ATTACHMENT 2

BRSP WATER CONSERVATION PLAN

Technical Memorandum

HydroScience
Strategic Water Solutions

Sacramento • Berkeley • San Jose

To: John Tallman, LV Bickford Ranch LLC

From: Kyle Horn

Reviewed by: Curtis Lam

Subject: Bickford Ranch Water Conservation Plan

Date: October 2, 2015

Introduction

HydroScience Engineers was retained by LV Bickford Ranch LLC (Owner), to prepare a Water Conservation Plan (WCP) for the Bickford Ranch. The Owner will incorporate these water conservation measures into the Bickford Ranch design to reduce the overall water demand for Bickford Ranch.

This technical memorandum identifies potentially feasible efforts and planning approaches to reduce water usage in Bickford Ranch. The potential reduction for demand several of these methods are presented in this memorandum. Specifically, this TM:

- Develops a baseline water use inventory for the project
- Identifies and describe methods for reducing water consumption
- Estimates the reduction in water demand using the recommended measures
- Analyzes additional demand reductions using New Construction Demand factors and BMP's

Baseline Water Use

The baseline water use for the project was established based on the Bickford Ranch Water Master Plan dated June 16, 2014, and updated per Owner comments provided September 20, 2015.

Table 1: Bickford Ranch Water Demands

Land Use Designation	Abbreviation	Total Area (acres)	Dwelling Units	Annual Demand (AFY)
Residential				
Rural Residential	RR	-	27	21
Low Density Residential	LDR	-	1798	862
Medium Density Residential	MDR	-	65	25
Non-Residential				
Public and Private Parks	PR	32.4	-	91
School	P/QP	15.0	-	42
Tank Site	P/QP	3.0	-	8
Fire Station	P/QP	1.4	-	4
Open Space Parkways	OS	77.5	-	37
Recreation Centers	LC	17.2	-	48
Roads	ROW	53.5		9
Landscape Areas	LA	17.1		48
Totals		**-**	**1,890**	**1,195**

Notes:
1. Based on values from the Bickford Ranch Specific Plan (August 2015)

For single-family residential areas, the annual water demands shown in **Table 1** were subdivided based upon an approximated residential water usage distribution for Bickford Ranch as presented in **Table 2.** These estimated values were provided by the City of Roseville and were utilized to estimate the impact various conservation measures would have on the Project's water demand. Water use specific to PCWA was not immediately available. Thus, HydroScience utilized water use data for one of the PCWA retailers. As shown in **Table 2**, landscaping was the most significant form of water use in a single-family, residential dwelling with approximately 51% of overall demand being dedicated to watering landscaped areas. Further analysis will describe methods to reduce this consumptive pattern and provide feasible methods to decrease the demand of landscaped areas.

Table 2: Typical Residential Water Usage

Use	Percent of Total Use[1]
Landscaping	51%
Toilets	13%
Faucets, cooking, cleaning	10%
Shower	9%
Clothes washer	8%
Bath	6%
Toilet leaks	2%
Dishwasher	1%

Notes:
1. Typical water usage based on information in the City of Roseville FAQs regarding water conservation - http://www.roseville.ca.us/faqs/categoryqna.asp?id=7#790

Water demands for the front and back yards of RR, LDR, and MDR parcels were separated to allow different water conservation measures to be applied in each yard. Water conservation measures that are feasible to implement in front yards may be more difficult to implement in back yards, which led to the segregation of these demands. RR, LDR, and MDR properties typically have a driveway in the front of the house, resulting in a slightly larger area in the back yard requiring irrigation. This resulted in an estimate of 60% of the total landscape demand applied to the back yard and 40% for the front yard. Rural residential estate lots incorporate much larger areas of land resulting in larger water demand requirements; however, it was assumed that landscaping percentages within the front and back yards of rural residential estate lots would remain consistent with LDR and MDR design.

