City of Sutter Creek &
Amador Regional Sanitation Authority

WASTEWATER MASTER PLAN UPDATE

FINAL

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Technical Memorandum 1 Update
Evaluation of Existing Facilities

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Technical Memorandum

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To: City of Sutter Creek and Amador Regional Sanitation Authority

From: Angela Singer, P.E.

Reviewed By: Bill Slenter, P.E.

Subject: TM #1 Update – Evaluation of Existing Facilities

Date: February 24, 2012 (Revised November 20, 2017)

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Sutter Creek (City) to review, update, and finalize the Draft Wastewater Master Plan (Master Plan) prepared in November 2012. This technical memorandum (TM) is the first in a series of five TMs that comprise the Master Plan document.

1.0 Introduction

This TM describes and evaluates the current capacities and conditions of existing wastewater treatment and disposal systems owned and operated by the City and Amador Regional Sanitation Authority (ARSA), respectively. This TM forms the foundation for alternatives development and evaluation, which will be performed in subsequent TMs as a part of the Sutter Creek Wastewater Master Plan and ARSA Master Plan updates.

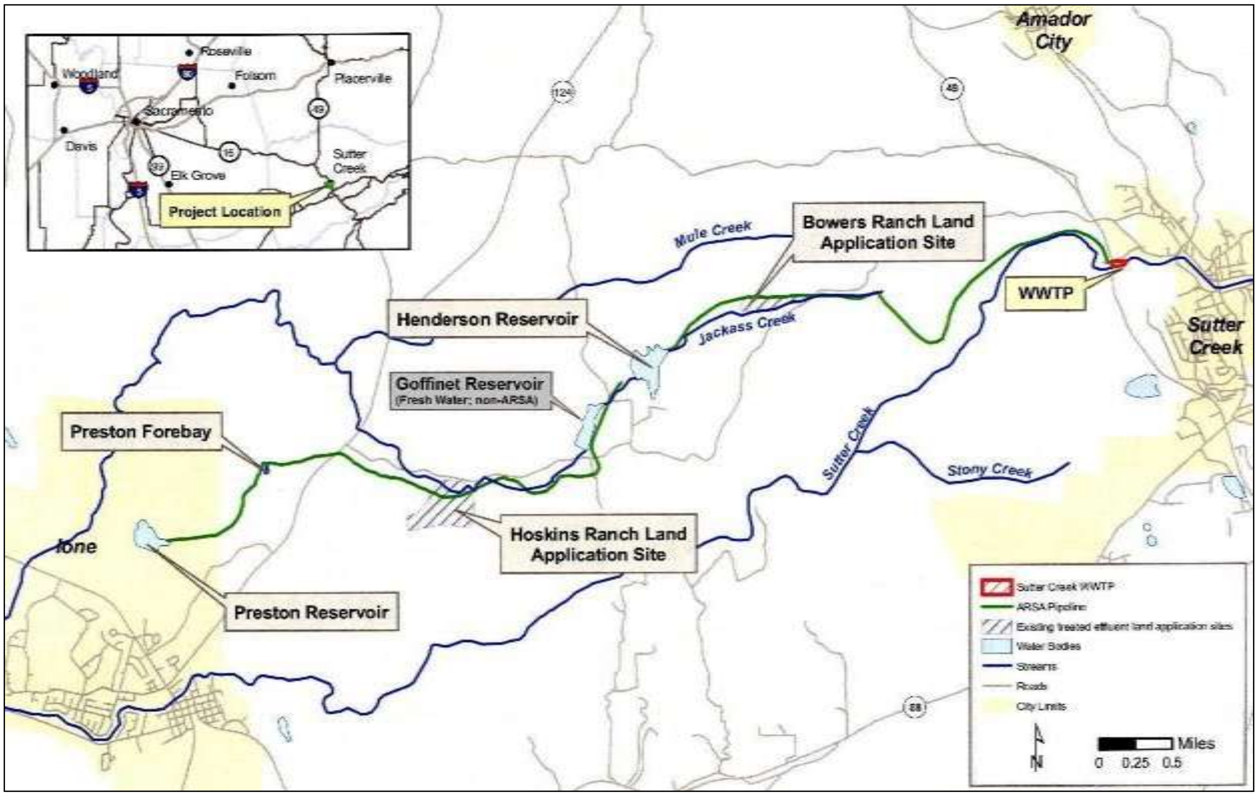
1.1 Background Information

The City owns and operates the Sutter Creek Wastewater Treatment Plant (WWTP), shown on **Figure 1**, which serves the cities of Sutter Creek and Amador City, and Amador County Service Area #4 (CSA #4)/Amador Water Agency (AWA) Wastewater Improvement District #11 (WID #11), which generally comprises the community of Martell. Secondary effluent produced by the WWTP is discharged to the ARSA system for storage and reuse/disposal. The Amador Regional Sanitation Authority (ARSA) is a joint powers agency (JPA) providing wastewater conveyance and disposal services to its member agencies: the City of Sutter Creek, the City of Amador, and Amador County. The ARSA system is a series of pipelines, storage reservoirs, stock troughs, and land application sites in Amador County, southwest of the WWTP. Primary components of the ARSA system are shown on **Figure 1**.

The main documents used in gathering information for this TM are:

- Draft Sutter Creek Wastewater Master Plan, HDR, Inc., February 2010 (2010 Draft SC WWMP)
- Draft Amador Regional Sanitation Authority Master Plan, HDR, Inc., February 2010 (2010 Draft ARSA MP)
- Sutter Creek Wastewater Treatment Plant/ARSA System Title 22 Engineering Report, Thompson-Hysel Engineers, October 22, 2004 (Title 22 Report)
- City of Sutter Creek Wastewater Treatment Plant WWTP Process Evaluation, IRM/WL Troxel & Associates, June 28, 2011 (Troxel Report)
- Henderson Reservoir Dam Assessment, HDR, Inc., July 10, 2008 (Henderson Dam Report)

Figure 1: Existing WWTP and ARSA System



Modified from WWTP Draft EIR

- Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion, Environmental Stewardship & Planning, Inc., February 17, 2010 (WWTP Draft EIR)
- ARSA, City of Ione, and CDCR: Regional Water Recycling Feasibility Study, HydroScience, August 2016 (Regional Study)

A more complete list of sources of information used in developing this analysis is included in the references **Section 0** at the end of this TM. The evaluation described in this TM utilized a combination of existing information that was reviewed and determined to be valid, existing information that was adjusted to account for current conditions, and all-new information developed for this TM. Footnotes to each table indicate the source of the information and whether any modifications were made.

2.0 EXISTING SYSTEM DESCRIPTION

HydroScience reviewed existing reference documents and conducted two separate site visits. The first site visit was a one-day site visit of the existing facilities on November 8, 2011. Roger Henderson, City Chief WWTP Operator, led the WWTP tour. Cory Stone, ARSA Operator, led the ARSA tour. George Allen, City Head WWTP Operator, also provided information on current plant operations. The second site visit occurred on April 27, 2017 as part of the WWMP update and consisted of a tour of Henderson Reservoir and adjacent sites for existing and potential future disposal facilities. This section provides a description of the existing facilities and any additional observations noted during the site visits. While similar to the descriptions contained in the 2010 Draft SC WWMP, this description also incorporates updates to WWTP processes.

2.1 Sutter Creek Wastewater Treatment Plant

The WWTP treats domestic wastewater from the City of Sutter Creek, Amador City and the Martell area, and discharges secondary effluent to ARSA for disposal. The WWTP currently has a permitted average dry weather flow (ADWF) capacity of 0.48 million gallons per day (MGD). The WWTP was originally constructed in 1949. The original structural work and processes for the trickling filter and the clarigesters are original. Subsequent modifications were completed that included aerators for the emergency overflow pond, enlargement of the emergency overflow pond, updated electrical service from 200- to 400-amp, and addition of a dewatering screw press. Other than these modifications, records of prior repairs/replacements are poor or nonexistent. It is estimated that the majority of the concrete structures and buried mechanical piping are original, which places the overall age of the facility at approximately 68 years. At the end of this 25- year master planning period, the age of these original facilities will be approximately 93 years.

The WWTP consists of the following primary components (WWTP Draft EIR):

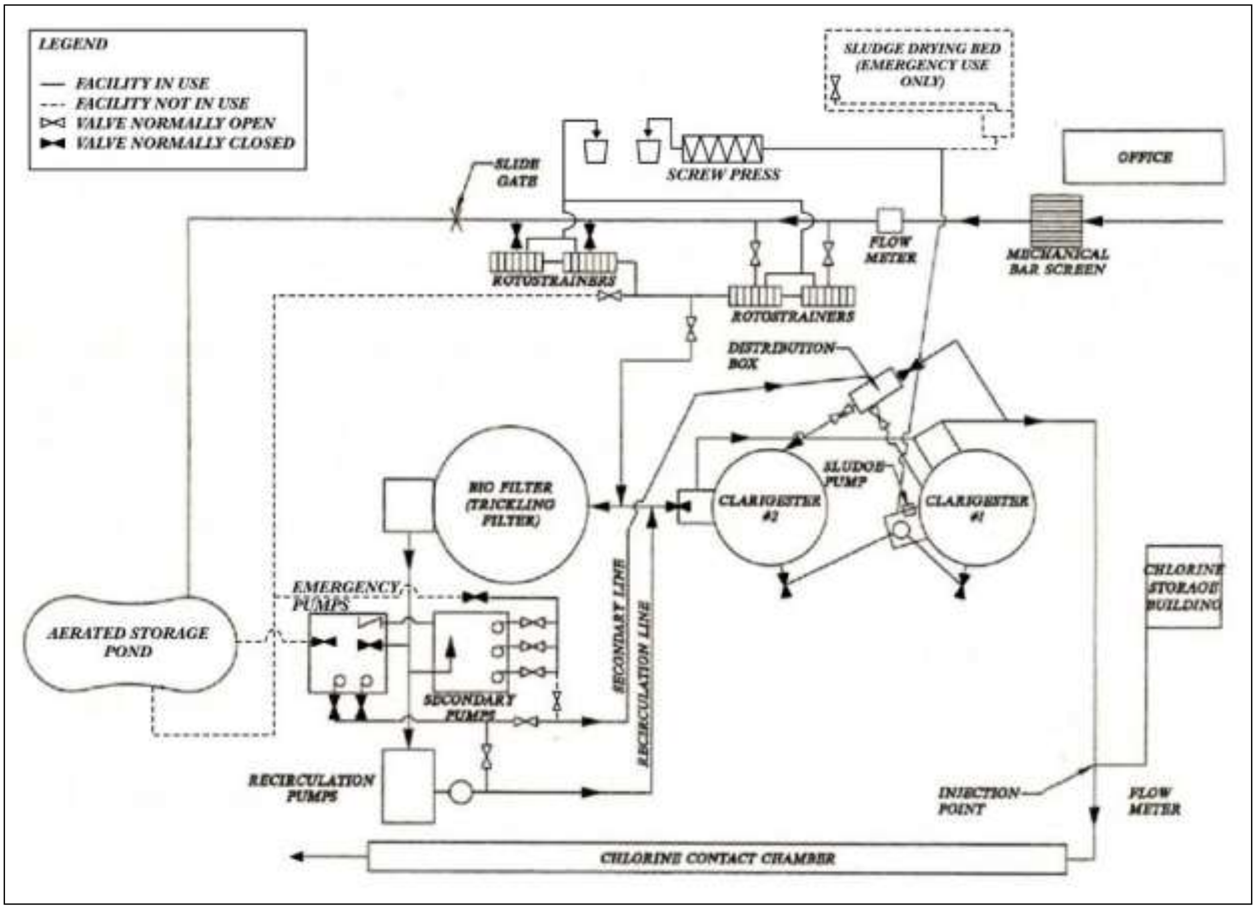
- Mechanical bar screen;
- Flow meter;
- Primary treatment using rotating fine screens (Roto-Strainers) with 0.01 inch openings, the solids to dumpster via screw conveyor;
- A trickling filter with a five foot rock media depth;
- Two secondary clarigesters with combined secondary clarifier and unheated anaerobic digestion processes;
- Sodium hypochlorite disinfection in 30,000-gallon chlorine contact channel;
- Sludge dewatering using an inclined screw press; the solids to dumpster;
- Two sand sludge drying beds and one synthetic media sludge drying bed;
- 1.1 million gallon (MG) aerated emergency storage pond; and
- Emergency standby power.

The current plant configuration is shown in **Figure 2**.

Wastewater is conveyed through the collection system to the WWTP via a 15-inch diameter influent pipeline. Influent wastewater then passes through the mechanical bar screen and flow meter, after which peak flows can be equalized in the 1.1-MG aerated storage basin. The wastewater is then routed in a channel to four parallel Roto-Strainers where primary solids are removed by a doctor blade and discharged by a screw conveyor to a dumpster.

Effluent from the Roto-Strainers flows by gravity to the 70-foot diameter trickling filter. Effluent collected in the underdrains of the trickling filter is routed through the secondary pump station to recirculation pumps. The recirculation pumps recycle flow back to the trickling filter at up to 200%

Figure 2: Current Sutter Creek WWTP Configuration



Modified from Title 22 Report

of the average flow. Overflow from the recirculation pump station flows to the secondary pump station and is then pumped to two “clarigesters” for secondary treatment. The clarigesters combine secondary sedimentation and sludge storage/digestion in a single unit process. The top portion of the clarigester is the clarifier section with a depth of approximately six feet. Both clarigesters operate in parallel to settle and digest solids from the trickling filter effluent stream.

Secondary effluent from the clarigester is disinfected using bulk sodium hypochlorite in a 4,000 cubic-foot chlorine contact basin, which consists of five chambers controlled by weirs to approximate plug flow and provide detention time. Disinfected effluent is then discharged to the ARSA treated effluent conveyance pipeline, which is discussed in further detail below.

The digester tanks, located beneath the clarifier, provide digestion of accumulated solids. Digested solids are drawn off the digesters with an electric motor-driven rake arm/mixer, a polymer coagulant is added and solids are pumped to a screw press or to the covered sludge drying beds for dewatering prior to transport by a private septic company for disposal at Forward Landfill in Manteca, California. The drying beds are only used for redundancy when the screw press is being serviced.

Electricity is provided by Pacific Gas and Electric Company via a 60-kV, wood pole distribution line. In 2008, the plant's average annual electricity use was 96,180 kWh.

2.2 ARSA Disposal System

Secondary effluent produced at the Sutter Creek WWTP is discharged to the ARSA system for storage and reuse/disposal. The ARSA effluent disposal system is a series of pipelines, storage reservoirs, stock troughs, and land application sites in Amador County, southwest of the Sutter Creek WWTP. **Figure 1** depicts the ARSA system, the primary components of which are:

- Effluent pipeline (ARSA pipeline) from the Sutter Creek WWTP to Preston Reservoir;
- Irrigation on Bowers Ranch;
- Henderson Reservoir;
- Irrigation on Hoskins Ranch; and
- Preston Forebay

The City of Ione currently accepts effluent from ARSA, which it stores, treats and disposes (along with effluent from Mule Creek State Prison [MCSP, operated by CDCR] and Preston Water Treatment Plant) through the following system components:

- Preston Reservoir;
- Castle Oaks Water Reclamation Plant (COWRP);
- Castle Oaks Golf Course; and
- Percolation Pond 6 at Ione WWTP (winter disposal)

In fall of 2007, an agreement was reached between the Regional Partners (2007 Ione Disposal Agreement) under which Ione must accept up to 650 AF of secondary treated wastewater for disposal from ARSA and/or MCSP annually (MCSP may contribute up to 350 AF counted against ARSA's and MCSP's 650 AF combined total disposal amount). Furthermore, the agreement limits total discharges to 10 AF per month from October through March of each year, 97 AF for April and May, and 99 AF per month from June through September. The annual total based on these monthly limits is 650 AFY, and MCSP's share of this total is 350 AFY. The City of Ione currently accepts up to 300 AFY of effluent from ARSA as part of the 2007 Ione Disposal Agreement. This agreement includes a five-year cancellation clause, which was invoked by the City of Ione in July 2017. The City of Ione has proposed that ARSA discontinue flows to the lower Henderson/Preston system by July 31, 2022. Thus it is anticipated that the lower Henderson facilities will no longer be available for use beyond July 2022.

The CDCR also has a 737 AFY water right diversion off Sutter Creek which allows the diversion of 4.5 cubic feet per second (cfs) of surface water to the ARSA system from March 1st through October 31st, and the right to store 469 AFY in Henderson Reservoir and 268 AFY in Preston Reservoir collected from November 1st to May 1st at a maximum diversion rate of 15 cfs.

2.2.1 Conveyance Facilities

Secondary effluent is conveyed from the Sutter Creek WWTP to the land application sites and storage facilities through the ARSA pipeline, which is approximately 7.5 miles long from the WWTP to the Preston Reservoir. The pipeline is approximately 35 years old and consists of ductile iron and unreinforced concrete pipe from 10- to 21-inches in diameter, and provides the only means to convey treated effluent to the existing storage reservoirs and reuse sites. **Table 1** describes the individual components of the ARSA pipeline.

Table 1: ARSA Pipeline Components

Pipeline Segment		Diameter (in)	Material	Length (ft)	Notes
From	To				
WWTP	Diversion Structure	12	Ductile Iron	1,850	Hydraulic bottleneck. Capacity depends on water surface elevation at the intake.
Diversion Structure	Siphon	10 to 18	Ductile Iron	8,000	
Jackass Creek Siphon		24	Ductile Iron	Approx. 450	Above-grade creek crossing (see **Figure 3**).
Siphon	Henderson Reservoir	10 to 12	Unreinforced Concrete	7,000	
Henderson Reservoir	Preston Reservoir	12 to 30	Unreinforced Concrete	Approx. 22,300	First 3,300 LF slip-lined in 1983 to inhibit exfiltration near fresh water Goffinet reservoir.

ARSA leases the pipeline and reservoirs from the CDCR. The original agreement was struck in 1977 and subsequently superseded by Ground Lease No. L-2070, executed on February 23, 2009 and set to expire on September 18, 2037.

Figure 3: Jackass Creek Siphon

2.2.2 Storage Facilities

Henderson Reservoir is used as a secondary effluent storage facility on the ARSA system for all effluent not discharged on Bowers Ranch, and is located in the Jackass Creek drainage, as shown on **Figure 1**. Preston Forebay and Preston Reservoir are located downstream of Henderson Reservoir and receive any effluent discharged from Henderson and not otherwise disposed of on Hoskins Ranch. Outflow from Preston Reservoir is discharged into the Ione wastewater system. As discussed previously, invocation of the 5-year cancellation clause by the City of Ione eliminates the ARSA use of storage and disposal facilities downstream of Preston Forebay (i.e Preston Reservoir). The current ARSA storage facilities are listed in **Table 2**.

Table 2: Existing Storage Reservoirs

Reservoir	Ownership	Surface Area (acre)
Henderson	State of CA	5 to 29 (30 max operational area)
Preston Forebay	State of CA	2
Preston Reservoir	State of CA	0 to 18

Modified from: 2010 Draft ARSA MP

Henderson Reservoir (see **Figure 4**) is created by an earthen dam on Jackass Creek, which was originally completed in 1855, reconstructed to an approximate height of 46 feet, and raised ten feet in 1922 to the current height of 56 feet. The dam footprint covers approximately two acres. The reservoir's maximum operational surface area with freeboard is 29 acres. The surface area at the spillway elevation is 30 acres (with no freeboard).

A corrugated metal diversion pipeline was installed in 1979 along the north side of Henderson Reservoir to reduce Jackass Creek inflow to the ARSA system by capturing runoff from the 14-acre tributary watershed and bypassing the reservoir. The pipeline was replaced in 2006 with a 48-inch corrugated plastic pipe. In addition to this diversion pipeline, an interceptor ditch is located

Figure 4: Henderson Reservoir

along the south side of the reservoir which conveys stormwater runoff around the reservoir. Thus the watershed area considered for the water balance is the 4.3 acres of sloped areas of the reservoir, as well as the difference between the water surface area at a given depth and the maximum water surface area.

2.2.3 Effluent Disposal Facilities

Effluent in the ARSA system is reclaimed through land application and supplied to 22 stock water troughs along the ARSA pipeline. The existing ARSA effluent disposal facilities are summarized in **Table 3**.

Table 3: Current Effluent Disposal Facilities

Disposal Site	Ownership/ Agreement	Type of Disposal	Area (acres)	Subject to 5-Year Cancellation Clause
Noble Ranch	ARSA Easement	1,300 AFY Easement	Undetermined	No
Bowers Ranch	ARSA Agreement	Flood Irrigation	36 in use 40+/- available	No
Henderson Reservoir	ARSA/CDCR Land Lease	Evaporation	5 to 29	No
Hoskins Ranch	ARSA Agreement	Sprinkler Irrigation	36 in use 60+/- available	No
Preston Forebay	ARSA/CDCR Land Lease	Evaporation	2	No
Preston Reservoir	ARSA/CDCR Land Lease	Evaporation	0 to 18	Yes
Castle Oaks Golf Course	JPA with City of Ione	Sprinkler Irrigation	Est'd 120 +/-	Yes
Ione Percolation Ponds	JPA with City of Ione	Percolation Ponds	Unknown	Yes

Source: 2010 Draft ARSA MP modified by January 5, 2012 Memo from Gene Weatherby

Bowers Ranch (see **Figure 5**) is contracted to provide 40 acres of pastureland, which is currently approximately 60% developed for flood irrigation (i.e. 24 acres). Hoskins Ranch (see **Figure 6**) provides approximately 60 acres of pastureland, which is currently approximately 40% developed for spray irrigation (i.e. 24 acres).

ARSA has an easement and agreement for the use of Hoskins Ranch for effluent disposal, which requires a minimum of 60 acres to be made available to ARSA for irrigation and a minimum of 25 AFY of effluent to be made available to Hoskins Ranch. This agreement was for a period of six years, estimated to have begun in 2003 and therefore likely expired. Bowers Ranch likely has a similarly expired agreement.

If the Bowers Ranch and Hoskins Ranch disposal facilities are expanded to their full buildout potential of 40 acres and 60 acres, respectively, the ARSA system will still not achieve adequate capacity under a 100 RP rainfall year to dispose of current flows without Ione, and would experience a shortfall.

Figure 5: Bowers Ranch Disposal Area

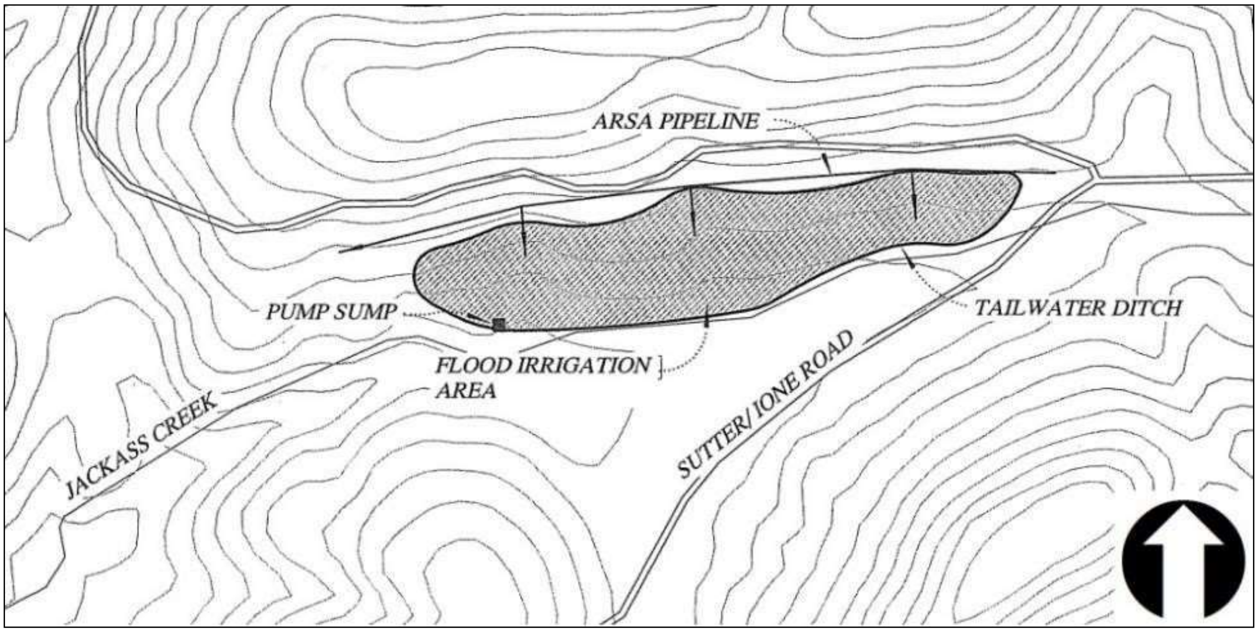


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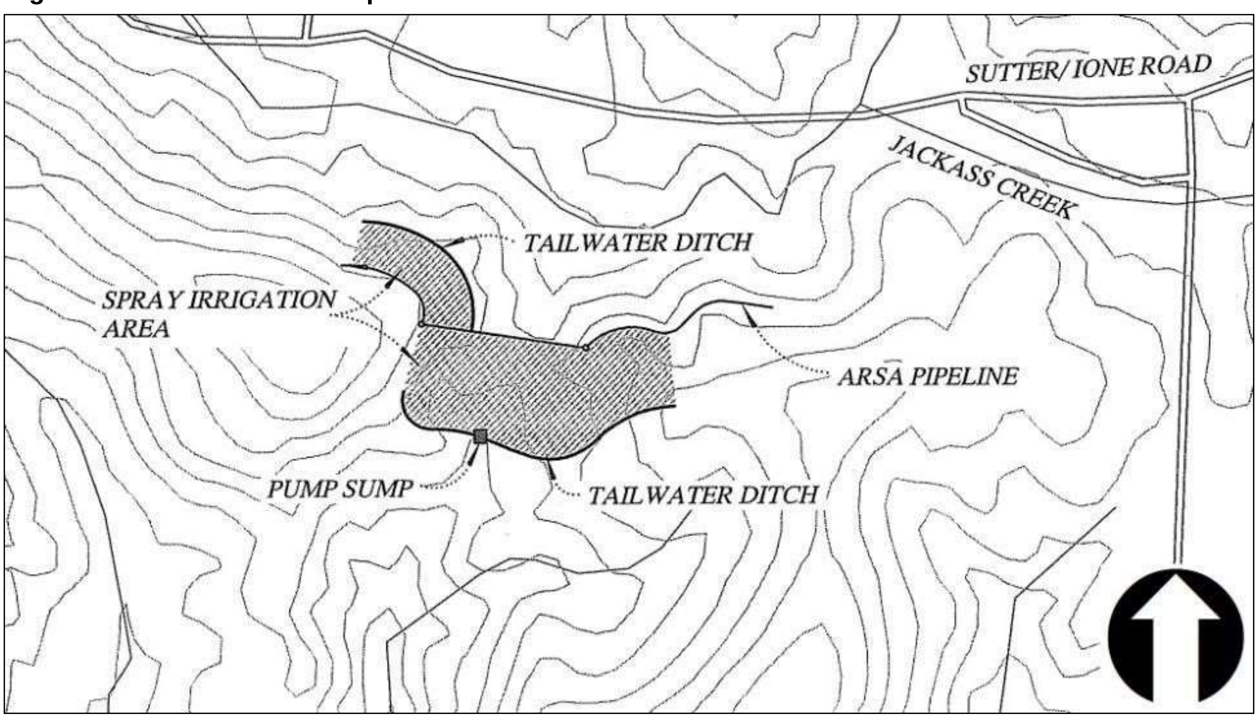
Figure 6: Hoskins Ranch Disposal Area



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3.0 EXISTING SUTTER CREEK WWTP EVALUATION

This section provides an evaluation of the capacity and condition of the WWTP. The evaluation presented in this section is based on our review of existing reports (listed in **Section 0,** References at the end of this TM), a one-day site visit, and interviews with the City's WWTP operator and plant operations consultant, Gene Nelson of Aquality Water Management (Aquality). Hydraulic modeling, stress testing, and condition assessments were not included in the scope of this TM.

3.1 Process and Hydraulic Capacity

The permitted ADWF of the WWTP is 0.48 MGD. Of the recent existing documentation reviewed by HydroScience, the Troxel Report was the only report to provide an evaluation of individual WWTP processes and WWTP design capacities. The Troxel Report considered organic as well as hydraulic loading and calculated the expected design capacities of each process, the results of which are summarized in **Table 4**.

Table 4: WWTP Process Capacities

Process	Average Day Flow (MGD)	Max Month Flow (MGD)	Peak Flow (MGD)	Comment
Fine Screens (Roto-Strainers)	-	-	1.80	Firm capacity
High-Rate Trickling Filter with Recirculation	0.47	0.61	0.96 (process) 1.75 (hydraulic)	High rate organic loading (40 lb/kcf/d) or greater
Clarigester Clarifier	0.90	1.20	1.95	Equalized
Clarigester Digester	0.52	0.66	-	30 day HRT, 40 lb VSS/kcf/d
Chlorine Contact Basin	-	-	1.44	30 min peak

Notes:
Source: Troxel Report
HRT = hydraulic retention time
lb/kcf/d = pounds per thousand cubic feet per day
lb VSS/kcf/d = pounds volatile suspended solids per thousand cubic feet per day

Through our observations and consultation with the WWTP operator and Aquality, we concur with these process design values and have verified that the flows fall within typical hydraulic and organic loading for high-rate trickling filters. Note that without specific process water quality data (especially after the rotary screens), the process loading capacity of the trickling filter cannot be accurately verified. For the clarigesters, the WWTP operator noted that during high flow events that both the clarigesters have reached their hydraulic capacity.

The current age of the original WWTP is 68 years. A wastewater master plan would typically assume full replacement of concrete structures every 50 years, mechanical every 15 to 20 years, and electrical components every 10 to 15 years. Unless significant rehabilitation has recently occurred at the WWTP, or a condition assessment demonstrated that the facilities are in better-than-average condition, significant rehabilitation or replacement should be planned.

3.2 Limiting Factors

As shown in **Table 4**, the limiting organic process is the trickling filter, currently estimated at a peak capacity of 0.96 MGD. The trickling filter process capacity depends on its influent organic loading, and may be higher than 0.96 MGD if the rotary screen is found to reduce BOD by 30% or more. Evaluation of each unit process is required to confirm the performance characteristics of each process.

The aerated emergency storage pond has a volume of 1.1 MG, which can provide approximately two days of storage for the WWTP's permitted ADWF of 0.48 MGD for times of planned maintenance. For wet weather, the storage pond, combined with the 0.96 MGD process capacity of the WWTP, allows a wet weather capacity rating of approximately 1.73 MGD (assuming 30% reserve storage capacity for consecutive storms). The storage pond has had surface aerators installed with the intent to improve organic loading capacity.

Daily records from 2012 to 2016 were reviewed and are summarized in **Table 5**. The WWTP usually operates below its 0.96 MGD process capacity, but it exceeds this capacity under storm conditions, during which the emergency overflow basin must be employed. There are several recent years (see **Table 5**) during which peak day flows approach the wet weather capacity of 1.73 MGD. Because of the nature of inflow and infiltration (I/I) in the collection system, instantaneous influent peak wet weather flows (PWWF) to the WWTP may sometimes exceed the 1.80 MGD hydraulic capacity of the fine screens before they can be equalized in the emergency overflow basin. Year 2013 was particularly dry, thus, the wet weather flows were also lower than normal. The average for 2014-2016 is shown in **Table 5** as a typical representation of recent influent wastewater flows.

Table 5: WWTP Influent Flows (2012-2016)

Parameter	2012	2013	2014	2015	2016	Average (2014-2016)
Annual Average Flow (MGD)	0.337	0.306	0.320	0.292	0.351	**0.321**
Minimum Day Flow (MGD)	0.129	0.224	0.225	0.201	0.078	**0.168**
ADWF (MGD) June through September	0.280	0.296	0.264	0.258	0.270	**0.264**
PWWF (MGD)	1.525	0.443	1.633	1.571	1.327	**1.510**
Peaking Factor (PWWF/ADWF)	5.4	1.5	6.2	6.1	4.9	**5.7**

Notes:
1. This data represents WWTP influent flow. The City monitors influent and effluent flows separately. Effluent flows vary due to process flow variations and equalization. Corresponding monthly average effluent flows from 2014-2016 are incorporated into the water balances and vary slightly from influent flows.
2. ADWF are consistent between influent and effluent monitored values.

3.3 Condition Assessment

According to existing information and operator interviews, the WWTP equipment is in fair to good operating condition. However, the concrete containment structures are remaining from the original 1949 WWTP construction. **Table 6** lists the known WWTP deficiencies and potential improvements for increasing operational efficiency and WWTP capacity. The recommended monitoring will allow a true assessment of the various process capacities.

Table 6: Existing WWTP Deficiencies

Process	Issue/Deficiency	Potential Improvement
Influent Flow Meter	Inaccurate readings in 2011.	Calibrate
Trickling Filter	Inefficient operation. Trickling Filter organic loading of 0.96 MGD is the process bottleneck. No water quality data is available to monitor process performance.	Run recirculation pumps and periodically sample the trickling filter effluent to maximize the efficiency of the filter. Use the City's two ISCO auto samplers to continuously monitor BOD/SS and settleable solids in trickling filter influent (rotary screen effluent). This will allow proper loading calculations and facilitate optimization of trickling filter operation. Consider addition of a primary clarification process to reduce organic loading on the trickling filter. This could be achieved by converting one clarigester to a primary clarifier and making associated improvements to sludge digestion and handling.
Disinfection	Manual chlorine dosage produces residuals up to 25 ppm, which is inefficiently high.	Automate the chlorine dosage to reduce chemical usage and increase disinfection effectiveness.
Disinfection	Nearby tree debris interferes with disinfection and clogs basin.	Cover the chlorine contact basin.
Sludge Digestion	Clarigesters are inefficient digesters.	Convert the clarigesters to clarifiers only, and construct a separate 25,000 gallon digester (for current flow rates).
Aerated Emergency Storage Pond	Use of aerators disrupts secondary treatment processes and is inefficient use of energy	Use the overflow basin as an emergency overflow basin only, not for aeration/treatment. Install a new sump pump to dewater this basin to the headworks, not to the clarigester.
Electrical System	At capacity (2010 Draft SC WWMP).	Upgrade electrical service during next improvement project.

Source: Identified by operators, Aquality, and HydroScience staff during interviews and site visits for the 2012 Wastewater Master Plan.

4.0 EXISTING ARSA DISPOSAL SYSTEM EVALUATION

This section provides an evaluation of the capacity and condition of the ARSA disposal facilities described previously. The evaluation presented in this section is based on our review of existing reports (listed in the **References** section at the end of this TM), our site visits, interviews with City and ARSA staff and their consultants, and our professional judgment. New condition assessments were not included in the scope of this TM.

4.1 ARSA System Capacity

This section presents an independent water balance for the ARSA system and also addresses the loss of facilities downstream of Hoskins Ranch in light of the recent invocation of the five-year cancellation clause in the 2007 Ione Disposal Agreement. This section also describes the additional storage and disposal capacity that would need to be developed elsewhere in the ARSA system.

4.1.1 Conveyance Capacity

The ARSA pipeline capacity was conservatively estimated by the 2010 Draft ARSA MP to be approximately 2.0 MGD. **Table 1** summarized the segments of the ARSA pipeline and indicated (based on the 2010 Draft ARSA MP) that the first segment from the WWTP to the Diversion Structure is believed to be the limiting factor holding the overall hydraulic capacity at 2.0 MGD. Improvements to this segment could remove this bottleneck and increase overall pipeline capacity beyond 2.0 MGD. A detailed hydraulic analysis of the pipeline was not included in the scope of this TM.

4.1.2 Storage Capacity

The available storage volumes presented in the 2010 Draft ARSA MP did not take into account sludge accumulation which is known to be significant. A stage storage spreadsheet for Henderson Reservoir, provided by the client, was based on an aerial topographic survey and provides the relative volume and surface area based on water depth. The spreadsheet is assumed to account for sludge accumulation. Revised capacities are based on the updated storage survey and are summarized in **Table 7**. Future removal of accumulated sludge would potentially increase the estimated capacity of Henderson Reservoir.

Table 7: ARSA Storage Reservoirs – Adjusted Capacities

Reservoir	Volume with 2-ft Freeboard (AF)	Surface Area (acre)	Dead Pool (AF)	Available Storage (AF)
Henderson Reservoir [1]	393	5 to 29	0	393
Preston Forebay [2]	17	2	17	0

Notes:
1. Henderson Reservoir source: stage storage spreadsheet provided by Gary Ghio based on aerial topographic survey from 2007.
2. Preston Forebay source modified from: Eugene Weatherby, January 5, 2012

4.1.3 Disposal Capacity

Water balances were presented in the 2010 Draft ARSA MP that included and excluded Gold Rush Ranch for existing and future flows. The 2010 Draft ARSA MP water balances without Gold Rush Ranch included the non-ARSA fresh water Goffinet Reservoir as well as some land application areas not yet developed, so they were not valuable for determining the capacity of the existing ARSA system. Therefore, in support of this evaluation of existing facilities, we prepared independent water balances to evaluate the capacity for the disposal and storage facilities actually in operation now. Gold Rush Ranch was not included in the water balance calculation described in this section as it is not an existing disposal facility.

4.2 Water Balance Methodology

The ARSA system water balances were prepared using the following methodology.

1. These water balances were developed for the primary purpose of determining maximum storage and disposal capacity of each system component under existing conditions.
2. Typically, reservoirs can provide incidental disposal through evaporation and percolation. Evaporation was accounted for in the water balances; however, no credit was taken for percolation as there is no evidence that meaningful amounts of percolation occur.
3. Water balances were calculated over a two year period. Year 1 was assumed to be a very wet precipitation year equivalent to a 100-year storm with corresponding peak wastewater flows and Year 2 was assumed to be an average precipitation year with average wastewater flows. This two-year scenario gives a conservative estimate of the seasonal storage capacity of the reservoir and accounts for potential carry-over storage from Year 1 to Year 2. Understanding potential carry-over is intended to help identify the disposal needs to eliminate carry-over from year to year.
4. The rainfall data used for Year 1 precipitation has a 100 year return period frequency (100RP), and the second year is an average annual precipitation return period frequency.
5. The water balance accounts for higher I/I flows into the collection system and consequently, higher wastewater flows to the ARSA system during the 100RP precipitation in Year 1.
6. The water balance accounts for changes in evaporative surface area as the stored volume in reservoirs change.
7. The water balance uses a starting volume of zero AF in Henderson Reservoir on October 1, assuming that the reservoir would be fully drained by ARSA in preparation for the wet season, consistent with operating objectives.

4.2.1 Water Balance Input Parameters

The following input parameters were used to develop the water balance models to confirm the storage capacity of the reservoirs and determine the disposal capacity of the ARSA system.

1. The City provided WWTP flow data from 2011 to 2016, which was used to estimate the secondary effluent flows in the ARSA system (**Table 5**). A typical average dry weather flow of 0.263 MGD (295 AFY) was established based on 2014 – 2016 flows with an average annual flow of 0.332 MGD. A peak year flow of 0.458 MGD (512 AFY) was estimated based on historical rainfall dependent response curves. Both were used in the water balance calculations. The permitted average dry weather flow (ADWF) for the existing Sutter Creek WWTP is 0.480 MGD (538 AFY).
2. Henderson Reservoir is reported by the City (Gene Weatherby, January 2012) to have a usable storage volume of 393 AF and surface area from 5 acres to 29 acres. It is estimated that the volume is at a minimum at the end of the dry season and at a maximum at the end of the wet season.
3. No credit was taken for percolation at Henderson Reservoir as the actual rate has not been precisely quantified and may be very low.
4. In accordance with current operating practices, flows from Jackass Creek were not included due to the diversion. Rainfall over a 4.3 acre watershed area plus the exposed area of the reservoir slopes depending on the depth plus the water surface area of the reservoir was accounted for.
5. The ARSA operators store water in the Henderson Reservoir throughout the year. The water level is allowed to drop during the summer months when irrigation water demands are high. To maximize available storage capacity, it was assumed that the reservoir is fully drained by October 1.
6. The disposal capacity of the Preston Forebay is calculated with a constant water surface elevation and surface area of 2.0 acres. The percolation rate is reported by the City to be near zero.
7. The disposal capacity of each disposal site was varied throughout the year as the precipitation and ambient temperatures change. The existing disposal sites are constructed on private grass covered cattle grazing properties with slopes ranging from 3 to 30%.
8. On Bowers Ranch, ARSA has a 40-acre flood irrigation disposal easement. Currently, 36 acres of the 40 acres is equipped for irrigation disposal.
9. ARSA has a 60-acre spray field irrigation disposal easement on Hoskins Ranch. Currently, approximately 36 acres of the 60 acres available is equipped for spray field disposal.
10. ARSA has an existing land application disposal easement for 1,300 AFY on Noble Ranch. Disposal facilities do not yet exist on the site, so this site is not considered in our existing system water balance.
11. A portion of the water used to irrigate the Castle Oaks Golf Course comes from the ARSA system. Excess water from the ARSA system flows to the City of Ione tertiary WWTP, is treated, and then pumped to the golf course for reuse. The average annual capacity of the golf course is reported to be 530 AFY. This water balance accounted for monthly contractual flows per the current agreement.

4.2.2 Water Balance Summary

Detailed water balance tables and figures illustrating flows and capacities in each component of the ARSA system are included in **Attachment A**. In the water balance model, the Henderson Reservoir reached a maximum volume of 312 AF during the 100RP wet season, which is less than the reservoir capacity of 393 AF reported by ARSA.

The disposal capacity of the existing ARSA system is 223 AFY for the 100RP year and 267 AFY for the average year precipitation return period, as shown in **Table A-1** (**Attachment A**), and summarized in **Table 8**. Flows from the WWTP (average year flow of 372 AFY and peak year flow of 512 AFY) discharged in excess of the ARSA system disposal capacity are currently discharged to the City of Ione for final disposal.

Table 8: Existing ARSA System Disposal Capacities

Disposal Site	Type of Disposal	Area (acres)	Disposal Capacity (AFY)	
			100RP	Avg Year
Bowers Ranch (Existing)	Flood Irrigation (Evap – Precip)	24	49	53
	Flood Irrigation (Percolation) [1]		73	73
	Sprayfield Irrigation	12	36	41
Henderson Reservoir	Evap – Precip – Runoff (No Percolation)	Varies [2]	-44	-20
Hoskins Ranch (Existing)	Sprinkler Irrigation	36	109	120
Subtotal of ARSA Disposal Capacity (without Ione Facilities)			**223**	**267**
Total Flow into the ARSA System			512	372
Total Flow Discharged to Ione Disposal Facilities [3]			300	300
Remaining Capacity (+) or Shortage (-)			10	195

Notes:
1. Percolation disposal at Bower's Ranch is based on a percolation rate of 0.237 in/day from June through October.
2. Disposal capacity changes with water surface area. Disposal capacity shown here is based on current flow condition and monthly distribution.
3. Total discharged to Ione disposal is assumed to be the contractual amount.

Subtotals in **Table 8** summarize the disposal capacity of the existing system with City of Ione storage and disposal facilities downstream of Hoskins Ranch. The total ARSA disposal capacity plus the contractual flow limit has enough capacity to accommodate 100RP conditions with no carryover storage. It is noted that the Regional Water Quality Control Board does not allow carryover from a 100RP year.

When the Bowers Ranch and Hoskins Ranch disposal facilities are expanded to their full buildout potential of 40 acres and 60 acres, respectively, **Table 9** shows that the total ARSA disposal capacity is 291 AFY for the 100RP year and 353 AFY for the average year return period (see **Attachment A Table A-2**).

Table 9: ARSA Disposal Capacity at Buildout (without Ione Facilities)

Disposal Site	Type of Disposal	Area (acre)	Disposal Capacity (AFY)	
			100RP	**Avg Year**
Bowers Ranch (Buildout)	Flood Irrigation (Evap – Precip)	24	49	53
	Flood Irrigation (Percolation) [1]		73	73
	Sprinkler Irrigation	16	48	55
Henderson Reservoir	Evap – Precip – Runoff (No Percolation)	Varies [2]	-21	28
Hoskins Ranch (Buildout)	Sprinkler Irrigation	60	142	144
Total ARSA Buildout Disposal Capacity			**291**	**353**
Total Flow into the ARSA System			512	372
Additional ARSA Capacity Required to Replace Ione Disposal			**-221**	**-19**

Notes:
1. Percolation disposal at Bowers Ranch is based on a percolation rate of 0.237 in/day from June through October.
2. Disposal capacity changes with water surface area. Disposal capacity shown here is based on current flow condition and monthly distribution.

The disposal system would not provide adequate effluent disposal capacity for the two back-to-back flow conditions described above, even with Bowers and Hoskins Ranch built out. During the 100RP year, an additional 221 AF of disposal capacity is needed.

4.3 ARSA System Condition Assessment

Based on available reports and studies, site visits, consultation with the ARSA operator, and professional judgment, the following section presents an evaluation of the ARSA system condition.

4.3.1 <u>Conveyance System Condition</u>

The known deficiencies of the ARSA pipeline are listed in **Table 10**. This list was developed based on a review of the 2010 Draft ARSA MP, a tour of the facilities, and discussions with the ARSA Operator.

Based on this information, while complete replacement may be needed before the pipeline reaches an age of 70 years (about 35 years from now), within the 25 year planning horizon the City and ARSA should implement an increased maintenance program that includes interior and exterior inspections, material evaluations, and repair and phased replacement.

According to the ARSA operator, in 1983 a 3,300-lineal-foot section of 20-inch concrete pipe was slip-lined in three-foot mortared sections to protect Goffinet reservoir, which stores fresh water. This segment of pipe was located downstream of Henderson Reservoir between the parshall flume and Sutter Ione Road. As indicated in **Table 10**, the ongoing maintenance program may consider additional segments for slip-lining to reduce leaks and improve pipeline integrity.

Table 10: Existing ARSA Pipeline Deficiencies

Segment	Deficiency	Information Source	Potential Action or Improvement
All	Surface Exposure/Shallow Bury Depth	2010 Draft ARSA MP	CCTV of shallow pipe subject to traffic loading. Prioritize shallow pipe for replacement, subject to condition verification.
All	Leaky joints	ARSA Operator	Repair leaks.
All	Air relief valves (ARVs) are mostly non-functional, buried, and/or inaccessible	ARSA Operator	Repairing or replacing ARVs will eliminate trapped air to potentially improve capacity and minimize pipe damage due to water hammer.
All	No isolation valves	ARSA Operator	The addition of isolation valves would be useful in isolating sections for future repairs.
WWTP to Sutter-Ione Road	Capacity bottleneck	2010 Draft ARSA MP	Study segment to determine actual capacity. If required, install upsized new pipeline parallel to the existing.
WWTP to Henderson Reservoir	No maintenance access points	ARSA Operator	Add access ports for maintenance, inspection, and repair.
Jackass Creek Siphon	Above-grade creek crossing in flood plain	HydroScience Site Visit	Protect or relocate (bury) siphon, based on a more detailed engineering evaluation of risk.
From Henderson Reservoir to Preston Forebay	Age, leaking joints, surface exposure	2010 Draft ARSA MP	Increase maintenance budget to account for repair and replacements of the sections of pipeline serving Hoskins Ranch. Perform more detailed condition assessment. Consider slip-lining additional sections to reduce leakage. After July 2022, ARSA will no longer send effluent beyond Hoskins Ranch.

4.3.2 Storage Facilities Condition

The Division of Safety of Dams (DSOD) has jurisdiction over the reservoir dams in the ARSA system. The Henderson Reservoir dam has several identified deficiencies, summarized in **Table 11**.

Table 11: Existing Henderson Reservoir Deficiencies

Deficiency	Information Source	Potential Improvement
Dam Structural Deficiencies	2008 Henderson Dam Report	Report discussed repairs including buttressing, construction of a stability berm, repair of embankment cracks and other modifications. More recent discussions with DSOD indicate dam replacement per DSOD standards will not be required as the dam is stable.
Spring Bleed-off Line	DSOD Discussions (January 2012)	DSOD allowed a repair with sand.
Corroded Outlet Pipe	DSOD Discussions (January 2012)	The repair design is complete to slipline the portion of the underdrain located under the dam and open cut trench and replace the portion that is exposed.
Sludge Accumulation Reduces Capacity	Weatherby–Reynolds–Fritson Memo, February 11, 2009	Dredge estimated 44 AF of settled solids in late September (reach minimum water level by October 1st to maximize wet weather storage capacity).
Existing Dam Height Restricts Capacity	WWTP Draft EIR	Replace the dam in its existing location, adding approximately seven feet to allow for WWTP flow up to 0.9 MGD ADWF. Challenges include the diversion of flow to other temporary storage or land disposal sites during construction.

There is a spring bleed-off line beneath the dam that produces a relatively constant low flow, and the reservoir outlet pipe was internally inspected and found to have sections of the bottom of the pipe completely corroded away. DSOD allowed ARSA to temporarily repair the spring bleed-off line with sand in 2013, and the reservoir outlet pipe will be sliplined under the dam and the exposed section will be replaced via open cut trench. It is likely infeasible to raise the dam to provide more storage capacity unless the entire dam is replaced at considerable expense.

4.3.3 Effluent Disposal Facilities Condition

The land application areas are relatively low maintenance, approximately 15 years old, and are in good condition. The majority of the land use of the disposal sites is for cattle grazing.

5.0 CONCLUSIONS

The following is a summary of findings for this evaluation of existing City treatment and ARSA storage and disposal systems:

1. The permitted ADWF of the WWTP is 0.48 MGD. Unit processes are generally in fair to good operating condition. Most unit processes are believed to have the capability to operate at higher flows, with the trickling filters being the limiting factor.
2. Increased monitoring of trickling filter performance, including typical influent BOD loading, will provide better data on the maximum capacity of this process.
3. Other improvements were identified that would improve both WWTP performance and capacity in order to accommodate an increase in flow.
4. Reducing I/I in the City's gravity collection system will increase available hydraulic capacity to the WWTP, storage, and disposal systems.
5. Removal of accumulated sludge in Henderson Reservoir may free up additional capacity for storage (depending on configuration of the outlet).
6. Under the rainfall conditions evaluated in this TM (100RP followed by average rainfall year), the existing ARSA system does not have adequate disposal capacity during a 100RP rainfall year to handle current flows after Ione stops accepting effluent from ARSA.
7. If the Bowers Ranch and Hoskins Ranch disposal facilities are expanded to their full buildout potential of 40 acres and 60 acres, respectively, the ARSA system without Ione would not have adequate capacity under consecutive 100RP and average rainfall years to store and dispose of flows under current conditions.
8. The ARSA pipeline is approximately 35 years old. While complete replacement may be needed before the pipeline reaches an age of 70 years (approximately 35 years from now), within the 25-year planning horizon the City and ARSA should implement an increased maintenance program that includes interior and exterior inspections, material evaluations, and repair and phased replacement. The maintenance program should include the repair/ replacement of broken ARVs and an evaluation and mitigation of capacity bottlenecks. The maintenance program would focus on the segments that will continue to be utilized after flows to Ione cease.
9. ARSA has completed the design of the repair to the Henderson Dam outlet pipes to address DSOD requirements (see **Table 11**). ARSA has temporarily addressed the corroding spring bleed-off line by filling with sand.

