

City of Riverside

**WASTEWATER COLLECTION AND TREATMENT  
FACILITIES INTEGRATED MASTER PLAN**

**VOLUME 10: CIP AND OVERALL  
IMPLEMENTATION SCHEDULE  
CHAPTER 2: OPERATION AND MAINTENANCE COST**

**FINAL**  
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**WASTEWATER COLLECTION AND TREATMENT  
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**VOLUME 10: CIP AND OVERALL IMPLEMENTATION SCHEDULE  
CHAPTER 2: OPERATION AND MAINTENANCE COST**

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## OPERATION AND MAINTENANCE COST

### 2.1 PURPOSE

The purpose of this chapter is to provide a summary of the additional Operation and Maintenance (O&M) costs that will occur between now and 2025 because of the treatment projects that are recommended for the City of Riverside (City) Regional Water Quality Control Plant (RWQCP). These projects are based on the analyses and recommendations presented in the other volumes of this Master Plan.

### 2.2 BACKGROUND

The RWQCP currently treats approximately 33 mgd. The expansion projects were identified based on the flow projections made in Volume 2, Chapter 3 - Population and Flow Projections. Figure 2.1 shows the projected average daily flow for the RWQCP for the master planning period for both the high-growth and low-growth scenarios.

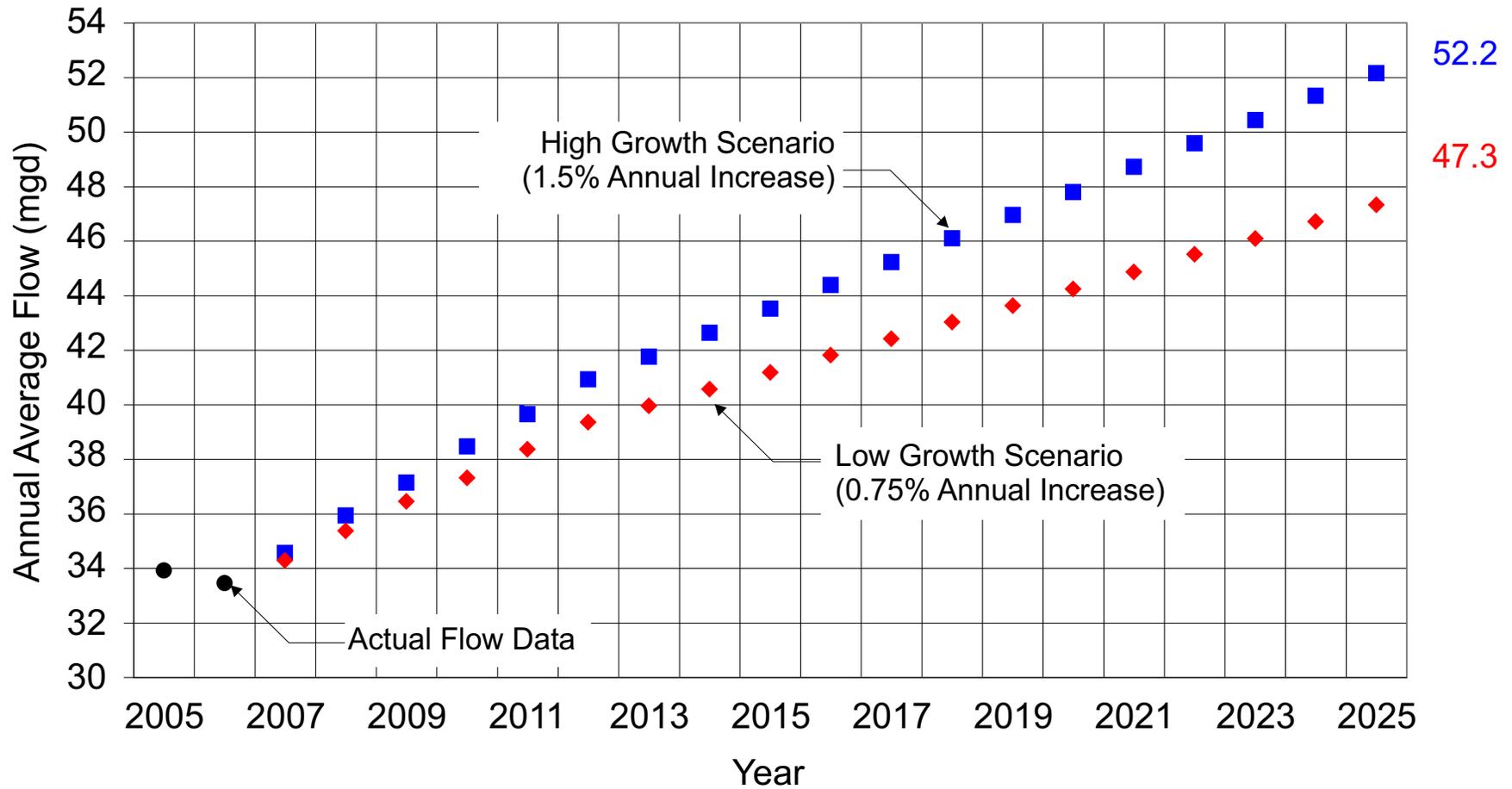
The capital costs of the master plan projects are discussed in Volume 10, Chapter 1 - Capital Costs and Implementation Schedule. These include collection system, liquid and solids treatment systems, energy management, and odor control projects.

