GeoDesign Inc

June 28, 2019

RJL Holdings, LLC
14155 Beavercreek Road
Oregon City, OR 97045

Attention: Jamison and Robert Luther

Response to City of Oregon City's Geotechnical Review Comments
Geologic Hazards Development Permit
Forest Edge Apartments
Oregon City, Oregon
GeoDesign Project: RJLHold-1-01

INTRODUCTION

This letter addresses geotechnical review comments received from the City of Oregon City (City) for proposed redevelopment of the Lower Campus of the Forest Edge Apartments complex located in Oregon City, Oregon. The City's geotechnical consultant, Foundation Engineering, Inc. (FEI), provided initial review comments for the project in a memorandum dated April 18, 2019. FEI reviewed the project plans prepared by PACE Engineers, Inc. (dated February 2019) as well as the July 2018 comprehensive geotechnical report prepared by GeoDesign, Inc.[1] However, FEI did not have our March 2019 supplemental report[2] that addressed criteria for the Geologic Hazards Development Permit as well as updated monitoring data and recommendations for the proposed project. We contacted Tim Pfeiffer with FEI and forwarded the March 2019 supplemental report for FEI's review. Thereafter, FEI provided modified review comments for the project in a second completeness review memorandum dated June 24, 2019, which is presented in Attachment A. This letter is intended to address the remaining review comments from FEI.

[1] GeoDesign, Inc., 2018. *Report of Geotechnical Engineering Services; Lower Campus Slope Stability and Dewatering System Evaluation; Forest Edge Apartments; Oregon City, Oregon*, dated July 31, 2018. GeoDesign Project: RJLHold-1-01
[2] GeoDesign, Inc., 2019. *Supplemental Report of Geotechnical Engineering Services; Geologic Hazards Development Permit; Forest Edge Apartments; Oregon City, Oregon*, dated March 12, 2019. GeoDesign Project: RJLHold-1-01

ADDITIONAL RECOMMENDATIONS

Additional geotechnical recommendations for the proposed redevelopment project are provided below, organized in accordance with the review comments received from FEI.

SITE PREPARATION

Stripping and Grubbing

The existing topsoil zone should be stripped and removed from all fill areas and for a 5-foot margin around proposed pavement areas. The stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas. Trees and their root balls should be grubbed to the depth of the roots, which could exceed 3 feet below ground surface. Depending on the methods used to remove the preceding material, considerable disturbance and loosening of the subgrade could occur. We recommend that disturbed soil be removed to expose stiff native soil. The resulting excavations should be backfilled with structural fill.

Old Pavements and Undocumented Fill

Old pavements and undocumented fill soil may exist in portions of the project area from prior site development. Reliable strength properties are extremely difficult to predict for undocumented fill. In order to reduce the risk of settlement or adverse effects on slope stability for proposed fill slopes, we recommend removing the undocumented fill and replacing it with structural fill or scarifying and re-compacting the on-site soil to structural fill requirements. A member of our geotechnical staff should observe all subgrade areas to help identify unsuitable undocumented fill soil.

Subgrade Evaluation

A member of our geotechnical staff should observe the exposed subgrades after old pavements are removed and site cutting and subgrade improvement have been completed to determine if there are areas of unsuitable or unstable soil. The subgrade should be proof rolled with a fully loaded dump truck or similar heavy, rubber-tired construction equipment to identify soft, loose, or unsuitable areas after subgrade compaction is complete. Proof rolling should be observed by a qualified geotechnical engineer or their representative. Areas that appear to be too wet and soft to support proof rolling equipment should be evaluated by probing.

STRUCTURAL FILL

General

Structural fill includes fill beneath foundations, pavements, other areas intended to support structures, or within the influence zones of structures. Fills should only be placed over a subgrade that has been prepared in conformance with the "Site Preparation" section. However, all material used as structural fill should be free of organic matter or other unsuitable material and should meet the specifications provided in Oregon Standard Specifications for Construction – 2018 (OSSC) 00330.14 (Selected Granular Backfill) or OSSC 00330.15 (Selected Stone Backfill), depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill are provided below.

On-Site Material

Near-surface soil at the site consists primarily of fine-grained soil. This soil can be used for structural fill provided it is adequately moisture conditioned, free of organic debris, and meets the requirements provided in OSSC 00330.12 (Borrow Material). The site soil is sensitive to small changes in moisture content and is highly susceptible to disturbance when wet. Use of the on-site material as structural fill will not be possible during wet weather. If construction is planned for the wet season, then careful consideration of the construction methods and schedule should be made to reduce over-excavation of disturbed site soil.

Laboratory testing indicates that the moisture content of the on-site material (at the time of our explorations) is considerably greater than the anticipated optimum moisture content required for adequate compaction. It is likely that moisture conditioning (drying) will be required to achieve adequate compaction, even during the dry season. We recommend using imported granular material for structural fill if the on-site material cannot be properly moisture conditioned.

When used as structural fill, the on-site soil should be placed in lifts with a maximum uncompacted thickness of 8 inches. The silt should be compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

Pavement Aggregate Base

Aggregate base used beneath conventional pavements should be clean, crushed rock or crushed gravel that is fairly well graded between coarse and fine. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

Trench Backfill Material

Trench backfill placed beneath, adjacent to, and at least 2 feet above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 sieve and meet the specifications provided in OSSC 00405.13 (Pipe Zone Material). The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments, within paved surfaces, or beneath proposed or future building pads, the remainder of the trench backfill should consist of well-graded, granular material with a maximum particle size of 2½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 Sieve and meet the specifications provided in OSSC 00405.14 (Trench Backfill, Class B, C, or D). This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department. The upper 2 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill material that is free of organics

and material over 6 inches in size and meet the specifications provided in OSSC 00330.12 (Borrow Material). This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Drain Rock

Backfill for subsurface drains should consist of drain rock meeting the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material) and have at least two angular faces. The drain rock should be wrapped in a geotextile fabric meeting the specifications provided in this section.

