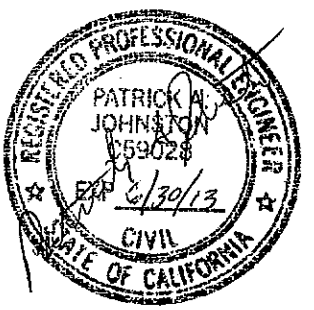
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# Sonoma County Airport Area Recycled Water Project Planning Update

13 September 2011




Prepared for

**The Town of Windsor**
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K/J Project No. 1068013*00

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# Section 1: Introduction

## 1.1 Purpose of Report

The Town of Windsor (Town) and the Sonoma County Water Agency (Agency) are interested in understanding the potential for developing an Urban Water Reuse Project in the Sonoma County Airport Area. Such a project could offset existing potable water demands and result in benefits to the Town and Agency by increasing the available water supply, improving supply reliability, and by reducing peak summer demands on the supply, storage and transmission facilities. The commercial and light industrial businesses in the Airport Area would also benefit, by having a drought-proof water supply for landscape irrigation.

In 2003, Kennedy/Jenks Consultants assessed irrigation demands for recycled water within the Airport Area, and determined the facilities and costs required to serve disinfected tertiary recycled water to various customers from the Town's Wastewater Treatment Plant (Town WWTP). A conceptual-level market assessment of recycled water demands within the Town's broader service area also was performed, along with an assessment of conveyance facility upsizing that would be required within the Airport Area to preserve flexibility for delivering recycled water to other parts of the Town's service area in the future.

The current planning evaluation focuses on updating the prior work to reflect changes in development that have occurred during the last 5 years, and to determine the amount of recycled water that is available from the Town WWTP since a portion of the flow is diverted to the Geysers Pump Station and no longer available for local projects. In addition, an assessment of the potential use of disinfected tertiary recycled water produced at the Agency's Airport Wastewater Treatment Plant (Airport WWTP) is provided.

This report includes five sections. Section 1 provides background on the Town and Airport WWTPs. Section 2 describes the recycled water supply and availability. Section 3 presents the irrigation demands within the Airport Area and within the Town's Redevelopment Area and areas east of Highway 101. Section 4 identifies potential project alternatives, based on the supply and demand analyses. Section 5 presents conclusions.

As described in the Scope of Services, this planning effort is a feasibility study of possible concept-level alternatives that are intended to help Town and Agency staff obtain additional input on recycled water opportunities from policy makers, potential customers, and other stakeholders prior to developing a comprehensive master planning effort/capital improvement plan.

## 1.2 Background

### 1.2.1 Town WWTP

The Town owns and operates a 2.25-million-gallon-per-day (MGD) advanced treatment water reclamation facility and associated storage ponds, pump stations, and discharge/disposal pipelines. From October 1st through May 15th, disinfected tertiary recycled water may be

discharged to surface waters (at Mark West Creek) in accordance with the permit requirements of the North Coast Regional Water Quality Control Board. From May 16th through September 30th, disinfected tertiary recycled water discharges are not allowed, so recycled water is stored and beneficially used for landscape irrigation where possible. In mid-2011, the Town started up its Geysers Pump Station, which sends between 0.33 MGD and 1.25 MGD to the Geysers steamfields via the City of Santa Rosa's transmission system, where it ultimately is injected into the earth for geothermal energy production.

### 1.2.2 Airport WWTP

The Agency owns and operates a 0.9-MGD advanced treatment water reclamation facility and associated storage ponds and pump stations. Although these treatment facilities have an emergency discharge pipeline, there is no permit in place that allows for a surface water discharge. The Agency currently operates the facilities as a "zero discharge" system, by using the recycled water for land application at the Sonoma County Airport (Airport) and by providing recycled water to a limited number of customers, primarily local dairies. Since the Airport itself does not have significant landscape irrigation needs, and irrigation of areas near runways has a potential to attract birds, recycled water from the Airport WWTP could be redirected for beneficial use and potable offset at other locations. The proximity of the commercial and light industrial customers in the Airport Area to the Airport WWTP presents an attractive group of potential customers who could benefit from receiving recycled water for irrigation use.

# Section 2: Recycled Water Supply and Availability

This section summarizes the supply of recycled water from the Town and Airport WWTP, currently and in the future, and availability of recycled water for future use.

### 2.1.1 Town WWTP Water Balance

The Town prepared a water balance for its WWTP, as part of the Draft NPDES Permit Amendment (RMC, October 2009), which was recently updated in October 2010. This information was used to determine the average monthly recycled water supply that could reliably be served to irrigation customers from the existing wastewater treatment plant and storage facilities, while meeting contractual commitments for the Geysers Recharge Project. The October 2010 water balance update is included in Appendix A.

The Town WWTP currently has an average dry weather flow (ADWF) of approximately 1.35 MGD. This flow has decreased from prior years when the ADWF was closer to 1.6 MGD. The flow reduction is due to successful water conservation measures and reduced occupancy associated with the recent economic recession. The current ADWF is assumed to represent a "worst-case" scenario, from the standpoint of ADWF supply for water recycling.

Table 2-1 presents the existing recycled water supply and demands for the Town, based on the current 1.35 MGD ADWF and dry-year hydrologic conditions. The existing demands are divided into fixed and flexible demand categories. Fixed demands are assumed to be a continuing Town commitment for service, but it is assumed that the flexible demands could be redirected for beneficial use in the Airport Area or elsewhere. As Table 2-1 shows, during a dry hydrologic year, it is estimated that approximately 22 million gallons per year (MGY) could be transferred to the Agency's storage ponds during low-demand months. This volume of water could be available for use within the Airport Area. However, the Town expects to expand its urban recycled water system, according to its 2010 Urban Water Management Plan (UWMP). Additions to the system for serving the Airport Area are not contained in the 2010 UWMP financial plan.

A 0.4% annual population growth rate is used to project the future increase in the Town WWTP flows over time, and this rate is consistent with the 2009 Association of Bay Area Governments (ABAG) growth projection for the Town of Windsor. Table 2-2 presents the estimated future recycled water supply and demand for the next 25 years. Note that the projections of recycled water supply assume that existing irrigation commitments of the Town would not change. The above estimate would need to be altered if customer priorities change and additional recycled water becomes available in the future.

Table 2-1 Existing Town Recycled Water Supply and Demands (Dry-Year Hydrologic Condition)[2]

| Month | Fixed Demands (MG) | | | | | | | Irrigation Monthly Demand %[1] | Flexible Demands (MG) | | | Total Supply (MG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Geysers Recharge | Urban Irrigation | Shone & Gallo Irrigation | Shone Pond Refilling | Frost Protection Irrigation | Private Irrigation | Discretion Irrigation | | Excess Flow to Geysers | Transfers to Agency[3] | Creek Discharge[2] | |
| Jan | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0 | 2 | 0 | 24 |
| Feb | 20 | 0 | 0 | 1 | 4 | 0 | 0 | 2% | 0 | 0 | 0 | 25 |
| Mar | 22 | 0 | 0 | 7 | 4 | 0 | 0 | 3% | 0 | 8 | 0 | 41 |
| Apr | 21 | 7 | 3 | 0 | 4 | 1 | 0 | 5% | 0 | 5 | 0 | 41 |
| May | 22 | 30 | 15 | 0 | 0 | 6 | 0 | 16% | 0 | 0 | 0 | 73 |
| Jun | 6 | 33 | 17 | 0 | 0 | 6 | 0 | 17% | 0 | 0 | 0 | 62 |
| Jul | 6 | 36 | 18 | 0 | 0 | 7 | 0 | 19% | 0 | 0 | 0 | 68 |
| Aug | 6 | 35 | 17 | 0 | 0 | 6 | 0 | 18% | 0 | 0 | 0 | 64 |
| Sep | 6 | 27 | 13 | 0 | 0 | 5 | 0 | 14% | 0 | 0 | 0 | 51 |
| Oct | 22 | 16 | 8 | 0 | 0 | 3 | 0 | 8% | 0 | 0 | 0 | 48 |
| Nov | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0 | 7 | 0 | 28 |
| Dec | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0 | 0 | 0 | 22 |
| **Total** | **195** | **184** | **91** | **8** | **12** | **34** | **0** | **100%** | **0** | **22** | **0** | **546** |

**Source:** Table adapted from Water Reclamation Treatment, Storage, and Disposal Water Balance Analysis Model V2.3 (RMC, 13 October 2010), which is included in Appendix A. Assumes ADWF of 1.35 MGD and dry-year hydrologic conditions.

[1]Monthly % of Fixed Demands is the sum of fixed irrigation demands per month divided by the total fixed annual demands (does not include Geysers). This is used in Table 2-6 to estimate the monthly demand from the Airport WWTP and additional recycled water demands.

[2]This estimate represents a dry hydrologic year. In an average or wet year, irrigation demands may change and creek discharge may be required.

[3]Transfers to Agency refers to recycled water transferred from the Town WWTP to the Agency's Airport ponds for storage.

Table 2-2 Projected Town Recycled Water Supply, 2010 - 2035

| Year | Projected ADWF[1] | | Existing Users[2] | Projected Available Recycled Water[1] | |
|---|---|---|---|---|---|
| | MGD | MGY | MGY | MGY | AFY |
| 2010 | 1.35 | 546 | 524 | 22 | 67 |
| 2015 | 1.4 | 557 | 524 | 33 | 102 |
| 2020 | 1.4 | 568 | 524 | 45 | 138 |
| 2025 | 1.4 | 580 | 524 | 57 | 175 |
| 2030 | 1.5 | 591 | 524 | 69 | 213 |
| 2035 | 1.5 | 603 | 524 | 82 | 251 |

[1]Based on 2009 Association of Bay Area Governments annual growth rate projection of approximately 0.4% for the Town of Windsor. Assumes dry-year hydrologic conditions.
[2] Assume existing irrigation commitments of the Town would not change.

### 2.1.2 Airport WWTP Water Balance

The Airport WWTP currently has an ADWF of about 0.9 MGD. Table 2-3 presents the average monthly recycled water production from 2009 and 2010. Similar to the Town's water supply assumptions, the Agency's recycled water production in 2009-10 was reduced due to the impacts of successful water conservation and the economic recession.

Table 2-3 Average Monthly Volume of Tertiary Effluent Produced at the Airport WWTP

| Month | 2009 (MG) | 2010 (MG) | Average (MG) |
|---|---|---|---|
| Jan | 30 | 7 | 19 |
| Feb | 29 | 34 | 31 |
| Mar | 34 | 47 | 40 |
| Apr | 30 | 41 | 36 |
| May | 35 | 45 | 40 |
| June | 28 | 37 | 32 |
| July | 25 | 34 | 30 |
| Aug | 24 | 31 | 27 |
| Sept | 21 | 24 | 23 |
| Oct | 28 | 26 | 27 |
| Nov | 28 | 13 | 21 |
| Dec | 12 | 37 | 25 |
| **Total Annual Supply** | **324** | **376** | **350** |

**Source:** Airport Self Monitoring Summary Reports, provided by Agency.

The Agency currently is committed to serving 127 MGY (390 AFY) to existing irrigation customers. The remaining amount of recycled water supply available, therefore, is estimated to be 223 MGY (350 – 127 = 223 MGY).

Table 2-4 summarizes the available recycled water that is projected to be available over the next 25 years. This projection is developed using a 0.2% annual population growth rate, and this is consistent with the 2009 Association of Bay Area Governments annual growth rate projection for the Larkfield area.

Table 2-4 Projected Airport Recycled Water Supply, 2010 - 2035

| Year | Projected ADWF[1] | | Existing Users | Projected Available Recycled Water[1,2] | |
|---|---|---|---|---|---|
| | MGD | MGY | MGY | MGY | AFY |
| 2010 | 0.9 | 350 | 127 | 223 | 684 |
| 2015 | 0.9 | 353 | 127 | 226 | 694 |
| 2020 | 1.0 | 356 | 127 | 229 | 703 |
| 2025 | 1.0 | 359 | 127 | 232 | 713 |
| 2030 | 1.0 | 363 | 127 | 236 | 723 |
| 2035 | 1.0 | 366 | 127 | 239 | 732 |

[1]Based on existing wastewater flows and 0.2% annual growth rate projection (ABAG, 2009).
[2]Per the Agency, the future flows from Sutter Hospital are not included in the projection, because Sutter's net flow to the Airport WWTP will be zero, due to water conservation offsets required as a condition of the Sutter project's approval.

### 2.1.3 Combined Town/Agency Water Balance

The combined recycled water supply that could be developed from the Town and Airport WWTPs is shown in Table 2-5 through the year 2035. There is 751 AFY supply available now that could be put to beneficial use for irrigation, which is equal to approximately 50% of the Town's existing recycled water commitments. These supply amounts are used in the alternatives analysis presented in Section 4.

Table 2-5 Projected Recycled Water Supply for Future Use

| Year | Town | | Airport | | Projected Total | |
|---|---|---|---|---|---|---|
| | MGY | AFY | MGY | AFY | MGY | AFY |
| 2010 | 22 | 67 | 223 | 684 | 245 | 751 |
| 2015 | 33 | 102 | 226 | 694 | 259 | 796 |
| 2020 | 45 | 138 | 229 | 703 | 274 | 841 |
| 2025 | 57 | 175 | 232 | 713 | 290 | 888 |
| 2030 | 69 | 213 | 236 | 723 | 305 | 936 |
| 2035 | 82 | 251 | 239 | 732 | 321 | 984 |

The Town water balance in Appendix A includes a storage analysis of the existing 2010 scenario. The Storage and Disposal table in Appendix A shows that the Town and Agency have adequate storage to serve the Airport Area. The estimated required storage shown in Table 2-6 (158 MG) is well below the Town's 165 MG and the Agency's 295 MG of available storage capacity (total of 459 MG).

Table 2-6 shows the projected 2010 recycled water supply by month.

Table 2-6 Recycled Water Available by Month for 2010

| Month | Supply (MG) | Monthly Demand %[1] | Existing Demand[2] (MG) | Available Recycled Water (MG) | Estimated New Demand[3] (MG) | Estimated Storage Required[4] (MG) |
|---|---|---|---|---|---|---|
| Jan | 42 | 0% | 22 | 21 | 0 | 73 |
| Feb | 56 | 2% | 27 | 29 | 4 | 98 |
| Mar | 81 | 3% | 37 | 44 | 8 | 135 |
| Apr | 76 | 5% | 42 | 34 | 11 | **158** |
| May | 113 | 16% | 92 | 21 | 38 | 141 |
| Jun | 95 | 17% | 84 | 11 | 42 | 109 |
| Jul | 97 | 19% | 91 | 6 | 46 | 70 |
| Aug | 92 | 18% | 87 | 5 | 43 | 31 |
| Sep | 74 | 14% | 69 | 5 | 34 | 3 |
| Oct | 75 | 8% | 58 | 17 | 20 | 0 |
| Nov | 49 | 0% | 21 | 28 | 0 | 28 |
| Dec | 46 | 0% | 22 | 25 | 0 | 52 |
| **Total** | **896** | **100%** | **650** | **245** | **245** | **158 max** |

[1]From Table 2-1: Existing Town Recycled Water Supply and Demands (Dry-Year Hydrologic Condition).
[2]Existing Demand includes monthly Windsor demand from Table 4 and annual Airport demand of 127 MG spread out by month using the Monthly %.
[3]Estimated New Demand distributes the available 245 MG recycled water available annually by month using the Monthly % Demand column to reflect a generic irrigation demand pattern similar to the existing Windsor irrigation demands.
[4]Estimated Storage Required subtracts Estimated New Demand from Available Recycled Water plus storage from the previous month.

