Memorandum

DATE: June, 20, 2016

TO: Catherine Kutsuris, Interim General Manager
Town of Discovery Bay Community Services District

FROM: Tom Elson
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SUBJECT: Supporting Analysis on Groundwater Conditions
2016 Self-Certified Water Conservation Standard

Introduction

This memorandum provides supporting analysis of water supply reliability for the Town of Discovery Bay Community Services District (TODB) used for the individualized self-certified supply conservation standard. The analysis was prepared to comply with the June 2016 State of California Emergency Drought Regulations and in accordance with the Guidance for Water Supply Reliability Certification and Data Submission.

Groundwater is the sole source of supply for the TODB water system. As such, the TODB Community Services District monitors well operations and groundwater conditions to ensure that sufficient supply is available to meet the requirements of its water supply permit. For the subject Water Supply Reliability Certification, this memorandum draws upon prior evaluations of supply including nature, extent, and continuity of the aquifer source, groundwater quality and storage as a function of historical use and hydrology, and overall conditions in the groundwater basin from which the groundwater source is derived.

Previous Investigations, Planning, and Monitoring

The Town of Discovery Bay along with other local water agencies funded a groundwater resources study of eastern Contra Costa County (Luhdorff & Scalmanini Consulting Engineers, 1999) to establish a basic understanding of groundwater resources in the region. The east Contra Costa County area was the subject of an AB3030 groundwater management plan (Diablo Water District, 2007) and the same local agencies cooperatively conduct monitoring under a California Groundwater Elevation Monitoring plan (2014). TODB prepared water master plans in 1999 and 2010 to ensure that infrastructure development matched growth in demand and prepared an Urban Water Management Plan in 2015.

Through each of these activities, local groundwater conditions have continually been evaluated for sufficiency in meeting demand and to determine whether the groundwater source was reliable and sustainable at the level of current and projected future use. Operationally, TODB conducts thorough well performance testing on a bi-annual basis to identify maintenance needs.

Geologic Setting and Groundwater Occurrence

Discovery Bay is located in eastern Contra Costa County in the northwestern San Joaquin River Valley portion of the Great Valley geomorphic province of California. The province is characterized by the low relief valley of the north-flowing San Joaquin River and the south-flowing Sacramento River, which merge in the Delta region just north of the community, draining westward to the Pacific Ocean.

To the west of Discovery Bay, the Coast Range province consists of low mountains of highly deformed Mesozoic and Cenozoic marine sedimentary rocks. These thick marine rocks extend eastward below the Great Valley where they are targets of deep well gas exploration.

Overlying the marine rocks is a sequence of late Cenozoic (Miocene, Pliocene, and Pleistocene) non-marine sedimentary deposits. Surface exposures of these deposits occur in small areas along the edge of the Coastal Range. The beds dip moderately to the east and extend below the San Joaquin Valley. In the subsurface, the nature of these deposits is poorly known, but they are believed to be dominated by fine-grained clays, silts, and mudstones with few sand beds. The lower portion of these deposits may be in part equivalent to the Miocene-Pliocene Mehrten Formation along the east side of the Great Valley. The upper portion of Pliocene and Pleistocene age may be equivalent to the Tulare Formation along the west side of the San Joaquin Valley to the south, and the Tehama Formation of the Sacramento Valley to the north. It is believed that these deposits extend from about 400 feet to 1,500-2,000 feet below the San Joaquin River. Water quality from electric logs is difficult to quantify, but groundwater appears to become brackish to saline with depth.

Late Cenozoic (Pleistocene and Holocene; 600,000 years to present) sedimentary deposits overlie the older geologic units. These deposits are largely unconsolidated beds of gravel, sand, silts, and clays. The deposits thicken eastward from a few tens of feet near the edge of the valley to about 400 feet at the Contra Costa County line. West of Discovery Bay, the deposits are characterized by thin sand and gravel bands occurring within brown, sandy silty clays and are believed to have formed on an alluvial fan plain fed from small streams off the Coastal Range to the west. The alluvial plain deposits interbed and interfinger with deposits of a fluvial plain to the east. The fluvial deposits consist of thicker, more laterally extensive sand and gravel beds of stream channel origin interbedded with flood plain deposits of gray to bluish, sandy to silty clays. Discovery Bay overlies the fluvial plain area of eastern Contra Costa County, and its supply is derived from wells completed in these deposits to a maximum depth of about 350 feet.