Geotextile Fabric

A geotextile drainage fabric will be required at the interface of the on-site soil and drain rock. In addition, geotextile subgrade fabric is required where soft subgrade is encountered. Drainage and subgrade fabric should be either woven or unwoven and meet the specifications provided in OSSC 02320 (Geosynthetic Installation) for drainage (Type 1 or 2) and subgrade fabric. The geotextiles should be installed in conformance with the specifications provided in OSSC 00350 (Geosynthetic Installation).

RETAINING STRUCTURES

While significant retaining walls are not anticipated for this project, short gravity walls ranging from 1 foot to 3 feet in height are anticipated along the uphill border of the access road adjacent to the Berryhill Slope southwest of the property.

Assumptions

Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional modular block retaining walls, (2) the walls are less than 3 feet in height, (3) the backfill is drained and consists of imported granular material, and (4) the backfill has a slope flatter than 2H:1V for a lateral distance equal to the wall height. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

Wall Design Parameters

Unrestrained site walls (i.e., rotation on the wall occurs) that retain native soil should be designed to resist active earth pressures of 35 to 55 pounds per cubic foot (pcf) when supporting slopes (upward behind the wall) between 4H:1V and 2H:1V, respectively. Where retained slopes are between inclinations of 4H:1V and 2H:1V, the designer may linearly interpolate between these active earth pressures. For the embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of 7H2 pounds per lineal foot of wall, where H is the average height of the soil supported by the wall in feet and applied at 0.6H from the base of the wall.

If retaining walls are restrained from rotation (no rotation allowed in the wall) before they are backfilled, the aforementioned active earth pressures shall be increased by 15 pcf. If other surcharges (e.g., slopes steeper than 2H:1V, foundations, vehicles, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, then additional

pressures may need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

Wall Drainage and Backfill

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, then our office should be contacted for revised design forces.

The backfill material placed behind the walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of drain rock placed and compacted in conformance with the "Structural Fill" section.

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of the finished grade. The drain rock and drainage geotextile fabric should meet specifications provided in the "Structural Fill" section. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be postponed to at least four weeks after the wall is backfilled, unless survey data indicate that settlement is complete before that time.

ABANDONING OLD UTILITIES

Old utilities should be removed as they are encountered during the site excavation process. There may be remnant pipes left in place after the contractor excavates and constructs the proposed improvements. Abandoned utility lines left in place should be filled with grout or other suitable flowable backfill.

DEWATERING WELL SYSTEM OPERATION AND MAINTENANCE PLAN

GeoDesign will provide an Operation and Maintenance Plan for the dewatering well system as a separate document.

INSTRUMENTATION MONITORING UPDATE

We provided an update to inclinometer and water-level monitoring data in our March 2019 supplemental report. As of March 2019, water levels were significantly lower than previously recorded natural water levels (i.e., levels unaffected by the dewatering system), and inclinometers showed no significant displacements since January 2019. We collected another round of monitoring data on June 13, 2019. Those data indicate that water levels continue to be

depressed by the dewatering system, and the inclinometers continue to show no significant displacements. Summary plots of the water levels and inclinometers are presented in Attachment B.

FUTURE MONITORING PLAN

Monitoring data should continue to be collected from all inclinometers and piezometers at the Forest Edge Apartments on a quarterly basis. This monitoring frequency could be reduced if data collected during seasonal cycles with above-average precipitation indicate no excessively high water levels or significant inclinometer displacements.

We further recommend that, after a storm resulting in greater than 1 inch of precipitation in a 24-hour period, the site should be visually inspected and select water levels should be measured, including GD-1p, GD-2p, LT-2i, and GD-3p. This monitoring should occur within one to two days following the significant rainfall, which would allow the stormwater to infiltrate and affect groundwater. If water levels are higher than the range previously observed since the dewatering system has been active, the dewatering well system should be inspected to verify operation. Also, data should be collected from the inclinometers and vibrating-wire piezometers installed at GD-8i, GD-10i, and GD-11i.

GEOTECHNICAL REVIEW OF PLANS

GeoDesign has reviewed the grading and stormwater management plans prepared by PACE Engineers for redevelopment of the Lower Campus of the Forest Edge Apartments. In our professional opinion, the plans have been prepared in general accordance with our geotechnical recommendations for the project.

LIMITATIONS

We have prepared this letter for use by RJL Holdings, LLC and other members of the design and construction teams for the proposed project. The data and letter can be used for bidding or estimating purposes, but our letter, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other nearby sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The scope does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our letter for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the letter was prepared. No warranty, express or implied, should be understood.

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this letter or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Erick J. Staley, C.E.G.
Senior Associate Engineering Geologist

Expires 06/01/2020

Jeffery D. Tucker, P.E., G.E.
Principal Engineer

cc: David Poulson, PACE Engineers, Inc. (via email only)
Joe Sturdevant, PACE Engineers, Inc. (via email only)

EJS:JDT:sn
Attachments
One copy submitted (via email only)
Document ID: RJLHold-1-01-062819-geol.docx

ATTACHMENT A

ATTACHMENT A

MODIFIED GEOTECHNICAL REVIEW COMMENTS

Foundation Engineering, Inc. prepared the completeness review memorandum presented in this attachment dated June 24, 2019. It lists items still required to complete the geotechnical component of the Geologic Hazards Development Permit.

Foundation Engineering, Inc.
Professional Geotechnical Services

Memorandum

Date: June 24, 2019

To: Josh Wheeler, P.E.
Development Projects Manager
City of Oregon City

From: Timothy J. Pfeiffer, P.E., G.E.

