City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 4: WASTEWATER TREATMENT SYSTEM
CHAPTER 14: IMPLEMENTATION SCHEDULE AND COST

FINAL
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carollo
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City of Riverside

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CHAPTER 14: IMPLEMENTATION SCHEDULE AND COST

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IMPLEMENTATION SCHEDULE AND COST

14.1 PURPOSE

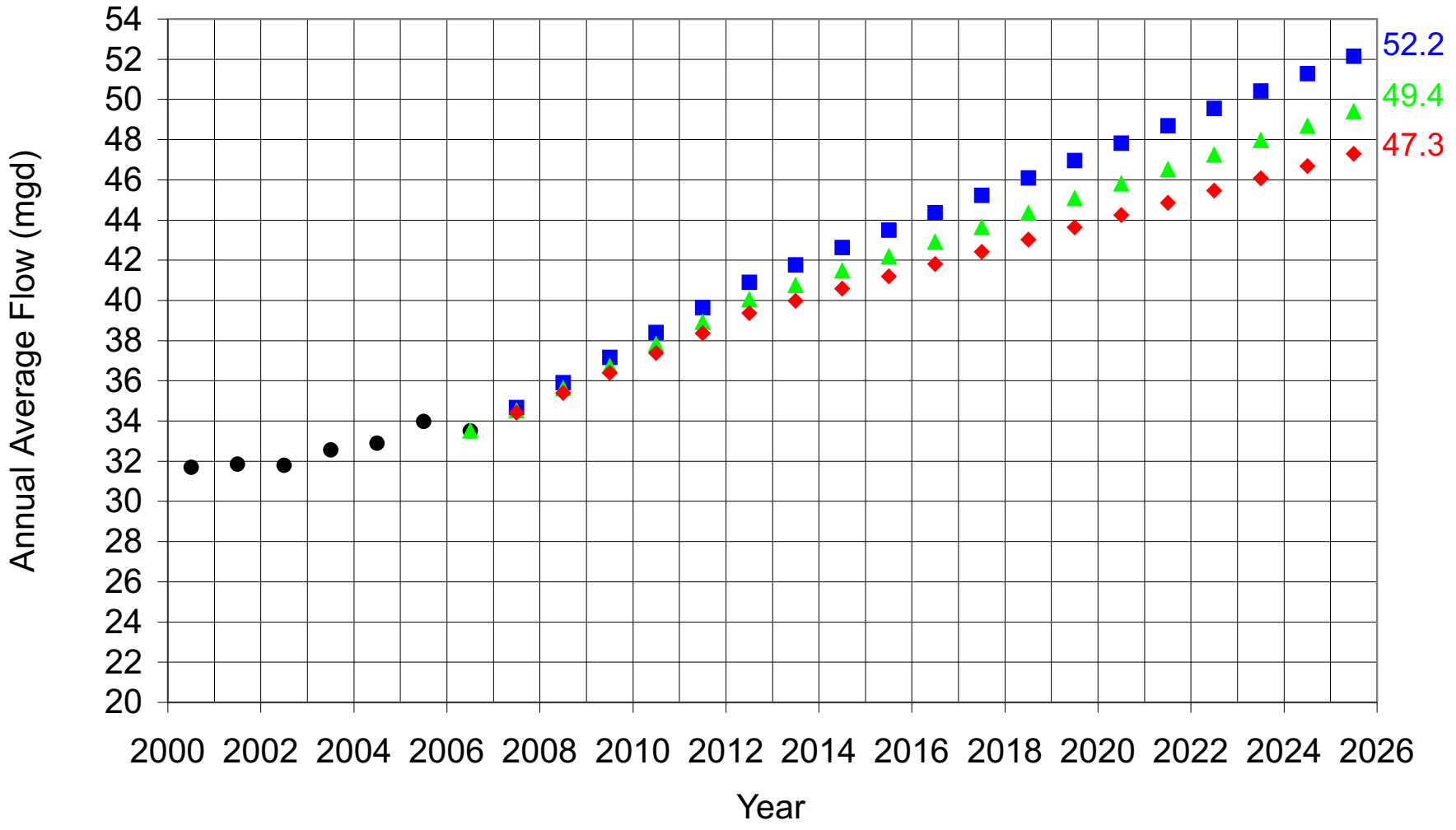
The purpose of this chapter is to present schedules and costs for the selected liquid stream process projects for the City of Riverside (City) of the Regional Water Quality Control Plant (RWQCP) Integrated Master Plan. The selected projects are derived from the analyses performed and presented in Chapters 1 through 13 of this volume of the Master Plan. This chapter is closely tied to Volume 8, Chapter 8 - Implementation Schedule and Cost for the solids stream projects.

14.2 CONCLUSIONS AND RECOMMENDATIONS

- The Plant 1 Primary Expansion, the Plant 1 Membrane Bioreactor (MBR) Facilities, and Acid-Phase Digester additions will be combined into one project.
- Based on the schedules for the low-growth scenario presented in this chapter, the combined project of Plant 1 Primary Expansion, MBR Facilities, and Acid-Phase Digester additions should start in the summer of 2008.
- The total project cost is $228 million for the liquid- and solid-stream projects described in this chapter, based on an Engineering News-Record (ENR) value of 8,570 (Los Angeles, August 2006). The mid-point of construction costs, adjusted by the schedule and phasing, are presented in Volume 10 - CIP and Overall Implementation Schedule.

14.3 BACKGROUND

In Volume 2, Chapter 3 - Population and Flow Projections, the projected average daily flow for the RWQCP is 49.4 mgd. This is based on increasing the flow at the same rate as the projected population growth, which is 1.09 percent for the City. Because population and flow projections may be different from actual values, a 90-percent confidence interval is applied to the data. This results in a high-growth scenario at 1.50 percent and low-growth scenario at 0.75 percent. Figure 14.1 shows the projected annual average influent flows for the RWQCP, along with projections using the high- and low-growth scenarios. At the beginning of the Integrated Master Plan process, the City decided that the high-growth scenario should be used as the design basis for all process alternative evaluations (August 2006). However, after the process alternative evaluations were completed (August 2007), it was determined that the slow down in the housing market would cause wastewater flows into the RWQCP to increase at a slower rate than was originally projected. Because of this slow down, the City decided that the low-growth scenario should



RWQCP FLOW PROJECTIONS

FIGURE 14.1

be used for establishing the Capital Improvement Plan (CIP). Based on the existing capacity and future flow requirements, implementation schedules for both high- and low-growth scenarios are developed for the liquid-process projects listed below:

- A new 15-mgd headworks facility (annual average basis).
- Plant 1 Primary Expansion: Four circular primaries to treat 32 mgd on an annual average basis, two primary effluent equalization basins of a total volume of 12.1 MG, primary equalization pump station, primary sludge pump station, primary sludge thickening facilities (gravity belt thickeners), and a biofilter for odor scrubbing.
- A two-phase 32-mgd MBR facility (annual average basis). The first phase will expand the Plant 1 secondary treatment facilities from 20 to 26 mgd. The second phase will expand the secondary facilities from 26 to 32 mgd.
- A new Chlorine Contact Basin (CCB) of 8 mgd on an annual average basis.

