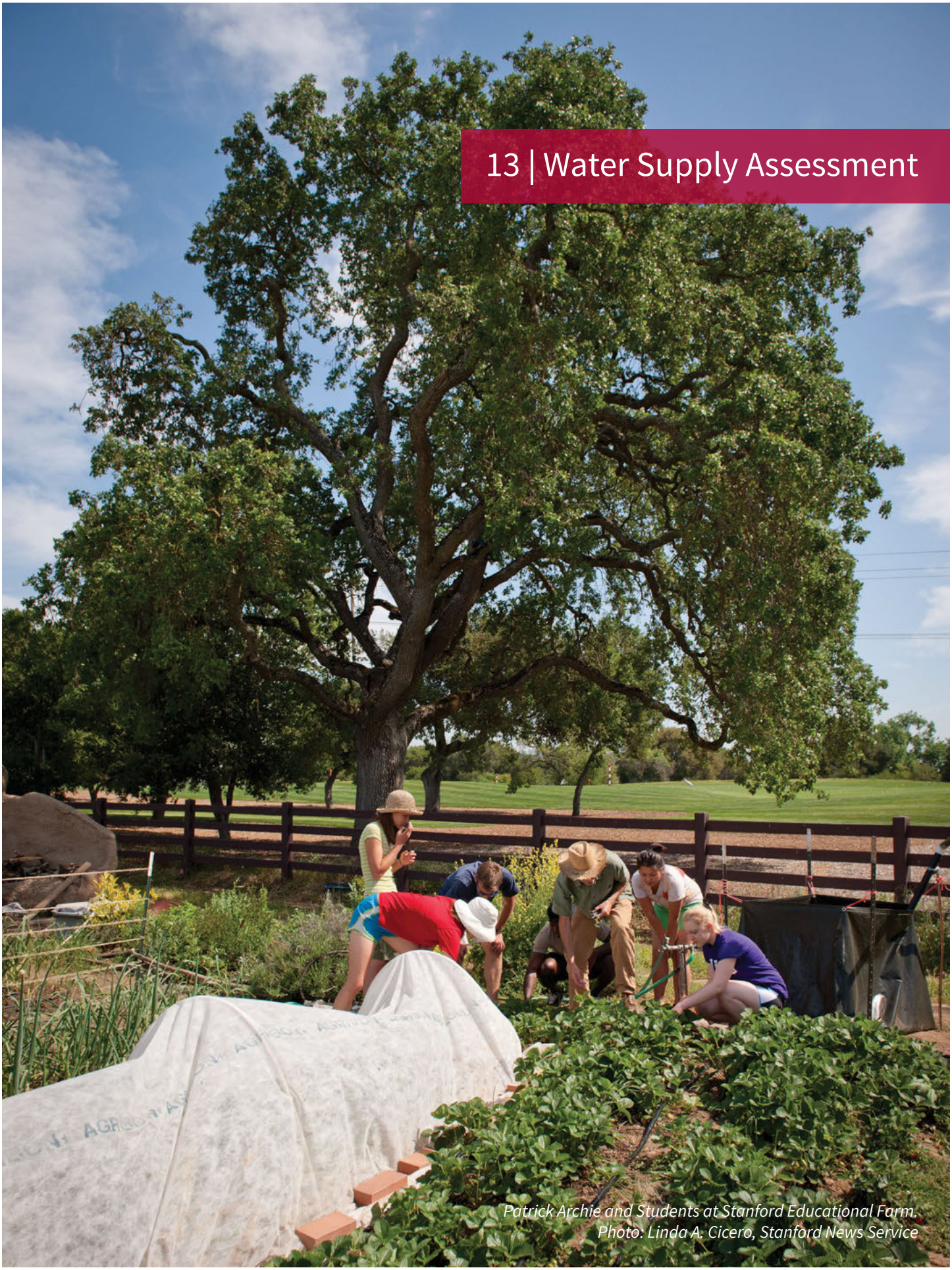
13 | Water Supply Assessment



Patrick Archie and Students at Stanford Educational Farm.
Photo: Linda A. Cicero, Stanford News Service

WATER SUPPLY ASSESSMENT

FOR THE

STANFORD 2018 GENERAL USE PERMIT

Prepared by

STANFORD UNIVERSITY

and

Schaaf & Wheeler

CONSULTING CIVIL ENGINEERS

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SANTA CLARA COUNTY

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FOR

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Table i. Acronyms Used in this Report

Acronym	Description
ac-ft, AF	Acre-feet
ac-ft/yr, AFY	Acre-feet/year
ccf, hcf	Hundred cubic feet
gpd	Gallons per day
gpcd	Gallons per capita day, or gallons per person per day
gsf	Gross square feet
mgd	Million gallons per day
sq-ft, sf	Square feet
USF	Usable square foot
BAWSCA	Bay Area Water Supply & Conservation Agency
BMP	Best management practice
CEF	Central Energy Facility
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CIWQS	California Integrated Water Quality System Project
CWC	California Water Code
DDW	SWRCB Division of Drinking Water
DMM	Demand management measure
DRIP	Drought Implementation Plan
DWR	California Department of Water Resources
ET	Evapotranspiration
EIR	Environmental Impact Report
eWRIMS	Electronic Water Rights Information Management System
GUP	General Use Permit
ISG	Individual Supply Guarantee
ISL	Interim Supply Limitation
LAFCO	Local Agency Formation Commission
RWQCP	Regional Water Quality Control Plant
SB	California Senate Bill
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SWRCB	State Water Resources Control Board
UWMP	Urban Water Management Plan
WBIC	Weather Based Irrigation Controller
WSA	Water Supply Assessment
WVS	Written Verification of Supply

Table ii. Units of Measure Used in this Report

Unit	Equals
1 acre-foot	= 43,560 cubic feet = 325,851 gallons
1 cubic foot	= 7.48 gallons
1 CCF	= 100 cubic feet = 748 gallons
1 MGD	= 1,000,000 gallons/day = 1,120 acre-feet / year

Summary of Revisions

This March 2017 version of the Water Supply Assessment for the 2018 Stanford General Use Permit contains the following revisions to the version provided to Santa Clara County in November 2016:

- As directed by Santa Clara County staff, the 2015-2018 scenario has been revised to exclude the approved Escondido Village Graduate Residences project. This project would be under construction by 2018, but is not anticipated to be occupied until 2020.
- A 2015-2020 scenario has been added to reflect conditions at full development of the existing 2000 General Use Permit. This scenario is identical to the 2015-2018 growth scenario except it includes occupancy of the approved Escondido Village Graduate Residences project.
- An additional 40,000 square feet of academic and academic support space have been added to ensure that the Water Supply Assessment addresses potential water demand associated with 40,000 square feet of child care or other trip-reducing space proposed as part of the application for the 2018 General Use Permit.
- Text changes have been made to reflect comments by the County's peer reviewers.
- Updated discussion of groundwater pumping to address comments on the EIR Notice of Preparation.

Summary of Water Supply Assessment

Project: Stanford 2018 General Use Permit, Santa Clara County, California

This Water Supply Assessment (WSA) has been prepared pursuant to the requirements of Senate Bill 610 (Chap. 643, Statutes of 2001), Water Code §§ 10910-10915. The WSA evaluates whether there will be sufficient water supplies to meet the water demands of development under Stanford University's proposed 2018 General Use Permit (2018 General Use Permit). Under the 2018 General Use Permit, Stanford proposes to add 2.275 million gross square feet (gsf) of academic and academic support space, 40,000 gsf of childcare or other space used to reduce vehicle trips, and 3,150 housing units/beds, of which no more than 550 would be faculty/staff units, during the period from 2018 to 2035. For purposes of this WSA, it is assumed that the new housing under the 2018 General Use Permit would include 550 faculty/staff units and 2,600 student beds. As explained below, the estimated total potable water demands of the Stanford University campus at project buildout are calculated at 2.44 million gallons per day (mgd). This is substantially below Stanford's long-term Individual Supply Guarantee of 3.03 mgd of potable water from the San Francisco Public Utilities Commission (SFPUC). In addition to potable

demand, the total estimated non-potable water demands (for landscape irrigation use) at project buildout are calculated at approximately 1.35 mgd, which can be met through a combination of non-potable local surface supplies and groundwater. Based on the analysis that follows, the WSA concludes that there will be sufficient supplies to serve the water needs of the 2018 General Use Permit during normal, single dry and multiple dry water years over a 20-year projection.

This WSA is being prepared for approval by Santa Clara County (County), as the lead agency under the California Environmental Quality Act (CEQA) for the environmental review of the 2018 General Use Permit Project. The WSA will be included in the County's Environmental Impact Report (EIR) for the 2018 General Use Permit.

Section 1 - Introduction

1.1 Project Overview

The 2018 General Use Permit is located in unincorporated Santa Clara County on the existing Stanford University campus and adjacent Stanford lands. Under the 2018 General Use Permit, Stanford proposes to add 2.275 million gsf of academic and academic support space, 40,000 gsf of childcare or other space used to reduce vehicle trips, and 3,150 housing units/beds, of which no more than 550 would be faculty/staff units, during the period from 2018 to 2035. For purposes of this WSA, it is assumed that the new housing under the 2018 General Use Permit would include 550 faculty/staff units and 2,600 student beds. Further description of the 2018 General Use Permit is provided in Section 2.0 below.

Potable water supply for Stanford is provided by the SFPUC. Non-potable supply, which is used primarily for irrigation, is obtained from Stanford's local surface water sources and groundwater wells.

1.2 Purpose of Water Supply Assessment

This WSA is being prepared pursuant to the requirements of Senate Bill 610 (2001). Under this law, a WSA is required for any "project" that is subject to CEQA and that meets certain criteria, including a proposed residential development of more than 500 dwelling units. See Water Code §§ 10910(a), 10912(a). The 2018 General Use Permit is subject to CEQA, and the County is preparing an EIR for the project. Further, the 2018 General Use Permit meets the criteria for preparing a WSA under SB 610, as it will add more than 500 dwelling units in addition to other proposed development. As a result, a WSA is required, and it will be incorporated into the County's EIR for the 2018 General Use Permit.

The purpose of the WSA is to evaluate whether "the total projected water supplies, determined to be available … for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses." Water Code § 10910(c)(4).

