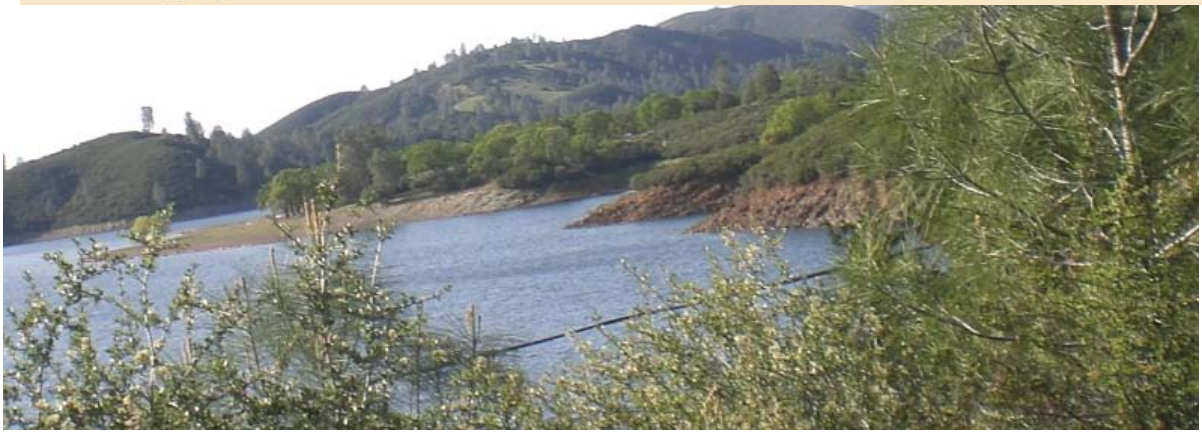
Camp Berryessa

Operations, Design and Preliminary Engineering Study

Napa County Regional Park and Open Space District

Dedicated to the Preservation and Enjoyment of the Natural Resources of Napa County



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January 2010

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January 2010

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I. INTRODUCTION

Use and management of Lake Berryessa is evolving. Lake Berryessa is a large, multi-purpose irrigation, flood control, municipal and recreation reservoir located and constructed behind Monticello Dam, operated by the Bureau of Reclamation (Reclamation). Monticello Dam was constructed in the late 1950s and Lake Berryessa established then, with its miles of shoreline and a number of boat-oriented recreational resort facilities operated largely by private concessionaires. Camp Berryessa, a former Boy Scout facility, is one component of the array of facilities that have in the past served the recreational needs of specific segments of the multi-county area. With an eye to the future, the Napa County Regional Park and Open Space District (District) has entered into an agreement with Reclamation to study the site and its potential to more broadly serve public outdoor education and recreation needs. The purpose of this present Feasibility Study and Master Plan is to explore the physical and economic viability of a public use facility with a primary goal of facilitating and supporting outdoor recreation, environmental education, research and restoration, serving students, youth groups and non-profit organizations at Camp Berryessa.

With the termination of the Reclamation's long-term concessionaire resort leases in 2008, which had virtually privatized shoreline access and use, there is a gap in public recreation and access at the Lake, as well as new opportunities to construct sustainably designed facilities. Future development of Camp Berryessa needs to be integrated into the new use mix. There are three primary project goals:

1. The Camp Berryessa project will develop facilities that will serve a broad range of constituents with a mix of outdoor education and recreation opportunities, with a primary focus on students, youth organizations and other groups.
2. Site development will focus on sustainable, energy-efficient design, use of natural and/or recycled materials and resource conservation.
3. Programs and infrastructure should be self-supporting to avoid fiscal impacts to the District and Reclamation.

This study provides the baseline data, planning and design recommendations in several areas to facilitate these goals: to identify the extent of infrastructure needed to support such a facility, provide an estimate of facility capital improvement costs, as well as provide an economic analysis to determine market demand, the likelihood of competing with existing and planned facilities and the fiscal viability of long-term operations and management of such a facility. Since the pre-existing site infrastructure has largely been demolished, the proposed project represents a unique opportunity to design and develop a range of facilities that reflect environmentally-sound design as well as provide visitor-serving facilities to a range of user groups that can generate revenues sufficient for ongoing operations and maintenance.

The Camp Berryessa Project presents an exciting opportunity to develop an environmentally sustainable outdoor education facility on a spectacular site on the north shore of Lake Berryessa. This project has the potential to become an important demonstration project that offers outdoor environmental education opportunities in the Coastal Range,

and the ability to demonstrate environmentally sustainable design practices to minimize resource impacts, such as use of sustainable/recycled materials, effective siting for wind and solar access, composting toilets, waste stream greywater and runoff management, water conservation, and green building practices. Within reach of multiple urban centers of the North and East Bay and Sacramento Valley, the Camp can provide opportunities for environmental education and access to view and enjoy unique environmental habitat for school and youth groups, environmental and outdoor recreational organizations, as well as family-oriented visitors.

Camp Berryessa also provides a unique setting for water-related recreational activities in a sheltered water area, such as swimming, kayaking and canoeing. In addition, the site's setting and topography present a unique opportunity to design the site to maximize access to users of all abilities, with the potential to increase usage for groups with unique needs and disabilities. The Camp Berryessa site presents significant interpretive and outdoor education opportunities, as well as the potential to bring increased use and revenue to the Lake Berryessa area. The site provides an opportunity to educate the public, especially youth groups about the area's resources, history, and environmental management, provided that the site uses match the projected income for operation and management of the facilities. Collaboration with potential nonprofit partners with the organizational capabilities to manage the programs and infrastructure at the site are a necessary component of a successful project.

II. STUDY OBJECTIVES AND DESIGN GUIDELINES

Development of Camp Berryessa will provide opportunities for a range of recreational and educational activities, protect and enhance sensitive habitat areas, provide safe access for users with a wide range of abilities and needs, and provide a linkage to other facilities. This Feasibility Study and Master Plan provides a blueprint for appropriate uses, development, and management of the site. The Feasibility Study includes a review of baseline conditions, constraints, and opportunities, provides projections of visitor education and youth group use and demand, financial viability analysis, regional and historic context, relationship to existing and future park facilities, and management options. The study also includes an evaluation of environmental review and permitting requirements, capital construction and annual Operations and Maintenance costs, and potential project phasing to implement the Master Plan. The preliminary Camp design and site development has focused on minimizing impacts to existing wildlife, plant and water resources, and thereby minimizing environmental impacts. Study objectives and work tasks included:

1. Identifying the site's "carrying capacity". The study evaluated the site's historic use, water supply viability, wastewater disposal options, energy needs and potential users in order to define a mix of development/infrastructure options to determine the optimal site configuration.
2. Reviewing existing well records and records of the now-demolished on-site wastewater disposal system, which have been evaluated in addition to the completion of field studies. These were used to determine utility infrastructure needs.

Site Planning and Design Guidelines:

1. Environmentally sensitive architectural design choices should reflect the site's scenic character and respect the rural setting. There are many potential design scenarios that fulfill the need for environmentally sensitive and sustainable design.
2. Trails, roads, parking areas, recreation facilities, and other built elements should be sited in appropriate locations to protect native trees, minimize wildlife conflicts, and facilitate use and management of the site, consistent with the Bureau of Reclamation's--Lake Berryessa management goals.
3. Structures should be sited to maximize solar access, and on-site solar (and wind energy) power should be installed as part of infrastructure improvements.
4. Opportunities for user education and outdoor recreation programs should focus on the area's unique wildlife habitat and physical setting.
5. Built elements should have visual integrity consistent with site character utilizing earth tones, natural materials, matte finishes and structure height and placement to blend with the rustic setting.
6. Site improvements should provide barrier-free circulation elements and recreational opportunities, consistent with guidelines for outdoor developed recreation areas, to the extent feasible.
7. Site improvements should provide sufficient parking (in appropriate locations) and infrastructure for camp users, as well as safe ingress/egress to the site.
8. The final site design should accommodate safety and security issues, and integrate design components to minimize risk.
9. The Site Plan should recognize limitations and resources available for on-going operations, maintenance and management, and incorporate design strategies that minimize maintenance needs and costs, but provide efficient use.
10. The Feasibility Study and Master Plan should identify potential project partners to help manage the site and provide educational and recreational opportunities for visitors.
11. Consistent with Bureau of Reclamation requirements, all permanent structures should be above 455 foot elevation mean sea level.

III. EXISTING CONDITIONS

A. Regional Setting

Camp Berryessa is a former Boy Scout Camp located on Lake Berryessa along the east shore of Putah Creek (Figure 1). Lake Berryessa and most of its shoreline areas and hillslopes immediately above this (including Camp Berryessa,) are owned by the federal government, and operated under the jurisdiction of Reclamation, which maintains a Branch office at the Lake. The Lake, located approximately 30 miles northeast of Napa, is a reservoir that was formed when Reclamation built Monticello Dam on Putah Creek in 1957. The Lake is used for agricultural irrigation as well as drinking water, and is one of the largest bodies of fresh water in California. It is also a major recreation destination, serving the San Francisco Bay Area as well as Sacramento Valley, and offers opportunities for boating and water sports, camping, fishing, hiking and other outdoor recreation activities.

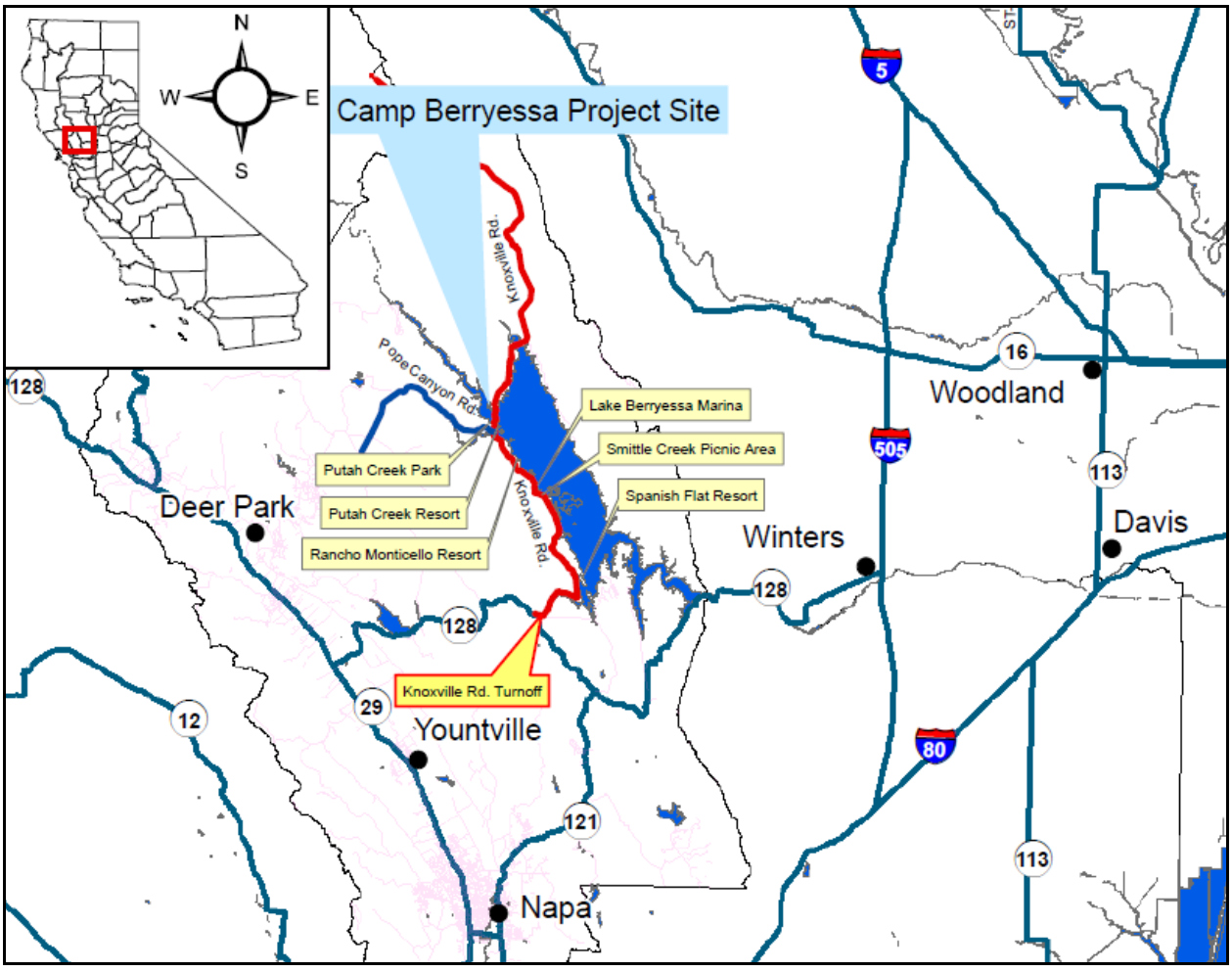


Figure 1. Project Location Map

B. Local Setting

The Camp Berryessa site includes approximately 10 acres of land suitable for development, on a peninsula that extends into the Putah Creek arm of Lake Berryessa. Approximately half the site contains oak woodland, with the remainder containing chaparral scrub vegetation. The improvements and infrastructure which served the prior Boy Scout camp have been removed. The site is surrounded by water on three sides, with sandy gravel beaches. Camp Berryessa has direct access to and can utilize adjacent Reclamation lands, as well as nearby lands managed by the California Department of Fish and Game (CDFG) and US Bureau of Land Management. The site's location offers the potential for both extensive water-based and trail-based outdoor recreation activities. However, the primary recreational feature of the location is its potential for water-based activities, including swimming and non-motorized boating, especially during the hot spring and summer months.

C. Site History

Prior to the completion of Monticello Dam, the area was inhabited by indigenous people, a hunter-gatherer society known as the Southern Patwin people. The valley was named after Jose and Sisto Berryessa, owners of a large Mexican land grant. The town of Monticello was a small farming community located in the Berryessa Valley prior to the building of the dam, and remnants of the town site include scattered foundations beneath the lake's surface.

D. Camp Berryessa Boy Scout Facility

Camp Berryessa was established as a Boy Scout Camp by the Mount Diablo Silverado Council (which includes the Napa area), and offered a range of activities for Boy Scout use, under a federal permit. The property was used for campers and training courses, and included facilities such as camp waterfront and aquatic access, three activity shelters, a bathroom/shower facility, BB gun and archery ranges, a chapel, and an amphitheater. When the facility was closed in 2004, all structures were removed, and the water well was decommissioned in 2008. The only infrastructure remaining at the site are gravel roads, disconnected electrical service and several utility poles equipped with lights (Historic Scout Camp photos courtesy of Bill Goshorn, Silverado District Boy Scouts of America).

Camp Berryessa July 2000, from http://www.silvergatebsa.com/berryessa_work.htm

http://www.silvergatebsa.com/the_stage_is_set.htm









http://www.silvergatebsa.com/camporee_2003.htm

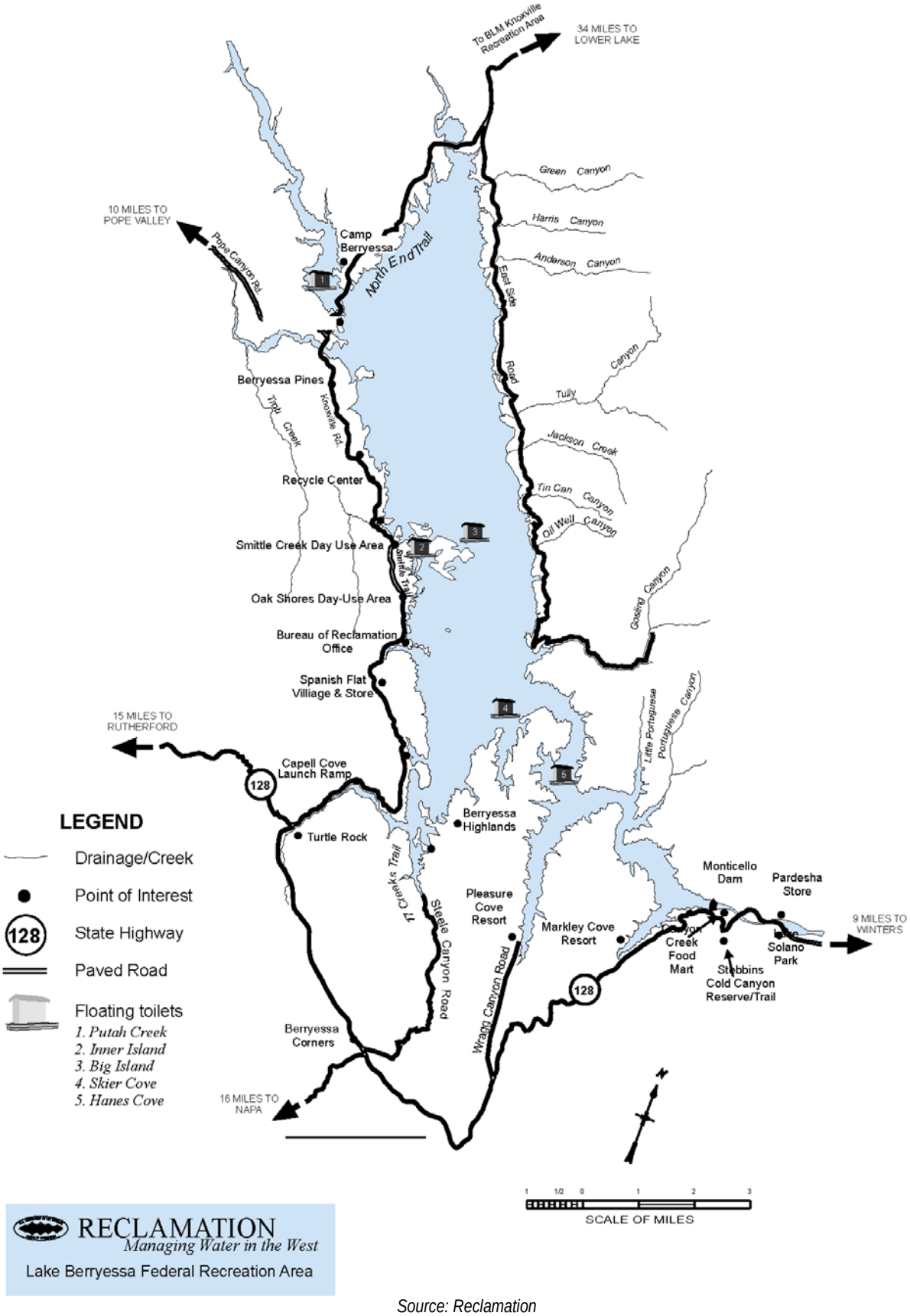
E. Reclamation's Lake Berryessa Visitor Services Plan (VSP)

Planning for recreational land use and operations on federal lands at Lake Berryessa is subject to the VSP, adopted by a federal Record of Decision (ROD) in 2006. The goal of the VSP is "*to support traditional, short-term, and diverse outdoor recreation opportunities for the public*". The VSP prescribes basic management principles to guide and support lake-wide integration of Government and commercial operations (concessionaires) in the best interests of the visiting public. Dating from the 1960's the VSP ROD limits future development of the concession areas to facilities that support short-term, traditional, non-exclusive, and diverse recreation opportunities at the lake, and includes the demolition and removal of the existing private facilities from federal property at Lake Berryessa. It also commits Reclamation to partner with other Government agencies, private landowners, and private organizations to design/construct a regional trail system for non-motorized recreation, and to include a multipurpose shoreline trail.

Since adoption of the VSP, five of the seven privately-run concessionaires operating lodging, camping and boating facilities on the Lake have been closed, and many of the privately-owned trailers and infrastructure have been removed. The closest of these facilities is the former Putah Creek Resort, located approximately one mile south of the Camp. Facilities at this resort included picnicking, camping, restaurant, store and a boat launch, and a similar array of new facilities is conceivable when a new concessionaire is selected. Reclamation maintains day use facilities at Smittle Creek and Oak Shores, and a boat launch ramp at Capell Cove.

The closest paid public boat launch is located at the Pope Creek arm of the Lake, south of Camp Berryessa, and the closest free boat ramp is at Cappell Cove. There is a free hand launch for canoes and kayaks near where Elucuara Creek flows into the Lake at the northern end of Lake Berryessa. According to the VSP ROD, Camp Berryessa will be developed and operated as a group-camp and activity area on a reservation basis. Facilities will be developed for use by a wide range of groups and will include covered dining, meeting, and educational spaces, as well as showers and laundry facilities. The VSP also stipulated that Camp Berryessa have a non-motorized boat launch ramp to facilitate kayak and canoe use and a buoy line to separate boaters from swimmers.

The VSP ROD further stipulates that development of Camp Berryessa be accomplished through partnership agreements with organizations and local agencies. Development will involve minimum use of Federal appropriations. The boat launch at Camp Berryessa will be restricted to non-motorized craft, and a no-impact boat-in camping program will be initiated.

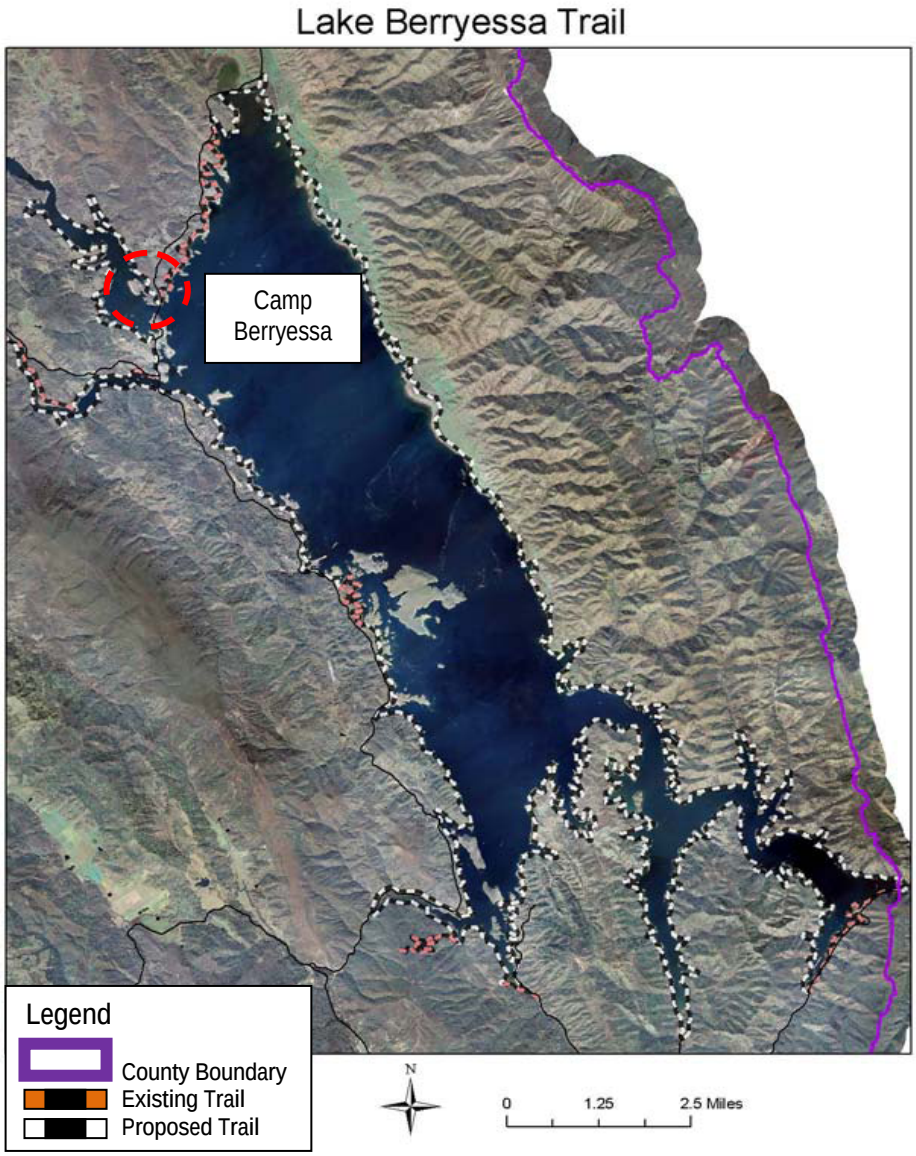


Source: Reclamation

F. Napa County Regional Park and Open Space District's Role

The Napa County Regional Park and Open Space District (District) has entered into an agreement with Reclamation to study the feasibility of an overnight camp and educational facility at the site. The primary goal for the facility is to facilitate and support outdoor recreation, environmental education, research and restoration serving students, youth groups and non-profit organizations. Secondary purposes include other forms of outdoor recreation and nature-based activities, to the extent they are compatible with and support the primary goal. The District wishes to establish a facility which employs sustainable development techniques, maximizes energy efficiency, maintains a rustic character, is financially self-sufficient, and serve a diverse and flexible array of users.

G. Regional Trail Systems



Camp Berryessa is very well located to provide connections to a planned and partially implemented regional trail network. In addition to local trails that connect camp use areas, the camp will provide connections to other existing and potential trail systems. This includes the Lake Berryessa Trail, part of the VSP/ROD goal to implement a multiuse, visitor serving, non-motorized recreational trail circumnavigating the shoreline of Lake Berryessa. The non-profit organization Berryessa Trails and Conservation (www.berryessatrails.org) is providing technical assistance to the Bureau of Reclamation with the planning and building of this trail. The Lake Berryessa Trail is envisioned to greatly broaden the available kinds and quality of recreational experiences at, and thereby the economic base of Lake Berryessa. Trails at Camp Berryessa will improve connections between Camp Berryessa and the main shoreline of Lake Berryessa, as well as the shore of the Putah Creek arm of the lake. Alignment planning and preliminary design for the Lake Berryessa trail began in 2007. Completion of the entire trail is a long-range endeavor. The cost to construct and operate the trail will be estimated during the planning phase currently underway by BT&C.

H. Environmental Setting

1. Geology/Topography

Lake Berryessa is located in the northeastern portion of Napa County, among the hilly to steep mountains of the California Coast Range. The eastern shores and both ends of the Lake are underlain predominantly by Cretaceous Knoxville sandstone and shale, over which the Bressa, Dibble, Los Gatos, Maymen, Sobrante, and Tehama soils series formed. The western side of the lake is bounded by Jurassic Franciscan sedimentary and associated intrusive rocks, such as serpentine and dolerite. The Montara, Hambright, and Henneke soils developed over those materials. The flat portions of Camp Berryessa are underlain by weathered and fractured sandstone, while the hilltop area consists of serpentine rock.

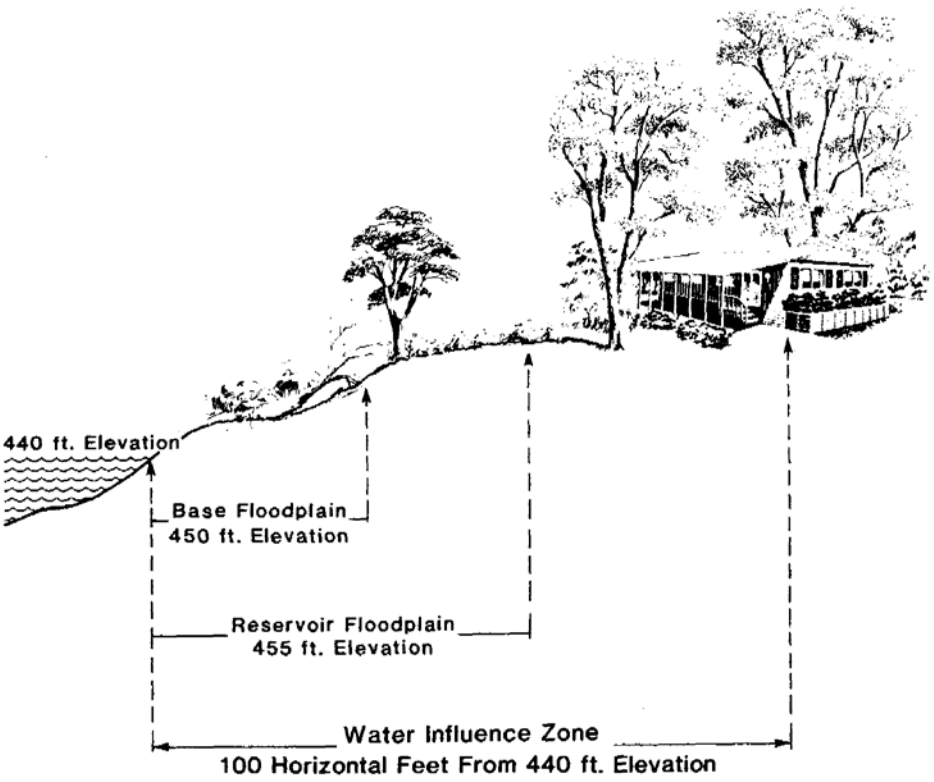
The coast range between Monticello Dam and the Pacific Ocean is cut by numerous faults. The Wragg Canyon fault is located 3 miles from Monticello Dam; the Concord-Green Valley and the West Napa Faults are approximately 25 to 30 miles southwest the dam, and are viewed by the State of California as having a low probability of seismic activity in the foreseeable future.

2. Soils

The 1992 Reservoir Area Management Plan (RAMP) Environmental Impact Statement included a soils map that indicates the Camp Berryessa site consists of Henneke Gravelly Loam. However, site specific review and analysis of the site soils indicate that Montara underlies the flat areas, with the hillsides largely consisting of Henneke. These are shallow gravelly loam soils with fractured bedrock at depths ranging from about 18 to 24 inches. Site soil conditions are discussed more fully in the Onsite Wastewater Feasibility Study (Appendix A).

3. Development Elevation

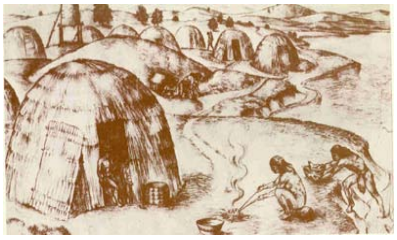
According to Reclamation's 1992 Lake Berryessa Reservoir Area Management Plan (RAMP), all permanent structures at Lake Berryessa should be located above elevation 450 mean sea level (MSL). The reservoir water level may fluctuate from 455 feet MSL to a minimum elevation of 253 feet MSL. A water level of 309 feet MSL is considered dead storage elevation. During the severe drought of 1977, the level was lowered to 388 feet MSL. According to the RAMP, generally all existing structures and facilities, including those for long-term uses, located in the Base Floodplain (440 feet to 450 feet MSL) will need to be flood-proofed per Reclamation instructions, or removed. The RAMP also calls to prohibit storage of solid wastes, materials, equipment, and other inappropriate items in shoreline areas to protect water supplies, eliminate clutter and aesthetic incompatibility, improve public access, and minimize safety hazards. The reservoir water level may fluctuate from 455 feet MSL to a minimum elevation of 253 feet MSL. During preparation of this Feasibility Study/Master Plan, Reclamation senior staff interpreted the VSP to mean that all permanent structures and facilities at Camp Berryessa will need to be located above 455 feet MSL (1929 datum). This includes the wastewater disposal field facility. This is a more stringent requirement for locating permanent facilities than was contained in the 1992 RAMP.



Base Floodplain, Reservoir Floodplain and Water Influence Zone

Source: Reclamation

4. Cultural Resources



The earliest dwellers of the historic Berryessa Valley through which Putah Creek flowed were the Miwok and Patwin Native American tribes. They lived on the valley floor along the rich riparian forest of the creek and its tributaries.

(Source: Bureau of Reclamation; http://www.usbr.gov/mp/ccao/berryessa/facts.html)

These people lived as a hunter gather society along the valley until the early 1800's when early European settlers forced them to leave the valley floor and settle in the surrounding hills. The now-drowned valley where the ancient villages occurred, and where early California farmers and ranchers subsequently lived lies beneath Lake Berryessa by more than 50 feet in the Camp Berryessa area. As a result of this, and the prior occupation of the site by Boy Scout Camp, the chances of finding and disturbing cultural resources artifacts during site development are very remote. None the less a detailed cultural resources field investigation was completed by Reclamation archaeologists as part of the approval process prior to the wastewater feasibility study backhoe trench fieldwork. No cultural resources were identified at that time as occurring at the Camp Berryessa site.

5. Biological Resources

a. Plant Communities

Six major habitat types that occur in the immediate Lake Berryessa area are Blue Oak Woodland, Valley Oak Woodland, California Mixed Chaparral, Chamise Chaparral, Cismontane Introduced Grassland, and Mixed Northern Riparian Woodland. At Camp Berryessa, there are three types:

- *Blue Oak Woodland* is the dominant habitat type surrounding the lake. It occurs both as thin stands along the west and south shores and as open forests along the east shore, throughout the valleys and on lower slopes of the surrounding hillsides. At Lake Berryessa, Blue Oak Woodland occurs with Cismontane Valley Grassland and inter-grades with Valley Oak Woodland and the chaparral habitat types.
- *California Mixed Chaparral* covers many of the south-facing slopes and the higher ridges. It is often found adjacent to oak woodland and grassland habitats. At Lake Berryessa it is commonly associated with steep rock outcrops.
- *Chamise* chaparral is found on the shallowest and dry soils, exclusively on south-facing slopes. It is a homogeneous habitat consisting almost entirely of chamise, with some manzanita and buckbrush.

The Camp Berryessa site is vegetated with oak, chaparral, and gray pine. The gently sloping area along the Lake and north-facing slopes include black oak, scrub oak and chaparral. The hilltop area is underlain by serpentine rock and is primarily covered by chamise and manzanita. South-facing slopes include Blue oak canopy with a grassy understory, and with scattered specimens of shrubs such as ceanothus, toyon, chamise, coyote brush, manzanita and poison oak. The steep areas immediately adjacent to the camp area include mixed chaparral and chamise.

b. Wildlife

Mammals. Mammals present in and near the Lake Berryessa area include black-tailed deer, mountain lion (*Felis concolor*), which is a specially protected mammal under the State Fish and Game code, Section 4800; coyote, black bear, bobcat, gray fox, raccoon, striped skunk, jackrabbit, California ground squirrel and various other small animals. A complete list of wildlife species is provided in the RAMP.

Birds. (Common and Protected Species) More than 80 species of birds are found in the Lake Berryessa area. These include the turkey vulture, great horned owl, belted kingfisher, bald eagle, Cooper's hawk, golden eagle, Aleutian Canada goose, mallard, California quail, osprey and wild turkey. Pursuant to the federal Migratory Bird Treaty Act of 1918 (MBTA), it is illegal to "take" any migratory bird without a federal permit, excluding only three non-native species; English (house) sparrow, starling, and rock dove (pigeon). The MBTA prohibits killing, possessing or trading

in migratory birds except in accordance with regulations prescribed by the Secretary of the Interior. Raptors, or birds of prey (e.g. eagles, hawks, and owls), and their nests are protected under both federal and state law. Bald and golden eagles receive protection under the federal Bald and Golden Eagle Protection Act of 1948.

At Lake Berryessa, the peregrine falcon, no longer federally listed as a threatened species, is resident in the area. Golden eagles and Aleutian Canada geese winter on and near the lake. Waterfowl and fish attract eagles and open water and sprouting grasses provide habitat for the geese. The northern spotted owl and western snowy plover are listed as threatened, but neither species has been observed at the lake. The bald eagle, also listed, has been observed in the immediate vicinity of the reservoir, and two active nests have been observed on the western side of the lake. The greater sand hill crane, a migrant species, and the white-tailed kite, a year-round resident, are both on the state's fully protected list.

Special large birds which inhabit the lake area include osprey, bald eagle, and Western and Clark's grebes. Ospreys nest regularly at Lake Berryessa. Their nests are readily recognizable as large bulky structures made of wood sticks in the tops of tall, often dead trees, and on platforms on utility poles. Bald eagles do not nest in the Lake Berryessa area, but often over-winter there.

(Source: http://www.weforanimals.com/)

Amphibians and Reptiles. The western pond turtle, the western rattlesnake and the western fence lizard are found in the Lake Berryessa area. The giant garter snake and the California red-legged frog both are listed as threatened species, but none have been reported in the study area. The shoreline and streams at Camp Berryessa do not contain habitat considered essential to the survival of the red-legged frog.

Fish. Recreational sport fishing is a major activity at the Lake. Sport fish present include largemouth and smallmouth bass, rainbow and brown trout, crappie or panfish, and catfish. There is open-season, all-year fishing at the Lake.

c. Wetlands

The VSP/FEIS did not identify any wetlands at the Camp Berryessa site, and there are no obvious creeks or wetlands present, such as springs, seeps, etc. However, the shoreline area will likely be considered as Waters of the United States and boat launches, decks, and other shoreline facilities will require approval and permits from both Reclamation and the US Army Corps of Engineers.

d. Threatened, Endangered and Rare Species

Special-status species are those that are:

- Listed or proposed for listing as endangered or threatened by United States Fish and Wildlife Service (USFWS) and/or the California Department of Fish and Game (CDFG);
- Candidates for listing by USFWS;
- Considered endangered, threatened, or rare (Lists 1-4) by California Native Plant Society (CNPS) (plants only);
- Species of special concern or special interest to CDFG.

Federal and state endangered species legislation gives special status to several species that *may* occur in one or more of the areas encompassing Lake Berryessa and its tributaries. In the Camp Berryessa area (USGS Quad Walter Springs, CA), raptors such as the bald eagle and peregrine falcon inhabit the area, as well as elderberry, which provides habitat for the federally threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Special Status species that are potentially present are listed in Tables 1 and 2.

The CEQA/NEPA environmental document that will need to be completed prior to any facility construction will provide a complete review and assessment of potential impacts on biological resources, including wetlands, riparian, and all sensitive species habitat, and a thorough discussion of potential impacts on special status plant and animal species. Where appropriate, avoidance, mitigation, protection and enhancement restoration mitigation measures will be identified. These will be included in the project's construction plans. It is possible that some regulatory permits may be required along with coordination with state and federal resource and regulatory agencies.

Table 1: Special Status Plant Species Potentially Occurring in the Project Area

Scientific Name	Common Name	Fed/State/ CNPS Status	Preferred Habitat
Federal, State and CNPS proposed, candidate or species of concern			
Astragalus rattanii var. jepsonianus	Jepson's milk-vetch	--/--/ 1B.2	Cismontane woodland, valley and foothill grassland, chaparral. Commonly on serpentine in grassland or openings in chaparral. 320-700m.
Erigeron greenei	Greene's narrow-leaved daisy	--/--/1B.2	Chaparral. Serpentine and volcanic substrates, generally in shrubby vegetation. 75-1060M.
Fritillaria pluriflora	adobe-lily	--/--/1B.2	Chaparral, cismontane woodland, foothill grassland. Usually on clay soils; sometimes serpentine. 55-820m.
Hesperolinon bicarpellatum	two-carpellate western flax	--/--/1B.2	Serpentine chaparral. Serpentine barrens at edge of chaparral. 150-820m.
Hesperolinon sp. nov. "serpentinum"	Napa western flax	--/--/1B.1	Mostly found in serpentine chaparral. 225-850m.
Layia septentrionalis	Colusa layia	--/--/1B.2	Chaparral, cismontane woodland, valley and foothill grassland. Scattered colonies in fields and grassy slopes in sandy or serpentine soil. 145-1095m.
Leptosiphon jepsonii	Jepson's leptosiphon	--/--/1B.2	Chaparral, cismontane woodland. Open to partially shaded grassy slopes. On volcanics or the periphery of serpentine substrates. 100-500m.
Navarretia rosulata	Marin County navarretia	--/--/1B.2	Closed-cone coniferous forest, chaparral. Dry, open rocky places; can occur on serpentine. 200-635m.
Streptanthus breweri var. hesperidis	green jewel-flower	--/--/1B.2	Chaparral, cismontane woodland. Openings in chaparral or woodland; serpentine, rocky sites. 130-760m.

