

Attachment 13– Geohydrologic Investigation
Interim Summary Letter
(Campbell Geo, Inc., 2016)

C A M P B E L L · G E O , I N C .

ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

May 13, 2016

Environmental Science Associates
550 Kearny Street, Suite 800
San Francisco, CA 94108

Attn: Mr. Bob Battalio

Subject: Geohydrologic Investigation – Interim Summary Letter
UCSB North Campus Open Space Restoration Project
Goleta, California

Dear Bob:

This interim summary letter describes our ongoing field investigation of shallow groundwater and analysis of previously collected data at the proposed restoration project near Devereux Slough for the University of California Santa Barbara's North Campus Open Space project. The objective was to track changes in hydrologic parameters in shallow groundwater and to produce a summary of the data to assist in the restoration effort. Future site use is planned to be passive open space. The north area of the property was previously developed as the Ocean Meadows Golf Course (OMGC), which has not been in operation for several years.

The Cheadle Center for Biodiversity and Ecological Restoration (CCBER) installed an array of eleven (11) shallow groundwater monitoring wells in 2011, and in 2013 added nine (9) additional wells, dispersed throughout the north (OMGC) and south regions of the Open Space. Water levels in the wells have been measured at least once a month manually by CCBER personnel beginning in August, 2011. Water level measurements were accompanied by salinity measurements beginning in September, 2015.

An initial site visit was conducted by this office in November 2015 to collect data from the existing twenty (20) monitoring wells labeled MW-1 through MW-20 on the attached figures. The wells are 1- and 2-inch diameter PVC, cased into what we understand were hand augered borings. The measured well depths range from 3 to 9 feet below ground surface.

Wells MW-1 through MW-11 are located on the south parcel, outside of the former OMGC area. Wells MW-12 through MW-20 are located in the former OMGC area, which exhibits distinct groundwater hydrology from the data exhibited in the south parcel wells.

Survey of Existing Monitoring Wells

In order to derive accurate and comparable groundwater elevations from both the CCBER's previously recorded data and the data collected by this office, Campbell Geo arranged for all twenty of the monitoring wells to be surveyed by Stantec to the NAVD 88 elevation datum. The Stantec survey sheet is appended to this letter with notations for elevations of top of casing and ground surface at each well. The survey data has been used to update and modify a spreadsheet to calculate 2011 through early 2016 groundwater elevations for the twenty shallow monitoring wells.

Installation of Data Loggers

To record groundwater elevation fluctuations accurately and continuously, and to track selected water quality parameters, three (3) Solinst "LTC Level Logger Junior Edge" units were installed in wells MW-12, MW-16, and MW-20 in January 2016. Holes were drilled through the locking caps installed on those wells to expose the well headspace to site barometric pressure. Barometric pressure was recorded onsite by a Solinst "Barologger" unit, which CCBER personnel maintain. Data from that unit was downloaded and sent to Campbell-Geo by CCBER personnel concurrent with data collection from the three well loggers. The data from the loggers was then compensated using the data from the Barologger utilizing Solinst's proprietary software. The barologger was programmed previously by CCBER for other purposes to collect measurements every fifteen minutes and, to mesh the data accurately, we set the well loggers to record data on the same schedule.

The three well loggers also recorded conductivity and water temperature (see discussion below). The conductivity sensor on each logger was calibrated by comparing readings against measurements made by a portable calibrated YSI-556 unit, whose sensor

was submerged in the same groundwater sample. The data logger device was then adjusted as needed. This method provides confidence that the water quality trends are being accurately measured. Details were recorded in our field notes.

Groundwater Elevation Calculations

Using the surveyed elevations of the well casings, all previously recorded CCBER data were converted in groundwater elevations. That data was combined with Campbell Geo's level logger groundwater elevation data to produce one master table encompassing the total period of groundwater monitoring. Hydrographs for MW-12, MW-16, and MW-20 were produced from those tables, and are included in this summary as Plates 5-7.

Additionally, elevation data was processed to find a representative period of low and high groundwater values during the 2011 through early 2016 monitoring period. The sampling event with the overall lowest groundwater elevation occurred on October 24, 2014, and the highest on March 10, 2016. The data from those dates were used to generate groundwater elevation contour maps, Plates 3 and 4, attached. To contribute to the site grading plan, we have also marked the October 2014 (low level) and March 2016 (high level) groundwater elevations on the attached ESA Figure 7 – Project Grading Cross-Sections.

Groundwater Quality

Shallow groundwater quality has been evaluated by measurement of electrical conductivity (E_c) by Campbell-Geo with calibrated instruments and by measurement of salinity by CCBER personnel using a portable refractometer. The E_c data is a measurement of the water's capability to pass electrical flow, which is directly related to the concentration of ions in the water. Salinity is a measure of dissolved salts in water, and is not equivalent, strictly speaking, to conductivity. The E_c data has been measured in units of $\mu\text{S}/\text{cm}$ and the salinity data in units of parts per thousand (ppt).

For the purpose of this investigation, both parameters provide a reasonable indication of groundwater quality trends to guide the site restoration efforts. In general,

Mr. Bob Battalio, ESA
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UCSB North Campus Open Space Restoration Project
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Page 4

the south parcel wells (MW-1 through MW-11) show better water quality than the OMGC wells (MW-12 through MW-20). Some of the monitoring wells in the former OMGC area have exhibited very high E_c readings ranging from 2,740 to 104,759 $\mu\text{s}/\text{cm}$. The salinity readings in the OMGC wells have ranged from and 2 to 100 ppt. Wells on the south parcel have exhibited lower E_c and salinity readings (583 to 1,027 $\mu\text{s}/\text{cm}$ and 0 to 15 ppt).

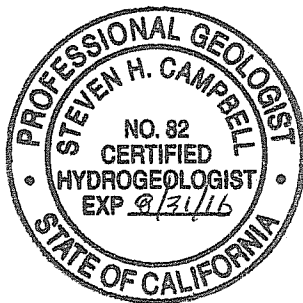
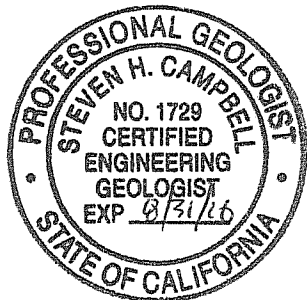
A more comprehensive report with the tabulated data will be prepared in the coming weeks.

Please contact us if you have any questions.

Sincerely,
Campbell-Geo, Inc.



