ECONOMICS OF SUSTAINABLE WATER REUSE IN THE NAPA VALLEY

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Background and Introduction

Town of Yountville (Town) currently delivers tertiary treated recycled water to a golf course and 770 acres of vineyards. The Town produces approximately 450 acre-feet (AF) of recycled water annually and delivers approximately 275 AF to customers. In an effort to balance both demands on the local water supplies and compliance with more stringent discharge requirements, the Town is developing a recycled water expansion project that will reuse more of its high quality effluent.

Funded by planning grants from the U. S. Bureau of Reclamation (Bureau) and the State Water Resources Control Board (State Board), the Town's work includes developing a range of project alternatives which have the potential to contribute to the resolution of several regionally-based, watershed specific management problems.

The project area is tributary to the Napa River which supports a number of endangered species and is on the State Water Resources Control Board's list of "impaired water bodies" for sediment, pathogens and nutrients. Restoration of the Napa River is the subject of the award-winning Napa River Plan. Both wastewater discharges and agricultural diversions can negatively impact the habitat of the Napa River. Pumping irrigation water from groundwater aquifers also reduces the flow of water in the Napa River. An expanded recycled water system will reduce discharge and provide an alternative water supply. This is consistent with the Napa River Plan and the Regional Water Quality Control Board's Basin Plan.

While the Town draws its primary water supply from local, state-operated Rector Reservoir, it can supplement this supply with State Water Project (SWP) water. The operation of the SWP and its impact on the Sacramento-San Joaquin Delta is arguably the largest regional water management problem facing California today. An expanded recycled water project could lessen dependence on imported water.

Finally, the groundwater in the Napa Valley is a very valuable and increasingly taxed resource. Some of the Town's recycled water customers do not have any irrigation water source besides the recycled water. The 2050 Napa Valley Water Resources Study (Napa 2050 Study) recognizes that expanded water recycling within the Napa Valley would provide an alternative water supply and reduce demands on the local groundwater basin. Recycled water is also a more sustainable and reliable source of water than the local surface water, which is affected by droughts.

The Town operates a small utility system with a limited rate base of 800 customers and its efforts to responsibly contribute to regionally-based watershed management problems must be developed in the context of being affordable and manageable in the rural context. Specifically the Town has analyzed alternatives for expanding the recycled water system in order to:

- Maximize the recycled water supply delivered to current/future customers
- Minimize discharges to the Napa River

- Establish a flexible system for connecting new customers.

Water Supply Drivers and Benefits

Water Supplies

The Town has defined a study area that includes its municipal boundaries, the California Department of Veterans Affairs Yountville Veteran's Home and approximately 4,000 acres of vineyards within a five mile radius of its existing recycled water pipelines. The study area has four principal sources of water, besides recycled water. These include:

- Rector Reservoir which provides primary water supply to the Town and the Veteran's Home
- Groundwater which provides municipal and agricultural water supply
- The Napa River which provides irrigation supply for some vineyards
- The SWP's North Bay Aqueduct which can provide backup municipal water supply.

The Rector Reservoir supply provides potable water for the Town and the Veteran's Home and environmental water supply to the California Department of Fish & Game. The Town's contractual capacity allowance in Rector Reservoir is 500 AF per year. Based on safe yield reliability analyses developed by the California Department of Water Resources (DWR), this supply is estimated to be reduced to 125 AF per year in dry years.

The Town overlies the Napa Valley groundwater subasin, which provides municipal and agricultural water supply in the area. The Town has developed a groundwater supply system which is anticipated to yield 300 AF when used as an emergency supply. The Napa 2050 Study projects that the safe yield of this basin is 28,000 AF for all users. The Napa 2050 Study indicates that basin demands could exceed supply during dry years by 6,000 AF in 2020 and 10,000 AF in 2050. For preliminary planning purposes, the Town estimated that the study area could experience shortages of 600 to 1,000 AF (10-percent of the total basin shortages) because the 4,600 acre Study Area is approximately 10-percent of the 45,900 acre groundwater basin area. Complicating this simple estimate of potential shortage is the fact that the groundwater supply is subject to geographic variability. Generally, groundwater is available west of the Napa River but much scarcer east of the Napa River.