Table 2: Special Status Bird, Mammal, Reptile, Amphibian, Invertebrate and Fish Species Potentially Occurring in the Project Area

Scientific Name	Common Name	Fed/State/ CNPS Status	Preferred Habitat
Federal and State threatened, endangered, and special concern species			
Birds			
Agelaius tricolor	tricolored blackbird	--/SC/--	Highly colonial species, most numberous in central valley & vicinity. Largely endemic to california. Requires open water, protected nesting substrate, & foraging area with insect prey within a few km of the colony.
Aquila chrysaetos	golden eagle	--/--/--	Rolling foothills, mountain areas, sage-juniper flats, & desert. Cliff-walled canyons provide nesting habitat in most parts of range; also, large trees in open areas.
Athene cunicularia	burrowing owl	--/SC/--	Open, dry annual or perenial grasslands, deserts & scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the california ground squirrel.
Falco mexicanus	prairie falcon	--/--/--	Inhabits dry, open terrain, either level or hilly. Breeding sites located on cliffs. Forages far afield, even to marshlands and ocean shores.
Haliaeetus leucocephalus wsteri	bald eagle	D/E/--	Ocean shore, lake margins, & rivers for both nesting & wintering. Most nests within 1 mi of water. Nests in large, old-growth, or dominant live tree w/open branches, especially ponderosa pine. Roosts communally in winte
Riparia riparia	bank swallow	--/T/--	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole.
Antrozous pallidus	pallid bat	--/SC/--	Deserts, grasslands, shrublands, woodlands & forests. Most common in open, dry habitats with rocky areas for roosting. Roosts must protect bats from high temperatures. Very sensitive to disturbance of roosting sites.
Myotis evotis	long-eared myotis	--/--/--	Found in all brush, woodland & forest habitats from sea level to about 9000 ft. Prefers coniferous woodlands & forests. Nursery colonies in buildings, crevices, spaces under bark, & snags. Caves used primarily as night roosts.
Myotis yumanensis	Yuma myotis	--/--/--	Optimal habitats are open forests and woodlands with sources of water over which to feed. Distribution is closely tied to bodies of water. Maternity colonies in caves, mines, buildings or crevices.
Rana boylii	foothill yellow-legged frog	--/SC/--	Partly-shaded, shallow streams & riffles with a rocky substrate in a variety of habitats. Need at least some cobble-sized substrate for egg-laying. Need at least 15 weeks to attain metamorphosis.
Actinemys marmorata marmorata	northwestern pond turtle	--/SC/--	Associated with permanent or nearly permanent water in a wide variety of habitats. Requires basking sites. Nests sites may be found up to 0.5 km from water.

Sources: 1) CNDDB search of project quadrangle (Walter Springs) and three neighboring quadrangles (Brooks, Chiles Valley, Lake Berryessa

E – Endangered under the Federal or State Endangered Species Act
T – Threatened under the Federal or State Endangered Species Act
C- Candidate
D - Delisted
SC – California species of special concern
1A - Presumed extinct in CA
1B.1 – RTE in CA & elsewhere; Seriously threatened in CA
1B.2 - RTE in CA & elsewhere; Fairly threatened in CA
1B.3 - RTE in CA & elsewhere; Not very threatened in CA
2.3 - RTE in CA only; Not very threatened in CA
3.1 - More info is needed; Seriously threatened in CA

IV. SITE CARRYING CAPACITY AND INFRASTRUCTURE PLANNING

A. Water Supply

1. Existing Well and Water Supply


Existing Well

Based on discussions with Don Huckfeldt of Huckfeldt Well Drilling (Napa), who drilled and completed a well for Camp Berryessa when it was a Boy Scout facility in 1993, it appears that there is an available source of groundwater under the property for water supply. However, the quality is questionable for purposes of cooking and as a source of potable drinking water and will require a treatment system. Mr. Huckfeldt has well completion records (drillers report) indicating that the completed well is about 223 feet deep, and was capable of producing over 100 gallons per minute (gpm) at the time of drilling. However, this information conflicts with information provided by Bureau of Reclamation personnel familiar with the property who indicated that the historical well had capacity problems and further observed that a "Coyote" well regulator was placed on the pump. Such a device is typically used to shut down and protect a pump during periods when a well is dry, as a dry well can cause serious damage to an operating pump.

In addition to the well and pressure tank, the site had a booster pump that discharged water to two storage tanks located on the hilltop. The pump, controls and pressure tank, and any surface sanitary seal present were removed from the site following the de-commissioning of the Boy Scout Camp following its closure in 2004. The well was not officially "abandoned", as we observed and inspected the open casing well during our May, 2009 field work for on-site wastewater disposal.

Based on our review of the well completion report and inspection of the well casing in May 2009, we found the following:

1. The well is about 225 feet deep, but was caved at about 100 feet, with 6-inch PVC casing intact, installed in what appears to be highly weather volcanic tuff and weathered/fractured serpentine bedrock.
2. A 12-foot concrete seal was originally constructed on the wells, but removed during demolition. The original 10- to 12-inch gravel pack was observed starting at about 18 inches from ground surface.
3. Static groundwater was observed at an elevation of 56 feet below ground surface, May 2009, following 2 to 3 years of drought. Wellhead elevation per topographic map is approximately 484 feet, 1988 NAD, with the lake level at an elevation estimated to be about 426 to 428 feet (based on comparison of air photo and topography). This puts the groundwater water level in the well within a few feet of the lake elevation. This indicates that the lake and well may possibly be hydraulically connected through rock fracture continuity or porosity of the bedrock, although this would need to be further evaluated by more accurate field elevation surveys of both water bodies.

The Environmental Protection Agency's (EPA) Safe Drinking Water Information System (SDWIS) indicates that the site violated drinking water standards for coliform each year from 1999 until 2002, when the site was no longer used. This history of water quality violations is due to high coliform counts, and could be related to the lack of proper annular surface seal, possible well connectivity to the lake (as mentioned above), or proximity to the now-abandoned on-site wastewater disposal system. Further information is available at the SDWIS website: http://oaspub.epa.gov/enviro/sdw_report_v2.first_table?pws_id=CA2800638&state=CA&source=Surface_water&population=25&sys_num=1

Based on this information and field observations, the existing well is not suitable for potable use and should be reconstructed according to State Well Standards or re-drilled. Specifically, the reconstructed well should have a 50-foot annular seal for protection against surface contamination, which is the most likely cause of the historical water quality violations. Re-drilling and re-construction of the well near the existing location/borehole would probably be the most effective approach as finding water in areas of fractured rock can be problematic and even locally "hit or miss".

Estimation of the long-term, sustainable yield of a well is difficult to make in a water well drawing from semi-porous, fractured bedrock such as the rock material exposed at the surface of the well head. It appears that volcanic rock is underlain by hard serpentine rock at depth, as the well is very near the contact between the two rock types. The sustainable well yield is related to the extent of rock fracturing, how continuous the fractures are, and if they are connected to the surface in such a way that they allow rainfall groundwater recharge, or if fractures and porous rock are in fact connected in some fashion to the lake for recharge. If un-connected to the lake, and the rainfall recharge is minimal, the simple well productivity test (which found 100gpm productivity) conducted during well drilling and well development in 1993 could simply be an artifact of water that had been stored in localized rock fractures that serve as only a short term/temporary reservoir for the well. Over time this stored rock fracture related water could be drawn down and if not re-supplied by new rainfall recharge water, would create the sort of periodic dry well problems reported by Bureau of Reclamation at Camp Berryessa.

When the existing well is reconstructed or re-drilled nearby, a pump test is recommended to further evaluate the production capacity of the well. A minimum 72-hour constant rate pumping test is recommended. The results of pumping drawdown and recovery during this test will provide a basis for estimating the sustainable yield. As a general guideline, for fractured rock wells, the sustainable yield is typically assumed to be no more than about 25 percent of the production rate during a short-term pumping test due to the uncertainties of fractured rock water storage and flow. This provides a conservative factor of safety. If the new well provides insufficient water to meet anticipated camp demands, then a second new well should be considered. A second well could potentially be drilled in the same geologic formation and fracture pattern trend on the north side of the serpentine hilltop, adjacent to the loop road, about 500 feet to the north of the existing decommissioned well.

QUADRUPLICATE
For Local Requirements

Page 1 of 1
Owner's Well No. _____
Date Work Began 3-30-94 , Ended 4-4-94
Local Permit Agency Napa County Environmental Mgmt.
Permit No. 35588 Permit Date 3-31-94

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 462863

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DEPTH TO FIRST WATER 118 (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	15	brown sandy clay
15	115	soft brown/green serpentine
115	120	fractured serpentine
120	145	brown/green soft serpentine
145	155	green serpentine
155	160	fractured serpentine
160	175	serpentine
175	180	fractured serpentine hard
180	223	serpentine

RECEIVED
APR 15 1994
ENVIRONMENTAL MANAGEMENT

TOTAL DEPTH OF BORING 223 (Feet)
TOTAL DEPTH OF COMPLETED WELL 217 (Feet)

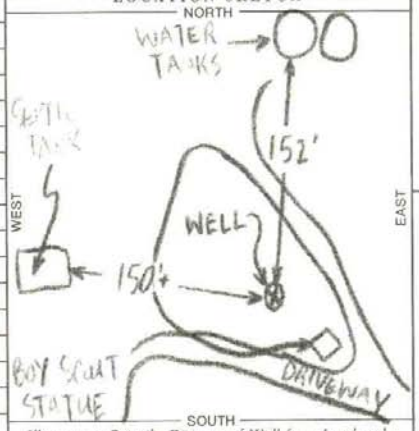
WELL OWNER

Name Mt. Diablo Silverado Council
Mailing Address 800 Ellinwood Way
CITY Pleasant Hill STATE CA ZIP 94523

WELL LOCATION

Address (Camp Berryessa) 7900 Knoxville Rd.
City Napa
County Napa
APN Book 019 Page 010 Parcel 18
or Township ___ Range ___ Section ___
or Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S) (✓)

___ MONITORING
WATER SUPPLY
___ Domestic
X Public
___ Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD Rotary (air) FLUID ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 82 (Ft.) & DATE MEASURED 4-4-94
ESTIMATED YIELD* 125 (GPM) & TEST TYPE air lift
TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 215 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL/GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	12								
60	223	10								
+1	3				X		steel	8		
+1	97		X				plastic	6	SDR-21	.0
97	217			X			plastic	6	SDR-21	.062

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	3	X			concrete
3	51		X		grout
51	217			X	pea gravel

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS 2110 Penny Lane CITY Napa STATE CA ZIP 94559
Signed Lloyd Huckfeldt (WELL DRILLER/AUTHORIZED REPRESENTATIVE) DATE SIGNED 4-7-94
C-57 LICENSE NUMBER 439-746

DWR 188 REV. 7-90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

2. Water Demand

The water supply needs of a campground facility are similar to its wastewater disposal requirements, and vary from about 20 to as much as 40 gallons per day per person, with 30 gallons the typical expectation for periods of higher water usage (hot summer months). Assuming a camp population between 80 to as much as 200 persons per day, this equates to a water supply demand of between 1,600 gallons per day to as much as 8,000 gallons per day. Water storage should be equal to several days and water demand should be provided for emergency purposes and to even-out the water demand during high and low usage periods. Should a second rock fracture well be needed, both wells could pump into the same hill-top storage tank.

Typically a poor producing well in fractured rock (that produced just enough to warrant well development) produces water in the range of 1 to 5 gallons a minute with a good producing well in an area of heavily fractured rock, and rock with some primary porosity producing 10 to 20 gallons per minute. Although it is not a good idea to operate a well 24 hours a day, 365 days a year, without anticipated high maintenance and periodic failure, if a 3 gpm well was equipped with a suitable (3,000-5,000 gallon) storage tank, the well/storage tank system would be capable of producing up to 2,100 gallons per day during a 12-hour pumping period. A well would only need to produce a modest 11 or 12 gallons per minute during the 12 hour pumping period (with adequate storage) to meet the needs of 200 users with a relatively high water demand of 40 gallons per day. Based on what we presently know about the old well, this seems to be achievable, although further evaluation, including pump testing is required to verify this in view of the reports of dry well conditions.

B. Wastewater Suitability

The Camp Berryessa site has some definite limitations on wastewater disposal due to shallow soils and somewhat slow percolation rates. A 200-foot required setback from the observed high water line of Lake Berryessa, the Reclamation stipulation that the wastewater disposal area be located above elevation 455 feet, and the presence of very shallow serpentine soils in the hilltop area further limit the available soil disposal area. Based on the field work conducted for the Feasibility Study a shallow mound sub-surface drip dispersal system is recommended as the preferred disposal option. The subsurface drip system would need to weave around the existing trees (and tree roots), although it is likely that some trees would need to be removed to construct the system. Such a system will require pre-treatment of the wastewater stream.

Wastewater loading rates will vary considerably throughout the year, depending on the kinds of facility users and their water needs. In addition, construction of a full kitchen/cafeteria and shower facilities (Alternative D) would substantially increase wastewater loading. Based on our fieldwork and review of facility information, and provided timely actions are taken to manage wastewater carefully, we believe that the facility can routinely handle a user population of 80 to 100 people, with a peak special event user population for rare events of up to 200 people (see Appendix A Onsite Wastewater Feasibility Study Report).

C. Electrical System Improvements

According to PG&E, the electrical power previously supplied to Camp Berryessa was a single phase system with a small residential panel and meter and a separate meter to the water supply well. Although the overhead electrical lines to the previous facility remain intact, the meter, breaker box/electrical panel and other electrical system components were demolished when the camp was dismantled.

Existing Electrical Supply

A new three phase electrical power system will need to be brought to the camp facilities to support the proposed facility improvements. The new electrical system will need to include new commercial electrical panels or breaker boxes for the central facilities, restroom/showers, the storage/maintenance building, host site and each group and tent cabins and shade shelters. Since well pump electrical service has a lower service fee than other residential/commercial uses, then a separate panel and meter will need to be run to the well.

D. Sustainable and Renewable Energy Facilities

1. Solar (Photovoltaic) Energy System

Small commercial solar power (photovoltaic) systems are proposed to be included in the project improvement plans for Camp Berryessa. Alternative A would have a 10-kW system, while Alternatives B, C and D would have 20- to 26-kW systems. For comparison purposes, a typical residential household solar system provides about 2 to 3 kW of output and a typical family in the North Bay area uses about 400 to 450 kW hours (kWhs) of electricity per month, or about 4,700 to 5,000 kWhs annually. This is about 4.5 to 5 kWh per person per day. As an environmental education facility with a focus on energy and water conservation, and with mostly outdoor activities, it is anticipated that typical spring/early summer electricity usage would be about 2 to 2.5 kWh per person per day. This will vary somewhat with each Alternative, as Alternative A provides more rustic facilities than B, while C and D provide more visitor-serving accommodations, requiring more energy. Assuming a 60% total annual occupancy with a total facility capacity of 29,000 persons (to conservatively estimate electrical power needs), that equates to 17,500 persons annually, or a total annual electrical usage of about 35,000 kWhs (at 2 kWh per visitor day) up to about 44,000 kWhs (at 2.5 kWs per visitor per day).

An approximately 20- to 26-kW solar facility would be needed to more fully meet the electrical energy needs of the facility (depending on Alternative) using the occupancy assumptions and electricity use rates identified above. The proposed solar facilities (in addition to the 1- to 2-kW wind turbine system) would provide from 70% (Alternative A) to 100% of the facility's electrical energy needs at this utilization rate. With a typical panel array in this area producing about 1 kW per 100 sq. ft., 1,000 to as much as 2,600 sq. ft. of ground or roof space would be needed.

The solar energy system as presently envisioned would consist of an array of solar panels, an inverter and connection to the grid. The current thought is to place the solar panels on the roof of the storage/maintenance

building common to all options so that it can be seen from the adjacent hilltop for classroom discussion purposes. Additional solar panels would also be included in the design of the Central Facilities (kitchen/dining/classroom, etc) of Alternatives C and D. In addition, several of the shade shelters that are equipped with small electric cooking surfaces would also have solar panels on their roof systems in Alternatives B, C, and D. Alternative B, which does not include Central Facilities, could have solar panels on the restroom/shower building, if needed.

Some of the units with solar panels on the shade shelters could be connected to storage batteries and also supply power to the immediately adjacent tent cabins and therefore be "off the grid" to demonstrate this concept and technology to students and visitors.

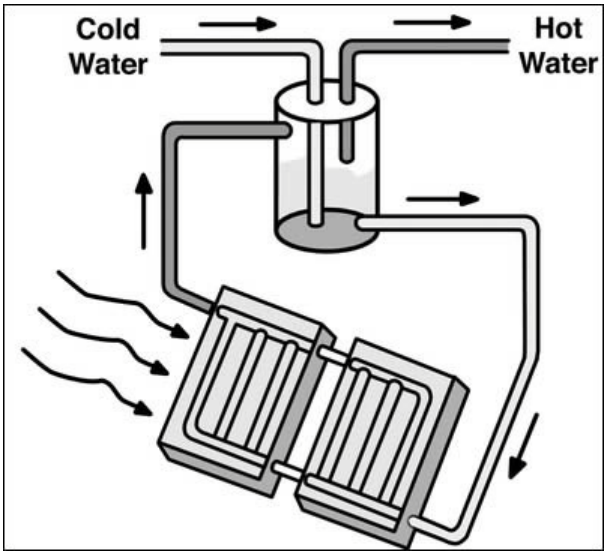
At an approximate cost of about $5.50 per watt installed (reflecting rebates to non-profits), a 10-kW system would cost about $55,000, and the 26-kW system would cost about $143,000. The "off-grid units" on the shade structures with storage batteries would add an additional $48,000 to the total costs. The final design should confirm the size of the photovoltaic system that is needed, as well as the details for the "off-grid" units on some of the shade shelters and adjacent tent cabins. In addition, some commercially available, pre-designed shade shelters (such as Classic Recreation Systems) now offer integrated solar panels.

2. Wind Turbine Energy System

A small (1- 2 kW) wind turbine generator would also be installed on the Central Facility hilltop area and would be tied into the same inverter and grid connection as the solar panels. A low torque/low speed turbine would sit on a 45 foot high tower. Since Camp Berryessa is located in a marginal wind power area, the main purpose of the turbine is educational, and it may not be entirely cost effective in terms of generating power. However, there is some advantage to its use, since it can be tied into and take advantage of the solar power inverter and grid connection. A relatively small 1kW system is included in Alternatives A&B, and a larger 2kW system would be included in Alternatives C&D.

3. Passive Solar Hot Water Heaters

Passive solar hot water heaters are proposed to serve several of the rinse-off stations/utility sinks located within or near select tent cabin shade shelters, and for the swimmer rinse-off stations. The envisioned system would be an "evacuated tube system", which consists of a series of transparent outer glass tubes that allow light to pass through to an internal water pipe coated with a layer that absorbs the sun's rays, heating the water in the tubes. A vacuum is maintained between the tube and the outer glass which serves as insulation to minimize heat loss.



In a passive or "thermosiphon" system, a hot water storage tank receives flow from the heated tubes with the tank placed above the solar collectors so that cold water sinks into the collectors, where it is warmed by the sun, and rises into the tank. A continuous flow of water through the collectors is created without the need for pumps. The tank and heating tube system would be located on the roofs of the shade shelter buildings, possibly paired with the shade shelter/tent cabin complexes that are "off the grid".

E. Graywater and Rainwater Harvesting

Graywater is untreated household waste water which has not come into contact with toilet waste. It includes used water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. It does not include waste water from kitchen sinks, dishwashers, or laundry water from soiled diapers (*California Graywater Standards 1995*). Use of graywater systems is regulated under the California Department of Health Services. Updates to the California Plumbing Code to reflect new technology and ease the regulatory hurdles associated with graywater were completed 2009, but have not yet been fully implemented in Napa County.

Opportunities for use and management of graywater are appropriate and should be incorporated into the design plans, and could potentially provide a source of non-potable water for some limited camp needs, such as irrigation. In addition it provides an opportunity to dispose and reuse water, such as wash-down and dust control areas at camp sites, given the limited wastewater disposal capacity at the site. However, use of graywater comes at the expense of "blackwater" (wastewater) treatment, as it reduces the dilution effect making the blackwater higher in biological oxygen demand and more difficult to treat. In addition current (although in flux) state regulations may require some low level of treatment of graywater necessitating two treatment units instead of one. However, separation and reuse of graywater may have some educational/demonstration benefit in keeping with the themes and objectives of the camp facility.

For simplicity and cost effectiveness, a graywater storage and subsurface disposal system could be considered for the separate shower facility building located on the serpentine hilltop and common to all site alternatives. The subsurface drip disposal site could be located on the slope above the upper parking area, or could utilize an isolated portion of the designated wastewater disposal site.

Rainwater harvesting is the collection, conveyance, storage and use of rainwater. A raindrop as it falls from the sky is soft, and is among the cleanest of water sources. Captured rainwater is sodium free, but can contain contaminants from the catchment surface, storage area or other points of contact. If needed as a potable water source, it would need to be treated, filtered and monitored.

Rainwater harvesting is also recognized as an important water conserving measure, and is best implemented in conjunction with other water efficiency measures. Rainwater harvesting can be used for a number of different purposes including landscape irrigation, domestic use, aquifer recharge, and stormwater abatement. Rainwater harvesting can be as simple as channeling rain running off an unguttered roof to a planted landscape area via contoured landscape. More complex systems include gutters, pipes, storage tanks or cisterns, filtering, pump(s), and water treatment. Basic components include:

- Catchment surface: the collection surface from which rainfall runs off (roof)
- Gutters and downspouts: channel water from the roof to the tank
- Leaf screens, first-flush diverters, and roof washers: components which remove debris and dust from the captured rainwater before it goes to the tank
- One or more storage tanks, also called cisterns
- Delivery system: gravity-fed or pumped to the end use
- Treatment/purification: for potable systems, filters and other methods to make the water safe to drink

For the Camp Berryessa site, rainwater harvesting could be considered for any large buildings that have sizable roof mass. Simple systems could be considered for shade structures, cabin roofs etc. to capture and channel runoff into any landscape and garden areas, but is likely most feasible only at the Central Facility (Alternatives C and D). It could also be used on the Storage/Office Building roofs in all alternatives. Where possible, use of graywater and rainwater harvesting should be utilized conjunctively to provide irrigation water for fire suppression and shade landscape areas. Again, it may be more valuable as a demonstration project rather than substantial water supply source, especially

since extensive landscaping is not anticipated at the site. Pre-engineered rainwater catchment systems are also commercially available.

The Master Plan shows a relatively simple system for the Storage/Office Building area for Alternatives A and B, and a more complex and expensive system for the Central Facilities under Alternatives C and D.

F. Compost Facility

Small, self-contained compost facilities for use by campers and for kitchen wet garbage would be provided at the central activity center (Alternatives A and B) and central facilities/kitchen area (Alternatives C and D). Again, the value in this is in its educational merit for site visitors and tone as a "green facility".

G. Composting Toilets

Composting toilets (2) are proposed for the tent cabin housing and day use areas. Conventional (low) flush toilets will be provided at the restroom/shower facility near the central services area with the kitchen and dining area. The composting toilets proposed are available commercially from several vendors and include the building housing the system. The cost estimate is based on pricing supplied by Clivus Multrum (http://www.clivusmultrum.com).

(Source: http://www.clivusmultrum.com)

V. MARKET ANALYSIS AND ECONOMIC FEASIBILITY

This section of the report reviews the site development alternatives and provides a summary of the market demand study and economic and financial analysis prepared for the project. The full report is included in Appendix C.

A. Site Development Alternatives

Four development scenarios were evaluated in this Feasibility Study:

A. Rustic. The Rustic Alternative would have approximately 12 group sites, with each site including a space for tents and also including a shade structure with picnic tables, water spigot, utility sink and a cooking grill. Each cluster of four group sites would be served by a composting toilet structure. Each group site would accommodate 8 to 12 campers. Campers would provide their own sleeping pads, bedding and towels, and would be responsible for all food preparation equipment, cooking and cleaning. Rinse-off stations would be provided at each toilet. A day use area, activity center, amphitheatre, and shower facilities would also be provided, as well as a non-motorized boat launch, kayak launch, swimming platforms, and other recreational facilities. The facility would be managed by a volunteer camp host, with any needed maintenance by private contractors.

B. Enhanced Rustic. The Enhanced Rustic Alternative would have approximately 25 to 30 tent cabins for sleeping (up to 4 beds per cabin), arranged in pairs, with each pair of tent cabins sharing a covered cooking and eating pavilion, and utility sink with fresh water faucet. Composting toilets would be provided for clusters of tent cabins. Campers would provide their own sleeping bags and towels, but tent cabins would include mattresses; campers would be responsible for all food preparation equipment, cooking and cleaning. Rinse-off stations would be provided at each toilet. The facility would be managed by a volunteer camp host, with any needed maintenance by a part-time maintenance employee, with additional repairs by private contractors.

C. Enhanced Rustic with Central Facilities. This would have approximately 25-30 tent cabins for sleeping, as well as a central, (potentially air conditioned) cooking, dining and meeting facility. The central facility would also have showers and a restroom with flush toilets. Recreational facilities would be similar to Alternatives A and B. Food preparation and cleaning would be the responsibility of those using the facility. The facility would be managed by a volunteer camp host, with a small maintenance staff.

D. Enhanced Rustic with Central Facilities and Services. This Alternative is similar to the Enhanced Rustic with Central Facilities, but includes paid staff that prepares and serves food, provides cleaning and laundry services, and provides more complete management of the site. This Alternative would include permanent sleeping quarters, including dormitories and wood cabins that could be used by staff and/or guests using the facility.

Figures 2 through 5 depict the four potential development scenarios and the plan sheet legends contain a summary of the facilities provided.

LEGEND

- SEASONAL SHADE STRUCTURE (2)
- TENT AND SHADE STRUCTURE (12 GROUP SITES)
- COMPOSTING TOILET (2)
- FLUSH TOILET & SHOWER FACILITY (1)
- SUPPLEMENTAL VAULT TOILET FOR SUMMER USE (2)
- RINSE OFF STATION (2)
- WELL - WITH PUMP & 5000 GAL STORAGE TANK, POTENTIAL WINDMILL SITE.
- AMPHITHEATER / CAMPFIRE AREA (SEATING FOR 40 - 50)
- CANOE/KAYAK DOCK
- SWIMMING PLATFORM/DOCK
- STORAGE BUILDING, OFFICE / CAMPSTORE
- ACTIVITY CENTER
- CAMP HOST RV SITE: INCLUDES SHADE STRUCTURE WITH SOLAR HOOKUP, WATER SERVICE
- WASTEWATER TREATMENT / STORAGE RESERVOIR (5000 GALS)
- WELCOME / DROPOFF KIOSK (NO VEHICULAR ACCESS BEYOND THIS POINT)
- PARKING AREA - 37 STD STALLS, 14 COMPACT STALLS & 4 ADA STALLS. WITH OVERFLOW PARKING FOR BUSES & TRAILERS
- SWIMMING BUOY
- ELEVATION 440' - APPROXIMATE 100 YR HIGH WATER LINE
- 200' WASTEWATER SETBACK SHORELINE HIGH WATER
- ELEVATION 455' - DEVELOPMENT AREA
- INFORMAL TENT CAMPING AREA (SUMMER ONLY)
- WASTEWATER DISPERSAL AREA (13000 SQ FT)
- ACCESS ROAD - BLUE SHALE
- PRIMARY TRAIL (ADA) - COMPACTED BLUE SHALE
- SECONDARY PATH - COMPACTED AND STABILIZED EARTH
- INTERPRETIVE TRAIL

N

0 60 120

1" = 60'

* *ELEVATIONS BASED ON NGVD 29 DATUM*

CAMP BERRYESSA FEASIBILITY STUDY

NAPA COUNTY REGIONAL PARK AND OPEN SPACE DISTRICT

1195 Third Street, Room 210
Napa, California 94559

Napa County Regional Park and Open Space District

QUESTA ENGINEERING CORP.
Civil Environmental & Water Resources
(510) 236-6114
FAX (510) 236-2423
questa@questaec.com
P.O. Box 70356 1220 Brickyard Cove Road Point Richmond, CA 94807

Sht:	Rev:	Date:	By:	Description:	App'd:

Design: MH
Drawn: BJV
Checked: JP
Appr'd:

SITE PLAN
ALTERNATIVE A: RUSTIC

Size: D | Project: 280047
Scale: AS NOTED
Date: 01/12/09
Sheet: 2 OF 6

LEGEND

- SEASONAL SHADE STRUCTURE (2)
- SHADE STRUCTURE (12' X 12') WITH PICNIC TABLE, WATER SPIGOT (2) AND UTILITY SINK.(2)
- TENT CABIN (28)
- COMPOSTING TOILET (2)
- FLUSH TOILET & SHOWER FACILITY (1)
- SUPPLEMENTAL VAULT TOILET SUMMER USE (2)
- RINSE OFF STATION
- WELL - WITH PUMP & 5000 GAL STORAGE TANK, POTENTIAL WINDMILL SITE.
- AMPHITHEATER / CAMPFIRE AREA (SEATING FOR 40 - 50)
- CANOE/KAYAK DOCK
- SWIMMING PLATFORM/DOCK
- STORAGE BUILDING, OFFICE / CAMPSTORE
- ACTIVITY CENTER
- CAMP HOST RV SITE: INCLUDES SHADE STRUCTURE WITH SOLAR HOOKUP, WATER SERVICE
- WASTEWATER TREATMENT / STORAGE RESERVOIR (5000 GALS)
- WELCOME / DROPOFF KIOSK (NO VEHICULAR ACCESS BEYOND THIS POINT)
- PARKING AREA - 37 STD STALLS, 14 COMPACT STALLS & 4 ADA STALLS. WITH OVERFLOW PARKING FOR BUSES & TRAILERS
- SWIMMING BUOY
- ELEVATION 440' - APPROXIMATE 100 YR HIGH WATER LINE
- 200' WASTEWATER SETBACK SHORELINE HIGH WATER
- ELEVATION 455' - BUILDING SETBACK
- INFORMAL TENT CAMPING AREA (SUMMER ONLY)
- WASTEWATER DISPERSAL AREA
- ACCESS ROAD - BLUE SHALE
- PRIMARY TRAIL (ADA) - COMPACTED BLUE SHALE
- SECONDARY PATH - COMPACTED AND STABILIZED EARTH
- INTERPRETIVE TRAIL

** ELEVATIONS BASED ON NGVD 29 DATUM*

CAMP BERRYESSA FEASIBILITY STUDY

NAPA COUNTY REGIONAL PARK AND OPEN SPACE DISTRICT

1195 Third Street, Room 210
Napa, California 94559

Napa County Regional Park and Open Space District

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Sht:	Rev:	Date:	By:	Description:	App'd:

Design: MH
Drawn: BJV
Checked: JP
Appr'd:

SITE PLAN
ALTERNATIVE B: ENHANCED RUSTIC

Size: D | Project: 280047
Scale: AS NOTED
Date: 01/12/09
Sheet: 3 OF 6

LEGEND

- S — SEASONAL SHADE STRUCTURE (2)
- S/W — SHADE STRUCTURE (12' X 12') WITH PICNIC TABLE, WATER SPIGOT (2) AND UTILITY SINK.(2)
- TENT CABIN (28)
- T — COMPOSTING TOILET (2)
- T S — FLUSH TOILET & SHOWER FACILITY (TS)
- SUPPLEMENTAL VAULT TOILET SUMMER USE (2)
- RINSE OFF STATION
- WELL - WITH PUMP & 5000 GAL STORAGE TANK, POTENTIAL WINDMILL SITE.
- AMPHITHEATER / CAMPFIRE AREA (SEATING FOR 40 - 50)
- CANOE/KAYAK DOCK
- SWIMMING PLATFORM/DOCK
- S/O — STORAGE BUILDING, OFFICE / CAMPSTORE
- A — ACTIVITY CENTER
- CAMP HOST RV SITE: INCLUDES SHADE STRUCTURE WITH SOLAR HOOKUP, WATER SERVICE
- SOLAR - POWERED CENTRAL FACILITY: FLUSH TOILETS, SHOWERS, KITCHEN, DINING AREA & OFFICE/CLASSROOM
- WASTEWATER TREATMENT / STORAGE RESERVOIR (5000 GALS)
- W — WELCOME / DROPOFF KIOSK (NO VEHICULAR ACCESS BEYOND THIS POINT)
- H — PARKING AREA - 37 STD STALLS, 14 COMPACT STALLS & 4 ADA STALLS. WITH OVERFLOW PARKING FOR BUSES & TRAILERS
- SWIMMING BUOY
- 440 — ELEVATION 440' - APPROXIMATE 100 YR HIGH WATER LINE
- 200' WASTEWATER SETBACK SHORELINE HIGH WATER
- 455 — ELEVATION 455' - BUILDING SETBACK
- INFORMAL TENT CAMPING AREA (SUMMER ONLY)
- WASTEWATER DISPERSAL AREA
- ACCESS ROAD - BLUE SHALE
- PRIMARY TRAIL (ADA) - COMPACTED BLUE SHALE
- SECONDARY PATH - COMPACTED AND STABILIZED EARTH
- INTERPRETIVE TRAIL

N

0 60 120

1" = 60'

* *ELEVATIONS BASED ON NGVD 29 DATUM*

SHADE STRUCTURE/ LOCKING KAYAK STORAGE (SUMMER ONLY)

SU

WW

WASTEWATER SITE STORAGE

HORSESHOE PITS

BOCCE BALL COURTS

BEACH VOLLEYBALL

ACTIVITY CENTER

DAY USE AREA

STORAGE, OFFICE, CAMP STORE

RESTROOM SHOWERS

DINING/ KITCHEN

SHADE/TRELLIS

(E) WELL

CAMP HOST

PROPOSED LAKE BERRYESSA TRAIL

PULLOUT

ENTRY ROAD

RAMP

ARCHERY TARGET RANGE

SHALLOW WATER ACCESS

SUMMER/WINTER FACILITIES

ROPES COURSE/ ROCK CLIMB FEATURE

CAMP BERRYESSA FEASIBILITY STUDY

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Design: MH
Drawn: BJV
Checked: JP
Appr'd:

SITE PLAN
ALTERNATIVE C: ENHANCED RUSTIC WITH CENTRAL FACILITIES

Size: D | Project: 280047
Scale: AS NOTED
Date: 01/12/09
Sheet: 4 OF 6

PLOT STYLE: ----- | PAGE SETUP: ----- | D-SIZE PRINT | ONE INCH | PLOT DATE: 1/12/2010 | LAST SAVED: 1/12/2010 | P:\2008\280047_CAMP_BERRYESSA\CAD\280047_CAMP BERRYESSA SITE (COLORIZED).DWG

LEGEND

- SEASONAL SHADE STRUCTURE (2)
- SHADE STRUCTURE (12' X 12') WITH PICNIC TABLE, WATER SPIGOT (2) AND UTILITY SINK.(2)
- TENT CABIN (16)
- COMPOSTING TOILET (2)
- FLUSH TOILET & SHOWER FACILITY (1)
- SUPPLEMENTAL VAULT TOILET SUMMER USE (2)
- RINSE OFF STATION
- WELL - WITH PUMP & 5000 GAL STORAGE TANK, POTENTIAL WINDMILL SITE.
- AMPHITHEATER / CAMPFIRE AREA (SEATING FOR 40 - 50)
- CANOE/KAYAK DOCK
- SWIMMING PLATFORM/DOCK
- STORAGE BUILDING, OFFICE / CAMPSTORE
- ACTIVITY CENTER
- CAMP HOST RV SITE: INCLUDES SHADE STRUCTURE WITH SOLAR HOOKUP, WATER SERVICE
- SOLAR - POWERED CENTRAL FACILITY: FLUSH TOILETS, SHOWERS, KITCHEN, DINING AREA & OFFICE/CLASSROOM
- PERMANENT SLEEPING STRUCTURES (12)
- WASTEWATER TREATMENT / STORAGE RESERVOIR (5000 GALS)
- WELCOME / DROPOFF KIOSK (NO VEHICULAR ACCESS BEYOND THIS POINT)
- PARKING AREA - 37 STD STALLS, 14 COMPACT STALLS & 4 ADA STALLS. WITH OVERFLOW PARKING FOR BUSES & TRAILERS
- SWIMMING BUOY
- ELEVATION 440' - APPROXIMATE 100 YR HIGH WATER LINE
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- PRIMARY TRAIL (ADA) - COMPACTED BLUE SHALE
- SECONDARY PATH - COMPACTED AND STABILIZED EARTH
- INTERPRETIVE TRAIL

N

0 60 120

1" = 60'

* *ELEVATIONS BASED ON NGVD 29 DATUM*

SHADE STRUCTURE/ LOCKING KAYAK STORAGE (SUMMER ONLY)

PROPOSED LAKE BERRYESSA TRAIL

PERMANENT SLEEPING QUARTERS

ACTIVITY CENTER

DAY USE AREA

STORAGE, OFFICE, CAMP STORE

RESTROOM SHOWERS

DINING/ KITCHEN

SHADE/TRELLIS

(E) WELL

CAMP HOST

PHOTOVOLTAIC PANELS

WASTEWATER SITE STORAGE

HORSESHOE PITS

BOCCE BALL COURTS

BEACH VOLLEYBALL

SHALLOW WATER ACCESS

SUMMER/WINTER FACILITIES

ROPES COURSE/ ROCK CLIMB FEATURE

ARCHERY TARGET RANGE

RAMP

PULLOUT

PULLOUT

ENTRY ROAD

SU

WW

T

S

W

CAMP BERRYESSA FEASIBILITY STUDY

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Design: MH
Drawn: BJV
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Appr'd:

SITE PLAN
ALTERNATIVE D: ENHANCED RUSTIC WITH CENTRAL FACILITIES AND SERVICES

Size: D | Project: 280047
Scale: AS NOTED
Date: 01/12/09
Sheet: 5 OF 6

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B. Summary of Market Analysis Findings

The favorable characteristics of the site, in combination with market demand factors, indicate that Camp Berryessa is an ideal location for a science education camp as well as a group use destination facility for Napa and adjacent county student and group markets, with additional potential visitation from nearby Sacramento Valley and San Francisco Bay Area markets. Each of four proposed Camp Berryessa design alternatives, to varying degrees, offers an opportunity for sustainable science and environmental education and targeted group use activities.

1. Recreation and Population Findings

- Activities that may be made available at Camp Berryessa constitute an excellent representation of high-demand adult and youth recreation opportunities, including but not limited to beach activities, day hiking, boating, wildlife viewing and bird watching, camping in developed areas, swimming, fishing, and paddle sports.

- Activities with significant latent demand (unfulfilled demand) for both adult and youth populations are also well represented at Camp Berryessa, indicating a strong position within regional markets. These activities include swimming, canoeing, kayaking, hiking, bicycling, nature photography, and wildlife viewing.

- Projections thru 2018 show a steadily increasing elementary and high school student population for Napa and adjacent counties.

- General population projections within the wider region show similar increases in total growth.

2. Factors Impacting Demand

- Primary competition in the local market area comes from Walker Creek Ranch, Clem Miller Education Center at Pt. Reyes, and Slide Ranch, all in Marin County. Regional competitors include Sly Park and Camp Arroyo in the Sacramento area. The 4-H Camp at Las Posadas in Napa County, which serves the six-county Bay Area, also partially competes for some potential camp users.

- There are currently no similar facilities in Napa County or immediately adjacent Solano or Sonoma Counties.

- Each of these competing facilities has long established use patterns with regional schools and community groups.

- In addition to user fees, these facilities also enjoy significant revenue (up to 40%) from external sources such as donations from local businesses, and supporting non-profit foundations, as well as generating a portion of their operating funds from grant sources.

- Additionally, the majority of these facilities are fully developed group destinations in line with Alternative C and particularly Alternative D scenarios.

- These and other comparable facilities draw 75% of their attendees from targeted markets which are either the home county in some combination with an adjacent county, or a specifically targeted effort to attract San Francisco Bay Area populations.

- In addition to Napa County, the nearby counties with the most robust school age population trends include Solano and Yolo and to a lesser extent, Sonoma County. Other regional growth is most apparent in central valley counties.

3. *Projection Assumptions*

- There are significant un-served or underserved markets within school age populations in this area.
- Education camp agreements with Napa County Office of Education and directly with local schools could be obtained. However, like most school districts and county educational offices, resources are currently very limited for making any commitments that require expenditure of funds.
- The fully developed facility (Alternatives C and D) will be operated by a professional manager (typically a not for profit organization) with knowledge in the educational camp market including building relationships with school and community groups and associated marketing activities.
- Fees for use will be within the range of existing competitive facilities.
- In addition to dedicated education activities, Camp Berryessa will host special use group activities including but not limited to recreational (triathlon, Bass fishing, kayaking tours, etc.) and other events (weddings, family reunions, training sessions, Native American groups, astronomy groups, etc.). Revenues from these special use group activities are critical to filling in the gaps between primary target user groups in generating sufficient revenues for the facility to be financially self-sufficient.
- As the level of site development increases, so will market penetration and potential days of use per year.
- Increased use increases potential revenues proportionally, while many operation and maintenance costs are fixed.
- Grants and donations may contribute somewhat to capital and replacement costs, but are more likely to contribute to development of educational materials and scholarships.

4. *Observations*

- The Rustic (Alternative A) scenario represents the least amount of monetary risk, though likely also represents the lowest rate of site utilization, especially for the target environmental education market. Other special interest groups (kayak outings, triathlon and bicycle races, etc.) will still be attracted to the more rustic facilities of Alternatives A and B.
- Given existing information, convenience camping alternatives (tent cabin and rustic cabin Alternatives B, C and D) represent a unique development type for the Lake Berryessa region. Until other facility concession agreements are finalized by the Bureau of Reclamation, we assume that Camp Berryessa will not significantly compete with current or anticipated private or public sector facilities; this assumption could change depending on what new private concession facilities are approved by the Bureau of Reclamation.
- Hosting general events such as bass tournaments, weddings, and other public group uses may compete in the future with other Lake Berryessa facilities, although there are currently no similar facilities at the Lake area.
- Camp Berryessa is ideally positioned to work with Napa area schools, which had during this research no formal connection with a science or outdoor education facility.
- There may exist opportunities to work with several University of California Davis science departments (for example Lake Berryessa is home to a robust raptor population and UCD has a raptor research center).
- Sponsorship and or donation opportunities may be developed with Napa county businesses including the wine industry and its association with the enology institute and the UC Davis.

