RECLAMATION

Managing Water in the West

Lake Berryessa Concession Infrastructure Design

Draft Infrastructure Basis of Design Report

Napa County, California

U.S. Department of the Interior
Bureau of Reclamation
Sacramento, California

July 2015

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Lake Berryessa Concession Infrastructure Design

Draft Infrastructure Basis of Design Report
Napa County, California

Prepared by

United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region, Central California Area Office

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Sacramento, California

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Abbreviations and Acronyms

AB	Aggregate Base
ACoE	Army Corps of Engineers
ACoEEDM	Army Corps of Engineers Engineering Design Manual
ADA	Americans with Disabilities Act
Avg	Average
BOD	Biological oxygen demand
CMU	Concrete masonry units
DRAFAC	Design of Recreation Areas and Facilities-Access and Circulation
Ft	Feet
Gpd	Gallons per day
Gpm	Gallons per minute
HDPE	High-density polyethylene
HMA	Hot mix asphalt
Lbs	pounds
LDCHSCBLF	Layout, Design and Construction Handbook for Small Craft Boat Launching Facilities
LDGMBF	Layout and Design Guidelines for Marina Berthing Facilities
MG	Million gallons
Mg/l	milligrams per liter
Mph	Miles per hour
MSL	Mean Sea Level
NBRID	Napa Berryessa Resort Improvement District
NCRSS	Napa County Road and Street Standards
NFPA	National Fire Protection Association
Ppm	Parts per million
Psi	Pounds per square inch
PVC	Polyvinyl chloride
RRFDG	Reclamation’s Recreation Facility Design Guidelines
RAMP	Reservoir Area Management Plan
Reclamation	Bureau of Reclamation
ROD	Record of Decision
RV	Recreational Vehicle
SF	Square feet
SRAFSR	State Responsibility Area Fire Safe Regulations
TN	Total nitrogen

1	Vpd	Vehicle trips per day
2	VSP	Visitors Service Plan
3		

Chapter 1
Introduction

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) is undertaking the Lake Berryessa Concession project to meet the future needs for outdoor recreation at Lake Berryessa. The goal is to develop site design layouts of facilities with associated infrastructure at the five sites identified below to a 60 percent design level, and evaluate the financial feasibility of the proposed facilities and services. This project, combined with Reclamation's other commercial service planning efforts at Lake Berryessa, will culminate in the development and management of necessary and appropriate long-term recreation facilities and services at Lake Berryessa.

1.1 Lake Berryessa

Lake Berryessa is part of the Solano Project, a federal water project owned by Reclamation, which provides municipal and irrigation water to Solano County. The reservoir is also used for flood control, hydropower, fish and wildlife, and recreation. The reservoir is located in Napa County, 70 miles northeast of San Francisco, 65 miles west of Sacramento, and approximately 20 miles from the center of Napa Valley's wine country. Five existing recreation areas are the subject of this report, as listed below. Other Reclamation owned facilities around Lake Berryessa are not a part of this work.

- Putah Canyon
- Monticello Shores
- Berryessa Point
- Spanish Flat
- Steele Canyon

Figure 1-1 shows the location of the recreation areas at Lake Berryessa.

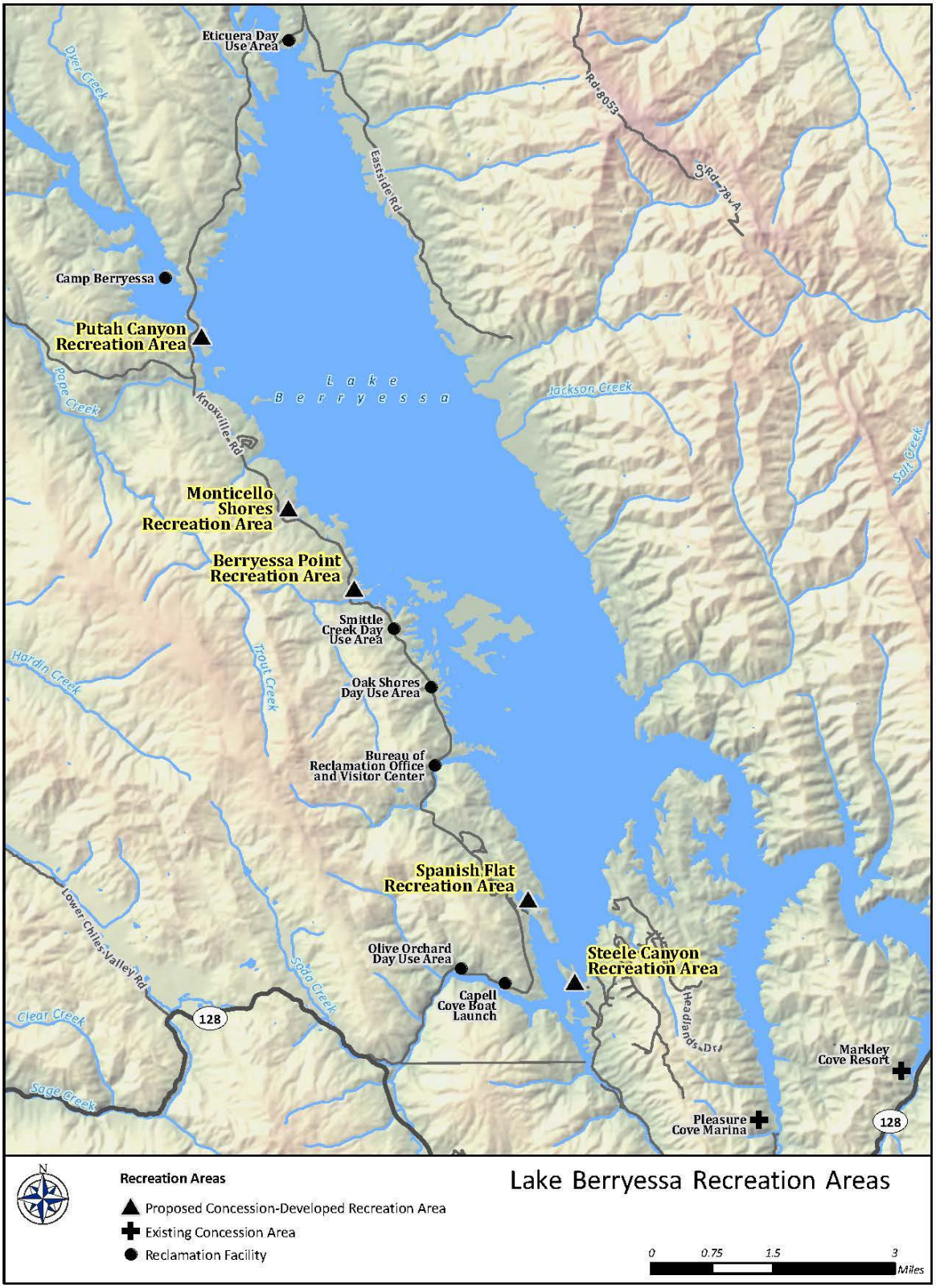

Figure 1-1. Lake Berryessa Recreation Areas

1.2 Infrastructure Design Scope

The scope of the Infrastructure Design task is to develop appropriate site grading, construction methods and materials as well as determine an appropriate level of utility service and infrastructure to support the recreational uses. The Infrastructure Design elements will be used to develop preliminary cost estimates for proposed developments at the recreation areas. This task also identifies design codes and building standards.

The infrastructure plans are based on the Required facilities identified in the conceptual site plans. These details are intended as design guides for a concessionaire to support the ultimate development of the sites. The final above-ground architectural designs are to be determined by the concessionaires, with Reclamation approval.

The infrastructure addressed in this report includes site grading, potable water, sewer, electricity, access and other surfaced areas. Potable water and wastewater services and infrastructure are identified, including necessary treatment processes. For electricity designs, this report identifies electrical service, including transformers, panels, and meters at each recreation area. This report also provides design details on access, including vehicle circulation, pedestrian paths, parking, and boat launches.

1.3 Relationship to Other Project Tasks

The Infrastructure Design is a single task in the Lake Berryessa Concession project. It is closely related to the other project tasks, both by incorporating results and providing inputs. The Lake Berryessa Concession planning process is an iterative one to achieve the goals of the Visitors Service Plan (VSP) Record of Decision (ROD) and identify financially feasible site plans and infrastructure plans to include in the prospectus for concessionaires to bid on the recreation area developments.

1.3.1 Financial Feasibility Evaluation

The financial feasibility evaluation estimates capital costs, operating expenses, and revenues to determine the financial viability of the proposed recreation areas. The infrastructure designs provide the information needed to estimate construction costs of the recreation developments. These costs are inputs into the financial feasibility evaluation.

1.4 Reclamation Design Guidance

Several Reclamation documents provide guidance on the infrastructure design of recreation areas. The site plans also follow this design guidance relative to siting and layout of facilities.

1.4.1 Visitor Services Plan Record of Decision

Reclamation issued the Future Recreation Use and Operations of Lake Berryessa, referred to as the VSP ROD, in June 2006. The VSP ROD amends the 1993 Reservoir Area Management Plan (RAMP). The VSP ROD addresses only certain concessions and recreation management activities at Lake Berryessa with all other items, features, activities, and operations approved in the 1993 RAMP ROD remaining unchanged and in effect. Together, they provide the comprehensive recreation and resource management guidance for Reclamation at Lake Berryessa. Reclamation's stated goal at Lake Berryessa is "to provide outdoor recreation facilities and services for the visiting public at Lake Berryessa which will accommodate a variety of aquatic-related recreation experience opportunities, to the extent and quality and in such combination that will protect the aesthetic and recreational values and assure optimum short-term recreational use and enjoyment and social benefit."

Relative to facilities, the VSP ROD limits future development of the recreation areas to facilities that support short-term, traditional, non-exclusive and diverse recreation opportunities at the lake. All facilities must be constructed or installed, operated and maintained by the concession contractors.

1.4.2 Reclamation Recreation Facility Design Guidelines

Reclamation's Recreation Facility Design Guidelines (April 2013) provide a checklist of initial design data and examples of recreation facility design details. The Site Plans referenced these guidelines in siting of facilities and services. For the infrastructure designs, these guidelines were used to design utilities, including water, sewer, and electricity. The appendices of the Recreation Facility Design Guidelines include example designs for an entrance station, camping and picnicking facilities, trailer dump stations, comfort station buildings, boating facilities, fishing facilities, recreation area roads and utilities, and foot trail and beach access. It is anticipated that the Recreation Facility Design Guidelines will continue to be a resource for concessionaires in the planning and budgeting of recreation infrastructure.

1.4.3 Reclamation Concession Management

The Concession Management Guidelines, Subchapter 1-1, page 1-5 states the following relative to construction:

> "All construction should harmoniously integrate with the environment. Facilities that are historic or cultural resources should be managed to maintain their intrinsic qualities through sustained conservation. Architectural style, design elements, and construction materials should reflect the area and its history.

Plans and specifications for any and all construction and landscaping development on Government-owned lands assigned to the concessionaire must be approved, in writing, by Reclamation before the work may begin. Plans must be prepared in accordance with Reclamation standards.

All concession-related construction activities must conform to nationally applicable codes, such as the International Building Code and the National Fire Protection Association codes, including the International Fire Code, in the latest editions. Regional and local codes are to be adhered to when they are more stringent than national codes or address unique issues. Even where area jurisdiction requires adherence to local codes, concession-related construction will conform to any higher standards in national codes. The seismic safety standards are to be applied to new buildings designed and constructed within Reclamation."

Reclamation Directives and Standards, LND 04-01 further states that "All the concessionaires' facilities will be harmonious in form, line, color, and texture with the surrounding landscape."

These guidelines and standards were used in the development of the site grading and required utility services.

1.4.4 Reclamation Sustainable Buildings Implementation Plan

Executive Order 13423, signed on January 24, 2007, and Executive Order 13514, signed on October 5, 2009, require Federal agencies to design, construct, and operate Federal buildings in a more sustainable manner to reduce environmental and economic impacts. The Guiding Principles to achieve the executive orders are:

1. Employment of integrated design principles
2. Optimization of energy efficiency and use of renewable energy
3. Protection and conservation of water
4. Enhancement of indoor environmental quality
5. Reduction of environmental impacts of materials

Reclamation has developed a Guiding Principles Checklist for New Construction and a Guiding Principles Checklist of Existing Buildings to convey detailed information on each of the Guiding Principles and act as a tool for assessing and documenting the requirements.

1.5 Report Organization

This report is organized into the following chapters:

- Chapter 1 Introduction
- Chapter 2 General Description
- Chapter 3 Sustainable Design
- Chapter 4 Site Design
- Chapter 5 Architecture
- Chapter 6 Geology and Geotechnical
- Chapter 7 Structural
- Chapter 8 Mechanical
- Chapter 9 Electrical & Lighting
- Chapter 10 Water Treatment & Conveyance
- Chapter 11 Wastewater Collection & Treatment

The appendices contain additional details, including the 60% Design Level Site and Infrastructure Plans, Geotechnical Investigation Report, Opinion of Probable Construction Cost, a table of contents for the construction specifications, and material cutsheets for various components of the water, electrical, and wastewater components.

- Appendix A: Five volumes of 60% design level site and infrastructure plans, one for each of the five recreation areas (bound separately)
- Appendix B: Specification table of contents
- Appendix C: Draft geotechnical investigation report
- Appendix D: Opinion of probable construction cost
- Appendix E: Potable water system data
- Appendix F: wastewater system data
- Appendix G: Electrical equipment data

Chapter 2
General Description

This chapter defines the minimum (Required) and maximum (Authorized) quantities for buildings, structures, and recreation facilities to be provided at each of the subject concession areas at Lake Berryessa. The facilities provide or support recreation services as recommended by the Market Assessment and further developed in the Site and Infrastructure Plans.

Table 2-1 lists and defines the types of facilities and services recommended at Lake Berryessa. The required and authorized facilities and services are identified by recreation area in this chapter and shown on the site layouts for each recreation area in Appendix A. All publicly accessible facilities and services must meet accessibility requirements.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Camping	
Tent Site	Tent-only sites are required to have a picnic table and fire pit. A tent site can be with or without a 12 ft x 12 ft elevated (max 18 in high) level pad, All tent sites are spaced a minimum of 35 ft apart as measured between living areas and fire pits. An area of clustered parking spaces and a water spigot are nearby, if water service is a required service at the recreation area. Each cluster of parking spaces shall consist of the same number of nearby tent sites, plus one extra parking space within the grouping for emergency, park ranger, dumpster, maintenance, or other temporary use. A handicap access aisle shall not be used for any kind of parking space. The nearby parking space for each tent site shall not be more than 250 ft away and shall not be closer than 5 ft. One out of every 5 tent sites shall be handicap accessible. Each handicap accessible tent site shall have a 5 ft. wide accessible sidewalk leading to it from a nearby access aisle adjacent to a handicap accessible parking space with access aisle. At each handicap accessible tent site, there is at least one handicap accessible picnic table and fire pit. *Required and Authorized services include at least 1 nearby parking space per designated area for a tent.*
Overnight Group Use Area	Area identified for temporary clustered tent-only sites with a central group area with several picnic tables and fire pits. Size varies to accommodate 20-50 people. Parking and water spigot is nearby. This area and its associated parking shall be designed to conform to accessibility requirements. *Authorized services include upright barbeques (BBQ).*

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
RV Site	RV sites are required to have a picnic table and fire pit, and are required to have water, sewer, and electric hook ups, if provided at the recreation area. Sites are typically 1,800 to 2,200 square ft for most RV parking spaces and 2,800 to 3,200 square ft for larger accessible double unit RV parking spaces. RV sites are generally intended for back-in vehicle maneuvering, however RV sites can also be pull-through parking spaces, such as standard sites. Each RV parking space shall include a picnic table and fire pit, and shall not be closer than 30 ft to each other. One out of every 5 RV parking areas shall be handicap accessible. At each handicap accessible RV site, there is at least one handicap accessible picnic table and fire pit. See Figures B-1 and B-4 per RRFDG (see Appendix B). *Authorized services include an upright BBQ*.
Standard Site	Standard sites can serve tents, vehicles with trailers, or RVs and are required to have the following: a picnic table, a fire pit, parking for one car with trailer. Standard sites are generally intended to be pull-through, but can be back-in. Water, sewer, and electric hook ups are required at some standard sites, as shown on the site plans. Sites are typically 1,800 to 2,200 square ft for most combined trailer/tent site parking spaces and 2,800 to 3,200 square ft for larger accessible double unit combined trailer/tent site parking spaces and generally 100 ft long x about 30 ft wide for pull-through campsite parking spaces. Each standard site shall include a picnic table and fire pit, and shall not be closer than 30 ft to each other. One out of every 5 standard site parking areas shall be handicap accessible. At each handicap accessible standard site, there is at least one handicap accessible picnic table and fire pit. See Figures B-5 and B-6 per RRFDG (see Appendix B). Water spigot is nearby. *Authorized services include utility hookups for all standard sites and an upright BBQ.*
Hike-in/Boat-in Tent-Only Site *(Authorized Service Only)*	Tent-only sites accessible only via hiking or boat-in. Each site includes a picnic table and fire pit. Sites are typically 100 ft apart. Water spigot nearby. No designated parking space. Sites are near the shoreline where boat can be anchored to a mooring.
Floating Campsite *(Authorized Service Only)*	Campsites on water spaced about 400 ft apart. These sites accommodate up to 15 people and have a table, propane barbecue grill, food locker, accessible restroom, covered living area and an upper sun deck/sleeping area with room for tents. Typically 20x24 ft. Drinking water must be brought in by visitors.
Lodging	
Cabins	Overnight structure, constructed on-site, set on a foundation or otherwise permanently placed. Site about 2,500 square ft or more. Cabins are above the 455 ft contour. Cabin includes restroom, sink, stove, table, sitting area, and one or two beds. Required units sleep up to 4 adults. Picnic table and fire pit are located outside. Includes water, sewer, and electric hookups and two parking spaces. Cabins shall not be closer than 24 ft to each other.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Cabins (Cont.)	Where there is more than 1 cabin, at least 2 cabins shall be handicap accessible in accordance with handicap standards for outdoor areas. Each handicap accessible cabin has a 5 ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. Each handicap accessible cabin shall have at least one handicap accessible picnic table and fire pit. If a handicap accessible cabin is leased by a person who is not handicapped, then the nearby handicap accessible parking space can be used by the renter of the handicapped facility. *Authorized services include an upright BBQ, additional furniture and amenities, or larger cabins that sleep more.*
Park Models	Movable structure designed for long-term or semi-permanent placement. Since they are movable, park models are typically located in areas between the 440 and 455 ft contours, and in the 100 ft buffer zone above the 455 ft contour. Park models must remain under 400 square ft for transport and to avoid being defined as a manufactured home. Park models include a restroom, sink, stove, table, sitting area, and one or two beds. Required units sleep up to 4 adults. A picnic table and fire pit are located outside. Includes water, sewer, and electric hookups and two parking spaces. Park models for public access shall not be closer than 24 ft to each other. Park models for employee housing shall not be closer than 10 ft to each other. Where there is more than 1 park model, at least 2 park models shall be handicap accessible in accordance with handicap standards for outdoor areas. Each handicap accessible park model has a 5 ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. Each handicap accessible park model shall have at least one handicap accessible picnic table and fire pit. If a handicap accessible park model is leased by a person who is not handicapped, then the nearby handicap accessible parking space can be used by the renter of the handicapped facility. *Authorized services include an upright BBQ, additional furniture and amenities, or larger park models that sleep more above the 455 ft contour.*
Yurts *(Authorized Service Only)*	Round, semi-permanent, tent-like structure. Consists of a durable fabric, tension band, and a wood frame set upon a level wood platform. Site about 2,500 square ft or more. Yurts are movable structures and can be below the 455 ft contour. Yurts include basic furniture, including cots or bunk beds, shelf with drawers, table, and couch. Picnic table and fire pit are located outside. Sleeps up to 4 adults. No sewer, water, or electric hookups. Water spigot and comfort stations nearby. Two required parking spaces are located near the structure. Yurts shall not be closer than 50 ft to each other.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Yurts *(Authorized Service Only) (Cont.)*	Where there is more than 1 yurt, at least 2 yurts shall be handicap accessible in accordance with handicap standards for outdoor areas. Each handicap accessible yurt has a 5 ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. Each handicap accessible yurt shall have at least one handicap accessible picnic table and fire pit. If a handicap accessible yurt is leased by a person who is not handicapped, then the nearby handicap accessible parking space can be used by the renter of the handicapped facility. *Authorized services include an upright BBQ, additional furniture and amenities, and water, sewer, and electric hookups.*
Rustic Cabins *(Authorized Service Only)*	Constructed on-site, set on a foundation or otherwise permanently placed. Rustic cabins are only located above the 455 ft contour. Includes cots or bunk beds and a shelf for some storage. Sleeps up to 4 adults. A picnic table and fire pit are located outside each rustic cabin. No sewer, water, or electric hookups. Water spigot and comfort stations are nearby. Two required parking spaces are located near the structure. Rustic cabins shall not be closer than 24 ft to each other. Where there is more than 1 rustic cabin, at least 2 rustic cabins shall be handicap accessible in accordance with handicap standards for outdoor areas. Each handicap accessible rustic cabin has a 5 ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. Each handicap accessible rustic cabin shall have at least one handicap accessible picnic table and fire pit. If a handicap accessible rustic cabin is leased by a person who is not handicapped, then the nearby handicap accessible parking space can be used by the renter of the handicapped facility. *Authorized services include an upright BBQ.*
Tent Cabins *(Authorized Service Only)*	Constructed on-site of prefabricated wood and canvas, and set on a level wood platform as a semi-permanent structure. Tent cabins are above the 455 ft contour. Includes cots or bunk beds. A picnic table and fire pit are located outside each tent cabin. Sleeps up to 4 adults. No sewer, water, or electric hookups. Water spigot and comfort stations are nearby. Two required parking spaces are located near the structure. Tent cabins shall not be closer than 50 ft to each other. Where there is more than 1 tent cabin, at least 2 tent cabins shall be handicap accessible in accordance with handicap standards for outdoor areas. Each handicap accessible tent cabin has a 5 ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. Each handicap accessible tent cabin shall have at least one handicap accessible picnic table and fire pit. If a handicap accessible tent cabin is leased by a person who is not handicapped, then the nearby handicap accessible parking space can be used by the renter of the handicapped facility. *Authorized services include an upright BBQ*.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Boating	
Marinas	Marina building includes cashier with service desk, waiting area with benches and tables, and restrooms. The marina building can be constructed on ground or be floating. The marina building can be combined with a restaurant and retail sales. Handicap accessibility requirements will apply to all marina buildings and if on ground, accessibility can be provided by a lift service. Per the LDGMGF, the parking requirement is 0.6 parking spaces per boat slip. The marina parking lot is as close as possible to the marina building. Marina buildings and services are required at Putah Canyon, Steele Canyon, and Spanish Flat. *Marina is an authorized service at Monticello Shores and Berryessa Point.* At Putah Canyon, the marina is a 1,200 square ft floating marina and is combined with the *authorized restaurant and retail service*. At Steele Canyon the marina building is on ground in a 1,015 square ft building. *As an authorized service, the marina building can be combined with a restaurant and retail service in a larger (up to 3,150 square ft) building.* At Spanish Flat, the marina is a 600 square ft floating marina and is combined with the *authorized restaurant and retail service*.
Marina Gangways, Main Docks, Marginal Docks, Finger Floats, Fuel and Sanitary Docks, Other Service Gangways	All marina gangways, docks, floats and appurtenances are to be a pre-fabricated, modular-type construction and assembly, furnished with typical manufacturer's commercial standard design features and term warranty. All facilities shall be from the same manufacturer, and handicap accessibility requirements will apply where the general public has access. The Gangway is 12 ft wide, typically publicly accessible with a continuous maximum 5% gradient, and articulated to move vertically as water levels rise and fall. The Gangway is a required facility/service connecting the marina's Main Dock to the land based publicly accessible parking spaces and collector sidewalks. The attached Main Dock is 12 ft wide, and at a continuous level with the water surface of the reservoir, and provides level connections and continuous access to Marginal Docks and Finger Floats. If a floating marina building is nearby, the Main Dock, in some areas, can function as a dock for fuel dispensing and sanitary waste collection, The fuel and sanitary service dock will typically serve a minimum of 2 boats at a time per RRFDG Chapter III Section H.1. k. The Main and Marginal Docks and Finger Floats are assumed to always be floating about 2 ft above the water surface of the reservoir.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Marina Gangways, Main Docks, Marginal Docks, Finger Floats, Fuel and Sanitary Docks, Other Service Gangways (Cont.)	Marginal docks are less than 300 ft long and are 6 ft wide for powerboat slips, or 8 ft wide for houseboat slips. Finger Floats are 20 ft long by 3 ft wide for powerboats, or 40 ft long by 6 ft wide for houseboats. A Fuel and Sanitary pump out Dock, accessible to the public, is 40 ft long and 12 ft wide. Other Service Gangways, typically used for connecting fuel or sanitary services to land based bulk fuel and collected sanitary waste storage tanks, and not publicly accessible, are less than 300 ft long and minimum 6-ft wide.
Boat Slips, Berths, and Fairways	Boat slips are uncovered and accommodate various sizes of boats for both private boats and boat rentals. The docks, finger floats, and boat slips are positioned to be functional assuming a reservoir low water level at elevation 400 ft. If the reservoir drops to this elevation, each slip will still have a minimum water depth of 9 ft remaining underneath per RRFDG Chapter III Section H.1.a. Berth dimensions will follow LDGMBF recommendations, however, for purposes of developing a feasible design on the site plans, the following assumptions are used. Single berth clearance for a powerboat is a minimum of 9 ft wide, and double berths are a minimum of 18 ft wide. Single berth clearance for a houseboat is a minimum of 16 ft wide, and double berths are a minimum of 32 ft wide. In accordance with LDGMBF Section G, page 59, each boat berth shall have 0.6 single vehicle parking spaces. Fairway dimensions will allow for safe maneuvering of boats between rows of slips. Fairway dimensions will follow LDGMBF recommendations, however, for purposes of developing a feasible design on the site plans, the following assumptions are used. For powerboats, the site plans show a minimum 42 ft width; this assumes a 24 ft long boat x 1.75 = 42 ft. For houseboats, the site plans show a minimum 105 ft width; this assumes a 60 ft long boat x 1.75 = 105 ft. Handicap access requirements to boat slips and berths will apply. *Authorized services include covered boat slips and water spigots placed periodically along the Main Dock or at each boat slip.*
Boat Rental	Boat rental service desk is located in the marina building or in a small structure near the boat ramp, depending on the type of boats or watercraft available for rent. Boat rentals are a required service at Putah Canyon, Spanish Flat, and Steele Canyon. Fuel storage and dispenser are a required service where power boat rentals are available. Where boats furnished with sanitary facilities are rented, a sanitary pump-out and storage facility is a required service. Handicap accessibility requirements will apply. *Authorized services include additional kayaks, canoes, and paddle boards. Boat rental is an Authorized service at Monticello Shores.*

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Boat Launch, Vehicle with Boat Trailer Parking, and Information Kiosk	Sources of boat launch, vehicle with boat trailer parking, and kiosk information: • California Department of Boating and Waterways, Boating Facilities Division, Layout, Design and Construction Handbook for Small Craft Boat Launching Facilities (LDCHSCBLF) dated March 1991. • Reclamation Recreation Facility Design Guidelines, US Department of interior Bureau of Reclamation (RRFDG) dated April 2013 Boat Launch is as follows: • Publicly accessible boat launch ramps are required at Putah Canyon, Spanish Flat, and Steele Canyon. All boat launch ramps are in the same locations as existing launches. Boat launches are single or multi-lane. Each lane is 15 ft wide minimum. A courtesy dock can serve two lanes. General design of boat ramps will conform to RRFDG Ch. III H. 2 and LDCHSCBLF requirements. Vehicle with Boat Trailer Parking is as follows: • The vehicle with boat trailer parking lots at Putah Canyon, Spanish Flat, and Steele Canyon have 30 ft wide two-way access on either side of parking spaces. Parking spaces are 12 ft wide x 55 ft long minimum for cars with trailers. Majority of boat trailer parking is within 600 ft of top of launching ramp. General design of vehicle with boat trailer parking will conform to RRFDG Ch. III H. 7 requirements. Kiosk is as follows: • An Information kiosk is located nearby. General design of kiosk will conform to RRFDG Appendix A, Figure A-4. Handicap accessibility requirements will apply. *An authorized service is an extension of the boat launch at Spanish Flat to accommodate lower water levels, installation of ramps at Berryessa Point and Monticello Shores, and installing additional ramps near the marinas at Putah Canyon and Spanish Flat.*
Fish Cleaning Station *(Authorized Service Only)*	Includes a 20 ft x 20 ft roof for shade and shelter, a pre-manufactured 96 in x 60 in cutting table with sink and pre-rinse water supply, electrical service for lights and outlets for automatic cutting utensils, and a drain leading to an underground vault for storing waste. Table is positioned in the center of a 22 ft x 22 ft concrete pad with 5 ft clear accessible space provided all around the table. General design of a fish cleaning station will conform to RRFDG Appendix F, Figure F-1. Handicap accessibility requirements will apply.
Courtesy dock	Movable dock, typically 6 ft wide x 60 ft long that is part of a boat launch ramp for loading and unloading, and to mark launching lanes on the ramp.
Boat Exclusion Area	Buoys are used to identify areas where boats and powered personal water craft are prohibited from entering.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Day Use	
Individual Day Use Site	Individual site with a picnic table and upright BBQ. A parking lot is nearby to service multiple individual day use sites. Comfort station and water spigot are nearby. Handicap accessibility requirements will apply.
Group Day Use Area *(Authorized Service Only)*	Large sites, typically with a group shelter with multiple picnic tables, table and sink, and a larger upright BBQ to accommodate groups of 20 or 50 people. Includes water hookup. Handicap accessibility requirements will apply.
Playground *(Authorized Service Only)*	Site includes varied children's playground equipment with safety surfacing, and age appropriate play structures. Playground area and related infrastructure are publicly accessible and handicap accessibility requirements will apply.
Open Space/Recreation Area *(Authorized Service Only)*	Open area near an accessible playground that generally includes various recreation options, such as recreation courts, bocce ball, tennis, basketball, or volleyball. Handicap accessibility requirements will apply.
Trail Connection	A trail connection is an identified location where trails are anticipated to eventually connect. There is a sign and parking nearby, and handicap accessibility requirements will apply.
Multi-Use Special Events Center *(Authorized Service Only)*	Large building for special day-use events, such as seminars, conferences, school group gatherings, reunions, weddings, retreats, etc. Includes central reception area, kitchen, restrooms, storage room, and additional small conference rooms. Assumes total occupancy for approximately 100 people and parking for approximately 50 cars (NCZCO requires 0.5 parking spaces per person for 'conference center'). Approximately 3,050 square ft. Handicap accessibility requirements will apply.
Amenities	
Restaurant *(Authorized Service Only)*	Restaurant services are *authorized* at Putah Canyon, Steele Canyon, Monticello Shores, Berryessa Point, and Spanish Flat. Restaurants may offer varying levels of food service, such as sit-down/full service or fast-casual/take-out, such as a sandwich counter, small café, or grill. Full-service restaurant sizes may vary and serve up to 40 customers. Serving beer, wine, and/or liquor is an *authorized service*. At Putah Canyon, the *authorized* restaurant is in the floating marina and is a take-out counter with sandwiches, salads, or other café items. An *authorized* use is seasonal operation of the restaurant. At Steele Canyon, the *authorized* restaurant is separate from the marina building and assumes about 30 customers at 2,592 square ft. Additional seating can be located outside on a deck. About 22 parking spaces are needed per NCZCO requirements of 1 parking space per 120 square ft of building. At Monticello Shores, Berryessa Point, and Spanish Flat, the *authorized* restaurant is a take-out sandwich shop/grill in a separate building or located in the marina service building that can be operated seasonally or year-round.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Retail Store *(Authorized Service Only)*	Retail building and service selling food snacks, ice, beverages, recreation supplies, wood, or other items for camping and boating activities. Retail can be combined with the marina building or a restaurant. At Putah Canyon, the *authorized* retail store is combined with the marina portion of the building. About 1-2 parking spaces are needed per NCZCO requirements of 1 parking space per 250 square ft of retail. At Steele Canyon, the *authorized* retail store is combined with the marina building. About 4 parking spaces are needed per NCZCO requirements of 1 parking space per 250 square ft of retail. Retail is an *authorized service* at Monticello Shores, Berryessa Point, and Spanish Flat. The required number of parking spaces will be provided.
Facilities/ Infrastructure	
Entry Station	Small building located at vehicle entrance to recreation area for visitor registration, fee collection, etc. At least 2 entry lanes and one exit lane. Setback a minimum of 150 ft. off Knoxville Road or main public right-of-way. Handicap accessibility requirements will apply. Includes 2 parking spaces, one of which is a van-accessible parking space with access to the entry station. Vehicle turnaround space is typically identified for vehicles to turn around and exit in a nearby area visible to the Entry Station building. The station building is approximately 52 square ft. Figure A-1a per RRFDG (see Appendix B). A self service fee depository is also included at the entry station area. Approximately 25 square ft. Figure A-2 per RRFDG (see Appendix B). *Authorized services include a manual or automatic gate and one-way spike strips and an additional entry station at Putah Canyon*.
Restroom	At all sites, men's and women's restrooms are located inside buildings that have other uses (such as the marina, concessionaire offices, multi-purpose building, restaurants, and single building retail stores), and are open during normal business hours. Handicap accessibility requirements will apply to all restrooms with toilet stalls, sinks, soap dispenser, towel dispenser or hand dryer, and waste receptacle.
Vault Toilet	Prefabricated 2-unit vault toilet buildings are typically located in areas that do not have underground water service or sewer. Handicap accessibility requirements will apply in addition to use of sweet-smelling technology. Building footprint is approximately 250 square ft. Figure D-4d per RRFDG (see Appendix B). *An authorized service is electric hookup and replacing vault toilets with comfort stations with toilets only*.
Comfort Station with Toilets only	Restroom with water, sewer, and electric hookups. Handicap accessibility requirements will apply. Building footprint is approximately 700 square ft. Figure D-3 of RRDFG.
Comfort Station with Toilets and Family Room only	Restroom with water, sewer and electric. One dish washing sink is included. Handicap accessibility requirements will apply. Building footprint is approximately 925 square ft. Figure D-3 of RRDFG. An authorized service is comfort station with toilets, family room, and showers only.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Comfort Station with Toilets, Family Room and Showers only	Restroom typically located in or near camp site areas. Each has water, sewer, and electric and accessible shower stalls. One dish washing sink is included. Handicap accessibility requirements will apply. Building footprint is approximately 925 square ft. Figure D-3 of RRDFG (see Appendix B).
Comfort Station with Toilets, Family Room, Showers and Laundry *(Authorized Service Only)*	Restroom typically located in or near campsite areas. Each has full water, sewer, and electric, accessible shower stalls, and laundry facility including washer and drier units, folding tables, vending machines. Handicap accessibility requirements will apply. Building footprint is approximately 1,100 square ft. One dish washing sink is included. Figure D-3 of RRDFG (see Appendix B). Laundry is only provided at Putah Canyon and Steele Canyon.
Fuel and Sanitary Land Based Storage Facility	Fuel dispensing is required at marinas. Sanitary services are required where houseboats are used or floating marina buildings are used. The fuel and sanitary service dock typically serves a minimum of 2 boats at a time per RRFDG Chapter III Section H.1. k. Storage tanks for bulk fuel and collected sanitary waste are located at a nearby land based storage facility on the shoreline near the gangway to the dock. Footprint size of the pad for both storage tanks is about 30 ft x 40 ft. These tanks are accessed by fuel and sanitary trucks. Fuel and sanitary storage is required at Putah Canyon, Spanish Flat and Steele Canyon. *As an authorized service, Monticello Shores has a fuel dispenser, bulk fuel storage, and sanitary storage facilities.*
RV Dump Station	Includes an area for disposal of stored sewage, a water source to flush sewage holding tanks, and separate potable water source. Handicap accessibility requirements will apply. Pull through space for RVs. Figures C-1a and C-1b of RRFDG (see Appendix B).
Small Boat Repair/ Yard Shop *(Authorized Service Only)*	Building and service yard area for boat repairs. Where marinas are located, the building is combined with a tow service. At Steele Canyon and Putah Canyon, these are 30 ft x 60 ft buildings with nearby service yard for maintenance, repairs, and storage.
Concessionaire Office *(Authorized Service Only)*	Building or park model-structure for supervisor, administrative, and maintenance personnel.
Dry Boat Storage *(Authorized Service Only)* and Open Boat Storage	Required service at Putah Canyon, an open land area is provided that will store a grouping of about 20-30 boats on trailers. A tractor with universal boat trailer operation will move boats. *At Steele Canyon, authorized boat storage consists of two separate 4-story, 3 sided buildings, each with a sloped roof provide storage space for about 96 stacked boats. A fork-lift operation will move boats. An authorized service is a fully enclosed building.*
Camp Host Site	An RV site or a standard site with full hookups, picnic table, and fire pit. *An upright BBQ is an authorized service*. At Spanish Flat, the camp host site has water and electric hookup only. A camp host site is *authorized* for Monticello Shores and Berryessa Point.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Employee Housing *(Authorized Service Only)*	Multiple park models to house seasonal or permanent employees. There is at least one parking space per employee housing unit, plus one additional parking space as an extra in each parking space area. Handicap accessibility requirements will apply. *At Steele Canyon, there are 10 park models as an authorized service. Employee housing is an authorized service at Putah Canyon with 6 park models*
Parking and Access	
Vehicle Parking Spaces, Pedestrian Access and Walkways	Vehicle parking will meet or exceed the requirements of ACoEEDM. 90 degree vehicle parking spaces, including handicap parking spaces and adjacent access aisles, are 10 ft wide x 20 ft long. 45 degree vehicle parking spaces, including handicap parking spaces and adjacent access aisles, are 10 ft wide x 17 ft long and are only located off one way access drives Vehicle parking spaces are not closer than 5 ft to any cabin, park model, yurt or tent site. All pedestrian access aisles adjacent to handicap parking spaces will have an evident accessible path leading to an accessible facility. Each vault toilet has at least two parking spaces, and each restroom has at least 3 parking spaces; at each of these locations, at least one space is handicap accessible with an access aisle An access aisle cannot be used for parking at any time, but it can be used as a drop off or pick up area. Handicap accessible parking spaces, including handicap accessible RV parking spaces and handicap accessible pull-through parking spaces are sloped at 2% or less and are paved with pavement markings with an accessible parking sign. Adjacent access aisles are paved. Other RV and pull-through sites may be steeper with a gravel surface. The approaches and exits of these parking spaces may be steeper, but with no more than a 9% algebraic difference between adjacent surfaces. Other gravel parking and pavement surfaces can be at outdoor boat storage areas, vehicle with boat trailer parking spaces and single RV and pull-through parking spaces, and tent site, cabin and yurt parking spaces that are not for handicap parking. Pedestrian walkways that are an accessible route will be a paved concrete sidewalk, and will be a minimum of 5 ft wide. Each handicap accessible lodging facility, including tent sites, has a 5-ft wide accessible route sidewalk leading to it from a nearby handicap accessible parking space. In vehicle parking lots adjacent or close to marinas, there are 5-ft wide collector sidewalks placed on the perimeter of the lot adjacent to many of the parking spaces closest to the marina use. These collector walks are used to off-load equipment and supplies by the public from their vehicles, provide a safe pedestrian access route to the marina main entrance gangway, and provide potential for convenient reserved parking for employees, staff and possible service vehicles. Each restroom and vault toilet has at least one handicap parking space and accessible route sidewalk.
Vehicle with Boat Trailer Parking	Parking areas have 30 ft wide two-way drive lanes. Each parking space is 12 ft x 55 ft. per RRFDG Chapter III Section H.7.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Access Drive Sources of Design, Access Drive Width, and Access Drive Profiles	Primary access drives are generally located and designed to be in the same general footprint and follow the existing access drives, however, periodic deviations are needed due to the following: 1) desired access to other areas of interest, 2) smoother or more continuous, or safer transition gradients, 3) a need to find or create flatter areas for handicap parking and access areas, 4) to create better or safer visibility at intersections, 5) to reduce potential for erosion due to slopes being too steep or abrupt, and others. Surface materials on access drives and vehicle circulation areas are either pavement or gravel. The design intent for paved surfaces is to provide this type surfacing in higher traffic areas such as primary access drives leading in and out of the site, particularly to the top of public boat ramp areas where vehicles with trailers maneuver and turn. Paved surfaces will also be needed on the access drives leading to the marina facilities, and where steep access drives lead into a property off the adjacent County Roads toward and past a Control Station building. Paved surfaces are also needed at truck maneuvering areas around bulk fuel and sanitary waste storage tanks, and at handicap parking spaces and access aisles. Although there are a few other exceptions, most other vehicle access drives and roads can have a gravel surface. The following summarizes the design sources and criteria for various access drive road width and profile scenarios: The Department of Army Corps of Engineers (ACOEEDM) Engineering and Design Manual EM 1110-2-410 dated 31 Dec 1982, titled: Design of Recreation Areas and Facilities-Access and Circulation. Chapter 2, Elements of Design and Chapter 7, Parking California Title 14 Natural Resources, State Responsibility Area (SRA) Fire Safe Regulations, published July 4, 2014. American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets, dated 2011. Caltrans Highway Design Manual (CHDM), dated 9/22/14. Access Drive Widths are as follows: 24 FT WIDE TWO-WAY CIRCULATION ROAD is defined as a 24 ft wide corridor, consisting of 20 ft wide pavement with 2 ft wide gravel shoulders. From ACOEEDM: paragraphs 2-4 b. (2) (a) and 2-4 d. (4) (a) and also: SRA 1273.01 Road Width. Per input from Reclamation, some 24 ft wide two-way circulation roads are not paved, and gravel is the preferred surface material, see plans. 16’ WIDE ONE-WAY CIRCULATION ROAD is defined as a 16 ft wide corridor, consisting of 12 ft wide pavement with 2 ft wide gravel shoulders. From ACOEEDM: paragraphs 2-4 b. (2) (b) and 2-4 d. (4) (a) and also: SRA 1273.08 One-Way Roads. Per input from Reclamation, some 16 ft wide one-way circulation roads are not paved, and gravel is the preferred surface material, see plans.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Access Drive Sources of Design, Access Drive Width, and Access Drive Profiles (Cont.)	16' WIDE OFF ROAD SHARED ACCESS DRIVE is defined as a 16 ft wide corridor, consisting of 12 ft wide pavement with 2 ft wide gravel shoulders. From matching requirements of SRA 1273.08 One-Way Roads, and also: exceeds 10 ft width requirement of SRA 1273.10 Driveways. Per input from Reclamation, some 16 ft wide off-road shared access drives are not paved, and gravel is the preferred surface material, see plans. 15' WIDE SERVICE ROAD is defined as a 15 ft wide corridor, consisting of 12 ft wide pavement with 1.5 ft wide gravel shoulders. From ACOEEDM, paragraphs 2-4 b. (3) the standard is 10 ft wide, and 2-4 d. (4) (b) the standard is 1.5 ft wide. SRA 1273 does not address 'service drives', but has standards for 'one-way roads' (12 ft wide not including shoulders) and 'driveways' (10 ft wide or 14 ft unobstructed). The 15 ft width is a conservative compromise of the above standards and could possibly change to 10 ft wide pavement with 1.5 ft wide shoulders. Per input from Reclamation, 15 ft wide service roads are not paved, and gravel is the preferred surface material, see plans. 12-FT WIDE MAINTENANCE ACCESS ROAD is defined as a 12 ft wide corridor, consisting of 10 ft wide gravel with 1 ft wide gravel shoulders, and is typically placed on non-publicly access drives to, from, and around the perimeter of the infrastructure ponds, and is on the access ways to spray fields and other infrastructure facilities. This width is also used where the existing access width no longer has access to the public and may serve a similar function as previously, or where an increased width would substantially increase earthwork costs and aesthetic impacts. This road definition is per input from Reclamation. THREE-POINT TURNAROUND is defined as a 16 ft or 24 ft wide corridor, consisting of 12 ft and 20 ft wide pavement respectively, with 2 ft. wide gravel shoulders. From SRA 2014 1273.05. Roadway Turnarounds, and CA Dept. of Forestry & Fire Protection-CalFire, Fire Safe Standards-Turnouts and Turnarounds pg. VI-11. This type of turnaround is only placed at dead ends off which buildings are accessed. An SRA Roadway Turnaround is not placed at the ends of parking lots, although a regular vehicle turnaround is typically provided. The SRA required 'T' shape is modified to a 'Y' shape to make it easier to navigate, and to offer a more aesthetic or 'natural' look, thereby 'fitting' better into adjacent topography. 'Y' shape turnaround areas are not used where RVs or vehicles with trailers are expected to travel. Per input from Reclamation, some three-point turnarounds are not paved, and gravel is the preferred surface material, see plans.

