Appendix H – TM 10.7

Well Interference

FUGRO CONSULTANTS, INC.

1000 Broadway, Suite 440
Oakland, California 94607
Tel: (510) 268-0461
Fax: (510) 268-0137

April 26, 2012
Project No. 0103.128

TECHNICAL MEMORANDUM 10-7 (Rev., Final)

To: Mr. Greg Bartow
San Francisco Public Utilities Commission

From: Peter Leffler, C.Hg.

Subject: **SFPUC Regional Groundwater Storage and Recovery Project; South Westside Basin Third Party Well Survey and Well Interference Analysis**

INTRODUCTION

This Technical Memorandum (TM) was prepared to document work performed by Fugro as part of contract CS-879A with Kenned/Jenks Consultants (Kennedy/Jenks) for the San Francisco Public Utilities Commission (SFPUC) pursuant to the amended Task Order authorizations CUW30103-TO-1.12 of the Regional Groundwater Storage and Recover (GSR) Project. This project is funded by the SFPUC's Water System Improvement Program (WSIP).

The San Francisco Public Utilities Commission is conducting environmental review for the proposed Regional Groundwater Storage and Recovery (GSR) Project in the South Westside Groundwater Basin in northern San Mateo County. The proposed GSR Project involves a partnership between SFPUC and the City of Daly City, California Water Service Company (Cal Water), and the City of San Bruno. The study area encompasses a portion of San Mateo County located between Millbrae and Daly City. Each of the Partner Agencies (Daly City, Cal Water, and San Bruno) has historically obtained municipal water supplies from a combination of groundwater and SFPUC surface water. In the proposed project, the SFPUC would provide a greater allocation (supplemental supply) of surface water to Partner Agencies (PAs) during average and wet years in order to allow Partner Agencies to reduce groundwater pumping. The project would create in-lieu groundwater recharge, which would be tapped during drought cycles via new wells installed by the SFPUC between Millbrae and Daly City. For reference, put/take/hold periods are defined as follows (see Kennedy/Jenks, 2012, Section 2.1.1 for more details):

- A put period is when the PAs would receive supplemental surface water from the SFPUC "in-lieu" of groundwater pumping. The reduced pumping would effectively increase the volume of groundwater in storage that would be available during dry years or an extended drought.
- A take period is when water shortages are triggered and water is recovered from the SFPUC Storage Account. During take periods, both the proposed GSR Project

wells and the PA wells would extract groundwater. The SFPUC would recover "stored" groundwater by pumping the proposed 16 GSR project wells. In addition, the PAs would return to their typical groundwater pumping.

- A hold period is when there are no water shortages, but the SFPUC Storage Account is "full" and supplemental water deliveries do not occur. During hold periods, the PAs would return to their typical groundwater pumping, and the GSR Project wells would pump only small amounts to exercise the wells.

Purpose of Study

The proposed project would only extract groundwater up to the amount in the SFPUC Storage Account. However, due to the possibility for localized effects, this study is being conducted as part of the effort to evaluate the localized cones of depression around proposed GSR wells that may potentially affect individual existing third-party wells. The other purpose of this Technical Memorandum is to provide the SFPUC with a well inventory (e.g., identification of existing wells, well location) of private third party irrigation wells in the South Westside Groundwater Basin. The well data in this memo were used as input to a third-party well interference (drawdown) analysis conducted by MWH related to proposed new GSR Project wells (labeled as CUP-X) to be installed by the SFPUC for extraction of in-lieu groundwater recharge stored under the GSR Project in the South Westside Groundwater Basin. The MWH well interference results were then superimposed on future regional groundwater levels to estimate how proposed GSR pumping would affect future static water levels of third party wells. MWH previously completed a well interference analysis for municipal wells (MWH, 2008) and was retained by the SFPUC to complete a similar analysis for third party wells as part of this study.

Background

The third-party (i.e., irrigation) groundwater pumpers in the South Westside Groundwater Basin that are the subject of this TM include the Colma cemeteries, California Golf Club, and Lake Merced Golf Club (Figures 1 and 2). In addition, this study provides GSR-related well interference calculations for the Olympic Golf Club and San Francisco Golf Club located near or within San Francisco City/County limits. A separate well interference study was conducted previously for Partner Agency municipal wells and included in the Conceptual Engineering Report (MWH, 2008).

The SFPUC invited cemetery and golf course owners/representatives to a Workshop that was held on June 25, 2009 at the Colma Town Hall Council Chamber. A presentation was given by SFPUC regarding plans for the proposed GSR Project. Attendees were informed that the SFPUC was conducting a survey of third party well owners as part of a series of studies in the groundwater basin to evaluate potential effects of the proposed project. A data request list pertaining to the well survey was made available to all attendees. As a follow-up, individual meetings were held with all known large irrigation well owners.

It is our understanding that some private homeowner irrigation wells exist in Hillsborough (HydroFocus 2007, 2011), however the GSR Project is not expected to affect these wells due to

their distance from proposed GSR wells (about two miles south of CUP-M-1). The Green Hills Golf Club operates irrigation wells in Millbrae that are located about 0.75 miles from the nearest proposed GSR well (CUP-M-1) and greater than two miles from the next closest GSR well. In general, MWH determined that well interference effects on wells greater than 1.5 miles from a proposed GSR well would be negligible (Appendix B). Review of well logs for Green Hills Golf Club indicate that aquifer (sand) layers are within the depth interval from 120 to 260 feet below ground surface. The depth to water from 140 to 170 feet at these wells indicates unconfined aquifer conditions. Well CUP-M-1 has sand layers from 190 to 410 feet below ground surface with a depth to water of 160 feet. Theis calculations using an unconfined storage coefficient (0.05) and transmissivity value of 8,000 gpd/ft (derived from CUP-M-1 pumping test) show mutual interference drawdown of less than 5 feet after 7.5 years of continuous pumping. Given the distances from GSR wells and the small proposed pumping capacity of CUP-M-1 (about 150 gpm), the offsetting benefits of the GSR Put cycles, and differences in screen intervals and geologic conditions, mutual interference drawdown effects from GSR wells on Green Hills Golf Club wells are expected to be negligible.

Mr. Don Curry of CSW/Stuber-Strough was retained to facilitate contacting third party cemetery well owners due to his history of working with the cemeteries on their wells and water distribution facilities. Site visits were conducted with the California Golf Club and all Colma cemeteries that use groundwater for irrigation. The site visits included requests for well information, and measurement of water levels if an access port was available. Cypress Lawn did not provide a field visit to their irrigation wells nor provide any information regarding their wells. The SFPUC conducted site visits with the Olympic and San Francisco golf clubs. Multiple meetings were conducted with Lake Merced Golf Club, but they did not provide a field visit to their wells. Pump Repair Service (which services pumps in many of the third party wells) was also contacted to request data for various third party wells they service for owners that gave their approval for release of the information.

Previous Studies

Department of Water Resources (DWR) driller's logs and existing hydrogeologic reports and additional information obtained from the SFPUC were reviewed for purposes of undertaking the analysis in this Technical Memorandum. The Recycled Water Feasibility Study (Carollo, 2008) includes information that was used to help identify existing owners of wells that pump groundwater for irrigation purposes.

DATA COLLECTION

Site Visits

Owners of third party wells were contacted and site visits arranged as follows:

Holy Cross Cemetery - A site visit was conducted on September 11, 2009 and included a meeting with Mr. Roger Appleby (General Manager). Locations were obtained for four existing wells, and groundwater levels were measured in three of the four wells. A new (replacement) well was drilled in 2008, which would serve as the primary well in the future (Holy Cross 4). The current existing primary well (Holy Cross 1) is expected to become a secondary

well. Available data from the 1999 to 2001 time period indicated the pumping rate for Holy Cross 1 was approximately 725 to 760 gpm. The existing emergency well (Holy Cross 2) would be maintained as a backup well, and the existing secondary well (Holy Cross 3) is planned for abandonment. The well interference analysis was conducted using Holy Cross 4 as the primary well and Holy Cross 1 as the secondary well.

A brief follow-up site visit was conducted on March 8, 2010 to obtain a groundwater level in the primary well that could not be obtained during the September 2009 site visit, and also to obtain groundwater levels in the other Holy Cross Cemetery wells.

Italian Cemetery - A site visit was conducted on January 22, 2010 and included a meeting with Giuseppe Timpano (Facility Manager). The location and a groundwater level were obtained for one existing primary well (IC-5). This is the only well utilized by the Italian Cemetery and they have no secondary or backup well. Available data from the 1999 to 2001 time period indicated the pumping rate was approximately 260 gpm. Future plans are to continue using this one primary well, and this primary well was used in the well interference analysis.

Woodlawn Cemetery - A site visit was conducted on January 22, 2010 and included a meeting with Margaret Hambrick. Locations were obtained for two existing wells (primary and backup), and a groundwater level was obtained in the primary well. Future plans are to continue using the same two wells. Available information from 2008 indicated that the primary well pumped at approximately 500 gpm. The well interference analysis was conducted using the primary well and backup well.

Eternal Home Cemetery - A site visit was conducted on February 4, 2010 and included a meeting with Lisa Matson (Office Manager). The location and a groundwater level were obtained for one existing primary well (ET-2). This is the only well utilized by the Eternal Home Cemetery and they have no secondary or backup well. Future plans are to continue using this one primary well. The well pumps water to an approximately 10,000 gallon storage tank located uphill from the well. At the time of our site visit, the well was reported to pump at an instantaneous rate of approximately 100 gpm. Available data from the 1999 to 2001 time period indicated the pumping rate ranged from 150 to 200 gpm. The well interference analysis used this one primary well.

Hills of Eternity/Home of Peace/Salem Cemeteries - A site visit was conducted on February 8, 2010 and included a meeting with James Carlson (Executive Director). Locations were obtained for two existing wells (HE-2 at Hills of Eternity and HP-3 at Home of Peace) and one proposed replacement well at Home of Peace Cemetery. Groundwater levels could not be obtained from the two existing wells. Historic operations have utilized the two existing wells to serve the three cemeteries, with the Home of Peace well being the primary well and Hills of Eternity well being the secondary well. Recently the primary (Home of Peace) well went out of service , and the Hills of Eternity well is currently the only well in operation. Available data from the 1999 to 2001 time period for the Hills of Eternity well indicated the pumping rate ranged from 170 to 180 gpm.

The proposed replacement well was drilled in 2010, and additional information on that well was obtained from Don Curry in 2011. Future plans are to use the new replacement well located at Home of Peace as the primary well to serve all three cemeteries (Hills of Eternity/Home of Peace/Salem). The future backup well would be the existing Hills of Eternity well (HE-2). The well interference analysis was based on the new replacement well at Home of Peace as the primary well and the existing Hills of Eternity well as the back-up well.

Cypress Lawn Cemetery - A site visit was conducted on February 4, 2010 and included a meeting with Ken Varner (President and CEO). We were not given a site visit to the wells and were not provided with a map of well locations. Ken said that they operate a primary well that is approximately six years old that pumps into the lake, and have a back-up well known as the South Well. The primary well is used to irrigate approximately 140 acres. They have an additional 32 acres of land on Hillside irrigated with water obtained from Cal-Water. Apparently two wells were damaged and/or lost during the BART construction process, including a well known as the North Well. Due to the lack of well data obtained for this study, well interference calculations for Cypress Lawn were conducted for historic wells known as Cypress 3 and 4. General well locations and construction data necessary to conduct the analysis were obtained from a review of DWR well logs and previous studies. Although specific current well locations could not be obtained, the selected well locations should provide representative well interference drawdowns for potential well locations on Cypress Lawn property.

California Golf Club - A site visit was conducted November 17, 2009 and included a meeting with Rick Kavakoff and Dennis Mahoney (General Manager). Locations were obtained for four existing wells, and groundwater levels were obtained in three of the four wells. Well 8 is considered the primary well (90% of pumping), Well 7 is a secondary well (10% of pumping), and Wells 5 and 6 are backup wells. Well 7 was tested at a rate of 200 gpm at the time of installation (1994), and Well 8 was originally tested at 800 gpm (2001). Future plans are to continue use of the wells as described above. The well interference analysis used Well 8 as the primary well and Well 7 as the secondary well.

Olivet Cemetery - A site visit was conducted on March 8, 2010 and included a meeting with Mario Falla, who is in charge of maintenance at the cemetery. A location was obtained for the one existing primary well. The port was not able to be accessed at the well head to obtain a groundwater level in the well. The well was tested at 480 gpm at the time of installation (1999). The well interference analysis used the one existing well which serves as the sole source of irrigation water supply for the cemetery.

Lake Merced Golf Club (LMGC) – Meetings were conducted March 5, 2010, March 11, 2011, and June 21, 2011 with Donna Lowe (General Manager) and other golf club representatives. LMGC did not provide a site visit to their wells and did not have any information on their wells, although they did provide a map with golf course well locations and indicated that essentially Well 3 is the only active well. Attempts were made to arrange for access to Pump Repair Service files for LMGC wells; however, multiple attempts at doing so were not successful. It is not clear whether or not Pump Repair Service is the most recent provider of pump contracting services, as LMGC indicated in our meetings that multiple pump service providers have been used over the years. The well interference analysis used Well 3 as

the primary and only well. The majority of water utilized by LMGC has been recycled water since 2005.

Olympic Golf Club - A site visit and data collection effort for Olympic Golf Club were conducted by SFPUC. Data obtained by SFPUC were compiled and provided in this TM for use in MWH well interference calculations. Olympic Golf Club Well No.1 and Well No. 2 were used in the well interference analysis.

San Francisco Golf Club - A site visit and data collection effort for San Francisco Golf Club were conducted by SFPUC. Data obtained by SFPUC were compiled and provided in this TM for use in MWH well interference calculations. San Francisco Golf Club Well No. 2 was used in the well interference analysis.

Other Data Sources

CSW/Stuber-Strough assisted in making contacts with the cemetery owners and providing historic well data from their files related to their work for certain cemeteries. Some of the historic well data provided by CSW was related to well testing completed as follow-up work to the Colma area BART EIR. In addition, CSW/Stuber-Strough provided recent data regarding two new cemetery well installation projects with which they have been involved - one at Holy Cross and one at Home of Peace.

Pump Repair Service has historically been and continues to be the primary contractor providing pump services for several third party well owners in northern San Mateo County. Permission was obtained from each cemetery and golf course owner (with the exception of Cypress Lawn and Lake Merced Golf Club) to contact Pump Repair Service to ask for available well and pump data. At least some data were obtained from Pump Repair Service for the following cemeteries: Holy Cross, Hills of Eternity, Olivet, Eternal Home, Italian, Woodlawn, and California Golf Club.

Fugro submitted a request to California DWR for copies of well completion reports in the Colma area. The package of well completion reports obtained from DWR includes several reports for wells associated with the cemeteries and golf courses that are the subject of this survey. These reports were reviewed for purposes of undertaking this study for the SFPUC.

Well Inventory

A well inventory spreadsheet was compiled from the data obtained for this study (Table 1). The spreadsheet generally includes information on the following: well name and use, top of well screen, and specific capacity calculations. Well head elevation data were uniformly not available for any of the wells in this survey; thus, reference point elevations were estimated from Google Earth. Despite certain limitations in data availability mentioned above, it is our opinion that the available data are sufficient to allow for an adequate assessment of effects on third party wells from the proposed GSR Project.

General locations for each well identified in the field are plotted in Figures 1 and 2. The Colma cemeteries that pump groundwater extend from Woodlawn Cemetery in the north to Holy

Cross Cemetery in the south (Figure 2). The proposed GSR wells nearest to the Colma cemetery wells include CUP-11A at the northern end, CUP-18, CUP-19, CUP-22A, and CUP-23 at the southern end of the Colma cemeteries. Lake Merced Golf Club is located about 7,000 feet northwest of Woodlawn Cemetery, and the nearest proposed GSR wells are CUP-3A, 5, 6, and 7. Olympic and San Francisco golf clubs are located about 12,000 feet northwest of Woodlawn Cemetery, and about 4,000 to 5,000 feet from the nearest GSR wells (CUP-3A, 5, 6, and 7). California Golf Club wells are located about 6,000 feet southeast of Holy Cross Cemetery, and the nearest proposed GSR wells are CUP-31 and CUP-36-1.

Well screen information was obtained for most wells. CSW/Stuber-Strough provided the well screen information for the newly constructed Home of Peace well. The recently installed wells have top of screen intervals at 420 feet below ground surface (bgs) for the Holy Cross Replacement Well (Primary Well 4), and 400 feet bgs for the Home of Peace (Hills of Eternity and Salem) Replacement Well. These two new wells appear to be screened both above and below the W clay. In terms of the numerical model, these two wells are assumed to have screens in both Model Layer 4 and Model Layer 5. Other active wells such as Hills of Eternity, Olivet, Eternal Home, and Italian cemeteries have top of screens at depths ranging from as shallow as 224 feet bgs to as deep as 308 feet bgs, and all appear to be screened above the W clay in Model Layers 2, 3, and 4. The Holy Cross Secondary Well 1 is screened in from 368 feet bgs, likely contains screens both above and below the W clay, and is assumed to have screens in Model Layers 3, 4, and 5.

The Woodlawn primary well is screened from 275 feet bgs, which appears to encompass and extend slightly below the W clay. The Woodlawn primary well screen intervals are assumed to correspond primarily to Model Layers 2, 3, and 4. Lake Merced Golf Club Well 3 is screened from 294 feet bgs, and may extend into but not below the W clay. The Lake Merced Golf Club Well 3 screen intervals are assumed to correspond primarily to Model Layers 2, 3, and 4. California Golf Club Well 8 is screened from 320 feet bgs in an area of the basin where the W clay is not present. CGC8 well screen intervals correspond to Model Layers 3, 4, and 5.

It was assumed that Cypress Lawn Wells 3 and 4 are sufficient to represent the existing active wells for the cemetery. Cypress Lawn Well 3 is located at a higher surface elevation and screened at various depth intervals from 191 feet bgs (assumed to correspond to Model Layers 2, 3, and 4). Cypress Lawn Well 4 is located at a lower surface elevation and screened from 330 feet bgs (assumed to correspond to Model Layers 3, 4, and 5).

Based upon the well data collected for this study (and making certain assumptions about Cypress Lawn Cemetery and Lake Merced Golf Club wells), the wells tend to fall into two groups: one with relatively shallow elevations for the top of screen and one with deep elevations for the top of screen. Five cemeteries that have wells with tops of screens ranging from -100 feet (NGVD 29) to -166 feet (NGVD 29) include Eternal Home, Italian, Hills of Eternity, Woodlawn, and Olivet. Cypress Lawn Well 3 is assumed to have a top of screen elevation of about -40 feet (NGVD 29). Lake Merced Well 3 is assumed to have a top of screen elevation of -140 feet (NGVD 29). Two cemeteries that installed wells within the last two years having deeper top of screens at -274 and -279 feet (NGVD 29) include Holy Cross and Home of Peace (which also would serve Hills of Eternity and Salem). The assumed representative primary

Cypress Lawn well (No. 4) being used for this study has a somewhat intermediate depth top of screen at about -240 feet (NGVD 29), and California Golf Club Well 8 has top of screen at -259 feet (NGVD 29).

In terms of groundwater level measurements, some historic data are available from the time each well was installed. Other historic groundwater level data for several wells encompass the 1999-2001 time period. In addition, groundwater level measurements were obtained from the wells with accessible sounding ports during the site visits for this study. In general, groundwater levels increased 35 to 36 feet on average between spring 2001 and spring 2010 (Table 2). As discussed further below, this increase in water levels is generally attributed to the In-Lieu Recharge Demonstration Study, which started in 2002 (L&S, 2005).

Specific capacity calculations for this study are summarized in Table 1. Well specific capacities generally range from about 5 to 15 gallons per minute per foot of drawdown. The third party wells are generally operated at pumping rates ranging from about 150 to 800 gpm, with typical drawdowns in the range of 20 to 100 feet.

Data were obtained for several wells with respect to the type of pumps installed, capacity/head ratings, and pump curves. These data are summarized in Table 3. Pump models, pump curves, and capacity/head ratings were obtained for the following wells: Holy Cross 1, Holy Cross 4, Woodlawn, Italian, Eternal Home of Peace, Hills of Eternity, Olivet, and California Golf Club. Similar pump data were also available for Olympic Club and San Francisco Golf Club Wells (LSCE, 2012). As discussed further below, pump data were used to estimate changes in pumping rates under the maximum depth to water conditions during future Take cycles.

GROUNDWATER FLOW MODEL SCENARIO RESULTS

A numerical groundwater flow model for the Westside Groundwater Basin was developed over a period of time from 2000 to 2011 by HydroFocus and Gus Yates, who were retained by Daly City (HydroFocus 2007, 2009, 2011). It has been a collaborative effort sponsored by Daly City with review by the SFPUC, Cal Water, San Bruno and their respective consultants. Groundwater studies being conducted by the SFPUC for the San Francisco Groundwater project and the GSR Project have utilized the calibrated Westside Basin Groundwater Flow Model as one of the tools for evaluating potential project effects. Kennedy/Jenks Consultants have been the lead in applying the existing model to future project scenarios for the groundwater studies with review and input by Luhdorff & Scalmanini and Fugro.

Other studies currently being conducted by SFPUC include application of the groundwater flow model to a future scenario developed for the GSR Project. These model scenarios and results are described in detail in a Technical Memo prepared by Kennedy/Jenks (2012). Although the analyses conducted for this TM primarily are based upon analytical techniques, some applicable groundwater model scenario results are provided herein for comparison. In particular, model scenario 2 for the GSR Project is shown for comparison purposes in some of the graphical plots of analytical results for specific wells.

ANALYTICAL DATA ANALYSIS RESULTS

Colma Cemetery Wells

The analytical data analysis for the Colma area wells included in this study involved the following steps:

1. Based upon review of water level data from 2001 to 2010 for cemetery wells (cemetery well water level data was only available for early 2010 and was assumed to be similar to 2009 levels), it was concluded that an appropriate groundwater level recovery rate for the Colma area is 8.6 feet per 4,300 acre-feet of in-lieu recharge (this represents the amount of in-lieu recharge in the Daly City and Cal Water areas during a future Put Year). The rationale for this conclusion is that the SFPUC storage account calculations provided by SFPUC indicate that it had accumulated 17,987 acre-feet (af) of in-lieu recharge (as of the end of 2009) in Daly City and Cal Water areas since 2002 (Appendix A). It is assumed that the approximately 18,000 af of increased storage correlates with the 36-foot rise in groundwater levels at the cemetery wells between 2001 and 2010. Thus, dividing 18,000 af of Put by a total water level rise of 36 feet equals 500 af of Put per foot of groundwater level rise.
2. Under the proposed project, a year of Put is equal to about 6,180 af for the three Partner Agencies. However, factoring out Put for the San Bruno wells (due to the significant distance from Colma) results in a total in-lieu recharge of about 4,300 acre- feet per year (AFY) during a proposed project Put year in the Daly City and Cal Water areas. Using the above logic, a year of Put at 4,300 af divided by 500 af per foot of water level rise results in a Put year groundwater level rise of 8.6 feet.
3. The proposed GSR well locations were reviewed for proximity to Colma to determine the amount of Take from GSR wells in the Colma region. The only wells excluded from the Take calculation were CUP-41-4, CUP-44-1, CUP-44-2, and CUP-M-1 due their considerable distance from the Colma area (greater than two miles). Assuming a total Take year extraction of 7.23 MGD (8,100 AFY), and subtracting the Take amounts from the four wells listed above results in about 6,460 af of extraction from GSR wells in the Daly City, Colma, and Cal Water areas. Assuming that Take year extraction works in reverse of the recovery of water levels during Put years yields a one foot water level drop per every 500 af removed during a Take year. Dividing 6,460 af by 500 af per 1 foot of groundwater level decline yields 12.9 feet of groundwater level decline during a proposed Take year due to GSR pumping.
4. The background groundwater level decline due to regional groundwater (i.e., Partner Agency and third party wells) pumping was evaluated using both available cemetery well groundwater level data prior to 2002 (and the onset of the In-Lieu Recharge Demonstration Study) and groundwater flow model simulation results. Tabulation of pre-2002 cemetery well groundwater level data is provided in Appendix A. Data available from wells at three cemeteries (Eternal Home, Hills of Eternity, and Holy Cross) indicate groundwater level decline rates ranging from 1 to 2 feet per year between 1960 and 2001. The HydroFocus (May 2011) Historical Simulation (1958-2009) showed an average water level decline of about 1 foot/year, and the

HydroFocus 2008 No Project Scenario showed decline rates of 0.6 to 0.8 feet/year. The Existing Conditions Scenario (Scenario 1) by KJ (2012) showed a background groundwater level decline rate of about 0.75 feet/year in the Colma cemetery area. Based on available field data and model simulations, a background groundwater level decline rate of 0.75 feet/year is considered to be representative of future Hold year Partner Agency and cemetery well pumping effects on Colma area groundwater levels.

5. Combining the values above, we have a Put Year recovery rate of 8.6 feet/year, a Take Year decline rate of 12.9 feet/year, and a Hold Year decline rate of 0.75 feet/year. The Take Year decline rate of 12.9 feet/year is assumed to already include the background (Hold Year) decline rate related to basin pumping because many of the years in the 2001 to 2010 time frame used in the analysis did not have in-lieu recharge.

Using an example cemetery well (Eternal Home), a starting depth to water of 225 feet below ground surface was measured in early February 2010 (assumed representative of 2009 conditions). Based on the amount of in-lieu SFPUC storage account being approximately 20,000 af, another 40,500 af is required to achieve a full SFPUC Storage Account. Thus, it would require 6.5 years of Put at a rate of 6,180 AFY (4,300 AFY in Daly City and Cal Water areas) to achieve 60,500 af of in-lieu storage when starting with 20,000 af of storage. 6.5 years of Put at the proposed rate would increase groundwater levels another 56 feet at the Eternal Home well, resulting in the regional static water level associated with a Full SFPUC Storage Account being 169 feet bgs (the high point on Figure 3 in future scenario year 7).

The proposed Put/Hold/Take year sequence for the GSR scenario (Table 4) was used to develop a plot of future groundwater levels (depth to water and groundwater elevation) for the Eternal Home well (Figures 3 and 4). Both the Existing Conditions (Scenario 1) and the GSR scenario (Scenario 2) include the Design Drought. Using the annual changes in groundwater levels associated with Put, Hold, and Take years described above, Figures 3 and 4 show how regional groundwater levels are estimated to fluctuate at the Eternal Home well over the course of 47 future years based on the assumptions and calculations used in this analysis.

The next step was to add in the local GSR drawdown as calculated by MWH (Appendix B) to regional groundwater level fluctuations shown in Figures 3 and 4. Local well interference drawdowns ranged from 41 feet after one year of Take to 76 feet after 7.5 years of Take. The resulting new (end of water year) static water level for the Eternal Home Cemetery Well ranged from approximately 169 feet bgs (-41 feet NGVD 29) to 361 feet bgs (-233 feet NGVD 29). The background water level decline (i.e., existing conditions from 2009/2010 water level or 20,000 AF SFPUC storage account starting condition) would result in a static water level decline from 225 feet bgs (-97 feet NGVD 29) to 258 feet bgs (-130 feet NGVD 29) at the end of the Design Drought (Year 44). The background water level decline for existing conditions was calculated by applying an annual groundwater level decline of 0.75 feet per year (i.e., equal to Hold Year groundwater level decline). The annual background water level decline in this analysis is assumed to be linear for purposes of this analysis; however, in reality, depletion of aquifer storage and the related rate of decline in groundwater levels will generally decrease over time if

groundwater extraction remains constant and there is available recharge. Therefore, the assumption of a consistent rate of decline is conservative.

The groundwater model results for Scenario 2 are plotted on Figure 4 for comparison with analytical results. There is general agreement between analytical and groundwater model results in terms of both short-term and longer term groundwater level fluctuations. The analytical results generally show equal or lower static water levels during Take cycles than Layer 4 groundwater model results and can be considered more conservative (i.e., more of a worst case) in evaluating potential effects of the GSR Project on the Eternal Home well.

Figures 3 and 4 show that Take-Year static water levels fall below existing conditions between the first and second year of drought. Scenario 2 static water levels (SWLs) for the Eternal Home Cemetery Well with implementation of the GSR Project are estimated to reach a maximum depth of 105 feet below the existing conditions (i.e., without the GSR Project) SWLs. The maximum decline in groundwater levels for the Eternal Home Cemetery well occurs at the end of the Design Drought in future scenario year 44 (middle of the eighth consecutive year of Take). The static water level in the well declined to 285 feet bgs (before factoring in local GSR well interference drawdown). Addition of the local well interference effects results in a SWL declining to a low of 363 feet bgs (compared to an existing conditions level of 258 feet bgs).

It should be noted that the absolute lowest static water level occurs in the middle of scenario year 44 (when the Design Drought ends and SFPUC Storage Account is empty) and not at the end of the year (361 feet bgs) as shown in the figures. The lowest level occurs when Take ends within future scenario year 44 at a SWL of 363 feet bgs (groundwater elevation of -235 feet NGVD 29).

Similar analytical analyses as described above were conducted for other Colma cemetery wells and the tables and figures with results for these wells are provided in Appendix C. In general and as described above, after the first year of Take static water levels begin to decline to below the level expected without the project (20,000 acre-feet SFPUC storage account starting condition). However, it should be noted that static water levels are generally positive (i.e., higher than would be expected under existing conditions) under all other conditions except the three years of recovery needed after the Design Drought to return to Existing Conditions water levels. Overall, GSR Project static water levels in cemetery wells are higher than existing conditions for 75% of years.

Analysis of Installed Pump Capacities for Colma Cemetery Wells

Limited data were obtained concerning the specific pumps installed in the various cemetery and golf course irrigation wells. Although complete data sets were unable to be obtained for any of the wells, the available data combined with certain assumptions were used to obtain estimates of how GSR-related effects on static water levels might alter pumping capacities for wells that had sufficient pump data. Wells with sufficient data available for analysis were Italian Cemetery Well, Olivet Cemetery Well, Home of Peace Well, Hills of Eternity Well, Holy Cross Cemetery Wells 1 and 4, Eternal Home Well, Woodlawn Primary Well, and California Golf Club wells and the results are summarized in Table 5.

The pump in the Italian Cemetery well has a capacity/head rating of 260 gpm at 420 feet. It was assumed that the pump had a total dynamic head of 420 feet and was pumping at 260 gpm at the time of the spring 2001 groundwater level measurement (294 feet bgs). Based upon a specific capacity of 4.8 gpm/ft and a pumping rate of 260 gpm, the pumping drawdown in the well was estimated to be 54 feet - resulting in a pumping water level of 348 feet bgs (294 + 54 feet) as of spring 2001. Thus, the discharge head needed to achieve 420 feet of total dynamic head (TDH) was estimated to be 72 feet (420 - 348 feet).

Utilizing the data and assumptions outlined above, a calculation was first made for the existing conditions. Under this future condition, the new static water level was calculated to be 290 feet, a decline of 33 feet from the initial SWL. Analysis of this condition using the pump curve for the well suggests a pumping capacity of 265 gpm with a pumping water level of 345 feet. The new pumping water level of 345 feet plus the 72 feet of discharge head yields a total dynamic head of 417 feet.

A similar analysis/calculation as described above was applied to the estimated maximum depth to water for the GSR Scenario. In this case, the SWL declines to 400 feet bgs. Analysis of this condition using the pump curve suggests that the Italian well pump capacity would decline to 145 gpm with a pumping water level of about 430 feet. Addition of the discharge head of 72 feet yields a TDH of 502 feet.

A similar logic/analysis as described above for the Italian Cemetery well was applied to the Olivet Cemetery Well, Home of Peace Well, Hills of Eternity Well, Holy Cross Cemetery Well 1 and 4, Eternal Home Well, and Woodlawn Primary Well, and results are provided in Table 5. The overall results indicate that the lowest point during a Design Drought would result in pump capacity declines ranging from about 10 to 50 percent from existing conditions for all wells except Woodlawn (87% decline). The encroachment of pumping water levels into the well screen intervals under the two different water level conditions described above (Existing Conditions and GSR Project) varies depending on well construction details. In the case of the Italian Cemetery, Eternal Home, and possibly Olivet Cemetery wells, it appears that they have historically had pumping water levels within the upper portion of the screen interval. However, existing conditions and GSR Project conditions would result in much greater decline of pumping water levels into the screen intervals, which might be expected to result in decreasing specific capacity (i.e., estimated future pumping capacities could be somewhat lower than described above). The Holy Cross Well 1 maintains pumping water levels above the top of screen under historic conditions and the existing conditions scenario; and then pumping water level declines approximately 25 feet into the screen interval by the end of the GSR Project scenario. These differences with respect to decline of pumping water levels into screen intervals reflect the generally shallow top of screen settings for the Italian and Olivet wells compared to the somewhat deeper (intermediate) top of screen setting for the Holy Cross Well 1. Schematic examples of what could be typical water levels in third party well under both Existing Conditions and GSR Project Conditions are provided in Appendix D.

The Holy Cross Well 4 has a significantly lower specific capacity (6 gpm/ft) than the Holy Cross Well 1 (11 gpm/ft). Therefore, although the top of screen in Holy Cross Well 4 is deeper than in Well 1, the end of Design Drought pumping well level declines all the way through the

upper screen interval in Well 4. This condition of pumping water levels remaining above the top of screen without the GSR project versus declining through the upper well screen with the GSR project could result in a lower specific capacity during the latter half of the Design Drought with GSR wells pumping. The Home of Peace Replacement well has a specific capacity of 11 to 12 gpm/ft and the analysis presented herein shows that the pumping water level only encroaches into the uppermost portion of the well screen by about 5 feet at the end of the Design Drought.

The pump curve for the Woodlawn Primary Well indicates that the installed pump is apparently designed to operate within a relatively narrow range of water levels compared to other pumps in cemetery wells. The dramatic decline in pumping capacity estimated for future end of Design Drought GSR conditions for the Woodlawn Well (87%) compared to other cemetery wells (10 to 50%) is largely due to the particular pump installed in the well as opposed to differences in water level declines (e.g., about 15 feet more at Woodlawn than other cemetery wells) .

California Golf Club Wells

The data analysis for the California Golf Club wells is similar to the Colma cemetery wells and involved the following steps:

1. Based upon review of water level data from 2001 to 2010 for the CGC wells and the Colma area well data analysis (recovery rate of 8.6 feet/year), it was concluded that an appropriate recovery rate of CGC wells is approximately 8.5 feet/year.
2. Based upon review of the Colma area well data GSR Take Year analysis (decline rate of 12.9 feet/year) along with the estimated Take-Year groundwater level decline rate of up to 24 feet/year estimated by L&S for the Cal Water Well Field area (personal communication, Will Halligan), it was concluded that an appropriate decline rate for CGC wells is approximately 18.5 feet/year (average of Colma area 12.9 feet/year and 24 feet/year).
3. The groundwater level decline due to Partner Agency/third party pumping was estimated based upon the Colma area analysis (0.75 feet/year) and the groundwater model result for Model Layer 4 at the California Golf Club well (about 0.7 feet/year). Thus, it is concluded that the Hold year decline rate at the California Golf Club is 0.75 feet/year.
4. Summarizing the values above, the Put Year recovery rate is 8.5 feet/year, the Take Year decline rate is 18.5 feet/year, and the Hold Year decline rate is 0.75 feet/year.

A depth to water of 235 feet below ground surface (-174 feet NGVD 29) was measured in 2001 (pre In-Lieu Recharge Demonstration Study). Based upon a Fall 2009 measured depth to water of 214 feet and other data collected for this study, it is estimated that a representative Spring 2010 depth to water in CGC Well 8 is 200 feet. The proposed Put/Hold/Take year sequence for the GSR Project scenario (Table 6) was used to develop a plot of future (depth to water) groundwater levels for California Golf Club Well 8 (Figure 5). Using the annual changes in groundwater levels associated with Put, Hold, and Take years described above, Figure 5 shows how regional groundwater levels are estimated to fluctuate at the California Golf Club

Well 8 over the course of 47 future years based on the assumptions and calculations used in this analysis. A similar analysis was completed for California Golf Club Well 7 (Figure C-19 in Appendix C).

The next step was to add in the local GSR drawdown as calculated by MWH (Appendix B). This value ranged from 43 feet after one year of Take to 74 feet after 7.5 years of Take. The resulting new static water level for California Golf Club Well 8 ranged from approximately 145 feet bgs (-84 feet NGVD 29) to 400 feet bgs (-339 feet NGVD 29) (Figure 6). The background water level decline (i.e., existing conditions) would result in a static water level decline from 200 feet bgs (-139 feet NGVD 29) to 233 feet bgs (-172 feet NGVD 29) at future scenario year 44 without the GSR project. A similar analysis was completed for California Golf Club Well 7 (Figure C-20 in Appendix C).

Review of Figures 5 and 6 shows that Take-Year static water levels fall below the static water level without the project during the first year of drought. Subsequent years of drought continue to reduce static water levels further below where static water levels would be without the project. The static water levels reach a maximum depth of 169 feet below the existing conditions SWL.

As described above, during the first year of Take static water levels for the GSR Project scenario begin to decline to below the level expected without the project. However, it should be noted that static water levels are generally positive (i.e., higher than would be expected under existing conditions) during non-Take years leading up to the Design Drought. Overall, GSR Project static water levels at California Golf Club wells are higher than existing conditions for 68 percent of years.

Analysis of changes in pumping capacity using the California Golf Club Well 8 pump curve indicate that the lowest well pumping capacity under the GSR Project would be about 475 gpm compared to the existing conditions capacity of 800 gpm. The decline in pumping capacity at Well 8 amounts a maximum of 41 percent for the GSR Project as compared to existing conditions without the GSR project. The pumping capacity analysis for California Golf Club Well 7 shows a greater decline of 78 percent from 200 to 45 gpm. The difference in pumping capacity decline at the two California Golf Club wells is mostly a function of the characteristics of the pump curve for the specific pumps installed in each well.

Lake Merced Golf Club Wells

The data analysis for the Lake Merced Golf Club wells included in this study is similar to the Colma cemetery wells and involved the following steps:

1. Based upon the Colma area well data analysis (recovery rate of 8.6 feet/year) along with the estimated groundwater level recovery rate (11 to 15 feet/year) in Park Plaza and other Daly City wells during the in-lieu recharge demonstration study, it was concluded that an appropriate recovery rate of LMGC wells is approximately 10.5 feet/year.

2. Based upon review of the Colma area well data GSR Take year analysis (decline rate of 12.9 feet/year) along with an estimated groundwater level decline rate during Take Years for Daly City wells of 16 to 21 feet (personal communication, Will Halligan), it was concluded that an appropriate decline rate for LMGC wells is approximately 15 feet/year.
3. The groundwater level decline due to Partner/third party pumping was estimated based upon the Colma area analysis (0.75 feet/year) and the groundwater model result for Model Layer 4 at CUP-6 (about 1.0 feet/year). Thus, it is concluded that the Hold year decline rate at the Lake Merced Golf Club is 0.75 feet/year.
4. Summarizing the values above, the Put Year recovery rate is 10.5 feet/year, the Take Year decline rate is 15 feet/year, and the Hold Year decline rate is 0.75 feet/year.

Based upon review of water level data from 2001 to 2010 for the two wells near LMGC (CUP-6-420 and DC-8), the Winter/Spring 2010 groundwater elevation was estimated to be 238 feet bgs (-84 feet NGVD 29). The initial 6.5 Put Years result in an initial full SFPUC Storage Account regional groundwater elevation of -16 feet (NGVD 29) (DTW of 170 feet bgs) as indicated in Figure 8.

The proposed Put/Hold/Take year sequence for the GSR scenario (Table 7) was used to develop plots of future (depth to water) groundwater levels for Lake Merced Golf Club Well 3 (Figures 7 and 8). Using the annual changes in groundwater levels associated with Put, Hold, and Take years described above, Figures 7 and 8 show how regional groundwater levels are estimated to fluctuate at the Lake Merced Golf Club Well 3 over the course of 47 future years based on the assumptions and calculations used in this analysis.

The next step was to add in the local GSR drawdown as calculated by MWH (Appendix B). This value ranged from 29 feet after 1 year of Take to 56 feet after 7.5 years of Take. The resulting new static water level for the Lake Merced Golf Club well ranged from approximately 170 feet bgs (-16 feet NGVD 29) to 356 feet bgs (-202 feet NGVD 29) (Figure 8). The background water level decline (i.e., existing conditions) would result in a static water level decline from 238 feet bgs (-84 NGVD 29) to 271 feet bgs (-117 feet NGVD 29).

Review of Figures 7 and 8 shows that Take-Year static water levels initially stay above the static water level without the project at least through the end of the second year of drought. The third year of Design Drought brings the static water level below the existing conditions. Static water levels reach a maximum depth of 87 feet below the existing conditions SWLs. As described above, it takes at least until after the third year of Take for static water levels to decline to below the level expected without the project. However, it should be noted that static water levels are generally positive (i.e., higher than would be expected under existing conditions) under all other conditions except for initial recovery after the Design Drought. Overall, GSR Project static water levels at Lake Merced Golf Club are higher than existing conditions in 83 percent of years.

No pump information could be obtained for Lake Merced Well 3. However, given the magnitude of water level declines (87 feet) at Lake Merced Well 3 compared to the range of water level declines at cemetery wells (95 to 116 feet), it is anticipated that the range of pump capacity reduction is likely in the lower end (i.e., 10 to 30%) of the 10% to 50% range in pump capacity reduction at most cemetery wells.

Olympic Club Wells

The analytical data analysis for the Olympic Club area wells included in this study is similar to the Colma cemetery wells and involved the following steps:

1. Based upon review of water level data from January 2002 to January 2005 for Lake Merced area wells LMMW-3D and LMMW-6D, it was concluded that an appropriate groundwater level recovery rate for the Olympic Club area is 3.6 feet per 3,070 acre-feet of in-lieu recharge (this represents the amount of in-lieu recharge in the Daly City area during a future Put Year). The rationale for this conclusion is that the SFPUC storage account calculations provided by SFPUC indicate that it had accumulated 5,665 af of in-lieu recharge (as of the end of January 2005) in the Daly City area since 2002 (Appendix A). The study period for this analysis stopped as of January 2005 to avoid any groundwater level bias associated with the initiation of Daly City recycled water deliveries to the Olympic Club, Lake Merced Golf Club, and San Francisco Golf Club. It was also necessary to account for Lake Merced water additions during the January 2002 to January 2005 period, and this was accomplished by treating the total additions of 1,160 af to Lake Merced the same as in-lieu recharge in the Daly City area. Thus, the total amount of in-lieu recharge used in this calculation is 6,825 af (5,665 af + 1,160 af). It is assumed that the 6,825 af of increased storage correlates with the approximate 8-foot rise in groundwater levels at the Lake Merced wells near Olympic Club between January 2002 and January 2005. Thus, dividing 6,825 af of in-lieu recharge (Put) by a total water level rise of 8 feet equals 850 af of Put per foot of groundwater level rise.
2. Under the proposed project, a year of Put is equal to about 6,180 af for the three Partner Agencies. However, factoring out Put for the Cal Water and San Bruno wells (due to the significant distance from Olympic Club) results in a total in-lieu recharge of about 3,070 AFY during a proposed project Put year in the Daly City area. Using the above logic, a year of Put at 3,070 af divided by 850 af per foot of water level rise results in a Put year groundwater level rise of 3.6 feet.
3. The proposed GSR well locations were reviewed for proximity to Olympic Club to determine the amount of Take from GSR wells in the region. The wells included in the Take calculation were CUP-3A, CUP-5, CUP-6, CUP-7, CUP-10A, and CUP-11A. Assuming Take year of 7.23 MGD (8,100 AFY), and subtracting the Take amounts from the 11 wells not listed above results in about 3,360 af of extraction from GSR wells in the Daly City area. Assuming that Take year extraction works in reverse of the recovery of water levels during Put years yields a one foot water level drop per every 850 af removed during a Take year. Dividing 3,360 af by 850 af per 1

foot of groundwater level decline yields 4.0 feet of groundwater level decline during a proposed Take year due to GSR pumping.

4. The background groundwater level decline due to regional groundwater pumping was evaluated using both available groundwater level data prior to 2002 (and the onset of the In-Lieu Recharge Demonstration Study) and groundwater flow model simulation results. Available measured pre-2002 groundwater level data in this area for Olympic Club were collected primarily during the 1987 to 1992 drought. Available data indicate groundwater level decline rates of about one foot per year during the drought. The HydroFocus (May 2011) Historical Simulation (1959-2009) showed a water level decline of 0 to 0.2 in the Olympic Club area, and the HydroFocus 2008 No Project Scenario showed essentially no change in groundwater levels. The Existing Conditions Scenario (Scenario 1) by KJ (2012) showed a background groundwater level decline rate of about 0.5 feet/year in the Olympic Club area. Based on available field data and model simulations, a background groundwater level decline rate of 0.5 feet/year is considered to be representative of Hold year groundwater level declines in this area.
5. Combining the values above, we have a Put Year recovery rate of 3.6 feet/year and a Take Year decline rate of 4.0 feet/year, and a Hold Year decline rate of 0.5 feet/year.

A depth to water of 120 feet below ground surface (-45 feet NGVD 29) was measured in July 2001 (pre In-Lieu Recharge Demonstration Study) in Olympic Club Well 1 (#9). Because the water level was measured in mid-summer, it was assumed a representative Spring water level would be somewhat higher at 115 feet (-40 feet NGVD 29). The measured rise in water levels in this area from 2002 to 2009 is about 15 feet in LMMW-3D/6D; thus, a representative Spring 2010 depth to water is assumed to be 100 feet (-25 feet NGVD 29) in Olympic Club Well 1. The proposed Put/Hold/Take year sequences for the GSR scenario (Table 8) was used to develop a plot of future (depth to water) groundwater levels for Olympic Golf Club Well 9/No. 1 (Figure 9). Using the annual changes in groundwater levels associated with Put, Hold, and Take years described above, Figure 9 shows how regional groundwater levels are estimated to fluctuate at the Olympic Golf Club Well 1 (#9) over the course of 47 future years based on the assumptions and calculations used in this analysis.