- The highest percentage of students that might use the facility is assumed to come from within the home county of Napa. Though a small overall population, we would expect a fairly dramatic increase in the number of Napa County 5th graders attending a Camp Berryessa science camp as the site features more amenities and as the site manager develops closer relationships over time, with Napa County schools.

- The next most important market is in the sub-regional market or adjacent county schools. We assume a somewhat lower percentage of attendance from them due to distance and the availability of other competitive camp locations.

- The large regional Sacramento Valley and San Francisco Bay markets need limited market penetration activity in order to provide good numbers of attendees. However, even as the site is developed with greater amenities, distance and competing alternatives will mean that market growth in these regions will be slow initially but steady and moderate over time.

- Finally, a percentage of use may be targeted toward other special use groups. A successful science and environmental education camp project will need to have flexibility in its programming, especially in initial facility development years, when it may need to offer facilities to the general camping public. However, in the long term we do not anticipate that the site will need to offer facilities to the general camping public; rather targeted group use – many within the overall science and environmental mission – should be adequate.

- Some of these groups may include but are not limited to:
    - Other education groups including high school, community college, and university.
    - Kayak and canoe camps and eco tours up the adjacent the creek watershed.
    - Other associated boating groups
    - Trails and hiking groups.
    - Birding and associated wildlife viewing groups.
    - Scouting and other youth groups.
    - Stargazing and astronomy groups.
    - Other science or heritage oriented groups
    - Retreats for corporate, eco, or teacher education purposes.
    - Training, especially water rescue and emergency response.

C. Summary of Economic Analysis

1. Cost/Revenue Analysis

One of the primary objectives of this Feasibility Study is to determine if anticipated revenues from camper user fees meet or exceed estimated annual Operating and Maintenance (O&M) costs, including possibly providing for an allowance for replacement of depreciating fixed assets in a sinking fund. Revenues derived at the Camp Berryessa facility will be a function of number of visitors or visitor days, and the daily charge or user fee, and possibly funds raised by an affiliated non-profit foundation. Only user fees are considered in this analysis, since there is no affiliated non-profit foundation at this time, and establishment of such a foundation has its own challenges and costs.

Tables 3 and 4 below provides a comparative summary of the previously discussed Annual O&M Costs and the corresponding total annual revenues needed to meet these costs in terms of number of visitor days times daily user fees. The columns on the left side of the tables do not include an allowance for replacement of assets, or sinking fund costs, while the columns on the right side of the tables include such an allowance. Table 3 uses a lower daily user fee that represents the lower range of the market, comparable to a more primitive State Park Campground with minimal services for the Rustic and Enhanced Rustic Alternatives (A and B), or a State Park or National Park with a fuller range of facilities and services for the Rustic with Central Facilities, and/or Services (Alternatives C and D). Table 4 uses higher end user fees such as might be provided at a well-managed private campground or at one of the better environmental education camps we surveyed with a wide array of facilities and services.

Both tables indicate the occupancy percentage that would be needed to fully meet annual O&M expenses, with and without inclusion of sinking fund costs. This required occupancy or usage level needed to meet annual operating costs (expressed as a percentage of available days) is provided for both an annual basis and for five months or 20 weeks of the year (September, October, and March through June) when weather conditions are favorable and when school groups and other groups are mostly likely to use the facility. This is based on a site capacity of 80 persons, and 365 available days (29,200 available visitor days) for the annual calculation, and 100 days (8,000 visitor days) for the five-month calculation. Note that the target usage rate is to be used only as a decision-making "tool", and shows the occupancy level which is needed to break even on operational costs. Some scenarios would require greater than 100 percent occupancy and are clearly not achievable. Others should be achievable depending on a combination of market conditions and management expertise (marketing and cost management).

Table 3: Operating Costs, Revenues, and Occupancy - Low End User Fees

Alter-native	Without Sinking Fund			With Sinking Fund		
	Annual O&M Cost	Usage Needed to Meet Cost	Percent Occupancy Required	Annual O&M Cost	Usage Needed to Meet Cost	Percent Occupancy Required
A	$100,800	10,080 visitor days @$10.00/day	35% annually 126% 5-month	$124,700	12,470 visitor days @$10.00/day	43% annually 156% 5-month
B	$167,800	13,983 visitor days @$12.00/day	47% annually 174% 5-month	$207,900	17,325 visitor days @$12.00/day	59% annually 216% 5-month
C	$421,890	24,817 visitor days @$17.0/day	85% annually 310% 5-month	$482,500	28,382 visitor days @$17.00/day	97% annually 355% 5-month
D	$545,590	15,588 visitor days @$35.00/day	53% annually 195% 5-month	$622,700	17,791 visitor days @$35.00/day	61% annually 222% 5-month

Table 4: Operating Costs, Revenues, and Occupancy - High End User Fees

Alter-native	Without Sinking Fund			With Sinking Fund		
	Annual O&M Cost	Usage Needed to Meet Cost	Percent Occupancy Required	Annual O&M Cost	Usage Needed to Meet Cost	Percent Occupancy Required
A	$100,800	4,800 visitor days @$21.00/day	16% annually 60% 5-month	$124,700	5,938 visitor days @$21.00/day	20% annually 74% 5-month
B	$167,800	6,214 visitor days @$27.00/day	21% annually 78% 5-month	$207,900	7,700 visitor days @$27.00/day	26% annually 96% 5-month
C	$421,890	12,054 visitor days @$35.00/day	41% annually 151% 5-month	$482,500	13,786 visitor days @$35.00/day	47% annually 172% 5-month
D	$545,590	8,393 visitor days @$65.00/day	29% annually 105% 5-month	$622,700	9,580 visitor days @$65.00/day	33% annually 120% 5-month

2. Summary of Economic Analysis Findings

The data presented in the above tables indicate several things about the economic feasibility of developing the Camp Berryessa site:

- Relatively high occupancy rates (35% to 53%) expressed on an annual basis would be needed to meet operating costs if the facility were to charge out at the low end of the user fee- in the analysis where sinking fund costs are not considered. For comparison purposes, a typical county or state park campground (other than facilities for instance in major attraction areas like Yosemite Valley) have occupancy rates in the 22 to 25% range, while the average hotel typically needs occupancy rates in the 60% to 70% range to turn a profit. Hotels in Napa and Sonoma County had occupancy rates July 2008 to July 2009 of 63.7% to 72.9% respectively.
- Only Alternatives A and B of the High End User Fee scenario that does not consider sinking fund costs would have occupancy rates of less than 100% (over 100% not possible) if the facility were to be used only during the five-month typical school use period, and none would be less than 100% in the Low End User Fee scenario for the five-month occupancy period.
- Very high occupancy rates (up to 97%) expressed on an annual basis would be needed to meet operating costs if the facility were to charge out at the low end of the user fee in the analysis where sinking fund costs are considered.
- No occupancy rates of less than 100% were determined for the five-month user period for the Low End User fee, and only Alternatives A and B had use rates of less than 100%, for the High End User rate for the five-month period, but these rates of occupancy likely cannot be achieved.
- Modest occupancy rates (20% to 47%) were determined for the scenario with High End User fees, and where sinking fund costs are included in the calculation for the annual use basis.
- Only Alternatives A and B had occupancy rates of less than 100% (74% and 96%) for the High End User fee, for the five-month occupancy period.
- The occupancy rates required for the Low End User fees, even where sinking fund costs are not considered, are likely not achievable for the annual period basis, but likely can be achieved after several years for the High End User fees. The fee for Alternative C would need to be higher to make this Alternative more feasible.

3. Conclusions and Recommendations

Based on the above analysis, the following conclusions can be drawn and recommendations made:

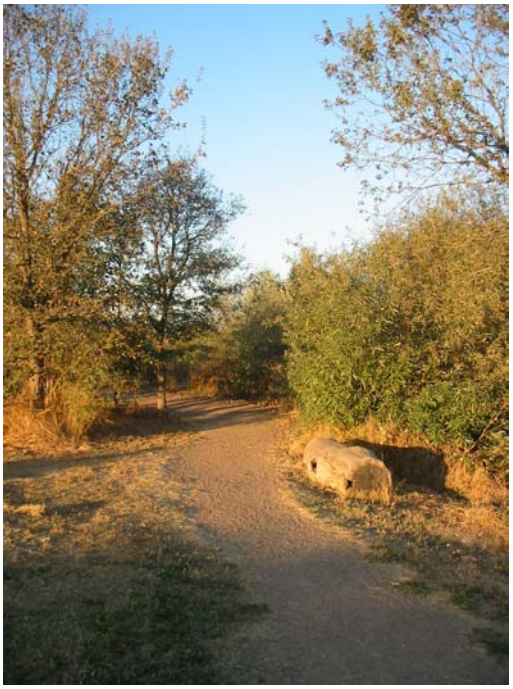
- To be economically viable and successful, the facility will need to attract a number of special use groups and host special events, (astronomy clubs, bike racing or triathlon meets) in addition to its core environmental education facility focus, including special events during the summer months, especially if sinking fund costs are factored into the annual costs of operations and maintenance.
- It appears that opening the facility to the general public, or a wider range of groups by special reservation during at least portions of the summer months, for instance July 4 and Labor Day weekends, will need to be seriously considered, again especially if sinking fund costs are factored into the analysis. Uses during this period could be run through a separate support Foundation or Concessionaire.
- The facility will need to be priced smartly and appropriately, perhaps with special event prices and summer use events partially subsidizing the core focus of the facility.

- A daily use capacity of 80 persons (not including any staff) was used in the analysis, based in part on water supply/wastewater constraints and the housing facilities that will be provided. This is a conservative analysis as for instance water/wastewater peak storage or temporary facilities can be provided to accommodate larger special event crowds, and space has been provided for seasonal tent camping.
- In terms of monetary risk and in consideration of the large differences in O&M costs between Alternatives A and B vs. Alternatives C and D, ($100,00 to $208,000 annual for A and B vs. $422,000 to $623,000 for C and D) a phased development approach should be considered. This phasing will also allow for development of a user group constituency and market for the facility.
- The market and economic analysis indicates that the Camp Berryessa project is feasible. However, this feasibility is dependent on a range of assumptions including market penetration and visitation growth, adequate fee structure, professional management, an active marketing program, and the capacity to build relationships with educators and other stakeholders in the immediate region.
- Given the necessary use levels, fees, and associated operations and maintenance costs, we recommend a phased approach beginning with Alternative A, but targeting Alternative D type development as the final objective. Accordingly each development alternative could serve, in some form, as a phase in long term facility planning. This approach allows Camp Berryessa management the opportunity to generate grants and other capital development funding, build stakeholder partnerships, establish programming, identify potential education audiences, attract early user groups, and begin to assess the extent to which special users other than education specific use may be attracted to the facility. In summary, developing Camp Berryessa into a successful Napa County education institution and special use destination facility is feasible but will take time and a sustained long-term effort.

D. Preferred Site Development Alternative

Based on the market and economic analysis summarized above and contained in the Appendix, the recommended site development concept is similar to Alternative D, although the analysis recommends a phased approach for financial risk management and because the extent of site development will ultimately be dependent on availability of grant funding. Site development and facility construction would move in stages from A to B and C, before all of components for provision of full services and facilities are provided in Alternative D. However, it is not fully clear at this point if Alternative A (tent camping only in prepared locations) should be the initial development, or if some tent cabins similar to Alternative B should also be initially provided. Alternative D would provide more permanent fixed structures (small wood cabins and dorms) than Alternative C, in addition to more staffing, and therefore some thought will need to be given as to how to transition from Alternative C, with some tent cabins where permanent wood structures are shown on the site plans.

VI. MASTER PLAN



The Master Plan provides the framework for development of the site, and identifies planned site elements, based on the preferred alternative(s) developed as part of the Market and Economic Analysis. The Master Plan reflects a desire to provide environmental education opportunities at the site that allow for flexibility in accommodating a variety of user interests, facilities that serve groups of varying sizes, and a design that incorporates maintenance and management efficiency. An important part of the Master Plan is also flexibility in the managing of temperature conditions in the sleeping units; they must have good ventilation with openings to accommodate the very hot conditions during the summer months, and also provide warmth during the chilly winter and early spring months. Several building styles are provided (tent cabins, wood cabins, dormitories) that meet visitor needs while providing flexibility considering the potential range of users. The focus of all built elements will be to use local and renewable materials to the maximum extent feasible to promote sustainability. In general, site furnishings should be simple and reflect the rural natural setting, with materials and furnishings that blend in with the site. Local suppliers of recycled materials should be considered.

A. Master Plan Objectives

Objectives of the Camp Berryessa Master Plan include:

- Identifying a mix of activities, facilities, users and practices that can result in an operation which is fiscally self-sustaining.
- Developing a common theme for site improvements that reflects the site's heritage and natural surroundings.
- Providing prescriptions for the orderly development and management of the site for multiple users and groups.
- Providing recommendations for site circulation and access that provides an enjoyable experience by limiting vehicles to the perimeter.
- Encouraging flexibility in building design, with a range of types and sizes to reflect a variety of user needs.
- Including amenities such as amphitheater, interpretive trail, archery area, fish cleaning station, bocce courts, horseshoes, ropes course and rock climbing wall, or other features to provide a variety of recreational opportunities.
- Emphasizing outdoor gathering areas, while providing shelter from summer heat and winter and shoulder season cool or wet weather.
- Identifying sites and needed improvements for water access and non-motorized water craft recreation.
- Providing an estimate of project costs for plan implementation as well as annual operations and maintenance costs.

- Providing estimates of revenue streams for various alternatives for comparison with operations and maintenance costs to test economic feasibility

B. General Design Guidelines

The following design guidelines provide a description of the types and character of improvements that can form a unified design vision:

1. Camp amenities should be simple, compatible with the natural environmental setting, and reflecting the site's scenic value. Consider views of the surrounding areas when siting buildings, utilities and storage areas to preserve the viewshed. Buildings should be in scale with the existing tree canopy, which is relatively low.
2. Painted surfaces should be limited, with a focus on a neutral color palette that reflects the wooded landscape setting and minimizes the built elements of the site. Generally, unfinished wood siding, earth-tone concrete surfacing or non-reflective galvanized sheeting is preferred.
3. Shade structures and outdoor gathering areas should be a basic component of the design. Group dining facilities and meeting area should be designed to maximize ventilation and access to outdoor spaces.
4. Structures should be consolidated within similar rooflines and structural forms
5. Parking, maintenance, and storage areas should be located away from the main camp area.
6. Multiple access points should be provided for water-oriented recreation.
7. Impervious surfaces should be avoided.
8. Rainwater harvesting should be implemented for the Central Facilities area.
9. Graywater use for non-potable water needs should be maximized.
10. Camp operations should be energy self-sufficient through a combination of energy conservation measures and installing solar energy units.
11. Rustic or recycled elements for site furnishings, such as galvanized feeders for planters, galvanized silos for utility and storage elements, and other simple structures consistent with the rustic setting, should be utilized.
12. Native plant species should be utilized for landscape planting, for shade, ecological restoration, and to provide buffers and screening where appropriate.
13. Planting and design should consider clear zones for fire suppression and management.
14. Earthwork and grading should be minimized, with structures fit into the natural topography rather than placed on graded pads.
15. Water consumption should be minimized.
16. Convenient recycling and composting features should be incorporated into the design and operation of the camp.
17. Camp facility design should be able to flexibly accommodate a wide range of user groups.
18. The facility should have the ability to be constructed in phases as needed to keep initial costs in line with initial revenues, while allowing for expansion over time to match financial resources and demand for facilities.

C. Site Layout

All of the Design Alternatives (Figures 2 through 5) utilize a similar site layout and facilities arrangement that takes advantage of the existing loop road and parking area, with a focus on the prominent serpentine hill near the center of the peninsula as the activities center. The constraints of positioning the wastewater disposal site above elevation 455 feet MSL, and below the very shallow soils of the serpentine hill, and the desire to scatter the facilities in small groups throughout the available area also dictated the facilities layout and design scheme. The 455-foot elevation limitation on location of permanent structures further dictated to some extent the locations of the tent cabins and shade structures. The site layout and location of roads, structures, and facilities should be considered to be preliminary, and some changes to these are possible during final engineering design.

D. Roads, Paths and Circulation System

1. Entry

Visitor access to the site will be directed from the existing access road to a drop off site with a message board kiosk providing site information. Widened pullout areas have been graded by Reclamation staff and should be rocked, with erosion protection of the road shoulder to reduce erosion and sediment potential along the road. Pullouts should be maintained every 200-400 feet to allow visibility and minimize potential access conflicts. The existing compacted gravel road and parking area surfaces should be improved as needed to serve emergency vehicles, buses and other vehicles, and for drainage and all weather use.

2. Site Circulation

Circulation components include the access road, parking and drop-off areas, as well as interior paths to connect the cabins and sleeping areas, showers and restrooms, group facilities and other areas. Vehicular access should be limited in these areas, so that site visitors can travel with limited vehicular conflict. Interior areas can be served by electrically operated ATVs or golf cart service vehicles for maintenance and transport of larger items. Roads and paths within the central portion of the site will be suitable for emergency access. Campers should be provided hand-pulled carts to transport personal items from the parking area to their camping sites.

The internal circulation system would be designed to provide a firm and stable surface with slopes and cross slopes in compliance with regulations for ADA accessibility. The Construction Cost Estimate assumes surfacing using a local “blue shale” gravel surface.

3. *Connections to Local Trails*

Trails and roads at Camp Berryessa will include sections of the Lake Berryessa Trail and connections to trail segments at Knoxville Road. Regional trail connections are shown on Figure 6.

4. *Interpretive Trail Loop*

Within the site, there are opportunities to create an interpretive loop with stations for educational activities focusing on the flora, fauna and history of the area, as well as sustainability concepts. Potential stations to be explored include:

- Site history and culture
- Wildlife and plants
- Geology and soils
- Lake Berryessa aquatic environment
- Watershed concepts
- Flood control, drinking water, and irrigation functions of the Lake
- Site sustainability elements; use of recycled materials, composting toilets and composting of food waste, solar and wind energy, water and energy conservation, roof run-off harvesting, graywater, etc.

5. *Components*

- All-weather road design suitable for school buses, trucks and emergency vehicles
- Utilize existing access roads to minimize need for new earthwork.
- Locate parking on east side of site, away from main camp area, to provide sense of entry and maintain a quiet camping environment.
- Make primary roads and paths ADA accessible.
- Include trail signage and interpretive elements.

TO WALTER SPRINGS, STONE CORRAL CREEK AND BERRYESSA HIGHLANDS

019550001000

019010018000

019550001000

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019040002000

LA POINTE TRAILHEAD

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019040001000

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019010019000

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019040004000

019550001000

CAMP BERRYESSA

019550001000

PUTAH CREEK TRAILHEAD

T

0 400 800

1" = 400'

LEGEND

- T — TRAILHEAD
- SWIMMING PLATFORM
- LOOKOUT
- SWIM BUOY (5 MPH LIMIT)
- LAKE BERRYESSA NORTH END TRAIL ALIGNMENT SUBJECT TO CHANGE
- LAKE BERRYESSA TRAIL (PROPOSED)
- CAMP BERRYESSA TRAIL
- LOCAL TRAIL - INFORMAL TRAILS (NOT ADA DUE TO TERRAIN)
- INTERPRETIVE TRAIL
- RECLAMATION TAKE LINE
- PROPERTY LINE

CAMP BERRYESSA FEASIBILITY STUDY

NAPA COUNTY REGIONAL PARK AND OPEN SPACE DISTRICT

1195 Third Street, Room 210
Napa, California 94559

Napa County Regional Park and Open Space District

QUESTA ENGINEERING CORP.

Civil Environmental & Water Resources

(510) 236-6114
FAX (510) 236-2423
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P.O. Box 70356 1220 Brickyard Cove Road Point Richmond, CA 94807

Sht:	Rev:	Date:	By:	Description:	App'd:

Design: MH
Drawn: BJV
Checked:
Appr'd:

REGIONAL TRAILS

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P:\2008\280047_CAMP_BERRYESSA\CAD\280047_CAMP BERRYESSA SITE (COLORIZED).DWG

Roads and parking areas should be constructed of compacted gravel, quarry fines, or other stabilized, semi-permeable surfacing materials from local sources (to match surrounding natural surface areas).

Primary trail surfaces (which will be wider to accommodate service vehicles, bicycles and pedestrians) should be constructed of stabilized quarry fines, local blue shale gravel, or other permeable surface, combined with soil cement or other stabilizer in areas where fully compliant ADA is needed. The primary trail system will provide access to the group facilities and sleeping areas. Primary trails should be 8-10 feet wide.

Secondary pedestrian paths will be informal compacted earth paths, with access to some camping areas stabilized to fully meet ADA requirements. Heavily used paths can be stabilized earth with sealer for winter access and longevity if needed. Secondary paths should be 4 to 6 feet wide.

Downed logs, boulders, stone and other borders or barriers should be incorporated into the design of the roads, trails and path system to keep users on the trails to prevent trampling and disturbance of understory vegetation. Barriers or borders should be incorporated into the primary trail design. An interpretive pathway should also be considered and is shown on Figures 2 through 5.

The 50- to 60-stall parking area will be permeable surface, with ADA compliant design. Parking should include bus parking and emergency access circulation.

E. Structures

With a primary goal of sustainability, materials re-use and energy efficient design, several choices were reviewed for the dwelling areas, group facilities and other structures at the site. These included:

- Prefabricated/modular units
- Straw Bale construction
- Earth/adobe construction
- Rasta block/concrete
- Tents and tent cabins

1. Materials

Straw Bale Construction is the creation of wood and steel frame filled with straw bales and then plastered. The straw bales are thick, pest and fire resistant and have high insulation values.

Sandbag Construction is the stacking of sandbags filled with adobe dirt to create house walls. When walls are laid up, a concrete bond beam is constructed and the roof is installed. Exterior insulation is then installed and covered with plaster.

Rasta blocks are large hollow core blocks made of recycled foam and cement. After the blocks are laid up they are filled with cement and the roof is installed. The blocks provide insulation and a base for plaster both inside and out.

Autoclaved Aerated Concrete (AAC) is ultra lightweight concrete with a unique cellular structure that provides superior energy efficiency, fire resistance and acoustical properties. AAC was developed by architect Dr. Johan Eriksson in 1923 at the Royal Technical Institute in Stockholm, Sweden. In 1945, Josef Hebel invented a method to produce reinforced AAC, by incorporating steel into the production process.

Pumicecrete is a form and pour system for lightweight aggregate cement. Often a "form contractor" is used to assemble the needed forms and pour the Pumicecrete. Pumicecrete provides thick walls, good insulation values and the ability to plaster inside and out with little or no lath.

Tent Cabins. Tents are portable and typically consist of a canvas structure stretched on a wooden frame. Tent cabins typically are hybrid structures that have solid wood lower walls, roll-up mesh upper walls, and canvas, fiberglass or wood/recycled plastic lumber pitched roofs. At Camp Berryessa, these structures would need to be placed on a firm and stable surface to ensure accessibility. This could consist of a level pad area flush with the land surface, or a deck structure with a ramp that connects to an accessible route. Canvas tent cabins with side panels that can be rolled up during periods of hot weather are recommended for most of the provided sleeping facilities because of their flexibility and low costs. However, the mix of units should also consider several of the more open-framed styles, such as "Unit One" as well as some solid wall cabins such as "Spirit Cabins" or "KOA" style wood cabins for use by smaller groups during the winter months. The smaller cabins would typically house two to four campers, although to provide maximum flexibility, some units should be included that accommodate six to eight campers, as well as larger dormitory cabins housing 16 to 20 (Alternative D on the Site Plan).

2. Group Facilities

Group facilities should be centrally located to take advantage of solar exposure, utility connections, water/wastewater distribution and view opportunities. This includes:

- Shower/Restroom Facility. The restrooms and separate shower facility would include accommodations for a minimum of 6 to 8 users, for Alternatives A and B and up to 12 to 16 users for Alternatives C and D. Several vendors provide pre-engineered, pre-constructed buildings for toilets and showers. Typically the showers are small, single-room/single-usage areas.
- Kitchen Facility. This space could be attached to or separate from the shower/restroom facility, and would be sized to facilitate group dining. The kitchen should be sized to handle 40 or 50 people, serving 80 to 100 camp users in 2 shifts as necessary. (Alternatives C and D only).
- Dining/Group Activity Area. The group activity area would function as a dining facility as well as activity area, and is envisioned as a flexible space that could be partially enclosed or opened to a large deck or trellised patio to accommodate up to 40 to 50 users at a time. Up to 150 users could be accommodated in two or more shifts. Alternatives A and B envision use of a more informal open-sided roofed or trellised structure, while Alternatives C and D envision an architecturally designed building appropriate to the site.

- Storage/Amphitheater/Classroom/Laboratory. The group activity and meeting area can also function initially as a classroom for instruction on natural history and sustainability. A small area for storage of teaching materials should also be provided, although initially it is thought that either

portable/mobile teaching exhibits would be used, or that visiting instructors would provide their own teaching materials. A separate 30 student classroom/laboratory could be considered for a later phase.

- Office. A small office for permanent staff would be located within the main structure.
- Depending on the final design decision, the kitchen, dining area, and meeting area or classroom could be small individual buildings, or part of one large building that expands over time as the facility is built out. Alternative D assumes over 4,000 square feet of facilities.

The group facilities would be designed in accordance with the General Design Guidelines for the site, which include:

- Structure to be constructed to blend with site in form and height, with rustic appearance
- Structure to be oriented to maximize site views
- Solar orientation
- Graywater system/rainwater catchment to be considered as a demonstration project
- Sustainable building design, including ventilation, materials, methodology and use

3. Sleeping Areas

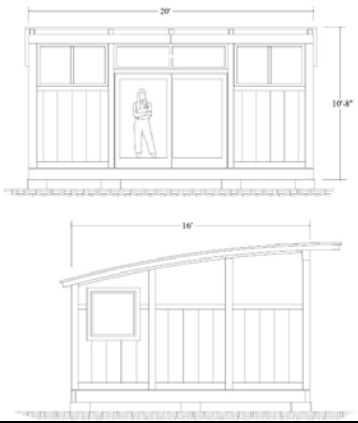
It is envisioned that sleeping accommodations would be of a variety of types and sizes to allow flexibility for a variety of users, to reflect seasonality of use and to allow phasing of implementation. Permanent facilities could include modular tent cabin units that could be utilized year-round, as well as sleeping decks or platforms to accommodate seasonal tent cabins. Event/temporary usage with individual user provided tents could be accommodated within the meadow area, with the provision of supplemental portable/temporary sanitary facilities.

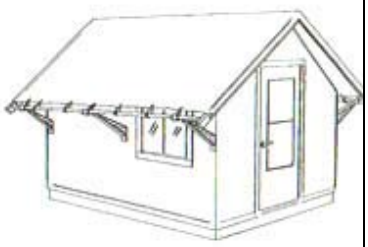
Alternative D includes several small wood cabins of varying sizes, sleeping four to eight, as well as small individual rooms (for teachers) and dormitories for larger groups and classes of 12 to 16 campers. Cabins and even small dormitories are available as pre-engineered/pre-constructed units that can be delivered ready to assemble the site, or can be custom designed and built specifically for the Camp Berryessa setting.

Partial Wood-sided Tent Cabin
California State Park System

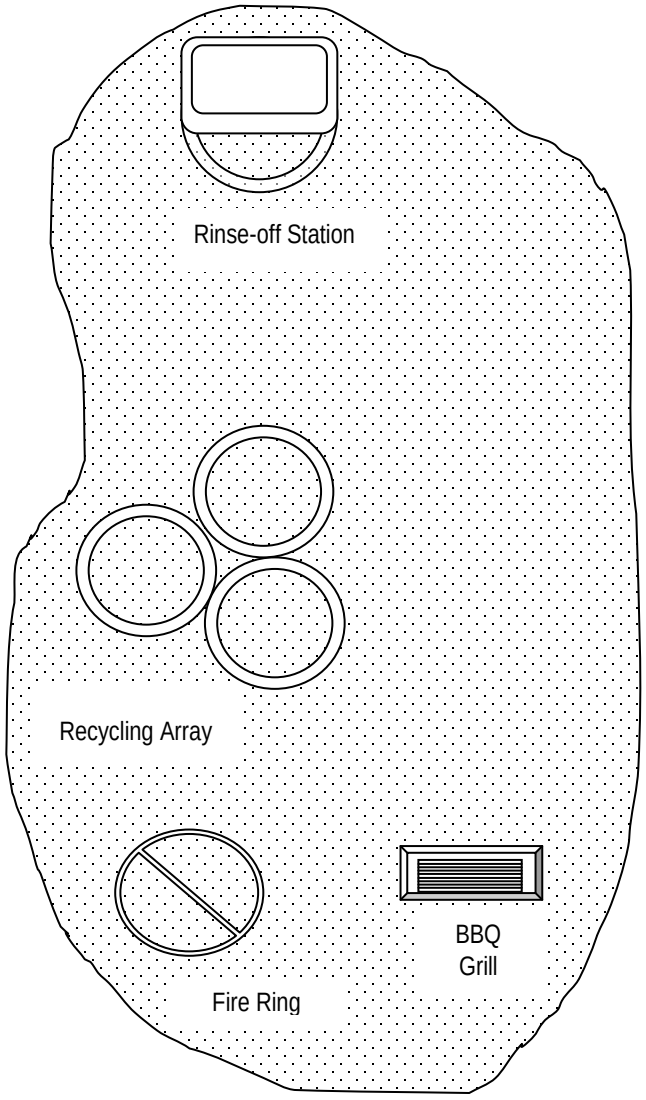
Full Canvas Tent Cabin
California State Park System

Table 5: Sleeping Quarters Prototypes

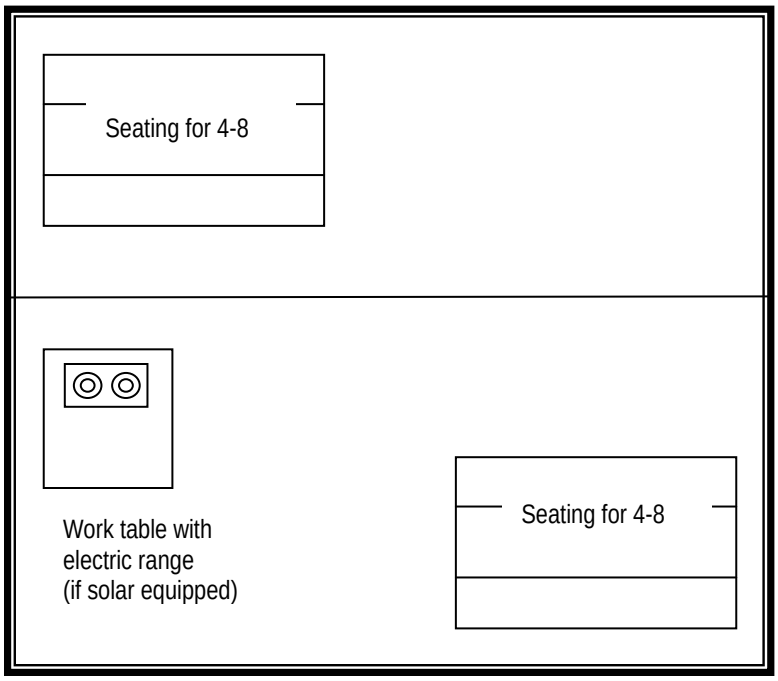
Description	Name Contact Pricing	Details
 	Cabin Fever* 85 NW 71 Street #106 Miami Florida 33150 www.cabinfever.us.com akelly@cabinfever.us.com 305-582-5293 Office 305 200 3191 Fax Price: $100/SF * Similar design/price offered by MetroShed, based in Orlando, FL www.Metroshed.com	Floor system: Foundation pads and risers, perimeter beams, joists, plywood sub-floor. Walls: Insulated wall sections, rough sawn siding, spruce trim, windows and entry door Windows and Doors: 100% virgin Vinyl windows and doors, all with insulated glass. Roof: Curved steel roof beams, 1-1/2" thick solid wood roof deck, warranted Duro-Last roof membrane. Hardware: All hardware. Instruction / build manual
	Modern Cabana 602 Minnesota Street San Francisco, CA 415-206-0330 sales@moderncabana.com Price: $140/SF+	Clear inland cedar siding Hardware: All hardware. Instruction / build manual
	Spirit Cabins 6672 Gunpark Drive, #200 Boulder, Colorado 80301 800.716.8512	• 6'x11' Enclosed Porch • Storage Loft/Open Attic Above Porch • 2" x 4" Framing on 16" Centers • Architectural shingles • Lodgepole Pine Log Siding • Insulated Double-Pane Windows • 4" x 4" Treated Runners • 36" Solid Pine Exterior Door

Description	Name Contact Pricing	Details
	Unit One Shelter-Kit 22 Mill Street Tilton, NH 03276 E: shelter-kit.com T: (603) 286-7611 F: (603) 286-2839 12-ft. wide modules, can be connected, customized Price: $70/sf+	Shelter-Kit supplies the material and engineering, you supply the labor. Sold in kit form, our 12' x 12' modular shell is completely weather tight, and is available with an optional Deck or Porch. It's also expandable - you can add any number of modules at any time to build a larger house. The kit contains everything needed to complete the shell: pre-cut, pre-drilled lumber for the post & beam frame; flooring; siding; roofing; trim, and nails and screws. Galvanized steel bolts and custom-machined aluminum hardware fasten key structural members together. The standard kit also includes a screened 12' wide sliding glass door, a 5' x 3' sliding window, and all the tools required for assembly
	Modern-Shed 5136 NE 54th St. Seattle, A 98105 Tel. (206) 524-1188 Fax (206) 524-1189 info@modern-shed.com Price: $130/SF+	Unit includes 36" glass door and a 30"x30" operable window. The floor, walls and roof are insulated. The walls have a pre drilled wire chase and are covered with finished maple plywood. There is a choice of floor colors to pick from. The transom window around the top is filled with glass. There are optional decks that can be added to the shed to extend the room to the outside. All exterior parts come pre painted.
	Sweetwater Bungalows $30/sf + platform www.sweetwaterbungalows.com/	Wood frame tent cabin with canvas shell, engineered to last approximately 15 years. Assemble on wood platform. Available options include Rain Fly/awning. Doors, windows, and extra interior height at sides. DIMENSIONS 10' x 12' , 12' x 14' , 14' x 20'
	Straw Bale http://www.ci.berkeley.ca.us/Marina/marinaexp/straw%20features.html 	City of Berkeley Shorebird Nature Center is a straw bale structure with green building features, including: • Straw Bale Exterior Walls • Passive Solar Design • Building Integrated Photovoltaics • Hot Water Solar Panels for Radiant Heating System • Natural Linoleum Floors • Interior Walls from compressed straw panels • Recycled and Sustainably Harvested Wood Framing • Cabinetry from Wheat Straw particleboard • Countertops made from Recycled Glass (Counter/ Production)

4. Schematic Shade Shelter Configuration



Utility Work Area



Shade Shelter

Table 6: Cost Assumptions for Shade Shelter

Item Description	Model # used for Estimate	Unit Cost	Installed Cost
16'x 20' Shade Shelter , with 4" thick concrete pad 	Natural Structures Wrangell Mountain Shelter 98-W16020-8T 16' x20'	$13,000 $4,000 solar panels included w/ solar panel system costs	$17,800
ADA Picnic Table 	Sonoma County Probation #1	$415	$700
Storage Locker 	Sonoma County Probation #12	$330	$650
Electric Cooktop  	Kenyon Polar Series 120v Or Kenyon KISS stainless series	$750	$1,600
Utility Table 	Pilot Rock ULT B3	$420	$800
Barbecue Grill 	Sonoma County Probation Camp Barbecue #19	$225	$400

Item Description	Model # used for Estimate	Unit Cost	Installed Cost
Rinse-off Station, including hose bib, galvanized utility sink, and gravel infiltration ring 	Custom	Allow $2,500	$2,500
Trash/Recycle Array 	Pilot Rock RA3/G-PW	$860	$1,200
Fire Ring 	Sonoma County Probation 30" Fire Ring #21	$250	$350
Solar water unit for rinse-off station and utility sink	Heliodyne	$2,000	$2,000
Total Cost of Shade Shelter			$28,000

Notes:

1. *At least 5% of the shelter configurations must be ADA accessible, with an increased cost of approximately 40% per shelter (two of 12 shade structures)*
2. *Alternative A would not have solar water or electricity*
3. *Rinse-off Station includes galvanized utility sink with hose bib and gravel-filled drainage area*
4. *Assume two four-person tables per shelter, could use one eight-person table for cost efficiency*
5. *Solar water units would be utilized for shower units only due to tank and component requirements.*

5. Recreational Facilities

The Camp Berryessa site is ideally suited to non-motorized water sports. As indicated in the VSP, motorized watercraft will not be allowed near the Camp Berryessa shoreline within the Putah Creek arm of the lake, and the near-shore area will be buoyed off to separate swimmers and kayakers from the motorized boating public.

The camp Berryessa site affords exceptional opportunities for camp users to enjoy swimming, kayak/canoe boating, paddlecraft and other water oriented activities. The site offers sandy beach access which is suitable to provide universal lake access.

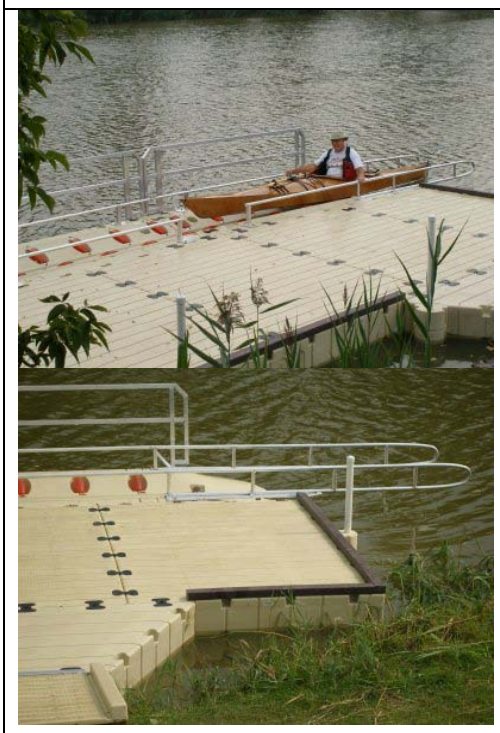
Recreational components that may be included in the mix of activities shown on the site plans include:

- archery
- swimming
- canoe/kayaking
- ropes and rock climbing
- beach volleyball
- bocce court
- hiking
- fishing

Planned improvements to facilitate these activities include:

- dock and kayak launch
- non-motorized boat launch
- swimming platforms

Table 7: Recreational Facilities

Description	Name Contact Pricing	Details
	EZDock 3500 Raider Drive, Hurst, TX. 76053 webinfo@ezdocktexas.com Tel: (800) 654-8168 http://www.ezdock.com	Accessible kayak dock and launch • Accessible kayak dock for easy access. • Kayaker's can launch into the water with less trouble as they load the kayak on the docking system and push off into the water. • EZ Dock is made from plastic polyethylene and rubber which is much more durable than wood. Both of these products are environmentally friendly. • EZ Dock complies with the US Access Board's accessibility guidelines.

	Classic Recreation Systems www.classicrecreation.com Natural Structures Inc. www.naturalstructures.com Romtec www.Romtec.com	Shade Structures • Shade structures should be of materials and form to complement other structural types. • Shade structures should include water spigot, trash receptacle, solar/mister system (if applicable), picnic table and other amenities.
		• Reclamation Shade Shelter with pad, picnic table and barbecue
 	Challenges Unlimited Inc. 1304 Beatrice Town Line, RR#6 Bracebridge, Ontario, P1L 1X4 info@challengesunlimited.com (800) 480-3867 (705) 385-4209 http://www.challengesunlimited.com	Ropes Course • Ropes course designed for universal access. • A special ropes course designed for people with disabilities. • Ropes courses can be designed as a “high elevation” or “low elevation” ropes course depending on the need. • Both courses can be designed with universal access in mind. • Various components including: slides, ramps, swings, ropes, bridges, etc. depending on the need. • Price: $8,500-$10,000

	Source: Don Fox	Barbecues • If 2 or less are provided, both must be accessible • If 2 or more, 50% must be accessible • 40% on an outdoor recreation must have an access route.
	Source: Don Fox	Benches • At least one bench must be accessible • If 2 or more benches, 50% must be accessible (50% with backs, 25% with arms • Seat height-17 inches-19 inches
	Source: Don Fox Available from Sonoma County Probation Department	Picnic Tables • Table clearance – 36 inches surrounding the useable portion • Where 2 or fewer tables, both must be accessible • If 2 or more tables, 50% must be accessible • 40% must be connected to access route
	Koolfog, Inc. 36425 Bankside Dr. Suite B Cathedral City, CA 92234 info@koolfog.com Tel: (760) 321-9203 Fax:(760) 321-2613 http://www.koolfog.com	Water Mister • Water mister has been added to shade canopy to provide extra cooling. • There is a significant drop in temperature where mister/shade canopy has been added compared to covered areas without water misters.