Subject: Geohazards (Chapter 17.44) Completeness Review (#2)

Project: GEO 19-01, PR-126-2019 - Forest Edge Apartments
Tax lot 3s2e04c - 807
Project # 2172001 (202)

We previously provided a completeness review dated April 18, 2019. Subsequently we received a "Supplemental Report of Geotechnical Engineering Services prepared by GeoDesign", dated March 12, 2019. This report provided the results of the additional monitoring and a final geotechnical opinion regarding the adequacy of the system to provide mitigation for the site. The report also included recommendations for grading, earthwork and surface drainage and management of surface water. We understand that no new structures or retaining walls are planned. The following items are still required for completeness:

1. A maintenance and operating plan for the dewatering system and ongoing monitoring.

2. Review of the grading and stormwater drainage plans by the geotechnical engineer and confirmation that the plans are consistent with their recommendations.

In addition, the following is required for the plans related to the geologic hazards:

1. Plans for abandoning existing waterlines, stormwater facilities and sewer lines not in service.

2. Provisions for sanitary sewers, storm drains, and water lines to accommodate the landslide conditions as recommended by the geotechnical engineer.

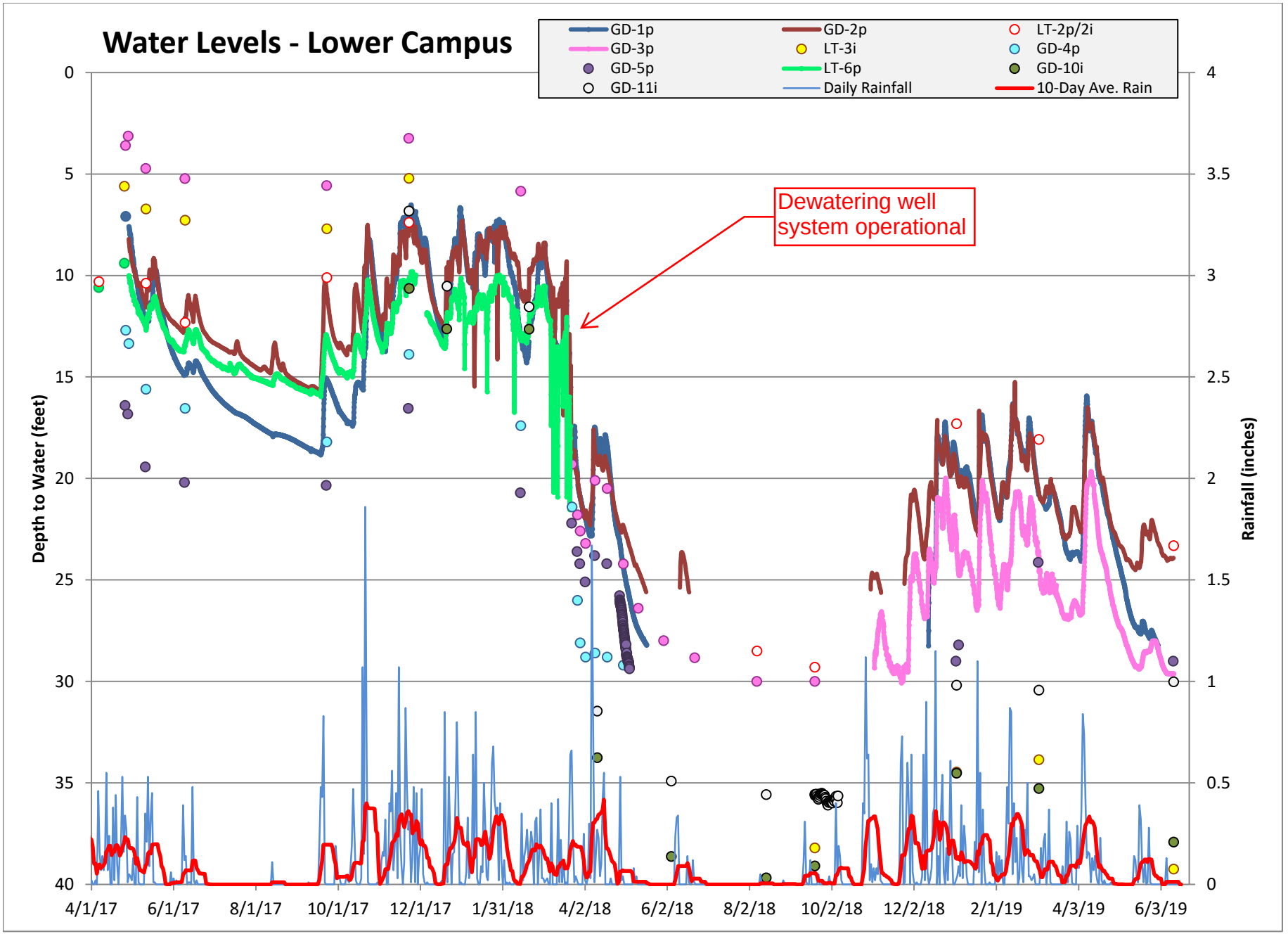
We hope this discussion meets your current needs and look forward to assisting you further. Please do not hesitate to call with any questions.

ATTACHMENT B

ATTACHMENT B

INCLINOMETER AND PIEZOMETER DATA PLOTS

Inclinometer and piezometer data plots are presented in this attachment. Data were collected from both the Lower and Upper Campuses.


