2.1 CLIMATE

The South Westside Basin's location in a valley between the Pacific Ocean and San Francisco Bay gives it a variable, but mild, marine climate. Winters are mild and moderately wet and summers are cool and dry (National Oceanic and Atmospheric Administration, 2009). The valley serves as a gap in the coast range, allowing cool, moist marine air into the central Bay Area. Generally, areas closer to the Pacific Ocean or closer to the valley experience the most marine effects, notably lower summer temperatures and lower evapotranspiration, while those areas in the south of the basin, such as Burlingame, experience less marine influence and have more sunshine, higher summer temperatures, and higher evapotranspiration rates.

This climate, along with limited outdoor water use, contributes to water demand that is only somewhat higher in the summer than in the winter. Average monthly temperature and reference evapotranspiration data are shown in Table 2.1. Temperature data are from San Francisco International Airport (SFIA), within the Plan Area; however, the closest reference evapotranspiration data is from Woodside, south of the Plan Area. Temperature, evapotranspiration, and rainfall are variable in the basin and are driven by proximity to the Pacific Ocean and local topography. Areas closer to the ocean are cooler and cloudier, with lower evapotranspiration. Higher elevation areas have more rainfall.

Table 2.1 Average Monthly Temperature and Reference Evapotranspiration

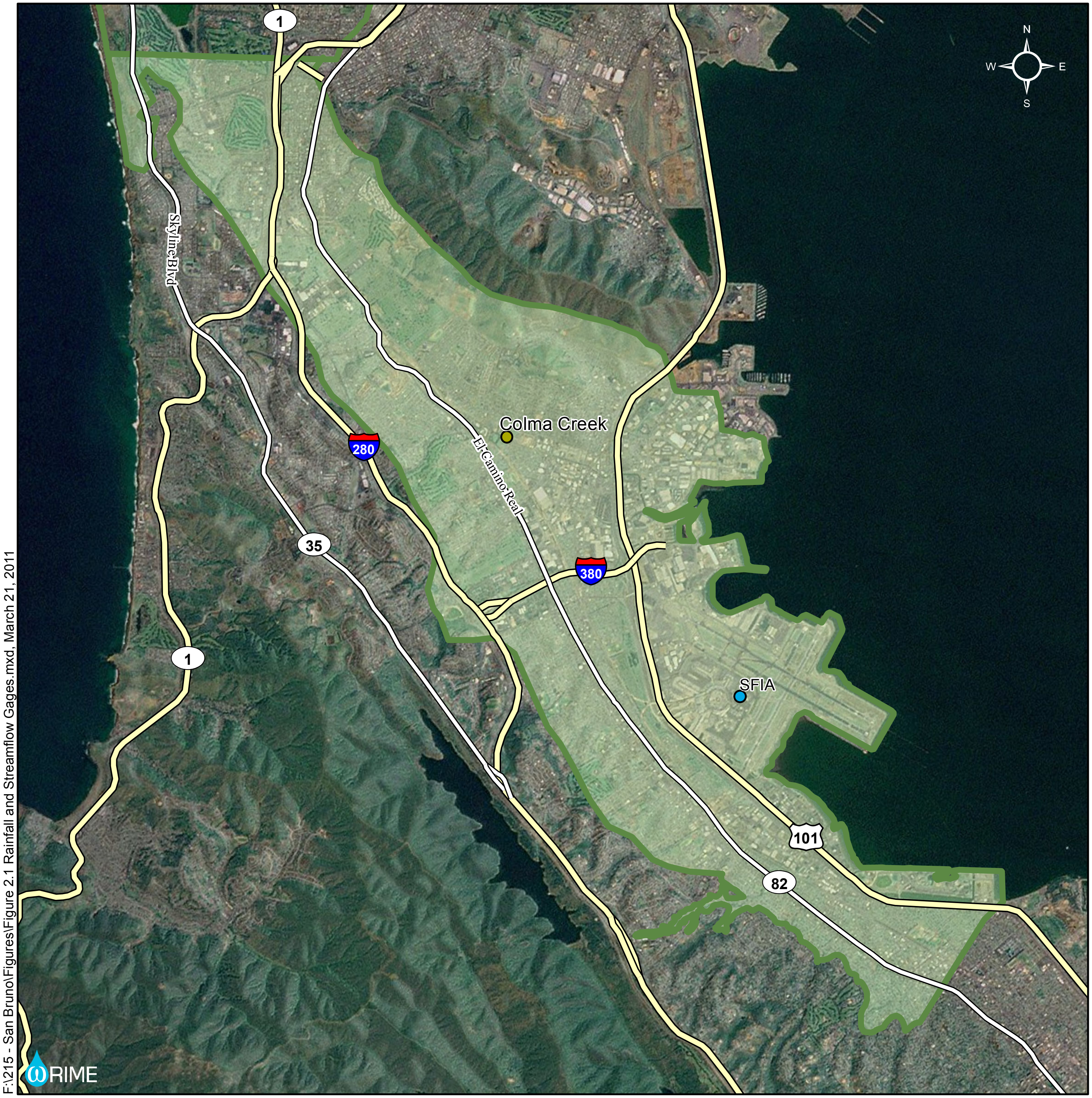
Parameter	Month												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average maximum temperature (°F)*	55.8	59.1	61.2	63.8	66.8	70.0	71.4	72.1	73.5	70.1	62.9	56.4	65.3
Average minimum temperature (°F)*	42.5	45.0	46.2	47.7	50.3	52.7	54.1	55.0	54.9	51.9	47.4	43.2	49.2
Precipitation (inches)**	4.4	3.6	2.8	1.4	0.4	0.1	0.0	0.1	0.2	1.0	2.3	3.7	20.0
Average reference evapotranspiration (inches)***	1.83	2.21	3.42	4.84	5.61	6.26	6.47	6.22	4.84	3.66	2.36	1.83	49.54

* Source: Western Regional Climate Center, 2011. San Francisco WSO AP, California (047769). Period of record 7/1948 – 9/2010.
** Source: NOAA-NCDC, 2007, 2009, 2011
*** Source: California Irrigation Management Information System (CIMIS), 2009. 96 Woodside. Period of record 10/1990 – 1/1994

The National Weather Service through its Cooperative Network collects rainfall data at SFIA: Coop ID #047769 (see Figure 2.1). Data are available from May 1928 through present.

The historical record of annual rainfall and the cumulative departure from annual mean at SFIA are shown in Figure 2.2. The long-term average annual precipitation for the period from 1949 to 2010 is 20 inches. Figure 2.3 shows the long-term average monthly precipitation at SFIA. Most precipitation occurs as rainfall during the mild winters, from November through April. A map of the spatial distribution of precipitation by HydroFocus (2011) is shown in Figure 2.4. Across the basin, annual precipitation ranges from less than 20 inches along San Francisco Bay near SFIA and along the Pacific Ocean in Daly City to approximately 24 inches in the center of the valley near Colma and South San Francisco to approximately 30 inches in the hills above the valley.

Figure 2.1
Rainfall and Streamflow Gages

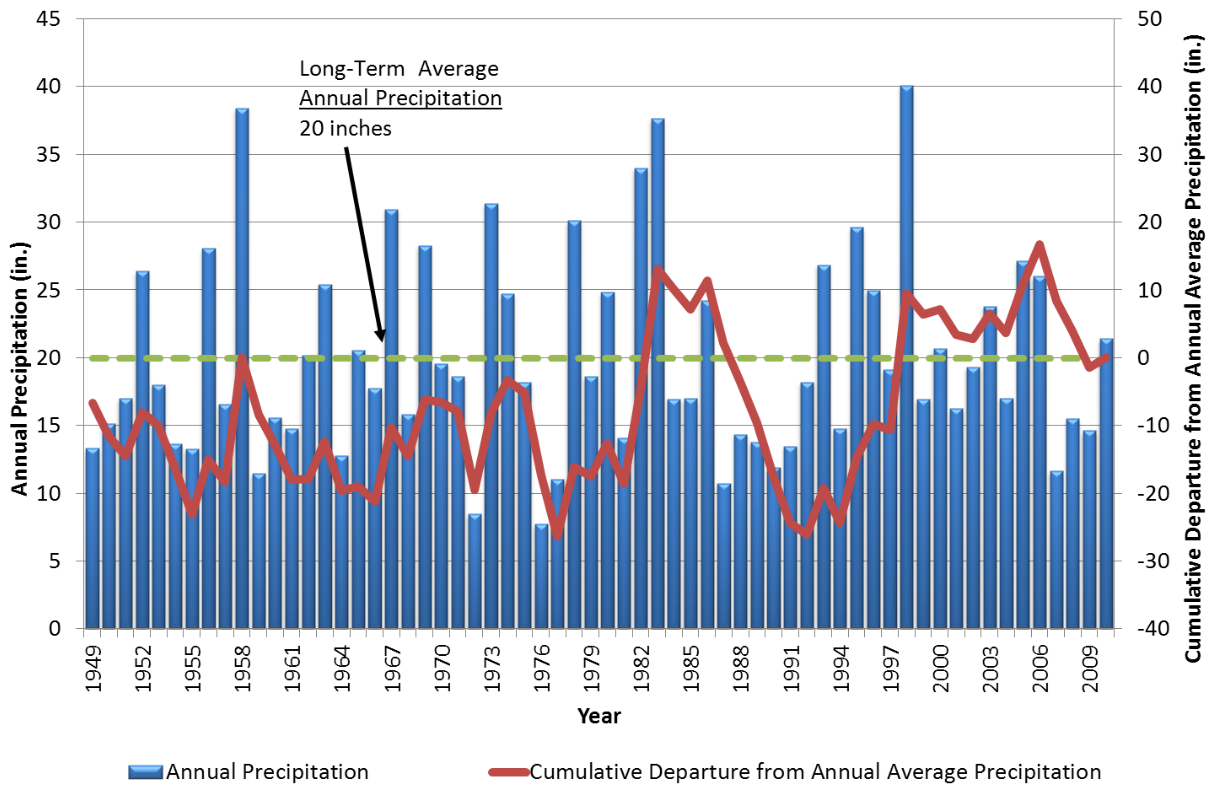


Legend

- Highways
- Groundwater Basin
- Plan Area
- NOAA Precipitation Gage
- USGS Streamflow Gage

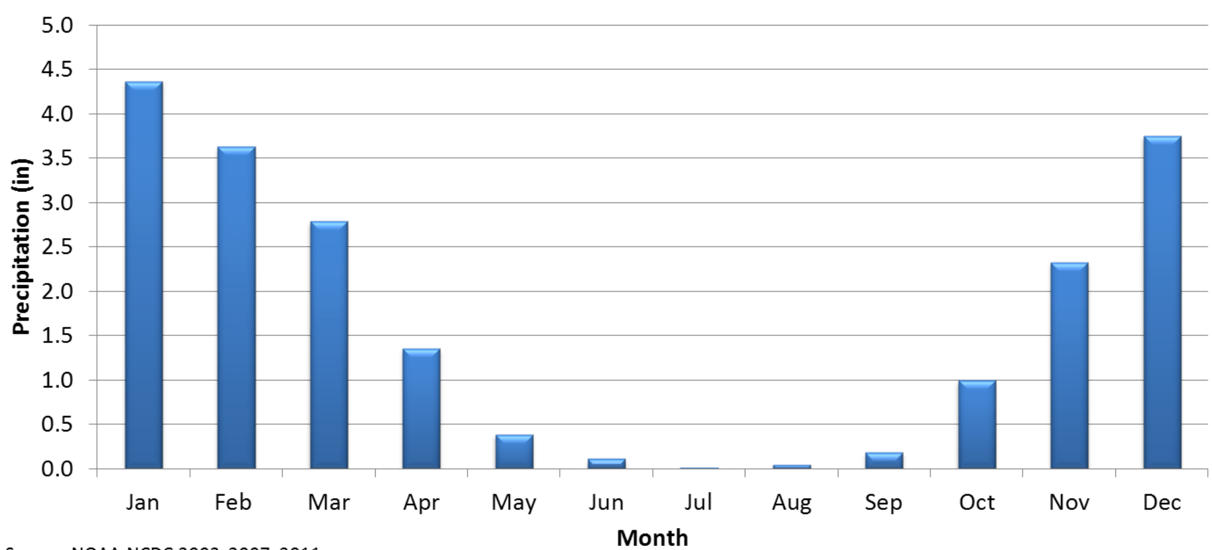
0 0.5 1 2 Miles

F:\215 - San Bruno\Figures\Figure 2.1 Rainfall and Streamflow Gages.mxd, March 21, 2011



Data Source: NOAA-NCDC, 2002, 2007, 2011.

Figure 2.2 Historical Annual Precipitation and Cumulative Departure from Mean Precipitation



Source: NOAA-NCDC 2002, 2007, 2011

Figure 2.3 Average Monthly Precipitation

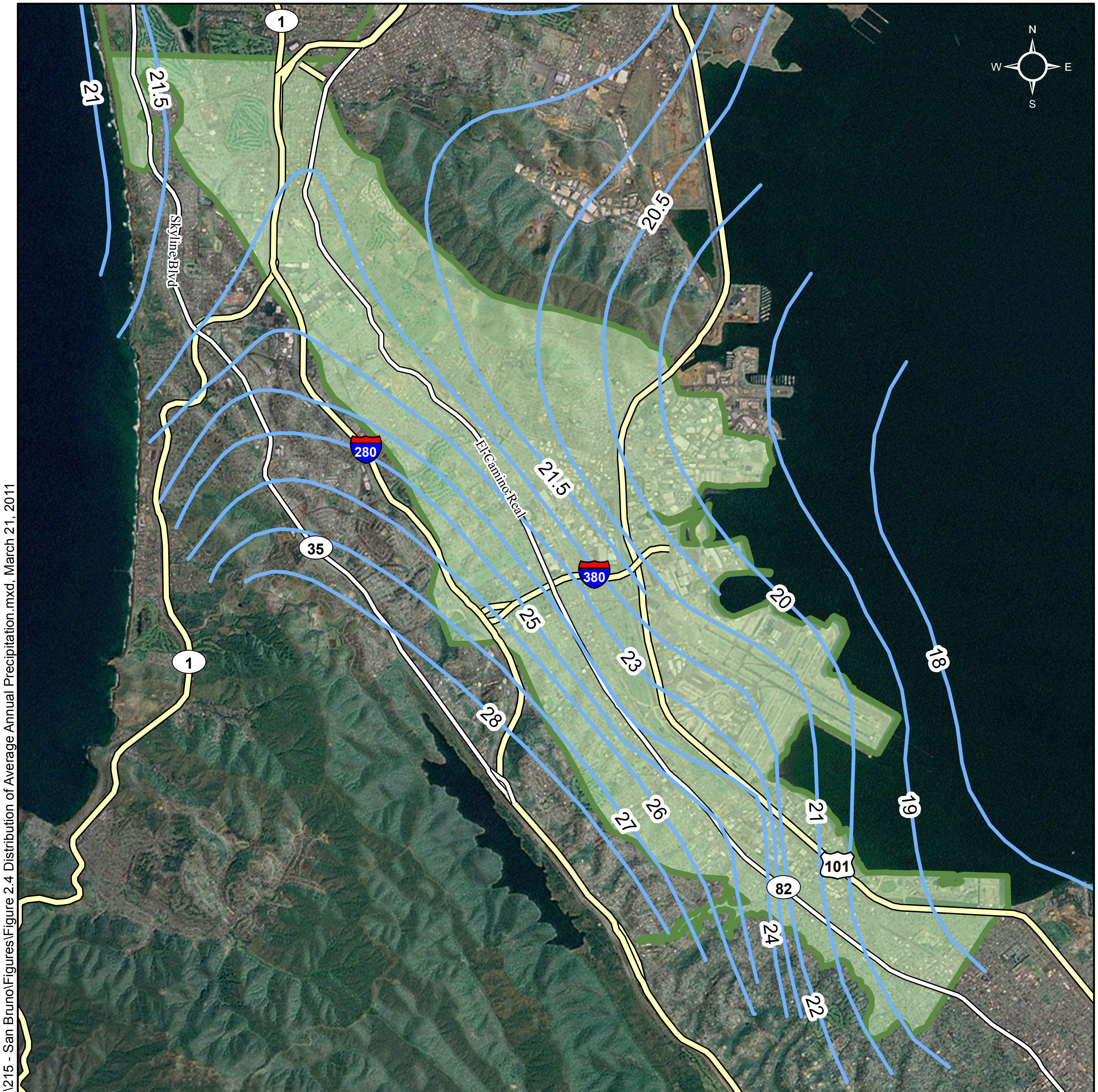


Figure 2.4
Distribution of Average Annual Precipitation

Legend

Precipitation (in)

Highways

Groundwater Basin

Plan Area

0 0.5 1 2 Miles

Source: Precipitation - HydroFocus, 2011

F:\215 - San Bruno\Figures\Figure 2.4 Distribution of Average Annual Precipitation.mxd, March 21, 2011

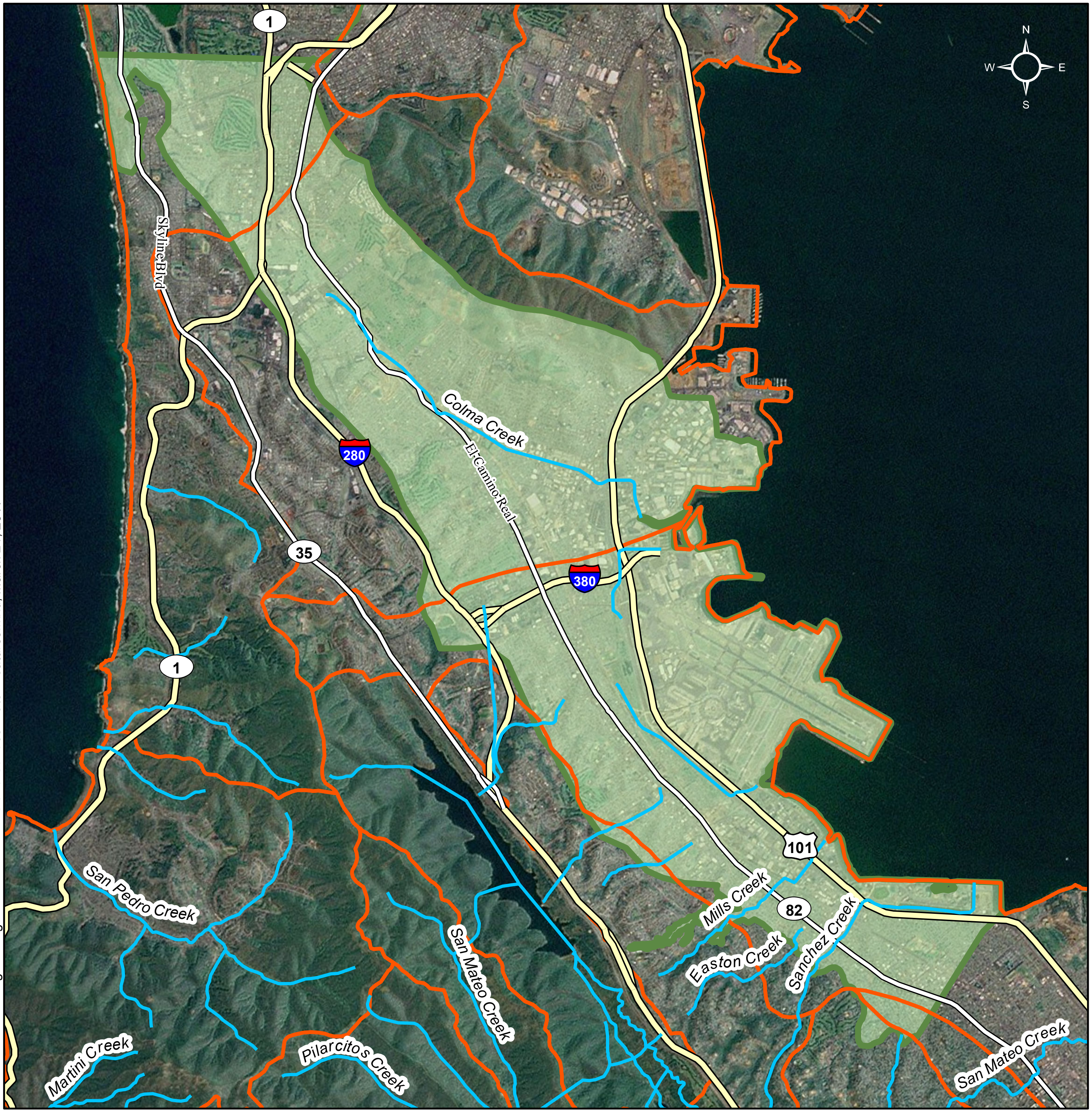
2.2 SURFACE WATER

Major watersheds and surface water features are shown in Figure 2.5. The largest watersheds are Colma Creek Watershed and Vista Grande Watershed.

Colma Creek is a small creek draining much of South San Francisco and the surrounding area before entering into San Francisco Bay just north of SFIA and the eastern terminus of Interstate 380. Within the valley portion of the watershed, Colma Creek is an open engineered channel from the bay to near the Colma/South San Francisco city line. Much of the area upstream of South San Francisco and some small tributaries within South San Francisco drains through underground storm drains. Some of the uppermost reaches of the creek are natural channels, particularly on the slopes of San Bruno Mountain (Oakland Museum of California, 2011).

The only USGS streamflow gage in the South Westside Basin was located on Colma Creek (Figure 2.1). No longer active, the gage has recorded data from 1963 until 1996. Average monthly flows from the gage are presented on Figure 2.6a and the percent exceedance of daily streamflow is shown in Figure 2.6b. Average monthly streamflow is low, less than 5 cubic feet per second (cfs) in the summer and less than 20 cfs in the winter. High flow conditions are typically below 200 cfs. Work has been performed on the stream channel to reduce flooding in the area, particularly near Holy Cross Cemetery.

Figure 2.5
Watersheds and Surface Water Features



Legend

- Creeks/Streams
- Highways
- Watersheds
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

Source: NHD database and USGS

F:\215 - San Bruno\Figures\Figure 2.5 Watersheds and Surface Water Features.mxd, March 21, 2011

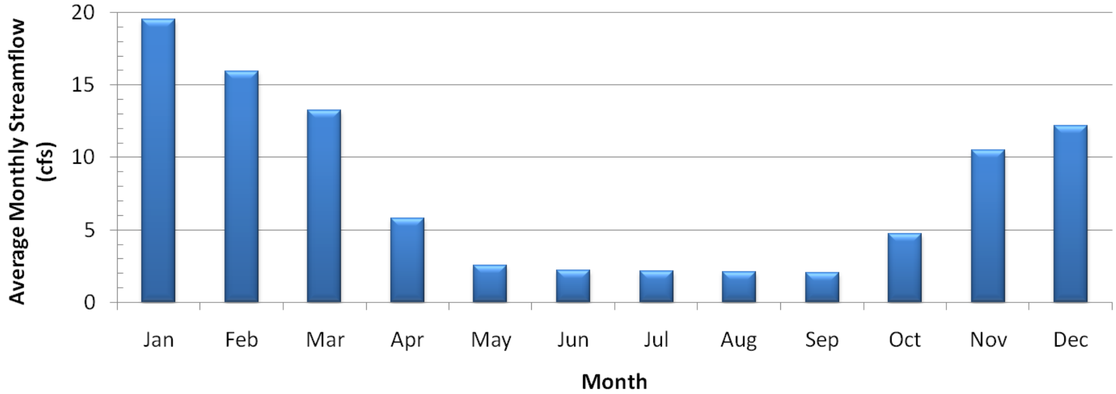


Figure 2.6a Average Monthly Colma Creek Streamflow, 1963-1996

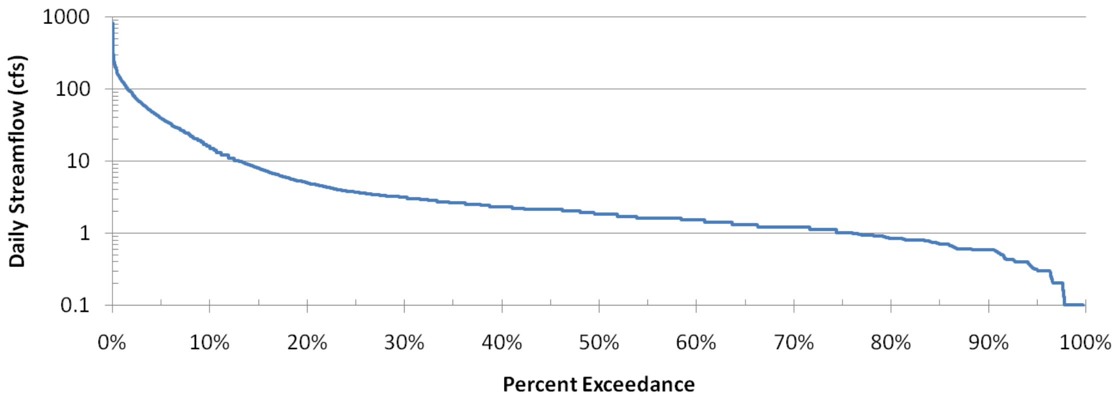


Figure 2.6b Daily Colma Creek Streamflow Exceedance, 1963-1996

The Vista Grande Watershed historically drained into Lake Merced, but has since been altered to flow to the Pacific Ocean. The 2.5 square mile watershed includes portions of Daly City as well as portions of unincorporated San Mateo County. Stormwater flows through the Vista Grande Canal for about 3,500 feet before flowing into the Vista Grande Outfall Tunnel. The tunnel discharges to the Pacific Ocean through an outfall beach structure below Fort Funston in Golden Gate National Recreation Area. (RMC, 2006)

Other creeks in the South Westside Basin include:

- San Bruno Creek in San Bruno
- Millbrae Creek in Millbrae
- Mills Creek in Burlingame
- Sanchez Creek in Burlingame

- San Mateo Creek, just south of the South Westside Basin in San Mateo

The major water features in the North Westside Basin are Lake Merced and several smaller lakes. These features, as they relate to groundwater, are discussed in the draft North Westside Basin GWMP.

2.3 GROUNDWATER

2.3.1 GEOLOGIC SETTING

The South Westside Basin is a structural basin within the Coast Ranges province of California. The Coast Ranges are dominated by northwest oriented mountain ranges and valleys. The mountains are steep but modest in elevation. Locally, the Santa Cruz Mountains and the valley that makes up the South Westside Basin are part of these features. Highest elevations include the following:

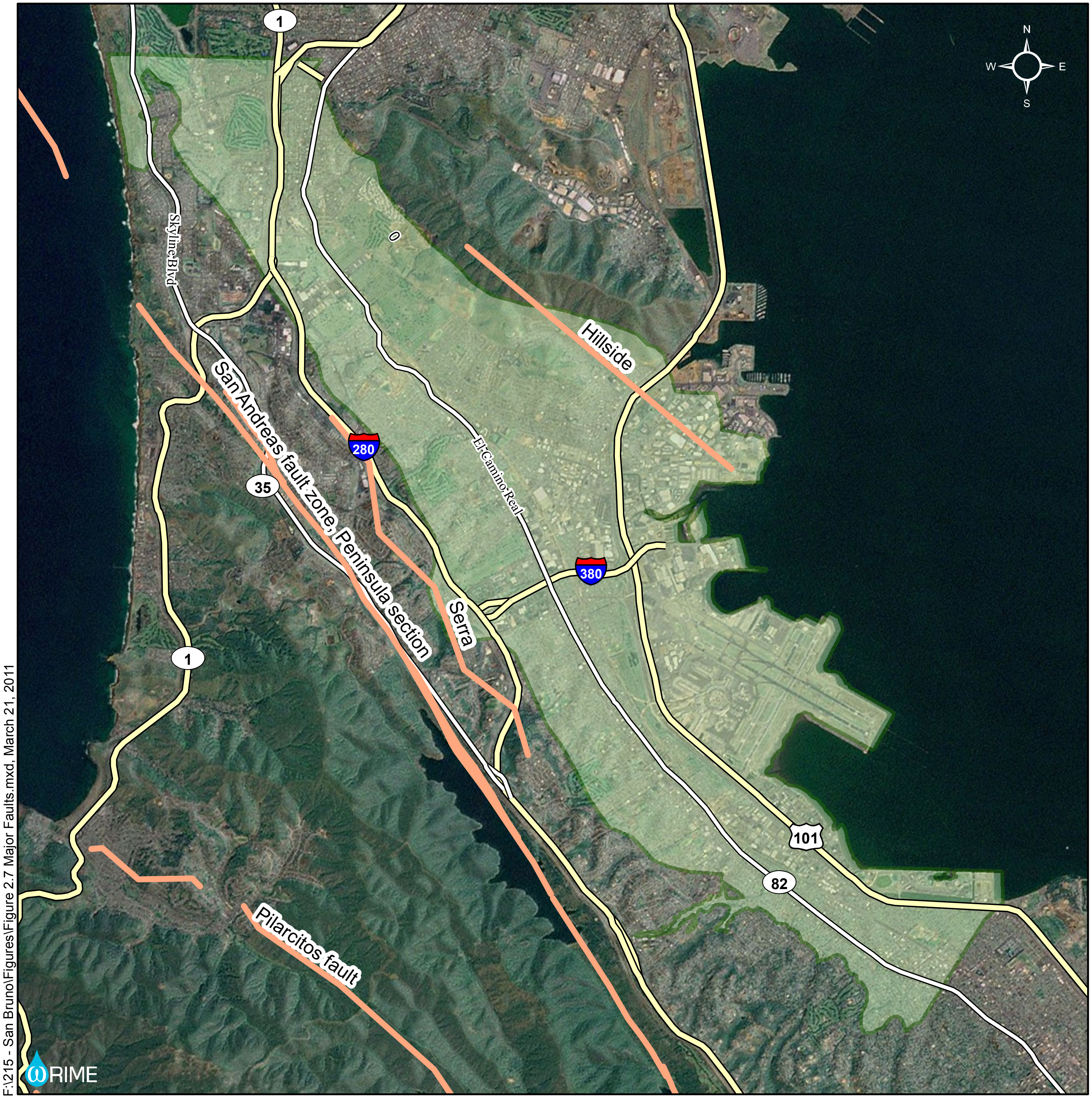
- Scarpet Peak southwest of the basin, 1,944 feet (ft)
- San Bruno Mountain northeast of the basin, 1,316 ft
- Mount Davidson in San Francisco, 927 ft

The northwest trend is a result of tectonics, with major northwest trending faults in the vicinity of the South Westside Basin: San Andreas Fault, Serra Fault, and the Hillside Fault (Figure 2.7)

The Franciscan Formation forms the basement underlying the unconsolidated sediments that are the primary sources of groundwater for the area and forms most of the mountains surrounding the South Westside Basin (Burns & McDonnell and ERM-West, 2006; Bonilla 1998). A map of bedrock elevation is presented on Figure 2.8 based on HydroFocus (2003). The Mesozoic-age formation is highly deformed and comprised of a unique mix of rocks related to tectonic subduction. This subduction resulted in materials from the oceanic plate being scraped off and accreted onto the continental materials as well as low-temperature, high-pressure metamorphism. The scraping results in the presence of deep-ocean materials such as chert, while metamorphism results in rocks such as serpentine and blueshist. The most common materials are greywacke (a poorly sorted sandstone containing angular clasts) and shale, resulting from deep ocean deposition in a method similar to a landslide. Composition of the Franciscan Formation is variable; locally the Franciscan has significant greywacke and shale in what is known as the San Bruno Mountain terrane to the northeast of the South Westside Basin and pillow basalts, minor chert, limestone, and greywacke in what is known as the Permanente terrane to the southwest (Sloan, 2006).

The Merced Formation and the Colma Formation are the major unconsolidated units in the South Westside Basin and are the primary sources of groundwater. These formations were

Figure 2.7
Major Faults



Legend

- Highways
- Plan Area
- Faults

0 0.5 1 2 Miles

Source: USGS

F:\215 - San Bruno\Figures\Figure 2.7 Major Faults.mxd, March 21, 2011

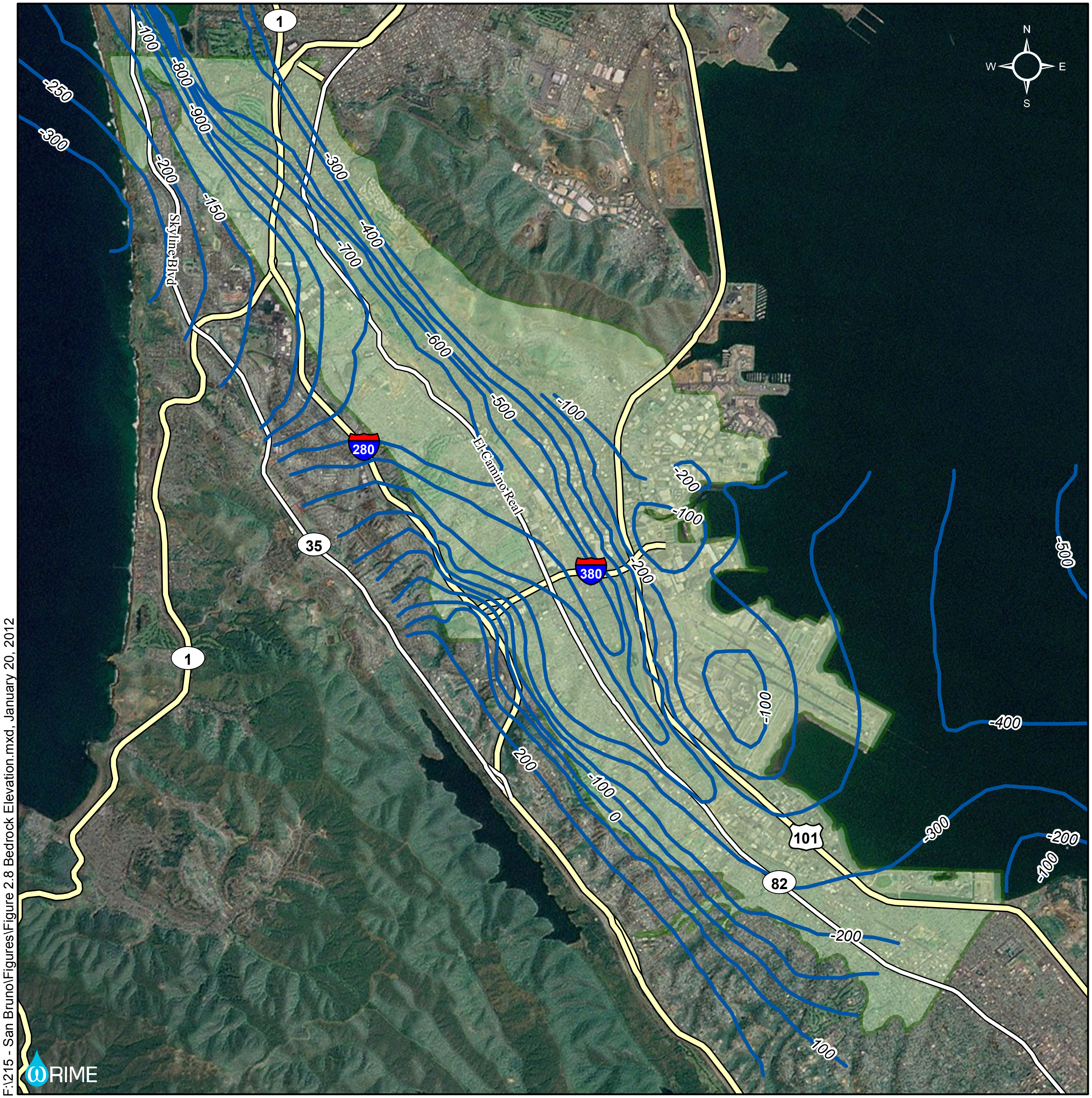


Figure 2.8
Bedrock Elevation

Legend

Highways

Plan Area

Bedrock Elevation (ft)

0 0.5 1 2 Miles

Source: Bedrock Elevation - Phillips et al., 1993 and Hensolt and Brabb, 1990 as cited in HydroFocus, 2003

City Of SAN BRUNO

CALIFORNIA WATER SERVICE CO.

DALY CITY CALIFORNIA

RIME

F:\215 - San Bruno\Figures\Figure 2.8 Bedrock Elevation.mxd, January 20, 2012 deposited on top of the Franciscan. During recent geologic history, the South Westside Basin alternated between being submerged below the Pacific Ocean and being above sea level, the result of tectonic subsidence, changes in sea level due to global climatic conditions, and tectonic uplift. At least 30 episodes of transgression and regression are recorded in the Merced and Colma Formations near Daly City (Clifton and Hunter, 1987, 1991) as changes from shallow marine to non-marine sediments. These episodes resulted in the layers of clays and sands seen in the subsurface today.

