GeoDesign Inc

March 12, 2019

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

Attention: Jamison and Robert Luther

Supplemental Report of Geotechnical Engineering Services
Geologic Hazards Development Permit
Forest Edge Apartments
Oregon City, Oregon
GeoDesign Project: RJLHold-1-01

INTRODUCTION

GeoDesign, Inc. is pleased to provide this supplemental report to RJL Holdings, LLC providing additional discussion and geotechnical recommendations for redevelopment of the Lower Campus of the Forest Edge Apartment complex located in Oregon City, Oregon. In July 2018 we provided a comprehensive geotechnical report[1] summarizing our geologic characterization of the site, subsurface exploration program, slope stability analysis, preliminary geotechnical recommendations, and installation and performance of a preliminary subsurface dewatering system installed at the Lower Campus.

Since preparation of the comprehensive report, PACE Engineers, Inc. (PACE) has prepared preliminary plans for reconstructing the Lower Campus. Plans include reconstruction of roads and utilities to restore the complex to habitable condition. We understand the buildings that remain on the site will be refurbished, but they have not experienced significant damage and do not require structural reconstruction. A new stormwater management system is proposed to control stormwater from both the Lower and Upper Campuses to a suitable discharge point at an established natural drainage downslope of the built area. Surface water from the Berryhill slope will also be collected and diverted into the new stormwater system. This is an important feature of the proposed project; controlling stormwater in a functional system is key to mitigating the slope stability hazards.

[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

PACE has prepared a Geologic Hazards Development Permit (GHDP) application package for the reconstruction project, which also retroactively includes the preliminary dewatering system. As part of the GHDP application, a "preliminary engineering geologic assessment report" and a "preliminary geotechnical engineering report" must be prepared, as described under points 7 and 8 from the City of Oregon City's guidance document[2] explaining requirements for the GHDP Type II Land Use Application. Much of the technical content required for the GHDP geotechnical reports is already included in our July 2018 comprehensive report. We submit this supplemental report to address the criteria required for the GHDP, including additional recommendations as needed. We also provide an update to the ongoing instrumentation monitoring at the site.

SUPPLEMENTARY DISCUSSION AND RECOMMENDATIONS

Excerpts from the City's GHDP guidance document are italicized below, followed by relevant discussion and recommendations for each criterion.

ENGINEERING GEOLOGY CONSIDERATIONS

7. Preliminary engineering geologic assessment report, prepared by a suitably qualified and experienced engineering geologist who is registered in the state of Oregon and who derives his or her livelihood principally from that profession, containing a description of:

a. Geologic formations, bedrock and surficial materials including artificial fill;

Site conditions, including the geologic formations, surface materials, and artificial fill, are discussed in Section 3 of the comprehensive report. Prior explorations and interpretations of landsliding by other consultants are also discussed, as well as surface reconnaissance, subsurface explorations, and installation and monitoring of inclinometers and piezometers completed by GeoDesign since 2017.

b. Location of any faults, folds, etc.;

Faults and seismicity are discussed under Section 3.1.2 of the comprehensive report, including discussion of the Bolton fault, which is the nearest mapped fault to the site location. This fault is not considered to be active during the late Quaternary by the U.S. Geological Survey.

c. Structural data including bedding, jointing, and shear zones;

The geologic formations encountered in the subsurface at the site consist mostly of unconsolidated to partially indurated soil units (such as the Troutdale Formation) or severely weathered bedrock units (such as the weathered Boring Lavas). The structure of these geologic strata is relatively flat-lying. The comprehensive report discusses in detail the interpreted depth and attitude of the shear zone underlying the Lower Campus landslide based on borings and inclinometer data. The shear zone is located at depths ranging from 44.5 to 80 feet below ground surface across the site, corresponding to a relatively flat-lying shear zone below most of the Lower Campus.

[2] Oregon City Municipal Code Chapter 17.44 U.S. – Geologic Hazards Development Permit, U.S. Geologic Hazards Application Requirements: Type II Land Use Application; updated May 29, 2015.

d. Off-site geologic conditions that may pose a hazard to the site or that may be affected by on-site development;

The history of landslide activity is discussed in the comprehensive report, including both the ancient landslide that originally formed the Upper and Lower Campuses and the more recent landsliding at both the Forest Edge Apartments and the Berryhill Apartments upslope to the west. Off-site conditions affecting the Lower Campus slope stability include migration of groundwater from uphill areas into the Lower Campus subsurface; stormwater from uphill areas flowing onto the Lower Campus and infiltrating into the subsurface, such as from the steep slope between the Berryhill Apartments and the Lower Campus; stormwater from the Upper Campus flowing onto the Lower Campus and infiltrating; and erosion of the slope toe along Newell Creek.

Off-site areas that could be affected by the Lower Campus include the Berryhill Apartments, the Upper Campus, and the Newell Creek stream channel. The Berryhill slope was recently reconstructed by the owner of the Berryhill Apartments, including installation of a tieback soldier pile wall intended to prevent the remnant ancient landslide block that underlies the Berryhill Apartments from future landsliding. The Upper Campus is not currently affected by deep-seated landsliding.

It is important to emphasize the currently proposed project will primarily restore roads, utilities, and other aspects of the existing apartment complex development. New systems include the stormwater management system and the dewatering system, both of which benefit slope stability. The dewatering system in particular should not only improve slope stability for the Lower Campus but should consequently have positive effects on off-site areas such as the Berryhill slope.

Erosion of the slope toe along Newell Creek is a natural process that likely cannot be prevented without installation of a rock buttress or similar erosion-resistant material. This construction would occur in a sensitive environment and would be practically infeasible, as discussed in the comprehensive report. Stabilizing the Lower Campus landslide would lessen displacement of the hillside toward the stream and therefore lessen the degree of erosion and sediment influx into the stream as a consequence.

e. Cross sections showing subsurface structure, logs of subsurface explorations and analysis if necessary to evaluate the site; and

A cross section presenting our interpretation of the Lower Campus subsurface is presented on Figure 5 and subsurface logs are presented in Appendix A of the comprehensive report. We conducted slope stability analyses of the existing conditions and conditions anticipated following operation of a dewatering system in Section 4.1 of the comprehensive report. Cross sections of the slope models with analytical results are presented in Appendix F of the comprehensive report.

f. Signature and certification number of the engineering geologist.

The comprehensive report is signed and appropriately sealed by an engineering geologist, as is this supplemental report.

g. Report shall also contain a statement as to whether any hazard areas should not be disturbed because of the potential for damage to the site or neighboring properties.

