Winters Wastewater Treatment Facility Master Plan Update
April 26, 2016

CITY OF WINTERS
california
Est. 1875

LARRY WALKER ASSOCIATES

Purpose and Goals

Provide a roadmap for guiding and addressing wastewater treatment facility needs through 2035.

- 1996 Wastewater Treatment Facilities Master Plan
  - 2001 Supplemental Report
  - Draft 2007 Wastewater Treatment Facilities Master Plan
- Work in conjunction with Sewer Collection System Master Plan
- Meet wastewater treatment needs for next 20 years
- Promote recycled water use

Solar Array
Pond No. 1
Stage 2 Pond No. 2
Stage 2 Pond No. 1
Stage 1 Pond No. 1
Stage 1 Pond No. 2
Polishing Pond
North Spray Field
Pond No. 2
Pond No. 3
Irrigation P.S. No. 1
Recycle/Transfer P.S.
South Spray Field
Pond No. 4
N
W
E
S
0 0.05 0.1 0.2
Miles

Key Differences between 1996 and 2016 Master Plans

Parameter	1996 Plan	2016 Plan
Population	4,778 (1991)	6,979 (2014)
Design population	12,500 (2010)	8,800 (2035)
Design per capita wastewater generation rate (gal/day/person)	130	85
Average wastewater flow (million gallons per day [MGD])	0.62 (1991)	0.59 (2014)
Design capacity (MGD)	0.70	0.92
Proposed design capacity (MGD)	1.62	0.92
Wastewater disposal	Spray fields	Agricultural irrigation/ spray fields

Alternatives Evaluated

Alternative	Treatment Level	Pond 1	New Ponds	Existing Ponds
1A	Secondary	Full	Lined	Unlined
1B	Secondary	Full	Lined	Lined
2A	Secondary	Empty	Lined	Unlined
2B	Secondary	Empty	Lined	Lined
3A	Partial Tertiary	Empty	Lined	Lined

Key assumptions

- Full water recycling
- Design for 100-year annual rainfall

Water Balance

Alternative 1A Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	3.6	4.43	6.9	7.9	12.7	0.0	-1.7	0.0	110.5
Nov	0.825	24.8	6.12	9.5	2.31	3.6	7.9	6.6	0.0	16.2	16.2	94.3
Dec	0.776	24.1	10.08	15.7	1.71	2.7	7.9	0.0	0.0	29.2	45.3	65.1
Jan	0.700	21.7	11.48	17.9	1.71	2.7	7.9	0.0	0.0	29.0	74.3	36.2
Feb	0.801	22.4	9.30	14.5	2.46	3.8	7.9	0.0	0.0	25.2	99.5	11.0
Mar	0.759	23.5	6.64	10.3	4.09	6.4	7.9	9.9	0.0	9.7	109.2	1.3
Apr	0.761	22.8	3.02	4.7	5.61	8.7	7.9	13.6	0.0	-2.7	106.5	4.0
May	0.736	22.8	1.23	1.9	7.50	11.7	7.9	18.1	0.0	-13.0	93.5	17.0
Jun	0.695	20.8	0.33	0.5	8.58	13.3	7.9	34.0	0.0	-33.9	59.6	50.8
Jul	0.735	22.8	0.05	0.1	9.55	14.9	7.9	37.8	0.0	-37.7	21.9	88.6
Aug	0.683	21.2	0.09	0.1	8.53	13.3	7.9	33.8	0.0	-33.6	-11.7	122.2
Sep	0.806	24.2	0.52	0.8	6.27	9.8	7.9	17.9	0.0	-10.6	-22.3	132.8
Total		273	51.2	79.7	62.8	97.6	94.9	184.4	0.0	-24.1		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is full at beginning of wet season		
Wastewater Generation Rate	85	gpcd
Population	8,800	people
Existing Pond Surface Area	32.5	acres
New Pond Surface Area	9	acres
Existing Storage	288	acre-ft
New Storage Required	51	acre-ft
Orchard Irrigation Area	162	acres
Spray Field Irrigation	0	MG

Storage Pond Needs

Alternative	Existing (ac-ft)	Phase I Addition (ac-ft)	Phase II Addition (ac-ft)	Total (ac-ft)
1A	288 (1)	51	0	339
1B	288 (1)	91	91	561
2A	380	0	0	380
2B	380	23	0	403
3A	380	0	0	380

(1) Assumed that Pond 1 is maintained to be full

Recycled Water and Costs*

Alternative	Volume of Recycled Water (ac-ft)	PW Capital Costs ($)	PW O&M Costs ($)	Total Present Worth Cost ($)
1A	570	$2.5M	$5.6M	$8.1M
1B	800	$7.8M	$5.6M	$13.4M
2A	580	$1.1M	$5.6M	$6.8M
2B	830	$4.6M	$5.6M	$10.2M
3A	800	$23.3M	$11.7M	$35.1M

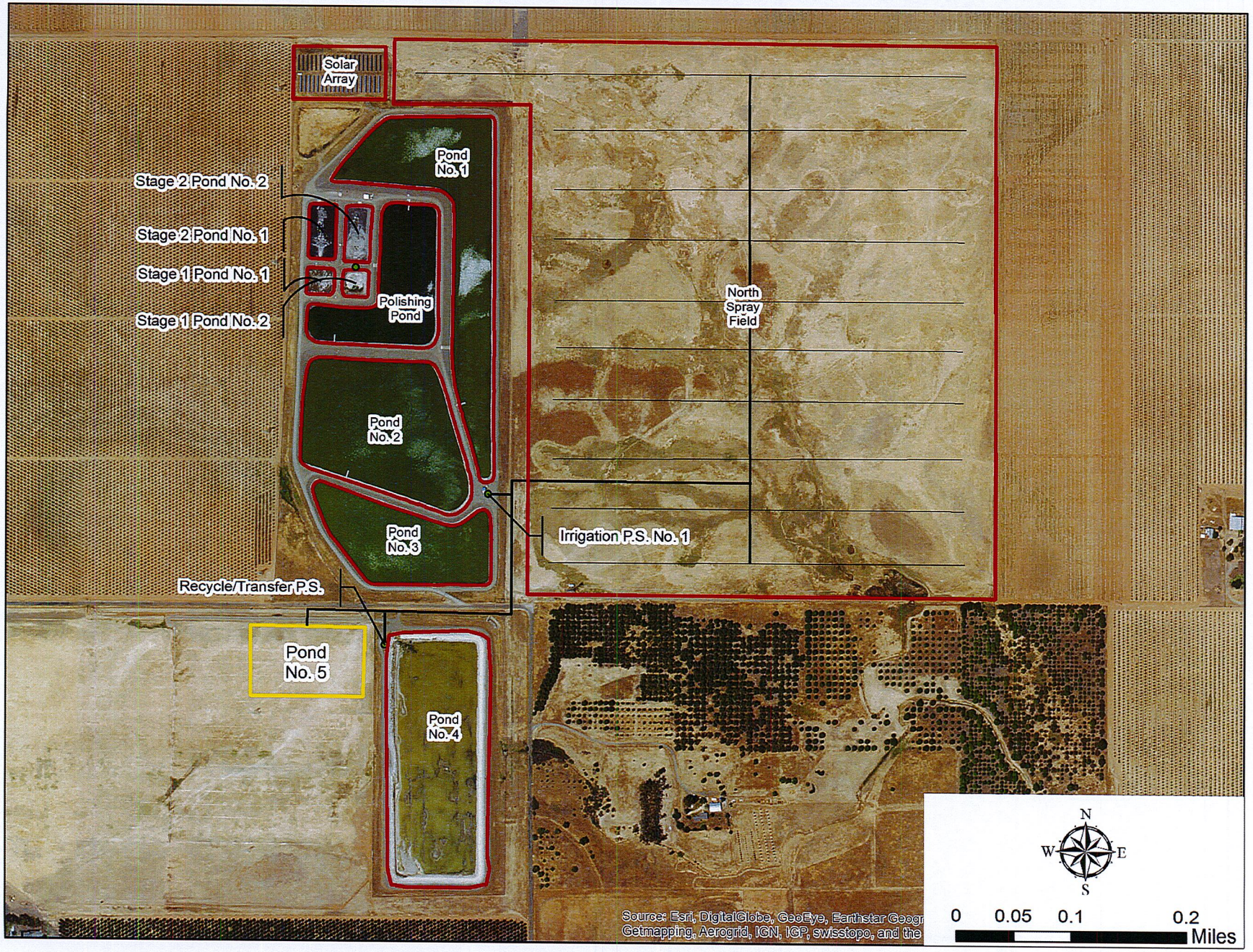
*Costs do not include capital and O&M costs for recycled water distribution pipes

Cost Considerations

- Capital
  - Construction of new storage pond(s)
  - Storage pond lining
  - Transfer/recycled water pump station
  - Equipment replacement
- O&M
  - Labor
  - Chemicals
  - Energy

Alternatives Comparison

Factor	Max	Alternatives				
		1A	1B	2A	2B	3A
Present worth cost	40	35	25	40	30	10
Recycled water production	5	3	5	3	5	5
Spray field land disposition	5	5	3	5	5	5
Ease/reliability of operation	5	5	5	5	5	3
Health, safety, odor risk	5	3	3	3	3	5
Regulatory considerations	20	15	15	15	15	18
Environmental considerations	20	10	14	14	16	18
Total	100	76	70	85	79	64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Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geogr
Getmapping, Aerogrid, IGN, IGP, swisstopo, and the

MARCH 2016

DRAFT

CITY OF WINTERS

Wastewater Treatment Facility Master Plan Update

Prepared by

LARRY WALKER ASSOCIATES

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Appendix A: City of Winters Waste Discharge Requirements Order No. R5-2002-0136

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List of Acronyms

BOD_5	5-day biochemical oxygen demand
BPTC	Best Practicable Treatment and Control
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
ET_0	reference evapotranspiration rate
gpcd	gallons per capita per day
gpm	gallons per minute
hp	horsepower
lb/day	pounds per day
MBR	membrane bioreactor
MG	million gallons
mg/L	milligrams per liter
MGD	million gallons per day
POTW	Publicly-owned treatment works
psi	pounds per square inch
TSS	Total suspended solids
UV	ultraviolet
WDR	Waste Discharge Requirements
WRR	Water Recycling Requirements
WWTF	City of Winters Wastewater Treatment Facility

Executive Summary

The Wastewater Treatment Facility Master Plan Update was prepared to re-evaluate the wastewater treatment facilities necessary to serve the estimated City of Winters (City) population of 8,800 by 2035 and comply with probable regulatory requirements and to identify the apparent best alternative for phased implementation of the facilities.

TREATMENT, RECYCLE, AND DISPOSAL ALTERNATIVES

The City has an ultimate goal of fully recycling its final effluent by providing it to local farmers for crop irrigation. The Wastewater Treatment Facility Master Plan Update identified and evaluated five alternatives that feature different levels of storage pond lining and treatment levels that will allow the City to reach that goal while minimizing, if not eliminating, the use of the existing spray fields for final effluent disposal. Principal features and present worth costs of each alternative considered in this Master Plan Update are summarized in Table ES-1.

Table ES-1. Comparison of Facility Requirements for Treatment and Recycle/Discharge Alternatives

Component	Alternative				
	1A	1B	2A	2B	3A
Treatment Process	Aerated ponds	Aerated ponds	Aerated ponds	Aerated ponds	Tertiary MBR
Storage Pond Lining	New only	All ponds	None	All ponds	All ponds
Effluent Recycle/Disposal	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle
Storage Volume (acre-feet)					
Existing	288 (1)	288 (1)	380	380	380
Phase 1 – New	51	91	0	23	0
Phase 2 – New	0	91	0	0	0
Total	339	561	380	403	380
Spray Field Usage (acres) (2)					
Existing	133	133	133	133	133
Phase 1	-40	-40	-40	-40	-40
Phase 2	-93	-93	-93	-93	-93
Total	0	0	0	0	0
Water Recycling Volume (acre-feet)	570	800	580	830	800
Present Worth Cost (3)	$8,163,000	$13,406,000	$6,766,000	$10,232,000	$35,050,000

(1) For this alternative, it is assumed that Pond 1 is full and provide zero storage capacity at the beginning of the wet season.

(2) Before the City moves towards full recycling, the spray fields will continue to be necessary to dispose of final effluent in excess of recycled water demand. Once the City

fully recycles all its final effluent, it may be possible to identify alternative uses for the spray fields.

(3) Present worth costs do not include the costs associated with installing recycled water conveyance facilities. The City needs to identify recycled water users prior to sizing and designing this system.

ANALYSIS OF ALTERNATIVES

The various alternatives are compared by means of the ranking matrix presented in Table ES-2 in which numeric scores are assigned to each alternative for various monetary and non-monetary factors. Scoring is based on a combination of field experience, published information, regulatory knowledge, and best professional judgment.

Table ES-2. Summary Comparison of Alternatives Ranking

Factor	Alternative					
	Maximum	1A	1B	2A	2B	3A
Present worth cost	40	35	25	40	30	10
Recycled water production	5	3	5	3	5	5
Spray field land disposition	5	5	3	5	5	5
Ease/reliability of operation	5	5	5	5	5	3
Health, safety, odor risk	5	3	3	3	3	5
Regulatory considerations	20	15	15	15	15	18
Environmental considerations	20	10	14	14	16	18
Total	100	76	70	85	79	64

APPARENT BEST ALTERNATIVE

The apparent best alternative will depend on the need to line existing storage ponds to achieve Best Practicable Treatment and Control (BPTC). If the Central Valley Regional Water Quality Control Board determines through a BPTC Evaluation that lining of existing storage ponds is not required, then Alternative 2A is the preferred alternative based on its low cost and highest overall ranking. However, if lining of the existing storage ponds is required to achieve BPTC, then Alternative 2B becomes the preferred alternative.

Introduction

BACKGROUND

The City of Winters (City) owns and operates the Wastewater Treatment Facility (WWTF), which provides treatment and disposal of wastewater from approximately 7,000 residents in the City. The City most recently updated its Sewer Master Plan – Wastewater Treatment Facilities in August 1996 (1996 Master Plan). The 1996 Master Plan outlined a three-phase implementation plan to update wastewater treatment and disposal facilities to meet the needs of a design population of 12,500 by 2010. The City implemented Phases 1A and 1B of the 1996 Master Plan in 2001 and 2002, respectively, which increased the rated average dry weather design flow of the WWTF to 0.96 million gallons per day (MGD).

Subsequent to the 1996 Master Plan, the City prepared a draft Wastewater Facilities Master Plan Update in January 2007 (2007 Draft Master Plan). The 2007 Draft Master Plan was developed to re-evaluate the wastewater treatment and disposal facilities necessary for a design population of 12,500 in addition to complying with potential regulatory requirements that could have been imposed on the City based on groundwater study findings and developments in treatment process technology. The 2007 Draft Master Plan outlined multiple alternatives ranging from expansion of existing treatment and disposal facilities to upgrading treatment technologies to allow for alternative disposal options. Due to overall economic conditions beginning in late 2007, land development in the City slowed significantly, and growth expectations were not realized.

PURPOSE

As economic conditions have improved in recent years, land development activity in the City has started to increase with new development being planned and initiated. To meet future growth expectations and expand recycled water opportunities, the City is re-evaluating the WWTF to determine how to expand and/or upgrade the existing treatment and disposal facilities as part of this Wastewater Treatment Facility Master Plan Update. This update will also consider existing, near-term, and potential long-term regulatory requirements in developing and identifying the apparent best alternative for implementation.

This update is organized into the following sections:

- Description of existing facilities and conditions
- Assessment of regulatory requirements that may affect decisions regarding treatment and discharge/water recycling alternatives
- Development of design considerations
- Identification and development of wastewater treatment and disposal facilities alternatives to accommodate future needs, including preliminary site layouts, design criteria, and planning level capital and operating costs
- Analysis of alternatives by comparison of total present worth costs and non-monetary factors
- Selection of a recommended alternative and description of a plan for phased implementation of the recommended facilities.

Existing Facilities and Conditions

The WWTF treats wastewater through a two-stage aerated pond system that includes a polishing pond and chlorination facilities for disinfection. Final effluent can be stored in four storage ponds, disposed of on 170 acres of spray fields, or provided as recycled water to local farmers for crop irrigation. A site map identifying the location and configuration of existing facilities is presented in Figure 1. Design data and rated capacities for existing treatment and storage/recycle/disposal facilities are presented in Table 1 and Table 2, respectively.

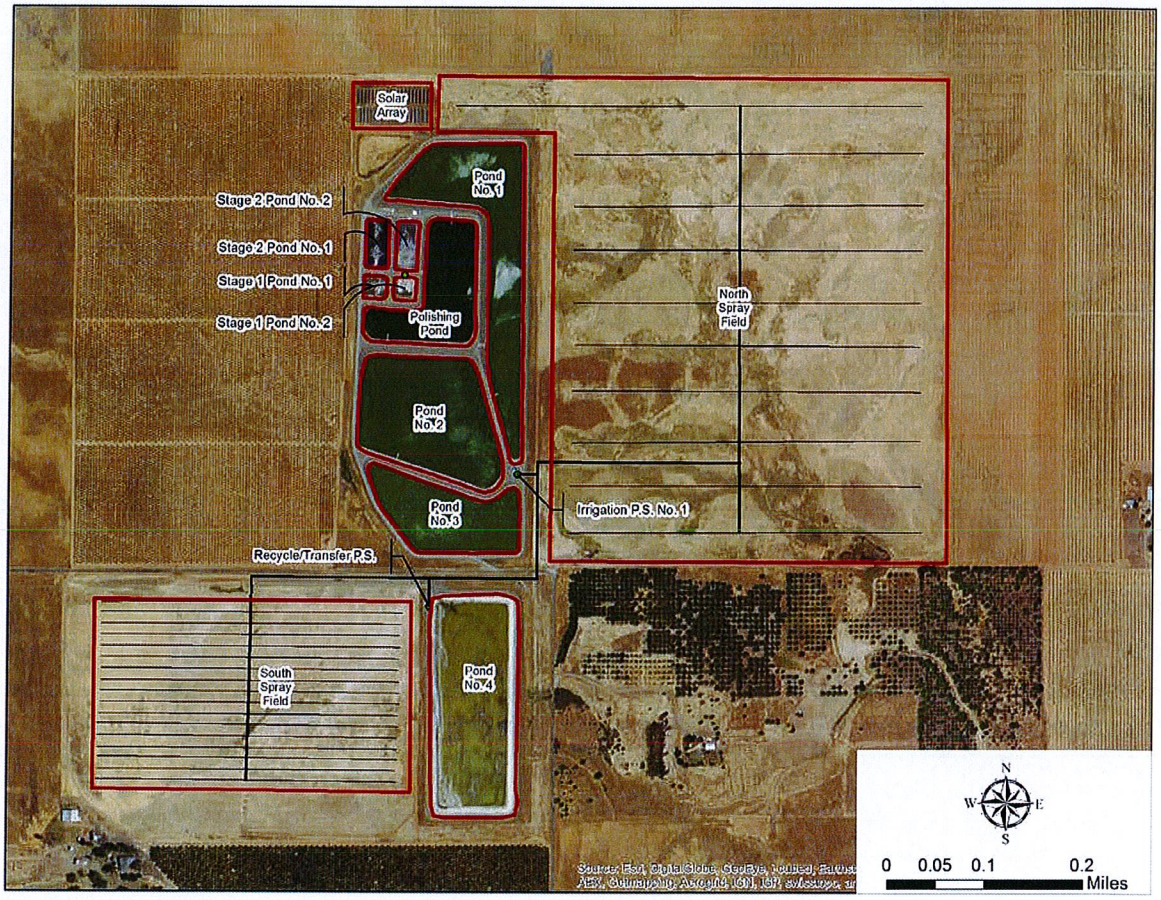

Figure 1. Site Map of Current Winters Wastewater Treatment Facility

Table 1. Design Criteria for Existing Treatment Facilities

Parameter	Unit	Value
Flow		
Current (2014)	MGD	0.59
Average dry weather design capacity	MGD	0.92
Peak wet weather capacity	MGD	6.0
Influent pump station (East Street)		
Number of pumps	ea	3
Horsepower	hp	1 @ 47 2 @ 88
Pump capacity	gpm	1 @ 475
Flow meter capacity	MGD	3.7
Aerated Pond Stage 1 (Primary)		
Number of ponds	ea	2
Aerators per pond/unit horsepower	ea/hp	1 @ 25
Oxygen transfer capacity per pond	lb/day	1,560
Volume per pond	MG	0.68
Depth	ft	10
Aerated Pond Stage 2 (Secondary)		
Number of ponds	ea	2
Aerators per pond/unit horsepower	ea/hp	2 @ 10
Oxygen transfer capacity per pond	lb/day	720
Volume per pond	MG	1.2
Depth	ft	10
Polishing Pond		
Number of ponds	ea	1
Surface area	acres	5.0
Pond re-aeration rate	lb/day	500
Volume	MG	14.6
Disinfection System		
Type	–	Hypochlorite
Capacity	gal/hr	10.5

Table 2. Design Criteria for Existing Storage and Water Recycling/Disposal Facilities

Parameter	Unit	Value
Storage Ponds		
Number of ponds	ea	4
Pond Area		
Pond No. 1	acre	10.8
Pond No. 2	acre	10.4
Pond No. 3	acre	6.1
Pond No. 4	acre	16.0
Pond Volume		
Pond No. 1	acre-ft	92
Pond No. 2	acre-ft	95
Pond No. 3	acre-ft	53
Pond No. 4	acre-ft	140
Irrigation Pump Station		
Number of pumps	ea	2
Horsepower per pump	hp	75
Capacity per pump	gpm	1,200
Transfer/Tailwater Pumping Station		
Number of pumps	ea	2
Horsepower per pump	hp	15
Capacity per pump	gpm	1,200
Irrigation System		
North Spray Field		
Area	acre	130
Type of distribution system	–	buried solid-set
Type of sprinklers	–	big-gun impact
Capacity per sprinkler	gpm	324 @ 60 psi
Number of sprinklers	ea	104
South Spray Field		
Area	acre	40
Type of distribution system	–	surface aluminum
Type of sprinklers	–	1-nozzle impact
Capacity per sprinkler	gpm	10.7 @ 60 psi
Number of sprinklers	ea	448

Design Conditions

Future wastewater facilities must be designed to accommodate projected wastewater flows and loadings from all discharge sources. To estimate the volume of wastewater that must be treated and disposed of by the WWTF during the next 20 years (i.e., 2035), water balances were conducted based on two wastewater generation rates to determine if the current WWTF has the capacity to handle the anticipated volume of wastewater. Based on that analysis, a wastewater generation rate was selected for this Master Plan update. This section also discusses near-term and long-term regulatory requirements that may impact the City's operation of the WWTF and presents design criteria used for developing the alternatives.

WATER BALANCE

Water balances were developed to identify the range of volumes of wastewater that the WWTF may need to treat and dispose of by 2035. An initial set of water balances were developed using two wastewater generation rates based on recent data, current and projected water recycling and irrigation rates, local precipitation and evaporation rates, seepage rates, and projected future population. These wastewater generation rates were evaluated to determine the appropriate design wastewater generation rate that was used to develop alternatives for improving the WWTF to manage future needs.

Wastewater Inflow

Water balances designed to identify future needs are typically based on projected population and an expected wastewater generation rate.

Projected 2035 Population

In January 2014, the United States Census Bureau estimated that the population of the City was approximately 6,979. Between 2007 and 2013, the City's population only grew at an average annual rate of 0.1 percent due to the economic conditions beginning in late 2007 that significantly impacted land development in the City. Over the last few years as economic conditions have improved, land development activity in the City has increased with new development being planned and initiated. The City currently anticipates adding approximately 619 housing units and 30 apartment units over the next 20 years.

Census data from 2013 also indicates that the average household size in the City was approximately 2.82 persons per household.[1] Based on the anticipate addition to housing stock over the next 20 years and the average household size, the estimated population of the City in 2035 is approximately 8,800. This corresponds to an annual population growth rate of 1.1 percent.

[1] United States Census Bureau. 2009-2013 American Community Survey 5-Year Estimates, Winters, California. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk, Last accessed September 24, 2015.

Wastewater Generation Rate

A wastewater generation rate of 130 gallons per capita per day (gpcd) was used in the development of the 2007 Draft Master Plan. This design generation rate included an allowance for potential future commercial and industrial discharges. In June 2014, a wastewater generation rate analysis was conducted using influent wastewater flows to the WWTF between January 2007 and April 2014 and recent population information data. This analysis yielded an updated wastewater generation rate of 102 gpcd.[2] A major reason for the reduced wastewater generation rate was reduced sewer infiltration and inflow as a result of sewer system improvements. Between 2012 and 2013, the City, through its Capital Improvement Program (CIP), rehabilitated and/or replaced approximately 17,000 feet of sewer lines in older neighborhoods. This project, which was completed in early 2013, reduced inflow, infiltration, and exfiltration of wastewater to the WWTF from approximately 0.063 MGD to 0.017 MGD.