Water Levels - Lower Campus
GD-1p
GD-2p
LT-2p/2i
GD-3p
LT-3i
GD-4p
GD-5p
LT-6p
GD-10i
GD-11i
Daily Rainfall
10-Day Ave. Rain
Dewatering well system operational
Depth to Water (feet)
Rainfall (inches)
0
5
10
15
20
25
30
35
40
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/17
6/1/17
8/1/17
10/1/17
12/1/17
1/31/18
4/2/18
6/2/18
8/2/18
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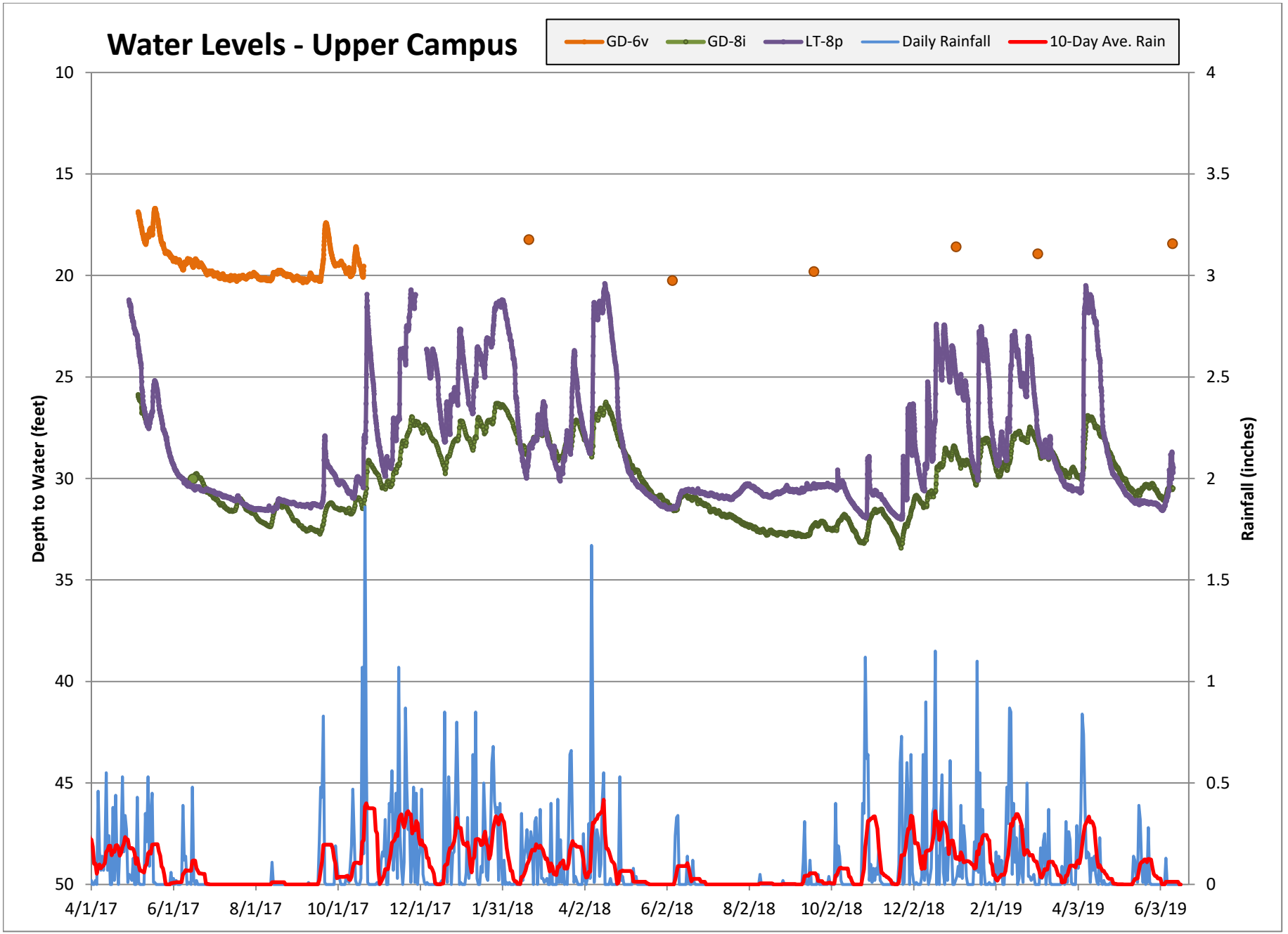
2/1/19
4/3/19
6/3/19