Table 2-1. Description of Facilities and Services to be Provided at Lake Berryessa Recreation Areas

Facility/Service	Description
Access Drive Sources of Design, Access Drive Width, and Access Drive Profiles (Cont.)	CUL-DE-SAC TURNAROUND The minimum radius of cul-de-sac turnarounds is 42 ft per input from Reclamation. The 42 ft dimension is interpreted as an outside radial dimension, and a 2 ft wide outside shoulder is included as part of the 42 ft, as illustrated on page 7 of 22 in SRA Recommended Change to SRA Fire Safe Regulations California Code of Regulations title 14, 1270 Fire Safe Regulations sketch dated 2/6/13, and from page 2 of SRA Fire Safe Regulations, 2014 1273.05 Roadway Turnarounds: "The minimum turning radius for a turnaround shall be 40 ft from the centerline of the road…" From ACoEEDM: there is no mention of cul-de-sac turnarounds. From RRFDG: there is no mention of cul-de-sac turnarounds. Per input from Reclamation, some cul-de-sac turnarounds are not paved, and gravel is the preferred surface material, see plans. Access Drive Profiles are as follows: • CHDM, Chapter 80 – Application of Design Standards has Topic Number 82.1, paragraph (8), titled: Transportation Facilities Under the Jurisdiction of Others. The paragraph states: "Generally, if the local road or street is a Federal-aid route it should be designed to conform to AASHTO standards." Therefore, the road profiles are designed using AASHTO standards as a primary reference. • Crest Vertical Curve criteria: For sight stopping distance purposes, at 15 mph design speed, use 76.7 lf as a minimum length per AASHTO. The drawings use 80 lf min. in areas where a 15 mph speed is expected. Reduced crest vertical curve distances are used in areas where the 15 mph speed limit is not expected, like top of boat ramps, site entrance areas and intersections. • Valley Vertical Curve criteria: For 15 mph design speed, use 45 lf min. for length of curve per AASHTO. The drawings use 50 ft min. in areas where a 15 mph speed is expected. Reduced valley vertical curve distances are used in areas where the 15 mph speed limit is not expected, like site entrance areas and intersections. There are no net changes in grade anywhere of 9% or more without a vertical curve. Maximum slope or grades of all publicly accessed drives and roads will not exceed the existing gradient that is at the same location, or 13.5%. Slope or grades of publicly accessed boat ramps will conform to LDCHSCBLF recommendations. Minimum stopping sight distance for 15 mph roads is 100 ft in accordance with CHDM, Table 201.1. An increase of 20% of the distance should be applied where sustained downgrades are steeper than 3%. Public access drives and roads steeper than 10% will be paved, their shoulders can be gravel.

ACoEEDM – Army Corps of Engineers Engineering and Design Manual (Dec 1982)
LDCHSCBLF - Layout, Design and Construction Handbook for Small Craft Boat Launching Facilities
LDGMBF – Layout and Design Guidelines for Marina Berthing Facilities (July 2005)
NCZCO – Napa County Zoning Code of Ordinances
RRFDG – Reclamation Recreation Facility Design Guidelines (April 2013)
SRAFSR – SRA Fire Safe Regulations (updated 2012)

2.1 Putah Canyon Recreation Area

Putah Canyon Recreation Area includes a mix of required camping, lodging, day use, and boating services. The northern portion of the property has all of the required facilities. Development of the northern portion is split on both the east and west sides of Knoxville Road. The southern portion near Pope Canyon Road has only a few proposed improvements that include camping or day use, which are identified as authorized services.

The development on the east side of Knoxville Road includes an entry station, boat launch, tent sites, RV sites, and park models. This is the only entry station at the site and also regulates entry to the west side of the site. The area north of the entry station consists of RV sites, RV dump station, standard sites with and without utilities, tent-only sites, and park models. South of the entry station are additional RV sites, day use sites, boat trailer parking, and a four lane boat ramp. Some of the area west of the existing boat ramp is prohibited from development due to known and documented contaminated subsurface soil conditions. This area is used as overflow parking.

Development on the west side of Knoxville Road includes a marina, tent sites, and day use. Entrance to this side of the site is served by an iron ranger and there is no staffed entry station. An entry station is authorized on this side of the site. The area north of the entrance includes day use sites, tent-only sites, and the marina. The marina has 201 boat slips and 15 houseboat slips. There is a fuel dispenser and sanitary pump for houseboats on the main dock. The marina building is also on the dock to provide service for boat rentals and private boat slips. The boat rental services includes a mix of houseboats, fishing boats, ski boats, kayak/canoes, paddle boards, jet skis and pontoons. There are on-shore fuel storage and sanitary storage tanks. South of the entrances is a dry boat storage area and the wastewater facilities.

The following are unique site design characteristics for the Putah Canyon site plan.

Site Layout (Northern Portion)

- Water, sewer, and electricity would be available on this portion of the property.

- There is one entry station on the east side of Knoxville Road, which serves both the east and west side services. There is an iron ranger on the west side of Knoxville Road visible from the entrance station. The entrance station and iron ranger are placed a minimum of 150 ft from Knoxville Road to allow for queuing of vehicles.

- Site layout features on the east side of Knoxville Road include:
  - Boat trailer parking is close to the existing boat launch. Day use sites line the parking lot along the shore. There is also nearby overflow parking.
  - An RV dump station is centrally located in relation to the RV sites.
  - Tent-only sites are scattered on the knoll in the center of the site and also along the shoreline at the northern end of the site.
  - Five park models are somewhat isolated on a peninsula.
  - At the northern portion of the property, there is a trail connection.
  - Water facilities are located at the north end of the property, including a groundwater well and water storage tank.
- Site layout features on the west side of Knoxville Road include:
  - Parking spaces lined near the gangway to the floating marina building. The floating marina building is 1200 sf and includes boat rental service.
  - The marina has 201 required boat slips, 15 required houseboat slips, and a fuel dispensing and sanitary waste receiving station on the dock.
  - Tent-only and day use sites are located on top of the hill and hill side overlooking the lake.
  - There is a dry boat storage area for 30 boats on trailers.
  - Wastewater facilities include treatment and storage ponds and spray fields.
- Authorized services at Putah Canyon Northern Portion include:
  - Playground and group day use shelter near the boat exclusion area.
  - Fish cleaning stations near the boat launch and marina.
  - An additional park model on the peninsula near the required park models.
  - Employee housing south of the dry boat storage area. Employee housing includes 6 park models and shared picnic tables and barbeque. Parking is adjacent to the park models.

- A boat repair building and concessionaire office near the dry boat storage area.

- Restaurant and retail store combined with the marina building.

Site Layout (Southern Portion - Authorized Only)

- The only publicly accessible day use or camping facilities in this area are located east of Knoxville Road. A one-way vehicle access drive can be provided via an existing service road curb cut north of the Pope Canyon intersection. The exit is located toward the south at an existing curb cut near the bridge crossing over Pope Canyon.

- Since there is no sewer or water hook-up proposed in this area, a 2-unit vault toilet would serve as the comfort station facility for the campground or day use area.

- Public recreation facilities are limited to 20 tent-only sites or 20 day use sites, and an iron ranger would serve to collect fees, and employees would check the area daily. Two access gates would block the area from vehicle access when necessary.

Development of the Putah Canyon Recreation Area shall consist of the Required improvements and may entail the additional Authorized facilities as detailed in Table 2-2.

Table 2-2. Required and Authorized Facilities at Putah Canyon

Item	Required No. of Units	Additional Authorized No. of Units	Total
Camping			
Tent Site	47	20	67
Standard Campsite without Utilities	14	0	14
Standard Campsite with Utilities	5	0	5
RV Sites with Utilities	18	0	18
Camp Host Site with Utilities	1	0	1
RV Dump Station	1	0	1
Playground and Group Area	0	1	1
Iron Ranger	1	1	2
Lodging			
Park Models	5	1	6
Boating			
Launch Lane Boat Ramp	4	2	6
Courtesy Dock	2	2	4
Launch Lane Boat Ramp (marina use only)	0	1	1
Courtesy Dock (marina use only)	0	1	1

Table 2-2. Required and Authorized Facilities at Putah Canyon

Item	Required No. of Units	Additional Authorized No. of Units	Total
Boat Slips	201	0	201
Houseboat Slips	15	0	15
Kiosk (Boat Ramp Sign)	1	0	1
On-Shore Fuel and/or Sanitary Storage Tank	1	0	1
Fuel Dispensing and/or Sanitary Connection	1	0	1
Fish Cleaning Station	0	2	2
Employee Housing (Park models)	0	6	6
Marina Service and Building	1	0	1
Concessionaire Building	0	1	1
Boat Repair, Yard Shop, or Tow Service	0	1	2
Dry Boat Storage (# boats)	30	0	30
Boat Rental Service	1	0	1
Day Use			
Individual Day Use Site	18	20	38
Group Day Use Area	0	1	1
Kiosk (Trail Connection)	0	1	1
Lake			
Boat Exclusion Zone	2	0	2
Amenities			
Restaurant	0	1	1
Retail Store	0	1	1
Facilities/Infrastructure			
Entry Station	1	1	2
Entry Station Vault Toilet	1	0	1
Vault Toilet	0	1	1
Comfort Station, Toilets Only	3	1	4
Comfort Station, Toilets & Family Room	1	0	1
Comfort Station, Toilets, Family Room, & Showers	1	0	1
Comfort Station, Toilets, Family Room, Showers, & Laundry	0	1	1
Access Road Close Gate	2	1	3
Parking			
Single Vehicle Parking at Marina	126	0	126
Vehicle with Boat Trailer Parking	55	0	55

2.2 Monticello Shores Recreation Area

Monticello Shores Recreation Area is proposed to include very little required development, allowing potential bidders to propose a financially feasible site plan.

Entrance to the site is served by an entry station with a single vault toilet. There will be a paved entrance road to this entry station, with enough room to turn around. Past this entry station, a graveled access road will branch off to the north to provide access to the potable groundwater well and water storage facility. There will be no sewer service required and only electrical infrastructure for the entry station, groundwater well, and security lighting.

Development of the Monticello Shores Recreation Area shall consist of the Required improvements and may entail the additional Authorized facilities as detailed in Table 2-3.

Table 2-3. Required and Authorized Facilities at Monticello Shores

Item	Required No. of Units	Additional Authorized No. of Units	Total
Camping			
Tent sites	0	130	130
Standard Sites without Utilities	0	4	4
Standard Sites with Utilities	0	8	8
RV Sites with Utilities	0	21	21
Hike-In/Boat-In Tent Sites	0	20	20
Overnight Group Use Area (50 occupants)	0	1	1
Camp Host Site with Utilities	0	1	1
RV Dump Station	0	1	1
Lodging			
Park Models	0	28	28
Cabins	0	9	9
Yurts	0	6	6
Rustic Cabins	0	4	4
Tent Cabins	0	5	5
Floating Campsite	0	3	3
Boating			
Launch Lane Boat Ramp	0	4	4
Courtesy Dock	0	2	2
Boat Slips	0	50	50
Kiosk (Boat Ramp Sign)	0	1	1
On-Shore Fuel and/or Sanitary Storage Tank	0	1	1
Fuel Dispensing and/or Sanitary Connection	0	1	1
Fish Cleaning Station	0	1	1
Marina Service and Building	0	1	1

Table 2-3. Required and Authorized Facilities at Monticello Shores

Item	Required No. of Units	Additional Authorized No. of Units	Total
Boat Rental Service	0	1	1
Day Use			
Individual Day Use Site	0	8	8
Group Day Use Area	0	1	1
Kiosk (Trail Connection)	0	1	1
Lake			
Boat Exclusion Zone	0	1	1
Amenities			
Restaurant	0	1	1
Retail Store	0	1	1
Facilities/Infrastructure			
Entry Station	1	0	1
Entry Station Vault Toilet	1	0	1
Vault Toilet	0	9	9
Comfort Station, toilets only	0	1	1
Comfort Station, toilets and family room	0	5	5
Comfort Station, toilets, family room, and showers	0	6	6
Access Road Close Gate	1	0	1
Parking			
Single Vehicle Parking at Marina	0	30	30
Vehicle with Boat Trailer Parking	0	49	49

2.3 Berryessa Point Recreation Area

Berryessa Point is proposed as a dry camping site. Entrance to the site is served by an iron ranger and there is no staffed entry station. Development on the site includes 49 tent-only sites. It is assumed that Berryessa Point would be bundled with another recreation area and managed remotely.

There would be no required boating, lodging, or day use facilities. There would be no sewer or potable water and the recreation area would only have vault toilets. Electrical infrastructure would include security lighting.

The following are unique site design characteristics for the Berryessa Point site plan.

Site Layout

- An iron ranger would be stationed at the new site entry location.

- Past the iron ranger, the paved entrance road becomes a gravel main road, continuing east towards to the peninsula. All tent-only sites are on a gravel loop road.
- There are two vault toilets serving the tent-only sites.
- Authorized facilities at Berryessa Point include:
  - An entry station.
  - The concessionaire can choose to make the recreation area an RV park instead of a camping area. There are 41 authorized RV sites that could be developed instead of the 49 tent-only sites. An RV dump station is authorized if the concessionaire develops the RV sites. A water well with associated treatment, storage, and distribution systems as well as enhanced electrical facilities are also authorized to support the RV park development.
  - A camp host site.
  - A group use shelter or similar structure at the end of the peninsula.
  - 17 individual day use sites along the peninsula, which would require additional single vehicle parking.
  - A floating marina, combined with retail and a take-out counter style restaurant, with 50 boat slips. Public parking for cars with boat trailers is not authorized, however 30 single vehicle parking spots for the marina will be necessary.
  - Single lane boat launch, which would also require boat trailer parking.
  - A fuel dispenser on the marina dock with fuel storage nearby.
  - Fish cleaning station
  - Additional vault toilets to serve authorized services.

Development of the Berryessa Point Recreation Area shall consist of the Required improvements and may entail the additional Authorized facilities as detailed in Table 2-4.

Table 2-4. Required and Authorized Facilities at Berryessa Point

Item	Required No. of Units	Additional Authorized No. of Units	Total
Camping			
Tent Site	49	0	49
RV Sites with Utilities	0	41	41
Camp Host Site with Utilities	0	1	1
RV Dump Station	0	1	1
Iron Ranger	1	0	1
Boating			
Launch Lane Boat Ramp	0	1	1
Courtesy Dock	0	1	1
Boat Slips	0	50	50
Kiosk (Boat Ramp Sign)	0	1	1
On-Shore Fuel and/or Sanitary Storage Tank	0	1	1
Fuel Dispensing and/or Sanitary Connection	0	1	1
Fish Cleaning Station	0	1	1
Marina Service and Building	0	1	1
Day Use			
Individual Day Use Site	0	17	17
Kiosk (Trail Connection)	0	1	1
Gazebo/Group Use Shelter	0	1	1
Amenities			
Restaurant	0	1	1
Retail Store	0	1	1
Facilities/Infrastructure			
Entry Station	0	1	1
Vault Toilet	2	0	2
Parking			
Single Vehicle Parking at Marina	0	30	30
Single Vehicle Parking	60	18	78

2.4 Spanish Flat Recreation Area

Spanish Flat Recreation Area includes a mix of required tent camping, day use, and boating services. There are no required services on the southern peninsula of the site.

The entry station is located at the bottom of the entrance road off of Knoxville Road. There is a marina with 75 boat slips and no houseboat slips, parking lot, and day use sites just north of the entry station. South of the entry station is a boat trailer parking lot with a 2-lane boat launch. There are day use sites that line the parking lot along the shore line. There are tent sites north of the parking lot.

Water and electric utilities would be available for the entire site. There is no wastewater service required at Spanish Flat. There are 3 vault toilets and an RV dump station. Potable water is provided by Spanish Flat Water District.

Although this site has the most acreage of all 5 sites, the majority of the property north of the site entry is inaccessible to vehicles due to steep topography and the lack of potential areas to develop convenient and efficient water crossings. Recreation uses north of the site entry, if allowed, are limited to strenuous hiking only.

The following are unique site design characteristics for the Spanish Flat site plan.

Site Layout

- The new site entry building is placed down the hill from the exit off of Knoxville Road to allow additional space for improved and safer queuing of vehicles as they enter the site off the main road. The building also has a nearby accessible parking area.

- The marina has boat rental services and private boat slips. Boat rentals include a mix of fishing boats, ski boats, kayak/canoes, paddleboards, jet skis, and pontoons. Fuel dispensing and storage is located off the peninsula to the southwest of the marina.

- The boat trailer parking lot is designed as a linear loop arrangement, parallel to the shoreline. Although earthwork associated with the new boat trailer parking lot would not be visible from the lake, this parking lot design creates a flat area along the shoreline that would require a graded vegetated slope that needs to be stabilized with natural grasses.

- West of the marina and boat trailer parking area are tent-only sites, day use sites, the camp host site, and an RV dump station in a small turn-around area. Reclamation has installed a RV dump station shown on the site plans. RV sites on the southern peninsula are authorized services.

- An access road leads to the top of the hill on the peninsula where there is a water storage tank to store fire flows.

- Authorized facilities at Spanish Flat include:

  – Wastewater service is authorized at Spanish Flat.

  – A playground near the boat trailer parking lot.

  – A restaurant and retail store combined with the floating marina.

- A single lane boat launch to serve the marina.
- Fish cleaning station.
- Extension of the boat ramp to accommodate lower water levels and a new 2-lane boat ramp.
- The southern peninsula of the site has a mix of authorized camping, lodging, and day use services, including tent-only sites, standard sites, RV sites, yurts, rustic cabins, tent cabins, and day use sites. Vault toilets or comfort stations would be required to service these facilities.
- A concessionaire building is also authorized on the peninsula.

Development of the Spanish Flat Recreation Area shall consist of the Required improvements and may entail the additional Authorized facilities as detailed in Table 2-5.

Table 2-5. Required and Authorized Facilities at Spanish Flat

Item	Required No. of Units	Additional Authorized No. of Units	Total
Camping			
Tent sites	17	39	56
Standard Sites without Utilities	0	10	10
RV Sites with Utilities	0	12	12
Camp Host Site with Utilities	1	0	1
RV Dump Station	1	0	1
Playground and Group Area	0	1	1
Lodging			
Yurts	0	3	3
Rustic Cabins	0	4	4
Tent Cabins	0	3	3
Boating			
Launch Lane Boat Ramp	2	2	4
Courtesy Dock	1	1	2
Launch Lane Boat Ramp (marina use only)	0	2	2
Courtesy Dock (marina use only)	0	1	1
Boat Slips	75	0	75
Kiosk (Boat Ramp Sign)	1	0	1
On-Shore Fuel and/or Sanitary Storage Tank	1	0	1
Fuel Dispensing and/or Sanitary Connection	1	0	1
Fish Cleaning Station	0	1	1
Marina Service and Building	1	0	1
Concessionaire Building	0	1	1

Table 2-5. Required and Authorized Facilities at Spanish Flat

Item	Required No. of Units	Additional Authorized No. of Units	Total
Boat Rental Service	1	0	1
Day Use			
Individual Day Use Site	10	8	18
Boat Exclusion Zone	1	0	1
Kiosk (Trail Connection)	0	1	1
Lake			
Boat Exclusion Zone	1	0	1
Amenities			
Restaurant	0	1	1
Retail Store	0	1	1
Facilities/Infrastructure			
Entry Station	1	0	1
Vault Toilet	3	1	4
Comfort Station, toilets only	0	2	2
Comfort Station, toilets, family room	0	1	1
Access Road Close Gate	1	1	2
Parking			
Single Vehicle Parking at Marina	45	0	45
Vehicle with Boat Trailer Parking	33	0	33

2.5 Steele Canyon Recreation Area

Steele Canyon Recreation Area is designed with similar facilities proposed at Putah Canyon, including marina, boating, camping, lodging, and day use. There is a main 2-way access road that travels from the entry station north through the site.

At the south end of the site near the entry station, there is boat trailer parking boat launch, RV sites and standard sites. As the road continues past the parking lot, there are standard sites with utilities on west side. The road continues westerly past a day use area with individual day use sites and a comfort station to a parking lot with the marina building. North of the parking lot and on the northern peninsula of the site, there are park models and cabins, which have water, wastewater, and electric utilities.

Water, wastewater, and electric utilities would be available for the entire site. Water and wastewater treatment services for the entire site will be provided by NBRID. There is a pipeline from the main road north of the boat trailer parking east through the site to connect to the NBRID system.

The following are unique site design characteristics for the Steele Canyon site plan.

Site Layout

- The new site entry building is located in the same area as existing, but has a new accessible parking area and a new vehicle turnaround that allows vehicles to immediately exit the area.

- The boat launch remains in the existing location, and nearby is a larger parking lot for vehicles with boat trailers. The Required 6-lane boat ramp is narrower than the existing 10-lane ramp, 4 ramp lanes are Authorized. South of the parking lot is an access loop with RV sites.

- An RV dump station is located along the 2-way access drive at the north end of the boat trailer parking lot.

- No buildings or structures are located within 25 ft of the centerline of the existing electric towers per PG&E requirements.

- Proceeding westerly on the 2 way access drive, the marina building is ahead on the left. The marina services include both boat rentals and private boat slips. South of the marina building is the access to the dock and boat slips. The marina has 178 boat slips and 32 houseboat slips. There is a fuel dispenser and sanitary pump for houseboats on the main dock. The boat rental services includes a mix of houseboats, fishing boats, ski boats, kayak/canoes, paddle boards, jet skis and pontoons. There are on-shore fuel storage and sanitary storage tanks just east of the access to the gangway.

- On the northern peninsula, there are 15 cabins and 12 park models that are generally isolated from the rest of the site.

- Authorized facilities at Steele Canyon include:

  – A major campground for RVs sited up gradient, to the east and northeast of the main road. Standard sites are located around an access loop on the small peninsula. Comfort stations would be required to serves these sites. A comfort station with showers and laundry is authorized.

  – A playground, group day use structure, and an area for recreation courts.

  – An employee housing area with its own access drive and parking area.

- A concession office building and maintenance/yard area complete with a small boat repair with tow service building, and a covered, 4 story dry boat storage building that is anticipated to house about 72 boats. Inside the storage building, the boats would be lifted by forklift, and the exterior pavement will need to be designed to accommodate loads. Boats will be moved between the boat ramp and building by a concessionaire operated tractor pulled universal boat trailer system. Adjacent to the enclosed boat storage building is a smaller dry boat storage facility with space for storing 24 boats and one open wall for ease of access. The storage buildings are situated to minimize potential grading of the nearby steep slopes. There would be fencing around the facility.

- Retail services combined with the marina in the same building. A separate building for a restaurant. Additional parking would be required for the restaurant.

- 100 additional boat slips, 4 additional launch lanes at the existing boat ramp with 2 courtesy docks, two fish cleaning stations, 5 hike-in/boat-in tent-only sites, and 3 floating campsites. Additional parking would be required for these facilities.

- A multiuse events center for planned group events like seminars, small conferences, school group gatherings and possibly family reunions, weddings or other similar venues or activities. Additional parking would be required for the multiuse center.

Development of the Steele Canyon Recreation Area shall consist of the Required improvements and may entail the additional Authorized facilities as detailed in Table 2-6.

Table 2-6. Required and Authorized Facilities at Steele Canyon

Item	Required No. of Units	Additional Authorized No. of Units	Total
Camping			
Tent sites	0	19	19
Standard Sites without Utilities	0	22	22
Standard Sites with Utilities	10	22	32
RV Sites with Utilities	4	7	11
Hike-In/Boat-In Tent Sites	0	5	5
Overnight Group Use Area (20 occupants)	0	1	1
Camp Host Site with Utilities	1	0	1
RV Dump Station	1	0	1
Playground and Group Area	0	1	1

Table 2-6. Required and Authorized Facilities at Steele Canyon

Item	Required No. of Units	Additional Authorized No. of Units	Total
Lodging			
Park Models	12	0	12
Cabins	15	0	15
Floating Campsite	0	3	3
Boating			
Launch Lane Boat Ramp	6	4	10
Courtesy Dock	4	2	6
Boat Slips	178	100	278
Houseboat Slips	32	0	32
Kiosk (Boat Ramp Sign)	1	0	1
On-Shore Fuel and/or Sanitary Storage Tank	1	0	1
Fuel Dispensing and/or Sanitary Connection	1	0	1
Fish Cleaning Station	0	2	2
Employee Housing (Park models)	0	10	10
Marina Service and Building	1	0	1
Concessionaire Building	0	1	1
Boat Repair, Yard Shop, or Tow Service	0	1	1
Dry Boat Storage (# boats)	0	96	96
Boat Rental Service	1	0	1
Day Use			
Individual Day Use Site	10	0	10
Group Day Use Areas	0	1	1
Kiosk (Trail Connection)	0	1	1
Multi-Use Special Events Center	0	1	1
Lake			
Boat Exclusion Zone	1	0	1
Amenities			
Restaurant	0	1	1
Retail Store	0	1	1

Table 2-6. Required and Authorized Facilities at Steele Canyon

Item	Required No. of Units	Additional Authorized No. of Units	Total
Facilities/Infrastructure			
Entry Station	1	0	1
Entry Station Vault Toilet	1	0	1
Comfort Station, toilets only	2	3	5
Comfort Station, toilets and family room	1	2	3
Comfort Station, toilets, family room, and showers	0	1	1
Comfort Station, toilets, family room, showers, and laundry	0	1	1
Access Road Close Gate	1	0	1
Parking			
Single Vehicle Parking at Marina & Restaurant	128	60	188
Vehicle with Boat Trailer Parking	75	0	75

2.6 Summary of Required and Authorized Facilities and Services

Table 2-7 summarizes the number of required facilities and services proposed at each site. Table 2-8 summarizes the number of authorized facilities at each site.

Table 2-7. Proposed Quantities of Required Facilities at Each Recreation Area

Facilities	Putah Canyon	Monticello Shores	Berryessa Point	Spanish Flat	Steele Canyon	Total
Camping						
Tent sites	47	0	49	17	0	**113**
Standard Sites without Utilities	14	0	0	0	0	**14**
Standard Sites with Utilities	5	0	0	0	10	**15**
RV Sites with Utilities	18	0	0	0	4	**22**
Hike-in/Boat-in tent sites	0	0	0	0	0	**0**
Overnight Group Use Area (50 occupants)	0	0	0	0	0	**0**
Overnight Group Use Area (20 occupants)	0	0	0	0	0	**0**
Camp Host Site with Utilities	1	0	0	1	1	**3**
RV Dump Station	1	0	0	1	1	**3**
Playground and Group Area	0	0	0	0	0	**0**
Iron Ranger	1	0	1	0	0	**2**
Lodging						
Park Models	5	0	0	0	12	**17**
Cabins	0	0	0	0	15	**15**
Yurts	0	0	0	0	0	**0**

Table 2-7. Proposed Quantities of Required Facilities at Each Recreation Area

Facilities	Putah Canyon	Monticello Shores	Berryessa Point	Spanish Flat	Steele Canyon	Total
Rustic Cabins	0	0	0	0	0	**0**
Tent Cabins	0	0	0	0	0	**0**
Floating Campsite	0	0	0	0	0	**0**
Boating						
Launch Lane Boat Ramp	4	0	0	2	6	**12**
Courtesy Dock	2	0	0	1	4	**7**
Boat Slips	201	0	0	75	178	**454**
Houseboat Slips	15	0	0	0	32	**47**
Kiosk (Boat Ramp Sign)	1	0	0	1	1	**3**
On-Shore Fuel and/or Sanitary Storage Tank	1	0	0	1	1	**3**
Fuel Dispensing and/or Sanitary Connection	1	0	0	1	1	**3**
Fish Cleaning Station	0	0	0	0	0	**0**
Employee Housing (Park models)	0	0	0	0	0	**0**
Marina Service and Building	1	0	0	1	1	**3**
Concessionaire Building	0	0	0	0	0	**0**
Boat Repair, Yard Shop, or Tow Service	0	0	0	0	0	**0**
Dry Boat Storage (# boats)	30	0	0	0	0	**30**
Boat Rental Service	1	0	0	1	1	**3**
Day Use						
Individual Day Use Site	18	0	0	10	10	**38**
Group Day Use Area	0	0	0	0	0	**0**
Kiosk (Trail Connection)	0	0	0	0	0	**0**
Multi-Use Special Events Center	0	0	0	0	0	**0**
Lake						
Boat Exclusion Zone	2	0	0	1	1	**4**
Amenities						
Restaurant	0	0	0	0	0	**0**
Retail Store	0	0	0	0	0	**0**
Facilities/Infrastructure						
Entry Station	1	1	0	1	1	**4**
Entry Station Vault Toilet	1	1	0	0	1	**3**
Vault Toilet	0	0	2	3	0	**5**
Comfort Station, toilets only	3	0	0	0	2	**5**
Comfort Station, toilets and family room	1	0	0	0	1	**2**
Comfort Station, toilets, family room, and showers	1	0	0	0	0	**1**
Comfort Station, toilets, family room, showers, and laundry	0	0	0	0	0	**0**
Access Road Close Gate	2	1	0	1	1	**5**
Parking						
Single Vehicle Parking at Marina	126	0	0	45	128	**299**

Table 2-7. Proposed Quantities of Required Facilities at Each Recreation Area

Facilities	Putah Canyon	Monticello Shores	Berryessa Point	Spanish Flat	Steele Canyon	Total
Vehicle with Boat Trailer Parking	55	0	0	33	75	**163**

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Table 2-8. Proposed Quantities of Authorized Facilities at Each Recreation Area

Facilities	Putah Canyon	Monticello Shores	Berryessa Point	Spanish Flat	Steele Canyon	Total
Camping						
Tent sites	20	130	0	39	19	**208**
Standard Sites without Utilities	0	4	0	10	22	**36**
Standard Sites with Utilities	0	8	0	0	22	**30**
RV Sites with Utilities	0	21	41	12	7	**81**
Hike-in/Boat-in tent sites	0	20	0	0	5	**25**
Overnight Group Use Area (50 occupants)	0	1	0	0	0	**1**
Overnight Group Use Area (20 occupants)	0	0	0	0	1	**1**
Camp Host Site with Utilities	0	1	1	0	0	**2**
RV Dump Station	0	1	1	0	0	**2**
Playground and Group Area	1	0	0	1	1	**3**
Iron Ranger	1	0	0	0	0	**1**
Lodging						
Park Models	1	28	0	0	0	**29**
Cabins	0	9	0	0	0	**9**
Yurts	0	6	0	3	0	**9**
Rustic Cabins	0	4	0	4	0	**8**
Tent Cabins	0	5	0	3	0	**8**
Floating Campsite	0	3	0	0	3	**6**
Boating						
Launch Lane Boat Ramp	2	4	1	2	4	**13**
Courtesy Dock	2	2	1	1	2	**8**
Launch Lane Boat Ramp (marina use only)	1	0	0	2	0	**3**
Courtesy Dock (marina use only)	1	0	0	1	0	**2**
Boat Slips	0	50	50	0	100	**200**
Houseboat Slips	0	0	0	0	0	**0**
Kiosk (Boat Ramp Sign)	0	1	1	0	0	**2**
On-Shore Fuel and/or Sanitary Storage Tank	0	1	1	0	0	**2**
Fuel Dispensing and/or Sanitary Connection	0	1	1	0	0	**2**
Fish Cleaning Station	2	1	1	1	2	**7**
Employee Housing (Park models)	6	0	0	0	10	**16**
Marina Service and Building	0	1	1	0	0	**2**
Concessionaire Building	1	0	0	1	1	**3**

Table 2-8. Proposed Quantities of Authorized Facilities at Each Recreation Area

Facilities	Putah Canyon	Monticello Shores	Berryessa Point	Spanish Flat	Steele Canyon	Total
Boat Repair, Yard Shop, or Tow Service	1	0	0	0	1	**2**
Dry Boat Storage	0	0	0	0	96	**96**
Boat Rental Service	0	1	0	0	0	**1**
Day Use						
Individual Day Use Site	20	8	17	8	0	**53**
Group Day Use Area	1	1	0	0	1	**3**
Kiosk (Trail Connection)	1	1	1	1	1	**5**
Multi-Use Special Events Center	0	0	0	0	1	**1**
Gazebo/Group Use Shelter	0	0	1	0	0	**1**
Lake						
Boat Exclusion Zone	0	1	0	0	0	**1**
Amenities						
Restaurant	1	1	1	1	1	**5**
Retail Store	1	1	1	1	1	**5**
Facilities/Infrastructure						
Entry Station	1	0	1	0	0	**2**
Entry Station Vault Toilet	0	0	0	0	0	**0**
Vault Toilet	1	9	0	1	0	**11**
Comfort Station, toilets only	1	1	0	2	3	**7**
Comfort Station, toilets and family room	0	5	0	1	2	**8**
Comfort Station, toilets, family room, and shower	0	6	0	0	1	**7**
Comfort Station, toilets, family room, shower, and laundry	1	0	0	0	1	**2**
Access Road Close Gate	1	0	0	1	0	**2**
Parking						
Single Vehicle Parking at Marina & Restaurant	0	30	30	0	60	**120**
Vehicle with Boat Trailer Parking	0	49	0	0	0	**49**

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Chapter 3
Sustainable Design

Executive Order 13423, signed on January 24, 2007, and Executive Order 13514, signed on October 5, 2009, require Federal agencies to design, construct, and operate Federal buildings in a more sustainable manner to reduce environmental and economic impacts. The Guiding Principles to achieve the executive orders are:

- Employment of integrated design principles
- Optimization of energy efficiency and use of renewable energy
- Protection and conservation of water
- Enhancement of indoor environmental quality
- Reduction of environmental impacts of materials

Reclamation has developed a Guiding Principles Checklist for New Construction and a Guiding Principles Checklist of Existing Buildings to convey detailed information on each of the Guiding Principles and act as a tool for assessing and documenting the requirements.

