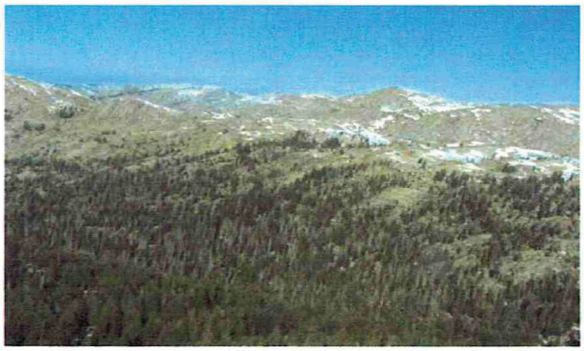
Water Solutions, Inc.



Water Supply Augmentation Feasibility Report

Prepared for the City of Milpitas, California

March 2015

Prepared by: Water Solutions, Inc.

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Water Supply Augmentation Feasibility Report

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March 27, 2015

Executive Summary

Water is one of the most important elements that a city provides for its citizens. We use it ubiquitously and yet we do not appreciate the engineering behind the simple turn of a tap. Milpitas with the rest of California, is going into the fourth year of a drought causing reservoirs and aquifers to be lower and lower. Time is of the essence as there are actions that will likely be required in the immediate future. The purposes of the report are to provide near term actions and long term actions for water supply augmentation. The evaluation of water augmentation includes conservation, recycled water, surface water detention, groundwater, water rights acquisition, desalination and storage.

For six months, Water Solutions, Inc. has researched, studied and honed the technical memoranda into a single document called a "Weighted Sum Decision Matrix" (Decision Matrix) shown as Figure 1. This table weights criteria that can be compared and contrasted among the augmentation tasks. It is an interactive document that tabulates and re-tabulates as you adjust the weighting of criteria. For instance, one criterion that is compared across all tasks would be "ease of implementation". In this case, the higher the number, the easier the task is to implement. Ease of implementation for Task 1: Conservation is weighted with a "1" due to limited conservation staff and customers' conservation behaviors are not easily controlled by the City. Furthermore, conservation behaviors tend to be short term. Ease of implementation for Task 4: Groundwater is weighted with a "5" as drilling a production well is a one time infrastructure improvement. The Criteria are: costs, available water, order of magnitude of infrastructure needed, issues to be resolved, operational and maintenance considerations, effectiveness, reliability, benefit, life cycle, and ease of implementation.

The Decision Matrix can change with each person's point of view. It is the aggregate of those points of view that reveal the best choice. The shown Decision Matrix has weighting of the criteria by Water Solutions as an example. Water Solutions, Inc. encourages the Council to take a tour of the Decision Matrix to see their point of view.

Figure1: Weighted Sum Decision Matrix

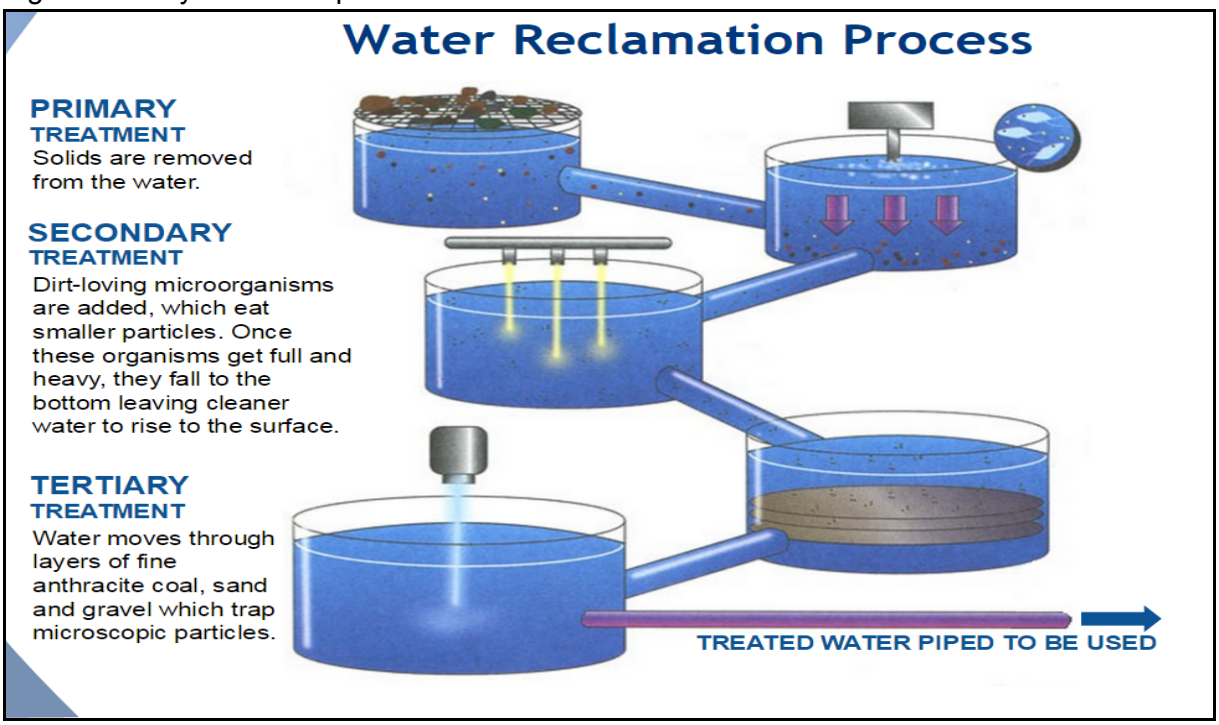
Concerns	Importance	Task 1: Conservation	Task 2: Recycled Water	Task 3: Surface Water Detention	Task 4: New Groundwater Wells (2@2.5 MGD)	Task 5: Water Rights Acquisition (10 MGD)	Task 6: Desalination (10 MGD)	Task 7: Additional Storage Capacity*
Amount of Water Saved (hcf per year)		880,000	272,000	440,000	2,440,000	4,900,000	4,900,000	
Capital Costs		$6,630,000	$37,000,000	$17,700,000	$6,000,000	$76,700,000	$20,000,000	$6,000,000
Operating Costs (per year)		$140,000	$0	$160,000	$1,780,000	$1,000,000	$2,680,000	$60,000
Lifetime (years)		20	75	50	40	50	20	50
Lifetime Costs ($/hcf)		$0.54	$1.81	$1.17	$0.79	$0.52	$0.75	
Available Volume of Water	**5**	4	2	3	3	5	5	1
Order of Magnitude of Infrastructure Needed	**3**	5	3	1	4	1	1	3
Issues to Be Resolved	**5**	1	1	1	4	1	1	3
Operational & Maintenance Considerations	**1**	4	5	1	1	1	1	2
Effectiveness	**5**	3	5	3	3	5	5	1
Reliability	**3**	4	5	5	3	3	3	4
Cost	**4**	1	2	3	5	1	2	4
Benefit	**5**	2	5	4	4	5	5	1
Life Cycle	**2**	2	5	5	4	5	2	5
Ease of Implementation	**5**	1	4	1	5	1	1	3
The higher the score the better the result.	**SCORE**	**94**	**92**	**101**	**145**	**112**	**110**	**77**
								**No water made available, only stored*
Lifetime cost is (capital costs + operating costs * lifetime) / (water saved *lifetime)								

Conservation: Milpitas' residential water usage is within the lower range of Bay Area cities. We recommend that the City continue the existing conservation efforts with the assistance of Santa Clara Valley Water District's (countywide) conservation programs (rebates/house calls). The planned Capital Improvement Program to install smart meters is a valuable tool for water conservation.

Recycled water: The supply of recycled water could be unlimited as it is dependent on population size and is not significantly influenced by weather. However, physical improvements are required at the treatment plant to increase the available water supply. See Additional storage task for discussion of peak shaving. Less than 10% of the discharge is being processed into recycled water. We recommend pursuing recycled water supply. See Figure 2 for a brief overview of the processes that produce recycled water. All of these processes occur at the San Jose-Santa Clara Regional Water Treatment Facility. South Bay Water Recycling adds chlorine to the tertiary water and operates the pipelines, tanks and pump stations that make up the transmission system.

Milpitas has been selling recycled water since 1997. The system could be expanded by 95,320 feet (for about $37 million) of purple pipe to serve cooling tower customers, construction watering, school, parks, golf courses and business irrigation. San Diego recently approved a $6 billion dollar, indirect potable reuse program. While Milpitas does not need to go to that extreme in its water recycling, Milpitas should commit to creating loops to complete a current system of dead-ends. Loops will increase reliability and is necessary for 24-7 type uses such as cooling towers. The investment for pipeline extensions will last for 75 years. There may be some cost to the customer to install on-site piping, but with a reduction of nearly 1 million gallons of potable water per day during peak periods, it is a top three contender for "Go Now".

Figure 2: Recycled water process



Surface water detention: The detention of stormwater for potable water is land intensive (land needed to capture the stormwater) and highly regulated (water supply rights and treatment process). Surface water retention and detention within Santa Clara County is performed by Santa Clara Valley Water District (SCVWD).

Groundwater: Our number one recommendation is to get existing wells producing and drill more if the City desires more independent water supply. Groundwater wells can be improved and new ones drilled. Pinewood Well and Curtis Well should be cleaned to confirm their potential production. If more production is required, then new wells can be drilled for $350,000 per well, treated and connected to the system for about $3 million per well. Milpitas can pump up to 8.2 million gallons per day (mgd) of water out of the aquifer, via Pinewood Well (2.5 mgd), Curtis Well (0.7 mgd) and two new proposed production wells (2.5 mgd each). Starlite Park and Hall Memorial Park, in the west section of the City, are good hydrogeological sites for new wells. Minimal treatment should be required: in-pipe ozonation and/or blending with the water distribution system.

Sustainability of wells is based on the surface water detention and subsequent aquifer recharge as currently performed by SCVWD. Theoretically, recharge credits could be earned if the City were to contribute to the recharge effort by creating more surface retention/detention areas, percolation ponds or bioswales and injection wells.

Surface water rights acquisition: The process of water rights is complicated and expensive, but if water can be found, this diversification can be even more reliable than ground water. Milpitas currently has two sources of water: San Francisco Public Utilities Commission (⅔) and Santa Clara Valley Water District (⅓). However, if the City wishes to pursue the acquisition of water rights, there will be extensive legal fees, before any water is acquired. This is a long-term project and the actual purchase of the rights will be very expensive. Furthermore, if water treatment is required, the cost escalates and the feasibility worsens. Additionally, if the water is far away from the City, the infrastructure (pipes, pumps, etc.) improvement costs and/or wheeling of the water must be included. It is not prudent for City to get into the very expensive and complicated water rights at this time considering the other alternatives. There is a possibility of purchasing unused treated water allotment and our recommendation is to pursue this option.

Desalination: The process of getting potable water from salty water or brackish water is another costly alternative. Australia had a seven year drought and built desalination plants. However, they were decommissioned after the drought ended as energy, operations and maintenance expenses of desalination were costly. The more salt in the water the more expensive it is to produce water. Milpitas may have some access to brackish water, which is less salty than the bay water, but the expense is still significant. It is recommended that the City consider a partnership with a regional water purveyor for a local desalination plant.

Additional storage: Additional tanks are not necessary as this does not increase the water supply (it is only a container). Tanks or reservoirs are commonly used to manage peak shaving (peak shaving is the use of tanks to feed peak demand when there is a daily limited supply). The City already exceeds the California Department Water Resources storage requirement according to Water Code §64554(a)(1). Additional potable water tanks, within the City, are not recommended. The initial obstacles include funding, permitting and finding land for the storage tank; however, Water Solutions, Inc. does recommend recycled water storage for peak shaving.

Funding requires constant awareness of the changing grants, loans, etc from the various agencies as they become available. There is a large amount of money that has been earmarked for water development with the passing of Proposition 1 in the last election; this funding should be sought now as such funds, historically, are used very quickly.

In conclusion, it is important to realize that the state of the game in the water utilities business is efficiency and clear decision making. Therefore Water Solutions, Inc. feels strongly that the effective use of a deterministic tool such as a Weighted Sum Decision Matrix is a must. As priorities change, so will the decisions we make. In order to make a sound decision at this time the City Council need to be clear on their priorities and opportunities. Given the priorities of concern that we have developed with the City of Milpitas utilities engineering staff, the matrix has shown that **New Groundwater Wells, Recycled Water and Conservation are the avenues to take to augment the water supplies of the City**.

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Introduction

Currently, the City of Milpitas, hereafter referred to as “the City,” purchases all of it’s water used for potable distribution from San Francisco Public Utilities Commission and Santa Clara Valley Water District. Although the City is doing a good job at managing water supplies, additional measures can be taken to ensure reliability and reduce costs. The following options were examined for their feasibility to augment the water supply reliability for the City of Milpitas: Conservation efforts, increased recycled water use, surface water retention ponds, additional groundwater use, acquiring water rights, water desalination, additional storage capacity and securing funding.

The following is the Feasibility Report for the Water Supply Feasibility Study Report prepared by Water Solutions, Inc. for the City of Milpitas. The specific topics covered in this document summarize the specific recommendations and options for each of the tasks of the technical memoranda (See, Technical Memoranda - Water Supply Feasibility Study):

- Task 1 - Conservation
- Task 2 - Recycled Water
- Task 3 - Surface Water Detention
- Task 4 - New Groundwater Wells
- Task 5 - Water Rights Acquisition
- Task 6 - Desalination
- Task 7 - Additional Storage
- Task 8 - Funding

Regarding funding, Milpitas has several constraints. The City will not have sufficient reserves or revenue streams to qualify for loans, nor can it afford to pay back the loans. The City might be able to pay back $20 million in bonds. Due to these constraints, the City will have to pick which projects it to complete based on what the City can afford.

Any questions regarding the Water Supply Feasibility Study should be directed to Water Solutions, Inc. at (650) 204-9596.

Data

This report was compiled from the technical memorandum written in response to growing concerns regarding the water supply for the City of Milpitas. Data was collected and analyzed from historical water usage and rate structures, case-studies of cities with similar water requirements and referencing water resource literature. Investigative research for agriculture, commercial and residential water use data was also used. In addition, the California Code of Regulations - Title 22, the City of Milpitas Public Utilities staff and records and consulting hydrogeologist, James S. Ulrick. Data was also collected from South Bay Water Recycling online resources, Silicon Valley Advanced Water Purification Center information, research using online articles, water resources literature and contacting water agencies for information.

Additional information regarding permits and regulations were gathered from the State Water Resource Control Board website, United States Environmental Protection Agency online publications, California Department of Fish and Wildlife and the Santa Clara Valley Water District website.

Methodology

The tasks referenced in this report were used to analyze the effectiveness of various water augmentation strategies, the life-cycle requirements and specific questions relating to each method. The specific topics for each task addressed in this Feasibility Study are as follows:

A. Description of Proposed Water Supply Augmentation Measure
B. Available Volume of Water
C. Order of Magnitude Description of Infrastructure Needed
D. Issues to Be Resolved
E. Operational & Maintenance Considerations
F. Possible Implementation Schedule
G. Effectiveness, Reliability, Costs & Benefits
H. Life Cycle & Ease of Implementation (See conclusion for Decision Tree and Weighted Sum Decision Matrix)

A. Description of Proposed Water Supply Augmentation Measure

Task 1: Water Conservation Recommendations

(A. Description of measure)

A multi-pronged approach is needed to capture enough water to reduce consumption by 20% by 2020 and to manage higher water costs from San Francisco Public Utility Commission and Santa Clara Valley Water District, to allow for reliability even in a drought.

A Conservation Project Manager. This Manager will execute the conservation implementation plan:

- manage the conservation measures to be implemented
- coordinate with Santa Clara Valley Water District's residential and commercial cradle-to-grave (audit, rebates and retrofits) water conservation program
- educate customers using the media

It is important to take advantage of the District's conservation program as modern toilets, shower heads and urinals all offer significant reductions in water usage.

Second, poor data collection is the biggest weakness in any conservation program. The City

is poised to create a truly modern water system, and data collection should be a major goal. Water meters and system analysis software upgrade (Badger Beacon software) has already been budgeted through the Capital Improvement Program at a cost of $6,475,000. The cost for a baseline leak audit is $150,000; once found leaks need to be fixed. SCADA should be researched.

Third, water and wastewater rates are an administrative decision, that cost nothing, but can generate the income needed to offset the loss of water sale due to conservation. The more you save, the less you make; but we have to save! Raising of rates will generate needed revenue and encourage both residential and commercial customers to conserve further.

Fourth, outdoor irrigation conservation measures are also free to Milpitas customers. Weather-based water meters are not recommend for residential customers, but are recommended for commercial situations. All customers can be encouraged to landscape with drought resistant plants, lawn reductions and xeriscapes, also through Santa Clara Valley Water District.

Last, regulatory strategies for water conservation should be reviewed to make sure they are in line with the City's current, and evolving, water conservation goals.

Task 2: Recycled Water Recommendations

(A. Description of measure)

The City's current recycling system can be augmented. South Bay Water Recycling can produce a lot more water for the City. The City can create incentives for adding new commercial, government and industrial recycled water customers. With only a modest investment in additional distribution pipes the City could potentially save as much as 1 million gallons per day of potable water during peak use periods. The infrastructure required to expand the City's recycled water system involves the addition of approximately 95,320 feet of purple pipe, 150 isolation valves, tees and saddles as well as purple pipe service laterals and water meters, which would be purchased by the customers. The proposed recycled water system expansion is expected to serve not only all cooling tower customers and potential industrial customers, but also the majority of high-irrigation use customers would be required to connect to the recycled water system.

San Jose Water Company is expanding the purple pipe distribution system in the City of San Jose, south of the Landess/Park Victoria intersection on the San Jose/Milpitas border. Adding a turnout there will feed the proposed Segment 5 (Figure A1 in Appendix), creating a much needed loop that will greatly improve maintenance, and therefore reliability.

Using recycled water instead of potable water will expand the potable water supply and help to secure a "drought-proof" supply of recycled water for any number of uses. Using recycled

water for non-potable applications such as construction watering, street sweeping and sewer flushing is inherently less costly than using valuable potable water. Recycled water can be used for residential landscaped common areas, schools, parks, government buildings, agriculture, golf courses, and a few other uses. This may require the construction of pump stations and a reservoir if the hillside golf courses are to be supplied with recycled water. The City is one of the first Bay Area cities to convert to recycled water for construction and can adjust the system based on operational experience.

Water Solutions, Inc. suggests multiple tiers for implementation of these conversions to recycled water, with the most cost effective water savings being afforded by the first tier of improvement and further savings by latter tiers.

Figure 2: Recycled Water Implementation Tiers

Tier	Improvement
1	Conversion of Non-potable uses to recycled water along existing alignment.
2	Conversion of Cooling towers to recycled water along existing alignment.
3	Pipeline constructions

Task 3: Surface Water Detention

(A. Description of measure)

Water Solutions, Inc. recommends investigating surface retention ponds for use as construction water by means of stormwater retention ponds, reservoirs or lagoons. Also, the use of a surface percolation pond can be used in a sustainable manner to store stormwater and manage groundwater supplies.

“Task 3. Surface water Detention” of the technical memoranda illustrates the various strategies the City of Milpitas can employee to capture stormwater for treatment, construction water uses and even for potable use. In addition, the implementation requirements were determined for each. Also, regulatory requirements, site locations, an implementation plan and additional operational considerations were included for surface water retention ponds, water detention facilities and percolation ponds for groundwater replenishment.

Note that surface water diversions require a surface water right (see Task 5: Water Rights Acquisition).

Augment Surface Water Retention Pond Usage

Milpitas could utilize existing or construct new surface retention lagoons to be used for

collecting and storing stormwater. These could be used for irrigation, habitat restoration, water feature purposes or as potable water (with additional treatment). Existing locations that could be expanded or retrofitted for use as construction water are Hidden Lake Park, Hall park Lagoon, the retention basin off Quince Lane, and the Glenmoore Circle Lagoon near Hall Park. Additional locations for surface water and surface water augmentation include Spring Valley Pond, Sandy Wool Lake, and retention ponds at local golf courses. Additional surface water ponds and lagoons could be constructed to provide stormwater capture and treatment.

Also, existing ponds could be modified to provide additional water treatment and/or storage for construction purposes. This would include vegetative lined canals, bioswales and constructed wetlands. Examples of possible locations for expanding retentions lagoons or using for construction or irrigation water include:

- Hidden Lake Park
- Hall park Lagoon
- Spring Valley Pond
- Sandy Wool Lake
- retention ponds at local golf courses

See “Task 3: Surface Water Detention” technical memorandum for maps locating all the available surface water ponds, as well as the local streams and creeks throughout Milpitas capable of capturing stormwater.

Surface Percolation Ponds

Hydrological recharge to augment groundwater supplies could be accomplished by surface water percolation or by use of injection wells into appropriate geological formations/aquifers. This water could be used:

- To manage groundwater levels
- Provide additional water storage capacity
- Prevent salt-water intrusion (if present)
- Prevent land-subsidence

Hydrological Recharge by use of Injection Wells

Injection wells are used for a variety of purposes, including:

- preventing saltwater intrusion
- managing groundwater supplies
- storing water for future use

In this scenario, stormwater is collected, treated and distributed to underground aquifers by use of abandoned wells, dry wells or newly constructed wells designed specifically for this purpose (the best option for medium to large scale projects). Although, typical appropriate well-design and well-construction techniques vary according to the specific purpose of each well. The design and construction of injection wells is critical, as they are more likely to fail

than typical wells.

Surface Water for Construction, Irrigation and Environmental Restoration:

In regards to using surface water for construction purposes (i.e. at Hidden Lake, etc.) we recommend two options:

A. Put a side cut at the sidewalk and pad closest to the water source - Attach a gate valve to allow water trucks to pull in and fill-up their tanks with non-potable water. This could be used as a perm fill station. Fees could include a flat rate, metered withdrawals, or a keypad (or card swiper) pedestal to control water use.
B. Single phase power 100 amp at 230 volt can control water level run on regular basis.
    a. If Option A is chosen, the City is recommended to do a pump test to confirm it works (permanent installation).
    b. The City should also pull pH and total dissolved solids samples on that water.

Surface water could also be used to irrigate Spring Valley golf course, Summit Point golf course, provide water for nearby surface water features or augment water-sensitive habitats. However, City water infrastructure cannot be built in the surrounding hillside due to the enactment of Measure Z. If there is a way around this measure, then this possibility is ideal.

In addition, water credits might be acquired by negotiating with Santa Clara Valley Water District. The resulting agreement would be executed by means of water trading for groundwater or creek/stream replenishment. In this scenario water access entitlements could be traded or sold, depending on the legal status of the water rights. Water trading is a voluntary exchange and can be used to benefit environmental systems such as streams and creeks by improving instream water quality. The City should initiate an informal discussion with Santa Clara Valley Water District as soon as possible.

Task 4: New Groundwater Wells Recommendations

(A. Description of measure)

Pinewood and Curtis wells can be refurbished and new wells could be drilled. Pinewood needs no regulatory treatment, but blending for taste may be necessary to please the Milpitas customers. The Curtis well will need both treatment and blending. Prior to use, a state water quality report must be completed, as well as treatment (not necessary if similar in quality to Pinewood) and disinfection. We would recommend the use of in-pipe blending with San Francisco Public Utilities Commission and Santa Clara Valley Water District supplies, as well as disinfection with in-pipe ozonation. This could potentially occur at the Gibraltar tank site or at the well site itself. A cost-benefit of those two choices still needs to be done. Also, groundwater use as recycled backup to water is another option; however, this would limit available water applications.

As with any managed groundwater basin, smaller monitoring wells are required throughout

the basin to manage the water level and quality of the production wells. By drilling these lower-cost wells upfront, the City would be able obtain data on the quantity and quality of new production wells, with a very modest financial outlay.

Assuming similar quality of new wells to that of Pinewood well (the primary municipal well for Milpitas emergency water supply), treatment would be minimal. We recommend the city pursue a managed groundwater well extraction program, much like what Alameda County Water District operates to the immediate North. Upon successful implementation of a groundwater well extraction plan, a groundwater percolation strategy could be implemented by the City to supplement and refresh the extracted groundwater well supplies with stormwater, or possibly even treated recycled water. However, Santa Clara Valley Water District does currently conduct instream recharge of the Santa Clara Basin deep aquifer at the upstream sites on Coyote Creek.

Options for groundwater use include the following:

- leave as an emergency supply
- point of use supply; drill pilot holes to determine the quality and quantity of water at parks, schools and government buildings to irrigate landscape. Develop groundwater wells for use, as feasible
- treat well water for hardness at Pinewood well to secondary potable standards and add to the drinking water supply
- drill pilot holes in Starlite Park and Hall Memorial Park to determine the feasibility of adding groundwater wells to augment the water supply (based on the USGS data and recommendations contained in this memo)
- drill pilot holes and determine the feasibility of shallow groundwater wells on the south-eastern section of Milpitas and at Quince Lane
- consider coordinating and forming partnerships with Santa Clara Valley Water District regarding the construction of recharge facilities; involving percolation ponds and/or injection wells
- pump groundwater for surface water features; i.e. ponds, artificial wetlands, etc. for public recreation, environmental rehabilitation and water storage

The southwestern area of the City lies above the most permeable and transmissive aquifer layers. Any well drilled to 500 feet or more in this area would have every good access to to water available in the deeper Santa Clara basin aquifer. It is this southwestern corner of the City where pilot holes are advised to be drilled.

Task 5: Water Rights Acquisition Recommendations

(A. Description of measure)

The City of Milpitas (City) currently holds no “water rights.” The amounts purchased from San Francisco and Santa Clara Valley Water District are purchases under contract, not water rights. Similarly, Milpitas has a right to groundwater underlying the City, but the use of

groundwater in the Santa Clara Basin is managed by the Santa Clara Valley Water District.

Water rights, as applied to surface water, is a complicated topic with a number of legal implications. Unless these rights are asserted by a property owner, despite being entitled to an owner, they can be “lost” and thereafter “found” by another party, who may then claim them. It is these lost rights that the City should be looking for, if it decides to embark on a quest for water rights. That is, to identify potential rights, the City should undertake a systematic search to identify any unclaimed water in the Milpitas area.

Generally, surface water may be acquired by a new appropriation, a change in an existing water right, or by contractual agreement and transfer of water rights. For certain purposes, a water right is treated as a real property right, which may be sold and/or transferred. Water rights in certain watersheds are subject to adjudication by the court or curtailment by the State Water Board.

New Appropriation

Where unappropriated water is available, a new water right may be established by filing an Application to Appropriate Water with the State Water Board. Appropriation is a complicated, multi-staged process with layers of environmental review and regulatory oversight. The following analysis provides a general overview of the process.

In granting an application, the State Water Board must consider the impacts of the project on water quality and the environment under the California Environmental Quality Act. In addition to California Environmental Quality Act review, water projects often include other environmental review and permitting requirements, including several certificate and permitting requirements. (See “Task 5: Water Rights Acquisition” for a complete list of permits, environmental review requirements, California Environmental Quality Act and wildlife mitigation measures).

Water Transfers

A water transfer results in a reallocation of water among water users, providing flexible water allocation and use. The Urban Water Management Plan requires a description of the opportunities for exchanges or transfers of water (Water Code §10631(d)). There are a number of types of water transfers, which are generally grouped into short and long-term transfers. A short-term transfer is any transfer of one-year or less; a long-term transfer is any transfer longer than one year.

Transfers may be surface water transfers or groundwater transfers. For surface water transfers, two types of surface water supplies may be transferred. The first is a supply where the entity holding the water right will temporarily transfer that supply or a portion of that supply. The second is a supply where an entity contracts for the water supply (like a lease)

but does not hold the underlying water right and wishes to transfer that supply or a portion thereof. For groundwater transfers, there are three types, namely, use of groundwater in lieu of surface water, transfer of banked groundwater, and direct transfer of groundwater. The most common types of water transfer are 1) Crop Idling (leaving idle land that otherwise would have been planted in order to transfer the water thus conserved), 2) Groundwater Substitution (pumping groundwater for use in the seller's service area and transferring the surface water that the seller otherwise would have diverted), and 3) Reservoir Reoperation (releasing surplus storage for transfer).

Water Wheeling

As mentioned above, the wheeling of water is a process wherein one entity passes water through the transmission and distribution mains of another entity in order to supply the customers of the first entity. For example, if a county owns water that is allocated to certain customers, but does not have any mains reaching those customers, it may be possible for the county to "wheel water" through a community water system that lies between the supply and the customers, even if that community water system is not owned by the county.

The best option, from a legal standpoint, for the City to obtain water through an acquisition will depend on the geographic, environmental, and political setting of the subject water right. The City would have the most control over the water if local water was available and the City could acquire it as either unappropriated water or vested water rights available to purchase (e.g., old agricultural rights).

The preliminary water sources reviewed for acquisition should be determined from the technical memorandum provided, see "Task 3. Surface Water Detention" as well "Task 4. New Groundwater Wells." A list of the major surface water features throughout Milpitas are labeled, as well as possible groundwater extraction locations.

Placer County and the City of Roseville, California, are two such entities. Placer County has customers throughout the county. However, Roseville is its own water supplier. The county and the city have worked out an agreement where the customers of the county that are on the far side of Roseville from the County supplies receive water delivered from the county via the Roseville distribution system.

Also, a prescriptive right is a right acquired through the adverse possession of someone else's water right, that is, a right obtained through the uncontested use of a water right held by another entity for a period of five years or more. Prescriptive rights are difficult to obtain and can only be granted by a court (not highly recommended).

Task 6: Desalination Recommendations
(A. Description of measure)

The allure of desalination is the ability to create a near-endless supply of water that is resistant to drought. However, the immense costs of brine disposal, operating costs, up-front capital investment and environmental concerns are enough to make desalination the most costly of all treated waters available. However, desalination is still a viable option for a long-term augmentation method or back-up supply; especially with collaboration amongst neighboring agencies. Also, designing a system with a properly designed pretreatment system, as well as treating brackish groundwater (as compared to San Francisco Bay waters), can drastically reduce operating costs.

However, if the water is available, brackish groundwater treatment is much more feasible than seawater treatment. If the City were to perform a brackish groundwater research study, much like the one that Santa Clara Valley Water District is paying to have done at Stanford, the City could find that a reliable supply of brackish water is available at a reasonable cost (e.g. Alameda County at Newark).

If this type of project is to move forward and augment the City's water supply during this or the next drought, legal issues must be tackled head on and partnerships should be formed. Project timeline planning should take into account the considerable lengths of time legal matters often take.

Task 7: Additional Storage Capacity Recommendations
(A. Description of measure)

Currently, Milpitas exceeds the state requirements for the quantity of treated potable water to be stored. This results in a problem where the City has a hard time "turning over" or using, the water stored in the tanks before it becomes stagnant. Stagnant water can not be used due to increased turbidity, stratification and lack of chlorine. Circulation is critical. Without circulation the water at the top of the tank sits with no circulation, leading to stratified and stagnant water. Also the chlorine which remains in the stagnated water can become depleted, leading to microbial growth as well as tastes and odors. The City must move ahead with the design, acquisition and installation of a Supervisory Control And Data Acquisition (SCADA) system to automate operator control over system management and tank turnover.

Additional potable storage could be created to enhance reliability of the drinking water supply and to store water for use during peak periods, yet that may exacerbate the turnover problem. Similarly, recycled water storage could ease the burden of peak period use. Stormwater storage tanks could be used to reduce flooding and to improve wetland productivity through controlled release. However, water storage via the construction of additional reservoirs may be difficult for the City due to land rights acquisition.

Total stored water is 16.26 million gallons. The City's 2009 Water Master Plan Update sets out a more stringent requirement resulting in an overall storage requirement of 22.8 million gallons, leaving the City 6.6 million gallons short of its self-imposed requirement.

Note also that another district tank sized at 6.6 million gallons is planned for the Transit Area Specific Plan in the Piper Drive area. This will exceed even the self-imposed requirement for water storage.

Task 8: Funding Recommendations

(A. Description of measure)

Currently, there are a variety of funding options available to the City, which are detailed below. Though most federal funding is available through the state, some funding can be garnered directly from federal sources. Funding for water resource projects are currently available as grants and loans (State Water Resources Control Board, 2014); contact information for these sources is provided in the Conclusion section of this document. The City may be eligible for funding due to the necessity for water infrastructure that is required for continued reliability and drought management in the City.

The use of rate hikes and bonds is common for funding water infrastructure improvements. These measures would provide accessible funding for the City, although the timeline for rate hikes and bonds are dependent upon administrative functions. Bonds, loans and grants are the most effective means for allocating funding for infrastructure improvements.

Increases in connection fees, service charges and institution of fines could also be implemented for funding; however, this could prove unpopular. Fines in particular, are more effectively used to discourage negligent water use than to increase revenues to fund improvement projects. Leveraging fines can make people angry and is susceptible to issues of harassment, etc. Connection fees and service charges would be an effective way of generating funds; however, additional sources of funding would undoubtedly be required.

A tax increase could provide the required funding if the community votes in favor of such a measure. This would be an effective way for determining community support, as well as provide the necessary funding without the costs associated with loans.

B. Available Volume of Water

Task 1: Conservation

(B. Available volume of water)
Potential Saved: 879,454 hundred cubic feet per year.
A savings of 879,454 hundred cubic feet of water per year out of a total 4,975,000 hundred cubic feet per year (BAWSCA 2012-13) for a population of 70,000. This represents be a 17% savings from 2013 averages or 1.8 million gallons per day. Background data is provided in Task 1: Conservation.

Task 2: Recycled Water

(B. Available volume of water)
Potential Saved: 271,692 hundred cubic feet per year.
Water usage for five months in 2014 for a number of high volume consumers was examined. This data was taken from metering records over the non-peak usage period months of January 2014 through May 2014. The potable water consumption offset through expansion of the recycled water system is a yearly 271,692 hundred cubic feet, or nearly 1 million gallons per day during peak use periods. Background data is provided in Task 2: Recycled Water.

Task 3: Surface Water Detention

(B. Available volume of water)

Potential Saved: 435,600 hundred cubic feet per year.
The theoretical amount of water that can be retained in a reservoir from a rain event is based on the drainage area, rainfall rate and infiltration losses.

The average rainfall for Milpitas during a typical year is 15”. With an area of 13.64 sq. miles this equates to a maximum stormwater quantity of about 10,900 acre-feet of water per year that reaches the City. However, the amount that could be collected would be much less due to percolation through the soils and uncollected stream run-off

If one were to assume an imperviousness factor of 0.50, which describes an area as being approximately half-covered with impervious materials such as asphalt and concrete, then the accompanying collectable stormwater volume becomes approximately 5,000 acre-feet. Without use of the Graphical Storage Method as is dictated by standard since the calculation of stormwater detention basin sizing is an in-depth topic, we can break down the approximate maximum size of a stormwater detention basin by using the number of storms. Assuming the 5,000 acre feet falls upon the City predominantly during the winter storm season, which

generally consists of 5-20 storms, we can assume that the maximum needed size of a stormwater detention basin would be 1,000 acre feet. This is equivalent to 435,600 hundred cubic feet per year, or 0.89 million gallons per day.

Instream Recharge

Instream recharge is used by Santa Clara Valley Water District and is the acceptable method of surface recharge. This is effectively accomplished by damming the natural creek flow and constructing a percolating detention basin via which additional recharge is accomplished. Of course, this depends upon the geology of the creekbed too. Berryessa Creek seems to be a natural location for further in-stream recharge, as it is currently unobstructed.

Task 4: New Groundwater Wells

(B. Available volume of water)

Potential Saved: 2,439,840 hundred cubic feet per year.
The south-western section of the City of Milpitas overlays a good groundwater aquifer that is quite productive and its use is recommended. A maximum of 2.5 million gallons per day of water could be extracted per well (using a withdrawal rate of 2,000 gallons per minute) with the addition of new wells and the use of the Pinewood well (Ulrick). Maximum withdrawal can not be maintained over time due to equipment restrictions and aquifer recharge. Five million gallons per day, or 2,439,840 hcf per year per well is a more reasonable expectation, although potentially as much as 8.2 million gallons could be produced.

Task 5: Water Rights Acquisition

(B. Available volume of water)

Potential Saved: 4,880,050 hundred cubic feet per year.
The best water rights to pursue would be old, unused agricultural rights or existing, senior rights. Compared to other options, these rights would bring fewer possibilities of protests based on environmental concerns.

Once an acceptable appropriative right has been identified as suitable for purchase, the treatment and transport of the water to Milpitas must then be considered. The cost of treatment is potentially high, but the cost of transporting raw water to a treatment plant in Milpitas is potentially much higher. To effectively treat 10 million gallons per day (or 4,880,050 hundred cubic feet per year), which is the City's average demand, a small surface water treatment plant would need to be constructed, ideally, on City-owned land near the water source. If these are not immediately appurtenant to the City, this water could then be piped to a local community and "wheeled" to Milpitas through other water districts' distribution systems.

This approach would probably involve training and maintaining a surface water treatment personnel group (an outside contractor), although treatment could potentially be conducted in-house by trained water treatment plant operators, or even contracted out to another community for operations.

Water Wheeling

According to Section 81460 of the Water Code, Alameda County Water District is allotted 15,709 hundred cubic feet or 11.8 million gallons per day from the San Francisco Public Utilities Commission. Alameda County Water District uses 8.96 million gallons per day (or 76%) of this water for 20% of its total demand of 43.5 million gallons per day. Alameda County Water District uses 9.06 million gallons per day (or 77%) of this water for 93.7% of its total 9.67 million gallons per day demand. These figures show that Alameda County Water District is comparatively water-rich in comparison with other Bay Area water districts.

If a short-term or emergency supply were needed, the Alameda County Water District interties, both of which are 8-inches in diameter, could each suffice to supply the City with approximately 2.3 million gallons per day per day, thus providing 4.6 million gallons per day, which is nearly half of Milpitas' average demand of 10.12 million gallons per day. If more interties were constructed and connected, it would be possible to purchase an even higher volumetric flow rate from Alameda County Water District, should the need arise. In fact, discussions with Alameda County Water District management have revealed that the district is indeed interested in selling its additional capacity to the City. Alameda County Water District is interested in recouping lost revenue due to conservation by its consumers.

Task 6: Desalination

(B. Available volume of water)

Potential Saved: 4,880,050 hundred cubic feet per year.
The available volume of water that can be derived from desalination is theoretically nearly infinite. However, in practical terms, the amount of available water from desalination would depend on brackish water sources, likely from shallow wells or groundwater aquifers. Note that the prospects don't appear to be very good thus far and further investigation will be needed. Partnerships with existing local desalination projects seems like the greatest choice at this point.

Task 7: Additional Storage

(B. Available volume of water)

Potential Saved: no data
"Peak shaving" is the process of reducing the amount of water purchased from the utility

company during peak hours when the charges are highest to reduce demand on the supplier's system. If the average daily usage, as measured in 2011-12, is 10.12 million gallons per day, and the maximum day demand is 25.2 million gallons per day, the resulting peak-demand increase is 15.1 million gallons per day (i.e., the maximum day demand minus average daily usage). As long as there is sufficient storage to meet the maximum day demand, increased water rates can be avoided. Currently, the City has plenty of storage for full peak demand shaving and need not add any more for implementation of this process. Moreover, neither wholesaler charges peak rates. However, the City should consider installing a recycled water tank for peak shaving of recycled water. See "Task 2: Recycled Water" and technical memorandum for additional information.

C. Order of Magnitude Description of Infrastructure Needed

Task 1: Conservation

(C. Magnitude of infrastructure)
Many of the conservation measures do not require any additional modifications or additions to existing infrastructure. For instance, no additional City infrastructure is required for:

- rate structure adjustments
- water-efficient retrofits
- integrated land-use planning
- performing leak detections

However, minor changes to on-site infrastructure are required. These changes include:

- enhance water use data collection and analysis so use and conservation can be quantified.
- replacing low-use lawns with native vegetation
- replacing leaking pipes
- planning for multi-family residences (with recycled water irrigation)
- weather-based smart controllers for landscape irrigation (contact Water Solutions, Inc. for a smart-controller design and implementation project proposal)
- explore planning requirements to redevelop infrastructure into "mixed-use" land-use planning zones in order to encourage land-use decisions that are "water-wise" for the City.

Task 2: Recycled Water

(C. Magnitude of infrastructure)

Approximately 95,320 feet of recycled water lines are proposed to be installed (purple pipe, saddles, tees and air relief valves). Also, purple pipe service laterals, valves and water meters would be required. Note, meters can be purchased by customers for a reduced water rate or could be supplied by the City. All new developments, street repairs and renovations should include a recycled water aspect.

A list of potential customers who could benefit the City by using recycled water is included in "Task 2. Recycled Water" of the Technical Memorandum.

Task 3: Surface Water Detention

(C. Magnitude of infrastructure)

The rehabilitation of existing infrastructure at Hidden Lake Lagoon and at the other existing surface water ponds to provide more construction water, is an extremely easy way for the City to reduce potable water use for non-potable uses.

Surface percolation ponds would be an effective approach for stormwater catchment but would require the construction of additional facilities, infrastructure, permitting and operational considerations. From a preliminary perspective, the retention basin off Quince Lane seems like a promising location for this application; however, additional geotechnical investigation is required.

Bioswales and vegetative-lined canals should be constructed for all future stormwater collection and conveyance systems. This will reduce organics present in the water, as well as provide habitat, improved aesthetics and easier treatment options for using the water at a later date.

The design and construction of injection wells for artificial groundwater recharge is another possible, yet aggressive alternative if the Santa Clara Valley Water District is to allow a waiver for this kind of activity under its District Act.

Also, Collected stormwater and surface water must meet National Pollutant Discharge Elimination System standards before discharge into any streams, creeks or waterways. Treatment to recycled water standards, as well as periodic monitoring, must be completed before distribution to the recycled water supplies, as well as distribution for construction

purposes. Methods for treatment should be determined based on all available water quality data and reports to treat all water quality constituents of concern.

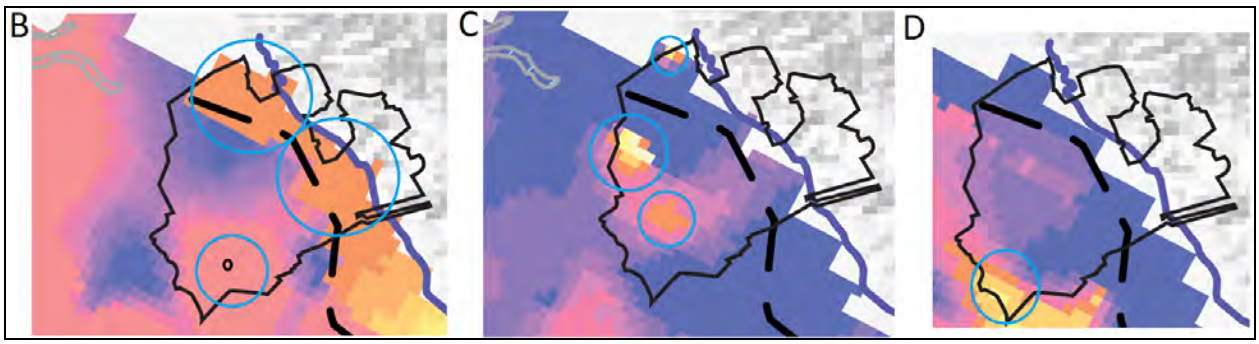
Task 4: New Groundwater Wells

(C. Magnitude of infrastructure)

There are several considerations when selecting groundwater sources; water quality and the withdrawal rates. These constituents should be identified prior to constructing the production well systems. Pilot holes should be drilled to provide estimates for the quality and quantity of water that can be reasonably withdrawn; the location to be determined from available groundwater data.

The following figures were taken from the United States Geological Survey - Possible locations for new well sites are circled in light-blue:

Figure 3: Specific Storage Capacity



The lighter colors indicate a greater specific storage multiplier for groundwater in Milpitas. The areas with the greatest specific storage are circled in light-blue for clarity; the small dot on Layer B is the location of pinewood well; a fairly good location, based on a United States Geological Survey.

The primary infrastructure required for a municipal well includes the following:

- submersible pump
- submersible electrical cable
- well casing
- flexible or rigid downhole pipe
- centralizers
- well pad
- electrical controls
- treatment with electrical cabinet or housing
- backup generator

Treatment and chlorine injection (prophylactic or residual chlorine) should be added before the water is added to the water supply. A full Title 22 report (State Water Quality Testing) should be conducted to determine site-specific water treatment methods.

Permitting of municipal wells is a relatively simple process. First an appropriate site must be found, away from wastewater and other wells. Then, the site must be approved by the State Water Regional Control Board-Drinking Water Program, after which the County will review the site and issue a drilling permit for $400. At this point in time, the Santa Clara Valley Water Department, as the steward of the groundwater basin, will issue the well permit.

Task 5: Water Rights Acquisition

(C. Magnitude of infrastructure)

Water rights may depend on obligations regarding wildlife and environmental mitigation measures when developing the water source. The infrastructure required may vary and can include intakes, surface water ponds, constructed wetlands, bio-swales, additional piping, vegetative-lined channels and treatment systems.

Task 6: Desalination

(C. Magnitude of infrastructure)

The principal processes for desalination use semi-permeable membranes and large pressures to cause water to flow against the concentration gradient and through the membranes, in a process called reverse osmosis. Along with the production of fresh water, is the generation of a salty brine water effluent.

Milpitas does not have direct access to the Bay and would either need to participate in a regional project or install a small brackish groundwater desalination treatment plant.

Pretreatment is accomplished using conventional filtration, microfiltration, ultrafiltration and increasingly commonly, a combination of conventional and ultrafiltration.

- intake
- pump
- pretreatment
- chemicals
- waste disposal
- backup generator

Sometimes chemicals are added to pretreatment liquid for the purposes of enhancing filtration or for cleaning the filters.

- liquid chlorine, in the form of sodium hypochlorite, is often added as a disinfectant
- flocculants like aluminum chloride can be added to make suspended matter easier to filter.
- citric acid, phosphates and other acids may be used to clean the membranes periodically; however, this step results in an additional waste stream that must be dumped to sewerage
- water additives can be used to prevent scaling compounds in the water from precipitating and clogging the reverse osmosis unit

Reverse osmosis plants require specialized pumps that operate at high pressures (>300 psi for brackish water). The first pump is usually a well pump that pushes Bay water or brackish water through conventional treatment, and is followed by a high speed centrifugal pump. This centrifugal pump can produce pressures in excess of 1,000 or pressure per square inch and can require thousands of horsepower, accumulating electricity costs that can add up to hundreds of thousands of dollars per month.

Task 7: Additional Storage

(C. Magnitude of infrastructure)

Steel

Welded steel tanks cost more to purchase than bolted steel tanks and have a 60-year life expectancy. Welded steel tanks must be repainted every 15 years, typically at a cost of one-third of the tank purchase cost. Painting requires that the tank be out of service for approximately one month, and requires men to be introduced to the sanitary environs of the tank. The budget cost for design and construction of a welded steel tank is $1.85 per gallon or $925,000 for a 500,000-gallon tank.

Bolted steel tanks use thin steel and must be replaced after 20 to 25 years. Given that their cost is more than half the cost of a welded steel tank and their life-cycle is shorter, their life cycle cost is therefore higher. In corrosive environments such as the California Coast, these tanks may experience paint failure in as few as 15 years due to the bolt/panel interface.

Two steel variants reduce or eliminate the paint cost issue but have aesthetic issues. The first, corten, is a self-healing or oxide-coated steel that is a rusty red color but is stable. Water reservoirs constructed of this material have to be painted on the inside, and the only color option for the exterior is “rust red.” The second, stainless steel, is much higher in cost, and typically is only used for the bolt-together, sheet-metal tanks. Although tanks of stainless steel reduce or eliminate painting inside and out, they are often considered “too shiny.”

Fiberglass

Fiberglass is an extremely long-lasting and corrosion-free material that can be used for water tanks from a thousand to millions of gallons. Although these tanks can be sited above ground, they tend to have a larger footprint than steel tanks due to lower tank heights. The cost of fiberglass tanks is typically two to three times the cost of concrete or steel tanks due to fabrication and assembly costs.

Buried cylindrical fiberglass tanks are an excellent choice due to the minimal surface footprint, tank longevity and complete corrosion immunity. While these tanks are reasonable to purchase, the cost of trucking to the site typically doubles the tank cost. In 2014, a 75,000 gallon tank delivered to the Bay Area has a budget price of $200,000, yielding a cost per gallon of $2.66. The use of multiple tanks increases the overall operational risk due to interconnections and valves, over the life of the installation. These tanks are best suited for applications where only one or two tanks are required.

Concrete

There are effectively two methods of constructing concrete tanks: pre-stressed and cast-in-place. Both methods provide effective, corrosion-free storage at all sizes. If necessary, concrete tanks can be buried. Because they are strong, concrete water tanks are ideal for under driveways, courtyards, or sheds, or in other areas where they would have to withstand loads. Concrete tanks are built on site because of the weight of the material.

Task 8: Funding

(C. Magnitude of infrastructure)
None

D. Issues to be Resolved

Task 1: Conservation

(D. Issues to be resolved)

- A multi-pronged approach is needed to capture enough water to allow for 30% growth over 30 years, to reduce consumption by 20% by 2020 and to manage higher water costs from San Francisco Public Utility Commission and Santa Clara Valley Water District.
- The Milpitas community can increase their participation in the existing conservation program that Santa Clara Valley Water District offers.
- Considering rate structures and regulatory strategies will help build proactive plan for future.
- When commercial and industrial customers conserve irrigation usage, the City loses revenue that is needed to pay for overhead costs. Rate increases can be used to counteract this issue. There is a consultant looking at this at the moment.
- There is a point of diminishing returns with a conservation program; getting the last percentages of a population to participate can take more time and therefore money.

Task 2: Recycled Water

(D. Issues to be resolved)

A recycled water system upgrade requires a substantial investment in infrastructure.

The infrastructure and planning requirements for “mixed-use” land-use planning zones should be explored to encourage land-use decisions that are “water-wise” for the City. Also, a recycled water aspect should be included in all new developments including roads, renovations or housing projects.

Coordination will be required to connect new customers to the existing and planned recycled water system.

There is a lack of reliability in the recycled water distribution system.

Task 3: Surface Water Detention

(D. Issues to be resolved)

- investigation of the sites outlined in this memorandum for surface water detention or retention and percolation pond sites.
- pursuit of senior water rights (least likely to be protested) - less time until acquisition
- pursuit of old agricultural water rights (more likely to be available) - longer timeframe
- querying Santa Clara Valley Water District if they will reward the City will recharge credits if the City provided surface water detention that replenishes the aquifer.
- regulatory requirements, siting and treatment

Task 4: New Groundwater Wells

(D. Issues to be resolved)

Pinewood Well

- connect Pinewood well with the existing potable water system by means of in-pipe ozonation and blending to reduce hardness, or by one of the options as shown in Task 4: New Groundwater Wells.
- proper staffing with Certified Operators will be required.
- backup power may be recommended.

Curtis Well

- onsite treatment/onsite blending
- pump to Gibraltar tank for centralized treatment or blending.

New Wells

- as with any managed groundwater basin, smaller monitoring wells should be drilled throughout the basin to manage the water level and quality of the production wells. By drilling these lower cost wells upfront, the City would be able obtain data on the quantity and quality of new production wells, with a very modest financial outlay.
- an up-front investment in a series of pilot wells should be installed throughout the city at Starlite Park, Hall Memorial Park, Quince Lane and as appropriate. This should be done to determine groundwater levels, sustainable withdrawal rates and to determine suitable sites for percolation ponds or injection wells. Collaboration with the Santa Clara Valley Water District should be pursued for partnerships involving recharge facilities for ease of implementation, draft water right agreements and dependable operation.
- a sound understanding of the Santa Clara Valley groundwater basin is needed if the City wishes to drill new groundwater wells.The determination of groundwater sources should be addressed for drilling locations. Monitoring wells, in collaboration with a competent hydro geologist, geotechnical engineer or geologist, should be used to determine exact drilling locations.
- determination of sites suitable for percolation and detention capacity to groundwater

supplies at Quince Ln., etc. based on the findings of the technical memorandum "Task 4: New Groundwater Wells." Also, determine water quality constituents of concern regarding surface water percolation for each potential site.

- the requirement of Groundwater Management Planning was instituted in 2013 by Assembly Bill 359 with the intent of "...monitoring and management of groundwater levels within the groundwater basin" (www.leginfo.ca.gov, 2014). This Bill adopts principles of sustainability that heretofore were not considered within water law. Both the Groundwater Management Plan (Santa Clara Valley Water District, 2012) and the Urban Water Management Plan (Milpitas, 2010) address the issue of new groundwater wells in the City; however, they do not state explicitly that this option is being pursued.

Task 5: Water Rights Acquisition

(D. Issues to be resolved)

Major issues to be resolved include determination of water rights for the four surface water ponds managed by the City of Milpitas, as well as investigating potential water rights for groundwater use and additional surface water ponds throughout the City, as well as the creeks that run through the City. Regardless of water levels, rights must be held to divert these streamflows for any purpose.

Task 6: Desalination

(D. Issues to be resolved)

Issues to resolve include the following:

- determine if there are any City land rights adjacent to San Francisco Bay waters
- locate brackish groundwater sources
- create a dialogue with other Districts with current projects underway.

Task 7: Additional Storage

(D. Issues to be resolved)

Issues to resolve include the following:

- determine locations for additional storage capacity.
- determine usefulness of recycled water storage based upon demand and supply.

Task 8: Funding

(D. Issues to be resolved)

None

E. Operational and Maintenance Considerations

Task 1: Conservation

(E. Operation and maintenance)

Annual operation and maintenance costs: $140,274
To manage this multi-pronged conservation strategy, we recommend that one full-time employee be hired. This Conservation Project Manager will be responsible for the execution of the various elements of the implementation plan, from within the Public Works Department.

This Full-Time Project Manager employee position's mission will be to:

- manage the existing Conservation program
- encourage customers to call Santa Clara Valley Water District for an audit
- educate customers on Milpitas water policy through media

The annual cost of a Project Manager (Administrative Analyst II), at a salary of $97,456, is $140,274 including taxes and benefits. Alternately a consulting firm could provide this service.

Task 2: Recycled Water

(E. Operation and maintenance)

Annual operation and maintenance costs: $0 (South Bay Water Recycling assumes O&M tasks)

The use of recycled water for irrigation purposes by big users such as parks and industrial buildings can cause drops in pressure. On the other hand, small users such as residential buildings minimize pressure drops in the system by turning their systems on and off at varying times. When a large number of big users utilize a recycled water system, the resulting pressure drops in the system may negatively affect the availability of water for all users. In many cases, upgrading from the existing "tree distribution" to a grid distribution will mitigate the pressure drops. However, with a large number of small users, the pressure changes don't affect other users nearly as much, as smaller users can control when they turn their irrigation systems on and off. Some locations such as San Diego and Las Vegas have adopted a mandatory outdoor watering schedule requiring residents and commercial customers to limit outdoor watering to designated days and times, as determined by the City (Las Vegas Valley Water District website. 2014).

For the last ten years, South Bay Water Recycling has been capturing about 10 million

gallons per day of wastewater that would normally be lost to the Bay (approximately total 100 million gallons per day outfall). They intend to increase capacity as demand increases. Currently their capacity is greater than the need. This recycled water will be available to communities purchasing water from South Bay Water Recycling (such as the City) and will become a sustainable water supply for future generations (City of San Jose website. 2014).

There are two considerations regarding operation and maintenance reliability of recycled water systems. One is that the peak recycled water use occurs at night-time, when most irrigation of public green spaces (parks, playgrounds, golf courses) takes place. The actual peak is approximately 3.6 times the normal demand and occurs between 21:00 and 03:00 hours. Given that the low use period is around 14:00 hours, to protect system reliability, the City may wish to review requiring daytime use or additional storage (reservoirs or tanks). It seems logical that an analysis should be performed to determine if a reservoir should be constructed to smooth out the demand peaks. This is of course how water systems are designed and it follows that the recycled water system may well need the same consideration. A reservoir located within the City would help to reduce the impact of supply line repairs.

A single connection, as mentioned above, makes the system more vulnerable than a multiple connection system. To supplement this single connection, and to form a loop, additional connections could be made in two places:

- 2,200 foot connection could be made along McCandless Dr. and Trade Zone Blvd. to the 6 inch end at Ringwood Ave. and Trade Zone Blvd
- 12 inch connection could be made by horizontal boring for 900 feet, under Coyote Creek, from the intersection of Barber Lane and McCarthy Blvd. to the 30 inch transmission line under Coyote Creek Trail

Task 3: Surface Water Detention

(E. Operation and maintenance)

Annual operation and maintenance costs: $0 as Santa Clara Valley Water District currently does this. However, if Milpitas were to assume some of this task the cost to Milpitas in operations and maintenance costs would be $160,000, or 2% of the $8 million capital cost of installation, for mowing and streamflow maintenance of a new detention basin.

If a determined effort is made to retain surface water in the City there are a number of operational challenges that will need to be met. First, the City staff will be responsible for maintenance of any new retention facilities that are built. This means regular mowing of the basin during the dry seasons, if necessary, as well as maintenance of the vegetation-lined channels that lead up to these basins. Also, the City will be responsible for maintenance of any riparian areas that the City will doubtless need to purchase prior to construction of any

basins. Lastly, the entire stormwater system the especially recharge areas themselves will be required to be free of trash at all times, thus complicating the use of such a system.

It will take one full-time-employee approximately 100 hours to mow a 1,000 acre foot basin at 10 feet deep. This is approximately two weeks of full time labor needed approximately once per two months during the dry season.

The use of surface water can have detrimental or positive effects on aquatic wildlife. Promoting projects that improve water quality and habitat development should be taken into consideration. Stormwater runoff should be directed towards bio-swales and natural filtration methods before entering surface retention ponds. Ideally, bioswales would be located in major creek tributaries, as well as between pumping and the surface retention feature. These features require maintenance that will require significant manpower and investment.

Task 4: New Groundwater Wells

(E. Operation and maintenance)

Annual operation and maintenance costs: $1,780,000 per well for pumping electrical costs.

The Treatment Operator Certification Level 1 (T1) license is required for basic treatment procedures for water distribution systems. In order to proceed with disinfection treatment on the utilized wells, a source for chemicals such as sodium hypochlorite or calcium hypochlorite will be needed. The City must also implement a Water Quality Monitoring Plan to assess wells on a regular basis and ensure that operating wells are up to standard.

Regular well maintenance such as pump operations, response to alarms (including supply volume and pressure), treatment, additional sampling and reporting, would be required. Planning should include the cost of these ongoing activities, as well as the initial investment for the well, submersible pump, energy costs, treatment, and connection.

Additionally, a groundwater percolation strategy could be implemented by the City to supplement and refresh the extracted groundwater well supplies with stormwater, or possibly even treated recycled water. However, Santa Clara Valley Water District does currently conduct instream recharge of the Santa Clara Basin deep aquifer at the upstream sites on Coyote Creek.

Task 5: Water Rights Acquisition

(E. Operation and maintenance)

Annual operation and maintenance costs: $1,000,000 for operation and maintenance of a 10 million gallon per day surface water treatment plant.

See Surface Water and Groundwater sections of this report for operational and maintenance considerations.

Task 6: Desalination

(E. Operation and maintenance)

Annual operation and maintenance costs: $2,680,000 for operation and maintenance of a 10 million gallon per day brackish water desalination plant.

Often, brine processing, handling and disposal is the most significant cost when operating a desalination plant; amounting to up to 66% of operating costs and 75% of overall costs. However, energy costs are significant, and depending on the system, can be the greatest operating cost. Energy is consumed by centrifugal pumps operating at 1,000 psi or more and can total hundreds of thousands of dollars per day for large facilities. Other costs include maintenance, operator costs, analytical testing, and membrane replacement costs.

Task 7: Additional Storage

(E. Operation and maintenance)

Annual operation and maintenance costs: $60,000.

After cleaning and painting, water storage tanks must be disinfected before being placed in service. Cleaning should be done using either 1) liquid sodium hypochlorite solution, or 2) calcium hypochlorite granules or tablets. Water entering the tank should be treated or disinfected as necessary, or screened before being stored. The storage tank should inspected periodically to find any cracks or structural problems.

The type of pump selected should be based on criteria that include maximum flow rates, piping distances, elevation changes, system pressure. Water Solutions, Inc. would recommend the use of a multistage, variable-drive submersible pump able to withstand the

harsh environment of the tank or reservoir. Often, two or more pumps can be run in parallel to allow for service/repairs without disrupting the flow and to provide emergency backup.

Management of the control system (including a depth sounding pressure transducer), pressure, volumetric flow rates, and daily operations would need to be conducted by staff. Annual inspections of the tank must be conducted, and cleaning of the tank must be conducted every five years.

A conveyance system is needed to connect incoming water supplies with tanks or reservoirs, treatment housing, and water mains for potable consumption. The design of the pipe system should be based on soil-type, water flow rates, piping distance, system pressure. Recommended materials include ductile or galvanized iron, PVC, flexible PVC or reinforced concrete (more suitable for water collection).

Additionally, a pressure reducing valve (PRV) needs to be installed from the Santa Clara Valley Water District supplied area to the San Francisco Public Utilities Commision supplied zones. Since the SFPUC supplied area operates at a higher pressure, if pressure drops low in the District sourced zones, supply from SFPUC fills the District zones. There is already a PRV supplying water in this way from the SFPUC supplied zone into Milpitas, and one is needed to support the SFPUC zones with supply from the District. This will improve reliability.

Neither intertie has a meter on the Milpitas side of the line. This should be remedied so the City can confirm the usage reported by SCVWD and SFPUC.

Task 8: Funding

(E. Operation and maintenance)

Annual operation and maintenance costs: (see Task 1)

The only cost for seeking funding for special water projects is personnel time. A single employee could be assigned to research funds and write grants. The cost would be that of a full-time college-educated employee. This employee could very well be the same as the Conservation Manager outlined in Task 1: Conservation, or the City could hire a consultant.

F. Possible Implementation Schedule

Task 1: Conservation

Task 1: Conservation, Implementation Plan

Proposed Implementation Schedule:

Ordinance

1. Complete writing of new ordinance(s) for water conservation (1 Jun. 2015)
2. Enact new ordinance for water conservation (1 Aug. 2015)
3. Begin enforcement of new ordinance (1 Oct. 2015)

Smart Meter

1. Large meter pilot testing (July-Sept 2014)
2. Large meter install (Oct.-Dec. 2014)
3. Small meter pilot (Jan.-Mar. 2015)
4. Small meter install (Apr.-June 2015)
5. Antennas install (July 2015 - Feb. 2016)

Outreach

1. Advertisement and education of SCVWD rebate programs (on-going)

SCADA

1. City-wide pressure and flow sensors installation (Jan. 2016 - Mar. 2017)
2. Remote control valve installation (July 2017 - Dec. 2018)

System-wide Leak Detection

1. Hiring of leak detection company (July 2017 - Mar. 2018)
2. Aging infrastructure field investigation (July 2015 - on-going)

Task 2: Recycled Water

Task 2: Recycled Water, Implementation Plan

Possible Implementation Schedule:

1. Contact potential recycled water customers from the list provided to add recycled water lines, as feasible (May, 2015)
2. Prepare new Ordinance. (June 2015)
3. City approves Ordinance. (July 2015)
4. Begin project plans for installing recycled water lines to additional customers (July, 2015)
5. TASP construction (July 2014 - June 2015)
6. Segment 1 engineering (Jan. - June 2015)
7. Segment 1 construction funding application (July 2015 - Mar. 2016)

8. Segments 2-5, tank/pump, loops planning funding application (July 2015 - Mar. 2016)
9. Ordinance enacted. (Aug. 2015)
10. Segment 1 construction (Apr. 2016 - Sept. 2016)
11. Hire a consulting engineer to design installation of all segments: (April 2016)
12. Segments 2-5, tank/pump, loops engineering (Apr. 2016 - Sept. 2016)
13. Finalize project plans for Industrial/Cooling Towers, City Potable Irrigation lines and other Potable Irrigation connections to the recycled water system. (July. 2016)
14. Open construction contracts for bid. (Mar. 2017)
15. Finalize bid documents. (May 2017)
16. Segments 2-5, tank/pump, loops construction funding application (Oct. 2016 - June 2017)
17. Segments 2-5, tank/pump, loops construction (July 2017 - Mar. 2019)
18. Permit Paperwork. (Mar. 2019)

Task 3: Surface Water Detention - NOT IMPLEMENTED

Note: Surface water detention is not to be implemented at this time but the City will continue with construction water fill stations:

1. Engineering July 2015 - Sept. 2015
2. Construction Oct. 2015 - Dec. 2015

Task 3: Surface Water Detention Implementation Plan

Implementation Schedule:

1. Contact State Water Resources Control Board, Santa Clara Valley Water District and follow National Pollution Discharge Elimination System standards for special permitting requirements for non-potable use of stormwater. (March-July 2015)
2. Hire a geologist for geotechnical site investigations to determine appropriate sites for surface water detention and/or percolation ponds. (1 August 2015)
3. Hire a consultant to look for available water rights in this order of preference: senior appropriative water rights; old agricultural appropriative rights; riparian rights near boundaries between neighboring communities (such as Fremont) for SF Bay and wetland restoration projects. (1 October 2015)
4. Hire a consultant to prepare an application for water rights, including all supporting documents. (1 December 2015 or later)
5. Hire a consultant to prepare plan designs for additional surface water detention facilities and/or percolation ponds. (2016 or later)
6. File a fully completed water right application with the Division of Water Rights. (2016 or later)
7. Pay all required fees. (2016 or later)
8. Commence environmental review and permitting requirements. (2016 or later)
9. Finalize environmental review and permitting requirements. (2016 or later)

10. Finalize plan designs for water detention and/or percolation ponds. (2016 or later)
11. Finalize contract documents and bid contract for construction. (2016 or later)
12. Begin construction. (2017 or later)

Task 4: New Groundwater Wells

Task 4: New Groundwater Wells, Implementation Plan

Possible Implementation Schedule:

1. Engineering funding application for treatment at Curtis, blending at Pinewood and 2 new wells (April 2015 - Dec. 2015)
2. Engineering of on-site blending treatment vs Gibraltar treatment (Jan. 2016 - June 2016)
    a. Hire a consultant to implement the “Blending Study” at Pinewood Well to dilute hardness concentration. (Apr. 2016)
3. Engineering of Curtis well treatment for hardness (Mn) (Jan. 2016 - June 2016)
4. Engineering of site selection, test bore and construction of Well #1 (Jan. 2016 - June 2016)
5. Engineering of site selection, test bore and construction of Well #2 (Jan. 2016 - June 2016)
    a. Hire a well driller to drill pilot holes at each of the proposed specific sites. (Apr. 2016)
    b. Consult with a hydrogeologist to establish a more detailed evaluation of hydrogeologic conditions, together with water quality and access to the water distribution system, of specific sites based on pilot holes. (Apr. 2016)
    c. Hire an engineering consultant to design treatment and improvements for the Curtis Well. (June 2016)
    d. Hire an engineering consultant to design improvements for the Pinewood well, dependent upon results of blending study. (June 2016)
    e. Establish sites for new wells based on consultants conclusions and results of data from pilot wells. Obtain approvals and drilling permits. (June 2016)
6. Construction application for treatment at Curtis, blending of Curtis & Pinewood and 2 new wells (July 2016 - Mar 2017)
7. Construction for treatment at Curtis and 2 new wells (Apr. 2017 - Sept. 2017)
    a. Begin drilling new wells to a depth of 800 feet. (July 2017)
    b. Hire an engineering consultant to design improvements for the new wells, dependent upon results of water quality analyses and pump testing. (July 2017)
    c. Put contracts out to bid for construction of Curtis well treatment and improvements for all new/existing wells. (August 2017)
    d. Begin construction of Curtis well treatment and improvements for all new/existing wells. (September 2017)
    e. Complete construction of all treatment and well improvements. (December

2017)

8. Construct on-site or Gibraltar blending treatment and install of Pinewood generator and control (Apr. 2017 - Sept. 2017)
9. Permitting for Gibraltar, Curtis and 2 new wells (Oct. 2017 - Mar. 2018)
    a. Submit Permit Amendment Application to State Regional Water Control Board-Drinking Water Program. (January 2018)
    b. Complete permitting process and begin supplying water. (Mar. 2018)

Task 5: Water Rights Acquisition - NOT IMPLEMENTED

Note: Water rights acquisition is not to be implemented at this time but the City will begin a long term process of ongoing water right research. The City has also begun negotiations for an additional treated surface water allotment.