### 2.3 OPERATION AND MAINTENANCE COST CRITERIA

The O&M costs for the existing facilities were provided by the City. These costs are presented in Volume 11, Chapter 3 - Financial Planning Tool. The O&M costs of the existing facilities are excluded from the discussion in this chapter. The additional O&M costs for the recommended treatment system projects are based on energy consumption, chemical supply, and labor, based on the influent flow projections. The additional O&M costs are presented in August 2006 dollars, inflated with an escalation rate of 6 percent for the first 5 years and 4 percent thereafter. The electricity rate is \$0.09 per kWh in 2006 dollars.

### 2.4 OPERATION AND MAINTENANCE COST BREAKDOWN

This section presents the yearly average O&M costs for the major master plan projects. These costs are based on the analyses and recommendations presented in the other volumes of this Master Plan.



**TOTAL PROJECTED  
AVERAGE DAILY FLOW  
FOR RWQCP**

FIGURE 2.1

Table 2.1 lists the breakdown of the additional O&M costs. All costs are adjusted for inflation in the year they are assumed to occur. A brief description of these projects is presented below. The additional O&M costs in Table 2.1 do not begin until 2010, even though the master plan period begins in 2006, because no master plan projects that have additional O&M costs associated with them will be completed before 2010.

### **2.4.1 Collection System**

The O&M costs for the recommended collection system projects are assumed to be the same as the current costs with adjustments for inflation factored in. These costs are not included in this chapter. The inflation-adjusted costs are included in the rate analysis, which is presented in Volume 11, Chapter 3 - Financial Planning Tool.

### **2.4.2 Treatment System**

The additional O&M costs for the recommended treatment system projects are presented below.

#### **2.4.2.1 Liquid Stream Treatment and Odor Control Projects**

New Headworks: O&M costs are added from 2023, based on the requirement for additional capacity in addition to the existing capacity of approximately 45 mgd.

Plant 1 Primary Expansion: The existing Plant 1 clarifiers have gone beyond their useful life and require relatively intensive maintenance to consistently provide effective treatment. In addition, rectangular clarifiers require more O&M than circular ones at the same capacity. Therefore, the O&M costs for the existing 20-mgd rectangular clarifiers will be approximately the same as the new 32-mgd circular clarifiers, so no additional O&M costs for primary clarifiers are included. O&M costs for primary effluent equalization and biofilters are added from the year 2013, based on the requirement for additional capacity over time.