The base front yard demand is 40% of the total landscape demand of 51% **(Table 2)**, or 20.4% of total residential water usage. The base backyard demand is 60% of the total landscape demand of 51% **(Table 2),** or 30.6% of total residential water usage. The estimated baseline water use is shown in **Table 3.**

Table 3: Residential Base Water Use

Land Use Designation	Annual Demand (AFY)	Annual Front Yard Demand (AFY)	Annual Back Yard Demand (AFY)	Total Annual Irrigation Demand (AFY)
Rural Residential	21	4	6	10
Low Density Residential	862	176	264	440
Medium Density Residential	25	5	8	13
Total	**908**	**185**	**278**	**463**

Methods for Reducing Water Consumption

The potentially feasible methods identified in this report can be used either in combination or independently to reduce water consumption among the Bickford Ranch land use types. Each method of water conservation considered is discussed below.

Limiting the amount of turf in front yards and replacing turf with low water use plantings: One of the simplest and most effective ways to conserve water is to limit the area of turf being irrigated or exchanging higher water use plant materials such as turf for lower water using plant materials. Planting varieties are available that dramatically reduce water demand when used to replace turf while maintaining viewshed quality. The actual demand for these plantings will depend on the individual species planted.

Residential: It was assumed that replacing turf with low water use plantings could be accomplished on all types of residential property, including rural, low, and medium density residential parcels. In order to assess the potential impact of this change on residential parcels, the following assumptions were made:

- When accounting for driveways and hardscape areas, the landscaped area in the front yard for rural, low, and medium density residential units represents 75% of the front yard area. Of this landscaped area, it was initially assumed that 70% of the front yard area was turf and 5% was low water use plantings. The turf area would be reduced to 42% of the front yard.
- Planting the remaining 28% of the front yard landscaped area with low water using materials results in:
  - 25% hardscape (driveway, paths)
  - 42% turf
  - 33% low water use plantings
- Low water use plantings can use 30% of the water used on turf (a 70% water savings). This estimate is based on data collected by the Fair Oaks Horticultural Center that low water use plantings use between 65-75% less water than an average turf lawn (Garden Notes, June 2008).
- Low water use plantings use low volume systems like a drip or micro spray system designed to achieve uniformity of 90% rather than an overhead spray irrigation system. This also assumes that landscaping is irrigated properly (no over- or under-watering).

Table 4 presents the base and new residential landscaped areas.

Table 4: Reduced Landscape Turf Areas

Land Use Designation	Front Yard Irrigated Area[1]	Base Condition		Base Condition with Water Conservation	
		Turf Area	Low Water Use Area	Turf Area	Low Water Use Area[2]
Rural Residential	75%	70%	5%	42%	33%
Low Density Residential	75%	70%	5%	42%	33%
Medium Density Residential	75%	70%	5%	42%	33%

Notes:
1. As a percentage of the front yard
2. Includes 5% existing low water use plantings + 28% new water use plantings.
3. Represents the percentage of the entire exterior area for HDRs.

Table 5 presents the results of the residential water savings for replacing landscape turf.

Table 5: Reduced Landscape Turf Water Savings – Residential

Land Use Designation	Annual Front Yard Demand[1] (AFY)	Annual Front Yard Turf Demand (AFY)	Reduced Turf Annual Front Yard Demand (AFY)	Water Savings (AFY)
Rural Residential	4	4	3	**1**
Low Density Residential	176	172	131	**45**
Medium Density Residential	5	5	4	**1**
Total	**185**	**181**	**138**	**47**

Notes:
1. From Table 3.
2. Value rounded to nearest whole number.

As an example of how these values were calculated, the calculation for the annual front yard turf demand and the reduced annual front yard demand are presented below.

For the annual front yard turf demand, as calculated for low-density residential land-uses, 75% of the front yard area is landscaped; 70% turf and 5% low water use plantings. Since low water use plantings use 30% of the water required for turf, this 5% area is equal to 1.5% turf area. This resulted in the following annual front yard demands.