The following sections present steps taken in the proposed design as well as future considerations that concessionaires should evaluate with regards to sustainability, expanding on the items noted above.

3.1 Site Layout, Materials, and Grading

As sustainable site design is an important objective for the five sites, the proposed site layout of new facilities generally reflects what was previously developed at each property. Since each site was previously developed as a public campground, a majority of proposed design solutions already reflect what was formerly there. Many of the new facilities are proposed to remain in the same place, and in some instances the proposed improvements are intended to repair or improve damaged systems. Also, all proposed improvements are intended to be developed in compliance with contemporary regulatory land development practices. This is particularly true with the improved site access locations, on-site access drives, boat launch areas, and overnight camping areas.

Sustainable site design occurs at a variety of scales, and all scales should foster a transformation in land development and land management practices that highlights the importance of human and natural ecosystem services. The land use practices at each concessionaire property will be defined as sustainable if they enable natural and built systems to work together to “meet the needs of the

present without compromising the ability of future generations to meet their own needs" (from Our Common Future by United Nations World Commission on Environment and Development, dated 1987). This means that redeveloping these five campgrounds, from the selection of materials, to performing site grading operations, will hold the potential to improve, and to regenerate both the human use services and natural systems, to the betterment of both.

During the site design process, efforts made by the concessionaire to create a more sustainable landscape will be encouraged such as:

- maintaining the existing balance of atmospheric gasses
- regulating local temperatures through shading, evapotranspiration and windbreaks
- reducing and removing air pollution
- creating, storing and providing water for human use
- retaining soil and preventing land resource damage from siltation
- reducing vulnerability to damage by flooding, storms, fires, and drought
- providing habitat for pollinator species
- encouraging and conserving biological and genetic diversity of native species
- providing safe and ecologically sound human use activities
- offering educational and aesthetic experiences through developing an appreciation of nature

Sustainable site design features and practices are encouraged, particularly when choosing materials in the landscape and when performing grading or earthwork operations. Specifically related to these aspects and properties of site design, a sustainable site design approach for all existing and proposed facilities should at least include a review of the following:

- Protect the reservoir shoreline, on-site water resources, and established buffers.
- Provide landscape amenities that do not require long-term irrigation.
- Manage stormwater on-site.
- Control and manage known invasive species.
- Minimize soil disturbance as much as possible.
- Preserve areas of mature vegetation where possible.
- Use native vegetation.
- Use vegetation to moderate building heating and cooling requirements.
- Use vegetation to reduce pavement heat island effects.

- Select sustainable building materials.
- Reuse salvaged materials.
- Use materials with recycled content.
- Use regional materials.
- Promote sustainability awareness and education.
- Reduce light pollution.
- Restore and revegetate disturbed soils.
- Plan for sustainable site maintenance.
- Minimize outdoor energy consumption for landscape and exterior operations.
- Use renewable energy sources for landscape electricity needs
- Monitor performance of sustainable site design practices

3.2 Stormwater

The stormwater elements in the 60 percent design consist of regionally located detention basins throughout each project site. Stormwater runoff is intended to be collected and conveyed to the basins where runoff will be detained and allowed opportunity for infiltration into the underlying soils. The detained stormwater may potentially be harvested and reused onsite for irrigation, vehicle washing, or other non-potable uses if allowed by federal, state, and local permits.

To improve sustainability and reduce stormwater runoff, the final stormwater design performed by the concessionaire could incorporate site design measures and Low Impact Development (LID) techniques in addition to, or in lieu of, the stormwater detention basins identified on the drawings. A list of sustainable stormwater Best Management Practices (BMPs) that should be considered during the concessionaire's development of the sties is provided below:

- Stream Setbacks and Buffers - a vegetated area including trees, shrubs, and herbaceous vegetation, that exists or is established to protect a stream system, lake, reservoir, or coastal estuarine area;

- Soil Quality Improvement and Maintenance - improvement and maintenance of soil through soil amendments and creation of microbial communities;

- Tree Planting and Preservation - planting and preservation of healthy, established trees that include both evergreens and deciduous, as applicable;

- Rooftop and Impervious Area Disconnection - rerouting of rooftop drainage pipes to drain rainwater to rain barrels, cisterns, or permeable areas instead of the storm sewer;

- Porous Pavement - pavement that allows runoff to pass through it, thereby reducing the runoff from a site and surrounding areas and filtering pollutants;

- Green Roofs - a vegetative layer grown on a roof (rooftop garden);

- Vegetated Swales - a vegetated, open-channel management practice designed specifically to treat and attenuate storm water runoff; and

- Rain Barrels and Cisterns - system that collects and stores stormwater runoff from a roof or other impervious surface.

3.3 Water

Sustainability considerations have been designed of the water system through the integrated selection of sizing, materials and configuration. The system configuration is coordinated with other utility improvements to provide better construction efficiency. The selection of materials and sizing of the piping and equipment optimizes the system performance under consideration of the initial materials investment, energy efficiency, the protection of the water supply and conservation of water. Sizing of the distribution system integrated all of these considerations in providing sufficient performance characteristics to deliver the design fire suppression flow rate through as small diameter pipe as possible and matching that with pumping systems to be as energy efficient as possible. Where appropriate, variable frequency drives are used to further increase the energy efficiency.

3.4 Wastewater

Sustainable concepts incorporated into the design of the wastewater collection and treatment facilities include:

- Existing facilities were used to the maximum extent possible. For example, wastewater at Steele Canyon will be treated by an existing wastewater treatment plant instead of constructing a new treatment facility.

- Treatment ponds were used in lieu of mechanical treatment systems where there was enough available land.

- Wastewater treatment facilities were designed to produce an effluent that could be discharged onsite without negatively impacting groundwater quality.
- Pump selection was based on maximum efficiency at the most common operating condition.
- All motors will be specified as National Electrical Manufacturers Association (NEMA) premium efficiency.
- Gravity conveyance piping was used to the greatest practical extent to minimize the amount of pumping needed.
- Pipe sizes and thicknesses were minimized to the greatest practical extent to reduce the amount of material needed to construct the wastewater collection system.
- The depth of buried piping was minimized to reduce the amount of earthwork needed to install piping.

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Chapter 4
Site Design

Building from the Conceptual Site plans, nominally a 30 percent level design, the sections below summarize the design criteria and detail the site design aspects of the proposed improvements as depicted on the 60 percent design plans.

4.1 Design Criteria and Assumptions

The Bureau of Reclamation's publication Recreation Facility Design Guidelines (RRFDG), dated April 2013, is the primary source for site design criteria and assumptions. Building facilities shall meet the International Building Code, the International Plumbing Code, National Electric Code, all applicable fire codes and all other design codes applicable to the development performed by the contractor. Facilities shall be compliant with the National Fire Protection Association (NFPA) Life Safety Code, and all accessibility requirements (Architectural Barriers Act Accessibility Standards, 2010 Americans with Disabilities Act (ADA) standards for Accessible Design and the Accessibility Guidelines for Outdoor Developed Areas).

Between 30 and 60% design, site design criteria from additional resources has been reviewed and discussed with Reclamation. Some of the criteria and resources are described and listed in Table 2-1 herein. It is important to note that not all of the design criteria in these resources is incorporated into the 60% site design plans. With the unique characteristics of this scenic natural setting, and past, historic use of camping and outdoor recreation activities, the design challenges to bring contemporary up-to-date, and permissible camping and outdoor recreation activity back to these properties are numerous.

All applicable codes, standards, and interpretations of resource design criteria incorporated into the site design have been reviewed and approved by Reclamation throughout the design process. Any deviations or adjustments to typical standards or guidelines are likely due to unique, complex, or difficult on-site conditions that were considered cost prohibitive, unsuitable for public use, too detrimental to the environment, impacting overall aesthetic appeal, or a combination of these factors.

The VSP ROD includes the following design requirements relative to location of facilities.

a. From elevation 440 to elevation 455 feet above mean sea level (MSL): Reserved for day-use facilities (marina facilities, swimming areas,

picnic sites) and the following non-permanent overnight use facilities: park models approved for short-term occupancy, RV and travel trailer sites, campgrounds, and tent camping. Picnic tables, BBQ grills, restrooms, and other supporting infrastructure for these facilities must be flood-proofed. Flood-proofing for these structures and facilities includes, but is not limited to, sealed openings, removable utilities, flotation devices, and anchoring. Park models must be removed during the off-season or in anticipation of high-water events.

Retail stores and food and beverage facilities may be located at elevations 440'-455' MSL but only where certified by Reclamation as flood-proof in accordance with reservoir operation requirements, health and safety codes, and other requirements. Flood-proofing for these facilities includes, but is not limited to, stilts, lifts, floating barges, or other features that safely elevate the structure above elevation 455' MSL.

b. From elevation 455' MSL to the Federal Property Line: Hotels, motels, conference facilities, cabins, cottages, and lodges must be located above the reservoir surcharge area (455' MSL and below). This is consistent with project operational requirements for flood control, water supply, and water quality, and promotes compliance with health and safety code requirements. In addition, the following overnight use facilities and supporting infrastructure may be located at or above elevation 455' MSL: park models approved for short-term occupancy, RV and travel trailer sites, campgrounds, tent camping, and picnic sites.

c. From elevation 455' MSL plus 100 Linear Foot (LF) Buffer toward the Federal Property Line: All cabins, park models, or cottages approved by Reclamation for annual occupancy – along with aeration ponds and sewage system infrastructure other than pipelines, lift stations, and other appurtenant devices – must be located above elevation 455' MSL plus 100 LF buffer. All other facilities identified in paragraphs a. and b. above may also be located above this level. The 100 LF buffer preserves space at each concession area for short-term occupancy facilities consistent with the VSP ROD.

The VSP ROD also includes the following environmental commitments that relate to construction and development.

- Reclamation shall require that Best Management Practices be included in all construction activities to minimize potential soil erosion during construction. Measures shall be implemented to separate construction areas from water sources, and to protect wetlands. Disturbed and stockpiled soils shall be covered in suitable locations to prevent erosion, and disturbed areas shall be covered as necessary for protection from wind and rain.

- Wherever possible, new development shall be sited within existing developed areas. Any undeveloped areas disturbed by construction activities shall be rehabilitated as appropriate.

- Future proposals for new access drives and roads or other transportation facilities shall take advantage of existing corridors in order to minimize potential impacts. Wherever feasible, the re-planting of vegetation and re-use of landscape materials disturbed during construction will be used.

- Temporary impacts to fish and wildlife resources from development activities shall be mitigated by rehabilitating disturbed habitat and by employing construction techniques to limit the amount of soil erosion, dust, and noise.

- The redevelopment of concession areas shall include provisions to ensure facilities are sited to minimize visual intrusions from the lake, with new structures and supporting utilities designed to be architecturally compatible with or blend with the surrounding environment.

- New units or structures constructed or installed, operated, and maintained by contractors shall conform to thematic requirements that reflect a natural condition.

4.2 Access Drives and Parking Areas

For on-site public access drives and roadways, review of design criteria as found in the Design of Recreation Areas and Facilities-Access and Circulation Engineering and Design Manual EM 1110-2-410 dated 31 Dec 1982 by the Department of the Army Corps of Engineers (DRAFAC) has been incorporated into the site plans. Additionally, Napa County Road and Street Standards (NCRSS) has been reviewed with respect to pavement design and thicknesses. Other design criteria from State Responsibility Area Fire Safe Regulations (SRAFSR) has been incorporated including a 24 ft wide access drive consisting of a 20 ft wide paved two-way travel lane (per SRAFSR Art. 2, 1273.01) with 2 ft wide shoulders on each side. Secondary access drives are generally for less heavily travelled access ways and one-way traffic, 14 ft wide, with 12 ft wide pavement lane (per SRSFSR Art. 2, 1273.08). Per input from Reclamation, gravel has been substituted for pavement in many locations, refer to the plans and Table 2-1. Also, nearby existing developments, such as Camp Berryessa, are being investigated by Reclamation for comparative dimensional purposes and possible applicability to the five campground sites at Lake Berryessa.

The DRAFAC manual is presently the current and latest edition. Another more recent ACoE recreation manual refers to it, and it is presently found in the list of active ACoE publications. The DRAFAC recognizes that roads on recreation sites are considered as a primary recreation facility. As such, since a large percentage of recreation site visitors are sightseers, design emphasis should be on safety, aesthetics, protection of existing resources, and accessibility to those with disabilities.

The five campground sites each have naturally unique topographic and landform characteristics that offer strong reasons to maintain their genuine aesthetic character. The topographic terrain and physical features of each site have been analyzed, together with other design controls. The general topographic character of these properties can be fundamentally described as Rolling, and in some areas on some sites, Mountainous, according to the DRAFAC following definitions of terrain classifications:

- "Rolling terrain is that condition where the natural slopes consistently rise above and fall below the roadway grade line and where occasional steep slopes offer some restrictions to horizontal and vertical alignment."

- "Mountainous terrain is that condition where longitudinal and transverse changes in the elevation of the ground with respect to the roadway are abrupt."

In addition to type of topography, recreation roads in DRAFAC are classified into three major types as follows:

- An Access Road is an access drive that is generally considered the approach that vehicles use after they leave the public right-of-way, usually a two-way, two-lane access drive, designed as a recreation road that is environmentally pleasing.

- A Circulation Road is an access drive that connects with the access road and leads to and through the recreation area and facilities and may be two-way.

- A Service Road is primarily used for maintenance and supply vehicles in the recreation area, and sometimes can be used as public hiking/biking trails and firebreaks, typically one-lane wide, with turnarounds and passing lanes provided where needed.

To help formulate a basis of design for the on-site access drives, it is also appropriate to understand the design characteristics of Knoxville and Steele Canyon Roads, which share many similar features such as an average 24 ft. pavement width, lane stripe markings down the centerline and along the edges of pavement, and speed limit warning signs at curves. Other common roadway

elements include steel guardrail, super-elevated curves, vertical reflective delineator posts, and in some areas, vertical curbs. Posted speed limit signs vary from 25 to 45 mph. All five campground sites are accessed from these roads. Once vehicles leave these roads and proceed into a campground, the campground access drives should, in ACoE words, "…be designed and built primarily to support and provide recreation experiences" and designs should "…demonstrate knowledge and concern for protection of the resources and aesthetics of the area through which the access road passes…" (pg.2-1).

The DRAFAC states that 20 to 30 miles per hour designs should be considered for recreation roads where suitable and economic. In this context at Lake Berryessa, the campground access drives should offer a driving experience that is different from the experiences undertaken to get there along Knoxville and Steele Canyon Roads. As these sites are developed, speeds should be slower, and more emphasis should be given to scenery, aesthetics, and encouragement of safe recreational activity. The ACoE manual offers dimensional criteria for two way traffic with speeds 20 mph or greater, and with this limit, suggest a 22 ft wide pavement width (per Table 2-8). Most other developments off Knoxville Road (as seen from Google Maps), including resorts and marinas, have speed limits posted at 15 mph or less, their pavement widths are less than 24 ft, and pavement striping is not there, not evident, or only at site entrances. All residential areas off Knoxville Road have two-way pavement widths less than 24 ft, sometimes significantly less, and do not post a speed limit.

Therefore, as a basis of design for the two-way access drives, the design of all five campground sites are based on a 'reduced design footprint' when compared to recommendations in the DRAFAC manual and existing conditions in the region, by implementing a 20 ft wide paved cross-section with 2 ft wide shoulders. Additionally, the design of access drives and roads on all five campground sites is based on a 15 mph speed limit, or less, and no striping. If at some point delineation of pavement edges is desired, the inclusion of finished grade pavement reflector insets, and/or rumble strips in lieu of stripe-line markings will be the responsibility of the concessionaire and will be in keeping with providing a visible safety edge while minimizing aesthetic impacts. The in-pavement reflector and rumble strip delineation materials are visually non-obtrusive during the daytime, and therefore contribute to the ACoE directive of having these access drives become "…places to which people go for a special kind of experience, rather than merely places to get away from everyday activities." (pg. 1-2). The 24 ft width dimension reduces alterations to the natural landscape and conforms to recommendations of SRAFSR Art. 2, 1273.01. For lesser travelled and one-way access drives, both the DRAFAC and SRAFSR documents recommend 12 ft wide pavements with a 1 ft wide shoulder on either side of the pavement. The 60% site design criteria for access drives deviates from this standard to conform better with the existing conditions, thereby avoiding cost prohibitive and environmentally damaging materials, and to improve overall aesthetic impacts of increased use.

In accordance with DRAFAC: "There are few applications of curb in design and construction of recreation roads." (paragraph 2-4, page 2-21 item (2) c.). However, where protection of infrastructure facilities is necessary, concessionaires shall install cast-in-place vertical concrete curbs or other permanent type barriers such as bollards, large rocks or other type of simple, low profile, naturally looking barrier. In some publicly accessible areas, cast-in-place concrete vertical or mountable curbs will be necessary to direct vehicles, protect buildings, or to control stormwater, and these areas will be evaluated in subsequent phases of design. Precast concrete tire stops will be used at all handicap parking spaces.

For design of pavement layer thicknesses and materials, the NCRSS (Page 12, Section 14) provides definitions of different classifications of streets and roads (a through i) based on vehicle trips per day (vpd), but this also assumes year round use. This section also states; "All roads are required to be paved with the exception of agricultural special purpose roads and residential driveways which shall be surfaced per detail C-10. Pavement structural sections shall be determined by the designed Traffic Index (which is on page 38 and only deals with house subdivisions for residential and residential collector streets). The minimum structural section shall be 2-in of hot mix asphalt (HMA) over 5 inches of Class 2 aggregate base (AB) in accordance with Section 27 of the Standards." Detail C-10, on page 32, refers to Section 15 for design criteria of each street and road classification, but does not address pavement thickness. Section 27 clearly defines materials, all related to Caltrans standard specs, but does not address pavement thickness, or seasonal use areas.

In the absence of County criteria that address the unique aspects of the work proposed at the recreation sites, where pavement is required, the design of the site paving for the access drives and the parking areas shall be flexible pavement consisting of hot mix asphalt (HMA) over aggregate base (AB). Pavement design was performed per Caltrans design procedures as referenced by NCRSS using an assumed pavement design life of 20 years. The daily number of Equivalent Single Axle Loads (ESAL) is assumed to be between 20 (Traffic Index = 7) and 40 (Traffic Index = 8) for access drives and 6 (Traffic Index = 6) for parking areas. The California R-Value for the subgrade is assumed to be 45, or greater. Based on these design criteria, the following pavement section thicknesses are recommended and incorporated into the design details:

- Access drives and paved roads including top of boat ramp access areas, steep service drives, fuel and sanitary storage tank areas, and RV dump areas (Flexible Pavement):
  - HMA: 4 inches.
  - AB: 6 inches.

- Although parking areas including handicap parking spaces with access aisles and other handicap accessible parking areas (Flexible Pavement) have a lower traffic index (as noted above), input from Reclamation led to parking areas having identical sections as access drives. This allows larger vehicles to traverse any pavement without need to sign or segregate, and results in:
  - HMA: 4 inches.
  - AB: 6 inches.

Construction recommendations with further details regarding materials, subgrade preparation, placement, and compaction are provided in the Geotechnical Report included as Appendix C.

4.3 Pedestrian Walkways

Pedestrian walkways are limited to areas where pedestrians are expected to gather, such as at publicly accessible buildings, marina parking lot areas, around site entry control facilities, fish cleaning stations, group gathering and playground areas, plus handicap accessible access aisles, camp sites, buildings, and tables when designated as accessible. Surface materials, grades, and slopes of accessible walkways shall also conform to ADA. All facilities that are handicap accessible will typically need an accessible route leading to them from nearby access aisles adjacent to handicap accessible parking spaces. Many accessible routes start at the front of an access aisle, and continue parallel to the edge of parking lot pavement, and proceed to the destination.

For consistency of materials in and around buildings, design of all accessible route pedestrian walkways shall be a minimum of 4-ft wide, and have a surface consisting of a minimum 4-inch layer cast-in-place, non-reinforced, concrete slab with a broom finish, on top of a 4-inch base of aggregate stone, on top of compacted subgrade. This is consistent with recommendations found in DRAFAC, pg. 5-2, Section 5-4 a. (1 & 2), and pg. 5-4, Section 5-4 a. (4) (b).

Where walkways direct pedestrians to cross areas of vehicular traffic, a highly visible combination of signs and/or surface markings shall be furnished at the crossing to inform and caution motorists of possible pedestrians in the route of travel.

4.4 Launch Ramps

Boat launch ramps, floating boarding docks, and boarding dock lanes are designed to meet *Recreation Facility Design Guidelines*, U.S. Department of the Interior, Bureau of Reclamation, September 2002 and *Layout, Design and Construction Handbook for Small Boat Launching Facilities*, California

Department of Boating and Waterways, Boating Facilities Division, March 1991. Minor conflicts defaulted to the more stringent standard.

Reclamation boat launch ramp slope design criteria are between 12 to 15% grade, with a target grade of 12.5% as the ideal slope. The existing ground slope for the proposed ramp locations is very steep, and as such, all of the ramps were designed at 15% slope to minimize fill quantities, with the exception of the southern Putah Canyon ramp, which was designed for a 14% slope.

Since the existing ground slope for the proposed ramp locations is very steep, the design included a 3 foot high rip rap berm for the areas beyond the ends of the ramps where the slope drops off steeply to prevent vehicles from getting stuck if traveling beyond the edge of the concrete ramp edge.

The ramps are designed for cast-in-place construction. Although concrete planks can be installed in-water, they are typically much more expensive than cast-in-place ramps (often double the cost). The concrete portion of the ramp construction will need to occur in the dry, with low lake water levels. The rip ramp can be placed in the wet, but with difficulty because of the need for placement of filter fabric underlay.

For public information purposes, concessionaires will furnish all publicly accessible launch ramps with a standard Reclamation kiosk that is highly visible, accessible, and located near the top of the ramp.

Wherever possible, the ramps are situated to allow for vehicles to approach the ramp from a clockwise direction so that backing maneuvers can be more visible over the left-hand shoulder as the driver is backing a trailer into the water. The possibility of better visibility should translate into safer maneuvers.

After cars with boat trailers check-in at the entry control station of each campground property, the vehicles will travel through very few, if any, overnight camping areas. The parking areas for cars with boat trailers are convenient to the site entrance. Overnight camping areas should not be near the boat trailer parking areas, however, if the site constraints prevented their separation, efforts by the concessionaires need to be made to visually screen them from each other, and noise reducing materials should be offered to enhance buffering between the two land uses.

4.4.1 Steele Canyon

Historically, this publicly accessible ramp is the most heavily used. Ultimately, the ramp is Authorized for ten ramp lanes. Initially, six ramp lanes are Required as shown in the 60% Design drawings. Upon reconstruction of the ramp, there will be a new formally designated nearby car with boat trailer parking area and public restroom, and use of the ramp will likely increase.

4.4.2 Putah Canyon

One four lane boat launch ramp is Required, and one two lane launch ramp is Authorized for this site. On the west side of Knoxville Road, there is a small two lane ramp, generally not intended for regular public use since there are no nearby parking spaces for cars with boat trailers. Its primary use is intended to be limited to maintenance, safety and convenience access to be performed by concessionaire, marina boat rental, and dry boat storage operations personnel. The ramp is convenient to marina boat slips and is Authorized. On the east side of Knoxville Road, there is a larger, publicly accessible Required ramp and upon reconstruction, there will be a new formally designated nearby car with boat trailer parking area and public restroom. The ramp is Required to provide four launch lanes, and the addition of two supplemental lanes contiguous with the four lanes is Authorized.

4.4.3 Spanish Flat

One two lane boat launch ramp is Required, and one two lane launch ramp is Authorized for this site. The northern ramp is generally not intended for regular public use since there are no nearby parking spaces for cars with boat trailers. Its primary use is intended to be limited to maintenance, safety and convenience access to be performed by concessionaire and marina boat rental and operations personnel. The ramp is convenient to marina boat slips and is Authorized. The Required ramp location is intended for public use with a nearby formally designated car with boat trailer parking area and public vault toilet.

4.4.4 Monticello Shores

This site is Authorized for a new four lane publicly accessible boat ramp with three courtesy docks and a new formally designated nearby car with boat trailer parking area. Services that are also Authorized near the ramp include: a standard marina type facility with boat slips and docks, fish cleaning station, vault toilet, and a small boat rental service that will provide hourly to daily public rentals for a limited number of kayaks, paddleboards, and jet skis that will be stored in a nearby secure storage building overnight and when not in use.

4.4.5 Berryessa Point

This site is Authorized for one small publicly accessible ramp with a single lane and courtesy dock. Public use would be limited to hand carry and/or car-top type boats since there are no nearby parking spaces for cars with boat trailers. Marina or boat slip facilities are also Authorized.

4.5 Vehicle Surface Material Quantities

Vehicle surfaces implemented throughout the project area include paved and gravel access drives and paved and gravel parking areas as described in Section 4.2 above. Approximate quantities of the new vehicle surface materials for each site are provided in Table 4-1 below. Boat launch ramp material quantities are detailed in Table 4-2 below.

Table 4-1. Vehicle Surface Material Quantities

Site	Paved Quantity (ft^2)	Gravel Quantity (ft^2)	Total (ft^2)
Steele Canyon	195,800	348,000	543,800
Putah Canyon	101,300	439,800	541,100
Spanish Flats	76,500	162,900	239,300
Monticello Shores	13,400	71,500	84,900
Berryessa Point	22,200	53,500	75,600
Total	**409,100**	**1,075,700**	**1,484,800**

Table 4-2. Boat Launch Ramp Material Quantities (for Required facilities)

Recreation Area	Boat Launch Lanes	Boarding Float Lanes	Concrete Ramp Length	Concrete Ramp Surface Area, SF	Concrete, CY	Aggregate Base, CY	Rip Rap, CY
Putah Canyon Ramp 2	4 x 15’	3 x 8’	224	19,040	440	303	279
Spanish Flat Ramp 2	2 x 15’	1 x 8”	250	10,749	251	162.4	498
Steele Canyon	6 x 15’	4 x 8’	200	26,000	574	393	249

4.6 Grading Cut & Fill Quantities

While the overall intent of site design is to locate facilities such as site entrances, access drives, camping sites, boat launches and infrastructure areas in the same location as they were formerly, it is necessary that earthwork and grading operations be performed so that the new site improvements will accommodate more modern camping venues, in addition to conforming to contemporary land development regulations. RV’s, recreational use of electronic devices, water related recreational activities, and consumer perceptions and expectations for daily conveniences, overnight accommodations, and inclusion of those with disabilities, have all changed significantly over the years, and publicly accessible landscapes need to adapt to these changes.

To accommodate the changes, parking spaces, particularly for RVs, need to be standardized per Reclamation guidelines, and in most cases need to be made larger and flatter. Access to electric power needs to be readily available and accessible. Trailered personal water craft such as jet skis, small sailing craft, paddleboards, and kayaks have become much more common, and recent updated exterior ADA regulations specifically for outdoor recreation areas tend to require more open, flatter areas to satisfy accessibility needs. Each of these changes typically ask for, if not require or demand, a landscape with land that is more open and level, or flat. Therefore, the need is high for new site design, earthwork and grading to accommodate these needs.

Although the sites are located within Napa County, the design standards found in NCRSS cannot be fully implemented due to the unique regional topographic character of the landscape. The area's uncommon landscape of high, steep hills and deep valleys are the primary reason this area is an attraction, and the on-site access drives should not be designed like roads and streets found in a typical year-round suburban housing or commercial development. Therefore, some design standards in NCRSS such as criteria for vertical and horizontal curves, maximum slope gradient, pavement width and cross section, curb, gutter and sidewalk applications, traffic control devices, super elevation requirements, and turnaround standards are recommended to be adjusted. The adjustments are needed to accommodate physical site limitations such as grade differentials, and to preserve unique features of the natural environment such as the natural water courses, steep slopes, geologic features, unique vegetation, etc., in addition to a desire for utilizing former design features and continuing localized design protocol.

According to Section 3 on page 6 of NCRSS (revised 8/9/11), any 'Exceptions to Standards' need to be documented in a written request to the Director of Public Works, stating the section(s) for which an exception is requested, material facts supporting the contention of the applicant, the details of the exception or mitigating measure proposed, a map showing the proposed location and siting of the exception or mitigation measures, and shall be accompanied by a fee established by resolution of the Board of Supervisors. According to NCRSS, granting exceptions to the standards is possible when properly submitted, reviewed, and approved by the approving body. The exceptions should be allowed if they are deemed to comply with the overall goal of protecting and preserving the unique features of the natural environment, while also complying with SRA Fire Safe Regulations (14 CCR 1270-1274).

To accommodate the proposed facilities, approximate quantities of earthwork cut and fill have been determined by assigning finished grades and contours to the proposed improvements using the original topographic survey base map as provided by Reclamation. For the purposes of this design, AutoCAD Civil 3D software, version 2013 has been used, and grading design information related to earthwork and proposed contours has been input in such a manner that changes

can be made when attempts are made to optimize numeric quantities. Site grading design data, including vertical and horizontal curve criteria, longitudinal and side slope information, access drive and roadway stationing, and cross sectional dimensions, to name a few items, can be input and adjusted to suit project wide, and/or localized, conditions. It is important to note that the quantities are approximate, and subject to change, as the site design is further refined.

To summarize preliminary findings, overall quantities at each property show a need to remove excess cut to off-site locations to accommodate the proposed facilities. This is expected due to the existing steep slopes, and demand for flatter land at campground sites, accessible permanent cabin sites, larger and flatter vehicle parking and vehicle circulation areas, enhanced site entry improvements, and other facilities associated with the new marinas. At this time, the net cut and fill quantities are as follows:

- Steele Canyon = 31,500 cy cut
- Putah Canyon = 53,500 cy cut
- Spanish Flat = 2,500 cy fill
- Monticello Shores = 2,000 cy cut
- Berryessa Point = 200 cy fill

With additional levels of examination, it should be emphasized that the grading plans are a work-in-progress, and will likely be refined. Efforts can be made to improve (reduce) the cut numbers, however, it is important to note that these numbers only reflect surficial contours, and do not account for the net import of material that will occur for new pavement AB and AC placement, as well as buried utility trench zone bedding material imports. Design for stormwater basins, likely requiring net cut, are also not included, as the design of stormwater conveyance and handling is the responsibility of the concessionaire. Therefore, it is advantageous to continuously work toward reducing cuts on a per site basis as site design moves forward. Reclamation may be able to identify areas within the individual recreation areas that can accommodate the import and stockpiling of net cut material, however at the time of this report's preparation, such sites have not been identified.

4.7 Stormwater Detention

The proposed infrastructure at the project sites will likely result in increased volumes of stormwater runoff during precipitation events. The increase is anticipated because the current topographic survey does not reflect, or show, previously impervious areas that were likely there for many years, perhaps decades, under previous land management practices. At the very least, the prior history of intensive campground use undoubtedly created areas that were significantly compacted, and have since become vegetated due to lack of use.

To manage the new stormwater runoff, the project site design proposes implementing stormwater detention basins. The locations of the detention basins, as shown in the site plans, were strategically chosen based on factors such as topography, proximity to runoff sources (i.e. impervious surfaces), available space, and aesthetics. The method used for sizing the detention basins is described below. Note that the 60 percent design discussed herein does not incorporate other necessary stormwater infrastructure such as curb and gutter, catch basins, piping, swales, and outfalls.

The stormwater detention basins were sized in accordance with the State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) Waste Discharge Requirements (WDRs) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s), Water Quality Order No. 2013-0001-DWQ, General Permit No. CAS000004 (General Permit). The General Permit Section E.12.e.ii.c provides numeric sizing criteria for stormwater retention and treatment systems. The volumetric criteria, which are most appropriate for detention basins, specify two different methods: the Urban Runoff Quality Management (URQM) method and the California Stormwater Quality Association (CASQA) method. The URQM method specifies capture of the 85th percentile 24-hour storm runoff event while the CASQA method specifies at least 80 percent capture of annual runoff volumes.

The two volumetric sizing methods were reviewed in association with local precipitation data obtained from the National Oceanic and Atmospheric Association (NOAA) National Climatic Data Center. Both the URQM and CASQA methods utilize data from 10 precipitation stations located throughout California, and it is important to choose a station that has precipitation patterns that are most similar to the project location. Based on available precipitation data from NOAA, the average annual precipitation at Lake Berryessa was determined to be approximately 28 inches. This value correlates most closely with precipitation data from the Truckee Ranger Station (Station ID 9043) in Nevada County which has an average precipitation of approximately 24 inches. The Truckee Ranger Station and Lake Berryessa are also similarly located on the east side of mountain ranges where shadowing and other climatic conditions tend to occur. Therefore, the Truckee Ranger Station was chosen for stormwater detention basin sizing despite the closer geographic proximity of other precipitation stations.

The URQM and CASQA methods both result in a design storm depth to be used for detention basin sizing. The CASQA method was ultimately chosen for use because it resulted in a design storm of 0.81 inches which was slightly more conservative than the 0.79 inch design storm from the URQM method. Figure 4-1 provides the stormwater capture curves that were used for determining the design storm values using the CASQA method as provided in the Stormwater Best Management Practice Handbook, New Development and Redevelopment, January 2003 (CASQA, 2003).

For this analysis, it was assumed that only runoff from impervious surfaces would enter the detention basins, and a global runoff coefficient of 0.9 was used. Each basin was sized for 48-hour drawdown rates and 80 percent capture of the annual runoff volume which is the minimum requirement of the General Permit.

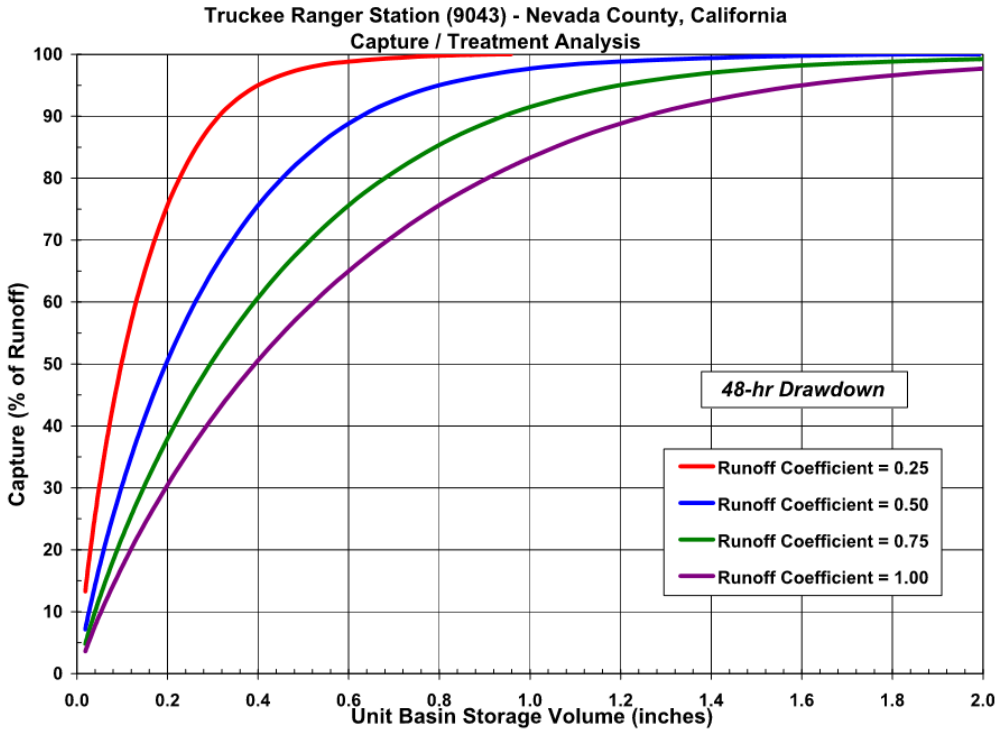

Figure 4-1. CASQA Volumetric BMP Capture Curves for the Truckee Ranger Station (CASQA, 2003).