The Merced Formation contains several major beds of sands and clays. The lower portion of the formation contains locally derived materials from the Coast Ranges, while the upper portion contains sediment from the Sierra Nevada and Cascades identifying the movement of the outlet of the Sacramento and San Joaquin rivers near their current outlet at the Golden Gate.

Beds in the vicinity of coastal Daly City dip to the northeast at 45 to 70 degrees in the lower 4,000 ft; 25 to 45 degrees in the middle 600 ft; and 5 to 20 degrees in the upper 500 ft (LSCE, 2004). The Merced Formation dips more than 40 degrees to the northeast in the portion of the South Westside Basin from San Bruno to Daly City (Fio and Leighton, 1995). From San Bruno into Millbrae and between the Serra and San Andreas faults, the Merced dips to the southwest and to the northeast, depending on location, due to faulting and folding (Rogge, 2003). East of the Serra Fault, the Merced appears to dip to the northeast based on observations by Rogge.

The Colma Formation has a very similar mineral composition to the underlying Merced Formation. The Colma Formation is younger (Pleistocene-age) than the Merced and was deposited on top of the tilted Merced Formation. The layering in the Colma Formation remains primarily horizontal (Sloan, 2006).

Bay Muds are also present along the margins of San Francisco Bay at ground surface or below artificial fill. These recently deposited materials are fine-grained clays and silts with organic matter and minor sand lenses that were deposited in still waters and accumulated as sea levels rose (Lee and Praszker, 1969).

2.3.2 WATER-BEARING FORMATIONS

Groundwater used for water supply within the South Westside Basin is found in the Merced and Colma formations discussed above. Water is produced from the coarse-grained layers within these complex, layered formations. Grain size typically decreases from the northwest to the southeast.

The elevation of the bedrock surface is shown in Figure 2.8; the deepest portions of the basin is in the northwest, becoming thin in Millbrae and south into Burlingame. Water bearing formations are also thin near San Francisco Bay due to a bedrock ridge extending in a north-south orientation near SFIA, which, together with surficial deposits of Bay muds in these areas, reduces the potential for seawater intrusion in this area (WRIME, 2007).

The "W" clay is a major aquitard in the Daly City area, with municipal production occurring below the "W" clay. The "W" clay is not present south of Daly City, but a fine grained unit at 300 ft below mean sea level is present in the South San Francisco area (LSCE, 2004) and several clay units are in the upper portion of the aquifer in the San Bruno area. Perched aquifer conditions occur throughout the Plan Area. Numerous shallow wells installed for remediation or monitoring of contaminants nearly always encounter the water table within 30 feet of ground surface (HydroFocus, 2003).

The characteristics of the water bearing formations have been studied through several aquifer tests outlined in the *Alternatives Analysis Report* (MWH, 2007) and are summarized below. These tests provide estimates of transmissivity, a measure of the ability of an aquifer to transmit groundwater. For the South Westside Basin as a whole, previous studies have shown a range of transmissivities of 668 to 4,100 ft^2/day (CH2M HILL, 1997 *as referenced in* MWH, 2007). More specifically, transmissivities have been estimated for the following:

- Daly City area at the Jefferson Well as 2,190 ft^2/day
- CalWater wellfield area as 1,000 to 20,000 ft^2/day
- San Bruno area at SB-16 as 1,890 ft^2/day (LSCE, 2004; MWH, 2007)

2.3.3 PARTIAL BARRIERS TO SEAWATER INTRUSION

The lack of historical seawater intrusion despite historical data of groundwater levels below sea level near both the Pacific Ocean and San Francisco Bay is likely due to natural hydrogeologic conditions that act as partial barriers and inhibit the flow of water from these saltwater bodies into the freshwater aquifer.

2.3.3.1 Pacific Ocean

Significant faulting and folding of the Merced Formation near the Pacific Ocean has been shown to be a barrier to seawater intrusion from the Pacific Ocean. It has been concluded that groundwater extraction within the South Westside Basin largely occurs within sequences with no direct connection with the Pacific Ocean (LSCE, 2010). Monitoring wells at Thornton Beach and Fort Funston exhibit groundwater levels above sea level. The potential for seawater intrusion is more likely to the north of Fort Funston, in the vicinity of LMMW-6D, where the faulted and folded conditions do not exist and there is a potential pathway into the South Westside Basin from the northwest. This area, however, is farther from the influence of active production wells and water levels are thus higher than elsewhere in the South Westside Basin. A network of monitoring wells are used to collect groundwater data along the Pacific Ocean: at the Old Great Highway, the northwestern part of Golden Gate Park, the Oceanside Wastewater Treatment Plan, the San Francisco Zoo, Fort Funston, and Thornton Beach.

2.3.3.2 San Francisco Bay

Relatively thick Bay Mud deposits and a buried bedrock ridge within 50 to 300 ft of the land surface provide some protection to the southern portion of the South Westside Basin from seawater intrusion from San Francisco Bay. Previous efforts have identified areas where the depth to bedrock is deepest and installed monitoring well clusters in the two most likely locations for seawater intrusion. These wells (SFO-S, SFO-D, Burlingame-S, Burlingame-M, and Burlingame-D) provide water level and water quality data. While this barrier has been historically effective, hydraulic connections between the main pumping aquifer and shallower wells closer to the Bay have been shown through water level impacts when San Bruno groundwater production wells are turned on (impacts at SFIA monitoring wells; ERM (2005)) and through depressed water levels near the bayshore (including SFO-S, SFO-D, Burlingame-S, Burlingame-M, and Burlingame-D). While not a completely understood pathway from San Francisco Bay into the main pumping aquifer, this hydraulic connection indicates that there is some potential for seawater intrusion in the future in this area. Risks of seawater intrusion increase with greater gradients between depressed groundwater levels in the drinking water aquifer and sea level at San Francisco Bay. Such risks can be reduced through increasing groundwater levels by increased recharge or decreased groundwater production.

2.3.4 SOILS

Surface soils impact the amount of water that infiltrates to groundwater rather than contributing to surface runoff. The characteristics of surface soils thus play a role in groundwater recharge. Due to the urban nature of the area, the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) does not have a comprehensive classification of these soils according to their infiltration capacity. However, USDA-NRCS does summarize the general soils for the area (Figure 2.9). Generally, soils in the northwest (Daly City and Colma) are well drained soils associated with former sand dunes (categorized as "Urban land-Orthents, smoothed"). Soils in the southeast (San Bruno, Millbrae, and Burlingame) have variable drainage properties in the low elevations near and to the east of El Camino Real (categorized as "Urban land-Orthents, reclaimed" and "Urban land-Orthents") and are well drained in the uplands to the west of El Camino (categorized as "Urban land-Orthents, cut and fill").

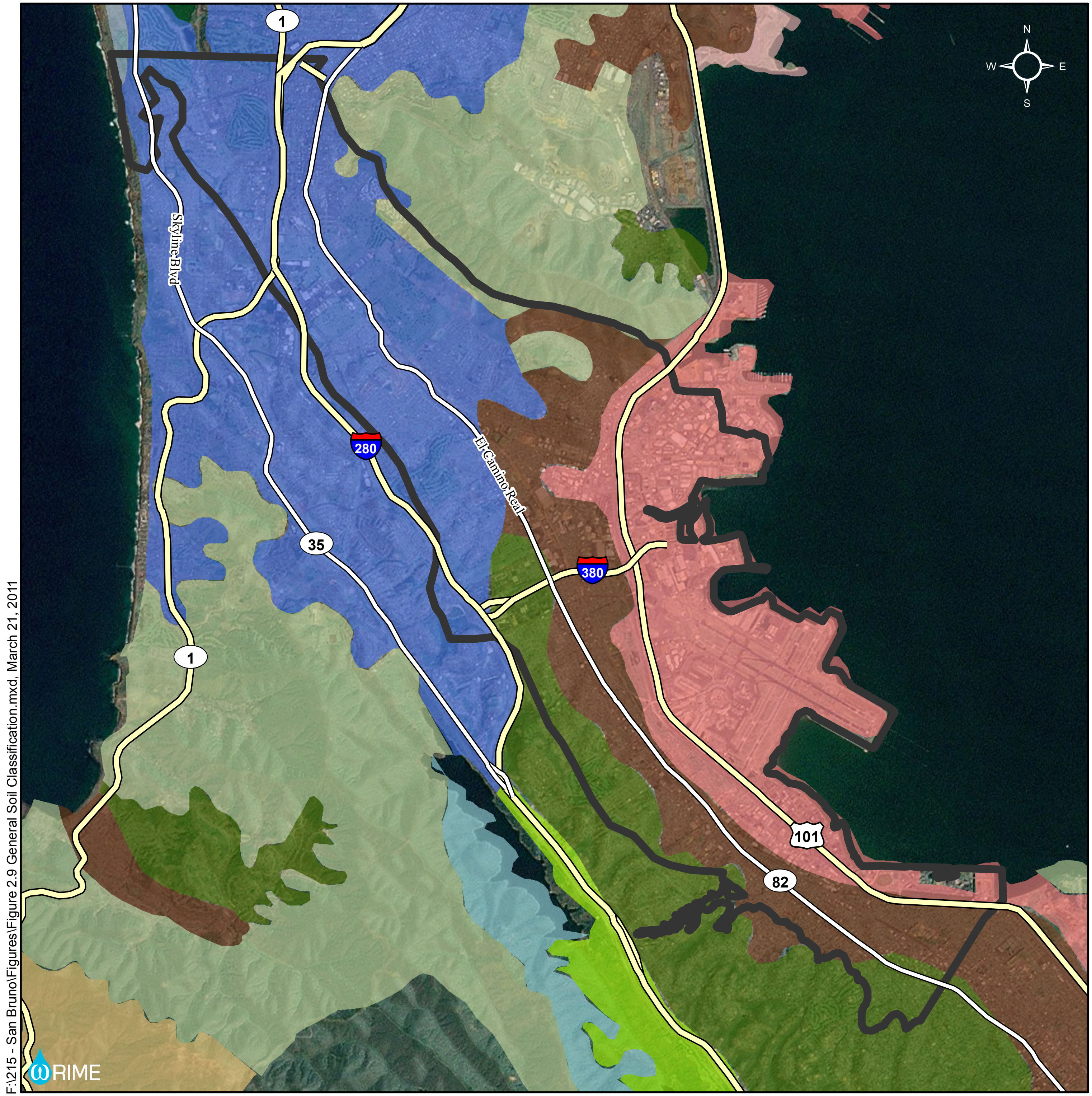
2.3.5 Recharge

Additional water is added to the aquifer system through recharge, the percolation of water downward from the ground surface through unsaturated sediments into the aquifer. The amount of recharge is controlled by

- Climate, including precipitation and evapotranspiration
- The slope of the ground surface, which impacts whether water seeps into the ground or becomes runoff into surface drainages
- Land use, including the amount of impervious surfaces, plant types, and usage of irrigation
- Leakage from water and sewer pipes
- Soil characteristics
- Subsurface characteristics

Estimates of recharge for the South Westside Basin were developed for the Groundwater Model (HydroFocus, 2011) and are summarized in Figure 2.10. The recharge estimates show that groundwater recharge is highest in the northwestern portions of the basin, corresponding to areas of sandy soils, and in areas with significant unpaved, irrigated land, such as golf courses and cemeteries. Recharge is lowest along the margins of San Francisco Bay, corresponding to areas with Bay Muds, and along the steep slopes of San Bruno Mountain.

Figure 2.9
General Soil Classification



Legend

- Highways
- Plan Area

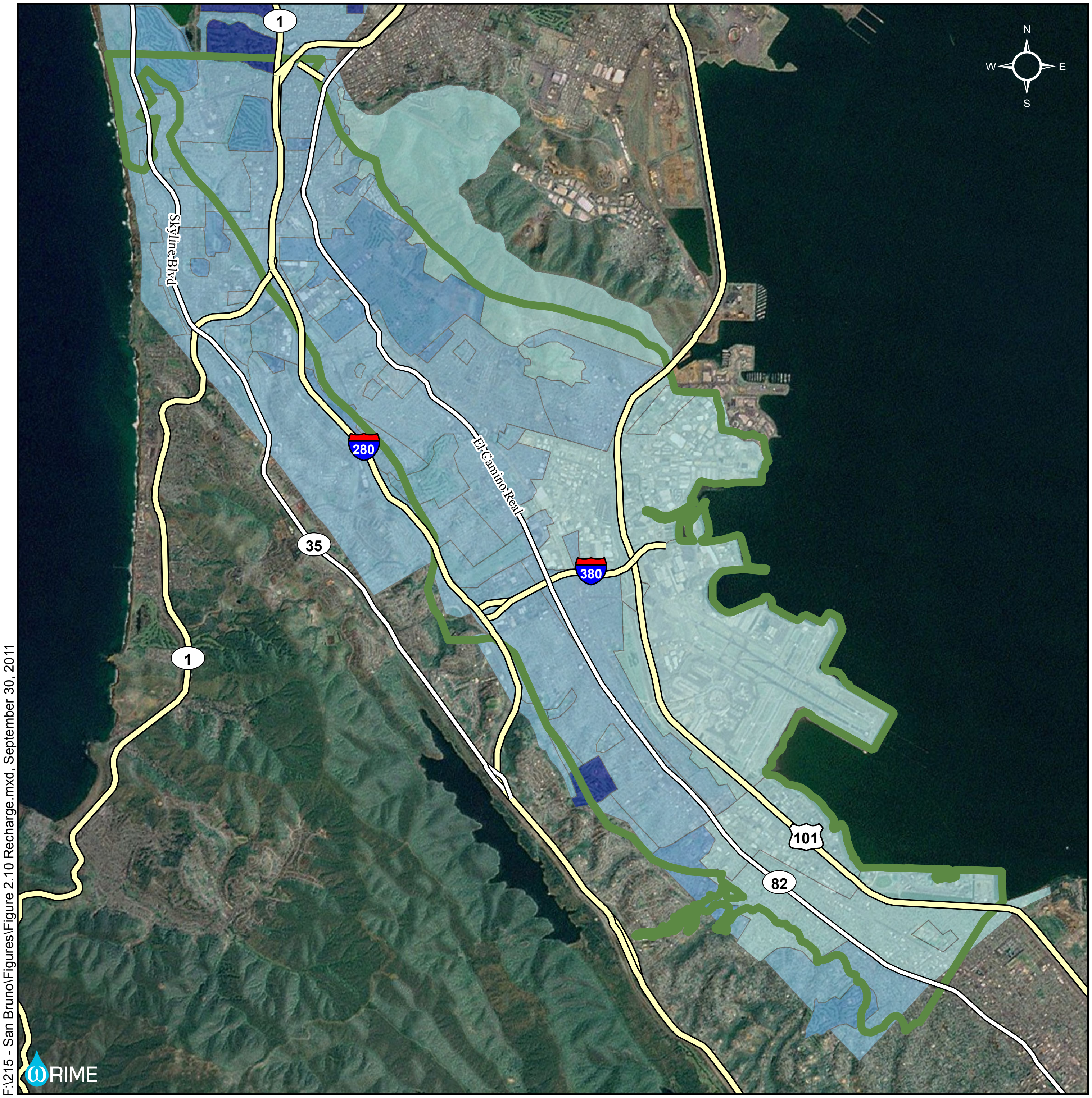
Soil Types

- Urban Land-Sirdrak
- Urban Land-Orthents, smoothed
- Alambique-McGarvey
- Scarper-Miramar
- Barnabe-Candlestick-Buriburi
- Fagan-Obispo
- Urban Land-Orthents, cut and fill
- Alambique-Zeni-Zeni Variant
- Novato-Reyes
- Urban Land-Orthents, reclaimed
- Urban Land-Orthents

0 0.5 1 2 Miles

Source: Soils - USDA - SCS, 1991

Figure 2.10
Estimated Recharge



Legend

Highways

Recharge (inches per year)

0 - 4

4 - 8

8 - 12

12 - 16

Plan Area

0 0.5 1 2 Miles

Source: Recharge - HydroFocus, 2011

F:\215 - San Bruno\Figures\Figure 2.10 Recharge.mxd, September 30, 2011

2.3.6 Early Development and Groundwater Usage

Early development in the South Westside Basin was primarily agricultural, with dairy cattle operations serving the nearby cities. Development of the type seen today began around the turn of the 20th century. Burials within the City of San Francisco were prohibited in 1900 and existing cemeteries were evicted in 1937. These events resulted in the establishment of the cemeteries in Colma. The 1906 earthquake resulted in the migration of people out of the damaged cities and into the undeveloped and newly developed areas in the South Westside Basin, particularly along the streetcar line that extended from San Francisco south through Daly City, San Bruno and beyond, as far as San Mateo by the late 1890s (Gillespie and Gillespie, 2009). San Francisco International Airport began operating in 1927, further driving urban growth. The most significant urban growth occurred during World War II as numerous industrial facilities operated out of South San Francisco, resulting in demand for area housing and commercial space. This growth continued until the area approached build-out. Historical population growth for the cities in the South Westside Basin (right axis), as well as for San Francisco (left axis), is shown in Figure 2.11.

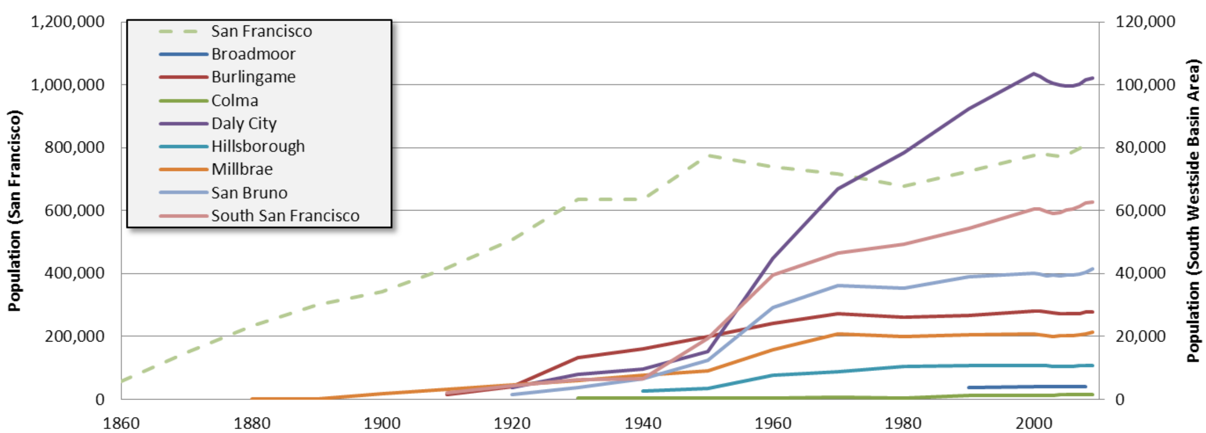


Figure 2.11. Historical Population Growth in the South Westside Basin

Historical groundwater use increased with development of the South Westside Basin through the 1960s. Beginning in the 1960s, groundwater use by municipal users began to decline (Figure 2.12), a result of conservation by customers as well as operational decisions as the water agencies have access to both groundwater and imported water through SFPUC's Hetch Hetchy system. Since the early 1960s, municipal groundwater use in the South Westside Basin has declined by approximately 25 percent, while imported water use has increased by approximately 40 percent.

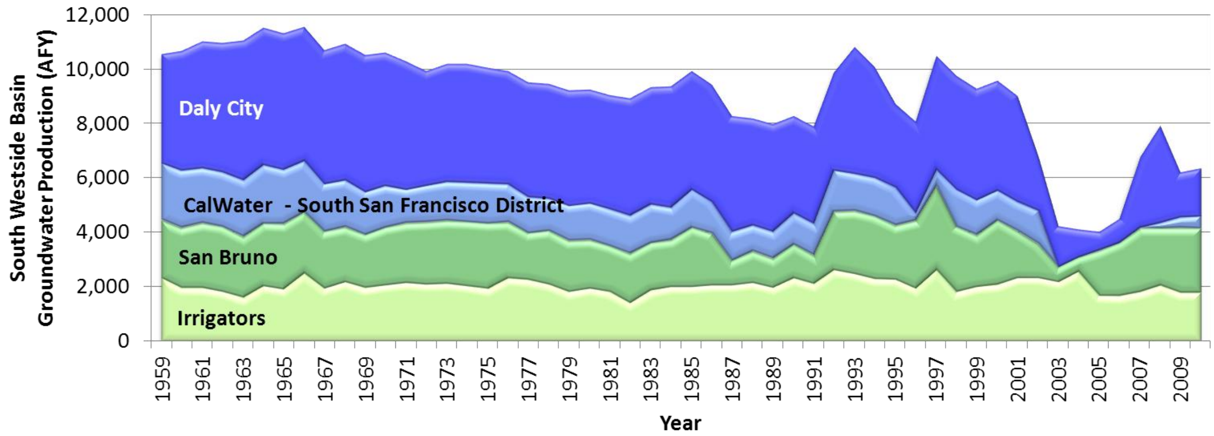


Figure 2.12. Historical Municipal Groundwater Production, South Westside Basin

2.3.7 Groundwater Levels

There are little data on groundwater levels from the early development period of the South Westside Basin. Before groundwater production began, groundwater levels were likely close to the surface within the valley, draining to the Pacific Ocean in the west and to Colma Creek, San Francisco Bay, and other drainages to the east. A report from 1914 (Bartell, 1914) noted that San Bruno produced water from three artesian wells, which, when turned off, overflowed approximately 1 inch above the top of casing. Artesian flow was noted as being maintained through the previous two dry seasons. The same report noted pumping water levels in South San Francisco's nine wells of 55 to 60 ft below ground surface.

Through the early 1940s, groundwater levels remained above sea level in the Daly City area, although in the South San Francisco area groundwater levels were already 100 ft below sea level by that time (Kirker, Chapman & Associates, 1972). Groundwater levels remained relatively stable throughout the basin from the 1970s until the implementation of the ILPS in late 2002, which resulted in rising groundwater levels. Hydrographs present historical groundwater levels on Figures 2.13a-e (locations are presented on Figure 2.14). Current groundwater level conditions are shown in Figure 2.15.

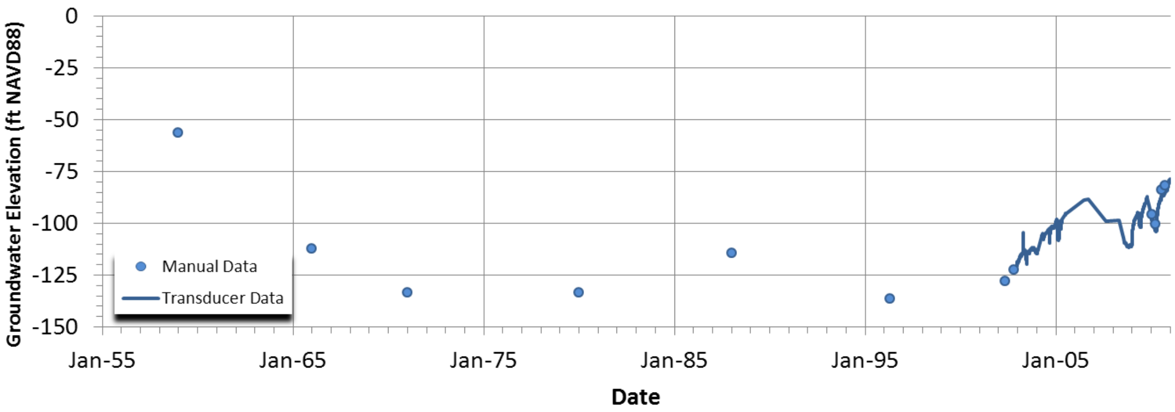


Figure 2.13a. Historical Groundwater Elevation, DC-8

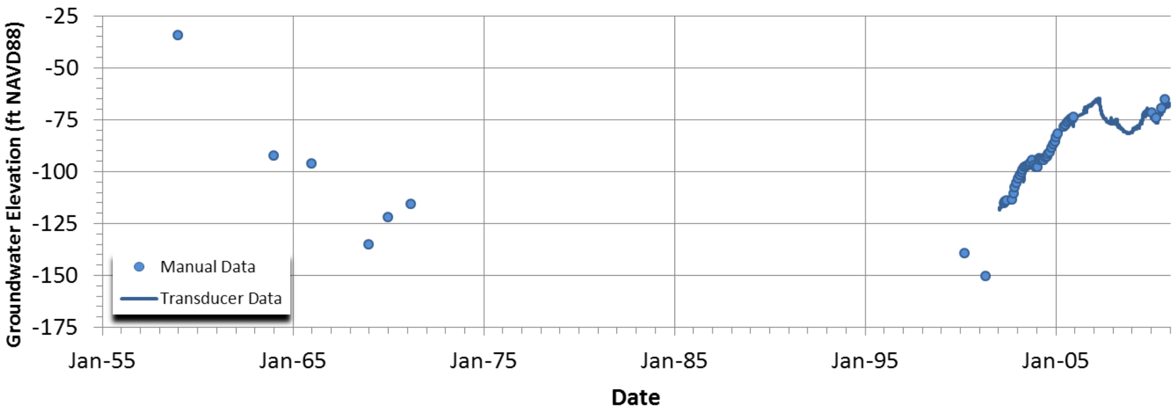


Figure 2.13b. Historical Groundwater Elevation, DC-1

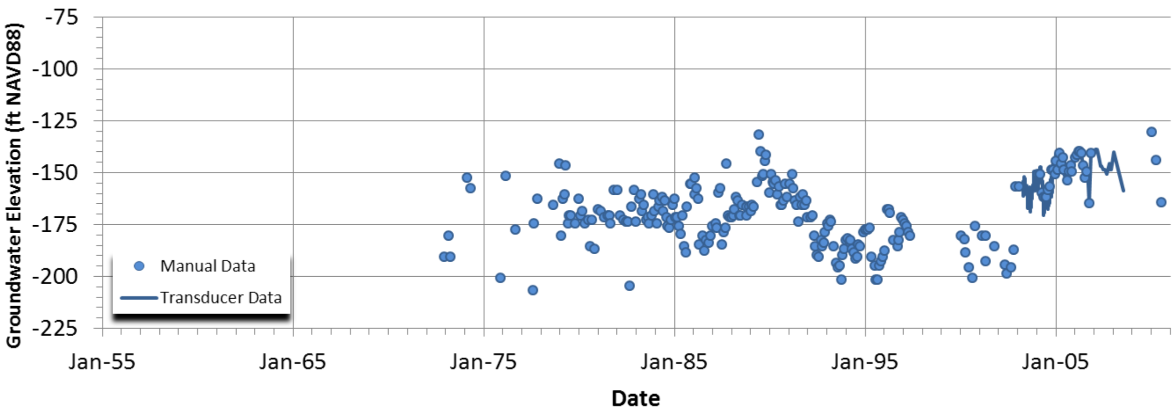


Figure 2.13c. Historical Groundwater Elevation, SS 1-20

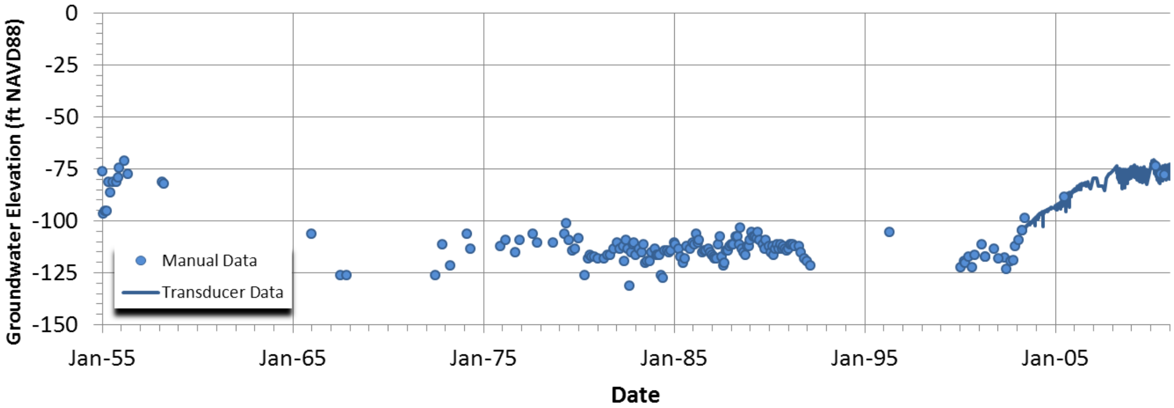


Figure 2.13d. Historical Groundwater Elevation, SS 1-02

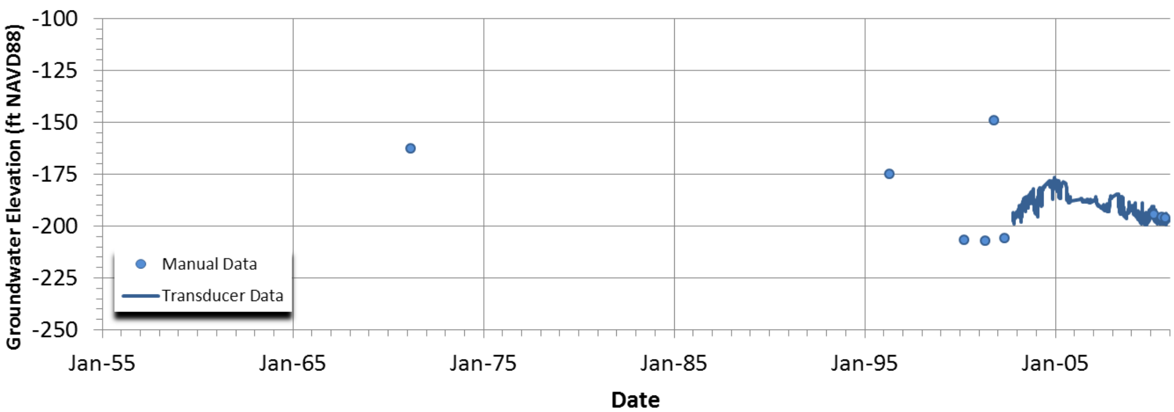


Figure 2.13e. Historical Groundwater Elevation, SB 12

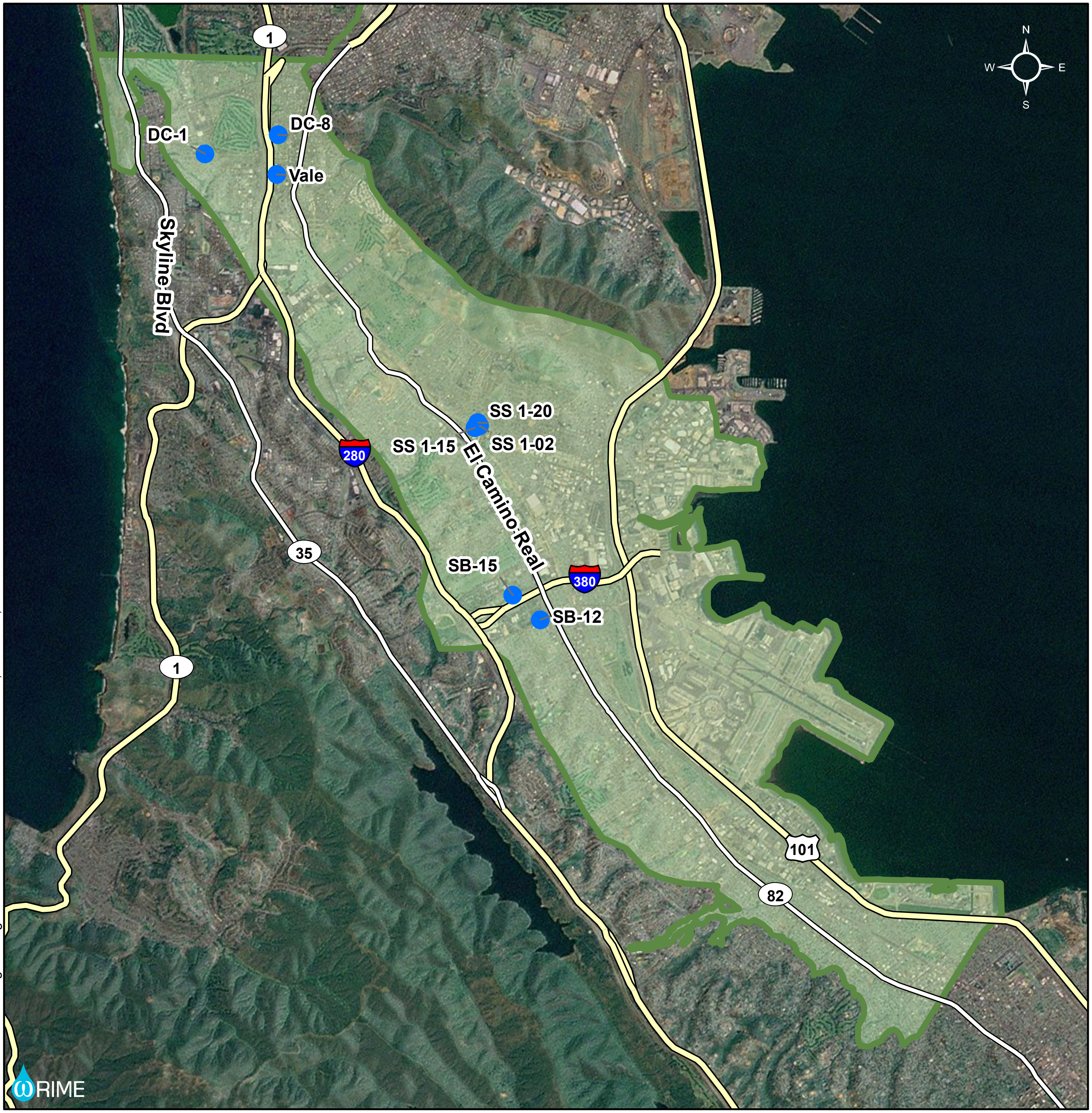


Figure 2.14
Location of Selected Wells

Legend

- Selected Wells
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

F:\215 - San Bruno\Figures\Figure 2.13 Location of Selected Wells.mxd, March 21, 2011

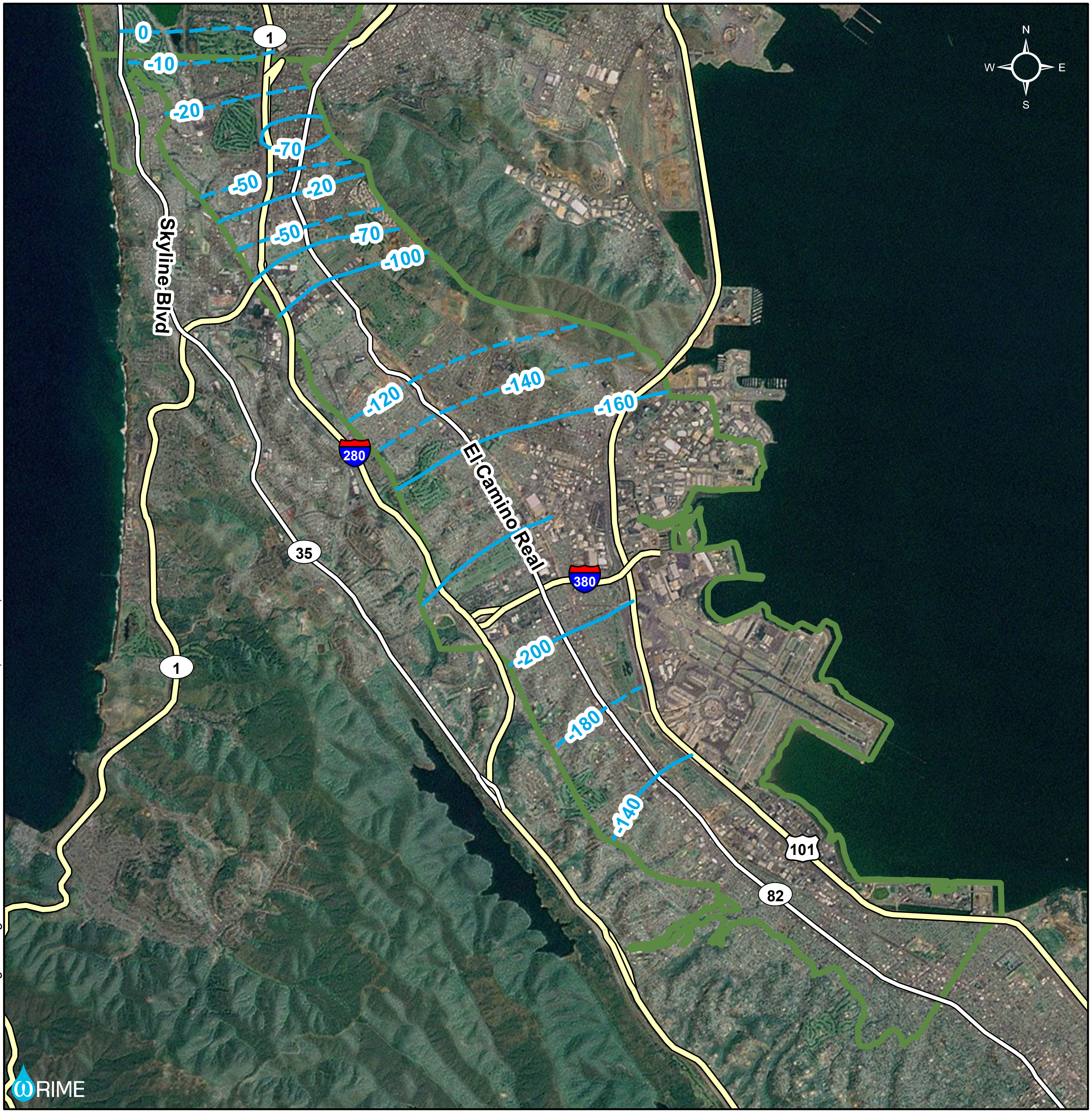


Figure 2.15
Groundwater Elevation Contours Primary Production Aquifer, Fall 2010

Legend

- Groundwater Elevation Contour (ft) (dashed where inferred)
- Highways
- Groundwater Basin

0 0.5 1 2 Miles

Source: Groundwater Levels: SFPUC, 2011

F:\215 - San Bruno\Figures\Figure 2.14 Groundwater Contours 2010.mxd, March 31, 2011

2.3.8 Groundwater Quality

Groundwater used for water supply in the South Westside Basin is generally good and delivered water meets all state and federal regulations. However, the quality of untreated groundwater in the basin is variable. Lower quality groundwater increases the cost of treatment for use as a drinking water source. Poor quality groundwater may not be economically, technically, or politically feasible for use as a water supply source.