14.4 COST AND SCHEDULE CRITERIA

The implementation schedule for each project consists of a planning/design period and a construction/start-up period. A 2-year duration for the planning and design period is used for each project to include a conservative schedule at the master plan level. The construction and start-up period ranges from 1.5 to 4 years based on a general guideline of a contractor being able to perform approximately $2 million/month worth of construction. When final implementation projects are established, adjustments should be made to this schedule guideline based on experience, looking at factors such as project sequencing and equipment procurement times. For some of the projects, it may be possible to shorten the planning/design and construction/start-up schedules. However, for the Master Plan, the schedules will be presented based on the criteria described above.

The costs for these projects are based on the information presented in the previous chapters for Volume 4 - Water Treatment System. They are based on costs in August 2006 dollars. These costs will be adjusted to their midpoint of construction before placement in the CIP, which is presented in Volume 10 - CIP and Overall Implementation Schedule.

14.5 LIQUID STREAM TREATMENT FACILITIES SCHEDULE

Figure 14.2 shows the proposed layout of the new facilities including the solids treatment facilities proposed in Volume 8 - Solids Treatment and Handling. The schedules for the liquid stream treatment facilities are discussed as follows:

14.5.1 New Headworks

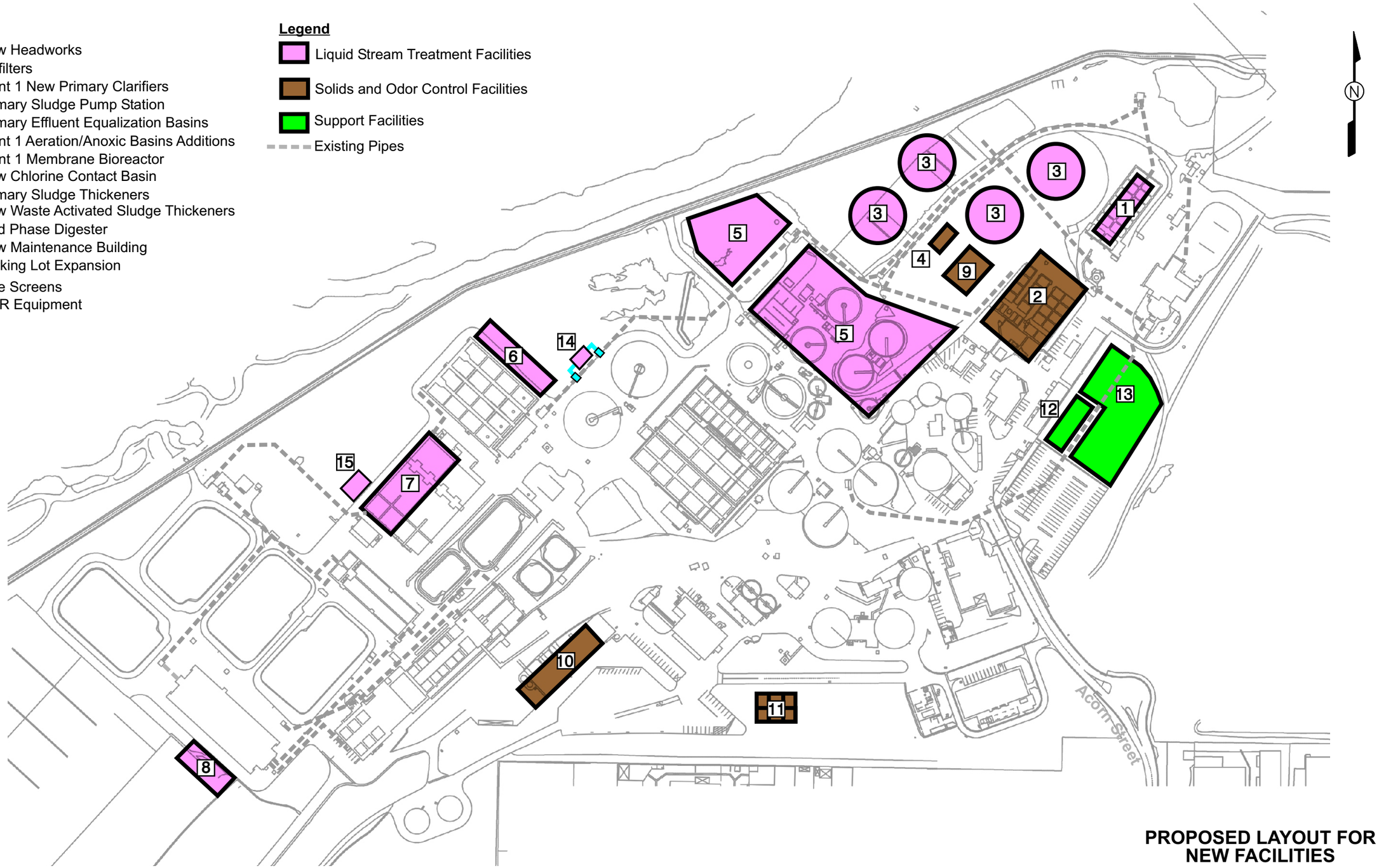
As described in Volume 4, Chapter 5 - Preliminary Treatment, the existing headworks facility is designed for a peak flow of 100 mgd. Based on a wet weather peaking factor of

Key

1 New Headworks
2 Biofilters
3 Plant 1 New Primary Clarifiers
4 Primary Sludge Pump Station
5 Primary Effluent Equalization Basins
6 Plant 1 Aeration/Anoxic Basins Additions
7 Plant 1 Membrane Bioreactor
8 New Chlorine Contact Basin
9 Primary Sludge Thickeners
10 New Waste Activated Sludge Thickeners
11 Acid Phase Digester
12 New Maintenance Building
13 Parking Lot Expansion
14 Fine Screens
15 MBR Equipment

Legend

Liquid Stream Treatment Facilities
Solids and Odor Control Facilities
Support Facilities
Existing Pipes



PROPOSED LAYOUT FOR NEW FACILITIES

FIGURE 14.2

2.2, the headworks capacity is 45 mgd on an annual average basis. Figure 14.3 shows the proposed schedule of the new headworks facility. The duration of the construction and start-up period is 1.5 years, and the duration of the planning and design period is 2 years. The project needs to start at the beginning of 2019 to be completed by the summer of 2022 for the low-growth scenario, assuming the existing headworks capacity is 45 mgd as originally designed.

As presented in Volume 4, Chapter 5 - Preliminary Treatment, the limitation of the existing headworks is the grit basins, which may be re-rated to 37 mgd on an annual average basis. Figure 14.3 also shows the schedule for the new headworks project if the grit basin capacity is 37 mgd. The project should have started in 2006 for the low-growth scenario, assuming the limitations of the grit basins. Because the limited removal efficiency of the grit basins will not cause overflows, the new headworks can be delayed so that completion is in 2022, as described in the previous paragraph, if the City is willing to accept the increased mechanical wear and tear from the grit that goes through the headworks.

