APPENDIX E2

Fiddyment Ranch SPA No. 3, Water Conservation Plan

TECHNICAL MEMORANDUM

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

To: Environmental Utilities Dept & Planning and Redevelopment Dept., City of Roseville

Cc: Steve Hicks, Signature Properties

From: Mike Motroni, PE, LEED AP

Date: 27 August 2010

Subject: Fiddyment Ranch SPA No. 3, Water Conservation Plan

Introduction

The City of Roseville (City) is requesting that the Fiddyment Ranch SPA #3 project applicant prepare a water conservation plan documenting methods for the achievement of water demand reduction. This technical memorandum (TM) seeks to identify baseline water usage, water conservation methods, and estimates water demand reductions. The Sierra Vista Specific Plan (SVSP) Water Conservation Plan, dated July 6, 2009 was reviewed as part of this TM. The same methods used in the SVSP Water Conservation Plan have been analyzed in this TM.

Baseline Water Usage

Wood Rodgers is concurrently preparing the Domestic Water Study, Fiddyment Ranch SPA No. 3 (Water Study) dated August 6, 2010. The water demands estimated for the project include both potable and recycled water demands. Total water demands used in the Water Study are calculated based upon the City unit water demand factors for various land use types and are presented in **Table 1: Land Use Water Demands**.

Table 1: Land Use Water Demands

GENERAL PLAN LAND USE	UNIT DEMAND FACTOR	ACRES (acres)	DWELLING UNITS	DEMAND[1] (ac-ft/year)
LDR (Residential)	600 to 430 gpd/DU	469.0	2,145	1,389
MDR (Residential)	323 gpd/DU	55.8	609	220
HDR (Residential)	177 gpd/DU	79.1	1,976	392
CC (Commercial)	2,598 gpd/acre	40.9	-	119
LDR (Pocket Park)	2,988 gpd/acre	6.1	-	21
OS (Open Space)	-	240.0	-	0
OS (Paseo)	2,988 gpd/acre	6.7	-	22
PQP (Elementary School)	3,454 gpd/acre	10.6	-	41
PR (Park)	2,988 gpd/acre	18.2	-	61
PR (Sports Complex)	2,988 gpd/acre	29.8	-	100
TOTAL		**956.2**	**4,730**	**2,365**
2% System Losses				**47**
Total with 2% System Losses				**2,412**

Source: Fiddyment Ranch SPA No. 3, Domestic Water Study by Wood Rodgers dated August 6, 2010

[1] Demands reflect only those parcels within the SPA 3 land use plan where water conservation measures will be applied. Not all Fiddyment Ranch demands within the West Roseville Specific Plan are included.

Table 2: Typical Residential Water Use outlines the typical residential water use for the City. It is important to note that residential landscape irrigation is responsible for the single most demand of household water usage at 51% of total residential water usage. Toilet use qualifies for the second most use of household water demand with 13% of the total residential water usage.

Table 2: Typical Residential Water Use

TYPICAL WATER USAGE	PERCENTAGE OF TOTAL USE
Landscape Irrigation	51%
Toilets	13%
Faucets, Cooking, Cleaning	10%
Shower	9%
Clothes Washer	8%
Bath	6%
Toilet Leaks	2%
Dishwasher	1%

Source: City of Roseville FAQ's regarding water conservation
http://www.roseville.ca.us/faqs/categoryqna.asp?id=7

Consistent with the SVSP Water Conservation Plan, it is assumed the backyard consists of 60% of landscape irrigation demand and the front yard consists of 40% of landscape irrigation demand. Therefore approximately 20.4% and 30.6% of total residential water is used in front yard and backyard irrigation, respectively. **Table 3: Residential Baseline Landscape Irrigation Use** shows the annual irrigation demand by land use and front yard verses backyard. High density residential is assumed to consist of multi-family dwellings where irrigation and landscaping is controlled by a property association or property manager. This analysis assumes property associations or apartment owners will be required to comply with project turf reduction requirements.

