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GEOTECHNICAL DESIGN REPORT

Beacon Lite Road Improvements

EL PASO COUNTY, COLORADO

SHANNON & WILSON

April 2022

Shannon & Wilson No: 104129-001

Submitted To: Michael Baker International
165 S. Union Blvd., Unit 1000
Lakewood, CO 80228
Attn: Eric King, PE

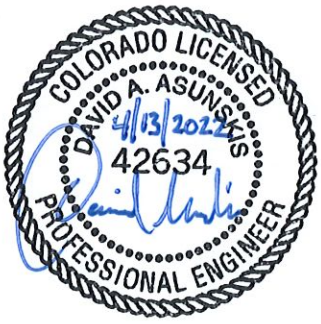
Subject: GEOTECHNICAL DESIGN REPORT, BEACON LITE ROAD IMPROVEMENTS, EL PASO COUNTY, COLORADO

This report presents the results of our geotechnical study and recommendations for improvements to the Beacon Lite Road south of the County Line intersection. The report was prepared by Shannon & Wilson as a subconsultant to Michael Baker International.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.



David Asunskis, PE
Associate

DAV:DAA/daa/jma

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1 INTRODUCTION

This report presents our geotechnical and pavement design recommendations for El Paso County's proposed improvements to Beacon Lite Road located north of Monument, Colorado; refer to Figure 1. This report summarizes our subsurface explorations and laboratory testing, presents recommendations for permanent cut slopes and pavements, and presents construction considerations associated with the geotechnical and pavement aspects of The Project. Our services were conducted in general accordance with our October 4, 2019 subconsultant agreement and subsequent scope of work modifications with Michael Baker International (Michael Baker). We prepared a previous geotechnical report addressing the intersection of Beacon Lite Road and County Line Road (Shannon & Wilson, 2020).

2 SITE AND PROJECT DESCRIPTION

Beacon Lite Road is located approximately 500 to 1,000 feet west of I-25, traversing Black Forest Divide Pass (also locally known as Monument Hill) from south to north. The Project consists of improving an approximately one-mile-long segment of Beacon Lite Road between Wakonda Way and County Line Road; refer to Figure 2. Beacon Lite Road, which is maintained by El Paso County, consists of a single lane in each direction and is surfaced with aggregate.

The basis of our understanding of the proposed improvements to Beacon Lite Road are provided in the conceptual plans provided in Appendix D (Michael Baker, 2020b). Based on conceptual improvement plans and electronic topographic files provided by Michael Baker (2021), the grade of Beacon Lite Road increases from approximately 7,202 feet at Wakonda Way to approximately 7,370 feet at the tie-in to the County Line Road. The proposed improvements along Beacon Lite Road are to smooth the horizontal and vertical roadway profile.

Between approximately Sta. 104+00 and 110+00, the current alignment of Beacon Lite Road is a relatively tight radius curve that traverses around a hill. The existing hill slopes vary from approximately 10 horizontal to 1 vertical (10H:1V) to 5H:1V (Michael Baker, 2021). As shown in Figure 2, the roadway will be realigned in this area using a through-cut. The cut will be approximately 600 feet long with a maximum height of 32 feet and have side slopes of 3H:1V. The existing alignment of Beacon Lite Road has exposed rock cuts (up to 5 feet high). Bedrock in the cut appears to be raveling, which results in accumulations of loose, sandy material forming flatter surfaces.

Between Sta. 117+00 and Sta. 128+50, a grade raise is proposed. A maximum fill height of 15 feet is proposed. We anticipate the fill material will consist of material generated from the cut from Sta. 104+00 to 110+00. Embankment slopes are anticipated to be a maximum of 3H:1V.

The proposed roadway section for Beacon Lite Road will consist of one northbound and one southbound 12-foot-wide lane with two 6-foot-wide shoulders with curb and gutter. The roadway will be paved with hot mix asphalt (HMA).

3 FIELD EXPLORATIONS AND LABORATORY TESTING

Shannon & Wilson conducted a subsurface exploration program over five days from April 4, 2020 to July 16, 2020. The subsurface exploration program was completed concurrently with our investigation for the intersection of Beacon Lite Road and County Line Road. The subsurface investigation consisted of drilling and sampling twenty-one borings; refer to Figure 2 for locations of our subsurface explorations. Borings were designated SW-01 through SW-24. The proposed boring SW-07 was not completed due to access limitations. Proposed borings SW-14 and SW-15 were not completed due to underground utility conflicts. Borings SW-02 through SW-06 were completed approximately in the proposed realignment locations on private property. Right of entry for these boring locations were provided by Michael Baker. Borings were staked and located for horizontal position with a mapping grade GPS.

Borings SW-24 through SW-29, and the supporting laboratory data, were presented in our 2020 geotechnical report (Shannon & Wilson, 2020). For completeness, boring SW-24 and the corresponding laboratory data are included with this report.

Appendix A presents a discussion of the drilling, sampling, and testing procedures used in completing the borings. Appendix A also presents the individual exploration logs and an explanation of the symbols and terminology used.

Geotechnical laboratory tests were completed on selected samples retrieved from the borings to estimate index and engineering properties. Tests included natural water content, grain size distribution, Atterberg limits, one-dimensional swell/consolidation, Hveem Stabilometer (R-value), and corrosion. Laboratory test methods and results are provided in Appendix B. The natural water content, fines content, and Atterberg limits are also shown on the individual boring logs included in Appendix A.

4 SUBSURFACE CONDITIONS

4.1 Geologic Setting

A pair of regional geologic maps of the area (Thorson, 2003; Thorson and Madole, 2004) indicate that the bedrock geology along the project alignment consists of Eocene-age (33.9 to 56 million years old) Dawson Formation bedrock, specifically facies unit five (TKda5), which consists of arkosic sandstone with paleosols and occasional claystone interbeds. Subsurface conditions encountered in our explorations were generally similar to those mapped by Thorson (2003) and Thorson & Madole (2004).

4.2 Beacon Lite Road Pavement Subgrade

Anticipated subgrade conditions at the pavement subgrade elevation along the alignment are summarized in Exhibits 4-1 and 4-2. Subgrade conditions generally are anticipated to consist of Dakota Formation sandstone and soil derived from Dakota Formation sandstone (residuum). The observed subsurface conditions consisted of:

- Silty, clayey sand to silty sand with varying amount of gravel (AASHTO A-1-b and A-2-4 soils). Laboratory testing indicates the subgrade soils have either non-plastic fines or plasticity index (PI) values of 7 or less, with a fines content ranging from 18 to 28 percent.
- Clayey sand with trace to few gravel (AASHTO A-2-6 soils with the exception of borings SW-16 [A-2-7] and SW-18 [A-6]). Laboratory testing of subgrade soils indicate PI values of ranging 12 to 36 with a fines content ranging from 12 to 36 percent.

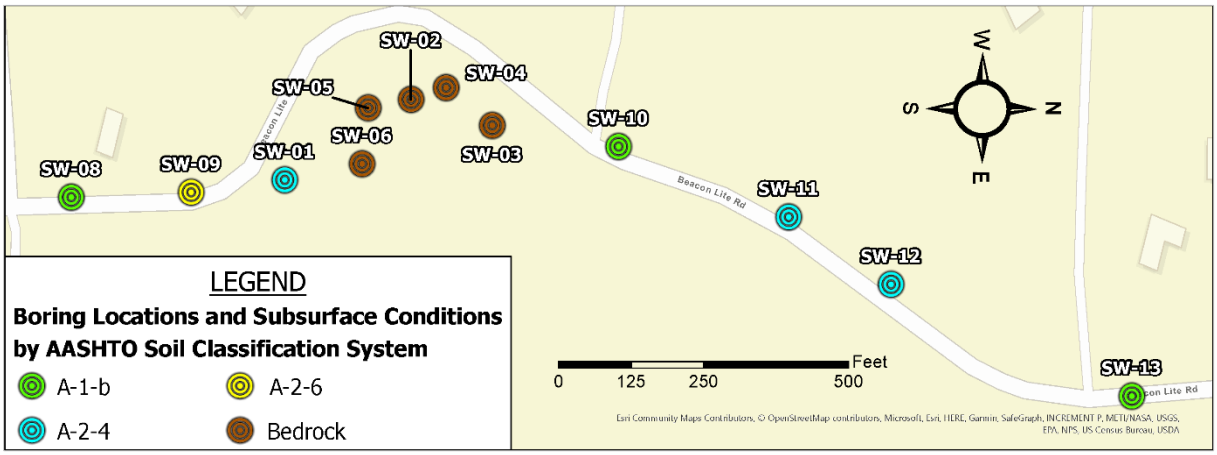

Exhibit 4-1: Generalized Pavement Subgrade Conditions (Sta. 100+00 to 125+00)

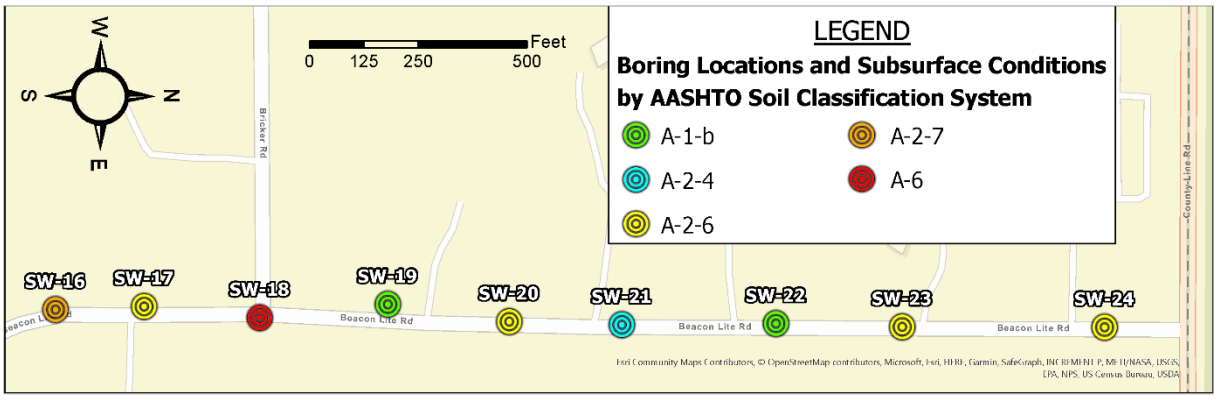

Exhibit 4-2: Generalized Pavement Subgrade Conditions (Sta. 125+00 to 155+00)

4.3 Through-Cut

At the proposed through-cut, borings SW-02 through SW-06 encountered relatively shallow bedrock at depths ranging from 3 to 6 feet. The proposed cut soils in the approximately upper 20 to 30 feet consisted of extremely weak, highly to moderately weathered, weakly cemented sandstone. The sandstone was interbedded with extremely weak claystone seams/layers typically less than 5 feet thick. It is unclear from the data if these layers are continuous between borings. The approximate claystone seams/layers locations are indicated in Exhibit 4-3.

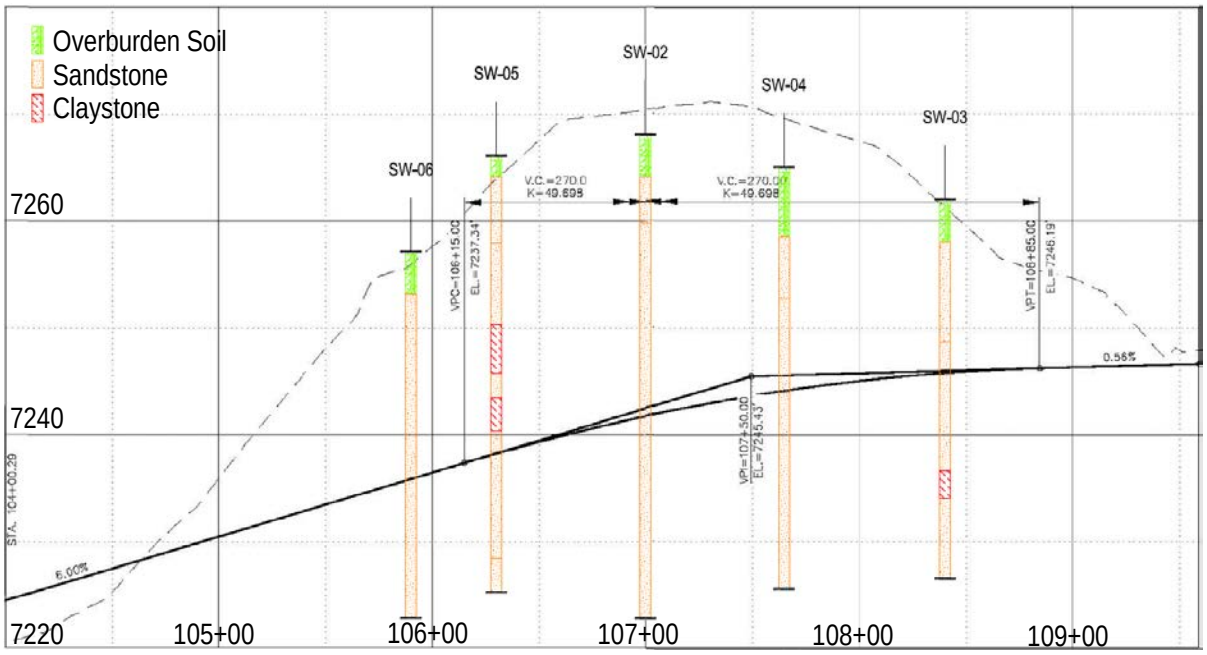

Exhibit 4-3: Through-Cut Generalized Subsurface Profile

4.4 Embankment Fill Areas

Borings SW-11 though SW-13 and SW-16 are located in the vicinity of the proposed fill area (Sta. 117+00 and Sta. 128+50). Borings SW-11 and SW-16 (the southern and northern extent of the fill area, respectively) each encountered residual bedrock overlying sandstone bedrock at 4.5 feet. Overburden soils encountered in these borings consisted of loose to medium dense sand, similar to the subgrade conditions described in Section 4.1. Bedrock was not encountered in borings SW-12 and SW-13.

4.5 Groundwater

Groundwater was not encountered in any of the borings during drilling. Fluctuations of groundwater levels are possible and will depend on many factors, including seasonal variations, local precipitation, and water levels in nearby drainage structures. Nevertheless, we do not anticipate that groundwater will impact the design or construction of the project.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Embankments and Permanent Slopes

5.1.1 Fill Slopes

For the proposed roadway embankment side slopes, we recommend fill slopes not exceed 3H:1V for maintenance, erosion control and slope stability.

We estimate a total embankment settlement of 1 to 2 inches at locations where embankment fill heights are up to 15 feet. We anticipate that approximately 3/4 of the settlement will occur as the fill is placed. The remaining settlement is anticipated to occur within a few months after the completion of fill placement.

5.1.2 Permanent Cut Slopes

We understand that proposed cut slopes in overburden soils are anticipated to be nominal in height (generally less than 5 feet) and are planned at a maximum slope of 3H:1V. In our opinion, this will provide a generally accepted factor of safety (FS) of 1.3 or greater (CDOT Geotechnical Design Manual, 2017). We recommend planting vegetation to reduce the potential for erosion to occur on the slopes.

The proposed through-cut indicated in Section 4.3 will predominately be in Dakota Formation Sandstone. The proposed cut could be excavated as steep as 2H:1V to meet the global stability requirements provided in the CDOT Geotechnical Design Manual (2017) in

the absence of groundwater. However, as discussed in Section 5.1.3, flatter slopes may be desirable to reduce erosion and long-term maintenance. Regardless, the upper 5 feet of the slope (in the overburden soils) should be sloped at a maximum of 3H:1V. If seeps are encountered during construction, we should be notified to reevaluate the slope stability.

5.1.3 Erosion Control

Due to the weak cementation of the sandstone bedrock, cuts in Dakota Formation Sandstone are anticipated to be highly erodible. Grading and drainage should be designed to reduce the flow of water over the face of the slopes. Feasible alternatives for erosion control can vary based on the initial construction costs, as well as the desired post-construction effort for the County (consisting of higher maintenance). These alternatives include:

- Installing a permanent cut slope at a flat enough angle (3H:1V or flatter) such that little maintenance would be required.
- Using a steeper slope (2H:1V) with a mid-slope bench and wide toe ditch. The bench should be graded to divert water and direct flow to a ditch on the side of the bench. Ditches should include appropriate erosion control measures. Regardless, the upper 5 feet of the slope in soil should be installed at a flatter angle (3H:1V).
- Cutting the lower portion of the through-cut at a 2H:1V angle and protecting the slope with erosion control measures. Regardless, the upper 5 feet of the slope in soil should be installed at a flatter angle (3H:1V).
- Cutting the slope at a 2H:1V angle with the anticipation of regular maintenance.

In addition, relatively fast-growing vegetation or other erosion control features should be considered in all areas of on the through-cut slopes.

5.1.4 Temporary Cuts

Temporary excavations could be required. The Contractor will be responsible to evaluate the stability of temporary slope and excavation configurations that may be required during construction.

The safe slope for the excavation of subsurface materials depends on many factors, including: (1) the presence of groundwater; (2) the type, density, and shear strength of the subsurface materials; (3) the depth of excavation; (4) the presence of adjacent structures; (5) surcharge loading adjacent to the excavation (including excavated material, existing dead or live loads, and construction equipment); and (6) time of construction.

To the extent that temporary excavation slopes are feasible, we recommend 1.5H:1V slopes be used for cost estimating and planning purposes only and limited to slopes up to 20 feet in height. Due to the presence of claystone seams/layers, steeper slopes are not recommended.

Flatter slopes would likely be required if groundwater is encountered during excavation. If temporary slopes will be made, they should be consistent with the Occupational Safety and Health Administration (OSHA) guidelines contained in 29 CFR 1926, Subpart P.

Consistent with conventional practice, the Contractor should be responsible for the actual temporary excavation slopes and shoring, including methods, sequence, and schedule of construction. The Contractor is able to observe the nature and conditions of the subsurface materials encountered and should evaluate the factors discussed above. If instability is observed, slopes should be flattened or shored. All excavations should be compliant with local, state, and federal safety regulations.

5.2 Pavement Design

We understand that Beacon Lite Road will be paved with HMA. Our pavement design and results are based on the design procedures presented in the 1993 AASHTO Guide for the Design of Pavement Structures with guidance from the El Paso County Engineering Criteria Manual (2016). The following sections summarize our pavement analysis and design assumptions (pavement design inputs and calculations are presented in Appendix C). Of note, the pavement analysis for Beacon Lite Road provided in Appendix C is unmodified from the pavement analysis provided in our 2020 geotechnical report.

5.2.1 Swelling Soil and Bedrock

Swell-susceptible soil and rock are common along the Front Range of Colorado. To assist us in determining the swell potential and along the roadway alignment, we reviewed a published geologic map of potentially swelling soil and rock in the Colorado Springs/Castle Rock area developed by Hart (1974). The mapping indicates that the project alignment has a low swell potential, which is characteristic of the Dawson Formation sandstone.

To further evaluate the roadway subgrade for swell potential, we performed four swell tests on overburden clayey sand subgrade. All tests indicated nil swell. As such, in our opinion, the risk of swell-related damage to the project pavements is low.

5.2.2 Subgrade Conditions

Based on our explorations, soils below the proposed pavements will vary along the alignment. Typically, clayey sand (AASHTO A-2-6 and A-6) was observed, but cleaner sands and silty sands were also observed (A-1-b and A-2-4). Fill soils generated from Dawson Formation sandstone or scarified and recompacted sandstone are generally anticipated to classify as A-2-6 soils.

The subgrade strength for the project was evaluated by R-value testing on the subgrade material. R-value testing was completed on A-2-6 soil generated from borings SW-17 and SW-24 with results of 30.1 and 24.8, respectively. For our analysis, we used a design subgrade R-value of 25.

5.2.3 Traffic Loading

Based on discussions with Michael Baker, Beacon Lite Road is classified as a rural minor collector. Current and projected traffic loading was provided in the Michael Baker traffic study of the Project area (2020a). The Project traffic study provided directional average daily traffic (ADT) values along the proposed pavement improvement areas. For design, we used a 2020 and 2040 NB Beacon Lite Road ADT value of 450 vehicles per day.

Although the Project traffic study indicates 1.6% to 2.0% truck traffic for the project alignment, the El Paso County, Engineering Criteria Manual, requires pavements be designed for a minimum of 4% truck traffic for rural minor collectors. For our analysis, we assumed a 1 to 1 ratio of single unit trucks (vehicle classes 4 through 7) and combination unit trucks (vehicle classes 8 through 13). To determine the 20-year design life 18-kip equivalent single axle loading (ESAL), we used Colorado truck equivalency factors for flexible pavements provided in the CDOT 2020 M-E Pavement Design Manual (2019a). We calculated a design ESAL traffic loading of 182,000 for Beacon Lite Road.

5.2.4 Recommended Pavement Section

Exhibit 5-1 summarizes our recommend pavement sections.

Exhibit 5-1: Pavement Sections

	Pavement Section[1]		
Roadway	HMA Surface Lift	HMA Bottom Lift	ABC[2]
Beacon Lite Road	1.5 in. SX	2.5 in. S	8

NOTES:

1 S and SX refer to the HMA gradation. Refer to Section 6.2.

2 CDOT Class 6 ABC material.

ABC = Aggregate Base Course, in. = inches

5.3 Sulfates and Corrosion

The soil and bedrock materials in Colorado area can be corrosive to substructure elements. To assist in estimating the corrosion potential at the site, samples of clayey sand and sandstone were tested for pH, resistivity, water soluble sulfates, and chlorides. The results are presented in Table B-1 in Appendix B.

Based on correlations developed by Roberge (2012) (summarized in Exhibit 5-2), the resistivity measured in the sample varied from 6,650 to 485 ohm-centimeters, which suggests a moderately to extremely corrosive subsurface. The concentration of water-soluble sulfates was 0.01% or not detected (less than 100 parts per million). Based on standard construction specifications prepared by CDOT, these test results correspond to Class 0 requirements for sulfate resistance (CDOT, 2019b).

The test results and the above discussion are provided to assist the designer in the selection of project materials, concrete type, or other features with respect to corrosion. As appropriate, the designer should consider protective measures, such as coatings, upsizing for section loss, or using alternative materials to reduce the corrosion potential.

Exhibit 5-2: Corrosivity Ratings Based on Soil Resistivity

Soil Resistivity (ohm-cm)	Corrosivity Rating
> 20,000	Essentially noncorrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
< 1,000	Extremely corrosive

6 CONSTRUCTION CONSIDERATIONS

The applicability of the above design parameters is contingent on good construction practice. Poor construction techniques may alter conditions from those upon which our recommendations are based, and therefore result in poor performance. Our analyses assumed that The Project is constructed according to El Paso County, Pikes Peak Region, CDOT construction standards and specifications (2019). The following sections provide additional construction considerations for this project.

6.1 Earthwork

6.1.1 Excavation Potential

We anticipate that excavation of overburden soil and shallow sandstone bedrock can be accomplished with conventional excavating equipment, such as dozers, front-end loaders, or scrapers. We do not anticipate blasting will be required for rock excavation. However, excavation in fresh rock could be slow at times and require the use of hydraulic excavators and dozers with ripper attachments.

6.1.2 Subgrade Preparation, Moisture Treatment, and Compaction

Proper subgrade preparation is required for adequate pavement performance. We recommend that CDOT standard specifications for earthwork be utilized for this project (CDOT, 2019b).

We recommend the bottom 8 inches of exposed subgrade in at-grade or cut areas be scarified in place, moisture treated, and recompacted as indicated below. The compacted surface should then be proof-rolled with a fully-loaded, tandem-axle, 10-yard dump truck or equivalent. Areas that are identified as being loose, soft, or yielding during proof-rolling should be compacted in place, removed and reconditioned, or replaced with granular fill material (material with less than 30% fines and a PI of less than 10). If loose, soft, or yielding soils are encountered after over-excavating 2 feet, a geogrid (Tensar biaxial grid BX1200, Tensar triaxial TX5, or equivalent product) should be installed at the base of the excavation before backfilling with granular fill. Care should be taken during proof-rolling and subgrade preparation to avoid disturbing subgrade soils and supporting soils that will remain in place, as they can rut and pump under repeated construction traffic. Additionally, subgrades should be protected from drying or wetting in excess of what is required to achieve the specified compaction requirements.

All fill material should be free of organics, contaminants, debris, and rock fragments larger than 3 inches. Fill material should be placed in horizontal lifts and compacted to a dense and unyielding condition following Section 203 of the CDOT Standard Construction Specifications (2019b). Granular soils that are encountered (AASHTO soil classification A-1, A-2 and A-3), should be compacted within 2% of optimum moisture content and recompacted to at least 95% of the maximum dry density as determined by AASHTO T99. We recommend that cohesive soils (AASHTO soil classification A-4, A-6 and A-7), if encountered, be compacted to 0% to 2% above optimum moisture content and recompacted to at least 95% AASHTO T99 (standard compaction effort).

6.1.3 Pavement Subgrade Soft Spot Repair

The soils along the proposed pavement subgrade, as well as fill soils generated from cuts in Dawson Formations bedrock can be prone to pumping during construction if exposed to elevated moistures and repeated loading from heavy equipment, in particular in widenings. Using newly placed fill as access roads (haul roads) that is placed wet of optimum or shortly after precipitation (particularly in rainy seasons) could require contractor re-working of the subgrade because of pumping or rutting conditions. To reduce the quantity of 'soft spot repair' or 'muck excavation' from the project quantities, The Project contract documents should make the Contractor responsible for protecting the fill that has been placed (protecting from surface water accumulating and ponding the haul road subgrade or

limiting construction traffic on the haul road). In our experience, the material excavated from these failing proof rolls, can be re-used if allowed to dry and it is re-compacted (as described in Section 6.1.3). The Contractor should be responsible for the expense of hauling away fill from soft spots and importing higher quality fill unless explicitly approved by the County. On-site representation could be used to make this determination and document decisions made during construction (refer to Section 7.2)

6.2 Paving Materials

6.2.1 Hot Mix Asphalt

We understand that El Paso County follows the Pikes Peak Region Asphalt Paving Specifications (2019) for HMA paving material mix design standards. Based on the anticipated traffic loading, the pavement mix design for The Project should be a performance graded binder of PG 58-28. We recommend a gyratory number of 75 be used for the mix design. In addition, we recommend using a Grade SX (½-inch nominal maximum aggregate size [NMAS]) mix for the surface layer of HMA and Grade S (¾-inch NMAS) for the underlying lift. Exhibit 5-1 provides our recommended lift thicknesses for The Project. A tack coat should be placed between subsequent lifts if the underlying lift will be used for traffic or left uncovered for a 24-hour period.

6.2.2 Aggregate Base Course (ABC) Materials

The El Paso County Engineering Criteria Manual (2016) references CDOT Section 703.03 for the ABC material. The ABC material should be placed in maximum 6-inch-thick lifts and compacted to a dense and unyielding condition and to at least 95% of the maximum dry density (AASHTO T180).

7 PLAN REVIEW AND CONSTRUCTION OBSERVATION

7.1 Plan Review

We recommend that we be retained to review the geotechnical aspects of the plans and specifications prior to bidding the work to determine that they are in accordance with our recommendations. While this step is often skipped in design document preparation, our experience is that the review can find discrepancies or misinterpretations and correct them before bidding, thus avoiding potential change orders during construction.

7.2 Construction Monitoring

We recommend that we be retained to observe geotechnical construction activities and confirm the adequacy of our recommendations in this report. Our involvement will help with developing alternative recommendations if conditions observed during construction are different from those assumed in this report. As a minimum, our support services should include review of the Contractor's geotechnical-related submittals, observation of pavement subgrades and permanent cut slopes, and as-needed support to clarify related issues.

8 LIMITATIONS

This report has been prepared for the exclusive use of Michael Baker International and El Paso County for the purpose of providing recommendations for the Beacon Lite Road Improvements project. This geotechnical design report should not be used without our approval if any of the following occurs:

- Assumptions stated in this report have changed.
- Project details change or new information becomes available such that our analyses and recommendations may be affected.
- A substantial period of time has passed since the date of this report.

If any of these occur, we should be retained to review the applicability of our analyses and recommendations.

Within the limitations of scope, schedule and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical and geological principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by a limited boring and testing program. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

9 REFERENCES

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0 1 2

Approximate Scale in Miles

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

Beacon Lite Road Improvements
El Paso County, Colorado

VICINITY MAP

April 2022 104129-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

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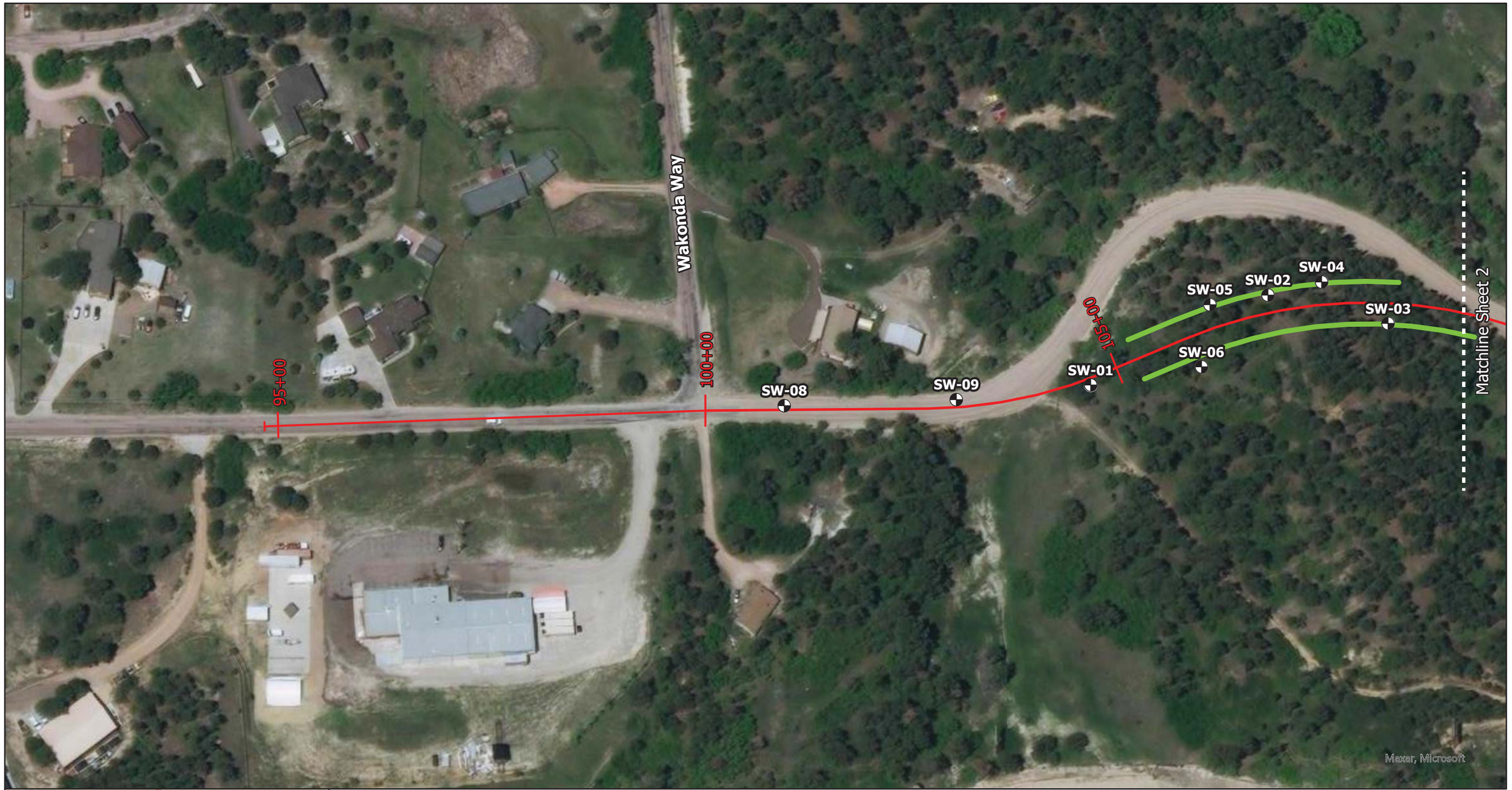
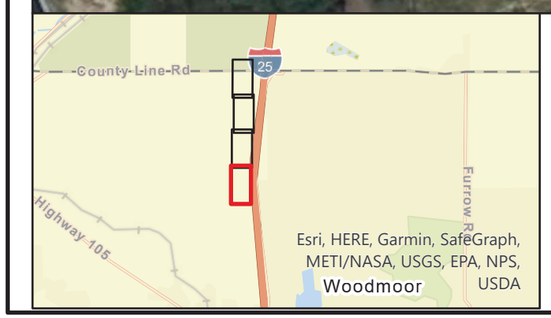




LEGEND

- Boring Designation and Approximate Location
- Proposed Roadway Centerline
- Proposed Roadway Cuts

0 150 300

Approximate Scale In Feet

N

Beacon Lite Road Improvements
El Paso County, Colorado

SITE AND EXPLORATION PLAN

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2
Sheet 1 of 4

LEGEND

- Boring Designation and Approximate Location
- Proposed Roadway Centerline
- Proposed Roadway Cuts