Since the June 2014 analysis, drought conditions in California have worsened and mandatory water conservation efforts were implemented that resulted in a significant reduction in overall influent wastewater flows to the WWTF. While the maximum three-month moving average influent flow rate used to develop the wastewater generation rate in June 2014 has remained relatively constant (0.709 MGD February-April 2014 vs. 0.708 MGD December 2014-February 2015), mandatory water conservation requirements were not implemented until after the wet season in 2015. A comparison of the average dry weather influent flow reveals a decrease from 0.503 MGD (June-August 2014) to 0.375 MGD (May-July 2015), which is likely due to the effect of mandatory water conservation measures. Although extrapolating the maximum three-month moving average influent flow based on reduction in average dry weather influent flow is not ideal, it provides an indication of how the wastewater generation rate may decrease with the current mandatory water conservation measures. Based on this extrapolation, the estimated maximum three-month moving average influent flow rate is 0.528 MGD, which translates into a wastewater generation rate of 75 gpcd (assuming a population of 7,000).

It is expected that the current drought situation will eventually abate, and mandatory water conservation measures will be relaxed. Although mandatory water conservation measures will be relaxed, it may be reasonable to expect that the overall future water usage (and wastewater generation rate) will not reach its pre-drought conditions. Based on this assumption, the two wastewater generation rates used to develop water balances as part of this Master Plan update are 85 gpcd, which represents an approximate midpoint between the pre- and post-mandatory water conservation conditions, and 102 gpcd, which represents the pre-mandatory water conservation condition. These wastewater generation rates assume a proportional increase in commercial and industrial discharges relative to the current conditions.

Estimated Future Influent Wastewater Flow Rates

Influent wastewater flow rate to the WWTF varies on a month-to-month basis due to factors including, but not limited to, seasonal events and businesses, precipitation, and inflow and

[2] Larry Walker Associates. Per Capita Wastewater Generation Rate Analysis Technical Memorandum. June 16, 2014.

infiltration. Using data collected between January 2012 and July 2015, the average daily influent flow rates and average monthly wastewater volumes are presented in Table 3.

Table 3. City of Winters Monthly Influent Wastewater Flow Characteristics

Month	Average Daily Influent Flow (MGD)	Average Total Influent Volume (MG)	% of Annual Volume
January	0.533	16.5	7.9%
February	0.605	17.1	8.2%
March	0.578	17.9	8.6%
April	0.580	17.4	8.4%
May	0.561	17.4	8.4%
June	0.529	15.9	7.6%
July	0.560	17.4	8.3%
August	0.520	16.1	7.7%
September	0.614	18.4	8.9%
October	0.543	16.8	8.1%
November	0.629	18.9	9.1%
December	0.591	18.3	8.8%
Total		208.1	100%

Assuming a 2035 population of 8,800, the projected annual volumes of wastewater to be treated and disposed of by the WWTF will be 270 MG (average dry weather flow 0.733 MGD) and 324 MG (0.879 MGD) based on wastewater generation rates of 85 gpcd and 102 gcpd, respectively. These volumes of wastewater were used in the initial set of water balances.

Precipitation

Historically, the City receives an annual average of 21.68 inches of precipitation.[3] The City operates the WWTF in compliance with Waste Discharge Requirements (WDR) (Order No. R5-2002-0136), which was issued by the Central Valley Regional Water Quality Control Board (Regional Water Board) in July 2002. A copy of the WDR is included in Appendix A. The WDR (Discharge Specification B.6) requires that "the facility shall have sufficient treatment, storage, and disposal capacity to accommodate allowable wastewater flow and design seasonal precipitation and ancillary inflow and infiltration during the winter months. Design seasonal precipitation shall be based on the total annual precipitation using a return period of 100 years, distributed monthly in accordance with historic rainfall patterns". Using historic precipitation data from the Western Regional Climate Center (1943-2010), the total annual precipitation using a return period of 100 years, which is the annual precipitation expected to occur once every 100 years, or equivalently, the annual precipitation with 1 percent chance of occurring each year, is 51.2 inches. The average monthly precipitation distribution was used to develop a distribution

[3] Western Regional Climate Center (Station 049742). http://www.wrcc.dri.edu (last accessed September 23, 2015).

for precipitation resulting from the 100 year total annual precipitation event, which is presented in Table 4. These precipitation rates are used in the water balances.

Table 4. City of Winters Monthly Precipitation Distribution

Month	Average Precipitation (in)	% of Annual Precipitation	Estimated Monthly Precipitation from 100-year Annual Total (in)
January	4.86	22.4%	11.48
February	3.94	18.2%	9.30
March	2.81	13.0%	6.64
April	1.28	5.9%	3.02
May	0.52	2.4%	1.23
June	0.14	0.6%	0.33
July	0.02	0.1%	0.05
August	0.04	0.2%	0.09
September	0.22	1.0%	0.52
October	0.99	4.6%	2.34
November	2.59	11.9%	6.12
December	4.27	19.7%	10.08
Total	21.68	100%	51.2

The water balances also consider precipitation that falls directly onto the polishing and storage ponds. The polishing pond and four storage ponds have a total surface area of 48.3 acres. In developing the water balances, additional storage may be necessary to accommodate future growth, increase in wastewater flow rates, and the 100-year annual precipitation total. The existing surface area of the polishing and storage ponds as well as new surface area of proposed storage pond(s) were used to calculate the volume of water in the ponds generated from precipitation.

Evapotranspiration

Evaporation of water from pond surfaces is based on the reference evapotranspiration rate (ET_0) measured by the California Irrigation Management Information System (CIMIS). CIMIS developed monthly average reference evapotranspiration rates by zones for California.[4] The City, which is located in Zone 14, has the monthly average reference evapotranspiration rates presented in Table 5. Generally, evaporation from pond surfaces typically exceed the reference evapotranspiration rates by approximately 10 percent. For the water balances, calculations are based on 110 percent of the reference evapotranspiration rates. The water balances also consider evapotranspiration of water from the polishing and storage ponds. As stated previously, the surface area of the existing polishing pond and storage ponds as well as new surface area of proposed storage pond(s) were used to calculate the water loss in the ponds due to evapotranspiration.

[4] California Irrigation Management Information System (CIMIS). Reference EvapoTranspiration ET_0 Zones, 1999. http://www.cimis.water.ca.gov/app_theme/images/etozonemap.jpg (last accessed September 23, 2015).

Table 5. City of Winters Monthly Average Reference Evapotranspiration Rate and Evapotranspiration Rates for Water Balances

Month	Monthly Average Reference Evapotranspiration Rate (in)	Monthly Average Evapotranspiration Rate used in Water Balances (in)
January	1.55	1.71
February	2.24	2.46
March	3.72	4.09
April	5.10	5.61
May	6.82	7.50
June	7.80	8.58
July	8.68	9.55
August	7.75	8.53
September	5.70	6.27
October	4.03	4.43
November	2.10	2.31
December	1.55	1.71
Total	57.0	62.8

Seepage

The existing storage ponds are currently not lined, which allows for percolation from the ponds into the subsurface and groundwater to occur. The 2007 Draft Master Plan used seepage rates of 8 inches per month for unlined Ponds 1-3, 4 inches per month for unlined Pond 4, and 1 inch per month for new, lined ponds. These seepage rates were used in developing the water balances.

Effluent Discharge and Recycling

The City currently disposes of its final effluent primarily on approximately 170 acres of spray fields – approximately 130 acres which are located to the east of the WWTF (North Spray Field) and 40 acres which are located to the southwest of the WWTF (South Spray Field). Disposal of final effluent to the spray fields is regulated by the WDR, which limits the application rate based on nitrogen requirements for vegetation, requires setbacks, and prohibits discharge 24 hours before, during, and 24 hours after precipitation events or if the spray fields are saturated. In 2012 and 2013, the City disposed of approximately 144 MG and 161 MG of final effluent at the spray fields, respectively. In 2014 and early 2015, the City significantly reduced the volume of final effluent disposed of in the spray fields because of opportunities for providing recycled water to local farmers.

The City intends to further expand its recycled water delivery capabilities and minimize the use of the spray fields for disposal of final effluent. The City has held discussions with several local farmers who are interested in using final effluent from the WWTF for irrigation of nuts, plums, and grapevines. Recycled water regulations have similar restrictions compared to the WDR on when irrigation can occur. For the purposes of this analysis, it is assumed that the City will provide recycled water to irrigate plum orchards located adjacent to the WWTF. Irrigation

requirements for plums is dependent on the crop coefficient, which varies monthly, and the evapotranspiration rate according to the following equation:

$$ET_c = ET_0 \times K_c$$

ET_c = water use by crop
ET_0 = water use by a reference crop (grass)
K_c = crop coefficient[5]

Because the water balances must be conducted based on 100-year total annual precipitation rates, it is conservatively assumed that recycled water to plum orchards will not occur between December and February, during which the highest precipitation totals are expected, for these water balances. Limited recycled water will be provided in November and March, which are months where there may still be significant precipitation. Additionally, the water balances assume that final effluent disposal to the spray fields will be minimized by providing recycled water to the extent possible.

Allowable Storage Capacity

The WWTF has a 5-acre polishing pond for settling solids in wastewater from the aerated ponds. Since the polishing pond is part of the treatment process, it will not be counted as part of the available storage capacity at the WWTF. As stated previously, there are four unlined storage ponds at the WWTF that are used to store final effluent prior to disposal in the spray fields. The City typically operates the storage ponds at the WWTF such that Ponds 2-4, which have a combined capacity of 93.8 MG, are empty at the onset of the wet season.[6] Because Pond 1 is operated such that it is not fully empty at the onset of the wet season, it is not considered as part of the available storage for the water balances. It should also be noted that the City must maintain a minimum two-foot freeboard for each pond.

Water Balance Summary

A water balance is a calculation of the difference between the water entering a system and water leaving the system with the difference representing the change in the amount of water stored in the ponds, ΔS. The inflows to the WWTF include the wastewater generated in the City (including inflow and infiltration) and precipitation directly into the storage ponds, Q_{inf} and $Q_{precipitation}$, respectively. The outflows include evapotranspiration, seepage, and water recycling, Q_{evap}, Q_{seep}, and $Q_{recycle}$, respectively. The calculation is as follows:

$$Q_{inf} + Q_{precipitation} - Q_{evap} - Q_{seep} - Q_{recycle} = \Delta S$$

ΔS is added to the previous total pond storage to determine the new volume in the storage ponds. Water balances based on the assumptions discussed above are presented in Appendix B.

In the water balance assuming a wastewater generation rate of 85 gpcd, a storage deficit of 8.9 MG would occur in April following the extended period of limited to no recycled water

[5] Food and Agriculture Organization of the United Nations. *FAO Mean Crop Coefficients for Subhumid Climates.* http://texaset.tamu.edu/cropcoe.php#FruitTrees (last accessed October 27, 2015).

[6] Communication with Jim Keating. July 24, 2015.

distribution and wet-season precipitation. Under this scenario, to meet the 2035 design conditions the City would need provide an additional storage pond with a surface area of approximately 9.0 acres assuming an average storage depth of 8.5 feet (a minimum 2-foot freeboard must be maintained). For comparison, if the City operated the WWTF such that Pond 1 was empty at the onset of the wet season, there would be adequate storage with the existing storage ponds.

In the water balance assuming a wastewater generation rate of 102 gpcd, a storage deficit of 30.4 MG would occur in April. Under this scenario, to meet the 2035 design conditions the City would to provide additional storage pond(s) with a surface area of approximately 15 acres assuming an average storage depth of 8.5 feet (a minimum 2-foot freeboard must be maintained).

As discussed previously, the wastewater generation rate of 102 gpcd was determined in 2014 prior to implementation of water use reduction requirements due to the current drought conditions. Based on recent data following the implementation of water use reduction, the wastewater generation rate may be as low as 75 gpcd. When the drought period ceases and mandatory water use restrictions are relaxed, the wastewater generation rate will likely increase from 75 gpcd, but seems unlikely to reach the pre-drought rate. For the purpose of this Master Plan update, the wastewater generation rate of 85 gpcd will be used to plan future WWTF requirements to manage wastewater through 2035.

REGULATORY REQUIREMENTS

Expansion of the capacity of the WWTF will require the WDR to be updated to reflect changes in capacity and treatment processes. Requirements under a new WDR will reflect any changes in Regional Water Board policies since the current WDR was issued in 2002. Prior discussions with Regional Water Board staff indicate that current policies must be followed and considered when identifying alternatives for expansion. Since the adoption of the City's WDR, the Regional Water Board has updated its areas of emphasis for regulating treatment and disposal of wastewater. Two areas of changes to regulations and emphasis are related to groundwater protection, specifically related to salts and nutrients, and recycled water.

The Regional Water Board determined that salt and nutrients may be pollutants of concern in groundwater. High concentrations of salts in groundwater that is used as a water supply can potentially damage vegetation if used for irrigation. Recent wastewater discharge permits have included provisions requiring source identification of salts to wastewater, and if high concentrations of salts are observed in final effluent, municipal agencies have been required to implement salt minimization measures. High concentrations of nutrients, specifically nitrate and nitrite, in groundwater that is used as a water supply can cause methemoglobinemia, or blue baby syndrome, in infants.

The Regional Water Board has determined that unlined treatment ponds, aerated lagoons, storage reservoirs may not be considered best practicable treatment and control (BPTC). Under Provision G.1.f of the WDR, BPTC must be provided if degradation to groundwater has been observed as a result of the permitted discharge. If groundwater degradation is found to be the result of WWTF operation, the requirement for BPTC would be imposed by the Regional Water Board in a new WDR. Based on requirements imposed in recent WDRs for other municipalities, the Regional Water Board may consider either pond lining, advanced secondary treatment with nitrogen removal, or tertiary treatment to be BPTC for the land application system currently

employed at the WWTF. The evaluation of BPTC is a facility-specific evaluation. Thus, it is difficult to determine what may be required in advance of the Regional Water Board's final determination. However, based on the Regional Water Board's current practices, it is possible that a new WDR for the continuation of the effluent storage and recycle system at the WWTF may require some type of storage pond lining or a higher level of treatment or both to mitigate potential impacts to groundwater.

As the current drought conditions have become progressively more severe, California has further emphasized increasing the use of recycled water to help supplement and preserve the water supply and mitigate overuse of groundwater supplies, which have resulted in subsidence. The State Water Resources Control Board (State Water Board) implemented a new recycled water policy in 2013 that outlines the requirements for gaining approval for and implementing recycled water programs and identifies the process for streamlining the permitting process. Following a realignment of state agencies, recycled water programs are now regulated by the Division of Drinking Water (formerly regulated by the California Department of Public Health) in conjunction with the Regional Water Board. Because of the emphasis on increasing the use of recycled water, California periodically provides grant funding as well as loans to assist municipalities in implementing a recycled water program. Depending on the anticipated use of the recycled water, different levels of treatment and regulations apply. A summary of what treatment levels of recycled water can be used is presented in Table 6.

The City can currently consistently produce disinfected secondary recycled water. For the proposed use of recycled water for agricultural irrigation, this level of treatment restricts recycled water use to surface irrigation of food crops where the edible portion is above ground and not contacted by recycled water (e.g., plums, grapevines). It should be noted that recycled water regulations also allow the use of undisinfected secondary effluent on orchards and vineyards where the edible portion of the crop is above ground and not contacted by recycled water or food crops that must undergo commercial pathogen-destroying processing before being consumed by humans. Thus, elimination of the disinfection treatment step could be a consideration depending on the proposed use of the recycled water.

If the City intends on moving towards full recycling of its final effluent, it may be possible for the City to have its WDR rescinded and be covered under an individual Water Recycling Requirements (WRR) or the State Water Board's *General Waste Discharge Requirements for Recycled Water Use* (Order No. WQ 2014-0090-DWQ), which are different permitting mechanisms. However, maintaining the current WDR provides operational flexibility for continuing discharge to the spray fields if recycled water demand does not meet or exceed the volume of recycled water produced by the WWTF.

Depending on the direction the City selects for its disposition of final effluent from the WWTF, other regulations, requirements, or studies may be required. These may include, but are not limited to, California Environmental Quality Act (CEQA), antidegradation analyses, groundwater studies, etc.

DESIGN CRITERIA AND LOADINGS

Design criteria and loadings for future facilities are summarized in Table 7. Sources of wastewater flows and loadings include domestic, commercial, industrial, inflow, and infiltration. The wastewater generation rate includes flow from all sources.

Table 6. Treatment Level Requirements for Recycled Water Uses

Treatment Level	Recycled Water Use
Undisinfected secondary	- Orchards where recycled water does not come into contact the edible portion of the crop - Vineyards where recycled water does not come into contact with edible portion of the crop - Non-food-bearing trees (no irrigation 14 days prior to harvesting or access by general public) - Fodder or fiber crops and pasture for animals no producing milk for human consumption - Seed crops not eaten by humans - Food crops that must undergo pathogen-destroying process before being consumed by humans - Ornamental nursery stock and sod farms (no irrigation 14 days prior to harvesting, retail sale, or access by general public)
Disinfected secondary-23	- Cemeteries - Freeway landscaping - Restricted access golf courses - Ornamental nursery stock and sod farms (unrestricted) - Pasture for animals producing milk for human consumption - Any non-edible vegetation where access is controlled
Disinfected secondary-2.2	- Surface irrigation of food crops where edible portion is produced above ground and not contacted by recycled water
Disinfected tertiary	- Food crops, including all edible root crops, where recycled water comes into contact with edible portion of crop - Parks and playgrounds - School yards - Residential landscaping - Unrestricted golf courses - Any other irrigation use not specified in §60304 of the California Code of Regulations and not prohibited by other sections of the California Code of Regulations

Table 7. City of Winters Wastewater Treatment Facility Design Criteria and Loadings for Future Conditions (2035)

Criterion	Unit	Value
Design population	persons	8,800
Wastewater generation rate	gpcd	85
Average dry weather design capacity	MGD	0.92
Peak wet weather capacity	MGD	6.0
5-day biochemical oxygen demand (BOD_5)	mg/L	250
Total suspended solids (TSS)	mg/L	250

Treatment, Recycle, and Disposal Alternatives

The *Standard Provisions and Reporting Requirements for Waste Discharge Requirements*, dated March 1, 1999, which are incorporated into the WDR, requires that the City project when it reaches the "hydraulic and treatment capacities of its treatment, collection, and disposal facilities". If the projection shows that the capacity will be reached within four years, the City must notify the Regional Water Board. Under the projected 2035 dry weather wastewater flow rate of 0.77 MGD, the City will not exceed its permitted average dry weather design capacity of 0.92 MGD. Based on the projected annual population growth rate of 1.1 percent, the City may not reach the permitted average dry weather design capacity beyond the planning period of this Master Plan update. Therefore, this Master Plan update does not consider the need to expand the capacity of the WWTF for the purpose of meeting treatment capacity. Instead, the proposed alternatives focus on expanding storage capacity in order to allow increased recycled water use. Tertiary treatment to produce a higher quality of recycled water that has more potential uses was also considered, and is discussed conceptually. However, this alternative requires a complete replacement of the current treatment system and is demonstrated to be likely cost prohibitive. An alternative possibility is that a portion of the total wastewater flow could be diverted for tertiary treatment through a package treatment system. Because the City does not have current plans requiring tertiary-level recycled water, this alternative could be considered in the future.

Alternative approaches to providing expanded wastewater treatment and effluent recycling and disposal facilities to meet design conditions are identified and described in this section. Five treatment and storage/disposal alternatives are identified for detailed evaluation and comparison:

- Alternative 1A – Year-round storage with a full Pond 1 and full recycle with lining of new storage ponds and no retrofit lining of existing ponds
- Alternative 1B – Year-round storage with a full Pond 1 and full recycle with lining of new storage ponds and retrofit lining of existing ponds
- Alternative 2A – Year-round storage with empty Pond 1 and full recycle with no retrofit lining of existing ponds
- Alternative 2B – Year-round storage with empty Pond 1 and full recycle with lining of new storage ponds and retrofit lining of existing ponds
- Alternative 3A – Tertiary treatment with year-round storage, empty Pond 1, and full recycle with retrofit of existing ponds.

Alternatives 1A and 1B, which assume that Pond 1 is full at the beginning of the wet season, feature expansion of the storage capabilities at the WWTF to allow recycled water production for use in primarily agricultural irrigation and other restricted landscape irrigation opportunities. These alternatives also address possible storage pond lining scenarios that might be required to meet BPTC requirements and protect groundwater quality. Alternatives 2A and 2B have similar planning factors as Alternatives 1A and 1B, but assume that Pond 1 is empty at the onset of the wet season. All of the alternatives assume that the City will move towards full water recycling and that use the existing spray fields for disposal of final effluent will be minimized. Until the City firmly identifies and executes contracts with recycled water users, it is assumed that the existing spray fields will be used to the minimum extent possible. A flow chart illustrating the relationship of the proposed alternatives is presented in Figure 2.

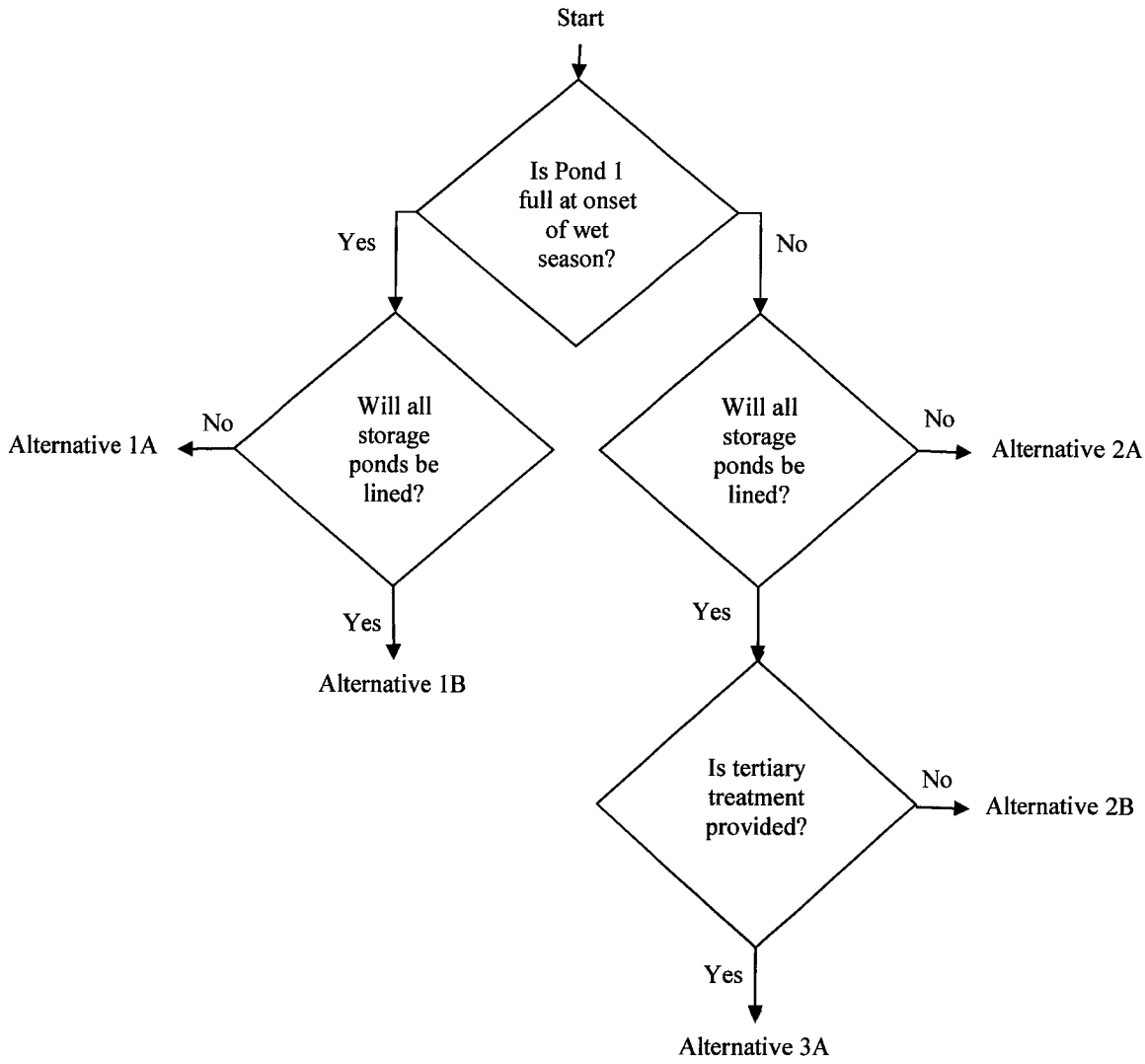

Figure 2. Relationship of Proposed Alternatives

The basic features of each of these proposed alternatives is presented in the following sections along with a summary of principal preliminary design information and estimated capital and operating costs.