6.0 REFERENCES

Amador Regional Sanitation Authority, City of Ione, and California Department of Corrections and Rehabilitation – Regional Water Recycling Feasibility Study, HydroScience Engineers, Inc., August 2016

Draft Sutter Creek Wastewater Master Plan, HDR, Inc., February 2010 (2010 Draft SC WWMP)

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Sutter Creek Wastewater Treatment Plant/ARSA System Title 22 Engineering Report, Thompson-Hysel Engineers, October 22, 2004 (Title 22 Report)

City of Sutter Creek Wastewater Treatment Plant WWTP Process Evaluation, IRM/WL Troxel & Associates, June 28, 2011 (Troxel Report)

Henderson Reservoir Dam Assessment, HDR, Inc., July 10, 2008 (Henderson Dam Report)

Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion, Environmental Stewardship & Planning, Inc., February 17, 2010 (WWTP Draft EIR)

Notice of Termination of Right of Disposal of ARSA and CSCR Effluent to the Castle Oaks Water Reclamation Plant from the City of Ione, August 05, 2011

Amador County Housing Element 2000-2014, AECOM, November 01, 2010

Preliminary Draft Amador County General Plan, March 1, 2011

Letter Re: Water Balance Sheets - City of Sutter Creek, Weatherby-Reynolds-Fritson Engineering and Design, August 8, 2011

Goffinet and Henderson Reservoir Evaluation, HDR, Inc., December 19, 2008

Letter Re: Sludge Removal and Conduit Repair at Henderson Reservoir, Weatherby-Reynolds-Fritson Engineering and Design, February 11, 2009

Monthly Evapotranspiration (ETo) for Plymouth Station #227, California Irrigation Management Information System (CIMIS), http://www.cimis.water.ca.gov/WSNReportCriteria.aspx

Sutter Hill CDF Station (048713), CA, Average monthly precipitation (Period of Record: 10/01/1943 to 06/10/2016), Western Regional Climate Center (WRCC), http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca8713

Sutter Hill Station, CA, Rainfall Depth Duration Frequency for 100RP, Department of Water Resources per Regional Water Quality Control Board

Pan Evaporation, WRCC, http://www.wrcc.dri.edu/htmlfiles/westevap.final.html

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ATTACHMENT A

City of Sutter Creek and ARSA

TM #1: Evaluation of Existing Facilities

Current Water Balance Tables

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Current Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
458,000	332,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Sprayfield Irrigation	Total
Area	(ac)	NA	36	36	72
Year 1	(ac-ft/yr)	-300	-261	-109	**-669**
Year 2	(ac-ft/yr)	-300	-224	-120	**-644**

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	512	11	312	81	0
Year 2	11	372	-153	174	219	0

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.414	39.4	0.263	25.0	14.4	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	0.540	49.7	0.263	24.2	25.5	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	0.646	61.4	0.263	25.0	36.4	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	0.644	61.2	0.263	25.0	36.2	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	0.592	50.9	0.263	22.6	28.3	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	0.554	52.8	0.263	25.0	27.7	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.483	44.5	0.263	24.2	20.3	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.371	35.3	0.263	25.0	10.3	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.322	29.6	0.263	24.2	5.4	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.301	28.7	0.263	25.0	3.6	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.309	29.4	0.263	25.0	4.3	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.320	29.5	0.263	24.2	5.2	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.458	512.4		294.8	217.68	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.255	24.3	0.263	25.0	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.276	25.5	0.263	24.2	1.2	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	0.475	45.2	0.263	25.0	20.1	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	0.462	43.9	0.263	25.0	18.9	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.422	36.2	0.263	22.6	13.6	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	0.442	42.1	0.263	25.0	17.0	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.320	29.4	0.263	24.2	5.2	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.282	26.8	0.263	25.0	1.8	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.257	23.6	0.263	24.2	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.261	24.9	0.263	25.0	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.269	25.6	0.263	25.0	0.6	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.265	24.4	0.263	24.2	0.2	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.332	371.9		294.8	78.66	100.0	28.57	44.26	56.00	3.43	3.72

Period		Bowers Ranch				Hoskins	Henderson Reservoir								
Years	Month	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-0.6	15.4	6.2	-21.0	-1.7	24.0	1.2	3.3	-1.3	0.0	3.2	-10.0	15.6	15.6
	Nov	0.0	0.0	13.0	-13.0	0.0	49.7	3.4	6.5	-0.6	0.0	9.3	-10.0	49.0	64.6
	Dec	0.0	0.0	18.7	-16.5	0.0	61.4	8.5	7.8	-0.8	0.0	15.4	-10.0	66.8	131.5
	Jan	0.0	0.0	18.6	-16.5	0.0	61.2	12.6	5.8	-1.2	0.0	17.2	-10.0	68.4	199.9
	Feb	0.0	0.0	15.8	-15.3	0.0	50.9	13.7	3.6	-1.7	0.0	15.6	-10.0	56.5	256.4
	Mar	0.0	0.0	13.8	-18.0	0.0	52.8	13.7	2.3	-3.2	0.0	12.8	-10.0	55.6	**311.9**
	Apr	0.0	0.0	9.9	-10.6	0.0	44.5	10.8	1.2	-7.0	0.0	5.1	-97.0	-47.4	264.5
	May	-4.4	4.4	3.8	-3.8	-13.3	30.9	3.9	0.6	-9.4	0.0	-4.9	-97.0	-84.3	180.2
	Jun	-7.6	29.6	1.1	-26.7	-22.8	0.0	0.9	0.3	-10.2	0.0	-8.9	-11.5	-43.3	136.9
	Jul	-9.4	28.7	0.0	-29.8	-28.2	0.0	0.0	0.0	-10.4	0.0	-10.4	-11.5	-50.1	86.8
	Aug	-8.4	29.4	0.4	-28.2	-25.3	0.0	0.2	0.2	-7.2	0.0	-6.8	-11.5	-43.6	43.2
	Sep	-5.8	29.5	1.0	-24.8	-17.5	0.0	0.4	0.5	-3.9	0.0	-3.1	-11.5	-32.1	11.1
	Total	-36.3	137.0	102.6	-224.3	-108.9	375.5	69.5	32.1	-57.0	-0.1	44.5	-300.0	11.1	
Year 2	Oct	-2.2	19.7	3.4	-21.0	-6.5	4.6	0.8	1.7	-1.5	0.0	1.0	-10.0	-10.9	0.2
	Nov	0.0	0.0	7.2	-7.2	0.0	25.5	1.5	3.8	-0.6	0.0	4.7	-10.0	20.1	20.3
	Dec	0.0	0.0	10.4	-10.4	0.0	45.2	3.0	5.1	-0.7	0.0	7.4	-10.0	42.6	62.8
	Jan	0.0	0.0	10.4	-10.4	0.0	43.9	4.6	4.3	-1.1	0.0	7.9	-10.0	41.8	104.6
	Feb	0.0	0.0	8.8	-8.8	0.0	36.2	5.2	3.1	-1.6	0.0	6.7	-10.0	33.0	137.6
	Mar	0.0	0.0	7.7	-7.7	0.0	42.1	5.3	2.3	-3.0	0.0	4.6	-10.0	36.7	**174.3**
	Apr	-1.6	1.6	5.5	-5.5	-4.8	27.8	4.4	1.4	-5.1	0.0	0.7	-97.0	-73.3	101.0
	May	-5.4	5.4	2.1	-2.1	-16.3	21.4	1.2	0.8	-5.4	0.0	-3.4	-97.0	-95.4	5.7
	Jun	-7.9	23.6	0.6	-26.7	-23.6	0.0	0.1	0.3	-2.8	0.0	-2.3	-11.5	-37.5	0.0
	Jul	-9.4	24.9	0.0	-29.8	-24.9	0.0	0.0	0.0	-3.0	0.0	-3.0	-11.5	-39.4	0.0
	Aug	-8.6	25.6	0.2	-28.2	-25.6	0.0	0.0	0.1	-2.7	0.0	-2.5	-11.5	-39.7	0.0
	Sep	-6.1	24.4	0.6	-24.8	-18.3	0.0	0.1	0.3	-2.1	0.0	-1.7	-11.5	-31.5	0.0
	Total	-41.2	125.3	57.1	-182.8	-120.1	246.6	26.4	23.4	-29.7	0.0	20.1	-300.0	-153.4	

2016 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
458,000	332,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Sprayfield Irrigation	Total
Area	(ac)	NA	40	60	100
Year 1	(ac-ft/yr)	0	-273	-142	**-415**
Year 2	(ac-ft/yr)	0	-238	-144	**-382**

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	512	222	393	0	31
Year 2	222	372	2	393	0	69

Period			WWTP Effluent					Historic Weather Data						Bowers Ranch				Hoskins	Henderson Reservoir								
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.414	39.4	0.263	25.0	14.4	6.02	3.09	3.14	3.96	0.05	0.01	-0.7	15.6	6.2	-21.0	-2.8	23.9	1.2	3.3	-1.3	0.0	3.2	0.0	24.3	24.3
	Nov	30	0.540	49.7	0.263	24.2	25.5	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	13.0	-13.0	0.0	49.7	3.9	6.3	-0.7	0.0	9.5	0.0	59.2	83.5
	Dec	31	0.646	61.4	0.263	25.0	36.4	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	18.7	-16.5	0.0	61.4	9.7	7.2	-0.9	0.0	16.0	0.0	77.4	160.9
	Jan	31	0.644	61.2	0.263	25.0	36.2	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	18.6	-16.5	0.0	61.2	14.2	5.1	-1.4	0.0	17.9	0.0	79.2	240.1
	Feb	28	0.592	50.9	0.263	22.6	28.3	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	15.8	-15.3	0.0	50.9	15.2	2.9	-1.9	0.0	16.2	0.0	67.1	307.1
	Mar	31	0.554	52.8	0.263	25.0	27.7	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	13.8	-18.0	0.0	52.8	15.0	1.8	-3.5	0.0	13.2	0.0	65.9	373.1
	Apr	30	0.483	44.5	0.263	24.2	20.3	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	9.9	-10.6	0.0	44.5	11.6	0.9	-7.5	0.0	5.0	0.0	19.9	**393.0**
	May	31	0.371	35.3	0.263	25.0	10.3	3.75	1.92	4.67	6.32	0.37	0.38	-5.9	5.9	3.8	-3.8	-22.2	29.4	4.6	0.3	-11.1	0.0	-6.3	0.0	0.0	**393.0**
	Jun	30	0.322	29.6	0.263	24.2	5.4	1.12	0.57	6.23	7.83	0.63	0.70	-10.2	29.6	1.1	-26.7	-29.6	0.0	1.4	0.1	-14.9	0.0	-13.4	0.0	-43.1	349.9
	Jul	31	0.301	28.7	0.263	25.0	3.6	0.04	0.02	7.53	8.90	0.78	0.87	-12.5	28.7	0.0	-29.8	-28.7	0.0	0.0	0.0	-17.3	0.0	-17.2	0.0	-45.9	304.0
	Aug	31	0.309	29.4	0.263	25.0	4.3	0.42	0.22	6.76	8.21	0.70	0.78	-11.3	29.4	0.4	-28.2	-29.4	0.0	0.5	0.1	-14.6	0.0	-14.1	0.0	-43.5	260.5
	Sep	30	0.320	29.5	0.263	24.2	5.2	1.02	0.52	5.30	6.09	0.49	0.53	-7.8	29.5	1.0	-24.8	-29.2	0.0	1.0	0.2	-10.6	0.0	-9.4	0.0	-38.6	221.9
	Total	365	0.458	512.4		294.8	217.68	100.0	51.29	42.40	56.00	3.02	3.26	-48.4	138.6	102.6	-224.3	-141.8	373.8	78.4	28.1	-85.7	-0.1	20.6	0.0	221.9	
Year 2	Oct	31	0.255	24.3	0.263	25.0	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-2.9	20.5	3.4	-21.0	-10.8	3.8	3.2	0.7	-5.8	0.0	-1.9	0.0	-8.9	213.0
	Nov	30	0.276	25.5	0.263	24.2	1.2	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	7.2	-7.2	0.0	25.5	6.5	1.5	-2.7	0.0	5.4	0.0	30.8	243.8
	Dec	31	0.475	45.2	0.263	25.0	20.1	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	45.2	10.1	1.9	-2.3	0.0	9.7	0.0	54.8	298.7
	Jan	31	0.462	43.9	0.263	25.0	18.9	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	43.9	11.1	1.4	-2.6	0.0	9.9	0.0	53.8	352.5
	Feb	28	0.422	36.2	0.263	22.6	13.6	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	8.8	-8.8	0.0	36.2	10.1	0.9	-3.1	0.0	7.9	0.0	40.5	**393.0**
	Mar	31	0.442	42.1	0.263	25.0	17.0	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	7.7	-7.7	0.0	42.1	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	**393.0**
	Apr	30	0.320	29.4	0.263	24.2	5.2	9.66	2.76	3.18	4.59	0.13	0.11	-2.2	2.2	5.5	-5.5	-8.1	27.3	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	**393.0**
	May	31	0.282	26.8	0.263	25.0	1.8	3.75	1.07	4.67	6.32	0.45	0.49	-7.2	7.2	2.1	-2.1	-26.8	19.5	2.6	0.2	-11.1	0.0	-8.4	0.0	-15.7	377.3
	Jun	30	0.257	23.6	0.263	24.2	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-10.6	23.6	0.6	-26.7	-23.6	0.0	0.8	0.1	-14.7	0.0	-13.9	0.0	-37.5	339.8
	Jul	31	0.261	24.9	0.263	25.0	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-12.5	24.9	0.0	-29.8	-24.9	0.0	0.0	0.0	-17.1	0.0	-17.1	0.0	-41.9	297.9
	Aug	31	0.269	25.6	0.263	25.0	0.6	0.42	0.12	6.76	8.21	0.71	0.79	-11.4	25.6	0.2	-28.2	-25.6	0.0	0.3	0.0	-14.5	0.0	-14.2	0.0	-39.8	258.0
	Sep	30	0.265	24.4	0.263	24.2	0.2	1.02	0.29	5.30	6.09	0.51	0.56	-8.1	24.4	0.6	-24.8	-24.4	0.0	0.6	0.1	-10.6	0.0	-9.9	0.0	-34.3	223.7
	Total	365	0.332	371.9		294.8	78.66	100.0	28.57	44.26	56.00	3.43	3.72	-54.9	128.4	57.1	-182.8	-144.2	243.5	61.0	7.9	-97.2	-0.1	-28.5	0.0	1.8	

Technical Memorandum 2 Update
Flow Projections

HydroScience
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Technical Memorandum

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Strategic Water Solutions

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To: City of Sutter Creek and Amador Regional Sanitation Authority

From: Angela Singer, P.E.

Reviewed By: Bill Slenter, P.E.

Subject: TM #2 Update – Flow Projections

Date: February 24, 2012 (Revised November 20, 2017)

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Sutter Creek (City) to review, update, and finalize the Draft Wastewater Master Plan (Master Plan) prepared in November 2012. This technical memorandum (TM) is the second in a series of five TMs that comprise the Master Plan document.

1.0 INTRODUCTION

TM #1 provided a description and evaluation of existing facilities. The purpose of this TM is to document existing wastewater flows to the Sutter Creek Wastewater Treatment Plant (WWTP), and to project wastewater flows over the 25-year planning period. The results of this analysis will be used to determine the size of future facilities for the evaluation of wastewater management alternatives in subsequent TMs.

1.1 Background Information

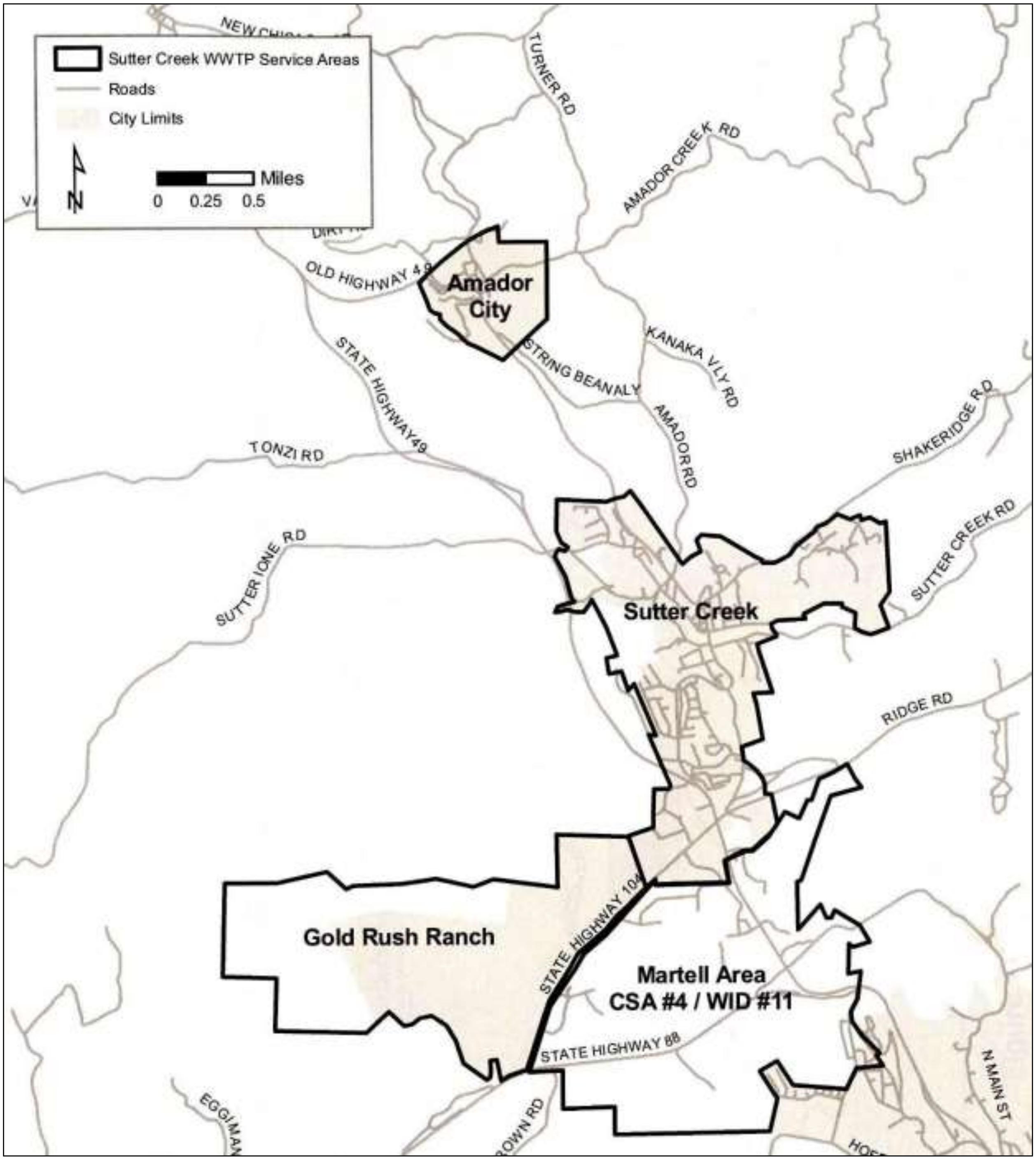
The City owns and operates the Sutter Creek WWTP, which currently treats domestic wastewater to secondary levels and has a permitted average dry weather flow (ADWF) capacity of 0.48 million gallons per day (MGD). The WWTP discharges secondary effluent to the Amador Regional Sanitation Authority (ARSA) for disposal and reuse west of the WWTP.

As shown on **Figure 1**, the WWTP serves the cities of Sutter Creek and Amador City, and Amador County Service Area #4 (CSA #4)/AWA Wastewater Improvement District #11 (WID #11), which generally comprises the community of Martell. The City has approved the development agreement for the Gold Rush Ranch and Golf Resort (GRR) project, which is located southwest of the current City limits (see **Figure 1**) and will be served by the Sutter Creek WWTP.

The cities of Sutter Creek and Amador City are primarily residential, while the Martell area contains a significant amount of commercial and industrial land uses. Growth within the Sutter Creek WWTP service area would include that resulting from infill development within the City and the Martell area. According to the 2016 Amador County General Plan, Amador City expects very little growth since it has nearly reached buildout.

In addition to infill development, the GRR project would comprise a significant portion of the growth and development in the service area. As approved, the GRR project includes an 18-hole golf course, 1,334 residential units, neighborhood commercial uses, and a public safety site, which are expected to develop over 25 years. For the purpose of the Wastewater Master Plan effort, it is assumed that the project would begin in 2020.

Figure 1: WWTP Service Areas



Source: Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion by Environmental Stewardship & Planning, Inc., dated February 17, 2010

The County also has a designated 690-acre large-scale Regional Service Center (RSC) land use designation for the Martell area. The County had originally estimated that this RSC area will develop an additional 1,200 to 3,000 residential units beginning in 2015, and will develop up to a total of 3.5 million square feet (MSF) of commercial and industrial area by 2035. Due to slower than expected growth, development was assumed to begin in 2020.

1.2 Sources

This TM was developed through research of existing information and through a series of discussions held with the City and Amador County (County) planning departments. The following information sources were used to develop flow projections in this TM:

- TM #1 Update – Evaluation of Existing Facilities, HydroScience, September 15, 2017 (TM #1)
- City of Sutter Creek/ARSA Sewer Subcommittee workshops held on November 9 and 30, 2011 and January 5, 2012
- Phone and email interviews with the Amador County Planning Department
- Amador County General Plan, July 2016 (2016 Amador County General Plan)
- United States Census Bureau 2010 Census Data, www.census.gov/2010census/
- Draft Sutter Creek Wastewater Master Plan by HDR, Inc., February 2010 (2010 Draft SC WWMP)
- Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion by Environmental Stewardship & Planning, Inc., February 17, 2010
- Gold Rush Ranch and Golf Resort Final Environmental Impact Report by Environmental Stewardship & Planning, Inc., June 8, 2009 (GRR Final EIR)
- Wastewater Engineering: Treatment, Disposal, and Reuse by Metcalf and Eddy, Fourth Edition 2003 (2003 Metcalf and Eddy)
- Design of Municipal Wastewater Treatment Plants, Water Environment Federation Manual of Practice B, 1998 (1998 WEF MOP B)

1.3 Flow Projection Methodology

Wastewater flows to the Sutter Creek WWTP were projected using the following methodology:

- This study has a planning period of 25 years, therefore, land use, population, and wastewater flows were projected using 2016 existing data to project year 2041.
- After reviewing land use information provided by the City and County, land use categories were grouped by wastewater generation characteristics and consolidated into three master plan land use categories: residential, commercial/industrial, and institutional.
- Population and housing estimates and growth projections were obtained from the California Department of Finance (DOF), 2010 Census and related tools, and 2014 Amador County Municipal Service Reviews (MSRs) for each service area

- For the GRR development, the GRR Final EIR projected a buildout rate of an equivalent 1,467 residential dwelling units with a population of 3,181 (2.17 capita per dwelling unit) over 25 years. As the GRR project has not yet been initiated, the growth rate was assumed to be slower based on more recent development conditions. Growth was assumed to be at a rate of 40 units per year. Population was estimated based on the equivalent persons per residence for the City of Sutter Creek.
- Based on the land used projections in the Amador County General Plan and a conservative estimate of development, it is assumed that the Martell Regional Service Center (RSC) development will accommodate 1,200 housing units over 20 years.
- The County planning department and the 2011 Amador County General Plan were the primary sources for the land use of non-residential areas within the service area, which projected non-residential growth from 1.08 MSF in 2010 to a total of 3.5 MSF of commercial and industrial areas by 2030.
- Amador City land use information was provided by the County Planning Department.
- Non-contributing land uses generate little or no wastewater and include storage facilities, parking lots, roads, vacant residential parcels, drainage channels, open waterways, parks, and sports fields.
- After the existing land use categories were consolidated into the master plan land use categories, annual growth rates were applied to each wastewater collection system within the service area over the 25-year planning period to project year 2041 population and land uses.
- WWTP influent flow data was analyzed over the three year period from 2009 to 2016. This WWTP flow data was used to develop and calibrate unit flows for each master plan land use category, and was then applied to the 2041 land use projections to project 2041 wastewater flows. These unit flow rates were assumed to be applicable to current flows as population and wastewater flows have not changed significantly in the last five years.

2.0 POPULATION PROJECTIONS

Population projections were developed by applying growth rates to population data for the various master plan land uses, as described in this section.

2.1 Existing Land Use and Population

The existing population data for 2016 and 2017 in Sutter Creek and Amador City was obtained from the DOF.

Based on 2010 census data, the projected 2016 population of Martell was 281, which formed the base for projections.

There are five schools in Sutter Creek: Amador High School, Sutter Creek Elementary, Sutter Creek Primary, North Star, and Independence High School. The City Planner estimates the number of students to be approximately 35% of the 2011 service area population (2010 Draft SC WWMP). It was assumed that this rate remained constant through future projections.

The existing 2016 land use and population for the service areas are summarized in **Table 1**.

Table 1: Existing 2016 Land Use and Population

Land Use/Population	Sutter Creek	Martell	Amador City	Total
Population	2,577	281	193	**3,051**
Residential Units	1,274	121	119	**1,514**
Commercial and Industrial (MSF)	0.35	1.09	-[1]	**1.44**
Institutional (Number of Students)	902	98	68	**1,068**

Notes:
1. Commercial and industrial facilities are measured in million square feet (MSF) and while present in Amador City, the dedicated area is relatively small and assumed to be negligible for the purpose of developing wastewater flow projections.

2.2 Land Use and Population Projections

The service area land use and population is projected over the 25-year planning period by applying anticipated growth rates to the existing 2016 land use and population.

2.2.1 Anticipated Growth Rates

The primary source of information for existing population growth rates was the California DOF, which identified a 0.2% population growth from 2016 to 2017. Beyond 2017, an annual population growth rate of 0.60% is projected through 2041, based on the 2014 Amador County Municipal Service Review (MSR). Residential housing growth rate is based on the number of housing units in 2015 and 2016 per the census American community survey from 2015 and project housing in 2016, which increased by three units (or 1.26%). This rate was assumed to continue into the future. Student populations are estimated to grow at the same rate as the population.

The City's commercial and industrial area, 0.353 MSF, was based on a 0.20% escalation since 2010, which was 0.349 MSF, and the projected annual growth rate of 0.60% was based on the population growth rate projected by the MSR.

Martell's population growth rate from 2015 to 2020 is estimated to be 0.84% compounding annually, which is equivalent to 0.167% annually. Additionally, the Amador County General Plan indicates that the Martell RSC will include 1,200 to 3,000 new residential homes. Due to relatively slow development in recent years, it was assumed that the more conservative number, 1,200 homes will be constructed over 20 years. The equivalent population density of 1.89 capita per dwelling unit for the new Martell RSC Housing component was calculated based on 2009 DOF estimates of 2.274 capita per dwelling unit with a 16.94% vacancy rate.

For Martell's commercial and industrial areas, an annual growth rate of 0.2% annually from 2011 to 2016 was assumed to establish 1.09 MSF by 2016. From 2016 on, 6.05% compounding annual growth was assumed until buildout occurs in 2036 (20-year period). Information was obtained from the County Planner and the 2011 Amador County General Plan, which projected non-residential growth from 1.08 MSF in 2010 to a total of 3.5 MSF by 2030.

Amador City is nearly built out, and its population barely increased from 2016 to 2017 according to DOF (0.15%). Projected growth rates based on Census projection tools estimate a rate of 0.98% growth over five years (2015-2020). An equivalent annual compounding rate of 0.2% was assumed.

The annual growth rates discussed above are summarized in **Table 2**.

Table 2: Anticipated Annual Growth Rates

Collection System	Land Use	Projected Annual Growth Rate
Sutter Creek	Residential & Institutional	0.60%
	Commercial & Industrial	0.60%
	Gold Rush Ranch (GRR)	82 capita; 40 residential units
Martell	Residential	0.17%
	Commercial & Industrial	6.05%
	Martell RSC Housing (MRSCH)	113 capita; 60 residential units
Amador City	All	0.20%

2.2.2 Residential Population Projections

The residential population for the service area was projected by applying the annual growth rates listed in **Table 2** to the existing populations summarized in **Table 1**. The residential population projections for the 25-year planning period are summarized in **Table 3**. For convenience, subtotals are provided to exclude the higher-risk MRSCH and GRR development projects.

Table 3: 25-year Residential Population Projections

Year	Sutter Creek	Martell	Amador City	Subtotal (No GRR/ MRSCH)	MRSCH	Subtotal (with MRSCH)	GRR	Total (with GRR & MRSCH)
2016	2,577	281	193	**3,051**	0	**3,051**	0	**3,051**
2021	2,645	283	195	**3,123**	113	**3,236**	164	**3,401**
2026	2,725	286	197	**3,208**	680	**3,888**	585	**4,473**
2031	2,808	288	199	**3,295**	1,247	**4,542**	1,021	**5,563**
2036	2,893	291	201	**3,384**	1,814	**5,199**	1,471	**6,669**
2041	2,981	293	203	**3,476**	2,268	**5,744**	1,936	**7,680**

Notes:
1. GRR = Gold Rush Ranch
2. MRSCH = Martell RSC Housing

2.2.3 Non-residential Land Use Projections

Similar to the residential population projections, the non-residential land uses were projected over the 25-year planning period by applying the annual growth rates listed in **Table 2** to the existing land uses summarized in **Table 1**. The non-residential land use projections are presented in **Table 4**.

Table 4: 25-Year Non-Residential Land Use Projections

Year	Commercial and Industrial Building Area (MSF)			Institutional (No. of Students)
	Sutter Creek	Martell	Total	
2016	0.353	1.091	1.443	1,068
2021	0.363	1.463	1.826	1,096
2026	0.374	1.963	2.337	1,129
2031	0.386	2.633	3.018	1,163
2036	0.397	3.500	3.897	1,199
2041	0.409	3.500	3.909	1,235

3.0 WASTEWATER FLOWS

Influent WWTP data was used to develop and calibrate unit flows for each master plan land use category, and then applied to the land use projections to estimate wastewater flows over the 25-year planning period.

3.1 Existing Flows

Originally, historic monthly WWTP influent flow data was reviewed for 1997 to 2003, and are summarized in **Attachment A**. Daily WWTP influent flow data was also analyzed over the more recent period from 2009 to 2016.

As shown in **Table 5**, 2009 and 2010 dry weather flows were consistent from one year to the next. However, 2011 dry weather flows are significantly lower than usual; even lower than the historic dry weather flows shown in **Attachment A**, indicating a possible flow meter problem in the dry weather data 2011. Therefore, WWTP flow data for 2011 was not used as a part of this analysis. Instead, a two-year average (summarized in **Table 5**) of daily flow data for 2009 and 2010 was originally used to calibrate wastewater flows against flow projections. More recent data provided for 2012-2016 indicates slow growth and stable wastewater flows; thus it is assumed that the unit flow calibration is applicable to current projections. Averages from 2014-2016 are included as reference in **Table 5,** (refer to TM#1 Table 5 for 2012-2016 annual flow data).

Table 5: WWTP Influent Flows (2009-2011) vs. 2014-2016 Average

Parameter	2009	2010	2-Year Average	2011	2014-2016 Average
Annual Average Flow (MGD)	0.346	0.426	**0.386**	0.328	**0.321**
Minimum Day Flow (MGD)	0.142	0.169	**0.156**	0.029	**0.168**
ADWF (June through September) (MGD)	0.319	0.306	**0.313**	0.211	**0.264**
Peak Day Flow (PDF) (MGD)	1.310	1.711	**1.511**	1.653	**1.510**
Peak Day Peaking Factor (PDF/ADWF)	4.1	5.7	**4.9**	8.8	**5.7**

Notes:
1. The 2014-2016 data was presented in **TM #1 Table 5**.

3.2 Flow Projections

Wastewater flows are projected by developing unit flow factors for each land use category using wastewater flow data, and applying those unit factors to population and land use projections over the 25-year planning period.

3.2.1 Unit Flows

ADWFs to the WWTP in 2009-2010 were isolated by contributing agency, divided by land use category, and calibrated to determine unit flow factors. The City and Amador City are primarily residential and contributed approximately 74% of the flows to the WWTP in 2009-2010. The Martell area is primarily commercial and industrial, and contributed approximately 26% of the flows to the WWTP in 2009-2010.

The calibration produced a residential unit flow factor of 74 gallons per capita per day (gpcd), which is within typical unit flow ranges of 80-100 gpcd, but is also consistent with water conservation trends found in similar agencies.

Commercial/institutional flows can vary greatly from 800 to 2,000 gallons per acre or more (1991 Metcalf and Eddy). The 2010 SC WWMP estimated that building square footage in the County covered approximately 25 to 33% of the acreage. The calibration of 2009-2010 flows produced a commercial/industrial unit flow factor of 51,000 gpd/MSF, which is in the low range of typical flows (equivalent to 800 gpd/acre at 36% coverage). This lower unit flow indicates light industrial and retail commercial existing land uses, which are consistent with what is currently found in the service area.

Institutional flows were estimated using an industry-standard unit flow of 18 gpd/student, which is on the upper range of what is typical for schools with cafeterias and no gym/shower facilities (2003 Metcalf and Eddy).

The final unit flow factors developed in this analysis are presented in **Table 6**.

Table 6 : Wastewater Unit Flow Factors

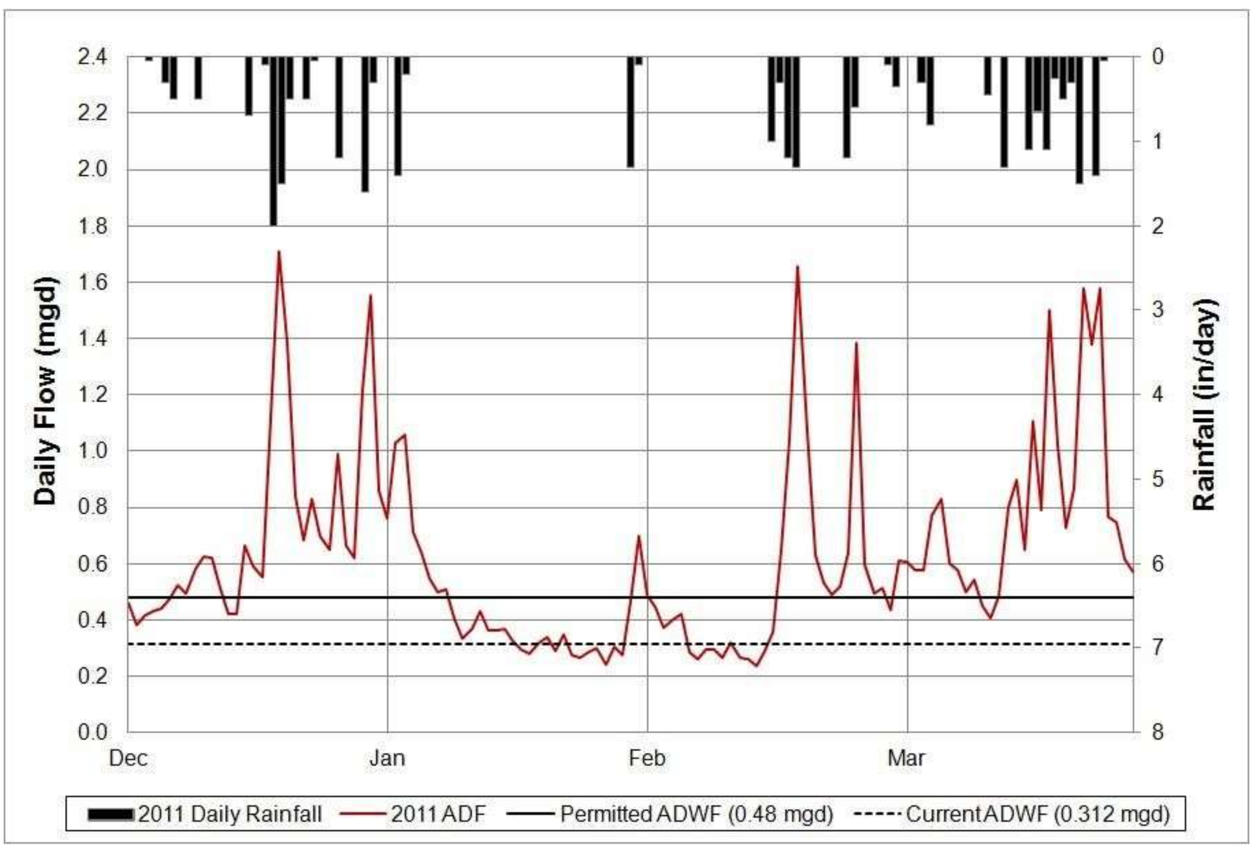
Land Use Category	Wastewater Unit Flow Factor (ADWF)
Residential	74 gpd per capita (gpcd)
Commercial and Industrial	51,000 gpd/MSF
Institutional	18 gpd per student

3.2.2 Wet Weather Peaking Factors

The City experiences heavy rainfall-dependent inflow and infiltration (I/I), as evidenced by **Figure 3** which shows an example of the direct relationship between the average daily influent flow to the WWTP and the amount and frequency of rainfall. As storms occur, the ground saturates, I/I increases, and flows to the WWTP increase.

For periods of consecutive storms (shown on **Figure 3** as multiple days in a row of rainfall) the ground remains saturated, and flows do not recede back to ADWF rates (shown in **Figure 3** for example in March 2011). However, the service area does not appear to have high groundwater infiltration other than during storms (therefore, it is characterized as rainfall-dependent I/I and not just groundwater infiltration), which is shown in **Figure 3** in January 2011 where flows subside to ADWF levels after less than two weeks without rain.

Figure 2: Example WWTP Influent Flows vs. Rainfall for 2011 Wet Season



Using the historic rainfall and WWTP flows summarized in **Attachment A**, the relationships between monthly rainfall depths and monthly average and peak day flows at the WWTP were used to project the collection system's response to monthly rainfall in the form of response curves. The monthly average and peak day response curves are shown in **Attachment B** in Figure B-1 and B-2, respectively.

Peak wet weather flows are developed for a specific design storm or a specific return period (RP) for annual rainfall. Hourly WWTP flow and rainfall data are required to project wet weather flows based on a specific design storm. For this analysis, only limited monthly and daily flow and rainfall data were available. The RWQCB has provided a RP100 at Sutter Hill of 51.29 in. The average precipitation from the period of record for Sutter Hill was used to determine the average annual rainfall distribution. The resulting distribution was used to calculate RP100 rainfall per month.

By applying the monthly average and peak day response curves developed in **Attachment B** to the monthly RP100 rainfall distribution from **Attachment C**, the projected RP100 average and peak day flows are projected in **Table 7**. From **Table 7**, the peak day flow (PDF) of the RP100 year was 1.720 MGD, which yields a wet weather peak day peaking factor (PDF/ADWF) of 5.49, which is the peaking factor that will be used for the existing collection system in this analysis.

Table 7: Projected Monthly Average and Peak Day Flows for RP100 Design Year

Month	% Annual Rainfall Distribution	RP100 Rainfall (in/month)	Projected RP100 ADF (MGD)	Projected RP100 PDF (MGD)
October	6.02%	3.09	0.414	1.069
November	12.67%	6.50	0.540	1.477
December	18.27%	9.37	0.646	1.720
January	18.17%	9.32	0.644	1.716
February	15.44%	7.92	0.592	1.609
March	13.44%	6.89	0.554	1.516
April	9.66%	4.95	0.483	1.308
May	3.75%	1.92	0.371	0.899
June	1.12%	0.57	0.322	0.684
July	0.04%	0.02	0.301	0.590
August	0.42%	0.22	0.309	0.624
September	1.02%	0.52	0.320	0.675
Total Rainfall	**100.0%**	**51.29**	**-**	**-**
Average Dry Weather Flow (ADWF)			**0.313**	**-**
Peak Day Flow (PDF)			**-**	**1.720**
Wet Weather Peaking Factor (PD/ADWF)			**5.49**	

It is noted that the modeled RP100 ADWF of 0.313 MGD is higher than what is typically experience in an average year (see **Table 5**), which has averaged 0.264 MGD in recent years. To be conservative, the projected RP100 flows are applied to the RP100 condition water balance and the assumed ADWF is based on the typical average. This provides a conservative estimate of I/I to the system during a RP100 year.

3.2.3 Flow Projections

The unit flows listed in **Table 6** were applied to the population projections in **Table 3**, to project the residential ADWFs summarized in **Table 8**.

Table 8: Residential ADWF Projections (MGD)

Year	Sutter Creek	Martell	Amador City	Subtotal (no GRR/ MRSCH)	MRSCH	Subtotal (without GRR)	GRR	Total (with GRR/ MRSCH)
2016	0.191	0.021	0.014	**0.226**	0.000	**0.226**	0.000	**0.226**
2021	0.196	0.021	0.014	**0.231**	0.008	**0.239**	0.006	**0.246**
2026	0.202	0.021	0.015	**0.237**	0.050	**0.288**	0.037	**0.325**
2031	0.208	0.021	0.015	**0.244**	0.092	**0.336**	0.069	**0.405**
2036	0.214	0.021	0.015	**0.250**	0.134	**0.385**	0.102	**0.487**
2041	0.221	0.022	0.015	**0.257**	0.168	**0.425**	0.136	**0.561**

Notes:
1. GRR = Gold Rush Ranch
2. MRSCH = Martell RSC Housing

The non-residential ADWF projections over the 25-year planning period were derived by applying the unit flow factors listed in **Table 6** to the land use projections in **Table 4**, and are summarized in **Table 9**.

Table 9: Non-Residential ADWF Projections

Year	Commercial and Industrial				Institutional (Schools)		Total Non-Residential Flows (MGD)
	Building Area (MSF)			Average Day Flow (MGD)	Number of Students	Average Day Flow (MGD)	
	Sutter Creek	Martell	Total				
2016	0.353	1.091	1.443	**0.037**	1,068	**0.019**	**0.056**
2021	0.363	1.463	1.826	**0.046**	1,096	**0.020**	**0.066**
2026	0.374	1.963	2.337	**0.059**	1,129	**0.020**	**0.080**
2031	0.386	2.633	3.018	**0.077**	1,163	**0.021**	**0.098**
2036	0.397	3.500	3.897	**0.095**	1,199	**0.022**	**0.116**
2041	0.409	3.500	3.909	**0.095**	1,235	**0.022**	**0.117**

Total 25-year flow projections to the Sutter Creek WWTP, both with and without GRR, are summarized in **Table 10**.

Table 10: Summary of Residential and Non-Residential ADWF Projections (MGD)

Year	Residential (No GRR/ MRSCH) (Table 8)	Non-Residential (Table 9)	Subtotal (No GRR/ MRSCH)	Residential MRSCH (Table 8)	Subtotal (with MRSCH)	Residential GRR (Table 8)	Total (with GRR/ MRSCH)
2016	0.226	0.056	**0.282**	0.000	**0.282**	0.000	**0.282**
2021	0.231	0.066	**0.297**	0.008	**0.306**	0.006	**0.312**
2026	0.237	0.080	**0.317**	0.050	**0.367**	0.037	**0.404**
2031	0.244	0.098	**0.342**	0.092	**0.434**	0.069	**0.503**
2036	0.250	0.116	**0.367**	0.134	**0.501**	0.102	**0.603**
2041	0.257	0.117	**0.375**	0.168	**0.542**	0.136	**0.679**

Notes:
1. GRR = Gold Rush Ranch
2. MRSCH = Martell RSC Housing

The peak day peaking factor of 5.49 (discussed in **Section 3.2.2**) is specific to the existing collection system and its response to rainfall-dependent I/I. Growth within the service area is expected to be infill development within the existing collection system, with the exception of GRR. GRR will be served by a separate, new collection system and trunk sewer that is expected to have lower I/I rates due to the City's improved development standards. Therefore, for the GRR development, a peak day peaking factor of 1.8 x ADWF is estimated. All other future development will be projected using the peak day peaking factor of 5.49 x ADWF. The total 25-year PDF projections to the Sutter Creek WWTP, both with and without GRR, are summarized in **Table 11**.

Table 11: 25-Year PDF Projections (MGD)

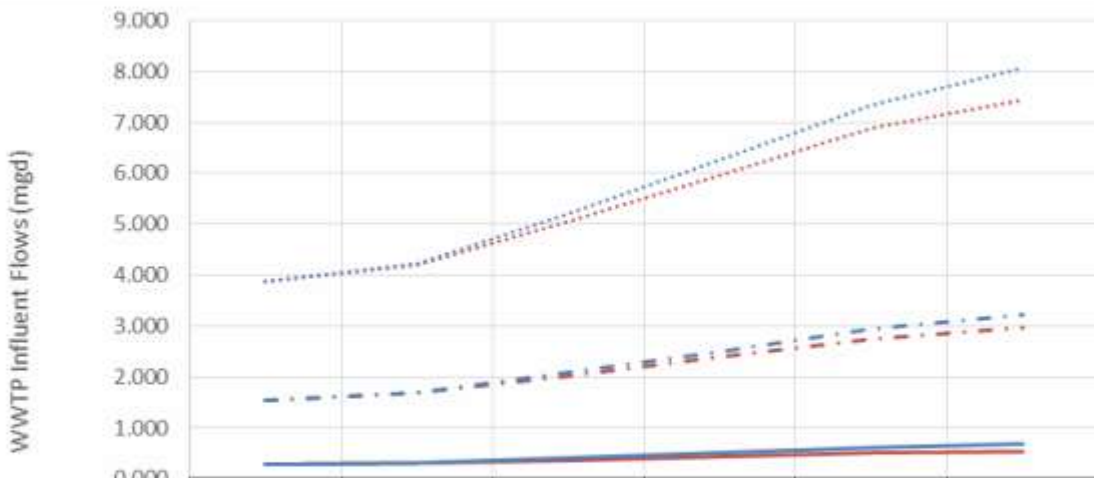
Year	Residential (No GRR/ MRSCH)	Non-Residential	Subtotal (No GRR/ MRSCH)	Residential MRSCH)	Subtotal (with MRSCH)	Residential GRR	Total (with GRR/ MRSCH)
2016	1.239	0.307	**1.547**	0.000	**1.547**	0.000	**1.547**
2021	1.269	0.363	**1.632**	0.046	**1.678**	0.011	**1.689**
2026	1.303	0.438	**1.741**	0.276	**2.018**	0.067	**2.084**
2031	1.338	0.537	**1.875**	0.507	**2.382**	0.124	**2.506**
2036	1.375	0.639	**2.014**	0.737	**2.751**	0.184	**2.935**
2041	1.412	0.644	**2.057**	0.921	**2.978**	0.245	**3.223**

Notes:
1. GRR = Gold Rush Ranch
2. MRSCH = Martell RSC Housing

Peak hourly flows (PHFs) to the WWTP will be much higher than peak day flows, but cannot be accurately projected without hourly flow data. Typical peak hour flows for a system this size can be estimated to be 2.5 times the PDF. PDF and PHF are presented graphically in **Figure 4**.

When compared with estimates projected in the 2010 SC WWMP, the ADWF projections in this analysis are approximately half of that shown in the 2010 SC WWMP because of significantly less-aggressive growth rates. At the time the 2010 SC WWMP was developed, there was limited

Figure 3: 25-Year Flow Projections



	2016	2021	2026	2031	2036	2041
ADWF w/out GRR	0.282	0.306	0.367	0.434	0.501	0.542
PDF w/out GRR	1.547	1.678	2.018	2.382	2.751	2.978
PHF w/out GRR	3.867	4.196	5.044	5.955	6.878	7.445
ADWF with GRR	0.282	0.312	0.404	0.503	0.603	0.679
PDF with GRR	1.547	1.689	2.084	2.506	2.935	3.223
PHF with GRR	3.867	4.223	5.210	6.265	7.337	8.059

flow monitoring data, thus typical peaking factors were used that are lower than those calculated in this analysis. As a result, PDF and PHF rates are slightly higher in this analysis than in the 2010 SC WWMP.

4.0 CONCLUSIONS

From the projected growth, the wastewater flows will exceed the current ADWF capacity of the Sutter Creek WWTP before the year 2036 without GRR and 2031 with GRR. The approximate wet weather capacity for the WWTP is 1.73 MGD, based on a process capacity of 0.96 MGD combined with use of the storage pond while retaining 30% capacity for consecutive storms. The 2021 PDF appears to be near or at the limit for wet weather capacity.

The current conveyance capacity of the ARSA Pipeline is 2.0 MGD. The wastewater flows during the wetter months are projected to exceed the capacity by 2026. ARSA will also need to increase disposal capacity to handle projected flows.

Reducing the amount of I/I in the collection system can reduce the PDF and make available hydraulic capacity at the WWTP and the ARSA pipeline to handle projected flows. Improvements to the collection system may reduce I/I and should be compared with costs of additional emergency storage and unit process upsizing to handle storm flows.

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ATTACHMENT A

City of Sutter Creek and ARSA

TM: 2 Flow Projections

Historic WWTP Influent Flows

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Table A-1: Historic WWTP Influent Flows (1997-2003)

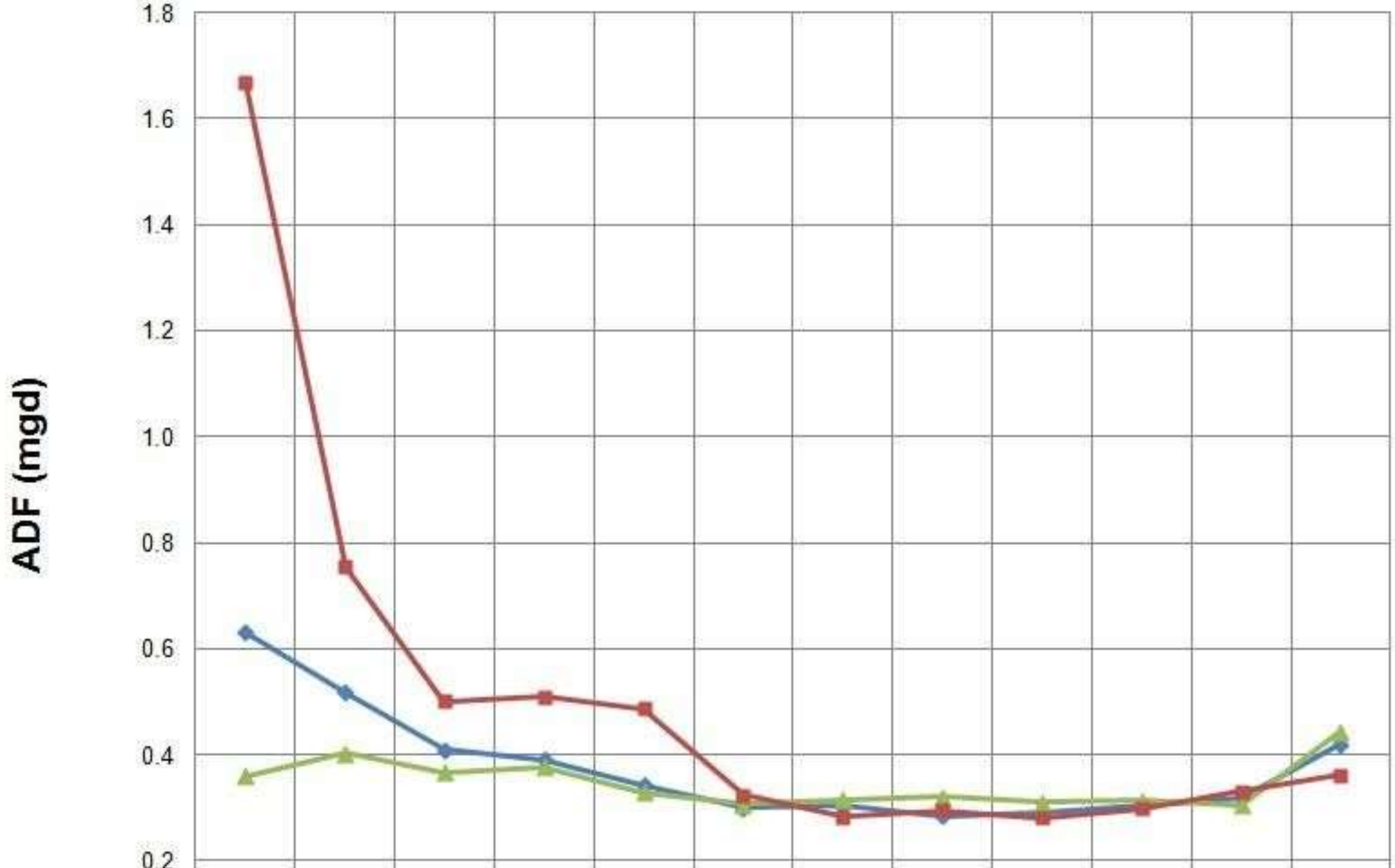
Year	1997	1998	1999	2000	2001	2002	2003	7-Year AVG
Annual Average Flow (MGD)	0.361	0.508	0.369	0.354	0.337	0.343	0.349	0.374
Minimum Day Flow (MGD)	0.038	0.175	0.142	0.156	0.124	0.206	0.200	0.149
ADWF (MGD) (June through Sept)	0.313	0.296	0.265	0.259	0.275	0.306	0.316	0.290
Peak Day Flow (PDF) (MGD)	1.475	1.595*	1.696	1.657	1.017	1.372	1.434	1.464
PDF/ADWF	4.7	5.4	6.4	6.4	3.7	4.5	4.5	5.1
Rain (in/year)	29.2	52.1	27.7	40.6	18.0	25.9	25.3	31.2

* Data provided by the City for January 1998 showed a peak day flow of 0.315 MGD and rainfall of 12.3 inches/month, which is statistically inconsistent with the remaining data, and was not used in this analysis.

Table A-2: WWTP Influent Flow Allocation by Collection System (1997-2003)

Collection System	1997	1998	1999	2000	2001	2002	2003	7-Year AVG	% Flow
Martell Flows (MGD)	0.043	0.042	0.041	0.043	0.045	0.048	0.051	0.045	11.9%
Amador City Flows (MGD)	0.027	0.027	0.024	0.023	0.022	0.021	0.021	0.024	6.3%
Sutter Creek Flows (MGD)	0.292	0.439	0.304	0.289	0.270	0.274	0.277	0.306	81.8%
Total Annual Average Flow (MGD)	**0.361**	**0.508**	**0.369**	**0.354**	**0.337**	**0.343**	**0.349**	**0.374**	

Figure A-1: WWTP Influent Monthly Average Day Flows



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9-Year Avg ('97-'03 & '09-'10)	0.632	0.518	0.411	0.392	0.343	0.299	0.304	0.285	0.291	0.303	0.319	0.420
Dry Years (3-Yr Avg)	0.360	0.403	0.368	0.378	0.329	0.307	0.315	0.321	0.311	0.314	0.305	0.443
Wet Year (1998)	1.668	0.755	0.501	0.510	0.486	0.325	0.284	0.295	0.281	0.298	0.330	0.362

ATTACHMENT B

City of Sutter Creek and ARSA

TM: 2 Flow Projections

Rainfall-Dependent I/I Analysis

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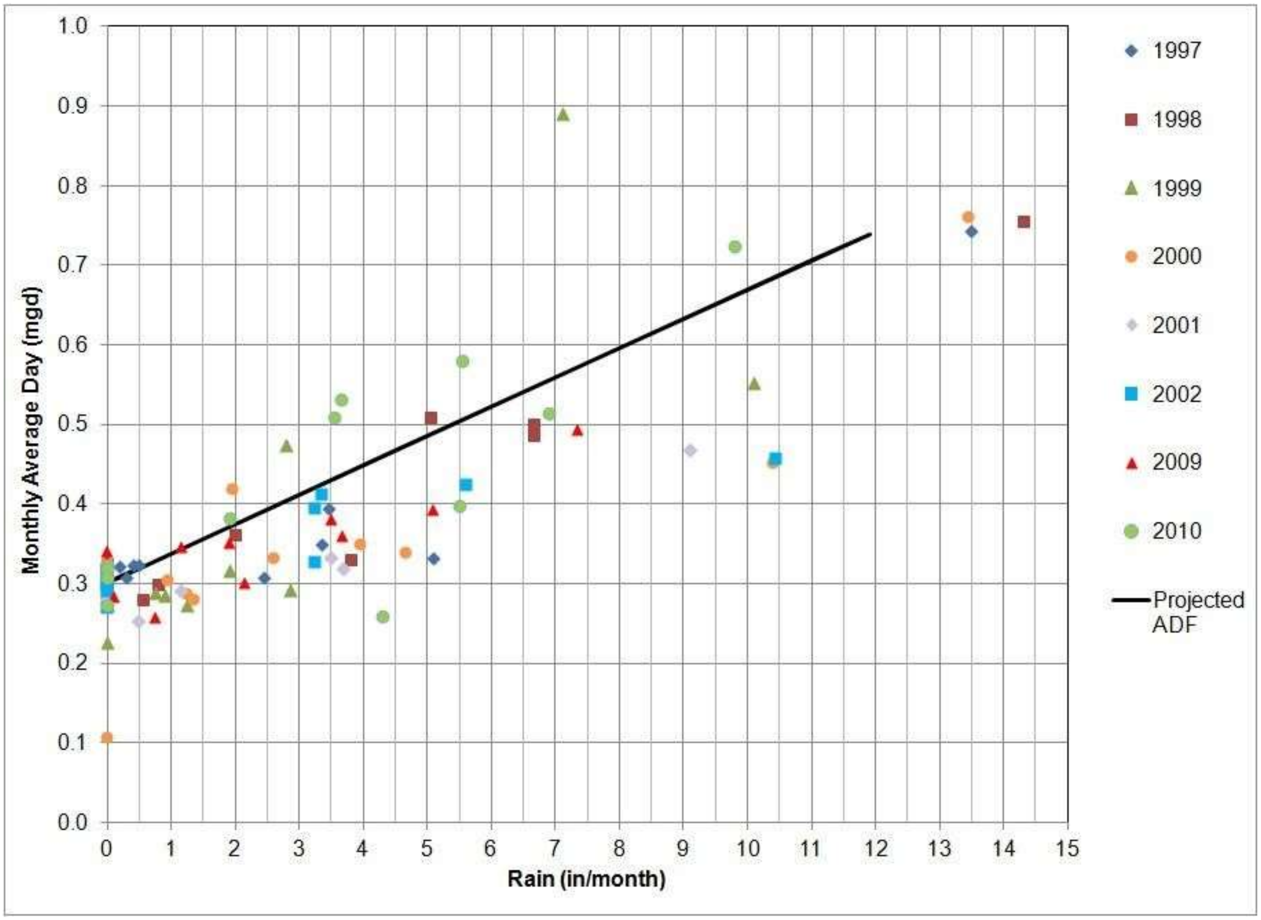
Figure B-1: WWTP Monthly Average Day Flow Projected by Monthly Rainfall Depth

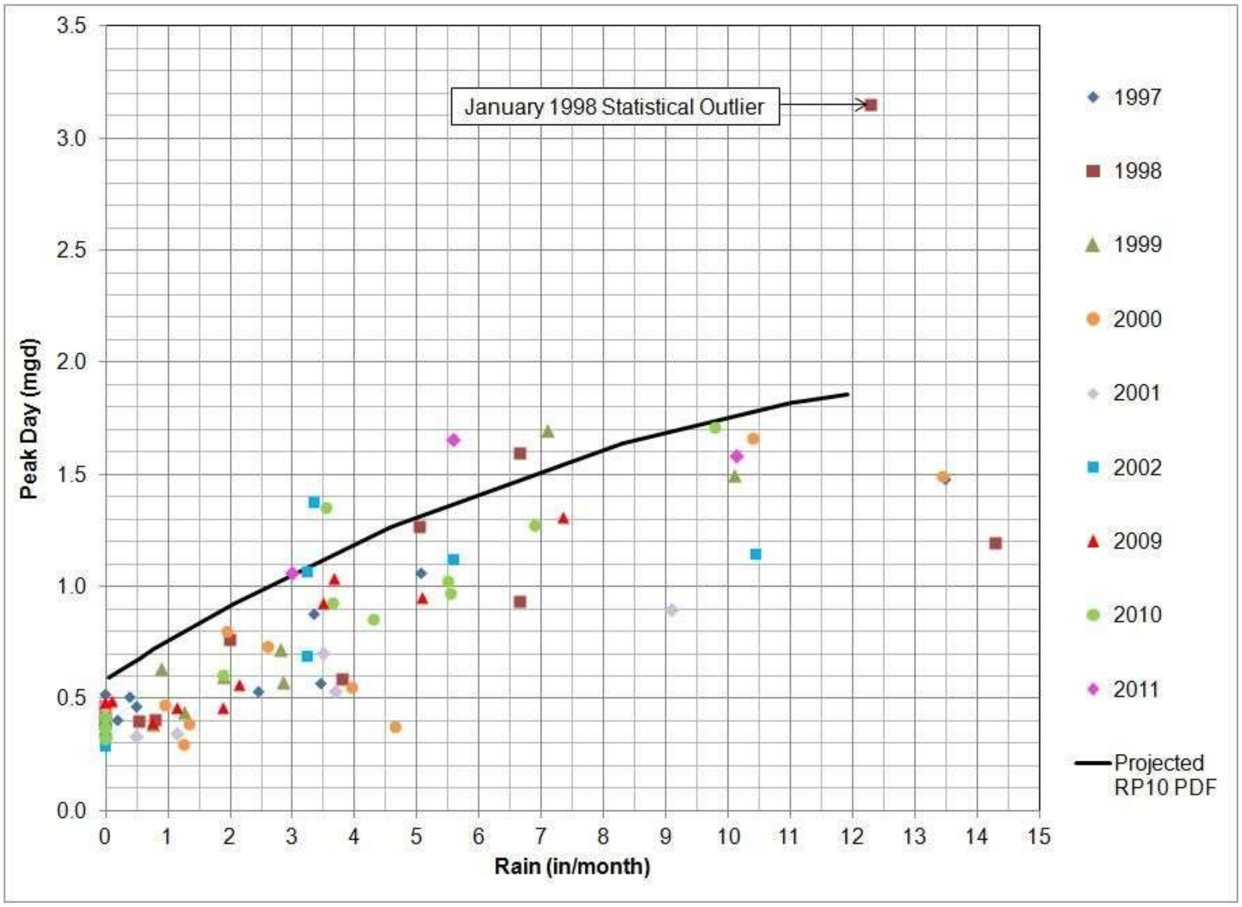


Based on monthly influent WWTP data provided by the City summarized in **Attachment A**.