Table 3: Residential Baseline Landscape Irrigation Use

GENERAL PLAN LAND USE	ANNUAL WATER DEMAND (ac-ft/year)	LANDSCAPE IRRIGATION DEMAND (ac-ft/year)	FRONT YARD DEMAND (ac-ft/year)	BACKYARD DEMAND (ac-ft/year)	WATER SYSTEM SAVINGS
LDR Low Density Residential	1,389	708	283	425	Potable Water
MDR Medium Density Residential	220	112	45	67	Potable Water
HDR High Density Residential	392	200	No Distinction between front and back yards		Recycled Water
Total	**2,001**	**1020**			

Water Conservation Methods

Various methods were analyzed to determine a quantifiable savings in water demand. These methods include limitations on turf areas, using smart weather irrigation controllers, using recirculation hot water systems and using low flow toilets.

Landscape Turf Reduction

The most effective and cost efficient way to reduce water demand is by limiting the use of turf and replacing turf with low water use plants. According to the Fair Oaks Horticulture Center, water efficient plants use approximately 65%-75% less irrigation water then turf. This TM assumes that low water use plants use 70% less water then turf. The reduced irrigation demand is primarily accounted for by the use of drip irrigation or other low water spray heads that contribute to the irrigation of a single shrub or multiple smaller plants. These types of irrigation systems eliminate overspray typical of traditional spray heads. It is also important that the shrub and plant selection are low water users.

Baseline turf area was determined for each type of land use. The area of turf was then reduced and replaced with low water use plants. It is estimated that 30% of the total front yard area is non-irrigated hardscape and 70% is irrigated landscape. For example, front yard residential turf as a function of total front yard irrigated landscaped area (excluding hardscape) is assumed to be 70% for the baseline case. Restricting turf area to 40% of total front yard irrigated landscaping and replacing the remaining 30% area with low water use plants results in significant water savings. See **Attachment 1** for a detailed example of front yard turf and planting areas.

To estimate water savings as a result of turf reductions, a turf reduction factor is established to represent the water demand based on the relationship between the area of original turf and the turf limitation to be implemented in the project area with additional low water use plants. The turf reduction factor is represented in **Attachment 2**.

For residential front yards the developer and builder are responsible for landscaping whereas individual home owners are responsible for backyard landscaping. Therefore, it is assumed that only the developer and builder can directly influence water demand within the front yards and not in the residential backyards. Backyards were not analyzed for turf reduction as the landscape material decision and design is the responsibility of the individual home owner and not the developer or builder.

Front yard residential turf reduction is only one component of overall turf irrigation. Similarly, turf at parks and paseos also contribute to significant irrigation demand. Consistent with the SVSP Water Conservation Plan, the analysis conducted in this TM reduces park turf from 80% of the park parcel to 60%. Additionally, paseos see a reduction in turf area to 30% of total landscape area. In each scenario low water use plants replace the area of reduced turf. Each turf reduction scenario is indicated in **Table 4: Landscape Turf Reduction** and **Table 5: Landscape Water Savings**.

Table 4: Landscape Turf Reduction

GENERAL PLAN LAND USE	ANNUAL IRRIGATION DEMAND (ac-ft/year)	% OF TOTAL FRONT YARD AREA[2]		% OF TOTAL IRRIGATED AREA	
		BASE TURF AREA	NEW TURF AREA	BASE TURF AREA	NEW TURF AREA
LDR	283[3]	49%	28%	70%	40%
MDR	45[3]	49%	28%	70%	40%
HDR	200	-	-	70%	40%
Parks	178[4]	-	-	80%	60%
Paseos	22	-	-	80%	30%
Total	**728**				

Table 5: Landscape Water Savings

GENERAL PLAN LAND USE	REDUCTION FACTOR	REDUCED DEMAND (ac-ft/year)	WATER SAVINGS (ac-ft/year)	WATER SYSTEM SAVINGS
LDR	0.734	208	75.0	Potable Water
MDR	0.734	33	12.0	Potable Water
HDR	0.734	147	53.0	Recycled Water
Parks	0.837	149	29.0	Recycled Water
Paseos	0.593	13	9.0	Recycled Water
Total		**550**	**178**	

By limiting turf in front yards, high density residential land uses, parks, and paseos, total irrigation demand can be reduced by 24% when excluding backyard irrigation. The net irrigation water savings by turf reduction is 178 acre-feet per year.