1.3 Identification of "Public Water Systems" Serving the Project

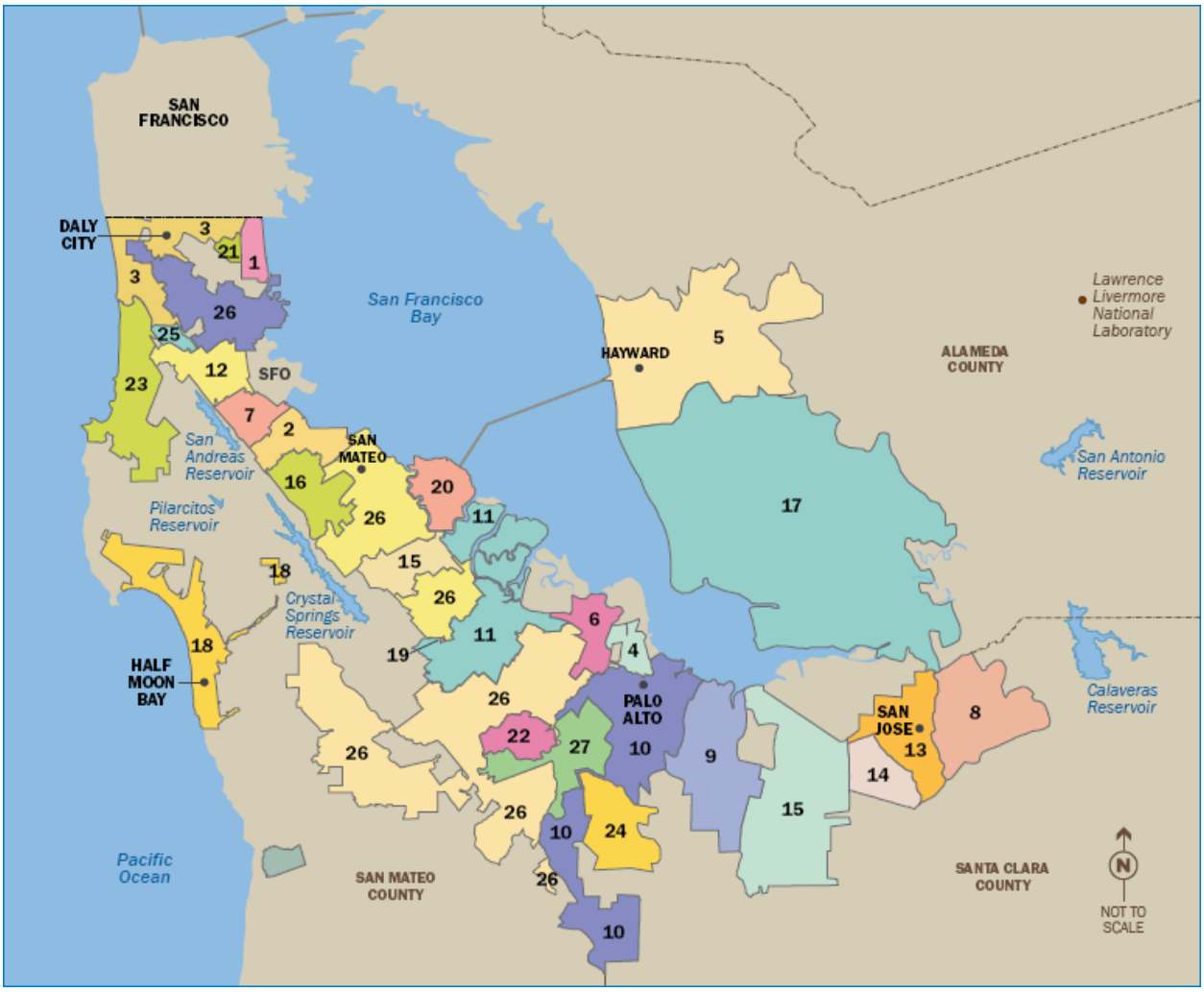
There is no identified "public water system" serving the Stanford campus. As a result, the County, as the CEQA Lead Agency for the 2018 General Use Permit, is responsible for preparation and approval of the WSA. See Water Code § 10910(b), (c)(4).

Stanford University currently has three sources of water supply: (1) water purchased wholesale from the SFPUC, (2) groundwater, and (3) local surface supplies.

The SFPUC acts as a "public water system" with respect to its retail customers in the City and County of San Francisco, but it does not serve as a "public water agency" when it provides water

to its wholesale customers (such as Stanford University), who are responsible for supplying water to the ultimate end users. Further, Stanford University, as a private entity that does not serve the general public, does not constitute a "public water system." As a result, the County is responsible for preparation and approval of the WSA with respect to potable water provided by SFPUC to Stanford to serve the 2018 General Use Permit Project. As a reference, Figure 1-1 shows the SFPUC Wholesale Service Area.

Figure 1-1: SFPUC Wholesale Service Area

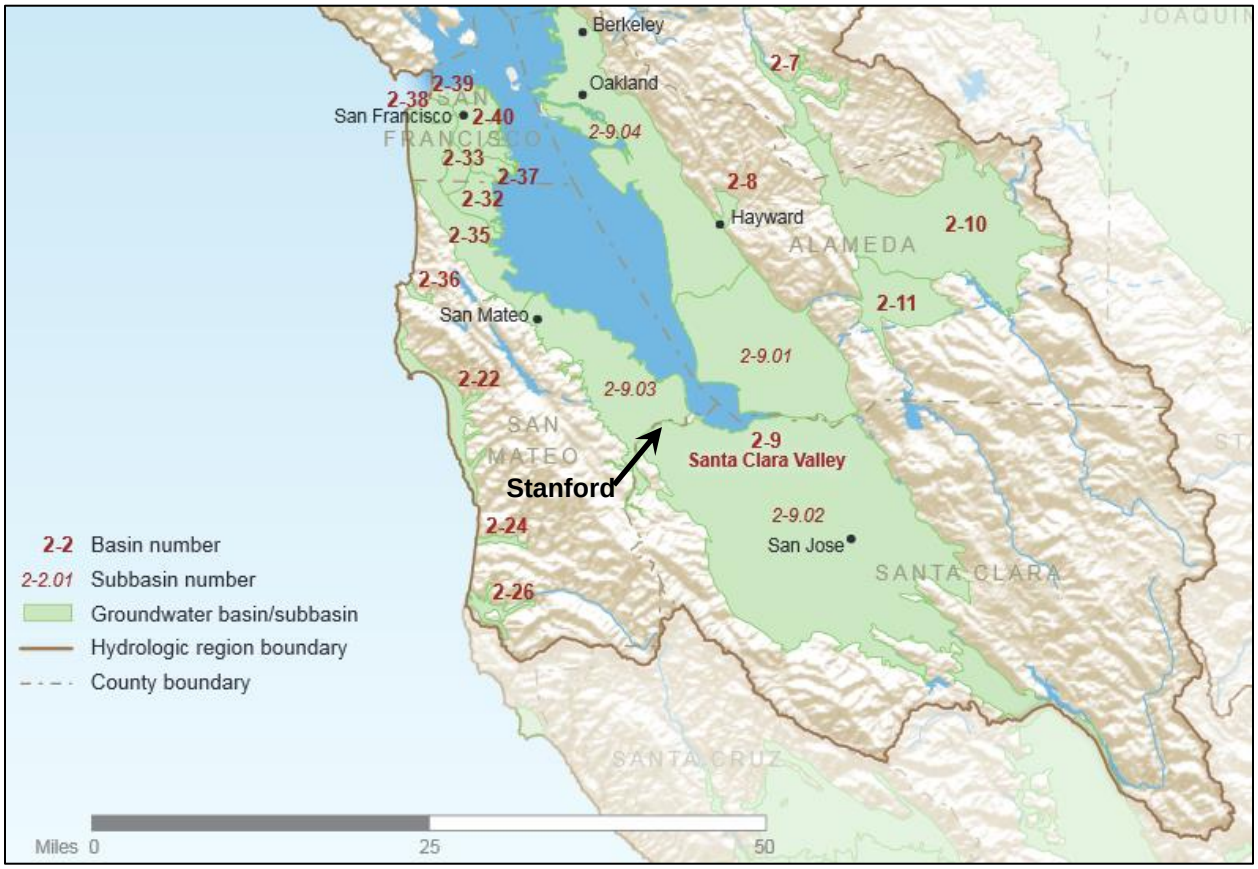


Stanford is Service Area 27, labeled in green. *(Source: SFPUC 2015 UWMP)*

With respect to groundwater (which is discussed further in Section 4.1.2 below), Stanford operates and maintains five active wells. These wells withdraw groundwater from the San Francisquito Cone, part of the Santa Clara Valley Groundwater Basin. Although the Santa Clara Valley Water District (SCVWD) oversees groundwater resources within the County and assesses a pumping fee for each acre foot of groundwater withdrawn, it does not serve as a "public water

system" with respect to Stanford's withdrawal of groundwater from its campus wells pursuant to its water rights. As a result, the County is responsible for preparation and approval of the WSA with respect to Stanford's groundwater usage for the 2018 General Use Permit Project. As a reference, Figure 1-2 below shows groundwater basins and subbasins located in the southern portion of the San Francisco Bay Hydrologic Region. Stanford is located in the Santa Clara Valley groundwater basin, at the boundary of the San Mateo Plain and Santa Clara Plain subbasins. Figure 1-3 below shows the location of Stanford's five groundwater wells.

