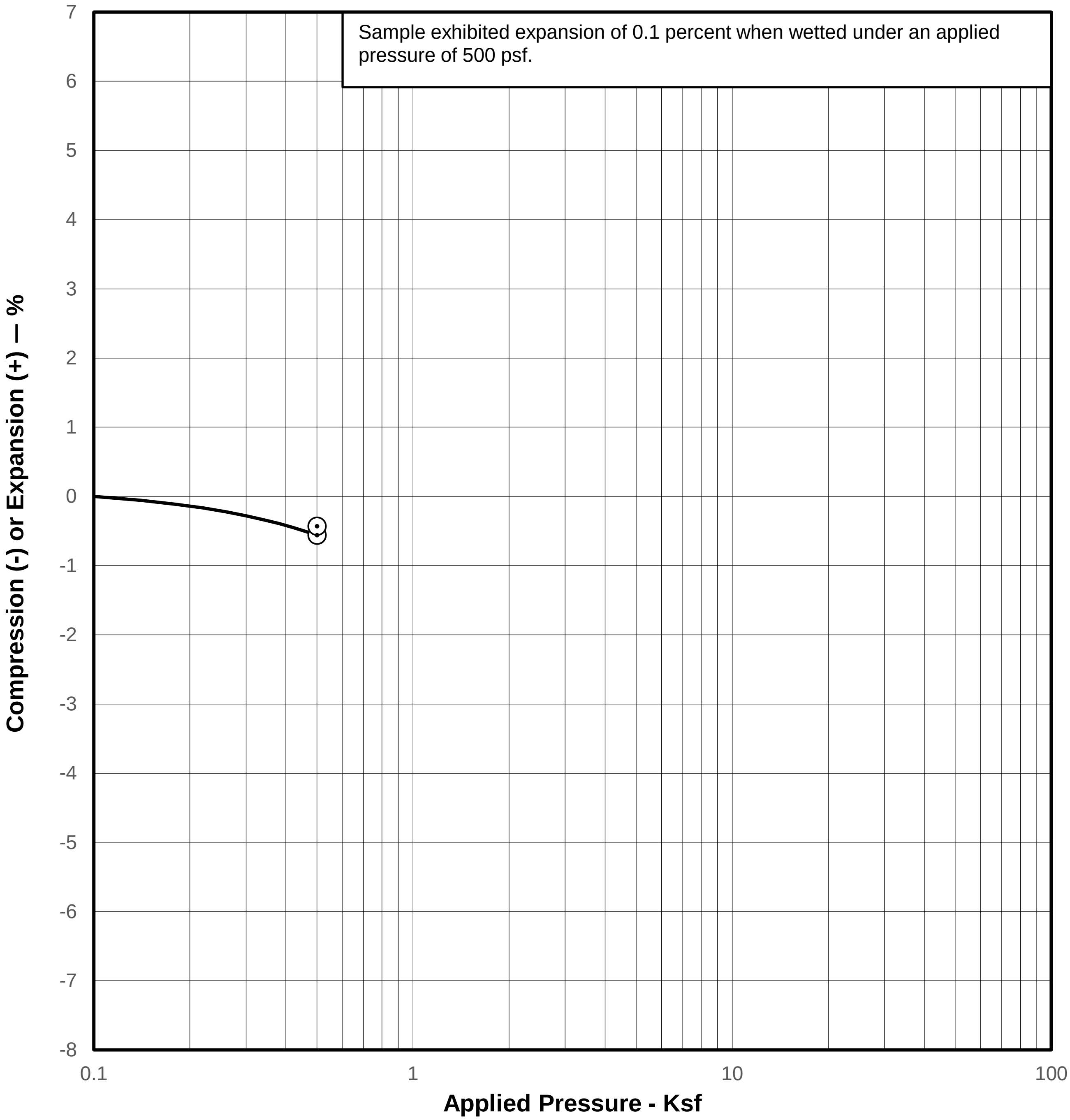


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-3 AT 4 FEET

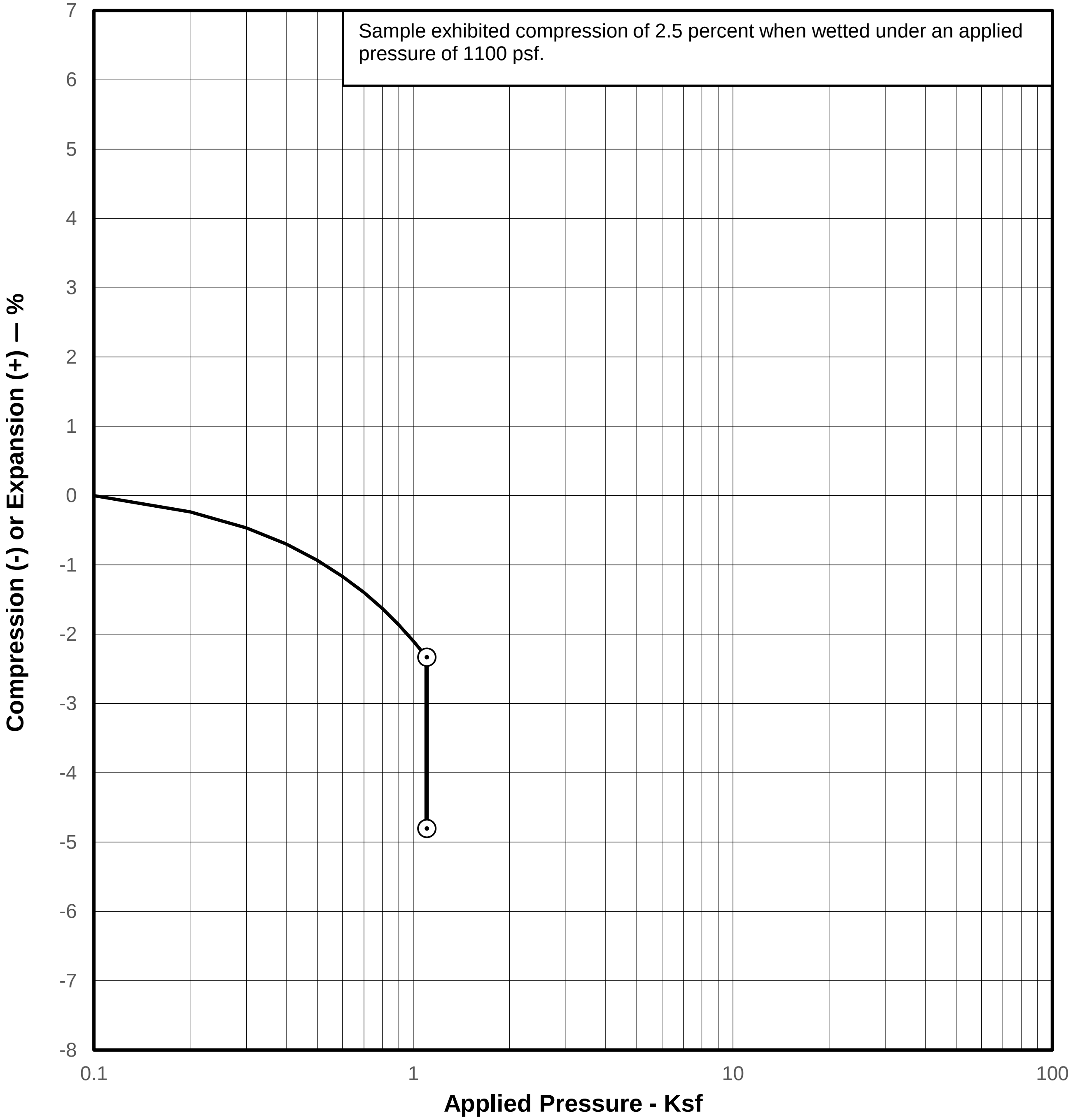
MOISTURE CONTENT:	11.8 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	99 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



SAMPLE OF:	CLAY, SANDY (CL)						
FROM:	TH-4 AT 4 FEET						
MOISTURE CONTENT:	9.2	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	110	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

Swell Consolidation
Test Results



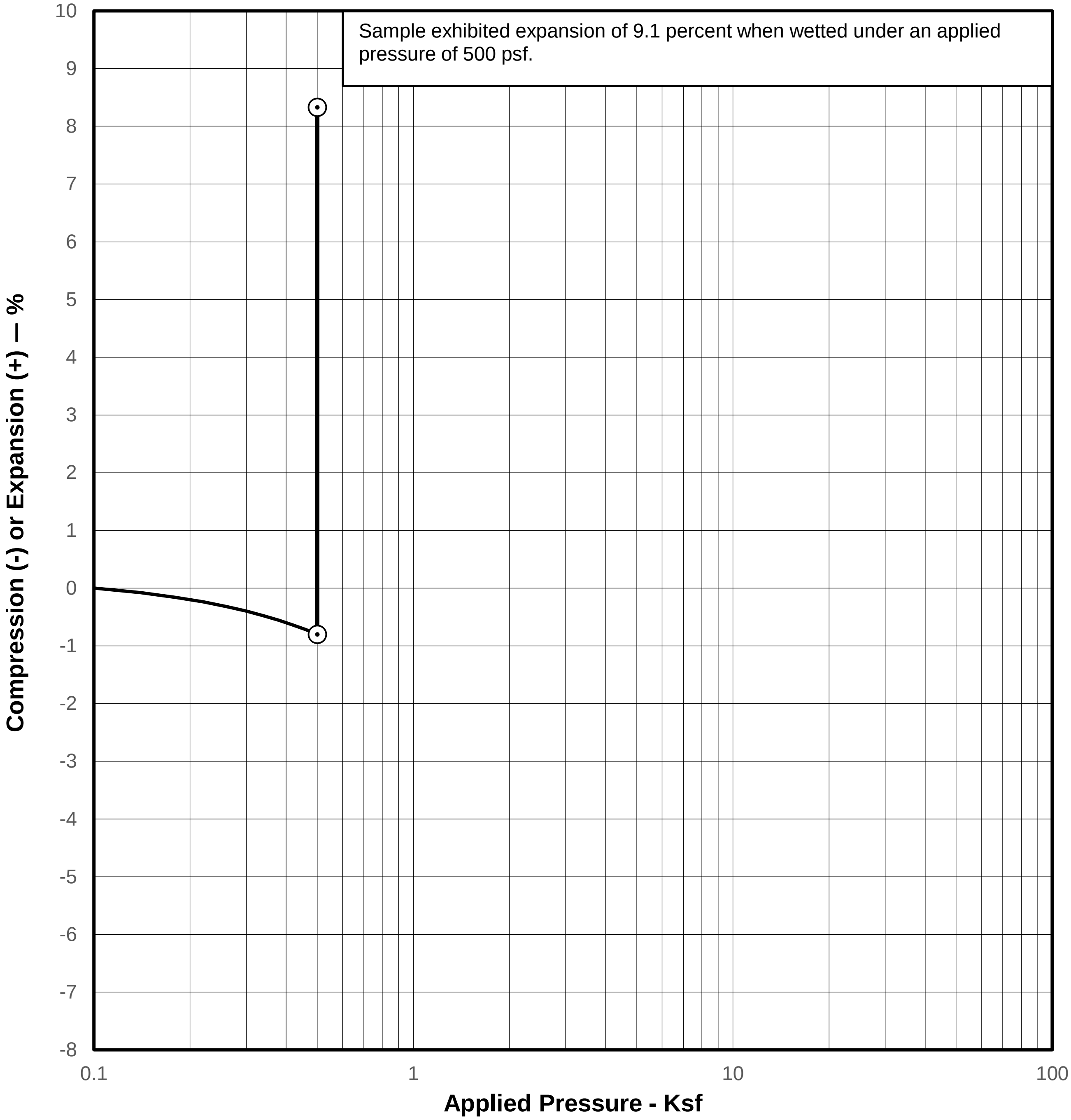
SAMPLE OF: SAND, CLAYEY (SC)

FROM: TH-4 AT 9 FEET

MOISTURE CONTENT: 16.0 % LIQUID LIMIT: ____ SILT AND CLAY: 31 %

DRY UNIT WEIGHT: 94 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

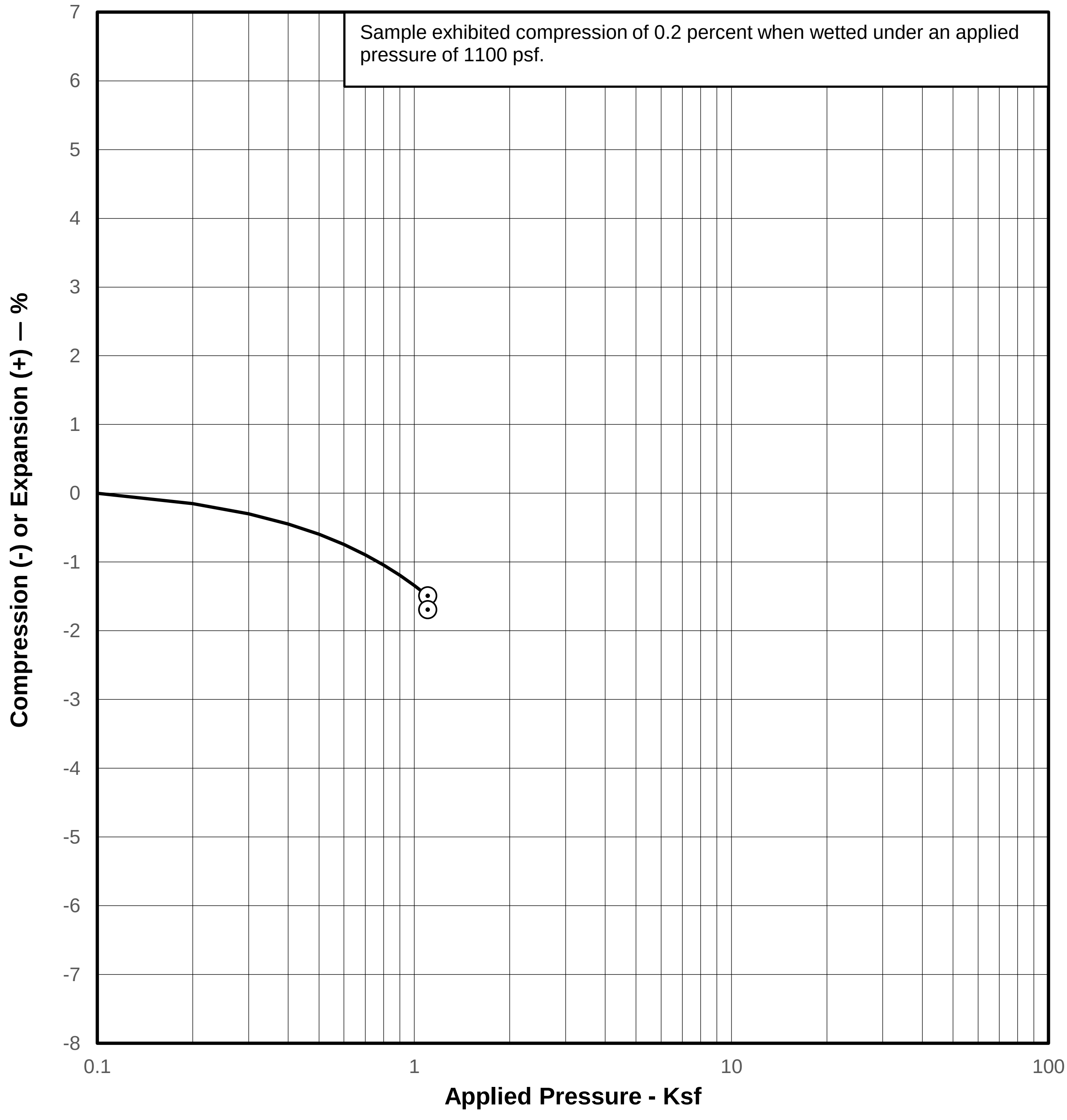
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-5 AT 4 FEET

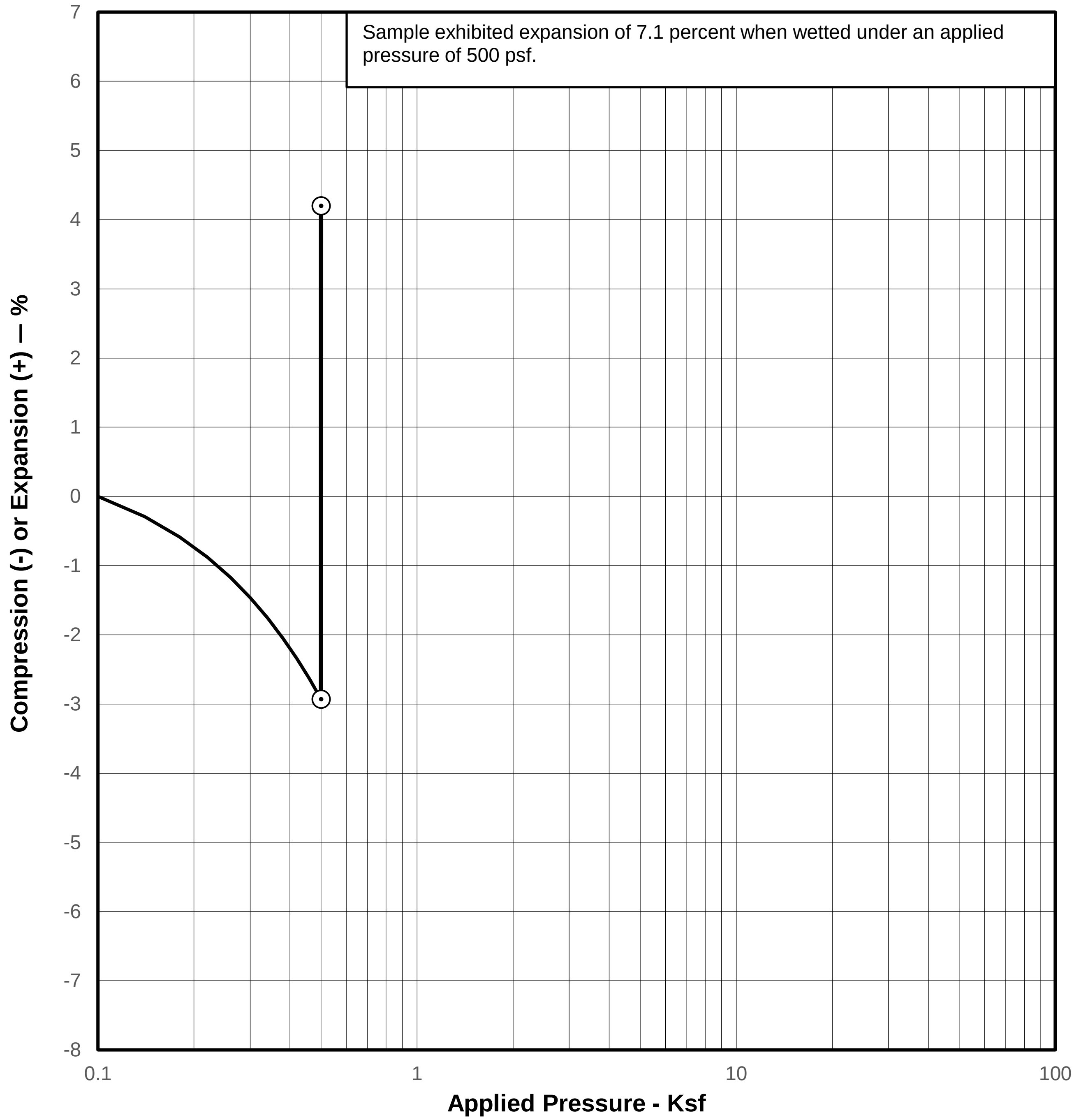
MOISTURE CONTENT: 17.8 %
DRY UNIT WEIGHT: 111 pcf
LIQUID LIMIT: ____
PLASTICITY INDEX: ____
SILT AND CLAY: ____ %
SOIL SUCTION: ____ pf

Swell Consolidation Test Results



SAMPLE OF:	CLAY, SANDY (CL)						
FROM:	TH-5 AT 9 FEET						
MOISTURE CONTENT:	24.5	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	93	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

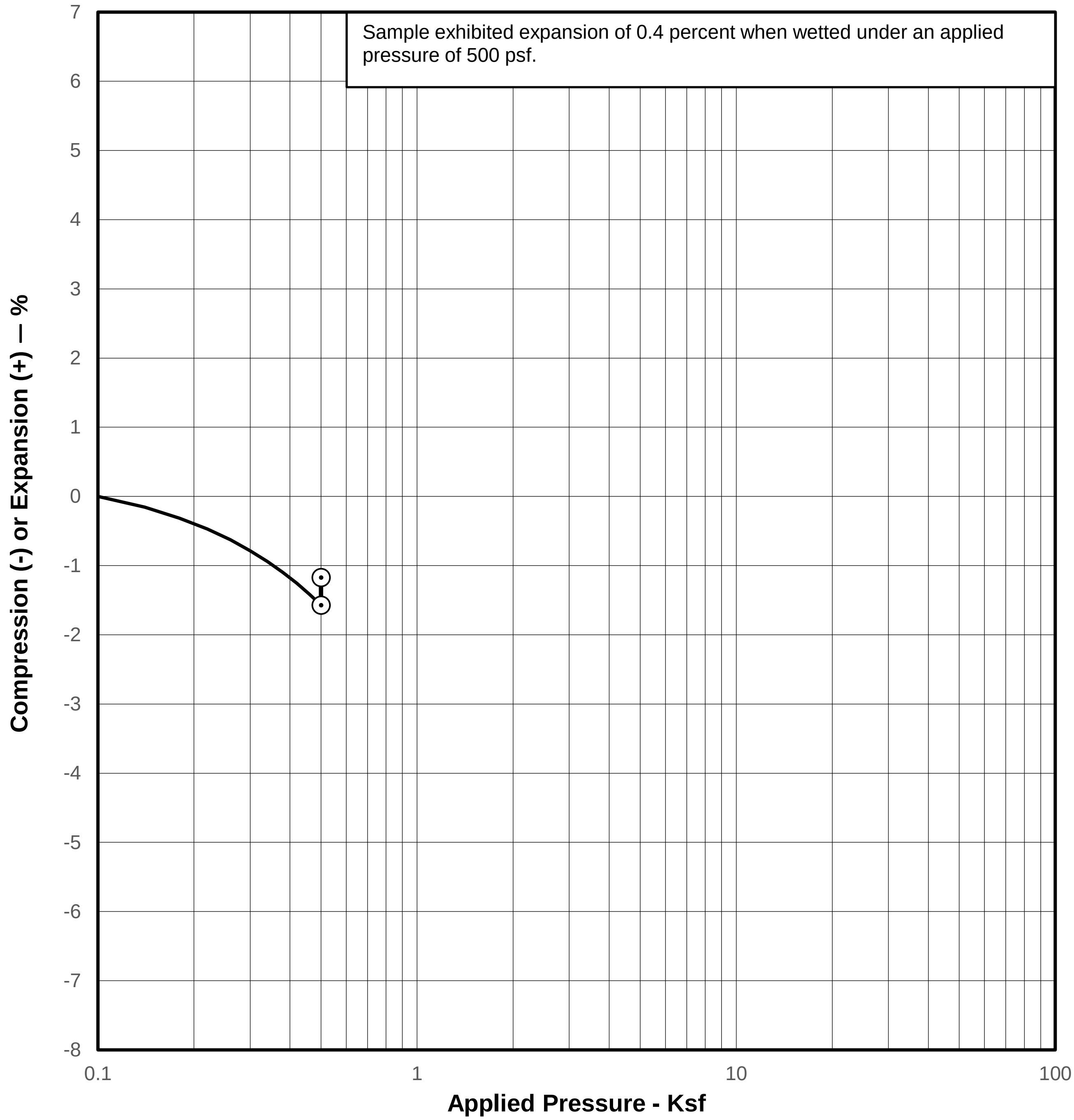
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-6 AT 4 FEET

MOISTURE CONTENT: 22.1 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 99 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

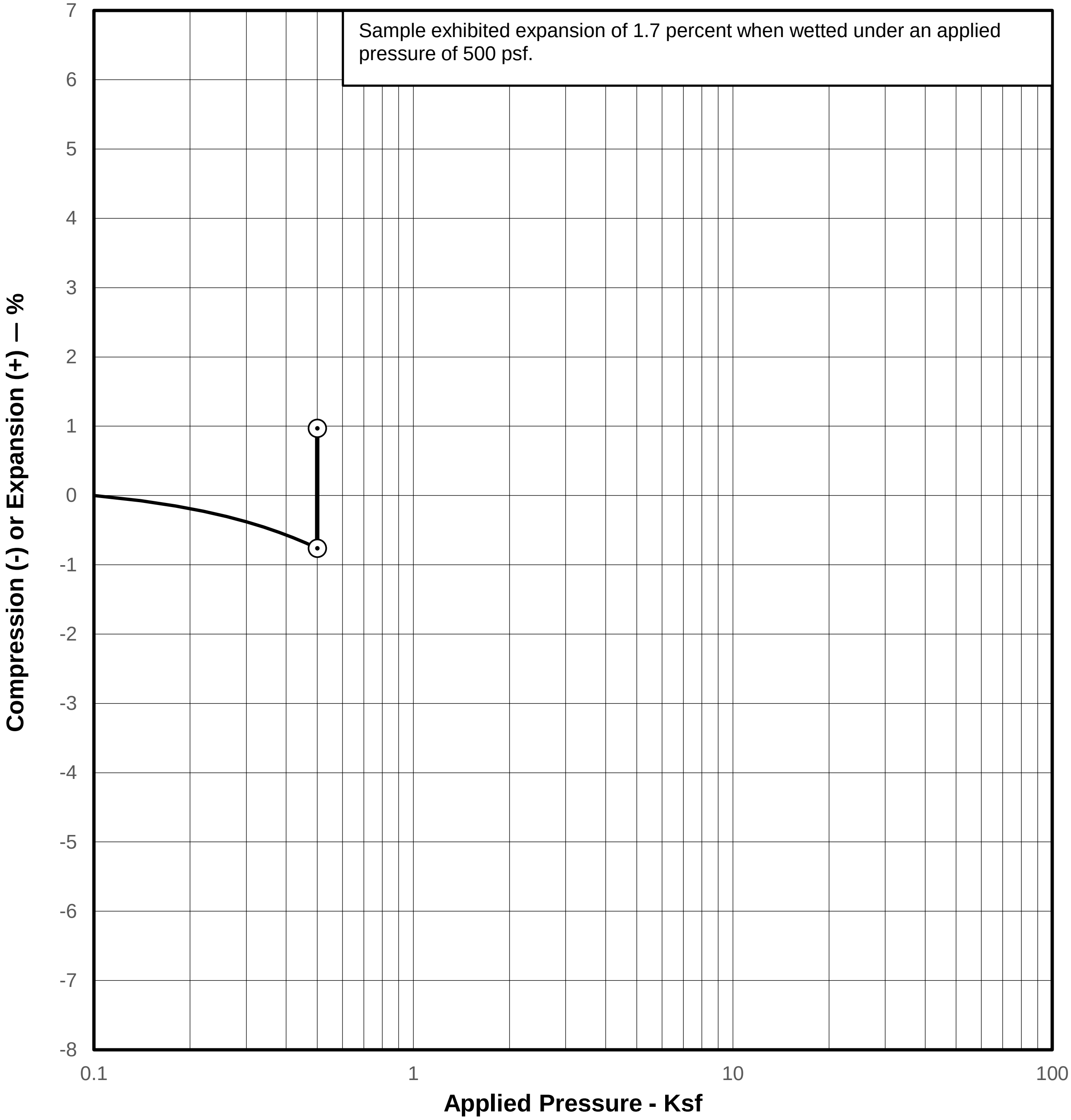


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-7 AT 4 FEET

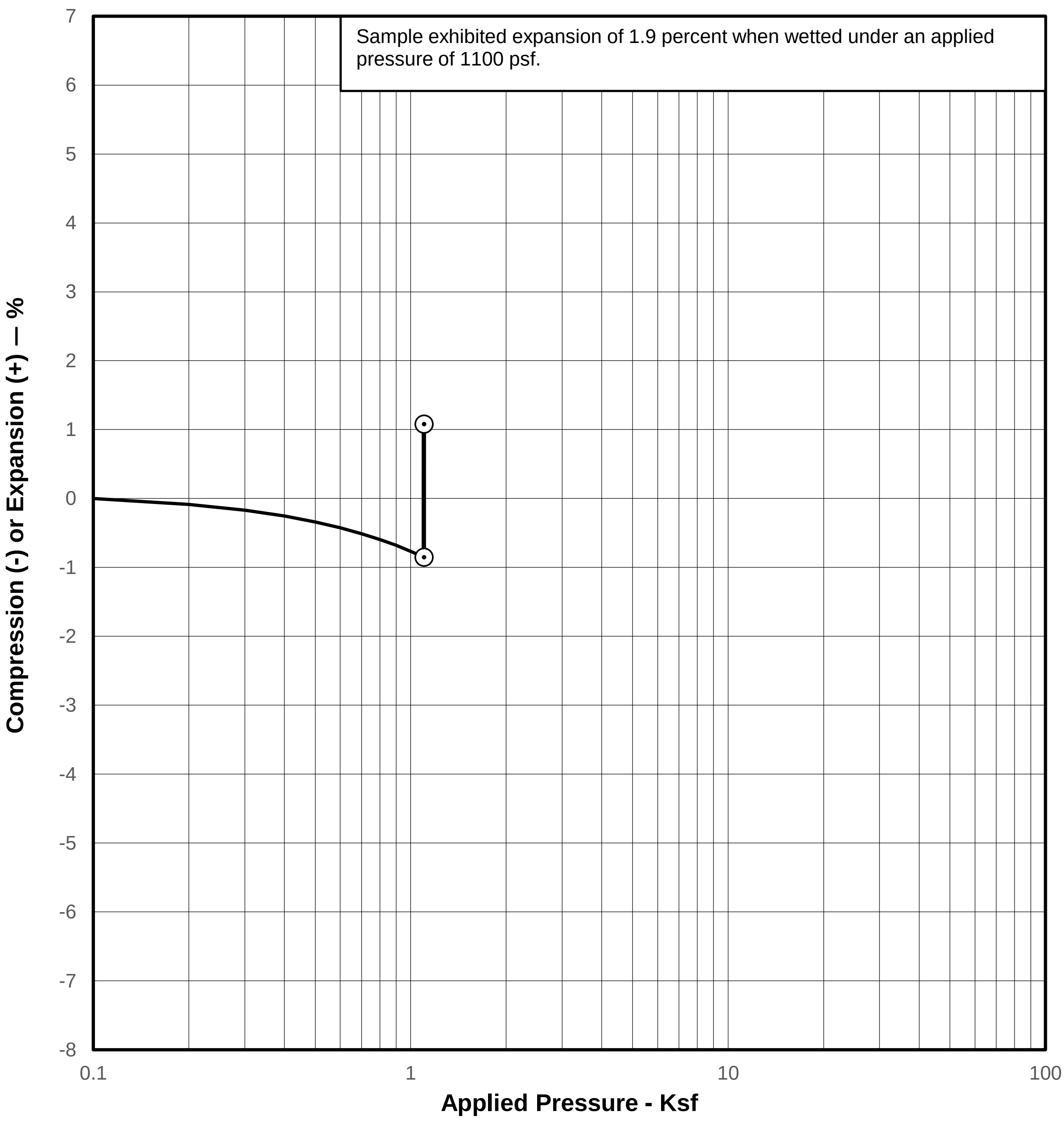
MOISTURE CONTENT:	24.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	105 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



SAMPLE OF:	CLAY, SANDY (CL)						
FROM:	TH-8 AT 4 FEET						
MOISTURE CONTENT:	23.2	%	LIQUID LIMIT:	69	SILT AND CLAY:		%
DRY UNIT WEIGHT:	101	pcf	PLASTICITY INDEX:	44	SOIL SUCTION:		pf

Swell Consolidation
Test Results

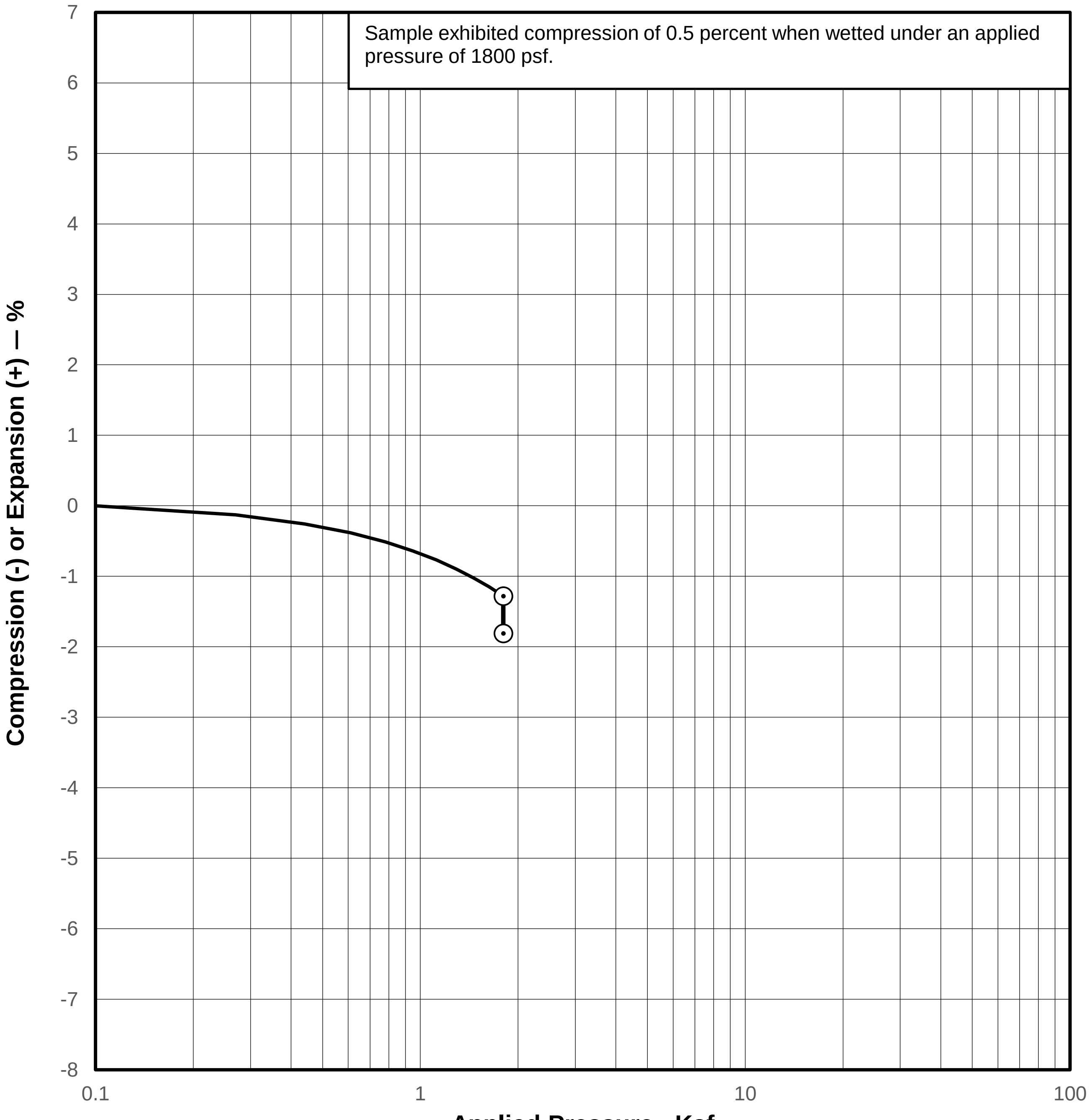


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-8 AT 9 FEET

MOISTURE CONTENT:	13.8 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	115 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

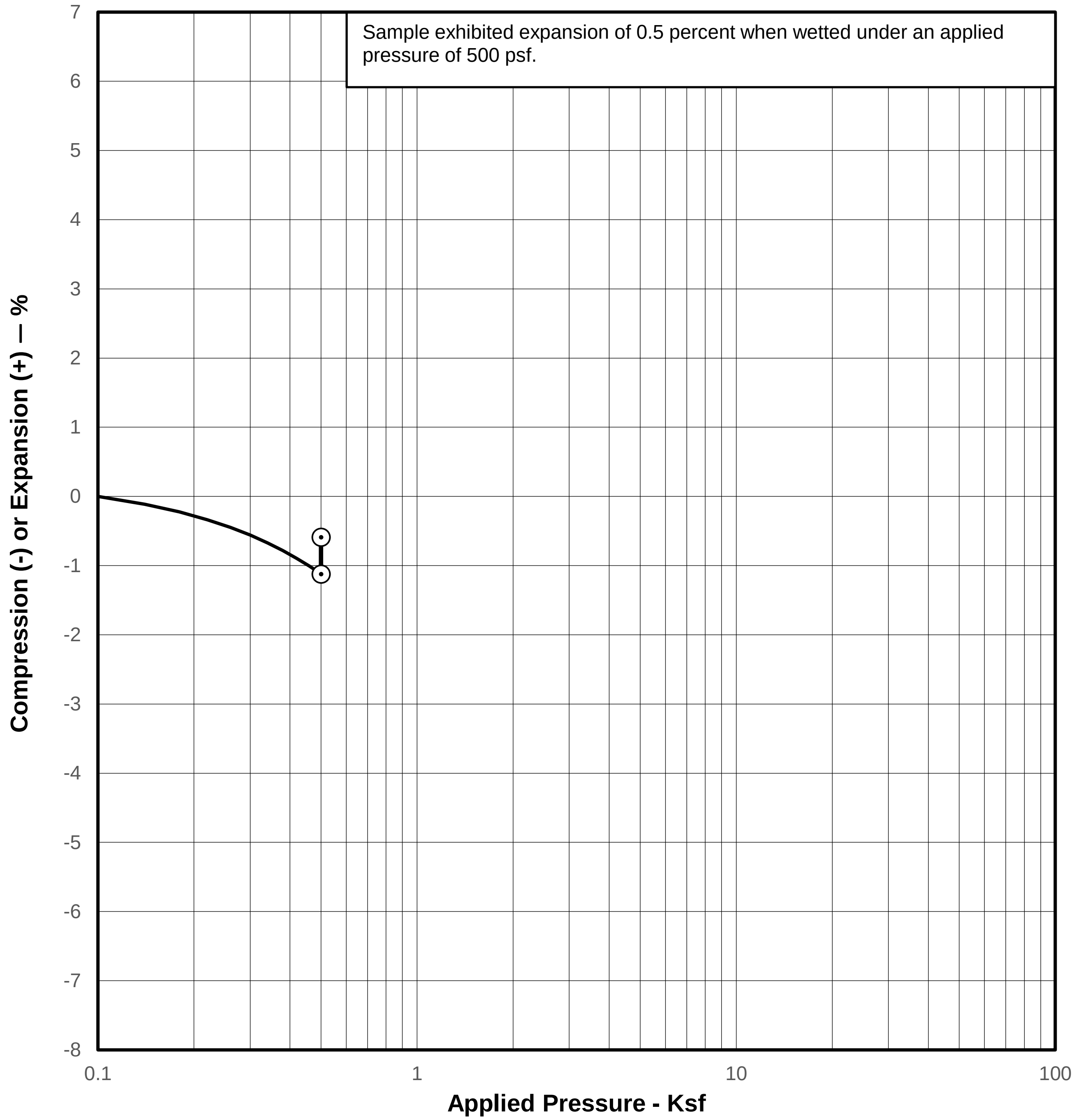


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-8 AT 14 FEET

MOISTURE CONTENT:	22.0 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	96 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

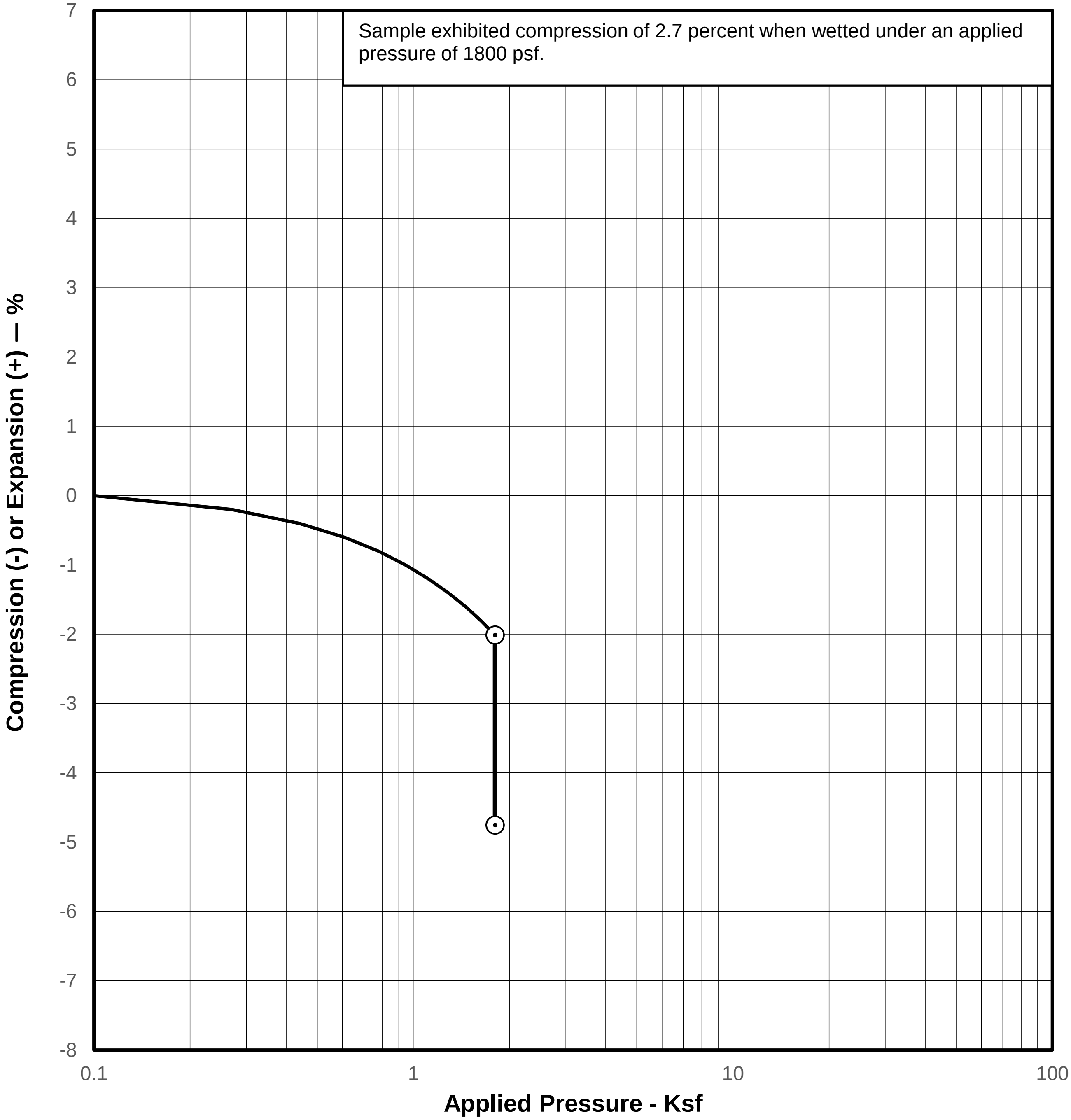
Swell Consolidation Test Results



SAMPLE OF:	CLAY, SANDY (CL)		
FROM:	TH-9 AT 4 FEET		

MOISTURE CONTENT:	15.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	107 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

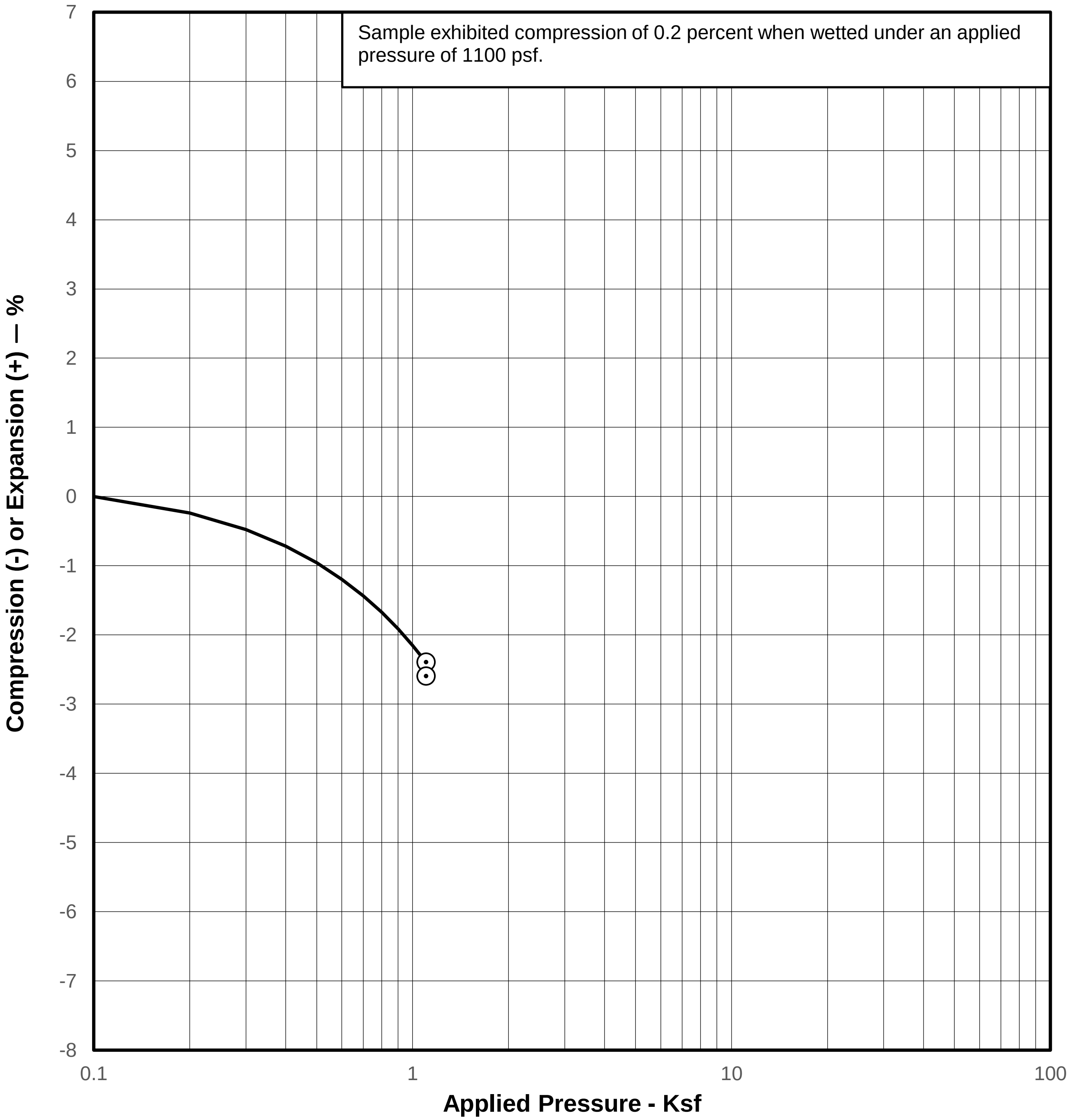


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-9 AT 14 FEET

MOISTURE CONTENT:	15.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	95 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

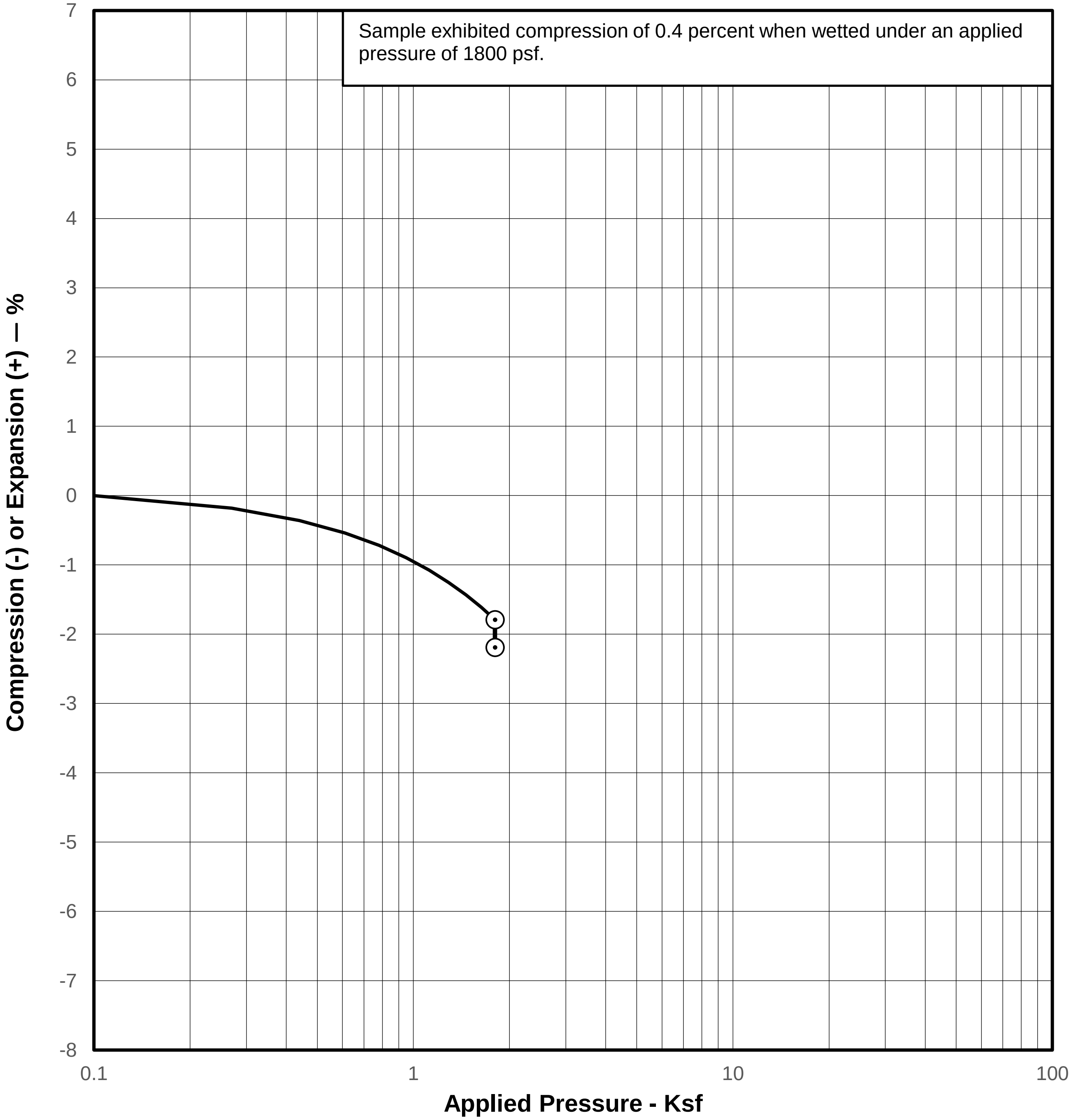


SAMPLE OF: SAND, CLAYEY (SC)

FROM: TH-10 AT 9 FEET

MOISTURE CONTENT:	10.0 %	LIQUID LIMIT:	36	SILT AND CLAY:	36 %
DRY UNIT WEIGHT:	117 pcf	PLASTICITY INDEX:	21	SOIL SUCTION:	pf

Swell Consolidation Test Results

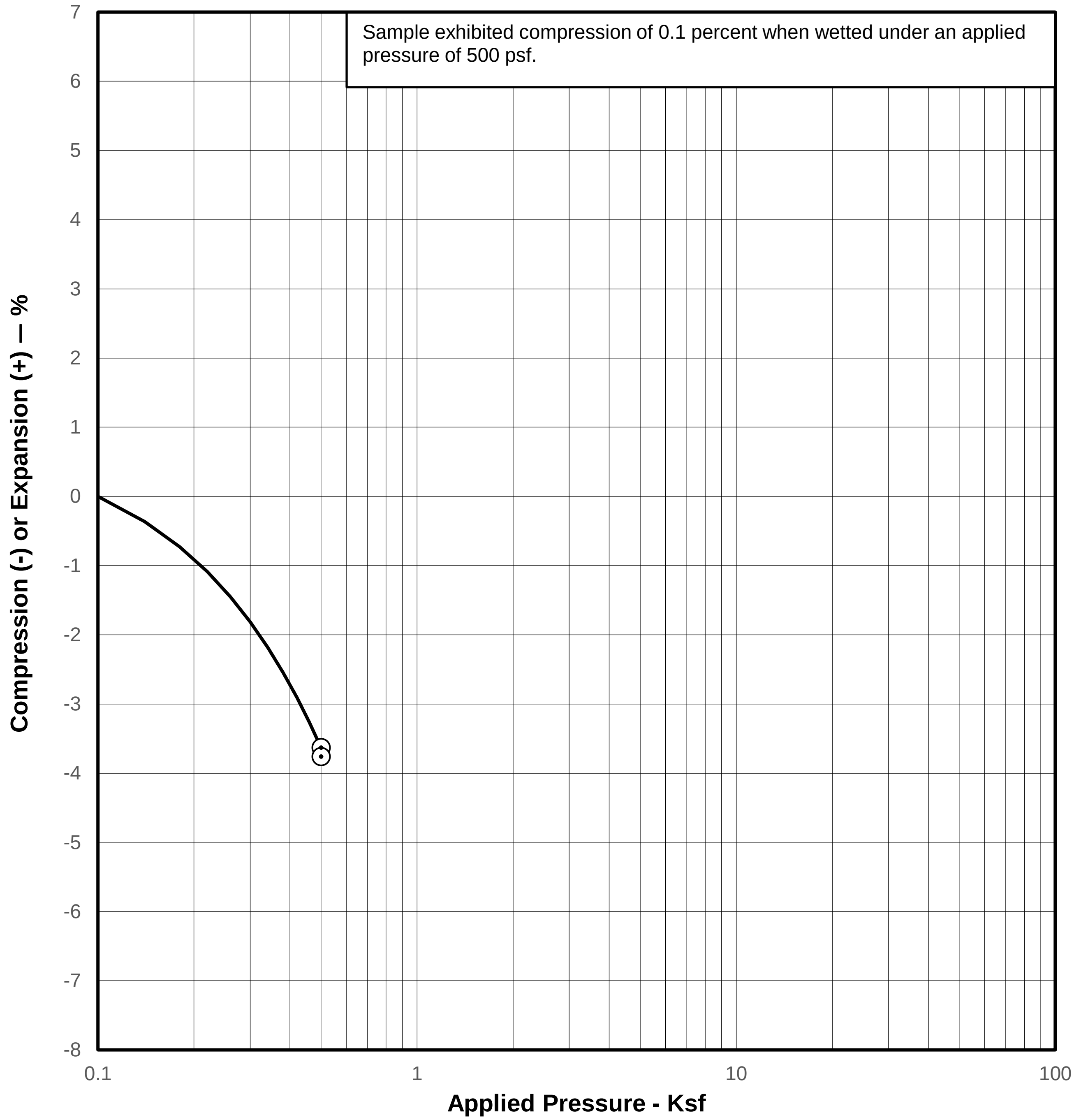


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-10 AT 14 FEET

MOISTURE CONTENT:	28.0 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	86 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