Task 5: Water Rights Acquisition, Implementation Plan

(Ideal) Implementation Schedule: (possible 10 year effort)

1. Obtain water rights for the use of surface water for construction purposes, see Task 3: Surface Water Detention for additional information, including implementation plan (July 2015)
2. Hire a consultant to look for available water rights in this order of preference: Senior appropriative water rights; Old agricultural appropriative rights (Oct. 2015)
3. Submit report for council approval (May 2016
4. Hire a consultant to prepare application for water rights, including all supporting documents (1 August 2016).
5. Conduct negotiations (2016-1019)
6. File a fully completed water right application with the Division of Water Right (2019).
7. Pay all required fees (2019).
8. Commence environmental review and permitting requirements (2019).
9. Finalize environmental review and permitting requirements (December 2019).
10. Open talks with other agencies for treatment and “wheeling water” (1 June 2020).
11. Finalize contract documents for surface water detention and/or surface water retention (1 September 2020).

Task 6: Desalination - NOT IMPLEMENTED

Note: Desalination is not to be implemented at this time, but the City will make an effort to be aware of partnership opportunities.

Task 6: Desalination, Implementation Plan

Proposed Implementation Schedule:

1. Hire a consultant to pursue research on existing brackish groundwater studies. (Aug. 2015)
2. Hire a consultant to pursue cooperation agreements with other desalination partners. (Oct. 2015)
3. Hire a groundwater hydrogeologist with experience with brackish groundwater to do an up to date study on possibilities for Milpitas. (July 2015)
4. Prepare siting plan (October 2015)
5. Report Siting plan to City Council for approval to begin design (December 2015)
6. Hire a consulting engineer to design a desalination installation (for bay water or brackish groundwater). (January 2016)
7. Begin environmental and legal efforts for new desalination facility (Sept. 2016)
8. Open construction contracts for bid. (Jan. 2018)
9. Finalize bid documents. (Mar. 2018)
10. Begin construction of the brackish groundwater desalination facility. (May 2018)
11. Finish construction of the desalination facility. (Dec. 2019)
12. Complete permitting with state and federal governments. (Jan. 2020)

Task 7: Additional Storage - NOT IMPLEMENTED

Note: Additional storage is not to be implemented at this time but the City will incorporate a recycled water tank and booster station into it's future recycled water system plans.

Task 7: Additional Water Storage, Implementation Plan

Proposed Implementation Schedule for Potable Water Storage:
None, Water Solutions, Inc. does not recommend any potable water storage improvements.
Proposed Implementation Schedule for Other Water Storage

1. Determine the potential need for additional recycled or storm water storage and the most suitable application(s) for meeting these needs. (June 2015).
2. Obtain water sources, water rights and/or cooperative water use agreements with San Francisco Public Utilities Commission and/or Santa Clara Valley Water District, or South Bay Water Recycling. (January 2016).
3. Secure funding for additional water storage (February, 2016).
4. Hire a geotechnical or hydrogeological consultant to pursue site investigations for optimal sites regarding additional water storage potential (March, 2016).
5. Site location and water quantity determination (April, 2016).
6. Develop a request for proposal or in-house project proposal documents; including bid documents, etc. (June, 2016).
7. Bid-procurement and awardance of contract for additional water storage (September, 2016).
8. Pre-construction meetings, determining consultants/contractors for environmental mitigation measures and developing construction schedules (October, 2016).
9. Begin environmental and legal efforts for additional water storage (November, 2016).

10. Surveying and preconstruction site tasks (February, 2017).
11. Begin construction of additional water storage structures (April 2017).
12. Finish construction of water storage structures (August, 2017).
13. Complete permitting with state and federal governments. (September, 2017).

Task 8: Funding

Task 8: Funding, Implementation Plan

Possible Implementation Schedule

1. Determine Appropriate Projects for which to garner funding (Mar. 2015)
2. Submit Funding Pre-Applications and Search www.grants.gov
    a. U.S. Bureau of Reclamation: WaterSMART & Title XVI (5 Jan. 2016) - www.grants.gov
    b. State Water Resources Control Board: Clean Water State Revolving Fund and Propositio n 13 (5 Jan. 2016)
    c. State Water Resources Control Board-Division of Drinking Water: Drinking Water State Revolving Fund (5 Jan. 2016)
3. Evaluate property or sales tax increases within existing tax structure (1 Feb. 2016)
4. Evaluate the City's tiered water-rates for possible increase by initiating a Planning Study for Site Specific Evaluation-based Tiered Water Rate increases (1 Feb. 2016)
5. Complete Planning Study for Rate Increases (1 June 2016)
6. Complete Full Funding Applications
    a. U.S. Bureau of Reclamation: WaterSMART & Title XVI (31 Mar. 2016)
    b. State Water Resources Control Board: Clean Water State Revolving Fund and Prop. 13 (30 June 2016)
        i. CWSRF Application: Engineering for Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion
        ii. CWSRF Application: Construction of Segment 1
        iii. CWSRF Application: Construction of Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion
    c. State Water Resources Control Board-Division of Drinking Water: Drinking Water State Revolving Fund (30 June 2016)
        i. DWSRF Engineering plan application for treatment at Curtis, blending at Curtis and Pinewood and 2 new wells (Apr. 2015 - Dec. 2015)
        ii. DWSRF SCADA construction application (Apr. 2015 - Dec. 2015)
        iii. DWSRF construction application for treatment at Curtis, blending at Curtis and Pinewood and 2 new wells (July 2016 - Mar. 2017)
7. Signing of Funding Agreements (~6 months after Submission of an Application)
8. Begin Public Comment Period on Site Specific Evaluation Tiered Rate Increases (1 Oct. 2016)
9. Finish Planning or Construction of Water Projects
10. Submit Claims for Reimbursement if funding not yet received

G. Effectiveness, Reliability, Costs & Benefits

Task 1: Conservation

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
Good data is the cornerstone of reliability and as such, the ongoing water meter upgrade within the City is an excellent program. Leak detection and water loss auditing is also a must in an old system such as the City's.

Based on the numbers of participants taking part in the Santa Clara Valley Water District's retrofit/rebate system, we believe that there is room for great effect here. New plumbing fixtures are not only more efficient these day but also more reliable than those of days past. 10% of current water usage can be achieved if retrofits become the norm. There is a point of diminishing returns with a conservation program; getting the last percentages of a population to participate can take more time and therefore money.

Costs:

- The annual operations cost of a Project Manager (Administrative Analyst II), at a salary of $97,456, is $140,274 including taxes and benefits.
- The capital cost of a leak detection audit is approximately $150,000 (one-time)
- The capital cost of the water meter upgrade is $6,475,000
- The total capital cost of this effort is then $6,625,000
- The lifetime cost per hundred cubic feet is then $0.54
- Rebates and incentives - none, to be covered by Santa Clara Valley Water District

Benefit:

- A savings of 879,454 hundred cubic feet of water per year out of a total 4,975,000 hundred cubic feet per year for a population of 70,000. This represents be a 17% savings from 2013 averages.

Figure 4: Ranking of Conservation Efforts by Infrastructure Cost-Benefit
SCVWD = Santa Clara Valley Water District; FTE = Full Time Employee; PM = Project Manager

	Conservation Method	Administrative Costs	Infrastructure Costs	Cost of Savings ($/hundred cubic feet) or Advantages
1	Rebates, retrofits, education	City Attorney City Council Public Works ● FTE: $140,274 annually for 10 years	● rebates and retrofit cost covered by SCVWD	● 675,184 hcf saved per year ● $0.21 /hcf saved each year ● 13.5 million hcf saved over 20 year lifetime ● $0.01/hcf saved over 20 year lifetime
2	Data Collection and Leaks	City Council Public Works ● FTE: $140,274 annually for 10 years	● leak audit: $150,000	● +/-4.1% of 10.21 mgd = 560 hcf saved per day ● 204,268 hcf saved per year ● $33.12/hcf saved each year ● 10.2 million hcf saved over 50 year lifetime ● $0.66/hcf saved over 50 year lifetime
3	Water and Wastewater Rate Increases	City Attorney City Council Public Works	● no cost	● significant income ● moderate unquantifiable* water savings
4	Landscape and Irrigation	City Attorney City Council Public Works	● cost covered by SCVWD ● (minor cost to Milpitas)	● significant unquantifiable* water savings
5	Regulation	City Attorney City Council Public Works	● no cost	● moderate unquantifiable* water savings
		TOTAL	$150,000	879,454 hcf saved per year

* This is yet another argument for increased quality and quantity of data collection.

Task 2: Recycled Water

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
As recycled water originates from wastewater (often considered one of the most reliable sources of water), this is one of the most effective sources to increase the available water supply for the City, over time.

Costs:
- The total capital cost of implementation of all loops (95,000 feet) identified as ideal additions to the recycled water system would cost $36,707,000.
- The ongoing cost of operations of the new recycled water lines is $0.00 since South Bay Water Recycling will inherit the system
- The total cost (capital and O&M combined) for the lifetime of the plant is therefore $1.80 per hundred cubic feet.

Benefit:
Recycled water system expansion would save nearly 1 million gallons per day of potable water during peak use periods. Mandatory connections would increase that amount by an unforeseen number based on other possible connections such as unquantified cooling tower consumption.

Task 3: Surface Water Detention

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
The effectiveness of a detention basin or pond is completely dependent on weather. If there is little or no rain, there can be little surface water absorption. Also, the quality of the maintenance that is done is a critical factor.

Costs:
Implementation of a surface water detention or surface percolation ponds would accrue the following costs:
- Construction water fill stations - Approximately $25,000 each
- Water Rights Acquisition Capital Costs - Approximately $2 million for rights to Berryessa Creek.
- Retention Basin Capital Costs - Approximately $8 million to $16 million. The cost of a percolation pond should be comparable to that of a surface retention basin.
- The total capital cost of implementation of all these elements would then cost $10,000,000.
- The ongoing cost of Operation and Maintenance - Approximately $160,000 annually.

- The total cost (capital and O&M combined) for the lifetime of the surface water detention facility is therefore $0.73 per hundred cubic feet.

Over the 50 year lifetime of a retention basin, these costs amount to $0.73 per hundred cubic feet of water augmenting the City's supply. This becomes $0.83 if you include the cost of acquiring water rights.

As it stands right now, Santa Clara Valley Water District is the manager of the Santa Clara Valley Basin and conducts in-stream recharge of the basin via Coyote Creek. If Milpitas were to pursue recharge in the eastern foothills along Berryessa creek, for example, they should also look for recharge credits from the District as well. However, since the District is the manager of the basin these opportunities may not be afforded to the City.

Benefits:
Additional acquisition of water rights for surface water and percolation ponds would allow the City to reduce the amount of water purchased each year and increase the reliability of the water system. Also, using a surface water capture and reuse program could recharge aquifers (through the use of surface percolation ponds) and provide a cost effective source of additional water.

Task 4: New Groundwater Wells

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
Groundwater wells can be easily and inexpensively refurbished. Pinewood well has hard water that will need to be treated by blended with either Santa Clara Valley Water District or San Francisco Public Utilities Commission. New wells can be drilled for a price that is cheaper than buying water. This source diversification allows Milpitas more water reliability than it has now, and for the future.

Additionally, Santa Clara Valley Water District is the official manager of the aquifer recharge, form which Milpitas will draw its groundwater. This makes groundwater wells an even more effective and reliable option.

Costs:
- Installation of additional wells (each producing an approximated 2.5 million gallons per day) will cost $350,000 each.
- Treatment of the Curtis Well (potentially at the Gibraltar tank site) should consist of ozonation with filtration and backwash, at a cost not to exceed $250,000 or $363 per hundred cubic feet of daily production, due to it's low capacity.
- Connection of any well to the distribution system could have a variable cost from a trivial amount up to $3 million dollars depending upon the pump station design.
- If electricity costs $0.11 per hundred cubic feet and the groundwater fee is $1.71 per hundred cubic feet, the total cost for pumping groundwater from a well is $1.82 per

hundred cubic feet.

- Therefore the total capital cost of implementation of a new groundwater well with treatment would be would cost $3,000,000.
- The ongoing annual cost of operations of the new well is $890,000 in electrical costs
- The total cost (capital and O&M combined) for the lifetime of the new well is therefore $1.98 per hundred cubic feet.

Benefits:
The completion of existing wells or addition of new groundwater wells to the City potable water distribution system could result in a considerable decrease of imported water. If two new wells were constructed in addition to the Pinewood and Curtis wells, potentially 8.2 million gallons could be reduced from imported water purchases daily. However, it is most reasonable to assume 1 million gallons per day ($1337 \text{ hcf/day} \times 365 \text{ days} = 488,005 \text{ hcf/yr}$) from each single source for the purpose of cost optimization.

Source	Flow (mgd)
Pinewood Well	2.5
Curtis Well	0.7
New Well #1	2.5
New Well #2	2.5
TOTAL	8.2

Task 5: Water Rights Acquisition

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
Treatment of surface water is an extremely effective way to provide a supply of water. Although water rights are rare, if surface water were to become available to the City, the City could invest in an extremely effective and time-tested, very reliable (albeit drought-prone) solution via a surface water treatment plant.

Costs:
Implementation of a surface water rights acquisition program could cost $1,700,000 or more in addition to the annual costs. Transmission of raw water would cost many millions of dollars for pipeline or canal, so water would need to be treated with a surface water treatment plant costing at least $75 million, and then transmitted via “water wheeling” or pipeline. “Water wheeling” would cost potentially hundreds of thousands of dollars, but would be a reasonable annual cost.

- Total capital cost of surface water acquisition and treatment is $76,700,000.
- Total operations and maintenance cost of surface water acquisition and treatment is $1 million annually.

- The total cost (capital and O&M combined) for the lifetime of the plant is therefore $0.52 per hundred cubic feet.

Benefits:

- Water rights acquisition would allow the City to be able to cease purchasing water from wholesalers entirely. Annual water transfers via “water wheeling” would be equivalent and would allow the city to avoid treating surface water, while purchasing from other more desirable parties.
- Approximately 10 million gallons per day of treated water (or 4,880,050 hundred cubic feet per year).
-

Task 6: Desalination

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
Desalination is an extremely effective way to get a new supply of water for any body of consumers. There is a nearly limited supply of salty water in the oceans and if that were to become available to the City through a brackish water aquifer or a direct intake the City could invest in an extremely effective solution via a desalination plant.

However, though desalination is effective, it is also unreliable. Desalination usually operates at very high pressures, and therefore it must be safe and reliable to pump in that way. Sadly, reverse osmosis membranes do not last long, and R/O can be considered one of the most unreliable, and therefore expensive, types of treatment systems available.

Costs:

- $20,000 for a background brackish groundwater study.
- $20,000 for a cooperation agreement with potential partners.
- Up to $20 million dollars for a brackish groundwater treatment facility producing 10 million gallons daily.
- The total capital cost of a desalination program would cost $20,040,000
- The ongoing cost of operations at the new desalination facility of $0.55 per hundred cubic feet or $2.68 million per year
- The total cost (capital and O&M combined) for the lifetime of the plant is $0.75 per hundred cubic feet.

Benefits:

- A savings of potentially 10 million gallons or 4,880,050 hundred cubic feet per year.

Task 7: Additional Storage

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
The addition of water storage tanks will not contribute directly to reduced water consumption. However, additional water storage will allow for greater amounts of stormwater, recycled water, groundwater or local sources of water to be stored, which can lead to opportunities for purchasing water at reduced rates by augmenting available water supplies.

Elevated tanks can be used to reduce operating costs, improve reliability and maintain constant pressures. This involves pumping water up a tower or mountain during times of reduced electrical rates in places with special rate structures.

Costs:

- ~$2.00 per gallon for small tanks less than 500,000 gallons.
- ~1.50 - $1.75 per gallon for tanks 500,000 gallons to 1 million gallons
- ~$1.25 per gallon for large tanks greater than 1 million gallons. ($1.25 Million per million gallons of storage).
- Pump Station Construction at $500,000+
- Regular maintenance costs of $3 million over the tank lifetime.
- Triennial maintenance and inspection costs.
- Routing costs at about $422,000 to $1,500,000 per mile (or about $10 to $35 per inch*foot = $422,000 / 5280 feet per 8 in pipe).
- Water rights acquisition costs
- Land acquisition costs
- The total capital cost of implementation of a 3 million gallon tank added to the recycled water system would cost $6,000,000.
- The ongoing cost of operations of the new recycled water tank is $0.00 since South Bay Water Recycling will inherit the system, although it would be $60,000 annually
- The total cost (capital and O&M combined) for the lifetime of the plant is therefore not available per hundred cubic feet since no water is saved.

Benefits:

- Additional water storage capacity for emergency supply
- Water supply reliability due to ruptured water mains, etc.
- Ability to store water when rates are lower and/or to store water from lower cost sources.
- Potential energy cost savings by pumping to elevated storage tanks when electrical rates are low and allowing gravity to supply pressure during peak hours.
-

Task 8: Funding

(G. Effectiveness, reliability, cost/benefit)

Effectiveness & Reliability:
The acquisition of funds for any of these tasks, whether grants or loans, improves the effectiveness of any of the options by leveraging the input of City funds. The effectiveness of money is inherently high in a commodity based economy.

Even if the financial markets cause interest rates to rise from their current lows, the loans available are at a rate less than half of the prime rate. This means that outside funding is an extremely reliable source of money.

Costs:
- There is a modest cost for applying for funding. A single employee position could provide services as both a fund researcher and a grant writer.

Benefits:
- Water Planning or Construction projects could be paid for in full or with loan money at a very low interest rate.

H. Life-Cycle & Ease of Implementation

Task 1: Conservation

(H. Lifecycle and ease of implementation)

Life Cycle: 20 years
The lifecycle of a water fixture is approximately 20 years.

Ease of Implementation:
By implementing ordinances or other measures significant gains can be made towards conservation with minimal effort. A Project Manager could be hired to facilitate implementing these measures, or the tasks could be shared internally by the existing staff. Santa Clara Valley Water District is a major ally in this effort. Cooperation with the district is required.

Task 2: Recycled Water

(H. Lifecycle and ease of implementation)

Life Cycle: 75 years
The lifespan of pipe for a recycled water system is approximately 75 years. This lifespan depends on a number of factors including global warming, traffic, and leaks.

Ease of Implementation:
Planning and construction of recycled water mains is a simple and common event involving the execution of a single construction contract following an engineering phase.

Task 3: Surface Water Detention

(H. Lifecycle and ease of implementation)

Lifecycle: 50 years
The lifecycle of surface water detention ponds and percolation ponds is highly dependent on construction design. Typical detention and percolation ponds have a lifetime of 80 to 100 years or more. However, the actual operational lifetime of a basin of this kind may be more like 50 years. Annual operation and maintenance is also required.

Ease of Implementation:

- Implementing surface water for construction water is relatively straight forward, inexpensive and easy to install. This includes connecting a water line to the lake with submersible pump and a connection point with isolation valves.
- Construction of additional surface water and percolation ponds can be complex and requires acquiring available land suitable for the application, excavation, material lining, and extensive geotechnical site investigation.
- Planning for and the acquisition of water rights is a complicated and uncommon event involving the execution of multiple contracts over the course of as many as ten years.

Task 4: New Groundwater Wells

(H. Lifecycle and ease of implementation)

Lifecycle: 40 years
The life cycle of any well installation is approximately 40 years.

Ease of Implementation:
Planning and construction of new groundwater wells is a common and uncomplicated task. The implementation plan is long and involves many steps, but through careful planning the use of wells can be a very feasible water augmentation strategy.

Task 5: Water Rights Acquisition

(H. Lifecycle and ease of implementation)

Lifecycle: 50 years
The life cycle of a water rights contract is effectively unlimited, dependent only upon the availability of the water in question and the continued interest of all parties.

Ease of Implementation:
Planning for and the acquisition of water rights is a complicated and uncommon event involving the execution of multiple contracts over the course of as many as ten years.

Task 6: Desalination

(H. Lifecycle and ease of implementation)

Lifecycle: 20 years
The life cycle of a brackish groundwater desalination facility is very much the same as a surface water treatment plant, being approximately 20 years.

Ease of Implementation:
By hiring consultants to do studies of past efforts and for the Milpitas area regarding brackish groundwater desalination, this process becomes much easier than if the City were to attempt to do this themselves. However, the legal entanglements of partnerships and desalination permitting are considerable.

Task 7: Additional Storage

(H. Lifecycle and ease of implementation)

Lifecycle: 50 years
The life cycle of a water storage tank depends on the type of material used for the construction and the design parameters for water storage tanks. Typically, a plastic or fiberglass tank will last between 20-35 years, while a concrete or steel tank can last significantly longer (40-60+years). Maintenance at around 15 to 20 years will be required for most concrete and steel tanks, including repainting, replacing seals and for other maintenance issues.

Ease of Implementation:

The ease of implementing new water storage infrastructure can be greatly increased by hiring a consultant to do hydrological and geological studies, as well as prepare design concepts for construction. However, additional costs may be accrued because of this. The process for additional water storage is relatively straight-forward and requires funding, contacting agencies for permitting and construction.

Task 8: Funding

(H. Lifecycle and ease of implementation)

Lifecycle: N/A
The life cycle of a low-interest for non-disadvantaged communities is 20 years.

Ease of Implementation:
Grant funding from U.S. Bureau of Reclamation is not as circuitous a process as are the State Revolving Funds.

Results

Given the input received from the City of Milpitas Engineering Staff, certain priorities were given to the following categories for evaluation (see table below). The higher the score, the greater the concern. The weighted scores reflect the City's considerations when comparing these different categories.

Figure 5: Weighting of Considerations for the Decision Matrix

Category of Evaluation	Score
Available Volume of Water	5
Order of Magnitude of Infrastructure Needed	5
Issues to Be Resolved	2
Operational & Maintenance Considerations	5
Effectiveness	4
Reliability	3
Cost	3
Benefit	4
Life Cycle	4
Ease of Implementation	5

These category scores were then applied to a Weighted Sum Model, a type of Decision Matrix invented by Stuart Pugh. The Pugh Concept Selection decision matrix method is a

quantitative technique used to rank the multi-dimensional options of an option set. It is frequently used in engineering for making design decisions but can also be used to rank investment options, vendor options, product options or any other set of multidimensional entities.
A basic decision matrix consists of establishing a set of criteria options which are scored and summed to gain a total score which can then be ranked. Importantly, it is not weighted to allow a quick selection process.

Figure 6: City's Quantitative Consideration Scores for the 8 Tasks

Concerns	Importance	Task 1: Conservation	Task 2: Recycled Water	Task 3: Surface Water Detention	Task 4: New Groundwater Wells (2@2.5 MGD)	Task 5: Water Rights Acquisition (10 MGD)	Task 6: Desalination (10 MGD)	Task 7: Additional Storage Capacity*
Amount of Water Saved (hcf per year)		879,000	272,000	436,000	2,440,000	4,880,000	4,880,000	
Capital Costs		$6,625,000.00	$36,707,000.00	$17,700,000.00	$6,000,000.00	$76,700,000.00	$20,040,000.00	$6,000,000.00
Operating Costs (per year)		$140,000.00	$0.00	$160,000.00	$1,780,000.00	$1,000,000.00	$2,680,000.00	$60,000.00
Lifetime (years)		20	75	50	40	50	20	50
Lifetime Costs ($/hcf)		$0.54	$1.80	$1.18	$0.79	$0.52	$0.75	
Available Volume of Water	5	4	2	3	3	5	5	1
Order of Magnitude of Infrastructure Needed	5	5	3	1	4	1	1	3
Issues to Be Resolved	2	1	1	1	4	1	1	3
Operational & Maintenance Considerations	5	4	5	1	1	1	1	2
Effectiveness	4	3	5	3	3	5	5	1
Reliability	3	1	5	5	3	3	3	4
Cost	3	1	2	3	5	1	2	4
Benefit	4	2	5	4	4	5	5	1
Life Cycle	4	2	5	5	4	5	2	5
Ease of Implementation	5	1	4	1	5	1	1	3
The higher the score the better the result.	**SCORE**	**106**	**118**	**104**	**141**	**114**	**105**	**87**

**No water made available, only stored*

A weighted decision matrix operates in the same way as the basic decision matrix but introduces the concept of weighting the criteria in order of importance. The resultant scores better reflect the importance to the decision maker of the criteria involved. The more important the criteria the higher the weighting it should be given. Each of the potential options are scored and also multiplied by the weighting given to each of the criteria in order to produce a result.

In decision theory, the weighted sum model is the best known and simplest multi-criteria decision analysis / multi-criteria decision making method for evaluating a number of alternatives in terms of a number of decision criteria.

Multiple-criteria decision-making or multiple-criteria decision analysis is a sub-discipline of operations research that explicitly considers multiple criteria in decision-making environments. Whether in our daily lives or in professional settings, there are typically multiple conflicting criteria that need to be evaluated in making decisions. Cost or price is usually one of the main criteria. Some measure of quality is typically another criterion that is in conflict with the cost. In purchasing a car, cost, comfort, safety, and fuel economy may be some of the main criteria we consider. It is unusual to that the cheapest car is the most comfortable and the safest one.

In our daily lives, we usually weigh multiple criteria implicitly and we may be comfortable with the consequences of such decisions that are made based on only intuition. On the other hand, when stakes are high, it is important to properly structure the problem and explicitly evaluate multiple criteria. In making the decision of whether to build a nuclear power plant or not, and where to build it, there are not only very complex issues involving multiple criteria, but there are also multiple parties who are deeply affected from the consequences.

Structuring complex problems well and considering multiple criteria explicitly leads to more informed and better decisions. There have been important advances in this field since the start of the modern multiple-criteria decision-making discipline in the early 1960s. A variety of approaches and methods, many implemented by specialized decision-making software, have been developed for their application in an array of disciplines, ranging from politics and business to the environment and energy.

The results of the Pugh method weighted sum model showed that there were three clear leaders of the three task's solutions. As such, the City should pursue the following options:

1. Task 4: New Groundwater Wells
    a. Site-specific hydrogeological investigations
        i. $20,000 per monitoring well or test-hole
    b. Development of the above-ground facilities at the Curtis and Pinewood wells
        i. Water Softening equipment for taste control at the Pinewood well
        ii. Blending facilities at the Curtis well or Gibraltar Tank Site
2. Task 2: Recycling
    a. Segment 1
    b. Segment 2
    c. Segment 3
    d. Segment 4
    e. Segment 5
    f. TASP Area Extensions
    g. Dixon Loop - City Completion
    h. California Loop
    i. Milmont Extension
    j. Yosemite-Sinclair Loop
    k. East Landess Extension
    l. Recycled Water Tank
3. Task 1: Conservation
    a. Encourage the rebates and retrofits with the Santa Clara Valley Water District (free to the City)
    b. Contract a Water Loss Auditing firm to identify and locate leaks
    c. Fund a Full-Time-Employee as a Water Conservation Manager (Admin III) to manage these programs and pursue funding opportunities (grant writing)

It is therefore recommended, that with the data in hand provided by all the available sources,

the City of Milpitas should pursue these three avenues of water supply improvement immediately. In addition, the City should consider purchasing water from Alameda County Water District as soon as possible.

Conclusion

In the search for water, there are rarely any low hanging fruit left over any more. This study has realized the preceding statement to be as true as ever. The topics of Conservation, Recycled Water, Surface Water Detention, New Groundwater Wells, Water Rights Acquisition, Desalination, Additional Storage, and Funding were all explored and our recommendations draw from that exploration.

Conservation is a nearly tapped out source of potable water savings which is clearly shown by the City's current water use. However, it seems clear from use reports of the effort, that few residents have chosen to take advantage of the retrofit rebates available to customers in the Santa Clara Valley Water District area, including the City. Moreover, and old city such as Milpitas undoubtedly has leaks, so a Water Loss Audit seems appropriate. Pursuing these efforts could save nearly 2 million gallons per day, which is 20% of the City's current average day demand.

Recycled water is "the new 'drought-proof' source" and as such can be considered a clear winner for the City. More than 95,320 feet of new purple pipe are recommended.

Surface water detention is a possible source of water security for the City although it is not recommended. If the Santa Clara Valley Water District (the Basin Manager) were to allow the recharge of the aquifer by the City, and moreover the contribution of "recharge credits" to the City for such efforts, this might be a good avenue to pursue. Due to the cost and complexities of this type of solution, its pursuit is not advised at this time. However, for a low capital investment, Hidden Lake could be used as an "easy basin" for non-potable water use during construction.

New groundwater wells are the clear leader in this study. For a well-known and not too exorbitant cost, water security and independence can be had. Although operating costs are high, the use of groundwater wells is a sure solution to the City's water supply conundrum.

Pursuing the acquisition of water rights is a costly, lengthy and complex process. Moreover, this is an expensive process to execute to convert water rights into a water source. We do not recommend this option at this time.

Pursuing a desalination project is also a time-consuming and complex process. Although the

regional desalination project is underway, the City is too late a comer and not sufficiently funded to gain a seat at this table. However, the City could do much as Santa Clara Valley Water District has done and hire a consultant to perform a brackish groundwater study, which, if it were to result in a good site for proposal, could provide a good source of water at a low operations and maintenance cost; much less that that of regular desalinated water. We also do not recommend pursuing this project at this time.

The need for additional potable water storage in the City is not present. However, the City could pursue the construction of a recycled water tank in the system to serve as a "peak-shaving" resource. This is recommended as part of the recycled water task project. Additional potable water storage is not recommended.

The pursuit of funding on the other hand is strongly advised and is such a good idea, that as such it has been excluded from evaluation along with the other tasks. Since most funding comes from two sources, "www.grants.gov" and the funding section of the State Water Resources Control Board, it's recommended that the City either hire a Full-Time-Employee, or a consultant such as Water Solutions, Inc., as a part time grant writer (see Conservation) or delegate existing staff to pursuing these funding opportunites forthwith.

Desalination and water rights acquisition provide the most available water, at least theoretically. Conservation is the next best saver of water. Note that as a conservation program proceeds, the last to conserve are the most expensive to reach. New groundwater wells, surface water detention and recycled water also provide more accurately calculable sums of water, though these are lesser in quantity than the above. However, the theoretical amount of groundwater available is much greater per the infrastructure needed than that of these other methods. New wells are also a simple, uncomplicated and common undertaking, which if done right, can be a boon unlike any other. While operation of a new well may consume the hours of one full time licensed water operator, the operations and maintenance concerns are not very great.

Nothing is more reliable than a new, properly constructed groundwater well for effective provision of high-quality water, if said water is drawn from a properly maintained aquifer. The cost of a new well and treatment is rarely more than $3 million, and the benefits of having up to 2.9 million gallons per day from a single, simple source for up to 40 years, are immeasurable.

With these opportunities and projects well in hand it is important to note that the situation of the City is not one that is unique. Many other water systems find themselves in shortages and other dire straits at this time in California's climatic history.

Appendices Of Technical Memoranda

Water Solutions Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 1: Conservation**

Summary

The City of Milpitas (the City) has three motivations to conserve water:

- The City's growth is predicted to be 30% over 30 years (2010-2035), the population increasing from 70,000 to 106,000 citizens. Water availability is a major challenge for such growth (City of Milpitas, Urban Water Management Plan, 2010). If sufficient water is not available, the City risks being considered "water-limited" by large businesses.
- There is a state-wide regulation movement to reduce consumption by 20% between 2009 and 2020.
- Santa Clara Valley Water District has just announced the need for 30% reduction.
- Water rates from San Francisco Public Utilities Commission's 30% increase between 2014 and 2018, will increase further (KTSF TV Ch26, 2014).

The purpose of this memorandum is to compare and evaluate water usage statistics and water conservation efforts of other countries, states and municipalities with those of the City in order to identify suitable conservation strategies for the City. The memorandum examines a number of opportunities to augment the City's current water supply by improving conservation efforts and provides a cost-benefit analysis of these opportunities.

Water usage is measured in many ways. The two units of measure given below are used in this memorandum when discussing water usage:

- *gross gallons per capita per day water consumption* is the averaged amount of water supplied each day through an entire water system (residential, commercial, industrial, government, leakage, etc.) divided by the total population.
- *residential gallons per capita per day water consumption* represents the average amount of indoor and outdoor water used in each household within a given area (i.e., irrigating lawns, washing machines, showering, etc.), divided by the number of persons residing in that area.

It is important to understand the difference between these two.

Water usage statistics provided by the City, the Bay Area Water Supply and Conservation Agency (see Appendix Figures A1 and A2) and the Santa Clara Valley Water District indicate that the City's residential water usage is relatively conservative at 65 residential gallons per capita per day, compared to other cities in 2014, and in 2015 Milpitas is down to 50 residential gallons per capita per day. Although average residential usage covers a range nationally and internationally, the figure of 50 gallons per capita per day is becoming a world-wide water industry standard for indoor residential water conservation (Vickers, 2010, p.12-15).

The following recent water consumption figures show that the City compares favorably with the Bay Area as a whole (Bay Area Water Supply and Conservation Agency Annual Survey, 2012-2013). See Appendix Figure A2: Gross gallons per capita per day comparisons, for more comparisons:

- Bay Area's gross gallons per capita per day: 127.1 gallons
- Bay Area's residential gallons per capita per day: 79 gallons

- The City's gross gallons per capita per day: 140 gallons
- The City's residential gallons per capita per day in 2015: 50 gallons

Bay Area Water Supply and Conservation Agency oversees the purchase of wholesale water for 26 member water utilities. Here are the high and low users according to the Agency's Annual Survey 2012-2013:

- Daly City had the lowest water consumption at 48.8 residential gallons per capita per day
- Purissima Hills Water District had the highest water consumption at 290.4 residential gallons per capita per day

See Figures A1 and A2 in the Appendix for a comparison of usage by other Bay Area Water Supply and Conservation Agency members. While at first glance the Daly City numbers seems low, in fact the Environmental Protection Agency is advocating use in this range. The following are useful benchmarks and reflect a growing push for 50 residential gallons per capita per day:

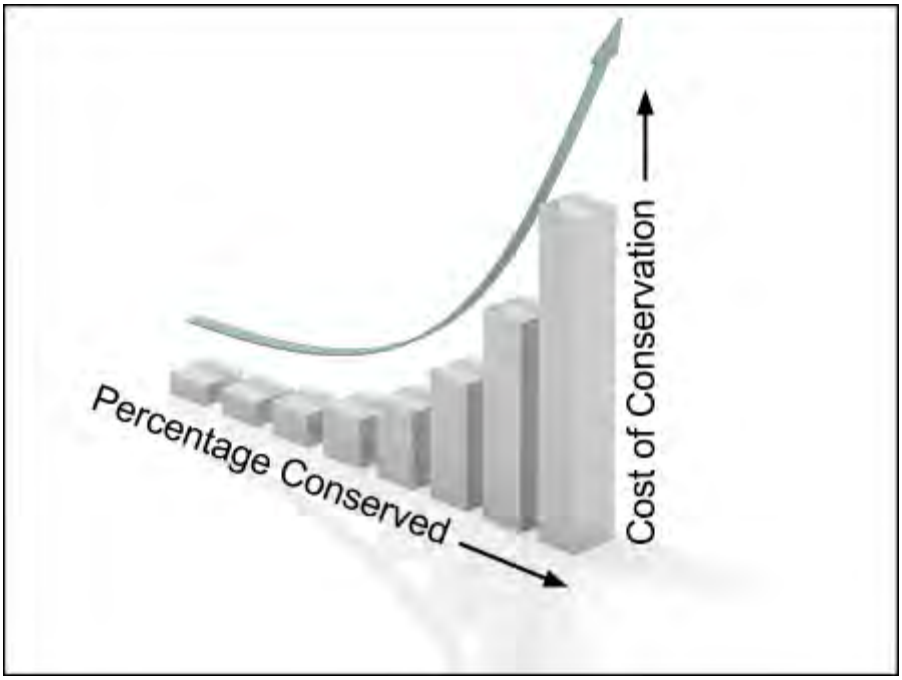
- Using the Environmental Protection Agency WaterSense specifications as a benchmark for indoor devices, the Environmental Protection Agency Post Retrofit study group (2000) defined efficient residential water use as 40 gallons per capita per day (de Oreo, *Home Energy Magazine*, 2013).
- Australia's average usage is 54 residential gallons per capita per day (and 84 gross gallons per capita per day).

- To reduce consumption by 20% by 2020 (California Department of Water Resources, 2009) Milpitas would need to conserve approximately 27.52 gallons in gross per capita per day usage (reducing gross gallons per capita per day from 140 to 112 gallons) and 13.1 gallons in residential per capita per day usage (reducing usage from 65 to 51.9 residential gallons per capita per day, which has already been done in 2014 according to Santa Clara Valley Water District.)

.

The City's water usage is already fairly conservative. As usage is reduced, approaching the goal, it becomes more expensive to save each additional gallon (Figure 1). Even so, several effective strategies are available to the City to conserve water at this time. For example, one-time conservation efforts implemented in times of drought can be continued during periods of normal rainfall.

Figure 1 - Conservation versus Cost



A multi-pronged approach will be needed to capture enough water to allow for 30% growth over 30 years and to reduce consumption by 20% by 2020. Conservation could achieve a 17% reduction, 879,454 hundred cubic feet per year. In addition, Recycling (see Task 2) could save 331,385 hundred cubic feet per year, nearly 1 million gallons per day, during peak use periods. (Note: a hundred cubic feet is a hundred cubic feet of water or 748 gallons; 1 million gallons is 3.07 acre-feet).

Conservation strategies for residential consumption tend towards consumer education and retrofit programs. Strategies for commercial consumption often require site specific

analysis to address technologies like recycling water to enhance conservation.

The biggest surprise in researching Conservation strategies for the City, is that Santa Clara Valley Water District offers most of the conservation resources and programs that we suggest, already. The District offers *free* cradle to grave conservation programs for both Milpitas residential and business customers. They even stated that their toilet retrofit program can be applied to the Sports Center; $300 rebate per toilet and free installation: that means the retrofit of the Sports Center will only be a small expense for the City of Milpitas. As much as 879,454 hundred cubic feet/year of water can be saved (see Figure: 9), at no cost to the City, simply by encouraging Milpitas customers to pick up the phone to start the rebate and retrofit process with the Santa Clara Valley Water District.

Data

The California Department of Water Resources acknowledges that "easily retrievable, standardized, and comprehensive baseline urban water use data is not available in California" (*California Water Plan Update*; California Department of Water Resources, 2005). The Public Water System Survey provides an annual estimate based on non-audited self-reporting. California uses Urban Water Management Plans, which are required every five years (*California Water Code*; California Department of Water Resources, 2002), to collect water use data, but the results are not compiled into a statewide database.

Water use data collection is a significant challenge in any conservation program. Nevertheless, data collection should be a major goal. The City recently embarked on a water meter modernization program that will provide this data; however, there is a cost associated with collecting and disseminating the data in a meaningful way, and this new cost needs to be included in future City Water Operations budgets.

Data collection is difficult at present, as the current metering technology involves a 1.5% +/- inaccuracy. This technological limitation creates inaccuracies in meter-based water accounting. Although the City's new water meter program may reduce this problem, the plus or minus inaccuracy of the new meters must be applied to all water use data. Aging meters, however, lead to an even higher inaccuracy such as under-registered usage.

Further, the data for outdoor residential irrigation consumption are collected inconsistently and the variables of climate, size of property, types of vegetation, etc., add further complications. Although theoretical calculations of evapotranspiration and irrigation requirements can be done, their complexity makes analysis difficult. Outdoor consumption is usually estimated by comparing peak summer and peak winter water usage. However, as there is usually some irrigation in the winter, calculations done this way tend to overstate indoor use and understate outdoor use (deOreo, William p.152).

Australia takes data collection seriously, and it shows in their gross gallons per capita per day usage figures. Every year, all major water utilities provide information for the audited National Performance Report, which uses standardized reporting categories ("National Performance Report 2011-2012: Urban Water Utilities - Introduction", National Water Commission and Water Services Association of Australia). This report would be analogous to an audited, expanded version of the Public Water System Survey results in California, if such a compilation existed (Cahill and Lund, 2011, p.2). Accurate data collection is the means by which Australia gets water consumption rates down.

Cost-Benefit Water Meter Retrofit to Digital with Beacon Software

Good data can be used to inform and educate the City and its customers about water usage, and to diagnose over-use, inefficiencies and leaks. Digital meters are slowly improving in battery life and reliability. Nevertheless, the cost of digital meters is still more than that of traditional meters, at $150-250 per meter (Badger E-Series Ultrasonic Meters) plus $400 for installation (½ hour labor).

Milpitas has already budgeted for water meter and software upgrades (Badger Beacon software) using the Capital Improvement Program at an anticipated cost of $6,475,000. Despite the high cost associated with installing the new meters, the benefit of real time data in assisting both consumers and the city to monitor water use will be significant.

Currently, the City reads manually meters every other month, 6 times per year. In the event of water rationing by the wholesale water providers serving Milpitas, the City would have to respond quickly to manage city wide water use. The available options are as follows.

Read Meters Manually Every Month

- public outreach
- staff and City personnel patrols for visible violations
- city-wide, door-to-door water audit outreach

Automated Meter Reading Every Month

- targeted calls
- mailers
- financial incentive
- visits to customers using excessive water as identified by the daily water usage figures from smart meters

Highly targeted conservation water audits would do best with real time water use data.

Some types and brands of smart meters are significantly more accurate at low flows, which can result in a one-time income increase from newly captured leaks at the customer connection. This financial increase is discounted due to the typical customer response of repairing the now identified leak.

It is generally held that collecting real time water use data provides a valuable tool in city water management; however, the actual benefit is not tangible unless conservation plays a significant role in the city water supply.

Methodology

In gathering information regarding water conservation, a number of reliable resources were uncovered. In *Water Use and Conservation,* Amy Vickers refers repeatedly to William de Oreo's *California Single Family Home Water Use Efficiency Study* from 2011. In de Oreo's work for the California Department of Water Resources, he establishes the primary data that many other authors refer to. In this way he should be credited herein as the primary resource.

A series of examinations of available information regarding water conservation in various regions was conducted. The information gathered and results of our study are recorded in the following sections of this technical memorandum.

A. Analyze historical per capita water usage data for readily available/obtainable counties within and outside of the San Francisco Bay Area region
B. Fit data to statistical distributions for the determination of statistical parameters and provide accurate comparison among data sets, including graphical illustrations. (*This task could not be completed due to lack of good data*).
C. Analyze conservation actions and related statistical results for effectiveness, to determine applicable methods considering other water retailers
D. Optional: Perform Mass Balance (water in equals water out study)
E. Optional: Conduct customer usage leak detection study (such as irrigation, toilet, etc.)
F. Optional: Conduct City-wide Home-Use audit of randomly selected representative homes
G. Optional: Perform study of distribution system using correlator
H. Optional: Perform study of point of sale water use (and loss) using correlator
I. Provide potential examples of conservation methods (irrigation, toilets, system water lost, additional effort of water audit of city parks, etc)

Legal and financial considerations will be addressed at the end of "Methodology" below.

There will be a final *Task 1 Implementation Plan Table* at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan

and ease of implementation. Feasibility will be discussed in Task 9.

Current water conservation efforts were compared for the following countries, states and municipalities:

- California
    - Alameda
    - East Bay
    - Milpitas
    - Los Angeles
    - Sacramento
    - San Francisco
    - San Jose
    - San Mateo County
    - Santa Clara
    - Windsor
- Nevada
    - Las Vegas
    - North Las Vegas
- New Mexico - Albuquerque
- Arizona - Tucson
- Colorado - Denver
- Georgia - Atlanta
- Kansas
- New York
- Oregon - Portland
- Rhode Island
- Texas
- Washington - Seattle
- Australia
- United Kingdom

The City was compared to cities and agencies throughout the Bay Area (California), Las Vegas, Colorado, New Mexico and Australia. These locations were chosen due to their similarities in features such as climate, infrastructure, economies, and types of land use. There were also relevant case-studies of their current conservation strategies. Australia and Las Vegas were chosen as extremes to illustrate differences in applying conservation measures, alternative approaches to conservation and different abilities to achieve a baseline in severe or constant drought conditions. Both of these sites are known around the world as water stressed; one city has rethought its water program, the other has yet to do so.

Water usage varies greatly among locations. Variables that influence these trends include the following:

- climate
- cultural memes (or behaviors)
- cost/availability of water
- availability of water using appliances
- agricultural practices
- irrigated areas of lawns, etc.

Integrated land use planning, efficient usage strategies, recycled water augmentation and education efforts were investigated for their applicability to the City to reduce water usage in a cost-effective manner. Urban density data and land use integration options were also studied as the means to provide water saving potential for planning purposes within the City of Milpitas.

A. Analyze historical per capita water usage data for readily available/obtainable counties within and outside of the San Francisco Bay Area region

Milpitas

The City has several reasons to conserve water, namely to:

- possibly grow 30% over 30 years (by 2030)
- reduce water consumption by 20%
- San Francisco Public Utility Commission (⅔ water source) will raise water rates by up to 30% annually over next 4 years
- Santa Clara Valley Water District (⅓ water source) will raise its rates too

Milpitas is situated in the north section of Santa Clara County and purchases its water as follows (City of Milpitas, 2014):

- Santa Clara Valley Water District (~⅓) and
- San Francisco Public Utilities Commission (~⅔).

The City's usage quantities per source (Bay Area Water and Conservation Agency annual report 2012-2013, p. 31):

- 29% or 1,443,000 hundred cubic feet; Santa Clara Valley Water District (1,079 millions of gallons)
- 62% or 3,115,000 hundred cubic feet; San Francisco Public Utility Commission (2,330 millions of gallons)
- 8.4% or 417,000 hundred cubic feet; recycled water (312 millions of gallons) TOTAL 4,975,000 hundred cubic feet (3,721 millions of gallons)

As of fall 2014, both the State of California and the Santa Clara Valley Water District have set a 20% mandatory water reduction from 2013 usage levels. The San Francisco

Public Utilities Commission has asked for a 10% voluntary reduction.

The City has an effective 14% mandatory water reduction effort in place, as well as the following conservation measures:

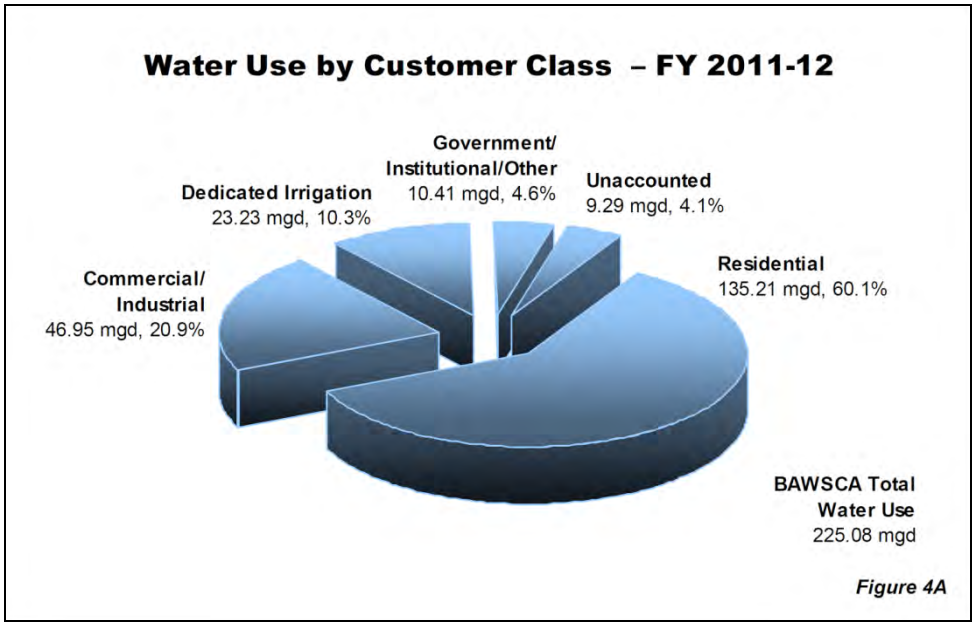
- provision of indoor and outdoor water use education, including tips on how to save water outdoors and advising residents to adjust their irrigation timers to watering before 6 a.m. or after 6 p.m.
- offering free low-flow devices
- initiating a landscape rebate program to upgrade irrigation equipment
- offering free water-wise house calls by a trained district technician
- making available high efficiency toilet rebates for up to $125
- offering a rebate of up to $175 for Tier 3 residential washing machines
- allowing commercial and industrial customers to borrow water meters for monitoring conservation efforts
- offering rebates of up to $400 per unit on high efficiency washers

All categories of water use—landscape, commercial, industrial and residential—appear to have opportunities for saving water, which include the following:

- replacing under-reading water meters
- implementing a leak detection program to fix leaky pipes

A $150,000 water audit and leak detection program would help to isolate unknown losses in the system (Gasner, Kate, 2015). This could reduce the City's water consumption by up to 4% (see "Unaccounted" 4.1% below) and possibly more (Bay Area Water and Conservation Agency data; see Figure 2, below).

Figure 2: "Bay Area Water Supply and Conservation Agency 2012-2013 Annual Survey"



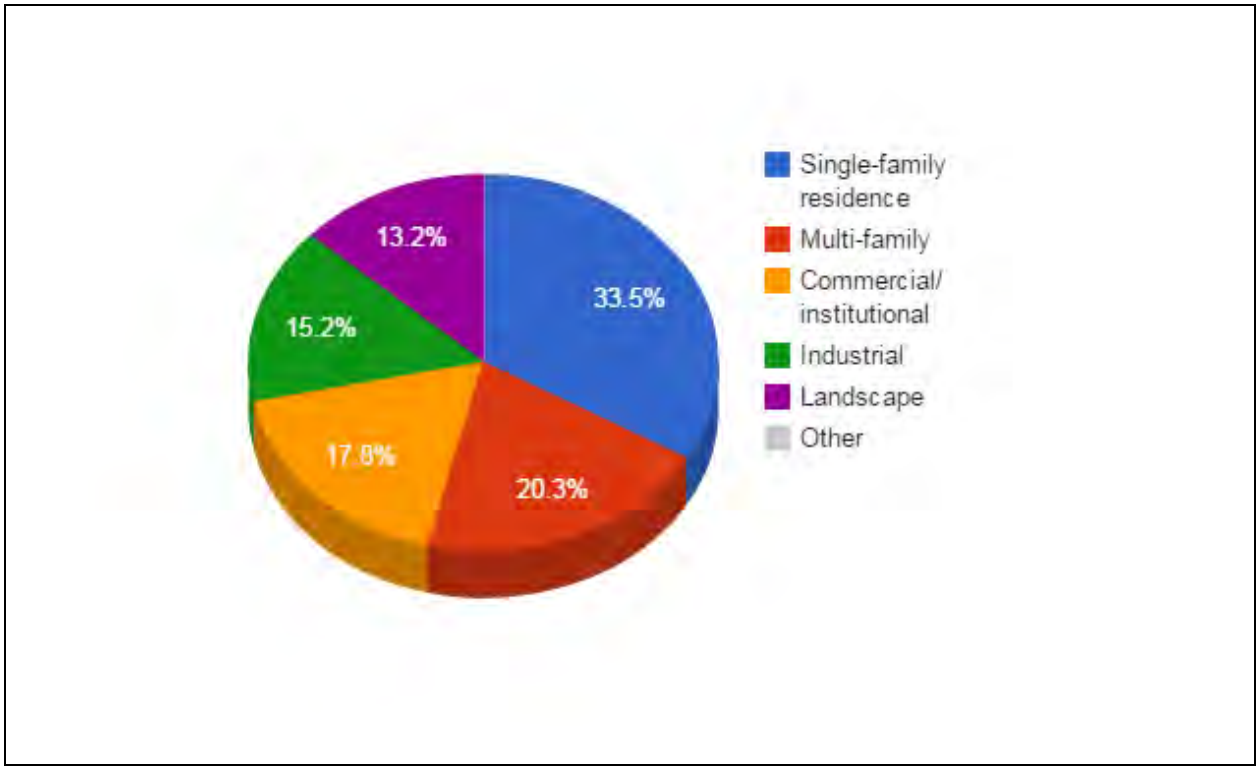
The Bay Area Water Supply and Conservation Agency 2012-2013 Annual Report presented gross per capita consumption as follows:

- Milpitas for 2007: 162 gross gallons per capita per day
- Milpitas for 2012-2013: 137.6 gross gallons per capita per day
- Bay Area average: 127.1 gross gallons per capita per day
- Daly City: 70.0 gross gallons per capita per day
- North Coast Community WD: 62.7 gross gallons per capita per day

To reduce consumption by 20% by 2020 (20x2020 California Water Resources Board), Milpitas would need to:

- reduce gross water consumption by 27.52 gross gallons per capita per day
    - reducing usage from 140 to 112 gross gallons per capita per day
- reduce residential water consumption by 13.1 residential gallons per capita per day
    - reducing usage from 65 to 51.9 residential gallons per capita per day, has already been done in 2014 according to Santa Clara Valley Water District.

Figure 3: Water Use by Customer Class - Projected 2015
(Figure 3 derived from Bay Area Water Supply and Conservation District Annual Survey 2012-2013 data)



Milpitas consumers *from most to least* consumption (based on 2015 projections in Figure 3 above) are as follows:

- single-family residence (largest consumer group)
- multi-family
- commercial/institutional
- industrial
- landscape
- other/fire (smallest consumer)

Using recycled water for irrigation and replacing lawned surfaces with native plants are approaches that could be taken to reduce potable water consumption.

Consumption dropped from 12.09 millions of gallons (in 2000) to 10.19 millions of gallons (in 2013), although demand seems to be increasing at a steady rate, with occasional and abrupt drops in consumption, most notably around 2002 and 2007. Although the cause of these decreases is unclear, possible explanations include economic downturn, rate increases, increased conservation efforts, drought awareness and/or reductions from large industrial customers.

The following tables outline the City's projected demand for water purchased from the Santa Clara Valley Water District, from San Francisco and for recycled water.

Daily Demand Projections By Source: Santa Clara Valley Water District

2012-2013 Actual	2015-2016 Projection	2020-2021 Projection	2025-2026 Projection	2030-2031 Projection	2035-2036 Projection
2.90 millions of gallons (3,877 hundred cubic feet)	3.30 millions of gallons (4,412 hundred cubic feet)	3.91 millions of gallons (5,227 hundred cubic feet)	5.15 millions of gallons (6,885 hundred cubic feet)	6.40 millions of gallons (8,556 hundred cubic feet)	8.20 millions of gallons (10,963 hundred cubic feet)

(Bay Area Water Supply and Conservation Agency 2012-2013 report, p. 35, Table 3D-5)

Daily Demand Projections By Source: City and County of San Francisco

2012-2013 Actual	2015-2016 Projection	2020-2021 Projection	2025-2026 Projection	2030-2031 Projection	2035-2036 Projection
6.48millions of gallons (8,663 hundred cubic feet)	7.07 millions of gallons (9,452 hundred cubic feet)	7.69 millions of gallons (10,281 hundred cubic feet)	8.25 millions of gallons (11,029 hundred cubic feet)	8.80 millions of gallons (11,765 hundred cubic feet)	8.90 millions of gallons (11,898 hundred cubic feet)

(City and County of San Francisco, 2010 Urban Water Management Plan, p. 47)

Daily Demand Projections By Source: South Bay Water Recycling

2012-2013 Actual	2015-2016 Projection	2020-2021 Projection	2025-2026 Projection	2030-2031 Projection	2035-2036 Projection
0.85 millions of gallons (1,136 hundred cubic feet)	0.99 millions of gallons (1,324 hundred cubic feet)	1.19 millions of gallons (1,591 hundred cubic feet)	1.38 millions of gallons (1,845 hundred cubic feet)	1.57 millions of gallons (2,099 hundred cubic feet)	1.77 millions of gallons (2,366 hundred cubic feet)

(Bay Area Water Supply and Conservation Agency 2012-2013 report, p. 35, Table 3D-4)

Santa Clara County

On February 25, 2014, the Santa Clara Valley Water District board extended conservation goals to reduce water usage further, by 20% by 2015. In 2009, the District Board of Directors had already called for a 15% mandatory water conservation target supported by an innovative promotional campaign entitled "There's never enough water to waste." The campaign continued in Fiscal Year 2010-11, with a mandatory

conservation target of 10%. The public responded by achieving a 17% rate of water conservation.

Assuming continued conservation, the District had projected a reduction in revenue of approximately $5.8 million in Fiscal Year 2010-11, which was addressed through operational efficiencies. Ongoing public outreach to encourage water conservation is allocated $750,000 in the budget.

Current water conservation programs focus on:

- landscape areas for residential and commercial
- technical assistance
- water efficiency technologies [Badger E-Series Ultrasonic Meters and weather-based irrigation controllers for commercial only]
- toilet retrofits
- commercial clothes washer replacements

An example of one of these programs is the “Brown is the New Green” campaign promoting conservation awareness by providing residents with free “shower buckets” to collect extra water and yard signs to place on landscape areas with information on how to save water (“Brown is the New Green”, 2014). The campaign has been servicing all of Santa Clara County (including the City) for several months.

Santa Clara Valley Water District has also created a digital “water tracker” that makes monthly assessments of the larger water supply and usage. Residents are required to limit their irrigation use to twice a week. New incentives in 2014 include:

- rebates for drought resistant landscaping
- irrigation hardware
- greywater laundry-to-landscape programs for residential and commercial
- commercial high-efficiency toilet programs
- residential high-efficiency clothes washers
- the sub-meter rebate program
- clean water and natural flood protection program

Bay Area Conservation

The average gross and residential water consumptions in the whole Bay Area Water Supply and Conservation Agency (excluding Stanford) for Fiscal Year 2012-13 were:

- gross gallons per capita per day: 127.1
- residential gallons per capita per day: 79

The City’s *residential* consumption is *lower* than the Bay Area average by 13.4 residential gallons per capita per day (at 65.6 residential gallons per capita per day in 2013, and 50 residential gallons per capita per day in 2014).

However, the City's *gross* consumption is *higher* than the Bay Area average by about 10 gross gallons per capita per day (at 137.6 gross gallons per capita per day).

As noted earlier, Daly City had the lowest reported residential consumption at 48.8 gallons per capita per day, while Purissima Hills Water District had the highest at 290.4 gallons per capita per day (see Figures 1 and 2 in the Appendix).

All owners of San Francisco County properties with over 1,000 square feet of newly constructed or rehabilitated landscape are required to implement efficient irrigation systems, utilize low-water-use and climate-appropriate plants and establish a site-specific water budget designed to keep the landscape healthy and water efficient. San Francisco Public Utilities Commission strongly promotes the use of water-efficient shower heads, aerators and toilets. Further, if shower heads produce more than 2.5 gallons per minute, if toilets use more than 1.6 gallons of water per flush, or if faucets use more than 2.2 gallons per minute, these devices must be replaced.

Alameda County Water District has a Water Saving Assistance Program that encourages residents to request a free water-use survey of their homes. Businesses participating in water-use efficiency programs are eligible to receive free water-conserving devices, for example, faucet aerators, toilet flappers and shower heads (Alameda County Water District website, Aug, 2014).

East Bay Municipal Utility District provides residents in the East Bay area with a rebate of $0.50 per square foot of yard if they replace their lawn with a WaterSmart California Friendly gardens, and $0.25 per square foot if a drip irrigation system is installed. Coupons for purchasing mulch are available at mulch retail locations, and free home water-audit kits are available to the public (East Bay Municipal Utility District website, 2014). The District advises taking cars to a commercial car wash that uses recycled water, to cover swimming pools to reduce evaporation and that residents be educated about how to read their water meters as a means of detecting leaks and about how to fix leaks. Also, residents are asked to run their dishwasher only when full, to install low-flow shower heads and high efficiency toilets, to put food coloring in the toilet tank so any leak becomes visible, and to plug the sink instead of running the water when rinsing a razor.

Windsor, CA, and Recycled Water

The Town of Windsor has been able to save about 55 acre-feet per year or 7% of its total water use by mandating the use of recycled water for new developments. City ordinances require that common landscaped areas, parks, and landscaped areas surrounding high schools and multi-family buildings are irrigated with recycled water. Dual plumbing systems are required for the high school and fire station's irrigation, process water and flush water. Recycled water is also used for irrigation of vineyards and for commercial wash water. Residents are required to make use of water conservation

incentives, rebates and giveaway programs to replace water-guzzling plumbing fixtures and appliances with water efficient models. If water escapes through leaks or breaks within the distribution system, the flaw must be detected and fixed within 72 hours or the customer involved can be fined. In times of extreme drought, residents are allowed 65 gallons per capita per day. The average gross water use to date is 140-150 gallons per capita per day (City of Windsor, Paul Piazza). Windsor provides an excellent example of what can be done through local policy change; however, the modest gains recorded to date also illustrate how slowly such policy shows a measurable effect (City of Windsor, CA website, 2013)

Los Angeles, CA

Compared to other California metropolitan areas, Los Angeles has the greatest potential for conserving water:

- before 1990, the average water use was 173 gross gallons per capita per day
- by 1990-2000, water use had fallen to 159 gross gallons per capita per day
- by 2009-2010, water use was estimated to be 117 gross gallons per capita per day

The continuing decrease is likely strongly influenced by mandatory conservation measures. Single family water use represents the majority of usage by the Los Angeles Department of Water and Power, followed by multi-family, commercial, etc. Also, outdoor use accounts for about 54% of residential use, but only about 32% of multi-family use (Los Angeles Department of Water and Power Urban Water Management Plan, 2010).

Water savings were achieved, in part, through legislation. The Water Conservation Act of 2009 (Senate Bill *X7-7*) required water agencies to reduce per capita water use by 20% by 2020 (conveniently marketed as “20x2020”). Also, assembly bills were approved to improve water management and provide funding for conservation efforts by water suppliers. Additionally, City ordinances have been utilized to mandate efficient shower heads, low-flow toilets and water-efficient landscaping. Customers with three acres or more of turf are required to reduce water by 10% or face a 100% surcharge on their water bill. Los Angeles Department of Water and Power will pay homeowners $2 per square foot of property and commercial customers $1 per square foot of property to replace conventional turf with water-wise landscaping (“Urban Water Conservation and Efficiency Potential in California” Pacific Institute, Natural Resources Defense Council, June, 2014).

Denver, CO

In Denver, Colorado, a homeowners association, helped reduce water use by 40% through joining with Denver Water. Together they installed eight new weather-based smart controllers that regulate the irrigation system in residential locations based on precipitation, soil makeup, wind and other environmental factors (“Saving Water for the

Future." Solutions, 2011). They also rebuilt storm drainages to promote more water soakage to plants, rather than letting the water running into the street. Homeowners are now required to maintain a grass height of 3.5 inches on residential lawns, which helps retain soil moisture. Denver Water pays commercial, industrial and institutional customers $18.50 for every thousand gallons of water they save.

Denver's "Accelerated Conservation Plan: 2007-2016" set a goal of reducing water usage by 20% and expanding the recycled water system to additional schools, parks and the local zoo. Denver Water has started delivering recycled water, which is dechlorinated, to Lake Ladora, Lower Derby Lake and Lake Mary, and to four wetlands. Denver Water is now partnering with 17 entities in a program called WISE, which stands for Water Infrastructure and Supply Efficiency. This program has yet to be approved, but if it is, the partnership will provide a new water supply through combining unused capacities (Denver Water website, 2014).

Las Vegas, Nevada

Gross per capita water use in the Las Vegas Valley is significantly higher than in other Western communities, owing in large part to high outdoor water demand—the average Las Vegas Valley resident uses approximately 100 gallons of water outdoors each day. The Southern Nevada Water Authority is among the highest for indoor water demand, using about 165 gallons per capita per day (Las Vegas Valley Water District website, 2014). Las Vegas provides a useful comparison for studying water conservation due to the combination of the following factors: excessive water use, water-demanding landscapes, large number of hotels, unsustainable groundwater withdrawal, an arid climate and poor conservation habits. This comparison, along with the disruptions to the economy that the City faces now, can be used to envision what might happen without proper water management. Already economic and residential growth are being threatened due to a lack of water, as water costs are quickly escalating. A run-away water demand has caught up with the City and is limiting its growth potential.