Water Levels - Upper Campus
GD-6v
GD-8i
LT-8p
Daily Rainfall
10-Day Ave. Rain
Depth to Water (feet)
Rainfall (inches)
10
15
20
25
30
35
40
45
50
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/17
6/1/17
8/1/17
10/1/17
12/1/17
1/31/18
4/2/18
6/2/18
8/2/18
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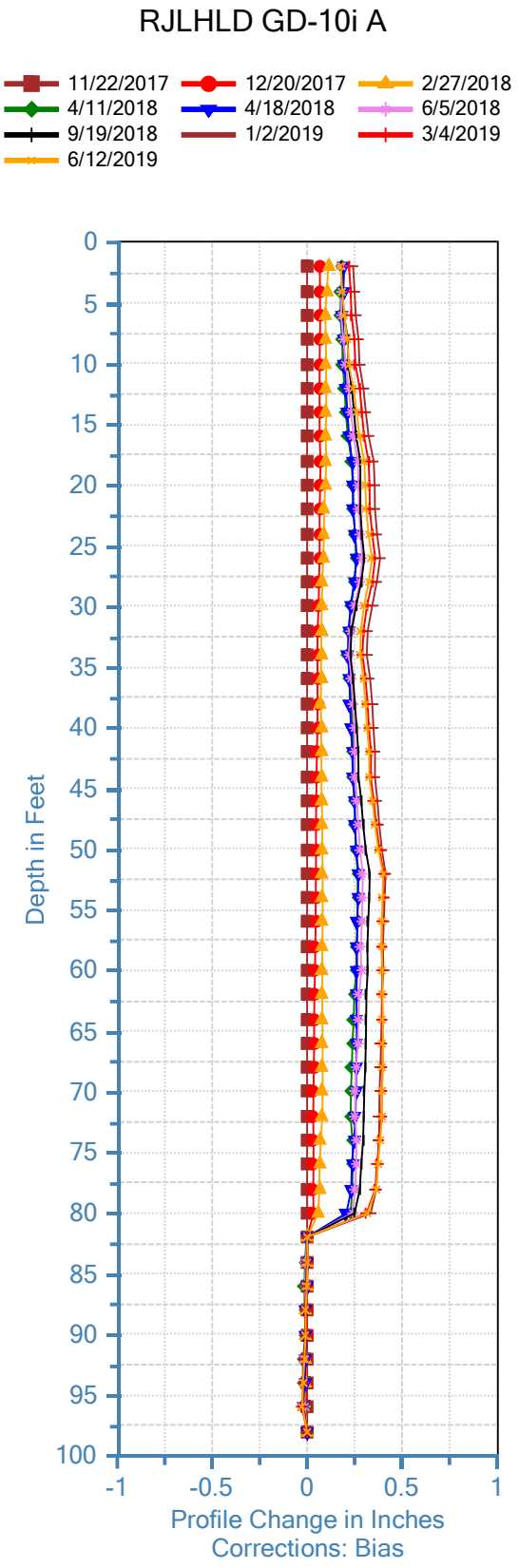
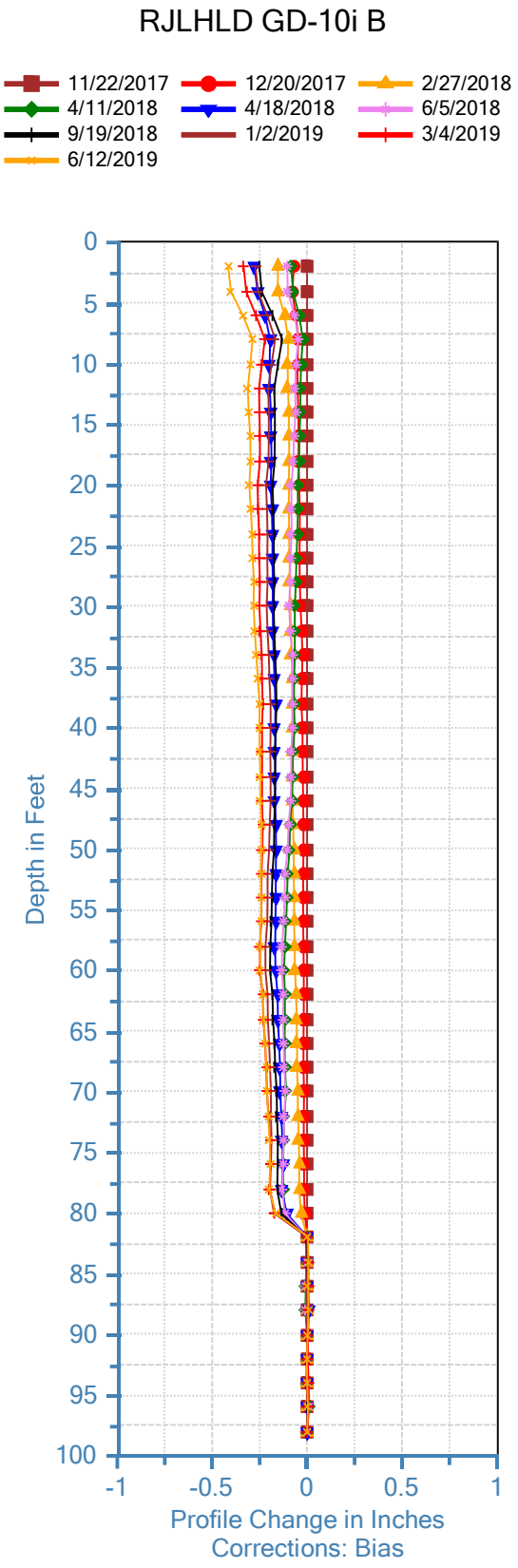
2/1/19
4/3/19
6/3/19