Table 2-7 shows the projected 2035 recycled water supply by month. The corresponding storage requirement shown in Table 2-7 (178 MG) is less than 40% of the Town's 165-MG and the Agency's 295-MG existing storage (total of 459 MG).

Table 2-7 Projected Recycled Water Available by Month for 2035

| Month | Supply (MG) | Monthly Demand %[1] | Existing Demand[2] (MG) | Available Recycled Water (MG) | Estimated New Demand[3] (MG) | Estimated Storage Required[4] (MG) |
|---|---|---|---|---|---|---|
| Jan | 46 | 0% | 22 | 24 | 0 | 84 |
| Feb | 60 | 2% | 27 | 33 | 5 | 112 |
| Mar | 87 | 3% | 37 | 50 | 11 | 152 |
| Apr | 82 | 5% | 42 | 41 | 15 | **178** |
| May | 123 | 16% | 92 | 31 | 50 | 159 |
| Jun | 103 | 17% | 84 | 19 | 55 | 123 |
| Jul | 106 | 19% | 91 | 15 | 60 | 78 |
| Aug | 100 | 18% | 87 | 13 | 57 | 35 |
| Sep | 80 | 14% | 69 | 12 | 44 | 3 |
| Oct | 81 | 8% | 58 | 23 | 26 | 0 |
| Nov | 53 | 0% | 21 | 32 | 0 | 32 |
| Dec | 50 | 0% | 22 | 28 | 0 | 60 |
| **Total** | **970** | **100%** | **650** | **321** | **321** | **178 max** |

[1]From Table 2-1: Existing Town Recycled Water Supply and Demands (Dry-Year Hydrologic Condition).
[2]Existing Demand includes monthly Windsor demand from Table 4 and annual Airport demand of 127 MG spread out by month using the Monthly %.
[3]Estimated New Demand distributes the 321 MG recycled water available annually by month using the Monthly % Demand to reflect an irrigation demand pattern similar to the existing Windsor demands.
[4]Estimated Storage Required subtracts Estimated New Demand from Available Recycled Water plus storage from the previous month.

## 2.2 Current Town Customer Base and Service Priorities

The Town is considering opportunities to achieve more potable water offset from its existing recycled water supply, independently of this study, as part of its Recycled Water Management Planning effort. Based on discussions with the Town, this planning update assumes that existing customers will continue to be served by recycled water, and that additional recycled water will not be supplied to Airport Area customers by discontinuing recycled water service to any existing customers. However, if service priorities do change in the future, the water balance would need to be revised to reflect reallocation of the water.

## 2.3 Conveyance Interties Between the Agency and Town WWTPs/Storage Facilities

### 2.3.1 Interties

The Town and Agency have two operational interties that connect their recycled water systems – one is located at Shiloh Road and the other at Starr Road.

The Shiloh Road intertie is an emergency connection located on Shiloh Road immediately north of the Airport ponds. According to the Agency, this intertie can transfer tertiary water from the Town to the Agency at a rate of 2,000 gpm, and can transfer secondary water from the Agency to the Town at a rate of 700 gpm.

According to the Agency, the Starr Road intertie can transfer tertiary water from the Town to the Agency at a rate of 1.5 MGD, or approximately 1,000 gpm.

As shown in Table 2-1, the water balance anticipates that the Town would transfer 22 MGY (67 AFY) to the Agency ponds during a dry year. The current interties appear to have sufficient capacity to accommodate the transfers that would be required under the water balance projections herein.

### 2.3.2 Use Agreement

The Town and Agency have an existing use Agreement that allows the Town to store 50 MG of recycled water in the Agency's Airport-Larkfield-Wikiup (ALW) Reservoirs. This agreement was revised through an amendment dated 12 January 2009. The agreement states that the Agency will provide the Town a reserved capacity of 50 MG in the ALW Reservoirs for the Town's tertiary-treated recycled water. The agreement allows for the Agency to endeavor to replenish the reserved capacity through land irrigation or transfer to others for land irrigation (Agency/Town, 2009).

As shown in Table 2-1, the water balance anticipates that the Town would transfer 22 MGY (67 AFY) to the Agency ponds during a dry year, which falls within the terms of the agreement. The existing agreement between the Town and Agency for recycled water transfers could be revised to allow additional flows to be conveyed from the Town to the Agency ponds in average or wet hydrologic years, but the Town may choose to serve other local demands instead.

### 2.3.3 Potential Agency GeoExchange Project

A preliminary investigation into a Regional GeoExchange Energy Efficiency Project (RGEEP) was initiated in 2009 by the Agency but not completed due to concept infeasibility. The concept of the RGEEP was to build a pipeline loop between the Airport WWTP and a local business park to deliver recycled water to geothermal exchange heat pumps for heating and cooling to reduce electricity consumption at the business park. Because the Agency is not pursuing a geoexchange project in the Airport Area, this update does not consider any joint project opportunities using recycled water.

# Section 3: Recycled Water Market Assessment

This section summarizes the potential existing and future recycled water demands for irrigation uses within the study area identified for this planning update. The study area includes:

- The Sonoma County Airport Area
- "Expanded Service Areas" (ESAs) within the Town's service area, east of Highway 101
- The Town's Redevelopment Area (RDA)

## 3.1 Methodology

The Market Assessment for the Airport Area was updated using the following methodology:

1. Reviewed historical water meter information and prior recycled water master planning information provided by the Town.
2. Reviewed historical (annual and monthly) evapotranspiration (ETo) and precipitation data from California Irrigation Management Information System (CIMIS) and the National Weather Service. ETo rates are dependent upon a combination of factors, including air temperature, wind velocity, solar and ground radiant effects, and vapor pressure.
3. Reviewed Zoning Map (Brelje & Race, 2005) and General Plan Map (Brelje & Race, 2005) information provided by the Town.
4. Performed field reconnaissance and review of satellite imagery to inventory developed and undeveloped land parcels in the Airport and ESAs.
5. Developed methods and criteria to estimate annual and peak season irrigation demands for existing and future development in both the Airport and ESAs that used the best available information. Criteria were established for years of normal weather patterns and for dry year conditions

### 3.1.1 Existing Irrigation Customers with Separate Meters

The customers of special interest are existing water accounts that have separate meters for indoor and outdoor uses. These accounts will be the easiest and least costly to convert from potable water to recycled water use.

Historical water meter readings from 2005 to September 2010 were obtained for these users. Historical precipitation and evapotranspiration trends during this period were reviewed to select water use data that were representative of average-year conditions. Because the 2007 through 2009 period were drought years in Sonoma County, and special water restrictions were in place, data from these years were not desirable and excluded from this evaluation. The year 2006 was identified as having precipitation and evapotranspiration patterns that are representative of an average year and, therefore, the 2006 meter information was used as the basis to estimate average annual irrigation demands for these potential customers.

In the interest of developing conservative values for projected water demands for the Airport Area, the decision was made to use the water meter data from 2006. This is prior to the drought years and prior to the implementation of much of the conservation efforts that were triggered by the drought-induced water restrictions. However, 2006 is not conservative in terms of estimating potable offsets. For the purpose of this study, using demands from an average year is more conservative in terms of estimating the remaining available recycled water for new customers. This helps ensure that there will be adequate supply for these customers.

### 3.1.2 Existing Irrigation Customers with a Combined Meter and Undeveloped Parcels

For existing water accounts with a combined meter for both irrigation and potable water service, and for undeveloped parcels zoned for commercial/light industrial, average annual irrigation demands were estimated using the best available information – and that information is from the existing customers with separate meters, where irrigation demands can be clearly delineated. The process for estimating the irrigation demands for combined meter customers and undeveloped parcels involved three steps:

1. First, the gross site area and 2006 monthly irrigation demands for all active, full-year, combined meter accounts (with the exception of the Sonoma County Airport) were aggregated using the Sonoma County Geographical Information System (GIS) and a linked meter information database.

2. Next, a ratio of average annual irrigation demand to gross site area was developed. This ratio is approximately 4.3 gallons/year/square foot of gross site area, which equates to 6.9 inches/year/square foot of gross site area.

3. Then, this ratio was applied to the gross areas of the existing sites with combined meters, and to undeveloped parcels, to estimate their demands.

This methodology uses the best available information to project irrigation demands for the Airport Area's specific land use and development characteristics, which are uniquely commercial and light industrial in nature.

### 3.1.3 Peak Irrigation Demand Criteria

The peak irrigation demands are developed using the following methodology, and these demands are used in sizing recycled water conveyance facilities.

- Average Annual Demand (AAD) – represents the annual irrigation demand during a year with average year hydrologic conditions and is typically measure in units of 100 cubic feet (CF), acre-feet (AF), or million gallons per year (MGY). The average annual demand is typically used to evaluate water supply benefits (potable offset) of a recycled water project.

- Average Month Demand (AMD) – represents the average monthly irrigation demand over the irrigating months of the year when evapotranspiration typically exceeds average rainfall (April through October). The AMD = AAD/7months.

- Peak Day Demand (PDD) – represents the demand over any 24-hour period during the peak irrigating month of the year, which is typically July for the Town area. The peak day demand is developed based on the peaking relationship between the average and peak month. The analysis of the ETo data showed that the ratio between the peak month and the average month during the irrigation season is 1.5. Therefore, the PDD = AMD x 1.5.

- Peak Hour Demand (PHD) – represents the instantaneous maximum flow rate required for irrigation. This demand is developed assuming irrigation in the Airport Service Area occurs relatively uniformly over a 9-hour irrigating period between 9 p.m. and 6 a.m. The PHD is typically expressed in gpm and used to establish the pressure and capacity requirements of pumping facilities and pipelines. The PHD = PDD x 24/9.

## 3.2 Airport Area Irrigation Demands

A summary of the Airport Area market assessment of potential irrigation demands is presented in Figure 3-1. The figure shows the potential irrigation customers in the Airport Area and their respective land use classifications (color), development status (hatch), and average annual irrigation demands (dot sizes). The total irrigation demand in the Airport Area is estimated to be approximately 542 AFY.

## 3.3 Redevelopment Area Irrigation Demands

The Redevelopment Area (RDA) is located at the north end of the Town, as shown in Figure 3-1. Based on discussions with the Town staff, the market assessment includes irrigation demands for Bell Village, Los Robles Park, Evergreen Mobile Home Park and the parcels within the RDA boundary that are north of Arata Lane. The RDA area contains primarily urban residential landscaping, so a recycled water project serving the RDA would also provide potable offset benefits.

A summary of the RDA market assessment irrigation demands is presented in Figure 3-1. The figure shows the potential irrigation customers and their respective land use classifications (color), development status (hatch), and average annual irrigation demands (dot sizes). The total irrigation demand in the RDA is estimated to be approximately 58 AFY. Additional demand information is provided in Appendix B.

## 3.4 Expanded Service Area Irrigation Demands

The Expanded Service Areas (ESAs) include two areas identified through discussions with Town staff, one generally to the northeast of the Airport Area and one generally to the southeast. The irrigation demands in the ESAs were included in the market assessment for subsequent inclusion in alternatives in Section 4. If the ESAs are served, facilities upsizing within the Airport Area would be required. The ESAs are shown in Figure 3-1. A significant portion of the irrigation demands in ESAs I and II are for agricultural use (mostly vineyards), although parks, commercial landscaping, and golf course irrigation uses are also present. Residential and commercial landscaping often have more consistent irrigation demand patterns over the entire irrigating season, whereas vineyards can have demands that are infrequent and highly weather/harvest dependent. It may be operationally easier and more cost-effective to

irrigate urban/commercial landscapes than vineyards, unless the vineyard has a reservoir that could be filled on the Town or Agency schedule.

The approach to the update of the ESA Market Assessment includes the following general steps:

1. Performed “windshield”-level field reconnaissance and online research using tools, such as Google Maps of the ESA, to determine updates to the customer types and locations identified in the previous study.
2. Reviewed Town of Windsor Water Reclamation Master Plan, December 2001 by Brelje & Race.
3. Reviewed available mapping that shows potential landscape irrigation customers within the area.
4. Calculated acreages for different type of potential recycled water irrigation customers using GIS parcel information from Sonoma County.
5. Utilized the annual irrigation water usage criteria for agricultural and non-agricultural land uses established in the Town’s prior Master Plan (by Brelje & Race, dated January 1999).

The market assessment in the ESA yielded a demand of 425 AFY for ESA I and 815 AFY for ESA II. Of these demands, the portion that is for vineyards or pasture is 286 AFY in ESA I and 653 AFY in ESA II. Additional demand information is provided in Appendix B.

## 3.5 Market Assessment Summary

Table 3-1 presents a summary of the market assessment irrigation demands.

Table 3-1 Market Assessment Summary

| | Average Annual Irrigation Demand (AFY) | | |
|---|---|---|---|
| **Area** | **Existing Customers** | **Future Customers** | **Total Customers** |
| Airport Area | 379 | 163 | 542 |
| RDA | 10 | 48 | 58 |
| ESA I | 380 | 45 | 425 |
| ESA II | 815 | 0 | 815 |
| **Total** | **1,584** | **256** | **1,840** |

## 3.6 Comparison of the 2003 and 2011 Market Assessments

The previous market assessment conducted by Kennedy/Jenks in 2003 estimated the average annual irrigation demands to be 502 AFY for the Airport Area, 380 AFY for ESA I, and 466 for ESA II. The total prior demand estimate is approximately 30% lower than the current estimate

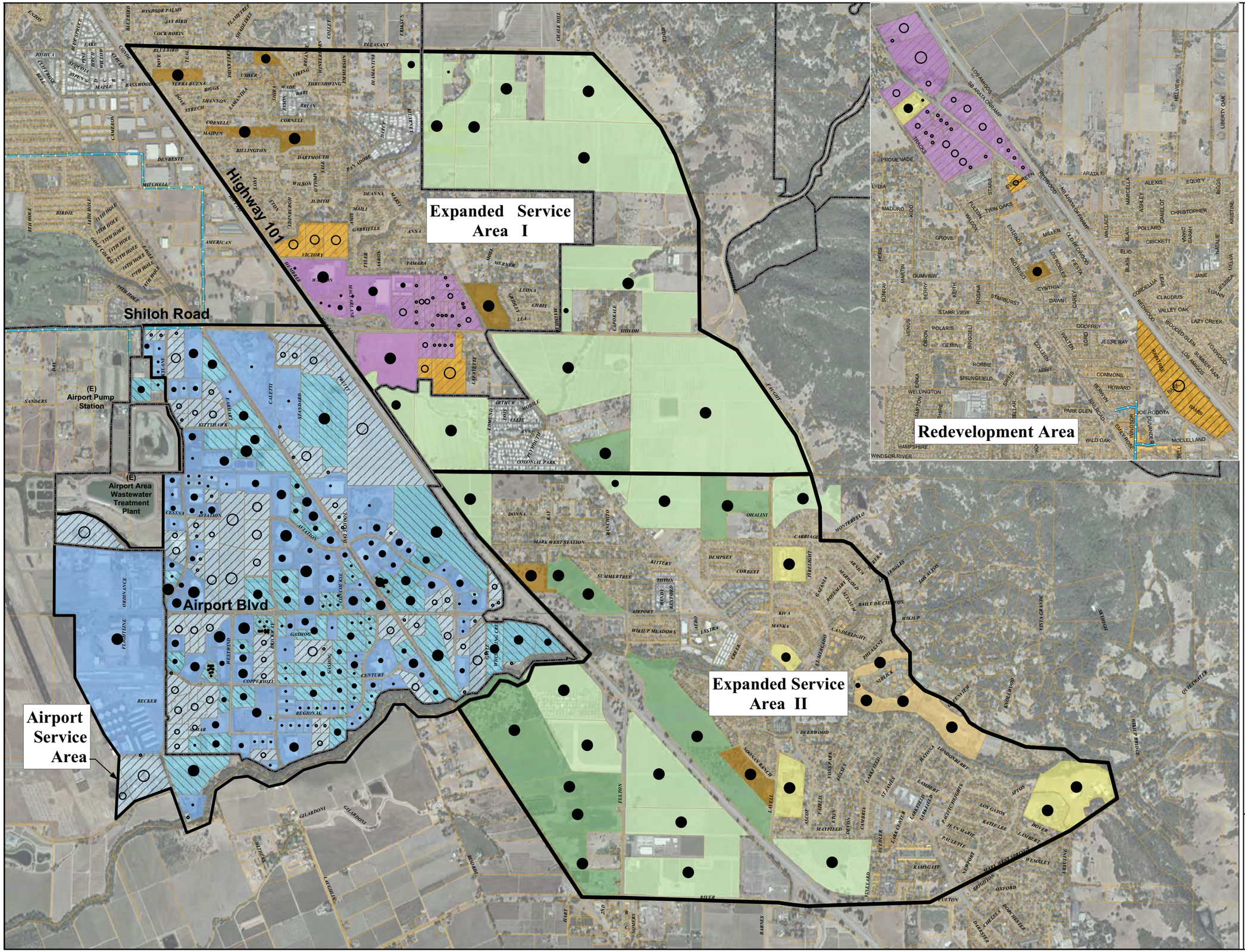
identified in Table 3-1. Some observations about the differences in the two assessments include:

1. The previous market assessment did not include the RDA.
2. Some parcels in the Airport Area have been developed since the 2003 assessment and the associated demands changed from the "future" to "existing" category.
3. Parcel boundaries in some parts of the Airport Area have changed, causing some refinements to the demands in these areas.
4. The ESA land uses for some parcels were adjusted based on the currently available planning information. The ESA boundaries were revised in certain areas based on updated Town and Agency priorities.
5. The irrigation demands for the ESAs in the 2003 study were "scaled down" by a factor that varied between 10% and 50% depending on the parcels to account for the elimination of customers that would potentially not be cost-effective to serve. The current assessment includes all of the demands, and at a higher level of detail.