Steven H. Campbell
Professional Geologist
State of California, #5576
Certified Engineering Geologist
State of California, #1729
Certified Hydrogeologist
State of California, #82



Alex Cruz
Staff Geologist

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Clients \ESA_NCOS\Letters L4.doc

Attachments: Plates 1-7
ESA Figure 7
Stantec (February, 2016)

Figures Attached

Plate 1 - Project Location Map

Plate 2 – Groundwater Hydrographs (MW-12, MW-16, and MW-20)

Plate 3 – Groundwater Elevation Contour Map – High Groundwater

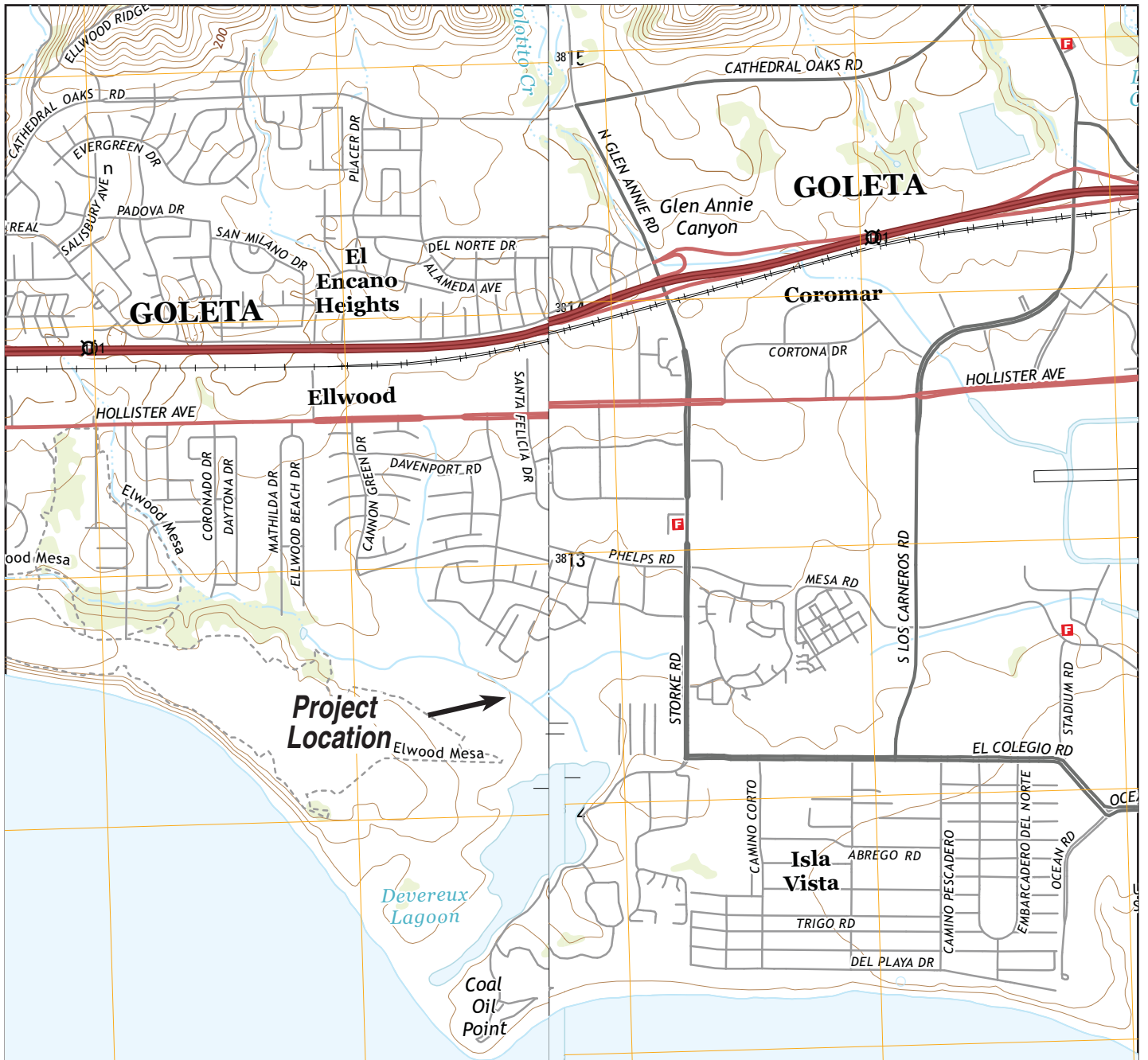
Plate 4 – Groundwater Elevation Contour Map – Low Groundwater

Plate 5 – Hydrograph Detail – MW-12

Plate 6 – Hydrograph Detail – MW-16

Plate 7 - Hydrograph Detail – MW-20

ESA Figure 7 with added groundwater elevations on Grading Cross-
Sections
Stantec Survey Sheet (February, 2016)



A portion of the U.S.G.S. "Dos Pueblos" & "Goleta" 7.5" quadrangle (2015)