The Napa County Flood Control and Water Conservations District (District) administers the SWP contract for municipalities in Napa County. The Town had historically held an entitlement for a total SWP contractual amount of 1,100 AF per year. Upon completion of its municipal well, the Town entered into an agreement with the District to sell this entitlement but retain an emergency supply of 25 acre-feet per year (intended to provide fire or short-term supply) and the right to be included in the District's dry-year water bank negotiations for an amount up to 200 AF. The Town is not guaranteed that it will receive the 200 AF and is obligated to pay market price for the water at the time it is secured.

Table 1 summarizes the water supplies available in the study area under normal and dry year conditions.

Table 1. Town of Yountville Water Supplies

Water Source	Full Entitlement	Normal Year	Dry Year
Rector Reservoir	500	500	125
Groundwater	300	300	300
State Water Project	NA	NA	200
Total Municipal Supplies	**1,900**	**1,300**	**625**

Water Demands

The Town is largely developed and land use restrictions within Napa County effectively preclude the expansion of urban uses into the prime vineyard area surrounding the Town. According to both the Town's *Water Supply Plan Supplement* and the Napa 2050 Study, estimated water demand at build-out is 679 AF per year, which is slightly over 8-percent greater than the Town's dry year supplies.

The Town used its water billing database to identify urban water uses that could be offset with recycled water. Table 2 lists the non-residential urban irrigation demand that could be converted to recycled water use and demonstrates that urban irrigation demands are quite modest.

Table 2. Urban Irrigation Use

User	Average Annual Water Use (AF)
Larkspur - Tot Lot	0.20
Yountville Park	2.90
Veterans Park	4.16
Hopper Creek	0.57
Vineyard Park	4.52
Washington St. Path	0.23
Heritage Park	0.62
Oak Leaf Bridge Park	0.02
Forrester Park	1.81
Forrester Creek Path	0.39
Foxglove Pathway	0.26
Van de Leur Park	1.33
Yountville Square Path	0.48
Government Bldg (6550 Yount)	1.80
Government Bldg (6516 Washington)	1.21
Government Bldg (6516 Washington)	0.06
Community Hall	1.71
Totals	22.27

Equally important to the water balance for the study area is the agricultural water demand, because agricultural demands are also placed on the groundwater basin and because recycled water can help offset the need for groundwater pumping. As part of its work, the Town developed estimated

agricultural demands within its study area through the use of a GIS database and historic recycled water delivery rates. Because the Town's water balance indicated that additional seasonal storage would be required to maximize delivery from the recycled water system, it divided the future agricultural customers into two groups.

Agricultural customers that do not receive recycled water from the Town but have the ability to store recycled water in onsite impoundments are considered important "early" targets for conversion because the new infrastructure required to serve them is limited to the conveyance system. These customers are located both east and west of the Napa River, indicating that they may have varying ability to utilize groundwater as an alternative supply. Table 3 presents the agricultural customers with available onsite storage and their projected demands.

Table 3. Agricultural Water Users with Onsite Storage

User	Average Annual Water Use (AF)
Berringer (West of Napa River)	84.0
Herrick (West of Napa River)	59.8
Silverado East	45.4
Silverado West	32.8
Totals	222.0

In addition the Town identified nine agricultural customers within the service area with 111 AF of annual demand but with little or no onsite storage infrastructure. These customers were considered part of a "buildout" or second phase project because of the need to develop additional recycled water storage in order to serve them. These potential customers are also located east and west of the Napa River, indicating that they have varying ability to develop an alternative water supply.

Water Balance

Table 4 summarizes the projected water balance for the Study Area. This water balance indicates that there is the potential for a small shortfall in the urban water supply during critically dry years. However, more importantly, as indicated in the Napa 2050 Study, dry years can challenge the groundwater basin which supports both municipal and agricultural supplies. The Town's ability to provide up to 333 AF of additional recycled water supply could provide an important element of reliability in critically dry years and reduce projected groundwater shortfalls during these periods.

Table 4. Water Supply and Demand Balance in the Study Area

Urban Water Balance	**Normal Year (AF)**	**Dry Year (AF)**
Urban Water Supplies (from Table 1)	1,300	625
Urban Water Demand (Napa 2050 Study)	679	679
Difference (Supply – Demand)	**621**	**(54)**
Additional Agricultural Demands in the Study Area	333	333
Potential Dry Year Groundwater Shortage (Napa 2050 Study)	**0**	**(600-1,000)**

Wastewater Disposal Drivers and Benefits

The Town's wastewater treatment plant, known as the Joint Treatment Plant, produces tertiary treated recycled water that is used for irrigation in the summer and is discharged to the Napa River during between October 1st and May 15th, provided there is sufficient dilution in the Napa River. The Napa River is tributary to the San Pablo Bay estuary, whose remaining tidal wetlands serve in a vital ecological role as nurseries for fisheries and wintering areas for migratory water birds. The Napa River is also habitat for endangered species, such as salmon.