We do not recommend reconstruction, altering grades, or installing any improvements in the slope downhill of the lowest paved area between the pavement and Newell Creek (i.e., the vegetated slope located east/northeast of the pavement). This area may continue to show signs of slope instability even after the majority of the Lower Campus landslide is stabilized by the dewatering system due to the abundant slide blocks and secondary scarps still needing to achieve an equilibrium position after the main slide has stopped moving.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

8. Preliminary engineering geotechnical report, prepared by a suitably qualified and experienced geotechnical engineer who is licensed in Oregon and who derives his or her livelihood principally from that profession, discussing:

a. Engineering feasibility of the proposed development and addressing strength properties of surface and subsurface soils with regard to stability of slopes

As previously discussed, the comprehensive report describes our slope stability analysis regarding the current stability and the anticipated improvement in stability from dewatering the landslide. Limited grading should be used (described below) to restore the road and other features to a useable condition. If limited grading is used as recommended, the slope stability analyses described in the comprehensive report is valid for the proposed reconstruction. The project should be feasible if the recommendations in our comprehensive report and this supplemental report are followed.

b. Appropriate types of foundations together with bearing values and settlement criteria for foundation design, soil erosion potential, permeability and infiltration rates

The proposed reconstruction of the Lower Campus does not include new buildings or other structures requiring footings. We understand the remaining buildings on the site have not experienced significant distress from landsliding and will not require retrofitting of any foundations. As such, we do not provide foundation recommendations for the proposed reconstruction project.

The fine-grained soil at this site is eroded easily by wind and water; therefore, erosion control measures should be carefully planned and in place before reconstruction begins. Surface water runoff should be collected and directed into away from slopes to prevent water from running down the slope face. Erosion control measures (such as straw bales, sediment fences, and temporary detention and settling basins) should be used in accordance with local and state ordinances.

The fine-grained soil on the site generally has low permeability and low infiltration rates. We do not recommend on-site infiltration of stormwater not only because of the low permeability of the near-surface fine-grained soil but also due to the hazard stormwater infiltration would present to slope stability.

c. Excavation, filling and grading criteria including recommended final slopes

We recommend not altering grades to the greatest extent possible for the proposed reconstruction. No more than 2 feet of fill should be placed in any portion of the site, and the amount of cut and fill should balance as much as possible. Permanent slopes from reconstruction should be no steeper than 2 horizontal to 1 vertical.

Excavation for utility trenches and other utility systems buried deeper than 2 feet should be conducted during the dry season. These excavations could present local stability hazards during the wet season.

We have reviewed the preliminary plans prepared by PACE (dated February 2019). The proposed grades are acceptable from a geotechnical perspective. We recommend a geotechnical engineer review final grading plans to verify the final proposed grades comply with these recommendations.

d. Surface and subsurface drainage

Surface Drainage – All stormwater from roofs, pavements, and other impermeable surfaces should be captured in a tightline stormwater system and directed to a suitable discharge. Section 5.2 of the comprehensive report provided preliminary recommendations for stormwater management that included separation of Upper and Lower Campus stormwater. Previously, stormwater from both the Upper and Lower Campuses was directed through a common system to a stormwater detention basin on the slope northeast of the Lower Campus before discharging into a natural drainage en route to Newell Creek. The detention basin is no longer a viable option and is not a recommended location for stormwater storage. Also, many of the transmission pipes throughout the Lower Campus and the roadway connecting the two campuses have been affected by ground movement.

Based on discussions with PACE, we understand the tributary drainage between the Upper and Lower Campuses is not available for disposal of stormwater from the Upper Campus. We understand the proposed reconstruction will use a buried tank detention system to capture stormwater from both campuses and release it to the previously established discharge point below the Lower Campus. New pipes will be installed for this system on the Lower Campus and the connecting roadway.

We recommend that the stormwater and other water-bearing utility systems be designed to avoid potential disruption from landsliding (such as being installed above ground with flexible joints) or the pipes and/or backfill should be able to tolerate differential displacement of several inches that could occur from slow, cumulative ground movement. This is a conservative design consideration to protect water-bearing utilities from possible small landslide displacement

accumulating over time. The stormwater detention facility should incorporate design redundancies, such as buried tanks in an impermeable containment, and be located in areas that have not shown previous signs of significant ground cracking. Preliminary plans at this time propose to place the buried tanks northeast of the lowest building on the Lower Campus in the currently paved parking lot, away from where significant ground cracks have been observed in the past.

Subsurface Drainage – Installation and performance of a preliminary dewatering well system is described in detail in the comprehensive report. We provide recommendations for monitoring and maintenance of the dewatering well system in Section 5 of the comprehensive report. The dewatering well system is crucial to stabilizing the Lower Campus landslide and must be vigilantly maintained.

e. Planting and maintenance of slopes

We recommend that trees and other vegetation remain on the existing slopes where they would not otherwise interfere with the proposed reconstruction. If vegetation has to be removed, bare soil should be protected against erosion until permanent vegetation can be re-established.

f. Other identified soil or subsurface constraints together with geotechnical remediation and other recommendations to alleviate or minimize their effects

The original apartment development included a roadway around the full perimeter of the Lower Campus. This roadway was disturbed by multiple landslide scarps starting in 2006 and was abandoned a couple years later during re-grading activities. The proposed reconstruction project requires a means for fire trucks to turn around or otherwise leave the site without moving backward. A turn-around or other widened, paved feature located at the downhill end of the road is not recommended because it would likely encroach onto the slope below the lowest paved surface, which should be avoided as described in the "Engineering Geology Considerations" section above. Current plans call for a replacement of the perimeter roadway to re-establish the roadway loop. This reconstructed roadway is intended only for use by fire-fighting equipment and will not have buried utilities.

We recommend this roadway be surfaced with gravel instead of asphalt or concrete pavement. The roadway will traverse previous locations of ground cracks. If slight adjustment on those cracks occur over time, the gravel surface will also allow for easier long-term maintenance of the roadway. The gravel surface will also avoid creating a significant area of impermeable surface and corresponding stormwater load to manage in the new stormwater system.

We recommend inclinometers GD-10i and GD-11i be preserved for possible future monitoring of slope stability. We also recommend that at a minimum, piezometers GD-1p, GD-2p, GD-3p, GD-4p, and GD-5p be preserved for future monitoring of water levels. Preserving LT-3i and LT-2i would also be desirable and is recommended if re-grading the site would allow it.

g. Signature and seal of the geotechnical engineer.

The comprehensive report is signed and appropriately sealed by the geotechnical engineer, as is this supplemental report.

h. The report shall also contain a statement as to whether the proposed development, constructed in accordance with the recommended methods, is reasonably likely to be safe and prevent landslide or other damage to other properties over the long term, and whether any specific areas should not be disturbed by construction.

The proposed project, constructed in accordance with the recommendations presented in our comprehensive report and supplemental report, is reasonably likely to be safe and prevent landslide or other damage to other properties over the long term. The dewatering system in particular provides an active means of stabilizing the landslide that should benefit adjacent properties. In addition to the slope below the lowest paved area discussed in the "Engineering Geology Considerations" section above, we recommend that construction activities should not disturb the Berryhill slope.

RECENT INSTRUMENTATION MONITORING

Since the spring of 2017 GeoDesign has monitored water levels in a variety of piezometers. The preliminary dewatering system was fully activated in March 2018, and water levels significantly dropped throughout the Lower Campus compared to levels recorded prior to installing the system. We provide updated piezometer data plots in the Attachment of this supplemental report, representing data collected from early April 2017 until our last monitoring event (March 4, 2019). The data show that during the 2018-2019 wet season, water levels have been mostly maintained below the lowest levels observed during the very dry 2017 summer. Water levels are currently 10 to 30 feet lower than observed during the 2017-2018 wet season prior to operation of the dewatering system. Rainfall has been comparable to the last wet season, indicating the dewatering system is the primary cause for lowered groundwater.