The next step was to add in the local GSR drawdown as calculated by MWH (Appendix B). This value ranged from 7 feet after one year of Take to 23 feet after 7.5 years of Take. The resulting new static water level for the Olympic Golf Club well ranged from 77 feet bgs (-2 feet NGVD 29) to 136 feet bgs (-61 feet NGVD 29) (Figure 10). The background water level decline (i.e., existing conditions) would result in a static water level decline from 100 feet bgs (-25 feet NGVD 29) to 122 feet bgs (-47 feet NGVD 29) at future scenario year 44 without the GSR project.

Review of Figures 9 and 10 shows that Take-Year static water levels fall below the static water level without the project during the fifth year of drought. Subsequent years of Design Drought continue to reduce static water levels further below where static water levels would be

without the project. The static water levels reach a maximum depth of 14 below the existing conditions SWLs.

As described above, after the fourth year of Take static water levels for the GSR Project begin to decline to below the level expected without the project. However, it should be noted that static water levels are positive (i.e., higher than would be expected under existing conditions) under all other conditions.

Analysis of changes in pumping capacity for using the Olympic Club Well No. 1 (#9) pump curve indicate that the well pumping capacity under the GSR Project at the end of the Design Drought would be about 660 gpm compared to the existing conditions capacity of 685 gpm. The decline in pumping capacity at Well 1 amounts to 4 percent for the end of the Design Drought with the GSR project as compared to existing conditions without the GSR project.

A similar analysis of changes in pumping capacity for using the Olympic Club Well No. 2 (#8) pump curve indicate that the well pumping capacity under the GSR Project at the end of the Design Drought would be about 935 gpm compared to the existing conditions capacity of 970 gpm. The decline in pumping capacity at Well 1 amounts to 4 percent for the end of the Design Drought with the GSR project as compared to existing conditions without the GSR project.

Alternative GSR Well Site Analysis

Three of the proposed 16 GSR well sites (CUP-3A, 7, and 44-1) were replaced by the three alternative well sites (CUP-20A, 22, and 36-2) and mutual interference drawdowns were calculated by MWH (Appendix B). Given the locations of wells removed (two at the northern end and one at the southern end of the GSR Project area) versus alternative well locations added (generally in the middle of the GSR Project area), the alternative well configuration analyzed in this study results in more drawdown in the Colma/South San Francisco area and less in the Daly City and San Bruno areas. The alternative well configuration could probably be viewed as a worst case for the Colma and South San Francisco areas, whereas the original 16 well configuration could likely be viewed as the worst case for the Daly City and San Bruno areas.

The amount of mutual interference drawdown in the alternative well site configuration scenario increased by 9 to 33 feet at Colma Cemetery wells, and 10 to 14 feet at the California Golf Club wells after 7.5 years of GSR Project pumping as compared to the original well site configuration. Drawdown at Lake Merced Golf Club wells for the alternative well site configuration (compared to the original well site configuration) decreased by 21 to 22 feet, and drawdowns at the Olympic and San Francisco Golf Clubs decreased by 11 to 13 feet after 7.5 years of GSR Project pumping. Detailed calculations on a well by well basis for both the original and alternative well site configurations are provided in the MWH memo in Appendix B.

Transfers among GSR Partner Agencies

Operation of the GSR project allows transfer of up to 10% of each partner's allowable pumping between partner agencies under certain conditions. However, transfers among partner agencies are not expected to occur during the later years of the design drought and therefore

would not exacerbate the adverse effects reported from the GSR Project without the transfer. Transfers during the later years of the design drought are unlikely because:

- In Daly City, the designated quantity is 3.43 million gallons per day (mgd). Based on the analyses conducted previously, the City of Daly City's aggregate discharge capacity from their entire well field is estimated to be 3.3 mgd at the end of the Design Drought. This would suggest that any transfer of designated quantity from San Bruno and/or Cal Water to Daly City would not be able to be conducted near the later stages of the Design Drought, since Daly City would not have excess well capacity to handle such an increase in production (4 mgd). Therefore, additional well interference from a transfer during a Design Drought would not be able to be conducted to a degree that would exacerbate anticipated well interference effects that have been evaluated for the GSR Project.
- In the South San Francisco area, Cal Water has a designated quantity of 1.37 mgd. This designated quantity is slightly less than the maximum capacity of Cal Water's treatment plant (1.4 mgd). At the end of the Design Drought, Cal Water's design well capacities are estimated to be 0.8 mgd and 1.2 mgd if replacement pumps are installed. Similar in nature to Daly City, Cal Water would not have any excess design well capacity to accept a transfer from Daly City and/or San Bruno, nor would Cal Water have excess treatment plant capacity. Therefore, it is highly unlikely that transfers to Cal Water could occur with the existing well and treatment plant constraints. Therefore well interference effects would not exceed those already evaluated for the GSR Project
- In the San Bruno area, it is estimated that there would be a limited amount of excess design capacity at the end of the Design Drought. This excess is about 0.2 mgd (140 gpm) above the 2.1 mgd designated quantity. It is highly unlikely that Daly City and/or Cal Water would transfer 10 percent of their designated quantity near the end of the Design Drought, because they would likely want to use as much of their designated quantity as possible since any transfer would likely be met with opposition from ratepayers who will likely be subject to water rationing. However, in the remote chance such a transfer was to be conducted, the additional capacity pumped by San Bruno would not result in additional interference on third-party wells, since there are not any identified third-party wells in the main portion of the basin in San Bruno within 1.5 miles of San Bruno municipal supply wells.

CUMULATIVE WELL INTERFERENCE ANALYSIS

Introduction

In addition to the proposed SFPUC GSR project, the proposed San Francisco Groundwater (SFGW) Supply Project involves groundwater extraction of 3 million gallons per day (MGD) from four new wells installed in the vicinity of Lake Merced, the Sunset District, and Golden Gate Park (Scenario 3a) and possibly an additional 1 MGD from conversion of two existing irrigation wells in Golden Gate Park to municipal use for a combined total of 4 MGD (Scenario 3b). The study area for the SFGW Supply Project encompasses the western portion

of San Francisco between the San Francisco/San Mateo county line and Golden Gate Park. The capacity of the proposed SFGW project, 3 or 4 MGD, would depend upon whether or not recycled water would become the source of irrigation water in Golden Gate Park. If the recycled water project is implemented, two existing irrigation wells at the west end of Golden Gate Park would be converted to municipal supply wells, and four additional municipal supply wells would be brought online to pump a total of 4 MGD from six wells on an average annual basis. If the recycled water project is not implemented, the two Golden Gate Park irrigation wells would continue irrigation pumping and only the four new municipal supply wells would be used to pump 3 MGD on an average annual basis for the SFGW project. This cumulative well interference analysis does not account for future additions of water to Lake Merced.

Background

In addition to GSR Project impacts to third-party wells described in this TM, Luhdorff and Scalmanini Consulting Engineers (LSCE) estimated well interference effects on third-party wells in San Francisco and the northern part of Daly City from the SFGW Supply Project (LSCE, 2012). The cumulative analysis includes assessment of well interference on third-party wells located in the SFGW Supply Project study area that may result from pumping of GSR wells. These calculations are added to well interference estimates from the SFGW Supply Project to obtain the total estimated well interference drawdown at the third-party wells, which incorporates pumping influences from both GSR and SFGW Supply Project wells.

The third-party wells in the South Westside Groundwater Basin that are the subject of this cumulative analysis include Lake Merced Golf Club Well 3 and two wells at Olympic Golf Club. The third-party wells in the North Westside Groundwater Basin that are considered in the cumulative analysis include one well at the San Francisco Golf Club. Other third party wells in the North Westside Groundwater Basin (e.g., Zoo well, Edgewood Development Center well, Pine Lake well) are too far away to warrant consideration in the cumulative analysis.

Previous Studies

As stated above, the third-party wells included in the GSR Project well interference analysis that are considered close enough to the subbasin boundary (between North and South Westside Basins) to show possible influence from SFGW Supply Project wells are the well at Lake Merced Golf Club, two wells at Olympic Club, and the San Francisco Golf Club well. GSR-related gross well interference estimates were 56 feet for Lake Merced Golf Club wells, 23 feet for Olympic Club wells, and 22 feet for San Francisco Golf Club well (Appendix B) as summarized in Table 10. Gross well interference estimates are the values derived directly from Theis calculations. Net well interference estimates provided in Table 11 are defined as the difference between gross estimates and water level declines associated with future existing conditions. The cumulative analysis provides estimates of drawdown at the golf club wells from the proposed SFGW Supply Project wells and the combined effects from both proposed projects. The Colma cemetery wells are located 2.6 to 3.8 miles from the nearest SFGW Project well at the Lake Merced Pump Station (LMPS) and the California Golf Club wells are about 5 miles from the LMPS well. As discussed further below, these other third-party wells are not considered in this study because interference effects would be negligible at these distances.

The LSCE study on third-party well Interference employed both Theis analytical and MODFLOW groundwater model-based calculations of well interference drawdown from proposed SFGW Supply Project wells (LSCE, 2012). Third-party wells included in that analysis that are considered close enough to the subbasin boundary (between North and South Westside Basins) to show possible influence from GSR Project wells include the Lake Merced Golf Club, Olympic Club, and San Francisco Golf Club. SFGW Supply project well interference estimates ranged from 4 to 6 feet for these well locations, as summarized in Table 12.

The two project-specific well interference analyses both provided estimated well interference effects at the Lake Merced, San Francisco, and Olympic Golf Club wells. Those previous results are combined in the current study to estimate total well interference effects from both proposed projects.

CUMULATIVE WELL INTERFERENCE CALCULATIONS

GSR Project Wells

The GSR wells located closest to the SFGW Project are in Daly City (CUP-3A, 5, 6, and 7). A 1.5-mile radius from the furthest north GSR well (CUP-3A) is shown on Figure 11 and encompasses the Olympic Club and San Francisco Golf Club. A 1.5-mile radius from the furthest south SFGW Project well (Lake Merced Pump Station) is also shown on Figure 11 and encompasses the Lake Merced Golf Club. These two 1.5-mile radii define the cumulative analysis study area and incorporate wells at the three golf courses.

As described in more detail below, due to the distances between the Daly City GSR wells and most San Francisco third-party wells (i.e., greater than 1.5 miles), combined with the presence of Lake Merced and associated vertical leakiness and areal recharge in the SFGW project area, the interference effects on third-party wells located north of Lake Merced (e.g., Zoo, Edgewood, Pine Lake) from GSR pumping south of Lake Merced (from CUP-3A, 5, 6, and 7) are considered to be negligible.

Previous Theis calculations of well interference effects by MWH for the GSR project conceptual engineering report (MWH, 2008) considered pumping wells within a 1.5-mile radius. The limitation of 1.5 miles was selected to represent a reasonable extent for a cone of depression given consideration of vertical leakage from one aquifer to another, groundwater recharge (that occurs related to precipitation, irrigation, and leaky pipes), interception of groundwater flow that otherwise discharges from the aquifer (e.g., coastal outflow), and/or encountering a surface water body (e.g., Lake Merced). As described by Driscoll (1986), the vertical leakage from upper to lower aquifers (and from underlying aquifers vertically upward to the pumped aquifer), groundwater recharge, and possibly other factors listed above, are expected to cause the cone of depression to stop expanding and stabilize.

SFGW Supply Project Wells

The SFGW Supply Project well interference study utilized Theis calculations (with a lower storativity value than used in the GSR Project calculations) and a sub-regional MODFLOW groundwater model to estimate well interference effects on third-party wells in the

Westside Basin within 1.5 miles of the SFGW Supply Project wells (LSCE, 2012). As discussed below, the study concluded that results from the sub-regional MODFLOW groundwater model provided more realistic estimates of potential interference effects for hydrogeologic conditions in the SFGW Supply project area. For the cumulative analysis, SFGW drawdown estimates for the Olympic Club and San Francisco Golf Club wells were obtained from the LSCE groundwater model results, and these model results were also used to provide SFGW drawdown estimates for the Lake Merced Golf Club wells. LSCE's report documents the model inputs in terms of pumping rates, transmissivity, storativity, and pumping durations. The MODFLOW model also accounts for vertical leakage that occurs from the Shallow Aquifer to deeper aquifers, which allows for a more realistic simulation of drawdown effects over long pumping durations than does the Theis analysis (which does not account for vertical leakage). Modeling was used because leakage was considered particularly important in the SFGW project area due to the hydrogeologic setting, which includes potential interaction between shallow and deeper aquifer units. The results of the well interference drawdown estimates are summarized in Table 12, and drawdown contour maps from the LSCE report are provided in Appendix E. The Theis analytical solution was used in the LSCE study to support assumptions that the cone of depression that developed did not appreciably expand after a one-year pumping duration.

The numerical flow model was constructed specifically for the SFGW Project well interference study using MODFLOW, to assess potential pumping influences in a multiple aquifer system more complex in nature than can be incorporated in the Theis solution. This model is a sub-regional model developed specifically for the evaluation of pumping influences for the SFGW Project. This model is not the basin-wide numerical groundwater flow model developed by Daly City (HydroFocus, 2011). The numerical model developed for this evaluation consists of multiple (3) layers separated by aquitards with assigned values of leakiness, in which vertical movement of water occurs. Unlike the Theis solution, the numerical model incorporates variations in hydrogeologic conditions north and south of Lake Merced where confinement decreases (i.e., due to pinch-outs of the "-100 Foot" and "X" Clay units). The numerical model provides a means to simulate how the pumping cones of depression around Project wells would be affected by changes in confinement as they expand beyond the lake footprint.

Well Interference Calculation Methodologies

The GSR Project and SFGW Supply Project well interference calculations described above utilize somewhat different approaches in that the GSR Project is based strictly upon Theis analytical calculations, whereas the SFGW Supply Project utilizes both Theis analytical calculations and a MODFLOW groundwater model for well interference analysis. The approach used for the GSR Project is considered appropriate for hydrogeologic conditions in the South Westside Groundwater Basin (SWB), and the SFGW Supply Project approach is considered appropriate for the North Westside Basin (NWB) hydrogeologic conditions. Important hydrogeologic differences between the North and South Westside Basins include generally shallower groundwater levels in the NWB, the presence of Lake Merced in the NWB, and multiple aquifers in the NWB (especially beneath and adjacent to Lake Merced) that result in greater vertical leakage in the NWB. There are also more open (fewer no-flow) hydrogeologic boundary conditions, higher aquifer hydraulic conductivities, and more rainfall recharge in the

NWB. A sensitivity analysis was conducted by LSCE on the Theis analytical solution storativity input value used in the SFGW Project analysis of well interference. The storativity value was changed to be consistent with the value used in the GSR Project analysis and the results were similar in nature to the numerical model results. This exercise provided greater certainty that the primary methods for analyzing well interference results for the GSR and SFGW projects are similar in nature.

The differences in basin hydrogeologic characteristics are such that the Theis analytical approach is generally adequate (although possibly slightly conservative) in evaluating mutual interference effects in the SWB; however, the Theis approach alone does not adequately simulate the nature of recharge, vertical leakage, and boundary conditions in the NWB. A MODFLOW groundwater flow model is necessary in the NWB to adequately simulate the effect of vertical leakage influences on well interference. The wells of concern in the cumulative analysis in terms of having measureable effects from both projects are the three golf clubs – Lake Merced, Olympic, and San Francisco. All of the golf club wells are located near the border between the NWB and SWB. The application of the MODFLOW groundwater flow model to these wells as part of the cumulative analysis is considered appropriate because the pumping wells in the SFGW project are located two-thirds of a mile or further north of the golf club wells where NWB hydrogeologic conditions described above serve to limit the areal extent of the cones of depression around pumping wells (e.g., vertical leakiness, Lake Merced is between SFGW pumping wells and golf club wells). GSR Project wells are located two-thirds mile or further south of the Olympic and San Francisco golf club wells in a different hydrogeologic regime where conditions are less conducive to limiting the extent of the cones of depression and where Theis analytical calculations with a higher storativity value than used in the SFGW well interference analysis would be more applicable.

Given the locations of the respective project wells and the golf club wells at issue in the cumulative analysis, it is likely that inaccuracies in the cumulative mutual well interference calculations at a given golf club well would be weighted toward being overestimated. The reasoning for this conclusion is that the cones of depression predicted for GSR wells by Theis analytical calculations do not account for likely increases in vertical leakiness (that would result in less drawdown) expected to occur in the vicinity of the Olympic and San Francisco golf clubs.

Combined Well Interference Drawdown Effects

The results from the two project-specific studies and additional calculations made for the cumulative analysis are summarized in Tables 10 and 11 for the GSR Project and Table 12 for the SFGW Supply Project. These results were added to obtain the combined well interference drawdown effects by both projects as summarized in Tables 13 and 14. Tables 13 and 14 show results for the 3-MGD and 4-MGD pumping scenarios under the SFGW project, as described previously. As indicated in Table 13, the results show the gross combined well interference drawdown of 28 feet at San Francisco Golf Club, 29 feet at Olympic Club, and 60 feet at Lake Merced Golf Club. The well sites influenced by the GSR project show a net drawdown impact as follows: 20 feet at Olympic and San Francisco Golf Clubs, and 91 feet at Lake Merced Golf Club (Tables 14 and 15).

CUMULATIVE WELL CAPACITY ANALYSIS

The consequences of the estimated interference drawdown effects are determined by considering well construction features and pump head-capacity relationships. Construction features and pump information for third-party wells subject to cumulative analysis are provided in Appendix F. The well capacity analysis method applied in this cumulative analysis evaluates the change, or reduction, in pumping capacity because of predicted increased drawdown from proposed project wells. The increased drawdown would represent additional head, or lift, for the pump and translates to reduced capacity according to the pump head-capacity relationship. When the additional head requirement caused by mutual well interference is small in relation to the total pump head (the sum of lift below ground surface, system discharge head, and other friction losses), there may be little discernible effect on the third-party well capacity. When the effect amounts to a substantial fraction of the total pump head, or when the pump head-capacity relationship is relatively flat, the interference effect may result in a large percentage change in operating capacity for the well. The potential operational effects on existing well capacities for the combined GSR and SFGW project influences are discussed below and summarized in Table 16.

San Francisco Golf Club

The San Francisco Golf Club (SFGC) irrigation well was drilled in 1985. As presented in the 2012 LSCE memorandum on SFGW project influences, the well is equipped with a 700-gpm well pump set to 350 feet, which is 10 feet above the top of the well screen. While the SFGW influences were estimated to have a negligible effect on pumping capacity, 28 feet of gross drawdown interference is estimated for the combined projects. This would have the effect of reducing the pump capacity by approximately 45 gpm from the reported design capacity, or 6 percent. However, due to a predicted slight decline in background water levels over the next 44 years, the net drawdown impacts for the cumulative scenario at the end of the Design Drought are estimated to be 20 feet. The estimated net reduction in well capacity in this case is 20 gpm or 3 percent (when comparing future end of Design Drought conditions to existing conditions without the projects). The net reduction in well capacity would be 20 gpm (or 3 percent) compared to the current pumping rate of 675 gpm.

The predicted decreases in capacity caused by the estimated interference drawdown do not indicate a loss in supply, but only slightly longer pumping times to produce the same quantity of water.

Olympic Club Wells

The active Olympic Club irrigation wells (Wells No.2/8 and No.1/9) were drilled in 1994 and 2001, respectively. Well 8 is equipped with a pump with a reported design capacity of 1,000 gpm and a setting depth of 270 feet, which is below the top of the screen interval (the well is screened from 200 feet bgs). Well 9 is equipped with a nominal 700-gpm pump with a setting depth of 250 feet, which is 10 feet above the top of screen in the well.

As is the case for the San Francisco Golf Club well, SFGW influences were previously determined to have a negligible effect on well capacity based on mutual well interference

drawdown of 6 feet. The estimated gross well interference drawdown for the combined GSR and SFGW projects at these well sites is 29 feet (Table 13). Examination of the pump curve for Well 8 indicates that cumulative mutual well interference would reduce its capacity by about 90 gpm, or 9 percent, from the design capacity of 1,000 gpm. The reduction in capacity for Well 9 is 60 gpm with a similar percentage change of 9 percent for the design capacity of 700 gpm.

However, due to a predicted slight decline in background water levels over the next 44 years, the net drawdown impacts at the end of the Design Drought (Table 14) are estimated to be 20 feet (when comparing future end of Design Drought conditions to existing conditions without the projects). The estimated net reduction in Well 9 capacity in this case is 45 gpm or 7 percent. The estimated net reduction in Well 8 capacity is 60 gpm or 6 percent.

Lake Merced Golf Club Well

Interference drawdown effects at the Lake Merced Golf Club (LMGC) Well 3 from the combined projects are estimated to be 60 feet (Table 13). The GSR Project alone is expected to account for over 90 percent of the well interference drawdown at Lake Merced Golf Club well. Therefore, the effect on well capacity for the combined projects is very similar to the effect on well capacity for just the GSR Project, which was addressed in the GSR Project well interference section of this TM. Pump information from LMGC Well 3 is not available; thus, the actual reduction in pumping capacity cannot be estimated at this time. However, the well capacity reduction was estimated to be in the range of 10 to 30% in the GSR section of this TM. The cumulative project well capacity reduction is estimated to also fall within the range of 10 to 30%.

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to evaluate the pumping of GSR wells on individual existing third-party wells. The third-party (i.e., irrigation) groundwater pumpers in the South Westside Groundwater Basin that are the subject of this TM include the Colma cemeteries, California Golf Club, and Lake Merced Golf Club (Figures 1 and 2). In addition, as part of the Cumulative Project Analysis, this study provides GSR-related well interference calculations for the Olympic Golf Club and San Francisco Golf Club located near or within San Francisco City/County limits.

GSR Project Analysis

The GSR project would only extract groundwater up to the amount that has been stored in the SFPUC Storage Account. However, due to the possibility for localized effects, this study was conducted as part of the effort to evaluate the localized cones of depression around proposed GSR wells that may potentially affect individual existing third-party wells. The results presented herein represent “worst case” with respect to being calculated at the end of the Design Drought (7.5 years continuous pumping) for the GSR Project wells. The Design Drought is two years longer than the historic drought of record (1987 to 1992).

The results of the data analysis for the GSR Project are summarized in Table 9. The analytical calculations indicate that the proposed GSR Project would cause cemetery well static

water levels to be from 95 to 116 feet lower than would occur without the project at the end of the Design Drought. The effects are greatest at the Woodlawn Cemetery well at the northern end of the group of Colma cemeteries, and least in the vicinity of Home of Peace, Hills of Eternity, and Cypress Lawn cemeteries. There is a gradual decline in GSR Project influence on cemetery wells from Woodlawn to Home of Peace. The project effects begin to increase again to the south of Cypress Lawn for the Holy Cross wells. Review of Figure 2 indicates that the pattern of project effects observed at the cemetery wells corresponds to the presence of three GSR wells at the north end near Woodlawn (CUP-10, CUP-11A, and CUP-18), one GSR well near the middle of the cemetery wells (CUP-19), and two GSR wells at the south end near Holy Cross (CUP-22A and CUP-23).

The maximum project effect at the Lake Merced Golf Club well amounts to about 87 feet compared to existing conditions. The Lake Merced Golf Club well is influenced primarily by GSR wells CUP-3A, CUP-5, CUP-6, and CUP-7. The maximum project effects at the California Golf Club wells amount to about 169 feet compared to existing conditions. The California Golf Club wells are influenced primarily by GSR wells CUP-31 and CUP-36-1 (and to a lesser extent by CUP-41-4 and CUP-44-2). While there are fewer GSR wells in vicinity of the California Golf Club, the area has greater overall drawdown due to an estimated Take year regional decline rate of 18.5 feet compared to 12.9 feet in the Colma area and 15 feet for Lake Merced Golf Club.

Pump curves and other pump information were obtained for most wells and certain assumptions were made to estimate how project-related changes in water levels may affect pumping rates (i.e., well capacity) and pumping water levels. The results indicated that pumping capacities would be reduced by 10 to 50 percent at the end of the Design Drought (with the GSR Project) at most wells. Greater decreases in pumping capacities were calculated for the Woodlawn Primary Well (87 percent) and California Golf Club Well 7 (78 percent) due to the specific characteristics of the pumps installed in these two wells.

It should be noted that the maximum effects described above occur for a short duration (i.e., a few months) in the middle of Future Scenario Year 44 (at the end of the Design Drought when the SFPUC Storage Account is empty). During the majority of the years (68 to 83%) while the project is in place there will be a net benefit (i.e., higher groundwater levels and higher pumping capacities) to third party wells from the proposed GSR Project. At other times during project take cycles, the project effects will be slightly to considerably less than those described above and analyzed in detail in this TM.

Cumulative Project Analysis

The well interference effects on third-party wells were estimated separately for each individual proposed project (Fugro, this TM; LSCE, 2012). The cumulative analysis section of this TM provides additional calculations using results of project-specific well interference studies to estimate combined effects on third-party wells from both proposed SFPUC projects. The results presented herein represent a “worst case” with respect to being calculated at the end of the Design Drought (7.5 years continuous pumping) for the GSR Project wells and incorporate interference estimated for the SFGW Project scenario consisting of 6 wells pumping at 4 MGD.

In summary, there are no well interference effects from pumping GSR Project wells (CUP-3A, 5, 6, and 7) on the Zoo, Edgewood, and Pine Lake wells located north of Lake Merced in San Francisco. The SFGW Supply Project has little effect (about 4 feet) on the Lake Merced Golf Club well located south of Lake Merced in northern San Mateo County. Greater effects from the combined projects occur for the San Francisco Golf Club and Olympic Club wells that are located along the San Francisco-San Mateo County line and between proposed wells for the two SFPUC projects.

Pumping capacity reductions from the combined projects were estimated to be 9 percent for the San Francisco Golf Club well and 9 percent for the Olympic Golf Club wells. The cumulative project pumping capacity for Lake Merced Golf Club Well 3 was estimated to decrease by 10 to 30%, primarily due to GSR pumping effects.

As discussed by LSCE (2012) for the SFGW Supply project, where groundwater use from third-party wells has been replaced by recycled water (e.g., golf clubs), mutual interference between high capacity irrigation supply wells no longer occurs (except possibly to a small degree when groundwater is used to supplement the recycled water source). As a result, it is likely that the estimated effects on capacities for some wells will be partially offset by less use of the golf club wells. Additionally, it should be noted that the reductions in well capacities have been evaluated based on the well construction features and the characteristics of the head-capacity relationships of the well pumps. As such, the influences may be eliminated when pumps eventually are replaced (due to normal wear and tear) and the increased drawdown is factored into pump sizing. Therefore, the reductions in well capacities are generally classified as an operational issue, one that is common where multiple pumpers co-exist in a groundwater basin setting.

REFERENCES

Carollo (2008), *Recycled Water Feasibility Study, Cities of South San Francisco, San Bruno, and Brisbane in Coordination with the California Water Service Company and the SFPUC*, consultant's report (September).

Driscoll, F.G. (1986), *Groundwater and Wells,* Johnson Division, St. Paul, MN.

Fugro (2004), *Spring 2004 Groundwater Sampling*, consultant's report prepared for the San Francisco Public Utilities Commission, June.

Gilman, Jeff, Personal Communication.

Halligan, Will, Personal Communication.

HydroFocus and Gus Yates (2007), *Westside Basin Groundwater-Flow Model (version 2.0), Historical Calibration Run (1959-2005) Results and Sensitivity Analysis*, December 7.

HydroFocus (2009), *Westside Basin Groundwater-Flow Model: Revised Historical Simulation and No-Project Simulation Results*, August 7.

HydroFocus (2011), Westside Basin Groundwater-Flow Model: Updated Model and 2008 No Project Simulation Results, version 3.1, May 6.

Kennedy/Jenks Consultants (2012), *Task 10.1 Technical Memorandum - Groundwater Modeling Analysis for the Regional Groundwater Storage and Recovery Project and San Francisco Groundwater Supply Project*, April 18.

Luhdorff and Scalmanini (2004), *Update on the Conceptualization of the Lake-Aquifer System, Westside Ground-Water Basin San Francisco and San Mateo Counties,* consultant's report prepared for the San Francisco Public Utilities Commission, April.

Luhdorff and Scalmanini (2005), *Results of In-Lieu Recharge Demonstration Fall 2002 Through Spring 2005 Westside Basin Conjunctive Use Pilot Project*, consultant's report prepared for the San Francisco Public Utilities Commission, October.

Luhdorff and Scalmanini (2006), *Hydrogeologic Conditions in the Westside Basin, 2005*, consultant's report prepared for the San Francisco Public Utilities Commission, November.

Luhdorff and Scalmanini (2012), Analysis of Well Pumping Influences, San Francisco Groundwater Supply Project, consultant's report prepared for the San Francisco Public Utilities Commission, April.

MWH (2008), *Conceptual Engineering Report, Groundwater Conjunctive Use Project, WSIP Project CUW30103*, consultant's report prepared for the Water Resources Division of the

San Francisco Public Utilities Commission in association with AGS, M. Lee, and Talavera & Richardson, November.

LIST OF TABLES

LIST OF FIGURES (CONTINUED)

APPENDICES

TABLES

Table 1. Well Inventory

Well Name	Current Well Name and Use	Future Use of Well	Top of Screen (feet bgs)	Pump Test Duration (hours)	Pump Test Q/s (gpm/feet)
Holy Cross 1	Primary Well	Secondary Well	368	4	10.8
				0.5	19.7
				0.5	19.7
				0.5	17.9
				0.5	17.8
Holy Cross 4	Replacement Well	Primary Well	420	1.5	6.0
California Golf Club 7	Secondary Well	Secondary Well	255	24	2.9
California Golf Club 8	Primary Well	Primary Well	320	24	15.1
				?	20.5
Woodlawn	Primary Well	Primary Well	275	3.33	17.5
Woodlawn	Backup well	Backup well			
Cypress Lawn 3	Not Available	Assumed to be secondary well	191	121.5	7.5
Cypress Lawn 4	Not Available	Assumed to be primary well	330	9	5.5
				0.5	2.9
Italian Cemetery	Primary Well	Primary Well	300	4	4.8
				0.5	4.0
				0.5	6.8
				0.5	10.2
				0.5	6.1
Home of Peace	Was Primary Well	To be abandoned	224	27	19.2
				0.5	11.9
				0.5	32.7
				0.5	13.2
				0.5	6.3
Will serve Home of Peace, Hills of Eternity, and Salem	Replacement well	Primary Well	400		
Hills of Eternity	Was Secondary Well	Back-up Well	224	108	16.8
	Now Primary Well			0.5	4.0
				0.5	5.1
				0.5	17.6
				0.5	6.2
Eternal Home	Primary Well	Primary Well	280	48	7.1
				0.5	5.5
				0.5	15.8
				24	7.0
				0.5	9.3
				0.5	9.1
Olivet Memorial	Primary Well	Primary Well	308	24	9.1
Olympic Club	No. 1 (#9)	Active	260	24	17.1
Olympic Club	No. 2 (#8)	Active	200	4	15.4
SF Golf Club	No. 1 (East)	Inactive	200		
SF Golf Club	No. 2 (West)	Active	360	1	6.1
LMGC	No. 3	Active	294	8	10.5

Notes: bgs = below ground surface; gpm = gallons per minutes; Q = discharge/pumping rate;
Q/s = discharge/foot of drawdown; SF = San Francisco; LMGC = Lake Merced Golf Club

Table 2. Groundwater Level Measurements

Cemetery Well Number	Well Name	Date	Approximate G.E. R.P. (Feet NGVD 29)	DTW (Feet)	Est. GW Elev. (Feet NGVD 29)
Holy Cross 1	Primary Well	5/13/1986	94	202	-108
		5/15/1986	94	218	-124
		1/5/1989	94	203.08	-109
		2/8/1989	94	202.34	-108
		3/15/1989	94	201.61	-108
		4/25/1989	94	202.6	-109
		5/31/1989	94	212.78	-119
		7/7/1989	94	214.68	-121
		8/16/1989	94	217.2	-123
		9/19/1989	94	209.92	-116
		10/27/1989	94	207.68	-114
		11/21/1989	94	207.29	-113
		12/7/1989	94	205.48	-111
		2/7/1990	94	204.2	-110
		3/6/1990	94	204.91	-111
		4/5/1990	94	205.51	-112
		5/1/1990	94	213	-119
		6/5/1990	94	213.97	-120
		7/2/1990	94	214.94	-121
		8/1/1990	94	215.76	-122
		9/5/1990	94	216.62	-123
		10/10/1990	94	213.99	-120
		11/6/1990	94	214.04	-120
		12/4/1990	94	208.08	-114
		2/5/1991	94	204.63	-111
		11/24/1998	94	238	-144
		1/18/1999	94	224	-130
		5/18/1999	94	237.4	-143
		2/7/2000	94	237	-143
		6/26/2000	94	255.7	-162
		3/13/2001	94	236	-142
		3/8/2010	94	199.7	-106
Holy Cross 3	Secondary Well	9/16/1960	138	192	-54
		12/21/1998	138	262	-124
		5/18/1999	138	232	-94
		2/9/2000	138	233.7	-96
		6/26/2000	138	250.5	-113
		3/13/2001	138	264	-126
		8/7/2003	138	262.32	-124
		9/11/2009	138	244.81	-107
		3/8/2010	138	230.63	-93
Holy Cross 2	Emergency Well	11/24/1998	127	238	-111
		5/18/1999	127	238	-111
		2/7/2000	127	252	-125
		6/26/2000	127	264	-137
		3/13/2001	127	252.3	-125
		9/11/2009	127	216.26	-89
		3/8/2010	127	204.73	-78
Holy Cross 4	Replacement Well	11/7/2008	114	232	-118
		9/11/2009	114	243.4	-129
		3/8/2010	114	221.13	-107
Cypress Lawn	Unknown	11/24/1998		223	
		7/8/1999		223	
Cypress Lawn	Unknown	11/25/1998		272	
		7/8/1999		233	
		3/13/2001		272	

Cemetery Well Number	Well Name	Date	Approximate G.E. R.P. (Feet NGVD 29)	DTW (Feet)	Est. GW Elev. (Feet NGVD 29)
Cypress Lawn	Unknown	8/2/1989		228	
		12/3/1998		223	
		7/8/1999		234	
Italian	Primary	4/19/1994	159	300	-141
		4/16/1999	159	276	-117
		7/8/1999	159	276	-117
		12/8/1999	159	295	-136
		6/27/2000	159	300.5	-142
		3/13/2001	159	294	-135
		1/22/2010	159	256.60	-98
Home of Peace		6/16/1998	128	239	-111
		7/8/1999	128	227	-99
		2/9/2000	128	227.9	-100
		6/27/2000	128	229.6	-102
		3/13/2001	128	234	-106
Hills of Eternity		5/15/1985	124	226	-102
		10/15/1996	124	244	-120
		12/16/1996	124	238	-114
		2/11/1999	124	238	-114
		7/8/1999	124	238	-114
		2/9/2000	124	240.3	-116
		6/27/2000	124	253	-129
		3/13/2001	124	242	-118
		10/26/2006	124	224	-100
		10/29/2007	124	214	-90
Eternal Home	Primary	2/15/1978	128	223	-95
		4/8/1999	128	253	-125
		7/15/1999	128	253	-125
		2/9/2000	128	259.5	-132
		6/27/2000	128	265	-137
		3/13/2001	128	261.4	-133
		2/4/2010	128	225.00	-97
Olivet		6/16/1998	150	269	-119
		7/8/1999	150	269	-119
Woodlawn	Primary Well	5/26/1982	135	227.8	-93
		8/6/2008		234.13	-234
		1/22/2010	135	220.00	-85
CGC 5		11/19/1966	53	159	-106
		1/30/1989	53	193.2	-140
		2/23/1989	53	196.3	-143
		11/17/2009	53	186.57	-134
CGC 6		8/8/1984	52	211.5	-160
		1/25/1989		183.8	-184
		11/17/2009	52	173.22	-121
CGC 7		3/14/1994	78	231.68	-154
		11/17/2009	78	NM	
					0
CGC 8		4/24/2001	61	235	-174
		10/26/2006	61	212	-151
		11/17/2009	61	213.85	-153
Olympic Club No. 1		7/9/2001		120	
		11/21/2008		101.76	
Olympic Club No. 2		11/12/1994		99.46	

Cemetery Well Number	Well Name	Date	Approximate G.E. R.P. (Feet NGVD 29)	DTW (Feet)	Est. GW Elev. (Feet NGVD 29)
SF Golf Club No. 1		4/24/1951	143.02	60.02	83.00
		4/5/1990	143.02	176.92	-33.90
		5/2/1990	143.02	178.07	-35.05
		6/5/1990	143.02	177.00	-33.98
		7/2/1990	143.02	178.84	-35.82
		8/1/1990	143.02	178.27	-35.25
		12/4/1990	143.02	178.42	-35.40
		2/5/1991	143.02	177.87	-34.85
		5/1/1991	143.02	178.42	-35.40
		9/17/1991	143.02	179.29	-36.27
		2/4/1992	143.02	178.42	-35.40
SF Golf Club No. 2		8/8/1985	139.10	210	-70.90
		1/5/1989	139.10	192.00	-52.90
		2/8/1989	139.10	190.47	-51.37
		3/20/1989	139.10	192.76	-53.66
		4/25/1989	139.10	202.34	-63.24
		10/25/1989	139.10	200.20	-61.10
		2/7/1990	139.10	198.06	-58.96
		3/6/1990	139.10	198.82	-59.72
		5/2/1990	139.10	213.26	-74.16
		8/1/1990	139.10	210.72	-71.62
		9/5/1990	139.10	203.81	-64.71
		10/10/1990	139.10	203.13	-64.03
		11/6/1990	139.10	203.09	-63.99
		11/1/1993	139.10	211	-71.90

Notes: CGC = California Golf Club; DTW = depth to water; R.P. = Reference Point (ground surface)
G.E. = Google Earth

Table 3. Pump Data

Cemetery Well Number	Well Name	Pump Type	Brand and Model	Horsepower	Capacity/Head Rating	Pump Setting Depth	Top Screen (feet bgs)	1999-2001 Q Range (gpm)	1999-2001 SWL Range (feet bgs)	1999-2001 PWL Range (feet bgs)	1999-2001 Q/s Range (gpd/ft)	2010 SWL (feet bgs)	Other Spec. Cap. Data and Date
Holy Cross 1	Primary Well	Submersible	Bryon Jackson/ 11MQH/12 Stage	200	800 gpm/ 700 ft.	340	368	725-760	236-256	276-296	17.8-19.7	200	10.8 @ 800 gpm (1986)
Holy Cross 4	Replacement Well	Submersible	Byron Jackson / 12EML/ 12 Stage	200	800 gpm/720 ft.	395	420	NA	NA	NA	NA	221	6.0 @ 950 gpm (2008)
Italian	Primary (only) Well	Submersible	Byron Jackson/ 8MQL/ 14 Stage	40	260 gpm/420 ft.	450	300	258-263	276-301	326-340	4.0-10.2	257	4.8 @300 gpm (1994)
Home of Peace	Abandoned						223	166-175	227-234	233-262	6.3-32.7	NA	19.2 @ 615 gpm (1966)
Home of Peace/Hills of Eternity/Salem	Replacement Well		10EMM/ 11 Stage		600 gpm/470 ft.	Unknown	400	NA	NA	NA	NA	240	11.6 @ 800 gpm (2010)
Hills of Eternity	Secondary	Submersible	Goulds/ VIS-T/ 8 Stage	40	235 gpm/500 ft.	305	224	170-181	238-253	263-280	4.0-17.6	NA	16.8 @ 505 gpm (1965)
Eternal Home	Primary (only) Well	Submersible	Byron Jackson/ 7MQH/ 20 Stage	30	Unknown	Unknown	280	155-200	253-265	270-287	5.5-15.8	225	7.1 @ 640 gpm (1978)
Olivet	Primary (only) Well	Submersible	Byron Jackson/ 8MQH/ 19 Stage	75	300 gpm/640 ft.	415	308	NA	267 (3/13/02)	320 (3/13/02)	NA	NA	9.1 @ 480 gpm (2002)
Woodlawn	Primary Well	Submersible	Byron Jackson/ 10MQH/ 6 Stage	50	500 gpm/300 ft.	350	275	550 (1982)	250 (1982)	281 (1982)	NA	220	17.5 @ 550 gpm (1982)
Woodlawn	Backup Well	Submersible		40	375 gpm/275 ft.		NA	NA	NA	NA	NA	NA	NA
Cypress Lawn 4	Primary	NA	NA	NA	NA	NA	330	600 (1989)	228 (1989)	338 (1989)	NA	NA	5.5 @600 gpm (1989)
Cypress Lawn 3	Secondary	NA	NA	NA	NA	NA							
California Golf Club 8	Primary Well		11MQL/ 9 Stage		800 gpm/ 400 ft.		320	800 (2001)	235 (2001)	288 (2001)	15.1 (2001)	214 (2009)	
California Golf Club 7	Secondary Well	NA	7MQH/15 Stage	30	200 gpm/350 ft.	NA	255	200 (1994)	232 (1994)	301 (1994)	NA	NA	2.9 @ 200 gpm (1994)
Lake Merced Golf Club 3	Primary (only active) Well	NA	NA	NA	NA	NA	294	800 (1986)	217 (1986)	293 (1986)	NA	NA	10.5 @ 800 gpm (1986)
Olympic 1 (No. 9)	Primary Well	Vertical Line Shaft Turbine	Byron Jackson/ 10GH/ 6 Stage	NA	700 gpm/276 ft.	250	260	NA	NA	NA	17.1	NA	NA
Olympic 2 (No. 8)	Primary Well	Vertical Line Shaft Turbine	Byron Jackson/ 11MQH/ 4 Stage	NA	1000/ 216 ft.	270	200	NA	NA	NA	15.4	NA	NA
San Francisco Golf Club 2	Primary Well	Vertical Line Shaft Turbine	Byron Jackson/ 10MQH/ 11 Stage	NA	700 gpm/ 390 ft.	350	360	NA	NA	NA	NA	NA	6.1 @ 700 gpm (1985)

Notes: gpm = gallons per minute; ft = feet; NA = Not Available; Q = discharge/pumping rate; Spec. Cap. = Specific Capacity (Q/s)

Table 4. Eternal Home Cemetery Well Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	ET Well DTW (Feet)	ET Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	ET Well SWL (Feet bgs)	ET Well GWE (Feet NGVD 29)	ET Well Background DTW (Feet)	ET Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	214.2	-86.2	27,742				225.8	-97.8	-81.2	-88.2
2	put	205.6	-77.6	33,925				226.5	-98.5	-73.9	-80.9
3	put	197.0	-69.0	40,108				227.3	-99.3	-68.6	-75.3
4	put	188.4	-60.4	46,291				228.0	-100.0	-66.8	-72.1
5	put	179.8	-51.8	52,475				228.8	-100.8	-61.6	-67.8
6	put	171.2	-43.2	58,658				229.5	-101.5	-58.6	-64.3
7	Put/Hold	169.1	-41.1	60,500				230.3	-102.3	-56.2	-62.2
8	Hold	169.9	-41.9	60,500				231.0	-103.0	-52.0	-63.2
9	Hold/Take	173.6	-45.6	58,475				231.8	-103.8	-61.9	-78.7
10	take	186.5	-58.5	50,375	41	227.5	-99.5	232.5	-104.5	-74.3	-101.3
11	Take/Put	194.1	-66.1	45,858	49	243.1	-115.1	233.3	-105.3	-80.2	-104.9
12	put	185.5	-57.5	52,042				234.0	-106.0	-77.0	-93.5
13	put	176.9	-48.9	58,225				234.8	-106.8	-75.0	-88.0
14	Put/Hold	174.2	-46.2	60,430				235.5	-107.5	-70.8	-82.8
15	Hold	175.0	-47.0	60,430				236.3	-108.3	-70.4	-83.0
16	Hold	175.7	-47.7	60,430				237.0	-109.0	-69.7	-82.5
17	Hold	176.5	-48.5	60,430				237.8	-109.8	-69.5	-83.0
18	Hold	177.2	-49.2	60,430				238.5	-110.5	-69.1	-83.1
19	Hold	178.0	-50.0	60,430				239.3	-111.3	-69.9	-84.0
20	Hold	178.7	-50.7	60,430				240.0	-112.0	-70.6	-85.0
21	Hold	179.5	-51.5	60,430				240.8	-112.8	-72.6	-87.4
22	Hold	180.2	-52.2	60,430				241.5	-113.5	-72.6	-87.8
23	Hold	181.0	-53.0	60,430				242.3	-114.3	-71.8	-87.1
24	Hold	181.7	-53.7	60,430				243.0	-115.0	-71.7	-87.4
25	Hold/Take	185.5	-57.5	58,405				243.8	-115.8	-78.9	-101.6
26	take	198.4	-70.4	50,305	41	239.4	-111.4	244.5	-116.5	-91.7	-123.8
27	take/put	205.9	-77.9	45,788	49	254.9	-126.9	245.3	-117.3	-97.5	-125.9
28	put	197.3	-69.3	51,972				246.0	-118.0	-95.0	-115.0
29	put	188.7	-60.7	58,155				246.8	-118.8	-89.7	-106.7
30	Put/Hold	186.1	-58.1	60,360				247.5	-119.5	-86.2	-101.6
31	Hold	186.8	-58.8	60,360				248.3	-120.3	-78.7	-96.4
32	Hold	187.6	-59.6	60,360				249.0	-121.0	-80.3	-95.2
33	Hold	188.3	-60.3	60,360				249.8	-121.8	-81.2	-96.1
34	Hold	189.1	-61.1	60,360				250.5	-122.5	-79.9	-95.7
35	Hold	189.8	-61.8	60,360				251.3	-123.3	-78.8	-95.2
36	hold/take	193.6	-65.6	58,335				252.0	-124.0	-86.4	-108.9
37	take	206.5	-78.5	50,235	41	247.5	-119.5	252.8	-124.8	-98.6	-130.3
38	take	219.4	-91.4	42,135	49	268.4	-140.4	253.5	-125.5	-105.3	-143.6
39	take	232.3	-104.3	34,035	57	289.3	-161.3	254.3	-126.3	-121.2	-158.9
40	take	245.2	-117.2	25,935	65	310.2	-182.2	255.0	-127.0	-131.3	-171.4
41	take	258.1	-130.1	17,835	68	326.1	-198.1	255.8	-127.8	-142.3	-183.9
42	take	271.0	-143.0	9,735	72	343.0	-215.0	256.5	-128.5	-158.1	-201.4
43	take	283.9	-155.9	1,635	75	358.9	-230.9	257.3	-129.3	-185.8	-224.8
44	take/hold/put	285.4	-157.4	1,168	76	361.4	-233.4	258.0	-130.0	-179.1	-209.7
45	put	276.8	-148.8	7,352				258.8	-130.8	-163.8	-188.4
46	put	268.2	-140.2	13,535				259.5	-131.5	-152.1	-171.4
47	put	259.6	-131.6	19,718				260.3	-132.3	-144.4	-160.1