Water Conservation in Australia

Urban centers throughout Australia were selected for this study due to their similarities with Milpitas in economy, infrastructure, climate, including a history of drought cycles (every 18 years), and culture. Although the urban water use data are sometimes configured differently, average gross per capita water use in Australia is lower than for California. Australia was battered by an extreme drought lasting from 2003 to 2012. It forced a rethinking of water use, and the lessons they learned can be applied to the City of Milpitas.

The Australian Bureau of Statistics creates a "water account" every three years with summary statistics and urban water usage. Data are retrieved through surveys, water utilities and research papers. An extensive report of water audits known as the National

Performance Report is then issued. Figure 4 below).

Figure 4: "Water Use in Selected Australian and Western Cities, 2010" Cahill and Lund - November, 2013:

Location	Residential use[b], lpcd (gpcd)	Urban use[b], lpcd (gpcd)
Portland, OR	219 (58)	390 (103)
Albuquerque, NM[c]	282 (74)	587 (155)
Tucson, AZ[d]	367 (97)	544 (144)
Denver, CO	393 (104)	604 (160)
California	394 (104)	568 (150)
San Francisco	172[a] (46[a])	295[a] (78[a])
Oakland/East Bay	277[a]–316 (73[a]–83)	439[a]–469 (116[a]–124)
San Diego	277[a]–350 (73[a]–92)	490[a]–524 (129[a]–138)
San Jose	307–323[a] (81–85[a])	489–519[a] (129–137[a])
Los Angeles	345[a]–376 (91[a]–99)	450[a]–547 (119[a]–145)
Sacramento	428[a]–455 (113–120[a])	642–667[a] (170–176[a])
Australia	204 (54)	318 (84)
Melbourne	150 (40)	238 (63)
Brisbane	172 (45)	289 (76)
Canberra	191 (50)	288 (76)
Sydney	207 (55)	312 (83)
Perth	284 (75)	399 (106)

Note: Data sources are Portland Water Bureau (PWB) 2011; Yuhas 2010; Tucson Water 2008; Denver Water 2011; DWR 2011; San Francisco Public Utilities Commission (SFPUC) 2011; East Bay Municipal Water District (EBMUD) 2011; Los Angeles Department of Water and Power (LADWP) 2011; San Jose Environmental Services Department (SJESD) 2011; San Diego Public Utilities (SDPU) 2011; Sacramento Department of Utilities (SDU) 2011; WSAA 2011.

[a]This data is from the Urban Water Management Plan.

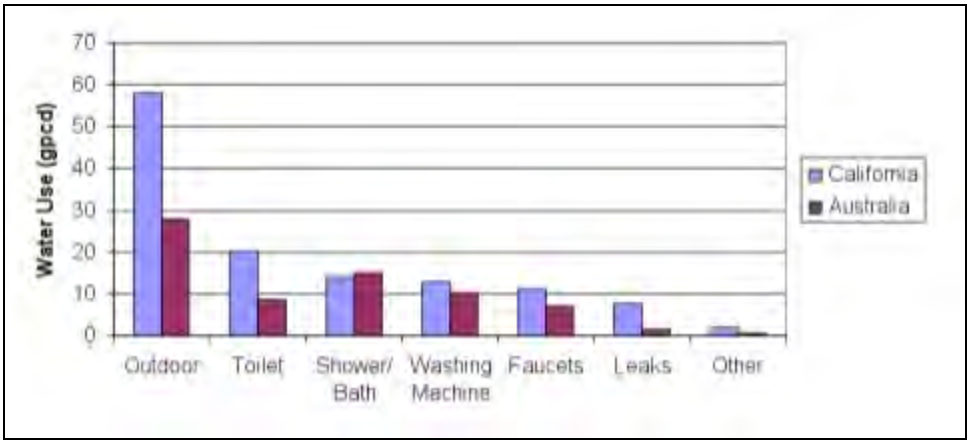
[b]This data does not include distribution system losses.

[c]This data is from 2009.

[d]This data is from 2007.

The methodology for determining outdoor residential water usage varies greatly among geographical areas. Outdoor water usage is the most significant type of usage for urban water consumption. The per capita outdoor residential water use is much lower in Australia than California (Figure 5).

Figure 5: Comparison of Californian and Australian End Uses of Water (California Water Blog website)



Average California residential water use is 104 residential gallons per capita. In comparison, average Australian residential use averages to 54 gallons per capita per day (Figure 4). The greatest differences between California and Australian residential water use relate to the following, in order of decreasing magnitude (Figure 5):

- outdoor water use
- toilets, leaks
- faucets
- washing machines
- other uses and lastly shower/baths

Since 1997, Caroma, Australia, has been using “dual flush” toilets that use half the amount of water per flush compared to common household toilets. In cities such as Melbourne, outdoor watering is prohibited between 10 a.m. and 8 p.m. and may be restricted more in particularly dry weather conditions. This prohibition has given residents the incentive to choose a less water-intensive landscape and to invest in rainwater tanks, which are exempt from watering restrictions and which reduce demand on the water supply system (Cahill and Lund, 2011). It should be noted that rainwater tanks have a limited value in California due to the long dry summer. Between 1994 and 2009, water usage in Australia fluctuated, with an overall decrease by 2009. This pattern is likely the result of the continuing implementation of conservation methods due to the seven year drought.

B. Fit data to statistical distributions for the determination of statistical parameters and provide accurate comparison among data sets, including graphical illustrations.

Note that the *theoretical* minimum for the residential water usage of a highly efficient household is approximately 32 gallons per capita per day**,** according to the "Urban Water Conservation and Efficiency Potential in California" (2014, p.4).
As noted earlier, the Environmental Protection Agency's Post Retrofit study group (2000), using the Environmental Protection Agency's WaterSense specifications as a benchmark for indoor devices, defined water efficiency as 40 residential gallons per capita per day (*Home Energy Magazine,* de Oreo, 2013 and California Department of Water Resources, *2011*).

California and Australia exemplify the wide range of gross water consumption that can occur in different areas (See Figure 4, Cahill and Lund, 2013):

- across California is 104 gross gallons per capita per day
- for Australia is approximately 54 gross gallons per capita per day, with an average usage of 50 residential gallons per capita per day

The following table (Figure 6) shows the range of residential water use averages throughout the United States and Australia. The water efficiency ratings and corresponding water use averages (residential gallons per capita per day) are given, as well as the amount of water Milpitas would need to save to achieve this rating.

Figure 6: Residential Gallons Per Capita per Day Usage Comparisons (Water Solutions, Inc.)

Rating*	rgpcpd	rgpcpd saved**	Relative Cost	Typical Example
Platinum	35	30	Very High	Theoretical Minimum
Gold	40	25	High	Australia - Low Average
Silver	47	18	Moderate	
Bronze	55	10	Low	
Excellent	65	0	No Cost	Milpitas
Good	79	-14	Less Available Water	Bay Area Average
Fair	100	-35	Limited Water Available	California Average
Poor	165	-100	Limited Water Available	Las Vegas
*Water Solutions, Inc. Rating			**rgpcpd minus previous rating value	

C. Analyze conservation actions and related statistical results for effectiveness, to determine applicable methods considering other water retailers: Milpitas Water Conservation Strategies

Water Rates Structure

Conservation pricing can encourage customers to conserve, but the pricing structure must be designed appropriately. This approach is the least expensive way to encourage water conservation. The following defines the three rate structures commonly in use.

A *Flat Rate* structure, such as that used in Sacramento, means everyone pays the same flat rate no matter what their usage. No one is motivated to conserve, as people can use as much water as they want with no financial consequence.

A *Uniform Rate* structure means that a dollar amount is assigned to the number of gallons used, for example $3.00/1,000 gallons. With this structure, as more water is used, more is paid, but along a single pricing tier (or at a set rate).

An *Increasing Block Rate* structure works by increasing the water rate based on usage. Low volumes are priced low, and higher volumes are tiered at higher prices. With this structure, water price effects water demand. Many large cities have implemented Increasing Block Rate structures, but they differ in:

- the number of blocks/tiers
- the block volume thresholds
- the block prices

Not all Increasing Block Pricing structures work to encourage conservation. A lesson can be learned by comparing Seattle and North Las Vegas. Seattle's Increasing Block Rate structure (per hundred cubic feet) sends a strong message to its customers by setting a modest rate for the first block of peak period usage ($5.13 per 3,740 gallons or 5 hundred cubic feet) to cover the essentials of cooking, cleaning, and bathing.

- The next two block structures are:
    - +23.6% ($6.34 per hundred cubic feet up to 13,464 gallons or 18 hundred cubic feet)
    - +130% more expensive than the first tier ($11.80 per hundred cubic feet for over 13,464 gallons or 18 hundred cubic feet)
- The third tier addresses peak period usage over sixty day periods:
    - $5.13 per hundred cubic feet for up to 10 hcf in 60 days
    - $6.34 per hundred cubic feet for the next 26 hcf in 60 days
    - $11.80 per hundred cubic feet for more than 36 hcf in 60 days

Peak use periods are the weeks and months when Las Vegas is hot, which is rare in Seattle, but can be an issue at times in Milpitas, especially considering nighttime irrigation.

The lowest Seattle price is higher than the highest North Las Vegas price, as can be seen below. Also, the volume thresholds are lower in Seattle, which means that Seattle is paying more for low usage than North Las Vegas. Smart block rate structuring can inspire conservation. It is the least expensive way to communicate to the population the value of water, linking the cost of water with the need to conserve.

North Las Vegas, in comparison, has four block rate structures. While increases of 30% to 40% are used in its Increasing Block Rate structure, it starts out with such a low block price and high block volume threshold that there is little incentive to conserve.

- $1.16 per 1,000 gallons up to 5,000 gallons
- $2.08 per 1,000 gallons up to 10,000 gallons
- $3.09 per 1,000 gallons up to 20,000 gallons
- $4.58 per 1,000 gallons over 20,000 gallons

North Las Vegas's water consumption is 165 residential gallons per capita per day. Note that this figure represents residential usage, not gross usage. In comparison, Seattle's residential usage is 63 gallons per capita per day. Of course, Seattle is located in the Pacific Northwest where the temperatures, humidity and annual rainfall are radically different from those in Las Vegas, which is bound to affect residential water usage.

A tiered rate structure can also be based upon Site Specific Evaluations. With this approach, each customer has a base index of water use. As long as that customer's water use stays below his particular base index, indicating that water is being conserved, the charge is below the nominal rate. However, if and when the base index is exceeded, indicating a higher-than-usual use of water, the charge to the customer is higher than the nominal rate.

There is no question that adjusting water rate structures to encourage conservation is an inexpensive way to curb consumption. Educational programs will help to explain why rate structuring helps everybody. Water consumption goals can monetarily encourage people to think twice about the amount of water they use.

The water industry has a goal of 50 gallons per capita per day for residential water consumption. When cities create well-priced and appropriately blocked rate structures for consumers, they communicate the value of water and encourage conservation with every statement that consumers receive. The following consumption figures (Gleick, 2010. p.105) provide an interesting comparison when you compare usage and rate structures:

- Seattle: 54 indoor + 9 outdoor residential gallons per capita per day = 63 gallons total

- Atlanta: 71 indoor + 20 outdoor residential gallons per capita per day = 91 gallons total
- Las Vegas: 65 indoor + 100 outdoor residential gallons per capita per day = 165 gallons total

Wastewater Rates Structure

As part of the continuum, wastewater is a product/service that, when priced appropriately, can encourage further water conservation. Wastewater rate structures vary markedly among Las Vegas, Atlanta and Seattle.

- Las Vegas has both a relatively weak inclining block structure for water and a low, flat wastewater charge. The way both variables are managed communicates limited appreciation of the value of water; as a result, the consumer will make little or no effort to conserve.
- Atlanta does better, using a two block increasing price structure for water, but the pricing is lower than for Seattle. For wastewater, Atlanta uses an increasing block structure that is more aggressive than Las Vegas and helps restrain consumption.
- Seattle uses aggressive block pricing for both water and wastewater, and the results are visible in the customers' low daily consumption.

The Milpitas / Santa Clara Valley Water District Water Conservation Programs

The Santa Clara Valley Water District offers a comprehensive conservation program that includes all of the rebates and retrofit opportunities that are calculated below. These calculations show how much water can be saved, and the money that can be saved as a result of not having to pay for expensive water. The calculations include the cost that the City would have to pay to implement its own rebate and retrofit program. *But,* because the Santa Clara Valley Water District already offers these rebate and retrofit services to Milpitas customers, it seems redundant for Milpitas to create their own program. A lot of water can be saved by marketing Santa Clara Valley Water District's conservation programs to Milpitas customers. A large amount of water can be saved, with little financial cost to the City.

The City of Milpitas could also try novel information marketing campaigns. Awards and demonstrations can get customer attention and encourage action. Business awards can be awarded to business who are 100% retrofitted to Environmental Protection Agency benchmarks. These awards should be publicized via billing statements, advertising, newspaper articles, social media, etc.

The City can inspire residential conservation by using inexpensive web technologies, in an innovative manner. Using the Environmental Protection Agency Post Retrofit study group (2000) and the The California Single-Family Home Water Use Efficiency Study (de Oreo, 2011) as examples, a house in Milpitas could be chosen and used as a conservation model. There could be an on-line capture of the example house whose

usage can be tracked and viewed as an example for other customers using electronic data loggers. Customers could apply to be a model house; two a year. In a series of interviews, the resident would blog or podcast their experience of the audit, the changes made, and water saved. The sample houses would agree to having their water use being tracked per toilet, shower, and appliance, and reflected on an online accounting website. A graduate student could find this a good project.

Residential Retrofit Cost-Benefits

The consumers of the City of Milpitas, to date, have not taken up this opportunity to conserve; the number of participants has been low. As described above, Milpitas will need to budget for an employee to market the Santa Clara Valley Water District's Conservation programs to the customers of Milpitas.

Residential Usage Benchmarks

As seen in Figure 7, below, there is a range of indoor residential conservation benchmarks. These benchmarks provide useful models. The table shows how benchmarks can range from the 2011 California Single-Family Home Water Use Efficiency Study, of 66 residential indoor gallons per capita per day, and the theoretical possibility of only 32 residential indoor gallons per capita per day (Figure 8).

Figure 7: Summary of Residential Benchmarks

Study	**Indoor residential gallons per household per day**	**Indoor residential gallons per capita per day** (divided by 2.64 people per household)	**Study Summary**
Residential End Uses of Water Study (1999)	186	70	flow trace data was obtained from portable data loggers attached to water meters of each study homes
EPA Retrofit Study (2000)	107	40	this figure is a suitable target for best management practices conditions
California Single-Family Home Water Use Efficiency Study (2011)	175	66	flow trace data was obtained from portable data loggers attached to water meters of each study homes

Urban Water Conservation and Efficiency Potential in California (2014)	---	35	Theoretical minimum. (see Figure 4)
Melbourne and Brisbane; "Residential Water Conservation in Australia and California" (Ryan Cahill and Jay Lund, 2011, p.4)		40-45	tri-yearly "Water Account" by the Australian Bureau of Statistics; data from surveys, water utilities, research papers, broadly consolidates information about water use
Milpitas; Bay Area Water Supply and Conservation Agency, 2012-2013		66	

Figure 8: Water Budget for One Person Using Efficient Appliances and Fixtures
(Urban Water Conservation and Efficiency Potential in California, 2014)

End Use	Assumptions	Gallons per person per day
Leaks	Reduced to zero	0
Toilets	4.8 flushes per day @ 1.28 gallons per flush	6.1
Clothes washer	2.3 loads per week @ 14.4 gallons per load	4.7
Shower	4.7 showers per week for 8.7 minutes each with conserving showerhead rated at 2.0 gpm and throttle factor of 72% for actual flow rate of 1.44 gpm	8.4
Bath	2.24 baths per week @ 18 gallons each	5.8
Faucets	10.1 minutes per day at an average flow rate of 0.64 gpm	6.5
Dishwasher	0.85 times per week @ 3.5 gallons per load	0.4
Total	**Efficient Household Water Budget**	**32**

Note: Average duration and frequency of usage were derived from the *California Single Family Water Use Efficiency Study* (DeOreo et al. 2011) and a 2005 article in the journal *Risk Analysis* whose authors summarized statistical studies of the showering and bathing behavior of Americans (Wilkes, Mason, and Hern 2005).

Cost-Benefit to Retrofit Residential Toilets

The following outlines the history regarding regulatory toilet conservation:

- Prior to 1970, most toilets consumed 6 gallons or more per flush.
- Effective January 1, 1978, California law required that all new toilets consume no

more than 3.5 gallons per flush.

- Congress enacted the *Energy Policy Act* of 1992 requiring that all new toilets use no more than 1.6 gallons per flush (gallons per flush) by 1994. At this time, there were only 16,000 homes in Milpitas (citydata.com).
- In 2007, the California Legislature enacted *Assembly Bill 715* (Laird, 2007), requiring that all toilets have an effective flush volume of 1.28 gallons per flush, by 2014.

Note that one can now purchase the Niagara brand conservation Stealth White 0.8 gallons per flush toilet, which is described later in this section.

Given that toilets have a 40 year lifespan, only a small fraction of toilets are likely to be changed each year. However, new building with conservation permitting may trigger retroactive compliance and require that fixtures like toilets be brought up to code. An additional 5,000 houses were built in the City between 1994 and 2014, for a total of 21,000 houses, and those 5,000 houses have 1.6 gallons per flush toilets as part of the new construction. Of the 16,000 older homes, perhaps 25% have replaced their toilets to meet the 1994 requirement of 1.6 gallons per flush. As a result, an estimated 12,000 toilets are still flushing at the 1978 requirement of 3.5 gallons per flush.

Residential Toilet Water Consumption in 2014:
The total number of households in the City in 2014 was 21,000.

Number and type of toilets in the houses:

- The 5,000 remodeled or new homes (since 1994) have 1.6 gallons per flush toilets.
- Another 4,000 homes (25% of 16,000 homes existing in 1994) have Retrofit voluntarily to 1.6 gallons per flush since 1994.
- 12,000 homes still use 3.5 gallons per flush toilets
- Very few have 1.28 gallons per flush toilets in 2014 (and thus the City may wait another 40 years to see a significant reduction in the amount of water used per flush).

Estimated residential toilet flushing in gallons per year in 2014:

- For the 21,000 houses in Milpitas in 2014:
    - 9,000 houses x 1.6 gallons/ flush x 2.64 people per house x 5.1 flushes/day = 193,882 gallons/day
      193,882 gallons/day x 365 day/yr
      = <u>70,766,784</u> gallons/year for 9,000 homes.
    - 12,000 houses x 3.5 gallons per flush x 2.64 people per house x 5.1 flushes/day = 565,488 gallons/day x 365 days
      = <u>206,403,120</u> gallons/year for 12,000 homes
      70,766,784 + 206,403,120 = <u>277,169,904</u>

Estimated amount of water used in residential toilet flushing in the City is:

$$70,766,784\ gallons/year\ (for\ 9,000\ homes\ with\ 1.6\ gallon\ per\ flush\ toilets) + ...$$
$$... + 206,403,120\ gallons/year\ (for\ 12,000\ homes\ with\ 3.5\ gallon\ per\ flush\ toilets)...$$
$$... = \ 277,169,904\ gallons/year.$$

Calculations with 0.8 gallons per flush toilets:
Below are calculations for the water savings possible if the whole of Milpitas switched to toilets that flush at 0.8 gallons per flush. The 0.8 gallons per flush toilet is not a regulatory requirement, but is available for the consumer local hardware stores. The toilet cited here is the Niagara Stealth, Model number: 77000WHAI1, which sells for approximately $150 (Lowes website, 2014).

- 5.1 flushes/day/person x 0.8 gallons/flush
  = 4.08 gallons/person/day for toilet use
- At 2.64 people per house x 4.08 gallons/day
  = 10.77 gallons/day for the average household toilet usage
- At 21,000 houses in Milpitas in 2014 x 10.77 gallons/day average toilet usage
  = 226,170 gallons daily for household toilets

Toilet Flushing with 100% of Milpitas Homes Using 0.8 Toilets in 2014:

$$226,170\ gallons/day \times 365\ days = 82.6\ million\ gallons/year = 110,400\ hundred\ cubic\ feet/year$$

In the 2011 California Single-Family Home Water Use Efficiency Study, deOreo observed that as many as 30% of the 1.6 gallons per flush toilets were actually flushing at more than 2.0 gallons per flush. However, toilet technology continues to improve.

Based on the calculations above, the water saving that could be obtained if the City invested in 0.8 gallons per flush toilets for its customers is estimated at:

Water Saved Annually by City Using 0.8 Toilets:

$$277,169,904\ gallons/year - 82.6\ million\ gallons/year = 194,617,854\ gallons/year$$
$$194,617,854\ gallons/year \div 748\ gallons/hundred\ cubic\ feet = 260,184\ hundred\ cubic\ feet/year$$

Cost to the City to replace toilets - $6.3 million

The cost of upgrading all toilets in the City is estimated at 21,000 homes x 2 toilets/home x $150/toilet = $6,300,000. These calculations show that an estimated 260,000 hundred cubic feet could be saved each year for the one-time cost of approximately $6,300,000 at a rate of $24.23 per hundred cubic feet. This amounts to $0.61 per hundred cubic feet saved over the lifetime of the toilets, forty years. Thus, if a consumer buys water for $2.62 per hundred cubic feet (the City's lowest water rate), the city is spending approximately one-fifth of that amount on new toilets.

Cost to the City to Retrofit Toilets: over 1 year and over 40 years:

$$\$6,300,000 \div 260,000\ hundred\ cubic\ feet\ per\ year = \$24.23\ per\ hundred\ cubic\ feet\ saved$$
$$\$6,300,000 \div (260,000\ hundred\ cubic\ feet\ per\ year \times 40\ years) = \$0.61\ per\ hundred\ cubic\ feet$$

amortized over 40 years

Cost to residential customers to replace toilets - $5-$11 million
Each consumer household will pay for toilet installation, the cost of which will vary from plumber to plumber. Current figures suggest the cost of one toilet installation is $125-$260 (Angie's List website). Therefore, with an installation cost of $125, the total cost to consumers is $5,250,000 ($125 x 21,000 homes x 2 toilets), and for an installation cost of $260, the cost is $10,920,000.

Cost to Residential Customers to Retrofit Toilets:

$$\$125/\textit{toilet installation} \times 21,000\ \textit{homes} \times 2\ \textit{toilets/house} = \$5,250,000$$
$$\$260/\textit{toilet installation} \times 21,000\ \textit{homes} \times 2\ \textit{toilets/house} = \$10,920,000$$

It is assumed that, should the City manage the installation, a lower contract installation price could be negotiated.

Some households may have other plumbing issues (such as pipe inclination or aged pipe) that would incur additional costs. In particular, pipe inclination becomes a critical factor as toilet water flow is reduced. A 2% decline is considered best; 1% is too slow, not moving solids along quickly enough, and 3% is too fast, leaving solids behind. Both situations require a plumber to be fixed.

Regarding the recycling of used toilets, numerous articles have been published on describing municipalities crushing porcelain toilets and using the material for sidewalks and road base material.

Note that the cost of conservation and subsequent reduction in rates income will be offset by the fact the City will buy considerably less water.

Cost-Benefit to Retrofit Residential Washing Machines
Prior to the 1980s, clothes washer water consumption was as much as 56 gallons per load. On average, the high-efficiency front-loading machines of today use 27 gallons (Vickers, p. 118).

Using the same rubric as used above for toilets, one can estimate that 12,000 homes are still using old washers. If each home has 2.64 persons in it, and each person washes 0.37 loads per day, this is 356.5 loads per year per home. This is a savings of 10,300 gallons per year per service connection. Thereby, by shifting from old to new machines, the City could save 124 millions of gallons per year (12,000 homes x 10,300 gallons). The life cycle of a clothes washer is 14 years (sfgate.com). If 124 millions of gallons (166,000 hundred cubic feet) is saved per year, the saving over the lifetime of all of the

washing machines would be 2.3 million hundred cubic feet.

This option has a lower payoff in terms of water saved per cost of a new appliance than that of toilets for example. Also, the cost of a new washing machine could be a challenge for most customers. However, the installation cost usually is included in the delivery, and the vendor usually will take the older washer away.

Cost-Benefit to Retrofit Residential Shower Heads

Water Savings

In 1994, shower heads were regulated for efficiency. At that time, there were 16,000 homes/condos/apartments in the City (*citydata.com*). The lifespan for shower heads is shorter than for toilets, and their replacement is less expensive, and so it is likely that 25% of the 16,000 homes have changed their shower heads already. Old shower heads used 6.5 gallons per minute, whereas the new 1994 rated shower heads use 2.5 gallons per minute. The following calculations assume that the average person showers for 5.3 minutes per day (Vickers p.94):

- Pre-1980 shower head water use was 12,600 gallons per person annually (6.5 gallons per minute x 5.3 min/day x 365 days/year).
- Post-1994 shower head water use is 4,800 gallons per person annually (2.5 gallons per minute x 5.3 min/day/person x 365 days/year).
- If new “low-flow” shower heads were installed throughout the City, the water savings would be 245 million gallons per year (4 gallons per minute saved x 12,000 homes x 5.3 min/day/person x 365 days/year x 2.64 persons/household).

Life cycle analysis of replacing shower heads

A shower head has a potential lifetime of 100 years or more; however, faucets have a lifetime of 20 years. When faucets go, they often trigger remodels which would include upgrading showerheads. One can then surmise that the actual lifetime of a shower head is approximately 20 years. Given that the amount of water saved by the installation of “low-flow” shower heads in all City homes would be 245 million gallons (or *328,000 hundred cubic feet) annually,* water savings over the lifetime of the shower heads is 4,903 million gallons (or 6.6 million hundred cubic feet) .

Cost to Retrofit shower heads

The cost of upgrading all remaining pre-1980s shower heads in the City is $144,000 (12,000 houses x 1 shower head/house x $12/shower head).

The 328,000 hundred cubic feet of water saved every year for a cost of $144,000 is equivalent to $0.44 per hundred cubic feet saved annually. This is equivalent to $0.02 per hundred cubic feet saved over twenty years.

Cost to Residential Customers to Replace Shower heads:

$$\$144,000 \div 328,000\ hundred\ cubic\ feet\ per\ year = \$0.44\ per\ hundred\ cubic\ feet\ saved\ annually$$
$$\$144,000 \div (246,000\ hundred\ cubic\ feet\ per\ year \times 20\ years) = \$0.02\ per\ hundred\ cubic\ feet$$

Thus, if a consumer buys water for $2.62 per hundred cubic feet (the City's lowest water rate), the City would be spending only slightly less than one percent of that amount if it purchased new shower heads.

Cost-Benefit to Retrofit Residential Faucets

Prior to the 1980s, faucet water use was as high as 7 gallons per minute; however, today's high-efficiency faucets use only 1 gallon per minute. There are roughly four faucets per household, and faucets have a lifetime of approximately 15 years (Vickers, p. 103).

Using the same rubric as used for toilets above, one can estimate that 12,000 homes are still using old faucets. At a saving of up to 18,000 gallons per year per household for switching from old to new faucets, the City could save 216 millions of gallons (or 289,000 hundred cubic feet) of water per year (12,000 homes x 18,000 gallons) by upgrading faucets, or 3,240 millions of gallons over the lifetime of the new faucets (or 4.33 million hundred cubic feet).

Although faucet retrofits seem like a feasible rebate option for the City as the payoff in terms of water saved is high, the changeover cost to the customer may be prohibitive. The cost of a new faucet varies a great deal, ranging from $40 to $600. Moreover, faucet installation can be expensive, more along the line of toilet installation, than shower head installation.

Commercial Retrofit Cost-Benefits

Cost-Benefit for Commercial Retrofit to Waterless Urinals

There are slightly under 6,000 commercial and industrial businesses in the City. Of these, approximately 1,700 have paid employees, for a total of approximately 50,000 employees (census.gov). The remaining 4,300 businesses are owner operated. Each of the 1,700 businesses is likely to have either a unisex restroom or one restroom for males and one for females. Therefore, using a conservative assumption that approximately half of the workforce is male, there likely are at least 1,700 locations where urinals would be used by a total of 25,000 or more males.

Water Savings

Waterless urinals, on the market since 1990, use no water to flush, as opposed to earlier models, which use from 1 to 5 gallons per flush. Assuming each male uses a urinal twice per day on average, the use of waterless urinals in the workplace would result in an

average annual saving of 2,600 gallons per male (3.5 gal/flush x 2 times/day x 365 days/year). For the total workforce, a *savings of 65 million gallons per year* (87,000 hundred cubic feet) annually (2,600 gallons x 25,000 males) will be achieved.

Life cycle analysis of installing waterless urinals
Given that the lifetime of a urinal is 20 years, water saving over the lifetime of an urinal is 1.74 million hundred cubic feet (87,000 hundred cubic feet x 20 yrs), and given that the cost of a waterless urinal is $350, this water savings is achieved for an initial cost of $600,000 ($350/urinal x 1,700 locations). This amounts to a lifetime cost per volume of $0.34 per hundred cubic feet.

Cost to install waterless urinals
The 87,000 hundred cubic feet of water saved every year for a cost of $600,000 represents a water savings cost of $6.90/hundred cubic feet per year, or $0.34 per hundred cubic feet over twenty years.

Cost to Commercial Customers to Replace Toilets with Waterless Urinals:

$$\$600,000 \div 87,000\ hundred\ cubic\ feet\ per\ year = \$6.90\ per\ hundred\ cubic\ feet\ saved\ annually$$
$$\$600,000 \div (87,000\ hundred\ cubic\ feet\ per\ year \times 20\ years) = \$0.34\ per\ hundred\ cubic\ feet$$

As a result, if a consumer buys water for $2.62 per hundred cubic feet (the City's lowest water rate), the City is only spending just over ten percent of that amount on new urinals.

These urinals do have some odor issues. As there is no water wash the urine away, the coating of urine on the vertical surface can stagnate and smell, if proper cleaning is not conducted regularly.

Note: The following options were not researched:

J. Optional: Perform Mass Balance (water in equals water out study)
K. Optional: Conduct customer usage leak detection study (such as irrigation, toilet, etc.)
L. Optional: Conduct City-wide Home-Use audit of randomly selected representative homes
M. Optional: Perform study of distribution system using correlator
N. Optional: Perform study of point of sale water use (and loss) using correlator

I. Provide potential examples of conservation methods (irrigation, toilets, system water lost, additional effort of water audit of city parks, etc)

Municipal Building Pilot Study - Sports Center Retrofit

Water conservation awareness should be achieved through "lead by example" approaches. Many of the conservation efforts in this memorandum can be implemented at government buildings, libraries, firehouses, schools, etc. Conservation measures can then be seen by customers, employees and business owners and evaluated to determine their relative effectiveness before being implemented throughout the City. This approach will advocate for conservation, lead to knowledgeable staff, promote awareness and encourage informed decisions.

A thorough retrofit of the City Sports Center might include a number of high-efficiency (or waterless) urinals, low-flow per flush toilets, faucets, as well as showerheads. When asked, the Santa Clara Valley Water District said their water conservation rebate/retrofit program would cover the costs of such a retrofit for the Sports Center (Santa Clara Valley Water District, phone call, Dec. 2014). Toilet installation by the District is included for commercial customers, making such a retrofit no cost the customer or the City of Milpitas. The benefit of such an effort is great, while the cost is nil.

Residential and Commercial Retrofit Cost-Benefits - Summary

Why reinvent the wheel? The Santa Clara Valley Water District has already created a cradle-to grave conservation program that offers a comprehensive selection of rebates and retro-fits for both commercial and residential customers. We outline the detailed calculations above to illustrate how much water can be saved through a good conservation program. What we discovered is that Santa Clara Valley Water District can do it all, at very little cost to the City of Milpitas.

As an example, Santa Clara Valley Water District gives a $300 rebate for high-efficiency toilets and waterless urinals, and installs them, at no cost to the City. The District said they would replace all the toilets in the Sports Complex, at no cost to the City, as part of the District's rebate and retrofit programs (Santa Clara Valley Water District, phone call, Dec. 2014).

To increase the awareness of Milpitas' customers to use the Santa Clara Valley Water District conservation programs:

- website - Use the City's website Conservation page to better lead people directly to Santa Clara Valley Water District's site, instead of embedding the link deep in

the Milpitas page.

- newspaper, radio and signs
- Milpitas Model House blog and podcast series. The City can inspire conservation by using inexpensive web technologies, in an innovative manner. Using the Environmental Protection Agency Post Retrofit study group and the The California Single-Family Home Water Use Efficiency Study as examples, a house in Mllpitas could be chosen and used as a conservation model. There could be an on-line capture of the sample house whose usage can be tracked and viewed as an example for other customers. Customers could apply to be a model house; two a year. They would interviewed, at least once a month, for a blog/podcast of their audit and retrofit experience, relating the fixes and the water saved. The sample houses would agree to having their water use being tracked per toilet, shower, and appliances with data-loggers, and the results reflected in an online accounting. A graduate student may find this a great project for their studies.

Outdoor Water Use

Santa Clara Water Valley Water District already offers landscape conservation programs for both residential and commercial customers. Residential customers are served by the Water-Wise program where a customer can call for a pre-inspection, then have someone assigned to them to shepherd the customer through the entire rebate process.

Businesses can ask for the same pre-inspection and follow-through. Santa Clara Valley Water District offers a rebate of $2 per square foot for converting high water using landscape to qualifying low water using landscape. They also offer rebates for landscape meters, flow sensors and hydrometers, and weather-based irrigation controllers.

The City can perform water efficiency evaluations for lawn sprinklers, the view of this report is that this measure is not aggressive enough and that City policy should be changed to eliminate potable water use for commercial landscape.

Municipal Water Leak Detection

The East Bay Municipal Utility District and others have implemented comprehensive leak detection programs for utility main leaks. One of the concepts is to deploy acoustic recording devices throughout the distribution system, which then report water main leaks. These programs start at $150,000 and can involve annual operating costs if special equipment is used (Gasner, Kate, 2015). Leak reduction results can be significant, as shown by the 4.1% figure referenced above.

Integrated Land-Use and Water-Use Planning

Land-use decisions “lock-in” specific water consumption patterns for decades. As a

result, strategic planning and collaboration among agencies regarding land-use decisions can have enormous impacts on the potential to reduce water use. Even simple meetings over coffee or lunch can provide valuable insight for efficient land-use design and water saving opportunities. Also, workshops for land-use planners, water providers, economic developers, elected officials and environmental experts can have many benefits, leading to more efficient land-use planning, greater customer satisfaction and a more enjoyable environment for a greater number of people. The results achieved for every dwelling, town and city have an impact on others (Journal - American Water Works Association, September 2014).

Urban density and zoning regulations are major factors in the amount of water being used. In general, large distances between houses lead to large areas of landscaping requiring irrigation, as well as providing potential for additional leakage surfaces along pipe routes. Efficient planning designs that cluster large water consumers and compact urban growth will reduce water usage.

Overlaying zoning, creating mixed-use zoning requirements and inspecting planned unit developments can also lead to enormous water savings. Water conservation targets could be grouped together to increase efficiency.

Multi-Family and Single Family Residential

Encouraging multi-family units with efficient water use is an effective strategy to conserve water. While the overall usage per parcel may be much higher than that of a single-family residence, the amount of water used by each person is much less (Vickers, p14). This approach would allow more people to live within Milpitas, using less water per person. The benefits of multi-family residences also include the following: benefits of shared cost for water-efficient strategies/appliances, more available “open space,” less lawned-irrigated surface, and shorter piping distances between customers. More opportunities for water conservation exist with multi-family residents, including dual-plumbed systems for flush/process water, grey water collection systems, weather and soil moisture compensating controllers for landscaping irrigation, and more sophisticated native vegetation selection. The downside of multi-family residential units includes disruption of view of the skyline and the possibility of water demand exceeding the supply (due to the possibility of a large influx of residents if many multi-family residences are constructed simultaneously).

In general, single family residences use more water per person than multi-family residences and require more land. Outside water use opportunities tend to increase as the amount of outside useable area increases. Also, the possible leakage area of pipes and water mains increases proportionately with the distance that water is conveyed. Clustering of water customers promotes ease in maintenance, as it is easier to upgrade infrastructure and locate leaks within a smaller area. Also, more open space, parks and

preserves can be available for recreational use when future residential growth is restrained to a smaller footprint.

Transit Area Specific Plan

The Transit Area Specific Plan (TASP) addresses high-density infill growth. It will be important to integrate into this plan the water saving measures available for such a design. Water efficient appliances, xeriscapes, open space, and use of alternative non-potable water sources for landscape irrigation (where absolutely necessary) will help to make this a sustainable design opportunity.

Lowering Water Pressure

The City currently controls the pressure in one pressure zone by means of valve and pump settings. Elsewhere in the system, customers use individual pressure regulators. The publication “Lowering Water Pressure to Conserve Water” (Watts website) describes how to reduce water use by lowering pressure. There can, however, be problems from lowering system pressure, as fire sprinkler systems may no longer operate correctly due to lower incoming pressure. An alternative is to install pressure reducing valves on the domestic line and maintain normal system pressure for fire service. Pressure reducing valves are used to lower the pressure between water mains and residential and commercial water systems; a pressure of 35-60 psi is considered adequate for most residential and commercial uses. In general, lower pressure causes less stress on household piping and appliances, thus reducing the likelihood of leaks in the pipes and fixtures. Lower pressure also reduces the amount of water used at faucets, shower heads and spigots over a given interval of time. Studies have shown that lowering the pressure from 100 psi to 50 psi reduces the flow rate of by approximately one third.

Although certain customers (such as firefighters) depend on higher water pressure, most customers could benefit from monitoring pressures and setting pressure reducing valves at lower levels. Large savings could be achieved by setting the water pressure between 36 and 42 psi. (“Water Pressure and Your Plumbing System,” Orange Water and Sewer Authority). There can be significant public dissatisfaction from water pressure less than 50 psi, however.

Legality

The implementation of water conservation measures can be supported by law enforcement and California Water Code provisions directed at water conservation and water shortages. Under the California Constitution a city may make and enforce within its limits all local, police, sanitary, and other ordinances and regulations, as long as they are not in conflict with state or federal laws. This provision includes regulations designed to promote public convenience, general prosperity, public health and/or public safety. Thus, conservation measures designed to make the most efficient use of a limited water supply are within the City's law enforcement jurisdiction.

The City may, by ordinance or resolution, adopt and enforce a water conservation program to reduce the quantity of water used for the purpose of conserving the water supplies of the public entity (Water Code §375). This step may include rate structure design, public education programs, and/or the requirement to install water-saving devices.

Water conservation measures can also be supported by the City's Urban Water Management Plan and the Water Shortage Contingency Plan under Water Code section 10610 et seq. As an urban water supplier, the City is obligated to pursue the efficient use of available supplies, including reasonable and practical efficient uses, and reclamation and demand management activities. The Urban Water Management Plan requires implementation of a Water Shortage Contingency Plan to ensure that the level of reliability of water service is sufficient to meet the needs during normal, dry, and multiple dry-water years. Most Water Shortage Contingency Plans set out a series of increasingly demanding, mandatory conservation measures to be used at the various stages of water-shortage severity.

Finally, the City may declare a water shortage emergency, when the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply, and may adopt such regulations and restrictions on water delivery and consumption as are needed to conserve the water supply for the greatest public benefit (Water Code §350).

Financial

Capital costs are $6,475,000 for residential water meter and software upgrades and $150,000 for the leak detection audit, totalling $6,625,000.

Lifetime costs were calculated by adding capital costs of $6,625,000, and yearly operating costs of $140,274 over 20 years is $2,805,480, equals $9,430,480 . The yearly water usage of 879,454 hundred cubic feet per year is also multiplied by the lifetime of 20 years is 17,589,080/hcf. By dividing the costs by the water usage the lifetime cost is calculated as $0.54 per hundred cubic feet over the lifetime of the conservation measures

Results

The City is a fairly conservative water user when compared to other locations within and outside of the Bay Area. However, conservation leaders and water usage studies suggest that the City could do more. Australia leads in conservation through the use of high-efficiency fittings and consistent water auditing. The Environmental Protection Agency Post Retrofit Group creates a concrete benchmark for modern indoor residential

usage.

Various water conservation strategies could be implemented by the City of Milpitas to address the following issues:

- The City growth is predicted at 30% by 2035 from 70,000 to 106,000 citizens (City of Milpitas, Urban Water Management Plan, 2010).
- There is a state-wide conservation movement to reduce consumption by 20% by 2020. The goal in terms of gross usage is to reduce consumption from 140 gross gallons per capita per day to 110.1 gross gallons per capita per day.
- San Francisco Public Utilities Commission will increase water rates by 30% between 2014 and 2018 (see ktsf.com/en/sfpuc-water-rate-increase-proposal/).

Conservation Cost-Benefit Summary

In the following table (Figure 9), conservation strategies are presented in the order of the best cost-benefit to the least, first in a summary table, and then with more detail in a bulleted list. As mentioned earlier, acquiring good data is very difficult. Where possible we have put emphasis on the amount of water saved and the cost of the effort in dollars per hundred cubic feet:

Figure 9: Ranking of Conservation Efforts by Cost-Benefit

SCVWD = Santa Clara Valley Water District

	Conservation Method	Administrative Costs	Infrastructure Costs	Cost of Savings ($/hundred cubic feet) or Advantages
1	Rebates, retrofits, education (retrofit only recommended for toilets, showerheads and urinals) via SCVWD	City Attorney City Council Public Works	● rebates and retrofit cost covered by SCVWD	● 675,184 hcf saved per year ● $0.21 /hcf saved each year ● 13.5 million hcf saved over 20 year lifetime ● $0.01/hcf saved over 20 year lifetime
2	Data Collection and Leaks	City Council Public Works ● FTE: $140,274 annually for 10 years	● meters: $6.475 million ● leak audit: $150,000	● +/-4.1% of 10.21 mgd = 560 hcf saved per day ● 204,268 hcf saved per year ● $33.12/hcf saved each year ● 10.2 million hcf saved over

				50 year lifetime ● $0.66/hcf saved over 50 year lifetime
3	Water and Wastewater Rate Increases	City Attorney City Council Public Works	● no cost	● significant income ● moderate unquantifiable* water savings
4	Landscape and Irrigation	City Attorney City Council Public Works	● cost covered by SCVWD ● (*minor cost to Milpitas*)	● significant unquantifiable* water savings
5	Regulation	City Attorney City Council Public Works	● no cost	● moderate unquantifiable* water savings
		TOTAL	$6.625 million	879,454 hcf saved per year

** This is yet another argument for increased quality and quantity of data collection.*

The lifetime costs for conservation is then:

$$(\$6,625,000 + (\$140,274 \times 20)) \div (879,454\ hundred\ cubic\ feet\ saved\ per\ year \times 20\ years) = \ldots$$
$$\ldots = \$0.54\ per\ hundred\ cubic\ feet$$

Figure 10: Cost-Benefit Retrofit Summary Residential and Commercial Fixture Retrofit

Appliance	Water Saved per Year	Water Saved over Appliance Lifetime	Cost to City	Cost to Customer
Toilet	260,184 hcf	10.5 million hcf over 40 years	$6,300,000 total $24.23/hcf saved per year $0.61/hcf over 40 yrs ($0 Free via SCVWD)	$125-$260 ($125 rebate/toilet)
Washing Machine	166,000 hcf	2.3 million hcf over 14 years	$0	$350-$1000 ($150 rebate from SCVWD)
Showerheads	328,000 hcf	6.6 million hcf over 20 years	$144,000 total $0.44/hcf saved per year	$0 (free from SCVWD)

			$0.02/hcf over 20 yrs ($0 Free via SCVWD)	
Faucets	289,000 hcf	4.33 million hcf over 15 years	$0	$40-$600 +install costs. No rebates.
Waterless Urinals	87,000 hcf	1.74 million hcf over 20 years	$600,000 total $6.90/hcf saved per year $0.34/hcf over 20 yrs ($0 Free via SCVWD)	$0 (minimal) ($300 rebate/installation free)

Note: Shaded cell costs can be covered by Santa Clara Valley Water District, not Milpitas.

1a. The Milpitas / Santa Clara Valley Water District Water Conservation Program
Milpitas should take advantage of the cradle-to-grave conservation program that Santa Clara Valley Water District already offers. Santa Clara Valley Water District can provide:

- audits for all customers
- offer rebates for WaterSense appliances, efficient washing machines, high efficiency toilets, shower heads and faucets
- provide retrofit appliances
- assess for leaks
- conduct pressure checks (38-42 pounds per square inch for efficient residential water pressure), determine the accuracy of metered water accounts
- replace or repair water meters as needed

The City of Milpitas could try novel information marketing campaigns. Awards and demonstrations can get customer attention and encourage action. Business awards can be awarded to businesses who are 100% retrofitted to Environmental Protection Agency benchmarks. These awards should be publicized via billing statements, advertising, newspaper articles, social media, etc.

The City can inspire residential conservation by using inexpensive web technologies in an innovative manner. Using the EPA Post Retrofit study group (2000) and the The California Single-Family Home Water Use Efficiency Study (de Oreo, 2011) as examples, a house in Milpitas could be chosen and used as a conservation model. There can be an on-line capture of the model house, the water usage of which can be tracked and viewed as an example for other customers using electronic data loggers. Customers could apply to be a model house; and as many as two homes per year could be chosen to participate. The resident would blog/podcast their experience of the audit, plus the fixes and water saved, in series of monthly interviews. The sample houses would agree to having their water use being tracked per toilet, shower, and appliance, and reflected in an online accounting. A graduate student might find this project compelling.

1b. Environmental Protection Agency Retrofit Goals (see retro-fit Summary Table above)

- Residential Toilet Retrofits could save at least 260,184 hundred cubic feet per year. The cost of conservation and the subsequent reduction in rates income is offset by the fact the City will purchase less water.
- Residential Washing Machine Retrofits are not a feasible rebate option for the City as the payoff is very low and the cost of a new washing machine could be a challenge for most customers.
- Residential Shower head Retrofits will save at least 328,000 hundred cubic feet per year or 4.92 million hundred cubic feet over 20 years, if all 12,000 shower heads in the City are replaced.
- Residential Faucet Retrofits are not a feasible rebates option for the City as the cost of a new faucet can be quite high and faucet installation is expensive.
- Commercial Waterless Urinal Retrofits will save 87,000 hundred cubic feet per year or 1.74 million hundred cubic feet over 20 years.

1c. Education: Educational materials can be distributed to all customers to encourage efficient water use. Although this is not the most effective tool to encourage conservation, retrofit business awards and residential house retrofit modelling using social media, may be worth trying.

2a. Data Collection is critical for conservation optimization. Reliable data can be used to inform and educate the City and its customers about their water usage and to diagnosis over-use, inefficiencies and leaks. Implementing programs to achieve accurate data collection is the way that Australia reduced its water consumption rates. The price of digital meters is now $75-250 per meter. Installation adds approximately $400 (½ hour labor; City equipment could depreciate single installation costs by ganging meter changes geographically). Milpitas has already budgeted for residential water meter and software upgrades (Badger Beacon software) via the Capital Improvement Program at $6,475,000.

2b. Leaks involve a small number of clients but represent a high percentage of water loss. Milpitas is an old town, and according to the Bay Area Water Supply and Conservation Agency, its residential water usage has increased in the last two years from 61 to 66 gallons per capita per day. A digital metering system would help to find leaks with accuracy and consistency. As infrastructure continues to decay, all cities in the United States will have to consider leaks, as London did in the last decade. A water system loss audit would cost the City $150,000 for a baseline water loss evaluation. Like London's "Leak Squad", the City needs a Water Loss Auditing program for monitoring system and residential water lines, responding quickly to leaks, encouraging citizen involvement and investigating peculiar water runoff concerns in a timely manner.

3a. *Water Rate structures* can be very effective in communicating the value of water to customers, whether they are residential, commercial, industrial or agricultural**.** Rate

structures can be designed so that lifestyle is not changed significantly and rates are not regressive, but so that conservation awareness is encouraged, action to reduce leaks and overuse is promoted and other water conservation measures are encouraged.

3b. Wastewater Rate structures can also encourage conservation.

4. Landscaping and Irrigation: Unlike indoor usage, which is highly definable, outdoor irrigation has many variables. According to the 2011 California Home Study Group only 54% of all homes irrigate with excess water (deOreo, 2011), and 62% of the excess is used by just 18% of the lots. This is critical information for water management, as it shows that for a typical water system, most of the outdoor saving will result from achieving changes with just a few of the customers. It is not recommended that weather-based irrigation controllers be made mandatory as research shows the controllers would use more water than the under-irrigators.

- use efficient watering schedules: weather-base controllers may not be cost effective for reducing residential usage (except for "rain shut-off"), but maybe useful for commercial usage; increase the duration between watering large lawned areas
- select drought-resistant plants, especially for corporate, commercial and public facilities
- supplement potable water with recycled water, when available
- implement low-flow irrigation
- maintain a grass height of 3.5 inches for residential lawns
- replace lawns with native landscape or "xeriscapes" and mandate water efficient landscaping for large areas (over 1000 sq. ft. of irrigated coverage)
- capture runoff by means of sidewalk planters
- promote municipal collaboration with volunteer organizations to achieve sustainable replanting (see DailyActs.org in Petaluma)
- data collection, even with a 1.5% +/- meter error rate, is vital to find leaks
- water bills that illustrate water usage clearly will help customer awareness
- water rates can be tiered to discourage water wasters
- audits can also help educate

5. Regulatory Steps

- promote land-use decisions that "lock-in" customers to efficient water practices:
  - dual plumbed systems (purple recycled and potable water) for irrigation and flush-water; possible locations include high schools, fire stations, and new large developments
  - recycled water for irrigation
  - greywater collection (for example from laundry for irrigation)
  - multi-family residences reduce urban sprawl and infrastructure costs. Note that this approach reduces the per capita consumption, but increases citywide consumption.

    - require Environmental Protection Agency retrofit standards for water efficient appliances
    - plan efficient water system infrastructure (eg. “mixed zones”, purple pipe routes). Land-use planning to promotes recycled water infrastructure and collaboration among neighboring agencies for recycled water sources
    - evaporative cooling systems for commercial developments and industrial process equipment
- drought and regulation: Implementation of policies and ordinances should be used, depending upon drought-severity. These measures should be used as a guideline for establishing new ordinances, policies and educational opportunities to save water for the City in a practical sense to allow the population to grow and prosper.

The increasing cost of implementing additional conservation measures over time will decrease the value of saving water. As noted earlier, as water usage is reduced over time, the water conservation efforts and spending required to achieve a given saving will increase. This is because the most effective measures are usually implemented first, and successive efforts impact the amount of water used less and less (see Figure 1).

Conclusion

The City’s water usage is already fairly conservative. As water reduction approaches the goal, savings through conservation become more expensive. However, Water Solutions, Inc. believes the City is especially fortunate to be able to circumvent that rising cost.

A multi-pronged conservation approach is needed to capture enough water to allow for 30% growth over 30 years, to reduce consumption by 20% by 2020 and to manage higher water costs from San Francisco Public Utility Commission and Santa Clara Valley Water District.

First, the City can further use Santa Clara Valley Water District’s residential and commercial cradle-to-grave (audit, rebates and retrofits) water conservation program. Educate customers using the media. It is important to take advantage of the District’s conservation program as modern toilets, shower heads and urinals all offer significant reductions in water usage.

Second, lack of, or poor water use data collection is the biggest weakness in any conservation program. The City is poised to create a truly modern water system, and data collection should be a major goal. A good start for the City will be the water meters and system analysis software upgrade (Badger Beacon software) that has already been budgeted through the Capital Improvement Program at a cost of $6,475,000. Once there is good data collection Milpitas will have more work to do. The cost for a baseline leak audit is $150,000.

Third, water and wastewater rates are an administrative decision, that cost nothing, but can generate the income needed to offset the loss of water sale due to conservation. It is one of the more complex cause and effects of the water trade: The more you save, the less you make; but we *have* to save! Raising of rates will encourage both residential and commercial customers to conserve further.

Fourth, outdoor irrigation conservation measures are free to Milpitas and should be eagerly encouraged to all City customers. While deOreo (California Single Family Home Water Use Efficiency Study, p152) does not recommend weather-based water meters for residential. He does recommend these meters for commercial situations. Residential and Commercial customers can both be encouraged to landscape with an attention to conservation with drought resistant plants, lawn reductions and xeriscapes, also through Santa Clara Valley Water District.

Last, regulatory strategies for water conservation should be reviewed to make sure they are in line with the City's current, and evolving, water conservation goals.

Task 1: Conservation, Implementation Plan

Proposed Implementation Schedule:

Ordinance

1. Complete writing of new ordinance(s) for water conservation (1 Jun. 2015)
2. Enact new ordinance for water conservation (1 Aug. 2015)
3. Begin enforcement of new ordinance (1 Oct. 2015)

Smart Meter

1. Large meter pilot testing (July-Sept 2014)
2. Large meter install (Oct.-Dec. 2014)
3. Small meter pilot (Jan.-Mar. 2015)
4. Small meter install (Apr.-June 2015)
5. Antennas install (July 2015 - Feb. 2016)

Outreach

1. Advertisement and education of SCVWD rebate programs (on-going)

SCADA

1. City-wide pressure and flow sensors installation (Jan. 2016 - Mar. 2017)
2. Remote control valve installation (July 2017 - Dec. 2018)

System-wide Leak Detection

1. Hiring of leak detection company (July 2017 - Mar. 2018)
2. Aging infrastructure field investigation (July 2015 - on-going)

Costs:

- The capital cost of a leak detection audit is approximately $150,000
- The capital cost of the water meter upgrade is $6,475,000
- The total capital cost of this effort is then $6,625,000
- The lifetime cost per hundred cubic feet is then $0.54
- Rebates and incentives - none; to be covered by Santa Clara Valley Water District

Benefit:

- A savings of 879,454 hundred cubic feet of water per year out of a total 4,975,000 hundred cubic feet per year for a population of 70,000. This represents be a 17.7% savings from 2013 averages.

Life Cycle:

The life cycle of new water meters is approximately 50 years. The life cycle of new fixtures is approximately 20 years.

Ease of Implementation:

By implementing ordinances or other measures significant gains can be made towards conservation with minimal effort. Santa Clara Valley Water District is a major ally in this effort. Cooperation with the district is required.

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Appendix

FIGURE A1 and FIGURE A2:

From Bay Area Water Supply and Conservation Agency (BAWSCA) Annual Report

Residential Per Capita Consumption and Single-Family Average Monthly Use Among BAWSCA Members - FY 2012-13

Member	Service Area Population	Residential Consumption* (ccf)	*Residential Per Capita Consumption (gpcpd)	**Single-Family Average Monthly Use (ccf)
Daly City	102,820	2,450,378	48.8	8
Westborough	13,259	320,606	49.6	***n/a
Brisbane/GVMID	4,282	104,478	50.0	4.5
CWS - South SF	59,567	1,478,039	50.8	7.9
East Palo Alto	25,927	653,028	51.6	***n/a
Hayward	148,756	4,213,609	58.0	9
San Bruno	41,114	1,220,423	60.8	***n/a
North Coast	39,000	1,226,220	64.4	7.6
Milpitas	67,894	2,173,280	65.6	10.0
Coastside	16,900	554,030	67.2	6.8
Millbrae	21,532	737,836	70.2	8.2
San Jose	15,178	537,869	72.6	8.6
Redwood City	86,647	3,078,065	72.8	9.9
Mountain View	73,656	2,715,045	75.5	9.2
Mid-Peninsula	26,270	1,004,087	78.3	9.1
CWS - Mid-Peninsula	128,037	4,922,016	78.8	10.7
Burlingame	30,282	1,178,972	79.8	10.2
Santa Clara	119,311	4,782,059	82.1	13.1
Sunnyvale	145,973	5,924,513	83.2	12.2
Alameda CWD	336,000	13,656,723	83.3	11.7
Estero	30,567	1,372,204	92.0	10.9
Palo Alto	66,368	3,183,737	98.3	13.3
Menlo Park	14,198	687,547	99.2	13.0
CWS - Bear Gulch	58,098	5,099,148	179.9	24.7
Hillsborough	10,850	1,417,783	267.8	28.3
Purissima Hills	6,127	868,180	290.4	35.1
Agency Totals	1,688,613	65,559,875		
Average Single Family Monthly Use				12.2
Average Residential Per Capita Consumption			79.6	

*Includes multi-family and single family accounts.

**Individually metered single family homes, townhouses, and condos.

***East Palo Alto, San Bruno and Westborough WD report multi-family with single family use.

Notes: Due to its unique service area, Stanford is excluded.

Gross Per Capita Consumption
Among BAWSCA Members - FY 2012-13

California Water Service (CWS) is separated into its three service areas.

Member	Service Area Population	*Total Consumption (ccf)	Gross Per Capita Consumption (gpcpd)
North Coast	39,000	1,192,485	62.7
Westborough	13,259	441,233	68.2
Daly City	102,820	3,512,499	70.0
East Palo Alto	25,927	1,010,939	79.9
San Bruno	41,114	1,752,095	87.3
CWS - Mid-Peninsula	128,037	6,046,107	96.8
Hayward	148,756	7,552,956	104.1
Millbrae	21,532	1,113,147	105.9
Redwood City	86,647	4,747,255	112.3
Stanford University	29,401	1,624,555	113.2
Mid-Peninsula	26,270	1,453,047	113.4
Coastside	16,900	996,377	120.8
CWS - South SF	59,567	3,620,826	124.6
Alameda	336,000	21,209,862	129.4
Burlingame	30,282	1,952,965	132.2
Sunnyvale	145,973	9,453,326	132.7
Estero	30,567	2,000,497	134.1
Brisbane/GVMID	4,282	287,290	137.5
Milpitas	67,894	4,558,000	137.6
Mountain View	73,656	5,070,586	141.1
Santa Clara	119,311	9,323,132	160.1
Palo Alto	66,368	5,547,735	171.3
CWS - Bear Gulch	58,098	6,116,162	215.7
Menlo Park	14,198	1,584,636	228.7
San Jose**	15,178	2,173,663	293.5
Hillsborough	10,850	1,609,532	304.0
Purissima Hills	6,127	972,733	325.4
Totals	1,718,014	106,923,640	
		Average gpcpd	127.5
		Median of Agencies	129.4

*Exclusive of recycled water; inclusive of unaccounted for water.

**Service area predominantly commercial/industrial.

Water Solutions Inc.

MEMORANDUM

Date: 27 March 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: City of Milpitas Conservation and Recycling Decision Matrix Report

Water Solutions, Inc. was asked to follow up on their City of Milpitas Water Augmentation Feasibility Study, to provide a breakdown of Conservation and Recycling measures by creating a Weight Sum Decision Matrix (Pugh Method) for the following data:

- amounts of water saved
- capital costs
- operating costs
- lifetimes
- lifetime costs of each sub-element

The above data will be weighted against the following choices:

- A Weighted Sum Decision Matrix for the proposed conservation tasks:
  - Residential Indoor
  - Residential Outdoor
  - Commercial Indoor
  - Commercial Outdoor

- A Weighted Sum Decision Matrix for the proposed recycled water tasks:
  - California Loop
  - Dixon Loop Completion
  - Milmont Dr. Extension
  - Yosemite-Sinclair Loop
  - E. Calaveras Extension
  - S. Milpitas-Landess Extension
  - Segment 1
  - Segment 2
  - Segment 3
  - Segment 4
  - Segment 5
  - TASP Area Extensions

Residential Indoors Results

The net savings of a residential indoor water conservation retrofit program are easily calculated by adding the savings from pages 24 through 28 of the Technical Memorandum *Task 1: Conservation*. Indoor toilet retrofits would save 328,000 hundred cubic feet per year, while indoor shower retrofits would save 260,184 hundred cubic feet per year. The combined total is 588,184 hundred cubic feet per year of indoor residential water savings.

Residential Outdoor Irrigation Data Results

As mentioned in the Water Solutions, Inc. Water Augmentation Feasibility Study, *Task 1: Conservation* there is very little good data:

> *"The California Department of Water Resources acknowledges that "easily retrievable, standardized, and comprehensive baseline urban water use data is not available in California" (California Water Plan Update; California Department of Water Resources, 2005). The Public Water System Survey provides an annual estimate based on non-audited self-reporting. California uses Urban Water Management Plans, which are required every five years (California Water Code; California Department of Water Resources, 2002), to collect water use data, but the results are not compiled into a statewide database."*

As a consequence of poor data availability and reliability, outdoor water use is often estimated by comparing maximum summer water usage with minimum winter water usage, the assumption being that outdoor irrigation is minimal in California during the winter.

From William de Oreo's 2011 paper (p.32), the California Single Family Water Use Efficiency Study we glean further data:

- only 87% of Californians are irrigating
- of that 87%, only 54% are over-irrigating
- average Theoretical Irrigation Requirement (TIR) is 89.9 kgal/year per connection
- average excess over TIR is 26.2 kgal/year
- 62% of excess use is attributed to 18% of the irrigation lots (15% of all the lots in the City).

In the general scope of residential irrigation the "under irrigation in the less-than-TIR group just about balances the over-irrigation in the more-that-TIR group" and the majority of excess savings will occur from only 15% of the lots (de Oreo, p 32).

Outdoor savings can be calculated by multiplying the average excess per lot by the number of service connections in Milpitas, and then converting to hundred cubic feet for colloquial use. This number, outdoor savings, is 735,561 hundred cubic feet per year.

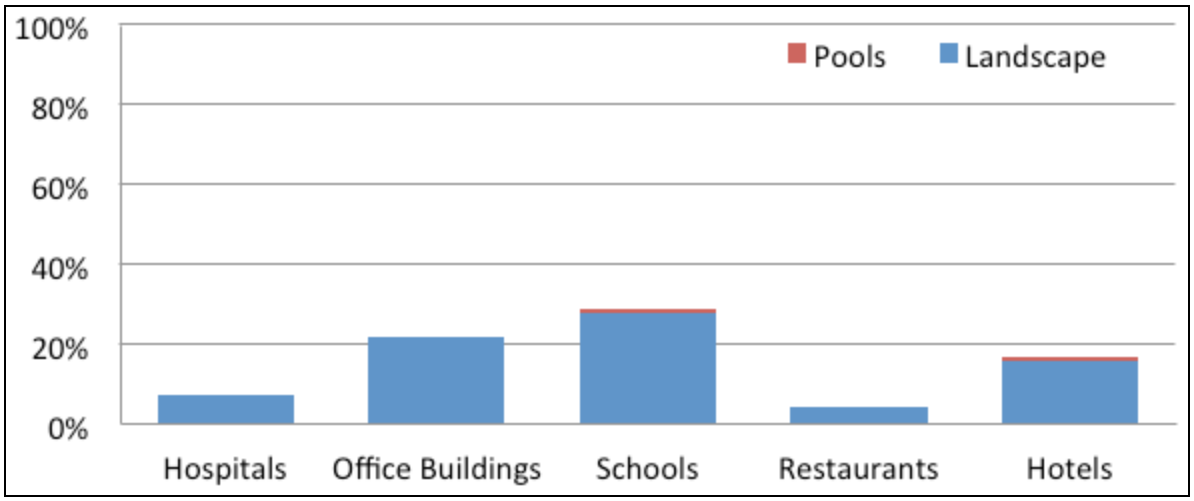
Commercial Indoor Results
Commercial indoor conservation can be done by retrofitting commercial toilets with waterless urinals, 1.28 gallon per minute or 0.08 gallon per minute low-flow toilets for a savings of 87,000 hundred cubic feet per year.

Commercial Outdoor Irrigation Data Results
Data for commercial irrigation is even less accessible than residential irrigation data. No one has done a study on commercial irrigation in California. The Environmental Protection Agency indicates irrigation water use can account for between 5 and 30 percent of a facility's total water use, as shown below.

Facilities can manage their own landscape in a manner that would save significant amounts of water. Facilities with large landscaped areas such as schools and commercial landscapes can improve landscape design, maintenance of irrigations system (particularly leaks) and weather/time controlled irrigation systems.

Milpitas enacted the Water Efficient Landscape Ordinance 238 in 2006. This ordinance required all new development be designed to comply with efficient water use for landscaping.

Percent Water Attributed for Outdoor Use



Studies have reported savings of 18-50% when switching commercial landscaping from water intensive landscape plants to those with lower water needs. Since the City currently uses 569,676 hundred cubic feet per year for outdoor commercial irrigation, it is feasible that as much as 284,838 hundred cubic feet per year could be saved by replanting commercial lawn grass with low-water use plantings.