Hydrogeologic Setting

Discovery Bay overlies the northwestern portion of the Tracy Subbasin (see **Figure 1**), which is one of sixteen subbasins in the San Joaquin Valley Groundwater Basin as designated in Department of Water Resources Bulletin 118, 2003 Update. The Tracy Subbasin boundaries are defined by the Mokelumne and San Joaquin Rivers on the north; the San Joaquin River on the east; and the San Joaquin-Stanislaus County line on the south. The western subbasin boundary is defined by the contact between the unconsolidated sedimentary deposits and the rocks of the Diablo Range (DWR, 2004).

The hydrogeology of Discovery Bay is illustrated through the geologic cross section shown on **Figure 2**. The cross section depicts the distribution of aquifer materials completed in TODB's supply wells. The maximum depth of groundwater development is about 350 feet below ground surface. Sand units encountered below this depth are interpreted as the uppermost, older non-marine deposits of largely fine-grained silt and clay with thin, fine sand interbeds. Water quality appears to be poor to brackish in the older, deeper sediments. Water quality in the primary production aquifer is described in the next section under Groundwater Conditions.

Overlying the older non-marine deposits are Pleistocene alluvium of generally thick beds of sand and gravel with a thin clay interbed. These are interpreted as stream channel deposits of a northward flowing ancestral San Joaquin River and represent the primary production aquifer from which all TODB supply wells extract groundwater (see **Figure 2**).

The primary production aquifer is confined by a thick sequence of grayish to bluish silt and clay with thin interbeds of sand. This unit appears to represent deposition on a floodplain with the main stream channels further east. Thin sands within this sequence appear to be flood-sprays of sand spread onto the flood plain.

A second aquifer sequence above about 140 feet below ground surface consists of a thinner sand and gravel bed, and is encountered in wells throughout Discovery Bay (see **Figure 2**). These appear to be stream channel deposits, but water quality is brackish to saline. As a result, this zone must be sealed off to protect water quality of the primary production aquifer and to avoid corrosion of the well casing. Overlying the brackish zone is a sequence of gray to brown silt and clay beds with some thin sand beds. These beds appear to be either floodplain deposits or distal alluvial plain deposits from the west.

Groundwater Conditions

Groundwater conditions in Discovery Bay are closely monitored to ensure that TODB can meet the requirements of its public water system permit. Groundwater level data for Discovery Bay have been collected since the late 1980s when the town was developed. Monitoring has evolved to

include compliance with CASGEM and for developing a Groundwater Sustainability Plan (GSP) with other local agencies under the 2014 Groundwater Sustainability Act. Water level and water quality trends are discussed below as indicators of reliability and sustainability of the source.

Groundwater Levels

Early water well driller reports for wells in Discovery Bay indicate that before significant development occurred, static groundwater levels were near sea level. At this elevation, water levels in wells were about 10 feet below ground surface. With the onset of pumping and initial growth, the static level in production wells exhibited seasonal variations between 10 and 40 feet below ground surface. During this period, pumpage increased from about 300 million gallons per year (MGY) in 1987 to about 800 MGY by 2001. Between 2001 and 2008, pumpage increased to 1,300 MGY. After 2008, pumpage leveled off as a result of the national economic downturn and water levels since 2008 have exhibited stable to rising trends. Water level measurements in fall 2014 and 2015 were higher than the last year of the 2007-09 statewide drought. **Figure 3** is a hydrograph showing water level data for TODB's production wells and denotes dry periods and pumpage.

TODB also conducts continuous monitoring of key monitoring wells with the use of water level transducers equipped with dataloggers. Data from this effort are complementary to the seasonal manual measurements in the TODB production wells. An example of output is shown on **Figure 4** with data from a shallow and deep monitoring well at the Well 4 site. The deep monitoring well data reflect daily drawdown induced by the operation of Well 4. The shallow monitoring well is completed in the brackish zone above 140 feet and serves as a sentinel to ensure that pumping influences in the primary production aquifer do not induce downward vertical flow of brackish groundwater.