Figure 1-2: Alluvial Groundwater Basins and Subbasins within the southern San Francisco Bay Hydrologic Region

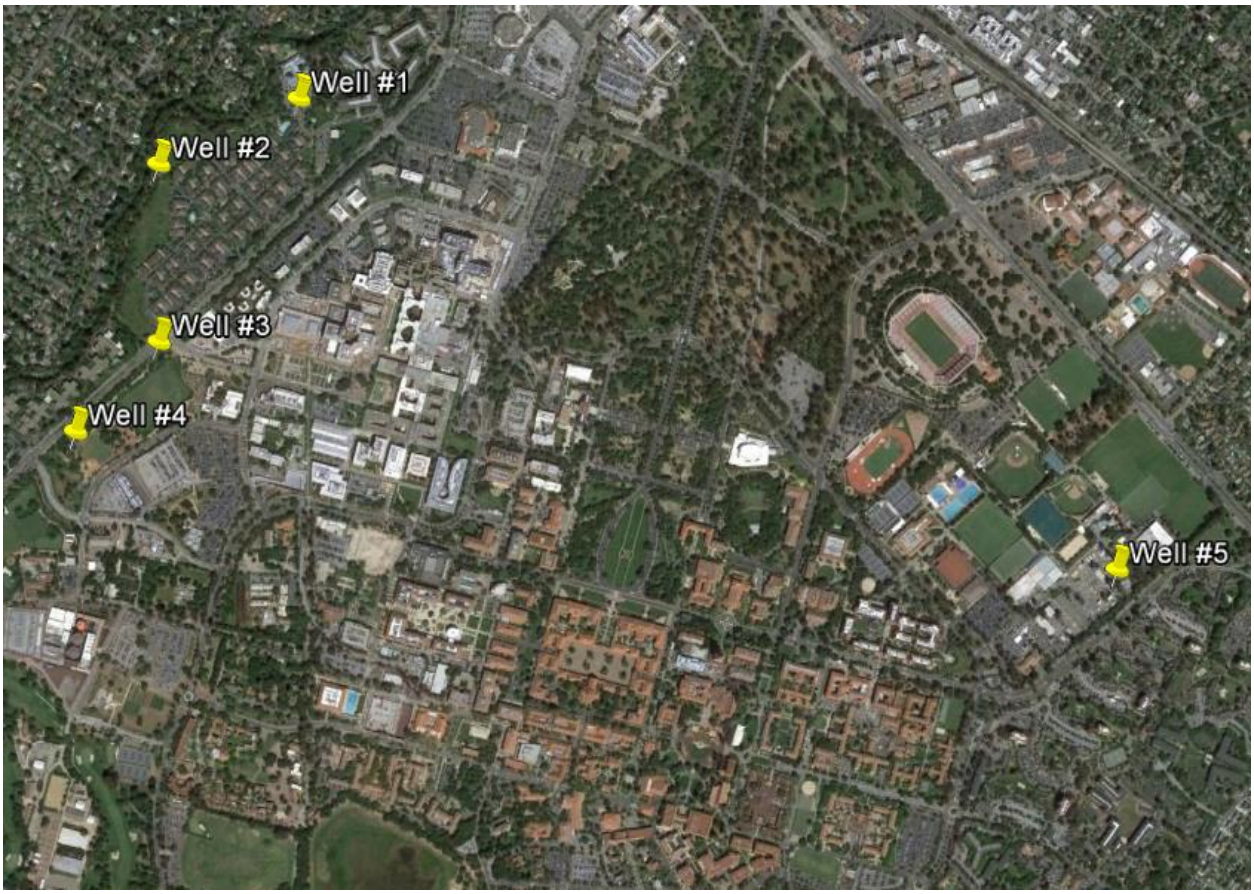


Subbasin 2-9.03 is the San Mateo Plain; Subbasin 2-9.02 is the Santa Clara Plain *(Source: Bulletin 118)*

With respect to local surface supplies (which are discussed in Section 4.1.3, below, and which are depicted in Figure 1-4, below), Stanford has surface water rights and diversion licenses under which it operates two reservoirs: Searsville Reservoir on Corte Madera Creek, and Felt Reservoir adjacent to Los Trancos Creek. These reservoirs are used to provide non-potable supplies for purposes of irrigation and backup fire protection. There is no "public water system" associated with Stanford's exercise of its water rights with respect to these local surface supplies. As a

result, the County is responsible for preparation and approval of the WSA with respect to usage of local surface water supplies to serve the 2018 General Use Permit.

Figure 1-3: Stanford Groundwater Production Wells

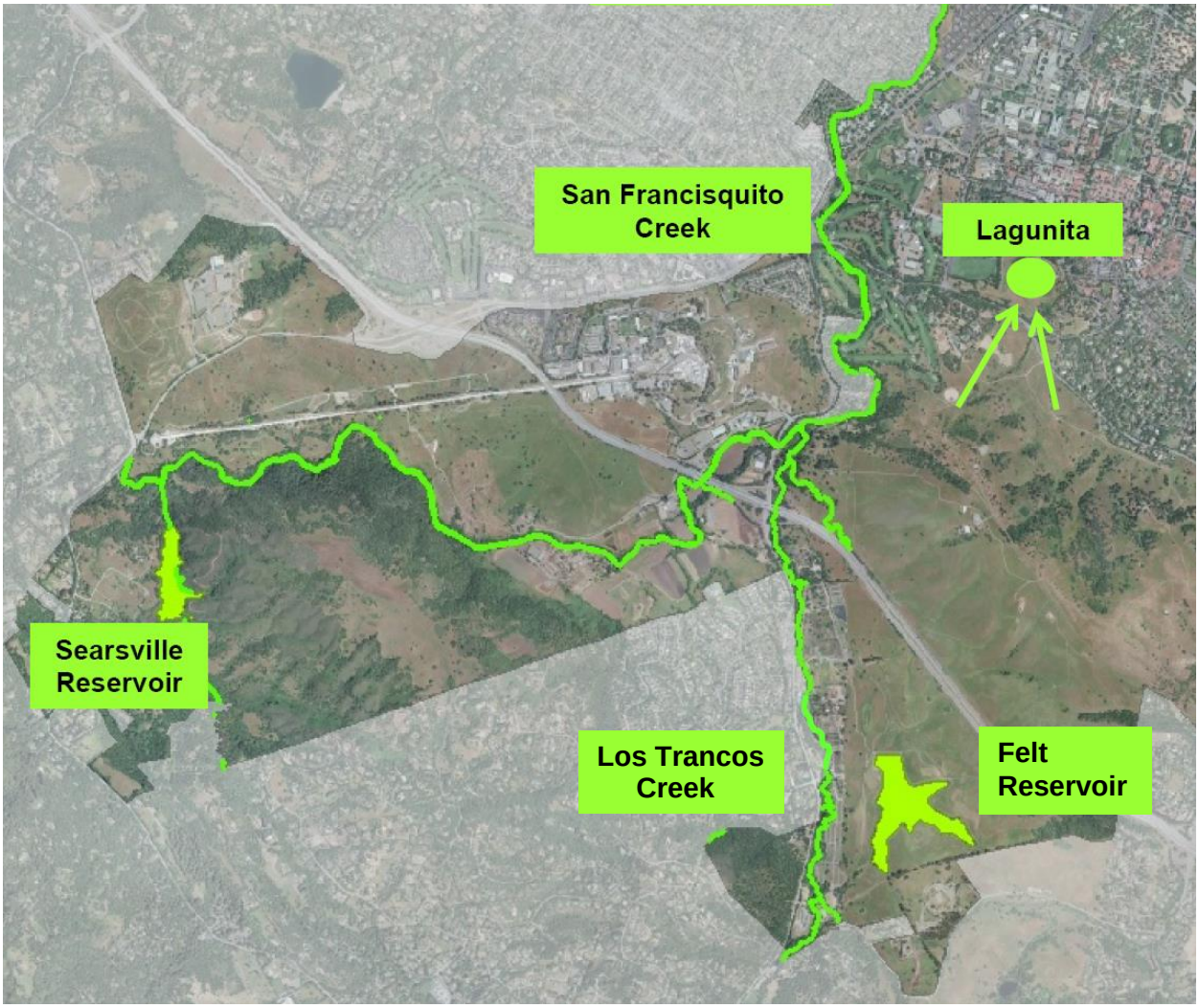


1.4 Relationship of WSA to SFPUC and SCVWD Urban Water Management Plans

The California Urban Water Management Planning Act (Water Code §§ 10610-10656) requires urban water suppliers meeting certain criteria to prepare plans (urban water management plans or UWMPs) on a five-year, ongoing basis. An UWMP must demonstrate the continued ability of the provider to serve customers with water supplies that meet current and future expected demands under normal, single dry, and multiple dry year scenarios. These plans must also include the assessment of urban water conservation measures and wastewater recycling. Pursuant to Water Code § 10632, the plans must also include a water shortage contingency plan outlining how the water provider will manage water shortages, including shortages of up to fifty percent (50%) of their normal supplies, and catastrophic interruptions of water supply. Stanford is not required to prepare an UWMP, but it provides usage statistics and demand projections to the SFPUC and SCVWD, who incorporate this data into their respective UWMPs. The SFPUC

adopted its 2015 UWMP in June 2016 and the SCVWD adopted its 2015 UWMP in May 2016. The 2015 UWMPs project demands through the year 2040. The 2015 UWMPs do not specifically address the water demands for the 2018 General Use Permit, which are analyzed in this WSA, but the future water demands projected in those documents are consistent with this study. The SFPUC UWMP includes Stanford's potable water demand projection of 2.40 mgd in 2035 and 2.70 mgd in 2040, while this study projects a potable water demand of 2.44 mgd. The SCVWD UWMP includes Stanford's total water demand projection of 4,300 AFY in 2035 and 4,700 AFY in 2040. This study projects a future total water demand of 4,620 AFY.