PROJECT LOCATION MAP

North Campus Open Space

Goleta, California

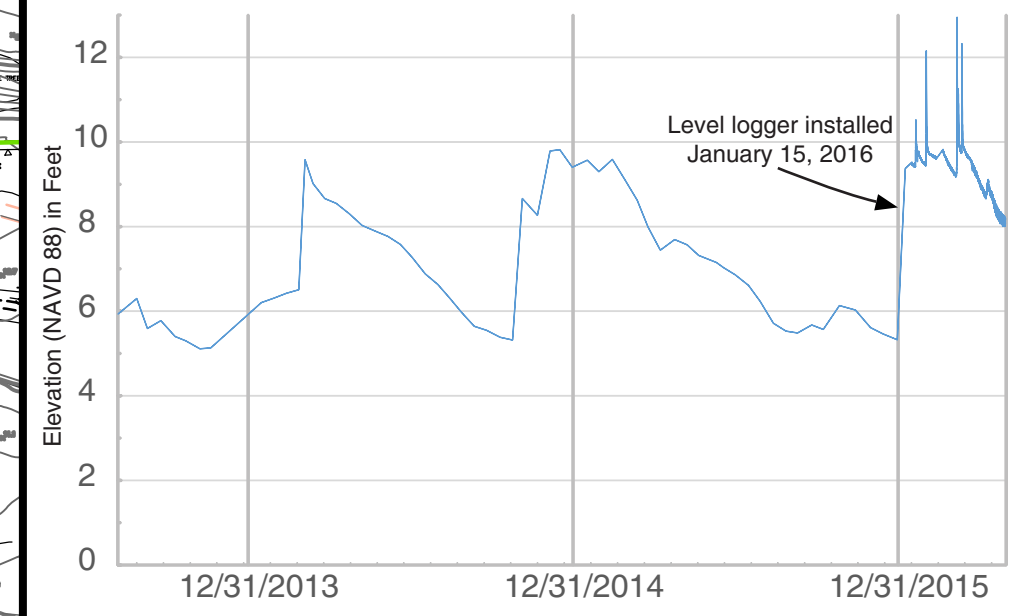


SCALE IN FEET

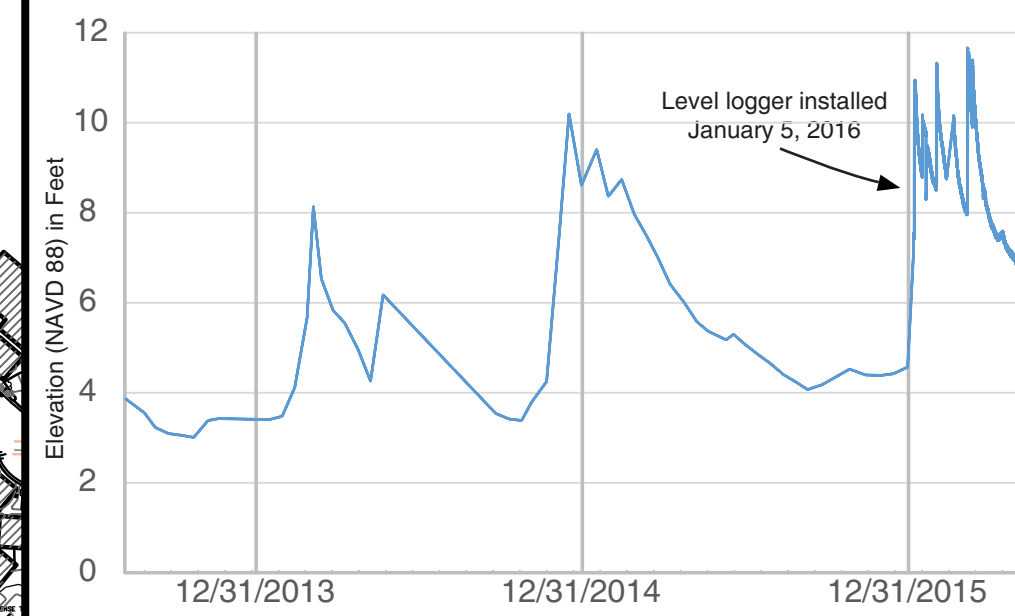


By DAS Date 9-27-10

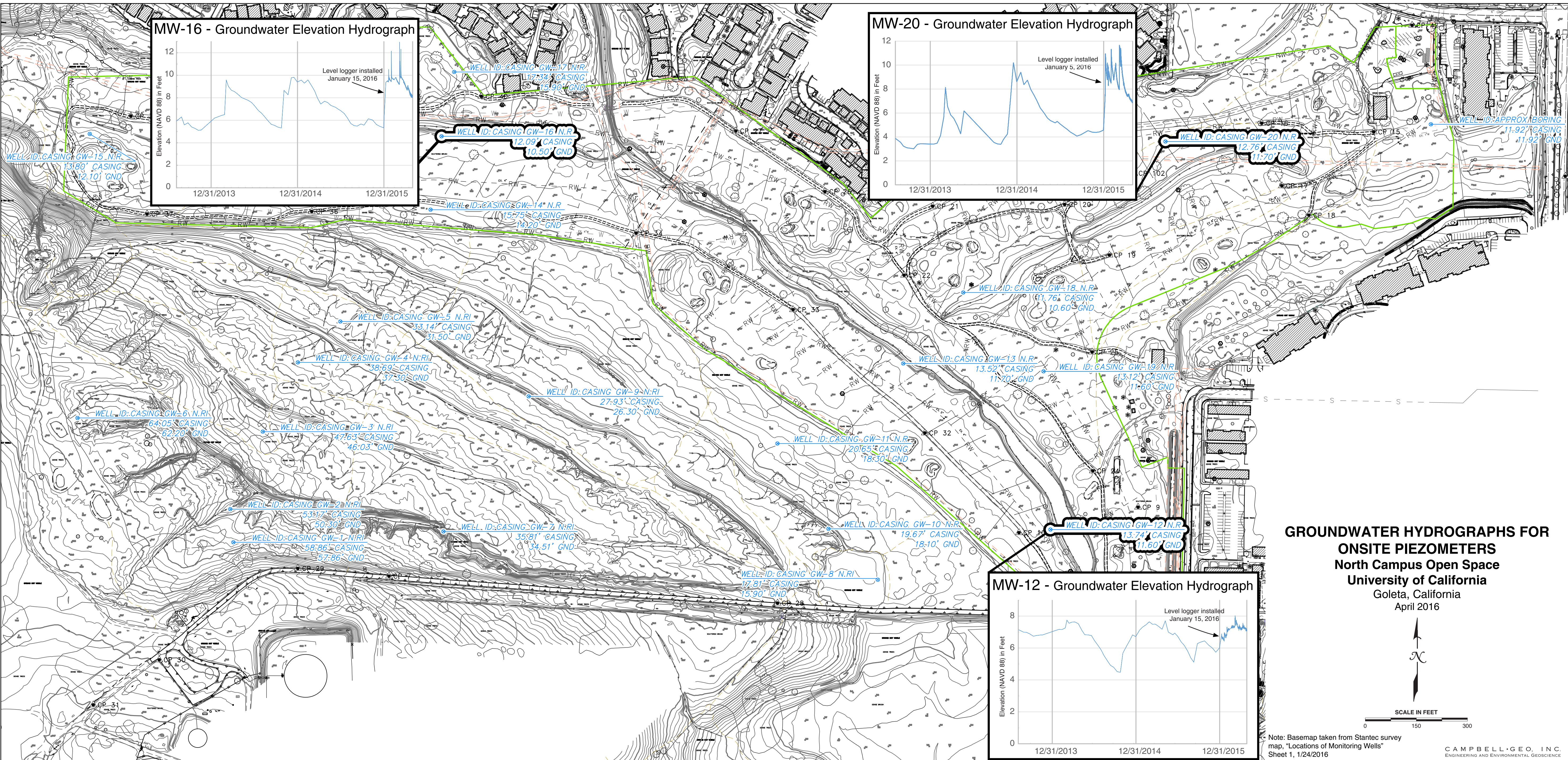
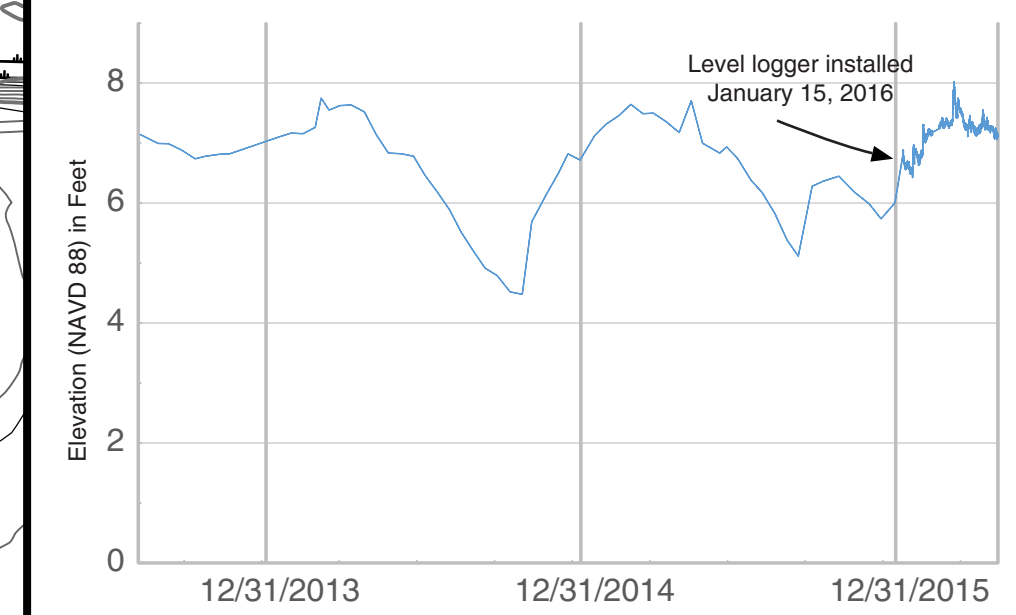
MW-16 - Groundwater Elevation Hydrograph