Milpitas Conservation Decision Matrix Concerns	Values	Residential Indoor (toilets, showerheads)	Residential Outdoor Irrigation*	Commercial Indoor (toilets)	Commercial Outdoor Irrigation
Amount of Water Saved (hcf per year)		588,184	735,561	87,000	284,838
Capital Costs		$0.00	$0.00	$0.00	$0.00
Operating Costs (per year)		$140,274.00	$140,274.00	$140,274.00	$140,274.00
Lifetime (years)		20	20	20	20
Lifetime Costs ($/hcf)		$0.24	$0.19	$1.61	$0.49
Available Volume of Water	**5**	4	5	2	3
Order of Magnitude of Infrastructure Needed	**5**	3	3	3	3
Issues to Be Resolved	**2**	1	1	1	1
Operational & Maintenance Considerations	**5**	5	5	5	5
Effectiveness	**4**	5	5	5	5
Reliability	**3**	5	5	5	5
Cost	**3**	2	2	2	2
Benefit	**4**	4	5	2	3
Life Cycle	**4**	5	5	5	5
Ease of Implementation	**5**	4	4	4	2
The higher the score the better the result.	**SCORE**	**159**	**168**	**141**	**140**

* from William DeOreo California Single Family Water Use Efficiency Study, 2011

Milpitas Recycle Decision Matrix Concerns	Values	California Loop	Dixon Rd. Loop Completion	Milmont Dr. Extension	Yosemite-Sinclair Loop	E. Calaversas Ext.	S. Milpitas-Landess Ext	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	TASP Area Extensions
5-Month Consumption Total (hcf per 5-mon)		2,796	5,339	1,787	1,745	1,735	2,846	5,039	no data	62,603	13,765	741	no data
Amount of Water Saved (hcf per year)		6,710	12,814	4,289	4,188	4,164	6,830	12,094	no data	150,247	33,036	1,778	no data
Linear Feet of Pipe		8,612	5,496	837	6,246	3,001	8,528	10,200	5,000	8,500	8,600	5,300	25,000
Volume saved/Pipe Length (efficiency)		0.78	2.33	5.12	0.67	1.39	0.80	1.19	no data	17.68	3.84	0.34	no data
Capital Costs		$3,229,500.00	$2,748,000.00	$313,875.00	$2,342,250.00	$1,125,375.00	$3,198,000.00	$3,900,000.00	$1,975,000.00	$3,187,500.00	$3,225,000.00	$2,087,500.00	$9,375,000.00
Operating Costs (per year) SBWR does O/M		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Lifetime (years)		75	75	75	75	75	75	75	75	75	75	75	75
Lifetime Costs ($/hcf)		$6.42	$2.86	$0.98	$7.46	$3.60	$6.24	$4.30	no data	$0.28	$1.30	$15.65	no data
Available Volume of Water	**5**	1	2	1	1	1	1	2	1	5	3	1	1
Order of Magnitude of Infrastructure Needed	**5**	3	2	1	3	2	3	4	2	3	3	2	5
Issues to Be Resolved	**2**	5	3	5	3	5	5	5	5	2	5	5	5
Operational & Maintenance Considerations	**5**	5	5	5	5	5	5	5	5	5	5	5	5
Effectiveness (efficiency)	**4**	1	3	4	1	2	1	2	1	5	4	1	1
Reliability	**3**	5	5	5	5	5	5	5	5	5	5	5	5
Cost	**3**	2	2	5	2	2	2	2	2	2	2	2	1
Benefit	**4**	1	2	1	1	1	1	2	5	5	3	1	1
Life Cycle	**4**	5	5	5	5	5	5	5	5	5	5	5	5
Ease of Implementation	**5**	4	1	4	2	4	2	4	4	3	4	4	4
The higher the score the better the result.	**SCORE**	**124**	**117**	**135**	**110**	**123**	**114**	**142**	**135**	**165**	**154**	**119**	**131**
			BART, UPRR, Thru SJ, Fremont		*RR & Creek Xing*				*improves reliability*	*tank & pumps*			

Preliminary recycled water tank sizing

RW: Yearly Usage	417000	ccf =	311916000.0	gals, FY12-13 =	311.92	MGY
RW: Average Daily Usage	1142	ccf =	854564.4	gpd, FY12-13 =	0.85	MGD
RW: Calc'd Max Day Demand	2571	ccf =	1922769.9	gpd, FY12-13 =	1.92	MGD
RW: Peak Hourly Usage	11	ccf =	7901.8	gph, FY12-13 =	0.01	MGph
RW: Peak Usage Demand	42	ccf =	31607.2	gals, FY12-13 =	0.03	MG
RW: Peak Demand Increase	1428	ccf =	1068205.5	gals, FY12-13 =	1.07	MG
RW: Golf Course 5 Mon Usage	62603	ccf =	46827044.0	gals, FY12-13 =	46.83	MG
RW: Golf Course Average Daily Usage	412	ccf =	307903.9	gpd, FY12-13 =	0.31	MGD
RW: Average Daily Usage w/Golf Courses	1554	ccf =	1162468.2	gpd, FY12-13 =	1.16	MGD
RW: Calc'd Max Day Demand w/Golf Courses	3497	ccf =	2615553.5	gpd, FY12-13 =	2.62	MGD
RW: Peak Demand Increase w/Golf Courses	1943	ccf =	1453085	gals, FY12-13 =	1.453	MG
Recomended Tank Size					3.00	MG
Number of days storage without golf courses					3.51	Days
Number of days storage with golf courses					2.58	Days

Water Solutions Inc.

MEMORANDUM

Date: 16 March, 2015
To: Steven Machida, Principal Civil Engineer - City of Milpitas
From: Water Solutions, Inc. - Consultant
Subject: **Task 2: Recycled Water**

Summary

The use of recycled water appears to be one of the best options for offsetting potable water consumption; by using non-potable recycled water for irrigation, etc., less potable water will be used. The City of Milpitas (the City) has been a recycled water retailer since 1997 via an agreement with the City of San Jose. The City is in a unique position of having both the infrastructure and the potential recycled water demand to be a regional leader in recycled water use. With a modest investment in additional distribution pipes the City could save as much as one million or more gallons per day of potable water.

The infrastructure required to expand the City's recycled water system involves approximately 95,000 feet of purple pipe in loops and extensions, as well as purple pipe service laterals and water meters, which would be purchased by the customers. The proposed recycled water system expansion is expected to serve all cooling tower customers, a number of potential commercial customers, as well as the majority of the irrigation customers. Currently, the City's irrigation customers, which include residential users, use potable water. In the long term, it is feasible that all irrigation water could come from purple pipe.

A list of potential recycled water customers is included in the conclusion, along with the recycled water main extensions or loops that may need to be installed to serve these customers.

The cost of commercial connections would need to analyzed as each customer will incur a cost to get connected to the purple pipe, which will depend on their distance to the pipe. A regulatory step may encourage people to comply in order to avoid fines.

Data

The information in this memo was gathered from:

- California Code of Regulations, Title 22, Article 3
- City of Milpitas Public Utilities staff and records
- Pedro Hernandez of the City of San Jose, Environmental Services Department, South Bay Water Recycling; phone.
- Eric Lacy, State Water Resources Control Board; phone.

Maps of the City recycled water mains were correlated with location data taken from water meter records and from known cooling tower and industrial users. This information was then analyzed to correlate nearness to existing recycled water mains with quantity of use. A subset of the listed users was identified as being within “range” of the recycled water mains, based on their use of potable water for nonpotable purposes, and studied as potential candidates for conversion to recycled water use. Similarly, the City utilities engineering staff has identified some pipeline extension routes and has drawn up a plan of proposed recycled water extensions (See Appendix A1).

This sort of analysis was conducted for all potential customers, taking into account the distance between each consumer and the existing recycled water lines. The resulting loops and extensions suggested as additions to the recycled water system are designed to maximize potable water consumption reductions while minimizing the construction of additional recycled water piping.

Methodology

A series of examinations of available information regarding recycled water in the City was conducted. The information gathered and results of our study are recorded in the following sections of this technical memorandum.

A. Evaluate the feasibility of converting existing potable landscape irrigation and cooling tower customers to recycled water
B. Discuss source of recycled water (treatment plant) related to supply and water quality, including how recycled water is relatively not affected by drought cycles (rainfall patterns)
C. Evaluate the construction of recycled water fill stations for construction activities (compaction and dust control)
D. Evaluate other possible demands that can be offset by recycled water
E. Discuss the concept of a few big user and many small users as they affect the distribution system, ownership vs. operational/maintenance responsibility of the South Bay Water Recycling system and Milpitas interest in growth of South Bay Water Recycling
F. Prepare infrastructure needed to implement recycled water system expansion for the proposed offset
G. Discuss South Bay Water Recycling modeling effort to date
H. Optional: Prepare preliminary hydraulic model (pressure, velocity, flow, pipe size,

pipe length, valve locations with illustration) as part of the expansion

I. Provide potential list of customers (irrigation and cooling tower), estimated reductions of consumptions

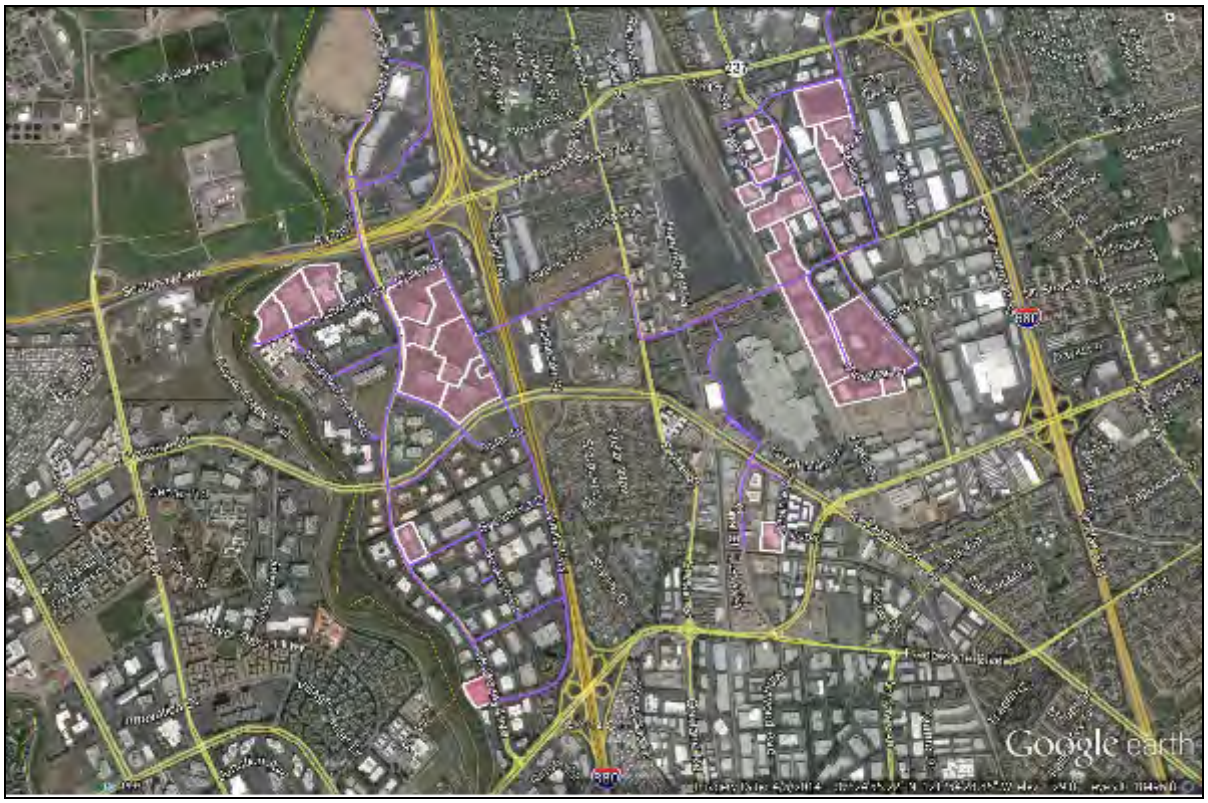
Legal and financial considerations will be addressed at the end of “Methodology” below.

There will be a final *Task 2 Implementation Plan Table* at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation. Feasibility will be discussed in Task 9.

A. Evaluate the feasibility of converting existing potable landscape irrigation and cooling tower customers to recycled water

The feasibility of converting existing potable-landscape-irrigation customers and cooling-tower customers to recycled water is quite good. All of the potential industrial and/or cooling tower customers are appurtenant to recycled water mains, which suggests that the possibility of such a conversion was foreseen earlier. It makes sense, therefore, to institute a mandatory connection for the existing list of potential industrial and cooling tower customers (see Figure 1).

Figure 1: Recycled Water Mains and Potential Industrial and Cooling Tower Customers



The following table indicates which additional recycled water mains could and should be installed forthwith to ensure significant reductions in potable water use for irrigation purposes:

Loop Name	Length	Cost @$375/ft	Water Savings (per 5 months)
California Loop	8,612’	$3,229,500	2,796 hundred cubic feet
Dixon Rd. Loop Completion	5,496'	$2,748,000 ($500/ft. horizontal bore)	5,339 hundred cubic feet
Milmont Dr. Extension (must be subsequent to Dixon Rd. Loop Completion)	837’	$313,875	1,787 hundred cubic feet
Yosemite-Sinclair Loop	6,246’	$2,342,250	1,745 hundred cubic feet
E. Calaveras Extension	3,001’	$1,125,375	1,735 hundred cubic feet
S. Milpitas-Landess Extension	8,528'	$3,198,000	2,846 hundred cubic feet
City Staff Proposed Segment 1	10,200’	$3,900,000 ($500/ft. x 600’ horizontal bore)	5,039 hundred cubic feet
City Staff Proposed Segment 2	5,000’	$1,975,000 ($500/ft. x 800’ horizontal bore)	No data
City Staff Proposed Segment 3	8,500’	$3,187,500	62,603 hundred cubic feet
City Staff Proposed Segment 4	8,600’	$3,225,000	13,765 hundred cubic feet
City Staff Proposed Segment 5	5,300’	$2,087,500 ($500/ft. x 800’ horizontal bore)	741 hundred cubic feet
TASP Area Extensions	25,000’	$9,375,000	No data

TOTALS	**95,320'**	**$36,707,000**	**113,205** (5mos.) **hundred cubic feet**

The information in this table is useful for assessing the feasibility of extending recycled water mains to potential new recycled-water customers. The data suggest that extending these lines would impose a one-time cost of $135.11 per hundred cubic feet of water saved annually and provide ongoing potable water savings of more than 271,692 hundred cubic feet per year or nearly 1 million gallons per day during peak water use periods. Given that the recycled water system would last for 75 years, this investment would save the City at least $71 million in purchased water savings over the lifetime of the system, at a lifetime cost of $1.80 per hundred cubic feet.

$$113,205\ hundred\ cubic\ feet/5months \div 5months\ \times 12months = 271,692\ hundred\ cubic\ feet/year$$

$$\$36,707,000 \div 271,692\ hundred\ cubic\ feet\ per\ year = \$135.11\ per\ hundred\ cubic\ feet\ saved$$
$$\$36,707,000 \div (271,692\ hundred\ cubic\ feet\ per\ year \times 75\ years) = \$1.80\ per\ hundred\ cubic\ feet$$
amortized over 75 years.

This is a reasonable cost/benefit for a construction project that would be executable within a relatively short timeframe such as five years. It is logical, therefore, that mandatory connections to recycled water would then be required where a recycled water main is appurtenant to the property and the customer is using potable water for irrigation. Additionally, main-to-house lateral pipe can be pre-installed for all new development. Once a predetermined number of developments come online, such as ten, a transmission line could then be installed.

B. Discuss source of recycled water (treatment plant) related to supply and water quality, including how recycled water is relatively not affected by drought cycles (rainfall patterns)

Wastewater is collected in Milpitas by the City-run sewer system. The sewer water flows to the San Jose-Santa Clara Regional Wastewater Facility (new name, also known as San Jose Water Pollution, old name, at 700 Los Esteros, SJ), which treats an average of 110 million gallons per day of wastewater and has the capacity to process up to 167 million gallons per day. Despite this sizeable production capacity, the consumption of recycled water by the County is only 14 million gallons per day on average, regardless of drought. San Jose-Santa Clara Regional Wastewater Facility treats the water to "disinfected secondary" (per Title 22 requirements).

This San Jose-Santa Clara Regional Wastewater Facility tertiary water is sent to South

Bay Water Recycling, also at the Esteros site, which treats the water further to provide 14 million gallons per day of “Disinfected Tertiary” water (per Title 22 requirements).

San Jose-Santa Clara Regional Wastewater Facility also sends its tertiary treated water to Silicon Valley Advanced Water Purification Center (also at the Esteros site). The Silicon Valley Water Advanced Purification Center uses micro-filtration, reverse osmosis, and ultraviolet disinfection, which is a standard above tertiary (per Title 22 requirements). The Silicon Valley Advanced Water Purification Center provides 8 million gallons per day at a quality of +/- 500 total dissolved solids (which is cleaner than tertiary) to South Bay Water Recycling.

Finally, at the South Bay Water Recycling main pump station, the South Bay Water Recycling tertiary water and the mixed low-dissolved solids and the cleaner-than-tertiary water from Silicon Valley Advanced Water Purification Center, are blended. South Bay Water Recycling provides water that ranks among the highest quality recycled water in California.

The South Bay Water Recycling blended water is then delivered to the following:

- City of Milpitas Water & Sewer
- City of Santa Clara Water & Sewer Utility
- San Jose Municipal Water System - Recycled Water
- San Jose Water Company (all neighboring districts)

Silicon Valley Advanced Water Purification Center currently uses a quarter of its available footprint and is considering the construction of satellite facilities closer to its users. The future of the Silicon Valley Advanced Water Purification Center looks to be indirect potable reuse via groundwater augmentation and recovery/active storage and recovery.

Note that the San Jose Water Company has also constructed a recycled water distribution line along its border with the City, which, according to some sources, may lead to an intertie and thus the completion of a “looped system” for the City. Water recycling in Milpitas began as a solution to a flow cap imposed (by the Regional Water Quality Control Board) on the San Jose-Santa Clara Regional Wastewater Treatment Facility. As a result, the hastily designed system did not necessarily meet all design needs. The “tree” approach to pipe construction needs to be modified by joining up dead-ends, to create loops that will increase the consistency of water delivery as water can be rerouted during system maintenance and repair.

Australia has been investigating the option of using recycled water for drinking purposes. Through the “National Demonstration, Education and Engagement Program” the Australian Water Recycling Centre of Excellence has been able to develop tools that can be used by the water industry when considering recycled water for potable use. This

project won the 2014 WateReuse International Award and can be used as an example for ways in which California can introduce the concept of drinking recycled water (Australian Water Recycling website, September 2014).

Orange County California has been operating a drinking-water-grade waste water treatment plant ("Orange County's Groundwater Replenishment System", p.11, Orange County Water District, 2010) since the 1970s. Called Water Factory 21 (the 21 representing a 21st century goal). In 2008, replacing Water factory 21, a Groundwater Replenishment System came online. With a new high-tech water purification system, it began to produce water similar in quality to bottled water. The Groundwater Replenishment System water will be used to service a larger, expanded seawater barrier and to help drought-proof Orange County's groundwater basin by providing better water reliability and more local control over part of our water future. While human consumption of re-used, treated wastewater is still technically and politically experimental, it has the possibility of being cutting edge. Non-consumptive use of recycled water is, however, a generally accepted industry goal.

San Diego recently approved "Pure Water San Diego," which will cost $3.5 billion to provide more than a third of the City's potable water by 2035. The price tag for recycled, purified water is currently higher than that of imported water, but this trend is widely expected to be reversed in the longer term. Mike McSweeney of the Building Industry Association of San Diego said that a reliable water supply is crucial to San Diego's growing population: "Without it, we can't build; without it, we can't live." ("SD OKs Landmark Water Recycling". U-T San Diego. 2014)

Some of the single family residential houses within the town of Windsor (known as Vintage Greens) were one of the first class of developments to utilize recycled water for irrigational purposes in Northern California. Since that time, the town of Windsor has been consistently using recycled water for irrigation of agricultural land and residential front/backyards and for recreational purposes in schools. The wastewater is treated to tertiary standards allowing for unrestricted use in reclaimed water applications throughout the city (City of Windsor website, 2014).

The Monterey Regional Water Pollution Control Agency has partnered with Monterey County Water Resources Agency to build reclamation projects including the Salinas Valley Reclamation Project recycled water plant and the Castroville Seawater Intrusion Project. The Salinas Valley recycled water plant has been treating wastewater to advanced tertiary level since 1998. This water continues to be used for unrestricted purposes throughout Monterey County. The Castroville Seawater Intrusion Project distributes recycled water (treated to secondary standards) to 12,000 acres of farmland within Northern Monterey County ("Changing Waste Water into Safe Water." Monterey Regional Water Pollution Control Agency website. 2014.).

Recycled water is often considered a more reliable water source than normal potable water sources such as watersheds and groundwater, as its production is influenced by population alone, rather than by seasonal changes. This assessment is not entirely true, as conservation efforts during times of drought may reduce wastewater. However, given that the volume of available recycled water is much greater than the current demand, the ceiling is rarely hit, and the common sentiment is that recycled water is nothing if not reliable.

The current recycled water infrastructure consists of a single connection to the 30 inch Transmission Pump Station line at the end of Technology Dr., coming directly from the Transmission Pump Station approximately 1 mile to the northwest. The Transmission Pump Station operates at 110 pounds per square inch and 700-3,000 gallons per minute, providing more than enough capacity for growth in the use of recycled water. This area, called Zone 1, is supplied by highly robust recycled water wholesaler supplies and facilities, however the infrastructure in the City lacks reliability, should it choose to increase its recycled water consumption.

South Bay Water Recycling is expanding the purple pipe distribution system in the San Jose Water Company territory, south of the Landess/Park Victoria intersection on the San Jose/Milpitas border. Adding a turnout there will feed the proposed Segment 5 (Figure A1 in Appendix), creating a much needed loop that will greatly improve maintenance, and therefore reliability. SBWR will also be addressing its planned expansion to keep up with consumption needs.

Moreover, there are two other considerations regarding reliability. One is that the peak recycled water use occurs at night-time, when most irrigation of public green spaces (parks, playgrounds, golf courses) takes place. The actual peak is approximately 3.6 times the normal demand and occurs between 21:00 and 03:00 hours. Given that the low use period is around 14:00 hours, to protect system reliability the city may wish to review requiring daytime use or additional storage (reservoirs or tanks). It seems logical that an analysis should be performed to determine if a reservoir should be constructed to smooth out the demand peaks. This is, of course, how water systems are designed, and it follows that the recycled water system may well need the same consideration. A reservoir located within the City would also reduce the impact of supply line repairs.

A second consideration is that the City has only one connection to the recycled water system. That connection, as aforementioned, makes the system more vulnerable than a multiple connection system. To supplement this single connection, and to form a loop, two additional connections could be made as follows:

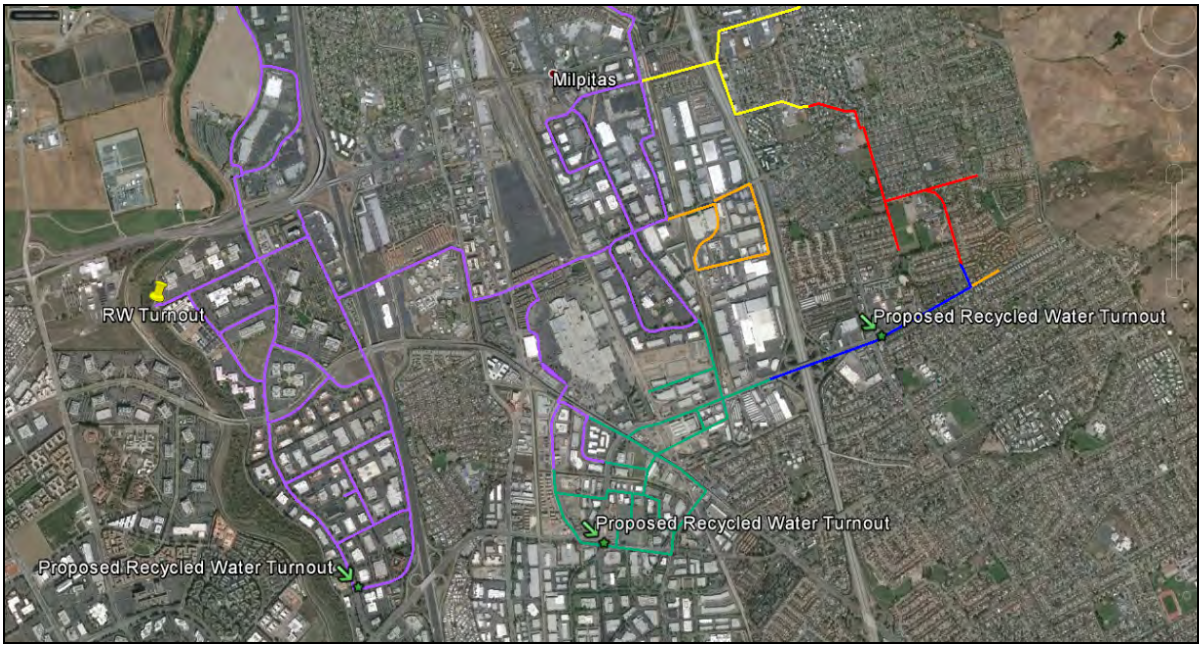
- A 2,200 foot connection could be made along McCandless Dr. and Trade Zone Blvd. to the 6 inch end at Ringwood Ave. and Trade Zone Blvd. This would be accomplished by the Transit Area Specific Plan extensions planned by the City.
- A 12 inch connection could be made by horizontal boring for 900 feet, under

Coyote Creek, from the intersection of Barber Lane and McCarthy Blvd. to the 30 inch transmission line under Coyote Creek Trail

C. Evaluate the construction of recycled water fill station for construction activities (compaction and dust control)

Using recycled water for non-potable applications such as construction watering, street sweeping and sewer flushing is inherently less costly than using valuable potable water. Following a Water Solutions, Inc. technical memorandum and design, four construction water fill stations have been created, two along McCarthy Boulevard, one at Eastern Curtis Park, and one along Gibraltar Drive. The City is one of the first Bay Area cities to convert to recycled water for construction and can adjust the system based on operational experience.

Figure 2: Proposed Recycled Water Turnout Locations



D. Evaluate other possible demands that can be offset by recycled water

According to the California Code of Regulations, Title 22, section 60304, multiple types of allowable water recycling applications are available to the City. An abbreviated list of these possibilities is given below, followed, in some cases, by the number of potential customers. A detailed list of recommended potential customers is provided at the end of

the document.

- Irrigation
    - parks & playgrounds
    - school yards
    - residential landscaping
    - public golf courses (2)
    - cemeteries (1)
    - freeway landscaping
    - restricted golf courses
    - nurseries
    - pasture
    - any non-edible vegetation
- cooling
- industrial process
- fire-fighting
- fountains
- commercial laundries (10)
- commercial car-washes (9)
- mixing concrete (1-7)
- dust control
- cleaning outdoor areas

F. Prepare infrastructure needed to implement recycled water system expansion for the proposed offset

Numerous infrastructural items are required to successfully implement an expanded recycled water system. They are as follows:

- approximately 95,000 feet of purple pipe is needed to connect all of the potential loops inserted in the expanded system
- around 150 isolation valves will need to be installed onto the purple piping to facilitate the flow of recycled water at approximately 1,000 foot intervals
- tees and saddles will also be needed at locations in the purple pipe where the system is accessed

Based on an analysis of potential connections, the expected increase from the expansion is an average of 1 million gallons per day of recycled water for irrigation use, plus additional flow for commercial and cooling tower users.

Purple pipe service laterals will be purchased as needed by customers, along with other connection-related appurtenances. As well, recycled water meters will be purchased by the customer to ensure that water usage data is readily available. These purchases will be made in accordance with a City or County ordinance requiring the installation of appropriate fittings.

H. Optional: Prepare preliminary hydraulic model (pressure, velocity, flow, pipe size, pipe length, valve locations with illustrations) as part of the expansion (optional; not researched)

I. Provide potential list of customers (irrigation and cooling tower), estimated reductions of consumptions

The following tables defines water usage for five months for a number of high volume consumers. This data was taken from metering records over the non-peak usage period months of January 2014 through May 2014. As described in section A of this memorandum, the water consumption reduction through expansion of the recycled water system is a yearly 271,692 hundred cubic feet, at a cost of $36,707,000. We suggest multiple tiers for implementation of these reductions, with the most water savings being afforded by the first tier of improvement and further savings by latter tiers.

Recycled Water Implementation Tiers

Tier	Improvement
1	Conversion of Non-potable uses to recycled water along existing alignment.
2	Conversion of Cooling towers to recycled water along existing alignment.
3	Pipeline constructions

Tier 1: Recommended Potable Irrigation Connections

ADDRESS	5 MON. CONSUMPTION TOTAL (hundred cubic feet)
367 CYPRESS DR	140
1851 MCCARTHY BLVD	547
501 MURPHY RANCH RD	52
800 BARBER LN	121
1551 CENTER POINTE DR	347
1077 GIBRALTAR DR	40

1007 GIBRALTAR DR	73
1177 GIBRALTAR DR	73
500 YOSEMITE DR	478
730 TASMAN DR	258
888 TASMAN DR	534
601 YOSEMITE DR	349
755 YOSEMITE DR	383
601 S MILPITAS BLVD	497
463 S MILPITAS BLVD	212
147 METROPOLITAN DR	250
200 S HILLVIEW DR	19
830 S HILL VIEW DR	370
1500 ESCUELA	13
690 S HILLVIEW DR	156
734 S HILLVIEW DR	86
480 S HILLVIEW DR	39
300 S HILLVIEW DR	139
233 S HILLVIEW DR	354
350 S MILPITAS BLVD	60
570 S MILPITAS BLVD	255
1107 SANDALWOOD LN	75
901 E CALAVERAS BLVD	807
555 LOS COCHES ST	28
511 LOS COCHES ST	46
48 LOS COCHES ST	83
765 E CALAVERAS BLVD	182

700 YOSEMITE DR	478
920 S MILPITAS BLVD	69
1090 S MILPITAS BLVD	179
240 E CURTIS AVE	15
700 S ABEL ST	162
800 S ABEL ST	95
GREAT MALL @ MCCANDLE ST	517
185 S MILPITAS BLVD	214
182 TOPAZ ST	50
190 TOPAZ ST	421
311 TURQUOISE ST	25
374 TURQUOISE ST	293
TOTAL	9,584 hundred cubic feet

Tier 1: Recommended City Irrigation Connections

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1101 S MAIN ST	6
209 GREAT MALL PKWY	281
130 HORIZON ST	408
511 PLATT/SARATOGA AVE	133
PIEDMONT RD @ST.JOHN'S CEMETERY	34
2087 ALVISO ADOBE	86
1331 E CALAVERAS	2271
120 N MILPITAS	84
1005 N MCCARTHY	60

1425 N MCCARTHY BLVD N SIDE DRIVEWAY	116
1265 N MILPITAS BLVD	183
355 JURGENS/MILMONT WAY	1563
TOTAL	5,225

Tier 2: Recommended Industrial/Cooling Tower Connections

COMPANY NAME	**ADDRESS**
Jefferson Smurfit Corp	201 S Hillview Dr
LINEAR TECHNOLOGY CORPORATION	275 S Hillview Dr
MISSION WEST PROPERTIES LP	233 S Hillview Dr
Headway Technologies	497 S Hillview Dr
KLA TENCOR CORP	3 Technology Dr
KLA TENCOR CORP	5 Technology Dr
KLA TENCOR CORP	7 Technology Dr
Trinet Milpitas Assoc LLC	345 Los Coches St
TRINET MILPITAS ASSOCS LLC	1530 Mccarthy Blvd
CISCO TECHNOLOGY INC	465 Barber Ln
CISCO TECHNOLOGY INC	510 McCarthy Blvd
CISCO TECHNOLOGY INC	771 Alder Dr
CISCO TECHNOLOGY INC	758 Barber Ln
CISCO TECHNOLOGY INC	0 Barber Ln
FR CAL NORTHWEST ALPHA LLC	1557 Centre Pointe Dr
Flextronics	1077 Gibraltar Dr
Flextronics	1007 Gibraltar Dr
Flextronics	727 Gibraltar Ct
LIFESCAN INC (already on RW)	1001 S Milpitas Blvd

Orinda Equity Parts LLC	461 S Milpitas Blvd
Peripheral Storage Inc	304 Turquoise St
Deck Stanley R	311 Turquoise St
Bryan Family Partnership II Ltd	195 S Milpitas Blvd
Seagate Technology LLC	155 S Milpitas Blvd

Tier 3: California Loop

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1081 CADILLAC CT	129
380 FAIRVIEW	604
120 CALIFORNIA CIR	1128
1430 CALIFORNIA CIR	549
1494 CALIFORNIA CIR	276
1524 CALIFORNIA CIR	110
TOTAL	2,796

Tier 3: Dixon City Loop Completion

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1854 N MILPITAS BLVD	666
98 DIXON RD	213
120 DIXON RD	238
1775 MILMONT DR	978
1770 MILMONT DR	163
231 DIXON LANDING RD	507

1901 MILMONT DR	1219
1900 MILMONT DR	1355
TOTAL	5,339

Tier 3: Yosemite-SinClair Loop

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
734 HILLVIEW DR	86
890 YOSEMITE DR	483
650 VISTA WAY	45
1021 YOSEMITE DR	38
565 SINCLAIR FRONTAGE RD	452
750 YOSEMITE DR	85
876 YOSEMITE DR	56
983 AMES AVE	27
945 AMES AVE	234
901 AMES AVE	212
871 AMES AVE	3
1250 AMES AVE	8
990 AMES AVE	11
980 AMES AVE	1
970 AMES AVE	4
TOTAL	1,745

Tier 3: E. Calaveras Extension

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**

901 E CALAVERAS BLVD	807
770 E CALAVERAS BLVD	272
1255 E CALAVERAS BLVD	581
95 DEMPSEY RD	4
49 DEMPSEY RD	54
98 PARK VICTORIA DR	17
TOTAL	1,735

Tier 3: Milmont Dr. Extension

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1775 MILMONT DR	978
LARKWOOD CT	646
1770 MILMONT DR	163
TOTAL	1,787

Tier 3: South Milpitas Landess Extension

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1090 S MILPITAS BLVD	179
999 MONTAGUE EXPY	380
905 MONTAGUE EXPY	92
1486 GLADDING CT	2
1051 PECTEN CT	38
1031 PECTEN CT	90
1475 DEMPSEY RD	79

1535 LANDESS AVE	1020
1350 S PARK VICTORIA DR	71
1785 LANDESS AVE	2
1795 LANDESS AVE	83
2154 CALLE VISTA VERDE DR	810
TOTAL	2,846

Tier 3: City Staff Proposed Segment 1

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
1331 E CALAVERAS BLVD	3272
CARDOZA PARK AVE	1320
KENNEDY DR #1	No data
KENNEDY DR #2	447
TOTAL	5,039

Tier 3: City Staff Proposed Segment 3

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
COUNTRY CLUB DR (Summitpointe Golf Course)	39,023
OLD CALAVERAS DR #1 (Ed Levin Park)	No data
OLD CALAVERAS DR #2 (Spring Valley Golf Course)	23,580
TOTAL	62,603

Tier 3: City Staff Proposed Segment 4

ADDRESS	5 MON. CONSUMPTION TOTAL (hundred cubic feet)
1300 EDSEL DR	863
FOOTHILL PARK (no address)	No data
#1 300 ROSWELL DR	1033
#2 300 ROSWELL DR	170
MURPHY SCHOOL DR	958
#1 511 PLATT/SARATOGA AVE	63
#2 511 PLATT/SARATOGA AVE	752
#1 1596 EVERGLADES DR	60
#2 1596 EVERGLADES DR	945
#1 EVERGLADES #511-10 DR	927
#2 EVERGLADES #511-10 DR	78
SKYLINE PARK WAY	419
FIELDCREST PARK WAY	753
915 SEQUOIA DR	140
YELLOWSTONE EAST OF SPV	No data
CHIPMAN/LYNWOOD	553
2154 CALLE VISTA VERDE DR	1482
CUESTA/TER HOA	1,182
RIDGEMONT COMMON DR	1,380
2300 LYNWOOD TERRACE	1,243
1357 TERRA ALTA DR	688
#1 YELLOWSTONE AVE	76

#2 YELLOWSTONE AVE	0
1500 YOSEMITE (Montessori School)	No data
2025 YOSEMITE (Sinnott School)	No data
TOTAL	13,765

Tier 3: City Staff Proposed Segment 5

ADDRESS	**5 MON. CONSUMPTION TOTAL (hundred cubic feet)**
#1 CREIGHTON PARK AVE	134
#2 CREIGHTON PARK AVE	607
TOTAL	741

Legal

The State legislature has declared that:

> The use of potable domestic water for nonpotable uses, including, but not limited to, cemeteries, golf courses, parks, highway landscaped areas, irrigation of residential landscaping and industrial and irrigation uses, is a waste or an unreasonable use of the water if recycled water is available (Water Code section 13500).

Retail water suppliers are required to identify potential uses for recycled water. The Urban Water Management Plan (Water Code section 10633) requires information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The City is required to use recycled water for certain irrigation and industrial purposes, if suitable recycled water is available. Further, the City may require the use of recycled water for certain uses at a reasonable cost to the user (i.e., supplying the treated recycled water at a cost comparable to, or less than, the cost of supplying potable domestic water). Such uses include:

- Irrigation of residential landscaping, under certain conditions
- Floor trap priming, cooling towers, and air-conditioning devices, under certain conditions
- Toilet and urinal flushing under certain conditions

Note that these applications will require permitting and approval from State Water Resources Control Board..

Standards for the use of recycled water in various applications fall into three categories. Below are the allowed uses for each of these categories.

(a) Tertiary Disinfection Treatment: Recycled water used for the following shall be disinfected tertiary recycled water, except for filtration being provided pursuant to California Code of Regulations, Title 22, section 60301.320(a). Coagulation need not be used as part of the treatment process, provided that:

- the filter effluent turbidity does not exceed 2 nephelometric turbidity units
- the turbidity of the influent to the filters is continuously measured
- the influent turbidity does not exceed 5 nephelometric turbidity units for more than 15 minutes and never exceeds 10 nephelometric turbidity units
- there is the capability to automatically activate chemical addition or divert the wastewater should the filter influent turbidity exceed 5 nephelometric turbidity units for more than 15 minutes (Water Code section 60307):
    - flushing toilets and urinals
    - priming drain traps
    - industrial process water that may come into contact with workers
    - structural fire fighting
    - decorative fountains
    - commercial laundries
    - consolidation of backfill around potable water pipelines
    - artificial snow making for commercial outdoor use
    - commercial car washes, including hand washes if the recycled water is not heated, where the general public is excluded from the washing process

(b) Secondary 23 Disinfection Treatment: Recycled water used for the following uses shall, at the least, be disinfected secondary-23 (total coliform count of 23 colonies per 100 milliliters or less) recycled water:

- industrial boiler feed
- non-structural fire fighting
- soil compaction
- mixing concrete
- dust control on roads and streets
- cleaning roads, sidewalks and outdoor work areas
- industrial process water that will not come into contact with workers

(c) Undisinfected Secondary Treated: Recycled water used for flushing sanitary sewers shall, at the least, be undisinfected secondary recycled water.

According to the Water Conservation Ordinance 240 the use of potable water for irrigation is prohibited where reclaimed water is available, except in the following situations:

- Abel/Main streetscape
- cultural resources
- temporary native planting establishment

The City Municipal Code Title VIII, Chapter 6, sections 3.05-06 should be changed to

require new developments, cooling and other potential uses of recycled water to take advantage of recycled water where reasonably available. *Reasonable availability* can be determined by evaluating the cost of installation against the cost of maintaining consumption at increasing rates, with savings projected over a 30 year infrastructure lifetime.

However, before a site can connect to recycled water, the construction documents (plans, engineering report, etc.) must be prepared by the new customer and approved by the City, the South Bay Water Recycling and the State Water Resources Control Board. The construction must be inspected for South Bay Water Recycling permit issuance. Dual plumbing is more complicated, with a periodic cross-connection testing after the initial construction, which typically occurs every four years. An annual self-inspection report by the customer is also required.

The California Code of Regulations Water Code (section 60310-60316) sets out the construction and other ongoing requirements. For example, no recycled water other than disinfected tertiary grade water can be used on parks or playgrounds or for irrigation near a well. In addition, signs displaying the wording "RECYCLED WATER - DO NOT DRINK" must be posted wherever recycled water is used.

Financial

It is advised that the City pursue additional funding in the form of grants and/or loans via the California and US governments (see technical memorandum *Task 8: Funding*). Alternately the recycled water system improvements could be incorporated into the City's sizeable Capital Improvement Program.

Milpitas will not have to pay operations and maintenance costs as South Bay Water Recycling will assume that responsibility after construction is complete.

Results

Evaluation of the available volume of water

Immediately connecting existing City and other irrigation customers to the existing recycled water system would save a small yet significant amount of potable water. Also attaching existing cooling tower customers to the recycled water system would save a similarly significant amount of water, especially during peak-use summer months.

The information provided to Water Solutions, Inc. by the City shows that expanding the recycled water pipelines would provide ongoing annual potable water savings of 271,692 hundred cubic feet or nearly 1 million gallons per day during peak periods.

Issues to be resolved

Reduction of potable water use by nearly 1 million gallons per day represents a

ten-percent reduction of average daily usage. Extrapolating that reduction into peak-use summer months shows a likely yield of even greater potable water savings.

Order of magnitude description of infrastructure needed

Between $30-40 million will be necessary to pay for the installation of all of the proposed recycled water lines. This represents a very large commitment by the City infrastructurally speaking however, the conversion to recycled water for non-potable use is a drought-proof solution to water shortage issues.

Operational/Maintenance Concerns

The use of recycled water for irrigation purposes by big users such as parks and industrial buildings can cause drops in pressure. On the other hand, small users such as residential buildings minimize pressure drops in the system by turning their systems on and off at varying times. When a large number of big users utilize a recycled water system, the resulting pressure drops in the system may negatively affect the availability of water for all users. In many cases, upgrading from the existing “tree distribution” to a grid distribution will mitigate the pressure drops. However, with a large number of small users, the pressure changes don’t affect other users nearly as much, as smaller users can control when they turn their irrigation systems on and off. Some locations such as San Diego and Las Vegas have adopted a mandatory outdoor watering schedule requiring residents and commercial customers to limit outdoor watering to designated days and times, as determined by the City (Las Vegas Valley Water District website. 2014).

For the last ten years, South Bay Water Recycling has been capturing about 10 million gallons per day of wastewater that would normally be lost to the Bay (approximately total 100 million gallons per day outfall). They intend to increase capacity as demand increases. Currently their capacity is greater than the need. This recycled water will be available to communities purchasing water from South Bay Water Recycling (such as the City) and will become a sustainable water supply for future generations (City of San Jose website. 2014).

Conclusion

Irrigation and cooling tower customers who currently use the potable water system within the City vary in their consumption volume. These customers are potential users of recycled water and can easily be required to connect to an expanded recycled water distribution system. The potential loop installations will help to service additional customers, for example, three laundries could be using recycled water as could a number of parks and schools with playgrounds (see Figure A2 in the Appendix). Those customers with the highest consumption rate per hundred cubic feet will be connected to the future loops and extensions. South Bay Water Recycling is adding purple pipe in northern San Jose, very near to Milpitas, prompting the suggestion of adding a recycled

water turnout for reliability.

These potential changes require proper piping, pumping and storage infrastructure be added to the current recycled water system. The implementation plan below incorporates the life-cycle and cost information previously presented.

Task 2: Recycled Water, Implementation Plan
Possible Implementation Schedule: 1. Contact potential recycled water customers from the list provided to add recycled water lines, as feasible (May, 2015) 2. Prepare new Ordinance. (June 2015) 3. City approves Ordinance. (July 2015) 4. Begin project plans for installing recycled water lines to additional customers (July, 2015) 5. TASP construction (July 2014 - June 2015) 6. Segment 1 engineering (Jan. - June 2015) 7. Segment 1 construction funding application (July 2015 - Mar. 2016) 8. Segments 2-5, tank/pump, loops planning funding application (July 2015 - Mar. 2016) 9. Ordinance enacted. (Aug. 2015) 10. Segment 1 construction (Apr. 2016 - Sept. 2016) 11. Hire a consulting engineer to design installation of all segments: (April 2016) 12. Segments 2-5, tank/pump, loops engineering (Apr. 2016 - Sept. 2016) 13. Finalize project plans for Industrial/Cooling Towers, City Potable Irrigation lines and other Potable Irrigation connections to the recycled water system. (July. 2016) 14. Open construction contracts for bid. (Mar. 2017) 15. Finalize bid documents. (May 2017) 16. Segments 2-5, tank/pump, loops construction funding application (Oct. 2016 - June 2017) 17. Segments 2-5, tank/pump, loops construction (July 2017 - Mar. 2019) 18. Permit Paperwork. (Mar. 2019)
Costs: Implementation of all loops (95,000 feet) identified as ideal additions to the recycled water system would cost $36,707,000.
Benefit: Recycled water system expansion would save nearly 1 million gallons per day (or 271,692 hundred cubic feet/year) of potable water during peak use periods. Mandatory connections would increase that amount by an unforeseen number based on other possible connections such as unquantified cooling tower consumption.
Life Cycle: The lifespan of pipe for a recycled water system is approximately 75 years. This lifespan depends on a number of factors including global warming, traffic, leaks (hydrogen sulphide), - C900 purple PVC (poly-vinyl chloride) - plastic pipe - Concrete (as well as asbestos-cement) - Cast Iron *(according to Waterworld.com: Aging pipe proves expensive for municipalities).*

Prioritization by life-cycle: The completion of loops is the priority. Therefore the California loop, which will service a large subset of industrial potable water users, should go in first, and the Dixon City Loop Completion project second.
Ease of Implementation: Planning and construction of recycled water mains is a simple and common event involving the execution of a single construction contract following an engineering phase.

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APPENDIX

Figure A1: City Utilities Staff Proposed Recycled Water Pipeline Extensions

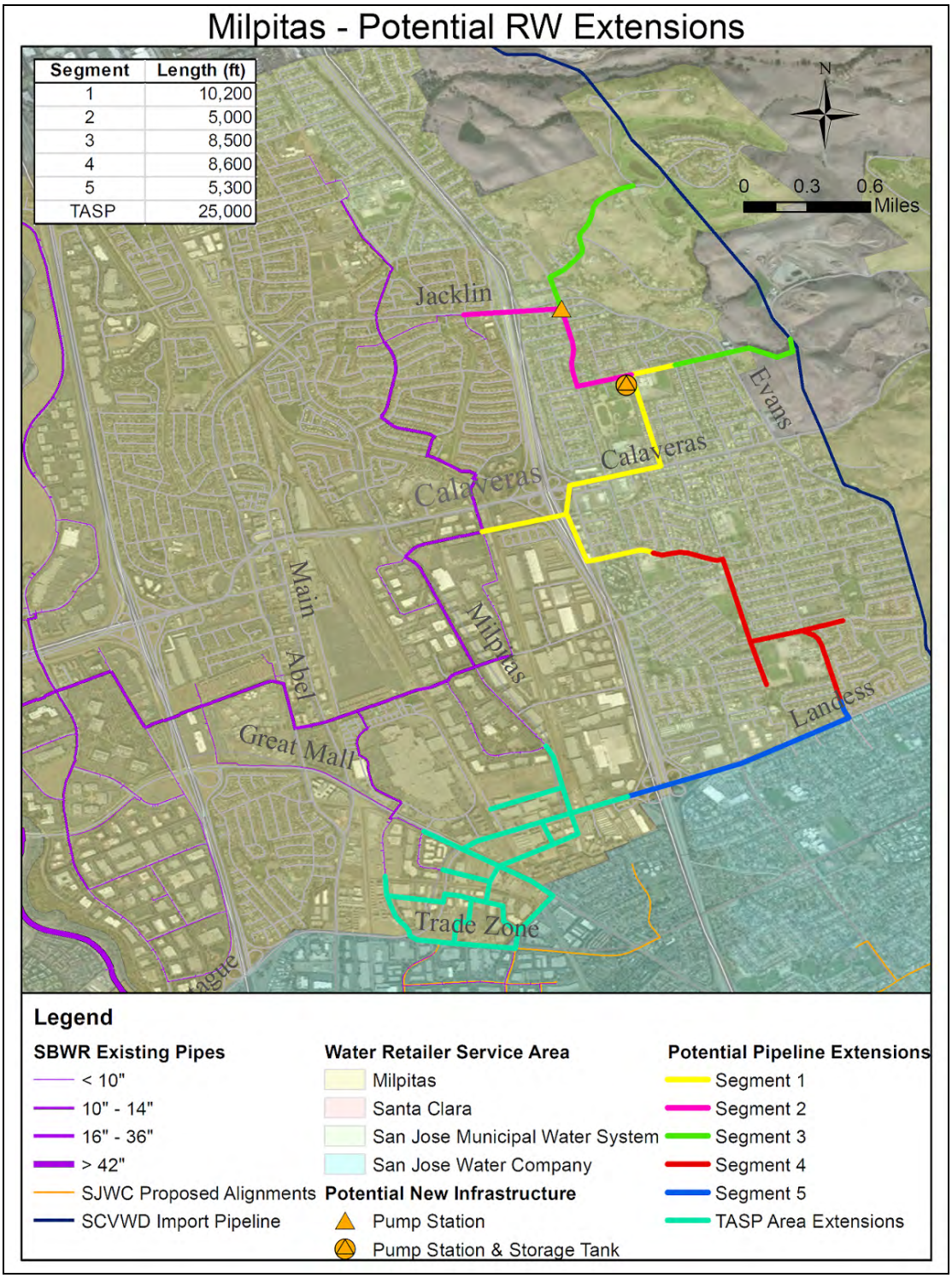


Figure A2: City Parks and Schools List

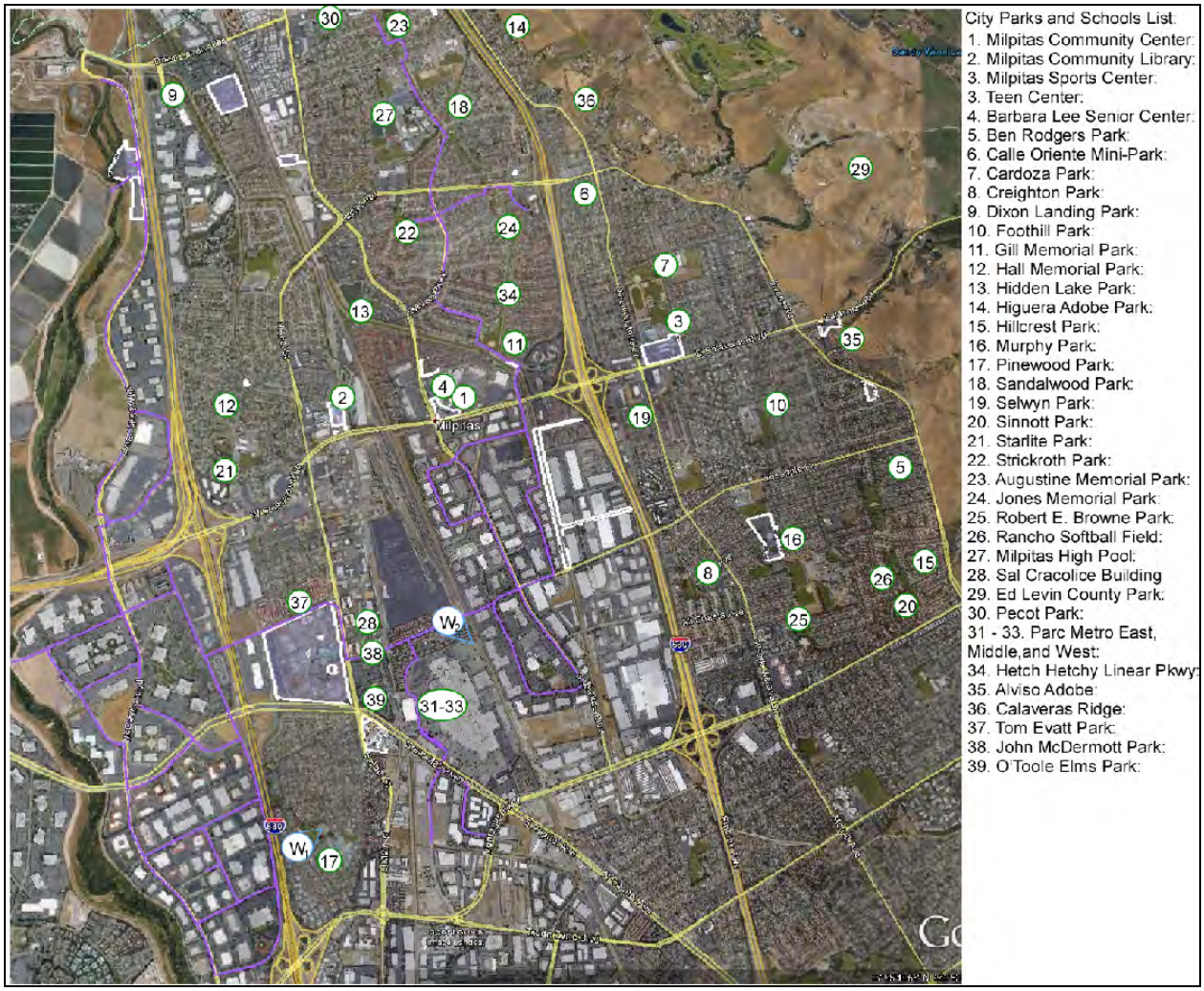
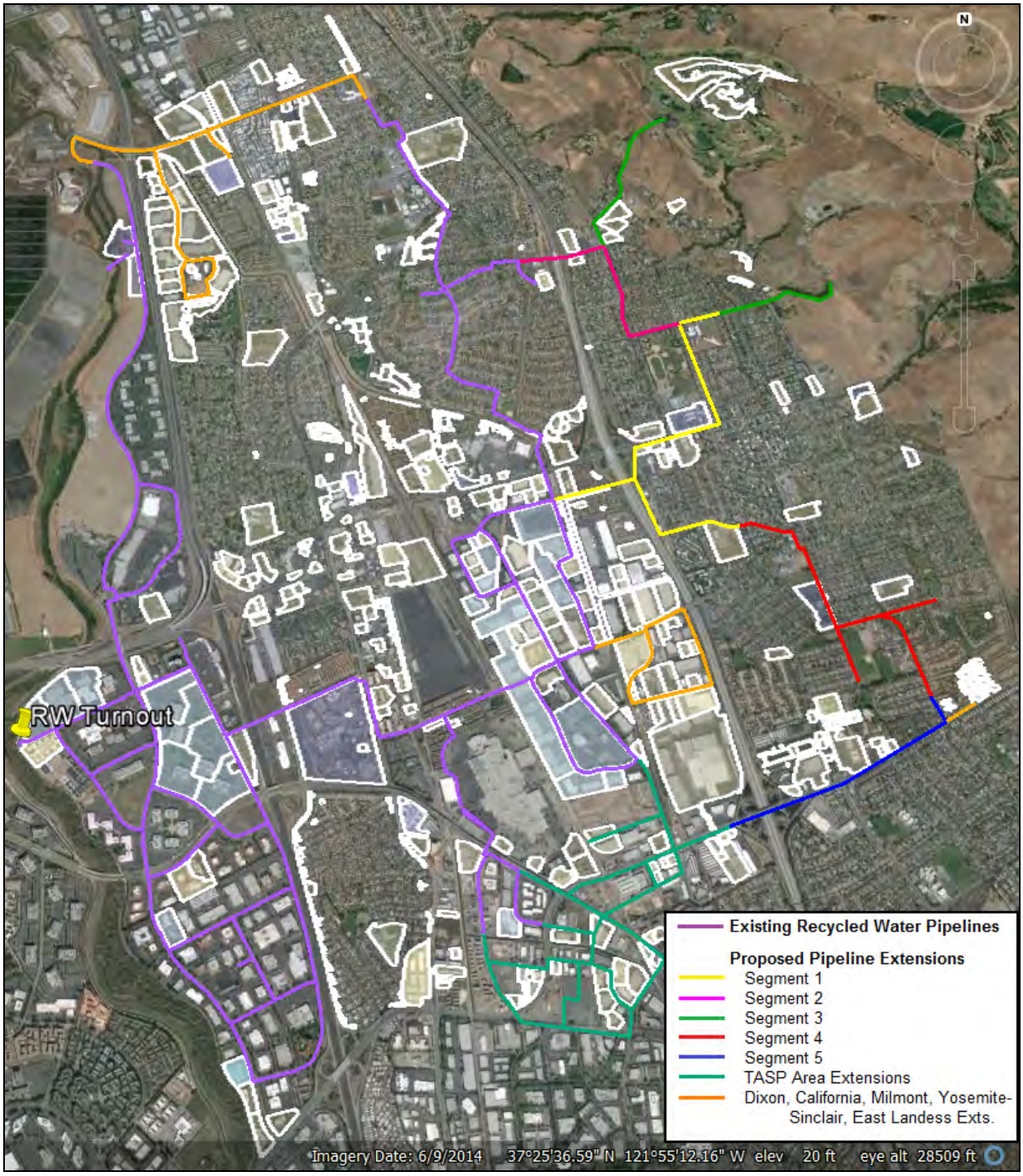


Figure A3: Proposed Recycled Water System Changes



MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 3: Surface Water Detention**

Summary

The purpose of this memorandum is to describe the various strategies the City of Milpitas can employ to capture stormwater for treatment, and construction water uses and for potable use, as well as the implementation requirements for each. The memorandum covers regulatory requirements, site locations, implementation and operational considerations for surface water retention ponds, detention facilities and for percolation ponds used for groundwater replenishment.

Retention ponds maintain a pool of water throughout the year, capturing stormwater runoff following storms. In general, surface water retention refers to water held in ponds, lagoons, reservoirs, lakes and other constructed or natural water features for the purpose of storing water. Because the water travels over asphalt, soils, concrete and other surfaces before reaching the retention area, contamination is an issue.

Detention ponds maintain water for a short period of time, holding water temporarily before it enters a stream.

Percolation ponds are surface water ponds with a porous or permeable bottom layer that allows water to “percolate” or seep through the soils to underlying aquifers. Percolation ponds should be constructed in a location that allows water to flow underground easily and be captured in a confined aquifer that prevents the water from flowing elsewhere. The storage potential for any given site depends on the size of the aquifer, basin and/or percolation layers, and can be significant if appropriate geological conditions are present. A substantial geotechnical investigation would be required to identify feasible sites if this option was used.

On the western side of the City, water drains into 13 storm pump stations used to pump

water into creeks. Whether stormwater is collected in ponds or pump stations, bioswales or vegetative-lined canals should be used to promote natural water treatment prior to pumping the water or before it enters a pond or lagoon. The City currently operates four stormwater retention basins (lagoons) that could be used for construction or other non-potable purposes with a minimal investment in infrastructure: Hidden Lake Lagoon, Hall Park Lagoon, the lagoon at Glenmoor Circle area and a retention basin off Quince Lane.

Each of these locations will be examined for the potential to augment non-potable water usage throughout the City, as well as the necessary infrastructure required for safe and reliable distribution of non-potable water. The options investigated in this report for stormwater storage and use are as follows:

- stormwater retention ponds
- surface percolation ponds
- stormwater detention facilities (for stormwater treatment)
- non-potable fill-stations from existing surface water
- storage tanks (to store stormwater, *see* Task 7: Additional Storage)
- tertiary-treated water for recycled water use
- groundwater injection of tertiary treated water
- bioswales, constructed wetlands and vegetative-lined channels to reduce stormwater pollution, which, in addition, provide recreational opportunities and wildlife habitat.

Use of stormwater for non-potable purposes such as construction water is an inexpensive and easily accomplished proposition. However, the benefit of such an effort is unpredictable due to uncertainties and fluctuations in the use of construction water, which is not a regular occurrence.

The detention of storm water for potable use is land intensive and highly regulated. The establishment of water rights and the subsequent construction of retention (or percolation) ponds is an expensive and time consuming process, potentially costing more than $35 million dollars over time. Nevertheless, this approach could be beneficial if recharge credits were given by the Santa Clara Valley Water District. This, however, requires close coordination with the Santa Clara Valley Water District and is a legal effort that must be thoroughly vetted prior to planning any new percolation pond facility.

This is a complicated process that Water Solutions, Inc. does not recommend at this time, but we do recommend that the City should be aware of groundwater recharge opportunities.

Data

The information in this memo was gathered from the California Code of Regulations, Titles 17 and 22, and the City Public Utilities staff and records. Other sources include the State Water Resources Control Board website, United States Environmental Protection Agency online publications, California Department of Fish and Wildlife, Santa Clara Valley Water District website, the City of Milpitas staff and publications about water storage. Additional information was obtained from representatives of several water districts, including Darin Taylor of the Santa Clara Valley Water District.

Methodology

The information in this section is presented under the following headings:

A. Discuss percolation and groundwater relation: hydrological recharge
B. Prepare design concepts for hydrological recharge
C. Prepare concept size of recharge area and preliminary water quality of retention basin, including the creek sources
D. Describe oversight and regulatory requirements (such as Fish and Wildlife, Regional Water Quality Control Board, Santa Clara Valley Water District, etc.) for surface water detention facility, including allowable usage capacity
E. Discuss ownership, participation/partner aspect
F. Optional: Prepare implementation guidelines based on available sources such as Groundwater Recharge Programs of Alameda County Water District and Santa Clara Valley Water District
G. Optional: Determine available area, water quality and creek source of potential sites based on historical data
H. Provide potential lists of sites, estimated reductions of consumptions

Legal and financial considerations will be addressed at the end of “Methodology” below.

There will be a final *Task 3 Implementation Plan Table* at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation. Feasibility will be discussed in Task 9.

A. Discuss percolation and groundwater relation: hydrological recharge

Hydrological recharge (also referred to as *groundwater recharge*, *deep drainage* and *deep percolation*) is a process wherein water moves downward from the surface of the ground to an aquifer, or area of groundwater storage. This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table.

Groundwater enters aquifers through the earth and is derived from stormwater, surface water or snowmelt percolation.

Artificial recharge can be used to augment hydrologic recharge, and includes adding collected stormwater, recycled water, surface water or other water sources to the groundwater. Recharge through the use of surface percolation, that is, the filtering of water through porous earth, is the most common form of artificial recharge. However, injection wells can also be used to augment recharge in areas with inadequate surface water percolation sites. The benefit of injection is the ability to tap into deeper aquifers; however, stringent treatment and permitting standards must be met.

Factors that affect groundwater recharge include:

- porosity of the soil or geologic feature
- area of water infiltration
- volume of the aquifer
- above-aquifer soils/clay layers (also known as *aquitards*) and the porosity of adjacent features

Typically, surface infiltration or percolation into an unconfined aquifer is used to augment groundwater supplies. In this scenario, surface water in ponds or retention basins is allowed to percolate naturally through the ground (or ponds that are engineered so this can happen) to reach suitable shallow, or unconfined aquifers. Water is then pumped from adjoining wells, as needed. This process can be enhanced by using rock beds and porous layers to feed water supplies directly to groundwater storage or recharge.

Groundwater recharge can also be accomplished through the use of injection wells. The choice of site locations for injection wells or percolation sites should be based on available aquifers, surrounding geology and other factors like city master plans, etc. Due to the complexity of groundwater percolation and local geology, a professional geologist with suitable experience should be consulted to assess possible site locations and provide geotechnical support. The four factors to consider when determining suitable locations for hydrological recharge sites are:

- local vegetation
- soil types
- elevation slopes
- type of geology present

Groundwater relation refers to the movement of groundwater through adjoining layers of soils, rocks, clay and other geologic formations and the effects of such movement. The ground acts like a giant sponge when it rains, and water is pulled into the earth by gravity, following cracks and porous routes through the soil. Geological formations can influence the path that water takes, and can even provide “pockets” where water is stored for long periods of time. These pockets, called aquifers, can store large volumes

of water by means of cracks in rocks, porous soil layers, confining layers of bedrock or other mechanisms. In general, groundwater relation will provide additional treatment of the water through filtration and microbial attenuation; however, local minerals, water constituents and salts can also be added, increasing the level of dissolved solids in groundwater. Also, some soils contain heavy metals, organic residuals, alkaloids and/or radioactive elements, which can also affect groundwater.

B. Prepare design concepts for hydrological recharge

Hydrological recharge occurs every time there is a rain event and water is conveyed through soils and geological formations. Due to the emergence of large areas of concrete, asphalt and other impervious surfaces within the last century, less water is now able to percolate through the soil in the San Francisco Bay Area. Also, due to continual groundwater pumping, the groundwater level is dropping, causing land subsidence (the sinking of the soil). Subsidence should be monitored and steps taken to prevent the loss of available water storing potential (i.e., loss of underlying aquifers), as well as property damage and loss of land. Groundwater management attempts to restore groundwater to historic levels to protect groundwater supplies for future use. This objective can be achieved by surface percolation ponds, which is the recommended approach, or by injection wells.

Surface Percolation Ponds or Injection Wells

During a significant rain event in Milpitas, the creek flow in a northwestern direction towards San Francisco Bay increases. As well, a significant portion of the water percolates through the soil and underlying geological formations and is conveyed as groundwater. Stormwater catchment could be used to increase the amount of water available for hydrological recharge.

Hydrological recharge could be accomplished by surface water percolation or by the use of injection wells tapping into appropriate geological formations/aquifers. The resulting augmented groundwater supply would:

- manage groundwater levels
- provide additional water storage capacity
- prevent salt-water intrusion
- prevent land-subsidence

For injection wells, tertiary recycled water or the equivalent would be needed for the injection water in accordance with Title 22, Division 4, Chapter 3, Articles 5.1 and 5.2 of the California Code of Regulations. However, as long as the well was located the proper distance away from the withdrawing wells, this water could be used at a later date for potable water supplies, irrigation, or emergency supplies. Note that this approach represents an advanced practice, called Indirect Potable Reuse, that would require public support and involve significant permitting requirements.

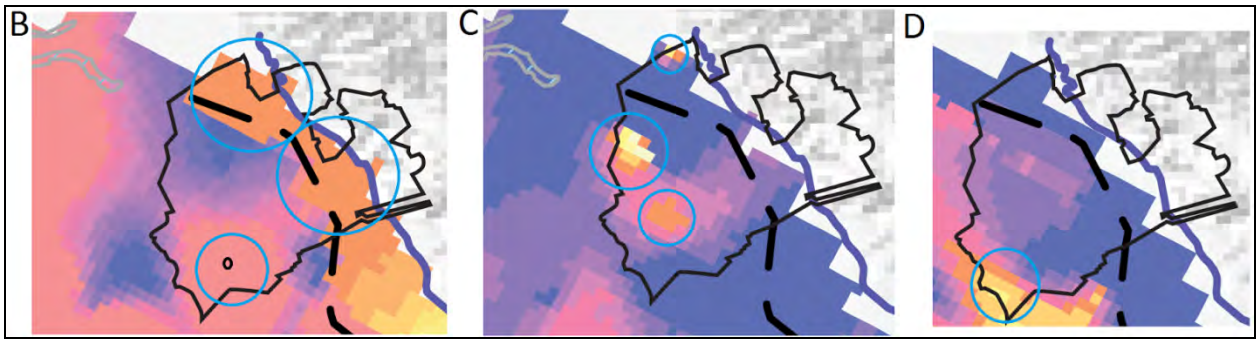
The method of water banking utilized by Semitropic and Kern Water Banking Districts in Kern County, California, involves both injection wells and percolation ponds to store water in subsurface aquifers. Collection wells are then strategically located to withdraw water, as needed. While this can be an effective method for storing water for drier months, the geologic sites appropriate for this process are limited, and wheeling the water has become problematic due to recent the State Water Project restrictions (Semitropic and Water Association of Kern County websites).

Ideally, surface water collection ponds are situated atop a confined layer of porous soil with a large water storage potential. The pond or bored holes are excavated and lined with porous rocks, sand or gravel to allow water to easily seep into the underlying aquifer. Water losses are mitigated by locating the collection ponds in an area with confined rock or clay layers and non-porous surrounding materials. Water is collected by stormwater catchments such as storm drains, stormwater collection basins and streams.