Equation of trendline is:

$y = 0.0368x + 0.3008$

Figure B-2: WWTP Peak Day Flow Projected by Monthly Rainfall Depth



Note: January 1998 peak day flow was an outlier inconsistent with the statistical data, and was therefore, not used in this analysis.

Based on monthly influent WWTP data provided by the City summarized in **Attachment A**.

Equation of trendline is: y = -0.0056x2 + 0.1734x + 0.5867

ATTACHMENT C

City of Sutter Creek and ARSA

TM: 2 Flow Projections

Average and 100 Year Rainfall and Monthly Distribution

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Used average rainfall to distribute 100-year													
SUTTER HILL CDF, CALIFORNIA (048713)													
MONTH	October	November	December	January	February	March	April	May	June	July	August	September	TOTAL
	6.02	12.67	18.27	18.17	15.44	13.44	9.66	3.75	1.12	0.04	0.42	1.02	100
Avg Precip	1.72	3.62	5.22	5.19	4.41	3.84	2.76	1.07	0.32	0.01	0.12	0.29	28.57
100-YR	3.09	6.50	9.37	9.32	7.92	6.89	4.95	1.92	0.57	0.02	0.22	0.52	51.29

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Technical Memorandum 3A Update
Initial Evaluation and Screening of Options

HydroScience
Strategic Water Solutions

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Technical Memorandum

HydroScience
Strategic Water Solutions

Sacramento • Berkeley • San Jose • Concord

To: City of Sutter Creek and Amador Regional Sanitation Authority

From: Angela Singer, P.E.

Reviewed By: Bill Slenter, P.E.

Subject: TM #3A Update – Initial Evaluation and Screening of Options

Date: November 26, 2012 (Revised November 17, 2017)

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Sutter Creek (City) to review, update, and finalize the Draft Wastewater Master Plan (Master Plan) prepared in November 2012. This technical memorandum (TM) is the third in a series of five TMs that comprise the Master Plan document.

1.0 INTRODUCTION

The purpose of this TM is to document the initial evaluation and screening of wastewater management options available to the City and the Amador Regional Sanitation Authority (ARSA). The results of this evaluation and screening are used to prioritize individual options for development into full wastewater management alternatives in subsequent TMs as a part of this Master Plan. This Master Plan presents an evaluation of wastewater treatment, storage, and disposal alternatives and related conveyance facilities. Upstream collection system modifications to support the alternatives are not significant to the screening process and, therefore, are not addressed.

1.1 Initial Evaluation and Screening

Each available wastewater management option includes the following four components:

- Wastewater treatment;
- Effluent conveyance;
- Effluent storage (if required); and
- Effluent disposal/reuse.

The method of disposal/reuse drives the degree of treatment and storage needed for a given option. In some cases there are opportunities to consider a satellite treatment facility located close to the point of disposal. Accordingly, options for satellite treatment and effluent disposal are the focus of the evaluation and screening, and associated conveyance and storage facilities (if required) are addressed in conjunction with these treatment and disposal options.

The primary options that will be screened in this TM are wastewater treatment plant (WWTP) locations and effluent disposal. Each of the options are as follows:

- **WWTP Locations**
  - Secondary Treatment Locations
    - *Existing Sutter Creek WWTP (SCWWTP) site:* Replace and expand treatment at the existing site.
    - Sate*llite WWTP at Gold Rush Ranch (GRR):* Replace treatment at the existing SCWWTP site, plus construct a satellite WWTP located at GRR.
  - Tertiary Treatment Locations
    - *Tertiary treatment train at SCWWTP:* Construct a tertiary treatment train at existing SCWWTP site, when needed.
    - *Satellite tertiary polishing plant at GRR:* Receive secondary effluent from SCWWTP and polish to Title 22 tertiary standards for reuse at the GRR golf course.
- **Effluent Disposal**
  - Land Disposal Options and Associated Storage
    - *ARSA Sprayfields:* Dispose to ARSA sprayfields, with expanded storage and disposal.
    - *Noble Ranch Sprayfields:* Dispose to Noble Ranch sprayfields, with storage at White Horse or Sutter Creek Reservoir.
  - Tertiary Reuse Option
    - *Reuse at GRR golf course:* Implement recycled water irrigation at GRR golf course.
  - Multi-Regional Disposal Option
    - *Regional Storage, Disposal, and Reuse in Ione:* Join multi-regional system for storage, land disposal, and continued treatment for recycled water supply to Castle Oaks Golf Course in Ione.
  - Surface Water Discharge Options
    - *Seasonal Discharge:* Construct and permit a new seasonal discharge to Sutter Creek with dilution credit, and supplement with required storage and land disposal.
    - *Year-round Discharge:* Construct and permit a new year-round discharge with no dilution credit, and discontinue storage and land disposal (other than tertiary reuse).

1.2 Evaluation and Screening Methodology

The purpose of this Master Plan is to identify wastewater management solutions to best serve the existing City and ARSA rate payers, while making provisions to serve the GRR development and other expected, yet unpredictable, areas of growth.

This initial evaluation and screening develops wastewater management options to a level of detail appropriate for comparison of sub-alternatives and screening based on relative sizes/risks and potential fatal flaws. This initial evaluation and screening is based on available information listed in **Section 1.3**, including the 2010 SC WWMP, the 2010 ARSA WWMP, the 2016 Multi-Regional Water Recycling Feasibility Study developed for the partner agencies (ARSA, Ione, and CDCR), the existing facilities evaluation in TM #1, the flow projections developed in TM #2, and surface water disposal options described in TM #3B. Further details and cost information will be developed in the next TM (TM #4 – Alternative Analysis) for options that survive this screening process.

1.3 Background Information

This TM was developed through research of existing information and through a series of workshops held with the Technical Subcommittee formed under the City/ARSA Sewer Subcommittee for the City of Sutter Creek and ARSA Wastewater Master Plan Updates Project (this Project) in 2012, and subsequently updated with more recent information in 2017. The main information sources that formed the basis for the development and screening of options for managing wastewater flows are listed below. Additional references and information sources are listed at the end of this TM.

- TM #1 Update – Evaluation of Existing Facilities, HydroScience, September 15, 2017 (TM #1)
- TM #2 Update – Flow Projections, HydroScience, September 15, 2017 (TM #2)
- TM #3B: Surface Water Discharge Evaluation, Robertson – Bryan, Inc., February 21, 2012 (TM #3B)
- Draft Sutter Creek Wastewater Master Plan, HDR, Inc., February 2010 (2010 Draft SC WWMP)
- Draft Amador Regional Sanitation Authority Master Plan, HDR, Inc., February 2010 (2010 Draft ARSA MP)
- Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion, Environmental Stewardship & Planning, Inc., February 17, 2010 (WWTP Draft EIR)
- City of Ione Alternative Analysis Wastewater Treatment Plant Compliance, Winzler & Kelly a GHD Company, June 15, 2012 (Ione Alternative Analysis)
- City of Sutter Creek/ARSA Sewer Subcommittee workshops held on November 9 and 30, 2011, January 5 and 23, 2012.
- ARSA, City of Ione, and California Department of Corrections and Rehabilitation (CDCR): Regional Water Recycling Feasibility Study, HydroScience, August 2016 (Regional Study).

1.4 Wastewater Flow Projections

Per the GRR development agreement, the City will serve the GRR development and provide recycled water for the GRR golf course when recycled water is available. The GRR project developers are obligated to fund infrastructure improvements according to this Master Plan. This initial evaluation reviews and screens options related to locating treatment, storage, and disposal facilities to serve the existing service area (flow conditions “without GRR”), and to provide provisions for the development of GRR (flow conditions “with GRR”). TM #2 presented wastewater flow projections developed for the 25-year planning period under average dry weather flow (ADWF), peak day flow (PDF), and peak hour flow (PHF) conditions, which are summarized in **Table 1**. Options are generated in this initial evaluation for the 25-year planning horizon (year 2041). No phasing or interim conditions are considered in this screening process.

Table 1: 25-year Wastewater Flow Projections[1]

Parameter	2016[2]	2021	2026	2031	2036	2041
Without GRR						
ADWF (MGD)	0.264	0.306	0.367	0.434	0.501	0.542
PDF (MGD)	1.510	1.678	2.018	2.382	2.751	2.978
PHF (MGD)	3.775	4.196	5.044	5.955	6.878	7.445
With GRR						
ADWF (MGD)	0.264	0.312	0.404	0.503	0.603	0.679
PDF (MGD)	1.510	1.689	2.084	2.506	2.935	3.223
PHF (MGD)	3.775	4.223	5.210	6.265	7.337	8.059

Notes:
MGD = million gallons per day
1. Flow projections were developed in TM #2 and presented in Table 10 and Table 11 of that TM.
2. 2016 values are represented by the average ADWF and PWWF for 2014-2016 developed in TM #1 Table 5.

2.0 WASTEWATER TREATMENT PLANT LOCATION OPTIONS

Per TM #1, significant portions of the existing WWTP will reach the end of their useful lives during the 25-year planning period and most structures will require rehabilitation or replacement. Also, the existing WWTP capacity is insufficient to address projected future flows (**Table 1**). This section discusses and screens options available for new WWTP facilities required to address these deficiencies.

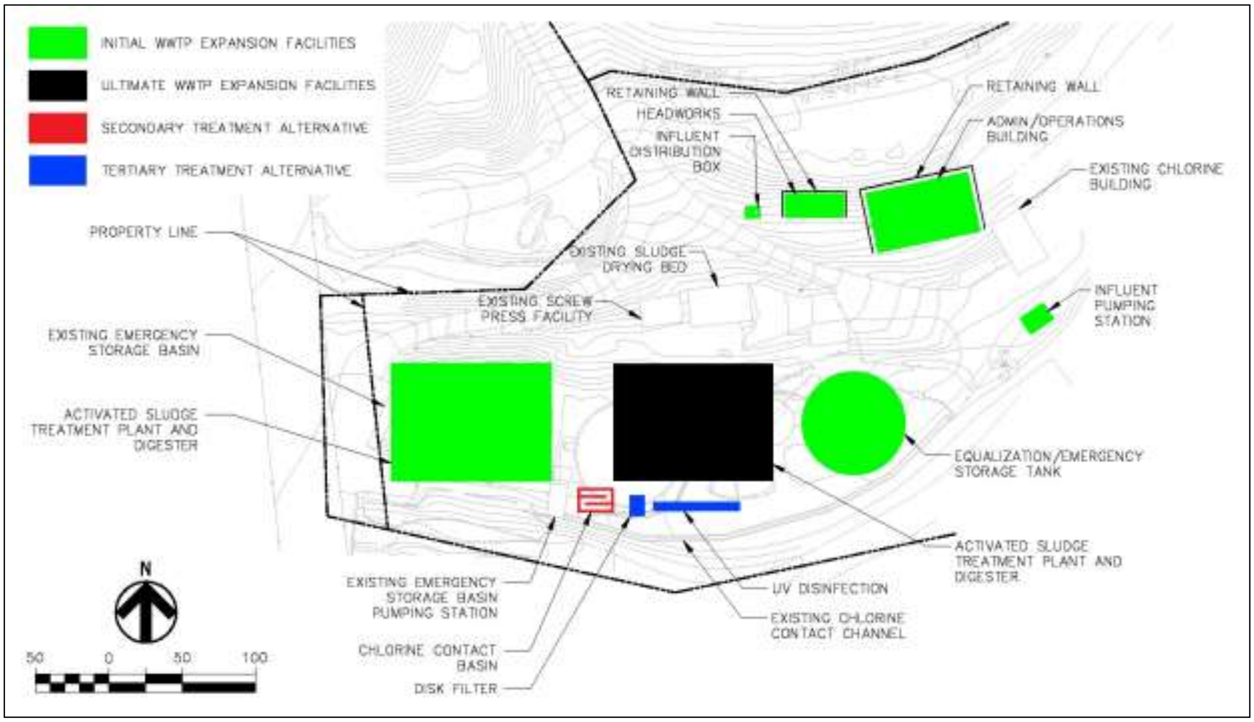
2.1 Secondary Treatment Locations

The options available for the location of the secondary WWTP(s) to serve the existing service area and GRR development are:

2.1.1 Existing SCWWTP site

This option addresses phased replacement and WWTP expansion at the existing SCWWTP site. The 2010 MP developed a phased replacement plan for unit processes at the existing SCWWTP site. HydroScience has reviewed and validated the conceptual approach, but has updated the facility plan to account for the flow projections from TM #2 and recent operational data summarized in TM #1. A conceptual configuration of the new WWTP facilities is shown in **Figure 1**. Some existing facilities will be incorporated into the expanded WWTP operations. Treatment processes/components of the proposed WWTP are: influent pumping station, headworks, flow equalization, activated sludge/digestion, future filtration, disinfection, effluent discharge facilities, solids dewatering, administration/operations building, and emergency back-up power. Initially,

Figure 1: Proposed SCWWTP Expansion Layout



the new WWTP facilities will be constructed with a treatment capacity of 0.5 MGD, expandable to the ultimate capacity of 1.0 MGD. Because the new facilities would be located on the existing site, initial construction activities would include demolition of a portion of the existing equalization basin in the western portion of the site followed by construction of the first phase. The existing SCWWTP would remain in operation during the majority of the new facilities construction.

2.1.2 <u>Satellite WWTP located at GRR</u>

This option includes upgrading/replacing the existing SCWWTP to treat Sutter Creek and Amador City flows, plus constructing a separate satellite WWTP located within the GRR development to treat Martell and GRR flows. Under this scenario, flows for Martell would no longer be conveyed to the existing WWTP and the ARSA storage facilities would no longer be available for storage of winter flows from the Martell area. For ease of operation and maintenance (O&M), both facilities are expected to utilize similar processes to those described above, only of smaller capacity as shown in **Table 2**. This option is only viable if the GRR develops, therefore, flow conditions "without GRR" are not considered.

Table 2: Influent Flows for Dual WWTP Option

Facility	Influent ADF (MGD)	Influent PDF (MGD)
SCWWTP	0.375	2.057
Additional WWTP at GRR (+Martell Flows)	0.304	1.166
Year 2041 Total Projected Flow	**0.679**	**3.223**

2.1.3 Screening

The following comparison of the two location options identifies critical decision factors as benefits (+) and drawbacks (-) that will subsequently be evaluated from a relative size/risk and fatal flaw standpoint.

Existing SCWWTP Site

+ Single effluent stream simplifies effluent disposal and allows maximum flexibility for multiple disposal methods.
+ ARSA storage and disposal system and any future surface water discharge outfall would be available for all flow from service area.
+ Allows for multi-regional disposal options in Ione for all flow from service area via the ARSA system, if this option becomes available in the future.
– Project risk is increased somewhat due to the need to phase construction around the existing WWTP operations.
+ This option is not reliant on other agencies or the development of GRR.
– To serve GRR, would require trunk sewer from GRR and recycled water pump station and delivery main to GRR.
+ Can ultimately meet anticipated summertime irrigation demand from GRR.
+ Single point of compliance and single facility to operate.

Satellite WWTP at GRR

+ Frees capacity in existing secondary SCWWTP. Diversion of Martell flows prolongs replacement/upgrade of the existing 0.45-MGD SCWWTP.
– Operating two WWTPs adds burden on WWTP operations, increasing O&M costs and risk of violation.
– Adds O&M cost for monitoring second point of compliance.
– Requires renegotiation of existing City/ Martell/Amador City agreement to redefine service area boundaries and renegotiate service fees.
– Depends entirely on GRR development and dedication of site and golf course disposal site. Subject to GRR development schedule.
– Requires construction of new local storage reservoir for winter effluent storage when the golf course cannot be irrigated. May also require additional reuse/disposal facilities near GRR.
– Requires reconfiguration or abandonment of two Martell pump stations and pipeline to SCWWTP.
– Any future surface discharge outfall to Sutter Creek could not serve the Martell/GRR communities without a new conveyance pipeline.
– Influent flows are projected to reach 0.3 MGD (see **Table 2**), which limits the rate of recycled water production to less than 0.3 MGD. Will likely require significant recycled water storage to meet peak GRR golf course demands (up to 2.0 MGD in dry months).
– Creates potential odor nuisance close to residential areas.

A review of these critical decision factors identifies the following as fatal flaws with the satellite WWTP at GRR option:

- This option depends entirely on GRR development for dedication of site and golf course disposal site. Subject to GRR development schedule.
- The satellite facility would be limited to 0.3 MGD, which is significantly less than the GRR golf course demands (up to 2.0 MGD in dry months).

Given the degree of uncertainty associated with the timing of GRR development, this option does not provide any level of flexibility for the condition where the GRR does not develop. Additionally, the anticipated shortfall of supply to address the anticipated 2.0 MGD peak irrigation demand from the golf course is a fatal flaw.

Based on this analysis, the preferred WWTP location is the existing SCWWTP site.

2.2 Tertiary Treatment Locations

The reuse of effluent for golf course irrigation requires water quality that meets Title 22 disinfected tertiary treatment standards. Tertiary treatment could be added to the existing WWTP as part of the upgrade, or addressed as a separate satellite WWTP facility at a different location. This section evaluates potential locations for the tertiary facilities.

2.2.1 Construct tertiary treatment train at SCWWTP

Title 22 filtration and disinfection facilities would be constructed at the SCWWTP per the proposed site plan in **Figure 1** and sized to serve Title 22 recycled water demands (i.e. GRR) if, and when, they occur.

2.2.2 Construct satellite tertiary polishing plant at GRR

Construct separate reclamation facility located within the GRR development to treat secondary effluent from the SCWWTP to tertiary levels for reuse on the GRR golf course.

2.2.3 Screening

The following comparison of the two tertiary treatment location options identifies critical decision factors as benefits (+) and drawbacks (-) that will subsequently be evaluated from a relative size/ risk and fatal flaw standpoint.

Tertiary Train at SCWWTP

+ Consolidating the effluent stream at SCWWTP allows maximum flexibility for multiple disposal methods, including discharge to Sutter Creek adjacent to the WWTP.
– Limited footprint at the SCWWTP site constrains treatment technology options to slightly more expensive technologies.
+ Consolidates support facilities including electrical power and controls, reducing capital and O&M costs.
+ Consolidates solids handling facilities, reducing capital and O&M costs.
– Requires recycled water pump station and conveyance pipeline to the GRR golf course in order to serve GRR with recycled water for irrigation.
– Piping easement issue must be addressed, placing some risk on project cost and feasibility.

Satellite Polishing Plant at GRR

– Remote facility adds burden for single WWTP operator and increases capital and O&M cost and risk of violation.
– Depends entirely on GRR development and dedication of site. Subject to GRR development schedule.
– Only feasible if recycled water is supplied to GRR golf course or other large beneficial use.
– Requires secondary effluent conveyance from SCWWTP to the remote tertiary treatment plant.
– Piping easement issue must be addressed, placing some risk on project cost and feasibility.
– Requires the construction of new recycled water storage near GRR.
– Adds O&M costs and risk associated with the second point of compliance.
+ Avoids footprint constraints at the existing WWTP site, potentially decreasing cost of tertiary facilities.
– Require separate power, controls, and solids handling facilities to support it, increasing capital and O&M costs.
– Creates potential odor nuisance close to residential areas.

The driving factors in comparing these two alternatives are:

- Because of the uncertainty associated with development of GRR, options that maximize future flexibility should be prioritized. Retaining all treatment at SCWWTP maximizes future flexibility for a variety of disposal and reuse alternatives, including multi-regional options in Ione.
- The consolidation of all treatment units at a single site reduces long-term O&M costs and compliance risks.

Therefore, for the purpose of this Master Plan and based on this screening analysis, the existing SCWWTP is the preferred location for tertiary treatment. Constructing a satellite tertiary treatment facility could be revisited at a later date without significant impact to the strategy selected through this master planning process.

3.0 EFFLUENT DISPOSAL OPTIONS

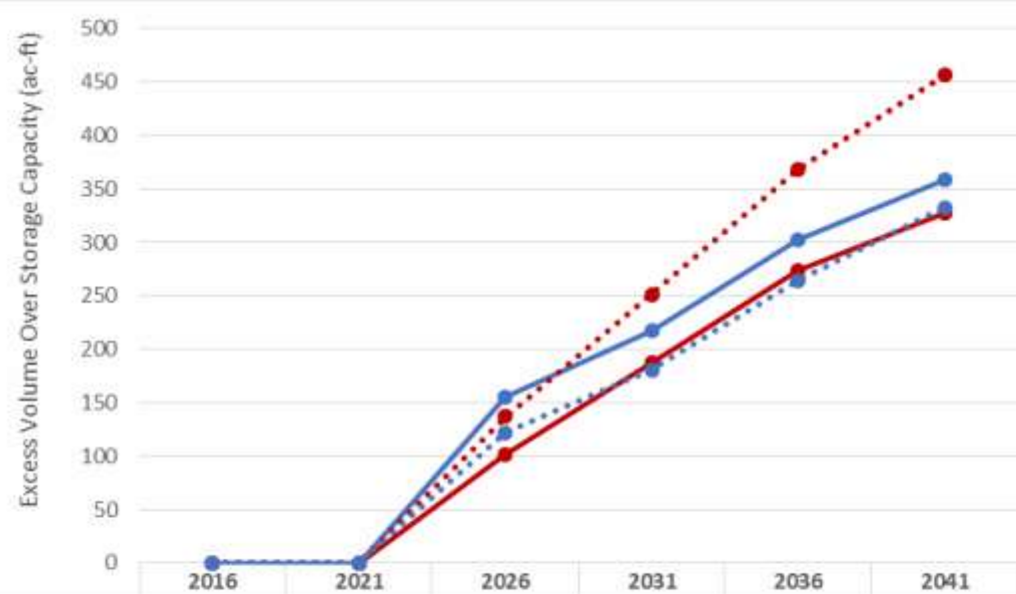
Effluent disposal options include continued use of sprayfields for disposal of secondary effluent, initiation of tertiary (Title 22) effluent reuse on the GRR golf course, multi-regional effluent disposal in Ione, and surface water discharge to Sutter Creek. Each disposal method caries unique water quality standards, requirements, and risks that affect the type and cost of wastewater treatment. Each method includes specific requirements for seasonal storage. Options for each disposal type are described in the following sections.

3.1 Land Disposal Options and Associated Storage

Available options for land disposal of secondary effluent from the SCWWTP are 1) sprayfields along the ARSA pipeline, and 2) Noble Ranch sprayfields. Some of the considerations for each option include storage and disposal requirements based on site specific capacity and the location and sizing of associated storage. Each of the requirements are discussed below.

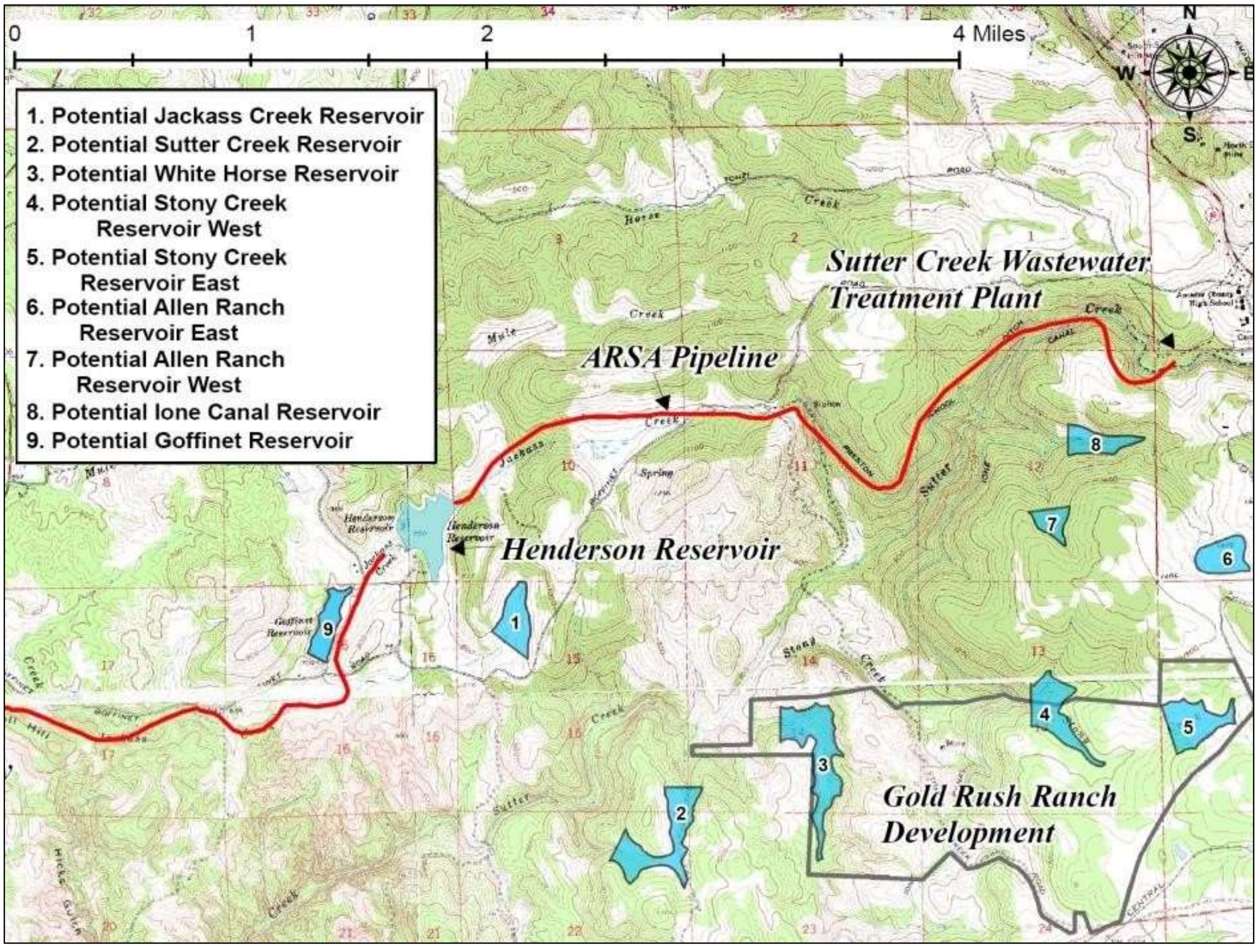
Storage and Disposal Requirements: The wastewater flows summarized in **Table 1** were used in a series of water balances to project effluent storage and land disposal requirements over the 25-year planning period for scenarios both with and without GRR. See **Attachments A, B, and C** for water balance methodology, input parameters, and results. The volume of excess effluent that exceeds the current storage and disposal capacity projected by the water balance are summarized in **Figure 2**. This figure assumes buildout of existing disposal sites Bowers and

Figure 2: Volume of Effluent Exceeding Storage Capacity



	2016	2021	2026	2031	2036	2041
Yr 1 w/o GRR (ac-ft)	0	0	101	187	274	327
Yr 2 w/o GRR (ac-ft)	0	0	156	217	302	359
Yr 1 with GRR (ac-ft)	0	0	137	251	369	457
Yr 2 with GRR (ac-ft)	0	0	122	181	265	333

Figure 3: Potential Storage Sites



Source: Modified from 2010 ARSA WWMP

Hoskins Ranches. The excess volume accounts for complete golf course construction at GRR by 2031 and does not rely on discharge to the City of Ione or other outside entities after the year 2022 based on recent invocation of the 5-year cancellation clause by the City of Ione. These represent the volume of water that must be managed via storage and disposal by ARSA to be fully independent.

Associated Storage: Each land disposal option drives the appropriate sizing and location for effluent storage. **Figure 3** illustrates the potential sites for new and/or expanded storage sites, and **Table 3** summarizes volumes and preference rankings from the 2010 ARSA WWMP. In some cases, new information has been obtained related to the feasibility of storage sites, and this information is noted in **Table 3**.

As shown in **Table 3**, Jackass Creek, Goffinet, Allen Ranch East, and Allen Ranch West have been screened from further consideration due to insufficient storage capacity or the fatal flaws shown in **Table 3**. That leaves the Ione Canal to serve as the required additional storage, along with Henderson improvements, for buildout of the ARSA sprayfields option, and either the Sutter

Creek Reservoir or the White Horse Reservoir to provide the required storage for the Noble Ranch sprayfields option.

Table 3: Potential Storage Sites

Map No.	Reservoir	Weighted Rank [1]	Maximum Capacity (AF) [2]	Notes	Screening [3] (Pass or Fail)
1	Jackass Creek	5	253	Insufficient storage capacity.	Fail
2	Sutter Creek	6	1,170		Pass
3	White Horse	6	1,716		Pass
4	Stony Creek West	4	527		Fail
5	Stony Creek East	5	1,198		Fail
6	Allen Ranch East	7	235	Unsuitable: mill tailings contamination.	Fail
7	Allen Ranch West	6	255	Insufficient storage capacity.	Fail
8	Ione Canal	6	617		Pass
9	Goffinet	7	197	Unsuitable: geologic fault through dam.	Fail

Notes:
1. 2010 ARSA WWMP, Table 6-2. Higher ranking is preferred.
2. AF = Acre-feet
3. Screening criteria: must have a Weighted Rank of 6 or 7 with no fatal flaws.
4. Henderson Reservoir was not ranked by the ARSA WWMP.

3.1.1 ARSA Sprayfields

As described in TM #1, the ARSA effluent disposal system is a series of pipelines, reservoirs, and sprayfields that convey, store, and dispose of secondary effluent. In order to expand the ARSA system for the 25-year planning period flow projections shown in **Table 1**, the ARSA pipeline, storage, and disposal fields upstream of Hoskins Ranch require expansion and rehabilitation. This includes replacing approximately 4.5-miles and sliplining approximately 0.5-miles of the ARSA pipeline, and repairing the outlet to Henderson Dam, which is in the design phase. Additional storage and sprayfield sites are needed to address projected wastewater flow increases. The 2010 ARSA WWMP identified a number of potential storage sites along the ARSA pipeline. Current and potential future sprayfield sites are shown on **Figure 4** and are summarized in **Table 4**. As discussed above, the Ione Canal storage site is expected to be developed as a part of this option.

3.1.2 Noble Ranch Sprayfields

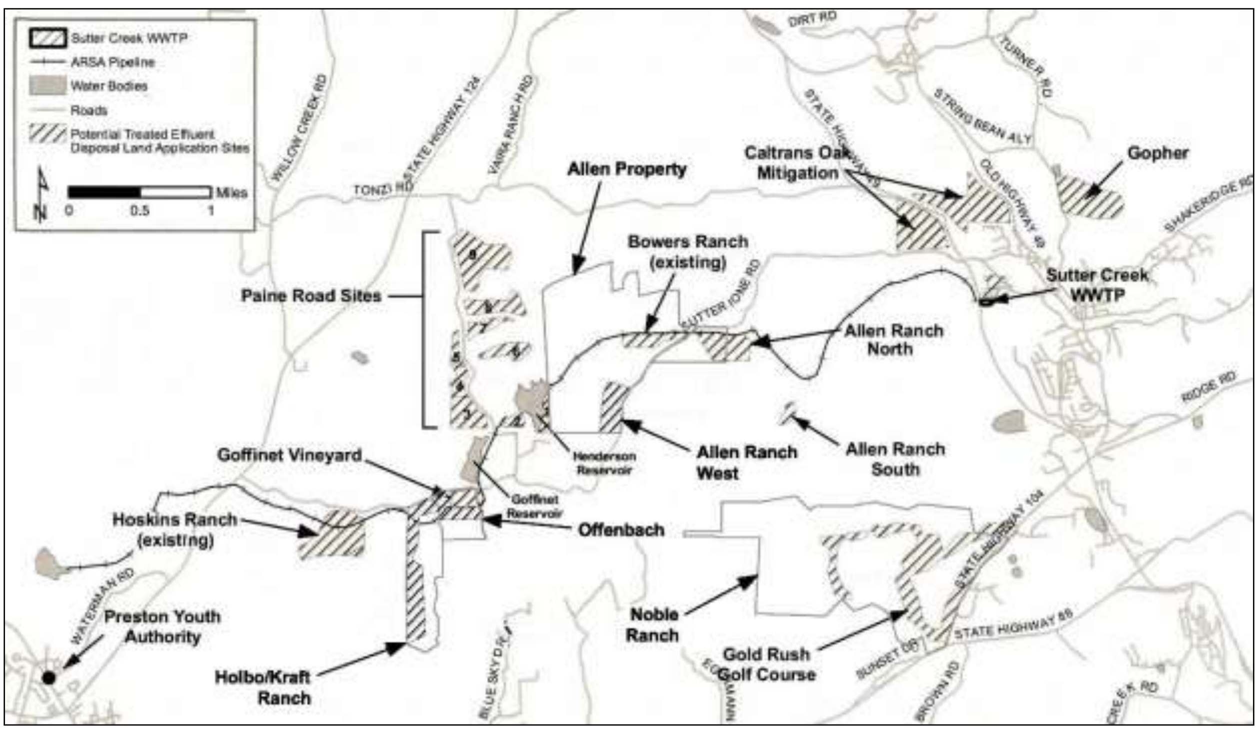
This option would involve replacing the existing ARSA system with new conveyance, storage, and sprayfields on the Noble Ranch easements owned by ARSA. This would include the construction of new effluent conveyance to Noble Ranch in prescribed City easements. Disposal to Noble Ranch would likely involve development of White Horse Reservoir, as described above. Noble Ranch is shown on **Figure 4** and facility details summarized in **Table 4**.

Table 4: Potential Sprayfields and Disposal Capacities during 100-Year Return Period

Disposal Site	Disposal Type	Pipeline Required	Pumping Required	Acres	Capacity (AFY)
Bowers Ranch (buildout)	Flood irrigation of pasture land	-	-	24	121
	Spray irrigation of pasture land	-	Yes	16	48
Hoskins Ranch (buildout)	Spray irrigation of pasture land along ARSA pipeline	-	-	60	181
Allen Ranch North	Tree irrigation along ARSA pipeline	0.1 mi	No	32	97
Allen Ranch West	Spray irrigation of pasture land	0.5 mi	Yes	40	121
Paine Road	Spray irrigation of pasture land along ARSA pipeline	1.0 mi	Yes	197	596
Holbo Ranch Wildlife Sanctuary	Wildlife drinking water, pasture land irrigation along ARSA pipeline	0.1 mi	No	20	61
Offenbach	Spray irrigation of pasture land along ARSA pipeline	0.1 mi	No	6	18
Goffinet Vineyard	Existing and expanded vineyard irrigation along ARSA pipeline	0.1 mi	Yes	40	121
Noble Ranch	Spray irrigation of ranch land	2.5 mi	Yes	850	2,570
Finley Ranch	Spray irrigation of ranch land	?	Yes	500	1,512
Bryson Cattle Co.	Spray irrigation of ranch land	?	Yes	300	907

Source: Modified from 2010 SC WWMP

Figure 4: Existing and Potential Sprayfield Sites



Source: Modified from 2010 WWTP Draft EIR

3.1.3 Screening

The ARSA and Noble Ranch sprayfields and the associated storage are screened below by identifying critical decision factors as benefits (+) and drawbacks (-) that will subsequently be evaluated from a relative size/risk and fatal flaw standpoint.

ARSA Sprayfields

+ This option maximizes continued benefit of existing infrastructure and agreements.
– ARSA pipeline and Henderson Dam are located on State land. Land lease expires in 2037 and would require renegotiation of the lease.
– Continued use of the system requires repair of the Henderson Dam outlet, which has been designed but not yet constructed.
– Continued use of the ARSA pipeline will carry increased O&M burden for ongoing repair, replacement, and rehabilitation of aging pipeline segments compared to a new conveyance system to Noble Ranch.
+ New sprayfields in close proximity to the ARSA pipeline are available for development.
– Short-term disposal agreements with multiple landowners can be an administrative burden.
– Regulatory compliance with multiple disposal sites is more complex.
– Ione Canal storage site requires more investigation to ensure its viability.

Noble Ranch Sprayfields

+ Consolidates storage for buildout flow to one reservoir (White Horse or Sutter Creek Reservoir).
– Any infrastructure and sprayfield land availability will be lost upon development of the GRR.
+ Single contract with single land owner for disposal reduces administrative and legal costs and lowers regulatory compliance risks.
– Piping easement issue must be addressed, placing some risk on project cost and feasibility.
+ Eliminates aging ARSA system O&M and repair, replacement, and rehabilitation costs, including those associated with Henderson Reservoir.
– Value of existing conveyance and sprayfield infrastructure is lost.
– Requires significant capital to plan, permit, and construct new conveyance and storage facilities.
– Adds new conveyance/storage/pumping O&M costs.
– Stops water supply for beneficial use to ranchers along existing ARSA pipeline.

A review of the critical decision factors indicates no compelling reason to eliminate either disposal option at this time. While it appears that the Noble Ranch sprayfields conflict with potential development of GRR, the GRR development agreement requires full replacement of conveyance, storage, and disposal facilities before building permits can be pulled. It may also be possible to incorporate White Horse reservoir into the expansion and continued use of the ARSA system. In order to determine the feasibility of this, the conveyance and return pipelines from White Horse reservoir would need to be evaluated and priced. This option is considered a sub option that would not affect the overall feasibility evaluation of each of these disposal sites, and therefore will be further developed later in this Master Plan.

3.2 Tertiary Reuse Options

Tertiary treated recycled water can be used to provide irrigation water to the GRR golf course. The GRR golf course has a maximum monthly demand of 188 AF during the month of July for a 100-year RP. The amount of tertiary treated effluent to be reused at the GRR project site by 2041 depends upon how much seasonal storage is available. The range of potential disposal capacity and facility needs for GRR golf course irrigation are summarized in **Table 5**.

Table 5: Reuse at GRR Golf Course and Parks

Effluent Quality	Disposal Site	Disposal Type	Pipeline Required	Pumping Required	Acres	Monthly Demand (AF)
Tertiary	GRR Golf Course	Golf course & park irrigation	2.3 mi	Yes	216	0 – 188

3.2.1 <u>Screening</u>

The following identifies critical decision factors as benefits (+) and drawbacks (-) of golf course irrigation that will subsequently be evaluated from a relative size/risk and fatal flaw standpoint. Neutral factors are indicated as (±).

<u>GRR Golf Course</u>

– Recycled water storage volume and location are unknown.

– Infrastructure construction depends entirely on the GRR development, which is subject to market, financing, and other exterior conditions.

\+ If GRR develops, GRR is obligated to construct the necessary conveyance, storage, and irrigation facilities.

– Conflicts with the option to dispose of secondary effluent on Noble Ranch sprayfields.

– The irrigation demand for the golf course is greater than available recycled water from month to month during the summer thus significant seasonal storage would be required to meet irrigation demands.

± City will serve recycled water to the GRR golf course, when recycled water is available.

Based on the above analysis, this option will be fully developed in TM #4 to provide for GRR entitlements under the GRR Development Agreement and Specific Plan.

3.3 Regional Disposal Option in Ione

ARSA, the City of Ione, and CDCR worked together to develop a Multi-Regional Water Recycling Feasibility Study (Multi-Regional Study) in August 2016, to evaluate opportunities to collaborate and manage treated effluent from the three entities. The following two multi-regional alternatives were evaluated as part of the Multi-Regional Study and shown in **Figure 5**:

- **Alternative 1:** Decommissioning of Henderson Reservoir and ARSA sprayfields, plus new storage reservoir on the Rancho Arroyo Seco (RAS) property and new disposal at the adjacent Dry Creek and Woodard Bottom irrigation fields.
- **Alternative 2:** Repair and continued use of Henderson Reservoir and expanded ARSA sprayfields, plus new storage reservoir on the RAS property and new disposal at the adjacent Dry Creek and Woodard Bottom irrigation fields. This alternative is the same as the first, except with the retention and expansion of existing ARSA facilities, the additional storage and disposal requirements would be less.

Table 6 summarizes the disposal and storage facility requirements for the two alternatives.

Table 6: Storage and Sprayfield Assessment of Alternatives

	RAS Reservoir + Dry Creek/Woodard Bottom Sprayfields	
	Alternative 1 Decommission Henderson Reservoir and ARSA Sprayfields	**Alternative 2** Retain Henderson Reservoir and Expand ARSA Sprayfields
Sprayfield Sites		
Expand ARSA Sprayfields (Acres)	0	100
Dry Creek Sprayfields (Acres)	403	335
Woodard Bottom Sprayfields (Acres)	115	115
Sprayfield Site Total (Acres)	**518**	**550**
Storage Facilities		
Henderson Reservoir	0	349
RAS Reservoir	±1,000	1,068
Storage Capacity Total	**±1,000**	**1,417**

Notes:
1. Alternative 1 does not provide sufficient disposal or storage to meet worst-case 2036 "High" storage requirements, per the Regional Study evaluation.

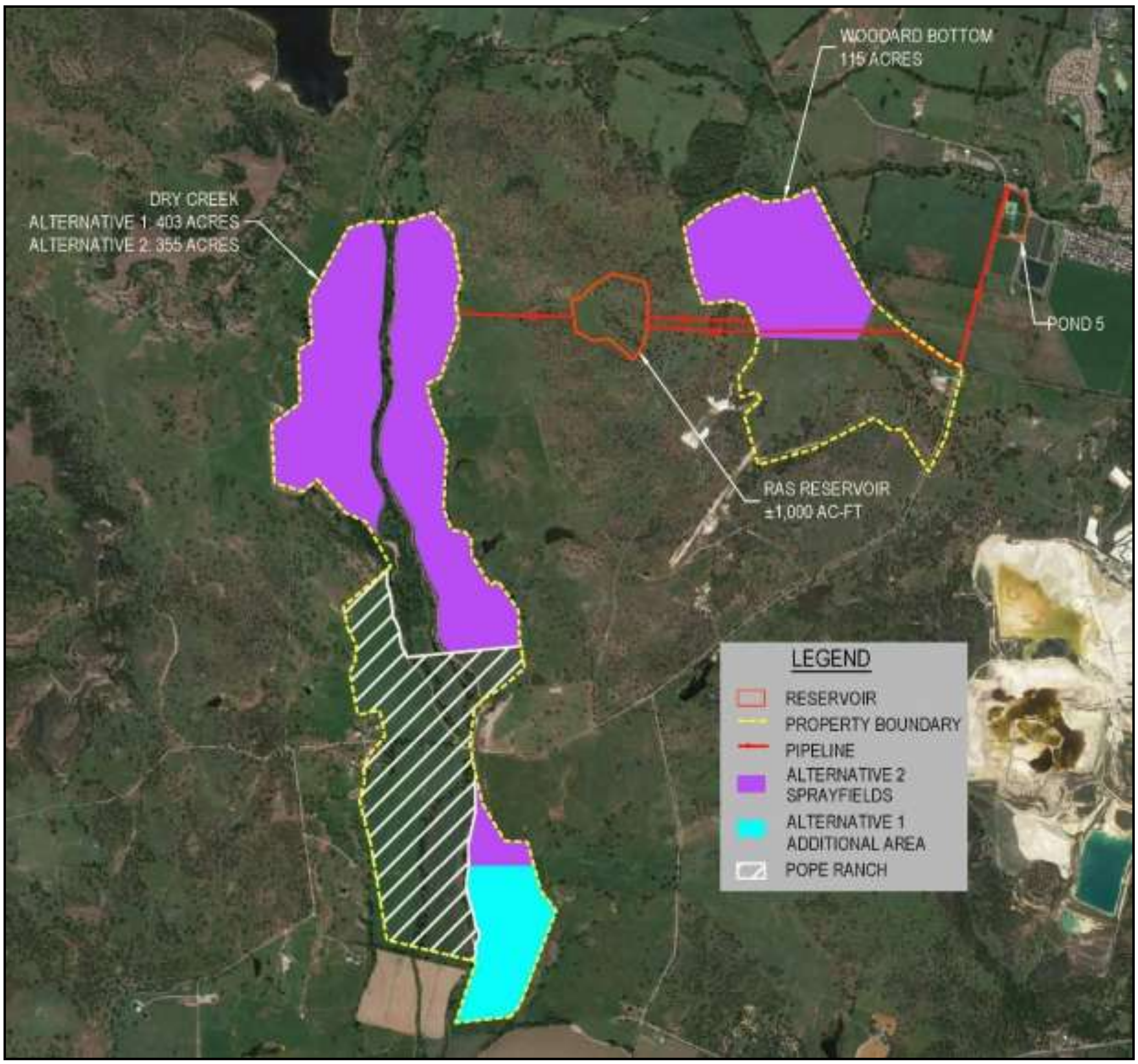
Alternative 2 is the recommended alternative per the Multi-Regional Study. Alternative 2 includes the continued use of Henderson Reservoir and expansion of the existing ARSA disposal system. This alternative also includes a new secondary effluent disposal system on the existing Woodard Bottom (115 acres) and Dry Creek (335 acres) irrigation fields. Storage would be constructed at the proposed site of the RAS reservoir. Alternative 2 consists of the following components:

- Retention of the existing Henderson Reservoir after it has been determined that the repair to the outlet pipeline is feasible.
- Expand existing ARSA land application sites
  - Bowers Ranch (existing 36 acres expanded to 40 acres).
  - Hoskins Ranch (existing 36 acres expanded to 60 acres).
- Construct recycled water supply conveyance of 6,400 feet of 16-inch forcemain from Ione Ponds to RAS Reservoir. This alignment would include a bridge mounting or trenchless

crossing under a drainage on Dave Burbeck Rd, crossing a decommissioned railroad on Dave Burbeck Rd, and crossing Sutter Creek at an existing weir and pumphouse.

- Construct new 1,068 AF reservoir at RAS
- Construct recycled water sprayfields:
  - Woodard Bottom property (115 acres)
  - Dry Creek property (minimum 335 acres)
- Construct gravity conveyance from RAS Reservoir to Dry Creek and Woodard Bottom sprayfields of 4,400 feet.

Figure 5: Regional Alternatives 1 and 2 Storage and Reuse Sites



Source: Multi-Regional Water Recycling Feasibility Study (August 2016)

3.3.1 Screening

The following identifies critical factors as benefits (+) and drawbacks (-) of a mulit-regional storage, disposal, and reuse system in Ione that will subsequently be evaluated from a relative size/risk and fatal flaw standpoint. Neutral factors are indicated as (±).

Regional Storage, Disposal, and Reuse in Ione

– Requires expansion and maintenance of the existing contractual agreement with the City of Ione. Delegates control of effluent disposal costs to the City of Ione.

– Requires replacement/rehabilitation of the ARSA pipeline.

– May prevent the City from supplying recycled water to GRR Golf Course.

– Ione has elected to terminate the effluent treatment and disposal agreement with ARSA, invoking the 5-year cancellation clause.

– Ione is in negotiations with the Regional Water Quality Control Board (RWQCB) for a new storage and disposal approach that has not yet been approved.

\+ Allows the SCWWTP to continue to treat to secondary levels translating to lower O&M costs compared to tertiary alternatives.

Due to the recent invocation of the 5-year cancellation clause by the City of Ione and the stated intent to pursue an independent effluent disposal and reuse approach, this alternative is no longer a feasible option for further consideration. Thus it will not be included in TM #4 for further analysis.

3.4 Surface Water Discharge Options

Sutter Creek is located directly adjacent to the SCWWTP. This section summarizes the options developed in TM #3B for discharging effluent to Sutter Creek. As described in TM #3B, in order for a new NPDES permit to be issued, surface discharge must be the only feasible, cost-effective solution (e.g., land disposal sites are unavailable, storage is cost-prohibitive, etc.). The cost information needed to make this determination will be further developed in TM #4 for the alternatives that survive this screening step.

TM #3B developed the two primary alternatives listed below for discharging to Sutter Creek. TM #3B is based on best available information. A full Report of Waste Discharge, Anti-Degradation Analysis, and negotiations with RWQCB staff must be completed before final effluent limitations are known. Any changes to limitations can have a significant impact on project cost.

3.4.1 New seasonal discharge to Sutter Creek with dilution credit

Construct and permit a new outfall pipe to Sutter Creek, directly adjacent to the WWTP. Utilize this outfall for part-time (seasonal) discharge to Sutter Creek under an NPDES permit. TM #3B also explored a variation of this approach: year-round discharge under a dilution credit. For the purposes of screening alternatives, this sub-alternative is not considered significantly different and will not be evaluated separately. As summarized in TM #3B, if a 20:1 dilution credit is granted, flows could only be discharged for the period between November 1 and April 30 and only when background creek flows provide that dilution or better. Sprayfield or other disposal facilities must remain operational in the dry season when effluent cannot be discharged to Sutter Creek. The net effect of this option would be to reduce the volume of seasonal effluent storage required.

3.4.2 New year-round discharge to Sutter Creek with no dilution credit

Year-round discharge to Sutter Creek without dilution credit allows for continuous discharge and altogether eliminates the need for the ARSA storage and land disposal system. However the limitations on effluent discharge are very strict. There are slightly stricter iron, manganese, and aluminum limits, and Title 22 requirements for coliform and turbidity will increase the size and cost of tertiary treatment.

Seasonal Discharge

- The RWQCB will not allow discharge to begin until all limitations can be met. The feasibility of meeting this requirement cannot be fully known at this time.
- Metals removal and meeting aquatic life criteria may be cost prohibitive.
- Strict effluent limitations will require sophisticated and expensive treatment including nutrient removal and ultraviolet disinfection.
- High energy costs related to Title 22 filtration, ultraviolet disinfection, blowers, nutrient removal, etc.
- Requires Grade III operator to supervise the facility, which increases O&M costs.
- The RWQCB will not grant dilution credit for TSS, BOD, Nitrogen, and some metals. This significantly reduces the treatment costs benefit of the seasonal option.
- Risky and high cost permitting. The RWQCB may require multiple years of additional creek flow measurements before a seasonal permit with dilution credit will be granted. Could significantly delay implementation, and results may be unfavorable for continuing down this path.
- Only allows discharge when Sutter Creek flows are 20-times wastewater discharges or better, which at times will be highly restricted. Historical data indicates that during a worst-case year, sufficient dilution may only occur 60% of the time during the wettest month (February).

Year-round Discharge

- The RWQCB will not allow discharge to begin until all limitations can be met. The feasibility of meeting this requirement cannot be fully known at this time.
- Metals removal and meeting aquatic life criteria may be cost prohibitive.
- Very strict effluent limitations will require sophisticated and expensive treatment including nutrient removal, Title 22 filtration, and ultraviolet disinfection.
- Higher energy costs related to Title 22 filtration, ultraviolet disinfection, blowers, nutrient removal systems, etc.
- Requires Grade III operator to supervise the facility, which increases O&M costs.
- Much higher water quality monitoring requirements significantly increase O&M costs.
- Higher risk of permit violations because of strict permit limits.

Seasonal Discharge

- – Likely requires instantaneous creek flow monitoring and rapid operational changes to accommodate sudden changes in creek flow.
- – May reduce, but does not eliminate, ARSA storage requirements. Does not eliminate need for land disposal.
- – May require significant effluent storage at the SCWWTP to take full advantage of the seasonal discharge windows.
- – Experience with other foothill WWTPs indicate most do not utilize seasonal discharge due to poor economic feasibility and high risk of a seasonal permit, but rather discharge year-round by using high levels of treatment.

Year-round Discharge

- + Eliminates ARSA storage and disposal infrastructure and its ongoing O&M costs.
- + Eliminates the need for additional seasonal effluent storage.
- + Creates a high quality effluent that is ready for Title 22 reuse, and a portion of this effluent can be diverted to reuse customers like GRR.

Anticipated permit conditions at Sutter Creek for a seasonal discharge permit with dilution credit are mostly identical to the anticipated permit conditions for year-round discharge with no dilution credit. There is little relief to be had for the limits that most impact the cost of the WWTP (BOD, TSS, Nitrogen, THMs, etc.). Therefore, there is no compelling advantage for the City to pursue a seasonal discharge permit with dilution credit because of the associated operational restrictions for when discharge can occur. In addition, the cost of keeping most of the existing ARSA storage and land disposal systems in place makes it cost-prohibitive. Therefore, only the year-round undiluted discharge option will advance to the alternatives evaluation in TM #4.

4.0 CONCLUSIONS

The following options will be further developed into full alternatives for use in a decision matrix in TM #4.

1. WWTP at the existing SCWWTP with tertiary treatment facilities, as needed.
2. Land disposal at ARSA sprayfields and the associated storage.
3. Land disposal at the Noble Ranch sprayfields and the associated storage.
4. Reuse at the GRR golf course.
5. Year-round surface discharge to Sutter Creek.