ALTERNATIVE 1A

Alternative 1A would be implemented in two phases and consist of the following operational parameters and facility features:

- Operational Parameters
  - Maintain a full Pond 1 at the onset of the wet season (Phase 1)
  - Cease use of South Spray Field (Phase 1)
  - Identify recycled water users (Phases 1 and 2)
  - Provide recycled water to users (Phases 1 and 2)
  - Cease use of North Spray Field upon implementation of full water recycling (Phase 2)
- Facilities
  - Construct new membrane-lined Pond 5 in South Spray Field location for additional storage capacity (Phase 1)
  - Retrofit transfer pumps (Phase 1)
  - Install recycled water pumping station (Phases 1 and 2)
  - Install recycled water conveyance system (Phases 1 and 2)
  - Replace aerators in aeration ponds (Phase 2)

Preliminary design data for facilities proposed under Alternative 1A are presented in Table 8. The site layout of the proposed facilities is presented in Figure 3 and discussed in further detail in the following sections.

Proposed Facilities

Existing Treatment System

The existing treatment system at the WWTF would not be modified under Alternative 1A. However, over the planning period of this Master Plan, the City would likely need to replace the aerators in its aeration ponds. Replacement of these units is included in this alternative.

Existing Storage Ponds

The existing storage ponds would not be lined under Alternative 1A.

Spray Fields

Under Alternative 1A, approximately 9.0 acres of the South Spray Field would be converted into a new storage pond, Ponds 5, to accommodate storage requirements for managing the 100-year annual precipitation period and allow full water recycling. Initially, the portion of the South Spray Field not intended for conversion to the new storage ponds as well as the North Spray Field could continue to be used for final effluent disposal. As the City increases its recycled water users and the area under which recycled water is used towards full water recycling, the City could phase out the use of the spray fields and identify other potential uses for the land (e.g., lease for farmers, sale of land).

Table 8. Preliminary Design Data for Alternative 1A Facilities

Component	Unit	Value	
		Phase 1	Phase 2
Stage 1 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25 1/15
Stage 2 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25
Storage Pond (New)			
Number of ponds	ea	1	–
Volume per pond	acre-ft	51	–
Surface area per pond	acre	9.0	–
Transfer/Recycled Water Pumping Station			
Number of transfer pump	ea	1	1
Unit capacity of transfer pump	gpm	300	300
Unit power of transfer pump	hp	15	15
Number of recycled water pumps	ea	2	1
Unit capacity of recycled water pump	gpm	1,200	1,200
Unit power of recycled water pump	hp	75	75
Flow meter	ea	1	–
Recycled Water Conveyance System [(1)]			

(1) The recycled water conveyance system would be implemented in Phases 1 and 2. The City needs to identify recycled water users prior to sizing and designing this system.

New Effluent Storage Pond 5

Storage Pond 5 (storage capacity of 51 acre-feet) would be constructed during Phase 1 on a portion of the South Spray Field as presented in Figure 3. This storage pond would be hydraulically connected to all other storage ponds by means of transfer piping and retrofit of the transfer pumping station into a recycled water pumping station. The new storage ponds would include a membrane liner to minimize seepage and potential groundwater impacts and maximize the volume of recycled water available to users.

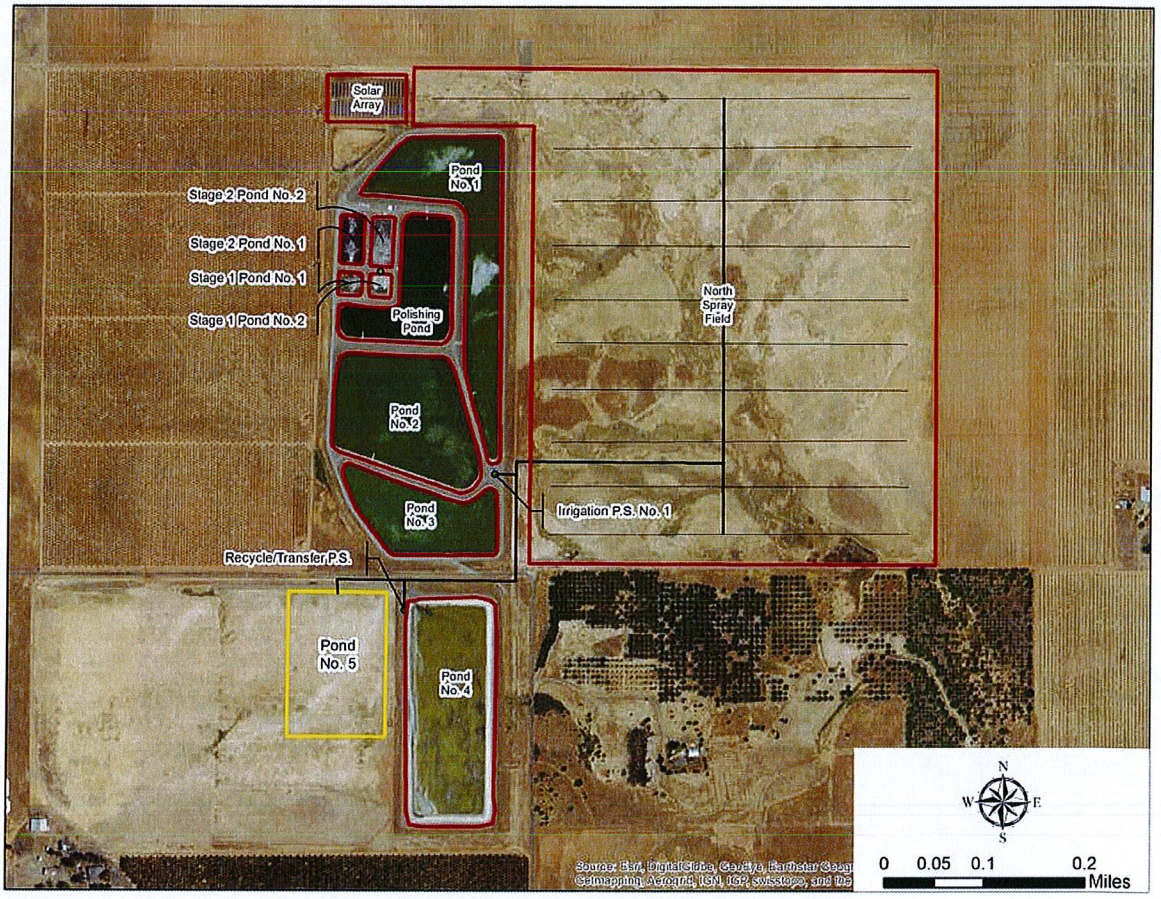

Figure 3. Layout of Proposed Facilities - Alternative 1A

Transfer/Recycled Water Pumping Station

The transfer pumping station adjacent to Pond 4 would be retrofitted to include pumps to convey recycled water to users. Two recycle water pumps (one duty, one standby), which would each have the capacity to deliver recycled water at 1,200 gallons per minute (gpm), would be added in Phase 1 with a third pump added during Phase 2. If the existing transfer pumps are still serviceable, they can be reconfigured to convey recycled water between all storage ponds. However, this Master Plan update, including cost estimates, assumes that the existing transfer pumps would be replaced with new pumps.

Recycled Water Conveyance System

A recycled water conveyance system would need to be constructed during Phases 1 and 2 to deliver recycled water from the WWTF to recycled water users. The City needs to identify potential recycled water users prior to sizing and designing this system.

Fencing

The new storage pond would be fenced with a chain-link security fence.

Alternative 1A Cost Estimate

Capital Costs

Estimated capital costs in 2015 dollars for proposed facilities under Alternative 1A are summarized in Table 9 and Table 10 for Phases 1 and 2, respectively. Because the City has not identified its potential recycled water users, the estimated capital costs do not reflect costs for the recycled water conveyance system.

Table 9. Estimated Capital Costs for Alternative 1A Phase 1

Item	Cost
Storage Pond 5 – earthwork	$486,100
Storage Pond 5 – membrane liner	$251,500
Transfer/Recycled Water Pumping Station	$333,200
Roads – 16 ft Type B	$19,800
Fencing	$26,900
Recycled Water Conveyance System	(1)
Construction Subtotal	$1,118,000
Tax on materials	$42,000
General Cost @ 10%	$116,000
Estimating Contingency @ 15%	$174,000
Construction Total	$1,450,000
Engineering, Management, and Contingency @ 40%	$580,000
Phase 1 Total	$2,030,000

(1) Some of the recycled water conveyance system would be implemented in Phase 1. The City needs to identify recycled water users prior to sizing and designing this system.

Table 10. Estimated Capital Costs for Alternative 1A Phase 2

Item	Cost
Stage 1 Aerated Ponds – aerators	$263,700
Stage 2 Aerated Ponds – aerators	$160,800
Transfer/Recycled Water Pumping Station	$38,600
Recycled Water Conveyance System [(1)]	
Construction Subtotal	$463,000
Tax on materials	$17,000
General Cost @ 10%	$48,000
Estimating Contingency @ 15%	$72,000
Construction Total	$600,000
Engineering, Management, and Contingency @ 40%	$240,000
Phase 2 Total	$840,000

(1) The remaining recycled water conveyance system would be implemented in Phase 2. The City needs to identify recycled water users prior to sizing and designing this system.

Operations and Maintenance Costs

For the purposes of comparison, estimated annual operation and maintenance (O&M) costs for Alternative 1A are summarized in Table 11 based on implementation of both phases. Because the City has not identified its potential recycled water users, the estimated O&M costs do not reflect costs for operating and maintaining the recycled water conveyance system. Present worth of the annual O&M cost is presented for a 20-year period and an interest rate of 5 percent.

Table 11. Estimated Operations and Maintenance Costs for Alternative 1A

Item	Unit	Quantity	Unit Cost	Total Cost
Operation Labor	hr	4,160	$71	$294,400
Hypochlorite	lb	75,000	$0.13	$9,600
Effluent monitoring	LS	1	$12,900	$12,900
Effluent pumping	kW-hr	740,000	$0.13	$95,200
Miscellaneous Energy	kW-hr	100,000	$0.13	$12,900
Miscellaneous Repair and Replacement	LS	1	$25,700	$25,700
Total Annual O&M Cost [(1)]				$450,700
Present Worth @ 20 yr, 5%				$5,616,700

(1) Operations and maintenance costs do not reflect costs for operating and maintaining the recycled water conveyance system. The City needs to identify recycled water users prior to sizing and designing this system.

ALTERNATIVE 1B

Alternative 1B would be implemented in two phases and consist of the following operational parameters and facility features:

- Operational Parameters
  - Maintain a full Pond 1 at the onset of the wet season (Phase 1)
  - Cease use of South Spray Field (Phase 1)
  - Identify recycled water users (Phases 1 and 2)
  - Provide recycled water to users (Phases 1 and 2)
  - Cease use of North Spray Field upon implementation of full water recycling (Phase 2)
- Facilities
  - Construct new membrane-lined Pond 5 in South Spray Field location for additional storage capacity (Phase 1)
  - Retrofit Ponds 3 and 4 with membrane liners (Phase 1)
  - Retrofit Transfer Pumping Station (Phase 1)
  - Install a new recycled water pumping station (Phases 1 and 2)
  - Install recycled water conveyance system (Phases 1 and 2)
  - Construct new membrane-lined Pond 6 in South Spray Field location for additional storage capacity (Phase 2)
  - Retrofit Ponds 1 and 2 with membrane liners (Phase 2)
  - Replace aerators in aeration ponds (Phase 2)

Preliminary design data for primary facilities proposed under Alternative 1B are presented in Table 12. The site layout of the proposed facilities is presented in Figure 4 and discussed in further detail in the following sections.

Proposed Facilities

Existing Treatment System

The existing treatment system at the WWTF would not be modified under Alternative 1B. However, over the planning period of this Master Plan, the City would likely need to replace the aerators in its aeration ponds. Replacement of these units is included in this alternative.

Existing Storage Ponds

Ponds 1-4 would be retrofitted with a membrane liner to minimize seepage and the potential impact on groundwater and meet potential BPTC requirements. Additionally, lining the existing storage ponds would maximize the volume of recycled water available to users. Only the bottom of the storage ponds would be lined and the existing slope protection of the ponds would be left in place. During the retrofit period, the storage ponds would be out of service. Because of the need to empty, dry, and retrofit the ponds, it may only be possible to retrofit one or two ponds at a time.

Table 12. Preliminary Design Data for Alternative 1B Facilities

Component	Unit	Value	
		Phase 1	Phase 2
Stage 1 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25 1/15
Stage 2 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25
Storage Ponds (New)			
Number of ponds	ea	1	1
Volume per pond	acre-ft	91	91
Surface area per pond	acre	16	16
Transfer/Recycled Water Pumping Station			
Number of transfer pump	ea	1	1
Unit capacity of transfer pump	gpm	300	300
Unit power of transfer pump	hp	15	15
Number of recycled water pump	ea	2	1
Unit capacity of recycled water pump	gpm	1,200	1,200
Unit power of recycled water pump	hp	75	75
Flow meter	ea	1	–
Recycled Water Conveyance System (1)			

(1) The recycled water conveyance system would be implemented in Phases 1 and 2. The City needs to identify recycled water users prior to sizing and designing this system.

Spray Fields

Under Alternative 1B, approximately 32 acres, or nearly the entire South Spray Field, would be converted into new storage ponds, Ponds 5 and 6, to accommodate storage requirements for managing the 100-year annual precipitation period and allow full water recycling. Initially, the portion of the South Spray Field not intended for conversion to the storage ponds as well as the North Spray Field could continue to be used for final effluent disposal. As the City increases its recycled water users and the area under which recycled water is used towards full water recycling, the City could phase out the use of the spray fields and identify other potential uses for the land (e.g., lease for farmers, sale of land).

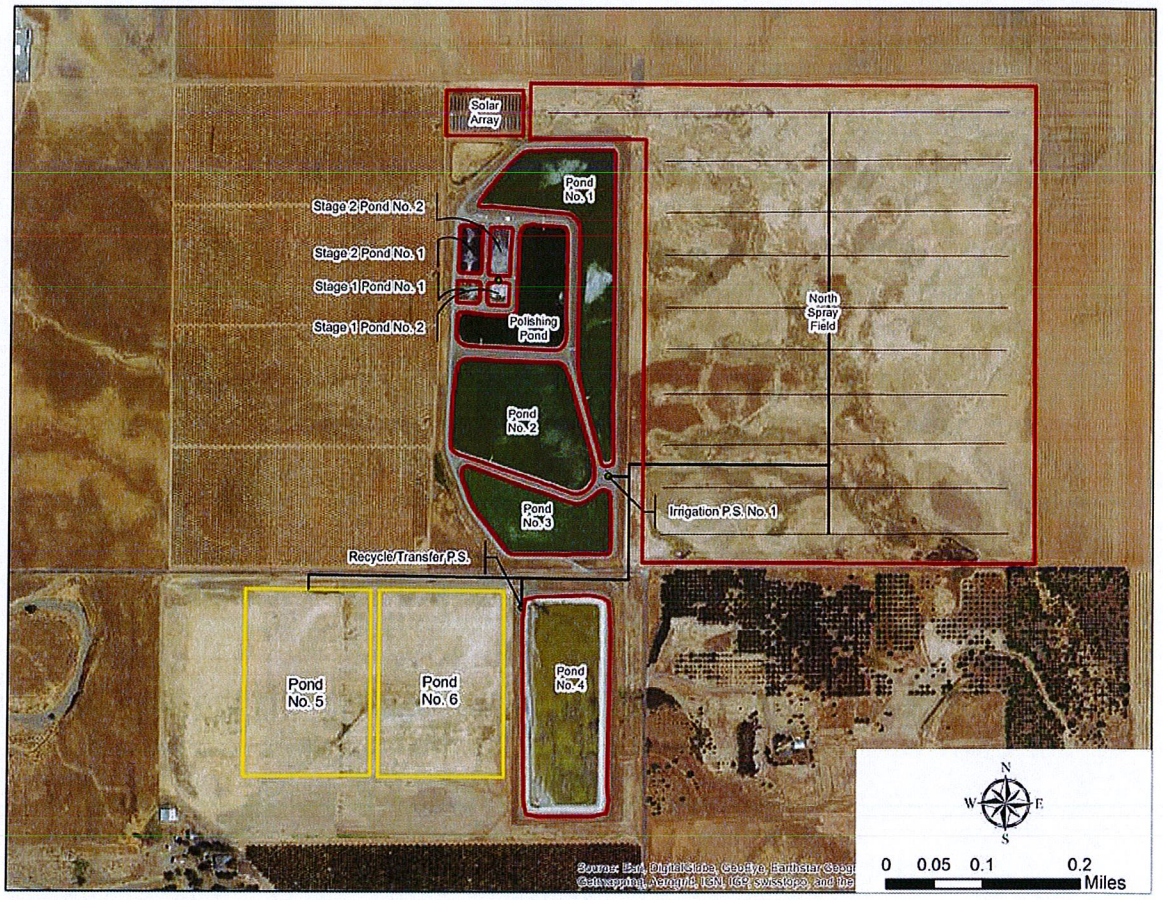

Figure 4. Layout of Proposed Facilities - Alternative 1B

New Effluent Storage Ponds 5 and 6

Ponds 5 and 6 would each storage capacities of 91 acre-feet, respectively, and would be constructed during Phase 1 and Phase 2, respectively, on a portion of the South Spray Field as presented in Figure 4. The ponds would be constructed in phases as the existing storage ponds are retrofitted with liners and increased storage capacity is needed to accommodate the decrease seepage losses. These storage ponds would be hydraulically connected to all other storage ponds by means of transfer piping and retrofit of the transfer pumping station into a recycled water pumping station. The new storage ponds would include a membrane liner to minimize seepage losses.

Transfer/Recycled Water Pumping Station

The transfer pumping station adjacent to Pond 4 would be retrofitted to include pumps to convey recycled water to users. Two pumps (one duty, one standby), each with the capacity of 1,200 gpm, would be added in Phase 1 with a third pump added during Phase 2. If the existing transfer pumps are still serviceable, they could be reconfigured to allow conveyance of recycled water between all storage ponds. However, this Master Plan update, including cost estimates, assumes that the existing transfer pumps would be replaced with new pumps.

Recycled Water Conveyance System

A recycled water conveyance system would need to be constructed during Phases 1 and 2 to deliver recycled water from the WWTF to recycled water users. The City needs to identify potential recycled water users prior to sizing and designing this system.

Fencing

The new storage ponds would be fenced with a chain-link security fence.

Alternative 1B Cost Estimate

Capital Costs

Estimated capital costs in 2015 dollars for proposed facilities under Alternative 1B are summarized in Table 13 and Table 14 for Phases 1 and 2, respectively. Because the City has not identified its potential recycled water users, the estimated capital costs do not reflect costs for the recycled water conveyance system.

Table 13. Estimated Capital Costs for Alternative 1B Phase 1

Item	Cost
Pond 3 Retrofit Lining	$159,500
Pond 4 Retrofit Lining	$990,600
Storage Pond 5 – earthwork	$862,700
Storage Pond 5 – membrane	$455,400
Transfer/Recycled Water Pumping Station	$333,200
Roads – 16 ft Type B	$23,900
Fencing	$34,800
Recycled Water Conveyance System	(1)
Construction Subtotal	$2,860,000
Tax on materials	$107,000
General Cost @ 10%	$297,000
Estimating Contingency @ 15%	$445,000
Construction Total	$3,709,000
Engineering, Management, and Contingency @ 40%	$1,484,000
Phase 1 Total	$5,193,000

(1) Some of the recycled water conveyance system would be implemented in Phase 1. The City needs to identify recycled water users prior to sizing and designing this system.

Table 14. Estimated Capital Costs for Alternative 1B Phase 2

Item	Cost
Stage 1 Aerated Ponds – aerators	$263,700
Stage 2 Aerated Ponds – aerators	$160,800
Pond 1 Retrofit Lining	$252,200
Pond 2 Retrofit Lining	$244,400
Storage Pond 6 – earthwork	$862,700
Storage Pond 6 – membrane	$455,400
Transfer/Recycled Water Pumping Station	$38,600
Roads – 16 ft Type B	$16,500
Fencing	$34,800
Recycled Water Conveyance System	(1)
Construction Subtotal	$2,329,000
Tax on materials	$87,000
General Cost @ 10%	$242,000
Estimating Contingency @ 15%	$362,000
Construction Total	$3,020,000
Engineering, Management, and Contingency @ 40%	$1,208,000
Phase 2 Total	$4,228,000

(1) The remaining recycled water conveyance system would be implemented in Phase 2. The City needs to identify recycled water users prior to sizing and designing this system.

Operations and Maintenance Costs

For the purposes of comparison, estimated annual O&M costs for Alternative 1B are summarized in Table 15 based on implementation of both phases. Because the City has not identified its potential recycled water users, the estimated O&M costs do not reflect costs for operating and maintaining the recycled water conveyance system. Present worth of the annual O&M cost is presented for a 20-year period and an interest rate of 5 percent.

Table 15. Estimated Operations and Maintenance Costs for Alternative 1B

Item	Unit	Quantity	Unit Cost	Total Cost
Operation Labor	hr	4,160	$71	$294,400
Hypochlorite	lb	75,000	$0.13	$9,600
Effluent monitoring	LS	1	$12,900	$12,900
Effluent pumping	kW-hr	740,000	$0.13	$95,200
Miscellaneous Energy	kW-hr	100,000	$0.13	$12,900
Miscellaneous Repair and Replacement	LS	1	$25,700	$25,700
Total Annual O&M Cost [1]				$450,700
Present Worth @ 20 yr, 5%				$5,616,700

(1) Operations and maintenance costs do not reflect costs for operating and maintaining the recycled water conveyance system. The City needs to identify recycled water users prior to sizing and designing this system.

ALTERNATIVE 2A

Alternative 2A would be implemented in two phases and consist of the following operational parameters and facility features:

- Operational Parameters
  - Empty Pond 1 before wet season (Phase 1)
  - Cease use of South Spray Field (Phase 1)
  - Identify recycled water users (Phases 1 and 2)
  - Provide recycled water to users (Phases 1 and 2)
  - Cease use of North Spray Field upon implementation of full water recycling (Phase 2)
- Facilities
  - Retrofit transfer pumps (Phase 1)
  - Install recycled water pumping station (Phases 1)
  - Install recycled water conveyance system (Phases 1 and 2)
  - Replace aerators in aeration ponds (Phase 2)

Preliminary design data for facilities proposed under Alternative 2A are presented in Table 16. The site layout of the proposed facilities is presented in Figure 5 and discussed in further detail in the following sections.

Table 16. Preliminary Design Data for Alternative 2A Facilities

Component	Unit	Value	
		Phase 1	Phase 2
Stage 1 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25 1/15
Stage 2 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25
Transfer/Recycled Water Pumping Station			
Number of transfer pump	ea	2	–
Unit capacity of transfer pump	gpm	300	–
Unit power of transfer pump	hp	15	–
Number of recycled water pump	ea	3	–
Unit capacity of recycled water pump	gpm	1,200	–
Unit power of recycled water pump	hp	75	–
Flow meter	ea	1	–
Recycled Water Conveyance System (1)			

(1) The recycled water conveyance system would be implemented in Phases 1 and 2. The City needs to identify recycled water users prior to sizing and designing this system.

Figure 5. Layout of Proposed Facilities - Alternative 2A

Proposed Facilities

Existing Treatment System

The existing treatment system at the WWTF would not be modified under Alternative 2A. However, over the planning period of this Master Plan, the City would likely need to replace the aerators in its aeration ponds. Replacement of these units is included in this alternative.

Existing Storage Ponds

The existing storage ponds would not be lined under Alternative 2A.

Spray Fields

Under Alternative 2A, the City would ultimately cease use of both the North and South Spray Fields for final effluent disposal as it increases its recycled water users and the area under which recycled water is used towards full water recycling. The City could phase out the use of the spray fields and identify other potential uses for the land (e.g., lease for farmers, sale of land).

Transfer/Recycled Water Pumping Station

The transfer pumping station adjacent to Pond 4 would be retrofitted to include pumps to convey recycled water to users. Three pumps (two duty, one standby), each with the capacity of 1,200 gpm, would be installed. If the existing transfer pumps are still serviceable, they could be reconfigured to allow conveyance of recycled water between all storage ponds. However, this Master Plan update, including cost estimates, assumes that the existing transfer pumps would be replaced with new pumps.

Recycled Water Conveyance System

A recycled water conveyance system would need to be constructed during Phases 1 and 2 to deliver recycled water from the WWTF to recycled water users. The City needs to identify potential recycled water users prior to sizing and designing this system.

Alternative 2A Cost Estimate

Capital Costs

Estimated capital costs in 2015 dollars for proposed facilities under Alternative 2A are summarized in Table 17 and Table 18 for Phases 1 and 2, respectively. Because the City has not identified its potential recycled water users, the estimated capital costs do not reflect costs for the recycled water conveyance system.

Table 17. Estimated Capital Costs for Alternative 2A Phase 1

Item	Cost
Transfer/Recycled Water Pumping Station	$372,000
Recycled Water Conveyance System [(1)]	
Construction Subtotal	$372,000
Tax on materials	$14,000
General Cost @ 10%	$39,000
Estimating Contingency @ 15%	$58,000
Construction Total	$483,000
Engineering, Management, and Contingency @ 40%	$193,000
Phase 1 Total	$676,000

(1) Some of the recycled water conveyance system would be implemented in Phase 1. The City needs to identify recycled water users prior to sizing and designing this system.