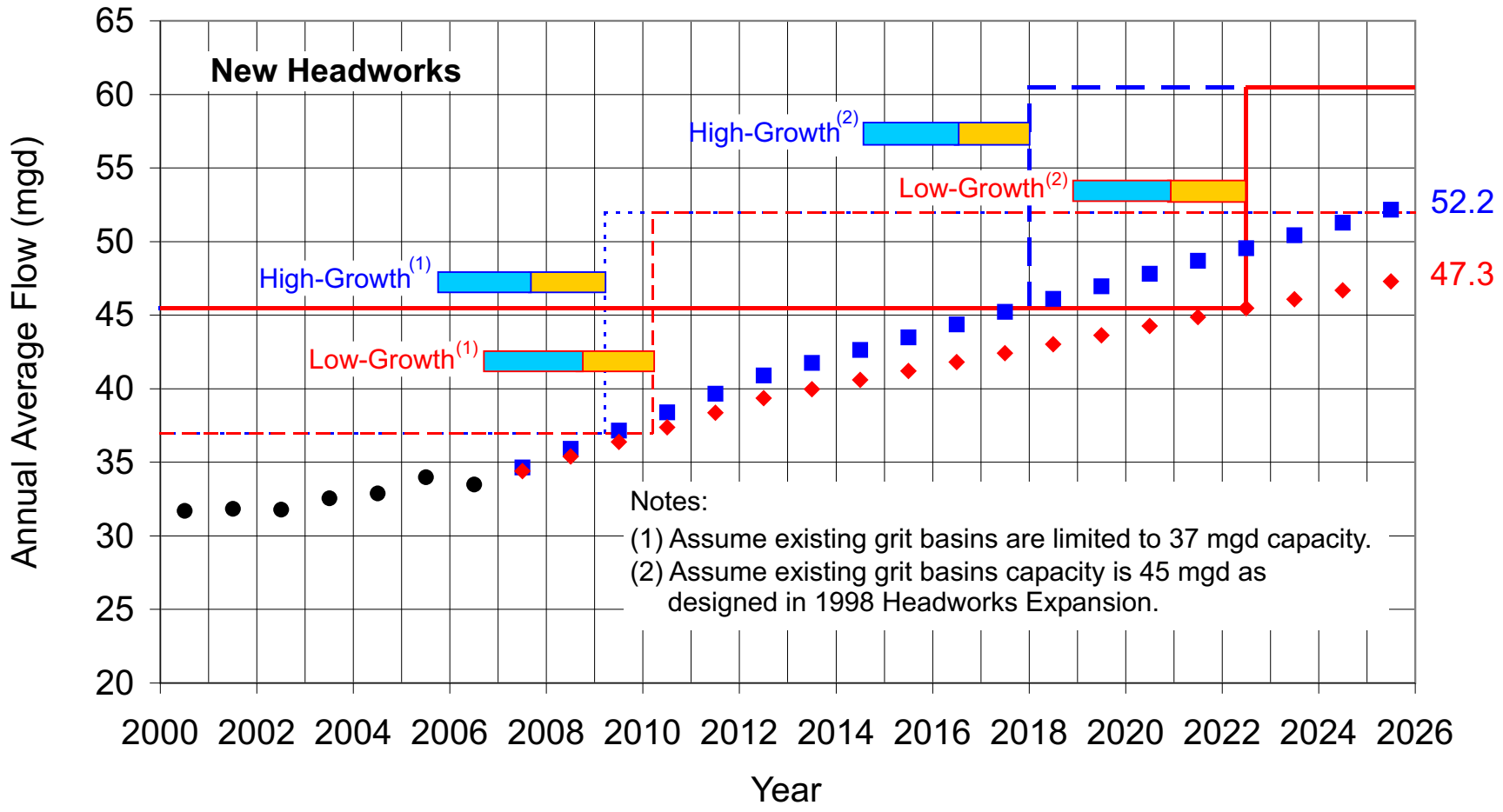
14.5.2 Plant 1 Primary Expansion

The existing capacity of the Plant 1 and Plant 2 primaries is 40 mgd. The Plant 1 Primary Expansion project includes primary clarifiers, a primary sludge pump station, primary sludge thickening facilities, primary equalization basins, a primary equalization pump station, and biofilters. These facilities are discussed in detail in Volume 4, Chapter 6 - Primary Treatment, Volume 4, Chapter 12 - Primary Effluent Equalization, and Volume 8, Chapter 4 - Solids Production and Thickening Options. Biofilter and primary sludge thickening facilities are also included in the Plant 1 Primary Expansion project, because they are needed at the same time as the other primary facilities. Figure 14.4 shows the schedule of the Plant 1 Primary Expansion. The duration of the construction and start-up period is 2.5 years, and the duration of the planning and design period is 2 years. The Plant 1 Primary Expansion project needs to start at the beginning of 2009 to be completed by the summer of 2013 for the low-growth scenario.

14.5.3 Plant 1 MBR Facilities

The existing capacity of the Plant 1 and Plant 2 secondary treatment is 40 mgd. As described in Volume 4, Chapter 7 - Secondary Treatment, the MBR project will be a two-phase project. The first phase includes installation of the following:

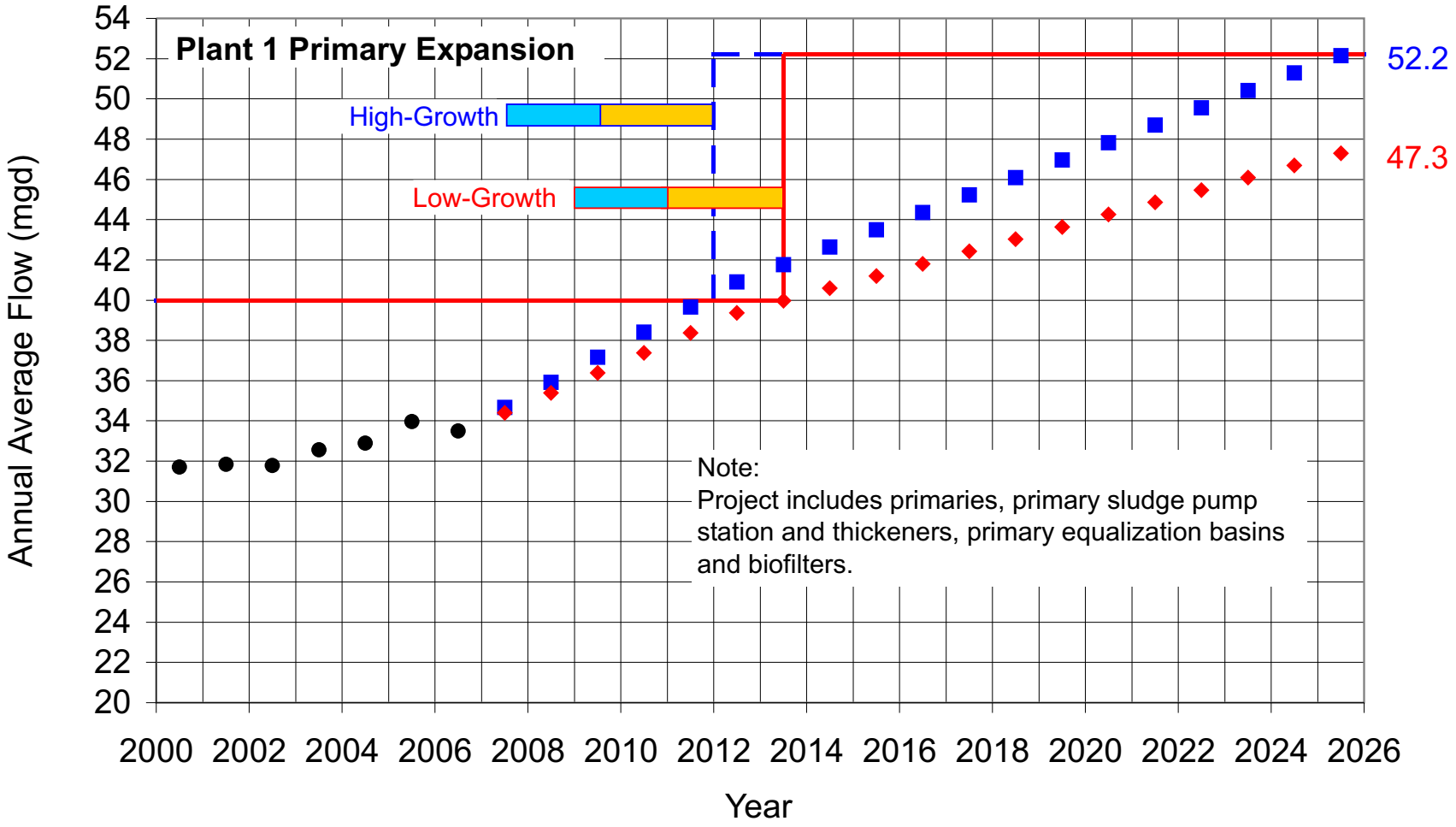
1. MBR modules of 26 mgd in the Plant 1 secondary clarifiers.
2. A 32-mgd fine screen facility.
3. Additional aeration basin channel.
4. Retrofit of the aeration basins and secondary clarifiers.