Table 3-2 below compares the 2003 and 2011 market assessments by area. Appendix B.3 includes additional information on the differences between the versions of the ESA market assessments.

Table 3-2 Comparison of the 2003 and 2011 Market Assessments

| Area | 2003 Unfactored Demands | 2011 All Customers | Difference |
|---|---|---|---|
| Airport Area | 502 AFY | 542 AFY | + 8% |
| ESA I | 380 AFY | 425 AFY | + 12%, identified additional customers (+14%), removed several customers (-3%), and changes to some customers' land use (+1%) |
| ESA II | 466 AFY | 815 AFY | + 75%, identified additional customers (+15%), removed several customers (-16%), and changes to some customers' land use (+76%) |
| RDA | -- | 58 AFY | Not included in 2003 |
| **Total** | **1,348 AFY** | **1,840 AFY** | **+ 30%** |




TOWN OF WINDSOR

**Airport Area**
**542 AFY Night**

**Expanded Service Area I Demands**
**139 AFY Night**
**286 AFY Day**
**425 AFY Total**

**Expanded Service Area II Demands**
**162 AFY Night**
**653 AFY Day**
**815 AFY Total**

**Redevelopment Area**
**58 AFY Night**

LEGEND

**Average Annual Demand (AFY)**
**Future**
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 6
- 6 +

**Average Annual Demand (AFY)**
**Existing**
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 6
- 6 +

Windsor Water Service Area

**Expanded Service Area Customer Classifications**
- Existing Commercial
- Existing Golf Course
- Existing Municipal or School
- Existing Park
- Existing Pasture or Seasonal Crop
- Existing Residential
- Existing Vineyard
- Future Commercial
- Future Residential

**Airport Area Customer Classifications**
- Dedicated Irrigation Meter
- No Dedicated Irrigation Meter
- Vacant

N

0 500 1,000 2,000
Feet

**Kennedy/Jenks Consultants**

Sonoma County Airport Area
Recycled Water Planning Update
Town of Windsor, California

**COMPREHENSIVE MARKET ASSESSMENT OF AVERAGE ANNUAL IRRIGATION DEMANDS**

May 2011

**Figure 3-1**

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# Section 4: Concept Project Alternatives

This section presents several conceptual-level project alternatives that could serve recycled water to various sets of customers in the Airport Area, RDA, and ESAs. The alternatives consider a variety of planning issues, such as supply and demand, distance from recycled water source, construction cost, and flexibility for future system expansion. Alternative descriptions and capital costs are developed so the benefits and costs of various alternatives can be compared to each other on a cost per AFY basis. The cost per AFY information presented herein is only intended to provide a basic means to compare recycled water project alternatives to each other. It is not intended to serve as a means to compare the cost-benefit of a recycled water project to existing water supplies or other alternative water supply options. A more rigorous life-cycle economic evaluation would be required to perform a comparison of various supply options.

## 4.1 Alternatives

The supply and demand information presented in Sections 2 and 3 were used to assist in identifying potential project alternatives for serving recycled water in the Airport Area, RDA and ESAs. Several observations about the relationship between the available recycled water supply and the irrigation demands include:

1. The available 2010 supply from the Town WWTP (67 AFY) is less than 20% of the existing irrigation demand in the Airport Area but is sufficient to meet both the existing and future demand in the RDA (58 AFY).
2. The available 2010 supply from the Town and Airport WWTPs (751 AFY) is almost twice the size of the existing irrigation demands in the Airport Area (379 AFY), so an adequate supply exists currently to serve the Airport Area.
3. The available 2010 supply from the Town and Airport WWTPs (751 AFY) is about 25% greater than the projected future demand of both the Airport Area and the RDA (600 AFY), so it may be possible currently to serve some portion of the ESA.
4. The projected 2035 supply from the Town and Airport WWTPs (984 AFY) is 384 AFY larger than the demand of both the Airport Area and RDA (600 AFY), so it may be possible to expand service in the ESA over time, as available supplies increase.
5. The available 2010 and projected 2035 supply from the Town and Airport WWTPs is insufficient to provide service now or in the future to all of the Airport Area, RDA, and ESAs I and II.

Meetings were conducted with Town and Agency staff to discuss and screen various project alternatives, and four alternatives were identified for evaluation under existing and future conditions, as shown in Table 4-1.

Table 4-1 Description of Alternatives

| Alt. | Location | Scenario | Supply (AFY) | Demand (AFY) | Supply Limited Under Existing Customer Priorities? |
|---|---|---|---|---|---|
| A | Airport Area (with no facility upsizing for ESA's I & II) | Existing | 751 | 379 | No |
| | | Future | 984 | 542 | No |
| B | Airport Area + ESAs I & II | Existing | 751 | 1,574 | Yes |
| | | Future | 984 | 1,782 | Yes |
| C | Airport Area + ESA I Urban Customers | Existing | 751 | 473 | No |
| | | Future | 984 | 681 | No |
| D | RDA | Existing | 67 | 10 | No |
| | | Future | 251 | 58 | No |

Alternatives A, B, and C would use recycled water from both the Town WWTP and Airport WWTP, while Alternative D would use recycled water only from the Town WWTP.

The pipeline alignments used to develop the various alternatives and potential groups of customers served by each pipeline alignment are shown on Figure B-1 in Appendix B. Table B-1 lists the pipeline segments and relevant information, including length, pipeline diameter, customers, demand served, and cost. The pipeline diameters are established using a design criterion of maximum pipeline velocity of 5 feet per second. The pipeline alignments are divided into segments, so the Town can consider a variety of other potential project combinations as planning of potential project opportunities continues.

The following sections describe each alternative and provide the estimated project costs. Note that the comparative cost per AFY is intended only to compare the alternatives in this report and is not intended to be compared to other unit costs that may account for project lifecycle costs, financing, offset costs, or other economic factors. Costs are at conceptual planning level in 2011 dollars and include a Planning-Level Contingency factor (25%) and an Engineering, Construction Services and Administration factor (25%).

### 4.1.1 Alternative A – Airport Area

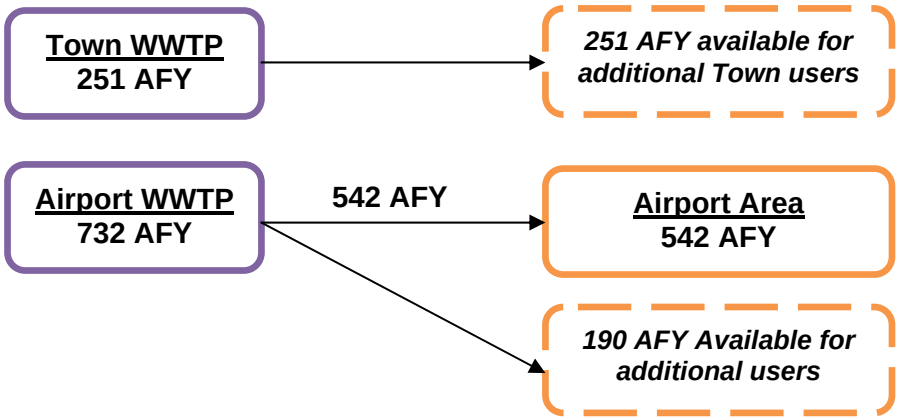
Alternative A would serve recycled water to customers in the Airport Area, as shown in Figure 4-5. Pipelines would be sized to accommodate existing and future demands but would not be upsized to provide future flexibility to serve customers beyond the Airport Area. This alternative would include over 40,000 feet of pipeline and a new pump station near the Airport ponds. Table 4-2 summarizes key components of Alternative A.

Table 4-2 Alternative A Summary

| Alternative A | Available Recycled Water Supply (AFY) | Demand (AFY) | Supply Limited? | Total Cost ($ mil) | Comparative Cost ($/AFY) |
|---|---|---|---|---|---|
| Existing | 751 | 379 | No | $8.9 | $16,000 |
| Future | 984 | 542 | No | | |

Figure 4-1 provides a schematic of how recycled water would be served to customers. The Town and Airport WWTP values represent additional supply after existing demand has been subtracted. This alternative does not use all available recycled water, but it is estimated that 442 AFY is available for additional users.

Figure 4-1 Alternative A Schematic (Future Scenario)




### 4.1.2 Alternative B – Airport Area + Expanded Service Areas I and II

Alternative B would serve recycled water to customers in the Airport Area and to all of the identified customers in ESAs I and II, as shown in Figure 4-6. The ESA customers considered for Alternative B consist of all of the customers identified in the two ESAs that could be served by recycled water. Pipelines would be sized to accommodate existing and future demands, which includes capacity in the pipelines with the Airport Area to accommodate expansion of the system into the ESA in the future to serve all ESA recycled water customers. This alternative would include over 100,000 feet of pipeline and a new pump station near the Airport ponds.

Alternative B was developed to understand the infrastructure requirements to serve all customers in the Airport Area and ESA I and II. Although currently supply limited, this alternative develops the upsized pipeline and pumping requirements to serve this extended network of customers. Therefore, if the Town pursues specific ESA recycled water customers in the future, the information regarding infrastructure requirements and sizing would be available.

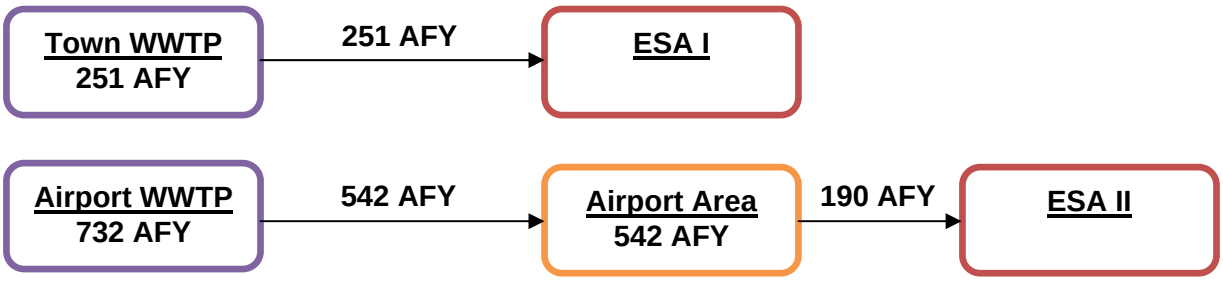
Table 4-3 summarizes key components of Alternative B.

Table 4-3 Alternative B Summary

| Alternative B | Available Recycled Water Supply (AFY) | Demand (AFY) | Supply Limited? | Total Cost ($ mil) | Unit Cost ($/AFY) |
|---|---|---|---|---|---|
| Existing | 751 | 1574 | Yes | $27.0 | $15,000 |
| Future | 984 | 1782 | Yes | | |

Figure 4-2 provides a schematic of how recycled water would be served to customers. Note that the Town and Airport WWTP values represent additional supply after existing demand has been subtracted. This alternative does not have enough supply to serve all potential customers, and it is estimated that an additional 798 AFY would be required to meet customer needs.

Figure 4-2 Alternative B Schematic (Future Scenario)




### 4.1.3 Alternative C – Airport Area + Partial Expanded Service Area I

Alternative C focuses on delivering recycled water to only one of the two ESAs in order to minimize the amount of distribution piping within the Airport Area that must be upsized in order to deliver recycled water to the ESAs.

Alternative C would serve recycled water to customers in the Airport Area and to a selection of the customers in ESA I, as shown on Figure 4-7. The ESA customers considered for Alternative C are within the Town's water service area boundary, are closer to existing recycled water pipelines, and are primarily urban irrigation customers. Pipelines would be sized to accommodate existing and future demands, which includes capacity in the Airport Area pipelines to serve the selection of ESA I customers. This alternative would include over 53,000 feet of pipeline and a new pump station near the airport ponds.

The alternative does not assign all of the recycled water that is projected to be available. This supply could be reserved for additional urban irrigation customers, in which the Town has expressed interest, or could be supplied to vineyards in ESA I. Although vineyards are considered to be less desirable customers than commercial, residential or park customers because of irregular irrigation demands, vineyards could be added as customers in the future without affecting the required diameters of the pipelines in the system since they would not be using water during the peak usage times.

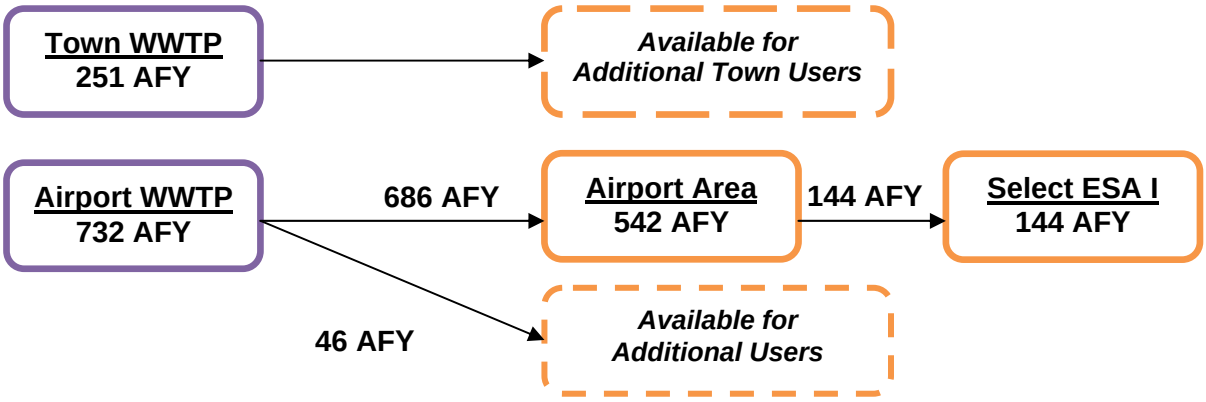
Table 4-4 summarizes key components of Alternative C.