The required volume of each stormwater detention basin was then calculated by multiplying the design storm (0.81 inches) by the area of impervious surfaces tributary to each basin. The resulting basin volumes are presented in Table 4-3 for all five project sites. The 60 percent design includes 15 stormwater detention basins for Steele Canyon, 13 detention basins for Putah Canyon, 7 detention basins for Spanish Flat, and 2 detention basins for Berryessa point. No detention basins are currently planned for Monticello Shores. The size of each detention basin varies greatly with a minimum value of 350 cubic feet, a maximum value of 9,250 cubic feet, a mean value of 2,943 cubic feet, and a median value of 2,000 cubic feet. As discussed previously in Section 3.2, the required number and size of stormwater detention basins could be reduced by implementing site control measures and LID based management techniques to reduce stormwater runoff volumes. It is important to note that these calculations and proposed

basins are for planning purposes only. The concessionaire of a given site is ultimately responsible for the site's stormwater design.

Table 4-3. Stormwater Detention Basin Sizing

Site	Retention Basin ID	Tributary Area (ac)	Required Basin Volume (ft^3)
Steele Canyon	SC-1	0.18	550
	SC-2	0.44	1,300
	SC-3	0.61	1,800
	SC-4	0.55	1,625
	SC-5	2.33	6,850
	SC-6	3.13	9,200
	SC-7	0.35	1,025
	SC-8	1.38	4,075
	SC-9	3.14	9,250
	SC-10	0.37	1,100
	SC-11	0.48	1,425
	SC-12	1.35	4,000
	SC-13	1.12	3,300
	SC-14	1.32	3,900
	SC-15	0.30	875
Putah Canyon	PC-1	0.52	1,525
	PC-2	1.09	3,225
	PC-3	0.59	1,750
	PC-4	2.29	6,750
	PC-5	0.98	2,900
	PC-6	0.42	1,225
	PC-7	1.74	5,150
	PC-8	0.26	775
	PC-9	1.18	3,450
	PC-10	0.49	1,450
	PC-11	0.86	2,525
	PC-12	1.44	4,225
	PC-13	0.11	350
Spanish Flat	SF-1	1.11	3,275
	SF-2	1.06	3,125
	SF-3	1.60	4,725
	SF-4	0.59	1,725
	SF-5	0.67	1,975
	SF-6	0.51	1,500
	SF-7	0.44	1,300
Berryessa Point	BP-1	1.26	3,700
	BP-2	0.67	2,000

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Chapter 5
Architecture

Architectural and structure design for the habitable above-ground improvements described in Chapter 2 are outside the scope of this Site and Infrastructure Design Task. Where shown on the drawings, improvements such as comfort stations, fish cleaning stations, entrance stations, and other building improvements are as detailed in the Recreation Facility Design Guidelines (April 2013). Final design and construction documentation shall meet the building code requirements and will be the responsibility of the concessionaire.

Above grade enclosures to support the infrastructure improvements, such as those for the water and wastewater treatment facilities are within the scope of this Design Task and are detailed in the drawings in Appendix A.

5.1 Design Assumptions

New buildings for uses such as marinas, restaurants, retail, multi-use function buildings, offices and other permanent concessionaire's operations will be designed to have an overall aesthetic appearance that fits in with the naturally appearing environment of the Lake Berryessa region. In all cases, the surrounding existing landscape should be the dominant visual element, and the new buildings should appear to blend-in as low-profile, unobtrusive, or sensitively designed elements in the landscape, taking advantage of scenic views, and reflecting the natural colors, textures and contours of the surrounding area. All new buildings should be an appropriate scale and form to function efficiently and satisfy needs, while at the same time, be deemed compatible with Reclamation's contemporary vernacular architecture as found on other Reclamation properties in the region. Custom designed structures require approval of Reclamation as building forms, materials and styles are limited.

Pre-manufactured enclosures required for water and wastewater treatment facilities will be pre-engineered and made of durable, low maintenance construction materials. On-grade construction floors will be concrete slab-on-grade with non-slip broom, stamp or float finish, or other non-slip finishes as approved. While the units require a relatively flat site, the delivery, mobilization and set-up require minimum site disturbance. Pre-engineered structures require approval of Reclamation as building forms, materials and styles are limited.

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Chapter 6
Geology and Geotechnical

Sections below summarize the data and conclusions contained within the Draft Geotechnical Report located in Appendix C.

6.1 Geologic Overview

Lake Berryessa fills a large North-Northwest – South-Southeast trending valley surrounded by mountains made of the sedimentary rocks of the Great Valley Sequence, which were deposited during the late Mesozoic Era (150 – 65 Ma). These rocks are mudstone/shale with interbedding of sandstone and locally conglomerate. At Lake Berryessa, the sequence is steeply folded, the strike direction generally trending North-Northwest – South-Southeast. Blocks of ultramafic rocks such as serpentine are included along North-Northwest – South-Southeast trending tectonic contacts.

The North-Northwest – South-Southeast trending eastern trace of the Berryessa Fault extends parallel to the central part of the western shoreline of Lake Berryessa. This fault trace is considered active during the Holocene, i.e. showing evidence consistent with movement during the past 10,000 years. The Berryessa Fault is considered a northern section of the Green Valley Fault, which constitutes a nearly continuous fault system about 70 miles long. The Green Valley Fault is a right-lateral, strike-slip fault, meaning the slip movement being mainly horizontal with the side of the fault opposite to the observer moving to the right.

Recent mapping of the Berryessa Fault (Lienkaemper, 2012) indicates the eastern fault trace extending along the western border of the Putah Canyon recreation area and within a mile of the Monticello Shores and Berryessa Point recreation areas.

6.2 Summary of Exploration Program

In October 2014, following site reconnaissance and staking out the exploration locations at all five recreation areas, a geotechnical investigation program consisting of drilling exploratory borings to depths up to 40 ft. and excavating test pits was performed. A field representative coordinated access and fire hazard mitigation measures with the USBR park ranger staff, logged the subsoil conditions per Unified Soil Classification System (USCS) and performed the percolation testing per EPA (1980).

The geotechnical investigation program included 40 borings and 25 test pits. At Putah Canyon, Monticello Shores, and Spanish Flat, 24 percolation tests were conducted using either test pits or borings. Soil samples collected during the field investigation were shipped to a geotechnical laboratory for geotechnical index testing. The laboratory testing program included moisture content (ASTM D2216), grain size distribution (ASTM D422) and Atterberg Limits (ASTM D2487).

6.3 Data

The subsurface materials at the five recreation sites were found to consist of sedimentary rocks, which at and near the ground surface are often highly weathered with parts of the rock material disintegrating or decomposed to soil. The thickness of the weathering zone varies from zero, where outcrops of fresh or slightly weathered (discolored) rocks exist at the ground surface, to several feet. The transition from completely decomposed rock (residual soil) to highly weathered to lightly weathered to fresh rock is usually gradual.

The sedimentary rocks and their weathering zones are locally overlain by Holocene deposits as well as by fill materials. The Holocene deposits include recent lake deposits at the shores of Lake Berryessa as well as alluvial deposits in some of the creeks and dry valleys and colluvium at some slopes. These deposits are generally not more than a few feet thick. Fill materials, however, were encountered at some locations with thicknesses exceeding 10 ft.

Groundwater was not encountered during the geotechnical investigations.

Percolation testing indicated generally low percolation rates of the tested soils.

The Geotechnical Report included as Appendix C summarizes and presents all of the data collected in the course of the geotechnical investigation as boring logs and test pit logs, percolation test data sheets, and laboratory test reports.

6.4 Conclusions and Recommendations

The subsoil conditions encountered generally provide sufficient bearing capacity for shallow foundations of the planned site improvements.

Excavations for some of the planned structures such as the wastewater treatment and storage ponds will encounter rock at various degrees of weathering. In addition to general excavation, some amount of rock excavation should be anticipated, which will require additional means such as blasting or the use of ripping equipment and breaking up with power-operated tools.

For planning the dispersal fields for treated wastewater, the results of percolation testing indicating generally low rates and in several instances no measurable rates of percolation need to be taken into consideration.

The Geotechnical Report included as Appendix C provides geotechnical design parameters for each geotechnical unit. Design recommendations include site preparation and earthworks, seismic design parameters, foundation engineering (spread footings, mat foundations), underground utilities and trench backfill, pavement design and boat launch ramp design. Construction recommendations include earthworks, slopes, paving and surfacing, and construction monitoring.

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Chapter 7
Structural

The structural design criteria and assumptions contained herein are limited in applicability to the infrastructure components, namely, foundations supporting water, wastewater, or electrical facilities. The applicable codes are:

- International Conference of Building Officials – International Building Code (IBC), 2012 Edition
- American Society of Civil Engineers (ASCE) – ASCE 7-10, Minimum Design Loads for Buildings and Other Structures
- American Concrete Institute (ACI) – ACI 318-11, Building Code Requirements and Commentary for Reinforced Concrete
- American Concrete Institute (ACI) – ACI 530-11, Building Code Requirements and Specification for Masonry Structures
- American Institute of Steel Construction (AISC) – Steel Construction Manual, Fourteenth Edition

Other codes or standards that may be used for design purposes include NFPA, NEC, NEMA, ASME, ANSI, AWWA, etc. Other local codes or zoning requirements shall be followed as required.

7.1 Design Criteria and Assumptions

7.1.1 Materials

- Concrete: f'_c = 4,000 psi for structural concrete; Reinforcing steel: ASTM A706 or ASTM A615, f_y = 60,000 psi
- Masonry: f'_m = 1,500 psi for masonry; Reinforcing steel: ASTM A706 or ASTM A615, f_y = 60,000 psi
- Structural Steel: ASTM A992, F_y = 50 ksi for wide flange shapes; ASTM A36, F_y = 36 ksi for other structural shapes, plates, and bars; Welding electrode: E70XX

7.1.2 Loads

- Live loading: Uniform and concentrated live loads for structures shall be determined in accordance with the more stringent of International Building Code 2012 Edition Table 1607.1 and ASCE 7-10 Table 4-1. H20-44 loading shall be assumed for the design of below grade structures subject to traffic. Traffic loading for access roads, parking areas, and boat launch ramps shall be as identified in the document entitled *Final 60% Design Geotechnical Engineering Report – Concession Infrastructure Design, Lake Berryessa, California by CDM Smith dated June 5, 2015* (geotechnical report).

- Flood loading: Structures and facilities below elevation 455' MSL shall be designed for flood loads assuming a flood elevation of 455' MSL. The design to resist uplift shall be in accordance with the International Building Code 2012 Edition and ASCE 7-10, and shall assume the sites are in non-coastal A-Zones.

- Wind loading: Wind loads shall be determined in accordance with the International Building Code 2012 Edition and ASCE 7-10 assuming a basic wind speed of 100 mph, Exposure D, and Risk Category I.

- Seismic loading: Seismic loads shall be determined in accordance with the site specific seismic design criteria presented in the geotechnical report. An Importance Factor of 1.0 consistent with Risk Category I shall be assumed for design.

- Load combinations: Design of structures, components, and anchorage (for structures and components) shall be performed using the load combinations in International Building Code 2012 Edition Sections 1605.2 (strength design) or 1605.3 (allowable strength design). For load combinations that include flood loads, ASCE 7-10 Section 2.3.3 (strength design) or 2.4.2 (allowable strength design) shall be used.

7.1.3 Foundations and Below-Grade Wall Design

Site-specific geotechnical design recommendations for foundations and below-grade walls have been provided in the geotechnical report. Reference the geotechnical report for foundation preparation recommendations and design parameters.

Below grade walls shall be designed for the following drained lateral earth pressures:

- At-rest (restrained) – 59 pcf
- Active (unrestrained) – 39 pcf (horizontal ground surface)
- Active (unrestrained) – 50 pcf (3H:1V sloped ground surface)

- Surcharge – 0.4 times applied surcharge
- Additional 40 pcf for restrained and unrestrained walls subjected to flood loads

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Chapter 8
Mechanical

Mechanical elements include those for plumbing, heating, ventilating, and air conditioning (HVAC), as well as specific above- and below-grade piping elements.

Plumbing and HVAC design considerations for habitable and occupied structures, such as park models, comfort stations, restaurants, marinas, and cabins, are outside the scope of this Design Task. Final design and construction documentation shall meet the applicable building code requirements and will be the responsibility of the concessionaire.

8.1 Design Criteria and Assumptions

Design criteria for above- and below-grade piping elements specific to the water and wastewater infrastructure are detailed in Chapters 10 and 11, respectively.

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Chapter 9
Electrical & Lighting

This chapter describes conceptual electrical services and infrastructure at each of the recreation areas.

9.1 Design Criteria and Assumptions

Electrical Service at all five sites is provided by Pacific Gas & Electric (PG&E). PG&E has 15kV-class (approximately 12kV operating voltage), 3-phase, overhead distribution in the area. While the PG&E main line, which generally follows the Knoxville Road and Steele Canyon Road, is three phase, the existing distribution on each site varies. Some of the PG&E 'spurs' that come off the road onto the sites are three phase and some are single phase. Generally, existing overhead lines will be reused to the extent practical. The intent is to use existing overhead lines as 'trunk' lines to bring power into the sites, but have PG&E bury cable for new on-site distribution. There are already a large number of existing overhead cables that crisscross the site, which makes for an unattractive and unorganized distribution network. Installing new buried lines will provide for a cleaner, more aesthetically pleasing site. PG&E will provide new services consisting of lines, transformers, and meters as indicated herein at Owners' expense. Each site will have multiple services. Service voltage will be determined by the facility type as outlined in Table 9-2.

Table 9-1. Recreational Vehicle Demand Factors

Number of Recreational Vehicle Sites	Demand factor (%)
1	100
2	90
3	80
4	75
5	65
6	60
7-9	55

Each service will provide power to a fused disconnect switch connected to a main lug-only distribution panelboard, which will power tent sites, RV areas, and other facilities. Electrical service wire from the transformer to the panel will be copper routed in PVC conduit. Conduit provides protection and enables the wire to be replaced if needed. Using copper wire helps reduce voltage drop from the transformer to the panel and enables smaller wire sizes than aluminum wire.

Direct buried aluminum wire provides power from panels to RV-style electrical power pedestals. Aluminum is less conductive than copper so cables must be larger to carry the same amount of power. However, aluminum conductors are substantially more economical than copper so even with an increased cable size using aluminum for the RV pedestals will cost less. Each of the RV pedestals will be on a loop fed circuit - originating at a distribution panel and 'daisy chained' from one RV pedestal to the next pedestal and so on. Wiring will be routed in common trenches as much as possible. The wire will be sized so the voltage drop is less than 3 percent from the panel to the pedestal, as required by the National Electric Code (NEC).

In most cases, copper wiring in conduit will be provided and used to power facilities and equipment other than electrical power pedestals on the sites. The wire will be sized so the voltage drop is less than 3 percent from the panel to the electrical equipment.

The following are electrical design assumptions made with respect to all sites.

- PG&E Electrical Service Assumptions:
  - Per communication with PG&E there is sufficient power available at the locations of all sites, so there won't be cost associated with upgrading any PG&E services off the sites themselves.
  - Per communication with PG&E all voltages that are used in design are available from the utility.
  - Available fault current from PG&E is not excessively high.
  - Fault current levels at each service disconnect (low voltage side of PG&E transformer) will be less than 22,000 amps.
  - Per communication with PG&E the largest pole mount transformer will be 75 KVA, single phase and 150 KVA three phase.
  - Per communication with PG&E, both pole mount and pad mount transformers are available.
  - Per communication PG&E will provide both overhead and underground primary service as requested by the customer.
  - Secondary metering will be used on the low voltage side of each transformer. This means there will be multiple meters that PG&E has to read at each site.
  - Steele Canyon is the only site that will have primary metering. Existing primary meter at Steele Canyon will be used for this.

  - Some of the sites have dilapidated power poles, transformers, and overhead lines. In some locations lines are hanging low or have been cut. Not all overhead electric lines are captured in site survey. It is likely that a significant number of poles, transformers, and lines that are on the sites will have to be removed. The removal of these existing utility-owned assets is not considered in this design. Bureau of Reclamation may incur a cost from PG&E for the removal of these assets.

  - Overhead telephone lines, believed to be owned by AT&T were identified on some sites. The status of these lines is unknown. The removal and/or relocation of these lines is not considered in this design package.

  - Transformers and power feed systems can be located in most locations on the site.

  - Electrical power can be accessed from any part of the utility line.

- RV sites, Park Model sites, and Standard sites with utilities assumptions:

  - All of these types of sites will be equipped with recreational vehicle-style electrical power pedestals.

  - These sites are designed according to NEC Article 551.

  - RV sites and Park Model sites will be equipped with electrical power pedestals containing 50A/30A/20A circuits with a minimum load of 9600VA (NEC Article 551.73) per site before demand factors are applied.

  - Standard sites will be equipped with electrical power pedestals containing 30A/20A circuits with a minimum load of 3600VA (NEC Article 551.73) per site before demand factors are applied.

  - Sites will be loop-fed allowing for multiple RV pedestals to be wired in a daisy chain fashion.

    - Pedestals will be essentially the same type of equipment for 50/30/20 amp and 30/20 amp sites. There will be one NEMA-style receptacle for each amperage circuit. The pedestal manufacturer will install the required receptacles with associated circuit breakers for the two pedestal arrangements.

  - Daisy chaining multiple sites permits application of an overall circuit load demand factor which allows the use of a reduced VA load per site. This reflects load diversity and non-concurrent electrical demand among the sites connected to a single circuit. The demand factors provided in NEC Table 551.73(A) are listed below for reference.

  - The demand factor allows the use of derated electrical loads on a per site basis for calculation of necessary feeder conductor sizes. Application of the demand factor allows the use of smaller wire, while still maintaining the required 3% voltage drop range. High summer ambient temperatures and use of air conditioners in RVs may cause the actual load at each site to be higher than calculated using the NEC demand factor. This would cause a larger voltage drop from the panel to the site during peak hours or times of the year. The ampacity of the wire was sized so the sites equipped with electrical power pedestals can draw at least 20 amps per site during peak times without exceeding cable or circuit breaker ratings. It is estimated the largest voltage drop during peak times is around 7%.

- Site Lighting will be provided to all parking lots on all sites. LED site lighting is recommended as it has much longer life and lower energy use than high intensity discharge sources such as sodium-vapor lights.

  - Putah Canyon: estimated 45 lights
    - 20: 15 foot pole @ 140 Watts, 12,000 Lumens
    - 25: 25 foot double light pole @ 210 Watts each, 17,000 Lumens

  - Monticello Shores: estimated 50 lights
    - 40: 15 foot pole @ 140 Watts, 12,000 Lumens
    - 10: 25 foot double light pole @ 210 Watts each, 17,000 Lumens

  - Berryessa point: estimated 20 lights
    - 20: 15 foot pole @ 140 Watts, 12,000 Lumens

  - Spanish Flat: estimated 35 lights
    - 25: 15 foot pole @ 140 Watts, 12,000 Lumens
    - 10: 25 foot double light pole @ 210 Watts each, 17,000 Lumens

  - Steele Canyon: estimated 60 lights
    - 40: 15 foot pole @ 140 Watts, 12,000 Lumens
    - 20: 25 foot double light pole @ 210 Watts each, 17,000 Lumens

The table below shows the estimated voltage, phase and amperage for all equipment to be powered on the five sites. The amperage is on a per site or per object basis.

Table 9-2. Estimated Equipment Power Demands

Powered Equipment	Voltage	Phase	Amps / Load
Marina with Boat Rental (Steele)	120/208V	3	400 Amp
Restaurant (Steele)	120/208V	3	400 Amp
Marina with Small Restaurant (Putah)	120/208V	3	400 Amp
Wastewater Treatment Equipment (Monticello)	120/208V	3	400 Amp
Boat Repair Building (Putah)	120/208V	3	200 Amp
Marina (Spanish)	120/208V	3	200 Amp
Enclosed 4-story Dry Boat Storage (Steele)	120/208V	3	120 Amp
Concessionaire Office with Bathrooms (Putah)	120/208V	3	120 Amp
Groundwater well pump	277/480V	3	200 Amp
Booster Pump	277/480V	3	200 Amp
Comfort Station (with Family Station)	120/240V	1	120 Amp
Comfort Station (with Laundry Room and Family Station)	120/240V	1	120 Amp
Comfort Station (without Laundry Room and Family Station)	120/240V	1	60 Amp
Accessible Entry Station sub-panel	120/240V	1	60 Amp
Boat Rental Service in Park Model Building (Monticello)	120/240V	1	60 Amp
Concessionaire Park Model (Spanish)	120/240V	1	60 Amp
Fuel and Fuel Storage (Putah, Spanish, Monticello)	120/240V	1	60 Amp
Fish Cleaning	120/240V	1	60 Amp
Employee Housing Park Models	120/240V	1	60 Amp
Cabins	120/240V	1	60 Amp
Park Models	120/240V	1	50 Amp, 9600VA
Standard Sites	120/240V	1	30/20 Amp, 3600VA
RV Sites	120/240V	1	50/30/20 Amp, 9600VA
Camp Host Standard Site	120/240V	1	50/30/20 Amp, 9600VA

9.2 Putah Canyon Recreation Area

Proposed electrical infrastructure at Putah Canyon includes seven transformers and meters to serve the full build-out scenario of Required and Authorized facilities. Two of the transformers will feed power to the park models, RV sites, and standard sites. The two accessible entry stations and the two comfort stations within proximity of the RV sites will also be powered by these transformers. One transformer will feed power to the marina complex, including retail and restaurant uses and the fuel storage and dispensing equipment. One transformer will feed power to the boat repair building and the Concessionaire office building with restrooms. One transformer feeds power to a comfort station and the fishing cleaning station along with parking lot lights. An additional transformer will be provided for groundwater pumps and a comfort station. The final transformer will feed the marina and fuel storage facility. Transformers will also power surrounding lights and septic pumps.

Following is a list of the transformers, panels, and equipment proposed at Putah Canyon. The transformer sizes are estimated based on the equipment being powered, and the transformer mounting methods indicated are probable based on typical PG&E installations. The actual installed transformer sizes and mounting methods will be determined by PG&E.

Transformer 1: 150KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 600 amp panel PC-PNL-1. Panel PC-PNL-1 provides power to the following equipment:

- 5 Standard sites: 30/20 amp
- 6 Park Models: 50 amp
- 2 Comfort stations: 120 amp
  - Provides power to lights, receptacles, electric heater and water control panel.

Transformer 2: 150KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding an 800 amp panel PC-PNL-2. Panel PC-PNL-2 provides power to the following equipment:

- 18 RV sites: 50/30/20 amp
- 2 Accessible Entry stations: 60 amp

Transformer 2A: 50KVA (est.), 120/240V, 1Φ, transformer feeding a 200 amp panel PC-PNL-2A. Panel PC-PNL-2A provides power to the following equipment:

- 5 Parking Lot Lights: 1 amp
- Fish Cleaning Station: 60 amp
- Comfort Station: 60 amp

Transformer 3: 150KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 400 amp panel PC-PNL-3. Panel PC-PNL-3 provides power to the following equipment:

- Boat Repair Building Subpanel: 200 amp
- Concessionaire Office Building: 120 amp
- Booster Pump: 40 amp
- Pump station: 40 amp

Transformer 4: 15KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding a 100 amp panel PC-PNL-4. Panel PC-PNL-4 provides power to the following equipment:

- Comfort Station Subpanel: 60 amp
  - Provides power to lights, receptacles, electric heater and water control panel.
- 5 Parking Lot Lights: 1 amp

Transformer 5: 250KVA (est.), 480/277V, 3Φ, pad mounted transformer feeding a 400 amp panel PC-PNL-5. Panel PC-PNL-5 provides power to the following equipment:

- Groundwater pump: 200 amp
- Pump station: 120 amp
- Comfort station: 60 amp

Transformer Marina: 225KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 400 amp panel PC-PNL-MARINA. Panel PC-PNL-MARINA provides power to the following equipment:

- Floating Marina Complex: 200 amp
  - Complex includes small retail counter and restaurant.
- Fuel dispensing and storage: 60 amp

The initial development of Required facilities only at Putah Canyon is defined in Table 2-2. Electrical service to the Required only facilities is shown in the 60% Design documents. All panels and transformers listed above are needed for Required facilities.

Transformer size shown in design documents are estimated. PG&E will determine the size of the transformer placed into service. Panels initially installed should be sized to align with the size of the transformer and the facilities put into service. Although transformer and panel sizes change, conductors are sized for final build out of both Required and Authorized facilities.

9.3 Monticello Shores Recreation Area

Proposed electrical service at Monticello Shores includes eleven transformers and meters to serve the full build-out scenario of Required and Authorized facilities. Five of the transformers will feed power to RV sites, standard sites, park models, cabins and one comfort station. Three transformers feed power to the accessible entry station, comfort stations, a fishing cleaning station, boat service park model, fuel dispensing & storage, and other loads within proximity of the subpanels. Two transformers will be dedicated to groundwater and booster pumps. An additional transformer will be provided for sewer treatment facilities. Transformers will also power surrounding lights and septic pumps.

Following is a list of the transformers, panels, and equipment proposed at Monticello Shores. The transformer sizes are estimated based on the equipment being powered, and the transformer mounting methods indicated are probable based on typical PG&E installations. The actual installed transformer sizes and mounting methods will be determined by PG&E.

Transformer 1: 250KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 1200 amp panel MS-PNL-1. Panel MS-PNL-1 provides power to the following equipment:

- 10 Park Models: 50 amp
- 9 Cabins: 60 amp

Transformer 2: 167KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding an 800 amp panel MS-PNL-2. Panel MS-PNL-2 provides power to the following equipment:

- 18 Park Models: 50 amp
- 4 Standard sites: 30/20 amp
- Comfort station: 120 amp

Transformer 3: 37.5KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 225 amp panel MS-PNL-3. Panel MS-PNL-3 provides power to the following equipment:

- 4 Standard Sites: 30/20 Amp
- Comfort station: 120 amp

Transformer 4: 250KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 600 amp panel MS-PNL-4. Panel MS-PNL-4 provides power to the following equipment:

- Waste Water Treatment Facility: 400 amp
- Pump Station: 120 amp

Transformer 5: 37.5KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding a 225 amp panel MS-PNL-5. The transformer size is estimated based on the equipment being powered. The installed size and mounting of the transformer will be determined by PG&E. Panel MS-PNL-5 provides power to the following equipment:

- Comfort Station: 120 amp

Transformer 6: 225KVA (est.), 480/277V, 3Φ, pad mounted transformer feeding a 250 amp panel MS-PNL-6. Panel MS-PNL-6 provides power to the following equipment:

- Ground water pump: 200 amp
- Security Lighting: 20 amp. Includes 480/240-120V transformer.

Transformer 7: 50KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 225 amp panel MS-PNL-7. Panel MS-PNL-7 provides power to the following equipment:

- 4 RV sites: 50 amp

Transformer 8: 167KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 600 amp panel MS-PNL-8. Panel MS-PNL-8 provides power to the following equipment:

- 17 RV sites: 50/30/20 amp

Transformer 9: 25KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding a 100 amp panel MS-PNL-9. Panel MS-PNL-9 provides power to the following equipment:

- Accessible Entry: 60 amp

Transformer 10: 50KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding a 225 amp panel MS-PNL-10. Panel MS-PNL-10 provides power to the following equipment:

- Fish Cleaning: 60 amp
- Boat rental service in park model: 60 Amp
- Fuel Dispensing(South end of park): 60 amp

Transformer 11: 225KVA (est.), 277/480V, 3Φ, pad mounted transformer feeding a 250 amp panel MS-PNL-11. Panel MS-PNL-11 provides power to the following equipment:

- Booster Pump: 120 amp

- Pump Station: 120

The initial development of Required facilities only at Monticello Shores is defined in Table 2-3. Electrical service to the Required only facilities is shown in the 60% Design documents. Only three transformers and three panels will be required at a reduced capacity as follows:

Transformer 4: 250KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 200 amp panel MS-PNL-4.

Transformer 6: 225KVA (est.), 480/277V, 3Φ, pad mounted transformer feeding a 250 amp panel MS-PNL-6.

Transformer 9: 25KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding a 100 amp panel MS-PNL-9.

Transformer size shown in design documents are estimated. PG&E will determine the size of the transformer placed into service. Panels initially installed should be sized to align with the size of the transformer and the facilities put into service. Although transformer and panel sizes change, conductors are sized for final build out of both Required and Authorized facilities.

9.4 Berryessa Point Recreation Area

Proposed electrical service at Berryessa Point includes four transformers and meters to serve the full build-out scenario of Required and Authorized facilities. Two of the transformers will feed power to the RV sites. One transformer feeds power to the groundwater pump and pump station. The final transformer feed power to security lights. Transformers will also power surrounding lights and septic pumps.

Following is a list of the transformers, panels, and equipment proposed at Berryessa Point. The transformer sizes are estimated based on the equipment being powered, and the transformer mounting methods indicated are probable based on typical PG&E installations. The actual installed transformer sizes and mounting methods will be determined by PG&E.

Transformer 1: 167KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding an 800 amp panel BP-PNL-1. Panel BP-PNL-1 provides power to the following equipment:

- 26 RV sites: 50/30/20 Amp

Transformer 2: 150KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 600 amp panel BP-PNL-2. Panel BP-PNL-2 provides power to the following equipment:

- 16 RV sites: 50/30/20 amp

Transformer 3: 225KVA (est.), 480/277V, 3Φ, pad mounted transformer feeding 400 amp panel BP-PNL-3. Panel BP-PNL-3 provides power to the following equipment:

- Ground water pump: 200 amp
- Pump station: 120 amp

The initial development of Required facilities only at Berryessa Point is defined in Table 2-4. Electrical service to the Required only facilities is shown in the 60% Design documents. Only one transformer and one panel will be required at a reduced capacity as follows:

Transformer 4: 15KVA (est.), 120/240, 1Φ, pad mounted transformer feeding 100 amp panel BP-PNL-4. Panel BP-PNL-4 provides power to the following equipment:

- Security Lights: 40 amp

Transformer size shown in design documents is estimated. PG&E will determine the size of the transformer placed into service. Panels initially installed should be sized to align with the size of the transformer and the facilities put into service. Although transformer and panel sizes change, conductors are sized for final build out of both Required and Authorized facilities.

9.5 Spanish Flat Recreation Area

Proposed electrical service at Spanish Flat includes six transformers and meters to serve the full build-out scenario of Required and Authorized facilities. One of the transformers will feed power to RV campsite areas, a comfort station and concessionaire park model office building. One transformer feeds power to the marina rand the accessible entry station. Two of the transformers feed power to comfort stations, camp host site, fuel storage &dispensing, parking lot lights, and a fish cleaning station. An additional transformer will be provided for the booster pump in the area. Transformers will also power surrounding lights and septic pumps.

Following is a list of the transformers, panels, and equipment proposed at Spanish Flat. The transformer sizes are estimated based on the equipment being powered, and the transformer mounting methods indicated are probable based

on typical PG&E installations. The actual installed transformer sizes and mounting methods will be determined by PG&E.

Transformer 1: 100KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 400 amp panel SF-PNL-1. Panel SF-PNL-1 provides power to the following equipment:

- Floating Marina: 200 amp
- Accessible entry: 60 amp

Transformer 2: 50KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 250 amp panel SF-PNL-2. Panel SF-PNL-2 provides power to the following equipment:

- Camp host site: 50 amp
- Fuel storage and dispensing: 120 amp

Transformer 3: 150KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 800 amp panel SF-PNL-3. Panel SF-PNL-3 provides power to the following equipment:

- Concessionaire office building: 120 amp
- 12 RV sites: 50/30/20 amp
- Comfort Station Subpanel: 120 amp
- Provides power to lights, receptacles, electric heater and water control panel

Transformer 4: 37.5KVA (est.), 120/240V, 1Φ, pole mount transformer feeding 225 amp panel SF-PNL-4. Panel SF-PNL-4 provides power to the following equipment:

- 2 Comfort stations: 60 amp
- Provides power to lights, receptacles, electric heater and water control panel

Transformer 5: 25KVA (est.), 120/240V, 1Φ, pole mount transformer feeding 100 amp panel SF-PNL-5. Panel SF-PNL-5 provides power to the following equipment:

- Fish cleaning station: 60 amp
- Parking lot lights: 5 amps

Transformer 6: 225KVA (est.), 480/277V, 3Φ, pad mount transformer feeding 250 amp panel SF-PNL-6. Panel SF-PNL-6 provides power to the following equipment:

- Booster pump station: 200 amp

Transformer 7: 225KVA (est.), 480/277V, 3Φ, pad mount transformer feeding 250 amp panel SF-PNL-7. Panel SF-PNL-7 provides power to the following equipment:

- Wastewater plant: 200 amp

The initial development of Required facilities only at Spanish Flat is defined in Table 2-5. Electrical service to the Required only facilities is shown in the 60% Design documents. Only three transformers and three panels will be required at a reduced capacity as follows:

Transformer 1: 100KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding a 400 amp panel SF-PNL-1.

Transformer 2: 50KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 125 amp panel SF-PNL-2.

Transformer 5: 25KVA (est.), 120/240V, 1Φ, pole mount transformer feeding 100 amp panel SF-PNL-5.

Transformer size shown in design documents are estimated. PG&E will determine the size of the transformer placed into service. Panels initially installed should be sized to align with the size of the transformer and the facilities put into service. Although transformer and panel sizes change, conductors are sized for final build out of both Required and Authorized facilities.

9.6 Steele Canyon Recreation Area

Proposed electrical service at Steele Canyon includes twelve transformers and meters. Three transformers north of the restaurant power cabins and park models. Three transformers east of the restaurant power RV/standard sites along with comfort stations nearby. One of the transformers will feed power to employee housing. One transformer feeds power to concessionaire office building with boat repair, boat storage facilities, and a comfort station. One transformer feeds power to standard sites, comfort station, and fish cleaning station. The final two transformers power comfort stations, RV & standard sites, and the accessible entry station. Transformers will also power surrounding lights and septic pumps.

Following is a list of the transformers, panels, and equipment proposed at Steele Canyon. The transformer sizes are estimated based on the equipment being powered, and the transformer mounting methods indicated are probable based on typical PG&E installations. The actual installed transformer sizes and mounting methods will be determined by PG&E.

Transformer 1: 250KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 1200 amp SC-PNL-1. Panel 1200 amp SC-PNL-1 provides power to the following equipment:

- 14 Cabins: 60 Amp

Transformer 2: 100KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 400 amp panel SC-PNL-2. Panel SC-PNL-2 provides power to the following equipment:

- 11 Park models: 50 amp

Transformer 3: 100KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 600 amp panel SC-PNL-3. Panel SC-PNL-3 provides power to the following equipment:

- Comfort Station Subpanel: 125 amp
  - Provides power to lights, receptacles, electric heater and water control panel
- 6 Standard sites: 30/20 amp
- 5 RV sites: 50/30/20 amp

Transformer 4: 100KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-4. Panel SC-PNL-4 provides power to the following equipment:

- 6 Standard sites: 30/20 amp
- 2 RV sites: 50/30/20 amp
- Comfort Station Subpanel: 125 amp
  - Provides power to lights, receptacles, electric heater and water control panel

Transformer 5: 150KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 800 amp panel SC-PNL-5. Panel SC-PNL-5 provides power to the following equipment:

- 10 Employee housing: 60 amp

Transformer 6: 225KVA (est.), 120/208V, 3Φ, pad mounted transformer feeding 600 amp panel SC-PNL-6. Panel SC-PNL-6 provides power to the following equipment:

- Concessionaire office with small boat repair, yard, shop: 200 amp
- Dry boat storage: 120 amp
- Comfort station: 120 amp
  - Provides power to lights, receptacles, electric heater and water control panel

Transformer 7: 75KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-7. Panel SC-PNL-7 provides power to the following equipment:

- 5 Standard sites: 30/20 amp
- Fish cleaning: 60 amp
- Comfort station: 60 amp
- Parking lot lights: 1 amp

Transformer 8: 100KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-8. Panel SC-PNL-8 provides power to the following equipment:

- 6 Standard sites: 30/20 amp
- 4 RV sites: 50/30/20 amp
- 4 parking lot lights: 1 amp
- Comfort station: 120 amps

Transformer 9: 37.5KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 225 amp panel SC-PNL-9. Panel SC-PNL-9 provides power to the following equipment:

- 2 Cabins: 60 amp

Transformer 10: 300KVA (est.), 120/208, 3Φ, pad mounted transformer feeding 800 amp panel SC-PNL-10. Panel SC-PNL-10 provides power to the following equipment:

- Restaurant Subpanel: 400 amp
  - Restaurant includes freezers, refrigerators, microwaves, coffee maker, receptacles, lights, furnace, air conditioning condensing unit, and instantaneous electric water heater.

- Marina Complex Subpanel: 400 amp
  - Marina includes freezers, refrigerators, microwaves, coffee maker, receptacles, lights, furnace, air conditioning condensing unit, and instantaneous electric water heater.