Table 18. Estimated Capital Costs for Alternative 2A Phase 2

Item	Cost
Stage 1 Aerated Ponds – aerators	$263,700
Stage 2 Aerated Ponds – aerators	$160,800
Recycled Water Conveyance System [1]	
Construction Subtotal	$425,000
Tax on materials	$16,000
General Cost @ 10%	$44,000
Estimating Contingency @ 15%	$66,000
Construction Total	$551,000
Engineering, Management, and Contingency @ 40%	$220,000
Phase 1 Total	$771,000

(1) The remaining recycled water conveyance system would be implemented in Phase 2. The City needs to identify recycled water users prior to sizing and designing this system.

Operations and Maintenance Costs

For the purposes of comparison, estimated annual O&M costs for Alternative 2A are summarized in Table 19 based on implementation of both phases. Because the City has not identified its potential recycled water users, the estimated O&M costs do not reflect costs for operating and maintaining the recycled water conveyance system. Present worth of the annual O&M cost is presented for a 20-year period and an interest rate of 5 percent.

Table 19. Estimated Operations and Maintenance Costs for Alternative 2A

Item	Unit	Quantity	Unit Cost	Total Cost
Operation Labor	hr	4,160	$71	$294,400
Hypochlorite	lb	75,000	$0.13	$9,600
Effluent monitoring	LS	1	$12,900	$12,900
Effluent pumping	kW-hr	740,000	$0.13	$95,200
Miscellaneous Energy	kW-hr	100,000	$0.13	$12,900
Miscellaneous Repair and Replacement	LS	1	$25,700	$25,700
Total Annual O&M Cost [1]				$450,700
Present Worth @ 20 yr, 5%				$5,616,700

(1) Operations and maintenance costs do not reflect costs for operating and maintaining the recycled water conveyance system. The City needs to identify recycled water users prior to sizing and designing this system.

ALTERNATIVE 2B

Alternative 2B would be implemented in two phases and consist of the following operational parameters and facility features:

- Operational Parameters
  - Empty Pond 1 before wet season (Phase 1)
  - Cease use of South Spray Field (Phase 1)
  - Identify recycled water users (Phases 1 and 2)
  - Provide recycled water to users (Phases 1 and 2)
  - Cease use of North Spray Field upon implementation of full water recycling (Phase 2)
- Facilities
  - Construct new membrane-lined Pond 5 in South Spray Field location for additional storage capacity (Phase 1)
  - Retrofit Transfer Pumping Station (Phase 1)
  - Install a new recycled water pumping station (Phases 1 and 2)
  - Install recycled water conveyance system (Phases 1 and 2)
  - Retrofit Ponds 3 and 4 with membrane liners (Phase 1)
  - Retrofit Ponds 1 and 2 with membrane liners (Phase 2)
  - Replace aerators in aeration ponds (Phase 2)

Preliminary design data for primary facilities proposed under Alternative 2B are presented in Table 20. The site layout of the proposed facilities is presented in Figure 6 and discussed in further detail in the following sections.

Proposed Facilities

Existing Treatment System

The existing treatment system at the WWTF would not be modified under Alternative 2B. However, over the planning period of this Master Plan, the City would likely need to replace the aerators in its aeration ponds. Replacement of these units is included in this alternative.

Existing Storage Ponds

The existing storage ponds (Ponds 1-4) would be retrofitted with a membrane liner to minimize seepage losses and meet potential BPTC requirements. Ponds 3 and 4 would be retrofitted during Phase 1 while Ponds 1 and 2 would be retrofitted during Phase 2. Additionally, lining the existing storage ponds would maximize the volume of recycled water available to users. Only the bottom of the storage ponds would be lined and the existing slope protection of the ponds would be left in place. During the retrofit period, the storage ponds would be out of service. Consequently, it may only be possible to retrofit one to two ponds at a time.

Table 20. Preliminary Design Data for Alternative 2B Facilities

Component	Unit	Value	
		Phase 1	Phase 2
Stage 1 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25 1/15
Stage 2 Aerated Ponds (2 ponds)			
Aerators per pond/unit horsepower	ea/hp	–	1/25
Storage Ponds (New)			
Number of ponds	ea	1	–
Volume per pond	acre-ft	23	–
Surface area per pond	acre	4	–
Transfer/Recycled Water Pumping Station			
Number of transfer pump	ea	1	1
Unit capacity of transfer pump	gpm	300	300
Unit power of transfer pump	hp	15	15
Number of recycled water pump	ea	2	1
Unit capacity of recycled water pump	gpm	1,200	1,200
Unit power of recycled water pump	hp	75	75
Flow meter	ea	1	–
Recycled Water Conveyance System [1]			

(1) The recycled water conveyance system would be implemented in Phases 1 and 2. The City needs to identify recycled water users prior to sizing and designing this system.

Spray Fields

Under Alternative 2B, approximately 4.0 acres of the South Spray Field would be converted into a new storage pond, Ponds 5, to accommodate storage requirements for managing the 100-year annual precipitation period and promote full water recycling. Initially, the portion of the South Spray Field that is not intended for conversion to the new storage ponds and the North Spray Field can continue to be used for final effluent disposal. As the City increases its recycled water users and the area under which recycled water is used towards full water recycling, the City can phase out the use of the spray fields and identify other potential uses for the land (e.g., lease for farmers, sale of land).

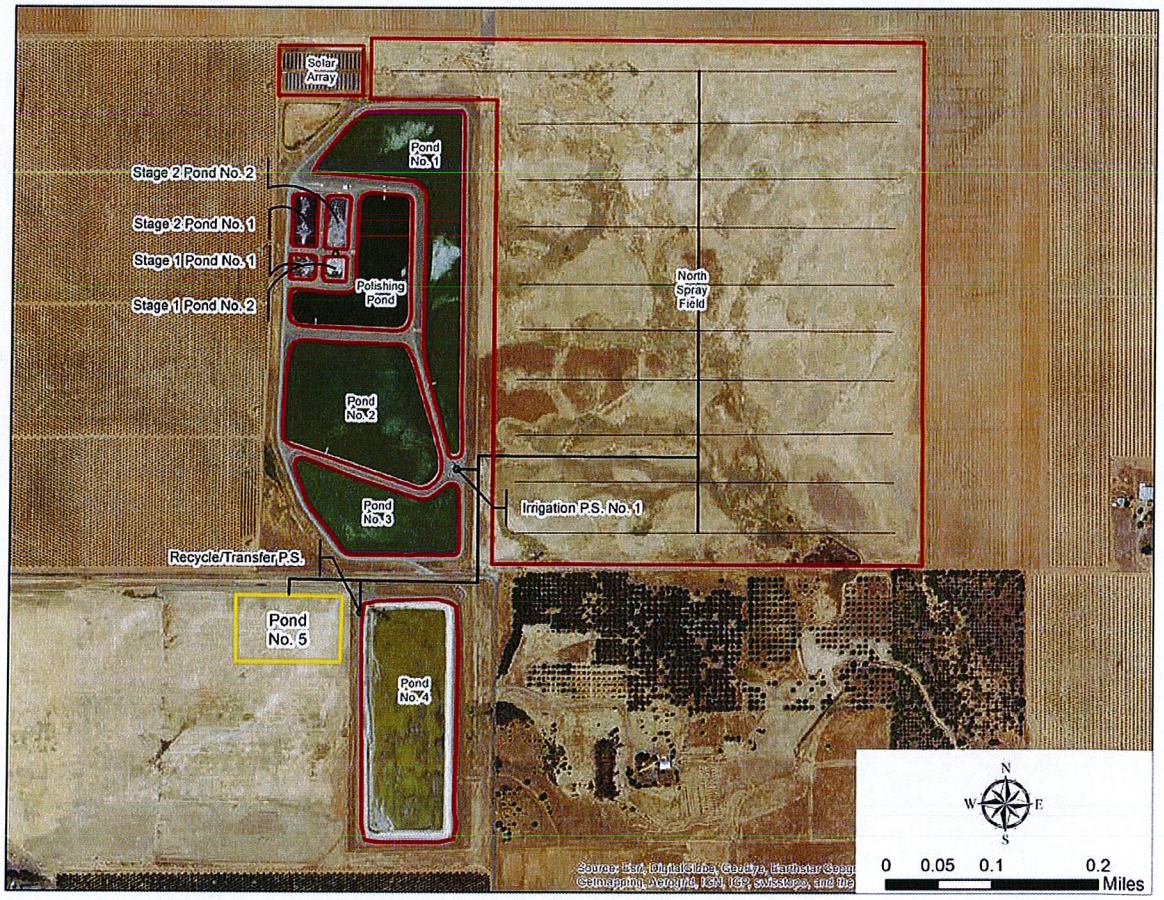

Figure 6. Layout of Proposed Facilities - Alternative 2B

New Effluent Storage Pond 5

Pond 5, which has a storage capacity of 23 acre-feet, would be constructed during Phase 1 on a portion of the South Spray Field as presented in Figure 6. This storage pond would be hydraulically connected to all other storage ponds by means of transfer piping and retrofit of the transfer pumping station into a recycled water pumping station. The new storage pond would include a membrane liner to minimize seepage.

Transfer/Recycled Water Pumping Station

The transfer pumping station adjacent to Pond 4 would be retrofitted to include pumps to convey recycled water to users. Two pumps (one duty, one standby), each with a capacity of 1,200 gpm, would be added in Phase 1 with a third pump added during Phase 2. If the existing transfer pumps are still serviceable, they could be reconfigured to allow conveyance of recycled water between all storage ponds. However, this Master Plan update, including cost estimates, assumes that the existing transfer pumps would be replaced with new pumps.

Recycled Water Conveyance System

A recycled water conveyance system would need to be constructed during Phases 1 and 2 to deliver recycled water from the WWTF to recycled water users. The City needs to identify potential recycled water users prior to sizing and designing this system.

Fencing

The new storage pond would be fenced with a chain-link security fence.

Alternative 2B Cost Estimate

Capital Costs

Estimated capital costs in 2015 dollars for proposed facilities under Alternative 1B are summarized in Table 21 and Table 22 for Phases 1 and 2, respectively. Because the City has not identified its potential recycled water users, the estimated capital costs do not reflect costs for the recycled water conveyance system.

Table 21. Estimated Capital Costs for Alternative 2B Phase 1

Item	Cost
Pond 3 Retrofit Lining	$159,500
Pond 4 Retrofit Lining	$990,600
Storage Pond 5 – earthwork	$316,500
Storage Pond 5 – membrane	$117,700
Transfer/Recycled Water Pumping Station	$333,200
Roads – 16 ft Type B	$16,500
Fencing	$17,600
Recycled Water Conveyance System	(1)
Construction Subtotal	$1,952,000
Tax on materials	$73,000
General Cost @ 10%	$203,000
Estimating Contingency @ 15%	$304,000
Construction Total	$2,532,000
Engineering, Management, and Contingency @ 40%	$1,013,000
Phase 1 Total	$3,545,000

(1) Some of the recycled water conveyance system would be implemented in Phase 1. The City needs to identify recycled water users prior to sizing and designing this system.

Table 22. Estimated Capital Costs for Alternative 2B Phase 2

Item	Cost
Stage 1 Aerated Ponds – aerators	$263,700
Stage 2 Aerated Ponds – aerators	$160,800
Pond 1 Retrofit Lining	$252,200
Pond 2 Retrofit Lining	$244,400
Transfer/Recycled Water Pumping Station	$38,600
Recycled Water Conveyance System [(1)]	
Construction Subtotal	$960,000
Tax on materials	$36,000
General Cost @ 10%	$100,000
Estimating Contingency @ 15%	$149,000
Construction Total	$1,245,000
Engineering, Management, and Contingency @ 40%	$498,000
Phase 2 Total	$1,743,000

(1) The remaining recycled water conveyance system would be implemented in Phase 2. The City needs to identify recycled water users prior to sizing and designing this system.

Operations and Maintenance Costs

For the purposes of comparison, estimated annual O&M costs for Alternative 2B are summarized in Table 23 based on implementation of both phases. Because the City has not identified its potential recycled water users, the estimated O&M costs do not reflect costs for operating and maintaining the recycled water conveyance system. Present worth of the annual O&M cost is presented for a 20-year period and an interest rate of 5 percent.

Table 23. Estimated Operations and Maintenance Costs for Alternative 2B

Item	Unit	Quantity	Unit Cost	Total Cost
Operation Labor	hr	4,160	$71	$294,400
Hypochlorite	lb	75,000	$0.13	$9,600
Effluent monitoring	LS	1	$12,900	$12,900
Effluent pumping	kW-hr	740,000	$0.13	$95,200
Miscellaneous Energy	kW-hr	100,000	$0.13	$12,900
Miscellaneous Repair and Replacement	LS	1	$25,700	$25,700
Total Annual O&M Cost [(1)]				$450,700
Present Worth @ 20 yr, 5%				$5,616,700

(1) Operations and maintenance costs do not reflect costs for operating and maintaining the recycled water conveyance system. The City needs to identify recycled water users prior to sizing and designing this system.

ALTERNATIVE 3A

Alternative 3A features a tertiary treatment system with a membrane bioreactor (MBR) system that would replace the existing aerated pond treatment system at the WWTF. The existing hypochlorite disinfection system would also be replaced by an ultraviolet (UV) light disinfection system. Final effluent from the proposed tertiary treatment system would meet Title 22 requirements for disinfected tertiary recycled water, which has unrestricted use for irrigation and recreational impoundments. The storage and recycling facilities under this alternative would be the same as those under Alternative 2A except that the existing aerated ponds would be converted into an equalization basin. Additionally, biosolids handling facilities would be installed to treat residual solids from the treatment process.

Alternative 3A would be implemented in two phases and consist of the following operational parameters and facility features:

- Operational Parameters
  - Empty Pond 1 before wet season (Phase 1)
  - Cease use of South Spray Field (Phase 1)
  - Identify recycled water users (Phases 1 and 2)
  - Provide recycled water to users (Phases 1 and 2)
  - Cease use of North Spray Field upon implementation of full water recycling (Phase 2)
- Facilities
  - Install MBR treatment system (Phase 1)
  - Install biosolids handling facilities (Phase 1)
  - Install UV light disinfection system (Phase 1)
  - Convert existing aeration pond to equalization pond (Phase 2)
  - Retrofit Transfer Pumping Station (Phase 1)
  - Install a new recycled water pumping station (Phases 1 and 2)
  - Install recycled water conveyance system (Phases 1 and 2)
  - Retrofit Ponds 3 and 4 with membrane liners (Phase 1)
  - Retrofit Ponds 1 and 2 with membrane liners (Phase 2)

Proposed Facilities

Treatment System

The aerated pond treatment system would be replaced by a tertiary treatment system that includes a headworks, MBR treatment process, biosolids treatment and dewatering processes, and UV light disinfection. The headworks facility would include an influent flow meter, mechanical screening, and a high-flow bypass channel. The MBR treatment process consists of a single-stage, three-tank process consisting of a mixed anoxic basin, a suspended-growth pre-aeration basin, and a microfiltration membrane basin. An MBR treatment system was selected in lieu of the conventional tertiary media filtration system to simplify operation of the system and improve performance reliability. The disinfection system would be UV light, which would replace the existing hypochlorite system. Solids from the MBR treatment process would be treated and dewatered with a thickener/aerobic digester system and gravity belt filter. Class B biosolids produced would need to be disposed of through composting, landfilling, or land application.

Equalization Basin

Peak flows in excess of the MBR system capacity would be diverted to a lined equalization basin that would be modified from the existing aerated pond. The existing aerators would be used to maintain aerobic conditions in the wastewater to prevent odors.

Existing Storage Ponds

The existing storage ponds (Ponds 1-4) would be retrofitted with a membrane liner to minimize seepage losses and meet potential BPTC requirements. Ponds 3 and 4 would be retrofitted during Phase 1 while Ponds 1 and 2 would be retrofitted during Phase 2. Additionally, lining the existing storage ponds would maximize the volume of recycled water available to users. Only the bottom of the storage ponds would be lined and the existing slope protection of the ponds would be left in place. During the retrofit period, the storage ponds would be taken out of service. Consequently, it may only be possible to retrofit one to two ponds at a time.

Spray Fields

Under Alternative 3A, the City would ultimately cease use of both the North and South Spray Fields for final effluent disposal as it increases its recycled water users and the area under which recycled water is used. The City could phase out the use of the spray fields and identify other potential uses for the land (e.g., lease for farmers, sale of land).

Transfer/Recycled Water Pumping Station

The transfer pumping station adjacent to Pond 4 would be retrofitted to include pumps to convey recycled water to users. Two pumps (one duty, one standby), each with a capacity of 1,200 gpm, would be added in Phase 1 with a third pump added during Phase 2. If the existing transfer pumps are still serviceable, they could be reconfigured to allow conveyance of recycled water between all storage ponds. However, this Master Plan update, including cost estimates, assumes that the existing transfer pumps would be replaced with new pumps.

Recycled Water Conveyance System

A recycled water conveyance system would need to be constructed during Phases 1 and 2 to deliver recycled water from the WWTF to recycled water users. The City needs to identify potential recycled water users prior to sizing and designing this system.

Alternative 3A Cost Estimate

Capital Costs

Estimated capital costs in 2015 dollars for proposed facilities under Alternative 3A are summarized in Table 24 and Table 25 for Phases 1 and 2, respectively. Because the City has not identified its potential recycled water users, the estimated capital costs do not reflect costs for the recycled water conveyance system.

Table 24. Estimated Capital Costs for Alternative 3A Phase 1

Item	Cost
Treatment System	
Headworks	$428,000
MBR System	$5,136,000
UV Light Disinfection	$651,000
Biosolids Handling	$2,251,000
Yard Piping	$306,000
Auxiliary Power	$347,000
Site Work @ 5%	$456,000
Electrical and Instrumentation @ 15%	$1,368,000
Pond 3 Retrofit Lining	$159,500
Pond 4 Retrofit Lining	$990,600
Transfer/Recycled Water Pumping Station	$333,200
Recycled Water Conveyance System	(1)
Construction Subtotal	$12,426,000
Tax on materials	$466,000
General Cost @ 10%	$1,289,000
Estimating Contingency @ 15%	$1,934,000
Construction Total	$16,115,000
Engineering, Management, and Contingency @ 40%	$6,446,000
Phase 1 Total	$22,561,000

(1) Some of the recycled water conveyance system would be implemented in Phase 1. The City needs to identify recycled water users prior to sizing and designing this system.

Table 25. Estimated Capital Costs for Alternative 3A Phase 2

Item	Cost
Pond 1 Retrofit Lining	$252,200
Pond 2 Retrofit Lining	$244,400
Equalization Basin	$138,400
Transfer/Recycled Water Pumping Station	$38,600
Recycled Water Conveyance System	(1)
Construction Subtotal	$674,000
Tax on materials	$25,000
General Cost @ 10%	$70,000
Estimating Contingency @ 15%	$105,000
Construction Total	$874,000
Engineering, Management, and Contingency @ 40%	$350,000
Phase 2 Total	$1,224,000

(1) The remaining recycled water conveyance system would be implemented in Phase 2. The City needs to identify recycled water users prior to sizing and designing this system.

Operations and Maintenance Costs

For the purposes of comparison, estimated annual O&M costs for Alternative 3A are summarized in Table 26 based on implementation of both phases. Because the City has not identified its potential recycled water users, the estimated O&M costs do not reflect costs for operating and maintaining the recycled water conveyance system. Present worth of the annual O&M cost is presented for a 20-year period and an interest rate of 5 percent.

Table 26. Estimated Operations and Maintenance Costs for Alternative 3A

Item	Unit	Quantity	Unit Cost	Total Cost
Operation labor	hr	6,240	$71	$441,500
MBR energy	kW-hr	1,241,000	$0.13	$159,700
Membrane replacement	LS	1	$56,600	$56,600
MBR chemicals/supplies	LS	1	$2,600	$2,600
Biosolids handling	LS	1	$102,900	$102,900
UV light disinfection system energy	kW-hr	168,000	$0.13	$21,600
UV lamp replacement	LS	1	$10,300	$10,300
Effluent monitoring	LS	1	$12,900	$12,900
Effluent pumping	kW-hr	740,000	$0.13	$95,200
Miscellaneous energy	kW-hr	100,000	$0.13	$12,900
Miscellaneous repair and replacement	LS	1	$25,700	$25,700
Total Annual O&M Cost [(1)]				$941,900
Present Worth @ 20 yr, 5%				$11,738,200

(1) Operations and maintenance costs do not reflect costs for operating and maintaining the recycled water conveyance system. The City needs to identify recycled water users prior to sizing and designing this system.

Analysis of Alternatives

Wastewater treatment and recycle/disposal alternatives are compared in terms of capacity requirements for principal storage and recycle facilities, total present worth costs, and non-monetary selection factors. Based on these comparisons, a recommended alternative is selected for inclusion in the Master Plan update.

DESIGN DATA COMPARISON

Design data for principal storage and recycle facilities under the alternatives evaluated are summarized and compared in Table 27.

Table 27. Comparison of Facility Requirements for Treatment and Recycle/Discharge Alternatives

Component	Alternative				
	1A	1B	2A	2B	3A
Treatment Process	Aerated ponds	Aerated ponds	Aerated ponds	Aerated ponds	Tertiary MBR
Storage Pond Lining	New only	All ponds	None	All ponds	All ponds
Effluent Recycle/Disposal	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle	Year-round storage/ recycle
Storage Volume (acre-feet)					
Existing	288 (1)	288 (1)	380	380	380
Phase 1 – New	51	91	0	23	0
Phase 2 – New	0	91	0	0	0
Total	339	561	380	403	380
Irrigation Area (acres) (2)					
Existing	133	133	133	133	133
Phase 1	-40	-40	-40	-40	-40
Phase 2	-93	-93	-93	-93	-93
Total	0	0	0	0	0

(1) For this alternative, it is assumed that Pond 1 is full and provide zero storage capacity at the beginning of the wet season.

(2) Before the City moves towards full recycling, the spray fields will continue to be necessary to dispose of final effluent in excess of recycled water demand. Once the City fully recycles all its final effluent, it may be possible to identify alternative uses for the spray fields.

PRESENT WORTH COST COMPARISON

Present worth costs of each alternative are summarized in Table 28. Present worth of annual operating and maintenance costs are calculated by applying a uniform-series present worth factor based on a 20-year period and a 5 percent interest to the estimated annual operating and maintenance costs. Present worth of Phase 2 facilities costs was determined by applying a single-

payment present worth factor based on a 10-year period and 5 percent interest rate to estimate Phase 2 capital costs.

Table 28. Comparison of Present Worth Costs of Treatment and Recycle/Discharge Alternatives

Item	Alternative				
	1A	1B	2A	2B	3A
Phase 1					
Construction	$2,030,000	$5,193,000	$676,000	$3,545,000	$22,561,000
Phase 2					
Construction	$840,000	$4,228,000	$771,000	$1,743,000	$1,224,000
Present Worth	$516,000	$2,596,000	$473,000	$1,070,000	$751,000
Operations & Maintenance					
Annual Cost	$451,000	$451,000	$451,000	$451,000	$942,000
Present Worth	$5,617,00	$5,617,000	$5,617,000	$5,617,000	$11,738,000
Total Present Worth	$8,163,000	$13,406,000	$6,766,000	$10,232,000	$35,050,000

OTHER MONETARY FACTORS

Two other monetary factors to consider include income from recycled water sale and potential sale or lease of the spray fields. Beginning in late 2014, the City began providing some recycled water to local farmers at the rate of $70 per acre-foot of recycled water in lieu of disposing of final effluent in the spray fields. As the City moves towards full water recycling, it is expected that the potential revenue stream from sale of recycled water will increase as the volume of recycled water produced and distributed increases. While tertiary recycled water is a higher quality and may receive a higher rate, for the purpose of this evaluation, it is assumed that its rate is similar to the secondary recycled water currently produced. A summary of the projected recycled water produced for each alternative is presented in Table 29.

Table 29. Projected 2035 Volume of Recycled Water Production

Alternative	Recycled Water Volume (acre-foot)
1A	570
1B	800
2A	580
2B	830
3A	800

The other monetary factor associated with the City moving towards full water recycling is that the existing spray fields may be repurposed. Potential options can include leasing the spray field land to farmers or selling the land. While this evaluation does not consider the revenue that can be generated from such options, the amount of land available differs with each alternative and is summarized in Table 30.

Table 30. Estimated Post-Project Spray Field Land Available

Alternative	Estimated Available Land (acres)
1A	164
1B	141
2A	173
2B	169
3A	173

NON-MONETARY FACTORS COMPARISON

Non-monetary factors to consider in selecting a recommended alternative include:

- Simplicity, ease, and reliability of process operation
- Risk of odors, health, and safety
- Regulatory requirements and potential liability
- Environmental considerations

The relative ranking of the various alternatives in relation to these factors are discussed below.