6. Restroom/Shower Facilities

All of the Alternatives evaluated included both composting toilets, utility sinks and water spigots, and cold water rinse off stations deployed within the groups of tent sites, and tent cabins and shade structures, as well as flush toilets and hot water showers connected to the wastewater facility and located in the activity area or central facilities area on the hilltop.

The restroom/shower facility shown on the site plans can either be pre-engineered systems using "off-the shelf plans", or custom designed by an architect and engineer for the camp Berryessa facility. Several vendors provide plans for pre-engineered facilities that have been used at California Parks and National Parks, National Forests, ad BLM and Reclamation managed lands. Vendors are also available to make changes to their standard plans in terms of layout, exterior siding and roofing choices and other components. These potential restroom/shower/ storage/ concession building vendors include (but are not limited to) ROMTEC, (www.romtec.com) CXT (www.cxtinc.com) and Murdock-Supersecur (www.Murdock-supersecur.com), among others. ROMTEC Evergreen offers sustainable LEED pre-engineered structures featuring upgraded insulation, solar and energy efficient fixtures.

A variety of styles are available for the restroom/shower facilities, including separate gender-specific facilities, with several stalls, and multiple individual unisex restrooms. Typically the shower facilities are individual rooms with inside door locks, and equipped with a bench, sink, toilet and shower stall. For ease of estimating costs, we used pre-engineered restroom-shower facilities. For Alternatives A and B we included costs for four stalls and six to eight shower rooms, while for Alternatives C and D we allowed for slightly larger restrooms and showers.

a. Composting Toilets

Composting toilets utilize aerobic decomposition, commonly called composting. Accumulated waste, toilet paper, tissues, and other organic materials are collected in a digester tank that has a sloping floor. Air is circulated by a fan through baffle walls and air channels to provide an oxygen-rich environment for microorganisms to digest and decompose organic materials. The aerobic decomposition generates heat that is transported out the vent stack. No methane gas is produced. Digesting waste slowly moves down the sloping floor, aided by decomposition and evaporation. The end product is aerated humus, similar to garden soil, which must be periodically removed through an access door. The toilet can be waterless, low water use (foam), or utilize a graywater irrigation system.

Self contained systems are available that include a waterless fixture and electric ventilation system to keep the bathroom area odorless. The vent fan can run on AC or solar power. Units can be supplied with a waterless hand-washing product. (source: www.clivusmultrum.com).

Composting toilets are shown on all four of the alternatives, strategically located amongst the areas of cabins and shade shelters.

b. Vault Toilets

Reclamation uses CXT vault toilets throughout their facilities. These are pre-built self contained units that are trucked and installed on site with no foundation. They utilize "Sweet Smelling Technology", developed by the US Forest Service to incorporate venting, aeration and circulation to avoid use of chemicals. The units contain vaults for periodic pumping; a standard single unit contains a 1,000 gallon vault with a capacity of approximately 15,000 uses.

7. Service Areas

a. Equipment and Maintenance Storage Building

A storage and maintenance area is proposed north of the group facilities, at the edge of the parking area. The same structure is proposed for all four Alternatives, although it could be downsized for Alternatives A and B. This area will accommodate deliveries, service vehicles, storage of materials and supplies and maintenance activities. This area will be screened from other areas of the site by the topography, and screen plantings if needed. This area can be separately fenced for use by personnel. It would include separately lockable compartments for user groups to store their equipment, such as facilities for storage of canoes and kayaks.

The approximately 2,000 sq. ft. storage/maintenance building could also contain a small office for staff, as well as a small Camp Store, possibly run by the Camp Host or a concessionaire.

As with the Restroom/Shower Facility, the storage/maintenance building could either be a pre-engineered facility, or custom designed and constructed for the Camp Berryessa site. For ease of estimating costs, we assumed a pre-engineered building as available from SC Barns, (scbarns.com) but there are a number of other manufacturers of larger pre-engineered structures that have an exterior look other than that of a steel sided building.

b. Camp Host Site

The Camp host site (a self contained trailer) will be located near the maintenance and storage area, adjacent to the parking area. This will allow visual access to the camp entry road and parking facilities. The camp host site will be located to fit visually within site, be separated from the main camp areas to avoid intrusion, yet provide a secure presence for safety and emergency needs. The camp host site will include a pad with utility hook-ups, a shade structure over the trailer, and an outdoor private area. The shade structure can have solar panels on top of it.

c. Wastewater Treatment, Storage and Disposal

A wastewater treatment, storage and disposal area is shown on the site plans. Depending on the alternative selected, the treatment unit will need to be sized and designed for the site. In addition to treatment, a 5,000 gallon wastewater underground vault for flow equalization is recommended. If graywater reuse is to be considered, then

separate graywater/blackwater treatment systems may be needed, with separate low level graywater pre-treatment storage and post-treatment storage prior to onsite use. The anticipated wastewater treatment system is discussed further in Appendix A.

F. Planting and Vegetation Management

Planting and landscape management at Camp Berryessa includes three components:

- *Landscape planting* composed of native and endemic plant species that demonstrate educational and cultural value;
- Landscaping for *fire suppression* in a high-fire watershed; and
- *Vegetation management* of non-native invasive species.

1. Landscape Planting

Significant planting is not anticipated for the camp, but some planting and vegetation management may be appropriate for four conditions:

- Shade
- Visual screening and buffering of utility areas
- Edible gardening
- Plantings for environmental education

Tree and planting areas will help define use areas. The structural diversity of the site may be enhanced by placing downed logs and other structural habitat elements to support wildlife use and increase the species diversity to include native flowering species. The planting palette should minimize introduction of non-native invasive species to the site. The following palette provides some of the basics for restoration planting; further information and restoration guidelines for the area can be found at http://nrs.ucdavis.edu/mcl/natural/index.html, the website for the McLaughlin Natural Reserve, which is operated by UC Davis approximately twenty miles north of Camp Berryessa.

Table 8: Plant Palette

Meadow Grasses

Blue Wildrye	*Elymus glaucus*
Creeping wildrye	*Leymus triticoides*
California brome	*Bromus carinatus*
California barley	*Hordeum californicum*
Pine bluegrass	*Poa secunda ssp. Secunda*
Purple needlegrass	*Nassella pulchra*
Idaho Fescue	*Festuca idahoensis*

Tree Canopy

California buckeye	*Aesculus californica*
Fremont cottonwood	*Populus fremontii*
Blue oak	*Quercus douglasiana*
Gray pine	*Pinus sabiniana*
Red willow	*Salix laevigata*

Flowering Plants & Screening Shrubs

Coyote brush	*Baccharis pilularis*
Blue blossom	*Ceanothus thrysiflorus*
Redbud	*Cercis occidentalis*
Sticky monkeyflower	*Diplacus auranticus*
Coffeeberry	*Rhamnus californica*
California rose	*Rosa californica*
Elderberry	*Sambucus mexicana*
Lupine	*Lupinus bicolor*

2. Native Plant Restoration

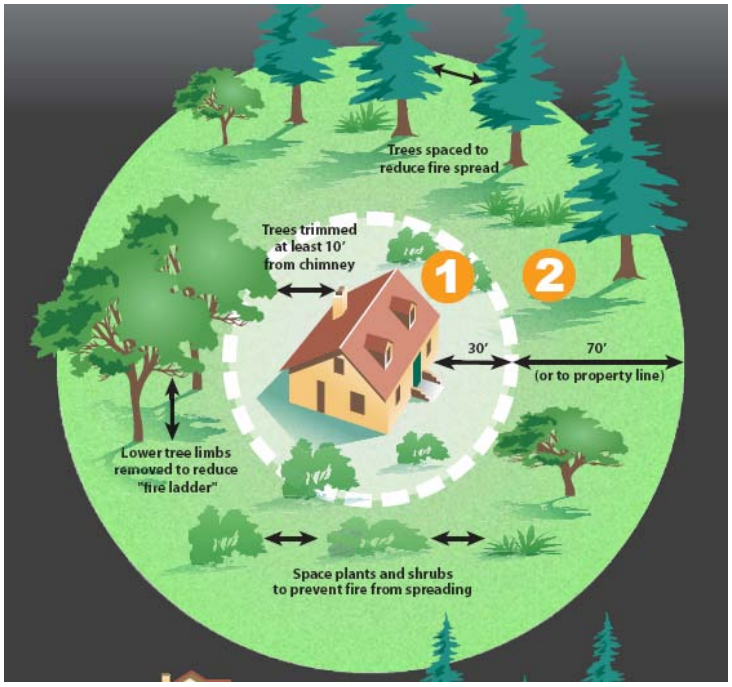
Where planting is needed, native plant species should be considered for screening shrubs and groundcover, as well as accent or special-use plantings with native species:

- Native Meadow Grasses
- Riparian Woodland
- Tree Canopy
- Flowering Plants & Screening Shrubs

Plants should be clustered to utilize available graywater and to provide a green buffer for fire suppression, to facilitate weed management and to separate use areas. In general, a minimum of two or more species of native shrubs or trees should be planted together in a mosaic design, with shrub groupings interspersed with trees where needed for screening of the site's maintenance and work areas.

Habitat for Pollinators. The plant palette includes a variety of flowering and fruiting plants to be used throughout the site to increase understory as well as edge vegetation to provide increased biodiversity. Flowering plants should be included throughout the site, and in each habitat type in appropriate locations.

3. Landscaping for Fire Suppression



Source: Cal Fire www.fire.ca.gov

The occurrence of wildland fires in the Camp Berryessa area can have significant and devastating effects on the watershed by greatly increasing sediment loads that fill in the lake and aquatic habitat areas. Using fire resistant materials, vegetation management, such as clearing understory vegetation, managing fuel buildup, establishing fire breaks and use of low-flammability landscape plantings may help reduce the risk of damage to infrastructure and watershed resources.

The zone where vegetation is managed for fire hazard is called "defensible space." At the camp, all residential areas should be sited to avoid existing trees, but where needed they should be limbed or thinned, as well as removal of hazardous brush, shrubs, and flammable vegetation.

In general, defensible space guidelines call for:

- Clear flammable vegetation on each side of road for a distance of 10 feet horizontally and 13 feet, 6 inches vertically.
- Remove dead wood, trim the lower branches, and limb all live trees to a minimum of 6 feet above the ground to limit ground to canopy contact (fire ladders).
- Trim tree limbs back a minimum distance of 10 feet from any barbecue or firepit area.
- Place dead logs in open areas only.
- Utilize fire-resistant building materials and roofing.
- Maintain the roof of all structures free of leaves, needles, or other vegetative debris.
- Maintain a compost site to recycle debris left from tree trimming and brush removal, or chip to provide mulch for weed management.

4. Vegetation Management

An integrated pest management program focused on invasive weeds, including seasonal grazing, biological control, hand-pulling, and revegetation should be considered to control weeds and enhance native plant diversity.

G. Art, Signs and Interpretive Elements

The site affords a rich opportunity to incorporate environmental art, educational components and interpretive displays into the camp setting. This could include displays to honor volunteers and donors who support the project vision, as well as cultural themes, natural history and environmental education, energy and water conservation, and recycling. An interpretive trail should be provided either using simple numbered posts with a trail guide, or interpretive panels. Other opportunities for incorporating art or design elements into the site in a non-obtrusive manner include pavement inserts, boulder groupings, benches and other amenities. Art and signage elements can include:

- Built elements (signs, benches) using materials from local sources
- Free-form walls, steps, logs, etc. can be incorporated into gathering area for seating
- Picnic tables and benches among existing trees
- Utilize downed logs, boulders to create seating and habitat elements.

H. Site Furnishings

Site furnishings should reflect the natural wooded setting of the Camp Berryessa site. Groups of picnic tables and benches are provided at each of the shade shelters, strategically located around the perimeter trail. The outdoor activity center and amphitheatre also have a large number of tables and benches.

In addition to utilizing salvage, recycled or reused timber, galvanized implements, benches and other amenities should consider use of adobe, boulders, recycled logs, and/or straw bale construction for simple shapes and forms, to delineate use areas and to form seating in group areas. Picnic tables and permanent benches should utilize a neutral color scheme and recycled materials if available.

VII. PRELIMINARY COST ESTIMATE

This section includes a preliminary estimate of project costs for implementation of the Master Plan and site elements, including water supply, wastewater and solar/electrical system. The Cost Estimate includes prioritized capital costs for site development, as well as operations, maintenance, and replacement costs.

Master Plan improvements include access road, internal trails and parking area improvements, entry signage, buildings, camp host site, storage areas, shade structures, restrooms, water supply and wastewater disposal facility improvements, solar/electrical improvements, planting and site furnishings.

It is anticipated that implementation will be supplemented by project partnerships, donor and volunteer efforts. Numerous environmental education opportunities can be implemented by volunteers or non-profit groups over time. This includes habitat enhancement projects such as:

- Installing bird boxes
- Weed eradication
- Installing seating areas and trail borders
- Planting and tending native plant areas
- Docent and educational guidance

Initial Capital Costs for constructing the Camp Berryessa facilities are estimated to range from about $1.7 million (Alternative A) to $3.3 million (Alternative D), depending on the Alternative selected. These cost estimates include a 20% contingency. Engineering Design, Environmental Review and Permitting, and Construction Management, which together total about 25% of construction costs, raise total initial or capital costs to about $2 million for Alternative A, to about $4 million for Alternative D. Costs for the construction of Alternatives B and C fall somewhere between these costs. Total Capital Construction Costs are summarized in Table 9 below.

Table 9: Capital Construction Costs

Alternative	Construction Costs	Construction Contingency 20%	Design & Inspection 20%	Env. Review & Permitting 5%	Total Cost Estimate
A	$1,378,700	$275,700	$275,700	$68,900	$1,999,000
B	$1,861,700	$372,300	$372,300	$93,100	$2,699,400
C	$2,691,700	$538,300	$538,300	$134,600	$3,902,900
D	$2,765,000	$553,000	$553,000	$138,300	$4,009,300

The basis for the cost estimates is included in the itemized spreadsheets in Appendix B. These are preliminary, planning level cost estimates, based on extensive research and discussions with several construction contractors and vendors familiar with the types of facilities being considered. It should be emphasized that the cost estimates are +/- 20 %, as the final engineering and architectural plans and designs for buildings, structures, and visitor serving improvements may differ from the currently anticipated size and conceptual design of the Alternatives presented in this Feasibility Study, and in selection of materials, vendor selections and other factors. In some cases, the names and product or model numbers of certain pre-engineered, pre-constructed and ready to install buildings and structures are provided. This should not be considered as the final selection and endorsement or specification of these, but it meant to provide the reader with the overall scale and intent of the Master Plan. In addition, there is an

opportunity to expand upon or reduce elements of the conceptual Master Plan, as well as combine or merge elements of two or more of the Alternatives during final facility architecture and engineering design.

Annual Operations and Maintenance Costs are estimated to range from as low as $88,200 for Alternative A, to as high as $430,000 for Alternative D as shown in Table 10 below. As with the construction cost estimates, annual Operations and Maintenance (O&M) costs for Alternatives B and C fall somewhere in between these two. The basis for the O&M estimates are also provided in spreadsheet format in Appendix B, along with a list of Assumptions used in preparing the estimates. Note on the spreadsheets that some of the operating costs such as utilities, employee staff and management salary costs, certain wear and tear maintenance items, and food and beverage costs will vary, depending on the level of camp occupancy or number of visitors to the facility. To account for these differences, costs for "low occupancy" and "high occupancy" assumptions are presented in separate columns in the summary table and spreadsheets. These are based on the occupancy estimates developed in the Market Analysis section of the report (see next section).

Table 10: Annual Operations, Maintenance, and Replacement Costs

Alternative	Annual O&M Low Occupancy	Annual O&M High Occupancy	Sinking Fund Replacement	Total Low Occupancy Sinking Fund	Total High Occupancy Sinking Fund
A	$88,160	$100,800	$23,820	$112,100	$124,700
B	$150,160	$167,800	$40,020	$190,300	$207,900
C	$309,250	$421,890	$60,570	$369,900	$482,500
D	$427,490	$545,590	$77,020	$504,600	$622,700

In addition to the Annual O&M cost, an annual cost for replacing some depreciable fixed assets are also shown, where appropriate, based on the estimated life of the item before needed replacement. This "sinking fund" for major repair and replacement is shown in a separate column in both the summary table and in the Appendix B spreadsheet for each Alternative. Annual sinking fund replacement costs range from about $24,300 for Alternative A to $75,000 for Alternative D. When sinking fund costs are included with annual O&M costs, total annual costs range from about $112,500 to as much as $620,700 for Alternative D. Since obtaining grants for routine, annual O&M are much more difficult to achieve than for capital construction, these dollars represent the income that must be met by user fees or other sources of revenue in order for the developed facility to be sustainable and not be a burden on the District.

VIII. PROJECT FUNDING AND PHASING OPTIONS

Project implementation will likely be completed in separate phases, depending upon funding commitment, permitting and opportunities to combine site development with other planned projects.

Phase 1:

- Infrastructure
- Well development and water system
- Wastewater improvements
- Roads, parking, trails, and circulation system
- Electrical
- Camp Host Site/Storage Building
- Trail connection to Knoxville Road trailhead
- Construct Alternative A – Sleeping Decks

Phase 2:

- Group facilities
- Tent Cabins (Alternatives B,C,D)
- Kayak/beach access
- Trail segment along Putah Creek/Berryessa shore

Phase 3:

- Permanent Sleeping Quarters
- Central Facilities
- Recreational amenities

Phase 4:

- Outer Camp (boat in)
- Trail segments to Outer Camp

Kayak access might be improved earlier, if site to be opened on interim basis for picnicking and other activities, with on-site camp host.

IX. NEXT STEPS

A. CEQA/NEPA Confirmation

Reclamation's EIS *Future Recreation Use and Operations of Lake Berryessa Final Environmental Impact Statement Solano Project, Napa, California Mid-Pacific Region* (11-04-05) and *Record of Decision* (6-02-06), included evaluation of the Camp Berryessa site and potential environmental effects. Uses identified in the Record of Decision and accompanying EIS included the following:

> *"Camp Berryessa will be developed and operated as described in Alternative D and managed as a group-camp and activity area on a reservation basis. Facilities will be developed for use by a wide range of groups and will include covered dining, meeting, and educational spaces, as well as showers and laundry facilities. Camp Berryessa will have a non-motorized boat launch ramp to facilitate kayak and canoe use and a buoy line to separate boaters from swimmers. Development of Camp Berryessa will be accomplished through partnership agreements with organizations and local agencies. Development will involve minimum use of Federal appropriations."*

Any new uses beyond those identified above would be subject to further environmental review by Reclamation, likely as a supplement to the FEIS with Reclamation as the Lead Agency. In addition, in order for the Board of Directors of the Napa County Regional Park and Open Space District to take further action of implementing the Master Plan, including directing the preparation of grant applications or directing the preparation of Engineering Plans for Construction, some CEQA compliance document will need to be completed. This would likely be in the form of an Initial Study/Mitigated Negative Declaration (IS/MND). However, a focused or full EIR could be required if any significant environmental issues turn up unexpectedly during the Initial Study.

B. Negotiation and Adoption of Lease or Similar Agreement between Reclamation and NCRPOSD

Agreement for use, operation and management of Camp Berryessa must be formalized by some form of agreement between the County and Reclamation. This will most likely be in the form of a Memorandum of Agreement or MOA.

C. Final Engineering and Design

Site development includes:

- Infrastructure including water and well improvements, wastewater system, rainwater catchment/storm drainage, electrical system, roads, paths, trails, retaining walls, parking areas
- Common area improvements including kitchen, dining area, bathroom/shower facility, camp host site, etc.
- Individual guest facilities, including decks, tent cabins, permanent residence units and associated common spaces
- Recreational facilities such as kayak launch, boat in camp facilities, play facilities (ropes course, horseshoes, interpretive elements, etc.
- Site landscaping/vegetation management

D. Project Permitting and Implementation

Infrastructure, earthwork, water supply improvements and wastewater system design components would be subject to review and approval of Reclamation and/or Napa County, depending on terms of any lease agreement between the property owner (Reclamation), leaseholder (District) and facility operator. Grading, building, water well, and wastewater disposal system permits would be needed from several County Departments. Regulatory permits may be needed from the US Army Corps of Engineers, the Regional Water Quality Control Board, and the California Department of Fish and Game for structures on the shore or within the water of Lake Berryessa, such as boat ramps, kayak launches, and swimming platforms.

X. REFERENCES

Lake Berryessa Visitor Services Planning Task Force, 2002. (VSP) *Visitor Services Plan*
U.S. Bureau of Reclamation, 1992. *Reservoir Area Management Plan* (RAMP)
U.S. Bureau of Reclamation 1992. *RAMP DEIS/FEIS*
U.S. Bureau of Reclamation, 2006. *Record of Decision* (ROD)
U. S. Department of Energy. *Small Wind Electric Systems.*
USDA NRCS. Napa County Soil Survey

Personal Communications

Bill Goshorn, Boy Scouts of America, Silverado District
Melissa Brockman, Bureau of Reclamation
Don Huckfeldt, Huckfeldt Well Drilling
Janet Rogers, Bureau of Reclamation

Appendix A
Onsite Wastewater Feasibility Study

Onsite Wastewater Feasibility Study

for

Camp Berryessa

Prepared for:

Napa County Regional Park and Open Space District
1195 Third Street
Napa, California 94558

Prepared by:

Questa Engineering Corporation
1220 Brickyard Cove Road, Suite 206
P. O. Box 70356
Point Richmond, California 94807

July 2009

Onsite Wastewater Feasibility Study

for

Camp Berryessa
Lake Berryessa, California

Prepared for:

Napa County Regional Park
and Open Space District
1195 Third Street, Room 210
Napa, California

Project #280047

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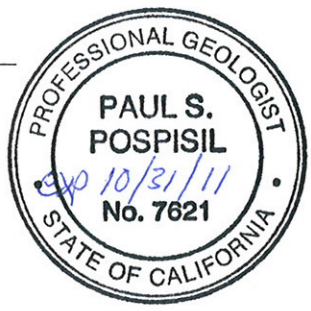
July 2009

Norman N. Hantzsche, P.E.



Paul Pospisil P.G.

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INTRODUCTION

This report has been prepared for the Napa County Regional Park and Open Space District (District). The purpose of the report is to inform the District of the feasibility of developing an onsite wastewater treatment system (OWTS) to assist in the planning of a proposed new outdoor recreational and educational facility at Camp Berryessa. The report presents the results of preliminary field investigations and parameters relating to the capacity, sizing, and recommendations for the design of a potential OWTS.

The Camp Berryessa site is the location of a former Boy Scout Camp located at Lake Berryessa along the east shore of Putah Creek. Since the decommissioning of the camp, the structures, including bathroom and shower facilities, have been removed and the former leachfield abandoned.

Questa Engineering Corporation (Questa) was retained by the District to investigate the site soil conditions pertaining to the dispersal of wastewater generated by the proposed new recreational facilities, and in general, determine the carrying capacity of this land considering any limitations that may be imposed by unfavorable or constrained soils, drainage and groundwater conditions, and in consideration of required setbacks from streams, lakes, wells, etc.

The work entailed the following:

- Site investigation to evaluate soil, groundwater and percolation characteristics in different areas of the property for onsite wastewater disposal suitability;

- Preliminary analysis of wastewater disposal capacity and OWTS design options based on site conditions and potential uses of the property;

- Preparation of a conceptual design and preliminary report including our findings and recommendations, as well as a cost estimate.

FIELD STUDIES

A site investigation was performed by Questa on May 13, 2009. It included soil profile observations of seven backhoe test pits and the completion of nine preliminary percolation tests. Napa County soil logging procedures were followed. Mr. Ray Franklin, representing the Napa County Environmental Management Department, was present to observe a portion of the field work. Although the property is on Bureau of Reclamation lands, the Bureau indicated that they would defer to Napa County standards for wastewater system design. The test locations are shown in **Figure 1**. The field observations are discussed as below.

Soil Conditions

The Camp Berryessa site is constrained for wastewater dispersal by very shallow soils underlain by low permeability weathered rock. During the field investigation, soil profile trenches T-1 through T-7 were excavated in a gently sloping area (5% to 8% slopes) maintaining a minimum 200-foot setback from the high water mark of the lake. Soils in this area generally consist of clay loam topsoil approximately 6 to 10-inches deep, underlain by heavy clay loam to clay subsoils to depths ranging between 12 and 25 inches. The underlying fractured, weathered rock includes mainly volcanic tuff, with serpentine in some locations (T-3 and T-7). Suitable soils were shallower in trenches T-2 and T-6 where lower-permeability zones were encountered at a depth of about 18 inches. No groundwater or evidence of seasonal groundwater (mottled or gleyed colors) was observed in any of the test pits.

Soil descriptions are presented in **Table 1**. More detailed soil profile logs for each of the test pits are provided in **Attachment A.**

Table 1
Soil Profiles
Camp Berryessa
May 13, 2009

T-1	*0" - 4"/ 8"*	*Brown Clay Loam/Lt. Density Clay topsoil*
	4"/ 8" - 25"	*Brown Mixture of Clay loam w/ pieces of Fractured Rock*
	25" - 33"	*Gray Fractured Fine-Grained Volcanic Tuff*
	33" - 69"	*Moderately Weathered Bedrock (Tuff), fractured*
T-2	*0" - 6"/10"*	*Reddish Brown Heavy Clay Loam to Clay*
	6"/10" - 18"	*Gray Brown Mixed pieces of Tuff and Clay Loams*
	18" - 36"	*Pale Gray Tuff (texture similar to Siltstone)*
T-3	*0" – 6"*	*Reddish Brown Lt. Clay Loam topsoil*
	6" – 15"/ 20"	*Reddish Brown Heavy Clay Loam to Clay (pockets of Lt. Clay Loam)*
	15"/ 20" – 24"/ 34"	*Reddish Brown and Gray/Green Mixed Serpentine Gravels and Clay Loam to Clay*
	24"/ 34" – 48"	*Highly Fractured and Sheared Serpentine, many sharp pieces of rock*
T-4	*0" – 9"*	*Reddish Brown Clay Loam to Clay*
	9" – 24"/ 30"	*Brown to Grayish Brown, Highly Fractured and Welded Tuff (broken into small cubes)*
	24"/30" – 39"	*Gray Brown Welded Tuff Block (hard angular, not weathered)*
T-5	*0" - 9"*	*Reddish Brown Loam topsoil*
	9" -20"	*Dark Brown Clay*
	20" – 53"	*Pale Yellow Fine Sandstone, some pockets of gravels*
T-6	*0" - 12"*	*Dark Gray Brown Teary Clay Loam topsoil*
	12" -20"/ 96"	*Brown to Green, Highly Fractured meta set/volc mixed with Clay Loam*
T-7	*0" – 6 to 10"*	*Dark Reddish Brown Heavy Clay Loam*
	6"/10" – 48"	*Very Weathered Serpentine, many soft, friable areas*
	48" – 72"	*Differentially Weathered Serpentine, some soft areas*

Setbacks

Based on discussions with Napa County personnel, a 200-foot wastewater dispersal field setback from the high water line of the lake was considered appropriate. A 100-foot setback from the existing on-site well was also used. Reclamation staff requested all permanent facilities, including the wastewater disposal field, be located above elevation 455 MSL (1929 Datum). There are no surface streams, springs or wetlands on the property. Setbacks are shown on **Figure 1.**

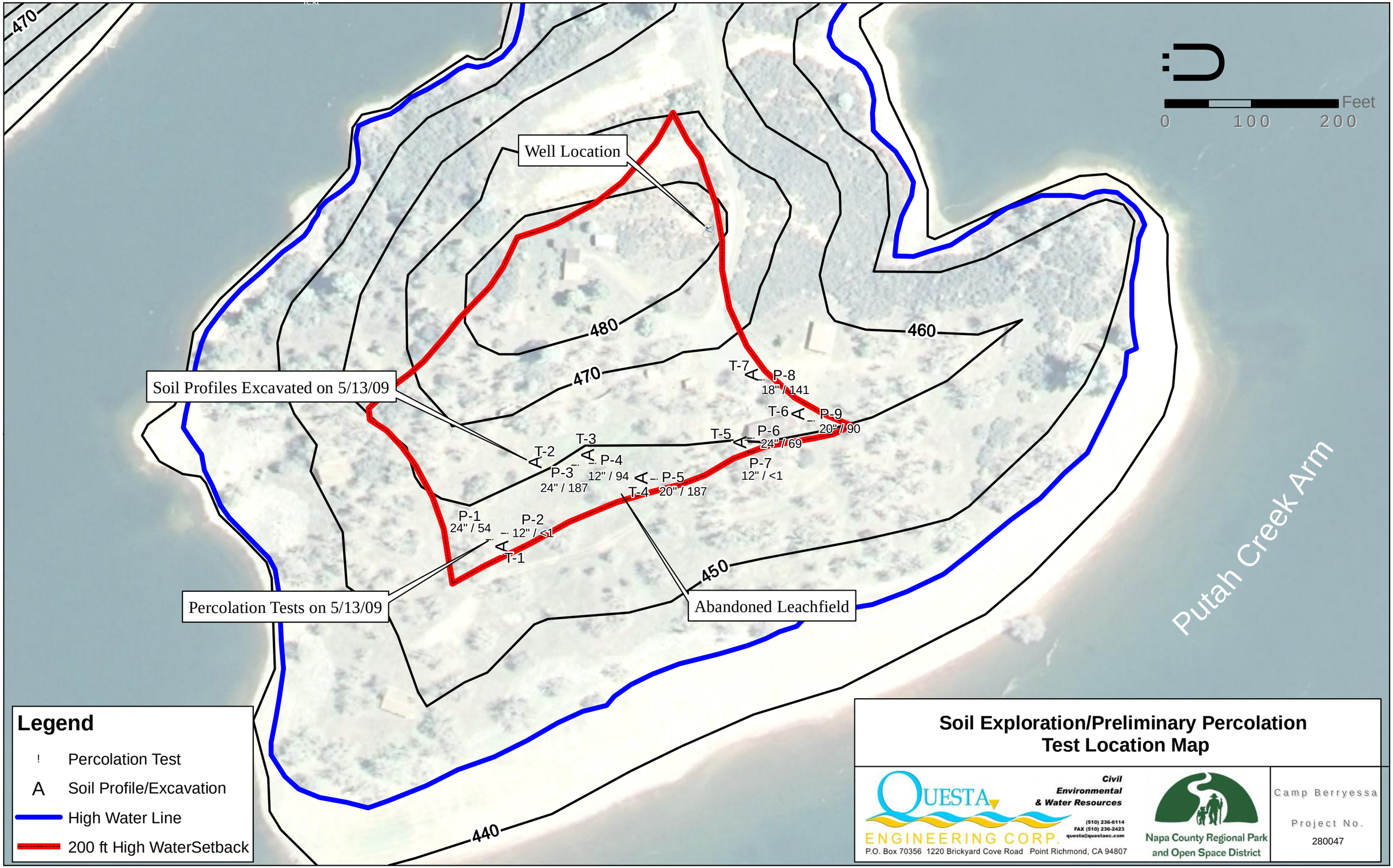
Percolation Testing

Nine percolation tests were conducted at depths ranging from 12 to 24 inches in order to determine the absorptive qualities of the shallow soils in the potential wastewater dispersal area. The locations of the percolation test holes are shown on **Figure 1**; data sheets are appended at the end of this report (**Attachment A**). Percolation rates varied widely. Percolation was very rapid in the upper 12 inches of soil (<1 minute-per-inch or MPI); four of the tests at 18-24 inches deep were in the range of 60 to 120 MPI; and three of the tests were >120 MPI ("failing").

As these tests were preliminary, a 24-hour pre-soak of the test holes was not conducted per the standard Napa County test procedures. Most of the holes were tested for four hours, providing enough time for the clays to absorb the moisture uniformly in the area of the test hole and for the clays to swell. Typically, the percolation rates stabilized during the test and, therefore, provide a reasonable estimate of percolation characteristics for the purposes of this feasibility analysis. Additional percolation testing should be performed for the final system design.

Table 2
Percolation Test Results

Test Hole Number	***Depth (inches)***	***Stabilized Percolation Rate (MPI)***
P-1	24	57.3
P-2	12	<1
P-3	24	266
P-4	12	100
P-5	20	200
P-6	24	73
P-7	12	<1
P-8	18	151
P-9	20	94


Well Location
Soil Profiles Excavated on 5/13/09
Percolation Tests on 5/13/09
Abandoned Leachfield
Putah Creek Arm
470
480
460
450
440
T-1
P-1
24" / 54
P-2
12" / <1
T-2
T-3
P-3
24" / 187
P-4
12" / 94
T-4
P-5
20" / 187
T-5
P-6
24" / 69
P-7
12" / <1
T-6
P-9
20" / 90
T-7
P-8
18" / 141
0
100
200
Feet
Legend
Percolation Test
Soil Profile/Excavation
High Water Line
200 ft High WaterSetback
Soil Exploration/Preliminary Percolation
Test Location Map
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Camp Berryessa
Project No.
280047

SOIL SUITABILITY FINDINGS AND RECOMMENDATIONS

Constraints

The site is constrained for wastewater dispersal as follows:

- **Shallow soil conditions.** Soil depth varies from 12" to 25". The minimum soil depth required by the Napa County Regulations is 24" for a mound system and 32" for a subsurface drip dispersal system.

- **Slow percolation rates.** The slow percolation rates in the 18 to 24-inch depth zone are not suitable for conventional leachfield systems. However, the majority of the test results meet the minimum Napa County requirement of 120 MPI for alternative treatment and dispersal systems. Such systems can consist of "imported soil mounds" or sub-surface drip dispersal systems.

- **Perched groundwater.** Shallow perched groundwater (perched on bedrock) is likely to occur during the wetter times in the winter, although there was no field evidence of seasonal perching observed.

These limiting soil conditions do not meet minimum Napa County requirements for conventional onsite wastewater disposal systems. The limited soil depth (less than 24 inches) is the most significant factor.

Soil Fill

The typical method to resolve the lack of soil depth is to import and buildup the soil profile with fill material of a suitable texture, and to conduct additional soils/percolation testing after the placement and settlement of the soil fill. A sub-surface drip dispersal system could then be installed in the fill. Such a system would require pre-treatment of the wastewater. We have previously implemented this type of soil fill solution on another property in Napa County, and we have recently confirmed with County staff that this remains an acceptable option. For the project site, we estimate that approximately 12 inches of soil fill (sandy loam or better) would be required to develop a suitable area for a subsurface drip dispersal system, and that the fill should cover the actual wastewater dispersal field area (5,000 to 10,000 square feet). Typically, fill soil is also placed over the lateral (downslope) run-out area extending a distance of approximately 25 feet, tapering from 12 inches at the edge of the dispersal field down to grade at 25 feet downslope.

WASTEWATER DISPERSAL CAPACITY ESTIMATE

The area determined to be available and suitable for a fill-modified shallow drip dispersal field is approximately 400-feet long by 25-feet wide. This would provide a dispersal area of approximately 10,000 square feet. The capacity for wastewater dispersal in shallow soil conditions such as this site is affected by two factors: (1) wastewater application rate in the dispersal field, based on the soil characteristics and wastewater quality; and (2) the linear loading rate, based on the soil hydraulic properties, depth and slope. A third factor that may come into play for seasonal use facilities is the evapotranspiration rate.

Wastewater Application Rate. Based on soil characteristics (clay loam to clay) and estimated percolation rates in the range of 60 to 120 MPI, the recommended loading rate for subsurface drip dispersal fields is 0.1 to 0.2 gallons per day per square foot (gpd/ft^2). Under these criteria a 10,000 ft^2 drip field area would have a capacity for approximately 1,000 to 2,000 gpd, depending on final percolation test results, and season of use.

Linear Loading Rate. Linear loading rate, sometimes referred to as "contour loading rate", is defined as the wastewater flow rate along a downslope projection of the dispersal field parallel to the slope, expressed in gallons per day per lineal foot (gpd/lf). This is a critical factor in areas of shallow soil conditions, where the flow of wastewater is primarily in a lateral direction, and is limited by the depth and properties of the soil above the restrictive layer. Acceptable linear loading rates can be determined from the application of Darcy's Law (Q=kia) describing water movement in soil, or using guidance tables developed based on Darcy's Law. **Attachment B** provides a copy of linear loading rate guidelines for different soil properties, depth and ground slope, developed by Jerry Tyler (University of Wisconsin). Using these guidelines, an appropriate linear loading rate for the Camp Berryessa site is determined to be in the range of 2.2 to 2.7 gpd/lf. Using an average value of 2.5 gpd/ft^2 times 400 lineal feet of lateral disposal field length gives an estimated capacity of approximately 1,000 gpd.

Evapotranspiration Rate. One of the advantages of a shallow drip dispersal field as compared to a conventional leaching trench is the ability to deliver treated wastewater to the root zone for plant uptake (evapotranspiration). In a seasonally warm climate such as Lake Berryessa, this additional evapotranspiration component can increase the effective wastewater dispersal capacity during certain times of the year. During warm weather periods, the ET can be added to the linear loading to estimate the total effective dispersal capacity. Monthly calculations are provided in **Attachment C** showing the resultant increase in disposal capacity, based on a water balance analysis that takes into account average monthly rainfall, runoff, and potential evapotranspiration. The calculations show a measurable net ET in the 10,000 ft^2 dispersal area from April through October, ranging from a low of about 500 gpd in October to a high of about 2,500 gpd in July. During the wet weather season (November-March) there is no net ET that would contribute to an increased wastewater dispersal capacity.

Monthly Disposal Capacity Summary. The ET estimates are combined with the wastewater drip field application rates and linear loading rate estimates to produce the monthly composite estimates of wastewater dispersal capacity for the Camp Berryessa site, as shown in **Table 3.**

Table 3
Wastewater Capacity Summary

Month	Drip Field Capacity (gpd)	Linear Loading Rate Capacity (gpd)	ET Contribution to Capacity (gpd)	Net Linear Loading plus ET Capacity (gpd)	Estimated System Capacity (gpd)
January	2,000	1,000	0	1,000	1,000
February	2,000	1,000	0	1,000	1,000
March	2,000	1,000	0	1,000	1,000
April	2,000	1,000	780	1,780	1,780
May	2,000	1,000	1,090	2,090	2,000
June	2,000	1,000	1,140	2,140	2,000
July	2,000	1,000	1,490	2,490	2,000
August	2,000	1,000	1,300	2,300	2,000
September	2,000	1,000	620	1,620	1,620
October	2,000	1,000	500	1,500	1,500
November	2,000	1,000	0	1,000	1,000
December	2,000	1,000	0	1,000	1,000

Carrying Capacity of Facility Based on Wastewater Disposal

For planning purposes, and based on wastewater flow information developed by the EPA, a campground equipped with showers and a small kitchen with an average flow of 30 gpd has an average daily wastewater generation of between 20 and 40 gallons per visitor per day. Actual wastewater generation varies by the season and by the kind of user group. For instance, a younger group of students utilizing the site for environmental education purposes may generate wastewater in the range of 10 to 15 gallons per day, while an older user group would likely generate wastewater closer to the higher daily totals, especially if used during the hot summer months. Typical daily use would be less than 10 gpd per person if no central kitchen/cafeteria and shower facilities were provided. Based on our experience, a wastewater flow rate for a facility with a kitchen/cafeteria, showers, and restroom is about 20 gpd per person, with peak uses of up to 30 gpd per person.

Assuming a 20 gallon per day typical wastewater generation during the winter months, and a here-in determined on-site system capacity of 1,000 gallons per day during this time period, would yield a campground capacity of about 50 persons during the winter months. Campground capacity as determined solely by on-site wastewater disposal capacity would increase to about 70 to 80 visitors per day during the early fall and spring periods when disposal capacity increases due to higher evapotranspiration rates, again using a 20 gpd assumption, with less capacity if a 25 gpd use were assumed. If no kitchen/cafeteria and shower facilities were provided, the campground could support a winter user population of about 100, and up to 200 during the hot summer months.

Management Actions to Extend Facility Carrying Capacity

There are number of planning and management actions that can be taken to cut down on the average wastewater generation that must be disposed of at an on-site treatment facility and therefore will increase the site carrying capacity and allowable usage of the facilities.