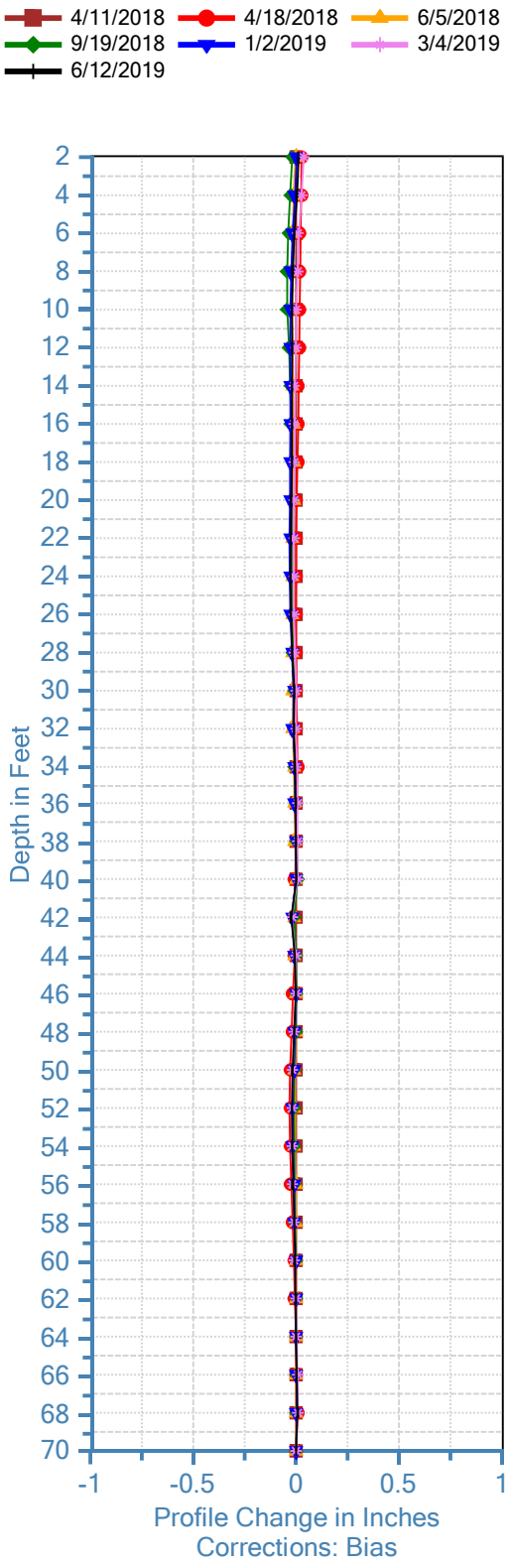
Lower Campus - Uphill



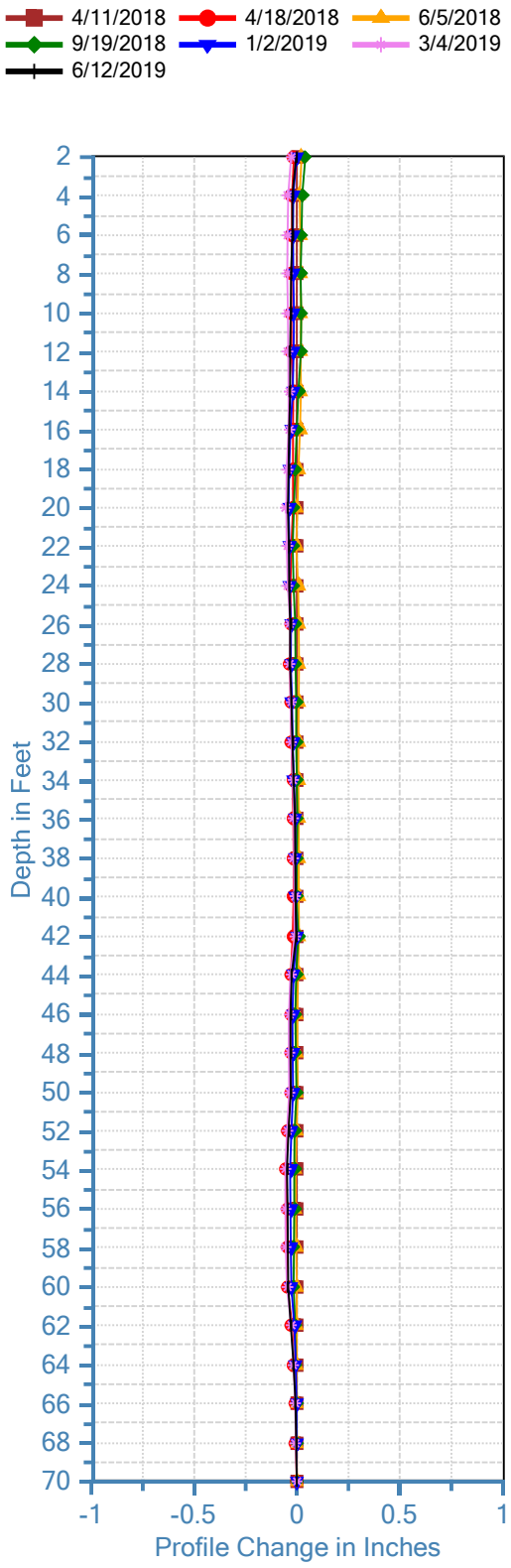


Lower Campus - Downhill
post-disturbance

RJLHLD GD-11i A

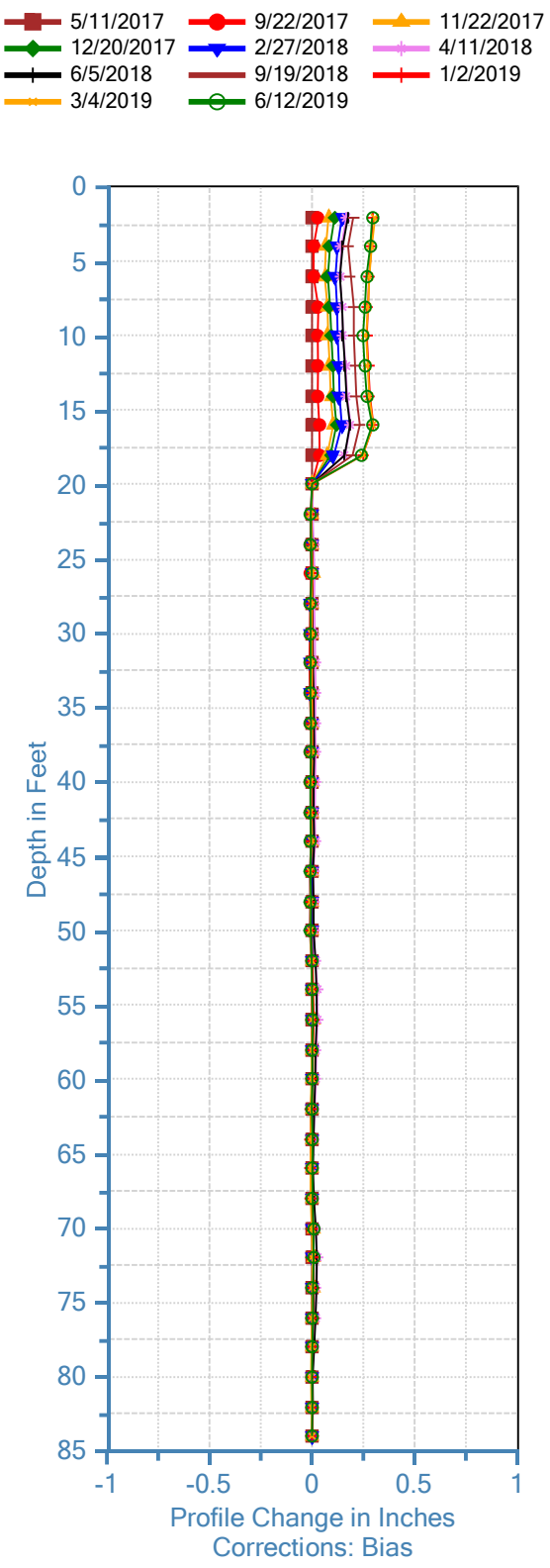