Table 4-4 Alternative C Summary

| Alternative C | Available Recycled Water Supply (AFY) | Demand (AFY) | Supply Limited? | Total Cost ($ mil) | Unit Cost ($/AFY) |
|---|---|---|---|---|---|
| Existing | 751 | 473 | No | $12.8 | $19,000 |
| Future | 984 | 681 | No | | |

Figure 4-3 provides a schematic of how recycled water would be served to customers. Note that the Town and Airport WWTP values represent additional supply after existing demand has been subtracted. This alternative does not use all available recycled water, but it is estimated that 298 AFY is available for additional users.

Figure 4-3 Alternative C Schematic (Future Scenario)




### 4.1.4 Alternative C – Potential Initial Pipeline Phases in Airport Area

Table 4-5 shows several options for potential phases within the Airport Area. The phase options provided are structured to consider alignments, starting at the Airport WWTP, which serve existing customers with high demands and/or to tie in with the existing recycled water system, and that cost approximately $1 million. Each phase option includes the recycled water demands that could be served (existing and total), estimated costs for the project, and some key considerations.

Table 4-5 Potential Initial Pipeline Phases in Airport Area

| # | Existing AFY | Total AFY | Total Alt. C Cost | $/AF[1] | Pipelines[2] | Key Considerations |
|---|---|---|---|---|---|---|
| 1 | 41 | 66 | $938,000 | $14,200 | 124, 122 | Unknown meter location and distribution pipelines required to serve Airport. Lowest $/AF conveyance cost. |
| 2 | 36 | 53 | $1,113,000 | $21,200 | 124, 107, 106, 156 | Serves existing users north of the WWTP with dedicated irrigation meters. |
| 3 | 25 | 42 | $1,556,000 | $37,100 | 124, 107, 106, 105 | Ties into existing Town recycled water pipeline. Smallest existing demand. |
| 4 | 52 | 78 | $1,689,000 | $21,500 | 124, 122, 107, 106 | Highest existing demand. Initiates north and south backbone |

[1]Not inclusive of pump station costs.
[2]Pipeline ID numbers correspond to Figure B-1 in Appendix B.

### 4.1.5 Alternative D – Redevelopment Area

Alternative D was developed to serve recycled water from the Town WWTP to customers in the northern RDA. As shown in Figure 4-8, the customers in the northern RDA include Bell Village, Los Robles Park, Evergreen Mobile Home Park, and parcels within the RDA boundary that are north of Arata Lane. This alternative would include over 8,000 feet of pipeline and a pump station upgrade at the Town WWTP.

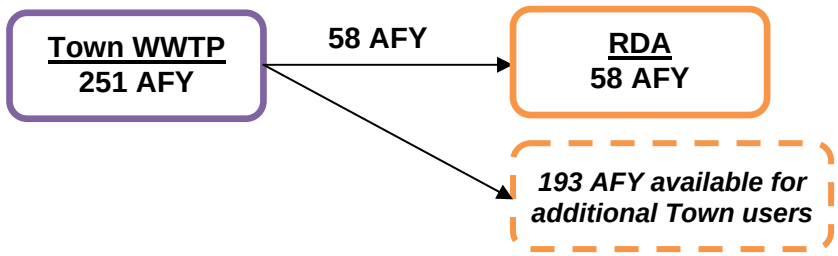
Table 4-6 summarizes key components of Alternative D.

Table 4-6 Alternative D Summary

| Alternative D | Available Recycled Water Supply at Town WWTP (AFY) | Demand (AFY) | Supply Limited? | Total Cost ($ mil) | Unit Cost ($/AFY) |
|---|---|---|---|---|---|
| Existing | 67 | 10 | No | $1.9 | $32,000 |
| Future | 251 | 58 | No | | |

Figure 4-4 provides a schematic of how recycled water would be served to customers. Note that the Town WWTP value represents additional supply after existing demand has been subtracted. This alternative does not use all available recycled water, but it is estimated that 193 AFY is available from the Town WWTP for additional users.

Figure 4-4 Alternative D Schematic (Future Scenario)




## 4.2 Additional Considerations

Alternatives A, C, and D appear to be feasible alternatives based on the projected future supplies and current customer demands. Alternative B could become feasible if customer priorities change and additional recycled water becomes available in the future.

The Town has expressed interest in the development of additional considerations that could be used to evaluate both potential alternatives and pipeline phases within the alternatives. As the Town continues to pursue recycled water planning, the following items could be considered.

Maximized Use of Recycled Water Supply – Alternatives A, C and D do not use all of available recycled water supply and leave open the option to serve other potential customers not identified in this planning update. The Town could consider an alternative that maximizes the

use of recycled water supply. This was not pursued as an alternative in this planning update since customer priorities currently are being assessed and since the Town has expressed interest to reserve some recycled water for potential urban irrigation customers.

Local Service – The Town has expressed a preference that the recycled water generated from the Town and Airport WWTPs be served to their respective areas. The Town could prioritize alternatives or pipeline phases in which recycled water from the Town WWTP serves the RDA and other potential urban irrigation customers and recycled water from the Airport WWTP serves the Airport Area and several ESA customers.

Potable Offset – The Town could prioritize alternatives or pipeline phases that maximize potable offset. Areas that have the most parcels within the boundary of the Town's water service area and, therefore, have the greatest potential for potable offset include the majority of the Airport Area and the northwestern half of ESA I.

Site Retrofit Costs – The Town could prioritize alternatives or pipeline phases that have a greater number of parcels with separate irrigation water meters to minimize site retrofit costs. Alternatively, the Town could consider alternatives with a greater number of undeveloped parcels that might pay their own pipeline costs as part of a mandatory use ordinance.

Agricultural Daytime Demands – The Town may want to consider serving some of the agricultural demands that are identified in the ESAs with recycled water from the Airport WWTP. In particular, there are vineyards in ESA I that could be served by the pipeline projects proposed in Alternative C. Agricultural demands are day-time demands and likely could be served using the proposed pipeline system with no additional upsizing. If the available 297 AFY is used to serve the day-time demands nearby the planned pipelines, this would reduce the unit cost of Alternative C from $19,000 to a lower value, depending on how much could be used.

## 4.3 Regulatory Considerations

Several regulatory considerations that may affect this project were explored in order to assist with the future implementation of the proposed alternatives.

### 4.3.1 Incidental Runoff

The North Coast Regional Board has a zero tolerance for discharge of treated tertiary water to existing watercourses. The regulatory environment related to incidental runoff has changed significantly to allow compliance using more reasonable Best Management Practices (BMPs) in the North Coast Region, and incidental runoff from sites irrigated with recycled water has been formally exempted from the Basin Plan seasonal discharge prohibition by the NCRWQCB. Kennedy/Jenks understands that the Town employed storm gates as a measure to comply with the seasonal discharge prohibition that existed for recycled water runoff when the original recycled water projects were placed into operation. It is the opinion of Kennedy/Jenks that the Town no longer needs to use the storm gates and they can be removed or permanently placed into an open position. This will require, however, that the Town incorporate the appropriate language into the Phase 2 Stormwater Permit and the upcoming WDR that will be renewed for the WWTP in 2012. In general, BMPs required under a stormwater permit are operational (not capital) and are common to irrigation sites regardless of water source.

### 4.3.2 Water Service Area Jurisdiction

Under state law, only water service providers make decisions regarding delivery of recycled water within their service area. A wastewater entity is allowed to serve recycled water in a water agency's service area, only if there is an express written approval from the local water service provider. Kennedy/Jenks is not aware of any regulatory hurdle associated with serving recycled water outside of an agency's wastewater service area. There may be institutional issues that must be negotiated, but not from a regulatory perspective.

### 4.3.3 Comingling Recycled Water from Different Sources

With respect to comingling recycled water produced by the Town and Agency's WWTPs, Kennedy/Jenks knows of no specific regulatory hurdles; however, regulatory and inter-agency coordination will be required. The compliance point for producing Disinfected Tertiary Recycled Water is within the WWTP following disinfection. If the recycled water is compliant at this location within the Town's and Agency's facilities, it can be comingled and delivered for any approved use under Title 22. In the event there was an accident, such as a pond embankment failure or a pipeline break that resulted in a discharge, the owner and operator of the facility in question would be responsible, regardless of where the water was produced. This is an issue that could be reviewed by legal counsel, clarified in an inter-agency agreement between the Town and Agency, and communicated to the NCRWQCB.

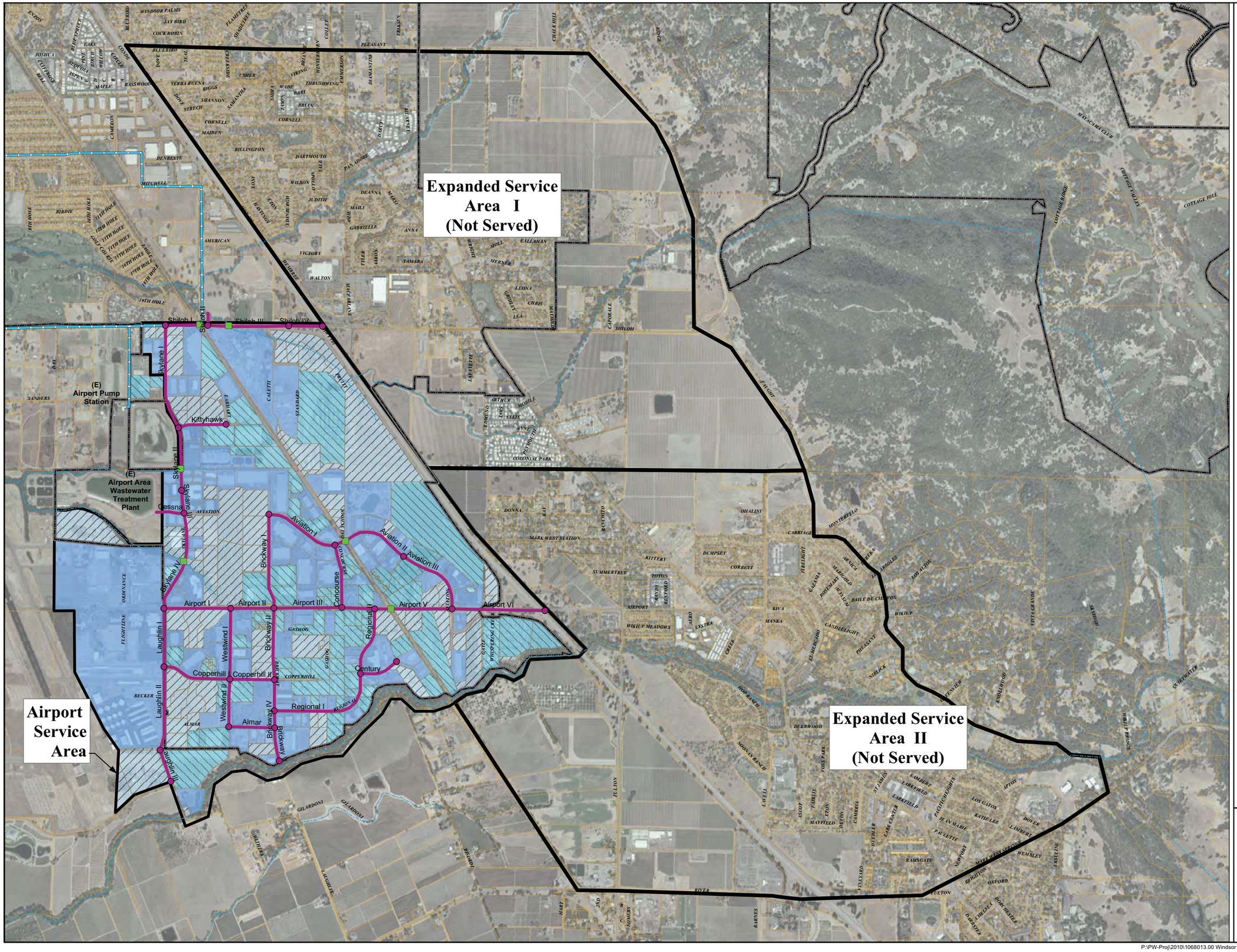
With respect to use of comingled recycled water onsite, the responsibility for onsite use is that of the designated Site Supervisor for overspray and runoff or irrigation line breaks and leaks, etc. The requirements for cross-connection testing and so forth would be coordinated by the Town and the Site Supervisor. The Town is responsible as it is the water entity serving the recycled water and billing the customer.

### 4.3.4 Other Regulatory Considerations

It is expected that the Town and Agency would need to communicate institutional arrangements to the NCRWQCB and any reporting requirements they may have. Since the Agency's WWTP does not have a discharge permit, it is possible that the NCRWQCB would want to verify that none of the Agency's recycled water is discharged by the Town. Because the State Water Resources Control Board issued a revised State Policy on Recycled Water that specifically is designed to promote and maximize the use of recycled water statewide, and to remove unreasonable regulatory barriers to using recycled water, Kennedy/Jenks does not see this issue as being more than a point of regulatory coordination (not a hurdle or fatal flaw) with the NCRWCB.

During the drought, the State mandated reductions in water diversions from the Russian River and this translated to restrictions on irrigating commercial landscaping in the Airport Area. Again, in reference to the new State Policy on Recycled Water, the use of recycled water in a joint Town/Agency project would create a potable offset that permanently eliminates the use of potable water (from the Russian River or wells) for irrigation in the Airport Area. Kennedy/Jenks does not see any possibility that such a project would create a risk to the Town or Agency from action by the SWRCB. Kennedy/Jenks does not believe the State can mandate removal of turf in any event, as the State can only restrict water diversions from waters of the state, and cannot

dictate what private citizens and companies do on their property (like install turf). A mandate on turf removal would appear to be under the purview of local planning departments.