- ***Drinking Water and Clean Gray Water Disposal at Each Campsite***

  A rinse-off station, and a utility sink with a water faucet and hose bib for drinking and washing hands can be provided (with County approval) at each shade shelter. Many facility users will avail themselves of the convenience of this, thereby reducing the generation of wastewater. Typically, the water would be allowed to percolate into a 2-foot-deep gravel bed contained within an open-bottomed concrete cylinder (a 36-inch-diameter concrete culvert).

- ***Vault and Composting Toilets***

  Several vault and composting toilets have been spread at strategic locations around the facilities. These are self-contained units that will not be tied into the wastewater disposal facilities. The vault toilets will need to be pumped by a septic tank pump truck from time to time, especially prior to or following large events. Use of these convenient facilities will also reduce the wastewater load going to the drip dispersal field.

- ***Large Event Portable Facilities***

  When a large, special event is planned that would otherwise exceed the capacity of the wastewater dispersal field, one additional option would be to bring in portable toilets for the event.

- ***Wastewater Storage for Flow Equalization***

  Wastewater flow volumes will vary by the day, week, and month, depending on the kind and size of the event, time of year, and user group. For instance, school groups would typically come in on an early afternoon on a Monday and leave Friday mornings, with the heaviest use by these groups during the early fall and spring. Wastewater generation could be light on Mondays and Fridays, heaviest in mid-week and extremely low on weekends during this portion of the calendar year. In some instances, use might be light during the weekday and heavy during the week end.

  One way to equalize the wastewater flow going to the disposal filed would be to provide additional storage of the wastewater load, prior to going to the treatment and disposal system. A 5,000 gallon underground wastewater storage tank can be utilized to provide for this ability to equalize flow. The tank can also be pumped out, prior to, and following a large event, and possibly even during an event, to further extend the wastewater capacity of the facility.

FACILITY REQUIREMENTS

Subsurface Drip Dispersal System

Based on the shallow soil depths, excellent permeability in the upper soils, and potential seasonal perched water conditions, the property is best suited for the use of subsurface drip dispersal. Drip dispersal systems afford the best opportunity for uptake of water by evapotranspiration, and also contribute to greater assimilation of nitrogen in the root zone. The seasonally high groundwater and shallow soils preclude the use of standard or pressurized leachfield trenches. A mound system may be possible in some of the area, but it would be much more intrusive on the landscape, more expensive, and not as effective in soil and plant assimilation of the treated wastewater, and would likely support a smaller user group.

Onsite wastewater disposal using subsurface drip has progressed significantly in recent years. Its acceptance as a viable method for disposal of secondary-treated effluent has grown, especially for situations constrained by shallow soils. There is now an increasing base of scientific information documenting the treatment effectiveness of subsurface drip methods and providing evidence that the wide dispersion of treated effluent through drip systems achieves better pathogen and nutrient removal than traditional gravity, pressure-dosed leaching trenches or mound systems. Briefly, the dripline consists of 1-inch diameter polyethylene tubing with pressure-compensating emitters spaced 24 inches apart. The drip lines will be installed at a depth of 8 to12 inches, following the landscape contours, and the lines will be spaced roughly 24 inches apart. The dripline is impregnated with bactericide and root intrusion inhibitors.

Based on standard design guidelines proposed for adoption by Napa County, a wastewater loading rate of 0.1 to 0.2 gallons per day per square foot of dispersal area would be appropriate for the site. This would require a dispersal area of 5,000 to 10,000 square feet of area for a 1,000 gpd design flow.

Treatment Options

As previously mentioned, a secondary treatment system is required ahead of the drip dispersal system for two primary reasons: (1) to compensate for the limited depth of soil in the dispersal area; and (2) to minimize the solids entering the drip tubing. The incorporation of secondary treatment will also provide the ability to reduce the wastewater nitrogen loading rates to meet Napa County and Regional Water Quality Control Board criteria.

The desired treatment level preceding drip dispersal systems is 20 mg/L for both biochemical oxygen demand (BOD) and total suspended solids (TSS). There are several different systems or technologies that can be used to meet these treatment requirements. A brief overview of potential options is provided below, along with a preliminary, qualitative ranking.

(1) Recirculating Sand Filter. The technology is well established and reliable. The costs are somewhat higher than the proprietary treatment designs (Alternatives 2, 3 and 5); however, the system components are less complex and not dependent upon a commercial manufacturer for future repair or replacement needs. The land area requirements for a 1,000 gpd system would be on the order of 1,000 to 1,500 square feet. **Ranking: High**

(2) Aerobic Treatment Unit. This system is well suited where space is a significant limitation; it would require about half the area of a recirculating sand filter. The major drawback for aerobic treatment units is the intensive use of energy. **Ranking: Moderate**

(3) AdvanTex® System. This system is most comparable to the recirculating sand filter, the main differences being a somewhat smaller space requirement and somewhat more complex treatment components and control equipment. **Ranking: Moderate to High**

(4) Subsurface Flow Wetland. This alternative is the most passive and least complex system, in terms of mechanical and electrical systems. The intangible benefit of this alternative would be its passive and natural treatment elements. Its main drawbacks are the lack of local experience, the greater dependence on natural biological systems for treatment, larger amount of land area required, plus a larger leachfield capacity to accommodate winter rainfall additions to the open wetland bed. Since the project site is primarily constrained by lack of soil/dispersal capacity, having to provide surplus capacity for rainfall would be a critical negative factor. **Ranking: Low to Moderate**

(5) Peat Filter. This alternative is a relatively simple system that would meet the treatment needs for the project. However, there is limited experience locally with peat system. The primary drawback of this alternative is the need to replace the peat media every seven years (from a peat supplier in Canada), and the limited local experience with management of effluent quality. **Ranking: Moderate**

MONITORING AND LARGE EVENT SCHEDULING

Considering the diversity of facility user variables involved, providing an accurate estimation of wastewater generation is a difficult task for the Camp Berryessa site. The task of determining a maximum facility capacity is further complicated by the fact that the facility manager can take certain actions to manage wastewater flow, such as dispersal of vault and composting toilets throughout the site, brining in special event portable toilets, and managing the large wastewater storage tank with more frequent pumping associated with special events. Because determining wastewater capacity is based on limited soil observations and field percolation testing, the wastewater absorption capacity of the dispersal filed itself can only be approximated, and therefore conservative assumptions are typically used in facility design. However, based on what we know of soil conditions and the ability to manage wastewater generation and disposal, including storage and pumping, we believe the facility can be routinely operated with a average user population of 80 to 100 people. This can be extended to 100 to as many as 120 people with good management, with a maximum of perhaps 200 people during unusual special events in the fall and spring peak use periods, provided the capacity of the facilities (wastewater levels in vaults and storage reservoirs) is closely monitored and timely pumping provided as needed.

Given the degree of experience-based management required, we recommend a program of accurate tracking of water and wastewater use, including pumping, so that this information can be used in facility management and event scheduling. With an accurate database of information, the camp host or reservation specialist will need to consider the history of use of previous kinds of events, and associated water and wastewater generation, as well as the performance of the dispersal field when scheduling. It may very well be that actual experience will indicate that the facility cannot handle back-to-back bookings of large events (150 to 200 people) without some one- to two-week recovery/rest period in-between large events.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The Camp Berryessa site has some definite limitations on wastewater disposal due to shallow soils and somewhat slow percolation rates. A 200-foot setback from the observed high water line of Lake Berryessa and the presence of very shallow serpentine soils in the hilltop area further limit the available soil disposal area. Based on the field work conducted to date a shallow mound sub-surface drip dispersal system is recommended as the preferred disposal option. The subsurface drip system would need to weave around the existing trees, (and tree roots) although it is likely that some trees would need to be removed to construct the system. Such a system will require pre-treatment of the wastewater stream.

Wastewater loading rates will vary considerably throughout the year, depending on the kinds of facility users and their water needs. In addition, construction of a full kitchen/cafeteria and shower facilities would substantially increase wastewater loading. Based on our fieldwork and review of facility information, and provided timely actions are taken to manage wastewater carefully, we believe that the facility can routinely handle a user population of 80 to 100 people, with a peak special event user population for rare events of up to 200 people.

ATTACHMENT A

SOIL AND PERCOLATION TEST DATA

Questa Engineering Corporation

SOIL PROFILE DESCRIPTION

Project Number: 280047 **Project Name:** Camp Berryessa **Date:** 5/13/2009
Project Location: **Boring Method:** **Logged By:** PP
Notes:

Test Hole No: T-1 **Water Table:** **Slope:** 5%±

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0 - 4" 8"	Clayloam/ Lt Density Clay	Moderate, abk	Brown	<15%	Few fine, medium to common very fine	so, frb, ss	Clear boundary. No mottles.
	4" - 25"	Mixture of Clayloam with Pieces of Fractured Rock		Brown			frb	
	25" - 33"	Fractured Fine Grained Siltstone	Frac	Gray				
	33" - 69"	Moderately Weathered Bedrook Fractured						

Notes:

Test Hole No: T-2 **Water Table:** **Slope:** 10%±

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0" - 6" 10"	Heavy Clay Loam to Clay	Moderate, strong, abk	Reddish Brown	<15%	Few Very fine and common very fine	frb, frm	Common very fine to coarse roots. Clear boundary. NO mottles.
	6" - 10" 18" ±	Mixed Pieces of Tuff and ClayLoams		Gray Brown				Common very fine to coarse roots.
	18" - 36"	Tuff (texture similar to silt stone, fairly hard to dig)		Pale Gray				

Notes:

Questa Engineering Corporation

SOIL PROFILE DESCRIPTION

Project Number: 280047 **Project Name:** Camp Berryessa **Date:** 5/13/2009
Project Location: **Boring Method:** **Logged By:** PP
Notes:

Test Hole No: T-3 **Water Table:** **Slope:** 10%±

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0 - 6"	Light Clayloam Topsoils	Moderate, sbk	Reddish Brown		Few very fine	vy frb, frb, ss	Common very fine to fine roots. Clear boundary. No mottles.
	6" - 15" 20"	Heavy Clayloam to Clay (Pockets of Light Clayloam)		Reddish Brown		Few fine to common very fine	frb, frm, s, vs	Common very fine to coarse roots. Diffuse boundary. No mottles.
	15" - 20" 24" - 34"	Mixed Serpentine Gravels and Clayloam to Clay		Reddish Brown & Gray/Green	>35%			Gradual boundary.
	24" 34" 48"	Highly fractured and Sheered Serpentine, Many Sharp Pieces of Rock						

Notes:

Test Hole No: T-4 **Water Table:** **Slope:** 6%±

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0" - 9"	Clayloam to Clay	Strong, abk, abk to Sab	Reddish Brown				
	9" - 24" 30"	High Fractured welded tuff (broken into small cubes)		Brown to Grayish Brown				Common very fine to fie roots.
	9" - 39"	Welded tuff block (hard angular not weathered)		Gray Brown				

Notes:

Questa Engineering Corporation

SOIL PROFILE DESCRIPTION

Project Number: 280047 **Project Name:** Camp Berryessa **Date:** 5/13/2009
Project Location: **Boring Method:** **Logged By:** PP
Notes:

Test Hole No: T-5 **Water Table:** **Slope:** 5%±

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0" - 9"			Reddish Brown	<15%	Common very fine	frb, frm	Common very finet o fine roots. No mottles.
	9" - 20"	Clay	abk	Dark Brown	15%	Few very fine	frm, v frm, s, sp	Common very fine to coarse roots. No mottles.
	20" - 53"	Fine sandystone, some pockets of gravels		Pale Yellow				Roots to 36"

Notes:

Test Hole No: T-6 **Water Table:** **Slope:** 2%

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0" - 12"	Teary Clayloam to Clay	abk,	Dark Gray Brown		Few very fine	frm	Common very fine to medium roots. No mottles.
	12" - 20" 8'	Highly fractured weathered meta set/volc mixed with clayloam		Brown to Green				Roots to 8'
	-							

Notes:

Questa Engineering Corporation

SOIL PROFILE DESCRIPTION

Project Number: 280047 **Project Name:** Camp Berryessa **Date:** 5/13/2009
Project Location: **Boring Method:** **Logged By:** PP
Notes:

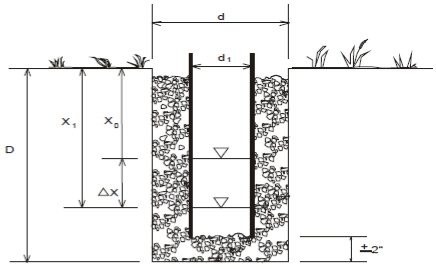
Test Hole No: T-7 **Water Table:** **Slope:** 5%

Graphic Log	Depth (inches)	Texture	Structure	Color	Rock	Pores	Consistency	Remarks
	0" - 6" 10"	Heavy Clayloam	Moderate, abk	Drak Reddish Brown	<15%	Common very fine	frb, frm, ss, s	Common very fine to fine roots. Gradual boundary. No mottles.
	6" - 10" 48"	Very Weathered Serpentine, Many Soft Friable Areas						Few common roots.
	48" - 72"	Different Weathered Serpentine, Some Soft Areas						Some roots.

Notes:

QUESTA ENGINEERING CORP.

PERCOLATION TEST DATA



Project Number: **280047** Date: **5/13/2009**
Project Name: **Camp Berryessa** Test by: **MF**
Location: Checked by: **PP**

Test Hole: **P1** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **24** Soil Type: Dk Brown Clay Slightly Moist

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate	
							Inches per Hour	Minutes per Inch
1	9:31:00 AM	2.250	10:01:00 AM	5.375	30.00	3.125	6.250	9.6
2	10:01:00 AM	2.875	10:31:00 AM	4.250	30.00	1.375	2.750	21.8
3	10:31:00 AM	3.000	11:28:00 AM	4.875	57.00	1.875	1.974	30.4
4	11:28:00 AM	2.875	11:58:00 AM	3.750	30.00	0.875	1.750	34.3
5	11:59:00 AM	3.000	12:29:00 PM	3.875	30.00	0.875	1.750	34.3
6	12:29:00 PM	3.000	12:59:00 PM	3.875	30.00	0.875	1.750	34.3
7	1:00:00 PM	3.000	1:30:00 PM	3.875	30.00	0.875	1.750	34.3

Adjustment Factor: **1.56** Adjusted Stabilized Rate: **53.5** Maximum Application Rate:

Adjustment Rate Method: Notes:

Remaining Presoak:

Test Hole: **P2** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **12** Soil Type: Fractured Rock in Sandy Clay

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate	
							Inches per Hour	Minutes per Inch
1	9:48:00 AM	3.000						
2	10:00:00 AM	3.000						
3	10:31:00 AM	3.000						
4	11:29:00 AM	3.000						

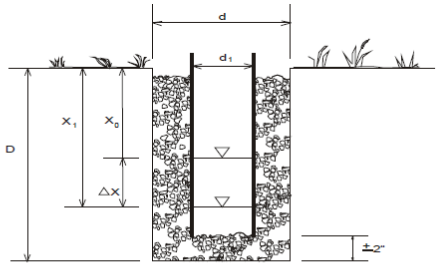
Adjustment Factor: Adjusted Stabilized Rate: **#N/A** Maximum Application Rate:

Adjustment Rate Method: Notes: **Went dry very fast in less than 1 minute for all 4 readings**

Remaining Presoak:

QUESTA ENGINEERING CORP.

PERCOLATION TEST DATA



Project Number: **280047**
Project Name: **Camp Berryessa**
Location:

Date: **5/13/2009**
Test by: **MF**
Checked by: **PP**

Test Hole: **P3** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **24** Soil Type: Dk Yellow Brown Clay

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	10:04:00 AM	3.000	10:46:00 AM	4.500	42.00	1.500	2.143	28.0
2	10:47:00 AM	3.000	11:34:00 AM	3.750	47.00	0.750	0.957	62.7
3	11:35:00 AM	3.000	12:05:00 PM	3.375	30.00	0.375	0.750	80.0
4	12:05:00 PM	3.000	12:35:00 PM	3.375	30.00	0.375	0.750	80.0
5	12:36:00 PM	2.750	1:06:00 PM	3.000	30.00	0.250	0.500	120.0
6	1:06:00 PM	3.000	1:36:00 PM	3.188	30.00	0.188	0.375	160.0

Adjustment Factor: **1.56** Adjusted Stabilized Rate: **249.6** Maximum Application Rate:

Adjustment Rate Method: Notes:

Remaining Presoak:

Test Hole: **P4** Hole Diameter (d): **10** Pipe Diameter (d_1): **4** Depth (D): **12** Soil Type: Lt Yellow Brown Clay/ Lt Green

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	10:16:00 AM	3.000	10:47:00 AM	6.125	31.00	3.125	6.048	9.9
2	10:49:00 AM	3.000	11:35:00 AM	4.250	46.00	1.250	1.630	36.8
3	11:36:00 AM	3.000	12:06:00 PM	3.500	30.00	0.500	1.000	60.0
4	12:07:00 PM	2.875	12:37:00 PM	3.500	30.00	0.625	1.250	48.0
5	12:38:00 PM	3.000	1:08:00 PM	3.500	30.00	0.500	1.000	60.0
6	1:08:00 PM	3.000	1:38:00 PM	3.500	30.00	0.500	1.000	60.0
7	1:38:00 PM				#NUM!	0.000	#NUM!	#NUM!

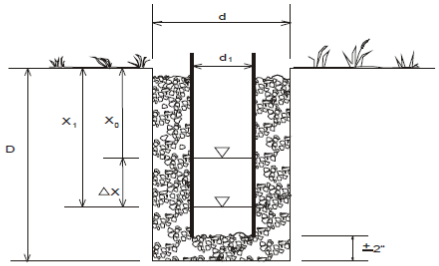
Adjustment Factor: **1.56** Adjusted Stabilized Rate: **93.6** Maximum Application Rate:

Adjustment Rate Method: Notes:

Remaining Presoak:

QUESTA ENGINEERING CORP.

PERCOLATION TEST DATA



Project Number: **280047** Date: **5/13/2009**
Project Name: **Camp Berryessa** Test by: **MF**
Location: Checked by: **PP**

Test Hole: **P5** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **20** Soil Type: Lt Yellow Brown Clay w/ Weathered Sand

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	10:43:00 AM	2.625	11:37:00 AM	2.875	54.00	0.250	0.278	216.0
*	11:37:00 AM	2.875	12:07:00 PM	3.000	30.00	0.125	0.250	240.0
*	12:07:00 PM	3.000	12:37:00 PM	3.125	30.00	0.125	0.250	240.0
*	12:38:00 PM	3.125	1:08:00 PM	3.375	30.00	0.250	0.500	120.0
2	1:09:00 PM	3.000	1:39:00 PM	3.250	30.00	0.250	0.500	120.0
3	1:42:00 PM	3.000						

Adjustment Factor: **1.56** Adjusted Stabilized Rate: **187.2** Maximum Application Rate:

Adjustment Rate Method: Notes: *** = No Fill**

Remaining Presoak:

Test Hole: **P6** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **24** Soil Type: Yellow Weathered Rock

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	11:01:00 AM	5.000	11:41:00 AM	9.125	40.00	4.125	6.188	9.7
2	11:42:00 AM	4.750	12:12:00 PM	5.875	30.00	1.125	2.250	26.7
3	12:12:00 PM	4.625	12:40:00 PM	5.500	28.00	0.875	1.875	32.0
4	12:41:00 PM	5.000	1:11:00 PM	5.875	30.00	0.875	1.750	34.3
5	1:12:00 PM	5.000	1:47:00 PM	5.750	35.00	0.750	1.286	46.7
6	1:48:00 PM	5.000	2:21:00 PM	5.750	33.00	0.750	1.364	44.0

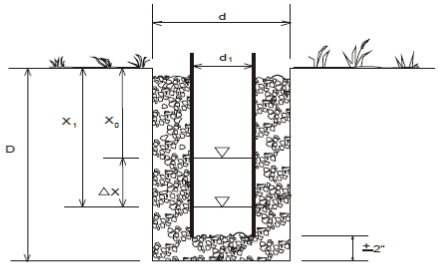
Adjustment Factor: **1.56** Adjusted Stabilized Rate: **68.6** Maximum Application Rate:

Adjustment Rate Method: Notes: **5-11" range**

Remaining Presoak:

QUESTA ENGINEERING CORP.

PERCOLATION TEST DATA



Project Number: **280047**
Project Name: **Camp Berryessa**
Location:

Date: **5/13/2009**
Test by: **MF**
Checked by: **PP**

Test Hole: **P7** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **12** Soil Type: **Lt Yellow Brown Clay**

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	11:10:00 AM	3.000				-3.000		
2	1:13:00 PM	3.000				-3.000		
3	2:21:00 PM	3.000				-3.000		

Adjustment Factor: Adjusted Stabilized Rate: **#N/A** Maximum Application Rate:

Adjustment Rate Method:

Remaining Presoak:

Notes: **Went dry very fast in less than 1 minute for all 3 readings**

Test Hole: **P8** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **18** Soil Type: **Weathered Serp**

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	11:18:00 AM	3.000	11:48:00 AM	4.125	30.00	1.125	2.250	26.7
2	11:48:00 AM	3.000	12:13:00 PM	3.500	25.00	0.500	1.200	50.0
3	12:14:00 PM	3.000	12:43:00 PM	3.375	29.00	0.375	0.776	77.3
4	12:43:00 PM	3.000	1:13:00 PM	3.375	30.00	0.375	0.750	80.0
5	1:13:00 PM	3.000	1:48:00 PM	3.250	35.00	0.250	0.429	140.0
6	1:48:00 PM	3.000	2:22:00 PM	3.375	34.00	0.375	0.662	90.7

Adjustment Factor: **1.56** Adjusted Stabilized Rate: **141.4** Maximum Application Rate:

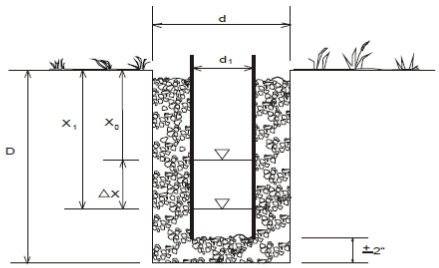
Adjustment Rate Method:

Remaining Presoak:

Notes:

QUESTA ENGINEERING CORP.

PERCOLATION TEST DATA



Project Number: **280047**
Project Name: **Camp Berryessa**
Location:

Date: **5/13/2009**
Test by: **MF**
Checked by: **PP**

Test Hole: **P9** Hole Diameter (d): **8** Pipe Diameter (d_1): **4** Depth (D): **20** Soil Type: **Lt Yellow Brown/ Brown Clay**

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch
1	11:55:00 AM	3.000	12:20:00 PM	6.125	25.00	3.125	7.500	8.0
2	12:20:00 PM	3.000	12:45:00 PM	3.875	25.00	0.875	2.100	28.6
3	12:45:00 PM	3.000	1:15:00 PM	3.750	30.00	0.750	1.500	40.0
4	1:15:00 PM	3.000	1:51:00 PM	3.625	36.00	0.625	1.042	57.6
5	1:51:00 PM	3.000	2:26:00 PM	3.625	35.00	0.625	1.071	56.0

Adjustment Factor: **1.56** Adjusted Stabilized Rate: **87.4** Maximum Application Rate:

Adjustment Rate Method: Notes:

Remaining Presoak:

Test Hole: Hole Diameter (d): Pipe Diameter (d_1): Depth (D): Soil Type:

Trial Number	Start Time (T_0)	Initial Water Level (inches) (X_0)	Time Read (T_1)	Final Water Level (Inches) (X_1)	Time Interval (minutes) (T)	Water Drop (inches) (ΔX)	Percolation Rate Inches per Hour	Percolation Rate Minutes per Inch

Adjustment Factor: Adjusted Stabilized Rate: **#N/A** Maximum Application Rate:

Adjustment Rate Method: Notes:

Remaining Presoak:

ATTACHMENT B

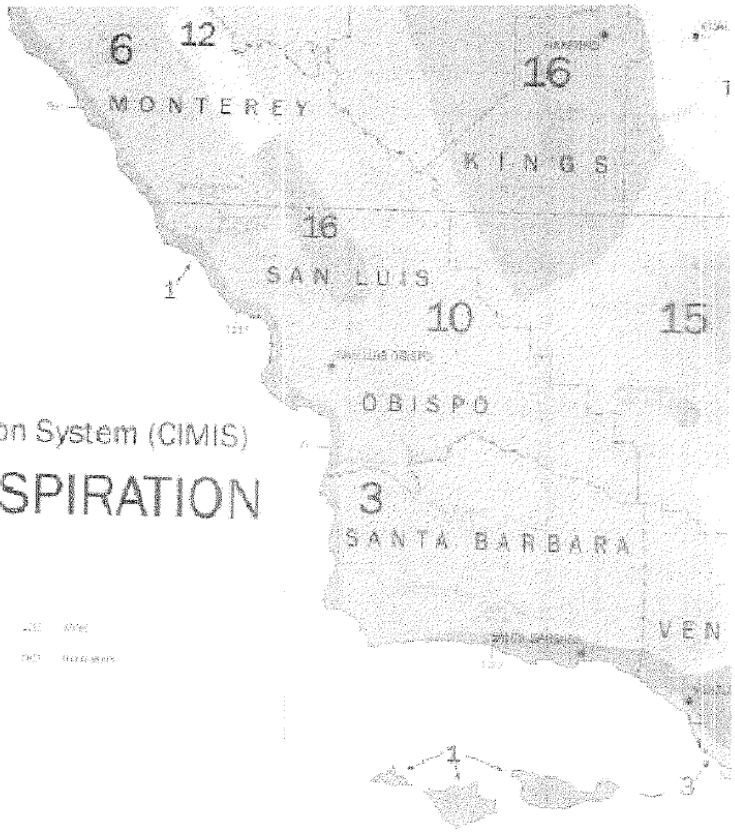
HYDRAULIC LINEAR LOADING RATE TABLE

Table 1. Infiltration rates in gal/da/ft^2 for wastewater of >30 mg/L or wastewater of <30 mg/L and hydraulic linear loading rates in gal/da/ft for soil characteristics of texture and structure and site conditions of slope and infiltration distance. Values assume wastewater volume of >150 gal/da/bedroom. If horizon consistence is stronger than firm or any cemented class or the clay mineralogy is smectitic, the horizon is limiting regardless of other soil characteristics

					Hydraulic Linear Loading Rate, gal/da/ft									
					Slope									
					0-4%			5-9%			>10%			
Soil Characteristics			Infiltration Loading Rate, gal/da/ft^2		Infiltration Distance, in.			Infiltration Distance, in.			Infiltration Distance, in.			
Texture	Structure													
	Shape	Grade	>30 mg/L	<30 mg/L	8-12	12-24	24-48	8-12	12-24	24-48	8-12	12-24	24-48	Row
COS, S, LCOS, LS	--	0SG	0.8	1.6	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0	1
FS, VFS,LFS,LVFS	--	0SG	0.4	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0	2
COSL, SL	--	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0	3
	PL	1	0.2	0.5	3.0	3.5	4.0	3.6	4.1	4.6	4.0	5.0	6.0	4
		2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-	5
	PR/BK /GR	1	0.4	0.7	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0	6
		2,3	0.6	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0	7
FSL, VFSL	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7	8
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-	9
	PR/BK /GR	1	0.2	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6	10
		2,3	0.4	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9	11
L	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7	12
	PL	1,2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-	13
	PR/BK /GR	1	0.4	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6	14
		2, 3	0.6	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9	15
SIL	--	0M	0.0	0.2	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4	16
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-	17
	PR/BK /GR	1	0.4	0.6	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0	18
		2,3	0.6	0.8	2.7	3.0	3.3	3.0	3.5	4.0	3.3	3.8	4.3	19
SCL,CL SICL	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-	20
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-	21
	PR/BK /GR	1	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4	22
		2,3	0.4	0.6	2.4	2.9	3.4	2.7	3.0	3.3	3.0	3.5	4.0	23
SC, C, SIC	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-	24
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-	25
	PR/BK /GR	1	0.0	0.0	-	-	-	-	-	-	-	-	-	26
		2,3	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4	27
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O

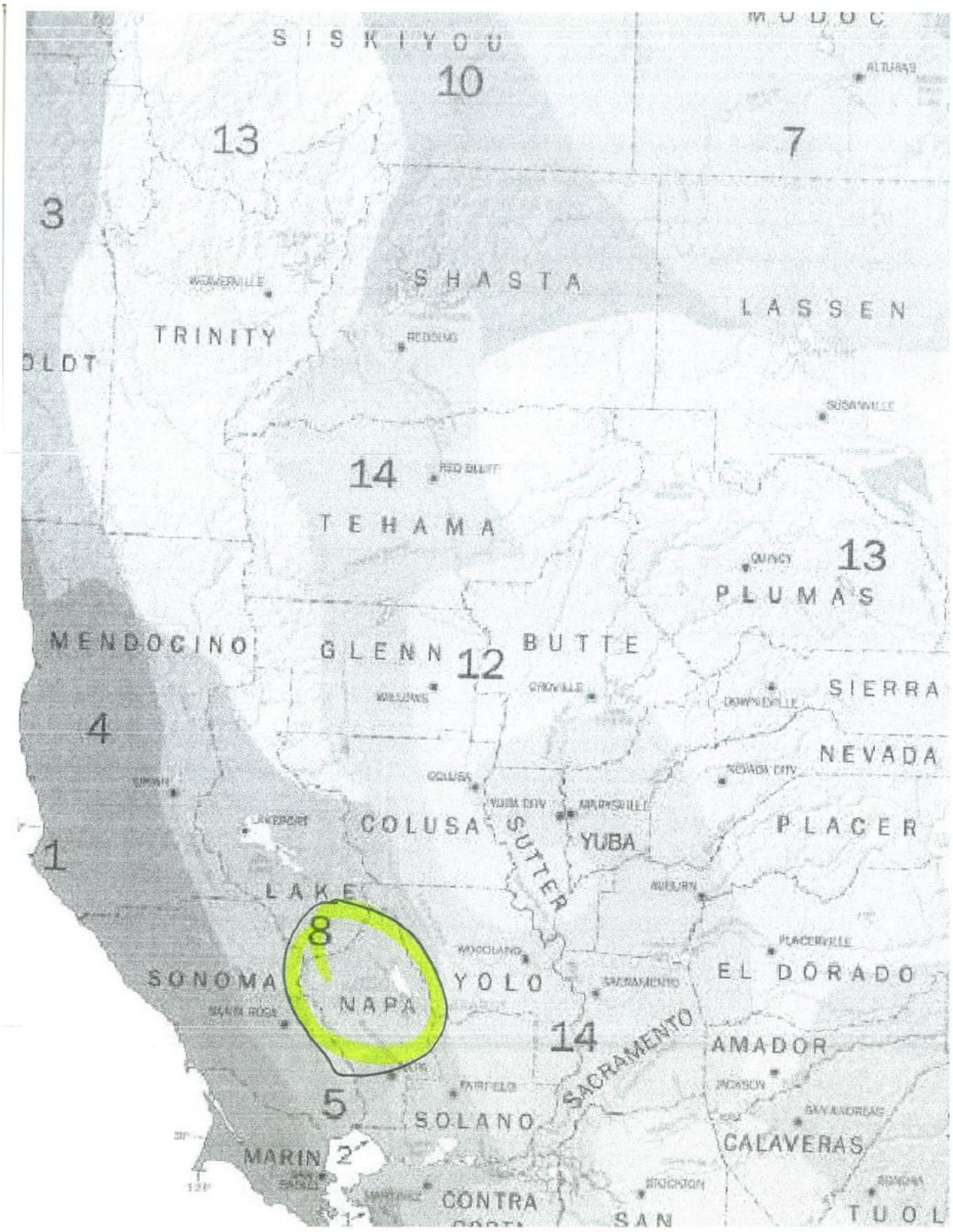
ATTACHMENT C

MONTHLY EVAPOTRANSPIRATION CALCULATIONS



ia Irrigation Management Information System (CIMIS)

RENCE EVAPOTRANSPIRATION


SISKIYOU
10
13
7
3
SHASTA
LASSEN
TRINITY
14
TEHAMA
13
PLUMAS
MENDOCINO
GLENN
12
BUTTE
SIERRA
4
NEVADA
COLUSA
SUTTER
YUBA
PLACER
1
LAKE
8
SONOMA
YOLO
EL DORADO
NAPA
14
SACRAMENTO
AMADOR
5
SOLANO
MARIN
2
CALAVERAS
CONTRA

Reference EvapoTranspiration (ETo) Zones

1 COASTAL PLAINS HEAVY FOG BELT
Lowest ETo in California. Characterized by dense fog

2 COASTAL MIXED FOG AREA
Less fog and higher ETo than zone 1

3 COASTAL VALLEYS AND PLAINS AND NORTH COAST MOUNTAINS
More sunlight than zone 2

4 SOUTH COAST INLAND PLAINS AND MOUNTAINS NORTH OF SAN FRANCISCO
More sunlight and higher summer ETo than zone 3

5 NORTHERN INLAND VALLEYS
Valleys north of San Francisco

6 UPLAND CENTRAL COAST AND LOS ANGELES BASIN
Higher elevation coastal areas

7 NORTHEASTERN PLAINS

8 INLAND SAN FRANCISCO BAY AREA
Inland area near San Francisco with some marine influence

9 SOUTH COAST MARINE TO DESERT TRANSITION
Inland area between marine and desert climates

10 NORTH CENTRAL PLATEAU & C
Cool, high elevation areas with
This zone has limited climate
selection is somewhat subject

11 CENTRAL SIERRA NEVADA
Sierra Nevada Mountain valley
with some influence from the

12 EAST SIDE SACRAMENTO-SAN
Low winter and high summer E
lower ETo than zone 14

13 NORTHERN SIERRA NEVADA
Northern Sierra Nevada moun
marine influence than zone 11

14 MID-CENTRAL VALLEY, SOUTH
TEHACHAPI & HIGH DESERT M
High summer sunshine and wi

15 NORTHERN & SOUTHERN SAN
Slightly lower winter ETo due t
summer ETo than zones 12 &

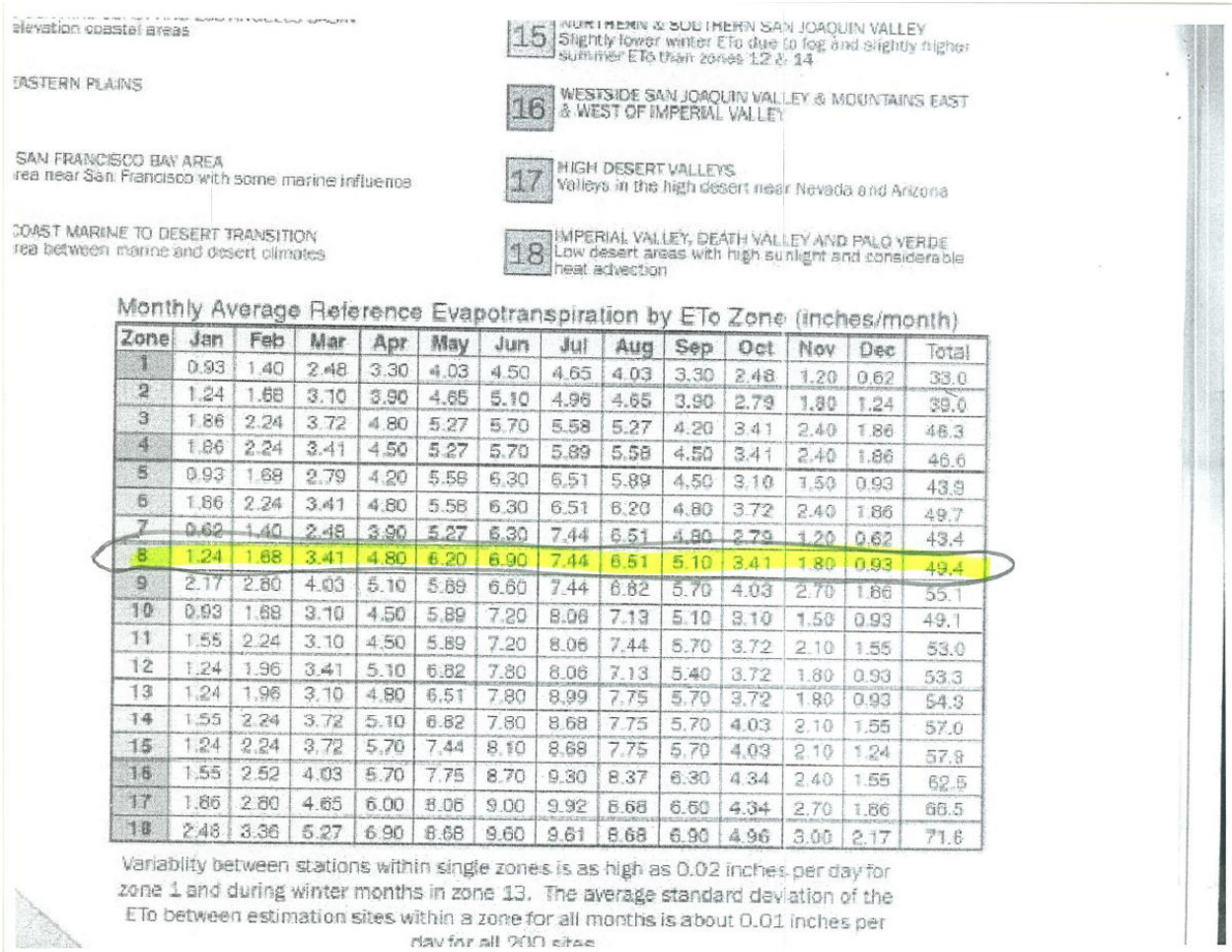
16 WESTSIDE SAN JOAQUIN VALL
& WEST OF IMPERIAL VALLEY

17 HIGH DESERT VALLEYS
Valleys in the high desert near

18 IMPERIAL VALLEY, DEATH VALL
Low desert areas with high su
heat advection

Monthly Average Reference Evapotranspiration by ETo Zone

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72



elevation coastal areas

EASTERN PLAINS

SAN FRANCISCO BAY AREA
rea near San Francisco with some marine influence

COAST MARINE TO DESERT TRANSITION
rea between marine and desert climates

15 NORTHERN & SOUTHERN SAN JOAQUIN VALLEY
Slightly lower winter ETo due to fog and slightly higher summer ETo than zones 12 & 14

16 WESTSIDE SAN JOAQUIN VALLEY & MOUNTAINS EAST & WEST OF IMPERIAL VALLEY

17 HIGH DESERT VALLEYS
Valleys in the high desert near Nevada and Arizona

18 IMPERIAL VALLEY, DEATH VALLEY AND PALO VERDE
Low desert areas with high sunlight and considerable heat advection

Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	33.0
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.4
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.0
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.3
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

Variablity between stations within single zones is as high as 0.02 inches per day for zone 1 and during winter months in zone 13. The average standard deviation of the ETo between estimation sites within a zone for all months is about 0.01 inches per day for all 200 sites

TABLE C2 - CAMP BERRYESSA DRIP FIELD ET

Month	1 Ave. Precip. (in./mo.)	2 Runoff @ 30%	3 Effective Precip.	4 Potential ET (in./mo.)	5 Net ET (in./mo.)	ET gpd/sq ft	ET gpd	Total Flow gpd
Jan	5.58	1.34	4.24	1.24	0.00	0		1,000
Feb	5.64	1.35	4.29	1.68	0.00	0		1,000
Mar	4.41	1.06	3.35	3.41	0.06	0		1,000
Apr	1.36	0.33	1.03	4.80	3.77	0.078	780	1,780
May	0.79	0.00	0.79	6.20	5.41	0.109	1,090	2,090
Jun	0.11	0.00	0.11	6.90	6.79	0.141	1,140	2,140
Jul	0.02	0.00	0.02	7.44	7.42	0.149	1,490	2,490
Aug	0.07	0.00	0.07	6.51	6.44	0.13	1,300	2,300
Sep	0.30	0.00	0.30	5.10	4.80	0.1	620	1,620
Oct	1.25	0.30	0.95	3.41	2.46	0.05	500	1,500
Nov	3.40	0.82	2.58	1.80	0.00	0	0	1,000
Dec	5.39	1.29	4.10	0.93	0.00	0	0	1,000
Total	28.32	6.49	21.8	49.4	37.14			

Column Notes:

1. Average monthly precip.

2. Runoff per CN evaluation;

3. Effective rainfall available for ET/Percolation = Precip-Runoff

4. DWR ref. ET Tables; Zone 8

ATTACHMENT D

ADVANTEX® TREATMENT SYSTEM

TECHNICAL LITERATURE AND ILLUSTRATIONS

AdvanTex™-AX
Treatment Systems Overview

Orenco Systems®
Incorporated
1-800-348-9843

Orenco's AdvanTex™-AX Treatment System is an innovative technology for onsite treatment of wastewater. The heart of the System is the AdvanTex™-AX Filter, a sturdy, watertight fiberglass basin filled with an engineered textile material. This lightweight, highly absorbent textile material treats a tremendous amount of wastewater in a small space. That's because textile has a very large surface area for biological breakdown of wastewater components – about 5 times greater than that of an equivalent volume of sand. Yet the AX10 has a footprint of only 10 sq. ft., while the AX20 has a footprint of 20 sq. ft.