Simplicity, Ease and Reliability of Process Operation

Each of the alternatives, except Alternative 3A, will continue to use the existing treatment system. The recycled water system (e.g., pump station) would be an expansion of the current irrigation system and depending on the alternative, there may be additional storage facilities to maintain. The proposed systems are all considered equally reliable because of redundant features included in the design of all systems. Alternative 3A also require a higher level of certification for facility operators.

As presented in Table 29, the volume of recycled water that may be produced by the WWTF can vary significantly depending on if the existing storage ponds are lined. The volume of recycled water that is expected to percolate into the subsurface in Alternatives 1A and 2A is substantially higher when compared to Alternatives 1B, 2B, and 3A. Retrofitting the existing storage ponds can help increase the volume and reliability of recycled water supply that is available to users.

Risk of Odors, Health, and Safety

The wastewater treatment processes under Alternatives 1A, 1B, 2A, and 2B would continue to consist of the aerated pond treatment system, which may potentially have odor issues due to processing raw wastewater in large open ponds. However, odors are not anticipated to be an issue if the aeration systems are operated properly and the ponds are maintained to avoid excessive accumulation of biosolids. For alternatives where new ponds would be installed, security fencing would be included, which would reduce security risk around the ponds.

The use of hypochlorite for disinfection under Alternatives 1A, 1B, 2A, and 2B is inherently riskier to health and safety than UV light disinfection under Alternative 3A.

Regulatory Considerations

Regulatory requirements for each alternative are expected to be similar because the City would transition from disposal of final effluent in the spray fields to year-round storage and full recycling. If the City moves towards full water recycling, the recycled water program would likely be permitted under an individual WRR or the State Water Board's general recycled water permit (Order No. WQ 2014-0090-DWQ). The City would also need to decide on the disposition of the remaining spray fields (e.g., maintain them for emergency discharge, lease or sell the land). If the City converts the remaining spray fields spray into a non-disposal site, then the City can request that the Regional Water Board rescind the current WDR such that the City is no longer obligated to operate (including conducting monitoring) under those conditions. If the City elects to maintain some flexibility with the spray fields, the City may want to operate under both the existing (or reissued) WDR and some form of a recycled water permit.

Tertiary treatment under Alternative 3A provides a more consistently, higher quality recycled water that has more potential uses than secondary recycled water. Tertiary effluent is also more likely to meet long-term discharge requirements, which could become more stringent in the future. However, for the City's anticipated recycled water use, secondary recycled water sufficiently meets the current regulations.

Environmental Considerations

Environmental considerations include water supply and energy conservation and groundwater protection. Each alternative plans a transition from disposing of final effluent in spray fields to full water recycling for agricultural and potentially landscape irrigation. Use of recycled water in this form is a higher form of reuse than currently practiced and will reduce the demand on surface water and groundwater resources. Energy demand for conveying recycled water is also expected to be less than the energy required to pump groundwater for irrigation for Alternatives 1A, 1B, 2A, and 2B. Energy demand for tertiary treatment (Alternative 3A) is much higher and may likely offset energy saved from pumping groundwater.

In proposing to line all storage ponds (existing and new), Alternatives 1B, 2B, and 3A are expected to provide a higher level of protection of groundwater in comparison to Alternatives 1A and 2A because percolation from the existing ponds would be minimized. Between Alternatives 1A and 2A, Alternative 2A does not require an additional storage pond to be constructed, which would reduce its potential environmental impacts from construction and operation and maintenance activities for the pond as well as ancillary structures. An additional benefit of reducing percolation from the existing ponds is that available recycled water volume would be maximized.

COMPARISON SUMMARY AND RANKING

The various alternatives were compared by means of the ranking matrix presented in Table 31in which monetary and non-monetary factors, discussed above, for each alternative were scored numerically. Scoring was based on a combination of published information, regulatory knowledge, and engineering judgment.

Table 31. Summary Comparison of Alternatives Ranking

Factor	Alternative					
	Maximum	1A	1B	2A	2B	3A
Present worth cost	40	35	25	40	30	10
Recycled water production	5	3	5	3	5	5
Spray field land disposition	5	5	3	5	5	5
Ease/reliability of operation	5	5	5	5	5	3
Health, safety, odor risk	5	3	3	3	3	5
Regulatory considerations	20	15	15	15	15	18
Environmental considerations	20	10	14	14	16	18
Total	100	76	70	85	79	64

APPARENT BEST ALTERNATIVE

The apparent best alternative will depend on the need to line existing storage ponds to achieve BPTC. If the Regional Water Board determines through a BPTC Evaluation that lining of existing storage ponds is not required, then Alternative 2A is the preferred alternative based on its low cost and highest overall ranking. However, if lining of the existing storage ponds is required to achieve BPTC, then Alternative 2B becomes the preferred alternative.

APPENDIX A

City of Winters Waste Discharge Requirements Order No. R5-2002-0136

CALIFORNIA REGIONAL WATER QUALITY CONTROL REGIONAL BOARD
CENTRAL VALLEY REGION

ORDER NO. R5-2002-0136

WASTE DISCHARGE REQUIREMENTS
FOR
CITY OF WINTERS
WASTEWATER TREATMENT FACILITY
YOLO COUNTY

The California Regional Water Quality Control Regional Board, Central Valley Region, (hereafter Regional Board) finds that:

1. Waste Discharge Requirements Order No. 91-232, adopted by the Board on 22 November 1991, prescribes requirements for the City of Winters Wastewater Treatment Facility (WWTF), which consists of wastewater collection, treatment, storage and land application areas.

2. Existing waste discharge requirements established by Order No. 91-232 are neither adequate nor consistent with current plans and policies of the Regional Board.

3. On 31 January 2002, the City of Winters (hereafter Discharger) submitted a Report of Waste Discharge (RWD) for a phased expansion of the WWTF to treat and dispose of domestic wastewater generated in the City of Winters.

4. For the purposes of this Order, the WWTF shall mean the wastewater treatment and storage ponds, and land application areas. The facility site location is shown on Attachment A, which is attached hereto and made part of this Order by reference.

5. The WWTF property is owned by the City of Winters (hereafter Discharger). The Assessor Parcel Numbers are 30-180-017, 30-210-012, -012, -009, -020, -010, 30-030-047, -046 and -012. As of the date of this Order, EcoResources is contracted to operate and maintain the WWTF.

6. The WWTF is located on County Road 32, northwest of the city of Winters in Sections 16 and 17, T8N, R1W, MDB&M. The WWTF is primarily surrounded by agricultural land and orchards. The facility site map is shown on Attachment B, which is attached hereto and made part of this Order by reference.

7. The 31 January 2002 RWD proposes that upon certified completion of improvements to the WWTF the maximum discharge be increased using a phased approach. Phase 1B consists of increasing the discharge from the existing 0.80 MGD to 0.92 MGD and Phase 2 consists of increasing the discharge from the 0.92 MGD to 1.20 MGD.

Existing Facility and Discharge

8. The WWTF consists of influent pumping, two 0.2-acre primary aeration ponds, two 0.4-acre secondary aeration ponds, one 5-acre polishing pond, 4 storage ponds having 43.3 total acres,

chlorination system and approximately 170 acres of land application areas. A schematic of the treatment and storage ponds are shown on Attachment C, which is attached hereto and made part of this Order by reference.

9. The following table summarizes the data submitted by the Discharger in monthly monitoring reports as required by Order No. 91-232.

		Specific Conductivity (µmhos/cm)	
Date	Flow (mgd)	Influent	Effluent
1/2001	0.624	1033	1145
2/2001	0.648	1019	1038
3/2001	0.616	1204	1005
4/2001	na	na	na
5/2001	0.591	na	na
6/2001	0.623	1029	1122
7/2001	0.632	1054	1210
8/2001	0.677	1202	1113
9/2001	0.635	1164	1080
10/2001	0.688	1104	1128
11/2001	0.688	1031	na
12/2001	0.652	1043	1012
1/2002	0.596	852	896
AVERAGE	**0.639**	**1067**	**1075**

na denotes not available, mgd denotes million gallons per day.

10. The land application areas that are irrigated with disinfected secondary wastewater are vegetated by native grasses, which are periodically grazed by sheep and cattle from the neighboring ranch. The recycled water is applied to the 130-acre land application area using big-gun sprinklers (104 installed) and 1-nozzle impact sprinklers (448 installed) are used for irrigation on the 40-acre land application area. The tailwater control system consists of 2 pumps at a capacity of 1,200 gpm.

Sanitary Sewer System

11. Wastewater from homes and businesses in the City of Winters is conveyed by gravity to the East Street pumping station from which it is pumped through a 2.7-mile, 14-inch diameter force main to the WWTF.

12. The Discharger's sanitary sewer system collects wastewater using sewers, pipes, pumps, and/or other conveyance systems and directs this raw sewage to the wastewater treatment facility. A "sanitary sewer overflow" is defined as a discharge to ground or surface water from the sanitary

sewer system at any point upstream of the wastewater treatment facility. Temporary storage and conveyance facilities (such as wet wells, regulated impoundments, tanks, highlines, etc.) may be part of a sanitary sewer system and discharges to these facilities are not considered sanitary sewer overflows, provided that the waste is fully contained within these temporary storage/conveyance facilities.

13. Sanitary sewer overflows consist of varying mixtures of domestic sewage, industrial wastewater, and commercial wastewater; this mixture depends on the pattern of land use in the sewage collection system tributary to the overflow. The chief causes of sanitary sewer overflows include grease blockages, root blockages, debris blockages, sewer line flood damage, manhole structure failures, vandalism, pump station mechanical failures, power outages, storm or groundwater inflow/infiltration, lack of capacity, and contractor caused blockages.

14. Sanitary sewer overflows often contain high levels of suspended solids, pathogenic organisms, toxic pollutants, nutrients, oxygen demanding organic compounds, oil and grease, and other pollutants. Sanitary sewer overflows can cause temporary excedences of applicable water quality objectives, pose a threat to public health, adversely affect aquatic life, and impair the public recreational use and aesthetic enjoyment of surface waters in the area.

15. The Discharger is expected to take all necessary steps to adequately maintain, operate, and prevent discharges from its sanitary sewer collection system. This Order requires the Discharger to prepare and implement a Sanitary Sewer System Operation, Maintenance, Overflow Prevention, and Response Plan.

Planned Changes in Discharge

16. The Discharger is presently planning to expand the WWTF to be able to treat anticipated increased flows due to forecasted population increases. The expansion will be implemented in a phased approach. This phased approach includes 4 phases, however, this Order will focus on Phase 1B and Phase 2.

17. Phase 1B includes improvements that have been proposed in the RWD that will support a maximum discharge of 0.92 MGD (from the current 0.80 MGD). Some of the improvements include regrading the existing 130-acre land application areas to allow fuller use, and replacement of two existing 15-hp aerators in the primary aeration ponds with two 25-hp brush type aerators.

18. Phase 2 includes improvements that have been proposed in the RWD that will support a maximum discharge of 1.20 MGD. Some of the Phase 2 improvements include the installation of a new influent pump station, new 25-hp brush type aerator to the existing polishing pond, expand chlorination system to 100 lbs/d, replacement of the existing big-gun sprinklers in the north spray field with small sprinklers and an automated system, expand irrigation pumping capacity to 1,365 gpm, add an additional 133-acre-ft storage reservoir and add 56 new acres of land application areas.

19. The Discharger has provided treatment process capacity computations for Phases 1B and 2 that include water balance calculations utilizing data from a 100-year storm event.

Site-Specific Conditions

20. Annual average precipitation in the vicinity averages approximately 17.27 inches per year. The average evapotranspiration rate is approximately 57 inches per year.

21. The facility lies within the Valley Putah-Cache Hydrologic Unit Area No. 511.00, as depicted on interagency hydrologic maps prepared by the Department of Water Resources in August 1986.

Groundwater Considerations

22. There are no existing groundwater monitoring wells located at the WWTF. This Order requires the discharge to install a monitoring well network to assess background and down gradient water quality of the WWTF. The wells will be installed to such a depth that will allow monitoring of the first encountered groundwater bearing zone.

23. Quarterly groundwater monitoring and complete a technical analysis of groundwater monitoring data is appropriate and necessary to determine applicable background concentrations and the nature and extent of groundwater impacts attributable to the discharge, if any.

24. The water supply for the City of Winters is from five groundwater wells. The water is disinfected prior to distribution. Based on data from the 1998 Consumer Confidence Report the source water quality is as follows:

Constituent	Weighted Average	Range
Nitrate, mg/L	19	10 - 27
Total Dissolved Solids, mg/L	399	260-450
Specific conductance, µmhos/cm	710	460-810
Chloride, mg/L	27	15-31
Sulfate, mg/L	32	21-34
Coliform bacteria	non detect	----------

Groundwater Degradation

25. State Water Resources Control Regional Board (State Board) Resolution No. 68-16 (hereafter Resolution 68-16 or the "Antidegradation Policy") requires that high quality waters of the state (i.e., background water quality) be maintained until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in the water quality policies (e.g., quality that exceeds water quality objectives). Any discharge to existing high quality waters must

be required to meet waste discharge requirements that will result in best practicable treatment or control of the discharge necessary to assure that a pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the state will be maintained.

26. Some degradation of groundwater beneath the WWTF (excluding the land application areas) is consistent with Resolution 68-16 provided that:

    a. The degradation is confined within a specified boundary;

    b. The discharger minimizes the degradation by fully implementing, regularly maintaining, and optimally operating best practicable treatment and control (BPTC) measures;

    c. The degradation is limited to waste constituents typically encountered in municipal wastewater as specified in the groundwater limitations in this Order; and

    d. The degradation does not result in water quality less than that prescribed in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition* (hereafter Basin Plan).

27. Some degradation of groundwater by some of the typical waste constituents released with discharge from a municipal wastewater utility after effective source control, treatment, and control is consistent with maximum benefit to the people of California. The technology, energy, water recycling, and waste management advantages of municipal utility service far exceed any benefits derived from a community otherwise reliant on numerous concentrated individual wastewater systems, and the impact on water quality will be substantially less. Degradation of groundwater by constituents (e.g., toxic chemicals) other than those specified in the groundwater limitations in this Order, and by constituents that can be effectively removed by conventional treatment (e.g., total coliform bacteria) is prohibited. When allowed, the degree of degradation permitted depends upon many factors (i.e., background water quality, the waste constituent, the beneficial uses and most stringent water quality objective, source control measures, waste constituent treatability).

28. Economic prosperity of local communities and associated industry is of maximum benefit to the people of California, and therefore sufficient reason exists to accommodate growth and groundwater degradation around the wastewater treatment facility, provided that the terms of the Basin Plan are met.

29. These waste discharge requirements do not allow degradation of groundwater beneath the land application areas. The Discharger is required to monitor the groundwater under the land application areas and, if the monitoring data indicate that the discharge of waste to the land application areas is causing groundwater to contain waste constituents in concentrations statistically greater than background water quality, then the Discharger may be required to submit a report to indicate how such degradation will comply with Resolution 68-16. Upon review of such report, this Order may be revised, including the groundwater limitations.

Treatment and Control Practices

30. This WWTF provides treatment and control of the discharge that incorporates:

    a. Technology for secondary treatment of municipal wastewater;

    b. Recycling of wastewater;

    c. Staffing and training to assure proper operation and maintenance.

31. The WWTF treats wastewater to secondary standards. Because of the lack of information regarding the shallow groundwater table, assumptions cannot be made regarding constituent attenuation in the vadose zone. In addition, the potential impacts on groundwater and the appropriate level of degradation that complies with Resolution 68-16 have not been fully evaluated. Therefore, the Discharger's current effort may not constitute BPTC as intended in Resolution 68-16, and this Order establishes a schedule for tasks to evaluate BPTC for each conveyance, treatment, storage, and disposal component of the facility and to further characterize groundwater for selected constituents. Completion of these tasks, and implementation of the approved strategies developed from that work, will ensure that BPTC and the highest water quality consistent with the maximum benefit to the people of the State will be achieved.

32. This Order establishes interim groundwater limitations for the WWTF that will not unreasonably threaten present and anticipated beneficial uses or result in groundwater quality that exceeds water quality objectives set forth in the Basin Plan. This Order contains tasks for assuring that BPTC and the highest water quality consistent with the maximum benefit to the people of the State will be achieved. Accordingly, the discharge is consistent with the antidegradation provisions of Resolution 68-16. Based on the results of the scheduled tasks, this Order may be reopened to reconsider groundwater limitations and other requirements to comply with Resolution 68-16.

Water Recycling

33. The Department of Health Services (DHS) has established statewide water recycling criteria in Title 22, CCR, Section 60301 et. seq. (hereafter Title 22). DHS revised the water recycling criteria contained in Title 22 on 2 December 2000. The revised Title 22 requires that all wastewater used for reclamation receive, at a minimum, secondary treatment. However, Title 22 does not define secondary treatment with respect to numerical limits for BOD_5 and total suspended solids (TSS). According to DHS, for uses not requiring disinfection, treated wastewater should, at a minimum, be adequately oxidized, contain dissolved oxygen near saturation levels, and be nonputrescible when applied to land.

Basin Plan, Beneficial Uses, and Regulatory Considerations

34. The Basin Plan designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Board. Pursuant to Section 13263(a) of the California Water Code, waste discharge requirements must implement the Basin Plan.

35. Surface water drainage is to Highland Canal, thence to Dry Creek, thence to Putah Creek thence to the Yolo Bypass. The beneficial uses of the Putah Creek to Yolo Bypass are municipal and domestic supply; agricultural irrigation and stock watering supply; contact recreation, other noncontact recreation; warm and potential cold freshwater habitat; warm water spawning and wildlife habitat.

36. The beneficial uses of the underlying groundwater are municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply.

37. The Basin Plan encourages water recycling.

38. The Basin Plan establishes numerical and narrative water quality objectives for surface and groundwater within the basin for implementation in waste discharge requirements. For narrative water quality objectives translators can be employed as prescribed in the Basin Plan to derive numerical limitations that protect designated beneficial uses.

39. The Basin Plan identifies numerical water quality objectives for waters designated as municipal supply. These are the maximum contaminant levels (MCLs) specified in Title 22, California Code of Regulations: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) of Section 64449. The Basin Plan's incorporation of these provisions by reference is prospective to incorporate changes as they take effect.

40. Narrative water quality objectives cover chemical constituents, tastes and odors, and toxicity. The toxicity objective requires that groundwater be maintained free of toxic substances in concentrations that produce detrimental physiological responses in humans, plants or animals. The chemical constituent objective requires that groundwater shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The tastes and odors objective requires that groundwater shall not contain tastes or odors producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

41. Water quality numeric criteria and guidelines developed and published by other agencies and organizations as necessary to protect designated beneficial uses are summarized in the attached information sheet. To not unreasonably affect any beneficial use, the most stringent of the

translated water quality criteria and numeric water quality objectives for a constituent must be the groundwater limitation implemented herein.

42. Section 13241 of the Water Code requires the Regional Board to consider various factors, including economic considerations, when adopting water quality objectives into its Basin Plan. Water Code Section 13263 requires the Regional Board to address the factors in Section 13241 in adopting waste discharge requirements. The State Board, however, has held that a Regional Board need not specifically address the Section 13241 factors when implementing existing water quality objectives in waste discharge requirements because the factors were already considered in adopting water quality objectives. As waste discharge requirements implement adopted water quality objectives, no additional analysis of Section 13241 factors is required.

43. The United States Environmental Protection Agency (EPA) has promulgated biosolids reuse regulations in 40 CFR 503, *Standard for the Use or Disposal of Sewage Sludge,* which establishes management criteria for protection of ground and surface waters, sets application rates for heavy metals, and establishes stabilization and disinfection criteria.

44. The Regional Board is using the Standards in 40 CFR 503 as guidelines in establishing this Order, but the Regional Board is not the implementing agency for 40 CFR 503 regulations. The Discharger may have separate and/or additional compliance, reporting, and permitting responsibilities to the EPA.

45. The State Board adopted Order No. 97-03-DWQ (General Permit No. CAS000001) specifying waste discharge requirements for discharges of storm water associated with industrial activities, and requiring submittal of a Notice of Intent by all affected industrial dischargers. If the wastewater treatment facility facilities are designed to collect all runoff and redirect them to the plant headworks then the Discharger will not be required to obtain coverage under the General Permit No. CAS000001. However, if the runoff in the plant area is not redirected to the headworks, then the Discharger is required to submit a notice of intent or notice of non-applicability for coverage under General Permit No. CAS000001.

46. On date 18 February 1997, in accordance with the California Environmental Quality Act (CCR, Title 14, Section 15261 et. seq.), the City of Winters certified a final Envionmental Impact Report for the phased expansion of the wastewater treatment facility including new spray fields and ultimately increasing the plants capacity from 0.55 MGD to 1.63 MGD. Recommended mitigation measures for potential significant impacts for water and groundwater quality are as follows:

Water Quality

a. California Regional Water Quality Control Board discharge requirements shall be met via the final design of the project. Requirements will include the specification that no applied wastewater reused for irrigation leave the site as surface runoff. Title 22 requirements will be met for reuse of wastewater for irrigation in design of treatment and disinfection systems.

b. Consistent with the General Plan policy VI.A.6, grading should be carried out during the dry months, April-October. Areas not being graded should be disturbed as little as possible. Construction and grading areas, as well as soil stockpiles should be covered or temporarily revegetated when left for long periods. Revegetation of slopes should be carried out immediately upon completion of grading. Temporary drainage structures and sedimentation basins must be installed to prevent sediment from entering and thereby degrading the quality of downgradient surface waters. A temporary and permanent erosion control plan shall be prepared with the final project design. These measures shall be incorporated into the State's required Stormwater Pollution Prevention Plan.
c. Facilities shall not be constructed and grading shall not be allowed with 100 feet of Dry Creek.

Groundwater Quality

a. California Regional Water quality Control Board requirements shall be met via the final design of the project.
b. A detailed geotechnical design report shall be performed prior to the final project design to determine groundwater levels across the site and seepage concerns resulting in recommendations with the intent of ensuring that significant groundwater impacts will not occur. The report shall meet the requirements of the Water Quality Control Board and recommendations of the final report shall be followed in the final design.
c. The final design shall incorporate drainage and pond sizing to accommodate 100-year rainfall events.

The Regional Board reviewed the mitigated negative declaration and concurs that implementing the outlined mitigation measures and compliance with Board adopted Waste Discharge Requirements will mitigate the risk of significant impacts to water quality.

47. Section 13267(b)(1) of the CWC provides that: "In conducting an investigation specified in subdivision (a), the Regional Board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the Regional Board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports."

48. The technical reports required by this Order and the attached "Monitoring and Reporting Program No. R5-2002-0136" are necessary to assure compliance with these waste discharge requirements. The Discharger operates the facility that discharges the waste subject to this Order.

49. The California Department of Water Resources (DWR) sets standards for the construction and destruction of groundwater wells (hereafter DWR Well Standards), as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 94-81* (December 1981). These standards, and any more stringent standards adopted by the State or county pursuant to CWC Section 13801, apply to all monitoring wells.

50. The discharge authorized herein and the treatment and storage facilities associated with the discharge, except for discharges of residual sludge and solid waste, are exempt from the requirements of Title 27, California Code of Regulations (CCR), Section 20005 et seq. (hereafter Title 27). The exemption, pursuant to Section 20090(a) of Title 27, is based on the following:

    a. The waste consists primarily of domestic sewage and treated effluent;

    b. The waste discharge requirements are consistent with water quality objectives; and

    c. The treatment and storage facilities described herein are associated with a municipal wastewater treatment facility.

51. State regulations that prescribe procedures for detecting and characterizing the impact of waste constituents from waste management units on groundwater are found in Title 27. While the wastewater treatment facility is exempt from Title 27, the data analysis methods of Title 27 are appropriate for determining whether the discharge complies with the terms for protection of groundwater specified in this Order.

52. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.

Public Notice

53. All the above and the supplemental information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge.

54. The State Department of Health Services was consulted regarding the public health aspects of water recycling.

55. The conditions of discharge in this Order were developed based on currently available technical information and applicable water quality laws, regulations, policies, and plans, and are intended to assure conformance with them. The Discharger may request that this Order be reopened if applicable laws and regulations change.

56. The Discharger and interested agencies and persons were notified of the intent to prescribe waste discharge requirements for this discharge, and provided an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

57. In a public meeting, all comments pertaining to the discharge were heard and considered.

IT IS HEREBY ORDERED that, pursuant to Sections 13263 and 13267 of the California Water Code, Order No. 91-232 is rescinded and the City of Winters, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted hereunder, shall comply with the following:

[Note: Other prohibitions, conditions, definition and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are part of this Order. This attachment and its individual paragraphs are referred to as "Standard Provisions" and are attached hereto and made part of this Order by reference.]

A. Discharge Prohibitions

1. The direct or indirect discharge of wastes and/or recycled water to surface waters or surface water drainage courses is prohibited.