0 150 300

Approximate Scale In Feet

N

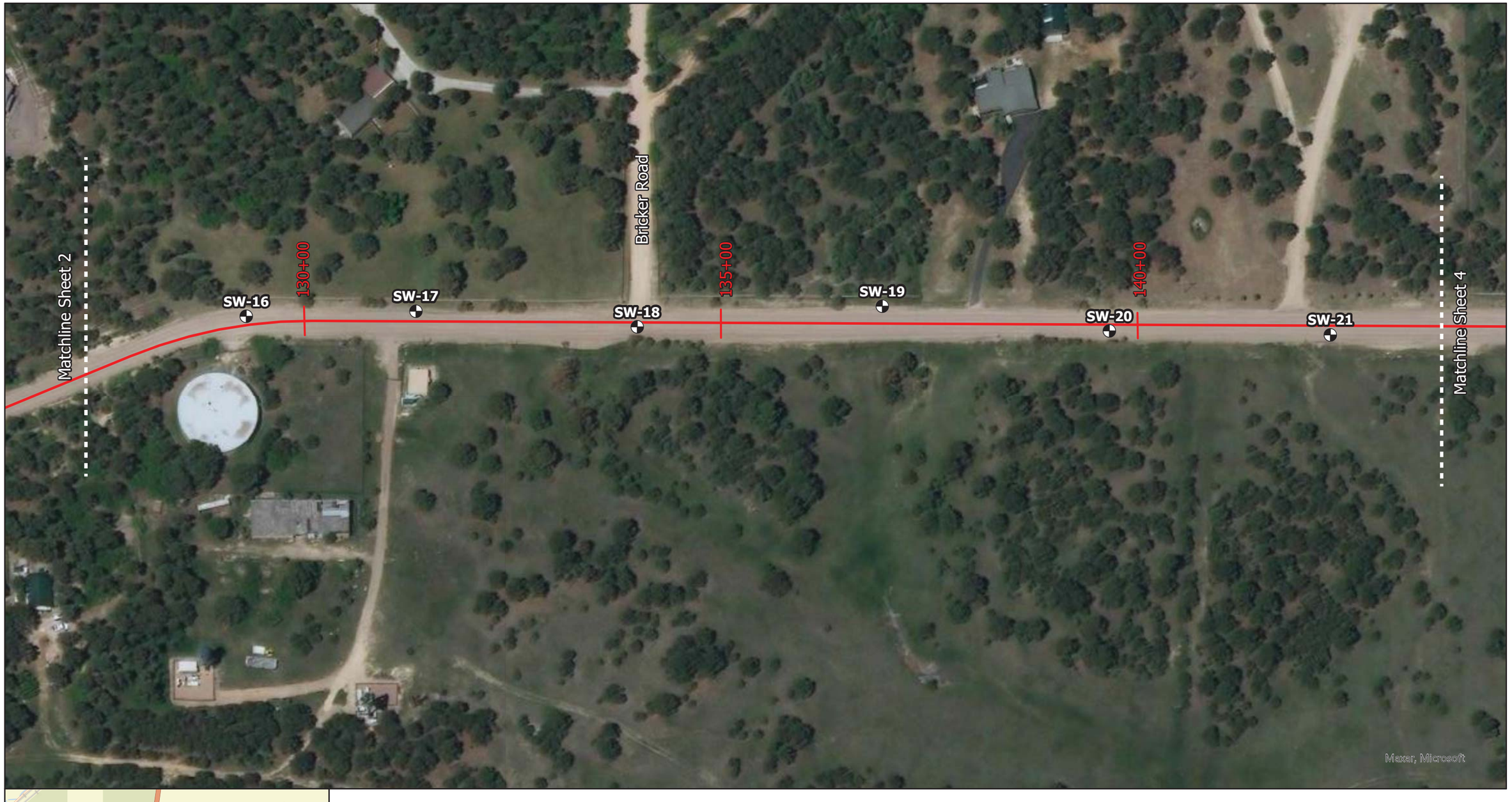
Beacon Lite Road Improvements
El Paso County, Colorado

SITE AND EXPLORATION PLAN

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2
Sheet 2 of 4



LEGEND

Boring Designation and Approximate Location

Proposed Roadway Centerline

0 150 300

Approximate Scale In Feet

N

Beacon Lite Road Improvements
El Paso County, Colorado

SITE AND EXPLORATION PLAN

April 2022 104129-001

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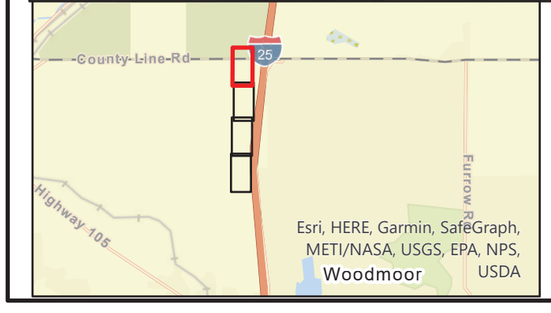
FIG. 2
Sheet 3 of 4



LEGEND

- Boring Designation and Approximate Location
- Proposed Roadway Centerline
- Boring Designation and Approximate Location (Shannon & Wilson, 2020)

0 150 300

Approximate Scale In Feet

N

Beacon Lite Road Improvements
El Paso County, Colorado

SITE AND EXPLORATION PLAN

April 2022 104129-001

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FIG. 2
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APPENDIX A: SUBSURFACE EXPLORATIONS

Appendix A

Subsurface Explorations

CONTENTS

Figures

APPENDIX A: SUBSURFACE EXPLORATIONS

A.1 INTRODUCTION

Shannon & Wilson's field exploration program along Beacon Lite Road a was conducted on April 23 and 24, 2020, May 4 and 5, 2020, and July 16, 2020 and consisted of drilling twenty-one borings designated SW-01 through SW-24. Borings SW-07, SW-14, and SW-15 were not completed due to difficult access (boring SW-07) and buried utility conflicts within Beacon Lite Road (borings SW-14 and SW-15). The methods used to conduct the field exploration program are described below.

A.2 EXPLORATIONS

The borings were coordinated (including subcontractor coordination and utility locates) and observed by Shannon & Wilson. Individual boring logs are presented in Figures A-3 through A-23. The exploration logs represent our interpretation of the contents of the field logs and select results of laboratory testing. The borings were drilled by Vine Laboratories, Inc. of Commerce City, Colorado (under subcontract to Shannon & Wilson) using a CME 55 truck mounted drill rig and a CME 750 buggy rig. The borings in the proposed roadway cuts (borings SW-01 through SW-06 and SW-24) were advanced to depths of approximately 11.5 to 45 feet. The remaining borings were advanced between 6 and 11.5 feet below the existing Beacon Lite Road grade. All borings were advanced with 4¼-inch-diameter solid-stem auger. On completion of drilling, borings SW-08 through SW-24 were backfilled with flowfill mixed on site. Borings SW-01 through SW-06 were backfilled with drill cuttings.

A.2.1 Soil Classification System

During drilling, our representative collected samples and prepared field logs of the explorations. Soil classification for this project was based on ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), and ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Soils were also classified using the AASHTO Soil Classification System based on AASHTO Standard M 145. The Unified Soil Classification System is summarized in Figure A-1.

The bedrock encountered in the borings was found to be very dense and hard when considered as a lithified soil material. However, when compared with other types of bedrock using the International Society for Rock Mechanics classification of rock strength, the rock resembles an extremely weak rock. Therefore, for completeness, the boring logs

contain dual descriptions of the bedrock using the Unified Soil Classification System and rock classification shown in Figure A-2, where appropriate.

A.2.2 Standard Penetration Test (SPT)

Disturbed samples were obtained in the borings in general accordance with the Standard Penetration Test (SPT) (ASTM Designation: D1586). The SPT consists of driving a 2-inch-outside-diameter (O.D.), 1.375-inch-inside-diameter split-spoon sampler 18 inches. An automatic, free-falling 140-pound hammer was used to advance the split spoon sampler. Based on 2019 testing[1, 2] of Vine Laboratories drill rigs, the reported energy transfer ratio for the automatic hammer was 97% for the CME-750X buggy mounted drill rig and 83% for the CME-55 truck mounted drill rig. During sampling, the Shannon & Wilson field representative recorded the number of blows for each 6-inch increment of penetration and summed the blow counts for the last two 6-inch increments. This sum is recorded as the penetration resistance number, or N-value. If high penetration resistance prevented driving the total length of the sampler, the Shannon & Wilson field representative recorded the partial penetration depth and blow count. The N-values provide a means for evaluating the relative density or compactness of cohesionless (granular) soils and consistency or stiffness of cohesive (fine-grained) soils (see Figure A-1). The raw N-values are shown on the individual boring logs. Representative portions of the split-spoon sample obtained in conjunction with the SPT were placed in a screw-top plastic jar and transported to our laboratory.

A.2.3 Modified California (MC) Test and Sampling

Samples were also obtained using a Modified California (MC) barrel sampler. The MC test procedure is similar to the SPT, except the sample barrel is larger (2½-inch O.D.) and lined with 2-inch-diameter brass tubing. The MC sampler is only driven 12 inches. During sampling, the Shannon & Wilson field representative recorded the number of blows for each 6-inch increment of penetration. As a result of the larger diameter, the MC sampler yields slightly higher raw blow count numbers when compared to SPT N-values for similar soils. Because the difference in blow counts does not significantly impact our evaluation, we used the field MC blow counts over the 12-inch increment to define the relative density and consistency/stiffness of the subsurface materials following SPT terminology. Representative

[1] 2019, GRL Engineers, Inc., Energy Measurements for Dynamic Penetrometers, Rigs(s): CME 750X Serial Number 304668, Geoprobe 6620DT serial Number 10046, CME 55 Serial Number 332955, and CME 55 Serial Number 404685, Standard Penetration Tests (SPT), Commerce City, Colorado, prepared for Vine Laboratories, Inc.; GRL Jon No. 192027-1, dated August 14, 2019.
[2] 2019, GRL Engineers, Inc., Energy Measurements for Dynamic Penetrometers, Rigs(s): CME 55 Serial Number 348175, Standard Penetration Tests (SPT), Commerce City, Colorado, prepared for Vine Laboratories, Inc.; GRL Job No. 192027-1-1, dated July 15, 2019.

samples were sealed in the brass liner tubes with plastic caps and transported to our laboratory for further testing.

A.2.4 Bulk Sampling

A bulk soil sample was obtained by collecting the drill cuttings from select borings. Approximately 20 pounds of cuttings were placed in a sealed plastic bag. The cuttings were further subsampled and placed into a screw top plastic jar in order to better preserve natural field moisture conditions. The samples were transported to our laboratory for further analysis and testing.

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

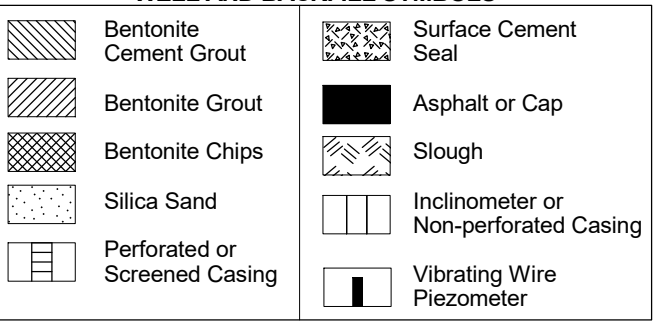
PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS



PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Beacon Lite Road Improvements
El Paso County, Colorado

SOIL CLASSIFICATION AND LOG KEY

April 2022 104129-001

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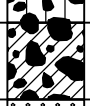
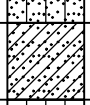
FIG. A-1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL		TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW		Well-Graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW		Well-Graded Sand; Well-Graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

Beacon Lite Road Improvements
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SOIL CLASSIFICATION AND LOG KEY

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SHANNON & WILSON, INC.
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FIG. A-1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Beacon Lite Road Improvements
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SOIL CLASSIFICATION AND LOG KEY

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FIG. A-1
Sheet 3 of 3

WEATHERING

TERM	DESCRIPTION
Fresh	No visible sign of rock material weathering
Slightly Weathered	Slight discoloration on surface
Moderately Weathered	Discoloring evident; Less than half of the rock material is decomposed
Highly Weathered	Entire rock mass discolored; More than half of the rock material is decomposed
Completely Weathered	Rock reduced to a soil with relict rock texture
Residual Soil	All rock material is converted to soil

STRENGTH

GRADE	DESCRIPTION	APPROX. UCS (psi)
R0	Extremely Weak Rock	36 to 145
R1	Very Weak Rock	145 to 700
R2	Weak Rock	700 to 3,600
R3	Medium Strong Rock	3,600 to 7,200
R4	Strong Rock	7,200 to 14,500
R5	Very Strong Rock	14,500 to 36,250
R6	Extremely Strong Rock	>36,250

JOINT ROUGHNESS COEFFICIENT (JRC)

COEFFICIENT	DESCRIPTION
14 to 20	VERY ROUGH: Near vertical edges evident
10 to 14	ROUGH: Smooth ridges, surface abrasion
6 to 10	SLIGHTLY ROUGH: Asperities on surface can be felt
2 to 6	SMOOTH: Appears and feels smooth
0 to 2	SLICKENSIDED: Visible polishing, striated surface

DISCONTINUITY DATA

SPACING	
DESCRIPTION	SPACING
Extremely Close	< 1 in
Very Close	1 to 2.5 in
Close	2.5 to 8 in
Moderate	8 to 24 in
Wide	24 in to 6 ft
Very Wide	6 to 20 ft
Extremely Wide	> 20 ft

DISCONTINUITY TERMS

FRACTURE - Collective term for any natural break excluding shears, shear zones, and faults

JOINT (JT) - Planar break with little or no displacement

FOLIATION JOINT (FJ) or BEDDING JOINT (BJ) - Joint along foliation or bedding

INCIPIENT JOINT (IJ) or INCIPIENT FRACTURE (IF) - Joint or fracture not evident until wetted and dried; breaks along existing surface

RANDOM FRACTURE (RF) - Natural, very irregular fracture that does not belong to a set

BEDDING PLANE SEPARATION or PARTING - A separation along bedding after extraction from stress relief or slaking

FRACTURE ZONE (FZ) - Planar zone of broken rock without gouge

MECHANICAL BREAK (MB) - Breaks due to drilling or handling; drilling break (DB), hammer break (HB)

SHEAR (SH) - Surface of differential movement evident by presence of slickensides, striations, or polishing

SHEAR ZONE (SZ) - Zone of gouge and rock fragments bounded by planar shear surfaces

FAULT (FT) - Shear zone of significant extent; differentiation from shear zone may be site-specific

APERTURE WIDTH	
TERM	SPACING
Very Tight	<0.1mm
Tight	0.1 to 0.25mm
Partly Open	0.25 to 0.5mm
Open	0.5 to 2.5mm
Moderately Wide	2.5 to 10mm
Wide	10mm to 1cm
Very Wide	1 to 10cm
Extremely Wide	10 to 100cm
Cavernous	>1m

Beacon Lite Road Improvements
El Paso County, Colorado

ROCK CLASSIFICATION AND LOG KEY

April 2022 104129-001

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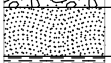
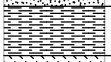
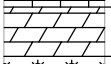
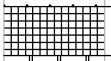
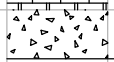
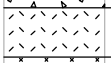
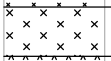
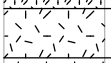
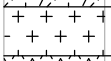
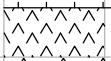
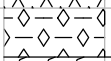
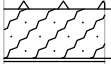
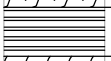
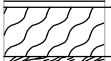
FIG. A-2
Sheet 1 of 2

ROCK CLASS KEY - P1 (NEW STRENGTHS) 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ SHAN_WIL.GDT 8/26/21

ROCK CLASSIFICATION SYMBOLS

BEDROCK TYPE	GRAPHIC SYMBOL	ROCK NAME
Clastic Sedimentary Rocks		Breccia
		Conglomerate
		Sandstone
		Siltstone
		Claystone
		Shale
		Coal
Carbonate Sedimentary Rocks		Limestone
		Dolomite
		Coral
Evaporite Rocks		Gypsum
		Halite
		Calcite
Extrusive Igneous Rocks		Tuff
		Rhyolite
		Dacite
		Andesite
		Basalt
Intrusive Igneous Rocks		Granite
		Grano-diorite
		Diorite
		Gabbro
Metamorphic Rocks		Marble
		Quartzite
		Slate
		Phyllite
		Schist
		Gneiss

Beacon Lite Road Improvements
El Paso County, Colorado

ROCK CLASSIFICATION AND LOG KEY

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 2 of 2

ROCK CLASS KEY - P2 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ SHAN_WIL.GDT 8/26/21

Total Depth:	*11.5 ft.*	Latitude:	*~ 39.11631°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86794°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

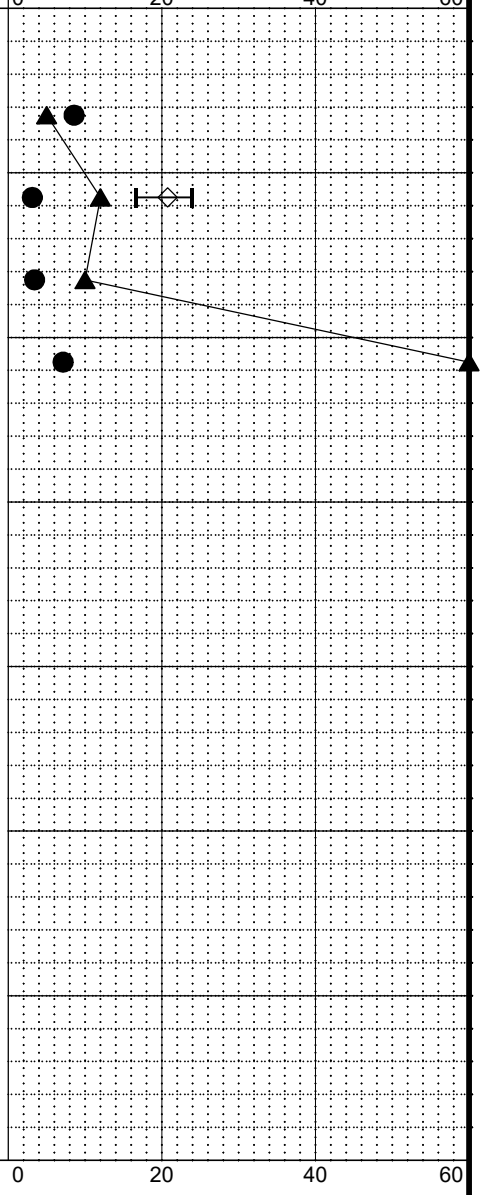
Depth, ft.	Soil Description
0.5	Topsoil.
3.3	Loose, brown, *Silty, Clayey Sand (SC-SM);* moist; scattered organics. [A-2-4]
8.0	Loose to medium dense, brown to light brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel, scattered roots. Residuum [A-2-4] [SANDSTONE: extremely weak; completely weathered (Dawson Formation).]
11.5	SANDSTONE: extremely weak, white to red-brown; completely to highly weathered; weakly cemented (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist; trace gravel.]
	BOTTOM OF BORING COMPLETED ON 04/24/2020

Symbol: S-1, S-2, S-3, S-4

Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-01

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-3

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*45.3 ft.*	Latitude:	*~ 39.1169°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86833°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Topsoil. — 0.5

Loose, brown, *Silty, Clayey Sand (SC-SM);* moist; scattered organics. — 2.0

Medium dense, light brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. Residuum [SANDSTONE: extremely weak; completely weathered (Dawson Formation).] — 4.0

SANDSTONE: extremely weak, light brown; completely to highly weathered (Dawson Formation).
[Very dense, *Clayey Sand (SC);* moist.] — 8.3

SANDSTONE: extremely weak to very weak, light gray to white; highly to moderately weathered; weakly cemented (Dawson Formation).
[Very dense, *Clayey Sand (SC);* moist.]

- Red-brown to red-yellow; fissile, laminations approximately 1/2-inch thick below 20 feet.

- Light gray to yellow-brown below 30 feet.

CONTINUED NEXT SHEET

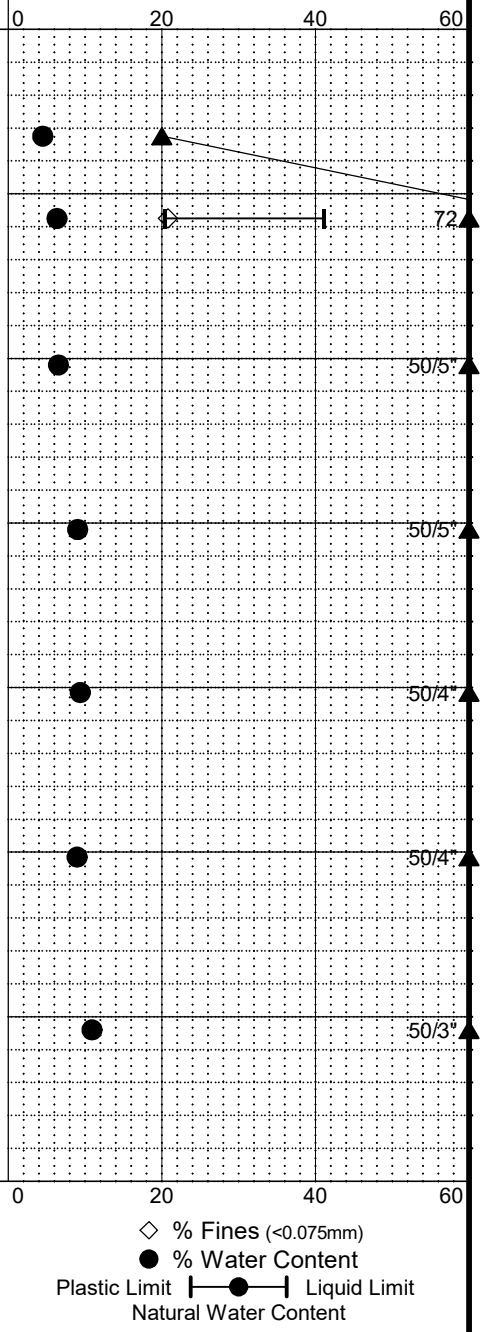
Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

Samples: S-1, S-2, S-3, S-4, S-5, S-6, S-7

Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-02

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

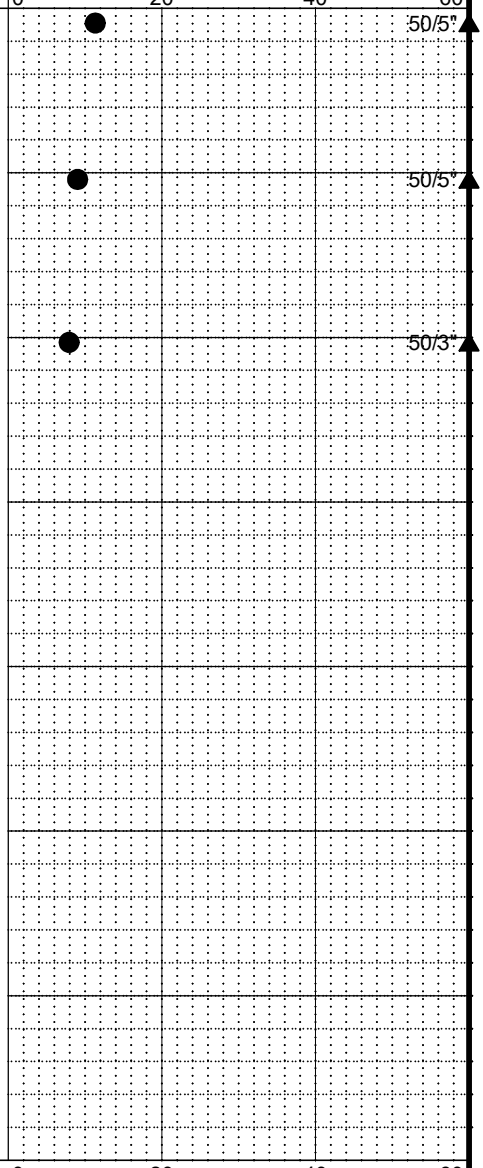
FIG. A-4
Sheet 1 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*45.3 ft.*	Latitude:	*~ 39.1169°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86833°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION	Depth, ft.	Symbol	Samples	Ground Water Depth, ft.	PENETRATION RESISTANCE (blows/foot)
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.					▲ Hammer Wt. & Drop: *140 lbs / 30 inches*
SANDSTONE: extremely weak to very weak (continued).			S-8		50/5"
- White below 40 feet.			S-9		50/5"
			S-10		50/3"
BOTTOM OF BORING COMPLETED ON 04/23/2020	45.3				



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-02

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 2 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*35.5 ft.*	Latitude:	*~ 39.11728°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.8682°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft.	Soil Description
0.5	Topsoil.
	Medium dense, light brown, *SIlty, Clayey Sand (SC-SM);* dry to moist; trace to few gravel. Residuum
4.0	[SANDSTONE: extremely weak; completely weathered (Dawson Formation).]
	SANDSTONE: extremely weak, light brown to yellow-brown with light red grains; completely to highly weathered; calcareous (Dawson Formation). [Dense to very dense, *Clayey Sand (SC);* moist; trace gravel.]
13.3	SANDSTONE: extremely weak to very weak, light brown to yellow-brown; highly to moderately weathered; calcareous; weakly cemented (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]
25.4	CLAYSTONE: extremely weak, red-brown to brown; moderately weathered (Dawson Formation).
28.0	[Hard, *Fat Clay with Sand (CH);* moist.]
	SANDSTONE: extremely weak, light brown to light red and yellow-brown; moderately weathered (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]
35.5	BOTTOM OF BORING COMPLETED ON 04/23/2020

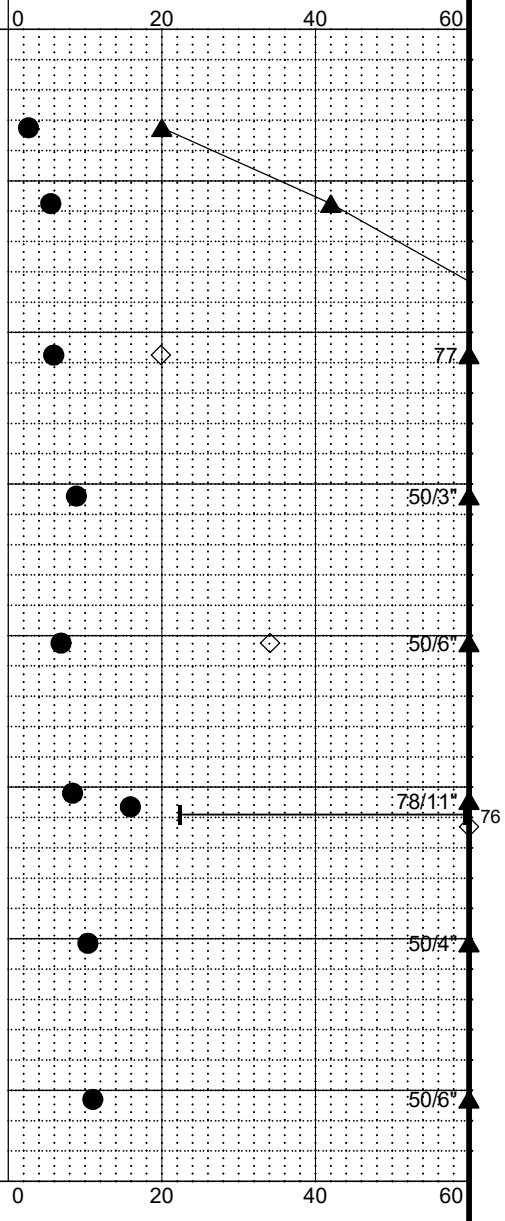
Symbol: S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8

Samples

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Modified California Sampler

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-03

April 2022 104129-001

SHANNON & WILSON, INC.
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FIG. A-5

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	39.5 ft.	Latitude:	~ 39.11707°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86838°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 750 Buggy	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Topsoil. — 0.5

Medium dense, light brown with light red grains, *Silty, Clayey Sand (SC-SM);* dry to moist; fine sand. Residuum
[SANDSTONE: extremely weak; completely weathered (Dawson Formation).]

6.5

SANDSTONE: extremely weak, light brown; highly weathered (Dawson Formation).
[Medium dense, *Clayey Sand (SC);* moist.]

12.3

SANDSTONE: extremely weak to very weak, light brown to light gray and yellow-brown; highly to moderately weathered (Dawson Formation).
[Very dense, *Clayey Sand (SC);* moist.]

- Fissile laminations approximately 1/2-inch thick from 19.2 feet to 19.4 feet.

- Fissile laminations approximately 1/2-inch thick from 34.0 feet to 34.5 feet.

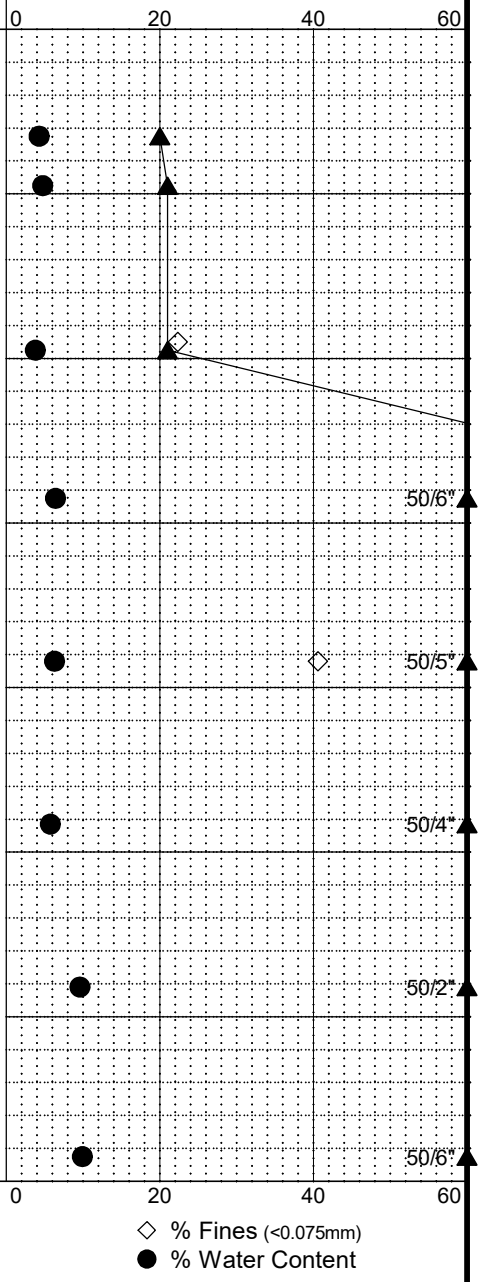
CONTINUED NEXT SHEET

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⊥ Standard Penetration Test

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-04

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FIG. A-6
Sheet 1 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*39.5 ft.*	Latitude:	*~ 39.11707°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86838°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Symbol	Samples	Ground Water Depth, ft.	**PENETRATION RESISTANCE** (blows/foot) ▲ Hammer Wt. & Drop: *140 lbs / 30 inches*
- SANDSTONE: extremely weak to very weak (Continued).					
	39.5		S-9		50/6" ▲
BOTTOM OF BORING COMPLETED ON 04/23/2020					

0 20 40 60

40 45 50 55 60 65

0 20 40 60

◇ % Fines (<0.075mm)
● % Water Content

LEGEND

* Sample Not Recovered
⌶ Standard Penetration Test

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-04

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 2 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

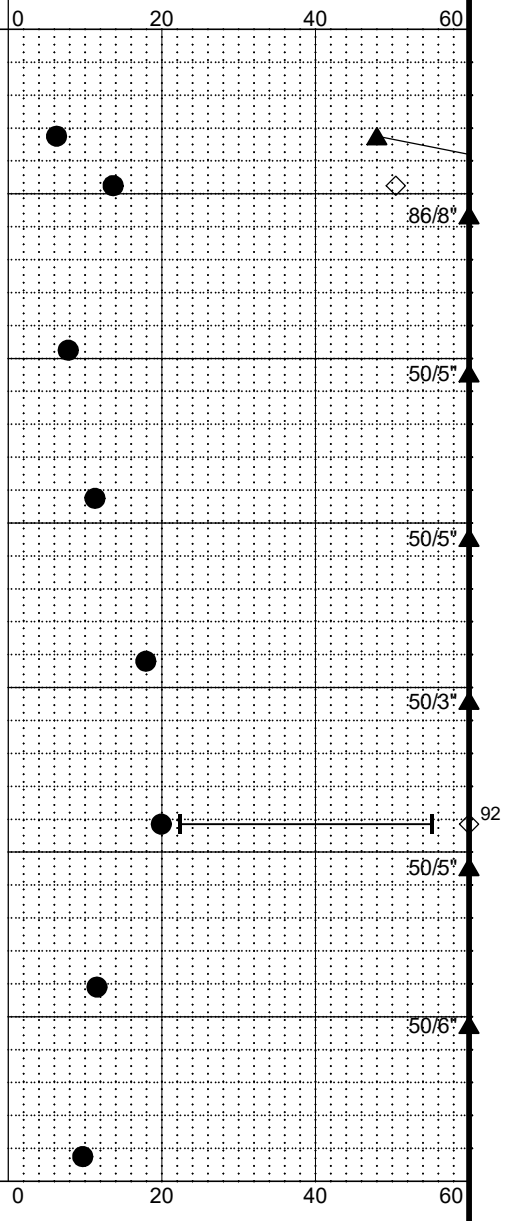
Total Depth:	*40.9 ft.*	Latitude:	*~ 39.1167°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86828°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION	Depth, ft.
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.	
Topsoil.	0.5
Loose, brown, *Silty, Clayey Sand (SC-SM);* moist; scattered organics.	2.0
SANDSTONE/CLAYSTONE: extremely weak; light brown to light gray and light red; completely to highly weathered; weakly cemented (Dawson Formation). [Dense to very dense, *Clayey Sand (SC)* to hard, *Sandy Lean Clay (CL); moist;* trace gravel.]	8.2
SANDSTONE: extremely weak; light gray to yellow-brown and brown; fissile with 1/2-inch thick beds; highly weathered (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]	15.8
CLAYSTONE: extremely weak, light gray to white; fissile with 1/4-inch thick beds; highly weathered (Dawson Formation). [Hard, *Sandy Fat Clay (CH);* moist.]	20.4
SANDSTONE: extremely weak to very weak, white; highly weathered (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]	22.7
CLAYSTONE: extremely weak, light gray to yellow-brown; fissile with 1/4-inch thick beds; highly weathered; calcareous nodules (Dawson Formation). [Hard, *Fat Clay (CH);* moist; few sand.]	25.8
SANDSTONE: extremely weak, light gray to yellow-brown and light brown; fissile with 1/4-inch thick beds, interbedded with 1/4-inch thick claystone seams; highly weathered (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]	
CONTINUED NEXT SHEET	

Symbol | Samples: S-1, S-2, S-3, S-4, S-5, S-6, S-7 | Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-05

April 2022 104129-001

SHANNON & WILSON, INC.
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FIG. A-7
Sheet 1 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*40.9 ft.*	Latitude:	*~ 39.1167°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86828°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION	Depth, ft.	Symbol	Samples	Ground Water Depth, ft.	PENETRATION RESISTANCE (blows/foot)
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.					▲ Hammer Wt. & Drop: *140 lbs / 30 inches*
SANDSTONE: extremely weak (Continued).			S-8		50/5"
SANDSTONE: extremely weak, red-brown to light gray and yellow-brown; highly to moderately weathered (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]	37.7		S-9		50/5"
BOTTOM OF BORING COMPLETED ON 04/24/2020	40.9				

0 20 40 60

40 45 50 55 60 65

0 20 40 60

LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-05

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 2 of 2

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*34.3 ft.*	Latitude:	*~ 39.11667°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86802°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 750 Buggy*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Topsoil. — 0.3

Very dense, light brown to light gray, *Silty, Clayey Sand (SC-SM);* moist; scattered roots. Residuum — 4.0

[SANDSTONE: extremely weak, completely weathered (Dawson Formation).]