System Performance

Orenco Systems® has been researching, designing, testing, and selling a variety of textile filters for about six years. Hundreds of Orenco's textile filters have been installed throughout the United States on sites ranging from federal demonstration projects to university testing facilities, single-family homes, commercial properties, and community systems.

Unlike other wastewater treatment technologies, the AdvanTex™-AX Treatment System provides consistent, reliable wastewater treatment, even during "peak flow" conditions. The AdvanTex™-AX Treatment System includes a processing tank and a control panel with a programmable dosing timer. So it discharges small amounts of treated wastewater, regularly, throughout the day.

AdvanTex™-AX treats waste to better than "secondary" standards. Effluent can be used for drip or subsurface irrigation, or discharged to shallow, inconspicuous trenches. It can also be discharged to fine-grained polishing filters for coliform removal and water reuse.

System Benefits

Significantly smaller land area is required for the AdvanTex™-AX Treatment System than is required for sand and gravel filters. That's because textile has demonstrated the capacity to support microbial populations that can treat filtered processing tank effluent at greater hydraulic loading rates. In fact, loading rates for AdvanTex™-AX Treatment Systems are typically 5-20 times higher than for sand filters. In addition, reductions in drainfield size are often permitted with AdvanTex™ Treatment Systems. Moreover, textile is lightweight, making it ideal for prepackaging and shipping, which simplifies installation and reduces costs.

Applications

The AdvanTex™-AX Treatment System is ideal for...

- New construction
- System upgrades and repairs
- Pretreatment of moderately high-strength waste
- Wherever typical secondary treatment standards suffice

System Operation and Maintenance

AdvanTex™ is easy to service, easy to clean, and generates virtually no troublesome activated sludge. Like most advanced technologies, the AdvanTex™-AX Treatment System requires regular maintenance. As a condition of warranty, property owners must purchase a service contract from a certified third party provider.

AdvanTex™-AX Filters Overview, cont.

The AdvanTex™-AX Treatment System comes with an audible alarm to signal maintenance or high water conditions. And it's sized to allow for a minimum of 24 hours of wastewater storage (at average daily flows). That means an operator can provide service to the system during normal working hours, regardless of when the alarm occurs.

The AdvanTex™-AX System's pumps typically run just 90 minutes per day, so AdvanTex™-AX uses very little power . . . an average of $5 per month (based on the national average of eight cents per kilowatt hour). Compare that to power costs of up to $20-$60 per month for many "activated sludge" aerobic treatment units.

Treatment Methodology

The AdvanTex™-AX Treatment System works just like a recirculating sand filter: a reliable, proven technology that Orenco's engineers have helped to perfect over the past 20 years. While the treatment process is similar, the proprietary treatment module is more efficient.

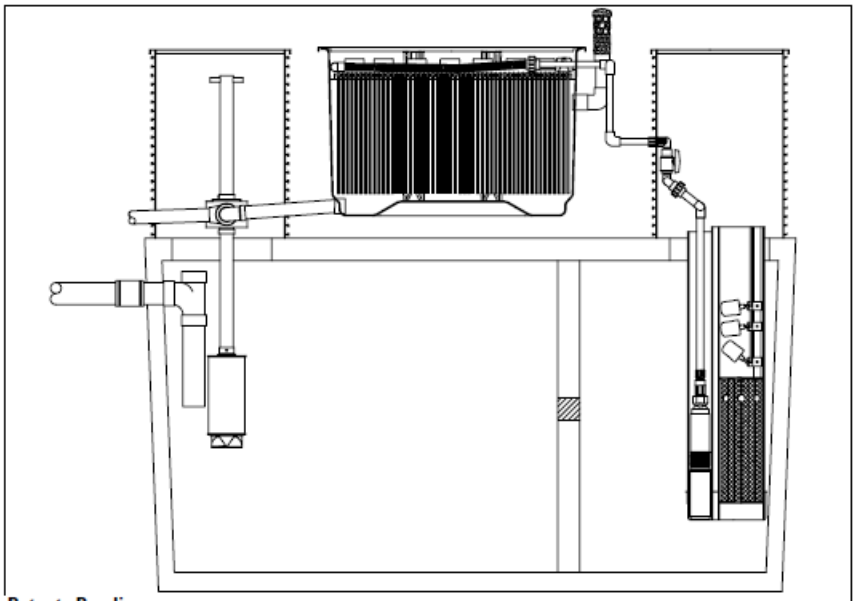
In an AdvanTex™-AX Treatment System, wastewater percolates through the textile media, whose complex fiber structure provides tremendous water-holding capacity and offers an extremely large surface area for biomass attachment. A visible biological film normally develops on the filter medium within a few days. BOD_5 and TSS reductions occur almost immediately.

Design Criteria

The AX10 and AX20 models use 1,500 to 2,000 gallon processing tanks for residential applications. The AX10 is typically used on 3 bedroom homes or smaller and the AX20 on 4 bedroom homes or smaller. Multiple units are used to handle larger residential and commercial flows.

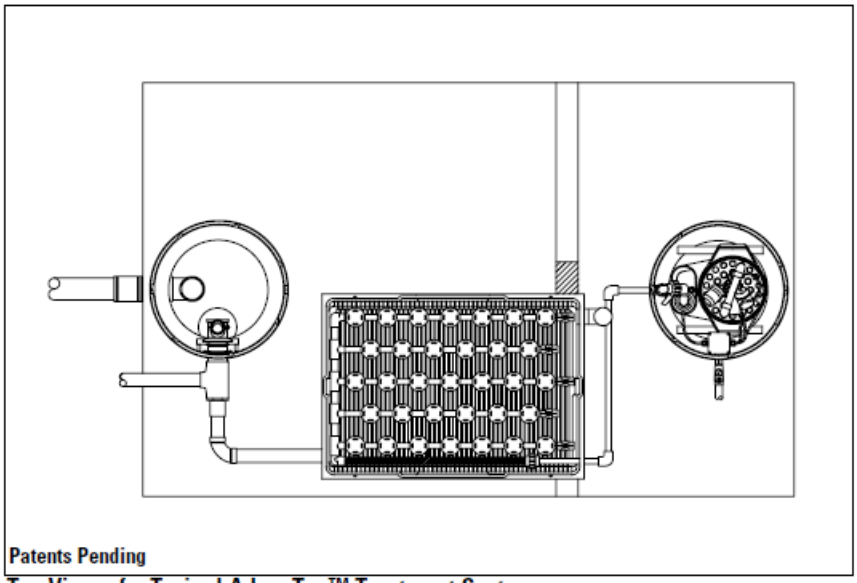
Final effluent quality will vary depending on influent waste strength. For commercial systems, please contact Orenco's Systems Engineering Department.

AdvanTex™-AX Filters Overview, cont.



Patents Pending

Side View of a Typical AdvanTex™ Treatment System



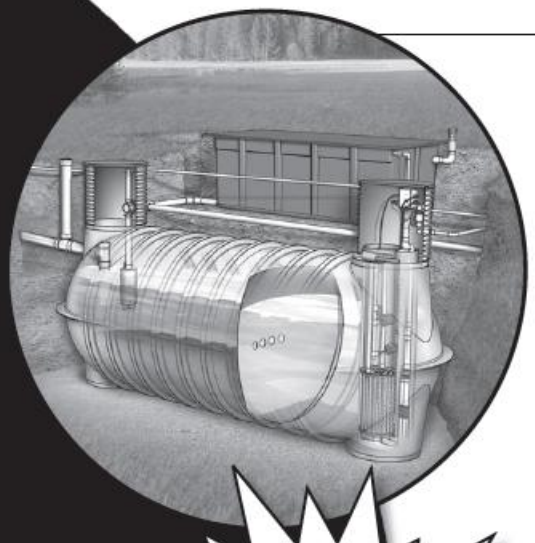
Patents Pending

Top View of a Typical AdvanTex™ Treatment System

Installation Guide

AdvanTex®-AX Treatment Systems

Residential Applications



An illustrated step-by-step guide for installing an Orenco Systems AdvanTex® Treatment System in a residential application.

New! Install Video Now Available! Call Your Dealer

NIM-ATX-AX-1
Rev. 3.4, © 2/07
Orenco Systems®, Inc.

Orenco Systems®
Incorporated

Changing the Way the World Does Wastewater®

800-348-9843
www.orenco.com
www.vericomm.net

Installation Guide: *Residential AdvanTex® Systems*

Installation Guide: *Residential AdvanTex® Systems*

Before You Begin

As the installer of an onsite wastewater treatment system, you play a crucial role. Dealers, regulators, homeowners, manufacturers, neighbors, service providers...we all rely on your expertise and good work. At Orenco, we've worked hard to make your installation as easy and "hassle-free" as possible.

Property owners, neighbors, regulators, dealers, manufacturers, and service providers all depend on your careful installation.

We're very proud of this wastewater treatment system. Like all our products, the AdvanTex® Treatment System has gone through extensive research, development, and field-testing. Then each component is built to written specifications and subjected to quality review before shipping. In addition, our AXN models meet the requirements of NSF-ANSI Standard 40 for Class I Systems. If this system or any of its components possesses flaws that would inhibit its proper functioning, please contact your authorized AdvanTex Dealer. The Dealer can also provide repair and replacement instructions and replacement components. If there is no authorized AdvanTex Dealer in your area, call Orenco Systems, Inc. at 800-348-9843.

This manual covers installation of all residential models of our AdvanTex Treatment Systems, including Mode 1 and Mode 3 configurations. If you're unsure which mode you are installing, check the design drawing. It's important that you read through this entire manual before doing anything.

In addition, the installation manual for the system's electrical control panel describes installation, wiring, timer settings, and operating instructions for Orenco control panels. Please read all control panel documentation, as well.

Also, be sure to get a copy of our AX20 Install Video from your AdvanTex Dealer. Watching the video will help you understand the installation process. However, please note that the manual contains more detail and is updated more often than the video, and *you must perform the installation according to the current manual to keep the warranty in force.*

Once you become familiar with the installation process, you should be able to install an AdvanTex filter in half a day, not counting the time to install the tank and dispersal system.

Important Notes

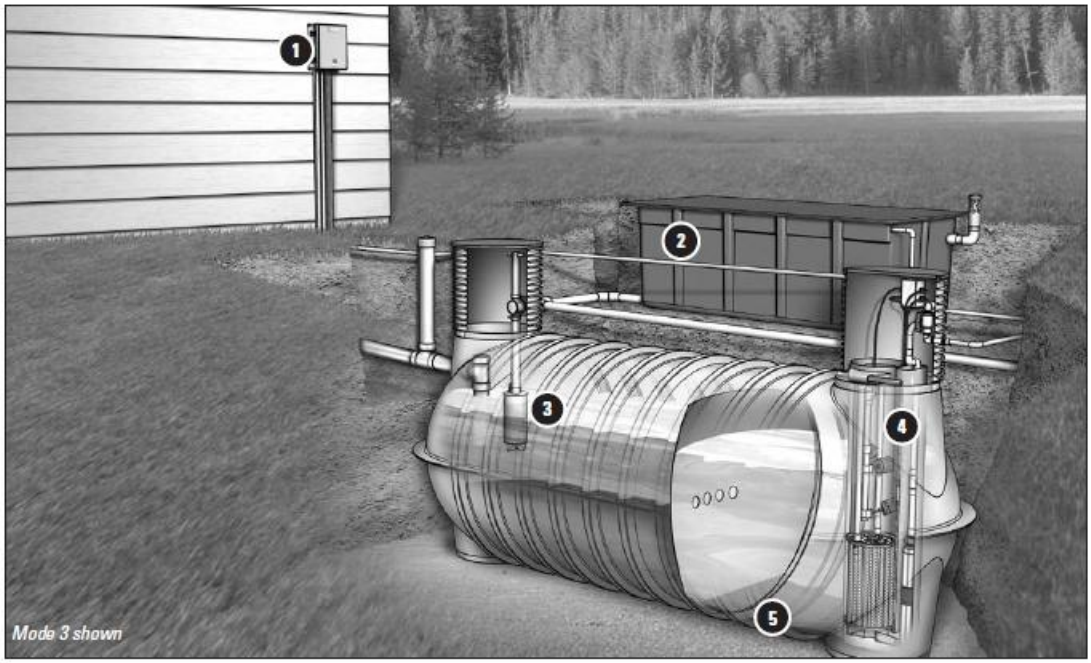
- *All tanks used with AdvanTex Treatment Systems must be prequalified. Call your local Dealer for specifics.*
- *The backwash discharge from a salt-type water softener must not be plumbed into an AdvanTex Treatment System, or the system's warranty will be void. Contact your AdvanTex Dealer if you have any questions about household plumbing arrangements that may interfere with the functioning of the system.*
- *All pipe diameters given are U.S. nominal IPS pipe sizes. If you are using metric pipe, you may need adapters to connect to the U.S. fittings supplied.*

Installation Guide: *Residential AdvanTex® Systems*

Overview

The AdvanTex Treatment System has five main functional units:

1. Control Panel
2. AdvanTex Filter Pod
3. Recirculating Splitter Valve
4. Biotube® Pumping Package
5. Processing Tank



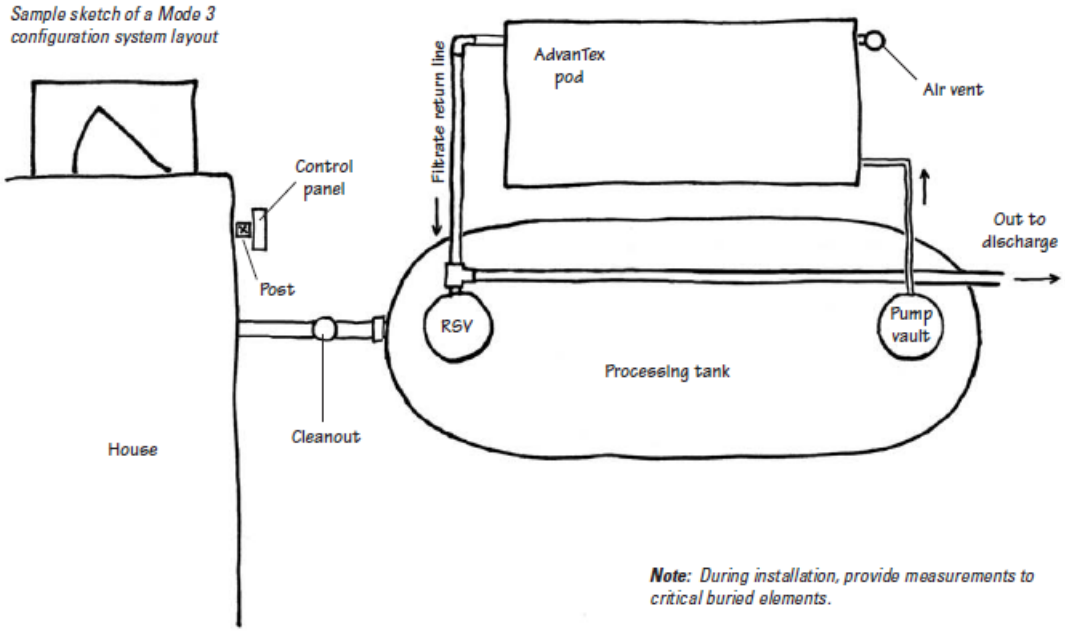
Raw sewage enters the two-compartment processing tank through its inlet tee. In the first compartment, the raw sewage separates into three distinct zones: a scum layer, a sludge layer, and a clear layer. Holes in the tank's baffle wall allow effluent from the clear layer to flow into the second compartment of the tank. The Biotube pump package in the second compartment pumps filtered effluent to a distribution manifold in the AdvanTex pod. Effluent percolates down through the textile media and is collected in the bottom of the filter basin. The treated effluent flows out of the filter basin through a 2-in. diameter pipe that returns the treated effluent to the recirculating splitter valve (RSV). The RSV automatically splits the return flow between the processing tank and the final discharge. The RSV also controls the liquid level within the processing tank. During extended periods of no flow, 100% of the treated effluent is returned to the processing tank.

The operation of the pump in the second compartment is controlled by a programmable timer in the control panel, which allows the pump to dose the filter for short periods (usually a half-minute or less), typically 72 times a day. This frequent "microdosing," which optimizes the treatment process, occurs 24 hours a day, to maintain the proper biological environment.

Step 1: Determine Tank and AdvanTex Pod Positions

Sketch exact positions of the processing tank and AdvanTex pod on the site. Also, sketch placement of the control panel (see the control panel's installation manual for details). The AdvanTex pod can be placed in several different positions in relation to the processing tank. Before determining which position is best, look to see how the filtrate return line needs to be run. Note that the 2-in. diameter outlet coupling for the filtrate return line and the 1-in. diameter inlet coupling for the transport pipe are typically installed in opposite corners of the AdvanTex pod, forming a diagonal across the pod.

Sample sketch of a Mode 3 configuration system layout



Note: *During installation, provide measurements to critical buried elements.*

NOTE: Be sure to position the tank and the AdvanTex pod so that there is at least a 1-1/2-in. (38-mm) drop in the line from the outlet at the bottom of the pod to the inlet of the RSV.

For multipod residential systems, contact your local Dealer for special instructions on layout, installation, and equipment.

Step 2: Excavate Site and Set Tank

Step 2a: Before excavating, consider the elevations required for the tank and AdvanTex pod. The AdvanTex pod must be elevated high enough above the tank to allow for a minimum 1/4 in. per foot slope (20 mm per meter, or a 2% slope) in the filtrate return line, which runs from the outlet of the filter to the inlet of the RSV.

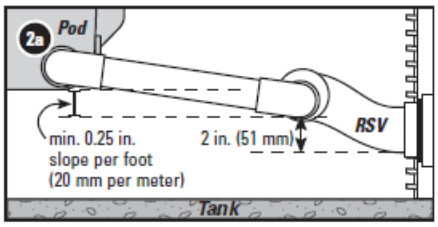
Using an Orenco Fiberglass Tank with Tank Saddle will create the correct slope. If a concrete tank is used or if an Orenco Fiberglass Tank without a Tank Saddle is used, you need to calculate how high to elevate the pod above the tank. Variables that affect this height are the length of the filtrate return line, the type of tank used, the style of the tank adapter, and the elevation of the RSV3Q penetration in the riser.

Step 2b: Another consideration is that the top of the AdvanTex pod should end up approximately 1-1/2 in. (38 mm) above finished grade, to allow for settlement and drainage. Take into account any planned landscaping that might affect the finished grade of the system.

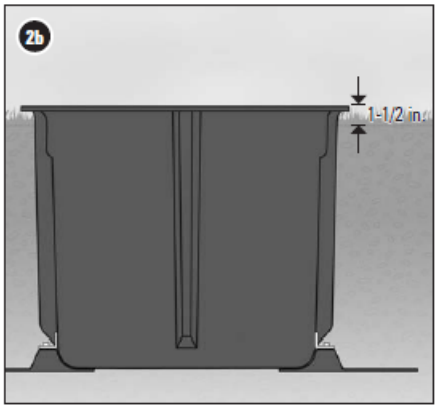
Step 2c: Outline an excavation area (with chalk, paint, string, etc.) for both the tank and AdvanTex pod. Excavate the hole for the tank per the tank manufacturer's recommendations. If the pod will be installed in its own hole instead of on top of the tank, make the hole at least 5 ft × 9-1/2 ft (1500 mm × 2900 mm) to accommodate the antiflotation flanges. For multipod systems, make sure you allow at least 44 in. (1118 mm) between each pod.

If your system will include a discharge pump basin (Modes 1B and 3B), you will need a hole for that, too. You can dig it when you dig the main hole, or later. Refer to Appendix 4 of this document for information about installing the pump basin.

Step 2d: Excavate to the proper depths as determined above for proper elevations. Make sure the bottom of the excavation is free of debris, especially rocks and other sharp objects. If the bottom of the excavation is uneven or rocky, lay a 3-in. (76 mm) bed of sand or pea gravel and compact the material to create an even, smooth surface.



Calculate the height of the pod above the tank based on the designed length of your filtrate return line and the installed height of your RSV above the tank.



The AdvanTex pod's lid should be 1-1/2 in. (38 mm) above finished grade

Step 2e: Follow the tank manufacturer's guidelines for setting the tank. If you are installing the AdvanTex pod over the top of the tank, follow the tank manufacturer's guidelines for watertight testing, antiflotation measures, and backfilling before proceeding with the AdvanTex installation.

NOTE: An AdvanTex pod can be attached to an Orenco FRP tank using the Fiberglass Tank Saddle (AX-SADDLE). Consult the Fiberglass Tank Saddle Installation Instructions (NIN-SAD-1), available from the Document Library at www.orenco.com. Some Dealers supply the pod already attached and plumbed so that the tank and pod can be installed as a unit, as shown in the illustration at left.

Step 2f: If you are using a pump basin, set it in its excavation and level it. Make sure the top of the pump basin matches the levels of the other riser lids, and be sure to orient the pump basin so that the grommets face in the correct directions, as shown on the site plan.

Step 3: Install Risers and Water Test Tank

NOTE: The External Splice Box (if one is used) and the bracket for the Recirculating Splitter Valve (RSV) should be installed on the riser before the riser is mounted. The Dealer typically installs these components before delivering the riser. If you need to install an External Splice Box or RSV bracket, refer to the instructions that come with them. If an Internal Splice Box is supplied instead, follow the instructions in Step 7c to install it after the riser is in place.

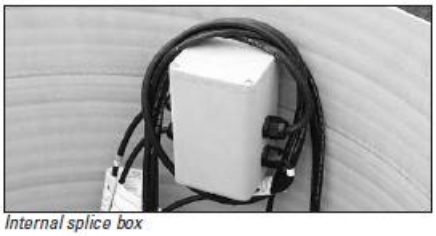
Step 3a: Refer to the Riser Sizing Chart at right to ensure you are installing the right size risers for your application. Orient risers with grommeted holes in the directions shown on your engineering plans. The riser that will have the RSV installed in it (inlet riser for Mode 3; outlet riser for Mode 1) must be installed so that the RSV inlet piping is oriented to accept the filtrate return line. For any risers that will have electrical conduits running to them, try to orient electrical grommeted holes to minimize the number of bends. (National Electrical Code limits the sum of all bends in a run to 360 degrees.)

Step 3b: Wipe the areas to be bonded with a clean rag to ensure a clean, dry bonding surface.

Step 3c: There are several methods of applying adhesive to the outside and inside of the riser tank adapter.* You can use ADH100 or methacrylate adhesive alone. However, because ADH100 does not provide a structural joint for approximately 24 hours and may therefore delay installation and backfilling, you may want to use both adhesives. If so, apply methacrylate adhesive to the outside surface of the riser tank adapter for a quick (usually an hour or less) structural joint.

External splice box

RSV bracket



Internal splice box

Riser Sizing and Tank Opening Chart

	Mode 1	Mode 3
Inlet riser	24 in. (610 mm)	24 in. (610 mm)
Inlet tank opening	20 in. (508 mm)	20 in. (508 mm)
Outlet riser	30 in. (762 mm)*	24 in. (610 mm)
Outlet tank opening	23 in. (584 mm)	20 in. (508 mm)

** Using the External Splice Box allows use of a 24-in. outlet riser.*

Methacrylate adhesive

** Orenco FRP tanks do not require an adapter. Risers are bonded directly to the tank.*

Apply bead of adhesive under RSV bracket

ADH100 adhesive

Step 3d: When applying adhesive to the riser with the RSV, apply an additional bead below the RSV bracket before placing the riser on the manway, because once the riser is in position, it is hard to reach under the RSV bracket with an adhesive gun.

Step 3e: Carefully slide the riser onto the adapter. Correctly orient the riser before the adhesive starts to set.

Step 3f: If you are using both types of adhesive, apply a bead of ADH100 adhesive to the inside of the adapter and riser joint. Use a tongue depressor or similar tool to form a continuous fillet between the tank adapter and the inside of the riser.

Step 3g: After the adhesives have hardened, fill the tank with clean water to a level 2 in. (51 mm) above the adhesive joint in the riser, to test the watertightness of the tank and the riser joint. Do not allow the water level to rise more than 3 in. (76 mm) into the riser because structural damage to the tank may occur. The inlet pipe into the tank needs to be turned up or plugged to allow the tank to be filled.

CAUTION: *Check the tank manufacturer's guidelines before filling the tanks. Some tank manufacturers require a partial or complete backfill before a tank is filled.*

Step 3h: When the tank proves watertight, pull the inlet plug to drain the excess water.

Step 4: Set AdvanTex Pod

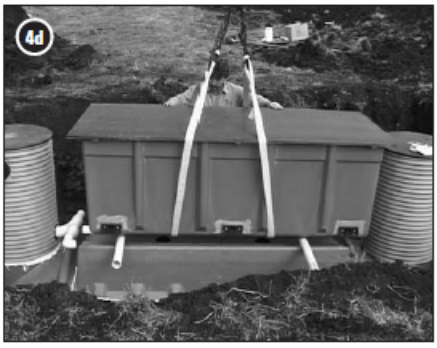
With a concrete tank:

Step 4a: If a concrete tank is used, we recommend placing the AdvanTex pod to the side of the tank. If you wish to install the pod directly over the top of the tank, follow the tank manufacturer's guidelines for backfilling the tank and place a layer of compacted soil or sand between the top of the tank and the bottom of the pod in order to get the required slope on the filtrate return line, as described in Step 2a.

Step 4b: Set the AdvanTex pod in place. An AX20 weighs about 300 lb (136 kg) dry. If moving the pod manually is not feasible, you can lift and set the pod into place by slinging two wide truck straps under the entire unit and lifting it with a backhoe.

Step 4c: AdvanTex pods come standard with predrilled fiberglass tabs on the bottom corners and a set of antiflotation flanges. The antiflotation flanges help prevent the pod from floating out of the ground under saturated soil conditions. The antiflotation flanges come with stainless steel bolts for attachment to the predrilled fiberglass tabs. With the flanges in position under the pod, mark and drill 17/64-in. (7-mm) diameter holes in the flanges to line up with the predrilled holes in the tabs. Use the 1/4-20 × 1.25 bolts and nuts provided to attach the flanges to the tabs.

NOTE: Do not try to hoist the pod with straps once the antiflotation flanges are attached! Lower the pod into the hole onto 2 × 4s or similar supports, bolt on the flanges, then remove the 2 × 4s.



With the Orenco Fiberglass Tank and Tank Saddle:

If you're using the Orenco Fiberglass Tank and Tank Saddle, the saddle should be attached to the tank already. If you need to attach the saddle to the tank, refer to NIN-SAD-1, *Tank Saddle Installation Instructions.** You will not need antiflotation flanges for the pod.

Step 4d: Using a backhoe, lower the pod onto 2 × 4s or sections of pipe and remove the lifting straps.

Step 4e: Sand the bottom edges of the pod that will rest on the pre-sanded areas of the saddle, and wipe them with acetone to prepare them for gluing.

Step 4f: Apply a bead of methacrylate adhesive to the sanded area of the saddle where the pod will rest, moving the pod on its supports as necessary.

Step 4g: Remove the supports one by one and lower the pod onto the saddle, making sure that the pod is completely seated in the saddle.

IMPORTANT: *Attaching the pod to the tank with the saddle adds the pod's buoyancy to the tank's, which in noncohesive soils** makes it necessary to pour a concrete antiflotation collar around the midseam of the tank. Consult a local soils engineer if you are unsure whether a concrete collar is needed. Instructions for pouring the collar are in the* Fiberglass Tank Installation Instructions *(NIN-TNK-1).**

* *These documents are included with the components to which they refer. You can also download them from the Document Library at www.orenco.com*

** *As described in OSHA Standards (29 CFR, Part 1926, Subpart P, Appendix A), noncohesive soils or granular soils include gravel, sand, or silt with little or no clay content. Granular soil cannot be molded when moist and crumbles easily when dry. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay. Cohesive soil does not crumble, can be excavated with vertical sideslopes, is hard to break up when dry, and when moist, can be rolled into threads without crumbling. For example, if at least a 2-in. (51-mm) length of 1/8-in. (3-mm) thread can be held on one end without tearing, the soil is cohesive.*

Step 5: Install Filtrate Return and Discharge Lines

If using a concrete tank:

Step 5a: Connect the outlet at the bottom of the pod to the reducing coupling on the split-flow tee using nominal 2-in. PVC pipe and fittings as necessary. We recommend using two 45° or 90° elbows to create the necessary minimum 2% slope (or minimum 1-1/2-in. [38-mm] drop) between the pod outlet and the tee.

If using an Orenco FRP Tank and Tank Saddle:

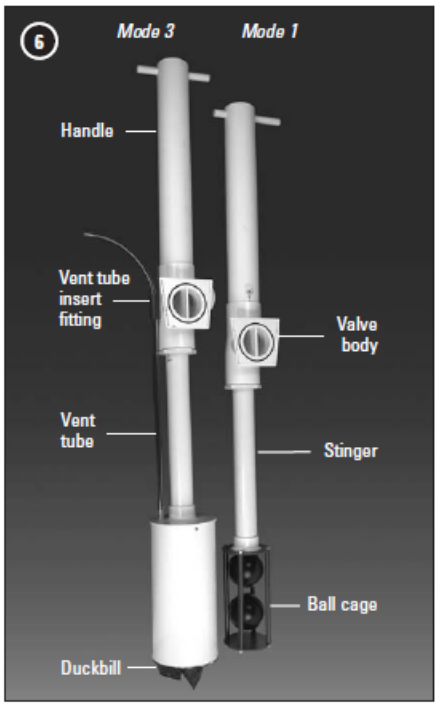
Step 5b: Set the pod onto the saddle without adhesive and dry-fit the plumbing. Mark the alignment of the fittings with a waterproof marker.

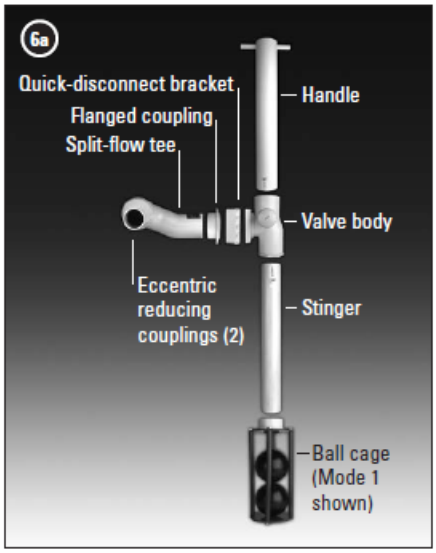
Step 5c: Apply methacrylate adhesive to the saddle and set the tank into it as described in Steps 4d to 4g.

Step 5d: While the adhesive is wet, glue the fittings together with ABS/PVC transition cement (IPS Weld-On® 794 or equivalent), starting at the split-flow tee, using the marks to align the parts. As the last step, apply cement to the outlet of the pod and the pipe elbow, slide the pod back toward the RSV on the wet adhesive, and connect the fittings.

For all installations:

Step 5e: Connect the 2-in. discharge line from the split-flow tee to the pump basin or to the dispersal area, maintaining a minimum slope of 1/4 in. per foot (2%), as described in Step 2a. Be careful not to create low spots where liquid can pond. Refer to Appendix 4 in this document for more information about installing the pump basin, including watertightness testing.





Step 6: Install Recirculating Splitter Valve

The Recirculating Splitter Valve (RSV) controls the recirculation of effluent returning from the AdvanTex filter pod. Floating balls in the valve rise and fall with the level of liquid in the tank. If the level is high, the valve directs effluent to the dispersal system. If the level is low, effluent returns to the tank for further treatment.

For systems operating in **Mode 1**, the recirculating splitter valve (RSV) is installed in the riser over the tank's second compartment (or in the inlet end of the second tank in a two-tank installation). Whenever possible, the RSV should be installed between the baffle wall and the pump system to ensure mixing of the return effluent.

For systems operating in **Mode 3**, the RSV (duckbill model) is installed in the riser over the tank's inlet. The RSV must be installed so as not to interfere with the inlet tee.

Step 6a: Verify that you have all the pieces of the RSV: the handle pipe, body, bracket, split-flow tee, stinger pipe, and RSV cage. The body and cage will be different depending on whether you are installing the Mode 1 or Mode 3 model.

Step 6b: If the RSV bracket is <u>not</u> installed, install it now, following the instructions supplied with it (NIN-RSV-3)*.

Step 6c: The RSV comes with an 18-in. (457-mm) long stinger pipe. Determine the correct stinger length for your installation and shorten or lengthen the pipe if necessary. If the low liquid level is not specified for the particular installation, refer to Appendix 3 of this manual for typical RSV and float settings. (The normal low liquid level — the level at which 100% of the filtrate returns to the tank — determines the stinger length.)

For almost all applications, the stinger will be shorter than 24 in. (610 mm), and the low liquid level will be approximately 6 in. (152 mm) below the top of the RSV cage. Stingers longer than 24 in. require modified RSV cages. Contact your Dealer or Orenco for more information.

***IMPORTANT:** Correct stinger length is critical to the proper operation of the system!*

* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*

Step 6d: After you've cut the stinger pipe to the correct length, attach it to both the RSV cage and the RSV body using PVC cement.

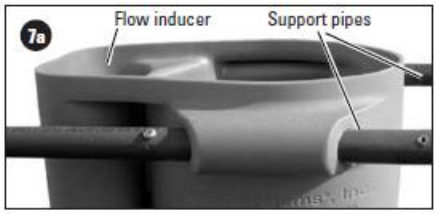
IMPORTANT: *Some RSV3Q parts are ABS and others are PVC. Use all-purpose ABS/PVC transition cement (such as IPS Weld-On® 794) to join them. Do not use primer on ABS parts.*

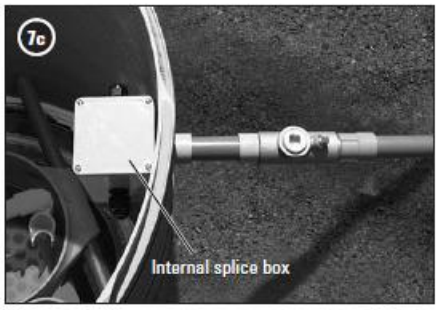
Step 6e: Mode 3 installations require the duckbill model RSV, which has a flexible PVC tube that vents the RSV cage to atmosphere. Push the flexible PVC tube onto the insert fitting on the cage. Thread the other end of the tube through the tube holder at the top of the RSV body. Leave about 6 in. (152 mm) of tube extending through the tube holder. Any excess can be cut off.

Step 6f: If your riser is less than 30 in. (762 mm) high, shorten the handle as needed by cutting out the excess. Then glue it into the top of the RSV body with ABS/PVC transition cement, such as IPS Weld-On® 794. Orient the handle crosspiece so that it is close to the side of the riser instead of sticking out into the middle.

Step 6g: Push the RSV body down into its bracket until the valve body is flush or almost flush with the bracket. Use your weight to push it down, and then wiggle it till you're sure it's snug.

Completed installation shown.





Step 7: Install Biotube® Pump Package

The Biotube pump vault holds the Biotube effluent filter and a high-head pump. Your vault may have support pipes to allow it to hang from the rim of the tank at the bottom of the riser, or it may be an "earless" vault designed to rest on the bottom of the tank.

Step 7a: If your vault includes support pipes, detach them from the packaging material, and remove one of the two screws from each pipe. Slide the support pipes through the holes in the support brackets at the top of the vault. Reinstall the screws.

Step 7b: Gently lower the vault into position in the access riser. If there are support pipes, they should rest on top of the tank, and if the vault is earless, it should rest on the tank bottom.

Step 7c: A splice box houses the connections for the pump and float switches. Either an internal splice box or an external splice box can be used.

To install an internal splice box into an access riser, lubricate both the outside of the conduit coupling and the grommet with pipe lubricant or an equivalent product and slide the coupling through the grommet until the box is snug against the riser wall. Use a conduit seal to ensure condensation does not affect the system.

The Dealer usually installs the external splice box before delivering the riser, but if yours is not installed, refer to the *External Splice Box Installation Instructions* (EIN-SB-SBEX-1)* supplied with it.

* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*

Step 7d: Screw discharge assembly into pump. Carefully lower the pump and discharge assembly into the flow inducer of the Biotube pump vault.

IMPORTANT: *Do not use the pump cable to lower the pump!*

Step 7e: Using pipe lubricant or an equivalent product, lubricate the access riser grommet and the gray nipple on the discharge assembly. Push the nipple through the grommet and orient the discharge assembly to make component removal for maintenance easy.

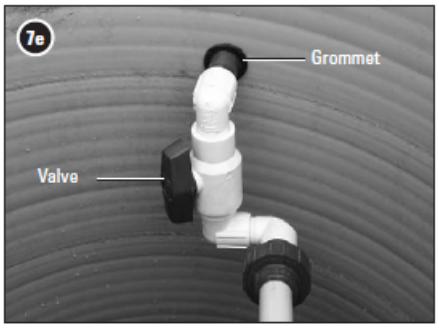
Step 7f: Clip the float switch assembly into the float bracket on the Biotube filter handle. Make sure you can detach it without removing the Biotube cartridge or pump vault.

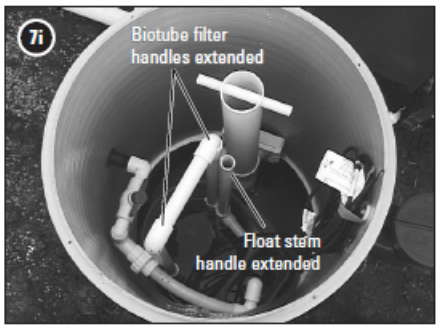
Step 7g: Although float switches are set at the factory for the appropriate depths, compare the float settings with the project plans and specifications to make sure the settings are correct. If you need to adjust a setting, refer to Appendix 3 at the end of this document for typical RSV and float settings for residential systems.

Step 7h: If you have an "earless" vault with a lifting rope, coil the rope neatly and secure it to the splice box along with the float cords so that it does not fall into the vault or interfere with the floats.

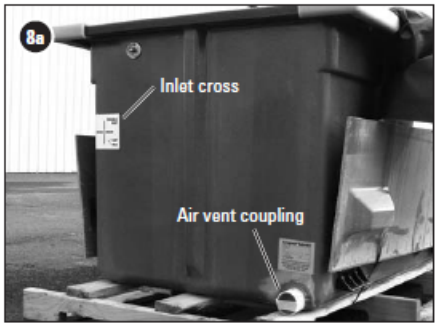
Step 7i: Make sure that the components are arranged in the riser so that you can pull out the Biotube filter cartridge and the float stem without having to disconnect anything. Extending the Biotube cartridge's handles with one-inch pipe and extending the float stem in the same way will make maintenance easier.

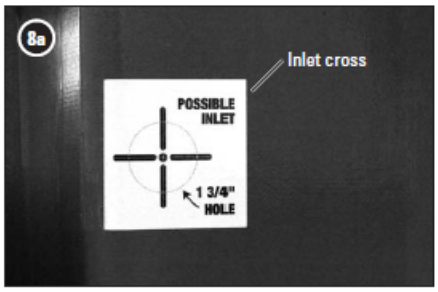
NOTE: *Refer to* ProSTEP Effluent Pump Packages Installation Guide (NIM-EPS-1) *for more detailed pump package installation instructions.* *

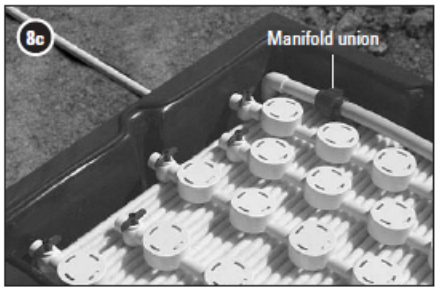




* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*







Step 8: Connect Transport Line to Pod

The transport line conveys effluent from the discharge assembly to the pod. The transport line can be connected to either end of the AdvanTex pod. Installing it in the end opposite the discharge line — on the same side as the passive air vent — will facilitate cleaning.

Step 8a: Determine which end of the pod you are installing the transport line into, and cut a 1-3/4-in. hole in the pod where it is marked with a cross. (If you are using piping other than U.S. nominal 1-in., measure your grommet and cut the hole to fit.) Remove any burrs and install the 1-1/4-in. grommet, sealing it in place with ADH100 adhesive.

Step 8b: From the inside of the pod, insert the lower manifold elbow through the grommeted hole, and connect the 1-in. transport line from the discharge assembly to this elbow. In cold weather installations, slope the line so that it drains back to the tank after every cycle. We recommend installing a coupling on the transport line outside the pod next to the grommet to prevent the line from being pushed into the pod during installation or maintenance.