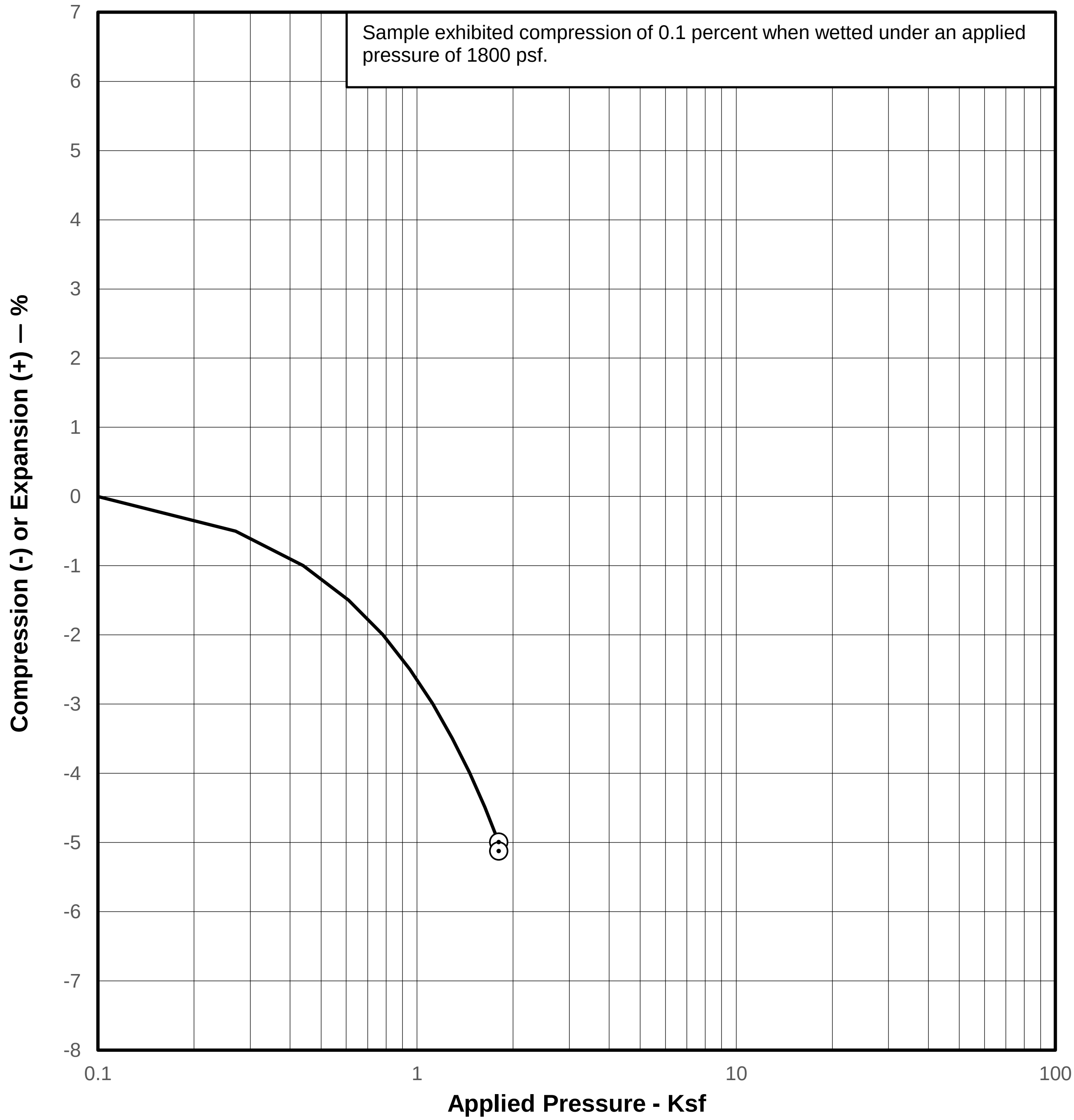
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-11 AT 4 FEET

MOISTURE CONTENT: 30.5 %   LIQUID LIMIT: ____   SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 84 pcf   PLASTICITY INDEX: ____   SOIL SUCTION: 3.17 pf

Swell Consolidation Test Results



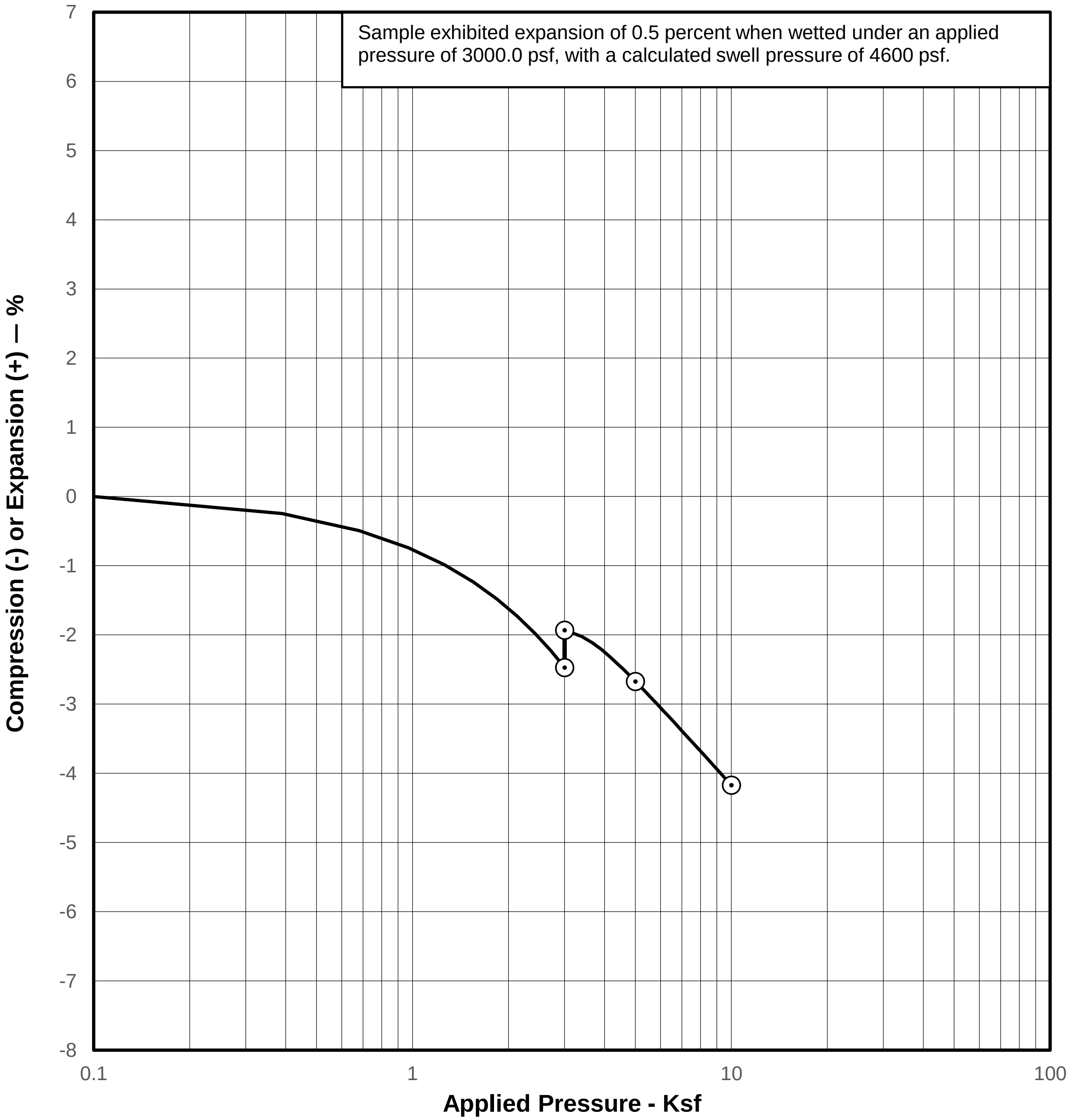
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-11 AT 14 FEET

MOISTURE CONTENT: 25.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

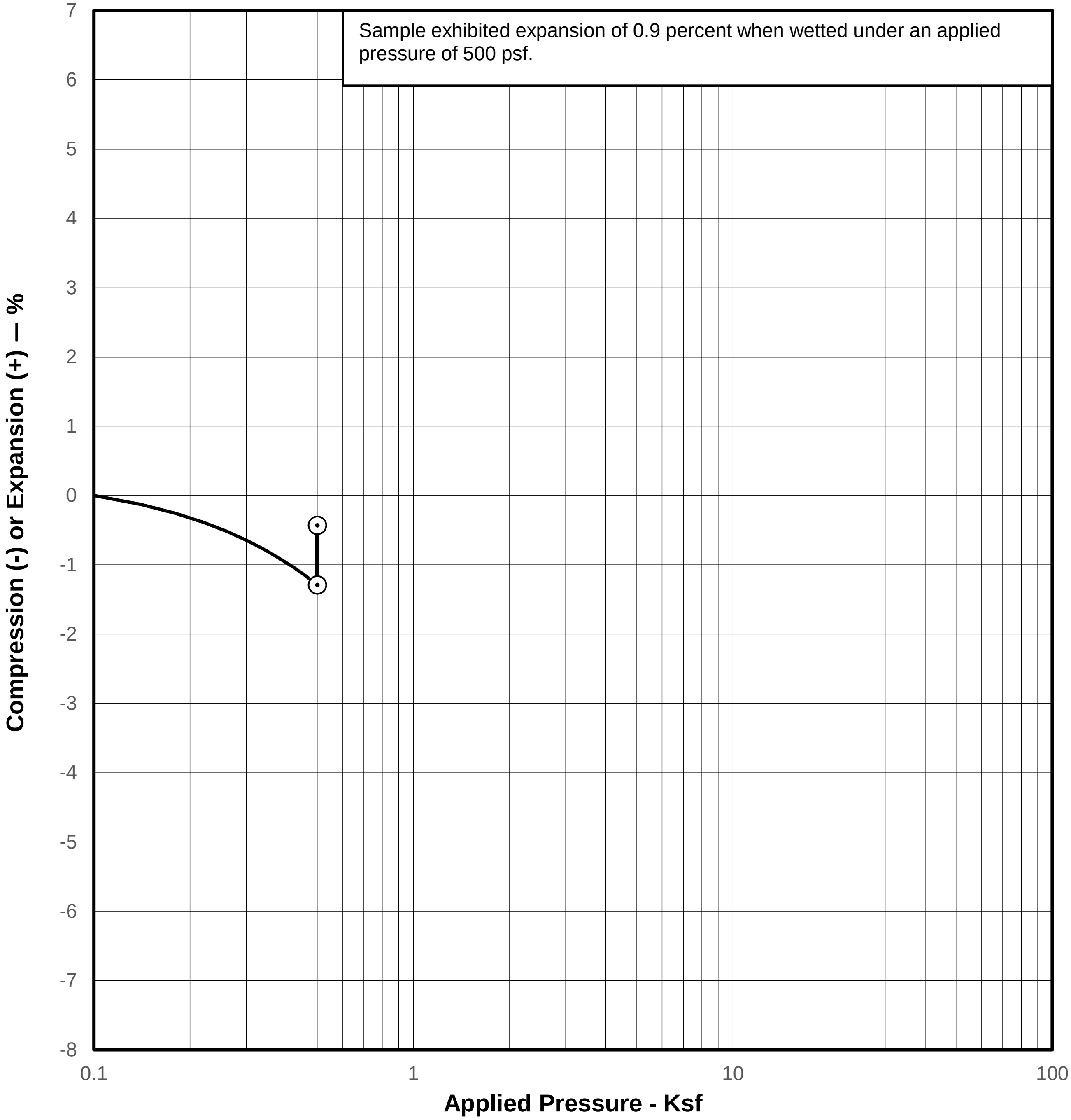
DRY UNIT WEIGHT: 92 pcf PLASTICITY INDEX: ____ SOIL SUCTION: 2.84 pf

Swell Consolidation Test Results



SAMPLE OF:	CLAYSTONE						
FROM:	TH-11 AT 24 FEET						
MOISTURE CONTENT:	27.0 %	LIQUID LIMIT:		SILT AND CLAY:		%	
DRY UNIT WEIGHT:	88 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.70	pf	

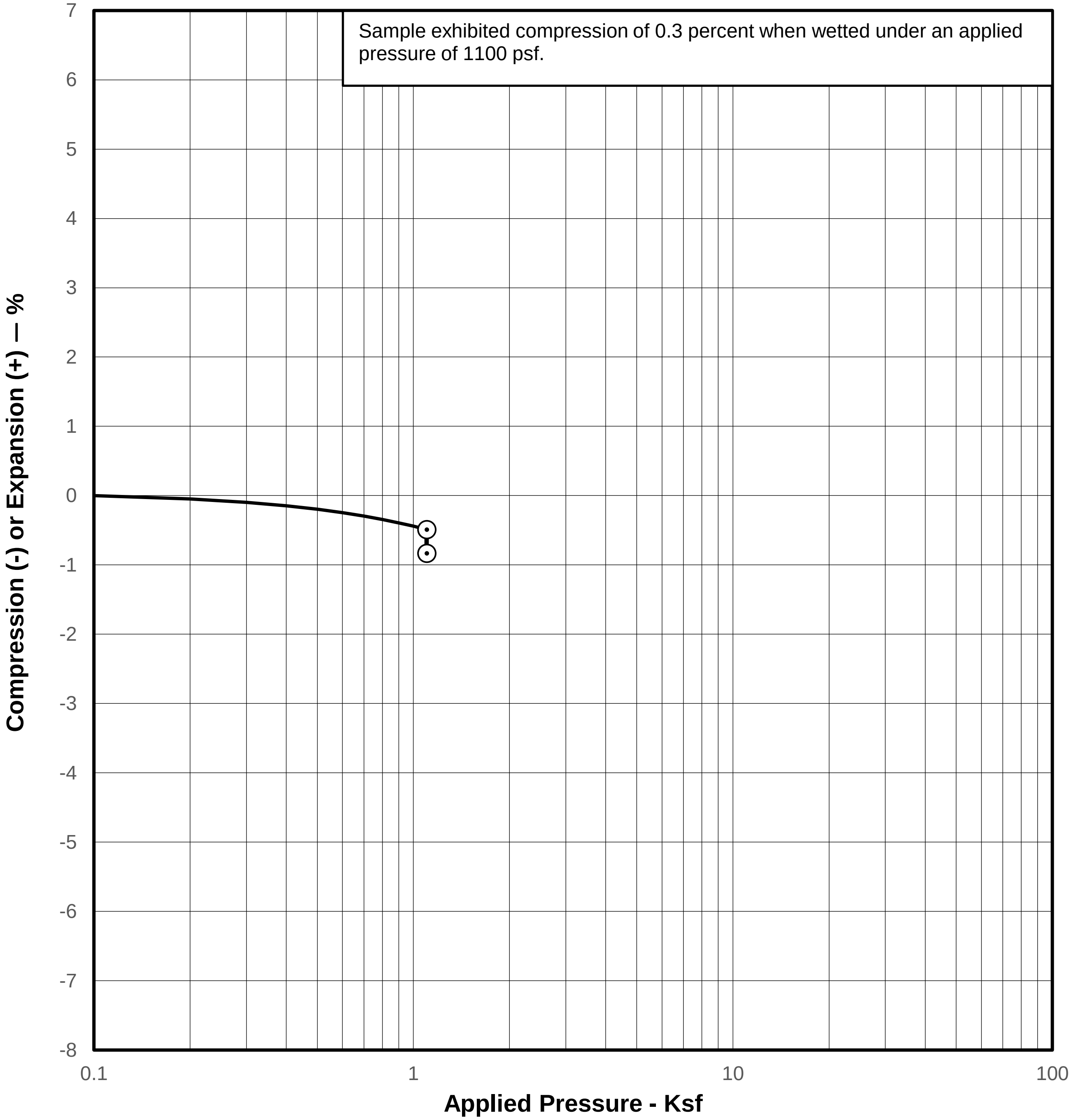
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-12 AT 4 FEET

MOISTURE CONTENT: 15.7 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 101 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

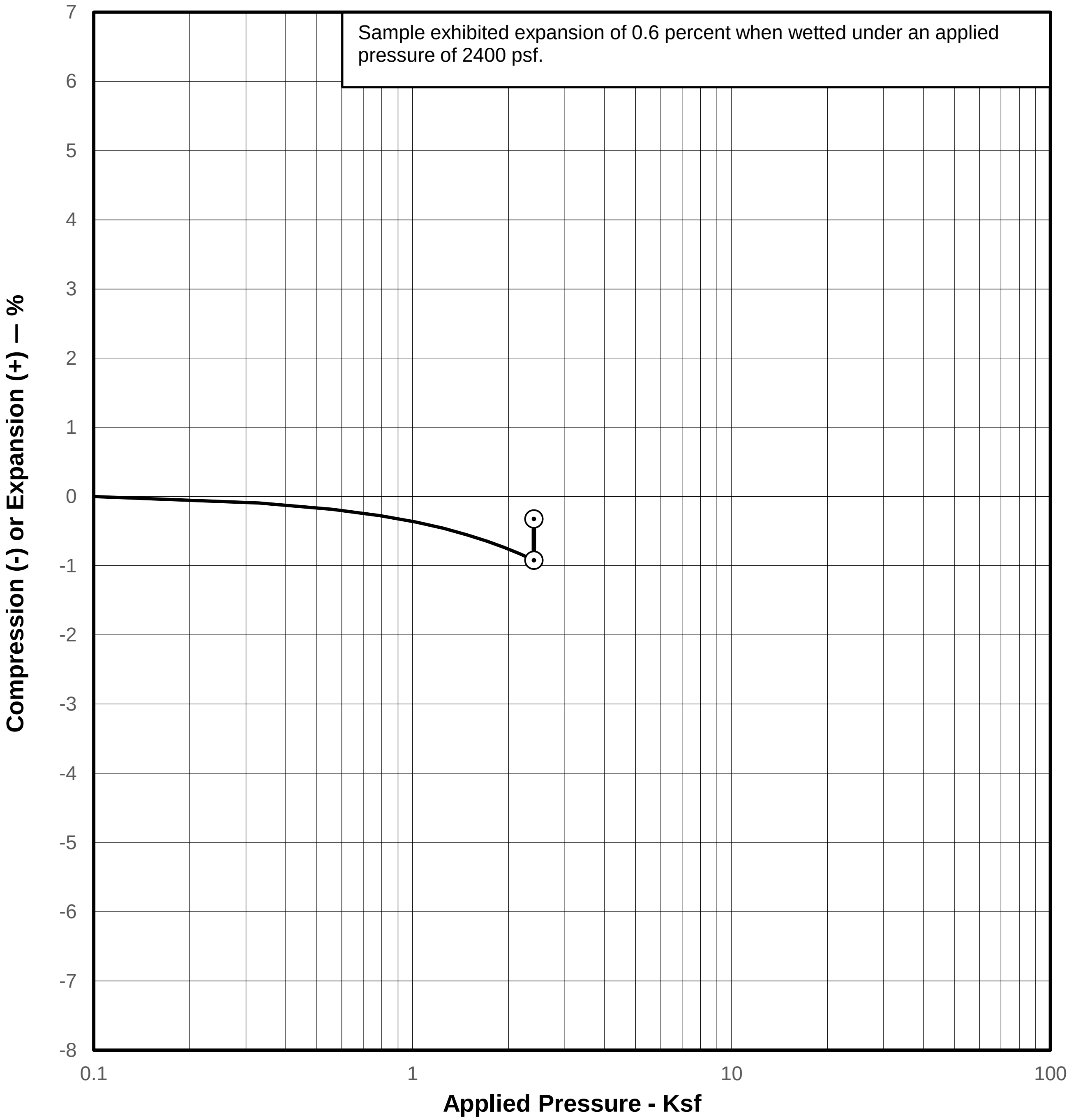


SAMPLE OF: SAND, CLAYEY (SC)

FROM: TH-12 AT 9 FEET

MOISTURE CONTENT:	9.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	116 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



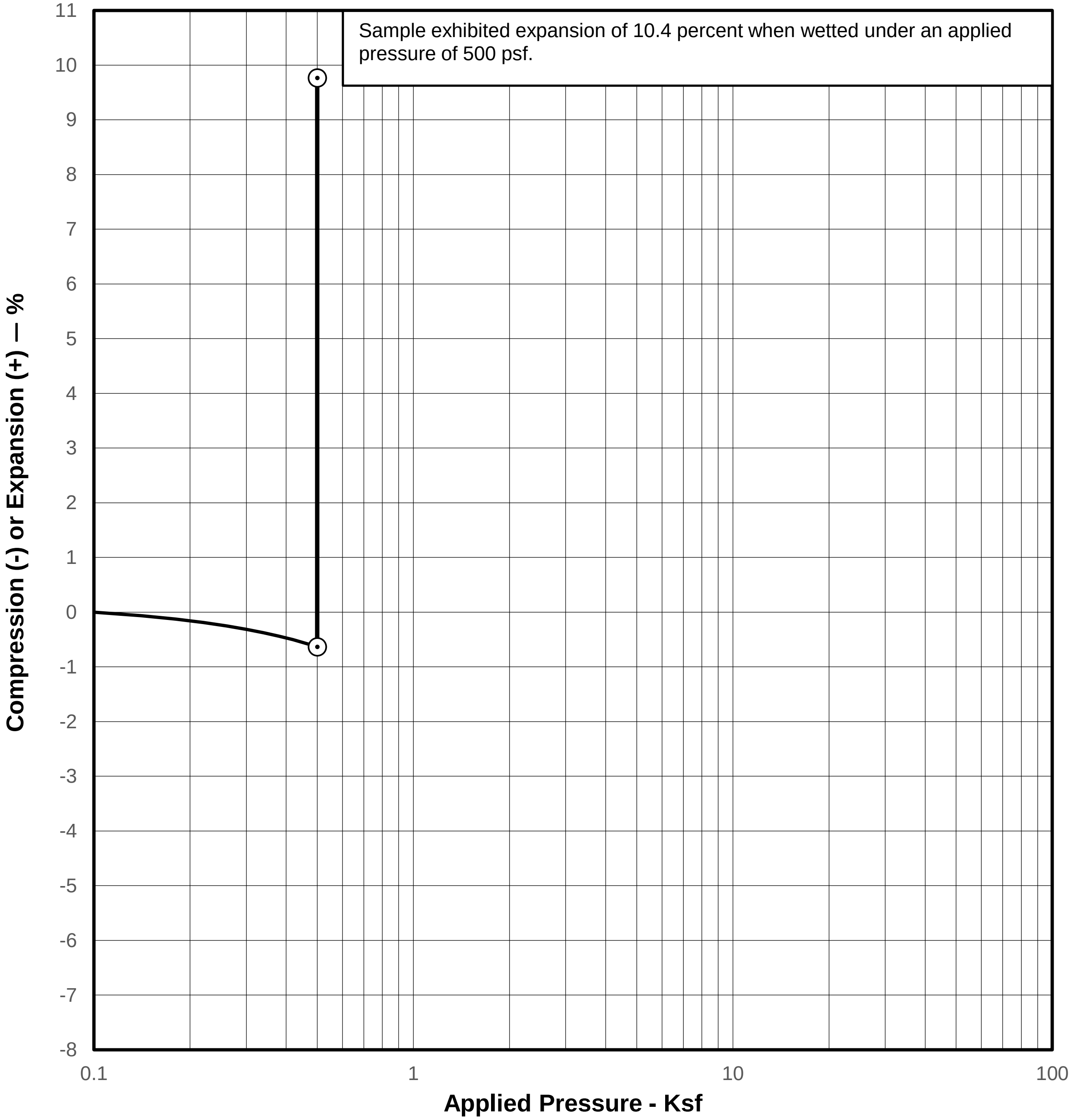
SAMPLE OF: WEATHERED CLAYSTONE

FROM: TH-12 AT 19 FEET

MOISTURE CONTENT: 34.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 85 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

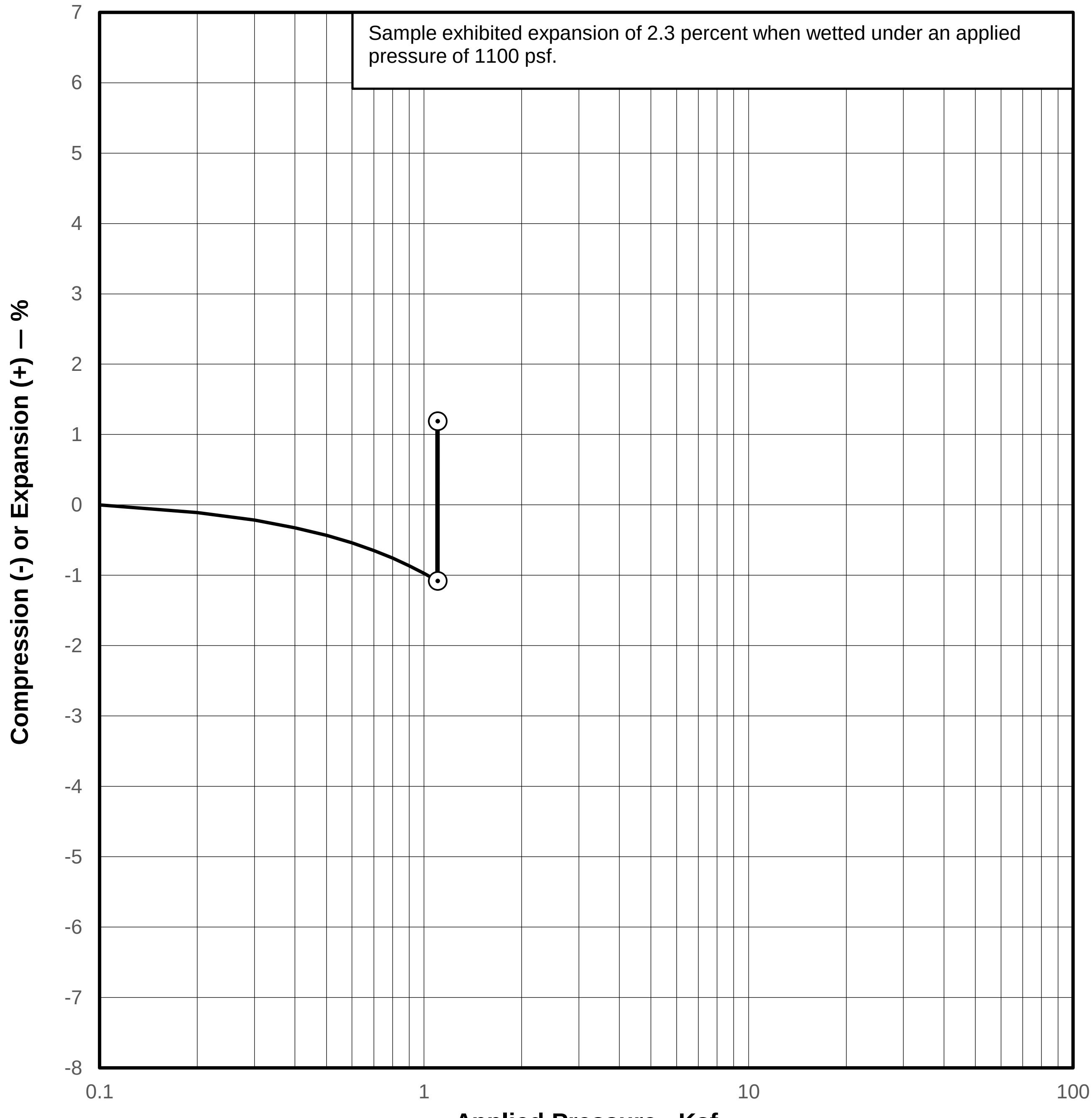


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-13 AT 4 FEET

MOISTURE CONTENT:	13.8 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	106 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

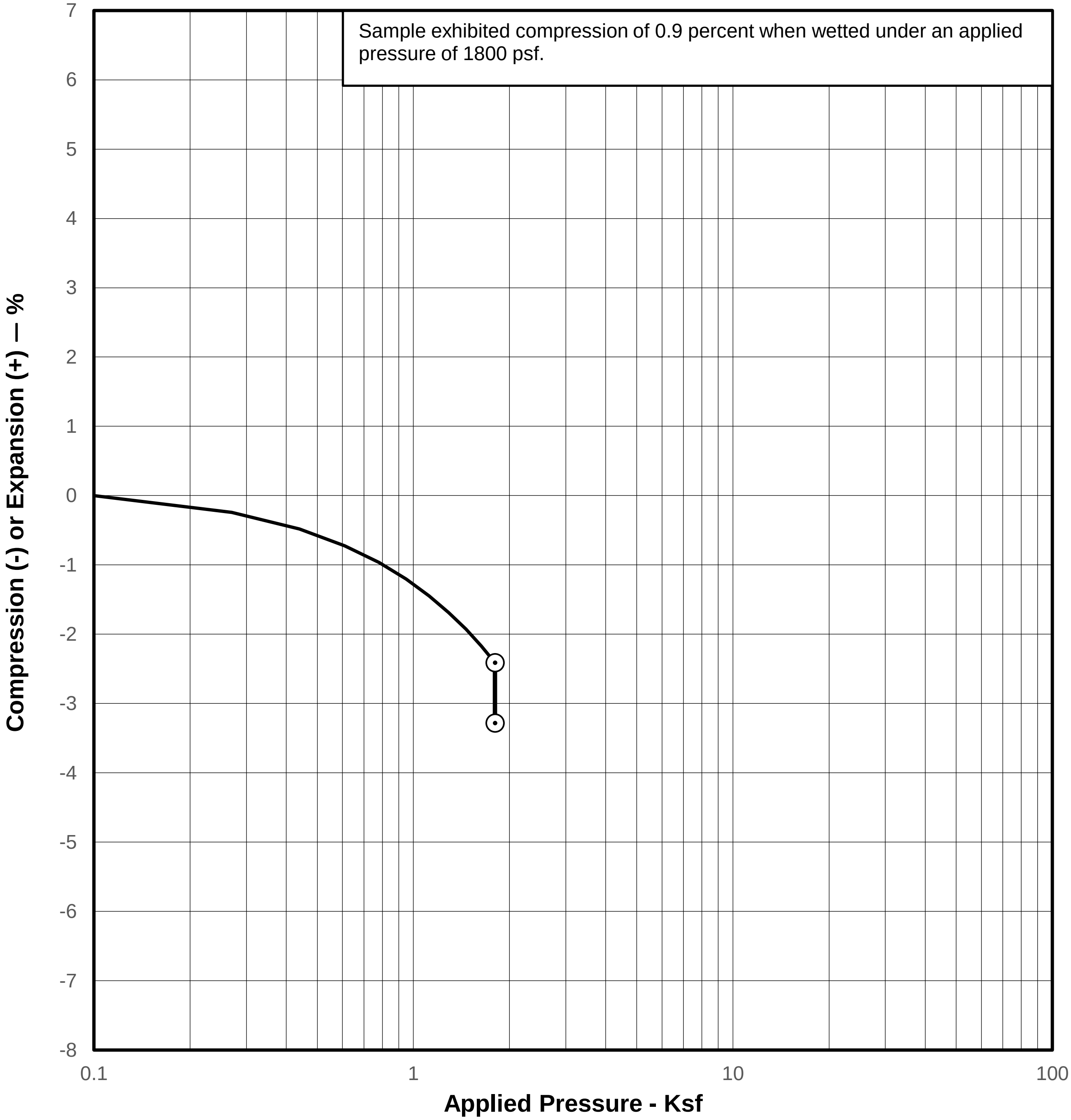


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-13 AT 9 FEET

MOISTURE CONTENT:	14.4 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	112 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

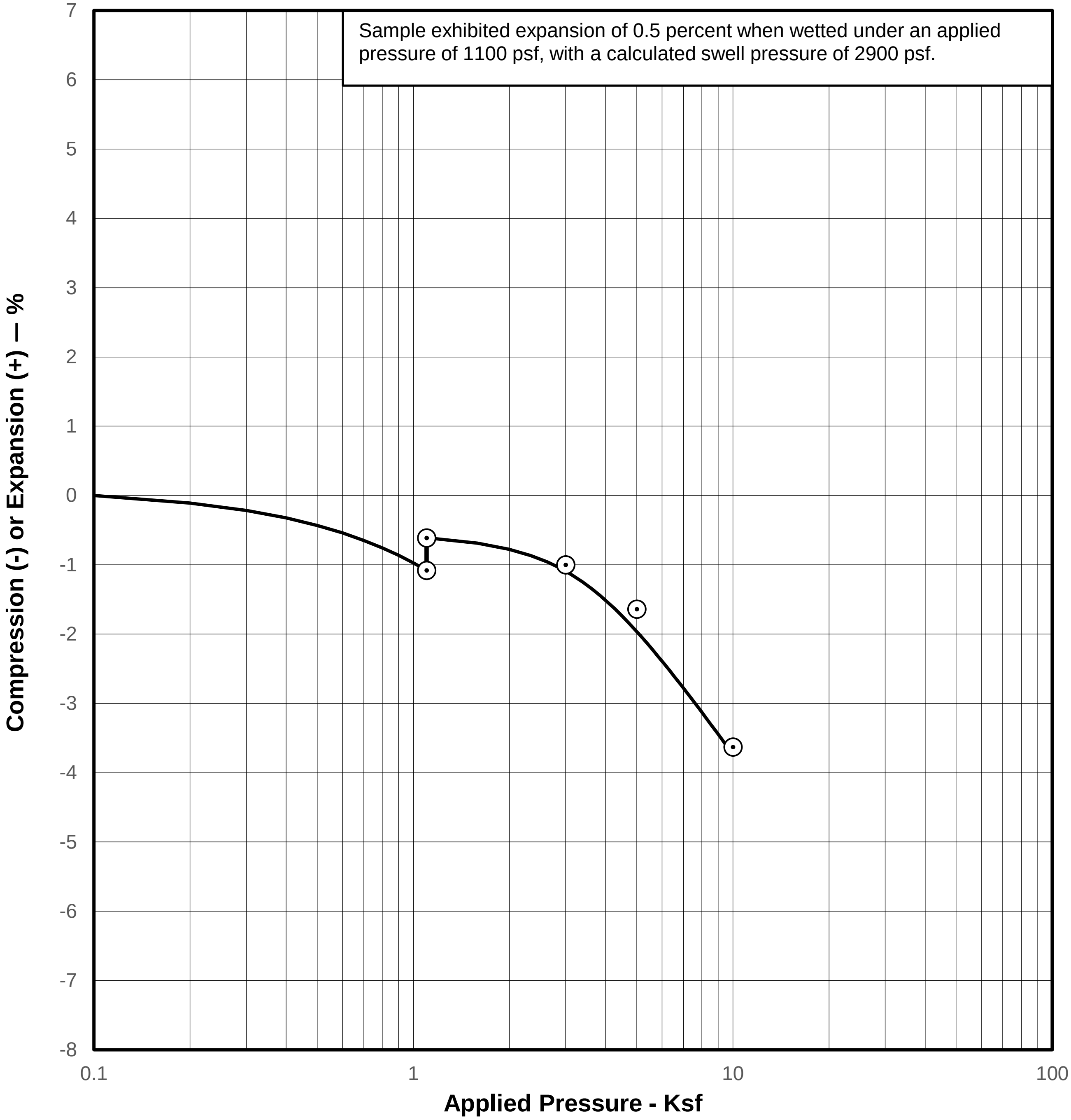
Swell Consolidation Test Results



SAMPLE OF: SAND, CLAYEY (SC)
FROM: TH-13 AT 14 FEET

MOISTURE CONTENT:	13.3 %	LIQUID LIMIT:	31	SILT AND CLAY:	39 %
DRY UNIT WEIGHT:	107 pcf	PLASTICITY INDEX:	18	SOIL SUCTION:	pf

Swell Consolidation Test Results

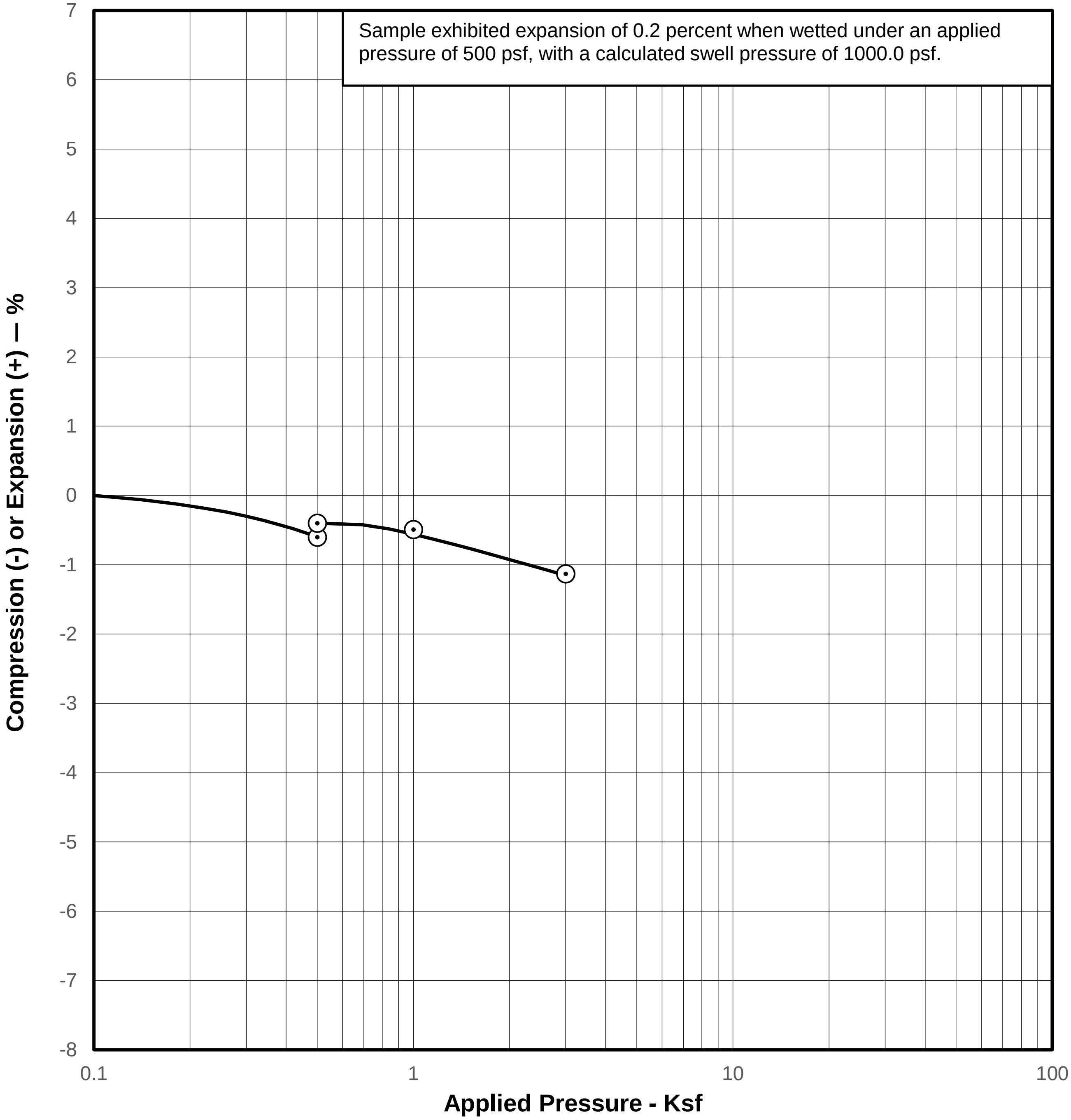


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-14 AT 9 FEET

MOISTURE CONTENT:	27.0 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	93 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

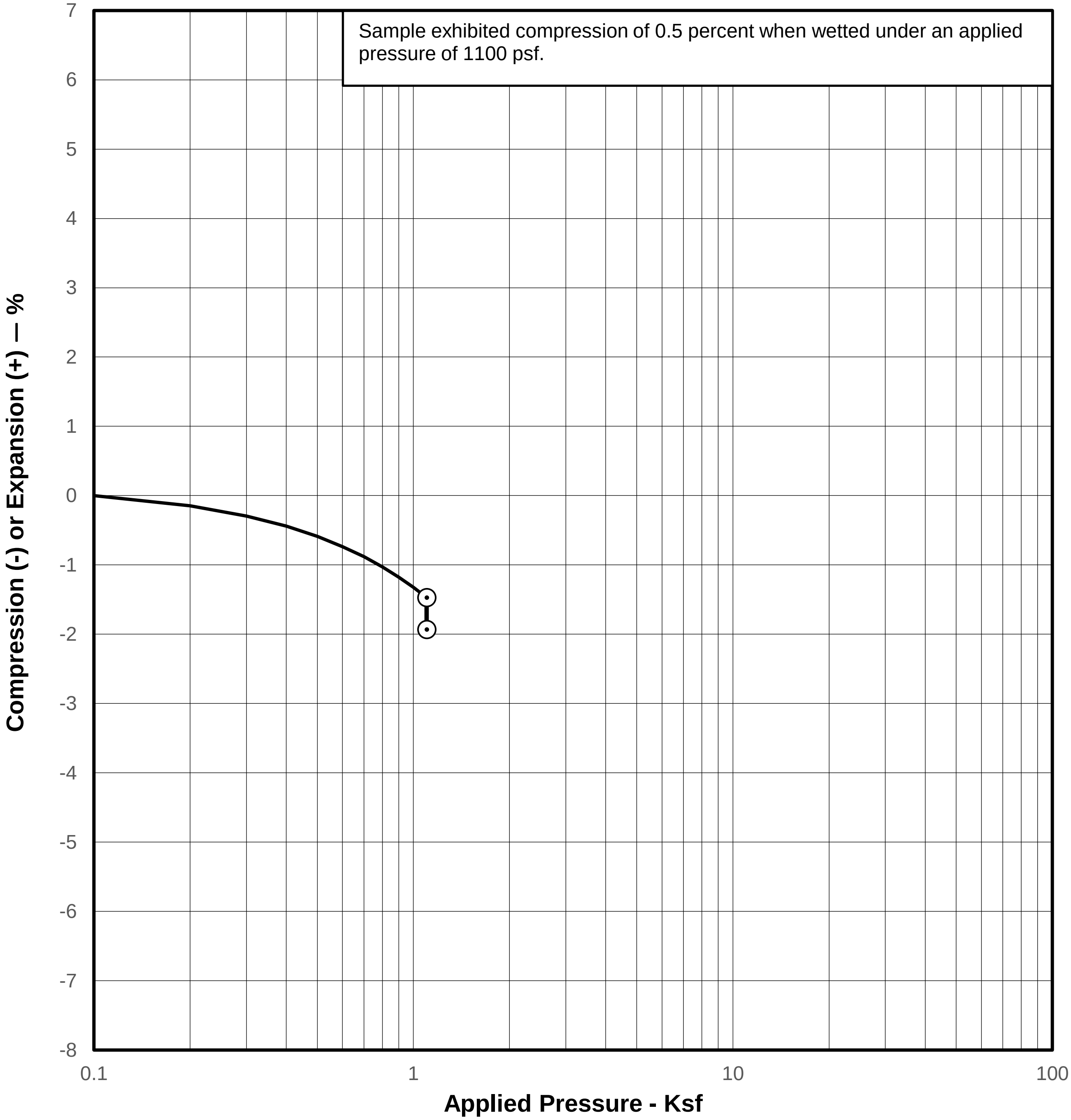


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-15 AT 4 FEET

MOISTURE CONTENT:	33.9	%	LIQUID LIMIT:			SILT AND CLAY:		%
DRY UNIT WEIGHT:	85	pcf	PLASTICITY INDEX:			SOIL SUCTION:	2.88	pf

Swell Consolidation Test Results

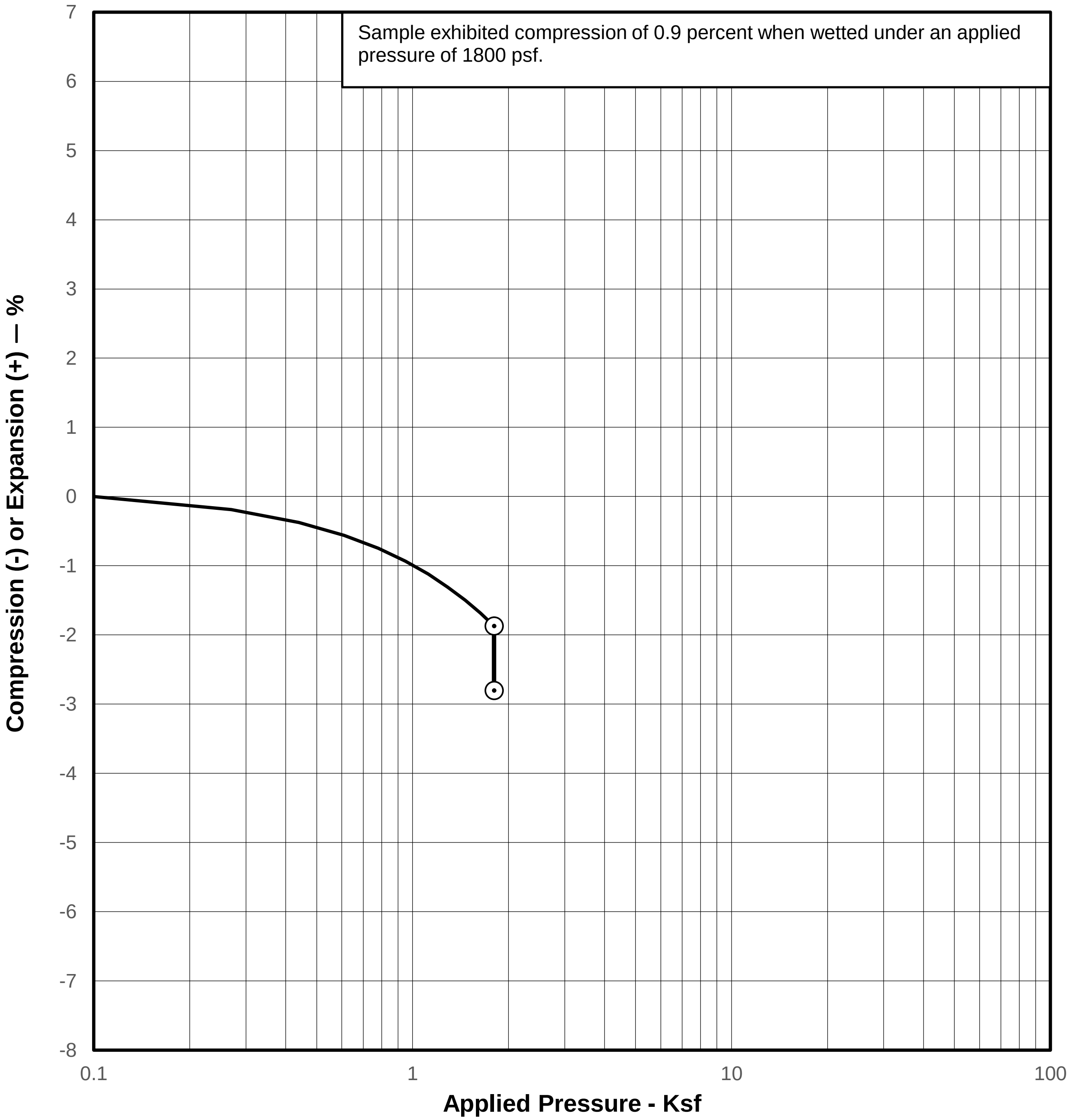


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-15 AT 9 FEET

MOISTURE CONTENT:	22.4 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	96 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.37 pf

Swell Consolidation Test Results

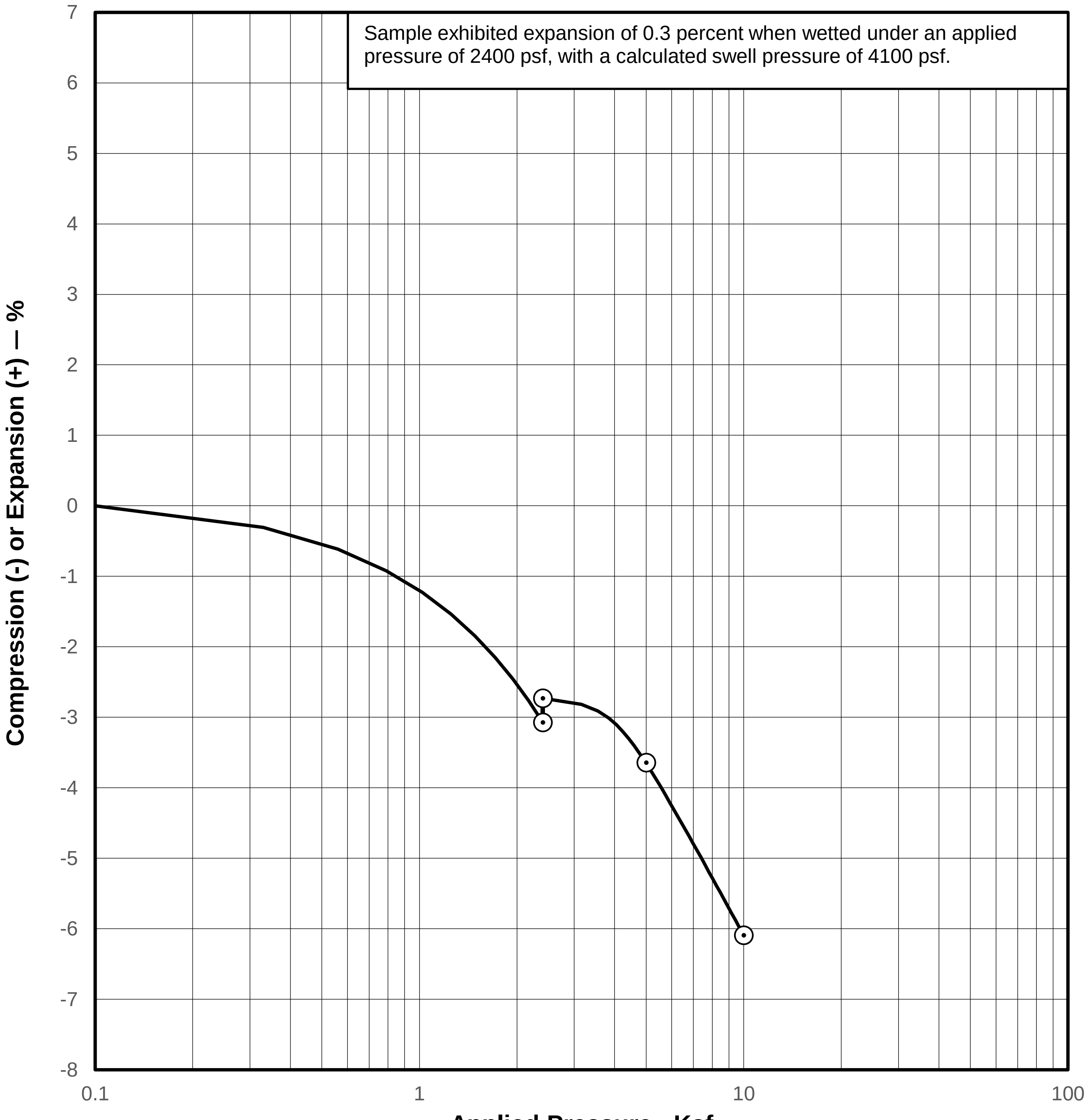


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-15 AT 14 FEET

MOISTURE CONTENT:	18.6 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	93 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.53 pf

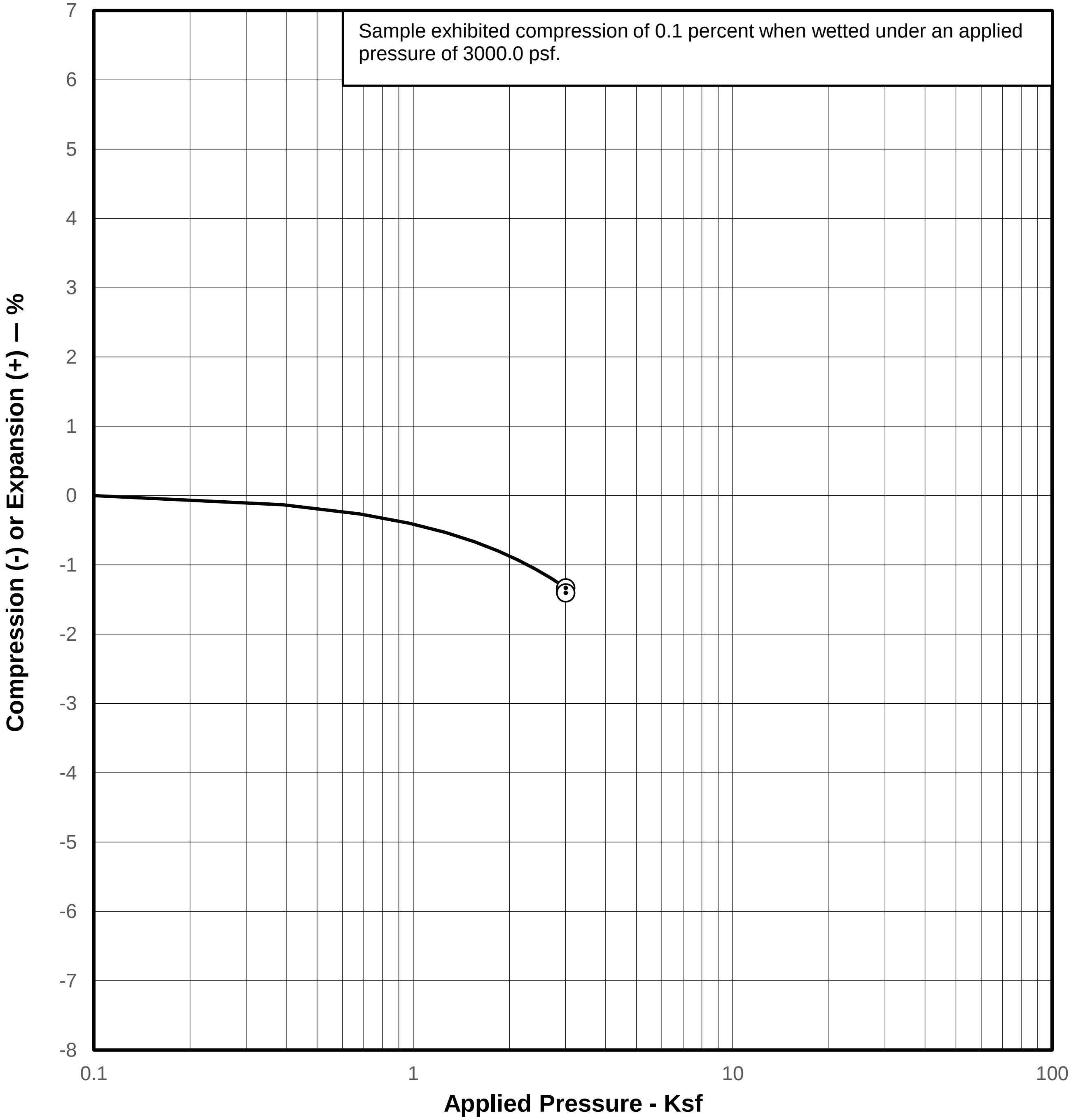
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-15 AT 19 FEET

MOISTURE CONTENT:	25.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	94 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.28 pf