Figure 1-4: Stanford Reservoirs and Creeks



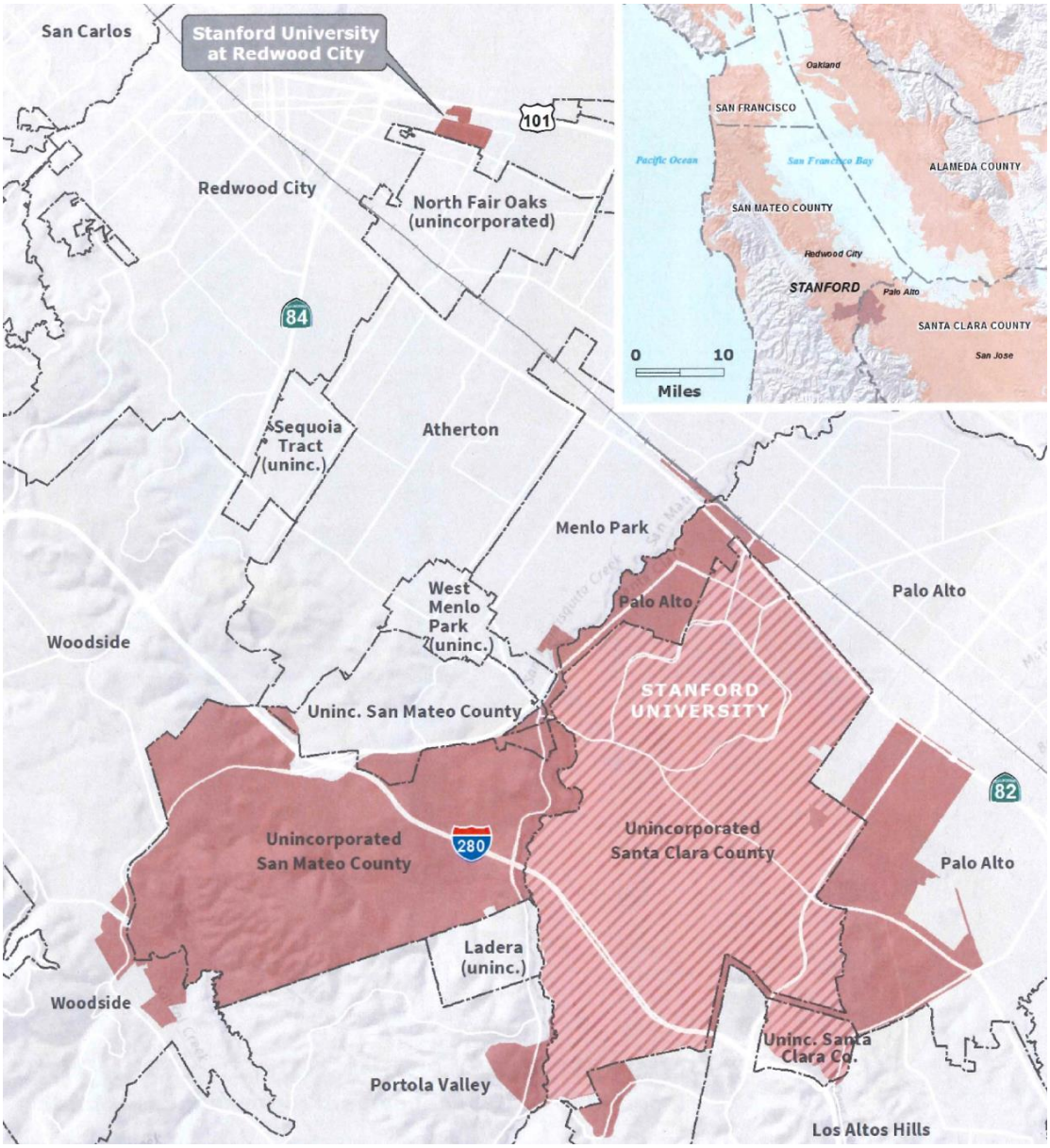
Source: Stanford University, Stanford's Water Resources presentation

Section 2 - Project Description and Water Demands

2.1 Project Description

The Stanford University campus occupies over 8,000 acres of land straddling the San Mateo – Santa Clara County line. Stanford's main campus is located in Santa Clara County, while other lands are located in the City of Palo Alto, unincorporated San Mateo County, and the cities of Menlo Park, Portola Valley, and Woodside. Stanford also owns discontinuous property in the city of Redwood City (Stanford University at Redwood City). Campus, city, and county boundaries are shown in Figure 2-1.

Figure 2-1: Stanford University Lands



Hatched area shows Stanford lands located in unincorporated Santa Clara County.

Under the 2018 General Use Permit, Stanford proposes to add 2.275 million gsf of academic and academic support space, 40,000 gsf of childcare or other space used to reduce vechile trips, and 3,150 housing units/beds, of which no more than 550 would be faculty/staff units, during the period from 2018 to 2035. For purposes of this WSA, it is assumed that the new housing under the 2018 General Use Permit would include 550 faculty/staff units and 2,600 student beds. Development will be located in areas within an Academic Campus land use designation, the approximate boundaries of which are Junipero Serra Boulevard, El Camino Real, Sand Hill Road and Stanford Avenue. The 2018 General Use Permit is located on Stanford lands in unincorporated Santa Clara County.

2.2 Potable Water Demands

Potable demands are projected by usage, described below and summarized in Tables 2-1 and 2-2. The analysis uses pre-drought conditions (Fiscal Year 2012-13) as the starting point because this captures pre-project conditions more accurately than subsequent years, during which drought conditions have temporarily but significantly affected campus water usage. Water usage in 2015 is included in other parts of the analysis to provide another point of comparison to the future projected water use under the 2018 General Use Permit.

2.2.1 Academic Buildings Potable Water Demands

As of 2012, Stanford had 9,104,902 square feet (sf) of academic building space. Buildings represent a mixture of classrooms, laboratories, offices and meeting spaces, among other uses, and water use is calculated on a per-square-foot basis. All potable water use is metered, and total annual potable water use for academic facilities in FY2012-13 was 0.66 mgd, or approximately 0.072 gallons/sf/day. This unit demand for potable water use is used to extrapolate from current potable water use to project the future potable water demand resulting from projected academic growth. Note that the potable water demands for academic facilities include both domestic indoor usage, as well as use of potable water for outdoor landscape irrigation for certain academic buildings.

In addition to the 412,603 sf developed between 2012-2015, plus another 769,354 sf scheduled for completion by Fall 2018 pursuant to the prior General Use Permit that was approved in 2000, Stanford proposes to develop 2,275,000 sf of additional academic and academic support space plus an additional 40,000 sf of additional childcare or other spce that would be used to reduce vehicle trips by 2035 under the 2018 General Use Permit. This results in a total potable water demand for academic and academic support space of 0.91 mgd, which represents a water demand increase of 0.25 mgd as compared to FY2012-13 levels.

2.2.2 Student Housing Potable Water Demands

As of 2012, Stanford housed 11,323 undergraduate and graduate students on campus. Student housing is measured in units of “beds” and represents a mixture of medium to high density dormitories and apartment-style units. For the purposes of potable water demand calculations,

student housing also includes dining halls and other facilities closely associated with on-campus residential life. All potable water use is metered, and total annual potable water use for student housing in FY2012-13 was 0.46 mgd, or approximately 40.6 gallons/bed/day. For comparison, California's state indoor water use target is 55 gallons/person/day.

The 2012 unit demand for potable water use is used to extrapolate from current potable water use to project future potable water demand that would result from projected growth. In addition to the 559 student beds developed between 2012-2015, plus another 416 beds scheduled for completion by Fall 2018 and another 2,020 beds scheduled for completion by Fall 2020[1], Stanford proposes to develop 2,600 additional beds of student housing under the 2018 General Use Permit, resulting in a total student housing stock of 16,918 beds and a potable water demand of 0.69 mgd for student housing in 2035. This represents a water demand increase for student housing of 0.23 mgd as compared to FY2012-13 levels.

2.2.3 Faculty/Staff Housing Potable Water Demands

As of 2012, Stanford provided potable water to 937 faculty and staff dwelling units. Units represent a mixture of medium to high density single family homes, townhomes and apartment-style units, and water use is calculated on a per-unit basis. All potable water use is metered, and total annual potable water use for faculty/staff housing in FY2012-13 was 0.52 mgd, or approximately 555 gallons/unit/day. This figure includes both domestic indoor uses, as well as outdoor landscape irrigation. For existing faculty/staff housing that is more urban in nature, little outdoor watering occurs, and per-unit potable water use averages 225 gallons/unit/day.

Unit demand is used to extrapolate from current potable water use to project the future water demand that would result from projected growth. Stanford expects to add 550 additional faculty/staff housing units by 2035 under the 2018 General Use Permit. These units will all be of the higher-density type (i.e., more urban in nature), so a per-unit demand of 225 gallons/unit/day is used for new units. This results in a total potable water demand for faculty/staff housing of 0.64 mgd in 2035, which represents a water demand increase of 0.12 mgd as compared to FY2012-13 levels. This projection may well be conservative, as Stanford may consider using non-potable sources to meet some of the new housing's outdoor landscape irrigation needs, depending on location.

2.2.4 Combined Potable Water Demands for Academic Buildings, Student Housing and Faculty/Staff Housing

Combining projected potable water use for academic development, student housing, and faculty/staff housing results in a potable water demand of 2.24 mgd at buildout of the 2018 General Use Permit Project in 2035, which represents an increase of 0.60 mgd as compared to

[1] Total includes 1,450 student beds that are beyond the initial 2000 General Use Permit authorization. These beds were approved by the County in March 2016.

FY2012-13 levels for these three types of uses. However, as explained in the next section below, improvements to the campus' Central Energy Facility (CEF) that were completed in 2015 are resulting in a significant decrease in water usage to serve campus energy needs. As shown in Table 2-4 below, Energy systems water demand went from 0.46 mgd in 2012 to 0.18 mgd in 2015, a reduction of over 60%.

2.2.5 Energy System Water Demands

Prior to 2012, a significant portion of Stanford's SFPUC water allocation was consumed by the evaporative cooling towers of the campus cogeneration and thermal energy plant (Central Energy Facility, CEF). Between 2012 and 2015, Stanford constructed a new energy facility/system that replaced its CEF as part of the Stanford Energy System Innovations project, a massive capital investment designed to decrease Stanford's carbon footprint by 50 percent, in addition to reducing net energy and water consumption and saving money over the long-term. The project replaced the steam-based campus heating system with a hot-water-based system. Rather than discharging waste heat to the atmosphere through evaporative cooling, the new state-of-the-art CEF recaptures this energy to supply the campus with heat and hot water. Also, the new CEF uses electric chillers to produce chilled water, rather than relying totally on cooling towers and evaporative cooling for this purpose. As a result, energy system water demand has been reduced by over 60% to 0.18 mgd. This savings of 0.28 mgd represents 13% of total baseline (FY2012-13) potable water use. Energy system water demand is projected to reach 0.20 mgd at buildout of the 2018 General Use Permit in 2035.