5.0 ADDITIONAL REFERENCES

Gold Rush Ranch and Golf Resort Final Environmental Impact Report, Environmental Stewardship & Planning, Inc., June 8, 2009

City and ARSA Contractual Obligations Memo to Sutter Creek Sewer Committee, June 14, 2011

Agreement Amending a Joint Exercise of Powers Agreement between the County of Amador, the City of Amador City, the City of Jackson, and the City of Sutter Creek for the Purpose of Creating an Agency for Implementing a Regional Wastewater Disposal Plan, September 17, 1982

Department of Corrections and Rehabilitation Ground Lease Covering Mule Creek Prison and Preston Youth Correctional Facility, February 23, 2009

Gold Rush Ranch and Golf Resort Off-site Infrastructure Summaries, Morton & Pitalo, Inc., May 1, 2007

Gold Rush Golf Resort Sutter Creek Recycled Water Plant Siting Report, Thompson-Hysell Engineers, June 23, 2003

White Horse Property Effluent Detention Dam Preliminary Summary of Hydrological Findings, Neil O. Anderson & Associates, Inc., January 3, 2002

Phase 1 of White Horse Property Effluent Detention Dam Preliminary Geotechnical and Geological Investigation, Neil O. Anderson & Associates, Inc., July 6, 2001

Proposed White Horse Reservoir Preliminary Environmental Assessment, NOA Environmental, December 18, 2001

White Horse Project Water Balances and Application Rates for Land Application of Wastewater, Neil O. Anderson & Associates, Inc., June 2001

Report to Determine Offer to Wolheb or White Horse Properties to Treat, Store, and Dispose of ARSA Wastewater, June 7, 2000

Goffinet and Henderson Reservoir Evaluation, HDR, Inc., December 31, 2008

Goffinet Dam Preliminary Geotechnical and Geologic Investigation, Paragon Geotechnical, Inc., November 21, 2008

Sludge Removal and Conduit Repair at Henderson Reservoir Memo to ARSA, Weatherby Reynolds Fritson Engineering and Design, February 11, 2009

Water Balances – City of Ione Wastewater Treatment Plant Compliance Project Memo to City of Ione, GHD, May 30, 2012

ARSA, City of Ione, and CDC): Regional Water Recycling Feasibility Study, HydroScience, August 2016.

ATTACHMENT A

City of Sutter Creek and Amador Regional Sanitation Authority
TM #3A Update – Initial Evaluation and Screening of Options
Water Balance Methodology and Input Parameters

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Water Balance Methodology

The ARSA system water balances were prepared using the following methodology.

1. These water balances were developed for the primary purpose of determining maximum storage and disposal capacity of each system component under existing conditions.
2. Typically, reservoirs can provide incidental disposal through evaporation and percolation. Evaporation was accounted for in the water balances; however, no credit was taken for percolation as there is no evidence that meaningful amounts of percolation occur.
3. Water balances were calculated over a two year period. Year 1 was assumed to be a very wet precipitation year equivalent to a 100-year storm with corresponding peak wastewater flows and Year 2 was assumed to be an average precipitation year with average wastewater flows. This two-year scenario gives a conservative estimate of the seasonal storage capacity of the reservoir and accounts for potential carry-over storage from Year 1 to Year 2. Understanding potential carry-over is intended to help identify the disposal needs to eliminate carry-over from year to year.
4. The rainfall data used for Year 1 precipitation has a 100 year return period frequency (100RP), and the second year is an average annual precipitation return period frequency.
5. The water balance accounts for higher I/I flows into the collection system and consequently, higher wastewater flows to the ARSA system during the 100RP precipitation in Year 1.
6. The water balance accounts for changes in evaporative surface area as the stored volume in reservoirs change.
7. The water balance uses a starting volume of zero AF in Henderson Reservoir on October 1, assuming that the reservoir would be fully drained by ARSA in preparation for the wet season, consistent with operating objectives.

Water Balance Input Parameters

The following input parameters were used to develop the water balance models to determine storage and land disposal requirements to meet future ARSA system requirements.

Wastewater Flows

1. Water balances were performed at five-year increments using the wastewater flows presented in **Table 1**, both with and without GRR.

Reservoirs

1. It was assumed that most watershed areas and drainages adjacent to the reservoirs will be diverted around the reservoir leaving only runoff to drain into the reservoir. Rainfall over a watershed area equivalent to the exposed area of the reservoir slopes depending on the depth plus the water surface area of the reservoir was accounted for.

2. Henderson Reservoir is reported by the City (Gene Weatherby, January 2012) to have a usable storage volume of 393 AF and surface area from 5 acres to 29 acres. It is estimated that the volume is at a minimum at the end of the dry season and at a maximum at the end of the wet season.
3. In accordance with current operating practices, flows from Jackass Creek were not included due to the diversion. Rainfall over a 4.3 acre watershed area plus the exposed area of the reservoir slopes depending on the depth plus the water surface area of the reservoir was accounted for.
4. Reservoir 2 was assumed to be located in an area similar in topography to Henderson Reservoir and, therefore, is estimated to have the same volume to surface area relationship.

Land Application Sites

1. The disposal capacity of each disposal site was varied throughout the year as the precipitation and ambient temperatures change. The existing disposal sites are constructed on private grass covered cattle grazing properties with slopes ranging from 3 to 30%.
2. On Bowers Ranch, ARSA has a 40-acre flood irrigation disposal easement. Currently, 36 acres of the 40 acres is equipped for irrigation disposal.
3. ARSA has a 60-acre spray field irrigation disposal easement on Hoskins Ranch. Currently, approximately 36 acres of the 60 acres available is equipped for spray field disposal.
4. ARSA has an existing land application disposal easement for 1,300 AFY on Noble Ranch. Disposal facilities do not yet exist on the site, so this site is not considered in our existing system water balance.
5. Water balance scenarios with GRR include a golf course and parks (assumed to begin construction in 2020), which will be irrigated with recycled water, thus reducing the land required for disposal. It was assumed that 50% of the golf course and parks would be constructed by 2026 with the remainder complete by 2031.
6. This water balance did not specifically examine disposal capacities in Ione, but instead determined the total storage and land disposal requirements of ARSA facilities only.

ATTACHMENT B

City of Sutter Creek and Amador Regional Sanitation Authority
TM #3A Update – Initial Evaluation and Screening of Options
Water Balance Results: Without GRR

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Base Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
458,000	332,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Sprayfield Irrigation	Total
Area	(ac)	NA	36	36	72
Year 1	(ac-ft/yr)	-300	-261	-109	-669
Year 2	(ac-ft/yr)	-300	-224	-120	-644

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	512	11	312	81	0
Year 2	11	372	-153	174	219	0

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.414	39.4	0.263	25.0	14.4	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	0.540	49.7	0.263	24.2	25.5	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	0.646	61.4	0.263	25.0	36.4	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	0.644	61.2	0.263	25.0	36.2	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	0.592	50.9	0.263	22.6	28.3	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	0.554	52.8	0.263	25.0	27.7	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.483	44.5	0.263	24.2	20.3	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.371	35.3	0.263	25.0	10.3	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.322	29.6	0.263	24.2	5.4	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.301	28.7	0.263	25.0	3.6	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.309	29.4	0.263	25.0	4.3	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.320	29.5	0.263	24.2	5.2	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.458	512.4		294.8	217.68	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.255	24.3	0.263	25.0	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.276	25.5	0.263	24.2	1.2	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	0.475	45.2	0.263	25.0	20.1	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	0.462	43.9	0.263	25.0	18.9	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.422	36.2	0.263	22.6	13.6	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	0.442	42.1	0.263	25.0	17.0	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.320	29.4	0.263	24.2	5.2	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.282	26.8	0.263	25.0	1.8	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.257	23.6	0.263	24.2	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.261	24.9	0.263	25.0	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.269	25.6	0.263	25.0	0.6	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.265	24.4	0.263	24.2	0.2	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.332	371.9		294.8	78.66	100.0	28.57	44.26	56.00	3.43	3.72

Period		Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-0.6	15.4	6.2	-21.0	-1.7	24.0	1.2	3.3	-1.3	0.0	3.2	-10.0	15.6	15.6	0.0
	Nov	0.0	0.0	13.0	-13.0	0.0	49.7	3.4	6.5	-0.6	0.0	9.3	-10.0	49.0	64.6	0.0
	Dec	0.0	0.0	18.7	-16.5	0.0	61.4	8.5	7.8	-0.8	0.0	15.4	-10.0	66.8	131.5	0.0
	Jan	0.0	0.0	18.6	-16.5	0.0	61.2	12.6	5.8	-1.2	0.0	17.2	-10.0	68.4	199.9	0.0
	Feb	0.0	0.0	15.8	-15.3	0.0	50.9	13.7	3.6	-1.7	0.0	15.6	-10.0	56.5	256.4	0.0
	Mar	0.0	0.0	13.8	-18.0	0.0	52.8	13.7	2.3	-3.2	0.0	12.8	-10.0	55.6	**311.9**	0.0
	Apr	0.0	0.0	9.9	-10.6	0.0	44.5	10.8	1.2	-7.0	0.0	5.1	-97.0	-47.4	264.5	0.0
	May	-4.4	4.4	3.8	-3.8	-13.3	30.9	3.9	0.6	-9.4	0.0	-4.9	-97.0	-84.3	180.2	0.0
	Jun	-7.6	29.6	1.1	-26.7	-22.8	0.0	0.9	0.3	-10.2	0.0	-8.9	-11.5	-43.3	136.9	0.0
	Jul	-9.4	28.7	0.0	-29.8	-28.2	0.0	0.0	0.0	-10.4	0.0	-10.4	-11.5	-50.1	86.8	0.0
	Aug	-8.4	29.4	0.4	-28.2	-25.3	0.0	0.2	0.2	-7.2	0.0	-6.8	-11.5	-43.6	43.2	0.0
	Sep	-5.8	29.5	1.0	-24.8	-17.5	0.0	0.4	0.5	-3.9	0.0	-3.1	-11.5	-32.1	11.1	0.0
	Total	-36.3	137.0	102.6	-224.3	-108.9	375.5	69.5	32.1	-57.0	-0.1	44.5	-300.0	11.1		0.0
Year 2	Oct	-2.2	19.7	3.4	-21.0	-6.5	4.6	0.8	1.7	-1.5	0.0	1.0	-10.0	-10.9	0.2	0.0
	Nov	0.0	0.0	7.2	-7.2	0.0	25.5	1.5	3.8	-0.6	0.0	4.7	-10.0	20.1	20.3	0.0
	Dec	0.0	0.0	10.4	-10.4	0.0	45.2	3.0	5.1	-0.7	0.0	7.4	-10.0	42.6	62.8	0.0
	Jan	0.0	0.0	10.4	-10.4	0.0	43.9	4.6	4.3	-1.1	0.0	7.9	-10.0	41.8	104.6	0.0
	Feb	0.0	0.0	8.8	-8.8	0.0	36.2	5.2	3.1	-1.6	0.0	6.7	-10.0	33.0	137.6	0.0
	Mar	0.0	0.0	7.7	-7.7	0.0	42.1	5.3	2.3	-3.0	0.0	4.6	-10.0	36.7	**174.3**	0.0
	Apr	-1.6	1.6	5.5	-5.5	-4.8	27.8	4.4	1.4	-5.1	0.0	0.7	-97.0	-73.3	101.0	0.0
	May	-5.4	5.4	2.1	-2.1	-16.3	21.4	1.2	0.8	-5.4	0.0	-3.4	-97.0	-95.4	5.7	0.0
	Jun	-7.9	23.6	0.6	-26.7	-23.6	0.0	0.1	0.3	-2.8	0.0	-2.3	-11.5	-37.5	0.0	0.0
	Jul	-9.4	24.9	0.0	-29.8	-24.9	0.0	0.0	0.0	-3.0	0.0	-3.0	-11.5	-39.4	0.0	0.0
	Aug	-8.6	25.6	0.2	-28.2	-25.6	0.0	0.0	0.1	-2.7	0.0	-2.5	-11.5	-39.7	0.0	0.0
	Sep	-6.1	24.4	0.6	-24.8	-18.3	0.0	0.1	0.3	-2.1	0.0	-1.7	-11.5	-31.5	0.0	0.0
	Total	-41.2	125.3	57.1	-182.8	-120.1	246.6	26.4	23.4	-29.7	0.0	20.1	-300.0	-153.4		0.0

2021 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
447,000	386,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Total
Area	(ac)	NA	36	36	72
Year 1	(ac-ft/yr)	-300	-261	-109	-669
Year 2	(ac-ft/yr)	-300	-224	-124	-648

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	500	3	304	89	0
Year 2	3	432	-116	206	187	0

Period			WWTP Effluent					Historic Weather Data						Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.405	38.5	0.306	29.1	9.4	6.02	3.09	3.14	3.96	0.05	0.01	-0.6	15.4	6.2	-21.0	-1.7	23.1	1.2	3.3	-1.3	0.0	3.2	-10.0	14.7	14.7	0.0
	Nov	30	0.527	48.6	0.306	28.1	20.4	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	13.0	-13.0	0.0	48.6	3.4	6.5	-0.6	0.0	9.3	-10.0	47.9	62.5	0.0
	Dec	31	0.631	60.0	0.306	29.1	30.9	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	18.7	-16.5	0.0	60.0	8.3	7.8	-0.8	0.0	15.3	-10.0	65.3	127.9	0.0
	Jan	31	0.629	59.8	0.306	29.1	30.7	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	18.6	-16.5	0.0	59.8	12.4	5.9	-1.2	0.0	17.1	-10.0	66.9	194.8	0.0
	Feb	28	0.578	49.7	0.306	26.3	23.4	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	15.8	-15.3	0.0	49.7	13.5	3.7	-1.7	0.0	15.5	-10.0	55.2	249.9	0.0
	Mar	31	0.541	51.5	0.306	29.1	22.4	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	13.8	-18.0	0.0	51.5	13.5	2.4	-3.2	0.0	12.7	-10.0	54.3	**304.2**	0.0
	Apr	30	0.472	43.4	0.306	28.1	15.3	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	9.9	-10.6	0.0	43.4	10.7	1.3	-6.9	0.0	5.1	-97.0	-48.4	255.8	0.0
	May	31	0.363	34.5	0.306	29.1	5.4	3.75	1.92	4.67	6.32	0.37	0.38	-4.4	4.4	3.8	-3.8	-13.3	30.1	3.8	0.7	-9.3	0.0	-4.8	-97.0	-85.0	170.7	0.0
	Jun	30	0.314	28.9	0.306	28.1	0.8	1.12	0.57	6.23	7.83	0.63	0.70	-7.6	28.9	1.1	-26.7	-22.8	0.0	0.9	0.3	-9.8	0.0	-8.6	-11.5	-43.0	127.7	0.0
	Jul	31	0.294	28.0	0.306	29.1	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-9.4	28.0	0.0	-29.8	-28.0	0.0	0.0	0.0	-10.0	0.0	-10.0	-11.5	-49.5	78.2	0.0
	Aug	31	0.301	28.7	0.306	29.1	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-8.4	28.7	0.4	-28.2	-25.3	0.0	0.2	0.2	-6.8	0.0	-6.4	-11.5	-43.2	35.0	0.0
	Sep	30	0.312	28.8	0.306	28.1	0.6	1.02	0.52	5.30	6.09	0.49	0.53	-5.8	28.8	1.0	-24.8	-17.5	0.0	0.4	0.5	-3.6	0.0	-2.8	-11.5	-31.8	3.2	0.0
	Total	365	0.447	500.4		342.4	159.47	100.0	51.29	42.40	56.00	3.02	3.26	-36.3	134.2	102.6	-224.3	-108.7	366.2	68.4	32.6	-55.2	-0.1	45.7	-300.0	3.2		0.0
Year 2	Oct	31	0.297	28.2	0.306	29.1	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-2.2	19.7	3.4	-21.0	-6.5	8.5	0.7	1.8	-1.3	0.0	1.2	-10.0	-6.8	0.0	0.0
	Nov	30	0.321	29.6	0.306	28.1	1.4	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	7.2	-7.2	0.0	29.6	1.5	3.8	-0.6	0.0	4.7	-10.0	24.2	24.2	0.0
	Dec	31	0.552	52.5	0.306	29.1	23.4	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	52.5	3.1	5.0	-0.7	0.0	7.4	-10.0	49.9	74.2	0.0
	Jan	31	0.536	51.0	0.306	29.1	21.9	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	51.0	5.0	4.1	-1.2	0.0	8.0	-10.0	49.0	123.2	0.0
	Feb	28	0.490	42.1	0.306	26.3	15.8	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	8.8	-8.8	0.0	42.1	5.7	2.9	-1.7	0.0	6.9	-10.0	39.0	162.1	0.0
	Mar	31	0.514	48.9	0.306	29.1	19.8	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	7.7	-7.7	0.0	48.9	5.9	2.1	-3.3	0.0	4.6	-10.0	43.5	**205.6**	0.0
	Apr	30	0.371	34.2	0.306	28.1	6.0	9.66	2.76	3.18	4.59	0.13	0.11	-1.6	1.6	5.5	-5.5	-4.8	32.6	4.9	1.2	-5.6	0.0	0.5	-97.0	-68.8	136.8	0.0
	May	31	0.327	31.1	0.306	29.1	2.0	3.75	1.07	4.67	6.32	0.45	0.49	-5.4	5.4	2.1	-2.1	-16.3	25.7	1.5	0.7	-6.5	0.0	-4.3	-97.0	-92.0	44.9	0.0
	Jun	30	0.298	27.5	0.306	28.1	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-7.9	27.5	0.6	-26.7	-23.7	0.0	0.2	0.3	-4.7	0.0	-4.2	-11.5	-39.4	5.4	0.0
	Jul	31	0.304	28.9	0.306	29.1	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-9.4	28.9	0.0	-29.8	-28.2	0.0	0.0	0.0	-3.4	0.0	-3.3	-11.5	-43.1	0.0	0.0
	Aug	31	0.313	29.8	0.306	29.1	0.7	0.42	0.12	6.76	8.21	0.71	0.79	-8.6	29.8	0.2	-28.2	-25.7	0.0	0.0	0.1	-2.7	0.0	-2.5	-11.5	-39.7	0.0	0.0
	Sep	30	0.308	28.4	0.306	28.1	0.2	1.02	0.29	5.30	6.09	0.51	0.56	-6.1	28.4	0.6	-24.8	-18.3	0.0	0.1	0.3	-2.1	0.0	-1.7	-11.5	-31.5	0.0	0.0
	Total	365	0.386	432.1		342.4	91.38	100.0	28.57	44.26	56.00	3.43	3.72	-41.2	141.3	57.1	-182.8	-123.6	290.8	28.7	22.4	-33.9	0.0	17.1	-300.0	-115.7		0.0

2026 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
538,000	464,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Total
Area	(ac)	NA	40	60	100
Year 1	(ac-ft/yr)	0	-273	-157	-430
Year 2	(ac-ft/yr)	0	-238	-180	-418

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	602	210	393	0	101
Year 2	210	519	-10	393	0	156

Period			WWTP Effluent					Historic Weather Data						Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.487	46.3	0.367	35.0	11.3	6.02	3.09	3.14	3.96	0.05	0.01	-0.7	15.6	6.2	-21.0	-2.8	30.7	1.2	3.3	-1.3	0.0	3.2	0.0	31.1	31.1	0.0
	Nov	30	0.634	58.4	0.367	33.8	24.5	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	13.0	-13.0	0.0	58.4	4.2	6.1	-0.7	0.0	9.6	0.0	68.0	99.1	0.0
	Dec	31	0.758	72.1	0.367	35.0	37.2	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	18.7	-16.5	0.0	72.1	10.7	6.7	-1.0	0.0	16.4	0.0	88.5	187.7	0.0
	Jan	31	0.756	71.9	0.367	35.0	36.9	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	18.6	-16.5	0.0	71.9	15.6	4.5	-1.5	0.0	18.5	0.0	90.4	278.1	0.0
	Feb	28	0.695	59.7	0.367	31.6	28.2	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	15.8	-15.3	0.0	59.7	16.4	2.4	-2.1	0.0	16.7	0.0	76.5	354.6	0.0
	Mar	31	0.651	61.9	0.367	35.0	27.0	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	13.8	-18.0	0.0	61.9	15.9	1.4	-3.8	0.0	13.5	0.0	38.4	393.0	37.0
	Apr	30	0.567	52.2	0.367	33.8	18.4	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	9.9	-10.6	0.0	52.2	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	393.0	57.2
	May	31	0.436	41.5	0.367	35.0	6.5	3.75	1.92	4.67	6.32	0.37	0.38	-5.9	5.9	3.8	-3.8	-22.2	35.6	4.6	0.3	-11.1	0.0	-6.3	0.0	0.0	393.0	7.2
	Jun	30	0.378	34.8	0.367	33.8	1.0	1.12	0.57	6.23	7.83	0.63	0.70	-10.2	34.8	1.1	-26.7	-34.8	0.0	1.4	0.1	-14.9	0.0	-13.4	0.0	-48.2	344.8	0.0
	Jul	31	0.354	33.7	0.367	35.0	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-12.5	33.7	0.0	-29.8	-33.7	0.0	0.0	0.0	-17.2	0.0	-17.1	0.0	-50.8	294.0	0.0
	Aug	31	0.362	34.5	0.367	35.0	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-11.3	34.5	0.4	-28.2	-34.5	0.0	0.5	0.1	-14.4	0.0	-13.9	0.0	-48.4	245.6	0.0
	Sep	30	0.376	34.6	0.367	33.8	0.7	1.02	0.52	5.30	6.09	0.49	0.53	-7.8	31.6	1.0	-24.8	-29.2	3.0	1.0	0.2	-10.3	0.0	-9.1	0.0	-35.3	210.3	0.0
	Total	365	0.538	601.6		411.7	191.71	100.0	51.29	42.40	56.00	3.02	3.26	-48.4	156.0	102.6	-224.3	-157.1	445.6	83.4	25.8	-85.9	-0.1	23.2	0.0	210.3		101.4
Year 2	Oct	31	0.357	33.9	0.367	35.0	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-2.9	20.5	3.4	-21.0	-10.8	13.5	3.1	0.7	-5.6	0.0	-1.8	0.0	0.8	211.2	0.0
	Nov	30	0.386	35.6	0.367	33.8	1.7	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	7.2	-7.2	0.0	35.6	6.5	1.6	-2.7	0.0	5.3	0.0	40.9	252.1	0.0
	Dec	31	0.663	63.1	0.367	35.0	28.1	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	63.1	10.3	1.8	-2.4	0.0	9.7	0.0	72.8	324.9	0.0
	Jan	31	0.645	61.3	0.367	35.0	26.4	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	61.3	11.6	1.2	-2.7	0.0	10.0	0.0	68.1	393.0	3.2
	Feb	28	0.589	50.6	0.367	31.6	19.0	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	8.8	-8.8	0.0	50.6	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	393.0	58.7
	Mar	31	0.618	58.8	0.367	35.0	23.8	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	7.7	-7.7	0.0	58.8	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	393.0	63.3
	Apr	30	0.446	41.1	0.367	33.8	7.3	9.66	2.76	3.18	4.59	0.13	0.11	-2.2	2.2	5.5	-5.5	-8.1	38.9	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	393.0	30.3
	May	31	0.393	37.4	0.367	35.0	2.5	3.75	1.07	4.67	6.32	0.45	0.49	-7.2	7.2	2.1	-2.1	-27.2	30.2	2.6	0.2	-11.1	0.0	-8.4	0.0	-5.4	387.6	0.0
	Jun	30	0.358	33.0	0.367	33.8	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-10.6	33.0	0.6	-26.7	-33.0	0.0	0.8	0.1	-14.8	0.0	-14.0	0.0	-47.0	340.6	0.0
	Jul	31	0.365	34.7	0.367	35.0	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-12.5	34.7	0.0	-29.8	-34.7	0.0	0.0	0.0	-17.1	0.0	-17.1	0.0	-51.8	288.8	0.0
	Aug	31	0.376	35.8	0.367	35.0	0.8	0.42	0.12	6.76	8.21	0.71	0.79	-11.4	35.8	0.2	-28.2	-35.8	0.0	0.3	0.0	-14.3	0.0	-14.0	0.0	-49.8	239.0	0.0
	Sep	30	0.370	34.1	0.367	33.8	0.3	1.02	0.29	5.30	6.09	0.51	0.56	-8.1	32.4	0.6	-24.8	-30.5	1.7	0.6	0.1	-10.1	0.0	-9.5	0.0	-38.3	200.6	0.0
	Total	365	0.464	519.4		411.7	109.86	100.0	28.57	44.26	56.00	3.43	3.72	-54.9	165.8	57.1	-182.8	-180.1	353.7	61.8	7.5	-96.8	-0.1	-27.7	0.0	-9.7		155.5

2031 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
635,000	548,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Total
Area	(ac)	NA	40	60	100
Year 1	(ac-ft/yr)	0	-273	-173	-445
Year 2	(ac-ft/yr)	0	-238	-199	-437

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	710	208	393	0	187
Year 2	208	613	-9	393	0	217

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.574	54.6	0.434	41.3	13.4	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	0.748	68.9	0.434	39.9	29.0	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	0.895	85.1	0.434	41.3	43.9	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	0.892	84.9	0.434	41.3	43.6	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	0.821	70.5	0.434	37.3	33.2	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	0.769	73.1	0.434	41.3	31.8	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.670	61.7	0.434	39.9	21.7	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.515	49.0	0.434	41.3	7.7	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.446	41.1	0.434	39.9	1.1	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.418	39.8	0.434	41.3	0.0	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.428	40.7	0.434	41.3	0.0	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.443	40.8	0.434	39.9	0.9	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.635	710.2		486.0	226.33	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.421	40.1	0.434	41.3	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.456	42.0	0.434	39.9	2.0	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	0.783	74.5	0.434	41.3	33.2	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	0.761	72.4	0.434	41.3	31.1	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.695	59.8	0.434	37.3	22.5	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	0.729	69.4	0.434	41.3	28.1	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.527	48.5	0.434	39.9	8.6	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.464	44.2	0.434	41.3	2.9	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.423	39.0	0.434	39.9	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.431	41.0	0.434	41.3	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.444	42.3	0.434	41.3	1.0	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.437	40.3	0.434	39.9	0.3	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.548	613.2		486.0	129.70	100.0	28.57	44.26	56.00	3.43	3.72

Period		Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-0.7	15.6	6.2	-21.0	-2.8	39.1	1.2	3.3	-1.3	0.0	3.2	0.0	39.5	39.5	0.0
	Nov	0.0	0.0	13.0	-13.0	0.0	68.9	4.7	5.9	-0.8	0.0	9.8	0.0	78.7	118.2	0.0
	Dec	0.0	0.0	18.7	-16.5	0.0	85.1	11.9	6.2	-1.1	0.0	17.0	0.0	102.1	220.3	0.0
	Jan	0.0	0.0	18.6	-16.5	0.0	84.9	17.1	3.8	-1.7	0.0	19.2	0.0	104.1	324.4	0.0
	Feb	0.0	0.0	15.8	-15.3	0.0	70.5	17.6	1.9	-2.2	0.0	17.2	0.0	68.6	393.0	19.1
	Mar	0.0	0.0	13.8	-18.0	0.0	73.1	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	393.0	86.8
	Apr	0.0	0.0	9.9	-10.6	0.0	61.7	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	393.0	66.7
	May	-5.9	5.9	3.8	-3.8	-22.2	43.1	4.6	0.3	-11.1	0.0	-6.3	0.0	0.0	393.0	14.7
	Jun	-10.2	35.7	1.1	-26.7	-38.1	5.4	1.4	0.1	-14.9	0.0	-13.4	0.0	-46.1	346.9	0.0
	Jul	-12.5	39.8	0.0	-29.8	-39.8	0.0	0.0	0.0	-17.2	0.0	-17.2	0.0	-56.9	289.9	0.0
	Aug	-11.3	39.1	0.4	-28.2	-40.7	1.7	0.5	0.1	-14.3	0.0	-13.8	0.0	-52.8	237.1	0.0
	Sep	-7.8	31.6	1.0	-24.8	-29.2	9.3	1.0	0.2	-10.1	0.0	-8.9	0.0	-28.8	208.3	0.0
	Total	-48.4	167.6	102.6	-224.3	-172.7	542.7	88.2	23.7	-86.2	-0.1	25.5	0.0	208.3		187.2
Year 2	Oct	-2.9	20.5	3.4	-21.0	-10.8	19.6	3.1	0.8	-5.6	0.0	-1.8	0.0	7.0	215.2	0.0
	Nov	0.0	0.0	7.2	-7.2	0.0	42.0	6.5	1.5	-2.7	0.0	5.4	0.0	47.3	262.6	0.0
	Dec	0.0	0.0	10.4	-10.4	0.0	74.5	10.5	1.7	-2.4	0.0	9.8	0.0	84.3	346.9	0.0
	Jan	0.0	0.0	10.4	-10.4	0.0	72.4	11.9	1.1	-2.8	0.0	10.1	0.0	46.1	393.0	36.4
	Feb	0.0	0.0	8.8	-8.8	0.0	59.8	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	393.0	67.8
	Mar	0.0	0.0	7.7	-7.7	0.0	69.4	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	393.0	73.9
	Apr	-2.2	2.2	5.5	-5.5	-8.1	46.4	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	393.0	37.7
	May	-7.2	7.2	2.1	-2.1	-27.2	36.9	2.6	0.2	-11.1	0.0	-8.4	0.0	0.0	393.0	1.3
	Jun	-10.6	36.6	0.6	-26.7	-39.0	2.3	0.8	0.1	-14.9	0.0	-14.1	0.0	-50.7	342.3	0.0
	Jul	-12.5	41.0	0.0	-29.8	-41.0	0.0	0.0	0.0	-17.1	0.0	-17.1	0.0	-58.1	284.2	0.0
	Aug	-11.4	39.4	0.2	-28.2	-42.3	2.9	0.3	0.0	-14.2	0.0	-13.9	0.0	-53.3	230.9	0.0
	Sep	-8.1	32.4	0.6	-24.8	-30.5	7.9	0.5	0.1	-10.0	0.0	-9.3	0.0	-32.0	198.9	0.0
	Total	-54.9	179.2	57.1	-182.8	-198.8	434.0	62.4	7.2	-96.7	-0.1	-27.3	0.0	-9.3		217.2

2036 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
733,000	633,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Total
Area	(ac)	NA	40	60	100
Year 1	(ac-ft/yr)	0	-273	-180	-453
Year 2	(ac-ft/yr)	0	-238	-206	-444

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	820	223	393	0	274
Year 2	223	708	-8	393	0	302

Period			WWTP Effluent					Historic Weather Data						Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.663	63.1	0.501	47.7	15.4	6.02	3.09	3.14	3.96	0.05	0.01	-0.7	15.6	6.2	-21.0	-2.8	47.5	1.2	3.3	-1.3	0.0	3.2	0.0	48.0	48.0	0.0
	Nov	30	0.864	79.6	0.501	46.1	33.4	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	13.0	-13.0	0.0	79.6	5.1	5.7	-0.9	0.0	9.9	0.0	89.5	137.5	0.0
	Dec	31	1.034	98.3	0.501	47.7	50.7	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	18.7	-16.5	0.0	98.3	13.0	5.7	-1.3	0.0	17.5	0.0	115.8	253.3	0.0
	Jan	31	1.030	98.0	0.501	47.7	50.4	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	18.6	-16.5	0.0	98.0	18.4	3.2	-1.8	0.0	19.8	0.0	117.8	371.2	0.0
	Feb	28	0.948	81.5	0.501	43.1	38.4	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	15.8	-15.3	0.0	81.5	18.6	1.4	-2.3	0.0	17.6	0.0	21.8	**393.0**	77.2
	Mar	31	0.888	84.5	0.501	47.7	36.8	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	13.8	-18.0	0.0	84.5	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	**393.0**	98.1
	Apr	30	0.773	71.2	0.501	46.1	25.1	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	9.9	-10.6	0.0	71.2	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	**393.0**	76.2
	May	31	0.595	56.6	0.501	47.7	8.9	3.75	1.92	4.67	6.32	0.37	0.38	-5.9	5.9	3.8	-3.8	-22.2	50.7	4.6	0.3	-11.1	0.0	-6.3	0.0	0.0	**393.0**	22.2
	Jun	30	0.515	47.5	0.501	46.1	1.3	1.12	0.57	6.23	7.83	0.63	0.70	-10.2	35.7	1.1	-26.7	-38.1	11.7	1.4	0.1	-14.9	0.0	-13.4	0.0	-39.7	353.3	0.0
	Jul	31	0.483	45.9	0.501	47.7	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-12.5	42.3	0.0	-29.8	-45.9	3.6	0.0	0.0	-17.3	0.0	-17.3	0.0	-59.6	293.7	0.0
	Aug	31	0.494	47.0	0.501	47.7	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-11.3	39.1	0.4	-28.2	-42.2	8.0	0.5	0.1	-14.4	0.0	-13.9	0.0	-48.1	245.6	0.0
	Sep	30	0.512	47.2	0.501	46.1	1.0	1.02	0.52	5.30	6.09	0.49	0.53	-7.8	31.6	1.0	-24.8	-29.2	15.6	1.0	0.2	-10.3	0.0	-9.1	0.0	-22.7	222.9	0.0
	Total	365	0.733	820.4		561.4	261.42	100.0	51.29	42.40	56.00	3.02	3.26	-48.4	170.1	102.6	-224.3	-180.3	650.3	92.0	21.9	-87.1	-0.1	26.8	0.0	222.9		273.8
Year 2	Oct	31	0.486	46.3	0.501	47.7	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-2.9	20.5	3.4	-21.0	-10.8	25.8	3.2	0.7	-5.8	0.0	-1.9	0.0	13.0	235.9	0.0
	Nov	30	0.527	48.5	0.501	46.1	2.3	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	7.2	-7.2	0.0	48.5	6.9	1.4	-2.8	0.0	5.4	0.0	53.9	289.8	0.0
	Dec	31	0.904	86.0	0.501	47.7	38.4	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	86.0	11.0	1.5	-2.6	0.0	10.0	0.0	96.0	385.8	0.0
	Jan	31	0.879	83.6	0.501	47.7	36.0	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	10.4	-10.4	0.0	83.6	12.3	0.9	-2.9	0.0	10.3	0.0	7.2	**393.0**	86.7
	Feb	28	0.803	69.0	0.501	43.1	26.0	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	8.8	-8.8	0.0	69.0	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	**393.0**	77.1
	Mar	31	0.842	80.1	0.501	47.7	32.4	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	7.7	-7.7	0.0	80.1	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	**393.0**	84.7
	Apr	30	0.609	56.0	0.501	46.1	9.9	9.66	2.76	3.18	4.59	0.13	0.11	-2.2	2.2	5.5	-5.5	-8.1	53.9	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	**393.0**	45.2
	May	31	0.536	51.0	0.501	47.7	3.3	3.75	1.07	4.67	6.32	0.45	0.49	-7.2	7.2	2.1	-2.1	-27.2	43.8	2.6	0.2	-11.1	0.0	-8.4	0.0	0.0	**393.0**	8.2
	Jun	30	0.489	45.0	0.501	46.1	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-10.6	36.6	0.6	-26.7	-39.6	8.4	0.8	0.1	-14.9	0.0	-14.1	0.0	-45.3	347.7	0.0
	Jul	31	0.498	47.3	0.501	47.7	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-12.5	42.3	0.0	-29.8	-47.1	5.0	0.0	0.0	-17.2	0.0	-17.2	0.0	-59.2	288.5	0.0
	Aug	31	0.513	48.8	0.501	47.7	1.1	0.42	0.12	6.76	8.21	0.71	0.79	-11.4	39.4	0.2	-28.2	-42.8	9.4	0.3	0.0	-14.3	0.0	-14.0	0.0	-47.3	241.2	0.0
	Sep	30	0.505	46.5	0.501	46.1	0.4	1.02	0.29	5.30	6.09	0.51	0.56	-8.1	32.4	0.6	-24.8	-30.5	14.1	0.6	0.1	-10.2	0.0	-9.5	0.0	-26.0	215.2	0.0
	Total	365	0.633	708.3		561.4	149.81	100.0	28.57	44.26	56.00	3.43	3.72	-54.9	180.6	57.1	-182.8	-206.0	527.7	63.8	6.6	-97.8	-0.1	-27.5	0.0	-7.7		301.9

2041 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
794,000	685,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Total
Area	(ac)	NA	40	60	100
Year 1	(ac-ft/yr)	0	-273	-181	-454
Year 2	(ac-ft/yr)	0	-238	-206	-444

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	888	237	393	0	327
Year 2	237	767	-7	393	0	359

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.718	68.3	0.542	51.6	16.7	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	0.936	86.2	0.542	49.9	36.2	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	1.119	106.5	0.542	51.6	54.8	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	1.115	106.1	0.542	51.6	54.5	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	1.026	88.2	0.542	46.6	41.6	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	0.961	91.4	0.542	51.6	39.8	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.837	77.1	0.542	49.9	27.1	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.644	61.3	0.542	51.6	9.6	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.558	51.4	0.542	49.9	1.4	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.522	49.7	0.542	51.6	0.0	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.535	50.9	0.542	51.6	0.0	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.554	51.1	0.542	49.9	1.1	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.794	888.1		607.7	282.99	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.527	50.1	0.542	51.6	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.570	52.5	0.542	49.9	2.5	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	0.979	93.1	0.542	51.6	41.5	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	0.952	90.5	0.542	51.6	38.9	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.869	74.7	0.542	46.6	28.1	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	0.912	86.7	0.542	51.6	35.1	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.659	60.7	0.542	49.9	10.7	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.580	55.2	0.542	51.6	3.6	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.529	48.7	0.542	49.9	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.539	51.2	0.542	51.6	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.555	52.8	0.542	51.6	1.2	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.547	50.3	0.542	49.9	0.4	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.685	766.8		607.7	162.17	100.0	28.57	44.26	56.00	3.43	3.72

Period		Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-0.7	15.6	6.2	-21.0	-2.8	52.8	1.2	3.3	-1.3	0.0	3.2	0.0	53.2	53.2	0.0
	Nov	0.0	0.0	13.0	-13.0	0.0	86.2	5.3	5.6	-0.9	0.0	10.0	0.0	96.2	149.4	0.0
	Dec	0.0	0.0	18.7	-16.5	0.0	106.5	13.7	5.4	-1.3	0.0	17.8	0.0	124.2	273.6	0.0
	Jan	0.0	0.0	18.6	-16.5	0.0	106.1	19.1	2.9	-1.9	0.0	20.1	0.0	119.4	393.0	6.9
	Feb	0.0	0.0	15.8	-15.3	0.0	88.2	18.9	1.3	-2.4	0.0	17.8	0.0	0.0	393.0	106.0
	Mar	0.0	0.0	13.8	-18.0	0.0	91.4	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	393.0	105.1
	Apr	0.0	0.0	9.9	-10.6	0.0	77.1	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	393.0	82.1
	May	-5.9	5.9	3.8	-3.8	-22.2	55.3	4.6	0.3	-11.1	0.0	-6.3	0.0	0.0	393.0	26.9
	Jun	-10.2	35.7	1.1	-26.7	-38.1	15.7	1.4	0.1	-14.9	0.0	-13.4	0.0	-35.8	357.2	0.0
	Jul	-12.5	42.3	0.0	-29.8	-47.0	7.4	0.0	0.0	-17.4	0.0	-17.4	0.0	-57.0	300.2	0.0
	Aug	-11.3	39.1	0.4	-28.2	-42.2	11.8	0.5	0.1	-14.5	0.0	-14.0	0.0	-44.4	255.8	0.0
	Sep	-7.8	31.6	1.0	-24.8	-29.2	19.5	1.0	0.2	-10.5	0.0	-9.3	0.0	-19.0	236.8	0.0
	Total	-48.4	170.1	102.6	-224.3	-181.4	718.0	94.0	21.0	-87.7	-0.1	27.2	0.0	236.8		326.9
Year 2	Oct	-2.9	20.5	3.4	-21.0	-10.8	29.7	3.3	0.6	-6.0	0.0	-2.1	0.0	16.7	253.6	0.0
	Nov	0.0	0.0	7.2	-7.2	0.0	52.5	7.2	1.3	-3.0	0.0	5.4	0.0	57.9	311.5	0.0
	Dec	0.0	0.0	10.4	-10.4	0.0	93.1	11.4	1.3	-2.6	0.0	10.1	0.0	81.5	393.0	21.7
	Jan	0.0	0.0	10.4	-10.4	0.0	90.5	12.4	0.8	-2.9	0.0	10.3	0.0	0.0	393.0	100.8
	Feb	0.0	0.0	8.8	-8.8	0.0	74.7	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	393.0	82.8
	Mar	0.0	0.0	7.7	-7.7	0.0	86.7	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	393.0	91.3
	Apr	-2.2	2.2	5.5	-5.5	-8.1	58.5	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	393.0	49.9
	May	-7.2	7.2	2.1	-2.1	-27.2	48.0	2.6	0.2	-11.1	0.0	-8.4	0.0	0.0	393.0	12.4
	Jun	-10.6	36.6	0.6	-26.7	-39.6	12.1	0.8	0.1	-14.9	0.0	-14.1	0.0	-41.5	351.5	0.0
	Jul	-12.5	42.3	0.0	-29.8	-47.1	9.0	0.0	0.0	-17.3	0.0	-17.3	0.0	-55.4	296.1	0.0
	Aug	-11.4	39.4	0.2	-28.2	-42.8	13.5	0.3	0.0	-14.4	0.0	-14.2	0.0	-43.5	252.6	0.0
	Sep	-8.1	32.4	0.6	-24.8	-30.5	17.9	0.6	0.1	-10.4	0.0	-9.8	0.0	-22.4	230.2	0.0
	Total	-54.9	180.6	57.1	-182.8	-206.0	586.2	64.7	6.2	-98.7	-0.1	-27.9	0.0	-6.6		358.8

ATTACHMENT C

City of Sutter Creek and Amador Regional Sanitation Authority
TM #3A Update – Initial Evaluation and Screening of Options
Water Balance Results: Including GRR

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Base Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
458,000	332,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	36	36	0	72
Year 1	(ac-ft/yr)	-300	-261	-109	0	-669
Year 2	(ac-ft/yr)	-300	-224	-120	0	-644

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	512	11	312	81	0
Year 2	11	372	-153	174	219	0

Period			WWTP Effluent					Historic Weather Data						GRR	Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.414	39.4	0.263	25.0	14.4	6.02	3.09	3.14	3.96	0.05	0.01	0.0	-0.6	15.4	6.2	-21.0	-1.7	24.0	1.2	3.3	-1.3	0.0	3.2	-10.0	15.6	15.6	0.0
	Nov	30	0.540	49.7	0.263	24.2	25.5	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	0.0	13.0	-13.0	0.0	49.7	3.4	6.5	-0.6	0.0	9.3	-10.0	49.0	64.6	0.0
	Dec	31	0.646	61.4	0.263	25.0	36.4	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	0.0	18.7	-16.5	0.0	61.4	8.5	7.8	-0.8	0.0	15.4	-10.0	66.8	131.5	0.0
	Jan	31	0.644	61.2	0.263	25.0	36.2	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	0.0	18.6	-16.5	0.0	61.2	12.6	5.8	-1.2	0.0	17.2	-10.0	68.4	199.9	0.0
	Feb	28	0.592	50.9	0.263	22.6	28.3	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	0.0	15.8	-15.3	0.0	50.9	13.7	3.6	-1.7	0.0	15.6	-10.0	56.5	256.3	0.0
	Mar	31	0.554	52.8	0.263	25.0	27.7	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	0.0	13.8	-18.0	0.0	52.8	13.7	2.3	-3.2	0.0	12.8	-10.0	55.5	**311.9**	0.0
	Apr	30	0.483	44.5	0.263	24.2	20.3	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	0.0	9.9	-10.6	0.0	44.5	10.8	1.2	-7.0	0.0	5.1	-97.0	-47.4	264.5	0.0
	May	31	0.371	35.3	0.263	25.0	10.3	3.75	1.92	4.67	6.32	0.37	0.38	0.0	-4.4	4.4	3.8	-3.8	-13.3	30.9	3.9	0.6	-9.4	0.0	-4.9	-97.0	-84.3	180.1	0.0
	Jun	30	0.322	29.6	0.263	24.2	5.4	1.12	0.57	6.23	7.83	0.63	0.70	0.0	-7.6	29.6	1.1	-26.7	-22.8	0.0	0.9	0.3	-10.2	0.0	-8.9	-11.5	-43.3	136.8	0.0
	Jul	31	0.301	28.7	0.263	25.0	3.6	0.04	0.02	7.53	8.90	0.78	0.87	0.0	-9.4	28.7	0.0	-29.8	-28.2	0.0	0.0	0.0	-10.4	0.0	-10.4	-11.5	-50.1	86.7	0.0
	Aug	31	0.309	29.4	0.263	25.0	4.3	0.42	0.22	6.76	8.21	0.70	0.78	0.0	-8.4	29.4	0.4	-28.2	-25.3	0.0	0.2	0.2	-7.2	0.0	-6.8	-11.5	-43.6	43.1	0.0
	Sep	30	0.320	29.5	0.263	24.2	5.2	1.02	0.52	5.30	6.09	0.49	0.53	0.0	-5.8	29.5	1.0	-24.8	-17.5	0.0	0.4	0.5	-3.9	0.0	-3.1	-11.5	-32.1	11.0	0.0
	Total	365	0.458	512.4		294.8	217.65	100.0	51.29	42.40	56.00	3.02	3.26	0.0	-36.3	137.0	102.6	-224.3	-108.9	375.4	69.5	32.1	-57.0	-0.1	44.5	-300.0	11.0		0.0
Year 2	Oct	31	0.255	24.3	0.263	25.0	0.0	6.02	1.72	3.14	3.96	0.18	0.18	0.0	-2.2	19.7	3.4	-21.0	-6.5	4.6	0.8	1.7	-1.5	0.0	1.0	-10.0	-10.9	0.1	0.0
	Nov	30	0.276	25.5	0.263	24.2	1.2	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	0.0	7.2	-7.2	0.0	25.5	1.5	3.8	-0.6	0.0	4.7	-10.0	20.1	20.3	0.0
	Dec	31	0.475	45.2	0.263	25.0	20.1	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	45.2	3.0	5.1	-0.7	0.0	7.4	-10.0	42.6	62.8	0.0
	Jan	31	0.462	43.9	0.263	25.0	18.9	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	43.9	4.6	4.3	-1.1	0.0	7.9	-10.0	41.8	104.6	0.0
	Feb	28	0.422	36.2	0.263	22.6	13.6	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	0.0	8.8	-8.8	0.0	36.2	5.2	3.1	-1.6	0.0	6.7	-10.0	33.0	137.6	0.0
	Mar	31	0.442	42.1	0.263	25.0	17.0	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	0.0	7.7	-7.7	0.0	42.1	5.3	2.3	-3.0	0.0	4.6	-10.0	36.7	**174.3**	0.0
	Apr	30	0.320	29.4	0.263	24.2	5.2	9.66	2.76	3.18	4.59	0.13	0.11	0.0	-1.6	1.6	5.5	-5.5	-4.8	27.8	4.4	1.4	-5.1	0.0	0.7	-97.0	-73.3	101.0	0.0
	May	31	0.282	26.8	0.263	25.0	1.8	3.75	1.07	4.67	6.32	0.45	0.49	0.0	-5.4	5.4	2.1	-2.1	-16.3	21.4	1.2	0.8	-5.4	0.0	-3.4	-97.0	-95.4	5.6	0.0
	Jun	30	0.257	23.6	0.263	24.2	0.0	1.12	0.32	6.23	7.83	0.66	0.73	0.0	-7.9	23.6	0.6	-26.7	-23.6	0.0	0.1	0.3	-2.8	0.0	-2.3	-11.5	-37.5	0.0	0.0
	Jul	31	0.261	24.9	0.263	25.0	0.0	0.04	0.01	7.53	8.90	0.78	0.87	0.0	-9.4	24.9	0.0	-29.8	-24.9	0.0	0.0	0.0	-3.0	0.0	-3.0	-11.5	-39.4	0.0	0.0
	Aug	31	0.269	25.6	0.263	25.0	0.6	0.42	0.12	6.76	8.21	0.71	0.79	0.0	-8.6	25.6	0.2	-28.2	-25.6	0.0	0.0	0.1	-2.7	0.0	-2.5	-11.5	-39.7	0.0	0.0
	Sep	30	0.265	24.4	0.263	24.2	0.2	1.02	0.29	5.30	6.09	0.51	0.56	0.0	-6.1	24.4	0.6	-24.8	-18.3	0.0	0.1	0.3	-2.1	0.0	-1.7	-11.5	-31.5	0.0	0.0
	Total	365	0.332	371.9		294.8	78.66	100.0	28.57	44.26	56.00	3.43	3.72	0.0	-41.2	125.3	57.1	-182.8	-120.1	246.6	26.4	23.4	-29.7	0.0	20.1	-300.0	-153.4		0.0

2021 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
456,000	394,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	36	36	0	72
Year 1	(ac-ft/yr)	-300	-261	-109	0	**-669**
Year 2	(ac-ft/yr)	-300	-224	-124	0	**-648**

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	510	10	311	82	0
Year 2	10	441	-111	214	179	0

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.413	39.3	0.312	29.7	9.6	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	0.538	49.5	0.312	28.7	20.8	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	0.643	61.2	0.312	29.7	31.5	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	0.641	61.0	0.312	29.7	31.3	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	0.590	50.7	0.312	26.8	23.9	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	0.552	52.5	0.312	29.7	22.9	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.481	44.3	0.312	28.7	15.6	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.370	35.2	0.312	29.7	5.5	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.321	29.5	0.312	28.7	0.8	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.300	28.6	0.312	29.7	0.0	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.307	29.3	0.312	29.7	0.0	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.319	29.3	0.312	28.7	0.6	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.456	510.4		349.2	162.63	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.303	28.8	0.312	29.7	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.328	30.2	0.312	28.7	1.5	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	0.563	53.5	0.312	29.7	23.9	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	0.547	52.0	0.312	29.7	22.4	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.500	42.9	0.312	26.8	16.1	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	0.524	49.8	0.312	29.7	20.2	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.379	34.9	0.312	28.7	6.2	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.334	31.7	0.312	29.7	2.1	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.304	28.0	0.312	28.7	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.310	29.5	0.312	29.7	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.319	30.4	0.312	29.7	0.7	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.314	28.9	0.312	28.7	0.2	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.394	440.6		349.2	93.20	100.0	28.57	44.26	56.00	3.43	3.72

Period		GRR	Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	0.0	-0.6	15.4	6.2	-21.0	-1.7	23.9	1.2	3.3	-1.3	0.0	3.2	-10.0	15.4	15.4	0.0
	Nov	0.0	0.0	0.0	13.0	-13.0	0.0	49.5	3.4	6.5	-0.6	0.0	9.3	-10.0	48.8	64.3	0.0
	Dec	0.0	0.0	0.0	18.7	-16.5	0.0	61.2	8.5	7.8	-0.8	0.0	15.4	-10.0	66.6	130.8	0.0
	Jan	0.0	0.0	0.0	18.6	-16.5	0.0	61.0	12.6	5.9	-1.2	0.0	17.2	-10.0	68.2	199.0	0.0
	Feb	0.0	0.0	0.0	15.8	-15.3	0.0	50.7	13.7	3.6	-1.7	0.0	15.6	-10.0	56.2	255.2	0.0
	Mar	0.0	0.0	0.0	13.8	-18.0	0.0	52.5	13.7	2.4	-3.2	0.0	12.8	-10.0	55.3	**310.6**	0.0
	Apr	0.0	0.0	0.0	9.9	-10.6	0.0	44.3	10.8	1.3	-7.0	0.0	5.1	-97.0	-47.6	263.0	0.0
	May	0.0	-4.4	4.4	3.8	-3.8	-13.3	30.8	3.9	0.6	-9.4	0.0	-4.9	-97.0	-84.4	178.5	0.0
	Jun	0.0	-7.6	29.5	1.1	-26.7	-22.8	0.0	0.9	0.3	-10.1	0.0	-8.9	-11.5	-43.2	135.3	0.0
	Jul	0.0	-9.4	28.6	0.0	-29.8	-28.2	0.0	0.0	0.0	-10.4	0.0	-10.3	-11.5	-50.0	85.3	0.0
	Aug	0.0	-8.4	29.3	0.4	-28.2	-25.3	0.0	0.2	0.2	-7.1	0.0	-6.7	-11.5	-43.5	41.7	0.0
	Sep	0.0	-5.8	29.3	1.0	-24.8	-17.5	0.0	0.4	0.5	-3.9	0.0	-3.0	-11.5	-32.0	9.7	0.0
	Total	0.0	-36.3	136.5	102.6	-224.3	-108.9	373.9	69.3	32.2	-56.7	-0.1	44.7	-300.0	9.7		0.0
Year 2	Oct	0.0	-2.2	19.7	3.4	-21.0	-6.5	9.1	0.8	1.8	-1.5	0.0	1.1	-10.0	-6.4	3.3	0.0
	Nov	0.0	0.0	0.0	7.2	-7.2	0.0	30.2	1.6	3.8	-0.6	0.0	4.7	-10.0	24.8	28.1	0.0
	Dec	0.0	0.0	0.0	10.4	-10.4	0.0	53.5	3.3	5.0	-0.8	0.0	7.5	-10.0	51.0	79.1	0.0
	Jan	0.0	0.0	0.0	10.4	-10.4	0.0	52.0	5.2	4.1	-1.2	0.0	8.0	-10.0	50.1	129.2	0.0
	Feb	0.0	0.0	0.0	8.8	-8.8	0.0	42.9	5.9	2.8	-1.8	0.0	6.9	-10.0	39.8	169.1	0.0
	Mar	0.0	0.0	0.0	7.7	-7.7	0.0	49.8	6.0	2.0	-3.4	0.0	4.6	-10.0	44.5	**213.5**	0.0
	Apr	0.0	-1.6	1.6	5.5	-5.5	-4.8	33.2	5.0	1.2	-5.7	0.0	0.4	-97.0	-68.2	145.3	0.0
	May	0.0	-5.4	5.4	2.1	-2.1	-16.3	26.3	1.5	0.6	-6.7	0.0	-4.5	-97.0	-91.5	53.8	0.0
	Jun	0.0	-7.9	28.0	0.6	-26.7	-23.7	0.0	0.3	0.3	-5.1	0.0	-4.6	-11.5	-39.9	13.9	0.0
	Jul	0.0	-9.4	29.5	0.0	-29.8	-28.2	0.0	0.0	0.0	-3.9	0.0	-3.9	-11.5	-43.6	0.0	0.0
	Aug	0.0	-8.6	30.4	0.2	-28.2	-25.7	0.0	0.0	0.1	-2.7	0.0	-2.5	-11.5	-39.7	0.0	0.0
	Sep	0.0	-6.1	28.9	0.6	-24.8	-18.3	0.0	0.1	0.3	-2.1	0.0	-1.7	-11.5	-31.5	0.0	0.0
	Total	0.0	-41.2	143.5	57.1	-182.8	-123.6	297.1	29.8	21.9	-35.7	0.0	16.0	-300.0	-110.6		0.0

2026 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
592,000	511,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	40	60	108	208
Year 1	(ac-ft/yr)	0	-273	-167	-194	-634
Year 2	(ac-ft/yr)	0	-238	-191	-224	-652

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	662	171	393	0	137
Year 2	171	572	-10	393	0	122