2. The bypass or overflow of untreated or partially treated waste is prohibited.

3. The application of recycled water to areas other that the designated land application areas is prohibited.

4. The application of recycled water that is applied at rates in excess of the vegetation nitrogen requirements, or at rates that would cause excess nitrogen, dissolved solids, or metals to leach to groundwater is prohibited.

5. The grading of surface water drainage courses and/or wetland areas in the land application areas is prohibited without water quality certification. Water Quality Certification is required for any project that impacts waters of the State (such as streams and wetlands). Those projects include, but are not limited to, stream crossings, modification of stream banks or stream courses, and filling or modification of wetlands.

6. The discharge of sewage from a sanitary sewer system at any point upstream of a wastewater treatment facility is prohibited. Discharge of treated wastewater downstream of the treatment plant, other than at the approved land application areas, is prohibited.

7. The discharge of waste classified as 'hazardous' under Section 2521, Title 23 CCR or 'designated', as defined in Section 13173 of California Water Code is prohibited.

8. The discharge of septage to the sanitary sewer system or the WWTF is prohibited.

9. The grazing of livestock in the land application areas, is prohibited.

B. Discharge Specifications

1. The monthly average dry weather flow shall not exceed 0.80 MGD. Upon certified completion of the facility improvements for Phase 1B, the Discharger shall submit a report prepared by a California licensed engineer describing the improvements. Upon written approval of the Phase 1B report from the Executive Officer, the monthly average dry weather flow shall not exceed 0.92 MGD. Upon certified completion of the improvements for Phase 2 the Discharger shall submit a report prepared by a California licensed engineer describing the improvements. Upon approval of the Phase 2 improvement report from the Executive Officer the monthly average flow shall not exceed 1.20 MGD. The flow rate limits shall be applied to the flow entering the headworks.

2. Public contact with wastewater shall be precluded or controlled through such means as fences and signs, or acceptable alternatives.

3. No waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of the Groundwater Limitations.

4. Objectionable odors originating at the facility shall not be perceivable beyond the limits of the property owned by the Discharger.

5. As a means of discerning compliance with Discharge Specification No. 4, the dissolved oxygen content in the upper one foot of any wastewater storage pond shall not be less than 1.0 mg/L.

6. All treatment, storage, and land application areas shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return frequency.

7. Application of recycled water shall be confined to the designated land application areas as defined in this Order.

8. Wastewater ponds shall be managed to prevent breeding of mosquitoes. In particular,

   a. An erosion control program shall be implemented to ensure that small coves and irregularities are not created around the perimeter of the water surface.

   b. Weeds shall be minimized through control of water depth, harvesting, or herbicides.

   c. Dead algae, vegetation, and debris shall not accumulate on the water surface.

9. The facility shall have sufficient treatment, storage, and disposal capacity to accommodate allowable wastewater flow and design seasonal precipitation and ancillary inflow and infiltration during the winter months. Design seasonal precipitation shall be based on total annual precipitation using a return period of 100 years, distributed monthly in accordance with historical rainfall patterns.

10. Freeboard in any pond shall never be less than two feet as measured from the water surface to the lowest point of overflow.

11. On or about **15 October** of each year, available pond storage capacity shall at least equal the volume necessary to comply with Discharge Specifications B.9 and B.10.

C. Effluent Limitations

1. Treated effluent discharged from the treatment plant/storage ponds to the land application areas shall not have total coliform exceeding a monthly average of 23 MPN/100 mL or a daily maximum of 240 MPN/100 mL.

2. No stored wastewater or effluent shall have a pH less than 6.5 or greater than 9.5.

D. General Solids Disposal Specifications

Sludge, as used in this document, means the solid, semisolid, and liquid residues removed during primary, secondary, or advanced wastewater treatment processes. Solid waste refers to grit and screenings generated during preliminary treatment. Residual sludge means sludge that will not be subject to further treatment at the WWTF. Biosolids refers to sludge that has been treated and tested and shown to be capable of being beneficially and legally used pursuant to federal and state regulations as a soil amendment for agriculture, silviculture, horticulture, and land reclamation activities.

1. Sludge and solid waste shall be removed from screens, sumps, ponds, and clarifiers as needed to ensure optimal plant operation.

2. Treatment and storage of sludge generated by the WWTF shall be confined to the WWTF property, and shall be conducted in a manner that precludes infiltration of waste constituents into soils in a mass or at concentrations that will violate the Groundwater Limitations of this Order.

3. Any storage of residual sludge, solid waste, and biosolids at the WWTF shall be temporary, and the waste shall be controlled and contained in a manner that minimizes leachate formation and precludes infiltration of waste constituents into soils in a mass or at concentrations that will violate the Groundwater Limitations of this Order.

4. Residual sludge, biosolids, and solid waste shall be disposed of in a manner approved by the Executive Officer and consistent with Title 27. Removal for further treatment, disposal, or reuse at disposal sites (i.e., landfills, WWTFs, composting sites, soil amendment sites) operated in accordance with valid waste discharge requirements issued by a Regional Water Quality Control Board will satisfy this specification.

5. Use of biosolids as a soil amendment shall comply with valid waste discharge requirements issued by a Regional Water Quality Control Board. In most cases, this will mean the General Biosolids Order (State Water Resources Control Board Water Quality Order No. 2000-10-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities*). For a biosolids use project to be covered by the General Biosolids Order, the Discharger must file a complete Notice of Intent and receive a Notice of Applicability for each project.

6. Use and disposal of biosolids shall comply with the self-implementing federal regulations of Title 40, Code of Federal Regulations (CFR), Part 503, which are subject to enforcement by the U.S. EPA, not the Regional Board. If during the life of this Order, the State accepts primacy for implementation of 40 CFR 503, then the Regional Board may also initiate enforcement where appropriate.

E. Land Application Area Specifications

1. Public contact with recycled wastewater shall be controlled through use of fences and cautionary signs, and/or other appropriate means. Perimeter warning signs indicating that recycled water is in use shall be posted at least every 500 feet along the property boundary and at each access road entrance to the properties. Each sign shall be in English and Spanish languages.

2. Any connection between the recycled water conveyance system and any potable water conveyance system, groundwater supply well, or surface water supply source for the purpose of supplementing recycled water shall be equipped with an appropriate backflow prevention device.

3. Direct or windblown spray shall be confined to the designated land application area and shall be prevented from contacting outdoor eating areas, drinking water facilities, homes, or surface watercourses.

4. The Discharger shall comply with the following setbacks within the land application areas:

Setback Distance (feet)	To
25	Property Lines
30	Public Roads
50	Surface Water Drainage Courses
100	Domestic/Irrigation Wells

5. The perimeter of the land application areas shall be graded to control runoff and prevent ponding along public roads or other public areas.

6. Irrigation with recycled water shall not be performed within 24 hours before, during, or within 24 hours after any precipitation event, nor shall it be performed when the land application areas is saturated.

7. Application rates for recycled water shall not exceed agronomic rates considering the crop, soil, climate, and irrigation management system in accordance with the operation and maintenance plan required by Provision G.1.b.

8. The land application area shall be managed to prevent breeding of mosquitoes. In particular:

   a. There shall be no standing water on the irrigation parcel areas 24 hours after effluent application to a parcel ceases;

   b. Ditches must be maintained essentially free of emergent, marginal, and floating vegetation, and;

   c. Low-pressure and unpressurized pipelines and ditches accessible to mosquitoes shall not be used to store effluent.

F. Groundwater Limitations

1. Release of waste constituents from any wastewater treatment, storage system component, or land application area associated with the WWTF shall not cause groundwater degradation under and beyond that system component, as determined by an approved well monitoring network, to:

   a. Contain any of the following constituents in concentration greater than as listed or greater than ambient background quality, whichever is greater:

Constituent	Units	Limitation
Boron	mg/L	0.6
Chloride	mg/L	106
Iron	mg/L	0.3
Manganese	mg/L	0.05
Sodium	mg/L	69
Total Coliform Organisms	MPN/100 mL	non detect
Total Dissolved Solids[1]	mg/L	450
Total Nitrogen	mg/L	10
Nitrite (as N)	mg/L	1

Constituent	Units	Limitation
Nitrate (as N)	mg/L	10
Ammonia (as N)	mg/L	0.5
Bromoform	µg/L	4
Bromodichloromethane	µg/L	0.27
Chloroform	µg/L	1.1
Dibromochloromethane	µg/L	0.37

[1] A cumulative impact limit that accounts for several dissolved constituents in addition to those listed here separately [e.g., alkalinity (carbonate and bicarbonate), calcium, hardness, phosphate, and potassium].

b. Contain any constituent not identified in Groundwater Limitation F.1.a in concentrations greater than background quality (whether chemical, physical, biological, bacteriological, radiological, or some other property or characteristic).

c. Exhibit a pH of less than 6.5 or greater than 8.5 pH units.

d. Impart taste, odor, toxicity, or color that creates nuisance or impairs any beneficial use.

G. Provisions

1. All technical reports required herein that involve planning, investigation, evaluation, or design, or other work requiring interpretation and proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code sections 6735, 7835, and 7835.1. To demonstrate compliance with sections 415 and 3065 of Title 16, CCR, all technical reports must contain a statement of the qualifications of the responsible registered professional(s). As required by these laws, completed technical reports must bear the signature(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work. All of the following reports shall be submitted pursuant to Section 13267 of the California Water.

   a. By **1 August 2003** submit a technical evaluation of the suspected seepage occuring from Storage Pond No. 4. Please include a workplan that will outline a schedule that will incorporate the mitigation measures to address this problem.

   b. By **1 August 2003**, the Discharger shall submit an Operation and Maintenance (O&M) Plan for the wastewater treatment facility and land application area. The O&M Plan shall instruct field personnel on how to manage the day-to-day discharge operations to comply with the terms and conditions of this Order and how to make field adjustments, as necessary, to preclude nuisance conditions (e.g., standing water and objectionable odors from ponded wastewater). It shall also include a nuisance condition troubleshooting flowchart and a description of notification requirements. A copy of the

O&M Plan shall be kept at the facility for reference by operating personnel. Key personnel shall be familiar with its contents. The O&M Plan shall include the following documents as report appendices:

i. A Cropping and Tailwater Control Plan which identifies the land application areas, wastewater application method, tailwater control method, tailwater control system schematic, berms/checks/furrows, crops to be grown, nitrogen removal calculations, and crop cutting/harvesting/disposal procedure, if applicable. This plan shall identify what measures will be taken to prevent wastewater from entering surface water drainage courses.

ii. A Grading Plan which describes grading activities which will allow application of wastewater in accordance with the WDRs, particularly Section D, Land Application Area Specifications. The grading of surface water drainage courses and/or wetland areas in the land application areas is prohibited without water quality certification. Water Quality Certification is required for any project that impacts waters of the State (such as streams and wetlands). Those projects include, but are not limited to, stream crossings, modification of stream banks or stream courses, and filling or modification of wetlands.

SANITARY SEWER EVALUATION

c. By **1 August 2004**, the Discharger shall submit a *Sanitary Sewer System Operation, Maintenance, Overflow Prevention, and Response Plan* (SSS Plan) that describes the actions designed to prevent, or minimize the potential for sanitary sewer overflows. The Discharger shall maintain the SSS Plan in an up-to-date condition and shall amend the SSS Plan whenever there is a change (e.g., in the design, construction, operation, or maintenance of the sanitary sewer system or sewer facilities) that materially affects the potential for sanitary sewer overflows, or whenever there is a sanitary sewer overflow. The Discharger shall ensure that the up-to-date SSS Plan is readily available to sewer system personnel at all times and that sewer system personnel are familiar with it.

i. At a minimum, the Operation and Maintenance portion of the plan shall contain or describe the following:

1. Detailed maps of the sanitary sewer system, identifying sewer mains, manholes, and lift stations;

2. A detailed listing of elements to be inspected, a description of inspection procedures and inspection frequency, and sample inspection forms;

3. A schedule for routine inspection and testing of all pipelines, lift stations, valves, and other key system components. The inspection/testing program shall

be designed to reveal problems that might lead to accidental spills and ensure that preventive maintenance is completed;

4. Provisions for repair or replacement of old, worn out, or defective equipment;

5. Provisions to minimize the need for manual operation of critical systems and provide spill alarms or other "fail safe" mechanisms;

6. The ability to properly manage, operate and maintain, at all times, all parts of the collection system that the Discharger owns or over which the Discharger has operational control;

7. The ability to provide adequate capacity to convey base flows and peak flows for all parts of the collection system the Discharger owns or over which the Discharger has operational control; and

8. How the Discharger will take all feasible steps to stop and mitigate the impact of sanitary sewer overflows in portions of the collection system the Discharger owns or over which the Discharger has operational control.

ii. At a minimum, the Overflow Prevention and Response Plan shall contain or describe the following:

1. Identification of areas of the collection system that historically have overflowed and an evaluation of the cause of the overflow;

2. Maintenance activities that can be implemented to address the cause of the overflow and means to prevent future overflows. Maintenance activities may include pretreatment of wastewater from industrial dischargers who discharge high concentrations of oil and grease in their wastewater;

3. Procedures for responding to sanitary sewer overflows designed to minimize the volume of sewer overflow that enters surface waters, and minimize the adverse effects of sewer overflows on water quality and beneficial uses;

4. Steps to be taken when an overflow or spill occurs, and procedures that will be implemented to ensure that all overflows and spills are properly identified, responded to and reported; and

5. A public notification plan, in which any posting of areas contaminated with sewage is performed at the direction of the Yolo County Health Department. All parties with a reasonable potential for exposure to an overflow event shall be notified.

GROUNDWATER QUALITY EVALUATION

d. By **1 August 2003**, the Discharger shall submit a workplan, prepared by a Registered Geologist, for characterization of groundwater quality. The workplan shall describe the installation of monitoring wells that will provide an adequate monitoring well network to evaluate groundwater quality upgradient and downgradient of the WWTF, including the land application areas. Every monitoring well shall be constructed to yield representative samples from the uppermost layer of the uppermost aquifer and to comply with applicable well standards. The workplan shall be consistent with, and include the items listed in, the first section of Attachment D, "*Items to be Included in a Monitoring Well Installation Workplan and a Monitoring Well Installation Report of Results.*"

e. By **1 January 2004**, the Discharger shall submit a groundwater well installation report prepared by a Registererd Geologist. The report shall be consistent with, and include the items listed in, the second section of Attachment D.

f. By **1 March 2005**, the Discharger shall submit a *Background Groundwater Quality Study Report*. For each groundwater monitoring parameter/constituent identified in the MRP, the report shall present a summary of monitoring data, calculation of the concentration in background monitoring wells, and comparison of background groundwater quality to that in wells used to monitor the facility. Determination of background quality shall be made using the methods described in Title 27, Section 20415(e)(10), and shall be based on data from at least four consecutive quarterly (or more frequent) groundwater monitoring events. For each monitoring parameter/constituent, the report shall compare measured concentrations for compliance monitoring wells with: 1) the calculated background concentration, and 2) the interim numeric limitations set forth in Groundwater Limitation F.1.a. Where background concentrations are statistically greater than the interim limitations specified in Groundwater Limitation F.1.a, the report shall recommend final groundwater limitations which comply with Resolution 68-16 for the waste constituents listed therein. Subsequent use of a concentration as a final groundwater limitation will be subject to the discretion of the Executive Officer. Where background concentrations are statistically less than the listed interim concentrations and the concentrations in the downgradient wells are statistically greater than background concentrations, the Discharger shall begin the preparation of a BPTC Evaluation Report to be approved by the Executive Officer.

If the BPTC evaluation report is required by this provision and subsequent monitoring results demonstrate the need to modify groundwater limitations this Order will be reopened and modified groundwater limitations adopted.

BPTC EVALUATION REPORT

Provisions G.1.h through G.1.j outline the schedule and compliance dates to be adhered to if the Discharger is required to submit a BPTC Evaluation Report per Provision G.1.g:

g. By **1 March 2006**, the Discharger shall submit a *BPTC Evaluation Workplan* that sets forth the scope and schedule for a systematic and comprehensive technical evaluation of each component of the facility's waste treatment and disposal system to determine best practicable treatment and control for each waste constituent listed in the Groundwater Limitation F.1.a of this Order. The workplan shall contain a preliminary evaluation of each component of the WWTF and effluent disposal system and propose a time schedule for completing the comprehensive technical evaluation. The schedule to complete the evaluation shall be as short as practicable, and shall not exceed one year.

h. By **1 August 2007**, the Discharger shall submit a *BPTC Evaluation Report and Implementation Workplan*. The report shall include a comprehensive evaluation of the BPTC measures studied, a discussion of BPTC measures proposed for implementation (i.e., recommendations for WWTF modifications), estimated concentration or mass loading reductions for each BPTC measure, specific methods the Discharger proposes to monitor and assure continuous optimal performance of BPTC measures, the source of funding, and proposed schedule for modifications. The schedule for full implementation shall be as short as practicable, and in no case shall it exceed four years past the Executive Officer's approval of the workplan unless specifically approved by the Regional Board. The component evaluation, recommended improvements, and implementation schedule are subject to the Executive Officer's approval.

i. By **30 November 2011**, the Discharger shall submit a technical report that proposes specific numeric groundwater limitations that (a) reflects compliance with applicable water quality objectives, background water quality, and full implementation of BPTC measures, and (b) describes how these were determined considering actual data from compliance monitoring wells, impact reductions through full implementation of BPTC, reasonable growth, etc. The Discharger should submit results of a validated groundwater model to support its proposal. In addition, the technical report shall describe the overall status of compliance with implementation of BPTC measures and compliance with all groundwater limitations.

OTHER REPORTS

j. **At least 60 days prior** to any biosolids removal and disposal, the Discharger shall submit a *Biosolids and Sludge Management Plan*. The plan shall include a detailed program and schedule for periodic pond cleanout and disposal of biosolids removed during pond cleanout, including at least the items listed in Attachment E of this Order.

k. A detailed design technical report shall be submitted to the Regional Board prior to the final design of the Phase II improvements. The technical report shall provide groundwater conditions within the area of the proposed reservoir and outline what engineering alternatives will be incorporated into the design of the reservoir that will provide adequate protection of water quality. If it is determined that a liner is required then a Construction Quality Assurance Plan shall be submitted for the installation of the liner.

2. Upon completion of tasks set forth in Provision G.1, the Regional Board shall consider the evidence provided and make a determination regarding whether the Discharger has justified BPTC and the appropriate final numeric groundwater limitations that comply with Resolution 68-16.

3. Upon the reduction, loss, or failure of the sanitary sewer system resulting in a sanitary sewer overflow, the Discharger shall take any necessary remedial action to (a) control or limit the volume of sewage discharged, (b) terminate the sewage discharge as rapidly as possible, and (c) recover as much as possible of the sewage discharged (including wash down water) for proper disposal. The Discharger shall implement all applicable remedial actions including, but not limited to, the following:

   a. Interception and rerouting of sewage flows around the sewage line failure;

   b. Vacuum truck recovery of sanitary sewer overflows and wash down water;

   c. Use of portable aerators where complete recovery of the sanitary sewer overflows are not practicable and where severe oxygen depletion is expected in surface waters; and

   d. Cleanup of sewage-related debris at the overflow site.

4. The Discharger shall comply with the Monitoring and Reporting Program No. R5-2002-0136, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.

5. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements", dated 1 March 1991, which are attached hereto and made part of this Order by reference. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."

6. The Discharger shall use the best practicable cost-effective control technique(s) including proper operation and maintenance, to comply with discharge limits specified in this order.

7. The Discharger shall report promptly to the Regional Board any material change or proposed change in the character, location, or volume of the discharge.

11. The Discharger shall report to the Regional Board any toxic chemical release data it reports to the State Emergency Response Commission within 15 days of reporting the data to the

Commission pursuant to section 313 of the "Emergency Planning and Community Right to Know Act of 1986."

12. The Discharger shall not allow pollutant-free wastewater to be discharged into the wastewater collection, treatment, and disposal system in amounts that significantly diminish the system's capability to comply with this Order. Pollutant-free wastewater means rainfall, groundwater, cooling waters, and condensates that are essentially free of pollutants.

13. The Discharger shall submit to the Regional Board on or before each compliance report due date, the specified document or, if appropriate, a written report detailing compliance or noncompliance with the specific schedule date and task. If noncompliance is being reported, then the Discharge shall state the reasons for such noncompliance and provide an estimate of the date when the Discharger will be in compliance. The Discharger shall notify the Regional Board in writing when it returns to compliance with the time schedule.

14. In the event of any change in control or ownership of land or waste discharge facilities described herein, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to this office.

15. At least **90 days** prior to termination or expiration of any lease, contract, or agreement involving disposal or recycling areas or off-site reuse of effluent, used to justify the capacity authorized herein and assure compliance with this Order, the Discharger shall notify the Regional Board in writing of the situation and of what measures have been taken or are being taken to assure full compliance with this Order.

16. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Regional Board or court orders requiring corrective action or imposing civil monetary liability, or in revision or recession of this Order.

17. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

18. The Regional Board will review this Order periodically and will revise requirements when necessary.

I, THOMAS R. PINKOS, Acting Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Regional Board, Central Valley Region, on 19 July 2002.

THOMAS R. PINKOS, Acting Executive Officer

MMW: 7/19/02

AMENDED INFORMATION SHEET

ORDER NO. R5-2002-0136
CITY OF WINTERS
WASTEWATER TREATMENT FACILITY
YOLO COUNTY

Background

The City of Winters is a community of approximately 6,200 residents located on the western edge of the Sacramento Valley about 30 miles west of Sacramento. The City is primarily surrounded by orchards and pasture lands.

The City of Winters wastewater treatment facility (WWTF) provides secondary treatment. The City owns the plant and the operation and maintenance is currently contracted to EcoResources. The WWTF provides treatment for primarily domestic wastewater, with the exception of a few large industrial dischargers, one being a nut processing facility.

The existing Winters WWTF was constructed in 1980. The original dry weather capacity was estimated at 1.0 MGD. However, due to apparent leakage from one of the storage ponds, the Regional Board adjusted the plant capacity to 0.70 MGD. As outlined in Order No. 91-232, the average daily dry weather discharge flow (ADWF) was limited to 0.70 MGD. As outlined in Discharge Specification B.4 of Order No. 91-232, upon completion of proposed improvements to the WWTF the ADWF could be increased, with staff approval, to 0.80 MGD. The expansion was completed and improvements included the construction of an additional 140 acre-ft storage pond (No. 4) and the addition of land application areas. In March 2001, the Regional Board granted the increase of the ADWF to 0.80 MGD. Order No. 91-232 is no longer consistent with the Regional Board's current plans and policies and will be rescinded upon the adoption of this Order.

The Discharger is proposing to increase the treatment, storage and disposal capacity of the existing aeration and storage ponds, and increase acreage of the land application areas. Existing wastewater treatment processes include influent pumping, two 0.2-acre (20 acre-ft) primary aeration ponds, two
0.4-acre (40 acre-ft) secondary aeration ponds, one 5-acre polishing pond, 4 storage ponds having 43.3 total acres (380 acre-ft), chlorination system and approximately 170 acres of land application areas.

The proposed improvements to the WWTF are to be implemented in phases (Phase 1B and Phase 2). Phase 1B proposed improvements will support a maximum discharge of 0.92 MGD. Some of the improvements include regrading the existing 130-acre land application areas and the replacement of two existing 15-hp aerators in the primary aeration ponds with two 25-hp brush type aerators.

Phase 2 proposed improvements will support a maximum discharge of 1.20 MGD. Examples of the Phase 2 improvements include the installation of a new influent pump station, new 25-hp brush type aerator to the existing polishing pond, expand chlorination system to 100 lbs/d, replacement of the existing big-gun sprinklers in the north spray field with small sprinklers and an automated system, expand irrigation pumping capacity to 1,365 gpm, add an additional 133-acre-ft storage reservoir and add 56 new acres of land application areas.

Effluent Disposal

The land application areas that are irrigated with disinfected secondary wastewater are vegetated by native grasses, which are periodically grazed by sheep and cattle from the neighboring ranch. The recycled water is applied to the 130-acre land application area using big-gun sprinklers (104 installed) and 1-nozzle impact sprinklers (448 installed) are used for irrigation on the 40-acre land application area. The tailwater control system consists of 2 pumps at a capacity of 1,200 gpm.

Basin Plan, Beneficial Uses, and Regulatory Considerations

The beneficial uses of the Putah Creek to Yolo Bypass are municipal and domestic supply; agricultural irrigation and stock watering supply; contact recreation, other noncontact recreation; warm and potential cold freshwater habitat; warm water spawning and wildlife habitat. The *Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, Fourth Edition* (Basin Plan), designates beneficial uses, establishes water quality objectives, and contains implementation plans and policies for all waters of the Basin. Beneficial uses often determine the water quality objectives that apply to a water body. For example, waters designated as municipal and domestic supply must meet the maximum contaminant levels (MCLs) for drinking waters. The Basin Plan sets forth the applicable beneficial uses (industrial, agricultural, and domestic supply in this instance) of groundwater, procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity.