Smart Weather Irrigation Controller

Typical irrigation controllers used in most landscape irrigation installations are timer based where run times are determined by the owner, tenant, professional landscape service, or property manager. Many users irrigate without the background knowledge or science behind irrigation principals. As a result many landscape areas are over watered. Smart irrigation controllers use algorithms to analyze soil conditions and weather to determine proper irrigation run times.

The US Bureau of Reclamation issued the technical memorandum, Summary of Smart Controller "Water Savings Studies" (USBR memorandum), dated April 2008. The USBR memorandum summarizes fourteen weather based controllers, nine soil moisture based controllers, and two weather and soil moisture based controllers. As part of this TM, the use of weather based smart irrigation controllers are used to reduce irrigation demand. For weather based controllers the studies in the USBR memorandum have associated water savings of between 7% and 41%.

[2] Assumes front yard hardscape is 30% of total font yard.
[3] Indicates front yard irrigation demand only.
[4] Assumes 98% of total park water demand is used for irrigation.

Consistent with the SVSP Water Conservation Plan this TM assigns a 20% water savings with the use of weather based smart irrigation controllers. Initial installation of smart irrigation controllers in all buildings and residences would be necessary to realize savings. Participation by all property owners results in 20% less irrigation demand as shown in **Table 6: Smart Irrigation Controller Water Savings**.

The weather based smart irrigation controllers still require users to program their controller to their own satisfaction without the extensive knowledge of extensive landscape irrigation concepts. The use of combination weather based and soil moisture based controllers will likely yield additional water savings. Water savings analysis for these types of controllers is fairly limited and requires additional initial investment.

It is important for builders to install smart water controllers that are capable of expansion and provide wiring for easy installation and connection to backyard landscape irrigation system. Without this convenience, home owners may purchase and install more convenient water irrigation controllers that are less expensive and forgo water conservation features.

Table 6: Smart Irrigation Controller Water Savings

GENERAL PLAN LAND USE	TYPICAL IRRIGATION DEMAND[5] (ac-ft/year)	REDUCED DEMAND (ac-ft/year)	WATER SAVINGS (ac-ft/year)	WATER SYSTEM SAVINGS
LDR (Front Yard)	208	166	42	Potable Water
LDR (Backyard)	425	340	85	Potable Water
MDR (Front Yard)	33	26	7	Potable Water
MDR (Backyard)	67	54	13	Potable Water
HDR	147	118	29	Recycled Water
Parks	149	119	30	Recycled Water
Paseos	13	10	3	Recycled Water
Total	**1042**	**833**	**209**	

Hot Water Recirculation Pump

Recirculating hot water pumps circulate hot water from the water heater through a loop in a home to near faucets and other hot water demand points. This allows for near instantaneous hot water without having to flow cold water through the pipes for hot water to arrive from the water heater. Fiddyment Ranch which is part of the West Roseville Specific Plan already requires residences to be installed with a recirculating hot water pump or similar water conservation device.

This TM assumes the average distance between the water heater and the hot water demand source is approximately 50 feet. The pipe is typically ¾" diameter. Therefore the average draw per hot water demand is 1.1 gallons of cold water before the hot water arrives at the demand point. Hot water recirculation pump water savings summarizes the total water savings by land use. This method assumes that each dwelling unit produces an average of six draws of hot water per day. The expected water savings are presented in **Table 7: Hot Water Recirculation Pump Water Savings**.

[5] Demand includes water conservation efforts achieved through turf reduction.

Equation 1: Annual Hot Water Draw

$$AnnualDraw = \frac{1.1\,{}^{gal}/_{draw} * 6\,{}^{draws}/_{day} * 365\,{}^{day}/_{year}}{325{,}851\,{}^{gal}/_{ac-feet}}$$

Table 7: Hot Water Recirculation Pump Water Savings

GENERAL PLAN LAND USE	DWELLING UNITS (DU)	WATER SAVINGS (ac-ft/year)	WATER SYSTEM SAVINGS
LDR	2,145	16	Potable Water
MDR	609	5	Potable Water
HDR	1,976	15	Potable Water
Total	**4,730**	**36**	

Low Flow Toilets

The 2007 California Plumbing Code requires water closets to consume not more then 1.6 gallons per flush. There is however a number of toilets available on the market that use less water per flush. Low flow toilets typically use 1.1 gallons per flush while ultra low flow toilets can use 0.8 gallons per flush. Low flow toilets use compressed air within the toilet bowl to effectively flush.