The Basin Plan for the San Francisco Bay Region lists the beneficial uses of the Napa River as:

- Agricultural & municipal water supply
- Habitat for cold and warm water species
- Habitat for rare species
- Spawning habitat
- Wildlife use
- Recreation use
- Navigation use

The Napa River is listed on the State Water Board's 2006 303(d) impaired water bodies list as impaired for nutrients, pathogens, and sedimentation and siltation. The Napa County Flood Control and Water Conservation District has partnered with the U.S. Army Corps of Engineers on an ambitious multi-year restoration program that intended to enhance beneficial uses, improve water quality and reduce flooding. The Town's recycled water program generally supports beneficial uses of the river and restoration of ecological function through the reduction of discharges to the River.

The Town's current National Pollutant Discharge Elimination System (NPDES) permit, which governs its discharge to the Napa River, requires some improvements to the reclamation system; however the Town's water balance generally indicates that the Town can operate within its seasonal discharge limits.

Project Alternatives and Costs

The Town reviewed five conceptual project alternatives that would provide a similar level of water supply in order to allow it to understand how an expanded recycled water program compared to other options in the study area. In developing alternatives and costs, the Town looked at the benefits provided to water supply reliability and developed a qualitative analysis of the beneficiaries from each alternative.

Secure additional SWP supply

Because the Town can receive SWP supply from the North Bay Aqueduct, one alternative would be to secure additional SWP supplies during dry years so that the Town did not need to utilize the potentially over-committed groundwater basin. This alternative is currently not institutionally possible because of limits in the Town's contract with the Napa Flood Control and Water Conservation District.

Tolerate the economic impacts of drought

This alternative would accept 600 – 1,000 AF of dry year shortages, indicating that very little groundwater could be available within the Study Area during critically dry years. According to recent work by the MKF Group, the total value of the wine industry in the Napa Valley can be documented at

$9.5 billion annually. Recognizing that the Study Area is approximately 10-percent of the Napa Valley, its annual economic value can be estimated at $950 million.

In order to develop a preliminary estimate the economic consequences of drought, the Town assumed that a critically dry year would occur once every 100 years and cost the area a year of economic production because of the unavailability of water. Less severe dry years were assumed to occur every 25 years and reduce economic production by one quarter. In order to compare these impacts with the cost of constructing a recycled water system, the Town assumed the system would have a 50 year life. Based on these assumptions, the economic cost of tolerating drought could run as high $24 million over a 50 year period.

Table 5 illustrates this calculation.

Table 5. Cost of Drought

	Chance of Occurrence	**Cost to Annual Economic Activity**		**Cost in Any Given Year**	**Frequency of Incurring Cost in a 50-year period**	**Estimated Cost of Drought Based on Frequency of Occurrence**
		%	**Total**			
Critical Dry Year	1 in 100	100%	$950 million	$9.5 million	0.5	$4.75 million
Ordinary Dry Year	1 in 25	25%	$237.5 million	$9.5 million	2.0	$19.00 million
Total						$23.75 million

All water users in the study area would feel the economic impacts of drought.

Construct an urban reuse system

This alternative would provide approximately 25 AF of dry year water supply benefits by offsetting irrigation use in the Town. While this would help the Town bridge its dry year gap, the volume of urban irrigation water used is quite modest with respect to other demands in the Study Area. While this alternative was not studied in detail because of the small volume of water demand served, it would require the construction of approximately 8,000 linear feet of 6-inch to 8-inch diameter piping in very congested urban conditions. The Town roughly estimated the construction cost at $2,000,000.

Construct a Phase 1 Reuse System

This alternative would provide 222 AF of dry year water supply benefits by connecting the Yountville Veterans Park (an urban user) and four vineyards with onsite storage to the recycled water system. This would reduce demands on groundwater by offsetting some urban and agricultural use. This alternative avoids the need for constructing additional treated effluent storage because available onsite storage ponds are used.

The cost of this alternative is estimated to be $4,300,000 and it provides a significant buffer against potential dry year shortfalls.

Beneficiaries of this alternative include all water users in the study area, both urban and agricultural because it provides reliability above and beyond available supplies.

