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City of Oxnard

Public Works Integrated Master Plan

RECYCLED WATER

PROJECT MEMORANDUM 4.2
INFRASTRUCTURE MODELING AND ALTERNATIVES

FINAL DRAFT
December 2015

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City of Oxnard

Public Works Integrated Master Plan

RECYCLED WATER

PROJECT MEMORANDUM 4.2
INFRASTRUCTURE MODELING AND ALTERNATIVES

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INFRASTRUCTURE MODELING AND ALTERNATIVES

1.0 INTRODUCTION

The purpose of this project memorandum (PM) is to examine the City's existing and planned recycled water distribution system in light of using recycled water to provide a sustainable water supply for the City over the planning horizon, 2015 to 2040. The outcome of this analysis is used to develop the list of recycled water distribution projects to be included in the Capital Improvement Program (CIP) of the Public Works Integrated Master Plan (PWIMP) with associated project cost, timing, and drivers. The CIP is an estimate of the City's capital expenses over the next 25 years to address limitations, rehabilitation needs, and recommended improvements to the water and recycled water systems. The CIP is intended to assist the City in planning future budgets and making financial decisions.

1.1 PMs Used for Reference

The recommendations outlined in this PM are made in concert with recommendations and analyses from other related PMs:

- PM 2.5 - Water System - Supply and Treatment Alternatives.
- PM 4.1 - Recycled Water - Background Summary.

1.2 Other Reports Used for Reference

In developing the alternatives in this PWIMP, recommendations from other reports were incorporated to ensure a well-rounded and holistic look at the water and recycled water systems. The following reports are used in this PWIMP analysis:

- Plans For Phase 1 Recycled Water Backbone System Hueneme Road Recycled Water Project Specification No. PW12-13 (City of Oxnard).

2.0 EXISTING RECYCLED WATER SYSTEM

The existing recycled water distribution system consists of the Recycled Water Backbone System (RWBS) (installed by the City in their Phase 1 Recycled Water Project) that is routed from the AWPF along Ventura Road north to the River Ridge Golf Course, approximately 10 miles. In addition, a portion of the Hueneme Road pipeline (also part of Phase 1), approximately 2 miles, is routed from the AWPF with eventual connection to agricultural RW users. Recycled water is pumped from the AWPF into the distribution system by finished water pumps located at the AWPF. There is currently no recycled water storage within the system that is owned and operated by the City. Further detail on each of these facilities is summarized below.

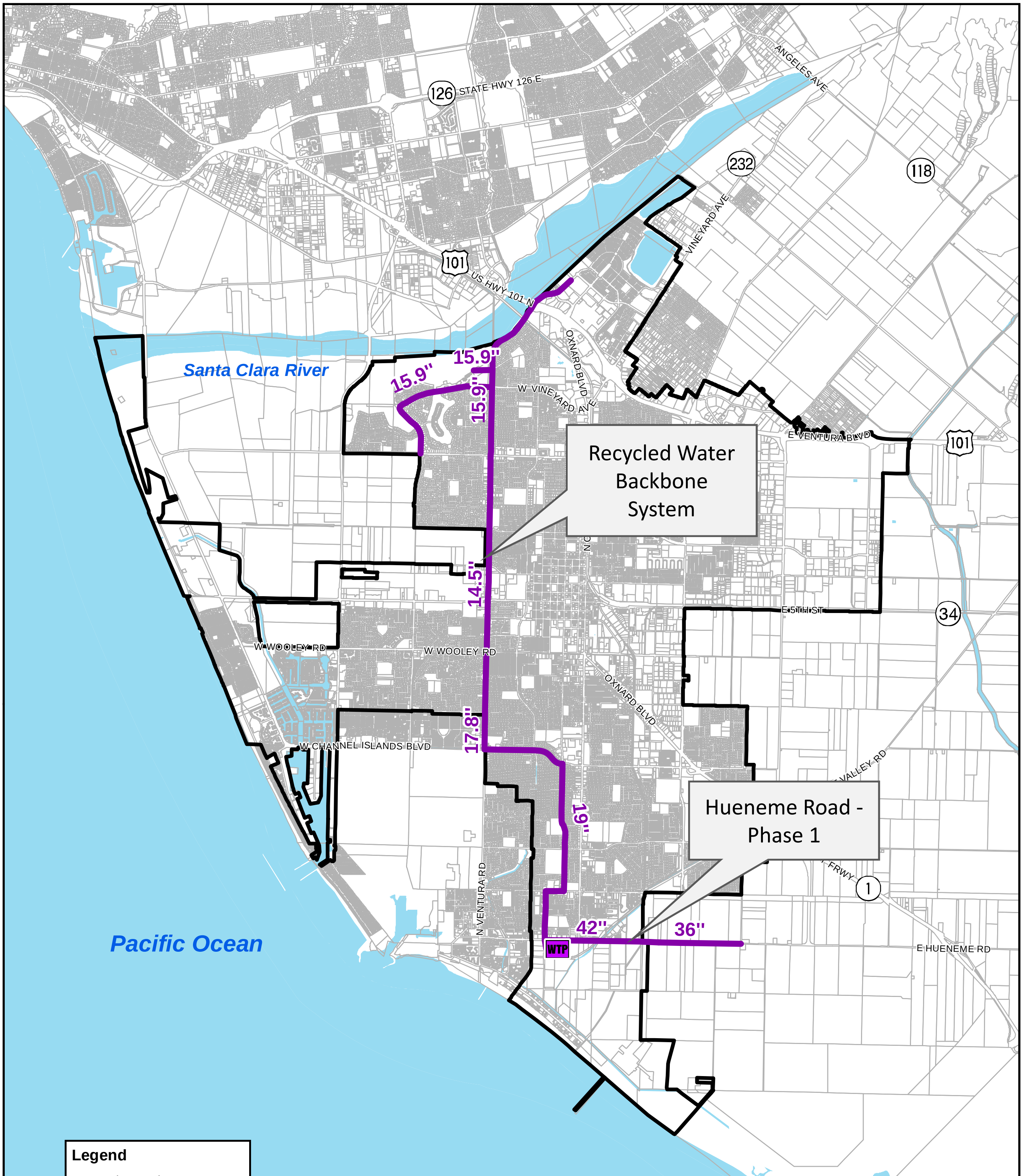
2.1 Recycled Water Backbone System (RWBS)

The RWBS pipeline consists of varied diameter pipeline segments starting from the AWPF on the corner of Hueneme Road and South J Street. At the start of the RWBS, the pipeline diameter is 19 inches. The pipeline continues up South J Street to the intersection of South J St. and W Pleasant Valley Road. At this location, the 19-inch diameter pipeline heads east to the intersection of W Pleasant Valley Road and South C Street. The pipeline continues north to the intersection of W Channel Islands Boulevard where it continues to the west, following the bend in the street. The 19-inch diameter pipeline continues until it reaches the intersection of S Ventura Road and W Channel Island Boulevard. At this location, the pipeline is reduced to a 17.8-inch diameter pipeline, and continues north for approximately 2,000 feet to the intersection of S Ventura Road and W Hemlock Street. The RWBS pipeline transitions into a 14.5-inch diameter pipeline then continues from W Hemlock, north to Gonzalez Road. Once the pipeline crosses Gonzalez Road, the pipeline's diameter increases to a 16-inch diameter PVC pipeline, which heads north to the intersection of N Ventura Road and Vineyard Avenue.

At this location, the RWBS remains a 16-inch diameter line and splits to the north and to the west. The north segment continues along the alignment of N Ventura Road until they reach the Interstate 101. Along this alignment a 2,000 section of pipeline extends to the west to serve the River Ridge Golf Course. The west segment loops down Vineyard Avenue to Patterson Road until the pipeline terminates at the intersection of Patterson Road and Gonzalez Road. Figure 1 shows the size and alignment of the existing recycled water system.

2.2 Hueneme Road – Phase 1

Based on the plans for Phase 1 Recycled Water Backbone System Hueneme Road Recycled Water Project Specification No. PW12-13, a 42 inch diameter pipeline was recently installed coming from the existing 36-inch diameter connection to the AWPF at the intersection of Hueneme Road and Perkins Road. The 42-inch diameter section of this pipeline continues to the intersection of Hueneme Road and Edison Drive. From there, a 36-inch diameter recycled water pipeline continues down Hueneme Road until the intersection at Olds Road. The Hueneme Road Phase 1 Pipeline terminates at this location, and is the starting location of the future Hueneme Road Phase 2 Pipeline. Figure 1 also shows the location of the Hueneme Road Phase 1 pipeline.



EXISTING RECYCLED WATER FACILITIES

FIGURE 1

CITY OF OXNARD

PM NO.4.2 – RECYCLED WATER DISTRIBUTION SYSTEM

PUBLIC WORKS INTEGRATED MASTER PLAN

3.0 PLANNING AND EVALUATION CRITERIA

3.1 Recycled Water Demands

Full Advanced Treatment (FAT) water demands are similar to water system demands in that they will have seasonal and/or daily variations in water use above the average day demand (ADD). Peaking conditions that are of particular significance to hydraulic analysis of the distribution system include:

- ADD:
  The ADD is the total annual production divided by number of days in the year.

- Maximum day demand (MDD):
  The MDD is the greatest water demand during a 24-hour period of the year.

- Peak hour demand (PHD):
  The PHD is the highest water demand during any 1-hour period of the year.

Irrigation demands often vary from drinking water demands in that the peak use is often over night to reduce the loss of irrigated water through evapotranspiration. A list of potential recycled water customers, their hydraulic requirements (maximum flow and minimum delivery pressure), and their diurnal demand timing is shown in Table 1. In addition to potential customers, the future planned IPR locations are also listed in Table 1. For most of the recycled water customers, their demand for water will be seasonal, peaking in the summer months, as shown in Table 1. The only exceptions to that are the New Indy Paper Company with a year-round demand of 456 gpm and the IPR operation which is expected to operate year-round as well. The RW customer demands are greater in the summer months, and therefore, there is more available water for IPR/ASR in the winter than in the summer. Figures 2 and 3 display the hourly available IPR/ASR water for Phase 1, 2, and 3 for both the summer and winter, respectively.

All of the above demands were input into the recycled water model, along with the hourly customer diurnals shown in Figures 2 and 3.

**Table 1 Potential Recycled Water Demands
Public Works Integrated Master Plan
City of Oxnard**

Phase	Location	Recycled Water Use	Required Flow (gpm)	Delivery Pressure (psi)	Daily Demand Timing
1	New Indy Paper Company	Irrigation	456	60	Constant
1	Reiter	Irrigation	1,400	60	6:00 a.m. - 6:00 p.m.
1	River Park Development	Irrigation	651	60	10:00 a.m. - 6:00 p.m.

Table 1	Potential Recycled Water Demands Public Works Integrated Master Plan City of Oxnard				
Phase	**Location**	**Recycled Water Use**	**Required Flow (gpm)**	**Delivery Pressure (psi)**	**Daily Demand Timing**
1	River Ridge Golf Course	Irrigation	1057	20[(2)]	Constant
1	Pleasant Valley County Water District Farmers	Irrigation	Remaining Phase 1 Capacity	60	When Available
2	Blending Station 1/6	IPR	8,000[(1)]	20[(3)]	Constant
2	Campus Park	IPR	6,000[(1)]	20[(3)]	Constant
2	Houweling Nursery	Irrigation	1,000	60	6:00 p.m. - 6:00 a.m.
2	Southland Sod	Irrigation	1,000	60	6:00 a.m. - 6:00 p.m.
3	Blending Station 3	IPR	8,000[(1)]	20[(3)]	Constant

Notes:
(1) There is no required amount for IPR; the required flow listed is equal to the maximum proposed capacity based on the recommended projects needed for water supply, per PM 2.5; IPR is to be maximized using excess flow after customer contracted flows are delivered.
(2) RW is pumped from on-site lake by the customer after delivery; therefore lower delivery pressures are acceptable.
(3) RW is delivered for ASR; lower delivery pressures are acceptable.

3.2 Recycled Water Supply

The recycled water supply to meet the recycled water demands noted above will come from the Advanced Water Purification Facility (AWPF). The current and planned expanded capacities of the AWPF are as follows:

- Existing (Phase 1) - 6.25 mgd (4,340 gpm).
- Phase 2 - 12.50 mgd (8,680 gpm).
- Phase 3 - 18.75 mgd (6,080 gpm).

The AWPF facility will operate, for the most part, in a constant output mode serving the average day demand for the recycled water customers with the remainder being available for IPR, as noted in the demand analysis above.

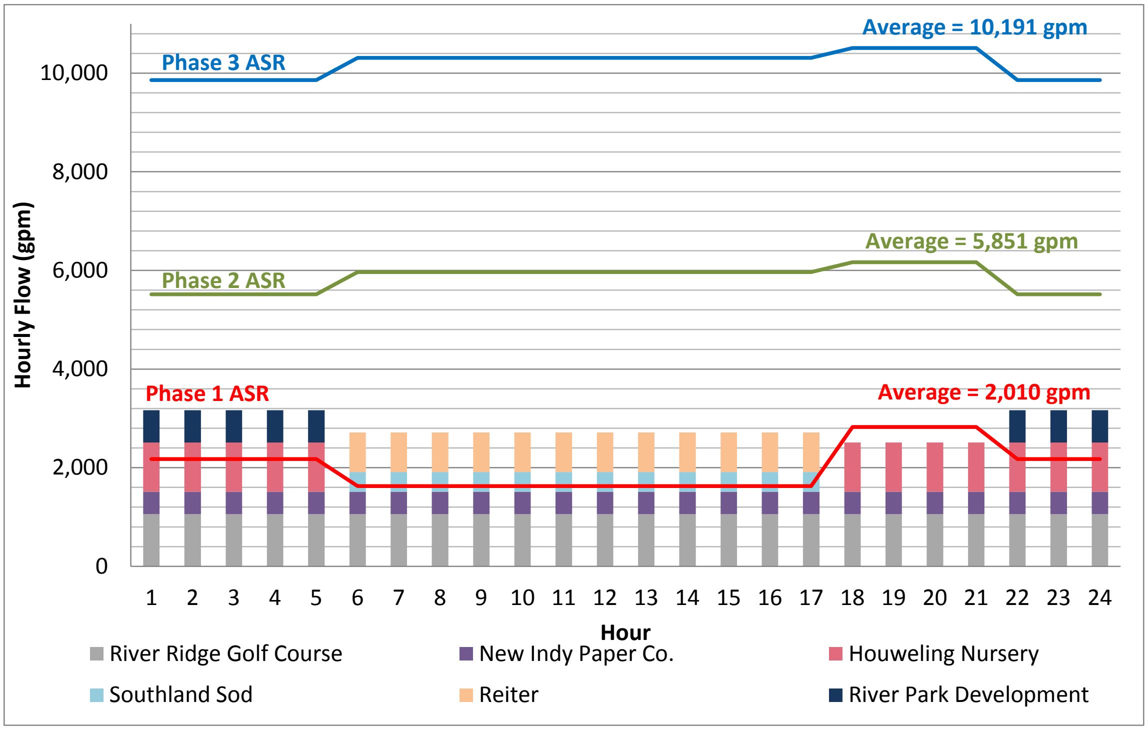


Figure 2 Summer Recycled Water Use

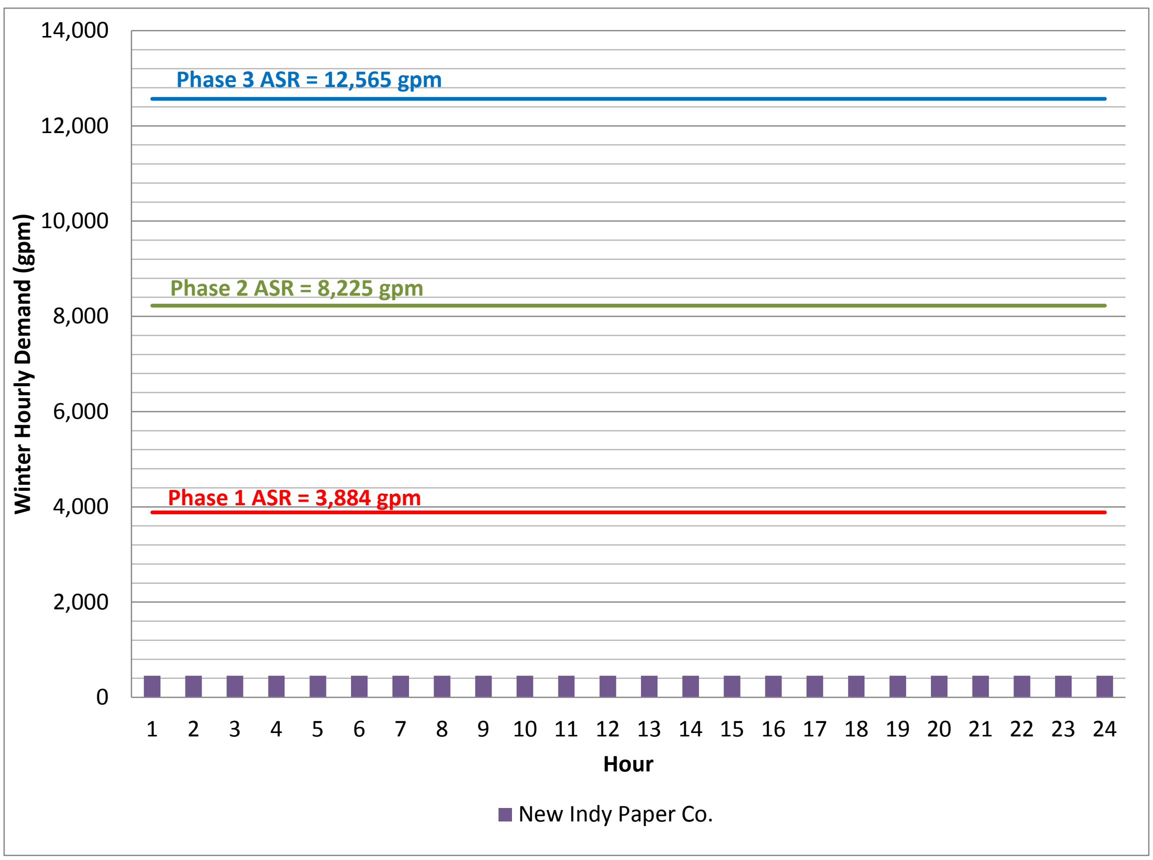


Figure 3 Winter Recycled Water Use

3.3 Distribution System Pressure and Pipeline Velocity

Pressures in the existing recycled water system will vary depending on distance from the AWPF pump station. For example, infrastructure closest to the AWPF will operate at 150 psi (close to the output pressure of the AWPF), while infrastructure farthest from the AWPF leading to the River Park Development will operate at 60 psi.

The minimum pressure requirement at each recycled water turnout varies and is typically the controlling design criteria for sizing pumping facilities and pipelines. Most irrigation customers require a minimum of 60-psi to avoid needing on-site booster pumps. The exception to this is the River Park Golf Course, which has a minimum pressure requirement of 20 psi. Because the Golf Course has an onsite storage pond accepting the recycled water, the delivery pressure required is just high enough to get the water into the pond. Customers closer to the AWPF may require a pressure reducing valve to reduce the higher delivery pressure at their location to more acceptable pressures.

In addition to pressure requirements, pipelines are sized to meet the following hydraulic criteria:

- Headloss less than 10 feet/1,000 feet of pipe.
- Velocity less than 7 feet per second.

Beyond these criteria, additional steps may be taken to reduce the potential for surge events such as increasing pipe sizes, installing slow shut valves, and looping pipe networks.

3.4 Recycled Water Pumping Facilities

For reliability purposes, it is desirable to maintain a firm pump station capacity equal to the PHD. Firm capacity is equal to the total capacity of the pump station, minus the capacity of the largest pump (in case one pump is out of service for maintenance).

3.5 Storage Requirements

Currently, there are no system-wide storage tanks in the recycled water distribution system. Some small recycled water users maintain their own on-site storage (as noted in PM 4.1), which reduces peak demand on the AWPF and the distribution system. Finished water storage was considered for the following RW operations:

- To provide operational storage for the IPR so that the ASR well pumps can operate at a consistent rate while meeting peak demands out of storage.
- To provide a decoupling and monitoring step for future direct potable reuse (DPR), as discussed further in PM 2.5.

3.5.1 Operational Storage for IPR

Operational storage is the amount required to provide the difference in quantity between the customer's peak demands and the system's firm supply capacity. Operational storage is recommended for the IPR operation. A storage tank would allow the IPR well pumps to operate at a constant rate equivalent to the average day demand.

For the purposes of this study, it was assumed that all IPR water would be extracted from the ground at a constant rate equal to 6.25 mgd. Storage sizing was determined by calculating the hourly storage accumulated throughout the day. The calculated size of the reservoir is the magnitude between the highest and lowest hourly accumulated value. In this case the minimum storage needed would be approximately 0.5 MG. For conservative planning purposes, however, it is recommended that the IPR storage tanks be sized at 1.0 MG to allow for additional operational flexibility and some emergency above ground storage. This operational storage is included in the Recommended Projects list in PM 2.5, as part of the ASR Wellfield installations. A detailed calculation of the storage analysis is presented in Appendix A.

3.6 Planning and Evaluation Criteria Summary

Table 2 summarizes all of the key planning criteria outlined for the RW system.

Table 2 RW Distribution System Design Criteria
Public Works Integrated Master Plan
City of Oxnard

Description	Value	Units
Minimum Pressure		
Recycled Water Customer	60	psi
ASR Sites (Campus Park, BS 1/6, and BS 3)	20	psi
Customer Storage Tanks/Ponds	20	psi
Maximum Pressure		
Recycled Water Customers without Pressure Regulators	90	psi
Recycled Water Customers with Pressure Regulators	150	psi
Pipeline	150	psi
Pipeline Criteria		
Maximum Velocity at PHD	7	fps
Design Velocity for New Pipelines	5	fps
Hazen-Williams C-factor	130	n/a
Minimum Size for New Pipeline s	8	inches
Head Loss for 1,000 feet of Pipeline	10	ft

4.0 EXISTING MODEL ASSESSMENT AND UPDATE

Hydraulic analysis of the City's recycled water conveyance system was performed using the Bentley WaterGEMS modeling software. WaterGEMS was developed for use in designing and analyzing complex pressurized piping systems, and includes features that facilitate hydraulic modeling, model optimization, and water quality modeling. In this case, WaterGEMS was used to replicate the City's existing and proposed recycled water system, and simulate system response to a variety of inputs and system constraints.

In WaterGEMS, each model component represents a specific aspect of the supply-demand processes occurring within the system. The model operates by reading input data files that contain parameters describing each component of the system, along with information describing how the various components work together to form the recycled water system. The result of the modeling process is a tabulation of pressure and flow conditions at desired locations within the study area.

The WaterGEMS output data was generated by the model based on the following input parameters:

- Pipeline and junction locations and elevations.
- Pump station capacities.
- Design pressure limitations.
- User demands and diurnal demand patterns.
- Pipeline diameters and lengths, materials, and friction loss coefficients.
- Valve characteristics.

These input parameters, along with other minor details describing additional components of the system, were used as the basis for computation of the supply-demand conditions within the recycled water system.

4.1 Existing Recycled Water Distribution Capacity

The WaterGems model was updated to reflect existing conditions of Oxnard's recycled water system, including up-to-date information on the AWPF, pump station, and pipelines. It was not necessary to model the processes of the AWPF and could have over complicated the hydraulic calculations in WaterGEMS. Therefore, the AWPF was modeled as a single fixed head reservoir at an elevation of 12.15 feet.

Using a fixed head reservoir to represent the AWPF allowed pumps to be activated or deactivated in the model to represent different scenarios. The existing scenario at the AWPF was modeled using a single variable speed pump as defined by the curve in

Appendix B. The dimensions and alignment of the existing RWBS and Hueneme Road Phase 1 pipelines were verified and updated in the existing model Phase 1 Scenarios.

The maximum flows available as well as delivery pressures at key locations in the recycled system under these existing conditions are presented below in Table 3. These flows and pressures adhere to the criteria established previously in Table 2.

Table 3 Existing System Maximum Hydraulic Analysis
Public Works Integrated Master Plan
City of Oxnard

Location	Maximum Available Flow (gpm)(1)	Delivery Pressure (psi)
Intersection of Patterson Road and Gonzalez Road	1,100	68
New Indy Paper Company	3,280	135
Pleasant Valley County Water District Farmers	2,830	78
Reiter	2,830	78
River Park Development	1,750	60
River Ridge Golf Course	2,500	65

Note:
(1) Maximum flow and delivery pressure given the existing system conditions (Phase 1 conditions).

Comparing the maximum flow available and the delivery pressure in Table 3 with the required flow and minimum pressures in Table 1 suggests that the existing system is adequately sized to meet the existing recycled water customer needs under the established design criteria.

In modeling the Hueneme Road Phase 1 pipeline, the maximum capacity and pressure that can be delivered, using the criteria established in Table 2, is 15,000 gpm at 60 psi. This is much greater than the 5,200 AFY (3,220 gpm) required by the agriculture customers the pipeline will serve. It should be noted that the agriculture customers will temporally be served water from the Ocean View Pump Station, via the SMP Pipeline, until the second phase of the Hueneme Road Pipeline is built. Once this pipeline is built the main pumps at the AWPF and the Phase 2 will begin operation as described in Section 4.3.

4.2 Build-Out Recycled Water Distribution Capacity

PM 2.5, Water System – Supply and Treatment Alternatives, made several recommendations regarding future water supply needs which included improvements and additions to the recycled water distribution system in order to accommodate those projects. To model the improvement/additions needed for the recommended water supply projects from PM 2.5, the following adjustments were made to the model:

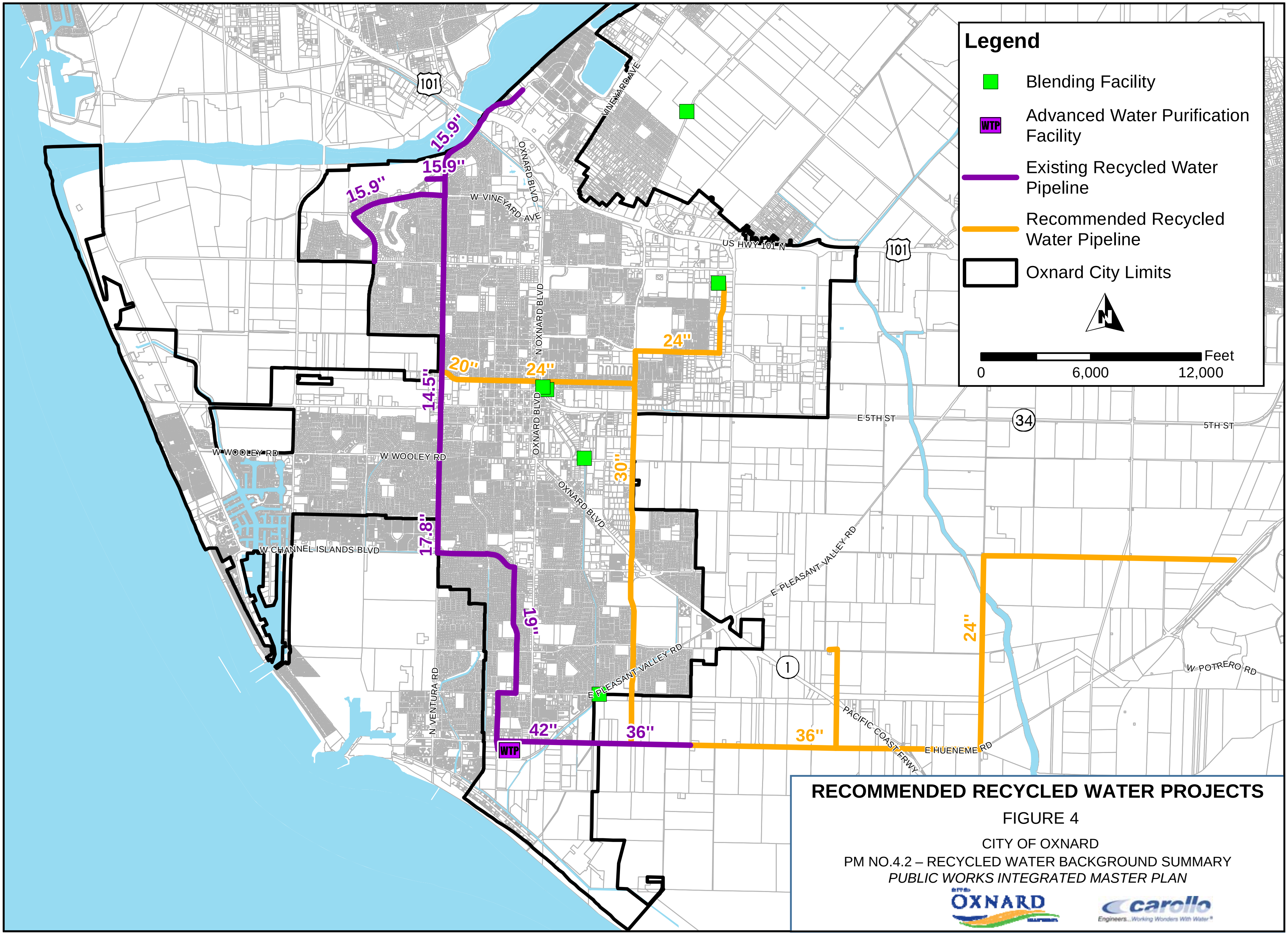
- The AWPF will supply up to 18.75 mgd of recycled water; hence, the recycled water model was adjusted by activating two additional pumps with the same properties as the pump station described in Section 4.11 of this PM.
- Three major pipeline additions were included:
  - The Hueneme Road Phase 2 pipeline;
  - The Recycled Water (RW) Loop, which connects the RWBS to Blending Station (BS) No. 1/6; and
  - The connection between the RW Loop and BS No. 3.

These planned pipeline projects are described below and presented in Figure 4. Additionally, the hydraulic modeling results of the future recycled water projects are tabulated in Table 4.

Table 4 Future System (2040) Maximum Hydraulic Analysis
Public Works Integrated Master Plan
City of Oxnard

Location	Maximum Required Flow (gpm)(1)	Delivery Pressure(2) (psi)
BS No. 1/6 (ASR)	8,000	116
BS No. 3 (ASR)	8,000	95
Campus Park (ASR)	6,000	123
Houweling Nursery	1,000	122
New Indy Paper Company	456	150
Reiter	800	133
PVWCD Farmers	(3)	
River Park Development	651	117
River Ridge Golf Course	1,057	122
Southland Sod	400	147

Note:
(1) Maximum flow is based on ultimate projects planned for build out as recommended in PM 2.5 (through 2040).
(2) Delivery pressure is estimated by the model based on maximum flow requirements and system conditions.
(3) RW flow is variable based on what RW is remaining after RW is supplied to the users already designated in the City's User Agreement (for details, see Appendix F in PM 4.1) and City uses. The maximum that would ever be conveyed through the Hueneme Road Pipeline is 5,200 AFY.



RECOMMENDED RECYCLED WATER PROJECTS

FIGURE 4

CITY OF OXNARD
PM NO.4.2 – RECYCLED WATER BACKGROUND SUMMARY
PUBLIC WORKS INTEGRATED MASTER PLAN

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4.3 Hueneme Road – Phase 2

The Hueneme Road Phase 2 Pipeline is planned to convey RW to the agricultural users east of the City. This planned pipeline will replace the temporary SMP Pipeline as the main supply source to the RW users of Hueneme Road.

The Phase 2 pipeline's alignment starts at the terminus of the Hueneme Road Phase 1 Pipeline, at the intersection of Hueneme Road and Olds Road. This 36-inch diameter pipeline continues east down Hueneme Road for 3.0 miles, to Wood Road. At this point, the pipeline transitions to a 24-inch diameter pipeline, and heads north on Wood Road until the intersection of Wood Road and Laguna Road. The 24-inch diameter pipeline then heads east on Laguna Road for approximately 15,000 feet where it terminates just before Lewis Road. The proposed alignment of this pipeline can be seen in Figure 4. Based on PM 2.5, the Hueneme Road Phase 2 pipeline will supply an agricultural demand to the farmers of up to 5,200 AFY or 3,225 gpm depending upon availability of RW supply.

4.4 RW Loop

The RW loop will be used to feed the various proposed ASR locations at Campus Park and BS Nos. 1/6 and 3. There will need to be an extension from the RW loop to BS No. 3. The RW Loop starts off with the existing 14.5-inch diameter pipeline at the intersection of S Ventura Road and W 2nd Street. From this location, a 20-inch diameter pipeline continues east down W 2nd Street to the Campus Park ASR Facility. The pipeline increases in diameter to a 24-inch diameter pipeline and continues past Campus Park and into BS No. 1/6. Once past BS No. 1/6 the 24-inch diameter pipeline continues down E 2nd Street until the intersection at N Rose Avenue. At this location, the pipeline splits into a pipeline that runs up N Rose Avenue to BS No. 3, and it splits to the South to complete the loop. The pipeline that runs to the south is a 30-inch diameter pipeline that continues southbound on N Rose Avenue until it connects to the existing 36-inch diameter Hueneme Road Pipeline.

The pipeline that heads to BS No. 3 is a 24-inch diameter line that starts from the 30-inch diameter pipeline at the intersection of E 2nd Street and N Rose Avenue. This pipeline continues north N Rose Avenue then East on Camino Del Sol then north on N Rice Avenue. The pipeline heads up N Rice Avenue until the centerline of Wankel Way where the 24-inch diameter pipeline heads east until it terminates at BS No. 3.

There are three major facilities being supplied by the RW loop. These three facilities are Campus Park, BS No. 1/6, and BS No. 3. The locations of each of these facilities as well as the RW Loop alignment are shown on Figure 4. Table 4 indicates, based on the results of the hydraulic analysis, that the RW Loop is sized with adequate capacity to meet future required flows with some capacity buffer.

4.5 Interim Phase Capacity Analysis

The recycled water model was also run to consider the interim Phase 1, 2, and 3 conditions (as proposed in PM 2.5 for implementation of Recommended Projects) for both summer and winter scenarios to ensure the criteria established in Table 2 was met after each phase. Table 5 summarizes how Phase 1, 2 and 3 were built into the model. The diurnal demands for summer and winter are shown in Figures 2 and 3, respectively, for the three phases. The results of the model analysis are presented in Table 6.

Table 5 Phase 1, 2, and 3 Recycled Water Modeling Scenarios
Public Works Integrated Master Plan
City of Oxnard

Phase	Model Topology Additions(1)	AWPF Flow (mgd)
Phase 1	• Hueneme Road Phase 2 Pipeline • Pipeline from RWBS to Campus Park • Pipeline from Campus Park to BS #1/6	6.25
Phase 2	• Complete Pipeline for RW Loop	12.50
Phase 3	• N/A	18.75

Note:
(1) Additions are to the existing recycled water described in Section 4.1; each additional Phase includes the addition of the Previous Phases.

The results of the hydraulic analysis, seen in Table 6, confirm the proposed recycled water distribution system when built out (all improvements completed through 2040) are adequate to provide the required flows to RW customers and IPR sites, as noted in Table 1. However, until the RW Loop is completed in Phase 2, the required flow cannot be delivered to Campus Park and River Ridge Development while meeting the minimum pressure requirement largely due to the 14.5-inch segment in the RWBS. Additionally, under these demand conditions, the 14.5-inch diameter pipeline along South Ventura Road exceeds the maximum velocity of 7.0 feet per second. This pipeline is the bottle neck in the RWBS and the cause for lack of available pressure at north end of the RW system under Phase 1 conditions. Once the RW Loop is complete, the lower pressures in the north of the system are projected to be resolved.

The maximum flow that can pass through the 14.5-inch diameter pipeline along South Ventura Road is 3,600 gpm. It is recommend that the quantity of ASR water in Phase 1 be reduced to ensure flow through this pipeline doesn't exceed 3,600 gpm. This results in an average summer ASR demand of 1,650 gpm, and an average winter ASR demand of 3,600 gpm. The results of this analysis may require a shift in the order in which ASR wells are added to the system and may necessitate an earlier completion of the RW Loop should potable water demands rise to the point that additional water supply is needed sooner rather than later.

Table 6 Interim Implementation Phase Hydraulic Analysis
Public Works Integrated Master Plan
City of Oxnard

Season	Summer						Winter					
Phase	**Phase 1**		**Phase 2**		**Phase 3**		**Phase 1**		**Phase 2**		**Phase 3**	
Location	**Daily Demand (gpm)**	**Minimum Delivery Pressure (psi)**	**Daily Demand (gpm)**	**Delivery Pressure (psi)**	**Daily Demand (gpm)**	**Delivery Pressure (psi)**	**Daily Demand (gpm)**	**Delivery Pressure (psi)**	**Daily Demand (gpm)**	**Delivery Pressure (psi)**	**Daily Demand (gpm)**	**Delivery Pressure (psi)**
Blending Station 1/6(1)	n/a	69	1,750	111	3,197	96	n/a	58	2,742	109	4,188	93
Blending Station 3(1)	n/a	n/a	1,750	136	3,197	90	n/a	n/a	2,742	102	4,188	86
Campus Park(1)	1,634	62	1,750	113	3,197	113	3,600	61	2,742	111	4,188	95
Houweling Nursery	n/a	n/a	1,000	130	1,000	104	n/a	n/a	0	131	0	126
Patterson Road and Gonzalez Road	0	65	0	100	0	85	0	60	0	109	0	93
New Indy Paper Company	456	138	456	138	456	138	456	138	456	138	456	138
Reiter	800	n/a	800	116	800	105	0	n/a	0	115	0	104
River Park Development	651	60	651	88	651	73	0	49	0	106	0	83
River Ridge Golf Course	1,057	62	1,057	96	1,057	81	0	57	0	108	0	90
Southland Sod	400	62	400	135	400	130	n/a	n/a	0	135	0	130

Note:
(1) Flows at ASR locations are split evenly among available ASR site in each phase. ASR flows for summer and winter come from Figures 2 and 3, respectively.

5.0 RECOMMENDED PROJECTS PRIORITY, COSTS AND SCHEDULE

Based on the analysis presented above, cost estimates, implementation priority, and schedule were developed for the recommended recycled water distribution projects. This information will be included in the overall Capital Improvement Program (CIP) and used as the basis for the financial analysis portion of the PWIMP to determine financial impact of the project to the City and its rate payers.

The main driver for the recycled water distribution projects is to convey additional recycled water either to additional non-potable irrigation users or to IPR/ASR sites for water supply use.

5.1 Cost, Priority and Schedule Summary

The Recycled Water Distribution System project costs are presented in Table 7 and are based on the preliminary layouts, sizing and configuration noted. Project costs are estimated based on unit costs developed from estimating guides, equipment manufacturer's information, unit prices and construction costs of similar facilities and other locations. A more detailed discussion of the basis of costs is included in PM 1.4, *Basis of Cost*.

The driver is noted next to each project along with their anticipated start year and length of project completion. The projects are categorized by priority which loosely also follows timing of the projects: 1) Phase 1 – Immediate needs (First 2 years); 2) Phase 2 – Near-Term Needs (Years 2 – 10); and 3) Phase 3 – Long-Term Needs (Beyond 10 years).

The overall prioritized project costs are summarized in Table 8. PM 2.5, *Supply and Treatment Alternatives* includes an overall schedule for completion of the water supply, treatment and distribution projects.

The costs and timing presented in this PM represent Carollo's best professional judgment of the capital expenditure needs of the City and of the timing needed to maintain a reliable and compliant system that can meet current and future water demands and wastewater generation needs. Timing of the projects was set to align with the seven master plan drivers, namely: R&R, regulatory requirements, economic benefit, performance benefit, growth, resource sustainability, and policy decisions. Project timing is also based on input from City staff and the condition assessments performed.

Though the costs developed in this PM match the costs analyzed as part of the Cost of Service (COS) Study (Carollo, 2015), the timing presented may differ. The COS Study will balance not only the CIP projects identified but also the rates and rate payer affordability based on a yearly balance along with the integrated costs for the different City funds and enterprises.

Table 7 Recommended Capital Improvement Projects for Recycled Water Distribution System[1]
Public Works Integrated Master Plan
City of Oxnard

Project Name	Driver	Start Year	Years to Implement	Un-escalated Project Cost ($)
Phase 1				
Connect Initial ASR Well at Campus Park to RWBS Line in Ventura Road - 2,000 feet of 20" pipe[2]	Water Supply	2015	2	$700,000
Construct Dedicated IPR Pipeline from Campus Park to BS 1/6 - 4,000 feet of 24" pipe[2]	Water Supply	2015	2	$2,500,000
		Phase 1 TOTAL:		**$3,200,000**
Phase 2				
Hueneme - Phase 2 (to Ag Users)	Water Supply	2016	2	
20,700 feet of 24" pipe				$12,900,000
16,000 feet of 36" pipe				$12,500,000
Recycled Water Loop (to ASR Sites)	Water Supply	2018	2	
9,000 feet of 24" pipe				$7,500,000
19,700 feet of 30" pipe				$10,200,000
		Phase 2 TOTAL:		**$43,100,000**
Phase 3				
DPR - 3, 3.1 MG Storage Tanks	Water Supply	2034	3	$22,200,000
Recycled Water Loop to BS 3 Connection – 10,600 feet of 24” pipe	Water Supply	2027	1	$5,500,000
		Phase 3 TOTAL:		**$27,700,000**

Notes:
(1) 20-City Average Index ENR CCI of 9,962 was used for February 2015. A R.S. Means Location Factor of 106.6 for Oxnard was used.
(2) Project associated with ASR Demonstration Well installation and is described in detail in PM 2.5, *Water System - Supply and Treatment Alternatives*.

Table 8	Overall Project Costs[1] Public Works Integrated Master Plan City of Oxnard
Phase	**Total Phase Cost**
1	$3.2 M
2	$43.1 M
3	$27.7 M
Total	**$74.0 M**

Notes:
(1) 20-City Average Index ENR CCI of 9,962 was used for February 2015. A R.S. Means Location Factor of 106.6 for Oxnard was used.

APPENDIX A – IPR STORAGE SIZING TO OFFSET POTABLE WATER

PM 4.2 Appendix A - Storage sizing to offset potable water

Diurnal Curve

Time	Peaking Factor	Phase 1 Demand (MG)
1:00 AM	0.92	0.24
2:00 AM	0.90	0.24
3:00 AM	0.77	0.20
4:00 AM	0.61	0.16
5:00 AM	0.55	0.14
6:00 AM	0.74	0.19
7:00 AM	1.06	0.28
8:00 AM	1.12	0.29
9:00 AM	1.08	0.28
10:00 AM	1.16	0.30
11:00 AM	1.20	0.31
12:00 PM	1.10	0.29
1:00 PM	1.02	0.27
2:00 PM	1.09	0.28
3:00 PM	1.00	0.26
4:00 PM	1.07	0.28
5:00 PM	1.03	0.27
6:00 PM	1.13	0.29
7:00 PM	1.22	0.32
8:00 PM	1.30	0.34
9:00 PM	1.12	0.29
10:00 PM	1.07	0.28
11:00 PM	0.92	0.24
12:00 AM	0.81	0.21
Average	**1.00**	**0.26**

Notes:

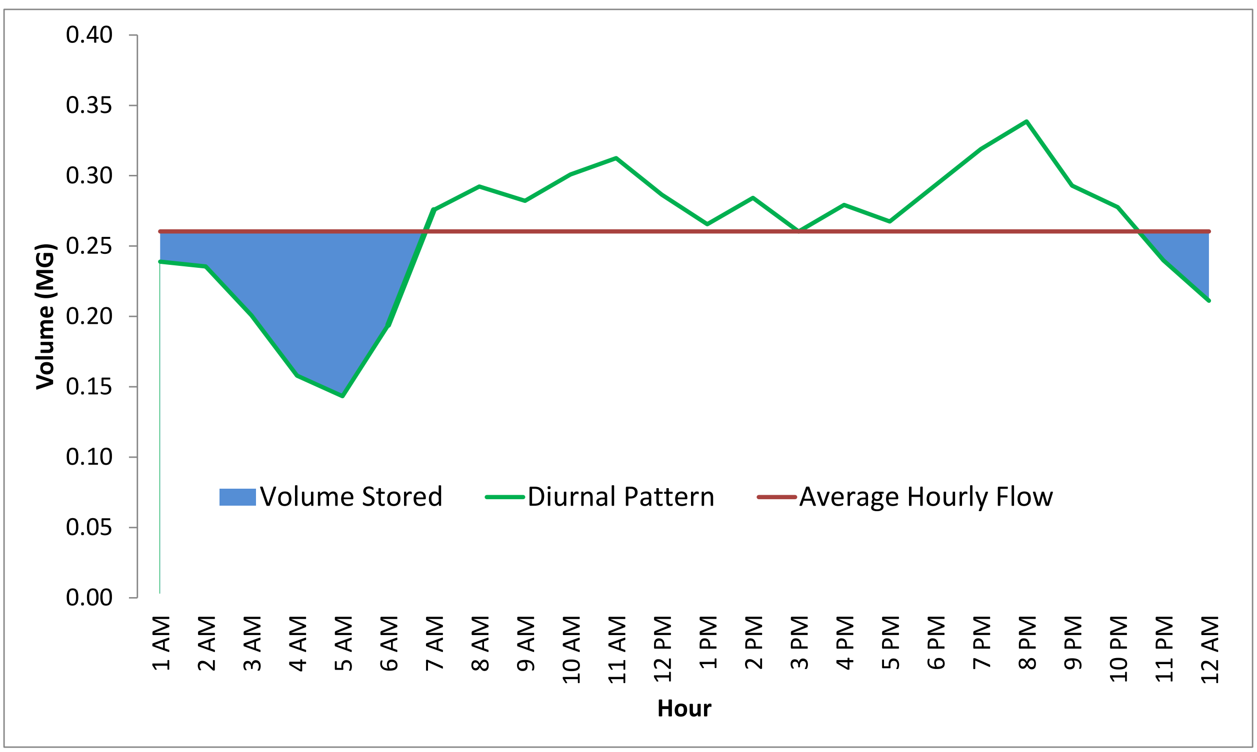
1) This diurnal curve comes from the updated calibrated model

Reservoir Sizing

Time	Inflow (MG)	Outflow (MG)	Storage (MG)	Accumulated Storage (MG)
1:00 AM	0.26	0.24	0.02	0.02
2:00 AM	0.26	0.24	0.02	0.05
3:00 AM	0.26	0.20	0.06	0.11
4:00 AM	0.26	0.16	0.10	0.21
5:00 AM	0.26	0.14	0.12	0.33
6:00 AM	0.26	0.19	0.07	0.39
7:00 AM	0.26	0.28	-0.02	0.38
8:00 AM	0.26	0.29	-0.03	0.34
9:00 AM	0.26	0.28	-0.02	0.32
10:00 AM	0.26	0.30	-0.04	0.28
11:00 AM	0.26	0.31	-0.05	0.23
12:00 PM	0.26	0.29	-0.03	0.20
1:00 PM	0.26	0.27	-0.01	0.20
2:00 PM	0.26	0.28	-0.02	0.18
3:00 PM	0.26	0.26	0.00	0.18
4:00 PM	0.26	0.28	-0.02	0.16
5:00 PM	0.26	0.27	-0.01	0.15
6:00 PM	0.26	0.29	-0.03	0.12
7:00 PM	0.26	0.32	-0.06	0.06
8:00 PM	0.26	0.34	-0.08	-0.02
9:00 PM	0.26	0.29	-0.03	-0.05
10:00 PM	0.26	0.28	-0.02	-0.07
11:00 PM	0.26	0.24	0.02	-0.05
12:00 AM	0.26	0.21	0.05	0.00
Max	**0.26**	**0.34**	**0.12**	**0.39**
Min	**0.26**	**0.14**	**-0.08**	**-0.07**

Minimum Required Volume (MG) = **0.39 - -0.07 =** **0.46**

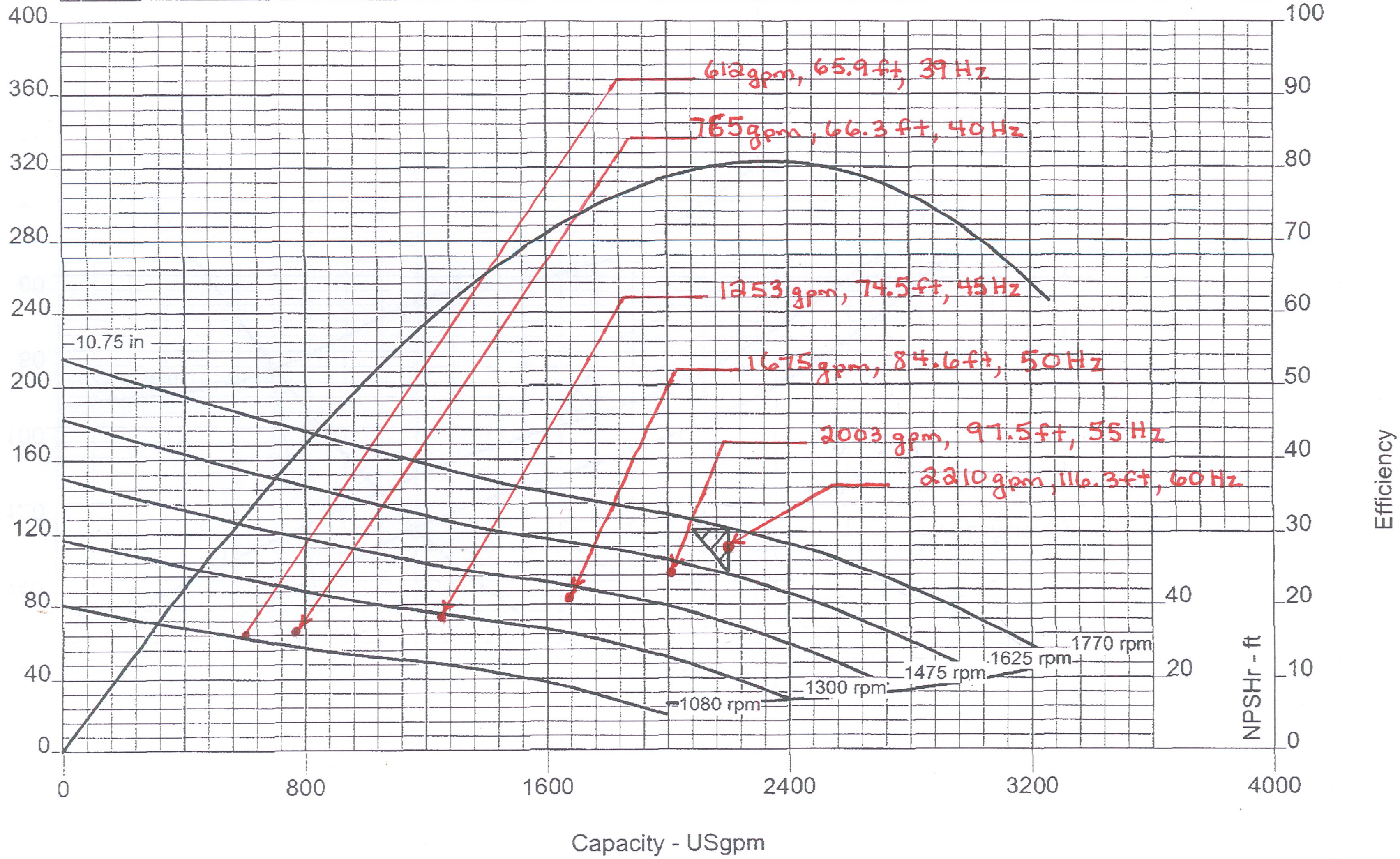
Storage Analysis



APPENDIX B – RECYCLED WATER PUMP CURVES

PM 4.2 Appendix B - Ocean View Pump Curve

Pump size & type 14ENL		Flowserve Pump Division		Curve number EC-2336	
Capacity	: 2200.0 USgpm	Specific gravity	: 0.997	Stage(s)	: 2 ← 2 stage installation
Head	: 121.5 ft	Running speed	: 1770 rpm	Date	: Jul 12, 2010



AWPF - Finish Water Pump No. 6
Field performance readings
flow / discharge pressure / speed
August 26, 2015

K. Hume

PM 4.2 Appendix B - AWPF Pump Curve

Pump size & type 16ENH	Flowserve Pump Division		Curve number EC-1822
Capacity : 4000.0 USgpm	Specific gravity : 0.997		Stage(s) : 5
Head : 360.0 ft	Running speed : 1770 rpm		Date : Jul 08, 2010