TOWN OF WINDSOR

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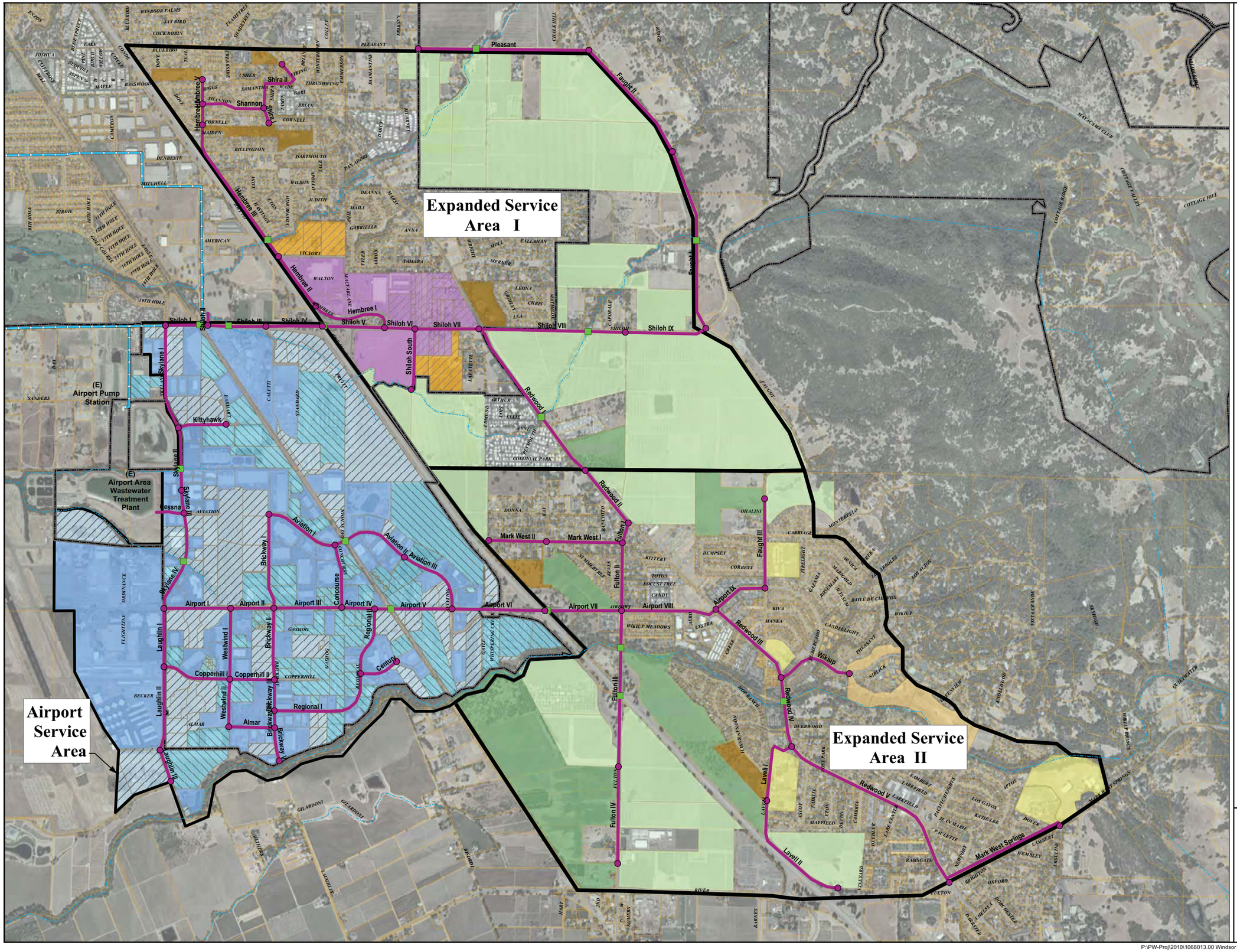
Sonoma County Airport Area
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Town of Windsor, California

**ALTERNATIVE A**
**AIRPORT AREA**
**RECYCLED WATER PROJECT**

May 2011

**Figure 4-5**

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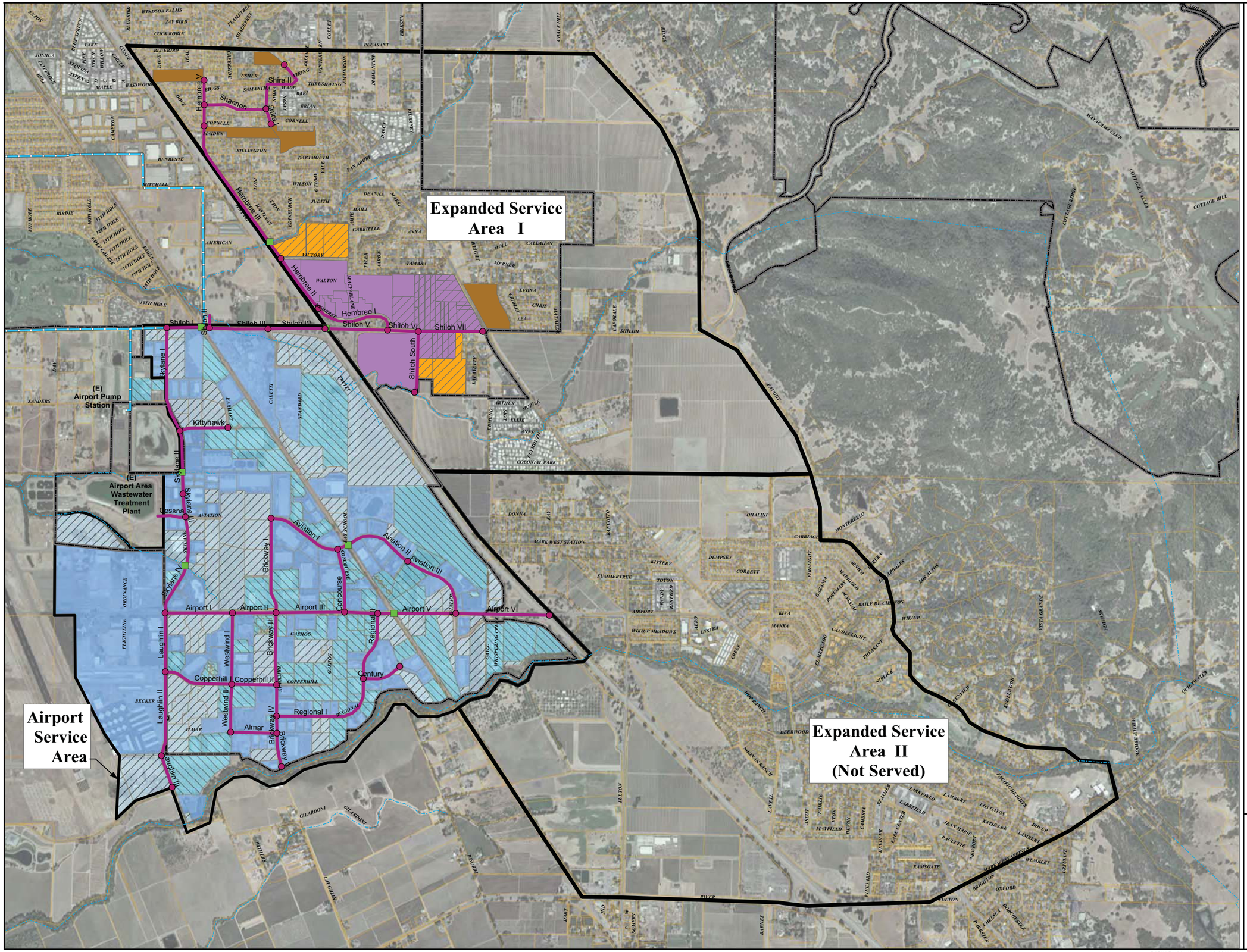
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**ALTERNATIVE B**
**AIRPORT AREA AND ESA I & II**
**RECYCLED WATER PROJECT**

May 2011

**Figure 4-6**

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TOWN OF WINDSOR

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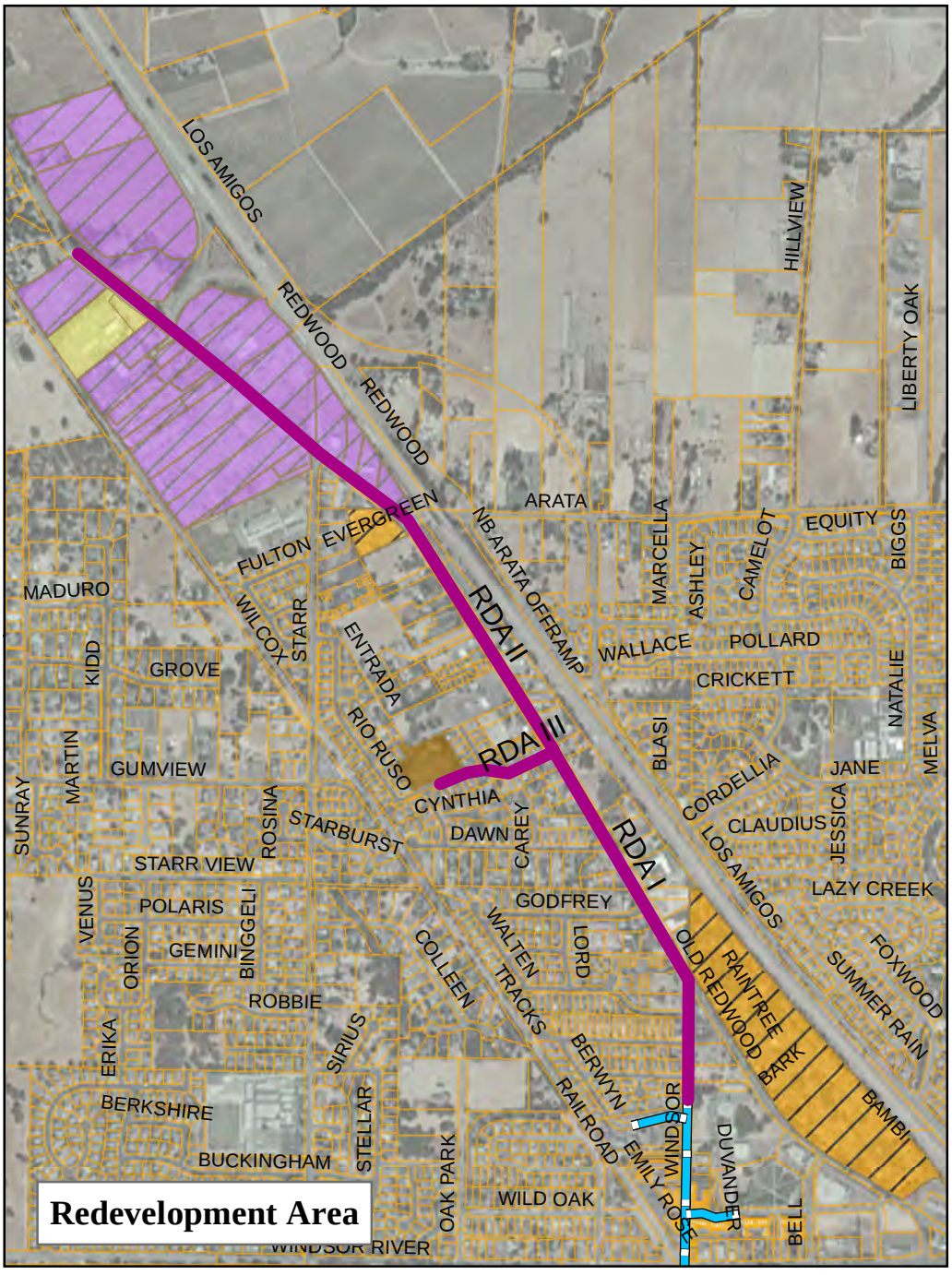
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**ALTERNATIVE C**
**AIRPORT AREA AND PARTIAL ESA I**
**RECYCLED WATER PROJECT**

May 2011

**Figure 4-7**

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TOWN OF WINDSOR

**Legend**

- RDA Pipelines
- Existing Recycled Water Pipelines
- Existing Commercial
- Existing Municipal or School
- Existing Park
- Existing Residential
- Future Commercial
- Future Residential

N

0 250 500 1,000
Feet

**Kennedy/Jenks Consultants**

Sonoma County Airport Area
Recycled Water Planning Update
Town of Windsor, California

**ALTERNATIVE D**
**REDEVELOPMENT AREA**
**RECYCLED WATER PROJECT**

May 2011

**Figure 4-8**

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# Section 5: Conclusion

The recycled water balance shows that approximately 751 AFY is available in dry hydrologic years from the Town and Airport WWTPs under existing flow conditions. Based on ABAG growth rates, approximately 984 AFY would be available in the future. The majority of the available supply is from the Airport WWTP.

The market assessment estimates the existing irrigation demands in the Airport Area currently are 379 AFY and would grow to be 542 AFY at full development. The Town of Windsor's RDA demand is about 58 AFY. Expanded Service Areas I and II have total demands of 425 AFY and 815 AFY, respectively.

Four concept alternatives were considered. Alternative A would serve only the Airport Area. Alternative B would serve the Airport Area and all of the ESAs. Alternative C would serve the Airport Area and a few properties in ESA I to optimize the supply and demand. Alternative D would serve only the RDA using flow from the Town WWTP.

Based on the projected future supplies, it appears that Alternatives A, C, and D are alternatives in which the supply is projected to meet the demand. Alternative B could be feasible if growth and supply increased more than expected. Alternative A would serve 542 AFY in future conditions and has an estimated, conceptual-level project cost of $8.9 million. Alternative C would serve 681 AFY in future conditions and has an estimated, conceptual-level project cost of $12.8 million. Alternative D would serve 58 AFY in future conditions and has an estimated, conceptual-level project cost of $1.9 million.

Both alternatives A and C do not show all available recycled water being used by the demands identified in the areas considered in this project. This means that there is projected to be some quantity of recycled water available for potential customers elsewhere. The Town has expressed a preference that the recycled water generated from the Town and Airport WWTPs be served to their respective areas. The Town may want to consider potential customers within the Town boundary using flows from the Town WWTP, which could offer additional potable water offsets within the Town's water service area. The Town may also want to consider serving some of the agricultural demands that are identified in the ESAs with recycled water from the Airport WWTP. In particular, there are vineyards in ESA I that could be served by the pipeline projects proposed in Alternative C. Agricultural demands are day-time demands, whereas the demands already included in Alternative C are entirely night-time. This means that these agricultural demands could likely be served with the proposed pipeline system, with no additional upsizing.

## References


Brelje & Race Consulting Engineers. *Evaluation of Joint Operation of the Water Reclamation Systems of the Airport-Larkfield-Wikiup Sanitation Zone, the Town of Windsor, and the City of Santa Rosa Subregional Reclamation System*. August 2005.

Brelje & Race Consulting Engineers. *Water and Wastewater Services Report, New Replacement Hospital Project*, Sutter Medical Center of Santa Rosa. 2009.

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RMC. *Town of Windsor Growth Control Report*. October 2010.

RMC. *Draft Technical Memorandum, Windsor NPDES Permit.* "Water Reclamation Treatment, Storage, and Disposal Water Balance Analysis Model V2.3." October 15, 2009.

Sonoma County Water Agency and Town of Windsor. *First Amendment to Agreement Between Airport-Larkfield-Wikiup Sanitation Zone and the Town of Windsor Regarding the Ownership, Construction, Operation and Maintenance of Wastewater Facilities to Permit the Transfer, Storage, and Disposal of Treated Wastewater of a Mutual-Aid Basis*. January 2009.

Town of Windsor. *Draft Water Master Plan Update*. 2007.

Town of Windsor. *Urban Water Management Plan*. 2010

# Appendix A

Town Water Balance

# Appendix A: Town Water Balance

A.1 RMC. *Draft Technical Memorandum, Windsor NPDES Permit.* "Water Reclamation Treatment, Storage, and Disposal Water Balance Analysis Model V2.3." October 15, 2009.