Swell Consolidation Test Results

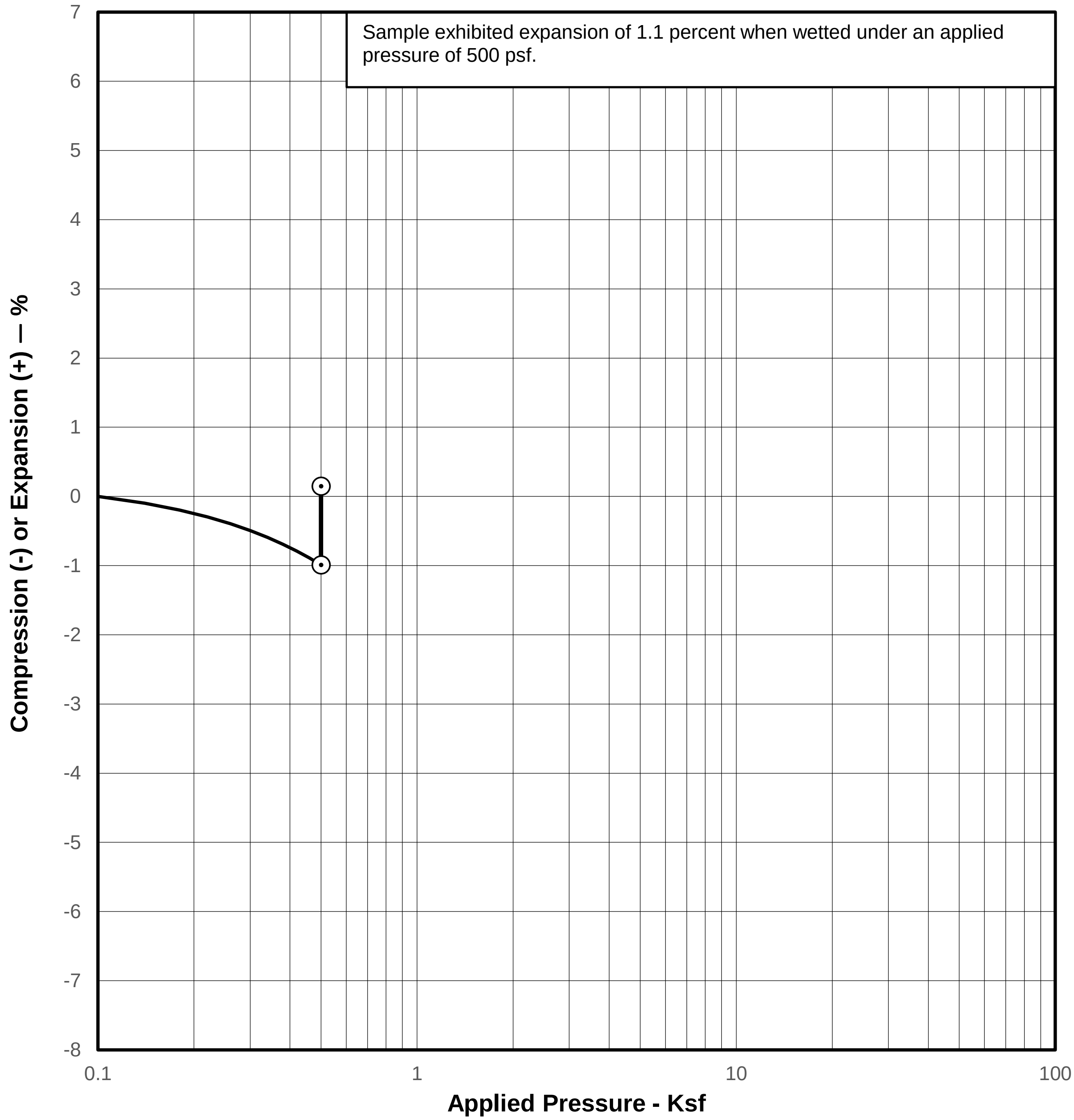


SAMPLE OF: CLAYSTONE

FROM: TH-15 AT 24 FEET

MOISTURE CONTENT:	30.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	90 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.08 pf

Swell Consolidation Test Results



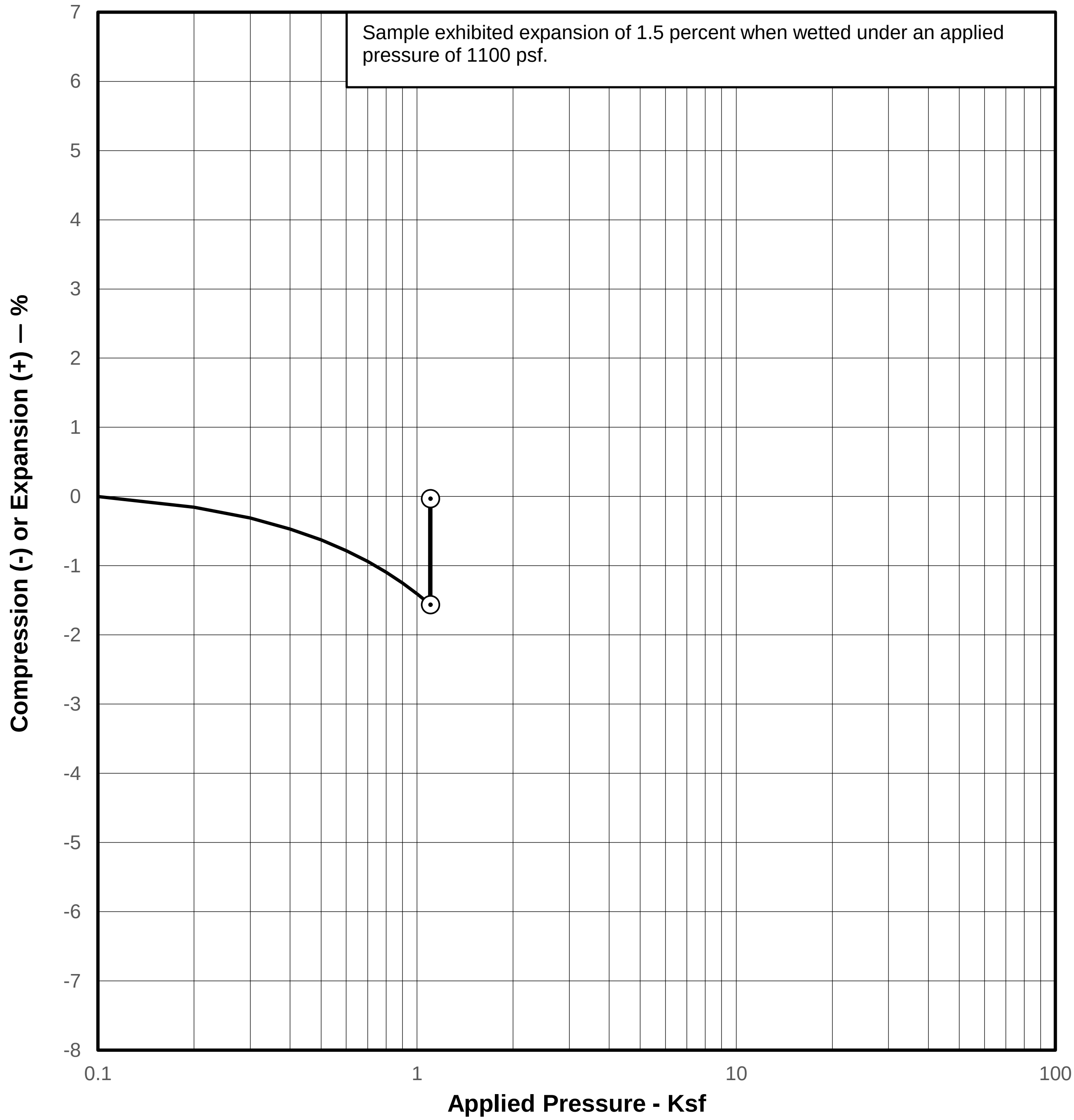
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-16 AT 4 FEET

MOISTURE CONTENT: 17.6 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 101 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

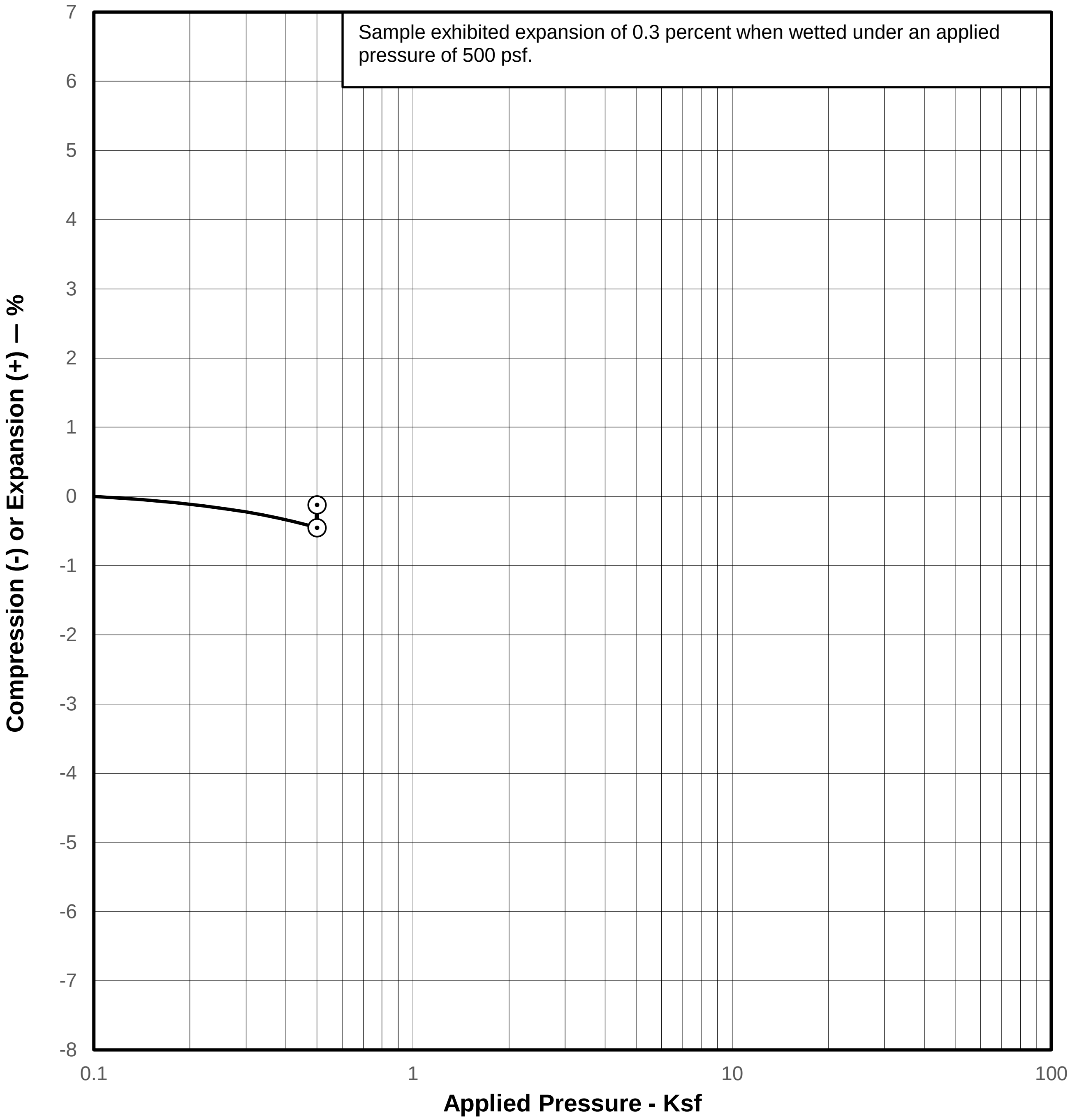


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-16 AT 9 FEET

MOISTURE CONTENT:	23.7	%	LIQUID LIMIT:			SILT AND CLAY:		%
DRY UNIT WEIGHT:	98	pcf	PLASTICITY INDEX:			SOIL SUCTION:		pf

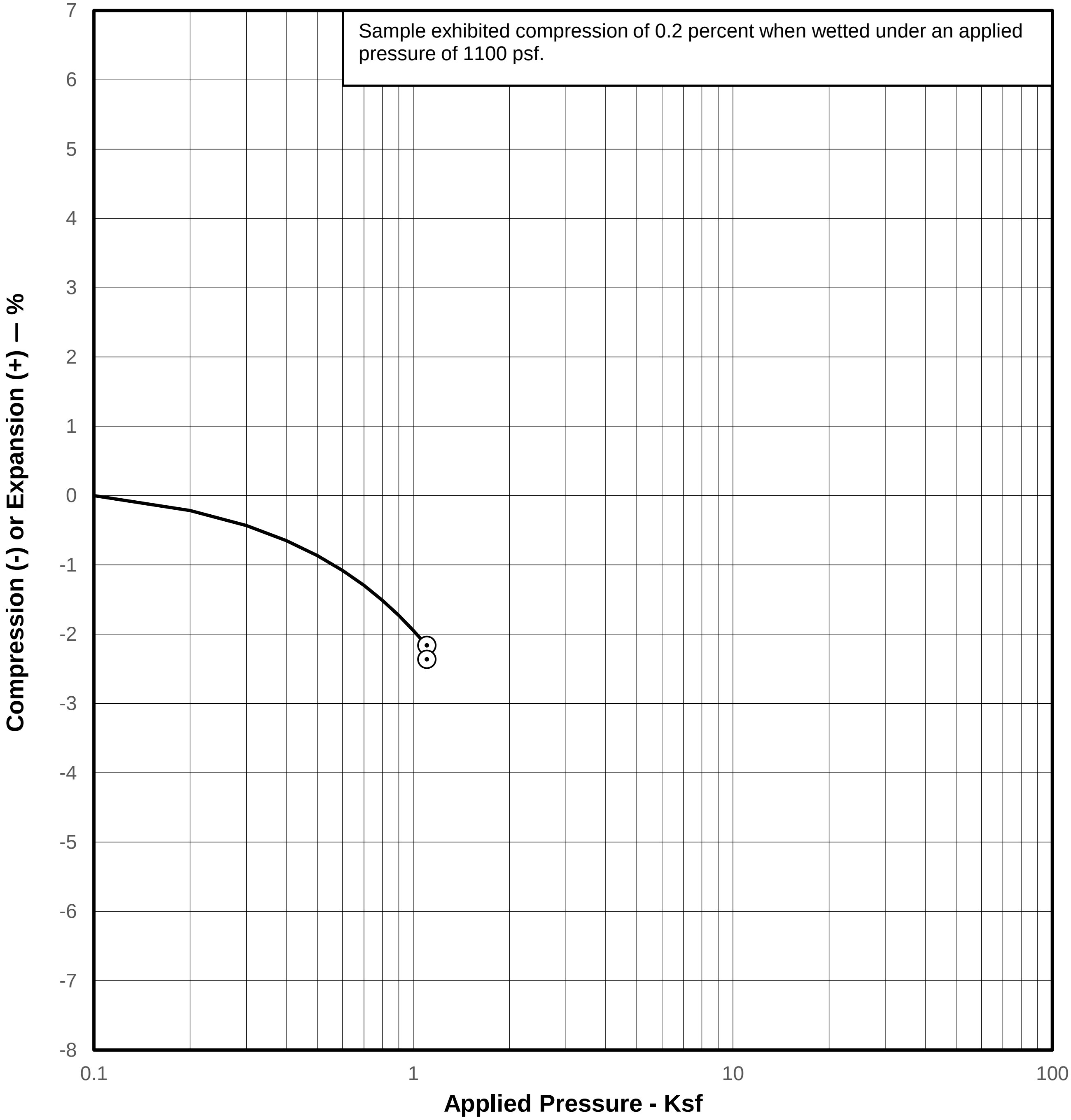
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-17 AT 4 FEET

MOISTURE CONTENT: 12.2 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 108 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results



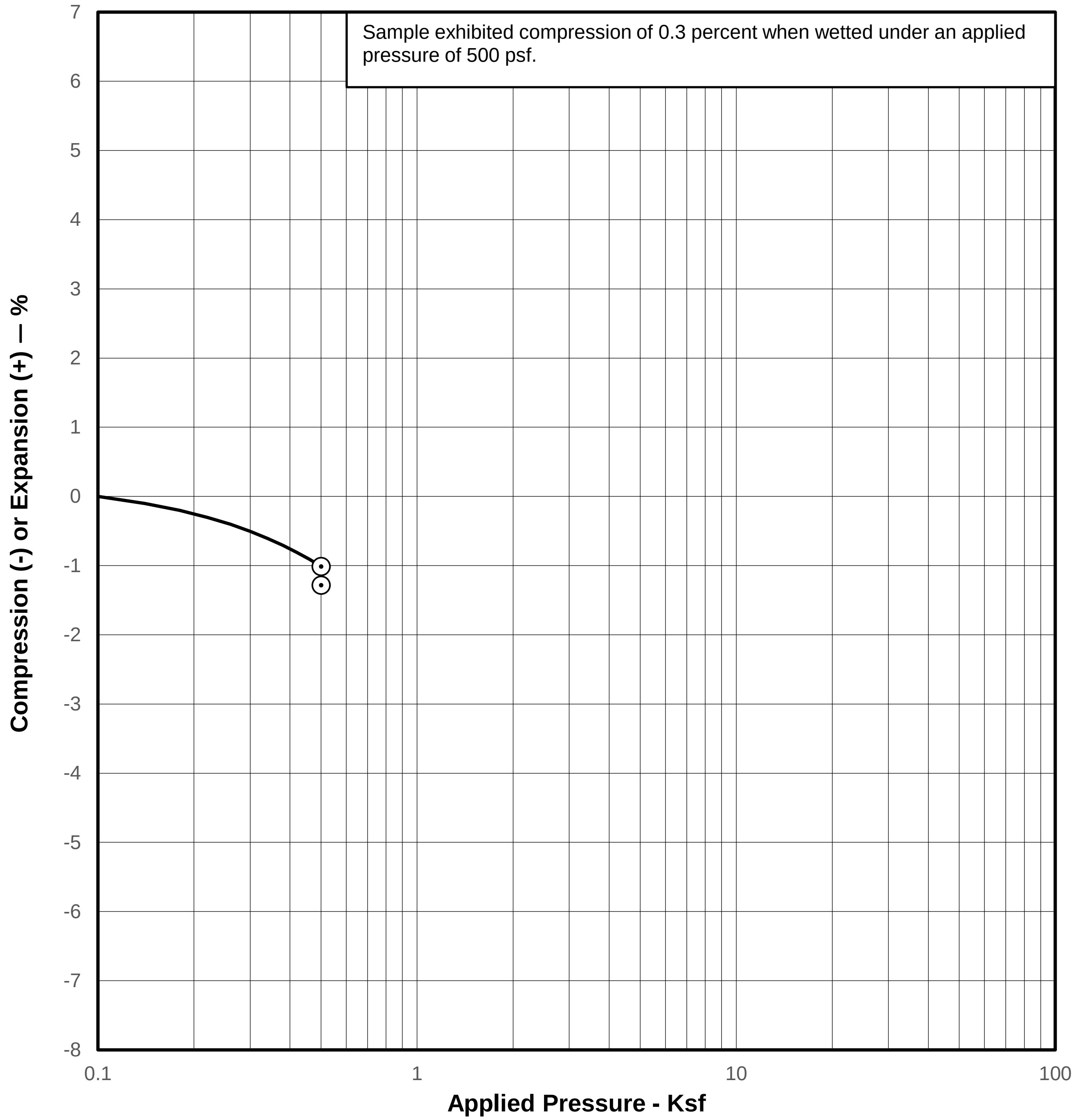
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-17 AT 9 FEET

MOISTURE CONTENT: 19.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 91 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

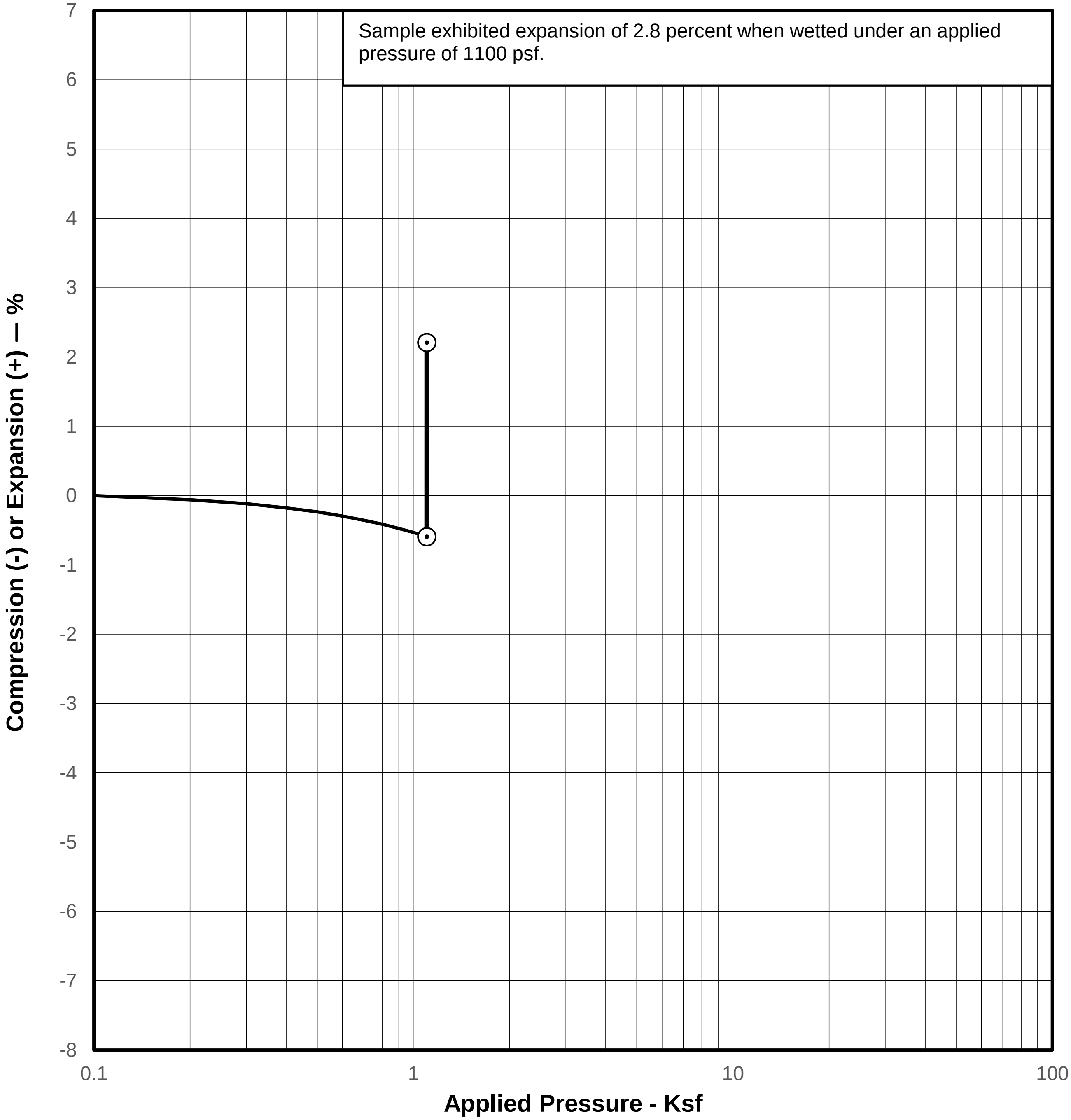
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-18 AT 4 FEET

MOISTURE CONTENT:	20.6 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	80 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



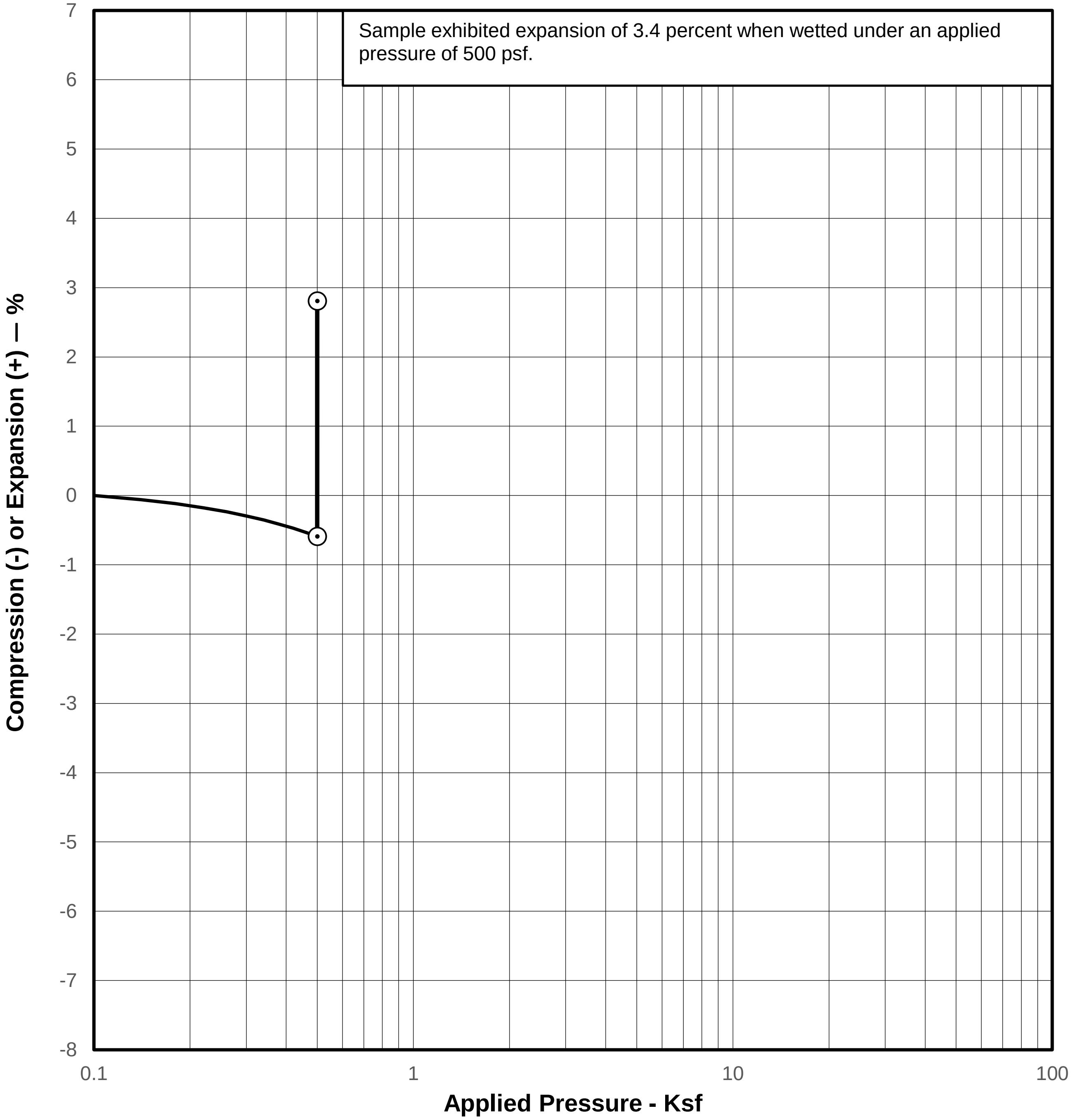
SAMPLE OF: CLAYSTONE

FROM: TH-18 AT 9 FEET

MOISTURE CONTENT: 39.6 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 79 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

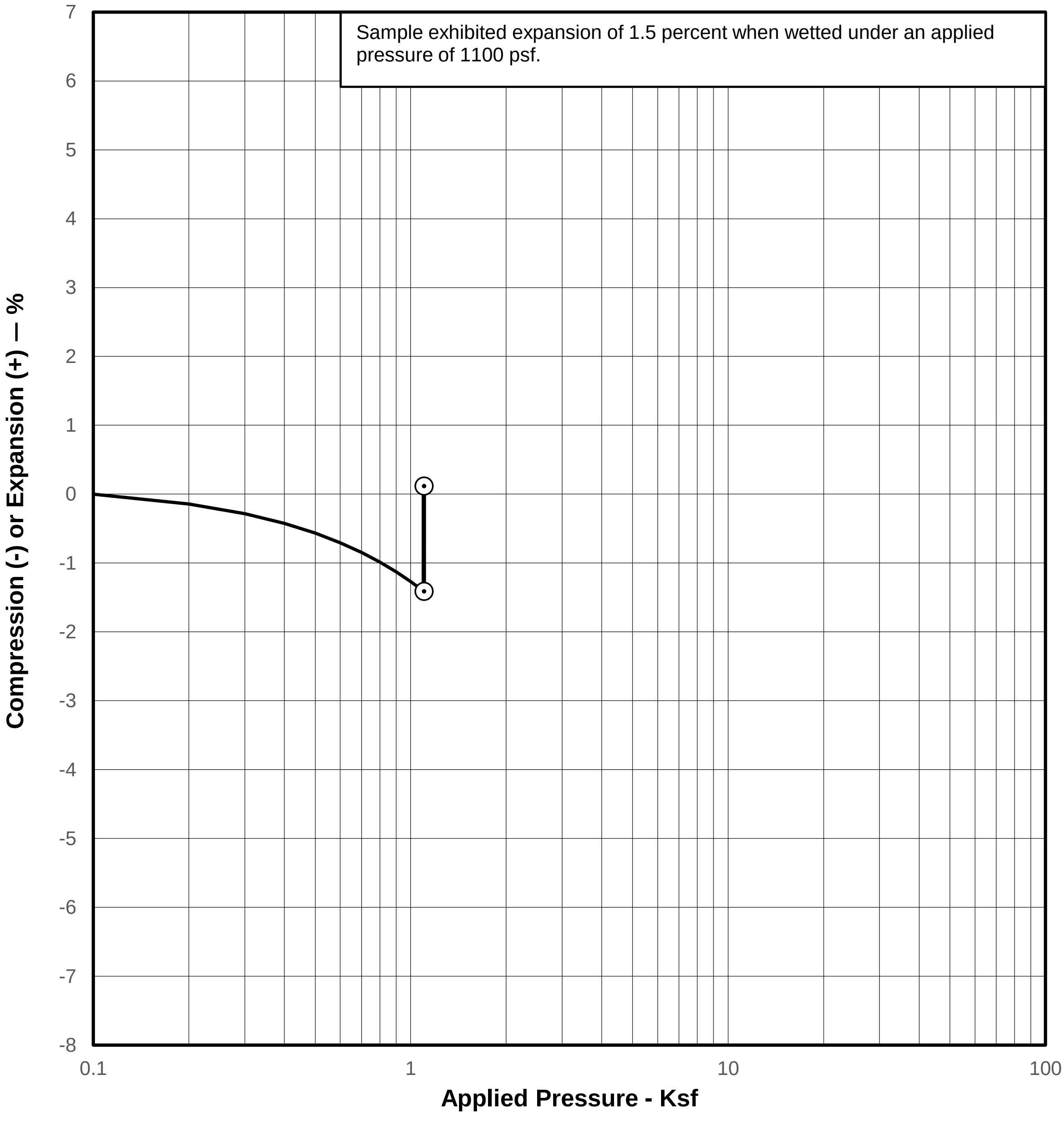
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-19 AT 4 FEET

MOISTURE CONTENT: 18.1 % LIQUID LIMIT: ______ SILT AND CLAY: ______ %
DRY UNIT WEIGHT: 97 pcf PLASTICITY INDEX: ______ SOIL SUCTION: ______ pf

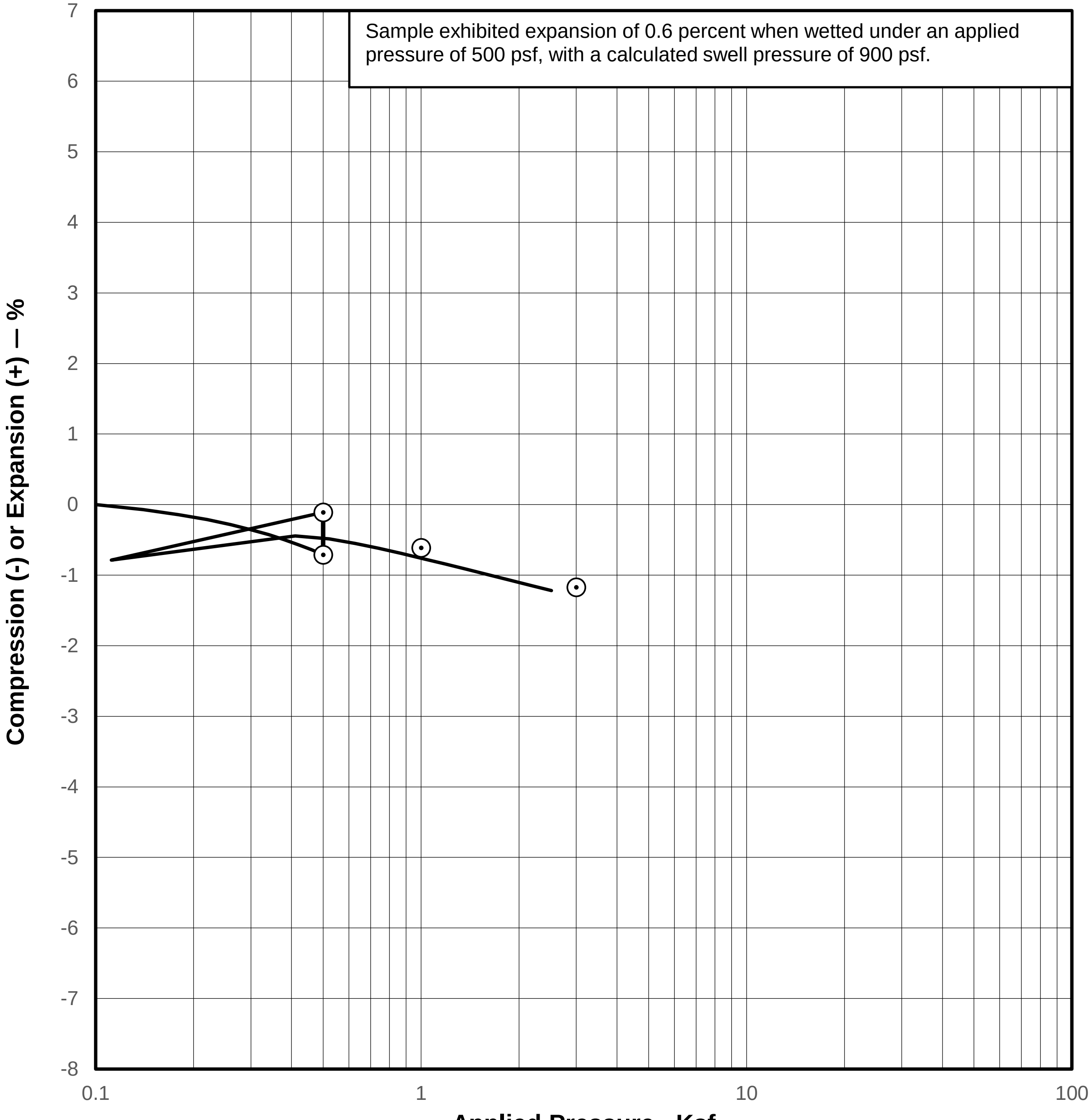
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-19 AT 9 FEET

MOISTURE CONTENT: 32.0 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 86 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

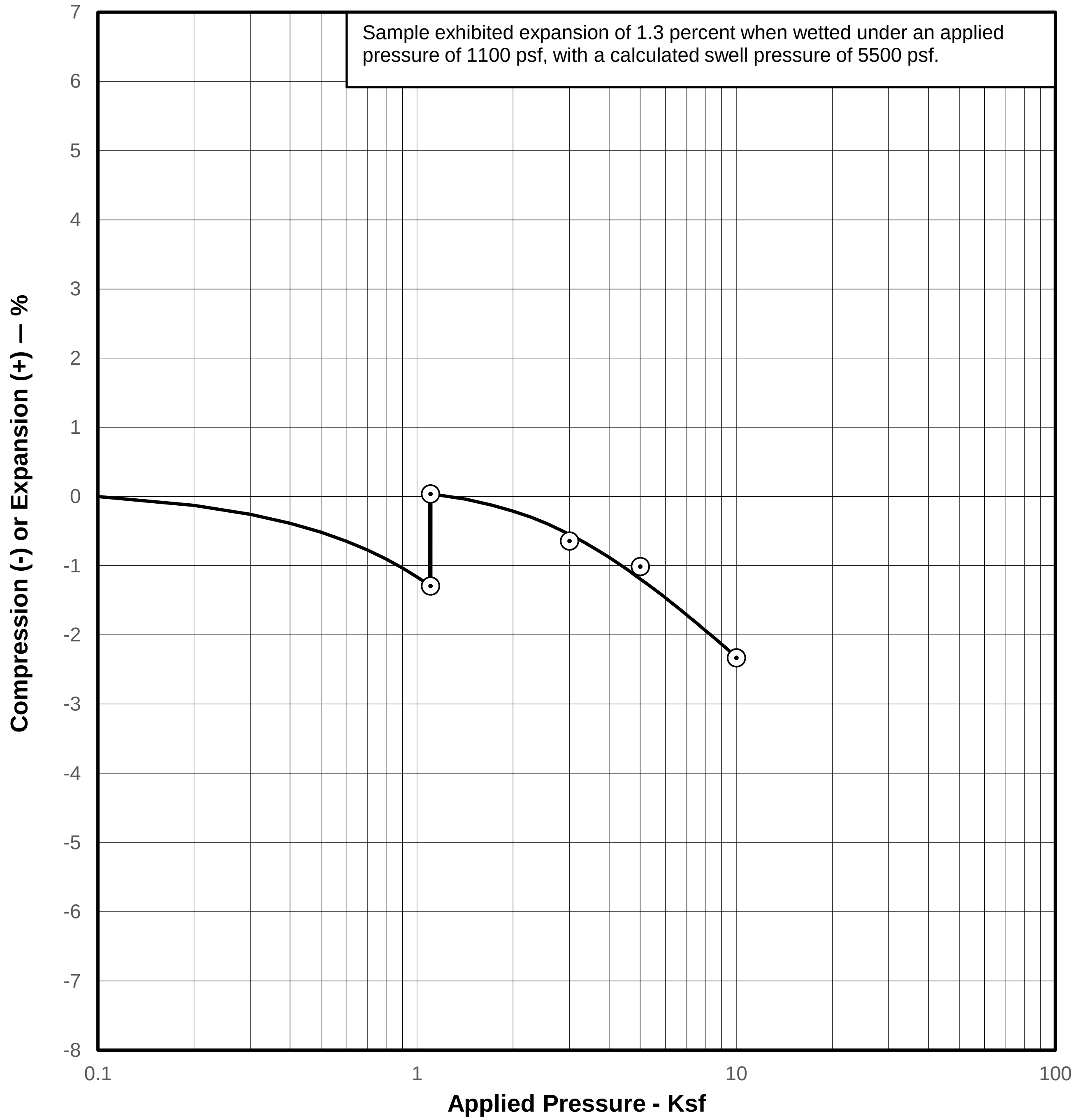


SAMPLE OF: CLAYSTONE

FROM: TH-20 AT 4 FEET

MOISTURE CONTENT:	25.9 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	91 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.67 pf

Swell Consolidation Test Results



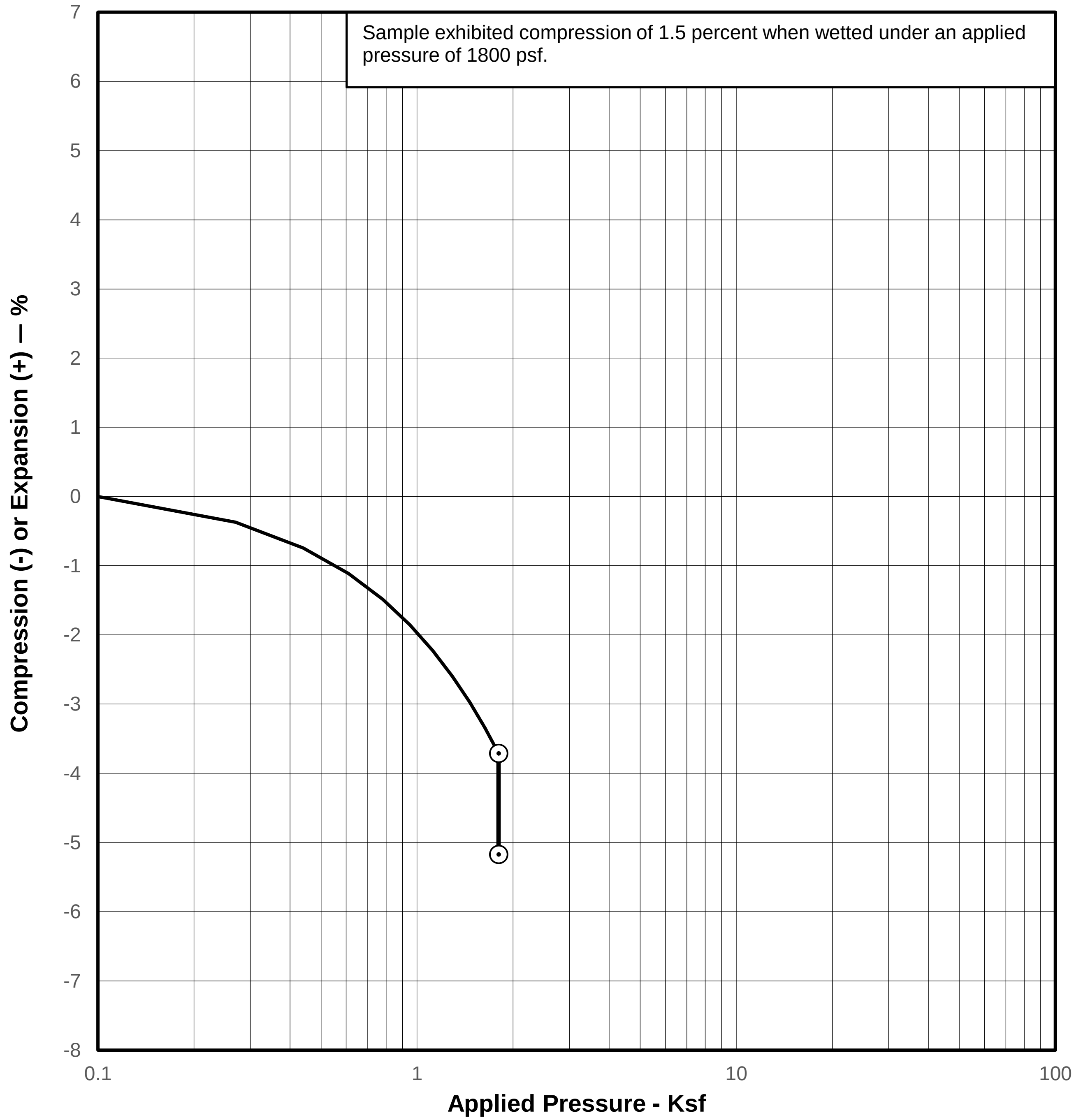
SAMPLE OF: CLAYSTONE

FROM: TH-20 AT 9 FEET

MOISTURE CONTENT: 31.1 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 88 pcf PLASTICITY INDEX: ____ SOIL SUCTION: 3.98 pf

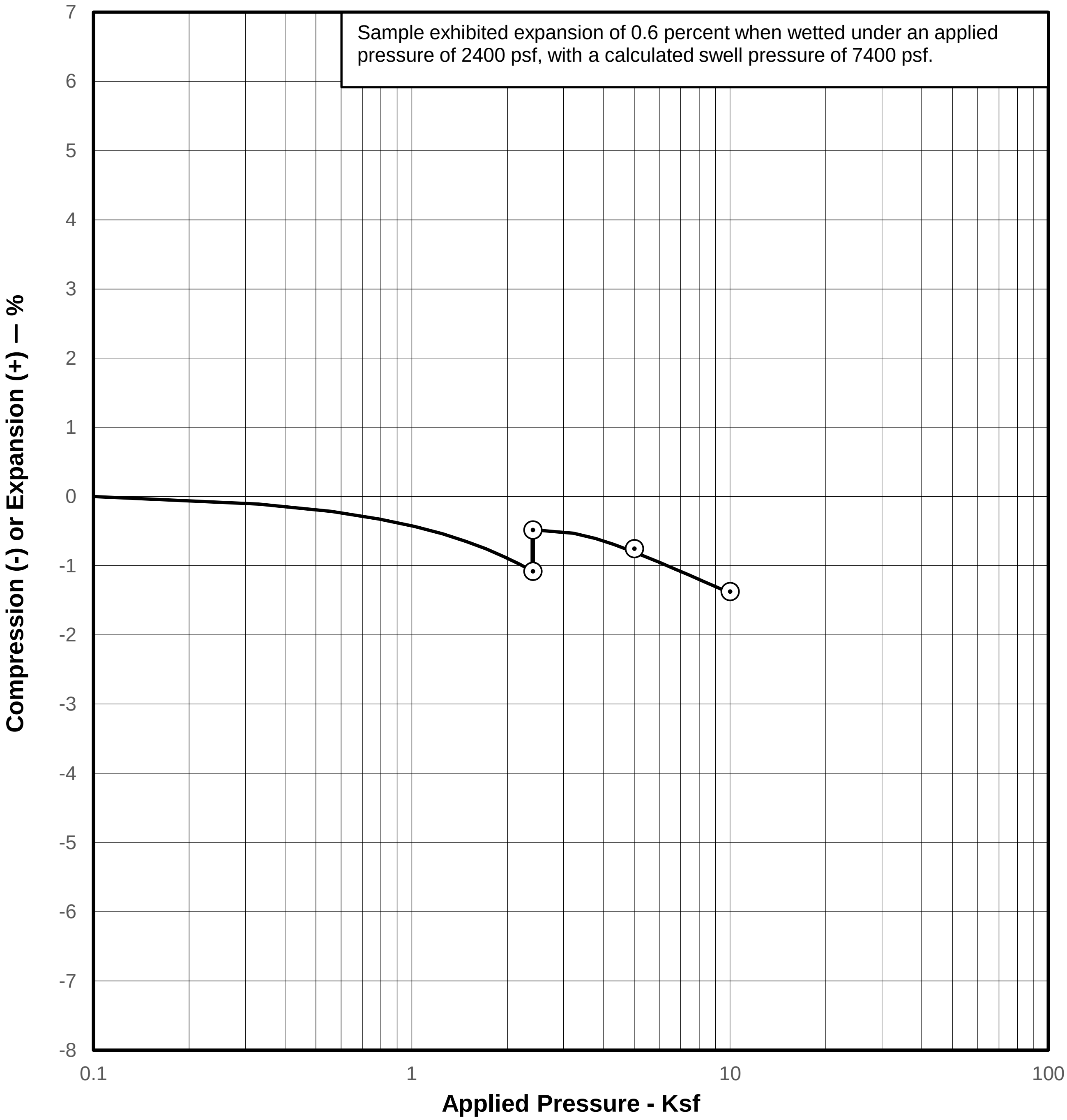
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-20 AT 14 FEET

MOISTURE CONTENT:	32.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	76 pcf	PLASTICITY INDEX:		SOIL SUCTION:	4.12 pf

Swell Consolidation Test Results

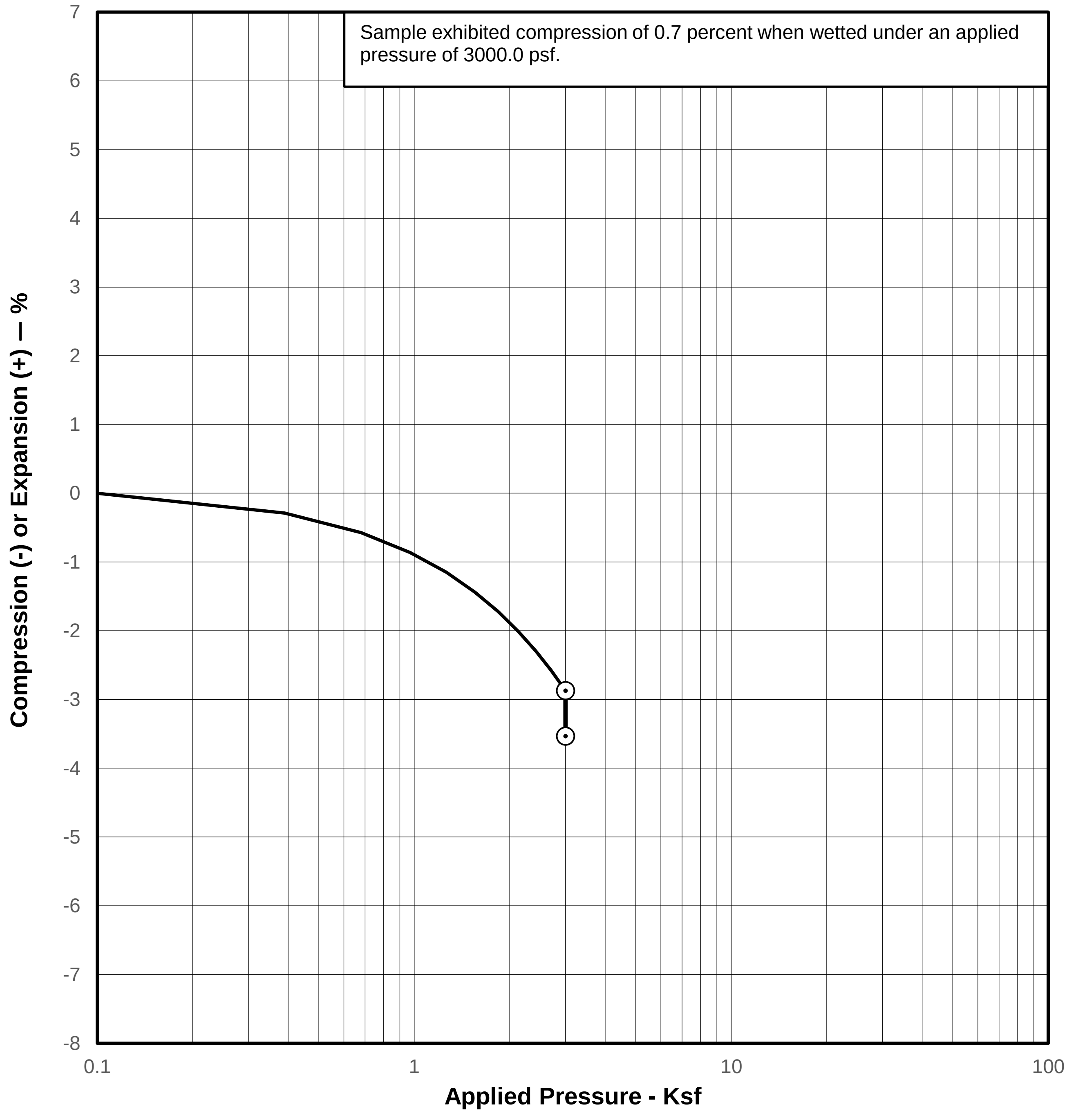


SAMPLE OF: CLAYSTONE

FROM: TH-20 AT 19 FEET

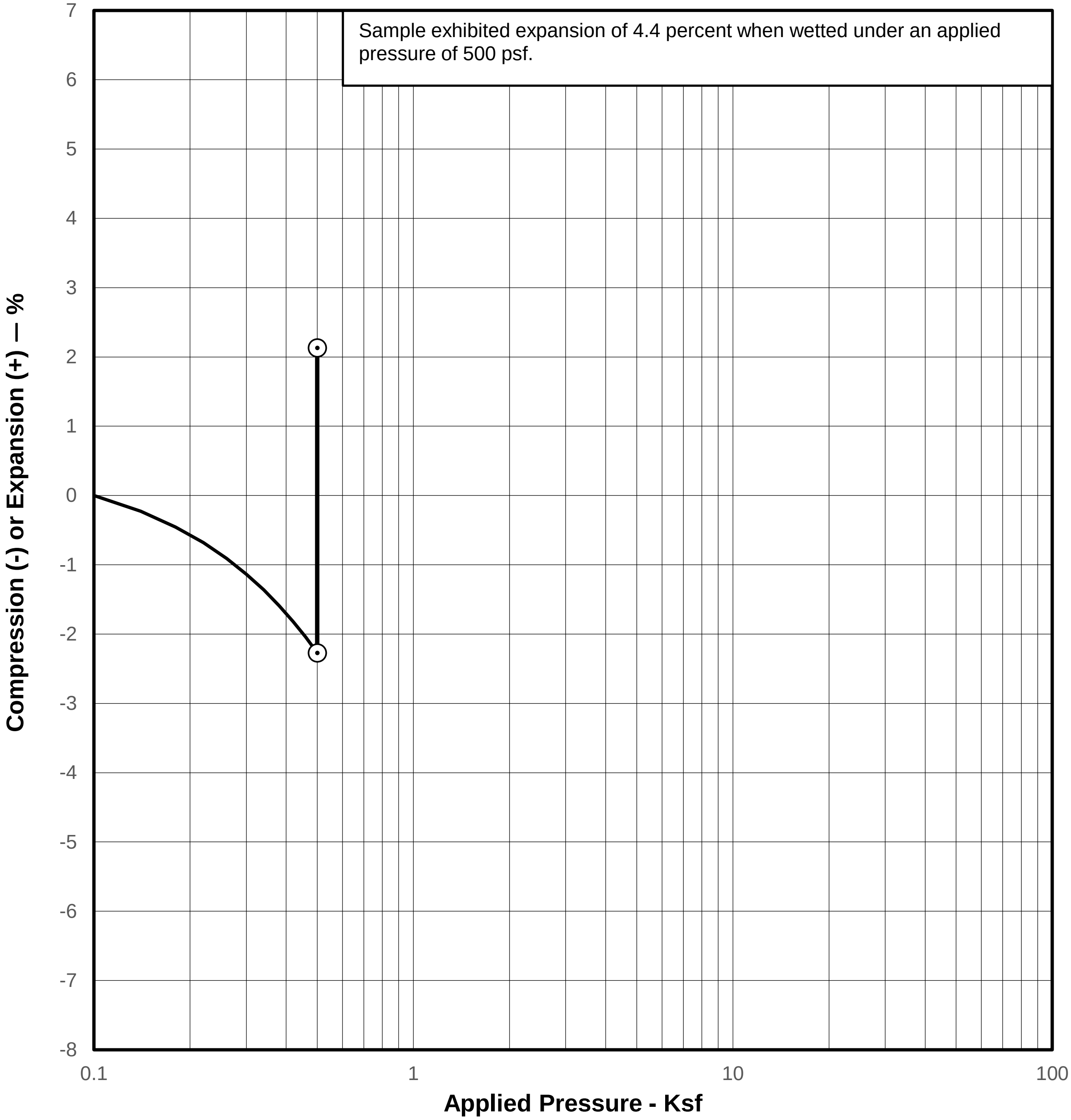
MOISTURE CONTENT:	29.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	93 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.88 pf