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase — High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase — Low-Growth Scenario)
- Preliminary Treatment Capacity(1) (High-Growth Scenario)
- Preliminary Treatment Capacity(1) (Low-Growth Scenario)
- Preliminary Treatment Capacity(2) (High-Growth Scenario)
- Preliminary Treatment Capacity(2) (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

NEW HEADWORKS SCHEDULE

FIGURE 14.3



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Primary Treatment Capacity (High-Growth Scenario)
- Primary Treatment Capacity (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

PLANT 1 PRIMARY EXPANSION SCHEDULE

FIGURE 14.4

5. Upsizing the blowers.

6. Upsizing the Waste Activated Sludge (WAS) pumps.

The second phase includes installation of membrane modules of 6 mgd, to bring the Plant 1 capacity to 32 mgd, and the RWQCP capacity to 52 mgd. Figure 14.5 shows the schedule of the MBR project. The duration of the construction and start-up period is 2.5 years, and 1.5 years, for the first- and second-phase, respectively, and the duration of the planning and design period is 2 years. The first-phase Plant 1 MBR Facilities project needs to start at the beginning of 2009 to meet the 2013 completion schedule for the low-growth scenario. The second-phase MBR Equipment project will start at the beginning of 2020 and to be completed in the summer of 2023 for the low-growth scenario.

14.5.4 New Chlorine Contact Basin

As described in Volume 4, Chapter 9 - Disinfection, a new 8-mgd CCB will be needed. Figure 14.6 shows the schedule for the CCB project. This project would need to begin in the summer of 2016 assuming the low-growth scenario, based on a construction and start-up period of 1.5 years and a planning and design period of 2 years.

14.5.5 New Maintenance Building and Flood Protection Levee

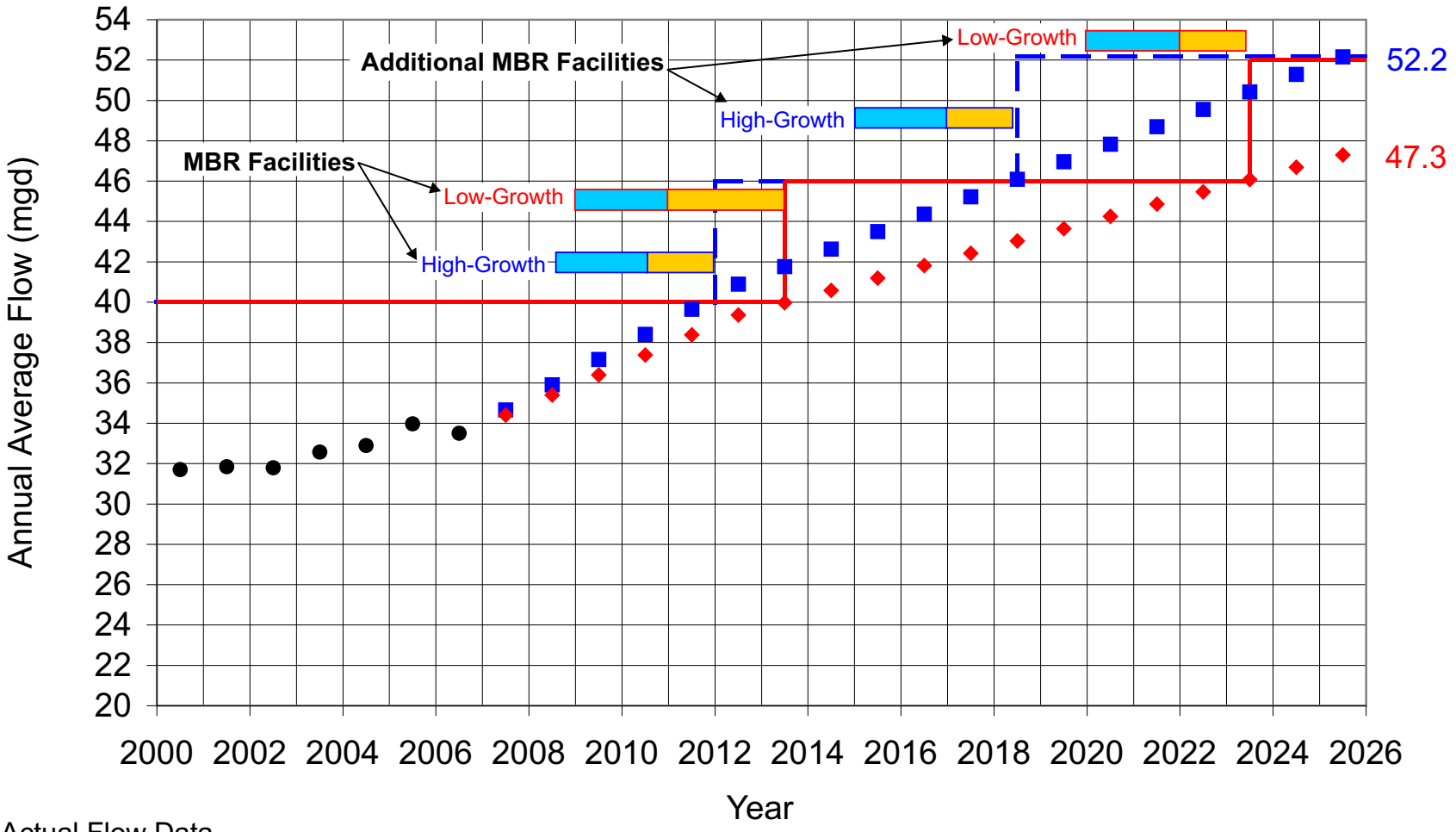
As described in Volume 4, Chapter 11 - Plant Utilities and Support Facilities, a new maintenance building, which meets a minimum of the Leadership in Energy and Environmental Design (LEED) standard, will be needed. Based on the simplicity of the project, the planning, design and construction can be shortened to 1.5 years. The project would start in the summer of 2014 to be completed by the end of 2015.