SANDSTONE: extremely weak, light brown to light gray and white; fissile with 1/8-inch thick beds; completely to highly weathered; weakly cemented (Dawson Formation).

[Very dense, *Clayey Sand (SC);* moist; trace gravel.]

- Moderately weathered below 19.0 feet.

- Very weak below 34 feet.

BOTTOM OF BORING — 34.3
COMPLETED ON 04/24/2020

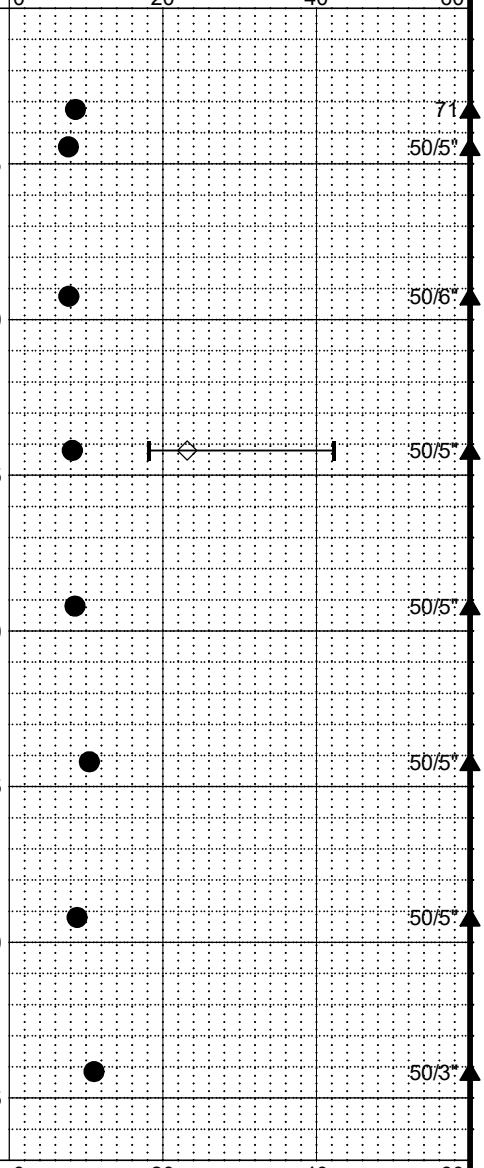
Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

Samples: S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8

Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a mapping grade GPS unit. The boring elevation was determined from an electronic topographic file of the Project site.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-06

April 2022 — 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	6.5 ft.	Latitude:	~ 39.1153°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	6 in.
Top Elevation:	~	Longitude:	~ -104.86786°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing (0.2)

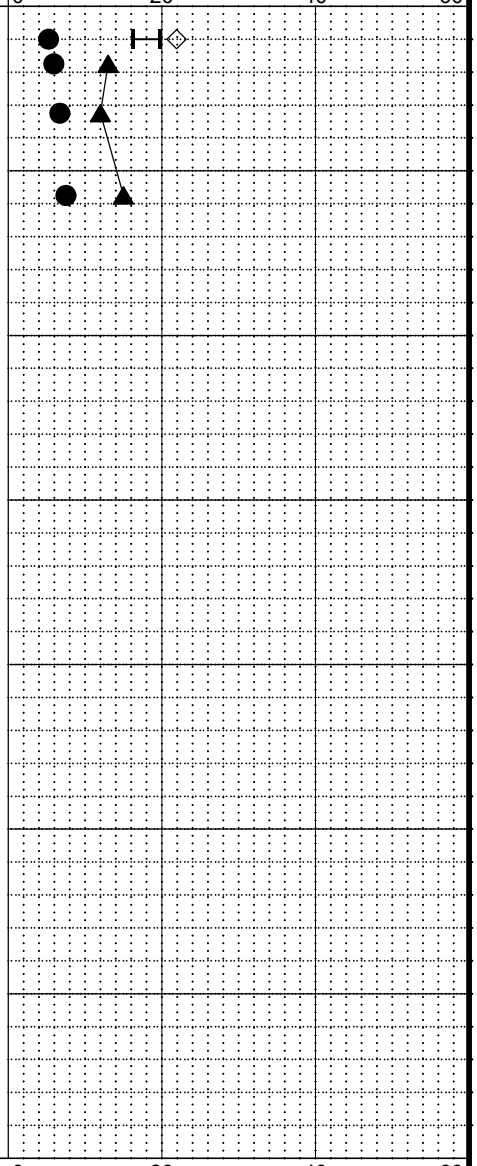
Medium dense, brown to light brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. [A-1-b]

Medium dense, brown to dark brown, *Poorly Graded Sand with Clay (SP-SC)* to *Clayey Sand (SC);* moist; trace to few gravel. [A-1-b] (4.5)

BOTTOM OF BORING (6.5)
COMPLETED ON 05/05/2020

Depth, ft. | Symbol | Samples (S-1 B-1, S-2, S-3) | Ground Water Depth, ft. (Groundwater Not Encountered During Drilling.)

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND
* Sample Not Recovered
Standard Penetration Test
Grab Sample

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES
1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-08

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-9

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	*11.5 ft.*	Latitude:	*~ 39.11587°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86788°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing — 0.3

Medium dense, brown to light brown, *Poorly Graded Sand (SP);* moist trace silt; trace gravel. [A-1-b] — 2.5

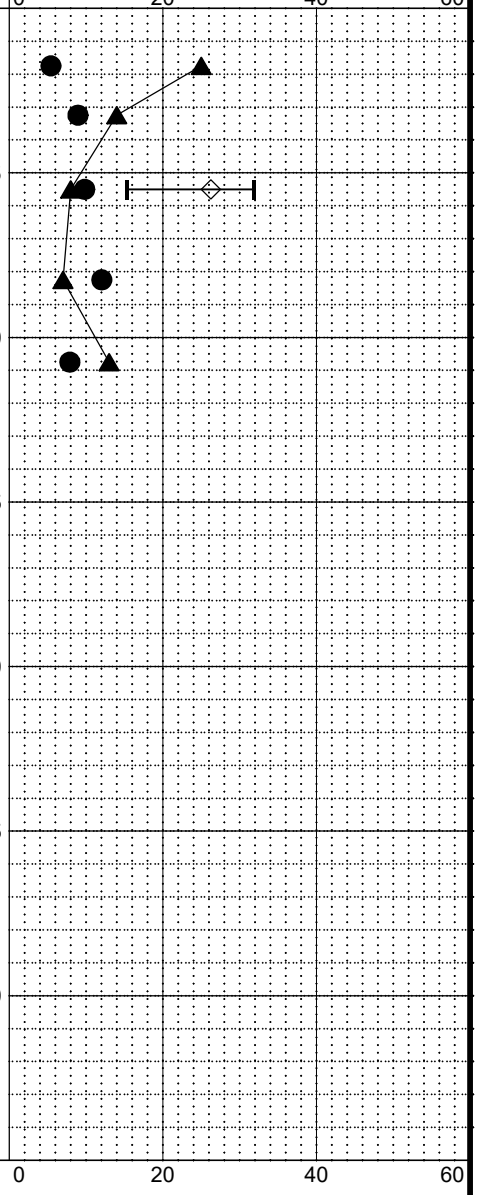
Loose to medium dense, *Clayey Sand (SC);* moist; trace gravel. [A-2-6]

Medium dense, dark brown, *Poorly Graded Sand with Clay (SP-SC);* moist; trace gravel. — 9.5

BOTTOM OF BORING — 11.5
COMPLETED ON 05/05/2020

Depth, ft. | Symbol | Samples (S-1, S-2, S-3, S-4, S-5) | Ground Water Depth, ft. (Groundwater Not Encountered During Drilling.)

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND
* Sample Not Recovered
Standard Penetration Test
Modified California Sampler

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES
1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-09

April 2022 | 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-10

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	6.5 ft.	Latitude:	~ 39.11788°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86811°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

0.2 — Aggregate Surfacing

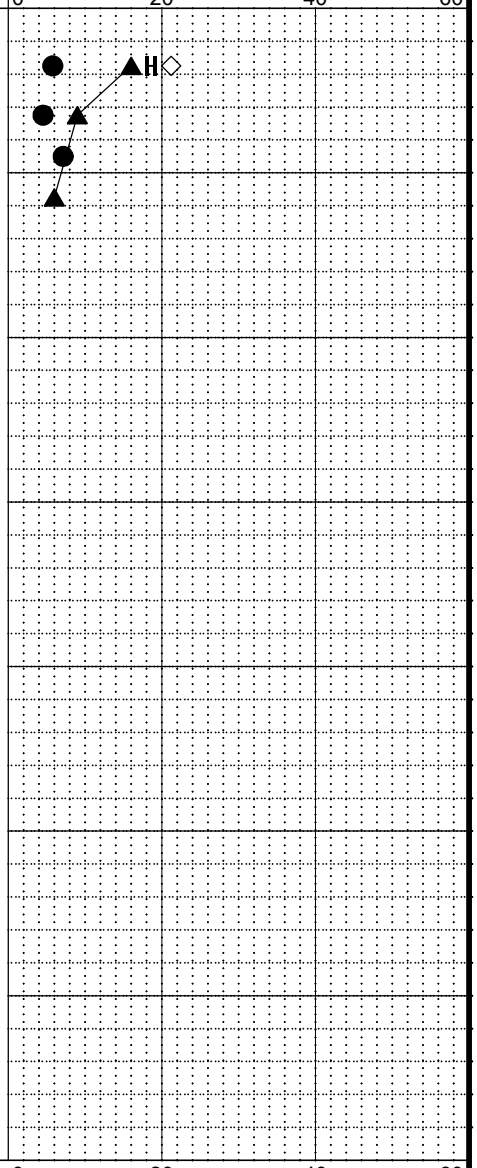
Loose to medium dense, brown to dark brown, *Silty Sand (SM);* moist; trace gravel. [A-1-b]

S-1, S-2, S-3

Groundwater Not Encountered During Drilling.

6.5

BOTTOM OF BORING
COMPLETED ON 05/05/2020



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-10

April 2022 104129-001

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FIG. A-11

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	6.5 ft.	Latitude:	~ 39.11869°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86778°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing

Loose to medium dense, brown to dark brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. [A-2-4]

SANDSTONE: extremely weak, yellow-brown to red-brown; highly weathered; iron oxide staining (Dawson Formation). [Very dense, *Clayey Sand (SC);* moist.]

BOTTOM OF BORING
COMPLETED OF 05/05/2020

Depth, ft.: 0.3, 4.5, 6.5

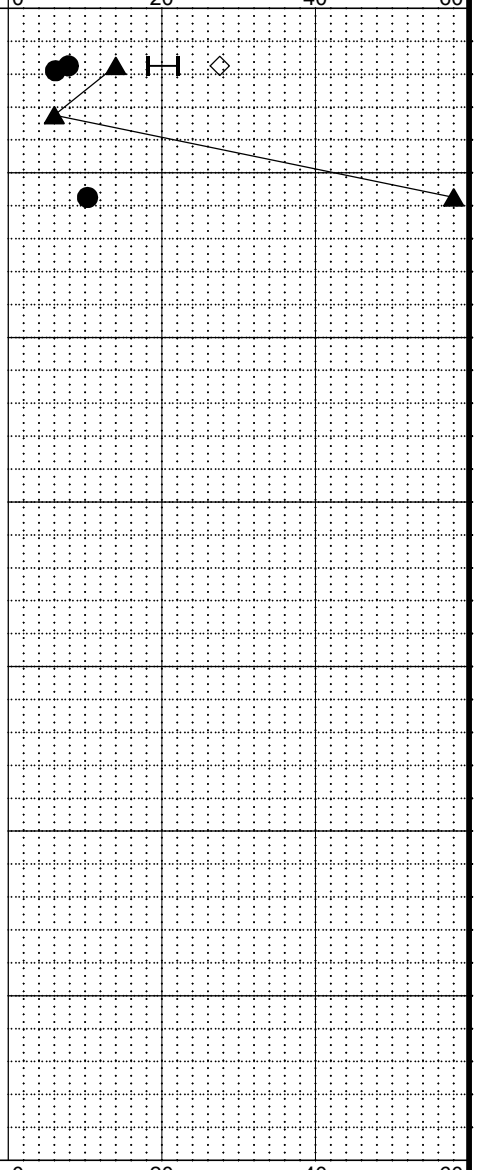
Symbol

Samples: S-1, S-2, S-3

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-11

April 2022 104129-001

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FIG. A-12

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*11.5 ft.*	Latitude:	*~ 39.11917°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*6 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86747°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

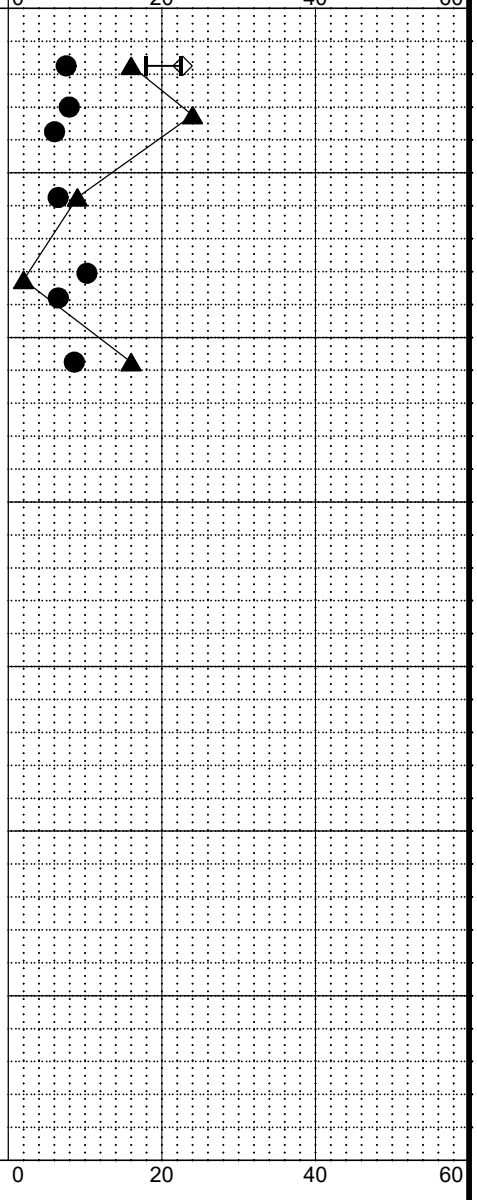
Depth, ft.	Soil Description
0.2	Aggregate Surfacing/Recycled Asphalt
0.4	Aggregate Surfacing
3.5	Medium dense, dark brown to brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. [A-2-4]
7.0	Loose to medium dense, brown to light gray, *Poorly Graded Sand (SP);* moist; trace silt and gravel. [A-1-b] - 1-inch seam of roots and organics at 5.5 feet.
8.6	Very loose, dark brown, *Poorly Graded Sand with Clay (SP-SC);* moist; trace to few organics.
11.5	Very loose to medium dense, *Poorly Graded Sand (SP);* moist. - Occasional clay nodules below 10 feet.
	BOTTOM OF BORING COMPLETED ON 05/05/2020

Symbol / Samples: S-1 B-1, S-2 G, S-3, S-4, S-5

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

Standard Penetration Test

Grab Sample

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-12

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	6 ft.	Latitude:	~ 39.12031°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86694°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

0.3 — Aggregate Surfacing

Loose to medium dense, brown to red-brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. [A-1-b]

3.7

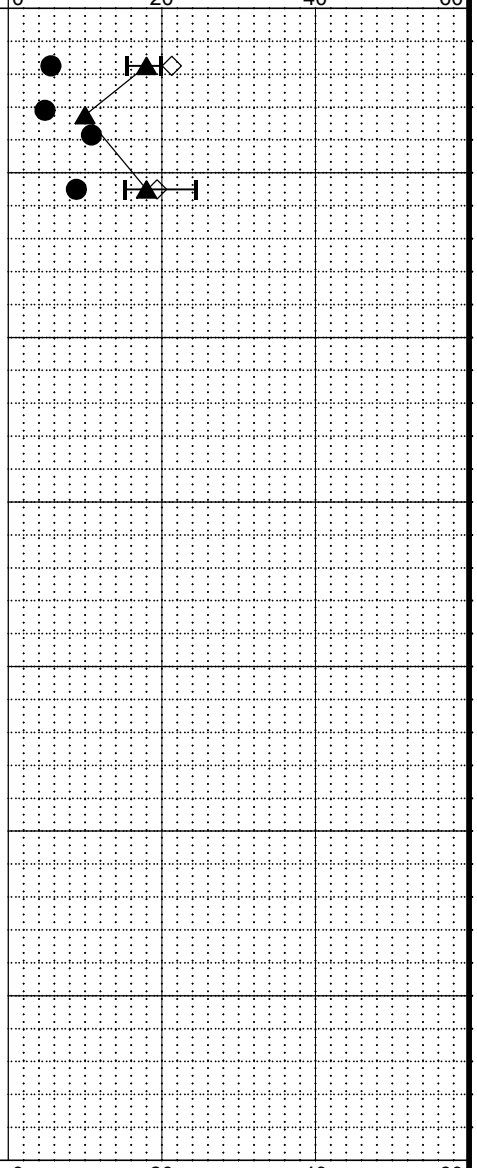
Loose to medium dense, dark brown to yellow-brown and red-brown, *Clayey Sand (SC);* moist; trace gravel. [A-2-4]
- Iron oxide staining below 4.5 feet.

6.0

BOTTOM OF BORING
COMPLETED ON 05/05/2020

S-1, S-2, S-3

Groundwater Not Encountered During Drilling.



LEGEND

* Sample Not Recovered
Standard Penetration Test
Modified California Sampler

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-13

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-14

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	5.9 ft.	Latitude:	~ 39.12271°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86778°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing — 0.3

Dense, brown to light gray, *Clayey Sand (SC);* moist; trace gravel. [A-2-7] Residuum [SANDSTONE: extremely weak, completely weathered (Dakota Sandstone).] — 4.5

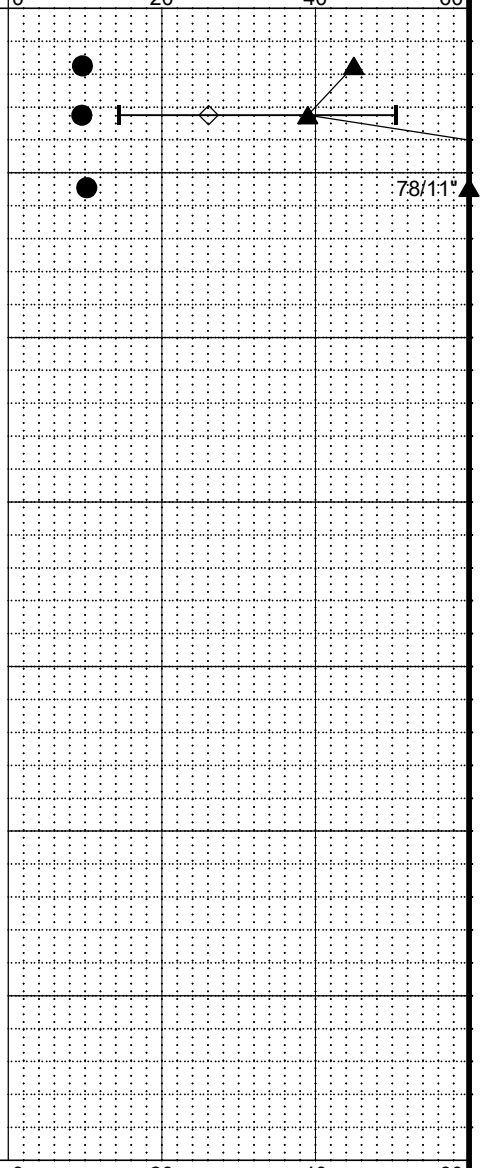
SANDSTONE: extremely weak to very weak, gray to brown; highly weathered; occasional iron oxide staining (Dakota Sandstone). [Very dense, *Clayey Sand (SC);* moist.] — 5.9

BOTTOM OF BORING
COMPLETED ON 05/04/2020

Depth, ft. | Symbol | Samples (S-1, S-2, S-3) | Ground Water Depth, ft. (Groundwater Not Encountered During Drilling.)

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-16

April 2022 | 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-15

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	6.5 ft.	Latitude:	~ 39.12327°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	6 in.
Top Elevation:	~	Longitude:	~ -104.8678°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches

Aggregate Surfacing

0.3

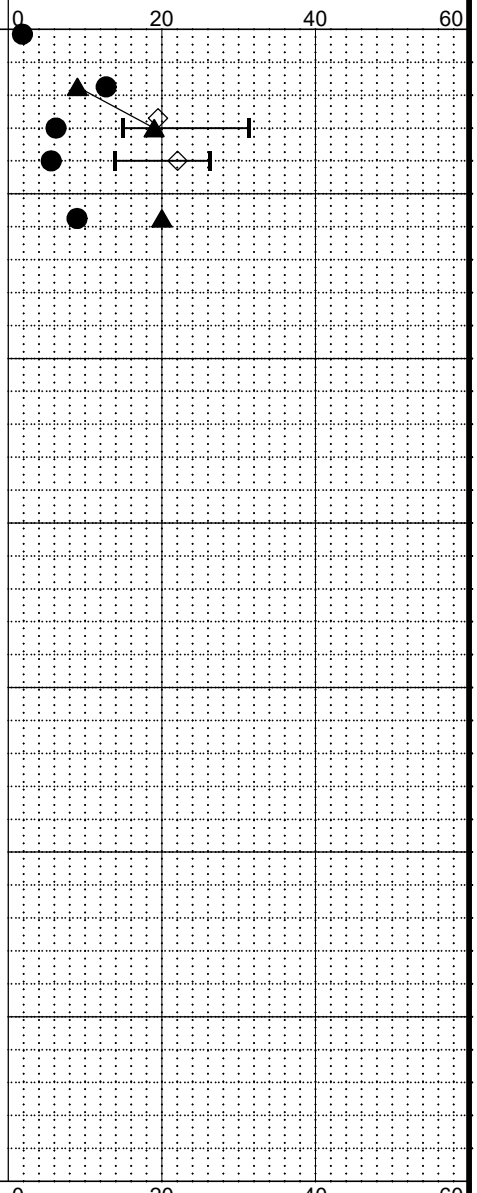
Loose to medium dense, dark brown to brown, *Clayey Sand (SC);* moist; few gravel. [A-2-6]

S-1 G, S-2, S-3, B-1, S-4

Groundwater Not Encountered During Drilling.

6.5

BOTTOM OF BORING
COMPLETED ON 05/04/2020



LEGEND

* Sample Not Recovered
Grab Sample
Standard Penetration Test
Modified California Sampler

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-17

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-16

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*11.5 ft.*	Latitude:	*~ 39.124°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86774°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing (0.3)

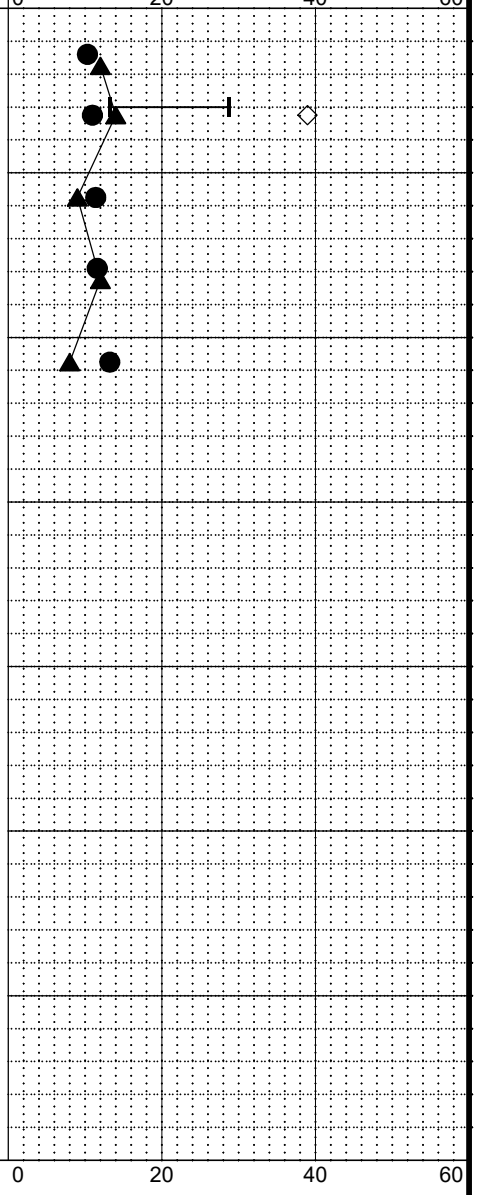
Loose to medium dense, brown, *Clayey Sand (SC);* moist. [A-2-6 to A-6]

BOTTOM OF BORING (11.5)
COMPLETED ON 05/04/2020

Depth, ft. | Symbol | Samples (S-1, S-2, S-3, S-4, S-5) | Ground Water Depth, ft. (Groundwater Not Encountered During Drilling.)

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-18

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-17

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	6.5 ft.	Latitude:	~ 39.1248°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	4 in.
Top Elevation:	~	Longitude:	~ -104.86783°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing

Medium dense to very dense, dark brown, *Silty Sand (SM);* moist; few gravel, occasional clay nodules. [A-1-b]

Loose, brown to dark brown, *Clayey Sand (SC);* moist; trace gravel. [A-2-6]

BOTTOM OF BORING
COMPLETED ON 05/04/2020

Depth, ft.: 0.2, 4.5, 6.5

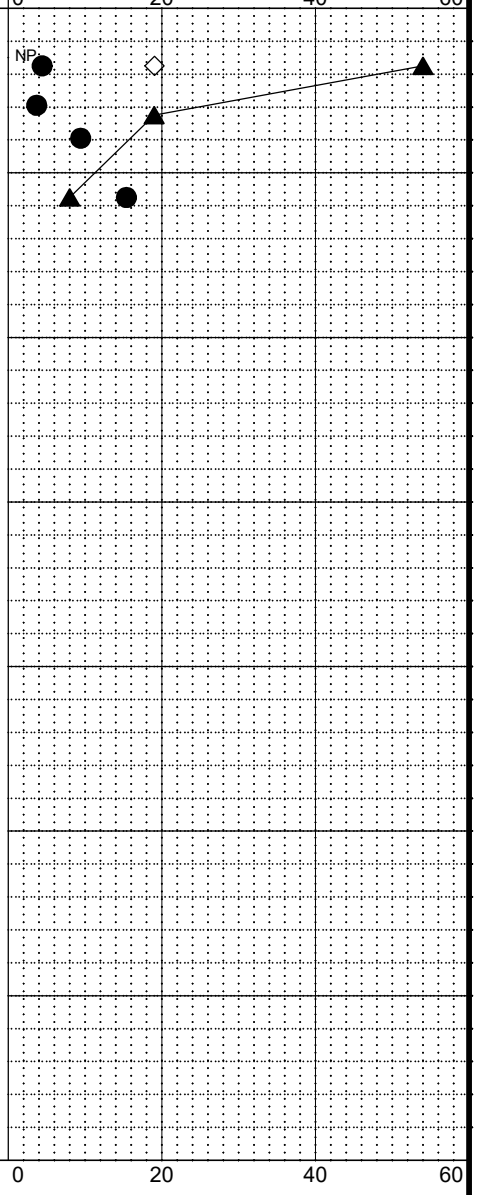
Symbol

Samples: S-1, S-2, S-3

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-19

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-18

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

REV 3

Total Depth:	*6.5 ft.*	Latitude:	*~ 39.12557°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*6 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86772°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft. | Symbol | Samples | Ground Water Depth, ft.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*

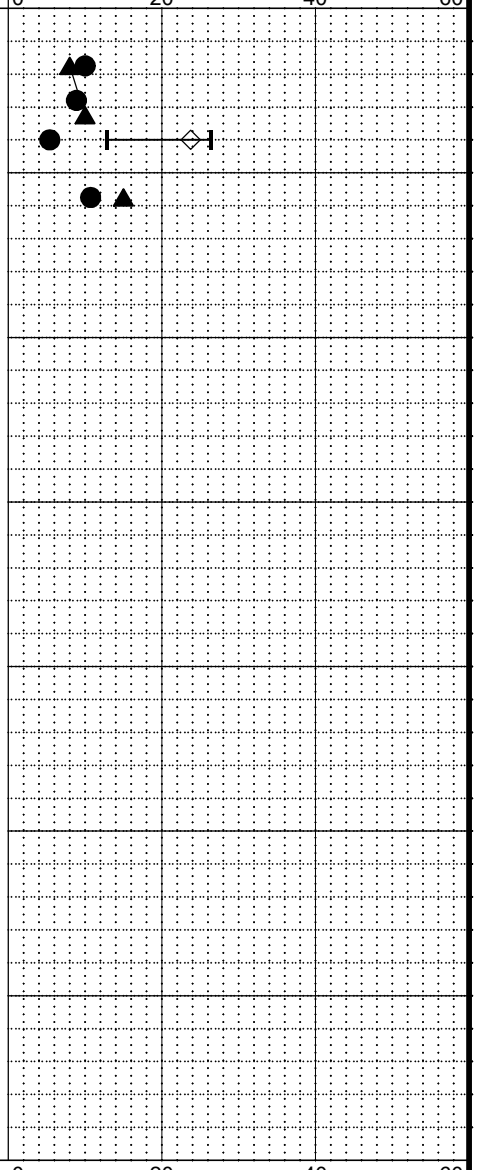
0.3 — Aggregate Surfacing

Loose to medium dense, brown to light brown, *Clayey Sand (SC);* moist; few gravel. [A-2-6]
- 1-inch gravel layer at 2.9 feet.

6.5 — BOTTOM OF BORING
COMPLETED ON 05/04/2020

Samples: S-1, B-1S-2, S-3

Groundwater Not Encountered During Drilling.



LEGEND

* Sample Not Recovered
Standard Penetration Test
Grab Sample

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-20

April 2022 | 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-19

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*11.5 ft.*	Latitude:	*~ 39.12628°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.8677°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

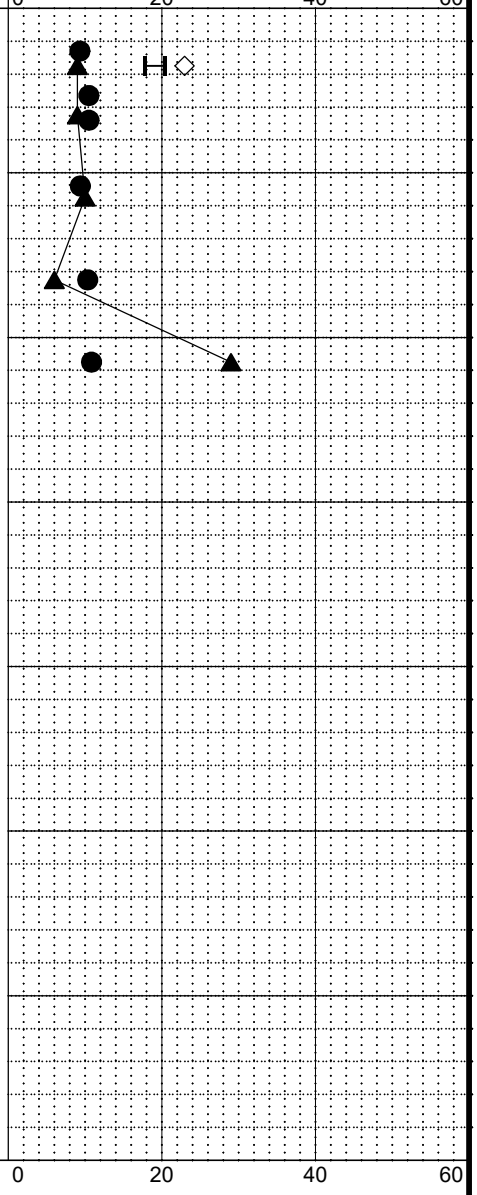
Depth, ft.	Soil Description
0.2	Aggregate Surfacing
2.4	Loose, dark brown, *Silty Sand (SM);* moist; trace gravel. [A-2-4]
2.8	-5-inch thick loose, clayey sand seam at 2.4 feet
4.5	Loose, brown to light brown, *Poorly Graded Sand with Clay (SP-SC)* to *Clayey Sand (SC);* moist; trace gravel. [A-2-6]
11.4	Loose to medium dense, brown to red-brown, *Poorly Graded Sand with Silt (SP-SM);* moist; trace gravel, occasional clay nodules and layers.
11.5	Medium dense, red-brown, *Poorly Graded Sand with Silt (SP-SM);* moist. Residiuum [SANDSTONE: extremetely weak; completely weathered (Dawson Formation).]
	BOTTOM OF BORING COMPLETED ON 05/04/2020

Symbol: S-1, S-2, S-3, S-4, S-5

Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-21

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-20

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*6.5 ft.*	Latitude:	*~ 39.12725°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.86772°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing

Medium dense to dense, brown, *Silty, Clayey Sand (SC-SM);* moist; trace gravel. [A-1-b]

Loose to medium dense, dark brown, *Silty Sand (SM);* moist to wet. [A-2-4]

Loose, brown, *Clayey Sand (SC);* moist; trace gravel.