The aquifers in the Milpitas area include a shallow, low quality, low-storage-potential aquifer and a deeper, much more voluminous aquifer. To facilitate effective access to the deeper water and to then recharge it, surface percolation must be conducted in the unconfined area to the east of the City, where both aquifers are exposed via porous soil.

The storage potential for surface percolation ponds is quite large and depends on the size of underlying aquifers. Figure 1 depicts the water storage multiplier for layers B, C and D for groundwater in Milpitas. Lighter colors indicate a greater specific storage multiplier and areas with the greatest specific storage areas are circled in light-blue.

Figure 1: Groundwater Storage Potential: Layers B, C, D



The Pinewood well is the small black circle in Layer B and is in a relatively good location for water storage via injection. Note that deep unconfined aquifers are the best choice for percolation ponds. The greatest storage potential for shallow aquifers appears to be near the northeastern section of Milpitas and near the area between Berryessa Creek and the foothills of Milpitas to the east, as shown in Layer B of Figure 1. The deeper layers of C and D may not be ideal for selection purposes because specific storage multiplier values are low near the unconfined, ideal percolation areas shown circled in

Layer B. However, the decision to use percolation ponds and determining the best site locations will require additional geotechnical site investigation.

One promising site that should be investigated for surface percolation ponds is the retention basin off Quince Lane and the surrounding area. This site appears to be adequate for shallow water storage, is near creek tributaries and is already operated by the City of Milpitas. The first steps in implementing surface percolation would be to perform geotechnical site investigations, to contact regulatory and governing agencies (State Water Resources Control Board, Santa Clara Valley Water District, Fish & Wildlife, etc.) and to determine design parameters.

Water Credits for Creek Recharge

Recharge from creeks would be undertaken predominantly over unconfined aquifers within Milpitas. One option would be to apply to the Santa Clara Valley Water District for a waiver from Section 26 of the Santa Clara Valley Water District *District Act* to give water credits for augmenting the natural recharge with water obtained from creeks, streams and runoff. Additional criteria or conditions may be required regarding recharge locations, quantity of water and/or water quality.

Options for Augmented Surface Water Detention Facilities and Percolation Ponds

The major creeks in the area that could be used to draw additional surface water during a storm event include:

- Coyote Creek
- Berryessa Creek
- Penitencia Creek
- Arroyos de los Coches Creek
- Calera Creek
- Piedmont Creek

Water rights to these creeks are mostly held by Santa Clara Valley Water District, and acquiring rights for new uses could be problematic (see Task 5: Water Acquisition). Currently, water is pumped into creeks using any or all of the 13 pump stations (Figure 2). Figure 3 shows the location of major creeks throughout Milpitas and Figure 4 shows surface water features.

Figure 2: Milpitas Detention Basin and Pump Station Locations

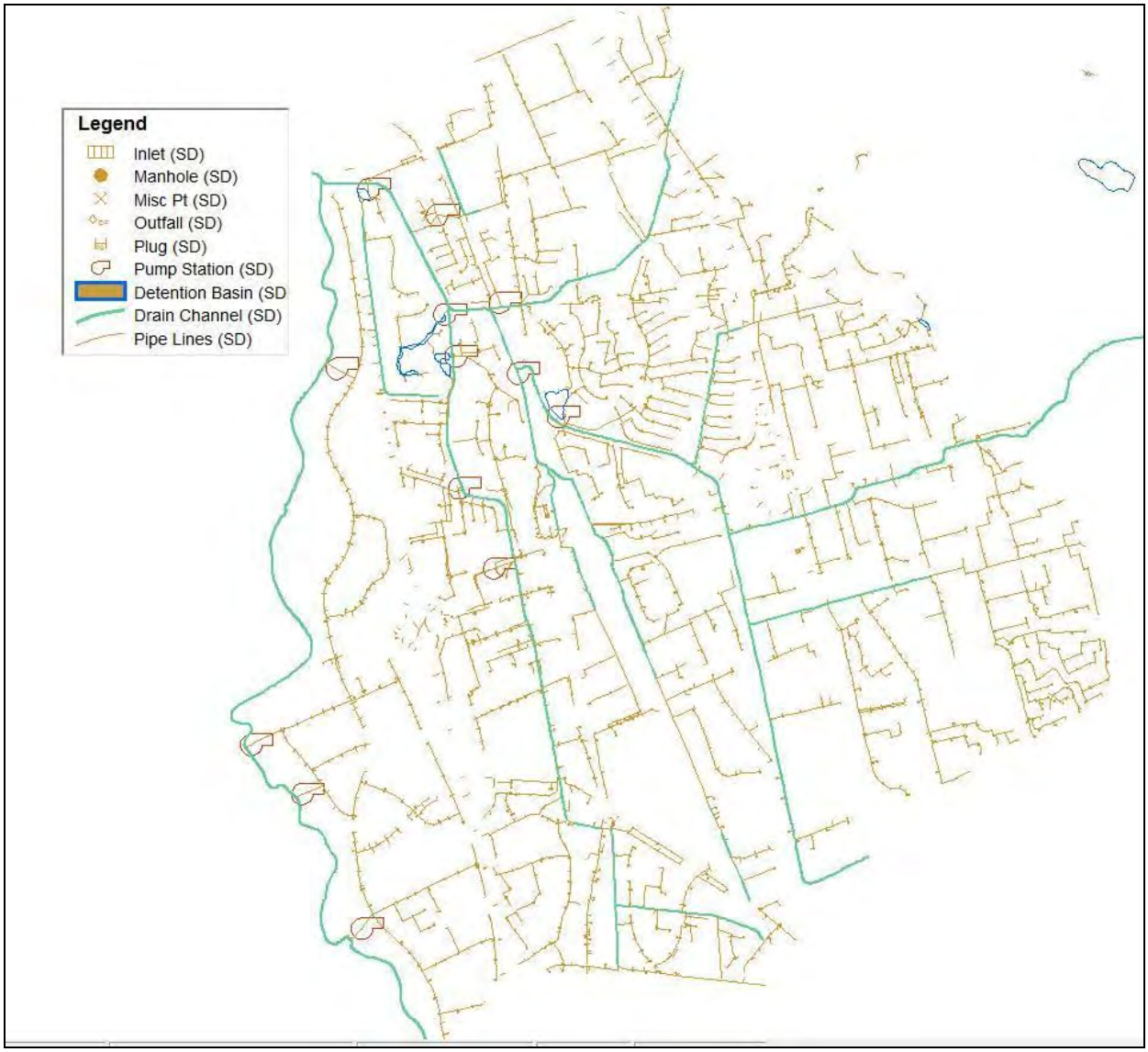


Figure 3: Major Creeks and Tributaries in the Milpitas Area

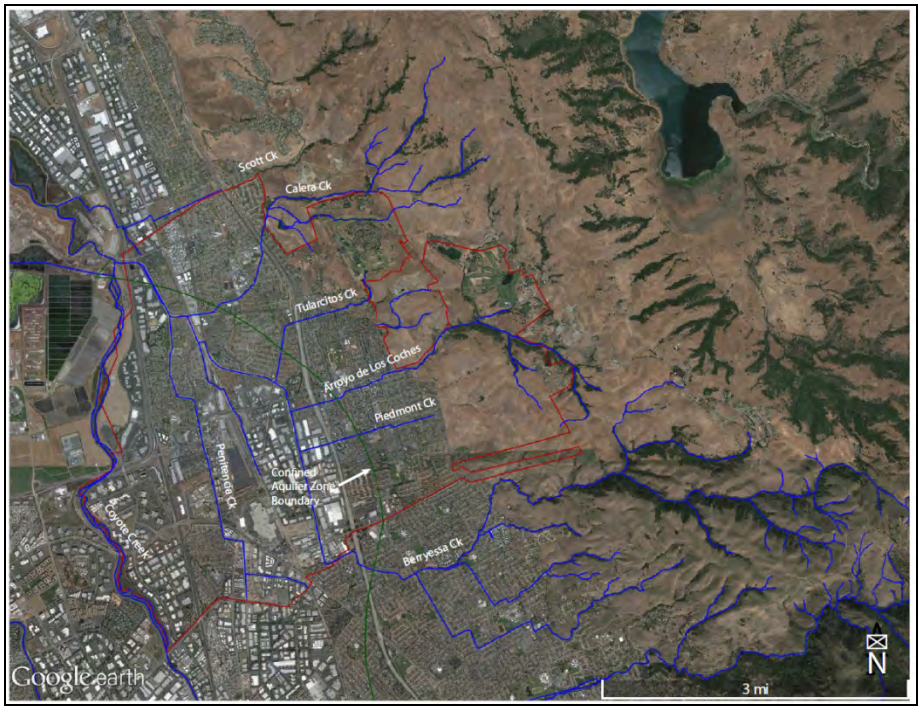


Figure 4: Milpitas Surface Water Features

These water features could provide water for the following options:

- potable use after surface water treatment,
- construction non-potable uses,
- stream recharge,
- and, storage volume for percolation ponds during storm events.

However, percolation ponds would be needed nearby to deliver the water to an adequate aquifer. Unfortunately, the shallow ground storage potential near many of the surface water ponds in Milpitas appears to be inadequate. The exceptions are Sandy Wool Lake, which could be expanded to provide water to nearby golf courses, surface percolation ponds at Quince Lane or newly planned percolation ponds. These locations provide unconfined access to the deeper aquifer that underlies the Santa Clara Valley.

Additional surface water ponds and lagoons could be constructed to provide stormwater capture and treatment. Also, existing ponds could be modified to provide additional water treatment and/or storage for recycled or construction purposes. These ponds should include vegetative-lined canals, bioswales and constructed wetlands. Examples of possible locations for expanded and new surface retentions lagoons include:

- Hidden Lake Park,
- Hall Park Lagoon,
- Spring Valley Pond,
- Sandy Wool Lake,
- local golf courses.

The natural evaporative loss for the region is approximately one meter, or three feet, of water per year. As a result, surface water impoundments like Sandy Wool Lake are best designed to be steep sided so that evaporative losses don't create excessive areas of exposed lake bed surface. Unfortunately, a deep water storage design often conflicts with the aesthetics and land use plans of an area. It takes a clever design for the storage facility to be both effective and compatible with parks and other viewsheds.

Hydrological Recharge by Use of Injection Wells

Injection wells are used for a variety of purposes, including:

- preventing saltwater intrusion
- managing groundwater supplies
- storing water for future use

In this scenario, stormwater is collected, treated and distributed to underground aquifers by means of abandoned wells or dry wells or by newly constructed wells designed specifically for this purpose of injection, which is the best option for medium to large scale projects. The design and construction of injection wells is highly specialized and much more complicated than that of withdrawal wells.

Figure 5A shows the relative horizontal conductivity of groundwater flow at various

depths (layers B, C and D). The locations exhibiting potential increased conductivity are circled; areas that are darker blue represent increased hydraulic conductivity.

Figure 5A: Milpitas Groundwater Horizontal Hydraulic Conductivity

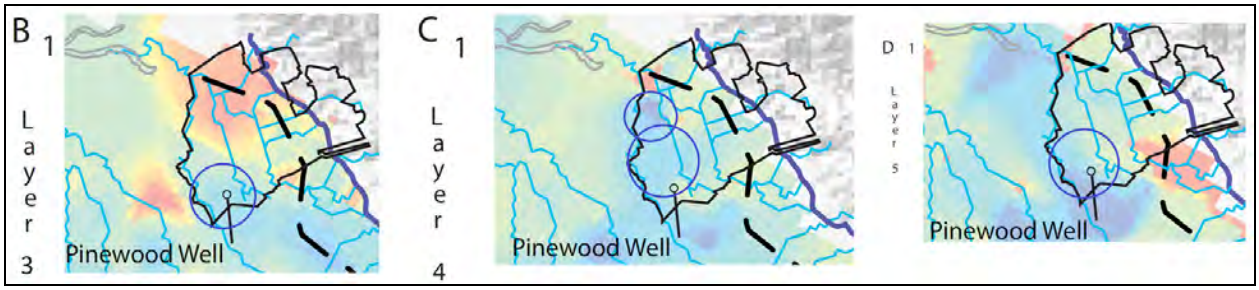
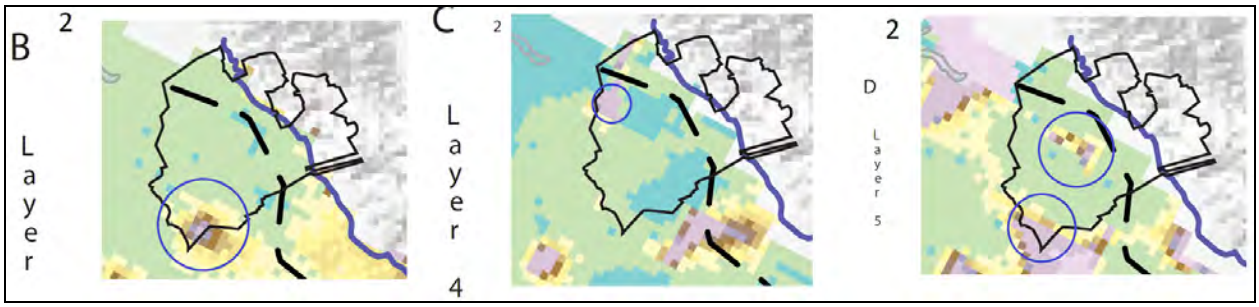


Figure 5B shows the vertical conductivity profiles for various depths. Based on the figures provided to sub-consultant Jim Ulrick by the U.S. Geological Survey (Ulrick, 2014), there appears to be increased horizontal conductivity near the southwestern edge of the City. Also, the vertical conductivity appears to increase along the southern section, in the northwest and also near the center of Milpitas. However, there is no clear indication of a location for an injection well. The decision to use injection wells and determining the best site locations will require additional geotechnical site investigation.

Figure 5B: Milpitas Groundwater Vertical Hydraulic Conductivity



Stringent water quality standards must be met for injection into groundwater supplies due to the potential for contamination. The cost of meeting and maintaining such standards should be accommodated in the budget for an injection project. The benefit of injection wells is the additional treatment gained as the water moves through geological formations. In contrast, surface water tends to accumulate biologically active pathogens, turbidity and other factors that negatively impact water quality. The governing bodies for injection wells are the United States Environmental Protection Agency and the State of California Water Resources Control Board Drinking Water division.

Injection wells could be used to achieve any or all of the following:

- augment the groundwater supply of the City
- provide options for stormwater and recycled water use
- restore groundwater levels to historic levels

More investigation would be required for:
- site location selection
- exact permitting requirements
- design proposals
- treatment options

Stormwater Storage Tanks

Above ground or below ground storage tanks, to capture and reuse stormwater, could be constructed near any of the locations shown. Underground or above ground storage tanks could be used to store water for construction uses, groundwater augmentation prior to treatment, habitat restoration and/or to minimize flooding. The benefits of tanks are the low to medium footprint, protection from contaminants and capability to store water without losses. However, tanks are generally costly and require expensive pumps, a collection and distribution system and periodic maintenance.

C. Prepare concept size of recharge area and preliminary water quality of retention basin, including the creek sources

Concept Size of Recharge Area

The theoretical amount of water that can be retained in a reservoir from a rain event is based on the following factors:
- drainage area (the amount of land receiving rainfall flowing to a common point)
- rainfall rate
- infiltration losses

The average rainfall for Milpitas during a typical year is 15". With an area of 13.64 sq. miles, the City thus receives a maximum stormwater quantity of about 10,900 acre-feet per year. However, the amount that could be collected would be much less due to percolation through the soil and uncollected stream run-off.

If one assumes an imperviousness factor of 0.50 (which indicates that approximately half of the area is covered with impervious materials such as asphalt or concrete), the amount of collectable stormwater becomes approximately 5,000 acre-feet per year. This is not using the Graphical Storage Method, which, although it is the standard method, it is a complex approach to calculating stormwater detention basin sizing. The approximate maximum size for a stormwater detention basin may be estimated as follows using the number of storms: Assuming the 5,000 acre-feet falls on the City's impervious areas predominantly during the winter storm season, which generally consists of 5-20 storms,

the maximum size needed for a stormwater detention basin can be assumed to be 1,000 acre-feet. This is equivalent to 435,600 hundred cubic feet per year, or 0.89 million gallons per day of available water. This detention storage is temporary.

Instream Recharge

Instream recharge is used by Santa Clara Valley Water District and is the acceptable method of surface recharge. This scenario is effectively accomplished by damming the natural creek flow and constructing a detention basin for additional recharge. Berryessa Creek seems to be a natural location for further in-stream recharge, as it is currently unobstructed.

Milpitas Creek Sources

The major creeks throughout Milpitas are as follows:

- Coyote Creek: Coyote Creek has the largest drainage area with a total of 319 square miles (U.S. Geological Survey); however, two dams are built further up along Coyote Creek (Coyote Creek Reservoir and Anderson Lake) and operated by Santa Clara Valley Water District.
- Berryessa Creek: Berryessa Creek exhibits large flows during the winter months and is susceptible to flooding on occasion with potential to damage property. Tributaries of Berryessa Creek include Penitencia Creek, Arroyo de los Coches, Calera Creek, and Piedmont Creek. Together they provide a drainage area of about 24 square miles that eventually merges with Berryessa Creek and then Coyote Creek.
- Penitencia Creek (tributary of Berryessa Creek)
- Arroyos de los Coches Creek (tributary of Berryessa Creek)
- Calera Creek (tributary of Berryessa Creek)
- Piedmont Creek (tributary of Berryessa Creek)

Quince Lane Retention Basin

There is a retention basin off Quince Lane (see Site G, Figure 6) that could also be investigated for surface water and groundwater storage potential.

Figure 6: Potential Surface Water Retention Locations in the Milpitas Area

Existing Detention Basins

The City currently operates four stormwater detention basins, namely*:*

- Hidden Lake Lagoon
- Hall Park Lagoon
- Lagoon at Glenmoor Circle area
- Retention basin off Quince Lane

Hidden Lake Lagoon is currently a hardened basin with no vegetation or wildlife inhabiting the location. The pond level is maintained by a series of subterranean drainage pipes draining water from adjacent neighborhoods into the creeks.
We identified the following two options for Hidden Lake Lagoon:

- Option 1: Install a side cut sidewalk and pad for a lift station to pull in the water; this could be a permanent fill station for construction water.
- Option 2: Install a single phase, 100 amp/ 230 volt power system to control the water level, running on a regular basis. Option 2 is an easy solution as the City already owns the pump. If it is chosen, the City is advised to test the pump to determine whether it works. The City should take samples of Hidden Lake Lagoon water for pH and total dissolved solids testing.

Additional surface water features in Milpitas that could be developed or used as a non-potable water source include:

1. Hall Park Lagoon off Abbott Ave
2. Glenmoor Circle area lagoon; ownership unknown
3. Quince Lane/Evans Road retention basin; ownership unknown
4. Private Retention basins have similar ownership/control problems:
    - Capitol Ave
    - Great Mall on the north end

Other potential sites included in this study are:

- Sandy Wool Lake
- Spring Valley Pond

Surface water storage methods that could be implemented by the City include the following:

- Surface retention ponds
- Percolation ponds
- Artificial wetlands
- Constructed reservoirs
- Storage tanks

It seems logical to further investigate surface water retention by means of stormwater retention ponds, reservoirs or lagoons as a source of construction or recycled water. Also, a surface percolation pond (possibly achieved through augmenting the retention pond at Quince Lane) can be used in a sustainable manner to store stormwater and manage groundwater supplies.

However, well water and hydrological recharge from the shallow aquifer appears to offer low production capacity, only “100 gpm here and there” rather than thousands of gallons per minute (Ulrick, 2014). Also, there are water quality concerns within the shallow aquifer, as recharge is accomplished mostly through natural percolation of untreated stormwater.

Future Investigation

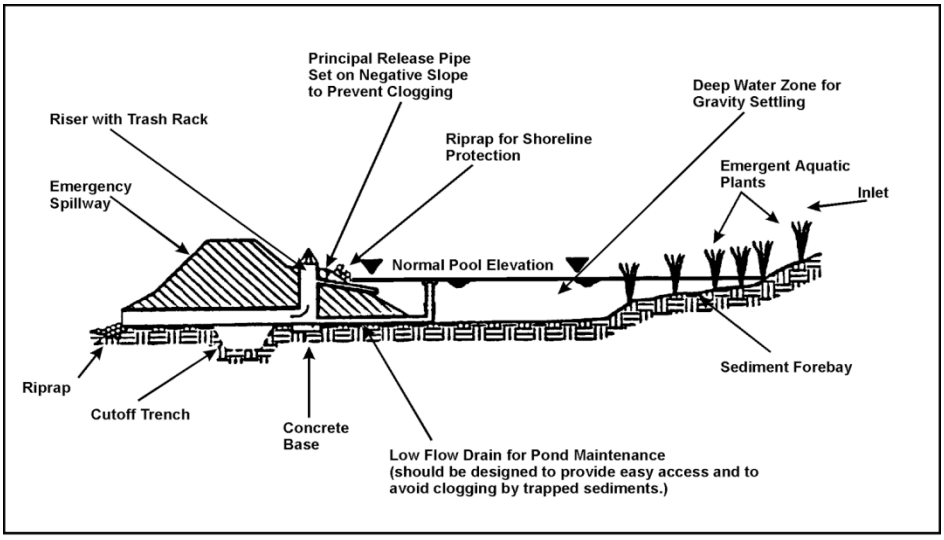
Future investigation should include the following:

- site location mapping
- stormwater quality and conveyance analysis
- source mapping
- geotechnical investigation (especially for percolation ponds or injection wells)

The ideal topographic conditions for a reservoir are a narrow gorge in which a dam may be built at minimum expense (Figure 7), and an expanding valley immediately above the gorge which will afford large storage per unit of surface area. The geology of the site frequently dictates the type of dam to be constructed. An earthen dam may be suitable in

a valley with deep, impervious soil. However, because potential locations for a reservoir are limited for the City of Milpitas, this option may not be feasible.

Figure 7: Typical Reservoir Design (Environmental Protection Agency Stormwater Management)



Source: Reference 2

Retention ponds are easily constructed; however, excavation costs can be high and the footprint is large. Retention ponds (or lagoons) should be located near the confluence of major creeks or stormwater basins and constructed with embanked sides to efficiently capture and store water. The bottom of each pond should be made of a non-pervious material or lining. Surface water features, such as aerating fountains, may be needed to minimize the likelihood of biological contaminants or nuisance issues such as recreation.

Detention ponds are more complicated than retention ponds and require concrete barriers, large gravel-lined channels, porous sub-layers and specific vegetation. However, the stormwater water quality is greatly improved, making this system a suitable method for treating stormwater before it is allowed to enter sensitive habitats. The construction cost of a detention basin is proportional to the volume needed to control the runoff from a rainfall event and can be approximated by the following equation:

$$C = 12.4 \times V^{0.760}$$

where "C" is the cost in U.S. dollars, and "V" is the pond volume in cubic feet needed to control a 10 year storm event.

Also, artificial wetlands could be used to store water, treat water and provide recreational opportunities. These are basically retention ponds with carefully-selected vegetation,

multiple ponds and recirculating units. This method is particularly suitable for removing abundant nitrates and organics, both of which are typically found in moderate to high concentrations in stormwater runoff.

Construction of retention ponds, lagoons or reservoirs requires careful consideration of creek sources, topography and water quality.

Water credits could possibly be acquired from the Santa Clara Valley Water District by trading for groundwater or creek/stream replenishment. With this approach, water access entitlements are either traded or sold, depending on the legal status of the water rights. Water trading is a voluntary exchange and can be used to benefit environmental systems such as streams and creeks by improving instream water quality. (See Task 5: Water Rights Acquisition for additional information regarding water credits and trading.)

Surface water could also be used to irrigate Spring Valley golf course and Summit Point golf course, and to provide water for nearby surface water features or augment water-sensitive habitats. However, City water infrastructure cannot be built in the surrounding hillside due to the urban growth boundary established by the enactment of Measure Z in 1998 (Measure Z: Santa Clara County website).

Water Quality Concerns

The Regional Water Quality Control Board performed a nonpoint source pollution study in Santa Clara County, finding that contaminant loads are directly proportional to stormwater runoff. Water quality varied among open space, commercial and residential, and heavy industry areas. However, the results documented the presence of cadmium, chromium, copper, lead, nickel, and zinc in most of these areas (Silicon Valley Rapid Transit Corridor FInal EIR. p4.18-5. 2003).

The use of surface water can have both detrimental and positive effects on aquatic wildlife. Promoting projects that improve water quality and habitat development should be a consideration. Stormwater runoff should be directed towards bioswales and other forms of natural filtration before entering surface retention ponds. Ideally, bioswales would be located in major creek tributaries, as well as between pumping and the surface retention feature.

The annual report from the City to the State Water Quality Control Board shows that the percentage of stormwater that has even a moderately low level of dissolved oxygen is small. As well, an apparently very small amount of trash is found in these waters (City of Milpitas, p10-1-10-4), and there is very little presence of hydrocarbons, odor, color, or turbidity (Santa Clara Valley Urban Runoff Pollution Prevention Program. All. 2013). In all, the water appears to be fairly clean compared with typical stormwater.

D. Describe oversight and regulatory requirements (such as Fish and Wildlife, Regional Water Quality Control Board, Santa Clara Valley Water District, etc.) for surface water detention facility, including allowable usage capacity

Overview of Regulatory Agencies

Regulations regarding stormwater, groundwater and surface water treatment are stringent in California. The following is a list of the governing agencies which are involved with applications relating to surface water construction projects and surface water use:

State Water Resource Control Board

- The exercise of some water rights requires a permit or license from the State Water Resources Control Board.
- The processing of an application includes the following steps: acceptance of the application, environmental review, public notice, protest resolution and permit issuance.

United States Environmental Protection Agency

- Regulations regarding the use of surface water for water storage applications are set by the Environmental Protection Agency under the Surface Water Treatment Rule and National Pollution Discharge Elimination System and define minimum creek level requirements. National Pollution Discharge Elimination System Stormwater permits must be obtained for applications using surface water ("Stormwater Permit Program" NPDES website: 2014).

California Department of Fish and Wildlife

- Wildlife impact mitigation measures will be required by the California Department of Fish and Wildlife in accordance with sections of the California Water Code regarding surface water collection, stream withdrawals, environmental easements, etc. The California Department of Fish and Wildlife has jurisdiction over the conservation, protection and management of fish, wildlife, native plants and habitats necessary for sustainable populations of fish and wildlife species. When appropriating new sources of water or construction near riparian habitats, the State Water Resources Control Board must consult with the California Department of Fish and Wildlife on the amounts of water needed for fish and wildlife and for impact mitigations measures.

Water Rights Acquisition

- Water rights must be obtained for the use of water in stormwater runoff, lakes, creeks or waterways. Steps for acquiring these rights vary according to location,

historic water usage, precedence and other factors. Many of the water rights in the Milpitas area are likely under the jurisdiction of the Santa Clara Valley Water District.

Stormwater Regulation

In California, stormwater management and use is regulated by the Regional Water Quality Control Board through the authority of the Federal *Clean Water Act*. The regulation of stormwater is aimed at minimizing the discharge of pollutants through a complicated permitting process. The type of permit and the permit requirements are dependent on the source of potential contamination in the stormwater discharge (e.g., municipal, construction, industrial).

Stormwater is runoff from rain or snowmelt that runs off surfaces such as rooftops, paved streets, highways and parking lots and can carry pollutants such as oil, pesticides, herbicides, sediment, trash, bacteria and metals.

- The Regional Water Quality Control Board and the United States Environmental Protection Agency regulate the runoff and treatment of stormwater in industrial, municipal and residential areas of California.
- The authority of State Water Resources Control Board and Regional Water Quality Control Board for stormwater regulation comes from the *Clean Water Act* which puts the framework for regulating stormwater discharges under the National Pollutant Discharge Elimination System Permit system.
- Cities and other jurisdictions that operate large, medium and small stormwater systems, as well as specific industrial activity sites including constructions sites, must apply for stormwater permits. The State Water Resources Control Board provides policy and regulatory oversight, on behalf of the federal government.
- Municipal Stormwater Permitting Program regulates stormwater discharges from municipal separate storm sewer systems (MS4s). Large and small municipal sewer system operators must comply with permits that regulate stormwater entering their systems under a two phase system. Phase 1 regulates stormwater permits for medium municipalities (serving between 100,000 and 250,000 people) and large municipalities (serving 250,000 people). The Phase I MS4 permits require the discharger to develop and implement a Stormwater Management Plan/Program with the goal of reducing the discharge of pollutants to the maximum extent practicable. The management programs specify what best management practices will be used to address certain program areas. The program areas include the following:
    - public education and outreach
    - illicit discharge detection and elimination
    - construction and post-construction
    - good housekeeping for municipal operations.

  In general, medium and large municipalities are also required to conduct

monitoring. Phase 2 regulates smaller municipalities, including non-traditional small operations, such as military bases, public campuses, and prison and hospital complexes.

Treatment Required for Potable Water Distribution

The Surface Water Treatment Rule was promulgated June 29, 1989, and specifies several different compliance dates depending on a variety of circumstances. Most surface water systems that are designated by the state as groundwater under the influence of surface water must provide both disinfection and filtration treatment in order to meet requirements for distribution. A recovery well placed near a recharge area is considered to be providing groundwater under the influence of surface water. Examples of monitoring criteria are turbidity, disinfection residuals, and coliform counts.

According to California Water Code §64653, all surface water must be treated by one of the following mechanisms:

- conventional filtration treatment
- direct filtration treatment
- diatomaceous earth filtration
- slow sand filtration
- membrane filtration

After filtration, all of these filters are required to have achieved:

- at least 99 percent *Giardia lamblia* cyst removal
- 90 percent virus removal
- 99 percent *Cryptosporidium* oocyst removal
- turbidity of 1 nephelometric turbidity unit or less (for reference, the turbidity of stormwater can be as high as 20,000 nephelometric turbidity unit).

Also according to Water Code §64654, all surface water must be treated with continuous disinfection to inactivate biological pathogens. Specifically, “water delivered to the distribution system shall not contain a disinfectant residual of less than 0.2 milligrams per liter for more than four hours in any 24 hour period.” Disinfection is also required to have a contact time sufficient to inactivate all biological contaminants. This objective is generally accomplished through the use of a specially designed tank, or an especially long run of transmission pipe before the first service connection.

Treatment Required for Indirect Potable Reuse *(aquifer injection)*

In the newly published recycled water regulations of 18 June, 2014, Article 5.2 (“Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application”) places requirements on Groundwater Replenishment Reuse Projects. California Code of Regulations, Section 60320.208 requires the following:

- At least 12-log enteric virus reduction
- 10-log *Giardia* cyst reduction

- 10-log *Cryptosporidium* oocyst reduction to be applied to recycled water used for recharge, prior to recovery via a groundwater well.

To achieve this massive log reduction, the State has allowed that "for each month retained underground...the recycled...recharge water will be credited with 1-log virus reduction." This natural treatment may be augmented by the following:

- Conventional surface water treatment, using settling and filtration is considered by the government to be capable of providing 3.5-log removal of *Giardia lamblia*.
- Direct filtration (without settling), diatomaceous earth filtration and slow sand filtration are credited with 2-log removal of *Giardia lamblia*.

Depending on the method of disinfection, further log reduction credits may be given for pathogen inactivation.

Treatment Required for Construction or Recycled Water

Collected stormwater and surface water must meet National Pollutant Discharge Elimination System standards before discharge into any streams, creeks or waterways. Treatment to recycled water standards, as well as periodic monitoring, must be completed before distribution to the recycled water supplies, as well as distribution for construction purposes. Methods for treatment should be based on all available water quality data and reports and should treat all water quality constituents of concern.

Regulatory Challenges

Water right agreements typically associate the ownership of rights with either surface water or groundwater. The acquisition of these rights is complicated, and is achieved through a set of rules and regulation that depend on the following factors:

- source of the water
- type/classification of the water
- timing of appropriation
- beneficial uses.

A ten-year period should be allowed for the approval process necessary for implementing new retention basins. There is the potential for significant restrictions from several regulatory agencies that may well see the newly created (or expanded) stormwater retention system as endangering habitat. They may therefore establish significant restrictions regarding withdrawals or municipal use. The process could include restrictions on:

- dredging (which would result in loss of volume)
- mandatory minimum water levels (which might preclude the City's use of the water) and, in the worst case, require that the City actually maintains water in the basin by adding water

E. Discuss ownership, participation/partner aspect

A surface water detention facility constructed in Milpitas could be owned exclusively by the City of Milpitas. However, acquiring water rights may be an issue and may require large expenditures and/or additional mitigation measures for procurement. Rights could be bought or traded.

Water Rights Acquisition

Historically, municipalities have considered stormwater as a runoff material to be managed to reduce flooding of city streets and homes. Many early cities used a combined stormwater and sewer system, which posed significant negative environmental implications from dumping untreated effluent during storm events. As the United States Environmental Protection Agency works to require these systems in the State to upgrade, rules on stormwater have focused on reducing damaging discharges. The use of stormwater for beneficial use is an uncharted regulatory landscape. The City of Milpitas may have an opportunity to be a national leader.

Ownership and Partnerships

Inclusion of Santa Clara Valley Water District and other relevant agencies in the planning of surface water use, stormwater collection and surface percolation ponds is highly recommended. In addition to sharing costs and operational considerations, these agencies can help secure permitting requirements and water rights. Also, partnerships with surrounding cities (such as Newark) should be investigated with a view to using stormwater runoff for environmental remediation efforts and habitat restoration near the confluence of the San Francisco Bay near Dixon Landing.

F. Optional: Prepare implementation guidelines based on available sources such as Groundwater Recharge Programs of Alameda County Water District and Santa Clara Valley Water District

(optional; not researched)

G. Optional: Determine available area, water quality and creek source of potential sites based on historical data

(optional; not researched)

H. Provide potential lists of sites, estimated reductions of consumptions

The most cost-effective locations for obtaining water to augment surface water uses would be the existing surface water retention basins throughout Milpitas, which are Hidden Lake Lagoon, Hall Park Lagoon, the Lagoon at Glenmoor Circle area and Retention basin off Quince Lane. Figure 6 shows the location of prominent creeks throughout Milpitas, with the potential sites for surface water retention augmentation circled in light blue (based on creek confluences with adjacent land availability potential). Note that the size of circle does not represent quantity of water.

In order of increasing potential collection volumes, the sites accumulating the largest stormwater drainage volumes are as follows:

A: Estuary confluence at Dixon Landing
C: Near Hall Memorial Park
F: Tularcitos and Berryessa Creek
K: Berryessa Creek
B: Calera Creek
H: Near Calaveras Road.

Figures 8A – 8E show close-up aerials for these potential sites for surface water retention or detention facilities, with the exception of Site F, which appears to have limited land availability nearby. Note that the actual availability of land must be determined for each site of interest.

Figure 8A - Site A: Confluence at Dixon Landing

- large land availability
- significant quantity of water potential
- existing surface water (seasonal)
- potentially sensitive wetland

Figure 8B: Site C: Near Hall Memorial Park Note: Hidden Park Lake is located just south of Site C area and is currently a major surface water feature for the city.	

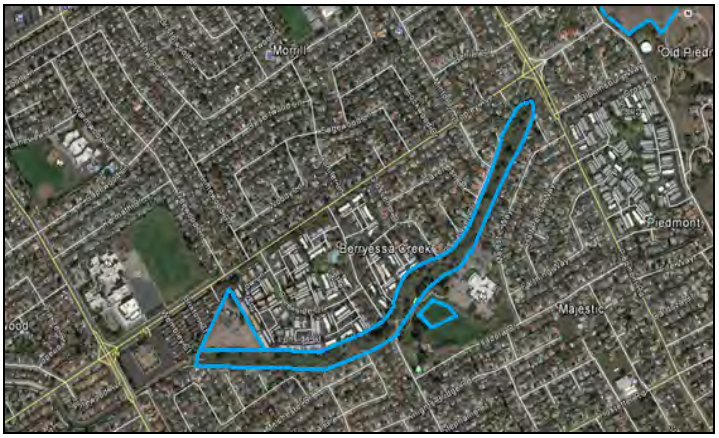
Figure 8C - Site K: Berryessa Creek ● large drainage area ● limited land availability (within San Jose) ● additional locations down creek may be available in Milpitas ● Eventually leads to Sites C and A (see *Figure 7: Potential Surface Water Locations*)	

Figure 8D - Site B: Calera Creek

- Existing surface pond circled and fed by Calera creek.
- This creek eventually leads to *Sites C and A.*
- Land availability *may be restricted due* to limitations f*rom Measure Z which* prohibits City development in the surrounding foothills.

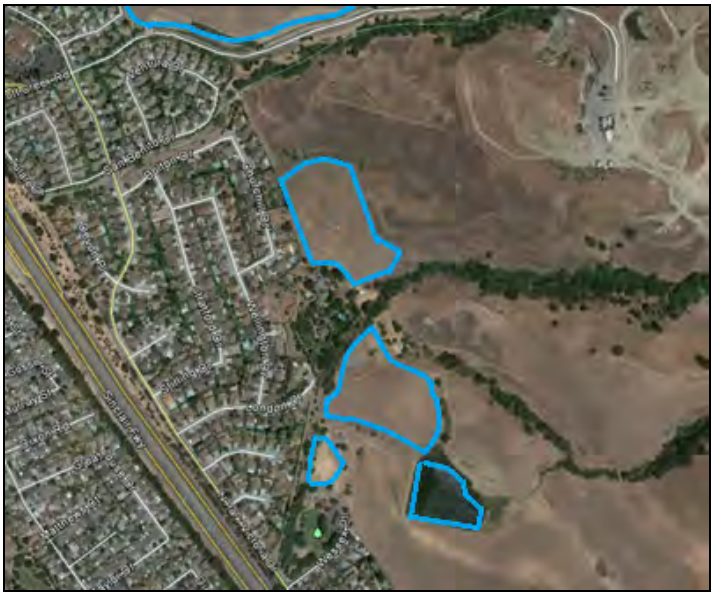
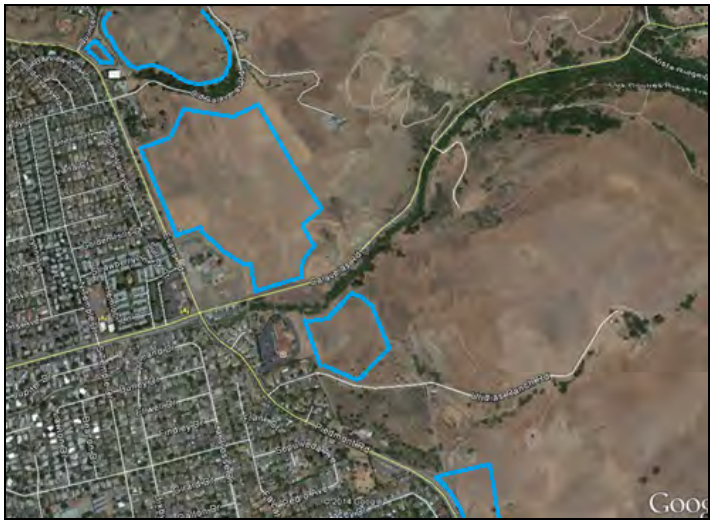


Figure 8E - Site H: Near Calaveras Road

The major creek here is Arroyo de los Coches. This creek eventually leads to Sites A, C and F.



Legal

The major legal challenges with regard to surface water detention are the acquisition of water rights to the creeks with which to recharge the deep groundwater aquifer, and the regulatory compliance efforts required to treat stormwater for use. These needs were

discussed earlier in this document.

Finances

The first step in establishing a retention basin would be acquiring water rights to Berryessa Creek. As discussed in Task 5: Water Rights, this could cost as much as $2 million.

$$1,000\ acre\ feet = 43,560,000\ cubic\ feet;$$

$$C = 12.4 \times V^{0.760} = 12.4 \times 43,560,000^{0.760} = \$7.93\ million$$

As set out earlier, the initial cost of a detention basin is characterized by the equation $C = 12.4\ V^{0.760}$, where "C" is the cost in U.S. dollars, and "V" is the approximate volume of the basin in cubic feet needed to control a 10 year storm event (Rutgers). According to Rutgers, the cost is estimated at $7.93 million for design, construction and permitting for a single retention basin. We expect that since the Rutgers figure is not a South Bay Area number, this estimate is low, and thus we doubled the amount and used $8 - $16 million in the Implementation Plan.

Recharge with Groundwater Pumping

If a waiver can be obtained from the Santa Clara Valley Water District for credits due to "dire water needs" for the City, this concept may then be feasible. At the current cost of $747 per acre foot of pumped groundwater from Santa Clara Valley Water District and more from the San Francisco Public Utilities Commission, the project would undoubtedly pay for itself in ten years or less, as these groundwater and treated water purchasing costs will go up, potentially as much as 50% annually, during some years (Taylord, Santa Clara Valley Water District).

If the waiver from Santa Clara Valley Water District for groundwater credits is gained at a rate of 75%, for example, the City would gain $560,250 in credit for every 1,000 acre feet of water recharged into the unconfined aquifer space annually. This would mean that over the 50 year lifecycle of the retention basin, at least $28 million would be saved on fees, as they increase. Concordantly, approximately 325 million gallons of groundwater would be available annually for use from wells such as the Pinewood Well, which produces at approximately 1 million gallons per day.

Approximately 2% annually would be needed for routine maintenance, amounting to $160,000 annually or $8 million over the 50 year lifetime of the project. If the cost to build is $8 million and the cost to maintain is $8 million ($16 million total costs), and the savings produced is $28 million, then this cost represents a gain of $12 million. The

project is especially feasible, however, because these numbers assume that the groundwater extraction fee of $747 will increase. Also, it is possible that groundwater will not be legally available if the Santa Clara Valley Basin becomes overdrawn. Thus, with a recharge and credit solution in place, an investment of the $16 million will increase water source security.

Results

It is clear that the major hurdles regarding the use of stormwater for the purpose of augmenting water supplies in the City are land availability, access to streambeds with which to recharge groundwaters (i.e. water rights), and the cooperation of the Santa Clara Valley Water District. The District will be needed to both provide their approval with plans to recharge, and also to provide water credit for water recharged into the groundwater basin. If the District is willing to provide these two things, then surface water detention becomes a costly, yet effective way to augment the City's water supplies with groundwater from captured runoff and streamflow.

If this surface water detention is pursued, a serious look at the options for sites will be needed. The best locations for actual recharge of the deep aquifer are to the east of the City, but may be precluded by Measure Z. Other locations within the City may seem viable, but will only recharge the shallow aquifer, even potentially causing groundwater upwelling as the aquifer becomes full. This document outlines some of the possible locations for new or renovated detention basins, but a more thorough planning study should be conducted.

The cost of a single retention basin for the purposes of percolation can be summarised as follows:

$$-\$8\ million,\ capital\ cost\ -\$8\ million,\ maintenance + \$28\ million,\ savings = \ \$12\ million$$

Over the 50 year lifetime of the retention basin, this amounts to $0.73 per hundred cubic feet of water augmenting the City's supply. This does not including the savings accrued from generating water internally instead of purchasing it, and does not include the costs of acquiring water rights..

$$\$16\ million,\ lifetime\ cost \div (435,600\ hundred\ cubic\ feet\ per\ year \times 50\ years) = \$0.73/hcf$$

Conclusion

Rehabilitation of the existing infrastructure at Hidden Lake Lagoon and at the other existing surface water ponds to provide more construction water is an extremely easy way for the City to reduce potable water use for non-potable uses.

The construction of an upstream retention basin for the purpose of groundwater recharge is a viable option that is contingent wholly upon the cooperation of the Santa Clara Valley Water District.

Surface percolation ponds would be an effective approach for stormwater catchment, but would require the construction of additional facilities and infrastructure, and involve permitting and operational considerations. From a preliminary perspective, the retention basin off Quince Lane seems like a promising location for this application; however, additional geotechnical investigation is required.

Bioswales and vegetative-lined canals should be constructed for all future stormwater collection and conveyance systems. This step will reduce organics present in the water, as well as provide habitat, improved aesthetics and easier treatment options for using the water at a later date.

The design and construction of injection wells for artificial groundwater recharge is a possible, although aggressive alternative, if the Santa Clara Valley Water District were to allow a waiver for this kind of activity under its *District Act*.

Water Solutions does not recommend action at this time for surface water detention, but do recommend that the City be aware of groundwater recharge opportunities.

Task 3: Surface Water Detention Implementation Plan (NOT IMPLEMENTED)

Implementation Schedule:

1. Retrofit existing surface water features to allow for construction purposes. Contact State Water Resources Control Board, Santa Clara Valley Water District and follow National Pollution Discharge Elimination System standards or special permitting requirements for non-potable use of stormwater. (March-July 2015)
2. Hire a geologist for geotechnical site investigations to determine appropriate sites for surface water detention and/or percolation ponds. (1 March 2015)
3. Hire a consultant to look for available water rights in this order of preference: senior appropriative water rights; old agricultural appropriative rights; riparian rights near boundaries between neighboring communities (such as Newark) for SF Bay and wetland restoration projects. (1 April 2015)
4. Hire a consultant to prepare an application for water rights, including all supporting documents. (1 May 2015 or later)
5. Hire a consultant to prepare plan designs for additional surface water detention facilities and/or percolation ponds. (1 June 2015 or later)
6. File a fully completed water right application with the Division of Water Rights. (1 June 2015 or later)
7. Pay all required fees. (1 August 2015 or later)
8. Commence environmental review and permitting requirements. (1 September 2015 or later)
9. Finalize environmental review and permitting requirements. (1 December 2016 or later)
10. Finalize plan designs for water detention and/or percolation ponds. (1 January 2016 or later)
11. Finalize contract documents and bid contract for construction. (1 February 2016 or later)
12. Begin construction. (1 June 2016 or later)

Costs:

Implementation of a surface water detention or surface percolation ponds would accrue the following costs:

- Construction water fill stations - Approximately $25,000 each
- Water Rights Acquisition Capital Costs - Approximately $2 million for rights to Berryessa Creek.
- Retention Basin Capital Costs - Approximately $8 million to $16 million. The cost of a percolation pond should be comparable to that of a surface retention basin.
- Total capital costs $10,000,000
- Maintenance costs - Approximately $160,000 annually.

Over the 50 year lifetime of a retention basin, these costs amount to $0.73 per hundred cubic feet of water augmenting the City's supply. This becomes $0.83 if you include the cost of acquiring water rights.

Benefit: Additional acquisition of water rights for surface water and percolation ponds would allow the City to reduce the amount of water purchased each year and increase the reliability of the water system. Also, using a surface water capture and reuse program could recharge aquifers (through the use of surface percolation ponds) as well as provide a cost effective source of additional water.
Lifecycle: The lifecycle of surface water detention ponds and percolation ponds is highly dependent on construction design. Typical detention and percolation ponds have a lifetime of 80 to 100 years or more. Annual operation and maintenance is also required.
Prioritization by lifecycle: 1. Construct water fill station at 4 existing surface water retention ponds. 2. Investigate the sites outlined in this memorandum for surface water and percolation pond sites. 3. Senior water rights (least likely to be contested) - less time until acquisition 4. Old agricultural water rights (more likely to be available) - longer timeframe
Ease of Implementation: ● Implementing surface water for construction water is relatively straight forward, inexpensive and easy to install. This includes connecting a water line to the lake with submersible pump and a connection point with isolation valves. ● Construction of additional surface water and percolation ponds can be complex and requires acquiring available land suitable for the application, excavation, material lining, and extensive geotechnical site investigation. ● Planning for and the acquisition of water rights is a complicated and uncommon event involving the execution of multiple contracts over the course of as many as ten years.

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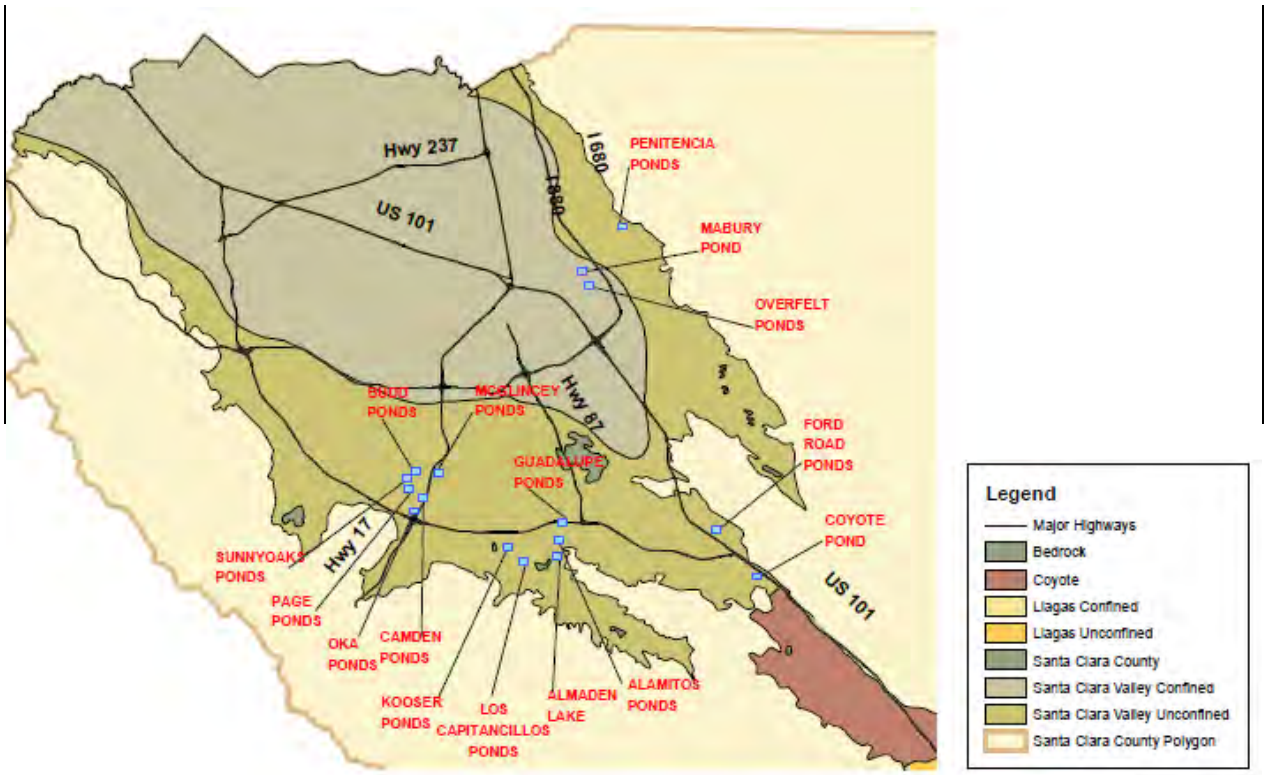
Appendix

Figure 9 - Surrounding Surface Water Features (Santa Clara Valley Water District)



Water Solutions Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 4: New Groundwater Wells**

Summary

The south-western section of the City of Milpitas overlays a good groundwater aquifer that is quite productive and its use is recommended. Up to 8.2 million gallons per day of water could be extracted (using a withdrawal rate of 2,000 gallons per minute) with the addition of two new wells and the use of the Curtis and Pinewood wells. Prior to use, a state water quality report must be completed, as well as treatment (if necessary) and disinfection. We would recommend the use of in-pipe blending with San Francisco Public Utilities Commission and Santa Clara Valley Water District supplies, as well as disinfection with in-pipe ozonation.

As with any managed groundwater basin, smaller monitoring wells are required throughout the basin to manage the water level and quality of the production wells. By drilling these lower-cost monitoring wells upfront, the cost of which is less than $20,000 per monitoring well, the City would be able obtain data on the quantity and quality of new production wells, which are approximately $350,000 to $1 million or more when completed, with a very modest financial outlay (Water Solutions, Inc. 2014).

Assuming that new wells would be of similar quality to that of Pinewood well (the primary municipal well for Milpitas emergency water supply), treatment would be minimal. We recommend the city pursue a managed groundwater well extraction program, much like what Alameda County Water District operates to the immediate north. Upon successful implementation of a groundwater well extraction plan, a groundwater percolation strategy involving percolating retention ponds or wetlands (see Task 3 memorandum), should be implemented to supplement and refresh the extracted groundwater well supplies with stormwater, or possibly even treated recycled water, if the basin manager (Santa Clara Valley Water District) approves of such. Of course, this is also contingent upon final

approval from the State Water Resources Control Board.
Note that surface water detention and groundwater recharge are associated and complicated issues as discussed in Task 3. Water Solutions, Inc. does not recommend Task 3 at this time, but we do recommend the the City should be aware of groundwater recharge opportunities.

In addition, the Pinewood Well water is primarily potable and is recommended to augment the water supply for the City of Milpitas. Issues to be resolved include both mineral and odor concerns which will require treatment or in-pipe blending with current water supplies. The addition of a small ozone system will resolve the taste and odor issues. Additionally, the use of a lime softening unit would also improve the quality of the water. It would be wise to plan on future wells being of similar quality to the Pinewood and Curtis wells which, while increasing the well infrastructure costs, allows for better long term operational budgeting. Blending well water with San Francisco Public Utilities Commission and Santa Clara Valley Water District water will dilute the hardness of the Pinewood water and may be an alternative to treatment.

Options for groundwater use:

- leave as an emergency supply
- point of use supply; drill pilot holes to determine the quality and quantity of water at parks, schools and government buildings to irrigate landscape; develop groundwater wells for use, as feasible
- treat well water at Pinewood well to potable standards and add to the drinking water supply
- drill pilot holes in Starlite Park and Hall Memorial Park to determine the feasibility of adding groundwater wells to augment the water supply (based on the United States Geologic Survey data and recommendations contained in this memo)
- drill pilot holes and determine the feasibility of shallow groundwater wells on the south-eastern section of Milpitas and at Quince Lane
- consider coordinating and forming partnerships with Santa Clara Valley Water District regarding the construction of recharge facilities; involving percolation ponds and/or injection wells (see Task 3 memorandum)
- pump groundwater for surface water features; i.e. ponds, artificial wetlands, etc. for public recreation, environmental rehabilitation and water storage

This is a complicated process that Water Solutions, Inc. does not recommend at this time, but we do recommend the the City should be aware of groundwater recharge opportunities.

Data

The information in this memo was gathered from:

- California Code of Regulations, Title 22
- City Public Utilities staff and records
- consulting hydrogeologist James S. Ulrick, Certified Hydrogeologist
- Behzad Ahmadi, Professional Engineer, of the Santa Clara Valley Water District Groundwater Monitoring and Analysis Unit

Methodology

The specific topics covered in this memorandum include the following:

A. Inspection of existing wells (Pinewood and Curtis) with recommended improvements for operation and regulatory compliance
B. Analyze historical hydrological data to determine groundwater sources (hydrogeological modeling) for potential sites (quality and quantity of water)
C. Identify necessary infrastructure for well operation (piping, pumps, motors, etc.)
D. Discuss the idea of adding well and pipe system to irrigate City parks and schools
E. Provide preliminary operational and maintenance considerations
F. Options: Perform groundwater modeling for sustainable production potential
G. Identify preliminary list of regulatory compliance requirement submittals
H. Provide potential lists of sites, operational/physical parameters, estimated reductions of consumptions

Legal and Financial considerations will be addressed at the end of Methodology.

There will be a final *Task 4 Implementation Plan Table* at the end of this memorandum. This will provide potential lists of sites, operational/physical parameters, estimated reductions of consumptions, and related implementation plan and summarized in feasibility section below.

A. Inspection of existing wells (Pinewood and Curtis) with recommended improvements for operation and regulatory compliance

Pinewood Well

The Pinewood Well was inspected by Water Solutions, Inc., on June 11, 2014. This inspection was followed by a report to the City entitled “Pinewood Well Review,” dated the

same day.

This well is not in use at this time. It has been constructed to very high standards and is located in a proven, high yield aquifer. While there are some issues such as the non-operational diesel drive, there is little to prevent the well from being put into operation while the City upgrades the facility to improve ease of operation and reliability. The high mineral content is likely the only issue requiring a significant expenditure; however, the yield of 2.9 million gallons per day, at 2,000 gallons per minute, will quickly pay for any practical investments in treatment and disinfection required for it's use (Ulrick).

Blending the well water with other water sources will dilute the concentrations of hardness and reduce taste and odor issues. As a result, immediate utilization of the well can be achieved. This well is already permitted and tested, which is a significant asset. The well water quality appears to be similar to that of current City standards (slightly more dissolved minerals and a hint of a sulphurous odor). The use of in-pipe ozonation will eliminate any odor issues and dissolved minerals can be reduced easily by in-pipe blending, or with a water-softening system.

Due to the artesian qualities of the well, electrical costs to pump the water can be assumed to be low. This is because artesian water is underground and under pressure. Electric motors draw sufficient power to accommodate whatever load is applied to the shaft. This means that an electric pump will pump more if the artesian pressure drops and less if it increases.

HydroScience Report

The following data was taken from the 2014 HydroScience Pinewood Well Blending technical memorandum. See *Appendix* for an excerpt from the *2014 HydroScience Pinewood Well Blending Study*:

"Pinewood Well meets all State and Federal regulations for public drinking water. However, the hardness level is greater than three times that of Santa Clara Valley Water District and over five times more than San Francisco Public Utilities Commission. The City used the Pinewood Well once and experienced a high volume of complaints from area residents due to hardness, taste, and odor.

Table 1: Hardness of City Water Supplies

Year	Pinewood Well (mg/L)	SFPUC (mg/L)	SCVWD (mg/L)
2013	340	53	96
2012	N/A	62	105
2011	N/A	57	88
2010	340	-	-
Average	**340**	**57**	**96**

"Recommendation

It is recommended that the City perform a hydraulic analysis of each option [of the 2014 HydroScience Pinewood Well Blending Report] to:

- *assess the area that will be impacted*
- *direction of flow*
- *pressure requirements*
- *confirm flows based on demand*

Analysis should be performed using the steady state model as well as the extended simulation period if available for the following criteria:

- *Max Day Demands*
- *Min Day Demands*
- *Peak Hour Demands*
- *Max Day with Fire Flow"*

Additional Recommendations

The Pinewood Well has water hardness of about 340 milligrams per litre; total hardness should be reduced to 120-150 milligrams per litre. However, to match the existing hardness of the water at the Pinewood Well with that of the City of Milpitas, the target hardness would need to be 57-96 milligrams per litre hardness. In-pipe blending, blending tanks, simple granular-activated carbon, lime softening and/or ozonation were compared for hardness and odor treatment potential, based on the findings of the 2014 HydroScience - Pinewood Well Blending report.

In-pipe blending would require the least investment cost to add Pinewood Well water to the potable water supply. The addition of a small booster pump (5 horsepower) and construction and connection to additional water mains would be required for operability**.**

Using *mixing tanks* to blend the well water with the potable water supply would require, in addition, a blending tank, tank housing (or below ground excavation) and an additional pump to increase the pressure to the water main from the tank (in addition to the submersible pump). Also, ozonation could be mixed in the blending tanks or, more simply, in-pipe.

An *ozonation* and/or a *lime softening* system could be included inline with the Pinewood

Well before blending (in-pipe or via blending tank) with San Francisco Public Utilities Commission supplies to help eliminate any possible odors, remove water hardness or trace biological concerns. Ozonation is excellent at resolving taste and odor issues, while lime-softening is used to reduce water hardness. Ozonation and/or lime softening should be combined with one or more of the following in-pipe blending location options (see Figure 1: Location Maps 1, 2 and 3 for possible conveyance routes):

Option A: *Pinewood Well Reserved for Emergency Supply*
This option would maintain the existing conditions at Pinewood Well; water would only be drawn during times of emergency. No major changes to the existing infrastructure would be required.

Option B: *In-Pipe Blending for Additional Water Supply*
In-pipe blending is a practical means of mixing groundwater obtained from Pinewood Well with existing water supplies. Infrastructure required would include a new water main, a small 5-horsepower pump and treatment systems. See *Scenario 1* for the simplest in-pipe blending option. However, more diffuse mixing could be achieved using the blending routes shown in *Scenario 2 & 3.* Either of these options would blend into two pipes to disperse the water between two residential streets, rather than the one pipe as shown in *Scenario 1*. Possible blending routes include the following (Figures 1-3 below):

Figure 1: Scenario 1 - Water drawn from Greenwood Way & Lonetree Court; to be blended with Pinewood Well water and distributed to Evergreen Way/Green Tree Way. This would require approximately 200 feet of additional water mains (Note: Evergreen Way & Green Tree Way share the same water main):

Figure 2: Scenario 2 - In-pipe blending from Starlite Dr. to Evergreen Way/Green Tree Way and Greenwood/Lonetree Ct (would require about 890 feet of additional water mains):

Figure 3: Scenario 3 - In-pipe blending from Moonlight Cir. to Evergreen Way and Greenwood/Lonetree Ct. (would require about 730 feet of additional water mains).

Option C: *In-pipe Blending with Ozonation*
In-pipe blending using the routes shown above can be combined with ozonation to achieve lower odor and taste issues present in the groundwater. A concentrator and side stream injection would be required.

Option D: *Blending with Ozone in a Contact Tank*
In addition to the equipment required by Option C, the following would be required for Option D: A non-pressurized contact tank would require additional pumps to raise the pressure to that of the water mains, or a pressurized contact tank (expensive). The size of the contact tank would be approximately 4250 gallons.

Option E: *Lime Softening*
Lime softening raises the pH of water to precipitate hardness ions (polyvalent cations such as Mg2+ and Ca2+) prior to blending or distribution directly into the water system. Hardness can be reduced to 50-85 milligrams per liter using lime softening and could then be added directly to the water supply or blended using one of the above options. A lime softening system would be required, as well as periodic disposal (or a flush system to the waste water line) of precipitated calcium carbonate and magnesium hydroxide.

Conclusion - Combination of Available Options
A variety of options are available to improve the quality of water and eliminate trace

odors and minerals. It is required by the City to maintain the quality of the existing water, therefore a combination of the following is recommended:

- lime softening
- ozonation and/or
- in-pipe blending to eliminate the trace presence of odors and minerals.

These would be great solutions to treat well water, in order to increase the water supply by blending with water of similar quality and consistency as existing supplies.

Finally, Water Solutions, Inc. has chosen a variation on the Hydroscience blending report plan. In-pipe blending could be accomplished by any of the options shown in *Figures 1-3* (above). In-pipe blending could be used by itself, without ozonation or other treatment. However, one configuration would be to draw water from Live Oak Ln. to blend with Pinewood Well, treat with ozonation and distribute between the three neighboring streets (Moonlight Cir., Evergreen Way and Greenwood Ct.). Keep in mind, the well water at Pinewood Well is some of the best in the county and does not require treatment.

Curtis Well

Curtis Well was also reviewed in conjunction with the review of the Pinewood Well. However, this well is not currently operational. Reviewing the water quality and lower production of this well, a treatment system will need to be installed prior to this well being brought on line. The Historical capacity of the Curtis Well is approximately 750,000 gallons per day, although current measurements suggest the capacity is much less. The modelled specific capacity of this source is 45 gallons per minute per foot; however, the measured specific capacity of this well is only 1 gallons per minute per foot, resulting in a approximated continuous yield of 500 gallons per minute or 720,000 gallons per day (Ulrick, 2014). There is currently a cased well at the site, but additional infrastructure is required for operation, including:

- well pad
- submersible pump
- downhole piping
- submersible electrical cables
- pump house
- chlorine injection
- treatment filters and other components

Recommended Improvements

Curtis Well could be used for potable water, recycled water, construction or retrofitted to be a reliable emergency supply. However, a number of steps are required to achieve optimal operation and regulatory satisfaction.

- First, an “Initial Sample Bacteriological Test” should be performed as per the

guidance provided in the back page of the book entitled “2014 Guide to California Drinking Water Regulations” provided to the City by Water Solutions, Inc.

- Second, the well should be run at 500 gallons per minute to study the blending water quality of the distribution system.
- Third, Title 22 compliance should be verified.
- Fourth, an Initial Drawdown Test pumping of the Curtis Well should be performed as per the protocol set out by the Drinking Water Program (State Water Resources Control Board website, 2014).

In addition, the State Drinking Water Program must be notified of the City’s intentions, and the City’s Water Permit listing must be verified. Water Solutions, Inc. did not review the State water system permit to confirm that the Curtis Well is currently listed. This must be done. In the event the well is not on the city water permit, several months may be required, prior to operation, to amend the City water system permit. As part of this permit process, the Drinking Water Program will review the complete Title 22 water quality analyses and provide a report to the City.

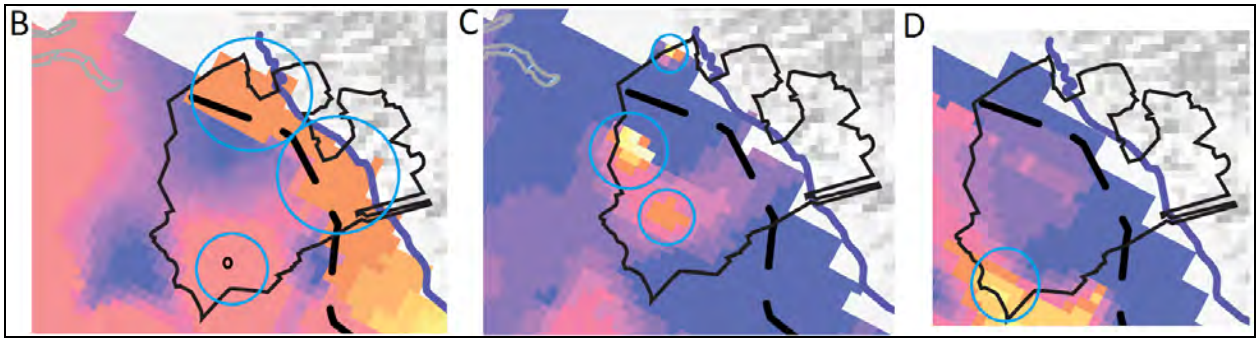
B. Analyze historical hydrological data to determine groundwater sources (hydrogeological modeling) for potential sites (quality and quantity of water)

New Groundwater Wells

The greatest potential for new groundwater wells appears to be in the south-western corner of the city (based on United States Geologic Survey hydrological and depth data, see Figure 4) and near the mid-western areas of Milpitas. Also, lower-yielding shallow wells or percolation ponds may be feasible on the eastern portion of Milpitas (see *Task 3: Surface Water*); however, contamination issues as well as low yields could be an issue in this area.