Swell Consolidation Test Results



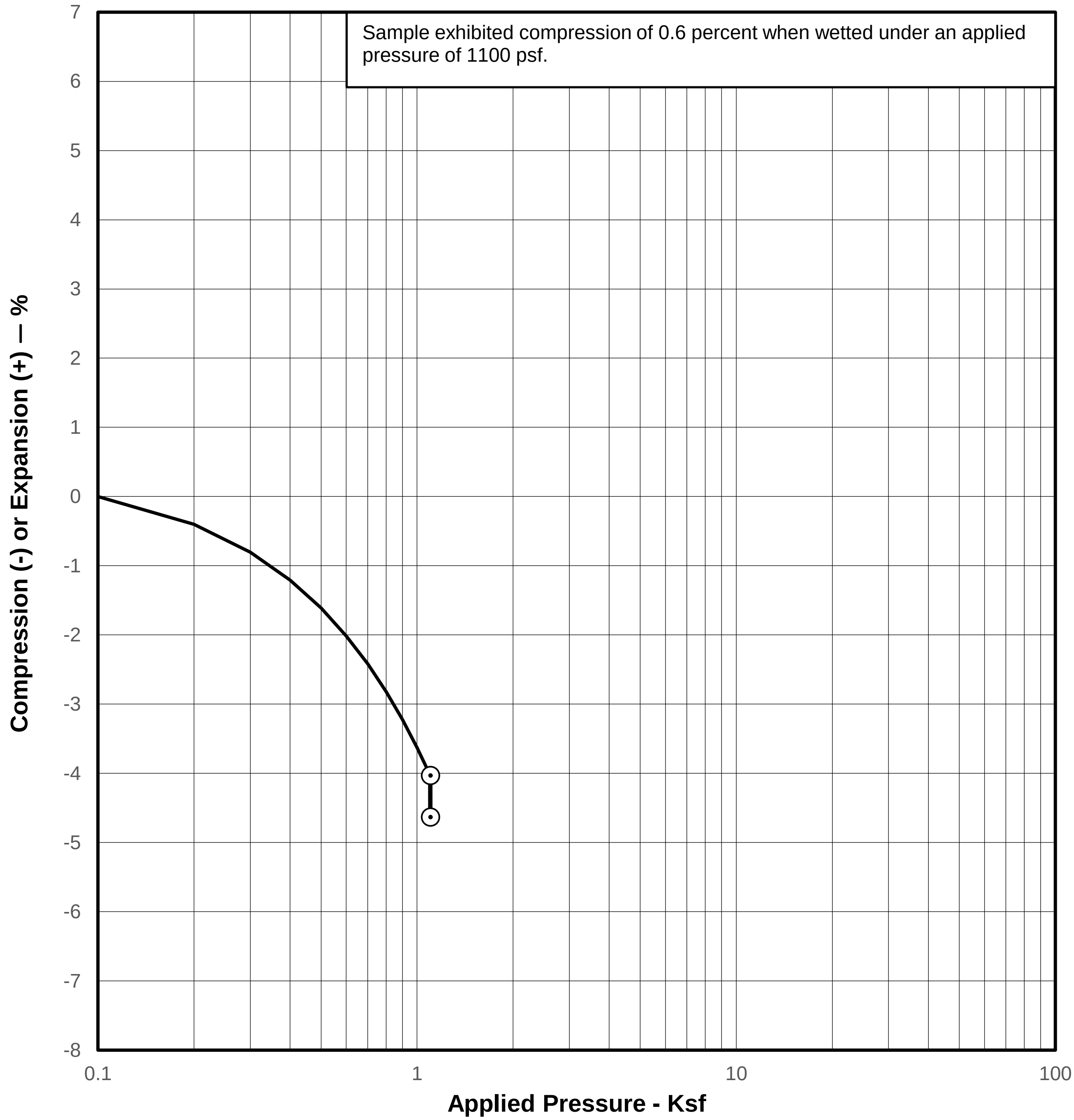
SAMPLE OF:	CLAYSTONE						
FROM:	TH-20 AT 24 FEET						
MOISTURE CONTENT:	30.3 %	LIQUID LIMIT:		SILT AND CLAY:	%		
DRY UNIT WEIGHT:	83 pcf	PLASTICITY INDEX:		SOIL SUCTION:	4.05 pf		

Swell Consolidation Test Results



SAMPLE OF:	WEATHERED CLAYSTONE						
FROM:	TH-21 AT 4 FEET						
MOISTURE CONTENT:	33.5 %	LIQUID LIMIT:	75	SILT AND CLAY:	%		
DRY UNIT WEIGHT:	83 pcf	PLASTICITY INDEX:	40	SOIL SUCTION:	pf		

Swell Consolidation Test Results



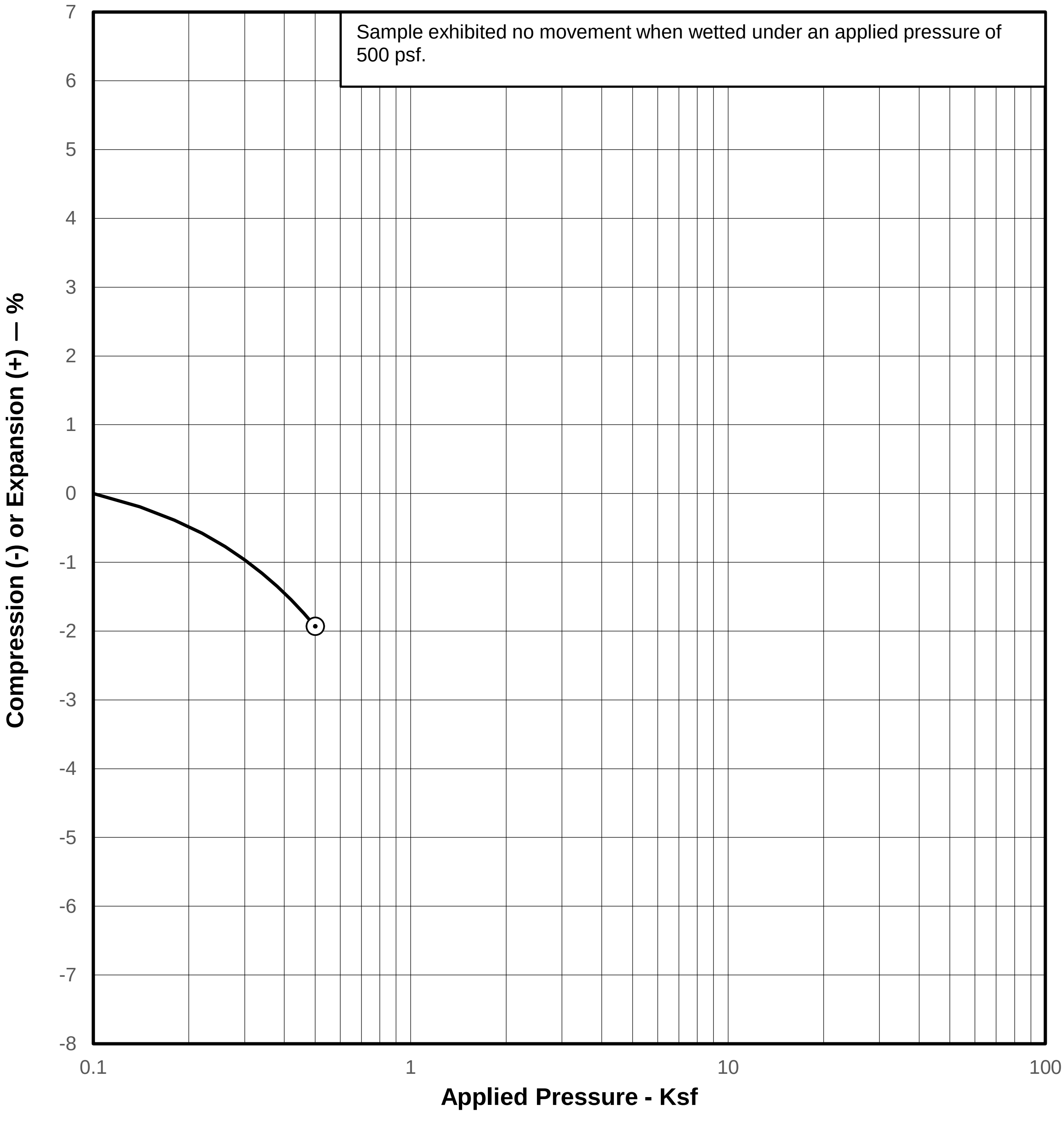
SAMPLE OF: CLAYSTONE

FROM: TH-21 AT 9 FEET

MOISTURE CONTENT: 33.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 75 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

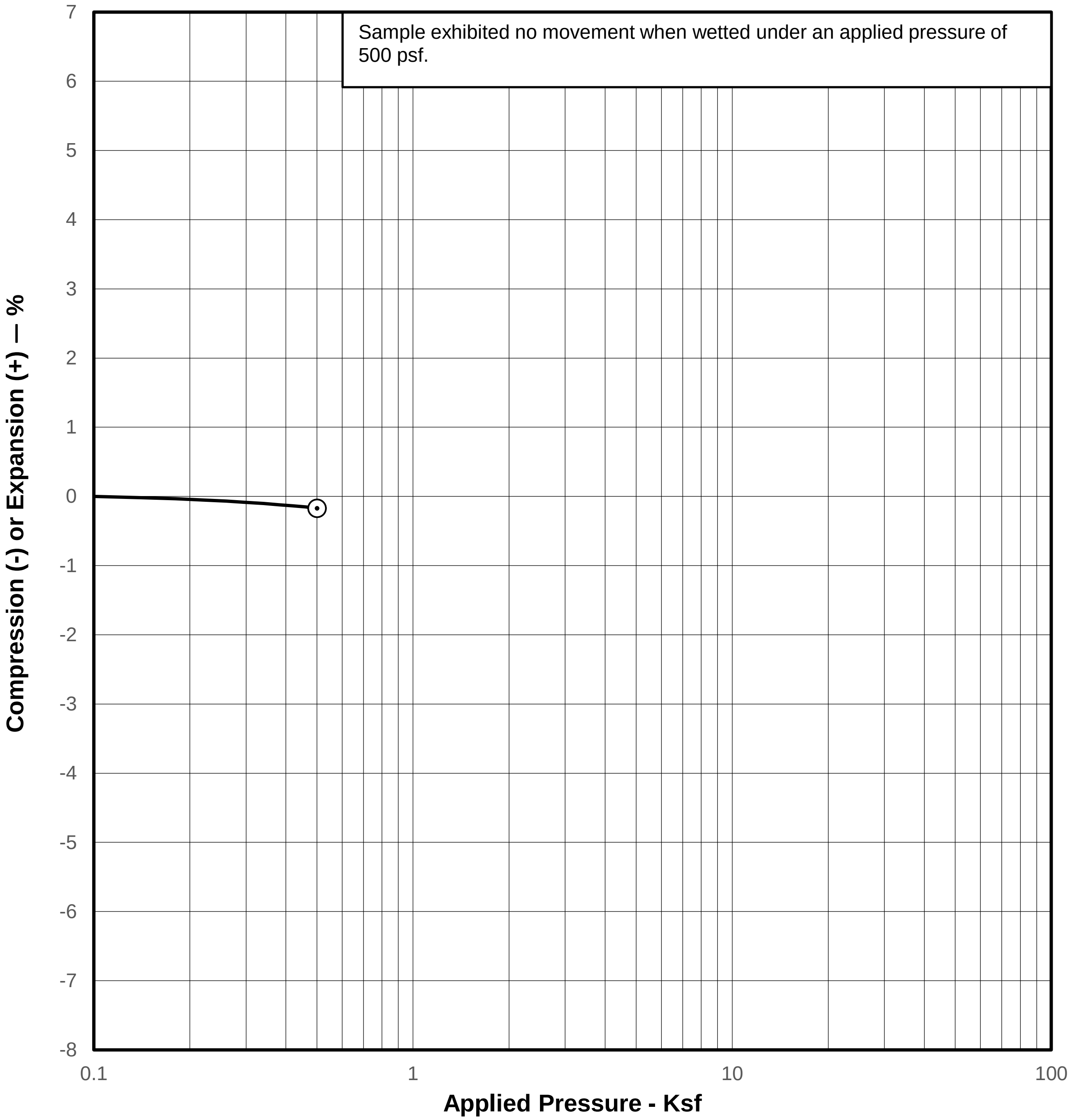
Swell Consolidation Test Results



SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE
FROM: TH-22 AT 4 FEET

MOISTURE CONTENT:	22.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	94 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



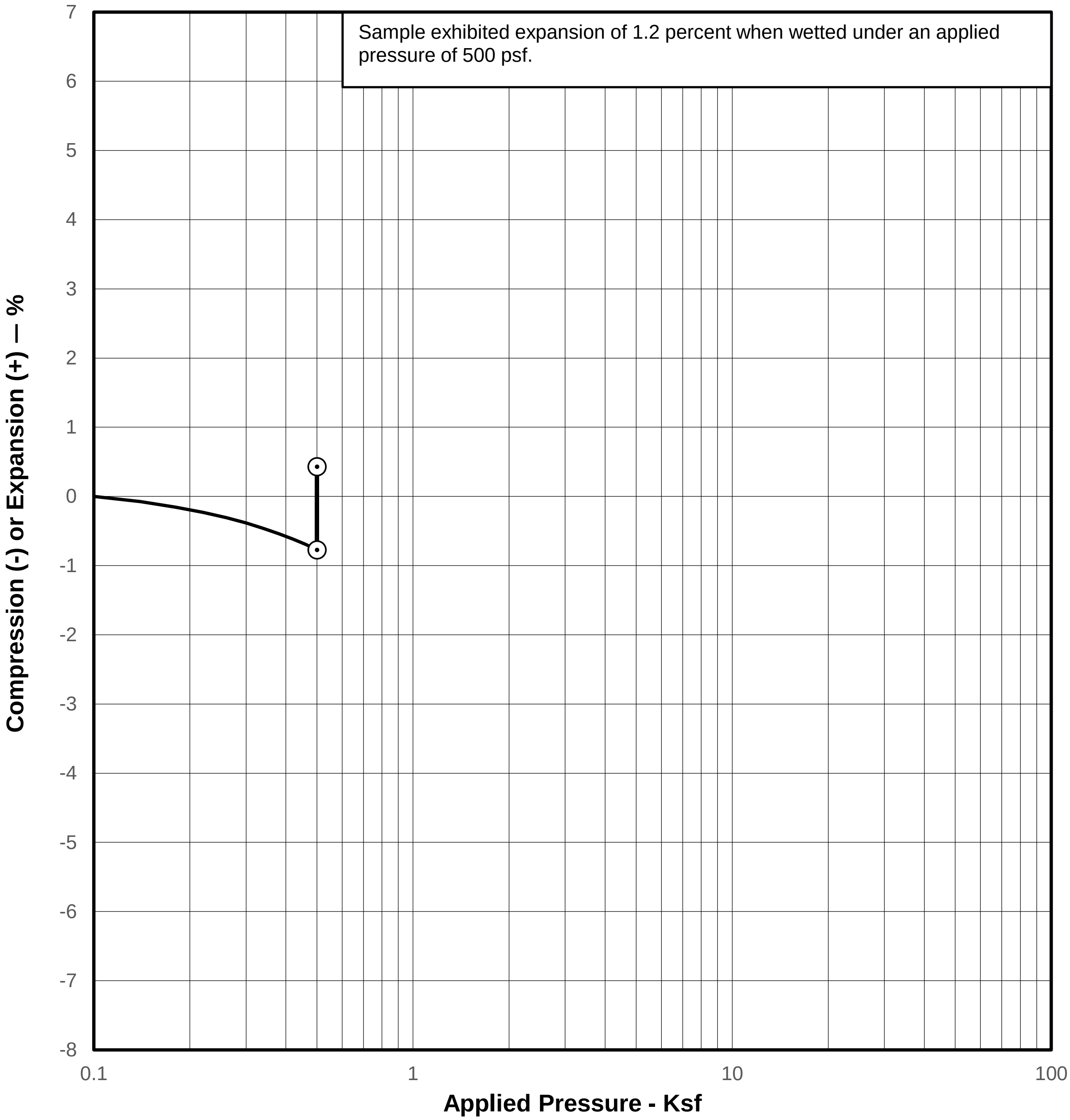
SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE

FROM: TH-23 AT 4 FEET

MOISTURE CONTENT: 23.9 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 97 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

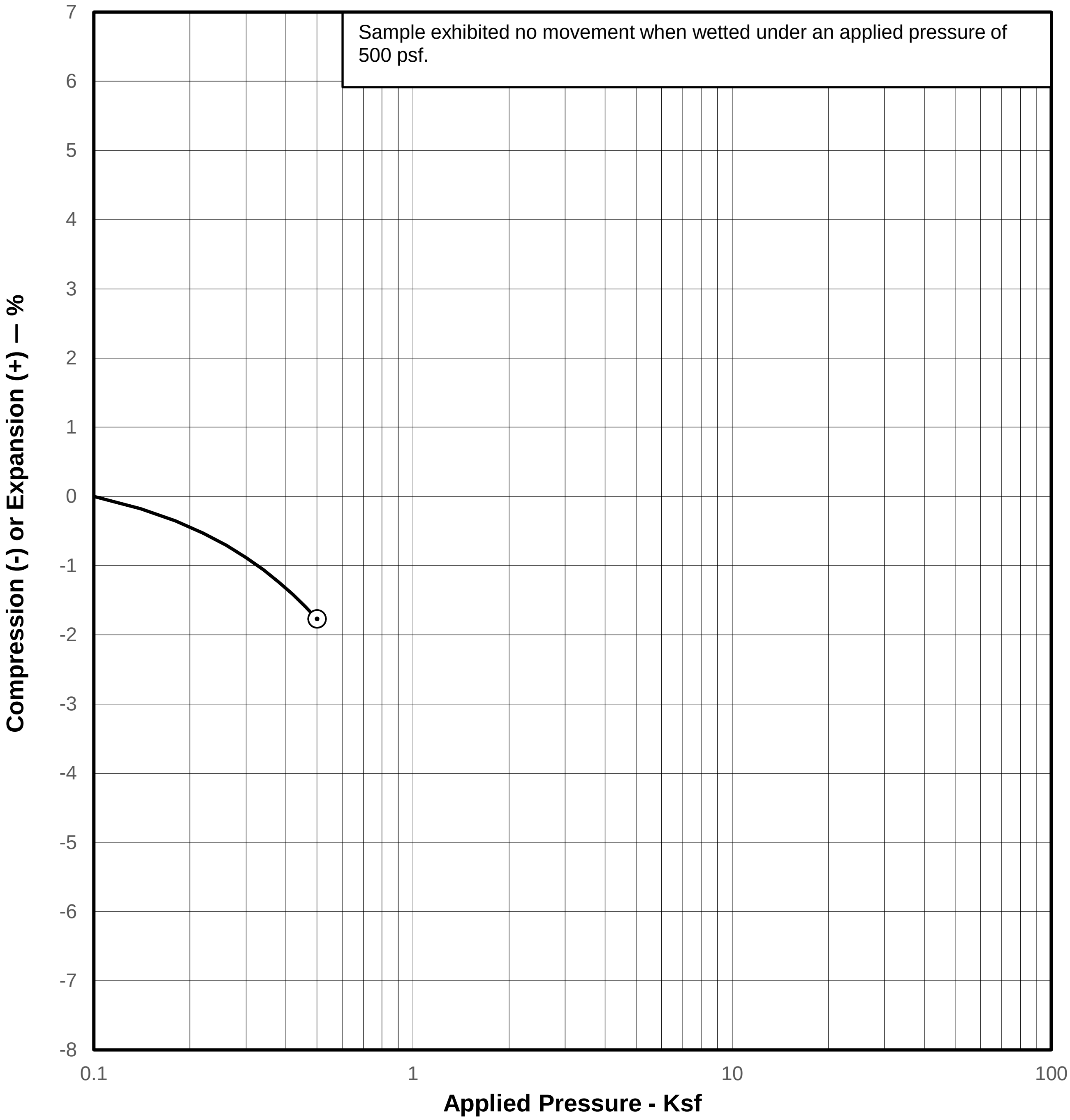
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-24 AT 4 FEET

MOISTURE CONTENT:	37.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	82 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

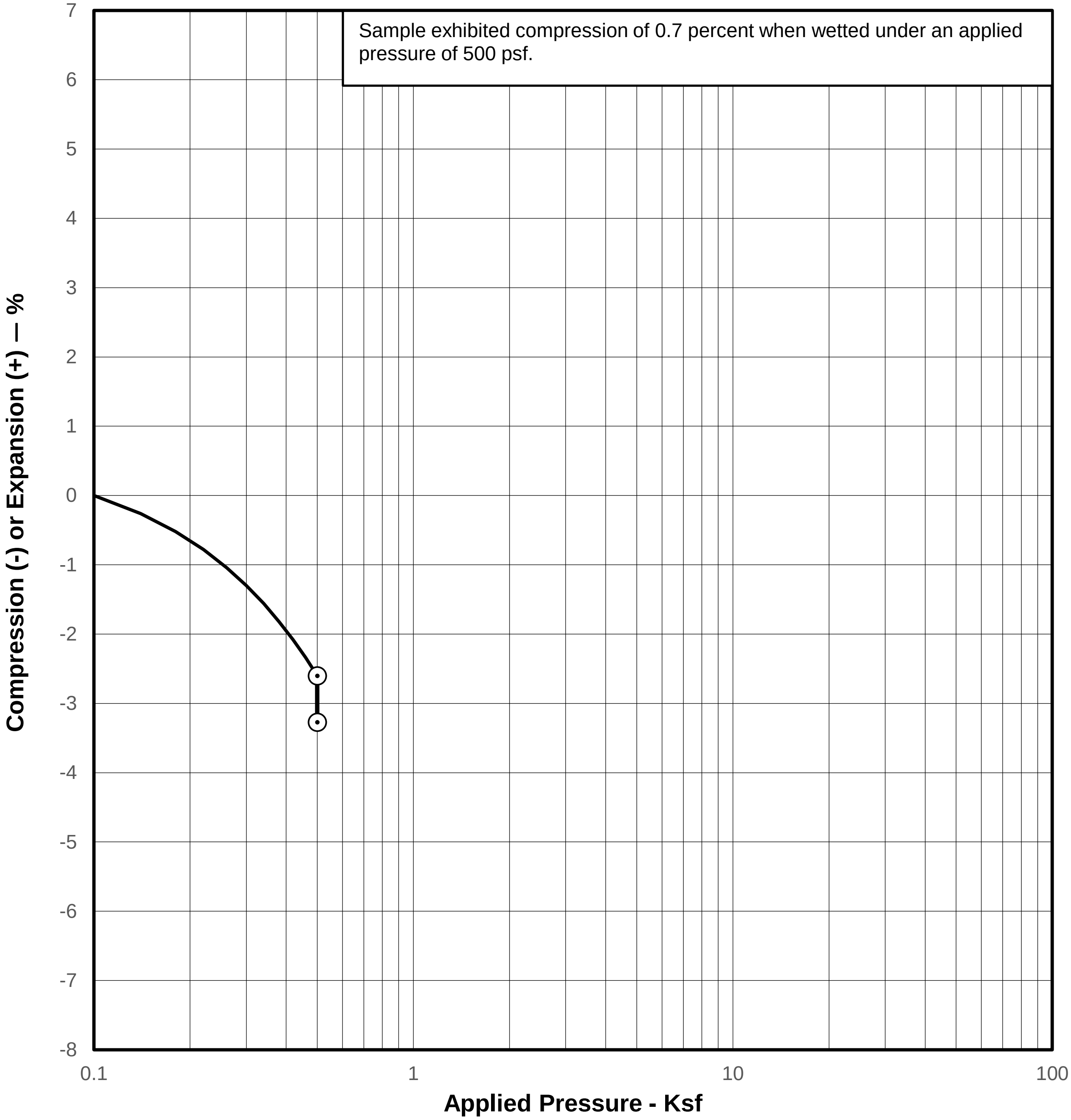
Swell Consolidation Test Results



SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE
FROM: TH-25 AT 4 FEET

MOISTURE CONTENT:	21.5	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	91	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

Swell Consolidation Test Results



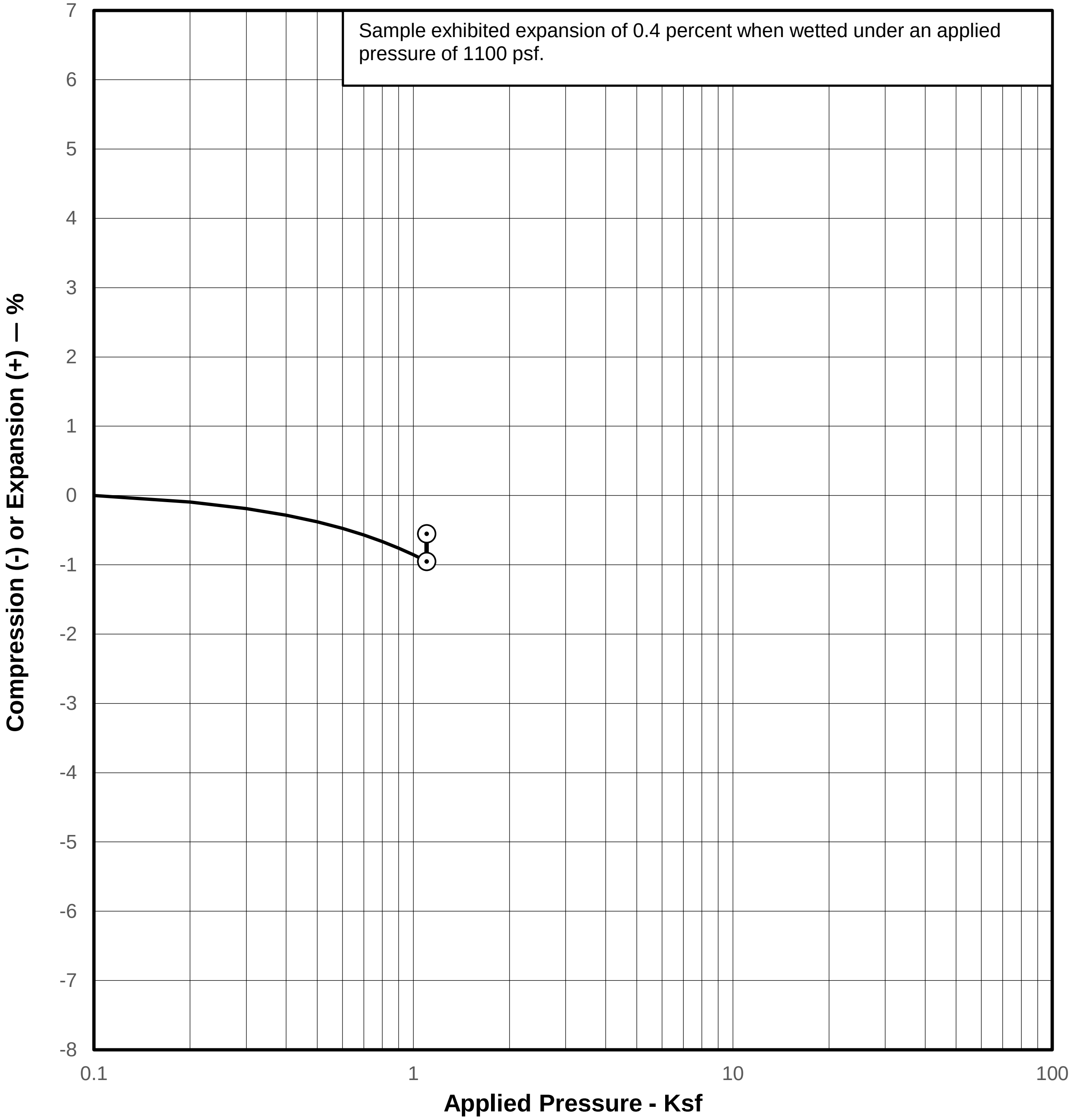
SAMPLE OF: SANDSTONE

FROM: TH-26 AT 4 FEET

MOISTURE CONTENT: 19.7 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 75 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

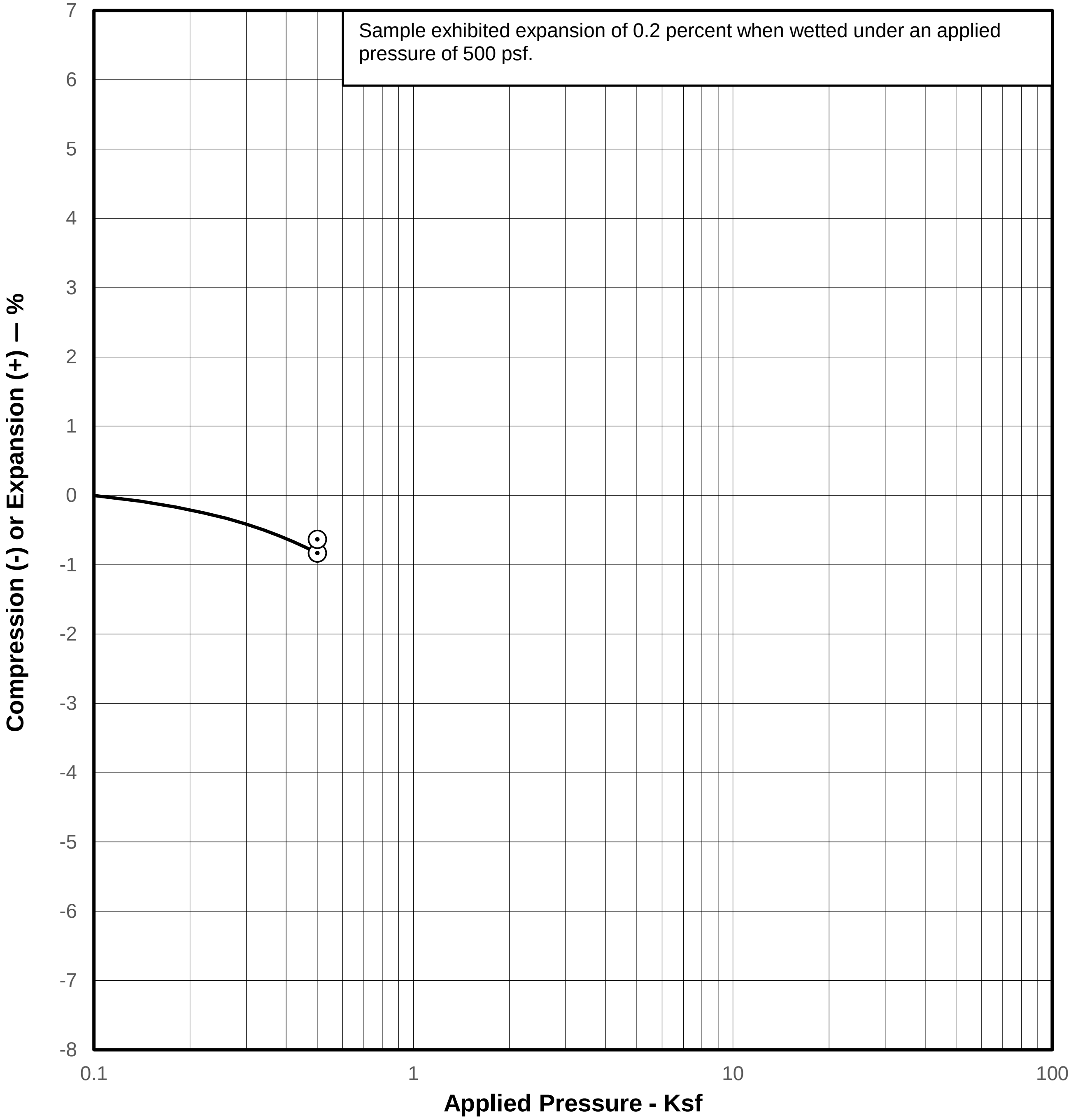


SAMPLE OF: CLAYSTONE

FROM: TH-27 AT 9 FEET

MOISTURE CONTENT:	31.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	83 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

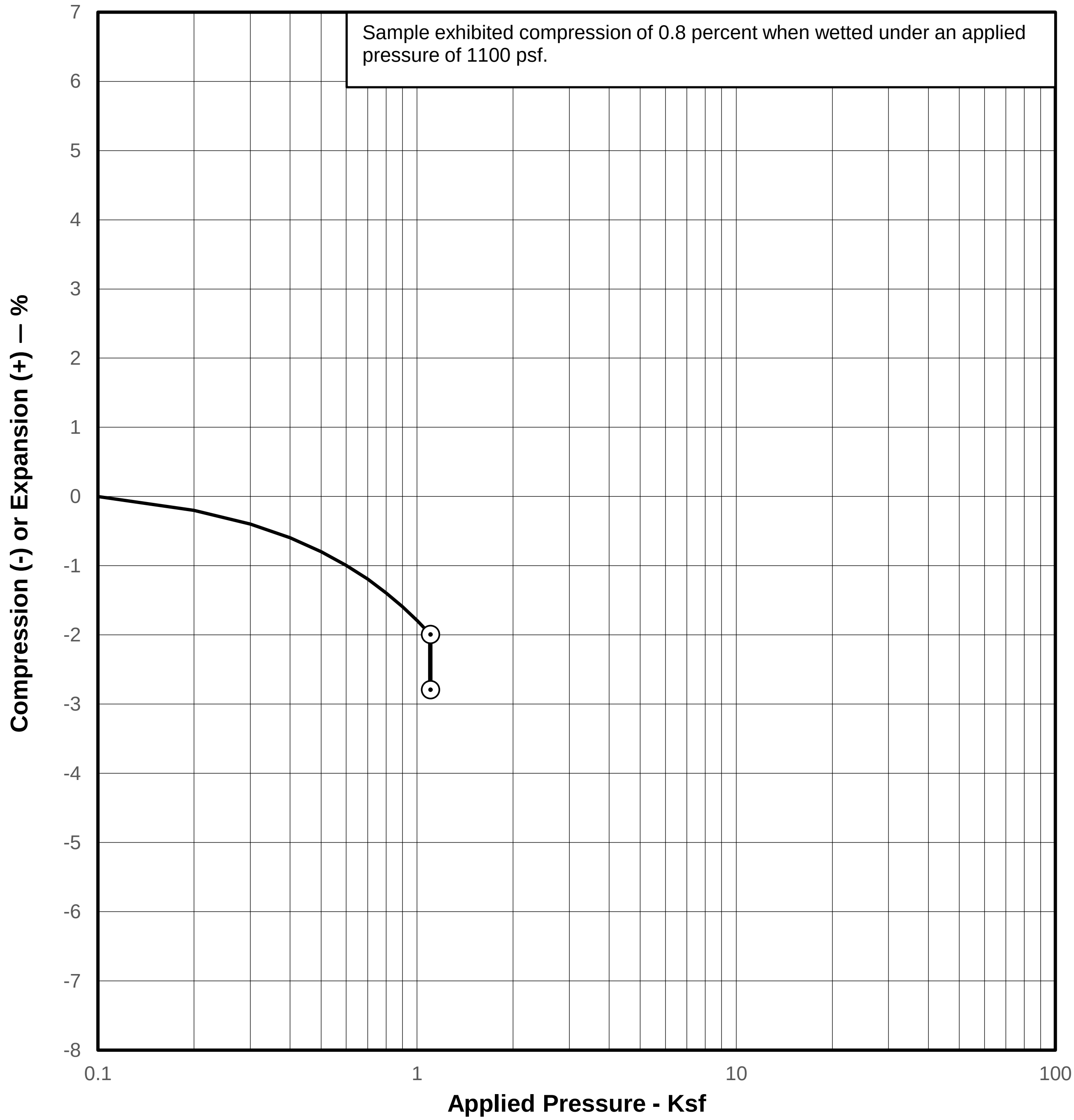


SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE

FROM: TH-33 AT 4 FEET

MOISTURE CONTENT:	19.9 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	98 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

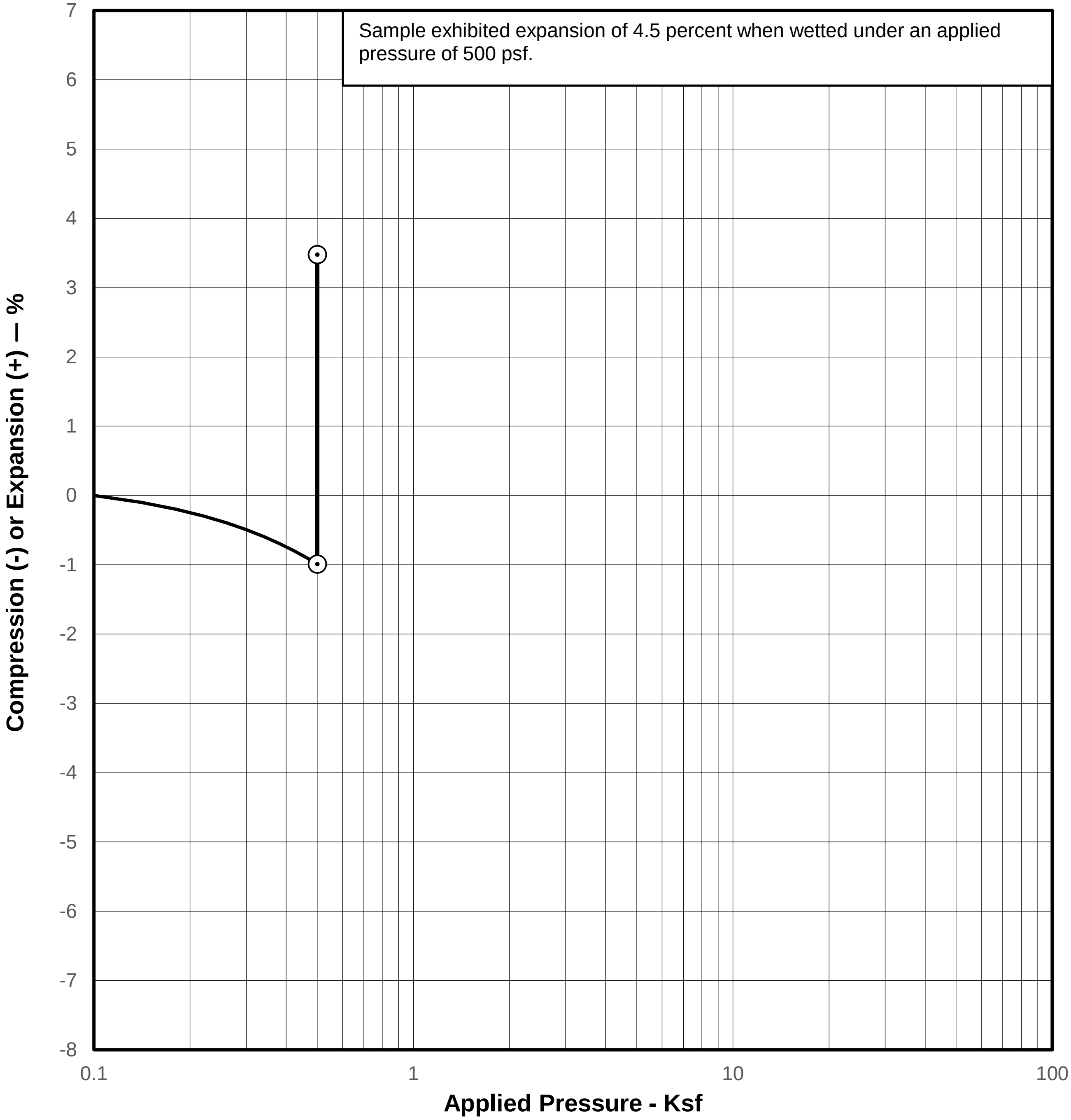
Swell Consolidation Test Results



SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE
FROM: TH-33 AT 9 FEET

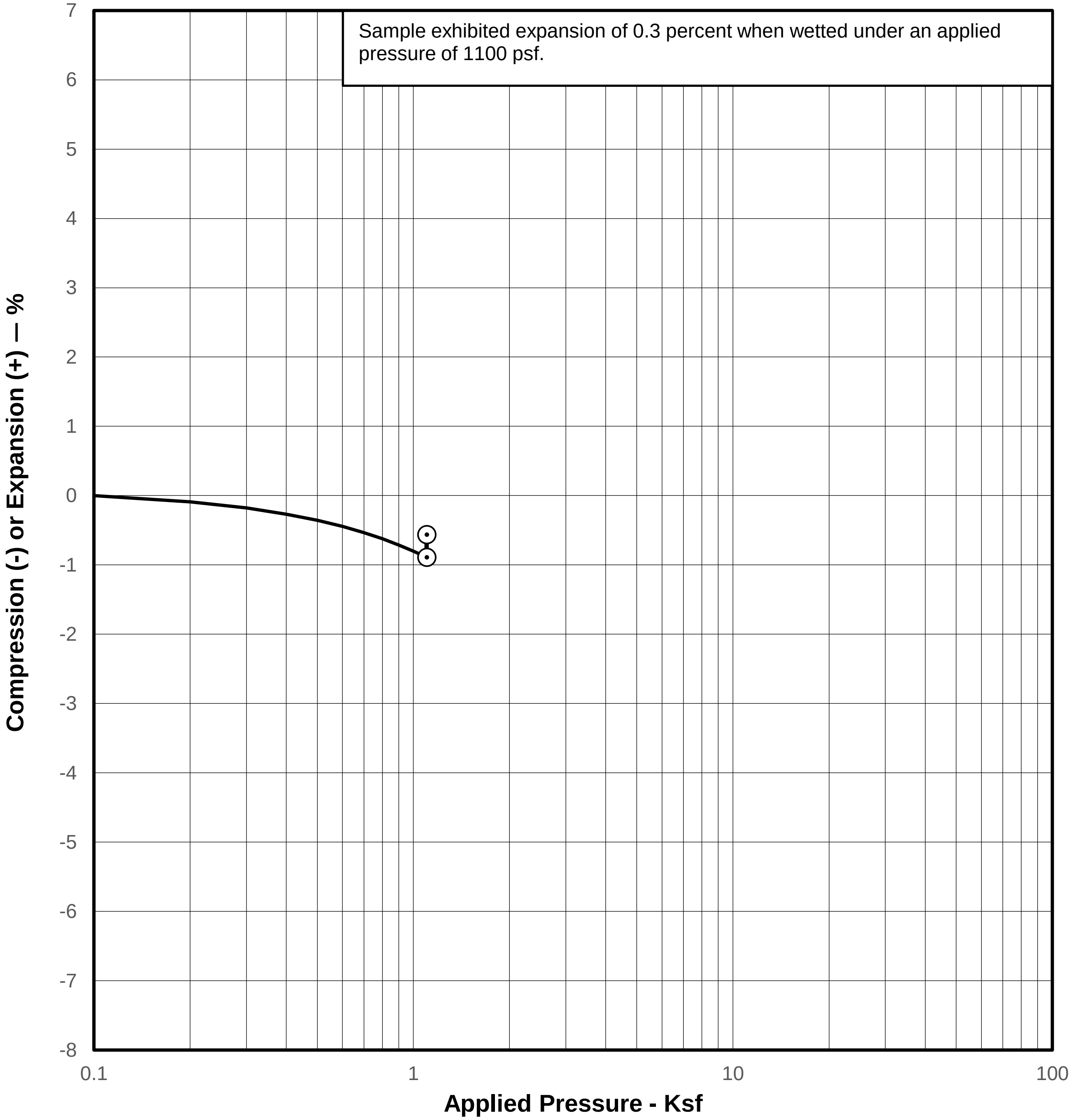
MOISTURE CONTENT: 22.3 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 92 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results



SAMPLE OF:	CLAY, SANDY (CL)						
FROM:	TH-34 AT 4 FEET						
MOISTURE CONTENT:	19.4	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	108	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

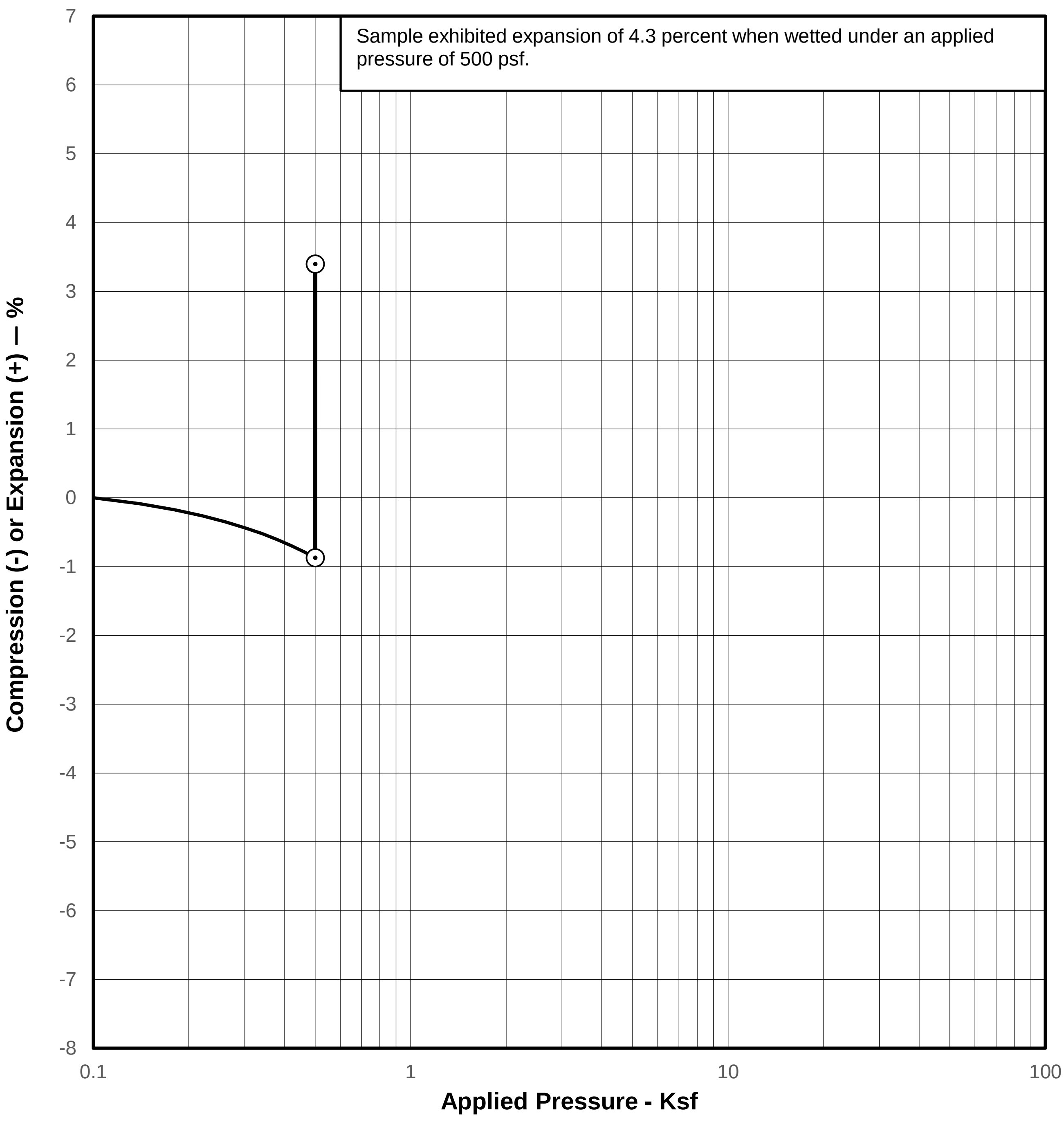
Swell Consolidation Test Results



SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE
FROM: TH-34 AT 9 FEET

MOISTURE CONTENT:	20.4 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	105 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

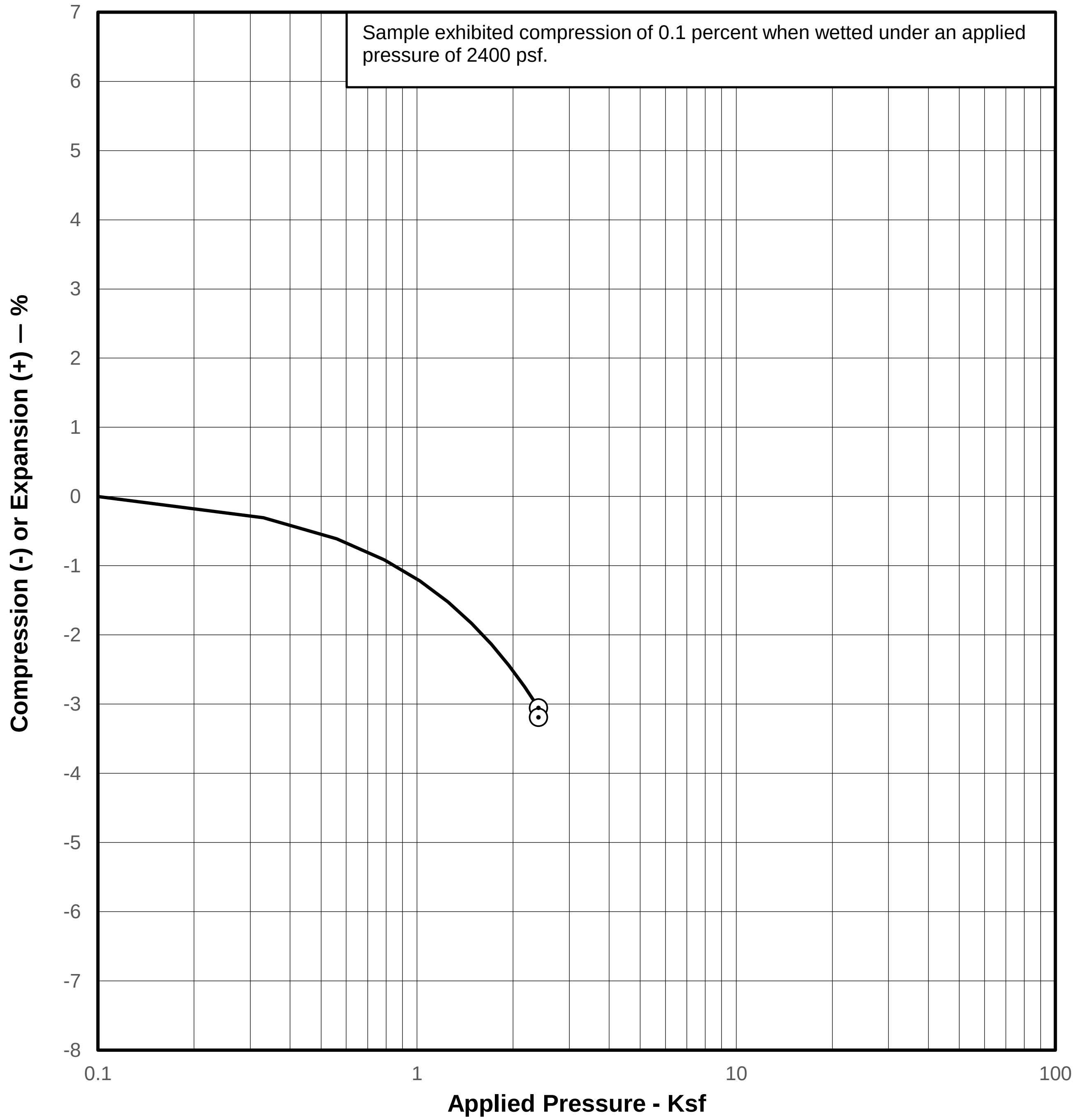
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-35 AT 4 FEET

MOISTURE CONTENT:	20.9	%	LIQUID LIMIT:	58	SILT AND CLAY:		%
DRY UNIT WEIGHT:	103	pcf	PLASTICITY INDEX:	37	SOIL SUCTION:		pf

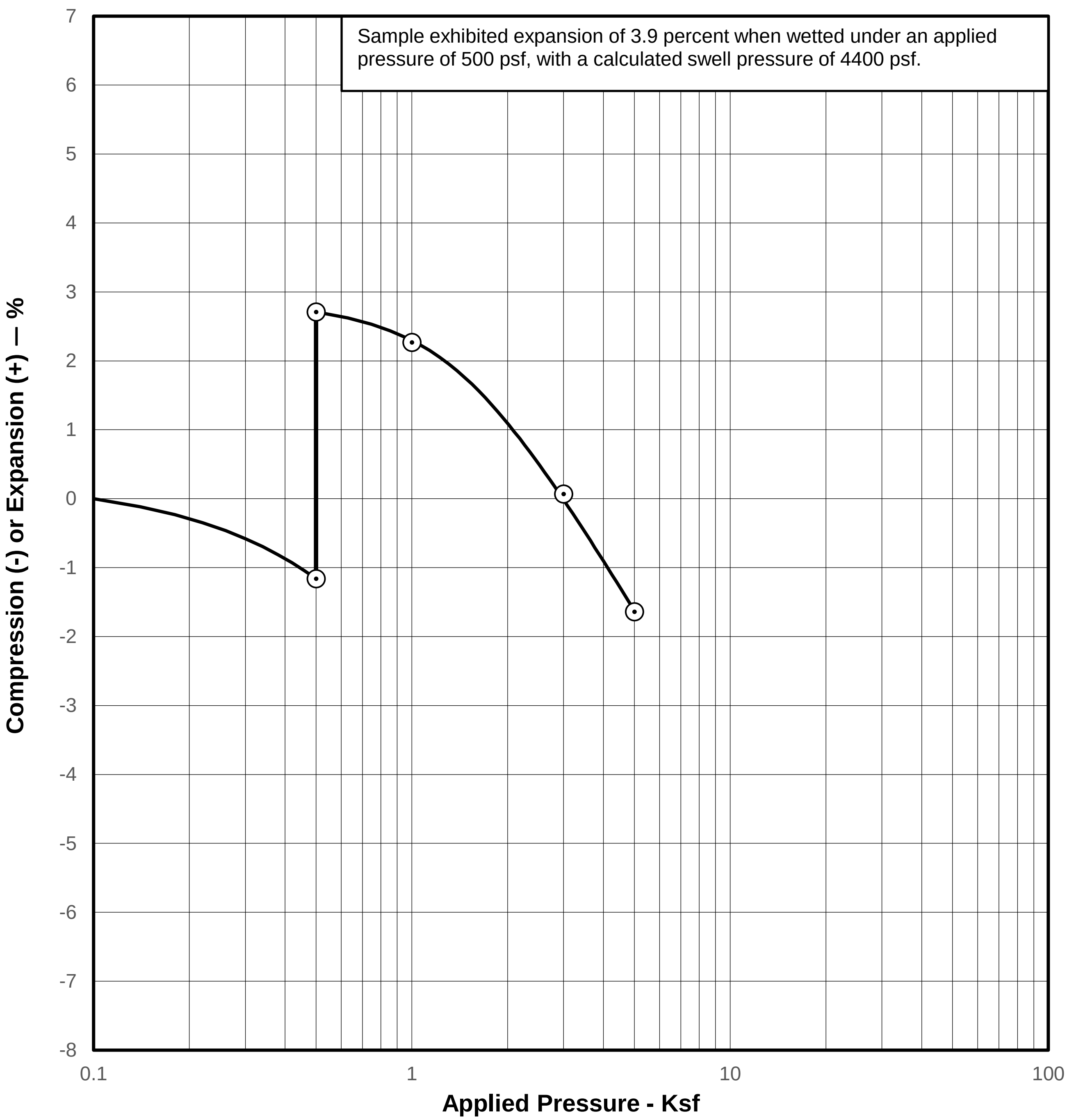
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-35 AT 19 FEET

MOISTURE CONTENT: 19.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 100 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

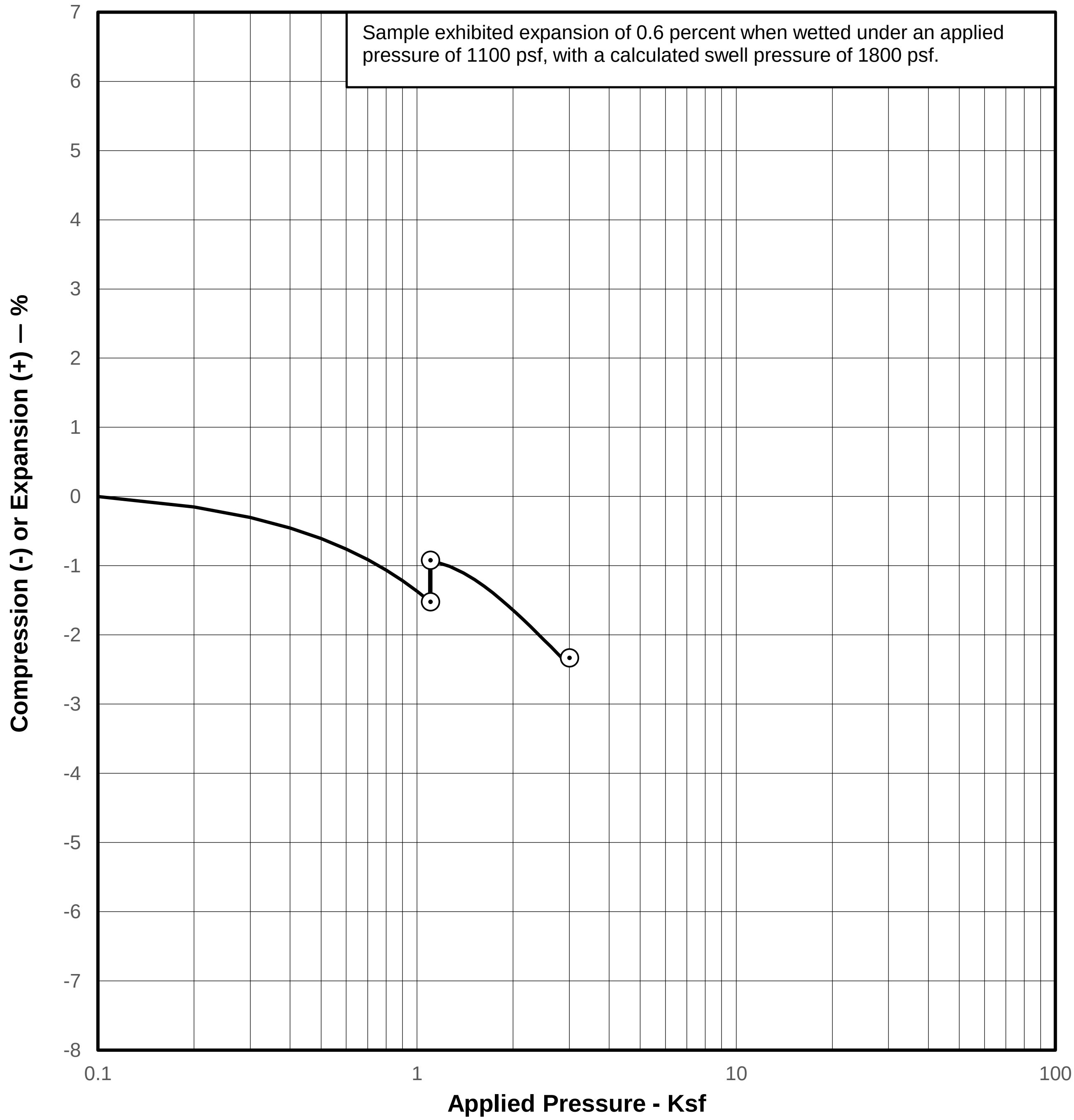
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-36 AT 4 FEET