BOTTOM OF BORING
COMPLETED ON 05/04/2020

Depth, ft.: 0.3, 3.0, 6.2, 6.5

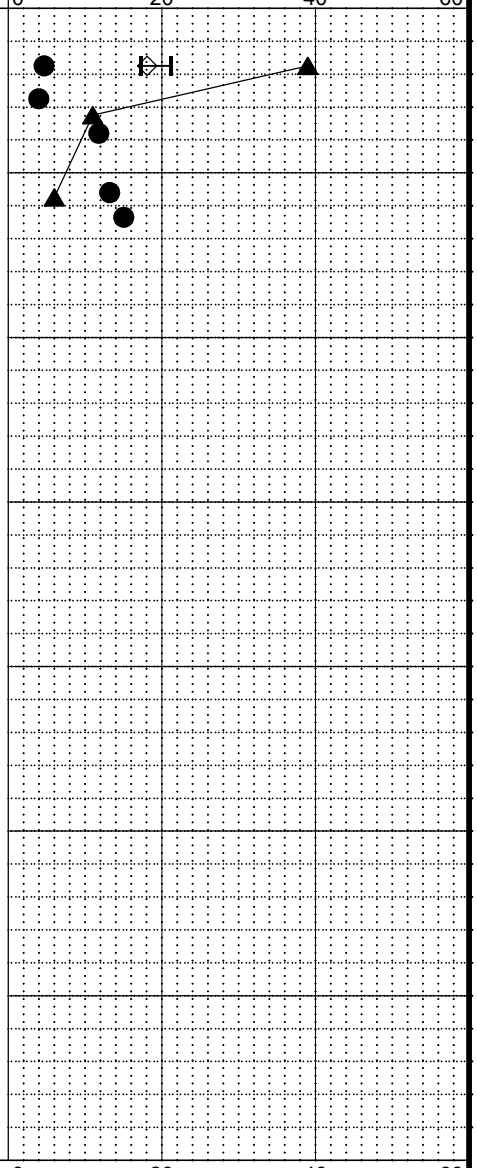
Symbol

Samples: S-1, S-2, S-3

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-22

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-21

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	*6.5 ft.*	Latitude:	*~ 39.12804°*	Drilling Method:	*Solid-Stem Auger*	Hole Diam.:	*4 in.*
Top Elevation:	*~*	Longitude:	*~ -104.8677°*	Drilling Company:	*Vine Laboratories*	Rod Type.:	*AWJ*
Vert. Datum:		Station:	*~*	Drill Rig Equipment:	*CME 55 Truck*	Hammer Type:	*Automatic*
Horiz. Datum:		Offset:	*~*	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Aggregate Surfacing/Recycled Asphalt

Medium dense, brown to red-brown, *Clayey Sand (SC);* moist; trace to few gravel. [A-2-6]

- Coarser sand below 5 feet.

BOTTOM OF BORING
COMPLETED ON 05/04/2020

Depth, ft.: 0.3; 6.5

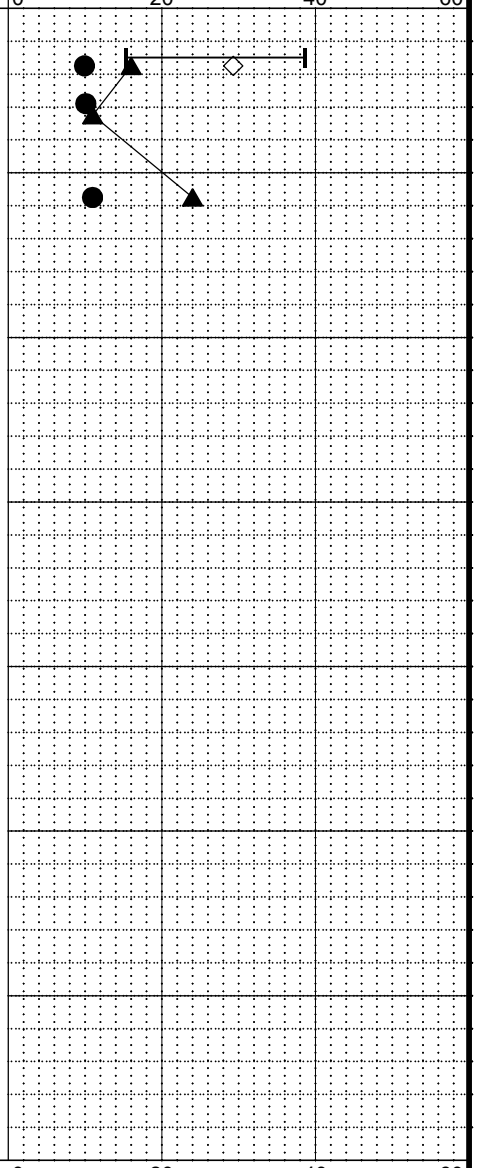
Symbol

Samples: S-1, S-2, S-3

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. USCS designation is based on visual-manual classification and selected lab testing.
5. The boring location was determined using a recreational grade GPS unit.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-23

April 2022 104129-001

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Geotechnical and Environmental Consultants

FIG. A-22

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

Total Depth:	25.5 ft.	Latitude:	~ 39.12932°	Drilling Method:	Solid-Stem Auger	Hole Diam.:	6 in.
Top Elevation:	~	Longitude:	~ -104.8677°	Drilling Company:	Vine Laboratories	Rod Type.:	AWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 55 Truck	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Depth, ft.	Soil Description
0.5	6 inches of Aggregate Surfacing/Recycled Asphalt
	Loose to medium dense, dark brown to red-brown, *Clayey Sand (SC);* moist; trace gravel. [A-6]
4.5	Medium dense, dark brown, *Clayey Sand (SC);* moist. [A-6]
6.8	Dense, red-brown, *Clayey Sand (SC);* moist. [A-6]
8.5	SANDSTONE: extremely weak, yellow-brown to red-brown; highly to slightly weathered; iron oxide staining. [Medium dense to very dense, *Clayey Sand (SC)* to *Silty Sand (SM);* moist.]
	- Completely weathered from 15 to 17 feet.
25.5	BOTTOM OF BORING COMPLETED ON 07/16/2020

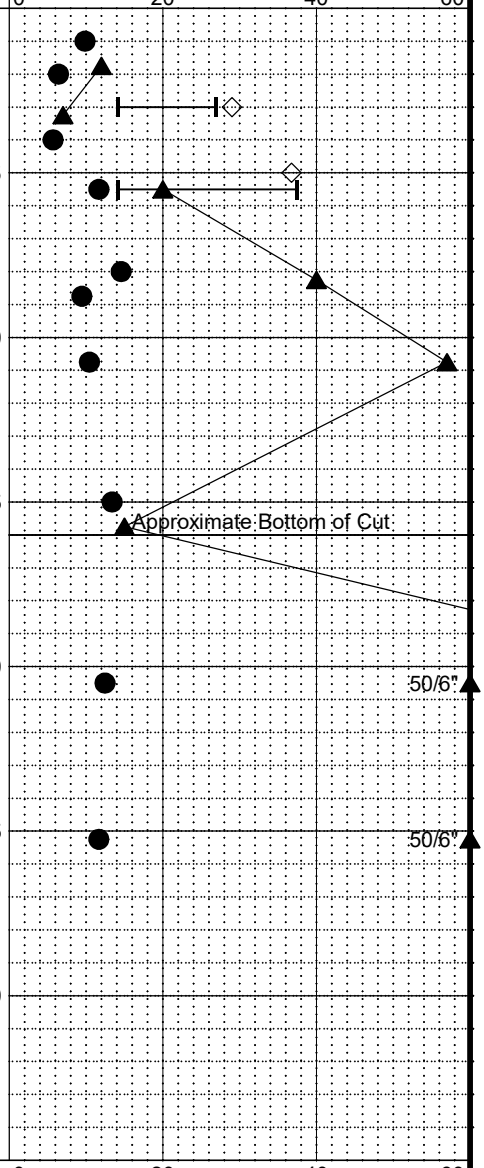
Symbol

Samples: S-2 B-1S-1, S-3, S-4, S-5, S-6, S-7, S-8

Ground Water Depth, ft.: Groundwater Not Encountered During Drilling.

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Grab Sample

Modified California Sampler

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ⊢●⊣ Liquid Limit

Natural Water Content

NOTES

1. Boring log revised from our September 10, 2021 geotechnical report.
2. Refer to Figures A-1 and A-2 for explanation of symbols, codes, abbreviations and definitions.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

Beacon Lite Road Improvements
El Paso County, Colorado

LOG OF BORING SW-24

April 2022 104129-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-23

REV 3

MASTER LOG E POCKETPEN LAT&LONG 104129-001 BEACON LITE RD IMPROVEMENTS.GPJ 4/13/22

APPENDIX B: LABORATORY TEST RESULTS

Appendix B

Laboratory Test Results

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Tables

Figures

APPENDIX B: LABORATORY TEST RESULTS

B.1 INTRODUCTION

Laboratory tests were completed on soil and bedrock samples retrieved from the borings in general accordance with American Association of State Highway Transportation Officials (AASHTO), American Society for Testing and Materials (ASTM) International, and Colorado Department of Transportation (CDOT) methods. The laboratory testing program was performed to classify the materials into similar geologic groups and provide data that can be used for design of the project. The geotechnical laboratory testing was performed at our in-house laboratory in Denver, Colorado as well as Vine Laboratories, Inc. of Commerce City, Colorado (under subcontract to Shannon & Wilson). Testing consisted of index tests and geotechnical engineering property tests. A summary of the laboratory test results is presented in Table B-1. The following sections describe the laboratory testing procedures.

B.2 GEOTECHNICAL INDEX TESTS

B.2.1 Water Content

Water content was determined for selected samples in general accordance with AASHTO T265, Laboratory Determination of Moisture Content in Soils. To perform this test, a sample was weighed before and after oven-drying, and the water content was calculated. Water content determinations are shown graphically on the boring logs and are also summarized in Table B-1. A water content test was generally taken on each sample, except for sands and gravels below the groundwater table where free water was observed in the sample jar.

B.2.2 Grain Size Analysis

The grain size distribution of selected samples was determined in general accordance with AASHTO T311, Standard Method of Test for Grain-Size Analysis of Granular Soil Materials. Results of these analyses are presented as grain size distribution curves by boring number series on Figure B-1 and summarized in Table B-1.

Selected samples were tested for the percentage of material passing the No. 200 sieve in general accordance with ASTM D1140, Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing. The percent fines (silt- and clay-sized particles passing the No. 200 sieve) are shown graphically on the boring logs in Appendix A and are also summarized in Table B-1.

B.2.3 Atterberg Limits

Soil plasticity was determined by performing Atterberg limits tests on selected fine-grained samples. The tests were completed in general accordance with AASHTO T89, Standard Test Method for Determining the Liquid Limit of Soils and AASHTO T90, Standard Test Method for Determining the Plastic Limit and Plasticity Index of Soils. The Atterberg limits include liquid limit (LL), plastic limit (PL), and plasticity index (PI equals LL minus PL) and are generally used to assist in classification of soils, to indicate soil consistency (when compared to natural water content), and to provide correlation to soil properties. The results of the Atterberg limits tests are plotted on a plasticity chart on Figure B-2, shown graphically on the boring logs in Appendix A, and summarized in Table B-1.

B.3 GEOTECHNICAL ENGINEERING PROPERTY TESTS

B.3.1 One-Dimensional Swell/Collapse Tests

One-dimensional swell/collapse tests were performed in general accordance with Method B of ASTM D 4546, Standard Test Methods for One-Dimensional Swell or Collapse of Soils. Relatively undisturbed drive samples were obtained modified California sampler lined with a thin-walled bass tube. The sample was then loaded at field moisture conditions in a fixed-ring consolidometer that measures vertical changes in volume for different loading conditions. During loading, the sample's pore pressures are allowed to drain from both the top and bottom of the sample. At a specified pressure, the sample is inundated with distilled water and then allowed to reach equilibrium. The vertical volume change caused from the water inundation was then measured and expressed in percent strain. The swell/collapse test reports are provided as Figures B-3 through B-6.

B.3.2 Corrosion

Corrosion testing was performed on select on soil samples for pH, resistivity, sulfate content, and chloride content. Testing for pH and resistivity were completed in general accordance with AASHTO T289, Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing and AASHTO T288, Standard Method of Test for Determining Minimum Laboratory Soil Resistivity, respectively. Sulfate content testing was completed in general accordance with CDOT laboratory procedure CP-L 2103, Sulfate Ion Content in Soil. Chloride content testing was completed in general accordance with AASHTO T291, Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil. Test results for sulfate and chloride content are given in units of percent by weight. The test results are summarized in Table B-1.

B.3.3 R-value

Hveem Staboilometer (R-value) test was completed by Vine Laboratories, Inc., of Commerce City, Colorado on a bulk subgrade sample. The test was completed in general accordance with AASHTO T190, Standard Method of Test for Resistance R-Value and Expansion Pressure of Compacted Soils. The R-value test results are summarized in Table B-1 and presented on Figures B-7 and B-8.

Table B-1 - Summary of Laboratory Test Results

SAMPLE DATA								GRAIN-SIZE ANALYSES[2]			ATTERBERG LIMITS			SWELL/COLLAPSE		CORROSIVITY				
		Depth (feet)		USCS	AASHTO	Natural Moisture	Moist Unit							Swell (+)	Inundation					
Boring	Sample	Top	Bottom	Symbol[1]	Soil Classification	Content (%)	Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	Collapse (-) (%)	Pressure (psf)	pH	Resistivity (ohm-cm)	Sulfate Content (%)	Chloride Content (%)	R-Value
SW-01	S-1	2.5	4.0			8.6														
	S-2	5.0	6.5	SC-SM	A-2-4 (0)	3.1		3	76	21	24	17	7							
	S-3	7.5	9.0			3.4														
	S-4	10.0	11.5			7.1														
SW-02	S-1	2.5	4.0			4.5														
	S-2	5.0	6.5	SC	A-2-7 (1)	6.3		3	76	21	41	20	21							
	S-3	10.0	10.4			6.5														
	S-4	15.0	15.4			9.0										8.2	6,650	< 0.01	0.03	
	S-5	20.0	20.3			9.4														
	S-6	25.0	25.3			9.0														
	S-7	30.0	30.8			10.9														
	S-8	35.0	35.9			11.3														
	S-9	40.0	40.4			9.0														
	S-10	45.0	45.3			7.9														
SW-03	S-1	2.5	4.0			2.6														
	S-2	5.0	6.5			5.5														
	S-3	10.0	11.5			5.9		4	76	20										
	S-4	15.0	15.8			8.9														
	S-5	20.0	20.5			6.9		2	64	34										
	S-6A	25.0	25.4			8.4														
	S-6C	25.4	25.9	CH	A-7-6 (29)	15.9				76	59	22	37							
	S-7	30.0	30.3			10.4														
	S-8	35.0	35.6			11.0														

Table B-1 - Summary of Laboratory Test Results

SAMPLE DATA								GRAIN-SIZE ANALYSES[2]			ATTERBERG LIMITS			SWELL/COLLAPSE		CORROSIVITY				
		Depth (feet)		USCS	AASHTO	Natural Moisture	Moist Unit							Swell (+)	Inundation			Sulfate	Chloride	
Boring	Sample	Top	Bottom	Symbol[1]	Soil Classification	Content (%)	Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	Collapse (-) (%)	Pressure (psf)	pH	Resistivity (ohm-cm)	Content (%)	Content (%)	R-Value
SW-04	S-1	2.5	4.0			4.3														
	S-2	4.0	5.5			4.7														
	S-3	9.0	10.5			3.8		2	76	22										
	S-4	14.0	14.5			6.4														
	S-5	19.0	19.4			6.3		0.3	59	41										
	S-6	24.0	24.3			5.7														
	S-7	29.0	29.2			9.6														
	S-8	34.0	34.5			9.9														
	S-9	39.0	39.5			9.5														
SW-05	S-1	2.5	4.0			6.3														
	S-2	4.0	5.5			13.7		1	48	51										
	S-3	9.0	10.5			7.8														
	S-4	14.0	14.5			11.3														
	S-5	19.0	19.4			17.9														
	S-6	24.0	24.3	CH	A-7-6 (33)	19.9				92	55	22	33							
	S-7	29.0	29.2			11.5														
	S-8	34.0	34.5			9.7														
	S-9	39.0	39.5			13.6														
SW-06	S-1	2.5	4.0			8.6														
	S-2	4.0	4.9			7.7														
	S-3	9.0	9.5			7.8														
	S-4	14.0	14.4	SC	A-2-7 (1)	8.2		3	74	23	42	18	24							
	S-5	19.0	19.4			8.6														
	S-6	24.0	24.4			10.4														
	S-7	29.0	29.4			8.8														
	S-8	34.0	34.3			11.0														
SW-08	B-1	1.0	5.0	SC-SM	A-1-b (0)	5.2		4	75	22	20	16	4							
	S-1	1.0	2.5			5.9														
	S-2	2.5	4.0			6.7														
	S-3	5.0	6.5			7.5														

Table B-1 - Summary of Laboratory Test Results

SAMPLE DATA								GRAIN-SIZE ANALYSES[2]			ATTERBERG LIMITS			SWELL/COLLAPSE		CORROSIVITY				
		Depth (feet)		USCS	AASHTO	Natural Moisture	Moist Unit							Swell (+)	Inundation			Sulfate	Chloride	
Boring	Sample	Top	Bottom	Symbol[1]	Soil Classification	Content (%)	Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	Collapse (-) (%)	Pressure (psf)	pH	Resistivity (ohm-cm)	Content (%)	Content (%)	R-Value
SW-09	S-1	1.0	2.5			5.4														
	S-2	2.5	4.0			8.9														
	S-3	5.0	6.0	SC	A-2-6 (1)	9.8	114.7			26	32	15	17	-0.2	150					
	S-4	7.5	9.0			12.0														
	S-5	10.0	11.5			7.9														
SW-10	S-1	1.0	2.5	SM	A-1-b (0)	5.8		5	74	21	19	18	1							
	S-2	2.5	4.0			4.5														
	S-3	5.0	6.5			7.1														
SW-11	S-1	1.0	2.5	SC-SM	A-2-4 (0)	7.8		3	70	28	22	18	4							
	S-2	2.5	4.0			6.1														
	S-3	5.0	6.5			10.3														
SW-12	S-1	1.0	2.5	SC-SM	A-2-4 (0)	7.5		0.5	77	23	22	18	4							
	S-2A	2.5	3.5			7.9														
	S-2B	3.5	4.0			6.0														
	S-3	5.0	6.5			6.5														
	S-4A	7.5	8.6			10.2														
	S-4B	8.6	9.0			6.5														
	S-5	10.0	11.5			8.6														
SW-13	S-1	1.0	2.5	SC-SM	A-1-b (0)	5.6		3	76	21	20	15	5							
	S-2A	2.5	3.7			4.8														
	S-2B	3.7	4.0			10.8														
	S-3	5.0	6.0	SC	A-2-4 (0)	8.9	124.2			19	24	15	9	0	150					
SW-16	S-1	1.0	2.5			9.7														
	S-2	2.5	4.0	SC	A-2-7 (3)	9.6		2	72	26	50	14	36							
	S-3	5.0	5.9			10.2														
SW-17	B-1	1.0	5.0	SC	A-2-6 (0)	5.6		13	65	22	26	14	12			7.4	1,100	0.01	0.109	30.1
	S-1	0.0	0.3			1.8														
	S-2	1.0	2.5			12.7														
	S-3	2.5	3.5	SC	A-2-6 (0)	6.2	118.0			20	31	15	16	0	150					
	S-4	5.0	6.5			8.9														

Table B-1 - Summary of Laboratory Test Results

SAMPLE DATA								GRAIN-SIZE ANALYSES[2]			ATTERBERG LIMITS			SWELL/COLLAPSE		CORROSIVITY				
		Depth (feet)		USCS	AASHTO	Natural Moisture	Moist Unit							Swell (+)	Inundation			Sulfate	Chloride	
Boring	Sample	Top	Bottom	Symbol[1]	Soil Classification	Content (%)	Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	Collapse (-) (%)	Pressure (psf)	pH	Resistivity (ohm-cm)	Content (%)	Content (%)	R-Value
SW-18	S-1	1.0	2.5			10.3														
	S-2	2.5	4.0	SC	A-6 (2)	11.0		0	61	39	29	13	16							
	S-3	5.0	6.5			11.4														
	S-4	7.5	9.0			11.6														
	S-5	10.0	11.5			13.2														
SW-19	S-1	1.0	2.5	SM	A-1-b (0)	4.4		12	69	19	NV	NP	NP							
	S-2A	2.5	3.4			3.7														
	S-2B	3.4	4.5			9.4														
	S-3	5.0	6.5			15.4														
SW-20	B-1	1.0	5.0	SC	A-2-6 (0)	5.4		5	71	24	26	13	13							
	S-1	1.0	2.5			10.0														
	S-2	2.5	4.0			8.9														
	S-3	5.0	6.5			10.7														
SW-21	S-1	1.0	2.5	SM	A-2-4 (0)	9.3		1	76	23	20	18	2							
	S-2A	2.5	2.8			10.5														
	S-2B	2.8	4.0			10.5														
	S-3	5.0	6.5			9.4														
	S-4	7.5	9.0			10.3														
	S-5	10.0	11.5			10.8														
SW-22	S-1	1.0	2.5	SC-SM	A-1-b (0)	4.7		5	77	18	21	17	4							
	S-2A	2.5	3.0			4.0														
	S-2B	3.0	4.0			11.8														
	S-3A	5.0	6.2			13.2														
	S-3B	6.2	6.5			15.0														
SW-23	S-1	1.0	2.5	SC	A-2-6 (2)	9.9				29	39	15	24							
	S-2	2.5	4.0			10.1														
	S-3	5.0	6.5			11.0														

Table B-1 - Summary of Laboratory Test Results

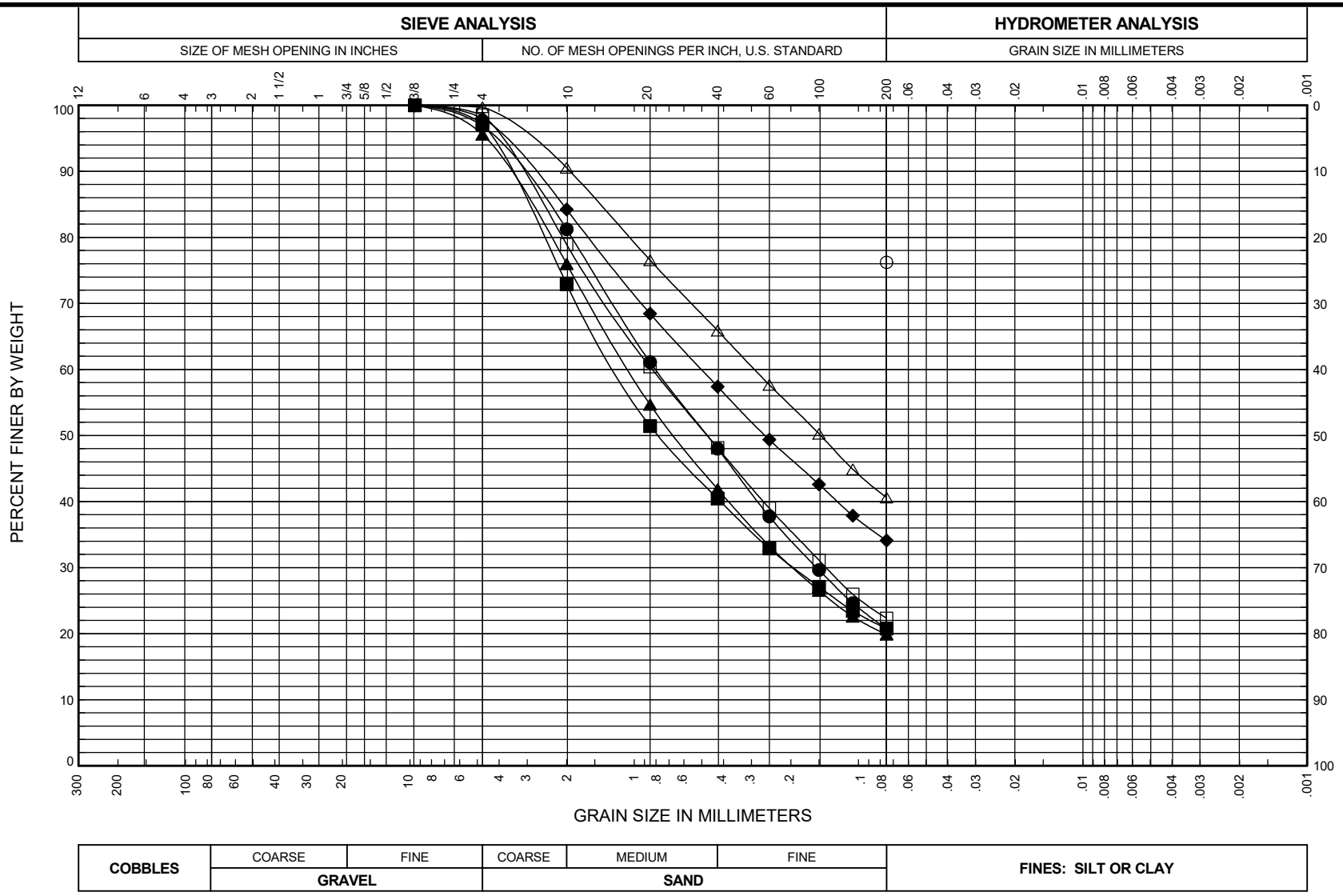
SAMPLE DATA								GRAIN-SIZE ANALYSES[2]			ATTERBERG LIMITS			SWELL/COLLAPSE		CORROSIVITY				
		Depth (feet)		USCS Symbol[1]	AASHTO Soil Classification	Natural Moisture Content (%)	Moist Unit Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	Swell (+) Collapse (-) (%)	Inundation Pressure (psf)	pH	Resistivity (ohm-cm)	Sulfate Content (%)	Chloride Content (%)	R-Value
Boring	Sample	Top	Bottom																	
SW-24	B-1	1.0	5.0	SC	A-2-6 (0)	6.4		5	66	29	27	14	13			8.5	485	< 0.01	0.118	24.8
	S-1	1.0	2.5			9.9														
	S-2	2.5	4.0			5.7														
	S-3	5.0	6.0	SC	A-6 (3)	11.7	119.3			37	37	14	23	0	150					
	S-4A	7.5	8.5			14.6														
	S-4B	8.5	9.0			9.5														
	S-5	10.0	11.5			10.4														
	S-6	15.0	16.5			13.4														
	S-7	20.0	21.0			12.5														
	S-8	25.0	25.5			11.7														

NOTES:

1 Refer to Appendix A, Figure A-1 for definitions.

2 Gravel defined as particles larger than the No. 4 sieve size, Sand as particles between the No. 4 and No. 200 sieve sizes, and Fines as particles passing the No. 200 sieve.

LL = Liquid Limit; ohm-cm = ohm centimeters; pcf = pounds per cubic foot; PI = Plasticity Index; PL = Plastic Limit; psf = pounds per square foot; USCS = Unified Soil Classification System



SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● SW-01, S-2	5.0	SC-SM	Silty, Clayey Sand; trace gravel	20.8	3.1	24	17	7
■ SW-02, S-2	5.0	SC	SANDSTONE [Clayey Sand; trace gravel]	20.8	6.3	41	20	21
▲ SW-03, S-3	10.0	SC	SANDSTONE [Clayey Sand; trace gravel]	19.9	5.9			
◆ SW-03, S-5	20.0	SC	SANDSTONE [Clayey Sand; trace gravel]	34.1	6.9			
○ SW-03, S-6C	25.4	CH	CLAYSTONE [Fat Clay with Sand]	76.2	15.9	59	22	37
□ SW-04, S-3	9.0	SC	SANDSTONE [Clayey Sand; trace gravel]	22.3	3.8			
△ SW-04, S-5	19.0	SC	SANDSTONE [Clayey Sand; trace gravel]	40.6	6.3			

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El Paso County, Colorado

GRAIN SIZE DISTRIBUTION

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FIG. B-1
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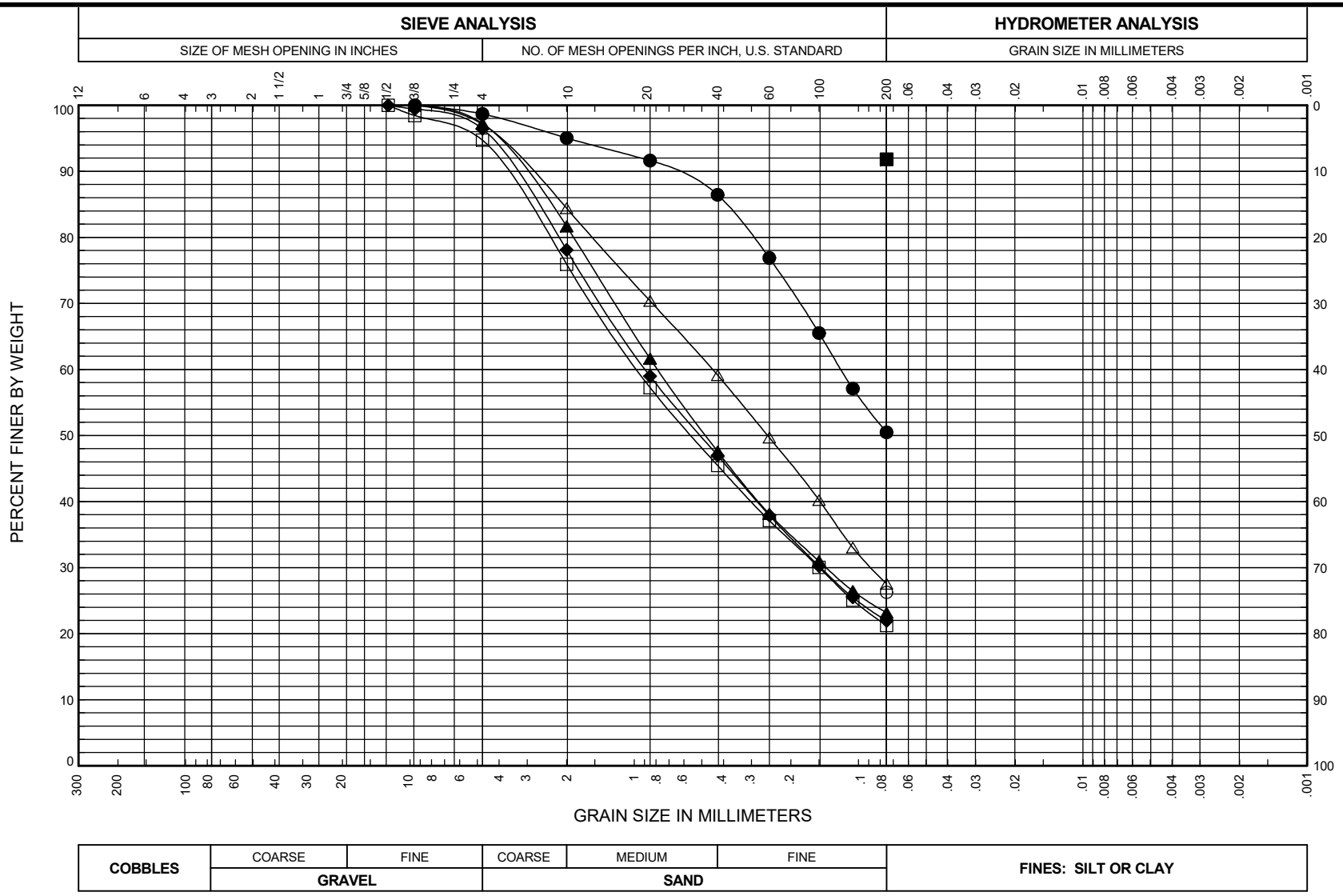

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● SW-05, S-2	4.0	CL	CLAYSTONE [Sandy Lean Clay; trace gravel]	50.5	13.7			
■ SW-05, S-6	24.0	CH	CLAYSTONE [Fat Clay; few sand]	91.8	19.9	55	22	33
▲ SW-06, S-4	14.0	SC	SANDSTONE [Clayey Sand; trace gravel]	23.2	8.2	42	18	24
◆ SW-08, B-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	21.9	5.2	20	16	4
○ SW-09, S-3	5.0	SC	Clayey Sand; trace gravel	26.3	9.8	32	15	17
□ SW-10, S-1	1.0	SM	Silty Sand, trace gravel	21.2	5.8	19	18	1
△ SW-11, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	27.5	7.8	22	18	4