Construct a Phase 2 Reuse System

This alternative could provide 333 AF of dry year water supply benefits by connecting the Yountville Veterans Park (an urban user) and all agriculture users in the study area to the recycled water system. This would reduce demands on groundwater by offsetting urban and agricultural use. This alternative requires construction 5 million gallons of treated effluent storage because not all agricultural users have available onsite storage ponds.

The cost of this alternative is estimated to be $11.7 million and provides additional buffer against potential dry year shortfalls.

Beneficiaries of this alternative include all water users in the study area, both urban and agricultural because it provides reliability above and beyond available supplies.

Economic Comparison and Conceptual Rate Policies

Table 6 summarizes the cost of each alternative, the water supply delivered, the cost per acre-foot of water delivered and beneficiaries for each alternative considered. Based on the alternatives developed by the Town, the Phase 1 Reuse System provides the best suite of benefits at the least cost. The alternative may also establishes a framework for qualifying for grants because it represents the most cost-effective way to enhance water supply reliability in the region. Both the Phase 1 and Phase 2 projects are more economically effective than tolerating drought, suggesting that even though the Phase 2 project is more expensive to construct, there may be regional value to undertaking this at some point in future. A pure urban reuse project is not an economically effective water supply project, largely because of the very limited amount of water use that can be offset.

Table 6. Summary Economic Comparison

Alternative	Capital Cost	Water Delivered (AF)	Cost per AF	Notes
Additional SWP	NA	NA	NA	Town's contract with Napa Flood Control and Water Conservation District limits amount of SWP available to the Town during dry years
Tolerate Drought	$24.0 million	600	$40,000	Impacts all water users
Urban Reuse System	$2.0 million	25	$80,000	Provides benefit to all water users
Phase 1 Reuse System	$4.3 million	222	$19,369	Provides benefit to all water users
Phase 2 Reuse System	$11.7 million	333	$35,135	Provides benefit to all water users

In order to secure support for the project, the Town went on to develop a set of conceptual rate policies, which helped to quantify the anticipated cost share for each type of project beneficiary.

For the Town, recycling water is an essential component in the overall wastewater system that minimizes effluent discharges into the Napa River and thereby benefitting all customers. As such, the recycled water system has historically been primarily funded with wastewater revenues. For the 2011-12 Fiscal Year, the Town's annual recycled water sales revenue is estimated at $30,000, accounting for approximately 3 percent of total revenues for the Wastewater Utility Enterprise.

The current recycled water rates are negotiated by user agreements. The rate structure is comprised of a fixed monthly meter charge and a usage charge per acre foot based on the amount of recycled water purchased. The meter charge ranges from $150 to $668 per month and does not change annually. For all customers, the consumption charge is $108 per AF, except for Mondavi Vineyards which is charged $103.19 per AF. The consumption charges are escalated 5 percent each year. Table 7 summarizes the Town's current recycled water customers and rates.

Table 7. Current Recycled Water Rates per Contracts

Customer	Monthly Meter Charge	Usage Charge per AF
Vintner's Golf Club	$0.00	$0.00
Chimney Rock	$150.00	$108.00
Stag's Leap	$495.00	$108.00
Clos du Val/Regusci	$667.57	$108.00
Mondavi	$0.00	$103.19

The Town's current recycled water customers have priority to receive recycled water and the Town can always meet the minimum daily flow to each of its users.

Value of Storage

The Town's demand for recycled water is seasonal and fluctuates based on the need for irrigation. The peak season occurs during the dry months between May and October. The off-peak season is the wet season between the months of November and April when there is typically little demand for irrigation. Based on the agreements, only the existing customers have priority to purchase recycled water during the peak season. The proposed expansion project will extend the recycled water system to additional customers allowing them to purchase and store recycled water during the off-peak season. The availability of off-peak storage is an asset that the proposed new customers bring to the system and this contribution needed to be considered in developing a cost sharing framework.

Expansion Project Funding

The recycled water system expansion includes distribution pipelines and other infrastructure that will enable the Town to deliver recycled water to additional customers and thereby minimizing discharges to the Napa River. The proposed project is estimated to cost $4.3 million. The Town evaluated several project funding options in order to understand the potential impact to rates.