MOISTURE CONTENT:	15.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	107 pcf	PLASTICITY INDEX:		SOIL SUCTION:	4.11 pf

Swell Consolidation Test Results



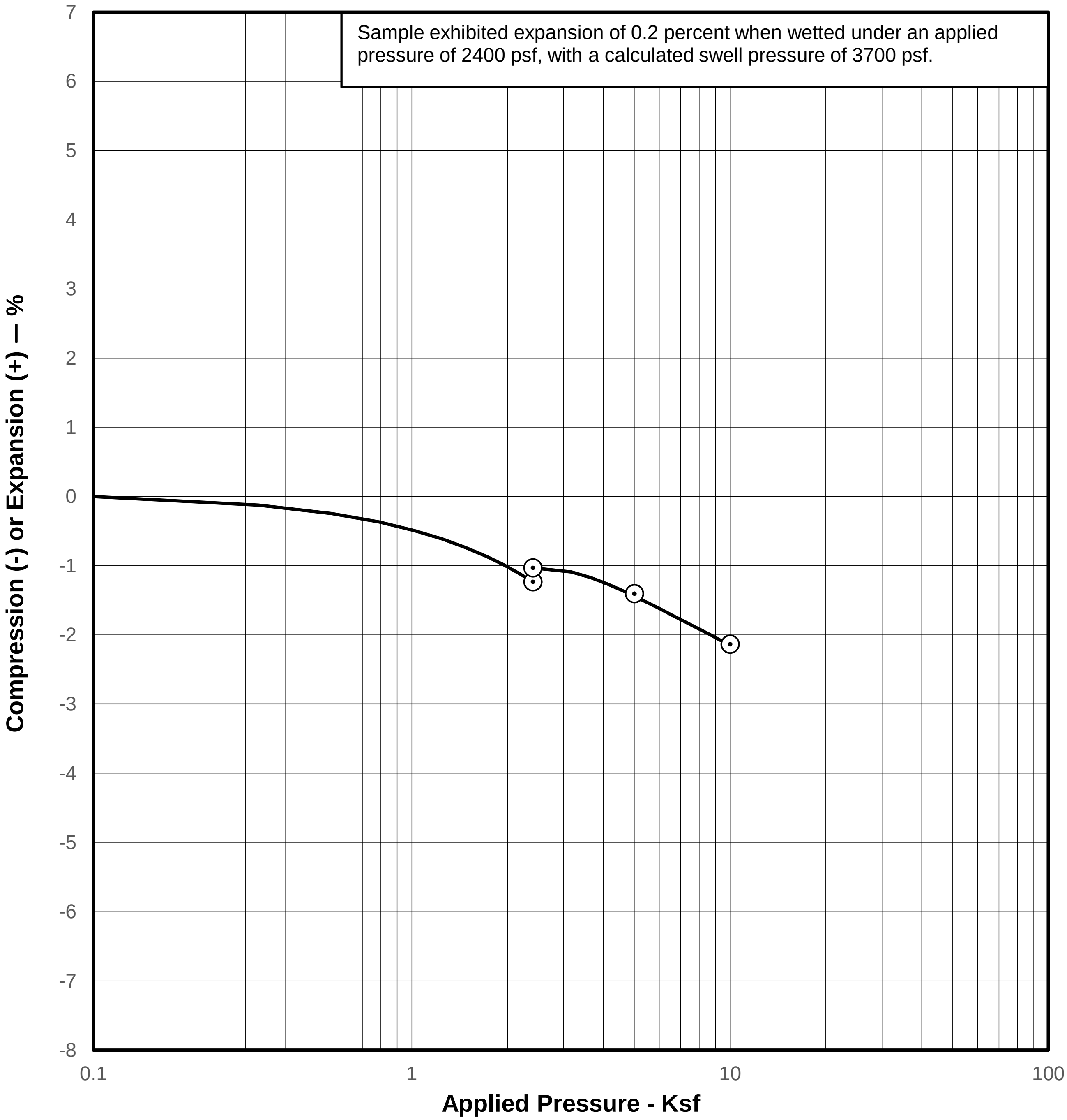
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-36 AT 9 FEET

MOISTURE CONTENT: 25.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 92 pcf PLASTICITY INDEX: ____ SOIL SUCTION: 3.71 pf

Swell Consolidation Test Results

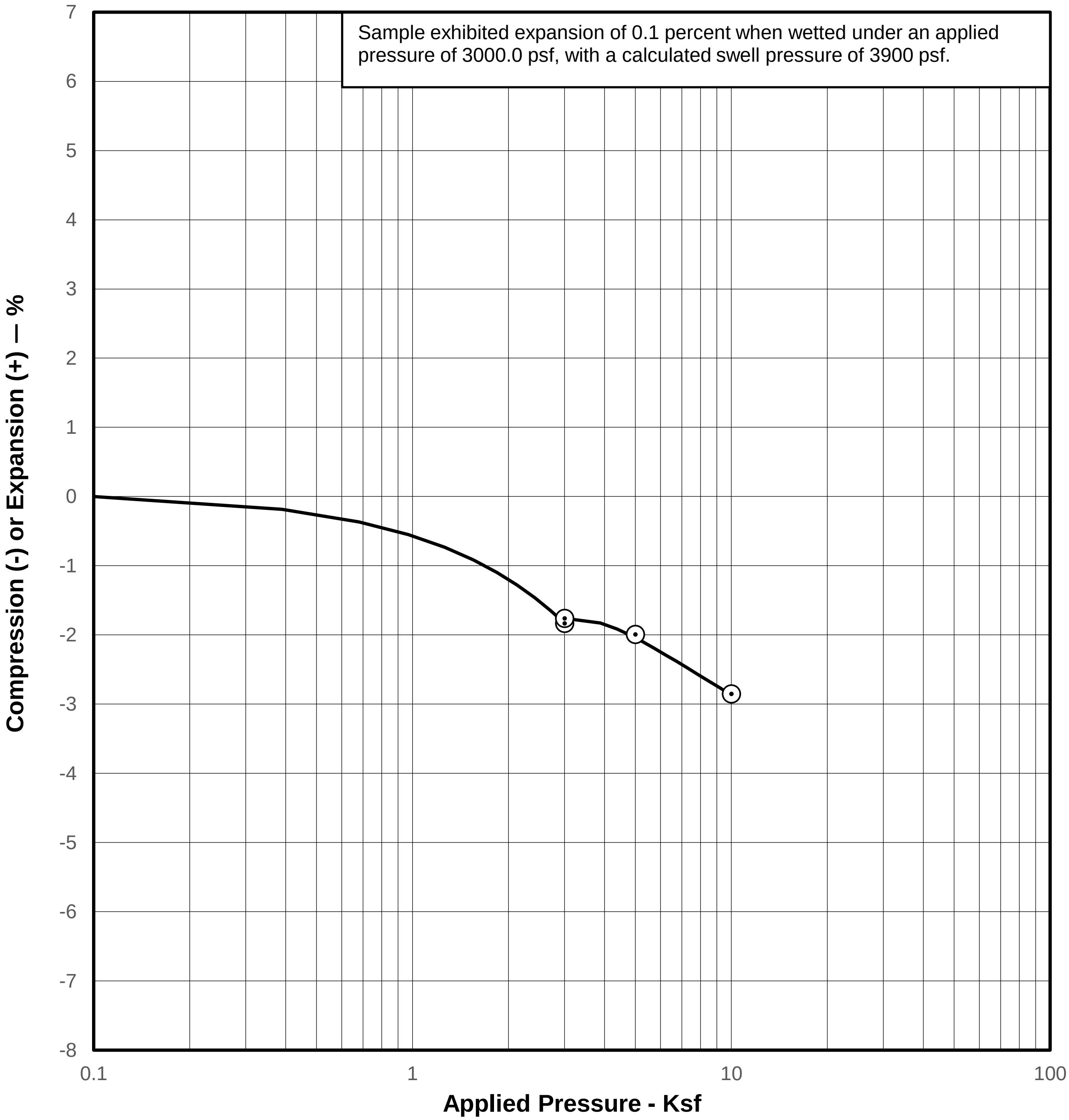


SAMPLE OF: CLAYSTONE

FROM: TH-36 AT 19 FEET

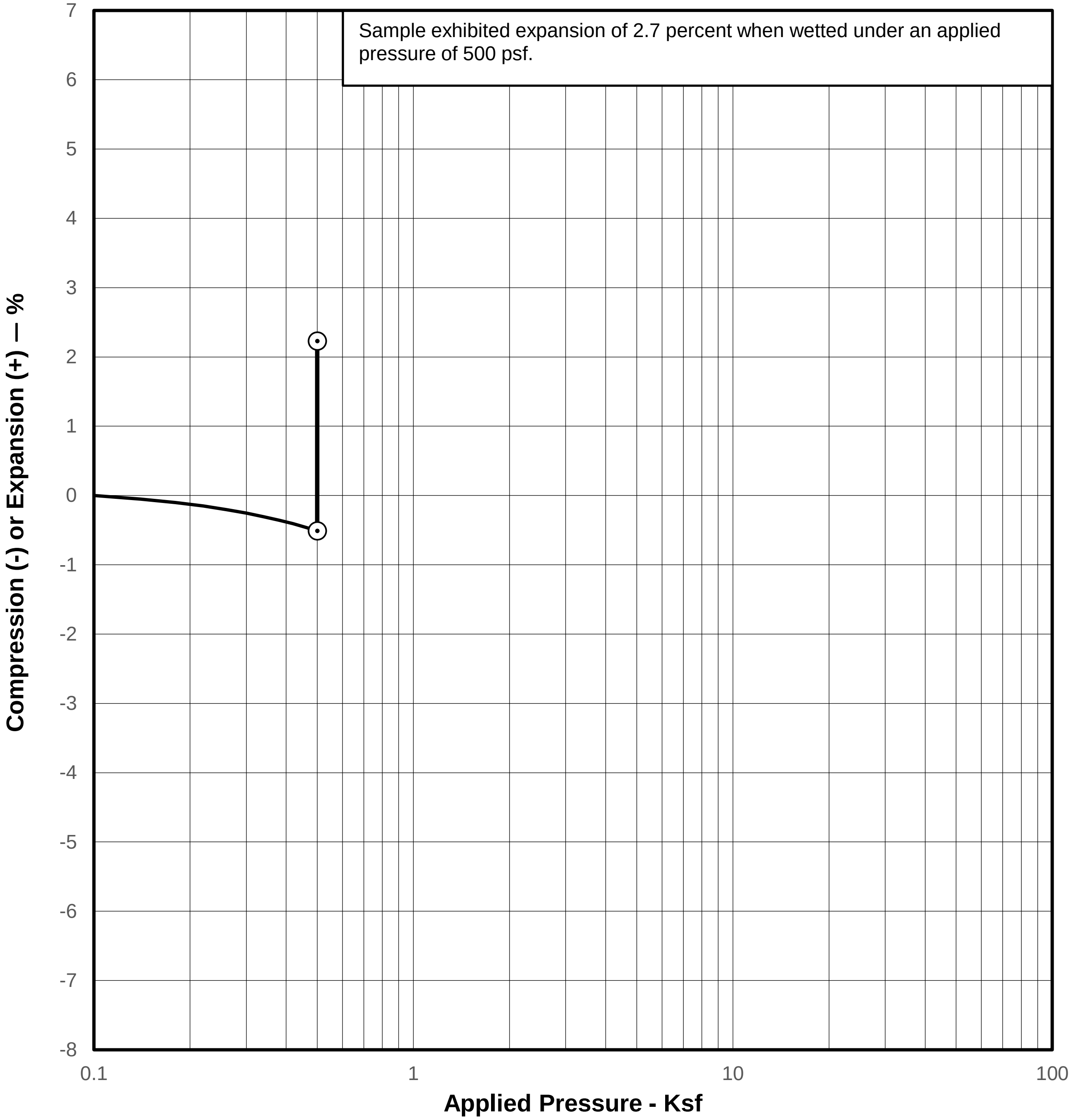
MOISTURE CONTENT:	26.4 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	94 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.27 pf

Swell Consolidation Test Results



SAMPLE OF:	CLAYSTONE						
FROM:	TH-36 AT 24 FEET						
MOISTURE CONTENT:	32.3	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	89	pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.58	pf

Swell Consolidation
Test Results

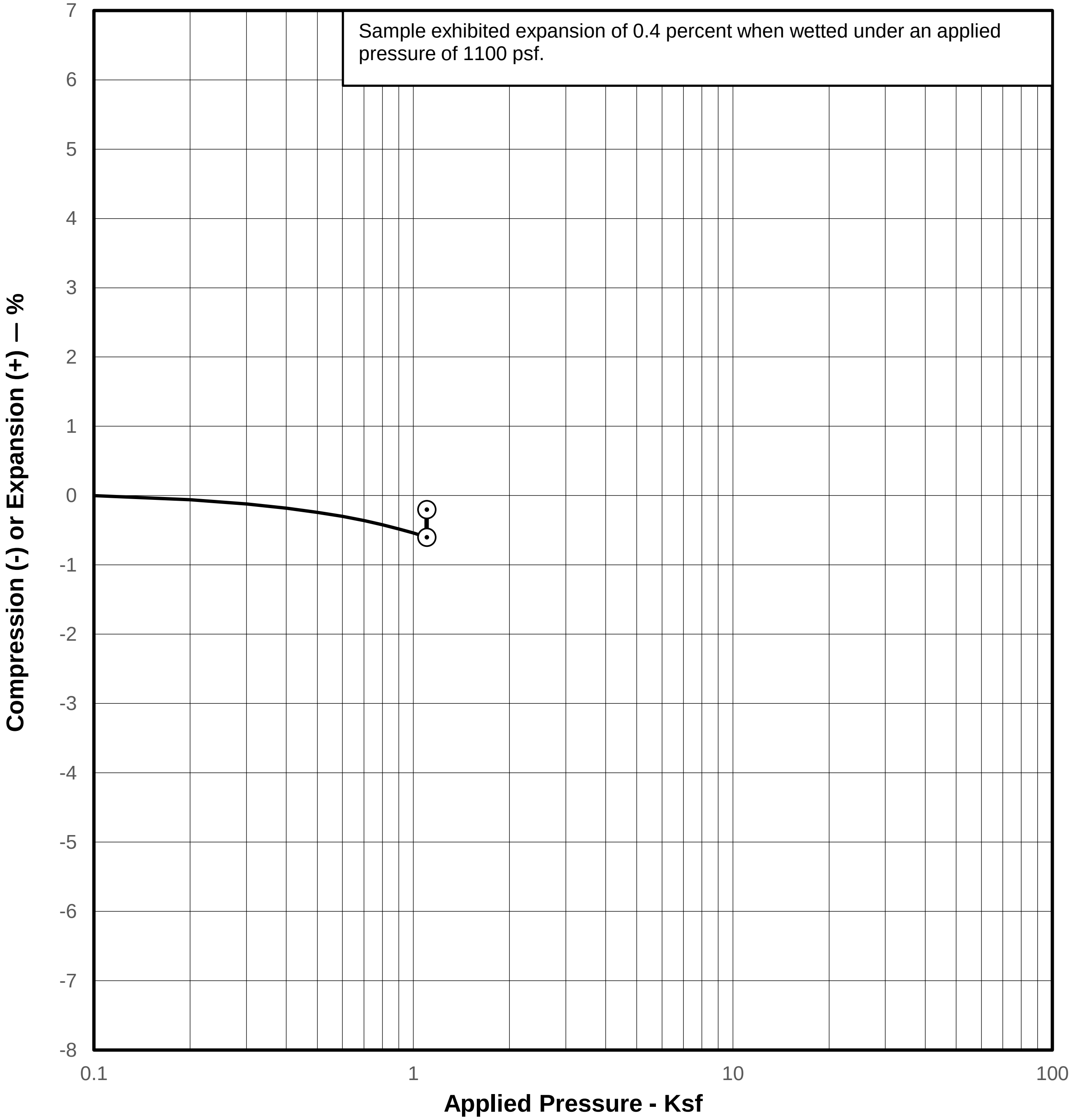


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-37 AT 4 FEET

MOISTURE CONTENT:	19.6	%	LIQUID LIMIT:			SILT AND CLAY:		%
DRY UNIT WEIGHT:	108	pcf	PLASTICITY INDEX:			SOIL SUCTION:		pf

Swell Consolidation Test Results



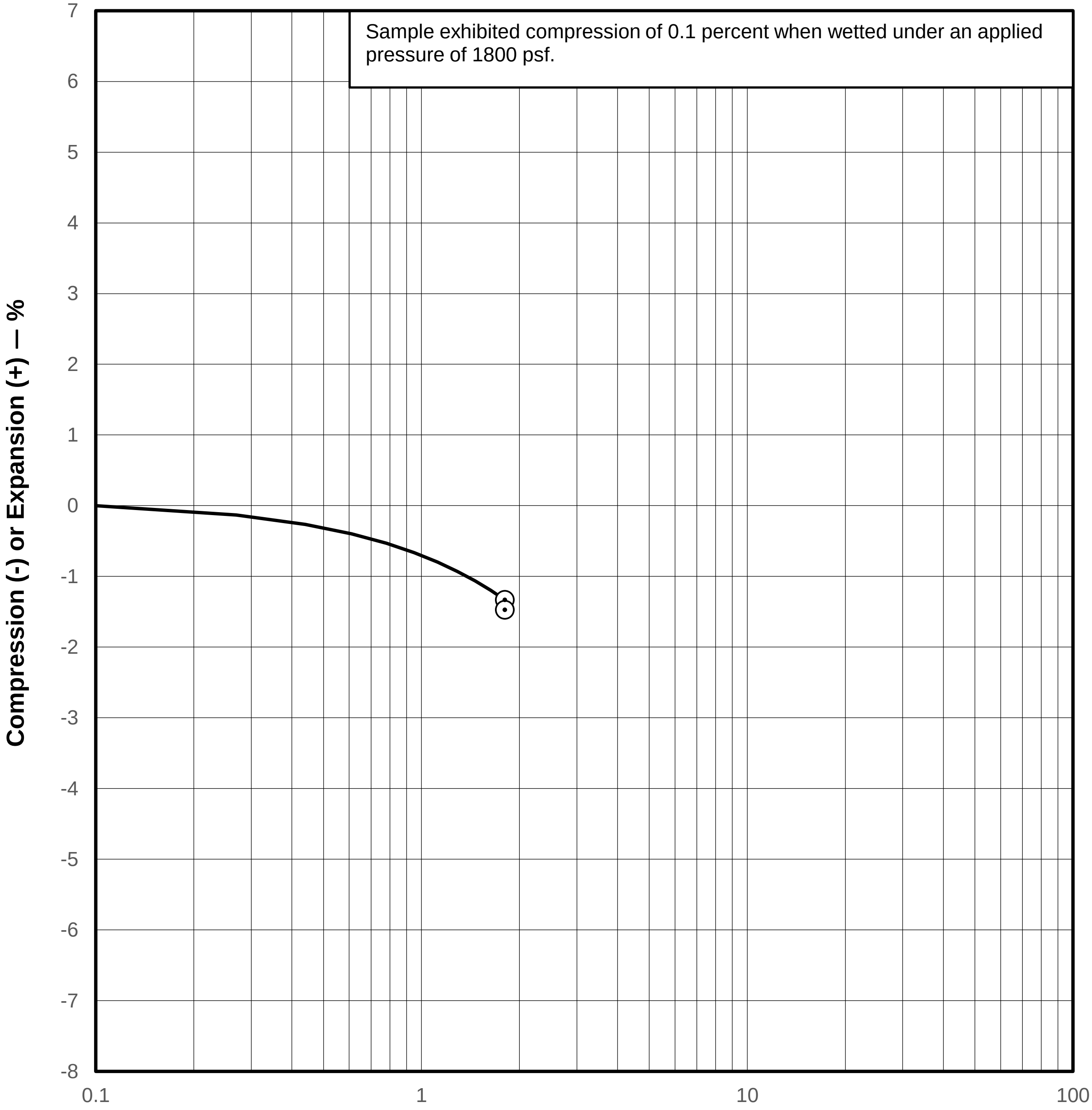
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-37 AT 9 FEET

MOISTURE CONTENT: 12.6 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 105 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

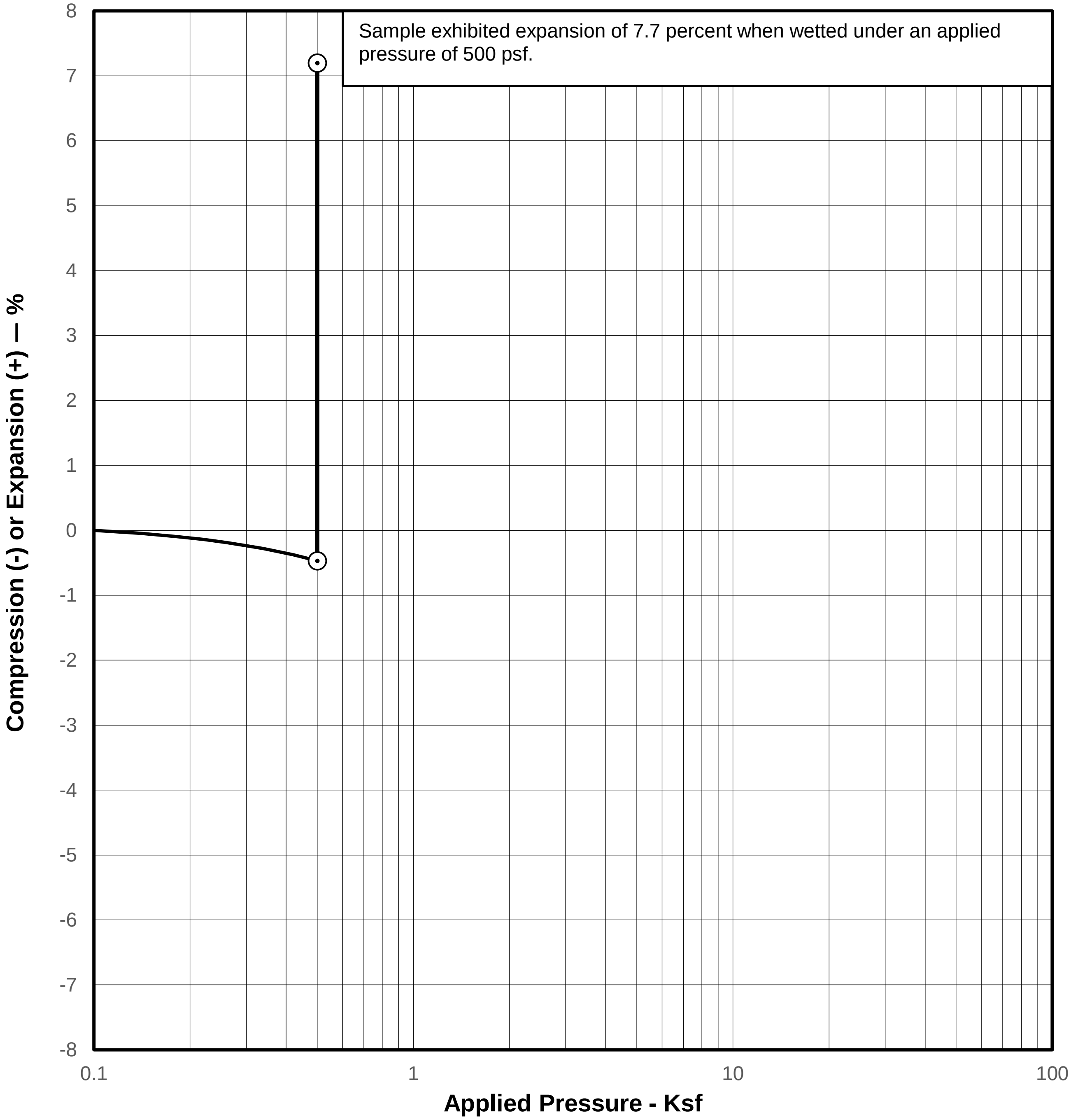


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-37 AT 14 FEET

MOISTURE CONTENT:	21.6	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	95	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

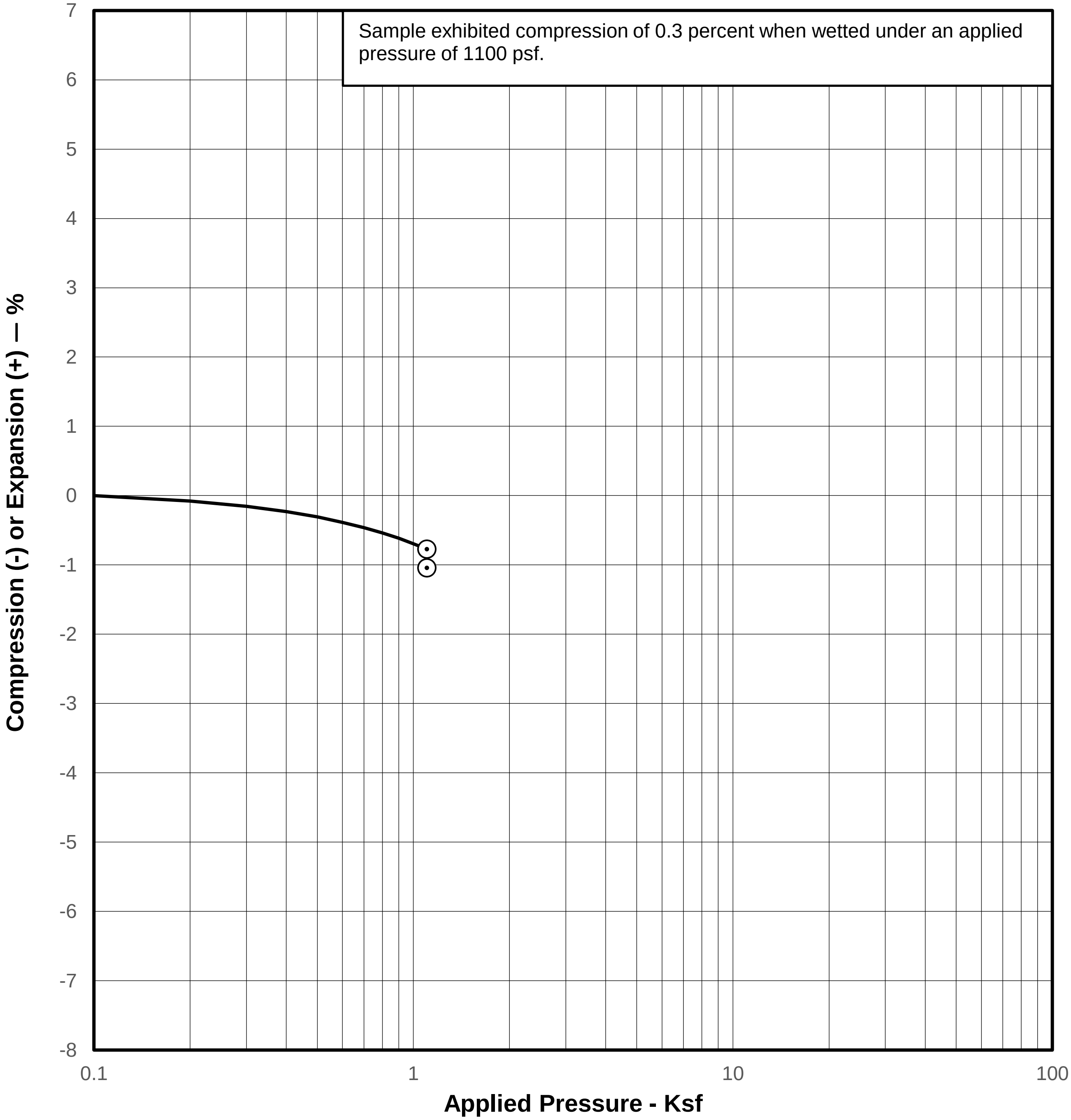
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-38 AT 4 FEET

MOISTURE CONTENT:	23.8	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	98	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

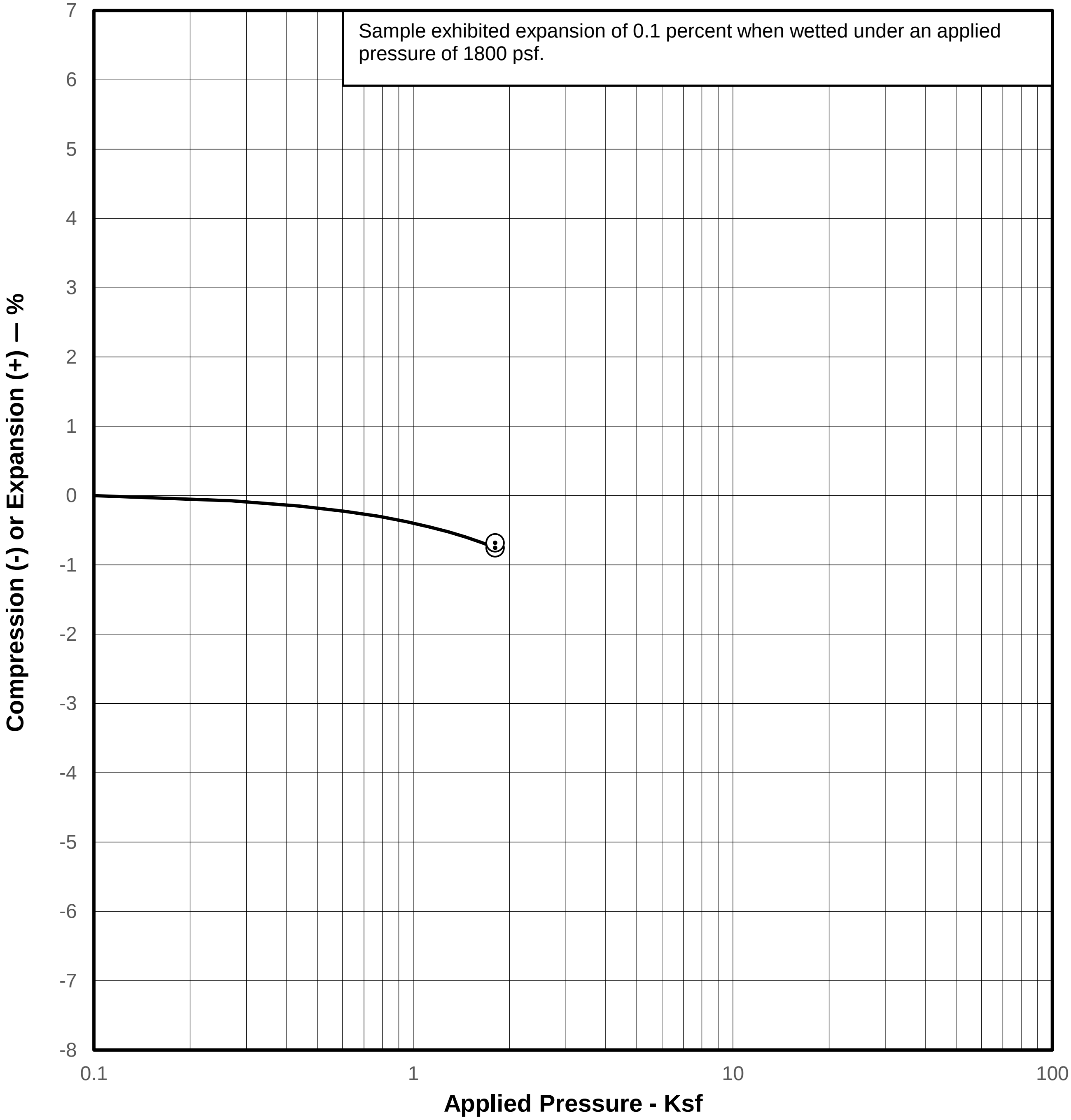
Swell Consolidation Test Results



SAMPLE OF: SAND, CLAYEY (SC)
FROM: TH-38 AT 9 FEET

MOISTURE CONTENT:	9.5 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	107 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



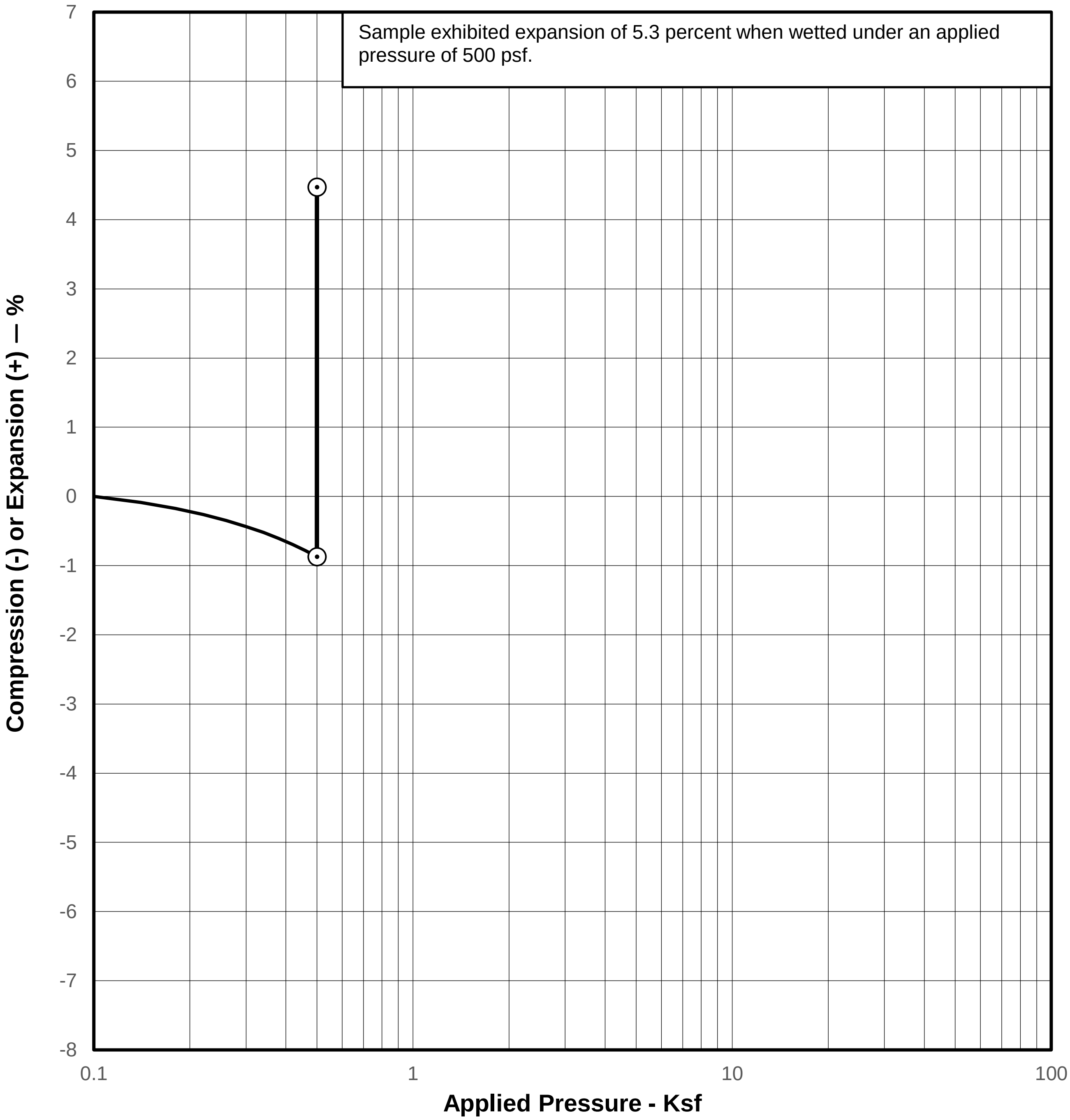
SAMPLE OF: CLAYSTONE

FROM: TH-38 AT 19 FEET

MOISTURE CONTENT: 28.4 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 102 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

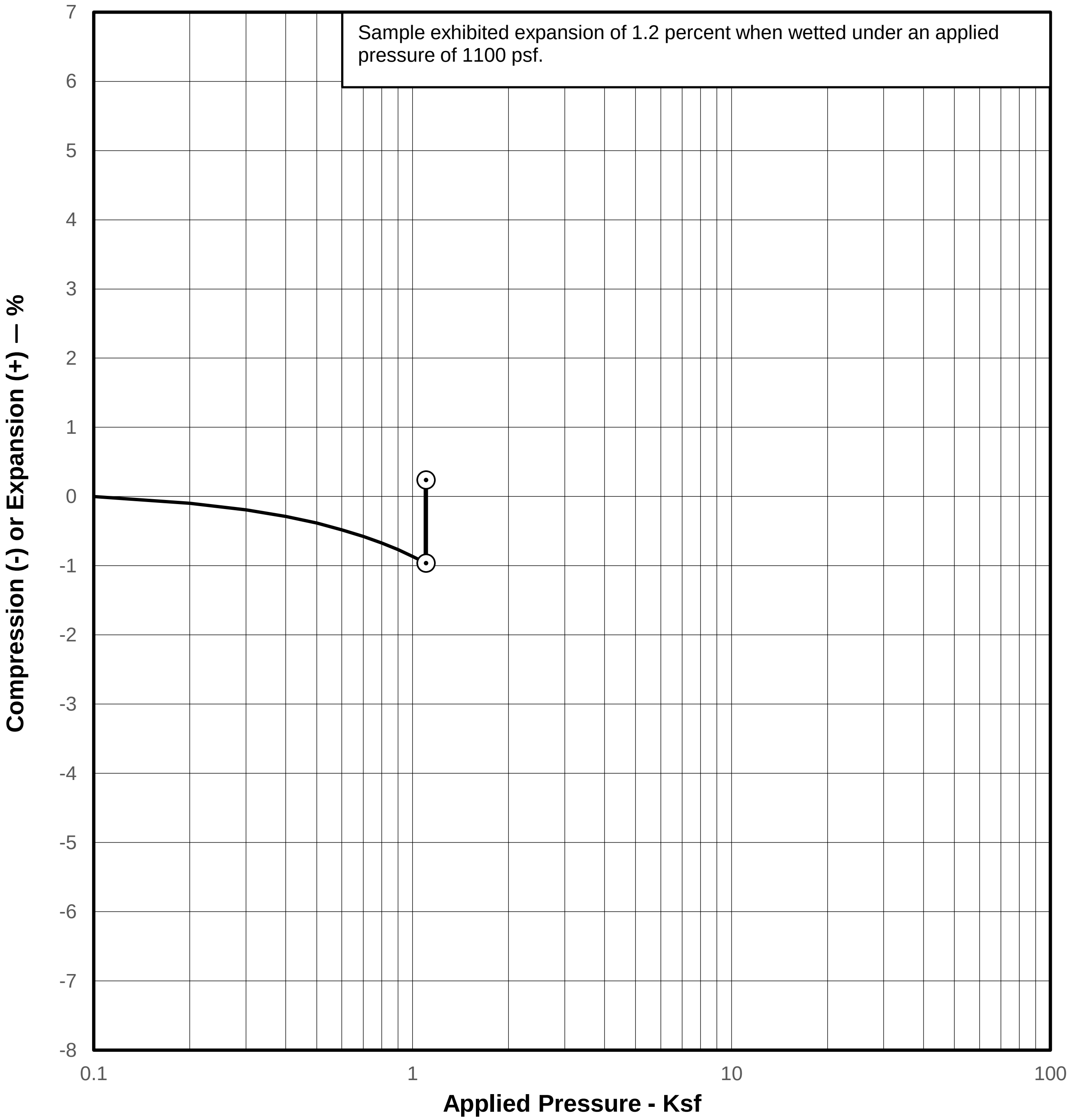


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-39 AT 4 FEET

MOISTURE CONTENT:	14.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	108 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

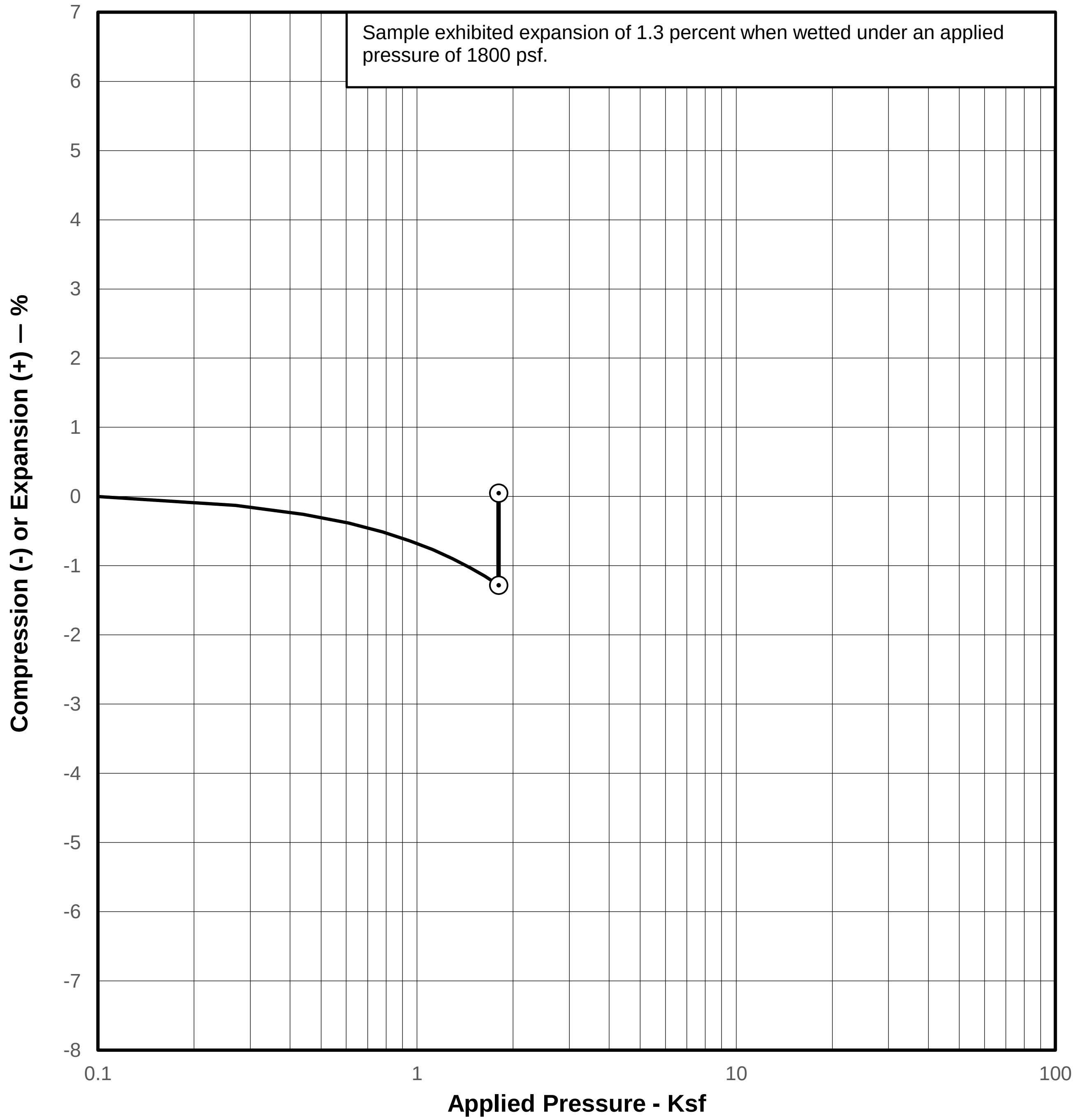


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-39 AT 9 FEET

MOISTURE CONTENT:	13.8	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	99	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

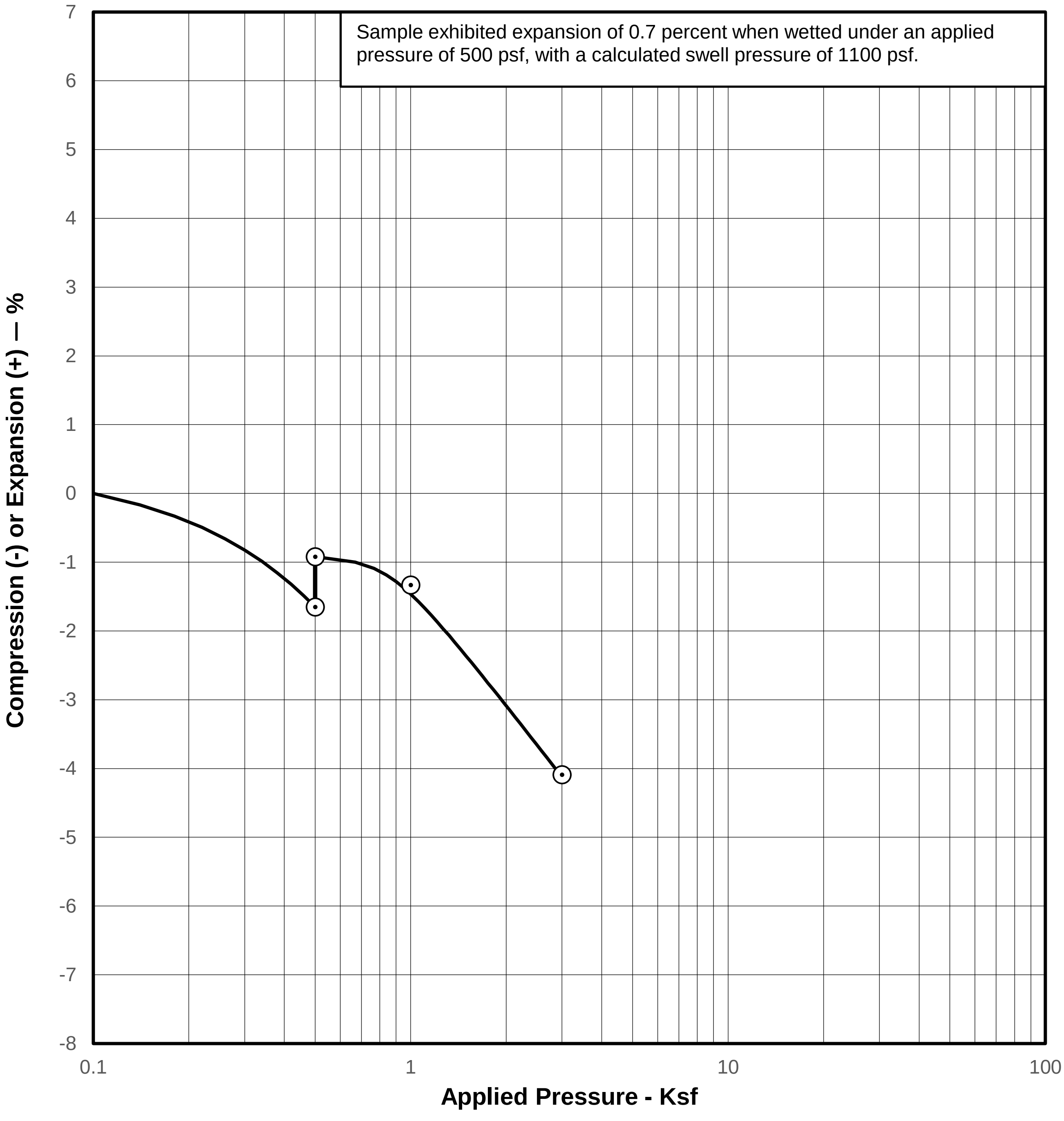
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-39 AT 14 FEET

MOISTURE CONTENT: 21.2 %   LIQUID LIMIT: ____   SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 104 pcf   PLASTICITY INDEX: ____   SOIL SUCTION: ____ pf

Swell Consolidation Test Results

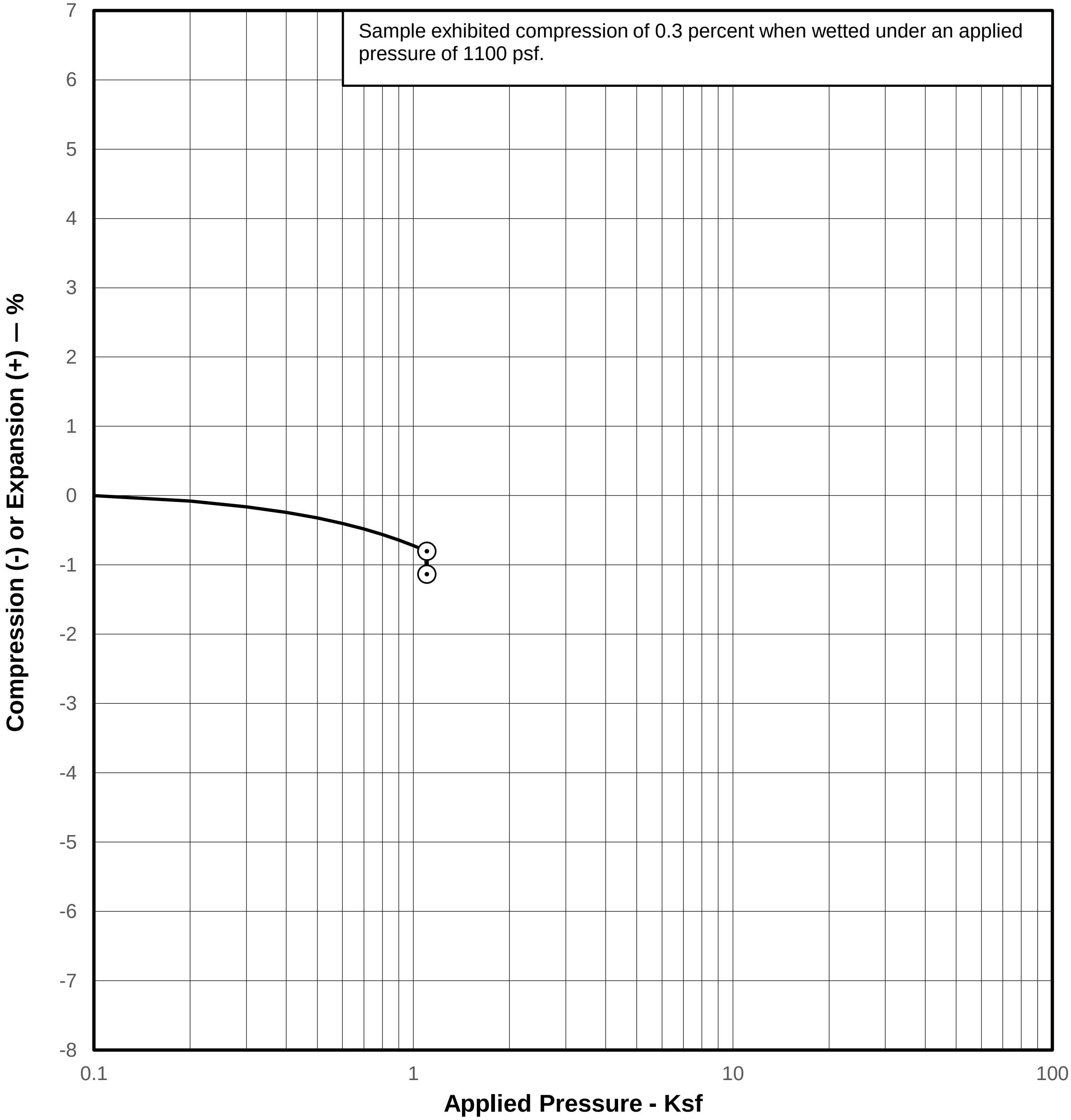


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-40 AT 4 FEET

MOISTURE CONTENT:	25.9 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	87 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.50 pf

Swell Consolidation Test Results



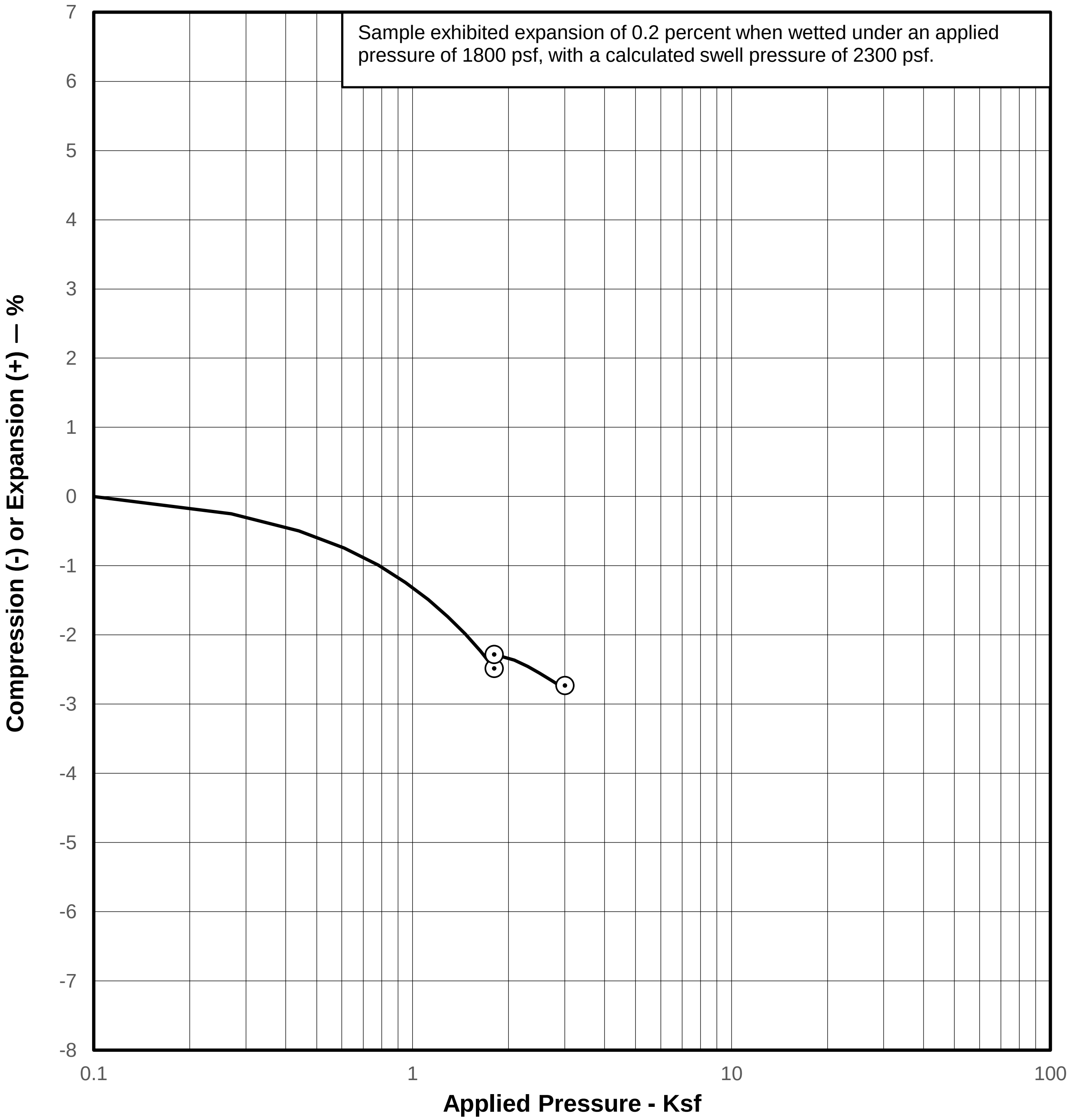
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-40 AT 9 FEET