MW-20 - Groundwater Elevation Hydrograph



MW-12 - Groundwater Elevation Hydrograph



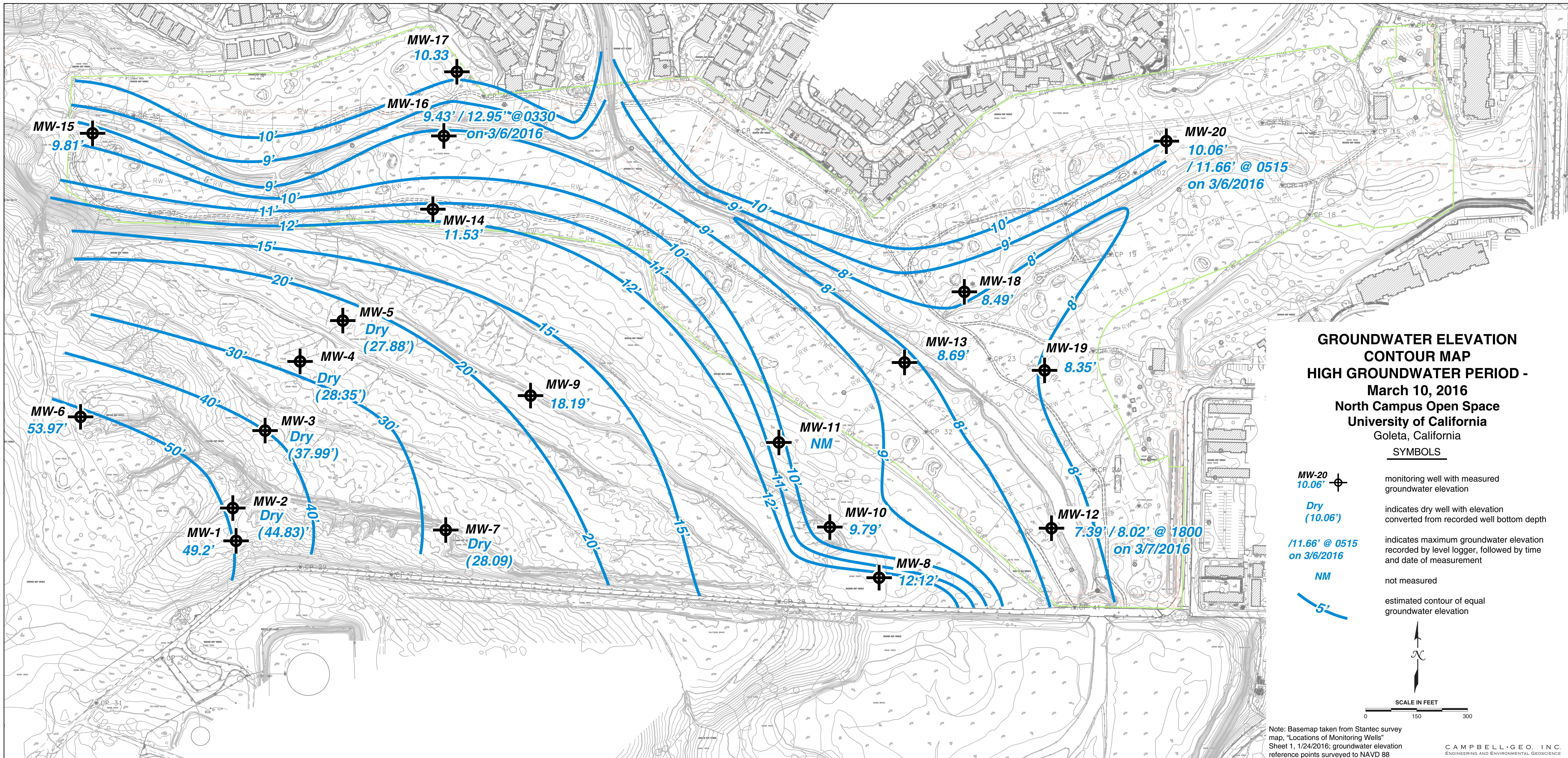
**GROUNDWATER HYDROGRAPHS FOR
ONSITE PIEZOMETERS
North Campus Open Space
University of California
Goleta, California
April 2016**

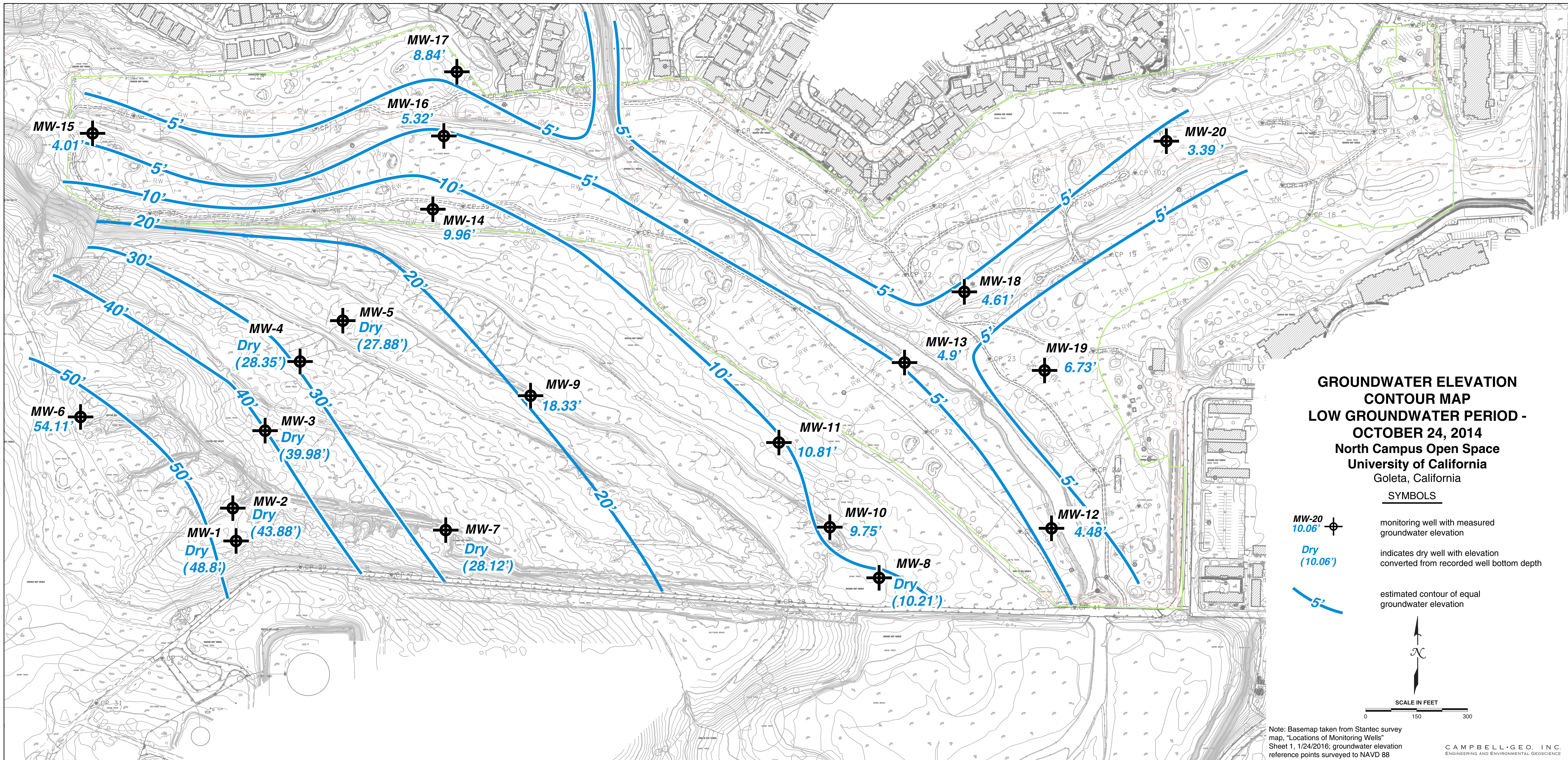


SCALE IN FEET
0 150 300

Note: Basemap taken from Stantec survey map, "Locations of Monitoring Wells" Sheet 1, 1/24/2016