Groundwater Quality

Groundwater quality from TODB supply wells meets all California primary drinking water standards. Groundwater does not meet secondary standards for manganese, which exceeds the drinking water maximum contaminant limit (MCL) of 0.050 mg/L. As a result, manganese removal treatment is employed so that all Title 22 requirements for drinking water are satisfied. Because of the depth of the primary production aquifer (see **Figure 2**) and presence of confining clay layers, source protection is achieved with deep annular seals in the well structure. As a result, none of the wells have exhibited anthropogenic sources of contamination such as volatile or semi-volatile organic contaminants that are often found in urbanized settings.

The most important water quality concern for the well sources in Discovery Bay is the brackish to saline water that occurs in the shallow zone above 140 feet (see **Figure 2**). With the exception of one well that has a compromised seal, all TODB wells exhibit stable levels of

dissolved mineral content. The problem well serves as an emergency standby source and is anticipated to be replaced.

Groundwater Sustainability and SGMA

In the absence of chronic downward trends in water levels or degraded water quality, TODB's groundwater supply is considered sustainable and does not exhibit any characteristics of unsustainability as defined under the 2014 Sustainable Groundwater Management Act (SGMA). Furthermore, the historic trends through variable hydrologic periods, including the stability in groundwater levels through the recent drought in water years 2013-15, indicate that groundwater pumpage is sustainable at current usage by TODB. To ensure future sustainability, TODB is a participant with other local agencies in seeking to develop a Groundwater Sustainability Plan under SGMA.

Total Available Supply

TODB water supply comes from six (6) existing groundwater production wells. The pumping capacity of these wells ranges from 850 gallons per minute (gpm) to 1,800 gpm. Four of the wells pump at the higher 1,800-gpm capacity. In accordance with the California Waterworks Standards (Title 22), the source capacity of TODB wells are sized such that the maximum day demand of the system can be met with the largest well offline. Thus, there is a redundancy in meeting the maximum day demand, for example, if a well is offline for maintenance during the high demand period.

The total pumping capacity of all TODB wells combined is 9,500 gpm. With the largest well offline, the combined pumping capacity of the remaining wells is 7,700 gpm. In comparison, the current maximum day demand is estimated to be approximately 6,000 gpm. Through an analysis of the TODB water demands (2010 Water Master Plan), it is estimated that when the annual demand reaches 1,800 million gallons per year (MGY) the maximum day demand of the system will be approximately 7,700 gpm. While the TODB supply wells could pump much more than 1,800 MGY if continually operated, this annual production represents the size of the system at which the maximum day demand would be equal to 7,700 gpm, and thus the capacity of the existing well field.

The groundwater questions on Worksheet 1 of the Guidance for Water Supply Reliability Certification and Data Submission form are supported by the data discussed in this technical memorandum as follows:

Do you know the volume of water in the aquifer that is in your source(s) of groundwater?

Yes. The minimum volume of groundwater available to TODB corresponds to the maximum annual historical extraction. While a greater volume might exist, data indicating that no undesirable effects occurred at the maximum pumpage rate provides a conservative estimate of source volume representing a measure of sustainable yield.

How frequently are groundwater elevations monitored?

*Key monitoring wells are equipped with transducers and dataloggers set at 15-minute frequency (see **Figure 4**). These wells are used to assess operations and are part of the CASGEM monitoring network for the groundwater subbasin that TODB overlies. Semi-annual monitoring of all production wells is performed at same time as CASGEM monitoring. Additional water level measurements are made at the time of well maintenance activities.*

At what depth is/was your water table?

*Water levels in TODB production wells indicate full recoveries after droughts in 2007-09 and 2012-14 and current water levels in Wells 1B, 2, and 4 are as high as anytime in the past 20 years (see **Figure 3**). MW4-Deep is used to represent conditions for the TODB well network. The profiles for all existing wells were evaluated for selection MW4 as the sentinel. The depth-to-water readings below were made when nearby production Well 4A was not running. The depth-to-water in feet in June 2013 and June 2016 for this well are as follows:*

June 20, 2013	***June 20, 2016***
57.4	*57.0*

How many feet can you withdraw without substantially affecting your ability to pump water?