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FIG. B-1
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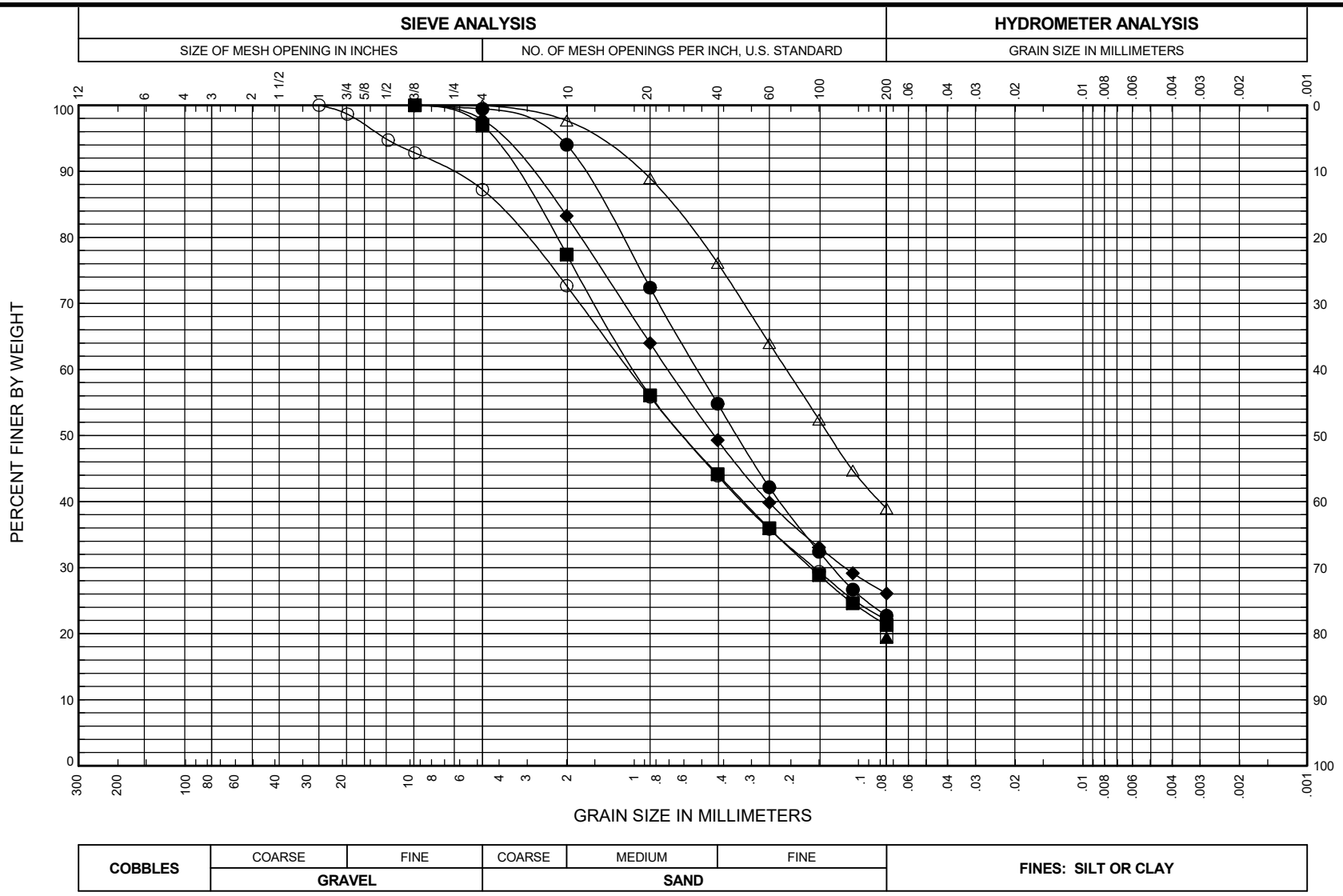

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● SW-12, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	22.7	7.5	22	18	4
■ SW-13, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	21.3	5.6	20	15	5
▲ SW-13, S-3	5.0	SC	Clayey Sand	19.4	8.9	24	15	9
◆ SW-16, S-2	2.5	SC	Clayey Sand, trace gravel	26.1	9.6	50	14	36
○ SW-17, B-1	1.0	SC	Clayey Sand, few gravel	22.1	5.6	26	14	12
□ SW-17, S-3	2.5	SC	Clayey Sand; trace gravel	19.5	6.2	31	15	16
△ SW-18, S-2	2.5	SC	Clayey Sand	38.9	11.0	29	13	16

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FIG. B-1
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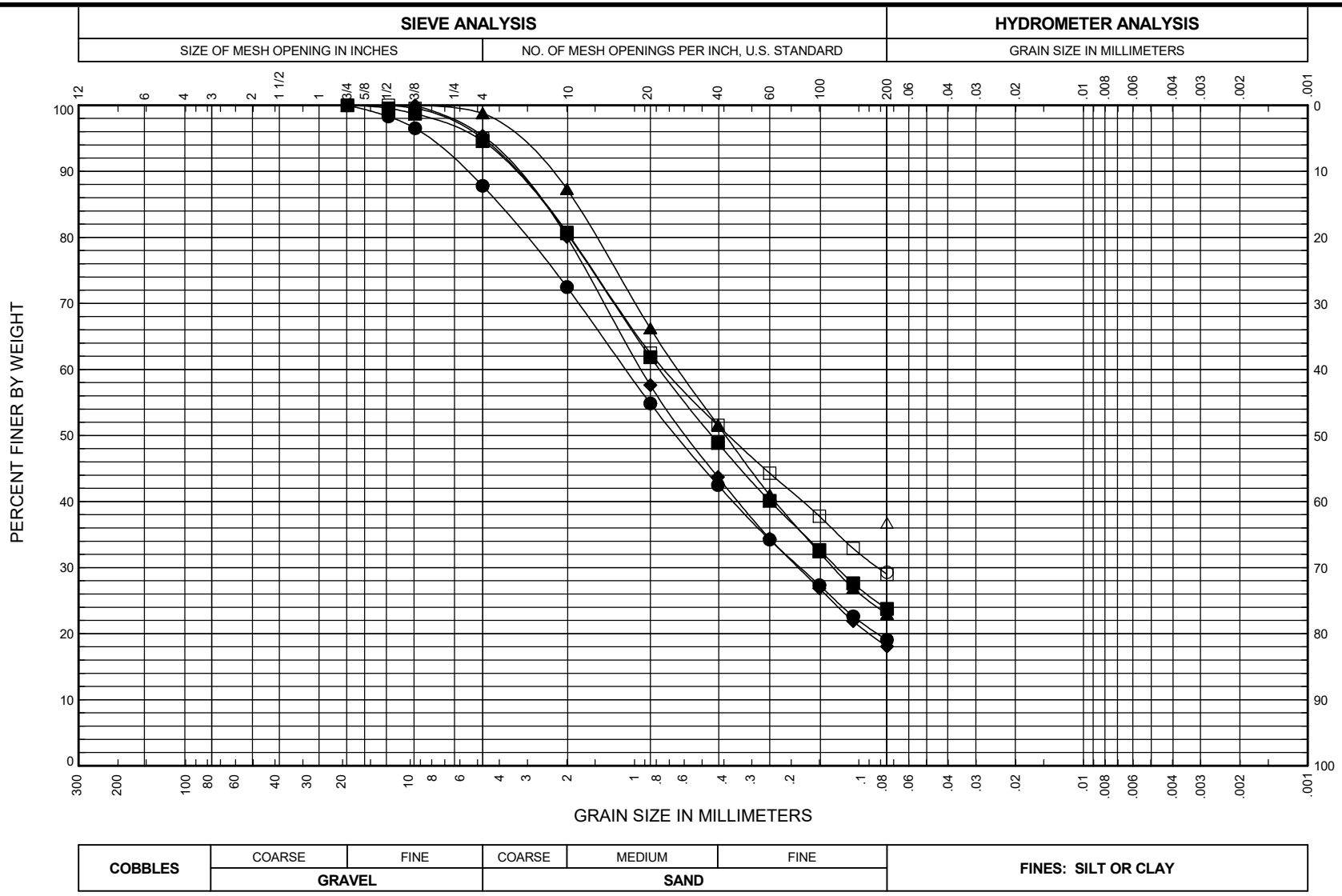

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● SW-19, S-1	1.0	SM	Silty Sand; few gravel	19.1	4.4	NV	NP	NP
■ SW-20, B-1	1.0	SC	Clayey Sand, few gravel	23.7	5.4	26	13	13
▲ SW-21, S-1	1.0	SM	Silty Sand, trace gravel	23.0	9.3	20	18	2
◆ SW-22, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	18.1	4.7	21	17	4
○ SW-23, S-1	1.0	SC	Clayey Sand; few gravel	29.3	9.9	39	15	24
□ SW-24, B-1	1.0	SC	Clayey Sand, trace gravel	29.0	6.4	27	14	13
△ SW-24, S-3	5.0	SC	Clayey Sand	36.8	11.7	37	14	23

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FIG. B-1
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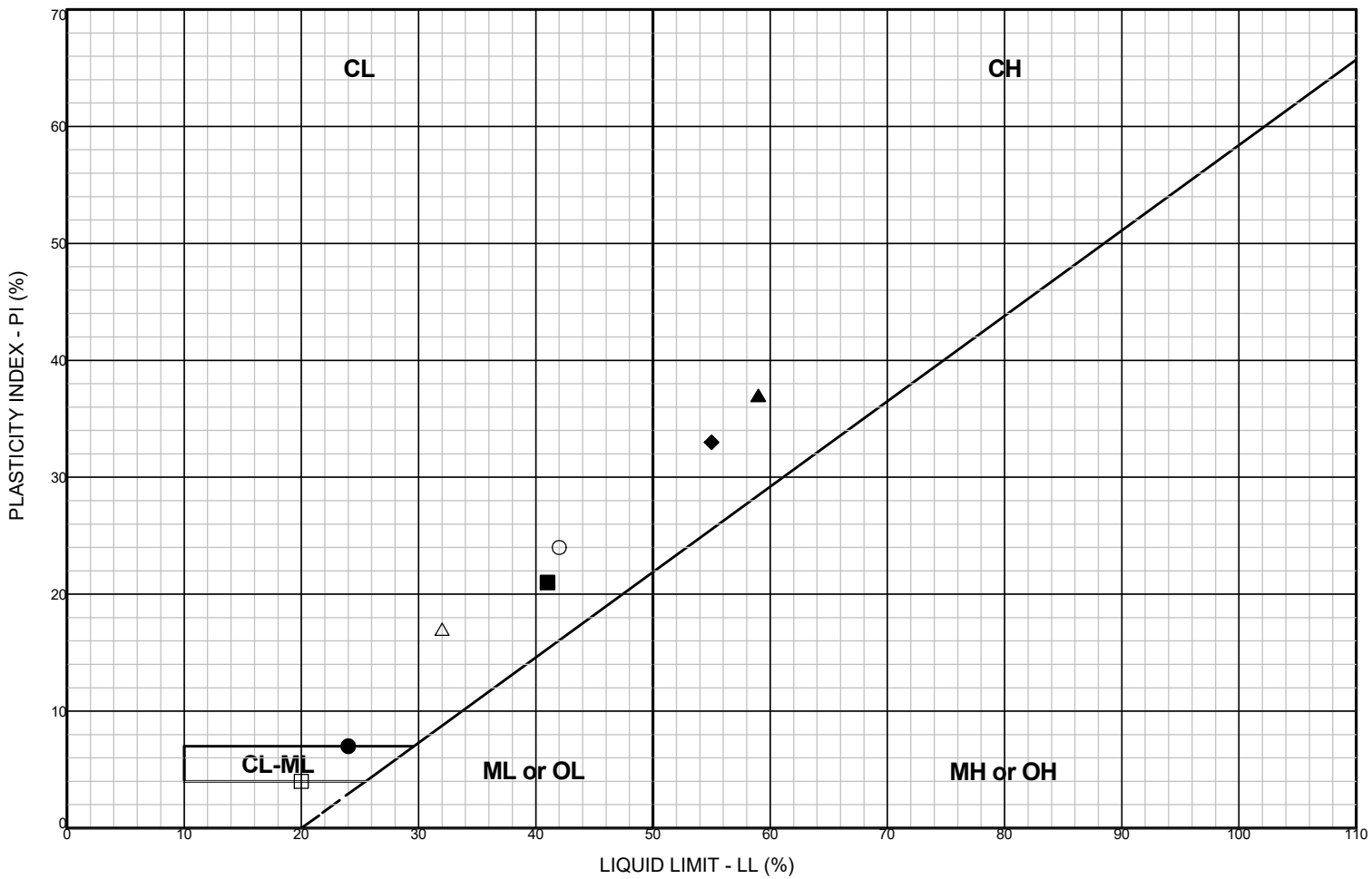

LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● SW-01, S-2	5.0	SC-SM	Silty, Clayey Sand; trace gravel	24	17	7	3.1	20.8
■ SW-02, S-2	5.0	SC	SANDSTONE [Clayey Sand; trace gravel]	41	20	21	6.3	20.8
▲ SW-03, S-6C	25.4	CH	CLAYSTONE [Fat Clay with Sand]	59	22	37	15.9	76.2
◆ SW-05, S-6	24.0	CH	CLAYSTONE [Fat Clay; few sand]	55	22	33	19.9	91.8
○ SW-06, S-4	14.0	SC	SANDSTONE [Clayey Sand; trace gravel]	42	18	24	8.2	23.2
□ SW-08, B-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	20	16	4	5.2	21.9
△ SW-09, S-3	5.0	SC	Clayey Sand; trace gravel	32	15	17	9.8	26.3

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PLASTICITY CHART

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FIG. B-2
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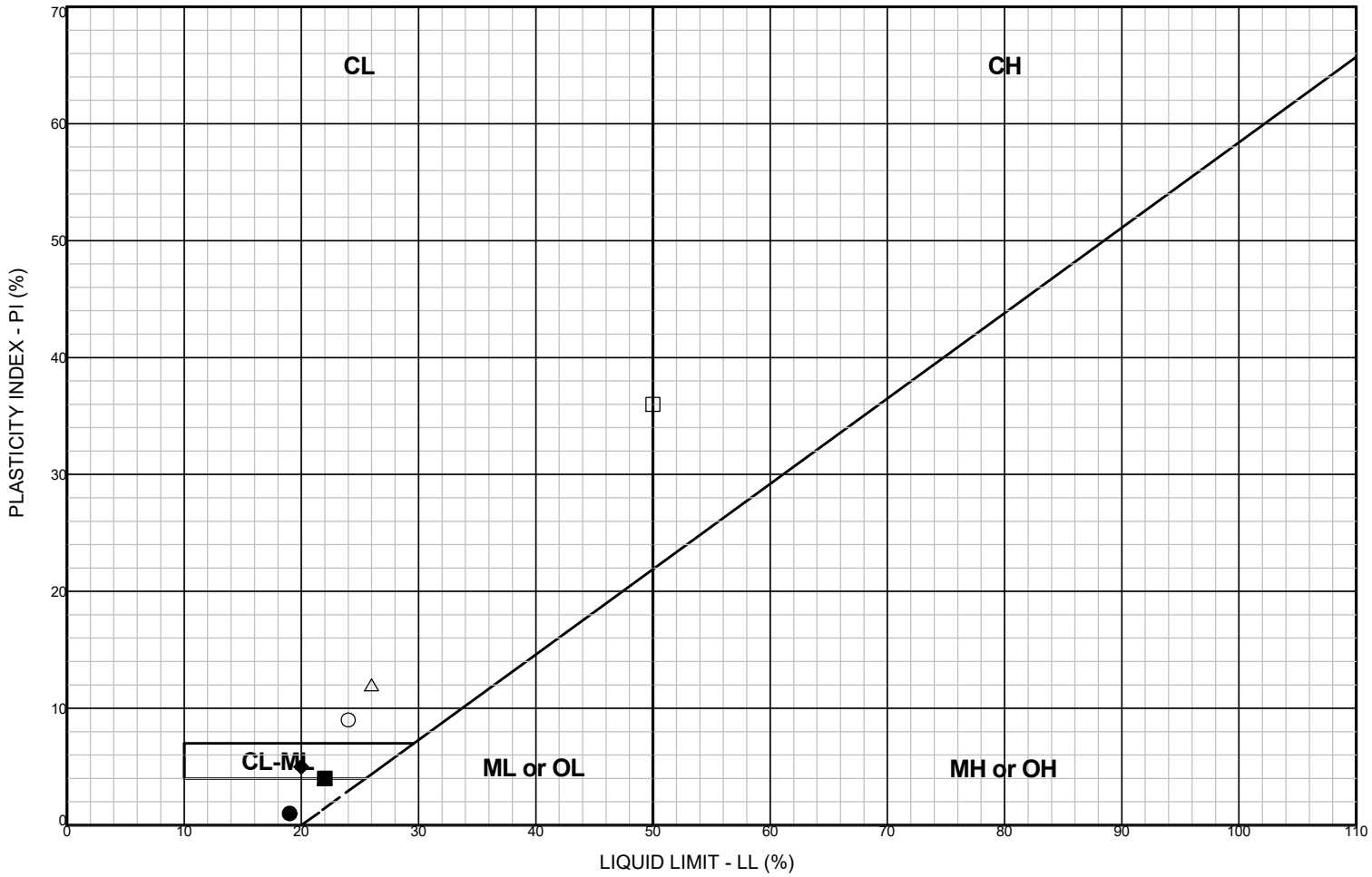

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CL-ML: Silty clays and clayey silts

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● SW-10, S-1	1.0	SM	Silty Sand, trace gravel	19	18	1	5.8	21.2
■ SW-11, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	22	18	4	7.8	27.5
▲ SW-12, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	22	18	4	7.5	22.7
◆ SW-13, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	20	15	5	5.6	21.3
○ SW-13, S-3	5.0	SC	Clayey Sand	24	15	9	8.9	19.4
□ SW-16, S-2	2.5	SC	Clayey Sand, trace gravel	50	14	36	9.6	26.1
△ SW-17, B-1	1.0	SC	Clayey Sand, few gravel	26	14	12	5.6	22.1

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PLASTICITY CHART

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FIG. B-2
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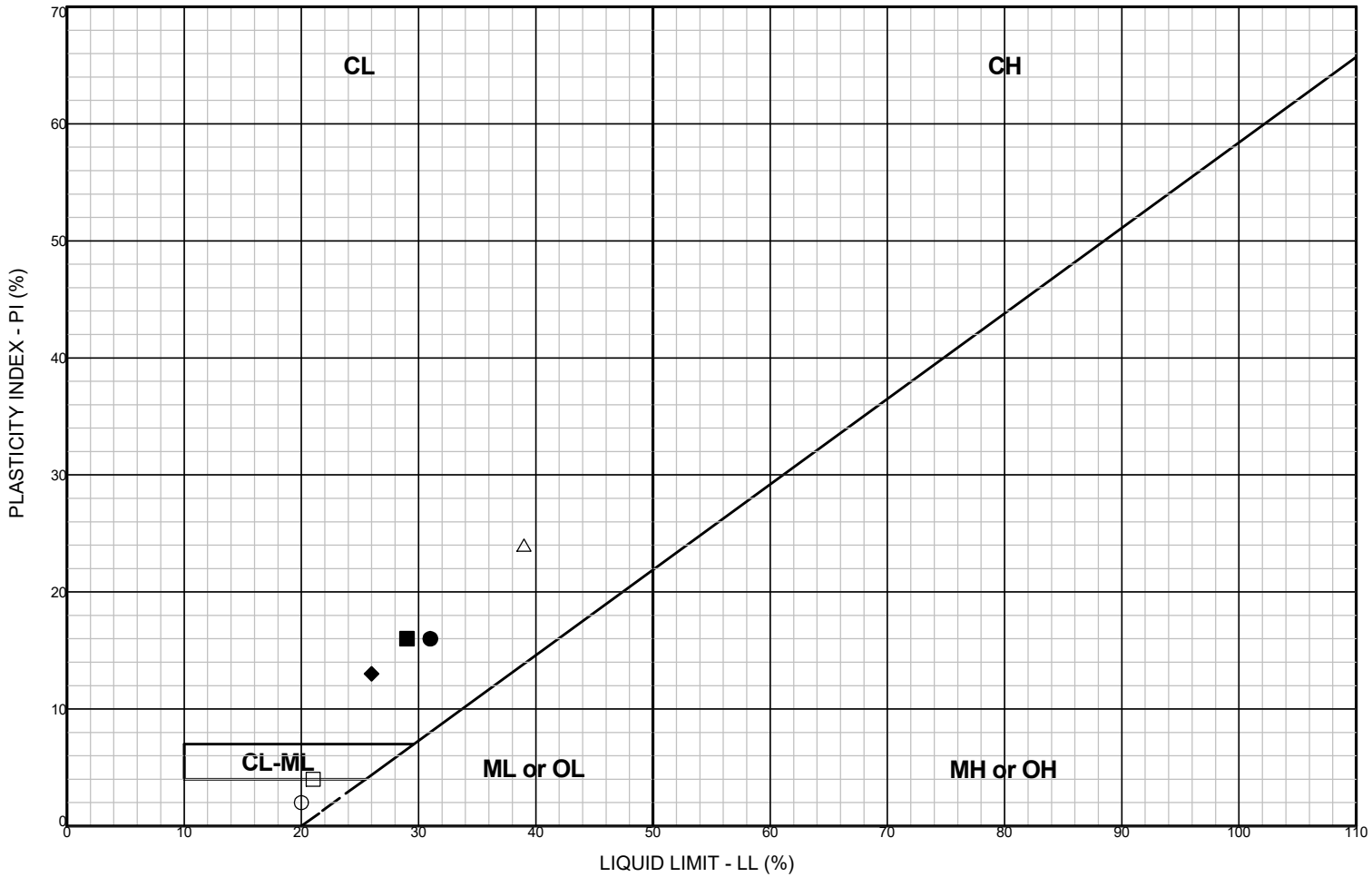

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CL-ML: Silty clays and clayey silts

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● SW-17, S-3	2.5	SC	Clayey Sand; trace gravel	31	15	16	6.2	19.5
■ SW-18, S-2	2.5	SC	Clayey Sand	29	13	16	11.0	38.9
SW-19, S-1	1.0	SM	Silty Sand; few gravel	NV	NP	NP	4.4	19.1
◆ SW-20, B-1	1.0	SC	Clayey Sand, few gravel	26	13	13	5.4	23.7
○ SW-21, S-1	1.0	SM	Silty Sand, trace gravel	20	18	2	9.3	23.0
□ SW-22, S-1	1.0	SC-SM	Silty, Clayey Sand, trace gravel	21	17	4	4.7	18.1
△ SW-23, S-1	1.0	SC	Clayey Sand; few gravel	39	15	24	9.9	29.3

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FIG. B-2
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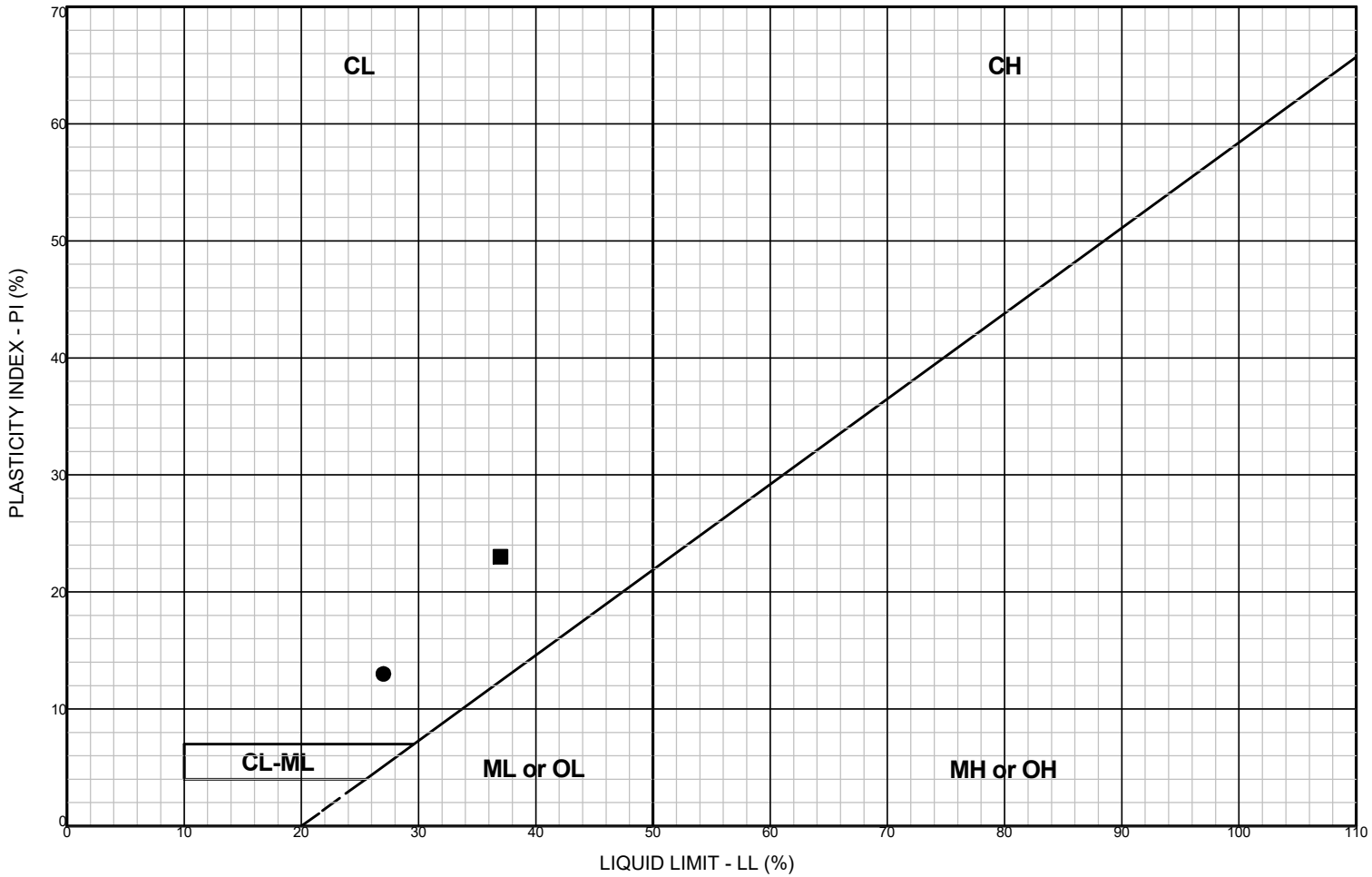

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CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

SAMPLE ID	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● SW-24, B-1	1.0	SC	Clayey Sand, trace gravel	27	14	13	6.4	29.0
■ SW-24, S-3	5.0	SC	Clayey Sand	37	14	23	11.7	36.8

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PLASTICITY CHART

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FIG. B-2
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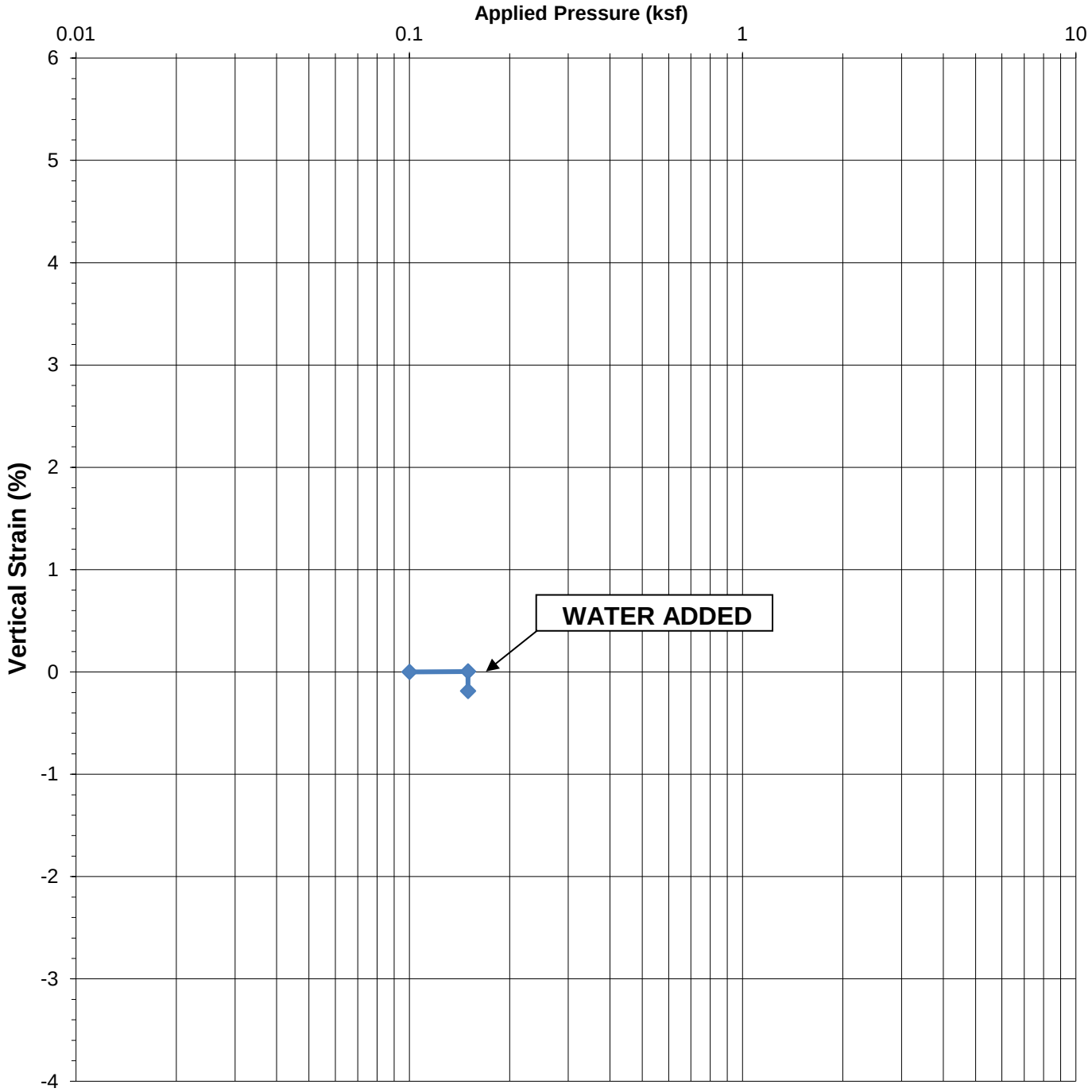
SWELL/COLLAPSE TEST REPORT
Boring SW-09 Sample S-3, 5 to 6 ft



Swell =	-0.2	%
Inundation Pressure =	150	psf
Initial Moisture Content =	9.8	%
Final Moisture Content =	15.6	%
Moist Unit Weight =	114.7	pcf

NOTE:
Testing was done in general accordance with Method B (an intact specimen obtained from a natural deposit) of ASTM D 4546, Standard Test Methods for One-Dimensional Swell or Collapse of Soils.

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SWELL/COLLAPSE TEST REPORT
BORING SW-09, SAMPLE S-3

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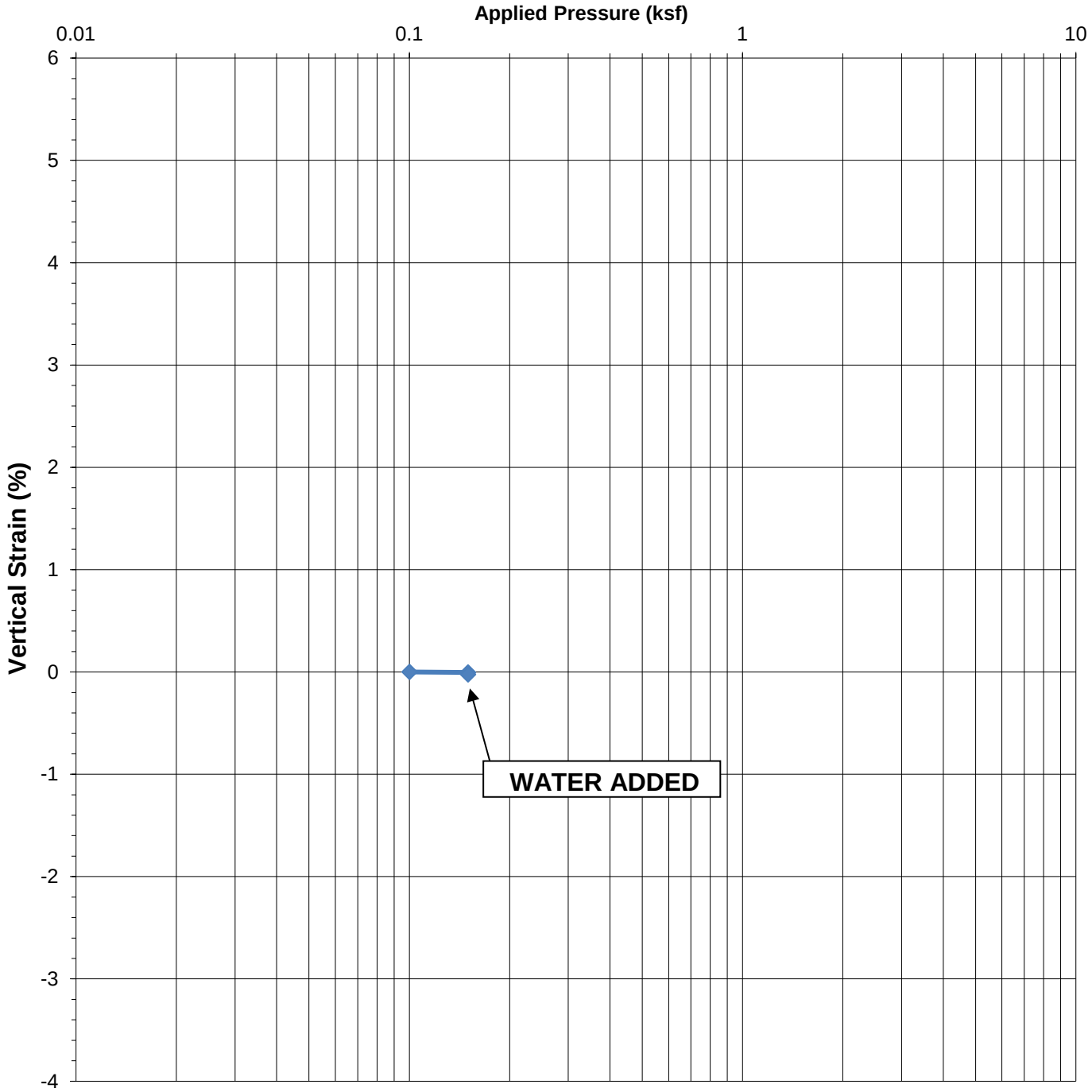
FIG. B-3

SWELL/COLLAPSE TEST REPORT
Boring SW-13 Sample S-3, 5 to 6 ft



Swell =	0.0	%
Inundation Pressure =	150	psf
Initial Moisture Content =	8.9	%
Final Moisture Content =	13.1	%
Moist Unit Weight =	124.2	pcf

NOTE:
Testing was done in general accordance with Method B (an intact specimen obtained from a natural deposit) of ASTM D 4546, Standard Test Methods for One-Dimensional Swell or Collapse of Soils.