Period			WWTP Effluent					Historic Weather Data						GRR	Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.536	51.0	0.404	38.5	12.5	6.02	3.09	3.14	3.96	0.05	0.01	-1.1	-0.7	15.6	6.2	-21.0	-2.8	34.3	1.2	3.3	-1.3	0.0	3.2	0.0	34.7	34.7	0.0
	Nov	30	0.698	64.2	0.404	37.2	27.0	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	0.0	13.0	-13.0	0.0	64.2	4.4	6.0	-0.8	0.0	9.7	0.0	73.9	108.7	0.0
	Dec	31	0.834	79.4	0.404	38.5	40.9	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	0.0	18.7	-16.5	0.0	79.4	11.3	6.5	-1.1	0.0	16.7	0.0	96.1	204.8	0.0
	Jan	31	0.832	79.1	0.404	38.5	40.7	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	0.0	18.6	-16.5	0.0	79.1	16.4	4.1	-1.6	0.0	18.9	0.0	98.0	302.8	0.0
	Feb	28	0.765	65.8	0.404	34.8	31.0	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	0.0	15.8	-15.3	0.0	65.8	17.1	2.1	-2.2	0.0	17.0	0.0	82.8	385.5	0.0
	Mar	31	0.717	68.2	0.404	38.5	29.7	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	0.0	13.8	-18.0	0.0	68.2	16.4	1.2	-3.9	0.0	13.6	0.0	7.5	393.0	74.3
	Apr	30	0.624	57.5	0.404	37.2	20.2	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	0.0	9.9	-10.6	0.0	57.5	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	393.0	62.5
	May	31	0.480	45.7	0.404	38.5	7.2	3.75	1.92	4.67	6.32	0.37	0.38	-41.4	-5.9	5.9	3.8	-3.8	-22.2	0.0	4.6	0.3	-11.1	0.0	-6.3	0.0	-28.4	364.6	0.0
	Jun	30	0.416	38.3	0.404	37.2	1.1	1.12	0.57	6.23	7.83	0.63	0.70	-38.3	-10.2	35.7	1.1	-26.7	-38.1	0.0	1.3	0.1	-14.5	0.0	-13.1	0.0	-51.2	313.4	0.0
	Jul	31	0.390	37.1	0.404	38.5	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-37.1	-12.5	37.1	0.0	-29.8	-37.1	0.0	0.0	0.0	-16.5	0.0	-16.5	0.0	-53.5	259.9	0.0
	Aug	31	0.399	38.0	0.404	38.5	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-38.0	-11.3	38.0	0.4	-28.2	-38.0	0.0	0.4	0.1	-13.5	0.0	-13.0	0.0	-51.0	208.9	0.0
	Sep	30	0.413	38.1	0.404	37.2	0.8	1.02	0.52	5.30	6.09	0.49	0.53	-38.1	-7.8	31.6	1.0	-24.8	-29.2	0.0	0.9	0.2	-9.4	0.0	-8.3	0.0	-37.4	171.4	0.0
	Total	365	0.592	662.2		453.1	211.02	100.0	51.29	42.40	56.00	3.02	3.26	-193.8	-48.4	163.8	102.6	-224.3	-167.2	448.5	85.9	24.7	-83.5	-0.1	27.0	0.0	171.4		136.8
Year 2	Oct	31	0.393	37.4	0.404	38.5	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-19.1	-2.9	20.5	3.4	-21.0	-10.8	0.0	2.7	0.9	-5.0	0.0	-1.4	0.0	-12.2	159.2	0.0
	Nov	30	0.425	39.1	0.404	37.2	1.9	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	0.0	7.2	-7.2	0.0	39.1	5.5	2.0	-2.3	0.0	5.2	0.0	44.3	203.6	0.0
	Dec	31	0.730	69.5	0.404	38.5	31.0	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	69.5	9.1	2.3	-2.1	0.0	9.4	0.0	78.8	282.4	0.0
	Jan	31	0.710	67.5	0.404	38.5	29.0	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	67.5	10.8	1.5	-2.6	0.0	9.8	0.0	77.3	359.7	0.0
	Feb	28	0.648	55.7	0.404	34.8	21.0	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	0.0	8.8	-8.8	0.0	55.7	10.2	0.8	-3.1	0.0	8.0	0.0	33.3	393.0	30.4
	Mar	31	0.680	64.7	0.404	38.5	26.2	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	0.0	7.7	-7.7	0.0	64.7	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	393.0	69.3
	Apr	30	0.491	45.2	0.404	37.2	8.0	9.66	2.76	3.18	4.59	0.13	0.11	-12.0	-2.2	2.2	5.5	-5.5	-8.1	31.0	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	393.0	22.4
	May	31	0.433	41.2	0.404	38.5	2.7	3.75	1.07	4.67	6.32	0.45	0.49	-41.2	-7.2	7.2	2.1	-2.1	-27.2	0.0	2.6	0.2	-11.1	0.0	-8.4	0.0	-35.6	357.4	0.0
	Jun	30	0.395	36.3	0.404	37.2	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-36.3	-10.6	36.3	0.6	-26.7	-36.3	0.0	0.7	0.1	-14.4	0.0	-13.6	0.0	-50.0	307.4	0.0
	Jul	31	0.402	38.2	0.404	38.5	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-38.2	-12.5	38.2	0.0	-29.8	-38.2	0.0	0.0	0.0	-16.4	0.0	-16.3	0.0	-54.6	252.9	0.0
	Aug	31	0.414	39.4	0.404	38.5	0.9	0.42	0.12	6.76	8.21	0.71	0.79	-39.4	-11.4	39.4	0.2	-28.2	-39.4	0.0	0.2	0.0	-13.3	0.0	-13.1	0.0	-52.5	200.4	0.0
	Sep	30	0.408	37.5	0.404	37.2	0.3	1.02	0.29	5.30	6.09	0.51	0.56	-37.5	-8.1	32.4	0.6	-24.8	-30.5	0.0	0.5	0.1	-9.2	0.0	-8.6	0.0	-39.1	161.3	0.0
	Total	365	0.511	571.7		453.1	120.92	100.0	28.57	44.26	56.00	3.43	3.72	-223.8	-54.9	176.2	57.1	-182.8	-190.6	327.5	58.2	9.1	-92.3	-0.1	-25.1	0.0	-10.1		122.0

2031 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	**ADF**
(gpd)	**(gpd)**
736,000	**635,000**

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	**(ac-ft)**	**393**	**0**	**393**
Surface Area	**(ac)**	29	**0**	**29**

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	**(ac)**	**NA**	**40**	**60**	**216**	**316**
Year 1	**(ac-ft/yr)**	0	-273	-180	-247	**-700**
Year 2	**(ac-ft/yr)**	0	-238	-206	-302	**-745**

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	**(ac-ft)**	**(ac-ft)**	**(ac-ft)**	**(ac-ft)**	**(ac-ft)**
Year 1	0	823	159	393	0	251
Year 2	159	711	-12	393	0	181

Period			WWTP Effluent					Historic Weather Data						GRR	Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.666	63.3	0.503	47.8	15.5	6.02	3.09	3.14	3.96	0.05	0.01	-2.1	-0.7	15.6	6.2	-21.0	-2.8	45.7	1.2	3.3	-1.3	0.0	3.2	0.0	46.1	46.1	0.0
	Nov	30	0.867	79.9	0.503	46.3	33.6	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	0.0	13.0	-13.0	0.0	79.9	5.0	5.8	-0.9	0.0	9.9	0.0	89.8	135.8	0.0
	Dec	31	1.037	98.7	0.503	47.8	50.8	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	0.0	18.7	-16.5	0.0	98.7	12.9	5.8	-1.2	0.0	17.4	0.0	116.1	252.0	0.0
	Jan	31	1.034	98.4	0.503	47.8	50.5	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	0.0	18.6	-16.5	0.0	98.4	18.4	3.2	-1.8	0.0	19.8	0.0	118.2	370.1	0.0
	Feb	28	0.951	81.7	0.503	43.2	38.5	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	0.0	15.8	-15.3	0.0	81.7	18.5	1.4	-2.3	0.0	17.6	0.0	22.9	**393.0**	76.5
	Mar	31	0.891	84.7	0.503	47.8	36.9	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	0.0	13.8	-18.0	0.0	84.7	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	**393.0**	98.4
	Apr	30	0.776	71.5	0.503	46.3	25.2	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	0.0	9.9	-10.6	0.0	71.5	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	**393.0**	76.5
	May	31	0.597	56.8	0.503	47.8	8.9	3.75	1.92	4.67	6.32	0.37	0.38	-56.8	-5.9	5.9	3.8	-3.8	-22.2	0.0	4.6	0.3	-11.1	0.0	-6.3	0.0	-28.4	364.6	0.0
	Jun	30	0.517	47.6	0.503	46.3	1.3	1.12	0.57	6.23	7.83	0.63	0.70	-47.6	-10.2	35.7	1.1	-26.7	-38.1	0.0	1.3	0.1	-14.5	0.0	-13.1	0.0	-51.2	313.4	0.0
	Jul	31	0.484	46.1	0.503	47.8	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-46.1	-12.5	42.3	0.0	-29.8	-46.1	0.0	0.0	0.0	-16.5	0.0	-16.5	0.0	-62.5	250.9	0.0
	Aug	31	0.496	47.2	0.503	47.8	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-47.2	-11.3	39.1	0.4	-28.2	-42.2	0.0	0.4	0.1	-13.3	0.0	-12.8	0.0	-55.0	195.9	0.0
	Sep	30	0.514	47.3	0.503	46.3	1.0	1.02	0.52	5.30	6.09	0.49	0.53	-47.3	-7.8	31.6	1.0	-24.8	-29.2	0.0	0.9	0.2	-9.1	0.0	-7.9	0.0	-37.1	158.7	0.0
	Total	365	0.736	823.2		563.3	262.32	100.0	51.29	42.40	56.00	3.02	3.26	-247.1	-48.4	170.1	102.6	-224.3	-180.5	560.5	91.6	22.1	-83.5	-0.1	30.1	0.0	158.7		251.3
Year 2	Oct	31	0.488	46.4	0.503	47.8	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-38.2	-2.9	20.5	3.4	-21.0	-10.8	0.0	2.6	1.0	-4.8	0.0	-1.2	0.0	-12.1	146.7	0.0
	Nov	30	0.528	48.6	0.503	46.3	2.4	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	0.0	7.2	-7.2	0.0	48.6	5.2	2.1	-2.2	0.0	5.2	0.0	53.8	200.5	0.0
	Dec	31	0.908	86.3	0.503	47.8	38.5	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	86.3	9.1	2.4	-2.1	0.0	9.3	0.0	95.7	296.2	0.0
	Jan	31	0.882	83.9	0.503	47.8	36.1	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	83.9	11.1	1.4	-2.6	0.0	9.9	0.0	93.8	390.0	0.0
	Feb	28	0.806	69.3	0.503	43.2	26.0	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	0.0	8.8	-8.8	0.0	69.3	10.5	0.7	-3.2	0.0	8.0	0.0	3.0	**393.0**	74.3
	Mar	31	0.845	80.4	0.503	47.8	32.6	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	0.0	7.7	-7.7	0.0	80.4	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	**393.0**	85.0
	Apr	30	0.611	56.2	0.503	46.3	9.9	9.66	2.76	3.18	4.59	0.13	0.11	-24.1	-2.2	2.2	5.5	-5.5	-8.1	30.0	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	**393.0**	21.4
	May	31	0.538	51.2	0.503	47.8	3.4	3.75	1.07	4.67	6.32	0.45	0.49	-51.2	-7.2	7.2	2.1	-2.1	-27.2	0.0	2.6	0.2	-11.1	0.0	-8.4	0.0	-35.6	357.4	0.0
	Jun	30	0.490	45.2	0.503	46.3	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-45.2	-10.6	36.6	0.6	-26.7	-39.6	0.0	0.7	0.1	-14.4	0.0	-13.6	0.0	-53.2	304.2	0.0
	Jul	31	0.499	47.5	0.503	47.8	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-47.5	-12.5	42.3	0.0	-29.8	-47.1	0.0	0.0	0.0	-16.3	0.0	-16.3	0.0	-63.3	240.9	0.0
	Aug	31	0.515	49.0	0.503	47.8	1.1	0.42	0.12	6.76	8.21	0.71	0.79	-49.0	-11.4	39.4	0.2	-28.2	-42.8	0.0	0.2	0.0	-13.0	0.0	-12.7	0.0	-55.5	185.4	0.0
	Sep	30	0.507	46.7	0.503	46.3	0.4	1.02	0.29	5.30	6.09	0.51	0.56	-46.7	-8.1	32.4	0.6	-24.8	-30.5	0.0	0.5	0.1	-8.8	0.0	-8.2	0.0	-38.7	146.7	0.0
	Total	365	0.635	710.8		563.3	150.32	100.0	28.57	44.26	56.00	3.43	3.72	-301.8	-54.9	180.6	57.1	-182.8	-206.0	398.6	58.2	9.1	-91.2	-0.1	-24.0	0.0	-12.1		180.6

2036 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
883,000	761,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	40	60	216	316
Year 1	(ac-ft/yr)	0	-273	-181	-296	-750
Year 2	(ac-ft/yr)	0	-238	-206	-350	-793

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	987	158	393	0	369
Year 2	158	853	-11	393	0	265

Period			WWTP Effluent					Historic Weather Data					
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.799	76.0	0.603	57.4	18.6	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	1.040	95.8	0.603	55.5	40.3	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	1.244	118.4	0.603	57.4	61.0	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	1.240	118.0	0.603	57.4	60.6	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	1.141	98.1	0.603	51.8	46.2	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	1.068	101.7	0.603	57.4	44.3	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	0.931	85.7	0.603	55.5	30.2	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.716	68.1	0.603	57.4	10.7	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.620	57.1	0.603	55.5	1.6	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.581	55.3	0.603	57.4	0.0	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.595	56.6	0.603	57.4	0.0	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.617	56.8	0.603	55.5	1.2	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.883	987.5		675.7	314.67	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.586	55.7	0.603	57.4	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.634	58.4	0.603	55.5	2.8	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	1.089	103.6	0.603	57.4	46.2	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	1.058	100.7	0.603	57.4	43.3	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	0.967	83.1	0.603	51.8	31.2	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	1.014	96.4	0.603	57.4	39.1	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.733	67.5	0.603	55.5	11.9	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.645	61.4	0.603	57.4	4.0	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.588	54.2	0.603	55.5	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.599	57.0	0.603	57.4	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.618	58.8	0.603	57.4	1.4	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.608	56.0	0.603	55.5	0.4	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.761	852.6		675.7	180.32	100.0	28.57	44.26	56.00	3.43	3.72

Period		GRR	Bowers Ranch				Hoskins	Henderson Reservoir									
Years	Month	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-2.1	-0.7	15.6	6.2	-21.0	-2.8	58.3	1.2	3.3	-1.3	0.0	3.2	0.0	58.7	58.7	0.0
	Nov	0.0	0.0	0.0	13.0	-13.0	0.0	95.8	5.6	5.5	-1.0	0.0	10.1	0.0	105.9	164.7	0.0
	Dec	0.0	0.0	0.0	18.7	-16.5	0.0	118.4	14.5	5.1	-1.4	0.0	18.1	0.0	136.5	301.2	0.0
	Jan	0.0	0.0	0.0	18.6	-16.5	0.0	118.0	20.1	2.5	-2.0	0.0	20.6	0.0	91.8	**393.0**	46.7
	Feb	0.0	0.0	0.0	15.8	-15.3	0.0	98.1	18.9	1.3	-2.4	0.0	17.8	0.0	0.0	**393.0**	115.8
	Mar	0.0	0.0	0.0	13.8	-18.0	0.0	101.7	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	**393.0**	115.3
	Apr	0.0	0.0	0.0	9.9	-10.6	0.0	85.7	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	**393.0**	90.7
	May	-68.1	-5.9	5.9	3.8	-3.8	-22.2	0.0	4.6	0.3	-11.1	0.0	-6.3	0.0	-28.4	364.6	0.0
	Jun	-57.1	-10.2	35.7	1.1	-26.7	-38.1	0.0	1.3	0.1	-14.5	0.0	-13.1	0.0	-51.2	313.4	0.0
	Jul	-55.3	-12.5	42.3	0.0	-29.8	-47.0	0.0	0.0	0.0	-16.5	0.0	-16.5	0.0	-63.5	249.9	0.0
	Aug	-56.6	-11.3	39.1	0.4	-28.2	-42.2	0.0	0.4	0.1	-13.3	0.0	-12.8	0.0	-55.0	195.0	0.0
	Sep	-56.8	-7.8	31.6	1.0	-24.8	-29.2	0.0	0.9	0.2	-9.0	0.0	-7.9	0.0	-37.1	157.9	0.0
	Total	-296.0	-48.4	170.1	102.6	-224.3	-181.4	675.9	95.8	20.2	-84.0	-0.1	32.0	0.0	157.9		368.6
Year 2	Oct	-38.2	-2.9	20.5	3.4	-21.0	-10.8	0.0	2.6	1.0	-4.7	0.0	-1.2	0.0	-12.0	145.8	0.0
	Nov	0.0	0.0	0.0	7.2	-7.2	0.0	58.4	5.2	2.1	-2.2	0.0	5.2	0.0	63.5	209.3	0.0
	Dec	0.0	0.0	0.0	10.4	-10.4	0.0	103.6	9.3	2.3	-2.1	0.0	9.4	0.0	113.0	322.3	0.0
	Jan	0.0	0.0	0.0	10.4	-10.4	0.0	100.7	11.5	1.2	-2.7	0.0	10.0	0.0	70.7	**393.0**	40.0
	Feb	0.0	0.0	0.0	8.8	-8.8	0.0	83.1	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	**393.0**	91.1
	Mar	0.0	0.0	0.0	7.7	-7.7	0.0	96.4	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	**393.0**	101.0
	Apr	-24.1	-2.2	2.2	5.5	-5.5	-8.1	41.2	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	**393.0**	32.6
	May	-61.4	-7.2	7.2	2.1	-2.1	-27.2	0.0	2.6	0.2	-11.1	0.0	-8.4	0.0	-35.6	357.4	0.0
	Jun	-54.2	-10.6	36.6	0.6	-26.7	-39.6	0.0	0.7	0.1	-14.4	0.0	-13.6	0.0	-53.2	304.2	0.0
	Jul	-57.0	-12.5	42.3	0.0	-29.8	-47.1	0.0	0.0	0.0	-16.3	0.0	-16.3	0.0	-63.3	240.9	0.0
	Aug	-58.8	-11.4	39.4	0.2	-28.2	-42.8	0.0	0.2	0.0	-13.0	0.0	-12.7	0.0	-55.5	185.4	0.0
	Sep	-56.0	-8.1	32.4	0.6	-24.8	-30.5	0.0	0.5	0.1	-8.8	0.0	-8.2	0.0	-38.7	146.7	0.0
	Total	-349.6	-54.9	180.6	57.1	-182.8	-206.0	483.3	58.9	8.8	-91.4	-0.1	-23.8	0.0	-11.2		264.7

2041 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
993,000	857,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	40	60	216	316
Year 1	(ac-ft/yr)	0	-273	-181	-333	**-787**
Year 2	(ac-ft/yr)	0	-238	-206	-386	**-829**

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	1111	158	393	0	457
Year 2	158	959	-11	393	0	333

Period: Years	Period: Month	Period: Days	WWTP Effluent: Monthly Flow	WWTP Effluent: Monthly Flow	WWTP Effluent: ADWF (Jun-Sep)	WWTP Effluent: ADWF (Jun-Sep)	WWTP Effluent: Estimated Inflow & Infiltration	Historic Weather Data: % of Total	Historic Weather Data: Precip	Historic Weather Data: Pan Evap	Historic Weather Data: Eto	Historic Weather Data: Crop Irrigation Demand	Historic Weather Data: Golf Course Irrigation Demand
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)
Year 1	Oct	31	0.899	85.5	0.679	64.6	20.9	6.02	3.09	3.14	3.96	0.05	0.01
	Nov	30	1.171	107.8	0.679	62.5	45.3	12.67	6.50	1.12	1.95	0.00	0.00
	Dec	31	1.400	133.2	0.679	64.6	68.6	18.27	9.37	0.91	1.27	0.00	0.00
	Jan	31	1.396	132.8	0.679	64.6	68.2	18.17	9.32	0.92	1.56	0.00	0.00
	Feb	28	1.284	110.3	0.679	58.3	52.0	15.44	7.92	1.00	2.01	0.00	0.00
	Mar	31	1.202	114.4	0.679	64.6	49.8	13.44	6.89	1.63	3.31	0.00	0.00
	Apr	30	1.048	96.5	0.679	62.5	34.0	9.66	4.95	3.18	4.59	0.00	0.00
	May	31	0.806	76.6	0.679	64.6	12.1	3.75	1.92	4.67	6.32	0.37	0.38
	Jun	30	0.698	64.3	0.679	62.5	1.8	1.12	0.57	6.23	7.83	0.63	0.70
	Jul	31	0.654	62.2	0.679	64.6	0.0	0.04	0.02	7.53	8.90	0.78	0.87
	Aug	31	0.669	63.7	0.679	64.6	0.0	0.42	0.22	6.76	8.21	0.70	0.78
	Sep	30	0.694	63.9	0.679	62.5	1.4	1.02	0.52	5.30	6.09	0.49	0.53
	Total	365	0.993	1111.1		760.3	354.08	100.0	51.29	42.40	56.00	3.02	3.26
Year 2	Oct	31	0.659	62.7	0.679	64.6	0.0	6.02	1.72	3.14	3.96	0.18	0.18
	Nov	30	0.713	65.7	0.679	62.5	3.2	12.67	3.62	1.50	1.95	0.00	0.00
	Dec	31	1.225	116.5	0.679	64.6	52.0	18.27	5.22	1.21	1.27	0.00	0.00
	Jan	31	1.191	113.3	0.679	64.6	48.7	18.17	5.19	1.22	1.56	0.00	0.00
	Feb	28	1.088	93.5	0.679	58.3	35.2	15.44	4.41	1.34	2.01	0.00	0.00
	Mar	31	1.141	108.5	0.679	64.6	43.9	13.44	3.84	2.18	3.31	0.00	0.00
	Apr	30	0.824	75.9	0.679	62.5	13.4	9.66	2.76	3.18	4.59	0.13	0.11
	May	31	0.726	69.1	0.679	64.6	4.5	3.75	1.07	4.67	6.32	0.45	0.49
	Jun	30	0.662	61.0	0.679	62.5	0.0	1.12	0.32	6.23	7.83	0.66	0.73
	Jul	31	0.674	64.1	0.679	64.6	0.0	0.04	0.01	7.53	8.90	0.78	0.87
	Aug	31	0.695	66.1	0.679	64.6	1.5	0.42	0.12	6.76	8.21	0.71	0.79
	Sep	30	0.684	63.0	0.679	62.5	0.5	1.02	0.29	5.30	6.09	0.51	0.56
	Total	365	0.857	959.4		760.3	202.90	100.0	28.57	44.26	56.00	3.43	3.72

Period: Years	Period: Month	GRR: Land Application	Bowers Ranch: Spray Irrigation	Bowers Ranch: Facility Influent Flow	Bowers Ranch: Precipitation (direct)	Bowers Ranch: Flood Irrigation	Hoskins: Land Application	Henderson Reservoir: Facility Influent Flow	Henderson Reservoir: Precipitation (direct)	Henderson Reservoir: Watershed Runoff (indirect)	Henderson Reservoir: Evaporation (water surface)	Henderson Reservoir: Percolation (direct)	Henderson Reservoir: Subtotal Disposal (incl. Hoskins)	Henderson Reservoir: Contractual Flow for Castle Oaks Golf Course	Henderson Reservoir: Change in Storage Volume	Henderson Reservoir: Final Storage Volume	Henderson Reservoir: Over Maximum Storage
	(mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	-2.1	-0.7	15.6	6.2	-21.0	-2.8	67.8	1.2	3.3	-1.3	0.0	3.2	0.0	68.2	68.2	0.0
	Nov	0.0	0.0	0.0	13.0	-13.0	0.0	107.8	6.0	5.3	-1.0	0.0	10.3	0.0	118.1	186.3	0.0
	Dec	0.0	0.0	0.0	18.7	-16.5	0.0	133.2	15.6	4.6	-1.5	0.0	18.6	0.0	151.8	338.2	0.0
	Jan	0.0	0.0	0.0	18.6	-16.5	0.0	132.8	21.1	2.0	-2.1	0.0	21.0	0.0	54.8	**393.0**	99.0
	Feb	0.0	0.0	0.0	15.8	-15.3	0.0	110.3	18.9	1.3	-2.4	0.0	17.8	0.0	0.0	**393.0**	128.1
	Mar	0.0	0.0	0.0	13.8	-18.0	0.0	114.4	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	**393.0**	128.0
	Apr	0.0	0.0	0.0	9.9	-10.6	0.0	96.5	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	**393.0**	101.5
	May	-76.6	-5.9	5.9	3.8	-3.8	-22.2	0.0	4.6	0.3	-11.1	0.0	-6.3	0.0	-28.4	364.6	0.0
	Jun	-64.3	-10.2	35.7	1.1	-26.7	-38.1	0.0	1.3	0.1	-14.5	0.0	-13.1	0.0	-51.2	313.4	0.0
	Jul	-62.2	-12.5	42.3	0.0	-29.8	-47.0	0.0	0.0	0.0	-16.5	0.0	-16.5	0.0	-63.5	249.9	0.0
	Aug	-63.7	-11.3	39.1	0.4	-28.2	-42.2	0.0	0.4	0.1	-13.3	0.0	-12.8	0.0	-55.0	195.0	0.0
	Sep	-63.9	-7.8	31.6	1.0	-24.8	-29.2	0.0	0.9	0.2	-9.0	0.0	-7.9	0.0	-37.1	157.9	0.0
	Total	-332.8	-48.4	170.1	102.6	-224.3	-181.4	762.8	98.4	19.1	-84.2	-0.1	33.1	0.0	157.9		456.6
Year 2	Oct	-38.2	-2.9	20.5	3.4	-21.0	-10.8	4.0	2.6	1.0	-4.7	0.0	-1.2	0.0	-8.0	149.8	0.0
	Nov	0.0	0.0	0.0	7.2	-7.2	0.0	65.7	5.3	2.1	-2.2	0.0	5.2	0.0	70.9	220.7	0.0
	Dec	0.0	0.0	0.0	10.4	-10.4	0.0	116.5	9.6	2.1	-2.2	0.0	9.5	0.0	126.0	346.7	0.0
	Jan	0.0	0.0	0.0	10.4	-10.4	0.0	113.3	11.9	1.1	-2.8	0.0	10.1	0.0	46.3	**393.0**	77.1
	Feb	0.0	0.0	0.0	8.8	-8.8	0.0	93.5	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	**393.0**	101.5
	Mar	0.0	0.0	0.0	7.7	-7.7	0.0	108.5	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	**393.0**	113.1
	Apr	-24.1	-2.2	2.2	5.5	-5.5	-8.1	49.7	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	**393.0**	41.0
	May	-69.1	-7.2	7.2	2.1	-2.1	-27.2	0.0	2.6	0.2	-11.1	0.0	-8.4	0.0	-35.6	357.4	0.0
	Jun	-61.0	-10.6	36.6	0.6	-26.7	-39.6	0.0	0.7	0.1	-14.4	0.0	-13.6	0.0	-53.2	304.2	0.0
	Jul	-64.1	-12.5	42.3	0.0	-29.8	-47.1	0.0	0.0	0.0	-16.3	0.0	-16.3	0.0	-63.3	240.9	0.0
	Aug	-66.1	-11.4	39.4	0.2	-28.2	-42.8	0.0	0.2	0.0	-13.0	0.0	-12.7	0.0	-55.5	185.4	0.0
	Sep	-63.0	-8.1	32.4	0.6	-24.8	-30.5	0.0	0.5	0.1	-8.8	0.0	-8.2	0.0	-38.7	146.7	0.0
	Total	-385.6	-54.9	180.6	57.1	-182.8	-206.0	551.2	59.6	8.5	-91.5	-0.1	-23.6	0.0	-11.2		332.7

Technical Memorandum 3B

Surface Water Discharge Evaluation

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TECHNICAL MEMORANDUM 3B
Surface Water Discharge Evaluation

Date: February 21, 2012

Prepared for: David Dauwalder, Bill Slenter, & Lani Good, HydroScience Engineers

Prepared by: Michael Bryan, Ph.D., and Michelle Brown, P.E.

Subject: NPDES Permitting Considerations for New Surface Water Discharge from Sutter Creek Wastewater Treatment Plant to Sutter Creek

Background

The City of Sutter Creek is master planning future treatment facilities at its Sutter Creek Wastewater Treatment Plant (SCWWTP), which is located adjacent to Sutter Creek. Currently, the SCWWTP discharges secondary treated effluent to the Amador Regional Outfall System, which is operated by the Amador Regional Sanitation Authority (ARSA), for storage and disposal. As part of evaluating future treatment and disposal options, a discharge of treated effluent from the SCWWTP to Sutter Creek, either on a seasonal basis or year-round, is being evaluated by the City and its consulting engineers. Obtaining a National Pollutant Discharge Elimination System (NPDES) permit from the Central Valley Regional Water Quality Control Board (Central Valley Water Board) would be required to discharge treated effluent from the SCWWTP to Sutter Creek.

Purpose of Memorandum

The purpose of this memorandum is to describe the various aspects of NPDES permitting for a municipal wastewater discharge to Sutter Creek, including anticipated NPDES permit limitations and provisions, necessary documentation to submit the Central Valley Water Board to support a surface water discharge request, process for obtaining a NPDES permit, and a budget estimate for the effort.

Setting

Sutter Creek has a watershed area of approximately 70 square miles and originates in the Sierra Nevada foothills at an elevation of approximately 3,500 feet msl. Sutter Creek flows through the downtown area of the city of Sutter Creek and westward along the southern edge of the existing SCWWTP site and continues in a westerly direction through the city of Ione, then approximately three miles to its confluence with Dry Creek west of Ione. Dry Creek flows westerly to the Cosumnes River, a tributary to the Mokelumne River, which flows into the Sacramento-San Joaquin Delta (Delta).

Sutter Creek Beneficial Uses

NPDES permit effluent limitations are developed from water quality criteria applicable to the receiving water to protect the designated beneficial uses. The Central Valley Water Board adopted its *Water Quality Control Plan, Fourth Edition (Revised September 2009), for the Sacramento and San Joaquin River Basins* (Basin Plan) that designates beneficial uses. The Basin Plan at page II-2.00 states that the "…beneficial uses of any specifically identified water body generally apply to its tributary streams." The Basin Plan does not specifically identify beneficial uses for Sutter Creek, but does identify existing uses for the Cosumnes River from source to the Delta, to which Sutter Creek, via several intermediate water bodies, is tributary. In addition, the Basin Plan implements State Water Resources Control Board (State Water Board) Resolution No. 88-63, which established state policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply. Based on the Basin Plan's "tributary statement," the beneficial uses applicable to Sutter Creek are summarized in **Table 1**. Based on the designated beneficial uses, water quality criteria applicable to Sutter Creek fall into three general categories: (1) for protection of aquatic life (chronic and acute effects); (2) for protection of human health; and (3) protection of agricultural uses.

Table 1. Beneficial uses of Sutter Creek.

MUN	municipal and domestic supply
AGR	irrigation and stock watering
REC-1	uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible
REC-2	other non-contact recreation
WARM	warm freshwater habitat
COLD	cold freshwater habitat
MIGR	migration of aquatic organisms, warm[1] and cold[2]
SPWN	spawning, reproduction, and/or early development, warm[1] and cold[2]
WILD	wildlife habitat

Notes:
[1] Striped bass, sturgeon, and shad
[2] Salmon and steelhead

Sutter Creek Flow Analysis

In developing water-quality based effluent limitations in NPDES permits, the Central Valley Water Board may grant dilution credit on a constituent-by-constituent basis, at the request of the discharger and provided data and studies are submitted to support the request. Primary State policy and guidance on determining dilution credits is provided by the State Water Board's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (May 2005) (commonly referred to as the Statewide Implementation Plan or SIP). The amount of dilution credit granted and the resulting effluent limitations depend on the critical receiving water flows and there being assimilative capacity (i.e., the background receiving water constituent concentration is less than the water quality criterion). Further, it must be demonstrated that the mixing zone, which is the portion of the receiving water downstream of the discharge that is allowed to exceed the water quality criterion, would not adversely affect the receiving water according to 11 specific requirements defined in the SIP. In summary, the SIP requires that a mixing zone not adversely affect aquatic life, overlap with drinking water intakes, and cause nuisance conditions.

The critical receiving water flow for assigning dilution credit is defined according to whether the lowest applicable water quality criterion for a particular constituent is an acute or chronic aquatic life criterion (e.g., most trace metals criteria) or a human health criterion (e.g., trihalomethane compounds), as follows.

- Aquatic life – acute: 1Q10 flow, which is the lowest 1-day average flow that occurs with a statistical frequency of once every 10 years.
- Aquatic life – chronic: 7Q10, which is the lowest 7-consecutive-day average flow that occurs with a statistical frequency of once every 10 years.
- Human health: harmonic mean.

Using best professional judgment, the Central Valley Water Board also applies a harmonic mean flow for agricultural criteria. These dilution flows are used with the permitted discharge rate and background receiving water constituent concentrations to calculate water-quality based effluent limitations.

Flow data for Sutter Creek near the city of Sutter Creek are available for discontinued U.S. Geological Survey (USGS) gage 11327000. Daily mean flow data are available for water years 1936-41 and 1961-80. All data were analyzed to determine the critical receiving water flows assuming a year-round discharge and a seasonal discharge from November 1 – April 30. **Table 2** summarizes the results of the analysis in million gallons per day (mgd). Both the 1Q10 and 7Q10 flows are zero on a year-round and seasonal, November 1 – April 30, basis. Therefore, no dilution credit would be granted for NPDES permit effluent limitations based on aquatic life criteria for these discharge scenarios. There appears to be some year-round and seasonal dilution flow available for effluent limitations based on human health and agricultural criteria. However, it is uncertain whether the Central Valley Water Board would grant dilution credit using only this historical data, or would want more recent flow data collected to confirm that these historical flow data for Sutter Creek adequately characterize current creek hydrology.

Table 2. Critical Sutter Creek flows (mgd) for USGS Gage 1132700, Sutter Creek near Sutter Creek.

Flow Parameter	Entire Record	Nov 1-Apr 30
1Q10	0.00	0.00
7Q10	0.00	0.00
Harmonic Mean	1.24	5.85
Lowest 30-day Average	0.00	0.00

Sutter Creek flow data also were analyzed to determine the frequency at which 20:1 dilution on a daily average basis has historically been provided in the November 1 through April 30 period, assuming at 1.0 mgd effluent discharge rate. **Table 3** summarizes the results of this analysis. Alternate higher limitations for biochemical oxygen demand (BOD), total suspended solids (TSS), and total coliform organisms may be granted when daily average dilution is at least 20:1 (the alternate limitations are discussed in the next section). The Central Valley Water Board requires continuous instream flow monitoring when these higher limitations are granted to prove that 20:1 dilution is provided. (Table 3 also summarizes the percent of flows greater than 70 mgd, which is relevant to the minimum dilution needed for trihalomethane compounds, discussed later in this memorandum.)

Table 3. Frequency Sutter Creek flow is greater than or equal to 20 mgd and 70 mgd for specified periods.

Period	% Daily Flow ≥ 20 mgd	% Daily Flow ≥ 70 mgd
Nov 1 - Apr 30	38%	12%
Nov	3%	0%
Dec	16%	5%
Jan	39%	14%
Feb	59%	22%
Mar	60%	20%
Apr	52%	13%

Anticipated Effluent Limitations

NPDES permits effluent limitations are either technology-based or water quality-based. Limitations are issued for conventional wastewater constituents, including BOD and TSS, pH, nitrate, and ammonia. Limitations also may be issued for pollutants, such as trace metals, organics, and pesticides, if those pollutants have been in the wastewater effluent at concentrations greater than or equal to water quality criteria applicable, or are at concentrations in the receiving water greater than applicable criteria and have been detected in the effluent.

Available SCWWTP effluent data from August 2003 and April 2008 for metals and general minerals, and Sutter Creek data from March 2003-February 2004 for metals, organics, pesticides, and conventional constituents were analyzed to preliminarily identify pollutant effluent limitations that could be issued in a NPDES permit for the SCWWTP. Constituents that would require effluent limitations were identified according to SIP procedures, commonly referred to as a "reasonable potential analysis" (RPA). Based on the RPA, effluent limitations would be triggered for: specific conductance (termed electrical conductivity in the NPDES permit), foaming agents (methylene blue active substances [MBAS]), aluminum, arsenic, copper, iron, manganese, and zinc (**Table 4**). The reporting limit for lead (3.0 µg/L) is greater than the lowest applicable criterion (0.7 µg/L), thus, it is uncertain as to whether a lead limitation would be triggered. However, it is uncommon for effluent lead concentrations to exceed criteria, thus it is assumed that no limitation for the SCWWTP would be triggered. If chlorine disinfection is used, then effluent limitations for trihalomethane compounds, dibromochloromethane (DBCM) and dichlorobromomethane (DCBM) in particular, also would be triggered, as chlorine disinfection wastewater treatment plants are not capable of producing effluent with DBCM and DCBM concentrations less than applicable criteria.

Table 4. Reasonable potential analysis results for Sutter Creek Wastewater Treatment Plant.

Constituent	Units	Lowest Criterion	Criterion Basis	RPA Results		
				MEC	B	Limitation Triggered?
Specific conductance	μmhos/ cm	700 [a]	Basin Plan (narr)	**706**	400	**Y**
Chloride	mg/L	106 [a]	Basin Plan (narr)	55	7.5	N
Fluoride	mg/L	2	MCL	< 0.1	0.1	N
Sulfate	mg/L	250	MCL	23	69	N
Total dissolved solids	mg/L	450 [a]	Basin Plan (narr)	304	282	N
Foaming agents (MBAS)	mg/L	0.5	MCL	**1.2**	< 0.10	**Y**
Aluminum	μg/L	87 / 200 [b]	EPA AQ / MCL	**686**	**228**	**Y**
Antimony	μg/L	6	MCL	< 5.0	< 5.0	N
Arsenic	μg/L	10	MCL	3.4	**60**	**Y**
Barium	μg/L	1000	MCL	< 50	< 100	N
Beryllium	μg/L	4	MCL	< 1.0	< 1.0	N
Cadmium	μg/L	1.1 / 1.9 [c]	CTR AQ	< 1.0	< 0.25	N
Chromium (total)	μg/L	50	MCL	< 2.0	< 1.0	N
Copper	μg/L	3.7 / 7.1 [c]	CTR AQ	**22**	5.3	**Y**
Iron	μg/L	300	MCL	**770**	210	**Y**
Lead	μg/L	0.7 / 2.1 [c]	CTR AQ	< 3.0	1.4	N
Manganese	μg/L	50	MCL	**87**	30	**Y**
Mercury	μg/L	0.050	CTR HH	< 1.0	0.0037	**Y** [d]
Nickel	μg/L	21 / 40 [c]	CTR AQ	< 5.0	< 3.0	N
Selenium	μg/L	5	CTR AQ	< 2.0	< 1.0	N
Silver	μg/L	0.23 / 2.4 [c]	CTR AQ	0.01	< 0.40	N
Thallium	μg/L	1.7	CTR HH	< 1.0	< 1.0	N
Zinc	μg/L	48 / 92 [c]	CTR AQ	**140**	21	**Y**

Notes:
B = maximum background Sutter Creek concentration
Basin Plan (narr) = narrative water quality objective in the Water Quality Control Plan for the San Joaquin River and Sacramento River Basins
CTR HH = California Toxics Rule (CTR) human health criterion for the consumption of water and organisms
CTR AQ = CTR criterion for the chronic protection of aquatic life
EPA AQ=USEPA Ambient Water Quality Criteria for the Protection of Freshwater Aquatic Life
MEC = maximum effluent concentration from all individual sample measurements
MCL = California drinking water Maximum Contaminant Level
Y = limitation required due to either because MEC >= lowest criterion or B > lowest criterion.

[a] Goal for agricultural beneficial use protection used by Central Valley Water Board.
[b] The Central Valley Water Board has determined that the U.S EPA's 87 μg/L chronic aquatic life criterion applies if site-specific water-effect ratio testing has not been conducted to refute its applicability. The next lowest applicable criterion is the secondary MCL of 200 μg/L.
[c] Hardness-dependent CTR criteria for metals shown as (Effluent) / (Sutter Creek).
[d] Concentration-based effluent limitation is not required based on reasonable potential analysis. However, Central Valley Water Board would issue a mass-based effluent limitation based on current practice to address Clean Water Act section 303(d) listing of the Delta as impaired due to mercury.

Table 5 summarizes effluent limitations that would be included in a NPDES permit for a SCWWTP discharge to Sutter Creek for conventional constituents and those identified through the RPA above. Effluent limitations for three scenarios are presented: 1) assuming no dilution credit; 2) assuming year-round discharge and the associated dilution credit; and 3) assuming a seasonal discharge and the associated dilution credit. Because no dilution flows are available for effluent limitations based on aquatic life criteria for either a year-round or seasonal permitted discharge (see Table 2), the effluent limitations based on aquatic life criteria would be the same regardless of the period of discharge. Only effluent limitations based on human health criteria would differ.

In cases where there is less than 20:1 dilution of the effluent in the receiving water, the Central Valley Water Board has found that it is appropriate to apply an equivalent level of treatment to that required by the California Department of Public Health Title 22 reclamation criteria (i.e., tertiary treatment) to receiving waters used for municipal and domestic supply (MUN), irrigation of agricultural land (AGR), and for contact recreation purposes (REC-1), which are designated uses of Sutter Creek. Thus, limitations would likely be issued for total coliform organisms as follows

- Effluent total coliform organisms shall not exceed:

  i. 2.2 most probable number (MPN) per 100 mL, as a 7-day median;

  ii. 23 MPN/100 mL, more than once in any 30-day period; and

  iii. 240 MPN/100 mL, as an instantaneous maximum.

In addition to total coliform limitations, an operational specification for turbidity would likely be included to monitor the effectiveness of treatment filter performance, as follows: 2 NTU daily average; 5 NTU, not to be exceeded more than 5 percent of the time within a 24-hour period; and 10 NTU as an instantaneous maximum.

Limitations for BOD 5-day and TSS would be based on the performance capability of the tertiary process. The Central Valley Water Board would not consider higher, more relaxed limitations for BOD, TSS, and total coliform unless 20:1 dilution could be demonstrated when discharge is planned to occur. When 20:1 or greater dilution is available, the more relaxed limitation that could be permitted would be 30 mg/L average monthly, 45 mg/L average weekly, and 60 mg/L maximum daily for BOD and TSS. The total coliform limitations could be 23 MPN/100 mL as a 7-day median and 230 MPN/100 mL maximum daily. The BOD and TSS percent removal limitations would be same as those in Table 5, as these are federal technology-based limitations for secondary treatment.

The ammonia limitations would be based on U.S. EPA's aquatic life criteria. These criteria vary by pH and temperature, and the Central Valley Water Board utilizes site-specific effluent and receiving water values to derive the effluent limitations. Ammonia limitations fall within a typical range for most discharges and the values presented in Table 5 are based on RBI's familiarity with other foothill discharger NPDES permits.

Table 5. Anticipated effluent limitations for discharge to Sutter Creek.

Constituent	Units	Effluent Concentration		No Dilution Credit			With Dilution Credit – Year-Round Discharge			With Dilution Credit – Seasonal Discharge		
		Aug. 2003	Apr. 2008	Average Monthly	Average Weekly	Maximum Daily	Average Monthly	Average Weekly	Maximum Daily	Average Monthly	Average Weekly	Maximu m Daily
Conventional Constituents												
BOD 5-day	mg/L	--	--	10	15	30	10	15	30	10	15	30
BOD 5-day -% removal	%	--	--	85	--	--	85	--	--	85	--	--
TSS	mg/L	--	--	10	15	30	10	15	30	10	15	30
TSS -% removal	%	--	--	85	--	--	85	--	--	85	--	--
pH	Std units	--	7.0	6.5 – 8.5 instantaneous min/max			6.5 – 8.5 instantaneous min/max			6.5 – 8.5 instantaneous min/max		
Ammonia (as N)	mg/L	--	--	0.8 - 1.0 [a]	--	2.1 [a]	0.8 - 1.0 [a]	--	2.1 [a]	0.8 - 1.0 [a]	--	2.1 [a]
Nitrate + Nitrite (N)	mg/L	--	0.25	10	--	--	10	--	--	10	--	--
Metals												
Aluminum	µg/L	686	380	71 / 200 [b]	--	143 / -- [b]	71 / 309 [b]	--	143 / -- [b]	71 / 716 [b]	--	143 / -- [b]
Arsenic	µg/L	--	3.4	10	--	20	10	--	20	10	--	20
Copper	µg/L	6	22	2.5	--	5.1	2.5	--	5.1	2.5	--	5.1
Iron	µg/L	520	770	300	--	--	548	--	--	1470 [c]	--	--
Manganese	µg/L	40	87	50	--	--	84	--	--	211 [c]	--	--
Zinc	µg/L	14	140	24	--	48	24	--	48	24	--	48
Other												
Dibromochloromethane	µg/L	--	--	0.41	--	0.82	0.79	--	1.6	2.2	--	4.5
Dichlorobromomethane	µg/L	--	--	0.56	--	1.1	1.1	--	2.3	3.3	--	6.5
Electrical conductivity	µmhos/cm	497	706	Perf. based [d]	--	--	Perf. based [d]	--	--	Perf. based [d]	--	--
Foaming agents (MBAS)	mg/L	1.2	0.43	0.5	--	--	1.0	--	--	3.0 [c]	--	--

Notes:
[a] Ammonia limitations are discharger-specific and derived from effluent and receiving water pH and temperature. However, ammonia limitations generally fall into the ranges specified based on RBI familiarity with other Central Valley discharger permits.
[b] The first value assumes the U.S. EPA aquatic life chronic criterion of 87 µg/L applies. The second value assumes only the drinking water MCL applies. When MCL is the controlling criterion, then no maximum daily effluent limitation applies.
[c] This is the maximum potential effluent limitation. When effluent limitations based on dilution credit are higher than the plant performance, the Central Valley Water Board typically restricts the limitation to the effluent mean concentration plus 3.3 times the standard deviation.
[d] See memorandum text for explanation of derivation of performance-based limitations for electrical conductivity.

The nitrate+nitrite limitation would be based on the drinking water maximum contaminant level (MCL) of mg/L-N. While this is for protection of human health, nitrate is of concern for acute effects; thus the longer-term harmonic mean dilution flow approach does not apply for obtaining dilution credit for nitrate+nitrite. Further, elevated nitrate+nitrite levels are of concern for biostimulation and effects on aquatic life. Thus, the Central Valley Water Board typically does not issue dilution credit for nitrate+nitrite, even to dischargers with ample dilution flows available, such as the Sacramento Regional Wastewater Treatment Plant. The Stockton Regional Wastewater Control Facility, which discharges to the San Joaquin River, currently has dilution credit for nitrate+nitrite, but is being required to conduct an extensive field study to determine the effects of the discharge on the aquatic environment and renewal of the dilution credit in the next NPDES permit term will depend on the study's findings.

The aluminum limitation would be based on either the U.S. EPA's aquatic life chronic criterion for aluminum of 87 µg/L or exceedance of the drinking water MCL of 200 µg/L, which is a Basin Plan objective. The Central Valley Water Board uses "best professional judgment" when applying the U.S. EPA's aquatic life criteria for aluminum and has found in some circumstances that it is not applicable. However, site-specific information and, sometimes, toxicity testing is required to justify not applying the 87 µg/L criterion, in which case the 200 µg/L MCL becomes the lowest applicable criterion. Because aluminum effluent limitations may be based on the MCL or aquatic life criteria, there are two sets of limitations are shown for aluminum. Relative to the MCL, there is assimilative capacity for aluminum, because the average background receiving water concentration is less than 200 µg/L, so dilution credit was applied to the effluent limitations based on the MCL. Based on the 2003 Sutter Creek data, there is no assimilative capacity for aluminum with respect to aquatic life criteria, which is not uncommon in that clay particles in surface waters contribute to high total recoverable aluminum concentrations.

The arsenic limitation would be triggered based on the Sutter Creek concentrations being greater than the water quality criterion and arsenic being detected in the SCWWTP effluent. Effluent concentrations of arsenic were well below the criterion. Thus, no dilution credit would be needed or granted, and the arsenic limitations would be the same regardless of whether the discharge is year-round or seasonal.

Limitations for iron, manganese, and foaming agents (MBAS) would be based on the respective drinking water MCLs. Dilution credit for this type of criterion is based on the harmonic mean flow and the average background concentration in the receiving water. The flow analysis indicates there is dilution flow in Sutter Creek for this type of criterion (see Table 2) and a review of the Sutter Creek data indicates that assimilative capacity is available for these constituents. When applying dilution credit, there may be instances when the effluent limitations are higher than that necessary for a plant to achieve consistent compliance. In those instances, a performance-based limitation calculated as the effluent mean concentration plus 3.3 times the standard deviation applied in the NPDES permit. This situation would apply to iron, manganese, and foaming agents for the seasonal discharge scenario.

Limitations for copper and zinc would be based on the California Toxics Rule (CTR) aquatic life criteria. These criteria are a function of hardness, and increase with increasing hardness. The Central Valley Water Board utilizes the lowest effluent and receiving water hardness to develop effluent limitations for these metals. The lowest effluent hardness was 34 mg/L and the lowest Sutter Creek hardness was 73 mg/L. The CTR criteria also are a function of a "water effect ratio" (WER), which is a multiplier that accounts for discharger-specific characteristics known to moderate the toxicity of these metals, such as high dissolved organic carbon concentrations. The SIP allows for developing and applying discharger-specific WERs in NPDES permitting. In RBI's experience conducting copper WER studies for tertiary-treatment plant dischargers, copper WERs have ranged from 3-9. A zinc WER conducted for a tertiary-treatment plant discharger resulted in a WER of 1.7. Based on the maximum effluent concentrations for copper (22 µg/L) and zinc (140 µg/L), a discharger-specific copper WER of 6 and a zinc WER of 3 would be needed to eliminate reasonable potential and not have copper or zinc limitations in the NPDES permit. However, the maximum effluent concentrations of these metals differ notably from the second values reported (see Table 5) and are higher than typically seen in final effluent; thus, it is uncertain how representative these maximum values are and additional data for these metals is desirable.

Salinity in Central Valley wastewater treatment plant discharges is of concern to the Central Valley Water Board, because of the salinity impairment in the Delta. The Central Valley Water Board addresses this concern in NPDES permits by issuing EC limitations that essentially cap the allowable EC level in the discharge to current performance levels, even when the EC is well below the agricultural goals and drinking water MCLs. When EC levels are greater than agricultural goals, the Central Valley Water Board has allowed dischargers to conduct site-specific studies to identify appropriate alternate EC levels for protection of the agriculture beneficial use in the area. In these cases, the MCL of 900 µmhos/cm become the next most stringent EC level.

DBCM and DCBM limitations would be based on the CTR criteria for protection of human health. For the seasonal and year-round discharge scenarios, assimilative capacity is assumed, since these compounds are typically not found in ambient foothill surface waters. Even with dilution credit, the effluent limitations would be relatively low compared to that typically produced by wastewater treatment plants utilizing chlorine disinfection.

In RBI's experience, foothill wastewater treatment plants discharging to surface waters are tertiary treatment plants to meet these types of stringent effluent limitations. Most discharge year-round. The El Dorado Hills Wastewater Treatment Plant discharges seasonally, typically November through April, and stores and reuses effluent in recycled water applications. The only low-flow creek discharger that does not have tertiary treatment is the City of Vacaville's Easterly Wastewater Treatment Plant, which produces tertiary-quality effluent with a secondary plant and nitrification. However, the City went through a Basin Plan amendment process to develop site-specific objectives for DBCM and DCBM, because it could not produce effluent capable of meeting the CTR criteria. In addition, as a requirement of its current NPDES permit, the City of Vacaville is currently constructing filtration for average dry weather flows and de-nitrification facilities.

The anticipated effluent limitations presented in Table 5 are based on permitting a SCWWTP discharge to Sutter Creek year-round or during the November 1 – April 30 period only. An alternate approach is to only permit discharge to Sutter Creek when a minimum daily average dilution flow is provided. Under this permitted discharge scenario, the SCWWTP effluent would be stored until a minimum flow in Sutter Creek is reached, after which effluent would be discharged. When Sutter Creek flow falls below the minimum required, the SCWWTP effluent is diverted to storage. Under this scenario, however, it is expected that still no dilution credit would be granted for aluminum, copper, and zinc, which would have limitations based on aquatic life criteria. No dilution credit would be granted for aluminum, because the maximum Sutter Creek concentration is greater than the 87 µg/L chronic criterion. Further, for copper and zinc, demonstration that the mixing zone would not negatively affect aquatic life would be required, which is a relatively high hurdle to convince the Central Valley Water Board permitting staff of. The lesser hurdle for compliance for these metals in a discharger-specific WER, as discussed above. No dilution credit would likely be granted for ammonia, also because of aquatic life concerns in the mixing zone. Dilution credit for nitrate, and also ammonia, would be unlikely due to nutrient enhancement concerns, as described previously. Also, based on available data, dilution credit for nitrate would not be needed for compliance. However, nutrient enhancement is less of a concern in the winter months and if the discharge was restricted to a minimum high dilution ratio (e.g., 20:1) only during the winter months, then exploratory discussions with Central Valley Water Board permitting staff regarding the possibility of allowing dilution for ammonia and/or nitrate under this scenario would be warranted.

Table 6 summarizes the minimum dilution (parts creek:parts effluent) needed for constituents likely to be issued human health criteria-based effluent limitations, based on the maximum effluent concentrations and average background Sutter Creek concentrations. Aluminum is presented because, as described above, the effluent limitations may be based on the drinking water MCL. Most constituents would need 5.5:1 or less, which is provided on a November 1 – April 30 basis. Thus, based on historical flow data, there would not be a need to limit the discharge to periods when Sutter Creek flow in a minimum rate, because 5.85:1 dilution is provided on a harmonic mean basis. The chlorine disinfection byproducts, dibromochloromethane and dichlorobromomethane would need at least 70:1 based on the assumed effluent and background concentrations of these compounds (effluent concentrations of these compounds were projected using data for another land disposal wastewater treatment in the Central Valley, since no data were available for SCWWTP). The frequency at which historical Sutter Creek flows are greater than 70 mgd is presented above in Table 3.

Table 6. Minimum dilution required for constituents likely to granted dilution credit in a SCWWTP NPDES permit.

Constituent	MEC	B	Lowest Criterion	Dilution Needed (parts creek: part effluent)
Aluminum [a]	686	112	200	5.5:1
Arsenic	3.4	20	10	not needed
Iron	770	100	300	2.4:1
Manganese	87	23	50	1.3:1
Dibromochloromethane	22 [b]	0.1 [b]	0.41	70:1
Dichlorobromomethane	33 [b]	0.1 [b]	0.56	71:1
Foaming agents (MBAS)	1.2	0.1	0.5	1.8:1

Notes:
B = average background concentration in Sutter Creek
MEC = maximum effluent concentration from all individual sample measurements
[a] Because aluminum limitations may be based on the drinking water MCL, dilution needed is presented.
[b] No data for these constituents was available; values shown are based on monitoring data at another Central Valley wastewater treatment plant the previously discharged to land and utilized chlorine disinfection.

Anticipated Monitoring and Reporting Requirements

NPDES permits contain a Monitoring and Reporting Program defining the types of monitoring required, monitoring frequency, and report submittal requirements. Monitoring of the influent, effluent, receiving water upstream and downstream of the outfall, storage pond (if used), groundwater, biosolids, and municipal water supply is required. Monitoring frequency requirements vary from discharger to discharger. For small communities with small discharges and relatively small operating budgets, the Central Valley Water Board typically requires a reduced monitoring frequency relative to large community discharges.

Table 7 provides a list of anticipated minimum monitoring requirements based on our review of other NPDES permits for small community discharges. It should be noted that the monitoring frequency is a discretionary determination by Central Valley Water Board permitting staff, and that staff preparing the permit for the SCWWTP may require more frequent monitoring than the minimum frequency presented in Table 7. Monitoring also would be required on a once-per-month basis for any other pollutant (e.g., metals, organics, and pesticides) for which an effluent limitation is issued. Monitoring of biosolids hauled off-site would be required once-per-year for priority pollutants. Also, if land discharge or reclamation occurs, associated monitoring would be required.

The annual costs associated with implementing the Monitoring and Reporting Program that would be part of any NPDES permit issued for the SCWWTP would vary depending primarily upon: 1) the exact frequency for monitoring of each constituent included in the adopted order, and 2) the amount of monitoring performed by outside contract laboratories and which laboratories are selected. Routine monthly monitoring could cost about $20,000-30,000 per year in analytical laboratory costs. Assuming only quarterly monitoring would be required, the priority pollutant monitoring during the third year of the NPDES permit term could cost about $30,000 in analytical laboratory costs.