Turf: $176AFY * \left(\frac{70\%}{71.5\%}\right) = 172AFY$ Low Water Use: $176AFY * \left(\frac{1.5\%}{71.5\%}\right) = 4AFY$

For the reduced annual front yard demand, as calculated for low-density residential land uses, reducing the base turf area in the front yards from 70% to 42% and replacing that area (28%) with low water use plantings resulted in the following annual demands.

$$176AFY * \left(\frac{42\%}{70\%} + \frac{28\% * 30\%}{70\%}\right) + 4AFY = 131AFY$$

Non-Residential: Turf reduction on non-residential parcels within Bickford Ranch was assumed to be employed in the parks, open space parkways, landscape areas, school, recreation centers, tank site, fire station and roadways. The assumptions used to estimate water conservation in these areas are as follows:

- The parks were assumed to use 98% of all water for landscape irrigation.
- The parks were estimated to irrigate approximately 80% of their parcel area. It was assumed the 80% turf would be reduced to 60%, with the remaining 20% turf being converted to low water use plantings.
- Low water usage plantings were assumed to use 30% of the water used on turf (a 70% water savings).
- Low volume irrigation systems like a drip or micro spray system design will be used for low water use areas to achieve uniformity of 90% rather than an overhead spray irrigation system.
- The school and recreation centers were assumed to use 70% of their water demand for landscape irrigation.
- The school and recreation centers were assumed to irrigate approximately 70% and 60% of their parcels respective turf area. The schools overall turf area was reduced to 40% turf and 30% low water use plantings while the recreation centers overall turf area was reduced to 40% and 20% respectively.
- Open space parkways and landscape areas were assumed to use 95% of their water demand for landscape irrigation
- Open space parkways and landscape areas were assumed to irrigate 80% of their parcels respective turf area. The open space parkways overall turf area was reduced to 20% with 60% being converted to low water use plantings.
- Roadway demand was limited to 5% of the theoretical base demand after water conservation. To achieve this, it was assumed that the irrigated area for turfgrass would be limited to 5% of the overall landscaped area, and that the remaining area would be irrigated with lower water use plantings.

Table 6 presents the results of the water savings for replacing landscape turf for non-residential parcels.

Table 6: Reduced Landscape Turf Water Savings – Non-Residential

Land Use Designation	Annual Irrigation Demand[2] (AFY)	Base Turf Area[1]	New Turf Area[1]	Low Water Use Area[1]	Reduced Irrigation Demand (AFY)	Water Savings (AFY)
Parks	89	80%	60%	20%	73	**16**
School	29	70%	40%	30%	20	**9**
Tank Site	1	15%	5%	10%	1	**0**
Fire Station	1	15%	5%	10%	1	**0**
Recreation Centers	34	60%	40%	20%	26	**8**
Open Space Parkways	35	80%	20%	60%	17	**18**
Roads	7	60%	5%	55%	3	4
Landscape Areas	47	80%	20%	60%	22	25
Total	**243**				**163**	**80**

Notes:
1. As a percentage of the parcel area.
2. This incorporates the reduction in water demand to account for only the fraction used for irrigation of parks described above.

Smart Irrigation Controller: A smart irrigation controller restricts irrigation to only the times and water application rates that are really needed. Demand for water varies greatly with weather patterns and time of year. Standard irrigation schedules do not account for actual weather conditions during the day, week, or month that could vary significantly from normal weather patterns. This deviation can result in significant water waste. A smart irrigation controller can account for these variations by using information for both weather and soil moisture conditions.

Fourteen studies estimating the percentage of water conservation associated with the use of smart irrigation controllers were summarized in a paper published by the US Bureau of Reclamation (USBR, April 2008). These studies estimated the range of water savings associated with their use to be between 7 to 41%.

It was noted that the references estimated water savings when going from one type of controller to the smart irrigation controller. However, not all houses have controllers for both the front and back yards. Some existing houses use impact heads connected to a hose to irrigate their front or back yards. This irrigation method is less efficient and results in higher water waste. Additionally, the developer will educate the homeowner on how to use the smart irrigation controller. Considering these issues, the percent of water savings for this measure using smart irrigation controllers was estimated to be 20%.