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SWELL/COLLAPSE TEST REPORT
BORING SW-13, SAMPLE S-3

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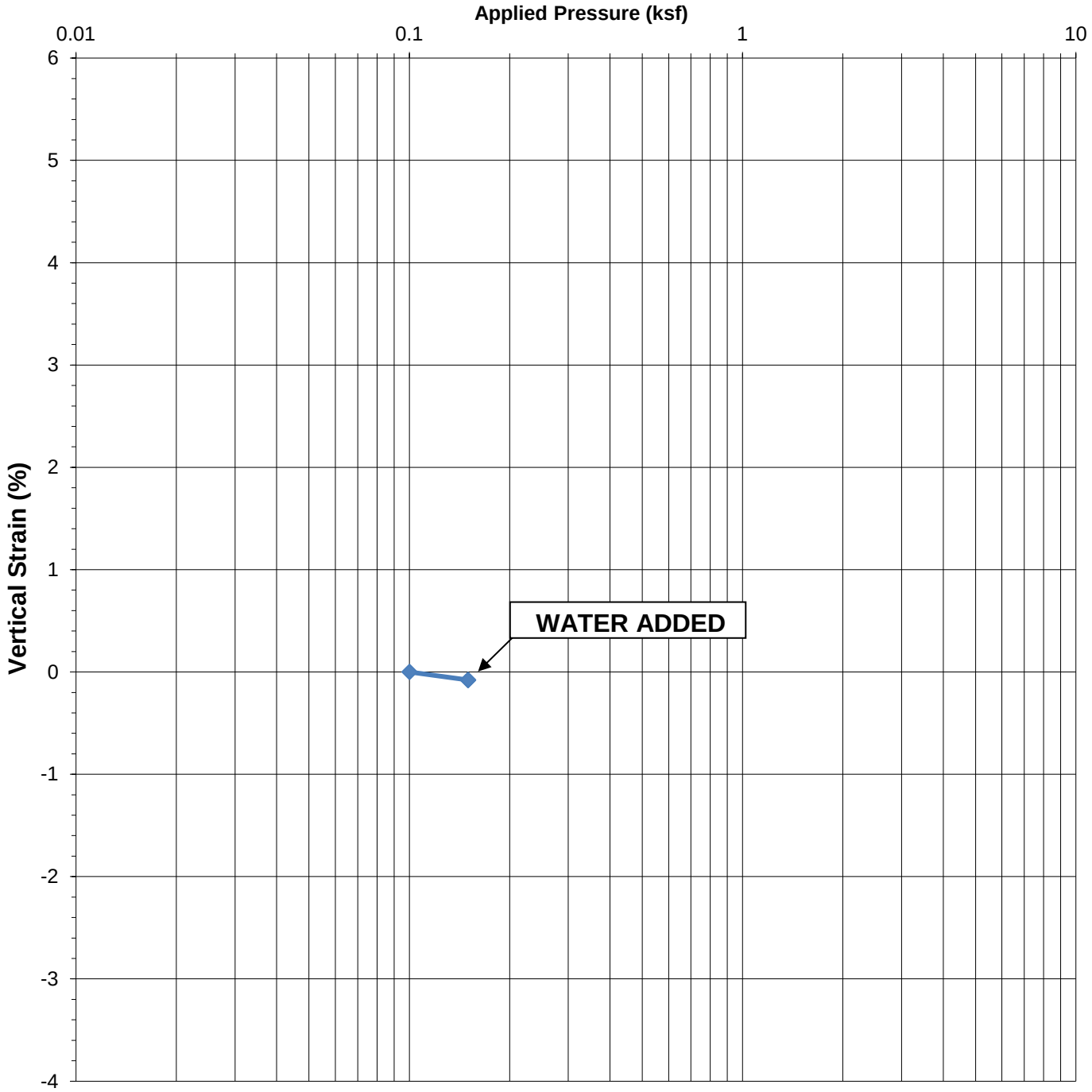
FIG. B-4

SWELL/COLLAPSE TEST REPORT
Boring SW-17 Sample S-3, 2.5 to 3.5 ft



Swell =	0.0	%
Inundation Pressure =	150	psf
Initial Moisture Content =	6.2	%
Final Moisture Content =	13.1	%
Moist Unit Weight =	118.0	pcf

NOTE:
Testing was done in general accordance with Method B (an intact specimen obtained from a natural deposit) of ASTM D 4546, Standard Test Methods for One-Dimensional Swell or Collapse of Soils.

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SWELL/COLLAPSE TEST REPORT
BORING SW-17, SAMPLE S-3

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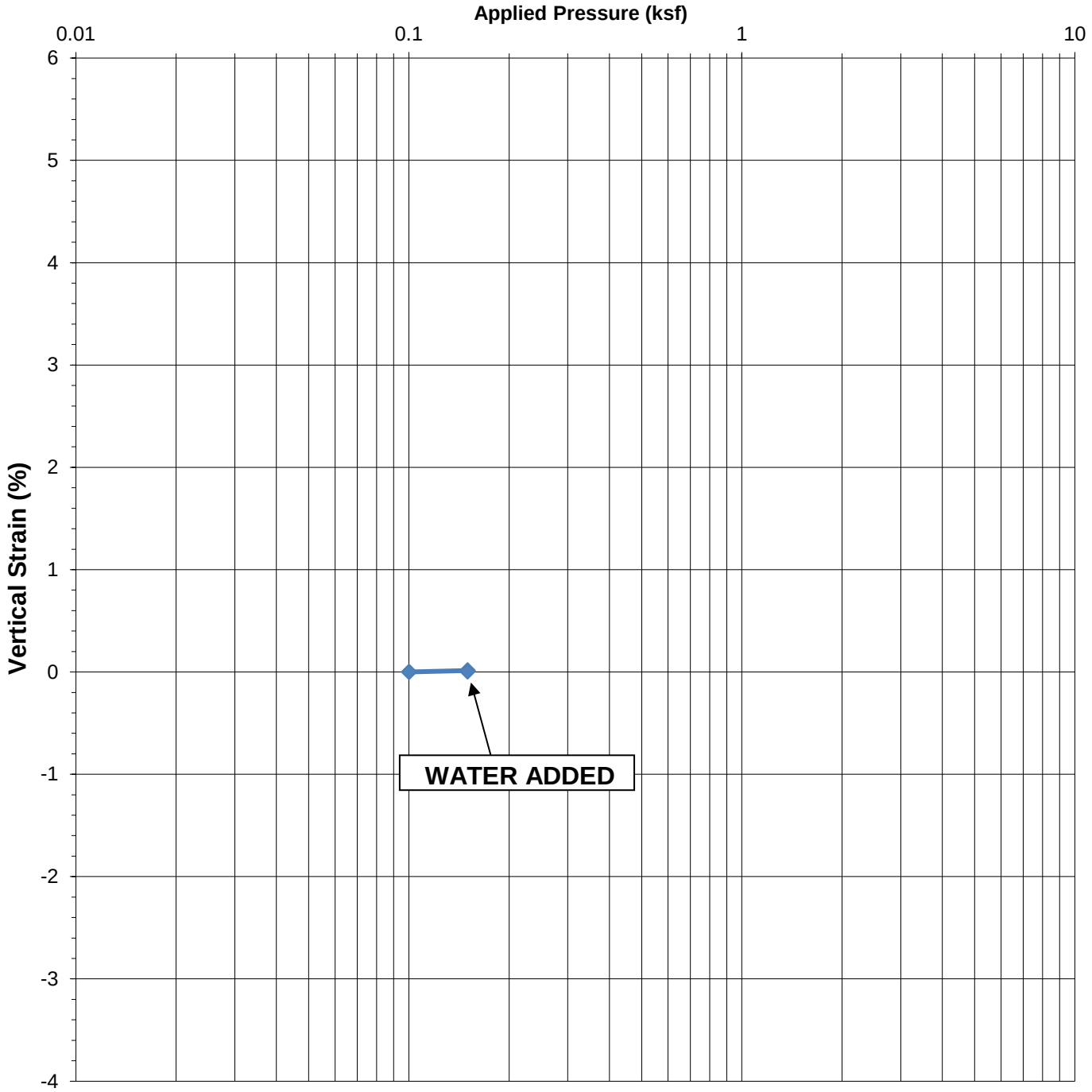
FIG. B-5

SWELL/COLLAPSE TEST REPORT
Boring SW-24 Sample S-3, 5 to 6 ft



Swell =	0.0	%
Inundation Pressure =	150	psf
Initial Moisture Content =	11.7	%
Final Moisture Content =	15.9	%
Moist Unit Weight =	119.3	pcf

NOTE:
Testing was done in general accordance with Method B (an intact specimen obtained from a natural deposit) of ASTM D 4546, Standard Test Methods for One-Dimensional Swell or Collapse of Soils.

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SWELL/COLLAPSE TEST REPORT
BORING SW-24, SAMPLE S-3

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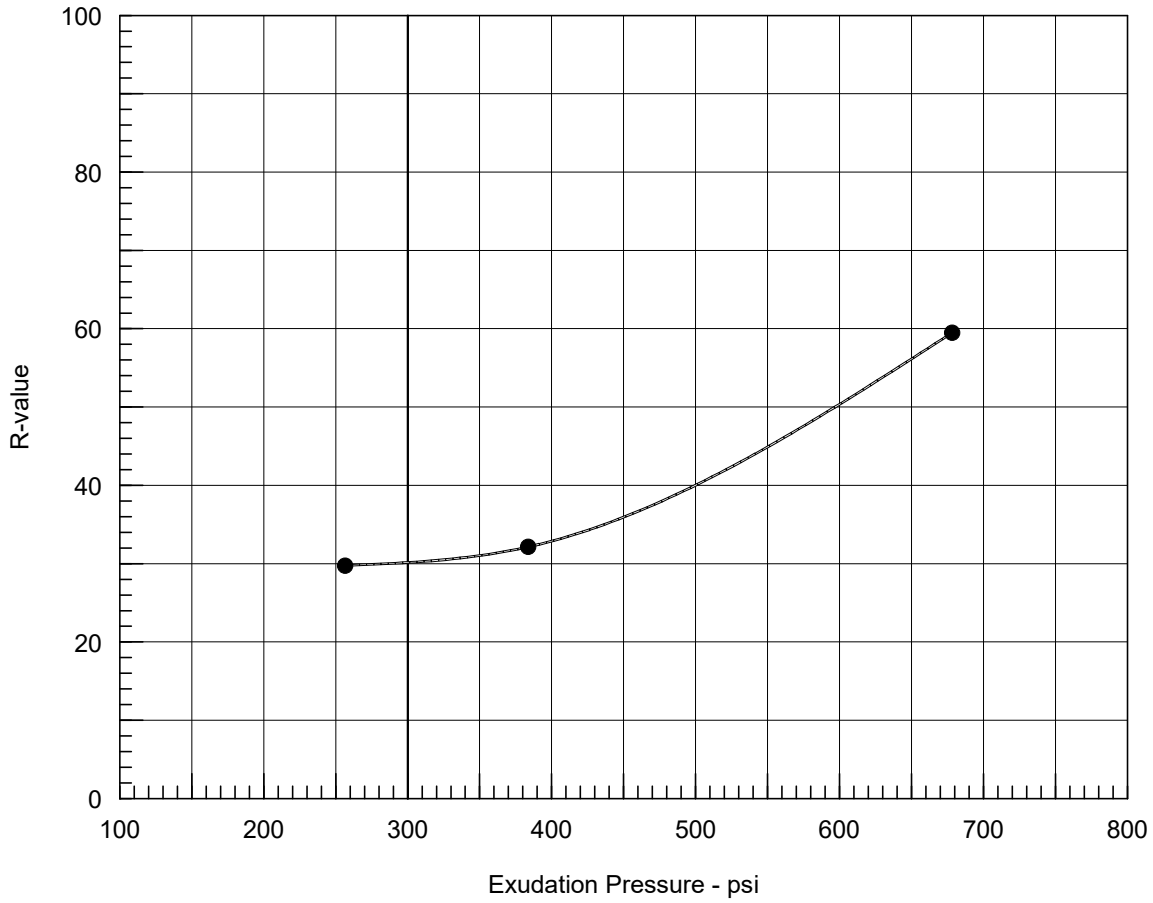
FIG. B-6

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - AASHTO T 190

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	129.2	8.9	0.00	77	2.51	384	32.1	32.1
2	350	130.0	7.4	0.00	35	2.44	678	61.0	59.5
3	350	130.9	9.4	0.00	80	2.51	256	29.8	29.8

Test Results	Material Description
R-value at 300 psi exudation pressure = 30.1	SW-17 / B1 / 1-5' Composite Bulk

Project No.: 20-5048
Project: Beacon Lite 104129
Location: Beacon Lite 104129
Sample Number: S1655
Date: 5/27/2020

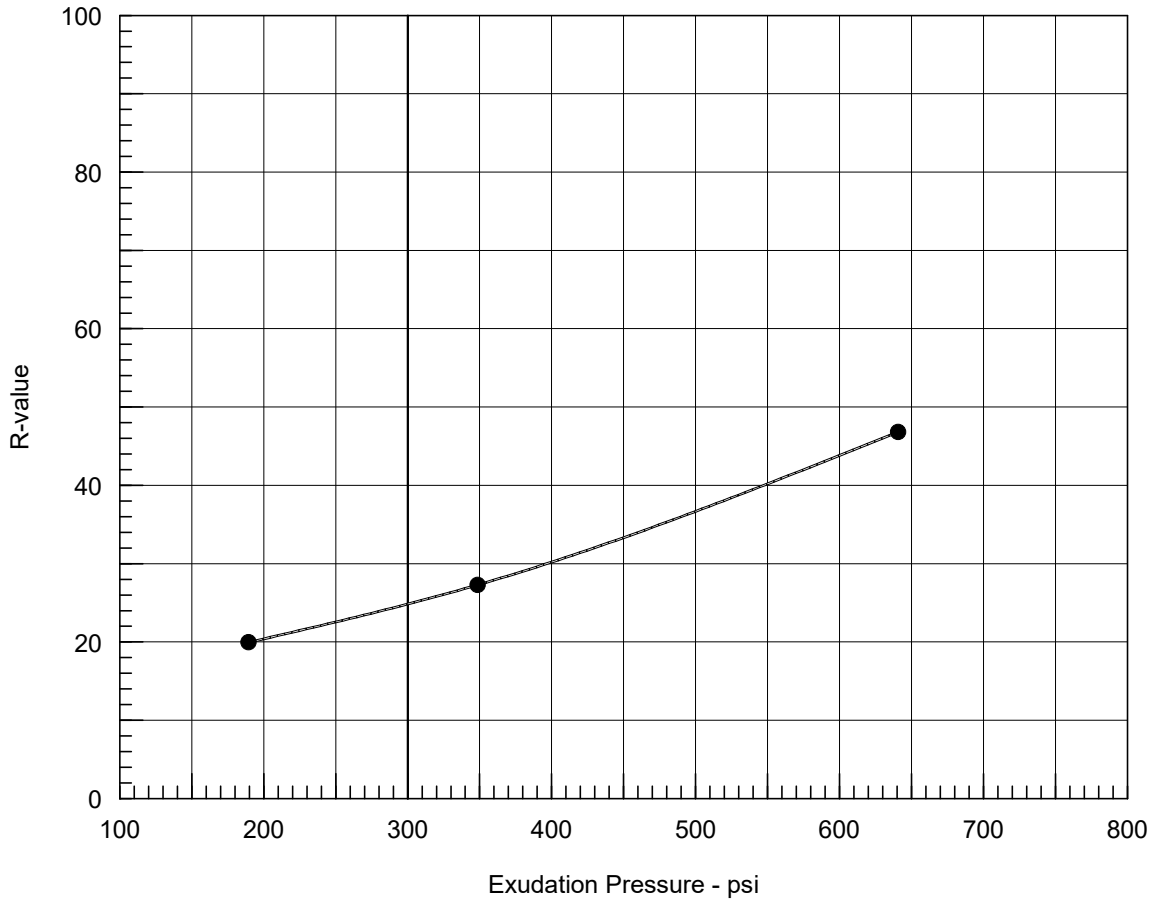
Tested by: Juan Romero
Checked by: Clay Hollowell
Remarks:

R-VALUE TEST REPORT

Vine Laboratories

FIG. B-7

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - AASHTO T 190

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	127.7	7.8	0.00	54	2.56	641	45.2	46.8
2	350	124.7	9.4	0.00	87	2.57	348	26.0	27.3
3	350	123.6	9.9	0.00	105	2.67	189	17.9	20.0

Test Results	Material Description
R-value at 300 psi exudation pressure = 24.8	SW-24 / 1-5' Composite Bulk

Project No.: 20-5048
Project: Beacon Lite 104129
Location: Beacon Lite 104129
Sample Number: S1654
Date: 5/27/2020

Tested by: Juan Romero
Checked by: Clay Hollowell
Remarks:

R-VALUE TEST REPORT

Vine Laboratories

FIG. B-8

APPENDIX C: PAVEMENT DESIGN CALCULATIONS

Appendix C

Pavement Design Calculations

Exhibits

Figure 8: Adjusted 2020 ADT at Beacon Lite Road and County Line Road

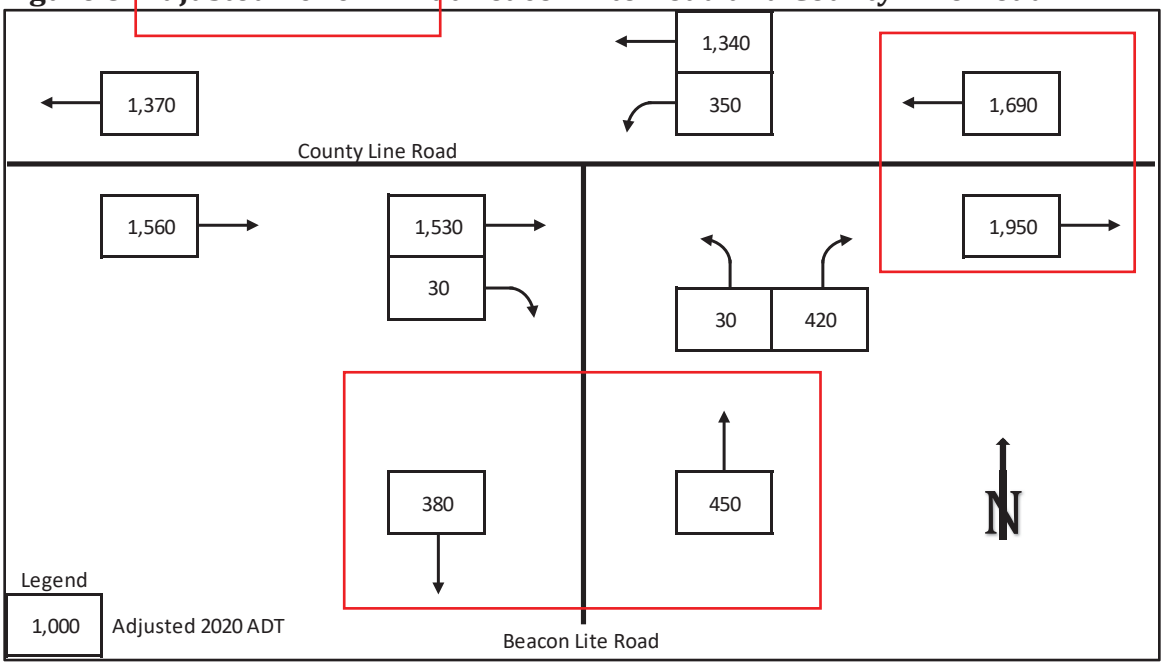
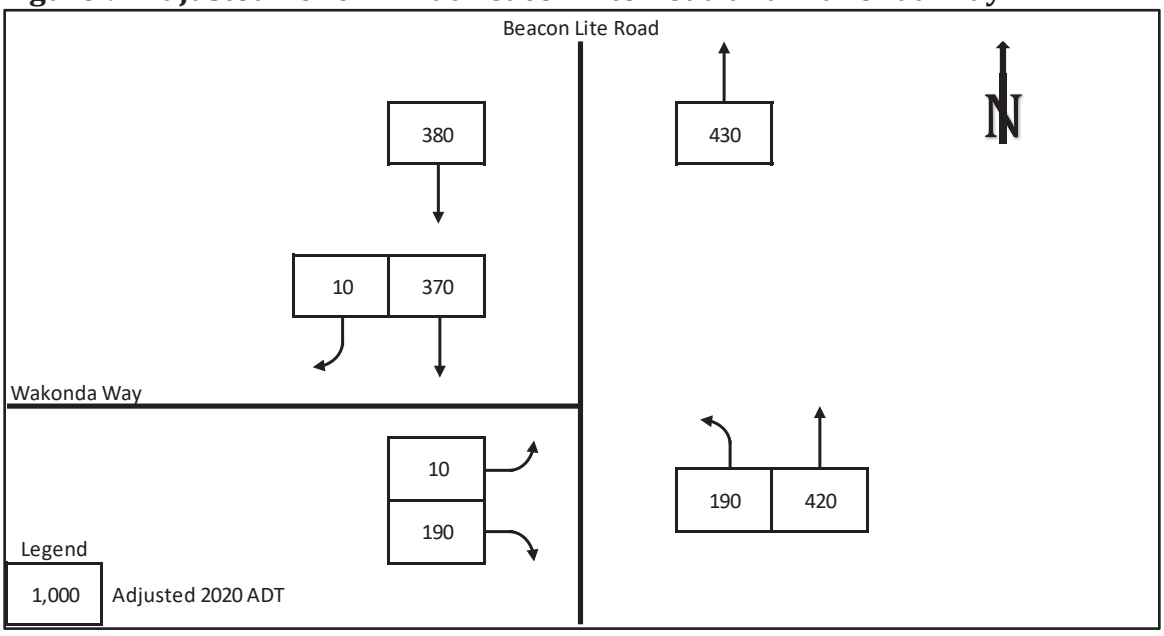


Figure 9: Adjusted 2020 ADT at Beacon Lite Road and Wakonda Way



The peak hour turning movement counts were compared with the peak hour tube counts and the tube counts were somewhat higher even without applying the seasonal adjustment factor. In the interest of providing a more conservative analysis, the seasonally adjusted peak hour data from the tube counts was used instead of the turning movement counts. The volumes from the tube counts were distributed at the intersections consistent with the distribution of traffic in the

Heavy Vehicles

turning movement counts. The estimated AM peak hour and the PM peak hour data are shown in Figure 10 and Figure 11 included in the figure are the peak hour factor (PHF) and the percentage of heavy vehicles (HV%) that were observed from the TMCs. At Wakonda Way there was only approach data on the southbound approach so the PHF and HV% observed there were assumed for all three approaches.

Figure 10: Estimated 2020 Peak Hour Counts at Beacon Lite Road and County Line Road

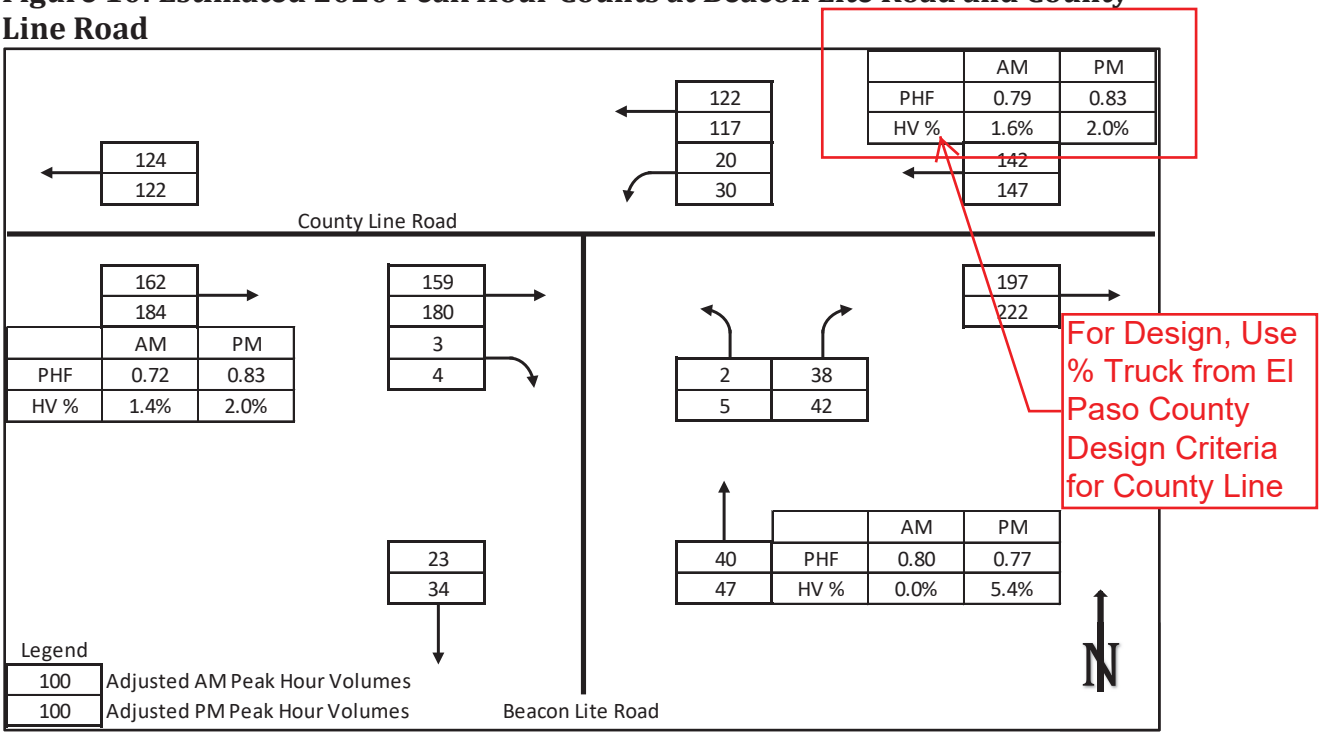
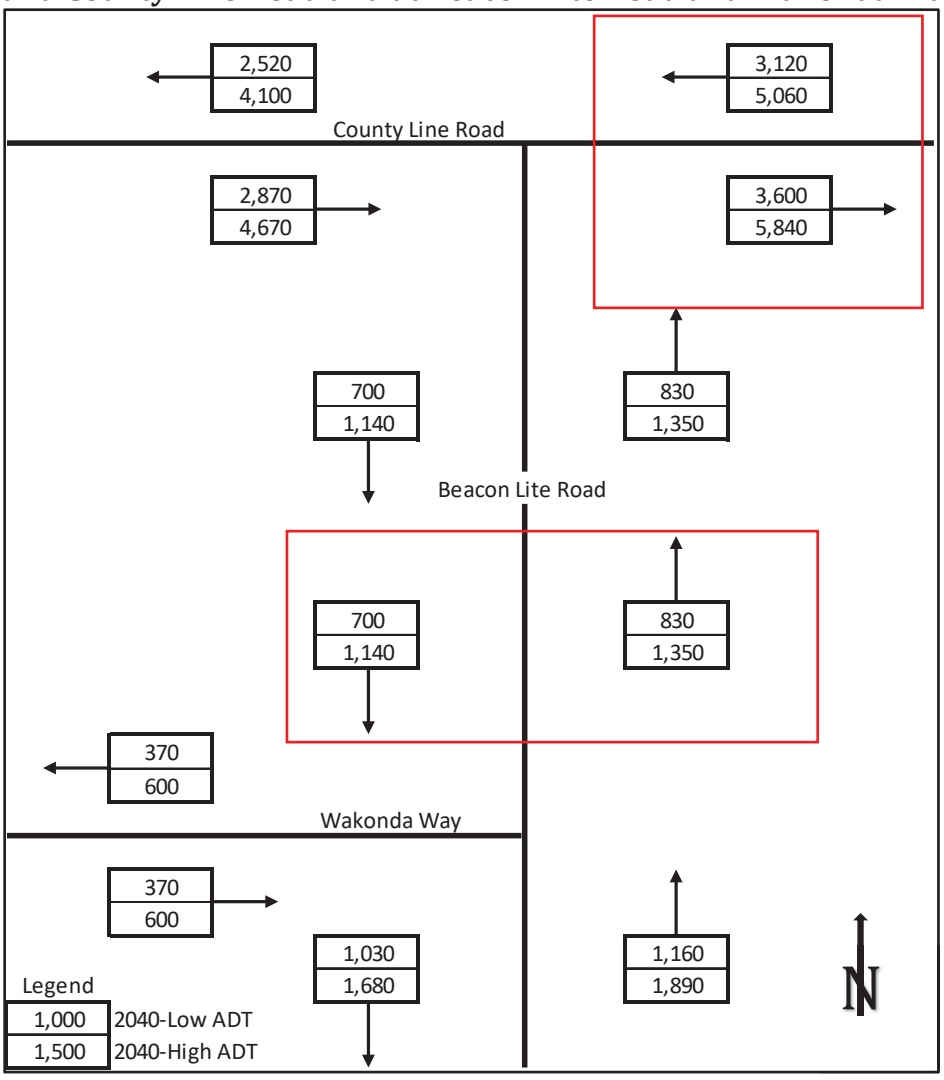


Figure 16: ADT Projections for 2040-Low and 2040-High at Beacon Lite Road and County Line Road and at Beacon Lite Road and Wakonda Way



Flexible Pavement 18-kip Equivalent Single-Axle Loading (ESAL) Worksheet

Project No: 104129-001

Location: Beacon Lite Road

Comment: Analysis based on Table D.21 of the 1993 AASHTO Guide for the Design of Pavement Structures

Traffic Study Year:	2020	
Paving Year:	2021	
Pavement Design Life (D):	20	years
2020 Two-way Average Daily Traffic (ADT):	450	vehicles per day (vpd)
2021 ADT:	475	vpd = 2020 ADT (1+r/100)^1
Estimated 2041 ADT:	1,427	vpd = 2020 ADT (1+r/100)^21
Growth Rate (r) :	5.65	%

Equations

b = 2021 ADT * (a/100)

c = b * 365

d = [(1+r/100)^20-1]/(r/100)

e = c * d

g = e * f

j = g * h * i

Vehicle Classification and Description	a Traffic Percentage	b 2021 ADT	c 2021 Total Traffic	d Growth Factors	e 20 yr Design Traffic Volume (total two-way volume)	f Flexible Pavement Equivalency Factor	g Roadway Design 18k ESAL	h Directional Distribution Factor	i Traffic Lane Factor	j Design Lane 18k ESAL
Passenger Cars	96.0	456	166,589	35.43	5,902,429	0.003	17,707	1.00	1.00	17,707
Single Unit Trucks	2.0	10	3,471	35.43	122,967	0.249	30,619	1.00	1.00	30,619
Combination Trucks	2.0	10	3,471	35.43	122,967	1.087	133,665	1.00	1.00	133,665
Total	100	475	173,530		6,148,363		181,991			**181,991**

Design ESAL 182,000

Notes

1. The current and projected ADT and percentage of truck traffic is based on traffic data provided byMichael Baker.
2. The flexible pavement equivalency factors, directional distribution factor, and traffic lane factor is based on Appendix H of the 2020 CDOT Pavement Design Manual. Shannon & Wilson assumed a 50:50 ratio of single unit trucks and combination trucks.