*Well 4A is representative of the TODB supply well network. The historic low static level is 66 to 68 feet recorded in the fall of dry years 2008, 2009, and 2014 (see **Figure 3**). In fall of 2009, when the historic low static water level was measured, a pump performance test was performed in which the pumping level was 132 feet at the operating flow rate. The pump setting depth is 180 feet, providing a margin of 48 feet. For the same pump setting depth, the low static water level could decline an additional 40 feet without requiring lowering of the pump or adversely affecting daily extraction in high demand months. As part of this determination, the pump curve and well profile were examined.*

References

Diablo Water District. 2007. *Groundwater Management Plan for AB 3030*. Prepared by Luhdorff & Scalmanini, May.

Luhdorff & Scalmanini Consulting Engineers. 1999. *Investigation of Groundwater Resources in the East Contra Costa Area*. Prepared for five water agencies in eastern Contra Costa County. March.

____. 2014. *East Contra Costa County Groundwater Elevation Monitoring (CASGEM) Network Plan*. Prepared by Luhdorff & Scalmanini, July.

____. 2014. *East Contra Costa County Groundwater Elevation Monitoring (CASGEM) Network Plan*. Joint plan for Town of Discovery Bay and five water agencies in eastern Contra Costa County. Prepared by Luhdorff & Scalmanini, July.