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; ET = Eternal Home; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table 5. Analysis of Well Pump Capacities for GSR Project and Cumulative Project

Well	Top of Screen (feet bgs)	Spring 2001 DTW (feet)	2010 DTW (feet)	Pump Setting Depth (feet bgs)	Capacity/Head Rating	Calculated PWL and Q for 2001 Conditions	Calculated Discharge Head (feet)	Existing Conditions DTW at Year 44 (feet)	PWL and Q for Existing Conditions at Year 44 (feet)	GSR Max DTW (feet)	PWL and Q for GSR Max DTW	Cumulative Design Drought Max DTW (feet)	PWL and Q for Cumulative DD Max DTW
Woodlawn Primary	275	256 (Est.)	220	350	500 gpm/300 ft. (1982 SWL=228 ft.)	450 gpm @ 315 ft.	33	253	450 gpm @ 312 ft.	369	60 gpm @ 405 ft.	NA	NA
Italian	300	294	257	450	260 gpm/420 feet	260 gpm @ 348 ft	72	290	265 gpm @345 ft.	400	145 gpm @ 430 ft.	NA	NA
Eternal Home	280	261	225	NA	200 gpm/460 feet (assumed)	200 gpm @283 ft.	177	258	200 gpm @280 ft.	363	100 gpm @ 374 ft.	NA	NA
Olivet	308	NA	NA	415	300 gpm/640 feet	300 gpm @ 300 ft.	340	264	300 gpm @ 297 ft.	363	180 gpm @ 381 ft.	NA	NA
Home of Peace	400	NA	240	NA	600 gpm/470 feet	600 gpm @ 328 ft.	142	273	600 gpm @ 325 ft.	370	440 gpm @ 406 ft.	NA	NA
Hills of Eternity	224	242	NA	310	235 gpm/500 feet	235 gpm @ 256 ft.	254	239	235 gpm @ 253 ft.	334	135 gpm @ 342 ft.	NA	NA
Holy Cross 1	368	236	200	340	800 gpm/700 feet	800 gpm @ 310 ft.	390	233	800 gpm @ 307 ft	337	625 gpm @ 393 ft.	NA	NA
Holy Cross 4	420	NA	221	395	800 gpm/720 feet	800 gpm @ 389 ft.	331	253	800 gpm @ 386 ft.	352	700 gpm @ 467 ft.	NA	NA
California Golf Club 7	255	235 (Est.)	200 (Est.)	NA	200 gpm/350 feet (1994 SWL=232 ft.)	200 gpm @ 301 ft.	49	233	200 gpm @ 302 ft.	401	45 gpm @ 417 ft.	NA	NA
California Golf Club 8	320	236	200 (Est.)	NA	800 gpm/400 feet	800 gpm @ 289 ft.	111	233	800 gpm @ 286 ft.	402	475 gpm @ 433 ft.	NA	NA
Olympic Club 1 (No. 9)	260	115 (Est.)	100	250	700 gpm/276 ft.	700 gpm @ 156 ft.	120	122	685 gpm@ 160 ft	136	660 gpm@ 164 ft	142	640 gpm@ 168 ft
Olympic Club 2 (No. 8)	200	115 (Est.)	100	270	1000 gpm/ 216 ft	1000 gpm @ 180 ft.	36	122	970 gpm@ 185 ft	136	935 gpm@ 195 ft	142	910 gpm@ 200 ft
San Francisco Golf Club 2	360	180 (Est.)	160 (Est.)	350	700 gpm/ 390 ft.	675 gpm @ 218 ft.	186	182	675 gpm@ 217 ft	196	660 gpm@ 228 ft	202	655 gpm@ 230 ft

Notes: DTW = depth to water; gpm = gallons per minute; PWL = pumping water level; Q = discharge/pumping rate; ft = feet

2001 DTW and 2010 DTW for Olympic Club and San Francisco Golf Clubs are estimated (i.e., not measured)

Table 6. California Golf Club Well 8 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	CGC8 Well DTW (Feet)	CGC8 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	CGC8 Well SWL (Feet bgs)	CGC8 Well GWE (Feet NGVD 29)	CGC8 Well Background DTW (Feet)	CGC8 Well Background GWE (Feet NGVD 29)	GW Model SC 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	189.4	-128.4	27,742				200.8	-139.8	-87.9	-130.7	-133.9
2	put	180.9	-119.9	33,925				201.5	-140.5	-84.6	-125.6	-128.0
3	put	172.4	-111.4	40,108				202.3	-141.3	-81.0	-120.4	-122.5
4	put	163.9	-102.9	46,291				203.0	-142.0	-78.5	-116.8	-119.5
5	put	155.4	-94.4	52,475				203.8	-142.8	-75.1	-112.1	-114.4
6	put	146.9	-85.9	58,658				204.5	-143.5	-72.3	-108.3	-110.8
7	Put/Hold	144.8	-83.8	60,500				205.3	-144.3	-73.3	-117.7	-121.7
8	Hold	145.6	-84.6	60,500				206.0	-145.0	-74.5	-124.3	-125.7
9	Hold/Take	150.8	-89.8	58,475				206.8	-145.8	-81.1	-140.5	-144.9
10	take	169.3	-108.3	50,375	43	212.3	-151.3	207.5	-146.5	-94.6	-169.5	-174.1
11	Take/Put	181.0	-120.0	45,858	50	231.0	-170.0	208.3	-147.3	-107.1	-183.7	-186.6
12	put	172.5	-111.5	52,042				209.0	-148.0	-103.0	-166.9	-170.2
13	put	164.0	-103.0	58,225				209.8	-148.8	-96.3	-153.2	-156.1
14	Put/Hold	161.4	-100.4	60,430				210.5	-149.5	-92.7	-152.8	-156.7
15	Hold	162.2	-101.2	60,430				211.3	-150.3	-93.9	-157.5	-161.6
16	Hold	162.9	-101.9	60,430				212.0	-151.0	-95.3	-160.9	-165.3
17	Hold	163.7	-102.7	60,430				212.8	-151.8	-96.5	-163.9	-168.1
18	Hold	164.4	-103.4	60,430				213.5	-152.5	-97.5	-166.1	-170.2
19	Hold	165.2	-104.2	60,430				214.3	-153.3	-99.0	-169.0	-173.3
20	Hold	165.9	-104.9	60,430				215.0	-154.0	-100.3	-171.4	-175.6
21	Hold	166.7	-105.7	60,430				215.8	-154.8	-101.5	-173.7	-177.4
22	Hold	167.4	-106.4	60,430				216.5	-155.5	-103.1	-176.1	-180.2
23	Hold	168.2	-107.2	60,430				217.3	-156.3	-103.8	-177.3	-181.4
24	Hold	168.9	-107.9	60,430				218.0	-157.0	-104.4	-178.6	-182.7
25	Hold/Take	174.1	-113.1	58,405				218.8	-157.8	-106.5	-186.9	-191.3
26	take	192.6	-131.6	50,305	43	235.6	-174.6	219.5	-158.5	-118.1	-211.5	-216.1
27	take/put	204.3	-143.3	45,788	50	254.3	-193.3	220.3	-159.3	-129.0	-221.7	-224.9
28	put	195.8	-134.8	51,972				221.0	-160.0	-123.8	-202.5	-206.0
29	put	187.3	-126.3	58,155				221.8	-160.8	-115.0	-184.8	-187.6
30	Put/Hold	184.7	-123.7	60,360				222.5	-161.5	-110.4	-182.5	-186.1
31	Hold	185.5	-124.5	60,360				223.3	-162.3	-107.3	-180.4	-181.9
32	Hold	186.2	-125.2	60,360				224.0	-163.0	-108.9	-183.1	-186.9
33	Hold	187.0	-126.0	60,360				224.8	-163.8	-110.2	-185.8	-190.3
34	Hold	187.7	-126.7	60,360				225.5	-164.5	-110.1	-186.1	-190.1
35	Hold	188.5	-127.5	60,360				226.3	-165.3	-109.9	-186.2	-189.7
36	hold/take	193.7	-132.7	58,335				227.0	-166.0	-112.6	-194.9	-199.7
37	take	212.2	-151.2	50,235	43	255.2	-194.2	227.8	-166.8	-123.9	-219.1	-224.3
38	take	230.7	-169.7	42,135	50	280.7	-219.7	228.5	-167.5	-133.9	-237.7	-240.6
39	take	249.2	-188.2	34,035	57	306.2	-245.2	229.3	-168.3	-147.5	-258.6	-264.1
40	take	267.7	-206.7	25,935	64	331.7	-270.7	230.0	-169.0	-157.3	-273.7	-279.2
41	take	286.2	-225.2	17,835	67	353.2	-292.2	230.8	-169.8	-166.4	-287.3	-293.0
42	take	304.7	-243.7	9,735	70	374.7	-313.7	231.5	-170.5	-174.0	-298.7	-304.1
43	take	323.2	-262.2	1,635	73	396.2	-335.2	232.3	-171.3	-181.4	-309.0	-314.1
44	take/hold/put	326.0	-265.0	1,168	74	400.0	-339.0	233.0	-172.0	-182.7	-296.3	-300.0
45	put	317.5	-256.5	7,352				233.8	-172.8	-171.8	-269.2	-272.7
46	put	309.0	-248.0	13,535				234.5	-173.5	-159.4	-245.3	-248.0
47	put	300.5	-239.5	19,718				235.3	-174.3	-148.9	-226.2	-228.8

Assumptions:

1) Put Rate of 5.52 MGD results in 8.5 feet/year increase in groundwater levels in CGC area
2) Take Rate of 7.23 MGD results in 18.5 feet/year decrease in groundwater levels in CGC area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in CGC area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; CGC = California Golf Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table 7. Lake Merced Golf Club Well 3 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	LMGC3 DTW (Feet)	LMGC3 GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	LMGC3 SWL (Feet bgs)	LMGC3 GWE (Feet NGVD 29)	LMGC3 Background DTW (Feet)	LMGC3 Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	224.9	-70.9	27,742				238.8	-84.8	-45.9	-46.4	-48.9
2	put	214.4	-60.4	33,925				239.5	-85.5	-36.3	-37.1	-40.6
3	put	203.9	-49.9	40,108				240.3	-86.3	-30.8	-31.5	-34.6
4	put	193.4	-39.4	46,291				241.0	-87.0	-26.7	-27.5	-30.4
5	put	182.9	-28.9	52,475				241.8	-87.8	-23.8	-24.5	-27.4
6	put	172.4	-18.4	58,658				242.5	-88.5	-21.3	-22.0	-24.7
7	Put/Hold	169.7	-15.7	60,500				243.3	-89.3	-26.2	-28.5	-35.9
8	Hold	170.5	-16.5	60,500				244.0	-90.0	-31.9	-34.2	-42.5
9	Hold/Take	174.8	-20.8	58,475				244.8	-90.8	-41.7	-45.7	-58.2
10	take	189.8	-35.8	50,375	29	218.8	-64.8	245.5	-91.5	-56.0	-60.5	-75.6
11	Take/Put	198.4	-44.4	45,858	35	233.4	-79.4	246.3	-92.3	-60.5	-62.2	-69.7
12	put	187.9	-33.9	52,042				247.0	-93.0	-50.6	-51.0	-53.5
13	put	177.4	-23.4	58,225				247.8	-93.8	-44.5	-44.9	-47.3
14	Put/Hold	174.1	-20.1	60,430				248.5	-94.5	-45.1	-47.2	-54.5
15	Hold	174.8	-20.8	60,430				249.3	-95.3	-49.0	-51.3	-59.1
16	Hold	175.6	-21.6	60,430				250.0	-96.0	-50.4	-52.8	-60.9
17	Hold	176.3	-22.3	60,430				250.8	-96.8	-53.0	-55.1	-62.8
18	Hold	177.1	-23.1	60,430				251.5	-97.5	-53.4	-55.6	-63.5
19	Hold	177.8	-23.8	60,430				252.3	-98.3	-54.7	-56.7	-64.4
20	Hold	178.6	-24.6	60,430				253.0	-99.0	-55.9	-57.9	-65.4
21	Hold	179.3	-25.3	60,430				253.8	-99.8	-57.5	-59.4	-67.3
22	Hold	180.1	-26.1	60,430				254.5	-100.5	-56.5	-58.7	-66.9
23	Hold	180.8	-26.8	60,430				255.3	-101.3	-55.5	-57.7	-65.9
24	Hold	181.6	-27.6	60,430				256.0	-102.0	-56.6	-58.7	-66.6
25	Hold/Take	185.9	-31.9	58,405				256.8	-102.8	-62.9	-66.6	-79.0
26	take	200.9	-46.9	50,305	29	229.9	-75.9	257.5	-103.5	-74.5	-78.8	-94.2
27	take/put	209.5	-55.5	45,788	35	244.5	-90.5	258.3	-104.3	-77.0	-78.7	-86.3
28	put	199.0	-45.0	51,972				259.0	-105.0	-65.7	-65.9	-68.5
29	put	188.5	-34.5	58,155				259.8	-105.8	-56.3	-56.7	-59.7
30	Put/Hold	185.2	-31.2	60,360				260.5	-106.5	-56.1	-58.2	-65.8
31	Hold	185.9	-31.9	60,360				261.3	-107.3	-57.0	-59.4	-68.1
32	Hold	186.7	-32.7	60,360				262.0	-108.0	-56.3	-58.7	-67.4
33	Hold	187.4	-33.4	60,360				262.8	-108.8	-57.5	-59.7	-67.8
34	Hold	188.2	-34.2	60,360				263.5	-109.5	-58.3	-60.3	-68.8
35	Hold	188.9	-34.9	60,360				264.3	-110.3	-58.1	-60.2	-69.0
36	hold/take	193.2	-39.2	58,335				265.0	-111.0	-64.5	-68.3	-81.1
37	take	208.2	-54.2	50,235	29	237.2	-83.2	265.8	-111.8	-76.4	-80.9	-96.0
38	take	223.2	-69.2	42,135	35	258.2	-104.2	266.5	-112.5	-85.5	-89.8	-105.8
39	take	238.2	-84.2	34,035	41	279.2	-125.2	267.3	-113.3	-96.6	-100.9	-116.1
40	take	253.2	-99.2	25,935	47	300.2	-146.2	268.0	-114.0	-106.4	-110.7	-126.1
41	take	268.2	-114.2	17,835	49	317.2	-163.2	268.8	-114.8	-115.3	-119.9	-135.8
42	take	283.2	-129.2	9,735	52	335.2	-181.2	269.5	-115.5	-127.6	-132.3	-148.7
43	take	298.2	-144.2	1,635	54	352.2	-198.2	270.3	-116.3	-143.3	-148.8	-166.3
44	take/hold/put	299.7	-145.7	1,168	56	355.7	-201.7	271.0	-117.0	-140.4	-141.3	-148.4
45	put	289.2	-135.2	7,352				271.8	-117.8	-121.1	-120.7	-123.3
46	put	278.7	-124.7	13,535				272.5	-118.5	-105.1	-105.0	-108.2
47	put	268.2	-114.2	19,718				273.3	-119.3	-91.4	-91.8	-95.7

Assumptions:

1) Put Rate of 5.52 MGD results in 10.5 feet/year increase in groundwater levels in LMGC area
2) Take Rate of 7.23 MGD results in 15.0 feet/year decrease in groundwater levels in LMGC area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in LMGC area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; LMGC = Lake Merced Golf Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table 8. Olympic Golf Club Well 1 (#9) Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	Oly1 Well DTW (Feet)	Oly1 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	Oly1 Well SWL (Feet bgs)	Oly1 Well GWE (Feet NGVD 29)	Oly1 Well Background DTW (Feet)	Oly1 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	95.5	-20.5	27,742				100.5	-25.5	-8.8	-21.1
2	put	91.9	-16.9	33,925				101.0	-26.0	-4.1	-16.5
3	put	88.3	-13.3	40,108				101.5	-26.5	-0.8	-12.0
4	put	84.7	-9.7	46,291				102.0	-27.0	1.3	-9.0
5	put	81.1	-6.1	52,475				102.5	-27.5	2.6	-6.7
6	put	77.5	-2.5	58,658				103.0	-28.0	3.6	-5.2
7	Put/Hold	76.8	-1.8	60,500				103.5	-28.5	3.4	-5.9
8	Hold	77.3	-2.3	60,500				104.0	-29.0	0.9	-9.6
9	Hold/Take	78.6	-3.6	58,475				104.5	-29.5	-2.4	-13.1
10	take	82.6	-7.6	50,375	7	89.6	-14.6	105.0	-30.0	-8.8	-21.6
11	Take/Put	84.7	-9.7	45,858	12	96.7	-21.7	105.5	-30.5	-13.2	-28.0
12	put	81.1	-6.1	52,042				106.0	-31.0	-10.9	-23.6
13	put	77.5	-2.5	58,225				106.5	-31.5	-9.1	-20.3
14	Put/Hold	76.5	-1.5	60,430				107.0	-32.0	-8.1	-19.2
15	Hold	77.0	-2.0	60,430				107.5	-32.5	-9.2	-21.5
16	Hold	77.5	-2.5	60,430				108.0	-33.0	-9.4	-22.7
17	Hold	78.0	-3.0	60,430				108.5	-33.5	-10.0	-23.5
18	Hold	78.5	-3.5	60,430				109.0	-34.0	-9.9	-24.1
19	Hold	79.0	-4.0	60,430				109.5	-34.5	-9.9	-24.1
20	Hold	79.5	-4.5	60,430				110.0	-35.0	-10.3	-24.5
21	Hold	80.0	-5.0	60,430				110.5	-35.5	-11.4	-25.3
22	Hold	80.5	-5.5	60,430				111.0	-36.0	-10.6	-25.6
23	Hold	81.0	-6.0	60,430				111.5	-36.5	-9.7	-24.9
24	Hold	81.5	-6.5	60,430				112.0	-37.0	-10.0	-24.7
25	Hold/Take	82.9	-7.9	58,405				112.5	-37.5	-11.9	-25.9
26	take	86.9	-11.9	50,305	7	93.9	-18.9	113.0	-38.0	-17.5	-32.8
27	take/put	89.0	-14.0	45,788	12	101.0	-26.0	113.5	-38.5	-20.7	-38.1
28	put	85.4	-10.4	51,972				114.0	-39.0	-17.4	-32.5
29	put	81.8	-6.8	58,155				114.5	-39.5	-14.0	-27.8
30	Put/Hold	80.8	-5.8	60,360				115.0	-40.0	-12.6	-25.7
31	Hold	81.3	-6.3	60,360				115.5	-40.5	-12.1	-26.6
32	Hold	81.8	-6.8	60,360				116.0	-41.0	-10.7	-26.3
33	Hold	82.3	-7.3	60,360				116.5	-41.5	-10.1	-25.6
34	Hold	82.8	-7.8	60,360				117.0	-42.0	-10.6	-25.6
35	Hold	83.3	-8.3	60,360				117.5	-42.5	-10.5	-25.9
36	hold/take	84.7	-9.7	58,335				118.0	-43.0	-11.9	-26.8
37	take	88.7	-13.7	50,235	7	95.7	-20.7	118.5	-43.5	-17.2	-33.4
38	take	92.7	-17.7	42,135	12	104.7	-29.7	119.0	-44.0	-21.9	-39.3
39	take	96.7	-21.7	34,035	15	111.7	-36.7	119.5	-44.5	-27.0	-45.2
40	take	100.7	-25.7	25,935	17	117.7	-42.7	120.0	-45.0	-31.9	-50.9
41	take	104.7	-29.7	17,835	19	123.7	-48.7	120.5	-45.5	-36.6	-56.9
42	take	108.7	-33.7	9,735	21	129.7	-54.7	121.0	-46.0	-42.0	-63.0
43	take	112.7	-37.7	1,635	22	134.7	-59.7	121.5	-46.5	-48.5	-70.6
44	take/hold/put	113.0	-38.0	1,168	23	136.0	-61.0	122.0	-47.0	-50.8	-74.6
45	put	109.4	-34.4	7,352				122.5	-47.5	-45.9	-67.1
46	put	105.8	-30.8	13,535				123.0	-48.0	-40.0	-59.3
47	put	102.2	-27.2	19,718				123.5	-48.5	-34.1	-52.0

Assumptions:

1) Put Rate of 5.52 MGD results in 3.6 feet/year increase in groundwater levels in Olympic Club area
2) Take Rate of 7.23 MGD results in 4.0 feet/year decrease in groundwater levels in the Olympic Club area
3) Hold Year results in 0.5 feet/year decrease in groundwater levels in the Olympic Club area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; Oly = Olympic Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table 9. Summary of Analytical Data Analysis for GSR Project

Well	Top of Screen (Feet bgs)	2001/2010 DTW (Feet)	Existing Conditions Max DTW at Year 44 (Feet)	GSR Design Drought End of Water Year Max DTW at Year 44 (Feet)	GSR Design Drought Max DTW Mid-Year 44 (Feet)	Max Depth Below Existing Conditions (Feet)
Woodlawn Primary	275	NA/220	253	367	369	116
Italian	300	294/257	290	398	400	110
Eternal Home	280	261/225	258	361	363	105
Olivet	308	NA/NA	264	361	363	99
Home of Peace	400	NA/240	273	368	370	97
Hills of Eternity	224	242/NA	239	332	334	95
Cypress 3	191	NA/NA	289	382	384	95
Cypress 4	330	272(?)/NA	232	328	330	98
Holy Cross 4	420	NA/221	253	350	352	99
Holy Cross 1	368	236/200	233	335	337	104
Olympic Club No. 1 (#9)	260	NA/NA	122	135	136	14
Olympic Club No. 2 (#8)	200	NA/NA	122	135	136	14
San Francisco Golf Club No. 2	360	NA/NA	182	194	196	14
Lake Merced Golf Club No. 3	294	NA/NA	271	356	358	87
California Golf Club No. 7	255	NA/NA	233	400	401	168
California Golf Club No. 8	320	235/NA	233	400	402	169

Notes: LMGC = Lake Merced Golf Club; CGC = California Golf Club; NA = Not Available;
bgs = below ground surface; DTW = depth to water

Table 10. Summary of Gross GSR Project Well Interference Drawdown Estimates for Third-Party Wells (feet)[3]

Well I.D.	San Francisco Golf Club Well 2	Olympic Golf Club Wells	Lake Merced Golf Club Well 3
Well CUP-3A (pumping at 400 gpm 7.5 years)	8.2	7.2	10.8
Well CUP-5 (pumping at 300 gpm for 7.5 years)	4.6	5.2	10.4
Well CUP-6 (pumping at 300 gpm for 7.5 years)	4.9	5.4	12.4
Well CUP-7 (pumping at 300 gpm for 7.5 years)	4.4	4.9	10.1
Other GSR Wells[1,2]	NA	NA	12.1
Totals	22	23	56

1. "Other GSR Wells" refers to GSR wells located south of CUP-5, 6, 7.
2. NA means not applicable because other GSR wells are too far away.
3. Gross Drawdown is equal to the difference between "Regional SWL with GSR Project" and "SWL with Local GSR Drawdown" as labeled on Figures 3 through 10.

Table 11. Summary of Net GSR Project Well Interference Drawdown Estimates for Third-Party Wells Compared to Existing Conditions (feet)[1]

Baseline Case	San Francisco Golf Club Well 2	Olympic Golf Club Wells	Lake Merced Golf Club Well 3
Existing Conditions – 20,000 AF beginning SFPUC storage account	14	14	87

1. Net Drawdown is equal to the difference between "SWL Under Existing Conditions without Project" and "SWL with Local GSR Drawdown" as labeled on Figures 3 through 10

Table 12. Summary of SFGW Supply Project Well Interference Drawdown Estimates for Third-Party Wells (feet)

Well I.D.	SF Golf Club[1]	Olympic Golf Club[1]	Lake Merced Golf Club[2]
SFGW Project with 4 Wells (3 MGD)	6	6	4
SFGW Project with 6 Wells (4 MGD)	6	6	4

1. Calculations from LSCE (2012).
2. Calculations made in this TM.

Table 13. Combined Gross GSR and SFGW Supply Project Well Interference Drawdown Estimates for Third-Party Wells (feet)

Well I.D.	SF Golf Club[1]	Olympic Golf Club[1]	Lake Merced Golf Club[1]
GSR and SFGW Project with 4 Wells (3-MGD)	28	29	60
GSR and SFGW Project with 6 Wells (4-MGD)	28	29	60

1. Drawdown estimates are sum of results from Tables 10 and 12.

Table 14. Combined Net GSR and SFGW Supply Project Well Interference Drawdown Estimates for Third-Party Wells (feet)

Well I.D.	SF Golf Club[1]	Olympic Golf Club[1]	Lake Merced Golf Club[1]
GSR and SFGW Project with 4 Wells (3-MGD)	20	20	91
GSR and SFGW Project with 6 Wells (4-MGD)	20	20	91

1. Drawdown estimates are sum of results from Tables 11 and 12.

Table 15. Summary of Analytical Data Analysis for Cumulative GSR and SFGW Projects

Well	Top of Screen (Feet bgs)	Estimated Spring 2001/2010 DTW (Feet)	Existing Conditions Future Scenario Year 44 Max DTW (Feet)	Cumulative Project Future Scenario Year 44 End of Water Year Max DTW (Feet)	Cumulative Project Future Scenario Year 44 Mid-Year Max DTW (Feet)	Cumulative Project Max Depth Below Existing Conditions (Feet)
Olympic Club No. 1 (#9)	260	115/100	122	141	142	20
Olympic Club No. 2 (#8)	200	115/100	122	141	142	20
San Francisco Golf Club No. 2	360	180/160	182	200	202	20
Lake Merced Golf Club No. 3	294	273/238	271	360	362	91

Notes: NA = Not Available; bgs = below ground surface; DTW = depth to water

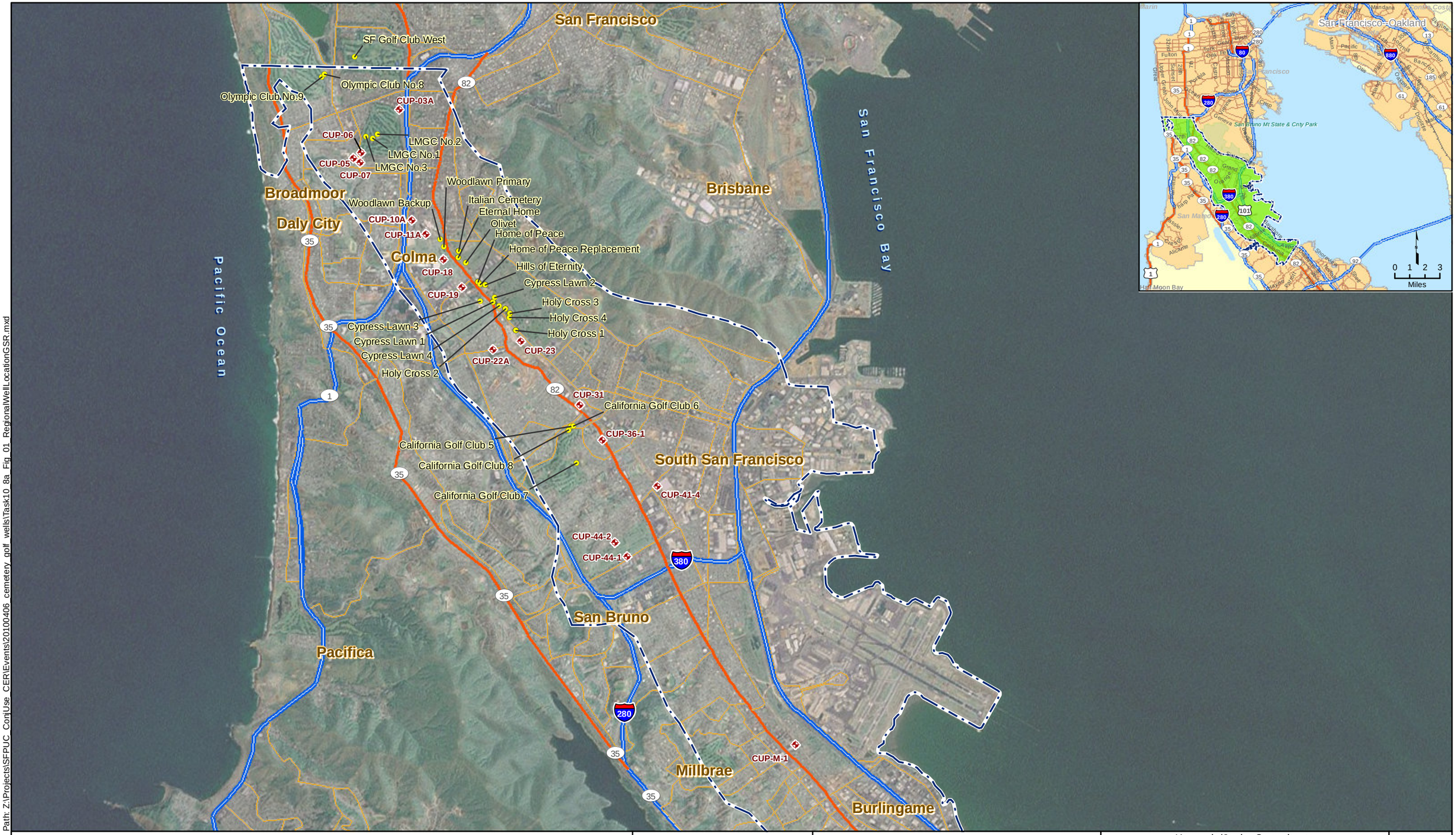
Estimated Spring 2001 DTW for Olympic Club Wells - based upon measured DTW in Olympic Club No. 1 in July 2001 (DTW= 120 feet) and then added 5 feet (115 feet) for presumed higher spring levels
Estimated Spring 2010 DTW for Olympic Club Wells - based upon measured rise in groundwater levels of about 15 feet from 2002 to 2009 observed in LMMW-3D and LMMW-6D (DTW=100 feet)
Estimated Spring 2001/2010 DTW for San Francisco Golf Club Well - personal communication, Jeff Gilman

Table 16. Combined GSR and SFGW Supply Project Well Interference Pumping Capacity Reductions for Third-Party Wells[1]

Well I.D.	SF Golf Club	Olympic Golf Club	Lake Merced Golf Club
Gross GSR and SFGW Project with 6 Wells (4-MGD)	6%	9%	10 –30%
Net GSR and SFGW Project with 6 Wells (4-MGD)	3%	7%	10 –30%

1. Reduction in pumping capacity discharge rates (gpm) are discussed in text where available information allows.

FIGURES



Path: Z:\Projects\SFPUC_ConjUse_CER\Events\20100406_cemetery_golf_wells\Task10_8a_Fig_01_RegionalWellLocationGSR.mxd

Note:
Cypress Lawn Cemetery well locations are estimated and not based on gps coordinates.
Other well locations are based on site visits and gps coordinates.

Legend

- GSR Project Proposed Well
- Third Party Well
- South Westside Groundwater Basin

0 2,500 5,000
Scale Feet
1 " = 5,000 '

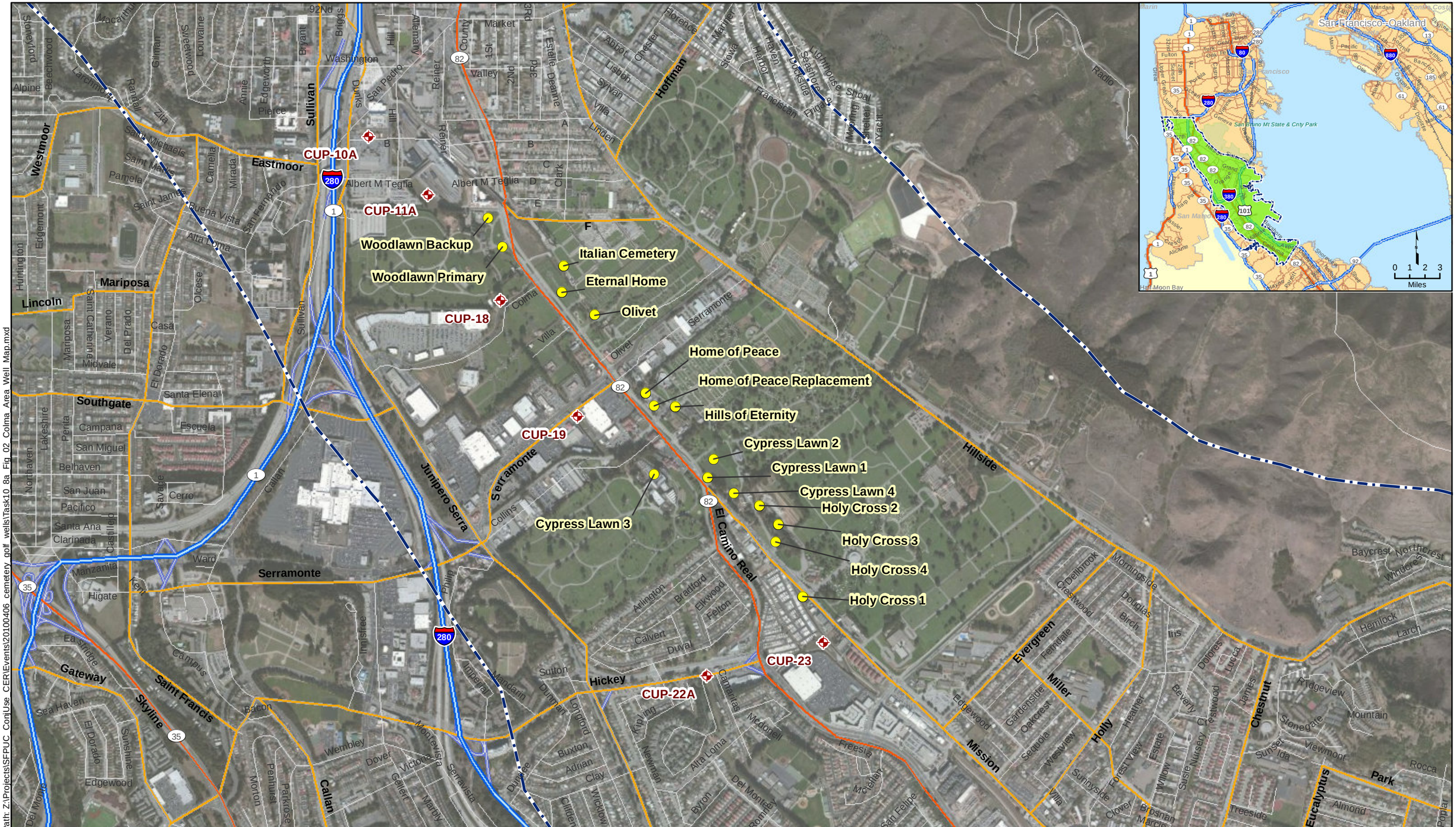
CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
ENGINEERING MANAGEMENT BUREAU

Kennedy/Jenks Consultants.
303 Second Street, Suite 300 South
San Francisco, CA 94107

REGIONAL WELL LOCATION MAP FOR GSR PROJECT

FIGURE
1

DATE
April 2012



Path: Z:\Projects\SFPUC_ConjUse_CERI\Events\20100406_cemetery_golf_wells\Task10_8a_Fig_02_Colma_Area_Well_Map.mxd

Note:
Cypress Lawn Cemetery well locations are estimated and not based on gps coordinates.
Other well locations are based on site visits and gps coordinates.

Legend

- GSR Project Proposed Well
- Third Party Well
- South Westside Groundwater Basin

0 600 1,200
Scale Feet
1 " = 1,200 '

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
ENGINEERING MANAGEMENT BUREAU

Kennedy/Jenks Consultants.
303 Second Street, Suite 300 South
San Francisco, CA 94107

COLMA AREA WELL LOCATION MAP

FIGURE
2

DATE
April 2012

Figure 3. Estimated Static Water Levels at Eternal Home Cemetery Well for GSR Project

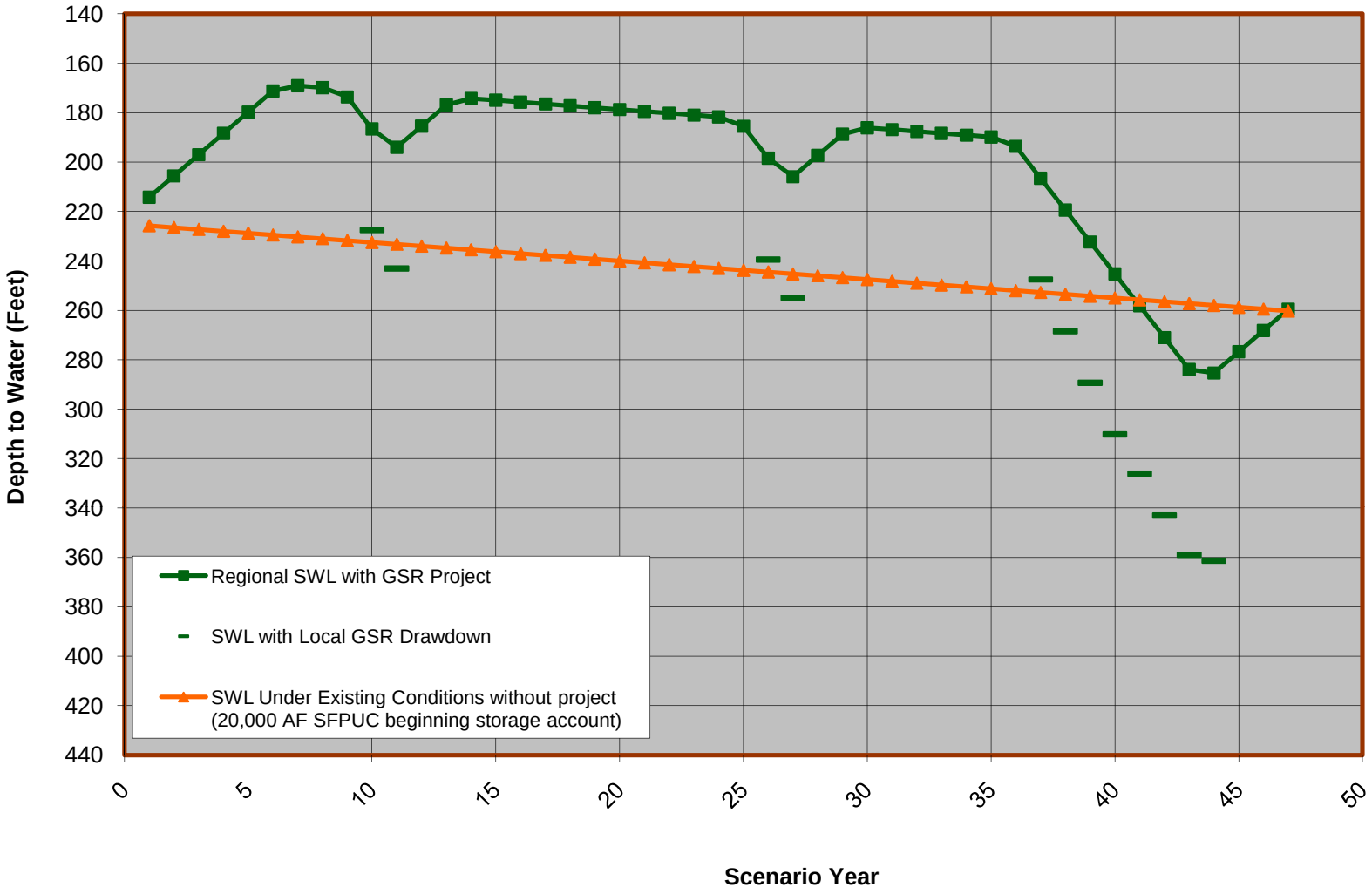


Figure 4. Estimated Groundwater Elevations at Eternal Home Cemetery Well for GSR Project (Scenario 2)

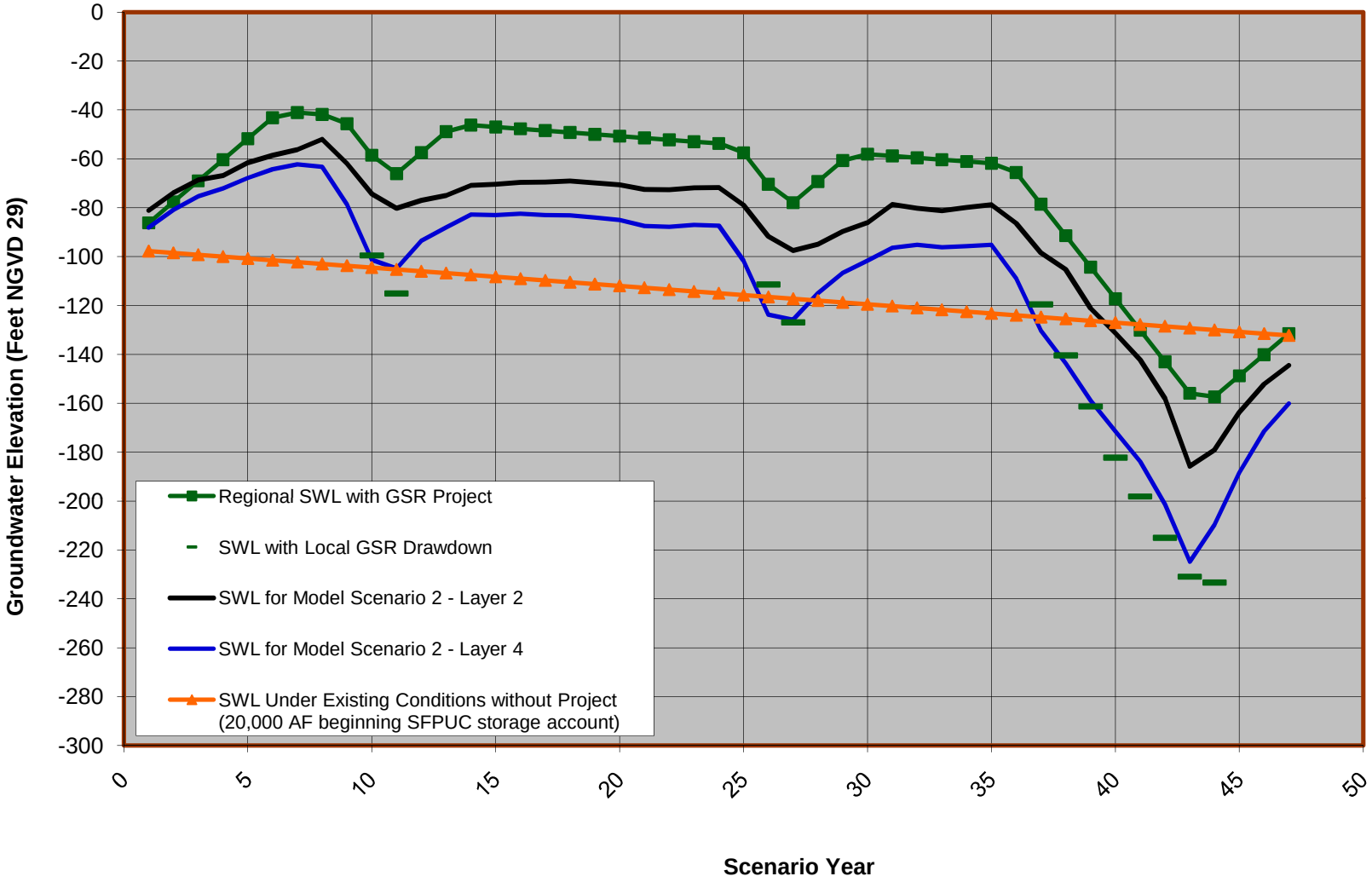


Figure 5. Estimated Static Water Levels at California Golf Club Well 8 for GSR Project