MOISTURE CONTENT: 13.3 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 101 pcf PLASTICITY INDEX: ____ SOIL SUCTION: 2.78 pf

Swell Consolidation Test Results

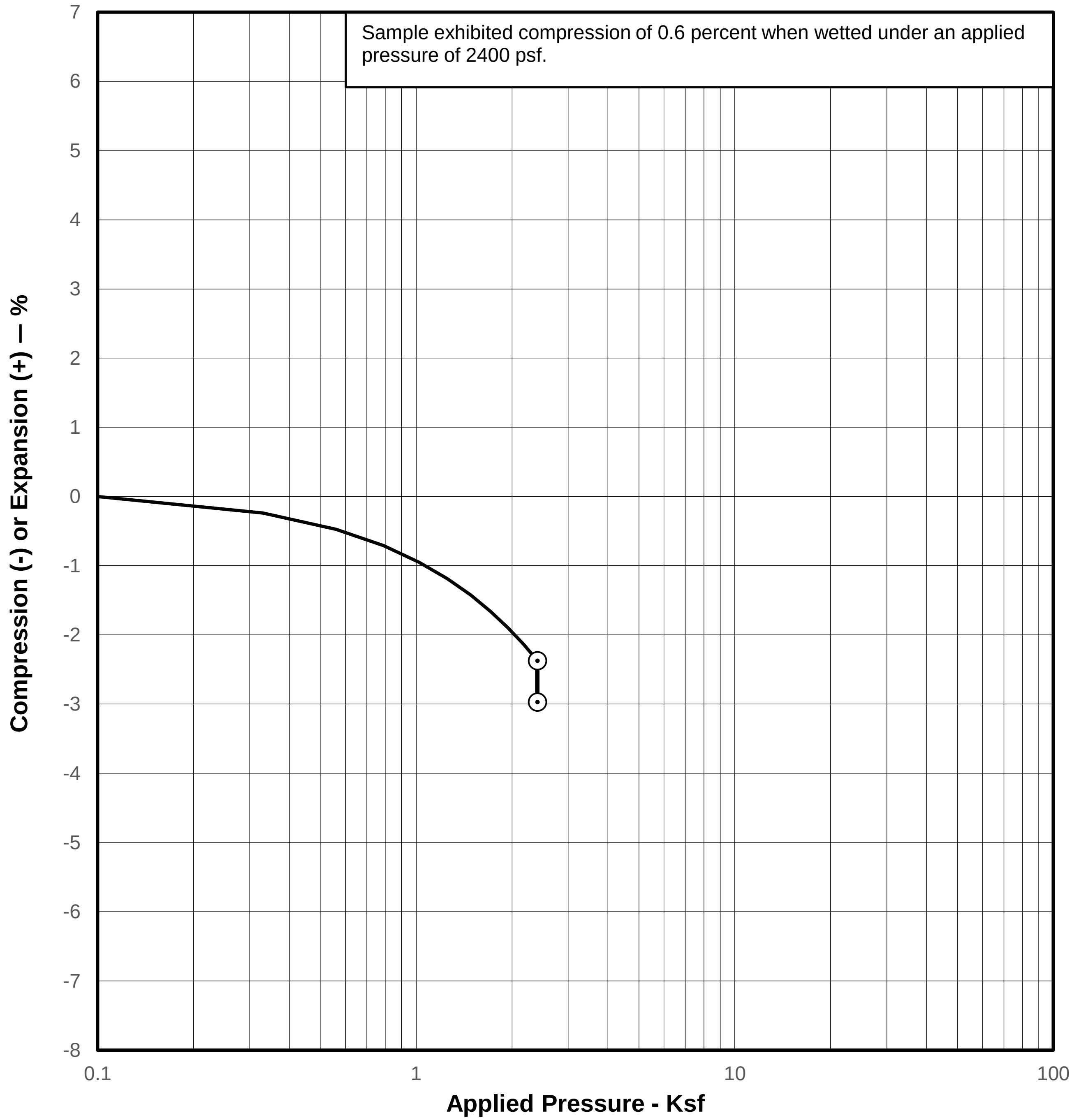


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-40 AT 14 FEET

MOISTURE CONTENT:	29.5	%	LIQUID LIMIT:			SILT AND CLAY:		%
DRY UNIT WEIGHT:	90	pcf	PLASTICITY INDEX:			SOIL SUCTION:	3.12	pf

Swell Consolidation Test Results

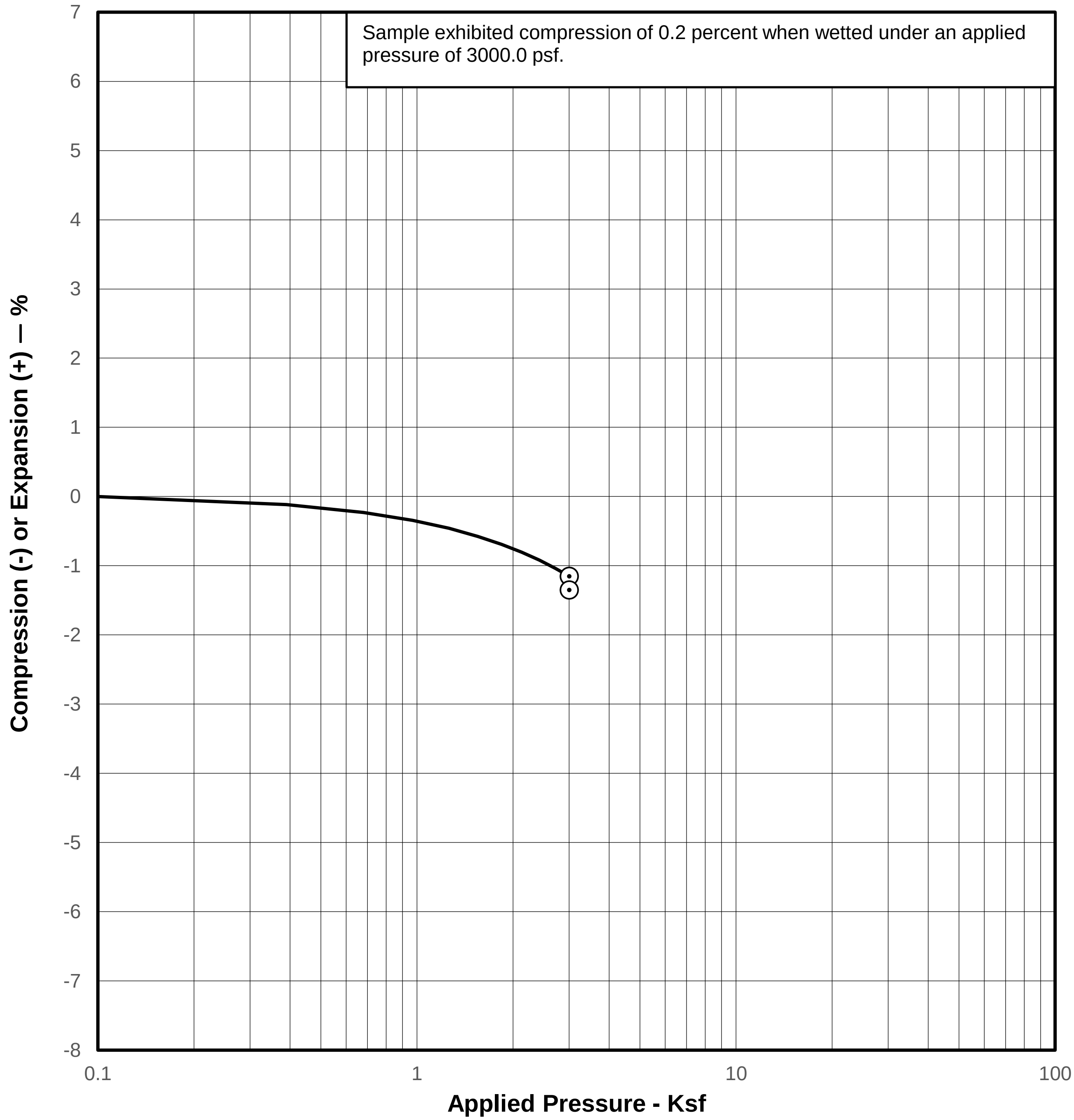


SAMPLE OF: CLAYSTONE

FROM: TH-40 AT 19 FEET

MOISTURE CONTENT:	30.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	84 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.20 pf

Swell Consolidation Test Results

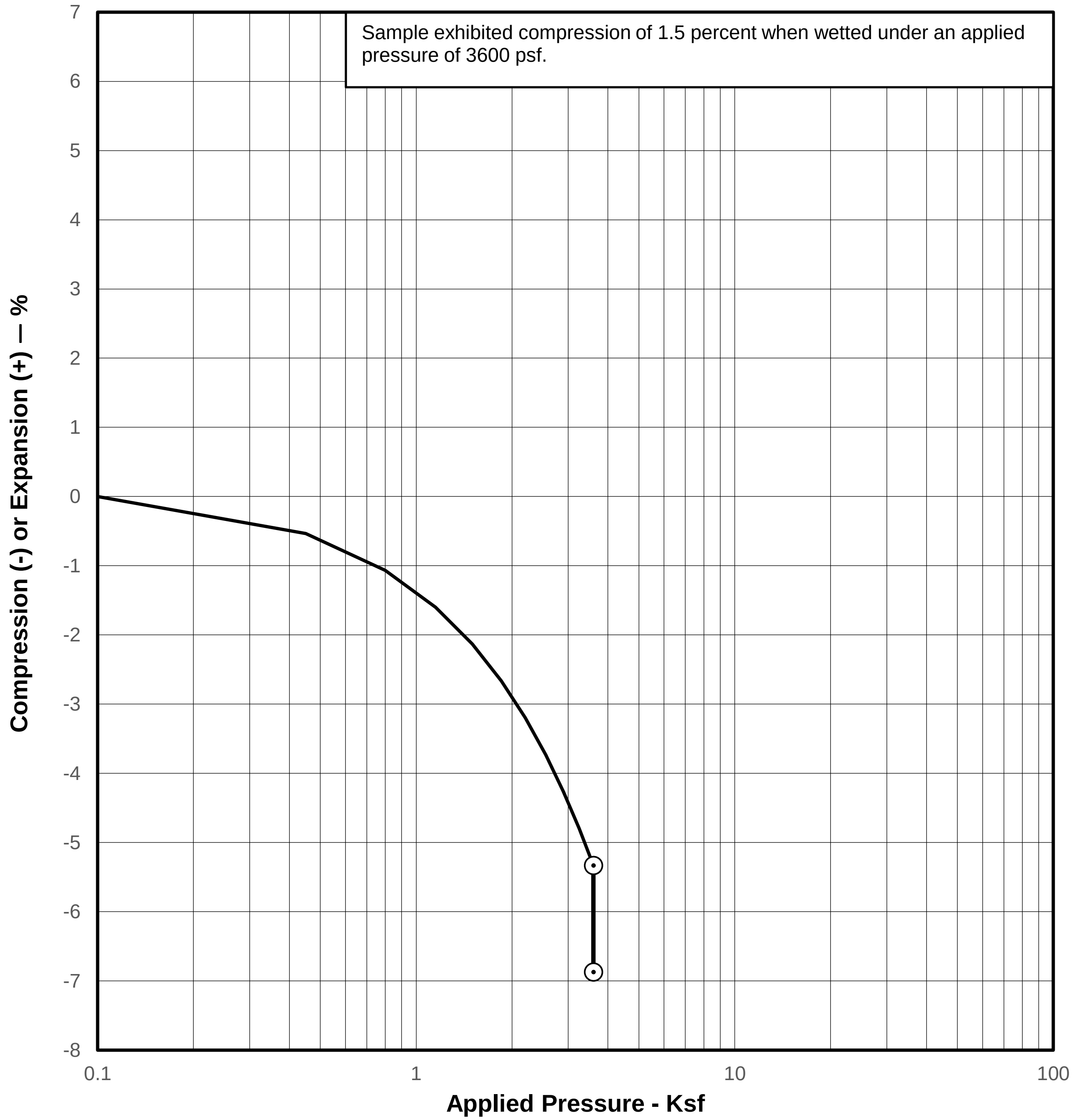


SAMPLE OF: CLAYSTONE

FROM: TH-40 AT 24 FEET

MOISTURE CONTENT:	26.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	90 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.73 pf

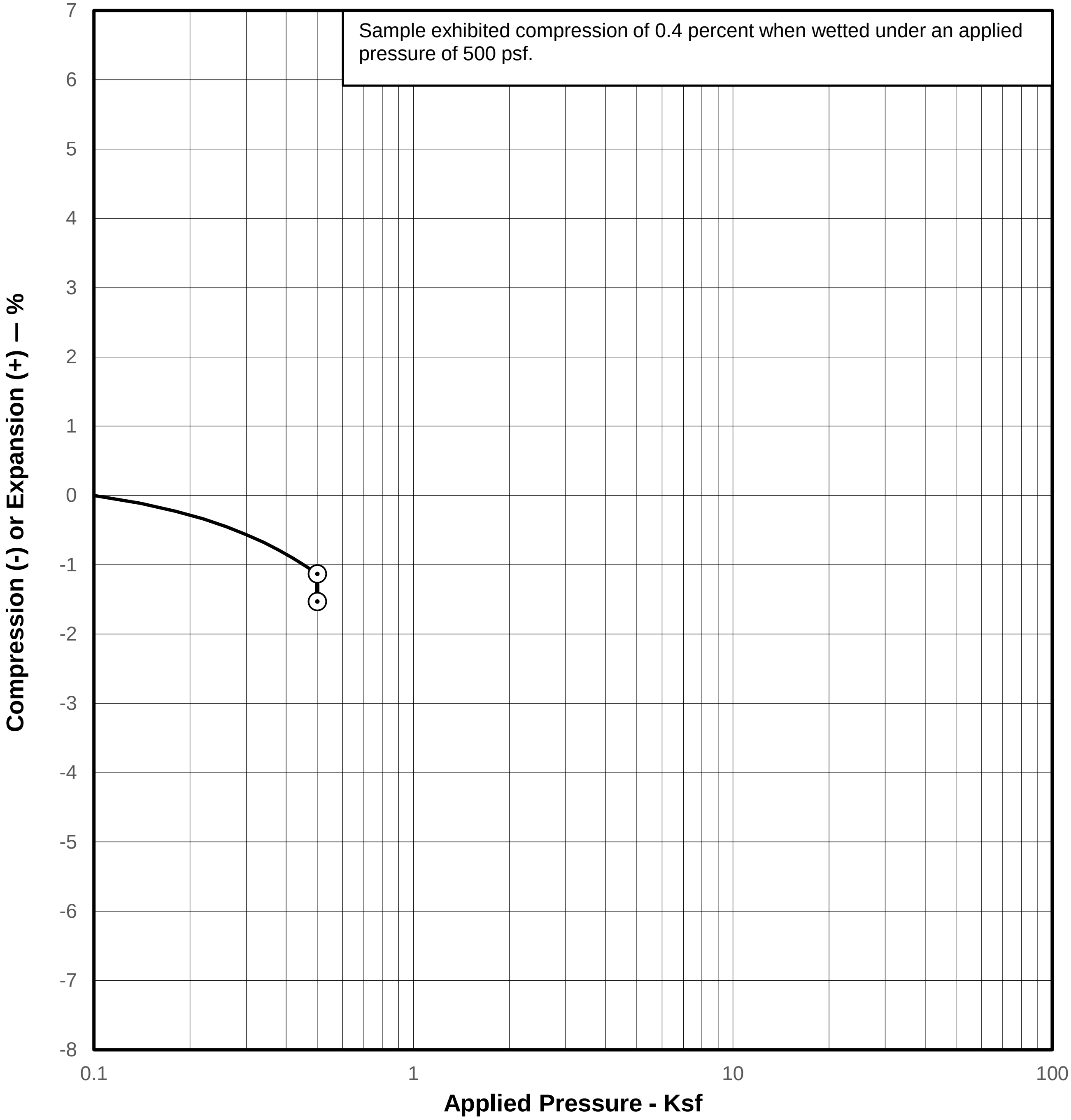
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-40 AT 29 FEET

MOISTURE CONTENT:	26.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	78 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.52 pf

Swell Consolidation Test Results

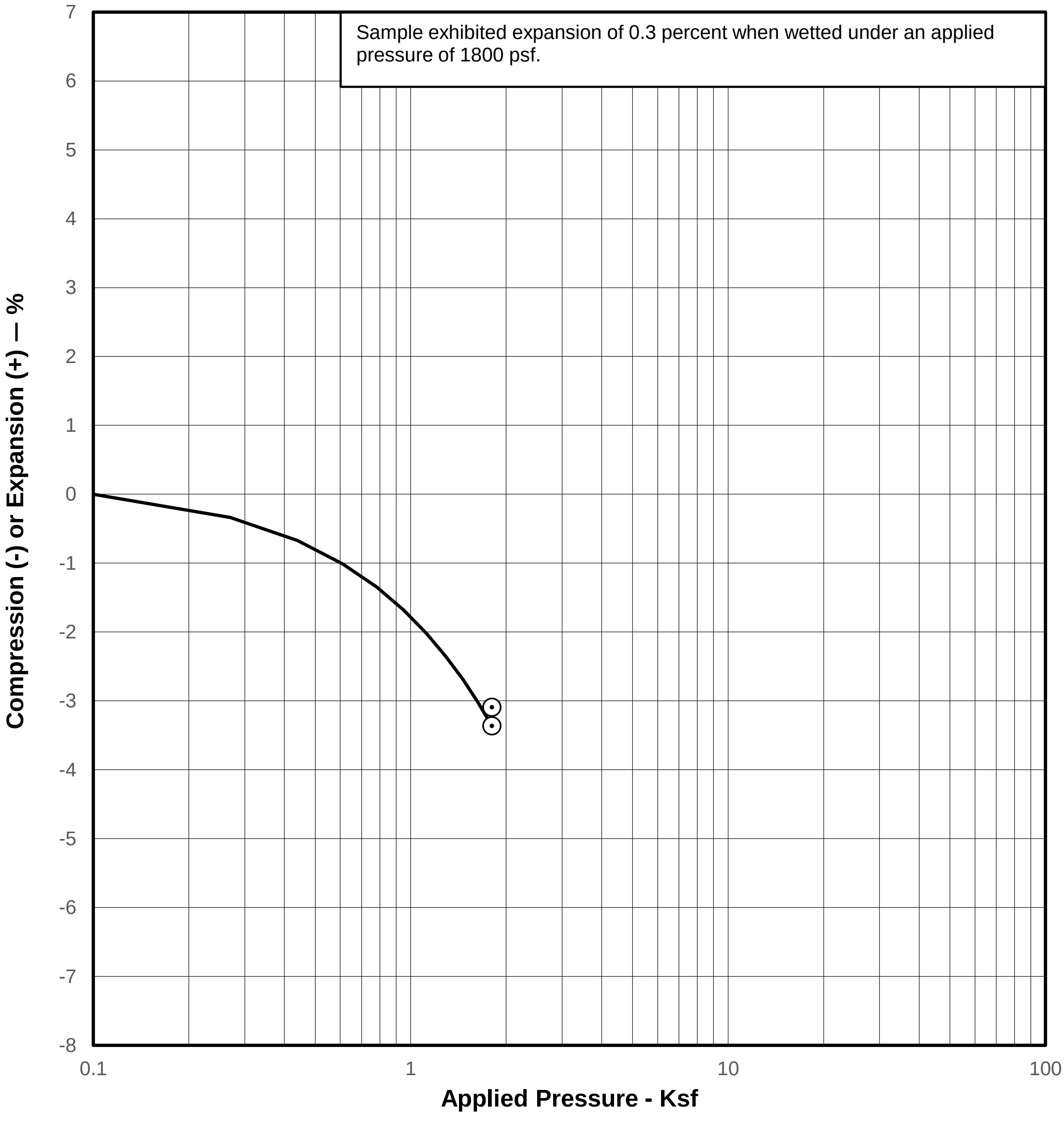


SAMPLE OF: SAND, CLAYEY (SC)

FROM: TH-41 AT 4 FEET

MOISTURE CONTENT:	15.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	98 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

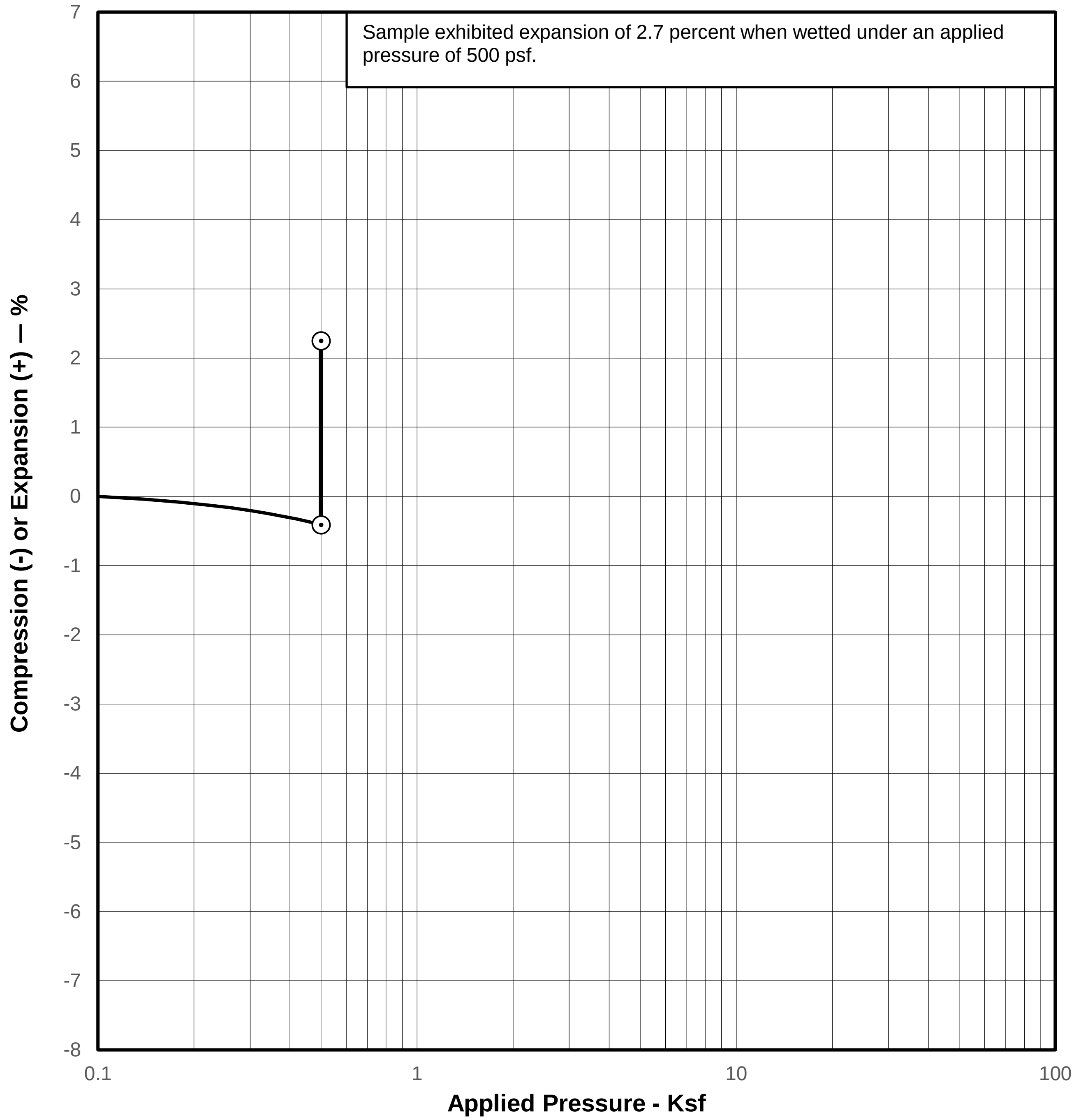


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-41 AT 14 FEET

MOISTURE CONTENT:	31.9	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	89	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

Swell Consolidation Test Results

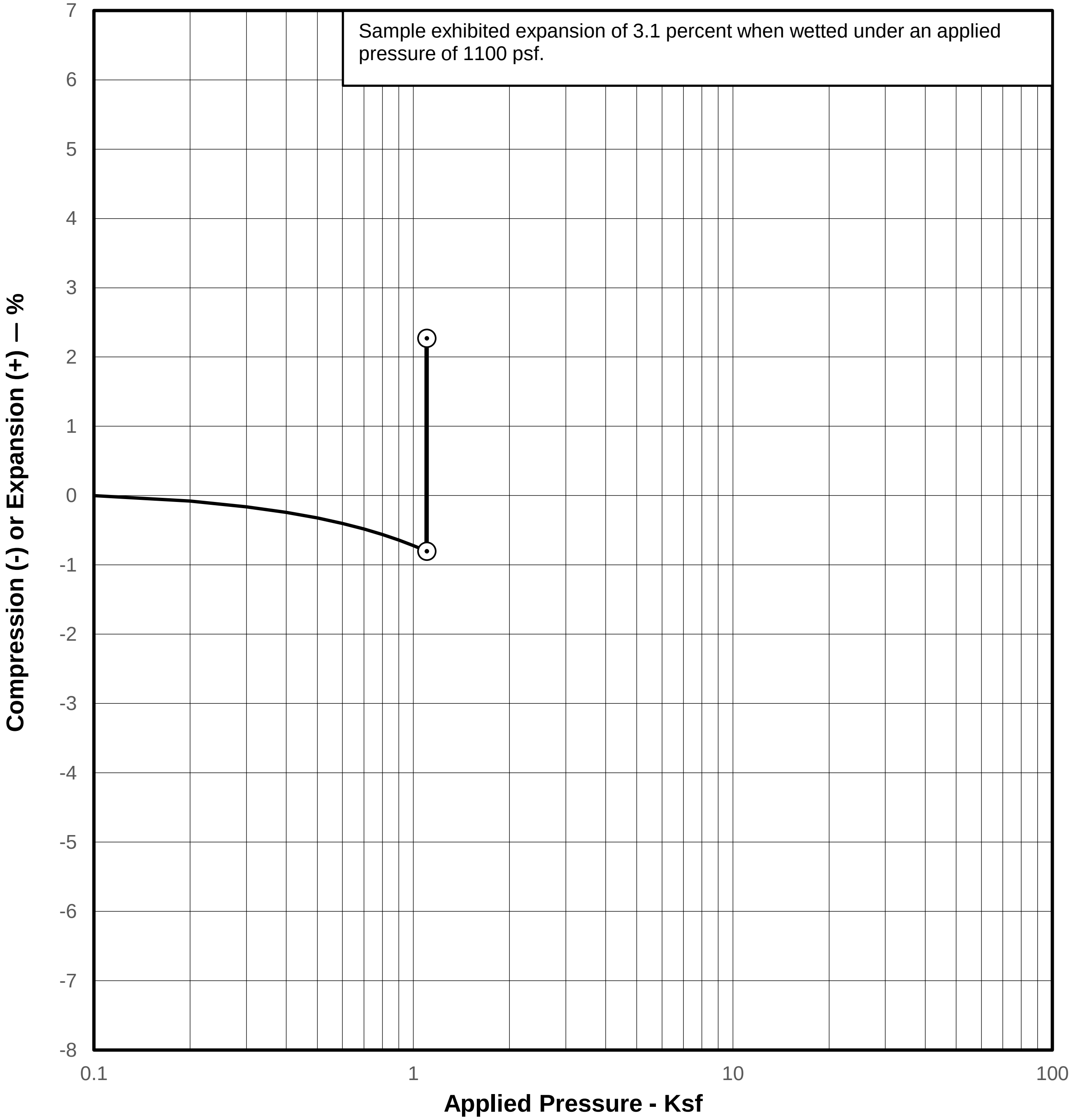


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-42 AT 4 FEET

MOISTURE CONTENT:	8.0 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	113 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

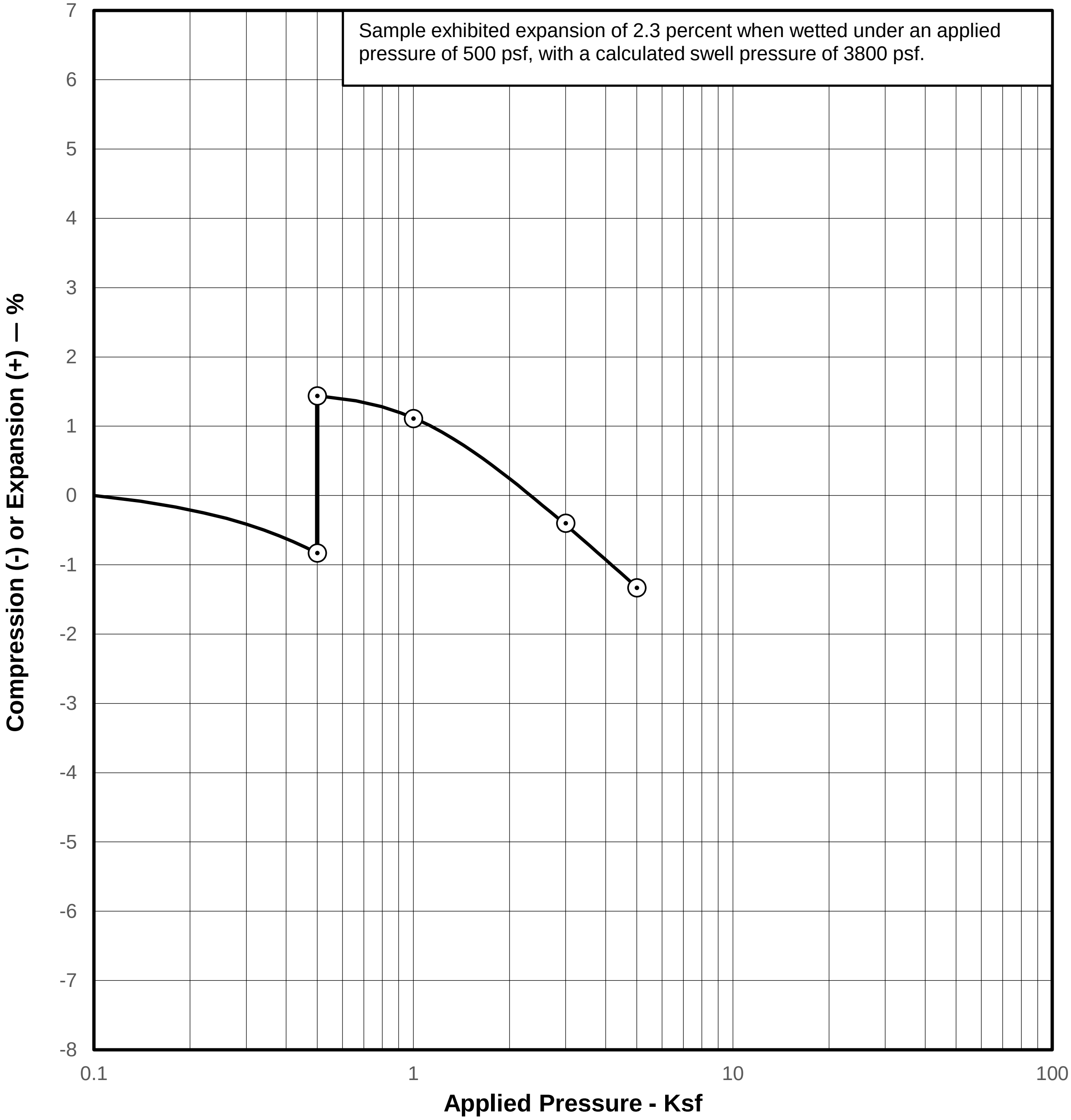


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-42 AT 9 FEET

MOISTURE CONTENT:	10.3 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	111 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

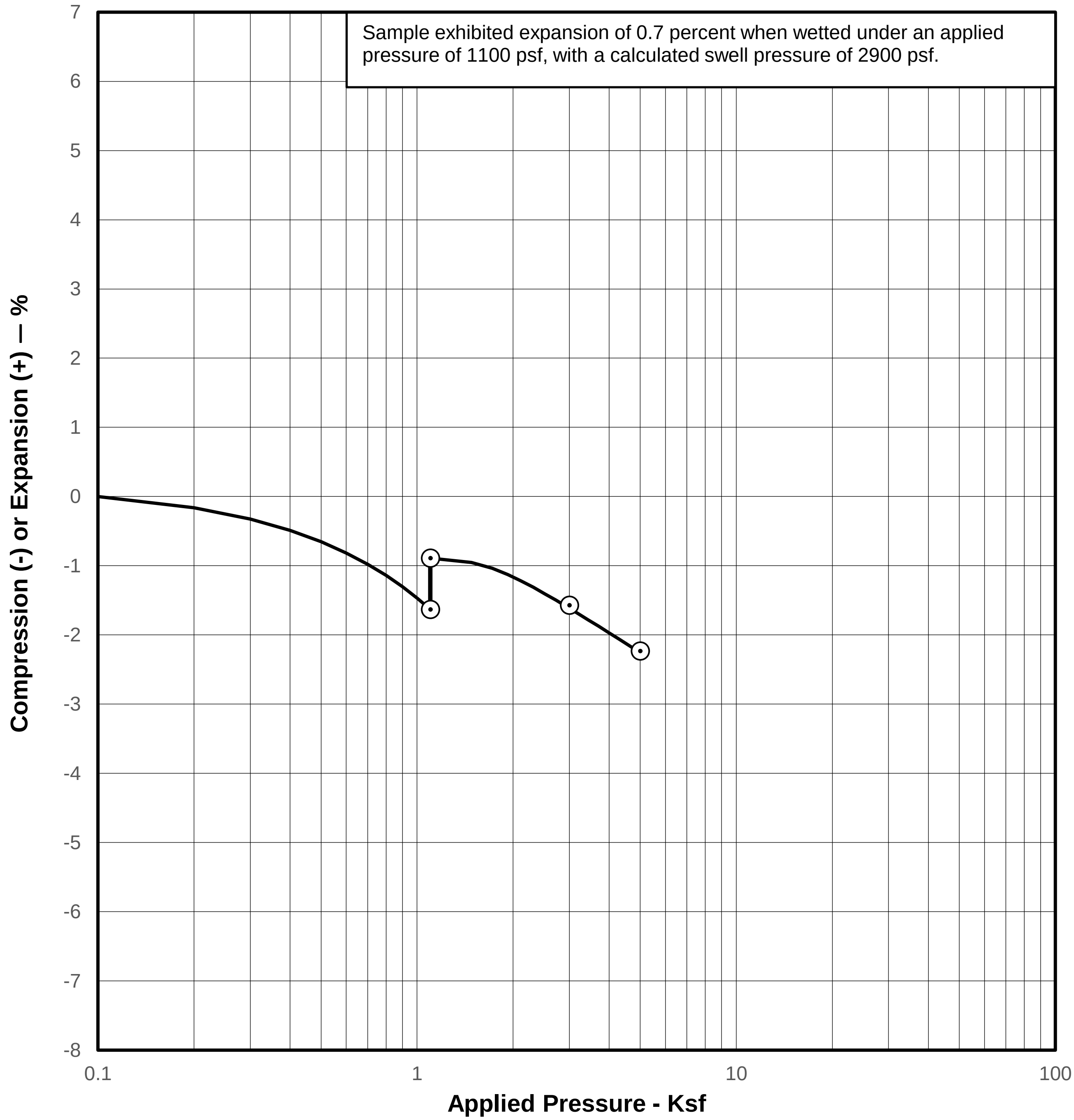
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-43 AT 4 FEET

MOISTURE CONTENT:	20.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	99 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.46 pf

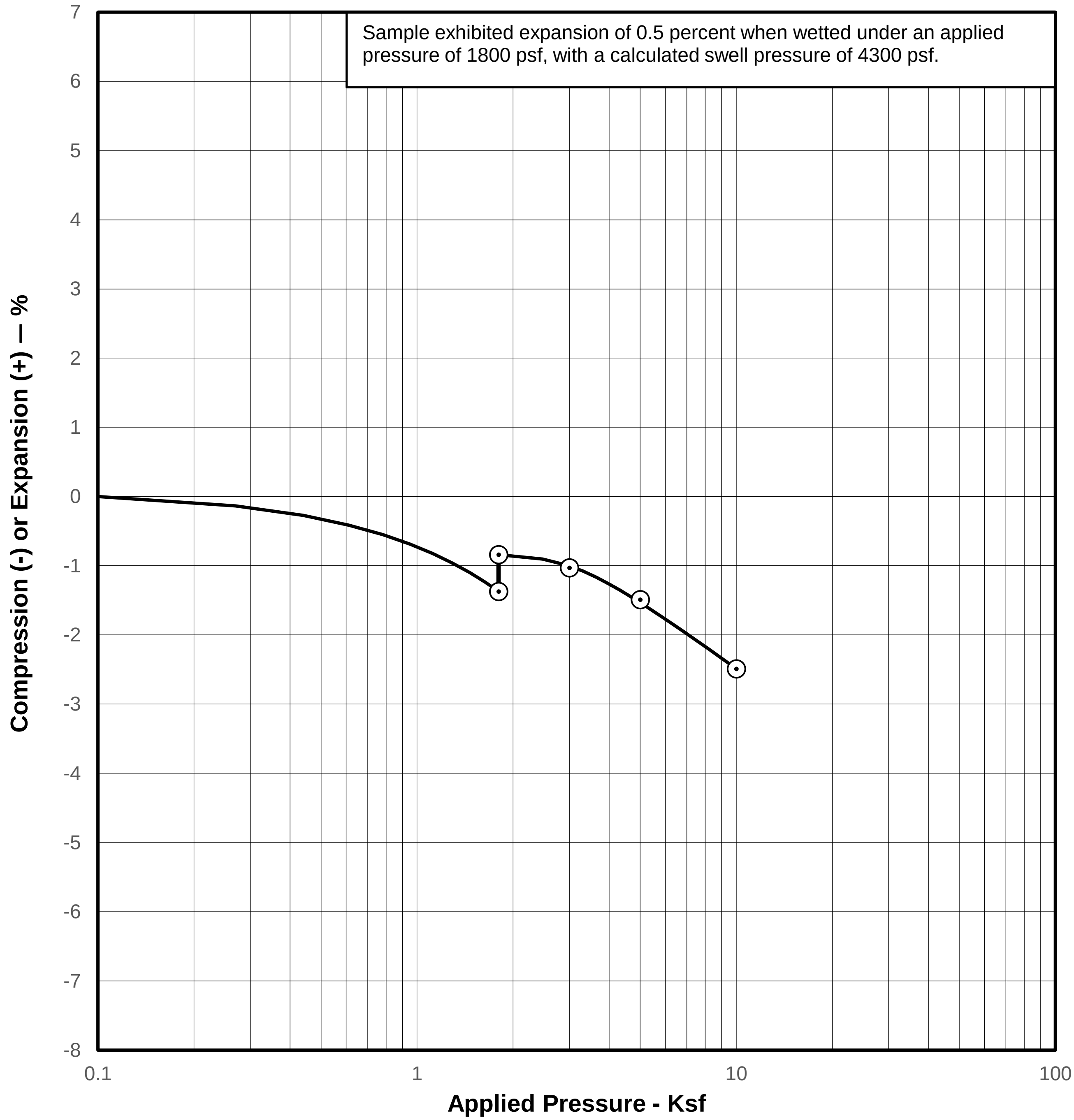
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-43 AT 9 FEET

MOISTURE CONTENT:	21.9 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	102 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.70 pf

Swell Consolidation Test Results

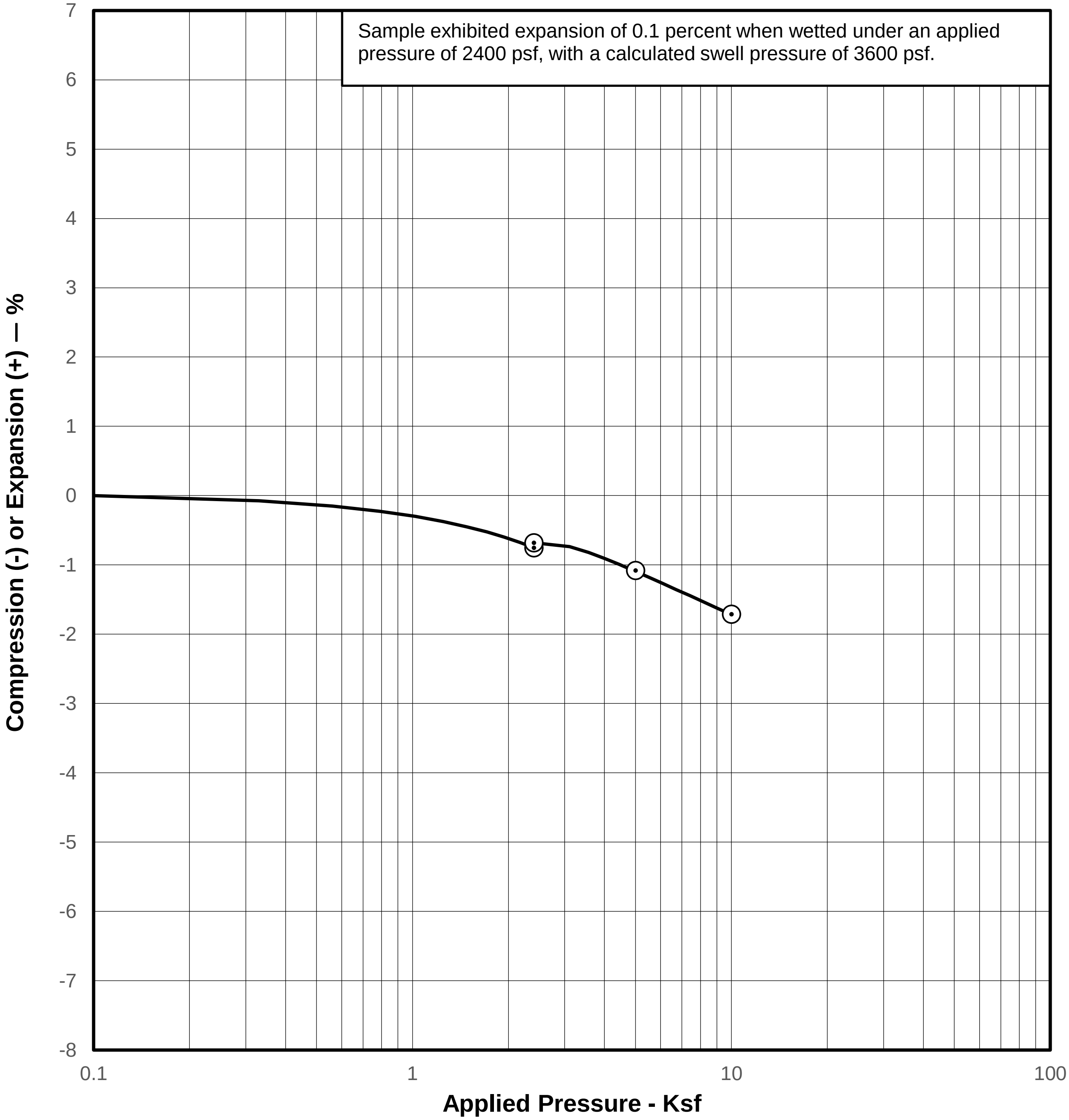


SAMPLE OF: CLAYSTONE

FROM: TH-43 AT 14 FEET

MOISTURE CONTENT:	34.8 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	84 pcf	PLASTICITY INDEX:		SOIL SUCTION:	3.47 pf

Swell Consolidation Test Results

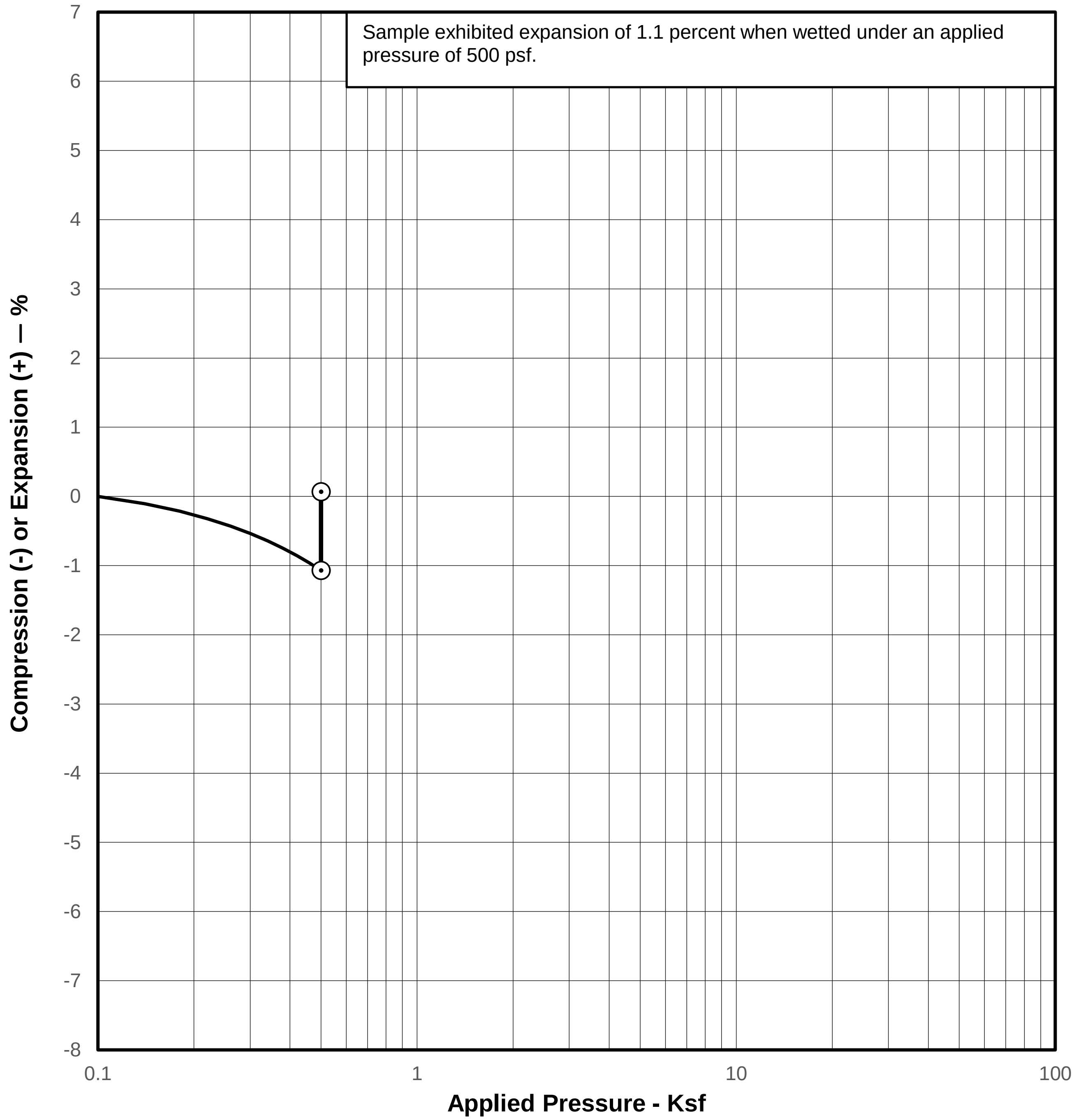


SAMPLE OF: CLAYSTONE

FROM: TH-43 AT 19 FEET

MOISTURE CONTENT:	30.2 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	95 pcf	PLASTICITY INDEX:		SOIL SUCTION:	2.84 pf

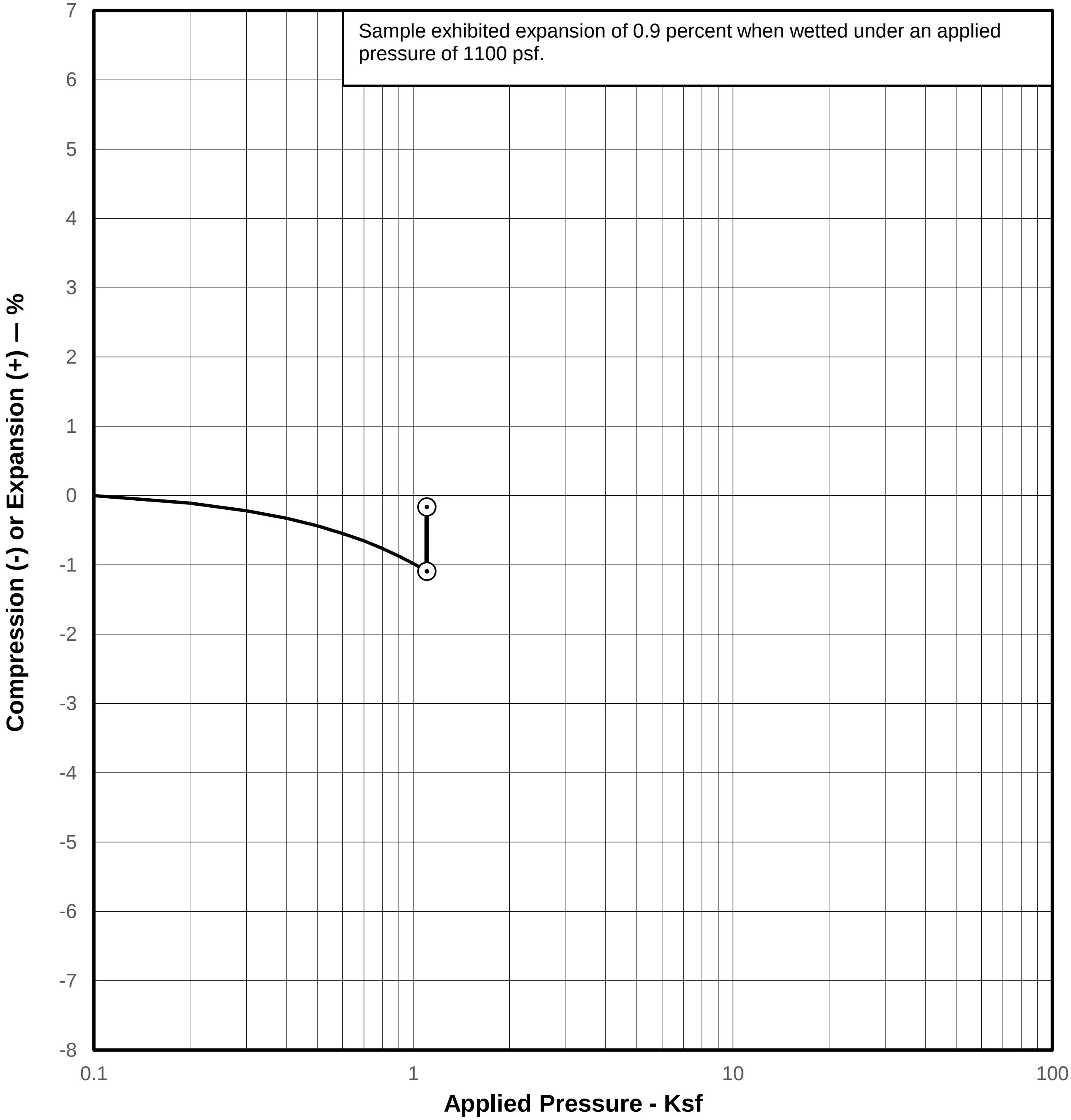
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: TH-44 AT 4 FEET

MOISTURE CONTENT: 17.9 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 102 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

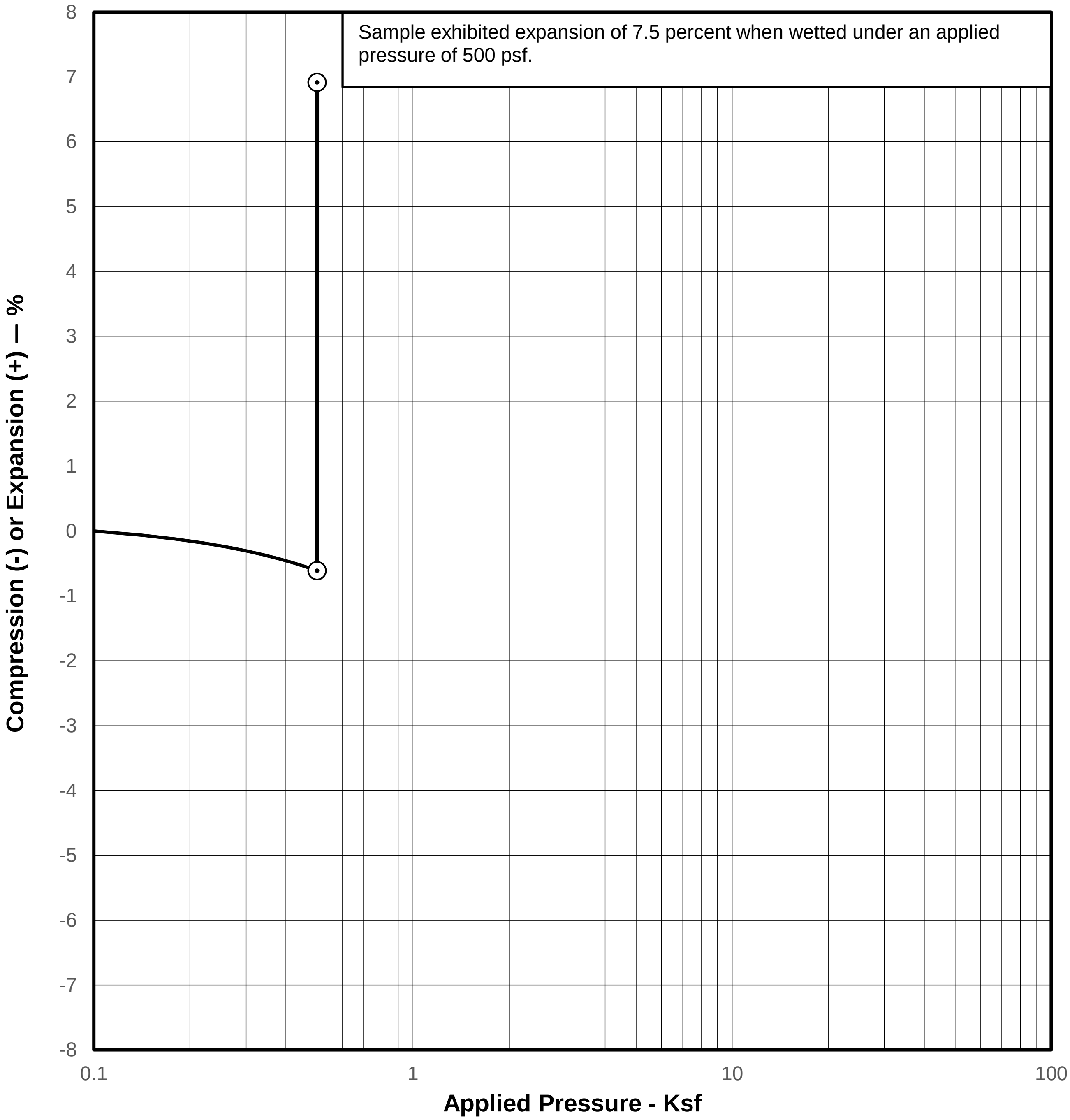


SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-44 AT 9 FEET

MOISTURE CONTENT:	26.4	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	96	pcf	PLASTICITY INDEX:		SOIL SUCTION:		pf