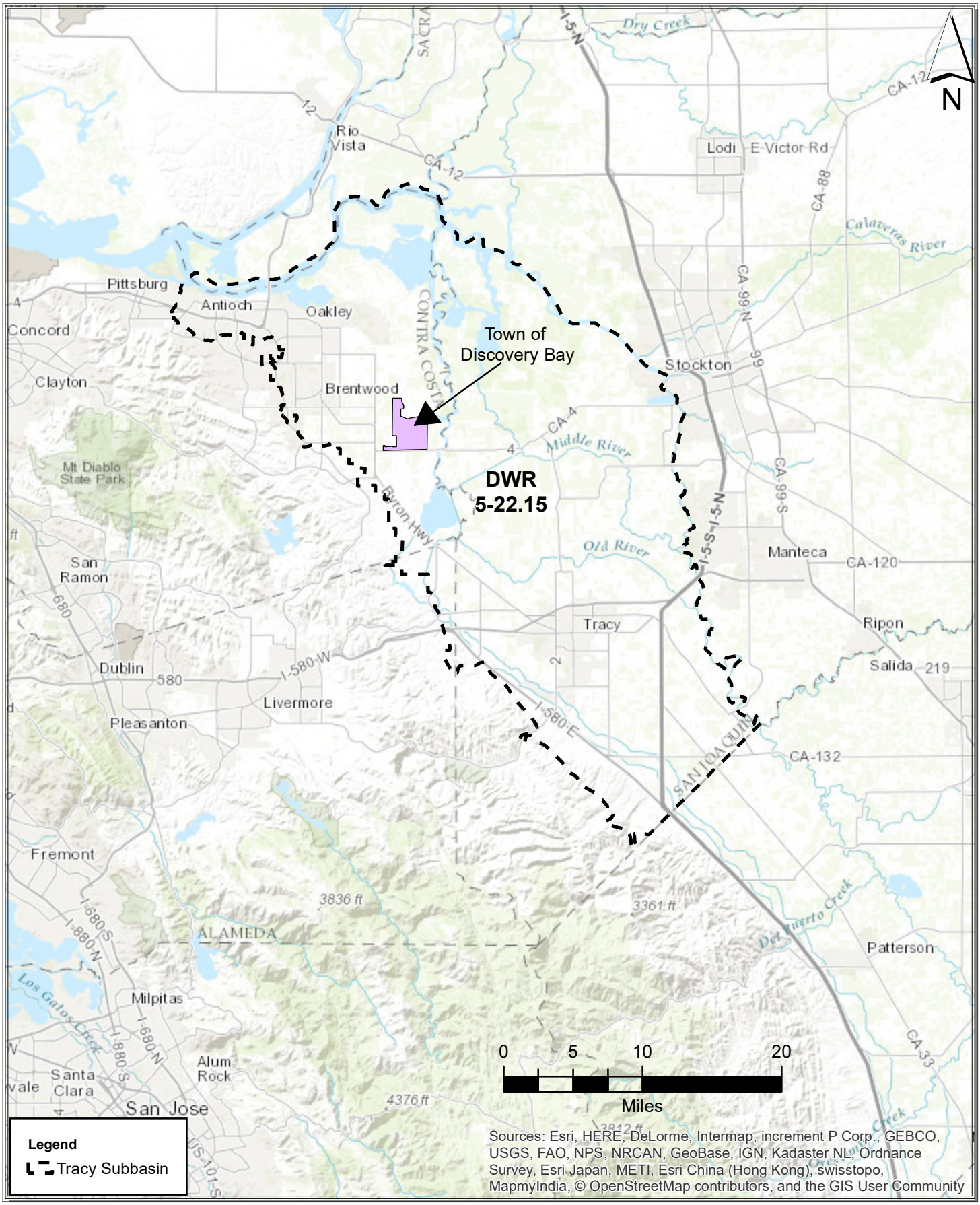

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Figure 1
Location Map
Town of Discovery Bay and Tracy Subbasin

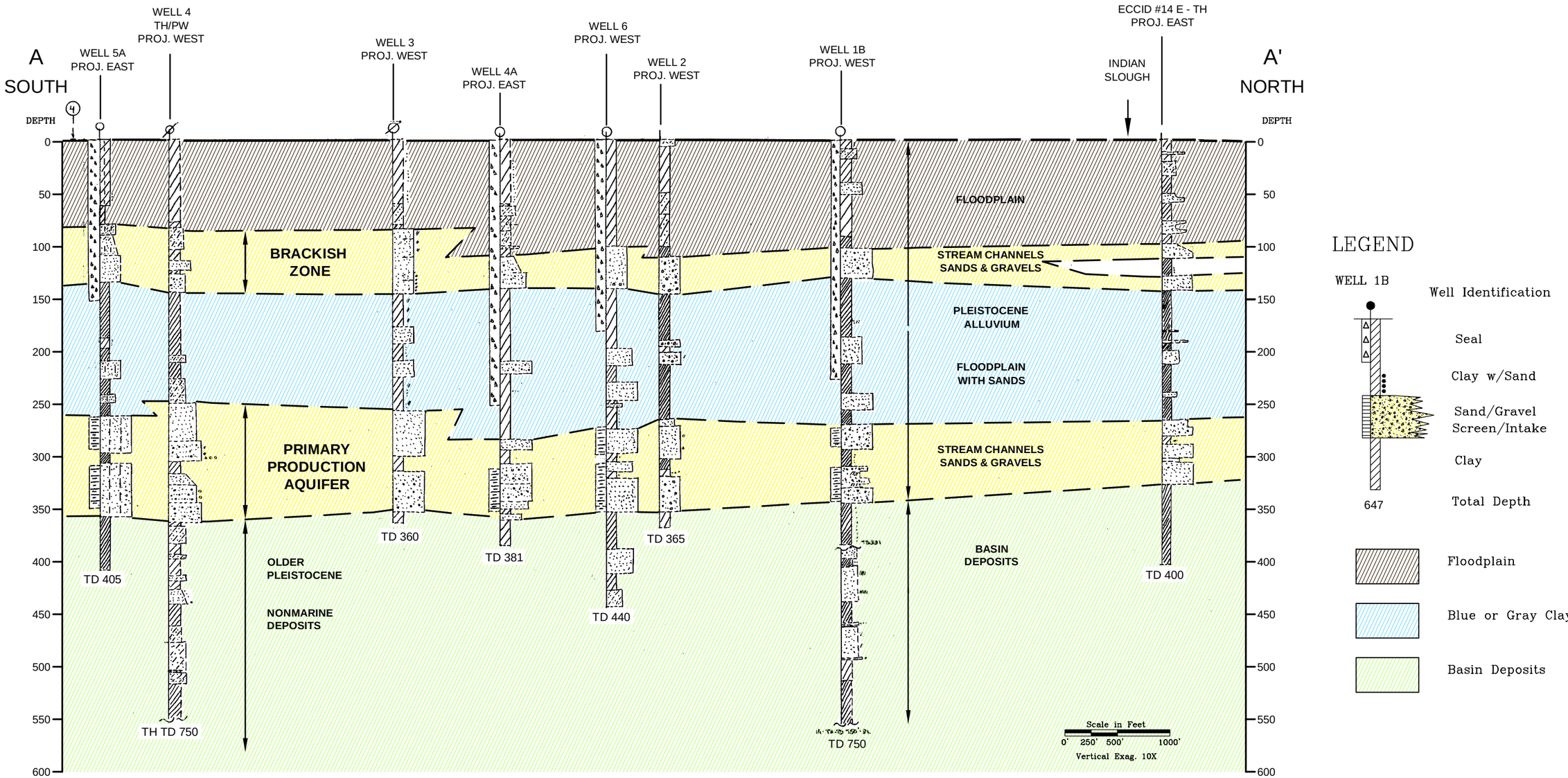

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Figure 2
Geologic Cross Section
Town of Discovery Bay