The following figures were taken from the United States Geological Survey - Possible locations for new well sites are circled in light-blue:

Figure 4 - Specific Storage Capacity at Three Depth Levels



Possible locations for wells to be drilled are outlined in the following sections. Up to 2.9 million gallons per day of water could be extracted (using a flow rate of 2,000 gallons per minute times 1,440 minutes per day yields 2.9 million gallons per day). However, careful hydrological modeling and pilot holes should be drilled to determine sustainable withdrawal rates and to monitor the groundwater basin. Also, a recharge program should be implemented by use of percolation ponds or injection wells to increase the amount of water into aquifers during storm events.

Forming a partnership with the Santa Clara Valley Water District regarding the construction of recharge facilities will be essential for the success of a project of this type - The recharged groundwater will likely become the rights of Santa Clara Valley Water District and costs for pumping will be required. Also, the Santa Clara Valley Water District currently operates the San Tomas injection well; results are available for a study regarding the recharge water quality project 2008-2009. Eventual partnership between neighboring San Francisco Bay Area water agencies to explore groundwater recharge, with highly-treated water, possibly including 10-log treated wastewater is also recommended (99.99999999% removal of water constituents).

Historical Hydrological Data

A sound understanding of the Santa Clara Valley groundwater basin is needed if the City wishes to drill more groundwater wells. The basin is unconsolidated alluvium resulting from a number of creeks running into the area from the foothills to the east. The eastern portion of the basin is unconfined, and does not contain an aquitard, meaning that contamination can spread from the surface into the groundwater. However, the western part of the City overlies a confined aquitard-protected area with water of good quality and yields that extends for 800 feet below the aquitard clay layer.

There are upper and lower aquifers in the Santa Clara Valley basin. Santa Clara Valley Water District can not access the lower aquifer with recharge water due to a clay aquitard. They are able to recharge into the upper aquifer at a shallow level. Because they can't reach the lower aquifer the pressure is higher in the shallower aquifer, and lower as one drills deeper. Needless to say, this is unfortunate as it may result in a shallower water table and hence flooding, and no recharge is actually occurring into the deeper, potable water aquifer. Nonetheless, the yield as indicated by the horizontal hydraulic conductivity simulations, is highest in the southeastern corner of the City at a depth of 600 to 800 feet below ground surface.

Interestingly, the water quality of existing wells drilled by the City is among the worst and the best in the basin. The Curtis Well is heavily laden with constituents such as iron and manganese and has the lowest specific capacity (ability to hold water) of those tested. These findings indicate there may be problems with the construction of the well. In contrast, the Pinewood Well is an example of some of the best water quality available in

the basin (Ulrick, 2014). As with any managed groundwater basin, smaller monitoring wells are required throughout the basin to manage the water level and quality of the production wells. By drilling these lower costs wells upfront, the City would be able obtain data on the quantity and quality of new production wells, with a very modest financial outlay.

Determination of Groundwater Sources

There are several considerations when selecting groundwater sources; water quality and the withdrawal rates. These constituents should be identified prior to constructing the production well systems. Pilot holes should be drilled to provide estimates for the quality and quantity of water that can be reasonably withdrawn; the location to be determined from available groundwater data.

The lighter colors (in Figure 4) indicate a greater specific storage multiplier for groundwater in Milpitas. The areas with the greatest specific storage are circled in light-blue for clarity; the small dot on Layer B is the location of Pinewood Well; a fairly good location, based on United States Geological Survey data (See Figure 4). Note that wells of greater depth tend to have the greatest storage capacity towards the South to the mid-West corners of the city. The various layers (i.e. B, C & D) indicate the depth and specific layer that was studied. Pilot wells should be constructed in the areas with the greatest groundwater storage potential; likely in the Southern section of the city. There is also a potential for small, shallow wells on the south-eastern section of Milpitas - See Layer B.

C. Identify necessary infrastructure for well operation (piping, pumps, motors, etc.)

The infrastructure required for a municipal well includes the following:

- a submersible pump
- a submersible electrical cable
- well casing
- a flexible or rigid downhole pipe
- centralizers
- a well pad
- electrical controls
- a treatment/electrical cabinet or housing

Additional components include:

- a well screen
- check-valves
- a variable frequency drive
- rectifiers
- an annular seal

- a well vent
- an air relief valve
- a flow sleeve
- a bypass valve and a
- distribution line connection

Treatment and chlorine injection (prophylactic or residual chlorine) should be added before the water is added to the water supply. A full Title 22 report, also known as State Water Quality Testing, should be conducted to determine site-specific water treatment methods.

Water Solutions, Inc. would recommend the use of a vertical turbine submersible pump with “Mandal’s Wellman” flexible downhole piping. Centralizers should be used to keep the downhole piping in place, and check valves must be installed at the wellhead or between the pump and down-hole piping. A flow sleeve must be used to cool the motor while it is running. Variable frequency drives provide a “soft start” to the pump and a dry-run sensor is needed to protect the motors. These controls can be incorporated into the pump controls and ideally are located in a pump house or convenient electrical control box.

If convenient, power should be connected directly to PG&E for ease of maintenance and dependable operation. However, a diesel engine, solar panels or hydrogen fuel cell could be used for remote areas. Water treatment could be undertaken with one of the following, depending on the water quality:

- screens
- sedimentation chamber
- green manganese sand filters
- ozone disinfection
- UV disinfection
- microfiltration or reverse osmosis

D. Discuss the idea of adding well and pipe system to irrigate City parks and schools

Irrigating city parks and school landscaping with water from existing wells could save money, provide additional potable water that would otherwise be used for irrigation and decrease the amount of purchased water. Wells should be installed as close as possible to the parks, schools or government buildings whose lawns are to be irrigated. One drawback would be the availability of shallow wells, thus driving up the costs by requiring deeper wells (500+ feet in many instances). However, careful geotechnical investigation, as well as the installation of pilot wells at potential sites (see below, *H. Potential List of Well Sites*) to help determine the ideal placement and feasibility installing shallow wells.

There are, however, several alternatives to irrigating City parks and schools with well water:

- treat the well water to drinking water standards and blend it into the current San Francisco Public Utilities Commission and Santa Clara Valley Water District water supplies before distribution
- connect existing wells directly to recycled water lines to be used for non-potable use (including irrigating lawns, landscapes, fields, etc.)
- drill additional wells site-specifically for large parks and schools, as feasible; treating the well water to drinking water or recycled water standards will provide more options for use

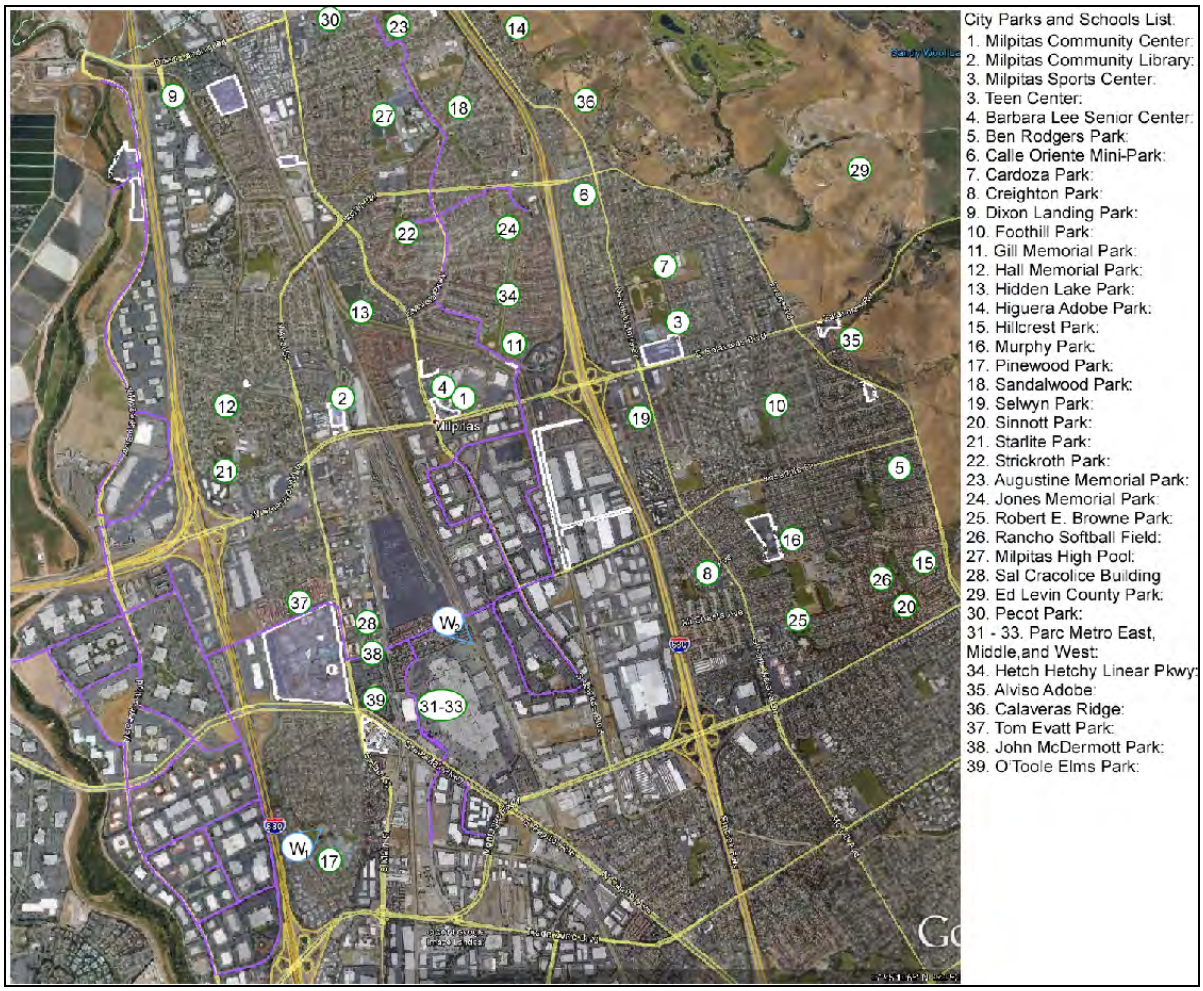
The following figure (Figure 3: *City Wells with Recycled Water Lines)* shows the location of many of the parks, schools and community centers throughout Milpitas, as well as the location of recycled water lines.

Presently, the recycled water system does not reach all of the City parks and schools. The addition of recycled water piping could provide the opportunity to irrigate many of the parks and school lawns with well water, without additional treatment (based on the results of Pinewood Well water quality report). A map of the major parks and schools, as well as existing recycled water piping is shown above (see *Figure 3 - City Wells with Recycled Water Lines*). Some of the park irrigation systems could be connected to the current recycled water system with the addition of relatively short recycled water pipe runs. However, most of the parks and schools are a considerable distance from recycled water piping. Longer recycled water mains would be required and Highway 680 would need to be crossed in order to connect to all of the parks.

The cost of laying water mains is approximately $179 per linear foot (Coastside County Water District website, 2014). However, the existing potable water distribution system is already in place and would require very little modification. By treating water from the existing and new wells to achieve potable water drinking standards, this water could be used for nearly any use. Additional changes to the infrastructure would be minimal for treated well water; thus, the greatest cost for a well would be the design and construction of a treatment system and connections to existing water lines.

Drilling new wells at parks and schools is also feasible - Additional wells located at parks and schools could be constructed to augment the water supply, irrigate fields and provide surface water retention at parks. A list of potential sites is provided below and can be used to drill pilot wells. Pilot wells will help to determine water depths and sustainable withdrawal rates, as well as to help map and monitor the Cities groundwater supplies.

Figure 5: City Wells with Recycled Water Lines



Pinewood Well could easily be blended into the City's water supply and Curtis Well could be added following cleaning of the well, as well as the addition of the infrastructure mentioned above. In addition to the 2014 Pinewood Well Blending Study, a driller's report is also available for Pinewood Well from when the well was drilled in 1978. Water Solutions, Inc. recommends blending with in-pipe ozonation and/or lime softening to augment the existing water supply.

E. Provide preliminary operational and maintenance considerations

Regular well maintenance and proper well management for recharging groundwater would be required if new groundwater wells were to be constructed. Planning should include the cost of these ongoing activities, as well as the initial investment for the well, submersible pump, energy costs, treatment, and connection.

An up-front investment in a series of pilot wells should be installed throughout the city at Starlite Park, Hall Memorial Park, Quince Lane and as appropriate. This should be done

to determine groundwater levels, sustainable withdrawal rates and to determine suitable sites for percolation ponds or injection wells. Collaboration with the Santa Clara Valley Water District should be pursued for partnerships involving recharge facilities for ease of implementation, draft water right agreements and dependable operation.

The *Treatment Operator Certification Level 1 (T1) license* is required for basic treatment procedures for water distribution systems. In order to proceed with disinfection treatment on the utilized wells, a source for chemicals such as sodium hypochlorite or calcium hypochlorite will be needed. The City must also implement a Water Quality Monitoring Plan to assess wells on a regular basis and ensure that operating wells are up to standard.

F. Option: Perform groundwater modeling for sustainable production potential

(not undertaken at this time)

G. Identify preliminary list of regulatory compliance requirement submittals

Permitting of municipal wells is a relatively simple process:

1. An appropriate site must be found, away from wastewater and other wells.
2. The site must be approved by the State Water Resources Control Board - Drinking Water Program
3. The County will review the site and issue a drilling permit for $400
4. Santa Clara Valley Water District, as the steward of the groundwater basin, will issue the well permit.
5. Once permission is given by the Santa Clara Valley Water District, a Permit Amendment Application must be submitted to the State Water Resources Control Board-Drinking Water Program. This Permit Amendment Application must be accompanied by a Technical, Managerial and Financial Assessment and a Permit Technical Report. State Water Resources Control Board fees for domestic (i.e. municipal) water supply permitting are variable, but sometimes range into tens of thousands of dollars.

The Permit Technical Report incorporates the following items:

General Water System Information

The proposed number of service connections, the type of service connections anticipated, period of use, consolidation evaluation and a map of facilities

Source Water Information

Description of source, water rights, water quantity, assessment of vulnerability to contamination and a source water quality analysis.

Treatment and Design Information

Description and layout, design capacities, well construction, treatment chemicals and disinfection facilities.

Distribution System Information

Location of water mains, pumping stations and storage tanks; distribution pressure.

Operational Plans

Water Quality Monitoring Plan, Water System Operations Plan, Disaster/Emergency Response Plan

California Environmental Quality Act Satisfaction

Preparing these requirements is challenging and time-consuming - State Water Resources Control Board-Drinking Water Program recommends the hiring of a consulting engineer to assist in preparing permitting application documents and coordinating permitting activities. This engineer will not only help the City with its immediate application needs, but could be hired in conjunction with additional City Engineering services.

H. Provide potential lists of sites, operational/physical parameters, estimated reductions of consumptions

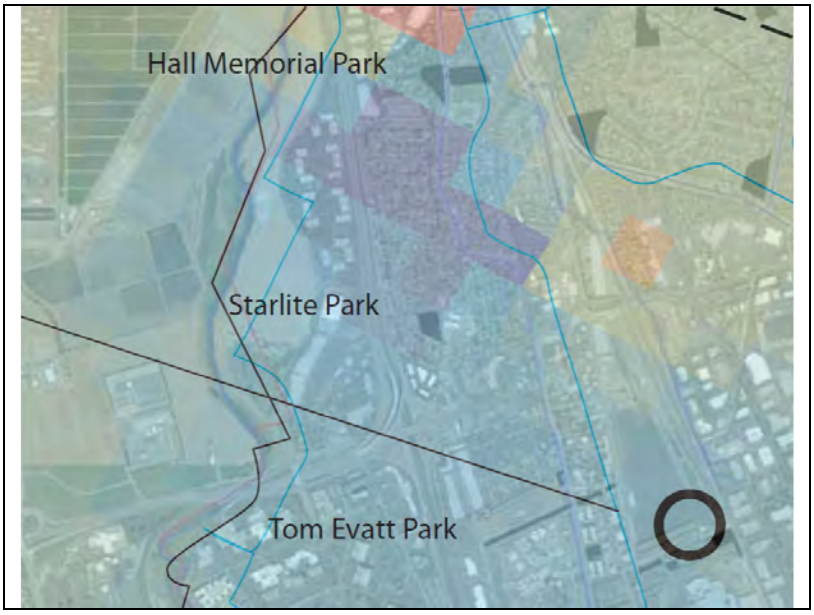
Pinewood Well is the most obvious choice for augmenting the potable water supply with groundwater or supplementing the recycled water supply. Although in a less productive area, Curtis Well would also be an acceptable choice. The addition of wells in the Southern and mid-section portions of the City, as outlined below, is also highly feasible.

Figure 4 indicates the specific storage multiplier throughout Milpitas. Yellow to red colors indicate increasing hydraulic storage (light-blue circled areas). Also, the modeled depth increases from the shallowest layer, to the deepest layer, as shown in *"B" Figure 4 - Specific Storage Capacity,* above.

Two potential sites for new wells at existing City Parks are, in order of preference, Starlite Park and Hall Memorial Park. These sites would avail themselves of the considerable groundwater presence at 400-600 feet depth as shown superimposed on United States Geologic Survey Model Layer 4 (Ulrick, 2014) in Figure 6, below.

The addition of low-yield shallow ground wells, injection wells or percolation ponds on the south-eastern side of Milpitas should also be investigated by use of pilot wells or additional geotechnical investigation.

Figure 6: United States Geologic Survey Model Layer 4



Operational/Physical Parameters

A *Water System Operations Plan* must be implemented to ensure wells are operating properly and efficiently. It is recommended that wells be checked on a monthly basis and a logbook record of levels kept for future references. Well monitoring datasheets are also available and could be used. The specific yield of a well is the gallons per minute of pump flow per feet of drawdown gallons per minute per foot. The drawdown is the distance between the static water level and the pumping water level. Changes in the specific yield of a well can be affected by drought, changes to the storage capacity of the aquifer, damage to the well, natural variance, water use by other wells and over pumping.

A *Disaster/Emergency Response Plan* must also be adopted by the City in case any of the wells being utilized for drinking purposes are damaged, exposed to contaminants, or shut down. As well as affecting water quality, damage to a well can also change the specific yield.

Estimated Reduction in Water Usage

Additional high-yielding wells such as Pinewood Well could dramatically increase the amount of available water for the City of Milpitas. The total amount of water that could be added to the water supply depends on sustainable withdrawal rates and can be as much as 2.5 million gallons per day per well; however, additional investigation is needed to determine a more-precise value. Regardless, the amount of water purchased by the City of Milpitas could be dramatically reduced by increasing available water from well water. With the additional of new wells, estimates for additional water usage would be at least 2.5 million gallons per day, especially if a sustainable percolation or injection plan is

adopted.

Legality

If groundwater is identified as an existing or anticipated source of water, the Urban Water Management Plan must include specific information about groundwater supply and management (Water Code § 10631b).

Unlike surface water, groundwater use is not regulated by the State Water Resources Control Board, and a *water rights* permit from the State Water Resources Control Board is not required for beneficial groundwater use. However, the *Santa Clara Valley Water District* was created by an act of the California Legislature, and operates as a State of California Special District, with jurisdiction throughout Santa Clara County. It manages the groundwater and charges a fee for its use. Also, drilling permits must be acquired from Santa Clara Valley Water District, as well as submitting a Permit Amendment Application to the State Water Resource Control Board. The Board, as well as the Santa Clara Valley Water District, should be contacted for special permitting requirements, for any possible recommendations.

Groundwater used as part of a municipal water supply system is considered an *appropriative right*, as compared to an *overlying groundwater right* (*City of Pasadena v. City of Alhambra,* 33 Cal. 2d 908, 927 (1949)). An appropriative groundwater right is established by the extraction of the groundwater and application to beneficial use.

In times of shortage or overdraft of an aquifer, the water available for extraction (i.e., the "safe yield") is allocated among competing water right holders according to certain priorities. The overlying groundwater right holders collectively have first call on the available water. If surplus water is available, the remaining water within the safe yield of the aquifer may be extracted by appropriative right holders based on the respective dates on which they began pumping water from the aquifer (i.e., the first in time, is the first in right). If the City initiated a new well it would likely be the lowest-priority water right holder. *This scenario becomes problematic only if there is a concern about exceeding the safe yield of the basin and creating potential shortages.*

On September 16, 2014 the Governor of California signed into law new groundwater legislation (*Sustainable Groundwater Management Act*, AB 1739, SB 1168, SB 1319) that establishes a new structure for managing the State's groundwater. The Act provides a framework for improved management of groundwater supplies by local authorities, and includes provisions for establishing agencies to deal with groundwater sustainability and adopting sustainable groundwater plans. Implementation of the Sustainable Groundwater Management Act should be tracked to determine its potential benefit for Milpitas.

Numerous agencies must be coordinated to achieve the installation of new groundwater wells in Milpitas. Milpitas is in the Santa Clara Valley. The State Water Resources Control Board is not active in the permitting process, but generally oversees the management of all the state's counties and water districts. Santa Clara Valley Water District manages the actual permitting process for groundwater use.

The requirement of Groundwater Management Planning was instituted in 2013 by *Assembly Bill 359* with the intent of "...monitoring and management of groundwater levels within the groundwater basin" (Legislative Counsel's Digest, 2011). This Bill adopts principles of sustainability that heretofore were not considered within water law. Both the Groundwater Management Plan (Santa Clara Valley Water District, 2012) and the Urban Water Management Plan (Milpitas, 2010) address the issue of new groundwater wells in the City; however, they do not state explicitly that this option is being pursued.

Finances

The Capital Improvement Plan program consists of annually prepared five year plans, and provides for both significant and minor changes to the City water system. The 2013-14 Capital Budget provides $2.4 million for Water Projects, at 12.7% of the total budget of $18.9 million. This allocation is far less than what will be needed for development of the Curtis and Pinewood wells alone. The drilling and completion of a new well could cost an additional $350,000, and with treatment and a substantial pump station, this cost would climb towards $3 million per well (Reynolds, 2014).

As well, there are recurring, non-capital costs. Operation and maintenance of a municipal water supply well, while not trivial, is not expensive, requiring only the energy to run the well and non-present staff, who are presumably already hired. If the Pinewood well, or new production wells could pump 3.5 million gallons per day or 2,400 gallons per minute, then at a calculated 250 horsepower or 186 kilowatts, utility costs could be as much as $1,428 per day of continuous operation, *or $0.11 per hundred cubic feet* (PG&E). Even at partial yet regular operation, these costs amount to hundred of thousands of dollars per year. The rate of 3.5 million gallons per day can not be sustained 24/7/365. The hydrogeological survey states that only 2.9 million gallons per day are possible, over time. The rate of 1 million gallons per day is a conservative withdrawal rate and is used for operations cost estimates for continuous use, however, 2.5 million gallons per day is a more likely production goal than 1 million gallons per day. Note that production well withdrawal should be married to an aggressive surface water retention and detention program to substantiate the withdrawal rate from the aquifer.

$$3.5\ million\ gallons\ per\ day \times 1337\ hcf/mg = 4680\ hundred\ cubic\ feet\ per\ day,$$
$$4680\ hcf/day \times 30\ days/mon = 140{,}400\ hundred\ cubic\ feet/month,$$
$$186\ kW \times \$0.112/kwh \times 720\ h/mon = \$15{,}000/month\ electricity\ costs\ (\$180k/yr),$$
$$\$15{,}000/mon \div 140{,}400\ hcf/mon = \$0.11/hundred\ cubic\ feet$$

On top of these costs are the fees for groundwater extraction. The Santa Clara Valley Water District was created by an act of the California Legislature, and operates as a state of California Special District, with jurisdiction throughout Santa Clara County. It manages the groundwater and charges a fee for its use. Santa Clara Valley Water District has not imposed rationing, but has set a water use reduction "target" of 20% less than the 2013 usage. The Santa Clara Valley Water District groundwater withdrawal fee for 2014-15 is $747 per acre foot. This means that at most, the City will be paying 65.5% of its water rate charges from customers to cover groundwater extraction fees to Santa Clara Valley Water District alone ($747 per acre foot or $1.71 per hundred cubic feet, versus Milpitas' minimum water rate of $2.62 per hundred cubic feet). This amount increases approximately 11.4% per year according to the Santa Clara Valley Water District Protection and Augmentation of Water Supplies report for 2013/14. If electricity costs $0.11 per hundred cubic feet and the groundwater fee is $1.71 per hundred cubic feet, the total cost for pumping groundwater from a well is *$1.82 per hundred cubic feet*.

$$\$0.11/hcf,\ elec. + \$1.71/hcf,\ fee - \$2.62/hcf\ low\ residential\ rate\ =\ \$0.80\ hcf\ net\ (gain)$$

Therefore, when compared with the cost of wholesale purchased water, this approach appears to be a good investment. Currently the City is purchasing treated Hetch-Hetchy water from the San Francisco Public Utilities Commission at a rate of $2.93 per hundred cubic feet or $1,276.31 per acre foot. This high rate results in a loss to the City of $0.31 per hundred cubic feet for water that is sold at the low-use (conservation) residential rate of $2.62. Although it is desirable to reward customers who conserve water, it is unwise to employ a pricing system that induces a net loss. Further, *this purchase rate is likely to rise annually by 17% on average, making this an increasingly costly and therefore unsustainable investment in the long term* (Javelosa-Rio). The City of Milpitas has recently hired a consultant to analyze its water rates structure.

$$\$2.93/hcf\ San\ Francisco\ Public\ Utilities\ Commission\ rate - \$2.62/hcf\ low\ residential\ rate\ = \\ =\ \$0.31/hundred\ cubic\ feet\ net\ (loss)$$

In addition to treated water from the San Francisco Public Utilities Commission, the City also buys wholesale treated water from the Santa Clara Valley Water District at a rate of $1.97 per hundred cubic feet and which, as indicated above, is expected to increase at a rate of 9.3% annually. This too is an expensive option; however, at the residential rate of $2.62 per hundred cubic feet, it does allow the City to achieve a net revenue.

If the City were to propose a new rates-increase structure to cover these fee increases, there might well be political opposition. Average rate increases for 2014 were 5.2%, although the five-year average is 8.25%. This pattern compares unfavorably with the

period of 1996 to 2012, when water rates increased at an average rate of 4.9% annually. Nonetheless, given growing public awareness of the intensifying problems relating to drinking water supplies, it is possible that rate increases of up to 15% annually might be possible, and may even be advisable.

Milpitas Minimum Water fee	Santa Clara Valley Water District Groundwater fees	Santa Clara Valley Water District Wholesale Treated water	San Francisco Public Utilities Commission
$2.62/hcf	$1.71/hcf $0.11/hcf PG&E costs $1.82/hcf $0.80/hcf GAIN +11.4% annual increase	$1.97/hcf $0.65/hcf GAIN + 9.3% annual increase	$2.93/hcf $0.31/hcf LOSS +17% annual increase

Results

There is a good case for developing existing well sources into sources for construction water (non-potable). Such a project would be very limited in scope, and also inexpensive. However, uses for construction water are limited. The production of potable water is an infinitely valuable commodity. Therefore, it seems more cost-effective, over project and infrastructure lifetimes, to develop existing feasible *potable* sources such as the Pinewood Well (the Curtis Well is not yet a feasible potable water source; it will require treatment).

In addition to the Pinewood Well, new production wells can be drilled, but they are expensive ($3 million each). The hydrogeologist's examination of the geological structure beneath the City has resulted in a fairly good picture of where new wells should be installed if any significant available water is to be had from them. In order of preference, the following have potential to be good sites for new wells:

1. Starlite Park
2. Hall Memorial Park

There is a great argument, financially, for the City to construct and operate its own potable water supply wells. Although they might cost $3 million to construct, the cost and

fees of running a well are small when compared to the costs for purchasing treated water.

If a well were to be run at 1 million gallons per day or 3.07 acre-feet per day or 1337 hundred cubic feet per day, at an Operations and Maintenance cost of $0.11 per hundred cubic feet per day and a fee of $747 per acre foot (or $1.71 per hundred cubic feet), then the annual cost of O&M would be $890,731 including fees, and the available volume of water would be 488,005 hundred cubic feet per year. Over 40 year this amounts to $35.6 million for O&M costs with fees:

$$((3.07 \times \$747) + (1337 \times \$0.11)) \times 365\ days \times 40\ years = \$35,600,000\ O\&M\ and\ fees$$

Moreover, producing 1 million gallons (a conservative production estimate) per day from the City's own well(s) frees the City from purchasing water from Santa Clara Valley Water District or San Francisco Public Utilities Commission. This results in a $38.0 million in savings over forty years, from not buying water at $847 acre feet minimum cost:

$$3.07\ af/d \times \$847/af \times 365\ days \times 40\ years = \$38.0\ million\ in\ saved\ purchased\ water\ fees$$

If one subtracts the cost of well Operations and Maintenance from the cost of purchased water, that's $2.39 million in savings, roughly the cost of putting in a new well. So, the well pays for itself, provided treated water costs escalate faster than energy costs, and water source security is obtained:

$$\$38.0\ million\ in\ purchased\ water\ fees - \$35.6\ well\ operation\ O\&M\ and\ fees$$

$$= \$2.39\ million\ in\ savings\ over\ 40\ years$$

Furthermore, if a 1 million gallon per day well were to be run 365 days per year for 40 years, this would result in O&M costs of only $2 million, and there would be no groundwater fees to be paid to Santa Clara Valley Water District or San Francisco Public Utilities Commission:

$$1337\ hcf/day \times \$0.11\ O\&M/hcf \times 365\ days \times 40\ years = \$2\ million\ O\&M\ costs\ over\ 40\ years$$

Therefore, it would be beneficial to somehow do away with the groundwater withdrawal fee imposed on well pumpers by the Santa Clara Valley Water District. One possibility for this is the idea of a *recharge credit* agreement between the City and the District. A recharge credit is like a rebate for the water the City would produce with groundwater drawn from a well, earned by recharging the aquifer with a percolation/injection system

(See *Task 3: Surface Water Detention* for costs).

The Santa Clara Valley Water District groundwater withdrawal fee could potentially be done away with if an agreement with the District were to be gained. Full recharge credit is possible,
though not assured. Therefore, if a 75% (for example) credit for recharge (see *Task 3: Surface Water Retention*) were to be given by Santa Clara Valley Water District, this would yield $560,000 every year for 1,000 acre feet of recharge water.

$$1,000\ af/y\ \times \$747 \times 75\% \ = \$560,000\ per\ 1000\ af/year\ recharge\ credits$$

If suddenly, the annual cost of operations were only $292,000 (versus $890,731 O&M + fees above), this would result in a **lifetime (40 year) cost of $13.2 million**, far less than the **$35.57 million in O&M and fees** incurred by pumping a well without recharge.

$$\$890,731 - \$560,000 = \$330,000\ annual\ cost\ of\ running\ a\ well$$
$$\$330,000 \times 40\ years = \$13.2\ mil,\ lifetime\ cost\ of\ running\ a\ well$$

$$\$35.6\ mil,\ well\ operation\ O\&M\ and\ fees - \$13.2\ mil,\ well\ operation\ O\&M\ and\ 25\%\ fees$$

$$= \$22.4\ million\ in\ savings\ over\ 40\ years$$

Most telling of all however, is the amount of money saved by not purchasing wholesale water and instead pumping well water that is awarded 75% recharge credits.

$$\$38.0\ mil,\ in\ purchased\ water\ fees\ - \$13.2\ mil,\ well\ operation\ O\&M\ and\ 25\%\ fees$$

$$= \$24.8\ million\ in\ savings\ over\ 40\ years$$

All of these numbers are highly conservative in light of the fact that fees for both groundwater extraction and treated potable water will increase at a rate of at least 10% annually hereafter. Therefore, in terms of both water security and life-cycle cost-benefit, new groundwater wells are a good option for the City.

Lastly, we can show that:

$$1337\ hcf/day \times 365\ days \times 40\ years\ = 19.5\ million\ hundred\ cubic\ feet\ produced\ over\ 40\ years$$

Just pumping groundwater:

$$\$3\ mil,\ capital\ cost\ of\ installing\ well\ and\ treatment + \$13.2\ mil,\ lifetime\ cost\ of\ running\ a\ well$$

$$= \$16.2\ million,\ lifetime\ cost\ over\ 40\ years$$

$$\$16.2\ million,\ lifetime\ cost \div 19.5 million\ hundred\ cubic\ feet\ produced = \$0.83\ per\ hcf$$

With recharge credits:

$$\$3\ mil,\ capital\ cost\ of\ installing\ well\ and\ treat. + \$35.6\ mil,\ lifetime\ cost\ of\ running\ well + fees$$

$$= \$38.6\ million,\ lifetime\ cost\ over\ 40\ years$$

$$\$38.6\ million,\ lifetime\ cost \div 19.5\ million\ hundred\ cubic\ feet\ produced = \$1.98\ per\ hcf$$

Conclusion

The City currently relies on a recycled water system for some irrigation purposes. The addition of new groundwater wells is advantageous because they not only provide for an increase in the water available for irrigation systems but also, with proper treatment, could increase the available supply of potable water. In addition, the reliance on importing outside sources of water would be reduced. The addition of Pinewood well would yield up to 2.5 million gallons per day and, following a comprehensive recharge program, additional capacity could be achieved by drilling new wells.

Starlite Park is an ideal place for the City to drill a well. In addition, any location in the western portion of the City that can be acquired for the purposes of well drilling would be appropriate. The following table lists a number of locations that are City owned parks and thus are possible locations for potential well sites. If each of these sites had a well pumping approximately 2.5 million gallons per day, potential reductions from wholesale distributors could be as much as 14 million gallons per day.

Potential Well Sites in Western Milpitas
Starlite Park, Milpitas, CA 95035
Hall Memorial Park, Milpitas, CA 95035

Of course, 2.5 million gallons per day is a lot to ask of any water source. However, if

yields of the Pinewood Well are considered indicative of yields of the lower groundwater aquifer in the southwestern corner of the City, this figure may be considered reasonable.

Each well would be providing water at contaminant levels lower than the maximum allowed and thus it is likely that no treatment would be necessary. If taste or odor problems arise, they can be abated by the use of simple, granular, activated carbon filters or by the addition of potassium permanganate as an oxidizer at a fraction of the cost of secondary contaminant treatment.

Task 4: New Groundwater Wells, Implementation Plan

Possible Implementation Schedule:

1. Engineering funding application for treatment at Curtis, blending at Pinewood and 2 new wells (April 2015 - Dec. 2015)
2. Engineering of on-site blending treatment vs Gibraltar treatment (Jan. 2016 - June 2016)
    a. Hire a consultant to implement the “Blending Study” at Pinewood Well to dilute hardness concentration. (Apr. 2016)
3. Engineering of Curtis well treatment for hardness (Mn) (Jan. 2016 - June 2016)
4. Engineering of site selection, test bore and construction of Well #1 (Jan. 2016 - June 2016)
5. Engineering of site selection, test bore and construction of Well #2 (Jan. 2016 - June 2016)
    a. Hire a well driller to drill pilot holes at each of the proposed specific sites. (Apr. 2016)
    b. Consult with a hydrogeologist to establish a more detailed evaluation of hydrogeologic conditions, together with water quality and access to the water distribution system, of specific sites based on pilot holes. (Apr. 2016)
    c. Hire an engineering consultant to design treatment and improvements for the Curtis Well. (June 2016)
    d. Hire an engineering consultant to design improvements for the Pinewood well, dependent upon results of blending study. (June 2016)
    e. Establish sites for new wells based on consultants conclusions and results of data from pilot wells. Obtain approvals and drilling permits. (June 2016)
6. Construction application for treatment at Curtis, blending of Curtis & Pinewood and 2 new wells (July 2016 - Mar 2017)
7. Construction for treatment at Curtis and 2 new wells (Apr. 2017 - Sept. 2017)
    a. Begin drilling new wells to a depth of 800 feet. (July 2017)
    b. Hire an engineering consultant to design improvements for the new wells, dependent upon results of water quality analyses and pump testing. (July 2017)
    c. Put contracts out to bid for construction of Curtis well treatment and improvements for all new/existing wells. (August 2017)
    d. Begin construction of Curtis well treatment and improvements for all new/existing wells. (September 2017)
    e. Complete construction of all treatment and well improvements. (December 2017)
8. Construct on-site or Gibraltar blending treatment and install of Pinewood generator and control (Apr. 2017 - Sept. 2017)
9. Permitting for Gibraltar, Curtis and 2 new wells (Oct. 2017 - Mar. 2018)
    a. Submit Permit Amendment Application to State Regional Water Control Board-Drinking Water Program. (January 2018)
    b. Complete permitting process and begin supplying water. (Mar. 2018)

Costs:

- Installation of additional wells (each producing an approximated 2.5 million gallons per day) will cost $350,000 each, at a rate of $74.80 per hundred cubic feet of daily production.
- Treatment at the Curtis Well should consist of ozonation with filtration and backwash, at a cost not to exceed $250,000 or $363 per hundred cubic feet of daily production, due to it's low capacity.
- Connection of any well to the distribution system could have a variable cost from a trivial amount up to $3 million dollars depending upon the pump station design.

Benefit:

The completion of existing wells or addition of new groundwater wells to the City potable water distribution system could result in a considerable decrease of imported water. If two new wells were constructed in addition to the Pinewood and Curtis wells, potentially 8.2 million gallons could be reduced from imported water purchases daily. However, it is most reasonable to assume 1 million gallons per day ($1337\ hcf/day \times 365\ days = 488{,}005\ hcf/yr$) from a single source for the purpose of cost optimization.

Life Cycle:

The life cycle of any well installation is approximately 40 years.

Prioritization by life-cycle:

1. Pinewood Well (this well is a high yield, clean well)
2. New wells (if properly constructed in appropriate areas, these wells should be high yield and clean too)
3. Curtis Well (this well is a low yield producer and has quality issues)

Ease of Implementation:

Planning and construction of new groundwater wells is a common and uncomplicated task. The implementation plan is long and involves many steps, but through careful planning the use of wells can be a very feasible water augmentation strategy.

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Appendices

Appendix A1: 2014 HydroScience Pinewood Well Blending technical memorandum

"Pinewood Well meets all State and Federal regulations for public drinking water. However, the hardness level is greater than three times that of Santa Clara Valley Water District and over five times more than San Francisco Public Utilities Commission. The City used the Pinewood Well once and experienced a high volume of complaints from area residents due to hardness, taste, and odor.

Pinewood Well is located within Pressure Zone 1SF (see Figure 3). Customers within this zone receive potable water from San Francisco Public Utilities Commission under normal conditions. Delivery pressure in this area ranges from between 70 to 75 pounds per square inch (psi). In order to activate the well, maintenance staff manually turns the well on. The City does not currently have Supervisory Control and Data Acquisition (SCADA) to operate the well remotely. However, there is a Programmable Logic Controller (PLC) that could be used to facilitate basic automation control. Once activated, groundwater travels through a 12-in water main before it tees off into two eight-in water mains. Groundwater from Pinewood Well has the ability to serve not only Zone 1SF, but it can deliver water to Zone 1SC as well. Zones 1SF and 1SC are connected by zone valves located on Live Oak Court, Cedar Way, and at the intersection of Main Street and Able Street (see Figure 4). The pressure in Zone 1SC is slightly higher than Zone 1SF at the intertie points by about 5 to 10 psi. There are pressure regulating valves that allow San Francisco Public Utilities Commission water to automatically move to Zone 1SC if there is a pressure drop in Zone 1SC. Customers within Zone 1SC receive purchased water from Santa Clara Valley Water District. Customers in Zone 1SC to the west of Zone 1SF are primarily commercial and industrial customers; whereas, those to the east of Zone 1SF consist of a mix of commercial and high density residential customers.

Distribution and Blending Options
Option 1: Delivery of Groundwater to Zone 1SC Using Existing Pipelines
A flow control valve would be installed on the 12-in main leaving the well just prior to the tee connection to Lonetree Ct. and Greenwood Way Another flow control valve would be installed between the tee and the isolation valve on Lonetree Way in order to blend groundwater with San Francisco Public Utilities Commission supply. The City would be able to adjust the flows by adjusting the pilot on the flow control valves. The flow control valves would fix the flows coming out of Pinewood Well and the San Francisco Public Utilities Commission supply coming from Lonetree Ct. regardless of pressure. In addition, it would prevent reversal of flow. The flow would be forced to move towards Greenwood Way as shown in Figure 5. The well pump would have to have a discharge pressure slightly greater than Zone 1SC. This option would affect 20 parcels within Zone 1SF including Pinewood Park. These customers would receive the blended water before it goes to Zone 1SC at a slightly greater pressure.

If the City chose to blend Pinewood Well with Santa Clara Valley Water District supply, then the valve on Lonetree Ct. would be closed as well as the closed valves shown on Figure 5. Again, the well pump would have to be set at a higher discharge pressure than Zone 1SC. The 20 parcels would receive 100% groundwater at 340 mg/L of hardness and blending would occur after the pressure regulating

valve located at the end of Live Oak Ct. The pressure regulating valve may be able to regulate flow, so no additional infrastructure would be needed. This would have to be verified with O&M staff.

Option 1a: Delivery of Groundwater to Zone 1SC with New Transmission Main
This option would call for installation of a dedicated 12-in transmission main that would parallel the existing main shown in Figure 5a from the west side of the tee till it reached the 14-in main located on Live Oak Court. A new 6-in main would be installed and service connections would be transferred from the 14-in main to the new 6-in main for customers on Live Oak Court. The new 6-in main would connect to the existing main on Starlite Drive before the isolation valve. This would allow the existing 14-in main to be used as a transmission main. Flow control valves would have to be installed on each source of supply line. The estimated cost for this option is XXX.
San Francisco Public Utilities Commission water would blend with groundwater at a new connection point near the tee. The
blended water would then flow through the new transmission main and bypass all Zone 1SF customers. The water would then flow to Zone 1SC customers on the west side of Zone 1SF. These customers are primarily industrial and commercial. If Pinewood Well is blended with Santa Clara Valley Water District water, the flow control valve feeding San Francisco Public Utilities Commission supply would be in the closed position to prevent San Francisco Public Utilities Commission water from mixing with groundwater. This would allow 100% of the groundwater to travel through the transmission main, bypassing the 20
parcels and blend with Santa Clara Valley Water District supply at the pressure regulating valve located at the end of Live Oak Ct.

Option 2: Delivery of Groundwater to Isolated Service Area in Zone 1SF This option is illustrated in Figure 6. San Francisco Public Utilities Commission water from the east would be blended with groundwater and flow westward into the southern portion of Zone 1SF. Valves would need to be closed to prevent the blended supply from mixing with the San Francisco Public Utilities Commission supply coming from Lonetree Court. This would only require installation of two flow control valves. This assumes Pinewood Well has a variable frequency drive (VFD) in order to fluctuate flow based on demand. In addition, either one or both of the pressure regulating valves on Lone Oak Ct. and Montague Exp. would need to be adjusted to allow additional water to flow into the isolated area in the event demand exceed the well output. This would affect primarily residential customers who will see an increase of approximately three times the current hardness level. Option 3: Blending Groundwater with San Francisco Public Utilities Commission and/or Santa Clara Valley Water District Supply in Storage Tank prior to Delivery in Distribution System This option is considered not feasible. Since both sources of supply meet Title 22 regulations, there is no need to break head just to blend and repump the water into the distribution system. This alternative would have a high capital cost and annual O&M expense due to additional energy usage and infrastructure. It is believed that adequate blending can be achieved using flow control valves as described in Options 1 and 2.

Option Summary
Based on mass balance analysis, Pinewood Well (340 mg/L hardness) can be blended effectively with San Francisco Public Utilities Commission supply (57 mg/L hardness) to achieve the targeted hardness level of 120 mg/L to 150 mg/L. The flow range for Pinewood Well would be approximately 246 to 825 gpm depending on the size of the distribution main and the level of hardness targeted. Groundwater can be blended with Santa Clara Valley Water District to achieve the target range; however, the amount of groundwater used would be less (110 to 550 gpm) since Santa Clara Valley Water District supply averages 96 mg/L of hardness.

The most common treatment method for a flow range of 1,200 gpm is lime softening. Lime softening does not remove all the calcium and magnesium ions that make up the majority of hardness. The treated water would be left with a hardness of about 50 to 85 mg/L. At this level, the water can be delivered directly to Zone 1SF customers since the change in hardness would be minimal. Split treatment is another option if the City wishes to use a greater volume of groundwater. The ratio of the amount of groundwater to treat versus untreated groundwater would be the same as that shown in Table 3 since the treated groundwater would have the same levels of hardness as San Francisco Public Utilities Commission supply.

The change in hardness level would not be as noticeable in Zone 1SC as it would be in Zone 1SF. Options 1 and 1a provide a distribution route that would minimize or eliminate impacts to Zone 1SF customers. Option 1 uses the existing distribution pipeline; whereas, 1a provides a new dedicated transmission main. Both options describe blending alternatives in the event the City wishes to blend with San Francisco Public Utilities Commission or Santa Clara Valley Water District supplies. It is believed that blending can be effectively achieved using flow control valves, making blending in a storage tank unnecessary. Blending in a storage tank would require breaking pressure head and repumping back into the distribution system. This would not only add to the capitol costs of the options presented, but it would increase annual O&M expenditure as well due largely to ongoing energy costs needed to repump the blended supply. The most common potential customer impacts include soap scum; difficulty to lather; increase use of detergent and soap; and spots on glassware, dishware, and plumbing fixtures.

Table 5 summarizes the key aspects associated with each option.

Recommended Improvements

Flow profiling is recommended for the Pinewood Well to determine whether sections of the well casing are contributing to contamination or exhibiting clogging. This process will isolate any sections of the well that are clogged or transmitting contaminated or odorous water. The well could then be flushed using methods determined by the chemistry found in the well, and affected sections of the well could be sealed to lower contamination levels.

Table 1: Hardness of City Water Supplies

Year	Pinewood Well (mg/L)	SFPUC (mg/L)	SCVWD (mg/L)
2013	340	53	96
2012	N/A	62	105
2011	N/A	57	88
2010	340	-	-
Average	**340**	**57**	**96**

Recommendation

It is recommended that the City perform a hydraulic analysis of each option to assess the area that will be impacted; direction of flow; pressure requirements; and to confirm flows based on demand. Analysis should be performed using the steady state model as well as the extended simulation period if available for the following criteria:

- *Max Day Demands*

• Min Day Demands
• Peak Hour Demands
• Max Day with Fire Flow

Assuming, the results of the hydraulic modeling effort indicates there is no fatal flaw and depending on the urgency and the amount of supplemental groundwater needed, it is recommended that the City start with Option 1. Santa Clara Valley Water District Blend and notify affected customers prior to implementation. This option does not require additional infrastructure; therefore, it can be implemented immediately once customer notification has been satisfied. Customer outreach will help mitigate customer complaints. This option will have the greatest impact on 20 parcels; however, the largest user of the 20 parcels will come from the City's Pinewood Park (6,000 gallons per day for irrigation). Hardness does not impact irrigation users as much as residential users. Many customers irrigate in the late evenings or early mornings. The City may choose to operate the well only during this time frame to reduce the impact to consumers who use water for bathing and cleaning. If this strategy is used, the City could incorporate the schedule into outreach material.

The next phase of this approach is to begin installation of two flow control valves as per Option 1. San Francisco Public Utilities Commission Blend. It is estimated that design and construction of the two flow control valves would take approximately six months or less. The flow control valves should be strategically located so that the City can install a dedicated transmission main in the future as per Option 1a or the City may choose to bypass this option and proceed directly with Option 1a. Either way, this would increase the flow of groundwater and decrease the hardness to the 20 parcels in Zone 1SF. Customers in Zone 1SC will not see a significant change in hardness since the target level will stay the same. Since San Francisco Public Utilities Commission supply is fluoridated, customers in Zone 1SC will receive suboptimal fluoridation. Customers in Zone 1SC should be notified of this change.

If the City chooses to bypass Option 1. San Francisco Public Utilities Commission Blend and proceed directly with Option 1a. San Francisco Public Utilities Commission Blend using a dedicated 12-in transmission main, then the implementation time will increase from less than 6 months to approximately 6 to 18 months to allow adequate time for design and construction. This option would bypass the 20 parcels and provide the City with the greatest flexibility. The transmission main can be used to blend groundwater with San Francisco Public Utilities Commission or Santa Clara Valley Water District supplies without impacting customers in Zone 1SF. In addition, sending blended groundwater to Zone 1SC will help the City better address the 20% reduction request from Santa Clara Valley Water District.

San Francisco Public Utilities Commission is only requesting a 10% reduction and the City of Milpitas has an Individual Supply Guarantee of 9.23 mgd with an interim supply allocation of 8.96 mgd. The average annual San Francisco Public Utilities Commission demand has been approximately 6 mgd. Thus, there appears to be more reliability in San Francisco Public Utilities Commission water supply at this time versus Santa Clara Valley Water District. Therefore, Option 2 is not recommended at this time. A storage tank and treatment system are also not recommended due to higher capital and O&M costs."

Appendix A2 - Aquifer Map

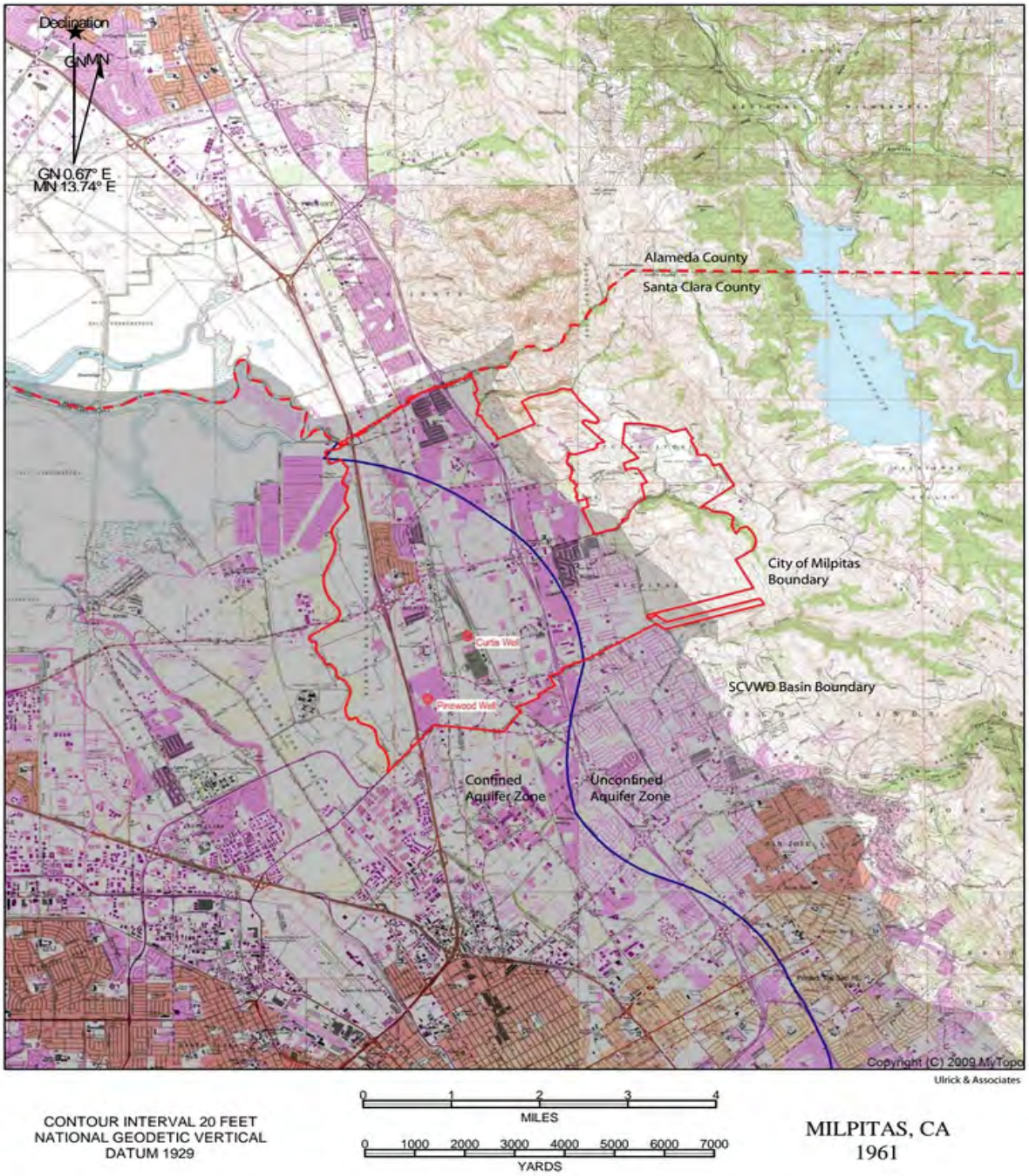

Figure 1. Topographic map showing SCVWD groundwater basin charge zone, confined aquifer boundary, City of Milpitas boundary, and Curtis and Pinewood wells.

Appendix A3 - From Correspondences with Ulrick & Associates:

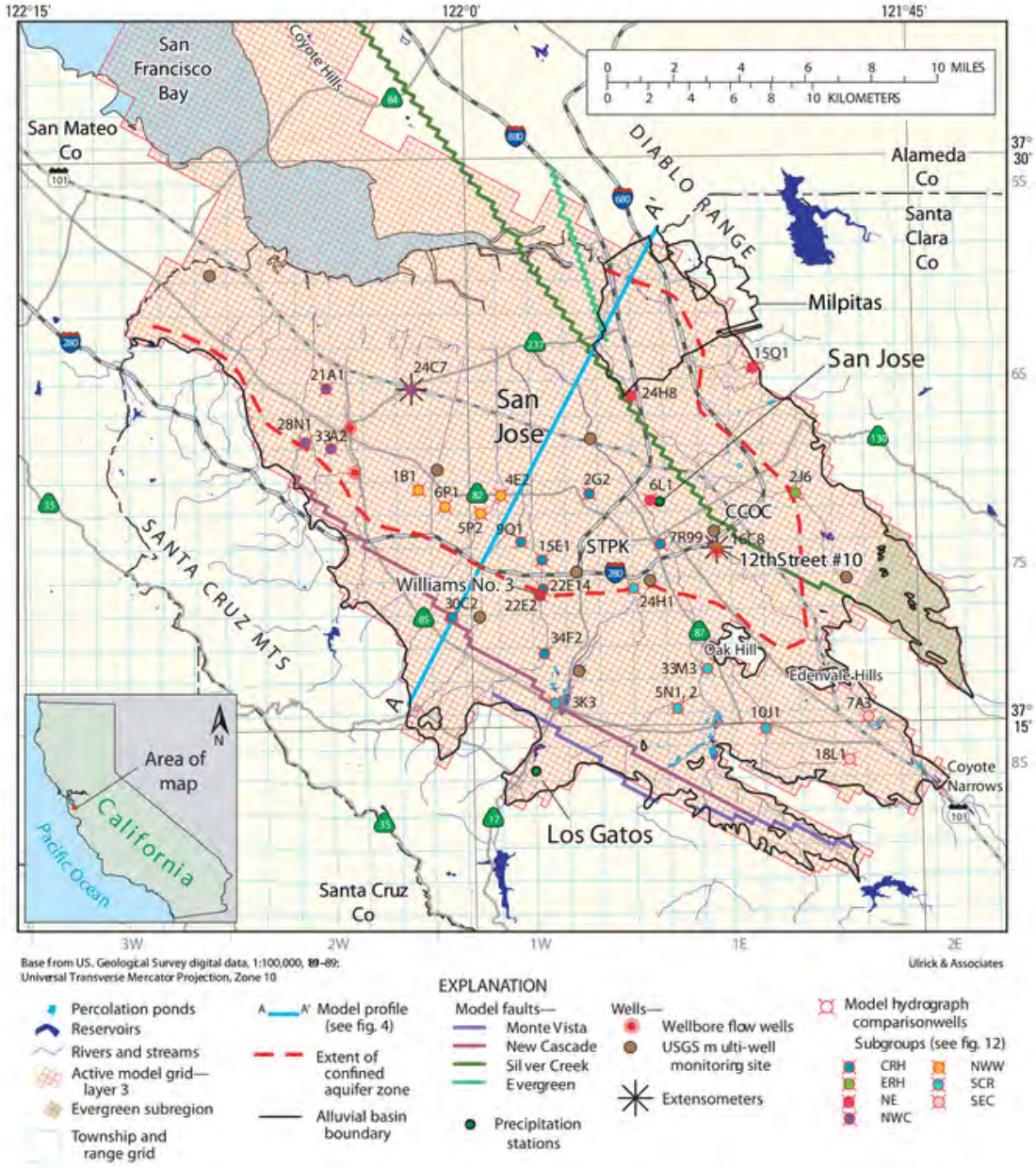

Figure 2. USGS Groundwater flow model area, model grid, selected water-level and compaction sites, confined aquifer boundary, City of Milpitas boundary, and geologic cross-section line A-A'.

Source: Hanson and Faunt, 2004

Appendix A4 - From Correspondences with Ulrick & Associates:

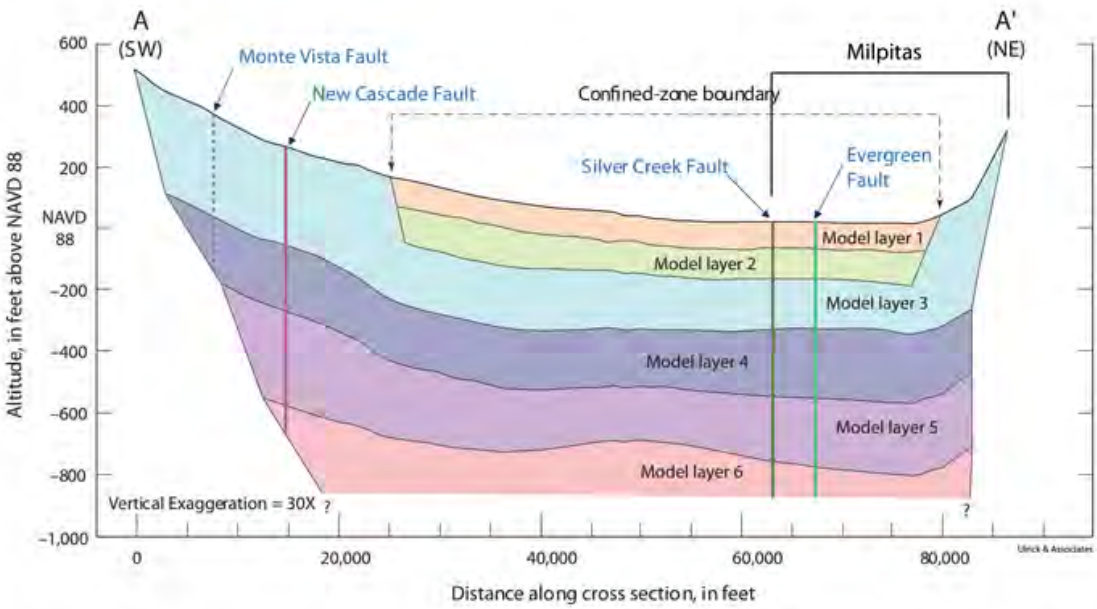

Figure 3. Cross-section A-A' showing groundwater flow model layers, geologic features, confined zone boundary, and City of Milpitas limits. See Figure 2 for location of section.

Source: Hanson and Faunt, 2004

XC is cross section A-A', location shown on Figure 1. The primary water-bearing depth intervals are

- Layer 3 (150 to 300 feet deep)
- Layer 4 (300 to 500 feet deep)
- Layer 5 (500 to 800 feet deep) is a possibility
- Layer 2 is a low conductivity aquitard (clayey layer)

The Silver Creek and Evergreen faults are shown to be outside of the city boundary. The east end of the cross section is the Hayward Fault.

Layers 3, 4, and 5 are shown in plan view. The main area of interest is horizontal hydraulic conductivity shown in the upper left corner of each figure. In general, conductivity (K) increases to the south and west within the limits of the city.

- Layer 3 K = 1 to 114 ft/day
- Layer 4 K = 1 to 60 ft/day
- Layer 5 K = 1 to 40 ft/day

The Pinewood Well K = 100 to 200 ft/day in layers 3 and 4. It is located near the southwest corner of the city. Generally, favorable sites for a well are in the south and west parts of the city and 150 to 500 feet deep."

Water Solutions Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 5: Surface Water Rights Acquisition**

Summary

The City of Milpitas (City) currently holds no “water rights”. Water rights, as applied to *surface water*, is a complicated topic with a number of legal implications. Unless these rights are asserted by a property owner, despite being entitled to an owner, they can be “lost” and thereafter “found” by another party, who may then claim them. It is these lost rights that the City should be looking for, if it decides to embark on a quest for water rights. To identify potential rights, the City should undertake a systematic search to identify any unclaimed water in the Milpitas area.

Acquiring, through legal acquisition, “lost” water rights could cost $2 million or more, and could take up to ten years. Purchase or lease of water rights could be done less expensively and over a shorter period of time.

Appropriative water rights are rights held by persons who do not hold the property appurtenant to the body of water, and it is these appropriative rights (which are more junior than riparian rights) that are commonly bought and sold. The purchase or lease of rights is a painstaking and legally costly endeavor, and should an environmental concern arise, a time consuming one too.

“Wheeling” refers to the process of moving water from one region to another using pipes owned by another entity. For example, to use water from East Bay Municipal Water District, the City would wheel through the City of Hayward and Alameda County Water District. Wheeling is less costly than installing a dedicated pipe, but it still has cost issues.

Surface water throughout Milpitas should be checked for available water rights (See technical memorandum, Task 3: Surface Water). If available, these rights could be purchased and the water used for construction water, recycled water or potable water.

However, a surface-water treatment plant could cost as much as $75 million at the outset, and incur a significant cost annually in operations and maintenance, including salaries for well-trained operators. Once the water is treated, it must be directed to its consumers, which would also incur significant costs. Water wheeling could be an effective tool to provide surface water to the City, should the available water be some distance away.

However, during this time of drought and unparalleled need, it is unlikely that the City would find a surface water seller, even though only 10 million gallons (or 30.5 acre-feet) of water is needed daily.

Water Solutions, Inc. has discovered the possibility of purchasing unused treated water allotment and our recommendation is to pursue this option.

Data

If water is taken from a lake, river, stream, creek or from underground supplies for a beneficial use, the California Water Code requires ownership of a water right. A water right is a legal entitlement authorizing water to be diverted from a specified source and put to beneficial, non-wasteful use. Water rights are property rights, but their holders do not own the water itself. Instead, they possess the right to use it. The various types of water rights are discussed below.

California law distinguishes between surface water and groundwater. Here, we are discussing the acquisition of surface water. Acquisition can be through:

- riparian water rights (held by an entity whose property is appurtenant to that source)
- appropriative water rights (rights to divert water from a surface water source for use on non-riparian land)
- prescriptive water rights (acquired through the adverse possession of someone else's water right; granted by court)

Generally, due to the limits and specific requirements for ownership of riparian and prescriptive water rights, municipal surface water supplies are derived from appropriative rights. Since 1914, the date of the *Water Commission Act,* surface water rights have been administered by the State Water Resources Control Board, and approval is required before using surface water. An appropriative water right that was acquired before 1914 (pre-1914 water right) does not require a water right permit unless water use has increased since the acquisition date.

The City currently has wholesale purchasing contracts for treated water (San Francisco Public Utilities Commission and Santa Clara Valley Water District Water Supply Agreements), which should not be confused with water rights. The agreement with the San Francisco Public Utilities Commission, for example, states only that the City is

guaranteed a minimum delivery of 5.341 million gallons per day of treated water from San Francisco Public Utilities Commission (Water Supply Agreement, 2009). Otherwise, the blanket agreement only goes on to stipulate the financial burdens of the wholesale customers and of the Commission itself.

Similarly, the agreement with Santa Clara Valley Water District only stipulates that the District will provide a supply to the City based upon the prospective delivery schedule, which is updated annually. The District is agreeing to deliver peak demand quantities lower than those that existing standard peaking factors would require; however, the agreement for this supply of water is available until 2054. This is, once again, a "Water Supply Agreement," not a lease or transfer of water rights. The agreement between South Bay Water Recycling and the City is similar, operating under a prospective deliveries schedule. Once more, this arrangement does not represent water rights – only contractual rights to supplied water.

Methodology

The information in this memo was gathered from:

- California Code of Regulations
- California Water Code
- The City of Milpitas Public Utilities, staff and records
- Leroy Jones, Distribution Manager for Placer County Water Agency
- San Francisco Public Utilities Commission
- Nathan A. Metcalf, Senior Counsel at Hanson-Bridgett LLP, attorneys at law

The subtasks and specific questions addressed in this memorandum include the following:

A. Discuss water right methods, including banking/transfers, idea of new development being required to obtain its equivalent water rights, etc.
B. Provide examples of various water rights
C. Discuss expansion of inter-tie connections with adjacent water suppliers for temporary short-term conditions
D. Identify most practical water right method, and related implementation plan and summarize in feasibility section

Legal and financial considerations will be addressed at the end of "Methodology" below.

There will be a final Task 5 Implementation Plan Table at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation.

A. Discuss water right methods, including banking/transfers, idea of new development being required to obtain its equivalent water rights, etc.

Generally, surface water may be acquired by:

- new appropriation
- purchase or change in an existing water right
- water transfers and contractual agreements
- water wheeling

For certain purposes, a water right is treated as a real property right, which may be sold and/or transferred. Water rights in certain watersheds are subject to adjudication by the court or curtailment by the State Water Resources Control Board.

New Appropriation

Where an unappropriated water is available, a new water right may be established by filing an *Application to Appropriate Water* with the California State Water Resources Control Board. Appropriation is a complicated, multi-staged process with layers of environmental review and regulatory oversight. The following analysis provides a general overview of the process.