Process to Obtain a NPDES Permit

The first step in obtaining a NPDES permit for new discharge to a surface water is to prepare and submit a report of waste discharge (RWD) to the Central Valley Water Board. The RWD consists of standard State and federal EPA application forms that identify the entity applying for the permit, as well as a facility and discharge characterization, and supplemental information and studies to justify the need for new discharge. The RWD needs to address the following:

- ☐ Service Area Description
- ☐ Facility Description
    - Location and Outfall
    - Treatment Processes
    - Design and Actual Flows
    - Biosolids Disposal
- ☐ Source Control and Pollution Prevention
- ☐ Effluent Characterization
- ☐ Receiving Water Characterization
- ☐ Antidegradation Analysis

Attachment 1 provides the Central Valley Water Board's list of application requirements for NPDES permits.

The RWD will need to provide a characterization of current effluent and receiving water quality. At a minimum, it is expected the Central Valley Water Board permitting staff would require at least quarterly monitoring data for one year for both the effluent and receiving water. Constituents to be characterized would include all 126 priority pollutants, plus other constituents of concern, such as general minerals.

The RWD needs to disclose whether a public agency has determined that the project is exempt from California Environmental Quality Act (CEQA) or has completed the appropriate CEQA documentation (e.g., initial study/mitigated negative declaration, environmental impact report). The NPDES process itself is exempt from CEQA. However, the Central Valley Water Board relies on information contained in CEQA documentation (e.g., alternatives analysis) to, in part, justify allowing the discharge.

Table 7. Anticipated minimum NPDES permit monitoring requirements.

Parameter	Sample Type	Minimum Sampling Frequency
Influent		
Flow	Meter	Continuous
BOD 5-day	24-hr composite	1/week
TSS	24-hr composite	1/week
Effluent		
Flow	Meter	Continuous
pH	Grab	1/week
BOD 5-day	24-hr composite	1/week
TSS	24-hr composite	1/week
Turbidity	Grab	1/day
Total coliform organisms	Grab	1/week
Ammonia	Grab	1/week
Nitrate	Grab	1/month
Nitrite	Grab	1/month
Temperature	Grab	1/week
Electrical conductivity	Grab	1/week
Hardness	Grab	1/month
Total dissolved solids	Grab	1/quarter
Standard minerals	Grab	1/Year
Priority pollutants	Grab	Quarterly or Monthly in 3rd Year of Permit Term
Acute toxicity[1]	Grab	1/Quarter
Chronic toxicity	Composite	2/Permit cycle
Receiving Water		
pH	Grab	1/week
Electrical conductivity	Grab	1/week
Dissolved oxygen	Grab	1/week
Turbidity	Grab	1/week
Temperature	Grab	1/week
Hardness	Grab	1/month
Fecal coliform bacteria	Grab	1/quarter
Priority pollutants	Grab	Quarterly or Monthly in 3rd Year of Permit Term 1/year
Groundwater		
Groundwater elevation	Measurement	1/quarter
Groundwater gradient	Calculated	1/quarter
pH	Grab	1/quarter
Electrical conductivity	Grab	1/quarter
Nitrate	Grab	1/quarter
Total chemical oxygen demand	Grab	1/quarter
Municipal Water Supply		
Total dissolved solids	Grab	1/year
Electrical conductivity	Grab	1/year
Standard minerals	Grab	1/year

[1] Acute toxicity monitoring may be eliminated following adoption of the State Water Quality Control Board's proposed toxicity policy.

Because the NPDES permit would be for a new surface water discharge, an antidegradation analysis would be required, as well. As part of adopting a NPDES permit for a new discharge, the Central Valley Water Board must make findings that allowing the new discharge is consistent with the State's antidegradation policy (i.e., State Water Board Resolution No. 68-16). The antidegradation analysis must include a socioeconomic analysis of technically and economically feasible alternatives for disposing of the wastewater other than to surface waters. In order for a NPDES permit to be consistent with the State's antidegradation policy, surface discharge must be the only feasible, cost-effective solution (e.g., land disposal is negatively impacting groundwater, disposal sites are uncertain/unavailable, storage is cost-prohibitive). The antidegradation policy only allows lowering the water quality in State waters if the new discharge:

(i) Provides maximum benefit to people of the State (socioeconomic benefit, relative environmental benefit),

(ii) Protects present and potential beneficial uses,

(iii) Maintains water quality higher than applicable standards, and

(iv) Uses best practicable treatment to meet waste discharge requirements.

The Central Valley Water Board issues a preliminary draft NPDES permit based on the RWD for the discharger's review and comment. The Central Valley Water Board's intent with this first draft and review is for the discharger to identify factual errors and make the necessary corrections prior to issuance of a tentative order for public review and comment. Following issuance of the tentative NPDES permit for review and comment, Central Valley Water Board permitting staff responds to public and discharger comments, sometimes also make changes to the NPDES permit based on those comments, and presents the order for adoption by the Board members at a scheduled Central Valley Water Board hearing. Designated parties are allowed to testify before the Board members if the permit is contested. If the tentative NPDES permit is not contested, it is typically adopted as a consent item at the hearing.

Once a RWD has been deemed complete the Central Valley Water Board, the Central Valley Water Board has as much time as it needs to issue a tentative NPDES permit for public review and comment. Currently, the Central Valley Water Board has been adopting a renewed or new NPDES permit within one year of submitting the RWD. The complexity of the NPDES permit being requested largely affects the timeline. The Central Valley Water Board holds six meetings per year to conduct business, including adoption of NPDES permits. NPDES permits are renewed every five years.

Estimated Cost to Obtain a NPDES Permit

The cost of obtaining a NPDES permit for a new surface discharge from the SCWWTP will depend on the number of supporting studies that must be completed in addition to the basic application materials that must be prepared. The cost, however, does not depend on whether the discharge is to be seasonal or year-round, as the same application materials must be prepared. For the SCWWTP, it is anticipated that in addition to the basic report of waste discharge, an evaluation of alternatives to a surface discharge will be needed. This will be needed for the antidegradation analysis, which would be required by the Central Valley Water Board to make findings regarding consistency with state policy. If dilution credit is desired, a supporting dilution credit and mixing zone study will be needed to support that request. Finally, a current characterization of effluent and Sutter Creek water quality will be needed.

The cost of the NPDES permit negotiation portion of the process is dictated by a number of factors, including the longevity of the process, which is affected somewhat by whether the process and permit negotiations are contentious and whether the discharger disagrees with substantial NPDES permit limitations and/or provisions included in the tentative order.

Table 8 provides a general range of costs that can be incurred for the preparation of the NPDES permit application materials and negotiating the permit with the Central Valley Water Board.

Table 8. General range of costs for obtaining a NPDES permit.

NPDES Permit Process Component	Cost Estimate (Range)
Collection of Additional Effluent and Receiving Water Data	$30,000
Basic application forms and report of waste discharge - Completed forms - Facility site map and schematics - Effluent and receiving water characterization - Sludge management plan - Pretreatment requirements (if applicable) - Land Discharge/Groundwater characterization	$25,000 – 35,000
Antidegradation Analysis (including evaluation of alternatives to surface water discharge)	$20,000 – 30,000
Dilution Studies (if needed/desired for higher effluent limitations, and assuming about 5 plus years of creek flow data are available)	$10,000 – 20,000
NPDES Permit Negotiation / Reviews / Adoption Hearing	$15,000 – 25,000
TOTAL	$100,000 – $140,000

Penalties for Non-compliance

California Water Code (CWC) section 13385 requires that the regional water quality control boards assess mandatory minimum penalties (MMPs) for serious and non-serious violations of NPDES permits. A mandatory minimum penalty of $3,000 must be assessed for each serious violation, defined, in part, as any waste discharge that violates the effluent limitations contained in the applicable waste discharge requirements by either 40% or 20%, depending on the constituent. A mandatory minimum penalty of $3,000 must also be assessed for each non-serious or chronic violation whenever effluent limitations are exceeded four or more times in any period of six consecutive months, not counting the first three violations. In addition, the CWC establishes certain exceptions to the requirement to assess MMPs, including:

- Chronic or serious violations that occur within the first 90 days in which a new wastewater treatment plant begins discharging.
- Where the discharger is in compliance with a time schedule order or a cease and desist order.

Because the SCWWTP would be a new surface water discharge, no compliance schedules would be granted. No discharge would be permitted until it could be demonstrated that NPDES permit requirements would be met.

ATTACHMENT 1

Central Valley Regional Water Quality Control Board

Application Requirements for NPDES Permits

California Regional Water Quality Control Board
Central Valley Region
Katherine Hart, Chair

11020 Sun Center Drive, #200, Rancho Cordova, California 95670-6114
(916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Matthew Rodriquez
Secretary for Environmental Protection

Edmund G. Brown Jr.
Governor

APPLICATION REQUIREMENTS FOR NPDES PERMITS
(see 40 CFR 122.21 for federal requirements for a complete NPDES Application)

Completed and signed NPDES Applications

Report of Waste Discharge (Form 200), plus
Form 1, plus
Form 2A, 2B, 2C, 2D, 2E or 2F
(http://www.waterboards.ca.gov/centralvalley/business_help/permit3.html)

Filing Fee for new discharges

http://www.waterboards.ca.gov/fees/docs/adoptedfeeschedule.pdf

Site map and schematic of facility

CEQA Documents (EIR, Negative Declaration, etc.), if available for project

Description of plans for growth or expansion of facilities, or other modifications planned for the next five years.

Recent Facility Upgrades and upgrades anticipated during the next NPDES permit cycle (five to seven years)

Anti-Degradation Analysis for new or expanding discharges.

- Infeasibility Study for Wastewater Disposal Alternatives
- Regionalization and Recycled Water Alternatives

California Toxic Rule/National Toxic Rule constituent analyses for effluent and receiving water

- Conducted within last permit cycle for permit renewals

Receiving Water Information

- Low flow data (7Q10 and 1Q10)
- Evaluation of background constituent concentrations to determine effluent constituents for which dilution may be needed
- Upstream and downstream receiving water hardness data (include effluent hardness data if ephemeral stream)
- Location of nearest downstream domestic, industrial and irrigation water diversions

Studies (as needed for the discharge)

- ☐ Dilution studies (if dilution is being requested)
- ☐ Mixing Zone Analysis for aquatic toxicity
- ☐ Water Effect Ratio Studies (if applicable)
- ☐ Thermal Plan exemption studies

Infeasibility Analysis (as potentially needed for future permit renewal; not applicable to new discharges)

- Evaluation of existing facilities' ability to comply with potential future permit requirements
- ☐ Description of proposed treatment upgrades or controls to be implement to comply with potential future permit requirements
- ☐ Timeline and milestone schedule for proposed upgrades and/or controls

Salinity

- ☐ Electrical conductivity of each water supply for community and annual volume supplied by each water source
- ☐ Summary and copies of regulations impacting wastewater salinity
- ☐ Plans and progress for salinity control for wastewater salinity

Sludge Management Plan

- ☐ Description of onsite and offsite solids and sludge treatment and disposal methods implemented
- ☐ Disposal method for all solids and sludge produced due to treatment of influent
- ☐ Monitoring required by entity receiving sludge or biosolids (i.e. landfill or sludge management contractor)
- ☐ Information on responsible parties for beneficial reuse per Part 503 Regulations
- ☐ Groundwater monitoring associated with potential impact to groundwater of stored or land-applied sludge to land.

Pretreatment

- ☐ Full description of pretreatment program implemented by Discharger for industrial flows into collection system

Groundwater

- ☐ Description of wastewater treatment, storage and/or disposal into ponds or wastewater applied to land
- ☐ Description of implemented BPTCs (i.e. pond liners) to minimize impact to groundwater
- ☐ Existing ground water monitoring requirements
- ☐ Existing groundwater data

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Technical Memorandum 4 Update
Alternatives Analysis

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Technical Memorandum

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To: City of Sutter Creek and Amador Regional Sanitation Authority

From: Angela Singer, P.E.

Reviewed By: Bill Slenter, P.E.

Subject: TM #4 Update – Alternatives Analysis

Date: November 26, 2012 (Revised November 30, 2017)

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Sutter Creek (City) to review, update, and finalize the Draft Wastewater Master Plan (Master Plan) prepared in November 2012. This technical memorandum (TM) is the fourth in a series of five TMs that comprise the Master Plan document.

1.0 INTRODUCTION

The purpose of this TM is to document the alternatives analysis process for the City of Sutter Creek (City) and the Amador Regional Sanitation Authority (ARSA) Wastewater Master Plan Updates Project (this Project). The results of this analysis are used to select a preferred alternative for managing the wastewater generated by the City and ARSA member agencies. The findings of this TM will be developed into a capital improvement plan (CIP) in TM #5.

1.1 Background Information

This TM was developed through research of existing information and studies; site visits to existing facilities; discussion with landowners, City staff, ARSA staff, Amador County staff, California Department of Corrections and Rehabilitation (CDCR) staff, the City of Ione staff, consulting engineers, and legal counsel; and through a series of workshops held with the Technical Subcommittee formed under ARSA and the City Sewer Subcommittee. The main information sources that formed the basis for the alternatives analysis are listed below. Additional references and information sources are listed in the **Additional References** section at the end of this TM.

- TM #1 Update – Evaluation of Existing Facilities, HydroScience, November 17, 2017 (TM #1)
- TM #2 Update – Flow Projections, HydroScience, November 17, 2017 (TM #2)
- TM #3A: Initial Evaluation and Screening of Options, HydroScience, November 17, 2017 (TM #3A)
- TM #3B: Surface Water Discharge Evaluation, Robertson – Bryan, Inc., February 21, 2012 (TM #3B)
- City of Sutter Creek/ARSA Technical Subcommittee Alternatives Analysis Workshop held on November 5, 2012
- Draft Sutter Creek Wastewater Master Plan, HDR, Inc., February 2010 (2010 Draft SC WWMP)

- Draft Amador Regional Sanitation Authority Master Plan, HDR, Inc., February 2010 (2010 Draft ARSA MP)
- Preliminary Draft Environmental Impact Report for the Sutter Creek Wastewater Treatment Plant Expansion, Environmental Stewardship & Planning, Inc., February 17, 2010 (WWTP Draft EIR)
- Gold Rush Ranch (GRR) and Golf Resort Final Environmental Impact Report, Environmental Stewardship & Planning, Inc., dated June 8, 2009 (GRR Final EIR)

2.0 ALTERNATIVES ANALYSIS PROCESS

The alternatives analysis process uses an established set of criteria composed of economic and non-economic factors to make comparisons between alternatives and to document the decision-making process, as detailed below.

2.1 Economic Factors

The economic factors include initial construction costs, annual operation and maintenance (O&M) costs, and equipment replacement costs necessary to keep the assets in service over the planning period. This planning-level comparison of alternatives uses a 25-year planning period, an inflation rate of 3.0 percent, and an interest rate of 6.0 percent.

2.2 Non-economic Factors

The non-economic factors evaluated in this analysis include:

- Institutional and public acceptance;
- Ease of O&M;
- Implementation time and constructability;
- Permits and regulatory; and
- Legal and right-of-way.

The non-economic factors are presented in this analysis as a relative comparison in terms of positive and negative risks or impacts.

2.3 Alternative Development Criteria

The following sections discuss the criteria used in the development of the alternatives.

2.3.1 Wastewater Flows

Alternatives are based on future peak flows, which were developed in TM #2 and are summarized in **Table 1**.

Table 1: 2041 Wastewater Flow Projections

Parameter	Year 2041 Flows (MGD)
Without GRR	
Average Dry Weather Flow (ADWF)	0.542
Peak Day Flow (PDF)	2.978
Peak Hour Flow (PHF)	7.445
With GRR	
ADWF	0.679
PDF	3.223
PHF	8.059

The Sutter Creek Wastewater Treatment Plant (SCWWTP) currently experiences significant peak wastewater flows during wet weather due to rainfall-dependent inflow/infiltration (I/I) in the collection system. This is a common issue for aging collection systems. The degree of I/I (see TM #2) impacts the required sizes, and thus the costs, of nearly all facilities downstream of the service areas, including treatment, conveyance, storage, and disposal. This analysis assumes current levels of I/I in the system continue.

2.3.2 Land Disposal

Land disposal alternatives are based on the storage and land disposal requirements summarized in **Table 2**, which are based on the requirements developed in TM #3A and modified by the extended water balance (included as **Attachment A**), which includes the GRR golf course reuse site.

Table 2: Year 2041 Effluent Storage and Land Disposal Requirements

	Units	Without GRR		With GRR
		Noble Ranch	ARSA Alignment	
Henderson Reservoir	AF		393	393
White Horse Replacement Storage Reservoir	AF	1,716	--	--
Additional Storage Volume (Ione Canal Reservoir)	AF	--	617	617
Total Storage Volume	**AF**	**1,716**	**1,010**	**1,010**
Available Flow to Meet Golf Course Irrigation Demand	AF	--	--	333
Continued use of Existing Sprayfield	acres	--	72	72
Land Required for New Sprayfield Disposal	acres	340	121	81
Total Sprayfields	**acres**	**340**	**193**	**153**

2.3.3 Wastewater Treatment Plant (WWTP) Improvements

Improvements will be required at the SCWWTP to replace aging equipment and provide adequate capacity for projected average and peak flows. All alternatives considered in this analysis require continued use of the WWTP to treat wastewater to either secondary or tertiary standards, therefore all alternatives include an element to improve the SCWWTP. The condition of the existing facilities was discussed in TM #1 and the reasoning behind the rehabilitation and replacement approach was discussed in TM #3A. Planned improvements are listed below, and include some degree of reuse of existing facilities.

- A new influent pump station utilizing submersible pumps in a wet well configuration.
- A new, fine screen headworks facility with vortex grit removal process followed by a flow split structure.
- Influent emergency storage/flow equalization basin able to return flows to the influent pump station.
- A new, modular, compact, activated sludge treatment facility will be constructed to provide aeration, clarification, and digestion and to facilitate a phased replacement project given the space constraints at the existing site.
- The existing screw press and drying bed will be used for waste solids dewatering.
- A new administration and operations building will be constructed in the northeast portion of the site.
- An emergency stand-by diesel generator with approximately 1.0 megawatt capacity will be provided to permit continued plant operation during a power outage.
- Nutrient removal, disinfection, filtration, and effluent discharge facilities vary by alternative and are outlined under each alternative description below. The degree of treatment called for in each alternative is driven by regulatory requirements for each type of discharge/use.

The proposed SCWWTP layout of these improvements is shown in **Figure 1**.

2.3.4 Surface Water Discharge Permitting

Direct discharges of effluent to Sutter Creek are based on the anticipated permit conditions outlined in TM #3B.

2.3.5 Gold Rush Ranch Infrastructure

It is expected that up to 333 AFY of golf course irrigation demand can be met by projected flows and seasonal storage at the Ione Canal Reservoir. GRR pipeline alignments and effluent storage locations are based on the GRR Final EIR.

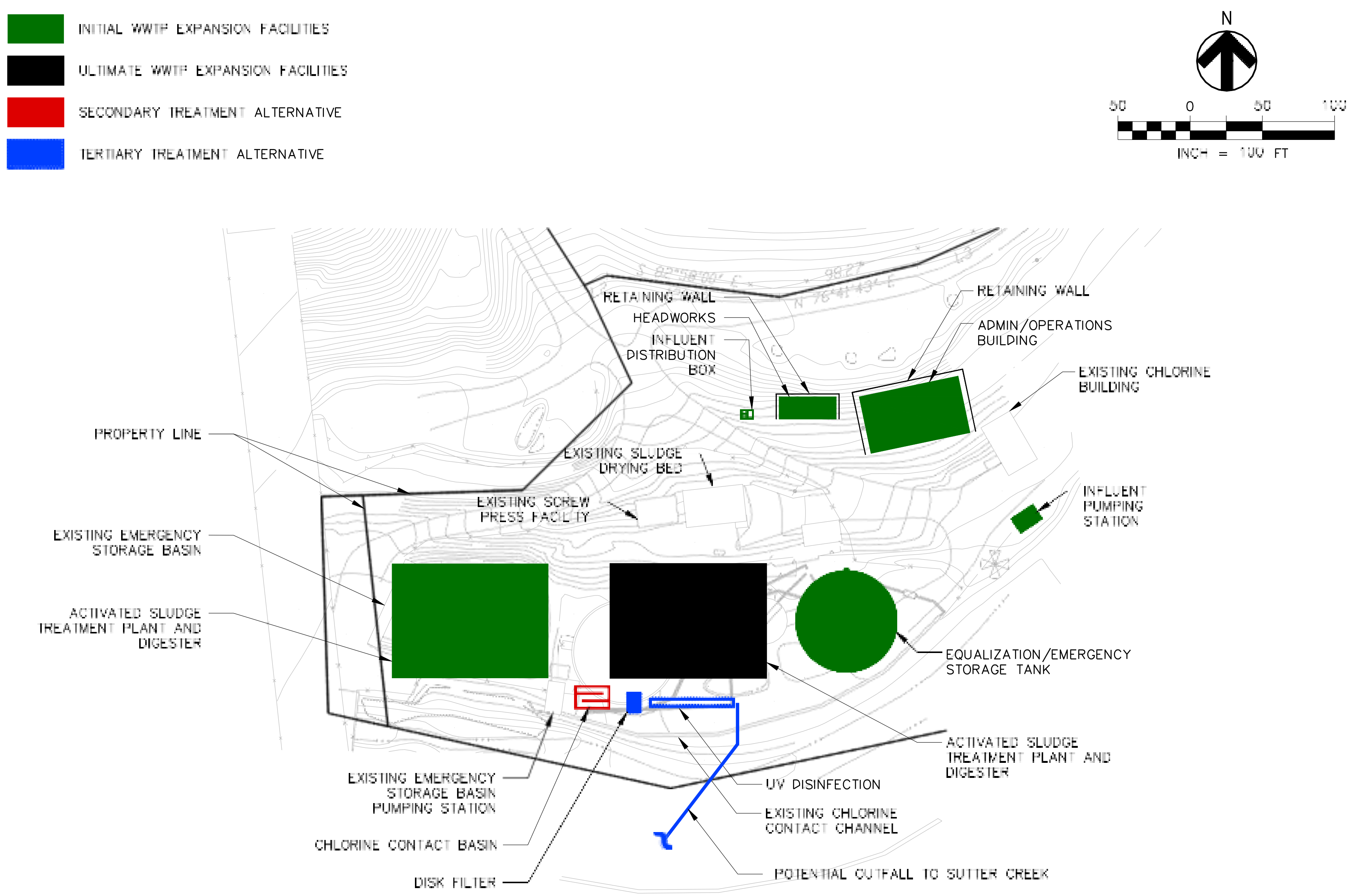

FIGURE 1

CITY OF SUTTER CREEK AND ARSA

WASTEWATER MASTER PLAN UPDATE

PROPOSED SCWWTP LAYOUT AND ALTERNATIVE 3: SURFACE WATER DISCHARGE

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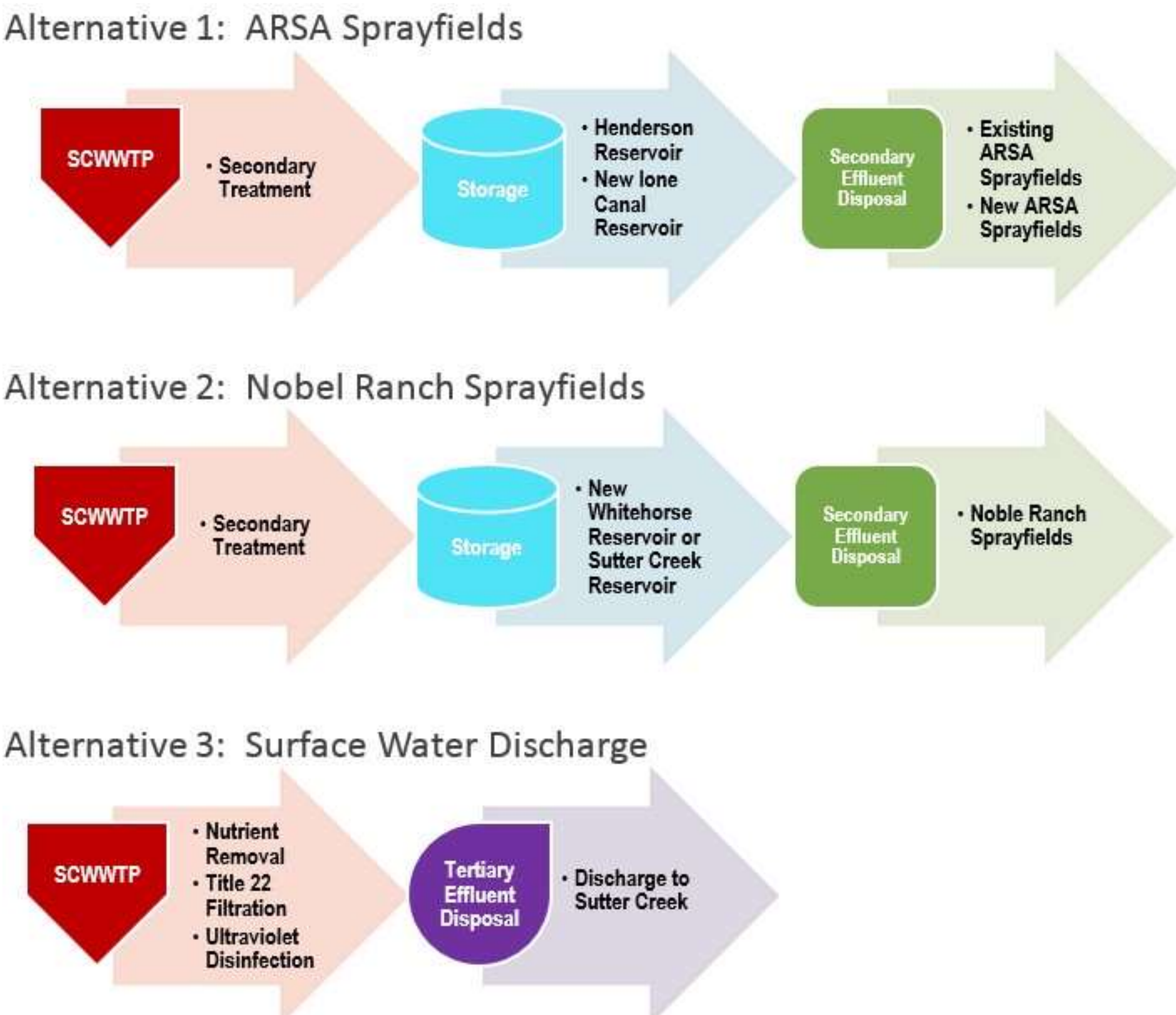
3.0 ALTERNATIVE DESCRIPTIONS

This section provides a description of the five alternatives developed from the options that passed the screening stage in TM #3A. The five alternatives are as follows:

- Alternative 1: ARSA Sprayfields
- Alternative 2: Noble Ranch Sprayfields
- Alternative 3: Surface Water Discharge
- Alternative 4: ARSA Sprayfields and Golf Course Irrigation
- Alternative 5: Surface Water Discharge and Golf Course Irrigation

Alternatives 1 and 2 address two approaches for continued seasonal storage and land disposal and assume GRR is not developed. Alternative 3 evaluates surface water direct discharge to

Figure 2: Alternatives without GRR



Sutter Creek and also assumes no development of GRR. Alternatives 4 and 5 are based on Alternatives 1 and 3 with the addition of the GRR development. There is no variation of Alternative 2 that addresses GRR development since the storage and disposal site is the same (the GRR development is proposed for the same property as Noble Ranch).

3.1 Alternatives without GRR Development

Figure 2 illustrates the three alternatives that do not include development of GRR. A discussion of each alternative is provided in the following sections.

3.1.1 Alternative 1: ARSA Sprayfields

Alternative 1 improves and expands the existing ARSA secondary effluent disposal system and consists of the following components, which are shown in **Figure 3**.

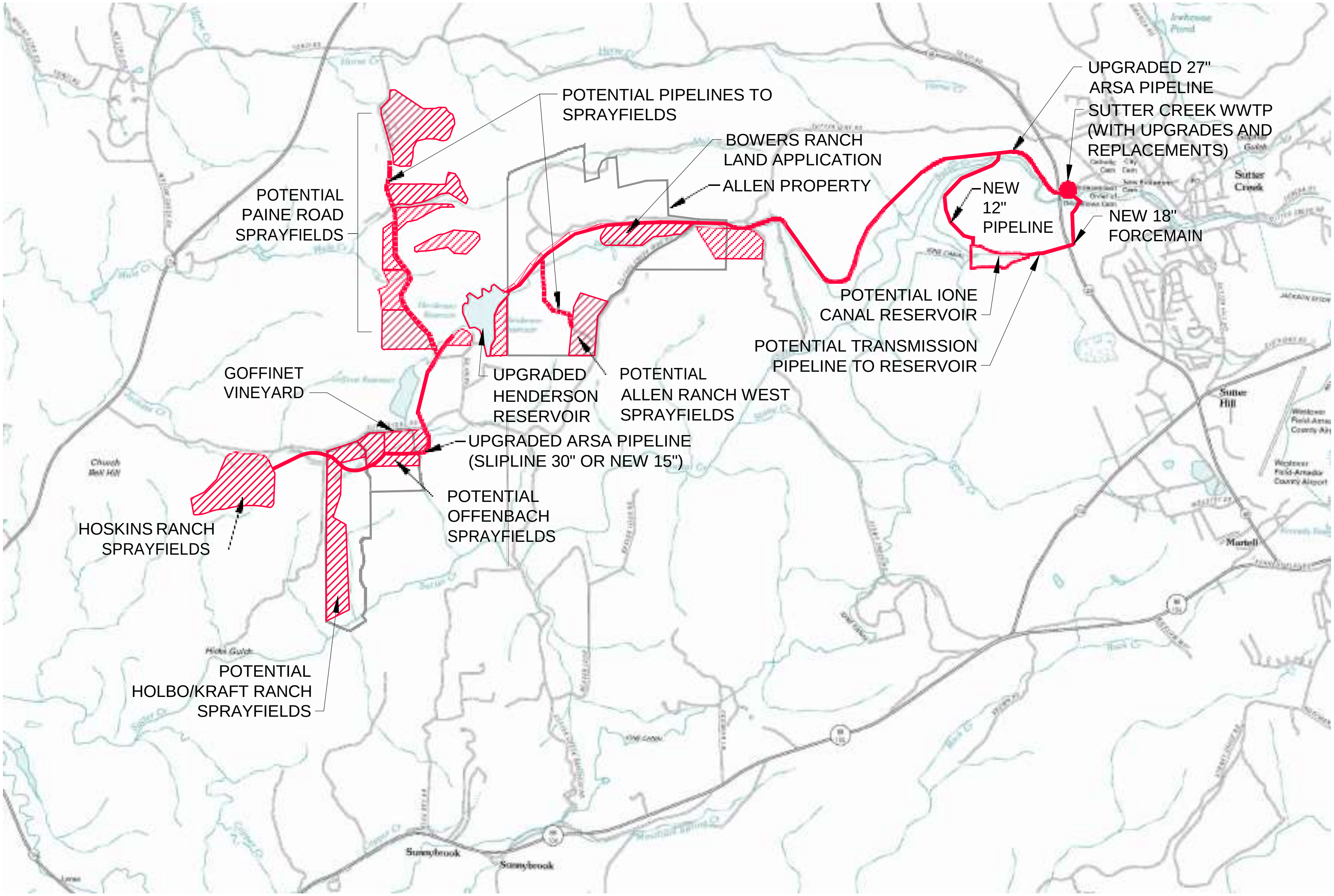
- Improve SCWWTP with an upgraded chlorine contact basin for disinfection and effluent pump station to convey peak flows to the potential Ione Canal Reservoir.
- Upgrade ARSA gravity pipeline from the SCWWTP to Henderson Reservoir to 27-inch[1] diameter in a phased manner over the 25-year planning period.
- Slipline existing 30-inch ARSA gravity pipeline from Henderson Reservoir to Hoskins Ranch or replace with a new 15-inch[1] pipeline over the 25-year planning period.
- Use Henderson Reservoir as-is with the option to remove sludge to regain available storage.
- Construct new Ione Canal Reservoir[2] (up to 617 AF), including approximately 33 acres of land acquisition.
- Construct new 18-inch force main to Ione Canal Reservoir from the SCWWTP.
- Construct new 12-inch[1] Ione Canal Reservoir gravity discharge pipe back to the existing ARSA pipeline.
- Maintain existing Bowers Ranch 36-acre land application site.
- Maintain existing 36 acres of sprayfield on Hoskins Ranch.
- Construct a minimum of 120 acres of new sprayfields[3] along the ARSA pipeline or Henderson Reservoir. This can include expansion of existing sprayfields (i.e. Bowers or Hoskins Ranches) or consolidation into a new single site.

---

[1] Anticipated gravity pipeline diameters are based on limited elevation data, and will likely change in some locations during the design phase when elevation survey information is available.

[2] Potential reservoir sites have been identified based on limited available information. Additional field investigation and engineering is required to determine site feasibility and final cost.

[3] Multiple potential sprayfields have been identified and are indicated in the figures, but not all of the potential sprayfields will be required to meet acreage requirements for disposal.



<u>NOTE</u>: SPRAYFIELD SITES ARE POTENTIALLY-AVAILABLE SITES FOR LAND APPLICATION. SEE TEXT FOR MINIMUM REQUIRED SPRAYFIELD ACREAGE AND OPPORTUNITIES FOR PHASED IMPLEMENTATION. NOT ALL SITES SHOWN WILL BE REQUIRED. TM 5 DISCUSSES OTHER SITES INCLUDING CONSOLIDATED SITES THAT COULD BE IMPLEMENTED AS AN ALTERNATIVE TO THESE LOCATIONS.

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FIGURE 3

CITY OF SUTTER CREEK AND ARSA
WASTEWATER MASTER PLAN UPDATE
ALTERNATIVE 1: ARSA SPRAYFIELDS

3.1.2 Alternative 2: Noble Ranch Sprayfields

Alternative 2 includes the abandonment of the existing ARSA disposal system and installation of a new secondary effluent disposal system on the proposed Noble Ranch effluent disposal easement. Alternative 2 is shown in **Figure 4** and consists of the following components:

- Abandon the existing ARSA disposal system. Sludge and sediment would be removed from Henderson Reservoir in accordance with existing agreements. No other demolition is included. Abandonment in place is assumed.
- Upgrade and improve SCWWTP with an upgraded chlorine contact basin for disinfection, and an effluent pump station to convey peak flows to the White Horse or Sutter Creek Reservoir.
- Construct new White Horse or Sutter Creek Reservoir[4] (approximately 1,716 AF or 1,170 AF, respectively) with approximately 80 acres of associated land acquisition.
- Construct new 18-inch force main to the potential new reservoir.
- Construct new 12-inch force main from potential new reservoir back to the Noble Ranch sprayfields.
- Construct 325 to 340 acres of new sprayfields[5] on the Noble Ranch effluent disposal easement (approximately 390 acres available).

3.1.3 Alternative 3: Surface Water Discharge

Alternative 3 includes the abandonment of the existing ARSA disposal system and a new discharge directly to Sutter Creek under the discharge permit conditions outlined in TM #3B. Alternative 3 is shown on **Figure 1** and consists of the following components:

- Abandon the existing ARSA disposal system. Sludge and sediment would be removed from Henderson Reservoir in accordance with existing agreements. No other demolition is included. Abandonment in place is assumed.
- Upgrade and replace SCWWTP to achieve advanced tertiary treatment including nutrient removal, disc filters capable of producing Title 22 effluent, and a new ultraviolet disinfection system.
- Construct a new outfall pipe and structure to Sutter Creek.

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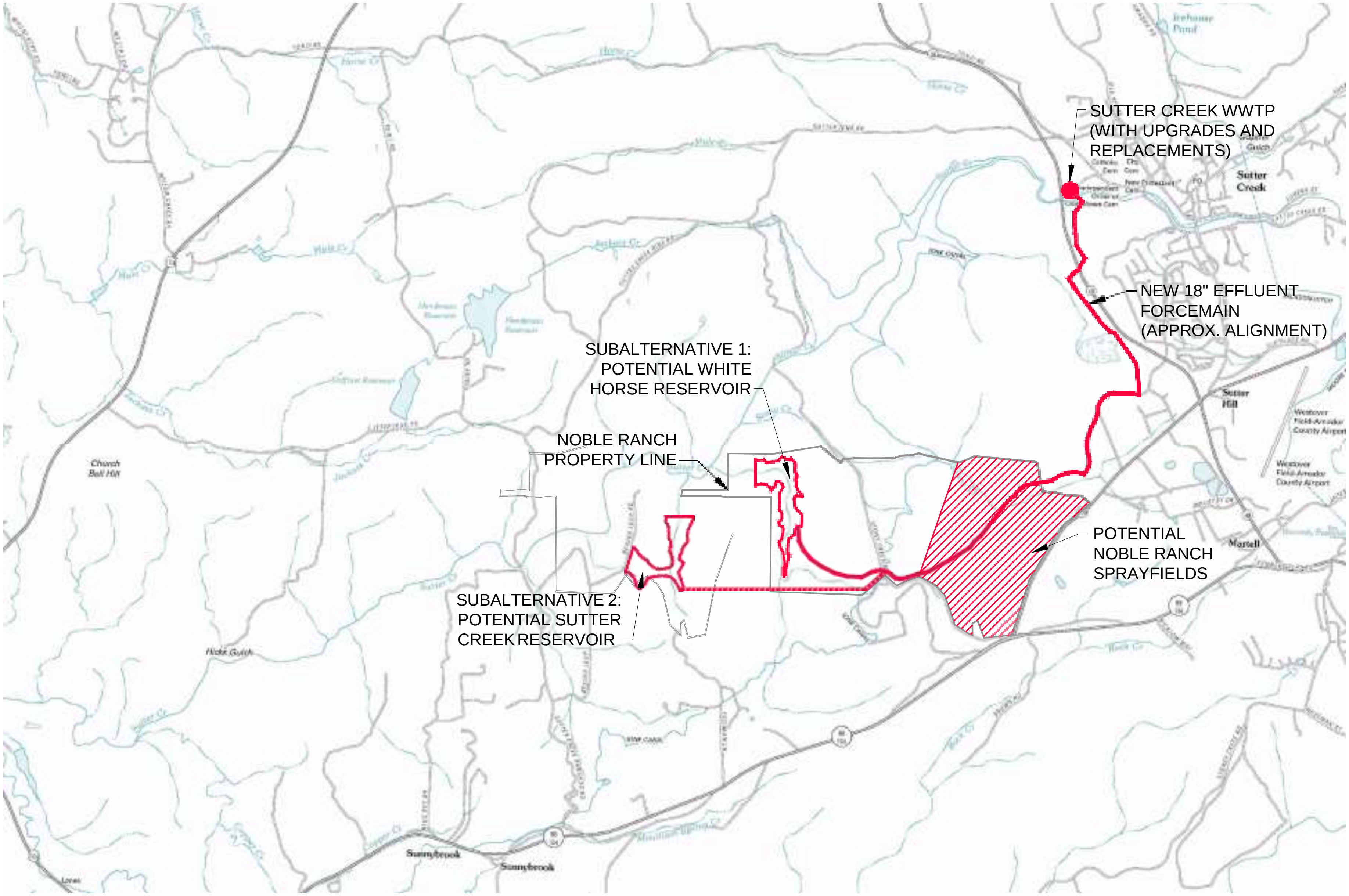
[4] Potential reservoir sites have been identified based on limited available information. Additional field investigation and engineering is required to determine site feasibility and final cost.

[5] The sprayfield area required depends upon the reservoir constructed. The larger sprayfield area is required with the larger reservoir due to the larger catchment area for precipitation and runoff. Multiple potential sprayfields have been identified and are indicated in the figures, but not all of the potential sprayfields will be required to meet acreage requirements for disposal.



NOTE: SPRAYFIELD SITES ARE POTENTIALLY-AVAILABLE SITES FOR LAND APPLICATION. SEE TEXT FOR MINIMUM REQUIRED SPRAYFIELD ACREAGE AND OPPORTUNITIES FOR PHASED IMPLEMENTATION. NOT ALL SITES SHOWN WILL BE REQUIRED. TM 5 DISCUSSES OTHER SITES INCLUDING CONSOLIDATED SITES THAT COULD BE IMPLEMENTED AS AN ALTERNATIVE TO THESE LOCATIONS.

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FIGURE 4

CITY OF SUTTER CREEK AND ARSA
WASTEWATER MASTER PLAN UPDATE
ALTERNATIVE 2: NOBLE RANCH SPRAYFIELDS

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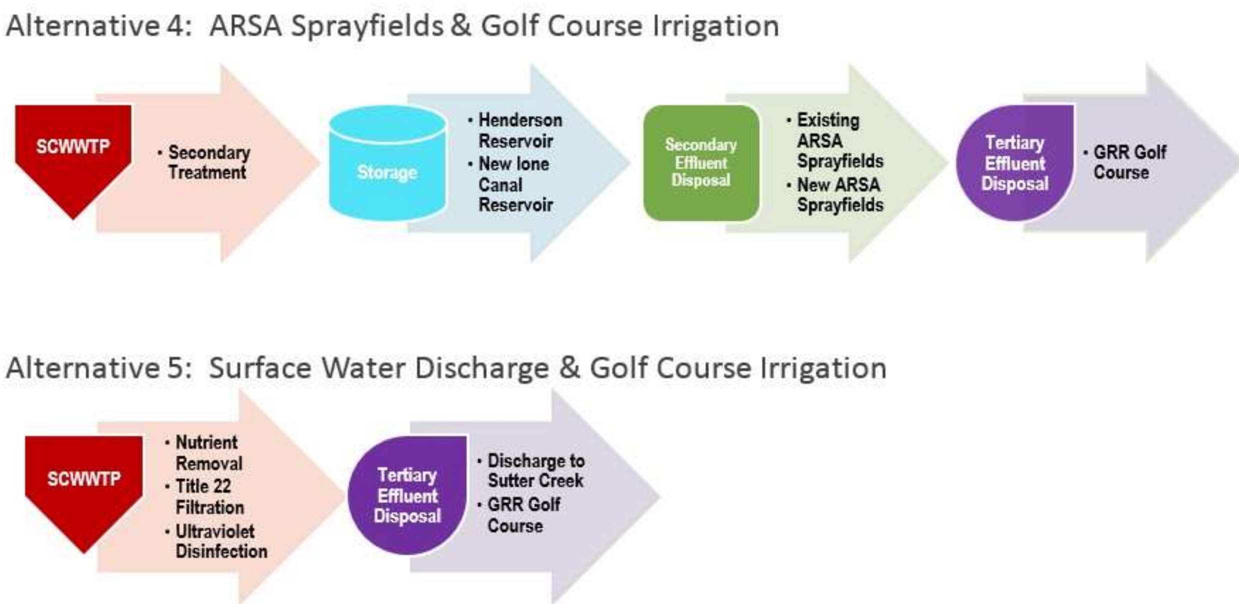
3.2 Alternatives with GRR

Alternatives that include the GRR development include reusing a portion of the effluent on the proposed GRR golf course. The two alternatives that will be evaluated in this analysis are shown in **Figure 5**.

Figure 5: Alternatives with GRR

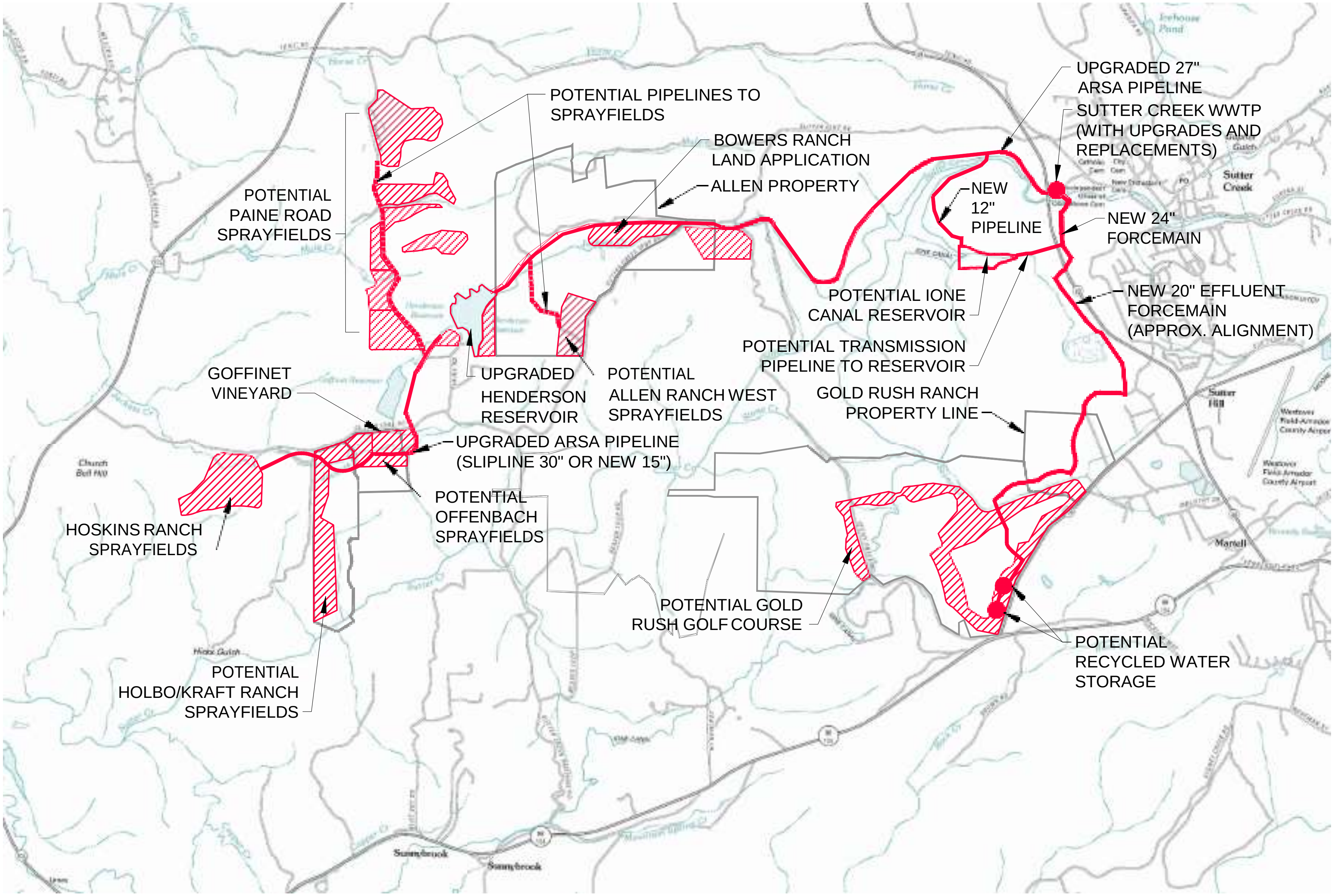


3.2.1 Alternative 4: ARSA Sprayfields and Golf Course Irrigation

Alternative 4 includes improvement and expansion of the existing ARSA secondary effluent disposal system and delivery of Title 22 effluent to the GRR golf course for reuse. Alternative 4 is shown in **Figure 6**: and consists of the following components:

- Upgrade and improve SCWWTP to achieve tertiary treatment, including disc filters capable of producing Title 22 effluent, a new chlorine contact basin for disinfection, and an effluent pump station to convey flow to the Ione Canal Reservoir and the GRR golf course.
- Upgrade ARSA gravity pipeline from the SCWWTP to Henderson Reservoir to 27-inch[6] diameter in a phased manner over the 25-year planning period.
- Use Henderson Reservoir as-is with the option to remove sludge to regain available storage.
- Maintain existing Bowers Ranch 36-acre land application site.

[6] Anticipated gravity pipeline diameters are based on limited elevation data, and will likely change in some locations during the design phase when elevation survey information is available.



NOTE: SPRAYFIELD SITES ARE POTENTIALLY-AVAILABLE SITES FOR LAND APPLICATION. SEE TEXT FOR MINIMUM REQUIRED SPRAYFIELD ACREAGE AND OPPORTUNITIES FOR PHASED IMPLEMENTATION. NOT ALL SITES SHOWN WILL BE REQUIRED. TM 5 DISCUSSES OTHER SITES INCLUDING CONSOLIDATED SITES THAT COULD BE IMPLEMENTED AS AN ALTERNATIVE TO THESE LOCATIONS.

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FIGURE 6

CITY OF SUTTER CREEK AND ARSA
WASTEWATER MASTER PLAN UPDATE
ALTERNATIVE 4: ARSA SPRAYFIELDS AND GOLF COURSE IRRIGATION

- Maintain existing 36 acres of sprayfield on Hoskins Ranch.
- Slipline the existing 30-inch ARSA gravity pipeline from Henderson Reservoir to Hoskins Ranch or replace with a new 15-inch[7] pipeline over the 25-year planning period.
- Construct new Ione Canal Reservoir[8] (up to 617 ac-ft), including approximately 33 acres of land acquisition.
- Construct new 20-inch force main to the potential Ione Canal Reservoir.
- Construct new 12-inch[8] Ione Canal Reservoir gravity discharge pipe back to the existing ARSA pipeline.
- Construct a minimum of 85 acres of new sprayfields[9] along the ARSA pipeline or Henderson Reservoir. This can include expansion of existing sprayfields (i.e. Bowers or Hoskins Ranches).
- Construct new 12-inch effluent force main to the GRR golf course recycled water storage facilities.
- Construct approximately 1.0 MG of recycled water storage at the GRR golf course.

3.2.2 Alternative 5: Surface Water Discharge and Golf Course Irrigation

Alternative 5 includes the abandonment of the existing ARSA disposal system, reuse of effluent on the GRR golf course, and discharge of effluent in excess of golf course demands directly to Sutter Creek under the anticipated discharge permit conditions outlined in TM #3B. Alternative 5 is shown on **Figure 7** and consists of the following components:

- Abandon the existing ARSA disposal system. Sludge and sediment would be removed from Henderson Reservoir in accordance with existing agreements. No other demolition is included. Abandonment in place is assumed.
- Upgrade and replace components of the SCWWTP to achieve advanced tertiary treatment including nutrient removal, disc filters capable of producing Title 22 effluent, a new ultraviolet disinfection system, and an effluent pump station to convey flows to the GRR golf course for reuse.
- Construct a new outfall pipe and structure to Sutter Creek.
- Construct new 12-inch effluent force main to the GRR golf course recycled water storage facilities.
- Construct approximately 1.0 MG of recycled water storage at the GRR golf course.

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[7] Anticipated gravity pipeline diameters are based on limited elevation data, and will likely change in some locations during the design phase when elevation survey information is available.

[8] Potential reservoir sites have been identified based on limited available information. Additional field investigation and engineering is required to determine site feasibility and final cost.

[9] Multiple potential sprayfields have been identified and are indicated in the figures, but not all of the potential sprayfields will be required to meet acreage requirements for disposal.

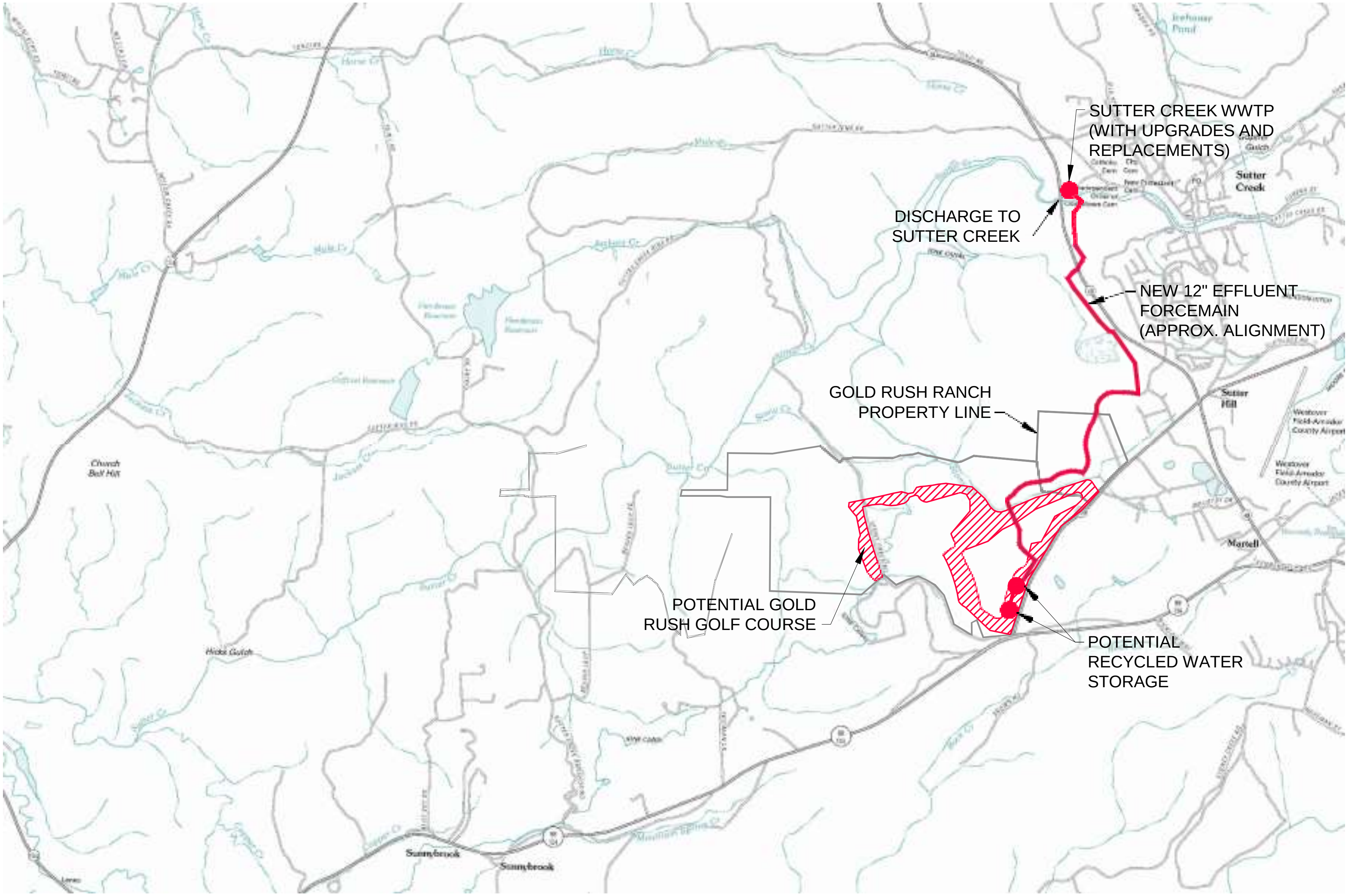

FIGURE 7

CITY OF SUTTER CREEK AND ARSA

WASTEWATER MASTER PLAN UPDATE

ALTERNATIVE 5: SURFACE WATER DISCHARGE AND GOLF COURSE IRRIGATION

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4.0 EVALUATION METHODOLOGY

This section discusses the evaluation criteria and methodology used in the alternatives analysis to select a preferred alternative for scenarios both with and without GRR.

The evaluation criteria are divided into two categories: economic and non-economic criteria. The economic category is presented in terms of net present value, while the non-economic criteria consider implementation and long-term risk factors.

4.1 Economic Analysis

Financial costs of the alternatives include initial capital costs to acquire and place the facilities in service, annual O&M costs, and equipment replacement costs required to keep the facilities in service over the 25-year planning period. The financial costs are provided in terms of net present value for the 25-year planning period. The following sections discuss the development of capital costs, O&M costs, and recurring costs.