2.3.8.1 Ambient Groundwater Quality

Ambient groundwater quality reflects the general groundwater quality on a regional scale. Most water quality data is available from existing municipal production wells, whose operators maintain a testing schedule to meet the requirements of the California Department of Public Health (DPH). Analysis of ambient water quality was performed based on raw groundwater quality data in a DPH database (2010).

Differences in the general chemistry of groundwater across the basin are shown through the Piper diagram on Figure 2.16. This diagram plots the relative concentrations of cations and anions. Similar waters will plot close to each other; different waters will plot farther apart. The close proximity of the plotted points shows the similarity of water across the South Westside Basin, however, there are noticeable differences between the water of the three agencies.

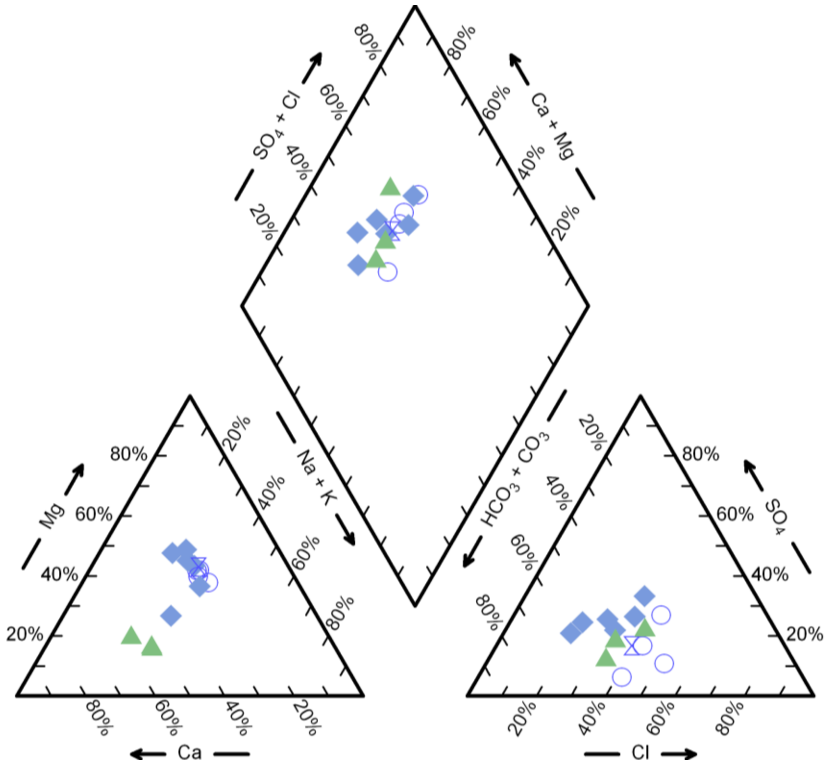
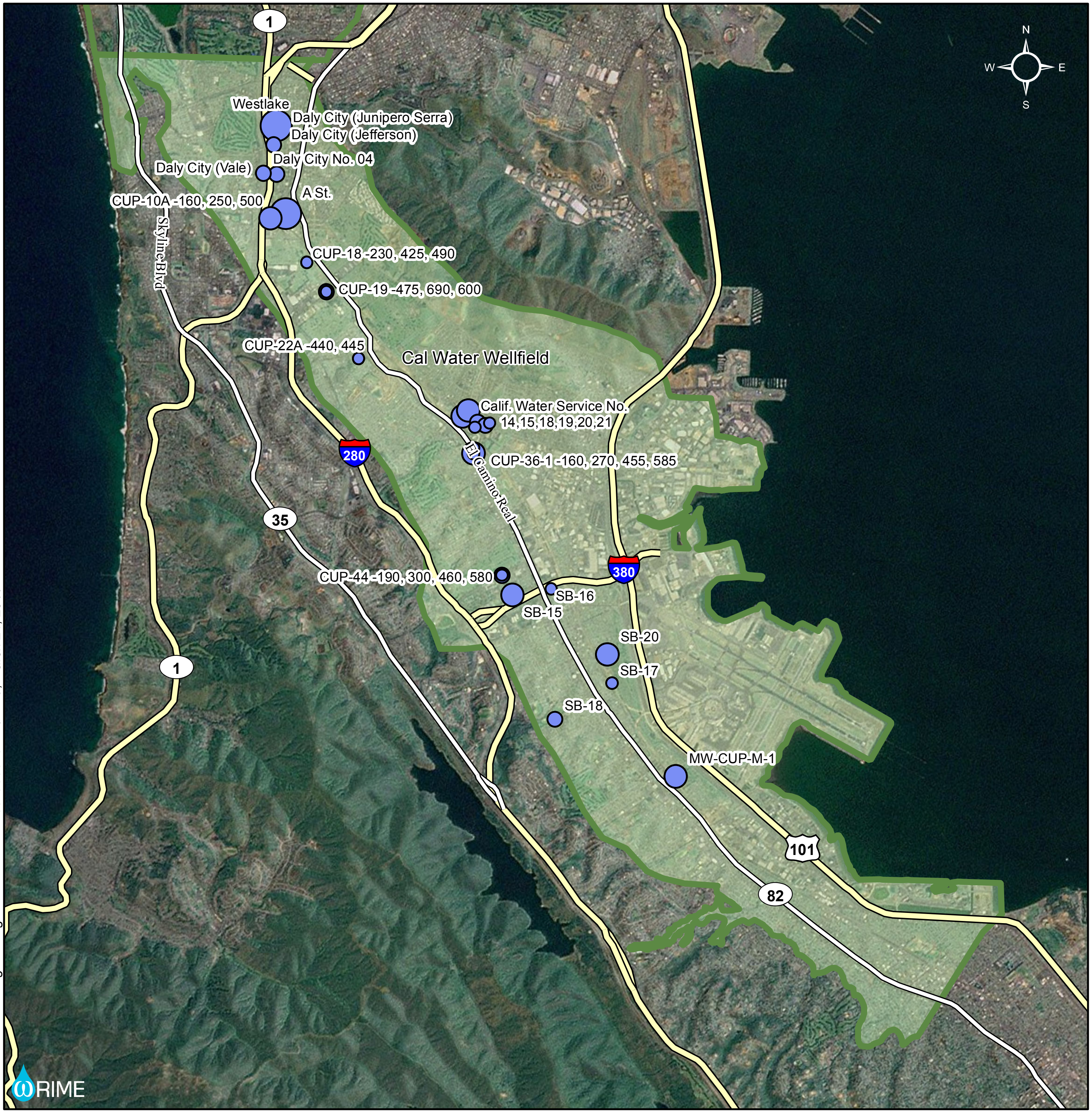


Figure 2.16. Piper Diagram of General Groundwater Chemistry for Wells Operated by Daly City (open blue), CalWater (filled blue), and San Bruno (filled green)

Analysis of the most prominent ambient water quality concerns, iron, manganese, nitrate, and total dissolved solids (TDS), was also performed based on raw groundwater quality data contained in the DPH database (2010). While these data are presented along with regulatory standards, it must be noted that a single detection of a contaminant may not indicate contamination. DPH would not consider a single detection of a contaminant, if unconfirmed with a follow-up detection, to be an actual finding. As another example, the presence of a contaminant in raw water does not necessarily mean that the water (and contaminant) was served by the water system to its customers, or, if served, that the contaminant was present at that concentration. Water systems may choose not use certain sources or may treat or blend them prior to service (DPH, 2010). While water containing higher concentrations of iron, manganese, nitrate, and TDS can be used following treatment, it is more economical to use water that does not require treatment.

Iron and manganese do not pose a risk to human health, but are an aesthetic concern for water users. High concentrations of iron and manganese can result in poor tasting water or water that stains fixtures. The source of iron and manganese in groundwater is typically naturally occurring soils and rocks containing iron and manganese. Secondary maximum contaminant levels (SMCL) are enforceable standards established by DPH based on consumer acceptance, rather than health risk. The SMCL is 300 micrograms per liter (µg/L) for iron and 50 µg/L for manganese. Figures 2.17 and 2.18 show the distribution of iron and manganese, respectively, over the Plan Area based on average 2005-2010 data from DPH. Generally, concentrations of iron and manganese are variable even within short distances. Figures 2.19a-c present historical trends in iron and manganese concentration for selected wells with locations shown in Figure 2.14. These figures show generally stable iron and manganese concentrations. The apparent increase in concentrations in the Vale Well is the result of higher detection limits for the later measurements and does not necessarily indicate increasing concentrations.

Figure 2.17
Iron Concentrations in Groundwater



Legend

Concentration (ug/L)

Iron (SMCL = 300)

- 0 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

Source: DPH, 2010

Figure 2.18
Manganese Concentrations in Groundwater

Legend

Concentration (ug/L)

Manganese (SMCL = 50)

- 1 - 5
- 5.01 - 10
- 10.01 - 20
- 20.01 - 50
- 50.01 - 100
- 100+
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

Source: DPH, 2010

City of San Bruno | California Water Service Co. | Daly City California

F:\2.17 - San Bruno\Figures\Figure 2.16 Manganese Concentrations.mxd.mxd, March 21, 2011

RIME

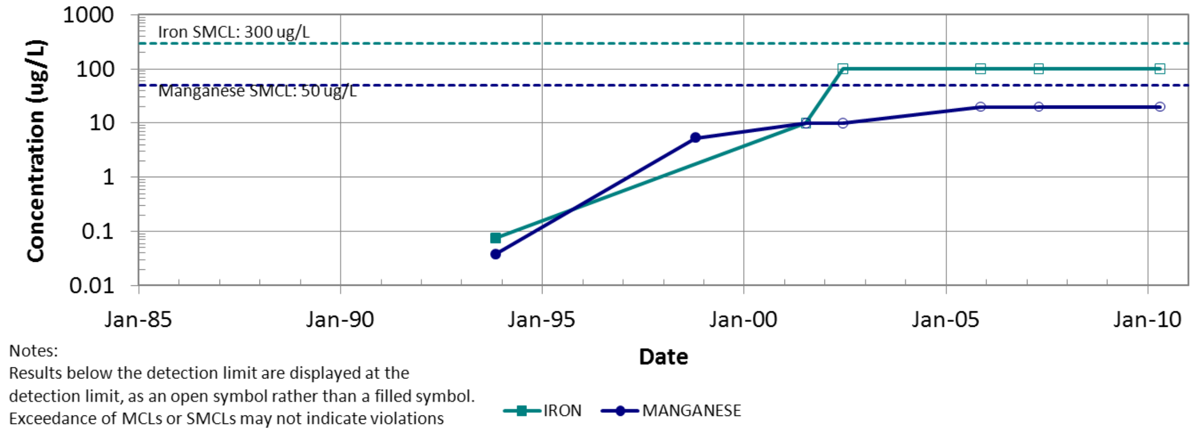


Figure 2.19a. Historical Iron and Manganese Concentrations, Vale Well

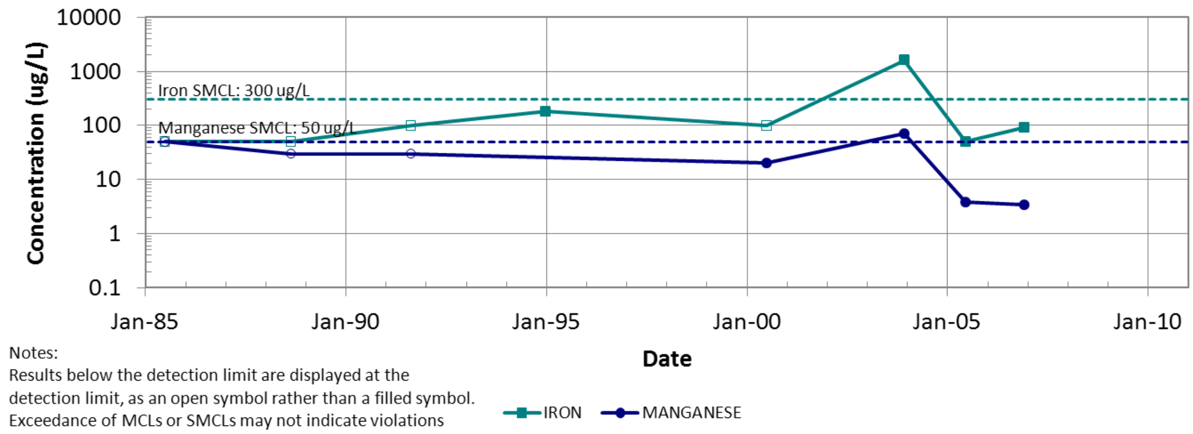


Figure 2.19b. Historical Iron and Manganese Concentrations, Well 01-15

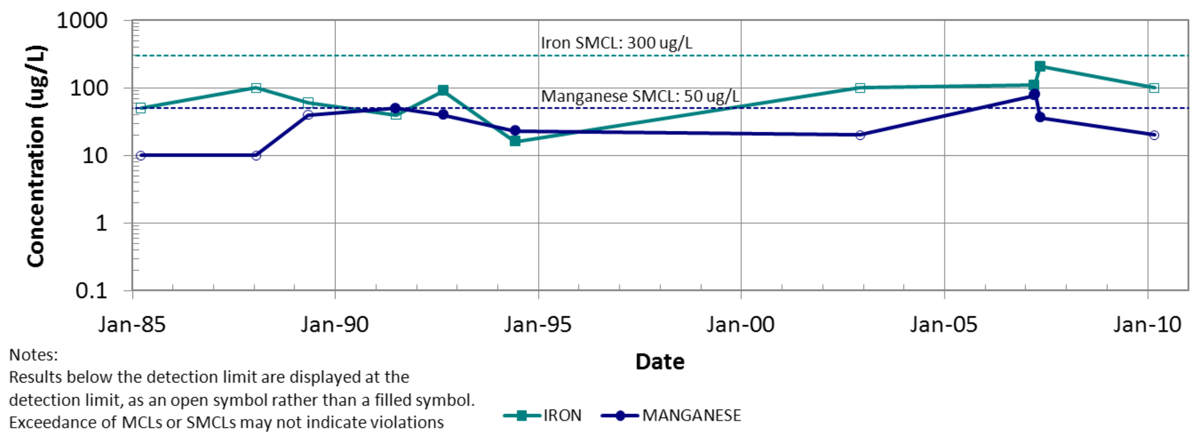
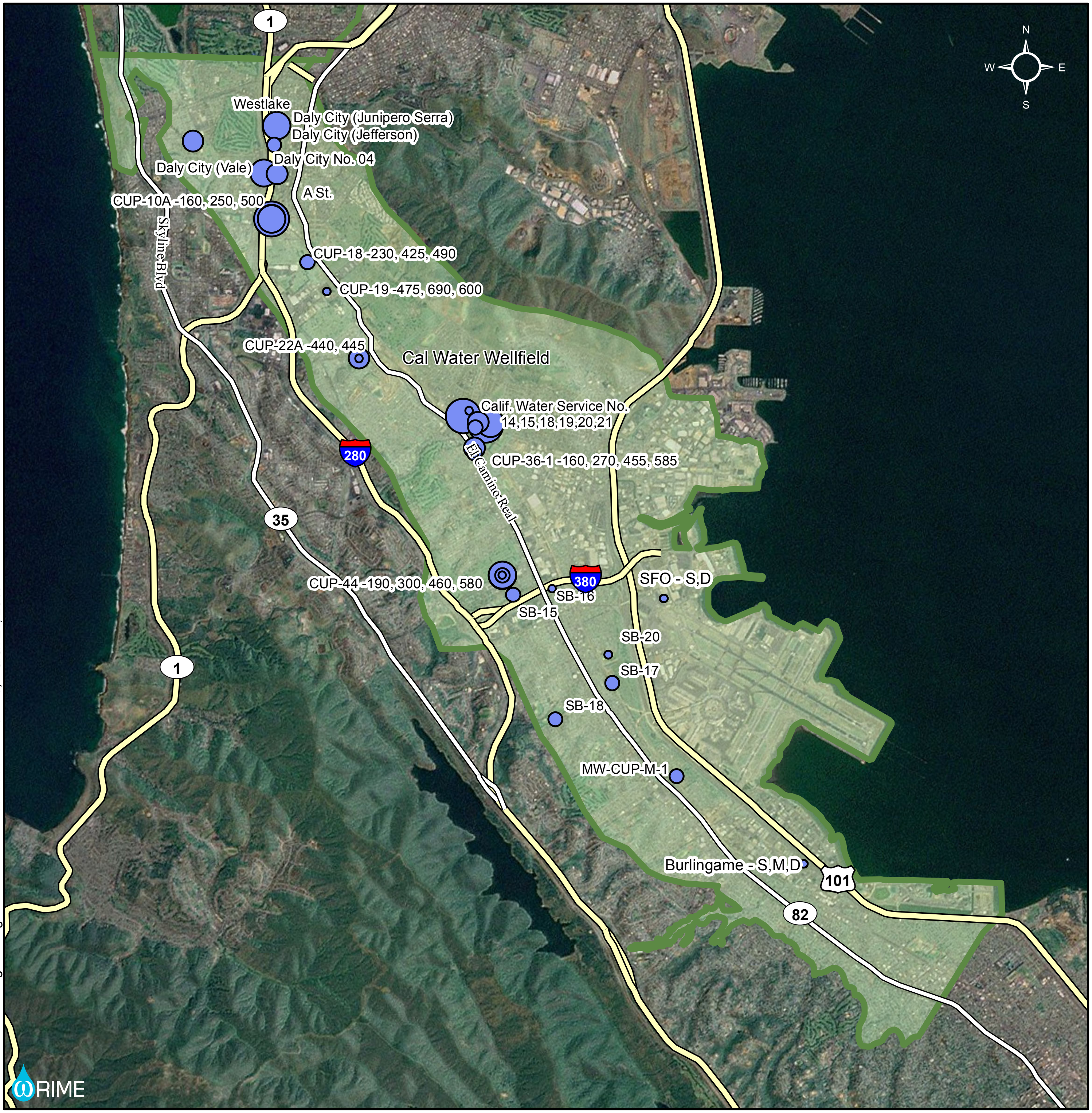


Figure 2.19c. Historical Iron and Manganese Concentrations, SB-15

Nitrate in groundwater poses a health risk if concentrations are too high and the water is not properly treated. Low levels of nitrate are naturally occurring, but higher levels are almost always the result of human activity, such as inorganic fertilizer, animal manure, septic systems, and deposition of airborne compounds from industry and automobiles. Maximum contaminant levels (MCL) are enforceable standards established by EPA and DPH to set the highest level of a contaminant allowed in drinking water. MCLs are set as close as feasible to the level below which there is no known or expected health risk using the best available treatment technology and taking cost into consideration (EPA, 2009). The MCL for nitrate is 45 milligrams per liter (mg/L) (as NO_3). Figure 2.20 shows the distribution of nitrate over the Plan Area based on average 2005-2010 data from DPH. Generally, nitrate concentrations are highest in the central portion of the Plan Area, South San Francisco, and lowest in the southern portion of the South Westside Basin, San Bruno. Some of this trend is due to the depth of the wells as the wells in South San Francisco are generally shallower than the other municipal wells in the basin and thus are more likely to show influences of contaminating activities at the surface. Figures 2.21a-c present historical trends in nitrate concentrations for selected wells with locations shown in Figure 2.14.

Figure 2.20

Nitrate as NO_3 Concentrations in Groundwater



Legend

Concentration (mg/L)

NO_3 (MCL = 45)

- 0.1 - 1.5
- 1.6 - 15
- 16 - 30
- 31 - 45
- 46 - 80

Highways

Groundwater Basin

Plan Area

0 0.5 1 2 Miles

Source: DPH, 2010

City Of San Bruno · California Water Service Co. · Daly City California

F:\2.19 - San Bruno\Figures\Figure 2.16 No3 Concentrations.mxd.mxd, March 21, 2011

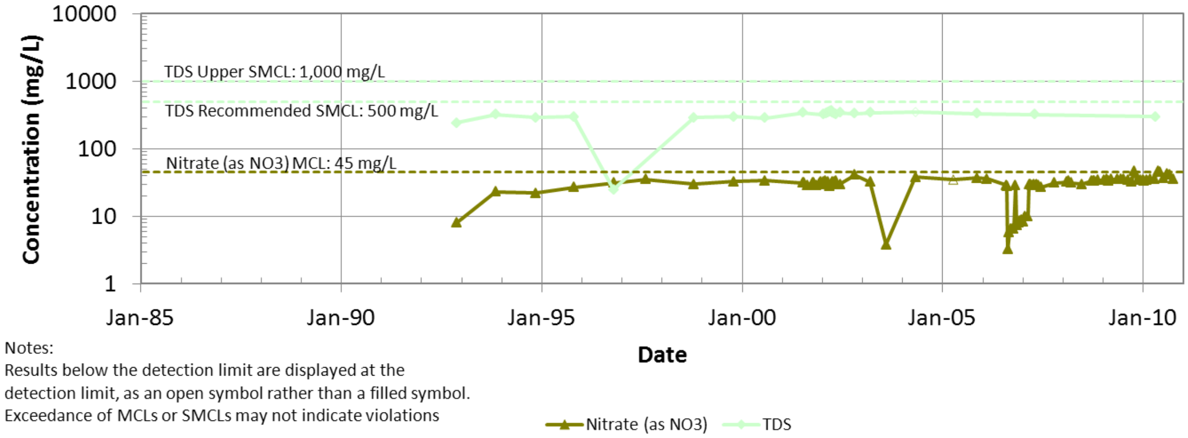


Figure 2.21a. Historical Nitrate and TDS Concentrations, Vale Well

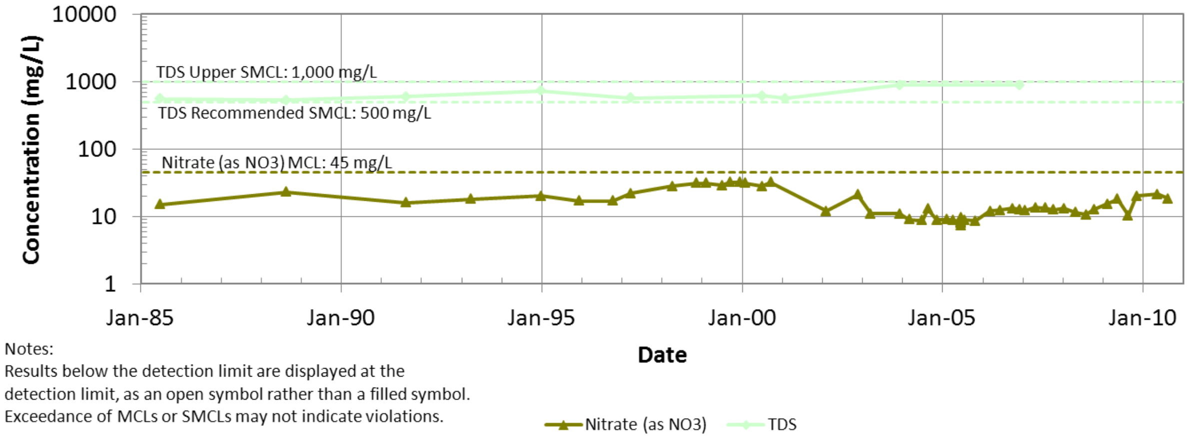


Figure 2.21b. Historical Nitrate and TDS Concentrations, Well 01-15

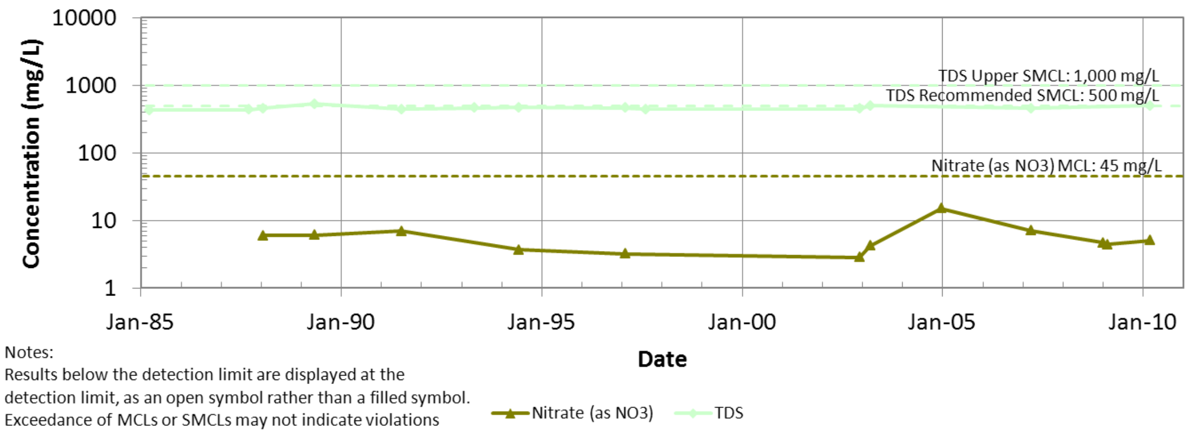


Figure 2.21c. Historical Nitrate and TDS Concentrations, SB-15

TDS do not pose a risk to health, but are an aesthetic concern for water users. High concentrations of TDS can cause scale buildup or hard water that is poor tasting. As TDS is a combined measurement of all dissolved compounds in the water, there are many naturally occurring sources as well as sources resulting from human activities. Irrigation often increases TDS as irrigation water collects salts that contribute to TDS as they percolate to the groundwater. This groundwater may be pumped back to the surface and used for irrigation again, further increasing TDS. Allowing water to leave the system or treating the water at the surface can break this cycle. Seawater intrusion can rapidly increase TDS in an aquifer. TDS has the following three SMCLs:

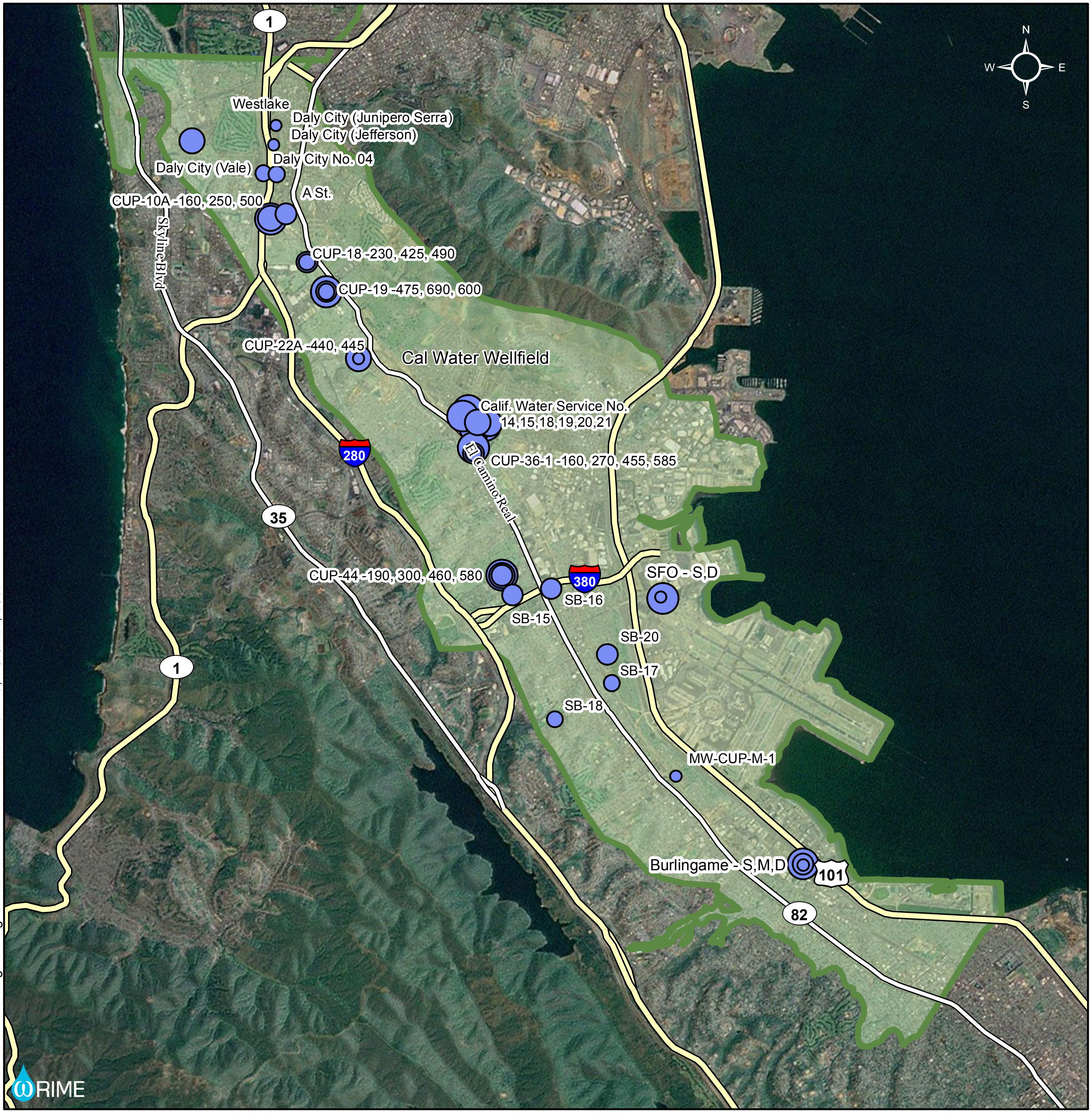
- Recommended: 500 mg/L. Constituent concentrations lower than the recommended contaminant level are desirable for a higher degree of consumer acceptance.
- Upper: 1000 mg/L. Constituent concentrations ranging to the upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable water.
- Short term: 1500 mg/L. Constituent concentrations ranging to the short term contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources. (DPH, 2009)

Figure 2.22 shows the distribution of TDS over the Plan Area based on average 2005-2010 data from DPH. Generally, TDS concentrations are highest in the central portion of the Plan Area, South San Francisco, and lowest in the northern portion of the South Westside Basin, Daly City. Some of this trend is due to the depth of the wells as the wells in South San Francisco are generally shallower than the other municipal wells in the basin and thus are more likely to show influences of contaminating activities at the surface. Figure 2.21a-c presents historical trends in TDS concentrations for selected wells with locations presented on Figure 2.14.

2.3.8.2 Point Source Contamination

In addition to ambient water quality concerns, contaminated groundwater from point sources can quickly remove wells from service and thus requires close coordination with regulatory agencies such as EPA, RWQCB, the California Department of Toxic Substances Control (DTSC), and local oversight programs, including San Mateo County Groundwater Protection Program. Based on a search of DTSC's Envirostor database and the Water Board's GeoTracker database, the sites summarized on Table 2.4 have been identified as federal, state, or voluntary cleanup sites potentially affecting the aquifer used for drinking water supply.

Figure 2.22
TDS
Concentrations in
Groundwater



Legend

Concentration (mg/L)

TDS (SMCL = 500/1000/1500)

- 250 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 600 +
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

Source: DPH, 2010

F:\2.19 - San Bruno\Figures\Figure 2.21 TDS Concentrations.mxd.mxd, March 21, 2011

Table 2.4
Open Contaminated Sites Potentially Impacting the Aquifer Used for Drinking Water Supply

Name	Address	ID	Potential Contaminants of Concern	Lead Agency
ARCO #0465	151 Southgate Avenue, Daly City	T0608100027	Benzene, Toluene, Xylene, Fuel Oxygenates, Gasoline	County of San Mateo Health Services Agency
Chevron 9-6982	892 John Daly Blvd, Daly City	T0608100148	Gasoline	County of San Mateo Health Services Agency
Agbayani Construction	88 Dixon Ct., Daly City	T10000002674	Tetrachloroethylene (PCE), Trichloroethylene (TCE), Vinyl chloride	County of San Mateo Health Services Agency
Gas & Wash Partners	247 87th St., Daly City	T10000003031	Benzene, Toluene, Xylene, Gasoline	County of San Mateo Health Services Agency
United Airlines Maintenance Center	San Francisco International Airport, South San Francisco	SL0608106162	Solvents	RWQCB
Chevron 9-5584, former	1770 El Camino Real, San Bruno	T0608179897	Gasoline	County of San Mateo Health Services Agency
1245 Montgomery Ave	1245 Montgomery Ave., San Bruno	SL0608187730	Benzene, Other Solvent or Non-Petroleum Hydrocarbon, TCE	RWQCB

As with all urban areas in the state, numerous Leaking Underground Fuel Tanks and Spills Leaks Investigation and Cleanup sites are present in the South Westside Basin and are being monitored and/or remediated under the regulatory lead of the RWQCB or the local oversight program. Leaking underground fuel tanks are typically at gas stations, while spills leaks investigation and cleanup sites have a variety of sources, but all involve hazardous wastes that have impacted soil and/or groundwater.

Many, but not all, of these point-source contaminants occur at the surface and tend to remain near the surface due to the chemical properties of the contaminants and the geologic conditions that slow the migration of these contaminants into the deep aquifer used by municipal groundwater producers in the basin and most private producers. Detailed coordination is required to ensure that corrective action on point sources is sufficient to protect groundwater quality. A map of known, active contaminated sites that have affected or could potentially affect groundwater, soils, or other environmental media is shown in Figure 2.23, as detailed by the Water Board's GeoTracker database system. Sites on Figure 2.23 are classified as follows:

- **Drinking Water Aquifer:** Sites listed on GeoTracker as Potentially Affecting Aquifer Used for Drinking Water Supply or Potentially Affecting Well Used for Drinking Water Supply
- **Shallow Groundwater:** Sites listed on GeoTracker as Potentially Affecting Other Groundwater (Uses Other Than Drinking Water)
- **Other Impact:** Sites listed on GeoTracker as Potentially Affecting Indoor Air, Sediments, Soils, Soil Vapor, Surface Water, or Under Investigation

Note that, in the South Westside Basin, only the United Airlines Maintenance Facility is listed as Potentially Affecting Well Used for Drinking Water Supply, and this site, like many others, is extensively monitored and actively undergoing remediation activities.

Groundwater here includes shallow, perched groundwater not directly used for water supply (Other Groundwater). The distinction between shallow, perched groundwater not directly used for water supply and groundwater used for drinking water supply is to some degree based on professional judgment by the preparers of the GeoTracker system; Section 5.4.3 contains recommendations for coordination with regulatory agencies to improve the accuracy and usefulness of these classifications for regional planning and public outreach.