Table 2-1: Summary of Existing and Proposed Development

Water use category	Unit of Measure	Existing development in 2012	Completed development 2012-2015	Projected development 2015-2018	Projected development 2018-2020	2018 GUP development 2018-2035	Total at Buildout Fall 2035
Academic and Childcare	sq. ft.	9,104,902	412,603	769,354	0	2,315,000	12,601,859
Student housing	beds	11,323	559	416	2,020	2,600	16,918
Faculty/staff housing	dwelling units	937	0	0	0	550	1,487

Table 2-2: Summary of Existing and Projected Potable Water Demand

Water use category	Unit of Measure	Existing development in 2012	Water Use FY2012-13 mgd	Water Use factor gal/day/unit	Buildout total Fall 2035	Water Use at Buildout, mgd
Academic and Childcare	sq. ft.	9,104,902	0.66	0.072	12,601,859	0.91
Student housing	beds	11,323	0.46	40.6	16,918	0.69
Faculty/staff housing	dwelling units	937	0.52	555	1,487	0.64 **
Energy Systems			0.46	NA		0.20
TOTAL			**2.10**			**2.44**

**Calculation of future FSH usage is based on a projected water consumption of 225 gal./unit/day for new FSH units, which will be more urban in nature than the existing FSH development. 225 gal./unit/day is based on current usage statistics for comparable existing FSH units (Olmsted Terrace, Pearce Mitchell, Peter Coutts).

2.3 Landscape Irrigation

The proposed development under the 2018 General Use Permit will occur as redevelopment or infill on Stanford's main campus, as it was under the 2000 General Use Permit, rather than new development of presently vacant land. Individual developments associated with the 2018 General Use Permit will have varying effects on landscape irrigation needs, depending on the type of development and what is replaced, which is currently not known. Development that replaces currently landscaped areas with buildings and/or pavement will cause irrigation needs to decrease, whereas similar development that replaces paved surface parking lots or non-landscaped areas with landscaping would require increased irrigation. Thererfore, a precise projection regarding future irrigation demand cannot be made at this time. However, as shown in Figure 4-2 (see Section 4.1), while non-potable irrigation usage fluctuates from year to year, over time this usage remained relatively constant as the 2000 General Use Permit was implemented; despite substantial campus growth under the 2000 General Use Permit, non-potable irrigation usage in 2015 was equivalent to such usage in 2000 (approximately 1 mgd). Under the 2018 General Use Permit, Stanford expects that the nature of development will continue similar to past development of the campus, and irrigation demand is therefore not expected to increase more under the 2018 General Use Permit than it did under the 2000 General Use Permit. For the purposes of this WSA, Stanford's irrigation demand is therefore conservatively projected to increase by 10% as a result of the 2018 General Use Permit.

Some areas of the Stanford campus (landscaping around certain academic buildings and throughout the existing FSH area) are irrigated with potable SFPUC water, and this usage is accounted for in the potable water demands section above. However, Stanford currently meets

the majority of irrigation demand with non-potable sources derived from local surface and groundwater. Stanford makes an effort to irrigate with non-potable sources wherever practical (primarily a function of proximity to non-potable water distribution infrastructure). In FY2012-13, Stanford used a total of 1,570 AF for landscape irrigation, or 1.40 mgd on average (see Table 2-3). Of this amount, approximately 0.18 mgd (13%) was potable supply from SFPUC, while 1.23 mgd (87%) came from local sources (surface and groundwater, 0.94 and 0.29 mgd respectively)[2].

The sources of landscape irrigation water, as well as the total amount used, can differ significantly from year to year. Both the quantity and timing of wet-season rainfall are highly variable, directly affecting both surface water availability and plant irrigation needs. During wet years, Stanford can divert more surface water from local streams, and plant irrigation needs are less than average, particularly if the rainy season extends into the fall or spring. In wet years, Stanford might meet most irrigation needs with surface water, relying very little on groundwater or potable SFPUC supply. In drier years, plants require more irrigation, and streamflows may be too low for Stanford to meet these demands with surface water, which is subject to minimum bypass flows retained in the creeks for passage and habitat; so Stanford pumps additional groundwater to meet its landscape irrigation needs (e.g., FY2013-14). Additionally, conservation-related supply cutbacks of potable water from SFPUC are more likely to occur during periods of drought.

Stanford uses low-water-demand, native plants in many of its landscaped areas. These plants are well adjusted to the region's Mediterranean climate and require little dry-season watering. New landscaping added as part of the 2018 General Use Permit will rely heavily on these plant varieties. As Stanford develops through the 2018 General Use Permit and beyond, landscaping decisions will provide opportunities to reduce irrigation needs or transition to irrigation systems that utilize non-potable water supplies.

[2] In addition to irrigation, surface water use also includes flow to Lagunita, which provides California tiger salamander habitat and groundwater recharge benefits.

Table 2-3: Summary of Irrigation Water Use, by Source

	FY:	2010-11	2011-12	2012-13	2013-14	2014-15
Surface Water	(AFY)	1,019	1,032	1,056	72	-
	(mgd)	0.91	0.92	0.94	0.06	0.00
	% total	84.9%	70.2%	67.3%	5.3%	0.0%
Ground-water	(AFY)	182	238	323	1,142	1,085
	(mgd)	0.16	0.21	0.29	1.02	0.97
	% total	15.1%	16.2%	20.6%	83.4%	88.8%
SFPUC Supply	(AFY)	-	201	191	156	137
	(mgd)	-	0.18	0.17	0.14	0.12
	% total	-	13.7%	12.1%	11.4%	11.2%
TOTAL	(AFY)	**1,201**	**1,471**	**1,570**	**1,370**	**1,221**
	(mgd)	**1.07**	**1.31**	**1.40**	**1.22**	**1.09**

SFPUC supply quantities are for dedicated irrigation meters only; FSH irrigation use (which is supplied by SFPUC) is not separately metered or reported *(Source: Stanford staff).*

2.4 Projected Total Water Demands

The total potable water demand projected with the 2018 General Use Permit is 2.44 mgd, as shown in Table 2-4 below. This represents an 16% increase from the FY2012-13 baseline, but is still 19% below the maximum SFPUC allocation of 3.03 mgd. Total water demands, including non-potable water for landscape irrigation, are projected to increase to 3.79 mgd by 2035, the year of expected 2018 General Use Permit buildout (Table 2-4).

Table 2-4: Projected Total Water Demands, 2020 – 2035 (mgd)[3]

Water Use Category	FY2012-13 Actual	FY2015-16 Actual	2020 Projected *	2025 Projected	2030 Projected	2035 Projected
Academic	0.66	0.47	0.74	0.80	0.85	0.91
Student housing	0.46	0.42	0.53	0.58	0.64	0.69
Faculty/staff housing	0.52	0.32	0.56	0.59	0.62	0.64
Energy Systems	0.46	0.18	0.17	0.18	0.19	0.20
TOTAL POTABLE	**2.10**	**1.39**	**2.00**	**2.15**	**2.29**	**2.44**
Landscape (Non-Potable)	1.23	0.81	1.27	1.29	1.32	1.35
TOTAL	**3.33**	**2.20**	**3.27**	**3.44**	**3.62**	**3.79**

* Assumes normal cooling year in 2020. 2015-16 energy demand reflects energy system conversion during the reporting year.

[3] Landscape demand refects non-potable demands met by the Lake Water system

Section 3 - Existing Water Demands

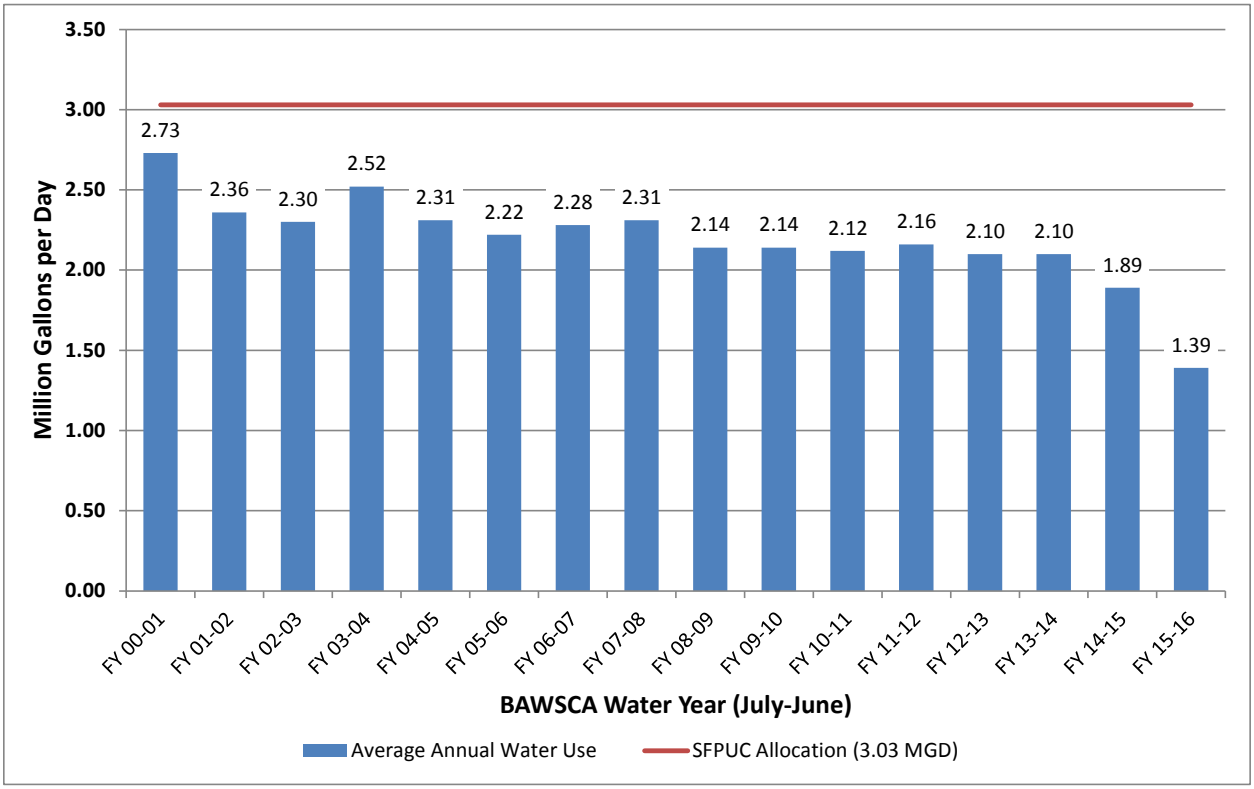
3.1 Historic and Current Water Demands

The SFPUC provides water to its 27 wholesale customers under the terms of a 2009 Water Supply Agreement. Under this Agreement, Stanford holds a long-term "Individual Supply Guarantee" (ISG) of 3.03 mgd overall annual average, which represents approximately 1.6% of SFPUC's total wholesale deliveries. The 2009 Agreement also contains "Interim Supply Limitations" (ISLs) that are in effect until 2018. Stanford's ISL under the 2009 Agreement is 2.91 mgd. Thus, Stanford holds an allocation from the SFPUC of 2.91 mgd until 2018 and then an allocation from the SFPUC of 3.03 thereafter. Note that although expressed in units of mgd, both the ISG and ISL are overall annual average targets. Daily or monthly usage may exceed these targets, and this is not uncommon during the summer months. The 2009 Agreement has a 25-year term (through 2034), but the SFPUC's 2015 UWMP assumes that the amount that is allocated to wholesalers (including Stanford) under the agreement will continue to be so allocated through the year 2040.