Swell Consolidation Test Results



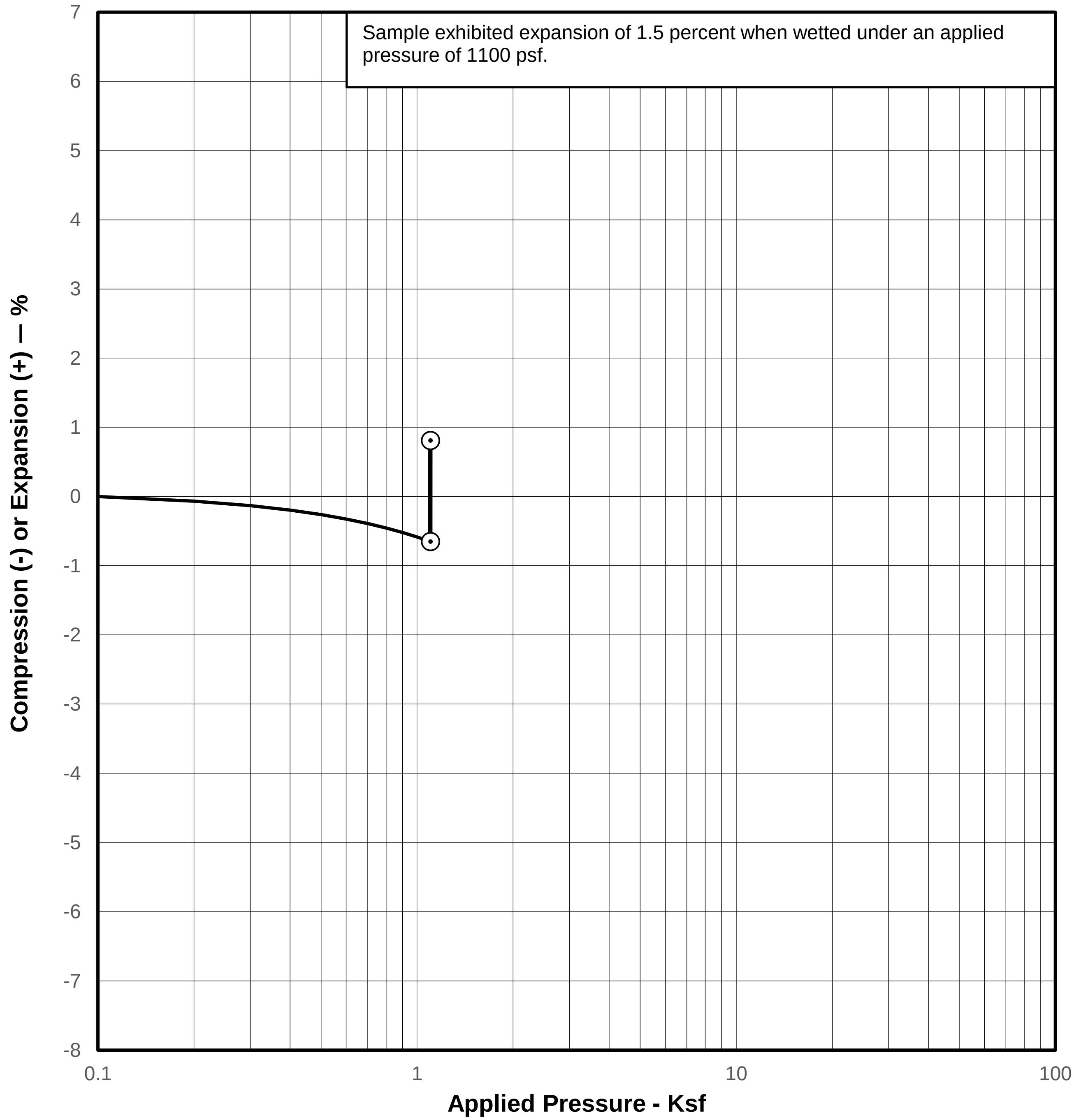
SAMPLE OF: CLAY, SANDY (CL)

FROM: TH-45 AT 4 FEET

MOISTURE CONTENT: 18.2 % LIQUID LIMIT: ______ SILT AND CLAY: ______ %

DRY UNIT WEIGHT: 108 pcf PLASTICITY INDEX: ______ SOIL SUCTION: ______ pf

Swell Consolidation Test Results



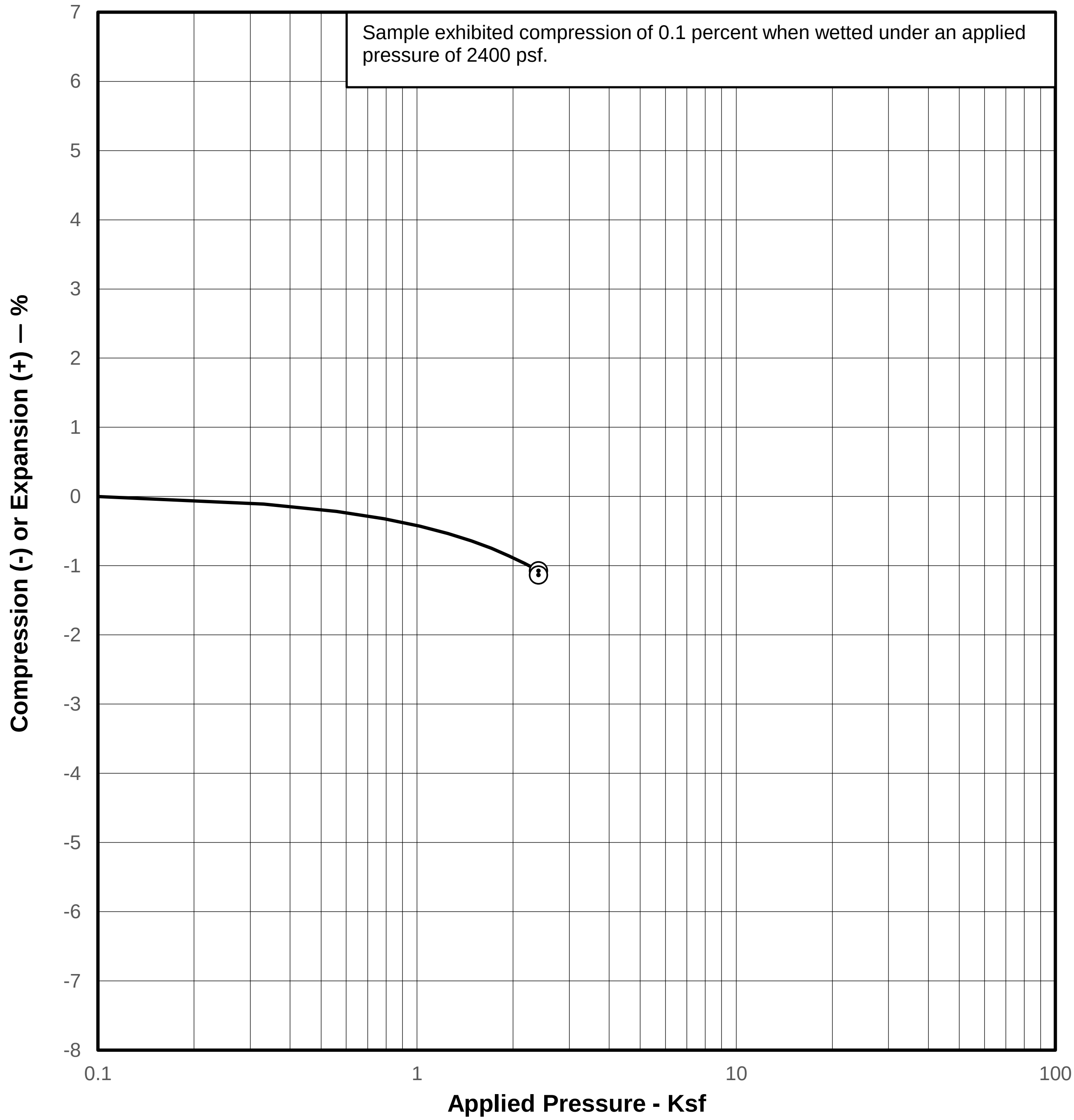
SAMPLE OF: CLAYSTONE

FROM: TH-45 AT 9 FEET

MOISTURE CONTENT: 28.3 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 90 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

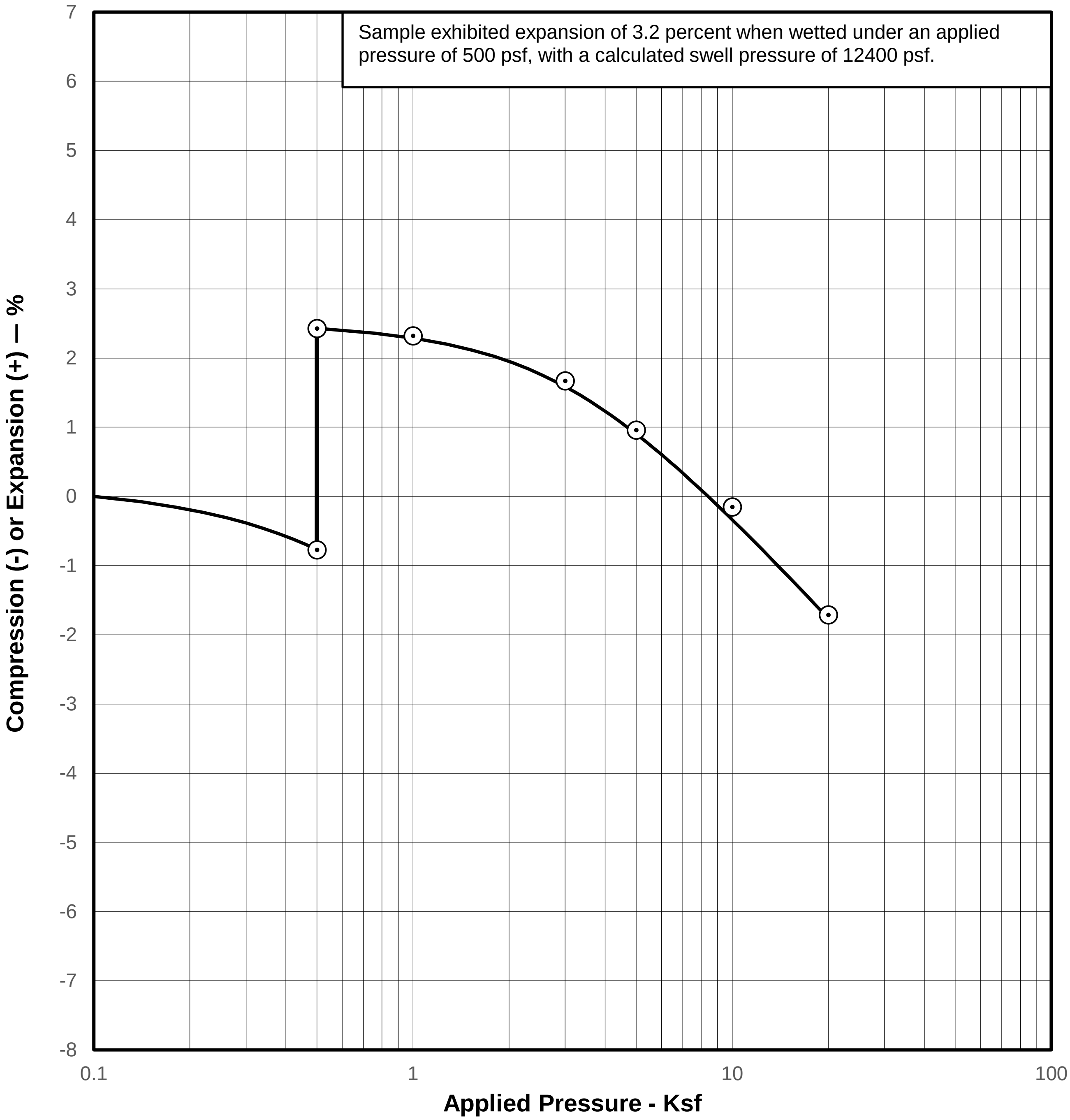


SAMPLE OF: CLAYSTONE

FROM: TH-45 AT 19 FEET

MOISTURE CONTENT:	34.7 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	89 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

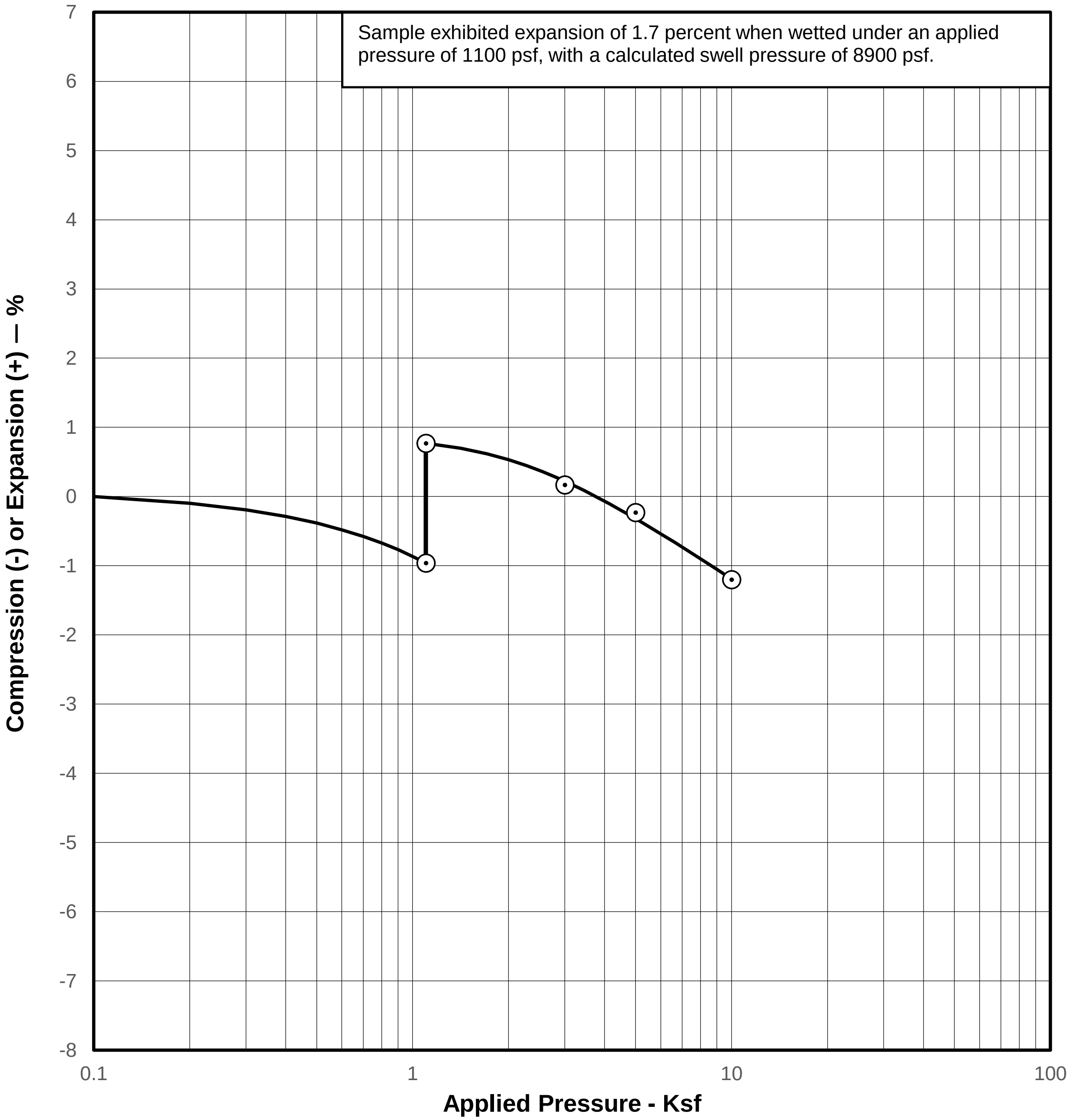


SAMPLE OF: CLAYSTONE

FROM: TH-46 AT 4 FEET

MOISTURE CONTENT:	26.8	%	LIQUID LIMIT:		SILT AND CLAY:		%
DRY UNIT WEIGHT:	95	pcf	PLASTICITY INDEX:		SOIL SUCTION:	4.06	pf

Swell Consolidation Test Results



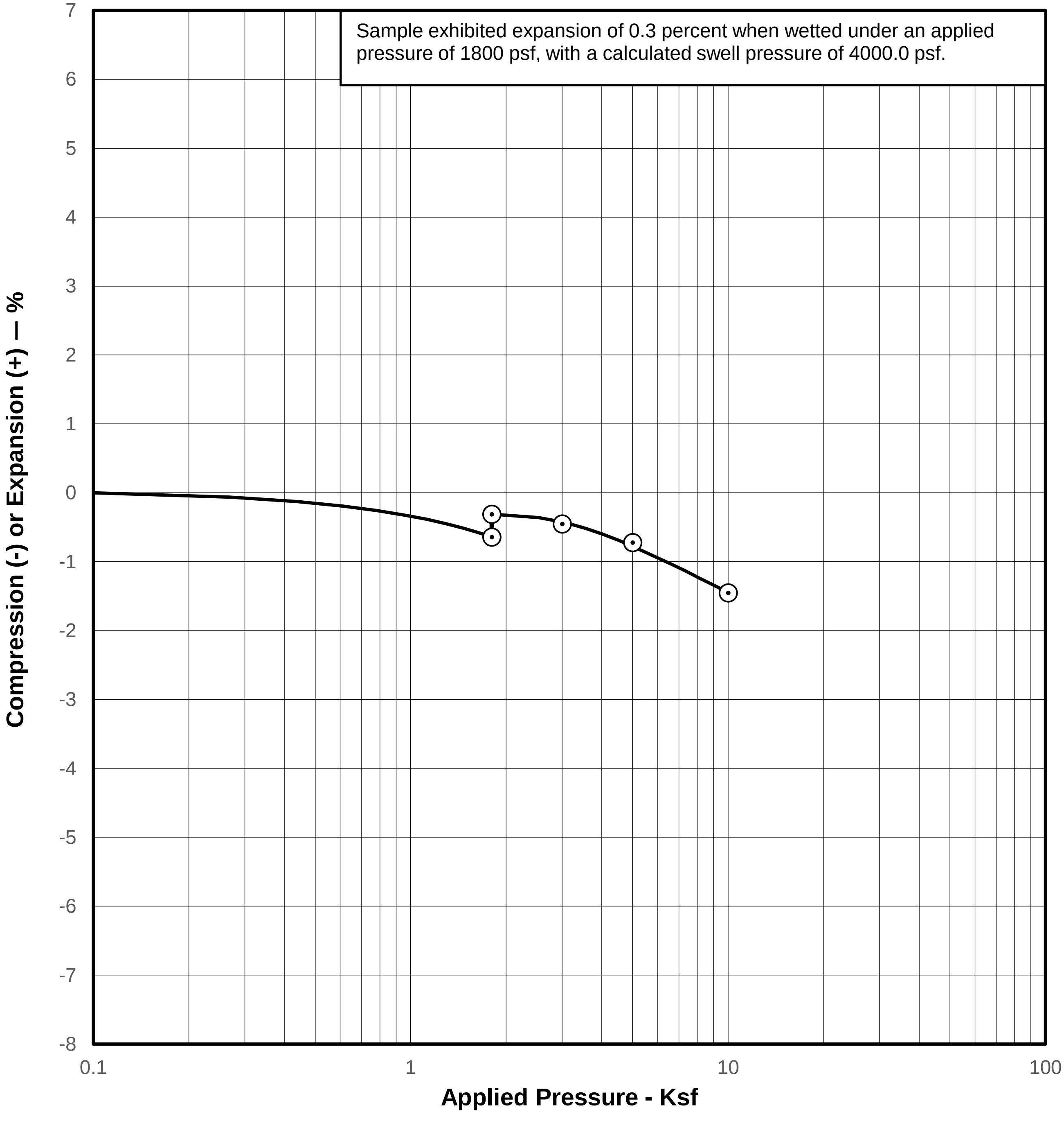
SAMPLE OF: CLAYSTONE

FROM: TH-46 AT 9 FEET

MOISTURE CONTENT: 33.9 % LIQUID LIMIT: ______ SILT AND CLAY: ______ %

DRY UNIT WEIGHT: 87 pcf PLASTICITY INDEX: ______ SOIL SUCTION: 4.04 pf

Swell Consolidation Test Results

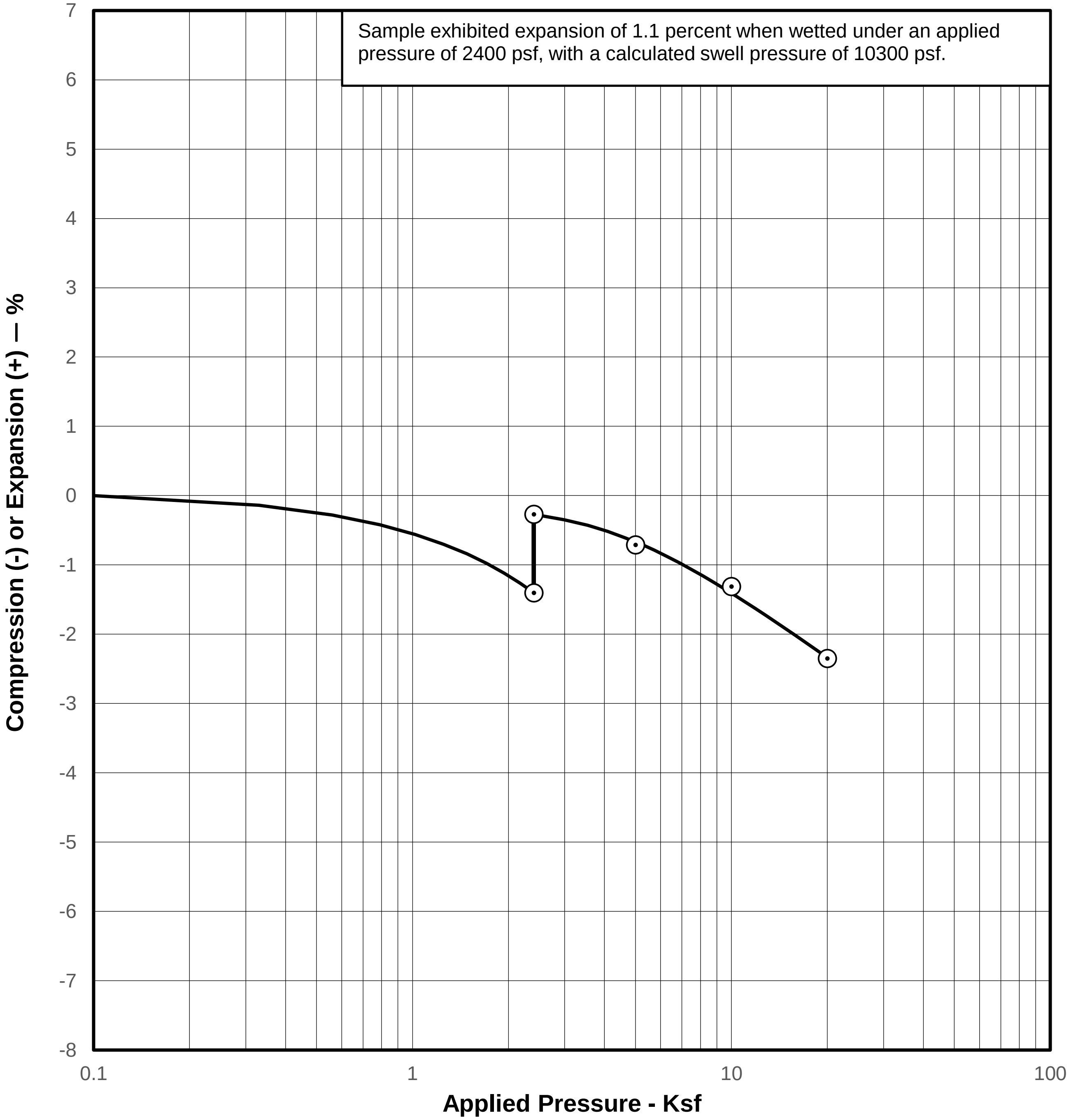


SAMPLE OF: CLAYSTONE

FROM: TH-46 AT 14 FEET

MOISTURE CONTENT:	29.8	%	LIQUID LIMIT:			SILT AND CLAY:		%
DRY UNIT WEIGHT:	94	pcf	PLASTICITY INDEX:			SOIL SUCTION:	3.97	pf

Swell Consolidation Test Results

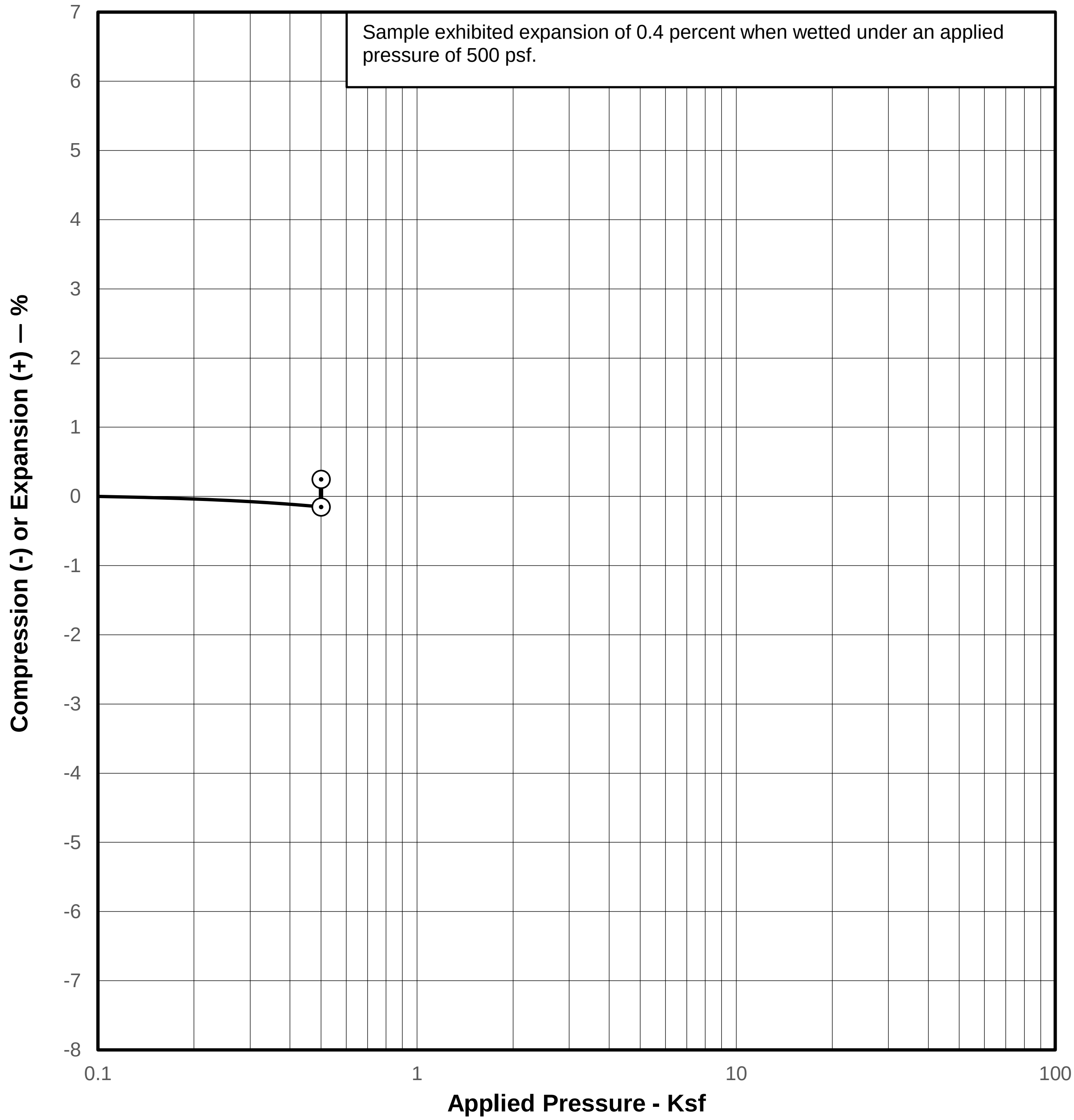


SAMPLE OF: CLAYSTONE

FROM: TH-46 AT 19 FEET

MOISTURE CONTENT:	32.5 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	91 pcf	PLASTICITY INDEX:		SOIL SUCTION:	4.04 pf

Swell Consolidation Test Results

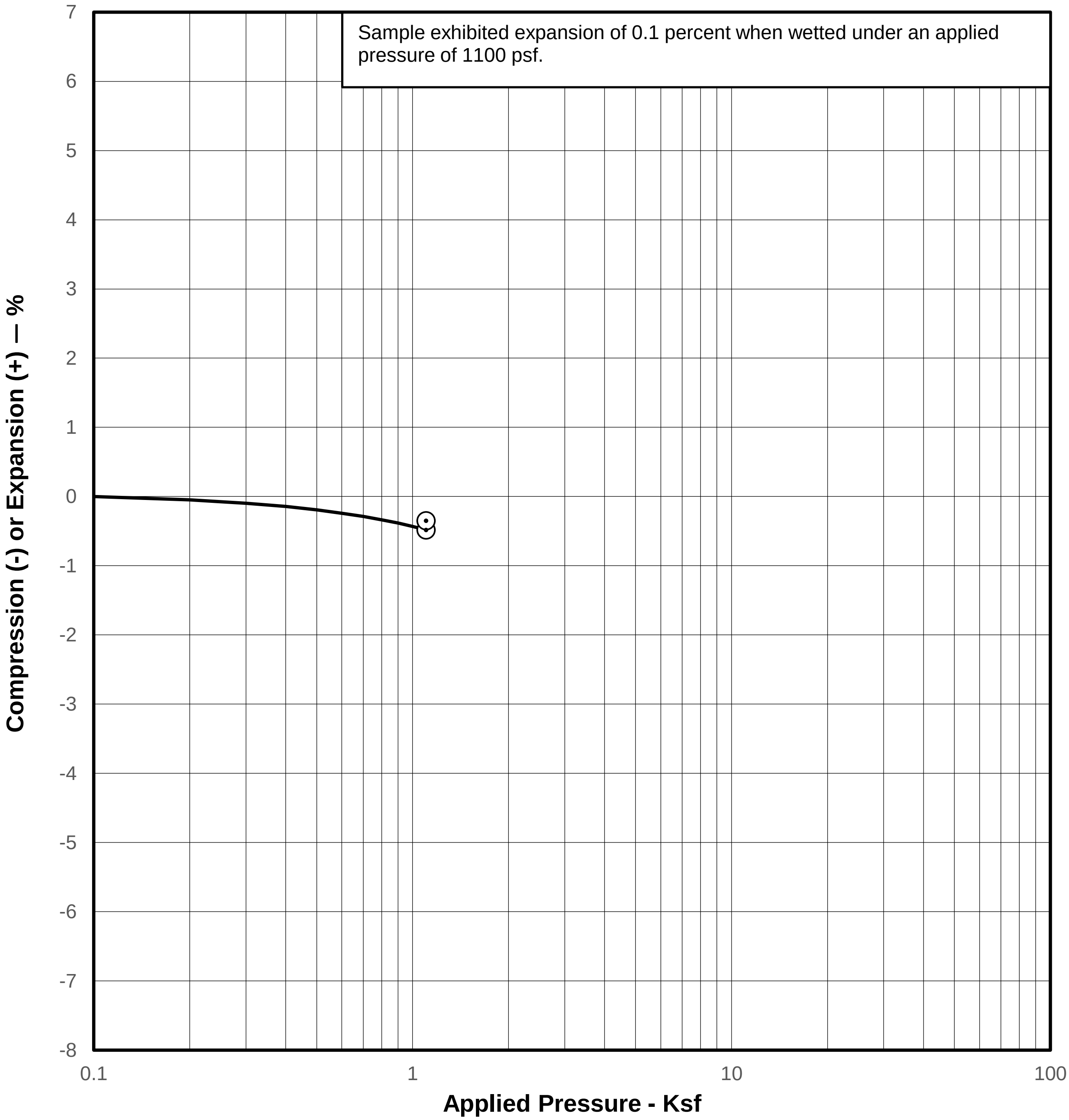


SAMPLE OF: CLAYSTONE

FROM: TH-47 AT 4 FEET

MOISTURE CONTENT: 30.6 %	LIQUID LIMIT:	SILT AND CLAY: %	
DRY UNIT WEIGHT: 91 pcf	PLASTICITY INDEX:	SOIL SUCTION: pf	

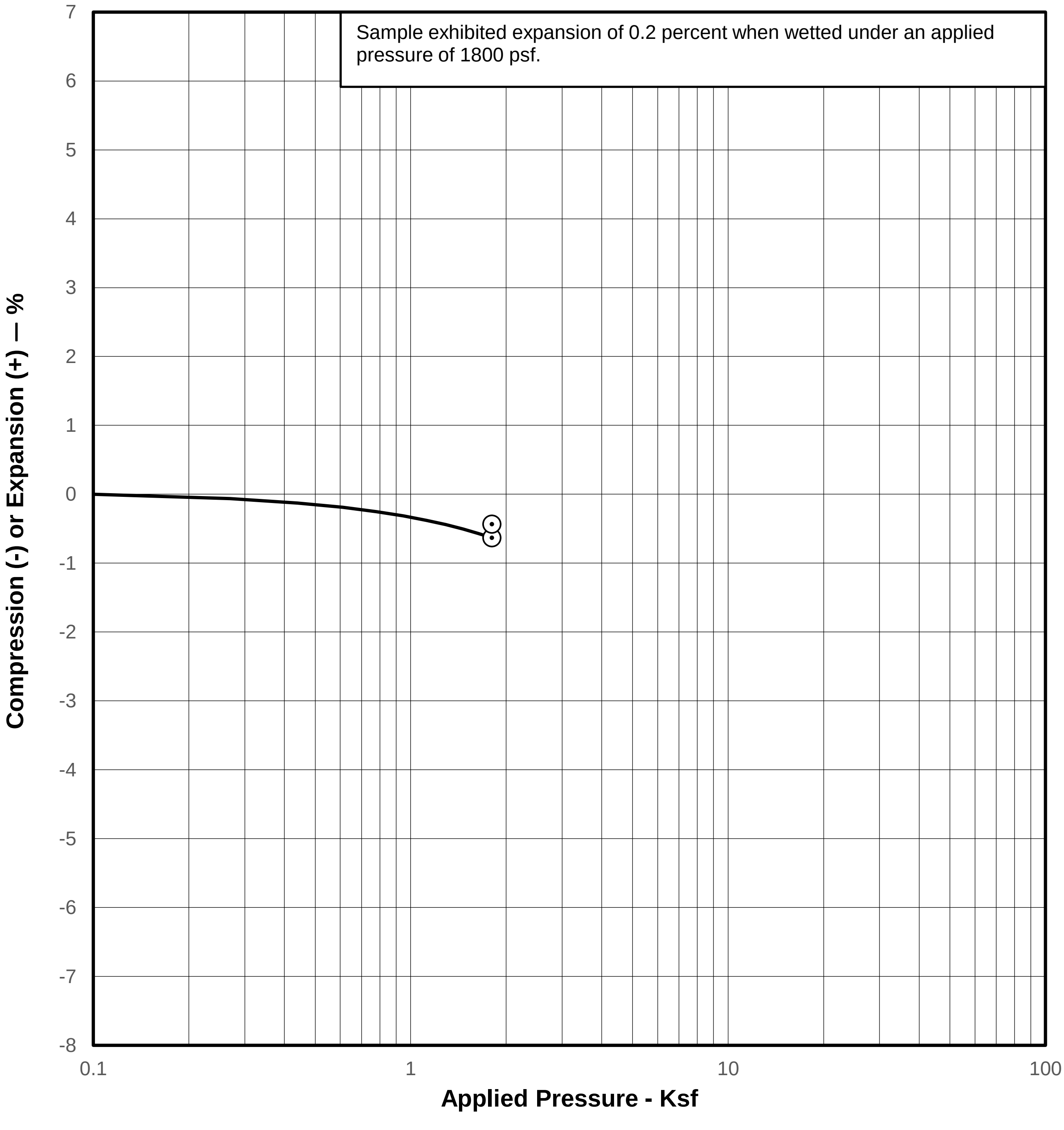
Swell Consolidation Test Results



SAMPLE OF: CLAYSTONE
FROM: TH-47 AT 9 FEET

MOISTURE CONTENT: 26.1 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 96 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results



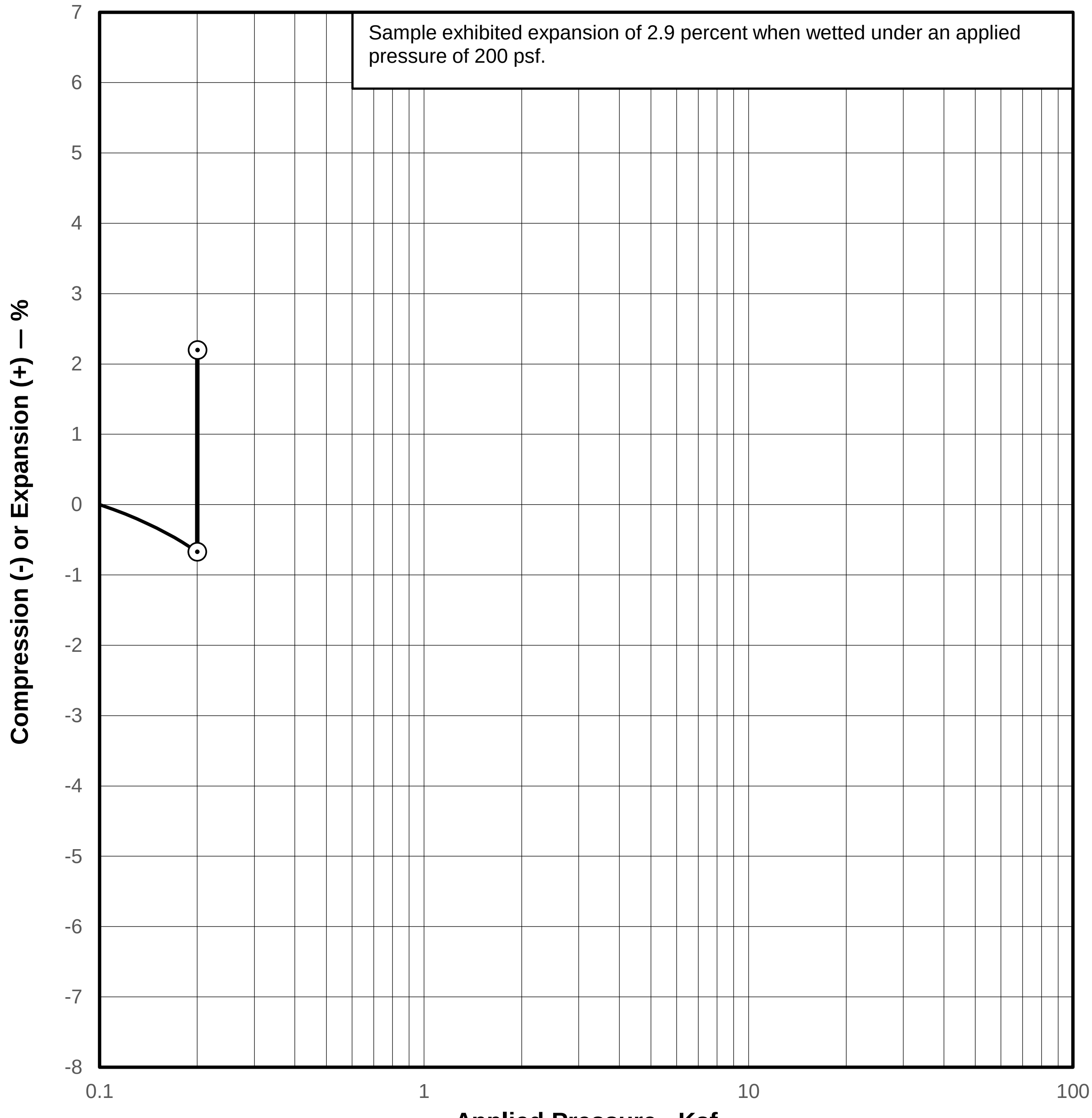
SAMPLE OF: CLAYSTONE

FROM: TH-47 AT 14 FEET

MOISTURE CONTENT: 23.0 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 103 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results



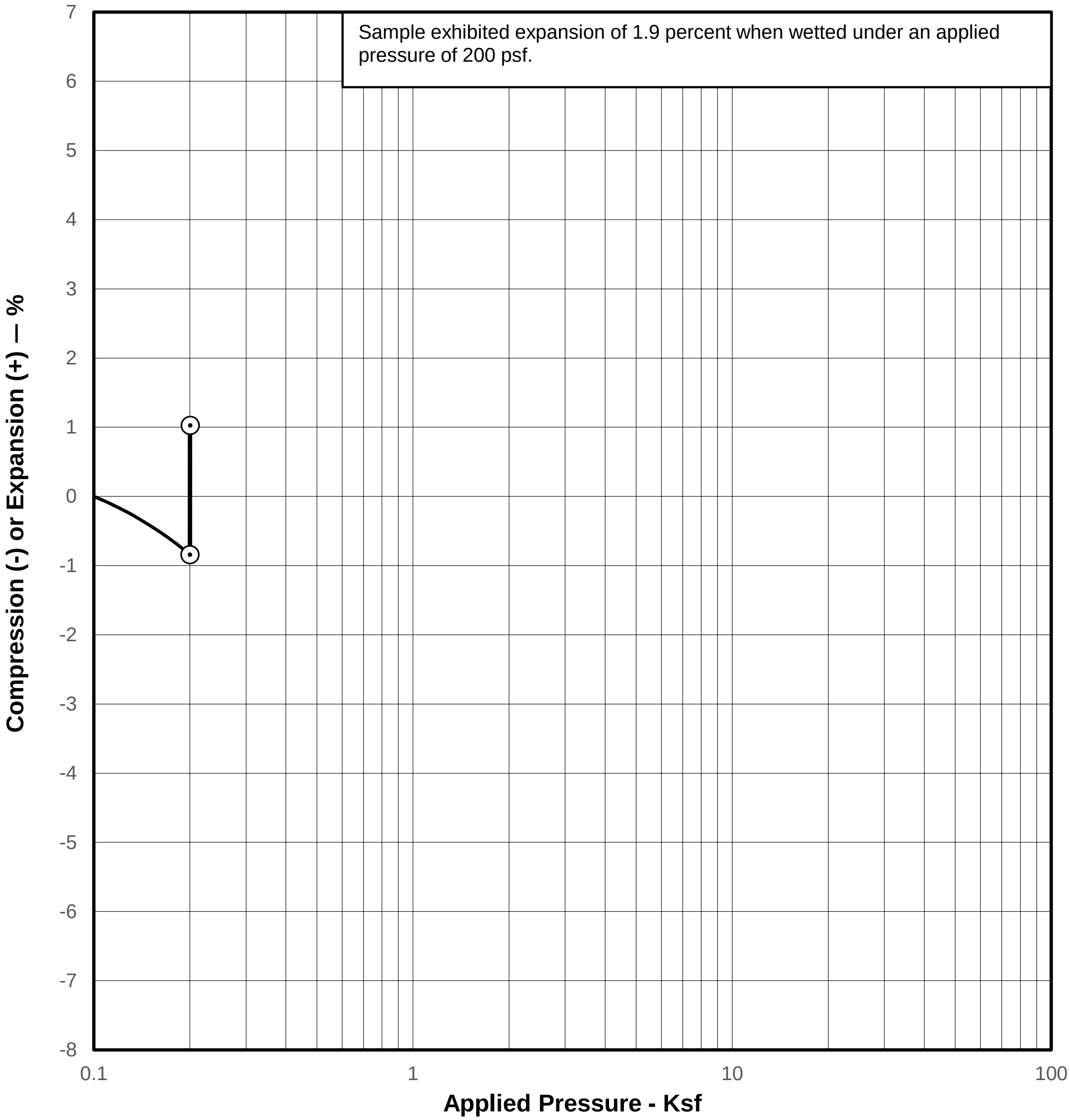
SAMPLE OF: WEATHERED CLAYSTONE

FROM: S-1 AT 1 FEET

MOISTURE CONTENT: 34.8 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 83 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

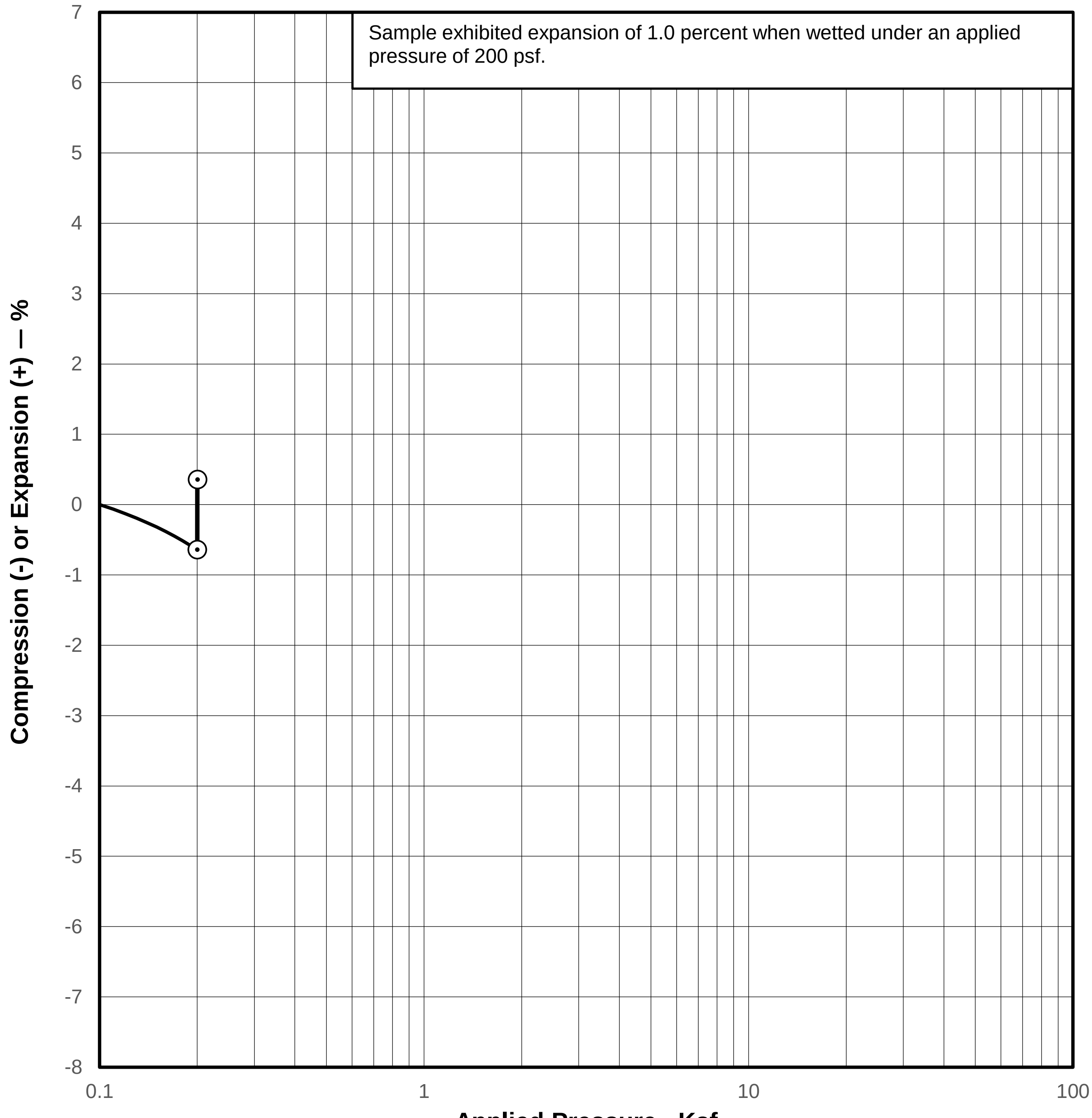


SAMPLE OF: CLAY, SANDY (CL)

FROM: S-2 AT 1 FEET

MOISTURE CONTENT:	21.5 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	92 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

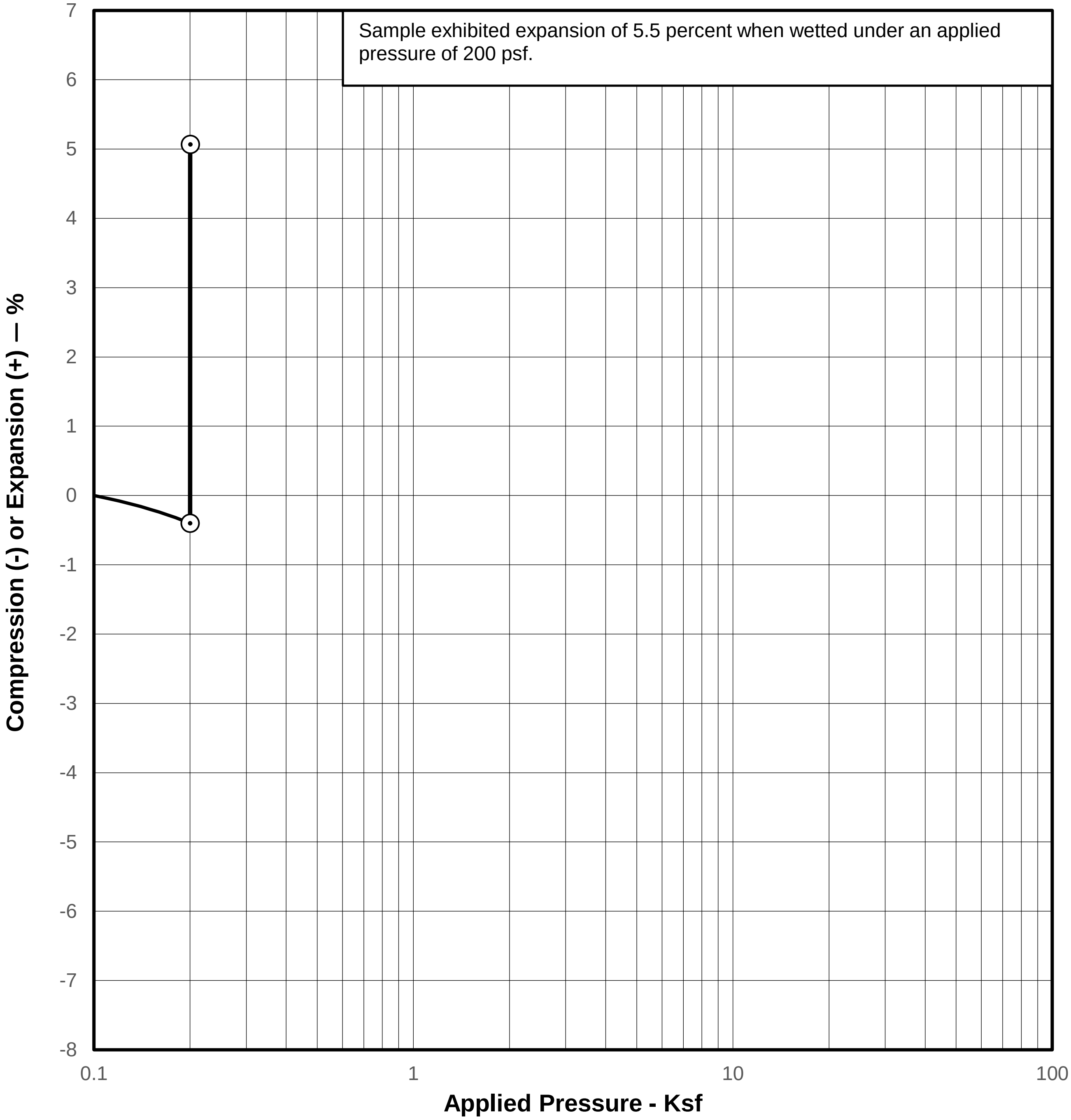
Swell Consolidation Test Results



SAMPLE OF: SAND, CLAYEY (SC)
FROM: S-3 AT 1 FEET

MOISTURE CONTENT: 21.4 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %
DRY UNIT WEIGHT: 101 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

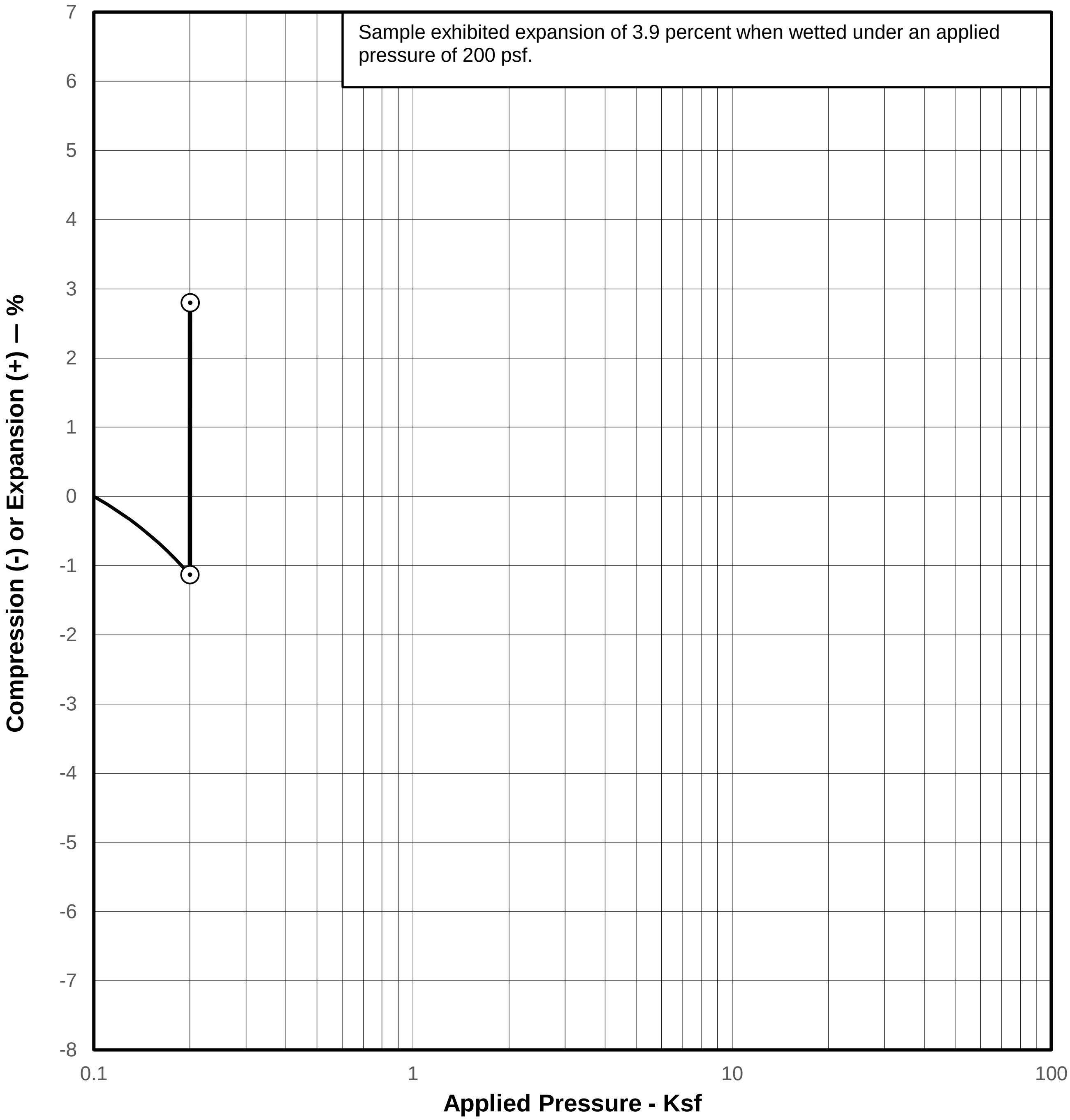
Swell Consolidation Test Results



SAMPLE OF: CLAY, SANDY (CL)
FROM: S-4 AT 1 FEET

MOISTURE CONTENT:	28.5 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	94 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results