2.3.9 Desalter Infrastructure

There is currently no desalination infrastructure in the South Westside Basin.

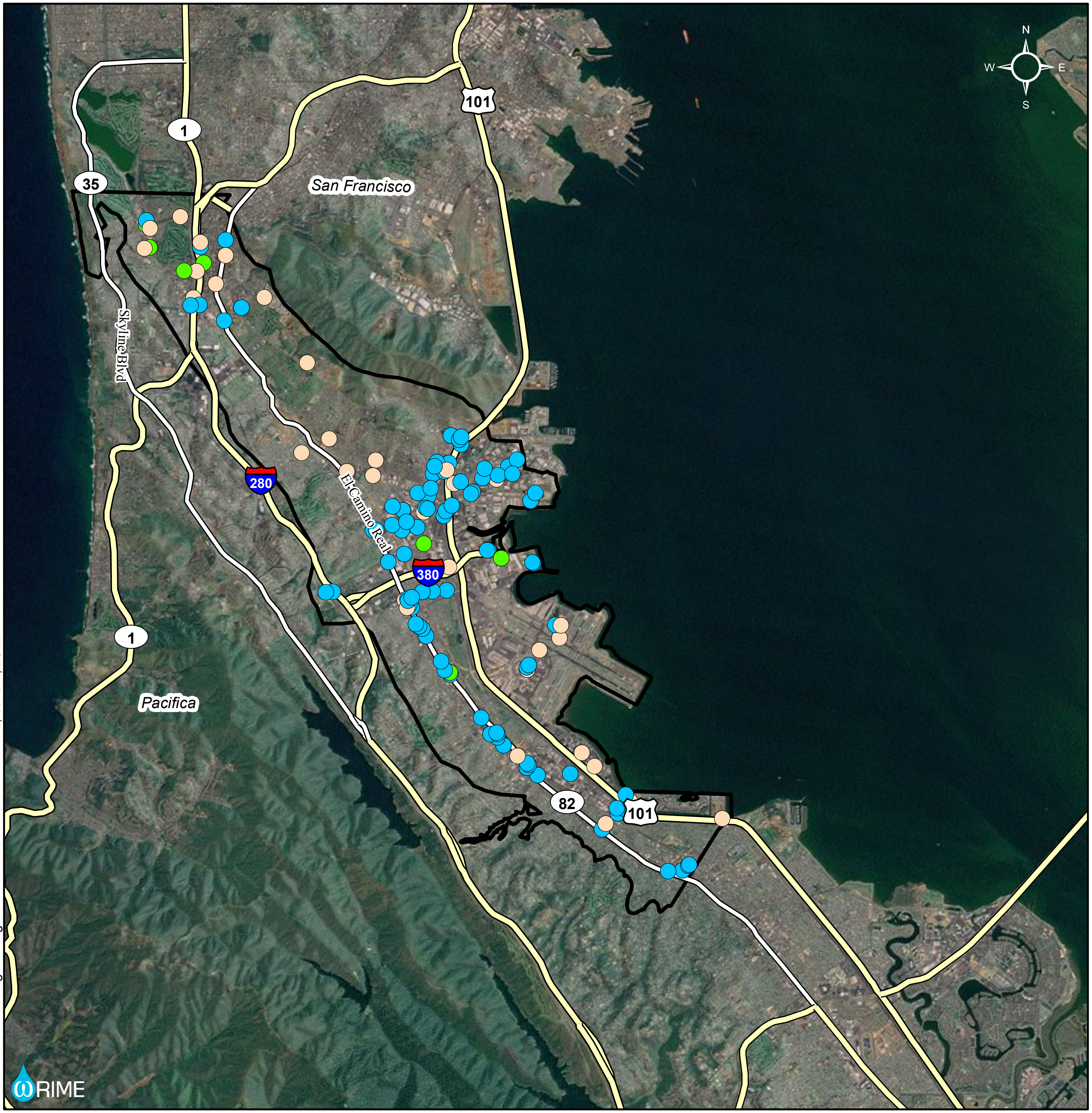


Figure 2.23
Contaminated Sites

Legend

Contaminated Sites by Potential Impact

- Drinking Water Aquifer
- Shallow Groundwater
- Other Impact
- Highways
- Plan Area

0 0.5 1 2 Miles

Source: Water Board, 2010

F:\215 - San Bruno\Figures\Figure 2.23 Contaminated Sites.mxd, June 4, 2012

2.3.10 Groundwater/Surface Water Interaction

Interaction between groundwater and surface water in the Plan Area is limited due to the significant depth to groundwater used for water supply, numerous clay layers that slow vertical migration of water through the subsurface, and the presence of only minor surface water features, such as Colma Creek, which are often channelized. The perched water table above the upper clay units interacts with local surface water courses, such as Colma Creek and smaller creeks. Groundwater tends to seep into the surface water courses near the Bay and the surface water recharges the groundwater at higher elevations. The perched aquifer, which is not used as a water supply, slowly recharges the deeper aquifer through the clay layers.

Lake Merced is an important surface water feature just north of the Plan Area. The draft North Westside Basin GWMP addresses issues with groundwater interaction with Lake Merced.

2.3.11 Subsidence and Liquefaction

Subsidence and liquefaction are both influenced by changes in groundwater levels. Low groundwater levels can contribute to subsidence while high groundwater levels can contribute to liquefaction.

Land subsidence here refers to the lowering of the ground surface as a result of groundwater level changes, not tectonic changes. Aquifers, particularly the fine-grained materials within or between the aquifers, are compressible. If groundwater levels decrease as a result of pumping or other causes, water may be released from beds of clay or silt around the coarser materials that are the primary source of water in the aquifer. The release of water from the beds of clay and silt reduces the water pressure, resulting in a loss of support for the clay and silt beds. Because these beds are compressible, they compact (become thinner), and the effects are seen as a lowering of the land surface (Leake, 2004). Whether or not subsidence through compression occurs in an area depends on groundwater levels (groundwater levels must decline) and on materials (sufficient compressible clays and silts must be present).

There are no available records of historical subsidence in the South Westside Basin. Significant studies have been performed to the south in the Santa Clara Valley, due to extensive subsidence in that area. Those studies show that the extent of subsidence in the area is focused on Santa Clara, where land subsided 8 ft from 1934 to 1967. To the north, subsidence is more limited, with less than 1 foot of subsidence in the Palo Alto area and approximately an inch of subsidence in the Redwood City area (Poland and Ireland, 1988). Studies have not been performed farther north, likely due to a lack of evidence of active subsidence.

The Plan Area has potential for liquefaction, where earthquake-induced shaking can cause a loss of soil strength, resulting in the inability of soils to support structures. This can occur in saturated soils where the shaking causes an increase in water pressure to the point where the soil particles can move easily within the soil-water matrix. Areas along San Francisco Bay have been rated as having "very high" susceptibility to liquefaction by the USGS (Figure 2.24; Witter et al., 2006). These areas are underlain by artificial fill over Bay Mud. While only covering the bayshore area, artificial fill over Bay Mud accounted for 50 percent of all historical liquefaction occurrences in the nine-county San Francisco Bay area and about 80 percent of those liquefaction occurrences resulted from the Loma Prieta earthquake (Witter et al., 2006). In the South Westside Basin, these units have a perched water table that is not influenced by groundwater production. Areas with high to moderate susceptibility to liquefaction include areas along current or former creeks, particularly Colma Creek. Other areas have low or very low susceptibility to liquefaction.

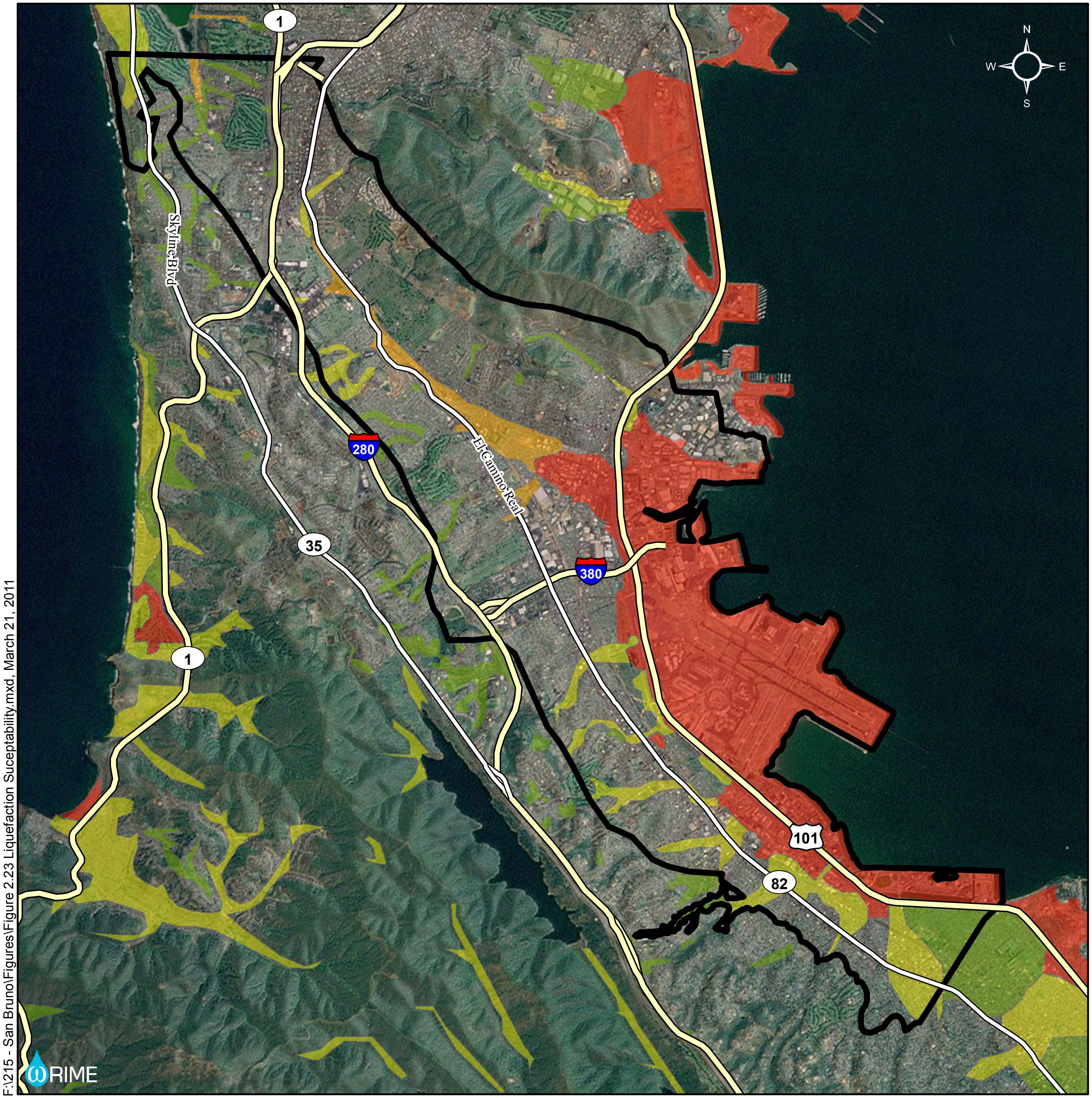


Figure 2.24
Liquefaction Suceptability

Legend

- Highways
- Plan Area

Liquefaction

- Very High
- High
- Moderate
- Low

0 0.5 1 2 Miles

Sources:
• Liquefaction Susceptability - Witten et al, 2006

F:\215 - San Bruno\Figures\Figure 2.23 Liquefaction Suceptability.mxd, March 21, 2011

2.3.12 GROUNDWATER MONITORING

Current South Westside Basin-wide groundwater monitoring is coordinated through the agencies throughout the Plan Area and is presented in annual groundwater monitoring reports prepared by SFPUC since 2005. The reports include details on semi-annual monitoring of groundwater production, level, and quality data as well as data on Lake Merced water levels. Prior to that date, San Mateo County maintained a semiannual groundwater monitoring program that included static water level and water quality monitoring. San Mateo County's reports covered the period from 2000 through 2003. The individual agencies also maintain long-term records of production, water levels, and water quality for their facilities.

2.3.12.1 Groundwater Level Monitoring

Groundwater level monitoring for use in the regional annual groundwater reports includes both dedicated monitoring wells and inactive production wells. Dedicated monitoring wells include wells installed as part of seawater intrusion monitoring, groundwater/surface water interaction monitoring, and as part of the GSR. Measurements are taken manually on a quarterly or semiannual basis in some wells, and daily through the use of electronic pressure transducers in other wells (SFPUC, 2010a). Monitoring wells measured in the South Westside Basin include the following:

- Daly City Area
    - LMMW-6D
    - Thornton Beach MW 225, 360, 670
    - DC-1 (Westlake 1)
    - Park Plaza MW460, 620
    - DC-8
    - CUP 10A MW160, 250, 500, 710
- Colma Area
    - CUP 18 MW230, 425, 490, 660
    - CUP 19 MW180, 475, 600, 690
    - CUP 23 MW230, 440, 515, 600
- South San Francisco Area
    - CUP 22A MW140, 290, 440, 545
    - SS 1-02
    - SS 1-20
    - CUP 36 MW160, 270, 455, 585
    - SSFLP MW120, 220, 440, 520
- San Bruno Area
    - CUP 44-1 MW190, 300, 460, 580
    - SB-12 (Elm Ave)

    - UAL-13C, 13D
    - SFO-S, -D
- Millbrae Area
    - CUP-M-1
- Burlingame Area
    - Burlingame-S, -M, -D

Additionally, groundwater levels are also monitored by the individual agencies, and include measurements of static or dynamic water levels, depending on the operational status of the well.

2.3.12.2 Groundwater Production Monitoring

Groundwater production data are summarized for the water agencies and for metered users of recycled water in SFPUC's annual reports. Other irrigation production is estimated and also presented in the report.

2.3.12.3 Groundwater Quality Monitoring

Groundwater quality is monitored for both regional analysis in SFPUC annual reports and to meet the DPH's requirements specified in Title 22 of the California Code of Regulations.

Individual agencies test the water quality in the active municipal productions wells on a schedule to meet DPH requirements and to ensure safe drinking water for their customers.

Water quality data are collected for use in SFPUC's annual reports, either specifically for the program or as part of the testing for DPH requirements or other programs such as seawater intrusion monitoring or monitoring for use in the proposed GSR.

2.4 IMPORTED WATER

Imported water in the South Westside Basin is supplied by SFPUC, which operates the Hetch Hetchy system. Details of the system are provided in the following two paragraphs, based on SFPUC's *Annual Water Quality Report* (SFPUC, 2010b). The *Annual Water Quality Report* is included in Appendix B and contains more detailed information on chemical constituents in the water supply.

The major sources of imported water are from the SFPUC and include Hetch Hetchy Reservoir and the local watersheds. Hetch Hetchy is located in the well-protected Sierra region and meets all federal and state criteria for watershed protection. Based on SFPUC's disinfection treatment practice, extensive bacteriological quality monitoring, and high operational standards, the state has granted the Hetch Hetchy water source a filtration exemption. In other words, the source is so clean and protected that SFPUC is not required to filter water from Hetch Hetchy Reservoir.

Hetch Hetchy Reservoir water is provided by SFPUC to Daly City, San Bruno, Millbrae, Burlingame, and to the Golden Gate National Cemetery. SFPUC provides water to CalWater from sources in accordance with the Raker Act.

Hetch Hetchy water is supplemented with surface water from two local watersheds. Rainfall and runoff collected from the Alameda Watershed, which spans more than 35,000 acres in Alameda and Santa Clara Counties, are collected in the Calaveras and San Antonio reservoirs. Prior to distribution, the water from these reservoirs is treated at the Sunol Valley Water Treatment Plant. Treatment processes include coagulation, flocculation, sedimentation, filtration, and disinfection. Fluoridation, chloramination, and corrosion control treatment are provided for the combined Hetch Hetchy and Sunol Valley Water Treatment Plant water at the Sunol Chloramination and Fluoridation Facilities. Rainfall and runoff captured in the 23,000-acre Peninsula Watershed in San Mateo County are stored in reservoirs, including Crystal Springs (Lower and Upper), San Andreas, and Pilarcitos. The water from these reservoirs is treated at Harry Tracy Water Treatment Plant, where treatment processes include ozonation, coagulation, flocculation, filtration, disinfection, fluoridation, corrosion control treatment, and chloramination.

Daly City has 10 SFPUC pipeline connections called turnouts. They are connected to the Sunset, San Andreas #2, and Crystal Springs #2 pipelines and can supply approximately 30.89 mgd at a rate of approximately 21,400 gallons per minute (Daly City, 2005).

CalWater - South San Francisco District receives water from 12 connections at 11 SFPUC turnouts and groundwater from eight wells. Portions of CalWater's distribution system rely solely on SFPUC imported surface water, while others use groundwater from CalWater's wellfield for all or a portion of their water supply (MWH, 2007).

San Bruno has four connections to SFPUC's water supply system and one connection to North Coast County Water District (NCCWD). During normal conditions, water from SFPUC is transported through the San Andreas Pipeline from the Harry Tracy Water Treatment Plant near Crystal Springs Reservoir and delivered to three of San Bruno's turnouts. San Bruno also has a connection to SFPUC's 60-inch diameter Sunset Supply Pipeline, which was recently fitted with a pressure reducing valve, and is currently used only for fireflow and other emergency situations. The Sunset Supply Pipeline can deliver water directly from SFPUC's Hetch Hetchy System. San Bruno's connection from the NCCWD extends from SFPUC's Harry Tracy Water Treatment Plant to Crystal Springs Terrace. San Bruno purchases treated water from the NCCWD to serve the Crystal Springs Terrace area. This connection is equipped with a pressure reducing valve at Regulating Station 1 (EKI, 2007; Brown and Caldwell, 2001).

Millbrae receives water from five SFPUC turnouts. The Harry Tracy Water Treatment Plant supplies filtered water in the higher elevations, while the Crystal Springs #2 and #3 pipelines deliver water to the lower elevations (BAWSCA, 2009).

Burlingame receives water from six metered turnouts connected to SFPUC’s Sunset Supply Pipeline and Crystal Springs Pipelines #2 and #3 (EKI, 2005).

2.5 RECYCLED WATER

Wastewater collection, treatment, and disposal performed by the local agencies is described in the following sections. Of these agencies, the North San Mateo County Sanitation District also includes treatment and distribution of recycled water as part of its wastewater activities.

2.5.1 TREATMENT PLANTS

Wastewater treatment plants in the South Westside Basin include:

- North San Mateo County Sanitation District’s (NSMCSD) treatment plant, which includes a recycled water facility permitted to distribute 2.77 mgd of tertiary recycled water.
- San Bruno and South San Francisco’s South San Francisco/San Bruno Water Quality Control Plant
- Burlingame’s Wastewater Treatment Facility
- City of Millbrae’s Water Pollution Control Plant

2.5.1.1 North San Mateo County Sanitation District Treatment Plant

The NSMCSD is a subsidiary of the City of Daly City and owns and operates a treatment plant at the southern end of Westlake Park in Daly City. The plant was expanded in 1989 to a capacity of 10.3 mgd. The NSMCSD provides collection, treatment and disposal for the majority of the residents of Daly City, along with Broadmoor Village, a portion of Colma, the Westborough County Water District in South San Francisco, and the San Francisco County Jail in San Bruno (Daly City, 2009).

In 2003, NSMCSD constructed facilities at its wastewater treatment plant to produce recycled water. The plant has the capacity and permits for production of approximately 2.77 mgd of tertiary-treated recycled water (SFPUC, 2008) and began delivery in 2004 to irrigation users.

2.5.1.2 South San Francisco/San Bruno Water Quality Control Plant

The South San Francisco/San Bruno Water Quality Control Plant was constructed in the early 1970s and is jointly operated by the cities of South San Francisco and San Bruno. The sewage of both cities is treated, as is wastewater from a portion of Colma and the Serramonte portion of Daly City. The Westborough Water District coordinates sewage treatment for the Westborough portion of South San Francisco under contract with Daly City.

The current design capacity of the treatment plant is 13 mgd with an actual capacity of 9 mgd average dry weather flow. A plant expansion, begun in the fall of 1998, increased the dry-weather operational capacity to 13 mgd. The expansion added three new primary clarifiers, additional secondary clarifiers, and removed obsolete equipment (South San Francisco, 2009).

2.5.1.3 City of Millbrae Water Pollution Control Plant

The City of Millbrae provides wastewater service to approximately 5,928 residential and 495 commercial customers. The City's Sanitation System has two components: collection and treatment/disposal. Wastewater is collected via a network of about 57 miles of sewer pipelines and two wastewater pumping stations, and then transported to the City's Water Pollution Control Plant for treatment and disposal (Millbrae, 2009a). In October 2009, Millbrae began a refurbishment of the Water Pollution Control Plant to improve treatment capabilities and minimize sanitary sewer overflows that can occur during stormy weather. This project will add a 1.2 million gallon flow equalization tank to retain the extra water that flows into the treatment plant during storms (Millbrae, 2009b).

2.5.1.4 Burlingame Wastewater Treatment Facility

The wastewater treatment facility at 1103 Airport Boulevard became operational during 1935-36. The facility has a designed capacity to treat 5.5 mgd of wastewater and 16 mgd during wet weather (Burlingame, 2009).

2.5.2 RECYCLED WATER INFRASTRUCTURE AND USERS

Existing recycled water infrastructure and users are in the Daly City / Lake Merced area. Recycled water for non-potable (non-drinkable) uses such as irrigation is encouraged to conserve drinking water supplies. Installation of recycled water pipelines in the NSMCSD began in the mid-1980s when water or sewer projects were constructed. As discussed in Section 2.5.1.1, NSMCSD's treatment plant has the capacity and permits for production of 2.77 mgd of recycled water.

Today, the system is used to irrigate landscaped medians in the Westlake area and golf courses at Olympic Club, Lake Merced Golf Club, and San Francisco Golf Club. These customers use an average of less than 1 mgd of recycled water. Construction is underway to expand the recycled water infrastructure and user base to include irrigation of Harding Park and Fleming golf courses.

Plainly marked purple pipelines, completely separate from drinking water systems, deliver the water to user sites. Water recycling is a safe and proven practice. For many years, recycled water has been safely used for landscape irrigation purposes throughout California and the world saving precious potable water for other uses (Daly City, 2009).

Studies have been performed to investigate recycled water opportunities based on production at the South San Francisco/San Bruno Water Quality Control Plant (Carollo, 2008, 2009). These documents analyzed irrigation demands and infrastructure needs. Demand analysis showed a Phase I average annual recycled water demand of 0.60 mgd and a Phase II average annual recycled water demand of 0.94 mgd. The estimated project costs are $44 million for Phase I and $43.8 million for Phase II. Such projects may be pursued in the future should costs become better aligned with the benefits of the additional reliable supply.

2.5.3 RECYCLED WATER QUANTITY AND QUALITY

Throughout the year, NSMCSD monitors water quality to maintain compliance with Title 22 for unrestricted use. Monitoring is performed for the following: flow rate, total coliform, contact time, turbidity, dissolved oxygen, dissolved sulfides, and applicable standard observations. NSMCSD additionally monitors pH, electrical conductivity, TDS, boron, chloride, sodium, sodium adsorption ratio, adjusted sodium adsorption ratio, and bicarbonate (ESA, 2009).

3 WATER REQUIREMENTS AND SUPPLIES

3.1 CURRENT AND HISTORICAL WATER REQUIREMENTS AND SUPPLIES

South Westside Basin groundwater, imported water from the SFPUC, and small quantities of recycled water are used to meet water demands in the South Westside Basin as summarized in Table 3.1. All annual values represent calendar years. Details by agency are provided in Section 3.1.2.

Table 3.1 Summary of Current Water Supply Sources (2010)

Entity	Supply (AFY)			
	South Westside Basin Groundwater[1]	Imported Water[2]	Recycled Water[1]	Total
Burlingame	0	4,389	0	***4,389***
CalWater	453	8,075	0	***8,528***
Daly City[3]	1,743 / 3,947	5,524 / 3,320	0	***7,267***
Millbrae	0	2,482	0	***2,482***
San Bruno	2,364	1,637	0	***4,001***
Irrigators[4]	1,800	0	412	***2,212***
Total[5]	***8,564***	***19,903***	***412***	***28,879***

1 – SFPUC, 2011. Since Olympic Club and San Francisco Golf Club overlie both the North Westside Basin and South Westside Basin, the irrigation use assumes the following: Olympic Club – 50 percent of total recycled water use in the North Westside Basin and 50 percent use in the South Westside Basin; and San Francisco Golf Club – 90 percent of total recycled water use in the North Westside Basin and 10 percent use in the South Westside Basin.
2 – BAWSCA, 2011
3 - Daly City banked 2,204 AF of water in a conjunctive use arrangement with SFPUC, resulting in lower than normal groundwater production and higher than normal imported water purchases in 2010. The first value listed is the actual groundwater production and imported water purchase. The second value listed is the adjusted value.
4 –For the irrigators, all groundwater production within the South Westside Basin is listed, including estimated production in Millbrae and Burlingame. For comparison to the basin yield estimate (which does not include the Millbrae and Burlingame area; see Section 3.5.2), a total irrigation production of 1,139 and a total South Westside Basin groundwater production of 5,700 AF (7,904 AF when including banked Daly City production) should be used.

5 – Totals utilize Daly City values adjusted for conjunctive use.

Water demand in the Plan Area is somewhat higher in the summer months than in the winter months, primarily due to outdoor use and irrigation demands. The current water supply facilities are capable of meeting demands throughout the year, including summer days with high water use. The typical average monthly water supply distribution is shown in Figure 3.1, based on monthly data from the South Westside Basin municipal water purveyors.

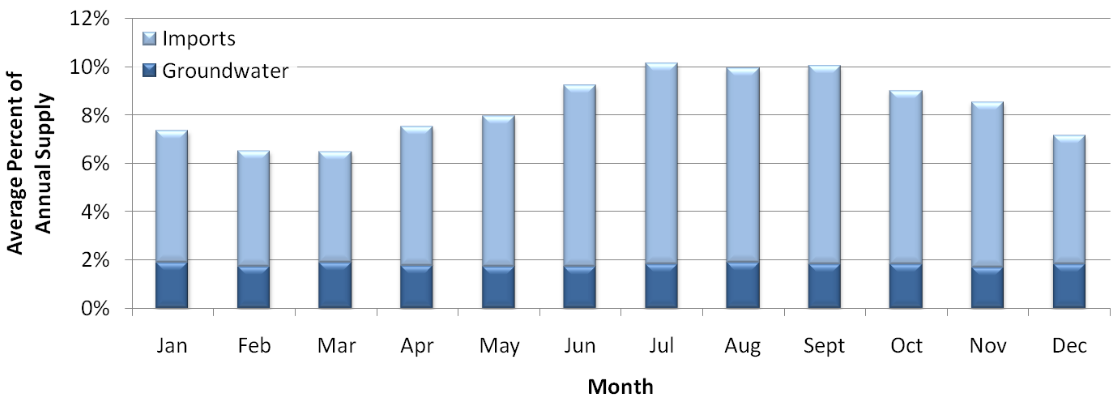


Figure 3.1 Average Monthly Distribution of Annual Municipal Supply, South Westside Basin

3.1.1 WHOLESALE WATER AGENCIES

Imported water is brought into the Plan Area by SFPUC, a wholesaler of imported water in the South Westside Basin and a retailer in the North Westside Basin.

The City and County of San Francisco, through SFPUC, own and operate a regional water system extending from the Sierra Nevada to San Francisco and serves retail and wholesale customers in San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne counties. The regional water system consists of water conveyance, treatment, and distribution facilities, and delivers water to retail and wholesale customers. The existing regional system includes more than 280 miles of pipelines, more than 60 miles of tunnels, 11 reservoirs, 5 pump stations, and 2 water treatment plants. The SFPUC currently delivers an annual average of approximately 265 mgd of water to its customers. The water supply source is a combination of local supplies from streamflow and runoff in the Alameda Creek Watershed and in the San Mateo and Pilarcitos creeks watersheds (referred to together as the Peninsula Watersheds), augmented with imported supplies from the Tuolumne River Watershed. Local watersheds provide about 15 percent of total supplies and the Tuolumne River provides the remaining 85 percent (ESA, 2009).

The SFPUC serves approximately one-third of its water supplies directly to retail customers, primarily in San Francisco, and about two-thirds of its water supplies to wholesale customers by contractual agreement. One retail customer, the Golden Gate National Cemetery in San Bruno, is located within the South Westside Basin. The wholesale customers are largely represented by BAWSCA, which consists of 27 total customers. Some of these wholesale customers have other sources of water in addition to what they receive from the SFPUC regional system, while others rely completely on SFPUC for supply (ESA, 2009).

3.1.2 Retail Agency Water Use

Details on water use by the retail agencies are presented in the following sections. Data are available from metered agency records, agency UWMPs, South Westside Basin annual groundwater reports, and BAWSCA's annual reports. From these data sources the following can be summarized: supply sources, quantification of the current supply mix, and quantification of historical groundwater production.

3.1.2.1 City of Burlingame

The City of Burlingame covers 4.3 square miles and has a population of approximately 28,000 people. Details of the Burlingame water supply system are summarized below based on the city's UWMP (EKI, 2005). Burlingame owns, operates, and maintains the potable water distribution system that serves drinking water to residential, commercial, and industrial establishments. The water supply is imported water purchased from SFPUC.

Burlingame's distribution system consists of six pumping stations, five water storage tanks, and buried pipes of varying compositions, ages, and sizes. The distribution system provides water to eight pressure zones within the city's water service area.

Approximately 80 percent of all service connections are located in the Aqueduct Zone, which contains most of Burlingame's commercial, industrial, and multi-family residence units. Water is transferred between pressure zones through a system of pipes and pumping stations. The pumping stations currently operated by the city are referred to as:

1. Donnelly
2. Easton
3. Skyview
4. Trousdale
5. Hillside
6. Sisters of Mercy (fire flow only)

Five of the pumping stations transfer water from the lower elevations of the city to the higher elevations, while the Sisters of Mercy station provides fire flow to the Sisters of Mercy property. The sizes of the pumps range between 7.5 and 75 horsepower.

The city's five water storage tanks provide aggregate water storage for 2.94 million gallons. The largest water storage facility is the Hillside Tank, which holds 1.5 million gallons. The smallest water storage facilities are the individual tanks at the Alcazar and Donnelly sites. There are two tanks at each site and each tank holds 0.05 million gallons.

The total water supply, all from SFPUC purchases, has averaged 5,100 AF over the past 14 years and has shown a slight declining trend over that time period (Figure 3.2). In 2010, the total water supply for Burlingame was 4,389 AF.

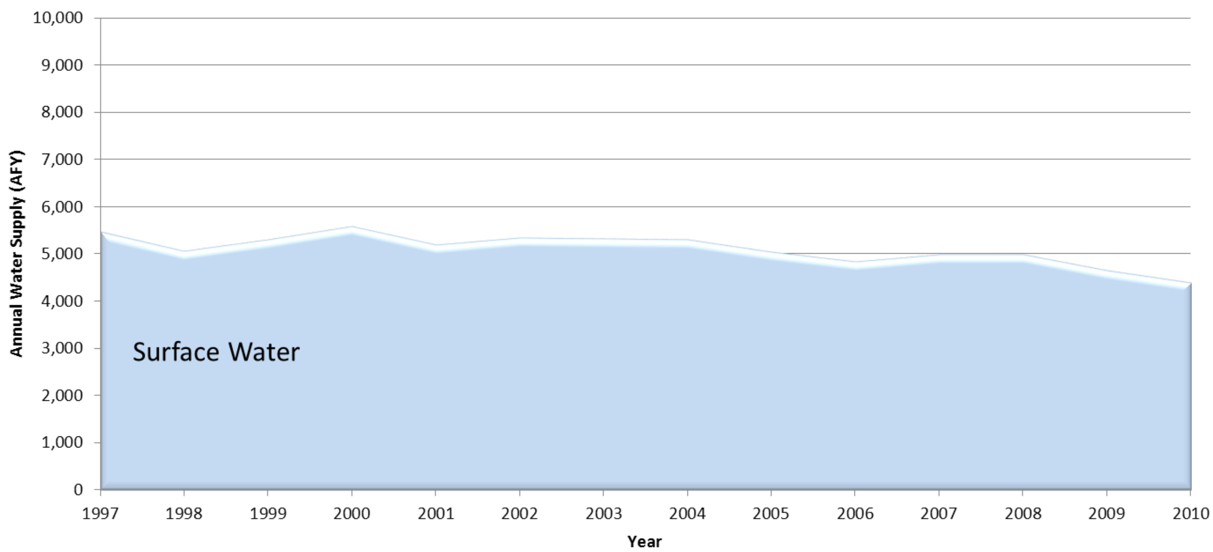


Figure 3.2 Historical Annual Water Supply, Burlingame

3.1.2.2 California Water Service Company –South San Francisco District

CalWater – South San Francisco District provides water to approximately 56,950 people in a service area of approximately 11 square miles. The service area includes South San Francisco, Colma, a small portion of Daly City, and an unincorporated area of San Mateo County known as Broadmoor, which lies between Colma and Daly City. The South San Francisco system includes 144 miles of pipeline, 12 storage tanks, one collecting tank, and 20 booster pumps.

CalWater uses groundwater and imported surface water from SFPUC to meet demands. CalWater's Individual Supply Guarantee with

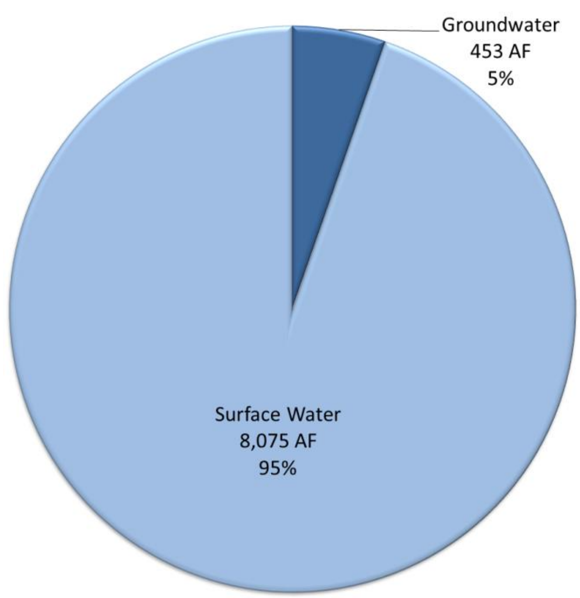


Figure 3.3a
Current (2010) Water Supply Sources, CalWater – South San Francisco District

SFPUC is 35.68 mgd (or approximately 39,967 AFY) and also supplies CalWater's other Bay Area Districts: Bear Gulch and Mid-Peninsula. Imported surface water has been used to a greater extent recently due to reduced groundwater production, as discussed in the following paragraph. In 2010, imported surface water accounted for 95 percent of CalWater's supply, while the remaining 5 percent was supplied by groundwater (Figure 3.3a).

The South San Francisco District has seven wells with a total design capacity of 1,365 gallons per minute (gpm). If operated full-time, these wells could produce 1.97 mgd (2,207 AFY). This production capacity represents approximately 20 to 25 percent of the annual demand in the district. While production in the 1950s and 1960s averaged 2,031 AFY, a maximum of 1,524 AFY has been pumped in calendar years since 1970. From 1998 to 2002, production averaged 1,212 AFY. However, recent years have seen little groundwater production due to participation in the ILPS and unforeseen issues with the wells. There was no groundwater production from 2003-2007; groundwater production steadily increased from when the wells were returned to service in 2008 to where CalWater produced 453 AF of groundwater in 2010. Historical water supplies by year are shown in Figure 3.3b. The district plans to return to earlier levels of production (1,535 AFY) in the future (CalWater, 2011).