Figure 3-1 shows domestic water demand at Stanford over the period 2001-2016. During this period, annual average consumption decreased from a maximum of approximately 2.7 mgd in 2001 to 2.1 mgd in 2012-13. This significant reduction has been achieved as a result of a rigorous water conservation program, despite substantial campus growth. As shown in Figure 3-1, annual usage since 2001 has been well below both the ISG of 3.03 and the temporary ISL of 2.91 that took effect in 2009. In FY 2014-15 and FY 2015-16, Stanford further reduced its SFPUC water use to less than 2.00 mgd by implementing the Stanford Energy Systems Innovations Project and additional mandatory conservation measures during the recent drought.

The SFPUC's 2015 UWMP included projections of future purchase requests from wholesale customers. The UWMP included Stanford's projection that purchase requests will increase from 2.00 mgd in 2015 to 2.40 mgd in 2035. This study projects a slightly higher demand at 2.44 mgd, which is still well within the limits of Stanford's ISG and ISL. The SFPUC's 2015 UWMP analysis of supply vs. demand uses the full wholesale contract ISG values, and not the projected demands.

Figure 3-1: Stanford Domestic Water Use, 2001-2016



Source: Stanford University Water Efficiency Program, compiled from BAWSCA Surveys and SFPUC Invoices

3.2 Dry Year Demands

Table 3-1 shows Stanford University's projected water demands and supplies from the SFPUC for normal, single dry, and multiple dry water years, under existing conditions (FY2012-13) and at the buildout of the 2018 General Use Permit Project in 2035. The projection of non-potable usage assumes that surface water is the primary source of irrigation supply, and groundwater is used to meet the remaining demand.

With respect to dry years, in its 2015 UWMP, the SFPUC advises wholesale customers to anticipate seeing their supply allocations reduced to as low as 83% of normal for a single dry year. In multiple dry year scenarios, supply might be further reduced to 72% of normal. Fiscal Year 2015-16 represented the third year of a multi-year drought, and no such curtailments were actually imposed by SFPUC, but the possibility of supply reductions should nonetheless be taken into account when planning future dry-year demand scenarios. The dry-year supply projections contained in Table 3-1, below, are based on the 83% and 72% planning factors from the SFPUC.

Table 3-1: Dry-Year Supply and Demand Summary (mgd)

	Water Year Type				
	Normal Year	Single Dry Year	Multiple Dry Years		
Supply			1	2	3
Potable Supply (SFPUC)					
ISG	3.03	2.51	2.51	2.18	2.18
ISL	2.91	2.42	2.42	2.10	2.10
Surface Water Supply	1.12	0.94	0.94	0.06	0.06
Groundwater Supply	1.52	1.52	1.52	1.52	1.52
Total Supply (ISG)	5.67	4.97	4.97	3.76	3.76
Total Supply (ISL)	5.55	4.88	4.88	3.68	3.68
Baseline Demand					
Potable Demand	2.10	2.11	2.11	1.79	1.58
met by ISL	2.10	2.11	2.11	1.79	1.58
Non-potable Demand	1.23	1.29	1.29	0.98	0.98
met by surface water	1.12	0.94	0.94	0.06	0.06
met by groundwater	0.11	0.35	0.35	0.92	0.92
Total Demand	3.33	3.41	3.41	2.77	2.56
2035 Demands					
Potable Demand	2.44	2.46	2.46	2.07	1.83
met by ISG	2.44	2.46	2.46	2.07	1.83
Non-potable Demand	1.35	1.42	1.42	1.08	1.08
met by surface water	1.12	0.94	0.94	0.06	0.06
met by groundwater	0.23	0.48	0.48	1.02	1.02
Total Demand	3.79	3.87	3.87	3.15	2.91

In Table 3-1, above, water demand increases in a single dry year or the first of multiple dry years due to natural plant irrigation demands increasing by 5%. In multiple dry years, potable demands would be reduced by 15% in the second year and 25% in the third year, reflecting conservation measures that would be implemented to reduce consumption. As shown in Table 2-4, Stanford has been able to achieve these types of reductions in the past. Excluding energy system usage, potable usage totaled 1.64 mgd in FY2012-13 and was reduced to 1.21 mgd in FY2015-16, reflecting a reduction of more than 25%. Stanford accomplished this reduction by replacing older water fixtures in campus residences with low-use models, and by significantly reducing irrigation with potable water. Stanford imposed two-day per week watering with potable water and also modified irrigation practices to avoid waste and cut back on watering of non-functional turf areas.

With respect to non-potable irrigation usage, this demand would be reduced by 20% in the second and third dry years of a multiple dry year scenario. As shown in Table 2-3, as with potable usage, Stanford has been able to achieve such reductions in the past. As shown in this table, non-potable irrigation usage (i.e., local surface water and groundwater supplies) totaled

approximately 1.23 mgd in FY2012-13 and was reduced to 0.97 mgd in FY2014-15, a reduction of more than 20%. As shown in Table 2-4 and Table 5-1, further significant reductions in non-potable usage were achieved in FY2015-16.

Section 4 - Water Supply

4.1 Current Water Supply

Stanford's primary source of water supply (and only normally utilized potable source) is purchased from the SFPUC under wholesale contract. Stanford has the capability to supplement potable supplies with groundwater if needed. In addition, Stanford uses local surface supplies and groundwater, for non-potable uses, primarily for landscape irrigation. The non-potable distribution system is referred to as the Lake Water System.

4.1.1 SFPUC Water

As described in the previous section, Stanford receives the majority of its total water, and 100% of its current potable water, as a wholesale purchase from the SFPUC. SFPUC's water supply consists primarily of diverted Tuolumne River flows conveyed through the Hetch Hetchy Project (approximately 85% of supply), with local sources making up the remaining 15%. This ratio can be as high as 93%:7% during dry years *(SFPUC 2010 UWMP)*. Total SFPUC system storage capacity is nearly 300 billion gallons. During normal years, the SFPUC supplies an average of 256 mgd to its retail and wholesale customers, with 81 mgd being delivered to retail customers and 184 mgd being sold to wholesale providers. Stanford holds an allocation of 3.03 mgd (annual average) from the SFPUC under the current water supply agreement. SFPUC participates in several regional water supply projects to ensure that it can meet dry-year demands with no greater than 20% rationing by its customers.

4.1.2 Groundwater

Stanford has the capability to use groundwater for potable consumption, but at present groundwater is not used for this purpose other than in emergencies. Groundwater currently is used for non-potable uses such as landscape irrigation, and is relied upon most heavily during dry years. Groundwater is pumped into Felt Reservoir for rediversion into the Lake Water System. Of Stanford's total water use between 2010 and 2015, groundwater use (3,500 AF) comprised about 13%.

Stanford maintains five active wells (See Figure 1-3 and Table 4-1). These wells withdraw groundwater from the San Francisquito Cone, a region of the Santa Clara Valley groundwater basin located along the boundary between the Santa Clara Plain and San Mateo Plain subunits. Water-bearing units in the San Francisquito Cone consist of sands and gravels deposited in alluvial fans at the foot of the Santa Cruz Mountains during the Pliocene and lower Pleistocene, which were subsequently covered in alluvium and Bay Mud. The Cone contains both confined and unconfined aquifer units, with water table surfaces generally sloping gently towards San Francisco Bay. Bulletin 118 describes groundwater level trends in both the Santa Clara and San Mateo Subbasins as stable, having largely recoverd from 1960s minima thanks to decreased

pumpage (many former pumpers now rely on imported surface water deliveries) and increased recharge.

The Santa Clara Valley groundwater basin has not been adjudicated, is not identified by the Department of Water Resouces (DWR) as an overdrafted basin, nor is it projected to enter a state of overdraft. The Santa Clara Valley Water District has submitted an application to the California Department of Water Resources to serve as the Groundwater Sustainability Agency for this basin. The SCVWD actively manages its water supply portfolio to ensure that groundwater use within the basin remains sustainable, employing methods such as managed groundwater recharge, conjunctive use, local surface water capture and storage, imported water, and recycled water to enhance and supplement groundwater supplies.

Stanford's wells have a combined total pumping capacity of approximately 4,450 AFY. In the most recent reporting year (FY2014-15, BAWSCA Annual Survey), Stanford withdrew a total of 721 AF from these wells. This was a dry year, and on average, Stanford pumps less than this amount (Table 4-2). Unpublished internal groundwater modeling studies have indicated that Stanford (or others) could withdraw up to 1,700 AFY (1.52 mgd) from its wells without impacting water quality in the aquifer or causing unacceptable impacts (e.g. excessive drawdown, land subsidence, saltwater intrusion).