Inclinometer data collected from inclinometers show the dewatering system is having a positive effect on slope stability. Significant displacement is not observed in the data from GD-11i since April 2018, located on the downhill side of the Lower Campus. A slight displacement (less than 0.1 inch) is observed between September 2018 and January 2019 in GD-10i, the uphill inclinometer on the Lower Campus. The March 2019 reading indicates no further displacement since January 2019. The Lower Campus landslide likely does not move as a single, rigid block. We anticipate that the dewatered landslide could still require time to reach an equilibrium position if it is influenced by uncontrolled surface water infiltration and groundwater pressures from off-site migration into the Lower Campus subsurface.

The displacement between September 2018 and January 2019 in GD-10i, followed by the lack of displacement from January through March 2019, could reflect the discovery of uncontrolled stormwater from the Upper Campus outlet. Previously, the outlet had been temporarily routed to the adjacent drainage off of the Lower Campus. For a time during the 2018-2019 wet season, the outlet apparently had shifted onto the pavement of the Lower Campus, releasing stormwater

into the graben adjacent to the Berryhill slope up until January 2019. The outlet was repositioned soon after discovery. While rainfall through February 2019 was above average, as measured at the National Weather Service station in Portland[3], displacement was not recorded on any inclinometer. This suggests control of both surface stormwater and subsurface dewatering at the site can stabilize the landslide even during normal wet-season conditions.

LIMITATIONS

We have prepared this report for use by RJL Holdings, LLC and other members of the design and construction teams for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, 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 report 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 report was prepared. No warranty, express or implied, should be understood.

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[3] https://w2.weather.gov/climate/index.php?wfo=pqr, accessed March 7, 2019.

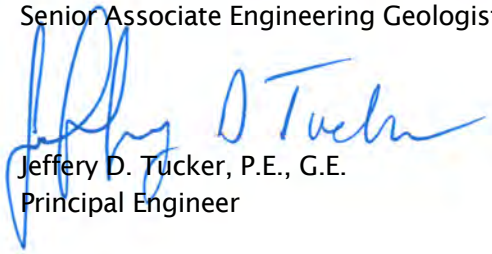
We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

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

Expires 06/01/2019



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

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

EJS:JDT:kt
Attachments
One copy submitted (via email only)
Document ID: RJLHold-1-01-031219-geolr.docx
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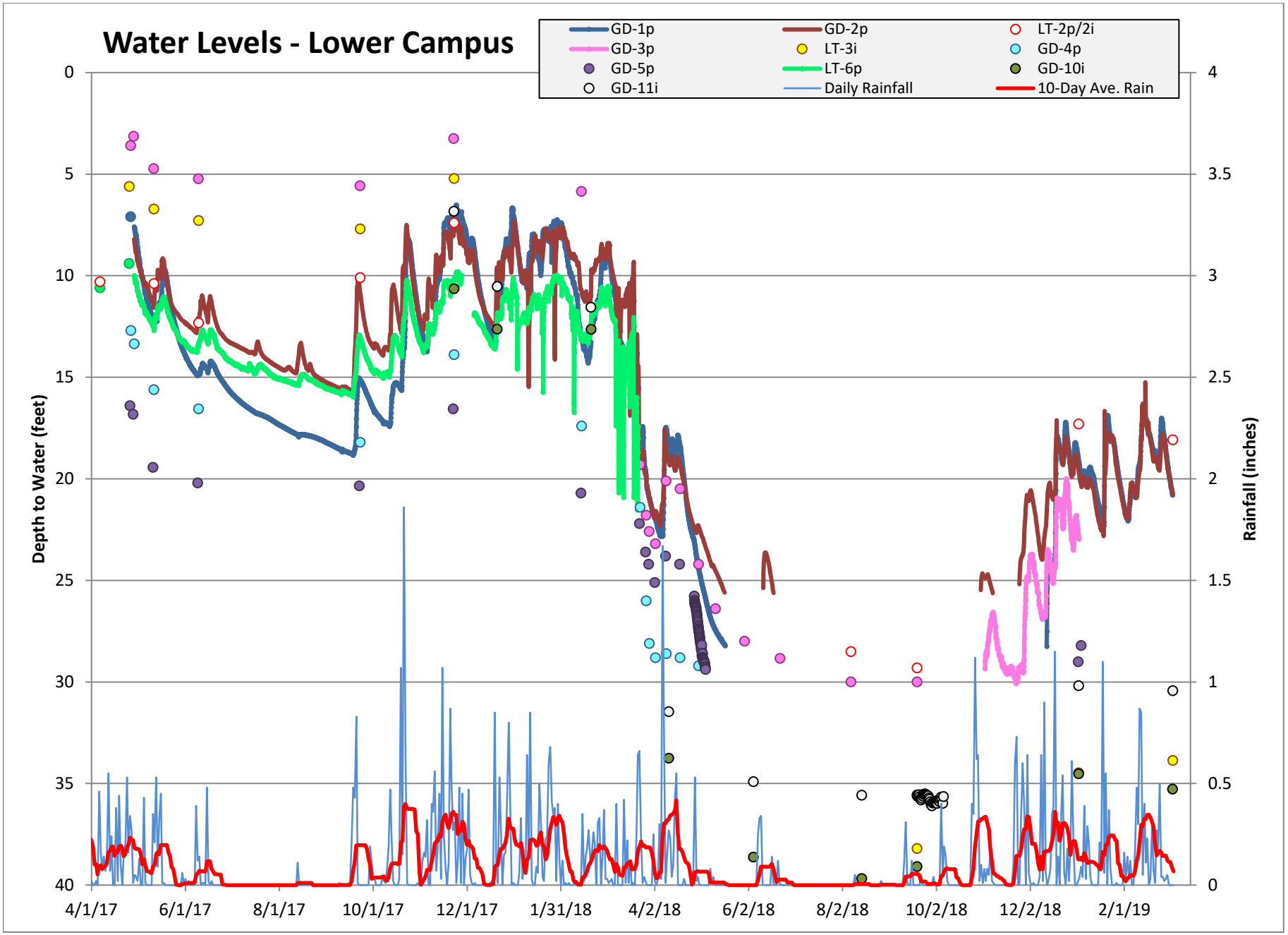
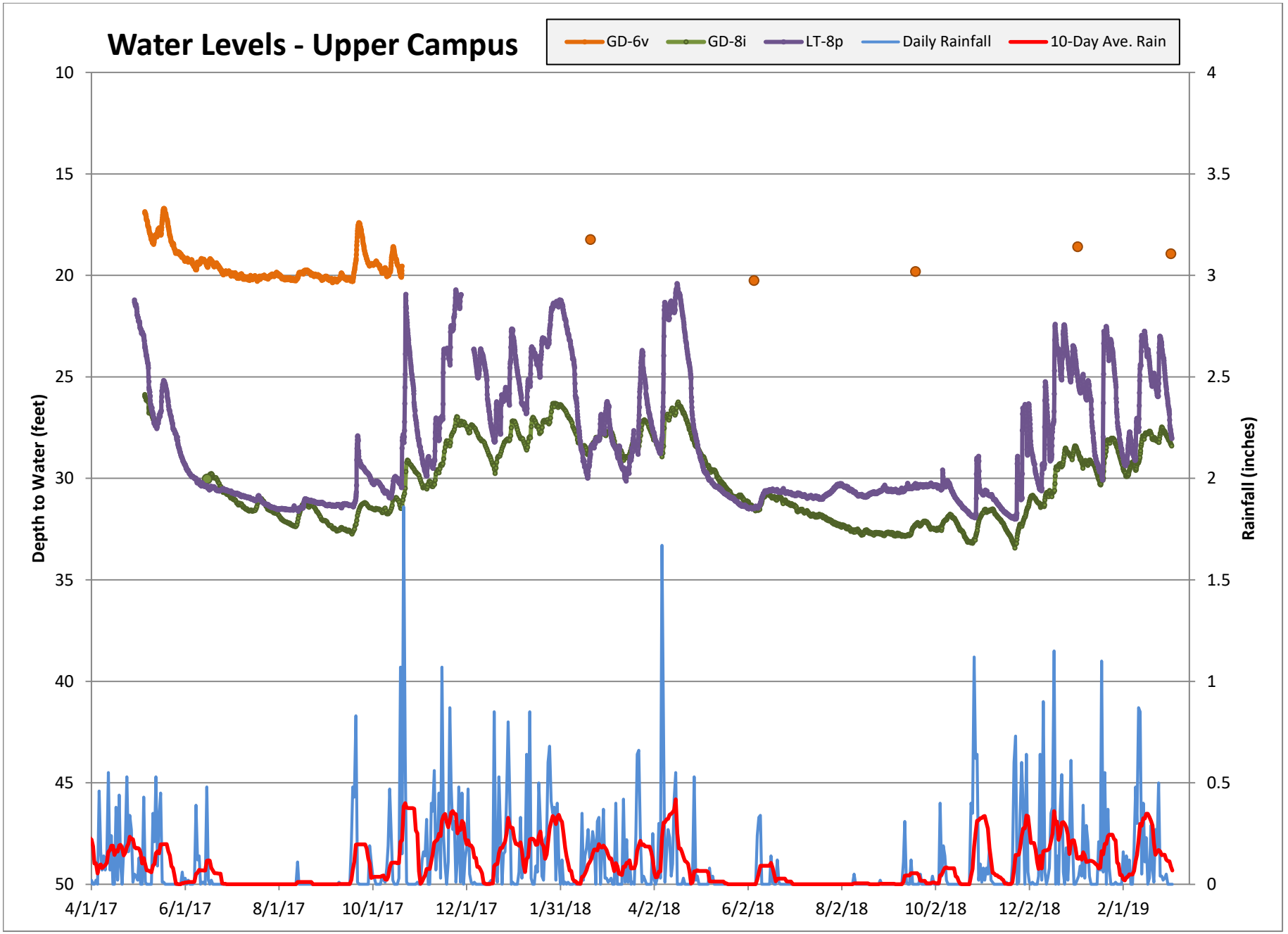
ATTACHMENT