As shown in **Table 2: Typical Residential Water Use**, toilet use represents 13% of the typical residential water use. This TM analyzes use of toilets that use a maximum of 1.28 gallons per flush or are 20% more water efficient then conventional 1.6 gallon per flush toilets. The water savings based on the use of low flow toilets not exceeding 1.28 gallons per flush are summarized in **Table 8: Low Flow Toilet Water Savings**.

Table 8: Low Flow Toilet Water Savings

GENERAL PLAN LAND USE	ANNUAL TOILET DEMAND (ac-ft/year)	EFFICIENT TOILET DEMAND (ac-ft/year)	WATER SAVINGS (ac-ft/year)	WATER SAVINGS SYSTEM
LDR	181	145	36	Potable Water
MDR	29	23	6	Potable Water
HDR	51	41	10	Potable Water
Total	**261**	**209**	**52**	

Conclusions

The implementation of water conservation methods described with this TM will reduce water demands by 475 acre-feet per year. The various water conservation methods and their water savings as a percent of total water demand are summarized in

Table 9: Summary of Water Conservation Methods. These methods reduce the projected water demands for Fiddyment Ranch SPA No. 3 of 2,412 acre-feet per year[6] to 1,937 acre-feet per year equivalent to a 19.7 percent reduction in demands. When considering the full Fiddyment Ranch portion of the West Roseville Specific Plan,

[6] As shown in **Table 1: Land Use Water Demands**

water demands are reduced from 4,140 acre-feet per year to 3,665 acre-feet per year as further described and evaluated within the Domestic Water Study.

This TM is based on a number of assumption and case studies done by others. Ultimate water conservation will depend on a variety of known and unknown factors. Participation by owners, tenants, property managers, and property landscape maintenance professionals will be required for the water conservation plan to be viable. Long term education and outreach will be required long after the installation of front yard landscaping, installation of smart irrigation controllers, hot water recirculation pumps, and low flow toilets. Education and outreach could be incorporated into neighborhood codes, covenants, and restrictions as well as ongoing city outreach efforts through mailers and public water conservation efforts.

This TM did not quantify water savings for every type of land use. It is important to note that additional water savings reductions can take place on public facilities and schools resulting in increased water savings. Engagement of other land use stakeholders would be required for their participation in water conservation methods. Their participation would most likely be on a case-by-case basis and therefore difficult to asses and quantify.

Table 9: Summary of Water Conservation Methods

WATER CONSERVATION METHOD	POTABLE WATER SAVINGS (ac-ft/year)	RECYCLED WATER SAVINGS (ac-ft/year)	WATER SAVINGS (ac-ft/year)	REDUCTION IN WATER USE[7]
Reduced Turf Area Table 5: Landscape Water Savings	87	91	178	7.4%
Smart Irrigation Controllers Table 6: Smart Irrigation Controller Water Savings	147	62	209	8.7%
Hot Water Recirculation Pump Table 7: Hot Water Recirculation Pump Water Savings	36	---	36	1.5%
Low Flow Toilets Table 8: Low Flow Toilet Water Savings	52	---	52	2.2%
Total	**322**	**153**	**475**	**19.7%**

References

2007 California Plumbing Code, § 402.2, 1 January 2008.

FAQs, how much water do I use? City of Roseville, http://www.roseville.ca.us/faqs/categoryqna.asp?id=7

Fiddyment Phase SPA No. 3 Recycled Water Study, Preliminary, Wood Rodgers, Inc., 6 August 2010.

Fiddyment Ranch SPA No. 3 Water Study, Preliminary, Wood Rodgers Inc., 6 August 2010.