Table 4-1: Existing Pumping Capacity

Well	Year Installed	Location	Estimated Capacity	
			(GPM)	(AFY)
Well 1	1934	Sand Hill Rd.	500	800
Well 2	1936	Sand Hill Rd.	625	1000
Well 3	2003	Sand Hill Rd.	550	900
Well 4	2004	Sand Hill Rd.	525	850
Well 5	1956	Bonair Yard	550	900
		TOTAL:	**2,750**	**4,450**

Source: Stanford staff

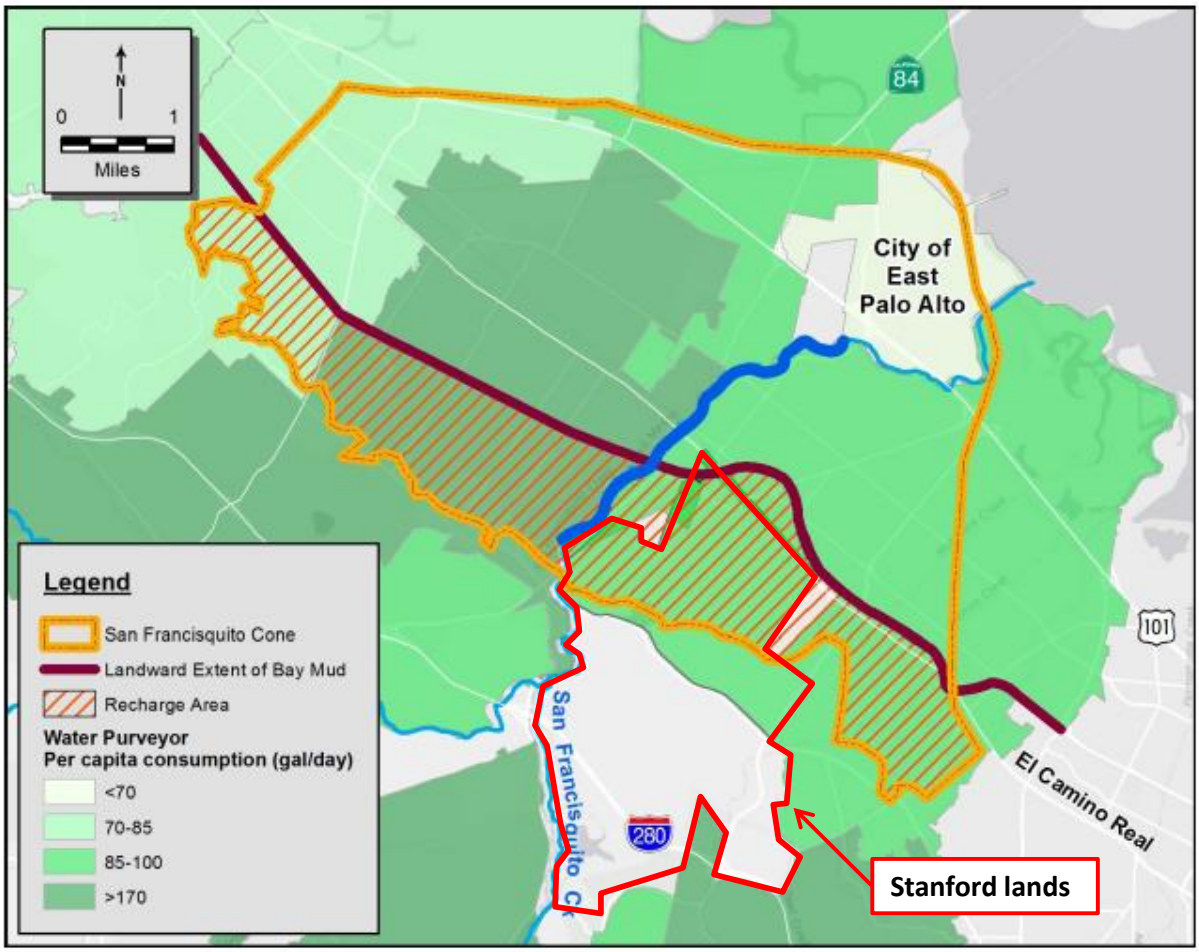
Table 4-2: Summary of Annual Groundwater Pumping (AF)

Year	2010	2011	2012	2013	2014	2015	Average 2010-2015
Well 1	33.0	10.0	47.5	53.9	175.1	96.5	69.3
Well 2	53.0	20.3	104.2	98.3	367.5	171.2	135.8
Well 3	150.9	53.2	0.0	214.2	241.8	150.4	135.1
Well 4	92.7	32.2	120.5	74.5	397.3	212.8	155.0
Well 5	3.9	10.8	88.1	76.0	177.2	177.2	88.9
Total Pumped	334	127	360	517	1359	808	584

Source: Stanford Staff (from well meters)

Recharge to the San Francisquito Cone primarily occurs within the bed and banks of San Francisquito Creek. Rainfall and landscape irrigation within the foothills of the Santa Cruz Mountains also percolate into the aquifer (see Figure 4-1). As a condition of the current (2000) General Use Permit, Stanford implemented a Campus-Wide Plan for Groundwater Recharge to mitigate the loss of recharge areas to development. Under that plan, surface water from various sources is conveyed to Lagunia Reservoir, which has the greatest recharge capacity on campus. When Lagunita Reservoir was kept filled year-round, its recharge to the aquifer was estimated to be 700 AFY. Lagunita Reservoir currently receives stormwater runoff and is only augmented with surface water during California tiger salamander breeding periods, so its contribution to the San Francisquito Cone is proportionally reduced.

Figure 4-1: San Francisquito Cone Recharge Areas[4]



[4] Source: Groundwater Management Plan for the City of East Palo Alto, Figure 13, prepared by Todd Groundwater, Stanford lands outline overlayed for this report

The Groundwater Management Plan for the City of East Palo Alto estimates inflows to the aquifer ranging from 5,000 AFY to 10,000 AFY. Current usage and outflows are estimated at 2,800 AFY, including estimated subsurface outflow to the San Francisco Bay. That study assumed Stanford's groundwater usage at 342 AFY, which is comparable to the projected normal-year demands estimated in this report. At the lower estimate of annual recharge, the aquifer could support approximately 2,200 AFY of increased annual usage by overlying communities (similar to the conclusion in Stanford's internal groundwater study). Temporary increases in groundwater usage in response to droughts or surface water supply interruptions can also be supported.

4.1.3 Local Surface Water

Stanford holds a combination of riparian and pre-1914 appropriative rights reported under four Statements of Water Diversion and Use (S004660, S004661, S015695, S015696) and one appropriative right licensed by the SWRCB (L001723). These water rights support Stanford's diversion operations from Los Trancos Creek and San Francisquito Creek, two streams that flow through Stanford lands, which supply Stanford's non-potable Lake Water system. These appropriative water rights date to 1886, 1870, and 1891, and the licensed right was issued in 1937. The rights provide water for recreation, irrigation, stockwatering, and fire protection purposes, and are summarized as follows:

- License 1723 authorizes diversion of up to 900 AFY from Los Trancos Creek and/or the San Francisquito Creek pump station, from December 1 to May 1, to storage in Felt Reservoir, which has a storage capacity of 1,050 acre-feet.
- Statements S015695 and S015696 document pre-1914 appropriative water rights to divert from those same diversion facilities to storage in Felt Reservoir.
- Statement S004660 documents Stanford's pre-1914 appropriative right to impound, divert and store water in Searsville Reservoir (Searsville Reservoir storage capacity has been reduced over time by sedimentation, but this pre-1914 appropriative water right has been exercised downstream at the San Francisquito Creek pump station).
- Statement S004661 authorizes the diversion of water from San Francisquito Creek to Lagunita for recreational and habitat purposes.

Water is impounded seasonally (during periods of high flow) in two reservoirs above campus: Searsville Reservoir on Corte Madera Creek (just above its confluence with Bear Gulch Creek), and Felt Reservoir east of Los Trancos Creek (see Figure 1-4). Water is then drawn from these reservoirs as needed. Because of the way in which waters from multiple sources commingle during diversion and storage, total diversion and usage statistics are reported in aggregate monthly quantities to the SWRCB, on an annual basis. Together, the rights to diverted surface waters can yield over 1,250 AFY (1.12 mgd) to the lake water system. Lake water is not treated

to meet domestic water quality standards. It is conveyed to campus via a separate system and used for the purposes of irrigation and backup fire protection. As mentioned in the preceding section, groundwater is also pumped into Felt Reservoir for diversion into the Lake Water distribution system.

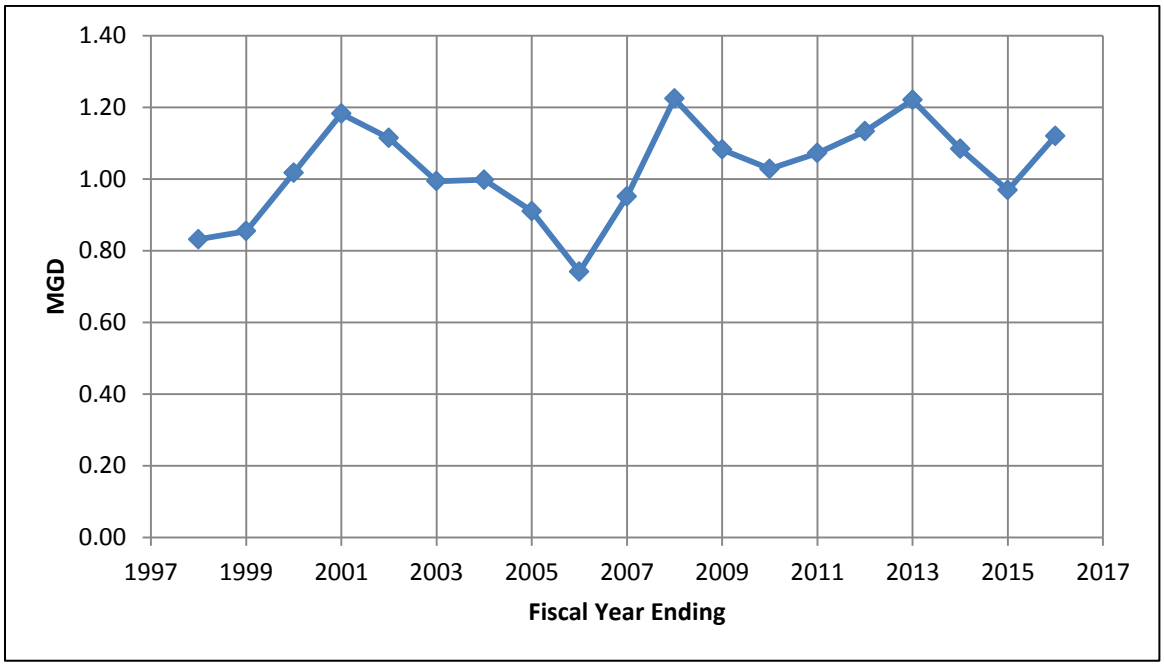
Table 4-3 shows the reported total annual diversions for Stanford's five permits for calendar years 2010 to 2015. Figure 4-2 shows the total Lake Water System use at Stanford for fiscal years 1997-98 to 2015-16, which includes both surface water and groundwater. During this period, total use ranged from a minimum of 0.74 mgd in 2005-06 to a maximum of 1.23 mgd in 2012-13. Average use in the Lake Water System is 1.03 mgd. Maximum monthly use typically occurs during the warm summer months of June through September, when irrigation demands are highest.