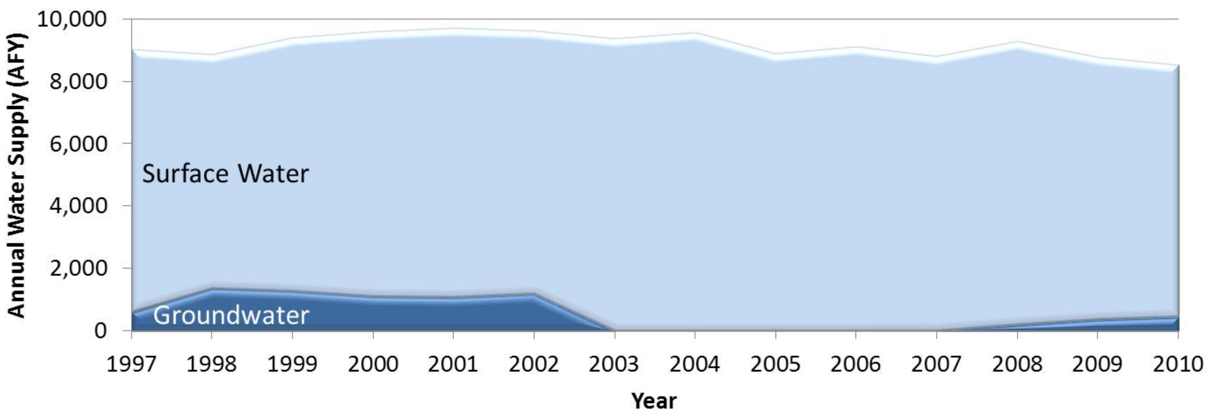


Figure 3.3b Historical Annual Water Supply, CalWater – South San Francisco District

3.1.2.3 City of Daly City

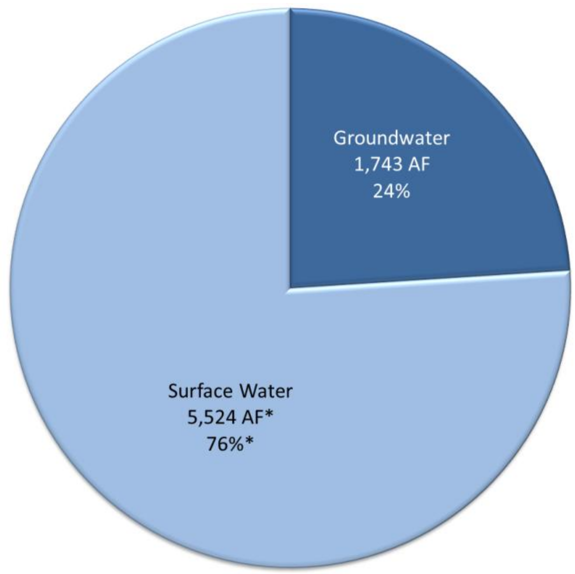
Daly City is in the northern part of San Mateo County, adjacent to the southern boundary of the City and County of San Francisco. Water service is provided by the Daly City Department of Water and Wastewater Resources. The city has an estimated 2009 population of 102,165, including small areas served by CalWater.

Daly City has three water sources: groundwater, water purchased from SFPUC, and recycled water.

Daly City's purchases of water from SFPUC are based on an Individual Supply Guarantee of 4.292 mgd (4,808 AFY) (Daly City, 2005) and are provided through 10 SFPUC turnouts. The turnouts can supply approximately 30.89 mgd at a rate of about 21,400 gpm (Daly City, 2005). During 2010, Daly City's water supply was provided by 76 percent imported surface water from SFPUC and 24 percent from local groundwater (see Figure 3.4a). The 76 percent includes participation in the ILPS. If the in-lieu water were accounted for as groundwater, the percentages would be 46 percent imported surface water and 54 percent groundwater. During normal well operation, SFPUC provides approximately 55 percent of the city's annual water supply. Daly City has been involved in the ILPS for much of the period since 2002 and purchases from SFPUC have contributed up to 92 percent of the city's annual water supply (Figure 3.4b).

Daly City has six active groundwater wells with a combined capacity of 4.25 mgd (4,760 AFY). During conjunctive use in an emergency or drought scenario, well water can contribute approximately 50 percent of the Daly City water supply (Daly City, 2005).

For the purposes of this document, recycled water produced by Daly City is accounted for under the user of the supply, Private Groundwater Producers in Section 3.1.3.



* Includes 2204 AF of in-lieu recharge water

Figure 3.4a Current (2010) Water Supply Sources, Daly City

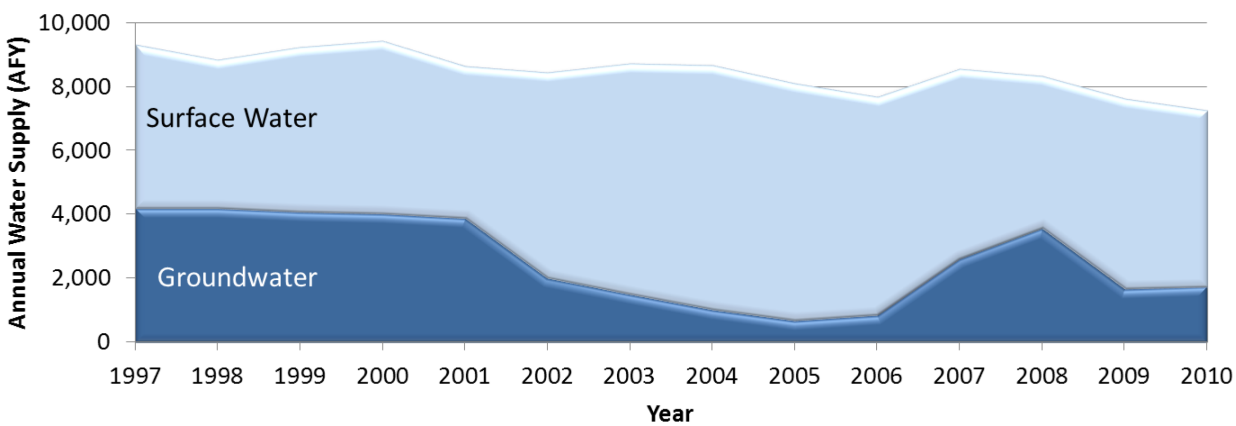


Figure 3.4b Historical Annual Water Supply, Daly City

3.1.2.4 City of Millbrae

Millbrae provides water to approximately 21,800 residents within a service area of 3.2 square miles (Figure 1.3). The City of Millbrae owns and operates approximately 70 miles of domestic water mains, 450 fire hydrants, 1,500 valves, 11 pressure reducing stations, 6 water storage tanks, 2 water pump stations, and approximately 6,500 service connections (Millbrae, 2005). Millbrae purchases its water from SFPUC and has an Individual Supply Guarantee of 3,531 AFY. Total water supplies averaged 2,790 AFY over the 1997-2010 period, and was 2,482 AF in 2010, as shown in Figure 3.5.

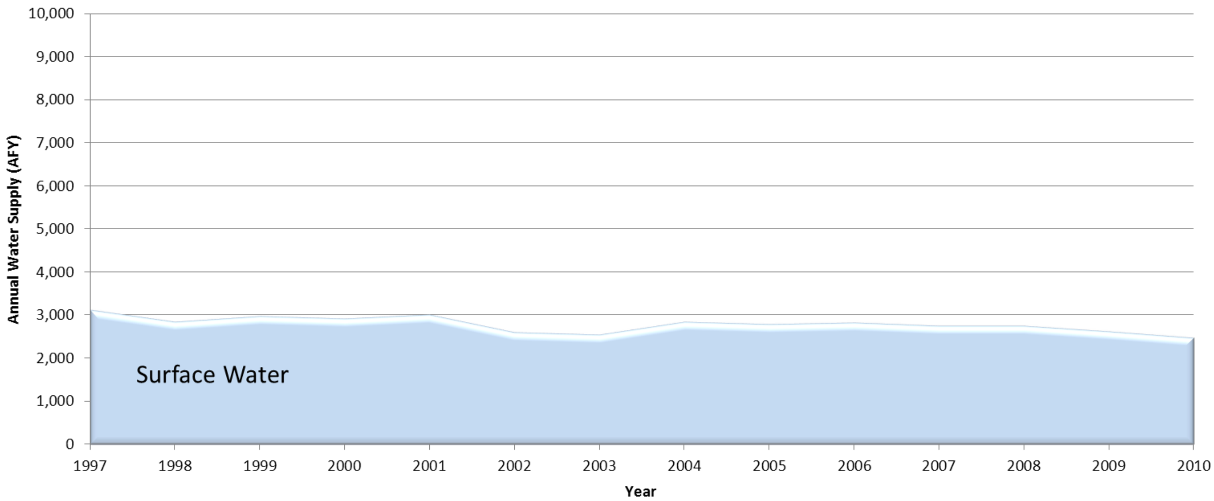


Figure 3.5 Historical Annual Water Supply, Millbrae

3.1.2.5 City of San Bruno

San Bruno owns, operates, and maintains the potable water distribution system that serves drinking water to residential, commercial, institutional, and limited industrial establishments within San Bruno's service area. The City of San Bruno covers 5.5 square miles and has a population of approximately 41,120 people. San Bruno's water system consists of five groundwater supply wells, eleven pressure zones maintained with eight booster pump stations, eight water storage tanks, one filtering plant, 900 fire hydrants, 9,000 valves, more than 100 miles of water mains ranging from 2 inches to 16 inches in

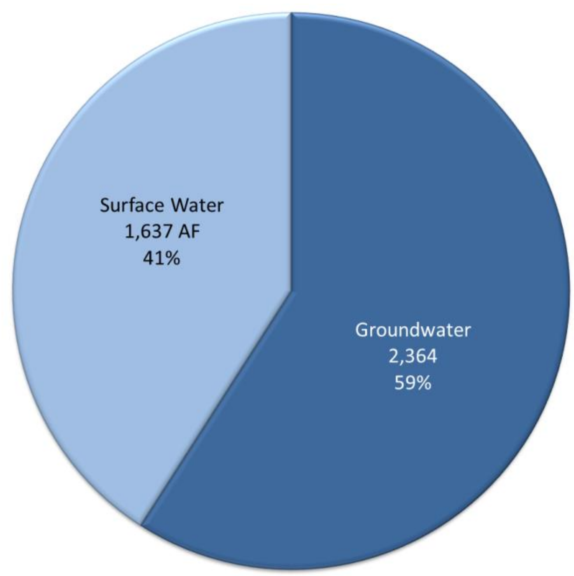


Figure 3.6a Current (2010) Water Supply Sources, San Bruno

diameter, and 12,415 metered service connections. San Bruno has four connections to the SFPUC water supply system and one connection to the NCCWD water supply system. San Bruno's water system can deliver water at a pressure of at least 30 pounds per square inch (psi) during peak-hour demand and 20 psi during maximum-day demand coincident with a fire flow (EKI, 2007).

Water supplied through the city's distribution system is a combination of groundwater pumped at San Bruno's five groundwater supply wells, and water purchased from SFPUC and NCCWD. Purchases from SFPUC are based on an Individual Supply Guarantee of 3.25 mgd (or approximately 3,600 AFY) (EKI, 2007). Note that one of San Bruno's five wells, SB-15, is not currently operational; a replacement well is in the process of sited and designed.

In 2010, groundwater wells provided 2,364 AF of water, or 59 percent of the total supply, while imported water provided the remaining 1,637 AF, as shown in Figure 3.6a. During the 1997 – 2010 period, not including the 2003-2004 In-Lieu Pilot Study, groundwater provided approximately 2,120 AFY, or 46 percent of the total supply, as shown in Figure 3.6b.

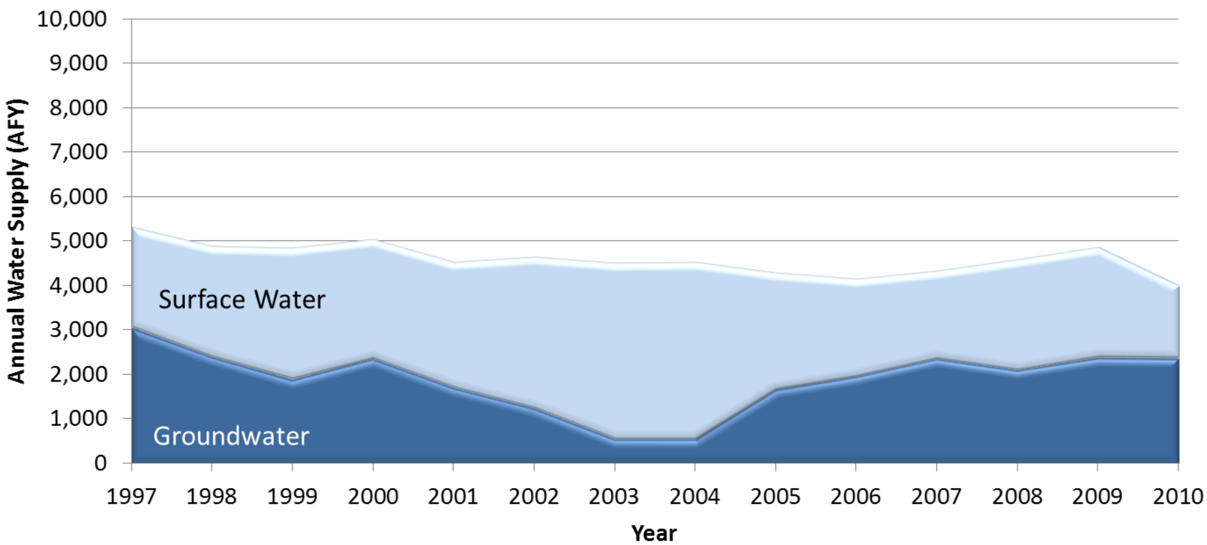


Figure 3.6b Historical Annual Water Supply, San Bruno

3.1.3 PRIVATE GROUNDWATER PRODUCERS

Private groundwater producers in the Plan Area pump groundwater primarily for irrigation of golf courses, cemeteries, and landscaping. There is some domestic production, particularly in the Hillsborough area. These users typically do not meter the volume of water produced, therefore these volumes must be estimated to present a complete picture of water use. Historical use of South Westside Basin groundwater by private groundwater producers has been estimated by HydroFocus (2011), to support the development of the Westside Basin Groundwater Flow Model (Groundwater Model), using land use, soils, and hydrologic data.

Additional data on private groundwater use is available in annual reports (SFPUC, 2011). Estimates of production are approximately 1,800 AFY based on current (2010) conditions in the basin. The 2010 estimate includes the users summarized in Table 3.2.

Table 3.2 Summary of 2010 Private Groundwater Production

Entity	2010 Production	Source	Notes
Lake Merced Golf Course	33 AF	metered (SFPUC, 2011)	
Olympic Golf Club	10 AF	metered (SFPUC, 2011)	
California Golf Club of San Francisco	237 AF	estimated* (HydroFocus, 2011)	Other estimate (Carollo, 2008) is 206 AF
Cemeteries	859 AF	estimated* (HydroFocus, 2011)	Other estimate (Carollo, 2008) is 787 AF
Subtotal, Daly City to San Bruno	***1,139 AF***		
Hillsborough area domestic wells**	326 AF	estimated* (HydroFocus, 2011)	
Green Hills and Burlingame Country Clubs**	335 AF	estimated* (HydroFocus, 2011)	
Subtotal, Millbrae to Burlingame*	***661 AF***		
Total**	**1,800 AF**		

*Estimates from HydroFocus (2011) are based on the average production using the 2008 No Project Baseline over the full 1959-2009 hydrology.

**These estimates include the Millbrae and Burlingame area production (Burlingame domestic wells, Green Hills Country Club and Burlingame Country Club). Without the Millbrae and Burlingame area, the private production is 1,139 AF. The without- Millbrae and Burlingame value is more appropriate for comparisons with the results of HydroFocus (2011) as that document summarized the private production in the Westside Basin only as far south as San Bruno. Minor differences between the average annual private production estimated by that document (1,122 AFY) and the without-Burlingame values presented here are a result of usage of calendar years in this document versus water years in the HydroFocus document, minor differences in developing the average value, and the incorporation of newly available metered data in this document.

Recycled water produced by NSMCSD is used by private groundwater producers. Much of this use is along the boundary with the North Westside Basin. For accounting purposes, recycled water use in the South Westside Basin includes use in Daly City medians, at Lake Merced Golf Club, and at the Olympic Golf Club, but not at the San Francisco Golf Club, which otherwise would use a groundwater well within the North Westside Basin. Based on this assumption, approximately 410 AF of recycled water was used in the South Westside Basin.

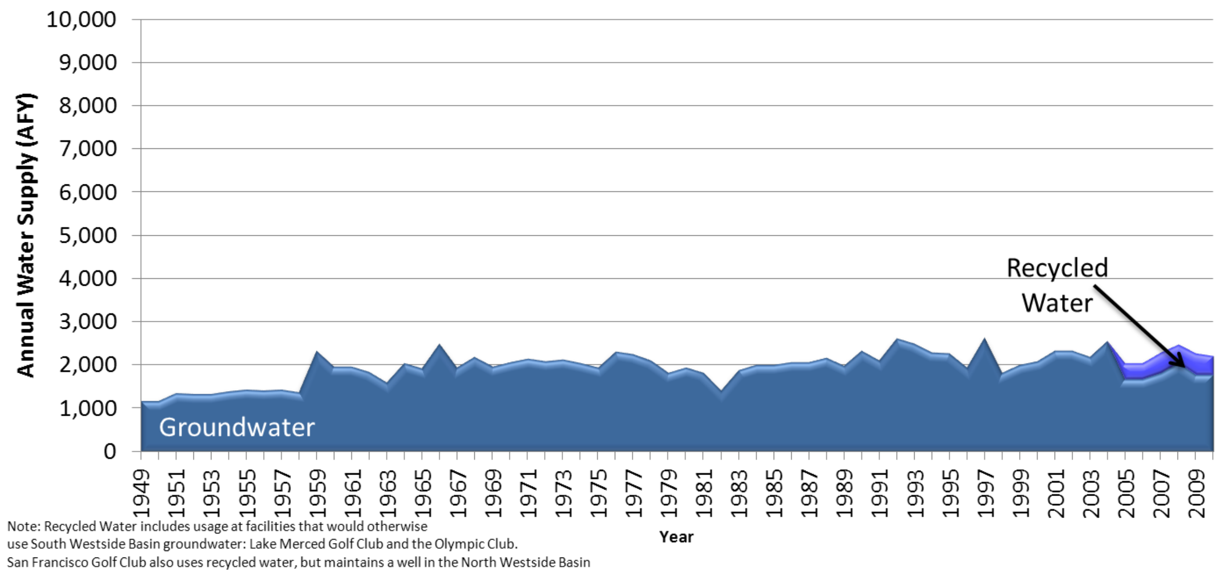


Figure 3.7 Historical Annual South Westside Basin Groundwater Production, Private Groundwater Producers

3.1.4 Total South Westside Basin

Current and historical water demands in the South Westside Basin have been met with purchases of imported surface water from SFPUC, local groundwater, and a smaller quantity of recycled water, as shown in Figure 3.8.

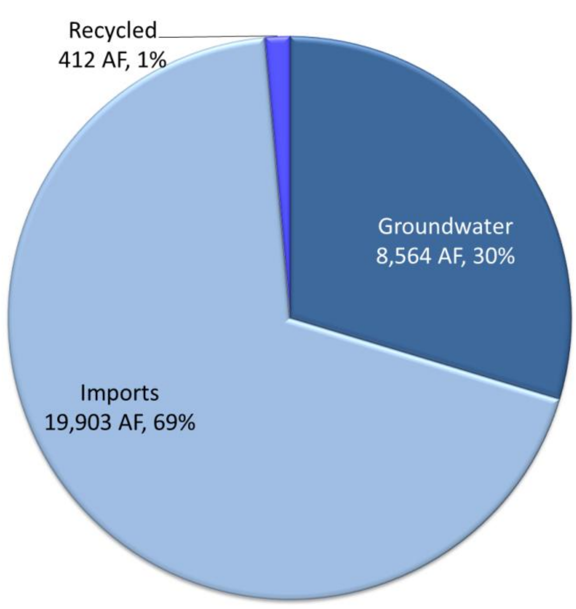


Figure 3.8 Current Water Supply Sources, South Westside Basin

South Westside Basin groundwater is an important component of the supply mix; Table 3.3 shows the percentage of the total water supply provided by groundwater in 2010 for the entities in the basin.

Table 3.3 2010 Groundwater Production by Entity as a Percent of Total Water Supply

Entity	Groundwater as Percent of Total Water Supply
Burlingame	0%
CalWater – South San Francisco District	5%
Daly City	24%*
Millbrae	0%
San Bruno	59%
private groundwater producer	81%

*54% if including in-lieu recharge

Figure 3.9 shows total annual groundwater production by major producer. In 2010, total groundwater production from the South Westside Basin was approximately 8,600 AF, including approximately 2,200 AF of banked groundwater under the ILRP to be potentially extracted at a later date. Figure 3.10 shows the distribution of groundwater production throughout the South Westside Basin, based on 2008 production data.

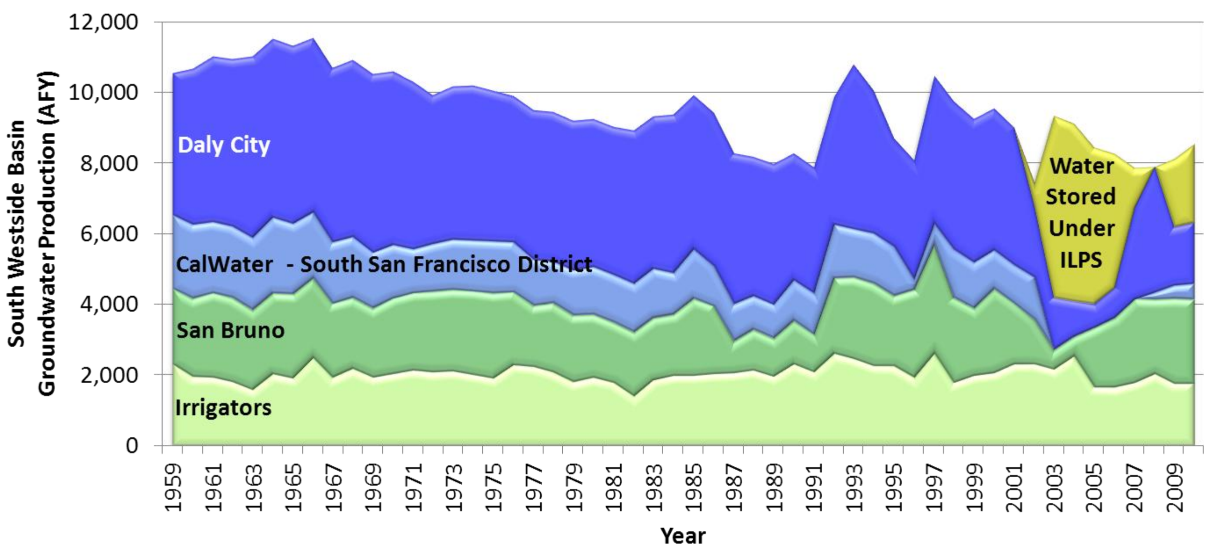


Figure 3.9 Historical Annual South Westside Basin Groundwater Production by Entity

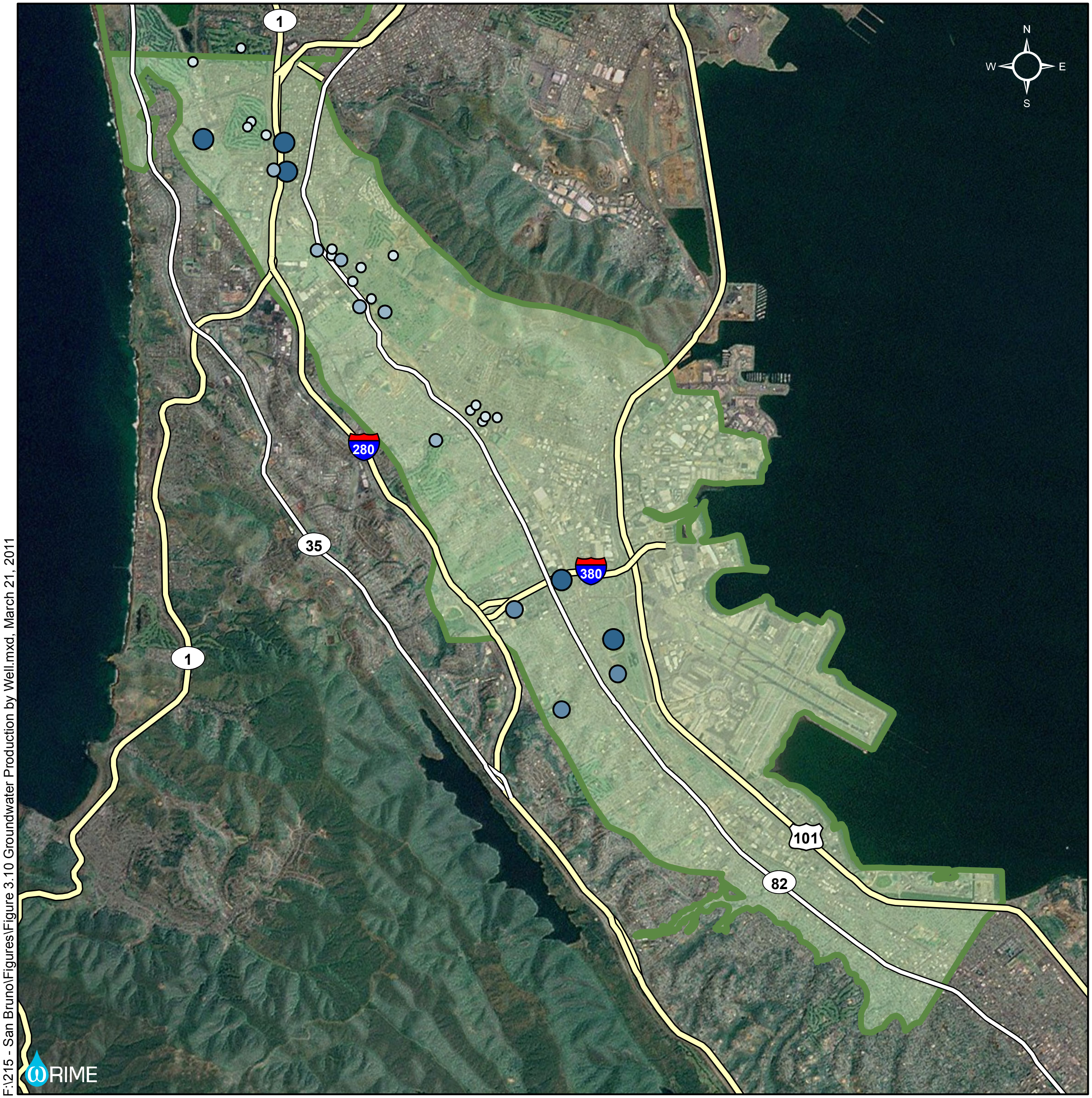


Figure 3.10
Groundwater Production by Well

Legend

- Highways
- Groundwater Basin
- Plan Area

2008 Production (af)

- 1 - 100
- 100 - 250
- 250 - 500
- > 500

0 0.5 1 2 Miles

Groundwater Production Sources:
CalWater, personal communication, 2009
City of Daly City, personal communicaiton, 2009
City of San Bruno, pers. comm., 2009
Hydrofocus, 2009
SFPUC, 2009

F:\215 - San Bruno\Figures\Figure 3.10 Groundwater Production by Well.mxd, March 21, 2011

3.2 CURRENT WATER BUDGET

A more thorough understanding of the groundwater conditions can be obtained through analysis of the water budget, which estimates the different inflows and outflows of the aquifer. There are several different components of inflows and outflows. A South Westside Basin water budget was estimated below based on the results of the Groundwater Model, which is described in *Westside Basin Groundwater-Flow Model: Updated Model and 2008 No-Project Simulation Results.* (HydroFocus, 2011).

The simplified version of the water budget equation for a basin is:

Inflow – Outflow = Storage Change **(1)**

Inflow, outflow, and storage consist of the following more detailed subcomponents:.

- Inflow
    - Applied water components
        - Agricultural water use
        - Landscape and outdoor irrigation
    - Recharge from precipitation
    - Boundary flow from Coast Range and San Bruno Mountain
    - Underflow from
        - North Westside Basin
        - Pacific Ocean
        - San Francisco Bay
- Outflow
    - Groundwater production
    - Underflow to
        - Pacific Ocean
        - San Francisco Bay
    - Evapotranspiration
- Groundwater storage change

Water budget estimates were based on HydroFocus's (2011) basin-wide groundwater modeling effort. That document included the development of the 2008 No Project Scenario, which simulates a 47-year continuation of anticipated land and water use conditions as of May 2008. It assumes no new projects are implemented, but includes new supply wells, planned operational changes to the magnitude and spatial distribution of pumpage, and existing recycled water projects in place as of May 2008. The 2008 No Project Baseline simulation results were averaged over the full 1959-2009 hydrology to develop an average annual water budget for the central portion of the South Westside Basin (Daly City southeast to San Bruno). The average annual water budget for the South Westside Basin is presented in Table 3.4.

Table 3.4 Estimated Average Annual* South Westside Basin Water Balance

Water Budget Component	Average Annual Volume (AFY)
Groundwater Production	8,756
Underflow to the Bayshore area	460
Underflow to Millbrae	429
Underflow to North Westside Basin	71
Total Outflow	***9,716***
Recharge, all sources	4,517
Underflow from the Bayshore area	762
Underflow from Millbrae	967
Underflow from North Westside Basin	2,167
Underflow across Serra Fault	1,109
Total Inflow	**9,522**
Change in Storage	***-194***

*Average of 1959-2009 Hydrology

The change in storage is less than zero, showing a reduction in groundwater in storage over time. However, this value is small and within the errors associated with the data and the model. For example, the 194 AFY is just 17% of the simulated unmetered groundwater production in the basin (1,122 AFY). There are significant unknowns in the volume of unmetered groundwater pumped by private groundwater producers as well as in other modeling parameters including future precipitation, recharge, and aquifer parameters. Given the uncertainties, the small change in storage, with outflows exceeding inflows by approximately 2 percent, should be considered as showing the basin essentially in balance.

3.3 PROJECTED WATER REQUIREMENTS AND SUPPLIES

Projected water use is an important component of determining the ability of a basin to meet future demands. Figure 3.11 illustrates the projected water supplies and demands through 2035 by the primary retail water agencies in the South Westside Basin using projections discussed in Section 3.3.1. Private groundwater producers are also included with the assumption of a continuation of current levels of production. The water served by the retail water agencies includes groundwater from the South Westside Basin, imported surface water purchased from SFPUC, and recycled water.

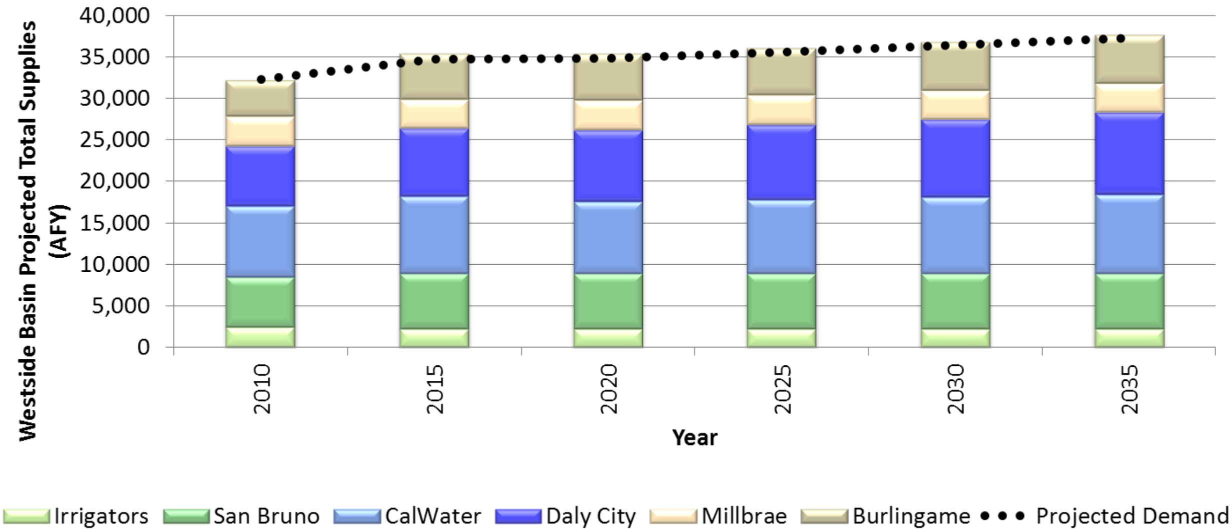


Figure 3.11 Projected Water Supplies in the South Westside Basin, by Agency

Table 3.5a presents current and projected South Westside Basin groundwater production through 2030. Table 3.5b presents the projected increase in South Westside Basin groundwater production compared to 2010 production.

While these projections represent the best available information from the agencies, they are subject to uncertainties related to climatic conditions, availability of water supplies, maintenance issues, and policy changes. Additionally, no projections are available for the private groundwater producers, whose production is assumed to remain at current levels, which themselves are largely estimated. Even with these uncertainties, the existing projections provide a good baseline for anticipated future use and for determining how the basin would respond to future use and management. These projections are not intended to set limits for the production by individual agencies; such limits may be established by the agencies in the future, but would likely be developed based on a wide range of demand and supply information, as discussed in Section 5.3.1, Action F5.

Table 3.5a Current and Projected South Westside Basin Groundwater Production (AFY)

Agency	2010	2015	2020	2025	2030	2035
Burlingame	0	0	0	0	0	0
CalWater – South San Francisco	453	1,535	1,535	1,535	1,535	1,535
Daly City	1,743* 3,947	3,349	3,842	3,842	3,842	3,842
Millbrae	0	0	0	0	0	0
San Bruno	2,364	2,364** 3,026	2,364** 3,026	2,364** 3,026	2,364** 3,026	2,364** 3,026
Private Producers* **	1,800	1,800	1,800	1,800	1,800	1,800
Total**	**8,564**	**9,048**	**9,541**	**9,541**	**9,541**	**9,541**

* Daly City's 2010 production was 1,743 AF, but does not include 2,204 AF of groundwater stored as a result of in-lieu water deliveries under the ILPS. For accounting purposes, this pumping may be included in 2010.

** San Bruno projects future groundwater production at its current rate. However, it is evaluating whether it can increase its production of groundwater to a rate of 3,026 AFY (2.7 mgd), which is consistent with a historical maximum annual production rate. San Bruno will coordinate with other basin users to ensure the groundwater basin is managed sustainably and in a manner consistent with the consensus driven basin yield analysis based on the modeling of HydroFocus, Inc.

*** Values for Private Producers include production outside of the area defined for the basin yield. See Section 3.5.

**** Totals utilize the Daly City values based on effective long-term pumping and San Bruno at its 2010 rate.

Sources: Daly City projected production: Brown and Caldwell, 2011;
San Bruno projected production: EKI, 2011;
CalWater projected production: CalWater, 2011

Table 3.5b Projected Change in South Westside Basin Groundwater Production, from 2010 Production (AFY)

Agency	2015	2020	2025	2030	2035
Burlingame	0	0	0	0	0
CalWater – South San Francisco	1,082	1,082	1,082	1,082	1,082
Daly City	1,606* -598	2,099* -105	2,099* -105	2,099* -105	2,099* -105
Millbrae	0	0	0	0	0
San Bruno	662** 0	662** 0	662** 0	662** 0	662** 0
Private Producers	0	0	0	0	0
Total*	**484**	**977**	**977**	**977**	**977**

* When compared to Daly City's actual 2010 production (1,743 AF), future Daly City groundwater production will increase by 2,099 AFY. However, Daly City's actual 2010 production does not include 2,204 AF of groundwater stored as a result of in-lieu water deliveries under the ILPS. For accounting purposes, this pumping may be included in 2010. Compared to the pumping value that includes the stored water, future Daly City groundwater production will decrease by 105 AFY.

** San Bruno projects future groundwater production at its current rate 2,354 AFY (2.1 mgd), but is evaluating its ability to increase its production of groundwater to a rate to 3,026 AFY (2.7 mgd). There is no change from the current rate, while the increase to the higher rate would be 662 AFY.

*** Totals utilize the Daly City values based on effective long-term pumping and San Bruno at its current rate.

The projected South Westside Basin supplies are shown in Figure 3.12 with the historical production discussed in Section 3.1. Projected demand in the South Westside Basin is within 300 AFY of projected supply.