4.1.1 Capital Costs

Independent estimates of probable construction costs (estimates) were developed for each of the alternative elements. Capital costs are presented in October 2017 dollars (monthly ENR Construction Index of 10,817.11). The estimates were prepared using cost curves from published data, bid results from similar projects, and select existing cost estimates and unit cost factors previously developed for the project (including those presented in the 2010 Draft SC WWMP and the 2010 Draft ARSA WWMP) that have been independently verified, modified, or updated by HydroScience.

The estimates are considered Class 5 estimates, based on the Association for the Advancement of Cost Engineering International (AACE) criteria. A Class 5 estimate is defined as a “Conceptual Level” or “Project Viability Estimate,” typically with engineering from 0 to 2 percent complete. Class 5 estimates are used to complete alternative comparisons, prepare planning level cost scopes, or evaluate design options and form the base work for the Class 4 “Design Baseline” or “Control Estimate.” Expected accuracy for Class 5 estimates typically range from minus 50% on the low side to plus 100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Given that this is a Class 5 estimate, a construction contingency of 35% is included in the estimated construction costs to account for unknown conditions, design completion level of the project, and bidding climate factors discussed above.

The total capital costs are developed by adding an allowance of 25% to the estimated construction costs to cover planning level activities, environmental reviews, legal, administration, construction services, change orders, and other related items.

The following describe the estimating procedures used in the economic analysis for the various components.

- **WWTP Facilities.** Independent cost estimates were developed for facilities at the SCWWTP. Detailed assumptions and costs are included in **Attachment B**.
- **Pump Stations.** A cost curve was used to estimate the cost for the new effluent pumping station at the SCWWTP. The cost curve used for the analysis was taken from Figure 29-3 in Pumping Station Design, Third Edition and is included in **Attachment C**. This cost curve was validated against recent bid data for similar pump stations.
- **New Pipelines.** Gravity pipeline and force main unit costs are based on an evaluation of recent bid tabs. Gravity pipeline costs are based on a unit cost of $23 per inch-diameter per lineal foot of pipe (plus a 35% construction contingency), and include mobilization; demobilization; traffic control; normal sheeting, shoring and bracing; excavation and dewatering; standard manholes at typical intervals; native soils surface restoration; erosion, sediment and stormwater control; overhead; and profit.

  Pressure pipeline costs are based on a unit cost of $20 per inch-diameter per lineal foot of pipe (plus a 35% construction contingency), and include mobilization; demobilization; traffic control; normal sheeting, shoring and bracing; excavation and dewatering; standard isolation and air/vacuum valves at typical intervals; native soils surface restoration; pressure testing; erosion, sediment and stormwater control; overhead; and profit. Detailed estimates are provided in **Attachment D**.
- **Storage Facilities.** All storage reservoirs are assumed to have an earthen dam composed of soils from nearby borrow sites, stormwater diversion facilities, outlet piping and spillway, a perimeter access road, and electrical facilities. An independent cost estimate was developed for the earthen dams, and construction costs for the reservoir appurtenances (access road, stormwater diversion, spillway, etc.) were based on costs presented in the 2010 Draft ARSA WWMP for Goffinet Reservoir. Costs from the 2010 Draft ARSA WWMP were escalated to October 2017 dollars using the monthly ENR Construction Index. The costs for outlet piping and spillways of differing dam sizes are estimated using the following relationship between cost and earthen dam volume: C2/C1 = (S2/S1)R, where C1 is the cost of the known dam, S1 is the size or volume of the known dam, and S2 is the size or volume of the new dam. R accounts for the non-linear relationship between dam volume and cost and typically ranges between 0.6 and 0.75, depending on the facility. For this high level of planning, we used the more conservative value of 0.6. C2 is then determined from the relationship: C2 = C1*(S2/S1)*0.6. **Attachment E** contains the summary sheet for the estimates. Sludge and sediment removal costs were based on estimates from Weatherby-Reynolds-Fritson Engineering and Design, which were escalated to October 2017 dollars using the monthly ENR Construction Index.
- **Land Application/Sprayfield Infrastructure.** The 2010 Draft ARSA WWMP estimated land application project costs in detail. These costs were validated against recent bid data and 2011 revised cost estimates for the Payne Road sites provided by Weatherby-Reynolds-Fritson Engineering and Design. Costs were escalated by the monthly ENR Construction Index and are presented in October 2017 dollars. After validation and escalation of the costs, a unit cost per acre was calculated and found to be relatively consistent between sites. The unit cost of $15,000/acre was used for planning purposes in this analysis, and includes pumping and transmission piping to the site.

4.1.2 O&M Costs

The O&M costs estimated for each of the alternatives is based on experience at similar facilities and surface water monitoring requirements outlined in TM #3B. O&M costs include labor, electrical, testing and reporting, chemical, repair, and sludge/sediment disposal costs for each alternative. Surface water discharge alternatives also include ongoing engineering support for permit compliance. The O&M costs are presented as a present worth value using an inflation rate of 3% and an interest rate of 6%.

4.1.3 Equipment Replacement Costs

- **Equipment Replacement.** Normal recurring capital costs include major rehabilitation projects and ongoing equipment replacement that occur over the life of the infrastructure. In general, mechanical equipment has a life of 15 years, electrical equipment has a life of approximately 20 years, and steel tankage has a 30-year life. Surface water discharge alternatives also include an allowance for unforeseen future treatment upgrades to achieve compliance with future discharge permits. A net discount rate of 3% was used in calculating the 25-year present worth value of the annual reserve fund.
- **Existing ARSA Pipeline Replacement.** For the ARSA pipeline, annual replacement costs were included so that the pipeline is fully replaced up to Hoskins Ranch by the end of the 25-year planning period. An additional cost of 10% was added to the cost for removal and disposal of the existing ARSA pipeline. A net discount rate of 3% was used in calculating the 25-year present worth value of the annual ARSA pipeline reserve fund. It is noted that the ARSA pipeline section from Henderson Reservoir to Hoskins Ranch would only be necessary if effluent continues to be disposed at this site. Development of adequate sprayfield up to and around Henderson would reduce the overall length and cost of pipeline replacement needed.

4.1.4 Land Acquisition and Easements

Costs for land acquisition were included at a rate of $17,500 per acre of ranch land. Land acquisition for storage reservoirs includes a 150-foot buffer zone around the perimeter of the reservoir. Pipeline easement acquisition costs were found to be insignificant (and were, therefore, not included) at $0.86 per lineal foot of pipeline, based on a 10-foot wide easement at a rate of 25% of the land acquisition cost per "Appraising Pipeline Easements – A Practical Approach" by Gary Valentine, *Right of Way Magazine*, March-April 2008.

4.2 Non-economic Analysis

The non-economic factors are presented in this analysis as a relative comparison in terms of positive and negative impacts for decision factors that have distinction between the alternatives.

4.2.1 Non-economic Factors

Table 3 discusses the non-economic factors applied in this alternatives analysis.

Table 3: Non-Economic Decision Factor Descriptions

Decision Factor	Description
Institutional/Public Acceptance	Likelihood of affected stakeholders to be accepting of the alternative and reach inter-agency agreements. Considers impacts on the community and their effects on community acceptance.
Ease of O&M	The level of ease of which the facilities can be operated. Considers the risk of unforeseen O&M challenges that could result in unexpected operation costs, fines, or other negative impacts.
Implementation Time/Constructability	The likelihood that the alternative is completed in time to meet critical deadlines. Considers unknowns and construction complexities that could unexpectedly delay completion.
Permits/Regulatory	The likelihood that the required permits can be secured, permit conditions can be complied with, and the costs of compliance will be consistent with the defined alternatives. Considers the potential for permit violations and future regulatory changes that have a negative impact on the cost and reliability of compliance.
Legal/Right-of-Way	The complexity of and ability to secure and comply with the required legal agreements and rights-of-way that must be secured and maintained for the 25-year planning period. Considers unexpected delays, compliance with GRR and other entitlements, or potential cost increases associated with securing the required legal agreements and rights-of-way.

4.2.2 Comparative Rating Methodology

The non-economic alternatives evaluation employs the use of a weighted matrix that considers the relative importance (weight) of each decision factor. This analysis presents a comparison of each of the alternatives by assigning a relative rating for each alternative on a scale of 1 to 5, with 5 being the most desirable/favorable. The rating methodology is outlined in the steps below and is applied to each decision factor, one at a time.

Step 1: For each factor, compare each alternative against the others and list the alternatives in order from most favorable to least favorable.

Step 2: Using the following chart, determine the ranking for the first (most favorable) alternative and the last (least favorable) alternative in the list.

If the first (most favorable) alternative is:	First (Most Favorable) Alternative	Last (Least Favorable) Alternative
Much more favorable than the last alternative	5	1
More favorable than the last alternative	4	2
Equally as favorable as the last alternative	3	3

Step 3: Compare any remaining alternatives with the most favorable and least favorable alternatives to determine their ratings relative to the ratings assigned in Step 2 to the most favorable and least favorable alternatives.

Step 4: Repeat Steps 1 through 3 for each decision factor.

The resulting weighted factors for the Factor vs. Factor analysis is provided in **Table 4** below. The weighted factors are used to evaluate each of the alternatives.

Table 4: Weighted Factors

Factor vs. Factor	Institutional Issues/ Public Acceptance	Ease of O&M	Implementation Time / Constructability	Permits/Regulatory	Legal/Right-of-Way	TOTAL	NORMALIZED TOTAL
Institutional Issues/ Public Acceptance		4	4	3	3	14	**9**
Ease of O&M	2		3	2	3	10	**6**
Implementation Time / Constructability	2	3		2	3	10	**6**
Permits/Regulatory	3	4	4		5	16	**10**
Legal/Right-of-Way	3	3	3	1		10	**6**

5.0 ALTERNATIVES EVALUATION

This section presents the results of the alternatives analysis for scenarios both with and without GRR. Alternatives excluding GRR are evaluated separately from alternatives including GRR, and a preferred alternative will be selected for each scenario. The development of GRR is considered an external factor that does not influence the ranking of alternatives.

5.1 Economic Analysis

Table 5 shows a summary of the costs for each alternative. A more detailed estimate is provided in Attachment F.

Table 5: Economic Analysis Results (in $Millions)

Element	Without GRR			With GRR	
	Alternative 1: ARSA Sprayfields	Alternative 2: Noble Ranch Sprayfields	Alternative 3: Surface Water Discharge	Alternative 4: ARSA Sprayfields & GRR Irrigation	Alternative 5: Surface Water Discharge & GRR Irrigation
WWTP					
0.55 MGD ADWF Secondary WWTP	18.6	18.6	0.0	0.0	0.0
0.55 MGD ADWF Advanced Tertiary WWTP	0.0	0.0	22.9	0.0	0.0
0.68 MGD ADWF Tertiary WWTP	0.0	0.0	0.0	24.3	0.0
0.68 MGD ADWF Advanced Tertiary WWTP	0.0	0.0	0.0	0.0	28.6
WWTP Subtotal	**18.6**	**18.6**	**22.9**	**24.3**	**28.6**
Effluent Conveyance					
Gravity Sewer	1.5	0.0	0.0	1.5	0.0
Forcemain	1.7	16.6	0.0	6.6	5.1
Effluent Conveyance Subtotal	**3.2**	**16.6**	**0.0**	**8.1**	**5.1**
Storage Facilities					
Henderson Reservoir Sediment Removal	3.5	3.5	3.5	3.5	3.5
Ione Canal Reservoir	15.1	0.0	0.0	15.1	0.0
Other (White Horse or Sutter Creek)	0.0	18.7	0.0	0.0	0.0
Recycled Water Storage	0.0	0.0	0.0	1.9	1.9
Storage Facility Subtotal	**18.5**	**22.2**	**3.5**	**20.5**	**5.4**
Sprayfield Disposal Sites					
Sprayfields	1.8	5.1	0.0	1.2	0.0
Total Estimated Construction Costs	**42.1**	**62.5**	**26.4**	**54.1**	**39.1**
Engineering, Legal, Admin, etc. @ 25%	10.5	15.6	6.6	13.5	9.8
Land Acquisition @ $17,500/acre	0.6	1.4	0.0	0.6	0.0
Total Capital Costs	**53.2**	**79.5**	**33.0**	**68.2**	**48.9**
Present Worth (PW) Capital	52.6	78.7	32.3	67.0	47.5
PW O&M	17.6	16.0	22.9	26.3	38.6
PW Ongoing Equip. Repl. Costs	5.0	4.6	6.4	6.8	11.5
PW ARSA Pipeline Replacement	23.2	0.0	0.0	23.2	0.0
Net Present Value	**98.3**	**99.4**	**61.7**	**123.3**	**97.6**

Notes:
All costs in October 2017 dollars. Capital costs include a 35% construction contingency.

6.0 NON-ECONOMIC ANALYSIS

The non-economic analysis of each alternative is documented in the decision matrix shown in **Table 6**. Decision factor importance weights were developed by a pairwise comparison (see **Attachment G**). Ratings for each alternative are provided as a relative comparison to the other alternatives. Rating values range from 1 to 5, with 5 being the most desirable.

Table 6: Non-Economic Analysis Results

ALTERNATIVE		DECISION FACTOR										
		Institutional Issues/ Public Acceptance		Ease of O&M		Implementation Time/ Constructability		Permits/Regulatory		Legal/Right-of-Way		
Factor Weight:		9		6		6		10		6		
R=Rating, WR=Weighted Rating:		R	WR	R	WR	R	WR	R	WR	R	WR	
Without GRR	Alternative 1 ARSA Sprayfields	4	**36**	4	**24**	4	**24**	3	**30**	2	**12**	**126**
	Alternative 2 Noble Ranch Sprayfields	2	**18**	4	**24**	2	**12**	3	**30**	1	**6**	**90**
	Alternative 3 Surface Water Discharge	3	**27**	1	**6**	3	**18**	1	**10**	4	**24**	**85**
With GRR	Alternative 4 ARSA Sprayfields & Golf Course Irrigation	4	**36**	3	**18**	1	**6**	3	**30**	2	**12**	**102**
	Alternative 5 Surface Water Discharge & Golf Course Irrigation	3	**27**	1	**6**	3	**18**	1	**10**	4	**24**	**85**

Note:
Rating is on a scale from 1 to 5, with 5 being the highest and most favorable.

Table 7: Evaluation of Alternative Decision Factors

Decision Factor	Comments
Institutional Issues/ Public Acceptance	Alternative 1 is favorable because it could continue the use of the existing institutional and disposal agreements with landowners, building off of those for new sites, and would continue the beneficial use of effluent for irrigation utilizing a currently-accepted wastewater management approach. Alternatives 3 and 5 are feasible but less favorable because they involve discharging of a portion or all of the effluent to surface waters in lieu of reuse. The discharge permitting process will require demonstration that degradation of waters of the State provide maximum benefit to the people of the State relative to land discharge and reuse options. Alternative 2 is least favorable because it requires the development of sprayfields in an area within the City limits that could be developed in the future for another purpose (GRR) as opposed to the ARSA pipeline corridor in Alternative 1. Alternative 4 avoids issues associated with surface water discharge but would require a combination of ARSA and new development disposal requiring two different levels of treatment.
Ease of O&M	Alternatives 3 and 5 are least favorable because of more complex WWTP operation, higher WWTP operator grade, intense sampling and reporting requirements, and higher risk of violation associated with a surface water discharge permit. Alternative 2 has new, consolidated storage and disposal facilities, so it would be easier to operate than Alternative 1. However, Alternative 1 has the potential to utilize consolidated sprayfield sites pending successful landowner agreements. Alternative 4 involves operating two reservoirs, more distribution pipes, and more sprayfield sites as well as more complex treatment but avoids surface water treatment.
Implementation Time/ Constructability	Alternative 1 is the most favorable because it involves adding to existing infrastructure in a phased manner, with the exception that the Ione Canal requires a new site and new infrastructure. Alternatives 3 and 5 are somewhat favorable because new reservoir construction is avoided and WWTP improvements are made on a single site, although permitting for surface water discharge can extend the timeline. Alternative 2 requires new dam construction and development of a new sprayfield site with conveyance infrastructure, but can be constructed while the existing ARSA system is still operating. Alternative 4 requires both a new reservoir as well as recycled water storage for GRR and conveyance infrastructure.
Permits/Regulatory	Alternatives 1, 2, and 4 avoids surface water discharge permitting and its associated complexities and uncertainties, but require new reservoirs which must be permitted. Alternatives 3 and 5 require surface water discharge permitting with an anti-degradation analysis and the risk of highly stringent permit limitations which cannot be fully predicted until significant study is done and which may affect capital cost, operating cost, and project feasibility.
Legal/Right-of-Way	Alternatives 3 and 5 are the most favorable because they requires very little additional right-of-way or property acquisition at the WWTP. Alternative 1 has risk in acquiring easements/right-of-way for the Ione Canal Reservoir, additional sprayfields, and pipelines. Alternative 2 is the least favorable because it has risk in acquiring easements/right-of-way for the new reservoir, plus implementing this alternative may have impacts to the GRR development.

7.0 CONCLUSIONS

In the case that the GRR does not develop, Alternative 1: ARSA Sprayfields is the preferred alternative because it has a significant advantage in the non-economic analysis score of the three alternatives considered in this grouping. The planning-level present worth cost is higher than Alternative 3. However, the costs for Alternative 3 are less certain until permitting efforts are undertaken, and replacement of the entire ARSA system with a surface water treatment plant would require the full cost of Alternative 3 to be borne sooner than Alternative 1, which can be phased over time.

If GRR does develop, Alternative 4: ARSA Sprayfields and Golf Course Irrigation is the preferred alternative because it has the best non-economic analysis score of the two alternatives considered in this grouping, and a present-worth cost which is reasonably close to Alternative 5 and not subject to the risks of surface water discharge permitting.

A capital improvement plan and implementation strategies will be developed in TM 5.

It is outside the scope of this Master Plan to evaluate the existing collection system and the potential for I/I reduction. Sewer inspection and repair for an entire collection system can be a costly exercise. The amount of I/I reduction achieved per dollar spent on inspections and repairs can vary widely depending on site-specific conditions. Given that I/I reduction beneficially reduces the sizes and costs of nearly all facilities downstream, it is recommended that the City and ARSA continue to explore opportunities for sewer inspection and repair, and balance the costs of this program with the costs of downstream infrastructure improvement.

8.0 ADDITIONAL REFERENCES

The following additional references were used in this alternatives analysis:

City and ARSA Contractual Obligations Memo to Sutter Creek Sewer Committee, June 14, 2011

Agreement Amending a Joint Exercise of Powers Agreement between the County of Amador, the City of Amador City, the City of Jackson, and the City of Sutter Creek for the Purpose of Creating an Agency for Implementing a Regional Wastewater Disposal Plan, September 17, 1982

Department of Corrections and Rehabilitation Ground Lease Covering Mule Creek Prison and Preston Youth Correctional Facility, February 23, 2009

Gold Rush Ranch and Golf Resort Off-site Infrastructure Summaries by Morton & Pitalo, Inc., May 1,2007

Gold Rush Golf Resort Sutter Creek Recycled Water Plant Siting Report by Thompson-Hysell Engineers, June 23, 2003

White Horse Property Effluent Detention Dam Preliminary Summary of Hydrological Findings by Neil O. Anderson & Associates, Inc., January 3, 2002

Phase 1 of White Horse Property Effluent Detention Dam Preliminary Geotechnical and Geological Investigation by Neil O. Anderson & Associates, Inc., July 6, 2001

Proposed White Horse Reservoir Preliminary Environmental Assessment by NOA Environmental, December 18, 2001

White Horse Project Water Balances and Application Rates for Land Application of Wastewater by Neil O. Anderson & Associates, Inc., June 2001

Report to Determine Offer to Wolheb or White Horse Properties to Treat, Store, and Dispose of ARSA Wastewater.

Goffinet and Henderson Reservoir Evaluation by HDR, Inc., December 31, 2008

Sludge Removal and Conduit Repair at Henderson Reservoir Memo to ARSA from Weatherby Reynolds Fritson Engineering and Design, February 11, 2009

Water Balances – City of Ione Wastewater Treatment Plant Compliance Project Memo to City of Ione from GHD, May 30, 2012

ATTACHMENT A
City of Sutter Creek and ARSA
TM 4: Alternatives Analysis
GRR Golf Course Water Balance

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2016 Water Balance - Sutter Creek Facilities (Bowers Ranch, Henderson, and Hoskins Ranch)

Year 1	Year 2
ADF	ADF
(gpd)	(gpd)
993,000	857,000

Reservoir	Units	Henderson Reservoir	Additional Storage	Total
Volume	(ac-ft)	393	0	393
Surface Area	(ac)	29	0	29

Amount of disposal

Annual Disposal	Units	Castle Oaks/ Ione	Bowers Ranch	Hoskins Ranch Spray Field	Gold Rush Ranch	Total
Area	(ac)	NA	40	60	216	316
Year 1	(ac-ft/yr)	0	-273	-181	-333	-787
Year 2	(ac-ft/yr)	0	-238	-206	-386	-829

Total Inflow	Active Starting Volume	Annual WWTP Effluent	Storage Accumulated	Max Storage Required	Approximate Available Capacity	Over Maximum Storage
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	0	1111	158	393	0	457
Year 2	158	959	-11	393	0	333

Period			WWTP Effluent						Historic Weather Data					GRR	Bowers Ranch					Hoskins	Henderson Reservoir								
Years	Month	Days	Monthly Flow	Monthly Flow	ADWF (Jun-Sep)	ADWF (Jun-Sep)	Estimated Inflow & Infiltration	% of Total	Precip	Pan Evap	Eto	Crop Irrigation Demand	Golf Course Irrigation Demand	Land Application	Spray Irrigation	Facility Influent Flow	Precipitation (direct)	Flood Irrigation	Land Application	Facility Influent Flow	Precipitation (direct)	Watershed Runoff (indirect)	Evaporation (water surface)	Percolation (direct)	Subtotal Disposal (incl. Hoskins)	Contractual Flow for Castle Oaks Golf Course	Change in Storage Volume	Final Storage Volume	Over Maximum Storage
	(mo)	(days)	(mgd)	(ac-ft)	(mgd)	(ac-ft)	(ac-ft)	(%mo)	(in/mo)	(in/mo)	(in/mo)	(ft/mo)	(ft/mo)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
Year 1	Oct	31	0.899	85.5	0.679	64.6	20.9	6.02	3.09	3.14	3.96	0.05	0.01	-2.1	-0.7	15.6	6.2	-21.0	-2.8	67.8	1.2	3.3	-1.3	0.0	3.2	0.0	68.2	68.2	0.0
	Nov	30	1.171	107.8	0.679	62.5	45.3	12.67	6.50	1.12	1.95	0.00	0.00	0.0	0.0	0.0	13.0	-13.0	0.0	107.8	6.0	5.3	-1.0	0.0	10.3	0.0	118.1	186.3	0.0
	Dec	31	1.400	133.2	0.679	64.6	68.6	18.27	9.37	0.91	1.27	0.00	0.00	0.0	0.0	0.0	18.7	-16.5	0.0	133.2	15.6	4.6	-1.5	0.0	18.6	0.0	151.8	338.2	0.0
	Jan	31	1.396	132.8	0.679	64.6	68.2	18.17	9.32	0.92	1.56	0.00	0.00	0.0	0.0	0.0	18.6	-16.5	0.0	132.8	21.1	2.0	-2.1	0.0	21.0	0.0	54.8	393.0	99.0
	Feb	28	1.284	110.3	0.679	58.3	52.0	15.44	7.92	1.00	2.01	0.00	0.00	0.0	0.0	0.0	15.8	-15.3	0.0	110.3	18.9	1.3	-2.4	0.0	17.8	0.0	0.0	393.0	128.1
	Mar	31	1.202	114.4	0.679	64.6	49.8	13.44	6.89	1.63	3.31	0.00	0.00	0.0	0.0	0.0	13.8	-18.0	0.0	114.4	16.4	1.1	-3.9	0.0	13.7	0.0	0.0	393.0	128.0
	Apr	30	1.048	96.5	0.679	62.5	34.0	9.66	4.95	3.18	4.59	0.00	0.00	0.0	0.0	0.0	9.9	-10.6	0.0	96.5	11.8	0.8	-7.6	0.0	5.0	0.0	0.0	393.0	101.5
	May	31	0.806	76.6	0.679	64.6	12.1	3.75	1.92	4.67	6.32	0.37	0.38	-76.6	-5.9	5.9	3.8	-3.8	-22.2	0.0	4.6	0.3	-11.1	0.0	-6.3	0.0	-28.4	364.6	0.0
	Jun	30	0.698	64.3	0.679	62.5	1.8	1.12	0.57	6.23	7.83	0.63	0.70	-64.3	-10.2	35.7	1.1	-26.7	-38.1	0.0	1.3	0.1	-14.5	0.0	-13.1	0.0	-51.2	313.4	0.0
	Jul	31	0.654	62.2	0.679	64.6	0.0	0.04	0.02	7.53	8.90	0.78	0.87	-62.2	-12.5	42.3	0.0	-29.8	-47.0	0.0	0.0	0.0	-16.5	0.0	-16.5	0.0	-63.5	249.9	0.0
	Aug	31	0.669	63.7	0.679	64.6	0.0	0.42	0.22	6.76	8.21	0.70	0.78	-63.7	-11.3	39.1	0.4	-28.2	-42.2	0.0	0.4	0.1	-13.3	0.0	-12.8	0.0	-55.0	195.0	0.0
	Sep	30	0.694	63.9	0.679	62.5	1.4	1.02	0.52	5.30	6.09	0.49	0.53	-63.9	-7.8	31.6	1.0	-24.8	-29.2	0.0	0.9	0.2	-9.0	0.0	-7.9	0.0	-37.1	157.9	0.0
	Total	365	0.993	1111.1		760.3	354.08	100.0	51.29	42.40	56.00	3.02	3.26	-332.8	-48.4	170.1	102.6	-224.3	-181.4	762.8	98.4	19.1	-84.2	-0.1	33.1	0.0	157.9		456.6
Year 2	Oct	31	0.659	62.7	0.679	64.6	0.0	6.02	1.72	3.14	3.96	0.18	0.18	-38.2	-2.9	20.5	3.4	-21.0	-10.8	4.0	2.6	1.0	-4.7	0.0	-1.2	0.0	-8.0	149.8	0.0
	Nov	30	0.713	65.7	0.679	62.5	3.2	12.67	3.62	1.50	1.95	0.00	0.00	0.0	0.0	0.0	7.2	-7.2	0.0	65.7	5.3	2.1	-2.2	0.0	5.2	0.0	70.9	220.7	0.0
	Dec	31	1.225	116.5	0.679	64.6	52.0	18.27	5.22	1.21	1.27	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	116.5	9.6	2.1	-2.2	0.0	9.5	0.0	126.0	346.7	0.0
	Jan	31	1.191	113.3	0.679	64.6	48.7	18.17	5.19	1.22	1.56	0.00	0.00	0.0	0.0	0.0	10.4	-10.4	0.0	113.3	11.9	1.1	-2.8	0.0	10.1	0.0	46.3	393.0	77.1
	Feb	28	1.088	93.5	0.679	58.3	35.2	15.44	4.41	1.34	2.01	0.00	0.00	0.0	0.0	0.0	8.8	-8.8	0.0	93.5	10.5	0.7	-3.2	0.0	8.0	0.0	0.0	393.0	101.5
	Mar	31	1.141	108.5	0.679	64.6	43.9	13.44	3.84	2.18	3.31	0.00	0.00	0.0	0.0	0.0	7.7	-7.7	0.0	108.5	9.2	0.6	-5.2	0.0	4.6	0.0	0.0	393.0	113.1
	Apr	30	0.824	75.9	0.679	62.5	13.4	9.66	2.76	3.18	4.59	0.13	0.11	-24.1	-2.2	2.2	5.5	-5.5	-8.1	49.7	6.6	0.4	-7.6	0.0	-0.6	0.0	0.0	393.0	41.0
	May	31	0.726	69.1	0.679	64.6	4.5	3.75	1.07	4.67	6.32	0.45	0.49	-69.1	-7.2	7.2	2.1	-2.1	-27.2	0.0	2.6	0.2	-11.1	0.0	-8.4	0.0	-35.6	357.4	0.0
	Jun	30	0.662	61.0	0.679	62.5	0.0	1.12	0.32	6.23	7.83	0.66	0.73	-61.0	-10.6	36.6	0.6	-26.7	-39.6	0.0	0.7	0.1	-14.4	0.0	-13.6	0.0	-53.2	304.2	0.0
	Jul	31	0.674	64.1	0.679	64.6	0.0	0.04	0.01	7.53	8.90	0.78	0.87	-64.1	-12.5	42.3	0.0	-29.8	-47.1	0.0	0.0	0.0	-16.3	0.0	-16.3	0.0	-63.3	240.9	0.0
	Aug	31	0.695	66.1	0.679	64.6	1.5	0.42	0.12	6.76	8.21	0.71	0.79	-66.1	-11.4	39.4	0.2	-28.2	-42.8	0.0	0.2	0.0	-13.0	0.0	-12.7	0.0	-55.5	185.4	0.0
	Sep	30	0.684	63.0	0.679	62.5	0.5	1.02	0.29	5.30	6.09	0.51	0.56	-63.0	-8.1	32.4	0.6	-24.8	-30.5	0.0	0.5	0.1	-8.8	0.0	-8.2	0.0	-38.7	146.7	0.0
	Total	365	0.857	959.4		760.3	202.90	100.0	28.57	44.26	56.00	3.43	3.72	-385.6	-54.9	180.6	57.1	-182.8	-206.0	551.2	59.6	8.5	-91.5	-0.1	-23.6	0.0	-11.2		332.7

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ATTACHMENT B

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

SCWWTP Facilities Details Costs

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Client: City of Sutter Creek **DRAFT**

Project: Sutter Creek Master Plan

Alternative 1: ARSA Sprayfields – Disinfected Secondary (Effluent BOD and TSS < 30 mg/L)

I. Phase 1

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A.	NON-CONSTRUCTION				
	Eng/Permit/Env/CM/Insp	0%	of	$14,902,771.60	$0.00
	Sub-Total A:				**$0.00**
					ENR Adjusted to Nov 2017
B.	CONSTRUCTION				
	Contractor Fees				
	Mobilization/ Demobilization	1	LS	$195,000.00	$227,604.05
	General Conditions, Temporary Facilities	1	LS	$145,000.00	$169,244.04
	Documentation, Bond, Insurance	1	LS	$240,000.00	$280,128.06
					$676,976.14
	Demolition				
	Trench	1	LS	$ 16,000	$18,675.20
	Trickling Filter	1	LS	$ 20,000	$23,344.00
	Clarifiers	2	EA	$ 22,000	$51,356.81
					$93,376.02
	Site Improvements				
	Earth work: Ex., Backfill Comp.	10	Days	$4,000.00	$46,688.01
	Off haul/ Import Material	40	Trips	$500.00	$23,344.00
	Paving and Grading	5,000	SF	$10.00	$58,360.01
	Piping, Valves and Misc Appurtenances	1	LS	$500,000.00	$583,600.12
	General Coatings	1	LS	$75,000.00	$87,540.02
					$799,532.17
	Headworks - V-notch Flow Meter Channel, Screening/ Washer Compactor and Influent Dist Box				
	Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,675.20
	Access	1	LS	$30,000.00	$35,016.01
	Concrete Slab	15	CY	$600.00	$10,504.80
	Concrete Walls	32	CY	$900.00	$33,615.37
	Concrete Misc	30	CY	$300.00	$10,504.80
	Screens Equipment	125%	of	$180,000.00	$262,620.06
	Grit Equipment	125%	of	$50,000.00	$72,950.02
	Miscellaneous Equipment	1	LS	$25,000.00	$29,180.01
					$473,066.26
	Lift Station	1	EA	$692,000.00	$807,702.57
	Effluent Lift Station	1	EA	$340,000.00	$396,848.08
	Emergency Storage Improvements	542,000	Per Gal	$ 1.23	$780,907.21
	Treatment Plant	1	LS	$2,900,000.00	$3,384,880.72
	Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,681.61
	Building	1,200	SF	$170.00	$238,108.85
	Admin/Ops Building	2800	SF	$300.00	$980,448.21
					$6,621,577.25
	Disinfection Equipment Upgrades				
	Pumps	125%	of	$11,000.00	$16,049.00
	Miscellaneous Equipment	1	LS	$5,000.00	$5,836.00
					$21,885.00
	Chlorine Contact Basin				
	Earth work: Ex., Backfill Comp.	3	Day	$4,000.00	$14,006.40
	Concrete Slab	128	CY	$600.00	$89,485.35
	Concrete Walls	125	CY	$900.00	$130,959.87
	Concrete Misc	15	CY	$300.00	$5,252.40
	Equipment and Instruments	1	LS	$110,000.00	$128,392.03
	Cover	1	LS	$100,000.00	$116,720.02
	Drain System	1	LS	$34,000.00	$39,684.81
	Miscellaneous Metal, Painting, Signs, ID	1	LS	$74,000.00	$86,372.82
	Testing	1	LS	$26,000.00	$30,347.21

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
				$641,220.91
Electrical and Controls	20%	LS	$8,557,281.59	$1,711,456.32
Sub-Total Construction:				**$11,039,090.08**
Contingencies	35%	of	$11,039,090.08	$3,863,681.53
Sub-Total B:				**$14,902,771.60**
C. SUMMARY				
Non-Construction:				$0.00
Construction:				$14,902,771.60
TOTAL PHASE 1 PROJECT				
Total Cost				$14,902,771.60
Phase 1 Project Cost (Rounded to Nearest $1,000):				**$14,903,000.00**

II. Buildout

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$3,649,722.39	$0.00
Sub-Total Section A:				$0.00
B. CONSTRUCTION				
Mobilization/ Demobilization	1	LS	$48,000.00	$56,025.61
General Conditions, Temporary Facilities	1	LS	$35,000.00	$40,852.01
Documentation, Bond, Insurance	1	LS	$58,000.00	$67,697.61
Treatment Plant	1	LS	$1,479,000.00	$1,726,289.17
Earth work: Ex., Backfill Comp.	5	Days	$4,000.00	$23,344.00
Admin/Ops Building	0	SF	$300.00	$0.00
Electrical and Controls	20%	of	$1,749,633.17	$349,926.63
Tertiary Treatment System	0	LS	$0.00	$0.00
Disinfection System	0	LS	$0.00	$0.00
Effluent Storage Tank	0	Per Gal	$ 1.23	$0.00
Sub-Total Construction:				**$2,264,135.04**
Contingencies	35%	of	$2,264,135.04	$792,450.00
Escalation to midpoint of construction	3.0%	inflation on	$3,056,585.04	$593,137.35
Sub-Total Section B:				**$3,649,722.39**
C. SUMMARY				
Non-Construction:				$0.00
Construction:				$3,649,722.39
TOTAL BUILDOUT PROJECT				
Total Cost				$3,649,722.39
Buildout Project Cost (Rounded to Nearest $1,000):				**$3,650,000.00**

III. PROJECT COST SUMMARY

Phase 1	$14,903,000.00
Buildout	$3,650,000.00
OVERALL PROJECT COST:	**$18,553,000.00**

IV. ANNUAL COSTS

Lift Station Power Estimate				
Average Flow (gpm)				317
Pressure (ft)				40
Pump Efficiency				75%
Motor Efficiency				90%
Power (Hp)				
Lift Station				9.5
Plant (Aeration)				91.1
Digestion				9.5
Misc				30
Total (Hp)				**140.1**
Power Cost (kwH)	915,231	at	$0.10	$91,523.12
Labor	8,344			
Operators (4)	0	hours per year	$55.00	$459,000.00
Senior Operator		hours per year	$65.00	$0.00
Total per year				**$459,000.00**
Re-painting every 10 years	10%	of	$50,000.00	$5,000.00
Reporting	0			
Continuous	0	LS	$0.00	$0.00
Weekly	4	EA	$0.00	$0.00
Quarterly	1	EA	$7,500.00	$30,000.00
Annual	0.00	EA	$10,000.00	$10,000.00
Tri-annually		EA	$0.00	$0.00
Total per year				**$40,000.00**
Lab Costs	10%	of	$596,000.00	$59,600.00
Chemical Costs	15%	of	$596,000.00	$89,400.00
Repair Costs	15%	of	$596,000.00	$89,400.00
Sludge Disposal	18%	of	$596,000.00	$107,280.00

ANNUAL COST PER YEAR: $941,203.12

V. ANNUAL REPLACEMENT RESERVE

	Time to Replace	Discount Rate	Est. Present Cost	
Headworks Equipment	15	3.00%	$335,570.07	$28,109.56
Lift Station Pumps	15	3.00%	$301,137.66	$25,225.27
EQ/ Emergency Storage Tank	30	3.00%	$780,907.21	$39,841.31
Blowers	15	3.00%	$150,000.00	$12,564.99
Tertiary Treatment Equipment	15	3.00%	$0.00	$0.00
Disinfection Equipment	15	3.00%	$144,441.03	$12,099.33
Electrical	20	3.00%	$1,711,456.32	$115,036.75

ANNUAL REPLACEMENT RESERVE PER YEAR: $232,877.20

Client: City of Sutter Creek
Project: Sutter Creek Master Plan
Alternative 2: Noble Ranch Sprayfields – Disinfected Secondary (Effluent BOD and TSS < 30 mg/L)

I. Phase 1

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$14,686,700.00	$0.00
Sub-Total A:				$0.00
				ENR Adjusted to Nov 2017
B. CONSTRUCTION				
Contractor Fees				
Mobilization/ Demobilization	1	LS	$195,000.00	$227,600.00
General Conditions, Temporary Facilities	1	LS	$145,000.00	$169,200.00
Documentation, Bond, Insurance	1	LS	$240,000.00	$280,100.00
Demolition				
Trench	1	LS	$ 16,000	$18,700.00
Trickling Filters	1	LS	$ 20,000	$23,300.00
Clarifiers	2	EA	$ 22,000	$51,400.00
Site Improvements				
Earth work: Ex., Backfill Comp.	10	Days	$4,000.00	$46,700.00
Off haul/ Import Material	40	Trips	$500.00	$23,300.00
Paving and Grading	5,000	SF	$10.00	$58,400.00
Piping, Valves and Misc Appurtenances	1	LS	$500,000.00	$583,600.00
General Coating	1	LS	$75,000.00	$87,500.00
Headworks - V-notch Flow Meter Channel, Screening/ Washer Compactor and Influent Dist Box				
Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,700.00
Access	1	LS	$30,000.00	$35,000.00
Concrete Slab	15	CY	$600.00	$10,500.00
Concrete Walls	32	CY	$900.00	$33,600.00
Concrete Misc	30	CY	$300.00	$10,500.00
Screens Equipment	125%	of	$180,000.00	$262,600.00
Grit Equipment	125%	of	$50,000.00	$73,000.00
Miscellaneous Equipment	1	LS	$25,000.00	$29,200.00
Influent Lift Station	1	EA	$692,000.00	$807,700.00
Effluent Lift Station	1	EA	$340,000.00	$396,800.00
Emergency Storage Improvements	542,000	Per Gal	$ 1.23	$780,900.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.00
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.00
Building	1200	SF	$170.00	$238,100.00
Admin/Ops Building	2800	SF	$300.00	$980,400.00
Disinfection Equipment Upgrades				
Pumps	125%	of	$11,000.00	$16,000.00
Miscellaneous Equipment	1	LS	$5,000.00	$5,800.00
Chlorine Contact Basin				
Earth work: Ex., Backfill Comp.	3	Day	$4,000.00	$14,000.00
Concrete Slab	128	CY	$600.00	$89,500.00
Concrete Walls	125	CY	$900.00	$131,000.00
Concrete Misc	15	CY	$300.00	$5,300.00
Equipment and Instruments	1	LS	$110,000.00	$128,400.00
Cover	1	LS	$100,000.00	$116,700.00
Drain System	1	LS	$34,000.00	$39,700.00
Miscellaneous Metal, Painting, Signs, ID	1	LS	$74,000.00	$86,400.00
Testing	1	LS	$26,000.00	$30,300.00

	Electrical and Controls	20%	LS	$7,757,700.00	$1,551,540.00
	Sub-Total Construction:				**$10,879,040.00**
	Contingencies	35%	of	$10,879,040.00	$3,807,660.00
	Sub-Total B:				**$14,686,700.00**
C. SUMMARY					
	Non-Construction:				$0.00
	Construction:				$14,686,700.00
	TOTAL PHASE 1 PROJECT				
	Total Cost				$14,686,700.00
	Phase 1 Project Cost (Rounded to Nearest $1,000):				**$14,687,000.00**

II. Buildout

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION					
	Eng/Permit/Env/CM/Insp	0%	of	$3,649,692.49	$0.00
	Sub-Total Section A:				$0.00
B. CONSTRUCTION					
	Mobilization/ Demobilization	1	LS	$48,000.00	$56,000.00
	General Conditions, Temporary Facilities	1	LS	$35,000.00	$40,900.00
	Documentation, Bond, Insurance	1	LS	$58,000.00	$67,700.00
	Treatment Plant	1	LS	$1,479,000.00	$1,726,300.00
	Earth work: Ex., Backfill Comp.	5	Days	$4,000.00	$23,300.00
	Admin/Ops Building	0	SF	$300.00	$0.00
	Electrical and Controls	20%	of	$1,749,600.00	$349,920.00
	Tertiary Treatment System	0	LS	$0.00	$0.00
	Disinfection System	0	LS	$0.00	$0.00
	Effluent Storage Tank	0	Per Gal	$ 1.23	$0.00
	Sub-Total Construction:				**$2,264,120.00**
	Contingencies	35%	of	$2,264,120.00	$792,440.00
	Escalation to midpoint of construction	3.0%	inflation on	$3,056,560.00	$593,132.49
	Sub-Total Section B:				**$3,649,692.49**
C. SUMMARY					
	Non-Construction:				$0.00
	Construction:				$3,649,692.49
	TOTAL BUILDOUT PROJECT				
	Total Cost				$3,649,692.49
	Buildout Project Cost (Rounded to Nearest $1,000):				**$3,650,000.00**

III. PROJECT COST SUMMARY

Phase 1	$14,687,000.00
Buildout	$3,650,000.00
OVERALL PROJECT COST:	**$18,337,000.00**

IV. ANNUAL COSTS

Lift Station Power Estimate				
Average Flow (gpm)				317
Pressure (ft)				40
Pump Efficiency				75%
Motor Efficiency				90%
Power (Hp)				
Lift Station				9.5
Plant (Aeration)				91.1
Digestion				9.5
Misc				30
Total				**140.1**
Power Cost (kwH)	915,231	at	$0.10	$91,523.12
Labor				
Operators (3.5)	7,301	hours per year	$55.00	$401,600.00
Senior Operator	0	hours per year	$65.00	$0.00
Total per year				**$401,600.00**
Re-painting every 10 years	10%	of	$50,000.00	$5,000.00
Reporting				
Continuous	0	LS	$0.00	$0.00
Weekly	0	EA	$0.00	$0.00
Quarterly	4	EA	$7,500.00	$30,000.00
Annual	1	EA	$10,000.00	$10,000.00
Tri-annually	0.00	EA	$0.00	$0.00
Total per year				**$40,000.00**
Lab Costs	10%	of	$538,000.00	$53,800.00
Chemical Costs	15%	of	$538,000.00	$80,700.00
Repair Costs	15%	of	$538,000.00	$80,700.00
Sludge Disposal	18%	of	$538,000.00	$96,840.00
ANNUAL COST PER YEAR:				**$850,163.12**

V. ANNUAL REPLACEMENT RESERVE

	Time to Replace	Discount Rate	Est. Present Cost	
Headworks Equipment	15	3.00%	$335,600.00	$28,112.06
Lift Station Pumps	15	3.00%	$301,125.00	$25,224.21
EQ/ Emergency Storage Tank	30	3.00%	$780,900.00	$39,840.94
Blowers	15	3.00%	$150,000.00	$12,564.99
Tertiary Treatment Equipment	15	3.00%	$0.00	$0.00
Disinfection Equipment	15	3.00%	$144,400.00	$12,095.89
Electrical	20	3.00%	$1,551,540.00	$104,287.86
ANNUAL REPLACEMENT RESERVE PER YEAR:				**$222,125.96**

Client: City of Sutter Creek
Project: Sutter Creek Master Plan
Alternative 3:Surface Water Discharge– NPDES Surface Discharge with enhanced nutrient removal (Effluent BOD, TSS and NO3

I. Phase 1

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$18,759,440.00	$0.00
Sub-Total A:				**$0.00**
				ENR Adjusted to Nov 2017
B. CONSTRUCTION				
Contractor Fees				
Mobilization/ Demobilization	1	LS	$216,000.00	$252,100.00
General Conditions, Temporary Facilities	1	LS	$160,000.00	$186,800.00
Documentation, Bond, Insurance	1	LS	$270,000.00	$315,100.00
Demolition				
Trench	1	LS	$ 16,000	$18,700.00
Trickling Filters	1	LS	$ 20,000	$23,300.00
Clarifiers	2	EA	$ 22,000	$51,400.00
Site Improvements				
Earth work: Ex., Backfill Comp.	10	Days	$4,000.00	$46,700.00
Off haul/ Import Material	40	Trips	$500.00	$23,300.00
Paving and Grading	5,000	SF	$10.00	$58,400.00
Piping, Valves and Misc Appurtenances	1	LS	$500,000.00	$583,600.00
General Coating	1	LS	$75,000.00	$87,500.00
Headworks - V-notch Flow Meter Channel, Screening/ Washer Compactor and Influent Dist Box				
Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,700.00
Access	1	LS	$30,000.00	$35,000.00
Concrete Slab	15	CY	$600.00	$10,500.00
Concrete Walls	32	CY	$900.00	$33,600.00
Concrete Misc	30	CY	$300.00	$10,500.00
Screens Equipment	125%	of	$160,000.00	$233,400.00
Grit Equipment	125%	of	$50,000.00	$73,000.00
Miscellaneous Equipment	1	LS	$25,000.00	$29,200.00
Lift Station	1	EA	$692,000.00	$807,700.00
Emergency Storage Improvements	542,000	Per Gal	$ 1.23	$780,900.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.00
Enhanced Nutrient Removal	50%	of	$3,384,900.00	$1,692,450.00
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.00
Building	1200	SF	$170.00	$238,100.00
Admin/Ops Building	2800	SF	$300.00	$980,400.00
Tertiary Treatment - Disk Filter				
Earth work: Ex., Backfill Comp.	1	Day	$4,000.00	$4,700.00
Concrete Misc	10	CY	$300.00	$3,500.00
Supplied Equipment	125%	of	$500,000.00	$729,500.00
Miscellaneous Equipment	1	LS	$10,000.00	$11,700.00
UV Disinfection				
Earth work: Ex., Backfill Comp.	1	Day	$4,000.00	$4,700.00
Concrete Slab	17	CY	$600.00	$11,900.00
Concrete Walls	28	CY	$900.00	$29,400.00
Concrete Misc	10	CY	$300.00	$3,500.00
Supplied Equipment	125%	of	$670,000.00	$977,500.00
Miscellaneous Equipment	1	LS	$10,000.00	$11,700.0

Outfall to Sutter Creek	1	LS	$60,000.00	$70,000.0
Electrical and Controls	20%	LS	$10,149,150.00	$2,029,830.00
Sub-Total Construction:				**$13,895,880.00**
Contingencies	35%	of	$13,895,880.00	$4,863,560.00
Sub-Total B:				**$18,759,440.00**

C. SUMMARY	
Non-Construction:	$0.00
Construction:	$18,759,440.00
TOTAL PHASE 1 PROJECT	
Total Cost	$18,759,440.00
Phase 1 Project Cost (Rounded to Nearest $1,000):	**$18,759,000.00**

II. Buildout

ITEMDESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$4,182,662.51	$0.00
Sub-Total Section A:				$0.00
B. CONSTRUCTION				
Mobilization/ Demobilization	1	LS	$53,000.00	$61,900.00
General Conditions, Temporary Facilities	1	LS	$40,000.00	$46,700.00
Documentation, Bond, Insurance	1	LS	$65,000.00	$75,900.00
Treatment Plant	1	LS	$1,479,000.00	$1,726,300.00
Enhanced Nutrient Removal	15%	of	$1,726,300.00	$258,945.00
Earth work: Ex., Backfill Comp.	5	Days	$4,000.00	$23,300.00
Admin/Ops Building	0	SF	$300.00	$0.0
Electrical and Controls	20%	of	$2,008,545.00	$401,709.00
Tertiary Treatment System	0	LS	$0.00	$0.0
Disinfection System	0	LS	$0.00	$0.0
Effluent Storage Tank	0	Per Gal	$ 1.23	$0.0
Sub-Total Construction:				**$2,594,754.00**
Contingencies	35%	of	$2,594,754.00	$908,160.00
Escalation to midpoint of construction	3.0%	inflation on	$3,502,914.00	$679,748.51
Sub-Total Section B:				**$4,182,662.51**

C. SUMMARY	
Non-Construction:	$0.00
Construction:	$4,182,662.51
TOTAL BUILDOUT PROJECT	
Total Cost	$4,182,662.51
Buildout Project Cost (Rounded to Nearest $1,000):	**$4,183,000.00**

III. PROJECT COST SUMMARY

Phase 1	$18,759,000.00
Buildout	$4,183,000.00
OVERALL PROJECT COST:	**$22,942,000.00**

IV. ANNUAL COSTS

Average Flow (gpm)				317
Pressure (ft)				40
Pump Efficiency				75%
Motor Efficiency				90%
Power (Hp)				
Lift Station				4.8
Plant (Aeration)				91.1
Digestion				9.5
UV Disinfection				29.5
Misc				30
Total				164.9
Power Cost (kwH)	1,076,881	at	$0.10	$107,688.07
Labor				
Operators (3)	6,258	hours per year	$55.00	$344,200.00
Senior Operator (1)	2,086	hours per year	$65.00	$135,600.00
Total per year				**$479,800.00**
Lamp Replacement Cost	140	per year	$280.00	$39,200.00
Re-painting every 10 years	10%	of	$50,000.00	$5,000.00
Reporting				
Continuous	1	LS	$10,000.00	$10,000.00
Weekly	52	EA	$500.00	$26,000.00
Quarterly	4	EA	$7,500.00	$30,000.00
Annual	1	EA	$10,000.00	$10,000.00
Tri-annually	0.33	EA	$75,000.00	$24,750.00
Total per year				**$100,750.00**
Lab Costs	10%	of	$732,438.07	$73,244.00
Chemical Costs	15%	of	$732,438.07	$109,866.00
Repair Costs	15%	of	$732,438.07	$109,866.00
Sludge Disposal	18%	of	$732,438.07	$131,839.00
Ongoing Engineering Support for Permitting	1	LS	$100,000.00	$100,000.00
ANNUAL COST PER YEAR:				**$1,257,253.07**

V. ANNUAL REPLACEMENT RESERVE

	Time to Replace	Discount Rate	Est. Present Cost	
Headworks Equipment	15	3.00%	$306,400.00	$25,666.08
Lift Station Pumps	15	3.00%	$201,925.00	$16,914.57
EQ/ Emergency Storage Tank	30	3.00%	$780,900.00	$39,840.94
Blowers	15	3.00%	$150,000.00	$12,564.99
Tertiary Treatment Equipment	15	3.00%	$741,200.00	$62,087.79
Disinfection Equipment	15	3.00%	$989,200.00	$82,861.90
Electrical	20	3.00%	$2,029,830.00	$136,436.46
Permit Compliance Upgrades	1		$100,000.00	$100,000.00
ANNUAL REPLACEMENT RESERVE PER YEAR:				**$476,372.72**

Client: City of Sutter Creek
Project: Sutter Creek Master Plan
Alternative 4: ARSA Sprayfields & Golf Course Irrigation – Disinfected Tertiary (Effluent BOD, TSS and NO3 <10 mg/L)

I. Phase 1

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$17,195,520.00	$0.00
Sub-Total A:				$0.00
				ENR Adjusted to Nov 2017
B. CONSTRUCTION				
Contractor Fees				
Mobilization/ Demobilization	1	LS	$230,000.00	$268,500.00
General Conditions, Temporary Facilities	1	LS	$170,000.00	$198,400.00
Documentation, Bond, Insurance	1	LS	$285,000.00	$332,700.00
Demolition				
Trench	1	LS	$ 16,000	$18,700.00
Trickling Filters	1	LS	$ 20,000	$23,300.00
Clarifiers	2	EA	$ 22,000	$51,400.00
Site Improvements				
Earth work: Ex., Backfill Comp.	10	Days	$4,000.00	$46,700.00
Off haul/ Import Material	40	Trips	$500.00	$23,300.00
Paving and Grading	5,000	SF	$10.00	$58,400.00
Piping, Valves and Misc Appurtenances	1	LS	$500,000.00	$583,600.00
General Coating	1	LS	$75,000.00	$87,500.00
Headworks				
Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,700.00
Access	1	LS	$30,000.00	$35,000.00
Concrete Slab	15	CY	$600.00	$10,500.00
Concrete Walls	32	CY	$900.00	$33,600.00
Concrete Misc	30	CY	$300.00	$10,500.00
Screens Equipment	125%	of	$180,000.00	$262,600.00
Grit Equipment	125%	of	$50,000.00	$73,000.00
Miscellaneous Equipment	1	LS	$25,000.00	$29,200.00
Influent Lift Station	1	EA	$720,000.00	$840,400.00
Effluent Lift Station	1	EA	$375,000.00	$437,700.00
Emergency Storage Improvements	603,000	Per Gal	$ 1.23	$868,800.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.00
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.00
Building	2,000	SF	$170.00	$396,800.00
Admin/Ops Building	2,800	SF	$300.00	$980,400.00
Tertiary Treatment - Disk Filter				
Earth work: Ex., Backfill Comp.	1	Day	$4,000.00	$4,700.00
Concrete Misc	10	CY	$300.00	$3,500.00
Supplied Equipment	125%	of	$600,000.00	$875,400.00
Miscellaneous Equipment	1	LS	$10,000.00	$11,700.00
Disinfection Equipment Upgrades				
Pumps	125	of	$11,000.00	$16,000.00
Miscellaneous Equipment	1	LS	$5,000.00	$5,800.00

Chlorine Contact Basin				
Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,700.00
Concrete Slab	133	CY	$600.00	$93,300.00
Concrete Walls	145	CY	$900.00	$152,000.00
Concrete Misc	30	CY	$300.00	$10,500.0
Equipment and Instruments	1	LS	$164,000.00	$191,400.0
Cover	1	LS	$149,000.00	$173,900.0
Drain System	1	LS	$50,000.00	$58,400.0
Miscellaneous Metal, Painting, Signs, ID	1	LS	$111,000.00	$129,600.0
Testing	1	LS	$38,000.00	$44,400.0
Electrical and Controls	20%	LS	$9,204,100.00	$1,840,820.00
Sub-Total Construction:				$12,737,420.00
Contingencies	35%	of	$12,737,420.00	$4,458,100.00
Sub-Total B:				$17,195,520.00
C. SUMMARY				
Non-Construction:				$0.00
Construction:				$17,195,520.00
TOTAL PHASE 1 PROJECT				
Total Cost				$17,195,520.00
Phase 1 Project Cost (Rounded to Nearest $1,000):				**$17,196,000.00**