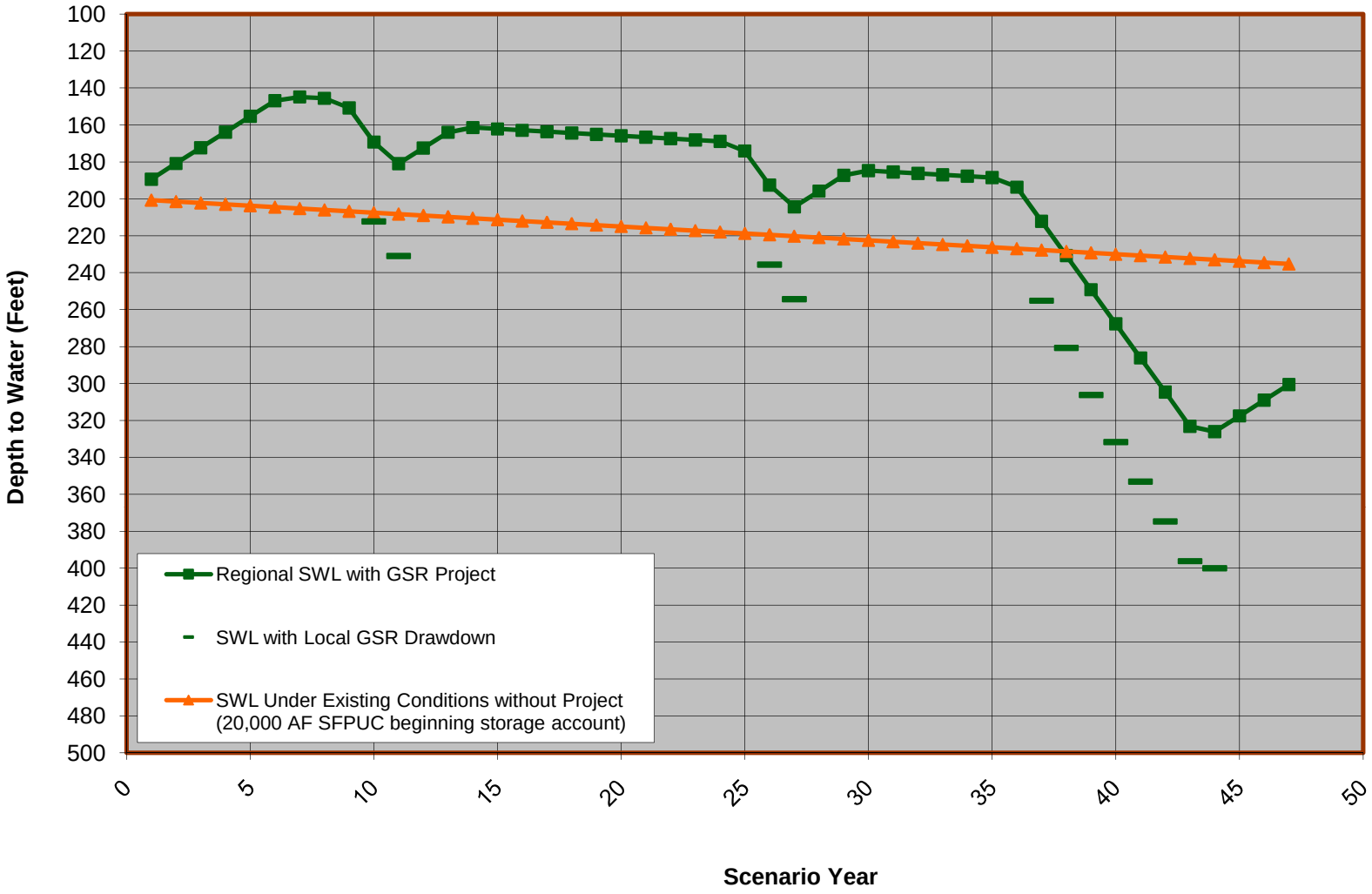


Figure 6. Estimated Groundwater Elevations at California Golf Club Well 8 for GSR Project (Scenario 2)

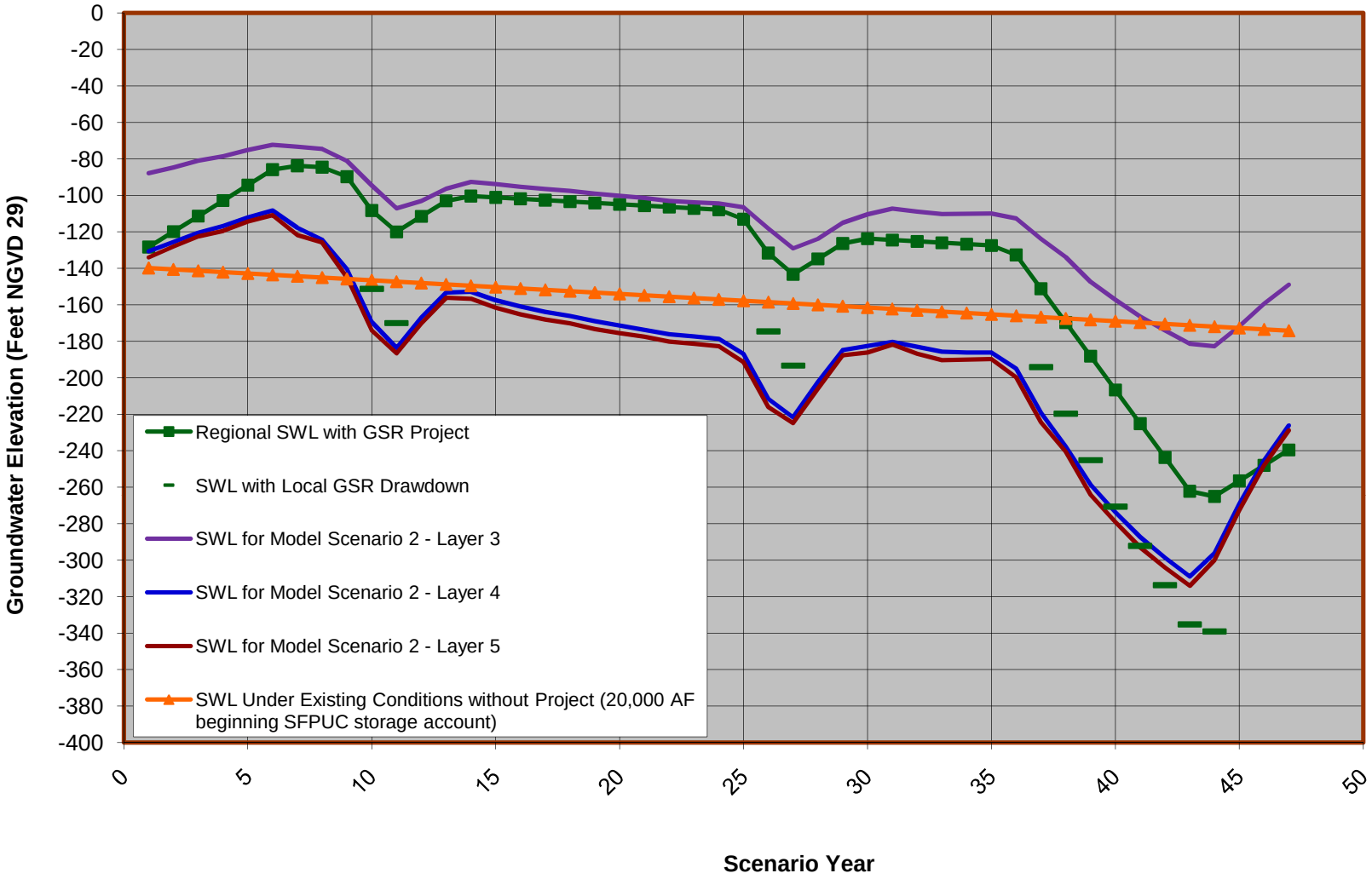


Figure 7. Estimated Static Water Levels at Lake Merced Golf Club Well 3 for GSR Project

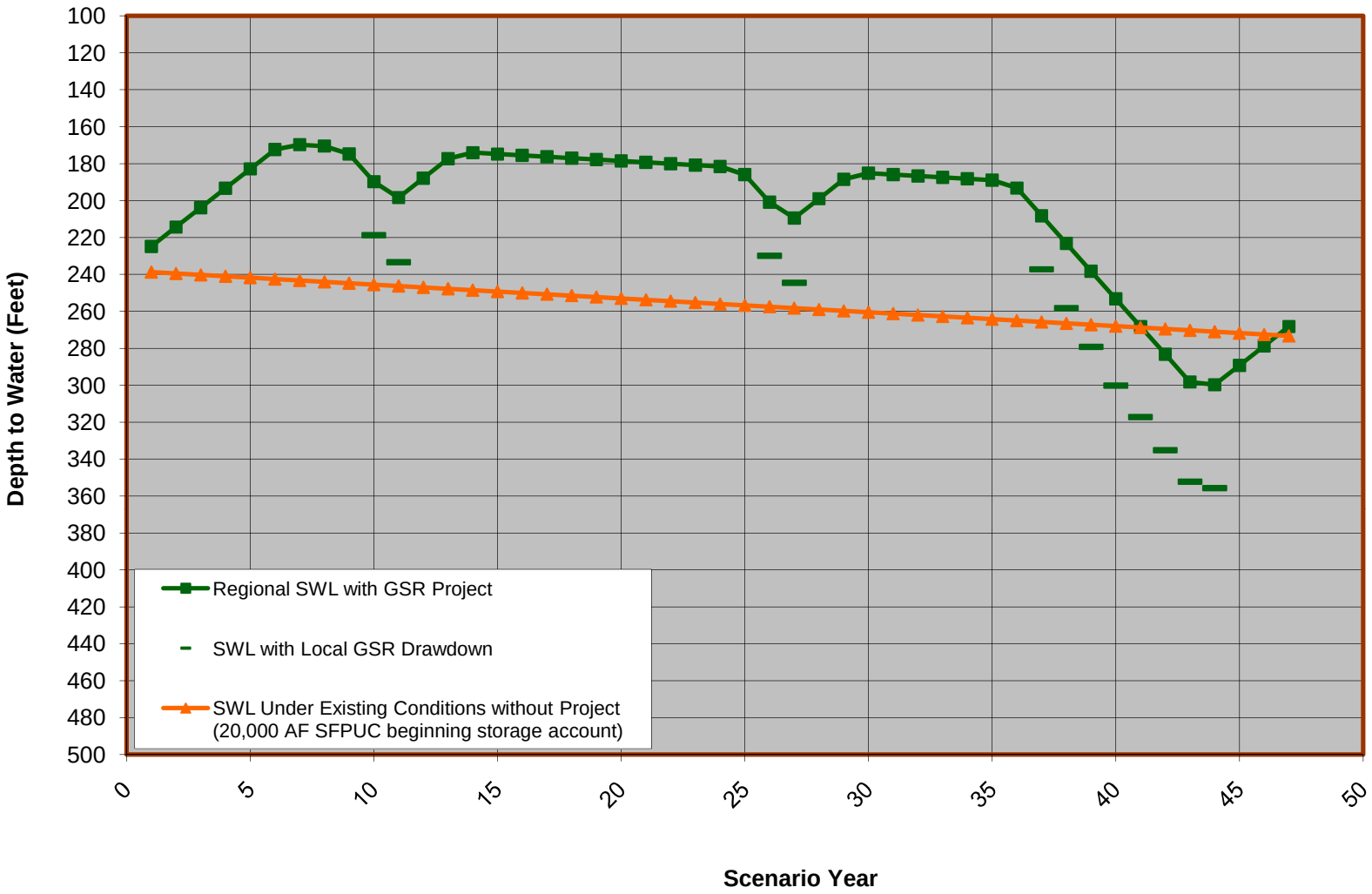


Figure 8. Estimated Groundwater Elevations at Lake Merced Golf Club Well 3 for GSR Project (Scenario 2)

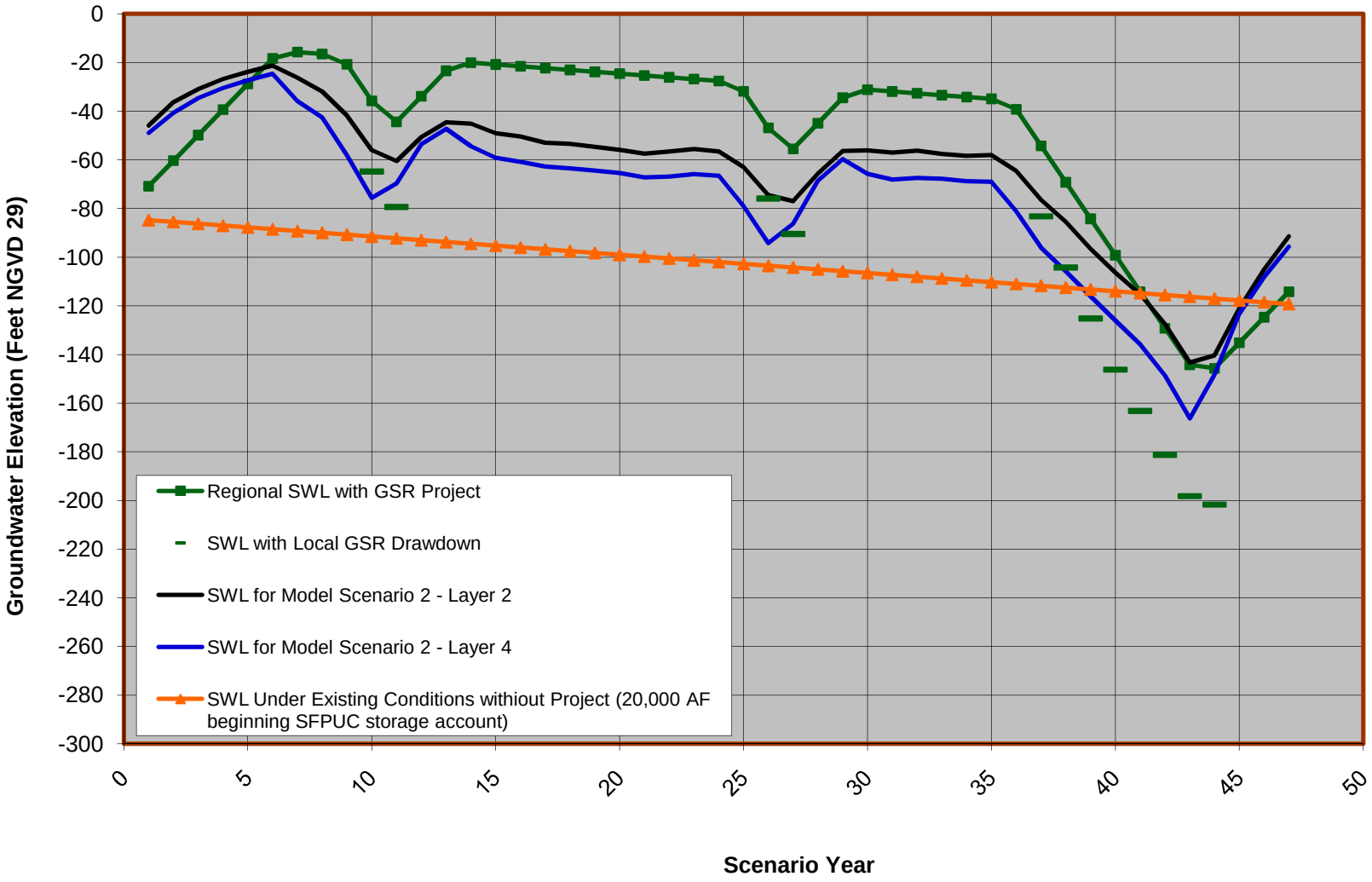


Figure 9. Estimated Static Water Levels at Olympic Golf Club Well 1 (#9) and Well 2 (#8) for GSR Project

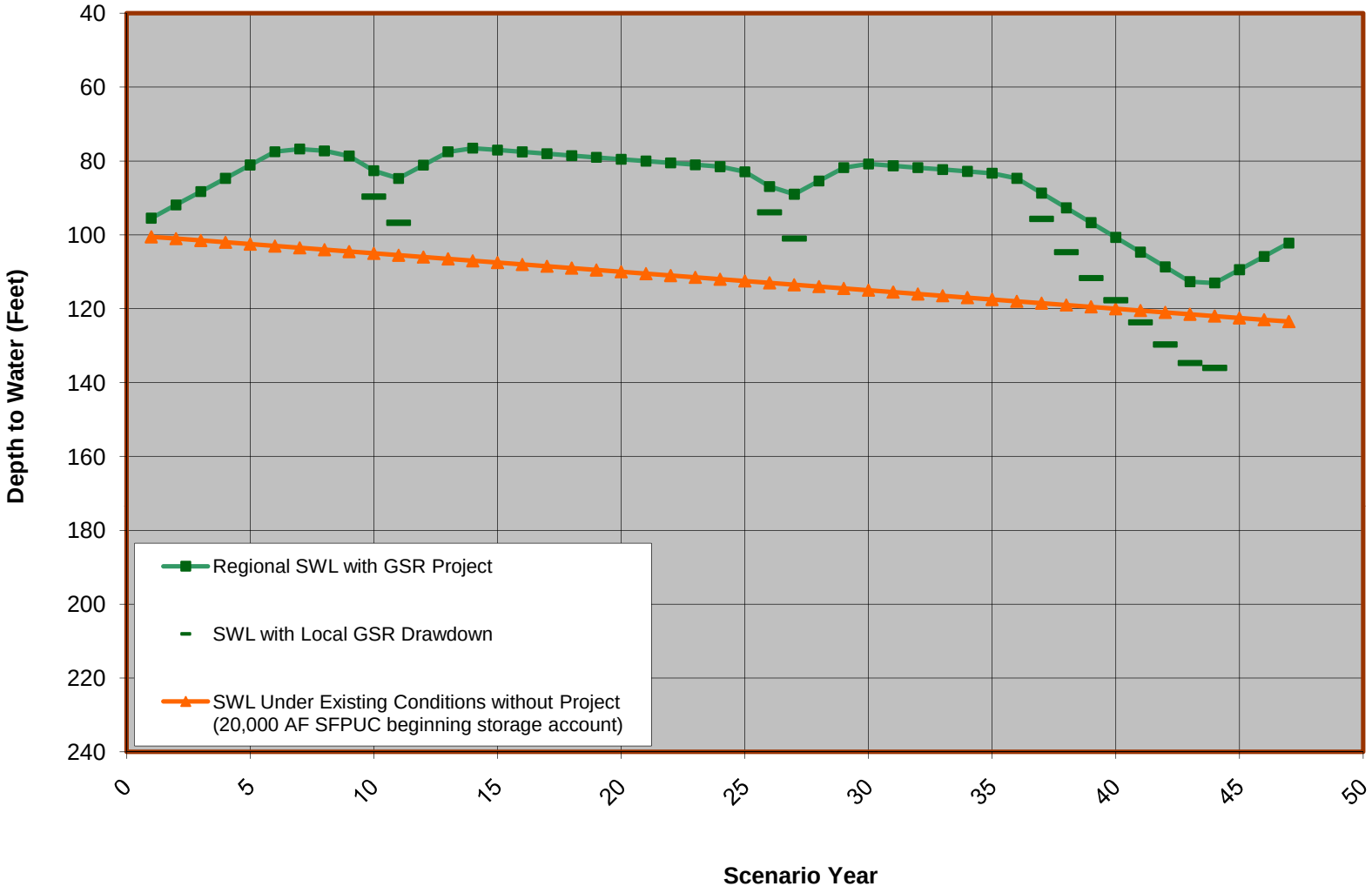
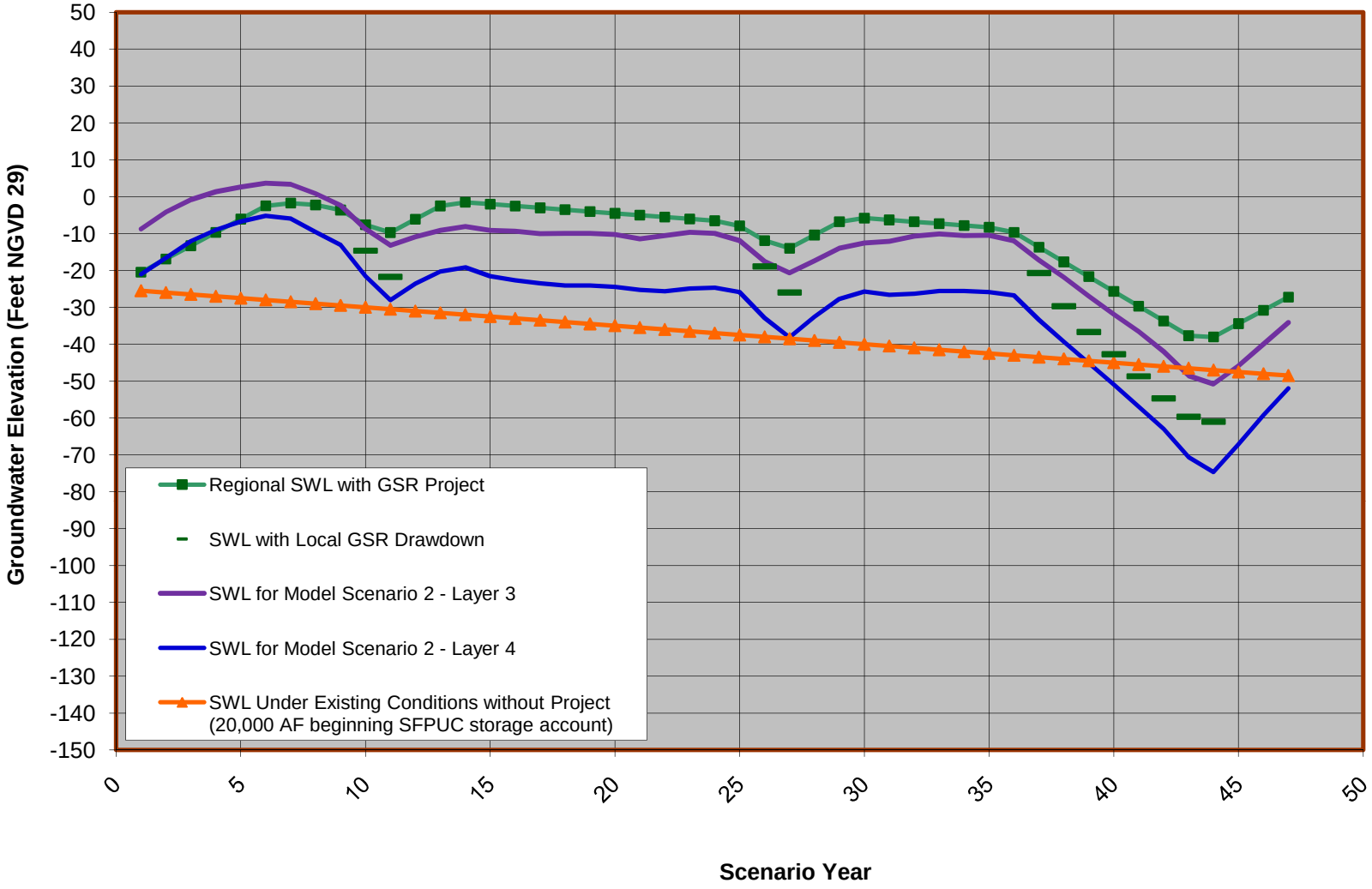


Figure 10. Estimated Groundwater Elevations at Olympic Club Well 1 (#9) for GSR Project (Scenario 2)



Path: Z:\Projects\SFPUC_ConUse_CER\Events\20100406_cemetery_golf_wells\Task10_7_Fig_11_RegionalWellLocationCumulative.mxd

Legend

- Study Area Boundary (based upon 1.5 mile radius)
- GSR Project Proposed Well
- Third Party Well
- South Westside Groundwater Basin
- SFGW Project Proposed Well

0 2,500 5,000
Scale Feet
1 " = 5,000 '

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
ENGINEERING MANAGEMENT BUREAU

Kennedy/Jenks Consultants.
303 Second Street, Suite 300 South
San Francisco, CA 94107

REGIONAL WELL LOCATION MAP FOR CUMULATIVE PROJECT

FIGURE **11**

DATE April 2012

APPENDICES

APPENDIX A

Table A-1. Colma Area Put Year Groundwater Level Rise Analysis

Well	Date	DTW (feet bgs)	Net Rise (feet)
Eternal Home	3/13/2001	261.4	
	2/4/2010	225	36
Hills of Eternity	6/27/2000	253	
	10/29/2007	214	39
Holy Cross 1	3/13/2001	236	
	3/8/2010	199.7	36
Holy Cross 2	3/13/2001	252.3	
	3/8/2010	204.73	48
Holy Cross 3	3/13/2001	264	
	3/8/2010	230.63	33
Italian	3/13/2001	294	
	1/22/2010	256.6	37

Logic/Data Analysis

In-lieu Recharge in Daly City/Cal Water areas from 2002 to 2009 = 18,147 AF

36 feet of rise/18,147 AF = 1 foot/500 AF

Amount of future Put in Daly City and Cal Water areas will be 4,300 AFY out of total Put of 6,180 AFY
(1,880 AFY will be in San Bruno)

4,300 AF per future Put Year/500 AF = **8.6 feet/year** (groundwater level rise per put year)

Assume 1 foot/500 AF relationship applies during take years as well

Amount of future CUP Take in Daly City and Cal Water areas will be 6,460 AF out of total Take of 8,100 AFY
(1,640 AFY of Take from wells CUP 41-4, CUP-44-1, CUP-44-2, and CUP-M-1 was discounted from Colma area)

6,460 AF per future Take Year/500 AF = **12.9 feet/year** (groundwater level decline per take year)

Table A-2. Colma Area Hold Year Groundwater Level Decline Analysis

Well	Date	DTW (feet bgs)	Net Decline (feet)	Years	Rate of Decline (feet/year)
Eternal Home	2/15/78	223			
	4/8/99	253	30	21	1.4
	3/13/01	261	38	23	1.7
Holy Cross 1	5/13/86	202			
	5/18/99	237	35	13	2.7
	3/13/01	236	34	15	2.3
Holy Cross 3	9/16/60	192			
	6/26/00	251	59	40	1.5
Hills of Eternity	5/15/85	226			
	7/8/99	238	12	14	0.9
	3/13/01	242	16	16	1.0

Logic/Data Analysis

Eternal Home Rate of Decline is about 1.5 feet/year
Two Holy Cross wells average Rate of Decline is about 2.0 feet/year
Hills of Eternity Rate of Decline is about 1.0 feet/year

Net average Rate of Decline for the three cemeteries from 1960 to 2001 is about 1.5 feet/year

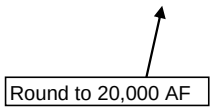
Hydrofocus Historic Model Run Rate of Decline in Colma area is about 1 foot/year
Hydrofocus Future No-Project Model Run Rate of Decline in Colma area is 0.6 to 0.8 feet/year

KJ Model Scenario 1 (Future No Project) Rate of Decline n Colma area is about 0.75 feet/year

Future Hold Year Rate of Decline used in anlaysis = **0.75 feet/year**

Summary of Supplemental Water Deliveries
Program Inception to December 31, 2009
As of 2/3/10

		Cal Water Ccf	Daly City Ccf	San Bruno Ccf			
October-02	31		82,452.00				
November-02	30		105,213.90				
December-02	31		108,989.30				
January-03	31		112,624.33	31,426.47			
February-03	28	33,951.87	98,320.86	79,994.65			
March-03	31	37,589.57	108,346.26	88,565.51			
April-03	30	36,377.01	104,961.23	85,708.56			
May-03	31	37,589.57	108,180.48	88,565.51			
June-03	30	36,377.01	104,886.36	85,708.56			
July-03	31	37,589.57	108,140.37	88,565.51			
August-03	31	37,589.57	108,433.16	86,310.16			
September-03	30	36,377.01	104,414.44	85,708.56			
October-03	31	37,589.57	109,300.80	82,883.69			
November-03	30	18,188.50		10,533.42			
December-03	31						
January-04	31						
February-04	29						
March-04	31						
April-04	30	37,589.58	109,306.15	65,709.89			
May-04	31	36,377.01	112,934.49	88,565.51			
June-04	30	37,589.58	122,084.22	62,852.94			
July-04	31	36,377.01	126,266.04	88,565.51			
August-04	31	37,589.58	126,950.53	88,565.51			
September-04	30	37,589.58	123,144.39	85,708.56			
October-04	31	36,377.01	141,422.46	88,565.51			
November-04	30	37,589.58	116,322.19	85,708.56			
December-04	31	36,377.01	124,954.55	88,565.51			
January-05	31	37,589.58		88,565.51			
February-05	28	37,589.58	109,621.66	59,995.99			
March-05	31	33,951.88	124,495.99				
April-05	30	37,589.58	109,983.96				
May-05	31	36,377.01	124,504.01				
June-05	30	37,589.58	120,379.68				
July-05	31	36,377.01	124,852.94				
August-05	31	37,589.58	125,205.88				
September-05	30	37,589.58	121,474.60				
October-05	31	36,377.01	125,494.65				
November-05	30	37,589.58	122,058.82				
December-05	31	36,377.01	129,724.60				
January-06	31	37,589.58	124,906.42				
February-06	28	37,589.58	113,911.76				
March-06	31	33,951.88	125,987.97				
April-06	30	37,589.58	121,073.53				
May-06	31	36,377.01					
June-06	30	37,589.58					
July-06	31	36,377.01	138,706.50				
August-06	31	37,589.58	115,407.75				
September-06	30	37,589.58	112,946.52				
October-06	31	36,377.01	115,421.12				
November-06	30	37,589.58	120,008.02				
December-06	31	36,377.01	124,605.61				
January-07	31	37,589.58	124,139.04				
February-07			109,248.66				
March-07			109,724.60				
April-07			102,418.45				
No supplemental deliveries May 2007 - May 2009							
subtotal ccf		1,605,439	5,463,951	1,705,340	**Total**	**8,774,730**	**ccf**
subtotal AF		3,685	12,541	3,914	**Total**	**20,140**	**AF**
June-09			165,750.00				
July-09			121,665.78				
August-09			119,991.98				
September-09			109,283.42				
October-09			117,137.70				
November-09			100,427.81				
December-09			102,699.20				
subtotal ccf			836,956	**ccf**			
subtotal AF			1,921	**AF**			



APPENDIX B

Regional Groundwater Storage and Recovery Project

To:	**Greg Bartow**
From:	**Matt Holt, PE** **Nick Johnson, PG**
Date:	**07/12/10**
Subject:	**Estimated Drawdown at Third Party Wells**

BACKGROUND AND OBJECTIVE

The Regional Groundwater Storage and Recovery Project in the South Westside Basin has been proposed to increase water supply reliability by balancing groundwater and surface water usage in wet and dry years. The proposed project includes installation of up to 16 Conjunctive Use wells to pump stored groundwater during dry years. The locations of primary and alternate Conjunctive Use wells are shown on Figure 1.

Groundwater extraction at Conjunctive Use wells will create localized cones of depression in water levels near each well. The purpose of this technical memorandum (TM) is to estimate potential groundwater level drawdown at representative Third Party wells resulting from operation of the Regional Groundwater Storage and Recovery Project.

METHODS AND ASSUMPTIONS

Water level drawdown at representative Third Party wells was estimated using a spreadsheet programmed to solve the Theis equation (Theis, 1935). The Theis equation estimates groundwater level drawdown at various distances from a pumping well based on an assumed rate and duration of pumping and estimated values of aquifer transmissivity and storage coefficient.

The Theis equation is a standard method for estimating time-varying drawdown. Its formulation assumes an idealized aquifer that is confined, homogenous, and isotropic, and has infinite areal extent. Although these conditions are rarely strictly met, the Theis equation generally provides informative results under a wide range of reasonably equivalent conditions. In the case of the South Westside Basin, the aquifer consists of multiple units that are unconfined at shallow depths and become increasingly confined with depth. Additionally, the basin is bounded by bedrock to the northeast and southwest. For each Conjunctive Use well evaluated, suitable aquifer parameter values were selected based on available aquifer tests generally representative of local conditions. Where unconfined or semi-confined conditions are present, the Theis equation may overestimate drawdown, and thus provide a conservative impact assessment. For these reasons, the Theis equation may be assumed to provide reasonable preliminary estimates of

drawdown for the purpose of this analysis[1]. Furthermore, this approach is consistent with the drawdown estimates presented in the project's Conceptual Engineering Report (MWH, 2008). More accurate estimates may require site-specific aquifer testing and three-dimensional groundwater modeling.

The transmissivities and storage coefficients assumed for this evaluation are based on aquifer tests in Daly City and San Bruno performed and analyzed by Luhdorff and Scalmanini Consulting Engineers (LSCE) in 2003 (LSCE, 2004). The transmissivity, specific yield, and storativity estimated from the Daly City test were 16,400 gallons per day per foot (gpd/ft), 0.14, and 2.4×10^{-3}, respectively. The transmissivity and storage coefficient estimated from the San Bruno test were 14,200 gpd/ft and 2.4×10^{-4}, respectively.

For the analysis presented in this TM, the storage coefficient for Daly City was adjusted to 5.2×10^{-2} to reflect semi-confined conditions and the storage coefficient for San Bruno was adjusted to 5.2×10^{-3} to reflect leaky confined conditions. These adjusted storage coefficients were agreed upon during discussions between LSCE, Fugro, and MWH in February 2008. Daly City aquifer parameters were applied to wells in Daly City and Colma, while San Bruno aquifer parameters were applied to wells in South San Francisco, San Bruno, and Millbrae.

Based on Fugro's well inventory in the Task 8L Technical Memorandum, MWH estimated drawdown for nineteen "third party" wells at golf courses and cemeteries in the South Westside Basin that are known to use groundwater for irrigation. The representative Third Party wells are shown on Figure 1. Drawdown was estimated for all active wells at each golf course. Drawdown was estimated for a primary well at each cemetery, and a secondary backup well where applicable. The locations of the primary and secondary wells for Cypress Lawn Memorial Park were not provided to the project team. Consequently, primary and secondary well locations have been assumed for Cypress Lawn, based on the estimated locations of Cypress Lawn wells 4 and 3, respectively.

The drawdown at each Third Party well was estimated by considering the pumping rates of all Conjunctive Use wells within 1.5 miles. Primary and alternate configurations of the Regional Groundwater Storage and Recovery Project were evaluated because the project environmental impact report includes 16 primary Conjunctive Use wells and 3 alternate Conjunctive Use wells. The alternate configuration replaces primary wells CUP-3A, CUP-07, and CUP-44-1 with alternate wells CUP-20A, CUP-22, and CUP-36-2. Since the project is only expected to use up to 16 wells, the primary configuration and alternate configuration provide a collective analysis of all 19 wells. Drawdown was estimated for pumping durations of 1, 4, and 7.5 years. The 7.5-year duration represents the design drought assumed for this project.

[1] The accuracy of the drawdown estimates presented in this TM is limited by the assumed conditions and the available data and tools. The South Westside Basin is a complex system that cannot be fully modeled with the Theis spreadsheet tool. The Theis spreadsheet tool may not adequately reflect the three-dimensional and boundary effects of the groundwater system. If an accepted groundwater model of the South Westside Basin has been completed, its use should be considered for validating and improving the results of this analysis.

Existing and proposed wells that were considered as part of this analysis are listed in Table 1 along with their well screen intervals, the assumed Conjunctive Use well pumping rates, and the assumed aquifer parameters.

RESULTS

Table 2 lists the estimated drawdown for Third Party wells, after 1, 4, and 7.5 years of pumping from the primary configuration of Conjunctive Use wells. Table 3 lists the estimated drawdown for Third Party wells, after 1, 4, and 7.5 years of pumping from the alternate configuration of Conjunctive Use wells.

The Regional Groundwater Storage and Recovery Project will be operated with a "put before take" principle, meaning that the volume of extracted groundwater will not exceed the amount that was stored through in-lieu recharge. Regional groundwater levels will be higher at the start of any take cycle than they were prior to groundwater storage activities associated with this project. The drawdown estimates shown in Tables 2 and 3 will be relative to regional groundwater levels 1, 4, and 7.5 years after the take cycle begins.

Aquifer testing at the selected well sites is recommended to collect site-specific aquifer parameters. Anticipated drawdowns should be re-estimated after the exploratory drilling and aquifer testing activities are completed.

REFERENCES

LSCE, 2004. Update on the Conceptualization of the Lake-Aquifer System, Westside Ground Water Basin, San Francisco and San Mateo Counties. Prepared for San Francisco Public Utilities Commission.

MWH, 2008. Conceptual Engineering Report. Prepared for San Francisco Public Utilities Commission. November.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

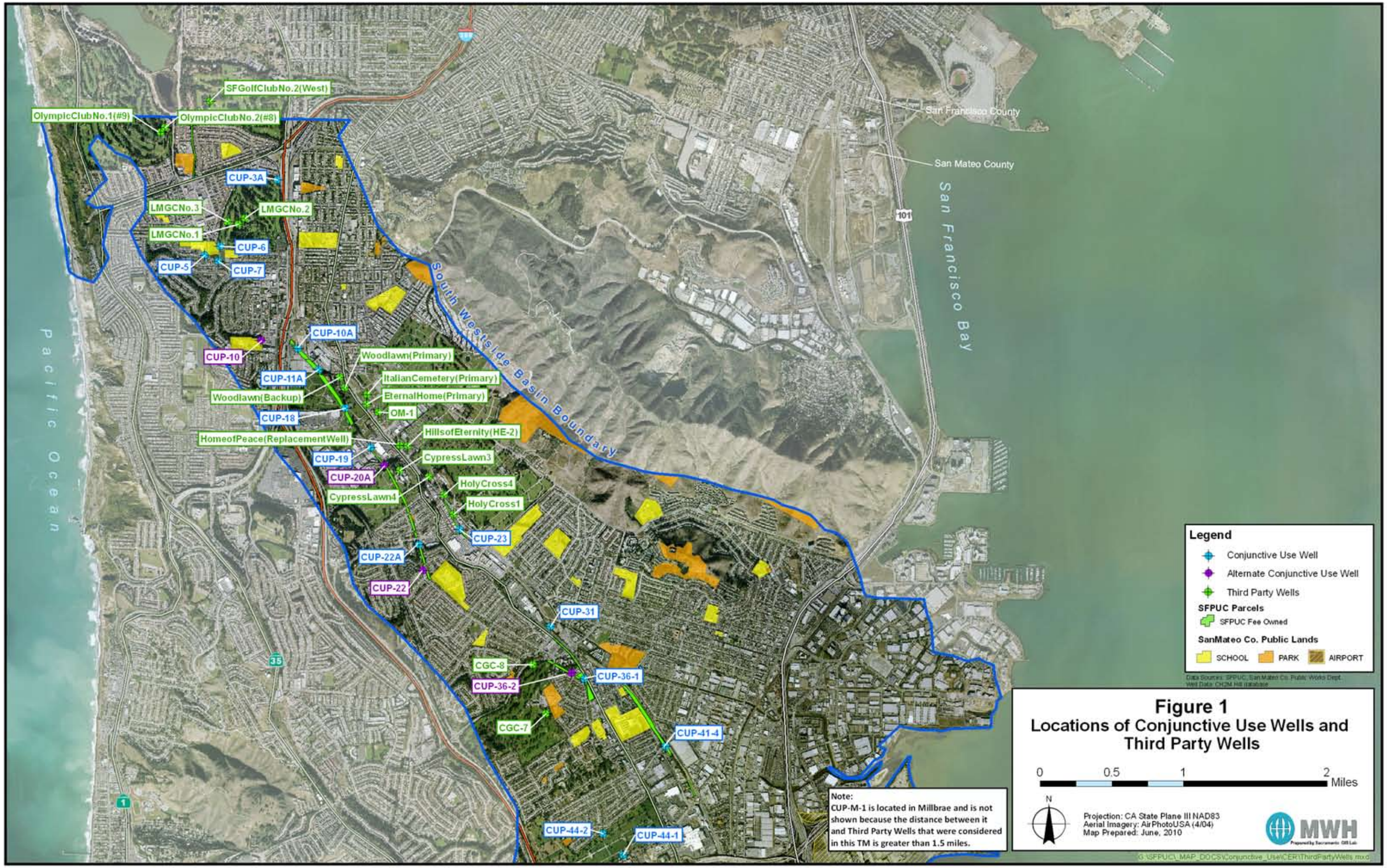

SFGolfClubNo.2(West)
OlympicClubNo.1(#9)
OlympicClubNo.2(#8)
CUP-3A
LMGCNo.3
LMGCNo.2
LMGCNo.1
CUP-6
CUP-5
CUP-7
CUP-10A
CUP-10
Woodlawn(Primary)
CUP-11A
ItalianCemetery(Primary)
EternalHome(Primary)
Woodlawn(Backup)
OM-1
CUP-18
HillsofEternity(HE-2)
HomeofPeace(ReplacementWell)
CUP-19
CypressLawn3
CUP-20A
HolyCross4
CypressLawn4
HolyCross1
CUP-23
CUP-22A
CUP-22
CUP-31
CGC-8
CUP-36-1
CUP-36-2
CGC-7
CUP-41-4
CUP-44-2
CUP-44-1
San Francisco County
San Mateo County
San Francisco Bay
South Westside Basin Boundary
Pacific Ocean
101
35
1
Legend
Conjunctive Use Well
Alternate Conjunctive Use Well
Third Party Wells
SFPUC Parcels
SFPUC Fee Owned
SanMateo Co. Public Lands
SCHOOL
PARK
AIRPORT
Data Sources: SFPUC, San Mateo Co. Public Works Dept.
Well Data: CH2M Hill (geotable)
Note:
CUP-M-1 is located in Millbrae and is not shown because the distance between it and Third Party Wells that were considered in this TM is greater than 1.5 miles.
Figure 1
Locations of Conjunctive Use Wells and Third Party Wells
0
0.5
1
2
Miles
N
Projection: CA State Plane III NAD83
Aerial Imagery: AirPhotoUSA (4/04)
Map Prepared: June, 2010
MWH
G:\SFPUC_MAP_DOCS\Conjunctive_Use\CER\ThirdPartyWells.mxd

Table 1
Conjunctive Use Wells and Representative Third Party Wells

System or Owner	Well	Future Use of Well	Screen Interval (depth, ft)	Assumed Pump Rate (gpm)	Assumed Trans-missivity (gpd/ft)	Assumed Storage Coeff.
Conjunctive Use well	CUP-3A	Primary	410 to 625 (Proposed in CER)	400	16,400	5.0E-02
Conjunctive Use well	CUP-5	Primary	410 to 730 (Proposed in CER)	300	16,400	5.0E-02
Conjunctive Use well	CUP-6	Primary	420 to 730 (Proposed in CER)	300	16,400	5.0E-02
Conjunctive Use well	CUP-7	Primary	420 to 730 (Proposed in CER)	300	16,400	5.0E-02
Conjunctive Use well	CUP-10A	Primary	430 to 730 (Proposed in CER)	400	16,400	5.0E-02
Conjunctive Use well	CUP-11A	Primary	440 to 730 (Proposed in CER)	400	16,400	5.0E-02
Conjunctive Use well	CUP-18	Primary	430 to 640 (Proposed in CER)	400	16,400	5.0E-02
Conjunctive Use well	CUP-19	Primary	400 to 640 (Proposed in CER)	400	16,400	5.0E-02
Conjunctive Use well	CUP-22A	Primary	400 to 640 (Proposed in CER)	330	14,200	5.0E-03
Conjunctive Use well	CUP-23	Primary	400 to 640 (Proposed in CER)	330	14,200	5.0E-03
Conjunctive Use well	CUP-31	Primary	375 to 580 (Proposed in CER)	220	14,200	5.0E-03
Conjunctive Use well	CUP-36-1	Primary	395 to 580 (Proposed in CER)	220	14,200	5.0E-03
Conjunctive Use well	CUP-41	Primary	375 to 580 (Proposed)	220	14,200	5.0E-03
Conjunctive Use well	CUP-44-1	Primary	400 to 620 (Proposed in CER)	330	14,200	5.0E-03
Conjunctive Use well	CUP-44-2	Primary	410 to 620 (Proposed in CER)	330	14,200	5.0E-03
Conjunctive Use well	CUP-M-1	Primary	Not Identified in CER	160	14,200	5.0E-03
Conjunctive Use well	CUP-20A	Alternate	Not Identified in CER	400	16,400	5.0E-02
Conjunctive Use well	CUP-22	Alternate	Not Identified in CER	330	14,200	5.0E-03
Conjunctive Use well	CUP-36-2	Alternate	Not Identified in CER	220	14,200	5.0E-03

Table 1
Conjunctive Use Wells and Representative Third Party Wells

System or Owner	Well	Future Use of Well	Screen Interval (depth, ft)	Assumed Pump Rate (gpm)	Assumed Trans-missivity (gpd/ft)	Assumed Storage Coeff.
The Olympic Club	No. 1 (#9)	Active	Top of screen at 260	N/A	16,400	5.0E-02
The Olympic Club	No. 2 (#8)	Active	Top of screen at 200	N/A	16,400	5.0E-02
San Francisco Golf Club	No. 2 (West)	Active	Top of screen at 360	N/A	16,400	5.0E-02
Lake Merced Golf Club	LMGC No. 1	Active	Top of screen not reported	N/A	16,400	1.4E-01
Lake Merced Golf Club	LMGC No. 2	Active	Top of screen not reported	N/A	16,400	1.4E-01
Lake Merced Golf Club	LMGC No. 3	Active	Top of screen at 294	N/A	16,400	1.4E-01
Olivet Memorial Park	OM-1	Primary Well	Top of screen at 220	N/A	16,400	1.4E-01
Woodlawn Memorial Park	Primary Well	Primary Well	Top of screen at 275	N/A	16,400	1.4E-01
Woodlawn Memorial Park	Backup Well	Backup Well	Top of screen not reported	N/A	16,400	1.4E-01
Italian Cemetery	Primary Well	Primary Well	Top of screen at 300	N/A	16,400	1.4E-01
Eternal Home Cemetery	Primary Well	Primary Well	Top of screen at 280	N/A	16,400	1.4E-01
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	Replacement Well	Primary Well	Not Constructed	N/A	16,400	5.0E-02
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	HE-2	Secondary Well	Top of screen at 224	N/A	16,400	1.4E-01
Cypress Lawn Memorial Park	Cypress Lawn 3	Assumed Secondary Well	Top of screen at 191	N/A	16,400	1.4E-01
Cypress Lawn Memorial Park	Cypress Lawn 4	Assumed Primary Well	Top of screen at 330	N/A	16,400	5.0E-02
Holy Cross Cemetery	Holy Cross 1	Secondary Well	Top of screen at 368	N/A	16,400	5.0E-02
Holy Cross Cemetery	Holy Cross 4	Primary Well	Top of screen at 420	N/A	16,400	5.0E-02
California Golf Club of San Francisco	CGC-7	Secondary Well	Top of screen at 255	N/A	14,200	5.0E-03
California Golf Club of San Francisco	CGC-8	Primary Well	Top of screen at 320	N/A	14,200	5.0E-03

Table 2
Summary of Calculated Water Level Drawdowns in Third Party Wells, Primary Configuration of Conjunctive Use Wells