The additional savings expected with the use of a smart irrigation controller are presented in **Table 7**. All of the land using turf reduction measures would also employ smart irrigation controllers. These calculations assume that the area of turf is reduced as described above.

Table 7: Smart Irrigation Controller Water Savings

Land Use Designation	Original Demand (AFY)[1]	Reduced Demand (AFY)	Water Savings (AFY)
Rural Residential			
Front Yard	3	2	**1**
Back Yard	6	5	**1**
Low Density Residential			
Front Yard	131	105	**26**
Back Yard	264	211	**53**
Medium Density Residential			
Front Yard	4	3	**1**
Back Yard	8	6	**2**
Parks	73	58	**15**
School	20	16	**4**
Tank Site	1	1	**0**
Fire Station	1	1	**0**
Recreation Centers	26	21	**5**
Open Space Parkways	17	14	**3**
Roads	3	2	1
Landscape Areas	22	18	4
Total	**579**	**463**	**116**

Notes:
1. Original demand includes the turf reduction water conservation measures that were previously described.

Model Water Efficient Landscape Ordinance: This ordinance was recently adopted by the California Water Commission, and will become effective on December 1, 2015 for all landscape projects adding a landscape area of 500 square feet or more, or all modifications to landscaping equal to or greater than 2,500 square feet requiring a building or landscape permit, plan check, or design review. For the purpose of Bickford Ranch, it is expected that this Ordinance is universally applicable. Components of this ordinance include turf reduction and the use of smart irrigation controllers, both of which have already been accounted for in the water conservation calculations listed above.

The key outcome with regards to quantifying water conservation for new landscapes is that the estimated total water use of the new landscape must be below the Maximum Applied Water Allowance for the property. The evapotranspiration (ET) adjustment factor was set to be a maximum of 0.55 for residential areas, and 0.45 for non-residential areas. It was assumed in previous water conservation plans that the landscaped areas had an ET adjustment factor that averaged 1.0. Thus, compliance with the Modified WELO has the effect of reducing the net allowed water available for irrigation of residential areas by 45%, and 55% for non-residential areas. This reduction in exterior irrigation demands is inclusive of previously accounted for water

reductions. To calculate the additional water conservation per the Modified WELO, the following formula was utilized.

Total additional water conservation per Modified WELO = (Water Reductions per Modified WELO – Already accounted for reductions)

The net effect of this requirement is detailed in **Tables 8 and 9** for each type of land use.

Table 8: Additional Residential Water Conservation per Modified WELO

Land Use Designation	Total Annual Irrigation Demand (AFY)	Water reductions per WELO (AFY)	Already accounted for reductions (AFY)[1]	Additional Water Conservation per Modified WELO (AFY)
Rural Residential	10	5	3	**2**
Low Density Residential	440	198	124	**74**
Medium Density Residential	13	6	4	**2**
Total	**463**	**209**	**131**	**78**

Notes:
1. Calculated as the sum of the turf reduction water savings and the smart controller water savings.

Table 9: Additional Non-Residential Water Conservation per Modified WELO

Land Use Designation	Total Annual Irrigation Demand (AFY)	Water reductions per WELO (AFY)	Already accounted for reductions (AFY) [1]	Additional Water conservation per Modified WELO (AFY)
Parks	89	49	31	18
School	29	16	13	3
Tank Site	1	1	0	1
Fire Station	1	1	0	1
Recreation Centers	34	19	13	6
Open Space Parkways	35	19	21	0[2]
Roads	7	4	5	0[2]
Landscape Areas	47	26	29	0[2]
Total	**243**	**135**	**112**	**29**

Notes:
1. Calculated as the sum of the turf reduction water savings and the smart controller water savings.
2. Already accounted for savings were more effective water conservation measures than the Modified WELO