II. Buildout

ITEMDESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$7,118,820.39	$0.00
Sub-Total Section A:				$0.00
B. CONSTRUCTION				
Mobilization/ Demobilization	1	LS	$90,000.00	$105,000.00
General Conditions, Temporary Facilities	1	LS	$70,000.00	$81,700.00
Documentation, Bond, Insurance	1	LS	$110,000.00	$128,400.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.0
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.0
Admin/Ops Building	0	SF	$300.00	$0.0
Electrical and Controls	20%	of	$3,417,600.00	$683,520.00
Tertiary Treatment System	0	LS	$0.00	$0.0
Disinfection System	0	LS	$0.00	$0.0
Effluent Storage Tank	0	Per Gal	$ 1.23	$0.0
Sub-Total Construction:				**$4,416,220.00**
Contingencies	35%	of	$4,416,220.00	$1,545,680.00
Escalation to midpoint of construction	3.0%	inflation on	$5,961,900.00	$1,156,920.39
Sub-Total Section B:				**$7,118,820.39**
C. SUMMARY				
Non-Construction:				$0.00
Construction:				$7,118,820.39

TOTAL BUILDOUT PROJECT	
Total Cost	$7,118,820.39
Buildout Project Cost (Rounded to Nearest $1,000):	**$7,119,000.00**

III. PROJECT COST SUMMARY

Phase 1	$17,196,000.00
Buildout	$7,119,000.00
OVERALL PROJECT COST:	**$24,315,000.00**

IV. ANNUAL COSTS

Lift Station Power Estimate				
Average Flow (gpm)				317
Pressure (ft)				40
Pump Efficiency				75%
Motor Efficiency				90%
Power (Hp)				
Lift Station				4.8
Plant (Aeration)				188.4
Digestion				18
UV Disinfection				34.9
Misc				30
Total				**276.1**
Power Cost (kwH)	1,803,276	at	$0.10	$180,327.60
Labor				
Operators (4)	8,344	hours per year	$55.00	$459,000.00
Senior Operator (1)	2,086	hours per year	$65.00	$135,600.00
Total per year				**$594,600.00**
Re-painting every 10 years	10%	of	$50,000.00	$5,000.00
Reporting				
Continuous	0	LS	$0.00	$0.00
Weekly	0	EA	$0.00	$0.00
Quarterly	4	EA	$7,500.00	$30,000.00
Annual	1	EA	$10,000.00	$10,000.00
Tri-annually	0.00	EA	$0.00	$0.00
Total per year				**$40,000.00**
Lab Costs	10%	of	$819,927.60	$81,993.00
Chemical Costs	15%	of	$819,927.60	$122,989.00
Repair Costs	15%	of	$819,927.60	$122,989.00
Sludge Disposal	18%	of	$819,927.60	$147,587.00
ANNUAL COST PER YEAR:				**$1,295,485.60**

V. ANNUAL REPLACEMENT RESERVE

	Time to Replace	Discount Rate	Est. Present Cost	
Headworks Equipment	15	3.00%	$335,600.00	$28,112.06
Lift Station Pumps	15	3.00%	$210,100.00	$17,599.36
EQ/ Emergency Storage Tank	30	3.00%	$868,800.00	$44,325.53
Blowers	15	3.00%	$150,000.00	$12,564.99
Tertiary Treatment Equipment	15	3.00%	$887,100.00	$74,309.33
Disinfection Equipment	15	3.00%	$207,400.00	$17,373.19
Electrical	20	3.00%	$1,840,820.00	$123,732.02
ANNUAL REPLACEMENT RESERVE PER YEAR:				**$318,016.48**

Alternative 5: Surface Water Discharge and Golf Course Irrigation - NPDES Surface Discharge with enhanced nutrient removal (

I. Phase 1

ITEM DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$20,422,670.00	$0.00
Sub-Total A:				**$0.00**
				ENR Adjusted to Nov 2017
B. CONSTRUCTION				
Contractor Fees				
Mobilization/ Demobilization	1	LS	$245,000.00	$286,000.00
General Conditions, Temporary Facilities	1	LS	$185,000.00	$215,900.00
Documentation, Bond, Insurance	1	LS	$305,000.00	$356,000.00
Demolition				
Trench	1	LS	$ 16,000	$18,700.00
Trickling Filters	1	LS	$ 20,000	$23,300.00
Clarifiers	2	EA	$ 22,000	$51,400.00
Site Improvements				
Earth work: Ex., Backfill Comp.	10	Days	$4,000.00	$46,700.00
Off haul/ Import Material	40	Trips	$500.00	$23,300.00
Paving and Grading	5,000	SF	$10.00	$58,400.00
Piping, Valves and Misc Appurtenances	1	LS	$500,000.00	$583,600.00
General Coating	1	LS	$75,000.00	$87,500.00
Headworks				
Earth work: Ex., Backfill Comp.	4	Day	$4,000.00	$18,700.00
Access	1	LS	$30,000.00	$35,000.00
Concrete Slab	15	CY	$600.00	$10,500.00
Concrete Walls	32	CY	$900.00	$33,600.00
Concrete Misc	30	CY	$300.00	$10,500.00
Screens Equipment	125%	of	$180,000.00	$262,600.00
Grit Equipment	125%	of	$50,000.00	$73,000.00
Miscellaneous Equipment	1	LS	$25,000.00	$29,200.00
Influent Lift Station	1	EA	$720,000.00	$840,400.00
Effluent Lift Station	1	EA	$375,000.00	$437,700.00
Emergency Storage Improvements	603,000	Per Gal	$ 1.23	$868,800.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.00
Enhanced Nutrient Removal	50%	of	$3,384,900.00	$1,692,450.00
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.00
Building	2,000	SF	$170.00	$396,800.00
Admin/Ops Building	2,800	SF	$300.00	$980,400.00
Tertiary Treatment - Disk Filter				
Earth work: Ex., Backfill Comp.	1	Day	$4,000.00	$4,700.00
Concrete Misc	10	CY	$300.00	$3,500.00
Supplied Equipment	125%	of	$600,000.00	$875,400.00
Miscellaneous Equipment	1	LS	$10,000.00	$11,700.00
UV Disinfection				
Earth work: Ex., Backfill Comp.	1	Day	$4,000.00	$4,700.00
Concrete Slab	20	CY	$600.00	$14,000.00
Concrete Walls	30	CY	$900.00	$31,500.00
Concrete Misc	10	CY	$300.00	$3,500.00
Supplied Equipment	125%	of	$700,000.00	$1,021,300.00
Miscellaneous Equipment	1	LS	$10,000.00	$11,700.0

Outfall to Sutter Creek	1	LS	$60,000.00	$70,000.0
Electrical and Controls	20%	LS	$11,089,250.00	$2,217,850.00
Sub-Total Construction:				**$15,127,900.00**
Contingencies	35%	of	$15,127,900.00	$5,294,770.00
Sub-Total B:				**$20,422,670.00**

C. SUMMARY

Non-Construction:	$0.00
Construction:	$20,422,670.00
<u>TOTAL PHASE 1 PROJECT</u>	
Total Cost	$20,422,670.00
Phase 1 Project Cost (Rounded to Nearest $1,000):	**$20,423,000.00**

II. Buildout

ITEMDESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL PRICE
A. NON-CONSTRUCTION				
Eng/Permit/Env/CM/Insp	0%	of	$8,185,756.26	$0.00
Sub-Total Section A:				$0.00
B. CONSTRUCTION				
Mobilization/ Demobilization	1	LS	$105,000.00	$122,600.00
General Conditions, Temporary Facilities	1	LS	$80,000.00	$93,400.00
Documentation, Bond, Insurance	1	LS	$130,000.00	$151,700.00
Treatment Plant	1	LS	$2,900,000.00	$3,384,900.00
Enhanced Nutrient Removal	15%	of	$3,384,900.00	$507,735.00
Earth work: Ex., Backfill Comp.	7	Days	$4,000.00	$32,700.00
Admin/Ops Building	0	SF	$300.00	$0.0
Electrical and Controls	20%	of	$3,925,335.00	$785,067.00
Tertiary Treatment System	0	LS	$0.00	$0.0
Disinfection System	0	LS	$0.00	$0.0
Effluent Storage Tank	0	Per Gal	$ 1.23	$0.0
Sub-Total Construction:				**$5,078,102.00**
Contingencies	35%	of	$5,078,102.00	$1,777,340.00
Escalation to midpoint of construction	3.0%	inflation on	$6,855,442.00	$1,330,314.26
Sub-Total Section B:				**$8,185,756.26**

C. SUMMARY

Non-Construction:	$0.00
Construction:	$8,185,756.26
<u>TOTAL BUILDOUT PROJECT</u>	
Total Cost	$8,185,756.26
Buildout Project Cost (Rounded to Nearest $1,000):	**$8,186,000.00**

III. PROJECT COST SUMMARY

Phase 1	$20,423,000.00
Buildout	$8,186,000.00
OVERALL PROJECT COST:	**$28,609,000.00**

IV. ANNUAL COSTS

Average Flow (gpm)				317
Pressure (ft)				40
Pump Efficiency				75%
Motor Efficiency				90%
Power (Hp)				
Lift Station				4.8
Plant (Aeration)				188.4
Digestion				18
UV Disinfection				34.9
Misc				30
Total				**276.1**
Power Cost (kwH)	1,803,276	at	$0.10	$180,327.60
Labor				
Operators (3)	6,258	hours per year	$55.00	$344,200.00
Senior Operator (1)	2,086	hours per year	$65.00	$135,600.00
Total per year				**$479,800.00**
Lamp Replacement Cost	140	per year	$280.00	$39,200.00
Re-painting every 10 years	10%	of	$50,000.00	$5,000.00
Reporting				
Continuous	1	LS	$10,000.00	$10,000.00
Weekly	52	EA	$500.00	$26,000.00
Quarterly	4	EA	$7,500.00	$30,000.00
Annual	1	EA	$10,000.00	$10,000.00
Tri-annually	0.33	EA	$75,000.00	$24,750.00
Total per year				**$100,750.00**
Lab Costs	10%	of	$805,077.60	$80,508.00
Chemical Costs	15%	of	$805,077.60	$120,762.00
Repair Costs	15%	of	$805,077.60	$120,762.00
Sludge Disposal	18%	of	$805,077.60	$144,914.00
Ongoing Engineering Support for Permitting	1	LS	$100,000.00	$100,000.00
ANNUAL COST PER YEAR:				**$1,372,023.60**

V. ANNUAL REPLACEMENT RESERVE

	Time to Replace	Interest Rate	Est. Present Cost	
Headworks Equipment	15	3.00%	$335,600.00	$28,112.06
Lift Station Pumps	15	3.00%	$210,100.00	$17,599.36
EQ/ Emergency Storage Tank	30	3.00%	$868,800.00	$44,325.53
Blowers	15	3.00%	$150,000.00	$12,564.99
Tertiary Treatment Equipment	15	3.00%	$887,100.00	$74,309.33
Disinfection Equipment	15	3.00%	$1,033,000.00	$86,530.88
Electrical	20	3.00%	$2,217,850.00	$149,074.36
Permit Compliance Upgrades	1		$100,000.00	$100,000.00
ANNUAL REPLACEMENT RESERVE PER YEAR:				**$512,516.51**

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ATTACHMENT C

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

Pumping Station Cost Curve

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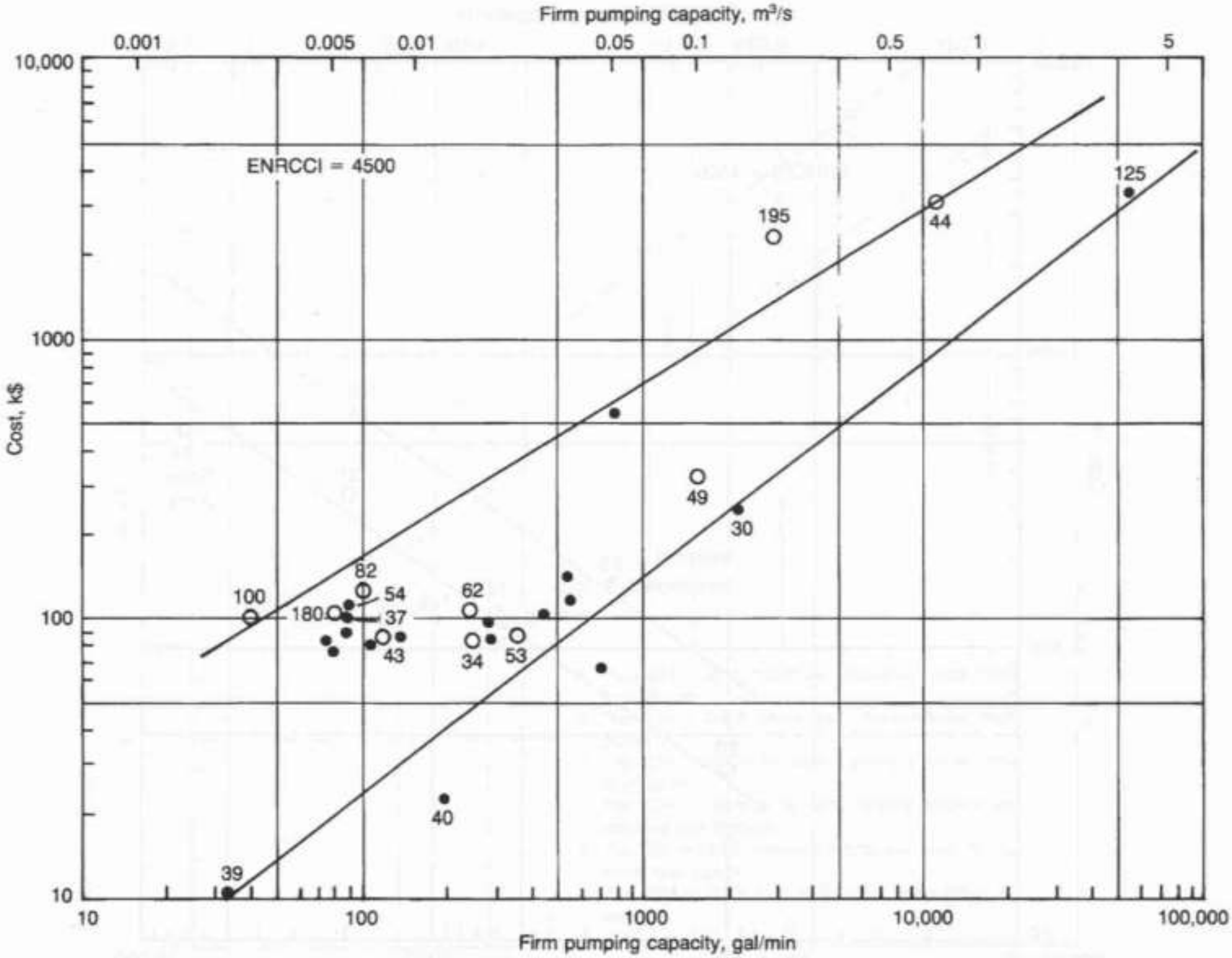

Figure 29-3. Construction costs of submersible-pump wastewater pumping stations. No standby power = solid circles; has standy power = open circles. The numbers are TDH in feet.

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ATTACHMENT D

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

Pipeline Unit Costs

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Sutter Creek & ARSA
Wastewater Master Plans
Pipeline Quantities, Unit Costs, and ARSA pipeline

Pipeline Unit Costs
Gravity sewer w/manholes: $23/in-diameter
Pressure Pipe: $20/in-diameter
+ 35% Construction Contingency
Pipe Easements = 10' wide @ $3,750/acre = $0.86/LF

Pipeline from	**LF**	**Data Source**
ARSA Line to Henderson	17,300	HDR
	20,500	HSe estimate from map
Henderson to Hoskins Ranch	9,600	HSe estimate from map
WWTP to GRR storage	15,800	HSe estimate from map
WWTP to White Horse Res	21,100	HSe estimate from map
White Horse to Noble	8,100	HSe estimate from map
WWTP to Sutter Creek Res	24,200	HSe estimate from map
SC Res to Noble	11,150	HSe estimate from map
Forcemain to Ione Canal	3,100	HSe estimate from map
Forcemain from Ione Canal	4,100	HSe estimate from map

ARSA Pipeline Replacement Cost (over 25-year planning period)

Item	**Unit**	**Unit**	**Quantity**	**Estimated**
27" Gravity Pipeline	$620	LF	17,300	$10,726,000
15" Gravity Pipeline	$345	LF	9,600	$3,312,000
Subtotal				**$14,038,000**
Removal of Exist. Pipe	5%	of Subtotal	1	$702,000
Engineering, Legal, Admin,etc.	25%	of Subtotal	1	$3,510,000
Contingency	35%	of Subtotal	1	$4,914,000
Estimated Replacement Cost				**$23,164,000**

	WWTP Phase 1 Peak Hour (gpm)	**WWTP Phase 2 Peak Hour (gpm)**	**Forcemain**
Pump Station Design Flow (Options 1-3)	4,600	5,200	18"
Pump Station Design Flow (Options 4-5)	4,600	5,600	20"

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ATTACHMENT E

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

Storage Reservoir Cost Estimates

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Sutter Creek & ARSA
Wastewater Master Plans
Storage Reservoir Costs

	Ione Canal	White Horse
Dam (CY)	344,700	397,000
Perimeter (ft)	4,400	10,300
Surface Area (ac)	16	42
Embankment Cost	$8,721,000	$10,045,000
Access Road, Stormwater Bypass	$836,000	$1,959,000
Outlet Piping, Spillway	$1,245,000	$1,355,000
Electrical	$346,000	$519,000
Subtotal	**$11,148,000**	**$13,878,000**
35% Contingency	$3,902,000	$4,858,000
Subtotal Construction Costs	**$15,050,000**	**$18,736,000**
25% Engineering, Admin, legal	$2,787,000	$4,684,000
Land Acquisition at $15,000/acre	$550,000	$1,360,000
Total Estimated Capital Cost	**$18,387,000**	**$24,780,000**

Henderson Res. Sludge Removal (44 ac-ft @ $25,400/ac-ft+35% Cont.)	
	$3,478,000

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ATTACHMENT F

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

Detailed Economic Analysis

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Attachment F - Detailed Economic Analysis Results
Sutter Creek & ARSA
Wastewater Master Plan

			Without GRR						With GRR			
			Alternative 1 ARSA Sprayfields		**Alternative 2** Noble Ranch Sprayfields		**Alternative 3** Surface Water Discharge		**Alternative 4** ARSA Sprayfields & Golf Course Irrigation		**Alternative 5** Surface Water Discharge & Golf Course Irrigation	
Element	**Unit**	**$/Unit**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantit**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
WWTP												
0.55 mgd Secondary WWTP	EA	$18,553,000	1	$18,553,000	1	$18,553,000	-	$0	-	$0	-	$0
0.55 mgd Advanced Tertiary WWTP	EA	$22,942,000	-	$0	-	$0	1	$22,942,000	-	$0	-	$0
0.68 mgd Tertiary WWTP	EA	$24,315,000	-	$0	-	$0	-	$0	1	$24,315,000	-	$0
0.68 mgd Advanced Tertiary WWTP	EA	$28,609,000	-	$0	-	$0	-	$0	-	$0	1	$28,609,000
				$18,553,000		**$18,553,000**		**$22,942,000**		**$24,315,000**		**$28,609,000**
Effluent Conveyance												
12" Gravity Sewer	LF	$370	4,100	$1,517,000	-	$0	-	$0	4,100	$1,517,000	-	$0
12" Forcemain	LF	$320	-	$0	11,150	$3,568,000	-	$0	14,300	$4,576,000	15,800	$5,056,000
20" Forcemain	LF	$540	3,100	$1,674,000	24,200	$13,068,000	-	$0	-	$0	-	$0
24" Forcemain	LF	$650	-	$0	-	$0	-	$0	3,100	$2,015,000	-	$0
				$3,191,000		**$16,636,000**		**$0**		**$8,108,000**		**$5,056,000**
Storage Facilities												
Henderson Reservoir Sludge Removal	EA	$3,478,000	1	$3,478,000	1	$3,478,000	1	$3,478,000	1	$3,478,000	1	$3,478,000
Ione Canal Reservoir	EA	$15,050,000	1	$15,050,000	-	$0	-	$0	1	$15,050,000	-	$0
Other (White Horse or Sutter Creek)	EA	$18,736,000	-	$0	1	$18,736,000	-	$0	-	$0	-	$0
Recycled Water Storage	Gal	$1.94	-	$0	-	$0	-	$0	1,000,000	$1,938,000	1,000,000	$1,938,000
				$18,528,000		**$22,214,000**		**$3,478,000**		**$20,466,000**		**$5,416,000**
Sprayfield Disposal Sites												
Sprayfields	acre	$15,000	121	**$1,815,000**	340	**$5,100,000**	-	**$0**	81	**$1,215,000**	-	**$0**
Total Estimated Construction Costs				**$42,087,000**		**$62,503,000**		**$26,420,000**		**$54,104,000**		**$39,081,000**
Engineering, Legal, Admin, etc. @ 25%				10,522,000		15,626,000		6,605,000		13,526,000		9,771,000
Land Acquisition @ $15,000/acre				$550,000		$1,360,000		$0		$550,000		$0
Total Capital Costs				**$53,159,000**		**$79,489,000**		**$33,025,000**		**$68,180,000**		**$48,852,000**
Present Worth Capital				$52,565,818		$78,679,818		$32,345,197		$67,023,050		$47,521,646
Present Worth O&M				$17,569,576		$16,027,765		$22,922,054		$26,285,861		$38,616,566
Present Worth Ongoing Equip. Repl. Costs				$5,045,027		$4,649,338		$6,430,927		$6,825,378		$11,484,396
Present Worth ARSA Pipeline Replacement Cost				$23,160,000	-	$0	-	$0	-	$23,160,000	-	$0
Net Present Value				**$98,340,422**		**$99,356,921**		**$61,698,178**		**$123,294,289**		**$97,622,609**

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ATTACHMENT G

City of Sutter Creek and ARSA

TM 4: Alternatives Analysis

Development of Factor Importance Weights Using Pairwise Comparison

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Pair-Wise Comparison Method:

Used to develop **factor importance weights** for use later in a weighted matrix.

If Factor A is:	Factor A	Factor B
Much more important than Factor B	5	1
More important than Factor B	4	2
Equal in importance to Factor B	3	3
Less important than Factor B	2	4
Much less important than Factor B	1	5

Factor vs. Factor	Institutional Issues/ Public Acceptance	Ease of O&M	Implementation Time / Constructability	Permits/Regulatory	Legal/Right-of-Way	TOTAL	NORMALIZED TOTAL
Institutional Issues/ Public Acceptance		4	4	3	3	**14**	**9**
Ease of O&M	2		3	2	3	**10**	**6**
Implementation Time / Constructability	2	3		2	3	**10**	**6**
Permits/Regulatory	3	4	4		5	**16**	**10**
Legal/Right-of-Way	3	3	3	1		**10**	**6**

Normalized Totals become the Factor Weights on a scale from 1 to 10, with 10 being the most favorable.

Decision Factor	Description
Institutional/Public Acceptance	Likelihood of affected stakeholders to be accepting of the alternative and reach inter-agency agreements. Considers impacts on the community and their effects on community acceptance.
Ease of O&M	The level of ease of which the facilities can be operated. Considers the risk of unforeseen O&M challenges that could result in unexpected operation costs, fines, or other negative impacts.
Implementation Time/ Constructability	The likelihood that the alternative is completed in time to meet critical deadlines. Considers unknowns and construction complexities that could unexpectedly delay completion.
Permits/Regulatory	The likelihood that the required permits can be secured, permit conditions can be complied with, and the costs of compliance will be consistent with the defined alternatives. Considers the potential for permit violations and future regulatory changes that have a negative impact on the cost and reliability of compliance.
Legal/Right-of-Way	The complexity of and ability to secure and comply with the required legal agreements and rights-of-way that must be secured and maintained for the 25-year planning period. Considers unexpected delays, compliance with GRR and other entitlements, or potential cost increases associated with securing the required legal agreements and rights-of-way.

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Technical Memorandum 5
Capital Improvement Plan

HydroScience
Strategic Water Solutions

www.hydroscience.com

Technical Memorandum

HydroScience
Strategic Water Solutions

Sacramento • Berkeley • San Jose • Concord

To: Amy Gedney, City Manager
City of Sutter Creek and Amador Regional Sanitation Authority

From: Angela Singer, P.E.

Reviewed By: Bill Slenter, P.E.

Subject: TM #5: Capital Improvement Plan

Date: November 30, 2017

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Sutter Creek (City) to review, update, and finalize the Draft Wastewater Master Plan (Master Plan) prepared in November 2012. This technical memorandum (TM) is the last in a series of five TMs that comprise the Master Plan document. This Master Plan evaluates wastewater treatment, storage, and disposal alternatives and related conveyance facilities.

1.0 INTRODUCTION

The purpose of this TM is to present the Capital Improvement Plan (CIP) for the recommended alternative identified in TM #4. TM #4 documented the proposed alternatives for managing long-term wastewater flows generated by the City and the Amador Regional Sanitation Authority (ARSA) member agencies. This TM presents an implementation strategy for the recommended project.

1.1 Background Information

This TM was developed through research of existing available information and through a series of discussions with the City of Sutter Creek and ARSA. The main information sources that formed the basis for CIP development were the five TMs prepared as part of the Wastewater Master Plan Update, including the following:

- TM #1 Update – Evaluation of Existing Facilities, HydroScience, November 20, 2017 (TM #1)
- TM #2 Update – Flow Projections, HydroScience, November 20, 2017 (TM #2)
- TM #3A Update – Initial Evaluation and Screening of Options, HydroScience, November 20, 2017 (TM #3A)
- TM #3B: Surface Water Discharge Evaluation, Robertson – Bryan, Inc., February 21, 2012 (TM #3B)
- TM #4 Update – Alternatives Analysis, HydroScience, November 30, 2017 (TM #4)

2.0 PROPOSED IMPROVEMENTS

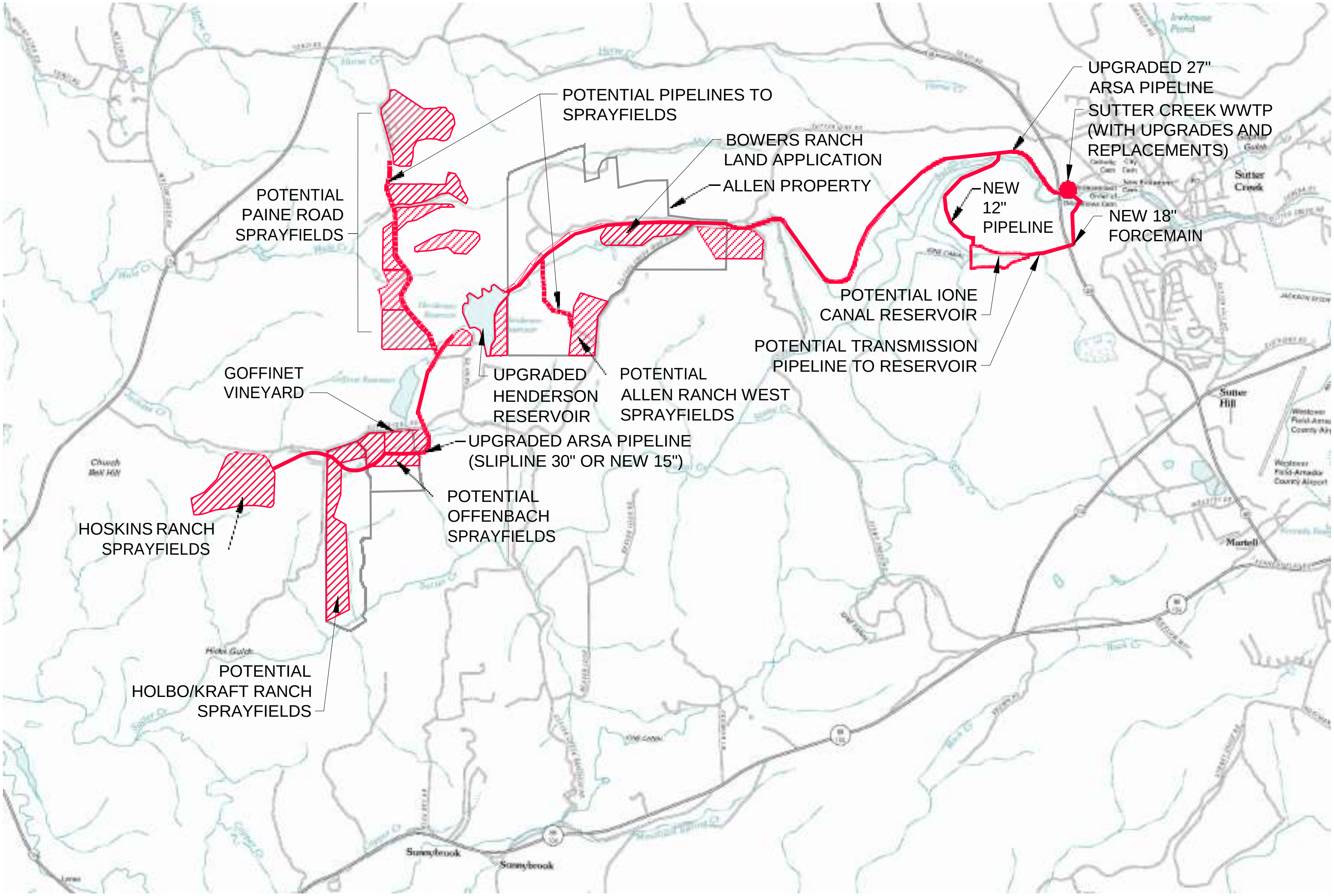
This TM presents the components of the preferred alternative as a Capital Improvement Plan (CIP). Alternative 1: ARSA Sprayfields is the preferred alternative under the condition where Gold Rush Ranch (GRR) does not develop. This TM also presents strategy for implementation of the alternative. Alternative 1 requires multiple components for implementation including the following, which are shown in **Figure 1**:

- Upgrade and improve the Sutter Creek Wastewater Treatment Plant (SCWWTP) with an upgraded chlorine contact basin for disinfection and effluent pump station to convey peak flows to the proposed Ione Canal Reservoir;
- Expansion of ARSA secondary effluent disposal system sites on existing sites/ranches, new disposal sites, or a combination of existing and new sites;
- Rehabilitation and replacement of portions of the ARSA pipeline to assure long-term viability;
- Construction of a new dam and reservoir at the proposed Ione Canal site; and
- Construction of related pipeline facilities both to and from the Ione Canal Reservoir to allow for operational flexibility.

2.1 WWTP Improvements

Improvements will be required at the SCWWTP to replace aging equipment and provide adequate capacity for projected average and peak flows. The alternative requires continued use of the WWTP to treat wastewater to secondary standards. The condition of the existing facilities was discussed in TM #1 and the reasoning behind the rehabilitation and replacement approach was discussed in TM #3A. Planned improvements are listed below, and include some degree of reuse of existing facilities:

- A new influent pump station utilizing submersible pumps in a wet well configuration;
- A new, fine screen headworks facility with vortex grit removal process followed by a flowsplit structure;
- Influent emergency storage/flow equalization basin able to return flows to the influent pump station;
- A new, modular, compact, activated sludge treatment facility will be constructed to provide aeration, clarification, and digestion and to facilitate a phased replacement project given the space constraints at the existing site;
- The existing screw press and drying bed will be used for waste solids dewatering;
- A new administration and operations building will be constructed in the northeast portion of the site;
- An emergency stand-by diesel generator with approximately 1.0 megawatt capacity will be provided to permit continued plant operation during a power outage;
- Upgraded chlorine contact basin for disinfection; and
- Effluent pump station to convey peak flows to the proposed Ione Canal Reservoir.

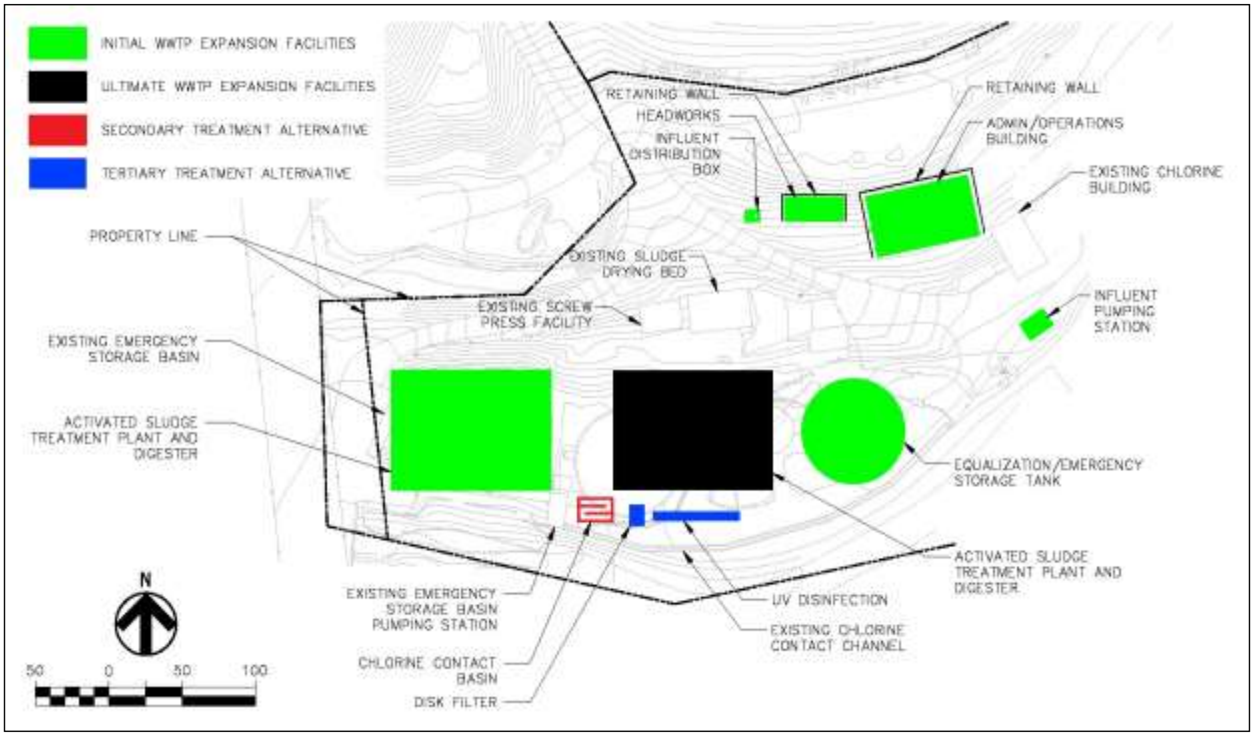


NOTE: SPRAYFIELD SITES ARE POTENTIALLY-AVAILABLE SITES FOR LAND APPLICATION. SEE TEXT FOR MINIMUM REQUIRED SPRAYFIELD ACREAGE AND OPPORTUNITIES FOR PHASED IMPLEMENTATION. NOT ALL SITES SHOWN WILL BE REQUIRED. TM 5 DISCUSSES OTHER SITES INCLUDING CONSOLIDATED SITES THAT COULD BE IMPLEMENTED AS AN ALTERNATIVE TO THESE LOCATIONS.

HydroScience

FIGURE 1
CITY OF SUTTER CREEK AND ARSA
WASTEWATER MASTER PLAN UPDATE
ALTERNATIVE 1: ARSA SPRAYFIELDS

Figure 2: Proposed SCWWTP Expansion Layout



The proposed SCWWTP layout of these improvements is shown in **Figure 2** and the estimated costs are provided in **Table 1**.

Table 1: WWTP Improvements Capital Cost Summary

Description	Cost ($Millions)
Phase I WWTP Improvements	
Contractor Fees, Demolition, and Site Work	1.6
Treatment/Pumping Upgrades/Improvements	7.1
Disinfection Improvements/Chlorine Contact Basin	0.7
Electrical and Instrumentation	1.7
Phase I Subtotal	**11.0**
Contingencies/Overhead (35%)	3.9
Engineering, Admin, and Legal (25%)	2.8
Phase I Total	**17.7**
Buildout WWTP Improvements	
Contractor Fees, Demolition, and Site Work	0.2
Treatment/Pumping Upgrades/Improvements	1.7
Electrical and Instrumentation	0.3
Buildout Subtotal	**2.2**
Contingencies/Overhead (35%)	0.8

Description	Cost ($Millions)
Engineering, Admin, and Legal (25%)	0.6
Midpoint Escalation (3% inflation)	0.6
Buildout Total	**4.2**
Phase I + Buildout	**21.9**

Notes:
1. All costs in October 2017 dollars. Costs for Alternative 1 are based on the comparative estimates presented in TM #4, but are presented broken down into separate line items and allowances.

2.2 Storage Reservoirs

2.2.1 Henderson Reservoir

A condition assessment for Henderson Reservoir was provided in TM #1 of the Henderson Reservoir. The Division of Safety of Dams (DSOD) has jurisdiction over the reservoir dams in the ARSA system. There is a spring bleed-off line beneath the dam that was producing a relatively constant low flow and the reservoir outlet pipe was internally inspected and found to have sections of the bottom of the pipe completely corroded away. DSOD allowed ARSA to temporarily repair the spring bleed-off line with sand in 2013 and the reservoir outlet pipe will be sliplined under the dam and the exposed section will be replaced via open cut trench. The outlet pipe repair design is complete and implementation is expected in the near future.

Sludge accumulation has also impacted storage capacity over time. Removing sludge can provide additional seasonal storage capacity in the reservoir in the interim prior to complete construction of a new reservoir; however, there would not be enough capacity recovered to eliminate the need for a second reservoir. Thus there is no long-term benefit to sludge removal unless there is a delay in construction of the new reservoir. **Table 2** provides the capital cost summary for Henderson Reservoir improvements.

Table 2: Henderson Reservoir Capital Cost Summary

Description	Cost ($Millions)
Reservoir Outlet Improvement[1]	0.5
Sludge Removal	2.6
Contingencies/Overhead (35%)	1.1
Engineering, Admin, and Legal (25%)	0.8
Henderson Reservoir Total	**5.0**

Notes:
1. The reservoir outlet cost was not included in TM#4 as this improvement is underway, but is included here for completeness.
2. All costs in October 2017 dollars. Costs for Alternative 1 are based on the comparative estimates presented in TM #4, but are presented broken down into separate line items and allowances.

2.2.2 Ione Canal Reservoir

It is assumed that the Ione Canal Reservoir would have an earthen dam composed of soils from nearby borrow sites, stormwater diversion facilities to prevent excessive collection of runoff, outlet piping and spillway, a perimeter access road, and electrical facilities. The Ione Canal Reservoir is estimated to have a capacity of 617 acre-feet (AF) of available storage based on examination of available topographic information. It is noted that the proposed reservoir site has been identified and sized based on limited and publicly available information. Thus, field investigation and engineering is required to determine site feasibility, true capacity, required construction methods, and final cost. Initial estimates for reservoir parameters are provided in **Table 3**.

Table 3: Ione Canal Estimated Parameters

Reservoir Parameter	Units	Ione Canal
Dam	Cubic Yard (CY)	344,700
Perimeter	feet	4,400
Surface Area	Acres	16
Volume	AF	617

Construction of the Ione Canal Reservoir will require up to 33 acres of land acquisition. The proposed storage reservoir was shown in **Figure 1**.

To transmit flows from the SCWWTP to the new reservoir, a new 18-inch force main will be required to handle peak day flows from the SCWWTP. The pipeline will be approximately 3,100 feet long.

A new gravity discharge pipeline from the new reservoir back to the ARSA pipeline will feed effluent back into the ARSA system for sprayfield disposal. The pipeline will be a 12-inch pipeline and will be approximately 4,100 feet. It is noted that the size and length is estimated based on limited and publicly-available information. The feasibility of a gravity pipeline and the final sizing and configuration of the pipeline will be determined after detailed topographical survey and geotechnical investigation of the alignment.

Table 4 provides the capital cost summary for Ione Canal Reservoir.

Table 4: Ione Canal Reservoir Capital Cost Summary

Description	Cost ($Millions)
Embankment Cost	8.7
Access Road, Stormwater Bypass	0.8
Outlet Piping, Spillway	1.2
Electrical	0.3
Contingencies/Overhead (35%)	3.9
Engineering, Admin, and Legal (25%)	2.8
Ione Canal Subtotal	**17.1**
Land Acquisition ($17,500/acre)	0.6
Associated Pipelines	4.1
Ione Canal Reservoir Total	**21.8**

Notes:
1. All costs in October 2017 dollars. Costs for Alternative 1 are based on the comparative estimates presented in TM #4, but are presented broken down into separate line items and allowances.

2.3 ARSA Sprayfields

The water balance was evaluated assuming implementation of the proposed Ione Canal Reservoir by 2026. Based on projected flows for 2041, ARSA will need to develop approximately 120 acres of sprayfields to provide adequate effluent disposal. Sprayfield development can be phased over the 25-year planning period, as needed. With the implementation of the 5-year cancellation clause, ARSA will need a disposal method by 2021for the flows that were previously sent to Ione. **Table 5** provides the projected disposal area requirement in 5-year increments for the correlating 5-year projected flows, which were developed and presented in TM #2, and assuming no effluent discharged in Ione by 2021.

Table 5: Projected Sprayfield Requirement to Meet 100-Year RP

	2021	2026	2031	2036	2041
Bowers [1]	36	36	36	36	36
Hoskins	36	36	36	36	36
Additional Sprayfield[2]	91	94	94	101	118
Total	**163**	**166**	**166**	**173**	**190**

Notes:
1. Bowers Ranch is currently 24 acres of flood irrigation and 12 acres of sprayfield, totaling 36 acres. The acreage represents continued use of flood irrigation with expansion of sprayfields to 16 acres for a total disposal area of 40 acres by 2036.
2. It is assumed that, prior to development of the Ione Canal Reservoir, some level of sludge removal from Henderson/I&I reduction will be required in order to accommodate 2021 flows.

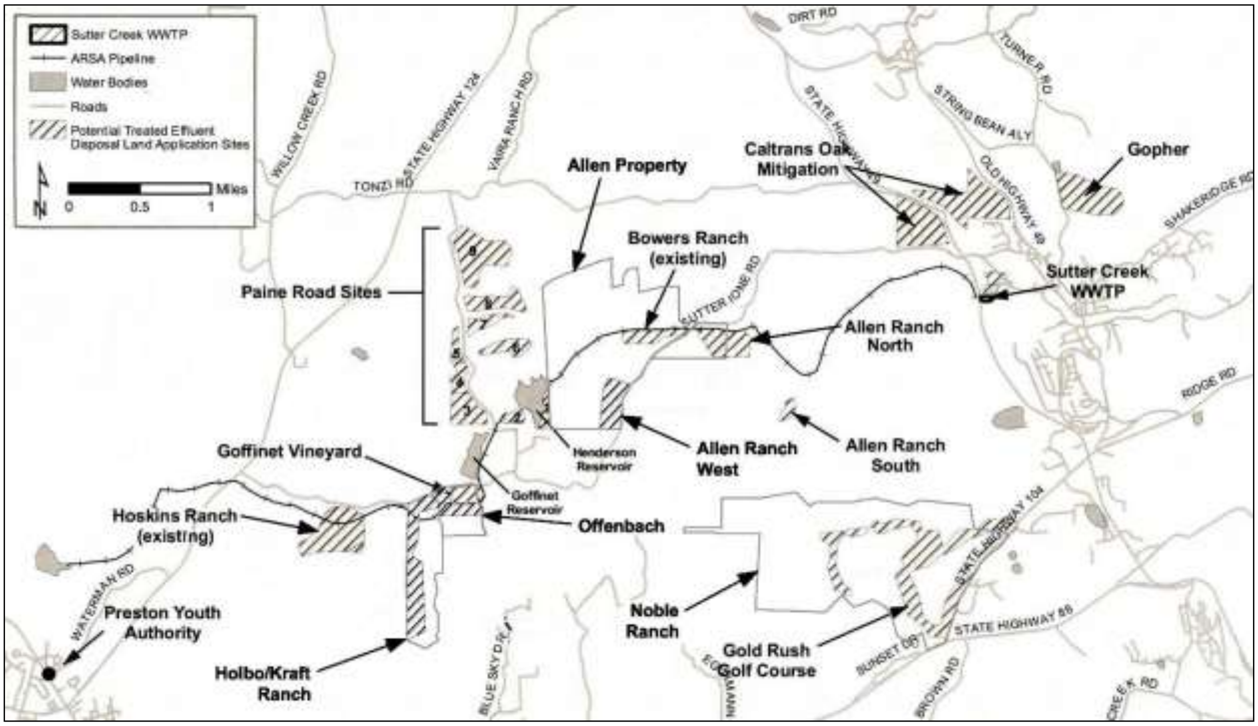
A number of sprayfield options have been identified for potential development along the ARSA pipeline downstream of the proposed Ione Canal Reservoir and around the existing Henderson Reservoir and are presented in **Figure 3**. The location of the Ione Canal Reservoir upstream of potential sprayfields provides maximum operational flexibility for reuse as this allows sprayfields to utilize accumulated seasonal storage during peak demand months. **Table 6** provides a list of the identified disposal sites and their respective capacities during a 100-year RP annual precipitation.

ARSA can choose to expand existing sprayfields and establish agreements with additional landowners in order to dispose of effluent at multiple ranches or identify a single ranch/land owner that can accept all secondary effluent project through 2041. From an operational perspective, having a single property that can accept the entire volume of secondary effluent is preferred as it minimizes the operations and maintenance (O&M) burden as well as costs related to O&M of multiple disposal fields. The total area required for disposal of projected 2041 flows is 193 acres. Of the sites identified in **Table 6**, there are three properties that can accommodate the entire disposal need including Paine Road, Finley Ranch, and the Bryson Cattle Company.

In addition, providing all disposal sites within upper Henderson would eliminate the need for the lower Henderson pipeline extending to Hoskins Ranch and thereby any improvements to that segment of pipeline.

Sprayfield development is estimated at $15,000/acre plus 25% to cover engineering, administration, and legal fees. **Table 7** provides the cost to supplement the existing sprayfields with the buildout acreage needed and the cost to abandon the existing disposal sites and develop all sprayfields on a single site.

Figure 3: Existing and Potential Sprayfield Sites



Source: Modified from 2010 WWTP Draft EIR

Table 6: Potential Sprayfields and Disposal Capacities during 100-Year Return Period

Disposal Site	Disposal Type	Pipeline Required	Pumping Required	Acres	Can Meet 2041 Flow
Bowers Ranch (buildout)	Flood irrigation of pasture land	-	-	24	No
	Spray irrigation of pasture land	-	Yes	16	No
Hoskins Ranch (buildout)	Spray irrigation of pasture land along ARSA pipeline	-	-	60	No
Allen Ranch North	Tree irrigation along ARSA pipeline	0.1 mi	No	32	No
Allen Ranch West	Spray irrigation of pasture land	0.5 mi	Yes	40	No
Paine Road	Spray irrigation of pasture land along ARSA pipeline	1.0 mi	Yes	197	Yes
Holbo Ranch Wildlife Sanctuary	Wildlife drinking water, pasture land irrigation along ARSA pipeline	0.1 mi	No	20	No
Offenbach	Spray irrigation of pasture land along ARSA pipeline	0.1 mi	No	6	No
Goffinet Vineyard	Existing and expanded vineyard irrigation along ARSA pipeline	0.1 mi	Yes	40	No
Finley Ranch	Spray irrigation of ranch land	Yes	Yes	500	Yes
Bryson Cattle Co.	Spray irrigation of ranch land	Yes	Yes	300	Yes

Source: Modified from 2010 SC WWMP

Table 7: Sprayfield Development Capital Cost Summary Options

Description	Cost ($Millions)
Maintain Existing Disposal Sites and Develop Additional 118 acres	1.8
Engineering, Admin, and Legal (25%)	0.5
Total Cost to Supplement Existing Sprayfields	**2.3**
Abandon Existing Disposal Sites and Develop Total 190 acres	2.9
Engineering, Admin, and Legal (25%)	0.7
Total Cost to Abandon Existing Sprayfields and Construct New Site	**3.6**

Notes:
All costs in October 2017 dollars. Costs for Alternative 1 are based on the comparative estimates presented in TM #4, but are presented broken down into separate line items and allowances. An alternative approach to abandon the existing disposal sites and develop a single site is presented as a refinement to Alternative 1, and will be carried forward to the CIP recommendation.

2.4 ARSA Pipeline

For implementation of the selected alternative, the ARSA pipeline will remain in service. As such, it will be necessary to replace or rehabilitate the pipeline to meet long term disposal needs. The gravity pipeline from the SCWWTP to Henderson Reservoir will need to be upgraded to a 27-inch pipeline phased over the 25-year planning period. The length of pipeline is approximately 20,500 feet.

The lower Henderson pipeline to Hoskins Ranch is approximately 9,600 feet. Upon decommissioning of the Hoskins sprayfield, the ARSA pipeline from Henderson Reservoir to Hoskins Ranch will no longer be required and can also be decommissioned and abandoned in place. Portions of the lower Henderson pipeline may be required to feed selected sprayfields.

In the event that the Hoskins Ranch disposal field remains in service, the existing 30-inch pipeline from Henderson to Hoskins Ranch will be sliplined or replaced with a new 15-inch pipeline over the 25-year planning period.

It is noted that the proposed diameters for the two pipeline segments are based on limited and publicly available information. A more detailed design will determine final recommended pipeline sizes based on a detailed topographic survey of the alignment.

ARSA pipeline improvements are estimated at $23/inch-diameter-foot (in-ft) for gravity pipeline and $20/in-ft for pressure pipe. **Table 8** provides the cost to improve/replace the ARSA pipeline.

Table 8: ARSA Pipeline Improvement Capital Cost Summary

Description	Cost ($Millions)
27" Gravity Pipeline (SCWWTP to Henderson)	10.7
15" Gravity Pipeline (Henderson to Hoskins)	3.3
Removal of Existing Pipeline (5%)	0.7
Engineering, Admin, and Legal (25%)	3.5
Contingencies/Overhead (35%)	4.9
Estimated Replacement Cost	**23.1**

Assuming Lower Henderson is abandoned (including Hoskins Ranch), then the pipeline improvements will only need to by complete up to the Henderson Reservoir, resulting in some cost savings. The total to replace only the Upper Henderson portion would be $17.7M.

2.5 Capital Cost Summary

The capital cost summary for the entire project is provided in **Table 9**. These costs assume that existing sprayfields will be abandoned and a single site will be developed.

Table 9: Total Project Capital Cost Summary

Description	Cost (Millions)
Phase I WWTP	17.7
Buildout WWTP	4.2
Henderson Reservoir Total	5.0
Ione Canal Reservoir Total	21.8
Total Cost to Abandon Existing Sprayfields and Construct New Site	3.6
Estimated ARSA Pipeline Replacement Cost	23.1
Total Capital Costs	**75.4**

3.0 CAPITAL IMPROVEMENT PLAN

Provided below in **Table 10** is a CIP schedule for the future planned projects to provide long-term management of wastewater effluent. The most critical projects are scheduled for earlier implementation. The required timing of projects may change if the rate of growth changes compared to the projections. Collection system I/I reduction could also help extend the timing of these projects.

Table 10: Proposed CIP Schedule and Budget in Millions ($)

Description	5-Year (2021)	10-Year (2026)	15-Year (2031)	20-Year (2036)	25-Year (2041)
Phase I WWTP	10.6	7.1	0	0	0
Buildout WWTP	0	0	4.2	0	0
Henderson Reservoir	5.0	0	0	0	0
Ione Canal Reservoir Total	0.8	21.0	0	0	0
Sprayfields	1.8	0	0	0.1	1.7
Estimated ARSA Pipeline Replacement Cost (Upper Henderson only)	0	0	3.5	7.1	7.1
Total Capital Costs	**18.2**	**28.1**	**7.7**	**7.2**	**8.8**

4.0 ALTERNATIVE REUSE APPROACHES

The scope of this Master Plan Update was limited to updating the wastewater management (treatment, storage, and disposal) approaches originally evaluated in the 2012 Master Plan with current information. The effluent storage and disposal options addressed by this study include ARSA storage and sprayfield disposal, surface water discharge, and tertiary reuse at GRR. Due to uncertainty regarding the timing of the GRR development and the cost of maintaining and expanding the existing ARSA system, there is value in examining a broader range of effluent reuse options that could augment or replace the existing ARSA sprayfields, offset existing or future potable water uses, and potentially provide a revenue source for ARSA and the City.

If the City and ARSA are interested in examining additional reuse opportunities, a Recycled Water Feasibility Study would be the recommended next step. The elements of such a study include:

Recycled Water Market Assessment: This would identify potential users of recycled water within the service area. User types could include: multi-family residential, commercial, industrial, office, schools, parks, highway landscaping, and large irrigation customers; as well as potential off-site users/agencies that may be interested in partnering with ARSA to obtain recycled water. The following would typically be identified for each customer:

- Water quality requirements (secondary, tertiary, or purified)
- Potential recycled water demands including seasonal variability
- Proximity to the WWTP and recycled water conveyance/transport requirements
- Required reliability of the recycled water supply
- Associated seasonal storage requirements
- Readiness and willingness to use recycled water
- Value of the recycled water to the user

The above data would be compiled into a matrix and ranked. In general, larger recycled water users in closer proximity to the WWTP, particularly year-round users requiring little or no seasonal storage to serve, would take precedence over smaller, seasonal recycled water customers farther from the WWTP. However, potential year-round recycled water customers are typically much less common than warm-season irrigation customers.

If desired, opportunities for Indirect Potable Reuse (IPR) could be explored. IPR involves treating wastewater to very high quality standards and introducing it back into the groundwater basin via recharge ponds or direct injection. Typically, reverse osmosis and advanced disinfection is required, and the feasibility depends on treatment affordability, hydrogeological conditions in the area, regulatory acceptance, and proximity of down-gradient beneficial uses of groundwater.

Legal/Institutional Analysis: This would address potential water rights issues, legal, and institutional requirements for implementation, the need for multi-jurisdictional agreements and permits, and any potential unresolved issues that could delay or impede implementation. A plan would be developed for addressing these issues. In this case, legal and institutional issues related to Amador Water Agency, the current water retailer for the region, and duplication of service would need to be examined.

Recycled Water Supply Analysis: This would determine the availability of recycled water and associated treatment, conveyance, and storage requirements to serve Phase 1 customers. The flow projections, future storage volumes, and disposal acreage amounts from this Master Plan would inform the analysis. The ability of the identified feasible recycled water customers to reliably utilize all of the effluent produced by the City and ARSA would be considered. Seasonal storage requirements associated with Phase 1 customers would be identified and compared to available storage sites (Henderson and Ione Canal Reservoirs), and the location and elevations of those reservoirs relative to points of use would be considered.

The City and ARSA could purse grant funding to help pay for this Feasibility Study. The California State Water Resources Control Board administers the Water Recycling Funding Program (WRFP) to promote the beneficial use of recycled water. The program reimburses up to 50% of planning costs, or a maximum of $75,000, for eligible studies.

Given the timing of Ione's stated intent to withdraw from the ARSA Agreement, and the projected future shortfalls in storage and disposal capacity identified herein, a grant application should be filed as soon as possible in order to facilitate identification of a feasible recycled water approach and any required interim wastewater management strategies at the earliest possible time.

HYDROSCIENCE ENGINEERS, INC., is a civil engineering firm that plans, designs, and manages the construction of water, wastewater, recycled water and stormwater projects. With offices in Sacramento, Berkeley, San Jose, and Concord, we understand and address the complex water and wastewater needs of California.

SACRAMENTO
10569 Old Placerville Road
Sacramento, CA 95827
916.364.1490

BERKELEY
741 Allston Way
Berkeley, CA 94710
510.540.7100

SAN JOSE
1922 The Alameda, Suite 212
San Jose, CA 95126
408.363.3884

CONCORD
1800 Sutter Street, Suite 590
Concord, CA 94520
925.332.5221

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Strategic Water Solutions

WWW.HYDROSCIENCE.COM
www.hydroscience.com