Owner	Well ID	Drawdown (ft) [1]			Number of Wells Used to Calculate Drawdown
		1 year	4 years	7.5 years	
The Olympic Club	No. 1 (#9)	7	17	23	4
The Olympic Club	No. 2 (#8)	7	17	23	4
San Francisco Golf Club	No. 2 (West)	7	17	22	4
Lake Merced Golf Club	LMGC No. 1	29	50	60	7
Lake Merced Golf Club	LMGC No. 2	27	47	58	7
Lake Merced Golf Club	LMGC No. 3	29	47	56	6
Olivet Memorial Park	OM-1	38	60	70	6
Woodlawn Memorial Park	Primary Well	45	73	87	9
Woodlawn Memorial Park	Backup Well	45	76	91	10
Italian Cemetery	Primary Well	40	68	81	9
Eternal Home Cemetery	Primary Well	41	65	76	7
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	Replacement Well (Primary Well)	36	58	68	6
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	HE-2 (Secondary Well)	34	56	66	6
Cypress Lawn Memorial Park	3 (Assumed Secondary)	35	56	66	6
Cypress Lawn Memorial Park	4 (Assumed Primary)	36	58	69	7
Holy Cross Cemetery	Holy Cross 1	43	64	75	7
Holy Cross Cemetery	Holy Cross 4	37	58	69	7
California Golf Club of San Francisco	CGC-7	41	63	73	7
California Golf Club of San Francisco	CGC-8	43	64	74	7

Table 3
Summary of Calculated Water Level Drawdowns in Third Party Wells, Alternate Configuration of Conjunctive Use Wells

Owner	Well ID	Drawdown (ft) [1]			Number of Wells Used to Calculate Drawdown
		1 year	4 years	7.5 years	
The Olympic Club	No. 1 (#9)	3	8	11	2
The Olympic Club	No. 2 (#8)	3	8	10	2
San Francisco Golf Club	No. 2 (West)	3	7	10	2
Lake Merced Golf Club	LMGC No. 1	17	31	39	5
Lake Merced Golf Club	LMGC No. 2	15	29	36	5
Lake Merced Golf Club	LMGC No. 3	17	29	35	4
Olivet Memorial Park	OM-1	50	80	93	8
Woodlawn Memorial Park	Primary Well	52	83	98	10
Woodlawn Memorial Park	Backup Well	51	85	100	10
Italian Cemetery	Primary Well	50	83	98	10
Eternal Home Cemetery	Primary Well	51	81	94	8
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	Replacement Well (Primary Well)	54	82	96	8
Salem Memorial Park, Home of Peace Cemetery, and Hills of Eternity Cemetery	HE-2 (Secondary Well)	51	80	93	8
Cypress Lawn Memorial Park	3 (Assumed Secondary)	57	85	99	8
Cypress Lawn Memorial Park	4 (Assumed Primary)	52	82	96	9
Holy Cross Cemetery	Holy Cross 1	61	92	107	10
Holy Cross Cemetery	Holy Cross 4	52	81	95	9
California Golf Club of San Francisco	CGC-7	49	72	83	8
California Golf Club of San Francisco	CGC-8	53	77	88	8

APPENDIX C

Table C-1. Woodlawn Cemetery Primary Well Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	WL Well DTW (Feet)	WL Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	WL Well SWL (Feet bgs)	WL Well GWE (Feet NGVD 29)	WL Well Background DTW (Feet)	WL Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	209.2	-74.2	27,742				220.8	-85.8	-77.5	-84.9
2	put	200.6	-65.6	33,925				221.5	-86.5	-70.8	-77.9
3	put	192.0	-57.0	40,108				222.3	-87.3	-65.7	-72.2
4	put	183.4	-48.4	46,291				223.0	-88.0	-61.8	-68.4
5	put	174.8	-39.8	52,475				223.8	-88.8	-58.0	-64.4
6	put	166.2	-31.2	58,658				224.5	-89.5	-54.5	-60.9
7	Put/Hold	164.1	-29.1	60,500				225.3	-90.3	-51.9	-59.1
8	Hold	164.9	-29.9	60,500				226.0	-91.0	-51.8	-60.7
9	Hold/Take	168.6	-33.6	58,475				226.8	-91.8	-63.1	-89.1
10	take	181.5	-46.5	50,375	45	226.5	-91.5	227.5	-92.5	-77.3	-111.3
11	Take/Put	189.1	-54.1	45,858	54	243.1	-108.1	228.3	-93.3	-80.1	-101.0
12	put	180.5	-45.5	52,042				229.0	-94.0	-75.3	-89.6
13	put	171.9	-36.9	58,225				229.8	-94.8	-72.7	-84.2
14	Put/Hold	169.2	-34.2	60,430				230.5	-95.5	-68.6	-79.6
15	Hold	170.0	-35.0	60,430				231.3	-96.3	-67.9	-79.7
16	Hold	170.7	-35.7	60,430				232.0	-97.0	-67.0	-79.3
17	Hold	171.5	-36.5	60,430				232.8	-97.8	-67.3	-79.9
18	Hold	172.2	-37.2	60,430				233.5	-98.5	-67.1	-80.1
19	Hold	173.0	-38.0	60,430				234.3	-99.3	-67.8	-80.9
20	Hold	173.7	-38.7	60,430				235.0	-100.0	-68.7	-81.9
21	Hold	174.5	-39.5	60,430				235.8	-100.8	-71.1	-84.3
22	Hold	175.2	-40.2	60,430				236.5	-101.5	-70.7	-84.6
23	Hold	176.0	-41.0	60,430				237.3	-102.3	-70.2	-84.0
24	Hold	176.7	-41.7	60,430				238.0	-103.0	-70.4	-84.4
25	Hold/Take	180.5	-45.5	58,405				238.8	-103.8	-81.6	-111.8
26	take	193.4	-58.4	50,305	45	238.4	-103.4	239.5	-104.5	-96.1	-133.5
27	take/put	200.9	-65.9	45,788	54	254.9	-119.9	240.3	-105.3	-98.2	-121.7
28	put	192.3	-57.3	51,972				241.0	-106.0	-93.9	-110.6
29	put	183.7	-48.7	58,155				241.8	-106.8	-88.5	-102.6
30	Put/Hold	181.1	-46.1	60,360				242.5	-107.5	-85.0	-98.0
31	Hold	181.8	-46.8	60,360				243.3	-108.3	-80.2	-93.7
32	Hold	182.6	-47.6	60,360				244.0	-109.0	-78.5	-91.9
33	Hold	183.3	-48.3	60,360				244.8	-109.8	-78.8	-92.5
34	Hold	184.1	-49.1	60,360				245.5	-110.5	-78.5	-92.4
35	Hold	184.8	-49.8	60,360				246.3	-111.3	-77.9	-92.0
36	hold/take	188.6	-53.6	58,335				247.0	-112.0	-88.5	-118.8
37	take	201.5	-66.5	50,235	45	246.5	-111.5	247.8	-112.8	-102.2	-139.8
38	take	214.4	-79.4	42,135	54	268.4	-133.4	248.5	-113.5	-113.2	-153.4
39	take	227.3	-92.3	34,035	64	291.3	-156.3	249.3	-114.3	-126.4	-167.8
40	take	240.2	-105.2	25,935	73	313.2	-178.2	250.0	-115.0	-137.7	-180.4
41	take	253.1	-118.1	17,835	77	330.1	-195.1	250.8	-115.8	-149.2	-192.9
42	take	266.0	-131.0	9,735	81	347.0	-212.0	251.5	-116.5	-171.9	-211.8
43	take	278.9	-143.9	1,635	85	363.9	-228.9	252.3	-117.3	-198.9	-235.6
44	take/hold/put	280.4	-145.4	1,168	87	367.4	-232.4	253.0	-118.0	-182.3	-205.8
45	put	271.8	-136.8	7,352				253.8	-118.8	-164.6	-183.7
46	put	263.2	-128.2	13,535				254.5	-119.5	-152.5	-167.2
47	put	254.6	-119.6	19,718				255.3	-120.3	-144.2	-156.2

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; WL = Woodlawn; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-2. Italian Cemetery Well Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Date	Year Type	IT Well DTW (Feet)	IT Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	IT Well SWL (Feet bgs)	IT Well GWE (Feet NGVD 29)	IT Well Background DTW (Feet)	IT Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	245.8	-86.8	27,742				257.4	-98.4	-81.2	-88.2
2	put	237.2	-78.2	33,925				258.1	-99.1	-73.9	-80.9
3	put	228.6	-69.6	40,108				258.9	-99.9	-68.6	-75.3
4	put	220.0	-61.0	46,291				259.6	-100.6	-66.8	-72.1
5	put	211.4	-52.4	52,475				260.4	-101.4	-61.6	-67.8
6	put	202.8	-43.8	58,658				261.1	-102.1	-58.6	-64.3
7	Put/Hold	200.7	-41.7	60,500				261.9	-102.9	-56.2	-62.2
8	Hold	201.5	-42.5	60,500				262.6	-103.6	-52.0	-63.2
9	Hold/Take	205.2	-46.2	58,475				263.4	-104.4	-61.9	-78.7
10	take	218.1	-59.1	50,375	40	258.1	-99.1	264.1	-105.1	-74.3	-101.3
11	Take/Put	225.7	-66.7	45,858	50	275.7	-116.7	264.9	-105.9	-80.2	-104.9
12	put	217.1	-58.1	52,042				265.6	-106.6	-77.0	-93.5
13	put	208.5	-49.5	58,225				266.4	-107.4	-75.0	-88.0
14	Put/Hold	205.8	-46.8	60,430				267.1	-108.1	-70.8	-82.8
15	Hold	206.6	-47.6	60,430				267.9	-108.9	-70.4	-83.0
16	Hold	207.3	-48.3	60,430				268.6	-109.6	-69.7	-82.5
17	Hold	208.1	-49.1	60,430				269.4	-110.4	-69.5	-83.0
18	Hold	208.8	-49.8	60,430				270.1	-111.1	-69.1	-83.1
19	Hold	209.6	-50.6	60,430				270.9	-111.9	-69.9	-84.0
20	Hold	210.3	-51.3	60,430				271.6	-112.6	-70.6	-85.0
21	Hold	211.1	-52.1	60,430				272.4	-113.4	-72.6	-87.4
22	Hold	211.8	-52.8	60,430				273.1	-114.1	-72.6	-87.8
23	Hold	212.6	-53.6	60,430				273.9	-114.9	-71.8	-87.1
24	Hold	213.3	-54.3	60,430				274.6	-115.6	-71.7	-87.4
25	Hold/Take	217.1	-58.1	58,405				275.4	-116.4	-78.9	-101.6
26	take	230.0	-71.0	50,305	40	270.0	-111.0	276.1	-117.1	-91.7	-123.8
27	take/put	237.5	-78.5	45,788	50	287.5	-128.5	276.9	-117.9	-97.5	-125.9
28	put	228.9	-69.9	51,972				277.6	-118.6	-95.0	-115.0
29	put	220.3	-61.3	58,155				278.4	-119.4	-89.7	-106.7
30	Put/Hold	217.7	-58.7	60,360				279.1	-120.1	-86.2	-101.6
31	Hold	218.4	-59.4	60,360				279.9	-120.9	-78.7	-96.4
32	Hold	219.2	-60.2	60,360				280.6	-121.6	-80.3	-95.2
33	Hold	219.9	-60.9	60,360				281.4	-122.4	-81.2	-96.1
34	Hold	220.7	-61.7	60,360				282.1	-123.1	-79.9	-95.7
35	Hold	221.4	-62.4	60,360				282.9	-123.9	-78.8	-95.2
36	hold/take	225.2	-66.2	58,335				283.6	-124.6	-86.4	-108.9
37	take	238.1	-79.1	50,235	40	278.1	-119.1	284.4	-125.4	-98.6	-130.3
38	take	251.0	-92.0	42,135	50	301.0	-142.0	285.1	-126.1	-105.3	-143.6
39	take	263.9	-104.9	34,035	59	322.9	-163.9	285.9	-126.9	-121.2	-158.9
40	take	276.8	-117.8	25,935	68	344.8	-185.8	286.6	-127.6	-131.3	-171.4
41	take	289.7	-130.7	17,835	72	361.7	-202.7	287.4	-128.4	-142.3	-183.9
42	take	302.6	-143.6	9,735	77	379.6	-220.6	288.1	-129.1	-158.1	-201.4
43	take	315.5	-156.5	1,635	80	395.5	-236.5	288.9	-129.9	-185.8	-224.8
44	take/hold/put	317.0	-158.0	1,168	81.5	398.5	-239.5	289.6	-130.6	-179.1	-209.7
45	put	308.4	-149.4	7,352				290.4	-131.4	-163.8	-188.4
46	put	299.8	-140.8	13,535				291.1	-132.1	-152.1	-171.4
47	put	291.2	-132.2	19,718				291.9	-132.9	-144.4	-160.1

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; IT = Italian; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-3. Olivet Cemetery Well Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	OV Well DTW (Feet)	OV Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	OV Well SWL (Feet bgs)	OV Well GWE (Feet NGVD 29)	OV Well Background DTW (Feet)	OV Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	220.2	-78.2	27,742				231.8	-89.8	-81.6	-91.8
2	put	211.6	-69.6	33,925				232.5	-90.5	-74.2	-84.8
3	put	203.0	-61.0	40,108				233.3	-91.3	-68.8	-79.3
4	put	194.4	-52.4	46,291				234.0	-92.0	-67.2	-76.0
5	put	185.8	-43.8	52,475				234.8	-92.8	-62.9	-72.1
6	put	177.2	-35.2	58,658				235.5	-93.5	-60.4	-68.5
7	Put/Hold	175.1	-33.1	60,500				236.3	-94.3	-58.3	-65.9
8	Hold	175.9	-33.9	60,500				237.0	-95.0	-49.7	-67.7
9	Hold/Take	179.6	-37.6	58,475				237.8	-95.8	-60.2	-80.7
10	take	192.5	-50.5	50,375	38	230.5	-88.5	238.5	-96.5	-69.5	-105.7
11	Take/Put	200.1	-58.1	45,858	46	246.1	-104.1	239.3	-97.3	-75.7	-112.9
12	put	191.5	-49.5	52,042				240.0	-98.0	-74.7	-100.2
13	put	182.9	-40.9	58,225				240.8	-98.8	-73.4	-94.0
14	Put/Hold	180.2	-38.2	60,430				241.5	-99.5	-69.5	-87.7
15	Hold	181.0	-39.0	60,430				242.3	-100.3	-69.2	-87.8
16	Hold	181.7	-39.7	60,430				243.0	-101.0	-68.7	-87.1
17	Hold	182.5	-40.5	60,430				243.8	-101.8	-68.1	-87.7
18	Hold	183.2	-41.2	60,430				244.5	-102.5	-67.3	-88.0
19	Hold	184.0	-42.0	60,430				245.3	-103.3	-68.1	-88.9
20	Hold	184.7	-42.7	60,430				246.0	-104.0	-68.5	-89.9
21	Hold	185.5	-43.5	60,430				246.8	-104.8	-69.7	-92.5
22	Hold	186.2	-44.2	60,430				247.5	-105.5	-70.3	-93.0
23	Hold	187.0	-45.0	60,430				248.3	-106.3	-69.4	-92.2
24	Hold	187.7	-45.7	60,430				249.0	-107.0	-69.0	-92.6
25	Hold/Take	191.5	-49.5	58,405				249.8	-107.8	-73.9	-105.0
26	take	204.4	-62.4	50,305	38	242.4	-100.4	250.5	-108.5	-83.9	-129.4
27	take/put	211.9	-69.9	45,788	46	257.9	-115.9	251.3	-109.3	-90.9	-134.8
28	put	203.3	-61.3	51,972				252.0	-110.0	-90.6	-122.7
29	put	194.7	-52.7	58,155				252.8	-110.8	-85.9	-113.6
30	Put/Hold	192.1	-50.1	60,360				253.5	-111.5	-82.7	-107.7
31	Hold	192.8	-50.8	60,360				254.3	-112.3	-72.7	-102.4
32	Hold	193.6	-51.6	60,360				255.0	-113.0	-77.8	-100.6
33	Hold	194.3	-52.3	60,360				255.8	-113.8	-79.2	-101.7
34	Hold	195.1	-53.1	60,360				256.5	-114.5	-77.0	-101.3
35	Hold	195.8	-53.8	60,360				257.3	-115.3	-75.3	-100.8
36	hold/take	199.6	-57.6	58,335				258.0	-116.0	-81.8	-112.4
37	take	212.5	-70.5	50,235	38	250.5	-108.5	258.8	-116.8	-91.4	-136.2
38	take	225.4	-83.4	42,135	46	271.4	-129.4	259.5	-117.5	-92.9	-151.2
39	take	238.3	-96.3	34,035	53	291.3	-149.3	260.3	-118.3	-110.8	-166.5
40	take	251.2	-109.2	25,935	60	311.2	-169.2	261.0	-119.0	-118.9	-179.4
41	take	264.1	-122.1	17,835	63	327.1	-185.1	261.8	-119.8	-128.5	-192.0
42	take	277.0	-135.0	9,735	66	343.0	-201.0	262.5	-120.5	-139.5	-208.2
43	take	289.9	-147.9	1,635	69	358.9	-216.9	263.3	-121.3	-157.9	-229.8
44	take/hold/put	291.4	-149.4	1,168	70	361.4	-219.4	264.0	-122.0	-158.9	-217.2
45	put	282.8	-140.8	7,352				264.8	-122.8	-150.6	-196.8
46	put	274.2	-132.2	13,535				265.5	-123.5	-141.7	-178.6
47	put	265.6	-123.6	19,718				266.3	-124.3	-136.2	-166.3

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; OV = Olivet; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-4. Home of Peace Cemetery Well Groundwater Levels for GSR Project (Scenario 2)

Date	Year Type	HP Well DTW (Feet)	HP Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	HP Well SWL (Feet bgs)	HP Well GWE (Feet NGVD 29)	HP Well Background DTW (Feet)	HP Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	229.2	-108.2	27,742				240.8	-119.8	-85.7	-98.5	-118.7
2	put	220.6	-99.6	33,925				241.5	-120.5	-79.3	-91.4	-111.2
3	put	212.0	-91.0	40,108				242.3	-121.3	-74.3	-85.9	-106.0
4	put	203.4	-82.4	46,291				243.0	-122.0	-71.7	-83.0	-103.2
5	put	194.8	-73.8	52,475				243.8	-122.8	-68.1	-79.2	-99.6
6	put	186.2	-65.2	58,658				244.5	-123.5	-64.9	-75.7	-96.5
7	Put/Hold	184.1	-63.1	60,500				245.3	-124.3	-62.0	-72.6	-107.0
8	Hold	184.9	-63.9	60,500				246.0	-125.0	-61.0	-74.7	-124.7
9	Hold/Take	188.6	-67.6	58,475				246.8	-125.8	-68.8	-85.3	-148.3
10	take	201.5	-80.5	50,375	36	237.5	-116.5	247.5	-126.5	-86.0	-113.1	-196.7
11	Take/Put	209.1	-88.1	45,858	43	252.1	-131.1	248.3	-127.3	-94.3	-125.3	-214.0
12	put	200.5	-79.5	52,042				249.0	-128.0	-87.3	-111.2	-170.1
13	put	191.9	-70.9	58,225				249.8	-128.8	-83.6	-103.8	-145.8
14	Put/Hold	189.2	-68.2	60,430				250.5	-129.5	-78.3	-96.2	-141.3
15	Hold	190.0	-69.0	60,430				251.3	-130.3	-78.0	-96.2	-154.1
16	Hold	190.7	-69.7	60,430				252.0	-131.0	-77.0	-95.5	-159.7
17	Hold	191.5	-70.5	60,430				252.8	-131.8	-77.2	-96.3	-163.4
18	Hold	192.2	-71.2	60,430				253.5	-132.5	-77.0	-96.6	-165.3
19	Hold	193.0	-72.0	60,430				254.3	-133.3	-77.6	-97.7	-167.6
20	Hold	193.7	-72.7	60,430				255.0	-134.0	-78.4	-98.7	-169.4
21	Hold	194.5	-73.5	60,430				255.8	-134.8	-80.6	-101.4	-171.9
22	Hold	195.2	-74.2	60,430				256.5	-135.5	-81.0	-102.1	-173.3
23	Hold	196.0	-75.0	60,430				257.3	-136.3	-80.1	-101.2	-173.6
24	Hold	196.7	-75.7	60,430				258.0	-137.0	-80.1	-101.6	-174.6
25	Hold/Take	200.5	-79.5	58,405				258.8	-137.8	-87.2	-111.5	-189.0
26	take	213.4	-92.4	50,305	36	249.4	-128.4	259.5	-138.5	-104.8	-138.6	-232.5
27	take/put	220.9	-99.9	45,788	43	263.9	-142.9	260.3	-139.3	-112.2	-148.5	-245.3
28	put	212.3	-91.3	51,972				261.0	-140.0	-106.1	-135.3	-200.1
29	put	203.7	-82.7	58,155				261.8	-140.8	-99.8	-124.8	-172.2
30	Put/Hold	201.1	-80.1	60,360				262.5	-141.5	-95.1	-117.7	-167.0
31	Hold	201.8	-80.8	60,360				263.3	-142.3	-89.1	-111.5	-173.3
32	Hold	202.6	-81.6	60,360				264.0	-143.0	-88.8	-109.9	-177.7
33	Hold	203.3	-82.3	60,360				264.8	-143.8	-89.6	-111.5	-181.7
34	Hold	204.1	-83.1	60,360				265.5	-144.5	-88.7	-110.9	-182.3
35	Hold	204.8	-83.8	60,360				266.3	-145.3	-87.9	-110.2	-182.1
36	hold/take	208.6	-87.6	58,335				267.0	-146.0	-94.9	-119.3	-196.3
37	take	221.5	-100.5	50,235	36	257.5	-136.5	267.8	-146.8	-111.5	-145.7	-239.3
38	take	234.4	-113.4	42,135	43	277.4	-156.4	268.5	-147.5	-121.9	-162.2	-265.6
39	take	247.3	-126.3	34,035	50	297.3	-176.3	269.3	-148.3	-136.2	-178.6	-287.4
40	take	260.2	-139.2	25,935	58	318.2	-197.2	270.0	-149.0	-146.7	-192.0	-303.1
41	take	273.1	-152.1	17,835	61	334.1	-213.1	270.8	-149.8	-157.4	-204.9	-316.5
42	take	286.0	-165.0	9,735	64	350.0	-229.0	271.5	-150.5	-170.0	-219.6	-328.0
43	take	298.9	-177.9	1,635	67	365.9	-244.9	272.3	-151.3	-189.2	-238.9	-338.0
44	take/hold/pu	300.4	-179.4	1,168	68	368.4	-247.4	273.0	-152.0	-186.2	-229.6	-309.0
45	put	291.8	-170.8	7,352				273.8	-152.8	-172.6	-210.1	-260.8
46	put	283.2	-162.2	13,535				274.5	-153.5	-158.8	-190.0	-227.3
47	put	274.6	-153.6	19,718				275.3	-154.3	-149.8	-176.4	-205.2

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; HP = Home of Peace; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-5. Hills of Eternity Cemetery Well Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	HE Well DTW (Feet)	HE Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	HE Well SWL (Feet bgs)	HE Well GWE (Feet NGVD)	HE Well Background DTW (Feet)	HE Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 1 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	195.2	-71.2	27,742				206.8	-82.8	-60.7	-69.2	-100.7
2	put	186.6	-62.6	33,925				207.5	-83.5	-56.2	-64.0	-93.5
3	put	178.0	-54.0	40,108				208.3	-84.3	-52.8	-59.8	-87.9
4	put	169.4	-45.4	46,291				209.0	-85.0	-50.0	-57.8	-85.2
5	put	160.8	-36.8	52,475				209.8	-85.8	-47.5	-54.6	-81.2
6	put	152.2	-28.2	58,658				210.5	-86.5	-44.7	-52.1	-77.8
7	Put/Hold	150.1	-26.1	60,500				211.3	-87.3	-41.6	-49.6	-74.8
8	Hold	150.9	-26.9	60,500				212.0	-88.0	-40.2	-45.4	-76.0
9	Hold/Take	154.6	-30.6	58,475				212.8	-88.8	-39.5	-49.4	-89.8
10	take	167.5	-43.5	50,375	34	201.5	-77.5	213.5	-89.5	-42.5	-55.8	-118.5
11	Take/Put	175.1	-51.1	45,858	41	216.1	-92.1	214.3	-90.3	-45.9	-60.7	-128.8
12	put	166.5	-42.5	52,042				215.0	-91.0	-47.1	-60.1	-114.5
13	put	157.9	-33.9	58,225				215.8	-91.8	-49.2	-59.9	-106.7
14	Put/Hold	155.2	-31.2	60,430				216.5	-92.5	-47.5	-57.3	-98.7
15	Hold	156.0	-32.0	60,430				217.3	-93.3	-46.2	-56.7	-98.7
16	Hold	156.7	-32.7	60,430				218.0	-94.0	-44.4	-55.7	-98.2
17	Hold	157.5	-33.5	60,430				218.8	-94.8	-43.4	-55.0	-98.9
18	Hold	158.2	-34.2	60,430				219.5	-95.5	-42.9	-54.4	-99.2
19	Hold	159.0	-35.0	60,430				220.3	-96.3	-42.6	-54.4	-100.4
20	Hold	159.7	-35.7	60,430				221.0	-97.0	-43.1	-54.9	-101.4
21	Hold	160.5	-36.5	60,430				221.8	-97.8	-46.1	-56.7	-103.9
22	Hold	161.2	-37.2	60,430				222.5	-98.5	-45.0	-56.7	-104.8
23	Hold	162.0	-38.0	60,430				223.3	-99.3	-43.8	-55.7	-103.9
24	Hold	162.7	-38.7	60,430				224.0	-100.0	-43.3	-55.3	-104.3
25	Hold/Take	166.5	-42.5	58,405				224.8	-100.8	-46.9	-58.8	-116.5
26	take	179.4	-55.4	50,305	34	213.4	-89.4	225.5	-101.5	-52.0	-66.5	-144.3
27	take/put	186.9	-62.9	45,788	41	227.9	-103.9	226.3	-102.3	-55.7	-71.8	-152.6
28	put	178.3	-54.3	51,972				227.0	-103.0	-58.0	-72.2	-139.0
29	put	169.7	-45.7	58,155				227.8	-103.8	-57.7	-69.9	-128.0
30	Put/Hold	167.1	-43.1	60,360				228.5	-104.5	-58.0	-68.2	-120.4
31	Hold	167.8	-43.8	60,360				229.3	-105.3	-55.1	-62.9	-113.5
32	Hold	168.6	-44.6	60,360				230.0	-106.0	-53.1	-64.1	-112.7
33	Hold	169.3	-45.3	60,360				230.8	-106.8	-52.3	-64.2	-114.4
34	Hold	170.1	-46.1	60,360				231.5	-107.5	-51.4	-63.0	-113.7
35	Hold	170.8	-46.8	60,360				232.3	-108.3	-51.3	-62.2	-112.8
36	hold/take	174.6	-50.6	58,335				233.0	-109.0	-53.5	-65.8	-124.6
37	take	187.5	-63.5	50,235	34	221.5	-97.5	233.8	-109.8	-57.6	-72.5	-151.8
38	take	200.4	-76.4	42,135	41	241.4	-117.4	234.5	-110.5	-63.2	-76.3	-167.9
39	take	213.3	-89.3	34,035	48	261.3	-137.3	235.3	-111.3	-71.2	-87.6	-185.4
40	take	226.2	-102.2	25,935	56	282.2	-158.2	236.0	-112.0	-77.5	-94.1	-198.9
41	take	239.1	-115.1	17,835	59	298.1	-174.1	236.8	-112.8	-84.0	-101.3	-211.9
42	take	252.0	-128.0	9,735	62	314.0	-190.0	237.5	-113.5	-92.8	-109.6	-226.3
43	take	264.9	-140.9	1,635	65	329.9	-205.9	238.3	-114.3	-102.3	-121.2	-244.8
44	take/hold/put	266.4	-142.4	1,168	66	332.4	-208.4	239.0	-115.0	-108.0	-124.7	-233.2
45	put	257.8	-133.8	7,352				239.8	-115.8	-110.0	-121.9	-213.8
46	put	249.2	-125.2	13,535				240.5	-116.5	-108.1	-117.5	-193.2
47	put	240.6	-116.6	19,718				241.3	-117.3	-106.0	-114.3	-179.3

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; HE = Hills of Eternity: GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-6. Cypress Lawn Cemetery Well 3 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	CL3 Well DTW (Feet)	CL3 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	CL3 Well SWL (Feet bgs)	CL3 Well GWE (Feet NGVD 29)	CL3 Well Background DTW (Feet)	CL3 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	245.2	-95.2	27,742				256.8	-106.8	-59.2	-109.6
2	put	236.6	-86.6	33,925				257.5	-107.5	-55.4	-102.4
3	put	228.0	-78.0	40,108				258.3	-108.3	-51.9	-96.8
4	put	219.4	-69.4	46,291				259.0	-109.0	-50.2	-94.6
5	put	210.8	-60.8	52,475				259.8	-109.8	-47.7	-90.5
6	put	202.2	-52.2	58,658				260.5	-110.5	-45.4	-87.3
7	Put/Hold	200.1	-50.1	60,500				261.3	-111.3	-43.0	-84.3
8	Hold	200.9	-50.9	60,500				262.0	-112.0	-40.4	-84.8
9	Hold/Take	204.6	-54.6	58,475				262.8	-112.8	-41.6	-97.4
10	take	217.5	-67.5	50,375	35	252.5	-102.5	263.5	-113.5	-45.5	-128.6
11	Take/Put	225.1	-75.1	45,858	46	271.1	-121.1	264.3	-114.3	-49.0	-144.1
12	put	216.5	-66.5	52,042				265.0	-115.0	-48.5	-128.9
13	put	207.9	-57.9	58,225				265.8	-115.8	-48.9	-119.6
14	Put/Hold	205.2	-55.2	60,430				266.5	-116.5	-47.2	-110.2
15	Hold	206.0	-56.0	60,430				267.3	-117.3	-46.6	-110.5
16	Hold	206.7	-56.7	60,430				268.0	-118.0	-45.5	-110.2
17	Hold	207.5	-57.5	60,430				268.8	-118.8	-44.7	-111.2
18	Hold	208.2	-58.2	60,430				269.5	-119.5	-44.1	-111.5
19	Hold	209.0	-59.0	60,430				270.3	-120.3	-43.8	-112.9
20	Hold	209.7	-59.7	60,430				271.0	-121.0	-44.1	-114.1
21	Hold	210.5	-60.5	60,430				271.8	-121.8	-46.0	-116.5
22	Hold	211.2	-61.2	60,430				272.5	-122.5	-45.8	-117.6
23	Hold	212.0	-62.0	60,430				273.3	-123.3	-44.7	-116.8
24	Hold	212.7	-62.7	60,430				274.0	-124.0	-44.3	-117.3
25	Hold/Take	216.5	-66.5	58,405				274.8	-124.8	-46.9	-126.7
26	take	229.4	-79.4	50,305	35	264.4	-114.4	275.5	-125.5	-52.7	-156.8
27	take/put	236.9	-86.9	45,788	46	282.9	-132.9	276.3	-126.3	-56.8	-170.0
28	put	228.3	-78.3	51,972				277.0	-127.0	-57.4	-155.4
29	put	219.7	-69.7	58,155				277.8	-127.8	-56.3	-142.5
30	Put/Hold	217.1	-67.1	60,360				278.5	-128.5	-55.6	-133.6
31	Hold	217.8	-67.8	60,360				279.3	-129.3	-52.6	-125.2
32	Hold	218.6	-68.6	60,360				280.0	-130.0	-52.4	-125.8
33	Hold	219.3	-69.3	60,360				280.8	-130.8	-52.0	-128.2
34	Hold	220.1	-70.1	60,360				281.5	-131.5	-51.3	-127.1
35	Hold	220.8	-70.8	60,360				282.3	-132.3	-51.0	-125.9
36	hold/take	224.6	-74.6	58,335				283.0	-133.0	-53.2	-135.5
37	take	237.5	-87.5	50,235	35	272.5	-122.5	283.8	-133.8	-57.9	-164.9
38	take	250.4	-100.4	42,135	46	296.4	-146.4	284.5	-134.5	-61.7	-181.5
39	take	263.3	-113.3	34,035	52	315.3	-165.3	285.3	-135.3	-69.8	-201.4
40	take	276.2	-126.2	25,935	56	332.2	-182.2	286.0	-136.0	-75.0	-215.3
41	take	289.1	-139.1	17,835	60	349.1	-199.1	286.8	-136.8	-80.6	-228.9
42	take	302.0	-152.0	9,735	63	365.0	-215.0	287.5	-137.5	-87.2	-241.9
43	take	314.9	-164.9	1,635	65	379.9	-229.9	288.3	-138.3	-95.4	-257.8
44	take/hold/put	316.4	-166.4	1,168	66	382.4	-232.4	289.0	-139.0	-99.5	-249.3
45	put	307.8	-157.8	7,352				289.8	-139.8	-99.2	-230.3
46	put	299.2	-149.2	13,535				290.5	-140.5	-97.2	-207.7
47	put	290.6	-140.6	19,718				291.3	-141.3	-95.6	-192.2

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; CL = Cypress Lawn; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-7. Cypress Lawn Cemetery Well 4 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	CL4 Well DTW (Feet)	CL4 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	CL4 Well SWL (Feet bgs)	CL4 Well GWE (Feet NGVD 29)	CL4 Well Background DTW (Feet)	CL4 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	188.2	-96.2	27,742				199.8	-107.8	-87.2	-109.6	-123.3
2	put	179.6	-87.6	33,925				200.5	-108.5	-81.4	-102.4	-115.7
3	put	171.0	-79.0	40,108				201.3	-109.3	-76.7	-96.8	-110.3
4	put	162.4	-70.4	46,291				202.0	-110.0	-74.6	-94.6	-107.9
5	put	153.8	-61.8	52,475				202.8	-110.8	-71.1	-90.5	-103.9
6	put	145.2	-53.2	58,658				203.5	-111.5	-68.2	-87.3	-100.9
7	Put/Hold	143.1	-51.1	60,500				204.3	-112.3	-65.2	-84.3	-109.4
8	Hold	143.9	-51.9	60,500				205.0	-113.0	-64.0	-84.8	-123.1
9	Hold/Take	147.6	-55.6	58,475				205.8	-113.8	-71.9	-97.4	-145.2
10	take	160.5	-68.5	50,375	36	196.5	-104.5	206.5	-114.5	-90.3	-128.6	-189.7
11	Take/Put	168.1	-76.1	45,858	47	215.1	-123.1	207.3	-115.3	-99.6	-144.1	-209.8
12	put	159.5	-67.5	52,042				208.0	-116.0	-92.0	-128.9	-172.4
13	put	150.9	-58.9	58,225				208.8	-116.8	-87.4	-119.6	-149.8
14	Put/Hold	148.2	-56.2	60,430				209.5	-117.5	-81.6	-110.2	-143.6
15	Hold	149.0	-57.0	60,430				210.3	-118.3	-81.3	-110.5	-155.1
16	Hold	149.7	-57.7	60,430				211.0	-119.0	-80.5	-110.2	-160.3
17	Hold	150.5	-58.5	60,430				211.8	-119.8	-80.6	-111.2	-163.7
18	Hold	151.2	-59.2	60,430				212.5	-120.5	-80.5	-111.5	-165.5
19	Hold	152.0	-60.0	60,430				213.3	-121.3	-81.1	-112.9	-168.0
20	Hold	152.7	-60.7	60,430				214.0	-122.0	-81.9	-114.1	-169.9
21	Hold	153.5	-61.5	60,430				214.8	-122.8	-83.8	-116.5	-172.0
22	Hold	154.2	-62.2	60,430				215.5	-123.5	-84.5	-117.6	-173.8
23	Hold	155.0	-63.0	60,430				216.3	-124.3	-83.7	-116.8	-174.1
24	Hold	155.7	-63.7	60,430				217.0	-125.0	-83.8	-117.3	-175.1
25	Hold/Take	159.5	-67.5	58,405				217.8	-125.8	-90.5	-126.7	-186.5
26	take	172.4	-80.4	50,305	36	208.4	-116.4	218.5	-126.5	-109.1	-156.8	-226.2
27	take/put	179.9	-87.9	45,788	47	226.9	-134.9	219.3	-127.3	-117.6	-170.0	-242.3
28	put	171.3	-79.3	51,972				220.0	-128.0	-110.9	-155.4	-203.6
29	put	162.7	-70.7	58,155				220.8	-128.8	-103.8	-142.5	-176.8
30	Put/Hold	160.1	-68.1	60,360				221.5	-129.5	-98.5	-133.6	-169.9
31	Hold	160.8	-68.8	60,360				222.3	-130.3	-92.2	-125.2	-172.8
32	Hold	161.6	-69.6	60,360				223.0	-131.0	-92.3	-125.8	-178.7
33	Hold	162.3	-70.3	60,360				223.8	-131.8	-93.4	-128.2	-182.9
34	Hold	163.1	-71.1	60,360				224.5	-132.5	-92.4	-127.1	-183.0
35	Hold	163.8	-71.8	60,360				225.3	-133.3	-91.5	-125.9	-182.4
36	hold/take	167.6	-75.6	58,335				226.0	-134.0	-98.2	-135.5	-194.4
37	take	180.5	-88.5	50,235	36	216.5	-124.5	226.8	-134.8	-116.0	-164.9	-233.7
38	take	193.4	-101.4	42,135	47	240.4	-148.4	227.5	-135.5	-126.7	-181.5	-257.2
39	take	206.3	-114.3	34,035	53	259.3	-167.3	228.3	-136.3	-141.2	-201.4	-281.0
40	take	219.2	-127.2	25,935	58	277.2	-185.2	229.0	-137.0	-151.6	-215.3	-296.6
41	take	232.1	-140.1	17,835	62	294.1	-202.1	229.8	-137.8	-162.0	-228.9	-310.3
42	take	245.0	-153.0	9,735	65	310.0	-218.0	230.5	-138.5	-172.7	-241.9	-321.5
43	take	257.9	-165.9	1,635	68	325.9	-233.9	231.3	-139.3	-187.2	-257.8	-331.5
44	take/hold/put	259.4	-167.4	1,168	69	328.4	-236.4	232.0	-140.0	-184.8	-249.3	-309.6
45	put	250.8	-158.8	7,352				232.8	-140.8	-173.7	-230.3	-265.9
46	put	242.2	-150.2	13,535				233.5	-141.5	-159.9	-207.7	-233.2
47	put	233.6	-141.6	19,718				234.3	-142.3	-150.5	-192.2	-211.5

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; CL = Cypress Lawn; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-8. Holy Cross Cemetery Well 1 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	HC1 Well DTW (Feet)	HC1 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	HC1 Well SWL (Feet bgs)	HC1 Well GWE (Feet NGVD 29)	HC1 Well Background DTW (Feet)	HC1 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	189.2	-95.2	27,742				200.8	-106.8	-83.4	-113.1	-125.1
2	put	180.6	-86.6	33,925				201.5	-107.5	-79.0	-106.9	-118.1
3	put	172.0	-78.0	40,108				202.3	-108.3	-75.0	-101.6	-112.8
4	put	163.4	-69.4	46,291				203.0	-109.0	-72.6	-99.1	-110.3
5	put	154.8	-60.8	52,475				203.8	-109.8	-69.4	-95.2	-106.1
6	put	146.2	-52.2	58,658				204.5	-110.5	-66.5	-91.8	-102.9
7	Put/Hold	144.1	-50.1	60,500				205.3	-111.3	-63.8	-89.7	-109.9
8	Hold	144.9	-50.9	60,500				206.0	-112.0	-64.7	-92.6	-121.3
9	Hold/Take	148.6	-54.6	58,475				206.8	-112.8	-75.3	-111.6	-139.1
10	take	161.5	-67.5	50,375	43	204.5	-110.5	207.5	-113.5	-93.8	-144.3	-178.5
11	Take/Put	169.1	-75.1	45,858	50	219.1	-125.1	208.3	-114.3	-100.2	-155.6	-200.7
12	put	160.5	-66.5	52,042				209.0	-115.0	-92.4	-139.4	-170.8
13	put	151.9	-57.9	58,225				209.8	-115.8	-86.8	-128.3	-150.8
14	Put/Hold	149.2	-55.2	60,430				210.5	-116.5	-81.2	-118.8	-144.4
15	Hold	150.0	-56.0	60,430				211.3	-117.3	-80.7	-119.5	-153.6
16	Hold	150.7	-56.7	60,430				212.0	-118.0	-80.2	-119.9	-158.1
17	Hold	151.5	-57.5	60,430				212.8	-118.8	-80.4	-121.1	-161.3
18	Hold	152.2	-58.2	60,430				213.5	-119.5	-80.6	-121.8	-163.1
19	Hold	153.0	-59.0	60,430				214.3	-120.3	-81.3	-123.5	-165.6
20	Hold	153.7	-59.7	60,430				215.0	-121.0	-82.1	-124.9	-167.6
21	Hold	154.5	-60.5	60,430				215.8	-121.8	-83.9	-127.4	-169.8
22	Hold	155.2	-61.2	60,430				216.5	-122.5	-84.8	-128.8	-171.7
23	Hold	156.0	-62.0	60,430				217.3	-123.3	-84.4	-128.4	-172.1
24	Hold	156.7	-62.7	60,430				218.0	-124.0	-84.7	-129.1	-173.2
25	Hold/Take	160.5	-66.5	58,405				218.8	-124.8	-94.8	-144.8	-181.3
26	take	173.4	-79.4	50,305	43	216.4	-122.4	219.5	-125.5	-113.2	-175.7	-216.2
27	take/put	180.9	-86.9	45,788	50	230.9	-136.9	220.3	-126.3	-118.3	-184.0	-234.3
28	put	172.3	-78.3	51,972				221.0	-127.0	-110.9	-167.9	-203.0
29	put	163.7	-69.7	58,155				221.8	-127.8	-103.6	-153.4	-178.9
30	Put/Hold	161.1	-67.1	60,360				222.5	-128.5	-98.1	-143.9	-171.6
31	Hold	161.8	-67.8	60,360				223.3	-129.3	-93.7	-137.0	-172.4
32	Hold	162.6	-68.6	60,360				224.0	-130.0	-92.3	-136.9	-177.4
33	Hold	163.3	-69.3	60,360				224.8	-130.8	-93.1	-139.3	-181.2
34	Hold	164.1	-70.1	60,360				225.5	-131.5	-92.6	-138.7	-181.3
35	Hold	164.8	-70.8	60,360				226.3	-132.3	-92.2	-137.9	-180.8
36	hold/take	168.6	-74.6	58,335				227.0	-133.0	-101.8	-153.3	-189.4
37	take	181.5	-87.5	50,235	43	224.5	-130.5	227.8	-133.8	-119.6	-183.7	-223.9
38	take	194.4	-100.4	42,135	50	244.4	-150.4	228.5	-134.5	-132.2	-202.9	-246.1
39	take	207.3	-113.3	34,035	57	264.3	-170.3	229.3	-135.3	-144.9	-222.7	-269.5
40	take	220.2	-126.2	25,935	64	284.2	-190.2	230.0	-136.0	-155.5	-237.5	-285.0
41	take	233.1	-139.1	17,835	68	301.1	-207.1	230.8	-136.8	-165.2	-251.1	-298.9
42	take	246.0	-152.0	9,735	70	316.0	-222.0	231.5	-137.5	-175.0	-263.8	-310.2
43	take	258.9	-164.9	1,635	73	331.9	-237.9	232.3	-138.3	-186.2	-277.3	-320.4
44	take/hold/put	260.4	-166.4	1,168	75	335.4	-241.4	233.0	-139.0	-179.0	-261.3	-305.4
45	put	251.8	-157.8	7,352				233.8	-139.8	-169.3	-241.5	-267.4
46	put	243.2	-149.2	13,535				234.5	-140.5	-156.5	-218.1	-236.9
47	put	234.6	-140.6	19,718				235.3	-141.3	-146.5	-200.9	-215.9

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; HC = Holy Cross; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-9. Holy Cross Cemetery Well 4 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	HC4 Well DTW (Feet)	HC4 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	HC4 Well SWL (Feet bgs)	HC4 Well GWE (Feet NGVD 29)	HC4 Well Background DTW (Feet)	HC4 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	210.2	-96.2	27,742				220.3	-106.3	-115.0	-126.9
2	put	201.6	-87.6	33,925				221.0	-107.0	-108.0	-119.3
3	put	193.0	-79.0	40,108				221.8	-107.8	-102.5	-113.9
4	put	184.4	-70.4	46,291				222.5	-108.5	-100.4	-111.7
5	put	175.8	-61.8	52,475				223.3	-109.3	-96.2	-107.4
6	put	167.2	-53.2	58,658				224.0	-110.0	-93.1	-104.4
7	Put/Hold	165.1	-51.1	60,500				224.8	-110.8	-90.8	-111.7
8	Hold	165.9	-51.9	60,500				225.5	-111.5	-91.3	-121.7
9	Hold/Take	169.6	-55.6	58,475				226.3	-112.3	-108.7	-141.8
10	take	182.5	-68.5	50,375	37	219.5	-105.5	227.0	-113.0	-141.1	-182.1
11	Take/Put	190.1	-76.1	45,858	44	234.1	-120.1	227.8	-113.8	-155.1	-204.2
12	put	181.5	-67.5	52,042				228.5	-114.5	-139.4	-173.2
13	put	172.9	-58.9	58,225				229.3	-115.3	-128.7	-152.5
14	Put/Hold	170.2	-56.2	60,430				230.0	-116.0	-118.9	-145.9
15	Hold	171.0	-57.0	60,430				230.8	-116.8	-119.5	-155.7
16	Hold	171.7	-57.7	60,430				231.5	-117.5	-119.9	-160.5
17	Hold	172.5	-58.5	60,430				232.3	-118.3	-121.0	-163.6
18	Hold	173.2	-59.2	60,430				233.0	-119.0	-121.4	-165.3
19	Hold	174.0	-60.0	60,430				233.8	-119.8	-123.2	-168.0
20	Hold	174.7	-60.7	60,430				234.5	-120.5	-124.5	-169.8
21	Hold	175.5	-61.5	60,430				235.3	-121.3	-126.7	-171.8
22	Hold	176.2	-62.2	60,430				236.0	-122.0	-128.1	-173.8
23	Hold	177.0	-63.0	60,430				236.8	-122.8	-127.7	-174.2
24	Hold	177.7	-63.7	60,430				237.5	-123.5	-128.2	-175.2
25	Hold/Take	181.5	-67.5	58,405				238.3	-124.3	-140.8	-183.8
26	take	194.4	-80.4	50,305	37	231.4	-117.4	239.0	-125.0	-171.6	-219.4
27	take/put	201.9	-87.9	45,788	44	245.9	-131.9	239.8	-125.8	-183.1	-237.8
28	put	193.3	-79.3	51,972				240.5	-126.5	-167.7	-205.3
29	put	184.7	-70.7	58,155				241.3	-127.3	-153.1	-180.3
30	Put/Hold	182.1	-68.1	60,360				242.0	-128.0	-143.4	-172.7
31	Hold	182.8	-68.8	60,360				242.8	-128.8	-134.7	-172.6
32	Hold	183.6	-69.6	60,360				243.5	-129.5	-136.3	-179.3
33	Hold	184.3	-70.3	60,360				244.3	-130.3	-139.1	-183.6
34	Hold	185.1	-71.1	60,360				245.0	-131.0	-138.0	-183.3
35	Hold	185.8	-71.8	60,360				245.8	-131.8	-136.7	-182.5
36	hold/take	189.6	-75.6	58,335				246.5	-132.5	-149.7	-192.1
37	take	202.5	-88.5	50,235	37	239.5	-125.5	247.3	-133.3	-180.0	-227.5
38	take	215.4	-101.4	42,135	44	259.4	-145.4	248.0	-134.0	-197.1	-248.4
39	take	228.3	-114.3	34,035	51	279.3	-165.3	248.8	-134.8	-218.6	-273.5
40	take	241.2	-127.2	25,935	58	299.2	-185.2	249.5	-135.5	-233.2	-288.9
41	take	254.1	-140.1	17,835	61	315.1	-201.1	250.3	-136.3	-246.9	-303.0
42	take	267.0	-153.0	9,735	65	332.0	-218.0	251.0	-137.0	-259.3	-314.0
43	take	279.9	-165.9	1,635	68	347.9	-233.9	251.8	-137.8	-273.2	-323.9
44	take/hold/put	281.4	-167.4	1,168	69	350.4	-236.4	252.5	-138.5	-261.0	-308.4
45	put	272.8	-158.8	7,352				253.3	-139.3	-241.6	-269.2
46	put	264.2	-150.2	13,535				254.0	-140.0	-217.9	-237.9
47	put	255.6	-141.6	19,718				254.8	-140.8	-201.1	-216.7