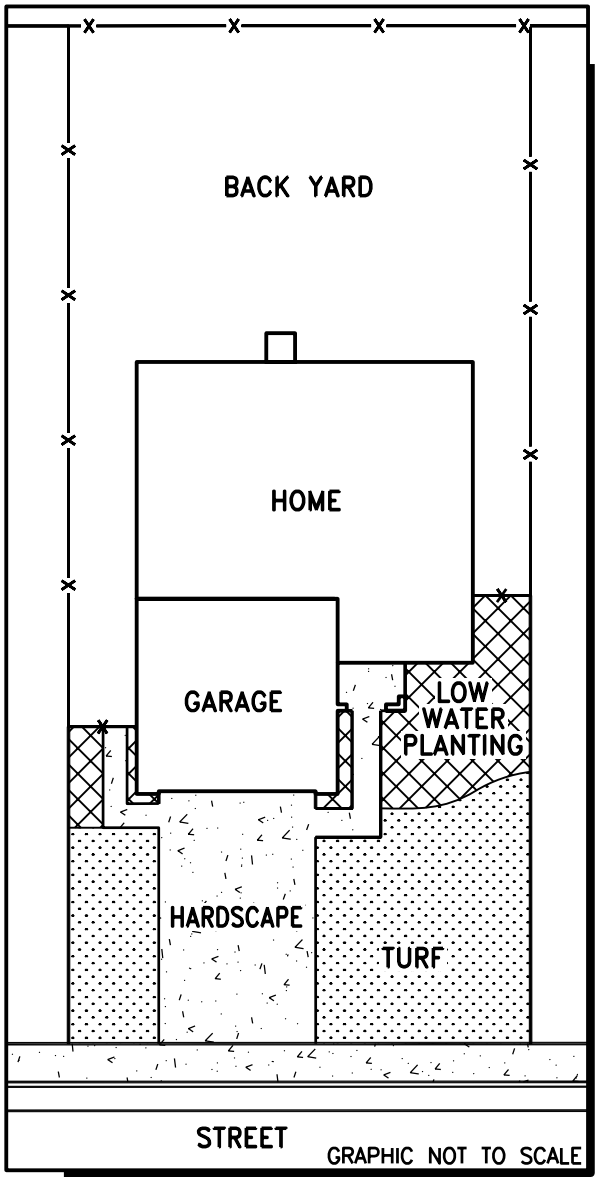
Garden Notes, Water Efficient Landscape Plant List, University of California & Sacramento County, Cooperative Extension (Fair Oaks Horticulture Center), June 2009.

Summary of Smart Controller Water Savings Studies, Final Technical Memorandum No. 86-68210-SCAO-01, U.S. Bureau of Reclamation, April 2008.

TM #1 – Sierra Vista Specific Plan Water Conservation Plan, HydroScience Engineers Inc., 6 July 2009.

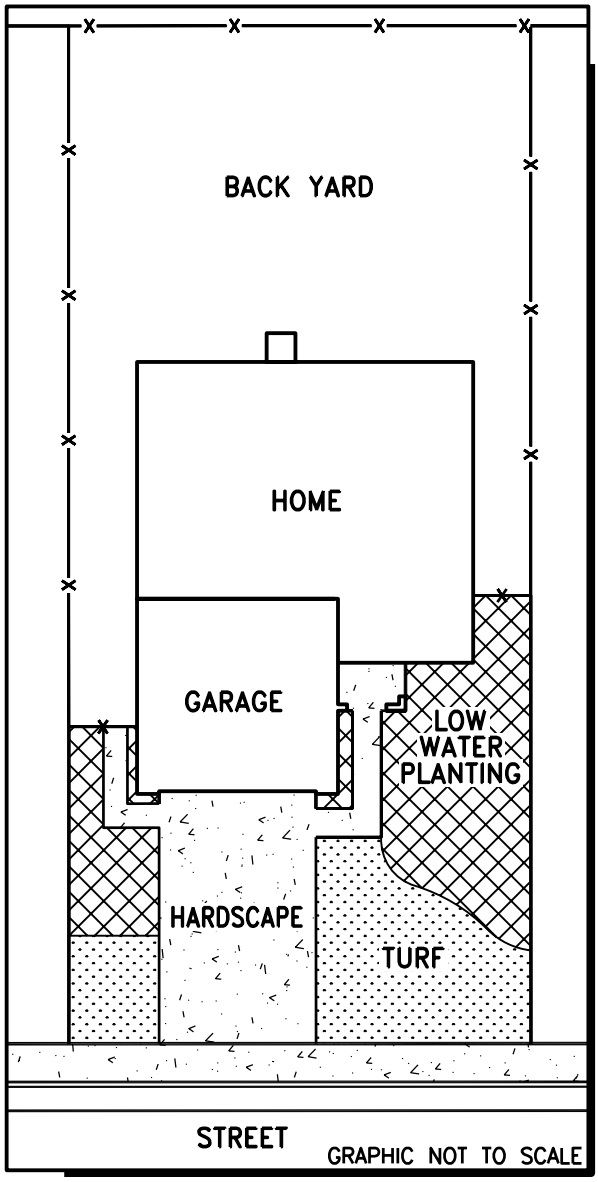
[7] As a percentage of Fiddyment Ranch SPA No. 3 demand of 2,412 acre-feet per year as shown in **Table 1: Land Use Water Demands**.