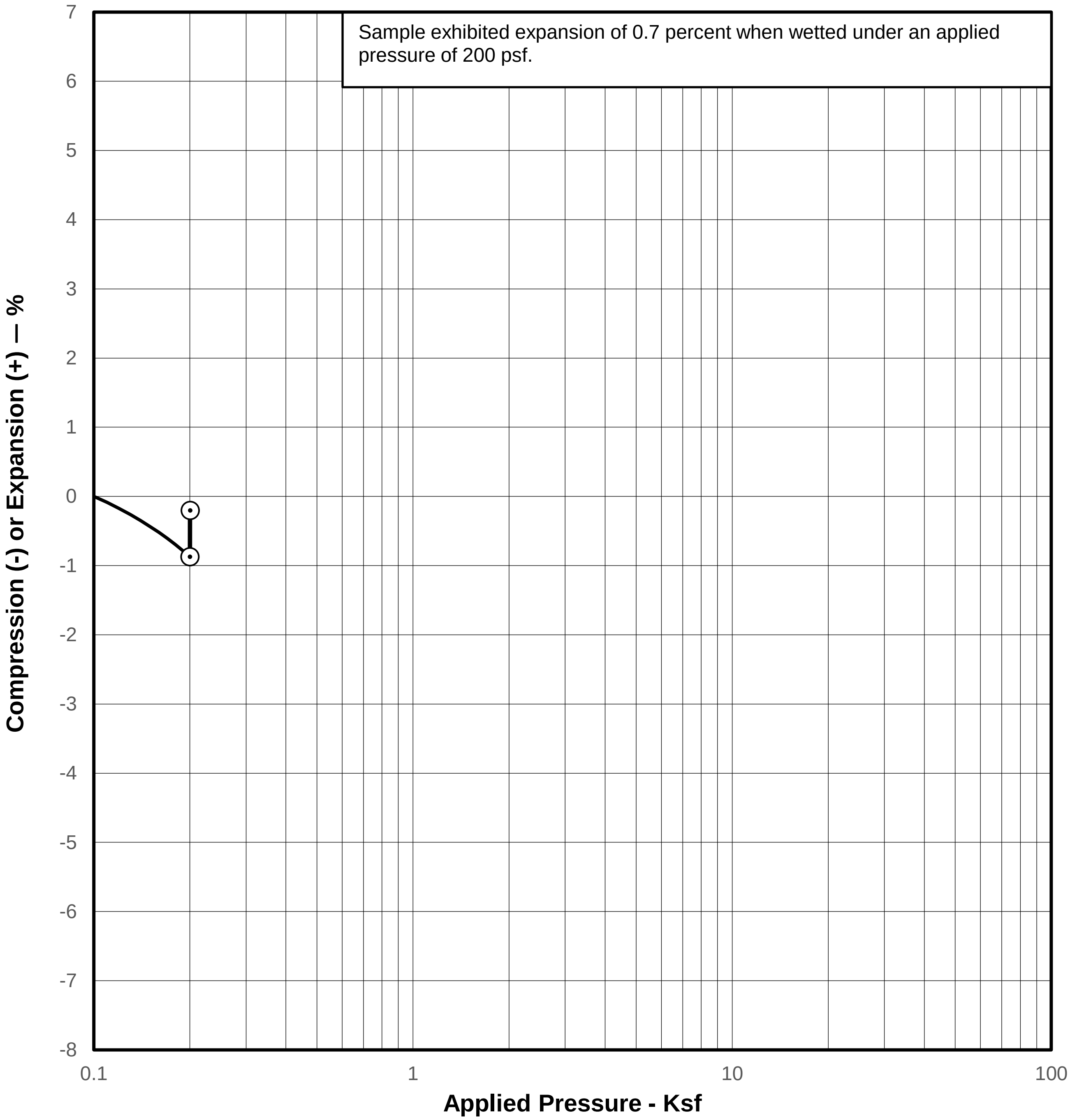
SAMPLE OF: CLAY, SANDY (CL)

FROM: S-5 AT 1 FEET

MOISTURE CONTENT: 17.4 % LIQUID LIMIT: ____ SILT AND CLAY: ____ %

DRY UNIT WEIGHT: 110 pcf PLASTICITY INDEX: ____ SOIL SUCTION: ____ pf

Swell Consolidation Test Results

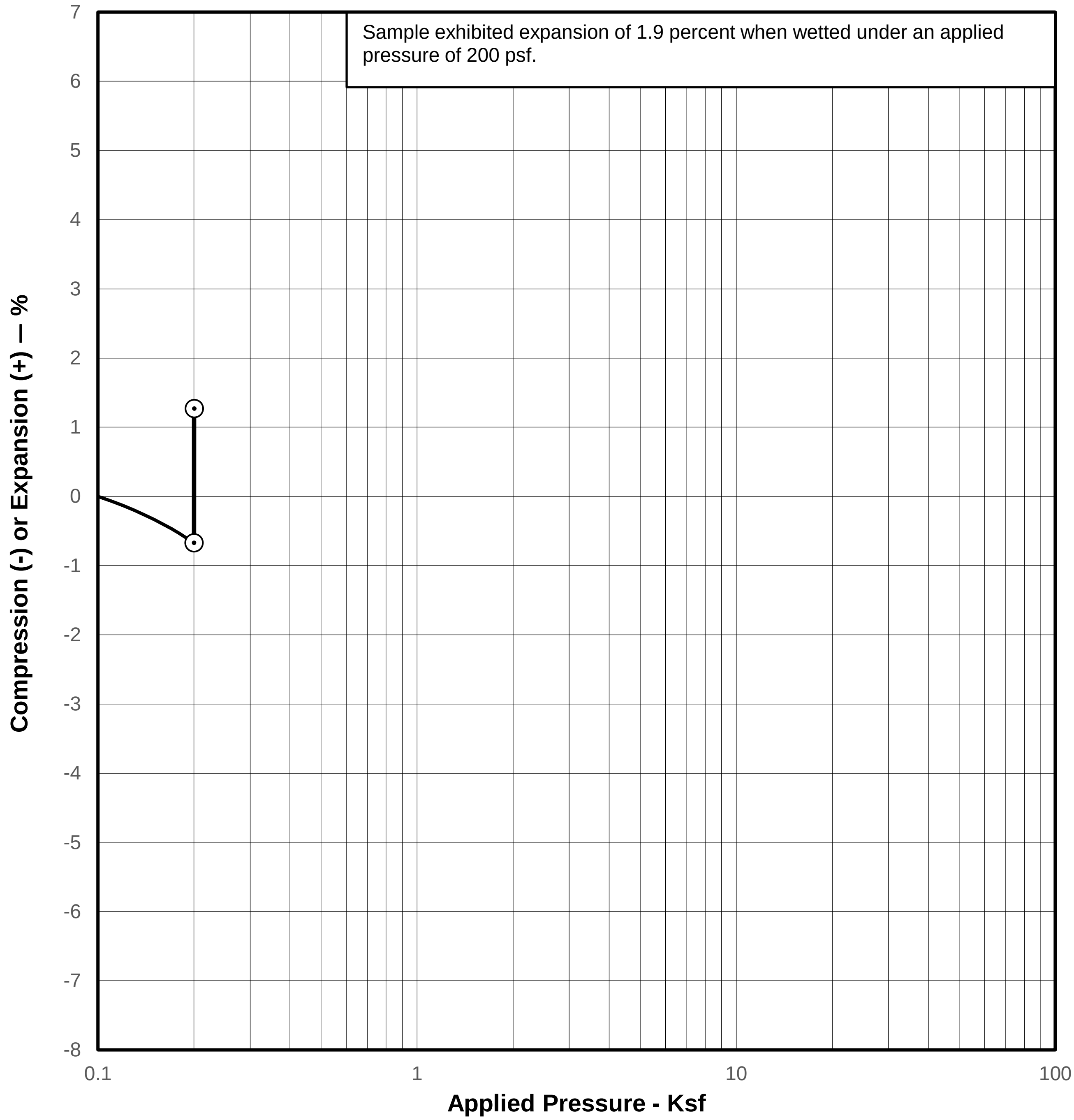


SAMPLE OF: INTERBEDDED CLAYSTONE/SANDSTONE

FROM: S-6 AT 1 FEET

MOISTURE CONTENT:	19.1 %	LIQUID LIMIT:		SILT AND CLAY:	%
DRY UNIT WEIGHT:	86 pcf	PLASTICITY INDEX:		SOIL SUCTION:	pf

Swell Consolidation Test Results

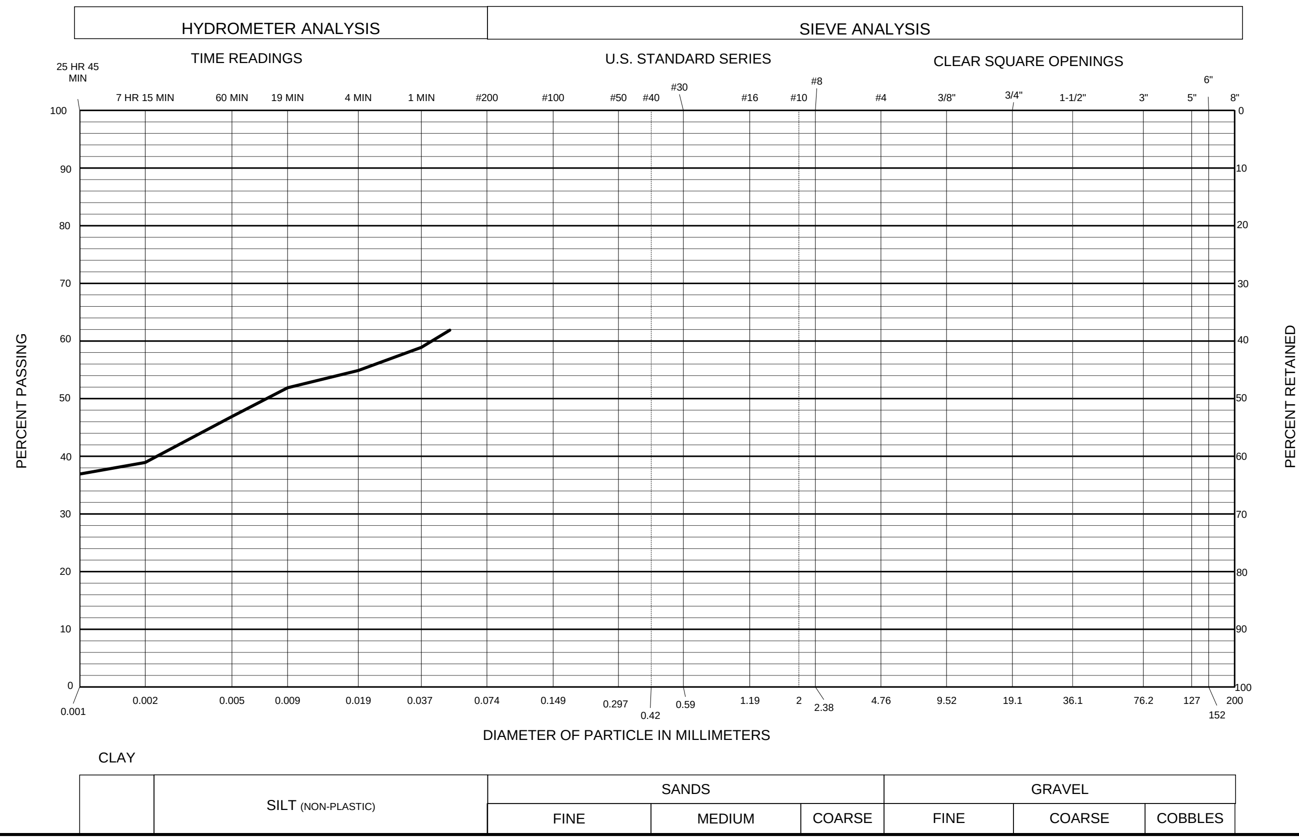


SAMPLE OF: CLAY, SANDY (CL)

FROM: S-1, S-4 AND S-5 AT 0-5 FEET

MOISTURE CONTENT:	19.7 %	LIQUID LIMIT:	49	SILT AND CLAY:	66 %
DRY UNIT WEIGHT:	100 pcf	PLASTICITY INDEX:	28	SOIL SUCTION:	pf

Swell Consolidation Test Results



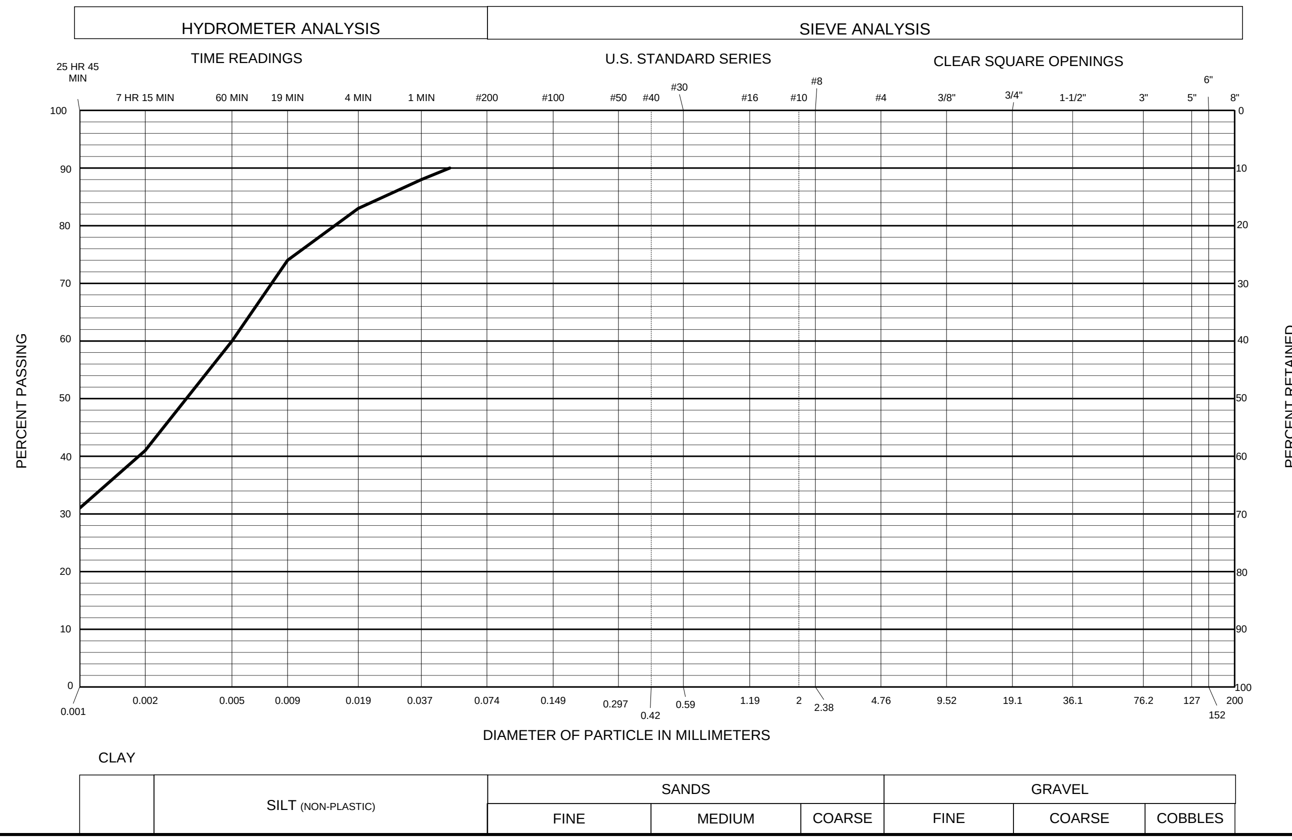
Sample of: CLAY, SANDY (CL)
From: TH-8 AT 4 FEET

Sand & Gravel: - %
Silt: - %
Clay: 39 %
Liquid Limit: -
Plasticity Index: 44

	Sieve Analysis													
Sieve Name	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Particle Size (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Passing	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	Hydrometer Analysis						
Elapsed Time	0.5 Min	1 Min	4 Min	19 Min	60 Min	435 Min	1545 Min
Particle Size (mm)	0.05	0.037	0.019	0.009	0.005	0.002	0.001
% Passing	**62**	**59**	**55**	**52**	**47**	**39**	**37**

Gradation/ Hydrometer Test Results



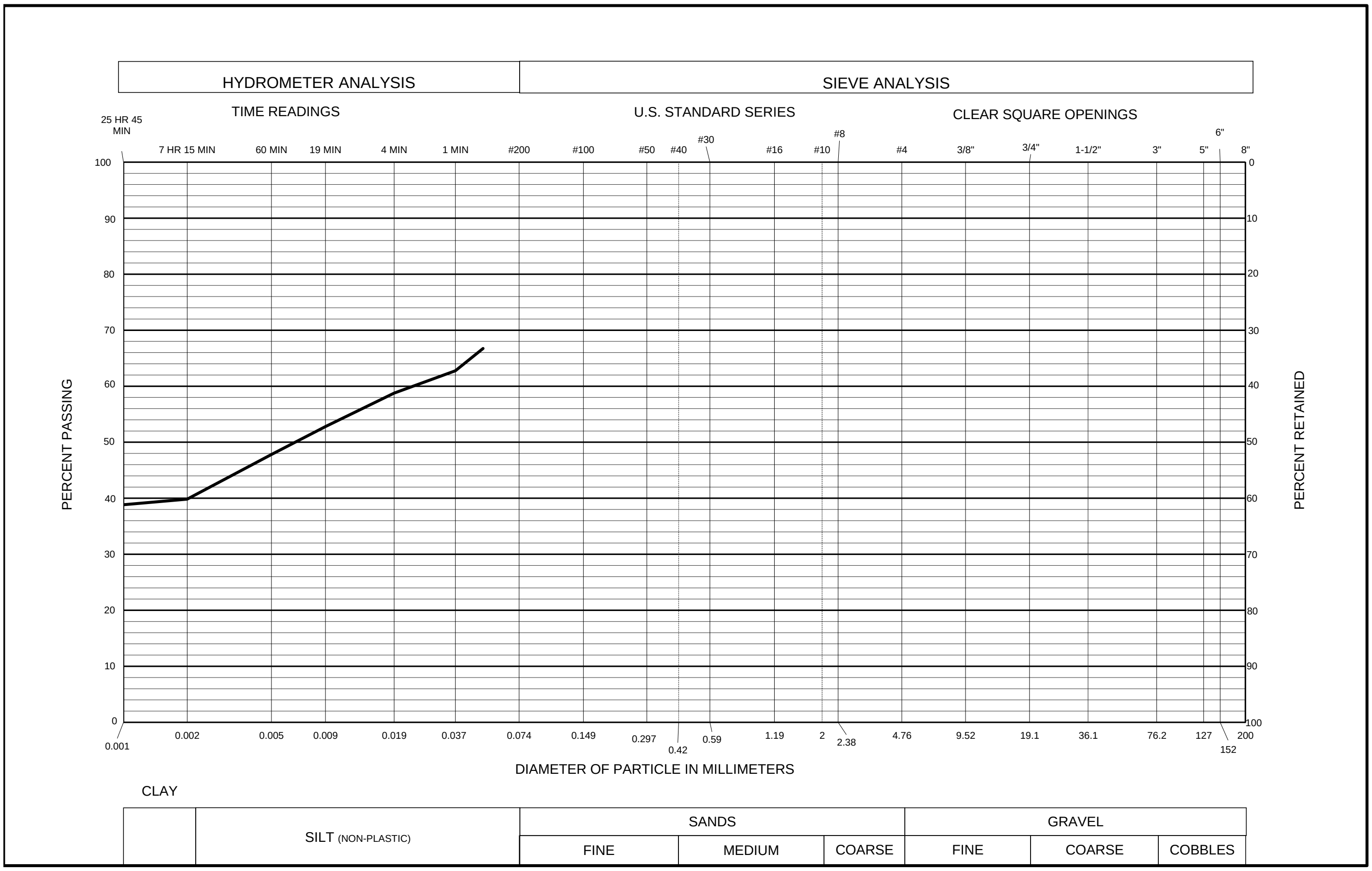
Sample of: WEATHERED CLAYSTONE
From: TH-21 AT 4 FEET

Sand & Gravel: - %
Silt: - %
Clay: 41 %
Liquid Limit: -
Plasticity Index: 40

	Sieve Analysis													
Sieve Name	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Particle Size (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Passing	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	Hydrometer Analysis						
Elapsed Time	0.5 Min	1 Min	4 Min	19 Min	60 Min	435 Min	1545 Min
Particle Size (mm)	0.05	0.037	0.019	0.009	0.005	0.002	0.001
% Passing	**90**	**88**	**83**	**74**	**60**	**41**	**31**

Gradation/ Hydrometer Test Results



Sample of: CLAY, SANDY (CL)

From: TH-35 AT 4 FEET

Sand & Gravel: - %

Silt: - %

Clay: 40 %

Liquid Limit: -

Plasticity Index: 37

	Sieve Analysis													
Sieve Name	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Particle Size (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Passing	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Hydrometer Analysis						
Elapsed Time	0.5 Min	1 Min	4 Min	19 Min	60 Min	435 Min	1545 Min
Particle Size (mm)	0.05	0.037	0.019	0.009	0.005	0.002	0.001
% Passing	**67**	**63**	**59**	**53**	**48**	**40**	**39**

Gradation/ Hydrometer Test Results

CTL Thompson, Inc. - Denver
1971 West 12th Avenue
Denver, CO 80204
(303) 825-0777
denver@ctlthompson.com

CTL | THOMPSON
Founded in 1971

Proctor Report

Report ID: PTR:25-01246-01

Client: Brightland Homes- GH Colorado, LLC

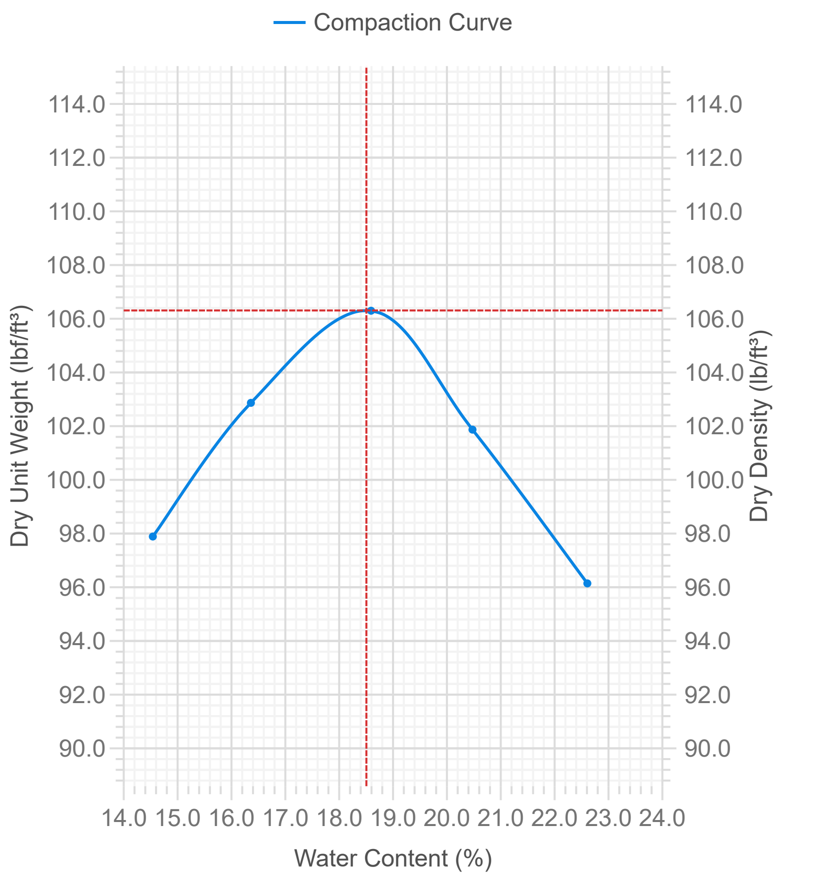
Project: Dawson Trails

West of I-25 & Crystal Valley Parkway Castle Rock CO 80104
DN52431.000E-120

Sample Details

Sample ID: 25-01246-01
Date Sampled: 3/11/2025
Material: CLAY, SANDY (CL)
Sample Number: S-1,4,5
Location:

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D698

Std. Maximum Dry Unit Weight (lbf/ft³):	**106.3**
Std. Optimum Water Content (%):	**18.5**
Method:	
Preparation Method:	Moist
Determined By:	Estimated
Tested By:	Adam Silverman
Date Tested:	3/24/2025

ASTM D4318

Liquid Limit:	**49**
Plastic Limit:	**21**
Plasticity Index:	**28**
Tested By:	Jeffery Jones
Date Tested:	3/25/2025

Comments

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

FIG. B-106

CTL Thompson, Inc. - Denver
1971 West 12th Avenue
Denver, CO 80204
(303) 825-0777
denver@ctlthompson.com

CTL | THOMPSON
Founded in 1971

California Bearing Ratio Report

Report ID: CBR:25-01246-01

Client: Brightland Homes- GH Colorado, LLC

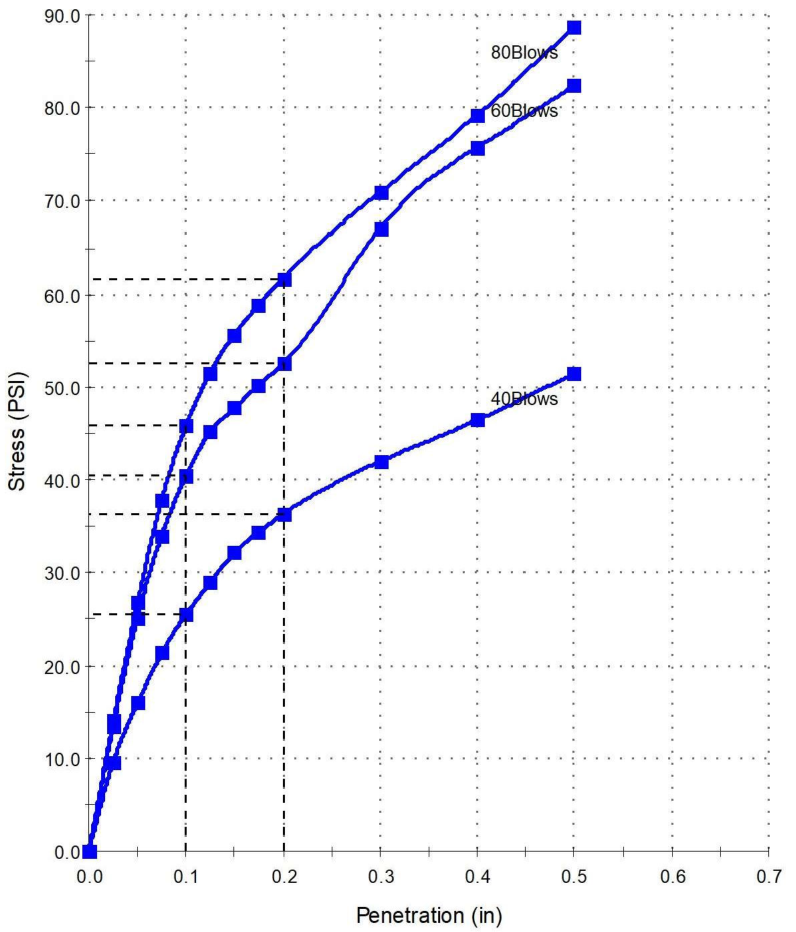
Project: Dawson Trails

West of I-25 & Crystal Valley Parkway Castle Rock CO 80104
DN52431.000E-120

Sample Details

Sample ID:	25-01246-01	**Date Sampled:**	3/11/2025
Sampling Method:			
Source:		**Material:**	CLAY, SANDY (CL)
Specification:			
Location:			
Tested By:	Taqi Hossaini	**Date Tested:**	3/31/2025

Stress vs Penetration



Overall Results

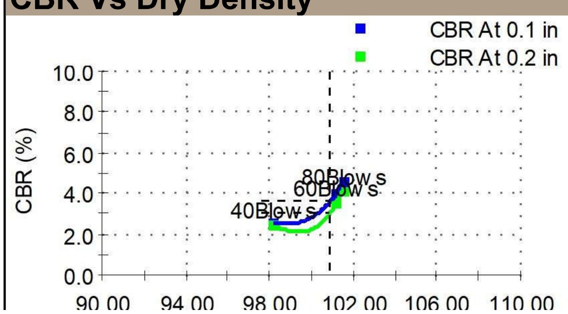
ASTM D 1883

CBR At 0.1in (%): 4
CBR At 0.2in (%): 3
At Dry Density (lb/ft³): 100.9

Test Results

Blows	80	60	40
Comp. Eff.			
Initial MC (%)	19.7	18.7	19.2
MC of Top 1in (%)	27.5	27.3	30.9
MC After (%)	22.4	22.4	21.8
DD Before (lb/ft³)	101.51	101.19	98.14
DD After (lb/ft³)	100.12	99.46	97.90
CBR (%)	4.6	4.0	2.5
% MDD	95.5	95.2	92.3
Sample Condition	Soaked	Soaked	Soaked
Immersion Period (h)			
Surcharge (lb)	15.00	15.00	15.00
Swell (%)	2.31	2.29	2.82

CBR Vs Dry Density



Comments

BRIGHTLAND HOMES
DAWSON TRAILS, MULTI-FAMILY TOWNHOMES (PARCEL E2)
CTL|T PROJECT NO. DN52,431-120-R1

FIG. B-107

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA SWELL (%)	COMPRESSION (%)	APPLIED PRESSURE (psf)	SWELL PRESSURE (psf)	SOIL SUCTION VALUE (pF)	ATTERBERG LIMITS LIQUID LIMIT	PLASTICITY INDEX	SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-1	4	14.0	99									25	SANDSTONE
TH-1	14	19.9	99									23	SANDSTONE
TH-2	4	14.0	106									21	SANDSTONE
TH-2	9	14.5	100									22	SANDSTONE
TH-2	14	13.0	100									12	SANDSTONE
TH-3	4	11.8	99	3.9		500							CLAY, SANDY (CL)
TH-3	9	8.5	109						40	23		22	SAND, CLAYEY (SC)
TH-3	19	13.3	112									34	SANDSTONE
TH-4	4	9.2	110	0.1		500							CLAY, SANDY (CL)
TH-4	9	16.0	94		2.5	1100						31	SAND, CLAYEY (SC)
TH-5	4	17.8	111	9.1		500					<0.01		CLAY, SANDY (CL)
TH-5	9	24.5	93		0.2	1100							CLAY, SANDY (CL)
TH-5	14	19.8	106									32	SAND, CLAYEY (SC)
TH-6	4	22.1	99	7.1		500							CLAY, SANDY (CL)
TH-6	9	21.3	72										CLAY, SANDY (CL)
TH-6	19	20.7	105									37	SANDSTONE
TH-7	4	24.1	105	0.4		500							CLAY, SANDY (CL)
TH-7	9	20.8	95									59	CLAY, SANDY (CL)
TH-7	14	26.1	101						46	16		36	SAND, CLAYEY (SC)
TH-8	4	23.2	101	1.7		500			69	44		71	CLAY, SANDY (CL)
TH-8	9	13.8	115	1.9		1100							CLAY, SANDY (CL)
TH-8	14	22.0	96		0.5	1800							CLAY, SANDY (CL)
TH-9	4	15.3	107	0.5		500							CLAY, SANDY (CL)
TH-9	9	16.3	104						57	36		65	CLAY, SANDY (CL)
TH-9	14	15.7	95		2.7	1800							CLAY, SANDY (CL)
TH-10	4	10.9	79										CLAY, SANDY (CL)
TH-10	9	10.0	117		0.2	1100			36	21		36	SAND, CLAYEY (SC)
TH-10	14	28.0	86		0.4	1800							CLAY, SANDY (CL)
TH-11	4	30.5	84		0.1	500		3.17					CLAY, SANDY (CL)
TH-11	9	9.2	95					3.41					SAND, CLAYEY (SC)
TH-11	14	25.8	92		0.1	1800		2.84					CLAY, SANDY (CL)
TH-11	19	10.9	100					3.28					CLAY, SANDY (CL)

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA: SWELL (%)	SWELL TEST DATA: COMPRESSION (%)	SWELL TEST DATA: APPLIED PRESSURE (psf)	SWELL TEST DATA: SWELL PRESSURE (psf)	SOIL SUCTION VALUE (pF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-11	24	27.0	88	0.5		3000	4600	3.70					CLAYSTONE
TH-12	4	15.7	101	0.9		500							CLAY, SANDY (CL)
TH-12	9	9.1	116		0.3	1100							SAND, CLAYEY (SC)
TH-12	14	28.2	100						56	35		68	CLAY, SANDY (CL)
TH-12	19	34.8	85	0.6		2400							WEATHERED CLAYSTONE
TH-13	4	13.8	106	10.4		500							CLAY, SANDY (CL)
TH-13	9	14.4	112	2.3		1100							CLAY, SANDY (CL)
TH-13	14	13.3	107		0.9	1800			31	18		39	SAND, CLAYEY (SC)
TH-13	19	34.7	86						68	44		82	CLAY, SANDY (CL)
TH-14	4	26.4	96									55	CLAY, SANDY (CL)
TH-14	9	27.0	93	0.5		1100	2900						CLAY, SANDY (CL)
TH-14	14	10.7	108									25	SAND, CLAYEY (SC)
TH-14	19	4.3										7	SAND, CLEAN TO SLIGHTLY SILTY (SP-SM)
TH-15	4	33.9	85	0.2		500	1000	2.88					CLAY, SANDY (CL)
TH-15	9	22.4	96		0.5	1100		3.37					CLAY, SANDY (CL)
TH-15	14	18.6	93		0.9	1800		3.53					CLAY, SANDY (CL)
TH-15	19	25.7	94	0.3		2400	4100	3.28					CLAY, SANDY (CL)
TH-15	24	30.3	90		0.1	3000		3.08					CLAYSTONE
TH-16	4	17.6	101	1.1		500					<0.01		CLAY, SANDY (CL)
TH-16	9	23.7	98	1.5		1100							CLAY, SANDY (CL)
TH-16	14	29.0	90						71	39		99	CLAYSTONE
TH-17	4	12.2	108	0.3		500							CLAY, SANDY (CL)
TH-17	9	19.8	91		0.2	1100							CLAY, SANDY (CL)
TH-18	4	20.6	80		0.3	500					<0.01		CLAY, SANDY (CL)
TH-18	9	39.6	79	2.8		1100							CLAYSTONE
TH-19	4	18.1	97	3.4		500							CLAY, SANDY (CL)
TH-19	9	32.0	86	1.5		1100							CLAYSTONE
TH-19	14	33.8	81						71	36		99	CLAYSTONE
TH-20	4	25.9	91	0.6		500	900	3.67					CLAYSTONE
TH-20	9	31.1	88	1.3		1100	5500	3.98					CLAYSTONE
TH-20	14	32.3	76		1.5	1800		4.12					CLAYSTONE
TH-20	19	29.7	93	0.6		2400	7400	3.88					CLAYSTONE
TH-20	24	30.3	83		0.7	3000		4.05					CLAYSTONE

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA: SWELL (%)	COMPRESSION (%)	APPLIED PRESSURE (psf)	SWELL PRESSURE (psf)	SOIL SUCTION VALUE (pF)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTICITY INDEX	SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-21	4	33.5	83	4.4		500			75	40		99	WEATHERED CLAYSTONE
TH-21	9	33.8	75		0.6	1100							CLAYSTONE
TH-21	14	30.6	82						72	38		43	INTERBEDDED CLAYSTONE/SANDSTONE
TH-22	4	22.1	94	0.0		500							INTERBEDDED CLAYSTONE/SANDSTONE
TH-22	9	22.9	98						46	17		32	INTERBEDDED CLAYSTONE/SANDSTONE
TH-23	4	23.9	97	0.0		500							INTERBEDDED CLAYSTONE/SANDSTONE
TH-23	9	27.2	72										INTERBEDDED CLAYSTONE/SANDSTONE
TH-23	19	22.6	85									57	INTERBEDDED CLAYSTONE/SANDSTONE
TH-24	4	37.1	82	1.2		500							CLAYSTONE
TH-24	9	18.8	94									32	INTERBEDDED CLAYSTONE/SANDSTONE
TH-25	4	21.5	91	0.0		500							INTERBEDDED CLAYSTONE/SANDSTONE
TH-25	14	13.7	103									34	INTERBEDDED CLAYSTONE/SANDSTONE
TH-26	4	19.7	75		0.7	500							SANDSTONE
TH-26	9	18.8	91									17	SANDSTONE
TH-27	4	13.9	110									11	SANDSTONE
TH-27	9	31.1	83	0.4		1100							CLAYSTONE
TH-28	4	10.4	106									11	SANDSTONE
TH-29	4	13.1	104									15	SANDSTONE
TH-29	9	20.9	102									26	SANDSTONE
TH-30	4	14.3	81									26	SANDSTONE
TH-30	9	13.8	96									26	SANDSTONE
TH-31	4	17.6	100									32	SANDSTONE
TH-31	14	17.1	96									19	SANDSTONE
TH-32	4	10.9	109									26	SANDSTONE
TH-32	9	16.7	115									29	SANDSTONE
TH-33	4	19.9	98	0.2		500							INTERBEDDED CLAYSTONE/SANDSTONE
TH-33	9	22.3	92		0.8	1100							INTERBEDDED CLAYSTONE/SANDSTONE
TH-33	14	19.7	111						45	16		26	SANDSTONE
TH-34	4	19.4	108	4.5		500							CLAY, SANDY (CL)
TH-34	9	20.4	105	0.3		1100							INTERBEDDED CLAYSTONE/SANDSTONE
TH-34	14	9.7	114									34	SANDSTONE
TH-35	4	20.9	103	4.3		500			58	37		77	CLAY, SANDY (CL)
TH-35	9	16.0	114									21	SANDSTONE

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA: SWELL (%)	SWELL TEST DATA: COMPRESSION (%)	SWELL TEST DATA: APPLIED PRESSURE (psf)	SWELL TEST DATA: SWELL PRESSURE (psf)	SOIL SUCTION VALUE (pF)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-35	19	19.8	100		0.1	2400							CLAYSTONE
TH-36	4	15.7	107	3.9		500	4400	4.11					CLAY, SANDY (CL)
TH-36	9	25.8	92	0.6		1100	1800	3.71					CLAY, SANDY (CL)
TH-36	14	7.5	98					3.89					CLAY, SANDY (CL)
TH-36	19	26.4	94	0.2		2400	3700	3.27					CLAYSTONE
TH-36	24	32.3	89	0.1		3000	3900	3.58					CLAYSTONE
TH-37	4	19.6	108	2.7		500							CLAY, SANDY (CL)
TH-37	9	12.6	105	0.4		1100							CLAY, SANDY (CL)
TH-37	14	21.6	95		0.1	1800							CLAY, SANDY (CL)
TH-38	4	23.8	98	7.7		500					0.10		CLAY, SANDY (CL)
TH-38	9	9.5	107		0.3	1100							CLAY, SANDY (CL)
TH-38	19	28.4	102	0.1		1800							CLAYSTONE
TH-39	4	14.1	108	5.3		500							CLAY, SANDY (CL)
TH-39	9	13.8	99	1.2		1100							CLAY, SANDY (CL)
TH-39	14	21.2	104	1.3		1800							CLAYSTONE
TH-40	4	25.9	87	0.7		500	1100	3.50					CLAY, SANDY (CL)
TH-40	9	13.3	101		0.3	1100		2.78					CLAY, SANDY (CL)
TH-40	14	29.5	90	0.2		1800	2300	3.12					CLAY, SANDY (CL)
TH-40	19	30.3	84		0.6	2400		3.20					CLAYSTONE
TH-40	24	26.3	90		0.2	3000		3.73					CLAYSTONE
TH-40	29	26.1	78		1.5	3600		3.52					CLAYSTONE
TH-41	4	15.7	98		0.4	500							SAND, CLAYEY (SC)
TH-41	9	10.8	114									27	SAND, CLAYEY (SC)
TH-41	14	31.9	89	0.3		1800							CLAY, SANDY (CL)
TH-41	19	32.9	89						65	34		82	CLAYSTONE
TH-42	4	8.0	113	2.7		500							CLAY, SANDY (CL)
TH-42	9	10.3	111	3.1		1100							CLAY, SANDY (CL)
TH-42	19	28.4	90						61	28		44	INTERBEDDED CLAYSTONE/SANDSTONE
TH-43	4	20.7	99	2.3		500	3800	3.46					CLAY, SANDY (CL)
TH-43	9	21.9	102	0.7		1100	2900	3.70					CLAY, SANDY (CL)
TH-43	14	34.8	84	0.5		1800	4300	3.47					CLAYSTONE
TH-43	19	30.2	95	0.1		2400	3600	2.84					CLAYSTONE
TH-44	4	17.9	102	1.1		500							CLAY, SANDY (CL)

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA SWELL (%)	COMPRESSION (%)	APPLIED PRESSURE (psf)	SWELL PRESSURE (psf)	SOIL SUCTION VALUE (pF)	ATTERBERG LIMITS LIQUID LIMIT	PLASTICITY INDEX	SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-44	9	26.4	96	0.9		1100							CLAY, SANDY (CL)
TH-44	14	27.9	94						53	23		51	CLAYSTONE
TH-45	4	18.2	108	7.5		500					0.07		CLAY, SANDY (CL)
TH-45	9	28.3	90	1.5		1100							CLAYSTONE
TH-45	19	34.7	89		0.1	2400							CLAYSTONE
TH-46	4	26.8	95	3.2		500	12400	4.06					CLAYSTONE
TH-46	9	33.9	87	1.7		1100	8900	4.04					CLAYSTONE
TH-46	14	29.8	94	0.3		1800	4000	3.97					CLAYSTONE
TH-46	19	32.5	91	1.1		2400	10300	4.04					CLAYSTONE
TH-47	4	30.6	91	0.4		500							CLAYSTONE
TH-47	9	26.1	96	0.1		1100							CLAYSTONE
TH-47	14	23.0	103	0.2		1800							CLAYSTONE
TH-48	4	10.0	88									22	INTERBEDDED CLAYSTONE/SANDSTONE
TH-48	14	19.7	93									24	INTERBEDDED CLAYSTONE/SANDSTONE
TH-49	4	24.4	101									44	INTERBEDDED CLAYSTONE/SANDSTONE
TH-49	9	32.7	92									18	INTERBEDDED CLAYSTONE/SANDSTONE
TH-50	4	19.2										27	INTERBEDDED CLAYSTONE/SANDSTONE
TH-50	9	22.1	84									53	INTERBEDDED CLAYSTONE/SANDSTONE
S-1	0-5	23.9							54	32		66	WEATHERED CLAYSTONE
S-1	1	34.8	83	2.9		200							WEATHERED CLAYSTONE
S-2	0-5	16.1							67	47		60	CLAY, SANDY (CL)
S-2	1	21.5	92	1.9		200							CLAY, SANDY (CL)
S-3	0-5	19.1							53	33		48	SAND, CLAYEY (SC)
S-3	1	21.4	101	1.0		200							SAND, CLAYEY (SC)
S-4	0-5	21.1							55	36		61	CLAY, SANDY (CL)
S-4	1	28.5	94	5.5		200							CLAY, SANDY (CL)
S-5	0-5	18.3							51	32		64	CLAY, SANDY (CL)
S-5	1	17.4	110	3.9		200							CLAY, SANDY (CL)
S-6	0-5	11.0							36	19		42	INTERBEDDED CLAYSTONE/SANDSTONE
S-6	1	19.1	86	0.7		200							INTERBEDDED CLAYSTONE/SANDSTONE
S-1,4,5	0-5	19.7	100	1.9		200			49	28		66	CLAY, SANDY (CL)

APPENDIX C

FLEXIBLE AND RIGID PAVEMENT MATERIALS, CONSTRUCTION AND MAINTENANCE GUIDELINES

MATERIAL GUIDELINES FOR FLEXIBLE AND RIGID PAVEMENTS

Aggregate Base Course (ABC)

1. A Class 5 or 6 Colorado Department of Transportation (CDOT) specified aggregate base course should be used. A recycled concrete alternative which meets the Class 5 or 6 designation is also acceptable.

2. Aggregate base course should have a minimum Hveem stabilometer value of 84. Aggregate base course or recycled concrete material must be moisture stable. The change in R-value from 300 psi to 100 psi exudation pressure should be 12 points or less.

3. Aggregate base course or recycled concrete should be laid in thin lifts not to exceed 6 inches, moisture treated to within 2 percent of optimum moisture content, and compacted to at least 95 percent of maximum modified Proctor dry density (ASTM D 1557, AASHTO T 180). The material should be placed without segregation.

4. Placement and compaction of aggregate base course or recycled concrete should be observed and tested by a representative of our firm. Placement should not commence until the underlying subgrade is properly prepared and tested.

Hot-Mix Asphalt (HMA)

1. HMA should be composed of a mixture of aggregate, filler, hydrated lime and asphalt cement. Mixes shall be designed with 1 percent lime. Some mixes may require polymer modified asphalt cement, or make use of up to 20 percent reclaimed asphalt pavement (RAP). A project mix design is recommended and periodic checks on the project site should be made to verify compliance with specifications.

2. HMA should be relatively impermeable to moisture and should be designed with crushed aggregates that have a minimum of 80 percent of the aggregate retained on the No. 4 sieve with two mechanically fractured faces.

3. Gradations that approach the maximum density line (within 5 percent between the No. 4 and 50 sieves) should be avoided. A gradation with a nominal maximum size of 1 or 2 inches developed on the fine side of the maximum density line should be used.

4. Total void content, voids in the mineral aggregate (VMA) and voids filled should be considered in the selection of the optimum asphalt cement content. The optimum asphalt content should be selected at a total air void content of about 4 percent. The mixture should have a minimum VMA of 14 percent and between 65 percent and 80 percent of voids filled.

5. Asphalt cement should meet the requirements of the Superpave Performance Graded (PG) Binders. The minimum performing asphalt cement should be PG 64-22 for use along the Front Range. The use of PG 58-28 or PG 58-22 asphalt cement has been known to cause tenderness in pavements in the Front Range area and should be avoided.

6. Hydrated lime should be added at the rate of 1 percent by dry weight of the aggregate and should be included in the amount passing the No. 200 sieve. Hydrated lime for aggregate pretreatment should conform to the requirements of ASTM C 207, Type N.

7. Paving should only be performed when subgrade temperatures are above 40˚F and air temperature is at least 40˚F and rising.

8. HMA should not be placed at a temperature lower than 245˚F for mixes containing PG 64-22 asphalt, and 290˚F for mixes containing polymer modified asphalt. The breakdown compaction should be completed before the mixture temperature drops 20˚F.

9. The maximum compacted lift should be 3 inches and joints should be staggered. No joints should be placed within wheel paths.

10. HMA should be compacted to between 92 and 96 percent of Maximum Theoretical Density. The surface shall be sealed with a finish roller before the mix cools to 185˚F.

11. Placement and compaction of HMA should be observed and tested by a representative of our firm. Placement should not commence until the subgrade is properly prepared, tested and proof-rolled.

<u>Portland Cement Concrete (PCC)</u>

1. Portland cement concrete should meet CDOT Class P concrete and have a minimum compressive strength of 4,200 psi at 28 days and a minimum modulus of rupture (flexural strength) of 650 psi. <u>A job mix design is recommended and periodic checks on the job site should be made to verify compliance with specifications</u>.

2. Portland cement should be Type II “low alkali” and should conform to ASTM C 150. Portland cement should conform to ASTM C 150.

3. Portland cement concrete should not be placed when the subgrade or air temperature is below 40ºF.

4. Free water should not be finished into the concrete surface. Atomizing nozzle pressure sprayers for applying finishing compounds are recommended whenever the concrete surface becomes difficult to finish.

5. Curing of the portland cement concrete should be accomplished by the use of a curing compound. The curing compound should be applied in accordance with manufacturer recommendations.

6. Curing procedures should be implemented, as necessary, to protect the pavement against moisture loss, rapid temperature change, freezing, and mechanical injury.

7. Construction joints, including longitudinal joints and transverse joints, should be formed during construction or sawed after the concrete has begun to set, but prior to uncontrolled cracking.

8. All joints should be properly sealed using a rod back-up and approved epoxy sealant.

9. Traffic should not be allowed on the pavement until it has properly cured and achieved at least 80 percent of the design strength, with saw joints already cut.

10. Placement of portland cement concrete should be observed and tested by a representative of our firm. Placement should not commence until the subgrade is properly prepared and tested.

FLEXIBLE PAVEMENT CONSTRUCTION GUIDELINES

Experience has shown that construction methods can significantly affect the life and serviceability of a pavement system. A site-specific mix design is recommended and periodic checks during the project should be made to verify compliance with specifications. We recommend the proposed pavement be constructed in the following manner:

1. The subgrade should be stripped of organic matter, scarified, moisture conditioned and compacted. Subgrade soils should be moisture conditioned to within 2 percent of optimum moisture content for sand and within 0 and 4 percent above optimum for clay, and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698, AASHTO T 99).

2. Utility trenches and all subsequently placed fill should be moisture conditioned, compacted, and tested prior to paving. As a minimum, fill should be compacted to 95 percent of maximum standard Proctor dry density.

3. After final subgrade elevation has been reached and the subgrade compacted, the resulting subgrade should be checked for uniformity and all soft or yielding materials should be replaced prior to paving. Concrete should not be placed on soft, spongy, frozen, or otherwise unsuitable subgrade.

4. If areas of soft or wet subgrade are encountered, the material should be subexcavated and replaced with properly compacted structural backfill. Where extensively soft, yielding subgrade is encountered, we recommend the excavation be inspected by a representative of our office.

5. Aggregate base course should be laid in thin, loose lifts no more than 6 inches, moisture treated to within 2 percent of optimum moisture content, and compacted to at least 95 percent of modified Proctor maximum dry density (ASTM D 1557, AASHTO T 180).

6. Asphaltic concrete should be hot plant-mixed material compacted to between 92 and 96 percent of maximum Theoretical density. The temperature at laydown time should be at least 245°F. The surface shall be sealed with a finish roller prior to the mix cooling to 185°F.

7. The maximum compacted lift should be 3 inches and joints should be staggered. No joints should be within wheel paths.

8. Paving should only be performed when subgrade temperatures are above 40°F and air temperature is at least 40°F and rising.

9. Subgrade preparation and placement and compaction of all pavement material should be observed and tested. Compaction criteria should be met prior to the placement of the next paving lift. The additional requirements of Castle Rock and Douglas County should apply.

RIGID PAVEMENT CONSTRUCTION GUIDELINES

Rigid pavement sections are not as sensitive to subgrade support characteristics as flexible pavement. Due to the strength of the concrete, wheel loads from traffic are distributed over a large area and the resulting subgrade stresses are relatively low. The critical factors affecting the performance of a rigid pavement are the strength and quality of the concrete, and the uniformity of the subgrade. We recommend subgrade preparation and construction of the rigid pavement section be completed in accordance with the following recommendations:

1. The subgrade should be stripped of organic matter, scarified, moisture conditioned and compacted. Subgrade soils should be moisture conditioned to within 2 percent of optimum moisture content for sand and within 0 and 4 percent above optimum for clay, and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698, AASHTO T 99).

2. After final subgrade elevation has been reached and the subgrade compacted, the resulting subgrade should be checked for uniformity and all soft or yielding materials should be replaced prior to paving. Concrete should not be placed on soft, spongy, frozen, or otherwise unsuitable subgrade.

3. The subgrade should be kept moist prior to paving.

4. Curing procedures should protect the concrete against moisture loss, rapid temperature change, freezing, and mechanical injury for at least 3 days after placement. Traffic should not be allowed on the pavement for at least one week.

5. Curing of the portland cement concrete should be accomplished by use of a curing compound in accordance with manufacturer recommendations.

6. Construction joints, including longitudinal joints and transverse joints, should be formed during construction or should be sawed shortly after the concrete has begun to set, but prior to uncontrolled cracking. All joints should be sealed.

7. Construction control and inspection should be performed during the subgrade preparation and paving procedures. Concrete should be carefully monitored for quality control. The additional requirements of Castle Rock and Douglas County should apply.

The design sections are based upon 10-year and 20-year periods. Experience in the Denver area indicates virtually no maintenance or overlays are necessary for a 20-year design period. We believe some maintenance and sealing of concrete joints will help pavement performance by helping to keep surface moisture from wetting and softening or heaving subgrade. To avoid problems associated with scaling and to continue the strength gain, we recommend deicing salts not be used for the first year after placement.

MAINTENANCE GUIDELINES FOR FLEXIBLE PAVEMENTS

A primary cause for deterioration of pavements is oxidative aging resulting in brittle pavements. Tire loads from traffic are necessary to "work" or knead the asphalt concrete to keep it flexible and rejuvenated. Preventive maintenance treatments will typically preserve the original or existing pavement by providing a protective seal or rejuvenating the asphalt binder to extend pavement life.

Annual Preventive Maintenance

- Visual pavement evaluations should be performed each year.
- Reports documenting the progress of distress should be kept current to provide information on effective times to apply preventive maintenance treatments.
- Crack sealing should be performed annually as new cracks appear.

3 to 5-Year Preventive Maintenance

- The owner should budget for a preventive treatment (e.g. chip seal, fog seal, slurry seal) at approximate intervals of 3 to 5 years to reduce oxidative embrittlement problems.

5 to 10-Year Corrective Maintenance

- Corrective maintenance (e.g. full-depth patching, milling and overlay) may be necessary, as dictated by the pavement condition, to correct rutting, cracking and structurally failed areas.

MAINTENANCE GUIDELINES FOR RIGID PAVEMENTS

High traffic volumes create pavement rutting and smooth, polished surfaces. Preventive maintenance treatments will typically preserve the original or existing pavement by providing a protective seal and improving skid resistance through a new wearing course.

Annual Preventive Maintenance

- Visual pavement evaluations should be performed each spring or fall.
- Reports documenting the progress of distress should be kept current to provide information of effective times to apply preventive maintenance.
- Crack sealing should be performed annually as new cracks appear.

4 to 8 Year Preventive Maintenance

- The owner should budget for a preventive treatment at approximate intervals of 4 to 8 years to reduce joint deterioration.
- Typical preventive maintenance for rigid pavements includes patching, crack sealing and joint cleaning and sealing.
- Where joint sealants are missing or distressed, resealing is mandatory.

15 to 20 Year Corrective Maintenance

- Corrective maintenance for rigid pavements includes patching and slab replacement to correct subgrade failures, edge damage and material failure.
- Asphalt concrete overlays may be required at 15 to 20 year intervals to improve the structural capacity of the pavement.