Assumptions:

1) Put Rate of 5.52 MGD results in 8.6 feet/year increase in groundwater levels in Colma area
2) Take Rate of 7.23 MGD results in 12.9 feet/year decrease in groundwater levels in Colma area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in Colma area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; HC = Holy Cross; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-10. California Golf Club Well 7 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	CGC Well DTW (Feet)	CGC Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	CGC Well SWL (Feet bgs)	CGC Well GWE (Feet NGVD 29)	CGC Well Background DTW (Feet)	CGC Well Background GWE (Feet NGVD 29)	GW Model SC 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	189.4	-111.4	27,742				200.8	-122.8	-45.1	-87.9	-130.7
2	put	180.9	-102.9	33,925				201.5	-123.5	-43.3	-84.6	-125.6
3	put	172.4	-94.4	40,108				202.3	-124.3	-41.3	-81.0	-120.4
4	put	163.9	-85.9	46,291				203.0	-125.0	-39.7	-78.5	-116.8
5	put	155.4	-77.4	52,475				203.8	-125.8	-37.7	-75.1	-112.1
6	put	146.9	-68.9	58,658				204.5	-126.5	-35.8	-72.3	-108.3
7	Put/Hold	144.8	-66.8	60,500				205.3	-127.3	-34.9	-73.3	-117.7
8	Hold	145.6	-67.6	60,500				206.0	-128.0	-34.0	-74.5	-124.3
9	Hold/Take	150.8	-72.8	58,475				206.8	-128.8	-35.1	-81.1	-140.5
10	take	169.3	-91.3	50,375	41	210.3	-132.3	207.5	-129.5	-37.9	-94.6	-169.5
11	Take/Put	181.0	-103.0	45,858	52	233.0	-155.0	208.3	-130.3	-41.7	-107.1	-183.7
12	put	172.5	-94.5	52,042				209.0	-131.0	-41.5	-103.0	-166.9
13	put	164.0	-86.0	58,225				209.8	-131.8	-39.6	-96.3	-153.2
14	Put/Hold	161.4	-83.4	60,430				210.5	-132.5	-38.2	-92.7	-152.8
15	Hold	162.2	-84.2	60,430				211.3	-133.3	-38.1	-93.9	-157.5
16	Hold	162.9	-84.9	60,430				212.0	-134.0	-38.1	-95.3	-160.9
17	Hold	163.7	-85.7	60,430				212.8	-134.8	-38.0	-96.5	-163.9
18	Hold	164.4	-86.4	60,430				213.5	-135.5	-38.0	-97.5	-166.1
19	Hold	165.2	-87.2	60,430				214.3	-136.3	-38.1	-99.0	-169.0
20	Hold	165.9	-87.9	60,430				215.0	-137.0	-38.3	-100.3	-171.4
21	Hold	166.7	-88.7	60,430				215.8	-137.8	-38.6	-101.5	-173.7
22	Hold	167.4	-89.4	60,430				216.5	-138.5	-39.2	-103.1	-176.1
23	Hold	168.2	-90.2	60,430				217.3	-139.3	-39.2	-103.8	-177.3
24	Hold	168.9	-90.9	60,430				218.0	-140.0	-39.3	-104.4	-178.6
25	Hold/Take	174.1	-96.1	58,405				218.8	-140.8	-39.7	-106.5	-186.9
26	take	192.6	-114.6	50,305	41	233.6	-155.6	219.5	-141.5	-42.9	-118.1	-211.5
27	take/put	204.3	-126.3	45,788	52	256.3	-178.3	220.3	-142.3	-47.0	-129.0	-221.7
28	put	195.8	-117.8	51,972				221.0	-143.0	-47.0	-123.8	-202.5
29	put	187.3	-109.3	58,155				221.8	-143.8	-45.1	-115.0	-184.8
30	Put/Hold	184.7	-106.7	60,360				222.5	-144.5	-43.7	-110.4	-182.5
31	Hold	185.5	-107.5	60,360				223.3	-145.3	-42.6	-107.3	-180.4
32	Hold	186.2	-108.2	60,360				224.0	-146.0	-43.0	-108.9	-183.1
33	Hold	187.0	-109.0	60,360				224.8	-146.8	-43.1	-110.2	-185.8
34	Hold	187.7	-109.7	60,360				225.5	-147.5	-42.9	-110.1	-186.1
35	Hold	188.5	-110.5	60,360				226.3	-148.3	-42.9	-109.9	-186.2
36	hold/take	193.7	-115.7	58,335				227.0	-149.0	-43.5	-112.6	-194.9
37	take	212.2	-134.2	50,235	41	253.2	-175.2	227.8	-149.8	-46.4	-123.9	-219.1
38	take	230.7	-152.7	42,135	52	282.7	-204.7	228.5	-150.5	-49.9	-133.9	-237.7
39	take	249.2	-171.2	34,035	58	307.2	-229.2	229.3	-151.3	-55.3	-147.5	-258.6
40	take	267.7	-189.7	25,935	62	329.7	-251.7	230.0	-152.0	-59.6	-157.3	-273.7
41	take	286.2	-208.2	17,835	66	352.2	-274.2	230.8	-152.8	-63.8	-166.4	-287.3
42	take	304.7	-226.7	9,735	69	373.7	-295.7	231.5	-153.5	-67.7	-174.0	-298.7
43	take	323.2	-245.2	1,635	71	394.2	-316.2	232.3	-154.3	-71.8	-181.4	-309.0
44	take/hold/put	326.0	-248.0	1,168	73	399.0	-321.0	233.0	-155.0	-74.8	-182.7	-296.3
45	put	317.5	-239.5	7,352				233.8	-155.8	-73.8	-171.8	-269.2
46	put	309.0	-231.0	13,535				234.5	-156.5	-71.6	-159.4	-245.3
47	put	300.5	-222.5	19,718				235.3	-157.3	-69.5	-148.9	-226.2

Assumptions:

1) Put Rate of 5.52 MGD results in 8.5 feet/year increase in groundwater levels in CGC area
2) Take Rate of 7.23 MGD results in 18.5 feet/year decrease in groundwater levels in CGC area
3) Hold Year results in 0.75 feet/year decrease in groundwater levels in CGC area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; CGC = California Golf Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-11 . Olympic Golf Club Well 2 (#8) Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	Oly2 Well DTW (Feet)	Oly2 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	Oly2 Well SWL (Feet bgs)	Oly2 Well GWE (Feet NGVD 29)	Oly2 Well Background DTW (Feet)	Oly2 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 2 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 5 GWE (Feet NGVD 29)
1	put	95.5	-20.5	27,742				100.5	-25.5	5.3	-21.1	-57.4
2	put	91.9	-16.9	33,925				101.0	-26.0	10.8	-16.5	-52.2
3	put	88.3	-13.3	40,108				101.5	-26.5	11.5	-12.0	-48.5
4	put	84.7	-9.7	46,291				102.0	-27.0	12.5	-9.0	-46.1
5	put	81.1	-6.1	52,475				102.5	-27.5	12.5	-6.7	-44.4
6	put	77.5	-2.5	58,658				103.0	-28.0	13.1	-5.2	-43.0
7	Put/Hold	76.8	-1.8	60,500				103.5	-28.5	13.5	-5.9	-62.8
8	Hold	77.3	-2.3	60,500				104.0	-29.0	12.1	-9.6	-81.3
9	Hold/Take	78.6	-3.6	58,475				104.5	-29.5	9.9	-13.1	-98.5
10	take	82.6	-7.6	50,375	7	89.6	-14.6	105.0	-30.0	6.3	-21.6	-137.6
11	Take/Put	84.7	-9.7	45,858	12	96.7	-21.7	105.5	-30.5	4.0	-28.0	-143.6
12	put	81.1	-6.1	52,042				106.0	-31.0	3.8	-23.6	-96.1
13	put	77.5	-2.5	58,225				106.5	-31.5	3.7	-20.3	-74.1
14	Put/Hold	76.5	-1.5	60,430				107.0	-32.0	4.8	-19.2	-81.6
15	Hold	77.0	-2.0	60,430				107.5	-32.5	4.8	-21.5	-95.9
16	Hold	77.5	-2.5	60,430				108.0	-33.0	6.4	-22.7	-102.2
17	Hold	78.0	-3.0	60,430				108.5	-33.5	5.1	-23.5	-105.0
18	Hold	78.5	-3.5	60,430				109.0	-34.0	6.4	-24.1	-106.5
19	Hold	79.0	-4.0	60,430				109.5	-34.5	6.1	-24.1	-107.3
20	Hold	79.5	-4.5	60,430				110.0	-35.0	5.7	-24.5	-108.1
21	Hold	80.0	-5.0	60,430				110.5	-35.5	3.9	-25.3	-109.1
22	Hold	80.5	-5.5	60,430				111.0	-36.0	7.1	-25.6	-109.8
23	Hold	81.0	-6.0	60,430				111.5	-36.5	7.8	-24.9	-110.0
24	Hold	81.5	-6.5	60,430				112.0	-37.0	6.6	-24.7	-110.2
25	Hold/Take	82.9	-7.9	58,405				112.5	-37.5	4.1	-25.9	-119.0
26	take	86.9	-11.9	50,305	7	93.9	-18.9	113.0	-38.0	0.4	-32.8	-154.2
27	take/put	89.0	-14.0	45,788	12	101.0	-26.0	113.5	-38.5	0.3	-38.1	-157.6
28	put	85.4	-10.4	51,972				114.0	-39.0	0.4	-32.5	-108.7
29	put	81.8	-6.8	58,155				114.5	-39.5	2.0	-27.8	-85.4
30	Put/Hold	80.8	-5.8	60,360				115.0	-40.0	2.3	-25.7	-92.0
31	Hold	81.3	-6.3	60,360				115.5	-40.5	4.9	-26.6	-104.8
32	Hold	81.8	-6.8	60,360				116.0	-41.0	8.0	-26.3	-109.4
33	Hold	82.3	-7.3	60,360				116.5	-41.5	7.1	-25.6	-111.6
34	Hold	82.8	-7.8	60,360				117.0	-42.0	5.9	-25.6	-112.6
35	Hold	83.3	-8.3	60,360				117.5	-42.5	7.2	-25.9	-113.0
36	hold/take	84.7	-9.7	58,335				118.0	-43.0	5.2	-26.8	-121.7
37	take	88.7	-13.7	50,235	7	95.7	-20.7	118.5	-43.5	1.9	-33.4	-156.5
38	take	92.7	-17.7	42,135	12	104.7	-29.7	119.0	-44.0	-1.0	-39.3	-175.8
39	take	96.7	-21.7	34,035	15	111.7	-36.7	119.5	-44.5	-5.4	-45.2	-187.8
40	take	100.7	-25.7	25,935	17	117.7	-42.7	120.0	-45.0	-8.7	-50.9	-196.5
41	take	104.7	-29.7	17,835	19	123.7	-48.7	120.5	-45.5	-11.3	-56.9	-203.3
42	take	108.7	-33.7	9,735	21	129.7	-54.7	121.0	-46.0	-16.1	-63.0	-209.4
43	take	112.7	-37.7	1,635	22	134.7	-59.7	121.5	-46.5	-21.0	-70.6	-214.8
44	take/hold/put	113.0	-38.0	1,168	23	136.0	-61.0	122.0	-47.0	-21.4	-74.6	-183.9
45	put	109.4	-34.4	7,352				122.5	-47.5	-20.1	-67.1	-136.2
46	put	105.8	-30.8	13,535				123.0	-48.0	-17.0	-59.3	-111.7
47	put	102.2	-27.2	19,718				123.5	-48.5	-12.8	-52.0	-97.2

Assumptions:

1) Put Rate of 5.52 MGD results in 3.6 feet/year increase in groundwater levels in Olympic Club area
2) Take Rate of 7.23 MGD results in 4.0 feet/year decrease in groundwater levels in the Olympic Club area
3) Hold Year results in 0.5 feet/year decrease in groundwater levels in the Olympic Club area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; Oly = Olympic Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-12. San Francisco Golf Club Well 2 Groundwater Levels for GSR Project (Scenario 2)

Future Scenario Year	Year Type	SFGC2 Well DTW (Feet)	SFCG2 Well GWE (Feet NGVD 29)	SFPUC Storage Account	GSR Local Drawdown (Feet)	SFGC2 Well SWL (Feet bgs)	SFGC2 Well GWE (Feet NGVD 29)	SFGC2 Well Background DTW (Feet)	SFGC2 Well Background GWE (Feet NGVD 29)	GW Model Sc 2-Lay 3 GWE (Feet NGVD 29)	GW Model Sc 2-Lay 4 GWE (Feet NGVD 29)
1	put	155.5	-16.5	27,742				160.5	-21.5	-9.1	-23.6
2	put	151.9	-12.9	33,925				161.0	-22.0	-4.2	-18.6
3	put	148.3	-9.3	40,108				161.5	-22.5	-0.7	-14.0
4	put	144.7	-5.7	46,291				162.0	-23.0	1.3	-11.0
5	put	141.1	-2.1	52,475				162.5	-23.5	3.3	-7.4
6	put	137.5	1.5	58,658				163.0	-24.0	3.4	-7.3
7	Put/Hold	136.8	2.2	60,500				163.5	-24.5	3.0	-8.5
8	Hold	137.3	1.7	60,500				164.0	-25.0	1.4	-10.6
9	Hold/Take	138.6	0.4	58,475				164.5	-25.5	-3.2	-15.9
10	take	142.6	-3.6	50,375	7	149.6	-10.6	165.0	-26.0	-9.9	-24.9
11	Take/Put	144.7	-5.7	45,858	11	155.7	-16.7	165.5	-26.5	-13.8	-31.0
12	put	141.1	-2.1	52,042				166.0	-27.0	-11.5	-26.2
13	put	137.5	1.5	58,225				166.5	-27.5	-9.7	-22.9
14	Put/Hold	136.5	2.5	60,430				167.0	-28.0	-9.1	-22.5
15	Hold	137.0	2.0	60,430				167.5	-28.5	-9.7	-24.3
16	Hold	137.5	1.5	60,430				168.0	-29.0	-9.9	-25.5
17	Hold	138.0	1.0	60,430				168.5	-29.5	-10.5	-26.3
18	Hold	138.5	0.5	60,430				169.0	-30.0	-10.2	-26.6
19	Hold	139.0	0.0	60,430				169.5	-30.5	-10.3	-26.9
20	Hold	139.5	-0.5	60,430				170.0	-31.0	-10.6	-27.2
21	Hold	140.0	-1.0	60,430				170.5	-31.5	-11.0	-26.6
22	Hold	140.5	-1.5	60,430				171.0	-32.0	-10.0	-26.8
23	Hold	141.0	-2.0	60,430				171.5	-32.5	-9.9	-27.5
24	Hold	141.5	-2.5	60,430				172.0	-33.0	-10.2	-27.3
25	Hold/Take	142.9	-3.9	58,405				172.5	-33.5	-12.7	-29.0
26	take	146.9	-7.9	50,305	7	153.9	-14.9	173.0	-34.0	-17.8	-35.0
27	take/put	149.0	-10.0	45,788	11	160.0	-21.0	173.5	-34.5	-21.4	-41.4
28	put	145.4	-6.4	51,972				174.0	-35.0	-18.0	-35.6
29	put	141.8	-2.8	58,155				174.5	-35.5	-13.4	-28.8
30	Put/Hold	140.8	-1.8	60,360				175.0	-36.0	-12.0	-26.8
31	Hold	141.3	-2.3	60,360				175.5	-36.5	-11.5	-27.7
32	Hold	141.8	-2.8	60,360				176.0	-37.0	-11.1	-29.3
33	Hold	142.3	-3.3	60,360				176.5	-37.5	-10.3	-28.4
34	Hold	142.8	-3.8	60,360				177.0	-38.0	-9.9	-26.8
35	Hold	143.3	-4.3	60,360				177.5	-38.5	-9.8	-27.1
36	hold/take	144.7	-5.7	58,335				178.0	-39.0	-12.8	-30.1
37	take	148.7	-9.7	50,235	7	155.7	-16.7	178.5	-39.5	-18.3	-37.1
38	take	152.7	-13.7	42,135	11	163.7	-24.7	179.0	-40.0	-22.2	-41.6
39	take	156.7	-17.7	34,035	15	171.7	-32.7	179.5	-40.5	-28.4	-49.3
40	take	160.7	-21.7	25,935	17	177.7	-38.7	180.0	-41.0	-33.3	-55.0
41	take	164.7	-25.7	17,835	19	183.7	-44.7	180.5	-41.5	-38.2	-61.4
42	take	168.7	-29.7	9,735	20	188.7	-49.7	181.0	-42.0	-43.7	-67.6
43	take	172.7	-33.7	1,635	22	194.7	-55.7	181.5	-42.5	-49.6	-74.1
44	take/hold/put	173.0	-34.0	1,168	22	195.0	-56.0	182.0	-43.0	-51.9	-78.8
45	put	169.4	-30.4	7,352				182.5	-43.5	-46.6	-70.5
46	put	165.8	-26.8	13,535				183.0	-44.0	-40.2	-62.0
47	put	162.2	-23.2	19,718				183.5	-44.5	-34.1	-54.5

Assumptions:

1) Put Rate of 5.52 MGD results in 3.6 feet/year increase in groundwater levels in San Francisco Golf Club area
2) Take Rate of 7.23 MGD results in 4.0 feet/year decrease in groundwater levels in the San Francisco Golf Club area
3) Hold Year results in 0.5 feet/year decrease in groundwater levels in the San Francisco Golf Club area
4) Exact Put amounts are derived from SFPUC (D. Cameron) spreadsheet for resequenced hydrology years.

Notes: DTW = depth to water; SFGC = San Francisco Golf Club; GWE = groundwater elevation; Sc = Model Scenario; Lay = Model Layer

Table C-13. SFPUC Storage Account and Colma Cemetery Water Level Changes for Third Party Well Interference Analysis.

Scenario Year	Put Months	Hold Months	Take Months	Put Storage Chanage	Take Storage Change	Net Storage Change	Put WL Change	Hold WL Change	Take WL Change	Net WL Change	Cum Storage Change
0	3	0	0	1,559	0	1,559	-2.17	0.00	0.00	-2.17	21,559
1	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	27,742
2	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	33,925
3	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	40,108
4	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	46,291
5	12	0	0	6,184	0	6,184	-8.60	0.00	0.00	-8.60	52,475
6	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	58,658
7	4	8	0	1,842	0	1,842	-2.56	0.50	0.00	-2.06	60,500
8	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,500
9	0	9	3	0	-2,025	-2,025	0.00	0.56	3.23	3.79	58,475
10	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	50,375
11	3	0	9	1,558	-6,075	-4,517	-2.17	0.00	9.68	7.51	45,858
12	12	0	0	6,184	0	6,184	-8.60	0.00	0.00	-8.60	52,042
13	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	58,225
14	5	7	0	2,205	0	2,205	-3.07	0.44	0.00	-2.63	60,430
15	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
16	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
17	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
18	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
19	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
20	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
21	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
22	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
23	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
24	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
25	0	9	3	0	-2,025	-2,025	0.00	0.56	3.23	3.79	58,405
26	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	50,305
27	3	0	9	1,558	-6,075	-4,517	-2.17	0.00	9.68	7.51	45,788
28	12	0	0	6,184	0	6,184	-8.60	0.00	0.00	-8.60	51,972
29	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	58,155
30	5	7	0	2,205	0	2,205	-3.07	0.44	0.00	-2.63	60,360
31	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
32	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
33	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
34	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
35	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
36	0	9	3	0	-2,025	-2,025	0.00	0.56	3.23	3.79	58,335
37	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	50,235
38	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	42,135
39	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	34,035
40	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	25,935
41	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	17,835
42	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	9,735
43	0	0	12	0	-8,100	-8,100	0.00	0.00	12.90	12.90	1,635
44	3	6	3	1,558	-2,025	-467	-2.17	0.38	3.23	1.43	1,168
45	12	0	0	6,184	0	6,184	-8.60	0.00	0.00	-8.60	7,352
46	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	13,535
47	12	0	0	6,183	0	6,183	-8.60	0.00	0.00	-8.60	19,718
Totals	182	247	138	92,868	-93,150	-282	-129.2	15.4	148.4	34.6	

Assumptions: Put Year Water Level Rise = 8.6 feet; Take Year Water Level Decline = 12.9 feet; Hold Year Water Level Decline = 0.75 feet. It is assumed that method of calculating Put/Take Year WL changes includes background decline component.

Table C-14. SFPUC Storage Account and California Golf Club Water Level Changes for Third Party Well Interference Analysis.

Scenario Year	Put Months	Hold Months	Take Months	Put Storage Chanage	Take Storage Change	Net Storage Change	Put WL Change	Hold WL Change	Take WL Change	Net WL Change	Cum Storage Change
0	3	0	0	1,559	0	1,559	-2.14	0.00	0.00	-2.14	21,559
1	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	27,742
2	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	33,925
3	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	40,108
4	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	46,291
5	12	0	0	6,184	0	6,184	-8.50	0.00	0.00	-8.50	52,475
6	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	58,658
7	4	8	0	1,842	0	1,842	-2.53	0.50	0.00	-2.03	60,500
8	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,500
9	0	9	3	0	-2,025	-2,025	0.00	0.56	4.63	5.19	58,475
10	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	50,375
11	3	0	9	1,558	-6,075	-4,517	-2.14	0.00	13.88	11.73	45,858
12	12	0	0	6,184	0	6,184	-8.50	0.00	0.00	-8.50	52,042
13	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	58,225
14	5	7	0	2,205	0	2,205	-3.03	0.44	0.00	-2.59	60,430
15	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
16	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
17	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
18	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
19	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
20	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
21	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
22	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
23	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
24	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
25	0	9	3	0	-2,025	-2,025	0.00	0.56	4.63	5.19	58,405
26	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	50,305
27	3	0	9	1,558	-6,075	-4,517	-2.14	0.00	13.88	11.73	45,788
28	12	0	0	6,184	0	6,184	-8.50	0.00	0.00	-8.50	51,972
29	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	58,155
30	5	7	0	2,205	0	2,205	-3.03	0.44	0.00	-2.59	60,360
31	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
32	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
33	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
34	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
35	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
36	0	9	3	0	-2,025	-2,025	0.00	0.56	4.63	5.19	58,335
37	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	50,235
38	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	42,135
39	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	34,035
40	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	25,935
41	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	17,835
42	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	9,735
43	0	0	12	0	-8,100	-8,100	0.00	0.00	18.50	18.50	1,635
44	3	6	3	1,558	-2,025	-467	-2.14	0.38	4.63	2.86	1,168
45	12	0	0	6,184	0	6,184	-8.50	0.00	0.00	-8.50	7,352
46	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	13,535
47	12	0	0	6,183	0	6,183	-8.50	0.00	0.00	-8.50	19,718
Totals	182	247	138	92,868	-93,150	-282	-127.7	15.4	212.8	100.5	

Assumptions: Put Year Water Level Rise = 8.5 feet; Take Year Water Level Decline = 18.5 feet; Hold Year Water Level Decline = 0.75 feet. It is assumed that method of calculating Put/Take Year WL changes includes background decline component.

Table C-15. SFPUC Storage Account and Lake Merced Golf Club Water Level Changes for Third Party Well Interference Analysis.

Scenario Year	Put Months	Hold Months	Take Months	Put Storage Chanage	Take Storage Change	Net Storage Change	Put WL Change	Hold WL Change	Take WL Change	Net WL Change	Cum Storage Change
0	3	0	0	1,559	0	1,559	-2.65	0.00	0.00	-2.65	21,559
1	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	27,742
2	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	33,925
3	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	40,108
4	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	46,291
5	12	0	0	6,184	0	6,184	-10.50	0.00	0.00	-10.50	52,475
6	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	58,658
7	4	8	0	1,842	0	1,842	-3.13	0.50	0.00	-2.63	60,500
8	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,500
9	0	9	3	0	-2,025	-2,025	0.00	0.56	3.75	4.31	58,475
10	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	50,375
11	3	0	9	1,558	-6,075	-4,517	-2.65	0.00	11.25	8.60	45,858
12	12	0	0	6,184	0	6,184	-10.50	0.00	0.00	-10.50	52,042
13	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	58,225
14	5	7	0	2,205	0	2,205	-3.74	0.44	0.00	-3.31	60,430
15	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
16	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
17	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
18	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
19	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
20	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
21	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
22	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
23	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
24	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,430
25	0	9	3	0	-2,025	-2,025	0.00	0.56	3.75	4.31	58,405
26	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	50,305
27	3	0	9	1,558	-6,075	-4,517	-2.65	0.00	11.25	8.60	45,788
28	12	0	0	6,184	0	6,184	-10.50	0.00	0.00	-10.50	51,972
29	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	58,155
30	5	7	0	2,205	0	2,205	-3.74	0.44	0.00	-3.31	60,360
31	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
32	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
33	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
34	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
35	0	12	0	0	0	0	0.00	0.75	0.00	0.75	60,360
36	0	9	3	0	-2,025	-2,025	0.00	0.56	3.75	4.31	58,335
37	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	50,235
38	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	42,135
39	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	34,035
40	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	25,935
41	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	17,835
42	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	9,735
43	0	0	12	0	-8,100	-8,100	0.00	0.00	15.00	15.00	1,635
44	3	6	3	1,558	-2,025	-467	-2.65	0.38	3.75	1.48	1,168
45	12	0	0	6,184	0	6,184	-10.50	0.00	0.00	-10.50	7,352
46	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	13,535
47	12	0	0	6,183	0	6,183	-10.50	0.00	0.00	-10.50	19,718
Totals	182	247	138	92,868	-93,150	-282	-157.7	15.4	172.5	30.2	

Assumptions: Put Year Water Level Rise = 10.5 feet; Take Year Water Level Decline = 15.0 feet; Hold Year Water Level Decline = 0.75 feet. It is assumed that method of calculating Put/Take Year WL changes includes background decline component.

Table C-16. SFPUC Storage Account and Olympic Club Well Water Level Changes for Third Party Well Interference Analysis (based upon 2002-2005 data only)

Scenario Year	Put Months	Hold Months	Take Months	Put Storage Chanage	Take Storage Change	Net Storage Change	Put WL Change	Hold WL Change	Take WL Change	Net WL Change	Cum Storage Change
0	3	0	0	1,559	0	1,559	-0.91	0.00	0.00	-0.91	21,559
1	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	27,742
2	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	33,925
3	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	40,108
4	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	46,291
5	12	0	0	6,184	0	6,184	-3.60	0.00	0.00	-3.60	52,475
6	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	58,658
7	4	8	0	1,842	0	1,842	-1.07	0.33	0.00	-0.74	60,500
8	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,500
9	0	9	3	0	-2,025	-2,025	0.00	0.38	1.00	1.38	58,475
10	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	50,375
11	3	0	9	1,558	-6,075	-4,517	-0.91	0.00	3.00	2.09	45,858
12	12	0	0	6,184	0	6,184	-3.60	0.00	0.00	-3.60	52,042
13	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	58,225
14	5	7	0	2,205	0	2,205	-1.28	0.29	0.00	-0.99	60,430
15	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
16	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
17	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
18	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
19	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
20	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
21	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
22	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
23	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
24	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,430
25	0	9	3	0	-2,025	-2,025	0.00	0.38	1.00	1.38	58,405
26	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	50,305
27	3	0	9	1,558	-6,075	-4,517	-0.91	0.00	3.00	2.09	45,788
28	12	0	0	6,184	0	6,184	-3.60	0.00	0.00	-3.60	51,972
29	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	58,155
30	5	7	0	2,205	0	2,205	-1.28	0.29	0.00	-0.99	60,360
31	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,360
32	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,360
33	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,360
34	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,360
35	0	12	0	0	0	0	0.00	0.50	0.00	0.50	60,360
36	0	9	3	0	-2,025	-2,025	0.00	0.38	1.00	1.38	58,335
37	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	50,235
38	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	42,135
39	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	34,035
40	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	25,935
41	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	17,835
42	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	9,735
43	0	0	12	0	-8,100	-8,100	0.00	0.00	4.00	4.00	1,635
44	3	6	3	1,558	-2,025	-467	-0.91	0.25	1.00	0.34	1,168
45	12	0	0	6,184	0	6,184	-3.60	0.00	0.00	-3.60	7,352
46	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	13,535
47	12	0	0	6,183	0	6,183	-3.60	0.00	0.00	-3.60	19,718
Totals	182	247	138	92,868	-93,150	-282	-54.1	10.3	46.0	2.2	

Assumptions: Put Year Water Level Rise = 3.6 feet; Take Year Water Level Decline = 4.0 feet; Hold Year Water Level Decline = 0.5 feet. It is assumed that method of calculating Put/Take Year WL changes includes background decline component.

Figure C-1. Estimated Static Water Levels at Woodlawn Cemetery Primary Well for GSR Project

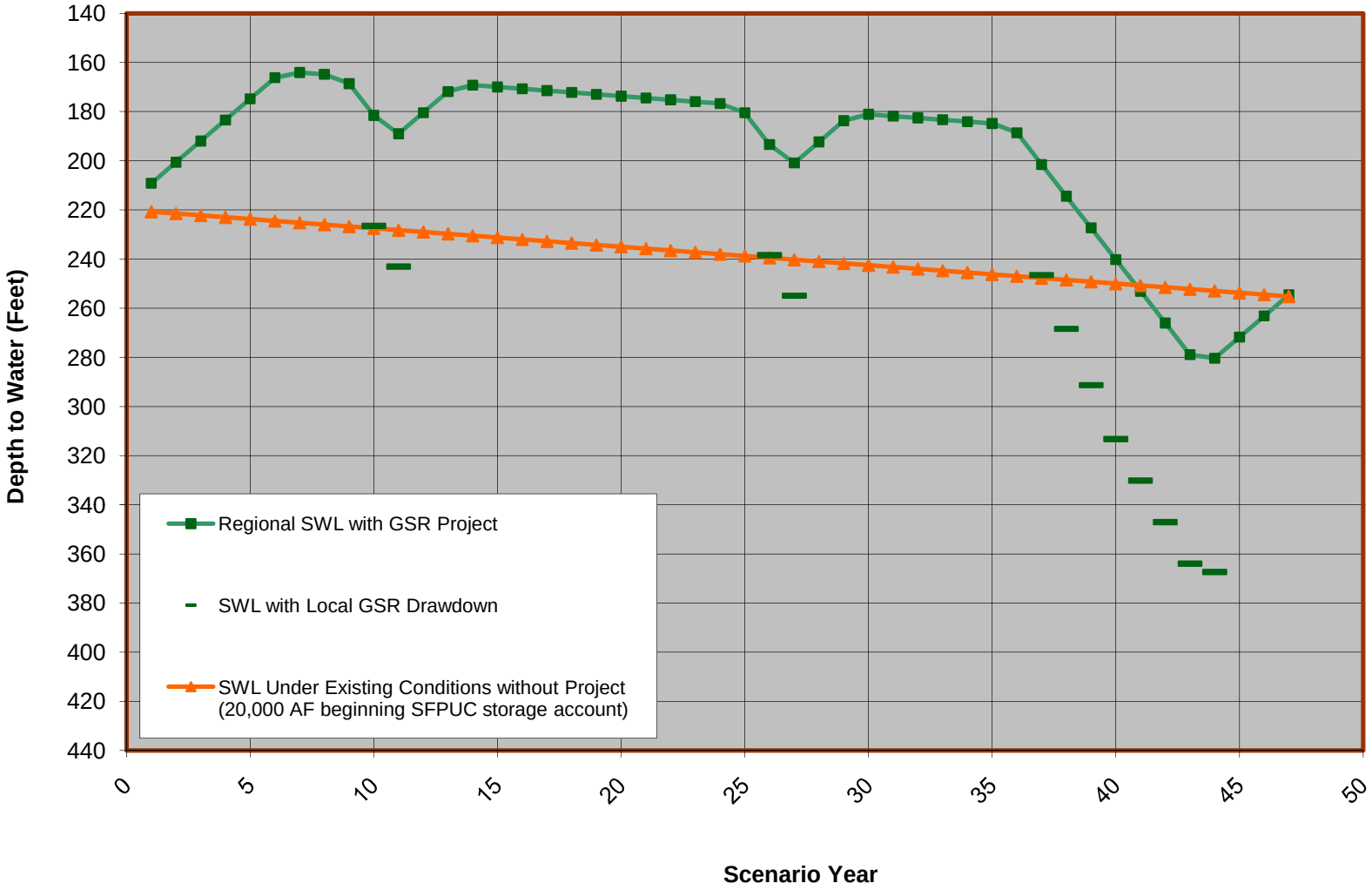


Figure C-2. Estimated Groundwater Elevations at Woodlawn Cemetery Primary Well for GSR Project (Scenario 2)

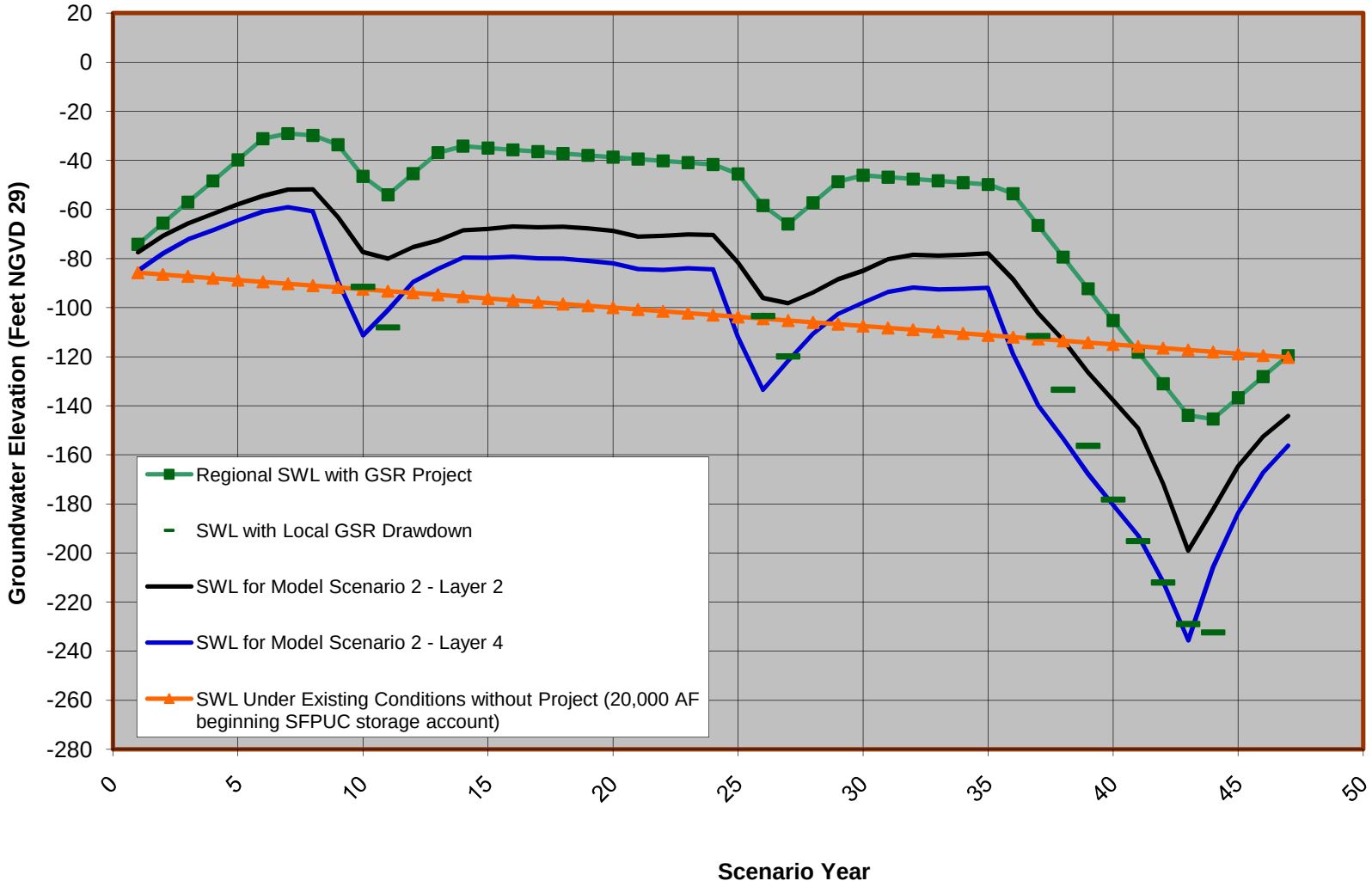


Figure C-3. Estimated Static Water Levels at Italian Cemetery Well for GSR Project

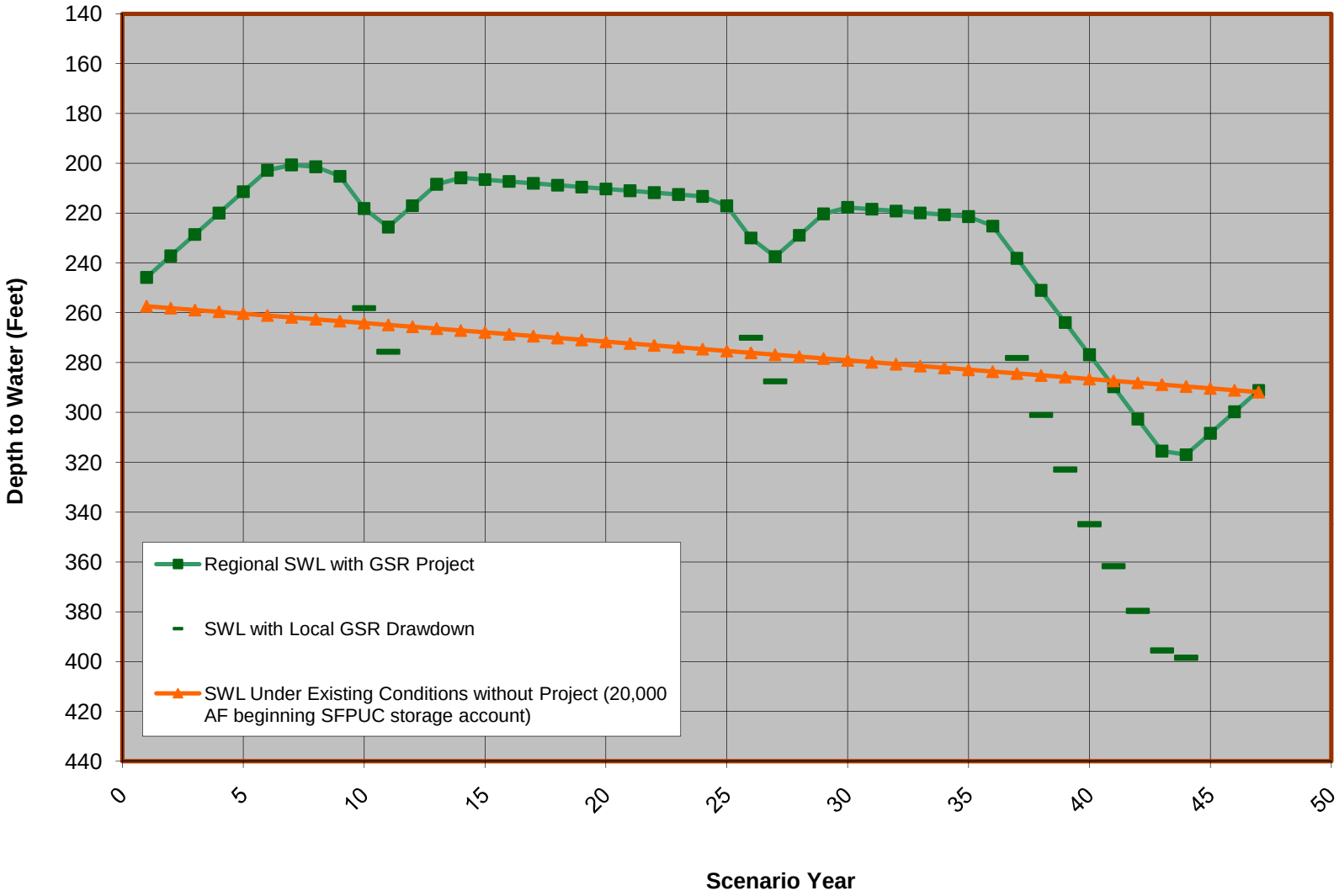


Figure C-4. Estimated Groundwater Elevations at Italian Cemetery Well for GSR Project (Scenario 2)

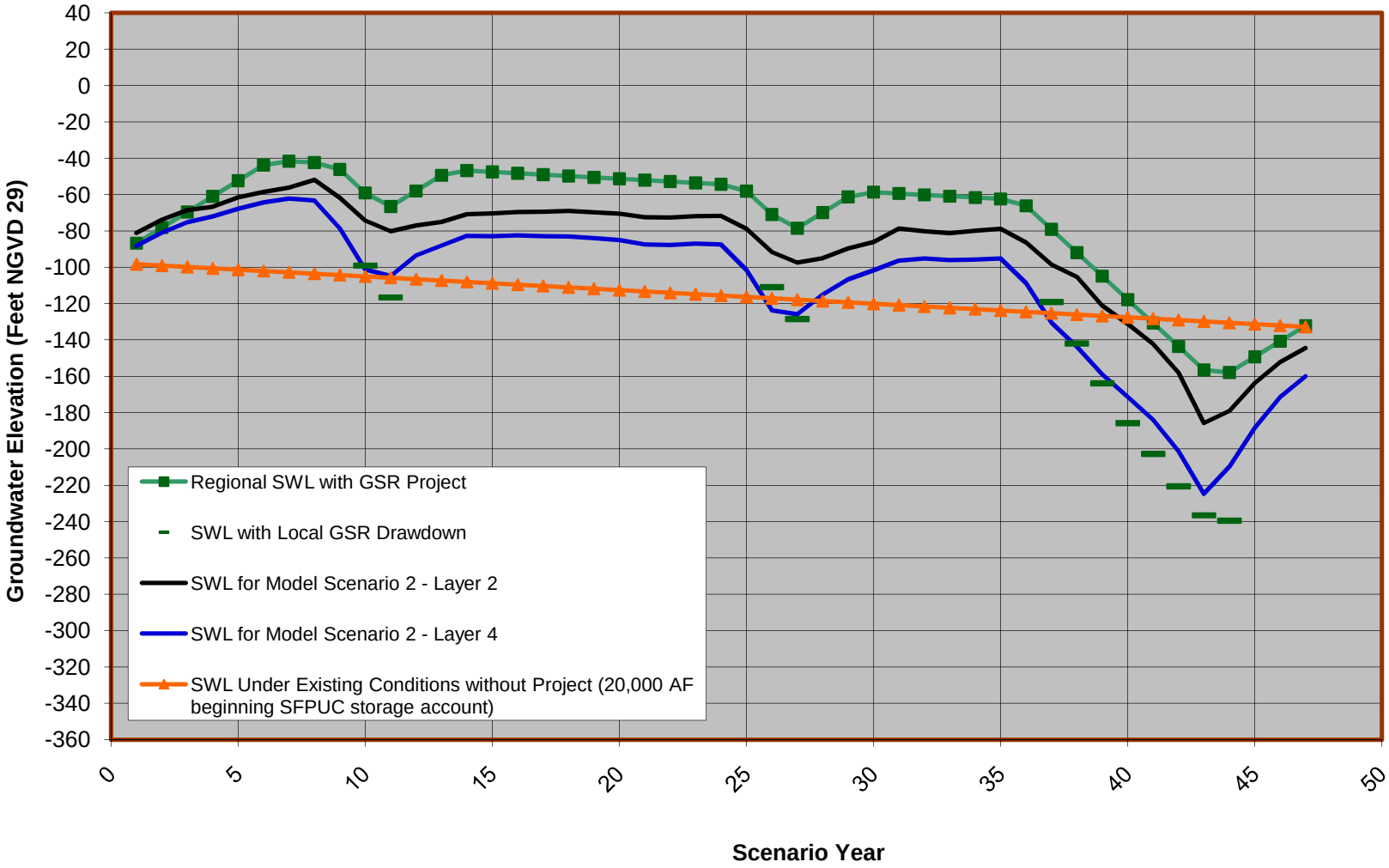


Figure C-5. Estimated Static Water Levels at Olivet Cemetery Well for GSR Project