Membrane Bioreactor (MBR) Facilities: O&M costs are added from the year 2013 based on the capacity requirement. Because high-quality filtrate from the MBRs does not require tertiary filtration, credit for tertiary filter O&M costs are given. Based on the previous years budget data provided by the City, tertiary treatment costs are approximately 32 percent of the total treatment cost. Applying the ratio of 32 percent to \$11.8 million for the budget year of 2006, the tertiary treatment O&M cost is \$3.8 million at the capacity of 33.5 mgd. Therefore, the tertiary treatment cost for 20 mgd is approximately \$2.3 million and the tertiary treatment savings for 13.5 mgd is approximately \$1.5 million in 2006 dollars. Table 2.2 shows the O&M costs of the existing tertiary treatment process.

<b>Table 2.1 Additional O&amp;M Cost Breakdown Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside</b>																
	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
New Headworks	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$20,000	\$42,000	\$65,000
Biofilters	\$0	\$0	\$0	\$47,000	\$98,000	\$104,000	\$110,000	\$116,000	\$122,000	\$129,000	\$136,000	\$143,000	\$151,000	\$159,000	\$168,000	\$177,000
Primary Clarifiers	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Primary Sludge Pump Station	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Primary Effluent EQ	\$0	\$0	\$0	\$40,000	\$84,000	\$89,000	\$94,000	\$99,000	\$104,000	\$110,000	\$116,000	\$122,000	\$129,000	\$136,000	\$143,000	\$151,000
Primary EQ Pumps	\$0	\$0	\$0	\$26,000	\$56,000	\$59,000	\$62,000	\$66,000	\$69,000	\$73,000	\$77,000	\$81,000	\$86,000	\$90,000	\$95,000	\$100,000
Fine (perforated) Screens, MBR Facility and RAS/WAS Pumps	\$0	\$0	\$0	\$195,000	\$417,000	\$447,000	\$478,000	\$511,000	\$546,000	\$583,000	\$622,000	\$663,000	\$706,000	\$752,000	\$796,000	\$843,000
Additional MBR Equipment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$4,000	\$8,000
Primary Sludge Thickeners (GBTs)	\$0	\$0	\$0	\$204,000	\$430,000	\$454,000	\$479,000	\$506,000	\$534,000	\$563,000	\$594,000	\$626,000	\$660,000	\$695,000	\$733,000	\$772,000
WAS Thickeners (GBTs)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Chlorine Contact Basin	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$9,000	\$33,000	\$59,000	\$87,000	\$117,000	\$150,000
Ozone + UV 52 mgd	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$838,000	\$884,000	\$932,000	\$982,000	\$1,035,000	\$1,090,000
Acid-Phase Digester	\$0	\$0	\$0	\$214,000	\$452,000	\$477,000	\$504,000	\$532,000	\$561,000	\$592,000	\$624,000	\$658,000	\$693,000	\$731,000	\$770,000	\$811,000
Reclaim and Reuse Water	\$97,000	\$103,000	\$107,000	\$111,000	\$115,000	\$120,000	\$125,000	\$130,000	\$135,000	\$140,000	\$146,000	\$152,000	\$158,000	\$164,000	\$171,000	\$178,000
Energy Management	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total Additional O&amp;M Cost</b>	<b>\$97,000</b>	<b>\$103,000</b>	<b>\$107,000</b>	<b>\$837,000</b>	<b>\$1,652,000</b>	<b>\$1,750,000</b>	<b>\$1,852,000</b>	<b>\$1,960,000</b>	<b>\$2,071,000</b>	<b>\$2,190,000</b>	<b>\$2,324,000</b>	<b>\$2,478,000</b>	<b>\$2,642,000</b>	<b>\$2,834,000</b>	<b>\$3,039,000</b>	<b>\$3,255,000</b>
<b>Ozone+UV Scenario Cost</b>														<b>\$3,153,000</b>	<b>\$3,329,000</b>	<b>\$4,195,000</b>

**Notes:**  
(1) All costs are as future value with an escalation rate of 6 percent through the year 2011 and 4 percent thereafter and adjusted based on the requirement to meet capacity over time.