ATTACHMENT

INCLINOMETER AND PIEZOMETER DATA PLOTS

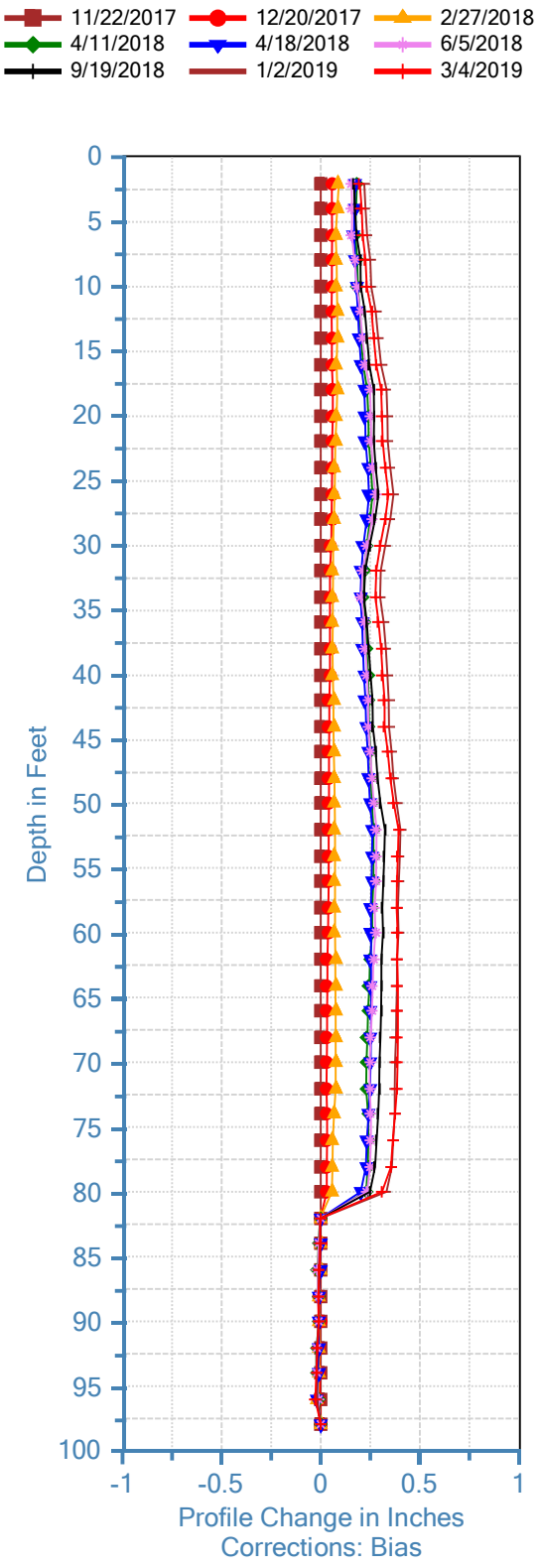
Inclinometer and piezometer data plots are presented in this attachment. Data were collected from both the Lower Campus and the Upper Campus.