Transformer 11: 15KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 100 amp panel SC-PNL-11. Panel SC-PNL-11 provides power to the following equipment:

- Accessible entry: 60 amp

Transformer 12: 100KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-11. Panel SC-PNL-11 provides power to the following equipment:

- 10 Standard sites: 30/20 amp
- Comfort station: 60 amp

The initial development of Required facilities only at Steele Canyon is defined in Table 2-6. Electrical service to the Required only facilities is shown in the 60% Design documents. Only eight transformers and eight panels will be required at a reduced capacity as follows:

Transformer 1: 250KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding a 1200 amp SC-PNL-1.

Transformer 2: 100KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 400 amp panel SC-PNL-2.

Transformer 3: 50KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 200 amp panel SC-PNL-3.

Transformer 7: 75KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-7.

Transformer 8: 100KVA (est.), 120/240V, 1Φ, pad mounted transformer feeding 400 amp panel SC-PNL-8.

Transformer 9: 37.5KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 225 amp panel SC-PNL-9.

Transformer 10: 300KVA (est.), 120/208, 3Φ, pad mounted transformer feeding 800 amp panel SC-PNL-10.

Transformer 11: 15KVA (est.), 120/240V, 1Φ, pole mounted transformer feeding 100 amp panel SC-PNL-11.

Transformer size shown in design documents are estimated. PG&E will determine the size of the transformer placed into service. Panels initially installed should be sized to align with the size of the transformer and the facilities put into service. Although transformer and panel sizes change, conductors are sized for final build out of both Required and Authorized facilities.

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Chapter 10
Water Treatment & Conveyance

Preliminary design of the water facilities include projections on system demands, storage requirements, and the distribution infrastructure required to deliver maximum day water demands and fire flows at the five recreation areas. A water distribution model was developed for each recreation area. The models were initially based on the design assumptions and system layouts provided in the 30 percent design. Each system was then refined to meet established design criteria; these refinements are described herein. The final 60 percent design drawings present a partial development scenario; however the water system is designed and sized for the long term build-out scenario of each recreation area.

Three of the five recreation areas—Putah Canyon, Monticello Shores and Berryessa Point will need new water supplies, however providing water service to Berryessa Point is an Authorized service, and is not Required. Water service at the other four recreation areas is a Required amenity. Since design of water service for Berryessa Point was previously considered for inclusion as a Required amenity, this chapter includes discussion of design criteria, regulatory requirements, and test results for consideration by the concessionaire. The design analysis assumed, based on available information that the new water supplies will be provided by a new ground water well at each recreation area. At this time, test wells have been drilled at two of the three recreation areas that require new water supplies. The test wells show that the ground water capacity and quality are not adequate to meet the design goals, and alternative water sources will be necessary. Well recovery rates and water quality design assessments are presented later in this chapter. One alternative to consider for the water supply is a surface water intake from Lake Berryessa along with treatment for potability.

Existing water systems are in place near the two remaining recreation areas—Steele Canyon and Spanish Flat. It is assumed that the existing water districts serving these recreation areas will provide the required potable and fire suppression water supply for these two recreation areas. For all five recreation areas, sizing and final design of the facilities are subject to change as more site specific information is obtained and the designs are finalized.

10.1 Design Criteria and Assumptions

A summary of design criteria for the water system to support long term build-out is summarized in Table 10-1. These values are based on assumptions that are defined herein.

Table 10-1. Design Criteria Summary

Parameter	Units	Value
Demands		
Maximum Day Consumptive Water Usage (gpd)		
Putah Canyon	gpd	29,269
Monticello Shores	gpd	40,955
Berryessa Point	gpd	12,824
Spanish Flat	gpd	15,000
Steele Canyon	gpd	44,115
Fire Flow		
Putah Canyon	gpm	300
Monticello Shores	gpm	300
Berryessa Point	gpm	300
Spanish Flat	gpm	300
Steele Canyon	gpm	1400
Pressure		
Minimum Residual Fire Flow Pressure	psi	20
Minimum Operational Pressure	psi	40
Materials		
Pipe Diameter Sizes	inches	2, 4, 6 and 8
Pipe Material	-	HDPE and DIP
Storage		
Site Storage Requirements	Two days of maximum day demand and minimum Fire Flow Storage	

10.2 Water Usage and Demand

The potable water system at each of the recreation areas is designed to meet the projected demands for both consumptive and fire flow requirements. The term ‘consumptive demand’ is being used in this report to refer to the water used at each recreation area, not including fire flow. Fire flows are accounted for separately from consumptive demands because the required water delivery rate to meet fire demands is significantly higher than consumptive requirements. Additionally, the volume of water required for fire protection is a large percentage of total storage requirements during most of the year. The relative proportion of fire flows to consumptive flows is a driver in overall system design and operations.

The term 'usage' refers to the total volume of water required over the course of a day. Water usage rates are used to calculate water storage requirements, water supply pump sizes and treatment capacity. The term 'demand' refers to the total volume of water needed at any given time. Demand projections are used to design distribution system infrastructure, which includes pipes, valves, booster pump and maximum demand pump systems.

A summary of projected water usage and projected consumptive demands for each recreation area is provided in Table 10-2 and Table 10-3. Detailed descriptions of the assumptions behind these values are provided in the following sections.

Table 10-2. Maximum Projected Usage

Recreation Area	Maximum Day Consumptive Water Usage
	gpd
Putah Canyon	29,269
Monticello Shores	40,955
Berryessa Point	12,824
Spanish Flat	15,000
Steele Canyon	44,115

Table 10-3. Projected Demands

Recreation Area	Maximum Consumptive Instantaneous Demand	Fire Flow Demand	Maximum Instantaneous Demand
	gpm	gpm	gpm
Putah Canyon	39	300	339
Monticello Shores	55	300	355
Berryessa Point	17	300	317
Spanish Flat	20	300	320
Steele Canyon	59	1400	1,459

10.2.1 Consumptive Demands

Maximum daily consumptive water usage volumes for each recreation area were calculated by multiplying the number of each type of facility at ultimate build out when both the required and authorized facilities have been constructed (tent site, RV site, cabin, etc.), by the maximum daily water demand for that type of facility and then totaling the water usage for all facilities. The projected water usage volumes for facilities were extrapolated from anticipated wastewater flows based on reference documents referred to in the 30 percent design report. Water usage volumes are approximated to be 30% greater than their resulting wastewater flows (based on historical comparisons found in Wastewater Engineering Treatment and Reuse by Metcalf and Eddy). The

water usage volumes for these facilities were calculated by multiplying the associated wastewater flow by 130%. Anticipated wastewater flow projections are described in Chapter 11.

The maximum day water usage will occur when all facilities at a given recreation area are fully occupied. It is anticipated that the majority of all water use at each recreation area occurs during daylight hours. The instantaneous demand for each recreation area is based on 80% of the maximum day water usage occurring over a ten-hour period. This assumption results in a peaking factor of approximately 1.9. This peaking factor is applied to the maximum consumptive daily usage evenly spread over the course of 24 hours to obtain the total demand that will need to be delivered to meet maximum consumptive instantaneous demand. The instantaneous consumptive demand, combined with fire flow demand, was used to size infrastructure at each recreation area.

The maximum consumptive daily water usages and instantaneous consumptive demands for each recreation area are summarized in Table 10-4. The detailed breakdown of projected water usage for each facility at each recreation area and the associated facility water usage rates are provided in Table 10-5 and Table 10-6, respectively.

Table 10-4. Consumptive Water Demands

Recreation Area	Maximum Day Consumptive Water Usage	Maximum Consumptive Instantaneous Demand
	gpd	gpm
Putah Canyon	29,269	39
Monticello Shores	40,955	55
Berryessa Point	12,824	17
Spanish Flat	15,000	20
Steele Canyon	44,115	59

Table 10-5. Projected Water Usage by Facility at Each Recreation Area

Lake Berryessa - Water and Wastewater Infrastructure Design Data										
Proposed Quantities of "Required and Authorized" Facilities & Water Usage at Each Recreation Area Based on Site Plans										
Item	**Putah Canyon**		**Monticello Shores**		**Berryessa Point**		**Spanish Flat**		**Steele Canyon**	
	No. of Units	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**
Camping										
Tent Site	67	6,566	130	12,740	0	-	56	5,488	19	1,862
Standard Campsite w/o Utilities	14	1,372	4	392	0	-	10	980	22	2,156
Standard Campsite with Utilities	5	650	8	1,040	0	-	0	-	32	4,160
RV Site with Utilities	18	2,340	21	2,730	41	5,330	12	1,560	11	1,430
Boat-in Campsite	0	-	20	720	0	-	0	-	5	180
Overnight Group Use Area (50 Occupants)	0	-	1	1,300	0	-	0	-	0	
Overnight Group Use Area (20 Occupants)	0	-	0	-	0	-	0	-	1	400
Camp Host Site with utilities	1	260	1	260	1	260	1	260	1	260
RV Dump Station	1	1,170	1	1,365	1	2,665	1	780	1	715
Lodging										
Park Models	6	2,340	28	10,920	0	-	0	-	12	4,680
Cabins	0	-	9	3,510	0	-	0	-	15	5,850
Yurts	0	-	6	588	0	-	3	294	0	-
Rustic Cabins	0	-	4	392	0	-	4	392	0	-
Tent Cabins	0	-	5	490	0	-	3	294	0	-
Floating Campsites	0	-	3	108	0	-	0	-	3	108
Boating										
Boat Slips	201	2,613	50	650	50	650	75	975	278	3,614
Houseboat Slips	15	1,470	0	-	0	-	0	-	32	3,136
Fish cleaning Station	2	4,020	1	1,000	1	1,000	1	1,500	2	5,560
Employee Housing (Park models)	6	1,560	0	-	0	-	0	-	10	2,600
Marina Service and Building	1	130	1	130	1	130	1	130	1	N.A.
Concessionaire Building	1	-	0	-	0	-	1	-	1	-

Table 10-5. Projected Water Usage by Facility at Each Recreation Area

Lake Berryessa - Water and Wastewater Infrastructure Design Data										
Proposed Quantities of "Required and Authorized" Facilities & Water Usage at Each Recreation Area Based on Site Plans										
Item	**Putah Canyon**		**Monticello Shores**		**Berryessa Point**		**Spanish Flat**		**Steele Canyon**	
	No. of Units	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**	**No. of Units**	**Water Usage (gpd)**
Day Use										
Individual Day Use Sites	38	988	8	208	17	442	18	468	10	260
Group Day Use Areas	1	325	1	325	0	-	0	-	1	325
Multi-Use Special Events Center	0	-	0	-	0	-	0	-	1	1,950
Gazebo/Group Use Shelter	0	-	0	-	1	325	0	-	0	-
Amenities										
Restaurant	0	-	0	-	0	-	0	-	1	1,664
Take out counter	1	520	1	520	1	520	1	520	0	-
Retail Store (Included with Marina)	1	930	1	930	1	930	1	930	1	930
Facilities/Infrastructure										
Comfort Station Toilets only[2]	4	-	1	-	0	-	3	-	5	-
Comfort Station, Toilets and family room[2]	0	-	5	-	0	-	1	-	3	-
Comfort Station, toilets, family room, and showers[2]	1	-	8	-	0	-	1	-	1	-
Comfort Station, toilets, family room, showers and laundry	1	1,300	0	-	0	-	0	-	1	1,300
Parking										
Vehicle with Boat Trailer Parking	55	715.0	49	637.0	44	572.0	33	429.0	75	975.0
Total Water Usage (gpd)		**29,269**		**40,955**		**12,824**		**15,000**		**44,115**

[1] Putah Canyon, Monticello Shore, Berryessa Point and Spanish Flat will have restaurant and retail facilities combined with Marina Service and Building

[2] Loading for Comfort Stations is assumed to be zero since the contributory loads are presented in other usages.

Table 10-6. Facility Water Usage Rates

Facility Type	Water Usage	Units
Tent Site without water & sewer hook ups	98	gal/d/site
Overnight Group Use Area (~50 people)	1300	gal/d/area
RV Site	130	gal/d/site
Standard Campsite w/o utilities	98	gal/d/site
Standard Campsite w/ Utilities	130	gal/d/site
Boat-in Campsite	36	gal/d/site
Floating Campsite	36	gal/d/site
Park Models - (4 persons capacity)	390	gal/d/unit
Yurts -(4 - persons capacity)	98	gal/d/unit
Tent Cabins	98	gal/d/unit
Rustic Cabins	98	gal/d/unit
Cabins (4-persons capacity)	390	gal/d/unit
Boat Slip	13	gal/d/slip
Houseboat Slip	98	gal/d/slip
Marina Service and Building	130	gal/day
Concessionaire Building	N.A.	gal/day
Individual Day Use Sites	26	gal/d/site
Group Day Use Areas (~20 people)	325	gal/d/area
Multi-Use Special Events Center (~20 people)	1950	gal/d/facility
Restaurant	1664	gal/d/facility
Take out counter	520	gal/d/facility
Laundry Facility	1300	gal/d/facility
Camp Host Site	260	gal/d/site
Employee Housing	260	gpd/Unit
Vehicle with Boat Trailer Parking	13	gal/d/spot
Retail Store	930	gal/day
Comfort Station Toilets only[1]	0	gal/day
Comfort Station, Toilets and family room[1]	0	gal/day
Comfort Station, toilets, family room, and showers[1]	0	gal/day
Comfort Station, toilets, family room, showers and laundry	1300	gal/day
Access Road Close Gate	0	gal/day
Vehicle Parking	0	gal/d/space
RV Dump Station	65	Gal/day/RV
Fish Cleaning Station	20	gal/day/slip

[1] Loading for Comfort Stations is assumed to be zero since the contributory loads are presented in other usages.

10.2.2 Irrigation Demands

Although irrigation is a large contributor to total water demand in municipal water systems in the western United States, for these recreation areas, it is assumed irrigation demands will not be required. Based on input from Reclamation, recreation areas will include natural landscaping that will be sustained by rainfall.

10.2.3 Fire Flow Demands

Each water system is designed to provide fire flow demand in addition to consumptive demand. Fire flow demand for each recreation area is based upon compliance with the 2013 California Fire Code (CFC) and NAPA County Amendments to Title 15.32 (Fire Code).

All recreation areas are currently analyzed as areas without having a public water supply system and following Fire Code Sections 15.32.800, 805-807 for fire flow demand and water storage provisions; subsequently, all recreation areas will be provided with fire flow with reserve supply using water storage tanks in accordance with NFPA 22. It is assumed that fire flow storage for the Steele Canyon Recreation Area will be provided by the local water district. Coordination will be needed to ensure that the existing infrastructure is compliant with NFPA 22. Building automatic fire sprinkler systems are required for buildings exceeding 3,600 square feet, in accordance with Fire Code §15.32.710 (CFC §903.2); additionally, it is anticipated that all Group R-1 cabins will require sprinklers in accordance with NFPA 13D (CFC §903.3.1.3), as permitted by CFC §903.2.8 exceptions. It is anticipated that Class I manual dry standpipes will be provided near marinas, bulkheads, fueling facilities and other buildings with hose connections within 150 feet of fire access roads, in accordance with CFC §2310, §3604, and NFPA 303; standpipe fire flow demand will be sized for Class II systems at 100 gpm for 30 minutes, in accordance with NFPA 303 §6.4 and NFPA 14 §7.8/10 (CFC §3604). The manual dry standpipe will be pressurized by the fire department and will not have a pressure demand on the system. Fire flow demand and storage is based on Napa County Fire Code Tables B105.2, B105.3, and B105.4 (see excerpted summary in Table 10-7) and require a minimum water storage volume for fire suppression of 12,000 gallons for light or moderate hazard buildings without automatic fire sprinkler systems, or up to 24,000 gallons for larger, high-hazard buildings with automatic fire sprinkler systems.

HDR consulted with the Napa County Fire Department staff on November 20, 2014, regarding the fire protection requirements for the project. HDR was advised that without detailed facility drawings, the County Fire Department would not provide specific guidance regarding fire flow requirements. This is a major issue that will need to be addressed as the design progresses. An in-person meeting at the Napa County headquarters should be held prior to the 90

percent design to better define design parameters and interpretation of the codes applicable to the project.

Table 10-7. Fire Flow Water Demand Excerpt

Fire Area / Fire Hazard Occupancy[1]				Fire Flow Duration	Automatic Fire Sprinkler Protection[2]			
					Non-sprinklered		Sprinklered	
					Fire Flow	Storage Volume	Fire Flow	Storage Volume
	Type of Construction[3]							
	I FR, II FR, II-1hr, III-1hr	II-N, III-N, IV-HT, V-1hr	V-N	Mins.	Gpm[4]	Gallons[4, 5]	Gpm[4, 6]	Gallons[4, 5, 6]
Light	16,800	13,300	12,600	60	200	12,000	200	6,000
Moderate	11,200	8,850	8,400	60	200	12,000	200	6,000
High	4,430	4,200	120	200	24,000	200	12,000	4,430
	6,650	6,320	120	300	36,000	300	18,000	6,650
	8,860	8,430	120	400	48,000	400	24,000	8,860

[1] Fire area in sq. ft. (less than or equal to), for fire hazard occupancy types see Fire Code Section A-III-A.5.2.1.
[2] Approved automatic sprinkler protection throughout building in accordance with standards NFPA 13 or NFPA 13-R.
[3] Types of construction based upon the Building Code.
[4] Add 10% to fire flow and storage volume if separation between buildings is less than 20 feet, to the values summarized in Table 10-6.
[5] Fire flow storage volume use shall be limited and dedicated to fire protection, see Fire Code Section 903.3.1.
[6] Fire flow and storage volume in sprinklered buildings is in addition to the water demand for the sprinkler system and in-lieu of outside hose stream demand allowance.

Water requirements for fire fighting will be supplied by the potable water distribution system at each recreation area.

A potential alternative to using the potable water distribution systems to meet fire flow requirements would be a system using lake water, in accordance with NFPA 1142, as permitted by Fire Code §15.32.800 (CFC §B103.3); this would require special approval from the fire code officials since it is intended for residential development projects. This alternative would require construction of two independent distribution systems-- one for potable water and one for untreated lake water. It was determined that the cost savings associated with the reduction in the required capacity of the potable water distribution system would not offset the additional cost associated with development of an independent non-potable water distribution system for fire flows. Furthermore, there are logistical concerns that would require a feasibility study because of fluctuations in lake elevation exceeding 20 feet, which negatively impacts a fire pumper truck's ability to draft water from the lake. A surface water intake for fire protection would likely require a fixed diesel driven fire pump house configuration. This would include a diesel fuel oil storage tank, an inland drafting well with lake-inlet below the lowest water elevation, and fire alarm system control, among other components.

Summary of Recreation Site Fire Flow and Storage Requirements

Fire flow demands at each recreation site have two components: site fire flow demands (to hydrants) and sprinkler demands. Site fire flow demands require 200 gpm and 6,000 gallons of storage, as noted in the 30 percent design documents. Additionally, sprinkler demands require approximately 100 gpm of flow and an additional 6,000 gallons of storage. Therefore, total required flow at Putah Canyon, Monticello Shores, Berryessa Point, and Spanish Flats is 300 gpm with 12,000 gallons of storage (as noted previously, providing water service at Berryessa Point is an Authorized service).

A proposed (Authorized) boat storage building at Steele Canyon will likely need to be sprinklered. This results in a significantly higher fire flow requirement, if the concessionaire chooses to provide the boat storage service. Depending on the location and height of the building, sprinkler demands may be 1000 gpm for 120 minutes, resulting in 120,000 gallons of storage required for the sprinklers. The Steel Canyon site fire flow requirements are approximated to be 400 gpm with 24,000 gallons of storage. The total fire flow requirements at Steele Canyon are approximated at 1,400 gpm flow and 144,000 gallons of storage. As described in Section 10.11 Steele Canyon Recreation Area, it is assumed that the existing water district will have the storage and distribution capacity to meet this demand.

10.2.4 Seasonal Fluctuations

Consumptive water demands at the five recreation areas will fluctuate with seasonal occupancy rates. For instance, water demands will peak during summer holiday weekends when all facilities are fully occupied, and will be at their lowest during winter months when occupancy is at a minimum. Demand fluctuations are an important operational consideration for each of the water distribution systems.

Projected fluctuations in weekly water demands were estimated based on the number of expected visitors. The Financial Feasibility Evaluation Report provided projected weekly occupancy rates for planning purposes. The projected occupancy rates indicate full occupancy during the week of Independence Day. Maximum day water demand is expected to occur during this week. Water demand for all other weeks was estimated by multiplying the maximum daily demand by the projected occupancy rate factor. The projected weekly fluctuations in water demand as a percentage of maximum day demand are presented in Figure 10-1. As shown, occupancy rates in winter months (November through March) will be approximately 10% of the maximum occupancy. The highest occupancy is expected during the summer months (May through September). The total water demand and resulting system operation recommendations will be impacted by the projected occupancy rate in each season.

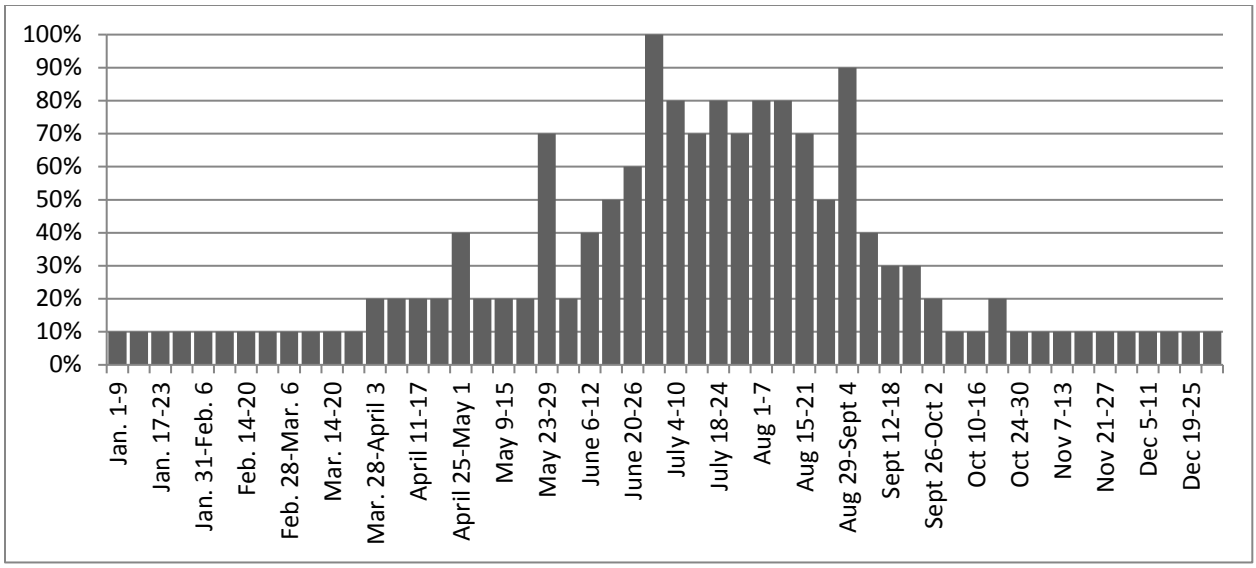

Figure 10-1. Projected Weekly Demand as a Percentage of Maximum Daily Demand for all Recreation Areas.

10.3 Water Supply

For the purpose of this document, it has been assumed that water will be supplied to Putah Canyon, Berryessa Point, and Monticello Shores by ground water wells located at each of these recreation areas (water service at Berryessa Point is an Authorized service). As part of that consideration it has been assumed that Reclamation has existing water rights for each well, based on previous site occupancy. It is anticipated that Spanish Flat and Steele Canyon will be supplied by the existing local municipal potable water systems and will not require new supply development. It is further assumed that agreements for municipal water supply at Spanish Flat and Steele Canyon will be secured by Reclamation or by the concessionaire. Obtainment of new water rights is not discussed herein.

Based on information provided by Reclamation regarding water well location, depth and expected production, test wells have been drilled at two of the three recreation areas that require new water supplies. CDM/HDR contracted for test wells to be drilled at Berryessa Point and at Monticello Shores. The test well at each location was drilled, developed and tested for production capacity. The sustained well production rate was 3 gpm at both locations. This production rate does not meet the water demand identified for each of these areas. Based on the test well results, alternative water supply should be considered for both sites. One option to consider is a new water intake constructed to take water directly from Lake Berryessa, routed through surface water treatment facilities, to provide the required potable and fire water demands. A new raw water intake structure and surface water treatment facilities will have major cost implications

to the development of each impacted recreation area. Verification that Reclamation has sufficient surface water rights for each location is necessary.

Reclamation is in the process of drilling a production well at Putah Canyon. However the project has not yet been completed; thus water quantity and quality data are unavailable at this time. The well designs proposed herein are based on the assumption that groundwater wells would prove to be feasible based on early input received from Reclamation.

Table 10-8. Test Well Production Results

Recreation Site Area	Total Test Well Depth	Initial Water Depth	Test Well Drawdown	Test Well Production[2]
	ft BGS[1]	ft BGS[1]	ft BGS[1]	gpm
Putah Canyon	N/A	N/A	N/A	N/A
Monticello Shores	495	96	442	3
Berryessa Point	426	64	225	3

[1] Below Ground Surface (BGS)
[2] After 4 hours of pumping

10.4 Water Quality

Water quality will have a significant impact on the final design of the water system at each recreation area. Potable water systems are required to comply with standards established by the Safe Drinking Water Act. Drinking water regulations are generally applied based on the type of raw water being used as a supply and the classification of the system. The water at each test well was tested for the components regulated by the California Department of Public Health (CDPH) under the assumed water system classification. The complete list of the National Primary Drinking Water Standards and the secondary standards are provided in Appendix E-1A for reference.

As previously mentioned, it is assumed that the Steel Canyon and Spanish Flat Recreation Areas will be supplied by existing municipal distribution systems and no additional water treatment will be needed. As previously discussed, water service at Berryessa Point is an Authorized amenity and may be omitted.

10.4.1 Regulatory Requirements and Permitting

Taken as a group, drinking water regulations are in place to ensure drinking water is microbially safe, contains minimal disinfection byproducts, and does not contain excess levels of metals. Compliance with the regulations requires each utility not only to produce and deliver water meeting the regulated water quality standards, but also to meet specific monitoring requirements.

A public water system provides water for human consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days each year. Public water systems are classified as community, non-transient non-community, or transient non-community systems. A definition of each is provided in Table 10-9. It is anticipated that the new water supply systems at the recreation areas will be classified as "transient non-community water systems," which is the least stringent of all the water system classifications.

Table 10-9. Classification of Public Water Systems

Classification	Criteria
Community (CWS)	Provides water to the same population year round
Non-transient Non-community (NTNCWS)	Serves at least 25 of the same people at least 6 months of the year, not year-round.
Transient Non-community (TNCWS)	Caters to transitory customers in nonresidential areas

At a minimum, the recreation areas that have been planned for supply by new wells—Putah Canyon, Berryessa Point, and Monticello Shores—will need to comply with the Ground Water Rule. An overview of the Ground Water Rule is provided in Appendix E-1B. If it is determined that the ground water quality is under the influence of surface water or if surface water is used in lieu of groundwater, the systems will need to comply with the Surface Water Treatment Rule.

In addition to meeting national water quality regulations, the new water distribution systems proposed for the Putah Canyon, Berryessa Point, and Monticello Shores Recreation Areas will each require an initial public water system permit from the CDPH. Additional information on the required permits and permit applications are provided in Appendix E-1C.

10.4.2 Existing Water Quality

Water quality results have been obtained from the test wells at Monticello Shores and at Berryessa Point. Both test wells were tested for the source water parameters monitored for transient non-community water system's (TNCWS's) supplied by ground water. A summary of the water quality results is provided in Table 10-10. Water quality has not yet been obtained for Putah Canyon or for the existing municipal water systems.

As shown in the table, the water quality at both locations tested positive for total coliform and positive for fecal coliform at Monticello Shores, in violation of CDPH criteria for TNCWS's. Both test wells tested negative for E. Coli. It is possible that the total coliform is related to anoxic iron reduction in the well. The water quality at Monticello Shores should be retested for fecal coliform, as this is unlikely to occur in a well with this depth.

Iron and manganese concentrations are very high at both Monticello Shores and Berryessa point and exceed the source water CDPH criteria for TNCWS's. Iron concentrations were 2,900 µg/L and 110,000 µg/L, respectively for Monticello Shores and Berryessa Point; the CDPH secondary maximum contaminant level (SMCL) for iron is 300 µg/L. Manganese concentrations were 120 µg/L and 1,400 µg/L respectively; the CDPH SMCL is 50 µg/L. Both iron and manganese are secondary contaminants, thus are not considered to present a risk to human health. They are regulated for aesthetic considerations. Both iron and manganese will oxidize in the presence of free chlorine and will create colored water issues.

The Total Dissolved Solids (TDS) are very high at both wells. The national secondary drinking water standards establish SMCL of 500 mg/L TDS. The concentrations were 633 mg/L and 1220 mg/L for Monticello Shores and Berryessa Point respectively. High TDS does not pose a direct health risk, but will result in an undesirable taste. Water with TDS at these levels is likely to not be tolerated by the public. The turbidity of both well samples was also high. The pH at Monticello Shores was 9.27, which is much higher than the national SMCL of 8.5. The pH at Berryessa Point was 8.08, which is in the range of typical drinking water standards. The water quality also indicates hard water, thus, the systems can expect deposition of carbonate compounds in pipes, valves and storage tanks.

The arsenic and total alkalinity concentrations at both recreation areas exceed the CDPH criteria for non-transient non-community water system's (NTNCWS's). Additionally, total chromium at Berryessa Point exceeds the NTNCWS criteria. However, none of these parameters are regulated under the TNCWS classification.

Table 10-10. Test Well Water Quality Data

Lake Berryessa - Test Well Water Quality Data, Spring 2015			Monticello Shores - Lab work order 1505690			Berryessa Point - Lab work order 1504B85		
California Department of Public Health (CDPH)	CDPH Source Chemical Monitoring Requirements TNCWS Ground Water		Measured Value (5/18/2015)		>CDPH TNCWS Criteria*?	Measured Value (4/29/2015)		>CDPE TNCWS Criteria?
Parameter	**Unit**	**MCL**	**Unit**	**Value**	**Yes (Y)**	**Unit**	**Value**	**Yes (Y)**
Total Coliform	MPN/100 ml	ND	MPN/100 ml	90	Y	MPN/100 ml	110	Y
E. Coli	MPN/100 ml	ND	MPN/100 ml	ND		MPN/100 ml	ND	
Fecal Coliform	MPN/100 ml	ND	MPN/100 ml	2	Y	MPN/100 ml	ND	
Fluoride	mg/l	2	mg/l	0.18		mg/L	0.38	
Nitrate as (NO3)	mg/l	45	mg/l	ND		mg/L	ND	
Nitrite (as N)	ug/l	1000	mg/l	ND		mg/L	ND	
Total Alkalinity, Bicarbonate, Carbonate, Hydroxide			$mgCaCO_3/L$	557		$mgCaCO_3/L$	525	
Iron	ug/l	300	ug/L	2900	Y	ug/L	110,000	Y
Manganese	ug/l	50	ug/l	120	Y	ug/l	1400	Y
pH*			UNIT	9.27		UNIT	8.08	
Turbidity			NTU	12.3		NTU	3300	
Total Dissolved Solids (TDS)			mg/L	633		mg/L	1220	
Total Hardness (by Titration)			$mgCaCO_3/L$			$mgCaCO_3/L$	196	
Calcium			mg/L	33		mg/L	27	
Magnesium			mg/L	100		mg/L	31	
Antimony			ug/L	ND		ug/L	ND	
Arsenic			ug/L	13		ug/L	22	
Barium			ug/L	160		ug/L	670	
Beryllium			ug/L	ND		ug/L	2.2	
Bromide			mg/L	ND		mg/L		
Cadmium			ug/L	ND		ug/L	1.3	
Chromium (total)			ug/L	12		ug/L	83	
Total Cyanide			ug/L	1.7		ug/L	1.8	
Mercury			ug/L	ND		ug/L	ND	
Nickel			ug/L	ND		ug/L	92	
Selenium			ug/L	ND		ug/L	ND	
Thallium			ug/L	ND		ug/L	ND	
Chloride			mg/L	8.6		mg/L	20	
Copper			ug/L	12		ug/L	98	
Molybdenum			ug/L	13				
Vanadium			ug/L	5.5				
Zinc			ug/L	420		ug/L	320	
Sulfate			mg/L	120		mg/L	180	

*CDPH does not establish pH criteria, but the national drinking water secondary standards are between 6.5-8.5

Additional water quality parameters were measured for both test wells; the full suite of water quality results measured for the Monticello Shores and Berryessa Point test wells is provided in Appendix E.

10.4.3 Potential Water Treatment

No treatment is anticipated for the Steele Canyon and Spanish Flat Recreation Areas. Treatment will be needed for the proposed groundwater systems at the Putah Canyon, Monticello Shores and Berryessa Point recreation areas, or if the surface water supply option is pursued (water service at Berryessa Point is Authorized and may be omitted). At a minimum, the ground water treatment process will include chlorination for viral disinfection. Given the size of the storage tank required at each recreation area, disinfection contact time should be easily attained in the storage tank. Chlorine feed equipment will be housed in the booster pump station which will be located at the storage tank site. Chlorine will be added to the raw water pipeline upstream of the water storage tank. The type of chlorine and the actual injection method is described below.

Given the test well water quality results for Monticello Shores and Berryessa Point, a treatment option would include peroxidation using permanganate or chlorine dioxide, coagulation, flocculation, sedimentation and filtration. Total Dissolved Solids (TDS) remaining in the water may be removed using Reverse Osmosis (RO). The conventional treatment train described would be needed for metals removal upstream of the RO. A typical RO recovery rate is on the order of 80%. The low well production coupled with the limited recovery rate would make treatment undesirable. Brine disposal options are typically challenging in non-coastal areas. Brine discharge to the lake may be feasible, but would need to be permitted through CDPH. Ion exchange is another treatment option, but the high alkalinity in the water would result in low bed volumes. Additionally the iron and manganese would be competing with arsenic and sulfate, which would further reduce bed volume capacity and increase cost.

Assuming that an adequate capacity of water could be obtained for the recreation areas with new water supplies, treated or untreated water would require disinfection prior to distribution. Disinfection would be achieved using liquid sodium hypochlorite system or a tablet feed system. The disinfection system will be designed to match the flow characteristics of the well pump at each site; disinfection system flows defined below are based on assumed well yields for each site. Chlorination of the raw well water may be accomplished using a 12%solution of sodium hypochlorite at a dosage of 2 parts per million (ppm). A metering pump operating in the range of 0.25 to 1.5 gallons per hour (gph) will be needed. The hypochlorite will be dosed into the raw water through an injection quill installed with a static mixer in the raw water pipeline ahead of the water storage tank. A chlorine analyzer that samples at the entry point to the distribution system (at the outlet of the storage tank) is required for reporting to the State on a daily basis. Sodium hypochlorite will be delivered in a 55-gallon drum and stored on a containment pallet. An example cut sheet for a containment pallet is provided in Appendix E-3E. Depending on the recreation area and the seasonal use rate, this volume of hypochlorite will hold enough solution to chlorinate the raw water for a period of 5 to 6 months. The chemical shelf life will need to be an operational consideration in the low season.

Alternatively, a tablet feeder chlorination system may be used. A tablet feeding system will need to operate in a water flow range of 40-90 gpm at a 2 ppm dosage. Additionally, a maximum of 0.5 to 1.5 pounds of chlorine per day will be needed. Tablet feeder chlorination systems require very little maintenance, and the calcium chloride tablets have a very long shelf life. This method is well-suited for fluctuating water demands projected for the recreation areas. However, the hardness of the well water will be a consideration when selecting chemical feed equipment. Calcium chloride tablet feeders are not well-suited for very hard waters. Cut sheets of proposed tablet feed equipment are provided in Appendix E-3A.

10.5 Distribution System Hydraulic Modeling

Hydraulic modeling was performed using the computer modeling package WaterGEMS Version 8i SelectSERIES 4 by Bentley Systems to assess the performance of the proposed potable water systems. The initial hydraulic model representing the proposed water system was developed from the 30 percent design drawings. A description of the model development and hydraulic scenario development is presented in Section 10.5.2.

The work described in this section was focused on properly sizing the system for long term build-out and determining the hydraulic head required to meet the design criteria. This section is not a complete distribution system master plan, and does not necessarily address all potential deficiencies in the proposed distribution systems (e.g., potential water age issues). Any water quality requirements and/or supplemental head requirements will be evaluated in future design phases.

10.5.1 Model Software Description

The WaterGEMS® package is a GIS-based software program with the capability to simulate hydraulic and water quality performance of water system components, including pipes, pumps, storage tanks, wells, and valves. The output of the model includes flows, pressures, velocities, tank levels, etc., under various operational and demand scenarios.

For the purpose of the 60 percent design effort, WaterGEMS® was used instead of InfoWater by Innovyze. The selection of this software was based in part because of the demand scaling tool that is helpful in analyzing low flow scenarios.

10.5.2 Model Development Procedure

A preliminary hydraulic model was developed using information from the 30% Infrastructure Design Report and Drawings. The initial pipe layouts, hydrant locations, demand allocation, and well and tank locations were based on these drawings. Because of updated consumptive demand estimates and fire flow

requirements, it was determined that the storage tank sizes needed to be increased to accommodate the long term build-out scenario. Because tank size and geometry impact the hydraulic grade line of the systems, these modifications were also included in the 30 percent hydraulic model.

Demands for each recreation area are based on the demand estimates presented in Table 10-5 and Table 10-6 and were spatially distributed within each recreation area based on the point of use locations designated in the 30 percent design drawings. Elevations of the distribution system components were estimated based on ground surface topographic data for the recreation areas.

Results from the preliminary hydraulic model were evaluated to identify potential improvements to the 30% Infrastructure Design. Refinements were then made to the preliminary model to reflect the enhancements of the planning developed during the 60% design effort. Results for both the preliminary model (30% Design) and the refined model (60%) are summarized in Section 10.5.5.