Antidegradation

The antidegradation directives of Section 13000 of the California Water Code require that waters of the State that are better in quality than established water quality objectives be maintained "consistent with the maximum benefit to the people of the State." Waters can be of high quality for some constituents or beneficial uses and not others. Policies and procedures for complying with this directive are set forth in the Basin Plan (including by reference State Water Board Resolution No. 68-16, "Statement of Policy With Respect to Maintaining High Quality Waters in California," or "Antidegradation" Policy).

Resolution 68-16 is applied on a case-by-case, constituent-by-constituent basis in determining whether a certain degree of degradation can be justified. It is incumbent upon the Discharger to provide technical information for the Regional Board to evaluate that fully characterizes:

- All waste constituents to be discharged;
- The background quality of the uppermost layer of the uppermost aquifer;
- The background quality of other waters that may be affected;
- The underlying hydrogeologic conditions;
- Waste treatment and control measures;
- How treatment and control measures are justified as best practicable treatment and control (BPTC);
- The extent the discharge will impact the quality of each aquifer; and
- The expected degradation to water quality objectives.

In allowing a discharge, the Regional Board must comply with CWC section 13263 in setting appropriate conditions. The Regional Board is required, relative to the groundwater that may be affected by the discharge, to implement the Basin Plan and consider the beneficial uses to be protected along with the water quality objectives essential for that purpose. The Regional Board need not authorize the full utilization of the waste assimilation capacity of the groundwater (CWC 13263(b)) and must consider other waste discharges and factors that affect that capacity.

This discharge has been occurring for years. Certain waste constituents in municipal wastewater are not fully amenable to waste treatment and control and it is reasonable to expect some impact on groundwater. Some degradation for certain constituents is consistent with maximum benefit to the people of California because the technology, energy, water recycling, and waste management advantages of municipal utility service to the State far outweigh the environmental impact damage of a community that would otherwise be reliant on numerous concentrated individual wastewater systems. Economic prosperity of

local communities is of maximum benefit to the people of California, and therefore sufficient reason to accommodate increases in wastewater discharge provided terms of reasonable degradation are defined and met. The proposed Order authorizes some degradation consistent with the maximum benefit to the people of the State.

This Order requires the Discharger to install a groundwater monitoring well network and perform groundwater monitoring at the site. There is insufficient groundwater data to date to establish the most appropriate groundwater limits. In addition, certain aspects of waste treatment and control practices have not been and are unlikely to be justified as representative of best practicable treatment and control BPTC. Reasonable time is necessary to gather specific information about the WWTF and the site to make informed, appropriate, long-term decisions. Therefore, this proposed Order, establishes interim receiving water limitations to assure protection of the beneficial uses of groundwater of the State pending the completion of certain tasks and provides time schedules to complete specified tasks. The Discharger is expected to identify, implement, and adhere to BPTC as individual practices are reviewed and upgraded in this process. During this period, degradation may occur from certain constituents, but can never exceed water quality objectives (or ambient background water quality should it exceed objectives) or cause nuisance.

Water quality objectives define the least stringent limits that could apply as water quality limitations for groundwater at this location, except where ambient background quality unaffected by the discharge of waste already exceeds the objective. The values below reflect water quality objectives that must be met to maintain specific beneficial uses of groundwater. Unless natural background for a constituent proves higher, the groundwater quality limit established in proposed Order is the most stringent of the values listed for the listed constituents.

Constituent	Units	Value	Beneficial Use	Criteria or Justification
Ammonia	mg/L	0.5	MUN [1]	Taste and Odor [2]
Boron	mg/l	0.7	AGR [3]	Boron Sensitivity [4]
	mg/l	0.63	MUN [1]	USEPA toxicity level [9]
Chloride	mg/L	106	AGR [3]	Chloride sensitivity on certain crops irrigated via sprinklers [4]
		142	AGR [3]	Chloride sensitivity on certain crops [4]
		250	MUN [1]	Secondary MCL [5] - Recommended
		500	MUN [1]	Secondary MCL [5] - Upper
Iron	mg/L	0.3	MUN [1]	Secondary MCL [6]
Manganese	mg/L	0.05	MUN [1]	Secondary MCL [6]
Nitrate as N	mg/L	10	MUN [1]	Primary MCL [7]
Nitrite as N	mg/L	1	MUN [1]	Primary MCL [7]
Sodium	mg/L	69	AGR [3]	Sodium sensitivity on certain crops [4]
Total Dissolved Solids	mg/L	450	AGR [3]	Salt sensitivity for certain crops [4]
		500	MUN [1]	Secondary MCL [5] - Recommended
		1,000	MUN [1]	Secondary MCL [5] - Upper
Total Coliform Organisms	MPN/100 ml	2.2	MUN [1]	Basin Plan
Trihalomethanes	µg/L	100	MUN [1]	MCL [8]
Bromoform	µg/L	4	MUN [1]	USEPA Cancer Potency Factor [9]
Bromodichloromethane	µg/L	2.7	MUN [1]	Cal/EPA Cancer Potency Factor [10]
Chloroform	µg/L	1.1	MUN [1]	Cal/EPA Cancer Potency Factor [10]
Dibromochloromethane	µg/L	0.37	MUN [1]	Cal/EPA Cancer Potency Factor [10]
pH	pH Units	6.5 to 8.5	MUN [1]	Secondary MCL [9]

[1] Municipal and domestic supply
[2] Council of the European Union, On the Quality of Water Intended for Human Consumption, Council Directive 98/83/EC (3 November 1998).
[3] Agricultural supply
[4] Ayers, R. S. and D. W. Westcot, Water Quality for Agriculture, Food and Agriculture Organization of the United Nations – Irrigation and Drainage Paper No. 29, Rev. 1, Rome (1985)
[5] Title 22, California Code of Regulations (CCR), section 64449, Table 64449-B
[6] Title 22, CCR, section 64449, Table 64449-A
[7] Title 22, CCR, section 64431, Table 64431-A
[8] Title 22, CCR, section 64439
[9] USEPA Integrated Risk Information System
[10] Cal/EPA Toxicity Criteria Database (OEHHA)

Municipal wastewater contains numerous dissolved inorganic waste constituents (i.e., salts, minerals) that together comprise total dissolved solids (TDS). Each component constituent is not individually critical to any beneficial use. Critical constituents are individually listed. The cumulative impact from these other constituents, along with the cumulative affect of the constituents that are individually listed can be effectively controlled using TDS as a generic indicator parameter.

Not all TDS constituents pass through the treatment process and soil profile in the same manner or rate. Chloride tends to pass through both rapidly to groundwater. As chloride concentrations in most groundwaters in the region are much lower than in treated municipal wastewater, chloride is a useful indicator parameter for evaluating the extent to which effluent reaches groundwater. Boron is another TDS constituent that may occur in wastewater in concentrations greater than groundwater

depending on the source water, to the extent residents use cleaning products containing boron, and whether any industrial dischargers utilize boron (e.g., glass production, cosmetics). Other indicator constituents for monitoring for groundwater degradation due to recharged effluent include total coliform bacteria, ammonia, total nitrogen, and Total Trihalomethanes (TTHMs), a by-product of chlorination. Dissolved iron and manganese are useful indicators to determine whether components of the WWTF with high-strength waste constituents, such as sludge handling facilities, are ineffective in containing waste. Exceptionally high TDS and nitrogen also typifies this type of release.

Treatment Technology and Control

Given the character of municipal wastewater, secondary treatment technology is generally sufficient to control degradation of groundwater from decomposable organic constituents. Adding disinfection significantly reduces populations of pathogenic organisms, and reasonable soil infiltration rates and unsaturated soils can reduce them further. Neither organics nor total coliform organisms, the indicator parameter for pathogenic organisms, should be found in groundwater in a well-designed, well-operated facility.

Chlorine disinfection of effluent causes formation of TTHMs, which are toxic priority pollutants. Treatment to reduce these in wastewater generally has not been performed, and little is known at this point on the typical impact on groundwater.

Municipal wastewater typically contains nitrogen in concentrations greater than water quality objectives, which vary according to the form of nitrogen. Degradation by nitrogen can be controlled by an appropriate secondary treatment system (e.g., oxidation ditch), tertiary treatment for nitrogen reduction, and agronomic reuse on harvested crops. The effectiveness varies, but generally BPTC should be able to control nitrogen degradation at a concentration well below the water quality objectives. The proposed interim limitation reflects water quality objectives.

Waste constituents that are forms of salinity pass through the treatment process and soil profile and effective control of long-term affects relies upon effective source control and pretreatment measures. In the best of circumstances, long-term land discharge of treated municipal wastewater will degrade groundwater with salt (as measured by TDS and EC) and the individual components of salts (e.g., sodium, chloride). The proposed Order sets water quality objectives for the interim while site-specific, constituent-specific limits are developed in conjunction with a BPTC evaluation of source control and pretreatment. The next Order will likely contain effluent limits for salt components other than chloride that, if met, assure groundwater quality will be controlled to an acceptable level.

Other constituents in treated municipal waste that may pass through the treatment process and the soil profile include recalcitrant organic compounds (e.g., ethylene glycol, or antifreeze), radionuclides, and pharmaceuticals. Hazardous compounds are not usually associated with domestic wastes and when present are reduced in the discharge to inconsequential concentrations through dilution with domestic waste, treatment, and the implementation of effective pretreatment programs. It is inappropriate to allow degradation of groundwater with such constituents, so proposed limitations are nondetect.

A discharge of wastewater that overloads soils with nutrients and organics can result in anaerobic conditions in the soil profile, which in turn creates organic acids and decreases soil pH. Under conditions of low soil pH (i.e., below 5), iron and manganese compounds in the soil can solubilize and leach into groundwater. Discharge of residual sludge to land may also lead to increases in groundwater alkalinity and hardness to concentrations that impair the water's beneficial uses and contribute to an overall increase in TDS. Overloading is preventable. Though iron and manganese limits are set at the water quality objective, groundwater pH is expected to remain the same as background.

Title 27

Title 27, CCR, section 20005 et seq. ("Title 27"), contains regulations to address certain discharges to land. Title 27 establishes a waste classification system, specifies siting and construction standards for containment of classified waste, requires extensive monitoring of groundwater and the unsaturated zone for any indication of failure of containment, and

specifies closure and post-closure maintenance requirements. Generally, no degradation of groundwater quality by any waste constituent is acceptable under Title 27 regulations.

Discharges of domestic sewage and treated effluent can be treated and controlled to a degree that will not result in unreasonable degradation of groundwater. For this reason, they have been conditionally exempted from Title 27. Treatment and storage facilities for sludge that are part of the WWTF are considered exempt from Title 27 under Section 20090(a), provided that the facilities will not result in a violation of any water quality objective. As the exemption specifically excludes the discharge to land of 1) solid waste that results from treatment of domestic sewage (e.g., grit and screenings) and 2) residual sludge (sludge that will not be subjected to further treatment by the WWTF), such discharges must compy with provisions of Title 27.

Accordingly, the municipal discharge of effluent and the operation of treatment or storage facilities associated with a municipal wastewater treatment facility can be allowed without requiring compliance with Title 27, but only if resulting degradation of groundwater is in accordance with the Basin Plan. This means, among other things, that degradation of groundwater must be consistent with Resolution No. 68-16 and in no case greater than water quality objectives.

Discharge Prohibitions and Specifications

The proposed order establishes a monthly average dry weather flow limit of 0.80 MGD. Upon certified completion of the facility improvements for Phase 1B the Discharger shall submit a report prepared by a California licensed engineer describing the improvements. Upon approval of the Phase 1B report from the Executive Officer the monthly average dry weather flow shall not exceed 0.92 MGD. Upon certified completion of the improvements for Phase 2 the Discharger shall submit a report prepared by a California licensed engineer describing the improvements. Upon approval of the Phase 2 improvement report from the Executive Officer the monthly average flow shall not exceed 1.20 MGD. The flow rate limits shall be applied to the flow entering the headworks. The discharge specifications regarding dissolved oxygen and freeboard are consistent with Regional Board policy for the prevention of nuisance conditions, and are applied to all such facilities.

In order to protect public health and safety, the proposed Order requires the Discharger to comply with many of the provisions of Title 22 and to implement best management practices with respect to effluent disposal (e.g., to dispose of effluent at reasonable rates considering the crop, soil, climate, and irrigation management plan.). This Order requires that the Discharger submit a Title 22 Engineering Report if the grazing of livestock is to continue.

Monitoring Requirements

Section 13267 of the CWC authorizes the Regional Board to require monitoring and technical reports as necessary to investigate the impact of a waste discharge on waters of the state. In recent years there has been increased emphasis on obtaining all necessary information, assuring the information is timely as well as representative and accurate, and thereby improving accountability of any discharger for meeting the conditions of discharge. Section 13268 of the CWC authorizes assessment civil administrative liability where appropriate.

The proposed Order increases the previous Order's influent and effluent monitoring requirements, and includes flow rates, wastewater storage ponds, land application areas, and groundwater monitoring requirements. In order to adequately characterize its wastewater effluent, the Discharger is required to monitor for settleable solids, BOD, coliform, TDS, nitrogen, sodium, and chloride. Monitoring of additional minerals is required on an annual basis. To ensure that disposal ponds do not create nuisance conditions, the Discharger is required to monitor freeboard available and dissolved oxygen content weekly.

The Title 27 zero leakage protection strategy relies heavily on extensive groundwater monitoring to increase a discharger's awareness of, and accountability for, compliance with the prescriptive and performance standards. With a high volume,

concentrated, uncontained discharge to land, monitoring takes on even greater importance. The proposed Order includes monitoring of applied waste quality, application rates, and groundwater.

Title 27 regulations pertaining to groundwater monitoring and the detection and characterization of waste constituents in groundwater have been in effect and successfully implemented for many years. No regulation currently specifies similar criteria more suitable for a situation where extensive infiltration into groundwater occurs. However, where, as here, such infiltration occurs, it is appropriate that the Title 27 groundwater monitoring procedures be extended and applied on a case-by-case basis under Water Code section 13267.

The Discharger must monitor groundwater for constituents present in the discharge and capable of reaching groundwater and violating groundwater limitations if its treatment and control, and any dependency of the process on sustained environmental attenuation, proves inadequate. The Discharger's existing network of groundwater monitoring wells is not adequate to fully characterize background water quality and potential groundwater impacts for the wastewater treatment facility and land application areas.

For each constituent listed in the Groundwater Limitations section, the Discharger must, as part of each monitoring event, compare concentrations of constituents found in each monitoring well to the background concentration or to prescribed numerical limitations to determine compliance.

Reopener

The conditions of discharge in the proposed Order were developed based on currently available technical information and applicable water quality laws, regulations, policies, and plans, and are intended to assure conformance with them. However, information is presently insufficient to develop final effluent and groundwater limitations, so the proposed Order contains interim limitations. Additional information must be developed and documented by the Discharger as required by schedules set forth in the proposed Order. As this additional information is obtained, decisions will be made concerning the best means of assuring the highest water quality possible and that could involve substantial cost. It may be appropriate to reopen the Order if applicable laws and regulations change, but the mere possibility that such laws and regulations may change is not sufficient basis for reopening the Order. The CWC requires that waste discharge requirements implement all applicable requirements.

Surface water drainage is to Highland Canal, thence to Dry Creek, thence to Putah Creek thence to the Yolo Bypass.

MMW: 7/19/02
AMENDED

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2002-0136

FOR
CITY OF WINTERS
WASTEWATER TREATMENT FACILITY
YOLO COUNTY

This Monitoring and Reporting Program (MRP) describes requirements for monitoring domestic wastewater, treated effluent, wastewater storage ponds, land application areas, and groundwater. This MRP is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer.

All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

Field test instruments (such as those used to test pH, specific conductivity and dissolved oxygen) may be used provided that:

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and
4. Field calibration reports are submitted as described in the "Reporting" section of this MRP.

INFLUENT MONITORING

Influent flow monitoring shall be performed at the headworks. Samples shall be collected at approximately the same time as effluent samples and should be representative of the influent. Influent monitoring shall include the following:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency
Influent Flow	gpd	Meter	Continuously	Monthly

Monthly Average Daily Flow	gpd	Calculated	Monthly	Monthly
BOD_5[1]	mg/L,	Grab	Weekly	Monthly
pH	pH units	Grab	Weekly	Monthly
Electrical Conductivity	µmhos/cm	Grab	Weekly	Monthly

[1] 5-day Biochemical Oxygen Demand

STORAGE POND MONITORING

Each of the storage ponds shall be sampled for the parameters specified below:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency
Freeboard	±0.1 feet	Measurement	Weekly	Monthly
Dissolved Oxygen[1]	mg/L	Grab	Weekly	Monthly
pH	pH units	Grab	Weekly	Monthly
Electrical Conductivity	µmhos/cm	Grab	Weekly	Monthly
Odors	--	Observation	Weekly	Monthly
Levee condition[2]	--	Observation	Weekly	Monthly

[1] Samples shall be collected at a depth of one foot from each pond in use, opposite the inlet. Samples shall be collected between 0700 and 0900 hours.

[2] Pond containment levees shall be observed for signs of seepage or surfacing water along the exterior toe of the levees. If surfacing water is found, then a sample shall be collected and tested for total coliform organisms.

EFFLUENT MONITORING

Effluent samples shall be collected before discharge to the land application areas and shall be representative of the volume and nature of the discharge. Effluent monitoring shall include the following:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency
Flow	mgd	Continuous	Continuous	Monthly
BOD_5	mg/L	Grab	Weekly	Monthly
Total Coliform Organisms[1]	MPN/100 ml	Grab	Weekly	Monthly
Electrical Conductivity	µmhos/cm	Grab	Weekly	Monthly
pH	Standard	Grab	Weekly	Monthly
Total Dissolved Solids	mg/L	Grab	Monthly	Monthly
Sodium	mg/L	Grab	Monthly	Monthly
Chloride	mg/L	Grab	Monthly	Monthly
Nitrate as NO_3	mg/L	Grab	Monthly	Monthly
Total Kjeldahl Nitrogen	mg/L	Grab	Monthly	Monthly
Total Nitrogen	mg/L	Grab/calculated	Monthly	Monthly

[1] If positive results are reported, a duplicate sample shall be collected and re-analyzed within ten days after the initial sample. If the concentration is >1600 MPN/100mL the lab shall be instructed to carry out the dilutions to 4 or 5, or until termination, which ever yields an actual concentration number.

LAND APPLICATION AREA MONITORING

Monitoring of the land application area shall be conducted daily and the results shall be included in the monthly monitoring report. Evidence of erosion, field saturation, runoff, or the presence of nuisance conditions shall be noted in the report. Effluent monitoring results shall be used in calculations to ascertain loading rates at the application area. Monitoring of the land application areas shall include the following:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency
Rainfall	Inches	Measurement	Daily	Monthly
Acreage Applied[1]	Acres	Calculated	Daily	Monthly
Application Rate[2]	Gal/acre/day	Calculated	Daily	Monthly
BOD_5 Loading Rate[2]	lbs/acre/day	Calculated[3]	Monthly	Monthly
Total Nitrogen Loading Rate[2]	lbs/acre/month	Calculated[3]	Monthly	Monthly
Total Dissolved Solids Loading Rate[2]	lbs/acre/month	Calculated[3]	Monthly	Monthly

[1] Land application areas shall be identified

[2] For each land application area.

[3] BOD_5, Total Nitrogen and TDS loading rates shall be calculated using the daily applied volume of wastewater, daily application area, and a running average of the three most recent results of BOD_5, Total Nitrogen and TDS which shall also be reported along with supporting calculations.

GROUNDWATER MONITORING

Prior to construction and/or sampling of any groundwater monitoring wells, the Discharger shall submit plans and specifications to the Regional Board for review and approval. Once installed, all new wells shall be added to the MRP and shall be sampled and analyzed according to the schedule below.

Prior to sampling, the groundwater elevations shall be measured and the wells shall be purged at least three well volumes until temperature, pH and electrical conductivity have stabilized. Depth to groundwater shall be measured to the nearest 0.01 feet. Samples shall be collected using standard EPA methods. Groundwater monitoring shall include, at a minimum, the following:

Constituent	Units	Type of Sample	Sampling and Reporting Frequency
Depth to Groundwater	0.01 feet	Measurement	Quarterly
Groundwater Elevation[1]	0.01 feet	Calculated	Quarterly
Gradient	feet/feet	Calculated	Quarterly
Gradient Direction	degrees	Calculated	Quarterly
Total Dissolved Solids	mg/L	Grab	Quarterly
Electrical Conductivity	µmhos/cm	Grab	Quarterly
Nitrate as Nitrogen	mg/L	Grab	Quarterly
Total Kjeldahl Nitrogen	mg/L	Grab	Quarterly
pH	pH units	Grab	Quarterly
Trihalomethanes	µg/L	Grab	Quarterly
Total Coliform Organisms	MPN/100 ml	Grab	Quarterly
Boron	mg/L	Grab	Quarterly

Constituent	Units	Type of Sample	Sampling and Reporting Frequency
Chloride	mg/L	Grab	Quarterly
Iron	mg/L	Grab	Quarterly
Manganese	mg/L	Grab	Quarterly
Sodium	mg/L	Grab	Quarterly
Standard Minerals[2]	mg/L	Grab	Annually

[1] Groundwater elevation shall be determined based on depth-to-water measurements using a surveyed measuring point elevation on the well and a surveyed reference elevation.

[2] Standard Minerals shall include, at a minimum, the following elements/compounds: Barium, Calcium, Magnesium, Potassium, Sulfate, Total Alkalinity (including alkalinity series), and Hardness.

SLUDGE MONITORING

A composite sample of sludge shall be collected when removed from the ponds in accordance with EPA's POTW Sludge Sampling and Analysis Guidance Document, August 1989, and tested for the following metals:

Cadmium Copper Nickel
Chromium Lead Zinc

Sampling records shall be retained for a minimum of five years. A log shall be kept of sludge quantities generated and of handling and disposal activities. The frequency of entries is discretionary; however, the log should be complete enough to serve as a basis for part of the annual report.

WATER SUPPLY MONITORING

A sampling station shall be established where a representative sample of the municipal water supply can be obtained. The water supply data collected for the City of Winters and compiled in the Consumer Confidence Report may be used. Data from each well shall be submitted. The Discharger may submit an average of each of the five wells and the high/low range. Water supply monitoring shall include at least the following:

Constituents	Units	Type of Sample	Sampling and Reporting Frequency
TDS	mg/L	Grab	Annually
Electrical Conductivity	µmhos/cm	Grab	Annually
pH	pH units	Grab	Annually
Standard Minerals[1]	mg/L	Grab	Annually

[1] Standard Minerals shall include, at a minimum, the following elements/compounds: Barium, Calcium, Magnesium, Sodium, Potassium, Chloride, Nitrate, Sulfate, Total Alkalinity (including alkalinity series), and Hardness.

REPORTING

In reporting monitoring data, the District shall arrange the data in tabular form so that the date, sample type (e.g., effluent, pond, etc.), and reported analytical result for each sample are readily discernible. The data shall be summarized in such a manner to clearly illustrate compliance with waste discharge requirements and spatial or temporal trends, as applicable. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall be reported to the Regional Board.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all Groundwater Monitoring Reports shall be prepared under the direct supervision of a Registered Engineer or Geologist and signed by the registered professional.

A. Monthly Monitoring Reports

Daily, weekly, and monthly monitoring data shall be reported in monthly monitoring reports. Monthly reports shall be submitted to the Regional Board on the **1st day of the second month following sampling** (i.e., the January Report is due by 1 March). At a minimum, the reports shall include:

1. Results of influent, effluent, pond, and land application area monitoring;
2. A comparison of monitoring data to the discharge specifications and an explanation of any violation of those requirements. Data shall be presented in tabular format;
3. If requested by staff, copies of laboratory analytical report(s); and
4. A calibration log verifying calibration of all hand-held monitoring instruments and devices used to comply with the prescribed monitoring program.

B. Quarterly Monitoring Reports

The Discharger shall establish a quarterly sampling schedule for groundwater monitoring such that samples are obtained approximately every three months. Quarterly monitoring reports shall be submitted to the Regional Board by the **1st day of the second month after the quarter** (i.e., the January-March quarterly report is due by May 1st) and may be combined with the monthly report. The Quarterly Report shall include the following:

1. Results of groundwater monitoring;

2. A narrative description of all preparatory, monitoring, sampling, and analytical testing activities for the groundwater monitoring. The narrative shall be sufficiently detailed to verify compliance with the WDR, this MRP, and the Standard Provisions and Reporting Requirements. The narrative shall be supported by field logs for each well documenting depth to groundwater; parameters measured before, during, and after purging; method of purging; calculation of casing volume; and total volume of water purged;

3. Calculation of groundwater elevations, an assessment of groundwater flow direction and gradient on the date of measurement, comparison of previous flow direction and gradient data, and discussion of seasonal trends if any;

4. A narrative discussion of the analytical results for all groundwater locations monitored including spatial and temporal tends, with reference to summary data tables, graphs, and appended analytical reports (as applicable);

5. A comparison of monitoring data to the groundwater limitations and an explanation of any violation of those requirements;

6. Summary data tables of historical and current water table elevations and analytical results;

7. A scaled map showing relevant structures and features of the facility, the locations of monitoring wells and any other sampling stations, and groundwater elevation contours referenced to mean sea level datum;

8. Copies of laboratory analytical report(s) for groundwater monitoring.

C. Annual Report

An Annual Report shall be prepared as the fourth quarter monitoring report. The Annual Report will include all monitoring data required in the monthly/quarterly schedule. The Annual Report shall be submitted to the Regional Board by **1 February** each year. In addition to the data normally presented, the Annual Report shall include the following:

1. The contents of the regular groundwater monitoring report for the last sampling event of the year;

2. If requested by staff, tabular and graphical summaries of all data collected during the year;

3. An evaluation of the groundwater quality beneath the wastewater treatment facility;

4. A discussion of compliance and the corrective actions taken, as well as any planned or proposed actions needed to bring the discharge into full compliance with the waste discharge requirements;

5. A discussion of any data gaps and potential deficiencies/redundancies in the monitoring system or reporting program;

6. A copy of the certification for each certified wastewater treatment facility operator working at the facility and a statement about whether the Discharger is in compliance with Title 23, CCR, Division 3, Chapter 26.