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
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
10/2/18
12/2/18
2/1/19

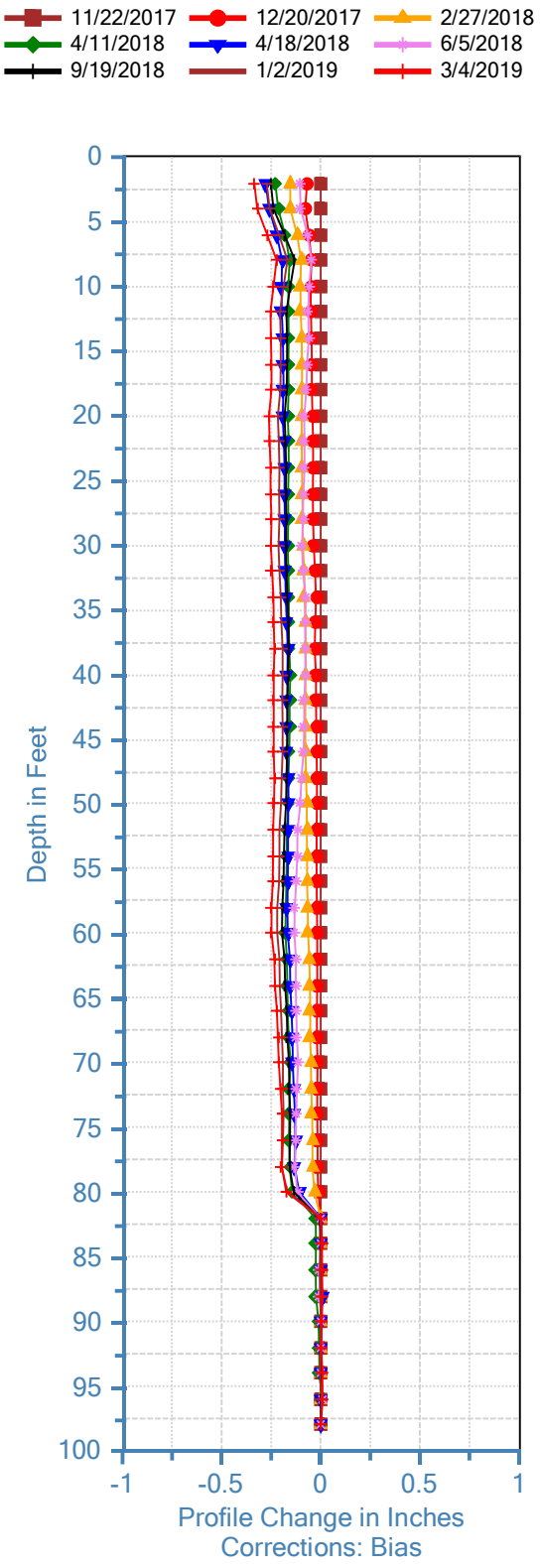

Water Levels - Upper Campus
GD-6v
GD-8i
LT-8p
Daily Rainfall
10-Day Ave. Rain
Depth to Water (feet)
Rainfall (inches)
10
15
20
25
30
35
40
45
50
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/17
6/1/17
8/1/17
10/1/17
12/1/17
1/31/18
4/2/18
6/2/18
8/2/18
10/2/18
12/2/18
2/1/19