<b>Table 2.2 Existing Tertiary Treatment O&amp;M Costs Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside</b>		
<b>Treatment Process</b>	<b>O&amp;M Cost</b>	<b>Percentage</b>
<b>Budget Year: 1997/1998</b>		
Primary Treatment <sup>(1)</sup>	\$1,637,000	18.6%
Secondary Treatment <sup>(1)</sup>	\$1,964,000	22.3%
Tertiary Treatment <sup>(1)</sup>	\$2,824,000	32.1%
Solids Treatment <sup>(1)</sup>	\$2,372,000	27.0%
<b>Plant Total<sup>(1)</sup></b>	<b>\$8,797,000</b>	<b>100.0%</b>
<b>Budget Year: 2006</b>		
Plant Total	\$11,760,000	
Tertiary Treatment <sup>(2)</sup>	\$3,770,000	
Treatment Capacity: 33.5 mgd		
<b>Tertiary Treatment for 20 mgd<sup>(3)</sup></b>	<b>\$2,250,000</b>	
<b>Tertiary Treatment Savings<sup>(3)</sup></b>	<b>\$1,520,000</b>	
<b>Notes:</b>		
(1) Budget data provided by the City for the August 2001 Revenue Plan.		
(2) Assume the same percentage as in 1997/1998.		
(3) When MBR is in operation, tertiary filters will be used for Plant 2 secondary effluent, which is 20 mgd on an annual average basis.		

Disinfection: In Volume 4, Chapter 9 - Disinfection, chlorine contact basins will be used for disinfection unless future regulations require different methods. O&M costs are added from 2020, based on the requirement for additional capacity in addition to the existing capacity of 44 mgd. Ozone and UV disinfection O&M costs are calculated as an alternative to chlorine disinfection. For the ozone and UV disinfection scenario, credits are given for the existing 44-mgd chlorination and dechlorination chemical costs. O&M costs for the new ozone and UV facilities are added from 2020 as a comparison to the chlorine scenario, though the start date of the ozone and UV disinfection project is undetermined.

#### **2.4.2.2 Solids Treatment**

Primary Sludge Thickeners: Primary solids are currently thickened in the Plant 2 primary clarifiers before digestion. Separate Gravity Belt Thickeners (GBTs) will be used after the completion of Plant 1 Primary Expansion in 2013. The future O&M costs for the new primary sludge thickeners are added from the year 2013, based on the requirement to meet capacity over time.

Waste Active Sludge (WAS) Thickeners: The existing Dissolved Air Flotation Thickeners (DAFTs) will be used until 2026, when new GBTs are installed. The additional O&M costs of the GBTs are not added for the master plan period until 2025.

Digestion: Acid-Phase Anaerobic Digestion O&M costs are added from the year 2013, based on the requirement to meet capacity over time.