> ***Option 1 – 25 percent USBR Grant and 75 percent SRF Loan*:** USBR administers funds for recycled water feasibility and construction projects through the Water Reclamation and Reuse Program (Title XVI), which can provide as much as 25 percent of construction costs with a

maximum of $20 million. The Town secured USBR funding for its planning work and is part of a regional coalition seeking construction funding. To finance the remaining 75-percent of the project costs, the Town can apply for a low interest loan through the Clean Water State Revolving Fund (SRF) Financial Assistance program administered by the State Water Resources Control Board (SWRCB). The SRF loan program offers 20- year fixed-rate loans for eligible recycled water and wastewater projects. The program can currently be used to fund up to $50 million of projects per year. The interest rate is set at roughly one half of the state's general obligation bond rate; current interest rates are approximately 2.6%. Debt repayment is typically secured by an agency's legal pledge to raise rates and fees as needed to repay debt service.

This funding option is the lowest cost option available to the Town with annual debt service payments estimated at $277,000.

***Option 2 - 100 percent SRF Loan*:** If the USBR grant funding is unavailable, the Town may also apply for a SRF loan to pay for the entire project cost. Debt service payments are projected at $302,000 per year.

Option 3 - Revenue Bond and Certificates of Participation (COPs) Financing: Revenue bonds and Certificates of Participation (COPs) are the most common types of debt financing used by utility enterprises, such as water and wastewater agencies. Although there are some technical differences between bonds and COPs, they function almost exactly the same from the issuer's standpoint. Debt repayment is secured by an agency's binding legal pledge to raise rates and charges necessary to repay debt and achieve a specified debt service coverage ratio. Revenue bonds and COPs are typically issued with terms of up to 30 years and offer relatively low tax-exempt municipal interest rates. Debt service estimates for this option are estimate to range from $341,000 to $379,000 depending on the term of the bonds.

Recycled Water Operating Water Costs: The Town does not currently allocate operating costs between the wastewater and recycled water systems because these systems are interrelated. The Town is currently working to quantify appropriate allocation of costs between the wastewater disposal and recycled water operation. Appropriately allocating these costs is key to establishing a rate structure that reflects fair-share cost allocation.

Proposed Recycled Water Rates

The Town would like to implement a two-tiered recycled water rate structure based on customer priority and season to encourage customers to buy recycled water during the off-peak season. The rates for the peak season (May through October) are given priority for the existing customers while the rates for the off-peak season would be designed to reflect the value of onsite storage, which allows new customers to purchase recycled water during the months of November through April. Existing customers may have the option of relinquishing their priority during the summer months during a given year and instead purchase recycled water in the off-peak months at a lower rate.

Conclusions and Lessons Learned

Since 1977, the Town has managed its water recycling system as part of its wastewater disposal strategy. With this planning effort, the Town has worked to set its recycling program within the context of the regional water supply. This viewpoint has helped illustrate the value that recycled water plays within the

Study Area. A selective and targeted recycled water system expansion is the least-cost way to optimize or maximize the regional water supply portfolio.

By reviewing alternative water supply projects together in its planning documents, the Town has been able to develop a conceptual system for allocating program costs and for acknowledging important assets (like onsite storage ponds). This type of comprehensive overview benefitted greatly from available planning documents. As a small community, the Town could not afford to develop a series of unique studies for its program. However by using available documentation to help with a “first-cut” analysis, a small community can position itself well for funding.

Comprehensive review of rate-setting strategies is important during the planning phase. The Town has historically set rates in an “opportunistic” fashion, which helped its program develop. However, as it works to expand its recycled water program, the Town’s efforts to build a rate structure based on benefits and costs positions the program for appropriately flexible growth. The Town is also learning that while it can demonstrate the economic value of the recycled water supply, it is difficult to ensure full cost-recovery from only agricultural water users. The cost of the groundwater supply is relatively low and the economic consequences of drought are rare. Matching public investment with some cost-recovery through agricultural water sales will likely provide the best strategy for expanding the recycled water system.

The Town and its customers have built an effective alternative water supply system that serves agricultural uses and a small community. This current planning effort positions the program as a local, decentralized water supply strategy that will enhance the reliability of community supplies in the 21st century.

References

1. West Yost & Associates (2005), 2050 Napa Valley Water Resources Study.

2. West Yost & Associates (2007), Town of Yountville Water Supply Plan Supplement.

3. Winzler & Kelly (2011), Technical Memoranda 1 and 2 for the Town of Yountville Recycled Water Expansion Project.

4. MKF Group (2005), Economic Impact of Wine and Vineyards in the Napa Valley.