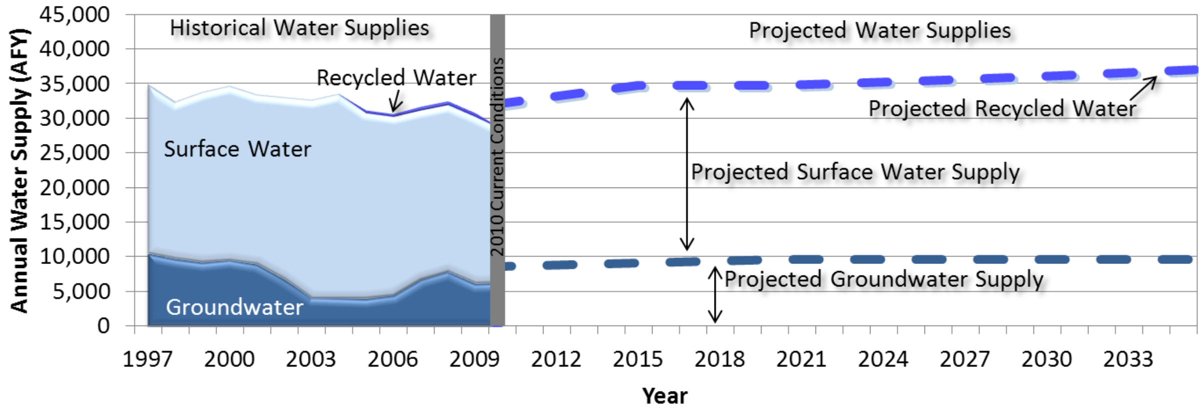


Figure 3.12 Historical and Projected South Westside Basin Groundwater Supply

3.3.1 AGENCY WATER PROJECTIONS

Detailed water supply projections for each retail water agency, as well as private irrigators, are provided in the following sections.

3.3.1.1 City of Burlingame

Water demands for the City of Burlingame are projected to increase from 4,389 AFY in 2010 to 5,852 AFY in 2035 (Burlingame, 2011), as shown in Figure 3.13. The projected supply meets the projected demand. No groundwater use is projected and imported water use is projected to stay within the city's Individual Supply Guarantee of 5,867 AFY.

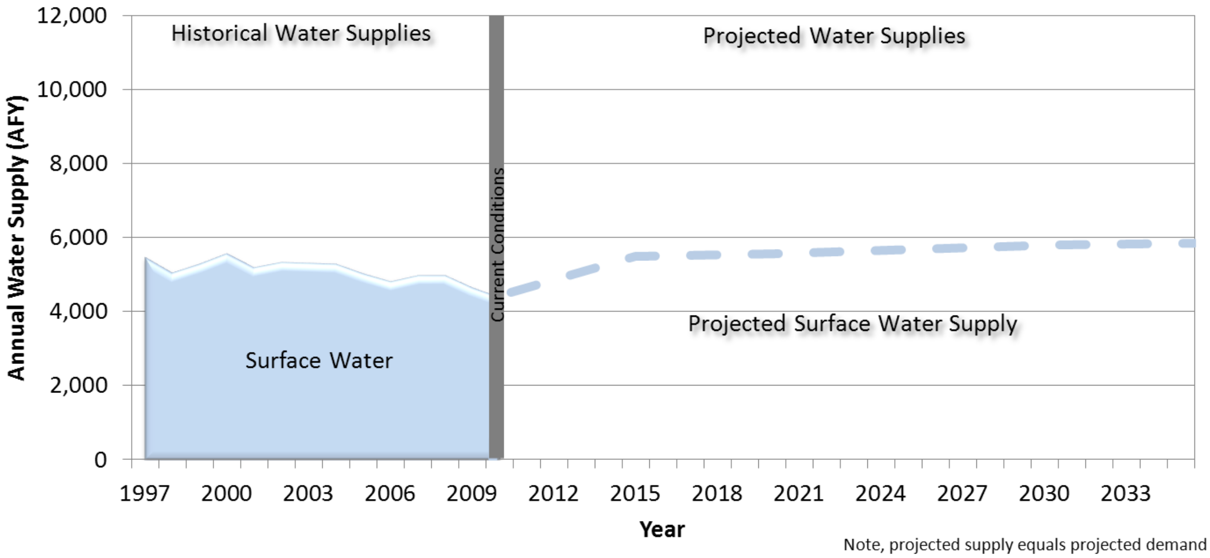


Figure 3.13 Projected Water Supply for Burlingame

3.3.1.2 California Water Service Company – South San Francisco District

Water demands for CalWater's South San Francisco District service area are projected to increase from 8,527 AFY in 2010 to 9,494 AFY in 2035. These demands will be met through:

- Approximately 1,100 AFY of additional South Westside Basin groundwater supplies as CalWater returns its wellfield to producing 1,535 AFY
- Reduction of surface water purchases by approximately 200 AFY (CalWater, 2011)

CalWater's projected supplies are shown in Figure 3.14. The projected supply meets the projected demand.

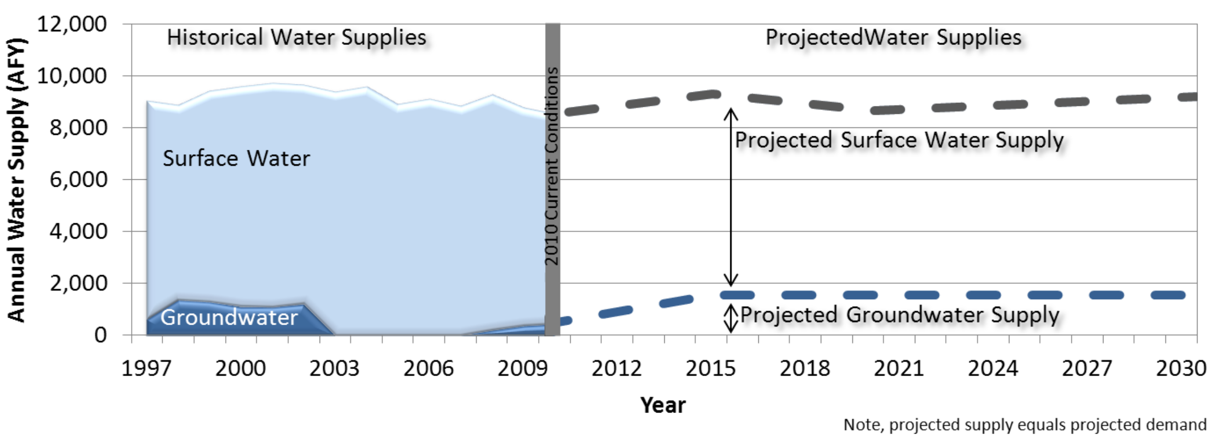


Figure 3.14 Projected Water Supply for CalWater

3.3.1.3 City of Daly City

Water demands for Daly City are projected to increase from 7,267 AFY in 2010 to 10,552 AFY in 2035. These demands will be partially met through:

- A decrease of approximately 100 AFY of South Westside Basin groundwater supplies
- An increase in surface water purchases by approximately 2,700 AFY (Brown and Caldwell, 2011)

These values are compared to 2010 supplies with in-lieu surface water deliveries accounted for as South Westside Basin groundwater. Total projected supplies in 2035 are 9,858 AFY and are less than the projected demand of 10,552 AFY. Daly City's projected supplies are shown in Figure 3.15. Imported water use is projected to exceed Daly City's Individual Supply Guarantee of 4,808 AFY, with a projected surface water supply of 6,016 AFY by 2035 (Daly City, 2011).

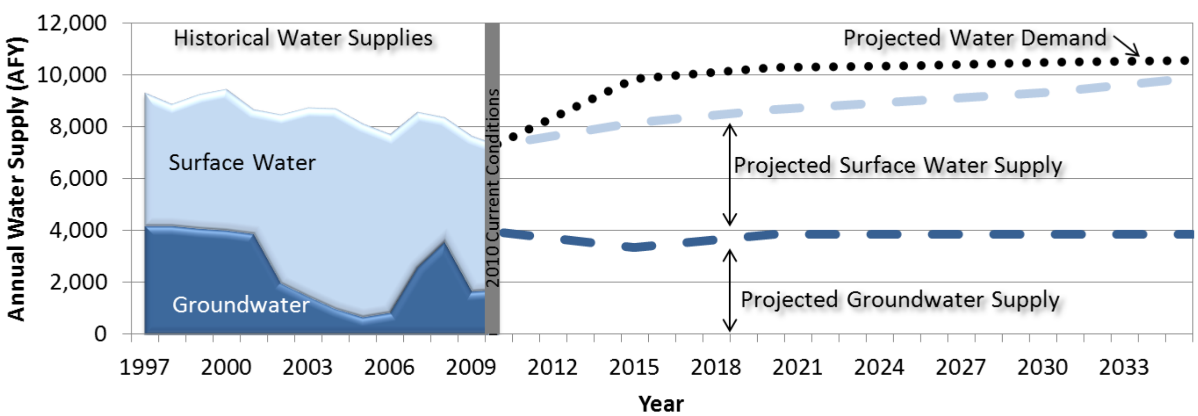


Figure 3.15 Projected Water Supply for Daly City

3.3.1.4 City of Millbrae

Water demands for Millbrae are projected to increase from 2,482 AFY in 2010 to 3,379 AFY in 2035. By 2035, total surface water supplies are projected to total 3,558 AFY (Millbrae, 2011), as shown in Figure 3.16. No groundwater use is projected and imported water use is projected to slightly exceed the city's Individual Supply Guarantee of 3,533 AFY.

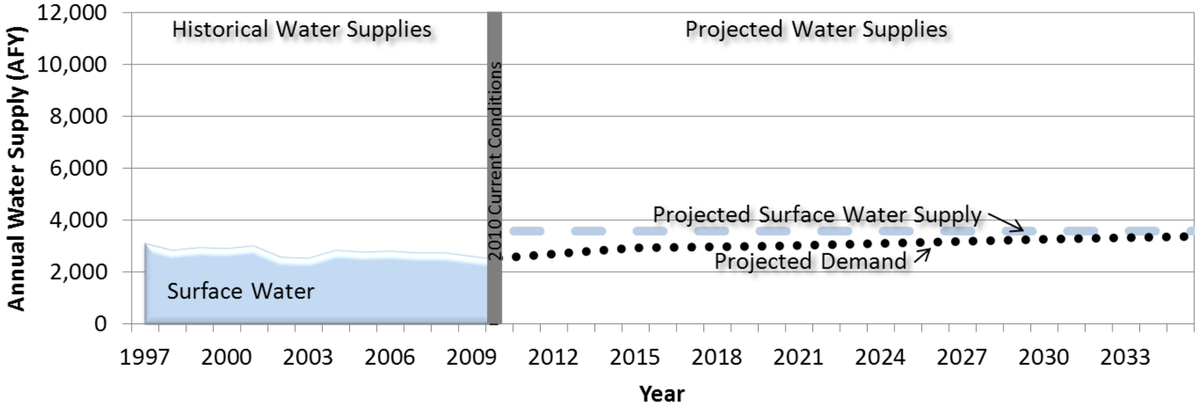


Figure 3.16 Projected Water Supply for Millbrae

3.3.1.5 City of San Bruno

Water demands for San Bruno are projected to increase from 4,001 AFY in 2010 to 5,751 AFY in 2035. These demands will be met through:

- Continued South Westside Basin groundwater production at 2,364 AFY
- Increase in surface water purchases from SFPUC and NCCWD from 1,637 AFY to 3,699 AFY
- Potential additional future groundwater production of 673 AFY. San Bruno will evaluate its ability to increase its groundwater production to 2.7 MGD, which is consistent with its historical maximum production rate. (EKI, 2011)

San Bruno's projected supplies are shown in Figure 3.17. Projected imported water purchases would be within San Bruno's Individual Supply Guarantee of 3,643 AFY.

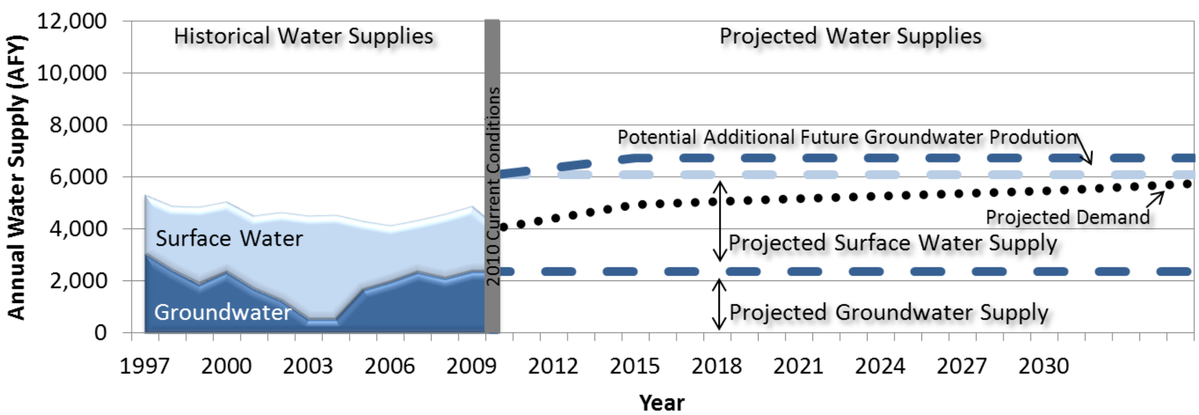


Figure 3.17 Projected Water Supply for San Bruno

3.3.2 Private Groundwater Producers

No projections of private groundwater use are available. Modeling results show an average demand of approximately 1,800 AFY (see Section 3.1.3). Future use is assumed to continue at this level. Of the 1,800 AFY, 1,139 AFY is produced from the area used to estimate basin yield, as described in Section 3.5

3.4 PROJECTED WATER BUDGET

The projected changes in South Westside Basin groundwater production indicated in agency projections in Section 3.3, show an increase in groundwater production of 977 AFY (Table 3.5b), from 8,564 AFY in 2010 to a projected 9,541 AFY in 2035.

The historical water budget analysis in Section 3.2 showed a basin only slightly out of balance under modeled conditions (8,756 AFY of groundwater production), with a change in storage of approximately -200 AFY. Groundwater production within the central portion of the South Westside Basin (Daly City southeast to San Bruno (an area consistent with the area analyzed in the historical water budget) is projected to increase from 7,904 AFY in 2010 to 8,881 AFY in 2035. This represents only a small increase in groundwater production of 124 AFY over the conditions analyzed in the historical water budget, leaving the basin nearly in balance.

The goals, objectives, elements, and implementation plan presented in the following sections seek to maintain this balance, accounting for increased competition for imported supplies and measures to improve the quantity of groundwater available to the stakeholders in the South Westside Basin.

3.5 BASIN YIELD

3.5.1 Basin Yield Definition

Basin yield is defined in this document as the maximum average annual groundwater production that could be maintained for a long-term time period and that would result in stable groundwater levels. This value does not explicitly take into consideration water quality, surface water resources, or environmental or socio-economic consequences. The basin yield is intended to be used along other data to guide groundwater management. Any use of groundwater has an impact; the aim of the basin yield is to assist in understanding the balances between the use of the groundwater and the impacts caused by that use. The balances in the Westside Basin are based on the following:

- There is a desire to maintain a sustainable groundwater reservoir by not pumping at levels that result in long-term declines in groundwater levels. Avoiding these declines will also avoid increased pumping costs and the need to deepen wells.

- o There is a desire to maintain groundwater levels at elevations that prevent or slow the migration of poor quality groundwater. Poor quality groundwater includes the point-source and non-point source contaminants discussed in Section 2.3.8 as well as seawater intrusion discussed in Section 2.3.3.
- o As there is little interaction between groundwater and surface water resources in the area, impacts to surface water resources are not directly considered.
- o The basin yield estimate will change over time in response to changing hydrology, groundwater production infrastructure, and the built environment. As such, the basin yield definition and estimate is intended to be reviewed and updated at regular intervals.

3.5.2 BASIN YIELD ESTIMATE

A variety of methods may be used to estimate basin yield. These include:

- Analysis of historical production and groundwater levels, identifying periods with stable water levels (if any) and the associated level of groundwater production.
- Development of a water budget to estimate inflow and outflows from the basin. Yield is then estimated as the sum of the change in storage and the volume of groundwater production.
- Development of a numerical groundwater model and simulations to estimate the yield.

The estimate of basin yield is developed through the use of the Groundwater Model, which incorporates the best available knowledge of the basin and was developed in a cooperative manner with extensive input. Basin yield is estimated as a level to maintain current groundwater levels. To reduce risk of seawater intrusion, groundwater levels need to be raised through increased recharge or decreased production. Higher groundwater levels would also reduce pumping costs and could help control migration of lower quality groundwater. Addressing seawater intrusion through the basin yield estimate may be revisited during implementation of the GWMP.

The basin yield estimate is based on work performed by HydroFocus (2011) to determine sensitivity to pumping and the level of municipal pumping that results in zero change in storage. The estimate does not include the southern portion of the South Westside Basin, including the Millbrae and Burlingame areas, due to limited groundwater use and higher model uncertainty due to limited data. In that groundwater modeling exercise, the near-term anticipated groundwater production was modeled over historical hydrology and recent land use. Recent groundwater elevations were used as initial conditions. Municipal groundwater production was then adjusted based on calculated uniform percentages for each water purveyor to determine a level of production that results in zero long-term change in storage. Production by private producers was left unchanged. The level of groundwater production with no long-term change in storage estimated by this scenario is approximately 10,600 AFY for the entire Westside Basin and approximately 8,600 AFY for the South Westside Basin. This value is consistent with the historical water budget analysis shown in Table 3.4, which showed a decline in storage of 194 AFY with a production of 8,756 AFY. These basin yield estimates are based on the current operating conditions in the basin; changes to the operating conditions in the basin may increase the yield (such as through capturing outflow to the Pacific Ocean through increased production or through increased recharge to the basin) or decrease the yield (such as by increasing outflows to the Pacific Ocean or San Francisco Bay through higher groundwater levels). Simulations indicated that groundwater production could be increased in one portion of the basin if production in adjacent areas is reduced. This is a result of the connectivity of the South Westside Basin aquifer and highlights that the aquifer is a shared resource among all groundwater producers. Due to the connectivity of the aquifer throughout the basin, the basin yield estimate is presented at the scale of the South Westside Basin.

Additional work was performed to estimate the variability of basin yield with respect to hydrology. Historical hydrology during the 1959-2009 time period simulated in the Groundwater Model was analyzed, and it was estimated that wet periods experienced approximately 30 percent more precipitation and dry periods experienced approximately 30 percent less precipitation than the overall average precipitation. Two additional model scenarios were developed, one with precipitation increased 30 percent across the full modeling period and one with precipitation decreased 30 percent across the full modeling period. The same methodology was applied to determine basin yield under these wetter and drier conditions. The estimated wetter period yield is 9,700 AFY and the estimated drier period yield is 7,200 AFY. Given the uncertainty in future hydrology, these values provide a range of yields to be used with the overall estimated basin yield of 8,600 AFY, which is based on historical hydrology.

Figure 3.18 compares the range of basin yield estimates to historical and projected groundwater production, showing that recent production is within the basin yield, although historical production exceeded the basin yield. The production shown in Figure 3.18 includes only production within the area defined for the basin yield estimate (i.e., does not include production in Burlingame and Hillsborough).

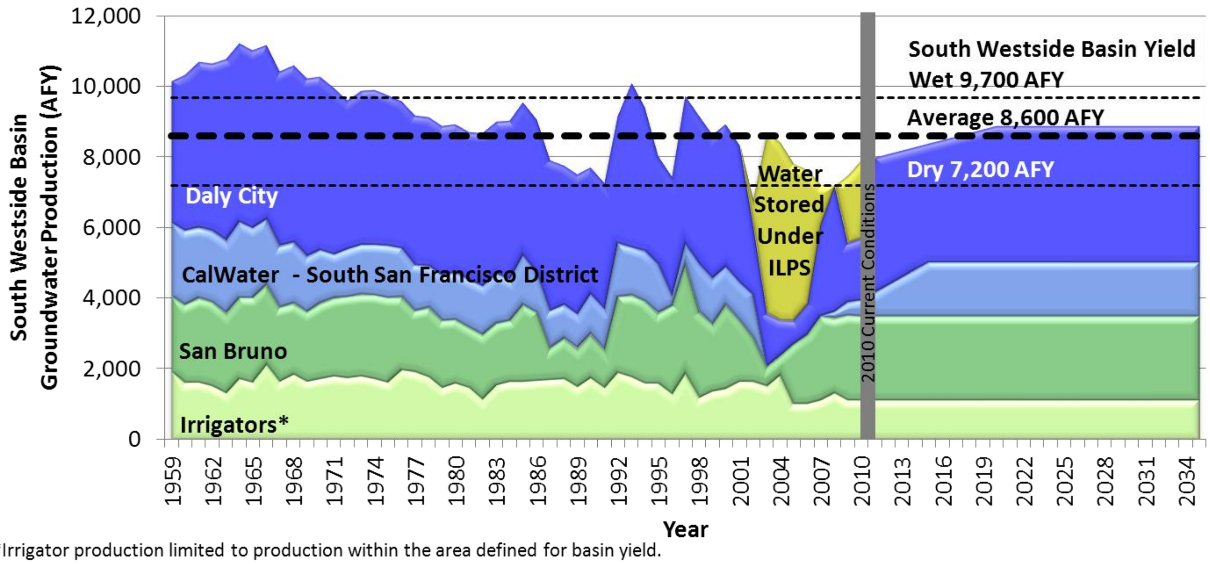


Figure 3.18
Comparison of Basin Yield Estimate and Historical Groundwater Production

Projected future production for 2020-2035 is 8,881 AFY, slightly above the average basin yield of 8,600 AFY, but within the range of yield.

These estimates are subject to uncertainty inherent in any groundwater model. Regular monitoring of static groundwater levels will assist in determining if groundwater levels are responding as anticipated over the long term.

3.5.3 BASIN YIELD USE

The Basin Management Objectives described later in this document are based upon groundwater levels rather than production volumes. As groundwater production is the most significant component of outflow from the basin, an understanding of the basin yield can assist in policy decisions on production which will directly impact groundwater levels in the basin. However, careful consideration must be given before using the basin yield to drive policy decisions.

- First, basin yield is a long-term average annual value. Dry years or other operational needs may require production above the basin yield; this can be acceptable if previous or subsequent years balance production with reduced pumping.
- Second, options to bring the basin into balance with the basin yield include increasing the volume recharged to the aquifer in addition to reducing groundwater production.
- Third, the basin yield is not a static value. Changes in the understanding of the groundwater basin, climate, land use, and location and quantity of groundwater production can all alter the estimate of basin yield. For example, decreasing production may bring production closer to the basin yield, but it will also reduce the basin yield

through reduced capture of additional recharge (less recharge due to higher groundwater levels) and increased natural discharge (more discharge to surface water due to higher groundwater levels). The availability and cost of alternate water supplies or development of recharge projects can also require revisions of the basin yield as this changes the socioeconomic impact of changes in groundwater production.

- Finally, benefits may be seen by approaching the basin yield value, even if the value itself is not met. Additional benefits can also be accrued by pumping significantly below the basin yield, through increasing groundwater levels resulting in increased groundwater in storage, decreased risk of seawater intrusion, and decreased energy costs for groundwater production.

4 GOAL AND OBJECTIVES FOR THE BASIN

4.1 SOUTH WESTSIDE BASIN GOAL

The goal of the GWMP is to ensure a sustainable, high-quality, reliable water supply at a fair price for beneficial uses achieved through local groundwater management.

Sustainable is defined for this GWMP as being able to continue groundwater production over the next 50 years or more with a similar real cost, quantity, and end-user quality as today. Beneficial uses include water supplies for municipal use, irrigation use, private wells, and environmental purposes.

Basin Management Objectives (BMOs) are required by SB 1938 , which amended Section 10753.7of the Water Code to state that groundwater management plans must include BMOs, including components relating to the monitoring and management of groundwater levels within the groundwater basin, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin.

The following five BMOs are defined to support this goal:

1) Maintain Acceptable Groundwater Levels
2) Maintain or Improve Groundwater Quality
3) Limit the Impact of Point Source Contamination
4) Explore Need for Land Subsidence Monitoring
5) Manage the Interaction of Surface Water and Groundwater for the Benefit of Groundwater and Surface Water Quantity and Quality

In turn, elements needed to meet the BMOs are presented in Section 5 (Elements of the Groundwater Management Plan), and an implementation plan is presented in Section 6 (Implementation) to support the objectives and elements. Together the goal, BMOs, elements, and implementation plan function as the overall groundwater strategy for the South Westside Basin. The BMOs are intended solely for these uses.

4.2 BASIN MANAGEMENT OBJECTIVE COMPONENTS

Basin management objectives, are adaptable, quantifiable objectives with prescribed monitoring and defined reporting and responses. These are the accomplishments that need to occur to meet the overall basin goal stated above. BMOs are defined through:

- Management areas and sub-areas
- Public input
- Monitoring
- Adaptive management
- Enforcement

4.2.1 Management Areas and Sub-areas

The management area is the entire Plan Area, as described in Section 1.2 and shown in Figure 1.1. Sub-areas are not needed and not defined because of the continuous nature of the aquifer system. Changes in aquifer characteristics across the South Westside Basin are gradual and are not conducive to defining sub-areas based on physical properties.

Future efforts should evaluate incorporating the North Westside Basin and its associated Sub-Areas and BMOs into a Groundwater Management Plan for the entire Westside Basin. The North Westside Basin is separated from the South Westside Basin only by a jurisdictional boundary (the county line).

4.2.2 Public Input

Public input is important in establishing BMOs. Local knowledge is needed to develop appropriate objectives and local acceptance is necessary to ensure implementation. Public input for the BMOs was gathered through Advisory Committee meetings and public meetings, as described in Sections 1.6 and 1.7.

4.2.3 Monitoring

Accurate, consistent, and accepted monitoring is necessary to ensure the BMOs are being met. This monitoring will show if objectives, which are quantitative to the extent possible, are being met and will trigger actions if defined thresholds are crossed. The monitoring must allow for quick and easy data sharing among all stakeholders to gain acceptability and to allow for action, if needed, in a timely fashion. Monitoring protocols are described under each BMO, in Section 2.3.12, and in Appendix C.

4.2.4 Adaptive Management

Every year brings new data and new conditions to the groundwater aquifer. As such, the BMOs are intended to be flexible and adaptive, allowing for changes due new physical, hydrologic, or operational conditions or new understanding of the physical system. Adjustments to BMOs are discussed in Section 5.7, Reporting and Updating.

4.2.5 ENFORCEMENT

In its current form, the GWMP does not have enforcement mechanisms for the BMOs. The BMOs are guidelines to be monitored and reported on for the benefit of all South Westside Basin users. As the BMOs are defined to meet a common goal, the Advisory Committee believes that enforcement will not be necessary. However, future plan revisions may implement enforcement mechanisms if deemed necessary by the Groundwater Task Force.

4.3 BASIN MANAGEMENT OBJECTIVES

The BMOs include definitions of acceptable groundwater levels, groundwater quality, land subsidence, and surface water/groundwater interaction, along with actions to be taken if defined triggers are met.

4.3.1 MAINTAIN ACCEPTABLE GROUNDWATER LEVELS

The BMO for groundwater levels is designed to maintain operationally acceptable groundwater levels. Operational acceptability is based on avoiding the following infrastructure impacts:

- **Water levels below the top of the existing well screens.** Water levels that are below the top of the screen can negatively impact efficiency of wells through higher incrustation rates, cascading water, and reduced hydraulic efficiency. Several municipal production wells have pumping water levels below the top of the screen under current conditions. Additional lowering of water levels beyond current and historical water levels may adversely impact the ability and cost to pump groundwater, on a case-by-case basis.
- **Water levels below existing pump intakes or bottoms of well screens.** These situations should be avoided whenever possible, as under such conditions groundwater cannot enter the well or cannot be pumped to the surface.

These BMOs are set to maintain conditions for operational purposes; however, they are not currently designed to fully meet the goal of sustainability. Current water levels and water levels meeting the above criteria can remain well below sea level, posing a risk for seawater intrusion. Geologic barriers appear to have thus far prevented seawater from intruding along the Pacific Coast or San Francisco Bay (see Section 2.3.3), but no barrier is perfect and the best way to prevent seawater from migrating into the aquifer is to maintain groundwater levels at or above sea level. Future revisions to this GWMP may seek to raise groundwater level targets to provide a more sustainable water level or may investigate alternate methods of preventing seawater intrusion, such as injection barriers. Such revisions to the GWMP will need to be developed in a manner that can meet the overall goal and will need to function within any then-existing conjunctive use agreements that may require availability of subsurface storage space.

Until then, this BMO will serve as a first step toward managing groundwater levels in the South Westside Basin.

Groundwater level monitoring, triggers, and actions are initially defined below for each well with available data. Note that these items are part of adaptive management of the basin and are thus subject to change as additional data are collected and more information is learned about the basin. This is particularly true for wells with short periods of record, notably the "CUP" wells. The static water level monitoring will monitor progress toward meeting BMOs. Monitoring includes static groundwater level measurements from April (spring) and October (fall) of each year from the designated wells. See details on static water level monitoring protocols are provided in Appendix C

4.3.1.1 Triggers

Groundwater level measurements will be adjusted to reflect conditions without any stored water, determined by modeling results that include conjunctive use projects. Trigger thresholds are developed based on historical water levels as these levels have been considered operationally acceptable by the groundwater producers in the South Westside Basin. The triggers are defined as follows:

- Trigger 1: Groundwater elevations below the historical minimum elevation (more details provided later in this section)
- Trigger 2: Groundwater elevations 10 ft below the historical minimum elevation

Adjustments to water level measurements are needed to account for water stored in the aquifer as part of a conjunctive use study and not part of the native groundwater supply. As this BMO addresses native groundwater, stored GSR Project and ILPS water, which is intended to be recovered, should not be included in BMO monitoring. The adjustment will be made based on differences seen in the Groundwater Model (HydroFocus, 2011) comparing water levels with conjunctive use and without conjunctive use, as shown in the equation below.

$$GWSE_{adjusted} = GWSE_{measured} + GWSE_{modeled,without\ conjunctive\ use} - GWSE_{modeled,with\ conjunctive\ use}$$

where GWSE = groundwater surface elevation

As modeling is required to analyze water levels without the conjunctive use project, reporting will only occur when the Groundwater Model is updated to extend the hydrologic period. It is anticipated that this will occur annually, although biennial updates may be sufficient and may be adopted during implementation. The method of adjustment may be altered if a more accurate and consistent method is identified and accepted by the Groundwater Task Force.

Groundwater level BMO triggers are shown in Table 4.1 based on the hydrographs included in Appendix D. The data presented uses the Groundwater Model to remove the impacts of the In-Lieu Pilot Study (see Section 1.5.3) initiated in 2002 between San Bruno, CalWater, Daly City, and SFPUC. These adjustments are intended solely for the use of BMO development. Trigger 1 for the BMOs is based on the historical low water level without the effects of the ILPS. For wells designated for seawater intrusion monitoring, Trigger 1 is the historical low minus two feet, rounded down. For other wells, Trigger 1 is the historical low minus five feet, rounded down to the nearest five. Trigger 2 is 10 feet below Trigger 1 for all wells. Well locations are shown in Figure 4.1.

4.3.1.2 Actions

If Trigger 1 is met, the Groundwater Task Force will meet to discuss the situation, including confirming the result, an analysis of trends, potential impacts to groundwater producers or the environment, and the most appropriate actions, both immediate and upon Trigger 2 (if met). Actions will be based on plan elements defined in Section 5 (Elements of the Groundwater Management Plan). These actions may include:

- Continued operation
- Conservation measures
- Increased monitoring
- Decreased production, potentially including assignment of pumping thresholds for individual entities
- Accelerated development of artificial or in-lieu recharge projects
- Substitution of alternate supplies
- Reoperation of existing wells or construction of new wells to move production to other parts of the basin

If Trigger 2 is met, the actions defined for Trigger 1, and any additional measures, actions, or mechanisms deemed necessary by the Groundwater Task Force, will be implemented.

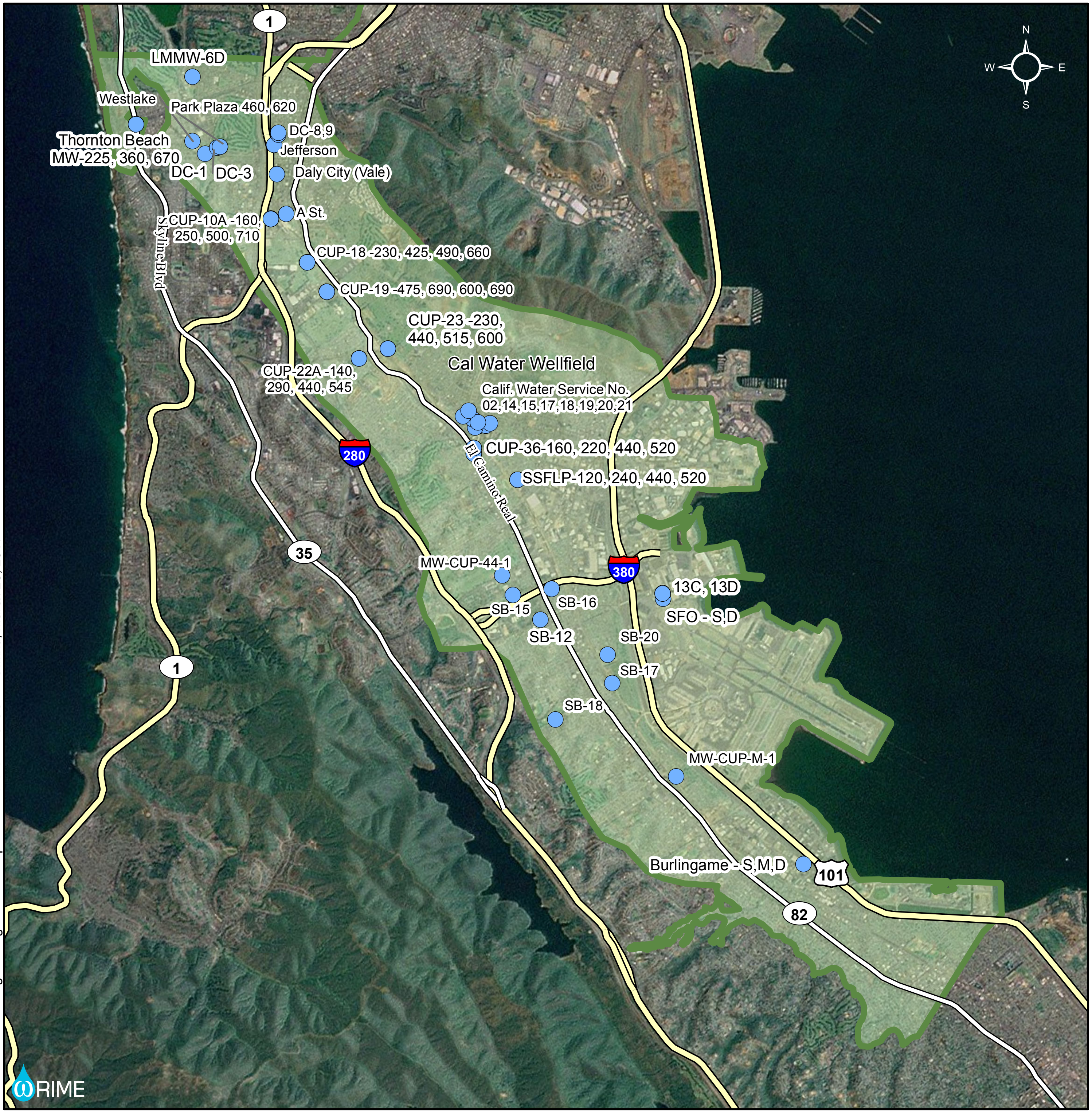
Table 4.1 Groundwater Level BMO Triggers

BMO Wells	Well Owner	Trigger 1 Adjusted Static Water Level (feet NAVD88)	Trigger 2 Adjusted Static Water Level (feet NAVD88)
SSF 1-02	CalWater	-130	-140
SSF 1-14	CalWater	n/a	n/a
SSF 1-15	CalWater	n/a	n/a
SSF 1-17	CalWater	n/a	n/a
SSF 1-18	CalWater	n/a	n/a
SSF 1-19	CalWater	n/a	n/a
SSF 1-20	CalWater	-220	-230
SSF 1-21	CalWater	n/a	n/a
DC-1 (Westlake)	Daly City	-130	-140
DC-3	Daly City	n/a	n/a
DC-8	Daly City	-165	-175
DC-9	Daly City	n/a	n/a
A Street Well	Daly City	n/a	n/a
Jefferson Well	Daly City	n/a	n/a
Vale Well	Daly City	n/a	n/a
Westlake 1	Daly City	n/a	n/a
Westlake 2	Daly City	n/a	n/a
Burlingame-S*	**San Bruno**	**-1**	**-14**
Burlingame-M*	**San Bruno**	**-4**	**-17**
Burlingame-D*	**San Bruno**	**-7**	**-20**
SB-12	San Bruno	-225	-235
SB-15	San Bruno	n/a	n/a
SB-16	San Bruno	n/a	n/a
SB-17	San Bruno	n/a	n/a
SB-18	San Bruno	n/a	n/a
SB-20	San Bruno	n/a	n/a
SFO-S*	**San Bruno**	**-2**	**-15**
SFO-D*	**San Bruno**	**-39**	**-51**
13C*	**UAL**	**-45**	**-57**
13D*	**UAL**	**-4**	**-16**
Fort Funston-S*	**USGS**	**2**	**-11**
Fort Funston-M*	**USGS**	**8**	**-5**
Thornton Beach MW 225*	Daly City	75	60
Thornton Beach MW 360*	**Daly City**	**11**	**-2**
Thornton Beach MW 670*	**Daly City**	**9**	**-4**
LMMW-6D*	SFPUC	-50	-60

BMO Wells	Well Owner	Trigger 1 Adjusted Static Water Level (feet NAVD88)	Trigger 2 Adjusted Static Water Level (feet NAVD88)
Park Plaza MW 460*	SFPUC	-120	-130
Park Plaza MW 620*	SFPUC	-220	-230
MW-CUP-10A-160*	SFPUC	55	45
MW-CUP-10A-250*	SFPUC	40	25
MW-CUP-18-230*	SFPUC	-70	-85
MW-CUP-18-425*	SFPUC	-80	-95
MW-CUP-18-490*	SFPUC	-135	-150
MW-CUP-18-660*	SFPUC	-180	-195
MW-CUP-19-180*	SFPUC	Dry Well	Dry Well
MW-CUP-19-475*	SFPUC	-150	-160
MW-CUP-19-600*	SFPUC	-185	-200
MW-CUP-19-690*	SFPUC	-185	-200
MW-CUP-22A-140*	SFPUC	Dry Well	Dry Well
MW-CUP-22A-290*	SFPUC	-120	-130
MW-CUP-22A-440*	SFPUC	-145	-160
MW-CUP-22A-545*	SFPUC	-190	-200
MW-CUP-23-230*	SFPUC	-115	-130
MW-CUP-23-440*	SFPUC	-150	-165
MW-CUP-23-515*	SFPUC	-195	-210
MW-CUP-23-600*	SFPUC	-190	-205
MW-CUP-36-160*	SFPUC	-545	-60
MW-CUP-36-270*	SFPUC	-95	-105
MW-CUP-36-455*	SFPUC	-195	-210
MW-CUP-36-585*	SFPUC	-210	-220
SSFLP-MW120*	SFPUC	-30	-40
SSFLP-MW220*	SFPUC	-45	-55
SSFLP-MW440*	SFPUC	-205	-220
SSFLP-MW520*	SFPUC	-210	-225
MW-CUP-44-1-190*	SFPUC	-25	-35
MW-CUP-44-1-300*	SFPUC	-40	-55
MW-CUP-44-1-460*	SFPUC	-225	-235
MW-CUP-44-1-580*	SFPUC	-225	-235
MW-CUP-M-1*	SFPUC	n/a	n/a

Notes: Wells with thresholds defined as a seawater intrusion monitoring well are shown in **bold**:
n/a: Not available. Triggers are to be developed at a later date for wells with limited data
* Dedicated Monitoring Well

Figure 4.1
Wells Monitored for Compliance with Groundwater Levels BMO



Legend
- Wells
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

F:\5.1 - San Bruno\Figures\Figure 5.1 Compliance Wells GW Levels BMO.mxd, March 23, 2011

4.3.2 MAINTAIN OR IMPROVE GROUNDWATER QUALITY

Maintenance of groundwater quality includes management actions to prevent seawater intrusion as well as impacts of elevated nitrate levels.