10.5.3 Hydraulic Design Criteria

The hydraulic design criteria listed below represent the current understanding of the minimum hydraulic design requirements for the proposed water distribution systems. The distribution system hydraulic modeling results were evaluated against these criteria to identify deficiencies and/or opportunities for improvement within the systems.

Water Demand

- Maximum Consumptive Demand
  - Assumes 100% occupancy of recreation areas
  - Demand values are summarized are in Table 10-4
  - Peak Hour Peaking Factor : approximately 1.9
- Maximum Total Demand (including fire flow)
  - Maximum consumptive demand plus fire flow of 300 gpm, except for hydrant serving Steele Canyon boat storage facility (see next bullet)
  - Maximum consumptive demand plus fire flow of 1,400 gpm at Steele Canyon boat storage facility
  - Assumes fire flow demand occurs at a single hydrant, e.g. only one event occurring at any one time

Distribution Piping

- Pipe material: High density polyethylene (HDPE)
- Pressure class: Varies depending upon recreation area
- Hazen Williams roughness coefficient (*C*): 130

Hydraulic Parameters

- Maximum Consumptive Demand:
  - Minimum allowable pressure: 40 psi
  - Maximum allowable velocity: 4 feet/second (fps)
  - Maximum allowable headloss gradient: 2 feet/1,000 feet (ft./1Kft)
- Maximum total demand (including fire flow)
  - Minimum residual pressure at fire hydrant: 20 psi

10.5.4 Hydraulic Modeling Scenarios

As described in Section 10.5.2, two design configurations were evaluated as part of this analysis. The initial configuration was based on the 30 percent design, and the refined configuration represents the updated pipe sizes proposed for the 60 percent design and enhanced development planning. Demand conditions, including maximum consumptive demand and maximum total demand (including fire flow), were evaluated for each design configuration. Details for each scenario evaluated are provided below.

30% Design – Scenario 1

- Demand: Maximum consumptive instantaneous demand
- Pipe Network: 30% Pipe design layout and sizes
- Storage: Tank levels at minimum fire flow storage requirement

30% Design – Scenario 2

- Demand: Maximum total demand (including fire flow)
- Pipe Network: 30% Pipe design layout and sizes
- Storage: Tank level at 1 foot above base

60% Design and Planning – Scenario 1

- Demand: Maximum consumptive instantaneous demand
- Pipe Network: 60% Pipe design layout and sizes
- Storage: Tank levels at minimum fire flow storage requirement

60% Design and Planning – Scenario 2

- Demand: Maximum total demand (including fire flow)
- Pipe Network: 60% Pipe design layout and sizes
- Storage: Tank level at 1 foot above base

10.5.5 Hydraulic Modeling Results

Key model inputs and results for the 30 percent design are summarized in Table 10-11 and Table 10-12 for Scenarios 1 and 2, respectively. The results show that maximum velocities and headloss gradients satisfy the design criteria for all of the recreation areas under the maximum consumptive use scenario. However, the results show that the 30 percent design does not meet the minimum hydraulic pressure criterion under maximum consumptive demand at Putah Canyon, Monticello Shores and Berryessa Point Recreation Areas. Additionally, there is a pressure deficiency at Berryessa Point Recreation Area during a fire flow event. It is assumed that the Steele Canyon Recreation Area will rely on an existing municipal water supply, appears to have adequate hydraulic pressure under both model scenarios.

Table 10-11. 30% Design – Scenario 1 Hydraulic Modeling Summary

Recreation Area	Model Inputs			Model Results			
	Maximum Consumptive Instantaneous Demand	Tank Level	Supply Pressure	Maximum Velocity	Maximum Headloss Gradient	Minimum Supplied Pressure	Pressure Deficiency (Criterion=40 psi minimum)
	gpm	ft	psi	ft/s	ft/1k ft	psi	psi
Putah Canyon	39	4.2	-	0.1	0.01	37	3
Monticello Shores	55	2.8	-	0.5	0.16	25	15
Berryessa Point	17	4.6	-	1.2	1.80	21	19
Spanish Flat	20	4.2	125	0.8	0.22	52	-
Steele Canyon	59	-	60	1.0	1.02	84	-

Table 10-12. 30% Design – Scenario 2 Hydraulic Modeling Summary

Recreation Area	Model Inputs			Model Results	
	Maximum Instantaneous Demand	Tank Level	Supply Pressure	Minimum Supplied Pressure	Pressure Deficiency (Criterion=20 psi minimum)
	gpm	ft	psi	psi	psi
Putah Canyon	339	1.0	-	34	-
Monticello Shores	355	1.0	-	22	-
Berryessa Point	317	1.0	-	19	1
Spanish Flat	320	0.0	125	49	-
Steele Canyon	1,459	-	60	33	-

Based on the modeling results for the 30 percent design configuration, it was determined that the diameters of certain pipes in each system could be reduced without significantly increasing headloss in the systems. The modified pipe sizes were incorporated in the model to represent the 60 percent design. Key

model inputs and results for the 60 percent design enhanced planning are summarized in Table 10-13 and Table 10-14 for Scenarios 1 and 2, respectively.

Table 10-13. 60% Design – Scenario 1 Hydraulic Modeling Summary

Recreation Area	Model Inputs			Model Results			
	Maximum Consumptive Instantaneous Demand	Tank Level	Supply Pressure	Maximum Velocity	Maximum Headloss Gradient	Minimum Supplied Pressure	Pressure Deficiency (Criterion=40 psi minimum)
	gpm	ft	psi	ft/s	ft/1k ft	psi	psi
Putah Canyon	39	4.2	-	0.3	0.075	37	3
Monticello Shores	55	2.8	-	0.5	0.158	25	15
Berryessa Point	17	4.6	-	0.3	0.083	21	19
Spanish Flat	20	4.2	125	1.3	1.073	53	-
Steele Canyon	59	-	60	1.0	1.022	84	-

Table 10-14. 60% Design – Scenario 2 Hydraulic Modeling Summary

Recreation Area	Model Inputs			Model Results	
	Maximum Instantaneous Demand	Tank Level	Supply Pressure	Minimum Supplied Pressure	Pressure Deficiency (Criterion=20 psi minimum)
	gpm	ft	psi	psi	psi
Putah Canyon	339	1.0	-	32	-
Monticello Shores	355	1.0	-	22	-
Berryessa Point	317	1.0	-	19	1
Spanish Flat	320	0.0	120	48	-
Steele Canyon	1,459	-	60	64	-

As shown in Table 10-13 and Table 10-14, the refinements to the 30 percent design did not eliminate the pressure deficiencies. It was determined that, regardless of pipe sizing, there is not enough static head in the distribution systems at Putah Canyon, Monticello Shores and Berryessa Point Recreation Areas to meet the minimum pressure criterion for maximum consumptive demand. Additionally, the minimum pressure criterion was not met at Berryessa Point Recreation Area during a fire flow event. Recommendations to address the pressure deficiencies are provided in Section 10.5.6. Model schematics and detailed model output are provided in Appendix E-2A. Pressure was adequate to meet the criterion at both Spanish Flat and at Steele Canyon.

10.5.6 Hydraulic Modeling Recommendations

The recommended approach to addressing the pressure deficiencies identified above is to add booster pumps, maximum demand pumps, and hydro-pneumatic tanks. The booster pumps and hydro-pneumatic tanks are proposed to address the anticipated pressure deficiencies under maximum consumptive demands.

The maximum demand pumps are proposed to address the anticipated pressure deficiencies under maximum total demands (including fire flows) at Putah Canyon, Monticello Shores and Berryessa Point recreation areas. Because of the lack of definitive input regarding potential sprinklers for the marina, retail and restaurant facilities, the three sites reliant upon ground water are proposed to have maximum demand pumps since the fire flows may be increased, thus resulting in additional friction losses. Additionally, the minimum allowable pressure criteria used in the model may need to be increased to allow proper sprinkler operation depending on the elevation of sprinkler heads. Some of these deficiencies may be resolved if the concessionaire chooses to not pursue Authorized services at a given recreation area; for instance, the marina at Monticello Shores is Authorized, as are all restaurants, additionally, water service at Berryessa Point is Authorized.

Alternatively, the pressure deficiencies at each site could be resolved by increasing the elevation of the storage tanks. However, it is unknown at this time if site constraints will allow raising the tanks, hence, the recommendation for the addition of pumps. This will require more detailed analysis in the future design phase.

Table 10-15. Recommendations for Pumps

	Hydro-pneumatic system[1]		Maximum Demand Pumps	
Recreation Area	Pressure (psi)/ Head (ft.)	Flow	Pressure (psi)/ Head (ft.)	Flow (gpm)
Putah Canyon[2]	3/7	Maximum Day Usage	-	-
Monticello Shore	15/35	Maximum Day Usage	-	-
Berryessa Point	19/44	Maximum Day Usage	19/44	319

[1] Hydro-pneumatic pump sizing would depend on tank size

[2] Pressure need can be met by raising minimum tank operations to 12 ft. from base

Because of projected seasonal fluctuations in water demands at the each of the recreation areas, there is potential for water quality issues related to excessive water age during periods of low occupancy. It is recommended that future analyses evaluate potential issues related to water age and possible measures for addressing them.

Finally, further analysis is recommended for the municipal water supply at Steele Canyon Recreation Area to ensure that this connection can meet the hydraulic pressure and fire flow requirements. Based on information provided from the Spanish Flat Water District, the consumptive demands will be met by the existing pressure and flow and fire demand will be met through use of one of the existing water storage tanks located at the site. However, there has been limited input and feedback from the respective water districts servicing these sites.

10.6 Distribution System Design

As previously discussed, the Putah Canyon, Berryessa Point, and Monticello Shores Recreation Areas will rely on new ground water wells for water supply; the Spanish Flat and Steele Canyon Recreation Areas will be supplied by existing municipal water systems. The distribution system for recreation areas that will be supplied by new ground water wells, or other water supply source, require more infrastructure than the recreation areas that will be supplied by existing municipal water systems. Also note that providing water service to Berryessa Point is an Authorized service, and may be omitted.

It is anticipated that the existing municipal water distribution systems will be able to meet the capacity and pressure requirements of maximum day at Steele Canyon and Spanish Flat without the need for additional treatment. It is also assumed that the Napa Berryessa Resort Improvement District, which is assumed to provide water to Steele Canyon, will be able to meet the requirements for both consumptive and fire flow conditions without the need for additional pumps or storage.

It is assumed that Spanish Flat Water District will be able to meet the consumptive demands at the Spanish Flat recreation area, but the District has indicated that they cannot provide adequate flow to the Spanish Flat recreation area to meet fire flow demands. Fire flow demand at Spanish Flat will be achieved through storage at the recreation area.

The general infrastructure design considerations that are common to both the ground water and municipal systems are discussed below. Specific infrastructure requirements for the ground water systems are discussed in Section 10.6.1; specific infrastructure requirements for the municipal systems are discussed in Section 10.6.2.

Distribution system infrastructure was designed based on refinements identified during model development. As shown on the drawings, water distribution lines are predominately 6 and 8 inches. Since the lines will also serve fire flows, they will be designed to comply with NFPA 24 for Private Fire Service Mains. The potable water distribution system will be constructed using various sizes of HDPE pipe, as required by Reclamation standards.

The minimum pressure during max day demands was assumed to be 40 pounds psi, which is a typical industry standard for minimum municipal distribution system pressure. The minimum pressure, or lowest head condition, results when system demands and pipe friction losses are high and storage tank levels are low, resulting in the lowest system pressures at points farthest away from the source or a high elevation relative to the water storage tank. If the available pressure anywhere within a recreation area, as developed by the assumed storage reservoirs' base elevation, was less than 40 psi during maximum day demand conditions or less than 20 psi during maximum day plus fire conditions,

a booster pump station was added within the system to increase the pressure in these low-pressure areas. Operational pressures at Spanish Flat and Steele Canyon will be provided by the existing local potable water pipelines, which reportedly have been sized for the additional demands required by these new developments. .

Connections for potable water will be included in the construction of marinas, park models, cabins, comfort stations, fish cleaning stations, standard sites with full hookups for utilities, and any other structure with water needs. For tent-only campsites, water spigots will be located nearby, with approximately one spigot for every ten tent sites. Fire hydrants will be located, as required, within 150 feet of any fire department access road.

Valves and Drains

The distributions system will contain a combination of air release/vacuum valves, blow-offs and drain valves. Air release/vacuum valves will be installed at high-elevation points in the distribution system. These valves open to release air and allow draining without causing a vacuum in the pipeline. Drain valves will be installed at low points, and blow-offs will be installed at dead ends to accommodate system maintenance. Cut sheets are provided in Appendix E-3G.

System Flushing

Water age is of primary concern for prevention of biological growth in the distribution system by maintaining a disinfectant residual. The disinfectant degrades over time, thus high water age is a water safety concern. Because of seasonal fluctuations in potable water demand, water age may be an issue in certain parts of the systems during low demand seasons. Therefore, regular flushing of the systems will likely be required during periods of low occupancy to maintain adequate water quality throughout the systems.

The water quality will need to comply with CDPH regulations. Demonstration of compliance will likely be required on a regular basis. If chlorine residual is not maintained, the non-disinfected water will need to be flushed out of the system. Flushing can be performed either manually or on an automated basis. Manual flushing would likely need to be performed by a state licensed water distribution operator; whereas automatic flushing stations may be desired to reduce maintenance and operation of the distribution system.

An automatic flushing station, such as the Eclipse #9400A manufactured by The Kupferle Foundry Company, can be installed on dead-end water lines and low use zones so there is periodic turnover of the water in the lines. Automatic flushing units are rather expensive, with an estimated cost of approximately $30,000 per unit for the #9400A, which measures water quality and flushes as needed. Less sophisticated units are available at approximately $3,000 per unit. The less sophisticated model can be programed to flush based on a timer, but does not include any internal sampling equipment.

Discharge from the flushing stations may require permits and will require further design to prevent freezing and to optimize the location of each flushing station. A dechlorination system would likely be needed at each station if the less sophisticated, timer based unit is selected. Alternatively, the system could be manually tested for chlorine residual and manually flushed, if necessary. Auto flushing stations were included in the design to minimize operational and maintenance requirements.

It is important to note that a discharge permit may be required for the flushing stations regardless of the discharge method. At this time, four of the more expensive, sophisticated units were assumed for each site, to contain the capital cost for this item. Auto flushing stations are only referenced and not shown on the drawings pending further analysis and discussions with Reclamation. Looping of some portions of the distribution system may help minimize the quantity of dead-ends in the system and in turn the locations where water age is likely to be of concern. However, the infrastructure layout at each site is not well suited for system looping.

10.6.1 Ground/Surface Water Distribution System Design

The well systems will operate as shown on the process flow diagram in the drawings. The well pump will discharge at the storage tank and will not be tied directly to the distribution system piping. A flow meter will be installed on the well discharge line to measure well production. The water will be disinfected upstream of the storage tank. Chemical dosing will be paced on the well discharge rate. Water will gravity flow from the storage tank to a duplex booster pump/hydro-pneumatic tank system, which will be used to maintain a minimum pressure in the system to meet maximum consumptive demands. An example cut sheet for a hydro-pneumatic tank is provided in Appendix E-3B.

Since maximum total demands are much higher than consumptive demands, a maximum demand pump will be activated to maintain pressure in the system during maximum instantaneous demands resulting from fire flows.

The water storage tank will be sized to store two days of maximum consumptive usage, in addition to the storage required to meet projected fire demands. Based on preliminary calculations, the detention time in the tank, in combination with time in the distribution system, will exceed the minimum chlorine contact time requirements.

Water Storage

A storage facility will be required to store potable water for distribution at Putah Canyon, Monticello Shores and Berryessa Point. The minimum required storage volume is determined from the sum total of the necessary operational and fire flow storage. Operational flow was determined for each recreation area as twice the projected maximum day flows described above. Note that off-season storage requirements will be substantially lower than peak-season storage requirements.

Storage will also be required at Spanish Flat. The Spanish Flat Water District has indicated that they cannot provide adequate flow to the Spanish Flat recreation area to meet fire flow demands. Thus storage will be required at the recreation area to maintain adequate fire flow volume. An existing tank at this location is available for use, but will need to be refurbished. Note that storage is not planned for consumptive demands. It is assumed that the Spanish Flat Water District will be able to provide adequate flow to meet this demand.

Figure 10-2. Existing Storage Facility at Spanish Flat

Fire flow storage is based on Table B105.2 of Chapter 15.32 of Napa County's Code of Ordinances (see Table 10-7 above) and requires a minimum water storage volume for fire protection of 12,000 gallons. Sizing of the tanks assumed that there would be two feet of freeboard, and one foot of unused dead-space for sediment collection. The height of the tank was sized to not exceed the height of the surrounding trees. Additionally, the tanks will comply with NFPA 22 Water Tanks for Private Fire Protection.

Steel storage tanks (bolted or welded) were located at the highest accessible elevations at each recreation area to assist in developing pressures throughout the distribution system. The need for easy access to each tank site and parking for future operations and maintenance needs was also considered in locating and sizing the task areas.

Each tank will be equipped with two access hatches-- one along the side of the tank and one located on the roof of the tank with an access ladder, for ease of maintenance. Each of the tanks will also have a vent on the roof, an overflow pipe, water level gauge, and drain. The inlet/outlet pipes will be used to fill the tank from the ground water well pump and to distribute potable water throughout the recreational area.

Dowsing Results

The proposed wells at Lake Berryessa were selected based on data supplied by Reclamation, which secured the services of a dowser (Jack Coel) in December 2013 to determine locations and depths of reliable, good quality water sources at Putah Canyon, Monticello Shores and Berryessa Point. Based on Mr. Coel's experience in the area, a number of potential sites were identified and a very brief write-up was provided to Reclamation with the recommended well locations for this project. The data included a depth range to the lowest water level (+/- 100 feet) and an anticipated yield in gallons per minute, with a horizontal distance from the located reference point where the water vane is located. Dowser data is located in Appendix E-4A.

Well dowsing estimations should be used with caution since there is no scientific evidence that dowsing is accurate. Results from dowsing should be explored further by drilling test wells at each recreation area. As previously noted, test wells constructed at Monticello Shores and Berryessa Point both resulted in water recovery rates that were vastly lower than predicted by the dowser report.

Well Design

If water wells are pursued, a site-specific design will be required for each ground water well based on the results of a more extensive well drilling and development program. The conceptual well design is presented in the 60 percent design drawings as a detail of each proposed well sites at the Putah Canyon, Berryessa Point and Monticello Shores Recreation Areas. The water supply wells must be drilled and constructed in compliance with State of California Water Well Regulations and Napa County well standards.

Ground water well sites were designed to fit within a 30- by 30-foot fenced area. The surface completion for each well will consist of a municipal grade pitless unit that attaches to the well casing to provide a sanitary underground discharge. Each well site will include a pitless unit, a transformer pad, electrical equipment pad, submersible well pump and a valve vault (including a flow meter, isolation valves and a check valve). The following section provides a description of the major components of the water supply wells.

The 60% design identifies each well to be drilled in a 16-inch diameter borehole using the reverse circulation drilling method. Based on Reclamation's preliminary information available, the well depths will range from 375 feet below ground surface (bgs) to 450 feet bgs (+/- 100 feet). Final well depths will be based on the geology encountered at each site. The wells will be constructed as 8-inch diameter (nominal) wells. Well materials will consist of A53 Grade B steel for the well casing and 304 stainless steel wire wrapped screen for the well screen. Each well will be constructed with a sanitary seal that extends a minimum of 50 foot bgs and is filled with a bentonite grout cement mixture that complies with the State of California Water Well Regulation.

Submersible Well Pump

Each well will be equipped with a submersible well pump. Sizing of the submersible pump must account for the Total Head (TH), which includes static head requirements (the pressure required to lift the water from below ground to the high-water level in the storage tank) in addition to the total dynamic head (TDH), which includes friction losses in the pipe. The well pumps will be sized to meet the maximum daily demand in a 12-hour period or to refill the storage required for fire flow in an 8-hour time frame, whichever is greater. The fire flow storage refilling rate is required to comply with fire code NFPA 22. For the purposes of 60 percent design, the well pumps were sized to meet the anticipated well yields identified in the dowser report provided by Reclamation.

Final pump design conditions will be based on additional hydrogeological assessment and final distribution system requirements.

Given these preliminary design conditions, a nominal 4-inch diameter (OD) submersible pump will be used to produce water from the wells. Numerous pump manufactures have pumps that operate within the design conditions listed above. An example is the Grundfos SP range of submersible pumps. The submersible motors for these types of pumps are generally 60 Hz motors and generally operate on single- or three-phase power. Cut sheets for Grundfos are provided in Appendix E-3F.

Pitless Unit

A pitless unit will be used to provide a sanitary below-grade discharge of the well water. The pitless unit will be made of steel and sized to match the 8-inch well casing. Therefore, the diameter of the upper casing will be 10 inches. The pitless unit will include a cast spool and discharge body that is galvanized for corrosion protection. The pitless unit will include a 5-foot bury depth and the top of the pitless case will extend 2 feet above the protective concrete slab. The concrete slab will be 6 feet long by 6 feet wide by 6 inches thick. The slab will be finished flush with the ground surface and will slope away from the well. Bollards will be installed in the concrete pad to protect the pitless unit.

Booster Pumps/Maximum Demand Pump

To meet pressure needs, water storage tank sites will have hydro-pneumatic tanks at each location. Duplex booster pumps will pump water into the hydro-pneumatic tanks and will be designed to maintain a 40-60 psi range. Booster pumps will range in size due to different flow requirements at each recreation area.

Hydro-pneumatic tank and booster pumps were designed to meet consumptive needs only. The consumptive water demands are much smaller than the maximum instantaneous demands. This variance does not facilitate selection of an efficient pump design to meet both demand points. Each of the recreation

areas will contain an additional maximum demand pump to meet fire flow. In compliance with NFPA 20 and 24, the proposed flow range would be:

- Flow range – 300-1400 gpm
- TDH – 20 psi minimum residual at the fire hydrants

Cut sheets for booster pumps and maximum demand pumps are provided in Appendix E-3F.

10.6.2 Master-Meter Distribution System Design

It is assumed that water will be supplied to the Steele Canyon and Spanish Flat Recreation Areas by existing municipal water distribution systems through master meter agreements. A master meter agreement at each site will allow the concessionaires to purchase all the water for the recreation area by a single metering point, rather than purchasing individual taps and water meters for each point of use. Under a master meter agreement, the concessionaire would own, operate and maintain all distribution system infrastructure located downstream of the master meter. The municipal water utility would be responsible for the water supply, water quality and infrastructure upstream of the master meter.

The Spanish Flat Recreation Area will be supplied potable water by the Spanish Flat Water District. The Steele Canyon Recreation Area will be supplied potable water by the Napa Berryessa Resort Improvement District (NBRID). Coordination with these water utilities will be needed during 90 percent design so that both systems meet any specific requirements of each utilities master meter agreements. It is recommended that a meeting be held with representatives of both municipal water districts with representatives from Reclamation present.

10.7 Putah Canyon Recreation Area

10.7.1 Potable Water Supply

It is assumed that a ground water well installed at Putah Canyon by Reclamation will be used to meet all of the potable water needs of the area. The ground water pump station was designed with a minimum flow rate of 62 gpm and a TDH of 203 feet to be able to pump from the assumed ground water level to the highest reservoir elevation.

Figure 10-3. Putah Canyon

A dowser was commissioned by Reclamation to identify proposed well drilling sites. The dowsing performed on December 12, 2013, identified four locations at Putah Canyon as potential well drilling locations. Water was estimated to be at 362 feet below grade (+/- 100 feet) with a well output of 62 gpm within a 15-foot radius of the identified location.

The water distribution system will be comprised of HDPE pipe in various diameters (mostly 8 and 6 inches) placed primarily in the proposed roadway. Because of the elevations throughout Putah Canyon, there will not be enough water pressure at certain locations from a gravitational water system; a booster pump station and hydro-pneumatic tank will be needed. The hydro-pneumatic tank will have a total tank capacity based on peak water demands and booster pumps operating at an average of 4 cycles per hour. The hydro-pneumatic tank and booster pumps will be located in a pre-engineered building approximately 625 square feet. It is assumed that three automatic flushing stations (Kupferle Eclipse #9400A or similar) will be required to maintain water quality throughout the distribution system during periods of low water demand. The automated flushing stations may be replaced with a manual sampling a flushing program performed by a licensed water distribution system operator. Alternatively, the concessionaire may elect to operate the Recreation Area with only a portion of the sites open during low use seasons. The isolated areas would then require periodic flushing to maintain water quality prior to putting back into regular service. The preliminary design criteria for the water distribution system are summarized in Table 10-16. Table 10-16 presents the information related to the full build-out of Required plus Authorized facilities. The definition of which facilities are Required and which are Authorized, refer to Table 2-2.

Table 10-16. Putah Canyon Water Facility Design Criteria

Parameter	Units	Value
Demands Criteria		
Ground Water Well Production Yield	gpm	62
Consumptive Water Max Day Demand	gpd	29,269
Required Fire Flow Demand [1]	gpm	300
Water Storage Design Criteria		
Required Fire Flow Storage	gallons	12,000
Peak Season Consumptive Storage	gallons	58,537
Total Peak Season Storage Requirements	gallons	70,537
Total Nominal Storage Capacity	gallons	75,000
Design Height of Storage Tank	ft	24
Design Inside Diameter of Storage Tank	ft	24
Hydro-pneumatic Tank Criteria		
Tank capacity	Gallons	700
Design Diameter	ft	3.5
Design Length	ft	10
Pump Criteria		
Ground Water Well pump	hp	5.0
Pump and Model Number	Grundfos Submersible Pump 60S50-9	
Booster Pump	hp	3.0
Pump and Model Number	Grundfos Vertical multistage centrifugal pumps CR 5-8	
Maximum Demand Pump	hp	7.5
Pump and Model Number	Grundfos Vertical multistage centrifugal pumps CR 45-1-1	

[1] Fire flow demand and storage numbers were developed using Table 10-6 of this report for sprinkled systems.

10.8 Monticello Shores Recreation Area

10.8.1 Potable Water Supply

It was originally anticipated that a ground water well with a pump designed at 82 gpm could be installed at Monticello Shores could be used to meet all of the water needs of the area. However, based on the much lower production (3 gpm) and poor water quality of test wells at this location, it is likely that an alternate water supply will be needed. If the well supply is pursued, a detailed hydrogeological investigation should be performed to identify an appropriate location and depth for each well to meet the site demands. Additionally, based on test well water quality, treatment will be needed to meet the secondary standards for iron, manganese and TDS.

A new drinking water treatment facility and raw water intake will be needed if surface water from the lake is used. It is anticipated that lake water would be treated and pumped to a new storage tank.

Figure 10-4. Existing Storage Facility at Monticello Shores

The water distribution system will be comprised of HDPE pipe in various diameters (mostly 8 and 6 inches) placed primarily in the proposed roadway. Because of the elevations of Monticello Shores, there will not be enough water pressure at certain locations from a gravitational water system; a booster pump station will be needed. The hydro-pneumatic tank will have a total tank capacity of 1,100 gallons based on peak water demands and booster pumps operating at an average of 4 cycles per hour. The hydro-pneumatic tank and booster pumps will be located in a pre-engineered building approximately 625 square feet. The potable water system extends throughout the recreation area except for the peninsula of tent-only sites. Visitors to these sites can access potable water from spigots throughout the recreation area, with the closest water spigot being just north of the boat trailer parking lot. It is assumed that three automatic flushing stations (Kupferle Eclipse #9400A or similar) will be required to maintain water quality throughout the distribution system during period of low water demand. The automated flushing stations may be replaced with a manual sampling a flushing program performed by a licensed water distribution system operator. Alternatively, the concessionaire may elect to operate the Recreation Area with only a portion of the sites open during low use seasons. The isolated areas would then require periodic flushing to maintain water quality prior to putting back into regular service.

The preliminary design criteria for the water distribution system are summarized in Table 10-17. Table 10-17 presents the information related to the full build-out of Required plus Authorized facilities. The definition of which facilities are Required and which are Authorized, refer to Table 2-3.

Table 10-17. Monticello Shores Water Facility Design Criteria

Parameter	Units	Value
Demands Criteria		
Ground Water Test Well Production Yield	gpm	3
Potable Water Max Day Demand	gpd	40,955
Required Fire Flow Demand [1]	gpm	300
Water Storage Design Criteria		
Required Fire Flow Storage	gallons	12,000
Peak Season Consumptive Storage	gallons	81,909
Total Peak Season Storage Requirements	gallons	93,909
Total Nominal Storage Capacity	gallons	100,000
Design Height of Storage Tank	ft	26
Design Inside Diameter of Storage Tank	ft	26
Hydro-pneumatic Tank Criteria		
Tank capacity	Gallons	1100
Design Diameter	ft	3.5
Design Length	ft	12
Pump Criteria		
Booster Pump	hp	5.0
Pump and Model Number	Grundfos Vertical multistage centrifugal pumps CR 10-5	
Maximum Demand Pump	hp	7.5
Pump and Model Number	Grundfos Vertical multistage centrifugal pumps CR 45-1-1	

[1] Fire flow demand and storage numbers were developed using Table 10-6 of this report for sprinkled systems.

10.9 Berryessa Point Recreation Area

10.9.1 Potable Water Supply

It was originally anticipated that a ground water well with a pump designed at 27 gpm could be installed at Berryessa Point to meet all of the water needs of the area. However, based on the much lower production (3 gpm) of test wells at this location, it is likely that an alternate water supply will be needed. Since providing water service to Berryessa Point is now considered Authorized, no additional consideration need be made unless a concessionaire chooses to provide water or another Authorized service that imposes consumptive or fire flow demand. If the well supply is pursued, a detailed hydrogeological investigation should be performed to identify an appropriate location and depth for each well to meet the site demands. Additionally, based on test well water quality, treatment will be needed to meet the secondary standards for iron, manganese and TDS.

If surface water from the lake is used in lieu of ground water, a new drinking water treatment facility and raw water intake will be needed. It is anticipated that lake water would be treated and pumped to a new storage tank.

Figure 10-5. Berryessa Point

The water distribution system will be comprised of HDPE pipe in various diameters (8 inch and 6 inches) placed primarily in the proposed roadway. Because of the elevations of Berryessa Point, there will not be enough water pressure at certain locations from a gravitational water system; a booster pump station located near the proposed ground water well site will be needed. Based on peak water demands, the hydro-pneumatic tank will have a total tank capacity of 350 gallons and booster pumps operating at an average of 4 cycles per hour. The hydro-pneumatic tank and booster pumps will be located in a pre-engineered building approximately 625 square feet. It is assumed that three automatic flushing stations (Kupferle Eclipse #9400A or similar) will be required to maintain water quality throughout the distribution system during periods of low water demand. The automated flushing stations may be replaced with a manual sampling a flushing program performed by a licensed water distribution system operator. Alternatively, the concessionaire may elect to operate the Recreation Area with only a portion of the sites open during low use seasons. The isolated areas would then require periodic flushing to maintain water quality prior to putting back into regular service.

The preliminary design criteria for the water distribution system are summarized in Table 10.18. Table 10-18 presents the information related to the full build-out of Required plus Authorized facilities. The definition of which facilities are Required and which are Authorized, refer to Table 2-4.

Table 10.18. Berryessa Point Water Facility Design Criteria

Parameter	Units	Value
Demands Criteria		
Ground Water Test Well Production Yield	gpm	3
Potable Water Max Day Demand	gpd	12,824
Required Fire Flow Demand [1]	gpm	300
Water Storage Design Criteria		
Required Fire Flow Storage	gallons	12,000
High Season Consumptive Storage	gallons	25,647
Total Peak Season Storage Requirements	gallons	37,647
Total Nominal Storage Capacity	gallons	40,000
Design Height of Storage Tank	ft	18
Design Inside Diameter of Storage Tank	ft	20
Hydro-pneumatic Tank Criteria		
Tank capacity	Gallons	350
Design Diameter	ft	3
Design Length	ft	6
Pump Criteria		
Booster Pump	hp	1.5
Maximum Demand Pump	hp	7.5

[1] Fire flow demand and storage numbers were developed using Table 10-6 of this report for sprinkled systems.

10.10 Spanish Flat Recreation Area

10.10.1 Potable Water Supply

The Spanish Flat Recreation Area will be supplied potable water by the Spanish Flat Water District, which would, without additional support, be able to meet the capacity and pressure requirements of maximum day and fire flow conditions. Negotiation of the water supply agreement with Spanish Flat Water District will need to confirm the ability of the District to meet the storage, flow, pressure and water quality requirements of the Spanish Flat Recreation Area.

There is currently a 6-inch diameter water main located within the Spanish Flat Recreation Area that is connected to the Spanish Flat Water District water distribution system. Treated water from the Spanish Flat Water District flows through a 2-inch water meter with a pressure of 120 psi as it enters the Spanish Flat recreation area. The Spanish Flat Water District has indicated that they cannot provide adequate flow to the Spanish Flat recreation area to meet fire flow demands. Thus storage will be required at the recreation area to maintain adequate fire flow volume. An existing tank at this location is available for use, but will need to be refurbished. According the Spanish Flat Water District staff, there is an existing line in place that was previously used to connect District water supply with the existing water storage tanks at the recreation area. The existing line is presumed to be 4 to 6-inch diameter and would require repair to make the line functional. Due to the unknown condition of this pipe, it is

assumed that a new 6-inch diameter line would be installed to fill the existing tank. New piping would then be installed to convey water from the existing tank to the distribution system.

It is assumed that storage for consumptive demands will not be needed; the Spanish Flat Water District will be able to provide adequate flow to meet this demand. Storage at the Spanish Flat recreation area will be needed for fire demands only. The existing water meter will not be designed to bypass the existing water storage tank. This will maximize tank turnover and in turn help reduce water age in the system. A flow control valve with controls to the water storage tank would likely be needed to control the volume and rate of water being delivered to Spanish Flat Recreation Area to comply with some pre-established agreement with the Spanish Flat Water District. This arrangement and an agreement would need to be established prior to final design.

Figure 10-6. Spanish Flat

There are two existing 24,000-gallon storage tanks located in the recreation area that are potentially available for on-site storage of potable water. The storage tanks are estimated to be more than 50 years old and will need to be refurbished or replaced. No water has been stored in the tanks since 2008, and it is possible that the tanks liners have been compromised during that time. Since storage is only needed for fire flow capacity, one of the tanks would provide sufficient storage capacity.

The water distribution system will be comprised of HDPE pipe in various diameters (mostly 8 and 6 inches) placed primarily in the proposed roadway. Water spigots will be located near campsites, with approximately one spigot for every ten campsites. It is assumed that three automatic flushing stations (Kupferle Eclipse #9400A or similar) will be required to maintain water quality

throughout the distribution system during periods of low water demand. The automated flushing stations may be replaced with a manual sampling a flushing program performed by a licensed water distribution system operator. Alternatively, the concessionaire may elect to operate the Recreation Area with only a portion of the sites open during low use seasons. The isolated areas would then require periodic flushing to maintain water quality prior to putting back into regular service.

The preliminary design criteria for the water distribution system are summarized in Table 10-19. Table 10-19 presents the information related to the full build-out of Required plus Authorized facilities. The definition of which facilities are Required and which are Authorized, refer to Table 2-5.

Table 10-19. Spanish Flat Water Facility Design Criteria

Parameter	Units	Value
Potable Water Max Day Demand	gpd	17,398
Required Maximum Fire Flow Demand	gpm	300
Required Fire Flow Storage	gallons	12,000

10.11 Steele Canyon Recreation Area

10.11.1 Potable Water Supply

It is assumed that the Steele Canyon Recreation Area will be supplied potable water by NBRID, which would, without additional support, be able to meet the capacity and pressure requirements of maximum day and fire flow conditions. Negotiation of the water supply agreement with NBRID will need to confirm the ability of the District to meet the storage, flow, pressure and water quality requirements of the Steele Canyon Recreation Area.

Figure 10-7. Steele Canyon

There is an existing capped 6-inch water main located within the Steele Canyon Recreation Area that is connected to the NBRID water distribution system. A pressure-reducing valve within the NBRID system maintains a pressure of approximately 65 psi in the water main at the Steele Canyon Recreation Area. According to NBRID staff, the existing NBRID system contains a 500,000-gallon storage tank located at an elevation 1,100 feet. It is assumed that there are adequate storage and pressure within the NBRID system to meet maximum day and fire flow requirements of the recreation area.

The water distribution system will be comprised of HDPE pipe in various diameters (mostly 8 and 6 inches) placed primarily in the proposed roadway. Water spigots will be located near campsites, with approximately one spigot for every ten campsites. It is assumed that three automatic flushing stations (Kupferle Eclipse #9400A or similar) will be required to maintain water quality throughout the distribution system during periods of low water demand. The automated flushing stations may be replaced with a manual sampling a flushing program performed by a licensed water distribution system operator. Alternatively, the concessionaire may elect to operate the Recreation Area with only a portion of the sites open during low use seasons. The isolated areas would then require periodic flushing to maintain water quality prior to putting back into regular service. The preliminary design criteria for the water distribution system are summarized in Table 10-20. Table 10-20 presents the information related to the full build-out of Required plus Authorized facilities. The definition of which facilities are Required and which are Authorized, refer to Table 2-6.

Table 10-20. Steele Canyon Water Facility Design Criteria

Parameter	Units	Value
Potable Water Max Day Demand	gpd	45,415
Required Maximum Fire Flow Demand	gpm	1,463
Required Fire Flow Storage	gallons	144,000

Chapter 11
Wastewater Collection & Treatment

This chapter summarizes the preliminary design of the wastewater collection and treatment systems at the five recreation areas included in the Project.

11.1 Design Criteria

A summary of the design criteria used for each recreation area is included in this Section. The development of the design criteria is discussed in detail in the following sections.