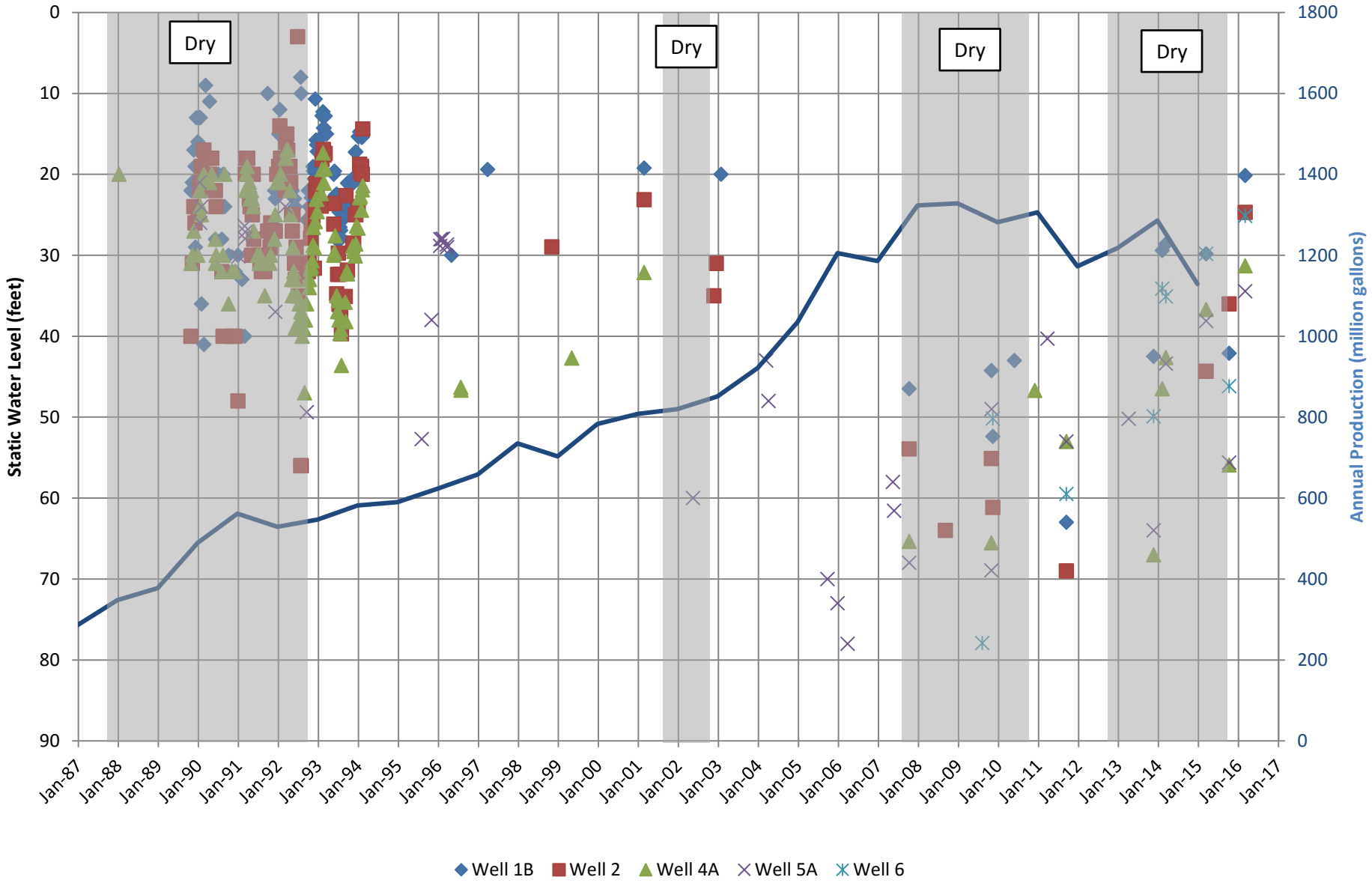

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Figure 3
Static Water Levels in TODB Production Wells