As described in Volume 4, Chapter 11 - Plant Utilities and Support Facilities, the flood protection levee may have to be raised. If the hydrology study and analysis confirms that the levee needs to be raised, this project would need to begin in the summer of 2012 to be completed in the summer of 2015, based on a construction and start-up period of 1.5 years and a planning and design period of 1.5 years.

14.5.6 Combined Project

Figure 14.7 and Figure 14.8 show the schedule for all of the projects on one graph for the high- and low-growth scenarios, respectively. The schedules for the separate projects are the same as described previously in Figures 14.3 through 14.6 in this chapter and in Figures 8.4 and 8.5 in Volume 8, Chapter 8 - Implementation Schedule and Cost.

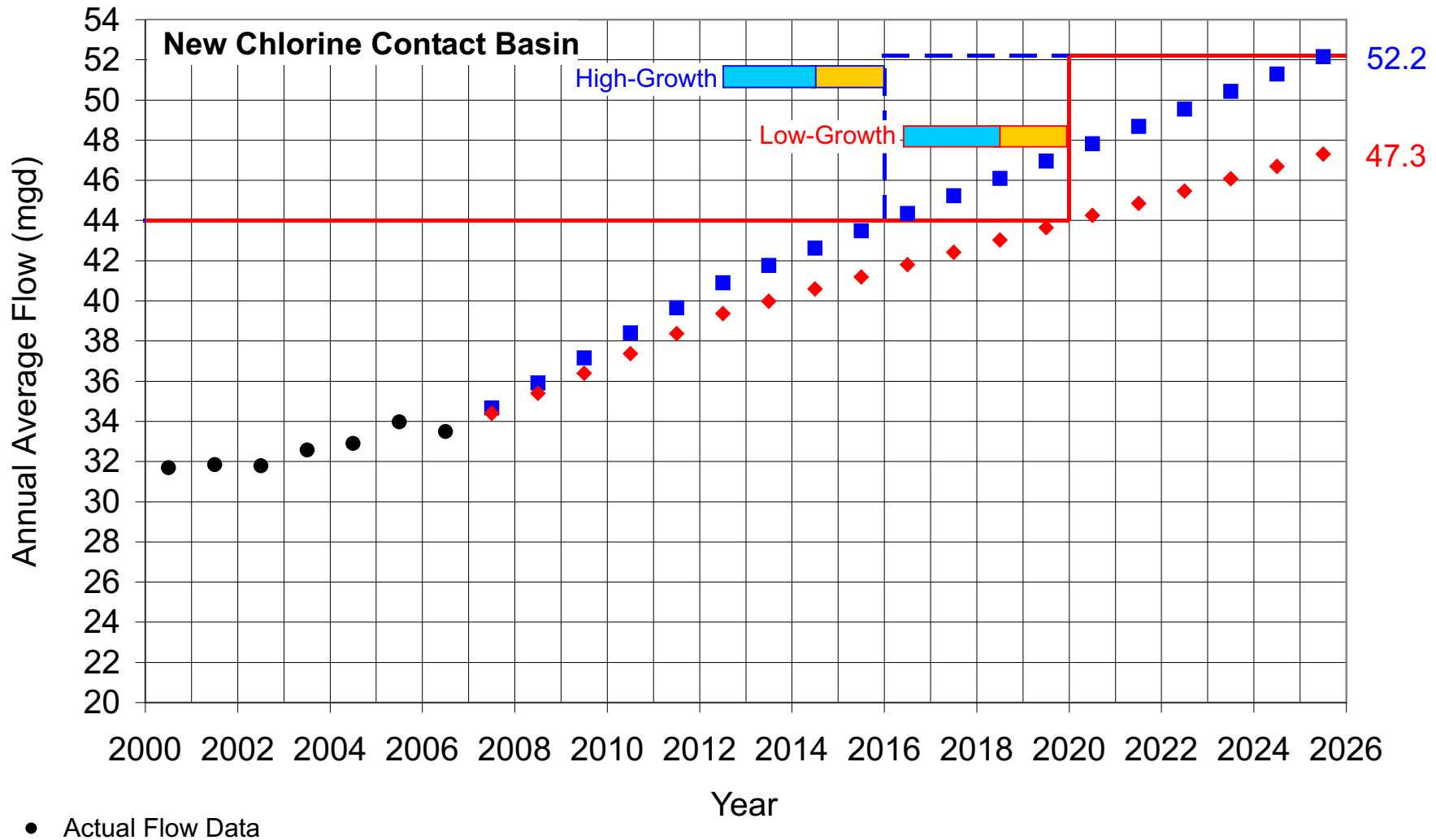
As Figure 14.7 and Figure 14.8 show, the Plant 1 Primary Expansion, Plant 1 MBR Facilities, and Acid-Phase Digester projects (discussed in Volume 8, Chapter 8 - Implementation Schedule and Cost) all need to start and finish at about the same time. An option to three separate projects is to combine the three projects into one project.



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Primary Treatment Capacity (High-Growth Scenario)
- Primary Treatment Capacity (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