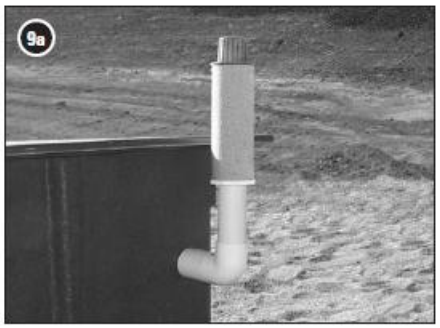
Step 8c: Temporarily disassemble the manifold union so that, when the pump first comes on during start-up, any debris in the transport piping will not be pumped into the manifold (which could then require orifice cleaning).

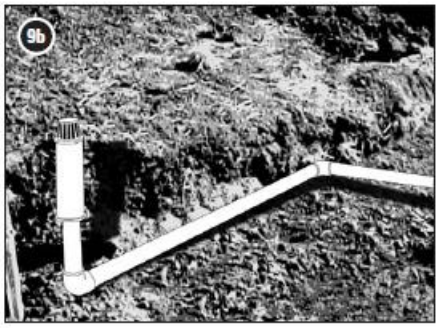
Step 9: Install Passive Air Vent

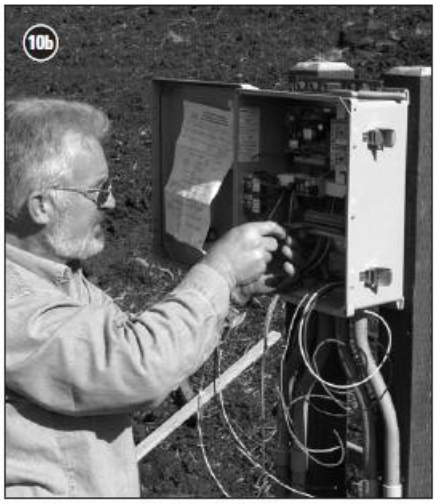
Step 9a: Using 2-in. PVC pipe, plumb the passive air vent to the 2-in. fitting that protrudes through the filter wall. Be sure the vent line is sloped to drain into the textile filter, to prevent accumulation of water in the vent line.

Step 9b: You might want to install the air vent near a wall or in a similar location where it is less likely to be damaged by a lawn mower or accidental kicking, etc. You can easily hide the air vent behind shrubbery or other landscaping and paint it if another color is desired.

IMPORTANT: *In all cases, the line between the air vent and the filter must be sloped back toward the filter. To prevent accumulation of water, do not allow any "bellies" or low points in the vent piping. Keep the 2-in. vent piping less than 20 ft (6 m) in total length.*







Step 10: Install Control Panel

For complete control panel installation instructions, see the installation manual for the electrical control panel that comes with your system. These instructions ship with the control panel and hang from a clip on the inside of the panel door.*

Step 10a: Make sure the instructions and the items supplied conform to state and local regulations.

Step 10b: A qualified and licensed electrician should install and service the panel and ancillary wiring in compliance with the National Electrical Code, as well as state and local codes. (Wiring diagrams can be found in the installation manual* that comes with the panel.) Wiring will include the following items:

a) Incoming power to the panel. One or more circuits may be required, depending upon the number of pumps and local electrical codes.
b) Incoming phone line to the panel (for VeriComm).
c) Wiring from the control panel to the pump and floats.
d) Wiring to a discharge pump and floats (if applicable).

***NOTE:** We do <u>not</u> recommend installing a control panel against the wall of a bedroom, living room, or other living space because it makes a periodic thump during operation. If it must be placed near the house, mount it on 4 × 4 (100 × 100 mm) posts next to the wall.*

* *If the instructions are missing or have been removed from the door pouch inside the control panel, call Orenco for a replacement or download a copy of the instructions from our online Document Library at www.orenco.com.*

Step 11: VeriComm® Control Panel Functional Test

VeriComm® (VCOM) telemetry-enabled panels are used for remote monitoring and control of AdvanTex pumping operations.

Fault conditions are automatically reported to the VeriComm Monitoring System, making the system virtually invisible to the homeowner. However, if fault conditions are not responded to, or if the system cannot communicate with the VeriComm Monitoring System, then local alarms may be activated.

Follow the procedures below to verify proper installation of the VeriComm panel.

*NOTE: For more detailed procedures specific to each panel model, refer to the documentation that comes with the panel.**

Step 11a: Familiarize yourself with the components of the telemetry control board.

Step 11b: Make sure the panel has been completely and correctly installed, and verify that the circuit breakers are in the "On" position. Also check the controller status. The "Power LED" located on the control board will be:

- *Blinking, which indicates the controller is operating normally, or*
- *Off (when power is applied), which indicates a possible problem with*
  - *~ the input fuse on the PC board;*
  - *~ the main fuse located inside the panel;*
  - *~ the controls circuit breaker located inside the panel; or*
  - *~ the incoming line voltage.*

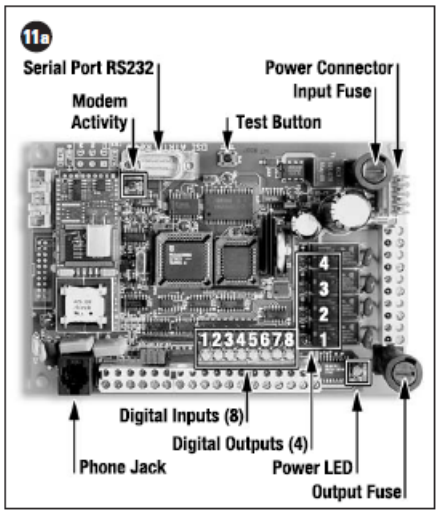
Step 11c: To enable Test Mode, hold the "Push-To-Silence" button on the front of the panel until the audible alarm sounds (approximately 15 seconds).

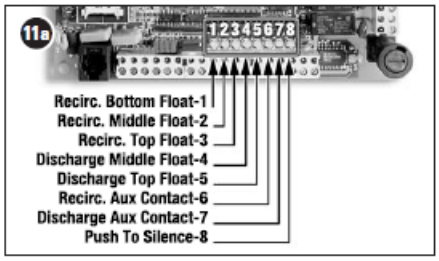
- *The appropriate digital input should be illuminated when the button is held in.*
- *When the audible alarm sounds to indicate that the panel is in Test Mode, release the button.*

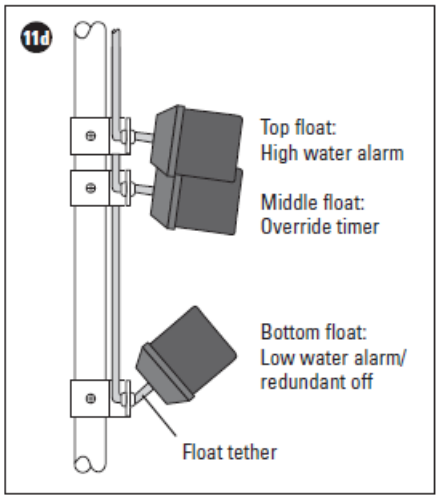
While in Test Mode, the panel will operate in the following manner:

- *The call-in function is disabled;*
- *Local audible and visual alarms are activated as alarm conditions occur;*
- *System Data Logs are suspended; and*
- *Timer cycles are shortened.*

Step 11d: Familiarize yourself with the floats on the system.

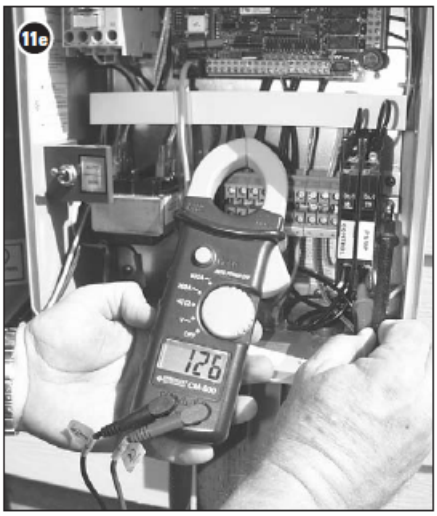




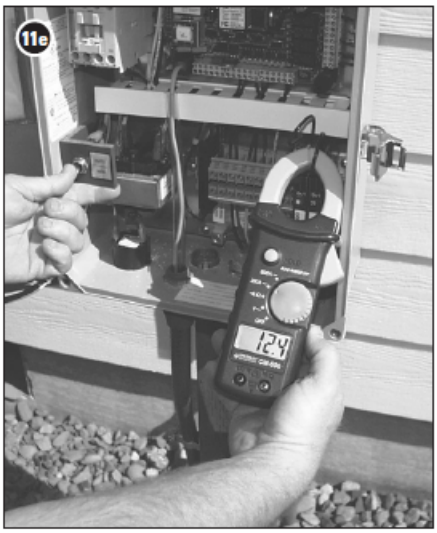


VeriComm® Recirculating Float Assembly shown

* *If the instructions are missing or have been removed from the door pouch inside the control panel, call Orenco for a replacement or download a copy of the instructions from our online Document Library at www.orenco.com.*



Measure voltage



Measure amperage

Step 12e: Verify that the pump is submerged in water before continuing. If the bottom float drops, the alarm should sound. Press down the spring-loaded "MAN/AUTO" switch located inside the panel. The pump should immediately activate. For verification, the appropriate digital input should illuminate, indicating that the auxiliary contact is on.

Measure the voltage and amperage of the pump.

a) Measure the voltage at the pump terminals in the panel. Measuring the voltage with the pump off will confirm that the correct voltage is connected. Then activate the pump by flipping the MAN/AUTO switch to MAN, or using a PDA or laptop with the Bluetooth Device, and measure the voltage while the pump is running. A low voltage condition could indicate that the site wiring is improperly sized.

b) Using a loop ammeter, place the ammeter clamp around the loop of wire located above the pump circuit breaker and read the amperage while the pump is running and connected to the discharge assembly with the valves at the end of the laterals closed. The amperage should be within the specifications of the pump.

Step 12f: Refer to the control panel documentation to test the floats that activate/deactivate the pump. To perform the float test, make sure there is a sufficient amount of liquid in the tank. If there is not enough liquid in the tank, turn the pump circuit breaker off.

Step 12g: Press and release the "Push-To-Silence" button 15 times within a one-minute period. This instructs the panel to call the VeriComm Monitoring System.

- *A red LED ("Modem Activity" component) should illuminate, indicating that the controller has established communication with the host. (This may take a few minutes.)*
- *Once the communication session has ended, the modem will automatically disconnect.*
- *If the LED does not illuminate within the specified time, verify that the phone line has a dial tone. This can be done by hooking up a phone to the line that is going into the panel.*

Step 12h: The panel will automatically disable Test Mode and return to normal operation after 30 minutes. To disable Test Mode manually, hold the "Push-To-Silence" button on the front of the panel until the audible alarm sounds (approximately 15 seconds). The appropriate digital input should be illuminated when the "Push-To-Silence" button is held in. When the audible alarm sounds to indicate that the panel is no longer in Test Mode, release the button.

Step 12: System Functional Test

Once power is connected to the control panel, follow these steps to prepare the system for operation.

Step 12a: For Mode 1B and 3B installations, fill the pump basin with water to a level just below the lowest float.

Step 12b: Verify both manual and automatic operation of the recirculation pump. Before running the pump, ensure that the tank's water level is at least 4 in. (102 mm) above the bottom float, but below the top float. *Be sure that you have temporarily disconnected the manifold union.* Hold the toggle switch in the control panel on "Manual" to test manual operation of the pump and clear any debris in the transport piping.

Step 12c: Reconnect and hand-tighten the manifold union. Verify that all the lateral ball valves are open, and run the pump in the "Manual" position for 5 or 10 seconds to flush any construction debris out of the manifold piping. Completely close all lateral valves after flushing is complete. With the pump still running manually, remove several orifice shields and measure the squirt height with a tape measure. The squirt height should measure approximately 3-5 ft (0.9-1.5 m). Windy conditions will cause the squirt heights to measure less.

NOTE: If the desired squirt height is not achieved or the system does not pressurize, check for debris, breaks, or closed valves. Also verify that the pump is receiving sufficient power. If the system still does not pressurize correctly, contact your Dealer or Orenco for technical assistance.

Step 12d: For more accurate residual head measurements, attach a piece of clear PVC to the end of the lateral. Record the residual head measurement at start-up and before and after servicing.

Step 12e: Return the MAN/AUTO switch to "Automatic." To facilitate quick testing of the automatic operation, put the panel into Test Mode.

Step 12f: Fill the tank with clean water up to a level approximately 1 in. (25 mm) above the RSV cage. At this point the water level should be well above the bottom float. In the control panel, turn on the pump by holding the toggle switch in the "Manual" position. As water begins running through the system, ensure proper drainage through the filtrate return line and RSV. All or some of the return filtrate flowing to the RSV should be exiting the system through the final discharge line. Check that no water is leaking at any of the plumbing joints.

***IMPORTANT:** Before using a generator to operate a pump, contact Orenco or your Dealer to make sure it can supply sufficient starting amperage.*

Step 13: Backfill Installation

NOTE: Before backfilling, make sure all pod and riser lids are bolted down.

Step 13a: Backfill the excavation. Follow the tank manufacturer's guidelines for backfilling the tank.

Step 13b: Backfill and compact around the AdvanTex pod in maximum 12-in. (305-mm) lifts. Native material is acceptable if there are no large or sharp rocks that may damage the filter walls. If native material is not usable, backfill with sand or pea gravel. Slope the ground away from the pod to prevent surface water from ponding on or around the pod.

IMPORTANT: *When backfilling, be careful not to alter the slope of pipes. Brace the pipes and carefully fill around them.*

Step 13c: Make sure all lids are secured before leaving.

IMPORTANT: *After backfilling, call the system's Service Provider to arrange for the official System Start-up.*

Appendix 1: *AX20 Timer Settings Worksheet*

The following chart shows recommended timer settings for a new system.

RESIDENTS	TIME ON (SEC)	TIME OFF (MIN)	NOTES
2	10 sec (.17 min)	20.00	•Assumes water usage of 50 gal. (190 L) per person per day and a return recirculation ratio of 3 : 1 (Filter recirculation ratio of 4 : 1). •Override OFF cycle time is set at one-half of the OFF cycle time. Override ON cycle time is set the same as the ON cycle time.
3	15 sec (.25 min)	19.75	
4	20 sec (.33 min)	19.45	
5	25 sec (.42 min)	19.70	
6	30 sec (.50 min)	19.50	

As you gain experience with a system, you may conclude that you need to make adjustments, sometimes significant ones. This worksheet is intended to help you determine appropriate start-up timer settings (Pump ON, pump OFF) for a single-pod AX20 system. Typical values and ranges are provided for each parameter. If you have any questions or if your values fall outside the desired ranges on this worksheet, contact your Dealer.

PARAMETER		TYPICAL VALUES	NOTES
	Number of people	3	Range of 2 to 8 people.
	Water usage per person	50 gpd (190 L/d)	Typical daily average is 50 gal. (190 L) per person.
Q_i	Actual daily flow (total)	150 gpd (570 L/d)	(Number of people) x (water usage per person).
R_b R_f	Return recirculation ratio Filter recirculation ratio	3 : 1 4 : 1	You can adjust this ratio (return flow to forward flow) up or down depending on system performance. (Range of 2 to 6.)
	Total daily flow to AX20	600 gpd (2280 L/d)	(Actual daily flow) x (return recirculation ratio + 1). Must be ≤ 3000 gpd (11,370 L/d). Actual flow should not exceed 500 gpd (1895 L/d). (500 gpd x 6:1 R_b = 3000 gpd)
Q_d	Actual pump dose rate	33.3 gpm (126 L/min)	Determine this value by field-testing or by using Orenco's *PumpSelect™*. Start at the low end.
T_d	Pump ON cycle time (dose)	0.25 min	Select a value between 0.17 minutes (10 seconds) and 0.75 minutes (45 seconds).
T_r	Pump OFF cycle time (rest)	19.75 min	See Pump OFF equation below.

PUMP OFF EQUATION	EXAMPLE

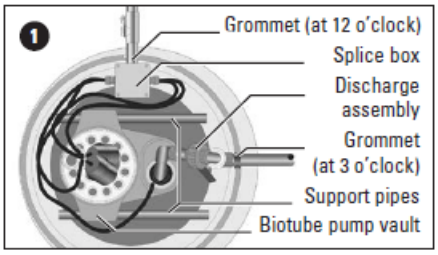
Plugging in the above values and rounding, we get the following:

$$T_r = \left[\frac{1440 \cdot T_d \cdot Q_d}{(R_b + 1) \cdot Q_i}\right] - T_d \qquad T_r = \left[\frac{1440 \cdot 0.25 \cdot 33.3}{(3 + 1) \cdot 150}\right] - 0.25 = 19.74 \approx 19.75$$

After you determine your Pump ON and Pump OFF times, double check to make sure your start-up settings fall within the cycle time (CT) range, below. If they don't, make adjustments per the "Note."

ADDITIONAL PARAMETERS		TYPICAL VALUES	NOTES
CT	Cycle time	20 min	Low flow applications may result in cycle times of an hour or more, which can cause the media to dry out or odors to develop in the recirc tank. If CT is much more than 30 minutes, consult your Dealer or Orenco for suggested adjustments.
	Pump cycles per day	72 cycles	1440 min/day ÷ (OFF cycle time + ON cycle time). Must not exceed the pump's maximum rated cycles per day of 300 cycles per day.
	Gallons per cycle	8.3 gal. (31 L)	With 68 orifices and using the Td range recommended above, you will maintain the recommended 0.08 to 0.25 gal. (0.45 to 0.95 L) per orifice per dose.

Appendix 2: *Installing Grommets*



Step 1: To install grommets in the field, first mark the riser for location of the grommets. (For Perma-Loc risers, you should try to avoid cutting through the pipe seam — the extra thick rib — unless it is unavoidable.)

Step 2: Using a 4-in. (100-mm) grinder or other cutting tool, notch through the PVC ribs to the wall of the PVC riser. Remove an area of ribbing equal to approximately 1 in. (25 mm) larger than the grommet diameter.

Step 3: Using a hammer and chisel, break the notched ribs from the riser. Use a grinder to remove any remaining rib material so that you are left with a smooth area, ensuring a watertight fit. (Hole saws with attached pocket cutters are available from Orenco; they cut away the ribs as the hole is cut, eliminating the need to notch and break the ribs.)

Step 4: Using the Grommet Hole Saw Sizing Chart below, select a hole saw for the grommet installation and drill out the opening. (If you are using pipe and grommets other than U.S. nominal sizes, ascertain the correct hole size for your grommet.) Use a deburring tool or knife to deburr the edges of the opening, being careful not to enlarge the opening.

Grommet Hole Saw Sizing Chart

Grommet Size (in.)	Hole Size (in.)
1/2	1
3/4	1-1/4
1	1-9/16
1-1/4	1-3/4
1-1/2	2-1/8
2	2-3/4
3	3-7/8
4	5

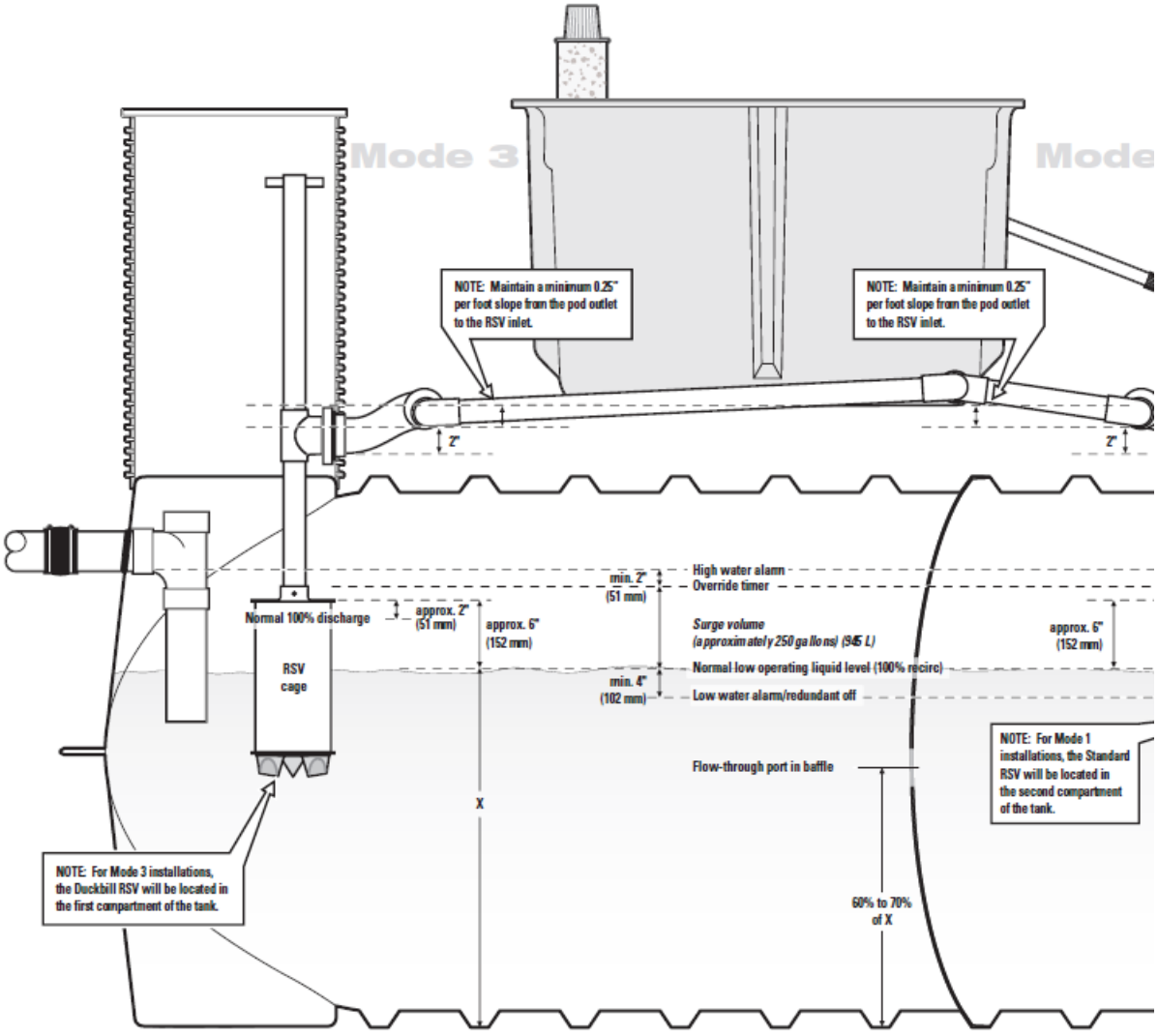
NOTE:
Grommet size = nominal (IPS) pipe size. For more information about grommet dimensions and actual pipe O.D., see Orenco's Grommet Submittal (NSU-RLA-PG-1), available from the Document Library at www.orenco.com.

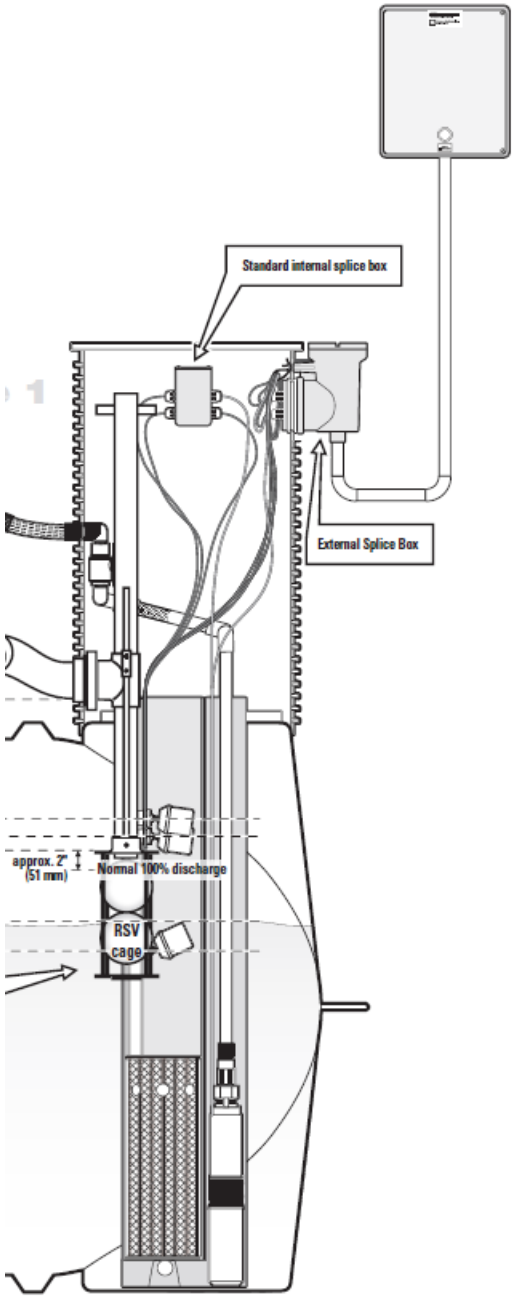
Step 5: Install the grommet in the riser. Apply a bead of ADH100 adhesive to the groove of the grommet prior to insertion into the riser hole. This will make the grommet more secure and will overcome any imperfections in the drilled hole.

Appendix 3: *RSV and Float Level Diagram*

This diagram shows RSV and float levels for a system that uses a VeriComm Control Panel. With an MVP Control Panel, a two-float configuration is used (the high water and override floats are combined), and therefore this top combination float may be located 1-2 in. (25-51 mm) below the invert of the inlet.

This diagram shows both a Mode 1 and a Mode 3 setup. For Mode 1 setups, the recirculating splitter valve (RSV) is installed in the second compartment, with the Biotube pump vault. For Mode 3 setups, the RSV is installed in the first compartment, under the inlet riser.





Determine the RSV Level

For stinger pipe lengths up to 24 in. (610 mm) long, the "normal low operating liquid level" will be approximately 5-6 in. (127-152 mm) below the top of the RSV cage. (The normal low operating liquid level is the level at which 100% of the filtrate returns to the tank.) For most residential applications, the recommended surge volume — the volume between the low liquid level and the high water alarm float — is approximately 250 gallons (948 L). For Mode 3 installations, the duckbill model RSV, which has a flexible PVC tube that vents the RSV cage to atmosphere, is required.

Determine the Float Levels

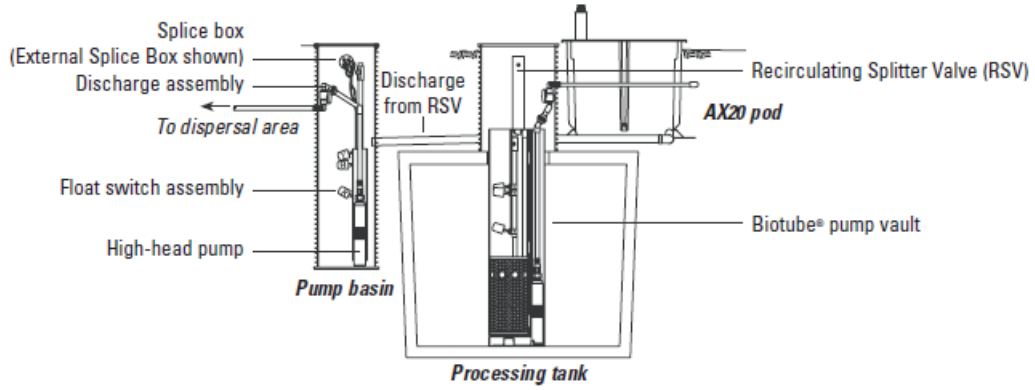
Be sure to check the plans for any site-specific or tank-specific float settings. The top float is normally set equal with the tank's invert of inlet. The bottom float should be approximately 4 in. below the normal low operating level.

NOTE: Before leaving the site, verify that the "low water alarm/ redundant off" float is positioned at least 10 in. (254 mm) below the top of the RSV cage.

Appendix 4: *PBAX Pump Basin Installation*

In AdvanTex® Treatment Systems, the Recirculating Splitter Valve (RSV) discharges treated effluent via gravity. If the dispersal area requires the use of a pump, the RSV discharges to a PBAX Pump Basin. From there, a high-head pump delivers it in doses to the drainfield.

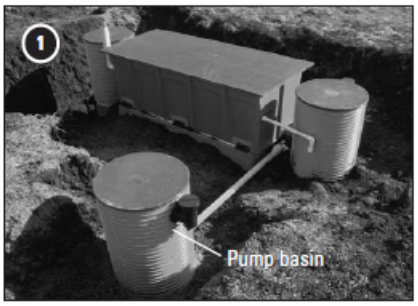
Typically, the PBAX consists of a 24-in. pump basin equipped with a high-head pump, a float switch assembly, a splice box, a discharge assembly, and a lid.



Step 1: Plan the Installation

The PBAX Pump Basin is typically installed near the AdvanTex system. For ease of installation, the excavation for the pump basin can be connected to the excavation for the tank as shown in the illustration, so that the bottom of the pump basin's hole is accessible.

NOTE: If groundwater will rise above the bottom of the pump basin at any time, you will need to set the pump basin in concrete to counteract its buoyancy.



Step 2: Install the Splice Box (if necessary)

The dealer typically installs the External Splice Box before delivering the riser. If it is not installed, or if an internal splice box is used, install it now following the directions supplied with the splice box.

External splice box

Internal splice box

Step 3: Set the Pump Basin in the Hole

Dig the hole for the pump basin four inches deeper than the height of the basin, and place a four-inch bed of compacted gravel in the bottom of the hole. Place the pump basin in the hole. Orient it so as to minimize the number of bends in the electrical conduit between the control panel and the splice box. Partially backfill the hole to support the basin while you're working on it.

If you are going to set the pump basin in concrete, set the basin on its gravel bed, mix a three-bag batch of concrete, and pour it around the bottom of the basin. The concrete should extend six inches on all sides of the basin.

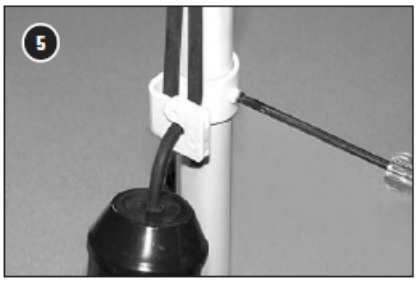
Step 4: Install the Filtrate Line

Step 4a: To mark the position of the inlet hole on the pump basin, extend a piece of pipe or a straightedge from the outlet of the RSV to the pump basin so that it slopes at least 1/4 in. per foot (2%). Mark the center of the inlet hole on the pump basin, and install a 2-in. grommet. Apply a bead of ADH 100 adhesive to the 2-in. grommet and install it in the hole. Lubricate the inside of the grommet with pipe lube.

Step 4b: Push the end of the 2-in. filtrate line through its grommet. It must extend far enough into the pump basin to allow attachment of an elbow, but not so far that it interferes with other components. Glue a downward-facing elbow to the end of the filtrate line inside the pump basin. Glue the other end of the line into the discharge coupling of the RSV tee.

Step 4c: Drill the appropriately sized hole for the line going to the dispersal area, and install a grommet.

Step 5: Set the Floats and Install the Float Assembly

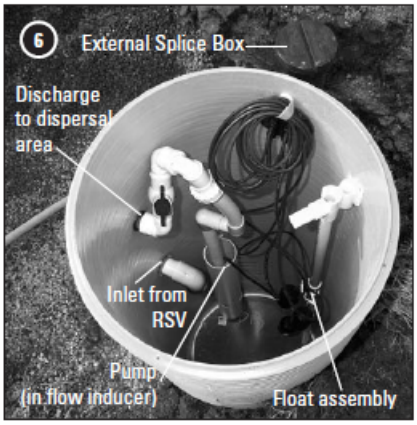


Step 5a: To adjust the height of the float switches, loosen the screw on the float collar and slide the collar along the float tree. Do not try to change the tether length.

Step 5b: Set the high level float even with the invert of the inlet pipe. Set the "Pump On" float two inches below that. Set the "Pump Off" float at a level that will produce the desired dose volume for the drainfield. A 24-in. pump basin holds 1.88 gallons per inch of height (2.8 liters per centimeter). Make sure that the "Pump Off" float is not below the pump's minimum liquid level. Make sure that the floats do not interfere with other components in the basin.

Step 5c: Install the float assembly in the bracket inside the basin. Wrap the cords neatly and secure them to the splice box using the hook-and-loop strip provided.

Step 6: Install the Pump and Discharge Assembly



Step 6a: Assemble the pump and discharge assembly using Teflon paste or tape. Lower the pump into the flow inducer at the bottom of the basin. Insert the nipple of the discharge assembly through the grommeted hole for the line to the dispersal field.

NOTE: Instructions for installing conduit and wiring in the External Splice Box can be found in the External Splice Box Installation Instructions *(EIN-SBEX-1)* supplied with the splice box.*

Step 6b: Lay the pipe for the line to the dispersal area in the trench and connect it to the discharge nipple using external flex hose. Do not bend the flex hose more than fifteen degrees. If local regulations require it, install toning wire on this pipe before backfilling.

Step 6c: Make sure the pump basin's lid is securely screwed on before you leave the site.

* *These documents are included with the component. You can also download them from the Document Library at www.orenco.com.*

Notes

AdvanTex®-AX Treatment Systems

Installation Guide

Residential Applications

AdvanTex® Treatment System AXN models meet the requirements of NSF-ANSI Standard 40 for Class I Systems.

Orenco Systems®
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800-348-9843
www.orenco.com
www.vericomm.net

NIM-ATX-AX-1
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O&M

OPERATION & MAINTENANCE MANUAL

AdvanTex® Treatment Systems

For Service Providers of

Residential AdvanTex® Treatment Systems

and for Homeowner Reference

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Your Expertise Matters

As the operator and service provider of an onsite wastewater treatment system, you play a crucial role. Property owners, neighbors, regulators, dealers, manufacturers ... all rely on your efficient and effective work.

All onsite systems require servicing, from the simplest of standard stone-trench systems to the most complex tertiary treatment systems. Regular servicing optimizes the treatment process and ensures that onsite systems are a sustainable technology.

To make servicing easier, Orenco has configured the AdvanTex® Treatment System and its components to be one of the most trouble-free and service-friendly residential treatment systems on the market. We've also provided this O&M Manual. In it, you'll find valuable information about . . .

- The AdvanTex System's configuration and treatment process
- Performance expectations (norms) at each stage in the treatment process
- System components
- Routine cleaning and maintenance procedures and frequencies
- Routine cleaning and maintenance checklist
- Testing procedures
- Troubleshooting tips
- Sample documentation
- Equipment and tools checklist

Operation and maintenance of an onsite treatment system requires an understanding of all the above information. So please read through this entire manual first, before providing any service. Then write in the Record of System Facts, on the back page. Reading the manual first and maintaining up-to-date records will save everyone time and money in the long run.

Also, at start-up and periodically thereafter, we recommend that you get together with the system user to review the *Homeowner's Manual* that comes with the system, especially the "Do's and Don'ts." This will educate the user on preventive maintenance and on the operating and maintenance responsibilities of system users and authorized personnel, as well as service-related obligations of the manufacturer. Meeting periodically with the user will also allow you to track any significant changes in the household (e.g., number of occupants, changes in water use, use of detergents, disposal of cleaning compounds, etc.).

We're very proud of the AdvanTex Treatment System. Like all our products, it has gone through extensive research, development, and field-testing. Then each component is built to written specifications and subjected to quality review, before shipping. In addition, our AXN models meet the requirements of ANSI-NSF Standard 40 for Class I Systems. If any component of this System does not meet your expectations, please call your authorized AdvanTex Dealer.

AdvanTex® Treatment Systems

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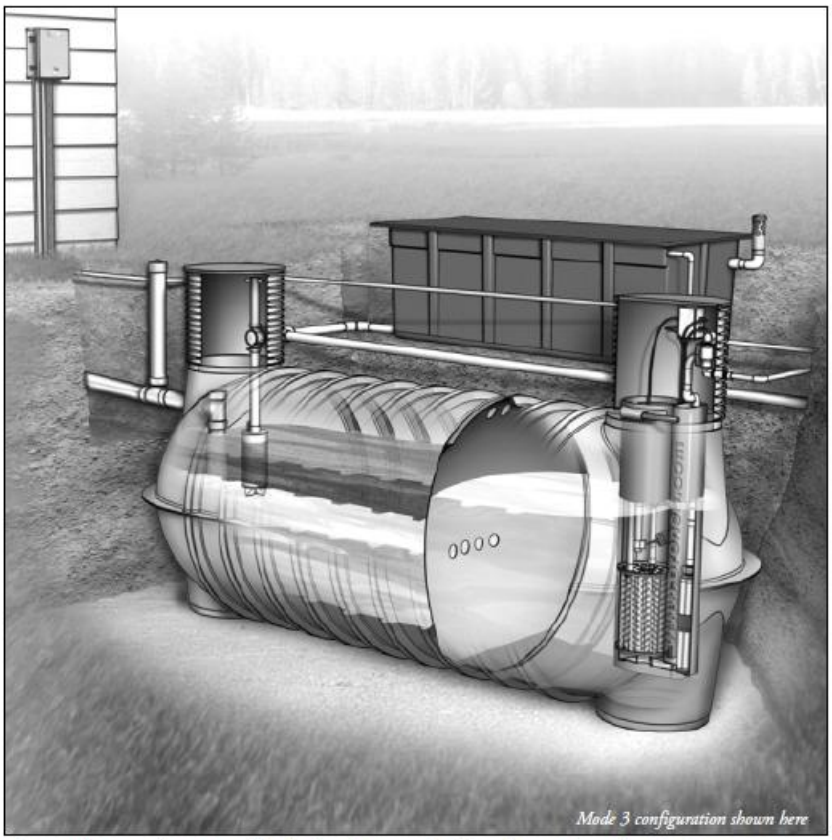
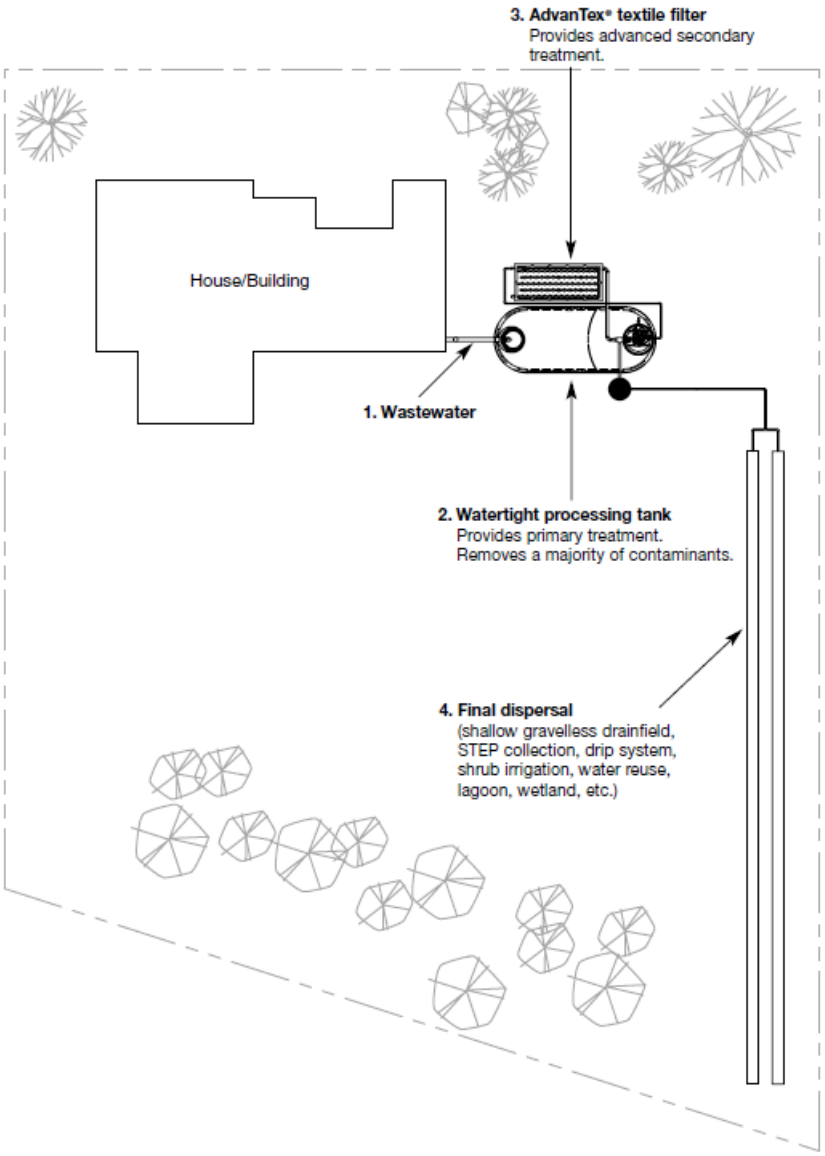
Typical System Configuration

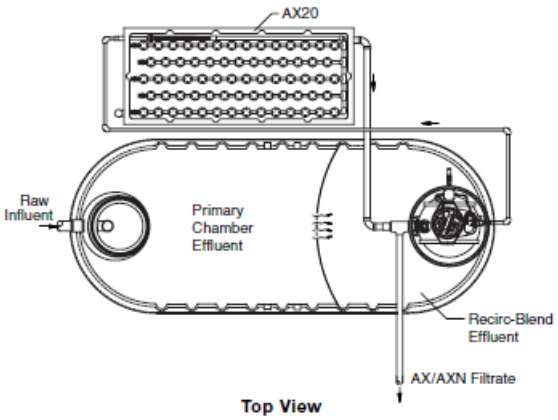


This 3D illustration shows a typical backyard configuration for the key elements of an AdvanTex® Treatment System, using an AX20 textile filter, which can be neatly positioned on top of or adjacent to the processing tank.