Lower Campus - Uphill

RJLHLD GD-10i A

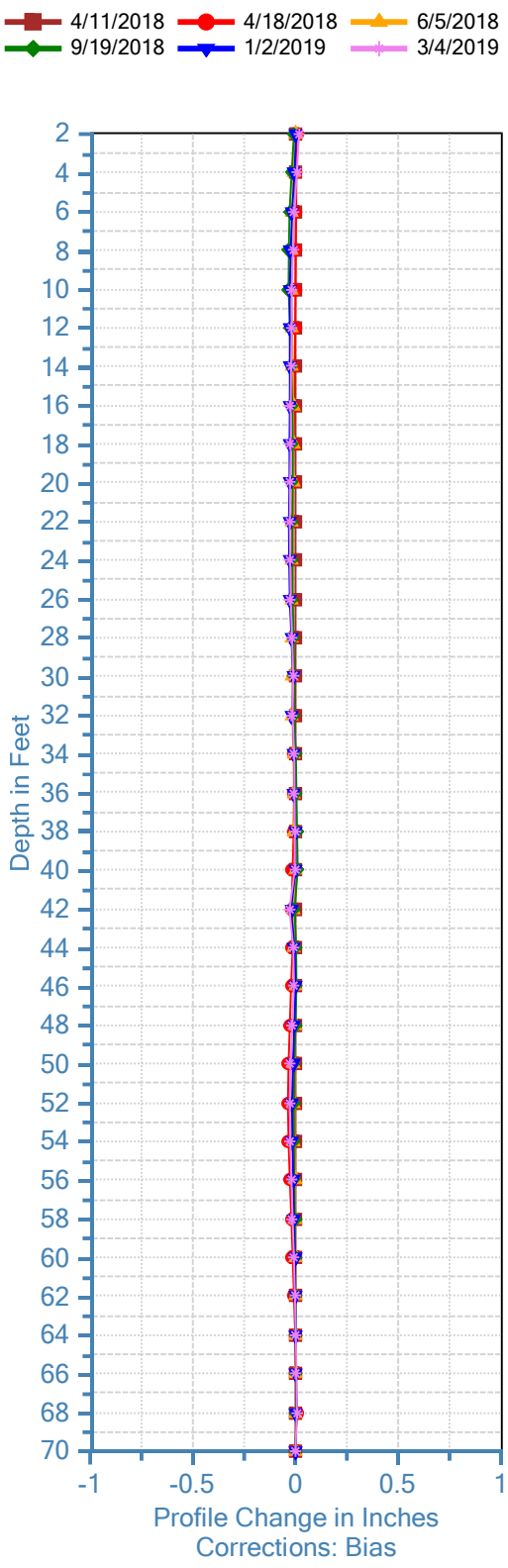


RJLHLD GD-10i B

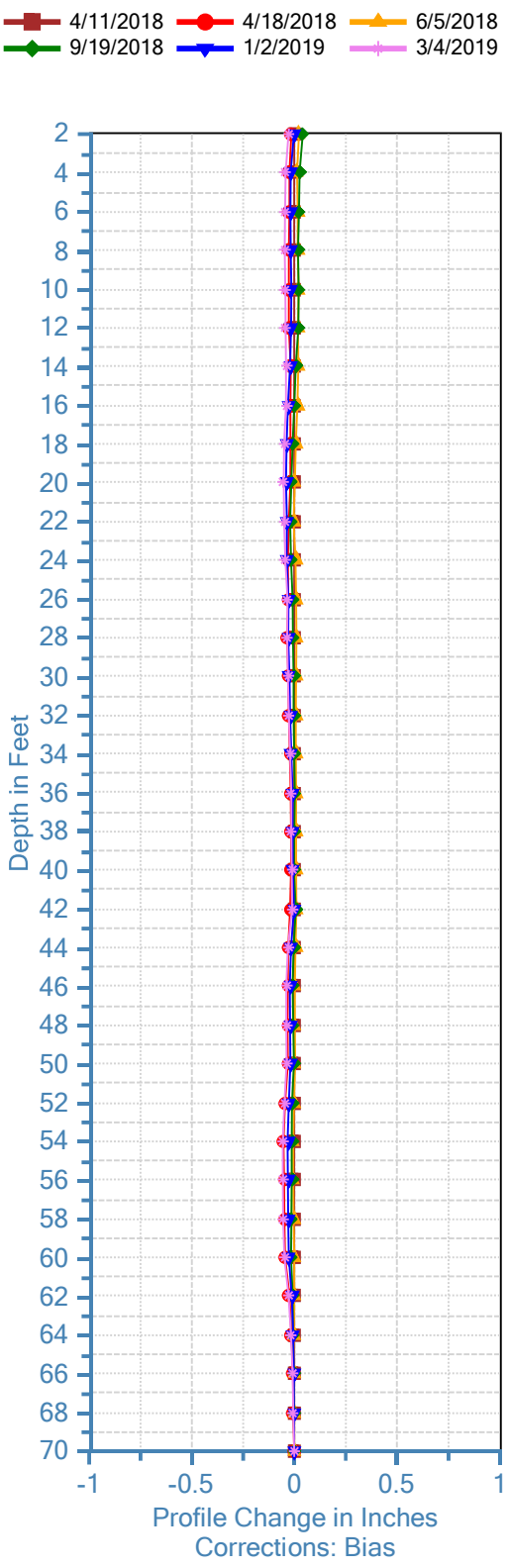


Lower Campus - Downhill post-disturbance

RJLHLD GD-11i A

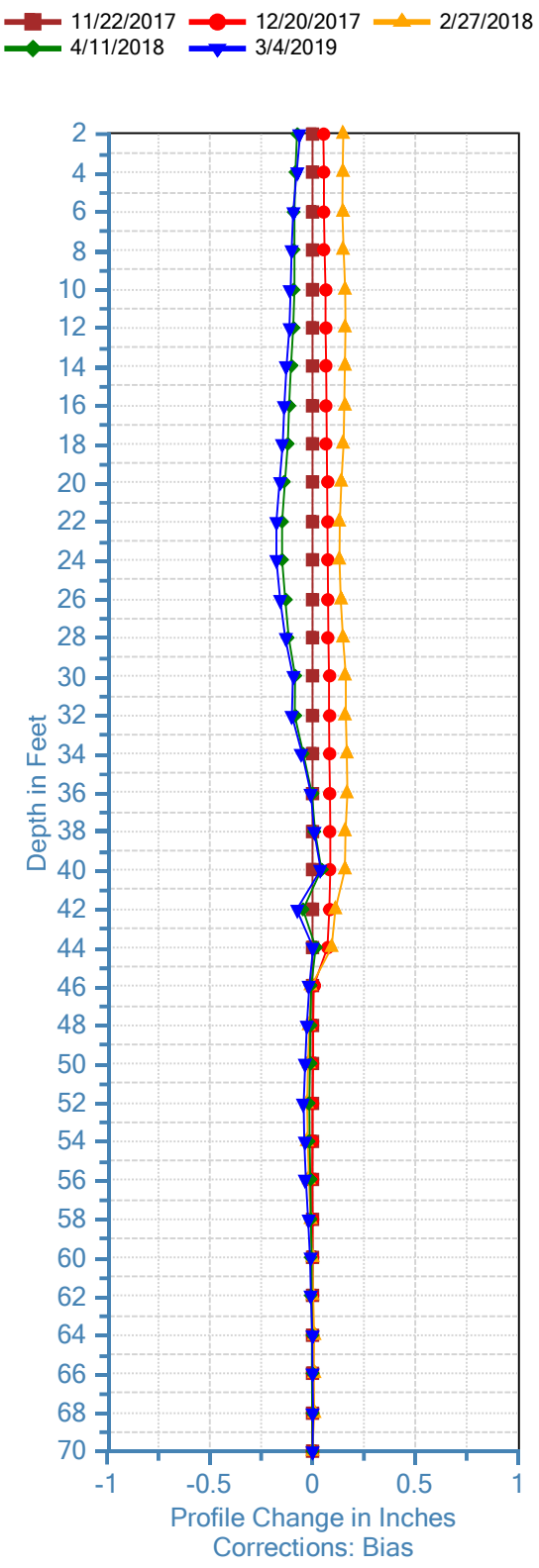


RJLHLD GD-11i B