# Appendix A



**Water Balance Analysis Model V2.3**

**Model Inputs**

**General Assumptions**

| | |
|---|---|
| Treatment Plant Influent Flow, ADWF (MGD) = | 1.40 |
| Annual Rainfall Condition [1=Wet, 2= Ave or 3= Dry]= | Dry |
| Creek Discharge Location [1=MWC, 2=RR or 3=None] = | MWC |
| Maximum Creek Discharge (percent of receiving flow) = | 1.00% |
| Average Irrigation Rate (inches per year) = | 30 |
| Assumed Total Storage Capacity [includes ERSP storage, if applicable] (MG) = | 165 |
| Dead Storage (percent of total) = | 10% |
| Assumed SCWA Storage Capacity dedicated to Windsor (MG) = | 50 |
| Frost Protection and Shone Pond demands met in Dry Years? (1=Yes, 0=No) = | 1 |
| Storage Pond Permeability (centimeters per second) = | 0.000001 |
| Assumed Pond Evaporation Area (acres per MG) = | 0.2864 |
| Assumed Pond Direct Rainfall Area (acres per MG) = | 0.3448 |
| Average Annual Geysers Disposal (MGD) [0, 0.5, 0.75,1.25] = | 0.5 |
| Carryover Storage from Previous Year (MG) = | 41 |
| Creek Discharge Maximum Pumping Capacity assumed (MGD) = | 8.64 |

**Irrigation Assumptions (Equivalent or Real acres, as indicated)**

| Discretion Irrigation | Private Irrigation | Urban Irrigation | Shone & Gallo | Frost Protection |
|---|---|---|---|---|
| 88 | 42 | 225 | 112 | 97 |
| Eq. acres | Eq. acres | Eq. acres | Eq. acres | Real Acres |

**Storage Targets**

| Month | EOM Storage Target (%) | EOM Storage Target (MG) |
|---|---|---|
| Oct | 20% | 33.0 |
| Nov | 30% | 49.5 |
| Dec | 50% | 82.5 |
| Jan | 70% | 115.5 |
| Feb | 85% | 140.3 |
| Mar | 92% | 151.0 |
| Apr | 92% | 151.0 |
| May | 85% | 140.3 |
| Jun | 65% | 107.3 |
| Jul | 45% | 74.3 |
| Aug | 30% | 49.5 |
| Sep | 25% | 41.3 |

**Discharge Priorities**

| Discharge Option | Priority |
|---|---|
| Geysers | Baseline |
| Urban Irrigation | 1.0 |
| Shone & Gallo | 2.0 |
| Frost Protection | 3.0 |
| Private Irrigation | 4.0 |
| Send RW to SCWA | 5.0 |
| Refill Shone Pond | 6.0 |
| Discretionary Irrigation | 7.0 |
| Mark West Creek | 8.0 |
| Excess Flows to Geysers | 9.0 |

**Model Outputs**

**Scenario:**
**Hydrology = Dry**
**ADWF = 1.4 MGD**
**Geysers = 0.5 MGD**
**Storage = 165 MG**

**Reliability of Deliveries (as a Percent of Customer Demands)**

| Month | Geysers | Urban Irrigation | Shone & Gallo Irrigation | Shone Pond Refilling | Frost Protection | Private Irrigation | Discretion Irrigation |
|---|---|---|---|---|---|---|---|
| Oct | 100% | 100% | 100% | ND | ND | 100% | ND |
| Nov | 100% | ND | ND | ND | ND | ND | ND |
| Dec | 100% | ND | ND | ND | ND | ND | ND |
| Jan | 100% | ND | ND | ND | ND | ND | ND |
| Feb | 100% | ND | ND | 14% | 100% | ND | ND |
| Mar | 100% | ND | ND | 86% | 100% | ND | ND |
| Apr | 100% | 100% | 100% | ND | 100% | 100% | ND |
| May | 100% | 100% | 100% | ND | ND | 100% | 0% |
| Jun | 100% | 100% | 100% | ND | ND | 100% | 0% |
| Jul | 100% | 100% | 100% | ND | ND | 100% | 0% |
| Aug | 100% | 100% | 100% | ND | ND | 100% | 0% |
| Sep | 100% | 100% | 100% | ND | ND | 100% | 0% |
| Note: "ND" = No Demand | | | | 100% | <---% Annual Shone Farm Demand Met | | |

**Potable Water Offset as a Result of RW Deliveries (Million Gallons)**

| Urban Irrigation | Shone & Gallo Irrigation | Shone Pond Refill | Frost Protection | Private Irrigation | Discretion Irrigation | Total |
|---|---|---|---|---|---|---|
| 183 | 91 | 8 | 12 | 34 | 0 | 329 |

**Storage and Disposal (All units in Million Gallons)**

| Month | Geysers Recharge | Urban Irrigation | Shone & Gallo Irrigation | Shone Pond Refilling | Frost Protection Irrigation | Private Irrigation | Excess Flows to Geysers | Discretion Irrigation | SCWA Transfers | Creek Discharge | Total Discharge | Emergency Discharge | EOM Windsor Storage | EOM Shone Storage | EOM SCWA Storage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carryover | | | | | | | | | | | | | 41.3 | 0.0 | 0.0 |
| Oct | 21.7 | 15.6 | 7.8 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 48.0 | 0.0 | 32.5 | 0.0 | 0.0 |
| Nov | 21.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 28.0 | 0.0 | 49.5 | 0.0 | 7.0 |
| Dec | 21.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21.7 | 0.0 | 82.1 | 0.0 | 7.0 |
| Jan | 21.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.0 | 23.9 | 0.0 | 115.5 | 0.0 | 9.1 |
| Feb | 19.6 | 0.0 | 0.0 | 1.1 | 3.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24.6 | 0.0 | 140.3 | 1.1 | 9.1 |
| Mar | 21.7 | 0.0 | 0.0 | 6.9 | 3.9 | 0.0 | 0.0 | 0.0 | 8.0 | 0.0 | 40.5 | 0.0 | 151.0 | 8.0 | 17.1 |
| Apr | 21.0 | 6.6 | 3.3 | 0.0 | 3.9 | 1.2 | 0.0 | 0.0 | 4.5 | 0.0 | 40.5 | 0.0 | 151.0 | 8.0 | 21.6 |
| May | 21.7 | 30.3 | 15.1 | 0.0 | 0.0 | 5.6 | 0.0 | 0.0 | 0.0 | 0.0 | 72.7 | 0.0 | 114.6 | 8.0 | 21.6 |
| Jun | 6.0 | 33.4 | 16.6 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 62.2 | 0.0 | 82.6 | 8.0 | 21.6 |
| Jul | 6.2 | 36.3 | 18.1 | 0.0 | 0.0 | 6.8 | 0.0 | 0.0 | 0.0 | 0.0 | 67.4 | 0.0 | 45.6 | 8.0 | 21.6 |
| Aug | 6.2 | 34.5 | 17.2 | 0.0 | 0.0 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 | 61.0 | 0.0 | 16.5 | 8.0 | 18.3 |
| Sep | 6.0 | 26.8 | 13.3 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 33.1 | 0.0 | 16.5 | 8.0 | 0.4 |
| Total | 194.5 | 183.4 | 91.3 | 8.0 | 11.6 | 34.2 | 0.0 | 0.0 | 21.6 | 0.0 | 523.4 | 0.0 | | | |

**Minimum Number of Days of Storage Buffer (assuming no discharges to MWC):** **20**

**Greenhouse Gas Emissions**

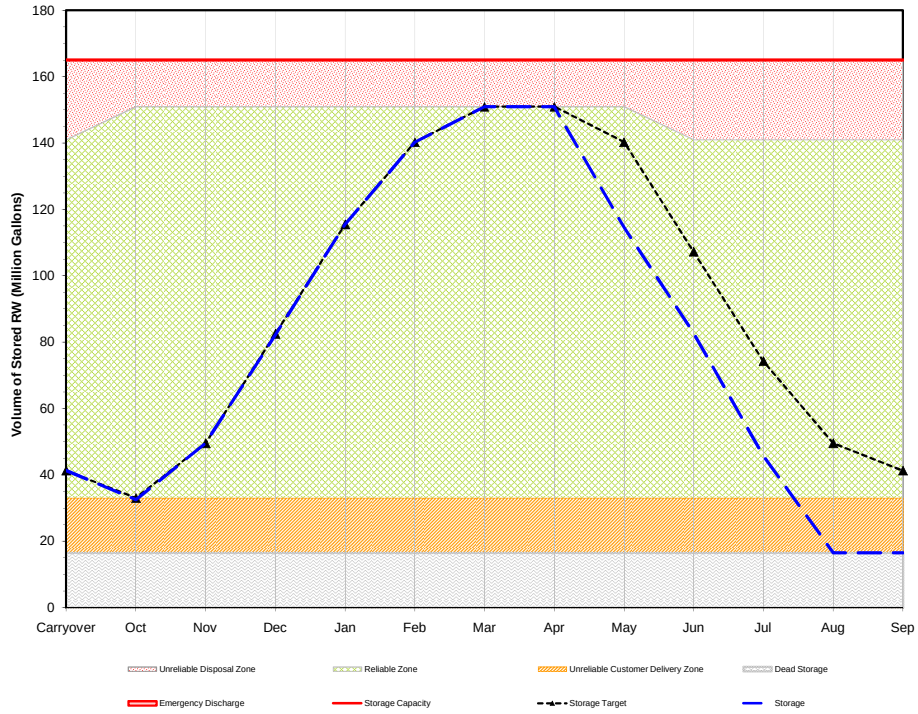
| Component | MGY | kWh | lb $CO_2$ |
|---|---|---|---|
| Geysers[1] | 195 | 2,828,500 | 3,247,000 |
| Pumping to ERSP[2] | 0 | 0 | 0 |
| Creek Discharge[3] | 0 | 0 | 0 |
| GW Irrigation[4] | 508 | 209,500 | 241,000 |
| RW Irrigation from ERSP[5] | 0 | 0 | 0 |
| RW Irrigation from Current Storage[6] | 307 | 241,500 | 277,000 |
| **Total** | | | **3,765,000 lbs of $CO_2$** |

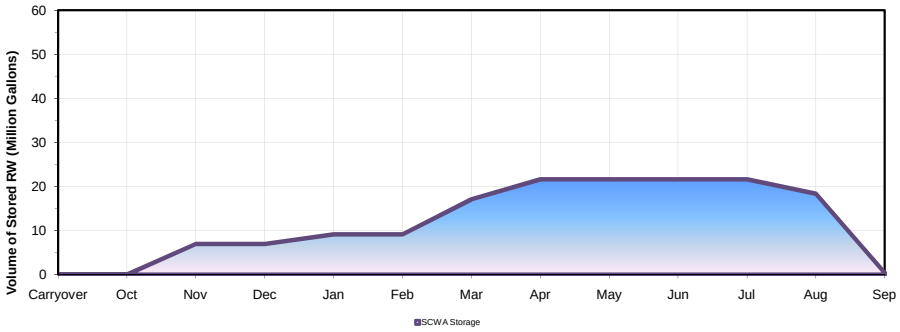
Assumptions:
Assume 1.148 lb/kWh (Climate Action Registry CO2 Emission Coefficient for Electric Power)
[1]Assume 3,700' TDH, 80% pumping efficiency
(These energy requirements are for transporting water from Windsor to Calpine - does not include injection well pumping)
[2]Assume 90' static head pumping + 5% to calculate TDH, 80% pumping efficiency
[3] Assume 190' static head pumping + 5% to calculate TDH, 80% pumping efficiency
[4] Assume 100' static head pumping + 5% to calculate TDH, 80% pumping efficiency, to pump groundwater.
Assumes 1,000 Equivalent acres are being irrigated with GW, less that supplied by RW
[5] Assume 100' static head pumping + 5% to calculate TDH, 80% pumping efficiency.
[6] Assume 190' static head pumping + 5% to calculate TDH, 80% pumping efficiency.

**Model Outputs**

**Scenario:**
**Hydrology = Dry**
**ADWF = 1.4 MGD**
**Geysers = 0.5 MGD**
**Storage = 165 MG**

**Effluent Storage System**
**End of Month Stored Effluent Volume**
**All Active Ponds**




Notes:

1) Unreliable Disposal Zone is a function of ADWF and Geysers disposal capacity.
This zone represents a 20 day storage buffer assuming no disposal other than Geysers.
2) The Unreliable Customer Delivery Zone is calculated as 10% of working storage (above dead storage)
This assumes that as storage increases, buffer space will subsequently increase to provide reliable deliveries to greater irrigation demands
3) Emergency Discharges are discharges or overtopping that occurs once maximum storage is reached.

# Appendix B

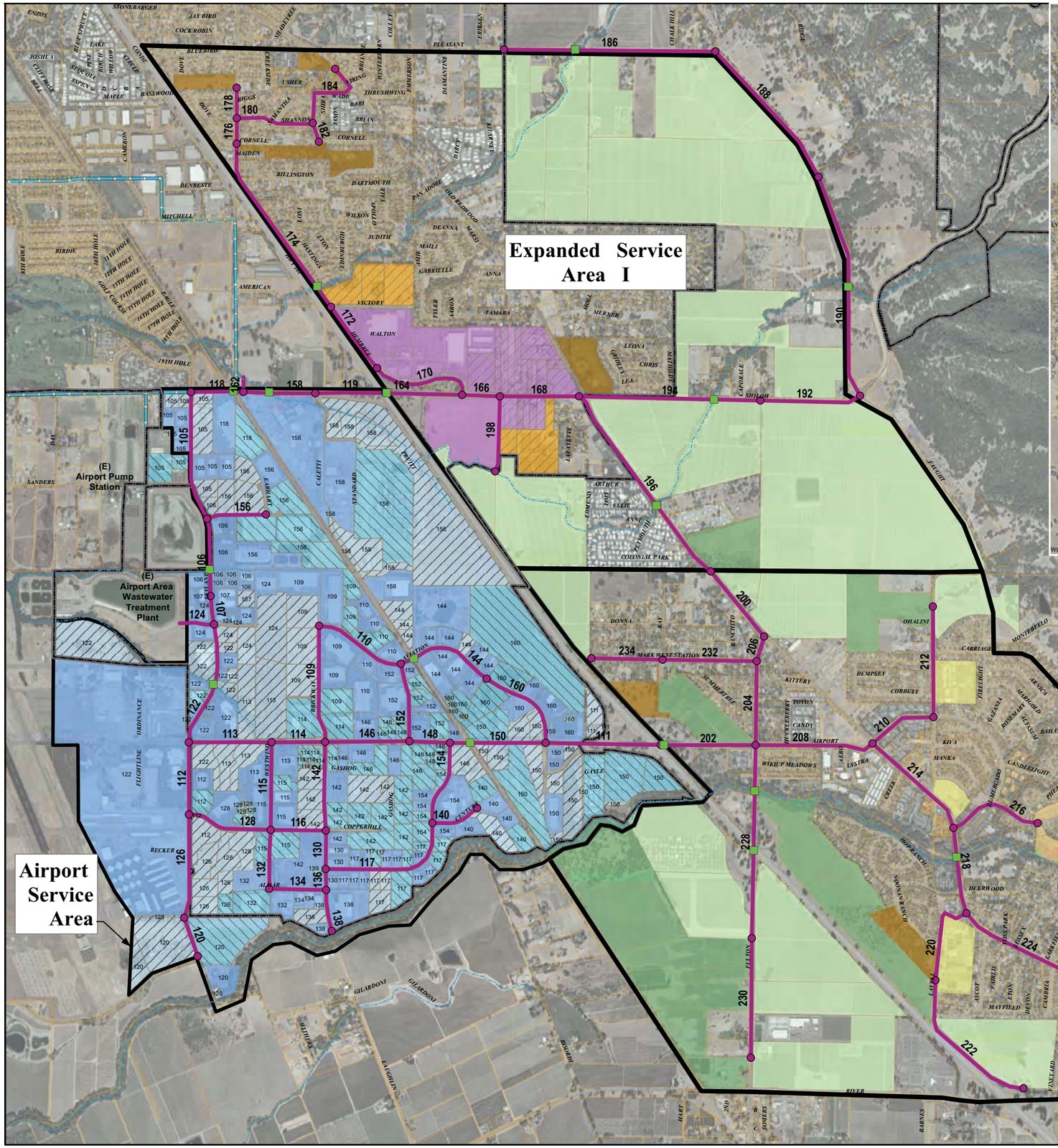
## Expanded Area Market Assessment

# Sonoma County Airport Service Area Recycled Water Irrigation Project
# Irrigation Market Assessment
# Expanded Service Area