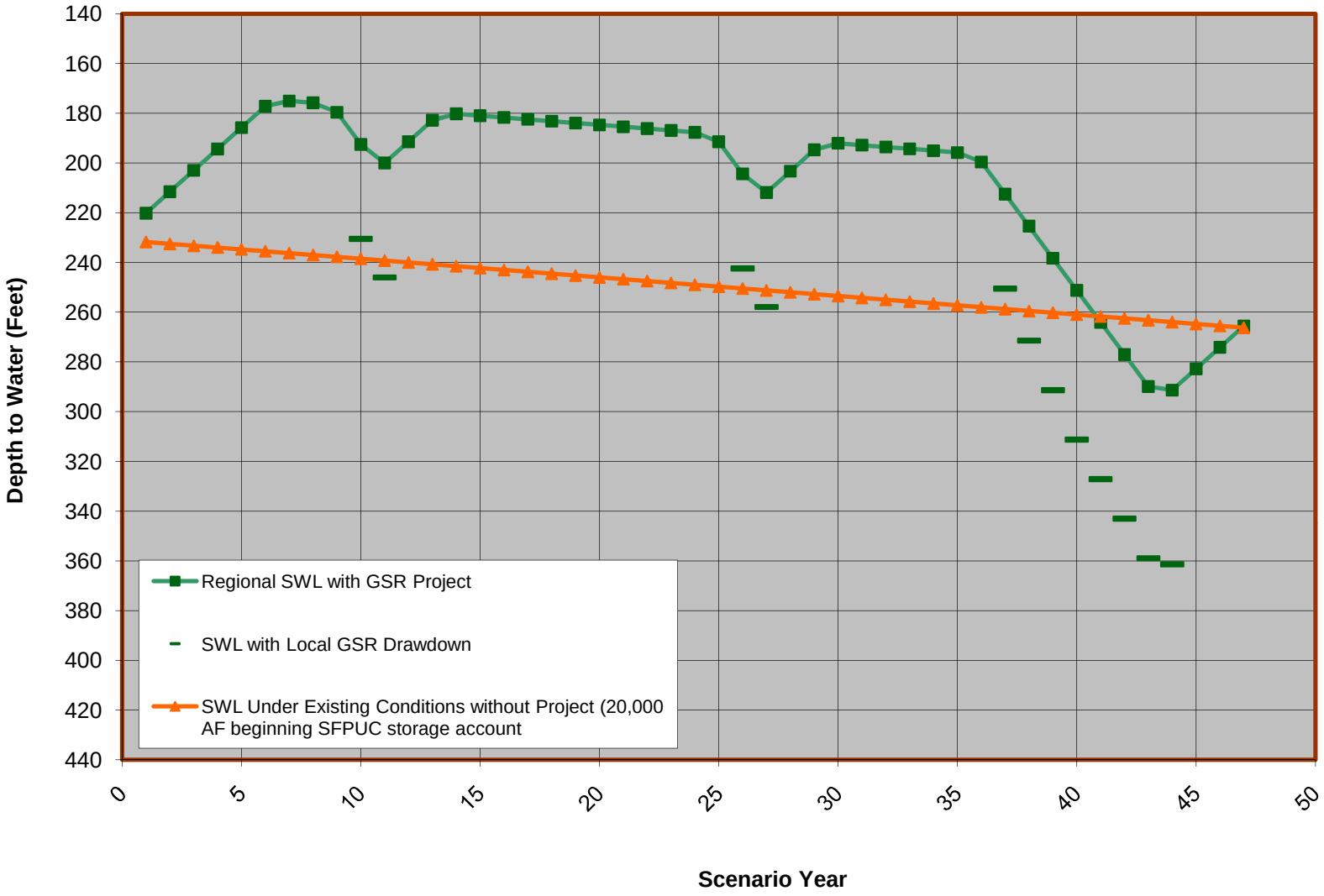


Figure C-6. Estimated Groundwater Elevations at Olivet Cemetery Well for GSR Project (Scenario 2)

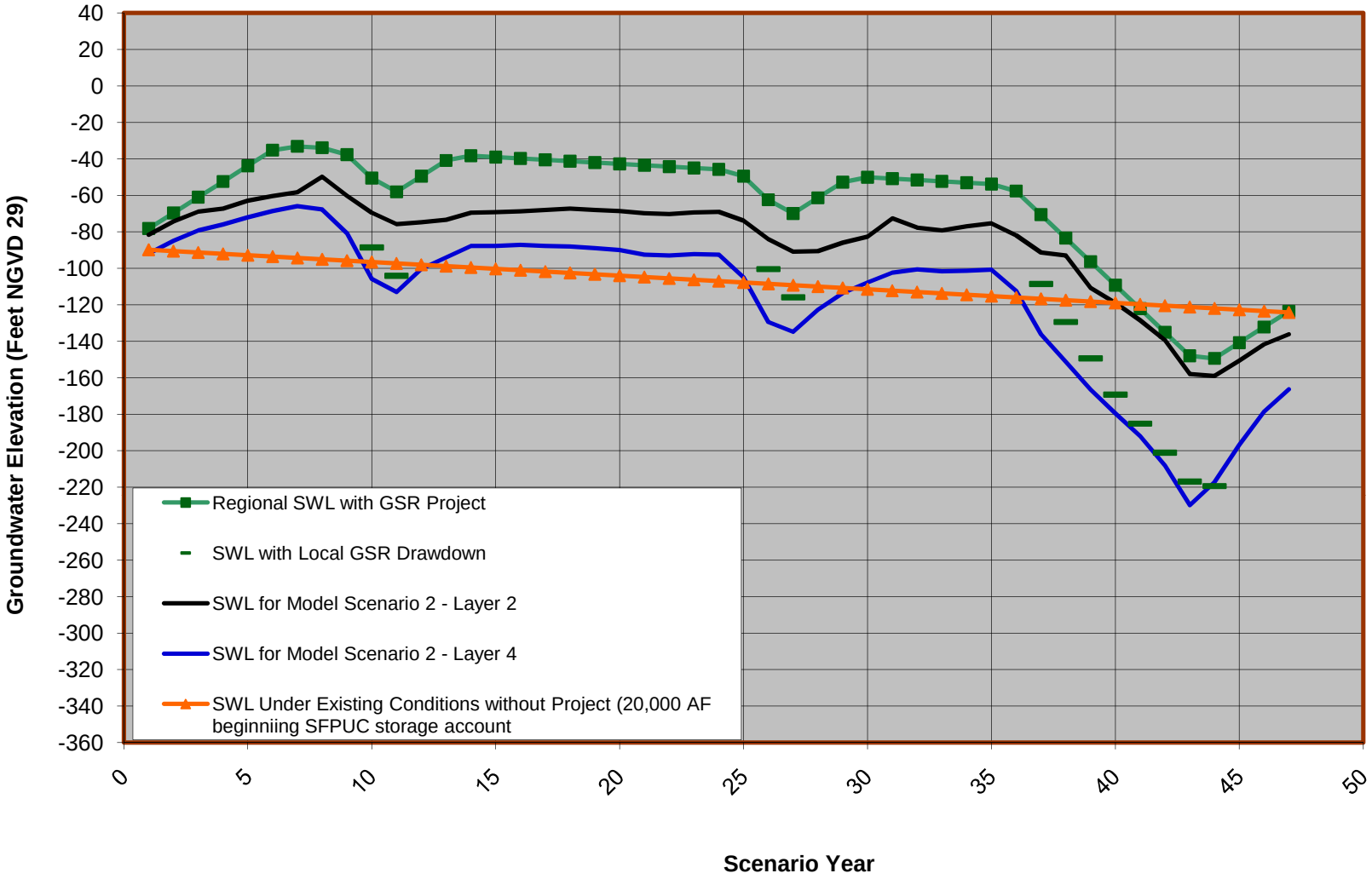


Figure C-7. Estimated Static Water Levels at Home of Peace Cemetery Well for GSR Project

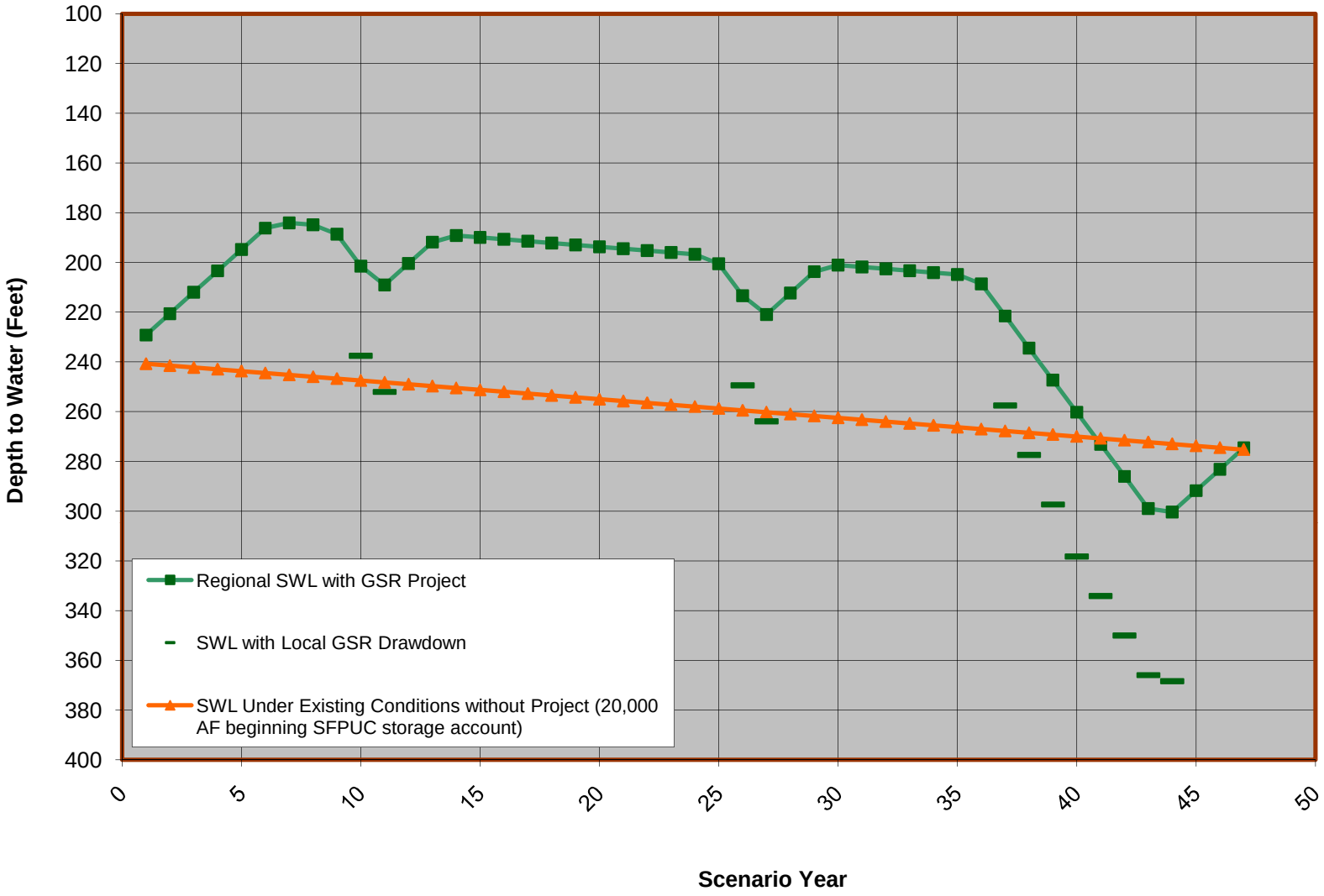


Figure C-8. Estimated Groundwater Elevations at Home of Peace Cemetery Well for GSR Project (Scenario 2)

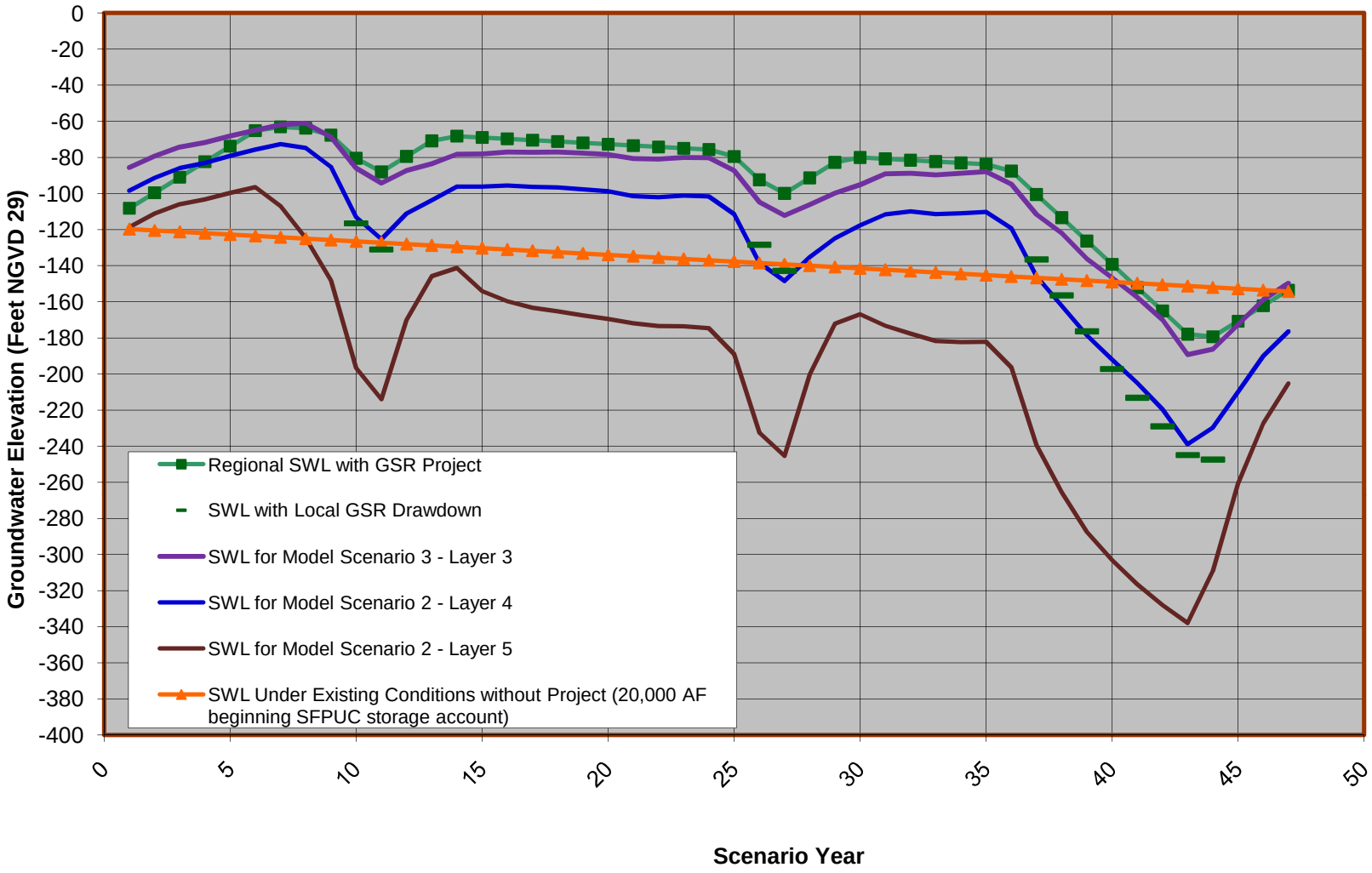


Figure C-9. Estimated Static Water Levels at Hills of Eternity Cemetery Well for GSR Project

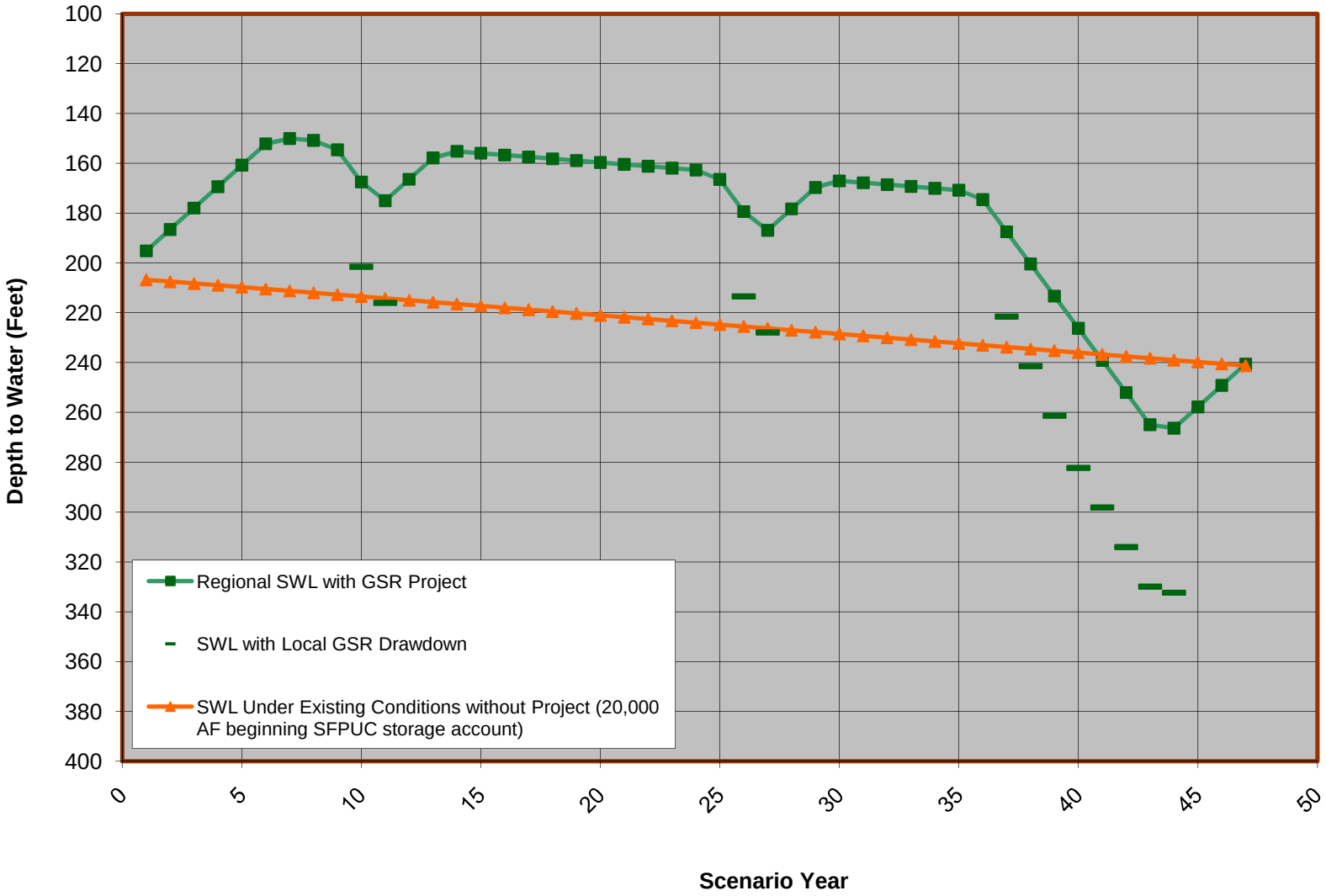


Figure C-10. Estimated Groundwater Elevations at Hills of Eternity Cemetery Well for GSR Project (Scenario 2)

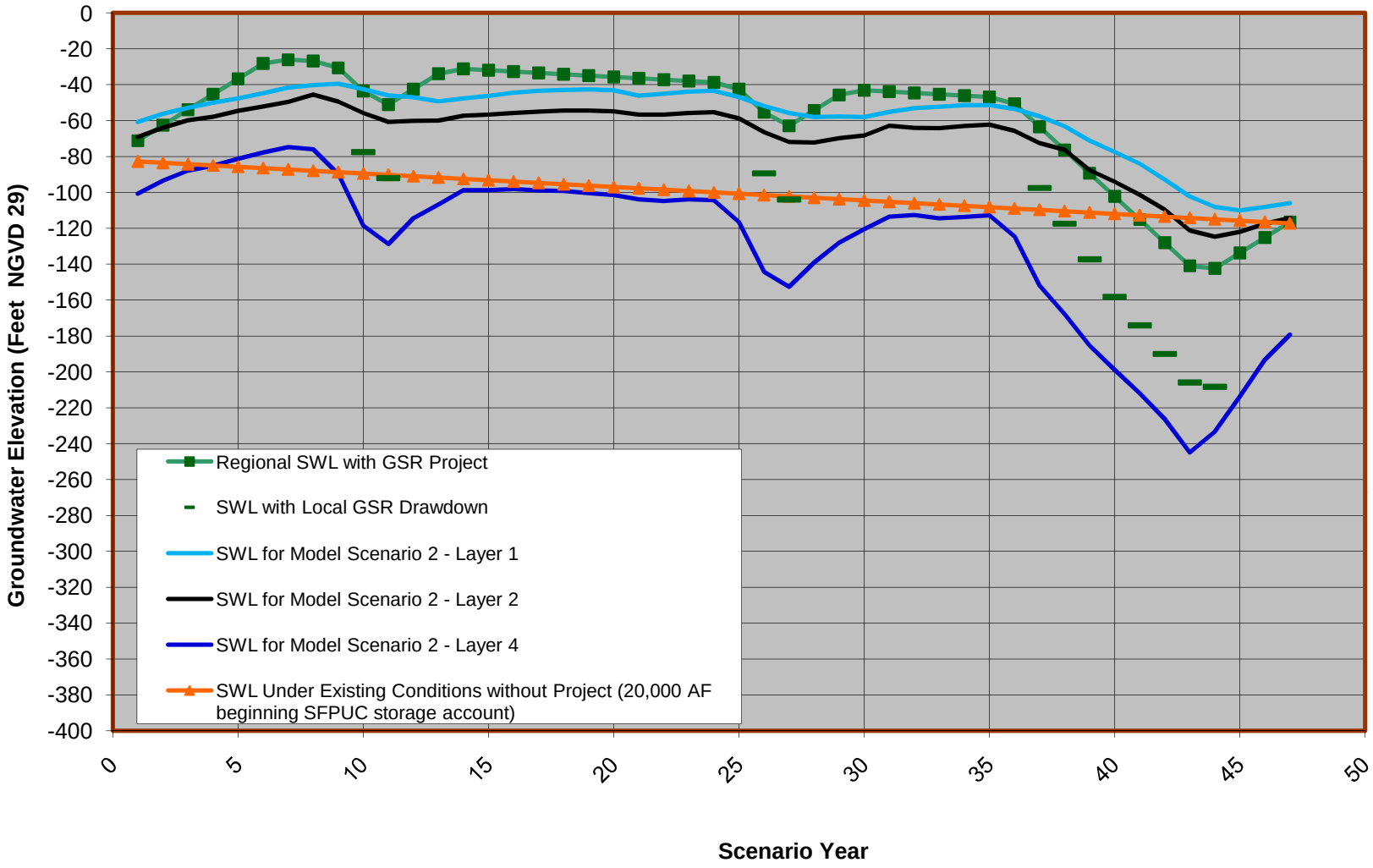


Figure C-11. Estimated Static Water Levels at Cypress Lawn Cemetery Well 3 for GSR Project

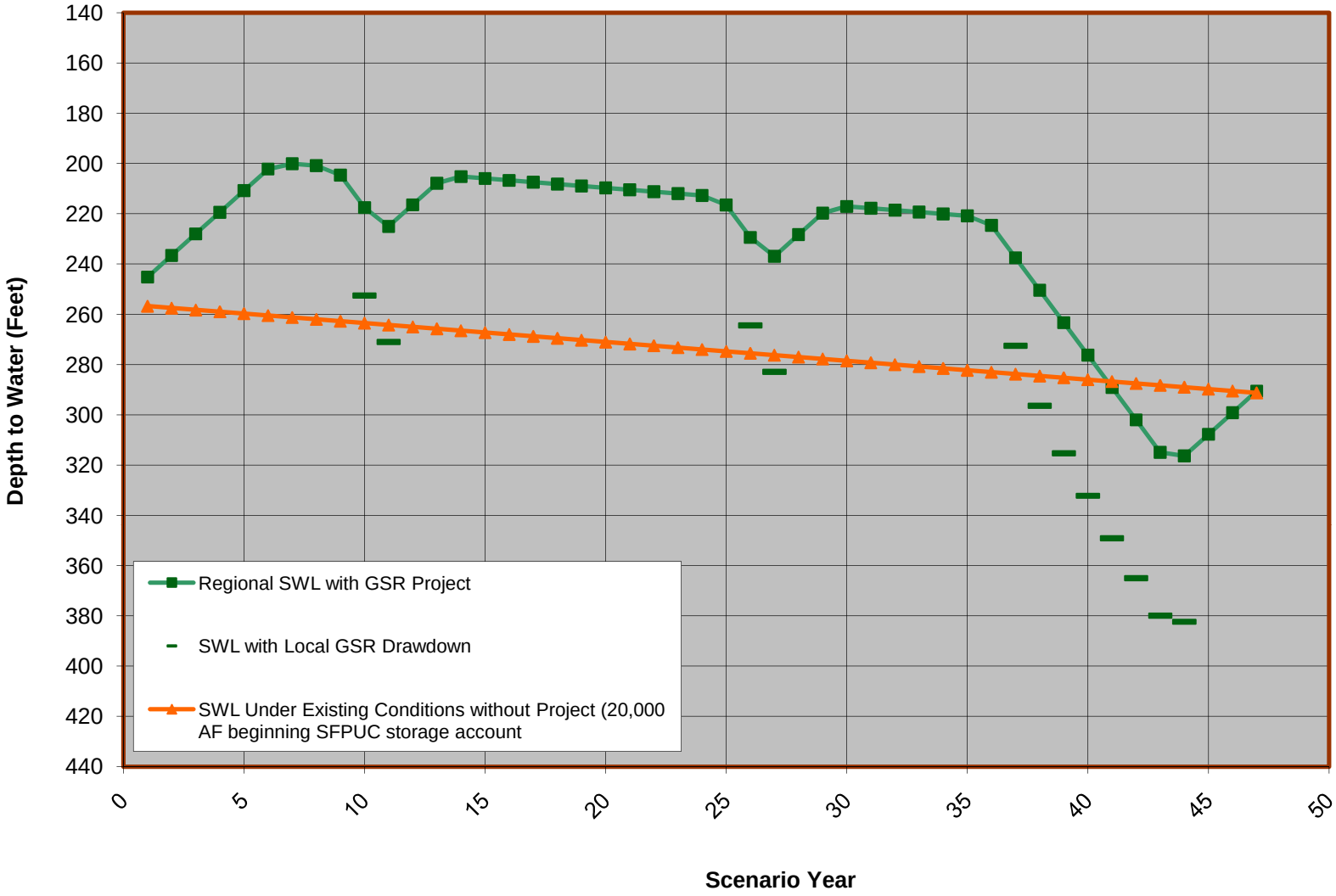


Figure C-12. Estimated Groundwater Elevations at Cypress Lawn Cemetery Well 3 for GSR Project (Scenario 2)

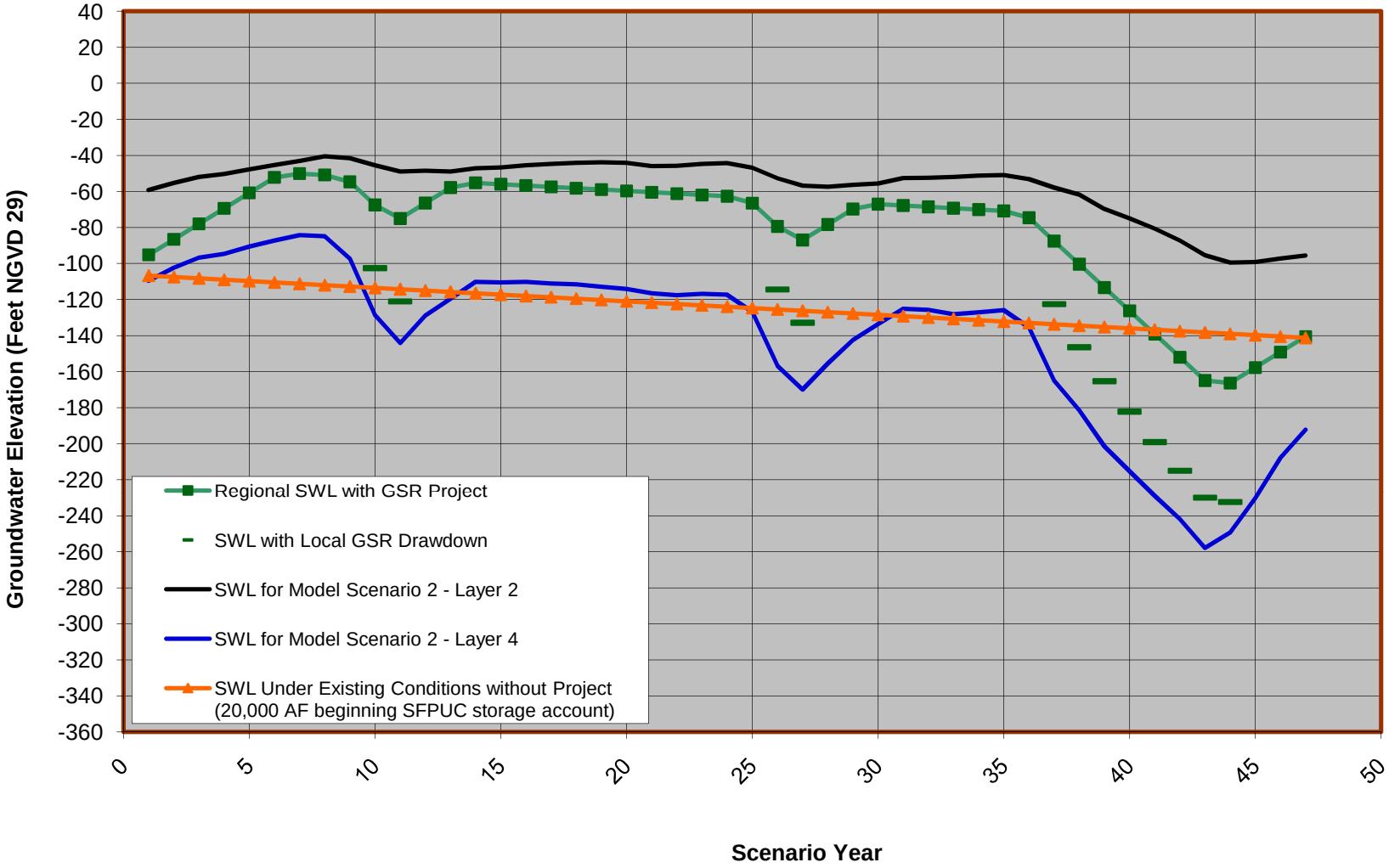


Figure C-13. Estimated Static Water Levels at Cypress Lawn Cemetery Well 4 for GSR Project

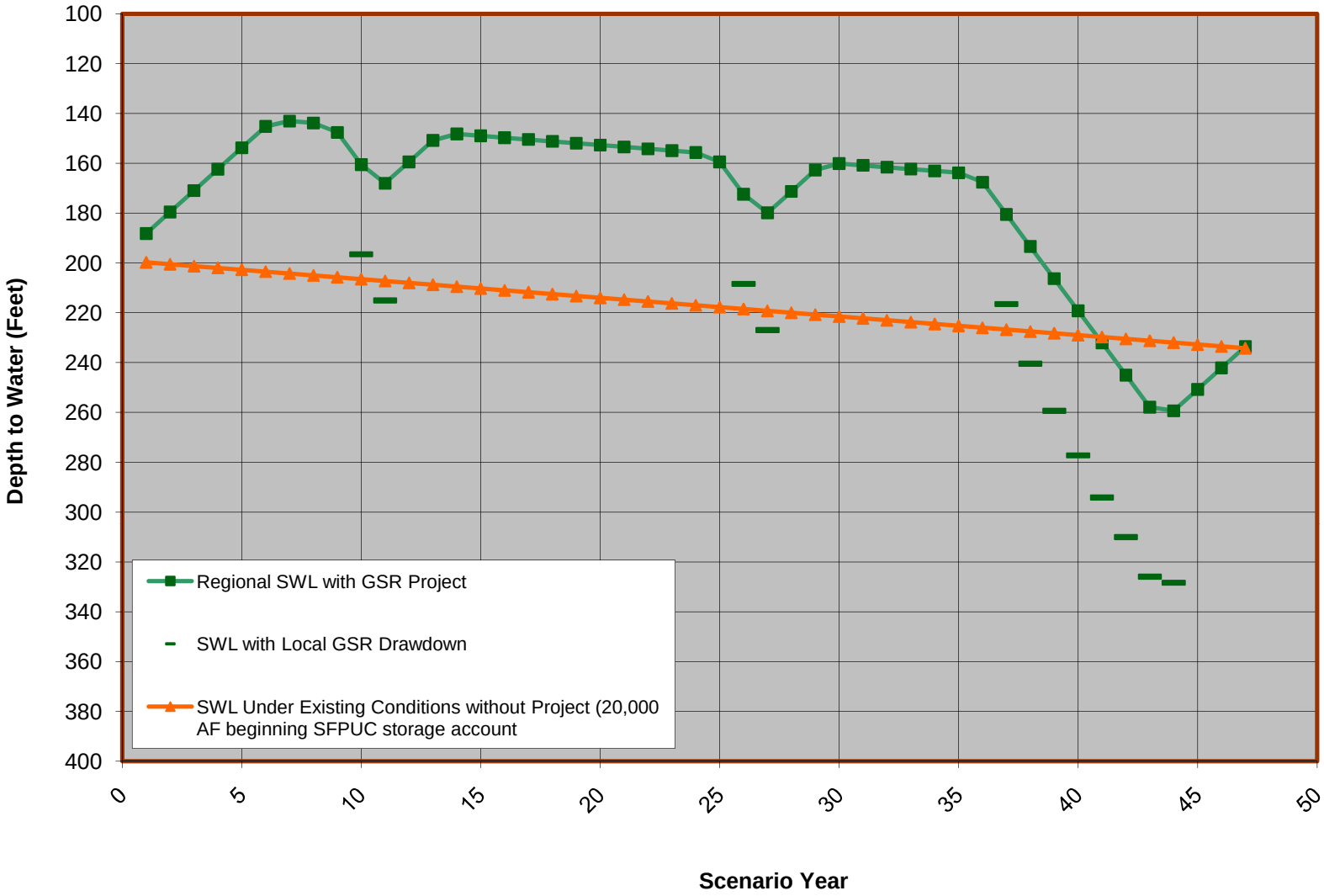


Figure C-14. Estimated Groundwater Elevations at Cypress Lawn Cemetery Well 4 for GSR Project (Scenario 2)

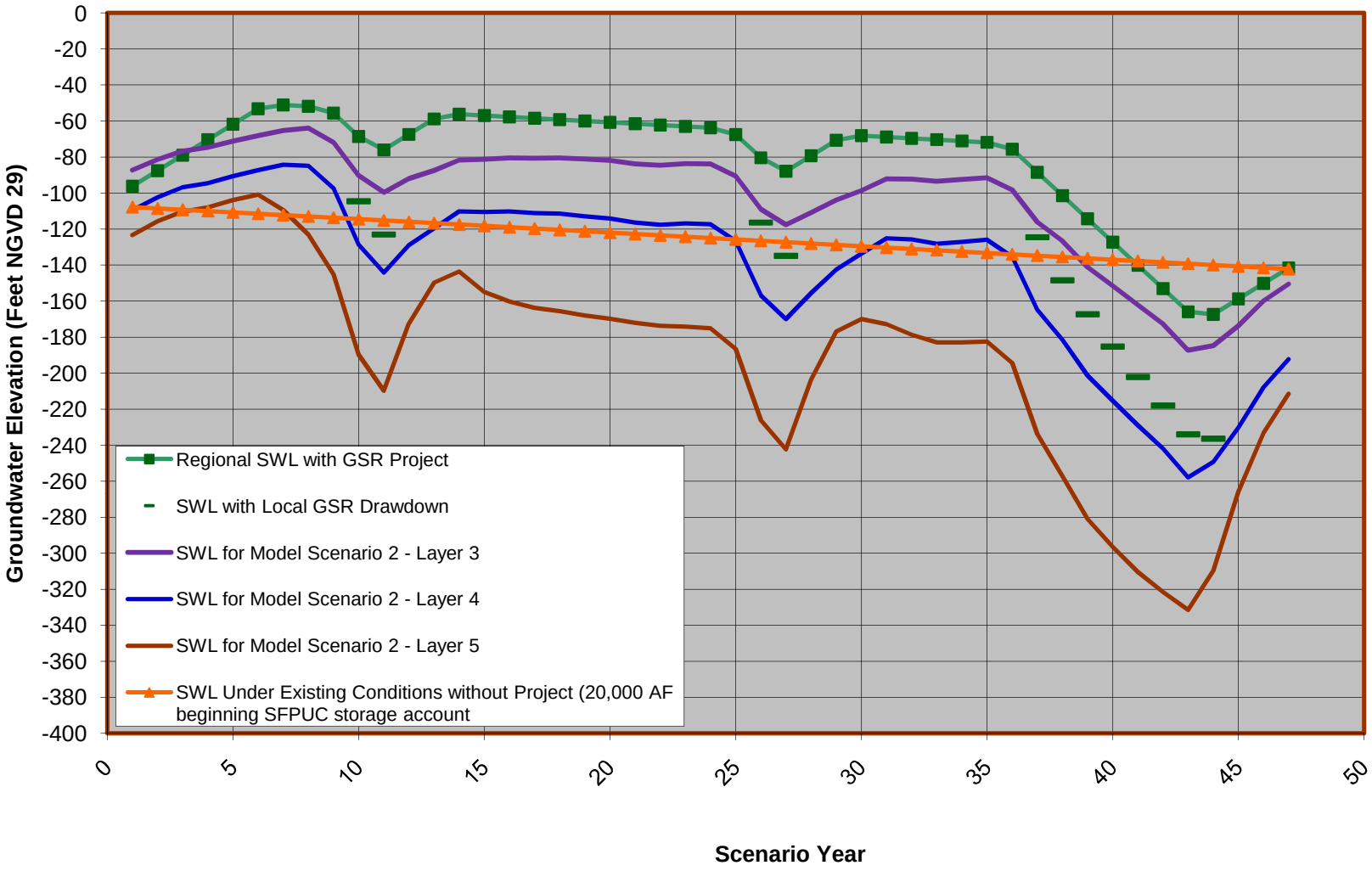


Figure C-15. Estimated Static Water Levels at Holy Cross Cemetery Well 1 for GSR Project

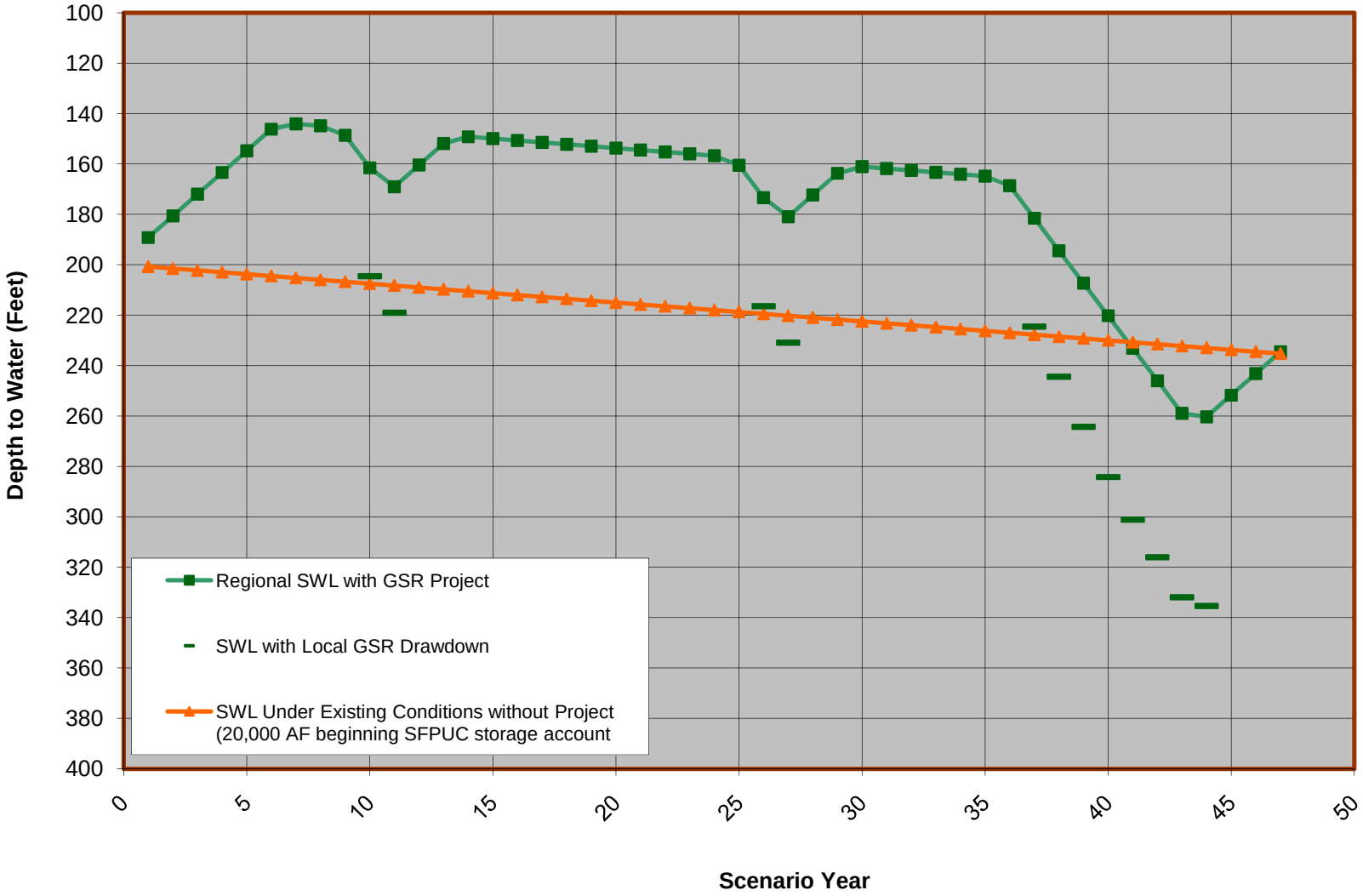


Figure C-16. Estimated Groundwater Elevations at Holy Cross Cemetery Well 1 for GSR Project (Scenario 2)

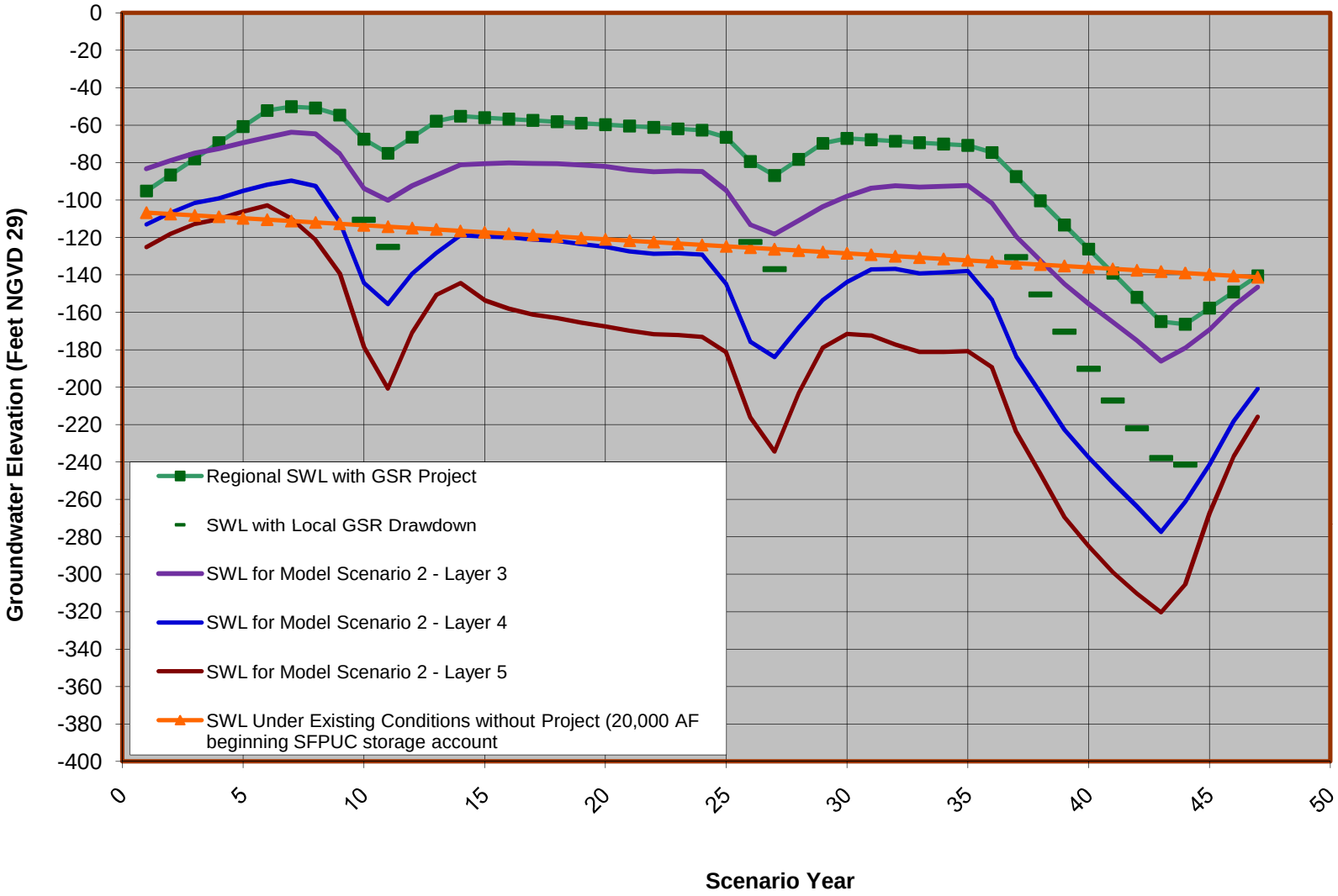


Figure C-17. Estimated Static Water Levels at Holy Cross Cemetery Well 4 for GSR Project