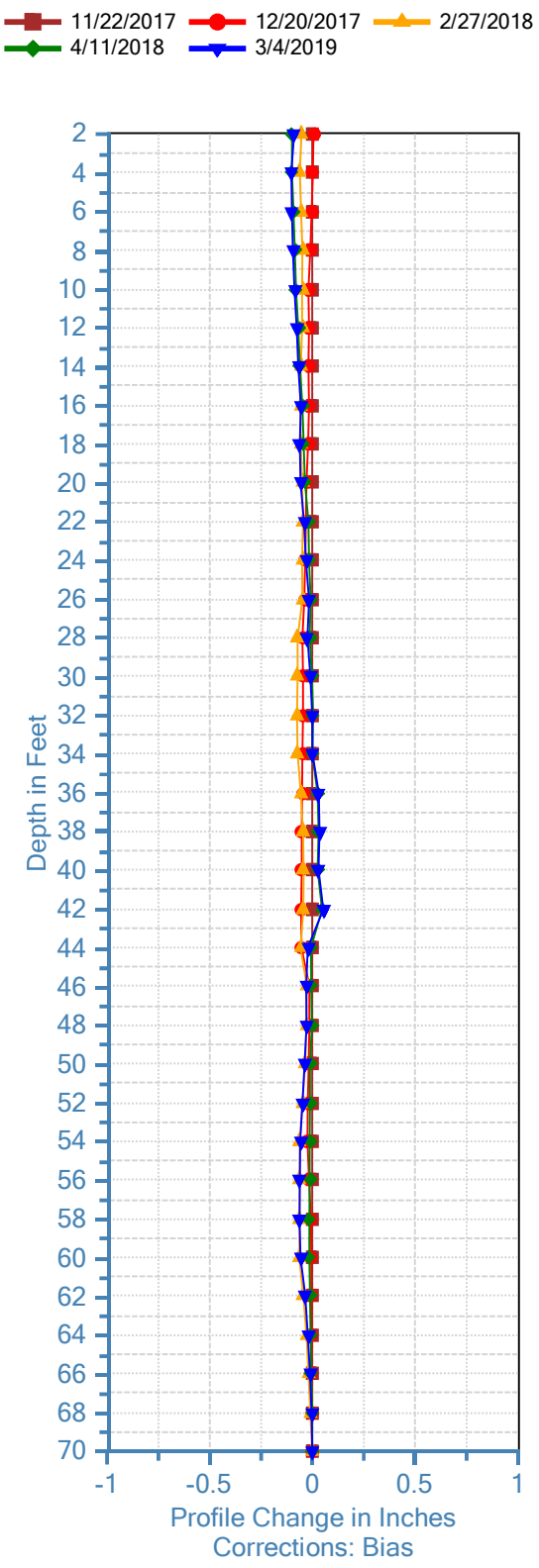


Lower Campus - Downhill
pre- and post-disturbance

RJLHLD GD-11i A

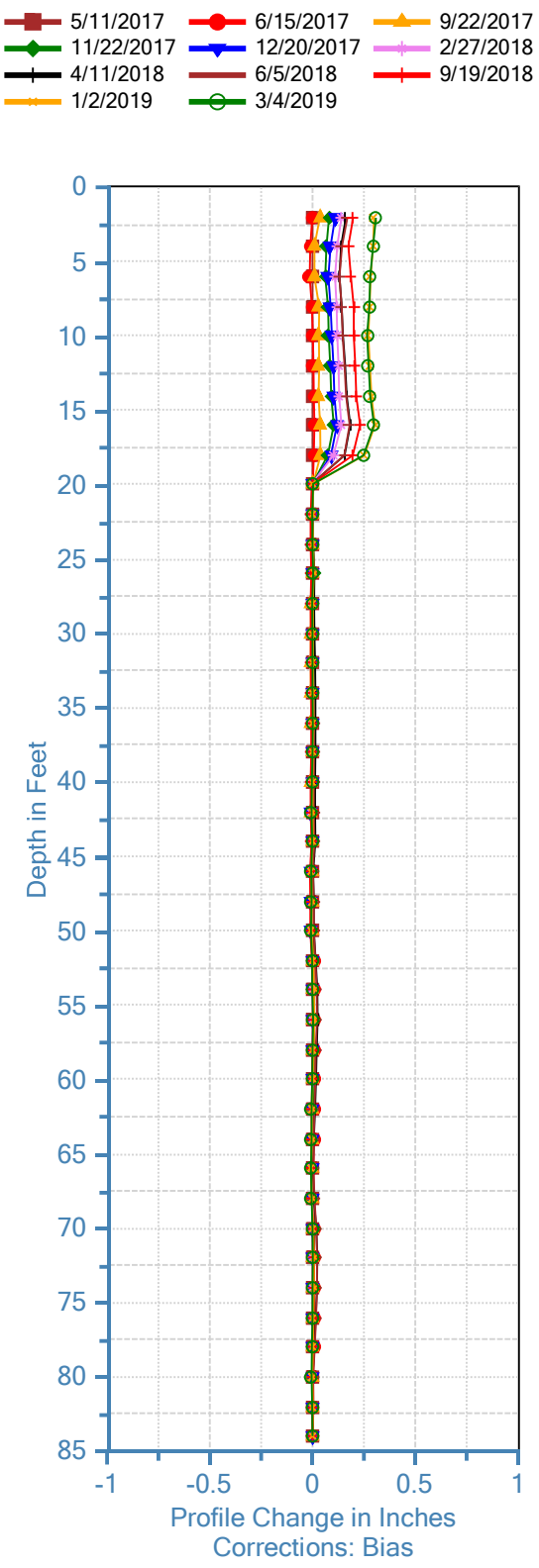


RJLHLD GD-11i B

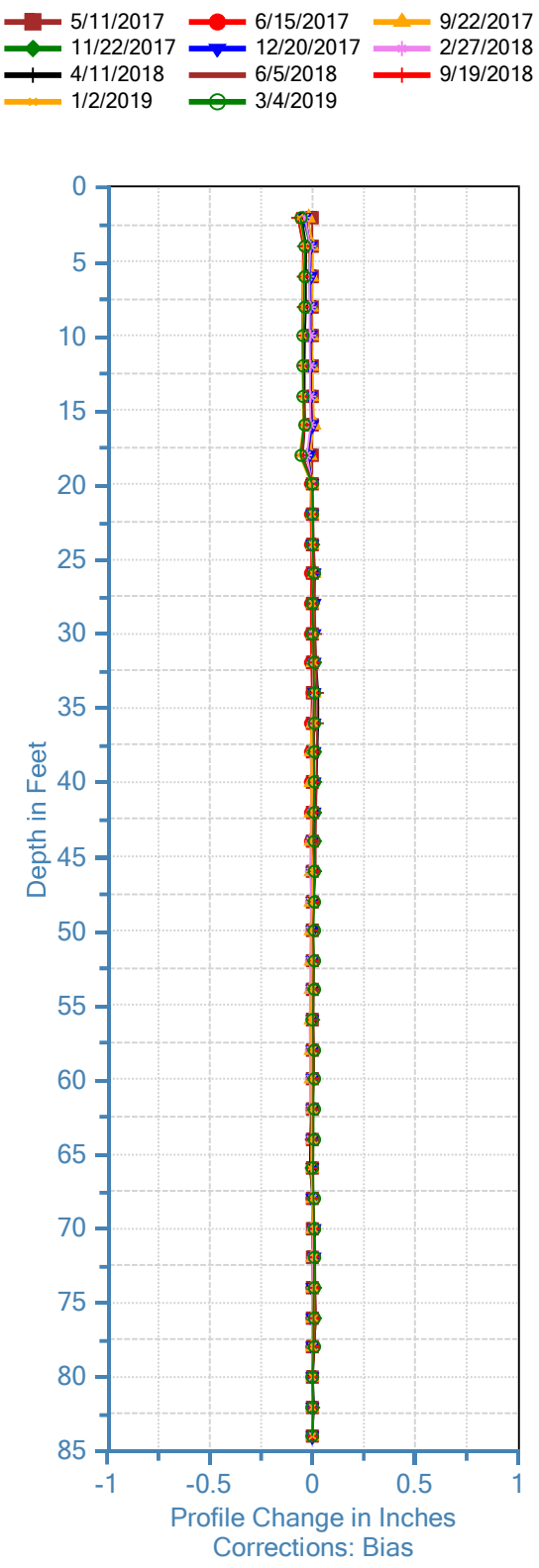


Upper Campus
Fill Failure

RJLHLD GD-8i A