BASELINE SCENARIO (TYP AS-BUILT)



FRONT YARD AREA:	1,757 SF	
FRONT YARD HARDSCAPE AREA:	527 SF	
FRONT YARD IRRIGATED AREA:	1,230 SF	
TURF AREA:	861 SF	
LOW WATER PLANTING AREA:	369 SF	
TURF AREA / IRR. AREA:	70%	100%
LOW WTR PLANTING / IRR. AREA:	30%	
HARDSCAPE AREA / TOTAL FRONT YARD AREA:	30%	
TURF AREA / TOTAL FRONT YARD AREA:	49%	100%
LOW WTR PLANTING / TOTAL FRONT YARD AREA:	21%	

PROPOSED SCENARIO



FRONT YARD AREA:	1,757 SF	
FRONT YARD HARDSCAPE AREA:	527 SF	
FRONT YARD IRRIGATED AREA:	1,230 SF	
TURF AREA:	492 SF	
LOW WATER PLANTING AREA:	738 SF	
TURF AREA / IRR. AREA:	40%	100%
LOW WTR PLANTING / IRR. AREA:	60%	
HARDSCAPE AREA / TOTAL FRONT YARD AREA:	30%	
TURF AREA / TOTAL FRONT YARD AREA:	28%	100%
LOW WTR PLANTING / TOTAL FRONT YARD AREA:	42%	

FRONT YARD IRRIGATION TURF / PLANTING AREA

WATER CONSERVATION PLAN

ATTACHMENT 1

FIDDYMENT RANCH SPA No. 3
SIGNATURE PROPERTIES
ROSEVILLE, CALIFORNIA

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JULY 22, 2010 | DRAWN: MPM | 1027.091

J:\1000-s\1027-Fiddyment Ranch\Phase3\Fiddyment Ranch-PH3-OA\Civil\Studies\Water\MAR-2010-UPDATE\Exhibits\ATTACH-1-FIDDY-CONSERV.dwg 7/29/10 11:08am mmotroni

Project: FEDDYMENT WATER CONSERVATION PLAN Project No.: 1027.091

Subject: TURF REDUCTION FACTOR CALCULATIONS - ATTACHMENT #2

Prepared By: M. MOTRONE Checked By:

TERMS DEFINED:

$A_{Landscape}$: total landscape area

A_{Turf}: turf area

A_{Plants}: non-turf area

D_{Total}: landscape irrigation demand factor

D_{Plants}: non-turf irrigation demand factor

D_{Turf}: turf irrigation demand factor

C_{Turf}: ratio of turf area to total landscape area

C_{Plants}: ratio of non-turf area to total landscape area

$D_{Baseline}$: Baseline case total irrigation demand

$D_{Conservation}$: Conservation case total irrigation demand

RF, Ratio of conservation case irrigation demand to baseline case irrigation demand

Project: FIDDYMENT WATER CONSERVATION PLAN Project No.: 1027.091

Subject: TURF REDUCTION FACTOR CALCULATION - ATTACHMENT 2

Prepared By: M. METRONE Checked By:

#1 $A_{LANDSCAPE} \cdot D_{TOTAL} = A_{TURF} \cdot D_{TURF} + A_{PLANTS} \cdot D_{PLANTS}$

#2 $D_{PLANTS} = 0.3 \cdot D_{TURF}$

#3 $A_{TURF} = A_{LANDSCAPE} \cdot C_{TURF}$

#4 $A_{PLANTS} = A_{LANDSCAPE} \cdot C_{PLANTS}$

#5 ASSUME: D IS IN GPM/ACRE, A IS IN ACRE, C IS UNITLESS

#6 $\cancel{A_{LANDSCAPE}} \cdot D_{TOTAL} = \cancel{A_{LANDSCAPE}} \cdot C_{TURF} \cdot D_{TURF} + \cancel{A_{LANDSCAPE}} \cdot C_{PLANTS}(0.3 \cdot D_{TURF})$

#7 $D_{TOTAL} = C_{TURF} \cdot D_{TURF} + C_{PLANTS}(0.3 \cdot D_{TURF})$

→ TOTAL DEMAND IN GPM/ACRE

#8 $RF = \frac{D_{CONSERVATION}}{D_{BASELINE}} = \frac{C_{TURF} \cdot D_{TURF} + C_{PLANTS}(0.3 \cdot D_{TURF})}{C_{TURF,0} \cdot D_{TURF} + C_{PLANTS,0}(0.3 \cdot D_{TURF})}$

#9 $RF = \frac{\cancel{D_{TURF}}(C_{TURF} + 0.3C_{PLANTS})}{\cancel{D_{TURF}}(C_{TURF,0} + 0.3C_{PLANTS,0})} = \frac{C_{TURF} + 0.3C_{PLANTS}}{C_{TURF,0} + 0.3C_{PLANTS,0}}$

#10 WHERE: $C_{PLANTS} = 1 - C_{TURF}$ ∴

#11 $$RF = \frac{C_{TURF} + 0.3 - 0.3C_{TURF}}{C_{TURF,0} + 0.3 - 0.3C_{TURF,0}}$$

WHERE RF AND C ARE UNITLESS

EXAMPLE #1

$C_{TURF} = 0.40$, $C_{TURF,0} = 0.70$

$$RF = \frac{0.40 + 0.3 - 0.3(0.40)}{0.70 + 0.3 - 0.3(0.70)}$$

$$RF = 0.734$$

Project: FIDDYMENT WATER CONSERVATION PLAN Project No.: 1027091

Subject: TURF REDUCTION FACTOR CALCULATION - ATTACHMENT 2

Prepared By: M. METRONE Checked By:

EXAMPLE #2:

$A_{LANDSCAPE} = 1$ ACRE

$A_{TURF,0} = 0.70$ ACRE, $A_{PLANT,0} = 0.30$ ACRE

$A_{TURF} = 0.40$ ACRE, $A_{PLANT} = 0.60$ ACRE

$D_{TURF} = 30$ GPM/ACRE

$D_{PLANTS} = 30\%\ (30\ GPM/AC) = 9$ GPM/ACRE } ASSUMED

BASELINE: 1 ACRE $D_{TOTAL,0} = 0.70$ ACRE $(30\ GPM/AC) + 0.30$ ACRE $(9\ GPM/AC)$

→ FROM EQUATION #1, SHEET 1 $D_{TOTAL,0} = D_{BASELINE}$

$D_{TOTAL,0} = 23.7$ GPM/ACRE

CONSERVATION: 1 ACRE $D_{TOTAL} = 0.40$ ACRE $(30\ GPM/AC) + 0.60(9\ GPM/AC)$

→ FROM EQUATION #1, SHEET 1 $D_{TOTAL} = D_{CONSERVATION}$

$D_{TOTAL} = 17.4$ GPM/ACRE

$$RF = \frac{D_{CONSERVATION}}{D_{BASELINE}} = \frac{17.4\ GPM/AC}{23.7\ GPM/AC}$$

$RF = 0.734$

RF EXAMPLE #1 = RF EXAMPLE #2