7. Summary of information on the disposal of sludge and/or solid waste;

8. The results from annual monitoring of the groundwater wells and water supply;

9. The results from any sludge monitoring required by the disposal facility; and

10. A forecast of influent flows, as described in Standard Provision No. E4.

A letter transmitting the self-monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of the those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Based on results of the monitoring program after a minimum of two years, the Discharger may request a reduction in the constituents monitored and/or sample frequency. If such reductions are warranted, this MRP may be revised by the Executive Officer.

The Discharger shall implement the above monitoring program on the first day of the month following adoption of this Order.

Ordered by: _____
THOMAS R. PINKOS, Acting Executive Officer

19 July 2002
(Date)

MMW: 7/19/02
AMENDED

APPENDIX B

Water Balance Calculation Tables

Alternative 1A Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	3.6	4.43	6.9	7.9	12.7	0.0	-1.7	0.0	110.5
Nov	0.825	24.8	6.12	9.5	2.31	3.6	7.9	6.6	0.0	16.2	16.2	94.3
Dec	0.776	24.1	10.08	15.7	1.71	2.7	7.9	0.0	0.0	29.2	45.3	65.1
Jan	0.700	21.7	11.48	17.9	1.71	2.7	7.9	0.0	0.0	29.0	74.3	36.2
Feb	0.801	22.4	9.30	14.5	2.46	3.8	7.9	0.0	0.0	25.2	99.5	11.0
Mar	0.759	23.5	6.64	10.3	4.09	6.4	7.9	9.9	0.0	9.7	109.2	1.3
Apr	0.761	22.8	3.02	4.7	5.61	8.7	7.9	13.6	0.0	-2.7	106.5	4.0
May	0.736	22.8	1.23	1.9	7.50	11.7	7.9	18.1	0.0	-13.0	93.5	17.0
Jun	0.695	20.8	0.33	0.5	8.58	13.3	7.9	34.0	0.0	-33.9	59.6	50.8
Jul	0.735	22.8	0.05	0.1	9.55	14.9	7.9	37.8	0.0	-37.7	21.9	88.6
Aug	0.683	21.2	0.09	0.1	8.53	13.3	7.9	33.8	0.0	-33.6	-11.7	122.2
Sep	0.806	24.2	0.52	0.8	6.27	9.8	7.9	17.9	0.0	-10.6	-22.3	132.8
Total		273	51.2	79.7	62.8	97.6	94.9	184.4	0.0	-24.1		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is full at beginning of wet season		
Wastewater Generation Rate	85	gpcd
Population	8,800	people
Existing Pond Surface Area	32.5	acres
New Pond Surface Area	9	acres
Existing Storage	288	acre-ft
New Storage Required	51	acre-ft
Orchard Irrigation Area	162	acres
Spray Field Irrigation	0	MG

Alternative 1B Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	5.1	4.43	9.7	2.0	18.0	0.0	-2.5	0.0	152.9
Nov	0.825	24.8	6.12	13.3	2.31	5.0	2.0	9.4	0.0	21.6	21.6	131.3
Dec	0.776	24.1	10.08	22.0	1.71	3.7	2.0	0.0	0.0	40.3	61.9	91.0
Jan	0.700	21.7	11.48	25.0	1.71	3.7	2.0	0.0	0.0	40.9	102.9	50.1
Feb	0.801	22.4	9.30	20.3	2.46	5.4	2.0	0.0	0.0	35.3	138.2	14.8
Mar	0.759	23.5	6.64	14.5	4.09	8.9	2.0	14.0	0.0	13.0	151.1	1.8
Apr	0.761	22.8	3.02	6.6	5.61	12.2	2.0	19.3	0.0	-4.1	147.0	5.9
May	0.736	22.8	1.23	2.7	7.50	16.4	2.0	25.8	0.0	-18.7	128.4	24.6
Jun	0.695	20.8	0.33	0.7	8.58	18.7	2.0	48.2	0.0	-47.4	81.0	72.0
Jul	0.735	22.8	0.05	0.1	9.55	20.8	2.0	53.7	0.0	-53.7	27.3	125.6
Aug	0.683	21.2	0.09	0.2	8.53	18.6	2.0	47.9	0.0	-47.2	-19.9	172.8
Sep	0.806	24.2	0.52	1.1	6.27	13.7	2.0	25.5	0.0	-15.8	-35.8	188.7
Total		273	51.2	111.6	62.8	136.8	24.5	261.7	0.0	-38.2		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is full at beginning of wet season	
Wastewater Generation Rate	85 gpcd
Population	8,800 people
Existing Pond Surface Area	32.5 acres
New Pond Surface Area	32 acres
Existing Storage	288 acre-ft
New Storage Required	181 acre-ft
Orchard Irrigation Area	230 acres
Spray Field Irrigation	0 MG

Alternative 2A Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	3.1	4.43	5.8	7.7	12.9	0.0	-1.2	0.0	123.8
Nov	0.825	24.8	6.12	8.0	2.31	3.0	7.7	6.7	0.0	15.4	15.4	108.5
Dec	0.776	24.1	10.08	13.2	1.71	2.2	7.7	0.0	0.0	27.4	42.7	81.1
Jan	0.700	21.7	11.48	15.1	1.71	2.2	7.7	0.0	0.0	26.8	69.6	54.3
Feb	0.801	22.4	9.30	12.2	2.46	3.2	7.7	0.0	0.0	23.7	93.3	30.5
Mar	0.759	23.5	6.64	8.7	4.09	5.4	7.7	10.1	0.0	9.1	102.4	21.4
Apr	0.761	22.8	3.02	4.0	5.61	7.4	7.7	13.8	0.0	-2.0	100.4	23.4
May	0.736	22.8	1.23	1.6	7.50	9.8	7.7	18.5	0.0	-11.5	88.8	35.0
Jun	0.695	20.8	0.33	0.4	8.58	11.3	7.7	34.6	0.0	-32.2	56.6	67.2
Jul	0.735	22.8	0.05	0.1	9.55	12.5	7.7	38.5	0.0	-35.9	20.7	103.1
Aug	0.683	21.2	0.09	0.1	8.53	11.2	7.7	34.4	0.0	-32.0	-11.2	135.1
Sep	0.806	24.2	0.52	0.7	6.27	8.2	7.7	18.3	0.0	-9.3	-20.5	144.3
Total		273	51.2	67.1	62.8	82.3	92.0	187.8	0.0	-21.7		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is empty at beginning of wet season		
Wastewater Generation Rate	85	gpcd
Population	8,800	people
Existing Pond Surface Area	43.3	acres
New Pond Surface Area	0	acres
Existing Storage	380	acre-ft
New Storage Required	0	acre-ft
Orchard Irrigation Area	165	acres
Spray Field Irrigation	0	MG

Alternative 2B Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	3.3	4.43	6.3	1.3	18.6	0.0	-0.8	0.0	131.2
Nov	0.825	24.8	6.12	8.7	2.31	3.3	1.3	9.7	0.0	19.2	19.2	112.0
Dec	0.776	24.1	10.08	14.3	1.71	2.4	1.3	0.0	0.0	34.7	53.8	77.4
Jan	0.700	21.7	11.48	16.3	1.71	2.4	1.3	0.0	0.0	34.3	88.1	43.1
Feb	0.801	22.4	9.30	13.2	2.46	3.5	1.3	0.0	0.0	30.9	119.0	12.2
Mar	0.759	23.5	6.64	9.4	4.09	5.8	1.3	14.5	0.0	11.3	130.3	0.9
Apr	0.761	22.8	3.02	4.3	5.61	8.0	1.3	19.9	0.0	-2.1	128.2	3.0
May	0.736	22.8	1.23	1.7	7.50	10.7	1.3	26.7	0.0	-14.0	114.2	17.0
Jun	0.695	20.8	0.33	0.5	8.58	12.2	1.3	49.9	0.0	-42.1	72.2	59.0
Jul	0.735	22.8	0.05	0.1	9.55	13.6	1.3	55.5	0.0	-47.5	24.6	106.6
Aug	0.683	21.2	0.09	0.1	8.53	12.1	1.3	49.6	0.0	-41.7	-17.1	148.3
Sep	0.806	24.2	0.52	0.7	6.27	8.9	1.3	26.3	0.0	-11.6	-28.7	159.9
Total		273	51.2	72.7	62.8	89.1	15.4	270.8	0.0	-29.4		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is empty at beginning of wet season		
Wastewater Generation Rate	85	gpcd
Population	8,800	people
Existing Pond Surface Area	43.3	acres
New Pond Surface Area	4	acres
Existing Storage	380	acre-ft
New Storage Required	23	acre-ft
Orchard Irrigation Area	238	acres
Spray Field Irrigation	0	MG

Alternative 3A Water Balance

Month	Average Influent Flow (mgd)	Total Influent Flow (MG)	100-year Rainfall (in)	Rainfall Volume (MG)	ETo (in)	ET Volume (MG)	Seepage (MG)	Water Recycling (MG)	Spray Fields (MG)	ΔS (MG)	ΣΔS (MG)	Remaining Storage (MG)
Oct	0.713	22.1	2.34	2.7	4.43	5.2	2.1	18.0	0.0	-0.4	0.0	123.8
Nov	0.825	24.8	6.12	7.2	2.31	2.7	2.1	9.4	0.0	17.8	17.8	106.0
Dec	0.776	24.1	10.08	11.9	1.71	2.0	2.1	0.0	0.0	31.8	49.6	74.2
Jan	0.700	21.7	11.48	13.5	1.71	2.0	2.1	0.0	0.0	31.1	80.8	43.1
Feb	0.801	22.4	9.30	10.9	2.46	2.9	2.1	0.0	0.0	28.4	109.2	14.6
Mar	0.759	23.5	6.64	7.8	4.09	4.8	2.1	14.0	0.0	10.4	119.6	4.2
Apr	0.761	22.8	3.02	3.6	5.61	6.6	2.1	19.3	0.0	-1.5	118.1	5.8
May	0.736	22.8	1.23	1.4	7.50	8.8	2.1	25.8	0.0	-12.4	105.7	18.1
Jun	0.695	20.8	0.33	0.4	8.58	10.1	2.1	48.2	0.0	-39.1	66.6	57.3
Jul	0.735	22.8	0.05	0.1	9.55	11.2	2.1	53.7	0.0	-44.1	22.4	101.4
Aug	0.683	21.2	0.09	0.1	8.53	10.0	2.1	47.9	0.0	-38.8	-16.3	140.1
Sep	0.806	24.2	0.52	0.6	6.27	7.4	2.1	25.5	0.0	-10.1	-26.4	150.2
Total		273	51.2	60.2	62.8	73.8	24.7	261.7	0.0	-26.8		
Avg Dry Weather Flow	0.741											

Water Balance Assumptions

Pond 1 is empty at beginning of wet season		
Wastewater Generation Rate	85	gpcd
Population	8,800	people
Existing Pond Surface Area	43.3	acres
New Pond Surface Area	0	acres
Existing Storage	380	acre-ft
New Storage Required	0	acre-ft
Orchard Irrigation Area	230	acres
Spray Field Irrigation	0	MG

APPENDIX C

Cost Estimate Tables

Alternative 1A Phase 1 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Storage Pond 5 (51 ac-ft)				
Stripping	6,000	CY	$4.50	$27,000.00
Excavation	83,000	CY	$4.50	$373,700.00
Compaction	83,000	CY	$1.03	$85,400.00
Lining	130,321	SF	$1.93	$251,500.00
Subtotal				$737,600.00
Transfer/Recycle Water Pumping Station				
Structural	1	ea	$248,907.60	$248,900.00
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	2	ea	$25,730.87	$51,500.00
Flow Meter	1	ea	$4,502.90	$4,500.00
Electrical	1	ea	$15,438.52	$15,400.00
Subtotal				$333,200.00
Road - 16 ft Type B				
Grading	2,400	LF	$1.03	$2,500.00
Material	2,400	LF	$7.20	$17,300.00
Subtotal				$19,800.00
Fencing				
Chain link	2,600	LF	$10.36	$26,900.00
Subtotal				$26,900.00
Construction Subtotal				$1,118,000.00
Tax on Materials				$42,000.00
General Cost @ 10%				$116,000.00
Estimating Contingency @ 15%				$174,000.00
Construction Total				$1,450,000.00
Engineering, Management, and Contingency @ 40%				$580,000.00
Project Total				$2,030,000.00

Alternative 1A Phase 2 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Stage 1 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
15-hp Aerator	2	ea	$51,461.75	$102,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$263,700.00
Stage 2 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$160,800.00
Transfer/Recycle Water Pumping Station				
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	1	ea	$25,730.87	$25,700.00
Subtotal				$38,600.00
Construction Subtotal				$463,000.00
Tax on Materials				$17,000.00
General Cost @ 10%				$48,000.00
Estimating Contingency @ 15%				$72,000.00
Construction Total				$600,000.00
Engineering, Management, and Contingency @ 40%				$240,000.00
Project Total				$840,000.00

Alternative 1B Phase 1 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Existing Pond 3 Retrofit Lining				
Bentonite	470	tons	$257.31	$120,900.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$159,500.00
Existing Pond 4 Retrofit Lining				
Lining	480,000	ea	$1.93	$926,300.00
Rip rap movement	1	LS	$64,327.18	$64,300.00
Subtotal				$990,600.00
Storage Pond 5 (91 ac-ft)				
Stripping	11,000	CY	$4.50	$49,500.00
Excavation	147,000	CY	$4.50	$661,900.00
Compaction	147,000	CY	$1.03	$151,300.00
Lining	236,000	SF	$1.93	$455,400.00
Subtotal				$1,318,100.00
Transfer/Recycle Water Pumping Station				
Structural	1	ea	$248,907.60	$248,900.00
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	2	ea	$25,730.87	$51,500.00
Flow Meter	1	ea	$4,502.90	$4,500.00
Electrical	1	ea	$15,438.52	$15,400.00
Subtotal				$333,200.00
Road - 16 ft Type B				
Grading	2,900	LF	$1.03	$3,000.00
Material	2,900	LF	$7.20	$20,900.00
Subtotal				$23,900.00
Fencing				
Chain link	3,360	LF	$10.36	$34,800.00
Subtotal				$34,800.00
Construction Subtotal				$2,860,000.00
Tax on Materials				$107,000.00
General Cost @ 10%				$297,000.00
Estimating Contingency @ 15%				$445,000.00
Construction Total				$3,709,000.00
Engineering, Management, and Contingency @ 40%				$1,484,000.00
Project Total				$5,193,000.00

Alternative 1B Phase 2 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Stage 1 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
15-hp Aerator	2	ea	$51,461.75	$102,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$263,700.00
Stage 2 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$160,800.00
Existing Pond 1 Retrofit Lining				
Bentonite	830	tons	$257.31	$213,600.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$252,200.00
Existing Pond 2 Retrofit Lining				
Bentonite	800	tons	$257.31	$205,800.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$244,400.00
Storage Pond 6 (72 ac-ft)				
Stripping	11,000	CY	$4.50	$49,500.00
Excavation	147,000	CY	$4.50	$661,900.00
Compaction	147,000	CY	$1.03	$151,300.00
Lining	236,000	SF	$1.93	$455,400.00
Subtotal				$1,318,100.00
Transfer/Recycle Water Pumping Station				
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	1	ea	$25,730.87	$25,700.00
Subtotal				$38,600.00
Road - 16 ft Type B				
Grading	2,000	LF	$1.03	$2,100.00
Material	2,000	LF	$7.20	$14,400.00
Subtotal				$16,500.00
Fencing				
Chain link	3,360	LF	$10.36	$34,800.00
Subtotal				$34,800.00
Construction Subtotal				$2,329,000.00
Tax on Materials				$87,000.00
General Cost @ 10%				$242,000.00
Estimating Contingency @ 15%				$362,000.00
Construction Total				$3,020,000.00
Engineering, Management, and Contingency @ 40%				$1,208,000.00
Project Total				$4,228,000.00

Alternative 2A Phase 1 Construction Cost Estimate

Transfer/Recycle Water Pumping Station				
Structural	1	ea	$248,907.60	$248,900.00
Transfer Pump	2	ea	$12,865.44	$25,700.00
Recycle Pump	3	ea	$25,730.87	$77,200.00
Flow Meter	1	ea	$4,502.90	$4,500.00
Electrical	1	ea	$15,438.52	$15,400.00
Subtotal				$371,700.00
Construction Subtotal				$372,000.00
Tax on Materials				$14,000.00
General Cost @ 10%				$39,000.00
Estimating Contingency @ 15%				$58,000.00
Construction Total				$483,000.00
Engineering, Management, and Contingency @ 40%				$193,000.00
Project Total				$676,000.00

Alternative 2A Phase 2 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Stage 1 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
15-hp Aerator	2	ea	$51,461.75	$102,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$263,700.00
Stage 2 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$160,800.00
Construction Subtotal				$425,000.00
Tax on Materials				$16,000.00
General Cost @ 10%				$44,000.00
Estimating Contingency @ 15%				$66,000.00
Construction Total				$551,000.00
Engineering, Management, and Contingency @ 40%				$220,000.00
Project Total				$771,000.00

Alternative 2B Phase 1 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Existing Pond 3 Retrofit Lining				
Bentonite	470	tons	$257.31	$120,900.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$159,500.00
Existing Pond 4 Retrofit Lining				
Lining	480,000	ea	$1.93	$926,300.00
Rip rap movement	1	LS	$64,327.18	$64,300.00
Subtotal				$990,600.00
Storage Pond 5 (23 ac-ft)				
Stripping	2,700	CY	$4.50	$12,200.00
Excavation	55,000	CY	$4.50	$247,700.00
Compaction	55,000	CY	$1.03	$56,600.00
Lining	61,000	SF	$1.93	$117,700.00
Subtotal				$434,200.00
Transfer/Recycle Water Pumping Station				
Structural	1	ea	$248,907.60	$248,900.00
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	2	ea	$25,730.87	$51,500.00
Flow Meter	1	ea	$4,502.90	$4,500.00
Electrical	1	ea	$15,438.52	$15,400.00
Subtotal				$333,200.00
Road - 16 ft Type B				
Grading	2,000	LF	$1.03	$2,100.00
Material	2,000	LF	$7.20	$14,400.00
Subtotal				$16,500.00
Fencing				
Chain link	1,700	LF	$10.36	$17,600.00
Subtotal				$17,600.00
Construction Subtotal				$1,952,000.00
Tax on Materials				$73,000.00
General Cost @ 10%				$203,000.00
Estimating Contingency @ 15%				$304,000.00
Construction Total				$2,532,000.00
Engineering, Management, and Contingency @ 40%				$1,013,000.00
Project Total				$3,545,000.00

Alternative 2B Phase 2 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Stage 1 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
15-hp Aerator	2	ea	$51,461.75	$102,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$263,700.00
Stage 2 Aerated Ponds				
25-hp Aerator	2	ea	$69,473.36	$138,900.00
Electrical	2	ea	$10,935.62	$21,900.00
Subtotal				$160,800.00
Existing Pond 1 Retrofit Lining				
Bentonite	830	tons	$257.31	$213,600.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$252,200.00
Existing Pond 2 Retrofit Lining				
Bentonite	800	tons	$257.31	$205,800.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$244,400.00
Transfer/Recycle Water Pumping Station				
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	1	ea	$25,730.87	$25,700.00
Subtotal				$38,600.00
Construction Subtotal				$960,000.00
Tax on Materials				$36,000.00
General Cost @ 10%				$100,000.00
Estimating Contingency @ 15%				$149,000.00
Construction Total				$1,245,000.00
Engineering, Management, and Contingency @ 40%				$498,000.00
Project Total				$1,743,000.00

Alternative 2B Phase 1 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Existing Pond 3 Retrofit Lining				
Bentonite	470	tons	$257.31	$120,900.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$159,500.00
Existing Pond 4 Retrofit Lining				
Lining	480,000	ea	$1.93	$926,300.00
Rip rap movement	1	LS	$64,327.18	$64,300.00
Subtotal				$990,600.00
Treatment System				
Headworks	1	ea	$428,000.00	$428,000.00
MBR System	1	ea	$5,136,000.00	$5,136,000.00
UV Light Disinfection	1	ea	$651,000.00	$651,000.00
Biosolids Handling	1	ea	$2,251,000.00	$2,251,000.00
Yard Piping	1	ea	$306,000.00	$306,000.00
Auxiliary Power	1	ea	$347,000.00	$347,000.00
Site Work @ 5%	1	ea	$456,000.00	$456,000.00
Electrical & Instrumentation	1	ea	$1,368,000.00	$1,368,000.00
Subtotal				$10,943,000.00
Transfer/Recycle Water Pumping Station				
Structural	1	ea	$248,907.60	$248,900.00
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	2	ea	$25,730.87	$51,500.00
Flow Meter	1	ea	$4,502.90	$4,500.00
Electrical	1	ea	$15,438.52	$15,400.00
Subtotal				$333,200.00
Construction Subtotal				$12,426,000.00
Tax on Materials				$466,000.00
General Cost @ 10%				$1,289,000.00
Estimating Contingency @ 15%				$1,934,000.00
Construction Total				$16,115,000.00
Engineering, Management, and Contingency @ 40%				$6,446,000.00
Project Total				$22,561,000.00

Alternative 3A Phase 2 Construction Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Item Cost ($)
Existing Pond 1 Retrofit Lining				
Bentonite	830	tons	$257.31	$213,600.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$252,200.00
Existing Pond 2 Retrofit Lining				
Bentonite	800	tons	$257.31	$205,800.00
Installation	3	day	$12,865.44	$38,600.00
Subtotal				$244,400.00
Equalization Basin				
Excavation	1,000	CY	$12.87	$12,900.00
Lining	61,600	SF	$1.93	$118,900.00
Site Work @ 5%	1	ea	$6,590.00	$6,600.00
Subtotal				$138,400.00
Transfer/Recycle Water Pumping Station				
Transfer Pump	1	ea	$12,865.44	$12,900.00
Recycle Pump	1	ea	$25,730.87	$25,700.00
Subtotal				$38,600.00
Construction Subtotal				$674,000.00
Tax on Materials				$25,000.00
General Cost @ 10%				$70,000.00
Estimating Contingency @ 15%				$105,000.00
Construction Total				$874,000.00
Engineering, Management, and Contingency @ 40%				$350,000.00
Project Total				$1,224,000.00

Alternatives 1A, 1B, 2A, and 2B Annual Operations and Maintenance Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Operation labor	hr	4160	$ 71	$ 294,400.00
Hypochlorite	lb	75000	$ 0.13	$ 9,600.00
Effluent pumping	kW-hr	740000	$ 0.13	$ 95,200.00
Effluent monitoring	LS	1	$ 12,900.00	$ 12,900.00
Miscellaneous energy	kW-hr	100000	$ 0.13	$ 12,900.00
Miscellaneous repair and replacement	LS	1	$ 25,700	$ 25,700.00
Total				$ 450,700.00
Present Worth @ 20 Years, 5%				$5,616,700.00

Alternative 3 Annual Operations and Maintenance Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Operation labor	hr	6240	$ 71	$ 441,500.00
MBR Energy	kW-hr	1241000	$ 0.13	$ 159,700.00
Membrane replacement	LS	1	$ 56,600	$ 56,600.00
MBR chemicals/supplies	LS	1	$ 2,600	$ 2,600.00
Biosolids handling	LS	1	$ 102,900	$ 102,900.00
UV light system energy	kW-hr	168000	$ 0.13	$ 21,600.00
UV lamp replacement	LS	1	$ 10,300	$ 10,300.00
Monitoring	LS	1	$ 12,900	$ 12,900.00
Effluent pumping	kW-hr	740000	$ 0.13	$ 95,200.00
Miscellaneous energy	kW-hr	100000	$ 0.13	$ 12,900.00
Miscellaneous repair and replacement	LS	1	$ 25,700	$ 25,700.00
Total				$ 941,900.00
Present Worth @ 20 Years, 5%				$11,738,200.00