Exhibit C-2

Flexible Pavement Design Worksheet

Job No.: 104129-001
Location: Beacon Lite Rd
Comment: Analysis follows design procedures form 1993 AASHTO Guide for Design of Pavement Structures with guidance from El Paso County Engineering Criteria Manual (ECM)

1. Pavement Design Life: 20.0 years

2. Traffic Loading (W_{18}): ESALs: 182,000 per lane

3. Serviceability:
   - p_0: 4.5
   - p_t: 2.0
   - ΔPSI: 2.5

4. Subgrade Resilient Modulus (M_R): R-value 25.0

M_R (psi) = $10^{(S1 + 18.72)/6.24}$ = 5,816 psi
S1 = [(R-value - 5) / 11.29] +3 = 4.77

M_R: 5,816 psi

5. Reliability:
   - R: 80 %
   - Z_R: -0.842

6. Design Standard Deviation (S_o):
   - S_o: 0.44

7. Required Structural Numbers (SN_i):

Analysis M_R	
30,000	SN_1: **1.375**
5,816	SN_2: **2.580**
-NA-	SN_3: **-NA-**

$$\log_{10}(W_{18}) = Z_R\ S_o + 9.36\ \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\ \log_{10}(M_R) - 8.07$$

Layer Analysis

8. Pavement Materials Characterization:

Layer	Material	Structural Layer Coefficients	Drainage Coefficients	Layer Modulus (psi)
1	HMA	a_1: 0.44	-	-
2	ABC	a_2: 0.11	m_2: 1.00	30,000
3		a_3:	m_3:	

9. Solutions for Thicknesses: [Figure 3.2, Part II of 1993 AASHTO]

$SN^*_1 = a_1D^*_1 >= SN_1$
$SN^*_2 = a_1D^*_1 + a_2D^*_2m_2 >= SN_2$
$SN^*_3 = a_1D^*_1 + a_2D^*_2m_2 + a_3D^*_3m_3 >= SN_3$

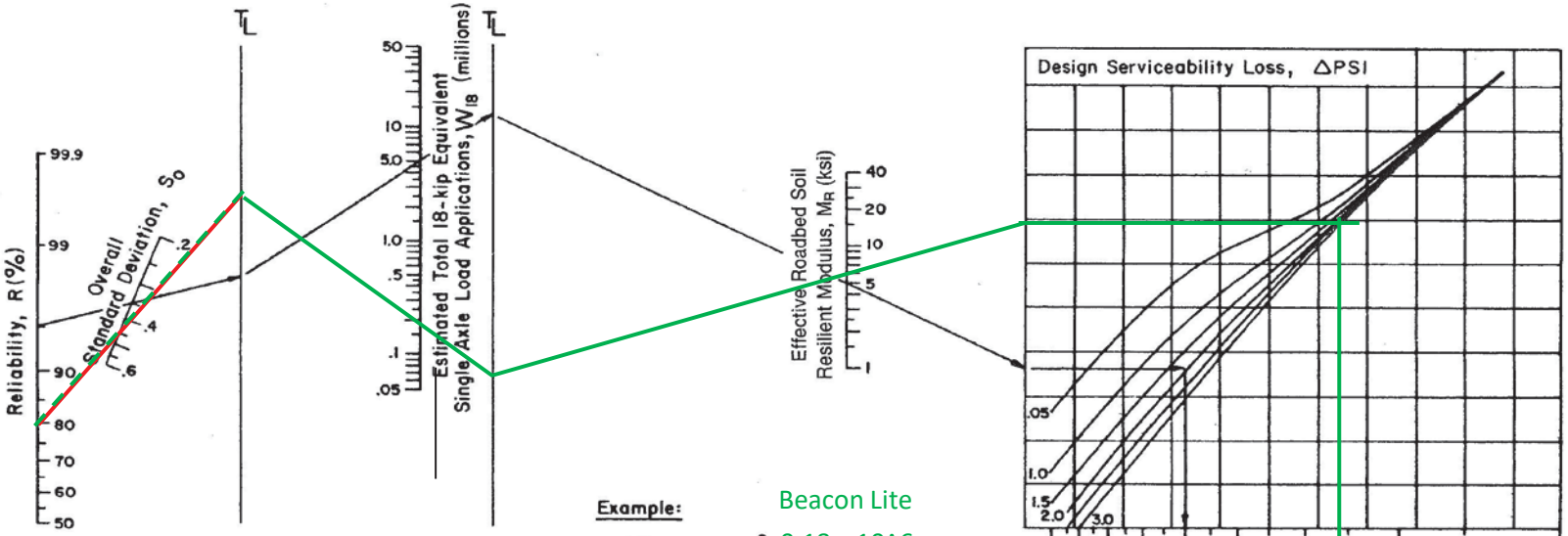
Recommended Thicknesses				
Layer	Material	Thickness (D^*_i)	SN^*_i	SN_i
1	HMA	4.0 inches	1.760	1.375
2	ABC	8.0 inches	2.640	2.580
3		inches		

Note: Required SN <= Pavement SN, Design is Acceptable

Exhibit C-3

NOMOGRAPH SOLVES:

$$\log_{10} W_{18} = Z_R * S_o + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2 - 1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$



Example: Beacon Lite

W_{18} = ~~5×10^6~~ 0.18 x 10^6

R = ~~95 %~~ 80%

S_o = ~~0.35~~ 0.44

M_R = ~~5000 psi~~ 5,800 psi

ΔPSI = ~~1.9~~ 2.5

Solution: SN = ~~5.0~~ ~2.6

Figure 3.1. Design Chart for Flexible Pavements Based on Using Mean Values for Each Input

104129-001

Exhibit C-4

APPENDIX D: CONCEPTUAL ROADWAY PLANS

Appendix D

Conceptual Roadway Plans

Exhibits

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19440 BEACON LITE RD
7110001006

BOYD KATHRYN C
2215 WAKONDA WAY
7110001001

S EDWIN III
ON LITE RD
1032

Right turn lane to be added during preliminary design for Beacon

PROPOSED PERMANENT EASEMENT (TYP)

WAKONDA WAY

BEGIN CURB AND GUTTER

PI: 100+00.00

BP: 94+00.00

BEGIN CONSTRUCTION
BEACON LITE ROAD
BEGIN RURAL SECTION
STA. 94+82.05

PI: 96+67.69

12'-0" LANE

4'-0" SHLDR

94+00 95+00 96+00 97+00 98+00 99+00 100+00 101

50' STORAGE

BEACON LITE RD

MATCH LINE STA 101+00

7'-10"

160' BAY TAPER

240' REDIRECT TAPER

BEGIN REDIRECT TAPER

END REDIRECT TAPER

Bay Taper/Redirect Taper Overlap per CDOT Figure Below

12'-0" TURN LANE

12'-0" LANE

4'-0" SHLDR

155' LANE LENGTH

315' DECELERATION

END RURAL SECTION
BEGIN URBAN SECTION
STA. 100+00.00

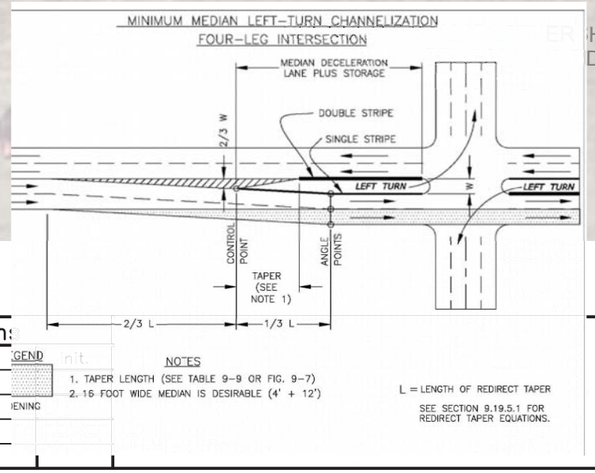
240' REDIRECT TAPER

BEGIN REDIRECT TAPER

BEGIN CURB AND GUTTER

12'*20:1

12'*20:1



0' 25' 50' 100'
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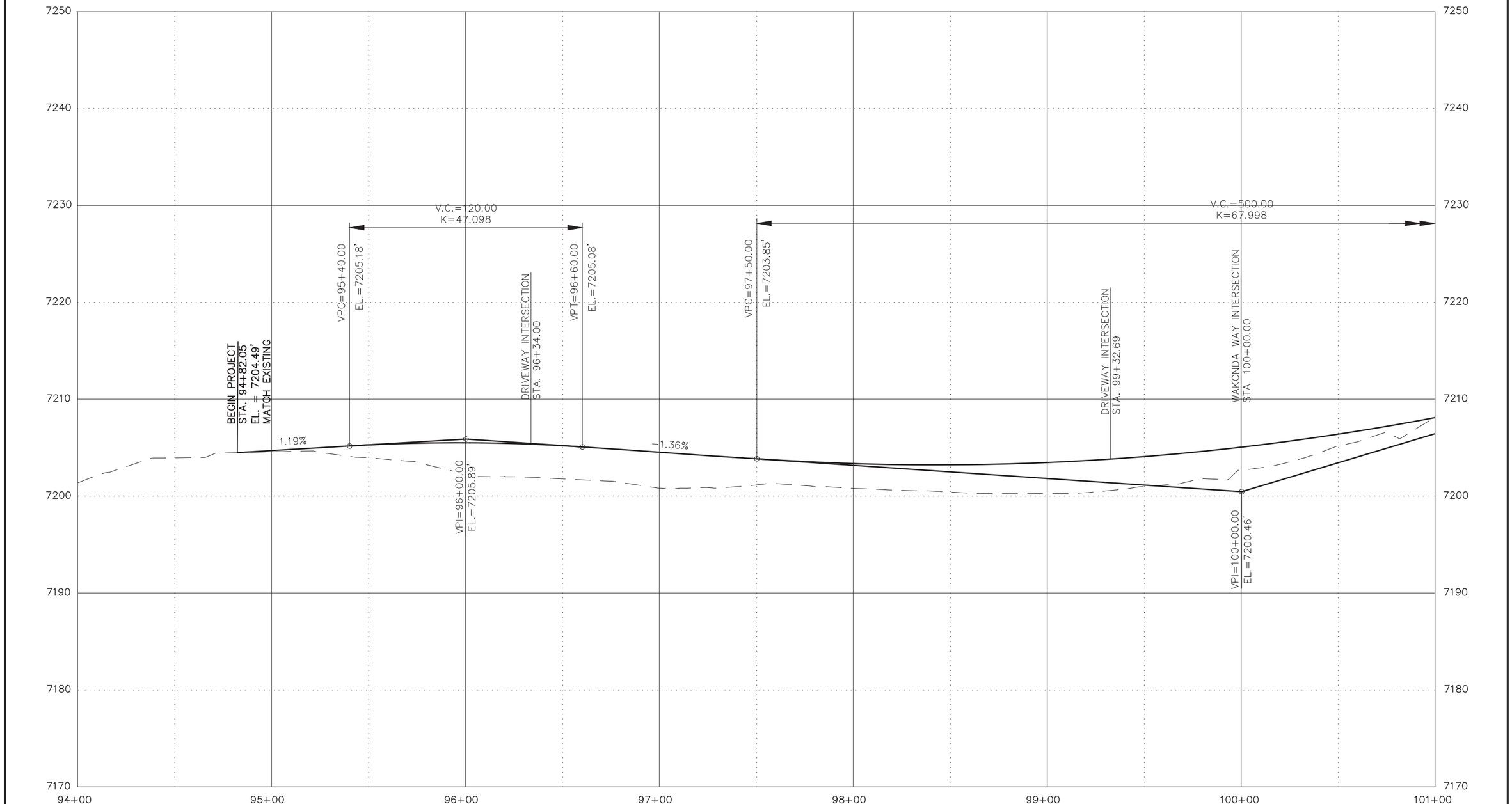

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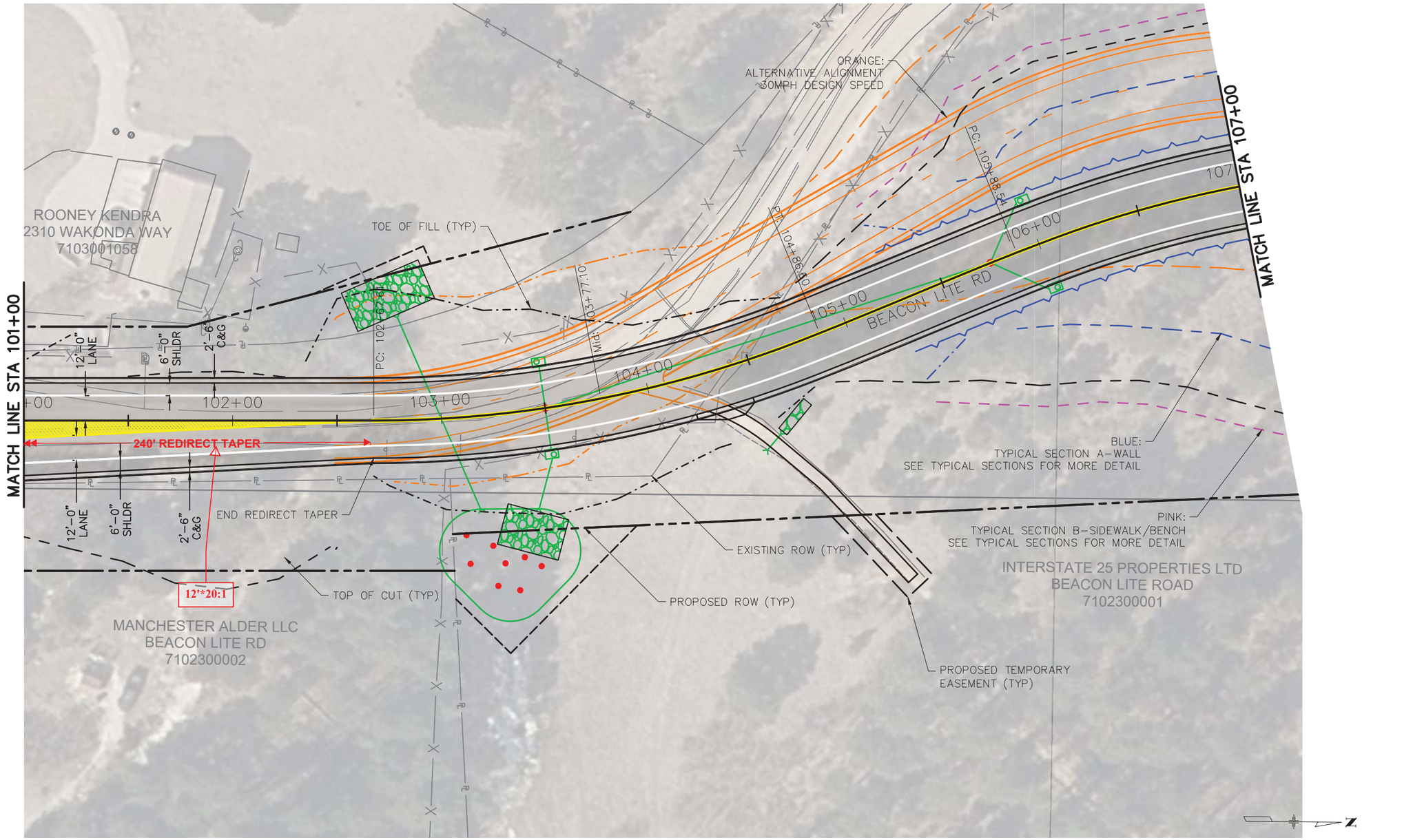

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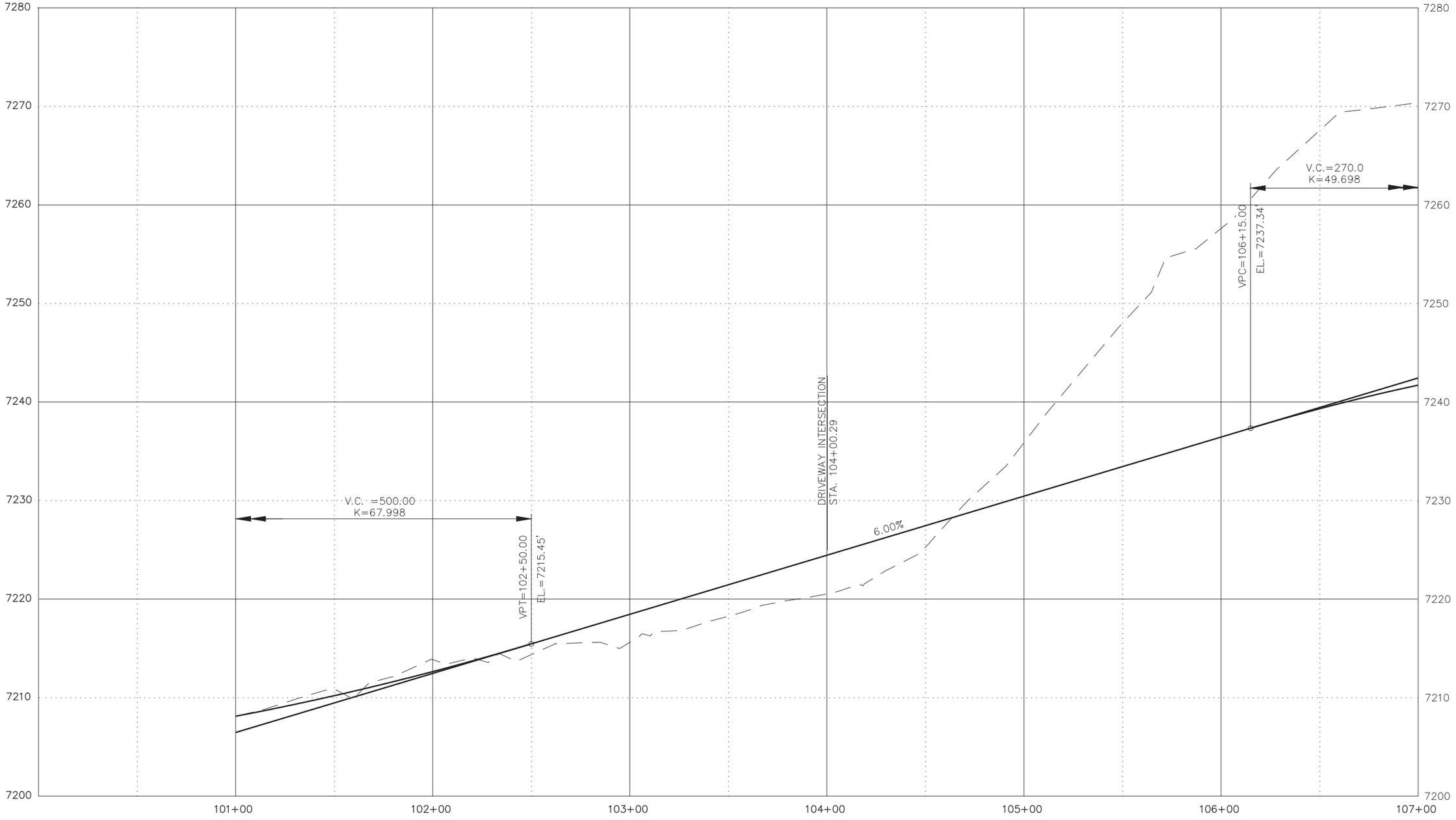

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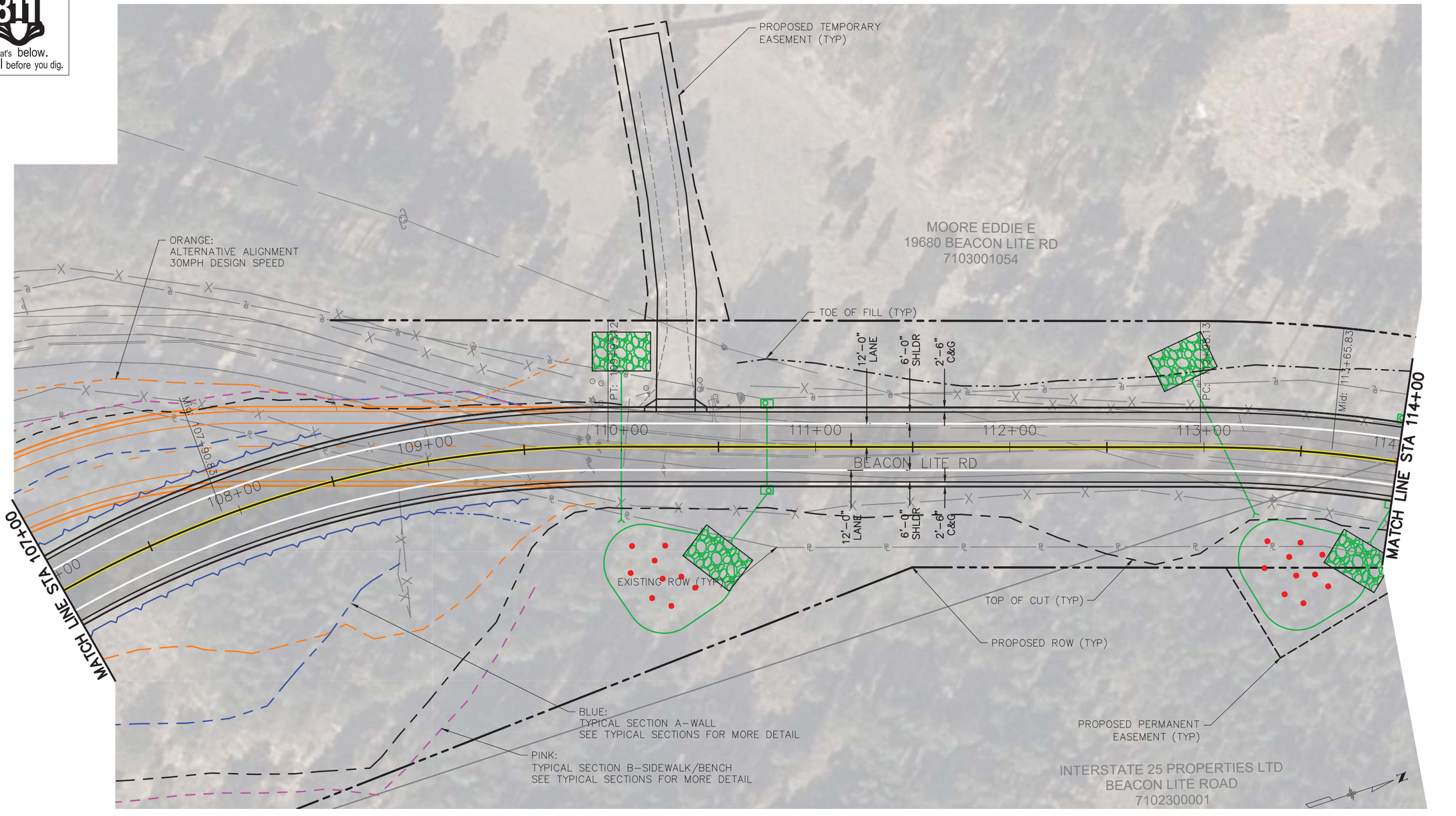

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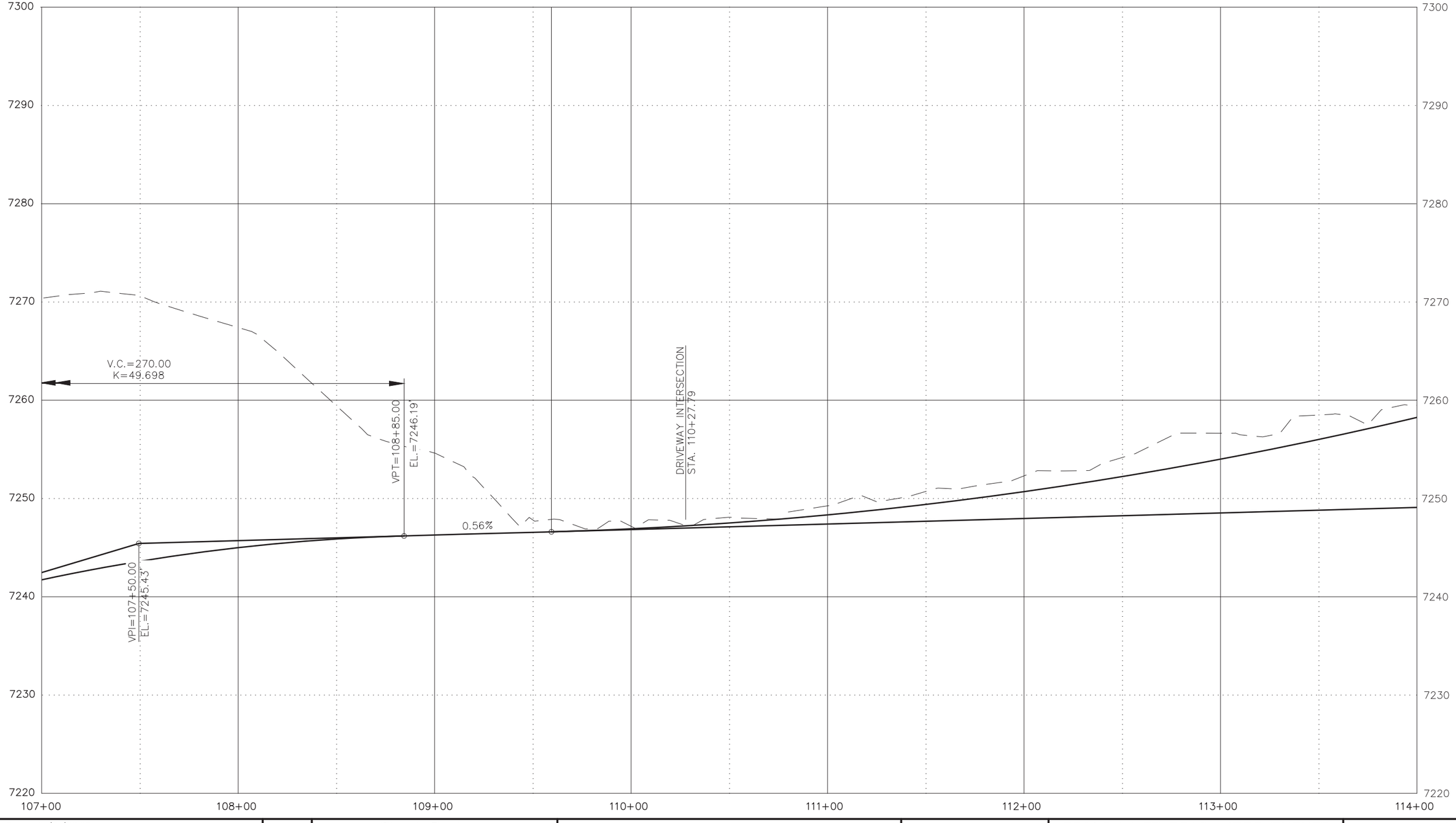

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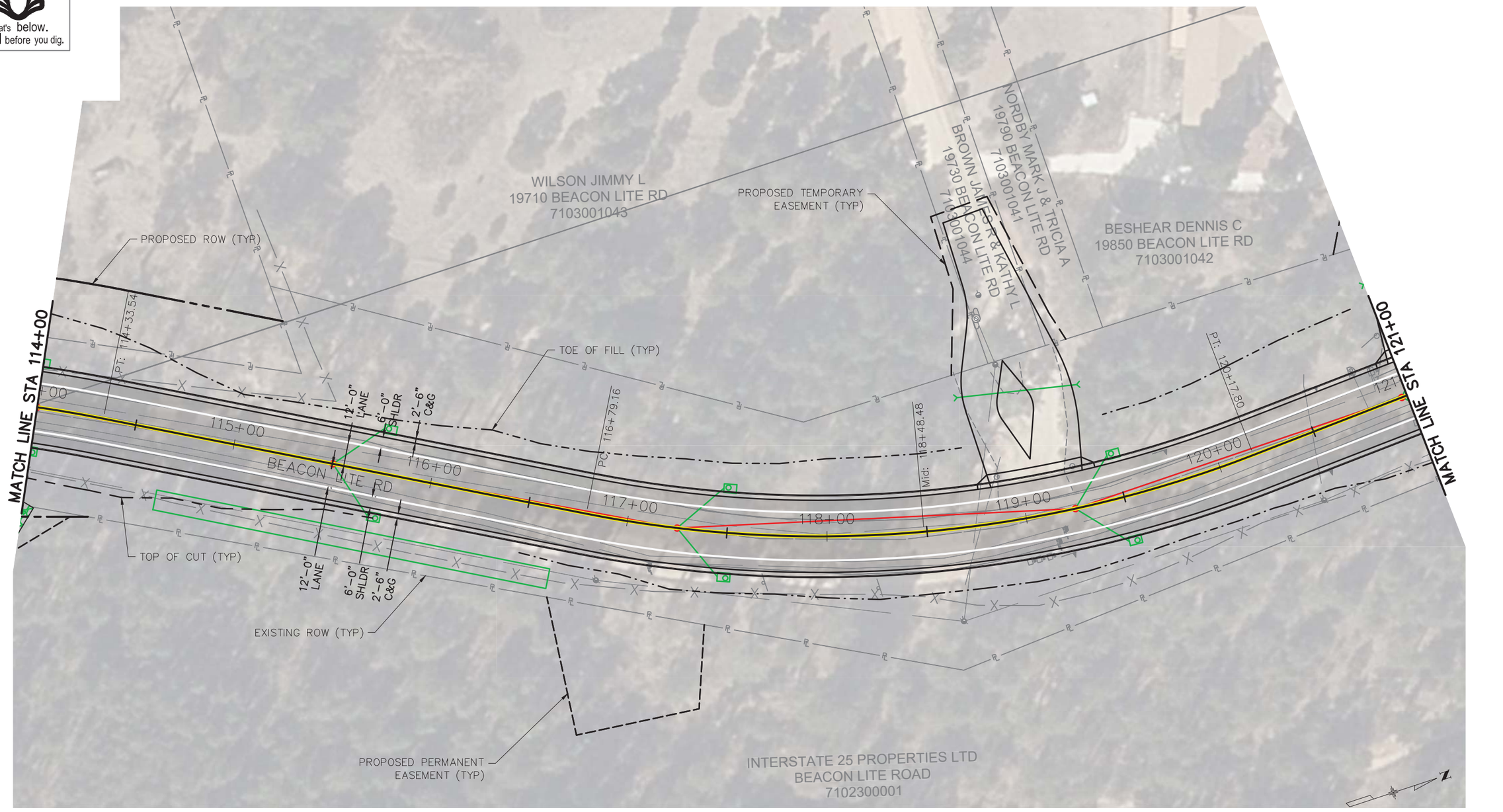

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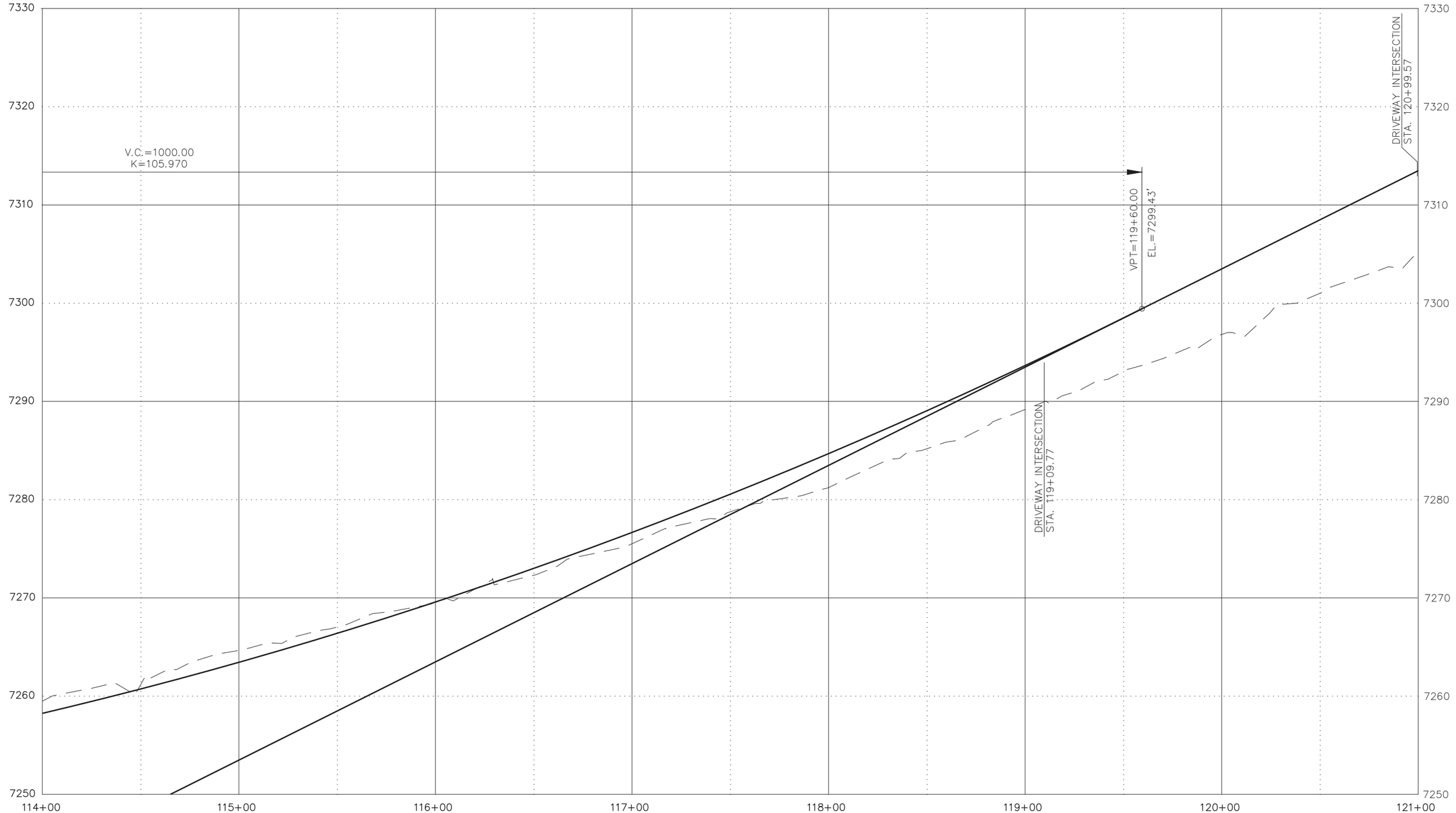