RJLHLD GD-11i B

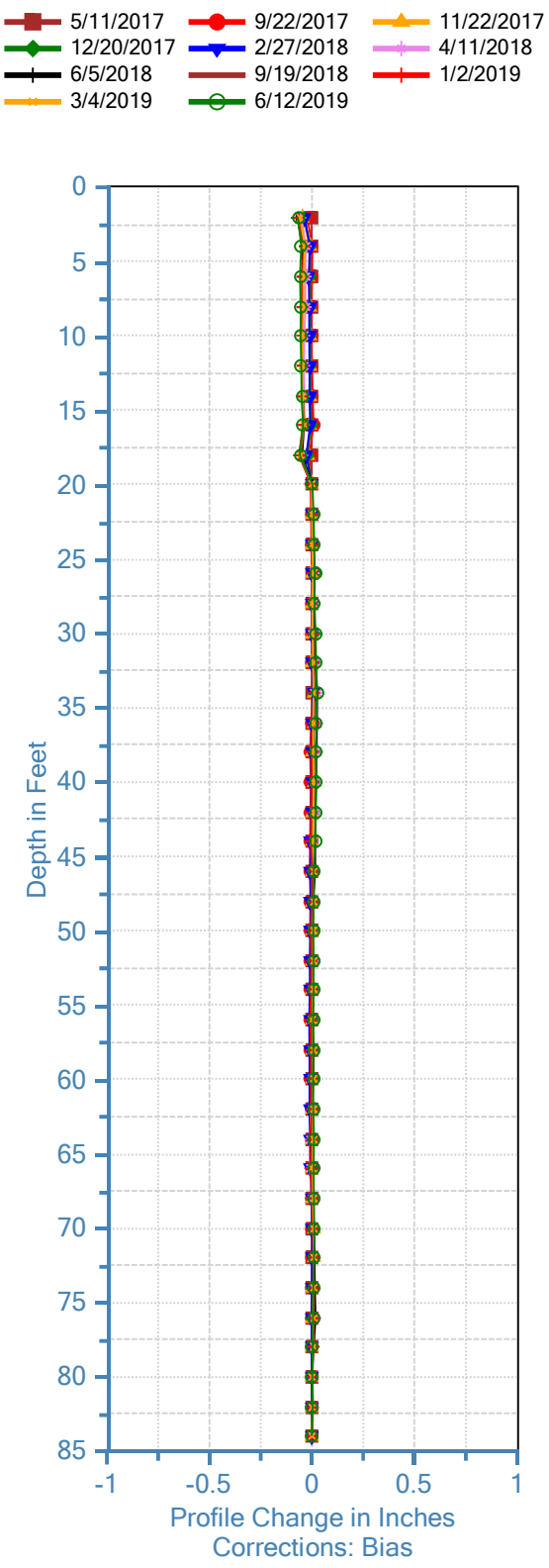


Upper Campus
Fill Failure

RJLHLD GD-8i A

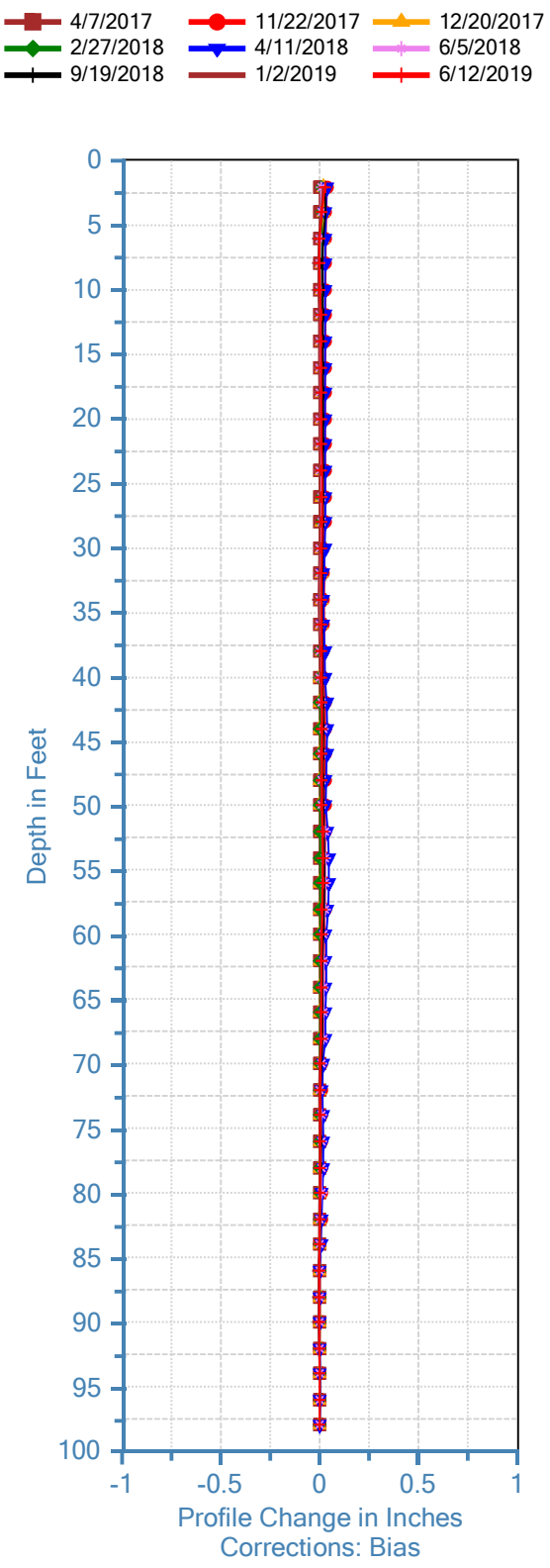


RJLHLD GD-8i B