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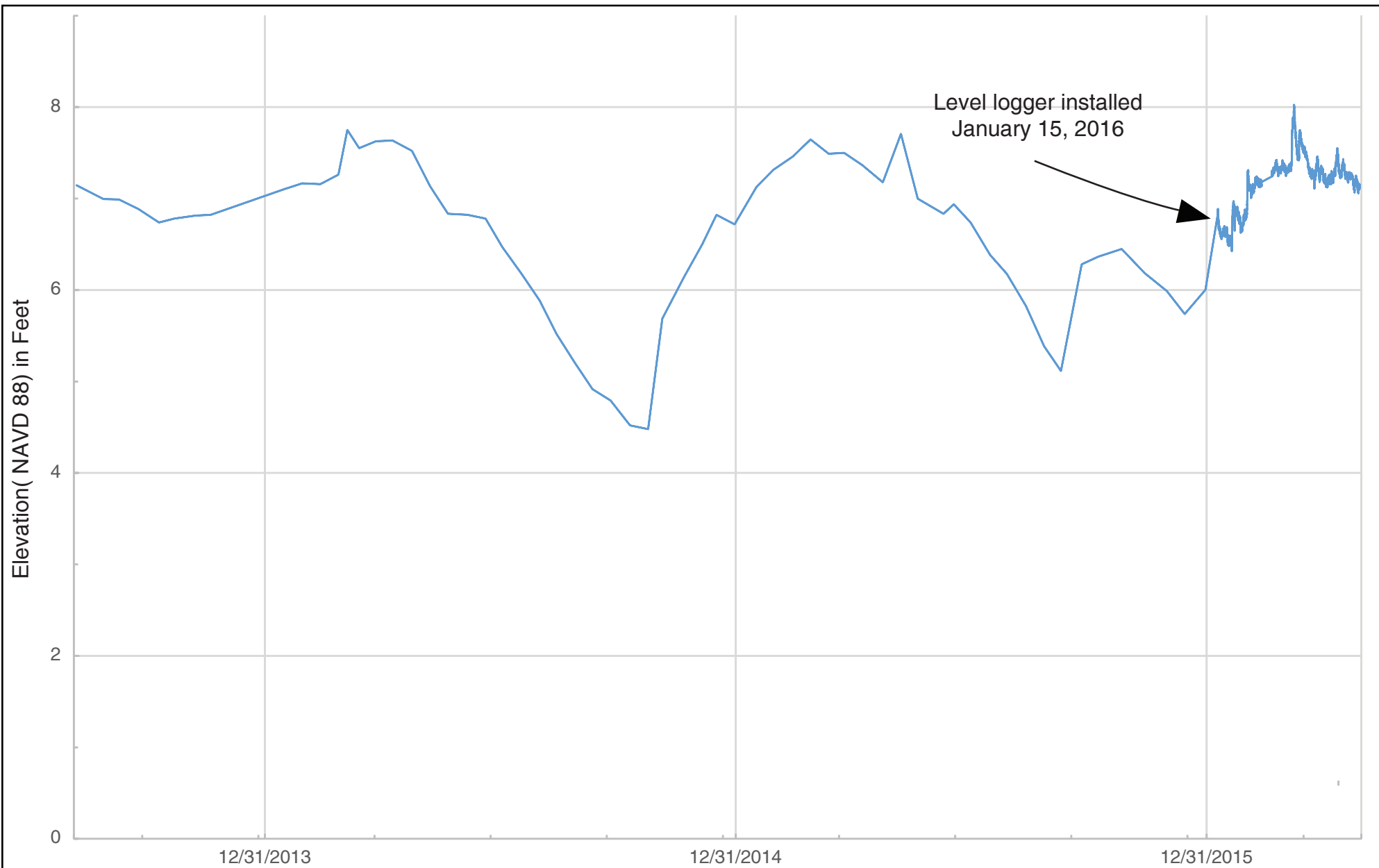
**GROUNDWATER ELEVATION
CONTOUR MAP
LOW GROUNDWATER PERIOD -
OCTOBER 24, 2014
North Campus Open Space
University of California
Goleta, California**

SYMBOLS

-  MW-20
10.06' monitoring well with measured groundwater elevation
-  Dry
(10.06') indicates dry well with elevation converted from recorded well bottom depth
-  5' estimated contour of equal groundwater elevation