### **2.4.3 Reclamation and Reuse**

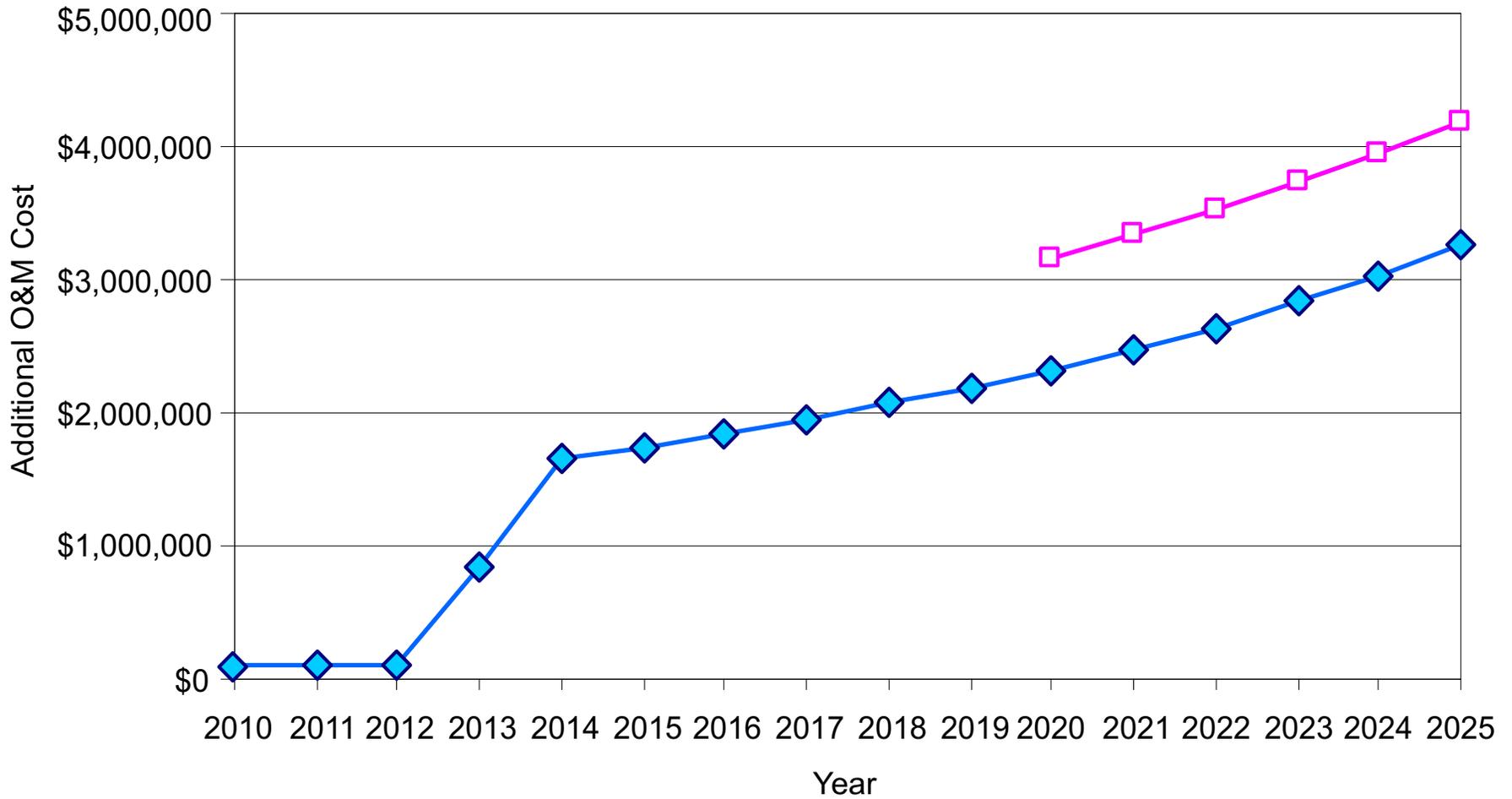
The reclamation and reuse project will be completed in 2010. The O&M costs are added from the year 2010.

### **2.4.4 Energy Management**

There are no additional O&M costs for the energy management projects, including cogeneration engines and fuel cells, discussed in this chapter. It is assumed that the O&M costs for the fuel cells will be similar to those for the existing cogeneration engines that they will replace, so only adjustments for inflation are considered. The inflation-adjusted costs are included in the rate analysis, which is presented in Volume 11, Chapter 3 - Financial Planning Tool.

## **2.5 TOTAL OPERATION AND MAINTENANCE COSTS**

The total additional O&M costs for all of the recommended projects from the year 2010 to the year 2025 are summarized on Figure 2.2. The total additional O&M cost increases by approximately \$0.7 million in 2013, when the combined project that includes the Plant 1 Primary Expansion, MBR Facilities, and Acid-Phase Digester is completed in the midyear. Figure 2.2 shows two scenarios for the total additional O&M costs for all the projects listed in Table 2.1, from 2010 through 2025. The blue line represents the additional O&M costs for these projects using chlorine disinfection. The pink line represents the additional O&M costs for these projects if regulatory requirements lead to the installation of ozone and UV disinfection.



- ◆ Total Additional O&M Cost
- Ozone+UV Scenario Cost

### TOTAL ADDITIONAL O&M COSTS

FIGURE 2.2