Stage 1 - Application

For the application stage, an applicant must:

- file a fully completed water right application with the State Water Resources Control Board - Division of Water Rights
- pay all required fees
- provide a Water Availability Analysis – information to allow the State Water Resources Control Board to determine if there is unappropriated water available for the project
- make a No Injury Determination – show that the proposed project would not deprive anyone who has a higher priority water right of the use of water under that right
- annalize the Public Trust Doctrine – show that the proposed project will not harm public trust resources (such as fish, recreation, and navigation uses)
- show that the proposed project is in the public interest

Stage 2 - State Water Resources Control Board and California Environmental Quality Act Review

In granting an application, the State Water Resources Control Board must consider the impacts of the project on water quality and the environment, under the *California Environmental Quality Act*. In addition to a *California Environmental Quality Act* review, water projects often include other environmental reviews and permitting requirements,

including:

- 1600 Certification – *Streambed Alteration Agreement* from California Department of Fish and Wildlife
- Fish bypass flows – California Department of Fish and Wildlife
- *Clean Water Act* 404 Permit – U.S. Army Corps of Engineers (to protect from the effects of construction activity in waterways)
- *Clean Water Act* 401 Certification – Regional Water Quality Control Board (diversion project will not violate California water quality standards)
- *Endangered Species Act* Issues:
    - *California Endangered Species Ac*t (if the project has the potential to harm a State-protected species)
    - U.S. Fish and Wildlife Service under the federal *Endangered Species Act* (if the project has the potential to harm a federally-protected species)
    - National Marine Fisheries Service under the federal *Endangered Species Act* (if the project has the potential to harm a federally protected anadromous species).

Stage 3 - State Water Resources Control Board Division of Water Rights Approval Period and Public Review

The State Water Resources Control Board Division of Water Rights advises that it may take three to four years to obtain a permit. However, there are a number of obstacles which could complicate, and therefore prolong the permitting process. In addition to a potential challenge, applications must be publicly noticed, and any interested person may file a written protest against approval of the petition claiming that approval of the petition would:

1. Interfere with prior water rights
2. Have an adverse environmental impact
3. Not best serve the public interest or public trust.
4. Be contrary to law
5. Not be within the jurisdiction of the State Water Resources Control Board

If unresolved, such a protest could end up in an administrative hearing before the State Water Resources Control Board, with a potential appeal to Superior Court.

Stage 4 - State Water Resources Control Board Issues Permit

If the State Water Resources Control Board approves the application, a water right permit is issued, which will contain specific permit conditions. The permit allows development of the water supply project and the taking and use of the water.

Stage 5 - State Water Resources Control Board Issues Water Rights License

After the project is fully developed and the water put to use, the State Water Resources Control Board will determine how much water is being beneficially used and will issue a water right license. The water right license is a vested right that confirms the actual use of water.

Purchase and Change of an Existing Water Right

In addition to filing for a new surface water appropriation, water rights can be purchased with a change in ownership and use. However, any change in the purpose of use, place of use, or point of diversion, requires the filing of a Petition for Change and State Water Resources Control Board approval. The Petition for Change process is similar to an application for a new appropriation, and the State Water Resources Control Board must make a finding that there is no injury to other water users and the change is not counter to the State's public trust obligations. A Petition for Change also requires a *California Environmental Quality Act* review, environmental permits and authorization (as described above), as well as being subject to a protest by any interested party.

Pre-1914, “senior” water right holders are not required to petition the State Water Resources Control Board to change the place of use under their right to transfer water. However, pre-1914 water rights are subject to the no injury rule and public trust analysis, and a complaint may be brought by a party injured by the change.

Proposals to move water out of a watershed are governed by specific area-of-origin laws, which seek to reassure users of water in the geographic area where such water originates, that their water supply needs will be protected from any impacts of exporting water out of the area of origin. Further, a municipal water supplier who enters into another watershed for the purpose of taking, diverting or transporting water for use by the municipality may be liable for damage caused to any property, business, trade, profession, or occupation by the diverting or transporting of water from that watershed (Water Code § 1245.)

Water Transfers and Contractual Agreements

A water transfer results in a reallocation of water among water users, providing flexible water allocation and use. The City’s Urban Water Management Plan requires a description of the opportunities for exchanges or transfers of water (Water Code §10631(d)). There are a number of types of water transfers, which are generally grouped into short and long-term transfers. A short-term transfer is any transfer of one-year or less; a long-term transfer is any transfer longer than one year.

Transfers may be surface water transfers or groundwater transfers.

For surface water transfers, two types of surface water supplies may be transferred:

- first is a supply where the entity holding the water right will transfer that supply or a portion of that supply.
- second is a supply where an entity contracts for the water supply but does not hold the underlying water right and wishes to transfer that supply or a portion thereof (middleman).

For groundwater transfers, there are three types, namely:

- use of groundwater in lieu of surface water
- transfer of banked groundwater
- direct transfer of groundwater

The most common types of water transfer are:

- crop Idling (leaving idle land that otherwise would have been planted in order to transfer the water thus conserved)
- groundwater Substitution (pumping groundwater for use in the seller's service area and transferring the surface water that the seller otherwise would have diverted)
- reservoir Reoperation (releasing surplus storage for transfer)

The California State Water Resources Control Board - Division of Water Rights manages the Water Transfers Program. The State Water Resources Control and the U.S. Bureau of Reclamation have developed procedures to assist in the processing of water transfers proposed by local or private entities. Under the Water Supply Agreement with the San Francisco Public Utilities Commission, priority will be given for the use of facilities to accommodate transfers by wholesale customers.

A water transfer must not:

- Injure other legal users of water
- Unreasonably impact fish, wildlife or other instream resources
- Not unreasonably impact the economy of the area from which the water is developed. Transfers that move water across the Sacramento/San Joaquin Delta (Delta) are difficult to complete due to operating restrictions in the Delta related to water exports and water transfers based on:
    - Water Right Decisions and Orders issued by the State Water Resources Control Board
    - Water quality objectives
    - Endangered/threatened species issues.

These restrictions are comprehensive and complicated.

Water Wheeling

As mentioned above, the wheeling of water is a process wherein one entity is delivered water via the transmission and distribution mains of another entity, in order to supply the customers of the first entity. For example, if a county owns water that is allocated to certain customers, but does not have any mains reaching those customers, it may be possible for the county to "wheel water" through a community water system that lies between the supply and the customers, even if that community water system is not owned by the county.

The City of Roseville is a part of Placer County, in California. Placer County has customers throughout the county. However, Roseville is its own water supplier. The county and the city have worked out an agreement where the customers of the county that are on the far side of Roseville receive water delivered from the county via the Roseville distribution system (Jones, 2014).

This is an uncommon arrangement, but it has been ongoing continuously since 2004. Milpitas could set up a similar agreement with any of six or seven nearby water systems that may have available water to sell to the City. Of course, this arrangement would be contingent on the willingness of the wheeling water systems to pass this purchased water through their systems to Milpitas.

This is not an inexpensive proposition. A preliminary estimate places the cost of wheeling water somewhere between that of new recycled water lines and desalination. These costs would include:

- legal fees
- permitting costs for a Water Supply Permit Amendment
- wheeling fees
- actual cost of purchasing the water

B. Provide examples of various water rights

Riparian water rights are rights to water in a surface water source that are held by the entity whose property is appurtenant to that source. A riparian water right is a right to use the natural flow of water on riparian land. Riparian land is land that touches a lake, river, stream, or creek. A riparian water right holder may consume a fixed percentage of water flow directly from a surface water source. For example, a farmer would be able to water his fields using a pump and an intake directly in the source water; however, that farmer would not be allowed to dam the source or otherwise impede its flow. A riparian right is limited by reasonable beneficial use.

Appropriative water rights are rights to divert water from a surface water source for use on non-riparian land. Many of these rights date back to the days of the California Gold Rush and, as such, are difficult to establish. As discussed above, after 1914, the date of the *Water Commission Act,* appropriative rights are administered by the State Water Resources Control Board, and approval is required before using the water. An appropriative water right that was acquired before 1914 (pre-1914 or “vested” water right) does not require a water right permit unless water use has increased. Priority of use depends on seniority of the water right: “first in time is first in right”. Therefore older rights are more senior than younger ones, and take precedence.

A prescriptive right is a right acquired through the adverse possession of someone else's water right, that is, a right obtained through the uncontested use of a water right held by another entity for a period of five years or more. Prescriptive rights are difficult to obtain and can only be granted by a court.

Reserved water rights are very rare. They refer to those waters set aside by the federal government when it reserves land for the public domain. Federally reserved water rights are important because they can take precedence over individual water rights that are filed at a later date. For example, Pueblo rights are historical rights from the times of the Spanish and Mexican governments in California. These rights are not lost if they are not used, and are superior to riparian and appropriative rights. Only Los Angeles and San Diego retain these rights presently.

C. Discuss expansion of inter-tie connections with adjacent water suppliers for temporary short-term conditions

In addition to its connections with Santa Clara Valley Water District and San Francisco Public Utilities Commision, the City has interties with Alameda County Water District to the north and San Jose Water Company to the south. Additional interties would allow the City to purchase additional water from Alameda County Water District and San Jose Water Company. San Jose Water Company, a private company, sources its water as follows: 40% is groundwater, 10% is surface water from the Santa Cruz mountains, and the remainder is purchased from Santa Clara Valley Water District.

According to Section 81460 of the Water Code, Alameda County Water District is allotted 15,709 hundred cubic feet or 11.8 millions of gallons per day from the San Francisco Public Utilities Commission. Alameda County Water District uses 8.96 millions of gallons per day (or 76%) of this water for 20% of its total demand of 43.5 millions of gallons per day. In contrast, Redwood City, for example, is allotted 15,753 hundred cubic feet or 11.8 millions of gallons per day from the San Francisco Public Utilities Commission. Alameda County Water District uses 9.06 millions of gallons per day (or 77%) of this water for 93.7% of its total 9.67 millions of gallons per day demand. These figures show that Alameda County Water District is comparatively water-rich in comparison with other Bay Area water districts.

If a short-term or emergency supply were needed, the Alameda County Water District interties, both of which are 8-inches in diameter, could each suffice to supply the City with approximately 2.3 millions of gallons per day per day, thus providing 4.6 millions of gallons per day, which is nearly half of Milpitas' average demand of 10.12 millions of gallons per day. If more interties were constructed and connected, it would be possible to purchase an even higher volumetric flow rate from Alameda County Water District,

should the need arise. In fact, discussions with Alameda County Water District management have revealed that the district is indeed interested in selling its additional capacity to the City. Alameda County Water District is interested in recouping lost revenue due to conservation by its consumers.

D. Identify most practical water right method, and related implementation plan and summarize in feasibility section

The best option, from a legal standpoint, for the City to obtain water through an acquisition will depend on the geographic, environmental, and political setting of the water right in question. The City would have the most control over the water if local water was available and the City could acquire it as either unappropriated water (water available for appropriative right) or as pre-1914 (vested) water rights available for purchase (e.g., old agricultural rights).

The preliminary water sources reviewed should be determined from the technical memorandum provided, see *Task 3 - Surface Water Detention* as well as *Task 4 - New Groundwater Wells*. A list of the major surface water features throughout Milpitas are labeled, as well as possible groundwater extraction locations.

The possibility of a new appropriation would depend on whether unappropriated water is available at the source. Further, any coastal stream or source that may impact a coastal stream could have endangered species issues (e.g., red legged frog, steelhead trout, etc.), which would impact the available water by requiring the dedication of water for environmental resources (e.g., mandatory fish flows). In addition, environmental interests might protest/challenge a new appropriation if there is potential for environmental impacts. Purchase of original longstanding water rights is advantageous; original longstanding water rights will have no contestant ownership issues, minimizing any potential claim of injury to an existing water rights owner. Nevertheless, any environmental issues associated with the required change could lead to a protest or *California Environmental Quality Act* challenge.

Purchasing a water right outside the watershed poses additional complications:

1. First, environmental and civil protections for the area of origin must be considered.
2. Second, the ability to use the water depends on contractual agreements to move the water to the service area. Particularly troubling is moving water out of, or through, the Delta. Transfer of a water right requires a willing seller and also requires contractual agreements to move the water.
3. Finally, water transfers are regulated by the State Water Resources Control Board and are subject to protest/challenge, as well as generally requiring *California Environmental Quality Act* review.

Legality

As described above, acquiring water rights is a complex and complicated, multi-staged process with layers of environmental review and regulatory oversight. The legal issues involved in any specific acquisition project can be influenced by the:

- type of water right involved
- nature of the project
- physical and environmental setting
- prevailing political views

Before initiating a water acquisition project, issues relating to permitting and regulatory compliance should be fully analyzed and potential legal challenges should be identified.

Finances

The legal costs of pursuing a water right depend on the particulars of the situation, the permits required, the extent of the environmental review, and the political setting (i.e., are protests likely to be filed). Cost estimates for acquiring a water right are as follows and amount to approximately $1.7 million (Metcalf, 2014):

- research for available water rights: $3,000,000
- legal fees: $65,000 – $500,000+
- government permitting fees: $2,150+
- Consultant fees: ~$100,000
    - water Availability Analysis
    - no Injury Determination
    - analyze the Public Trust Doctrine
    - show that the proposed project is in the public interest
- appeal of Water Board's Decision (possible): $50,000 – $200,000
- *California Environmental Quality Act* Consulting fees (possible): $30,000+
- government *California Environmental Quality Act* fees (possible): $6,500+
- Endangered Species Act - Habitat Conservation Plan: $300,000+
- Resolution of Protest, legal fees (possible): $200,000 – $600,000+
- actual cost of purchase water rights, per acre-foot $40 – $250

Additional costs associated with water rights acquisition relate to treatment and transport. Surface water treatment of 10 million gallons per day could be accomplished with a package plant system costing potentially $75 million or more. This means the total capital cost of surface water acquisition and treatment is $76,700,000.

$$10\ million\ gallons/day\ =\ 10,337\ hundred\ cubic\ feet/day$$
$$10,337\ hcf/day \times 365\ days = 4,880,050\ hcf/yr$$

Operations and maintenance costs could be significant. The City of Fresno estimates an annual cost of $2.9 million for four operators at a 30 million of gallons per day surface water treatment plant (Fresno 2008). Maintaining a staff of surface water treatment operators for 24 hours a day is not inexpensive, as surface water treatment requires a T-3 level operator. Therefore the total capital cost for Operations and Maintenance of a 10 million gallon per day plant is approximately $1 million annually.

$$(\$76,700,000 + (\$1\ million \times 50)) \div (4,880,050\ hundred\ cubic\ feet\ saved\ per\ year \times 50\ years) = \ldots$$
$$\ldots = \$0.52\ per\ hundred\ cubic\ feet$$

Transport of treated water would require right-of-way acquisition and many millions of dollars of City-owned pipeline extending from the treatment plant to the City distribution system. Alternately, water could be “wheeled” through water districts that lie in between the treatment plant and the City distribution system. The cost of wheeling water is undetermined, but is likely much less than building a transmission main; however, this approach requires the cooperation of neighboring water utilities.

Of course, the option of acquiring water rights depends on the availability of nearby water, see technical memorandum *Task 3 - Surface Water Retention*. However, it cannot simply be assumed that water rights will be readily available, as needed, and planning is required.

Results

It seems clear that the potential availability to possess water rights, while limited, is very powerful. If a water right can be found that could be held by the City, the City should make all possible efforts towards acquiring that right.

The costs and complexities of acquiring water rights are significant. However, the potential for payoff is quite great if recharge credit can be gained from the Santa Clara Valley Water District (see *Task 3: Surface Water Detention*), or if the necessary water quantity and investment funds are available for the construction of a Surface Water Treatment Plant.

Conclusion

If acquiring new water rights is determined to be a cost effective alternative for the City, the first step is searching for available rights in the area. A hydrogeologic assessment of

local stream flows – historic, present and future – would be next. The costs and complexities of transport of water from distant sources are great enough to disinterest most communities from pursuing this avenue of water augmentation.

The best water rights to pursue would be old, unused agricultural rights or existing, senior rights. Compared to other options, these rights would bring fewer possibilities of protests based on environmental concerns.

Once an acceptable appropriative right has been identified as suitable for purchase, the treatment and transport of the water to Milpitas must then be considered. The cost of treatment is potentially high, but the cost of transporting raw water to a treatment plant in Milpitas is potentially much higher. To effectively treat 10 million gallons per day, which is the City's average demand, a small surface water treatment plant would need to be constructed, ideally, on City-owned land near the water source. If these are not immediately appurtenant to the City, this water could then be piped to a local community and "wheeled" to Milpitas through other water districts' distribution systems. This approach would probably involve training and maintaining a surface water treatment personnel group (an outside contractor), although treatment could potentially be conducted in-house by trained water treatment plant operators, or even contracted out to another community for operations.

Alternately, and perhaps a better option, would be the construction of a relatively inexpensive wetlands-style series of retention ponds in the unconfined aquifer zone east of the City in the hills. This could provide a percolating groundwater recharge facility that could prove to be beneficial to the City, which is looking for its own sources of water, but which also needs the cooperation of the Santa Clara Valley Water District (See *Task 3: Surface Water Detention*).

In summary, surface water rights acquisition is a very complicated option for water augmentation, involving many parties and other potential elements. This option is also expensive. Its is likely to cost $2 million dollars at the least, and potentially much, much more. Last, the time required to acquire water rights, construct treatment and establish transmission to the City could be 10 years or more.

Task 5: Water Rights Acquisition, Implementation Plan (NOT IMPLEMENTED)

Implementation Schedule:

1. *Obtain water rights for the use of surface water for construction purposes, see Task 3: Surface Water Detention for additional information, including implementation plan (July 2015)*
2. *Hire a consultant to look for available water rights in this order of preference: Senior appropriative water rights; Old agricultural appropriative rights (1 Jan. 2016)*
2. *Hire a consultant to prepare application for water rights, including all supporting documents (1 May 2016).*
3. *File a fully completed water right application with the Division of Water Right (1 June 2016)*
4. *Pay all required fees (1 August 2016)*
5. *Commence environmental review and permitting requirements (1 September 2016)*
6. *Finalize environmental review and permitting requirements (1 December 2018)*
7. *Open talks with other agencies for treatment and "wheeling water" (1 June 2015)*
8. *Finalize contract documents for surface water detention and/or surface water detention (1 September 2015).*

Costs:

Implementation of a surface water rights acquisition program could cost $1,700,000 or more in addition to the annual costs. Transmission of raw water would cost many millions of dollars for pipeline or canal, so water would need to be treated with a surface water treatment plant costing at least $75 million, and then transmitted via "water wheeling" or pipeline. "Water wheeling" would cost potentially hundreds of thousands of dollars, but would be approachable in annual cost.

- Total capital cost of surface water acquisition and treatment is $76,700,000.
- Total operations and maintenance cost of surface water acquisition and treatment is $1 million annually.

Benefit:

- Water rights acquisition would allow the City to be able to cease purchasing water from wholesalers entirely. Annual water transfers via "water wheeling" would be equivalent and would allow the city to avoid treating surface water, while purchasing from other more desirable parties.
- Approximately 10 million gallons per day of treated water (or 4,880,050 hundred cubic feet per year).

Life Cycle:

The life cycle of a water rights contract is effectively unlimited, dependent only upon the availability of the water in question and the continued interest of all parties.

Prioritization by life-cycle:

1. Senior water rights (least likely to be protested) - less time until acquisition 2. Old agricultural water rights (more likely to be available) - longer timeframe
Ease of Implementation: Planning for and the acquisition of water rights is a complicated and uncommon event involving the execution of multiple contracts over the course of as many as ten years.

List of References

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Water Solutions Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 6: Desalination**

Summary

The allure of desalination is the ability to create a near-endless supply of water that is resistant to drought. However, the immense costs of brine disposal, operating costs, up-front capital investment and environmental concerns are enough to make desalination the most costly of all the treated waters available. However, desalination is still a viable option for a long-term augmentation method or for a back-up supply; especially with collaboration amongst neighboring agencies. Also, a system with a properly designed pretreatment system, as well as treating brackish groundwater (as compared to San Francisco Bay waters), can drastically reduce operating costs.

The infrastructure and the operating costs required to run a desalination facility are significant. The reverse osmosis membranes and facility infrastructure tend to have a short service life. Also, the high disposal costs of the brine water (the extra-salty water leaving the reverse osmosis unit), high energy costs, and membrane replacement costs results in a high life cycle cost.

Similarly challenging is the availability of land and intake waters for the construction and operation of a desalination facility. The distance of the City of Milpitas to the actual waters of the Bay presents a challenge, as do the capacity limitations of the upper aquifer, from which brackish water could be drawn. It is therefore important to explore all of the available options when deciding whether to pursue desalination for water augmentation and whether to explore partnership options with regional projects.

The legal hurdles for establishing a desalination facility can also be considerable. There are *seventeen, or more, potential legal implications, each of which may require attention before a desalination plant can begin operation.*

Using brackish groundwater, where available, is a more energy-friendly alternative to seawater desalination and could potentially be a more cost effective approach to augmenting water supplies than seawater desalination. This is due to the reduced energy costs to treat the water, lower disposal costs of brine (the concentrated salt water generated by desalination) and the lower operating pressures required to treat brackish water. Brackish water is classified as approximately 1,000-5,000 parts per million total dissolved solid, while seawater contains upwards of 40,000 parts per million total dissolved solid. Using brackish groundwater sources requiring low-pressure filtration systems (or reduced pressure reverse osmosis), could be a feasible plan to augment available water sources through desalination. By forming partnerships with neighboring communities, sustainable sources of brackish water can be used, energy costs can be reduced and investment costs can be shared.

Forming partnerships with neighboring communities for large, regional desalination plants or locally-run brackish desalination plants is likely the best solution to provide water source reliability and augmentation without the burden of overwhelming investment costs. Due to limited brackish groundwater sources, the City of Milpitas may not be ideally located for a desalination plant or a brackish water treatment plant. However, opportunities for partnerships and interagency cooperation should be encouraged. Coordinating or partnering with Bay Area regional desalination water projects when available should be investigated, as opportunities arise.

Data

The information for this memo was gathered from water resource literature, journals, peer-reviewed online articles, California desalination case-studies, public records and from Glenn Reynolds (Principal at Water Solutions, Inc.). Additional sources of information were gathered by contacting agencies involved in water desalination, the U.S. Environmental Protection Agency website and attending seminars relevant to this topic. Also, design plan summaries for various desalination projects were compared throughout California for quantity estimates.

Methodology

The methods used to determine the feasibility and recommendations for desalination in this memoranda include the following: Referencing water resource literature, journals and online articles for relevance to the construction of a desalination facility for Milpitas. Desalination case-studies throughout California were also compared for their relevance and various water agencies were contacted for additional information. Also, design plan

summaries were compared for various desalination projects throughout California for quantity estimates. This data was used to determine the applicability, costs and permitting requirements for desalination and brackish water treatment for the City of Milpitas; as well as the specific topics as follows:

A. Identify preliminary regulatory compliance requirements
B. Describe operational/physical parameters of desalination processing
C. Identify necessary infrastructure for well operation
D. Discuss ownership, participation/partner aspect
E. Identify current regional projects underway
F. Provide operational/physical parameters and estimated reductions of consumptions

Legal and financial considerations will be addressed at the end of "Methodology" below.

There will be a final *Task 6 Implementation Plan Table* at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation.

A. Identify preliminary regulatory compliance requirements

There are two major regulatory/permitting issues to consider when implementing desalination plants. The first involves the development of water sources (brackish or seawater) and the second is related to the management of discharging/disposing of desalination byproducts. Several federal permits are required to comply with environmental legislation relating to these issues, as discussed below.

The Clean Water Act
Sections 316(a) and 316(b) of the Clean Water Act authorizes the U.S. Environmental Protection Agency to address issues pertinent to discharging heated water into "receiving waters". This role applies to desalination plants co-located with a power plant ("Permits and Regulatory Requirements," Tamim Younos, Dec. 2005).

- Section 316(a) specifically addresses issues relating to disposing heated water into receiving waters.
- Section 316(b) specifically addresses issues relating to entrainment and impingement of marine life. Any environmental impacts due to implementation of desalination must be mitigated by the plant operator.

Section 402 of the Clean Water Act requires the U.S. Environmental Protection Agency to implement the National Pollution Discharge Elimination System Program. This program regulates the concentrate disposal and brine discharge from desalination plants. The Agency sets limits on an industry-wide, water-quality basis to ensure protection of the

water received. However, the Agency delegates to state governments the authority to issue permits and enforce proper disposal relating to the National Pollution Discharge Elimination System Program.

Through Section 404 of the Clean Water Act, the U.S. Army Corp of Engineers is authorized to issue permits for disposal of desalination discharge into U.S. navigable waters. If a desalination plant being constructed will excavate or fill navigable U.S. waters, the contractor must obtain a permit from the Army Corps of Engineers in order to proceed ("Permits and Regulatory Requirements," Tamim Younos, Dec. 2005).

The Resource Conservation and Recovery Act
The Federal Resource Conservation and Recovery Act establishes a system for managing hazardous and nonhazardous solid wastes in an environmentally correct manner. This Act applies to the disposal of desalination discharge (such as brine) into receiving waters, which is also addressed in several other sections of legislation.

The Porter-Cologne Water Quality Control Act
The *Porter-Cologne Water Quality Control Act* is considered "the principal legislation for controlling stormwater pollutants in California" (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013). This Act requires that Water Quality Control Plans be developed for water basins in California. Each plan is considered a blueprint to protect water quality in the various watersheds and identifies specific controls for discharges into these watersheds. Waste Discharge Requirements allow specific controls to be implemented. Desalination projects included in the the Water Quality Control Plan must comply with all rules and regulations in the Act.

The Endangered Species Act
The Endangered Species Act provides a program for the conservation of threatened/endangered animals and plants as well as their designated habitats. The U.S. Fish and Wildlife Service maintains the threatened and endangered species list and requires desalination plants to prepare a formal biological opinion if they may negatively impact any species on the list. As an example, the North American Green Sturgeon is federally listed as a threatened species. It resides in the bay which will require an evaluation of the potential impact of a proposed desalination plant.

Incidental Take Permit
An Incidental Take Permit is required when a state-listed, threatened or endangered species may be present within the project area. The US Fish and Wildlife Service acts as the lead agency for compliance with the *California Environmental Quality Act*. The Department of Fish and Game is allowed to issue an Incidental Take Permit for state-listed threatened or endangered species if:

1. the take is incidental to otherwise lawful activity
2. the impacts of the authorized take are minimized and fully mitigated

3. the measures required to minimize and mitigate the impacts of the authorization take are roughly proportional in extent to the impact, maintain the applicant's objectives, and are capable of successful implementation
4. adequate funding is provided to implement the minimization and mitigation measures
5. issuance of the permit will not jeopardize the continued existence of a State-listed species."

(Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013).

The permit process is usually initiated within the region where the permitted activity will take place by contacting the appropriate US Fish and Wildlife Service Regional Office. The following information may be needed when submitting an Incidental Take Permit application:

- review and analysis of the permit-compliance history for existing intake
- impingement and entrainment studies
- a flow and impingement/entrainment minimization plan

The Water Desalination Act

The Water Desalination Act authorizes the Secretary of Interior and the U.S. Bureau of Reclamation to award grants and enter into contracts through the Desalination and Water Purification Research and Development Program. These grants support desalination research, development and demonstration projects (Tamim Younos, Dec. 2005). In 2011, this Act reauthorized the Secretary of Interior to financially support desalination development and research through to the fiscal year of 2018 (OpenCongress website, Feb 2013).

The California Coastal Act

The California Coastal Act applies to desalination with regard to issues relating to environmental policies, growth inducement, coastal dependent vs. coastal related development and the feasibility of maintaining coastal areas (Tamim Younos, Dec. 2005). Section 30230, 30231, and 30224.5 are applicable to potential environmental issues due to desalination. Section 30213, 30222, 30222.5, 320234, 30250, 32054, 30255, and 30260 establish policies aimed at controlling growth and development in coastal areas.

According to the established desalination policies, new plants must take into account the coastal planning efforts and must not encourage growth outside of the set boundaries. Also, if a new plant is replacing an existing one, that plant must reduce or eliminate the existing impacts created by the current plant. The service area of a plant must be reviewed to ensure that the area of the plant is adequate to serve the maximum build-out of the service area. Coastal dependent developments receive the highest service priority, followed by recreational facilities. The only exceptions are locations where proposed, environmentally damaging development could affect public welfare and/or coastal development (Tamim Younos, Dec. 2005).

The environmental feasibility issues addressed in Section 30001.5 of the *California Coastal Act* relate to social, economic, environmental and technological feasibility:

- social feasibility takes into consideration the public's acceptance of mitigation measures
- economic feasibility looks at the cost of the measure
- environmental feasibility views the potential success of the measures
- technological feasibility views the ease of implementation of mitigation measures using the technology currently available

Coastal Development Permit

A Coastal Development Permit issued by the California Coastal Commission is required when a project is within an area that "encompasses the coastline and spans a distance of three miles offshore, and up to five miles inland" (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013). The specific information pieces that must be included when applying for this permit are:

- site development details
- location
- adjacent land use
- the presence of historic and/or cultural resources
- site maps

The largest concern with a project associated with desalination is the impingement and entrainment of marine life. If a desalination project involves open-ocean intake, a detailed study, clearly justifying the infeasibility of lower impact intake approaches, must be included in the permit application.

The California Environmental Quality Act (CEQA)

The *California Environmental Quality Act* does not identify and address specific types of projects but, instead, focuses on the significance of environmental impacts as determined through a "case by case" determination. This Act requires that every potentially large impact from a project be mitigated to a "less than significant level" (Schiffrin, 2012). Determining the significance of environmental impacts throughout a given development project is critical to achieving compliance with the *California Environmental Quality Act.* The lead agencies in given locations are authorized to determine significance thresholds.

Environmental Impact Report

"Environmental Impact Reports are required for projects that need discretionary approval from a State or local public agency that may have a potentially significant impact on the physical environment". These reports can be required by the *California Environmental Quality Act* or the *California Coastal Act* for development projects such as a desalination plant. An Environmental Impact Report only addresses environmental issues, and must be certified before the project will be given approval to proceed. The report issued by the

lead agency approving a given project must be used by other State or local public agencies when evaluating the potential environmental impacts of a project of the same type.

Lake or Streambed Alteration Agreement
The California Department of Fish and Game requires a *Lake or Streambed Alteration Agreement*, if the proposed development will occur within inland waters or within some areas of the bay/estuaries. This agreement is also required if project activities will significantly affect fish and wildlife resources. The agreement must set out the conditions that are necessary to protect wildlife resources and to comply with the *California Environmental Quality Act* (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013).

The Rivers and Harbors Appropriation Act
Section 10 of the *Rivers and Harbors Appropriation Act* requires that the Army Corp of Engineers authorize the issuance of a permit for any project affecting navigable waters in the U.S.. Such a permit may be either general or individual, depending on the anticipated environmental impact of the project (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013). Determination of whether the permit for a proposed project will be individual or general is made through an initial consultation with the Army Corp, for which the applicant must provide a well-defined concept of the anticipated intake and outfall of the given project.

For individual permits, the Army Corp of Engineers must notify the applicant within 15 days if there are any deficiencies in the application; once the application is completed, the Army Corp of Engineers must issue a public notice to this effect, allowing 30 days for comments. A general permit may be considered either regional or nationwide. In either case, the approval process is simple, and a permit application form may not be required (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013).

The National Historic Preservation Act
The *National Historic Preservation Act* directs federal agencies to ensure that historic preservation is taken into account for all activities that either indirectly, or directly, involve land use decisions. Section 106 of the Act requires that federal agencies consider the impact that any actions related to the desalination development may have on historic properties that are included on, or are eligible for inclusion on, the National Register of Historic Places (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013). The review process usually involves a formal consultation with the State Historic Preservation Officer, the Advisory Council on Historic Preservation and other parties that have knowledge of/interest in historic resources residing in the area impacted. Once the appropriate documentation is received, the State Historic Preservation Officer has 30 days to review and comment, and the Advisory Council on Historic Preservation has an additional 15 days. The review is usually completed prior to, or during, the *California*

Environmental Quality Act application process (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013).

Right-of-way Permit/Land Use Lease
The California State Lands Commission maintains a multiple-use management policy that assures the greatest benefit for the public. It is derived from legislation governing the use of State lands. In order to access State lands, a Right-of-Way Permit (or Land Use Lease) is required. Many proposed desalination plants plan on placing new intakes on state tidelands or changing existing intakes on these lands. Both of these actions require a Right-of-Way permit.

To obtain a permit, an initial inquiry regarding the use of State lands must be submitted to the California State Lands Commission. The Commission will then review the information given, and determine if the area is, in fact, within State jurisdiction. If it is, a Right-of-Way permit application is needed (Ocean Water Desalination Program Master Plan, Malcolm Pirnie, Jan. 2013). The proposed use of State land must comply with the provisions of the *California Environmental Quality Act,* and so the State Lands Commission may consult with the Department of Fish and Game for review of the permit.

Desalination development comes at a cost relating to the environment; removing seawater from a given location alters the ecosystem that once was there. Also, adding water with increased salinity to discharge waters has a high potential to change the water quality, adversely affecting wildlife. Also, impingement or entrainment of various types of wildlife living in aquatic environments near intakes can be a concern. Two types of fee-based mitigation measures can be required post development: Adult Equivalent Loss and Area of Production Foregone.

Adult Equivalent Loss
For Adult Equivalent Loss, a desalination plant pays a fee based on the number of adult fish eliminated by the entrainment of larval fish plus the fish loss due to impingement. This fee compensates for only the economic losses associated with adult fish.

Area of Production Foregone
For Area of Production Foregone, the mitigation fee is based on the cost of restoring sufficient habitat to produce marine organisms equivalent to those killed through entrainment (Mitigation and Fees for the Intake of Seawater by Desalination and Power Plants, Dominic Gregorio, Nov. 2011). Of the two mitigation methods, this one is preferable because the restoration of impacted habitat compensates for all wildlife harmed through entrainment, not just a select group of organisms, such as fish.

B. Describe operational/physical parameters of desalination processing

The key physical parameters for desalination processes are:

- site location
- water quality

Location is important for the proximity to suitable discharge sites (for brine) and required piping distances (for intake piping, discharge piping and to potable water mains). The water quality, which varies with location, dictates the type and extent of treatment which must be used. For example, the Bay Area Regional Desalination Project Site at Mallard Slough in East Contra Costa County experiences very high loads of total dissolved solids during low water periods because of its location at the mouth of the Sacramento River delta. In contrast, a site near the City of Milpitas, such as the mouth of Coyote Creek, shows higher values for suspended particulate matter when compared with the delta near Mallard Slough (USGS, 2014). The pretreatment methods would differ for each of these locations. Also, site specific measurements must be undertaken for each water supply.

Also important is the issue of land acquisition. The City limits are not actually adjacent to the San Francisco Bay. As a result, locating a desalination plant within the city limits is an unlikely prospect without the use of long and expensive intake and discharge pipelines. An alternative is to treat brackish groundwater from shallow aquifers or collection wells within the city limits or near the Bay. This strategy would allow the City to pursue a desalination project while taking advantage of the availability of brackish water, which has naturally less dissolved solids than Bay water. The effluent brine from treated brackish groundwater would also have similar concentration of salts as the Bay water, resulting in fewer environmental impacts than the discharges from seawater desalination.

Another alternative is to use slant wells, which would be drilled from the City limits into Bay water sources or ground adjacent to the bay. However, the San Jose-Santa Clara Regional Wastewater Facility in Alviso, which is directly northwest of the City, lies between the City and the Bay, thus legally precluding the use of that location and a radius of 2,000 feet around it.

Energy requirements for producing pure water from salt water includes:

- raw water supply handling
- treatment process
- drinking water distribution
- residuals management
- support staff

The typical pressure ranges are as follows:

- 15-30 PSI for fresh surface water
- 150-650 psi for brackish to saline water

- 650-1200 psi for typical seawater

Pumping energy depends on the amount of dissolved solids and the temperature of intake water; warmer water will, in general, require less energy. Typical pumping requirements based on 50% recovery at 34,000 milligrams per liter feed water total dissolved solid is approximately 7.5 Kilowatts times hours per 1000 gallons. ("Seawater Desalination Power Consumption," WaterReuse website. 2011). However, due to variations in pretreatment methods, salinity of feed water, concentrate disposal and conveyance, energy costs can range from 3.5 kW to 9.0 kW.

C. Identify necessary infrastructure for well operation

The principal processes for desalination use semi-permeable membranes and large pressures to cause water to flow against the concentration gradient and through the membranes, in a process called reverse osmosis. Along with the production of fresh water, is the generation of a salty brine water effluent.

Pretreatment is accomplished using conventional filtration, microfiltration, ultrafiltration and increasingly commonly, a combination of conventional and ultrafiltration.

- *conventional filtration* comprises two steps: settling and then filtration through a fine granular media such as anthracite coal
- *microfiltration* is a physical filtration process wherein a contaminated fluid is passed through a special pore-sized membrane to separate microorganisms and suspended particles from process liquid
- *ultrafiltration* is a form of filtration in which forces like pressure or concentration gradients lead to a separation through a semipermeable membrane. Ultrafiltration is not fundamentally different from microfiltration, as both methods separate through size exclusion or particle capture, although ultrafiltration results to higher quality water

Sometimes chemicals are added to pretreatment liquid for the purposes of enhancing filtration or for cleaning the filters.

- liquid chlorine, in the form of sodium hypochlorite, is often added as a disinfectant
- flocculants like aluminum chloride can be added to make suspended matter easier to filter.
- citric acid, phosphates and other acids may be used to clean the membranes periodically; however, this step results in an additional waste stream that must be dumped to sewerage
- water additives can be used to prevent scaling compounds in the water from precipitating and clogging the reverse osmosis unit

Reverse osmosis plants require specialized pumps that operate at high pressures (>300 psi for brackish water). The first pump is usually a well pump that pushes Bay water or

brackish water through conventional treatment, and is followed by a high speed centrifugal pump. This centrifugal pump can produce pressures in excess of 1,000 or pressure per square inch and can require thousands of horsepower, accumulating electricity costs that can add up to hundreds of thousands of dollars per month.

Replacing membranes, brine disposal and energy costs amount to nearly all of the operating costs of a desalination plant. Often, the greatest cost is brine disposal which can add up to over 60% of the operating and capital costs (Stanford University, "Final Report - Evaluation of Reverse Osmosis for Brackish Groundwater Desalination..."). Energy requirements can be the greatest operating cost, depending on the process; salinity concentrations of the feed water, recovery rate and pretreatment methods all contribute to changes in energy costs. Location challenges for a south bay desalination plant may also result in significant intake expense - Slant or horizontal intakes would be important options for the city to reduce intake costs. Brine disposal costs could be reduced by blending with treated wastewater effluent and returned to the bay or to a waste water discharge outfall. Also, an alternative energy source (such as solar panels or wind turbines) may be warranted for such a project.

D. Discuss ownership, participation/partner aspect

While it appears that the City could build a small-to-medium-sized desalination project on its own, the regulatory costs seem to favor the City collaborating with a nearby agency (at the very least with the Santa Clara Valley Water District) to access San Francisco Bay water or brackish groundwater desalination.

Forming partnerships with neighboring communities for large, regional desalination plants or locally-run brackish desalination plants is likely the best solution to provide water source reliability and augmentation without the burden of overwhelming investment costs. The City might attempt to form a partnership with agencies having an existing or planned desalination project, such as the Santa Clara Valley Water District which has been examining brackish water ground supplies recently. Due to limited brackish groundwater sources, the City of Milpitas may not be ideally located for a desalination plant or a brackish water treatment plant. However, opportunities for partnerships and interagency cooperation should be encouraged. Coordinating or partnering with Bay Area regional desalination water projects when available should be investigated, as opportunities arise.

There are currently two local projects which the City could benefit from by partnering with other agencies. The Newark Desalination Facility uses reverse osmosis to treat brackish groundwater to low mineral water is southern Alameda County. Also, the Bay Area Regional Desalination Project, comprising the efforts of Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission and Santa

Clara Valley Water District will eventually produce a large regional desalination plant in the Concord-Antioch area.

E. Identify current regional projects underway

The process of desalination has been utilized as a source of potable water in the Western United States for some time. The number of regional desalination plants continues to grow as groundwater aquifers are depleted, droughts persist and common water supplies decrease. Desalination in the United States has been instituted both as agency owned and operated systems, and as an investor owned entities. Both approaches have benefits and challenges. The following are a few examples of some of the projects currently underway:

Bay Area Regional Desalination Project

Currently underway is the Bay Area Regional Desalination Project. Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission and Santa Clara Valley Water District have been evaluating the idea of developing a shared regional desalination facility since 2003. In June 2010, Montgomery-Watson-Harza Global produced a Pilot Plant Engineering Report for this joint project, verifying the technical feasibility of a full-scale desalination facility to meet water quality targets ("Pilot Testing at Mallard Slough." Montgomery-Watson-Harza Global. June 8, 2010). The report recommends that the facility design be based on the level of pretreatment used. Due to the location, the facility will experience a wide range of salinities, and the most effective treatment will involve utilizing ultrafiltration membranes followed by a two-stage reverse osmosis process. An Alternative Analysis Report is currently being developed addressing key issues with the Bay Area Regional Desalination Project and providing options for implementing the project. This report is projected to be completed by the end of 2014 (Bay Area Integrated Regional Management Plan, 2014).

Alameda County Water District Aquifer Reclamation Program

In September 2003, the Newark Desalination Facility was created by the Alameda County Water District. The water is drawn from the Niles Cone Groundwater Basin, which contains brackish groundwater resulting from previous seawater intrusion. The Aquifer Reclamation Program was developed to prevent seawater within Niles Cone Groundwater Basin from spreading (Alameda County Water District website). This program produces water to supplement the aquifers within the basin to achieve freshwater conditions.

Through reverse osmosis, the Newark Desalination Facility converts brackish groundwater to low mineral water. This water is then blended with high mineral groundwater to obtain a uniform water hardness. The production rate at this facility is approximately 10 million gallons per day. Water Solutions, Inc. spoke with the general manager of Alameda County Water District in September 2014 concerning augmentation of the Milpitas Water Supply and while conceptually Alameda County Water District is

receptive to the idea, there seems to be an insufficient brackish supply to expand the system further.

Monterey Peninsula Water Supply Project
California American Water has proposed drilling slant wells close to the coastline from Marina to Moss Landing to collect ocean water for potable purposes. The goal is to produce nearly 10 million gallons per day of potable water through desalination to supply the Monterey Peninsula. Prior to installing the slant wells, 13 boreholes will be drilled and tested by hydrogeological experts to ascertain, for each location, the proportion of underground water that is ocean water and the proportion that is groundwater.

The potential impact on agricultural undertakings must also be considered, as slant well installation could impact the groundwater supply customarily used by Salinas Valley irrigation systems. The desalination plant will be located off Charles Benson Rd. in Marina, and water purification will be by reverse osmosis ("Monterey Peninsula Water Supply Project Progress Report," July 31, 2014).

Carlsbad Seawater Desalination Project
The Carlsbad Desalination Project is the largest seawater desalination project in the Western Hemisphere (Carlsbad Desalination Project website). When completed, it is hoped that it will have the highest energy efficiency and most advanced technology of all the desalination plants in California. This desalination plant includes a 10-mile, 54" diameter pipeline beginning in San Marcos and extending into the San Diego County Water Authority's distribution system. The plant is projected to be completed in 2016. San Diego County Water Authority has a 30-year design, build, operate contract with the investor firm, Poseidon Water.

Proposed Santa Cruz Desalination Plant
The proposed desalination facility in Santa Cruz would would have a capacity of 2.5 millions of gallons per day, have an intake 2000' offshore screening wildlife and be powered by solar panels and energy recovery units. Brine would be mixed with existing wastewater effluent (to reach the same salinity as the Ocean) and disposed of in the Ocean. The project would cost approximately $115 Million, including a 30% contingency and is between a partnership with the City of Santa Cruz and Soquel Creek Water District. The purpose of this facility is to supply water in peak months, recharge groundwater and prevent sea-water intrusion (Santa Cruz Water District[2] website).

San Antonio Water System

The San Antonio Water System is currently developing a brackish groundwater desalination program in south Bexar County, Texas. The plant will be located at the San Antonio Water System's Twin Oaks Aquifer Storage & Recovery site. Feasibility studies have confirmed that sufficient high-quality brackish groundwater is available within the Wilcox Aquifer to support the San Antonio Water System desalination program. This

program consists of three phases: Phase I involves developing a production field, a collection system and a treatment plant involving reverse osmosis, and is projected to be completed in 2016; Phases II and III are intended to meet the City of San Antonio's needs for the next 50 years and to reduce the use of water from the Edwards Aquifer (San Antonio Water System website).

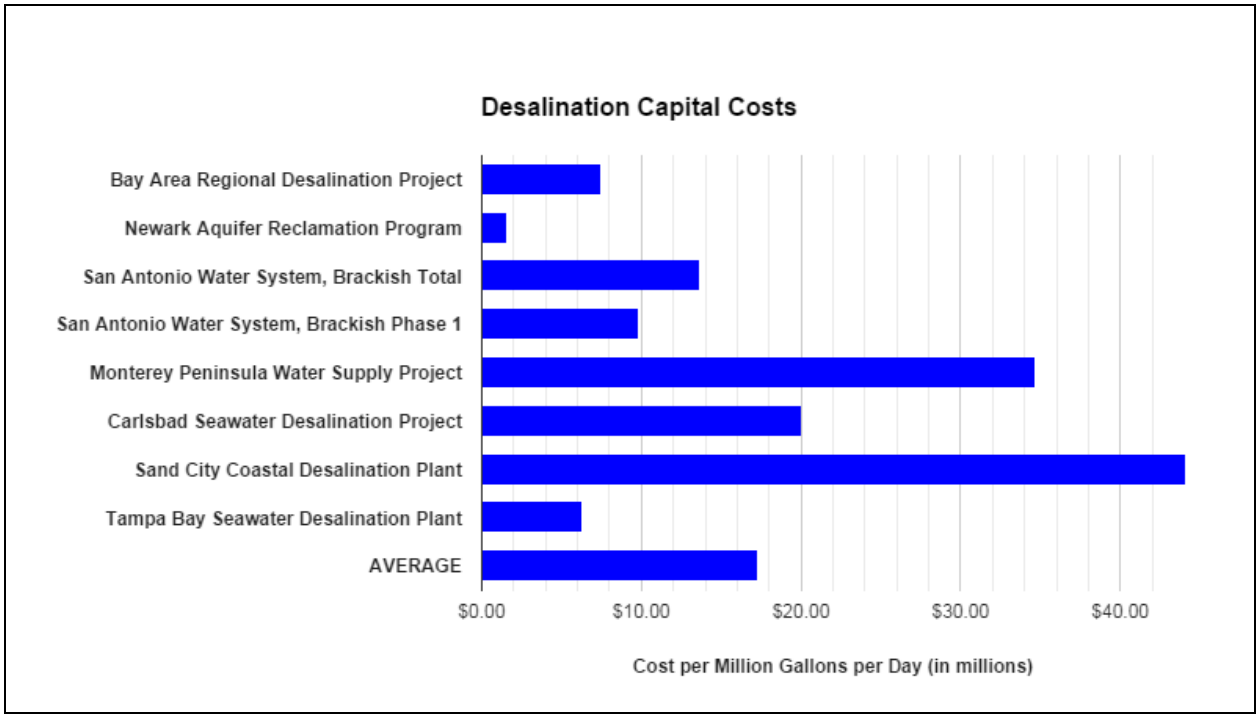
Tampa Bay Desalination Plant
The Tampa Bay Desalination plant was brought on line in 2007 following three project bankruptcies and a failed performance test. While the plant is capable of producing 25 million gallons a day, the water produced is significantly more expensive than traditional sources and was not being used in September of 2014 (Tampa Bay Water website).

The City of Santa Barbara California
The city constructed a "peaking" or emergency 6 million gallon per day desalination plant in 1992. The plant came on line coincident with the end of the drought and was decommissioned for operational cost reasons. As of September 2014 the city has authorized a study to rebuild the plant by 2016 (City of Santa Barbara website).

F. Provide operational/physical parameters and estimated reductions of consumptions

Typically, brine disposal is the most significant cost when operating a desalination plant, amounting to up to 66% of operating costs and 75% of overall costs (Reinhard, M., 2008). However, energy costs are significant, and depending on the system, can be the greatest operating cost. Energy is consumed by centrifugal pumps operating at 1,000 pounds per square inch or more and can total hundreds of thousands of dollars per day for large facilities. Other costs include maintenance, operator costs, analytical testing, and membrane replacements. The following chart (Figure 1: Desalination Capital Costs) shows the capital costs for several recent desalination plants, expressed in dollars per hundred cubic feet of potable water produced per day (the average operating cost is $2.14 per hundred cubic feet daily). These capital costs were collected from the aforementioned sources and compiled by water solutions, Inc. into Figures 1 and 2.

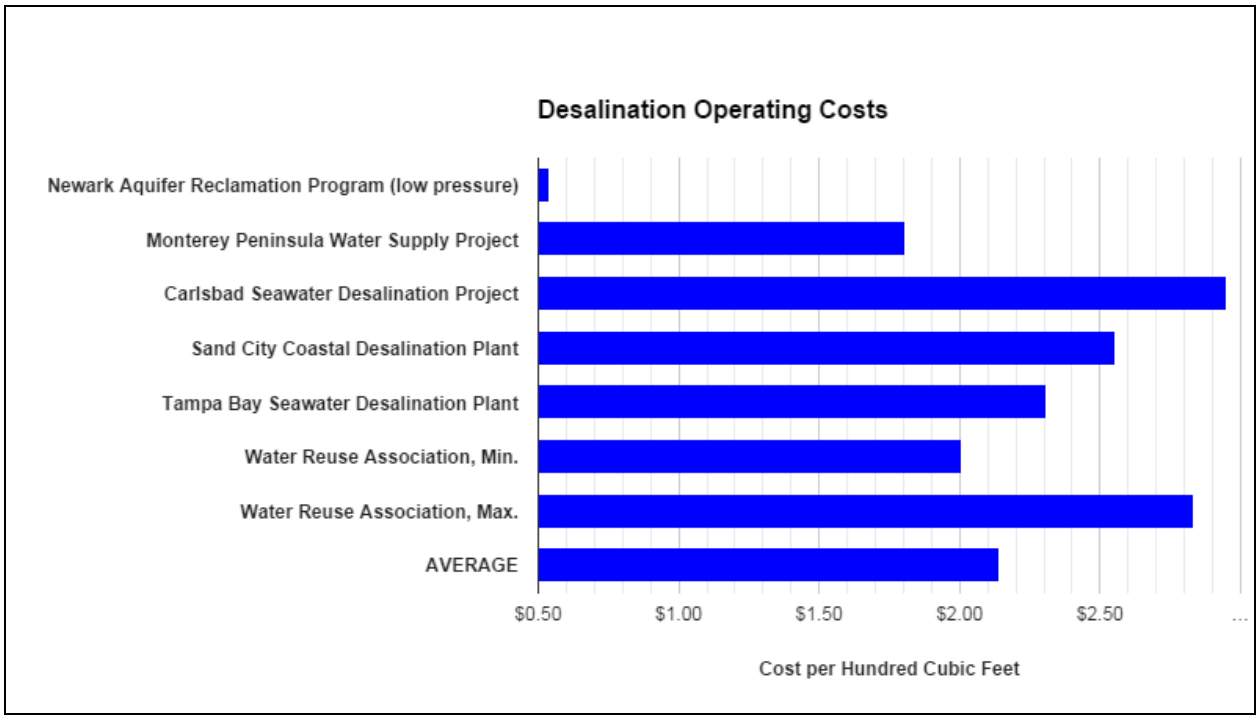
Figure 1: Desalination Capital Costs (Water Solutions, Inc.)



Desalination in Milpitas

The City of Milpitas currently has an average demand of 10.12 million gallons per day, according to the Bay Area Water Supply and Conservation Agency. Economies of scale dictate that a large plant would drive down the costs per unit, and so the City could benefit considerably by partnering with neighboring agencies or by building a plant sized to meet all of the City's demand and projected demands. By multiplying the average daily usage by the standard peaking factor of 2.25, one obtains the maximum potential daily demand, which provides an estimate for a designed plant capacity of 20 to 30 million gallons per day.

Figure 2: Desalination Operating Costs (Water Solutions, Inc.)



25 Million Gallon per Day Plant

At a cost of $17.25 million per million gallons per day, multiplied for a 25 million gallon per day plant, the City could expect costs of approximately $430 million for a plant capable of producing 25 millions of gallons per day. If the plant ran at half capacity to support average daily usage, operating costs would be $28,000 per day. Also, until the demand rose enough to meet the supplied quantity of water, Milpitas would have to export water, run the water at a lowered capacity or shut the plant down all together. The chart (Figure 2: Desalination Operating Costs) shows the operating costs for several desalination plants:

10 Million Gallon per Day Plant

Construction of a 10 million gallon per day plant at a cost of $20 million dollars per million gallons per day (more expensive due to economy of scale) would cost $200 million. Operating costs would be slightly more expensive (per volume of water) than a larger plant and could cost approximately $33,400 per day (based on a rate of $2.50 per hundred cubic feet). However, actual costs will vary depending on quantity of water, system efficiency, etc..

$$10\ million\ gallons/day\ =\ 10,337\ hundred\ cubic\ feet/day$$
$$10,337\ hcf/day \times 365\ days = 4,880,050\ hcf/yr$$

Using brackish water sources instead of seawater can reduce operating energy costs by over 5 times (based on a rate of $2.85 per hundred cubic feet for salt water at Carlsbad and the rate of $0.55 per hundred cubic feet of brackish water at Newark). Additionally, the capital cost would then be up to $20 million dollars for a brackish groundwater treatment facility producing 10 million gallons daily.

$$\$0.55\ per\ hundred\ cubic\ feet \times 4,880,050\ hundred\ cubic\ feet\ produced\ per\ year = \ldots$$
$$\ldots = \$2.68\ million,\ operations\ and\ maintenance\ costs\ per\ year$$

$$(\$20,040,000 + (\$2.68\ million \times 20)) \div (4,880,050\ hundred\ cubic\ feet\ per\ year \times 20\ yrs) = \ldots$$
$$\ldots = \$0.75\ per\ hundred\ cubic\ feet$$

Legality

The legal activity associated with implementing a desalination project relates primarily to:

- negotiating the necessary rights-of-way for the infrastructure and property
- achieving regulatory compliance with any permitting or environmental review under the *California Environmental Quality Act*
- obtaining contract review related to bid services and specifications

Costs for these activities vary depending upon the specific situation, but for a complete project can estimated to be $150,000 - $300,000, assuming no challenges (e.g., *California Environmental Quality Act* or contract challenge).

The Urban Water Management Plan requires a description of the opportunities for development of desalinated water as a long-term supply when using source water that includes, but is not limited to, ocean water, brackish water and groundwater (Water Code § 10631(i)). The Milpitas plan states clearly that, at this time, the City has no intent to pursue desalination options or participate in any regional projects due to cost and geography. This constraint is unfortunate, because brackish groundwater treatment might well be within the City's reach.

By perusing the large number of permits required to operate a desalination facility, one can easily see that the legal efforts required to establish such a plant are not to be discounted. It should be noted, however, that permits regarding the waste stream (the salty brine water leaving the facility) amount to more than half of the permitting hurdles for this type of project. Interestingly, at this time, the San Jose-Santa Clara Regional Wastewater Facility is under regulatory action for discharging low salinity water into the Bay. It is feasible, therefore, that the operation of a desalination plant by, and in or near,

the City could make possible the easy discharge of brine into the waste stream of the Regional Wastewater Plant for the purpose of mixing, thus avoiding legal pitfalls.

Finances

The costs of constructing and operating a desalination facility are significant, whether the source water is brackish groundwater, or bay, or seawater. Capital costs, while not to be ignored, can often be much less than those associated with operating reverse osmosis and pre-treatment plants, primarily because of energy costs. The following chart shows capital costs for the construction of recent desalination plants in terms of cost per gallon of drinking water (in dollars per gallon of drinking water capacity produced daily). The average capital cost is $17.25 million per million gallons daily.

Note that the cost of the brackish water desalination facility in Newark, CA, is much lower than that of other facilities. This difference is the result of intake infrastructure; a major element of a desalination plant is the intake and discharge, and a brackish water plant requires only wells as the intake facility. Note also that the Newark plant is a low pressure facility requiring no reverse osmosis filtration. The Newark plant is the best example of a recent, local, brackish groundwater plant and had a cost of $1.6 million per million gallons of daily production (Alameda County Water District, 2003).

The plant at Carlsbad, CA and Tampa Bay, FL both utilize pre-existing intakes and discharge facilities co-located at existing power plants. This pre-existing structure saves a lot of money, explaining why the Carlsbad plant is expected to cost much less than the Monterey Peninsula project, which is relatively far inland and will require slant wells to reach seawater.

Since the Tampa Bay project went bankrupt three times, the published capital costs may not include significant pre-bankruptcy costs.

The Sand City Coastal Desalination Plant (See Figure 1 and 2 for Desalination Capital and Operations Cost tables, above) illustrates the effect of economy of scale: In Monterey, the cost per unit of water is higher as the production capacity is only 267,000 gallons of drinking water per day.

Results

Desalination is an expensive proposition. The capital costs and especially the operating costs of desalination plant ownership are very high in comparison with any other method of water supply augmentation. However, if the water is available, brackish groundwater treatment is much more feasible than seawater treatment. If the City were to perform a

brackish groundwater research study, much like the one that Santa Clara Valley Water District is paying to have done by Stanford, the City could find that a reliable supply of brackish water is available at a reasonable cost (e.g. Alameda County at Newark).

If this type of project is to move forward and augment the City's water supply during this or the next drought, legal issues must be tackled head on. A considerable amount of manpower will be needed for such an effort. Project timeline planning should take into account the considerable lengths of time legal matters often take.

Conclusion

The primary benefit of desalination is the production of a local and reliable supply of potable water. However, the initial investment and operating costs can be substantial. Costly steps necessary before a facility can be operational include right-of-way acquisition, compliance with regulatory requirements, permitting and environmental review. Nevertheless, the highest costs are operating costs relating to energy usage.

Total electricity consumed will depend on the salinity of the supply. Historically, the quantity of brackish groundwater in Milpitas has been considered insufficient to justify the construction of a desalination plant. Although Alameda County Water District has indicated that additional production from brackish wells in the area of their Newark plant may not be feasible, additional sources of brackish groundwater for desalination may well be available to the south of the City in Santa Clara Valley. Nevertheless, use of brackish groundwater sources for desalination may prove unrealistic due to the scarcity of brackish groundwater in the area, which therefore would necessitate large transport distances.

In many instances, operating and start-up costs can be shared through partnerships or inter-agency cooperation agreements. These arrangements distribute capital costs and share the operating requirements of a municipal desalination project.

Other major issues for desalination projects are environmental impact mitigation and brine disposal. These activities can pose challenges, especially when disposing of brine where there is no wastewater treatment plant nearby. However, the City is very near the San Jose Santa Clara Regional Wastewater Facility, which might prove a considerable boon.

Task 6: Desalination, Implementation Plan (NOT IMPLEMENTED)

Proposed Implementation Schedule:

1. Hire a consultant to pursue research on existing brackish groundwater studies. (Mar. 2015)
2. Hire a consultant to pursue cooperation agreements with other desalination partners. (Mar. 2015)
3. Hire a groundwater hydrogeologist with experience with brackish groundwater to do an up to date study on possibilities for Milpitas. (July 2015)
4. Hire a consulting engineer to design a desalination installation (for bay water or brackish groundwater). (Jan 2016)
5. Begin environmental and legal efforts for new desalination facility (Sept. 2016)
6. Open construction contracts for bid. (1 Jan. 2018)
7. Finalize bid documents. (1 Mar. 2018)
8. Begin construction of the brackish groundwater desalination facility. (1 May 2018)
9. Finish construction of the desalination facility. (1 Dec. 2019)
10. Complete permitting with state and federal governments. (1 Jan. 2020)

Costs:

- $20,000 for a background brackish groundwater study.
- $20,000 for a cooperation agreement with potential partners.
- Up to $20 million dollars for a brackish groundwater treatment facility producing 10 million gallons daily.
- The total capital cost of a desalination program would cost $20,040,000
- The ongoing cost of operations at the new desalination facility of $0.55 per hundred cubic feet or $2.68 million per year
- The total cost (capital and O&M combined) for the lifetime of the plant is $0.75 per hundred cubic feet.

Benefit:

- A savings of potentially 10 million gallons or 4,880,050 hundred cubic feet per year.

Life Cycle:

The life cycle of a brackish groundwater desalination facility is very much the same as a surface water treatment plant, being approximately 20 years.

Ease of Implementation:

By hiring consultants to do studies of past efforts and for the Milpitas area regarding brackish groundwater desalination, this process becomes much easier than if the City were to attempt to do this themselves. However, the legal entanglements of partnerships and desalination permitting are considerable.

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Water Solutions, Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant
Subject: **Task 7: Additional Storage**

Summary

A number of storage measures could be employed by the City of Milpitas to benefit water supplies, water supply reliability, recycled water reliability, stormwater management and/or energy costs. Possible applications include:

- surface water retention basins for irrigation, construction water or recycled water
- elevated storage tanks to reduce electrical costs due to a special rate structure with the Pacific Gas & Electric Company
- groundwater storage by use of percolation ponds or injection wells
- above ground or below ground storage tanks for additional storage capacity

Currently, Milpitas exceeds the state requirements for the quantity of potable water to be stored. Additional potable storage could be created to enhance reliability of the drinking water supply and to store water for use during peak periods. Similarly, recycled non-potable water storage could ease the burden of peak period use. Stormwater storage tanks could be used to reduce flooding and to improve wetland productivity through controlled release. However, water storage via the construction of additional reservoirs may be difficult for the City due to land rights acquisition.

The various functions of water storage should be combined to maximize beneficial use. One example would be to use stormwater catchment to provide a buffer against flooding during storm events and also to augment sensitive riparian habitats throughout drier months. Possibilities for receiving water credits or grants with the State Water Resource Control Board are also available for projects of this scope.

Whilst Milpitas has potable storage covered, Water Solutions does recommend recycled non-potable water storage for peak-shaving.

Data

The information in this memo was gathered from the California Code of Regulations, Title 22, and the City Public Utilities staff and records. Other sources include the State Water Resource Control Board website, United States Environmental Protection Agency online publications, California Department of Fish and Wildlife, Santa Clara Valley Water District website, the City of Milpitas staff and publications about water storage. Additional information was obtained from representatives from several water districts, including Darin Taylor of the Santa Clara Valley Water District.

Methodology

A. Discuss sizing (peak shaving vs long term idea; tank, reservoir, underground) and water quality concerns
B. Discuss preliminary regulatory compliance requirements
C. Discuss groundwater banking
D. Discuss local storage in form of above and below ground vs offsite, active storage and recovery plant
E. Describe operational/physical parameters with necessary infrastructure for operation
F. Provide operational/physical parameters, estimated reductions of consumptions

Legal and financial considerations will be addressed at the end of “Methodology” below.

There will be a final *Task 7 Implementation Plan Table* at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation. Feasibility will be discussed in Task 9.

A. Discuss sizing (peak shaving vs long term idea; tank, reservoir, underground) and water quality concerns

Storage Tank Sizing & Water Quality

According to the calculation described in §64554(a) and (b)(3) of the California Code of Regulations Water Code, Milpitas (The City) has a maximum daily demand of 25.2 million gallons per day. According to the same section, Milpitas has a peak hourly demand of 1.58 million gallons per hour. The City is required “to meet four hours of peak hourly demand with source capacity, storage capacity, and/or emergency source connections.” This means the City must have at least 6.3 million gallons of potable water storage. The

City presently has 16.3 million gallons of storage capacity, 10 million gallons more than required by law; however, the City has very little water supplies other than those that are purchased.

The City's 2009 Water Master Plan Update (Table 5-7, Scenario 3) sets out a more stringent requirement. The following three components need to be satisfied for the storage sizing requirements to be met by the master plan:

- operational storage (20% of maximum day demand = 6.16 million gallons)
- emergency reserve storage (50% of maximum day demand = 15.4 million gallons)
- fire suppression storage (4 hours at 5,000 gallons per minute = 1.2 million gallons)

These components result in an overall storage requirement of 22.8 million gallons, leaving the City 6.6 million gallons short of its self-imposed requirement. Note that 22.8 million gallons represents the long-term requirement.

"Peak shaving" is the process of reducing the amount of potable water purchased from the utility company during peak hours when the charges are highest to reduce demand on the supplier's system. If the drinking water average daily usage, as measured in 2011-12, is 10.12 million gallons per day, and the maximum day demand is 25.2 million gallons per day, the resulting peak-demand increase is 15.1 million gallons per day (i.e., the maximum day demand minus average daily usage). As long as there is sufficient storage to meet the maximum day demand, increased water rates can be avoided. Currently, the City has plenty of storage for full peak demand shaving and need not add any more for implementation of this process.

Peak recycled water use however, is more taxing on the limited recycled water system than the potable water peaks are on the robust drinking water system. An analysis of existing peak use of recycled water using data from the BAWSCA Annual Survey 2012-13, estimated to be 1.92 million gallons per day maximum day demand versus 850,000 gallons of average daily usage, shows the need for approximately 1 million gallons of storage for each day of peak storage to be saved. This is for existing users only.

As further recycled water connections are made with potentially high-volume consumers such as Spring Valley and Summit Pointe Golf Courses, these numbers will go up, and we will see a change or "delta" in the amount of recycled water peak-shaving storage needed. Using potable water consumption data from January through May 2014 for the two golf courses, we see the average daily usage climb to 1.16 million gallons per day, and the maximum day demand climb to 2.62 million gallons per day. This leaves us with a new one-day peak storage requirement of 1.45 million gallons and a "delta" of roughly 500,000 gallons. Of course this does not include the sizeable Ed Levin Memorial Park. Milpitas does not know how much Ed Levin uses as it is a Santa Clara Valley Water District yet unknown to the City) voluminous consumption of recycled water that is

expected to occur in the future. Water Solutions, Inc. advises the City to pursue construction of a 3 million gallon recycled water storage tank to provide peak shaving support into the future.

Tanks and Reservoirs

While the term reservoir often means a large natural or artificial lake used as a source of water supply, in a drinking water context this term means a supply or source of water, often for storage. A storage (or service) reservoir stores and supplies water to the farthest point in the area at the required pressure, often through the use of booster pumps.

Flat areas with stable soils are the most suitable sites for constructing a tank. In hilly areas, it is best to select the highest point and construct an elevated tank. An elevated tank, or water tower, would be placed between the area serviced and the source of water supply. The pressure within the system depends upon the water level in the tank. Water levels are usually kept low to minimize pumping costs. The lowest effective water level is determined from the pressure required to guarantee a minimum pressure at any point in the area being serviced.