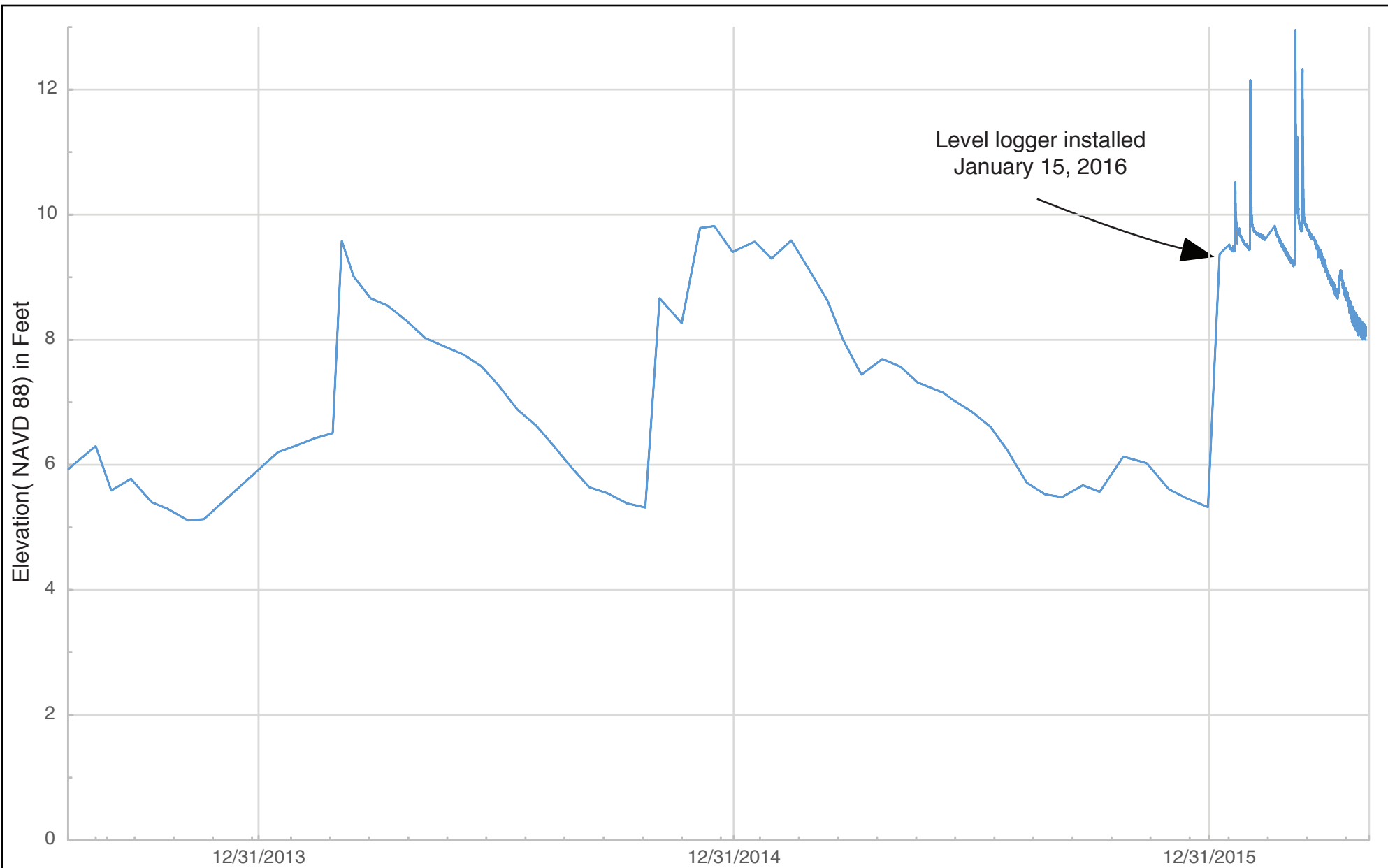
Note: Basemap taken from Stantec survey map, "Locations of Monitoring Wells" Sheet 1, 1/24/2016; groundwater elevation reference points surveyed to NAVD 88



MW-12 HYDROGRAPH
North Campus Open Space - UCSB
 Goleta, California
 April 2016

Note: Graph combines CCBER recorded data with Campbell Geo level logger data and direct measurements. Previously reported (CCBER) water elevations were updated to re-surveyed casing elevations, relative to NAVD 88.

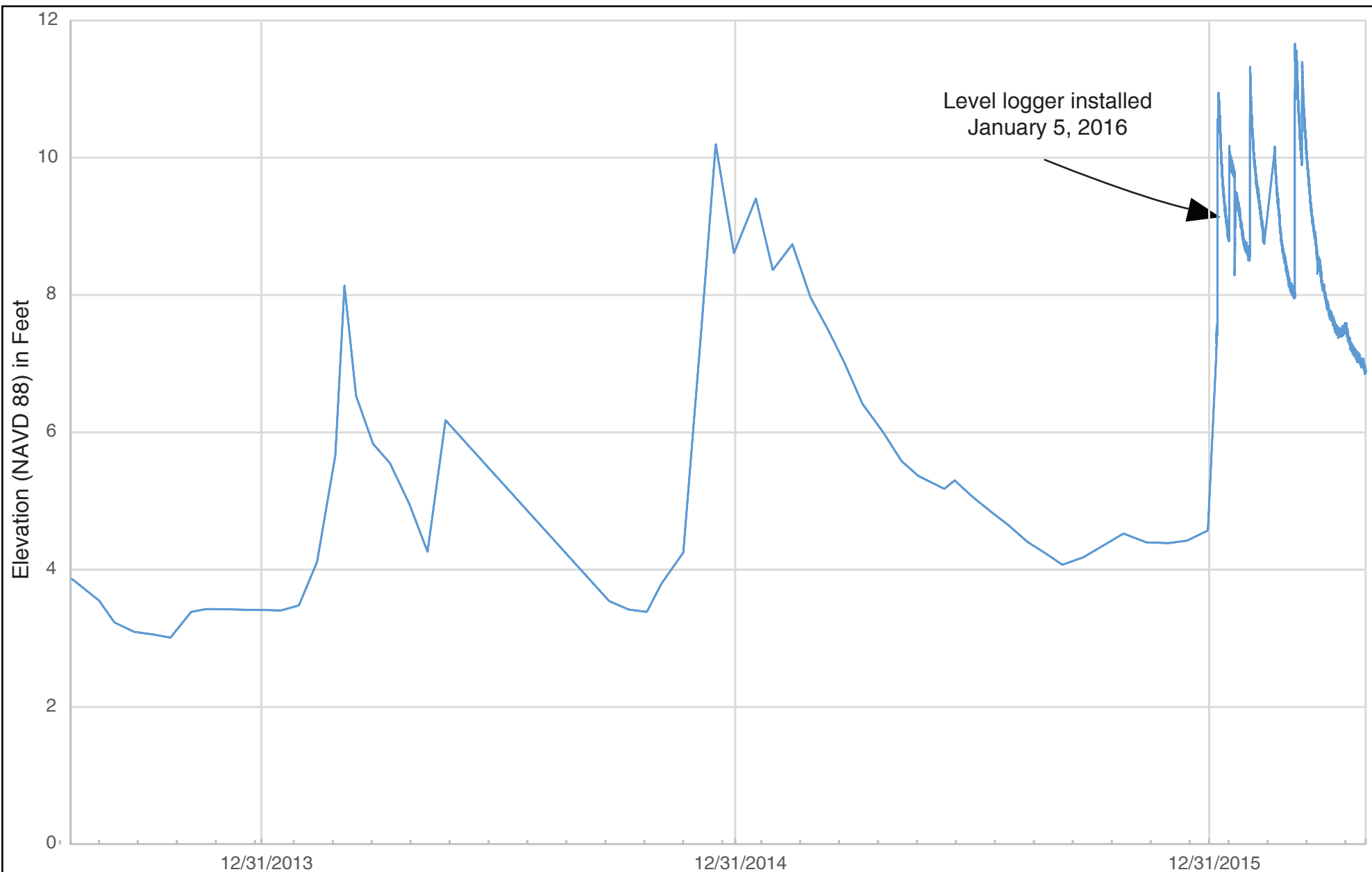
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MW-16 HYDROGRAPH
North Campus Open Space - UCSB
 Goleta, California
 April 2016

Note: Graph combines CCBER recorded data with Campbell Geo level logger data and direct measurements. Previously reported (CCBER) water elevations were updated to re-surveyed casing elevations, relative to NAVD 88