11.1.1 Putah Canyon

Wastewater collection, treatment, and disposal is a Required amenity at Putah Canyon. Wastewater generated at Putah Canyon will be collected using a Septic Tank Effluent Pumping (STEP) system. This system consists of short segments of gravity sewer that convey wastewater to septic tanks located throughout the site. Each septic tank has a dedicated grinder lift station. The lift station delivers effluent from the septic tank to the wastewater treatment facility through a network of small diameter force mains.

The proposed wastewater treatment facility at Putah Canyon consists of two facultative treatment ponds, followed by a treated effluent storage pond, and an effluent disposal spray field. The two ponds would treat the wastewater in parallel. Effluent from the treatment ponds will be discharged into the storage pond, where it will be stored until it can be discharged to the spray field. The ponds and spray fields at Putah Canyon are sized to treat flows from both Required and Authorized facilities at the site.

Other wastewater facilities at the site include an entry station vault toilet, boat pump out sewage storage vault and an RV dump station. These facilities are not connected to the collection system. Wastewater is stored at these facilities and is periodically pumped out and hauled to an offsite facility for treatment and disposal.

Design criteria for the Putah Canyon wastewater collection and treatment system is summarized in Table 11-1.

Table 11-1. Putah Canyon Wastewater Collection & Treatment System Design Criteria

Parameter	Units	Value
Collection System Type		
Type	-	STEP system
Gravity Pipe	-	PVC, SDR 26
Pressure Pipe	-	HDPE, DR 21
Total Design Flows		
Maximum Daily Flow	gpd	14,300
Maximum Monthly Flow	gpd	5,900
Average Annual	gpd	2,500
Treatment Pond		
Influent Concentrations, average		
BOD	mg/l	400
TSS	mg/l	400
TKN	mg/l	140
Effluent Concentrations		
BOD, max month	mg/l	50
TN, average annual	mg/l	30
BOD Loading	lb/ac/day	40
Number of Ponds	-	2
Surface Area, ea	ft^2	23,000
Volume, ea	gallons	700,000
Depth	ft	4
Number of Ponds	-	2
Side Slope	H:V	2:1
Freeboard	ft	2
Width of Access Road	ft	10
Storage Pond		
Volume	MG	1.7
Depth	ft	12
Number of Ponds	-	1
Side Slope	H:V	2:1
Freeboard	ft	2
Sprayfield		
Area	acre	1.3

11.1.2 Monticello Shores

There is no Required wastewater collection or treatment system at Monticello Shores. The only Required wastewater facility at this recreation area is an entry station vault toilet. Wastewater is stored at this facility and is periodically pumped out and hauled to an offsite facility for treatment and disposal.

Previous design effort had considered a Required wastewater treatment system, however it has since been reclassified as Authorized. The design basis for the now Authorized wastewater collection and treatment system at Monticello

Shores was: wastewater generated on the northern portion of Monticello Shores would be collected using a Septic Tank Effluent Pumping (STEP) system, which is the same type of system described above for Putah Canyon. The STEP system would discharge wastewater from the northern part of the site to a packaged wastewater treatment plant. Effluent from the treatment plant would be discharged into a storage pond, where it would be stored until it could be discharged to a spray field.

The previously considered wastewater collection and treatment system did not provide collection in the southern portion of Monticello Shores. Wastewater generated in this portion of the site was collected in vault toilets, however these vault toilets are also now Authorized. Wastewater collected at the vault toilets would be pumped out periodically and hauled to an offsite facility for treatment and disposal.

Other Authorized wastewater facilities at the site include an RV dump station and a fish cleaning station. These facilities, similar to vault toilets, were not connected to the collection system. Wastewater would be stored at these facilities, pumped out periodically, and hauled to an offsite facility for treatment and disposal.

The design criteria for the Authorized Monticello Shores wastewater collection and treatment system is summarized in Table 11-2.

It should be noted that the package treatment plant and spray field at Monticello Shores were sized to treat wastewater from only a portion of the Authorized facilities at the site. The package plant and spray field would require expansion to accommodate wastewater from all the Authorized facilities. Space was allocated on the site for this future expansion. The storage pond was sized based on wastewater flows from all Authorized facilities.

Table 11-2. Monticello Shores Wastewater Collection & Treatment System Design Criteria

Parameter	Units	Value
Collection System Type		
Type	-	STEP system
Gravity Pipe	-	PVC, SDR 26
Pressure Pipe	-	HDPE, DR 21
Total Design Flows		
Maximum Daily Flow	gpd	10,000
Maximum Monthly Flow	gpd	4,100
Average Annual Flow	gpd	1,700
Package Treatment Plant		
Type	-	Extended Aeration
Influent Concentrations, average		
BOD	mg/l	400

Table 11-2. Monticello Shores Wastewater Collection & Treatment System Design Criteria

Parameter	Units	Value
Collection System Type		
Type	-	STEP system
Gravity Pipe	-	PVC, SDR 26
Pressure Pipe	-	HDPE, DR 21
TSS	mg/l	400
TKN	mg/l	140
Effluent Concentrations		
BOD, max month	mg/l	50
TN, average annual	mg/l	30
Storage Pond		
Volume	gal	300,000
Depth	ft	12
Number of Ponds	-	1
Side Slope	H:V	2:1
Freeboard	ft	2
Sprayfield		
Area	acre	0.9

11.1.3 Berryessa Point

There is no Required wastewater collection or treatment system at Berryessa Point. The only Required wastewater facilities at this recreation area are vault toilets. Wastewater is stored at these facilities and is periodically pumped out and hauled to an offsite facility for treatment and disposal.

11.1.4 Spanish Flat

There is no Required wastewater collection or treatment system at Spanish Flat. The only Required wastewater facilities at this recreation area are vault toilets, an entry station vault toilet, an RV dump station, and a marina sewage storage vault. Wastewater is stored at these facilities and is periodically pumped out and hauled to an offsite facility for treatment and disposal.

Previous design effort had considered a Required wastewater treatment system, however it has since been reclassified as Authorized. The design basis for the now Authorized wastewater collection and treatment system at Spanish Flat was a wastewater collection and treatment system similar to the system considered at Monticello Shores. The collection system would have been a STEP system with a packaged wastewater treatment plant used to treat wastewater on site. Effluent from the treatment plant would be discharged into a storage pond, where it would be stored until it could be discharged to a spray field. The package treatment plant, storage pond, and spray field at Spanish Flat were sized to treat wastewater flows from both Required and Authorized facilities.

Additional Authorized facilities also include vault toilets and a fish cleaning station. These facilities would not be connected to a collection system. Wastewater would be stored at these facilities, pumped out periodically, and hauled to an offsite facility for treatment and disposal.

The design criteria for the Authorized Spanish Flat wastewater collection and treatment system is summarized in Table 11-3.

Table 11-3. Spanish Flat Wastewater Collection & Treatment System Design Criteria

Parameter	Units	Value
Collection System Type		
Type	-	STEP system
Gravity Pipe	-	PVC, SDR 26
Pressure Pipe	-	HDPE, DR 21
Total Design Flows		
Maximum Daily Flow	gpd	10,000
Maximum Monthly Flow	gpd	4,100
Average Annual Flow	gpd	1,700
Package Treatment Plant		
Type	-	Extended Aeration
Influent Concentrations, average		
BOD	mg/l	400
TSS	mg/l	400
TKN	mg/l	140
Effluent Concentrations		
BOD, max month	mg/l	50
TN, average annual	mg/l	30
Storage Pond		
Volume	gal	300,000
Depth	ft	12
Number of Ponds	-	1
Side Slope	H:V	2:1
Freeboard	ft	2
Sprayfield		
Area	acre	0.7

11.1.5 Steele Canyon

Wastewater collection and conveyance offsite is a Required amenity at Steele Canyon. Wastewater generated at Steele Canyon will be collected using a STEP system, similar to the system described for Putah Canyon. Segments of gravity sewer convey wastewater to septic tanks located throughout the site. Each septic tank has a dedicated grinder lift station. The lift station delivers effluent from the septic tank to a central pump station through a network of small diameter force mains. The central pump station will collect wastewater flow from the site and pump the flow at a more consistent and continuous rate

to the existing Napa Berryessa Resort Improvements District (NBRID) wastewater treatment facility. The NBRID wastewater treatment facility has the capacity to treat a maximum of 15,000 gallons per day (gpd) of wastewater from Steele Canyon. The average flow from Steele Canyon is less than 15,000 gpd, so NBRID has adequate capacity to treat all the flow from Steele Canyon. However, peak flows at Steele Canyon will exceed the 15,000 gpd capacity of NBRID. Therefore, the central pump station at Steele Canyon will also be equipped with below-grade storage vaults to store the excess wastewater during peak flow events. Wastewater conveyed into the storage vaults during peak flow events will be pumped to NBRID when flows fall below 15,000 gpd.

Other Required wastewater facilities at the site include vault toilets, a boat pump out sewage storage vault and an RV dump station. These facilities are not connected to the collection system. Wastewater is stored at these facilities and is periodically pumped out and hauled to an offsite facility for treatment and disposal.

The design criteria for the Steele Canyon wastewater collection and disposal system is summarized in Table 11-4.

Table 11-4. Steele Canyon Wastewater Collection & Treatment System Design Criteria

Parameter	Units	Value
Collection System Type		
Type	-	STEP system
Gravity Pipe	-	PVC, SDR 26
Pressure Pipe	-	HDPE, DR 21
Total Design Flows		
Maximum Daily Flow	gpd	22,400
Maximum Monthly Flow	gpd	9,300
Average Annual Flow	gpd	3,800
Treatment System		
Type	-	None
Central Pump Station		
Max Capacity	gpd	15,000
Storage Vault Capacity	gal	23,000

11.2 Design Flows

The development of the design wastewater flows for the recreation areas involves the following topics:

- Sources of Wastewater
- Seasonal Fluctuations

- Infiltration and Inflow
- Total Design Flows

Each of these topics is described in detail below.

11.2.1 Sources of Wastewater

Wastewater is generated at each recreation area from a number of sources including tent sites, RV sites, cabins, park models, boating facilities, etc. The sources of wastewater and the maximum daily wastewater generation rates from those sources are summarized in Table 11-5 and Table 11-6.

Table 11-5 includes data for facilities that are served by flush toilets and a sewer. Table 11-6 includes data for facilities that are not served by a sewer.

It should be noted that sources of wastewater identified in Table 11-5 are different than the locations at which the wastewater enters the collection system. For example, wastewater associated with a tent site enters the collection system through a nearby restroom and wastewater associated with an RV site enters the collection system through a sewer drop located at the RV site. The locations at which wastewater enters the collection system are discussed in Section 11.3.

Table 11-5. Wastewater Generation Assumptions

Wastewater Source	Maximum Daily Generation Rate	Units
Camping		
Tent Site	75	gal/d/site
Standard Campsite without utilities	75	gal/d/site
Standard Campsite with Utilities	100	gal/d/site
RV Site	100	gal/d/site
Hike-In/Boat-in Tent Sites	27.7	gal/d/site
Overnight Group Use Area (~50 people)	1,000	gal/d/area
Overnight Group Use Areas (~20 people)	375	gal/d/area
Camp Host Site with Utilities	200	gal/d/site
RV Dump Station	50	gal/RV site
Playground & Group Area	200	gal/d/site
Lodging		
Park Models	200	gal/d/unit
Cabins	300	gal/d/unit
Yurts	75	gal/d/unit
Rustic Cabins	75	gal/d/unit
Tent Cabins	75	gal/d/unit
Floating Campsite	27.7	gal/d/unit
Boating		
Boat Slip	10	gal/d/slip
Houseboat Slip	75	gal/d/slip

Table 11-5. Wastewater Generation Assumptions

Wastewater Source	Maximum Daily Generation Rate	Units
Fish Cleaning Station	25	gal/d/slip
Employee Housing (Park Models)	200	gal/d/facility
Marina Service and Building	100	gal/d/facility
Day Use		
Individual Day Use Sites	20	gal/d/site
Group Day Use Area	250	gal/d
Multi-Use Special Events Center (~20 people)	1,500	gal/d/facility
Amenities		
Restaurant (Full Service)	1,280	gal/d/facility
Restaurant (Take-out Counter)	400	gal/d/facility
Facilities/Infrastructure		
Comfort Station, toilets, family room, showers, and laundry	1,000	gal/d/facility
Parking		
Vehicle with Boat Trailer Parking	10	gal/d/spot

Sources:
15a North Carolina Administrative Code 02T.0114, University of Minnesota 2011
US Department of Agriculture Forest Service 2007
Erie & Van Sande Civil Engineers, Inc. 2011

Table 11-6. Wastewater Generation – Non-Sewered Facilities

Wastewater Source	Maximum Daily Generation Rate	Units
Vault Toilet	100	gal/1500 uses
RV Dump Station	50	gal/d/RV site
Fish Cleaning Station	25	gal/d/slip

Sources:
US Department of Agriculture Forest Service 1991
Metcalf and Eddy 2014

11.2.2 Seasonal Fluctuations

Wastewater generation at the five recreation areas will fluctuate seasonally with fluctuations in occupancy rates. For instance, wastewater generation will peak during summer holiday weekends when all facilities are fully occupied, and will be lowest during winter months when occupancy is at a minimum. Wastewater generation will also be lower during weekdays versus weekend days, even during the peak summer season.

Estimates of occupancy rates for the five recreation areas included in this Project were developed based on historical occupancy data from various recreation areas around Lake Berryessa (Reclamation 2014). Projected occupancy rates are summarized in Figures 11-1 and 11-2. Figure 11-1 shows projected weekend occupancy rates for each week of the year and Figure 11-2 shows weekday occupancy rates for each week of the year. Weekend occupancy rates are expressed as a percentage of the maximum occupancy. Weekday occupancy rates are expressed as a percentage of weekend occupancy rates.

As shown in Figures 11-1 and 11-2, weekend occupancy rates are typically 10 percent of maximum during colder months (October – March) and range from 20 to 100 percent of maximum during the rest of the year (April – September). Weekday occupancy rates range from 10 to 30 percent of weekend occupancy throughout the year.

The occupancy rates show in Figures 11-1 and 11-2 were used to develop the total design flows for the recreation areas, as discussed in Section 11.2.4.

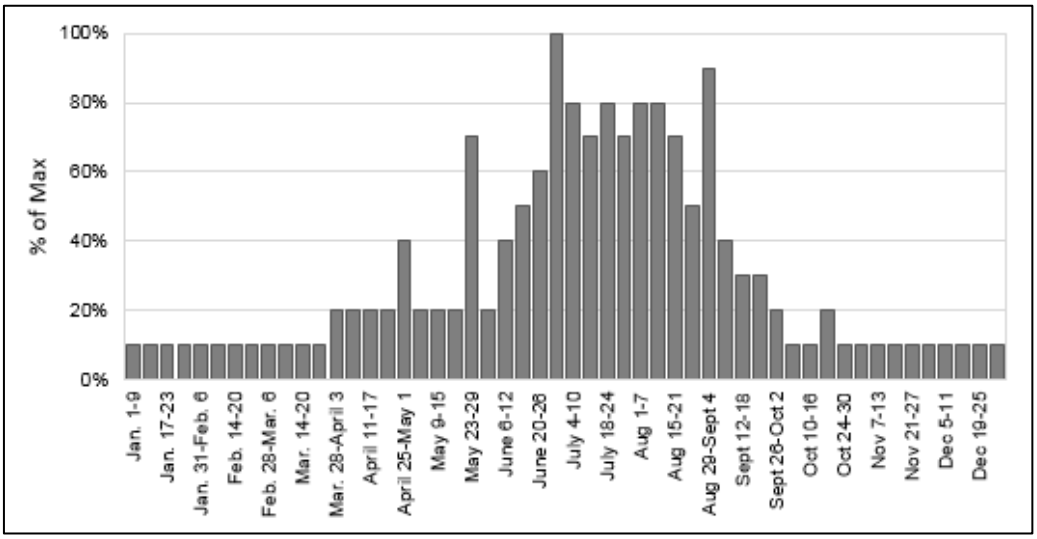

Figure 11-1. Weekend Occupancy Rates

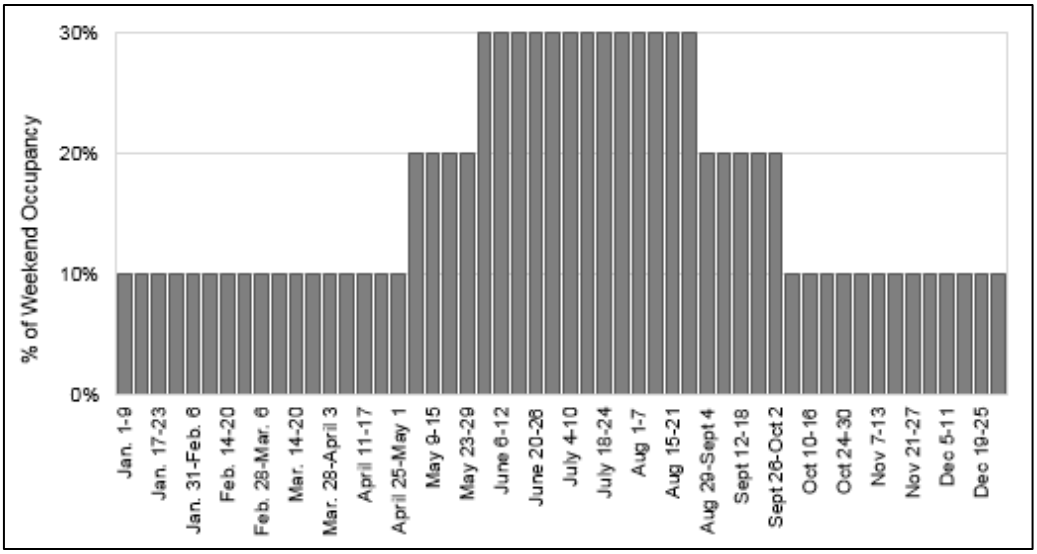

Figure 11-2. Weekday Occupancy Rates

11.2.3 Infiltration and Inflow

Other sources of flow into the wastewater collection system are infiltration and inflow (I&I). Groundwater entering the collection system through leaky pipe joints or cracked pipes is called infiltration. Inflow is the contribution of flow into the collection system from surface runoff.

The amount of I&I into the collection system during each month will vary throughout the year in proportion to the total monthly rainfall. The highest amount of I&I will be during the rainy season and the lowest amount will be during the dry season.

Projections for the amount of I&I contributed to the collection system for the recreation areas included in this Project are shown in Figure 11-3. The amount of I&I is expressed in terms of a percent of total annual wastewater generated at the site.

It was assumed that the total annual contribution of I&I into the gravity collection systems will be equal to 25 percent of the total amount of wastewater generated at the site. This is based on the amount of I&I reported by NBRID and Lake Berryessa Resort Improvement District (LBRID) for existing collection systems. The projected monthly amount of I&I was then developed based on ratios of average monthly precipitation versus total annual average precipitation. For example, the total annual average precipitation for the Lake Berryessa area is 25.2-inches. The average precipitation for January is 5.9-inches. Therefore, it was calculated that the projected I&I for January is six percent of the total annual wastewater generated at the site [25% x 5.9 in ÷ 25.2 in = 6%].

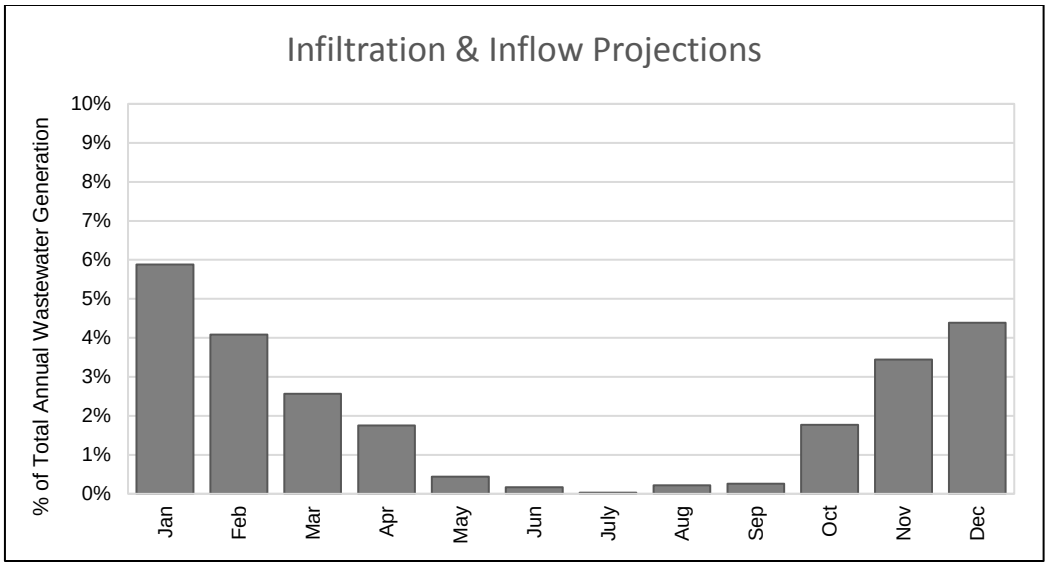

Figure 11-3. Inflow and Infiltration Projections

11.2.4 Total Wastewater Flows

After the wastewater and I&I flows enter the collection system it will be conveyed to a single point where it will then be treated on-site or pumped off-site for treatment. The design flow rates for the facilities that handle the combined flow from the whole site are summarized in Table 11-7. The design flow rates were developed as described below. Table 11-7 does not include values for Berryessa Point because there are no required or authorized collection or treatment facilities at that site.

Table 11-7. Wastewater Design Flows by Recreation Area[1]

	Design Flows (gallons per day, gpd)			
Recreation Area	**Putah Canyon**	**Monticello Shores**	**Spanish Flats**	**Steele Canyon**
Maximum Daily	14,300	25,700	8,000	22,400
Maximum Weekly	7,200	12,900,	4,000	11,200
Maximum Monthly	5,900	10,600	3,300	9,300
Average Annual Daily	2,500	4,400	1,400	3,800
Minimum Monthly	1,100	2,000	700	1,800
Minimum Daily	200	300	100	300

Notes:
[1] Wastewater design flows are based on the required and authorized facilities.

Maximum Daily Flow

Maximum daily flows are the highest flows that will enter the wastewater collection system over the course of any single day. These flows occur during the peak season weekends, when the occupancy is 100 percent (i.e. all facilities at a site are occupied).

These values were calculated by totaling the number of wastewater sources (tent site, RV site, etc.) at each recreation area, multiplying the sources by their corresponding maximum daily wastewater generation rates, and then totaling the flows for the recreation area. These values are summarized in Table 11-8. Values for both required and authorized facilities are presented in Table 11-8.

Maximum Weekly

The maximum weekly flow is the highest flow rate averaged over a week. Weekly flow rates were developed for each week of the year based on the maximum daily flows shown in Table 11-5 and the occupancy rates and I&I rates discussed in Section 11.2.2 and 11.2.3, according to the following equations. The highest of the weekly flow rates is the maximum weekly flow:

$$Weekend\ Flow = 2 \text{ days x Max Daily Flow} \times \text{Occupancy}_{\text{Weekend}}$$

$$Weekday\ Flow = 5 \text{ days} \times \text{Max Daily Flow} \times \text{Occupancy}_{\text{Weekend}} \times \text{Occupancy}_{\text{Weekday}}$$

$$Weekly\ I\&I = \text{Annual WW Flow x I\&I Ratio x 7 days/30 days}$$

$$Weekly\ Flow = \frac{Weekend\ Flow + Weekday\ Flow + Weekly\ I\&I}{7 \text{ days}}$$

Maximum Monthly

The maximum monthly flow is the highest flow rate averaged over a four week period. Maximum monthly flows were determined by calculating four week rolling averages of the weekly flows discussed above and determining the highest value.

Average Annual Daily

Average annual daily flows are the average flows into the collection system over the course of the whole year. Average annual daily flows were calculated by totaling the weekly flows discussed above and dividing the total by 52.

Minimum Monthly

The minimum monthly flow is the lowest flow rate averaged over a four week period. Minimum monthly flows were determined by calculating four week rolling averages of the weekly flows discussed above and determining the lowest value.

Minimum Daily

Minimum daily flows are the lowest flows that will enter the wastewater collection system over the course of any single day. These flows occur on off-season weekdays when there is no I&I. These values were calculated by multiplying the maximum day flow by the off-season weekend occupancy rate (0.10) and the weekday occupancy rate (0.10)

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Table 11-8. Proposed Quantities of Required Facilities and Maximum Daily Wastewater Generation at Each Site Based on Site Plans

Item	Putah Canyon				Monticello Shores				Spanish Flat				Steele Canyon			
	Required		Authorized		Required		Authorized[1]		Required		Authorized[1]		Required		Authorized	
	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)	No. of Units	Flow (gpd)
Camping																
Tent Site	47	3525	20	1500	0	0	130	9750	8	0	41	3675	0	0	19	1425
Standard Campsite without Utilities	14	1050	0	0	0	0	4	300	0	0	10	750	0	0	22	1650
Standard Campsite with Utilities	5	500	0	0	0	0	8	800	0	0	0	0	10	1000	22	2200
RV Site	18	1800	0	0	0	0	21	2100	0	0	12	1200	4	400	7	700
Hike-In/Boat-in Tent Sites	0	0	0	0	0	0	20	554	0	0	0	0	0	0	5	138.5
Overnight Group Use Area (50 people)	0	0	0	0	0	0	1	1000	0	0	0	0	0	0	0	0
Overnight Group Use Area (20 people)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	375
Camp Host Site with Utilities	1	200	0	0	0	0	1	200	1	0	0	200	1	200	0	0
Playground & Group Area	0	0	1	200	0	0	0	0	0	0	1	200	0	0	1	200
Lodging																
Park Models	5	1000	1	200	0	0	28	5600	0	0	0	0	12	2400	0	0
Cabins	0	0	0	0	0	0	9	2700	0	0	0	0	15	4500	0	0
Yurts	0	0	0	0	0	0	6	450	0	0	3	225	0	0	0	0
Rustic Cabins	0	0	0	0	0	0	4	300	0	0	4	300	0	0	0	0
Tent Cabins	0	0	0	0	0	0	5	375	0	0	3	225	0	0	0	0
Floating Campsite	0	0	0	0	0	0	3	83.1	0	0	0	0	0	0	3	83.1
Boating																
Employee Housing (Park Models)	0	0	6	1200	0	0	0	0	0	0	0	0	0	0	10	2000
Marina Service and Building	1	100	0	0	0	0	0	100	0	0	0	0	1	100	0	0
Day Use																
Individual Day Use Sites	18	360	20	400	0	0	8	160	19	0	2	420	10	200	0	0
Group Day Use Areas	0	0	1	250	0	0	1	250	0	0	0	0	0	0	1	250
Multi-Use Special Events Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1500
Amenities																
Restaurant (Full Service)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1280
Restaurant (Take-Out Counter)	0	0	1	400	0	0	1	400	0	0	1	400	0	0	0	0
Facilities/Infrastructure																
Comfort Station, with Laundry	0	0	1	1000	0	0	0	0	0	0	0	0	0	0	1	1000
Parking																
Vehicle with Boat Trailer Parking	55	550	0	0	0	0	49	490	33	0	0	330	75	750	0	0
Totals																
Total Flow (gpd)	-	9,085	-	5,150	-	0	-	25,612	-	0	-	7,925	-	9,550	-	12,802

Notes:
[1] Authorized facilities include those facilities that are Authorized to be sewered, even if the facility itself is a Required facility, in the event that the concessionaire chooses to build an Authorized wastewater system.

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11.3 Collection Systems

A wastewater collection system will be provided at specific recreation areas to convey the wastewater generated at the site to an on-site or off-site treatment facility. The design of the wastewater collection systems are discussed below.

11.3.1 Points of Entry into the Collection System

The wastewater generated from the sources discussed in Section 11.2.1 will enter the collection system at one of the facilities listed in Table 11-9. The peak flow rate for each of these facilities is also listed in Table 11-9. The peak design flow rates were developed based on the number and type of appurtenances (e.g. toilet, kitchen sink, etc.) that each facility is equipped with and a 0.5 service factor. The service factor is based on the assumption that up to 50 percent of appurtenances in a single facility will be operated simultaneously.

Table 11-9. Peak Flow Rates by Facility

Facility	Number of Units	Peak Flow Rate per Unit (gpm)[1]	Design Flow Rates (gpm)
Cabin			
Toilet	1	21	21
Kitchen Sink	1	4	4
Lavatory Sink	1	2.2	2
Shower	1	2.5	3
Subtotal			**30**
Service Factor			**0.5**
Design Flow			**15**
Park Model			
Toilet	1	21	21
Kitchen Sink	1	4	4
Lavatory Sink	1	2.2	2
Shower	1	2.5	3
Subtotal			**30**
Service Factor			**0.5**
Design Flow			**15**
Restaurant			
Toilet	2	21	42
Urinal	1	12	12
Kitchen Sink	3	4	12
Lavatory Sink	2	2	4
Dishwasher	1	6.5	7
Subtotal			**77**
Service Factor			**0.5**
Design Flow			**38**

Table 11-9. Peak Flow Rates by Facility

Facility	Number of Units	Peak Flow Rate per Unit (gpm)[1]	Design Flow Rates (gpm)
Marina			
Toilet	3	21	63
Urinal	1	12	12
Lavatory Sink	4	2	8
Subtotal			**83**
Service Factor			**0.5**
Design Flow			**42**
Office			
Toilet	1	21	21
Lavatory Sink	1	2	2
Subtotal			**23**
Service Factor			**0.5**
Design Flow			**12**
Comfort Station, toilets only			
Toilets	3	21	63
Urinal	1	22	22
Lavatory Sink	2	2	4
Subtotal			**89**
Service Factor			**0.5**
Design Flow			**45**
Comfort Station, toilets and family room			
Toilets	5	21	105
Lavatory Sink	5	2	10
Subtotal			**115**
Service Factor			**0.5**
Design Flow			**58**
Comfort Station, toilets, family room, and showers			
Toilets	5	21	105
Urinal	0	22	0
Lavatory Sink	5	2	10
Shower	2	3	6
Subtotal			**121**
Service Factor			**0.5**
Design Flow			**61**
Comfort Station, toilets, family room, showers, and laundry			
Toilets	5	21	105
Lavatory Sink	5	2	10
Shower	2	3	6
Clothes Washer	1	9.5	9.5
Subtotal			**131**
Service Factor			**0.5**
Design Flow			**65**

Table 11-9. Peak Flow Rates by Facility

Facility	Number of Units	Peak Flow Rate per Unit (gpm)[1]	Design Flow Rates (gpm)
Campsite with Utilities			
Toilet	1	10	10
Kitchen Sink	1	2	2
Lavatory Sink	1	2	2
Subtotal			**14**
Service Factor			**0.5**
Design Flow			**7**

[1] http://www.epa.gov/WaterSense/docs/matrix508.pdf

11.3.2 Gravity Piping

Gravity conveyance piping will be provided at the recreation areas to convey flows from the facilities listed in Table 11-9 to the STEP tanks described below. Gravity piping will be sized based on the design flows summarized in Table 11-9. The size and slope of each segment of gravity piping will be selected so that the piping can convey the total maximum flow when it is flowing a maximum of 60 percent full (i.e. the flow depth is 60 percent of maximum).

Gravity piping will consist of Standard Dimension Ration (SDR) 26 Poly-vinyl Chloride (PVC) sewer piping ranging in size from 4-inch diameter to 8-inch diameter. The piping will have gasketed bell and spigot joints. The pipe will be installed using standard open cut trench installation methods. The minimum depth of cover over the pipe will be 4-feet. Cleanouts will be provided on the piping at bends greater than 22.5-degrees. Manholes will be provided where more than two section of pipe intersect and where acute turns in the pipe are needed.

11.3.3 Septic Tank and Effluent Pump (STEP) Systems

The proposed Septic Tank Effluent Pumping (STEP) systems consist of a precast concrete septic tank and circular Fiberglass Reinforced Polymer (FRP) lift station with submersible sewage grinder pumps. Wastewater collected from campground facilities will flow by gravity into the septic tank where solids are retained and anaerobically degraded via the use of an interior baffle wall. The solids retained within the septic tank will be occasionally removed and hauled offsite for disposal. Liquid effluent will flow to the second chamber of the septic tank and then into the lift station wet well via gravity, where it is then pumped to a discharge point for further conveyance and/or treatment.

Each precast concrete septic tank has been sized with a working capacity equal to or slightly greater than the maximum daily flow from the collection area and conforms to the requirements of ASTM C1227-13. The dimensions of each septic tank vary upon the required capacity. The septic tank will be equipped with three maintenance holes to allow for inspection and cleaning; covers will be locking or bolted to prevent unauthorized access. The covers are required to be watertight when the finished grade surrounding the septic tank is less than 455-feet (the high water level of the Lake Berryessa reservoir). Precast concrete deadman are required to be designed and furnished by the tank manufacturer to resist buoyant forces acting on the tank during high groundwater conditions. Deadman are connected to the tank using corrosion resistant anchors. A single high level alarm float switch is located in the first chamber of the septic tank to indicate system blockage or excessive floatables requiring immediate attention. Although no septic tanks are located in roadways or parking lots, the tanks are H-20 rated to protect against inadvertent vehicle loading. Table 11-10 presents the design criteria of the STEP system septic tanks.

Table 11-10. STEP Septic Tank Design Criteria

Parameter	Value
Number of Chambers	2
Design Capacity, ea	24 hrs @ Max. Day Flow
Number of Access Maintenance Holes	3
Load Rating	H-20
Max. Bury Depth, ft	7

In accordance with the Napa County Code Title 13, Division II, Sewage Systems, septic tanks will be located a minimum of five feet from buildings or structures and a minimum of 10 feet from water lines.

As mentioned previously, effluent from the septic tank will flow by gravity to an effluent lift station, which consists of a wet well housing submersible grinder pumps. The wet well is constructed of FRP and has a bolted cover with a vent. The lift station height is dependent upon the septic tank depth. Four float type level switches control pump operation and provide a high level alarm. The selected pumps have a pump curve allowing for a wide range of total dynamic head (TDH) with little variance in discharge flow rate. The pumps are equipped with a lifting guiderail system. Each pump has a check valve and isolation valve located on the discharge pipe. The pumps are controlled and powered by a control panel located external to the wet well and housed in a NEMA 4X rated enclosure. The control panel enclosure and lift station wet well are protected from the roadway with two bollards. Table 11-11 presents the design criteria of the STEP system lift station.

Table 11-11. STEP Lift Station Design Criteria

Parameter	Value
Wet Well Diameter, in.	Varies
Wet Well Depth, ft.	Varies
Wet Well Material	FRP
Number of Pumps	2
Design Capacity, ea. pump	10 gpm
Max. Number of Pump Starts/Hour	5
Min. Total Dynamic Head, ft.	41
Max. Total Dynamic Head, ft.	125
Pump Type	Submersible Progressive Cavity Grinder
Motor Horsepower	1 HP
Voltage	240 V
Drive	Constant Speed

The effluent lift stations have been sized based on peak hour influent flows. The peak hour influent flow were calculated by multiplying the maximum daily flows by a peaking factor. The peaking factor used to determine the peak hour flow was calculated using the Gifft Equation, from Water Environment Federation (WEF) Manual of Practice (MOP) No. 9. The Gifft Equation is defined as:

$$Peaking\ Factor\ (PF) = \frac{5}{P^{1/6}}$$

$$Where\ P = Population\ in\ 1000s\ (people)$$

Table 11-12 presents the population assumptions used based on the type of facility.

The peaking factor was then used to calculate the peak hour flow rate using the following equation:

$$Peak\ Hour\ Flow\ Rate\ (gpm) = \frac{Total\ Daily\ Water\ Usage\ (gpd)}{(24\ hours\ x\ 60\ minutes)} \times PF$$

Using the calculations described above, the peak hour flows for the effluent lift stations at Steele Canyon were determined to range from 6 gpm to 23 gpm. The peak hour flows for the effluent lift stations at Putah Canyon were determined to range from 4 gpm to 16 gpm.

As shown in Table 11-11, the effluent lift stations will have two submersible grinder pumps. Each grinder pump will have a capacity of 10 gpm. At lift stations where the peak hour influent flow is less than 10 gpm, one of the pumps will be a duty pump and the other will be a standby pump. At lift stations where the peak hour influent flows exceeds 10 gpm, the pumps will operate in a lead/lag sequence and there will not be a standby pump. At these lift stations,

the wet well was sized so that the peak hour flow could be stored in the wet well even in the event that one of the duty pumps failed.

Table 11-12. Facility Population Assumptions

Facility Type	Population, ppl
Tent Site	4
Overnight Group Use Area (~50 people)	50
RV Site	4
Standard Campsite w/o Utilities	4
Standard Campsite w/ Utilities	4
Boat-in Campsite	4
Floating Campsite	4
Park Models	4
Yurts	4
Tent Cabins	4
Rustic Cabins	4
Cabins	4
Boat Slip	2
Houseboat Slip	4
Individual Day Use Sites	4
Group Day Use Areas (~20 people)	20
Multi-Use Special Events Center (~20 people)	20
Restaurant (Full Service)	40
Restaurant (Take-out Counter)	4
Comfort Station with Laundry Facility	10
Camp Host Site	2
Employee Housing	2
Vehicle with Boat Trailer Parking	1

11.3.4 Pressure Piping

The discharge piping from the STEP system effluent pumps will consist of DR 21 HDPE piping ranging in diameter from 1.25-inch to 4-inch. Segments of piping will be joined via butt fusion welding. Mechanical fittings will be used to join HDPE pipe to valves and other appurtenances. The piping will be installed with a minimum depth cover of 4-feet, but may be deeper at localized areas to cross under other buried infrastructure, such as water pipes. The pipe will be installed using standard open cut trench methods. Blow-offs (BOs) will be provided at low-points in the piping to facilitate draining for maintenance and air vacuum/air release (AVAR) valves will be provided at high points to allow venting of accumulated air, thereby prevent air binding of the pumped system. The pressure piping will be sized to maintain a velocity between one and three feet per second (fps) at maximum capacity. At velocities less than one fps, solids could settle in the force main. At velocities higher than three fps, there are a substantial amount of friction losses in the force main.