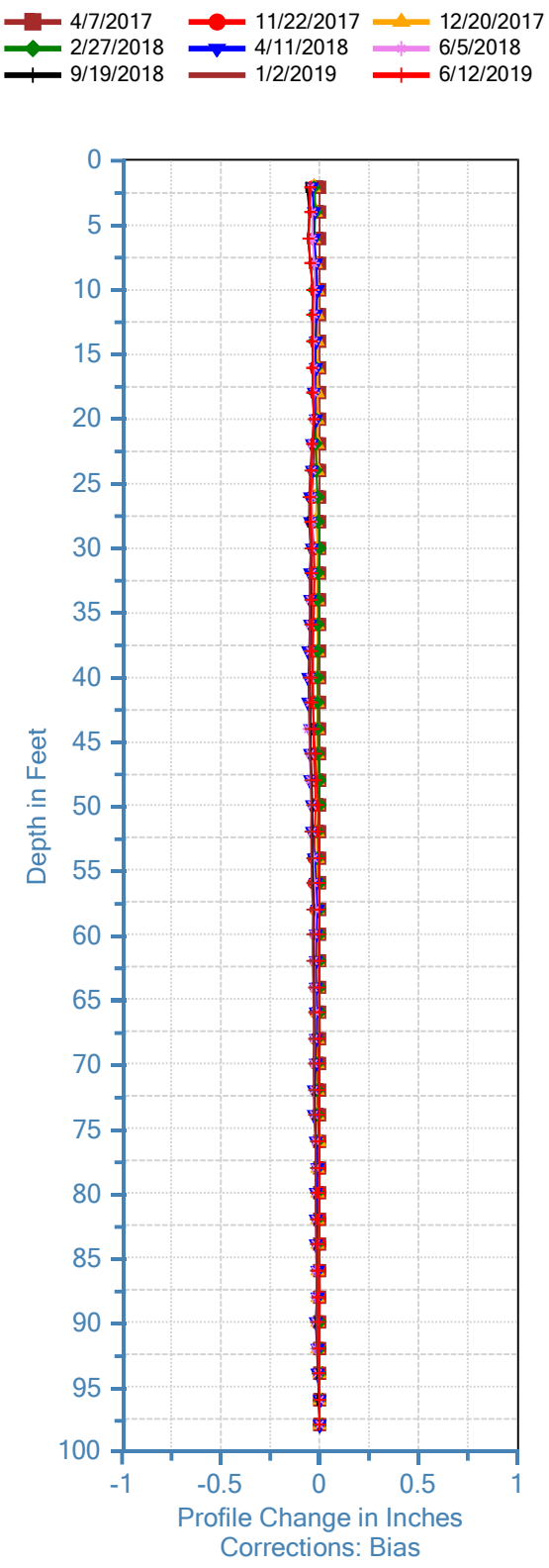


Upper Campus
Behind Bldg 5

RJLHLD LT-7 A

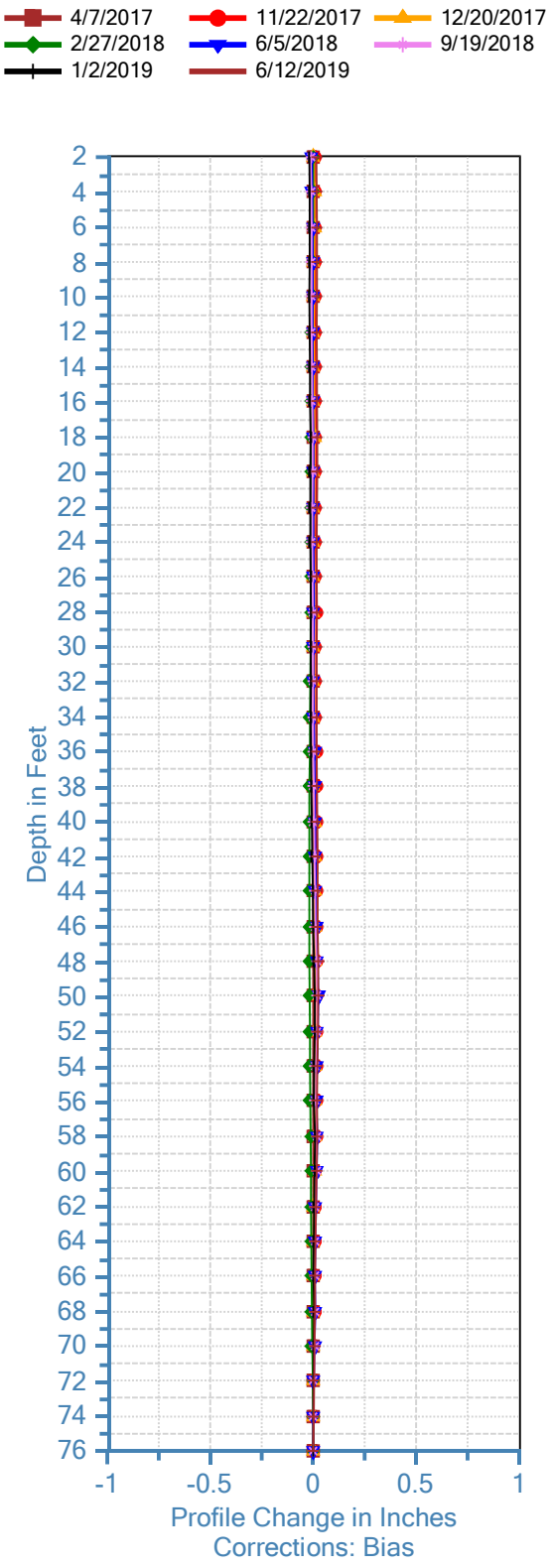


RJLHLD LT-7 B



Upper Campus - Uphill

RJLHLD LT-8 A



RJLHLD LT-8 B