4.3.2.1 Seawater Intrusion

While there has been no identified seawater intrusion in the production aquifer to date, the South Westside Basin is at risk for seawater intrusion as groundwater levels throughout the basin are below sea level. Monitoring wells have been installed and are being monitored for seawater intrusion indicators along the Pacific Ocean and along San Francisco Bay. As the monitoring network is not capable of monitoring for all potential seawater intrusion pathways, it is reasonable to expand the seawater intrusion monitoring to include production wells and other monitoring wells. Seawater intrusion indicators include chloride, a conservative constituent in seawater, as well as several ratios of ions that are impacted by ion exchange, dolomitization, adsorption, and other chemical processes as seawater first contacts aquifer materials in equilibrium with fresh water. The indicators include the following:

- Chloride: Chloride concentrations are the most common indicator of seawater intrusion. Chloride concentrations can increase rapidly as high-chloride seawater intrudes into low chloride water in the aquifer and are often the first indicator of seawater intrusion. Chloride can also be of other sources, such as sewage, agricultural return, or water in the soil from the time of formation.
- Chloride/Bromide Ratio: The chloride/bromide ratio can be used to distinguish seawater sources (ratio of approximately 297) from sewage (higher ratio), agriculture (lower ratio), and other sources.
- Sodium/Chloride Ratio: The sodium/chloride ratio can be used as an early indicator of seawater intrusion. Low ratios, lower than seawater (<0.56 weight ratio), can indicate seawater intrusion prior to significant increases in chloride concentrations. This is a result of cation exchange, as sodium replaces calcium on aquifer sediments. If seawater intrusion is in the early stages of progressing, the sodium/chloride ratio should decrease, with a resulting increase in the ratio of both calcium and magnesium to chloride.
- Calcium/Magnesium Ratio and Calcium/(Bicarbonate and Sulfate) Ratio: These ratios can also provide an early indication of seawater intrusion. Ratios greater than 1 can be an early indicator of seawater intrusion. This is a result of dolomitization, which increases calcium concentrations and reduces magnesium concentrations as calcium carbonate (e.g., calcite, limestone) transforms into calcium magnesium carbonate (e.g., dolomite) (Jones et al., 1999).

The approach is based on the level of available data. These ratios are used in other basins to study seawater intrusion, along with other ratios and stable isotope analyses. In the Central and West Coast Basins of Los Angeles County, chloride and TDS concentrations; ratios of chloride to bromide, iodide, and boron; isotopic data; age dating; and borehole data are used to assess saline groundwater (Land, et al., 2004). Seawater intrusion analysis in the Seaside Basin of Monterey County utilizes chloride concentrations, sodium/chloride ratios, other cation/anion ratios, geophysical logs, and analysis of groundwater levels (HydroMetrics, 2011). In the San Leandro and San Lorenzo areas of Alameda County, ratios of chloride to bromide, iodide, barium, and boron are used along with chloride concentrations, noble gasses and isotopic data to study seawater intrusion (Izbicki et al, 2003).

Annual monitoring will include pumping and static water level measurements and sampling for the following analytes:

Alkalinity	Ortho-phosphate	Calcium	Conductivity
Bromide	Sulfate	Magnesium	pH
Chloride	Total Dissolved Solids	Potassium	Total Bicarbonate
Nitrate	Boron	Sodium	Iron and Manganese

4.3.2.1.1 Triggers

With the exception of chloride, thresholds are not set for each indicator as the magnitude and timing of each requires analysis prior to making decisions on the status of the South Westside Basin. Chloride thresholds are necessary as the first signs of seawater intrusion need to be recognized rapidly to protect the overall water quality. Thresholds are set at approximately 10 percent above the historical maximum concentration over the past twenty years of sampling (1991 – 2010, with probable outliers removed). This allows for variability inherent in sampling and analytical testing, but will signal potential issues should concentrations increase. Additional information on seawater intrusion parameters for a selection of these wells is presented in Appendix E. Chloride thresholds for each well are presented in Table 4.2. Note that these thresholds are part of adaptive management of the basin and are thus subject to change as additional data are collected and more information is learned about the basin. This is particularly true for wells with short periods of record, notably the “CUP” wells. The well locations are shown in Figure 4.2. The SMCL for chloride is 250 mg/l (recommended), 500 mg/l (upper) and 600 mg/l (short-term).

Regular analysis of water quality and water level data will allow for identification of data gaps that may require installation of new monitoring wells at new locations and/or new depth intervals, geophysical testing, or more rigorous chemical and isotope analysis.

Table 4.2 Seawater Intrusion BMO Chloride Thresholds (mg/l)

Well	Chloride Threshold	Recent Result	1991-2010 Maximum
Burlingame-S	570	430	518
Burlingame-M	90	63	79
Burlingame-D	55	41	47
SB-15	160	110	145
SB-16	170	110	154
SB-17	65	58	58
SB-18	80	70	72.5
SB-20	100	84	88
SSF 1-14	145	123	129
SSF 1-15	150	110	135
SSF 1-17	115	103	103
SSF 1-18	100	65	91
SSF 1-19	135	120	122
SSF 1-20	185	140	167
SSF 1-21	215	180	196
MW-CUP-M1	60	51	51
MW-CUP-10A-160	145	128	128
MW-CUP-10A-250	145	128	128
MW-CUP-18-230	100	90	90
MW-CUP-18-425	100	91	91
MW-CUP-18-490	100	90	90
MW-CUP-18-660	n/a	n/a	n/a
MW-CUP-19-180	n/a	n/a	n/a

MW-CUP-19-475	110	99	99
MW-CUP-19-600	105	95	95
MW-CUP-19-690	180	160	160
MW-CUP-22A-140	n/a	n/a	n/a
MW-CUP-22A-290	120	106	106
MW-CUP-22A-440	80	71	71
MW-CUP-22A-545	120	106	106
MW-CUP-23-230	n/a	n/a	n/a
MW-CUP-23-440	n/a	n/a	n/a
MW-CUP-23-515	n/a	n/a	n/a
MW-CUP-23-600	n/a	n/a	n/a
MW-CUP-36-160	125	110	110
MW-CUP-36-270	130	118	118
MW-CUP-36-455	90	81	81
MW-CUP-36-585	205	186	186
MW-CUP-44-1-190	80	69	69
MW-CUP-44-1-300	95	84	84
MW-CUP-44-1-460	150	134	134
MW-CUP-44-1-600	95	85	85
SSFLP-MW120	200	173	180
SSFLP-MW220	115	100	104
SSFLP-MW440	75	61	65
SSFLP-MW520*	125	107	110
Park Plaza MW 620*	175	143	155
Park Plaza MW 460	n/a	n/a	n/a
LMMW-6D	n/a	n/a	n/a

Thornton Beach MW 225	n/a	n/a	n/a
Thornton Beach MW 360	n/a	n/a	n/a
Thornton Beach MW 670	n/a	n/a	n/a
A-Street	165	88	150
Jefferson	135	58	120
Junipero Serra	55	50	50
Vale	80	67	71
No. 4 Citrus	85	61	76
Westlake	200	99	180
SFO-S	13,600	10,000	12,400
SFO-D	605	550	550

Note: n/a: Not available; triggers are to be developed at a later date for wells with limited data

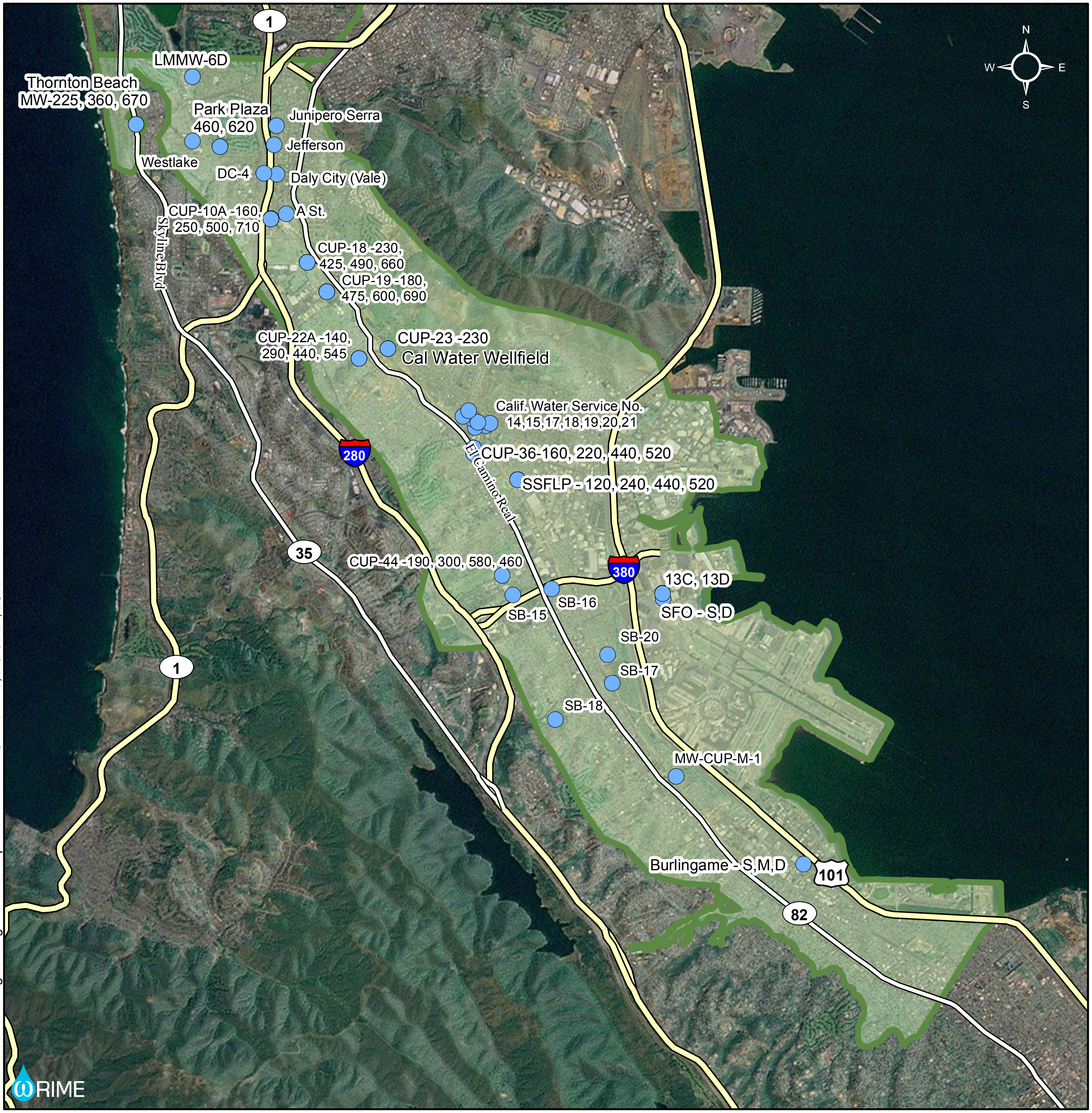


Figure 4.2
Wells Monitored for Compliance with Groundwater Quality BMO

Legend

- Wells
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

F:\5.1 - San Bruno\Figures\Figure 5.1 Compliance Wells WQ BMO.mxd, March 21, 2011

4.3.2.1.2 Actions

If the trigger threshold is met, the Groundwater Task Force will meet to discuss the situation, including confirming the result, an analysis of trends, analysis of other seawater intrusion indicators including analytical results and water level measurements, potential impacts to groundwater users or the environment, and the most appropriate actions.

If confirmed, analysis should be initiated to determine if the elevated value is likely the result of seawater intrusion, upconing of deep saline water, or other sources. Actions will be based on plan elements defined in Section 5, Elements of the Groundwater Management Plan. These actions may include:

- Continued operation
- Increased monitoring
- Studies of sources of chloride (seawater intrusion or upconing from deeper sediments) and additional options to manage water quality
- Reoperation or new wells to move production to other parts of the basin or different depths
- Decreased production to reduce seawater intrusion or upwelling
- Substitution of alternate supplies

4.3.2.2 Nitrate

Elevated nitrate levels in portions of the basin have become an increasing concern over the past several years. Although concentrations have largely remained below MCLs, individual wells have shown sudden increases and trends suggest possible issues in the future. The source of nitrate in the basin has not been studied, but historical and current land use point to either previous agricultural land uses, including extensive cattle operations, or current urban and turf-grass uses. If trends continue, work may be needed to identify the source and to determine how the region could keep nitrate levels within desired levels, potentially through development of a salt and nutrient management plan or through other studies. .

4.3.2.2.1 Triggers

This section defines nitrate monitoring, triggers, and actions on a well-by-well basis. Monitoring is based on existing DPH data collection efforts and local sampling of monitoring wells. Trigger 1 is based on 80 percent of the MCL, 36 mg/l, and Trigger 2 is based on 90 percent of the MCL, 41 mg/l.

It should be noted that data presented in this section is representative of raw water quality. Raw water quality is different from the water served to customers, as water purveyors pump selectively from wells based on quality and provide blended water from both groundwater and surface water sources to maintain a safe water supply in compliance with state and federal regulations.

Future nitrate monitoring should proceed annually, unless trends or levels indicate a need for more frequent measurements.

4.3.2.2.2 Actions

If Trigger 1 is met for one or more wells, the Groundwater Task Force will meet to discuss the situation, including confirming the result, an analysis of trends, potential impacts to groundwater users or the environment, and the most appropriate actions, both immediate and upon Trigger 2 (if met). The Groundwater Task Force will consider the status of all wells, including the wells below the trigger threshold, the quantity and quality of other supply sources for blending, and will also consider water level data and other environmental and operational factors that could contribute to increases in nitrate concentrations. Actions will be based on the plan elements and programs defined in Section 5, Elements of the Groundwater Management Plan.

If Trigger 2 is met, the actions defined for Trigger 1 and any additional measures, actions, or mechanisms deemed necessary by the Groundwater Task Force will be implemented.

Historical estimates of nitrate concentrations and current groundwater quality BMO trigger status are shown in Table 4.3. Note that the triggers are part of adaptive management of the basin and are thus subject to change as additional data are collected and more information is learned about the basin. This is particularly true for wells with short periods of record, notably the "CUP" wells.

Table 4.3 Groundwater Quality BMO Triggers

Well	1991-2010 Maximum Nitrate (as NO3) Concentration (mg/l)	Recent Nitrate (as NO3) Concentration (mg/l)	Trigger Status
Burlingame-S	< 1	ND	
Burlingame-M	ND	ND	
Burlingame-D	1	1	
SB-15	15	5	
SB-16	8	ND	
SB-17	6	5	
SB-18	7	7	
SB-20	7	1	
01-14	82	76	Trigger 2
01-15	32	18	
01-17	222	219	Trigger 2
01-18	85	76	Trigger 2
01-19	60	35	
01-20	104	4	
01-21	3	ND	
MW-CUP-M1	12	12	
MW-CUP-10A-160	35	35	
MW-CUP-10A-250	48	48	Trigger 2
MW-CUP-10A-500	36	36	Trigger 1
MW-CUP-10A-710			
MW-CUP-18-230	7	7	
MW-CUP-18-425	8	8	
MW-CUP-18-490	2	2	
MW-CUP-18-660			
MW-CUP-19-180			

Well	1991-2010 Maximum Nitrate (as NO3) Concentration (mg/l)	Recent Nitrate (as NO3) Concentration (mg/l)	Trigger Status
MW-CUP-19-475	1	1	
MW-CUP-19-600	ND	ND	
MW-CUP-19-690	ND	ND	
MW-CUP-22A-140			
MW-CUP-22A-290	33	33	
MW-CUP-22A-440	1	1	
MW-CUP-22A-545	24	24	
MW-CUP-23-230			
MW-CUP-23-440			
MW-CUP-23-515			
MW-CUP-23-600			
MW-CUP-36-160	26	26	
MW-CUP-36-270	8	8	
MW-CUP-36-455	ND	ND	
MW-CUP-36-585	ND	ND	
MW-CUP-44-1-190	35	35	
MW-CUP-44-1-300	37	37	Trigger 1
MW-CUP-44-1-460	2	2	
MW-CUP-44-1-600	ND	ND	
SSFLP-MW120	ND	ND	
SSFLP-MW220	1	1	
SSFLP-MW440	ND	ND	
SSFLP-MW520*	ND	ND	
Park Plaza MW 620*	1	< 1	
Park Plaza MW 460*			
LMMW-6D			

Well	1991-2010 Maximum Nitrate (as NO3) Concentration (mg/l)	Recent Nitrate (as NO3) Concentration (mg/l)	Trigger Status
A-Street	170	98	Trigger 2
Jefferson	31	10	
Vale	46	35	
No. 4 Citrus	71	63	Trigger 2
Westlake	61	33	
Junipero Serra	47	34	
SFO-S	8	ND	
SFO-D	ND	ND	

Note: Blanks: Triggers are to be developed at a later date for wells with limited data

4.3.3 Limit the Impact of Point Source Contamination

Point source contamination can also threaten water supplies in the South Westside Basin. Loss of a portion of the water supply due to point source contamination would require use of alternate supplies, which are limited. The point source contamination BMO seeks to coordinate with regulatory agencies to ensure potential impacts to water supplies and environmental receptors are fully incorporated into remedial actions and monitoring programs at contaminated sites. The BMO recognizes that clay layers only slow the migration of contaminants and that these contaminants, if not properly remediated, may reach the primary production aquifer at some concentration at some point in the future.

No quantitative thresholds are set for this BMO as there are numerous potential contaminants; however, a qualitative objective of limiting the impact of point source contamination is defined through identifying and protecting areas of basin recharge, ensuring rapid response to new detections of contaminants at any well, and fully cleaning up contaminated sites, including perched aquifer systems that eventually recharge the deeper aquifer used for water supplies. Full cleanup may be through remediation programs or natural processes. The following are actions to achieve this BMO:

- Use basin understanding and the existing Groundwater Model to identify important areas of basin recharge. Identify appropriate measures to protect those areas.
- Actively engage with regulatory agencies and potentially responsible parties on existing sites.

- o Notify regulators of contamination issues in wells, even for low-level detections, to ensure discovery of new problems as quickly as possible.
- o Coordinate with land use planners to ensure land uses are suitable for land overlying the aquifer.

4.3.4 EXPLORE NEED FOR LAND SUBSIDENCE MONITORING

The land subsidence BMO focuses on increased understanding of the possible problem through potential additional monitoring activities. There has been no evidence of historical land subsidence, even though water levels have declined significantly from pre-development levels. Land subsidence is most rapid immediately after the initial dewatering of sediments. Thus, land subsidence is not anticipated from sediments that have been historically dewatered. Should water levels decline in the future, it is unlikely that subsidence would occur as these materials are similar to those historically dewatered and would likely exhibit similar limited compressibility.

However, without any previous studies of subsidence, there is a potential that land subsidence may have occurred unnoticed or that deeper materials may behave differently. As such, there is a need to perform a subsidence study to assess the status of the subsidence in the South Westside Basin.

Interferometric synthetic aperture radar (InSAR) studies are included in the implementation of the plan. The results of the InSAR study may confirm that no land subsidence is occurring in the South Westside Basin, or could show the need for more formalized monitoring and development of quantitative BMOs, which may be established under the reporting and updating element contained in Section 5.7, Reporting and Updating.

4.3.5 MANAGE THE INTERACTION OF SURFACE WATER AND GROUNDWATER FOR THE BENEFIT OF GROUNDWATER AND SURFACE WATER QUANTITY AND QUALITY

This BMO seeks to manage changes in surface flow and surface water quality and quantity that directly affect groundwater levels or quality or are caused by groundwater production in the basin. As discussed in Section 2.3.10, there is little interaction between surface water and groundwater in the South Westside Basin. Colma Creek is the largest surface water feature, but it is relatively small and lined for most reaches. Other creeks are very small and drain local watersheds.

No quantitative thresholds are set for this BMO, however, the following qualitative objectives of maintaining or improving the interaction of surface water and groundwater are set:

- o Maintain natural watercourses and investigate potential benefits of removing lining from watercourses where feasible.

- Maintain baseflow in creeks.
- Monitor groundwater levels to assist in water level studies at Lake Merced in San Francisco County in the North Westside Basin.

5 ELEMENTS OF THE GROUNDWATER MANAGEMENT PLAN

California Water Code section 10753.8 states that a GWMP may include components relating to all of the following:

- Control of saline water intrusion
- Identification and management of wellhead protection areas and recharge areas
- Regulation of migration of contaminated groundwater
- Administration of a well abandonment and well destruction program
- Mitigation of overdraft conditions
- Replenishment of groundwater extracted by water producers
- Monitoring of groundwater levels and storage
- Facilitation of conjunctive use operations
- Identification of well construction policies
- Construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects
- Development of relationships with state and federal regulatory agencies
- Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination

These items are grouped and related back to the South Westside Basin GWMP goal and objectives in Table 5.1 and discussed in the following sections. Some of the items below call for consideration, evaluation, and the potential implementation of measures to address conditions in the groundwater basin. These items are intended to address goals and objectives of the GWMP, but do not propose specific actions or projects that might be developed on a case-by-case basis, as needed. Such specific actions or projects are not fully known at this time and may be subject to evaluation, including but not limited to environmental review, when and if proposed for implementation, and may require approval by regulatory agencies with jurisdiction over the proposed action following completion of any required environmental review.

Table 5.1
Summary of GWMP Objectives and Elements

Item	BMOs				
	Maintain Acceptable Groundwater Levels	Maintain or Improve Groundwater Quality	Limit the Impact of Point Source Contamination	Explore the Need for Land Subsidence Monitoring	Manage Interaction of Surface Water And Groundwater
Stakeholder Involvement	✓	✓	✓	✓	✓
Monitoring and Management					
Monitoring of groundwater levels and storage	✓		✓		✓
Monitoring of groundwater quality		✓	✓		✓
Monitoring of inelastic land subsidence				✓	
Monitoring of surface water/groundwater interaction	✓	✓			✓
Groundwater Storage					
Mitigation of overdraft conditions	✓	✓			✓
Replenishment of groundwater extracted by water producers	✓	✓			✓
Facilitation of conjunctive use operations	✓	✓			✓
Groundwater Quality					
Control of saline water intrusion		✓		✓	✓
Identification and management of wellhead protection areas and recharge areas	✓	✓	✓	✓	✓
Regulation of migration of contaminated groundwater		✓	✓	✓	✓
Administration of a well abandonment and well destruction program		✓	✓	✓	✓
Identification of well construction policies		✓	✓	✓	✓
Construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects	✓	✓	✓	✓	✓
Coordinated Planning					
Development of relationships with state and federal regulatory agencies	✓	✓	✓	✓	✓
Coordination with IRWMP efforts	✓	✓	✓	✓	✓
Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination	✓	✓	✓		✓
Reporting and Updating	✓	✓	✓	✓	✓

5.1 STAKEHOLDER INVOLVEMENT

Ongoing stakeholder involvement is critical to successful implementation of the GWMP. Interested parties include agencies within and near the South Westside Basin, environmental interests, and individuals and companies that rely on the groundwater basin for water supply. Coordination with these groups is necessary to ensure that goals and objectives continue to be consistent with the desires of the community; that a full range of alternatives are considered along with potential adverse impacts; and that progress can be made toward meeting the goal and objectives.

Actions

A1. *Distribute the GWMP in an electronic format to all parties that have expressed interest in the plan, including all agencies within and bordering the basin.*

A2. *Hold Groundwater Task Force (see Section 6.1) meetings on a semi-annual basis to discuss ongoing groundwater management issues and activities. These discussions will include other agencies, thus enabling cooperation between public entities whose service areas or boundaries overlie the groundwater basin. Meetings will focus on progress towards meeting BMOs, implementation of projects in this plan, new or updated status on the condition of the groundwater basin, and new or updated plans or strategies.*

A3. *Continue outreach to private groundwater producers, notably cemeteries, to involve these stakeholders in the ongoing groundwater management process.*

A4. *Reorient the GWMP web site from its current plan-development focus to an implementation focus, highlighting implementation activities and soliciting public input.*

A5. *Present actions implemented by the agencies at public meetings of the respective councils.*

A6. *Provide public notice for any revisions to the GWMP.*

5.2 MONITORING AND MANAGEMENT

Elements pertaining to Monitoring and Management of the South Westside Basin relate to groundwater levels and storage; groundwater quality; inelastic land subsidence; and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping.

5.2.1 GROUNDWATER LEVELS AND STORAGE

The South Westside Basin needs additional groundwater level and quality monitoring to meet the objectives of this plan and the needs of the individual water agencies. Monitoring protocols are included in Appendix C. Coordination among the agencies is necessary to make existing and future monitoring as complete as possible with respects to spatial distribution and timing.

Figure 5.1 shows all wells in the South Westside Basin with static water level measured at least once in 2009. Water level data are taken regularly by the water agencies, but typically static water levels are only taken when pumps are not operating due to maintenance activities. There is no existing basin-wide static groundwater level monitoring program.

To the extent possible, groundwater level monitoring should continue at all wells that are currently or have recently been measured, as shown in Figure 5.1. Water levels should be measured minimally in the spring (April) and fall (October). Datalogging pressure transducers should be installed in selected wells to determine variability between readings, which may refine future timing of groundwater level measurements. Measurements should be taken when the well and, to the extent possible, nearby wells are not pumping, to represent static water levels. In addition to the measurement, the pumping status at the well and nearby wells should be noted and preserved in the database. Additional monitoring details are provided in Appendix C.

Groundwater level monitoring should be coordinated with the California Statewide Groundwater Elevation Monitoring (CASGEM) program, a statewide groundwater elevation monitoring program that is intended to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. Daly City, CalWater, and San Bruno, through the South Westside Basin Voluntary Cooperative Groundwater Monitoring Association, are the monitoring entities for the portion of the South Westside Basin within their service area. Coordination with CASGEM should include consistent monitoring protocols between data provided to the CASGEM program and other data collected in the basin.

A key element of monitoring and management of groundwater levels and storage is the Groundwater Model. The Groundwater Model is used primarily to improve the understanding of the groundwater system, but also is useful for the following:

- Aggregating, organizing, and analyzing existing data
- Identifying data gaps
- Simulating impacts on groundwater levels and storage of various projects and of continuation of existing operations

The Groundwater Model is available for use by all interested stakeholders from Daly City. Output from the model may be used in GWMP implementation to ensure that projects are designed to meet the stated goal and objectives.

These activities result in a significant amount of data. Usage of a data management system, such as the existing HydroDMS, can assist in storing, accessing, and analyzing data across multiple agencies.

Figure 5.1
Wells Monitored for Groundwater Levels

Legend

- Wells
- Highways
- Groundwater Basin
- Plan Area

0 0.5 1 2 Miles

F:\6.1 - San Bruno\Figures\Figure 6.1 CFigure 6.1 Mon Wells GW Levels.mxd, March 21, 2011

WRIME

Actions

B1. *Implement a basin-wide semi-annual static water level measurement program that builds upon existing monitoring. The program should include the wells belonging to the retail water agencies. Other wells may be included if feasible.*

B2. *Use existing database structures with data from these databases imported into a central Data Management System (such as the existing HydroDMS) to facilitate data sharing between agencies.*

B3. *Coordinate among agencies to ensure that wells continue to be monitored to provide long-term records of water levels at specific locations, and to ensure a consistent and, to the extent feasible, complete dataset.*

B4. *Participate in the CASGEM program.*

5.2.2 GROUNDWATER QUALITY

Water quality monitoring is performed for Title 22 compliance by the water agencies. Figure 5.2 shows the locations of wells monitored for water quality at least once in the most recent 5-year period with available data from DPH (2006 – 2010) or other local monitoring activity. Monitoring protocols are contained in Appendix C. Additional water quality monitoring is needed to ensure sufficient data to define nitrate concentrations for use by the water quality BMOs in this GWMP.

Actions

C1. *Continue groundwater quality monitoring as needed to meet Title 22 requirements.*

C2. *Standardize data collection protocols and timing through coordination among agencies.*

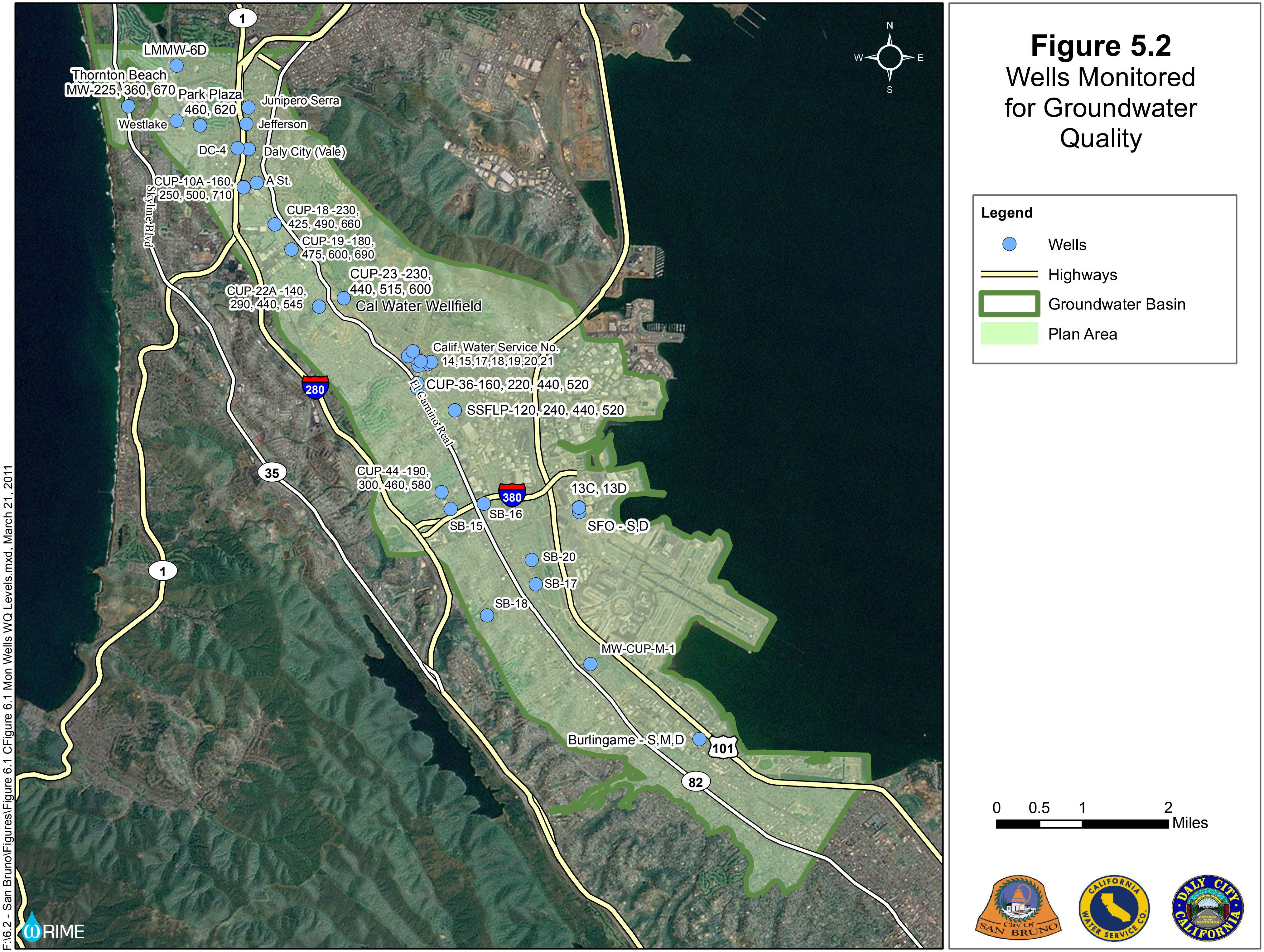
C3. *Continue to use existing database structures, with data from these databases imported into a central Data Management System (such as the existing HydroDMS).*

C4. *Fill gaps in the water quality monitoring network through sampling additional existing or newly constructed monitoring wells.*

C5. *Coordinate with the USGS on its National Ambient Water Quality Assessment (NAWQA) program and GAMA program to potentially integrate its efforts with local monitoring efforts.*

C6. *Consider development of a Salt and Nutrient Management Plan to assist in permitting of future recycled water projects.*

Figure 5.2
Wells Monitored for Groundwater Quality



5.2.3 INELASTIC LAND SUBSIDENCE

Monitoring land subsidence in the South Westside Basin is limited by the cost of traditional surveys and extensometer compared to the limited historical impact of subsidence in the basin. If land subsidence is reported in the area, or if water levels drop below historical lows, additional land subsidence monitoring will be considered. Relatively new technology, InSAR, allows for more cost-effective, regional scale land subsidence monitoring. Over time, these technologies are becoming more powerful and less expensive. Lower costs and opportunities to partner with others such as USGS may allow for land subsidence monitoring in the future.