Recirculating hot water: Recirculating hot water systems use a pump to keep the water in the hot water lines circulating back to the water heater to keep the water in the hot water lines hot. This provides hot water at the tap immediately and prevents having to let cold water flow until the water heats up. These systems can be operated in a number of different ways but all conserve water in the same manner. For this study, it was estimated that each draw for hot water would waste approximately 1.25 gallons per day per dwelling unit. This is equivalent to

drawing water through 50 ft of ¾-inch pipe with each draw, and drawing hot water in this manner six times per day per dwelling unit. The expected savings are presented in **Table 10**.

Table 10: Re-circulating Hot Water Savings

Land Use Designation	Dwelling Units (DU)	Water Savings (AFY)
Rural Residential	27	**0**
Low Density Residential	1,798	**15**
Medium Density Residential	65	**1**
Total	**1,890**	**16**

As an example of how these values were calculated, for the low-density residential land use, the total number of dwelling units is 1,798. The reduced water demand would be estimated to be:

$$1798DU * 7.5\frac{gal}{dayDU} * \frac{AF}{325{,}851gal} * 365day/yr = 15AFY$$

Summary

The water conservation measures identified for Bickford Ranch are similar to the water conservation measures recently included in other local Water Conservation Plans. These measures were selected based on their ability to cost-effectively achieve the necessary water savings.

The total estimated volumes of water conserved for each of these water conservation measures for Bickford Ranch land use plan are summarized in **Table 12**.

Table 12: Bickford Ranch Water Conservation Estimates

Method	Original Total Water Demand (AFY)	Potable Water Savings (AFY)	Total Percentage of Water Savings [1]
Reduced landscape turf – residential	1,195	47	**3.9%**
Reduced landscape turf – parks, right of way		80	**6.7%**
Smart irrigation controllers – all types of land uses		116	**9.7%**
Re-circulating hot water – residential		16	**1.3%**
Total Additional Savings by WELO		105	**8.8%**
Total		**364**	**30.4%**

Notes:
1. Percentages rounded to the nearest tenth of a percent, and represent overall water conservation percentages for both potable and recycled water.

If the described water conservation measures described in this memorandum were taken for Bickford Ranch, it is estimated that the Bickford Ranch potable water demand would be reduced by 364 AFY yielding an adjusted water demand of 831 AFY. This represents a 30.4% reduction from the original water demand for Bickford Ranch of 1,195 AFY.

Though the actual water conservation realized will depend, in part, on the participation of the homeowners or tenants of the affected parcels, it is expected that these measures could be implemented and maintained in the end by employing the following measures:

- Constructing the parcels with these water conservation measures in place. By simply having an available smart irrigation controller with the capacity to run the front and back yard systems pre-wired and in place, using this controller is a financially sound decision for the land owner versus replacing the controller with a different one.
- Landscape areas for non-residential land uses will be maintained by the County, the school district, or the Bickford Ranch homeowners association. It is expected that these professionals will be able to maintain these water savings through the professional management of these landscapes and required adherence to the water budget.
- For single-family residences, it is expected that a two-fold measure will be required to realize long-term water savings.
    1. Restrictions in the codes, covenants and restrictions for each parcel that would limit the types and/or locations of landscape in the front yards of each residence.
    2. Ongoing outreach by PCWA to remind and reinforce the need for water conservation. This can include attachments to the water bill, water audits that can be made available to landowners by PCWA, the promotion of the water conservation on the PCWA website, and the availability of water conservation staff to respond to specific questions.
    3. Educating homeowners on how to incorporate their backyard irrigation system into the controller and provide education materials.

References

1. University of California Cooperative Extension, Sacramento County Agriculture and Natural Resources, Garden Notes, June 2008.
2. US Bureau of Reclamation, Summary of Smart Controller Water Savings Studies, April 2008.
3. Tully and Young, *PCWA 2010 Urban Water Management Plan*, June 16, 2010.