11.4 Wastewater Treatment Facilities

On-site wastewater treatment facilities are Required at Putah Canyon. On-site wastewater treatment facilities were also considered for Monticello Shores and Spanish Flat, however were reclassified as Authorized and removed from the design due to cost considerations. The design of these facilities is discussed in this section. Wastewater generated at the Steele Canyon will be treated off-site at the NBRID wastewater treatment facility.

11.4.1 Influent and Effluent Design Criteria

The influent and effluent design criteria for the wastewater treatment facilities being provided as part of this Project are discussed below.

Influent Concentration Assumptions

As discussed previously, STEP systems will be used to collect wastewater at Putah Canyon and Steele Canyon. STEP systems are also recommended for installation at Monticello Shores and Spanish Flat if Authorized facilities are installed. In a STEP system, wastewater is collected in and preliminarily treated by septic tanks, which separate a portion of the solids from the liquid waste stream, before the liquids are pumped to a centralized treatment facility. A portion of the suspended solids in the wastewater entering a septic tank will be retained in the septic tank. These solids will accumulate in the tank and will be periodically pumped out and transported offsite for treatment and disposal. With the septic tank providing a primary level of treatment, the characteristics of the raw wastewater entering the septic tanks will be different than the characteristics of the wastewater leaving the tanks and being discharged to the treatment facility. Therefore, design characteristics were developed for both raw wastewater and septic tank effluent.

The raw wastewater and septic tank effluent characteristics that will be used for this design are summarized in Table 11-13 and Table 11-14, respectively. Development of the values in Table 11-13 and 11-14 is described in the section below.

Table 11-13. Design Wastewater Concentrations – Raw Wastewater

Item	Value	Units
BOD	800	mg/l
TSS	800	mg/l
TKN	140	mg/l (as N)

Table 11-14. Design Wastewater Concentrations – Septic Tank Effluent

Item	Value	Units
BOD	400	mg/l
TSS	400	mg/l
TKN	140	mg/l (as N)

Development of Influent Criteria Assumptions

To develop the design influent concentrations provided in Table 11-13 and 11-14, the wastewater at Pleasure Cove Marina, an existing recreation area on the shores of Lake Berryessa, was characterized. The characteristics of the Pleasure Cove Marina wastewater were then compared to the characteristics of typical raw wastewater to determine a relative strength of recreation area wastewater. The design concentrations of the individual wastewater parameters were then developed based on the relative wastewater strength.

Wastewater at Pleasure Cove Marina was characterized by collecting samples from the effluent chamber of a septic tank. The septic tank received wastewater from a restroom with flush toilets, RV sites with a sewer drop connection, and a houseboat sewage pump-out facility. A total of ten samples were collected over a four week period (October 29, 2014 through November 20, 2014), and included both weekdays and weekends. The samples were analyzed for BOD, chemical oxygen demand (COD), total suspended solids (TSS), volatile suspended solids (VSS), total dissolved solids (TDS), ammonia (NH3-N), total kjeldahl nitrogen (TKN), total phosphorus (TP), and specific conductivity. The results of the sampling are included in Appendix F and summarized in Table 11-15. The characteristics of typical raw wastewater are also given in Table 11-15 for comparison.

Table 11-15. Characteristics of Septic Tank Effluent at Pleasure Cove Marina vs. Typical Raw Wastewater

Item	Pleasure Cove Marina Septic Tank Effluent	Typical Raw Wastewater
COD	180	-
BOD	30	350
TSS	50	400
VSS	Not Detected	-
TKN	140	70
TP	14	-
TDS	1,240	860

Before evaluating the data in Table 11-15, it should be noted that the typical raw wastewater concentrations listed in the table are representative of raw wastewater that has not been treated by a septic tank, whereas the wastewater

sampled from Pleasure Cove Marina was treated by a septic tank. Therefore, the only constituents in Table 11-15 that can be directly compared are TKN and TDS. This is because septic tanks do not remove a significant amount of these constituents. Therefore, the concentrations of these constituents in the septic tank effluent can be considered equivalent to the concentrations in the raw wastewater entering the septic tank. Septic tanks do remove a portion of BOD and TSS from the raw wastewater. Consequently, the concentrations of BOD and TSS in the septic tank effluent cannot be directly compared to the typical concentrations of raw wastewater, which has not been treated by a septic tank.

As shown in Table 11-15, the concentration of TKN and TDS in the Pleasure Cove Marina septic tank effluent is 2 times and 1.5 times the typical raw wastewater concentrations, respectively. Therefore, the relative strength of the Pleasure Cove Marina raw wastewater is considered double the strength of typical raw wastewater.

The values listed in Table 11-14 were determined based on the assumption that the raw wastewater at the recreation areas included in this project will be double the strength of typical raw wastewater, matching the strength of wastewater determined for Pleasure Cove Marina. In other words, the design raw wastewater concentrations of BOD, TSS, and TKN were determined by multiplying the typical values listed in Table 11-15 by a factor of two.

The characteristics of the septic tank effluent were developed based on the raw wastewater characteristics and the assumptions that the septic tanks will remove, on average, 50 percent of the BOD and TSS from the raw wastewater, and that the septic tanks will not remove any of the TKN. Design septic tank effluent BOD and TSS concentrations were developed based on assumed raw wastewater concentrations and removal efficiencies rather than directly from the sampling data because the sampling was performed during a time of the year when occupancy at the recreation area was very low, resulting in increased septic tank detention times and higher removal of undissolved constituents like BOD and TSS. Therefore, while the concentrations of BOD and TSS in the samples provide a valuable data point, they may not be indicative of the average design conditions.

Effluent Criteria Assumptions

The effluent from the wastewater facilities at Putah Canyon will be discharged to spray fields (criteria also apply to Monticello Shores and Spanish Flat if Authorized wastewater systems at these sites are installed). The effluent discharged to the spray fields will meet the criteria summarized in Table 11-16. The criteria in Table 11-16 match the effluent criteria included in the Waste Discharge Requirements for the existing Napa Berryessa Resort Improvement District (NBRID) and the Lake Berryessa Resort Improvement District (LBRID) wastewater facilities (Central Valley RWQCB Order No. R5-2013-0114 and R-5-2013-0065). The final effluent limits will be determined by the permitting agency as described in Section 11.6.

Table 11-16. Effluent Criteria Assumptions

Item	Value	Units
BOD, max month	50	mg/l
TN, annual average	30	mg/l (as N)

11.4.2 Package Plants

As previously noted, on-site packaged wastewater treatment facilities were considered for Monticello Shores and Spanish Flat, however were eliminated from the design due to cost considerations and are now classified as Authorized. The designs for these systems was halted at an approximate 60 percent design level, however the data is presented for consideration by the concessionaires should wastewater collection, treatment, and disposal be undertaken at a future date. Six different package treatment processes were evaluated for use at these sites. These processes include a membrane bioreactor, a moving bed batch reactor, an integrated fixed-film activated sludge process, a sequencing batch reactor, a recirculating textile filter, and an extended aeration wastewater treatment process. These alternatives are described in further detail and evaluated below.

Membrane Bioreactor Treatment Process

The Membrane Bioreactor (MBR) process is a modified activated sludge process that uses membranes to provide the separation of the final effluent from the mixed liquor; producing a much higher effluent quality. The MBR process improves upon, and eliminates, the sludge settling problems associated with activated sludge processes. It also requires less operator attention, as the need to closely monitor the biology of the mixed liquor for settling inhibiting bacteria is eliminated. Another advantage of the MBR process is that the process can be operated at high mixed liquor suspended solids (MLSS) concentrations, which reduces the activated sludge reactor volume by half.

Figure 11-4 displays a process flow diagram for a MBR treatment process. This process includes fine screening, flow equalization, a package membrane bioreactor, and an effluent pump station. Solids generated from the process will be periodically pumped out with a sludge pumping truck and hauled off-site.

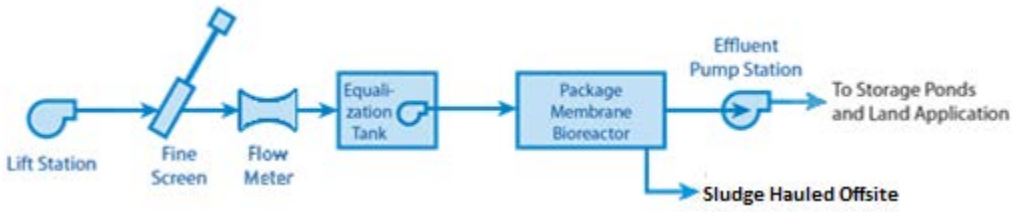

Figure 11-4. Process Flow Diagram of a Membrane Bioreactor Treatment Process

Moving Bed Batch Reactor Treatment Process

The Moving Bed Batch Reactor (MBBR) process is a modified activated sludge process that utilizes both activated sludge and thousands of plastic biofilm carriers (typically polyethylene, polypropylene, or HDPE) within an aerated wastewater treatment basin. The MBBR process eliminates the need to maintain food-to-microorganism ratios or MLSS concentrations as well as a return activated sludge pumping. This process operates under a continuous flow and achieves high rate biodegradation within the system; improving effluent quality. MBBR also improves reliability, simplifies operation, and requires less space than traditional activated sludge processes.

Figure 11-5 displays a process flow diagram for a MBBR treatment process. This process includes fine screening, flow equalization, a package MBBR aeration tank, and an effluent pump station. Solids generated from the process will be periodically pumped out with a sludge pumping truck and hauled off-site.

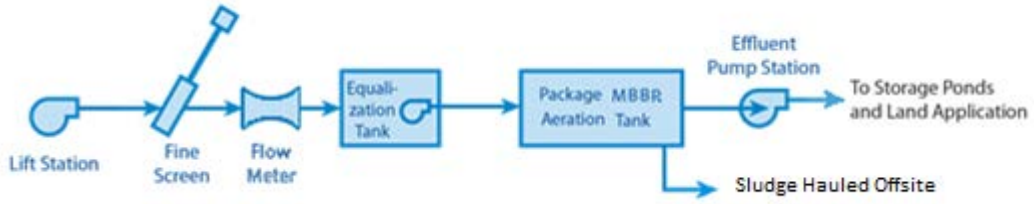

Figure 11-5. Process Flow Diagram of a Moving Bed Batch Reactor

Integrated Fixed Film Activated Sludge Treatment Process

The Integrated Fixed-Film Activated Sludge (IFAS) process is a process that utilizes both the conventional activated sludge process, including a bioreactor, a clarifier and return activated sludge system, and a fixed-film media within the biological reactor tanks. There are several types of media, including plastic carrier elements and foam cubes, which can be placed in bioreactors for biofilm development on surfaces. IFAS processes allow higher biomass inventory to be maintained than with conventional activated sludge processes, and at lower MLSS concentrations. Loading to the downstream clarifiers is reduced as result of the fixed-film media with attached biomass remaining in the reactor.

Figure 11-6 displays a process flow diagram for an IFAS treatment process. The process includes an equalization tank, the IFAS process, a secondary clarifier, and a chlorine contact tank. Solids generated from the process will be periodically pumped out with a sludge pumping truck and hauled off-site.

Figure 11-6. Process Flow Diagram of an Integrated Fixed-Film Activated Sludge Treatment Process

Sequencing Batch Reactor Treatment Process

The Sequencing Batch Reactor (SBR) process is a variation of the conventional activated sludge process. SBRs operate on a batch basis, with aeration and sedimentation performed sequentially in the same tank (on a time controlled cycle). This eliminates the need for return activated sludge pumps. Each cycle typically consists of four phases: fill, react, settle, and discharge. The effluent from an SBR is not continuous, unlike other activated sludge processes. As such, two or more parallel treatment trains are typically required.

Figure 11-7 displays a process flow diagram for an SBR treatment process. The process includes fine screening, flow equalization, a settling tank, a chlorine contact tank, and an effluent pump station. Solids generated from the process will be periodically pumped out with a sludge pumping truck and hauled off-site.

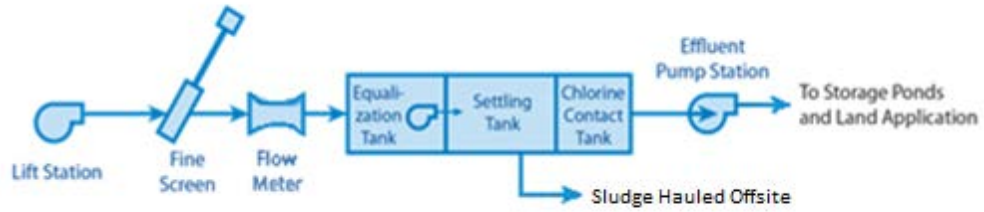

Figure 11-7. Process Flow Diagram of a Sequencing Batch Reactor Treatment Process

Recirculating Textile Filter Treatment Process

The Recirculating Textile Filter (RTF) process consists of screening, primary sedimentation, a pre-anoxic tank, an equalization tank, a textile filter media tank, a post-anoxic tank, a disinfection tank, and an effluent pumping system. The RTF media tank is a fiberglass basin filled with several sheets of an engineered textile media filter. As part of this treatment process, wastewater is recirculated over the textile media several times.

Figure 11-8 displays a process flow diagram for an RTF treatment process.

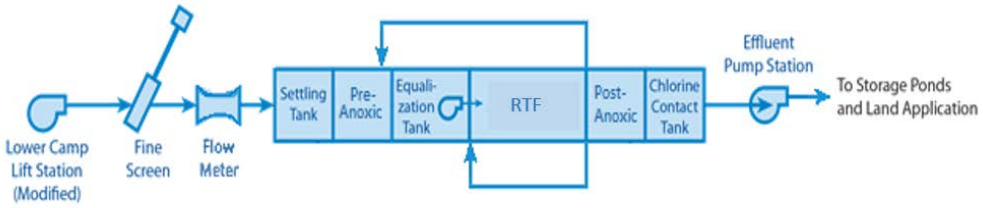

Figure 11-8. Process Flow Diagram of Recirculating Textile Filter Treatment Process

Extended Aeration Treatment Process

The Extended Aeration treatment process is a sewage treatment process that combines the conventional activated sludge process with an extended solids retention time. Extended aeration produces good effluent quality and typically requires minimal operator attention. This process operates at a low food-to-microorganism ratio, which results in endogenous bacterial decay producing less waste activated sludge.

Figure 11-9 displays a process flow diagram for an extended aeration treatment process. This process includes fine screening, an aerated flow equalization tank, an aeration basin, a settling tank, a chlorine contact tank, and an effluent pump station. Solids generated from the process will be periodically pumped out with a sludge pumping truck and hauled off-site.

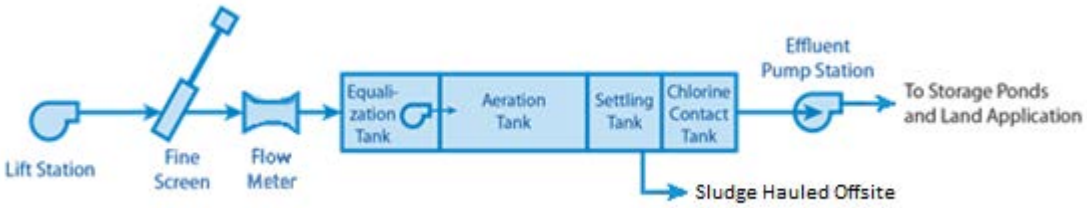

Figure 11-9. Process Flow Diagram of Extended Aeration Treatment Process

Comparison of Alternatives

The six treatment process alternatives described above – MBR, MBBR, IFAS, SBR, RTF and extended aeration – were evaluated based on cost, footprint, energy consumption, mechanical complexity, and process familiarity. A summary of the evaluation is provided in Table 11-17. The key observations are as follows:

- Capital Cost – The cost presented in Table 11-17 are equipment costs only. Costs do not include installation, engineering, and other overhead costs. The MBR process has the highest cost, closely followed by the MBBR process. These two processes have costs more than double those of the other processes. The extended aeration process has the lowest cost. It is important to note that the costs presented in Table 11-17 are for comparative purposes only, and are not intended for budget planning purposes.

- Process Footprint – The RTF process has the largest footprint. The other treatment processes have similar footprints and there is enough space at the recreation areas to accommodate any of the treatment processes other than the RTF process. Therefore, process footprint is not considered a critical differentiation factor.

- Energy Consumption – The MBR process has the highest energy consumption, followed by the extended aeration and SBRs. The MBBRs, IFAS, and RTF processes have the lowest energy consumption, because they do not have blowers. The energy consumption of all the package treatment process is relatively low and the cost to operate the package plants will be low when compared to the capital cost of the plant. Therefore, energy consumption is not considered a critical factor in the evaluation of alternatives.

- Mechanical Complexity –For this analysis, systems that had more mechanical equipment and more complex programming were considered to be more mechanically complex. Based on this definition, the IFAS and RTF processes are the least mechanically complex, because they have the least mechanical equipment, mainly due to the lack of blowers. The MBR and MBBR have the most mechanical equipment. Therefore, these processes are considered to be the most mechanically complex. The extended aeration process and SBRs fall between the two extremes.

- Process Familiarity – The package treatment plants that could be installed at Monticello Shores and Spanish Flat would most likely be operated by a local contractor who operates other plants in the area. Consideration should be given to local operators' familiarity with the various processes being considered for this project because the operator will be more likely to correctly operate and properly maintain a process they are familiar with. There are three treatment plants in the vicinity of Lake Berryessa including NBRID, LBRID, and Spanish Flat Water District. NBRID utilizes an MBR process, LBRID utilizes a pond system, and Spanish Flat Water District utilizes an extended aeration process. Local operators will be most familiar with these types of processes. Although none of the local plants utilized an SBR process, it is a fairly common process, so most operators will be familiar with it.

The other processes are less common and are not utilized at the local plants, so it is likely that the operators will not be familiar with these processes.

- Other Issues – The MBBR requires periodic replacement of the fixed film media, which increases the life-cycle cost of the process. The IFAS process does not utilize blowers, so it is difficult to increase aeration rates when needed. Also, historically there have been issues with controlling the type of microorganisms growing in the fixed film.

Table 11-17. Comparison of Alternatives

Process	MBR	MBBR	IFAS	SBR	RTF	Extended Aeration
Vendor	Ovivo	Headworks	WesTech/H20	Fluidyne	Advantex	PCS
Capital Cost	$640,000	$480,000	$210,000	$200,000	$280,000	$180,000
Footprint	620 ft^2 48’ x 13’	830 ft^2 26’ x 32’	420 ft^2 32’ x 13’	440 ft^2 26’ x 17’	3500 ft^2 35’ x 100’	690 ft^2 46’ x 15’
Energy Consumption	High	Moderate	Low	Moderate	Low	Moderate
Mechanical Complexity	High	High	Low	Moderate	Low	Moderate
Process Familiarity	High	Low	Low	Moderate	Low	High
Other Issues	-	Requires media replacement	Poor process control	-	-	-

Summary and Recommendation

Based on the criteria in Table 11-17, it is recommended that an extended aeration package plant be installed at Monticello Shores and Spanish Flat recreation areas, should the Authorized facilities be installed. This treatment process has the lowest cost, a moderate ease of use, and highest process familiarity. To help maintain cost competiveness, SBR packages should also be considered in the next phase of the project.

11.4.3 Treatment Ponds

As discussed previously, facultative treatment ponds is recommended at Putah Canyon recreation area for the Required treatment or wastewater generated at that site. The facultative pond will be sized based on the following criteria and assumptions:

- Ponds will be lined
- Maximum BOD loading of 40 pounds (lb.) BOD per acre per day
- Side slopes = 2H:1V
- Freeboard = 2 feet

- Water Depth = 4 feet
- 10 foot wide access road will be provided around each pond

11.4.4 Storage Ponds

Treated wastewater from the package plants or facultative ponds will be pumped to a wastewater storage pond, where it can be stored prior to disposal. The storage ponds will be sized based on the following criteria and assumptions:

- Volume of pond is determined by the water balance calculations described in Section 11.4.6
- Ponds will be lined
- Side slopes = 2H:1V
- Freeboard = 2 feet
- Water Depth = 12 feet
- 10 foot wide access road will be provided around each pond

11.4.5 Spray Fields

Treated wastewater from Putah Canyon will be sent to spray fields for disposal. Guidance for spray fields at Monticello Shores and Spanish Flat is also provided below, in the event that the Authorized wastewater collection, treatment, and disposal facilities are installed. The spray fields are designed based on the following criteria and assumptions:

- Required spray field surface area determined by the water balance calculations described in Section 11.4.6
- Maximum spray field slope for Putah Canyon and Spanish Flat = 10%
- Maximum spray field slope for Monticello Shores = 1%
- Each spray field will be equipped with a tail water collection system, see Section 11.4.7
- Spray filed will utilize impact sprinkler heads
- The distance between the spray fields and nearby facilities will be based on the setback requirements included in the Waste Discharge Requirements for the existing NBRID and LBRID wastewater facilities (Central Valley RWQCB Order No. R5-2013-0114 and R-5-2013-0065) and the setback requirements included in Napa County Code Title 13, Div II, Sewage Systems. The setback requirements for these existing facilities are:
  - 25 feet from a spray field to a property boundary
  - 30 feet from a spray field to a public road right of way
  - 100 feet from a spray field to a domestic water supply well

- 100 feet from a spray field to a residence
- 100 feet from a spray field to public parks, playgrounds, school yards, or similar place of potential public exposure
- 10 feet from water storage tanks
- 10 feet from domestic water line
- 10 feet from a building or structure

11.4.6 Water Balance Calculation

The water balance used to size the storage ponds and spray fields was developed by calculating the following values for each month of the year:

$$\Delta Vol_n = WW + Precip - Evap - Spray$$

$$Vol_n = Vol_{n-1} + \Delta Vol_n$$

Where:

$\Delta Vol_n = Change\ in\ volume\ of\ water\ in\ storage\ pond\ in\ month\ "n"\ (gal)$

$Vol_n = Water\ in\ storage\ pond\ in\ month\ "n"\ (gal)$

$Vol_{n-1} = Water\ in\ storage\ pond\ in\ month\ before\ month\ "n"\ (gal)$

$WW = Wastewater\ discharged\ to\ treatment\ system\ (gal)$

$$Precip = Rainfall\ (in)\ x\ \ Pond\ Area\ (ft2)\ x \left(\frac{7.48 \frac{gal}{ft3}}{12 \frac{in}{ft}} \right)$$

$$Evap = Evaporation\ (in)\ x\ \ Pond\ Area\ (ft2)\ x \left(\frac{7.48 \frac{gal}{ft3}}{12 \frac{in}{ft}} \right)$$

$$Spray = Spray\ Field\ \ Loading\ (in)\ x\ Area(ac)\ x \left(\frac{43560 \frac{ft2}{ac}\ x\ 7.48 \frac{gal}{ft3}}{12 \frac{in}{ft}} \right)$$

The spray field area and storage pond volumes are calculated using the above equations as follows:

- The spray field area is the area required so that the sum of all "ΔVol_n" values is equal to zero.

- The storage pond volume is equivalent to the maximum "Vol_n" value.

The spray field area and storage pond volume are dependent on each other, i.e., the two parameters are adjusted iteratively until a solution is found.

Other assumptions used to develop the water balance include:

- The precipitation rate used in the water balance calculation was the 100-year return interval storm precipitation rate of 74.1 inches per year (value reported in the water balance calculations included in the NBRID Report of Waste Discharge Technical Report prepared by Summit Engineering
- Pond evaporation = 0.76 times pan evaporation
- Pan evaporation rates were assumed to be equivalent to the rates reported for Lake Berryessa by the Western Regional Climate Center at: www.wrcc.dri.edu/htmlfiles/westevap.final.html. Reported pan evaporation rates vary throughout the year from 1.7 inches per/month in December to 13.2 inches/month in July.
- Spray field loading rates are the maximum rates that wastewater can be applied to the spray field without exceeding the capacity of the spray field to absorb the water through percolation or evapotranspiration (ET). Precipitation was also taken into consideration when calculating spray field loading rates.
- Spray field loading rates used in the water balance calculation were limited to 0.25 inches/day to keep the TN concentration in the percolate from exceeding 10 mg/l.
- Design daily percolation rates used in the water balance calculation were determined by applying a safety factor 0.05 to the percolation rates measured in the field and assuming that spraying operations would be limited to four hours per day.
- The percolation rates measured in the field during the geotechnical investigation were 1 inch/hour at Putah Canyon and Spanish Flat, and 0 inches/hour at Monticello Shores (see Geotechnical Report in Appendix C).
- ET rates were based on rates reported in the water balance calculations included in the NBRID Report of Waste Discharge Technical Report prepared by Summit Engineering. ET rates vary throughout the year from 0.88 inches/month in January to 6.97 inches/month in July.

- For design and operation purposes, it was assumed that storage ponds will be empty at the end of the dry season in September. This way, the ponds can fill up during the winter, when the spray fields cannot be used due to precipitation. The ponds will then be emptied over the course of the dry season, when spray fields can be used.

11.4.7 Spray Field Tail Water Collection System

To comply with permit requirements, each spray field will be equipped with a tail water collection system to contain any surface runoff that occurs during spraying operations. The tail water collection system will consist of a curb and gutter located along the down slope boundary of the spray filed. The curb and gutter will drain to a sump located at the low point of the spray field. A pump located in the sump will pump the collected tail water either back to the storage pond or to the sprinkler heads.

11.5 Miscellaneous Wastewater Facilities

There will be certain facilities at the recreation areas that are not served by sewers. Wastewater will be collected and stored at these facilities to be periodically pumped out and hauled off-site for treatment. These storage facilities are discussed in detail below.

11.5.1 RV Dump Stations

RV dump stations are designated areas for camping vehicles to dispose of stored sewage to a below grade storage tank. A water source will be available at the dump station for cleanup and sewage holding tank flushing. Wastewater collected and stored at RV dump station will be hauled to an offsite facility for treatment on a scheduled basis.

Each RV dump station will be equipped with a 4-inch diameter sewage drain leading to a below grade storage tank. The storage tank will be a watertight, H-20 loading rated precast concrete tank equipped with two gastight 24-inch diameter maintenance holes located at opposite ends of the tank for regular cleaning and maintenance. Each maintenance hole will have a bolted cover to prevent unauthorized access. The covers are required to be watertight when the finished grade surrounding the RV dump station is less than 455-feet. Precast concrete deadmen are required to be designed and furnished by the tank manufacturer to resist buoyant forces acting on the tank during high groundwater conditions. Deadmen will be connected to the tank using corrosion resistant anchors. The tank provides approximately 11,500 gallons of sewage storage. Storage capacity was selected to limit the required offsite hauling to a maximum of once every two weeks during peak season. The storage tank will not be equipped with a vent to limit odors present at the dumping station. A cover on the tank inlet is opened when a RV needs to connect to the tank. A concrete apron surrounding the inlet slopes toward the tank inlet with a curb

providing an easy-to-clean impervious surface preventing soil contamination in the event of a spill. Table 11-18 summarizes the design criteria of the RV dump station storage tank.

Table 11-18. RV Dump Station Storage Tank Design Criteria

Parameter	Value
Number of Chambers	1
Design Capacity, ea	11,500
Number of Access Maintenance Holes	2
Load Rating	H-20
Max. Bury Depth, ft	4

11.5.2 Vault Toilets

The layout of the above ground portion of the vault toilets is based on Reclamation Recreation Facility Design Guidelines (RRFDG).Vault toilets have two accessible toilet rooms; when located at an entry station, only one toilet room will be included, and is intended for entry staff's use only. Each toilet room will have a five foot diameter clear floor space and wall-mounted grab bars on each side of the toilet riser in compliance with American's with Disabilities Act (ADA) requirements.

Each toilet riser will have an independent 1,000 gallon capacity below grade storage tank providing enough storage for approximately 15,000 uses. The storage tank will have a black interior to prevent users from viewing the tank contents. The tank will be constructed of reinforced polyethylene with a sloping bottom towards a 24-inch diameter maintenance hole located outside the toilet room for cleaning and maintenance. The maintenance hole will have a bolted cover to deter unauthorized access. The storage tank will be encased in concrete to provide structural integrity and will be installed with a cast-in-place concrete deadmen anchored to the tank to resist buoyant forces. A black 12-inch diameter high density polyethylene vent will extend three feet above the highest point of the roof providing ventilation of the storage tank. The vent will work in conjunction with a static air louver located in the toilet room to create air draw through the storage tank and out the vent above the roof; this layout will reduce the noticeable odors within each toilet room. Stored waste will be hauled to an off-site facility for treatment on a scheduled basis. Table 11-19 summarizes the design criteria of the vault toilet storage tanks.

Table 11-19. Toilet Vault Storage Tank Design Criteria

Parameter	Value
Number of Tanks	1 per toilet room
Design Capacity, ea	1,000 gal
Tank Material	LLDPE
Tank Interior Color	Black
Tank Vent Diameter, in.	12
Tank Vent Color	Black
Maintenance Hole Diameter, in.	24
Max Bury Depth, ft.	1
Deadman Size	1.5'x9'x9'

11.5.3 Fish Cleaning Stations

All fish cleaning stations have been classified as Authorized. Some fish cleaning stations were previously considered Required, and their design criteria is summarized below for consideration.

Fish cleaning stations should be positioned close to boat launch and boat trailer parking areas. Fish cleaning stations should include a roof for shade and shelter, a pre-fabricated cutting table, water supply and manual spray wands for cleaning, and a table drain leading to a below grade precast concrete storage tank for water and fish carcasses. For the design of above grade improvements, refer to the RRFDG. Stored fish cleaning waste will be hauled to an off-site facility for treatment on a scheduled basis.

If installed, each fish cleaning station will include a precast concrete below grade waste storage tank. The tank will be watertight, H-20 loading rated, and equipped with two gastight 24-inch diameter maintenance holes located at opposite ends of the tank for regular cleaning and maintenance. Each maintenance hole will have a bolted cover to prevent unauthorized access. The covers are required to be watertight when the finished grade surrounding the fish cleaning station is less than 455-feet. Precast concrete deadmen are required to be designed and furnished by the tank manufacturer to resist buoyant forces acting on the tank during high groundwater conditions. Deadmen will be connected to the tank using corrosion resistant anchors. The tank should provide approximately 11,500 gallons of sewage storage, which is recommended to limit the required cleaning to a maximum of once every two weeks during peak season. The storage tank will require an 8-inch diameter vent and exhaust fan that draws air from within the tank and exhausts above the roof. Table 11-20 summarizes the design criteria of the fish cleaning station storage tank.

Table 11-20. Fish Cleaning Station Storage Tank Design Criteria

Parameter	Value
Number of Chambers	1
Design Capacity, ea	11,500
Number of Access Maintenance Holes	2
Load Rating	H-20
Max. Bury Depth, ft	4

11.5.4 Steele Canyon Lift Station

Steele Canyon Lift Station will collect all wastewater discharge from the Steele Canyon Campsite STEP systems. The combined 4-inch force main from all STEP systems will discharge to the Steele Canyon Lift Station wet well. The wet well will house two submersible duplex grinder pumps (one duty, one standby) that convey wastewater to Napa Berryessa Resort Improvement District (NBRID) for treatment. NBRID's treatment facility can receive a maximum of 15,000 gallons per day (gpd) from Steele Canyon Campsite. Wastewater flows generated at Steele Canyon are anticipated to occasionally exceed 15,000 gpd during peak season, primarily on peak weekends. Excess wastewater generated at these times will flow by gravity into two below grade precast concrete storage tanks. Stored wastewater will flow by gravity back to the wet well for conveyance to NBRID once capacity is available. To adhere to NBRID's capacity limit, and to make the system as operator-friendly and low-maintenance as possible, the design assumes the selected pumps maintain a flow rate equal to or less than 10.42 gallons per minute to ensure that flows to NBRID do not exceed the daily allowance. The lift station pumps will be equipped with Variable Frequency Drives (VFDs) to maintain an effluent discharge rate no greater than 10.42 gpm based on feedback from an inline flow meter located on the combined pump discharge. If higher capacity pumps are installed by the concessionaire, additional instrumentation and controls may be required to throttle the discharge to NBRID's limit.

Wastewater effluent from the Steele Canyon STEP systems will discharge into a 10-foot interior diameter, 15-foot tall precast concrete wet well. The wet well will be H-20 rated and the interior will be lined with a polyurethane coating. The wet well will house two pumps which are accessed from grade with a locking hatch. Four float type level switches will control pump operation and a high level alarm. The selected pumps have a pump curve allowing for a wide range of total dynamic head (TDH) with little variance in discharge flow. The pumps will be equipped with a lifting guiderail system. Each pump will have a check valve and isolation valve located on the discharge pipe. An H-20 rated precast concrete flow meter vault will be located at the discharge of the lift station to allow flow monitoring. The flow signal from the flow meter will be used in conjunction with the VFDs to maintain a discharge rate at or below 10.42 gpm. The pumps will be controlled and powered from a control panel located external to the wet well and housed on a NEMA 4X rated enclosure.

The control panel enclosure will be protected from the roadway with two bollards.

The Duty Pump On level float switch will be located at an elevation to limit the pump to a maximum of three starts/stops per hour. This float will be located at a level lower in elevation than the drain pipe from the storage tanks back into the lift station. This will ensure that the pump will engage to remove the wastewater from the wet well, even if the flap gate on the storage tank drain pipe is stuck open. The Standby Pump On float switch will be located at an elevation equal to the crown of the storage tank fill pipe. The storage tank fill pipe will be located at an elevation that provides adequate storage volume to accept one hour of flow from all STEP systems, with the assumption that one pump from each STEP system is operating at the design flow. This maximizes the storage in the wet well and prevents frequent use of the storage tanks, thereby limiting maintenance and flushing requirements. If the liquid level in the wet well continues to rise, a High Level Alarm will be activated. Table 11-21 presents the design criteria of the Steele Canyon Lift Station.

Table 11-21. Steele Canyon Lift Station Design Criteria

Parameter	Value
Wet Well Diameter, ft.	10
Wet Well Depth, ft.	15
Wet Well Material	Precast Concrete
Number of Pumps	1 Duty, 1 Standby
Design Capacity, ea.	8 gpm
Maximum Capacity, ea.	10.4 gpm
Max. Number of Starts/Hour	3
Min. Total Dynamic Head, ft.	33
Max. Total Dynamic Head, ft.	48
Pump Type	Submersible Progressive Cavity Grinder
Motor Horsepower	1 HP
Voltage	240 V
Drive	Variable Speed

A series of two precast concrete storage tanks will be connected to the Steele Canyon Lift Station wet well for storage of flows in excess of 15,000 gpd. The tanks were sized to accommodate three consecutive maximum day flows from the Steele Canyon Campground. The maximum daily flow is anticipated to be approximately 22,500 gpd, resulting in 7,500 gallons of excess storage required per day. Three consecutive peak days require a total storage volume of 22,500 gallons. Two 11,500 gallon precast concrete storage tanks were selected and will be located in series with an 8-inch diameter tank fill connection pipe between the two. The tank drain pipes will be located as close to the tank floor as possible to limit the volume of liquid retained within the tanks after use, however a small volume of liquid that cannot be drained from the tanks by gravity will remain and require flushing. The tank drain pipes will be installed

with a flap gate to prevent liquid from prematurely entering each storage tank. The tanks will be filled and drained by gravity alone and should be scheduled for annual cleaning. Each tank will be watertight, H-20 loading rated, and equipped with two gastight 24-inch diameter maintenance holes located at opposite ends of the tank for regular cleaning and maintenance. Each maintenance hole will have a bolted cover to prevent unauthorized access. Table 11-22 presents the design criteria of the Steele Canyon Lift Station storage tanks.

Table 11-22. Lift Station Storage Tank Design Criteria

Parameter	Value
Number of Tanks	2
Design Capacity, ea	11,500 gal
Number of Maintenance Holes, ea.	2
Load Rating	H-20
Tank Material	Precast Concrete
Bury Depth, ft.	1

11.6 Permitting of Wastewater Discharges

Wastewater disposal at Putah Canyon (as well as Monticello Shores and Spanish Flat, if Authorized facilities are constructed) will be regulated under the State Water Resources Control Board (SWRCB) Water Quality Order No. 97-10-DWG, General Waste Discharge Requirements (WDRs) to Land by Small Domestic Wastewater Treatment Systems. These General WDRs apply to domestic wastewater and treatment systems with a maximum daily flow of 20,000 gallons or less. Discharges seeking coverage under these General WDRs shall file a standard application for WDRs/Report of Waste Discharge (Form 200), or an equivalent document, along with the appropriate fees. The Regional Water Quality Control Board (RWQCB) staff will review the application and determine whether or not coverage under the General WDRs is appropriate and will notify the discharger when coverage under the General WDRs has begun. The application process is anticipated to take 6 months or less.

The following information needs to be included in the application form:

- Facility information (address, name of owner, owner type, etc.)
- Type of discharge (land or surface water)
- CEQA status
- Wastewater characterization including:
  - Design and actual flows

- List of constituents and the discharge concentration of each constituent
- List of appropriate waste discharge requirements
- Description and schematic of all treatment processes
- A description of any Best Management Practices (BMPs) used
- Description of disposal methods

A copy of the application form and the waste discharge requirements included in Water Quality Order No. 97-10-DWG are included in Appendix F.

It should be noted that if all the authorized facilities at Monticello Shores are constructed, the maximum daily wastewater flow at that site will exceed 20,000 gallons per day, and the discharge of wastewater from that site will no longer be covered under the General WDRs described above. If this occurs, an application for Individual WDRs will need to be submitted to the RWQCB along with the applicable fees. It is anticipated that the application process for Individual WDRs will take six months to one year.

The application for Individual WDRs requires the following information:

- A completed and signed Form 200
- A technical report prepared by a California registered Professional Civil Engineer that presents the information listed in the document titled "Technical Information for a Report of Waste Discharge for Discharges to Land in the WDR (Non 15) Program (Individual WDRs Only)" included in Appendix F.

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