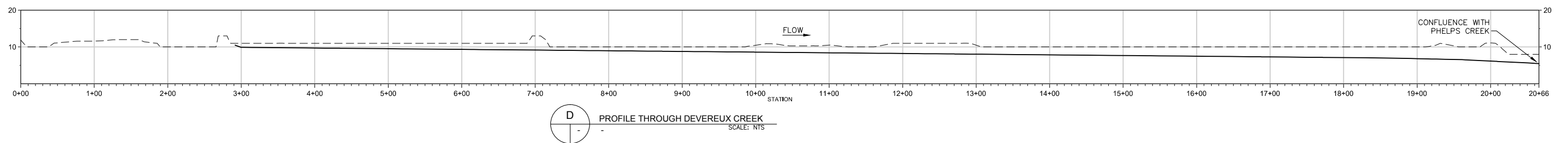
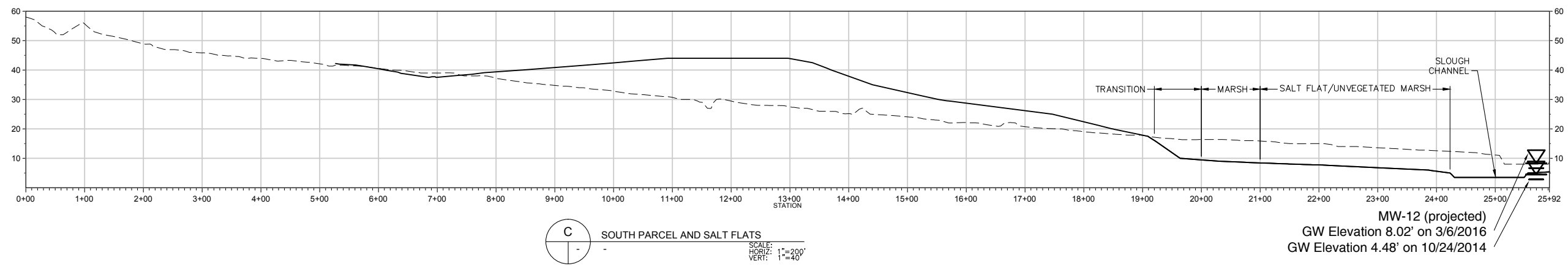
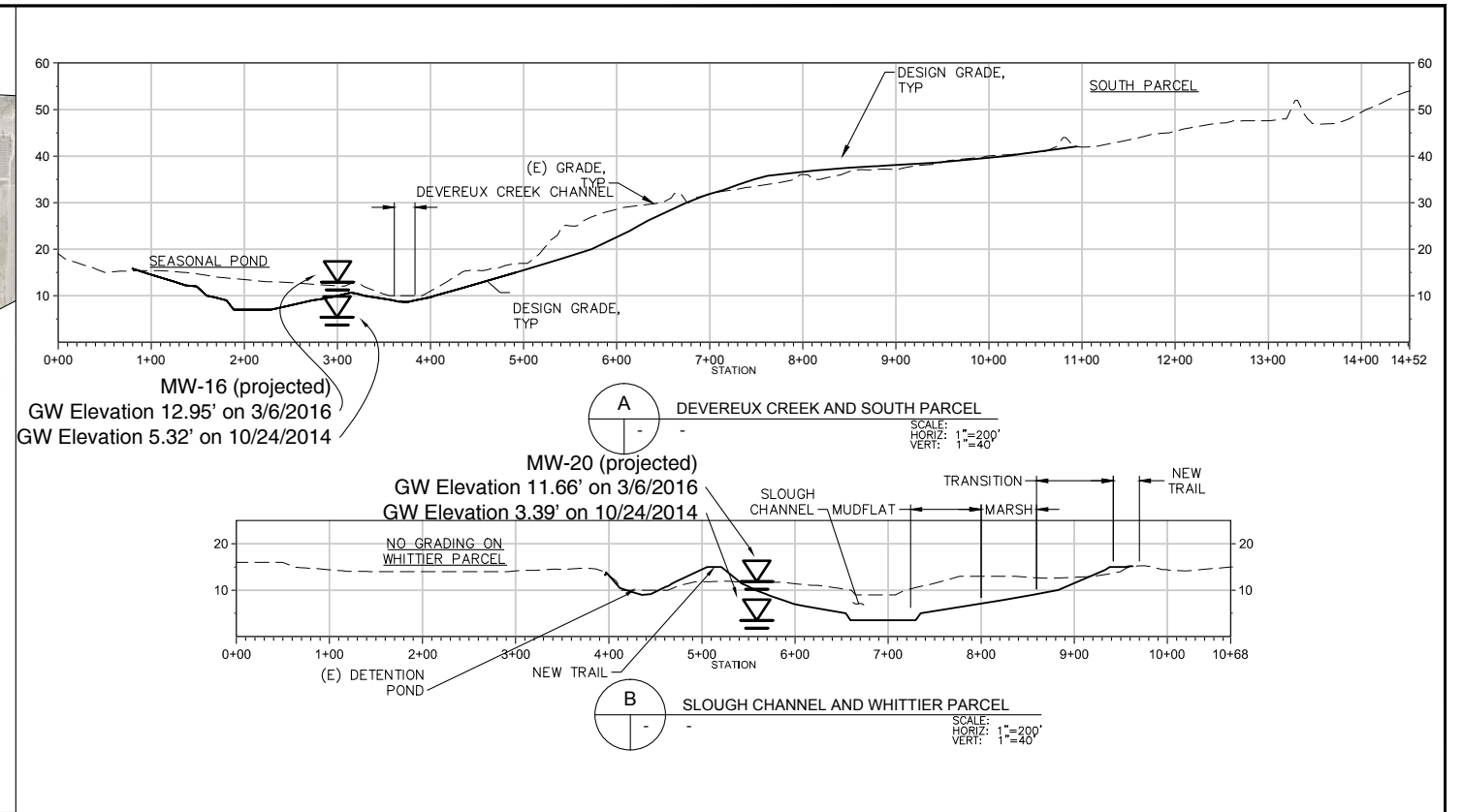
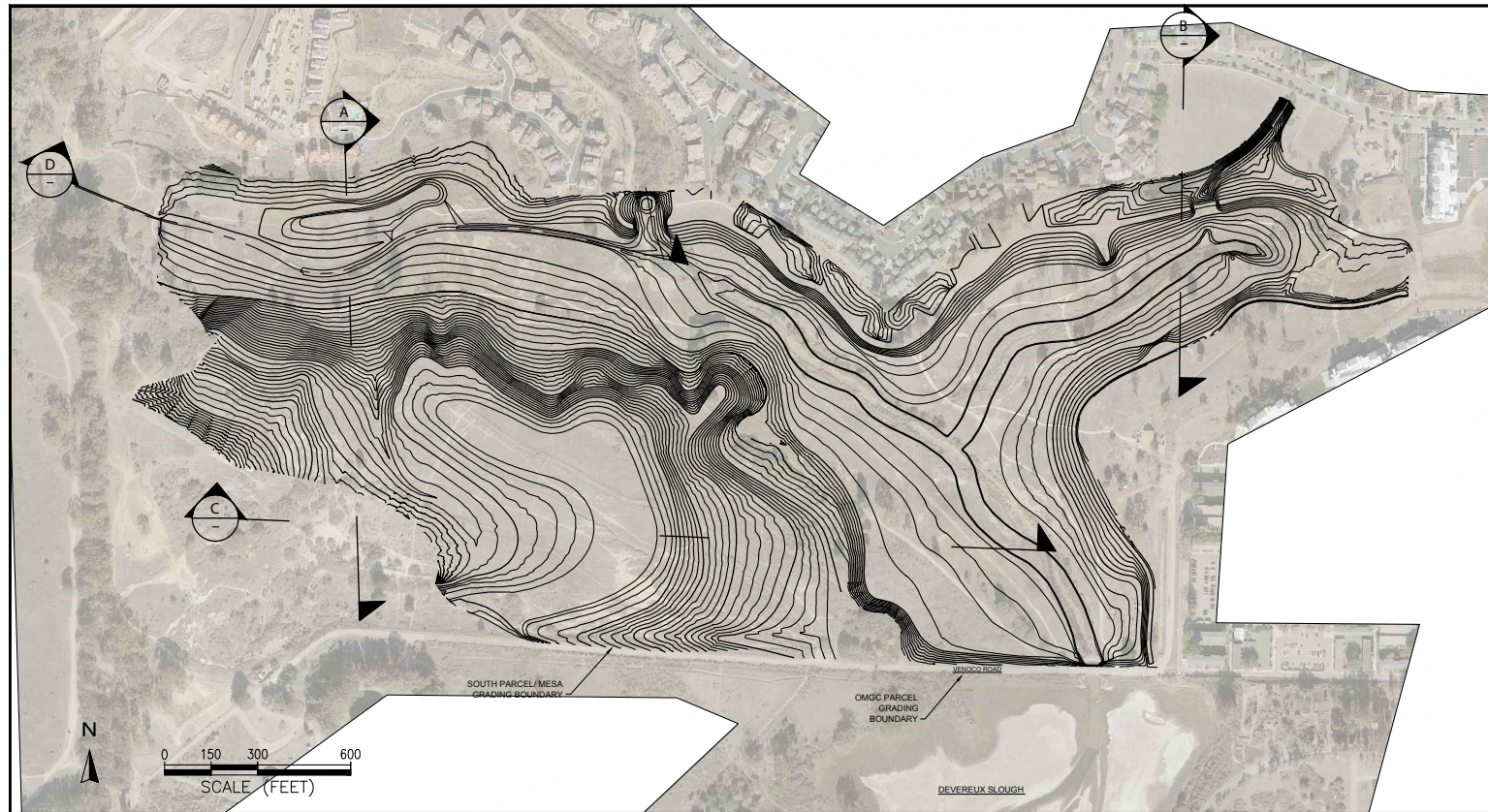
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MW-20 HYDROGRAPH
North Campus Open Space - UCSB
 Goleta, California
 April 2016