PLANT 1 MBR FACILITIES SCHEDULE

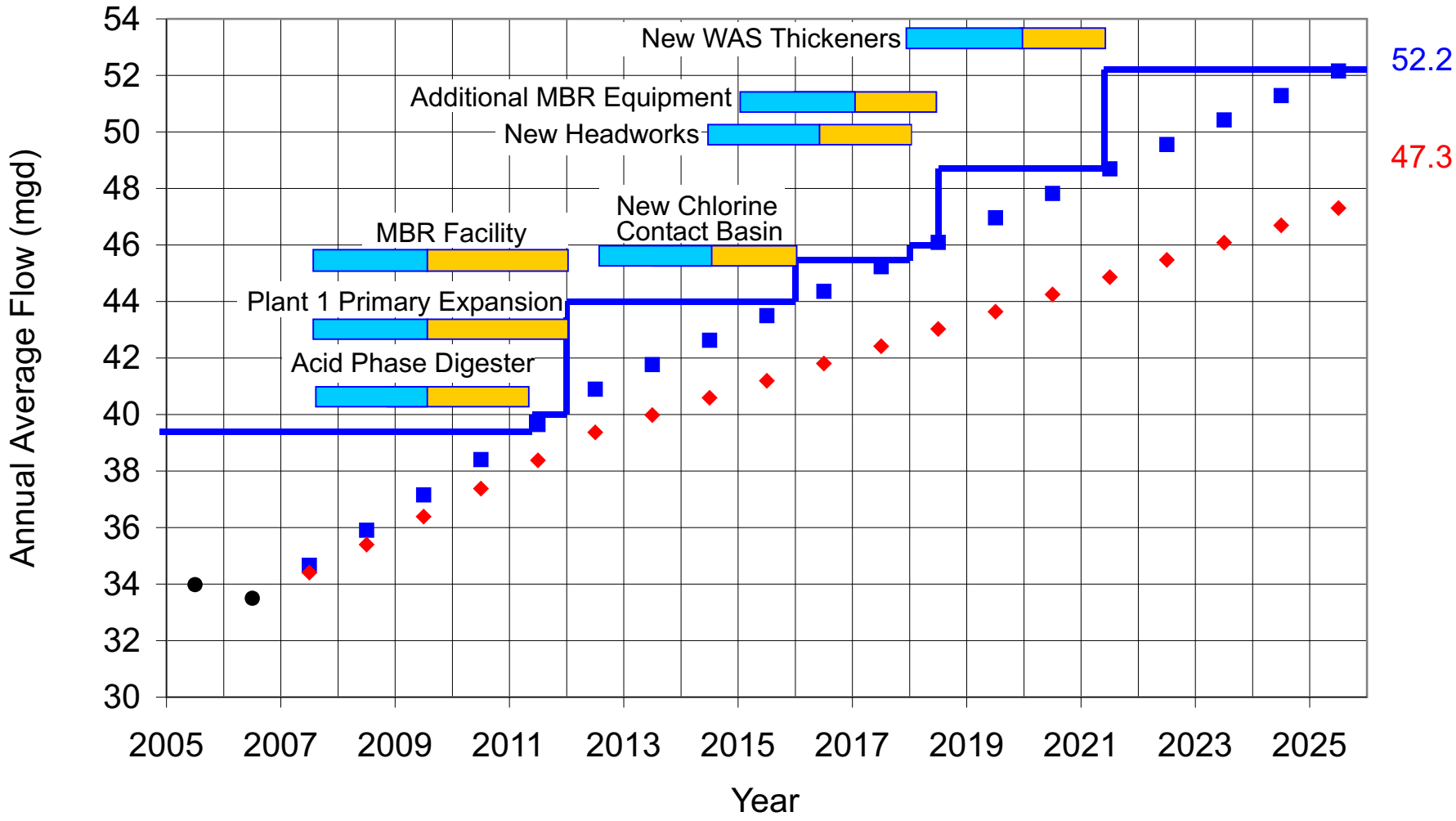
FIGURE 14.5



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Primary Treatment Capacity (High-Growth Scenario)
- Primary Treatment Capacity (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

NEW CHLORINE CONTACT BASIN SCHEDULE

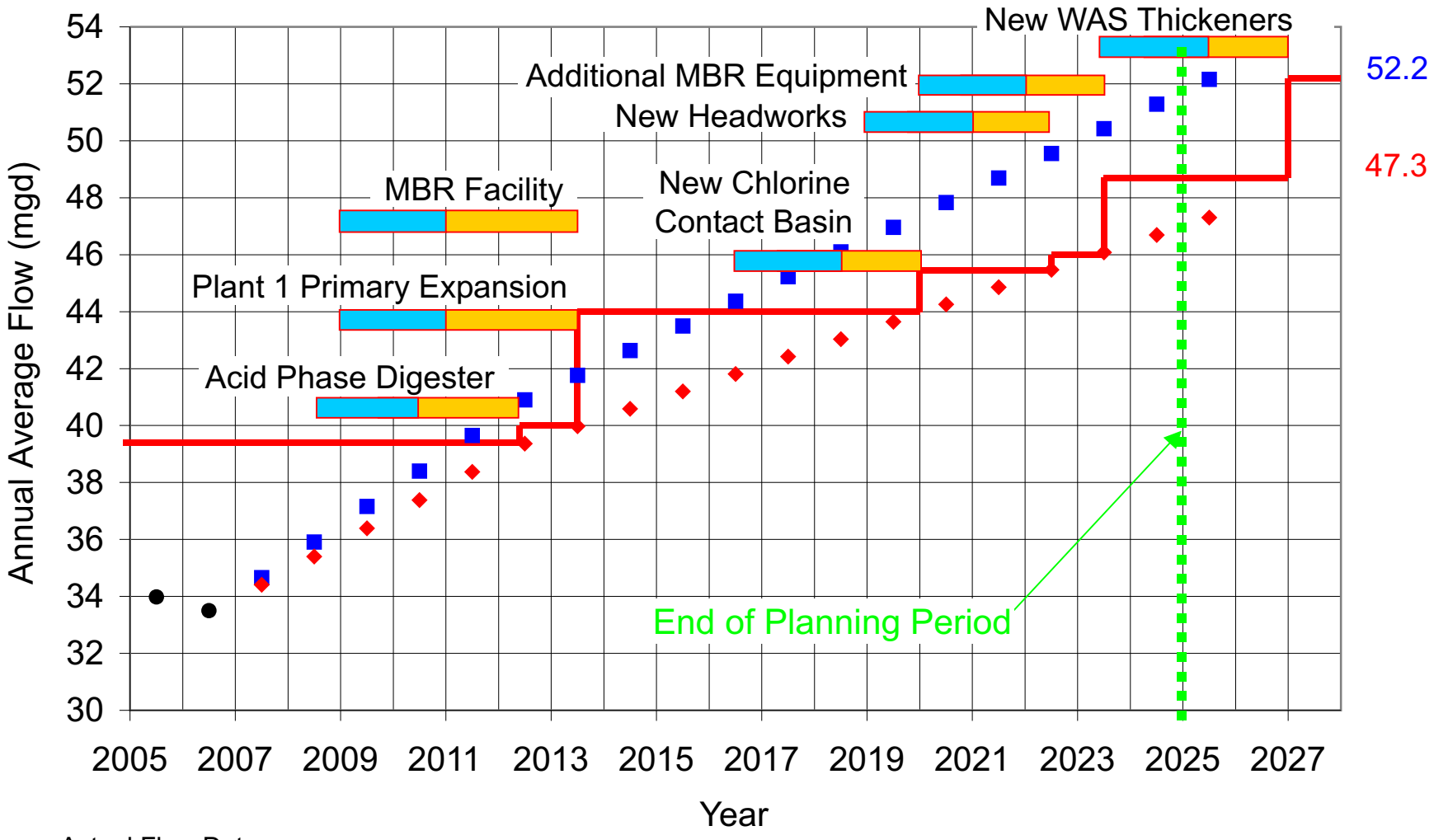
FIGURE 14.6



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Treatment Capacity (High-Growth Scenario)
- Planning/Design
- Construction/Startup

PROJECT SCHEDULE OVERVIEW FOR HIGH-GROWTH SCENARIO

FIGURE 14.7



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Treatment Capacity (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

PROJECT SCHEDULE OVERVIEW FOR LOW-GROWTH SCENARIO

FIGURE 14.8

There are advantages and disadvantages of doing separate projects versus a combined project. Table 14.1 shows a comparison of separate and combined projects.