Actions

D1. *Collect evidence, if any, of active inelastic land subsidence and assess the risk.*

D2. *Develop a land subsidence monitoring program, if needed, using InSAR or traditional surveying and extensometer methods.*

D3. *Partner with the USGS or nearby agencies to implement any needed monitoring.*

5.2.4 CHANGES IN SURFACE FLOW AND SURFACE WATER QUALITY THAT DIRECTLY AFFECT GROUNDWATER LEVELS OR QUALITY OR ARE CAUSED BY GROUNDWATER PUMPING

Surface flow within the South Westside Basin is minimal, primarily Colma Creek and other small creeks, as discussed in Section 2. However, Lake Merced is a significant water body with recreational uses to the north in the North Westside Basin. This GWMP intends to support the actions developed under the North Westside Basin GWMP through coordination with that plan during development and updates. The action listed below are reflective of the actions of the North Westside GWMP.

Action

E1. *Continue groundwater monitoring near Lake Merced to support ongoing studies.*

5.3 GROUNDWATER STORAGE

5.3.1 MITIGATION OF OVERDRAFT CONDITIONS

The South Westside Basin is currently considered not to be in a state of overdraft. Current pumping is estimated to be approximately at the basin yield, as estimated by the Westside Basin Groundwater-Flow Model (Hydrofocus, 2011). However, historical groundwater production has at times exceeded the basin yield, which has resulted in groundwater levels well below sea level. The groundwater level BMO is intended to serve as a prevention, coordination, and warning device.

Currently, the decisions and plans on groundwater production are made independently by each agency based on each agency's individual needs in coordination with the respective surface water supplies from the SFPUC. Under current basin management, there is little or no coordination among the agencies on the individual agency or total production from the basin. To manage the basin in a more robust and sustainable manner, there is a need to coordinate groundwater production among the agencies, along with appropriate level of monitoring and reporting of groundwater production, levels, and quality. This information can be used in several aspects of basin management, including:

- Keeping the Westside Basin Groundwater-Flow Model updated and using the model to evaluate the impact of collective production in comparison to the basin yield. In addition to investigating basin-wide conditions, the model can also provide details on the impact of the geographic distribution of production throughout the basin, so as to assist in managing the basin in a more sustainable manner. While more detailed analyses typically have higher uncertainties than regional analyses, they can provide information on estimated changes in the basin operations that can assist in groundwater management strategies.
- Updating the basin yield estimates over time as better data becomes available, and as operation of the basin evolves into a more coordinated manner. As a result, and in order to address any potential basin yield issues, there may be a need in the future to evaluate additional recharge opportunities or apportion production to each agency through voluntary agreements to assist in meeting groundwater level BMOs. Appropriate monitoring and robust modeling tools will assist in evaluating basin management options and safe yield should that become necessary in the future.

Actions

F1. *Should groundwater levels decline, analyze conditions to determine if the South Westside Basin is in overdraft or if conditions are due to short-term climatic variability or other factors. Analysis will include the use of the most up-to-date groundwater model.*

F2. *Should overdraft conditions occur, actions may include demand reduction through alternate supplies or conservation programs and increased recharge activities through in-lieu or direct recharge.*

F3. *Implement a voluntary groundwater pumping metering program for private wells, such as at golf courses or cemeteries, to improve overall basin understanding.*

F4. *Utilize the groundwater model to simulate the collective impacts of current, near-term, and long-term projected groundwater production*

F5. *If current or future production is considered beyond the basin yield and is anticipated to result in not meeting the Groundwater Level BMO, voluntarily apportionment of pumping to each agency may be performed to provide certainty on future levels of production. The apportionment will be determined by the water agencies at that time, but should consider historical production, access to* *alternate sources, status of existing infrastructure, water quality considerations, and projected needs.*

5.3.2 REPLENISHMENT OF GROUNDWATER EXTRACTED BY WATER PRODUCERS

Groundwater replenishment may take place to cost effectively increase stored water in the aquifer for normal and drought periods or to support regional water supply goals. As long as the South Westside Basin remains in a hydrologically balanced condition, replenishment will occur on a voluntary basis, as economically feasible projects and water sources become available.

Actions

Study the feasibility of and potential for implementing the following replenishment activities:

G1. *Direct recharge of storm water and other surface water, selecting replenishment water to best manage the quality of recharge waters and receiving waters*

G2. *Substitution of other water supplies such as recycled water or imported water for groundwater*

G3. *Conservation efforts*

G4. *Study the suitability of near surface conditions for improved recharge from low impact development techniques such as permeable pavement, swales, and others. Study should include subsurface materials and perched groundwater conditions.*

G5. *Should the basin become overdrafted for extended periods of time, appropriate actions for replenishment should be taken with proper governance structures.*

5.3.3 FACILITATION OF CONJUNCTIVE USE OPERATIONS

Conjunctive use operations can assist groundwater basin management as the agencies have access to both groundwater and surface water supplies. Conjunctive use in the South Westside Basin in the form of large-scale direct recharge through spreading basins may not be cost-effective due to high land costs and clay layers in the upper aquifer system, but potential options should be studied if identified. Conjunctive use could more likely take the form of in-lieu recharge, in which other supply sources, such as imports or recycled water, may replace groundwater, thus offsetting future groundwater pumping during times of reduced imported water supplies. Injection of water into the aquifer may also be considered. Consideration should be given to water quality changes that may occur due to recharge activities and the increase in groundwater levels, particularly with the potential mobilization of nitrate in the subsurface.

Actions

H1. *Consider the development, implementation, and maintenance of programs and projects to recharge aquifers. Programs may be local or regional in scope. These may use imported water, recycled* *water, and other waters to offset existing and future groundwater pumping, except in the following situations:*

- *Groundwater quality would be reduced, unless lower water quality provides maximum benefit*
- *Available groundwater aquifers are full*
- *Rising water tables threaten the stability of existing structures*

H2. *Support regional groundwater banking operations that are beneficial to the South Westside Basin and the region and support the goals of this GWMP.*

5.4 GROUNDWATER QUALITY

5.4.1 CONTROL OF SEAWATER INTRUSION

The threat of seawater intrusion in the South Westside Basin includes the potential migration of seawater from the Pacific Ocean and San Francisco Bay. Control of this migration includes monitoring groundwater levels, groundwater quality, and groundwater production. Should monitoring indicate increased risk of seawater intrusion, actions should be evaluated that would raise groundwater levels through increased recharge or decreased extraction.

Actions

I1. *Continue monitoring for seawater intrusion at the margins of the basin. Study the need for additional monitoring locations or inclusion of additional indicators or triggers.*

I2. *Combine seawater intrusion monitoring results with monitoring of basin-wide groundwater levels, groundwater quality, and production to fully determine risk of seawater intrusion.*

I3. *Evaluate the reduction of the gradient between sea level and groundwater levels through increased recharge or decreased production in the affected area.*

5.4.2 IDENTIFICATION AND MANAGEMENT OF WELLHEAD PROTECTION AREAS AND RECHARGE AREAS

The entire South Westside Basin is a source of recharge and requires protection to ensure high quality recharge and to maintain or enhance existing recharge quantities. Pervious areas such as open spaces and the numerous parks, cemeteries, and golf courses allow water to percolate into the soil and recharge the aquifer. No significant land use changes are anticipated in the built-out South Westside Basin, and these pervious areas are unlikely to be paved or otherwise developed. However, if such actions are considered in the future, the impact to the groundwater basin should be studied. Additionally, opportunities to increase pervious areas should be explored.

Drinking water source assessments produced by the groundwater agencies have identified uses that threaten groundwater quality in the South Westside Basin along with delineation of capture zones around wells. Uses that threaten some wells in the basin include:

- Automobile repair shops
- Automobile gas stations
- Dry cleaners
- Military installations
- Sewer collection systems
- Underground storage tanks - confirmed leaking tanks
- Utility stations - maintenance areas

Actions

J1. *Preserve and protect, to the extent possible, aquifer recharge areas.*

J2. *Implement public outreach efforts.*

J3. *Design recharge facilities to minimize pollutant discharge into storm drainage systems, natural drainage, and aquifers.*

J4. *Decrease storm water runoff, where feasible, by reducing paving in development areas, and by using design practices such as permeable parking bays and porous parking lots with beamed storage areas for rainwater detention. Exercise caution to avoid contamination from oil, gas, and other surface chemicals.*

J5. *Manage streams with natural approaches, to the maximum extent possible, where groundwater recharge is likely to occur.*

J6. *Identify prime recharge areas and consider offering incentives to landowners in exchange for limiting their ability to develop their property due to its retention as a natural groundwater recharge area. These incentives will encourage the preservation of natural water courses without creating undue hardship on the property owners, and might include density transfer functions.*

J7. *Submit the map of recharge areas (Figure 2.10) to local planning agencies and notify DWR and other interested persons when the map is submitted to those local planning agencies, as required by AB359 (Huffman)*

5.4.3 REGULATION OF THE MIGRATION OF CONTAMINATED GROUNDWATER

It is important to regulate contaminated groundwater migration both for protecting existing sources of groundwater and for developing new sources of groundwater. Coordination with regulatory agencies and potentially responsible parties will give water managers input into the cleanup and containment of contaminated sites and will improve long-term planning efforts based on the predicted impact of those hazards. Additionally, new, improved, and more cost-effective treatment technologies can potentially result in additional potable or non-potable supplies from groundwater that was previously considered unavailable for use.

Action

K1. *Coordinate with local regulatory agencies to share information about contaminated sites and about the South Westside Basin groundwater system and wells. Treatment systems will be investigated as new non-potable supply sources.*

K2. *Coordinate with the SWRCB to verify the classification of contaminated media at sites within the basin in their GeoTracker website.*

5.4.4 Administration of a Well Abandonment and Well Destruction Program

Abandoned or poorly constructed wells should be properly destroyed to prevent migration of contaminants down well bores from the surface to the aquifer or across clay layers within the aquifer. Well destruction in the basin is administered by San Mateo County's Groundwater Protection Program (GPP). Destruction of wells is performed in accordance with the procedures set forth in DWR's *California Well Standards*, Bulletin 74-90 (1990).

Actions

L1. *Survey abandoned wells in the South Westside Basin both physically and from county records.*

L2. *Coordinate with San Mateo County's Groundwater Protection Program on destruction standards and procedures, as well as on logging of status of abandoned and destroyed wells.*

L3. *Encourage and, if feasible, provide funding for the destruction of abandoned wells.*

5.4.5 Identification of Well Construction Policies

Well construction in the South Westside Basin also is administered by San Mateo County's Groundwater Protection Program.

San Mateo County's Groundwater Protection Program issues permits for the construction or abandonment of all water wells including, but not limited to driven wells, monitoring wells, cathodic wells, extraction wells, agricultural wells, and community water supply wells. The wells are inspected during different stages of construction to verify standards are met. All drinking water wells are evaluated once installation is complete to ensure compliance with California Well Standards set forth in DWR's *California Well Standards*, Bulletin 74-90 (1990) and minimum drinking water standards.

Actions

M1. *Coordinate with San Mateo County's Groundwater Protection Program staff to ensure all parties are aware of local and regional contamination plumes. Increased caution or restrictions may be necessary near these plumes.*

5.5 CONSTRUCTION AND OPERATION BY THE LOCAL AGENCY OF GROUNDWATER CONTAMINATION CLEANUP, RECHARGE, STORAGE, CONSERVATION, WATER RECYCLING, AND EXTRACTION PROJECTS

Properly designed, constructed, and operated projects can cost-effectively move the South Westside Basin towards meeting water quantity, water quality, and subsidence objectives.

These projects could include:

- Groundwater contamination cleanup

Actions

N1. *Remediate basin groundwater from point-source (e.g., TCE, fuels) and non-point-source (e.g., nitrate) contamination, in a cost-effective manner. Point-source cleanup activities will include interfacing with regulatory agencies, potentially responsible parties, and other nearby agencies and municipalities. These actions will seek to return the contaminated area, to the extent possible, to a water supply source. Cleanup activities will be performed by the potentially responsible parties, and the regulatory agencies. Payment for impacts to the water system, if any, will be sought from the potentially responsible parties.*

- Recharge

Actions

N2. *Evaluate and consider the construction and operation of projects to recharge good-quality surplus water to the groundwater basin. Recharge water may include storm water, surface water, recycled water, or imported water and will be captured through existing pumping facilities. Recharge water would be selected to mutually benefit groundwater quantity and quality. It is not anticipated that additional facilities will be needed to extract stored water. Facilities are anticipated to be small in scale, rather than large spreading basins that are not cost-effective in the urbanized South Westside Basin.*

- Storage – Additional surface storage, while beneficial, is not anticipated in the area beyond small scale water harvesting and detention basins.
- Conservation – Conservation is a key part of water demand management in the South Westside Basin, exhibited by already low per-capita water use. CalWater and Millbrae are signatories to the MOU of the California Urban Water Conservation Council and participate in demand-side management measures. These agencies have committed to implementing best management practices to reduce water demand.

Actions

N3. *Agencies should work to build upon already successful conservation efforts by considering signing the MOU and participating in the California Urban Water Conservation Council, or implementing equivalent local efforts.*

N4. *Encourage installation of water-conserving systems such as dry wells and gray water systems where feasible, especially in new construction. Also encourage installation of rain gardens, cisterns, or infiltrators to capture rainwater from roofs for irrigation in the dry season and flood control during heavy storms.*

N5. *Support outreach programs to promote water conservation and widespread use of water saving technologies.*

N6. *Encourage continued outdoor irrigation water conservation.*

- Water recycling – Recycled water is available from Daly City's tertiary treatment plant. Other treatment plants could potentially provide recycled water in the future.

Actions

N7. *Evaluate and consider the expansion of existing recycled water programs, including efforts to utilize effluent from other treatment plants in the basin. Significant opportunities are available for usage of tertiary recycled water at the cemeteries, if appropriate funding mechanisms can be developed.*

- Extraction – Continued groundwater extraction will likely be necessary to meet future demand.

Actions

N8. *Perform groundwater modeling during the planning stages to ensure there are no significant impacts from new wells.*

5.6 COORDINATED PLANNING

5.6.1 DEVELOPMENT OF RELATIONSHIPS WITH STATE AND FEDERAL REGULATORY AGENCIES

Federal and state regulatory agencies to develop of relationships with include the following:

- Federal
  - EPA – contaminated sites
  - USGS – aquifer and watershed conditions, groundwater and surface water monitoring
- State
  - DPH – drinking water quality and vulnerability
  - DTSC – contaminated sites
  - DWR – aquifer conditions

- RWQCB – surface water quality and groundwater quality, permitting
- Water Board – groundwater monitoring (GAMA)

Actions

O1. *Coordinate with these federal and state agencies on issues related to monitoring and contaminated sites as well as on opportunities for grant funding.*

5.6.2 COORDINATION WITH IRWMP EFFORTS

As noted in Section 1, Introduction and Background, the Plan Area is part of the Bay Area IRWMP. Coordination during implementation of the GWMP with these IRWMP efforts is important to ensure that local efforts help meet regional goals and vice-versa.

Action

P1. *Ensure that at least one member of the Groundwater Task Force is actively involved in the coordination of both the IRWMP and the GWMP. This member will provide dialogue between the two efforts.*

5.6.3 REVIEW OF LAND USE PLANS AND COORDINATION WITH LAND USE PLANNING AGENCIES TO ASSESS ACTIVITIES THAT CREATE A REASONABLE RISK OF GROUNDWATER CONTAMINATION

As discussed in Section 5.4.2, Identification and Management of Wellhead Protection Areas and Recharge Areas, certain land uses and activities can potentially impact groundwater quality. Avoiding these uses in recharge areas and near wells is a better strategy than mitigation once the land uses are already in place.

Actions

Q1. *Coordinate between stakeholders and land use planning agencies to encourage protection of the groundwater resource by limiting activities that create an unreasonable risk to groundwater. Maps of well locations with soil properties will be provided to assist land use planning agencies in their decision process.*

Q2. *Monitor environmental impact reports and comment on such reports to ensure the water resources are protected.*

Q3. *Involve water agencies through water supply assessments as required under SB 610. The water supply assessment documents water supply sufficiency by identifying sources of water supply, quantifying water demands, evaluating drought impacts, and providing a comparison of water supply and demand.*

5.7 REPORTING AND UPDATING

Reporting on the status of the GWMP implementation is important for the fulfillment of the actions and projects listed in the plan. Updating the plan is important to reflect changing conditions and understanding of the basin.

Actions

R1. *Report on the GWMP's implementation progress every 2 years; include details on monitoring activities, trigger status of BMOs, project implementation, and new or unresolved issues. Post reports and status tables or maps for BMOs on the Internet.*

R2. *Update the GWMP every 5 years, unless changes in conditions in the basin warrant updates on a different frequency. Updates will be limited to those sections that require updating. Notify the public of the update and develop the update with input from the public and the Groundwater Task Force.*

6 IMPLEMENTATION

6.1 GOVERNANCE

The current governance of the South Westside Basin is based on the individual interest model. Under the individual interest model, stakeholders govern and develop water resource projects individually. The individual interest model will be retained with representatives from each stakeholder eligible for participation in the Groundwater Task Force. Individual development of projects will be designed and implemented following the common goal, objectives, and elements described in this GWMP, and will be presented to the Task Force for informational and coordination purposes. Additionally, coordination between stakeholders will allow for easier implementation of projects spanning multiple jurisdictions or benefitting multiple jurisdictions. As a potential next step, the governance structure may be defined in a MOU, which may be developed and signed after the adoption of this GWMP. The primary feature of the governance of the South Westside Basin would be the South Westside Basin Groundwater Task Force (Groundwater Task Force), which would lead the implementation of this GWMP.

6.1.1 Roles and Responsibilities

The Groundwater Task Force will

- Guide the implementation of the GWMP
    - Discuss and advance regional and local groundwater projects such as
        - Conjunctive use
        - Stormwater capture
        - Alternate supplies, such as recycled water
    - Coordinate on monitoring and CASGEM compliance
    - Coordinate on groundwater modeling and data management
    - Coordinate with larger regional efforts such as the Bay Area IRWMP
    - Coordinate on grant and loan opportunities
    - Develop reporting for GWMP implementation
- Share hydrogeological and operational information with others, such as
    - Groundwater levels
    - Groundwater quality
    - Well performance
- Provide a forum for public interaction on groundwater issues
- Provide a basis for future governance, if needed

6.1.2 Membership and Participation

Membership in the Groundwater Task Force is anticipated to include representatives from San Bruno, Daly City, California Water Service Company, and SFPUC as well as other major stakeholders, as follows in alphabetical order:

- Agricultural representative
- BAWSCA
- California Water Service Company
- Cemetery representative
- Town of Colma
- City of Daly City
- Environmental representative
- Golf Course representative
- Public representative
- Representative for cities not using groundwater (Millbrae and Burlingame)
- City of San Bruno
- San Francisco Public Utilities Commission
- San Mateo County

Changes to the composition of the Groundwater Task Force may be made with unanimous consent of the signatories to the potential MOU and a majority of all members attending the meeting.

Other entities are also encouraged to attend the meetings, including City of South San Francisco, RWQCB, United Airlines, and other interested groups or individuals. Participation by these groups in the meetings should be encouraged to allow for transfer of knowledge and a unified implementation of groundwater management.

6.1.3 Administration

A Groundwater Task Force administrator is needed to provide leadership to maintain progress and meet the implementation goals of the GWMP. The potential MOU may establish the initial administrator and a procedure to change the administrator from time-to-time. The administrator must have adopted this GWMP. Responsibilities of the administrator include:

- Scheduling regular meetings
- Providing agendas and minutes
- Monitoring or directing the monitoring of progress towards meeting implementation goals
- Developing or directing the development of annual reports
- Updating the GWMP as necessary

6.1.4 Meetings

Groundwater Task Force meetings would provide a forum for representatives from stakeholder groups to discuss and resolve regional groundwater issues. The meetings would be at least twice a year and open to the public.

The meetings would be intended to allow for the sharing of information as well as for the development of programs or projects needed to implement the GWMP. Information sharing may include changes to water supply infrastructure, new monitoring data, or new problems or opportunities. New programs and projects may be developed and implemented by individual stakeholders, by groups of stakeholders, or by all stakeholders. The ultimate project-making authority remains within the entity sponsoring the project.

6.1.5 Voting

The representatives on the Groundwater Task Force would coordinate on matters relevant to groundwater management in the South Westside Basin, using the goal, objectives, and elements of this GWMP to guide their decisions. Some occasions may require a formal vote by the Groundwater Task Force, specifically for the following:

- Changing of the composition of the Groundwater Task Force
- Changes to the MOU

Decisions to change the composition of the group would require unanimous support among the signatories to the potential MOU and would require majority support among all members attending the meeting to move forward. Decisions of the group to change the MOU must be unanimous among the MOU signatories to move forward. Projects may move forward with the support of a subset of the group, but would do so outside of the auspices of the Groundwater Task Force.

6.1.6 Potential Future Governance

If deemed necessary by the Groundwater Task Force, a MOU may be signed to create a more formalized governance structure. It is not anticipated at this time that future needs would require a more structured management system through a JPA.

Advantages to the individual interest approach in this Plan and through the potential MOU include the following:

- Agencies can focus their resources on projects specific to their needs
- No loss of management control by local groundwater resources
- Ease of implementation because it is a continuation of the current approach to groundwater management in the region.

Moving to a mutual interest model based on a JPA could provide the following:

- Ease pursuing regional projects that would benefit the entire South Westside Basin
- Define who coordinates projects and what role each agency plays during regional project planning, construction, operation, and maintenance
- Generate economies of scale for large projects
- Increase likelihood of state funding for projects benefiting multiple entities
- Prevent individual stakeholders from undertaking actions not complementary to the BMOs.
- Improved framework for resolution of conflicts.

Any potential future need to develop a MOU or JPA would be discussed through the Groundwater Task Force.

6.2 DISPUTE RESOLUTION

Disputes relating to implementation of the GWMP will be resolved by the Groundwater Task Force. In the event that the Groundwater Task Force cannot resolve the dispute, an outside neutral third party will assist the parties in working towards a satisfactory resolution, with completion of all procedures within 60 to 90 days, unless the parties to the dispute agree to a longer timeframe. Costs incurred, if any, in this process will be equally shared by the involved parties.

6.3 FINANCING AND BUDGET

Financing of projects will be on a project-by-project basis and will be the responsibility of the sponsoring agency or group, unless other agreements are made. Financing for the reporting and updating of the GWMP will be shared among the GWMP participants, with details to be mutually agreed upon.

It is anticipated that SFPUC will, at their discretion, continue providing for the development of annual reports for the entire South Westside Basin, with support from the GWMP participants for data and review. Additional items not currently included in SFPUC's annual reports but required by this GWMP may require a funding agreement from the water agencies adopting and agreeing to this GWMP.

6.4 SCHEDULE

The following schedule highlights the key milestones for implementation of the Groundwater Management Plan.

Item	*Reference Section*	*Initial Completion*	*Recurrence*
Meet with stakeholders to define and consider adoption of a governance structure	***6.1***	***2 years***	***n/a***
Implement basinwide semiannual static groundwater level monitoring	***4.3.1, 5.2.1, App. C***	***1 year***	***n/a***
Add additional pressure transducers to existing groundwater level monitoring network	***5.2.1 App. C***	***2 year***	***n/a***
Implement a voluntary groundwater level monitoring program for private groundwater producers	***App. C***	***2 years***	***n/a***
Develop program to survey and destroy abandoned wells	***5.4.4***	***3 years***	***n/a***
Implement a voluntary groundwater production monitoring program for private groundwater producers	***App. C***	***3 years***	***n/a***
Identify recharge strategies to increase yield	***2.3.5, 5.3.1 5.3.2 5.3.3 5.4.1 5.4.2 5.5 5.6.3***	***2 years***	***As needed***
Update Groundwater Model	***4.3.1***	***1 years***	***1 year***
Complete subsidence analysis using InSAR	***4.3.4***	***5 years***	***As needed***
Continue public outreach and education	***5.1***	***2 years***	***Ongoing***
Report on GWMP	***5.7***	***2 years***	***1 year***
Update GWMP	***5.7***	***5 year***	***5 years***

7 REFERENCES

Alley, W. M., T. E. Reilly, and. O. E. Franke, 1999. *Sustainability of Groundwater Resources*. USGS Circular 1186, http://pubs.usgs.gov/circ/circ1186.

Bartell, M.J. 1914. *Field Examinations*. Prepared for M.M. O'Shaughnessy, City Engineer, City of San Francisco, Department of Public Works.

Bay Area Water Supply & Conservation Agency (BAWSCA). 2009. *BAWSCA Annual Survey – FY 2007-08*. January.

Bay Area Water Supply & Conservation Agency (BAWSCA). 2011. Spreadsheets of Monthly/Seasonal SFPUC Purchases Among BAWSCA Members. January.

Bonilla, M.G.. 1998. *Preliminary geologic map of the San Francisco South 7.5' quadrangle and part of the Hunters Point 7.5' quadrangle, San Francisco Bay area, California: A digital database*. USGS Open-File Report 98-354

Brown and Caldwell. 2001. *Water System Master Plan Update*. July.

Brown and Caldwell. 2011. *City of Daly City 2010 Urban Water Management Plan*. June.

Burlingame, City of. 2009. *Waste Water Treatment Plant.* http://www.burlingame.org/Index.aspx?page=82. Accessed on July 13.

Burns & McDonnell and ERM-West. 2006. *Building 84 Feasibility Study/Remedial Action Plan, United Airlines San Francisco Maintenance Center, San Francisco International Airport*. May 15.

California Department of Public Health (DPH). 2010. *California Drinking Water Data. December 1.*

California Department of Public Health (DPH). 2009. *California Regulations Related to Drinking Water.* http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Lawbook/dwregulations-08-13-2009.pdf. Accessed on August 25.

California Department of Water Resources (DWR). 1975. *California's Ground Water.* Bulletin 118.

California Department of Water Resources (DWR). 1980. *Ground Water Basins in California.* Bulletin 118-80.

California Department of Water Resource (DWR). 1990. *California Well Standards*. Bulletin 74-90.

California Department of Water Resources (DWR). 2003. *California's Groundwater.* Bulletin 118-03.

California Department of Water Resources (DWR). 2010. IWRIS: Integrated Water Resources Information System. http://app1.iwris.water.ca.gov/IWRIS. Accessed on February 4.

California Irrigation Management Information System (CIMIS). 2009. Climatic data http://www.cimis.water.ca.gov/cimis/monthlyEToReport.do. Accessed on March 23.

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). 1996. *San Francisco and Northern San Mateo County Beneficial Use Evaluation*. April.

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). 2007. *San Francisco Bay Region (Region 2) Water Quality Control Plan*. January.

California Water Service Company. 2011. *2010 Urban Water Management Plan South San Francisco District.* June.

Carollo. 2008. *Recycled Water Feasibility Study, Cities of South San Francisco, San Bruno, Brisbane in coordination with Cal Water and SFPUC.*

Carollo. 2009. *Recycled Water Facility Plan.*

Clifton, H.E., and Hunter, R.E., 1987, The Merced Formation and related beds; a mile-thick succession of late Cenozoic coastal and shelf deposits in the seacliffs of San Francisco, CA, in Hill, M.L., ed., Centennial field guide: Boulder, Colo., Geological Society of America, Cordilleran Section, v. 1, p. 257–262.

Clifton, H.E., and Hunter, R.E., 1991, Depositional and other features of the Merced Formation in sea cliff exposures south of San Francisco, CA, in Sloan, Doris, and Wagner, D.L., eds., 1991, Geologic excursions in northern California; San Francisco to the Sierra Nevada: California Division of Mines and Geology Special Publication 109, p. 35–44.

Daly City, City of. 2005. *2005 Urban Water Management Plan*. December.

Daly City, City of. 2009. *Recycling/Reusing Treatment Plant By-product*. http://www.dalycity.org/city_services/depts/wwr/waste_treatment.htm#5. Accessed on July 28.

EKI. 2005. *City of Burlingame Urban Water Management Plan*. November.

EKI. 2007. *City of San Bruno Urban Water Management Plan*. January.

EKI. 2011. *City of San Bruno Urban Water Management Plan*. June.

ERM. 2005. *Fourth Quarter 2004 Ground Water Monitoring Report United Airlines Building 84 FS/RAP San Francisco Maintenance Center.*

ESA. 2009. *Harding Park Recycled Water Project Draft EIR*.

Fio, J.L., and Leighton, D.A., 1995, *Geohydrologic framework, Historical Development of the ground-water system, and general hydrologic and water-quality conditions in 1990, south San Francisco Bay and Peninsula area, California*: U.S. Geologic Survey Open-File Report 94-357, 46 p.

Gillespie, K. and B. Gillespie. 2009. *An Overview of Daly City History*. http://www.dalycityhistory.org/overview.htm. Accessed on September 1.

Harden, D.R., 1998. *California Geology*.

Hensolt, W. H. and Brabb, E.E.. 1990. Maps showing elevation of bedrock and implications for design of engineered structures to withstand earthquake shaking in San Mateo County, California. Open-File Report 90-496. U. S. Geological Survey, Menlo Park, CA.

HydroFocus. 2003. Westside Basin Unified Groundwater Model. May 14.

HydroFocus. 2011. Westside Basin Groundwater-Flow Model: Updated Model and 2008 No-Project Simulation Results. May.

HydroMetrics. 2011. *Water Year 2011, Seawater Intrusion Analysis Report, Seaside Basin, Monterey County, California*. Prepared for Seaside Basin Watermaster. November.

Izbicki, J.A., Borchers, J.W., Leighton, D.A., Kulongoski, J, Fields, L., Galloway, D.L., and Michel, R.L. 2003. *Hydrogeology and Geochemistry of Aquifers Underlying the San Lorenzo and San Leandro Areas of the East Bay Plain, Alameda County, California:* U.S. Geological Survey Water-Resources Investigations Report 02–4259, 71 p.

Jones, B.F., A. Vengosh, E. Rosenthal, and Y. Yechieli. 1999. "Geochemical Investigations." *Seawater Intrusion in Coastal Aquifers: Concepts, Methods, and Practices*. Jacob Bear, Saul Sorek, Driss Ouazar, Eds.

Kennedy/Jenks. 2009. *Monitoring Well Installation Technical Memorandum South Westside Basin Conjunctive Use Project (CS 879C)*. April 9.

Kennedy/Jenks. 2010. *Phase 2 Monitoring Well Installation Technical Memorandum*.

Kirker, Chapman & Associates. 1972. *Daly City ground water investigation*. San Francisco, CA, 159 pp., 1972.

Land, M., Reichard, E.G., Crawford, S.M., Everett, R.R., Newhouse, M.W., and Williams, C.F. 2004. *Ground-Water Quality of Coastal Aquifer Systems in the West Coast Basin, Los*

Angeles County, California, 1999–2002: U.S. Geological Survey Scientific Investigations Report 2004–5067, 80 p.

Leake, S.A. 2004. *Land Subsidence from Ground-Water Pumping*. U.S. Geological Survey.

Lee, C.H. and M. Praszker. 1969. "Bay Mud Developments and Related Structural Foundations." *Geologic and Engineering Aspects of San Francisco Bay Fill*. California Division of Mines and Geology Special Report 97.

Luhdorff & Scalmanini Consulting Engineers (LSCE). 2004. *Update on the Conceptualization of the Lake-Aquifer System Westside Ground-Water Basin San Francisco and San Mateo Counties.* April.

Luhdorff & Scalmanini Consulting Engineers (LSCE). 2005. *Results of In-Lieu Recharge Demonstration, Fall 2002 through Spring 2005, Westside Basin Conjunctive Use Pilot Project*. October 13.

Luhdorff & Scalmanini Consulting Engineers (LSCE). 2010. Final Task 8B. *Technical Memorandum No. 1, Hydrologic Setting of the Westside Basin.* May 5.

MWH. 2007. *Alternatives Analysis Report for San Francisco Public Utilities Commission Water System Improvement Project, Groundwater Conjunctive Use Project.* October.

Millbrae, City of. 2005. *City of Millbrae 2005 Urban Water Management Plan*. December.

Millbrae, City of. 2009a. *Water Pollution Control Plant*. http://www.ci.millbrae.ca.us/index.aspx?page=98. Accessed on September 1.

Millbrae, City of. 2009b. *Ground Breaking Ceremony for the Water Pollution Control Plant Renovation Project*. http://www.ci.millbrae.ca.us/index.aspx?page=24&recordid=116&returnURL=%2findex.aspx%3fpage%3d93. Accessed on October 9.

National Oceanic and Atmospheric Administration. 2011. NCDC Weather Station - San Francisco International Airport. Accessed online at http://hurricane.ncdc.noaa.gov/dly/DLY?randomnum=64485550W115507. Accessed on February 1.

Oakland Museum of California. 2011. Guide to San Francisco Bay Area Creeks. Accessed online at http://museumca.org/creeks/1590-RescColma.html# on February 9, 2011.

Phillips, S. P., Hamlin, S. N. and Yates, E.B.. 1993. *Geohydrology, water quality, and estimation of ground-water recharge in San Francisco, California*, 1987-92. Water- Resources Investigations Report 93-4019. U. S. Geological Survey, Sacramento, CA.

Poland, J. F., And Ireland, R. L., 1988, Land Subsidence in the Santa Clara Valley, California as of 1982, U. S. Geological Survey Professional Paper 497-F, 61 p.

RMC and Jones & Stokes. 2006. *Bay Area Integrated Regional Water Management Plan (IRWMP)*. November.

RMC. 2006. *Vista Grand Watershed Study*. Prepared for the City of Daly City and SFPUC.

California Regional Water Quality Control Board, San Francisco Bay Region [RWQCB]. 2010. *San Francisco Bay Basin Water Quality Control Plan*. December.

Rogge, Erdmann. 2003. *Dimensions of the Westside Groundwater Basin, San Francisco and San Mateo Counties, California*. MS Thesis, San Francisco State University. May.

San Francisco Public Utilities Commission (SFPUC). 2005. *Final Draft North Westside Basin Groundwater Basin Management Plan.* April.

San Francisco Public Utilities Commission (SFPUC). 2008. *Proposed Harding Park Recycled Water Project*. Spring.

San Francisco Public Utilities Commission (SFPUC). 2010a. *2009 Annual Groundwater Monitoring Report, Westside Basin, San Francisco and San Mateo Counties, California. May.*

San Francisco Public Utilities Commission (SFPUC). 2010b. *Annual Water Quality Report…*

San Francisco Public Utilities Commission (SFPUC). 2011. *2011 Annual Groundwater Monitoring Report, Westside Basin, San Francisco and San Mateo Counties, California.*

Sloan, D. 2006. *Geology of the San Francisco Bay Region*, California Natural History Guide Series No. 79, Berkeley, University of California Press, 318p.

South San Francisco. 2009. *General Plan*.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 1991. *Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California*.

U.S. Environmental Protection Agency (EPA). 2009. *Drinking Water Contaminants*. http://www.epa.gov/safewater/contaminants/index.html Accessed on August 25.

Waltham, T. 2002. *Foundations of Engineering Geology*, 2nd Edition.

Western Regional Climate Center. 2011. Climatic data. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7769 Accessed on March 1.

Witter, R.C., Knudsen, K.L, Sowers, J.M., Wentworth, C.M., Koehler, R.D., Randolph, C.E., Brooks, S.K., and Gans, K.D. 2006. *Maps of Quaternary deposits and liquefaction susceptibility in the central San Francisco Bay region, California*: U.S. Geological Survey Open-File Report 2006-1037. (http://pubs.usgs.gov/of/2006/1037/).

WRIME. 2007. San Bruno Groundwater Monitoring Wells: Installation and Monitoring, An AB303 Project Report. April.

APPENDIX A – PUBLIC PROCESS

APPENDIX B – CONSUMER CONFIDENCE REPORTS

APPENDIX C – MONITORING PROTOCOLS

APPENDIX D – BASIN MANAGEMENT OBJECTIVE HYDROGRAPHS

APPENDIX E – SEAWATER INTRUSION INDICATORS