| | | | | Full Demands | | | | | Estimated | Selected Demands | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Expanded Service Area** | **Irrigation Period** | **Gross Site Area** | | **Annual Criteria** | **Annual Demand** | **Annual Demand** | **Peak Criteria** | **Peak Demand** | **% of Area Irrigated** | **Annual Demand** | **Annual Demand** | **Peak Demand** | **Comments** |
| | (Day/Night) | (sq ft) | acres | (in/ac-yr) | (AF/yr) | (MG/yr) | (gpm/acre) | (gpm) | | (AF/yr) | (MG/yr) | (gpm) | |
| | | | | | | | | | | | | | |
| Node I (Shiloh Road/Hwy 101): | | | | | | | | | | | | | |
| Vineyard: | Day | 25,769,969 | 592 | 5 | 246 | 80 | 5 | 2,958 | 0% | 0 | 0 | 0 | w/ onsite storage |
| Existing Pasture: | Day | 690,197 | 16 | 30 | 40 | 13 | 13 | 206 | 0% | 0 | 0 | 0 | on demand |
| Existing Town Park Site: | Night | 1,215,132 | 28 | 27 | 63 | 20 | 36 | 1,004 | 100% | 63 | 20 | 1,004 | on demand |
| Existing Commercial: | Night | 2,742,458 | 63 | 6 | 31 | 10 | 12 | 755 | 100% | 31 | 10 | 755 | on demand |
| Future Commercial: | Night | 1,654,539 | 38 | 6 | 19 | 6 | 12 | 456 | 100% | 19 | 6 | 456 | on demand |
| Future Residential: | Night | 1,354,239 | 31 | 10 | 26 | 8 | 19 | 591 | 100% | 26 | 8 | 591 | on demand |
| **Total** | **Day** | 26,460,166 | **607** | | **286** | **93** | | **3,160** | | **0** | **0** | **0** | |
| **Total** | **Existing Night** | 3,957,590 | **91** | | **94** | **31** | | **1,760** | | **94** | **31** | **1,760** | |
| **Total** | **Future Night** | 3,008,778 | **69** | | **45** | **15** | | **1,050** | | **45** | **15** | **1,050** | |
| | | | | | | | | | | | | | |
| Node II (Airport Blvd/Hwy 101): | | | | | | | | | | | | | |
| Vineyard: | Day | 11,892,068 | 273 | 5 | 114 | 37 | 5 | 1,365 | 0% | 0 | 0 | 0 | w/ onsite storage |
| Existing Pasture: | Day | 9,397,411 | 216 | 30 | 539 | 176 | 13 | 2,805 | 0% | 0 | 0 | 0 | on demand |
| Existing Golf Course: | Night | 1,370,949 | 31 | 27 | 71 | 23 | 13 | 409 | 0% | 0 | 0 | 0 | on demand |
| Existing Public/Municipal: | Night | 2,686,339 | 62 | 10 | 51 | 17 | 15 | 925 | 0% | 0 | 0 | 0 | on demand |
| Existing Town Park Site: | Night | 776,843 | 18 | 27 | 40 | 13 | 36 | 642 | 0% | 0 | 0 | 0 | on demand |
| **Total** | **Day** | 21,289,479 | **489** | | **653** | **213** | | **4,170** | | **0** | **0** | **0** | |
| **Total** | **Night** | 4,834,130 | **111** | | **162** | **53** | | **1,980** | | **0** | **0** | **0** | |
| | | | | | | | | | | | | | |
| RDA | | | | | | | | | | | | | |
| Existing Commercial: | Night | 0 | 0 | 6 | 0 | 0 | 12 | 0 | 100% | | | | on demand |
| Existing Public/Municipal: | Night | 222,113 | 5 | 10 | 4 | 1 | 15 | 76 | 100% | | | | on demand |
| Existing Residential | Night | 0 | 0 | 10 | 0 | 0 | 19 | 0 | 100% | | | | on demand |
| Existing Town Park Site: | Night | 111,928 | 3 | 27 | 6 | 2 | 36 | 93 | 100% | | | | on demand |
| Future Commercial: | Night | 3,282,503 | 75 | 6 | 38 | 12 | 12 | 904 | 100% | | | | on demand |
| Future Residential: | Night | 93,835 | 2 | 10 | 2 | 1 | 19 | 41 | 100% | | | | on demand |
| Future Residential (Bell Village): | Night | 1,183,989 | 27 | N/A | 9 | 3 | 19 | 516 | 100% | | | | on demand |
| **Total** | **Existing Night** | 334,041 | **8** | | **10** | **3** | | **170** | | **0** | **0** | **0** | |
| **Total** | **Future Night** | 4,560,327 | **105** | | **48** | **16** | | **1,460** | | **0** | **0** | **0** | |
| | | | | **TOTAL** | **1,299** | **423** | | | **TOTAL** | **139** | **45** | | |

Notes:

1. Annual and Peak Criteria per Town of Windsor 1999 Water Reclamation Master Plan (WRMP) by Brelje & Race, except as noted below.
2. All vineyard areas are assumed to have onsite storage ponds, therefore, the WRMP peak criteria was reduced by a factor of 10.
3. Orchards and Pastures are assumed to be irrigated during daylight hours, when farmers are working on their land, per the WRMP.
4. Site irrigation % are recommendations by Kennedy/Jenks that are intended to reflect the portions of the demand in these areas that might be cost-effectively served.
5. Annual demand for Bell Village taken from the Bell Village Water System Capacity Assessment (RMC, 2010)




TOWN OF WINDSOR

LEGEND

- Pipeline Junctions
- Airport Area, ESA and RDA Pipelines

**Expanded Service Area Customer Classifications**

- Existing Commercial
- Existing Golf Course
- Existing Municipal or School
- Existing Park
- Existing Pasture or Seasonal Crop
- Existing Residential
- Existing Vineyard
- Future Commercial
- Future Residential

**Airport Area Customer Classifications**

- Dedicated Irrigation Meter
- No Dedicated Irrigation Meter
- Vacant
- Proposed Bore and Jacked Crossings
- Existing Water Ways
- Windsor Water Service Area
- Existing Recycled Water Pipelines

**Kennedy/Jenks Consultants**

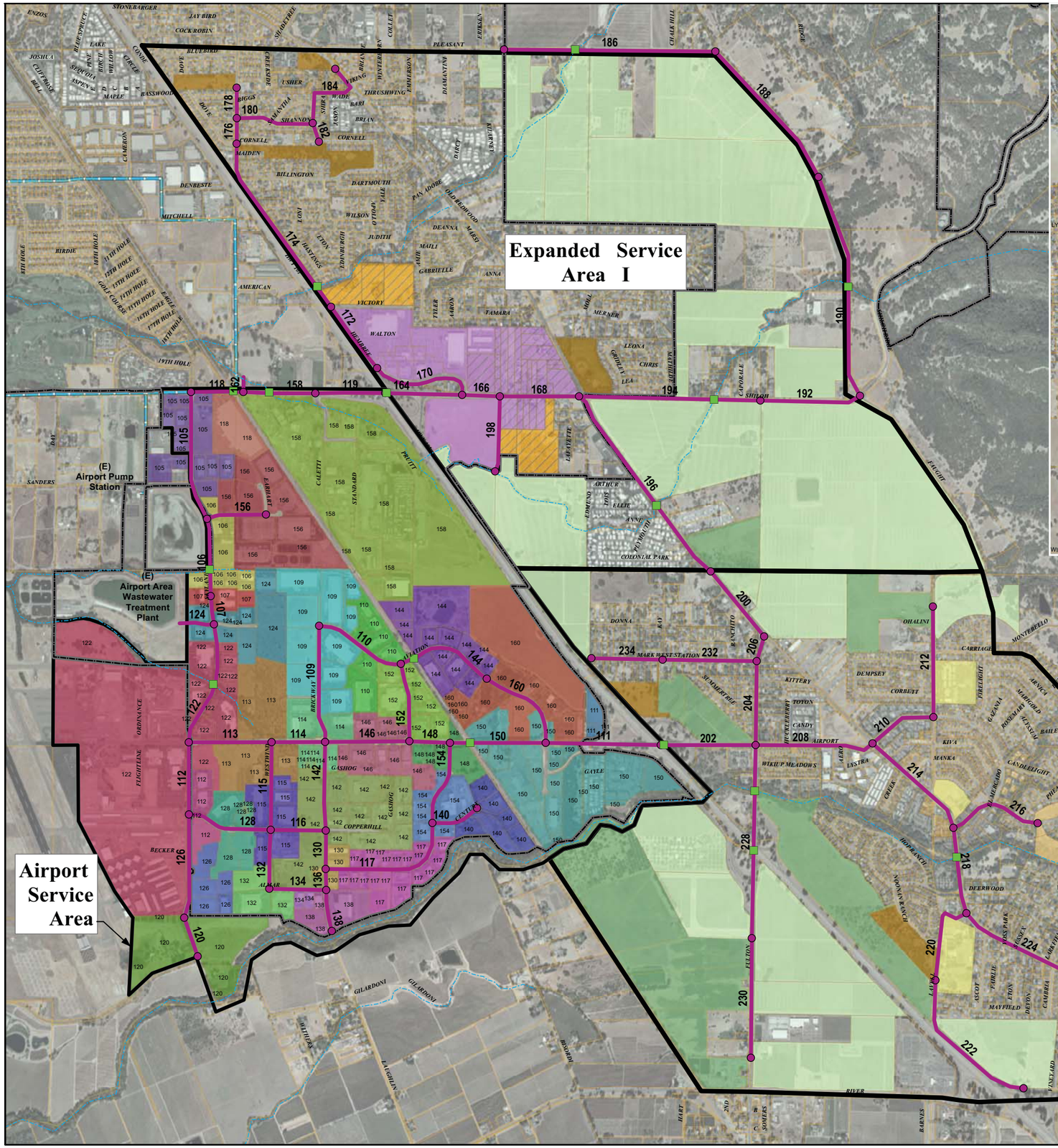
Sonoma County Airport Area
Recycled Water Planning Update
Town of Windsor, California

## POTENTIAL AIRPORT AREA CUSTOMERS SERVED BY PROPOSED ALIGNMENTS

May 2011

**Figure B-1**

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TOWN OF WINDSOR

**LEGEND**

- Pipeline Junctions
- Airport Area, ESA and RDA Pipelines

**Expanded Service Area Customer Classifications**

- Existing Commercial
- Existing Golf Course
- Existing Municipal or School
- Existing Park
- Existing Pasture or Seasonal Crop
- Existing Residential
- Existing Vineyard
- Future Commercial
- Future Residential

**Airport Area Parcels Colored By Pipeline Assignment**

105, 106, 107, 109, 110, 111, 112, 113, 114, 115, 117, 118, 120, 122, 124, 126, 128, 130, 132, 134, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160

- Proposed Bore and Jacked Crossings
- Existing Water Ways
- Windsor Water Service Area
- Existing Recycled Water Pipelines

N

0 500 1,000 2,000
Feet

**Kennedy/Jenks Consultants**

Sonoma County Airport Area
Recycled Water Planning Update
Town of Windsor, California

**POTENTIAL AIRPORT AREA CUSTOMERS SERVED BY PROPOSED ALIGNMENTS WITH PIPELINE ASSIGNMENTS SHOWN**

September 2011

**Figure B-2**

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## B.3 Expanded Service Area Market Assessment, Comparison to 2003

| Demand | Gross Site Area (ac) | | Annual Demand (AFY) | |
|---|---|---|---|---|
| | 2011 | 2003 | 2011 | 2003 |
| **ESA I** | | | | |
| Vineyard | 592 | 610 | 246 | 254 |
| Existing Pasture (or Grassland) | 16 | 0 | 40 | 0 |
| Existing Town Park Site | 28 | 21 | 63 | 48 |
| Existing Commercial | 63 | 34 | 31 | 17 |
| Future Commercial | 38 | 25 | 19 | 13 |
| Future Residential | 31 | 30 | 26 | 25 |
| Existing Orchard | 0 | 15 | 0 | 23 |
| **Total ESA I** | **767** | **736** | **425** | **380** |
| **ESA II** | | | | |
| Vineyard | 273 | 420 | 114 | 175 |
| Existing Pasture (or Grassland) | 216 | 58 | 539 | 145 |
| Existing Golf Course | 31 | 0 | 71 | 0 |
| Existing Public/Municipal | 62 | 61 | 51 | 51 |
| Existing Town Park Site | 18 | 42 | 40 | 95 |
| **Total ESA II** | **600** | **581** | **815** | **466** |