Table 14.1 Comparison of Separate and Combined Projects Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside

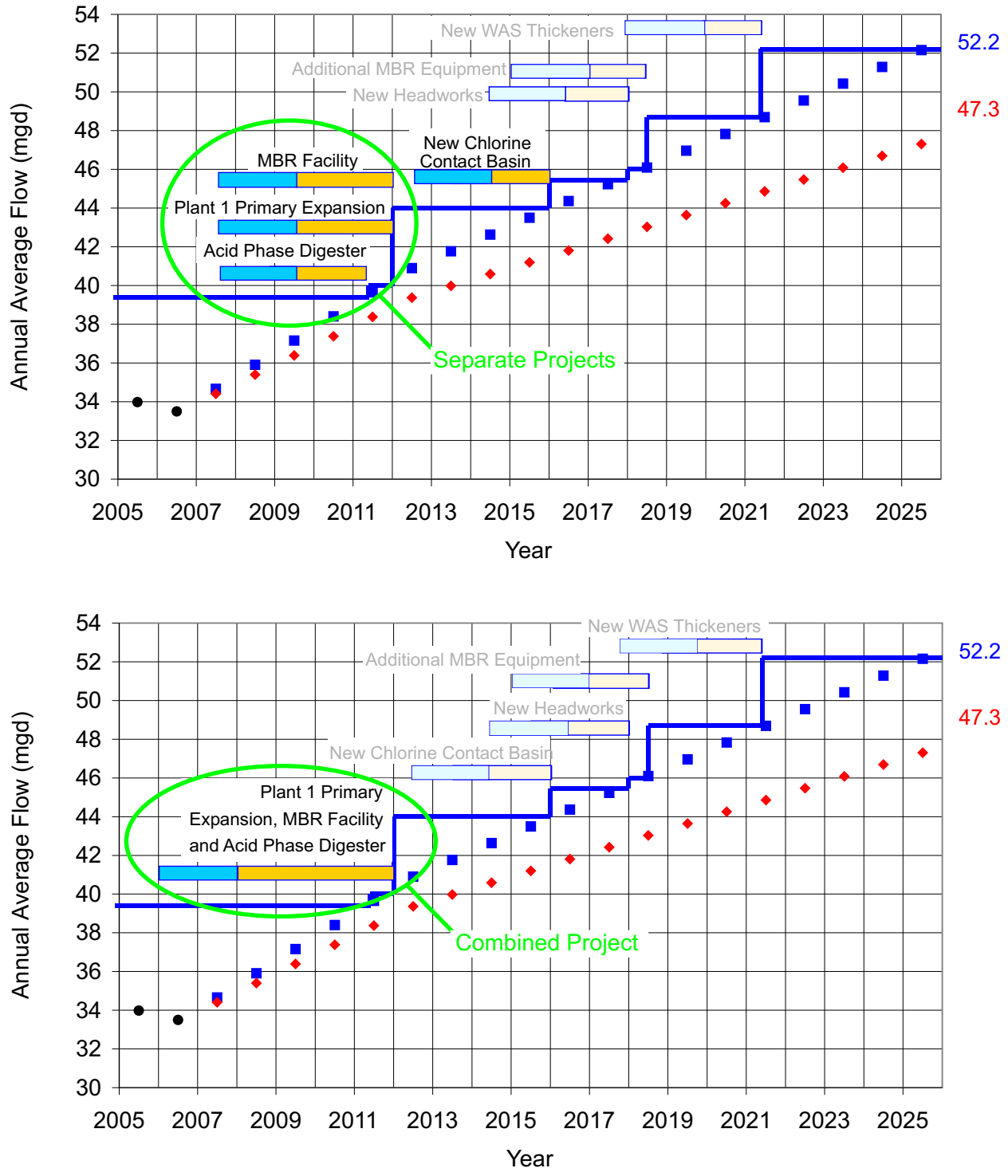
	Separate Projects	Combined Projects
Schedule	+	0
Bidding Market Competitors	+	–
Construction Cost	–	+
Management and Legal Cost	–	+
Construction Coordination	–	+

Ratings:
+ = Positive comparative characteristic.
– = Negative comparative characteristic.
0 = Neutral comparative characteristic.

A comparison of schedules for separate projects versus a combined project is contrasted in the highlighted upper and lower portions of Figures 14.9 and 14.10. Figure 14.9 shows the comparison for the high-growth scenario, and Figure 14.10 shows the comparison for the low-growth scenario. In the upper portion of Figures 14.9 and Figure 14.10, the project schedules for the separate projects are the same as described previously in Figure 14.7 and Figure 14.8, respectively. In the lower portion of Figures 14.9 and 14.10 for the combined project, the duration of the construction and start-up period is 4 years, and the duration of the planning and design period is 2 years. On this basis, the combined project should have started in 2007, based on the low-growth scenario. However, this is a conservative schedule for the Master Plan, which may be shortened, as will be described below.

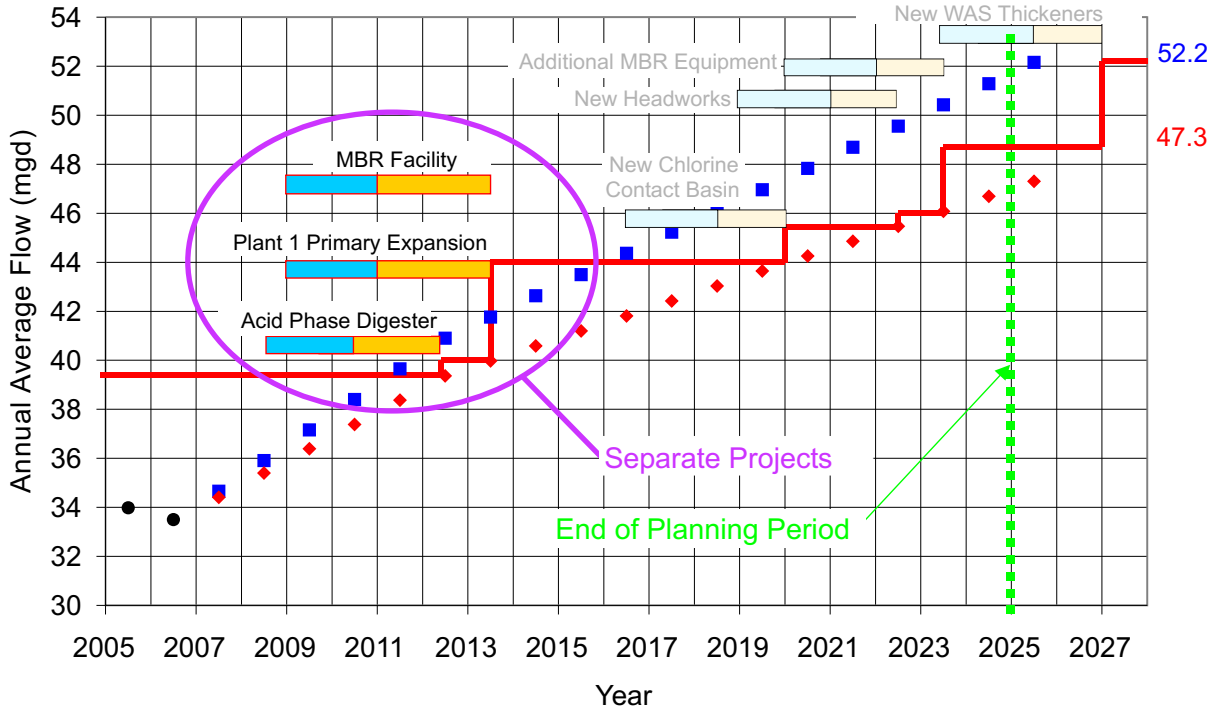
Based on Figure 14.10, a combined project would require a longer construction duration than separated projects. However, the additional time for this combined project may be minimized since there are three distinct projects, in separate areas of the RWQCP, being combined into one project. At the same time, there is a limit to the extent that the combined project schedule can be shortened. At some point, the contractor will charge a premium to further shorten the construction period. For example, the City may have to pay a premium to reduce the schedule of the combined project so that it equals the schedule of the three separate projects. If we assume that the combined project can be designed and constructed in 5 years (24 months of planning/design and 36 months of construction/start-up), then the project should start in the summer of 2008.