Table 4-3: Surface Water Diversions, 2010-2015 (AF)*

Year	2010	2011	2012	2013	2014	2015
Total Diverted	918.2	977.5	1004.9	407.0	127.4	85.0

**Total of all Stanford Water Rights*
Source: DWR eWRIMS online Water Rights Records Search database

Figure 4-2: Annual Lake Water System Use, 1998-2015



Source: Stanford staff

4.2 Future Water Supply

Stanford's overall water supply picture at 2018 General Use Permit buildout in 2035 will be similar to conditions at present. Stanford's potable water supply allocation from SFPUC will increase slightly from 2.91 to 3.03 mgd in 2018, when the ISL expires and the ISG is reinstated. Despite year-to-year variability in the availability of non-potable surface water sources, no long term changes in this supply are anticipated. Likewise, groundwater availability in 2035 should remain similar to today, as trends over the past several decades have shown stable/increasing groundwater levels in the Santa Clara Valley groundwater basin (*Bulletin 118*).

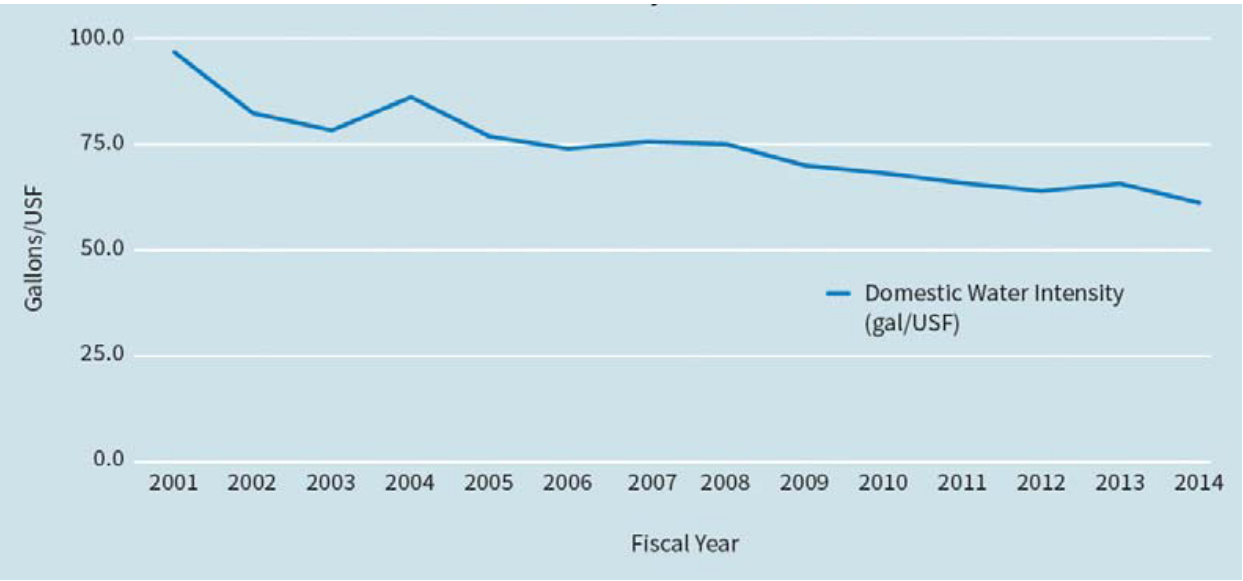
4.2.1 Conservation

Stanford has an active water conservation program. Following the early 1990s drought, Stanford employed aggressive measures to achieve conservation gains, including landscape and irrigation improvements and the replacement of 5-gallon toilets with low flow models. In its 2003 Water Conservation, Reuse and Recycling Master Plan, Stanford proposed fourteen additional conservation measures, evaluated the benefit and cost of each, and implemented them over the subsequent years. Today, over twenty such measures are in effect. Examples encompassing various categories include:

- **Plumbing**: Existing fixtures were replaced with lower water use models. For example: Ultra Low Flush toilets, low-flow showerheads, low- or no-flow urinals, high-efficiency washing machines, efficient pre-rinse nozzles in dining facilities, new steam sterilizers ("water misers") in Gilbert Biology Building.
- **Landscape:** Some existing landscaping has been replaced with water-efficient plants, and these types of plants are now used in new landscaping. Lake water is now used to irrigate the practice football field, select academic areas, and almost all newly landscaped areas. Additional weather-based irrigation controllers (WBICs) have been installed across campus, so that irrigation is applied only as necessary given current weather conditions.
- **Outreach**: Various outreach programs are now in place. Water audits have been conducted on over 50 faculty/staff housing units. A community website features monthly drought and water supply updates and an interactive map of water conservation projects on campus. A conservation video contest was held in 2014.

Following implementation of the Master Plan, potable water use at Stanford has decreased from nearly 2.5 mgd in 2004 to approximately 2.1 mgd in 2012-13, a decrease of 16% (Figure 3-1). By 2015 potable water use had decreased to 1.38 mgd as a result of additional drought conservation measures and Central Energy Plant replacement (SESI), a decrease of nearly 45% relative to 2004. Meanwhile, the population and developed area of the university have continued to grow, and water use intensity on campus (gallons per developed square foot) decreased by 37% between 2001 and 2012-13 (see Figure 4-3 below).

Figure 4-3: Stanford's SFPUC Domestic Water Use Intensity Trends Since 2001



USF = usable square foot
(Source: Sustainability at Stanford, Annual Report to Santa Clara County, Nov. 2014)

Section 5 - Supply Sufficiency Analysis

5.1 Comparison of Project Demands to Projected Supply

Projected water supply and demand is presented in Table 5-1, below. Based on current usage statistics and conservation achievements, Stanford's current domestic water supply of 2.91 mgd from the SFPUC is sufficient to meet current potable water demands of 2.10 mgd (non-drought conditions), as well as projected year 2035 demands of 2.44 mgd. Likewise, the current non-potable supply of 2.64 mgd from local surface (1.12 mgd) and groundwater (1.52 mgd) sources (see Sections 4.1.2 and 4.1.3 above) is sufficient to meet non-potable demands both now (1.23 mgd) and in the future (1.35 mgd). Total current supplies can adequately sustain the growth proposed in the 2018 General Use Permit through buildout in year 2035.

Buildout of the 2018 General Use Permit is projected to occur in the year 2035. After that date, water use under the 2018 General Use Permit is anticipated to remain constant (i.e., consistent with the 2035 demand projection). Therefore, this water supply assessment concludes that there is adequate existing water supply available over the 20-year projection period.

Table 5-1: Summary of Projected Demands and Projected Supply (mgd)

Water use category		FY2012-13 Actual	FY2015-16 Actual	2020 Projected	2025 Projected	2030 Projected	2035 Projected (2018 GUP buildout)
DEMAND	Potable	2.10	1.39	2.00	2.15	2.30	2.44
	Non-Potable	1.23	0.81	1.27	1.29	1.32	1.35
	TOTAL	**3.33**	**2.20**	**3.27**	**3.44**	**3.62**	**3.80**
SUPPLY	Potable	2.91	2.91	3.03	3.03	3.03	3.03
	Groundwater	1.52	1.52	1.52	1.52	1.52	1.52
	Surface Water	1.12	1.12	1.12	1.12	1.12	1.12
	TOTAL	**5.55**	**5.55**	**5.67**	**5.67**	**5.67**	**5.67**

5.2 Comparison of Project Demands to Projected Supply in Dry Years

Potable water supplied to Stanford by the SFPUC is deemed highly reliable. Storage and redundancy built into the SFPUC system ensure that even during periods of drought, the utility can provide its wholesale customers with at least 80% of their individual supply guarantees.

In single-dry-year scenarios, both at present and at projected 2018 General Use Permit buildout, Stanford's SFPUC allocation remains sufficient to meet all potable demands. Despite the fact that natural plant irrigation demands are higher in dry years, non-potable supply in a single-dry-year scenario remains adequate even without conservation cutbacks (see Table 3-1 in previous section).

In multiple-dry-year scenarios, Stanford would implement demand reduction measures to ensure that Stanford's potable and non-potable water use do not exceed the available supply. As explained above, in multiple dry year scenarios, potable demand would be reduced by 15% in the second year and 25% in the third year, reflecting conservation measures that would be implemented to reduce consumption. These reductions would ensure that Stanford will not exceed a curtailed SFPUC allocation. Such a reduction was successfully implemented during the most recent drought, and similar water savings could likely be achieved in future droughts as well.

Although groundwater supplies are adequate to meet non-potable demand during multi-year drought periods, irrigation demand reduction measures would nonetheless be implemented, similarly reducing non-potable water use by 20% in the second and third years of a multiyear drought.

5.3 Plans for Acquiring Additional Water Supplies

Under the provisions of Section 10911 of the California Water Code, if the water supplier concludes that water supplies will be insufficient for the proposed project, the water supplier shall provide its plans for acquiring additional water supplies. Based on current usage statistics and conservation achievements, Stanford's current domestic water supply is determined to be sufficient to sustain growth proposed in the 2018 General Use Permit to buildout in 2035. Stanford has no plans for acquiring additional water supplies at present.

Section 6 - Conclusion

6.1 Sufficiency of Water Supply for the Project

The analysis in this WSA demonstrates that there will be sufficient water supplies to serve buildout under the 2018 General Use Permit during normal, single dry, and multiple dry years.

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