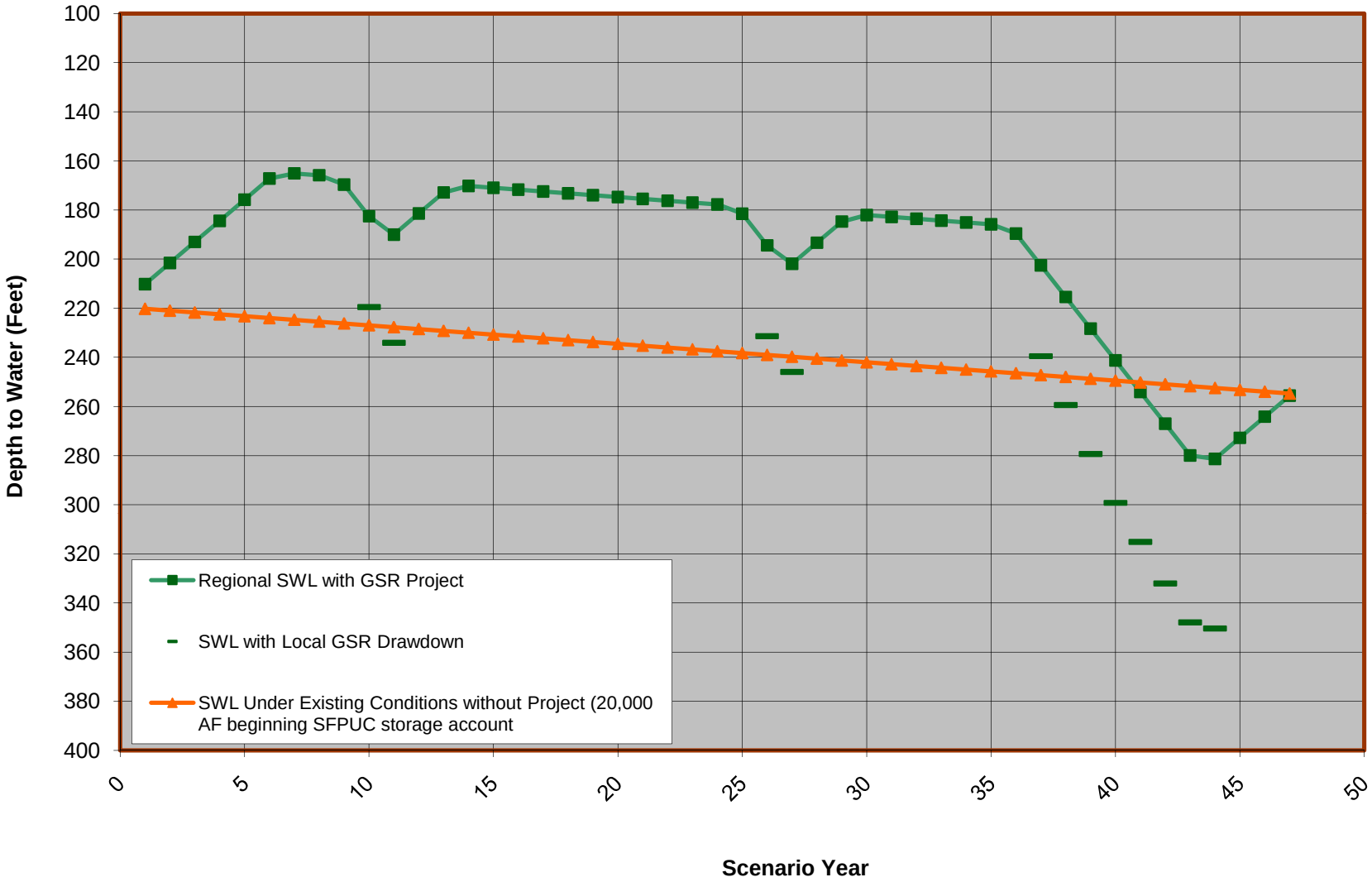


Figure C-18. Estimated Groundwater Elevations at Holy Cross Cemetery Well 4 for GSR Project (Scenario 2)

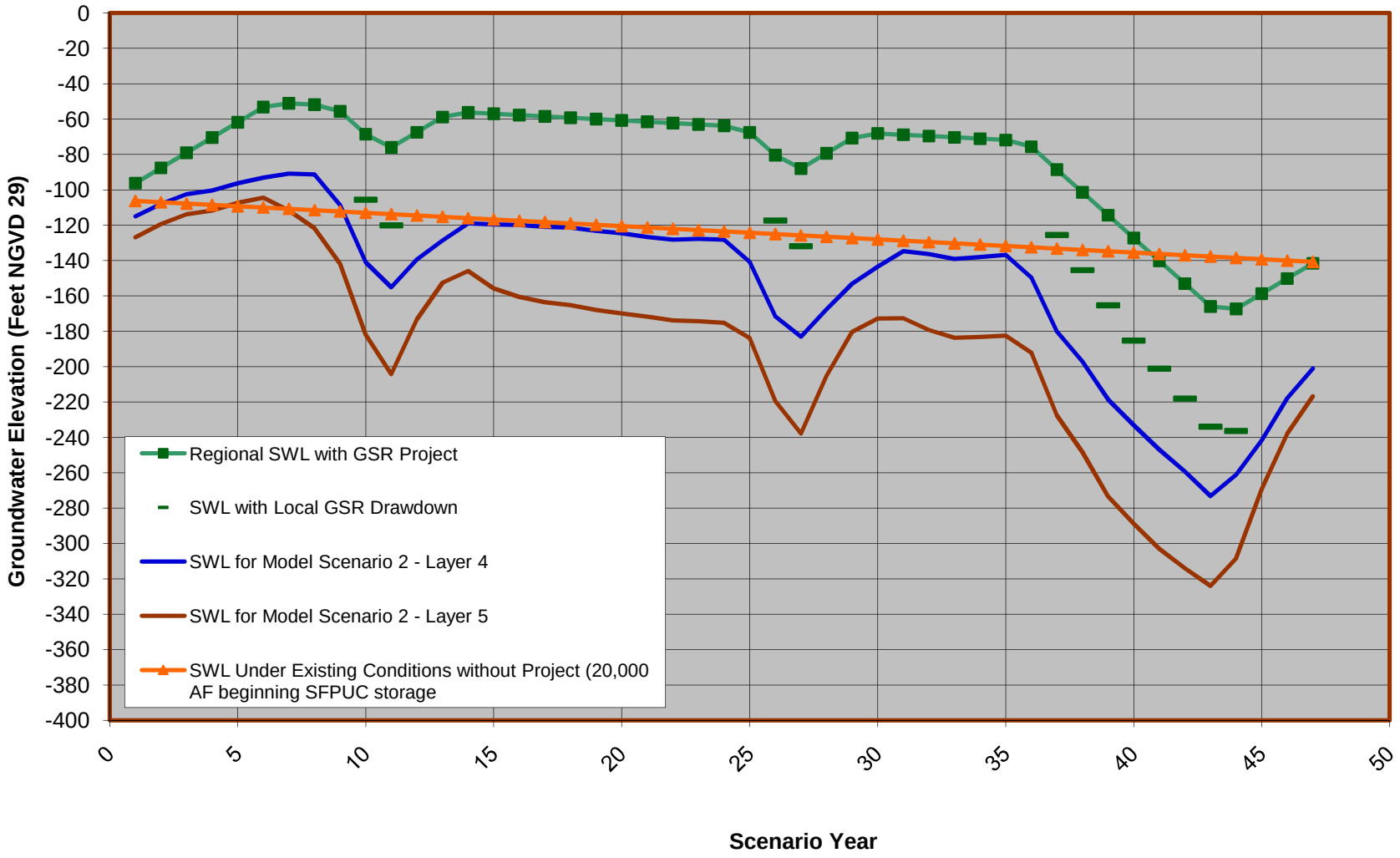


Figure C-19. Estimated Static Water Levels at California Golf Club Well 7 for GSR Project

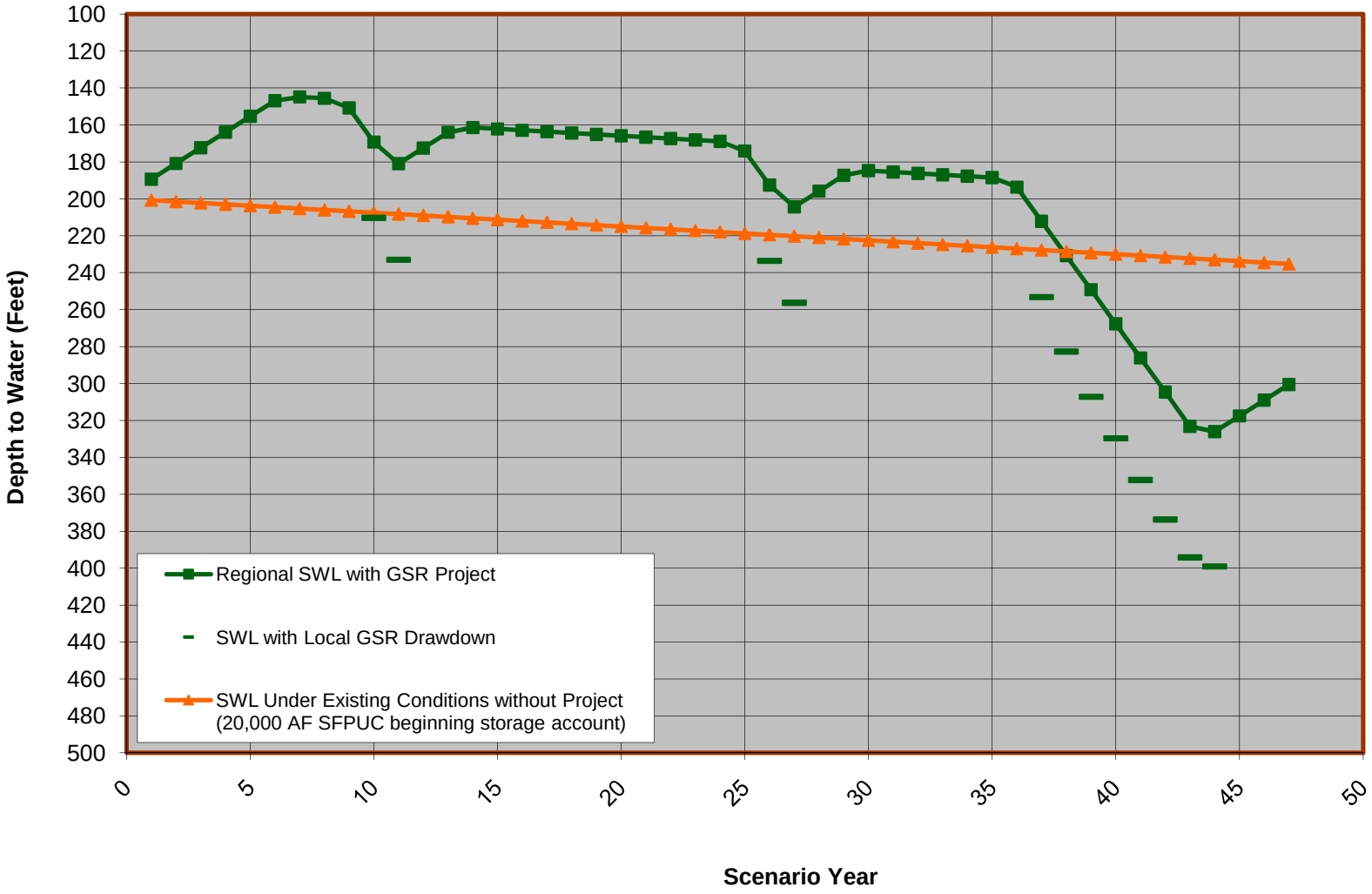


Figure C-20. Estimated Groundwater Elevations at California Golf Club Well 7 for GSR Project

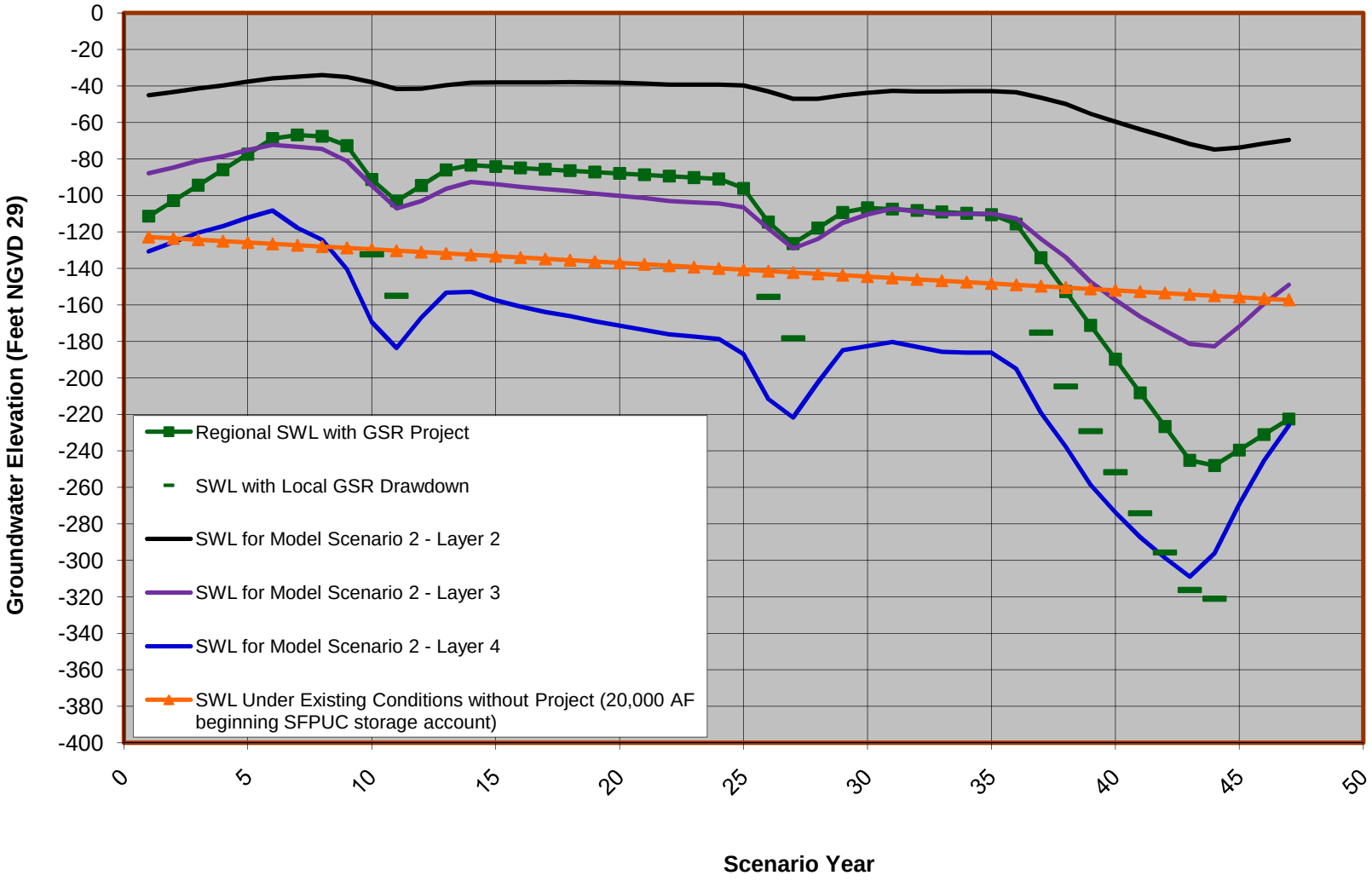


Figure C-21. Estimated Groundwater Elevations at Olympic Club Well No. 2 (#8) for GSR Project (Scenario 2)

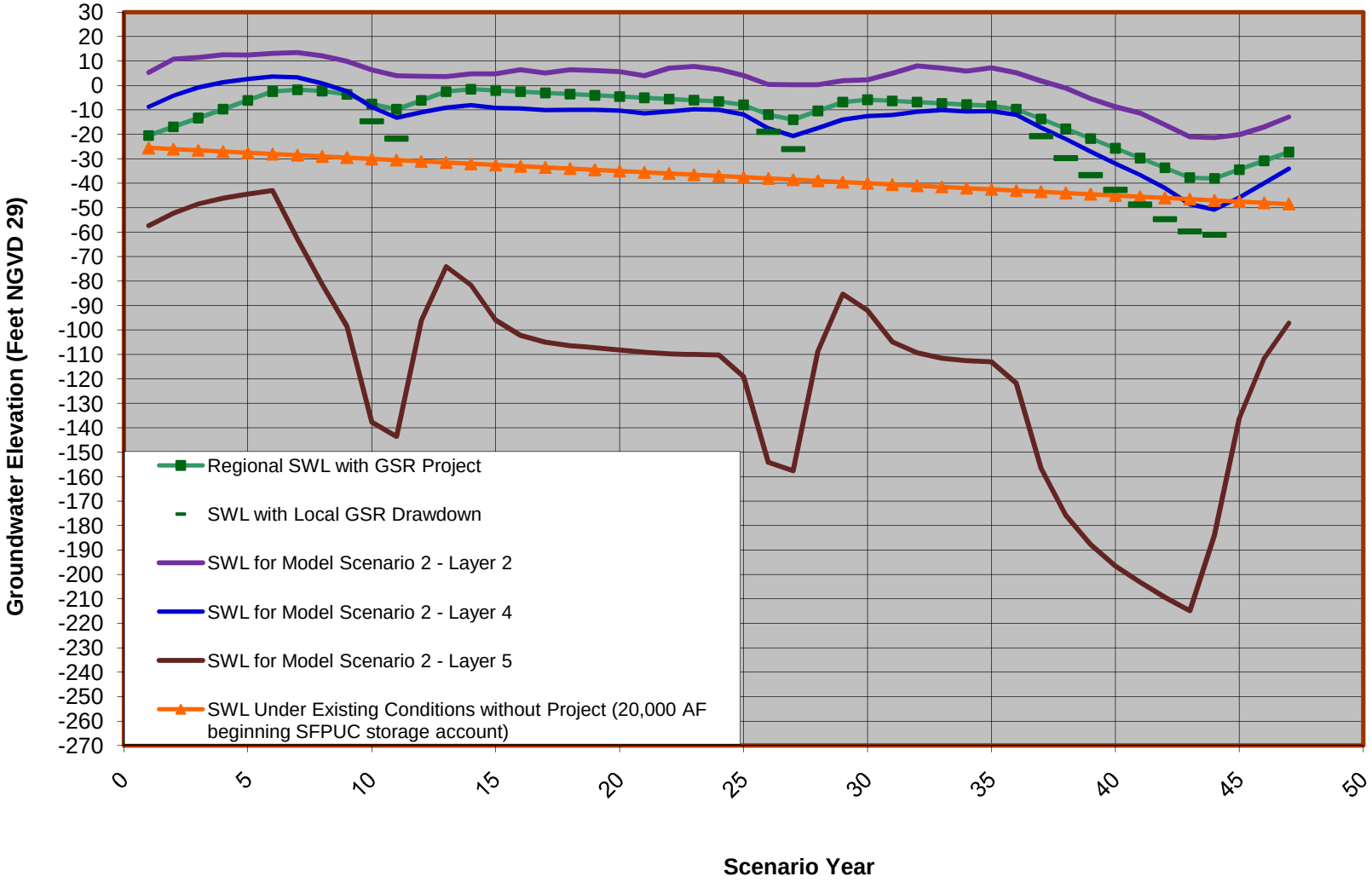


Figure C-22. Estimated Static Water Levels at San Francisco Golf Club Well 2 for GSR Project

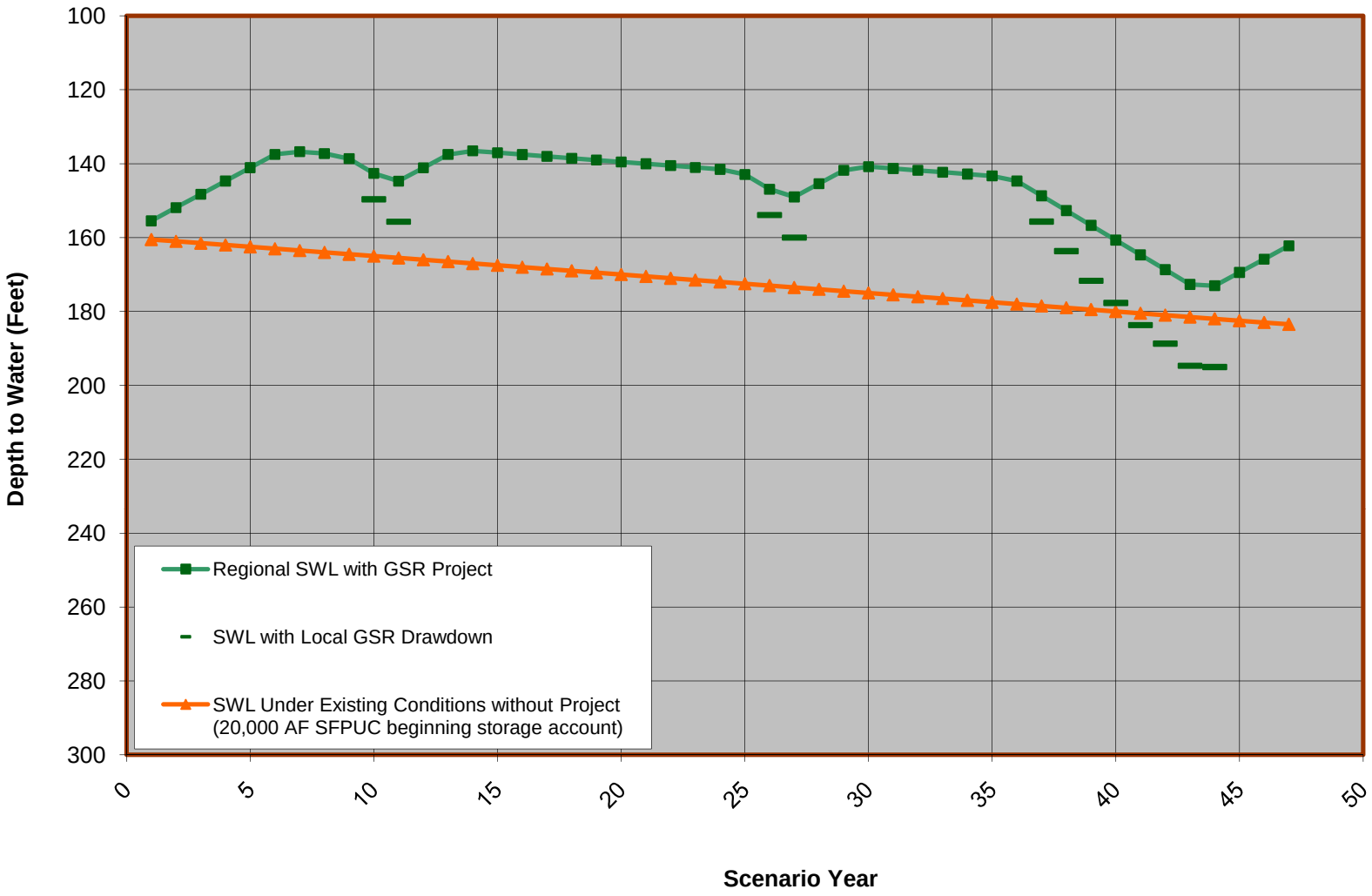
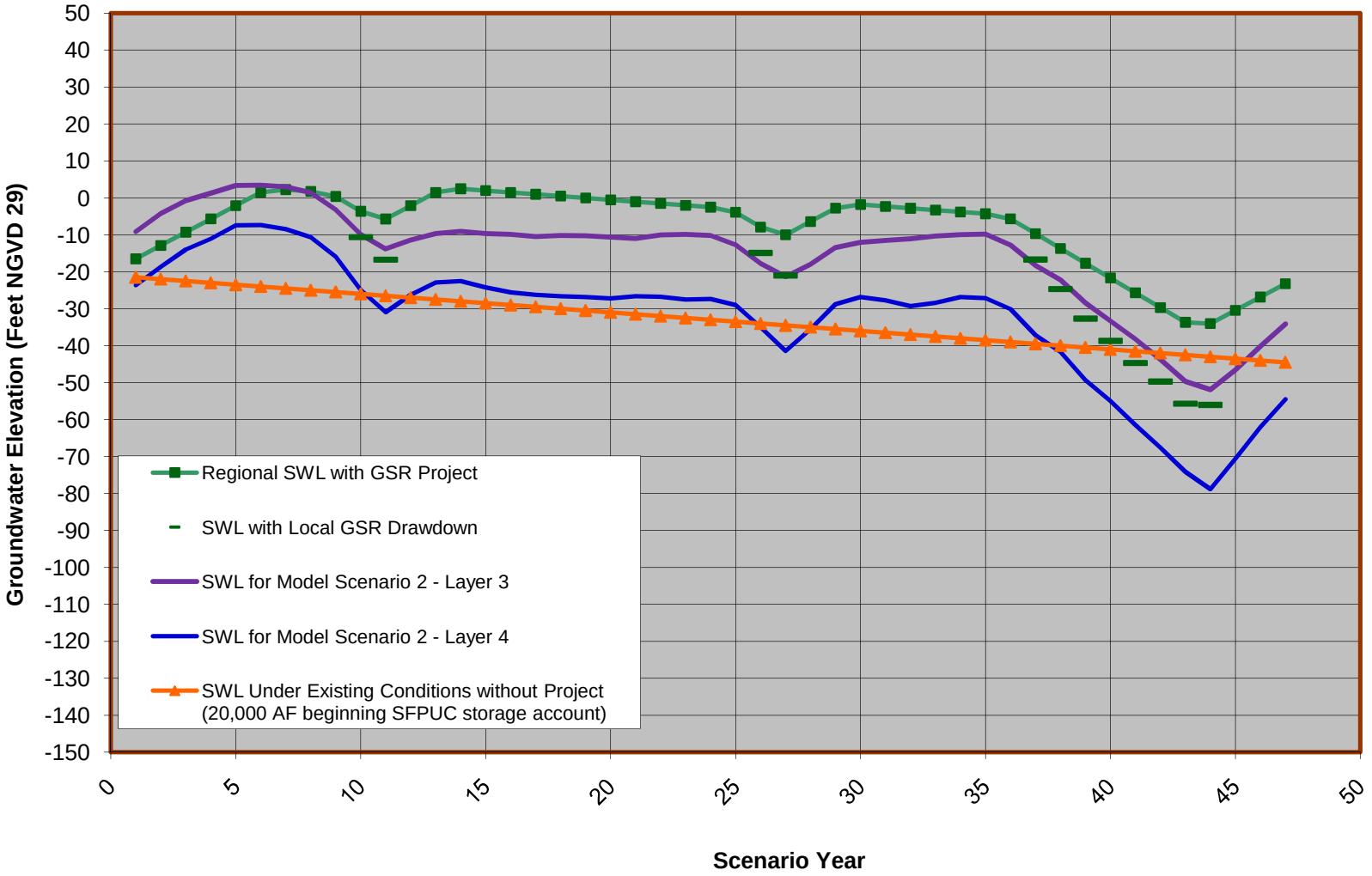


Figure C-23. Estimated Groundwater Elevations at San Francisco Club Well 2 for GSR Project (Scenario 2)



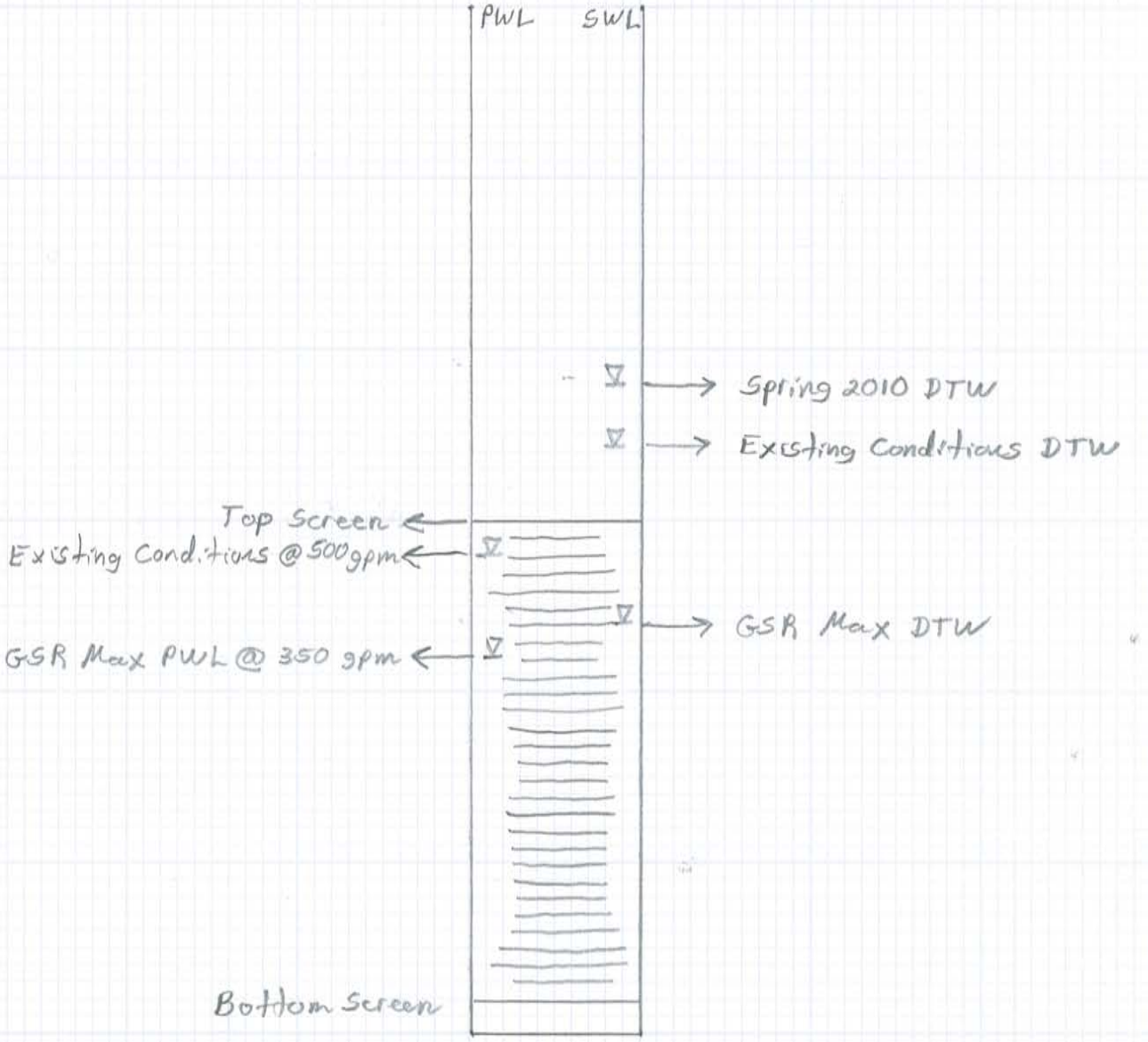
APPENDIX D

Job No.:_____ By:_____ Date:_____

Form: Vta.(comp 11/93)
COMPUTATIONS

Checked By:_____ Date:_____ Sheet No.____of____

Subject: Typical Third Party Well
Intermediate Depth to Top Screen



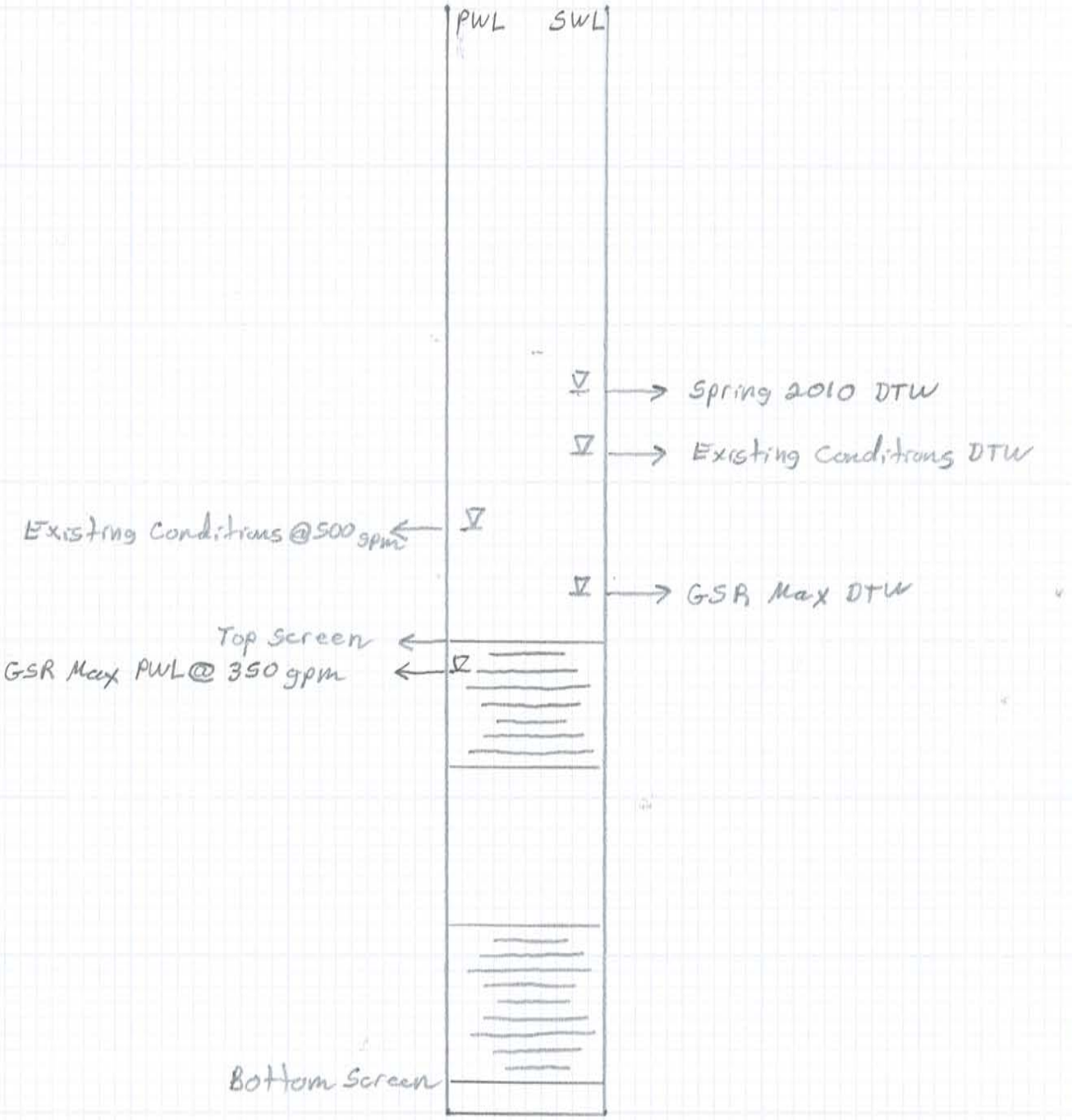
Note: Schematic - Not to Scale

Job No.:_____ By:_____ Date: _____

Form: Vta.(comp 11/93)
COMPUTATIONS

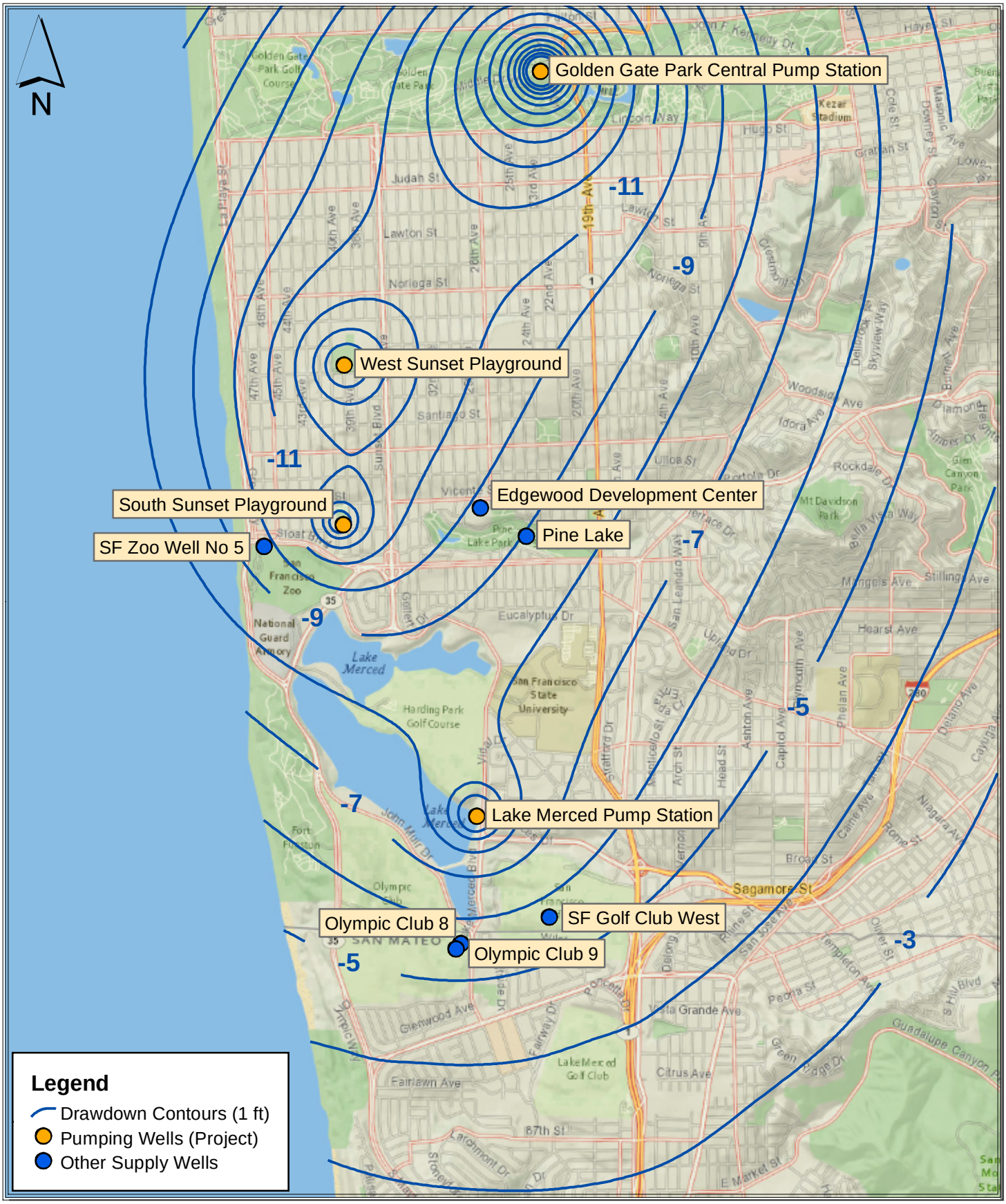
Checked By:_____ Date:_____ Sheet No.___of___

Subject: Typical Third Party Well
Deep Depth to Top Screen



Note: Schematic - Not to Scale

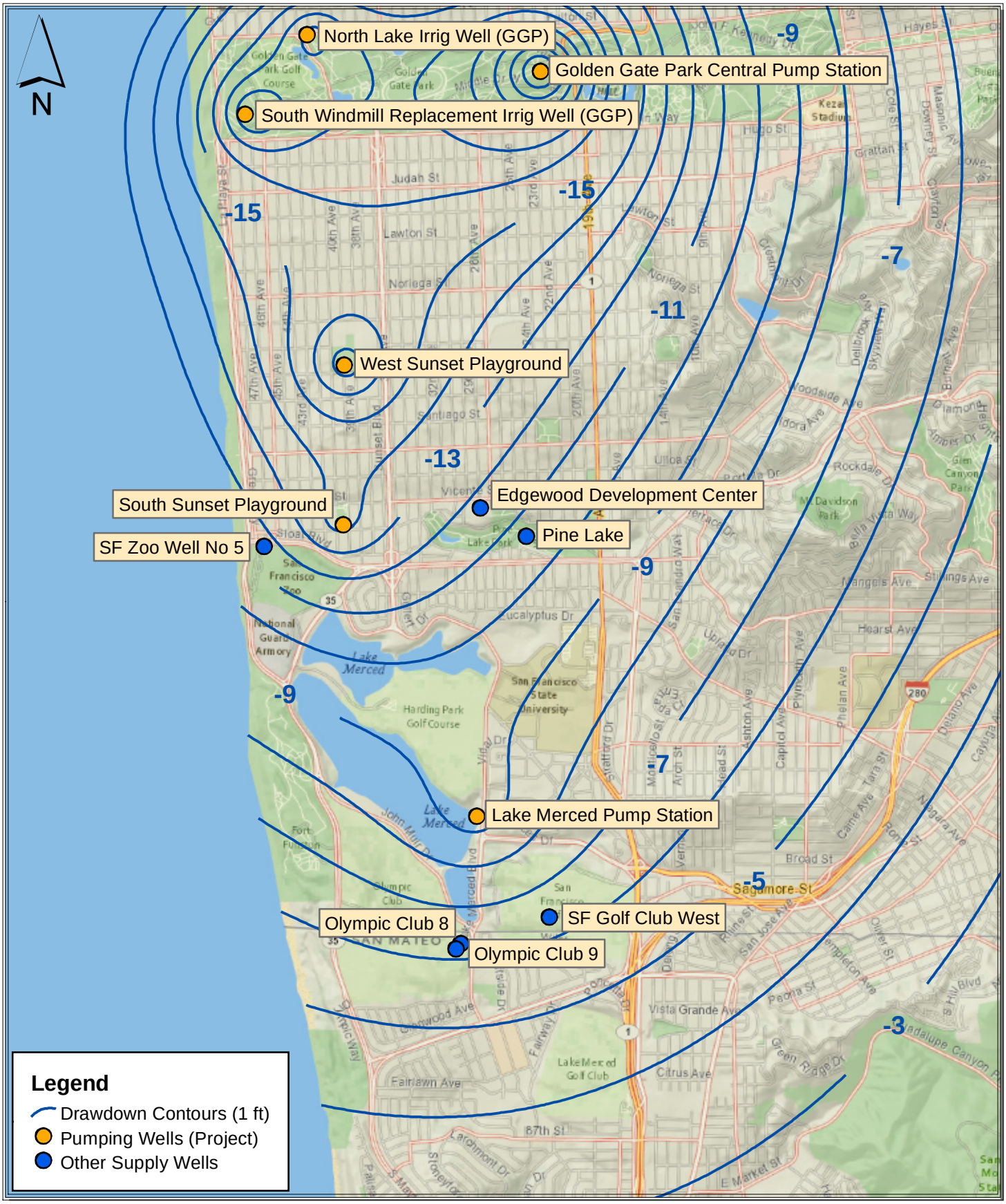
APPENDIX E



X:\2010 Job Files\10-077\Task 10 8a\GIS\Figure X ScenarioA_dd.mxd

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure No
Drawdown Following 1 Year of Pumping
Scenario A Four Project Wells Pumping



X:\2010 Job Files\10-077\Task 10 8a\GIS\Figure 2 ScenarioB_dd.mxd

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure No
Drawdown Following 1 Year of Pumping
Scenario B Six Project Wells Pumping

APPENDIX F

Appendix F-1
Third Party Well Construction Details

WELL	GROUND ELEVATION (ft NGVD)	TOP OF SAND PACK (ft bgs)	TOP OF SCREEN (ft bgs)
Elk Glen Well	172	60	170
SF Zoo Well No. 5	32	130	160
Pine Lake [1]	83	48	98
Edgewood Development Center [1]	158	30 (liner)	120 (liner)
Olympic Club 8	61	50	200
Olympic Club 9	78	230	260
SF Golf Club West	148	50	360
City of Daly City Westlake (DC2)	110	255	340
Lake Merced Golf Club No. 1			
Lake Merced Golf Club No. 2			
Lake Merced Golf Club No. 3		50	294

NOTES:

1 - Information obtained by Jeff Gilman, SFPUC Water Enterprise. Well also known as Stern Grove W-2.

Table F-2
Third Party Well Pump Data [1]

WELL	Pump Make	Pump Model	Stages	Current or Design Capacity (gpm)	Other Information
SF Zoo Well No. 5	Goulds	12DHLC	4	1,160	Current capacity as observed in 2009 using Magmeter: 1,160 gpm (multiple observations).
Pine Lake	Flowserve	8MEL	10	250	Current capacity as observed in 2010.
Edgewood Development Center	Grundfos	25S50	26	25	Grundfos pump was noted in 1993 inspection for Groundwater Master Plan. Current pump is Goulds; assume to have similar head-capacity relationship for analysis of interference effects.
Olympic Club 8	Byron Jackson	11MQH	4	1,000	260 ft Column; Pump Intake at 270 ft.
Olympic Club 9	Byron Jackson	10GH	6	700	240 ft Column; Pump Intake at 248-250 ft.
SF Golf Club West	Byron Jackson	10MQH	9	700	345 ft Shaft and Oil Tubes on Work Order.
City of Daly City Westlake (DC2)	Byron Jackson	10MQL	9	500	Pump setting depth at 415 ft.
Lake Merced Golf Club No. 1	Not Available				
Lake Merced Golf Club No. 2	Not Available				
Lake Merced Golf Club No. 3	Not Available				

NOTES:

1 - Pump data obtained from SFPUC records and information requests to well owners. Contacts and site visits to Pine Lake and Edgewood Development Center by Jeff Gilman, SFPUC Water Enterprise.

\