Note: Graph combines CCBER recorded data with Campbell Geo level logger data and direct measurements. Previously reported (CCBER) water elevations were updated to re-surveyed casing elevations, relative to NAVD 88.

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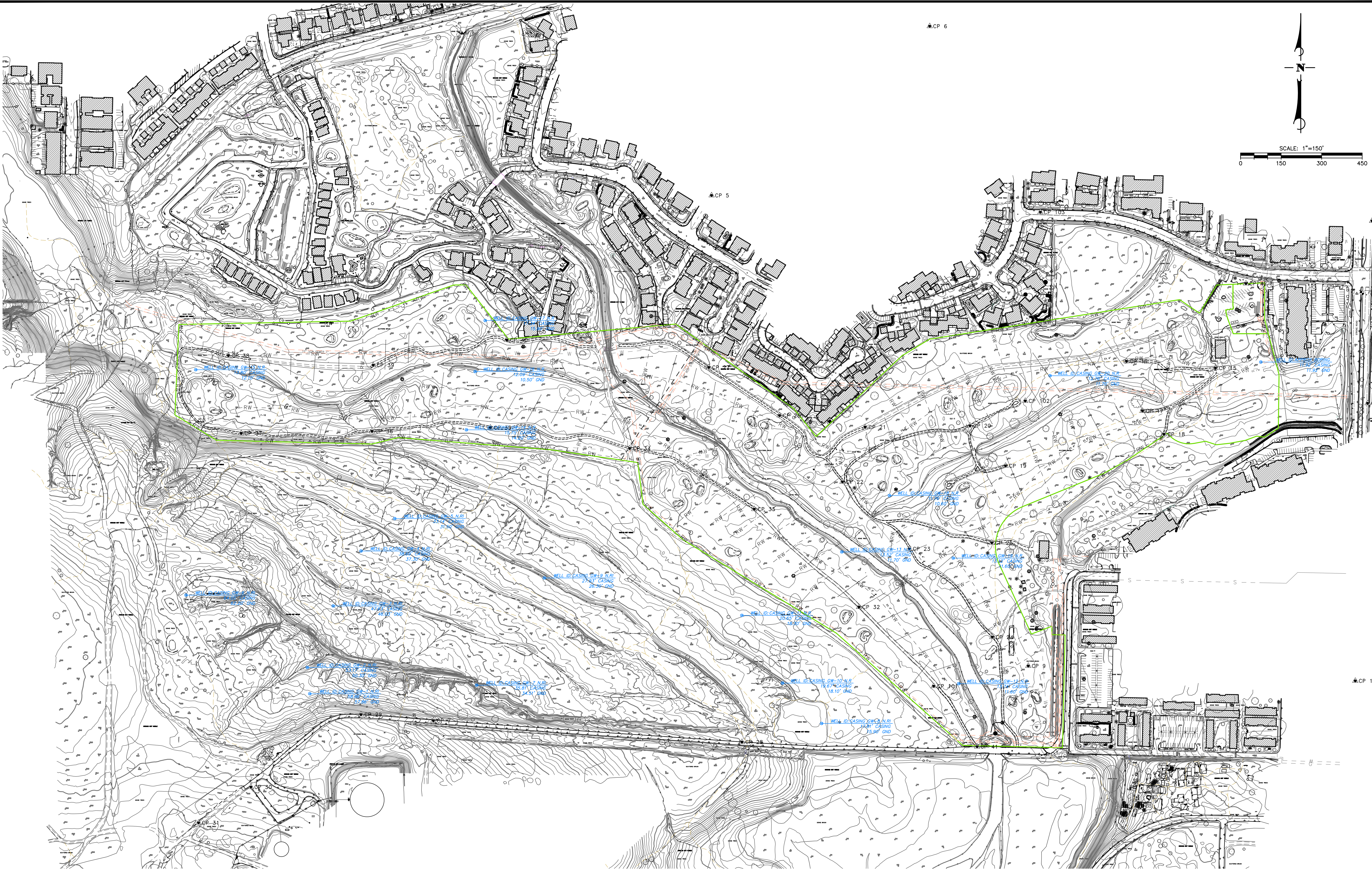
SOURCE: Aerial Photo: Stantec, 2015. Topography: Aerial Photogrammetry by Stantec, November 2015

UCSB NCOS Restoration Project . D140769.01



FIGURE 7
Project Grading Cross Sections - Phase 2

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NO.	DATE	REVISIONS	APPD.


Stantec
 111 East Victoria Street, Santa Barbara, CA 93101
 Phone: (805) 963-9532 Fax: (805) 966-9801

FIELD CREW: CE
 SURVEY COMPLETED: 1/16/2016
 OFFICE TECH: HMG
 COMPILATION COMPLETED: 1/21/2016

**LOCATIONS OF
 MONITORING WELLS
 SANTA BARBARA, CALIFORNIA
 FEBRUARY 2016**

PROJECT NUMBER
 2064109300
 SHEET
 1 of 1
 DWG
 2064109300\TOPO.DWG