# Appendix C

## Concept Alternatives Supporting Information

Appendix C Conveyance System

| Pipe ID | Name[1] | Length (ft) | Alt A Dia. (in) | Alt B Dia. (in) | Alt C Dia. (in) | Alt D Dia. (in) | Bore & Jack | Existing Customers | Existing AFY | Future Customers | Future AFY | Total Customers | Total AFY | Total Alt. A Cost[2] | $/AF[2,3] | Total Alt. B Cost[2] | $/AF[2,3] | Total Alt. C Cost[2] | $/AF[2,3] | Total Alt. D Cost[2] | $/AF[2,3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Airport Area Pipelines** | | | | | | | | | | | | | | | | | | | | | |
| 105 | Skylane I | 1,995 | 14 | 18 | 16 | | | 9 | 9 | 5 | 6 | 14 | 15 | $349,000 | $24,000 | $449,000 | $31,000 | $399,000 | $27,000 | $0 | $0 |
| 106 | Skylane II | 1,190 | 14 | 18 | 18 | | 1 | 9 | 7 | 1 | 1 | 10 | 8 | $358,000 | $44,000 | $418,000 | $51,000 | $418,000 | $51,000 | $0 | $0 |
| 107 | Skylane III | 435 | 14 | 18 | 18 | | | 2 | 3 | 0 | 1 | 2 | 4 | $76,000 | $18,000 | $98,000 | $23,000 | $98,000 | $23,000 | $0 | $0 |
| 109 | Brickway I | 1,801 | 8 | 8 | 8 | | | 7 | 20 | 3 | 9 | 10 | 29 | $180,000 | $6,000 | $180,000 | $6,000 | $180,000 | $6,000 | $0 | $0 |
| 110 | Aviation I | 1,430 | 8 | 8 | 8 | | | 6 | 23 | 0 | 0 | 6 | 23 | $143,000 | $6,000 | $143,000 | $6,000 | $143,000 | $6,000 | $0 | $0 |
| 111 | Airport VI | 1,765 | 8 | 20 | 8 | | | 0 | 0 | 3 | 2 | 3 | 2 | $176,000 | $80,000 | $441,000 | $200,000 | $176,000 | $80,000 | $0 | $0 |
| 112 | Laughlin I | 1,105 | 8 | 8 | 8 | | | 2 | 5 | 2 | 3 | 4 | 7 | $110,000 | $15,000 | $110,000 | $15,000 | $110,000 | $15,000 | $0 | $0 |
| 113 | Airport I | 1,267 | 10 | 20 | 10 | | | 2 | 19 | 4 | 16 | 6 | 35 | $158,000 | $5,000 | $317,000 | $9,000 | $158,000 | $5,000 | $0 | $0 |
| 114 | Airport II | 820 | 8 | 20 | 8 | | | 16 | 9 | 0 | 0 | 16 | 9 | $82,000 | $9,000 | $205,000 | $22,000 | $82,000 | $9,000 | $0 | $0 |
| 115 | Westwind I | 1,346 | 8 | 8 | 8 | | | 6 | 12 | 0 | 0 | 6 | 12 | $135,000 | $12,000 | $135,000 | $12,000 | $135,000 | $12,000 | $0 | $0 |
| 116 | Copperhill II | 846 | 8 | 8 | 8 | | | 0 | 0 | 0 | 0 | 0 | 0 | $85,000 | N/A | $85,000 | N/A | $85,000 | N/A | $0 | $0 |
| 117 | Regional I | 2,155 | 8 | 8 | 8 | | | 17 | 10 | 2 | 3 | 19 | 13 | $216,000 | $16,000 | $216,000 | $16,000 | $216,000 | $16,000 | $0 | $0 |
| 118 | Shiloh I | 805 | 12 | 12 | 12 | | | Existing Pipeline | | | | | | | | | | | | | |
| 119 | Shiloh IV | 1,072 | 8 | 16 | 16 | | | 0 | 0 | 0 | 0 | 0 | 0 | $107,000 | N/A | $214,000 | N/A | $214,000 | N/A | $0 | $0 |
| 120 | Laughlin III | 625 | 8 | 8 | 8 | | | 1 | 9 | 5 | 11 | 6 | 20 | $62,000 | $3,000 | $62,000 | $3,000 | $62,000 | $3,000 | $0 | $0 |
| 122 | Skylane IV | 1,919 | 14 | 20 | 14 | | 1 | 9 | 35 | 7 | 16 | 16 | 51 | $486,000 | $10,000 | $630,000 | $12,000 | $486,000 | $10,000 | $0 | $0 |
| 124 | Cessna | 532 | 14 | 30 | 24 | | | 5 | 5 | 4 | 9 | 9 | 15 | $93,000 | $6,000 | $200,000 | $14,000 | $160,000 | $11,000 | $0 | $0 |
| 126 | Laughlin II | 1,594 | 8 | 8 | 8 | | | 1 | 1 | 4 | 6 | 5 | 7 | $159,000 | $22,000 | $159,000 | $22,000 | $159,000 | $22,000 | $0 | $0 |
| 128 | Copperhill I | 1,310 | 8 | 8 | 8 | | | 9 | 7 | 3 | 5 | 12 | 12 | $131,000 | $11,000 | $131,000 | $11,000 | $131,000 | $11,000 | $0 | $0 |
| 130 | Brickway III | 589 | 8 | 8 | 8 | | | 2 | 1 | 2 | 0 | 4 | 1 | $59,000 | $50,000 | $59,000 | $50,000 | $59,000 | $50,000 | $0 | $0 |
| 132 | Westwind II | 902 | 8 | 8 | 8 | | | 3 | 7 | 0 | 0 | 3 | 7 | $90,000 | $13,000 | $90,000 | $13,000 | $90,000 | $13,000 | $0 | $0 |
| 134 | Almar | 872 | 8 | 8 | 8 | | | 2 | 1 | 0 | 0 | 2 | 1 | $87,000 | $163,000 | $87,000 | $163,000 | $87,000 | $163,000 | $0 | $0 |
| 136 | Brickway IV | 322 | 8 | 8 | 8 | | | 0 | 0 | 0 | 0 | 0 | 0 | $32,000 | N/A | $32,000 | N/A | $32,000 | N/A | $0 | $0 |
| 138 | Brickway V | 638 | 8 | 8 | 8 | | | 3 | 5 | 1 | 1 | 4 | 7 | $64,000 | $9,000 | $64,000 | $9,000 | $64,000 | $9,000 | $0 | $0 |
| 140 | Century | 755 | 8 | 8 | 8 | | | 5 | 9 | 1 | 2 | 6 | 12 | $75,000 | $6,000 | $75,000 | $6,000 | $75,000 | $6,000 | $0 | $0 |
| 142 | Brickway II | 1,360 | 8 | 8 | 8 | | | 11 | 17 | 5 | 9 | 16 | 26 | $136,000 | $5,000 | $136,000 | $5,000 | $136,000 | $5,000 | $0 | $0 |
| 144 | Aviation II | 1,546 | 8 | 8 | 8 | | 1 | 9 | 14 | 4 | 4 | 13 | 18 | $305,000 | $17,000 | $305,000 | $17,000 | $305,000 | $17,000 | $0 | $0 |
| 146 | Airport III | 1,292 | 8 | 20 | 8 | | | 10 | 16 | 0 | 0 | 10 | 16 | $129,000 | $8,000 | $323,000 | $21,000 | $129,000 | $8,000 | $0 | $0 |
| 148 | Airport IV | 623 | 8 | 20 | 8 | | | 5 | 8 | 1 | 3 | 6 | 11 | $62,000 | $6,000 | $156,000 | $14,000 | $62,000 | $6,000 | $0 | $0 |
| 150 | Airport V | 1,466 | 8 | 20 | 8 | | 1 | 7 | 25 | 12 | 13 | 19 | 38 | $297,000 | $8,000 | $517,000 | $14,000 | $297,000 | $8,000 | $0 | $0 |
| 152 | Concourse | 1,201 | 8 | 8 | 8 | | | 9 | 15 | 0 | 0 | 9 | 15 | $120,000 | $8,000 | $120,000 | $8,000 | $120,000 | $8,000 | $0 | $0 |
| 154 | Regional II | 1,299 | 8 | 8 | 8 | | | 7 | 7 | 0 | 0 | 7 | 7 | $130,000 | $18,000 | $130,000 | $18,000 | $130,000 | $18,000 | $0 | $0 |
| 156 | Kittyhawk | 912 | 8 | 8 | 8 | | | 5 | 19 | 3 | 6 | 8 | 25 | $91,000 | $4,000 | $91,000 | $4,000 | $91,000 | $4,000 | $0 | $0 |
| 158 | Shiloh III | 1,104 | 10 | 16 | 16 | | 1 | 2 | 18 | 10 | 37 | 12 | 55 | $288,000 | $5,000 | $371,000 | $7,000 | $371,000 | $7,000 | $0 | $0 |
| 160 | Aviation III | 1,467 | 8 | 8 | 8 | | | 12 | 39 | 2 | 2 | 14 | 41 | $147,000 | $4,000 | $147,000 | $4,000 | $147,000 | $4,000 | $0 | $0 |
| 162 | Shiloh II | 233 | 16 | 16 | 16 | | | Existing Pipeline | | | | | | | | | | | | | |
| **Redevelopment Area Pipelines** | | | | | | | | | | | | | | | | | | | | | |
| | RDA I | 2,723 | | | | 12 | | 2 | 4 | 27 | 39 | 29 | 43 | $0 | $0 | $0 | $0 | $0 | $0 | $408,000 | $9,000 |
| | RDA II | 4,910 | | | | 10 | | 1 | 6 | 0 | 0 | 1 | 6 | $0 | $0 | $0 | $0 | $0 | $0 | $614,000 | $102,000 |
| | RDA III | 862 | | | | 6 | | 0 | 0 | 1 | 9 | 1 | 9 | $0 | $0 | $0 | $0 | $0 | $0 | $65,000 | $7,000 |
| **Extended Area Pipelines** | | | | | | | | | | | | | | | | | | | | | |
| 164/ESA1 | Shiloh V | 1,177 | | 16 | 16 | | 1 | 1 | 6 | 0 | 0 | 1 | 6 | $0 | $0 | $385,000 | $64,000 | $385,000 | $64,000 | $0 | $0 |
| 166/ESA1 | Shiloh VI | 579 | | 16 | 12 | | | 2 | 14 | 11 | 11 | 13 | 25 | $0 | $0 | $116,000 | $5,000 | $87,000 | $3,000 | $0 | $0 |
| 168/ESA1 | Shiloh VII | 1,213 | | 16 | 8 | | | 1 | 23 | 16 | 20 | 17 | 43 | $0 | $0 | $243,000 | $6,000 | $121,000 | $3,000 | $0 | $0 |
| 170/ESA1 | Hembree I | 1,579 | | 12 | 12 | | | 7 | 11 | 0 | 0 | 7 | 11 | $0 | $0 | $237,000 | $22,000 | $237,000 | $22,000 | $0 | $0 |
| 172/ESA1 | Hembree II | 1,177 | | 10 | 10 | | | 1 | 1 | 3 | 14 | 4 | 15 | $0 | $0 | $147,000 | $10,000 | $147,000 | $10,000 | $0 | $0 |
| 174/ESA1 | Hembree III | 2,957 | | 8 | 8 | | | 1 | 11 | 0 | 0 | 1 | 11 | $0 | $0 | $296,000 | $27,000 | $296,000 | $27,000 | $0 | $0 |
| 176/ESA1 | Hembree IV | 394 | | 8 | 8 | | | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $39,000 | N/A | $39,000 | N/A | $0 | $0 |

Appendix C Conveyance System

| Pipe ID | Name[1] | Length (ft) | Alt A Dia. (in) | Alt B Dia. (in) | Alt C Dia. (in) | Alt D Dia. (in) | Bore & Jack | Existing Customers | Existing AFY | Future Customers | Future AFY | Total Customers | Total AFY | Total Alt. A Cost[2] | $/AF[2,3] | Total Alt. B Cost[2] | $/AF[2,3] | Total Alt. C Cost[2] | $/AF[2,3] | Total Alt. D Cost[2] | $/AF[2,3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 178/ESA1 | Hembree V | 466 | | 8 | 8 | | | 1 | 11 | 0 | 0 | 1 | 11 | $0 | $0 | $47,000 | $4,000 | $47,000 | $4,000 | $0 | $0 |
| 180/ESA1 | Shannon | 1,185 | | 8 | 8 | | | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $118,000 | N/A | $118,000 | N/A | $0 | $0 |
| 182/ESA1 | Shira I | 301 | | 8 | 8 | | | 1 | 12 | 0 | 0 | 12 | 12 | $0 | $0 | $30,000 | $3,000 | $30,000 | $3,000 | $0 | $0 |
| 184/ESA1 | Shira II | 1,423 | | 8 | 8 | | | 1 | 6 | 0 | 0 | 6 | 6 | $0 | $0 | $142,000 | $24,000 | $142,000 | $24,000 | $0 | $0 |
| 186/ESA1 | Pleasant | 3,238 | | 8 | | | 1 | 5 | 38 | 0 | 0 | 38 | 38 | $0 | $0 | $474,000 | $12,000 | $0 | $0 | $0 | $0 |
| 188/ESA1 | Faught II | 2,502 | | 8 | | | | 1 | 20 | 0 | 0 | 20 | 20 | $0 | $0 | $250,000 | $13,000 | $0 | $0 | $0 | $0 |
| 190/ESA1 | Faught I | 3,488 | | 12 | | | 1 | 1 | 45 | 0 | 0 | 45 | 45 | $0 | $0 | $673,000 | $15,000 | $0 | $0 | $0 | $0 |
| 192/ESA1 | Shiloh IX | 1,555 | | 14 | | | | 2 | 89 | 0 | 0 | 89 | 89 | $0 | $0 | $272,000 | $3,000 | $0 | $0 | $0 | $0 |
| 194/ESA1 | Shiloh VIII | 2,780 | | 16 | | | 1 | 2 | 30 | 0 | 0 | 30 | 30 | $0 | $0 | $706,000 | $24,000 | $0 | $0 | $0 | $0 |
| 196/ESA1 | Redwood I | 3,375 | | 8 | | | 1 | 1 | 40 | 0 | 0 | 40 | 40 | $0 | $0 | $487,000 | $12,000 | $0 | $0 | $0 | $0 |
| 198/ESA1 | Shiloh South | 1,157 | | 8 | | | | 2 | 24 | 0 | 0 | 24 | 24 | $0 | $0 | $116,000 | $5,000 | $0 | $0 | $0 | $0 |
| 200/ESA2 | Redwood II | 1,290 | | 8 | | | | 1 | 2 | 0 | 0 | 2 | 2 | $0 | $0 | $129,000 | $65,000 | $0 | $0 | $0 | $0 |
| 202/ESA2 | Airport VII | 1,453 | | 20 | | | 1 | 1 | 31 | 0 | 0 | 31 | 31 | $0 | $0 | $513,000 | $17,000 | $0 | $0 | $0 | $0 |
| 204/ESA2 | Fulton II | 1,286 | | 10 | | | | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $161,000 | N/A | $0 | $0 | $0 | $0 |
| 206/ESA2 | Fulton I | 394 | | 8 | | | | 1 | 13 | 0 | 0 | 13 | 13 | $0 | $0 | $39,000 | $3,000 | $0 | $0 | $0 | $0 |
| 208/ESA2 | Airport VIII | 1,835 | | 12 | | | | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $275,000 | N/A | $0 | $0 | $0 | $0 |
| 210/ESA2 | Airport IX | 1,077 | | 8 | | | | 1 | 8 | 0 | 0 | 8 | 8 | $0 | $0 | $108,000 | $14,000 | $0 | $0 | $0 | $0 |
| 212/ESA2 | Faught III | 1,695 | | 8 | | | | 2 | 64 | 0 | 0 | 64 | 64 | $0 | $0 | $170,000 | $3,000 | $0 | $0 | $0 | $0 |
| 214/ESA2 | Redwood III | 1,821 | | 12 | | | | 1 | 4 | 0 | 0 | 4 | 4 | $0 | $0 | $273,000 | $68,000 | $0 | $0 | $0 | $0 |
| 216/ESA2 | Wikiup | 1,489 | | 8 | | | | 5 | 71 | 0 | 0 | 71 | 71 | $0 | $0 | $149,000 | $2,000 | $0 | $0 | $0 | $0 |
| 218/ESA2 | Redwood IV | 1,328 | | 10 | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $316,000 | N/A | $0 | $0 | $0 | $0 |
| 220/ESA2 | Lavell I | 1,419 | | 10 | | | | 3 | 175 | 0 | 0 | 175 | 175 | $0 | $0 | $177,000 | $1,000 | $0 | $0 | $0 | $0 |
| 222/ESA2 | Lavell II | 2,408 | | 8 | | | | 1 | 13 | 0 | 0 | 13 | 13 | $0 | $0 | $241,000 | $19,000 | $0 | $0 | $0 | $0 |
| 224/ESA2 | Redwood V | 4,129 | | 8 | | | | 0 | 0 | 0 | 0 | 0 | 0 | $0 | $0 | $413,000 | N/A | $0 | $0 | $0 | $0 |
| 226/ESA2 | Mark West Springs | 2,357 | | 8 | | | | 2 | 29 | 0 | 0 | 29 | 29 | $0 | $0 | $236,000 | $8,000 | $0 | $0 | $0 | $0 |
| 228/ESA2 | Fulton III | 2,964 | | 14 | | | 2 | 5 | 232 | 0 | 0 | 232 | 232 | $0 | $0 | $819,000 | $4,000 | $0 | $0 | $0 | $0 |
| 230/ESA2 | Fulton IV | 1,834 | | 10 | | | | 4 | 134 | 0 | 0 | 134 | 134 | $0 | $0 | $229,000 | $2,000 | $0 | $0 | $0 | $0 |
| 232/ESA2 | Mark West I | 1,443 | | 8 | | | | 2 | 31 | 0 | 0 | 31 | 31 | $0 | $0 | $144,000 | $5,000 | $0 | $0 | $0 | $0 |
| 234/ESA2 | Mark West II | 1,092 | | 8 | | | | 1 | 9 | 0 | 0 | 9 | 9 | $0 | $0 | $109,000 | $12,000 | $0 | $0 | $0 | $0 |
| Pump Station | | | | | | | | | | | | | | | | | | | | | |
| | New Pump Station for Alts A, B, C, and Upgrade of Existing Pump Station for Alt D | | | | | | | | | | | | | $700,000 | | $1,800,000 | | $1,300,000 | | $150,000 | |
| **Total** | | **110,944** | | | | | | **256** | **1,584** | **142** | **258** | **1,472** | **1,841** | **$5,918,000** | **$11,000** | **$17,975,000** | **$10,000** | **$8,556,000** | **$13,000** | **$1,237,000** | **$21,000** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $ 12.50 | Pipeline cost per inch-diam/ft | Planning Level Contingency | 25% | $1,479,500 | $4,493,750 | $2,139,000 | $309,250 | |
| $ 150,000 | Estimated cost for each B&J crossing | Engineering, Construction Services and Administration | 25% | $1,479,500 | $4,493,750 | $2,139,000 | $309,250 | |
| | | Total | | **$8,877,000** | **$16,000** | **$26,962,500** | **$15,000** | **$12,834,000** | **$19,000** | **$1,855,500** | **$32,000** |

**Notes:**

[1]Numbering system indicates different sections of pipeline rather than a ranking system.

[2]Costs are in 2011 dollars. Costs for site retrofits are not included.

[3]N/A indicates that pipeline segment does not directly serve customers; however, pipeline segment would be required to connect to other segments with customer connections.

| | Total AFY |
|---|---|
| Alt A | 541 |
| Alt B | 1783 |
| Alt C | 681 |
| Alt D | 58 |