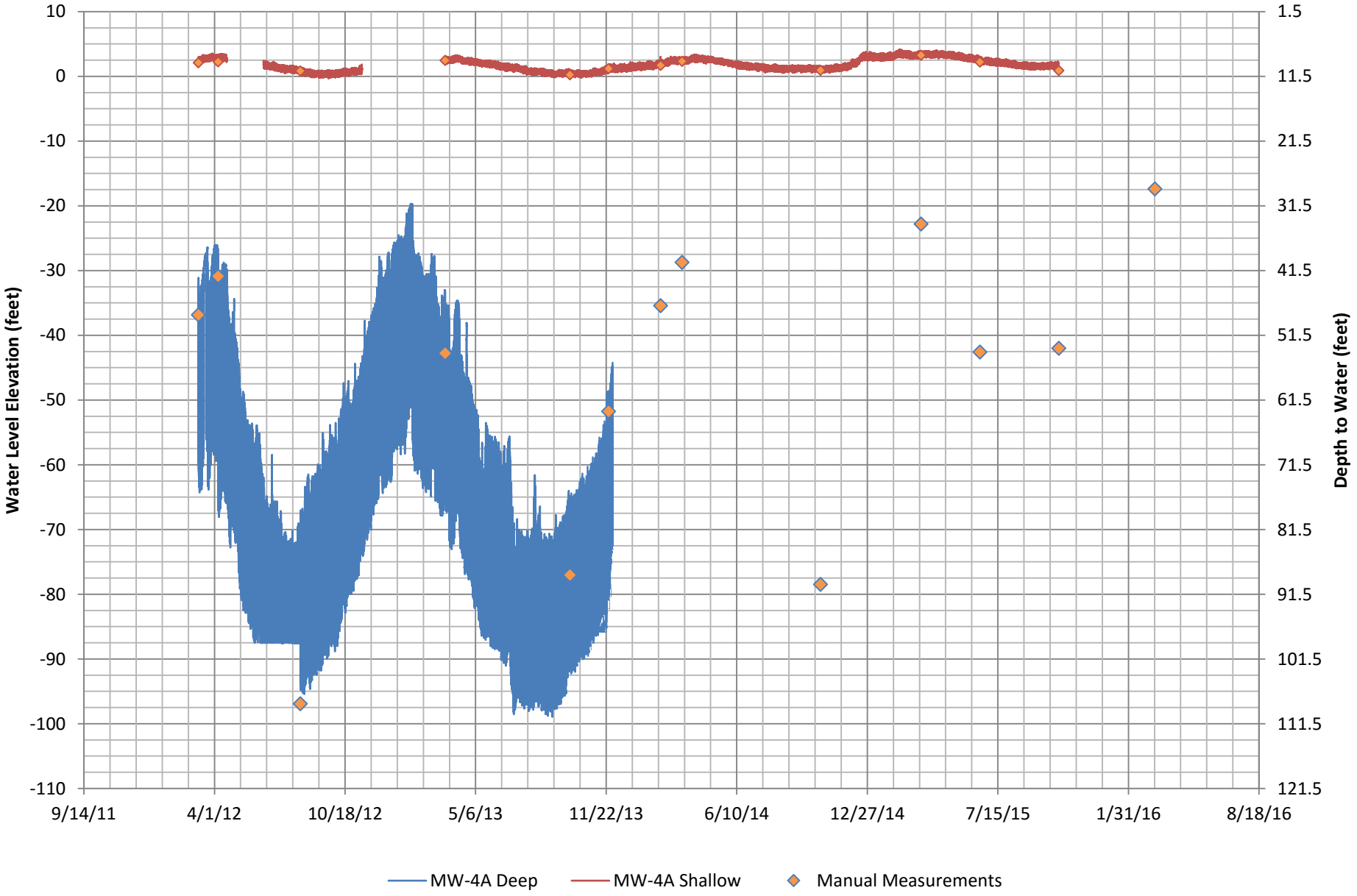

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Figure 4
Continuous Monitoring at Monitoring Well 4