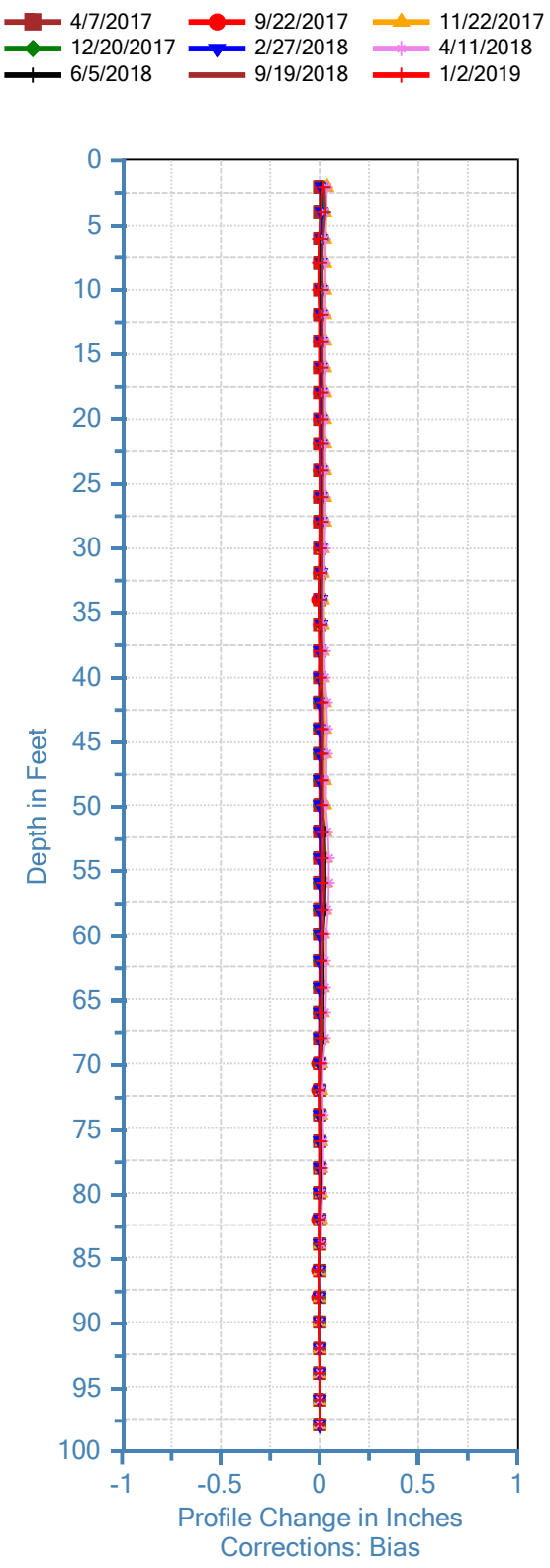


RJLHLD GD-8i B

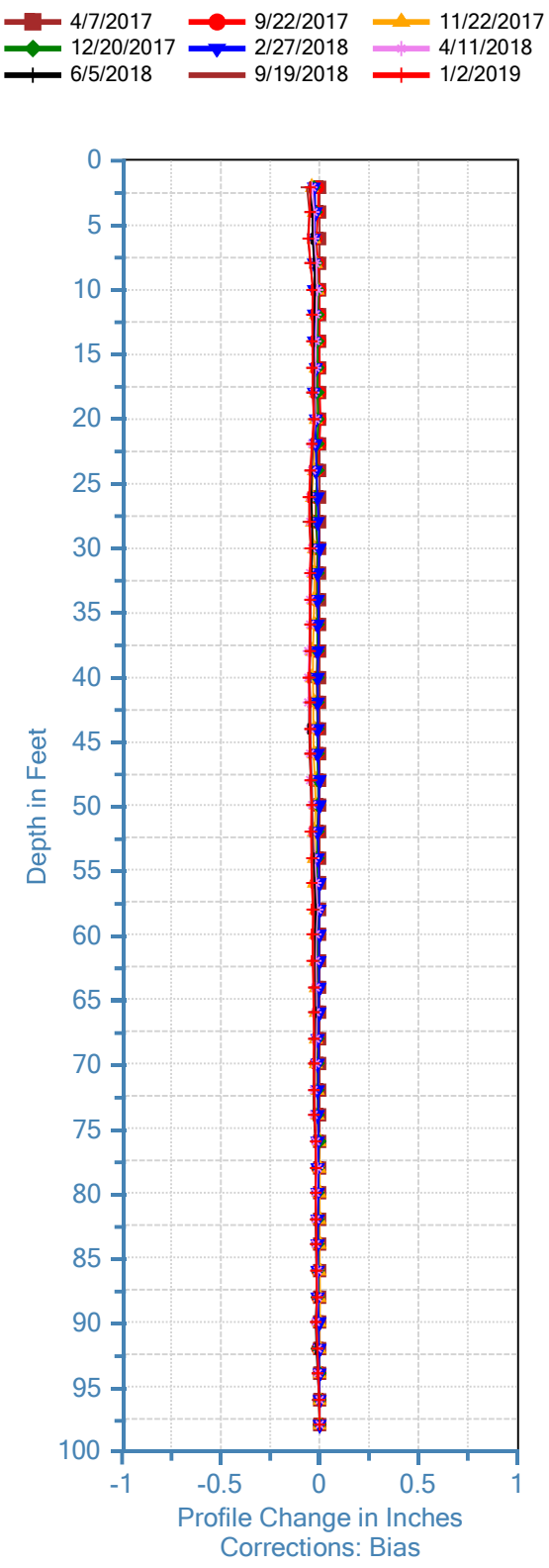


Upper Campus
Behind Bldg 5

RJLHLD LT-7 A

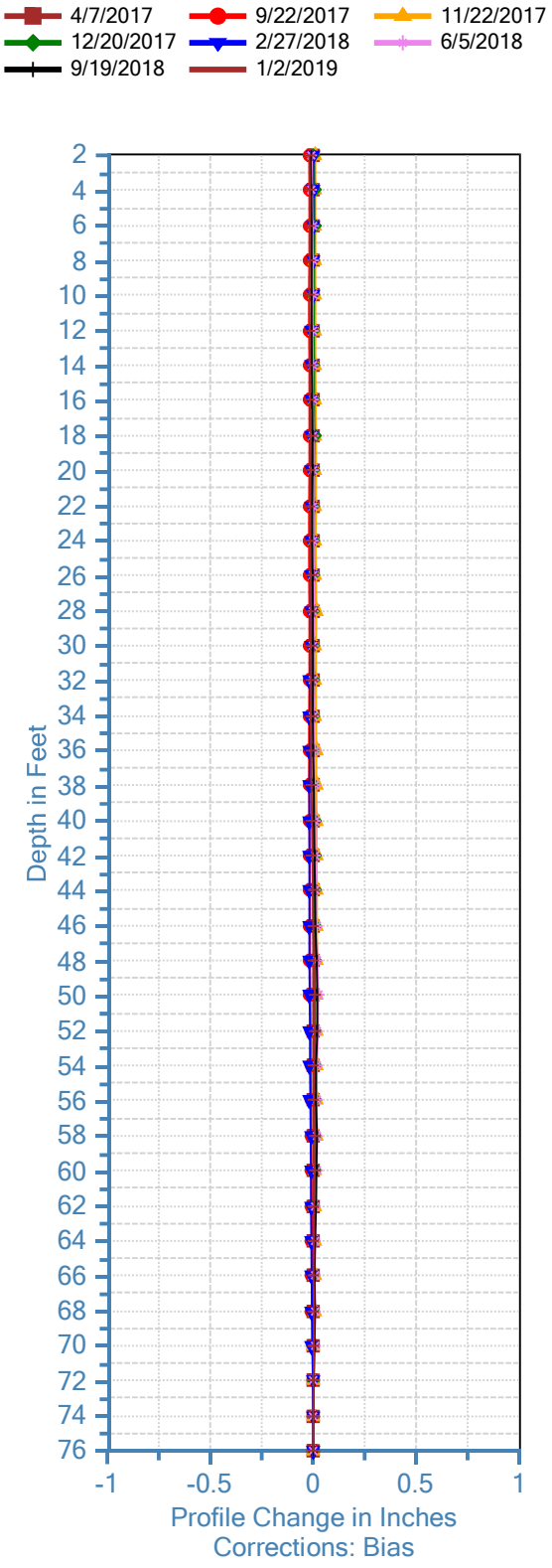


RJLHLD LT-7 B



Upper Campus - Uphill

RJLHLD LT-8 A



RJLHLD LT-8 B