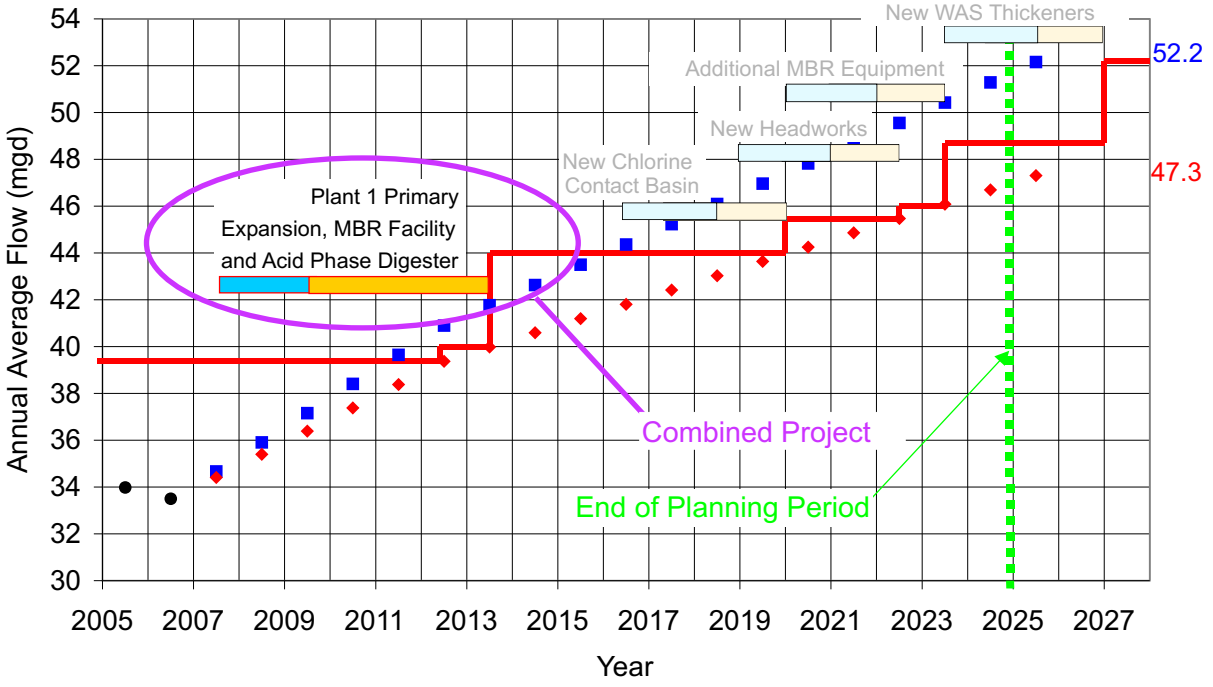
A combined project would be easier and less expensive for the City to design, coordinate, and manage. The construction cost is potentially lower, depending on the schedule, because the contractor can apply economies of scale to the work.



SEPARATE AND COMBINED PROJECTS SCHEDULE FOR HIGH-GROWTH SCENARIO

FIGURE 14.9





- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase — High-Growth Scenario)
- Master Plan Flow Projections (0.75% Annual Increase — Low-Growth Scenario)
- Treatment Capacity (Low-Growth Scenario)
- Planning/Design
- Construction/Startup

SEPARATE AND COMBINED PROJECTS SCHEDULE FOR LOW-GROWTH SCENARIO

FIGURE 14.10

One of the drawbacks to a combined project is the potential to limit the number of bidders. The combined project bid is likely to be in the $200 million range. In that price range, there are only a few contractors that have the capability to complete the work. On three recent Southern California projects in that price range, one received three bids and the others received two bids each. The concern is that the limited number of bids may increase the cost.

14.6 IMPLEMENTATION COST

Costs for the projects have been presented in the previous chapters in this volume and in Volume 8 - Solids Treatment and Handling. The total project costs of these projects are summarized in Table 14.2, based on an ENR value of 8,570 (Los Angeles, August 2006).

Table 14.2 Total Project Cost for Proposed Expansion Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside

Separate Projects	Project Cost[1]	Combined Projects	Project Cost[1]
Plant 1 Primary Expansion	$64 M	Primary, MBR, and Digester	$185 M
Primary Clarifiers		Primary Clarifiers	
Primary Sludge Pump Station		Primary Sludge Pump Station	
Primary Sludge Thickening Facility[2]		Primary Sludge Thickening Facility[2]	
Primary Effluent Equalization Basins		Primary Effluent Equalization Basins	
Biofilters		Biofilters	
MBR Facility	$108 M	MBR Facility	
Acid-Phase Digester[2]	$13 M	Acid-Phase Digester[2]	
New Chlorine Contact Basin	$4 M	New Chlorine Contact Basin	$4 M
New Headworks	$10 M	New Headworks	$10 M
Additional MBR Equipment	$12 M	Additional MBR Equipment	$12 M
WAS Thickening Facility[2]	$17 M	WAS Thickening Facility[2]	$17 M
Total Cost	**$228 M**	**Total Cost**	**$228 M**

Notes:
(1) As present value (ENR value of 8,570 for Los Angeles in August 2006).
(2) Details discussed in Volume 8 – Solids Treatment and Handling.

The left side of the table shows the project costs for the projects completed as separate projects. The right side shows the project costs for the Primary, MBR, and Digester projects as one combined project. The combined project cost for the Primary, MBR, and Digester projects is $185 million. This cost is the sum of the included separate projects. As described

previously, the cost of the combined project would likely be lower than the separate projects. However, at the master plan level, this reduction is difficult to determine and is subject to several factors, including schedule, which will be refined during detailed planning and design.

Costs are in August 2006 dollars. Final project costs will be determined based on schedule and phasing, which will increase the costs so that they represent the mid-point of construction values. These costs are presented in Volume 10, Chapter 1 - Capital Costs and Implementation Schedule. The total project cost for the liquid- and solid-stream projects described in this chapter is $228 million in August 2006 dollars.

Based on the discussion at the project meeting on March 21, 2007, it was decided that a combined project, consisting of the Plant 1 Primary Expansion, the MBR Facilities, and the Acid-Phase Digester, would be completed, instead of completing the projects separately.