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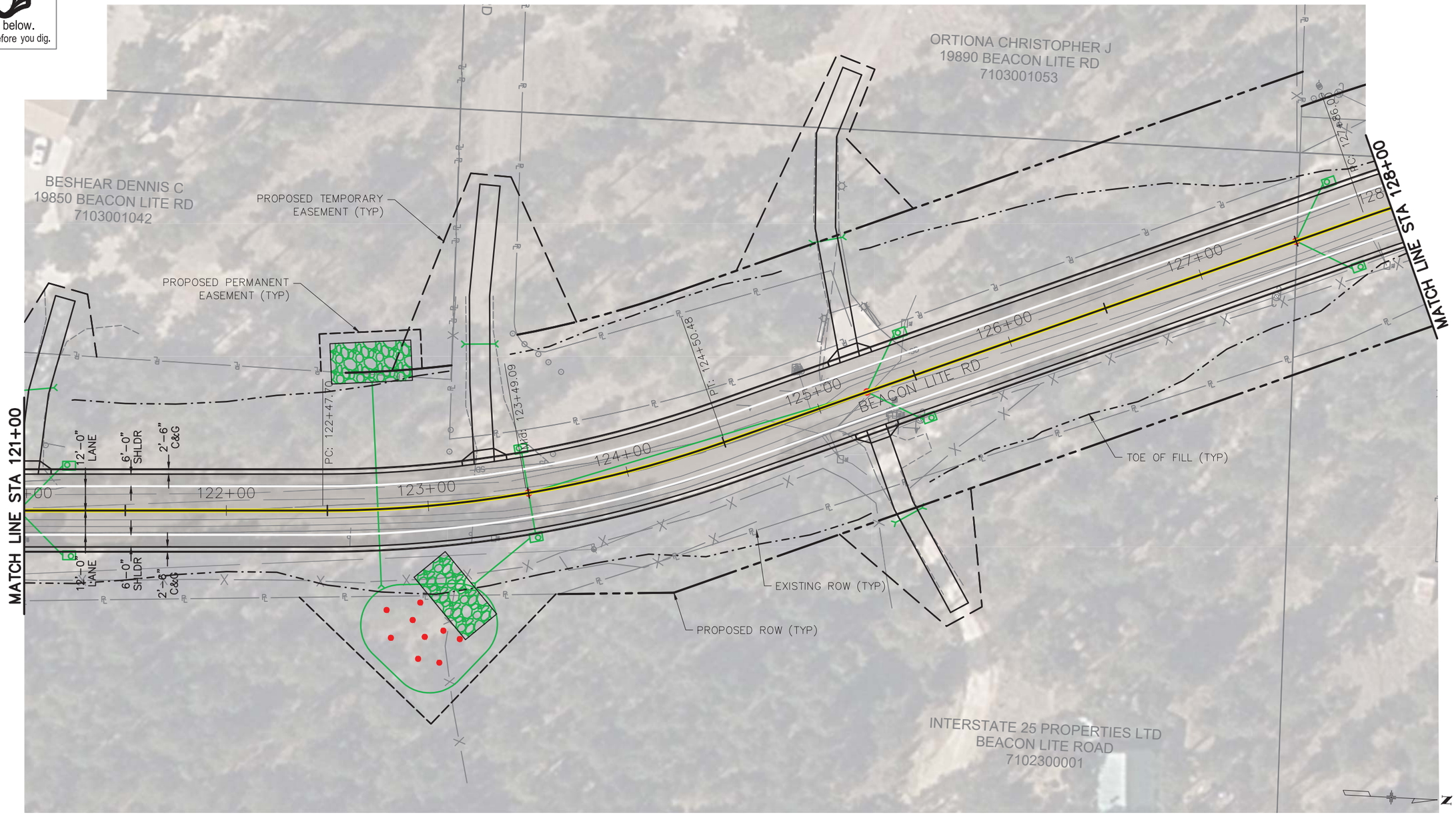

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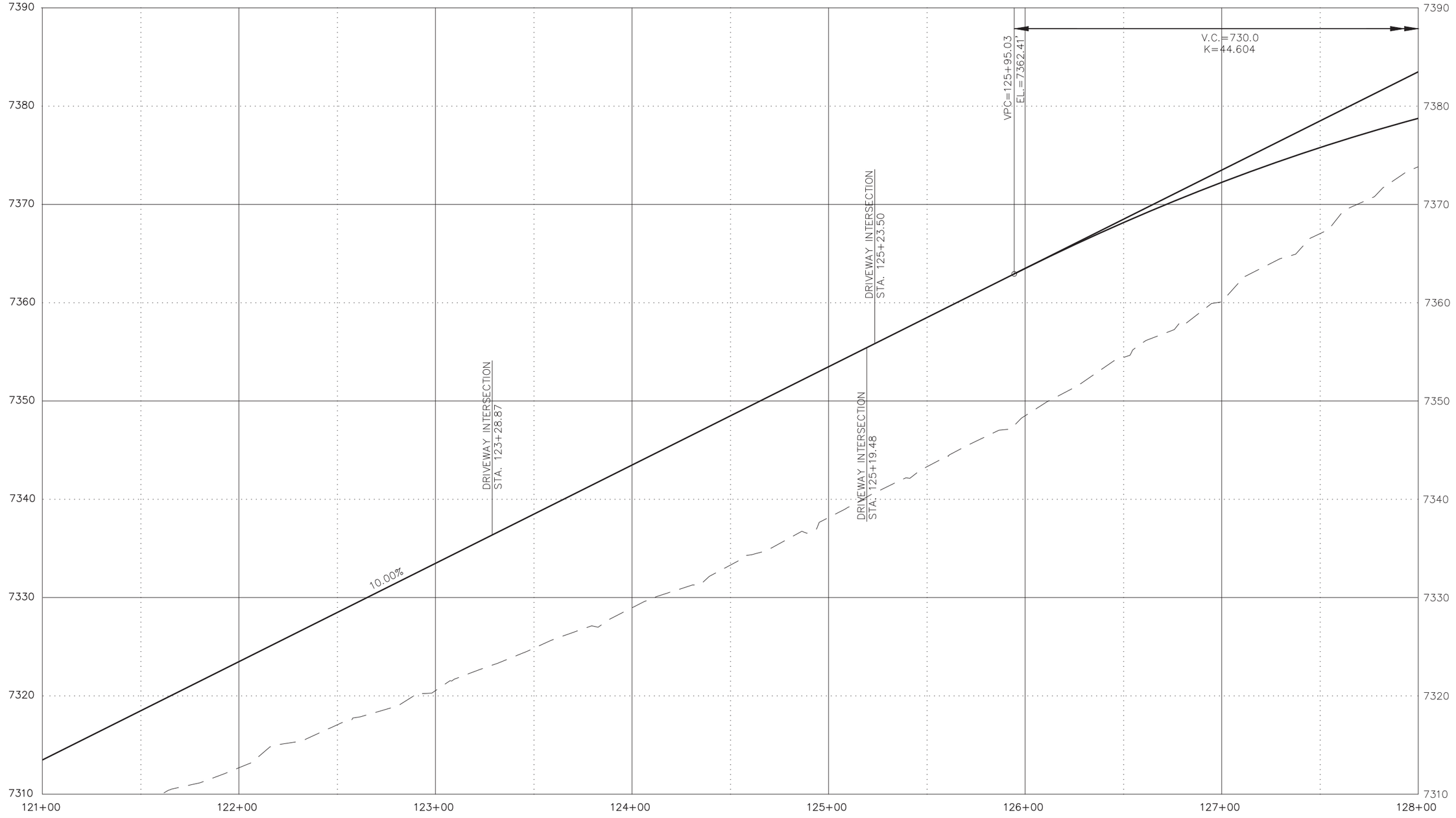

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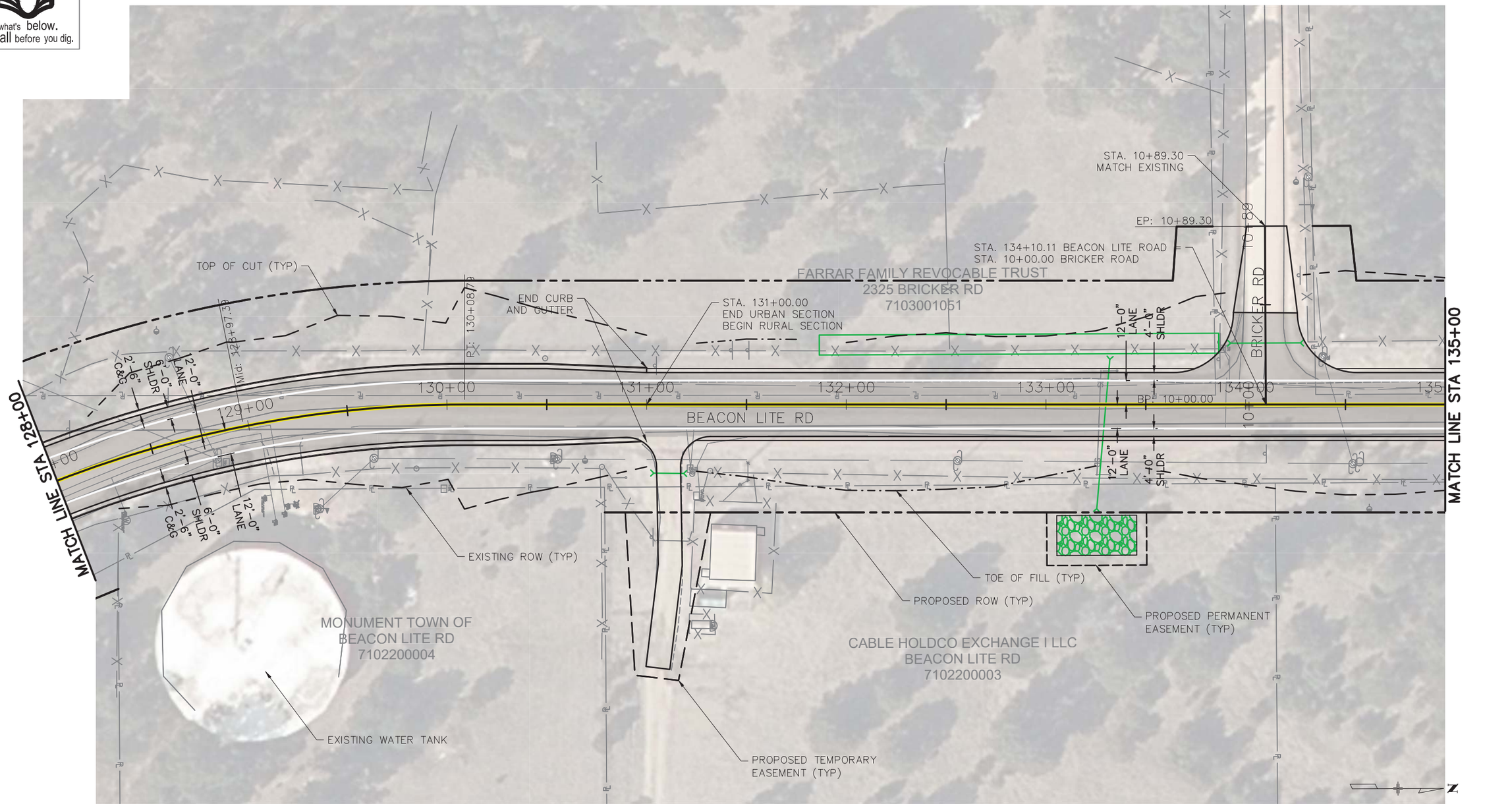

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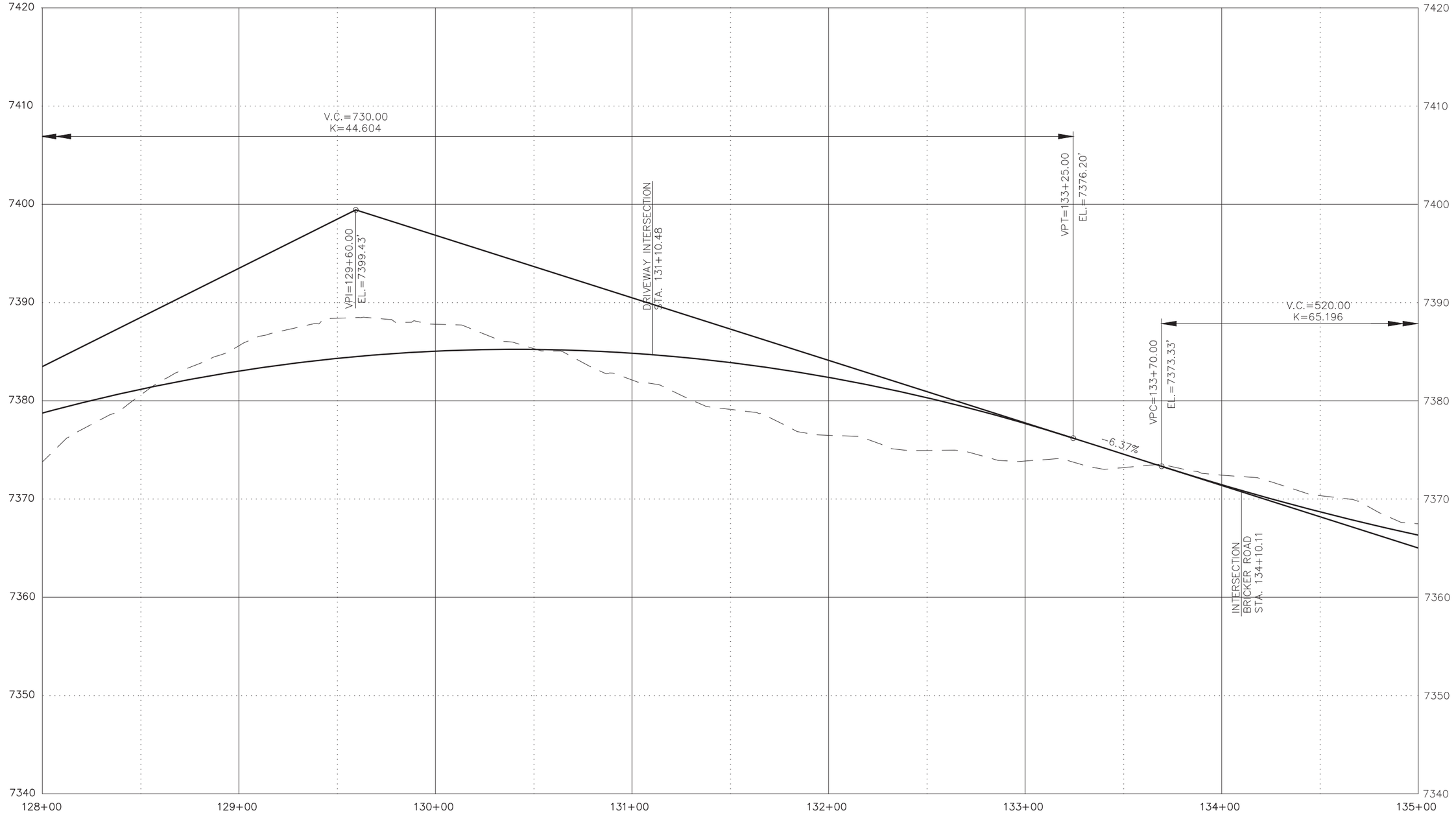

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ROADWAY PROFILE
BEACON LITE ROAD

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Subset Sheets: 12 OF 26

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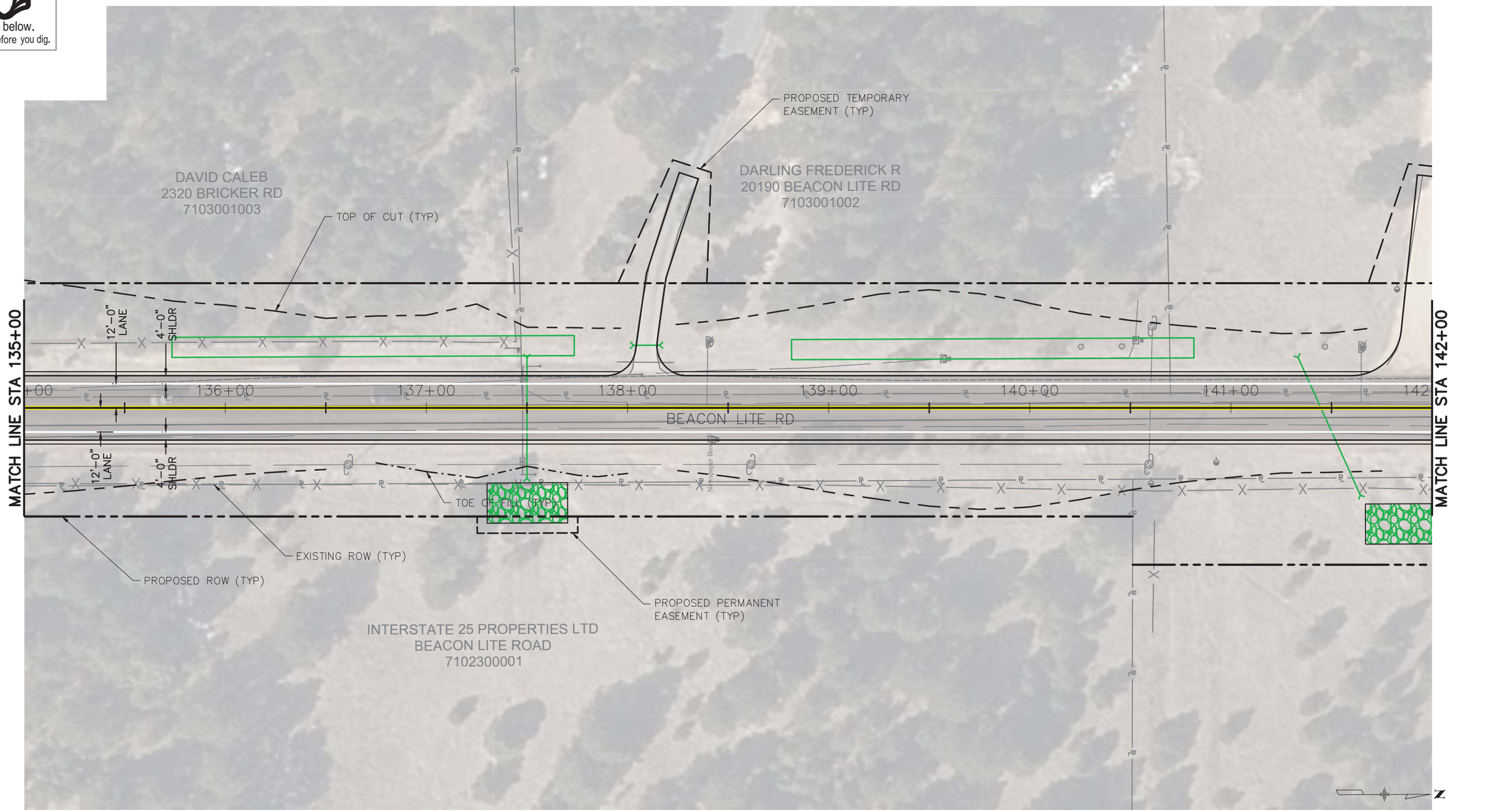

HORIZONTAL SCALE: 1"=50'

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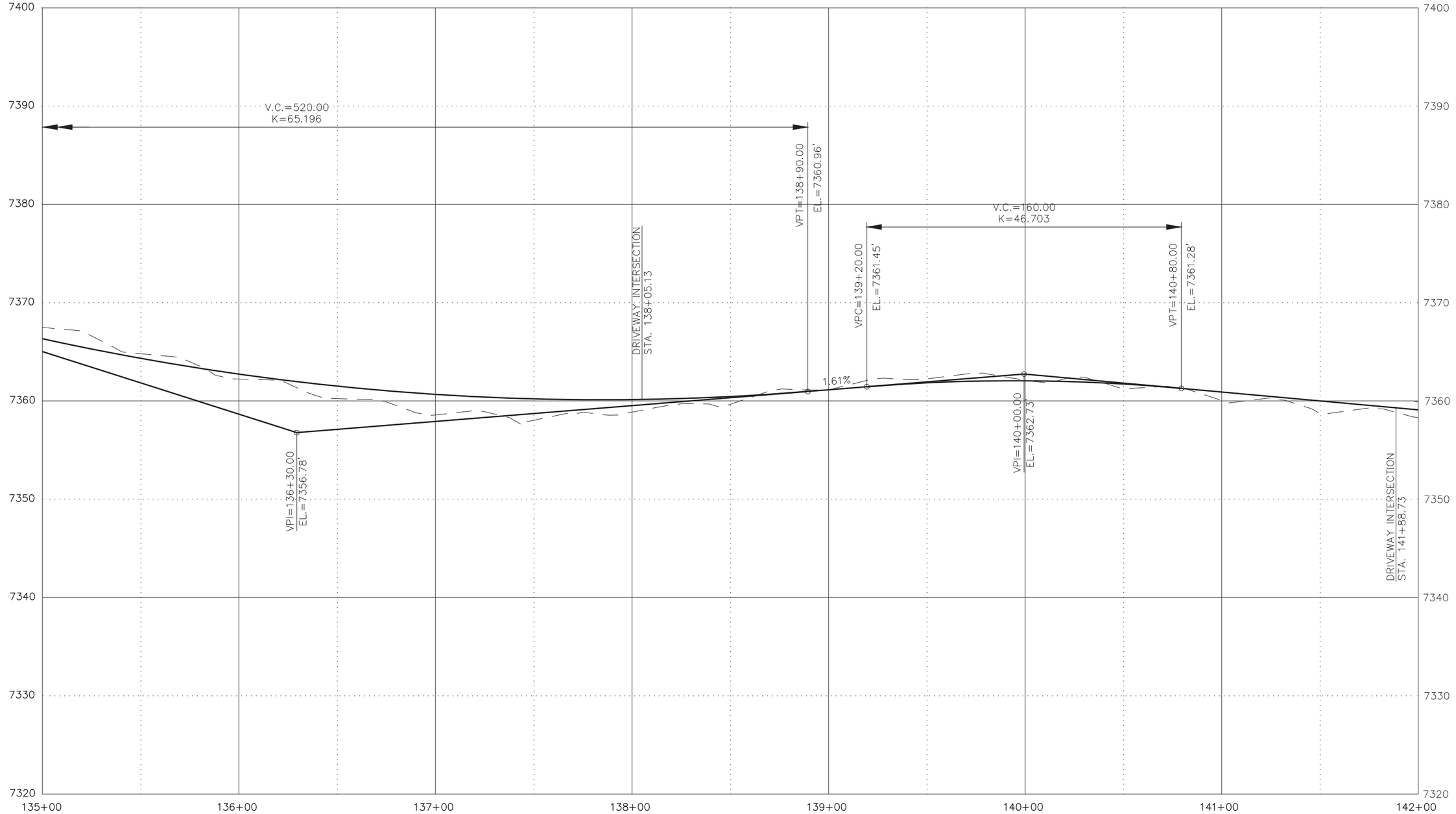
No Revisions:	Designer: KRS	Structure Numbers		128558
Revised:	Detailer: RBR			
Void:	Sheet Subset: ROADWAY	Subset Sheets: 13 OF 26		Sheet Number 16



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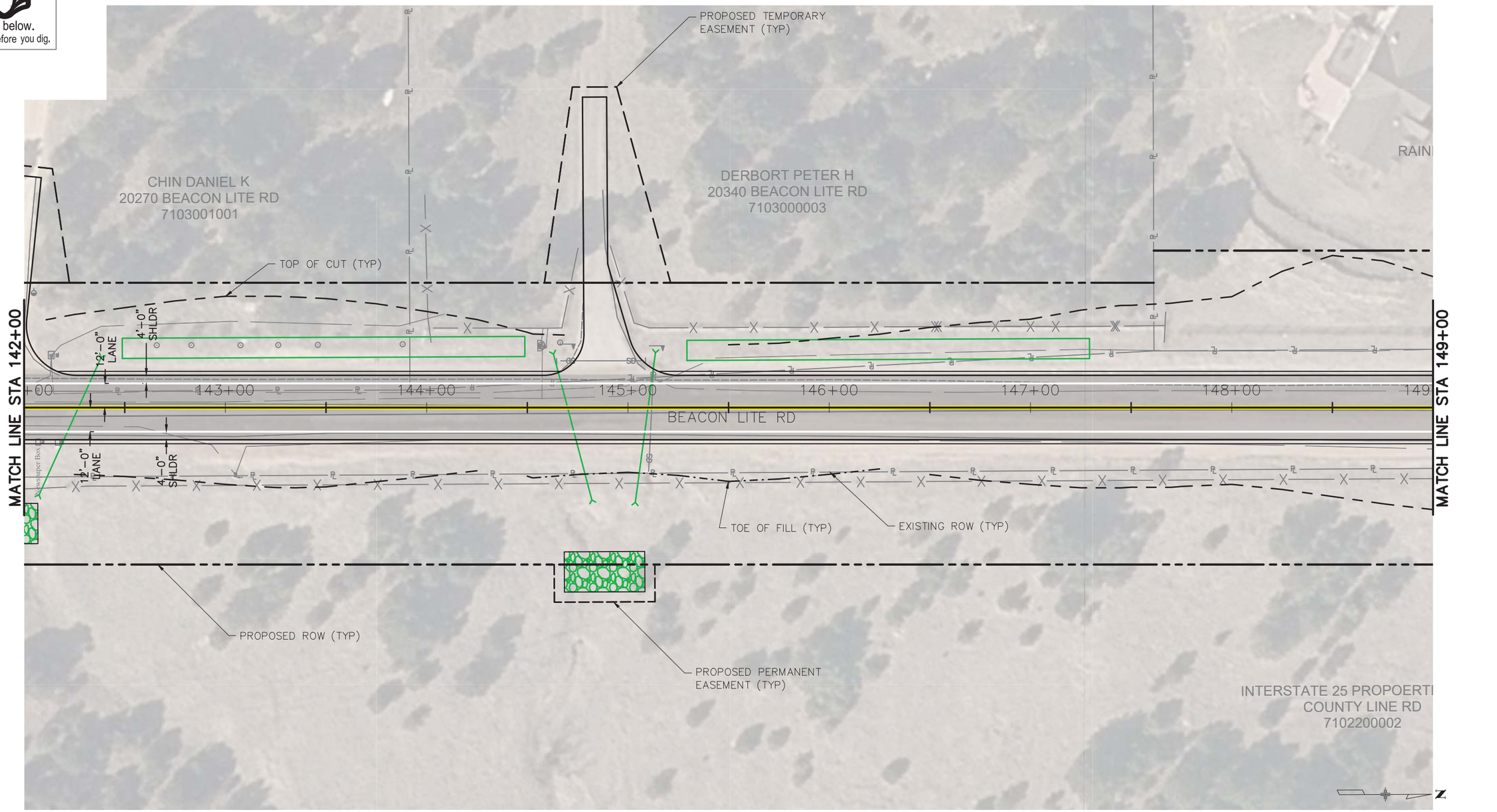
File Name: 175644_RDWY_Plan.dwg		Date:	Comments / Init.
Horiz. Scale: 1"=50' Vert. Scale: 1"=5'			
Unit Information Unit Leader Initials			
Michael Baker INTERNATIONAL — MICHAEL BAKER INTERNATIONAL, INC. 165 S. UNION BLVD., STE. 1000 LAKEWOOD, CO 80228 720.514.1100			

EL PASO COUNTY COLORADO

As-Constructed	BEACON LITE ROAD IMPROVEMENTS ROADWAY PROFILE BEACON LITE ROAD		Project No./Code
No Revisions:			128558
Revised:	Designer: KRS	Structure Numbers	
Void:	Detailer: RBR		
	Sheet Subset: ROADWAY	Subset Sheets: 14 OF 26	Sheet Number 17

811
Know what's below.
Call before you dig.



Print Date: 2/7/2020
File Name: 175644_RDWY_Plan.dwg
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Sheet Revisions		
Date:	Comments	Init.

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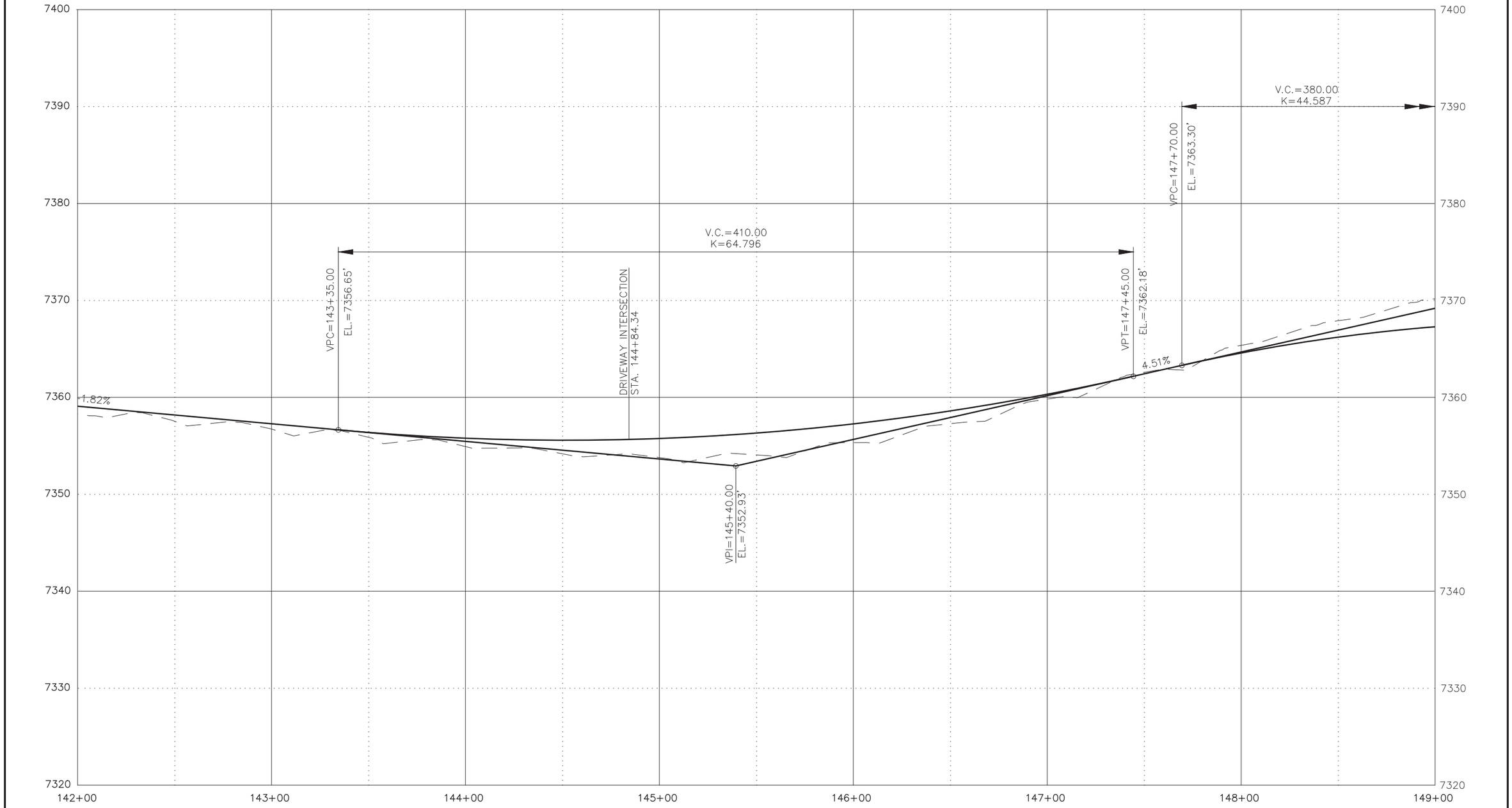
BEACON LITE ROAD IMPROVEMENTS
ROADWAY PLAN
BEACON LITE ROAD

Designer: KRS
Detailer: RBR
Sheet Subset: ROADWAY
Structure Numbers
Subset Sheets: 15 OF 26

Project No./Code
128558

Sheet Number 18



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BEACON LITE ROAD IMPROVEMENTS
ROADWAY PROFILE
BEACON LITE ROAD

Designer: KRS
Detailer: RBR
Sheet Subset: ROADWAY
Structure Numbers
Subset Sheets: 16 OF 26

Project No./Code
128558

Sheet Number 19

Know what's below. Call before you dig.

BOW PROPERTIES REVOC LIVING
20390 BEACON LITE RD
7103000002

PROPOSED TEMPORARY EASEMENT (TYP)

MATCH LINE STA 149+00

12'-0" LANE

4'-0" SHLDR

150+00 151+00 152+00 153+00 154+00 155+00 155+38

BEACON LITE RD

160' BAY TAPER

186' LANE LENGTH

50' STORAGE

STA. 155+37.66 BEACON LITE ROAD =
STA. 27+51.51 COUNTY LINE ROAD

155*1.2 for 4% downgrade

EXISTING ROW (TYP)

TOP OF CUT (TYP)

346' DECELERATION LENGTH

PROPOSED ROW (TYP)

ES LTD

26+00 27+00 28+00 29+00 PT 29+10.79

COUNTY LINE RD

El Paso Co
2-48

2. Exclusive Right Turn Lanes Required

Exclusive right turn lanes shall be provided wherever right turn lanes are specified as being needed by an approved TIS, identified in the MTCP, required by the ECM or determined to be warranted by the ECM Administrator. Information in the TIS shall be used to determine whether an exclusive right turn lane is warranted. Warrant determinations shall also be based on this chapter, which include:

- Expressway Right Turn Lane (State Highway Access Code Designation - EX): A right turn lane is required for any access with a projected peak hour right turn ingress turning volume of 10 VPH or greater. A right turn acceleration lane is required for any access with a projected peak hour right turn egress turning volume of 10 VPH or greater.
- Principal Arterials Right Turn Lane (State Highway Access Code Designation - RA for Rural and NR-A for Urban): A right turn lane is required for any access with a projected peak hour right ingress turning volume of 25 VPH or greater. A right turn acceleration lane is required for any access with a projected peak hour right turning volume of 50 VPH or greater when the posted speed on the roadway is greater than 40 MPH. A right turn acceleration lane may also be required at a signalized intersection if a free right-turn is needed to maintain an appropriate level of service in the intersection.
- Minor Arterials (State Highway Access Code Designation - RB for Rural and NR-B for Urban) and Lower Classifications Right Turn Lane: A right turn lane is required for any access with a projected peak hour right turning volume of 50 VPH or greater. An acceleration lane is generally not required.

Chapter 2 Transportation Facilities
Adopted: 12/23/2004
Revised: 12/13/2016
REVISION 6
Section 2.3.7-2.3.7

3. Acceleration Lanes Required

Where acceleration lanes are required, deviations may be considered at stop controlled intersections under certain circumstances. As stated in the AASHTO "Green Book" (PGDHS), acceleration lanes are not always desirable. Please refer to the "Green Book" for additional information concerning instances where acceleration lanes may not be desirable. Deviations may also be considered at intersections with traffic signals.

No Accel lane. Per Green Book, not warranted since Beacon is stop condition and drivers can wait for opening in traffic. Also a low volume road

0' 25' 50' 100'
HORIZONTAL SCALE: 1"=50'

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BEACON LITE ROAD IMPROVEMENTS
ROADWAY PLAN
BEACON LITE ROAD

Designer: KRS
Detailer: RBR
Sheet Subset: ROADWAY
Structure Numbers:
Subset Sheets: 17 OF 26

Project No./Code: 128558

Sheet Number 20

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

IMPORTANT INFORMATION

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims

being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland.