North Bay Water Reuse Authority

North Bay Water Reuse Program
Phase 2 Scoping Study Summary Report

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BRYANT & ASSOCIATES
Strategies & Solutions for Water Resources

NORTH BAY WATER REUSE PROGRAM
Expanding Water Supplies with Regional Reuse

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List of Abbreviations

ADWF	average dry weather flow
AF	acre-feet
AFY	acre-feet per year
ASR	aquifer storage and recovery
AWWF	average wet weather flow
BARWRP	Bay Area Regional Water Recycling Program
BHP	peak brake horsepower
Board	Board of Directors
CCI	Construction Cost Index
CEQA	California Environment Quality Act
CMSA	Central Marin Sanitation Agency
DAC	disadvantaged community
DWR	California Department of Water Resources
EIR/EIS	Environmental Impact Report/Environmental Impact Study
EJ	environmental justice
ENR	Engineering News Record
ET_O	evapotranspiration rate
ft	feet
gpd	gallons per day
HP	horsepower
I&I	inflow and infiltration
in	inch
Interior	U.S. Department of the Interior
IRWM	Integrated Regional Water Management
K_C	crop coefficient
LF	linear foot/linear feet
LGVSD	Las Gallinas Valley Sanitary District
MG	million gallons
mgd	million gallons per day
MMWD	Marin Municipal Water District
MOU	Memorandum of Understanding
MST	Milliken-Sarco-Tulocay
MWD	North Marin Water District
Napa SD	Napa Sanitation District
NBWRA	North Bay Water Reuse Authority
NBWRP	North Bay Water Reuse Program
NEPA	National Environmental Policy Act
Novato SD	Novato Sanitary District
NWPRR	Northwest Pacific Railroad
Program	North Bay Water Reuse Program
Reclamation	U.S. Bureau of Reclamation
SASM	Sewerage Agency of Southern Marin
SCWA	Sonoma County Water Agency
SVCSD	Sonoma Valley County Sanitation District
TAC	Technical Advisory Committee
TBD	to be determined

Title XVI	Title XVI Water Reclamation and Reuse
TWM	Total Water Management
UV	ultraviolet
WaterSMART	Sustain and Manage America's Resources for Tomorrow
WRF	Water Recycling Facility
WWTP	wastewater treatment plant

Executive Summary

The North Bay Water Reuse Authority's (NBWRA) Phase 2 Scoping Studies have been conducted to assist the Member Agencies in determining whether to proceed with feasibility-level engineering analysis, environmental documentation, and financial analysis for Phase 2 of the North Bay Water Reuse Program (NBWRP or Program). The NBWRA Member Agencies are Marin Municipal Water District (MMWD), Marin County, Las Gallinas Valley Sanitary District (LGVSD), North Marin Water District, Novato Sanitary District (Novato SD), City of Petaluma, Sonoma Valley County Sanitation District (SVCSD), Sonoma County Water Agency (SCWA), Napa Sanitation District (Napa SD), and Napa County.

ES.1 Scoping Study Process Overview

The NBWRA initiated Phase 2 Scoping Studies to explore, at a conceptual level, how to build on the NBWRP's Phase 1 success to further develop additional water supplies, therefore expanding water supply and management opportunities in the region. Although the Scoping Studies were conducted by the NBWRA, the process was developed with input and financial assistance from the U.S. Bureau of Reclamation (Reclamation) Mid-Pacific Region.

The three scoping studies included the following:

Membership and Outreach

The Membership and Outreach Study investigated additional agencies interested in joining the NBWRA and participating in the Scoping Studies.

Project Definition

The Project Definition Scoping Study provided preliminary information on the potential projects and costs of Phase 2 program construction and the potential scope to complete feasibility studies and environmental analysis.

New User Assessment and Multi-Purpose Storage Scoping Study and Scoping Studies Summary Report

This final Scoping Study focuses on the development and use of recycled water, and other water management options, from a regional-scale perspective – how can this resource best meet community priorities, reflect local values, and significantly contribute toward water supply reliability in the North Bay. The Scoping Study Summary Report documents the NBWRA Member Agencies' decisions regarding their proposed projects to be studied and used to formulate a regional program at a Reclamation Feasibility Study Level.

Using the outcomes from the Scoping Studies, the NBWRA has a clear set of objectives and criteria supported by a solid understanding of the diversity of projects to be addressed in the next level of investigations. The Phase 2 Feasibility Study will identify the most feasible, resilient new water supply alternatives for the region by using valuable resources that would otherwise be underutilized.

ES.2 Final Scoping Study Process

The NBWRA used a transparent decision making process to consider members' priority projects and to narrow down to a select group of candidate projects to be analyzed in future Feasibility Study investigations. In a workshop process, the NBWRA's Board of Directors and Technical Advisory Committee developed the specific NBWRP objectives and identified the projects to be addressed. The workshop schedule and topics addressed are summarized below.

Workshop #1 – January 2013

- Define objectives and criteria for Phase 2 projects
- Present workplan
- Agency commitment to workplan

Workshop #2 – March 2013

- Review objectives and criteria for approval
- Discuss potential multi-purpose storage concepts

Workshop #3 – May 2013

- Present projects and storage requirements
- Discuss the path forward to selection

Workshop #4 – August 2013

- Present list of potential projects
- Project conceptual layouts

Workshop #5 - November 2013

- Review project screening and prioritization
- Board to provide direction on project

Workshop #6 – January 2014

- Presentation of draft findings

Workshop #7 – April 2014

- Presentation of Draft Scoping Studies Summary and Recommendations

The Program activities and report were directly linked to and provided input into the workshops, as shown in Figure ES-1.

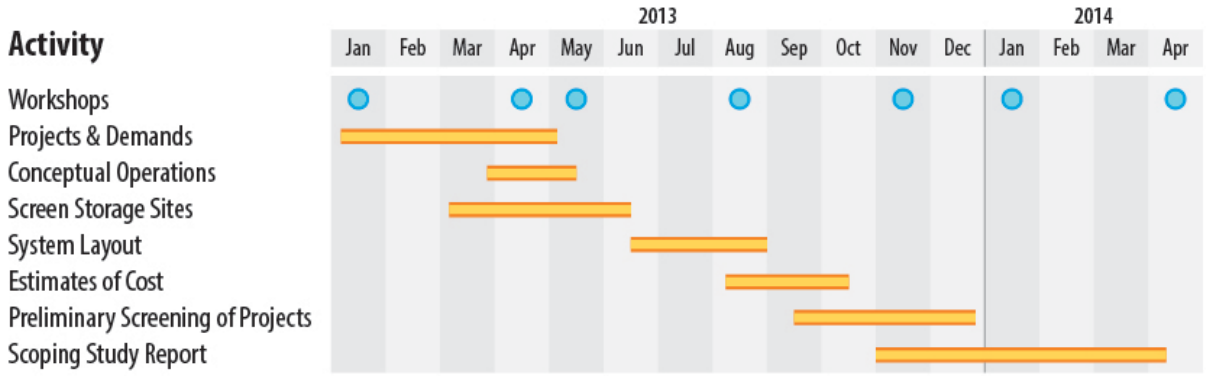

Figure ES-1
Phase 2 Workshop Process

ES.3 Program Objectives

Phase 2 Program objectives were developed and in turn used to guide the selection of projects for further study. At the Scoping Study level, the objectives assist in formulating conceptual thematic alternatives comprised of the potential projects identified by the NBWRA Member Agencies. In the next level of analysis, the Feasibility Study, alternatives will undergo screening, reformulation, and evaluation as more detailed layouts and costs are developed. The future Feasibility Study will also expand the primary objectives to define how to measure success of an alternative against the objectives.

The NBWRA used the Scoping Study workshop process to develop objectives for Phase 2. As a starting point, the NBWRA Member Agencies reviewed the Program's objectives from Phase 1 and the Memorandum of Understanding to align them with those of potential Federal and State funding program criteria that could assist with project implementation. This provided a basis in which to consider projects that provided multiple benefits, maximized the value of the water resource, and set a standard for future Federal, State, and local investment in the North Bay.

Table ES-1 illustrates the relationship between the Program's Phase 1, Reclamation, and California Department of Water Resources (DWR) Integrated Regional Water Management (IRWM) Plan objectives and criteria.

Table ES-1. Objectives that Influence Program Implementation

Phase 1 NBWRP Study	Bureau of Reclamation	DWR (IRWM Plan)
Offset urban and agricultural demands on potable water supplies	Increase water supplies and reduce demand on non-recycled water supplies	Address multiple goals
Improve local and regional water supply reliability	Address water supply sustainability	Integrate multiple resource management strategies
Give top priority to local needs for recycled water	Complete authorized Title XVI projects	Strategic considerations for IRWM Plan implementation (regionalism, partnerships and integration)
Enhance local and regional ecosystems	Promote projects that are ready to proceed	Project status

Table ES-1. Objectives that Influence Program Implementation

Phase 1 NBWRP Study	Bureau of Reclamation	DWR (IRWM Plan)
Maintain and protect public health and safety	Improve habitat and water quality	Technical feasibility
Promote sustainable practices	Incorporate use of renewable energy and promote energy efficiency	Benefits to disadvantaged community water issues
Implement recycled water facilities in an economically viable manner	Implement cost effective projects	Benefits to Native American tribal community water issues
	Meet legal and contractual water supply obligations	Environmental justice considerations
	Provide benefits to rural or economically disadvantaged communities	Project costs and financing
	Promote a watershed perspective/integrated resources management	Economic feasibility
		Climate change adaptation
		Reduce greenhouse gas emissions
		Reduce dependence on the Delta

These objectives were compared and aggregated to develop final Phase 2 Program Objectives, presented in Table ES-2. The goal was to develop Phase 2 Program Objectives compatible with criteria (objectives) of the NBWRA Member Agencies, as well as those of the potential implementation funding sources.

Table ES-2. NBWRP Phase 2 Program Objectives

Objective	Subobjective
Improve Regional Water Supply	▪ Improve local, regional, and state water supply reliability ▪ Address impaired groundwater basins ▪ Offset demands on potable water supplies ▪ Maintain and protect public health and safety ▪ Reduce dependence on the Delta
Sustainability	▪ Incorporate use of renewable energy and promote energy efficiency ▪ Address climate change adaptation ▪ Reduce greenhouse gas emissions
Watershed Approach	▪ Incorporate multiple agencies and stakeholders ▪ Address multiple resources management strategies
Economic Feasibility & Financial Viability	▪ Cost effectiveness ▪ Financially implementable projects
Readiness to Proceed	▪ Ability to start design ▪ Ability to start construction
Environmental Enhancement	▪ Enhance local and regional ecosystems ▪ Improve water quality for habitat ▪ Improve instream flows for aquatic life
Social Issues	▪ Provide benefits to rural or economically disadvantaged communities ▪ Address environmental justice considerations ▪ Enhance recreation and open space opportunities ▪ Maintain agricultural industry and culture

ES.4 Available Water Supply

The combined recycled water supply available in the NBWRA area for Phase 2 is the sum of all net supplies from the NBWRA Member Agencies. Table ES-3 summarizes the total available recycled water supply for Phase 2 by month. The total available annual recycled water supply for Phase 2 is 25,314 acre-feet per year (AFY), or 8,243 million gallons per year (MG/year).

The monthly available recycled water supplies are at their lowest during the summer irrigation demand period. The supply during June, July, and August represents six percent of the annual flow; therefore, to meet future summer demands, storage becomes a key element of the Phase 2 program.

Table ES-3. Projected Monthly and Annual Phase 2 Recycled Water Supplies

Month	Available Phase 2 Recycled Water Supplies	
	Million Gallons (MG)	Acre-Feet (AF)
January	1,074	*3,299*
February	923	*2,833*
March	1,165	*3,574*
April	915	*2,807*
May	571	*1,752*
June	178	*546*
July	115	*356*
August	201	*619*
September	397	*1,218*
October	657	*2,018*
November	746	*2,291*
December	1,301	*4,001*
Total	**8,243**	***25,314***

Phase 2 was developed to provide a broad range of water management projects. Besides recycled water, the projects encompass additional water supply sources from groundwater management and runoff capture in Marin and Sonoma Counties. These projects include groundwater management and recharge using stormwater flows in the Sonoma Valley basin and the Petaluma River watershed, groundwater banking of Russian River winter flows in Sonoma Valley, and runoff capture, treatment, and reuse in the Terra Linda area of Marin County. The amount of additional water supply available through these projects has not yet been determined and will be evaluated in more detail in the Feasibility Study.

ES.5 Potential Storage Needs

Table ES-4 presents the potential amount of seasonal, recycled water storage anticipated for each recycled water-producing NBWRA Member Agency if all of the Phase 2 Projects identified in this study were implemented (see Section 3 for all projects identified through this Scoping Study). This analysis provides a potential estimate of the amount of recycled water storage that may be necessary for Phase 2. Further analysis in the Feasibility Study will refine the operations and storage analysis for the final Phase 2 alternatives.

Table ES-4 indicates that approximately 6,161 AF of additional storage is needed area-wide to serve the water demands associated with all of the potential Phase 2 projects. Many NBWRA Member

Agencies have identified several potential storage projects that could be implemented over time as needed. Depending on the structure of the recycled water distribution system and its users, the required storage may be generated through a combination of recycled water storage (e.g., wet wells, finished water ponds, open storage ponds), distribution system storage (e.g., holding ponds or elevated reservoirs), or user storage (e.g., private agricultural ponds).

Table ES-4. Summary of Anticipated Maximum Recycled Water Storage Needed to Implement All Identified Phase 2 Projects

Agency	Potential Phase 2 Recycled Water Storage Needs	
	MG	*AF*
Novato Sanitary District	838	*2,574*
Las Gallinas Valley Sanitary District	58	*179*
Sonoma Valley County Sanitation District	241	*738*
City of Petaluma	483	*1,482*
Napa Sanitation District	387	*1,188*
Total	**2,007**	***6,161***

ES.6 Projects to be Addressed in Feasibility Study

The Scoping Study process asked NBWRA Member Agencies to think broadly and develop a comprehensive list of potential projects for the region. The NBWRA Member Agencies initially identified over 50 projects for consideration in Phase 2 (see Section 3). These potential projects included:

- Agricultural uses;
- Urban irrigation for parks, greenbelts, and commercial complexes;
- Environmental restoration;
- Recreation;
- Groundwater management and conjunctive use;
- In lieu stream flow;
- Climate change impacts and sea-level rise; and
- Energy efficient treatment and conveyance.

The NBWRA Member Agencies continued to work through these projects, reducing and refining the candidate project list, to yield a recommended group of diverse projects that could be designed and operated to best serve the region's many needs. Each NBWRA Member Agency reviewed the proposed timing of their potential projects, discussed priorities, and considered their own individual ability to fund the local share of costs.

Based on this process, at the January 2014 Workshop the NBWRA Member Agencies selected the following 22 projects for further evaluation in the Phase 2 Feasibility study (see Section 5.4). Although the January 2014 list is summarized here, the NBWRA Member Agencies will continue to discuss,

evaluate, and refine the Phase 2 project list following completion of this report as they move into the Feasibility Study.

- Novato SD has identified multi-purpose projects for storage, recycled water use, effluent management, and environmental enhancement. Project components would be developed in conjunction with Marin County and the California Coastal Conservancy.
- LGVSD seeks expansion of treatment facilities, additional storage, protection from sea level rise, and an environmental enhancement project in conjunction with Marin County.
- MMWD identified projects are distribution of recycled water provided by LGVSD.
- SVCSD seeks expansion of their recycled water distribution system in Sonoma Valley.
- SCWA is addressing groundwater recharge and salinity intrusion issues in the Sonoma Valley and groundwater recharge issues the Upper Petaluma River Watershed.
- The City of Petaluma has identified the need for additional treatment capacity, additional on-site seasonal storage, and expansion of their recycled water distribution systems.
- Napa SD has identified the need for expanding their treatment facilities and extending distribution pipelines. Storage is a major concern and a number of options have been identified for further study.

Table ES-5 provides more detail on each of the selected projects.

Table ES-5. NBWRA Member Agency Projects for the Phase 2 Feasibility Study

NBWRA Member Agency	Project Type	Project Title	Description
Novato SD	Storage	Storage Wetland	Construction of a 248-acre storage wetlands for secondary effluent
	Treatment	WWTP Capacity Upgrade	Improvements to wastewater treatment plant (WWTP) to increase tertiary capacity to 5 million gallons per day (mgd)
	Other	Tidal Prism and Habitat Restoration	Marin County/Novato SD project: Turn over leased Novato SD reclamation facility and use the land to restore tidal prism, enhance habitat, irrigate natural habitat, and address sediment issues in Novato Creek
LGVSD	Treatment	Tertiary Treatment Upgrades	Expansion of recycled water treatment capacity to treat up to 5.4 mgd of tertiary treatment in three phases
	Storage	Secondary Storage/Flood Protection	Traditional or horizontal levees would be installed to protect from existing flood threat and future sea level rise. The project includes the installation of a one million gallon effluent storage flow equalization basin to store secondary effluent for recycled water production / wet weather storage basin.
	Storage	Terra Linda Runoff Capture	Capture of Terra Linda dry weather channel runoff for WWTP treatment and water recycling
	Storage	Existing Storage Pond Repair/Upgrade	Increase secondary effluent storage for recycled water production by deepening and raising existing storage ponds and freshwater marsh. Increasing the height of the levees will protect against wet weather flooding and sea level rise. The project will include upgrading, replacing and or installing storage pumping, piping and structures.

Table ES-5. NBWRA Member Agency Projects for the Phase 2 Feasibility Study

NBWRA Member Agency	Project Type	Project Title	Description
	Storage	McInnis Marsh	LGVSD/Marin County project: Protect storage, treatment and recycled water facilities from flooding and sea level rise by installing horizontal levees and creating wetland habit. The project will reconnect Miller Creek to Gallinas Creek resulting in increased sediment conveyance. The horizontal levee will utilize recycled water to grow vegetation on horizontal levees. The project will reconfigure the treatment discharge outfalls.
MMWD	Distribution	Peacock Gap Main Pipeline Extension	Irrigation at Peacock Gap Golf Course - 170 AFY, 25,530 feet of 12-inch pipe
	Distribution	Peacock Gap Area Infill	Landscaping irrigation at Peacock Gap residential area - 30 AFY, 2,500 feet 6-inch pipe
SVCSD	Distribution	Sonoma Valley Pipelines	Irrigation for landscaping and agriculture in Sonoma Valley along Watmaugh Road and Peru Road, 3.2 miles of pipeline
SCWA	Storage	Groundwater Banking/Aquifer Storage and Recovery	Groundwater banking with Russian River winter flows in Sonoma Valley: Incremental increase in storage of 17,300 AF over a 30-year period
	Groundwater Management	Groundwater Management and Recharge: Sonoma Valley	Groundwater management and recharge program in Sonoma Valley groundwater basin
	Groundwater Management	Groundwater Management and Recharge: Petaluma River	Groundwater management and recharge program in Upper Petaluma River Watershed
Petaluma	Treatment	WWTP Capacity Upgrade	Increase capacity of tertiary production to meet current summer peak hour demand of 6 mgd
	Storage	Additional onsite storage	Additional onsite storage. Two options to be studied include: ▪ new recycled water storage pond ▪ raising height of oxidation ponds for storage use
	Distribution	Urban Recycled Water Expansion	Urban recycled water distribution system expansion to serve parks and open space, and school and institutional areas
	Distribution	Agriculture Recycled Water Expansion	Lakeville Highway distribution system for agricultural users
Napa SD	Distribution	Milliken-Sarco-Tulocay (MST) Pipeline	MST pipeline extension for landscape irrigation. Approximate demand: 77 AFY
	Treatment	Increase Filter Capacity	Construction of additional filters to increase treatment capacity by 1.7 mgd
	Storage	Additional WWTP Covered Storage	10-AF covered storage pond for tertiary water
	Storage	New seasonal storage	New seasonal storage. Four options to be studied include: ▪ raising the existing levees surrounding ponds ▪ new off-site pond (two locations) ▪ aquifer storage and recovery

ES.7 Summary of Findings

Based on the NBWRA's three-phase Scoping Study process, the following insights can be concluded for the Phase 2 Program:

- The alternatives developed in the Phase 2 Feasibility Study should integrate multi-benefit objectives to create a successful, achievable program that appeals to multiple funding sources;
- The NBWRA Member Agencies can capture and develop a significant, new, local, and reliable recycled water supply to implement Phase 2 projects;
- Due to the contrasting seasonality of recycled water supplies and the peak demand season, storage will be necessary to maximize beneficial use of this recycled water; and
- The NBWRA Member Agencies have identified a broad range of possible recycled water and groundwater management projects that cover all service areas and multiple project types.

Section 1
Introduction

The North Bay Water Reuse Authority's (NBWRA's) Phase 2 Scoping Studies have been conducted to assist the NBWRA's Member Agencies in determining whether to proceed to the next steps in feasibility-level engineering analysis, environmental documentation, and financial analysis for Phase 2 of the North Bay Water Reuse Program (NBWRP or Program). The NBWRA member agencies are Marin Municipal Water District (MMWD), Marin County, Las Gallinas Valley Sanitary District (LGVSD), North Marin Water District (NMWD), Novato Sanitary District (Novato SD), City of Petaluma, Sonoma Valley County Sanitation District (SVCSD), Sonoma County Water Agency (SCWA), Napa Sanitation District (Napa SD), and Napa County.

1.1 Background

The purpose of the Phase 2 Scoping Studies is to explore options for expanding recycled water use, and other water management options, within the North San Pablo Bay region beyond the projects currently being constructed as Phase 1 of the NBWRP. NBWRP Phase 2 Scoping Studies provide a transition to design and construction of Phase 2 when the NBWRP Phase 1 construction projects are completed in 2018.

1.2 Scoping Study Process

The Phase 2 Scoping Studies Summary Report is the culmination of three scoping studies conducted from March 2011 to May 2014. The scoping studies were designed to provide the NBWRA with an incremental decision-making process. At the conclusion of each scoping study, the NBWRA Member Agencies and potential new members had the information needed to decide if their respective needs were met through this approach and to determine if they would like to continue with the next study stage or leave the group planning process. After each of the first two scoping studies, the NBWRA decided to continue to the next level of detail. The final scoping study, documented in this report, provides information for the NBWRA Member Agencies to base their decision on whether to proceed with a U.S. Bureau of Reclamation (Reclamation) Title XVI Feasibility Study and to seek funding for both the feasibility studies and, ultimately, program implementation.

The three scoping studies included the following:

Membership and Outreach

The Membership and Outreach Study investigated additional agencies interested in joining the NBWRA and participating in the scoping studies.

Project Definition

The Project Definition Scoping Study provided preliminary information on the potential projects and costs of Phase 2 program construction and the potential scope to complete feasibility studies and environmental analysis. Additionally, it addressed another key aspect of the proposed Phase 2 Program:

- Initiation fee for new participants – financial options under which a new agency may become a fully vested participating member of the NBWRA while providing parity for the ratepayers who invested in Phase 1; and
- Conceptual-level programmatic and project-specific benefits of candidate Phase 2 projects to justify future local, state, and federal investments.

New User Assessment and Multi-Purpose Storage Scoping Study and Scoping Studies Summary Report

This final Scoping Study focuses on the development and use of recycled water, and other water management options, from a regional-scale perspective – how can this resource best meet community priorities, reflect local values, and significantly contribute toward water supply reliability in the North Bay. The Scoping Study Summary Report documents the NBWRA Member Agencies' decisions regarding their proposed projects to be studied and used to formulate a regional program at a Reclamation Feasibility Study Level.

1.3 New User Assessment and Multi-Purpose Storage Scoping Study Tasks

The New User Assessment and Multi-Purpose Storage Scoping Study builds on the previous efforts of earlier scoping studies and provides more detailed information regarding potential projects considered by the NBWRA Member Agencies. Key decisions have been made by the NBWRA Member Agencies as to the projects to be carried forward to the next level of detail based on the technical information provided, the program objectives developed to evaluate projects, and the agencies' institutional or financial constraints.

The selected projects to be carried forward will be analyzed in more detail in the Feasibility Study and will be used to formulate alternatives for screening and selecting a preferred program. A Conceptual Alternative has been formulated at this stage primarily to determine what the maximum program construction costs might be and to provide insight into the magnitude and mechanisms of funding that might be required. The Conceptual Alternative identified in this study is not proposed as the final regional program to be included in the Feasibility Study documentation.

Key tasks include of this study included:

- A decision process to support evaluation of projects for further detailed study;
- A definition of projects to meet multiple objectives of water supply for urban, agriculture, environmental benefits, and integrated regional water management;
- Potential storage options that support the Program's multiple objectives and quantify the potential costs of this critical but costly component of the regional water resource management program; and
- A final summary of all the Scoping Studies that describes conclusions reached through the methodical and adaptive approach the NBWRA used to make an informed decision regarding proceeding with Phase 2 feasibility analysis.

1.4 Report Contents

The Phase 2 Scoping Studies Summary Report is organized into six sections and five appendices:

- Section 1, Introduction, provides background on the scoping studies process and purpose of the Scoping Studies Summary Report;
- Section 2, Phase 2 Program Objectives, describes the objectives developed by the NBWRA to guide formulation of projects and alternatives for Phase 2;
- Section 3, Initial Project Identification, describes the full range of potential Phase 2 projects that were considered by the NBWRA Member Agencies over the course of the study period;
- Section 4, Water Operations/Storage Requirements, presents current and projected recycled water supplies for the NBWRA area and potential operations based on the full suite of potential Phase 2 projects;
- Section 5, Phase 2 Conceptual Alternatives, reviews initial alternatives formulated to meet various Program objectives and identifies the Conceptual Alternative based on member agency prioritization and funding constraints developed in January 2014;
- Section 6, Phase 2 Projects, contains the list of member agency projects selected for further evaluation in the future Feasibility Study as of January 2014 and presents conclusions of the Scoping Study;
- Appendices:

- A, References, includes citations used in the document;
- B, Scoping Study Workshop Presentations;
- C, Detailed Water Demand Calculations, presents the recycled water demand calculations for the project described in Section 3;
- D, Previous Scoping Studies, includes the Membership and Outreach Study Summary Memorandum, and the Project Definition Scoping Study Report; and
- E, Overview of Feasibility Level Study Scope of Work.

Section 2
Phase 2 Program Objectives

This section describes how specific Program objectives were developed and will be used to guide the formulation of alternatives. At the Scoping Study level, the objectives assist in formulating thematic conceptual alternatives comprised of the potential projects identified by the NBWRA Member Agencies (see Section 5). The objectives will also help illustrate the relative strengths of the alternatives during the Feasibility Study, when alternatives will undergo screening, reformulation, and evaluation as more detailed layouts and costs are developed. Future Feasibility Study analysis will also expand the primary objectives to define how to measure success of an alternative against the objectives.

The NBWRA used the Scoping Study workshop process to develop objectives for Phase 2 of the NBWRP (Appendix B includes the workshop presentations). The objectives setting process spanned three of the workshops, with a review of the objectives from Phase 1 of the NBWRP and then a summary of the objectives and criteria of funding programs. These objectives were compared and aggregated to develop final Phase 2 Program Objectives. The goal was to develop Phase 2 Program Objectives compatible with criteria (objectives) of the NBWRA Member Agencies, as well as those of the potential implementation funding sources.

Objectives are usually categorized into primary objectives and subobjectives. Primary objectives are more general, while subobjectives help define the primary objectives in more specific terms. For each subobjective, a performance measure is required to assess whether an objective is being achieved. Table 2-1 provides an example of the hierarchy of objectives, subobjectives, and performance measures. The Scoping Study defines the primary objectives and subobjectives. In the Feasibility Study, performance measures will be developed for each subobjective to evaluate alternatives.

Table 2-1. Example Objective Hierarchy for Alternative Evaluation

Primary Objective	Subobjectives	Performance Measures
Increase Diversity of Water Supplies	Maximize number of sources	Total number of sources
	Reduce contribution of largest source	Percent contribution of the largest source to total supply

Principles of decision-making suggest that primary objectives be developed using the following criteria:

- Distinctive: objectives should be developed to distinguish between one project (or alternative) and another;
- Measurable: objectives should be able to be measured in order to determine if they are being achieved, either quantitatively or qualitatively;
- Non-Redundant: objectives should not overlap with each other;
- Understandable: objectives should be easily explainable; and
- Concise: objectives should be kept to manageable numbers.

2.1 Phase 1 and Memorandum of Understanding Objectives

In the early appraisal level stages of Phase 1, a multiple benefits approach was identified to develop recycled water for urban, agricultural, and environmental uses in the North San Pablo Bay. This approach provided the foundational goals of the Program and provided the template for subsequent studies.

The Phase 1 studies' objectives were used in Environmental Impact Report/Environmental Impact Study (EIR/EIS) process to guide the environmental evaluation of recycled water alternatives. The EIR/EIS indicated the following:

> **"Alternatives Analysis and Project Objectives**
>
> The purpose of the NBWRP is to provide recycled water for agricultural, urban, and environmental uses thereby reducing reliance on local and imported surface and groundwater and reducing the amount of treated effluent releases to San Pablo Bay. Specific project objectives identified for the project include:
>
> - Offset urban and agricultural demands on potable water supplies;
> - Enhance local and regional ecosystems;
> - Improve local and regional water supply reliability;
> - Maintain and protect public health and safety;
> - Promote sustainable practices;
> - Give top priority to local needs for recycled water, and;
> - Implement recycled water facilities in an economically viable manner.
>
> It should be noted that these objectives are not mutually exclusive or prioritized. The objectives seek to develop a program that can meet multiple end-use needs identified within the region in an economically viable manner." (Reclamation and North Bay Water Reuse Authority 2009)

The above objectives are identical to the objectives of the Second Amended Memorandum of Understanding (MOU), which was developed to address the Phase 1 program. In the Third Amended MOU, the first objective was modified to read, "Offset urban and agricultural demands on surface water and groundwater supplies."

2.2 Objectives from Potential Funding Agencies

The Phase 1 objectives in the EIR/EIS were focused on meeting the criteria of the California Environment Quality Act (CEQA) and the National Environmental Policy Act (NEPA). However, as potential project descriptions for Phase 2 began to take shape, it became apparent that a more detailed definition of both project and Program benefits was needed to describe how both the objectives of the NBWRP and those of the state and federal agencies with the potential to provide implementation funding could be met in one set of mutually beneficial objectives. These project-specific and program-wide benefits were built into the foundation of the NBWRP from the beginning of Phase 1, but needed to be documented and recognized in the Phase 2 objectives. Consequently, as

the NBWRA considered Phase 2 Feasibility Study investigations and environmental review, implementation funding criteria was added to expand the Phase 2 objectives to be used for alternative formulation and evaluation.

The following subsections summarize the criteria that the Member Agencies must consider when creating alternatives that are compatible with criteria (objectives) of potential implementation funding sources. The objectives and criteria of Reclamation and the California Department of Water Resources (DWR) are described below.

2.2.1 Bureau of Reclamation

The U.S. Department of the Interior (Interior) established the WaterSMART (Sustain and Manage America's Resources for Tomorrow) funding program in February 2010 to facilitate the work of Interior's bureaus in pursuing a sustainable water supply for the nation. The program focuses on improving water conservation and sustainability and helping water resource managers make sound decisions about water use. It identifies strategies to ensure sufficient supplies of clean water for drinking, economic activities, recreation, and ecosystem health. The program also identifies adaptive measures to address climate change and its impact on future water demands. Reclamation's Title XVI Water Reclamation and Reuse (Title XVI) Program is an important part of WaterSMART.

WaterSMART funding proposals are ranked through a published set of evaluation criteria in which points are awarded for those projects that conserve water, incorporate renewable energy or address the water-energy nexus, address Endangered Species Act concerns, contribute to water supply sustainability, and/or incorporate water marketing. The Fiscal Year 2014 Title XVI WaterSMART program evaluated project applications on the following criteria (Reclamation 2013):

> **"The Evaluation Criteria comprised 200 points.**
>
> - Evaluation Criterion 1: Water Supply
>   - Subcriterion No. 1a. Stretching Water Supplies – 35 points
>   - Subcriterion No.1b. Contributions to Water Supply Sustainability – 20 points
> - Evaluation Criterion 2: Status of Project
>   - Subcriterion No. 2a. Progress Toward Completion of an Authorized Title XVI Project – 20 points
>   - Subcriterion No. 2b. Readiness to Proceed – 10 Points
> - Evaluation Criterion 3: Environment and Water Quality – 30 Points
> - Evaluation Criterion 4: Renewable Energy and Energy Efficiency – 25 Points
> - Evaluation Criterion 5: Cost per Acre-Foot of Water and Other Project Benefits – 25 Points
> - Evaluation Criterion 6: Reclamation's Obligations and Benefits to Rural or Economically Disadvantaged Communities
>   - Subcriterion No. 6a. Legal and Contractual Water Supply Obligations – 10 Points

- Subcriterion No. 6b. Benefits to Rural or Economically Disadvantaged Communities – 10 Points

- Evaluation Criterion 7: Watershed Perspective – 15 points"

2.2.2 State of California

DWR manages the Integrated Regional Water Management (IRWM) program and defines it as "…a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions." (DWR 2013a) Under the IRWM program, DWR has a number of grant program funding opportunities.

The IRWM Grant Program is designed to encourage integrated regional strategies for management of water resources and to provide funding for implementation projects that support integrated water management. The 2012 Guidelines established the general process, procedures, and criteria that DWR will use to implement the IRWM Grant Program and the Stormwater Flood Management Grant Program (DWR 2012). These 2012 Guidelines include acceptance of IRWM regions into the grant program, IRWM Plan standards and guidance, solicitation, submittal, review of grant applications, and award of grant funding.

Funding proposals are scored against criteria documented in each Proposal Solicitation Package. The review and score are based on the merit of the entire proposal as a whole versus the merit of an individual component. Each criterion is scored on a scale of 0 to 5, with a 0 being "low" and a 5 being "high." (DWR 2012)

"Where standard scoring criteria are applied, points will be assigned for a criterion as follows:

- A score of 5 points will be awarded where the criterion is fully addressed and supported by thorough and well-presented documentation and logical rationale.
- A score of 4 points will be awarded where the criterion is fully addressed but is not supported by thorough documentation or sufficient rationale.
- A score of 3 points will be awarded where the criterion is less than fully addressed and documentation or rationales are incomplete or insufficient.
- A score of 2 points will be awarded where the criterion is marginally addressed and documentation is incomplete and insufficient.
- A score of 1 point will be awarded where the criterion is minimally addressed and not documented.
- A score of 0 points will be awarded where the criterion is not addressed."

DWR's 2012 Guidelines describe the factors that a project review process should employ when considering projects for inclusion in the regional IRWM Plan. These factors are listed below (DWR 2012).

A. How the project contributes to the IRWM Plan objectives.

B. How the project is related to resource management strategies. (Does the proposed project contribute to the diversification of the water management portfolio?)

C. Technical feasibility of the project.

D. Specific benefits to critical disadvantaged community (DAC) water issues. ("… identification and consideration of water-related needs of DACs in the area within the boundaries of a region is among the basic items an IRWM Plan must address….Projects that specifically address such needs should be promoted in the project selection process.)

E. Specific benefits to critical water issues for Native American tribal communities. ("Projects that specifically address such needs should be promoted in the project selection process.")

F. Environmental Justice (EJ) considerations. ("In the project review process, a project that has not been examined for EJ concerns, or a project that is discovered to have EJ concerns, should not be instantly dismissed from consideration. However, addressing the lack of EJ assessment or modifying the project to mitigate EJ concerns may allow the project to move forward.")

G. Project Costs and Financing.

H. Economic Feasibility. ("As part of the project review process, the economic feasibility of a project should be considered. Either a cost-effectiveness or benefit-cost analysis may be used for the preliminary assessment depending on the nature of the project. A cost-effectiveness analysis may be preferable for habitat restoration projects for which it is difficult to assign monetary benefits. The chosen method of analysis must include the types of benefits and types of costs including capital costs, [operations and maintenance] costs, and potential adverse effects to others from the project")

I. Project Status. ("Project status is equivalent to readiness to proceed")

J. Strategic considerations for IRWM Plan implementation. ("One of the advantages of IRWM planning is to use the regional perspective to leverage any efficiency that might be gained by combining or modifying local projects into regional projects. … This factor acknowledges that there may be benefit in integrating local projects or project goals in developing regional projects.")

K. Contribution of the project in adapting to the effects of climate change.

L. Contribution of the project in reducing greenhouse gas emissions as compared to project alternatives

2.2.3 Comparison and Sorting of Objectives

Based on the preceding sections, Table 2-2 illustrates the relationship between NBWRP Phase 1, Reclamation, and DWR objectives and criteria. The table shows that NBWRP Phase 1 objectives appear to be less encompassing than those applied by Reclamation and DWR. However, as indicated earlier, although the NBWRP Phase 1 objectives did not specifically identify them, many of the objectives were, in fact, inherent in the alternatives and in the underlying tenants of the NBWRP. Therefore, incorporating funding agency objectives into the Phase 2 Program objectives is consistent with the historical focus and activities of the NBWRA and broadens the objectives to include more environmental and social issues thus yielding greater community benefit.

Table 2-2. Objectives that Influence Program Implementation

Phase 1 NBWRP Study	Bureau of Reclamation	DWR (IRWM Plan)
Offset urban and agricultural demands on potable water supplies	Increase water supplies and reduce demand on non-recycled water supplies	Address multiple goals
Improve local and regional water supply reliability	Address water supply sustainability	Integrate multiple resource management strategies
Give top priority to local needs for recycled water	Complete authorized Title XVI projects	Strategic considerations for IRWM Plan implementation (regionalism, partnerships and integration)
Enhance local and regional ecosystems	Promote projects that are ready to proceed	Project status
Maintain and protect public health and safety	Improve habitat and water quality	Technical feasibility
Promote sustainable practices	Incorporate use of renewable energy and promote energy efficiency	Benefits to disadvantaged community water issues
Implement recycled water facilities in an economically viable manner	Implement cost effective projects	Benefits to Native American tribal community water issues
	Meet legal and contractual water supply obligations	Environmental justice considerations
	Provide benefits to rural or economically disadvantaged communities	Project costs and financing
	Promote a watershed perspective/integrated resources management	Economic feasibility
		Climate change adaptation
		Reduce greenhouse gas emissions
		Reduce dependence on the Delta

Based on Table 2-2, the objectives were then categorized and aggregated into general topics. After a first sort, each of the objectives was identified as a primary or clarifying subobjective. The general topics for aggregating objectives were:

- Meet water supply needs;
- Offset potable or imported supplies;
- Sustainability;
- Watershed approach/multiple goals/strategies;
- Costs and economics;
- Readiness to proceed;
- Environmental enhancement; and
- Social issues.

The aggregated and sorted proposed objectives were then presented and discussed with the NBWRA Board of Directors (Board) and the Technical Advisory Committee (TAC) at the Scoping Study workshops. During the process, new categories for objectives were developed and some objectives became subobjectives under the new categories.

2.3 Objectives Developed at Scoping Study Workshops

The proposed Phase 2 objectives for alternative formulation, screening, and evaluation were discussed at Workshops 1, 2, and 3. The Phase 2 Program objectives and subobjectives resulting from Board and TAC input, presented in Table 2-3, will be used preliminarily in the Scoping Study and through the Feasibility Study.

Table 2-3. NBWRP Phase 2 Program Objectives

Objective	Subobjective
Improve Regional Water Supply	▪ Improve local, regional, and state water supply reliability ▪ Address impaired groundwater basins ▪ Offset demands on potable water supplies ▪ Maintain and protect public health and safety ▪ Reduce dependence on the Delta
Sustainability	▪ Incorporate use of renewable energy and promote energy efficiency ▪ Address climate change adaptation ▪ Reduce greenhouse gas emissions
Watershed Approach	▪ Incorporate multiple agencies and stakeholders ▪ Address multiple resources management strategies
Economic Feasibility & Financial Viability	▪ Cost effectiveness ▪ Financially implementable projects
Readiness to Proceed	▪ Ability to start design ▪ Ability to start construction
Environmental Enhancement	▪ Enhance local and regional ecosystems ▪ Improve water quality for habitat ▪ Improve instream flows for aquatic life
Social Issues	▪ Provide benefits to rural or economically disadvantaged communities ▪ Address environmental justice considerations ▪ Enhance recreation and open space opportunities ▪ Maintain agricultural industry and culture

2.4 Future Feasibility Level Activities Applying Objectives

At the Scoping Study level, the objectives and subobjectives can only be used to formulate thematic alternatives and qualitatively assess how these thematic alternatives perform against the objectives (see Section 5). The Scoping Study is reconnaissance level with limited quantification and is not intended for comparison between alternatives or selection of final alternatives.

The Scoping Study does develop a foundational framework and scope of work for approaching the alternatives formulation and screening that will occur during the Phase 2 Feasibility Study, based on the Member Agency preferences and insights learned. The application of these objectives into potential future Feasibility Study tasks is summarized in this subsection.

2.4.1 Weight Objectives

In most decision-making processes, the objectives are generally not all equally important. Some objectives may be more relevant for the decision-maker than others (e.g., for a given individual, operational flexibility may be more important than environmental and institutional constraints). Thus, weighting objectives is necessary at the detailed level of analyses in the Feasibility Study to better reflect the values and preferences of stakeholders and decision-makers.

One approach for determining the appropriate weights for objectives during the Feasibility Study is the "forced-paired comparison" method. This method is based on the premise that when presented with a series of elements, the relative importance of those elements versus each other is more simply decided when the elements are compared in pairs. The results of the comparison of each pair of elements are later aggregated to determine the overall importance of every element.

In this approach, each NBWRA Member Agency would compare each possible pair of primary objectives. Each stakeholder would choose which objective was more important. The results would be summed in order to get a relative percentage weight of importance for each objective. Each stakeholder's individual weightings for the objectives would be preserved and used to rank alternatives.

Figure 2-1 illustrates the weighting process using a grid to compare objectives one to another. For each box, the question is asked, "Which of these two objectives is most important to me?" This process would be used during the Feasibility Study process with each Member Agency to get an aggregated weighting and to understand the preferences of each individual member agency.

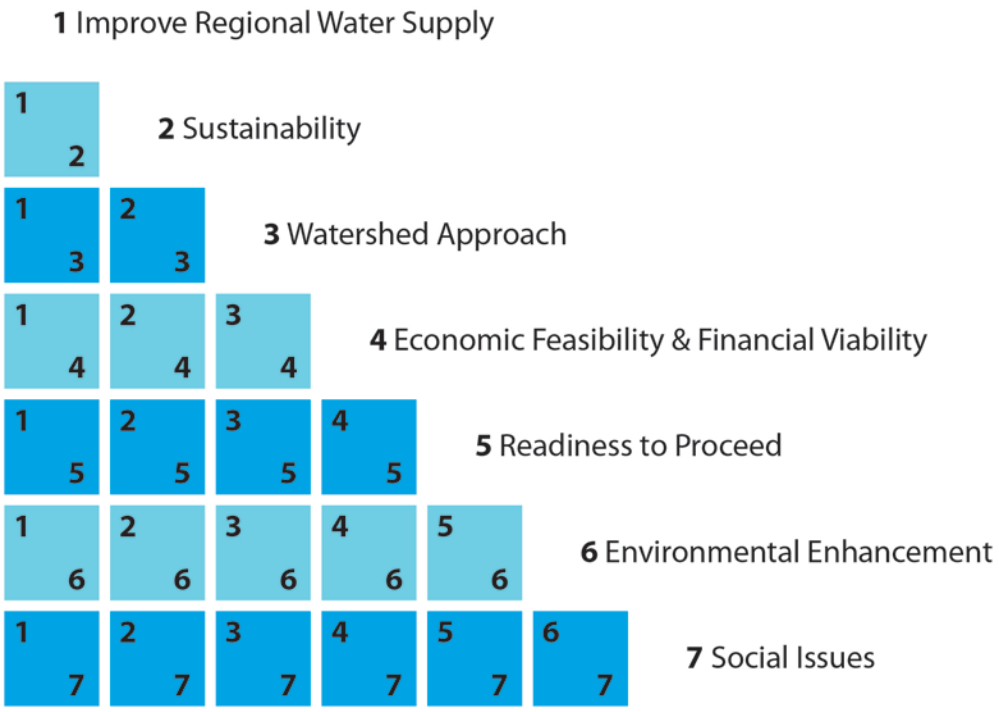

Figure 2-1
Weighting Grid for Pairwise Comparison of Objectives

2.4.2 Develop Measures of Success

During the Phase 2 Feasibility Study, appropriate performance measures will be developed for each subobjective. The performance measures are used to evaluate how well an objective is being achieved, either quantitatively or qualitatively. An example of performance measures for the secondary objective of "meet urban demands" might be the quantity of water available to meet demands or the frequency of supply shortages.

2.4.3 Use Criteria to Formulate Feasibility Level Alternatives

The Program objectives represent essential reasons or purposes "why" the NBWRA is considering undertaking Phase 2; however, they do not specify "how" the NBWRA should move forward to meet these objectives. The individual projects identified in Section 3 are the potential means for accomplishing the objectives and subobjectives. At the Scoping Study stage, these projects serve as building blocks to develop integrated conceptual alternatives with the potential of meeting the objectives. At the Feasibility Study stage, the conceptual alternatives will be refined or configured to maximize meeting objectives and well as to develop an equitable benefit to the NBWRA member Agencies.

Section 3
Initial Project Identification

The Project Definition Scoping Study identified an initial range of conceptual water supply and environmental enhancement projects provided by the NBWRA Member Agencies. This section builds on these projects and describes additional Phase 2 opportunities not previously identified in earlier NBWRP activities. This analysis was conducted to determine the broadest range of uses and projects prior to the members' decision to proceed with the more detailed Feasibility Study and environmental screening analyses. This list was derived from agency meetings and workshops conducted throughout the course of the Scoping Study. The potential projects identified here will be combined and formulated into conceptual alternatives that maximize the Program objectives summarized in Section 2.

Information was collected on potential projects seeking to maximize the value and use of all available water in the North Bay by using a Total Water Management (TWM) perspective to view the water resources system and incorporating principles of sustainability. TWM can be utilized to increase water resources efficiency and enhance overall benefits. It examines water systems in a more interconnected manner, focusing on reducing water demands for fresh water, increasing water recycling and reuse, creating groundwater supply assets from stormwater, matching water quality to end-use needs, and achieving environmental and societal goals through multi-purpose, multi-benefit projects. Concepts for the expanded NBWRP have been developed in conjunction with the Member Agencies through in-person meetings, follow-up telephone calls, and the workshop process to identify potential projects and to explore inter-agency partnership opportunities that could increase system efficiencies, cost savings, and regional benefits.

The following subsections provide a broad range of water management projects. The information is presented by county and agency. For each Member Agency, the project components are summarized by treatment, storage, distribution, groundwater management, and other project opportunities and interaction with agencies/organizations.

3.1 Marin County Subregion

The Marin County subregion includes NBWRA Members Agencies of Novato SD, LGVSD, MMWD, with additional input and interface from Member Agencies Marin County and NMWD.

3.1.1 Novato Sanitary District

Potential project opportunities for Novato SD were identified through several meetings with Novato SD staff. On January 7, 2013, the project team met with Beverly James and Sandeep Karkal. A Marin County agencies subregion meeting was also held on February 25, 2013, with Beverly James in attendance for Novato SD. Figure 3-1 presents the potential Phase 2 projects for Novato SD.

3.1.1.1 Recycled Water Treatment

Additional tertiary treatment capacity may be required if all the potential recycled water projects discussed below move forward. Either Novato SD's Davidson or Ignacio Plant sites could accommodate the up to 5 million gallons per day (mgd) of tertiary capacity that may be needed if additional demands are identified.

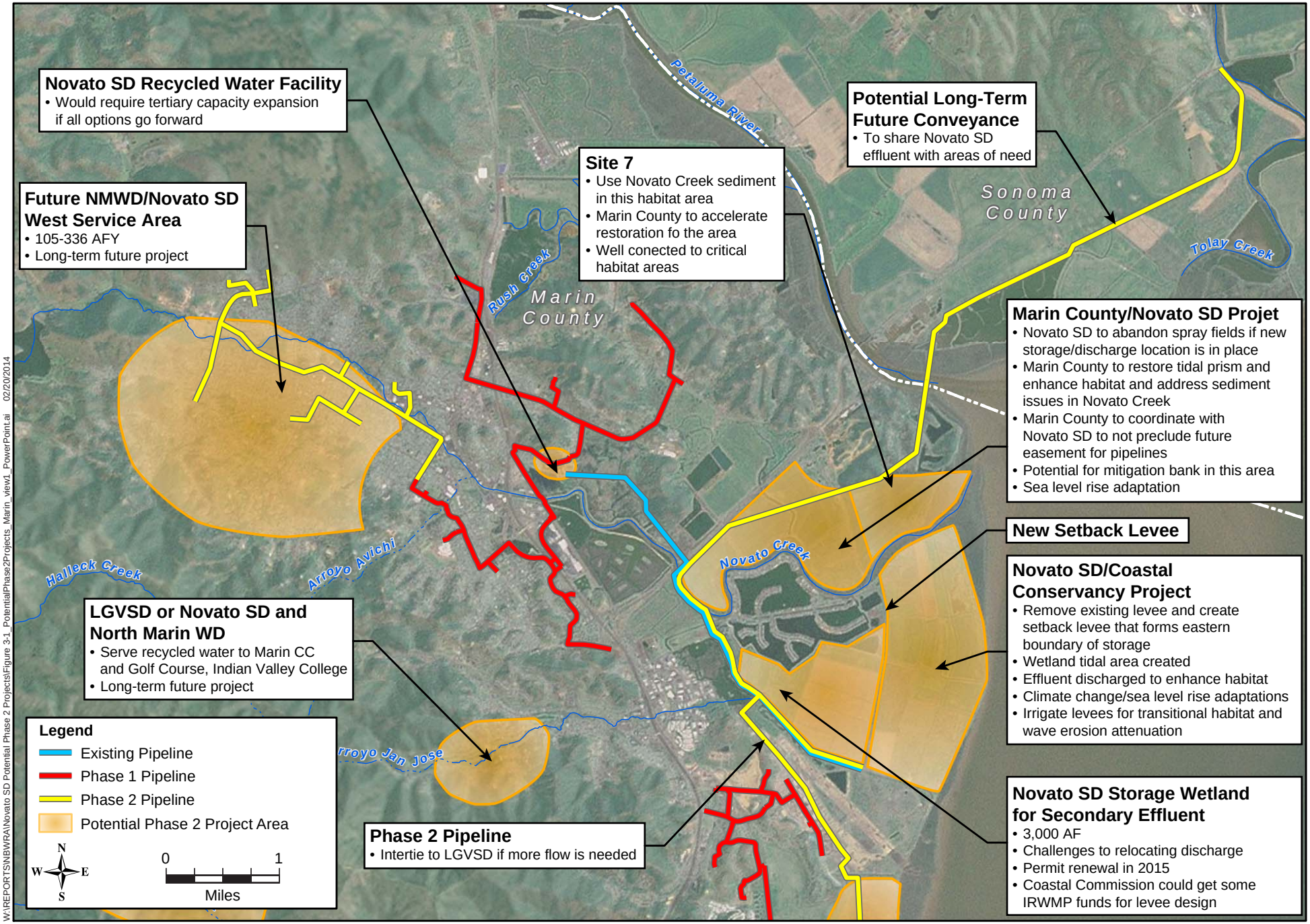

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Figure 3-1
Novato SD Potential Phase 2 Projects

3.1.1.2 Recycled Water Storage

Novato SD is considering construction of a new 248-acre multi-purpose storage wetlands for temporary secondary effluent storage. This project has been adapted from initial storage concepts presented in *Bel Marin Keys Unit V Restoration Project – Evaluation of NSD Outfall Alternatives* (California State Coastal Conservancy 2012), and *Phase 2 Project Definition Scoping Study Report* (North Bay Water Reuse Authority 2012). The storage wetlands would store secondary effluent from Novato SD's wastewater treatment plant (WWTP), providing wet weather storage for reuse during the summer months and reducing effluent discharged into San Pablo Bay in the summer. The storage wetlands would provide about approximately 3,000 acre-feet (AF) of capacity, about 94 days of storage at the average wet weather flow of 10.3 mgd from the WWTP.

The project would be conducted in conjunction with the California State Coastal Conservancy which plans to remove their existing bayside levee and construct a new setback, 9,000-linear foot (LF), earthen levee to create the new freshwater wetlands, as well as tidal wetlands. The ecotone slope earthen levee would be a hybrid approach that combines tidal marsh restoration with construction of levees to be adaptive to climate change and sea level rise. This concept allows for shoreline protection and environmental enhancement through upland slopes with moist grasslands and brackish marshes inland of the tidal marsh. According to a recent report on tidal marsh restoration for the Bay Institute, these horizontal levees are "designed to provide both elevation and salinity gradients that would allow the tidal marsh to both move landward and accelerate vertical accretion in order to keep pace with sea level rise" (ESA/PWA 2013). Effluent from Novato SD along the shore would irrigate the upland ecotone slope.

3.1.1.3 Recycled Water Distribution

Near-Term Projects

If the new storage wetlands is built, the existing outfall pipeline discharging into San Pablo Bay would be truncated to discharge into the new storage wetlands. Novato SD is evaluating the options for relocating their discharge under a separate study. During the winter, the overflow from the storage wetlands would flow directly into the adjacent new bay tidal wetlands created by the removal of the existing bayside levee.

A new flow splitting structure and pump station would be constructed to pump the water stored in the storage wetland to users. The pump station is assumed to include three 250-horsepower (HP) pumps (two duty, one standby). For agricultural reuse, the pump station would deliver the stored secondary effluent directly into the existing pasture irrigation system. For tertiary reuse, the pump station would pump the stored effluent to the Recycled Water Facility for further treatment to Title 22 tertiary standards before the recycled water is supplied to users.

Long-Term Future Projects

In previous NBWRA studies, a potential new 18-inch diameter pipeline was identified to convey secondary effluent from Novato to agricultural and vineyard users in Sonoma County. Recent discussions have determined that this is a long-term option to serve the southern Sonoma County area and is not needed at this time. In concept, the 43,800-LF pipeline would run northward from the pump station, and cross beneath the Petaluma River in order to reach agricultural users (primarily vineyard and pasture farms).

Previously, a 20,700-LF, 18" pipeline was identified that would run southward from the Novato SD pump station and interconnect with the LGVSD recycled water system. This pipeline will allow the two

systems to be able to share recycled water resources during peak usage periods in either area. However, unless demands exceed LGVSD supply, this pipeline is considered a long-term option that would be studied only if demands are demonstrated.

Two long-term recycled water distribution projects were identified through staff discussions. Novato SD staff suggested they may look to increase supply to NMWD, expanding their service area to the west. Previously, NMWD studied the west areas W-1, W-2, W-3, and W-5 in their 2004 *Recycled Water Master Plan* (North Marin Water District and Novato Sanitary District 2004). The recycled water demand in these areas was estimated to be 105 to 336 AF per year (AFY). However, NMWD indicated it is not ready at this time to proceed with this service area expansion.

Additionally, Novato SD suggested that Indian Valley Golf Course and Marin Country Club could be candidates for future recycled water service. No specific details have been developed at this time. More detailed study would be required at the Feasibility Study stage if it is to be included in the conceptual alternatives.

3.1.1.4 Groundwater Recharge

Novato SD has not identified any groundwater recharge projects as part of the NBWRP Phase 2.

3.1.1.5 Other Project Opportunities and Interaction with Agencies/Organizations

The construction of storage and coordinated efforts with the California State Coastal Conservancy would create a beneficial discharge of Novato SD effluent to improve habitat along the Marin County coast of San Pablo Bay and would address Novato SD effluent management issues in a synergistic manner. Novato SD's existing shallow water discharge pipeline would be abandoned and water quality of flows reaching San Pablo Bay would be improved after flowing through the ecotone slope and transitional wetlands before reaching the bay.

Construction of the storage wetlands would also create a synergistic solution in conjunction with Marin County. Currently Novato SD leases land from Marin County in the area south of Highway 37 and north of Novato Creek to use as ranch lands irrigated with recycled water. The storage and habitat project with California State Coastal Conservancy would allow Novato SD to return the leased lands to Marin County for potential other uses as identified in the Novato Creek Watershed Study currently in process. The Marin County wetland project is described further in Section 3.1.4. Additionally, giving up the leased lands would relieve Novato SD of the responsibility and costs associated with maintaining seven miles of levee on the southern border property.

Novato SD is also working with Marin County on the Novato Watershed Program, described further in Section 3.1.4. The program's goal is to identify opportunities to integrate flood protection and sediment management goals with creek and wetland restoration elements. This process includes evaluating alternatives that would reduce flood protection maintenance costs and impacts and increased resiliency to sea level rise.

3.1.2 Las Gallinas Valley Sanitary District

Potential project opportunities for LGVSD were identified through several meetings with LGVSD staff. On January 9, 2013, the project team met with Mark Williams and Susan McGuire. A Marin County agencies subregion meeting was also held on February 25, 2013, with Susan McGuire and Mike Cortez for LGVSD. Additionally, agency staff and Board members provided insights regarding projects at the Program workshops. Figure 3-2 presents the potential Phase 2 projects for LGVSD.

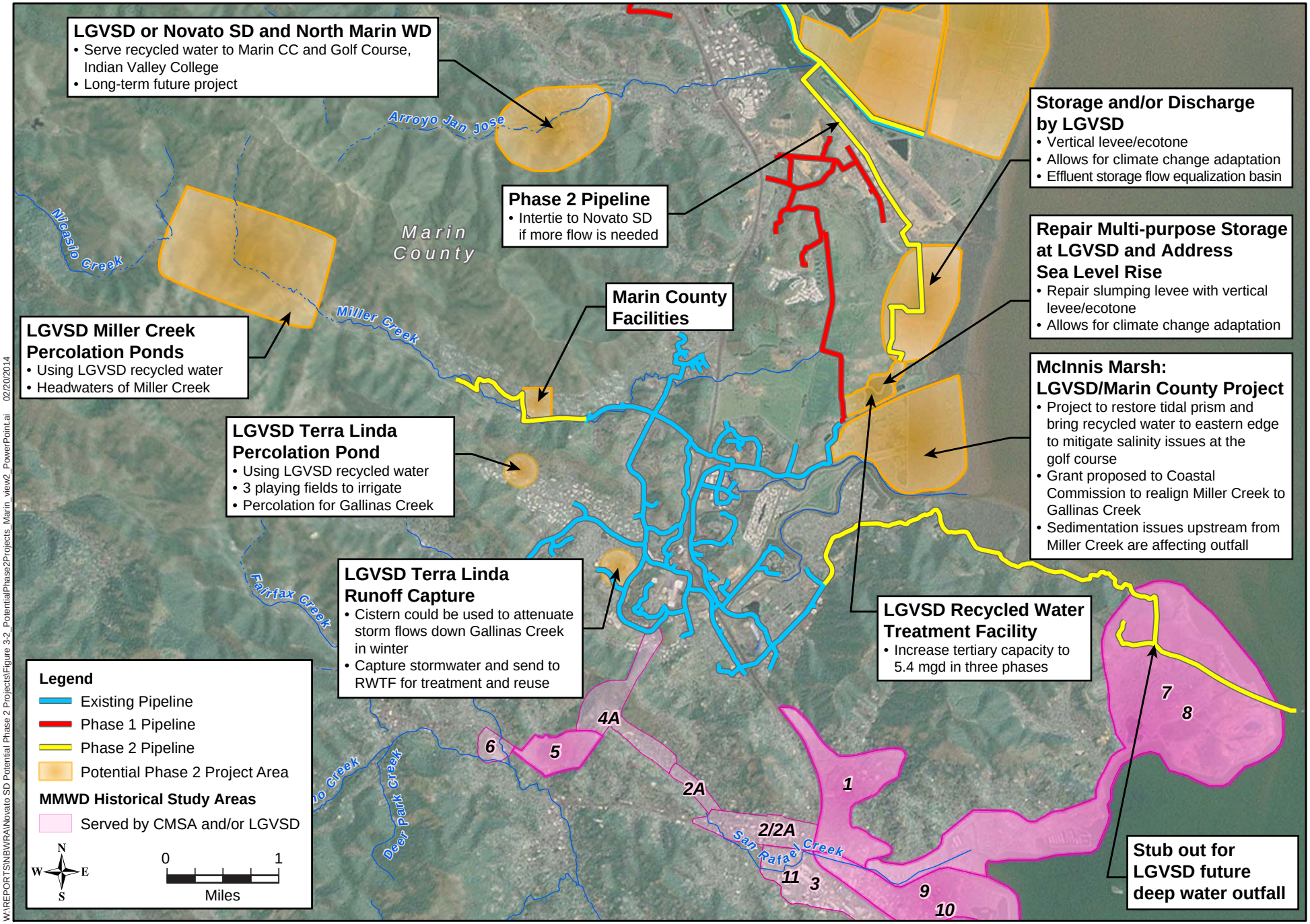

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Figure 3-2
LGVSD Potential Phase 2 Projects

3.1.2.1 Recycled Water Treatment

LGVSD is interested in expanding its new Recycled Water Treatment Facility, increasing tertiary treatment capacity from 1.4 to 5.4 mgd, in three phases, when additional irrigation demands are identified. The expansion would require the installation of two new membrane filtration units, two ultraviolet disinfection units, new influent pumps, a new discharge pump, and associated piping, electrical, and SCADA control upgrades.

3.1.2.2 Recycled Water Storage

LGVSD wants to improve its existing multi-purpose storage ponds and reclamation levees to address levee stability, sea level rise, and flooding from Miller Creek. The levees around the LGVSD's ponds, reclamation area, and Miller Creek are deteriorating and need to be replaced. Increasing the height of the levees will protect against wet weather flooding and sea level rise. The project would include upgrading, replacing, and/or installing storage pumping, piping, and structures. LGVSD is interested in ecotone slope horizontal levees which address sea level rise and climate change adaption, and provide for varied habitat.

LGVSD wants to investigate additional storage options that include increasing storage capacity up to 400 AF near its WWTP. Traditional or horizontal levees could be installed to protect from existing flood threat and future sea level rise. The project would include the installation of a one-million gallon (MG) effluent storage flow equalization basin to store secondary effluent for recycled water production or for use as a wet weather storage basin. The additional storage will provide sufficient capacity to serve potential customers in the adjacent NMWD and MMWD service areas.

3.1.2.3 Recycled Water Distribution

Long-Term Future Projects

In the 2013 update to the Bay Area IRWM Plan, NMWD included a potential project to extend its recycled water service to the Marin Country Club in Novato. This potential long-term concept would include approximately 2.5 miles of pipeline from the existing recycled water distribution system in Hamilton Field to the Marin Country Club and rehabilitation of the existing 500,000-gallon Norman Tank for conversion to recycled water storage. Recycled water would be produced at LGVSD and pumped to the rehabilitated tank for irrigation use. The proposed project would expand the existing NMWD Novato South project and add up to 140 AFY of recycled water demand, offsetting existing surface water, groundwater, and potable water now used for the country club's golf course turf irrigation. This project was also discussed by Novato SD.

3.1.2.4 Groundwater Recharge

LGVSD has identified one percolation project. A recycled water percolation pond could be located in upper Lucas Valley. Recycled water could be used to recharge Miller Creek during the low-flow summer months, serve new recycled water customers, and provide an additional source of water for fire protection. This would require the expansion of the MMWD recycled water distribution system.

3.1.2.5 Other Project Opportunities and Interaction with Agencies/Organizations

LGVSD is considering a runoff capture, treatment, and reuse project along Gallinas Creek. Dry weather drainage flows would be diverted to the LGVSD sewer system where they would be treated and used to supplement the recycled water demand. The potential project would divert summer low flows near the end of the concrete lining section by a diversions structure to the sewer.

LGVSD is currently coordinating with Marin County on Miller Creek and the McInnis Marsh area south of the LGVSD WWTP. A potential project to bring LGVSD effluent to the eastern edge of the marsh would provide multiple benefits: 1) enhance the habitat in the tidal area; 2) reduce salinity intrusion that has caused landscaping damage to the golf course; and 3) provide an additional discharge location for LGVSD effluent. The Marin County project is discussed in more detail in Section 3.1.4.

A second habitat restoration and effluent management project was identified north of the LGVSD WWTP. Similar to a project under discussion between Novato SD and the California State Coastal Conservancy, LGVSD is interested in investigating removing the current levee east of their spray fields and constructing setback horizontal levees at an elevation to address projected sea level rise impacts. The area between the horizontal levees and San Pablo Bay would be returned to tidal wetland with LGVSD discharge to enhance habitat in the transitional zones.

LGVSD is looking to coordinate with MMWD regarding MMWD's distribution projects. Since MMWD's supply of secondary treated wastewater for its recycled water plant comes from LGVSD, LGVSD is the likely source for additional supply to serve recycled water demand in the MMWD service area.

LGVSD has also expressed interest in participating in the pipeline to the Peacock Gap Golf Course (described below as a potential MMWD project in Section 3.1.3.3) to add a stub-out for a deep water discharge to San Pablo Bay. This concept would allow LGVSD more flexibility in the management of its effluent. This conceptual level project requires further detailed study if included in the Feasibility Study.

3.1.3 Marin Municipal Water District

Potential project opportunities for MMWD were identified through several meetings with MMWD staff. On January 8, 2013, the project team met with Michael Ban and Paul Sellier to review the previously identified projects and to identify new conceptual projects for study. A Marin County agencies subregion meeting was also held on February 25, 2013, with Paul Sellier in attendance for MMWD. In 2000, MMWD completed its *Recycled Water Expansion Feasibility Study* (Marin Municipal Water District 2000). Data in this section is drawn from that report plus updated demand information provided by MMWD staff. Figure 3-3 presents the potential Phase 2 projects for MMWD.

3.1.3.1 Recycled Water Treatment

Use of Central Marin Sanitation Agency (CMSA) effluent in MMWD's service area may require additional treatment for some uses because of the higher salt content of CMSA's wastewater influent. The 2000 study identified a potential 4-mgd treatment plant using microfiltration and reverse osmosis to reduce the salt concentration for recycled water use in landscape irrigation.

3.1.3.2 Recycled Water Storage

The 0.5-MG Peacock Gap tank would be converted from potable water storage to recycled water storage if the Peacock Gap project (see Section 3.1.3.3) proceeds. No other storage was specifically mentioned in the 2000 study; however, it would be reasonable to assume some system operational storage may be required to allow for overnight irrigation schedules typical of landscape irrigation systems.

3.1.3.3 Recycled Water Distribution

The 2000 *Recycled Water Expansion Feasibility Study* identified 21 potential service areas that could be served approximately 1,860 AFY by LGVSD and/or CMSA (Marin Municipal Water District 2000). The

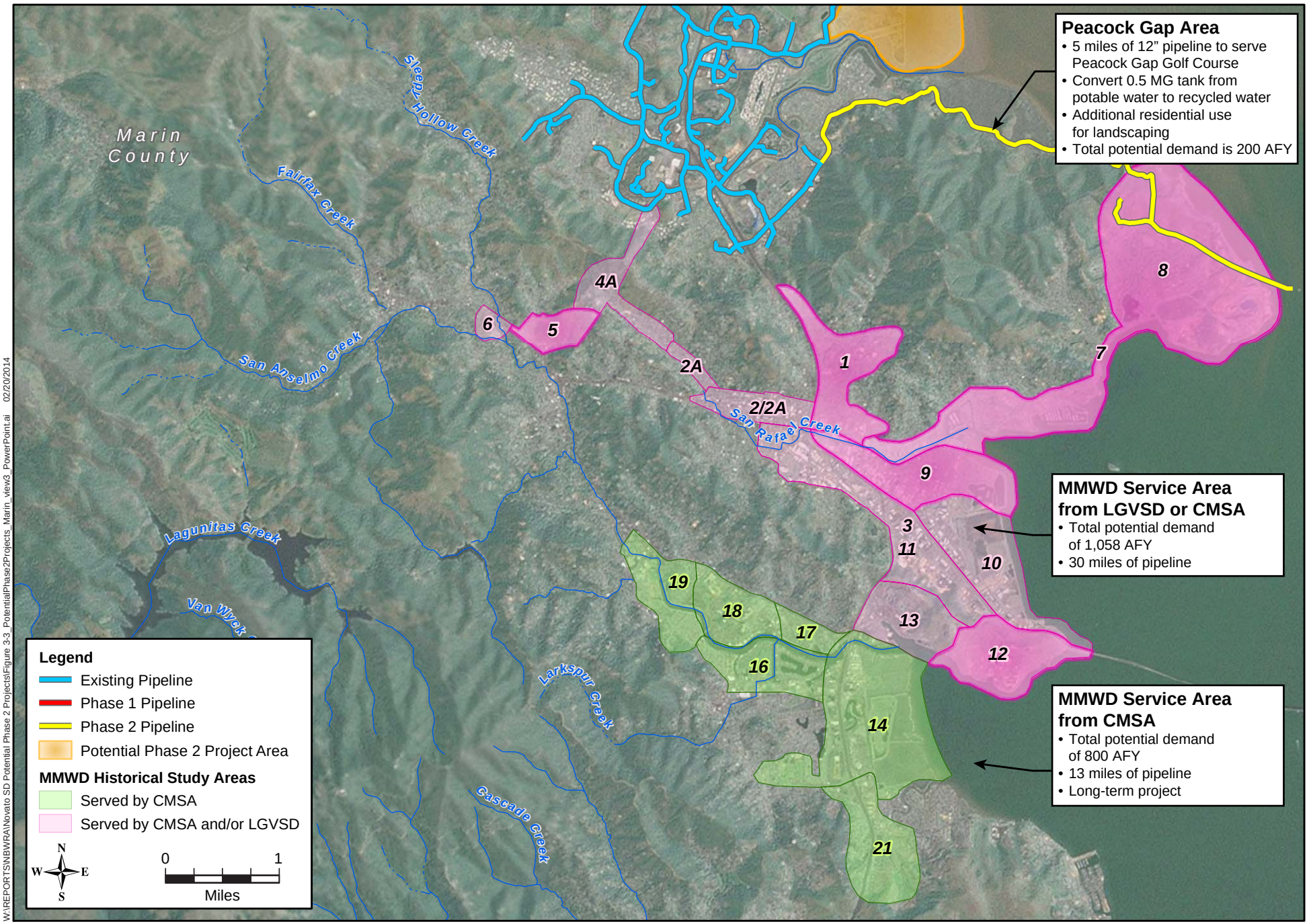

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Figure 3-3
MMWD Potential Phase 2 Projects

subareas that could be served by LGVSD or CMSA were estimated to have a demand of about 1,060 AFY. Included in the northern area is the Peacock Gap project previously identified in the Project Definition Scoping Study Report. The southern subareas that were anticipated to be served from CMSA had a demand of about 800 AFY.

MMWD staff indicated the most likely subareas to be considered for service area:

- Peacock Gap Golf Course and surrounding area (200 AFY);
- San Quentin Prison (175 AF).
- Mt. Tamalpais Cemetery (27 AFY);

The Peacock Gap area and the Mt. Tamalpais Cemetery could be served by either LGVSD or CMSA; these areas account for approximately 227 AFY of recycled water demand. The Peacock Gap project would provide approximately 170 AFY of tertiary recycled water for the Peacock Gap Golf Course and would consist of a 12" diameter pipeline totaling approximately 25,500 LF. The pipeline would begin at the end of the existing MMWD recycled water distribution system on North San Pedro Road, follow North San Pedro Road east towards Peacock Gap, and end at the existing Peacock Gap tank. Several homeowner associations and residential neighborhoods along the pipeline to the golf course would also be served recycled water for irrigation. MMWD has estimated the project would supply water to a total of 10 acres of landscaping, equating to approximately 30 AFY, based on typical water use rates for landscape irrigation.

The San Quentin Prison area would require a new treatment plant and distribution system storage at or near CMSA. MMWD is planning to partner with CMSA to update the costs and volumes of potential recycled water demand in these areas. This would be a stand-alone project to provide recycled water to San Quentin prison for toilet flushing. This project would, conceptually at least, consist of a small treatment plant and pump station co-located at CMSA with a pipeline directly to a new storage tank on the grounds of the prison. Although CMSA effluent is discharged within the Program boundaries CMSA is not a member of the NBWRA and funding is not available to CMSA under the NBWRP's Federal Authorization.

MMWD is exploring the use of recycled water from the Sewerage Agency of Southern Marin (SASM). MMWD and SASM are partnering to study the demand for recycled water in SASM's service area; however, service areas south of Point San Quentin are not in the geographic boundary of the NBWRP Federal Authorization and are not included in this study.

MMWD is considering extending its existing recycled water distribution system westward to serve additional customers in the Lucas Valley area. The project would include construction of a 6" pipeline totaling approximately 10,600 LF. The pipeline would begin at the end of the existing distribution system on Lucas Valley Road and follow Lucas Valley Road for approximately 3,000 LF. It would then turn north and west again and run through a mostly residential neighborhood with several institutional and recreational facilities. This new pipeline would supply recycled water for irrigation at those facilities. The estimated amount of recycled water supplied by this new pipeline is 21 AFY.

3.1.3.4 Groundwater Recharge

MMWD has not identified any groundwater recharge projects as part of the NBWRP Phase 2 Program.

3.1.3.5 Other Project Opportunities and Interaction with Agencies/Organizations

Expanding recycled water service in the MMWD service area would require close coordination and agreements with LGVSD or CMSA. Section 3.1.2.5 discusses potential coordination with LGVSD on distribution projects.

3.1.4 Integration with Marin County

The Marin County subarea has demonstrated significant opportunities for synergistic water supply, effluent management, and recreation and habitat restoration projects that would engage multiple agencies in cooperative alternatives. Additionally, these agencies share a commitment to design projects to leverage financial resources, mitigate impacts of sea-level rise due to climate change, and minimize discharges of highly treated recycled water into the bay.

On January 9, 2013, a meeting was held with Liz Lewis, Marin County Flood Control and Water Conservation District, to review the previously identified projects, identify new conceptual projects for study, and provide project information and insights. Liz Lewis also attended the Marin County agencies subregion meeting on February 25, 2013. Additional background information was drawn from the Marin County Watershed Program website, www.marinwatersheds.org.

3.1.4.1 Novato Creek Watershed

Marin County is currently conducting watershed studies on Novato Creek as part of the county-wide Watershed Program. The Novato Watershed Program is described as follows:

> "The purpose of the Novato Watershed Program is to identify opportunities to integrate flood protection goals with creek and wetland restoration elements. This process includes evaluating alternatives that would reduce flood protection maintenance costs and impacts and be resilient to sea level rise…This program seeks to provide the County and its partner agencies, City of Novato, North Marin Water District and the Novato Sanitary District, with alternatives that reduce sediment input from upstream sources and rely on the inherent ability of Novato Creek to scour its channel and transport more sediment to the Bay….This program will seek opportunities watershed wide to improve our operations and maintenance in a manner that is informed by sea level rise projections while we identify alternatives that would improve the creek's ability to transport sediment to the bay. The process considers the restoration of watershed health and function as a basic tenet to ensure our projects are eligible for the broadest range of funding at the State and Federal levels." (Marin County 2013)

As indicated in Section 3.1.1.5, construction of the proposed Novato SD storage wetlands would allow Novato SD to end its lease of lands owned by the Marin County Flood Control and Water Conservation District. The lands, referred to as "Flood Control Lands," are currently leased to Novato SD for a reclamation facility. Without use by Novato SD, the lands could be used for habitat enhancement, recreation, and restoration of the tidal prism in lower Novato Creek. Marin County's preliminary work on the area includes ongoing hydrologic and hydraulic studies, geomorphology, definition of fauna and flora, and preliminary design. The marsh restoration proposes the use of sediment dredged from nearby flood control channels as construction and maintenance material for the upland ecotone. Recycled water from Novato SD could be used to irrigate the upland ecotone slope. Marin County began design of marsh restoration in lower Novato Creek in winter 2013.

In conjunction with Novato SD, Marin County will incorporate analysis of a potential right-of-way alignment for a potential future pipeline to convey recycled water from the pond to agricultural and vineyard users in southern Sonoma County. Although this pipeline is considered just a future possibility by Novato SD that would be studied only if demands are demonstrated, the goal is to not preclude any future opportunities for expanded reuse.

3.1.4.2 Miller Creek Watershed

Miller Creek flows eastward until it passes under Highway 101 and enters the baylands at the Northwest Pacific Railroad (NWPRR) Bridge. Downstream of the NWPRR Bridge, the channel was rerouted to the south and placed into a narrow, leveed channel before reaching San Pablo Bay in the 1920s. From November through April, tertiary-treated recycled water is released by LGVSD to Miller Creek which leads to San Pablo Bay. The constrained Miller Creek alignment causes sediment to deposit in the area. The sediment acts as both a constraint to LGVSD flows to the bay and to fish migrating from the bay. There is interest in Marin County to address the issue and realign Miller Creek east of the NWPRR Bridge to provide a more natural, direct connection to San Pablo Bay.

This project could work in conjunction with the McInnis Marsh project discussed with LGVSD in Section 3.1.2.5. The McInnis Marsh located south of the LGVSD facilities has the potential for a brackish water marsh project for Marin County and LGVSD. Use of LGVSD flows could reduce saline intrusion into the McInnis County Park and golf course area, support the proposed habitat enhancement in the marsh, and provide LGVSD with an additional effluent management and reuse opportunity.

3.2 Sonoma County Subregion

3.2.1 Sonoma Valley County Sanitation District

Sonoma Valley faces multiple issues: water supply needs; reduced groundwater levels; and salinity intrusion into the groundwater basin. SCWA intends to address these concerns through a TWM approach that incorporates recycled water use and recycled water storage

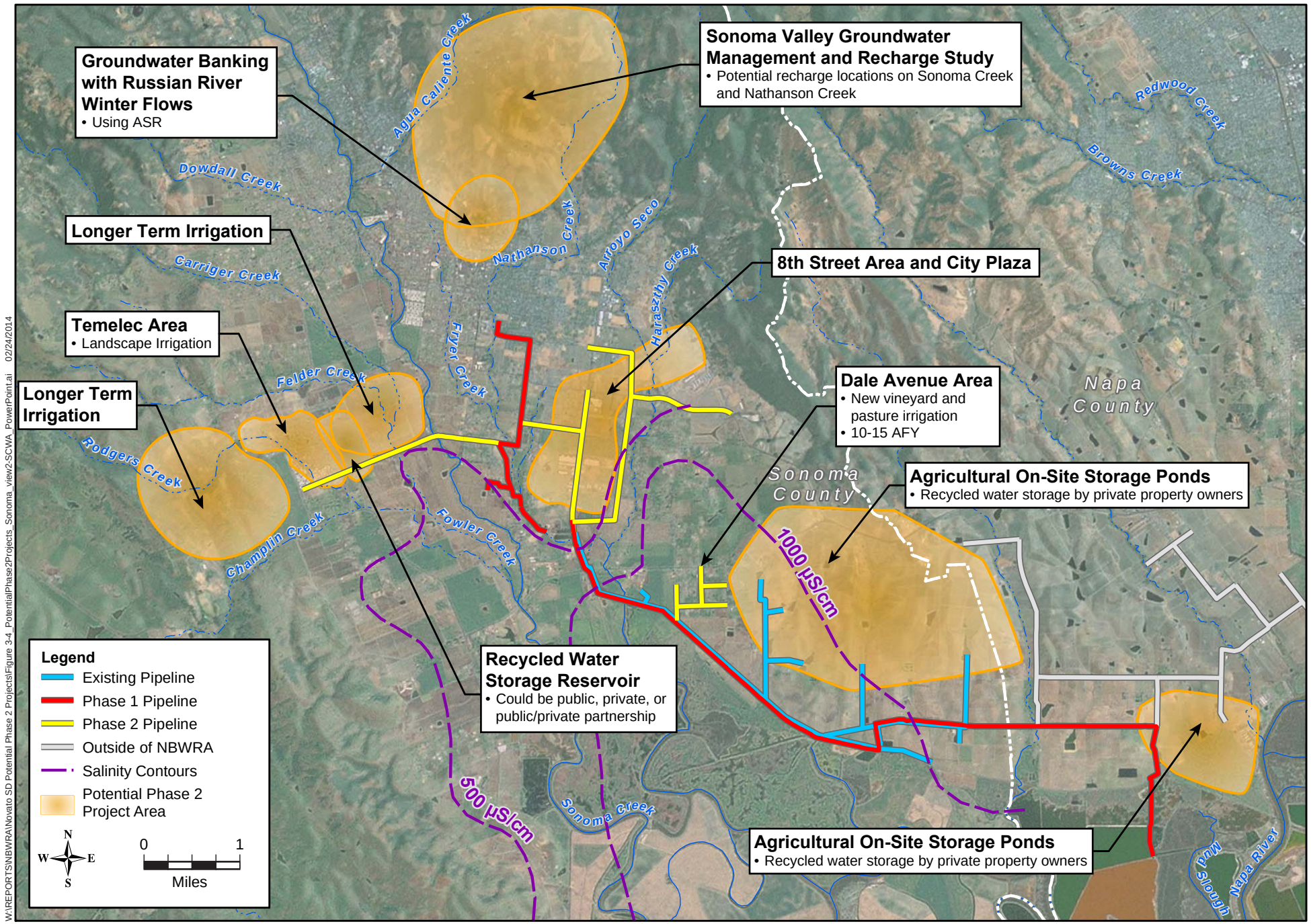
Potential project opportunities for SVCSD were identified through several meetings with SCWA staff. On January 9, 2013, the project team met with Kevin Booker, Jay Jasperse, Tom Dowdell, and Kent Gylfe. A follow-up meeting was also held on March 7, 2013 with Kevin Booker, Jay Jasperse, and Kent Gylfe. Additional input was provided during Program workshops. Figure 3-4 presents the potential Phase 2 projects for SVCSD.

3.2.1.1 Recycled Water Treatment

SVCSD has not identified any additional recycled water treatment capacity as part of the NBWRP Phase 2.

3.2.1.2 Recycled Water Storage

Significant winter effluent flows will soon be dedicated to salt pond restoration in the Napa-Sonoma Marshes Wildlife Area, reducing the need for seasonal storage for the next 10 to 15 years while the restoration work is underway. While no additional SVCSD-owned storage is identified at this time, there are other opportunities for additional storage of SVCSD-supplied recycled water within Sonoma Valley. Agricultural irrigators are potentially interested in taking winter effluent and storing it in their existing or new irrigation ponds. These agricultural areas are located in SVCSD's existing service area in the Carneros Region and to the east of the future SVCSD Salt Marsh pipeline. Through a review of



W:\REPORTS\NBWRA\Novato SD Potential Phase 2 Projects\Figure 3-4_PotentialPhase2Projects_Sonoma_view2-SCWA_PowerPoint.ai 02/24/2014

Data Source(s): ESRI World Imagery Service, CDM Smith, ESA
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Figure 3-4
SCWA/SVCSD Potential Phase 2 Projects

the vineyard acreage within the targeted area, it is estimated that approximately 314 AFY could be stored in private irrigation ponds.

Other areas in Sonoma Valley may also be suitable locations for public, private, or public/private partnerships for recycled water storage. These concepts would be evaluated in more detail in the Feasibility Study.

3.2.1.3 Recycled Water Distribution

Near-Term Projects

SVCSD has identified new recycled water pipelines to expand its recycled water service area north, east, and west of the SVCSD WWTP. One branch would begin at the WWTP and extend north for approximately three miles in the 8th Street area, with a potential demand of approximately 250 AFY. Another branch would connect to the end of an existing Phase 1 pipeline and continue west, with a potential demand of 400-550 AFY. A third location for new distribution pipelines is in the vicinity of Dale Avenue. New vineyard and pasture irrigation in this area have an estimated demand of 10 to 15 AFY. A fourth location for new distribution pipelines is in the vicinity of the City's Plaza. New landscape irrigation and/or parks in this area have an estimated demand of 25 to 75 AFY.

Potential Future Projects

SVCSD identified some areas in Sonoma Valley that may be opportunities for future recycled water service over the long-term. These areas include additional vineyard irrigation along Watmaugh Road, landscape irrigation at a senior community in Temelec, agricultural irrigation further west of Temelec, and irrigation at Sonoma Mission Inn. In addition, SVCSD identified the option of increasing the capacity of the tertiary effluent line from the WWTP from 12 mgd (currently two 10-inch diameter pipes) to 16 mgd able to accommodate all the treated effluent from the plant for either storage or distribution.

3.2.2 Sonoma County Water Agency

Sonoma Valley faces multiple issues: water supply needs; reduced groundwater levels; and salinity intrusion into the groundwater basin. SCWA intends to address these concerns through a TWM approach that incorporates groundwater storage of surface water and stormwater, along with SVCSD projects for recycled water distribution and recycled water storage.

Potential project opportunities for SCWA were identified through several meetings with SCWA staff. On January 9, 2013, the project team met with Kevin Booker, Jay Jasperse, Tom Dowdell, and Kent Gylfe. A follow-up meeting was also held on March 7, 2013 with Kevin Booker, Jay Jasperse, and Kent Gylfe. Additional input was provided during Program workshops. Figure 3-4 presents the potential Phase 2 projects for SCWA.

3.2.2.1 Groundwater Recharge

SCWA is currently conducting the Sonoma Valley Stormwater Management and Groundwater Recharge Scoping Study to identify potential projects that can meet groundwater management and recharge goals from SCWA's *Water Supply Strategies Action Plan* (Sonoma County Water Agency 2011a). In general, stormwater could be captured through a variety of methods and then allowed to infiltrate into the groundwater basin to aid in recovery of groundwater levels. The study considered projects that would decrease stormwater flows, increase conveyance, modify susceptibility to flood hazards, increase groundwater recharge, or mimic natural site hydrology. The April 2012 *Screening Evaluation and Prioritization Memo* screened and evaluated potential solutions, and identified three

types of projects to move forward for further study and feasibility evaluation: off-stream stormwater retention basins in lower-slope areas; high-flow diversion/recharge channels; and infiltration galleries. Potential locations for these projects include areas of Sonoma Creek and Nathanson Creek (Sonoma County Water Agency 2012). SCWA staff indicated they may conduct a demonstration project with the City of Sonoma, Valley of the Moon Water District, and other stakeholders. SCWA is currently conducting preliminary study of these concepts.

SCWA is also conducting the Upper Petaluma River Watershed Flood Control Project Scoping Study to identify potential projects that will provide regional groundwater recharge benefits within the Upper Petaluma River Watershed, along with flood mitigation. The study is evaluating concepts for their ability to meet the core objectives of groundwater recharge and flood hazard reduction, along with supporting objectives of improving water quality, increasing water supply, supporting energy and water efficiency and climate change resiliency, improving ecosystem functions, preserving agricultural land use and open space, and creating or enhancing community benefits.

The August 2012 *Project Strategy Memorandum* screened and evaluated potential solutions, and identified two types of projects to move forward for further study and feasibility evaluation: off-stream detention basins, which divert high flows to temporary holding ponds for flood reduction and recharge; and floodplain modifications, which create additional storage volume and potential recharge area using existing floodplains (RMC 2012). Specific locations for these projects are yet to be determined as the project is still in conceptual study. The potential project areas cover much of northern Petaluma north of East Washington Street.

3.2.2.2 Other Project Opportunities and Interaction with Agencies/Organizations

The *Sonoma Valley Groundwater Management Plan* included groundwater banking as one component of achieving groundwater sustainability in Sonoma Valley (Sonoma County Water Agency 2007). Modeling in the *Groundwater Management Plan* addressed banking of Russian River winter surplus flows, when potable demands are low, to the aquifer beginning in 2015. Stored groundwater would then be available for withdrawal during dry years. Groundwater banking was found to have the greatest benefit to groundwater storage of all water management options considered in the plan, with an incremental increase in storage of 17,300 AF over a 30-year period (Sonoma County Water Agency 2007). Potential groundwater wells for use in the project (either existing or new wells) could be located east of Sonoma Square. SCWA is conducting a feasibility study on this aquifer storage and recovery (ASR) program which will develop recommendations for potential pilot project locations. ASR is a specific type of aquifer recharge practiced with the purpose of both augmenting groundwater resources and recovering the water in the future for various uses.

SCWA will be conducting the Petaluma River Basin groundwater master plan with support from the City of Petaluma. One facet of the master plan will evaluate potential water banking in the northwestern and western areas of the city. Excess winter Russian River flows could be banked in the groundwater basin using city wells in the vicinity of Highway 101 and Stony Point Road. The currently unfunded groundwater master plan would provide additional investigation needed to determine whether a confined aquifer is present in this area. This project is also identified under Section 3.2.3.5.

3.2.3 Petaluma

Potential project opportunities for the City of Petaluma were identified through meetings and conference calls with City staff. On January 24, 2013, the project team met with Dan St. John and Rem Scherzinger. The project team met with Dan St. John, Dave Iribarne, Leah Walker, and Matt Pierce on

December 12, 2014. Additional input was provided during Program workshops and several conference calls. Figure 3-5 presents the potential Phase 2 projects for Petaluma.

Until recently, the City operated an extensive recycled water program that paid agricultural users to take the Ellis Creek Water Recycling Facility's (WRF's) disinfected secondary effluent during the irrigation season. Agricultural users began paying the City a commodity charge in summer 2013. The City needed to distribute the recycled water because it is restricted from releasing discharge to the Petaluma River between May 1 and October 30 by the San Francisco Bay Regional Water Quality Control Board. The majority of recycled water was used for irrigation of local agricultural and vineyard lands, and the remainder was used to irrigate a portion of Adobe Creek and Rooster Run Golf Courses.

The City is now focusing its efforts on expanding the distribution and use of tertiary treated effluent and has terminated the delivery of secondary effluent. Expanded tertiary use within the City's water service area provides financial benefit to the City from the sale of recycled water and from reduced costs of purchasing imported water from SCWA. Expanded tertiary use also meets the goals of providing "potable water offsets" and reduces the demand on the regional water supply during the critical summer season.

3.2.3.1 Recycled Water Treatment

Additional tertiary treatment capacity may be required at the WRF if all the potential recycled water projects discussed below move forward. The WRF has a capacity of 4.68 mgd of tertiary production. One of the City's priorities is a filter expansion to increase peaking capacity. An immediate capacity expansion is needed to meet current peak hour demand during the summer of 6 mgd. Since the extent of the potential projects that would be implemented over the long-term is still unknown, the full amount of future additional capacity required is difficult to quantify at this time. Further definition of the need will likely occur during Feasibility Study or through independent study by Petaluma. The project will involve re-rating or expanding the existing tertiary filters, increasing the high service pumping capability and adding UV disinfection within an existing structure.

3.2.3.2 Recycled Water Storage

Operational storage is needed to expand the existing tertiary distribution system. The City considered constructing a tank on the east side of the recycled water transmission system to serve peak hour and peak day demands. Recent changes to the recycled water pumping station at the WRF have deferred the need for this project.

The City identified the need for seasonal storage in order to expand their recycled water program. Seasonal storage would allow the plant to store enough winter flows to serve agricultural customers' demand and maximize the benefit of "potable water offsets" to help conserve regional supplies. Potential storage sites are located southeast of the WRF and could also provide habitat restoration or mitigation in partnership with the California State Coastal Conservancy. Additional storage capacity could potentially be gained by raising the height of the oxidation pond levees.

3.2.3.3 Recycled Water Distribution

As a part of Phase 2, the City of Petaluma would move forward with components of its planned expansion of the tertiary recycled water distribution system consisting of 113,000 LF of pipelines. The pipelines would range in size from 6" to 20" in diameter (City of Petaluma 2006). The Urban Recycled Water Expansion would extend recycled water pipelines from the end of an existing operating 20"

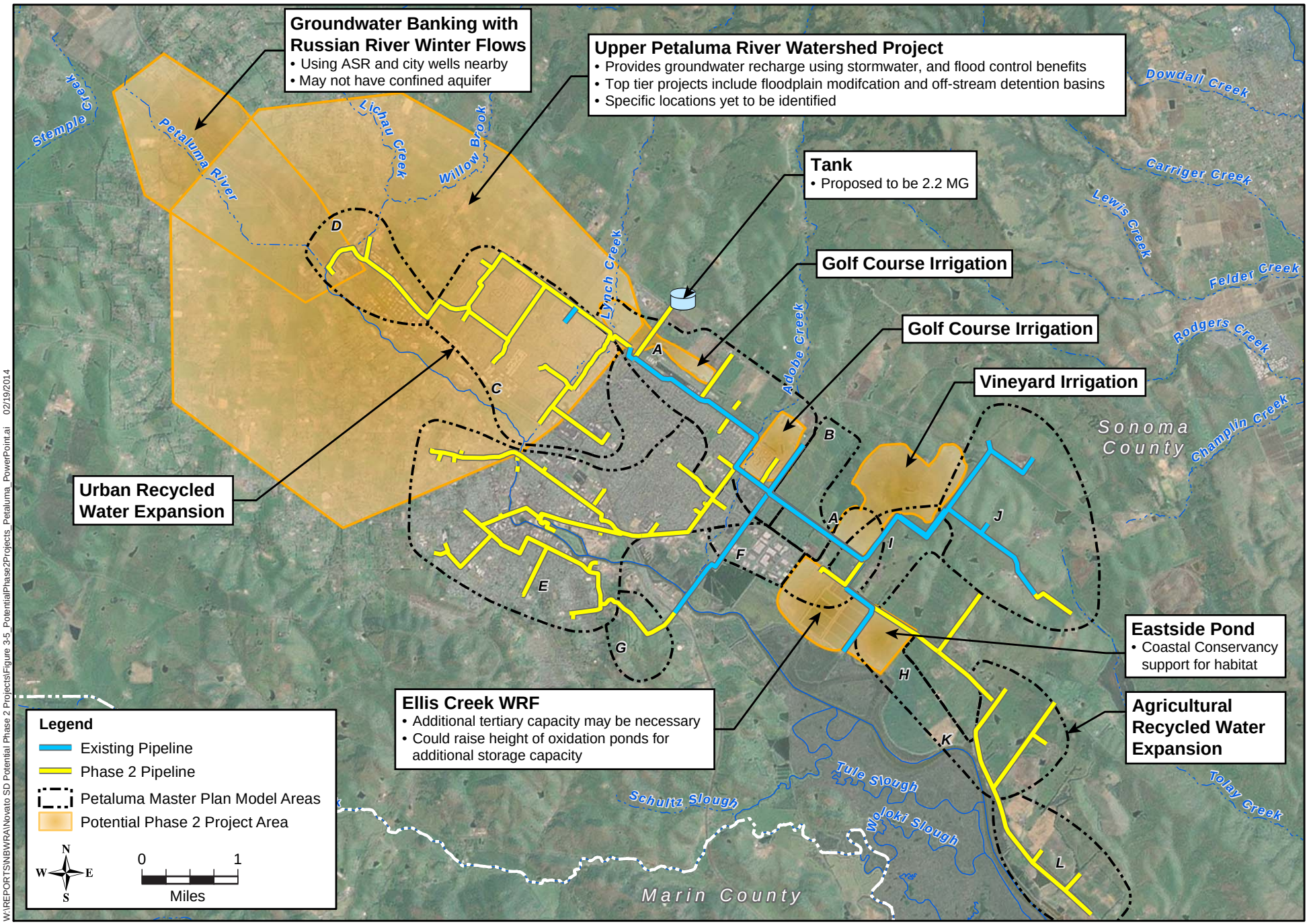

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Figure 3-5
Petaluma Potential Phase 2 Projects

pipeline that originates from the WRF and would run north westward to serve existing open space customers of the City's potable water system, serving approximately 195 AFY (Iribarne 2014). The distribution system would serve mostly schools, parks, landscape medians, and golf courses. The Agricultural Recycled Water Expansion would seek to serve tertiary recycled water to the agricultural customers along Lakeville Highway, approximately 2,585 AFY (Iribarne 2014).

The City has recently converted existing potable water customers to tertiary recycled water – two golf courses, parks, and other areas. The recycled water demand for these customers has averaged approximately 230 AFY over 2011-2012. Petaluma aims to convert additional open space irrigation customers (i.e. parks, schools, roadway landscaping medians, etc.) adjacent to the existing recycled water distribution system.

3.2.3.4 Groundwater Recharge

Petaluma has proposed the Capri Creek Project in the 2013 Bay Area IRWM Plan's Proposition 84 IRWM Implementation Grant application. The goals of the project are to achieve flood reduction, habitat enhancement, groundwater recharge opportunities, expand recreational and educational amenities, and water quality improvements. The project will include the design and construction of a reconfigured channel section, flood terraces, and trails to connect to existing pathways and will reduce flood elevations, provide water quality improvements, increased groundwater recharge opportunity, and riparian habitat enhancement. The project compliments current efforts to integrate other flood control projects with multiple benefits, and supplements the Denman Reach projects that provide similar benefits along the Petaluma River in the north west of the City.

3.2.3.5 Other Project Opportunities and Interaction with Agencies/Organizations

Petaluma is exploring opportunities to partner with SCWA on the Petaluma River Basin groundwater master plan and will evaluate potential water banking in the northwestern and western areas of the city, similar to the program proposed in Sonoma Valley (see Section 3.2.2.2). Excess winter Russian River flows and/or recycled water could be banked in the groundwater basin using city wells in the vicinity of Highway 101 and Stony Point Road. The currently unfunded groundwater master plan would provide additional investigation needed to determine whether a confined aquifer is present in this area.

3.3 Napa County Subregion

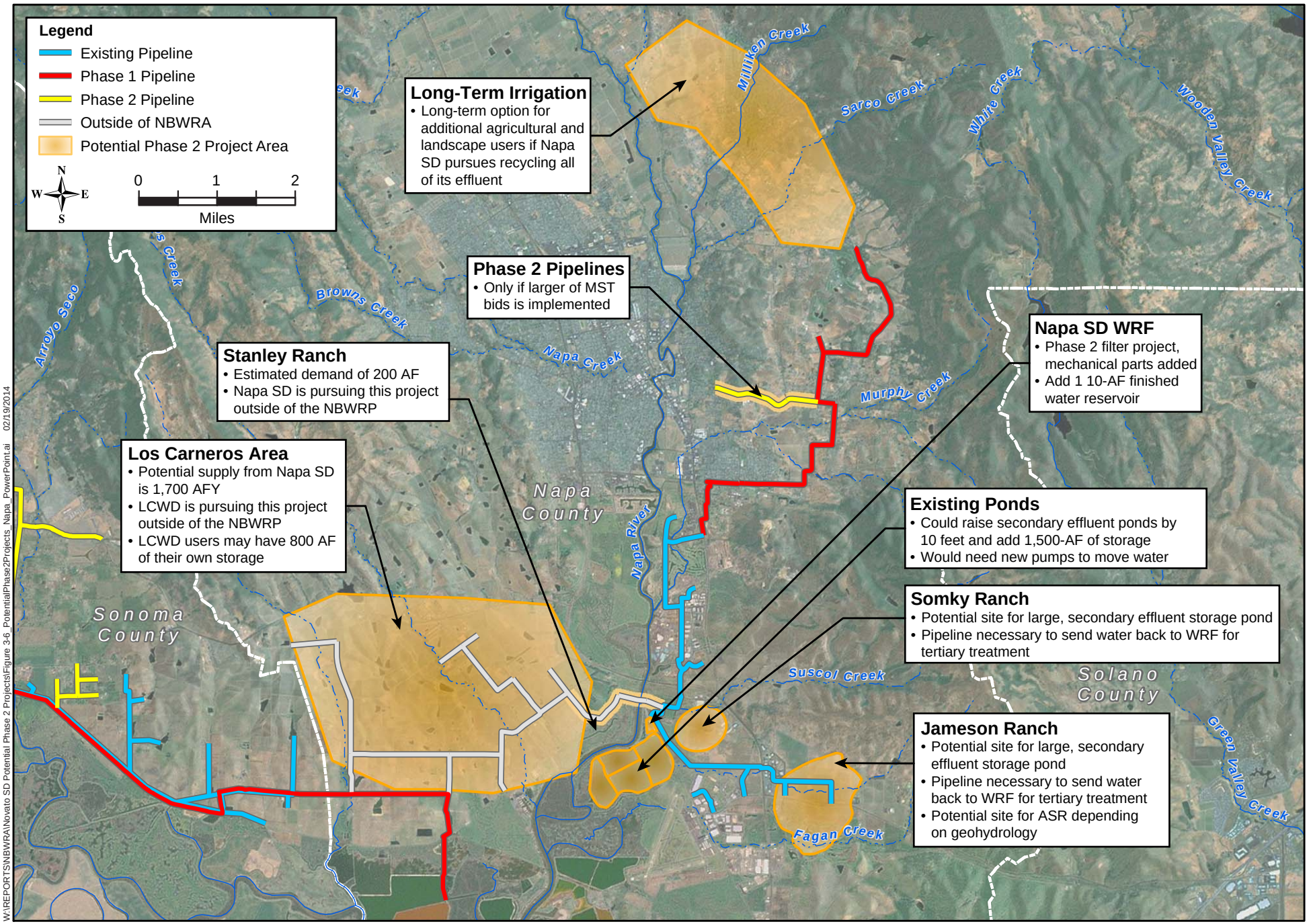
Potential project opportunities for Napa SD were identified through several meetings with Napa SD staff. The project team met with Tim Healy and Jeff Tucker on January 10, 2013 and March 7, 2013. Figure 3-6 presents the potential Phase 2 projects for Napa SD. Additional interface and input was provided by Napa County.

3.3.1 Napa SD

3.3.1.1 Recycled Water Treatment

Near-term Projects

As part of Phase 2, Napa SD will construct an additional 600 square feet of filters at the Soscol WRF to increase the tertiary treatment capacity by 1.7 mgd. The filter basins are being constructed as part of Phase 1 of the NBWRP; Phase 2 work will consist of adding the mechanical parts to the filter basins, and adding associated pumping, piping, and treatment capacity in the plant.



W:\REPORTS\NBWRA\Novato SD Potential Phase 2 Projects\Figure 3-6_PotentialPhase2Projects_Napa_PowerPoint.ai 02/19/2014

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Figure 3-6
Napa SD Potential Phase 2 Projects

Long-Term Projects

If Napa SD expands capacity for storage of seasonal secondary effluent (see 3.3.1.2 below) and recycled water demand exceeds the limitations of the filter system described above, additional secondary clarification (dissolved air flotation or flocculation), expanded filter capacity and another chlorine contact basin will be required to meet this recycled water demand.

3.3.1.2 Recycled Water Storage

Napa SD is considering a number of potential storage projects under Phase 2 to increase the irrigation season supply of recycled water. A 10-AF storage pond would be constructed to store tertiary-treated, finished recycled water that would be supplied to customers to meet daily peak demands. Similar to two existing finished water ponds at the WRF, the new pond would have a lined clay bottom, concrete-lined side slopes, and a Hypalon cover. Napa SD is also considering the possibility of a 1.2-MG storage tank on Napa State Hospital property to assist with pressure and peak demands in the Milliken-Sarco-Tulocay (MST) recycled water distribution area.

Napa SD has additionally identified several options for larger, seasonal storage of secondary effluent.

- At the WRF, Napa SD wants to investigate raising the height of the existing levees on their oxidation ponds by up to 10 feet and storing an additional 3,000 AF of secondary-treated recycled water. A geotechnical and structural investigation would be needed to evaluate the levees for their ability to be raised and hold that much more recycled water. If this project is proved to be feasible, the other seasonal storage options would not be necessary to pursue.

- Napa SD also identified their Somky Ranch and Jameson Ranch as potential sites for storage of seasonal, secondary-treated recycled water. Either of these ponds would require construction of a pipeline back to the WRF so the effluent could be treated to tertiary level prior to distribution. Somky Ranch is currently leased for potential development, but the status of that project is uncertain.

- Early Phase 1 studies identified ASR in Napa County as a potential option for additional storage for Napa SD. Napa SD had initiated a study to evaluate the viability of aquifer storage by assessing the potential capacity, benefits, and drawbacks of aquifer storage for local recycled water projects. The 2008 *Evaluation of the Hydrogeologic Feasibility of Aquifer Storage and Recovery* identified that 320 to 3,250 AF of storage was potentially available for Napa SD through ASR in the Jameson Ranch area (Napa Sanitation District and California Department of Water Resources 2008). Groundwater storage typically has fewer disturbances to local land uses and existing habitats than other types of storage, but physical and regulatory constraints can make this a challenging option. This storage concept would require geotechnical evaluation to determine the amount of volume that would be made available by hydrofracture. Hydrofracturing, commonly referred to as hydrofracking or simply "fracking," is a water well development process that involves injecting water under high pressure into a bedrock formation via the well. This is intended to increase the size and extent of existing bedrock fractures, thereby enlarging the network of water-bearing fractures as well as the size of the area supplying water to the well.

3.3.1.3 Recycled Water Distribution

Near-Term Projects

Napa SD has identified one new branch to their recycled water distribution system as a potential project for Phase 2. A 3,200-LF pipeline extension would expand the Phase 1 recycled water pipeline network in the MST area. The new 12" pipeline would supply an estimated 77 AFY of recycled water to an existing cemetery for landscape irrigation. This estimate was developed through an aerial review of the landscaped acreage at the cemetery. Other properties along the pipeline, such as a middle school and vineyards, could also be served, and contribute to an offset of Delta water. This project would most likely move forward only if the larger of the two MST pipeline designs is constructed under the Phase 1 Program.

Long-Term Projects

Napa SD's *Strategic Plan for Recycled Water Use in the Year 2020* identified long-term options for additional agricultural and landscape irrigation (Napa Sanitation District 2005). Seven strategies were proposed for consideration. At that time, it was recommended that Strategy No. 3, which maximized use of existing storage, be implemented in phases as funding became available. Using the existing storage, the maximum amount that could be recycled was determined to be 4,540 AFY. Strategy No. 3 was intended to provide water to three important areas in the vicinity of Napa: Carneros; MST; and Silverado.

However, the report noted that significantly greater use of recycled water could occur. The potential for recycled water production was estimated to be 9,800 AFY in 2020 and sufficient users were identified for all the recycled water produced. To serve this amount of recycled water, additional storage is necessary during the winter months when irrigation does not occur.

3.3.1.4 Groundwater Recharge

Napa SD has not identified any groundwater recharge projects as part of the NBWRP Phase 2.

3.3.1.5 Other Project Opportunities and Interaction with Agencies/Organizations

There are two projects under study in Napa County that are considering the use of recycled water from Napa SD. These projects are moving forward before the NBWRP's Phase 2 program would be ready for construction and are being pursued outside of the NBWRA Program. The total potential demand for these projects is approximately 1,900 AFY. The quantity of recycled water Napa SD would have available to serve these customers is dependent upon the amount of recycled water use developed in the MST area, which is one of Napa SD's Phase 1 projects.

3.4 Summary

The preceding sections described a wide range of potential near-term and conceptual long-term projects that could be used to formulate conceptual Phase 2 Alternatives for future Feasibility Study. The intent is to provide a complete picture of long-term potential for water use in the NBWRA area. Some projects have been noted as not likely for inclusion at this time due to project status or input from the Member Agency responsible for the project. However, as alternatives are formulated in the Feasibility Study, some of those projects may be cost-effective or provide benefits to support inclusion and potential implementation. The conceptual alternatives formulated from the projects are addressed in Section 5.

Section 4
Water Operations/Recycled Water Storage Requirements

This section presents the current and projected recycled water supplies for the NBWRA area derived from Member Agency flow projections. Additionally, the section provides a preliminary look at potential operations and potential recycled water storage needs based on the currently available information for the potential Phase 2 opportunities described in Section 3. As shown in the discussions below, the Member Agencies have sufficient supplies to serve additional users, beyond those identified in Section 3. If they are identified in the future, these users will further contribute to regional water supply resiliency. Many Member Agencies have identified several potential storage projects that could be implemented over time for a range of users and benefits as those are developed.

4.1 Recycled Water Supply

The following subsections estimate the recycled water supply based on information collected from each of the Member Agencies. The current and projected influent flows to the water reclamation plants are estimated and summarized agency. The projected influent flows are estimated based on anticipated population growth that may increase the flows and the potential reductions in flow due to anticipated inflow and infiltration (I&I) reduction projects and to water use conservation measures occurring in each agency's service area. The available recycled water supply for Phase 2 is then estimated by subtracting out the flows dedicated to existing uses and flows projected for use in the Phase 1 projects. Many of the Phase 1 projects did not rely on seasonal storage and used significant amounts of the summer supplies to meet peak summer demands; therefore, much of the recycled water supply produced in the summer is not available for Phase 2.

4.1.1 Marin County Subregion

The Marin County subregion includes discussion of the recycled water supplies of LGVSD and Novato SD. NMWD, MMWD, and Marin County do not generate recycled water and therefore are not discussed in this section.

4.1.1.1 Novato SD

Current and projected influent flows to Novato SD were developed using the *Phase 2 Project Definition Scoping Study Report* (NBWRA 2012) and the *Novato Sanitary District Facility Plan* (Novato Sanitary District 2004). The *Phase 2 Project Definition Scoping Study Report* documented the 2010 monthly inflows to Novato SD. The 2004 Facility Plan presented the projected average dry weather flow (ADWF), average wet weather flow (AWWF), and the average annual flow for 2025 (build-out). The projected build-out ADWF, AWWF, and seasonal peak flow patterns for 2025 were developed by using the monthly flow patterns from 2010 flow data.

Pre-Phase 1 (also referred to as "existing") recycled water demands and Phase 1 demands were developed using information about areas currently receiving recycled water from Novato SD in addition to areas that are proposed to be served by Novato SD or NMWD during Phase 1 as presented in the *Phase 2 Project Definition Scoping Study Report.* Recycled water supplies available for Phase 2

opportunities were developed by reducing the anticipated 2025 recycled water supply by the sum of the existing and expected Phase 1 recycled water demands.

Table 4-1 presents a summary of the calculations performed. Figure 4-1 shows the monthly distribution of 2010 WWTP inflows (blue line), projected 2025 WWTP inflows (green line), existing and Phase 1 recycled water demands (red line), and the supply available for future Phase 2 opportunities (purple line).

Table 4-1. Summary of Novato SD Inflows and Projected Phase 2 Recycled Water Supply

Month	WWTP Inflows (2010)		Projected WWTP Inflows (2025)		Existing & Phase 1 Demands		2025 Supply Available for Phase 2	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	224	*688*	280	*858*	0	*1*	279	*857*
February	204	*627*	270	*830*	0	*1*	270	*829*
March	214	*657*	267	*821*	2	*7*	265	*814*
April	202	*621*	256	*785*	18	*57*	237	*729*
May	156	*480*	233	*714*	23	*71*	210	*644*
June	130	*399*	215	*661*	44	*136*	171	*525*
July	132	*406*	212	*651*	52	*159*	160	*492*
August	127	*391*	211	*646*	53	*163*	157	*483*
September	128	*393*	211	*648*	36	*112*	175	*537*
October	136	*417*	214	*658*	29	*88*	186	*570*
November	144	*441*	221	*677*	4	*11*	217	*666*
December	236	*725*	281	*862*	1	*4*	276	*857*
Total [1]	**2,034**	***6,244***	**2,870**	***8,811***	**263**	***808***	**2,607**	***8,003***

Notes:
[1] Values have been rounded.

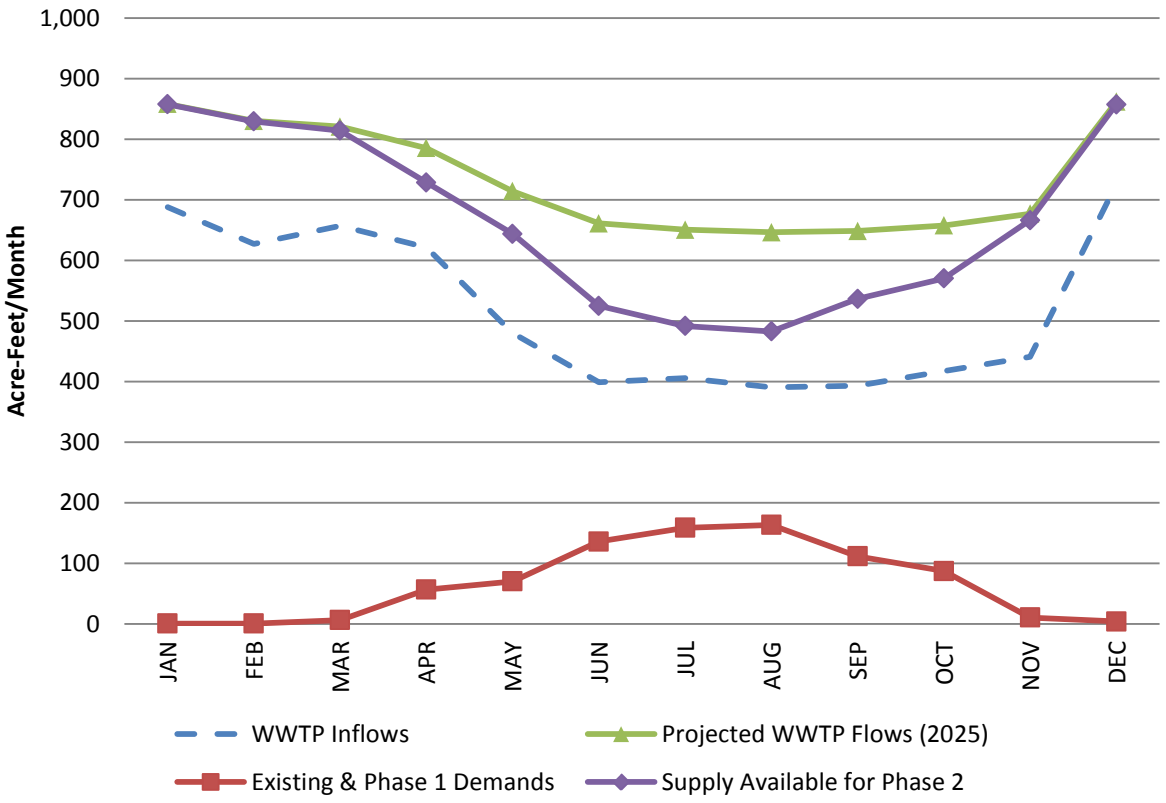


Figure 4-1
Novato SD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2

4.1.1.2 LGVSD

The potential 2030 recycled water supply for LGVSD was calculated by adjusting the 2010 monthly inflows described in the *Phase 2 Project Definition Scoping Study Report* using information provided by LGVSD (Williams 2011). This information indicated that LGVSD is essentially at build-out conditions and there is no expectation that base flows will increase by more than 100,000 gallons per day (gpd) over the next 20 years. LGVSD expects that I&I will decrease by approximately one percent every year. I&I reductions will reduce the seasonally-driven flow volumes, those above the base flow rate, that are received at the treatment plant. The monthly flows for 2030 were calculated by estimating the potential reduction in inflows due to I&I using the following steps:

1) Remove the 2010 base flow from each month. For this calculation, it was assumed that the base flow was equivalent to the minimum month's flow; this was 2.09 mgd in September 2010.

2) Reduce the remaining flow based on projected I&I reduction program. This was assumed to be 20%, equivalent to 20 years of a 1% reduction per year.

3) Add the flow from #2 above back to the base flow (2.09 mgd).

4) Add 100,000 gpd per information provided by LGVSD.

Existing and Phase 1 demands were estimated using information about areas currently receiving recycled water from LGVSD and MMWD in addition to areas that are proposed to be served by LGVSD and NMWD in Phase 1 as presented in the *Phase 2 Project Definition Scoping Study Report.* Recycled water supply available for Phase 2 opportunities was developed by reducing the projected 2025 recycled water supply by the expected sum of the existing and Phase 1 recycled water demands.

Table 4-2 presents a summary of the calculations performed. Figure 4-2 shows the monthly distribution of 2010 inflows (blue line), projected 2030 inflows (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line).

Table 4-2. Summary of LGVSD Inflows and Projected Phase 2 Recycled Water Supply

Month	WWTP Inflows (2010)		Projected WWTP Inflows (2030)		Existing & Phase 1 Demands		2030 Supply Available for Phase 2	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	144	*442*	131	*403*	0	*0*	131	*403*
February	125	*383*	114	*351*	0	*0*	114	*351*
March	114	*348*	107	*328*	0	*0*	107	*328*
April	109	*334*	103	*315*	19	*58*	84	*257*
May	79	*241*	79	*242*	23	*72*	55	*170*
June	69	*212*	71	*218*	45	*139*	26	*79*
July	67	*207*	70	*215*	53	*162*	17	*53*
August	66	*202*	69	*211*	54	*167*	14	*44*
September	63	*192*	66	*201*	37	*114*	28	*87*
October	66	*204*	69	*212*	29	*89*	40	*123*
November	69	*212*	71	*217*	0	*0*	71	*217*
December	126	*387*	117	*358*	0	*0*	117	*358*
Total [1]	**1,096**	***3,365***	**1,066**	***3,271***	**261**	***800***	**805**	***2,471***

Notes:
[1] Values have been rounded.

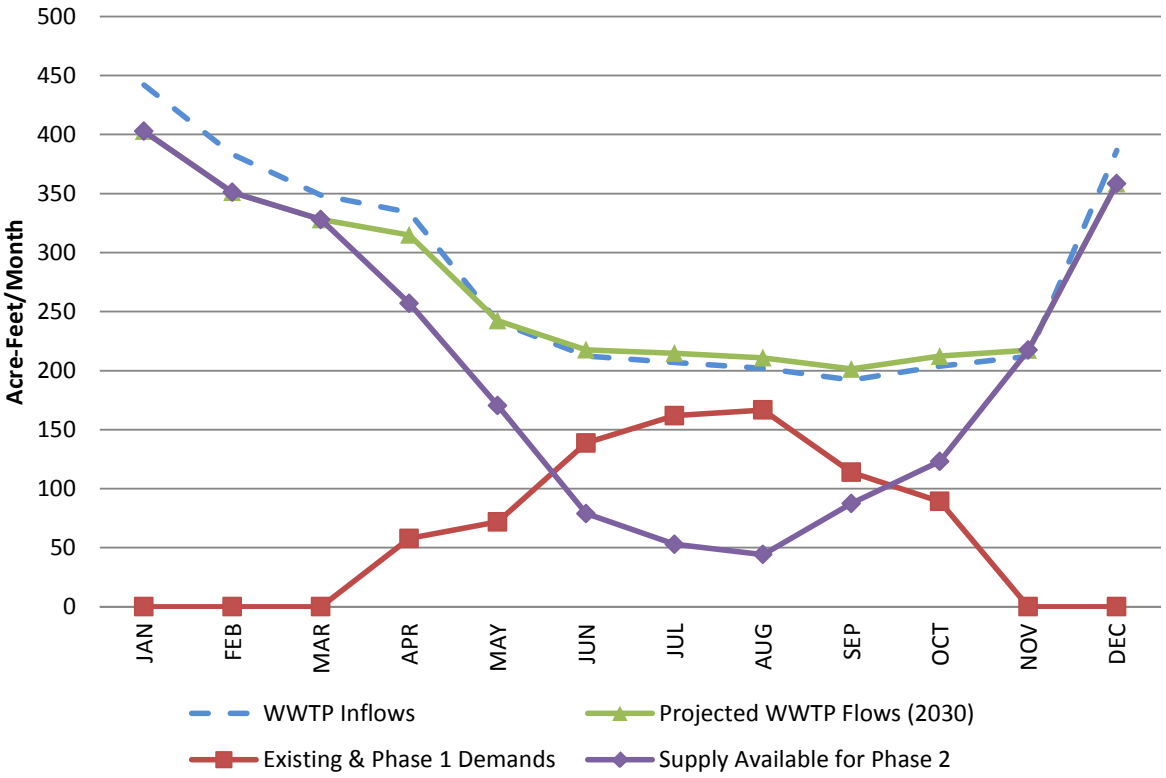


Figure 4-2
LGVSD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2

4.1.2 Sonoma County Subregion

The Sonoma County subregion includes discussion of the recycled water supplies of SVCSD and the City of Petaluma. SCWA does not generate recycled water and therefore is not discussed in this section.

4.1.2.1 SVCSD

Potential 2030 inflows to SVCSD were based on SVCSD's documented 2010 flows, as described in the *Phase 2 Project Definition Scoping Study Report*. The 2010 base flow was projected to 2030 by equating increased wastewater inflow to increases in the projected water use in the City of Sonoma and the Valley of the Moon Water District. It was assumed that the percentage increase in wastewater would be approximately equivalent to the percentage increase in water use. Based on the *Sonoma County Water Agency Urban Water Management Plan* (Sonoma County Water Agency 2011b), it was estimated that the total water supplied in 2010 to the City of Sonoma and the Valley of the Moon Water District was 4,105 AFY. The 2010 Urban Water Management Plan projected that in 2030 5,768 AFY would be supplied, a 40% increase over the 2010 value. This percentage increase was applied to the regional base wastewater flow, resulting in a 26 MG/month (or 80 AF/month) increase for each of the 2010 monthly flows.

Existing and Phase 1 recycled water demands were developed using information about areas currently receiving recycled water from SVCSD in addition to areas that are proposed to be served by SVCSD during Phase 1, as presented in the *Phase 2 Project Definition Scoping Study Report.* Recycled

water available for Phase 2 opportunities was developed by reducing the anticipated 2030 recycled water supply by the sum of the existing and expected Phase 1 recycled water demands.

Table 4-3 presents a summary of the calculations performed. Figure 4-3 shows the monthly distribution of the 2010 WWTP inflows (blue line), projected 2030 WWTP inflows (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line). Negative flows are shown for the available supply in the summer months, indicating that demand for recycled water is greater than the available supply for that particular month. The demands can be met because a seasonal storage reservoir was developed in Phase 1 to store winter flows to meet summer demands.

Table 4-3. Summary of SVCSD Inflows and Projected Phase 2 Recycled Water Supply

Month	WWTP Inflows (2010)		Projected WWTP Inflows (2030)		Existing & Phase 1 Demands		2030 Supply Available for Phase 2	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	171	*525*	197	*606*	106	*326*	91	*280*
February	148	*455*	175	*536*	106	*325*	69	*211*
March	152	*466*	178	*547*	107	*328*	72	*220*
April	148	*454*	174	*535*	116	*355*	59	*180*
May	91	*278*	117	*359*	81	*249*	36	*110*
June	71	*219*	98	*300*	122	*373*	-24	*-73*
July	66	*203*	92	*284*	120	*369*	-28	*-85*
August	68	*208*	94	*289*	81	*247*	13	*41*
September	65	*200*	92	*281*	29	*88*	63	*193*
October	81	*248*	107	*329*	9	*27*	98	*302*
November	89	*274*	116	*355*	106	*326*	9	*29*
December	198	*609*	225	*690*	106	*325*	119	*365*
Total [1]	**1,348**	***4,138***	**1,665**	***5,110***	**1,088**	***3,339***	**577**	***1,772***

Notes:
[1] Values have been rounded.

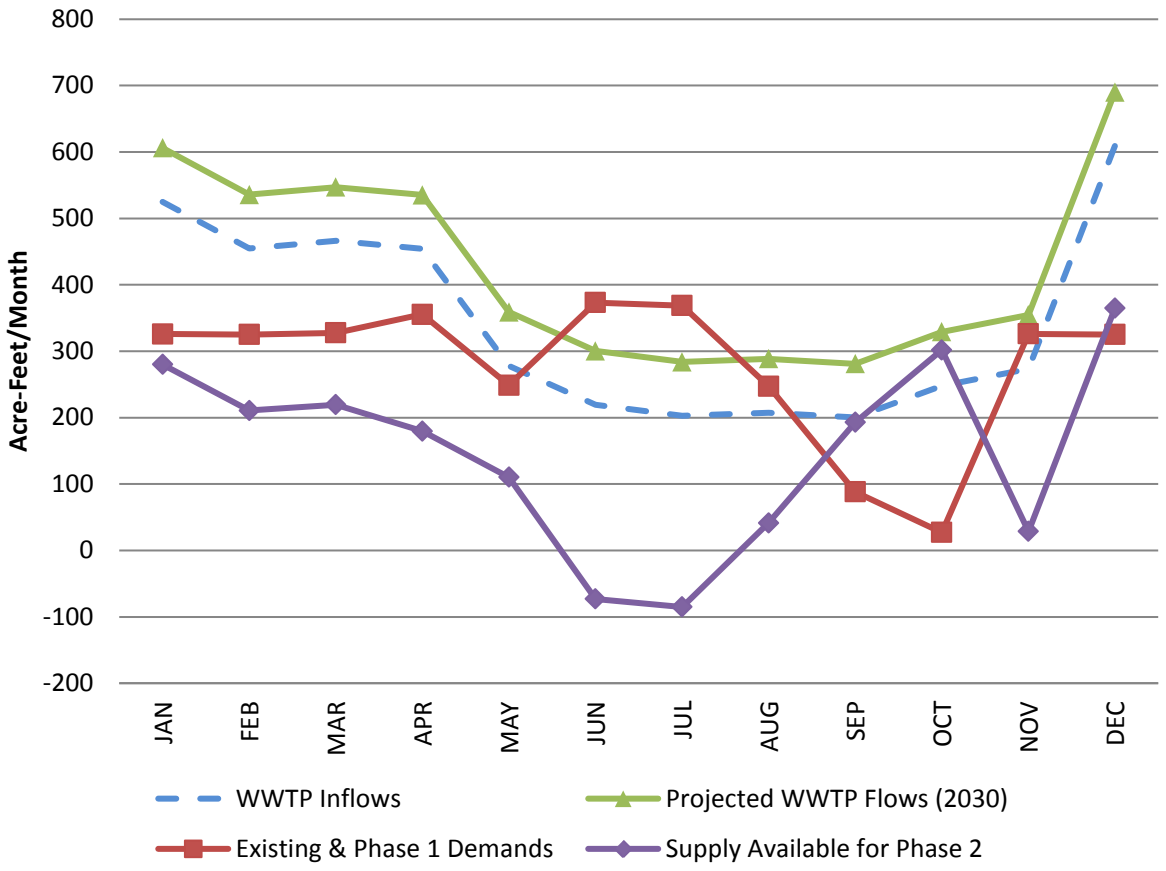


Figure 4-3
SVCSD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2

4.1.2.2 Petaluma

The City of Petaluma provided influent flows for 2010 (Iribarne 2013). These monthly values were adjusted to reflect the projected increase in Petaluma's ADWF from 2010 to 2025 as described in the *City of Petaluma Water Demand & Supply Analysis Report* (City of Petaluma 2006). The expected increase is approximately 0.59 mgd (1.8 AF/day), which was added to the 2010 monthly flows to develop the anticipated 2025 monthly flows.

Petaluma currently has an existing customer base for use of secondary treated recycled water for urban landscaping demands. Petaluma indicated that some of these existing customers will be converted to use tertiary water prior to the implementation of Phase 2, and provided the recent demands for these customers. Supplies available for Phase 2 opportunities were developed by reducing the anticipated 2025 flows by the expected pre-Phase 2 recycled water demands, evaporation at the WWTPs ponds, and on-site usage at the plant.

Table 4-4 presents a summary of the calculations performed. Figure 4-4 shows the monthly distribution of 2010 WWTP inflows (blue line), projected 2025 WWTP inflows (green line), the pre-Phase 2 tertiary recycled water demands (red line), and availability of supply for future Phase 2 opportunities (purple line).

Table 4-4. Summary of City of Petaluma Inflows and Projected Phase 2 Recycled Water Supply

Month	WWTP Inflows (2010)		Projected WWTP Inflows (2025)		Pre-Phase 2 Tertiary Demands		2025 Supply Available for Phase 2	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	238	*730*	256	*786*	0	*0*	256	*786*
February	185	*567*	201	*618*	6	*17*	196	*600*
March	191	*586*	209	*642*	12	*38*	197	*604*
April	190	*585*	208	*639*	58	*177*	151	*462*
May	161	*496*	180	*552*	89	*273*	91	*279*
June	146	*447*	163	*502*	114	*349*	50	*153*
July	131	*401*	149	*457*	119	*367*	29	*90*
August	134	*411*	152	*467*	105	*323*	47	*144*
September	131	*402*	149	*457*	79	*241*	70	*215*
October	146	*447*	164	*503*	41	*125*	123	*378*
November	148	*455*	166	*509*	6	*17*	160	*492*
December	248	*761*	266	*817*	0	*0*	266	*817*
Total [1]	**2,048**	***6,287***	**2,263**	***6,948***	**628**	***1,928***	**1,635**	***5,020***

Notes:
[1] Values have been rounded.

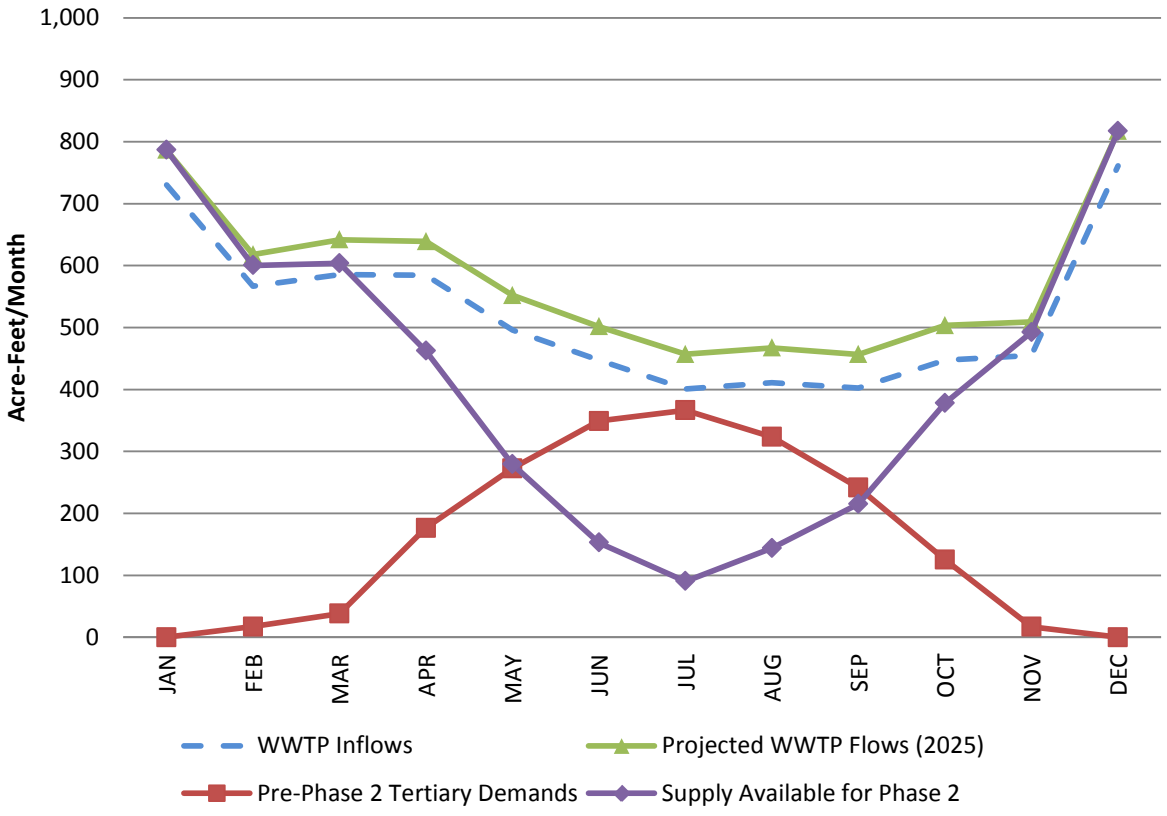


Figure 4-4
City of Petaluma Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2

4.1.3 Napa County Subregion

Napa SD is the only NBWRA Member Agency in Napa County that produces recycled water. Napa County does not generate recycled water and therefore is not discussed in this section.

4.1.3.1 Napa Sanitation District

Projected 2030 recycled water supplies for Napa SD were developed using the *Napa SD Wastewater Treatment Master Plan* (Napa Sanitation District 2011) in combination with historic 2012 flow data provided by Napa SD. The 2030 ADWF was estimated to be 8.55 mgd. The 2012 ADWF was calculated to be 6.59 mgd by averaging the monthly flows of August, September, and October 2012. Projected 2030 monthly influent flows were developed by increasing the 2012 monthly base flow by 1.96 mgd (6 AFY), the difference between the actual 2012 and estimated 2030 ADWF.

Napa SD's recycled water supply available for Phase 2 opportunities was developed by reducing the anticipated 2030 flows by the sum of the existing and anticipated Phase 1 recycled water demands and the demands for two new projects that will be served by Napa SD before the start of Phase 2. Phase 1 demands served by Napa SD were developed using information about areas proposed to receive recycled water by Napa SD presented in the *Phase 2 Project Definition Scoping Study Report.*

Table 4-5 presents a summary of the calculations performed. Figure 4-5 shows the monthly distribution of the 2012 WWTP inflow (blue line), projected 2030 WWTP inflow (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line). Negative flows are shown for the available supply in the summer months, indicating that demand for recycled water is greater than the available supply for that particular month and must be served from storage.

Table 4-5. Summary of Napa SD WWTP Inflows and Projected Phase 2 Recycled Water Supply

Month	WWTP Inflows Available (2012) [1]		Projected WWTP Inflows (2030)		Existing, Phase 1, and Pre-Phase 2 Demands [2]		2030 Supply Available for Phase 2	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	256	*786*	317	973	0	*0*	317	*973*
February	219	*673*	274	842	0	*0*	274	*842*
March	463	*1,421*	524	1,608	0	*0*	524	*1,608*
April	350	*1,075*	409	1,256	25	*78*	384	*1,179*
May	159	*489*	220	676	42	*127*	179	*549*
June	113	*348*	172	529	217	*667*	-45	*-138*
July	93	*285*	154	472	217	*666*	-63	*-194*
August	60	*183*	120	370	151	*463*	-30	*-93*
September	81	*250*	140	430	80	*245*	61	*186*
October	168	*515*	229	702	19	*57*	210	*645*
November	230	*706*	289	887	0	*0*	289	*887*
December	462	*1,418*	523	1,604	0	*0*	523	*1,604*
Total [3]	**2,654**	***8,149***	**3,371**	***10,350***	**750**	***2,302***	**2,621**	***8,048***

Notes:
[1] Available 2012 recycled water flows were derived by reducing total WWTP flows by the amount that Napa SD sold to existing recycled water users in 2012.
[2] Phase 1 demands do not account for existing areas currently served by Napa SD.
[3] Values have been rounded.

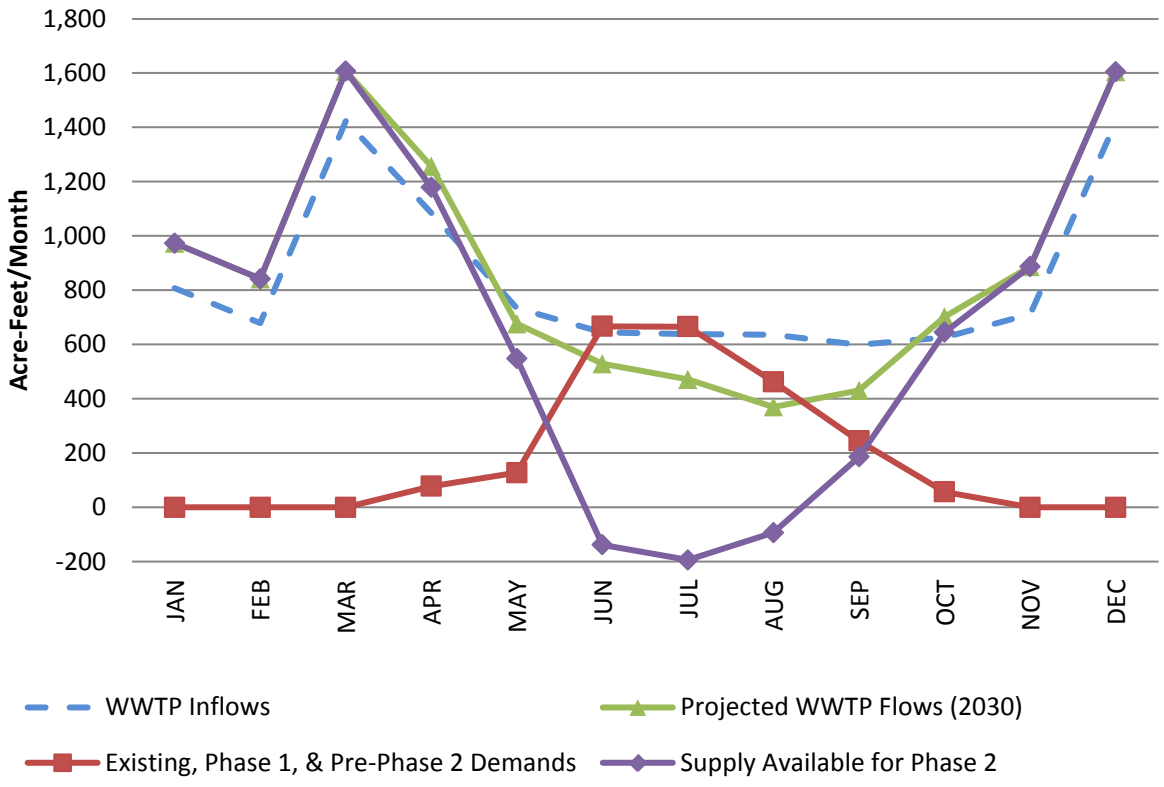


Figure 4-5
Napa SD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2

4.1.4 Summary of Available Recycled Water

The combined recycled water supply in the NBWRA area is the sum of all recycled water net supplies for all agencies. Table 4-6 below summarizes the total available supply by month for all the Member Agencies. The total available annual supply is 25,314 AFY (8,243 MG/year).

The monthly available supplies are at their lowest during the summer irrigation demand period. The supplies during June, July, and August represent approximately six percent of the annual supply; therefore, storage becomes a key element of the Phase 2 program to meet future summer demands.

Table 4-6. Projected Monthly and Annual Phase 2 Recycled Water Supplies

Month	Available Phase 2 Recycled Water Supplies	
	MG	AF
January	1,074	*3,299*
February	923	*2,833*
March	1,165	*3,574*
April	915	*2,807*
May	571	*1,752*
June	178	*546*
July	115	*356*

Table 4-6. Projected Monthly and Annual Phase 2 Recycled Water Supplies

Month	Available Phase 2 Recycled Water Supplies	
	MG	AF
August	201	*619*
September	397	*1,218*
October	657	*2,018*
November	746	*2,291*
December	1,301	*4,001*
Total	**8,243**	***25,314***

Figure 4-6
Total Available Recycled Water Supplies for Phase 2 by Month for All Member Agencies

4.2 Maximum Recycled Water Storage Needs

The following section presents the maximum potential recycled water storage needs for the NBWRA Member Agencies to implement the full suite of potential Phase 2 projects, based on the preliminary information presented in Sections 3 and 4.1. Depending on the structure of the recycled water distribution system and its users, the required storage may be generated through a combination of

recycled water storage (e.g., wet wells, finished water ponds, open storage ponds), distribution system storage (e.g., holding ponds or elevated reservoirs), or user storage (e.g., private agricultural ponds).

At the scoping study stage, only preliminary estimates of demand are available for the Phase 2 projects; therefore, the following subsections are intended to generally address the total seasonal storage needs of a Phase 2 program if all of the Phase 2 Projects from Section 3 were implemented. This analysis provides a potential estimate of the amount of recycled water storage that may be necessary to implement Phase 2. Further analysis in the Feasibility Study will refine the operations and storage analysis for the final Phase 2 alternatives.

4.2.1 Marin County Subregion

The Marin County subregion includes Novato SD, LGVSD, and MMWD.

4.2.1.1 Novato SD

Section 3.1.1 presents Novato SD's potential Phase 2 projects. To determine potential storage required to implement all of these projects, potential Phase 2 recycled water demands were estimated for each project. Table 4-7 presents these estimated demands based on assumed application acreage and water use patterns for the different types of use, as described in Appendix C.

Anticipated recycled water use to restore the tidal prism at the current reclamation facility was estimated using the average monthly precipitation and evapotranspiration rates for the region, as further discussed in Appendix C. Recycled water demands were estimated for providing freshwater to the brackish marsh to be created as part of the Coastal Conservancy project. Potential recycled water demand for sediment flushing in Novato Creek and irrigation of future horizontal levees was not estimated at this time. Marin County is continuing design of marsh restoration in lower Novato Creek in 2014 and will be developing more information about potential recycled water needs for their work.

Table 4-7. Novato SD: Estimated Phase 2 Project Demands

Phase 2 Project	Estimated Area (acres)	Estimated Recycled Water Demand	
		mgd	*AFY*
Restoration of tidal prism at current leased reclamation facility	1,000	3.05	*3,414*
Coastal Conservancy Project	1,100	2.77	*3,104*
Landscape irrigation at Marin Country Golf Course and Indian Valley College	80	0.16	*178*
Vineyard and pasture irrigation in Southern Sonoma County	962	0.86	*966*
Total	**3,142**	**6.84**	***7,663***

Novato SD's estimated recycled water supply available to meet Phase 2 demands, described in Section 4.1.1.1, was compared to the above estimated recycled water demands to determine whether recycled water storage would be needed to meet all the potential Phase 2 demands. Table 4-8 presents a tabular summary of Novato SD's available recycled water supply for Phase 2, all potential Phase 2 demands, supply available after Phase 2 projects, and potential recycled water storage needs to serve existing, Phase 1, and Phase 2 demands. Negative supplies indicate that demand for recycled water is greater than the available supply for that particular month and recycled water storage is necessary.

As shown in Table 4-8, Novato SD does not have sufficient recycled water supply to serve all existing uses, Phase 1 projects, and all potential Phase 2 projects; therefore, storage is required for these months (shown in last two columns). To fully serve existing uses, Phase 1 projects, and all potential

Phase 2 projects, Novato SD would need storage capacity for a total of 3,064 AF (998 MG). Figure 4-7 provides a graphical summary of this information.

Table 4-8. Novato SD: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2025 Supply Available for Phase 2		Anticipated Phase 2 Demands		2025 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	279	*857*	0	*1*	279	*857*	0	*0*
February	270	*829*	53	*164*	217	*665*	0	*0*
March	265	*814*	119	*366*	146	*448*	0	*0*
April	237	*729*	235	*721*	3	*8*	0	*0*
May	210	*644*	355	*1,090*	-146	*-447*	146	*447*
June	171	*525*	432	*1,325*	-261	*-800*	261	*800*
July	160	*492*	434	*1,333*	-274	*-842*	274	*842*
August	157	*483*	371	*1,138*	-213	*-655*	213	*655*
September	175	*537*	279	*857*	-104	*-320*	104	*320*
October	186	*570*	163	*502*	22	*68*	0	*0*
November	217	*666*	54	*165*	163	*502*	0	*0*
December	276	*857*	0	*1*	279	*856*	0	*0*
Total [1]	**2,607**	***8,003***	**2,496**	***7,663***	**111**	***340***	**998**	***3,064***

Notes:
[1] Values have been rounded.

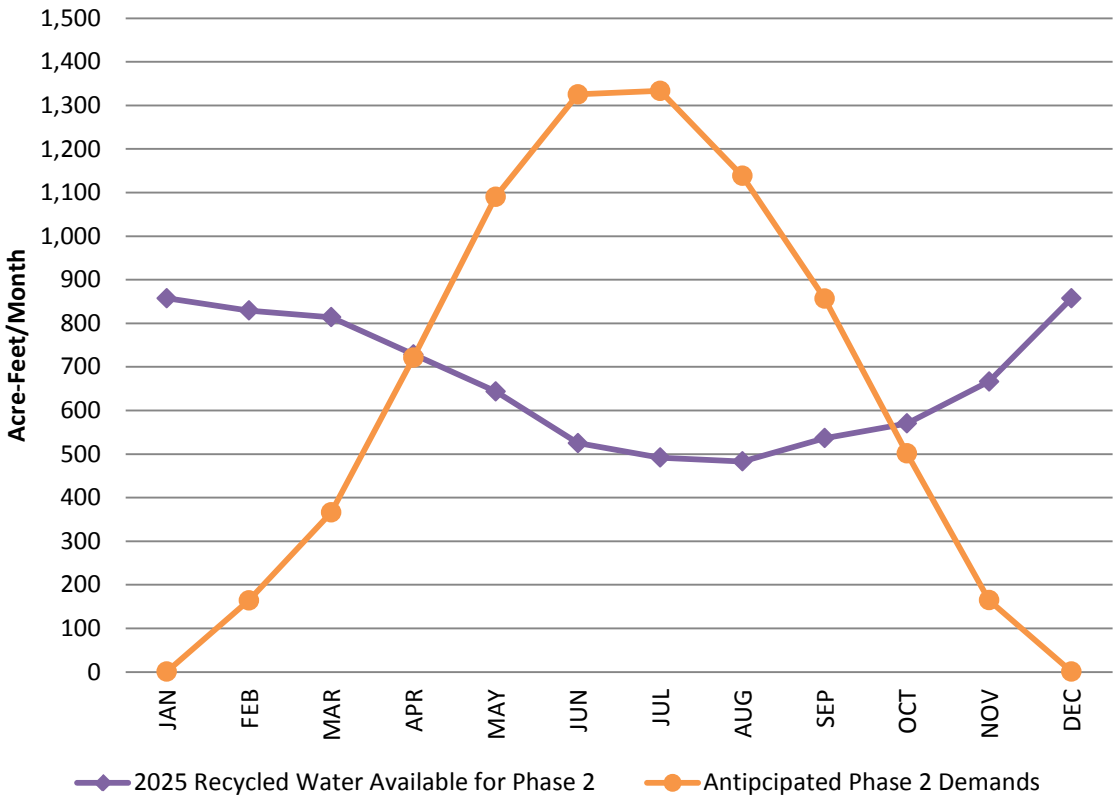


Figure 4-7
Novato SD: Available Phase 2 Supply and Anticipated Phase 2 Project Demands

At the completion of Phase 1 projects, Novato SD will have a storage capacity of approximately 490 AF (160 MG); therefore, Novato SD would need to construct a maximum of an additional 2,574 AF (838 MG) of storage to meet all of the potential Phase 2 projects.

4.2.1.2 LGVSD and MMWD

Sections 3.1.2 and 3.1.3 present LGVSD's and MMWD's potential Phase 2 projects, respectively. These projects would be served by supplies from LGVSD (except as noted below). To determine potential recycled water storage required to implement all of the combined LGVSD and MMWD projects, Phase 2 recycled water demands were estimated for each project. Table 4-9 presents these estimated demands based on information obtained from discussions with LGVSD and MMWD or engineering estimations of acreage and associated demands. Details on the estimated irrigation acreage and assumed monthly recycled water use are provided in Appendix C.

MMWD's potential Phase 2 project at San Quentin State Prison would use recycled water produced at CMSA and stored at a location nearby (to be determined). Therefore, this project is not included in the evaluation of potential storage required for recycled water produced by LGVSD.

Table 4-9. LGVSD and MMWD: Estimated Phase 2 Project Demands

Phase 2 Project	Estimated Area (acres)	Estimated Recycled Water Demand	
		mgd	*AFY*
Landscape irrigation at Peacock Gap Golf Course	76	0.15	*170*
Landscape irrigation in Peacock Gap residential area	13	0.03	*30*
Landscape irrigation at Mt. Tamalpais Cemetery	12	0.02	*27*
Habitat enhancement at McInnis Marsh	168	0.46	*517*
Landscape irrigation along Lucas Valley extension	9	0.02	*21*
Total [1]	**278**	**0.68**	***765***

Notes:
[1] Values have been rounded.

LGVSD's estimated recycled water available to meet all Phase 2 demands, described in Section 4.1.1.2, was compared to the above estimated recycled water demands to determine whether recycled water storage would be needed to meet the Phase 2 demands. Table 4-10 presents a tabular summary of LGVSD's available recycled water supply for Phase 2, all potential Phase 2 demands to be served by LGVSD, recycled water supply available after these Phase 2 projects, and potential recycled water storage needs to serve existing, Phase 1, and Phase 2 demands. Negative supplies indicate that demand for recycled water is greater than the available supply for that particular month and recycled water storage is necessary.

As shown in Table 4-10, in the months of June through September, LGVSD does not have sufficient recycled water supply to serve all existing uses, Phase 1 projects, and all potential Phase 2 projects; therefore, recycled water storage is required for these months (shown in last two columns). To fully serve existing uses, Phase 1 projects, and all potential Phase 2 projects, LGVSD would need storage capacity for a total of 219 AF (71 MG). Figure 4-8 provides a graphical summary of this information.

Table 4-10. LGVSD: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2030 Supply Available for Phase 2		Anticipated Phase 2 Demands		2030 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	131	*403*	0	*0*	131	*403*	0	*0*
February	114	*351*	4	*13*	110	*338*	0	*0*
March	107	*328*	9	*29*	97	*299*	0	*0*
April	84	*257*	23	*70*	61	*187*	0	*0*
May	55	*170*	31	*95*	25	*75*	0	*0*
June	26	*79*	42	*128*	-16	*-49*	16	*49*
July	17	*53*	44	*135*	-27	*-82*	27	*82*
August	14	*44*	41	*125*	-26	*-81*	26	*81*
September	28	*87*	31	*94*	-2	*-7*	2	*6*
October	40	*123*	20	*63*	20	*60*	0	*0*
November	71	*217*	4	*13*	67	*205*	0	*0*
December	117	*358*	0	*0*	117	*358*	0	*0*
Total [1]	**805**	***2,471***	**249**	***765***	**556**	***1,706***	**71**	***219***

Notes:
[1] Values have been rounded.

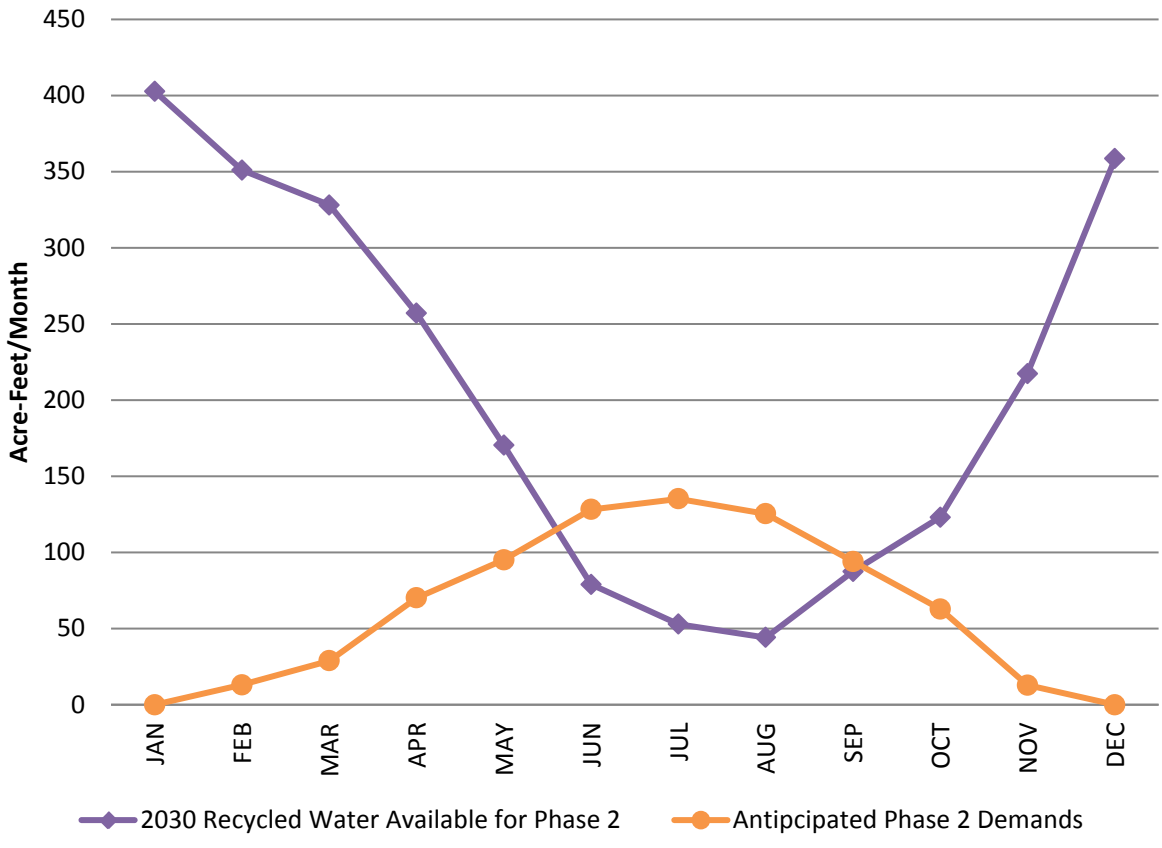


Figure 4-8
LGVSD: Available Phase 2 Supply and Anticipated Phase 2 Project Demands

At the completion of the Phase 1 projects LGVSD will have approximately 40 AF (13 MG) of recycled water storage available for use; therefore, LGVSD would need to construct a maximum of an additional 179 AF (58 MG) of storage to meet all of the potential Phase 2 projects.

4.2.2 Sonoma County Subregion

The Sonoma County subregion includes SVCSD and the City of Petaluma.

4.2.2.1 SVCSD

Section 3.2.1 presents SVCSD's potential Phase 2 projects. To determine potential storage required to implement all of SVCSD's Phase 2 projects, Phase 2 recycled water demands were estimated for each project. Table 4-11 presents these estimated demands based on information obtained from discussions with SVCSD or engineering estimations of acreage and associated demands. Details on estimated irrigation acreage and assumed monthly recycled water use are provided in Appendix C.

Table 4-11. SVCSD: Estimated Phase 2 Project Demands

Phase 2 Project	Estimated Area (acres)	Estimated Recycled Water Demand	
		mgd	*AFY*
Agricultural irrigation in West Area	1,100	0.49	*550*
Agricultural irrigation in 8th Street Area	500	0.22	*250*
Landscape irrigation at Sonoma Plaza	23	0.07	*75*
Landscaping irrigation in Temelec Area	24	0.01	*77*
Landscaping irrigation near Rodger's Creek	840	0.38	*420*
Agricultural irrigation near Carriger and Felder Creeks	464	0.21	*232*
Agricultural and pasture irrigation in Dale Avenue Area	150	0.07	*75*
Landscaping irrigation for Sonoma Mission Inn Golf Course	160	0.40	*450*
Total [1]	**3,261**	**1.85**	***2,129***

Notes:
[1] Values have been rounded.

SVCSD's estimated recycled water supply available to meet potential Phase 2 demands, described in Section 4.1.2.1, was compared to the above estimated recycled water demands to determine whether recycled water storage would be needed to meet Phase 2 demands. Table 4-12 presents a tabular summary of SVCSD's available recycled water supply for Phase 2, all potential Phase 2 demands, supply available after these Phase 2 projects, and potential storage needs to serve existing, Phase 1, and Phase 2 demands. Negative supplies indicate that demand for recycled water is greater than the available supply for that particular month and recycled water storage is necessary.

As shown in Table 4-12, in the months of May through August, SVCSD does not have sufficient recycled water supply to serve all existing, Phase 1 projects, and all potential Phase 2 projects; therefore, storage is required for these months (shown in last two columns). To fully serve existing uses, Phase 1 projects, and all potential Phase 2 projects, SVCSD would need storage capacity for a total of 1,924 AF (627 MG). Figure 4-9 provides a graphical summary of this information.

Table 4-12. SCVSD: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2030 Supply Available for Phase 2		Anticipated Phase 2 Demands		2030 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	91	*280*	0	*0*	91	*280*	0	*0*
February	69	*211*	0	*0*	69	*211*	0	*0*
March	72	*220*	0	*0*	72	*220*	0	*0*
April	59	*180*	17	*52*	42	*128*	0	*0*
May	36	*110*	131	*403*	-95	*-293*	95	*293*
June	-24	*-73*	190	*583*	-214	*-656*	214	*656*
July	-28	*-85*	185	*567*	-212	*-652*	212	*652*
August	13	*41*	119	*365*	-105	*-323*	105	*323*
September	63	*193*	39	*121*	23	*72*	0	*0*
October	98	*302*	12	*38*	86	*264*	0	*0*
November	9	*29*	0	*0*	9	*29*	0	*0*
December	119	*365*	0	*0*	119	*365*	0	*0*
Total [1]	**577**	***1,772***	**693**	***2,129***	**-116**	***-357***	**627**	***1,924***

Notes:
[1] Values have been rounded.

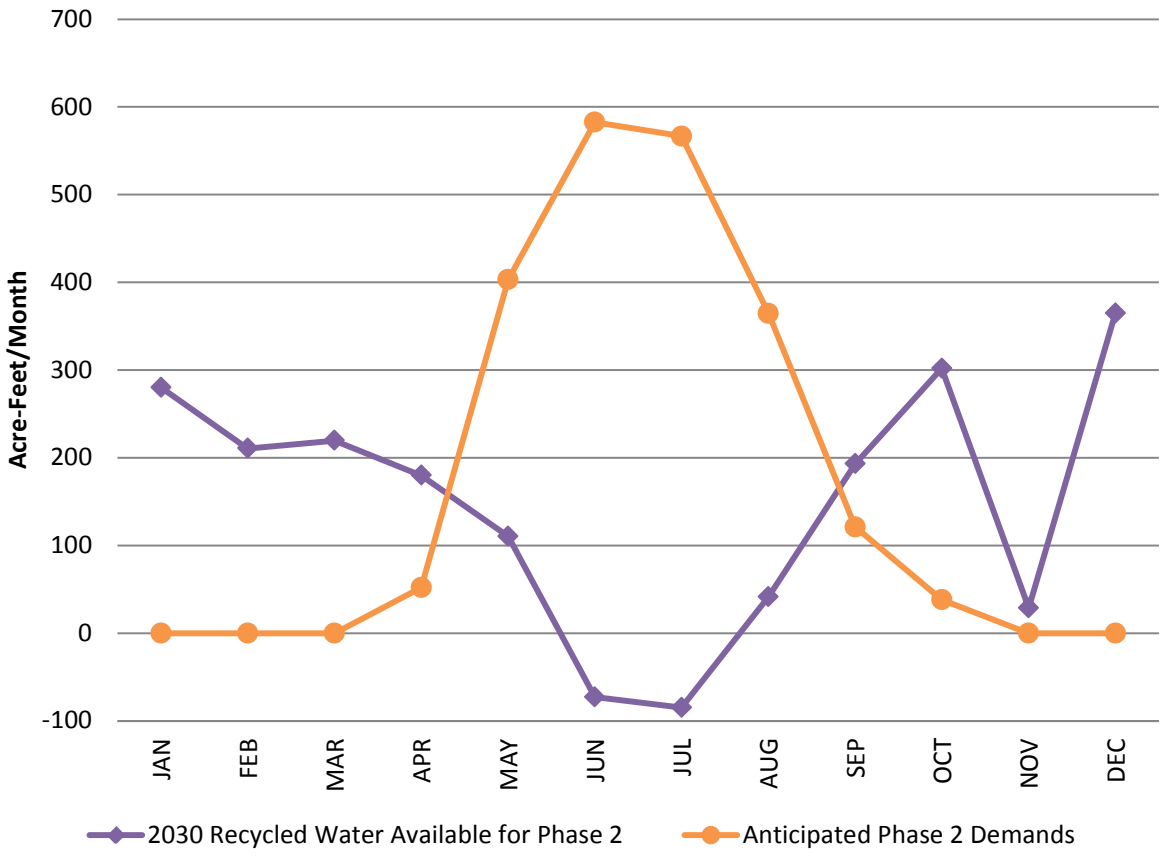


Figure 4-9
SVCSD: Available Phase 2 Supply and Anticipated Phase 2 Project Demands

At the completion of the Phase 1 projects, SVCSD will have a storage capacity of approximately 1,186 AF (386 MG); therefore SVCSD would need to construct a maximum of an additional 738 AF (241 MG) of recycled water storage to meet all of the potential Phase 2 projects.

4.2.2.2 Petaluma

Section 3.2.3 presents Petaluma's potential Phase 2 projects. To determine potential storage required to implement all of Petaluma's Phase 2 projects, recycled water demands were estimated for each project. Table 4-13 presents these estimated demands based on the information obtained from discussions with the Petaluma. Estimated water use for the landscape irrigation was based on assumed monthly water use per acre as further discussed in Appendix C.

Table 4-13. Petaluma: Estimated Phase 2 Project Demands

Phase 2 Project	Estimated Area (acres)	Estimated Recycled Water Demand	
		mgd	*AFY*
Urban Recycled Water Expansion	64	0.16	*195*
Agriculture Recycled Water Expansion	851	2.12	*2,585*
Total [1]	**915**	**2.38**	***2,780***

Notes:
[1] Values have been rounded.

Petaluma's estimated recycled water available to meet Phase 2 demands, described in Section 4.1.2.2, was compared to the above estimated recycled water demands to determine whether recycled water storage would be needed to meet Phase 2 demands. Table 4-14 presents a tabular summary of Petaluma's available recycled water supply for Phase 2, all potential Phase 2 demands, supply available after these Phase 2 projects, and potential recycled water storage needs to serve existing, pre-Phase 2, and Phase 2 demands. Negative supplies indicate that demand for recycled water is greater than the available supply for that particular month and recycled water storage is necessary.

As shown in Table 4-14, in the months of May through September, Petaluma does not have sufficient recycled water supply to serve all existing uses, pre-Phase 2 projects, and all potential Phase 2 projects; therefore, storage is required for these months (shown in last two columns). To fully serve existing uses, pre-Phase 2 projects, and all potential Phase 2 projects; Petaluma would need storage capacity for a total of 1,482 AF (483 MG). Figure 4-9 provides a graphical summary of this information.

Table 4-14. Petaluma: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2025 Supply Available for Phase 2		Anticipated Phase 2 Demands		2025 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	256	*786*	0	*0*	256	*786*	0	*0*
February	196	*600*	0	*0*	196	*600*	0	*0*
March	197	*604*	0	*0*	197	*604*	0	*0*
April	151	*462*	78	*241*	72	*222*	0	*0*
May	91	*279*	129	*395*	-38	*-115*	38	*115*
June	50	*153*	172	*529*	-122	*-376*	122	*376*
July	29	*90*	185	*568*	-156	*-478*	156	*478*
August	47	*144*	165	*505*	-118	*-362*	118	*362*
September	70	*215*	119	*366*	-49	*-151*	49	*151*
October	123	*378*	57	*176*	66	*202*	0	*0*

Table 4-14. Petaluma: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2025 Supply Available for Phase 2		Anticipated Phase 2 Demands		2025 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
November	160	*492*	0	*0*	160	*492*	0	*0*
December	266	*817*	0	*0*	266	*817*	0	*0*
Total [1]	**1,635**	***5,020***	**906**	***2,780***	**730**	***2,240***	**483**	***1,482***

Notes:
[1] Values have been rounded.

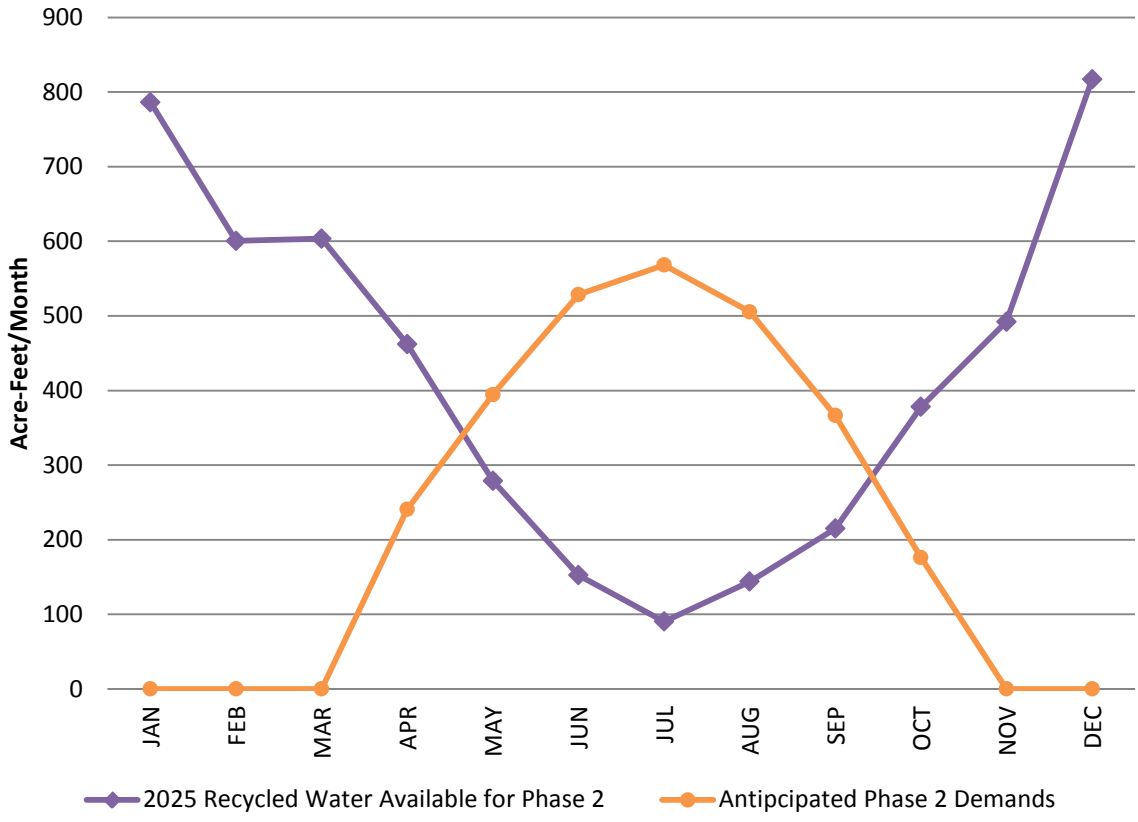


Figure 4-10
Petaluma: Available Phase 2 Supply and Anticipated Phase 2 Project Demands

Before Phase 2 begins, Petaluma will not have any storage capacity; therefore Petaluma would need to construct a maximum of 1,482 AF (483 MG) of recycled water storage to meet all of the potential Phase 2 projects.

4.2.3 Napa County Subregion

The Napa County subregion includes Napa SD.

4.2.3.1 Napa SD

Section 3.3.1 presents Napa SD's potential Phase 2 projects. To determine potential storage required to implement all of Napa SD's Phase 2 projects, recycled water demands were estimated for each

project. Table 4-15 presents these estimated demands based on the assumed application acreage and water use patterns based on the type of use. Details on estimated irrigation acreage and assumed monthly recycled water use are provided in Appendix C.

Table 4-15. Napa SD: Estimated Phase 2 Project Demands

Phase 2 Projects	Estimated Area (acres)	Estimated Recycled Water Demand	
		mgd	*AFY*
Landscape irrigation for MST pipeline extension	28	0.07	*77*
Agricultural irrigation for long-term project in northern Napa County	1,273	0.99	*1,106*
Total [1]	**1,301**	**1.06**	***1,183***

Notes:
[1] Values have been rounded.

Napa SD's estimated recycled water supply available to meet Phase 2 demands, described in Section 4.1.3.1, was compared to the above estimated recycled water demands to determine whether recycled water storage would be needed to meet Phase 2 demands. Table 4-16 presents a tabular summary of Napa SD's available recycled water supply for Phase 2, all potential Phase 2 demands, supply available after these Phase 2 projects, and potential storage needs to serve existing, Phase 1, pre-Phase 2, and Phase 2 demands. Negative supplies indicate that demand for recycled water is greater than the available supply for that particular month and recycled water storage is necessary.

As shown in Table 4-16, in the months of June through August, Napa SD does not have sufficient recycled water supply to serve all existing uses, Phase 1 project, pre-Phase 2 users, and all potential Phase 2 projects; therefore, storage is required for these months (shown in last two columns). To fully serve existing uses, Phase 1 projects, pre-Phase 2 projects, and all potential Phase 2 projects, Napa SD would need recycled water storage capacity for a total of 1,188 AF (387 MG). Figure 4-11 provides a graphical summary of this information.

Table 4-16. Napa SD: Available Phase 2 Recycled Water Supply and Maximum Storage Needs

Month	2030 Supply Available for Phase 2		Anticipated Phase 2 Demands		2030 Supply Available AFTER Phase 2		Maximum Storage Needed	
	MG	*AF*	MG	*AF*	MG	*AF*	MG	*AF*
January	317	*973*	0	*0*	317	*973*	0	*0*
February	274	*842*	0	*0*	274	*842*	0	*0*
March	524	*1,608*	0	*0*	524	*1,608*	0	*0*
April	384	*1,179*	27	*82*	357	*1,097*	0	*0*
May	179	*549*	44	*134*	135	*415*	0	*0*
June	-45	*-138*	86	*264*	-131	*-402*	131	*402*
July	-63	*-194*	90	*275*	-153	*-469*	153	*469*
August	-30	*-93*	73	*223*	-103	*-316*	103	*316*
September	61	*186*	48	*146*	13	*40*	5	*12*
October	210	*645*	19	*60*	191	*585*	0	*0*
November	289	*887*	0	*0*	289	*887*	0	*0*
December	523	*1,604*	0	*0*	523	*1,604*	0	*0*
Total [1]	**2,621**	***8,048***	**385**	***1,183***	**2,236**	***6,864***	**387**	***1,188***

Notes:
[1] Values have been rounded.

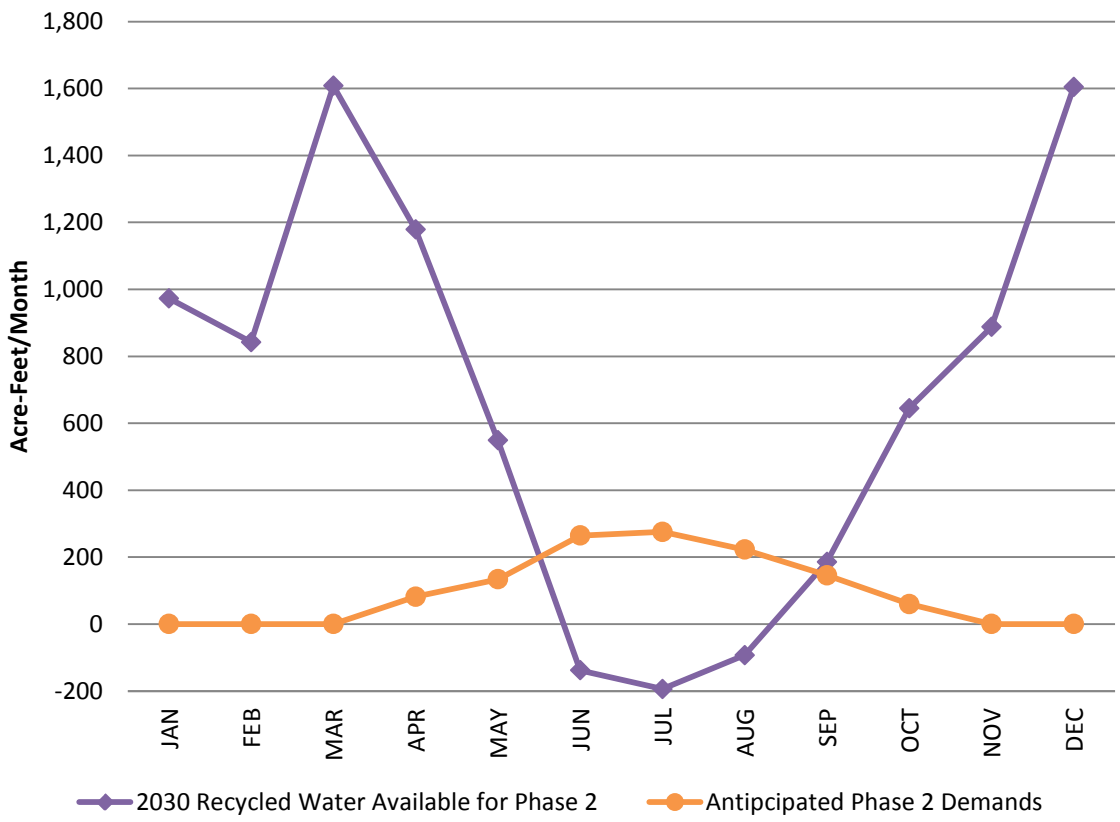


Figure 4-11
Napa SD: Available Phase 2 Supply and Anticipated Phase 2 Project Demands

Napa SD does not expect any excess storage to be available at the completion of Phase 1; therefore, Napa SD would need to construct a maximum of an additional 1,188 AF (387 MG) of recycled water storage to meet all of the potential Phase 2 projects.

4.3 Summary

The discussion in Section 4.2 presents the maximum potential amount of recycled water storage anticipated to be necessary for each recycled water-producing Member Agency to meet the entire list of proposed Phase 2 projects in each area. Table 4-17 presents a summary of these storage needs. Approximately 6,161 AF of additional storage is needed area-wide to serve all the water demands associated with the potential Phase 2 projects. Many Member Agencies have identified several potential storage projects that could be implemented over time as the recycled water supply is necessary. As shown in Table 4-17, the Member Agencies have recycled water supply available for additional projects if future users are identified.

Table 4-17. Summary of Anticipated Maximum Recycled Water Storage Needed to Implement all Identified Phase 2 Projects

Agency	Available Phase 2 Supply		Anticipated Phase 2 Demands		Anticipated Phase 2 Recycled Water Storage Needs	
	MG	*AF*	MG	*AF*	MG	*AF*
Novato SD	2,607	*8,003*	2,496	*7,663*	838	*2,574*
LGVSD	805	*2,471*	249	*765*	58	*179*
SVCSD	577	*1,772*	693	*2,129*	241	*738*
City of Petaluma	1,635	*5,020*	906	*2,780*	483	*1,482*
Napa SD	2,621	*8,048*	385	*1,183*	387	*1,188*
Total	**8,243**	***25,314***	**4,729**	***14,520***	**2,007**	***6,161***

Depending on the structure of the recycled water distribution system and its users, the required storage may be generated through a combination of recycled water storage (e.g., wet wells, finished water ponds, open storage ponds), distribution system storage (e.g., holding ponds or elevated reservoirs), or user storage (e.g., private agricultural ponds). At the Scoping Study stage of analysis, the required storage volumes are calculated on purely a recycled water supply-demand basis and do not take into consideration other operational factors (such as usable storage volume, rainfall, wave action, environmental habitat enhancements, etc.) which typically increase the amount of storage desired.

Section 5
Phase 2 Conceptual Alternatives

This section describes conceptual alternatives formulated by combining the individual projects identified by the Member Agencies and documented in Section 3. These initial conceptual alternatives are formulated to provide insight to the Member Agencies as they select the individual projects that should be addressed and ultimately used to formulate complete alternatives in the Feasibility Study. The Scoping Study is intended to identify alternative approaches to address the objectives and subobjectives of the NBWRA Phase 2 Program. No preferred alternative is established in this study; rather, this is an opportunity to understand the range of possibilities.

At the Scoping Study level of detail, not all aspects of the conceptual alternatives can be evaluated quantitatively against the program objectives (described in Section 2); therefore, no specific scoring or ranking of the alternatives are developed. However, viewing the conceptual alternatives qualitatively in the context of the program objectives provides guidance into how to form the final alternatives during the Feasibility Study. Key insights derived from this exercise include the following, which are further described in the sections below:

- How different combinations of projects compare to the program objectives and subobjectives identified in Section 2;
- How the combination of Member Agency individual projects can form alternatives that meet all the objectives of the Member Agencies and those of potential funding agencies; and
- What is the upper range of costs for an alternative if priority projects of the Member Agencies are included in a single conceptual alternative.

The following process was used to formulate conceptual alternatives and select a preliminary alternative for estimating the potential upper cost of the Phase 2 Program:

- Formulate thematic alternatives based on different focuses of water resources;
- Compile individual projects as the building blocks to form thematic alternatives;
- Review how the thematic alternatives perform versus the program objectives and subobjectives; and
- Draw projects from the thematic alternatives to formulate a single conceptual alternative for the purposes of gauging the scale of costs for such a program.

5.1 Development of Thematic Alternatives

In Phase 2, the NBWRP is evolving into a total water management program that addresses a broader range of water supply, effluent management, environmental enhancement, and social issues. Once the potential Phase 2 projects were identified by the Member Agencies and summarized in Section 3, the projects were initially grouped into thematic alternatives to demonstrate what alternatives would look like when attempting to maximize a particular type of benefit. The thematic alternatives were

framed around meeting different water resources goals. This is important to illustrate trade-offs between the themes and will aid the Member Agencies in refining alternatives for the Feasibility Study.

Four thematic alternatives were developed and are described below in more detail.

- Alternative 1 – Maximize Recycled Water Irrigation
- Alternative 2 – Maximize Non-Recycled Water Supplies
- Alternative 3 – Maximize Total Water Supply
- Alternative 4 – Maximize Environmental Enhancement

5.1.1 Maximize Recycled Water Irrigation

The objective of this thematic alternative is to focus on maximizing the use of recycled water typical of many Title XVI projects. Table 5-1 presents the Member Agency projects that were selected for Thematic Alternative 1. Not all Member Agencies are represented in this alternative because some agencies have not identified recycled water irrigation projects at this time.

LGVSD and MMWD would provide a synergistic coordination of water supply and water demand in Marin County. In Sonoma County, Petaluma would continue to expand its tertiary water service and construct storage to meet the summer demand periods. SVCSD would expand distribution and would add seasonal storage as needed. In Napa County, Napa SD would make treatment improvements and add seasonal storage to meet the needs of agencies building conveyance outside of the NBWRA membership. The primary funding support for this thematic alternative could be the Title XVI Program and WaterSMART construction grants, but additional funding mechanisms may also be available.

Table 5-1. Projects in Thematic Alternative 1 – Maximize Recycled Water Irrigation

Agency	Potential Projects
Marin Municipal Water District	▪ Expand recycled water distribution into San Rafael
Las Gallinas Valley Sanitary District	▪ Storage and treatment needed to meet MMWD supply needs
Novato Sanitary District	(no defined irrigation projects)
Petaluma	▪ Expand recycled water distribution ▪ Treatment increase to meet supply needs ▪ Operational and seasonal storage to meet supply needs
Sonoma Valley County Sanitation District	▪ 8 new distribution areas in Sonoma Valley ▪ Expand distribution network in Carneros ▪ Seasonal storage to meet supply needs
Sonoma County Water Agency	(no defined irrigation projects)
Napa Sanitation District	▪ Treatment improvements ▪ Expand distribution to the west in MST ▪ Increase operational and seasonal storage to meet supply needs

5.1.2 Maximize Non-Recycled Water Supplies

The objective of this thematic alternative is to focus on increasing water supplies in the region using supplies other than recycled water. Table 5-2 presents the Member Agency projects that were selected

for Thematic Alternative 2. Not all Member Agencies are represented in this alternative because some agencies have not identified projects for supplies other than recycled water at this time.

The primary sources of new water are derived from groundwater management in Sonoma County and stormwater capture in Marin County. Funding for these projects may come from Title XVI or other programs.

Table 5-2. Projects in Thematic Alternative 2 – Maximize Non-Recycled Water Supplies

Agency	Potential Projects
Marin Municipal Water District	(no non-recycled water projects)
Las Gallinas Valley Sanitary District	▪ Gallinas Creek stormwater capture
Novato Sanitary District	(no non-recycled water projects)
Petaluma	▪ Groundwater management using stormwater capture and recharge at Capri Creek ▪ Groundwater banking of surface water flows and/or recycled water
Sonoma Valley County Sanitation District	(no non-recycled water projects)
Sonoma County Water Agency	▪ Groundwater management using stormwater capture and reuse in Upper Petaluma River Watershed ▪ Groundwater management using stormwater capture and reuse in Sonoma Creek Watershed ▪ Groundwater banking of surface water flows
Napa Sanitation District	(no non-recycled water projects)

5.1.3 Maximize Total Water Supply

The objective of this thematic alternative is to maximize the water supply to the region using all sources of water identified. This is the combination of Thematic Alternatives 1 and 2. Table 5-3 presents the Member Agency projects that were selected for Thematic Alternative 3. Novato SD is not represented in this alternative because its current list of projects does not include recycled water irrigation (for non-environmental purposes) or other water supply development.

It is anticipated that a combination of Title XVI and other funding programs will be needed to support such an alternative because the size and diversity of the projects are beyond the scope of traditional Title XVI projects.

Table 5-3. Projects in Thematic Alternative 3 – Maximize Total Water Supply

Agency	Potential Projects
Marin Municipal Water District	▪ Expand recycled water distribution into San Rafael
Las Gallinas Valley Sanitary District	▪ Storage and treatment needed to meet MMWD supply needs ▪ Gallinas Creek stormwater capture
Novato Sanitary District	(no water supply projects)
Petaluma	▪ Expand recycled water distribution ▪ Treatment increase to meet supply needs ▪ Operational and seasonal storage to meet supply needs ▪ Groundwater management using stormwater capture and recharge at Capri Creek ▪ Groundwater banking of surface water flows and/or recycled water
Sonoma Valley County Sanitation District	▪ 8 new distribution areas in Sonoma Valley ▪ Expand distribution network in Carneros ▪ Seasonal storage to meet supply needs

Table 5-3. Projects in Thematic Alternative 3 – Maximize Total Water Supply

Agency	Potential Projects
Sonoma County Water Agency	▪ Groundwater management using stormwater capture and reuse in Upper Petaluma River Watershed ▪ Groundwater management using stormwater capture and reuse in Sonoma Creek Watershed ▪ Groundwater banking of surface water flows
Napa Sanitation District	▪ Treatment improvements ▪ Expand distribution to the west in MST ▪ Increased operational and seasonal storage to meet supply needs

5.1.4 Maximize Environmental Enhancement

As a fourth theme, the Maximize Environmental Enhancement alternative stresses the benefits that could be derived from focusing on projects that enhance wetland, pond, stream, or riparian habitat. Table 5-4 presents the Member Agency projects that were selected for Thematic Alternative 4. Not all Member Agencies are represented in this alternative because some agencies do not have projects specifically designed to provide environmental benefits.[1]

LGVSD and Novato SD both are considering projects to provide brackish marsh enhancements to the Marin County side of San Pablo Bay. SCWA's groundwater management project in the Upper Petaluma River and the Sonoma Creek watersheds may include some stream restoration components.

Table 5-4. Projects in Thematic Alternative 4 – Maximize Environmental Enhancement

Agency	Potential Projects
Marin Municipal Water District	(no specific environmental enhancement projects)
Las Gallinas Valley Sanitary District	▪ McInnis Marsh wetlands restoration ▪ Repair pond levees with climate change adaption ▪ Develop storage wetlands and brackish marsh with climate adaptation
Novato Sanitary District	▪ Develop storage wetlands and brackish marsh with climate adaptation ▪ Assist restoration of wetlands and improve sediment transport along Novato Creek
Petaluma	(no specific environmental enhancement projects)
Sonoma Valley County Sanitation District	(no specific environmental enhancement projects)
Sonoma County Water Agency	▪ Groundwater management using stormwater capture and reuse in Upper Petaluma River and Sonoma Creek watersheds
Napa Sanitation District	(no specific environmental enhancement projects)

5.2 Conceptual Alternative Development

After reviewing the composition of the thematic alternatives, it was clear that additional factors should be taken into consideration to develop successful alternatives that will be evaluated in the Feasibility Study. The process used to develop the conceptual alternative, the most likely mix of projects to be further studied, is described below.

[1] Many "traditional" Title XVI recycled water projects do have both direct and indirect environmental benefits (e.g., reduced stream diversions, reduced groundwater pumping, recycled water storage as wildlife habitat, etc.) which can be integrated into projects and through designed enhancements.

5.2.1 Meeting Multiple Objectives

The thematic alternatives were based on taking each theme to logical extremes. The proposed Phase 2 objectives for alternative formulation, screening, and evaluation were addressed in the four thematic alternatives. Each thematic alternative had certain strengths, but did not meet all Program objectives or subobjectives. To address all the objectives and subobjectives of the NBWRP Phase 2 program requires drawing individual projects from the thematic alternatives to develop true multi-purpose programs.

Figure 5-1 below characterizes the approach to draw from each of the thematic alternatives that represents the extremes to create a conceptual alternative that incorporates the best facets of each thematic alternative. This resulting conceptual alternative is multi-purpose in nature, meets the program objectives, and will be competitive when NBWRA seeks funding support from Federal and State agencies.

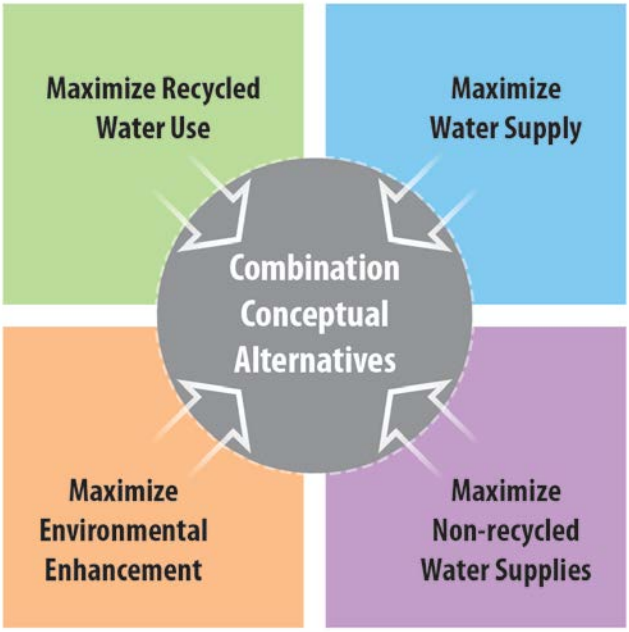


Figure 5-1
Conceptual Alternative Development

5.2.2 Program-Wide Filters

Once Member Agency projects are viewed from their ability to meet the objectives and subobjectives, additional filters are needed to help evaluate the full potential and scale of the Phase 2 Program prior to proceeding with feasibility level studies. These additional filters include the following.

- Timing for implementation – are projects still conceptual, in design, or ready to construct?
- Type of project – storage, treatment, distribution, environmental, or multi-purpose?
- Timing on the planning horizon – will projects be implemented while the feasibility study and supporting environmental documentation are still valid?

- Available funding tools – what is the capacity of the potential funding tools and their ability to meet Member Agency needs in implementing projects?
- Available local funds – what are the Member Agency financial thresholds for undertaking multiple projects?

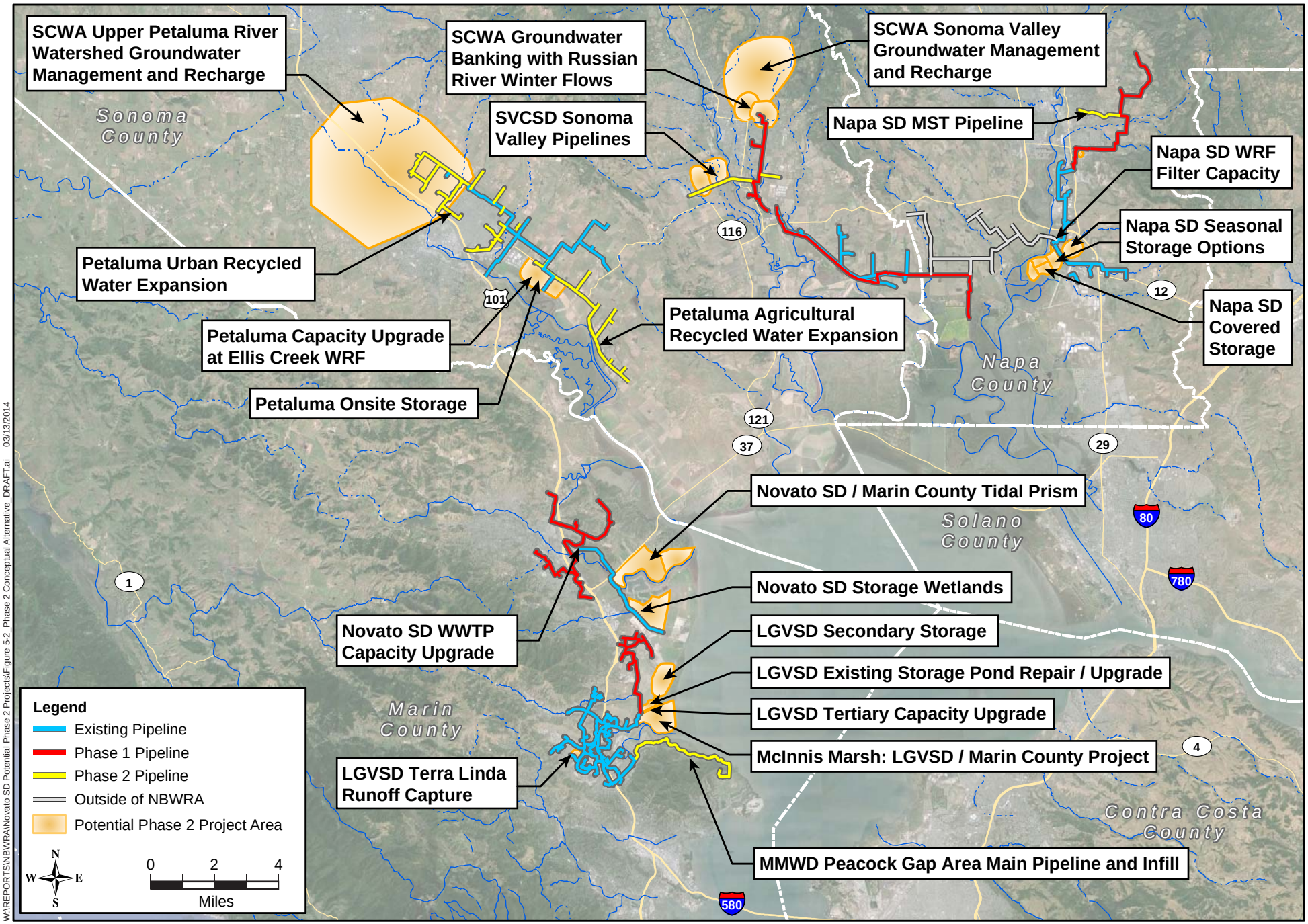
By applying these additional filters, further guidance is provided to Member Agencies to assist with project selections and understand how they contribute toward preliminary program scaling and preliminary positioning for Phase 2.

5.3 Conceptual Alternative

Each Member Agency was asked to review their list of projects discussed in Section 3 and provide additional input regarding their project priorities and implementation timeframe. The implementation timeframe is particularly important for developing the conceptual alternative. Assuming a total Phase 2 initiation and construction period of about 10 years (2018-2028), projects initiated in the first 8 years (2018-2025) are anticipated to be those receiving detailed evaluation in the Phase 2 feasibility study and project-level analysis in the environmental documentation. Projects initiated outside that period, 2026-2028, are anticipated to still be included in the studies, but at a programmatic level of detail. This distinction is made because the timeframe for continued validity of the evaluation in the environmental documents is shorter than the total implementation period of Phase 2.

The Member Agencies reviewed the potential timing of their projects, discussed their priorities, and considered their own individual ability to fund the local share of costs. From the over 50 projects identified in Section 3, the Member Agencies selected 22 projects for initial consideration in the Phase 2 feasibility study. These projects, presented in Table 5-5 and shown on Figure 5-2, form the Conceptual Alternative, a preliminary list of projects for feasibility analysis as defined in Workshop 5 in January 2014. Some projects were identified as starting during the 2028-2025 timeframe, but had estimated completion from 2026-2028.

The Member Agencies continue to discuss, evaluate, and refine the Phase 2 project list following completion of this report. The final list of projects for the Phase 2 Feasibility Study will be completed subject to the negotiations between the Member Agencies and will be incorporated into the MOU.



W:\REPORTS\NBWRA\Novato SD Potential Phase 2 Projects\Figure 5-2_Phase 2 Conceptual Alternative_DRAFT.ai 03/13/2014

Data Source(s): ESRI World Imagery Service, CDM Smith, ESA
Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

CDM Smith

Figure 5-2
Phase 2 Conceptual Alternative

Table 5-5. Projects in the Conceptual Alternative

Agency	Project Type	Project	Implementation Timeframe										
			Project-Level								Programmatic		
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
MMWD	Distribution	Peacock Gap main pipeline extension											
	Distribution	Peacock Gap area infill											
LGVSD	Storage	Secondary effluent storage/treatment plant flood protection											
	Treatment	Expansion of recycled water treatment capacity to 5.4 mgd											
	Storage	Existing storage pond repair/upgrade											
	Storage	McInnis Marsh - LGVSD/Marin County project											
	Storage	Terra Linda dry weather runoff channel water capture											
Novato SD	Storage	Construction of storage wetlands for secondary effluent											
	Treatment	Increase tertiary capacity to 5 mgd											
	Other	Marin County/Novato SD project to turn over leased reclamation facility and restore tidal prism, enhance habitat, irrigate natural habitat, and address sediment issues in Novato Creek											
Petaluma	Distribution	Urban recycled water system expansion											
	Treatment	Increase capacity of tertiary production to meet current summer peak hour demand of 6 mgd											
	Storage	Additional onsite storage (potential options include new recycled water storage pond or raising height of oxidation ponds for storage use)											
	Distribution	Agricultural recycled water system expansion											
SVCSD	Distribution	Agricultural and landscaping irrigation in Sonoma Valley along Watmaugh Road and Peru Road, 3.2 miles of pipeline (four segments)											
SCWA	Storage	Groundwater banking with winter Russian River flows in Sonoma Valley											
	Stormwater Capture & Recharge	Groundwater management and recharge in Sonoma Creek watershed											
	Stormwater Capture & Recharge	Groundwater management and recharge in Upper Petaluma River Watershed											
Napa SD	Storage	Additional WWTP covered storage											
	Distribution	MST pipeline extension for landscape irrigation											
	Treatment	Construction of additional filters to increase treatment capacity by 1.7 mgd											
	Storage	New seasonal storage (options include raising the existing levees surrounding ponds, new off-site pond, or ASR)											

The Scoping Study provides a qualitative evaluation of the conceptual alternative; however, even at this level of detail, the conceptual alternative broadly meets the Phase 2 objectives. Table 5-6 presents the initial analysis of which objectives are met by the Conceptual Alternative and which objectives may need additional analysis before making that determination.

Table 5-6. NBWRP Phase 2 Program Objectives Compared to the Conceptual Alternative

Objective	Subobjective	
Improve Regional Water Supply	▪ Improve local, regional, and state water supply reliability	▪ Yes
	▪ Address impaired groundwater basins	▪ Yes
	▪ Offset demands on potable water supplies	▪ Yes
	▪ Maintain and protect public health and safety	▪ Yes
	▪ Reduce dependence on the Delta	▪ Yes
Sustainability	▪ Incorporate use of renewable energy and promote energy efficiency	▪ TBD[1]
	▪ Address climate change adaptation	▪ Yes
	▪ Reduce greenhouse gas emissions	▪ TBD
Watershed Approach	▪ Incorporate multiple agencies and stakeholders	▪ Yes
	▪ Address multiple resources management strategies	▪ Yes
Economic Feasibility & Financial Viability	▪ Cost effectiveness	▪ TBD
	▪ Financially implementable projects	▪ TBD
Readiness to Proceed	▪ Ability to start design	▪ TBD
	▪ Ability to start construction	▪ TBD
Environmental Enhancement	▪ Enhance local and regional ecosystems	▪ Yes
	▪ Improve water quality for habitat	▪ Yes
	▪ Improve instream flows for aquatic life	▪ Yes
Social Issues	▪ Provide benefits to rural or economically disadvantaged communities	▪ NA[2]
	▪ Address environmental justice considerations	▪ NA
	▪ Enhance recreation and open space opportunities	▪ Yes
	▪ Maintain agricultural industry and culture	▪ Yes

[1] TBD = to be determined. Further study will determine if the conceptual alternative meets these subobjectives.
[2] NA = not applicable. There are no environmental justice communities, as defined by DWR's IRWM process, within the Phase 2 program boundary.

5.4 Reconnaissance-Level Costs

The projects in the Conceptual Alterative, identified in Table 5-5 and determined through the January 2014 workshop, were evaluated to prepare a reconnaissance-level cost estimate to determine the potential scale of Phase 2 alternatives. The cost estimating approach taken here is the same as was used for the Phase 1 projects as documented in Appendix F of the *North San Pablo Bay Restoration and Reuse Project, Draft Phase 3 Engineering and Economic/Financial Analysis Report* (Sonoma County Water Agency and U.S. Bureau of Reclamation 2008). Although feasibility-level costs estimating approaches were applied, the level of detail for the project layouts and descriptions must be considered as a reconnaissance-level of detail based on the information available at the time of this study. Therefore, the estimates of costs can only be considered reconnaissance level in this report. The results of the estimating effort, performed in accordance with Title XVI guidelines, are presented below.

5.4.1 Approach

The Reclamation guidance documents used for estimating the feasibility- level costs consist of the following:

- Cost Estimating, Directives and Standards, "FAC 09-01" (U.S. Bureau of Reclamation 2007);
- Cost Estimating, Directives and Standards, "FAC TRMR-9" (U.S. Bureau of Reclamation 2006a); and
- Cost Estimating, Policy, "FAC TRMR-8" (Reclamation 2006b).

Only the major components were incorporated in the cost estimates, including: distribution pipelines; treatment plant improvements; system storage components; and distribution pump stations. The estimates also include allowance, contingency, and non-contract costs such as engineering, legal and license fees, and engineering construction services.

All present worth costs are based on cost indices that are measures of the average change in process over time. For this study, the Engineering News Record's (ENR) Construction Cost Index (CCI) for San Francisco was used. This index is widely used for studies and estimates of construction projects and is published quarterly in ENR. The Phase 1 cost estimates were based on an April 2008 CCI of 9155; the Phase 2 costs have been brought up to date by utilizing a September 2013 ENR CCI of 10,388. A few of the costs are based on an evaluation of recent construction cost experience by each of the participating agencies.

5.4.2 Unit Cost Curves and Estimating Assumptions

Unit costs for each of the major construction components were initially provided and agreed upon by the member agencies during the Phase 1 technical workshop process. The unit costs used to develop the Phase 1 cost estimates were updated to reflect a September 2013 ENR CCI of 10,388, and were reviewed by the participating agencies during the Project Definition Scoping Study process. Table 5-7 provides a summary of the unit cost associated with the Phase 2 project components.

Table 5-7. Project Unit Construction Cost Comparison

		Project Unit Construction Costs Used in 2008 Feasibility Study (ENR CCI (SF) = 9,155)		Project Unit Construction Costs for Preliminary Cost Estimate (updated to ENR CCI (SF) = 10,388)
Construction Item	**Unit**	**Unit Costs**	**Source**	**Unit Costs**
Pipeline <12" (cut and cover)	inch-ft	$10.04	Napa SD[1]	$11.39
Pipeline 18" (cut and cover)	inch-ft	$11.45	Napa SD[1]	$12.99
Pipeline 24" (cut and cover)	inch-ft	$12.87	Napa SD[1]	$14.60
Pipeline 30" (cut and cover)	inch-ft	$14.40	Napa SD[1]	$16.34
Pipeline 36" (cut and cover)[2]	inch-ft	$15.93	Napa SD[1,2]	$18.08
Pipeline (microtunnel)	inch-ft	$135	Napa SD	$153.19
Storage (pond impoundment)	acre-ft	$23,230	SCWA	$26,360
Storage (reservoir)	MG	$1,085,000	Novato SD/LGVSD/ CDM Smith	$1,231,000
Treatment Upgrades	mgd	$2,500,000	Napa SD	$2,837,000
Pump Stations	HP	Formula[3]	SCWA	Formula[4]

Sources:
[1] Napa SD Strategic Plan for Recycled Water Use (Napa Sanitation District 2005).
[2] Price for 36" and larger pipe extrapolated from smaller pipe diameters.
[3] Formula: Construction Cost = $19,717 x BHP^(0.69). Updated to April 2008 ENR CCI = 9,155
[4] Formula: Construction Cost = $22,372 x BHP^(0.69). Updated to September 2013 ENR CCI = 10,388

Treatment Costs: Due to the specific nature of the work and costs associated with any upgrades at a WWTP, actual cost estimates for each individual treatment upgrades project, where available, were used, instead of a unit cost. A unit cost was used for the Napa SD WWTP and Novato SD WWTP treatment upgrades, in the absence of a project-specific construction cost estimate.

Pipeline Costs: Pipeline costs were calculated by first determining a base cost for each pipe size for a base construction condition. For this study, construction through rural or barren land using conventional dry trenching techniques was used as the base condition.

As discussed in the *North San Pablo Bay Restoration and Reuse Project, Draft Phase 3 Engineering and Economic/ Financial Analysis Report* (Sonoma County Water Agency and U.S. Bureau of Reclamation 2008), these base condition costs were increased to reflect potential geological and geotechnical constraints that may exist along each of the pipeline segments. Because a specific evaluation of the geotechnical conditions along each of the proposed Phase 2 project pipelines has not yet been performed, an engineering judgment of the conditions, based on work performed during Phase 1, was used to develop these estimates. In general, initial pipeline unit costs for any particular pipeline segment were increased by 0 to 100 percent, depending upon potential geotechnical constraints. Costs for pipe sizes ranging from 4" to 54" in diameter were developed for use in this study, and are based on the unit costs used during Phase 1, updated to the ENR CCI of 10,388.

Pumping Costs: The estimated brake horsepower was used as the basis for developing pump station costs. Although the type of pump station can affect costs, this factor was not considered in the pump cost due to the uncertainties and variety of pump station operating requirements, and equipment preferences of each participating agency. As a result, the pump station costs developed using the formula below reflect what may be considered by some to be a basic pumping facility, with a minimal footprint and security fencing, but without any more substantial buildings to house equipment.

Land acquisition costs for pump stations were not included in the cost estimate. While some treatment plants may need to purchase additional land if expanded to distribute recycled water to users, others will not require any land acquisition. Booster pump stations, however, will likely require costs for land, as they would not be located at the treatment plant sites.

The Bay Area Regional Water Recycling Program (BARWRP) study determined that construction cost was found to be proportional to the peak brake horsepower (BHP) raised to the 0.69 power. The following equation calculates the construction cost of a pump station (updated to the ENR CCI of 10,208):

$$\text{Construction Cost} = \$22{,}372^{2} \times \text{BHP}^{(0.69)}$$

For multiple pumps constructed at a single station (e.g., at a WWTP), the BHP values of all pumps at the station were summed to develop the pump station cost.

Storage Costs: Unit costs for constructing earthen storage reservoirs were estimated at approximately $26,360 per AF of storage created, based on historic storage pond construction costs from SVCSD updated to the ENR CCI of 10,388. Further adjustments to this unit cost, if necessary, are shown in Table 5-8.

[2] BARWRP Study, based on ENR CCI of 6700, used Construction Cost = $14,430 x BHP$^{(0.69)}$. BARWRP TM No. 2, 1999.

5.4.3 Phase 2 Project Construction Costs

The estimated construction costs for the variety of potential Phase 2 projects and project elements are presented in Table 5-8. A few unit costs were modified slightly by using engineering judgment to apply more appropriately to the type of work related with the project. These adjustments to unit costs stated in Table 5-7 are noted in the comments portion of Table 5-8. Finally, the total estimated capital costs for the potential Phase 2 projects are presented in Table 5-9.

The Probable Total Project Capital Costs includes the following elements:

- **Subtotal Cost:** Calculated using the unit costs developed by the member agencies for the Project as discussed in Section 5.4.2. The unit costs assumed a normal (average) construction environment, and did not include such activities as significant rock excavation or dewatering, unusual working hours, or exotic construction methods.
- **Allowance for Unlisted Items:** Per Reclamation Directives and Standards and Engineering Research Center guidelines, a markup of 15 percent of the total Subtotal Cost was added to account for additional work that may be identified during additional design phases of the Project.
- **Contingency:** Per Reclamation Directives and Standards, a markup of 20 percent of the total Subtotal Cost was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes or changes in project planning.
- **Opinion of Probable Construction Costs:** This reflects an estimate of the capital costs of a feature or project from award to construction closeout. The Opinion of Probable Construction Costs equals the construction contract cost plus contingencies. Contingencies are intended to account for costs resulting from changes in design and/or differing site conditions encountered during construction. The Opinion of Probable Construction Cost is often called the Field Cost by Reclamation.
- **Non-Contract Cost:** This term refers to the costs of work or services provided by consultants/contractors in support of the project. This cost item reflects 25 percent of the Opinion of Probable Construction Costs to cover the following items:
  - Preliminary and final design engineering, preparation of construction plans and specifications (11%);
  - Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13%); and
  - Project administration, legal support (1%).
- **Opinion of Probable Total Project Capital Cost:** The sum of the total Opinion of Probable Construction Costs plus Non-Contract costs. The Opinion of Probable Total Project Capital Cost is often called the Construction Cost by Reclamation.

The Opinion of Probable Total Project Capital Costs for the proposed list of Phase 2 projects as of January 2014 is $206,700,000.

Table 5-8. Proposed Phase 2 Projects' Estimated Construction Contract Costs

Agency	Project / Components	Unit Rates and Costs					Comments
MMWD	**Peacock Gap Main Pipeline Extension**	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	12	25,530	11.39	1.35	$4,709,991	Length from MMWD memo emailed by Michael Ban on March 16, 2012.
	Peacock Gap Area Infill	**Unit Cost**				**Total**	
	pipelines	Lump Sum				$2,800,000	Capital costs of $3.5 million provided in email from Michael Ban on March 16, 2012, assumed to have 25% contingency. This value includes 2,500 feet of 6" pipe ($230,611).
LGVSD	**Tertiary Treatment Upgrades**	**Volume (MGD)**		**Unit Price ($/MGD Increase)**		**Total**	
	tertiary treatment plant upgrade 2018/2019	1.3		$284,900		$370,370	Estimated based on construction costs of recently completed LGVSD tertiary membrane and ultraviolet (UV) packages and amount of work required to increase existing total tertiary capacity from 1.4 mgd to 5.4 mgd. Costs designated by agency per Mark Williams, October 9, 2013.
	tertiary treatment plant upgrades 2019/2020	0.4		$3,174,603		$1,111,111	
	tertiary treatment plant upgrades 2022/2023	2.4		$472,813		$1,111,111	
	Secondary Storage/Treatment Flood Protection	**Length (LF)**		**Unit Price ($/LF)**		**Total**	
	flood protection levee for storage pond	2,000		$556		$1,111,111	Levee measured along west, north, and east sides of treatment plant only. 1-MG effluent equalization storage pond. Agency cost estimate of $1.5 million.
		Volume (AF)		**Unit Price ($/AF)**		**Total**	
	storage pond	3.3		$26,360		$86,988	
	Terra Linda Runoff Capture	**Unit Cost**				**Total**	
		Lump Sum				$555,556	Assumes approximately 100 linear feet of concrete channel improvements, diversion structures, 24" piping connections to existing sewer within 300 feet. Agency estimated cost of $750,000.
	Existing Storage Pond Maintenance/Repair	**Length (LF)**		**Unit Price ($/LF)**		**Total**	
	levee repair	10,935		$250		$2,733,750	Repair of levees assumed to be 25 percent of cost of new levees; no piping needed. Agency cost of $5 million.
		Volume (AF of Soil)		**Unit Price ($/AF of Soil)**		**Total**	
	grading and excavation	90		$2,700		$243,000	Assumes average 1.5 ft excavation.
		Unit Cost					
	upgrade of pumping and piping structures	Lump Sum				$1,000,000	
	McInnis Marsh	**Unit Cost**				**Total**	
	habitat restoration	Lump Sum				$4,450,000	1,650-ft river channel; road improvement; 1,500-ft ecotone slope; 3,500 ft of channel to move water to eastern edge. Agency cost estimate of $6 million.
Novato SD	**Storage Wetland**	**Length (LF)**		**Unit Price ($/LF)**		**Total**	
	levee	5,800		$1,000		$5,800,000	Construction of new 15-ft tall levee; 248 acres. Estimated 3,000 AF storage capacity total.
	levee	1,750		$200		$350,000	Repairs to existing levee, raising of approximately 2 ft. Estimated 3,000 AF storage capacity total.
		Unit Cost				**Total**	
	repair/replace existing outfall pipeline	Lump Sum				$2,000,000	Discussion with Beverly James, March 9, 2012
		Unit Cost				**Total**	
	additional connection pipeline construction costs	Lump Sum				$200,000	Assumes 100 ft pipe, appurtenances, and a control structure
		Area (Acres)		**Unit Price ($/Acre)**		**Total**	
	grading	248		$2,420		$600,160	Rough site grading. Developed from RS Means fine grading estimates.
	WWTP Tertiary Capacity Upgrade	**Capacity (MGD)**		**Unit Price ($/MGD Increase)**		**Total**	
	treatment[2]	3.3		$2,837,000		$9,360,000	
	Tidal Prism and Habitat Restoration Marin County/Novato SD Project	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipeline	18	5,500	13.00	1.15	$1,479,752	Open cut 5,500 ft of 18-in pipe for irrigation.
	pump station	Formula = $22,372 x HP^0.69				$1,273,831	Pump station with single 310 HP pump.

Table 5-8. Proposed Phase 2 Projects' Estimated Construction Contract Costs

Agency	Project / Components	Unit Rates and Costs					Comments
Petaluma	**WWTP Capacity Increase**	**Capacity (MGD)**		**Unit Price ($/MGD Increase)**		**Total**	
	treatment[2]	2.6		$1,418,500		$3,690,000	Current capacity of two UV treatment channels totaling 5.2 mgd. Plant has a third UV channel rated at 2.6 mgd; this would be the next size increase. Conversation per Matt Pierce, October 10, 2013. Unit price is estimated at half due to existing treatment equipment in place.
	Urban Recycled Water Expansion	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	Phase 1B						Lengths and sizes taken from Petaluma Master Plan. Area C of Master plan contains Phase 2A and 2B. Portions of Area A and E of the Master Plan comprise were used to estimate Phase 1B. Lengths measured per David Iribarne's Recycled Water Map (Email sent January 21, 2014)
	pipelines	6	11,004	11.39	1.15	$864,677	
	pipelines	20	14,255	13.49	1.15	$4,423,724	
	Phase 2A						
	pipelines	6	1,200	11.39	1.15	$94,294	
	pipelines	10	2,377	11.39	1.15	$311,302	
	pipelines	12	12,604	11.39	1.15	$1,980,805	
	Phase 2B						
	pipelines	6	4,737	11.39	1.15	$372,226	
	pipelines	8	1,533	11.39	1.15	$160,614	
	pipelines	10	6,985	11.39	1.15	$914,784	
	pipelines	12	1,437	11.39	1.15	$225,834	
	Agriculture Recycled Water Expansion	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	Agricultural Phase 1						Lengths and sizes taken from Petaluma Master Plan modeling table. Agricultural Phase 1 matches Mater Plan model Scenario H.
	pipelines	20	11,601	13.49	1.15	$3,600,114	
	pipelines	24	4,319	14.61	1.15	$1,741,168	
	Agricultural Phase 2						Lengths and sizes taken from Petaluma Master Plan modeling table. Agricultural Phase 2 matches Mater Plan model Scenario K.
	pipelines	6	2,107	11.39	1.15	$165,565	
	pipelines	20	13,370	13.49	1.15	$4,149,084	
	Agricultural Phase 3						Lengths and sizes approximated based on model area map from Petaluma Master Plan. Agricultural Phase 3 matches Master Plan model Scenario L.
	pipelines	6	2,868	11.39	1.15	$225,363	
	pipelines	20	9,391	13.49	1.15	$2,914,289	
		Volume (MG)		**Unit Price ($/LF)**		**Total**	
	Storage	2		$1,231,000		$2,462,000	
		Unit Cost				**Total**	
	Upgrade of pumping and piping structures	Lump Sum				$1,000,000	
	Additional Onsite Storage						Two options recognized by agency for storage. Eastside Pond Cost is reflected in Project Totals.
	Eastside Storage Pond levee	**Length (LF)**		**Unit Price ($/LF)**		**Total**	
		11,050		$509		$5,622,461	Perimeter of outlined area measured using Google Earth.
	Conversion of Oxidation Ponds	**Length (LF)**		**Unit Price ($/LF)**			
		11,500		$330		$3,795,000	Assume raising levee around entire perimeter and costs one-third that of new levee.
SVCSD	**Sonoma Valley Pipelines**	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	Lengths measured from aerial mapping available from Google Earth. West Side Pipeline represents distribution to Temelec Area, Long Term Irrigation for Carriger and Felder Creek Area, and Irrigation near Rodgers Creek. Pipe size designated by Kevin Booker.
	West area pipelines (400-550 AFY)	14	13,337	11.88	1.15	$2,551,654	
	Peru Road	12	3,451	11.39	1.15	$542,348	

Table 5-8. Proposed Phase 2 Projects' Estimated Construction Contract Costs

Agency	Project / Components	Unit Rates and Costs					Comments
SCWA	**Groundwater Banking/ASR Storage**	**No. of Wells**		**Unit Price per Well**		**Total**	
	other	10		$750,000		$7,500,000	Assume deep ASR water wells.
		Diam (in)	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	18	3,000	13.00	1.20	$840,000	
	Groundwater Management & Recharge: Sonoma Valley	**Unit Cost**				**Total**	
	other	Lump Sum				$4,000,000	Preliminary cost estimate provided by Kevin Booker.
	Groundwater Management & Recharge: Upper Petaluma River	**Unit Cost**				**Total**	
	other	Lump Sum				$3,000,000	Preliminary cost estimate provided by Kevin Booker.
Napa SD	**MST Tulocay Pipeline**	**Diam (in)**	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	12	7,200	11.39	1.20	$1,180,000	Length measured from Google Map pipe size designated previously.
	Increase Recycled Water Filter Capacity	**Capacity (MGD)**		**Unit Price ($/MGD Increase)**		**Total**	
	treatment[2]	1.7		$653,595		$1,110,000	Based on capital cost estimate of $1.5 million per email from Jeff Tucker on November 5, 2013.
	Additional WWTP Covered Storage	**Volume (AF)**		**Unit Price ($/AF)**		**Total**	
	storage pond[2]	10		$148,148		$1,481,480	Based on capital cost estimate of $2 million provided in email from Jeff Tucker on April 5, 2012.
	New Seasonal Storage						Napa SD has identified a number of potential options for storage. Raising WWTP oxidation pond levees is reflected in project cost total below. If the oxidation pond option is found to be feasible, other storage options would not be needed.
	Raising WWTP Oxidation Pond Levees	**Length (LF)**		**Unit Price ($/LF)**		**Total**	
	Storage ponds	32,000		$750		$24,000,000	Assumes an increase of 14 cubic yards per linear foot to raise existing perimeter and internal levees by 5 feet.
	Jameson Ranch Storage Pond	**Volume (AF)**		**Unit Price ($/AF)**		**Total**	
	storage ponds	250		$26,360		$6,590,000	
		Diam (in)	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	18	12,000	13.00	1.20	$3,370,000	
	Somky Ranch Storage Pond	**Volume (AF)**		**Unit Price ($/AF)**		**Total**	
	storage ponds	250		$26,360		$6,590,000	
		Diam (in)	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	18	3,000	13.00	1.20	$840,000	
	ASR Storage	**No. of Wells**		**Unit Price per Well**		**Total**	
	other	10		$1,000,000		$10,000,000	Assumed deep groundwater ASR wells.
		Diam (in)	**Length (ft)**	**$/in-ft**	**Constructability[1]**	**Total**	
	pipelines	18	3,000	13.00	1.20	$840,000	
					Total Construction Contract Costs	**$122,470,517**	

Notes:
[1] Constructability reflects a potential cost increase due to site specific geotechnical or other currently unknown conditions that could affect construction.
[2] Agency supplied pricing used in Phase 2 item estimate due to insufficient information available to use Phase 1 estimating method.

Table 5-9. Summary of Proposed Phase 2 Projects' Total Estimated Capital Costs[1]

Agency	Projects	Distribution Pipelines	Pump Stations	Storage	WWTP Treatment Upgrades	Lump Sum or Other Construction Cost	Total Construction Contract Costs	USBR Allowance/ Contingencies (35%)[2]	Opinion of Probable Construction Costs	USBR Non-Contract Costs (25%)[3]	Opinion of Probable Total Project Capital Costs	Summary by Agency
MMWD	Peacock Gap Main Pipeline Extension	$ 4,709,991	$ -	$ -	$ -	$ -	$ 4,709,991	$ 1,650,000	$ 6,360,000	$ 1,590,000	$ 7,950,000	$ 12,680,000
	Peacock Gap Area Infill	$ 2,800,000	$ -	$ -	$ -	$ -	$ 2,800,000	$ 980,000	$ 3,780,000	$ 950,000	$ 4,730,000	
LGVSD	Tertiary Treatment Upgrades	$ -	$ -	$ -	$ 2,592,592	$ -	$ 2,592,592	$ 910,000	$ 3,500,000	$ 880,000	$ 4,380,000	$ 21,570,000
	Secondary Storage/Flood Protection	$ -	$ -	$ 86,988	$ -	$ 1,111,111	$ 1,198,099	$ 420,000	$ 1,620,000	$ 410,000	$ 2,030,000	
	Terra Linda Runoff Capture	$ -	$ -	$ -	$ -	$ 555,556	$ 555,556	$ 190,000	$ 750,000	$ 190,000	$ 940,000	
	Existing Storage Pond Repair/Upgrade	$ -	$ 1,000,000	$ 2,976,750	$ -	$ -	$ 3,976,750	$ 1,390,000	$ 5,370,000	$ 1,340,000	$ 6,710,000	
	McInnis Marsh	$ -	$ -	$ -	$ -	$ 4,450,000	$ 4,450,000	$ 1,560,000	$ 6,010,000	$ 1,500,000	$ 7,510,000	
Novato SD	Storage Wetland	$ 2,200,000	$ -	$ 6,750,160	$ -	$ -	$ 8,950,160	$ 3,130,000	$ 12,080,000	$ 3,020,000	$ 15,100,000	$ 35,540,000
	WWTP Capacity Upgrade	$ -	$ -	$ -	$ 9,360,000	$ -	$ 9,360,000	$ 3,280,000	$ 12,640,000	$ 3,160,000	$ 15,800,000	
	Tidal Prism and Habitat Restoration	$ 1,479,752	$ 1,273,831	$ -	$ -	$ -	$ 2,753,582	$ 960,000	$ 3,710,000	$ 930,000	$ 4,640,000	
Petaluma	WWTP Capacity Increase	$ -	$ -	$ -	$ 3,690,000	$ -	$ 3,690,000	$ 1,290,000	$ 4,980,000	$ 1,250,000	$ 6,230,000	$ 58,940,000
	Urban Recycled Water Expansion	$ 9,348,261	$ -	$ -	$ -	$ -	$ 9,348,261	$ 3,270,000	$ 12,620,000	$ 3,160,000	$ 15,780,000	
	Agricultural Recycled Water Expansion	$ 12,795,583	$ 1,000,000	$ 2,462,000	$ -	$ -	$ 16,257,583	$ 5,690,000	$ 21,950,000	$ 5,490,000	$ 27,440,000	
	Additional Onsite Storage	$ -	$ -	$ 5,622,461	$ -	$ -	$ 5,622,461	$ 1,970,000	$ 7,590,000	$ 1,900,000	$ 9,490,000	
SVCSD	Sonoma Valley Pipelines	$ 3,094,002	$ -	$ -	$ -	$ -	$ 3,094,002	$ 1,080,000	$ 4,170,000	$ 1,040,000	$ 5,210,000	$ 5,210,000
SCWA	Groundwater Banking/ASR	$ 840,000	$ -	$ -	$ -	$ 7,500,000	$ 8,340,000	$ 2,920,000	$ 11,260,000	$ 2,820,000	$ 14,080,000	$ 25,890,000
	Groundwater Management & Recharge: Sonoma Valley	$ -	$ -	$ -	$ -	$ 4,000,000	$ 4,000,000	$ 1,400,000	$ 5,400,000	$ 1,350,000	$ 6,750,000	
	Groundwater Management & Recharge: Petaluma River	$ -	$ -	$ -	$ -	$ 3,000,000	$ 3,000,000	$ 1,050,000	$ 4,050,000	$ 1,010,000	$ 5,060,000	
Napa SD	MST Tulocay Pipeline	$ 1,180,000	$ -	$ -	$ -	$ -	$ 1,180,000	$ 410,000	$ 1,590,000	$ 400,000	$ 1,990,000	$ 46,870,000
	Increase Filter Capacity	$ -	$ -	$ -	$ 1,110,000	$ -	$ 1,110,000	$ 390,000	$ 1,500,000	$ 380,000	$ 1,880,000	
	Additional WWTP Covered Storage	$ -	$ -	$ 1,481,480	$ -	$ -	$ 1,481,480	$ 520,000	$ 2,000,000	$ 500,000	$ 2,500,000	
	New Seasonal Storage	$ -	$ -	$ 24,000,000	$ -	$ -	$ 24,000,000	$ 8,400,000	$ 32,400,000	$ 8,100,000	$ 40,500,000	
	Total	$ 38,450,000	$ 3,280,000	$ 43,380,000	$ 16,760,000	$ 20,620,000	$ 122,470,000	$ 42,860,000	$ 165,330,000	$ 41,370,000	$ 206,700,000	

Notes:
[1] Based on Phase 1 Costing Methods Updated to ENR CCI = 10,388.34 [September 2013]
[2] USBR Allowance/Contingencies (35%) includes:
Allowance for Unlisted Items accounts for additional work that may be identified during additional design phases of the Project (15%),
Contingencies are considered as funds to be used after construction starts to pay contractors for overruns on quantities, changes site conditions, change orders, etc. (20%)
[3] Non-Contract Cost (25%) includes:
Preliminary and final design engineering, preparation of construction plans and specifications (11%),
Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13%),
Project administration, legal support (1%)

Section 6
Phase 2 Projects

The purpose of the Scoping Study process has been to assist the NBWRA Member Agencies in determining their involvement in the Program and their projects to be included in a Phase 2 Feasibility Study. Throughout this report and study process, there has been an evolution of the list of potential projects to be addressed in the Feasibility Study. The broadest list of over 50 potential projects derived from initial agency meetings and early workshops are documented in Section 3. Section 5 presents the list of 22 projects for feasibility analysis as they were defined in Workshop 5 in January 2014.

Although the January 2014 list is summarized here, the NBWRA Member Agencies will continue to discuss, evaluate, and refine the Phase 2 project list following completion of this report as they move into the Feasibility Study.

6.1 Purpose of Project List

The purpose of the Phase 2 Scoping Studies is to explore options for a program expanding recycled water use, and other water management options, within the North San Pablo Bay region beyond the projects currently being constructed as Phase 1 of the NBWRP. The scoping studies identified the broadest range of uses and projects prior to the Member Agencies' decisions to proceed with the more detailed Feasibility Study. Appendix D contains the work products from the first two scoping studies, the Membership and Outreach Study Summary Memorandum (June 2011) and the Project Definition Scoping Study Report (October 2012).

In the future Feasibility Study, the potential projects identified below in Section 6.2 will be combined and formulated into alternatives that maximize the Program objectives. Alternatives will undergo screening, reformulation, and evaluation as more detailed layouts and costs are developed. Future Feasibility Study analysis will also expand the primary objectives to define how to measure success of an alternative against the objectives. Appendix E contains an overview of the scope of work for the Feasibility Study.

6.2 Summary of Projects for Feasibility Level Study

This section provides a summary of the broad range of water management projects identified by the Member Agencies in January 2014 for more detailed analysis in the Feasibility Study. The NBWRA Member Agencies continue to discuss, evaluate, and refine the Phase 2 project list following completion of this report.

For each Member Agency, the project components are summarized by treatment, storage, distribution, groundwater management, and other project opportunities, and interaction with other agencies/organizations.

6.2.1 Novato Sanitary District

Novato SD has identified multi-purpose projects for storage, recycled water use, effluent management, and environmental enhancement. Project components would be developed in conjunction with Marin County and the California Coastal Conservancy.

Table 6-1. Novato SD Projects for Feasibility Study

Project Type	Project Title	Description
Storage	Storage Wetland	Construction of a 248-acre storage wetlands for secondary effluent
Treatment	WWTP Capacity Upgrade	Improvement to WWTP to increase tertiary capacity to 5 mgd
Other	Tidal Prism and Habitat Restoration	Marin County/Novato SD project: Turn over leased Novato SD reclamation facility and use the land to restore tidal prism, enhance habitat, irrigate natural habitat, and address sediment issues in Novato Creek

6.2.2 Las Gallinas Valley Sanitary District

LGVSD seeks expansion of treatment facilities, additional storage, protection from sea level rise, and an environmental enhancement project in conjunction with Marin County.

Table 6-2. LGVSD Projects for Feasibility Study

Project Type	Project Title	Description
Treatment	Tertiary Treatment Upgrades	Expansion of Recycled Water Treatment Capacity to treat up to 5.4 mgd of tertiary treatment in three phases
Storage	Secondary Storage/Flood Protection	Traditional or horizontal levees would be installed to protect from existing flood threat and future sea level rise. The project includes the installation of a one million gallon effluent storage flow equalization basin to store secondary effluent for recycled water production / wet weather storage basin.
Storage	Terra Linda Runoff Capture	Capture of Terra Linda dry weather channel runoff for WWTP treatment and water recycling
Storage	Existing Storage Pond Repair/Upgrade	Increase secondary effluent storage for recycled water production by deepening and raising existing storage ponds and freshwater marsh. Increasing the height of the levees will protect against wet weather flooding and sea level rise. The project will include upgrading, replacing and or installing storage pumping, piping and structures.
Storage	McInnis Marsh	LGVSD/Marin County project: Protect storage, treatment and recycled water facilities from flooding and sea level rise by installing horizontal levees and creating wetland habit. The project will reconnect Miller Creek to Gallinas Creek resulting in increased sediment conveyance. The horizontal levee will utilize recycled water to grow vegetation on horizontal levees. The project will reconfigure the treatment discharge outfalls.

6.2.3.Marin Municipal Water District

MMWD identified projects are primarily distribution of recycled water provided by LGVSD.

Table 6-3. MMWD Projects for Feasibility Study

Project Type	Project Title	Description
Distribution	Peacock Gap Main Pipeline Extension	Irrigation at Peacock Gap Golf Course - 170 AFY, 25,530 feet of 12-inch pipe
Distribution	Peacock Gap Area Infill	Landscaping irrigation at Peacock Gap residential area - 30 AFY, 2,500 feet 6-inch pipe

6.2.4 Sonoma Valley County Sanitation District

SVCSD seeks expansion of their recycled water distribution system in the Sonoma Valley area.

Table 6-4. SVCSD Project for Feasibility Study

Project Type	Project Title	Description
Distribution	Sonoma Valley Pipelines	Irrigation for landscaping and agriculture in Sonoma Valley along Watmaugh Road and Peru Road, 3.2 miles of pipeline

6.2.5 Sonoma County Water Agency

SCWA is addressing groundwater salinity intrusion and management issues in the Sonoma Valley and groundwater recharge issues in the Upper Petaluma River Watershed.

Table 6-5. SCWA Projects for Feasibility Study

Project Type	Project Title	Description
Storage	Groundwater Banking/ASR Storage	Groundwater banking with Russian River winter flows in Sonoma Valley: Incremental increase in storage of 17,300 AF over a 30-year period
Groundwater Management	Groundwater Management and Recharge: Sonoma Valley	Groundwater management and recharge program in Sonoma Valley groundwater basin
Groundwater Management	Groundwater Management and Recharge: Petaluma River	Groundwater management and recharge program in Upper Petaluma River Watershed

6.2.6 Petaluma

Petaluma has identified the need for additional treatment capacity, additional on-site seasonal storage, and expansion of their urban and agricultural distribution systems.

Table 6-6. Petaluma Projects for Feasibility Study

Project Type	Project Title	Description
Treatment	WWTP Capacity Upgrade	Increase capacity of tertiary production to meet current summer peak hour demand of 6 mgd
Storage	Additional onsite storage	Additional onsite storage. Two options to be studied include: ▪ new recycled water storage pond ▪ raising height of oxidation ponds for storage use
Distribution	Urban Recycled Water Expansion	Urban recycled water distribution system expansion to serve parks and open space, and school and institutional areas
Distribution	Agriculture Recycled Water Expansion	Lakeville Highway distribution system for agricultural users

6.2.7 Napa Sanitation District

Napa SD has identified the need for expanding their treatment facilities and extending distribution pipeline. Storage is a major concern and a number of options have been identified for further study.

Table 6-7. Napa SD Projects for Feasibility Study

Project Type	Project Title	Description
Distribution	MST Tulocay Pipeline	MST pipeline extension for landscape irrigation. Approximate demand: 77 AFY
Treatment	Increase Filter Capacity	Construction of additional filters to increase treatment capacity by 1.7 mgd
Storage	Additional WWTP Covered Storage	10-AF covered storage pond for tertiary water
Storage	New seasonal storage	New seasonal storage. Four options to be studied include: ▪ raising the existing levees surrounding ponds ▪ new off-site pond (two locations) ▪ aquifer storage and recovery

6.3 Summary of Findings

Based on the NBWRA's three-phase Scoping Study process, the following insights can be concluded for the Phase 2 Program:

- The alternatives developed in the Phase 2 Feasibility Study should integrate multi-benefit objectives to create a successful, achievable program that appeals to multiple funding sources;
- The NBWRA Member Agencies can capture and develop a significant, new, local, and reliable recycled water supply to implement Phase 2 projects;
- Due to the contrasting seasonality of recycled water supplies and the peak demand season, storage will be necessary to maximize beneficial use of this recycled water; and
- The NBWRA Member Agencies have identified a broad range of possible recycled water and groundwater management projects that cover all service areas and multiple project types.

Appendix A

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Appendix A
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Appendix B

Scoping Study Workshop Presentations

Appendix B-1

Workshop 1, January 28, 2013

(on CD only)

Appendix B-2

Workshop 2, April 15, 2013

(on CD only)

Appendix B-3

Workshop 3, May 20, 2013

(on CD only)

Appendix B-4

Workshop 4, August 19, 2013

(on CD only)

Appendix B-5

Workshop 5, November 18, 2013

(on CD only)

Appendix B-6

Workshop 6, January 27, 2014

(on CD only)

Appendix B-7

Workshop 7, April 21, 2014

(on CD only)

Appendix C

Detailed Water Demand Calculations

Appendix C

Detailed Water Demand Calculations

This appendix presents the detailed water demand calculations developed for several potential uses of recycled water in the NBWRA study area. These uses include:

- Vineyards;
- Landscaping and Pasturelands;
- Irrigated farms;
- Wetlands; and
- Winter Frost Protection.

Several of these calculations were developed in during the Phase 1 process and documented in Appendix B of the Phase 1 Feasibility Study (Sonoma County Water Agency and U.S. Bureau of Reclamation, 2008). For these calculations, a summary of the results is provided.

1.0 Vineyards

Appendix B of the Phase 1 Feasibility Study provided a description of how water use rates were estimates for vineyards in the study area. In summary, rates were calculated using evapotranspiration rates (ET_0) and crop coefficients (K_C). Calculations assumed that no irrigation water is applied to grapevines during the months of January, February, November, and December. Table C-1 summarizes the estimated water use rates for the Carneros region, Napa Valley, and Sonoma Valley.

Table C-1. Estimated Water Use Rates (AF/month/acre) for Vineyards

Month	Carneros Region	Napa Region	Sonoma Region
January	0.000	0.000	0.000
February	0.000	0.000	0.000
March	0.000	0.000	0.000
April	0.000	0.000	0.000
May	0.048	0.000	0.104
June	0.107	0.088	0.153
July	0.103	0.086	0.145
August	0.061	0.053	0.084
September	0.016	0.023	0.014
October	0.000	0.000	0.000
November	0.000	0.000	0.000
December	0.000	0.000	0.000
Total (AF/year/acre)	**0.335**	**0.250**	**0.500**

2.0 Landscaping and Pasturelands

Appendix B of the Phase 1 Feasibility Study provided a description of how water use rates were estimated for landscaped areas and pasturelands in the study area. Customers can apply recycled water to several grassed land uses, including urban landscaping, schools, parks, and pastureland. Estimated water use calculations take into consideration both ET_O and K_C for the local area. Peak water use typically occurs in the summer months (July and/or August), while, in general, water use during the winter months (November through March) is considered to be negligible. Table C-2 summarizes the estimated water use for landscaping and pasturelands in the NBWRA area.

Table C-2. Estimated Water Use Rates (AF/month/acre) for Landscaping and Pastureland

Month	Petaluma Region	Napa Region	Carneros Region	Sonoma Region	Marin Region	Novato Region	Las Gallinas Region
January	0.000	0.000	0.000	0.000	0.002	0.002	0.000
February	0.000	0.000	0.000	0.000	0.002	0.002	0.000
March	0.000	0.000	0.000	0.000	0.018	0.018	0.000
April	0.263	0.243	0.217	0.281	0.157	0.157	0.157
May	0.431	0.398	0.355	0.461	0.0195	0.195	0.195
June	0.578	0.533	0.476	0.618	0.376	0.376	0.376
July	0.621	0.573	0.511	0.664	0.439	0.439	0.439
August	0.552	0.509	0.455	0.591	0.452	0.452	0.452
September	0.401	0.369	0.330	0.428	0.309	0.309	0.309
October	0.193	0.178	0.158	0.206	0.242	0.242	0.242
November	0.000	0.000	0.000	0.000	0.030	0.030	0.000
December	0.000	0.000	0.000	0.000	0.12	0.012	0.000
Total (AF/year/acre)	**3.039**	**2.801**	**2.502**	**3.250**	**2.234**	**2.234**	**2.170**

3.0 Irrigated Farms

Appendix E of the Phase 1 Feasibility Study provided a description of estimated recycled water use for irrigated farms. Table C-3 summarizes the estimated monthly recycled water use rates.

Table C-3. Estimated Water Use Rates for Irrigated Farms

Month	Estimated Water Use (AF/month/acre)
January	0.008
February	0.001
March	0.021
April	0.063
May	0.135
June	0.222
July	0.281
August	0.305
September	0.208
October	0.086
November	0.009
December	0.001
Total (AF/year/acre)	**1.339**

4.0 Winter Frost Protection

Estimated recycled water use for winter frost protection was provided by Sonoma County Water Agency (Booker 2013). Table C-4 summarizes the estimated monthly recycled water use rates.

Table C-4. Estimated Water Use Rates for Winter Frost Protection

Month	Estimated Water Use (AF/month/acre)
January	0.042
February	0.042
March	0.042
April	0.042
May	0.000
June	0.000
July	0.000
August	0.000
September	0.000
October	0.000
November	0.042
December	0.042
Total (AF/year/acre)	**0.250**

5.0 Wetlands

The estimated recycled water use for wetlands was developed under the assumption that the wetlands are already established and operational. The volume of recycled water required to establish the wetlands will be dependent on the size and design of the wetland.

The following calculations estimated the monthly recycled water requirements to maintain the wetlands by keeping the soil saturated. In order to maintain the wetlands, the water entering the wetlands must be greater than the water leaving the wetlands. The following assumptions were made:

- There will be no change in the volume of recycled water stored in the wetlands.
- The soil is already saturated; therefore there would not be significant recycled water losses due to percolation into the soil.
- The volume of recycled water in the wetland is dependent on:
  - Water leaving the system through evapotranspiration (ET_0).
  - Water entering the system by precipitation.
  - Water entering the system through the delivery of recycled water.

In order to maintain the same storage volume in the wetlands, it was assumed that recycled water entering the wetlands must account for any reduction in volume which results when the ET_0 is greater than precipitation. Two sources of information were used:

- ET_0 for the ET_0 zone that the wetlands would be located in; and
- Precipitation data from the closest weather station in Novato, CA.

Table C-5 presents the data on ET_O and average monthly precipitation in Novato.

Table C-5. Monthly ET_O and Average Precipitation in Novato

Month	ET_O (inches/month)[1]	Average Monthly Precipitation (inches/month)[2]	Difference Between ET_O & Precipitation (inches/month)
January	0.93	2.12	-1.19
February	1.68	0.74	0.94
March	2.79	0.71	2.08
April	4.2	0.45	3.75
May	5.58	0.34	5.24
June	6.3	0.17	6.13
July	6.51	0.39	6.12
August	5.89	0.59	5.3
September	4.5	0.28	4.22
October	3.1	0.57	2.53
November	1.5	0.58	0.92
December	0.93	1.14	-0.21

Source:
[1] California Department of Water Resources 2013
[2] Precipitation data from Novato, CA. Data collection began in September 2007

For months with ET_O less than the average monthly precipitation (negative values in the last column of Table C-5), it was assumed that no recycled water would be needed to maintain the wetlands. For months with a greater ET_O than the average monthly precipitation, it was assumed that the difference (in inches per month) would be needed to maintain one acre of wetlands. Table C-6 presents the estimated volume of recycled water needed to maintain one acre of wetland habitat.

Table C-6. Monthly Recycled Water Requirement to Maintain Wetlands

Month	Difference Between ET_O & Precipitation (inches/month)	Water Needed To Maintain Soil Saturation (inches/month)	Volume of Recycled Water Needed (AF/acre/month)
January	-1.19	0	0
February	0.94	0.94	0.078
March	2.08	2.08	0.173
April	3.75	3.75	0.313
May	5.24	5.24	0.437
June	6.13	6.13	0.511
July	6.12	6.12	0.510
August	5.3	5.3	0.442
September	4.22	4.22	0.352
October	2.53	2.53	0.211
November	0.92	0.92	0.077
December	-0.21	0	0
Total (AF/year/acre)	--	**37.23**	**3.104**

To develop the estimated recycled water volumes, the size of the potential storage wetlands was estimated using Google Earth. The estimated monthly volumes from the last column of Table B-6 were applied to this acreage to determine the recycled water demand for wetlands for each wetlands project.

Appendix D

Previous Scoping Studies

Appendix D-1

Phase 2 Membership & Outreach Scoping Study Memorandum

(on CD Only)

Appendix D-2

Phase 2 Project Definition Scoping Study Report
(on CD only)

Appendix E

Overview of Feasibility Level Study Scope of Work

Appendix E

Overview of Feasibility Level Study Scope of Work

A draft scope of work to complete the Feasibility Study of the Phase 2 NBWRP has been developed to address the project components identified by the Member Agencies in the Scoping Study. The activities are summarized below. The complete scope is being developed and finalized with the Member Agencies.

E.1 Feasibility Study Program Components

The Feasibility Study program is comprised of a series of products to identify and screen the projects to develop an implementable program. Figure E-1 illustrates the products, the sequence of screening, and the purpose of the documents.

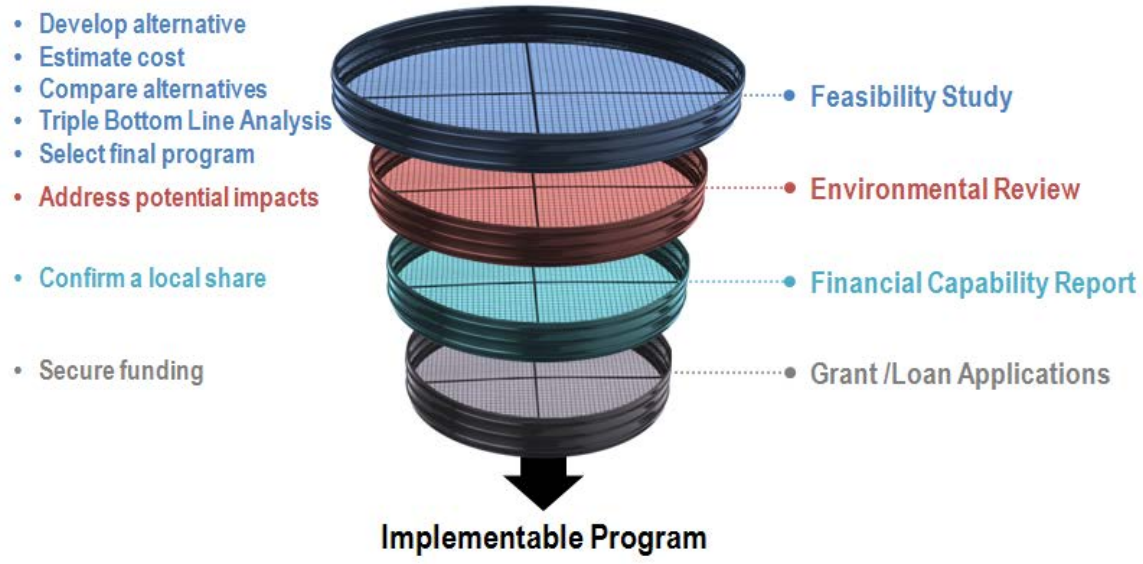

Figure E-1
Feasibility Study Components

E.2 Feasibility Study Program Scope Summary

A scope of work has been developed to address the planning, engineering, environmental, economic, public information, and grant aspects of the Phase 2 Feasibility Study. Three primary documents will be produced:

- Title XVI Feasibility Study Report, to identify the most feasible project alternatives in accordance with Reclamation's "Reclamation Manual Directives and Standards WTR 11-01, Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process" (U.S. Bureau of Reclamation 2008).

- Environmental Compliance Document, to meet the guidance of NEPA and CEQA. Currently, this document is assumed to be a Supplemental EIR/EIS which tiers off the Phase 1 EIR/EIS. This approach will be confirmed with Reclamation; however, project type, location and complexity may simplify or complicate analysis requirements for either CEQA/NEPA or permitting processes necessary to support Reclamation's Record of Decision.
- Financial Capability Determination, to develop a Reclamation-approved financial analysis. Currently, the scope of work is based on guidance is provided by Reclamation's "Reclamation Manual Directives and Standards WTR 11-02, Title XVI Financial Capability Determination Process WTR" (U.S. Bureau of Reclamation 2013).

The draft scope of work to complete the Feasibility Study of the Phase 2 NBWRP has been developed to address the project components identified above by the Member Agencies in the Scoping Study. The activities are summarized below. The complete scope is being developed and finalized with the Member Agencies.

- Management:
  - Workshops
  - Public involvement
  - Administration
- Title XVI Feasibility Study:
  - 10 specific sections required by Reclamation Guidance:
    - Introductory Information
    - Statement of Problems and Needs
    - Water Reclamation and Reuse Opportunities
    - Description of Alternatives`
    - Economic Analysis
    - Selection of the Proposed Title XVI Project
    - Environmental Considerations and Potential Effects
    - Legal and Institutional Requirements
    - Financial Capability of Sponsor
    - Research Needs
  - Triple Bottom Line analysis of the Program
- Environmental evaluation:
  - Environmental constraints analysis
  - Environmental compliance (NEPA/CEQA)
  - Notice of Intent, public meetings, EIR/EIS (drafts and final)
  - Certification materials

  - Permitting and regulatory process
  - Record of Decision
- Financial capabilities report:
  - Financial statements
  - Cost allocation
- Grant applications and management:
  - Study grant application(s)
  - Study grant management

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