Water towers can be made of concrete or steel and take various forms. The most common type is a cylinder with a curved or flat bottom. Shape is usually based on function and maintenance costs. Round tanks are inherently easier to maintain as they have no corners.

Storage reservoirs provide a reserve of treated water that is used to minimize interruptions of supply due to failures of mains, help maintain uniform pressure and provide a reserve of water for fire fighting/other emergencies. Reservoirs also allow for a decrease in the size of distribution mains and for pumping at the average, rather than the peak flow rate. The requirements of storage reservoirs are classified by their functions, as listed below.

Definitions/Classifications of Storage Requirements

Storage Facilities include reservoirs, towers and tanks provide storage for treated water before it is distributed. The storage should be capable for domestic, commercial and industrial purposes. Here is a list of types of storage that must be accounted for when estimating the size needed for a tank:

- *Operating Storage:* Storage that provides the difference in volume between the “pump on” and “pump off” levels when tank is being used normally. As the pump turns on, storage is used up until the pump turns off.
- *Equalizing Storage:* Extra water to be used when source pump capacity is less than the peak system demands.

- *Fire Storage:* The volume of water stored within the water system for fighting fires. This volume varies with the city size and type/size of construction within service area.
- *Emergency Storage:* Back-up water used to provide water to the system during unusual or emergency conditions. Depends upon the likelihood of interruption and time it takes for an alternative water supply storage to be created.
- *Dead Storage:* Storage in tanks or reservoirs that cannot be drawn out due to the level of the piping or to low pressures.

Tank Material Options

Steel

Steel water tanks can be cylindrical or spherical. Tanks can be welded or bolted. The tanks must be installed at or above grade to allow for repainting. The physical footprint is significant, at an average of 48 feet in diameter and 30 feet high.

Welded steel tanks cost more to purchase than bolted steel tanks and have a 60-year life expectancy. Welded steel tanks must be repainted every 15 years, typically at a cost of one-third of the tank purchase cost. Painting requires that the tank be out of service for approximately one month, and requires workers to be introduced to the sanitary environs of the tank. The budget cost for welded steel is $1.85 per gallon or $925,000 for a 500,000-gallon tank.

Bolted tanks use thin steel and must be replaced after 20 to 25 years. Given that their cost is more than half the cost of a welded steel tank and their life-cycle is shorter, their life cycle cost is therefore higher. In corrosive environments such as the California Coast, these tanks may experience paint failure in as few as 15 years due to the bolt/panel interface.

Two steel variants reduce or eliminate the paint cost issue but have aesthetic issues. The first, *corten*, is a self-healing or oxide-coated steel that is a rusty red color but is stable. Water reservoirs constructed of this material have to be painted on the inside, and the only color option for the exterior is “rust red.” The second, *stainless steel*, is much higher in cost, and typically is only used for the bolt-together, sheet-metal tanks. Although tanks of stainless steel reduce or eliminate painting inside and out, they are often considered too shiny.

Fiberglass

Fiberglass is an extremely long-lasting and corrosion-free material that can be used for water tanks. They come in thousands of gallons to millions of gallons in size. Although these tanks can be sited above ground, they tend to have a larger footprint than steel

tanks due to lower tank heights. The cost of fiberglass tanks is typically two to three times the cost of concrete or steel tanks due to fabrication and assembly costs.

Buried cylindrical fiberglass tanks are an excellent choice due to the minimal surface footprint, tank longevity and complete corrosion immunity. While these tanks are reasonable to purchase, the cost of trucking to the site typically doubles the tank cost. In 2014, a 75,000 gallon tank delivered to the Bay Area has a budget price of $200,000, yielding a cost per gallon of $2.66. The use of multiple tanks increases the overall operational risk due to interconnections and valves, over the life of the installation. These tanks are best suited for applications where only one or two tanks are required.

Concrete

There are effectively two methods of constructing concrete tanks: pre-stressed and cast-in-place. Both methods provide effective, corrosion-free storage at all sizes. If necessary, concrete tanks can be buried. Because they are strong, concrete water tanks are ideal for under driveways, courtyards, or sheds, or in other areas where they would have to withstand loads. Concrete tanks are built on site because of the weight of the material; however, transport of the concrete materials is still an expensive endeavor.

Concrete underground tanks can be more expensive to install than their counterparts as more excavation is required, but they are exceedingly durable and are at little risk of “floating” (where the tank may float to the surface because the tank has a lesser density than the dirt). Concrete tanks are also unlikely to rust, corrode, or experience damage from tree roots. If damage should occur, it can be easily repaired.

Cast-in-place concrete walls are made with ready-mix concrete placed into removable forms erected on site. The interior of the forms is lined with steel reinforcement prior to filling with concrete. The use of removable forms makes this an easy process, but the forms are large and heavy and must be transported, thus increasing costs. Nevertheless, using forms brings only a minor increase to the on-site footprint.

Using prestressed concrete provides a means of overcoming concrete's natural weakness in tension. It can be used to produce beams, floors or roofs with a longer span than is practical with ordinary reinforced concrete. Prestressed concrete construction is very much like cast-in-place construction, except that a casement of prestressed steel tension members is added. This step requires that a prestressing machine is transported to the site and mounted on the exterior of the tank, which increases the footprint somewhat. However, prestressed concrete tanks have a longer lifespan than cast-in-place tanks.

Table 1- Types of Tanks and their Life-Cycle Costs and Benefits

Type	Life	Cost	Paint and Corrosion	Above/Below Ground
Welded Steel	60 years	$1.85/gallon	15 year painting	Above ground
Bolted Steel	25 years	$1.00/gallon	15 year paint failure	Above ground
Fiberglass	35 years	$2.66/gallon	N/A	Either
Cast-in-Place Concrete	75 years	$1.75/gallon	N/A	Either
Pre-Stressed Concrete	100 years	$2.00/gallon	N/A	Either

Storage Tank Reservoirs in Milpitas

There are currently five storage tank reservoirs in the City:

- San Francisco Public Utilities Commission:
  - Gibraltar Prestressed Concrete 5.00 million gallons
  - Ayer Prestressed Concrete 5.60 million gallons
  - Tularcitos Steel 0.31 million gallons
  - Minnis Steel 0.35 million gallons
- Santa Clara Valley Water District:
  - Gibraltar Prestressed Concrete 5.00 million gallons

Total stored water 16.26 million gallons. The City's 2009 Water Master Plan Update sets out a more stringent requirement resulting in an overall storage requirement of 22.8 million gallons, leaving the City 6.6 million gallons short of its self-imposed requirement.

Note also that another district tank sized at 6.6 million gallons is planned for the TASP Piper Drive area. This will exceed even the self-imposed requirement for water storage.

Water Quality

It is understood that the residential and industrial water consumers within the City appreciate and desire consistent taste, odor and water quality. It is very likely, however, that this goal is not a sustainable state of affairs because any change in water supply will inevitably change water quality, if only by a minute amount.

There are various ways in which adding new sources affects water quality, most notably in taste and odor. Any additional source of water will invariably add or decrease certain

constituents such as dissolved sulfates, iron or manganese that greatly affect taste and odor.

The current source of water for the City is treated surface water from San Francisco Public Utilities Commision and Santa Clara Valley Water District, which comes from local reservoirs, from the Sacramento River Delta and from the Hetch Hetchy water system. According to the chart below (Figure 1 - Where Does Your Water Come From?), Santa Clara Valley Water District does not contribute groundwater to the City's water supply. This means that the City receives highly mixed and thoroughly treated water, albeit from a variety of sources.

Figure 1 - Where Does Your Water Come From? (Santa Clara Valley Water District website, 2014.) Note: That Milpitas was using recycled water at this time, although the chart does not indicate this.

	Local water			Imported water			Other
	Natural groundwater	From reservoirs to replenish groundwater	From reservoirs to drinking water treatment plants	Thru Delta to replenish groundwater	Thru Delta to drinking water treatment plants	From Hetch Hetchy	Recycled
Alviso						•	•
Campbell	•	•	•	•	•		
Cupertino	•	•	•	•	•		
Gilroy	•	•		•			•
Los Altos	•	•	•	•	•		
Los Altos Hills	•	•	•	•	•	•	
Los Gatos	•	•	•	•	•		
Milpitas			•		•	•	
Monte Sereno	•	•	•	•	•		
Morgan Hill	•	•		•			
Mountain View	•	•	•	•	•	•	•
Palo Alto						•	•
San Jose	•	•	•	•	•	•	•
San Martin	•	•		•			
Santa Clara	•	•	•	•	•	•	•
Saratoga	•	•	•	•	•		
Sunnyvale	•	•	•	•	•	•	•

Blending water from the Pinewood well with purchased treated surface water would add groundwater minerals to the mix. Many people find the taste of untreated groundwater quite pleasurable. However, to people accustomed to the softness (lack of mineral content) of surface water, the change to groundwater might be challenging. Therefore, treatment consisting of iron and manganese filtration as well as conventional softening or activated carbon filtration might be necessary to remove trace amounts of these constituents if a groundwater source is used.

Due to the need for additional sources of water, the City should consider a publicity campaign to go along with any new infrastructural source addition. In fact, even if the

additional sources are treated surface water, there might be taste and/or odor issues. By keeping the public aware of the possibility of change and up-to-date on any changes, public reaction to minute differences in water quality would be minimized. Most importantly, water provided to the community will continue to be safe, wholesome and clean.

B. Discuss preliminary regulatory compliance requirements

All potential avenues for additional storage will need to be reviewed and approved by the California government. The State has been given local primacy by the United States Environmental Protection Agency, the sole regulator of drinking water supplies in the United States.

Storage Tanks

The design and construction of storage tanks is strictly defined by the American Water Works Association standards. Each type of tank has a related standard and according to the Water Code, section 64585, these standards must be adhered to by law.

- welded water tanks must conform to American National Standards Institute/American Water Works Association standard D100
- factory-coated, bolted steel tanks must conform to American National Standards Institute/American Water Works Association standard D103
- storage tanks must be painted externally/internally with American Water Works Association D101 and D102 certified paint
- additionally, all water tank appurtenances such as piping, joints and fittings must conform to American Water Works Association specifications
- all materials used in the construction of the tank that will come into contact with the drinking water must be National Sanitation Foundation standard 61 approved National Sanitation Foundation. Materials requiring approval are listed on its website. Storage structures should be thoroughly cleaned and inspected every 3 to 5 years

Surface Water Reservoirs

The steps for acquiring rights for the use of surface water and groundwater are as follows:

- filing an application
- acceptance of the application
- environmental review
- public notice
- protest resolution
- permit issuance

Conditions may be placed on the permit. Riparian rights are also required for use of a

correlative share of the water flowing past a property.

"A water right is a legal entitlement authorizing water to be diverted from a specified source and put to beneficial, non-wasteful use. Water rights are property rights, but their holders do not own the water itself. They possess the right to use it. The exercise of some water rights requires a permit or license from the State Water Resources Control Board (State Water Board), whose objective is to ensure that the State's waters are put to the best possible use, and that the public interest is served.

In making decisions, the State Water Board must keep three major goals in mind:

1. *Developing water resources in an orderly manner;*
2. *Preventing waste and unreasonable use of water; and*
3. *Protecting the environment."*

- The State Water Resource Control Board, Water Rights

The California Department of Water Resources is the primary governing agency for projects involving dams, reservoirs, storage ponds, groundwater banking, etc. If the City decides to pursue any of these approaches, the Department will have to be satisfied.

"The [State of California Department of Water Resources], under the police power of the state, shall supervise the construction, enlargement, alteration, repair, maintenance, operation and removal of dams and reservoirs for the protection of life and property as provided in this part." (Chapter 4. Article 1)

Construction of any new dam or reservoir or the enlargement of any dam or reservoir shall not be commenced until the owner has applied for and obtained from the department written approval of plans and specifications. (Chapter 5. Article 1)"

- State of California Department of Water Resources; Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs

C. Discuss Groundwater Banking

Groundwater banking transports water to a centralized location during wet months to be stored and redistributed during the drier seasons. Two of the world's largest underground water storage and recovery facilities are in Kern County:

- Semitropic Water Storage Bank
- Kern Water Bank Authority

Their proximity to the California Aqueduct, Friant-Kern Canal and agricultural epicenters allows water to be distributed throughout Central and Southern California, as needed. The benefits of groundwater banking include the following:

- enhancement of the water supply reliability during drought years

- provision of an effective water management tool
- reduction in the number of groundwater pumping lifts for agricultural water users

Currently, there are several groundwater storage facilities in the area of Kern County. Note, the use of the Kern Water Bank is likely to prove infeasible due to practical limitations, however, this is a great example for groundwater banking potential.

Since the early 1990s, the water exchange market (including water rights trading) has expanded to account for approximately 5% of all water used annually by California businesses and residents. The length of the water contracts is shifting from short-term to extended, several-year durations. However, due to controversies arising from water banks withdrawing large amounts of water during droughts and from other issues, approval processes are now relatively complicated due to new pumping legislation.

Underground tanks are beneficial for:

- mixed use designs (e.g., building on top of a tank) and to conceal
- minimize the construction foot-print

D. Discuss local storage in form of above and below ground vs offsite, active storage and recovery plant

The primary types of storage structures are:

- hydropneumatic tanks include any circular steel tanks, concrete tanks, and composite structures that use air in such a way as to create pressure in the system
- ground-level reservoirs include lakes, constructed water tanks and artificial ponds for water storage
- elevated tanks use the force of gravity to regulate the pressure through the system. Although pumps are needed initially to transport the water to a storage tower or reservoir on a hill, they can operate during non-peak hours and thus take advantage of peak-tiered electrical rates, where available

The ability to store water increases water supply reliability. The ability to store alternate sources of water can reduce electrical costs, reduce supply infrastructure for local water generation and lead to opportunities for obtaining water at reduced rates. Increasing the capacity of water storage located in a centralized place can avoid distribution pressure losses resulting from long conveyance distances.

Underground Tanks

One of the greatest advantages of underground tanks is the ability to combine storage

capacity with building space. Given the proper loading requirements, underground tanks can be built under parking lots, recreational fields, buildings and other features.

Suitable types of underground storage tanks include fiberglass, carbon-fiber, cast-in-place concrete, fiber-reinforced plastic, steel/aluminum and composite overwrapped. The type of tank to be selected will depend on the soil conditions, quantity of water, budget criteria, aesthetic considerations and location. For example, steel/aluminum tanks should be avoided in corrosive soils, and cast-in-place concrete tanks may be difficult to construct in isolated or mountainous terrains.

Aboveground Tanks

Aboveground tanks include elevated tanks, standpipes, reservoirs and ground-level tanks.

- elevated tanks generally consist of a water tank supported by a steel or concrete tower; most elevated tanks are constructed of steel and generally are welded
- standpipes are tanks on the ground with a height greater than the diameter; most standpipes are constructed of steel and generally are welded
- reservoirs include a wide range of water storage systems including ponds, lakes, earth-embankment reservoirs and water storage structure
- the two main types of reservoirs used for large-scale municipalities are steel tanks and concrete tanks
- concrete tanks include cast-in-place, circular prestressed and hydraulically applied, concrete-lined reservoirs
- ground level tanks have the advantage of being convenient to drain, clean and be inspected by water system workers with relative ease; always, attention should be given to the safety of workers in confined spaces

Offsite Storage

The ideal location for off-site water storage is near a large seasonal water supply and adjacent to water tributaries. For purposes of this memo, the topic of additional off-site water storage includes obtaining water rights in reservoirs outside of Milpitas, offstream riparian habitat augmentation (and water storage) and flood-mitigation reservoirs.

The benefits of off-site water storage are:

- water supply reliability for municipal and industrial uses
- agriculture water supply
- creation or rehabilitation of wildlife refuges

The benefits of off-site storage include actions that:

- augment riparian environs to improve fish and threatened species survival
- water quality improvements for estuarine species

- recreation opportunities at new reservoirs
- could also lead to local flood damage mitigation
- offsite storage could also support improved flexibility and long-term viability of the Central Valley Project and State Water Project by increasing storage and conveyance capacity

Active Storage

The following water storage strategies can be considered active storage:

- stormwater banking
- indirect potable reuse
- intelligent storage capacity
- reservoirs that are used to decrease power costs via special rate structures, to increase reliability and to augment fire-suppression capacity are also a form of active storage.

Stormwater collection, storage, treatment and distribution can be considered stormwater banking. Active water harvesting is the development of a conveyance and storage system that collects stormwater from impermeable surfaces to store in reservoirs for future use. The benefit of stormwater collection and storage is the availability of water during drier months. Milpitas has the potential to collect a total of 10,880 acre-feet of stormwater (using the maximum theoretical collection for the average rainfall in Milpitas), based on an average annual precipitation rate of 15 inches and an area of 13.6 square miles (United States Census Bureau).

Indirect potable reuse is becoming more common due to necessity and to better management of the supplies. This approach involves injection of reverse-osmosis-treated reclaimed water into groundwater aquifers then a sustainable withdrawal from a recovery plant/well. One scenario would include groundwater wells with injection wells placed at a sufficient distances away from the groundwater well. The groundwater sources would be used for potable use, while the resulting effluent from the water treatment plant would undergo additional treatment to meet advanced treatment standards. The highly-treated recycled water would then be pumped into the injection wells. This process results in a closed-loop water supply that is resistant to cost- changes in imported water sources. Also, increased groundwater relation and percolation would lead to additional water treatment through aquifers.

New uses for improved intelligent water storage are also becoming available. IBM® Intelligent Water optimizes water operations by integrating data about a utility's infrastructure, assets and operations to deliver water more efficiently. The process uses advanced data management, visualization, correlation and collaboration technologies to transform vast amounts of data received from devices such as metering systems, assets

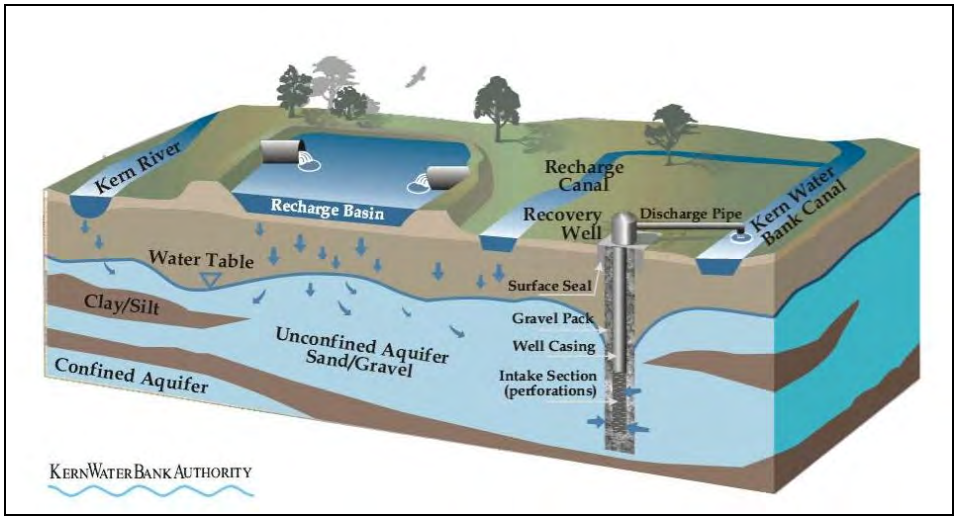
and other systems into information that can guide planning and operational decisions. The result is an overview of water operations that transcends individual systems, devices and departments.

Active storage could also include elevated or pneumatic tanks to store water, pumping during times of low electrical rates, if a special rate structure is available, and thus reducing electrical costs. This form of storage would place less strain on water and electrical infrastructure, as well as increasing fire-demand storage and reliability.

Recovery Plant

A recovery well/plant is a necessary part of an active groundwater management system and involves withdrawing water for potable water use and irrigation and monitoring usage. A recovery plant is basically a groundwater well that is strategically placed downstream from an injection well (based on groundwater streams). The amount of water that can be sustainably withdrawn from a recovery plant is based on rainfall rates, percolation, slope elevations, geology, amount of water added to injection wells (see Figure 2). Regular water quality testing and inspection are required.

Figure 2: Groundwater Banking Process



Disinfection

Based on the water quality and the results from a Title 22 report, treatment and/or disinfection is likely to be required depending on concentrations of contaminants in the water supply. Water quality testing will determine the best treatment and disinfection methods, based on the individual water constituents. (See “Task 3: Surface Water Detention” for additional information regarding groundwater wells and indirect potable reuse.)

E. Describe operational/physical parameters with necessary infrastructure for operation

Infrastructure Required

The operational parameters and infrastructure for additional storage capacity include:

- tanks/reservoirs
- pumps
- conveyance system
- potential treatment/disinfection
- monitoring
- maintenance

The following is a brief description of the steps necessary to implement additional storage capacity:

Tanks and Reservoirs

The available tank options are hydropneumatic tanks, ground-level reservoirs and elevated tanks. Tanks of welded steel, cast-in-place concrete and prestressed concrete are used most commonly for municipal water storage. However, reservoirs and surface retention ponds could provide a more cost-effective approach, depending on land availability. For a complete description of surface water reservoirs see “Task 3: Surface Water Detention.”

Pumps

The type of pump selected should be based on criteria that include maximum flow rates, piping distances, elevation changes, system pressure. Water Solutions, Inc. would recommend the use of a multistage, variable-drive submersible pump able to withstand the harsh environment of the tank or reservoir. Often, two or more pumps can be run in parallel to allow for service/repairs without disrupting the flow and to provide emergency backup.

Conveyance System

A conveyance system is needed to connect incoming water supplies with tanks or reservoirs, treatment housing, and water mains for potable consumption. The design of the pipe system should be based on soil-type, water flow rates, piping distance, system pressure. Recommended materials include ductile or galvanized iron, PVC, flexible PVC or reinforced concrete (more suitable for water collection).

Treatment and Disinfection

After cleaning and painting, water storage tanks must be disinfected before being placed

in service. Cleaning should be done using either 1) liquid sodium hypochlorite solution, or 2) calcium hypochlorite granules or tablets. Water entering the tank should be treated or disinfected as necessary, or screened before being stored. The storage tank should inspected periodically to find any cracks or structural problems.

Permitting Requirements

The State Water Resources Control Board and local permitting agencies should be contacted prior to construction. Encroachment permits, building permits, operating permits, and an amendment to the domestic water supply permit may be required.

Operational Parameters

The following is a list of the possible operational parameters involved with water storage: pumping costs, water flow rates, water quality, blending, disinfection, system pressure and system location.

F. Provide estimated reductions of consumptions

Estimated Reduction of Consumption

The addition of water storage tanks will not contribute directly to reduced water consumption. However, additional water storage will allow for greater amounts of stormwater, groundwater or local sources of water to be stored, which can lead to opportunities for purchasing water at reduced rates by augmenting available water supplies. The maximum amount of stormwater that can be collected in Milpitas, based on an average year with 15” of rainfall, is 10,800 acre-feet per year. However, this assumes every drop of rainfall is collected, whereas the amount that is feasible to collect would be much less.

Elevated tanks can be used to reduce operating costs, improve reliability and maintain constant pressures. This involves pumping water up a tower or mountain during times of reduced electrical rates in places with special rate structures.

Implementation Strategies

The following steps are needed to increase the available storage:

- secure funding
- create a request for proposal
- complete permitting requirements
- hydrologic site investigations
- secure land suitable for water collection and storage.

Legality

State Water Resource Control Board, Division of Drinking Water

The California Code of Regulations, Title 22, explicitly states requirements for drinking water and potable water sources to determine treatment and disinfection methods. These need to be followed and the appropriate permits need to be applied for and approved.

United States Environmental Protection Agency

Conditions regarding the use of surface water for water storage applications are set out by the Environmental Protection Agency under the Surface Water Treatment Rule, and under the National Pollution Discharge Elimination System's minimum creek level requirements. National Pollution Discharge Elimination System permits must be obtained.

California Department of Fish and Wildlife

Wildlife impact mitigation measures will be required by the California Department of Fish and Wildlife, in accordance with California Water Codes, which address surface water collection, stream withdrawals, environmental easements. The California Department of Fish and Wildlife has jurisdiction over the conservation, protection and management of fish, wildlife, native plants and habitats necessary for biologically sustainable populations of those species. When appropriating new sources of water, or constructing near riparian habitats, the State Water Resource Control Board is required to consult with the California Department of Fish and Wildlife on the amount of water needed for fish and wildlife and on impact mitigations measures.

Water Rights Acquisition

Water rights must be obtained for the use of water from stormwater runoff, lakes, creeks and waterways. Ownership of these rights varies based on location, historic water usage, precedence and other factors. Many water rights in the area are likely under the jurisdiction of the Santa Clara Valley Water District.

Finances

If the City were to pursue the construction of an additional 3 million gallons of recycled water storage, this might be at a fairly significant cost. Aside from land acquisition, this would cost approximately $3.75 million at least ($1.25 per gallon), if a single 3 million gallon tank were to be constructed. In addition there would be significant costs for the associated pump station and piping. Estimated at $6 million, this is not a trivial investment and one which provides a minimal payoff. Moreover, maintenance costs can be significant as well. Approximately 15% of the construction cost must be spent on

maintenance every 15-20 years. This means that for a $6 million tank site, approximately $3 million (or $3 million / 50 yrs. = $60,000 per year) will need to be spent over the 50-100 year lifetime of the tank to maintain it.

Outside funding sources may be needed to construct this type of project. Typical funding sources for capital improvement projects include the:

- California State Water Resource Control Board through grants awarded through the State Water Resource Control Board's Drinking Water Program
- California Department of Water Resources
- U.S. Bureau of Reclamation
- Environmental Protection Agency (Clean Water State Revolving Fund)
- Drinking Water State Revolving Fund
- United States Department of Agriculture for water improvement projects
- Grants for communities of under 10,000 persons are also offered in the State of California.
- A future funding source to watch for is California Proposition 1, which is a $7.5 billion dollar bond measure that was recently passed by Californian voters in November, 2014.
- www.Grants.gov is also a potentially useful funding source.

Results

Additional storage capacity for the City is not necessarily needed but is desirable. The 2009 update to the master plan recommends that the City have an additional 3.8 million gallons of potable water storage. However, this is the only recommendation for this amount of storage. In fact, because the City relies on purchased water pumped by other entities, the addition of one or more storage facilities would simply increase pumping costs to the City.

We recommend, therefore, that the City not pursue any further storage construction options at this time. Even though water is scarce, the money would be best spent elsewhere. The sole potentially viable option is to construct an elevated water tank for off-peak pumping and distribution system pressure regulation in the zone supported by the single pump station operated by the City.

Although not a recommendation, another possibility would be surface water storage (nonpotable) using stormwater. A storage facility could be constructed in Milpitas, and water rights could be shared with the Santa Clara Valley Water District or other adjacent districts. This facility would probably be owned exclusively by the City, with shared water rights with Santa Clara Valley Water District; however, shared ownership could be arranged. Acquisition of water rights would be challenging, and could encounter many issues, for example, water rights would need to be bought, traded or used for water

credits. Also, such facilities incur large capital costs, as well as land costs and the cost of mitigation measures for procurement.

Surface water collection and augmentation applications could be used for habitat restoration partnerships. Surface water ponds, acting as artificial wetlands, could be enhanced or constructed to provide aquatic habitats for animals, recreational opportunities for people, and environmental learning centers, as well as to provide an efficient means of treating surface water runoff. Projects of this nature could even include partnership between the City of Milpitas, Santa Clara Valley Water District, Alameda County Water District and other nearby districts to improve riparian habitats. Possible locations include the boundary between Milpitas and Fremont near Dixon Landing along the confluence of Coyote creek with the San Francisco Bay mud sloughs, as well as along Coyote Creek and along Berryessa Creek. Although work is already being done here, more could be undertaken. Project scope could include the augmentation (or construction) of wetlands for additional water storage and the construction of water storage tanks. Although unnecessary, water storage tanks could be used to reduce the overall footprint, provide additional stormwater storage capacity and help to regulate water levels in the estuary. This approach could augment native estuaries and thus provide habitat for wildlife. These wetlands would encourage recharge of the shallow and deeper aquifers and thus make more water available in these aquifers in the dry seasons.

Berryessa Creek has the potential to provide additional water storage in the event of flooding caused by severe storms, as well as having a relatively moderate-to-high potential for habitat improvements. Storm management could be expanded to increase the surface water storage potential by constructing water storage tanks and to incorporate the planting of native vegetation. This step could also create recreational opportunities and provide habitat for sensitive species. Similar restoration efforts could be made at Coyote Creek and, possibly, at Arroyo de los Coches and Piedmont Creeks.

Conclusion

Adding water storage to the City of Milpitas' system might save money and/or create additional regional water storage capacity in the form of groundwater recharge via stormwater, or as recycled non-potable water. It is feasible that the City might reduce electrical fees by pumping at off-peak hours or benefit from additional water credits, though not presently guaranteed, from Santa Clara Valley Water District, which is the groundwater manager. However, neither of these advantages directly addresses the City's need for additional water at this time. As stated above, Water Solutions, Inc. recommends that the City not pursue water storage construction options at this time.

If the City were to decide to pursue adding storage capacity to its system, the next step

would be to execute an implementation plan. The following is the sequence for implementation and construction of additional water storage structures: secure funding, create a request for proposal and complete permitting requirements. The most important step would be to secure adequate land suitable for ground/surface water collection and storage. The location of any infiltration ponds would be determined by drainage areas, geological conditions and available land (see “Implementation Plan” below for additional information).

Task 7: Additional Water Storage, Implementation Plan (NOT IMPLEMENTED)

Proposed Implementation Schedule:

1. Determine the potential need for additional water storage and the most suitable application(s) for meeting these needs. (June 2015).
2. Obtain water sources, water rights and/or cooperative water use agreements with San Francisco Public Utilities Commission and/or Santa Clara Valley Water District. (January 2016).
3. Secure funding for additional water storage (February, 2016).
4. Hire a geotechnical or hydrogeological consultant to pursue site investigations for optimal sites regarding additional water storage potential (March, 2016).
5. Site location and water quantity determination (April, 2016).
6. Develop a request for proposal or in-house project proposal documents; including bid documents, etc. (June, 2016).
7. Bid-procurement and awardance of contract for additional water storage (September, 2016).
8. Pre-construction meetings, determining consultants/contractors for environmental mitigation measures and developing construction schedules (October, 2016).
9. Begin environmental and legal efforts for additional water storage (November, 2016).
10. Surveying and preconstruction site tasks (February, 2017).
11. Begin construction of additional water storage structures (April 2017).
12. Finish construction of water storage structures (August, 2017).
13. Complete permitting with state and federal governments. (September, 2017).

Costs:

- ~$2.00 per gallon for small tanks less than 500,000 gallons.
- ~1.50 - $1.75 per gallon for tanks 500,000 gallons to 1 million gallons
- ~$1.25 per gallon for large tanks greater than 1 million gallons. ($1.25 per million gallons of storage).
- Pump Station Construction at $500,000+
- Regular maintenance costs of $3 million over the tank lifetime ($3 million / 50 yrs = $60,000 per year).
- Triennial maintenance and inspection costs.
- Routing costs at about $422,000 to $1,500,000 per mile (or about $10 to $35 per inch*foot = $422,000 / 5280 feet per 8 in pipe).
- Water rights acquisition costs
- Land acquisition costs

Benefit: ● Additional non-potable water storage capacity for emergency supply and peak-shaving ● Water supply reliability due to ruptured water mains, etc. ● Ability to store water when rates are lower and/or to store water from lower cost sources. ● Potential energy cost savings by pumping to elevated storage tanks when electrical rates are low and allowing gravity to supply pressure during peak hours.
Life Cycle: The life cycle of a water storage tank depends on the type of material used for the construction and the design parameters for water storage tanks. Typically, a plastic or fiberglass tank will last between 20-35 years, while a concrete or welded steel tank can last significantly longer (40-60+years). Maintenance at around 15 to 20 years will be required for most concrete and steel tanks, including repainting, replacing seals and for other maintenance issues. We would recommend a tank with a lifetime of approximately 50 years.
Ease of Implementation: The ease of implementing new water storage infrastructure can be greatly increased by hiring a consultant to do hydrological and geological studies, as well as prepare design concepts for construction. However, additional costs may be accrued because of this. The process for additional water storage is relatively straight-forward and requires funding, contacting agencies for permitting and construction.

List of References

- California Code of Regulations.
- California Department of Fish and Wildlife website. Web access: Nov. 2014.
- City of Milpitas Public Utilities, staff and records
- Darin Taylor, Project Manager of the Santa Clara Valley Water District. Phone call: Nov. 2014.
- Santa Clara Valley Water District website. Web access: Nov. 2014.
- State Water Resource Control Board (State Water Resource Control Board) website. Website access: Nov. 2014. http://www.waterboards.ca.gov/waterrights/board_info/water_rights_process.shtml.
- United States Census Bureau website. Web access: Nov. 2014.
- United States Environmental Protection Agency (EPA) online publications. Web access: Nov. 2014.
- "Where Does Your Water Come From?" Santa Clara Valley Water District. Web access: October 16, 2014. http://www.valleywater.org/services/wheredoesyourwatercomefrom.aspx

Water Solutions Inc.

MEMORANDUM

Date: 27 March, 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. Consultant
Subject: Task 8: Funding

Summary

Funding is a critical element of any infrastructural improvement campaign. Regularly required infrastructure repair projects can consume Capital Improvement Plan funds, often leaving little left over for critical improvements. During this time of drought, it is imperative that existing water resources be managed effectively. This requires fees and other regulatory actions to mitigate use. Customer conservation reduces their own payments, but also proportionally reduces the City's income. Growth can spur consumption. With that need also comes competition for what little supply is available. Moreover, as supplies of water dwindle, contaminants become more concentrated, thus lowering overall quality and requiring expensive treatment. For these, and other reasons, funding is exceptionally important for water infrastructure projects.

Currently, there are a variety of funding options available to the City of Milpitas, hereafter referred to as “the City,” which are detailed below. Though most federal funding is available through the state, some funding can be garnered directly from federal sources. Funding for water resource projects are currently available as grants and loans (State Water Resources Control Board, 2014); contact information for these sources is provided in the Conclusion section of this document. The City will be eligible for funding due to the necessity for water infrastructure that is required for continued growth and prosperity in the City.

The use of rate hikes and bonds is presently common for funding water infrastructure improvements. These measures would provide accessible funding for the City, although the timeline for rate hikes and bonds are dependent upon administrative functions. Bonds, loans and grants are the most effective means for allocating funding for infrastructure improvements.

Increases in connection fees, service charges and institution of fines could also be implemented for funding; however, this could prove unpopular. Fines in particular, are more

effectively used to discourage negligent water use than to increase revenues to fund improvement projects. Leveraging fines can make people angry and is susceptible to issues of harassment, etc. Connection fees and service charges would be an effective way of generating funds; however, additional sources of funding would undoubtedly be required.

A tax increase could provide the required funding if the community votes in favor of such a measure. This would be an effective way for determining community support, as well as provide the necessary funding without the costs associated with loans.

Funding requires a constant awareness of the changing loans, grants, etc. offered by the various agencies, as they become available.

Data

The information in this memo drew data from a variety of sources, including:

- California State Water Resource Control Board
- California Department of Water Resources
- U.S. Bureau of Reclamation
- Environmental Protection Agency (Clean Water State Revolving Fund and Drinking Water State Revolving Fund)
- United States Department of Agriculture
- City of Milpitas website
- Other water district websites
- Internet, such as: Grants.gov, SF Gate

Please see the List of References below for more specific sourcing.

Methodology

A. Discuss options of funding the improvements (grants, loans, meter rates (volumetric), connection fee, bonds, etc.).

Legal and financial considerations will be addressed at the end of “Methodology” below.

There will be a final Task 8 Implementation Plan Table at the end of this memorandum. This will define an implementation schedule, compare cost and benefit, life cycle of plan and ease of implementation. Feasibility will be discussed in Task 9.

Funding sources for water improvement projects are currently available from the United States Department of Agriculture grants for communities under 10,000 persons in size, as well as Proposition 50 Desalination Grants offered by the State of California. This

memorandum analyzed the various funding options (i.e. grants, loans meters rates, connection fees, bonds, etc) to determine the constraints of each; primarily the benefits and disadvantages for funding uses.

In addition to conventional funding sources, Grants.gov was examined for potentially useful funding. The California State Water Resources Control Board and California Department of Water Resources websites were also examined for active funding sources that might be useful to the City. Also forthcoming is California Proposition 1, a $7.5 billion dollar bond measure to be voted on by California voters this November (SFGate).

A. A. Discuss options of funding the improvements (grants, loans, meter rates (volumetric), connection fee, bonds, etc.).

Most federal funds for water infrastructure development come from the Environmental Protection Agency, and are routed through the California State Water Resources Control Board. The U.S. Bureau of Reclamation offers a direct application for its funds and they recommended that more direct federal funds may be found at Grants.gov.

Grants

Although grant funding for infrastructure projects is traditionally hard to acquire, it has recently become readily available with allocations such as:

Formerly Available Grant Monies
Grant monies are a moving target. Grants can be funded, depleted and replaced by new grants. This is a quick overview of what grant monies are currently available. Further research would need to be done to have a complete survey of what will be available at the time money is needed. Grant monies do not need to be repaid.

- American Recovery and Reinvestment Act: This Act was executed expediently and there is no more funding
- State Water Resources Control Board's Drinking Water Program provides funding via the Proposition 50 and 84 grant programs, which were longer-lasting and more recent, and have been mostly depleted as a result of grants

Currently Available Grant Monies

- California Department of Water Resources still has remaining funds. These funds are available from the Integrated Regional Water Management Grant Program, and the Desalination Grant Program.
- Proposition 13 monies, according to the State Water Resources Control Board, in a recent call, that in the amount of $2.5 million per year, are available as grants for recycled water projects, with a cap of $4 million or 25% of the project cost (Newton, Dan. Telephone Interview, Sept. 8, 2014).

- The Water Recycling Funding Program (through the State Water Resource Control Board) offers monies for Recycled Water Facilities Planning Studies. Approximately $75,000 per planning project is allowed for, though funding for the actual construction is limited.
- The U.S. Bureau of Reclamation operates two funding programs pertinent to the situation facing the City. In 2015, the WaterSMART program will provide $19 million in grants for projects that address water efficiency or initiate advanced water treatment of brackish groundwater, seawater or other impaired waters (Bureau of Reclamation: WaterSMART - Sustain…", 2014). The Title XVI Water Reclamation and Reuse Program is slated for $21.5 million, from which "Under the Title XVI Program" project sponsors may receive federal funding on a cost-shared basis for planning and pre-construction activities and for construction of specific, congressionally authorized water recycling projects ("Title XVI Water Reclamation and Reuse Program", 1992). Both of these programs post details of these opportunities at www.Grants.gov, where grant applications may be submitted online ("Bureau of Reclamation: WaterSMART...", 2009).

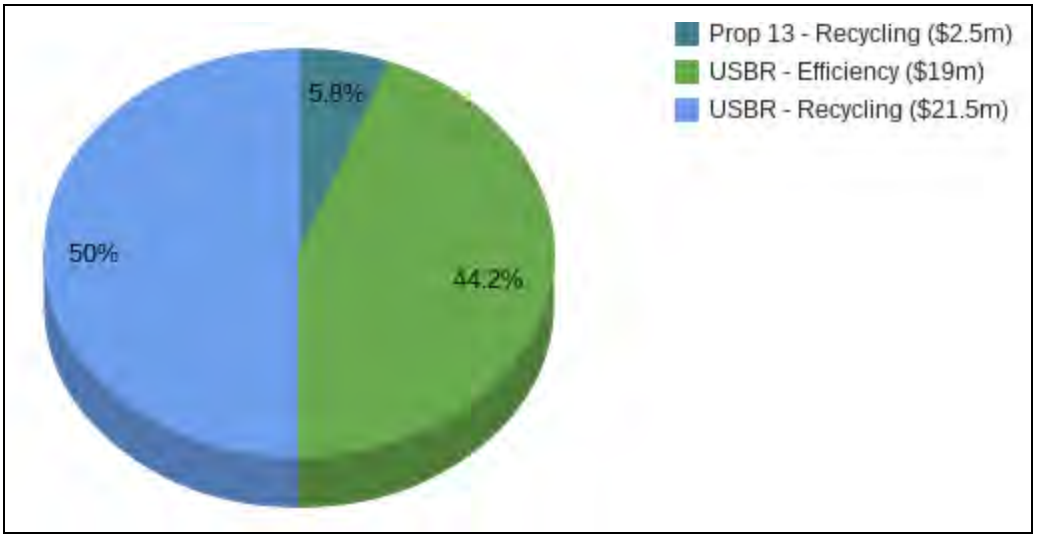


Figure 1: Potential grant funds (U.S. Bureau of Reclamation)

Meter Rates, Permitting & Connection Fees

Another way to obtain funding is to create a more steeply tiered rate structure for water meters. This can be accomplished by establishing "mixed-use" zoning codes that incorporate "water-wise" rate tier structures. This approach can be based upon specific types of customers, for example, single family residential and dedicated irrigation. A single family unit typically uses one water meter that services that specific house, whereas dedicated irrigation

customers typically are businesses with two meters -- one dedicated to the business facility and one to irrigation (City of Santa Rosa website, 2014). Commercial and industrial customers may also be tiered separately.

A tiered rate structure can also be based upon Site Specific Evaluations. With this approach, each customer has a base index of water use. As long as that customer's water use stays below his particular base index, indicating that water is being conserved, the charge is below the nominal rate. However, if and when the base index is exceeded, indicating a higher-than-usual use of water, the charge to the customer is higher than the nominal rate. Site specific evaluations do require resources and staff to implement.

In addition, connection fees can provide an important stream of single occurrence income. Increases in connection fees can be used for near-term improvements that would allow new customers such benefits as extended water treatment services, desalination plants, and new groundwater wells.

Connection fees can also provide a source of income when traditional customers are converted to recycled water customers, whether the conversion is required by ordinance or is voluntary. Further, as new recycled water connections come online, they will generate income, although the connection fee in this instance may be dedicated to offset the costs of infrastructural development for this or other projects. In fact, as grant and loan funding sources wax and wane for various types of projects, funds such as connection fees becomes useful for water projects in general. It may, therefore, be appropriate to allocate fees from recycled water connections to infrastructure improvements such as new wells, while grant funds for recycled water improvements are still available.

Permits are required from the City when constructing in the public right away, for commercial/residential development and when working near water system infrastructure - Funds allocated through encroachment and building permits can be used to offset costs of inspection, and, some instances, for water supply funding.

Loans

The U.S. Environmental Protection Agency's, the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund are long-standing sources of loan funding for recycled water and drinking water projects. These programs provide large loans for public water systems at low interest rates (a percentage of the prime rate). The programs have been administered in California by the State Water Resources Control Board for many years. Often considered the funding source that is most easily accessed, State Revolving Funds are very large funds that select recipients by ranking projects according to a sequence of eligibility priority groups. Various types of projects are eligible for SRF funding, with recycled water projects now being included. Loans are now available at 1%, which is very low compared to the usual range of 2.5% to 3.5% for a 20-year term. The Clean Water State Revolving Fund, Drinking Water State Revolving Fund and grant funding available through the State of California require two initial Pre-Applications, one for recycled water and one for drinking water, respectively. Loan monies must be repaid.

Bonds

Bonds are essentially a type of loan. Stock market investors are able to purchase “bonds” and receive repayment - generally with interest payments or increased value after a set time period. Water Utility Revenue Bonds may be a funding source for City’s water projects. These investments are considered the second-most-secure type of municipal bond and thus are attractive to lenders, even though they are only repayable with topically-generated revenue, such as water fees, but can not be paid with other tax revenues. General obligation bonds can also be issued by the City and are the most secure type of bond for lenders, being payable through tax revenue as well as other revenue streams.

Parcel Tax and Sales Tax Hikes

A sales tax or parcel tax hikes could be placed on a ballot for water projects or water capital improvement programs that would benefit the entire city or parcels adjacent to shared beneficial use. For example, a ½ cent sales tax could be implemented to fund recycled water irrigation projects in the right of way or recreational/water storage opportunities for adding surface water retention ponds.

Fines and Enforcement

Lastly, although fines are a less common and highly politicized form of revenue, they are becoming more prevalent in these times of recurring drought. Water may be rationed as it currently is in cities such as Santa Cruz, California: High use customers may be fined based on their level of water use; they may also be forced to audit their use, and if leaks are found and not repaired, additional fines may be levied. In some Southern California locales, conservation enforcement actions are taken against high-irrigation use. For example, customers with three or more acres of turf face a 100% increase in rates unless they reduce their consumption by 10% (“Drought in California...”, 2014). Fines should be sufficient to pay for enforcement - However, excessive fines should be avoided.

B. Describe constraints, any advantages and disadvantages of these options.

Grant Constraints

Grant funding for infrastructure projects can be difficult to acquire. In the recent past, funds were more readily available from sources such as the American Recovery and Reinvestment Act. Associated costs with acquiring grants include time and money to complete applications as well as the careful financial management of granted funds. Grants are basically free funding; no repayment or investment funds are required.

Meter Rate, Permitting & Connection Fee Constraints

Funds from meter rates and connections provide an important stream of income; connection fees are useful for supplying funding for water projects (i.e.new developments require additional connections and service fees which, in turn can be used to fund capital improvement projects to the development). Connection fees associated with permits, etc. are similarly important; however, these revenue streams are dependent on new development and exhibit “plug-flow” trends - Funds are generated all at once at construction without future revenue, in most cases. Recycled water connections could also be considered for a one-time revenue source.

Tiered service rates can allow additional funding, as well as provide sufficient water for sustained growth; however, certain customers may become upset or overall productivity can decrease. Also, less irrigation will lead to a drier City with less aesthetically appealing vegetation or lawned surfaces.

Loan Constraints

The largest constraints for acquiring loan funding for water projects include:

- interest rates
- public support
- completing applications properly
- service fees

The queue for receiving loan funds is based on when the application was processed and the necessity of the project. Other disadvantages to loans include long payback periods, investment costs and application costs.

Bond Constraints

Using bonds is considered to be a secure and dependable method for allocating funds for capital improvement or water supply projects. Unlike grants, bonds have to be paid back with interest, which can be a significant percentage of the total project costs.

Parcel Tax and Sales Tax Hikes Constraints

Possible benefits for a sales tax hike or parcel tax is the relative effectiveness of fund usage and public involvement; citizens are much more concerned about allocating funds and project quality. However, passing tax hikes can be very difficult to get on the ballot due to a large public resistance. Important public projects with limited funding sources, large public support and a large social benefit can be funded through the use of parcel tax and sales tax hikes.

Fine and Enforcement Constraints

Leveraging additional fines can be used to generate small revenues of funding - However, excessive fines can lead to citizen unrest and dissatisfaction. The use of fines are best used for enforcement and practical purposes.

C. Provide funding options and summarized in feasibility section below.

(See Results)

Legality

In general, the City's ability to fund alternative water supplies or the infrastructure required to obtain those supplies through increased taxes and charges is limited by the California Constitution. The provisions of the Constitution Articles XIIIA, XIIIB, XIIIC, and XIIID, all added by initiative, limit the taxation and appropriation power of local governments.

Proposition 13 added Article XIII A to the California Constitution. Billed as a property-taxpayer relief measure, it included a real property tax rate limitation (Article XIII A, § 1), a real property assessment limitation (Article XIII A, § 2), and a restriction on local taxes (Article XIII A, § 4). Additionally, Article XIII A, section 4 limited local governments by establishing a two-thirds voter approval requirement for any special tax to be imposed by cities.

Proposition 218 amended the California Constitution by adding Articles XIIIC and XIIID, which established substantive and procedural requirements and limitations on new, extended and increased taxes, new and increased property-related fees or charges, and all assessments. The substantive requirements generally mandate that the fees or charges do not exceed the cost to provide the service and the procedural requirements include providing notice, a public hearing and an approval (majority protest) process.

Financial

Taxes and water rates usually pay for a Capital Improvements Program via regular budget allotments. Generally, rate hikes, bonds and loans pay for special projects improvements beyond the Capital Improvements Program.

The only cost for seeking funding for special water projects is personnel time. A single employee could be assigned to research funds and write grants. The cost would be that of a full-time college-educated employee.

Results

> "The real silver bullet in the water marketplace would be a more rapid move toward smarter and full cost-based pricing,"
>
> - Maxwell, Steve, 2014, TechKNOWLEDGEy Strategic Group

The City is a high income area, with residents making approximately 130% of the California median household income. This is the metric that is used by the government to determine eligibility for grant funding and, as such, may reduce the City's eligibility for federal and state grants. However, household income does not eliminate the City as an applicant for loan funding or funding through other means. he following table provides a comparative analysis of the aforementioned funding options.

Since 1996, water and wastewater rates have increased by 4.9% per year, almost twice the rate of inflation as measured by the Consumer Price Index. The long term sustainability of the water industry in the U.S. depends on finding ways to make the necessary system improvements across the country, while understanding the impact of these improvements on customers' ability to pay for water services. Integrated resource planning, an approach endorsed by the Environmental Protection Agency, considers all water-related needs of a community while, at the same time, conducting a financial capability assessment. Such planning considers the costs of ongoing operations, repair and replacement, asset management and compliance actions. Also, included in this type of planning are capital financing and data from actual customer bills that can help to estimate affordable pricing (Davis, 2014).

ITEM	ADVANTAGES	DISADVANTAGES
Grants	Essentially free money with no obligation for targeted projects	City often ineligible; most currently available funds have been exhausted; timing is critical
CWSRF/DWSRF Loans	Very low rates (1%)	Lengthy application process; project priority may delay funding
Tiered Rate Structure	Very common process; self regulating; cost effective; drought independent	Negative impact on low-income households; fairness in the establishment of a site specific evaluation is an issue
Connection Fee Increases	Large one-time deposit on growth; potential limit on growth	Publicly unpopular; non-renewable source of funding
Bonds	Publicly popular; very common process	High interest rates
Fines	Cost effective; drought independent	Publicly unpopular; negative impact on low-income households

Conclusion

Choosing the appropriate funding avenue(s) can be difficult. Fortunately, the Environmental Protection Agency provides assistance in form of the Financial Alternatives Comparison Tool, which can be downloaded and used to determine the most cost effective method(s) to fund drinking water water programs. Financial Alternatives Comparison Tool provides a comprehensive analysis of a variety of useful reports on financing options using key financial figures. As well, it can create graphical comparisons of annual and total costs (Financing Alternatives Comparison Tool, 2014).

We recommend that, once the City has identified the projects it wishes to pursue, it immediately contact:

- The State Water Resources Control Board - Division of Drinking Water coordinator for Region II is Maria Pang at (916) 445-2493. This contact will help the City with their Universal Application for loan and grant funding from the state and the federal governments.
- The City should also immediately begin perusing the website www.grants.gov for U.S. Bureau of Reclamation funding opportunities and contact Sue Fry, U.S. Bureau of Reclamation Bay-Delta Office Manager at (916) 414-2400 for assistance in applying for WaterSMART Conservation funding or Title XVI Water Reuse funding.

Water Solutions is available to focus and strategize these requests.

Once access to potentially “free” money has been examined thoroughly, the City should immediately begin the planning of Site Specific Evaluated Tiered Water Rate Structure. The implementation of this structure and of corresponding rate increases would bolster the City’s current tiered rate structure. Subsequently, by substantially increasing the fees for customers who are not conserving, that is, not keeping their water below their base index, the structure would generate a sustainable stream of revenue that would be drought independent.

Some municipalities have gone so far as to set rate increases for far into the future. In San Diego County for example, some agricultural irrigation customers are paying as much as $1,500 per acre foot, and that number is expected to increase. The setting of a Drought Rate Structure is easily done by hiring a consultant to perform a study and produce a report which includes allocations and rate structures. Proposition 218 requires that a public hearing be publicized during this process. The result for the City would be a much greater Capital Improvement Program fund and an effective series of water system improvements.

Task 8: Funding, Implementation Plan

Possible Implementation Schedule

1. Determine Appropriate Projects for which to garner funding (Mar. 2015)
2. Submit Funding Pre-Applications and Search www.grants.gov
    a. U.S. Bureau of Reclamation: WaterSMART & Title XVI (5 Jan. 2016) - www.grants.gov
    b. State Water Resources Control Board: Clean Water State Revolving Fund and Proposition 13 (5 Jan. 2016)
    c. State Water Resources Control Board-Division of Drinking Water: Drinking Water State Revolving Fund (5 Jan. 2016)
3. Evaluate property or sales tax increases within existing tax structure (1 Feb. 2016)
4. Evaluate the City's tiered water-rates for possible increase by initiating a Planning Study for Site Specific Evaluation-based Tiered Water Rate increases (1 Feb. 2016)
5. Complete Planning Study for Rate Increases (1 June 2016)
6. Complete Full Funding Applications
    a. U.S. Bureau of Reclamation: WaterSMART & Title XVI (31 Mar. 2016)
    b. State Water Resources Control Board: Clean Water State Revolving Fund and Prop. 13 (30 June 2016)
        i. CWSRF Application: Engineering for Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion
        ii. CWSRF Application: Construction of Segment 1
        iii. CWSRF Application: Construction of Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion
    c. State Water Resources Control Board-Division of Drinking Water: Drinking Water State Revolving Fund (30 June 2016)
        i. DWSRF Engineering plan application for treatment at Curtis, blending at Curtis and Pinewood and 2 new wells (Apr. 2015 - Dec. 2015)
        ii. DWSRF SCADA construction application (Apr. 2015 - Dec. 2015)
        iii. DWSRF construction application for treatment at Curtis, blending at Curtis and Pinewood and 2 new wells (July 2016 - Mar. 2017)
7. Signing of Funding Agreements (~6 months after Submission of an Application)
8. Begin Public Comment Period on Site Specific Evaluation Tiered Rate Increases (1 Oct. 2016)
9. Finish Planning or Construction of Water Projects
10. Submit Claims for Reimbursement if funding not yet received

Costs

There is a modest cost for applying for funding. A single employee position could provide services as both a fund researcher and a grant writer.

Benefit

Water Planning or Construction projects could be paid for in full or with loan money at a very low interest rate.

Life Cycle The life cycle of a low-interest for non-disadvantaged communities is 20 years.
Prioritization by life-cycle 1. Grant funding from U.S. Bureau of Reclamation (no loan repayment, instant reimbursement) 2. Grant funding and loan funding from the State/State Revolving Fund (20-year life cycle)
Ease of Implementation Grant funding from U.S. Bureau of Reclamation is not as circuitous a process as are the State Revolving Funds.

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Description of Water Supply Augmentation Work Plan

Date: 27 March 2015
To: Steven Machida, Milpitas City Engineer
From: Water Solutions, Inc. - Consultant

As a result of the Water Supply Augmentation Study a lot of new sub-tasks will need to be planned and completed, staff will need to assigned and funding will need to be acquired.

The Water Supply Augmentation Work Plan spreadsheets help to see what needs to be done, by when and by who.

The first sheet simply lists the tasks, the sub-tasks, staffing time (as a percentage of a full-time employee), and funding source. Each sub-task is broken down into smaller actions, estimating how long each action would take, and then placed in sequence on a 5-year timeline.

With this spreadsheet three full-time employees were defined as being needed to complete the tasks and an additional three multi-year contract employees will be needed for support of the engineering staff.

On the second sheet we created a Staffing Plan. We took the first sheet and colorized the timelined sub-tasks. Each color represents how each employee should be assigned so as to allow for the best grouping of skill sets over task and time, accounting for continuity.

Only the #6 Project Engineer has a gap in the job's work flow of three months, April to June, 2017. Two employees, one as the TASP and Meters Project Engineer and one as Old Infrastructure and Conservation Outreach, will be full-time and ongoing. One employee will go full-time, then part-time (SCADA and water rights). Three project engineers will be needed for 3 and 4 years.

The Priorities List (third sheet) shows each task prioritized from 0 to 28. The zeros were assigned to tasks that have already been started.

Lastly, the fourth sheet calculates the System Operator Certification Requirements scores for treatment and distribution criteria for chief operators in each discipline. T2 and D4 chief operators will be required to conduct ongoing water system operation.

Work Plan Sheet 1 is deleted as it is the same information as sheet 2, staffing plan

Staffing Plan (with schedule and cost) of Work Plan related to Water Supply Augmentation Feasiblity Study

						Fiscal Year 2014-15				Fiscal Year 2015-16				Fiscal Year 2016-17				Fiscal Year 2017-18				Fiscal Year 2018-19			
Row	Task	Sub-Task	Staff	Cost	Funding	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June
1	Conservation	Smartmeter Concept	0.375	$6,250,000	Grant/Loan/CIP	Large Pilot (1 meter)					Large Install (60 meters)			Small Pilot				Small Install (16,000 meters)							
2		Outreach	0.25	$35,000	Water O&M				Ongoing: Advertisement and Education for SCVWD Rebate Programs etc.																
3		SCADA efficient water management	0.5	$5,000,000	Grant/Loan				Funding/Application: SCADA efficient water management			SCADA: Installation of City-wide Pressure & Flow Sensors					PG&E Power	SCADA: Installation of Remote control valves							
4		System-Wide Leak Detection	0.25	$175,000	CIP													Hiring of Leak Detection Company							
5		Aging Infrastructure Field Investigation	0.75	$105,000	Water O&M					Ongoing: Aging infrastructure field investigation															
6																									
7	Recycled Water	Recycled Water Modeling	0.25	$75,000	Grant/Loan								Modeling												
8		TASP Construction	0.375	$9,400,000	TASP	Construction (ongoing; development-driven)																			
9		Segment 1 (east extension)	0.375	$3,900,000	Grant/Loan			Engineering				Funding/Application: Construction of Segment 1			Construction										
10		Segment 2 (north loop)	0.25	$2,000,000	Grant/Loan				Funding/Application: Engineering for Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion			Consultant Selection	Engineering				Application: Construction of Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion			Construction					
11		Segment 3 (golf courses)	0.25	$3,200,000	Grant/Loan							Consultant Selection	Engineering							Construction					
12		Segment 4 (school & park)	0.25	$3,200,000	Grant/Loan							Consultant Selection	Engineering							Construction					
13		Segment 5 (south loop)	0.25	$2,000,000	Grant/Loan							Consultant Selection	Engineering								Construction				
14		Reservoir & Booster Pump Station	0.25	$10,000,000	Grant/Loan							Consultant Selection	Engineering									Construction			
15		Loop Completion	0.25	$12,800,000	Grant/Loan							Consultant Selection	Engineering										Construction		
16																									
17	Groundwater	Original Conceptual Blending Study (Done)																							
18		Blending Treatment: Onsite vs. transmission	0.375	$3,000,000	Grant/Loan				Funding/Application: Engineering for Treatment at Curtis, Blending of Curtis and Pinewood & Piping, Pinewood Generator & Control, 2 new wells			Consultant Selection	Blending & Piping Engineering	Funding/Application: Construction of Treatment at Curtis, Blending of Curtis and Pinewood, Pinewood Generator & Control, 2 new wells				Construction of Blending & Piping				Permit to Operate			Chief Treatment Operator (T2 Required by SWRCB) and 2x Shift Treatment Operators (T1)
19		Pinewood	0.25	$100,000	Grant/Loan							Consultant Selection	Blending & Piping Engineering					Construction of Blending & Piping				Permit to Operate			
20		Curtis	0.25	$500,000	Grant/Loan							Consultant Selection	Hardness (Mn, Fe) Treatment Engineering					Construction of Hardness Treatment and Blending & Piping				Permit to Operate			
21		New Well 1: Starlite?	0.25	$3,000,000	Grant/Loan							Consultant Selection	Site Selection, Test Bore, Engineering					Construction of New Well #1				Permit to Operate			
22		New Well 2	0.25	$3,000,000	Grant/Loan							Consultant Selection	Site Selection, Test Bore, Engineering					Construction of New Well #2				Permit to Operate			
23		New Well 3?	0.25	$3,000,000	Grant/Loan																				
24	Funding (all loans, to be repaid by gen'l oblig. or other bonds)	SWRCB Planning - Groundwater sources (reliability)	0.375	$52,500	Grant/Loan				Application: Engineering for Treatment at Curtis, Blending of Curtis and Pinewood & Piping, Pinewood Generator & Control, 2 new wells																
25		SWRCB Construction - SCADA efficient water management	0.375	$52,500	Grant/Loan				Application: SCADA efficient water management																
26		SWRCB Construction - Groundwater sources (reliability)	0.375	$52,500	Grant/Loan										Application: Construction of Treatment at Curtis, Blending of Curtis and Pinewood, Pinewood Generator & Control, 2 new wells										
27																									
28		SWRCB Planning - Recycled Water	0.375	$52,500	Grant/Loan				Application: Engineering for Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion																
29		SWRCB Construction - Recycled Water	0.375	$52,500	Grant/Loan							Application: Construction of Segment 1													
30		SWRCB Construction - Recycled Water	0.375	$52,500	Grant/Loan												Application: Construction of Segments 2, 3, 4 & 5, Tank & Pump Station, Loop Completion								
31																									
32	O&M	PRV from SCVWD to SFPUC Zone	0.25	$300,000	CIP				Engineering	Construction															
33	Desalination	Partnership Research	0.25	$35,000	Water O&M					Ongoing: Desalination Partnership research															
34	Water Rights	ACWD Purchase	0.25	$105,000	Water O&M			Negotiation for Purchase of Allotment																	
35		Water Rights Research	0.25	$35,000	Water O&M					Ongoing: Available water rights research															
36	Surface Water	Construction Water Flll Stations (4)	0.25	$200,000	Water O&M					Engineering	Construction														

Estimated Total New FTE Needed 3

Total Budget approx. $72 million

#1 TASP/Meters Engr.	1	FTE ongoing
#2 Old Infrastructure & Outreach Admin III	1	FTE ongoing
#3 SCADA & Water Rights Engr.	1	FTE => P/T
#4 Project Engr.	1.75	4 yr contract
#5 Project Engr.	1	4 yr contract
#6 Project Engr.	1.5	3 yr contract

FTE: full time employee

P/T: part time (employee)

Priorities List

0 means completed or already underway

* Refers to row number of work plan (staffing and schedule) spreadsheet

TASP and CIP are not counted for funding budget/level

Priority	Row *	Task	Sub-Task	Staff	Cost	Funding	
0	17	**Groundwater**	Original Conceptually Blending Study Done				
0	9	**Recycled Water**	Segment 1 (east extension)	0.375	$3,900,000	Grant/Loan	
0	8	**Recycled Water**	TASP Construction (by developers)	0.375	$9,400,000	TASP	
0	34	**Water Rights**	ACWD Purchase	0.25	$105,000	Water O&M	
1A	24	**Funding**	SWRCB Planning - Groundwater sources (reliability)	0.375	$52,500	Grant/Loan	
1B	28	**Funding**	SWRCB Planning - Recycled Water	0.375	$52,500	Grant/Loan	
1C	25	**Funding**	SWRCB Construction - SCADA efficient water management	0.375	$52,500	Grant/Loan	
1D	29	**Funding**	SWRCB Construction - Recycled Water sement 1	0.375	$52,500	Grant/Loan	
1E	30	**Funding**	SWRCB Construction - Recycled Water remain segments	0.375	$52,500	Grant/Loan	
1F	26	**Funding**	SWRCB Construction - Groundwater sources (reliability)	0.375	$52,500	Grant/Loan	
2	1	**Conservation**	Smartmeter Concept	0.375	$6,250,000	CIP	
3	19	**Groundwater**	Pinewood	0.25	$100,000	Grant/Loan	
4	20	**Groundwater**	Curtis	0.25	$500,000	Grant/Loan	
5	18	**Groundwater**	Blending Treatment: Pinewood-Onsite vs transmission Curtis-Onsite vs. Gibraltar transmission	0.375	$3,000,000	Grant/Loan	
6	7	**Recycled Water**	Recycled Water Modeling	0.25	$75,000	Grant/Loan	
7	5	**Conservation**	Aging Infrastructure Field Investigation	0.75	$105,000	Water O&M	
8	21	**Groundwater**	New Well 1: Starlite?	0.25	$3,000,000	Grant/Loan	
9	2	**Conservation**	Outreach	0.25	$35,000	Water O&M	
10	32	**O&M**	PRV from SCVWD to SFPUC Zone	0.25	$300,000	CIP	
11	4	**Conservation**	System-Wide Leak Detection	0.25	$175,000	CIP	
12	10	**Recycled Water**	Segment 4 (schools and parks)	0.25	$3,200,000	Grant/Loan	approx $15 million level
13	11	**Recycled Water**	Segment 3 (golf courses)	0.25	$3,200,000	Grant/Loan	
14	3	**Conservation**	SCADA efficient water management	0.5	$5,000,000	Grant/Loan	**recommended level ($ approx 22 million)**
15	12	**Recycled Water**	Segment 2 (north loop)	0.25	$2,000,000	Grant/Loan	
16	13	**Recycled Water**	Segment 5	0.25	$2,000,000	Grant/Loan	
17	14	**Recycled Water**	Reservoir & Booster Pump Station	0.25	$10,000,000	Grant/Loan	
18	15	**Recycled Water**	Loop Completion	0.25	$12,800,000	Grant/Loan	
19	22	**Groundwater**	New Well 2	0.25	$3,000,000	Grant/Loan	
20	23	**Groundwater**	New Well 3?	0.25	$3,000,000	Grant/Loan	
21	33	**Desalination**	Partnership Research	0.25	$35,000	Water O&M	
22	35	**Water Rights**	Water Rights Research	0.25	$35,000	Water O&M	
23	36	**Surface Water**	Construction Water Fill Stations	0.25	$200,000	Water O&M	
			total	approx	$72,000,000		

Operator certification level

Treatment Criteria	Points
Type: Groundwater & Purchased Treated Water	2
Median Coliform Density: less than 1 per 100 mL	0
Treatment Process: Hardness	3
Treatment Process: Blending (< MCL)	0
Treatment Process: Disinfection	10
Facility Flow (2 * 8.2 MGD)	17
TOTAL POINTS	**32**
REQUIRED CHIEF OPERATOR CERTIFICATION	**T2**

Distribution Criteria	Points
Population Served: 70,000	D4
Pressure Zones: 9	4
Distribution System Disinfection: Yes	5
Largest Pump: XXXXXXX	4
Storage Reservoirs: 5	4
TOTAL POINTS	**17**
ESTIMATED REQUIRED CHIEF OPERATOR CERTIFICATION	**D4**
6 Points for serving recycled water - SWRCB Calculated (updated April 14)	***D5***