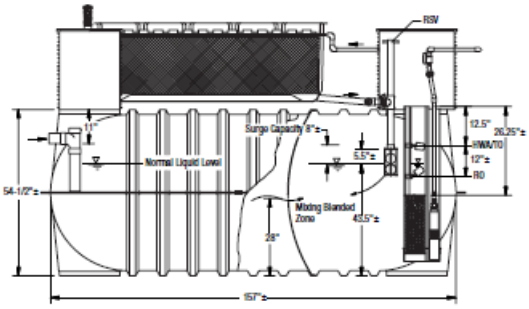
Typical System Configuration: Plan View



Treatment Process/Performance Expectations



Top View



Side View

Processing Tank

The processing tank provides primary wastewater treatment. The tank is an enclosed, watertight receptacle designed to collect wastewater; segregate settleable and floatable solids (sludge and scum); accumulate, consolidate, and store solids; digest organic matter; and discharge treated effluent. BOD (biochemical oxygen demand) removals of greater than 65% and TSS (total suspended solids) removals of greater than 70% are easily accomplished.

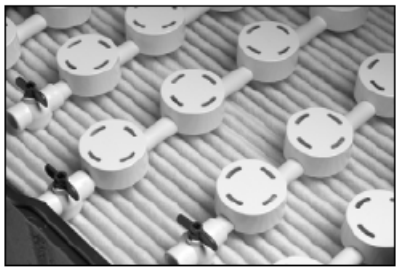
The tank operates as a plug-flow type of reactor (fluid and particles enter and exit the tank in progressive sequence). Wastewater separates into three distinct layers: a floating scum layer, a bottom sludge layer, and a clear zone in between, which is relatively free of large solids. A pump vault with effluent filter located at the outlet end of the tank draws liquid effluent from the clear zone, and the filtered effluent is dosed to the next step in the treatment process . . . the AdvanTex Textile Filter.

Because the AdvanTex Treatment System operates in the recirculating mode, the filtrate from the Textile Filter returns to the processing tank in one of two ways: to the back (outlet end) of the tank in Mode 1 and to the front (inlet end) of the tank in Mode 3. This plumbing configuration affects effluent quality. Effluent quality is also contingent upon a number of other conditions inside the tank:

- strength and characteristics of incoming waste (see "Raw Influent," page 7)
- average flows within design range (typically 40-60 gallons per person per day)
- adequate long-term solids retention for thorough digestion
- watertightness of tank (for proper stratification of incoming waste to prevent treatment short circuiting and hydraulic overloading)
- proper size of tank (for minimum 24-hour hydraulic retention time through the tank's clear zone, at average flow rates and when sludge and scum are developed fully)

If the above conditions are met, you can expect treatment performance per the table on page 7.

Treatment Process/Performance Expectations
(continued)



AdvanTex Textile Filter

The AdvanTex textile filter provides secondary wastewater treatment. The filter is a sturdy, watertight fiberglass basin filled with an engineered textile material. This lightweight, highly absorbent textile material treats a tremendous amount of wastewater in a small space.

The AdvanTex filter operates in the recirculating mode, just like a recirculating sand or gravel filter, but loading rates are typically 5-20 times higher, for a number of reasons. For one thing, the textile media has a very large surface area—about 5 times greater than that of an equivalent volume of sand. Textile also has a greater void volume (for free flow of oxygen) and greater water-holding capacity.

Wastewater percolates both through and between the textile media. A visible biological film normally develops on the filter medium within a few days. BOD_5 and TSS reductions occur almost immediately.

Within the filter, aerobic conditions exist that are ideal for microbes that convert ammonia to nitrate (nitrification). Other conditions exist, too, that result in further nitrogen reduction within the media. Some AdvanTex filters are configured (Mode 3) so that the filtrate recirculates back to the high-carbon, low-oxygen environment at the inlet end of the processing tank, which is ideal for microbes that reduce nitrates to nitrogen gas (denitrification). Harmless nitrogen gas is then released freely back into the atmosphere. The acclimation period for nitrification may range from four to eight weeks, or longer in colder climates.

AdvanTex filtrate effluent quality is dependent upon proper management of the recirc/blend effluent flowing into the filter (which, in turn, is dependent on the conditions described on the previous page). If proper conditions are met, and with typical average daily flows of 40-60 gallons per capita per day, you can expect the following treatment performance:

Performance Expectations

	BOD_5 mg/L	TSS mg/L	TKN mg/L
Raw Influent[1]	450	500	70
Primary Chamber Effluent	150	40	65
Processing Tank Recirc/Blend Effluent[2]	15-40	10-20	—[4]
AXN Filtrate[3]	5	5	—[4]

[1] *Source: Crites & Tchobanoglous. Small and Decentralized Wastewater Management Systems, p. 180, 183, 1998. McGraw-Hill. Based on 50 gpcd.*

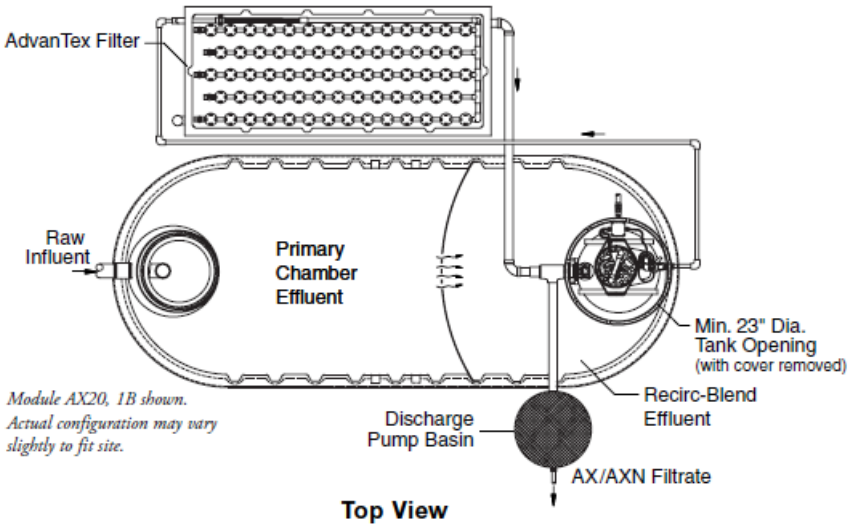
[2] *Will vary with recirc ratios and mode configuration. The numbers here represent a recirc ratio between 2:1 and 4:1 and are derived from Orenco and third-party testing in Mode 1.*

[3] *Actual performance results, based on a six-month accumulative average from NSF (National Sanitation Foundation) testing on the AX20N at 500 gpd, using composite sampling.* *See page 17 for additional information on treatment performance.*

Performance and servicing frequencies will tend to vary relative to the mass load being treated. Procedures for treating excessively high loads will require engineering review. For more information, please review AdvanTex Design Criteria.

[4] *Dependent on treatment system configuration and recirc ratios.*

Typical Materials List



Module AX20, 1B shown. Actual configuration may vary slightly to fit site.

Top View

Orenco's AdvanTex Treatment Systems come in multiple models and configurations. Following is a typical materials list (excluding the processing tank) for an AdvanTex AX20 system that requires a pump basin (some do not).

Processing Tank Access Equipment

Two Access Risers necessary:

One 24" dia., w/Lid

One 30" dia., w/Lid & necessary Grommets

Treatment System Equipment

PVC Splice Box

Universal Biotube® Pump Vault

Discharge Assembly

Float Switch Assembly

Orenco Pump, 115V

MVP or VCOM AdvanTex AXB Panel, 115V

Recirculating Splitter Valve Assembly

AdvanTex AX20 Filter (7.5' x 3' x 2.5')
w/Vent Assembly

Anti-Flotation Flanges

Pump Basin Equipment

PVC Pump Basin, 24" dia., w/Lid

PVC Splice Box

Discharge Assembly

Float Switch Assembly

Orenco Pump, 115V

Tools, Equipment, and Spare Parts List

Many of the recommended maintenance and troubleshooting procedures require specialized tools, equipment, and spare parts. At a minimum, we recommend you keep the following items on hand:

Tools and Equipment

anemometer (call for information)

beakers or bottles

camera (preferably digital)

calculator

channel lock pliers—6" and 12"

crimping tool—10 to 22 AWG

drill (cordless, with spare batteries, charger)

drill bit set—1/16" to 1/2"

electrical tester (voltage and amperage)

extension cord

flashlight with spare batteries/bulb

funnel

hacksaw with spare blades

hammer

heat gun (torch)

hole saw (vari-bits: 3/4" and 1-3/8")

hose with nozzle and backflow prevention device

pencil

Mirror on a Stick (available from Prototek)

pressure gauge (0 to 100 psi, 0 to 200 psi)

backpack pressure washer (portable)

screwdriver set (straight blade and Phillips)

shovel

SMUG device

snake (building sewer)

squirt-height gauge

stir sticks

tape measure

watch or stopwatch

wire strippers

wrench (24" pipe wrench)

wrench (lid bolt)

30 gal. garbage can

30 gal. garbage bags

Spare Parts

control panel parts:

— breakers

— contactors

fuses

epoxy

floats

heat shrink tubing

insulated butt connectors

king connectors

lid bolts

PVC fittings (3/4" to 2")

PVC glue/primer

PVC pipe (3/4" to 2")

Hygiene and Clean-Up

bleach/water solution

hand cleanser

paper towels

protective clothing

eye protection

rubber gloves

towels and rags

Miscellaneous

Patience and good humor!

Routine Cleaning & Maintenance Procedures

Orenco Systems requires regular inspection and maintenance of AdvanTex Treatment Systems as a condition of purchase. All activities are to be performed three-to-six months after system start-up; and an annual field-service inspection, including sampling, is to be scheduled in late spring or in early summer. For AXN systems, there is to be a minimum of four inspections during the first two years, and then annual inspections thereafter.

Following is a list of the routine cleaning and maintenance procedures we recommend or require. Failure to provide required maintenance will void the AdvanTex Treatment System warranty.

Copies of inspection and maintenance reports, along with any additional documentation, must be forwarded to and retained by the Authorized AdvanTex Treatment System Dealer who sold the system. If there is no Dealer, then the documentation must be forwarded to Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, OR 97479, ATTN: Systems Engineering.

Control Panel/Pumps/Alarms

WARNING: Only qualified/certified electricians or service providers should perform maintenance on electrical equipment.

1 Check pump operations. Place the MOA switch (Manual, Off, Automatic) to Manual and make sure the pump runs. Then switch back to Automatic and continue to check the automatic operation of the alarm floats, the recirc timer on the floats, the discharge timer on/off, and timer overrides. Refer to the installation, operation, and setting instructions for the control panel that comes with the system. A set of instructions is stored in a plastic pocket on the inside of the panel door.*

NOTE: Be sure to set the MOA switch back to Auto after testing.

2 Check voltages and motor run amps and record them on the Field Maintenance Report Form. If the voltage drop exceeds National Electric Code (NEC) requirements, have an electrician verify the service line and check pump windings.

3 Verify that the programmable timer settings for all pumps are correct. With MVP panels, you can check timer settings using the digital timer's function keys and large LCD display. With VeriComm® panels (shown here), you can check timer settings online or at the panel, using a laptop computer or PDA. If the timer settings have been changed, the current setting and date of change should be written on your Timer Setting Instructions and Record of System Facts, at the back of this Manual. Place the date and your initials by the recorded change. Appendix 3 gives typical timer settings for households of various sizes.

**If the instructions are missing, you can obtain another set from Orenco's online Document Library, at www.orenco.com, or by calling Orenco at 800-348-9843, or by calling your local AdvanTex Dealer.*

4 Read and record the elapsed time meter (ETM) and cycle counter (CT) values (from the panel's logic controller or from the Web-based telemetry software) on the Field Maintenance Report Form.

ETMs and CTs are valuable troubleshooting tools if problems occur with the system. ETM and CT data signal high water usage, low water usage or tank leakage, and excessive pumping, among other operating situations.

5 Confirm operation of audible and visual alarms per the installation, operation, and setting instructions for the control panel that comes with the system.

Pumping System

Pump systems should be inspected annually to ensure that they are operating properly. Unscrew the stainless steel bolts that fasten the fiberglass lid over the pumping equipment. Remove the fiberglass lid for an inspection that includes these steps:

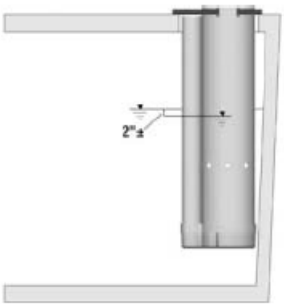
1 Verify that there are no obvious holes or leaks in the riser or around the perimeter of the riser connection to the tank. Wetness or water marks may be an indication of weeping.

2 Inspect splice box to ensure lid and connections are secure.

3 Verify that floats are in good condition and properly secured to the float tree. Verify that float cords are neatly wrapped inside the riser so that they cannot interfere with the operation of the floats.

4 Verify float operation. With MOA switch in Automatic, simulate system operation by lifting the floats in the same order that the liquid would lift them (bottom first, top last).

5 Determine whether the Biotube effluent filter needs cleaning by testing the change in the tank's liquid level when the pump is on. Turn the recirc pump on by flipping the MOA switch in the control panel to Manual. **Watch the liquid level inside the screened vault as the pump is running for about 30 seconds to determine if there is any noticeable liquid level differential between it and the tank liquid level.** Return the MOA switch to Auto. When the liquid level difference between the inside and outside of the vault is about two inches or more, or if the low-level alarm is activated, the Biotube cartridge may need to be cleaned.



If the Biotube needs cleaning, do the following:

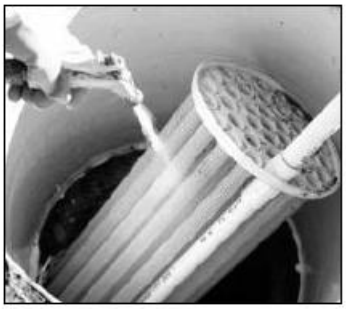
- Turn circuit breaker off at service panel
- Switch MOA and circuit breakers in control panel to "Off"
- Slide Biotube cartridge out of vault
- If necessary, the RSV valve may be removed to allow room in the riser for cleaning the Biotube

  — Pull RSV out of its Quick Disconnect holster (see photo next page) and place it in a plastic trash can

  — Hose off the trash can into the tank after replacing the RSV

NOTE: Refer to RSV installation instructions for details on how an RSV works.

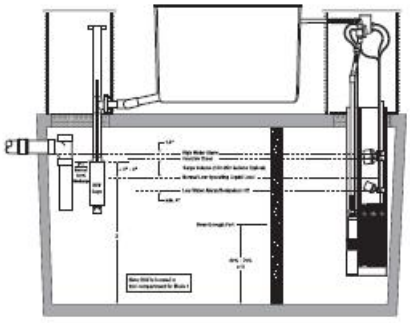
- Hold Biotube cartridge over open inlet of tank or primary compartment
- Carefully spray build-up into tank
- If there are significant solids in vault, remove and clean it too



6 Pull the pump and place it on a cleanable surface, like the riser lid, or in a plastic trash can. Check the intake screen; wash off particles as necessary. Record the kinds of particles (cigarette butts, hair, lint, gum, kitty litter, cloth wipes, grease build-up, etc.) on the Field Maintenance Report form. Report findings to user (for education).

7 Visually inspect the Recirculating Splitter Valve and verify that the liquid level in the tank is within the normal range. If low, the ball mechanism could be jammed in the seated position. Remove, disassemble, and inspect. If high, the RSV may require cleaning because it is not making a tight seal when seated. Remove, disassemble, and inspect.

NOTE: The figure below shows the RSV adjacent to the inlet of the processing tank, which is typical for Mode 3 systems (Mode 1 systems have the RSV in the second compartment of the tank — the Recirc Chamber). To read dimensional specifications, see full-sized drawing in Installation Guide, Appendix 2.



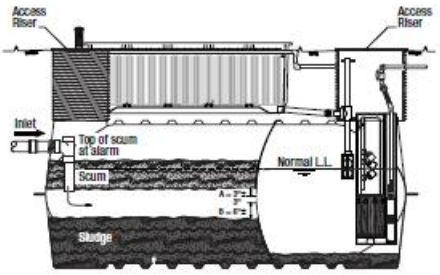
Processing Tank

1 If possible, verify no inlet flow when all household appliances are turned off. Access the inlet inspection port for visual verification of lack of flow. If the inlet inspection port is not readily accessible, then listen for trickling water at the access port. This could indicate faulty fixtures or leaky plumbing. Check building sewer cleanout for flow. If faulty plumbing isn't the problem, the

sound of trickling water could indicate I & I (infiltration and inflow) from ground or surface water. In that case, further investigation is necessary.

2 Inspect the processing tank for the following:

- Liquid depth (should be about 60-70% of the total inside depth of the tank)
- Odor (should be musty, not pungent)
- Color/consistency of scum (should be dark brown with a consistency that varies from dense and crusty to soft and amorphous)
- Effluent characteristics (should be no oily sheen or foam)
- Sludge and scum thickness (records should indicate typical growth accumulation of 1" of scum and 2" of sludge per year for 3-4 occupants)



Measurements of solids accumulation help to determine when the septic tank needs pumping. A recommendation for pumping should be made when the bottom of the scum layer is within 3" of the flow-through port of the baffle or when there is an accumulation of sludge to a depth within 6" below the flow-through port. After the first year's measurement of septic tank sludge and scum thickness, measurements need to be taken only about every three years, until the thicknesses approach their maximum depths.

Textile Filter

1 Inspect for ponding.* The filter should not be saturated. Effluent should move freely through the media.

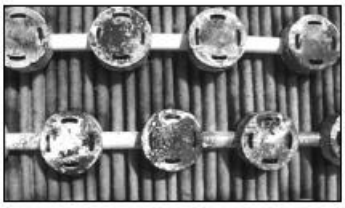
2 While manifold is pressurized, check for proper positioning of orifice shields over each orifice. (See photo, step 3, page 14.)

** If there is ponding in the textile filter because of a build-up of oil and grease, scrape a sample of the biomat and have it analyzed by an environmental lab to determine its characteristic. If there is ponding of indeterminate cause, coupled with a pungent odor, it may be necessary to clean the textile media. (Excessive cleaning will retard nitrification. Only clean as often as necessary.) The textile media hangs in individual sheets, and these sheets can be pulled out for cleaning (if necessary). First, remove the Recirculating Splitter Valve.*

Use a hose with spray nozzle or "low-pressure" pressure-washer, connected to the nearest spigot. Wash the biomat into the underdrain and it will flow back to the tank, as long as the Recirculating Splitter Valve has been removed. When done, replace RSV.

Remember: clean filter only if ponding and odor occur.

3 Verify that there is equal spray on and under all orifice shields. (Each orifice shield should show signs of organic biomat build-up on and underneath it. In this case, a clean orifice shield top is not better!)



4 Check for clogged orifices (orifice shields without spray or biomat build-up underneath). You should be able to observe uniform water droplets dancing around orifice shields while dosing.

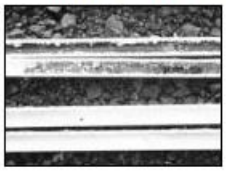
5 Assess the character and color of the biomat. If it seems appropriate, take a photo and comment on the growth and characteristics of the biological mat under and around the orifice shields. Biomats are natural and normally appear light-brown to dark-brown and gelatinous in texture. If the mat appears too light (yellowish with the texture of lard, wax, or margarine), the grease and oil concentrations should be checked.

If routine DO measurements show a decrease in DO, the biomat may be retarding oxygen transfer. Make sure there is no ponding or ventilation problem, then clean the sheets if necessary.

6 Check the odor emitting from the filter. If a strong or offensive odor (e.g., smell of rotten eggs, rotten cabbage, etc.) is emitted, measure the DO level in the filtrate and recirculation chamber and adjust the recirc time, if necessary. (Normally, systems will smell musty, earthy, or moldy but not pungent).

7 Check squirt height and compare residual pressure against the start-up value. This may take longer than just cleaning and flushing the manifold, but will help establish frequency of cleaning.

If the squirt height is 40-50% higher than the start-up value, clean and flush the manifold. (A 50% increase in squirt height signals approximately 18% orifice blockage.) To flush laterals you can run the pump or use a bottle brush or



Flushing with pump

Flushing with pressure washer or bottle brush

pressure washer. Brushing or pressure washing is best. (When you flush the laterals, biosolids slough into the bottom of the filter, flushing the underdrain at the same time, then return to the tank.) Verify again that all orifices are clear. Re-check squirt height.

8 Regardless of squirt height, be sure to open the flush valves and run the pump for two-to-three minutes to flush solids and biomass from the pod's underdrain back into the tank. This only takes a couple of minutes and can be done while accomplishing other tasks.

9 Verify passive ventilation and air flow. Use an anemometer (available through Orenco) to measure the air flowing through the system. 1-3 cubic feet per minute (cfm) is typical. The following chart shows how much airflow is needed* to handle the indicated strength of BOD_5 and ammonia:

Unit	Flow (gpd)	BOD_5 (mg/L)	Ammonia (mg/L)	Req. Air Flow (cfm)
AX20	500	150	65	0.8

**Ultimately, treatment is accomplished and final effluent quality provides the effective measure of treatment performance and capacity. Typical dissolved oxygen levels in the filtrate effluent will range from 3.5 to 5 mg/L DO.*

In the above photo, the measurement on the meter shows air velocity of 124 feet/minute, which, after mathematical conversion, means that 2.7 cfm (cubic feet/minute) is being drawn through the vent line. Slight atmospheric conditions are more than sufficient to cause two or more air changes to occur every hour.

Record inlet air flow and outlet air flow, where applicable, to ensure there isn't a large difference between them. A large difference means that leaking or bypassing is occurring. Clean vent pipe as necessary.

Miscellaneous

1 Exercise all mechanical valves. Fully open and close valves to ensure they have not failed or become stuck in one position.

2 Before leaving the site ...

a) Review the Maintenance Checklist to ensure all activities have been performed.

b) Be particularly careful to ensure the following:

— **Valves are back in their recommended positions**

— **Control panel has been set back to automatic and circuit breakers have <u>all</u> been switched back on**

— **Household water lines have been turned back on (if they were turned off earlier in the visit for I & I evaluation)**

— **Lids and lid bolts are properly in place and tightened**

Documentation

1 Complete all documentation and submit any required reports to the appropriate parties/agencies. Be sure to send a copy to the AdvanTex Dealer.

CAUTION! While providing O&M services, be sure to use proper personal protection equipment, such as rubber gloves and eye protection, as well as protective clothing, to cover parts of the body that will be exposed to wastewater or effluent. When finished, use proper personal hygiene.

Effluent Testing Procedures

Orenco Systems recommends regular testing of effluent from AdvanTex Treatment Systems as part of system maintenance. Copies of test results and additional comments/documentation must be forwarded to and retained by the Authorized AdvanTex Treatment System Dealer who sold the system. If no Dealer was involved in the sale, then documentation must be forwarded to Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, OR 97479, ATTN: Systems Engineering.

Protocol for Sampling, Testing, and Analysis

Sampling Locations — For residential systems, sample the discharge filtrate at the filtrate splitter valve. This location is illustrated on your system drawings. Pull the RSV out of its Quick Disconnect holster and lay it on a flat surface. Take the sample at the RSV inlet.

To take a sample that accurately represents the system's effluent quality, do two things:

1. Wash down, brush, or wipe the RSV inlet before taking the sample so that dislodged solids will not contaminate the sample.

2. Don't run the pump manually to force a quick sample. Take the sample during normal system operation.

Sampling Schedule — Typically schedule full-scale annual sampling events for spring.

Sampling and Storage Methods — Sampling equipment, minimum sample size, and storage procedures should conform to those recommended in the most current edition of *Standard Methods for the Examination of Water and Wastewater,* American Public Health Association (APHA), available from the Water Environment Federation, 703-684-2400.

Analytical Methods — Analytical methods should conform to *Standard Methods,* cited above.

Routine Tests, Frequencies, and Typical Values

While regional requirements vary, Orenco recommends that the following effluent tests be performed three to six months after system start-up. An annual field-service inspection, including sampling, is to be scheduled in late spring or in early summer. For AXN systems, there must be at least four inspections during the first two years, with sampling once a year as described on the Field Sampling Report Form, and then annual inspections with sampling thereafter.

These tests can be performed in the field; they cost very little and do not require lab work. However, they are very useful in assessing system performance and maintenance.

Parameter	Methodology	Typical Values*
Clarity	Visual[1]	Clear (15± NTUs)
Odor	Sniff[2]	Non-offensive (musty is OK; rotten egg or cabbage is not OK)
Biotube®	Visual	No liquid level differential inside/outside vault Norm: 1-2 year cleaning interval for recirculating systems
Oily film	Visual; inside the pump vault	None; no red, blue, green, or orange sheen
Foam	Visual; inside tank	None
pH	Field[3]	6-9

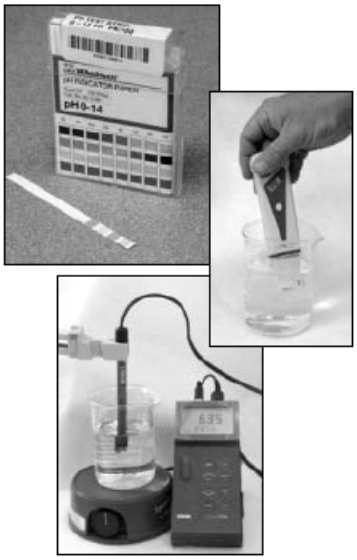
**Source: These typical values are recommended by various sources. Biotube parameters are based on Orenco research and development.*

[1] To check for clarity, service providers can carry a sample bottle of typical effluent, to compare against, or can use a portable turbidity meter.

Always put effluent sample in a clear glass container or beaker to evaluate clarity. Using a small, removable sticker, write the date and place it low on the beaker.

[2] *To check for odor, service providers can simply sniff the effluent sample or can use a sulfide measuring packet or an olfactory snifter device for detection of odors.*

[3] *To check for pH, service providers can use litmus paper, a pocket pH meter, or a benchtop pH meter.*



Supplemental Testing and Typical Values

If effluent is cloudy or smells pungent or if the biomat on the textile filter appears greasy, waxy, or oily, further tests and troubleshooting of the filtrate should be performed. The following filtrate tests provide invaluable information for troubleshooting and diagnosing problems and causes:

Parameter	Methodology	Typical Values (mg/L) AX[1]	
		Mode 1	Mode 3
BOD_5	Grab	10±	10±
TSS	Grab	10±	10±
TN	Grab	25±	5-15±
G&O	Grab	<1	
DO	Field[2]	2.5-6±	
pH	Field	6-8±	

[1] *AX values are based on Orenco and third-party testing.*

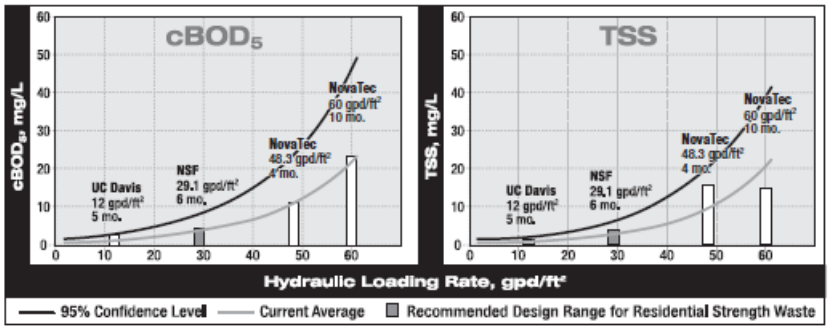
[2] *To check for Dissolved Oxygen, use a DO meter, available from VWR Scientific, Cole-Parmer, or Hach.*

[3] *Typical nitrogen reduction ranges from 60-80%±, with sufficient carbon source and alkalinity.*

Relationship Between Test Results and Loading Rates

As noted on pages 6-7, filtrate quality is dependent on a number of factors, including influent characteristics and loading rates. The following charts show how low-to-moderate loading rates produce BOD and TSS of <5mg/L, while higher loading rates produce BOD and TSS in the range of 15-25 mg/L.

Effluent Quality vs. Hydraulic Loading Rates
ANSI/NSF Standard 40 and Other Third Party Testing Results



Troubleshooting Tips for Operators: Process Treatment

Once you know the typical values for wastewater treatment system performance (see pages 6, 7, 16, and 17), you can be proactive and troubleshoot nontypical process indicators, before system performance is affected.

Troubleshooting Effluent Quality

If your effluent samples are cloudy and color/turbidity is significantly higher than expected (15 to 30 NTUs), do the following:

Septic Tank Recirc/Blend Filtrate

- Perform $cBOD_5$ and TSS tests
- Check the Biotube® filter for clogging
- Check to see if the textile filter smells of chemicals (medication, chlorine, etc.) or has a granular or crusty appearance. (For example, a white crystalline crust could signal that water softener discharge or industrial strength detergents have been flushed into the system.)
- Check to see if the recirc ratio is too high or the pump dose time is too long

If the effluent cBOD is high and TSS low, a large amount of soluble cBOD has not yet been consumed. That would likely be because the recirc ratio is too low for the influent strength or insufficient start-up time has elapsed. Typical organic reduction within the first 24 hours in residential systems is about 75% or greater. As the biomat begins to develop, greater reductions in the soluble cBOD will occur (typically within the first 7-10 days). With a higher influent strength, the soluble cBOD would not be readily removed until the biomat on the media is established.

If none of these troubleshooting steps made a difference, interview the user about system abuse, especially in the area of harmful chemicals, solvents, or strong cleaning agents. **Be sure to check that no water softener backwash is discharging into the processing tank! Water softener backwash can be extremely high in salts, which can disrupt system performance, especially nitrogen reduction processes!**

If no system abuse is uncovered, call Orenco to explore the following design remedies, in this order:

1. Expanded tankage (e.g., additional grease/oil tank)
2. Pretreatment (e.g., additional aeration)
3. Larger filter area (e.g., additional module)

Troubleshooting Odor

If the tank or textile filter smells like rotten eggs or cabbage:

- Check Dissolved Oxygen levels
- Use a DO meter or Colorimetric Kit
- Note filtrate DO levels that are <2.5 or >6 mg/L

Filtrate DO that's <2.5 mg/L indicates insufficient oxygen. If the filtrate DO is <2.5 mg/L:

- Check filter surface for evidence of clogging
- Check to ensure the pump is working
- Check to ensure ventilation is occurring
- Check to ensure the recirc ratio isn't too low; increase if too low
- Check to ensure influent strength isn't too high (see AdvanTex Design Criteria)
- Check to ensure hydraulic retention time isn't too high

Filtrate DO that's >6 mg/L indicates excessive aeration. If the filtrate DO is >6 mg/L:

- Check to ensure recirc ratio isn't too high
- Check to see if influent flows are below normal
- If influent flows are below normal or recirc ratio is too high, reduce recirc ratio

Troubleshooting Biotube Filter Clogging

If a visual inspection of the Biotube filter for biomass build-up shows the need for cleaning more often than once every 1-2 years (which is typical for recirculating systems), try the following:

- Verify the pump isn't running too long (typically 3 cycles/hour)
- Ensure the recirc ratio isn't too high
- Verify normal DO levels; if high, reduce recirc ratio
- Check for below normal influent flows
- Check influent Grease & Oil and TSS; if excessive, a review of component sizes may be required

Troubleshooting Oily Film

All signs of oil or grease anywhere in the system (in the tank, in the vault, on the effluent or textile filter) must be investigated. Ask the system user to identify the probable source:

- Recent change of car oil?
- Canning meat or poultry?
- Excessive use of garbage disposal?
- Excessive use of bath or mineral oils? (Jacuzzi® tub?)
- Excessive use of detergents?

If the system user can't identify the probable source, try the following:

- Sample/test effluent for BOD_5 and Grease & Oil
- Sample/test at all process steps, including influent (if possible)
- Label, date, and photograph all samples
- Use standard glass beakers and set samples in front of a common, uniform background, when photographing
- Check biomat accumulation at AdvanTex Filter
- Note if biomat is yellowish and wax-like or lard-like. If so, scrape biomat sample for analysis:
  - — Photograph/document biomat sample
  - — Send to lab with effluent samples

Note: Excessive Grease & Oil (>25 mg/L) is typically a design and management concern with commercial applications.

Troubleshooting Foam

Foam indicates that microbes are producing excessive gas byproducts. Foam rarely occurs in packed bed filters (and AdvanTex is a packed bed filter). If foam is present:

- Verify the pump isn't running too long
- Ensure the recirc ratio isn't too high
- Ask residents about detergent use

As an aid to troubleshooting, Appendix 3 gives typical timer settings for households of various sizes.

O&M For Nitrogen Reduction

AdvanTex Treatment Systems do an excellent job of reducing nitrogen, especially in the Mode 3 configuration, where Total Nitrogen* is typically reduced to 10 mg/L ±, with influent TKN of 55-65 mg/L. Because many people purchase AdvanTex for its nitrogen reducing capabilities, and because nitrogen reduction is a complex, many-staged process, it's important to understand the process, its related factors, the signs of effective nitrogen reduction, and how to keep the process optimized.

It's also important to know the Total Nitrogen limits required by the system user's permit. Some regulatory agencies have no requirement; some require a specific percentage reduction of a certain kind of nitrogen (90-95% nitrification of ammonia nitrogen, for example); and some require that Total Nitrogen be reduced to levels at or near drinking water quality at the point of final dispersal.

Finally, because influent characteristics greatly affect the amount of nitrogen reduction possible from any given system, it's vital to know the alkalinity of your waste source and the local/regional norms for organic and ammonia nitrogen.

The Process

In nitrogen reduction, ammonia is converted to nitrate and then reduced through bacterial action to nitrogen gas, which can be released harmlessly to the atmosphere. Optimum nitrogen reduction requires the following:

- Adequate alkalinity of approximately 250± mg/L or higher (lab test shows levels)
- pH of 6-8. Fixed film microbial processes generally thrive between pH 5.5 and 9. Treatment problems typically result from rapid changes in pH rather than extreme long-term mean values, although long-term levels can result in less efficient process activity
- Filtrate DO level of 2.5-8 mg/L, process tank DO level of <1 mg/L
- Adequate time for the nitrifying bacteria to develop (one to three months)
- Adequate temperature (below 40° F retards the process)
- Good organic removal

For a thorough description of the nitrogen reduction process, see Appendix 1. In residential wastewater, the ammonia level is typically about 60 mg/L and the Total Nitrogen level is typically about 65 mg/L.

Signs of Effective Nitrogen Reduction

Service providers frequently ask us, "How do I know if my wastewater treatment system is reducing nitrogen?" A thorough description of key indicators is included in the Appendix. Following is a brief summary:

- Clear, odorless filtrate effluent (a "see and sniff" test is generally considered sufficient)
- Normal-looking biomat on the textile filter (light-brown to dark-brown and gelatinous in texture)

Additional Filtrate Tests Will Show ...

- Typically, low BOD_5 and high clarity
- DO of 2.5-6 mg/L and odorless or odor that is not a nuisance
- Relatively low ammonia and high nitrate levels, since nitrification converts ammonia to nitrate

** Total Nitrogen is the sum of organic and ammonia nitrogen, nitrate nitrogen, and nitrite nitrogen. (TN=ON + NH3-n + NO3-n + NO2-n ... or ... TN=TKN-n + NO3-n + NO2-n)*

Troubleshooting Nitrogen Reduction

If you suspect that the System is not meeting expectations for nitrogen reduction, troubleshoot each of the critical factors that contribute to optimum nitrogen reduction, to determine a cause.

Filtrate Alkalinity Too Low — Available alkalinity determines the degree of nitrification possible for any wastewater treatment system, because it takes 7.14 parts alkalinity to nitrify 1 part ammonia.

If filtrate alkalinity is too low:

- Check the recirc ratio; a high recirc ratio increases alkalinity consumption*
- Check influent TKN or ammonia levels and source alkalinity

If a large quantity of nitrification is required, it may be necessary to add a buffering compound to the system, to raise alkalinity levels.

Filtrate pH Too Low — Nitrification is particularly sensitive to pH but tends to thrive at levels between pH 7.2 and 9. The nitrification process releases hydrogen that consumes alkalinity and causes pH levels to drop.

A pH level of <6 retards microbial activity of all kinds, including denitrification. Maintaining an alkalinity of 50 to 80 in the effluent is typically sufficient to maintain pH levels above 5.5. If the filtrate pH level is too low:

- Check influent alkalinity level (pH drops when too much available alkalinity is consumed)
- Check recirc ratios; reduce if too high*
- Ask system user about chemical discharges into the system, including carpet cleaners, chlorine, and photo developing agents

Filtrate DO Levels Outside Range of 2.5-6 mg/L — If your filtrate DO is too low (indicating insufficient oxygen), you may experience periodic sulfide odors during dosing events, or perhaps a more lasting smell within the filter pod. Try the following:

- Check for surface clogging/ponding and clean as necessary
- Check air flow through the vent assembly
- Check the recirc ratio; if it's too low (<2:1±) increase as necessary*

If your filtrate DO is too high (indicating excessive aeration), it's likely that excessive recirculation or insufficient hydraulic retention time are factors. Try the following:

- Decrease the recirc ratio*

High Filtrate Ammonia Levels — Because ammonia is consumed during nitrification, high ammonia levels are a sign that something is amiss. Try the following:

- Check for surface clogging/ponding and clean as necessary
- Check for sufficient aeration (measure DO)
- Ensure no blockage of air flow into textile filter (indicated by thick biomat development or a build-up of grease and oils)
- Ensure no blockage in the manifold, causing ...
  - — Localized hydraulic overloading, saturation
  - — Short circuiting
- Check for sufficient alkalinity; if insufficient, consider supplemental buffering. Call Orenco Engineering for assistance, if necessary.

**Keep in mind that a recirc ratio that's too high can generate a highly aerobic biomat growth on the pump filter; and a recirc ratio that's too low can tend to liberate periodic odors during dosing events. So search for the optimum ratio (typically between 2 and 4:1)*

Low Filtrate Nitrate Levels — Residential packed bed filters normally yield 98+ percent nitrification (ammonia to nitrate). Therefore the ammonia levels in the filtrate should be low and the nitrate levels higher. Some denitrification typically is experienced through the packed bed filter. So the normal nitrate level may vary. Be sure you are familiar with the mode of operation, as some AdvanTex modes are configured to produce lower nitrate levels. If it appears that nitrification is dropping off:

- Check the recirc ratio; adjust as necessary* (high recirc ratios may drive pH too low for effective nitrification/denitrification and low recirc ratios may not provide sufficient aeration)
- Verify incoming ammonia levels
- Check recirc/blend for sufficient organic food source (high BOD — see Table, page 7 — may cause greater oxygen demand through the filter, reducing nitrification)

Adequate Time and Temperature — Nitrifying bacteria require one to two months to develop, and extremely cold temperatures (below 40° F) retard that process. If the AdvanTex Treatment System has been installed in a very cold climate, nitrification may not "kick in" for several months until warmer temperatures are reached. Typically, a June-September installation provides the necessary temperatures for a 30-60 day nitrification start-up time. Once nitrifiers colonize, they typically continue to nitrify through normal winter conditions. Only in severely cold regions should additional insulation be necessary.

**Keep in mind that a recirc ratio that's too high can generate a highly aerobic biomat growth on the pump filter; and a recirc ratio that's too low can tend to liberate periodic odors during dosing events. So search for the optimum ratio (typically between 2 and 4:1)*

AdvanTex Treatment Systems

While regional regulations may vary, Orenco Systems requires that the following inspection and maintenance activities be performed, by a qualified provider, on all AdvanTex Treatment Systems sold. All activities are to be performed three-to-six months after system start-up; and an annual field-service inspection, including sampling, is to be scheduled in late spring or in early summer. For AXN systems, there is to be a minimum of four inspections during the first two years, and then annual inspections thereafter. Copies of inspection and maintenance reports and additional comments/documentation are to be forwarded to the AdvanTex Dealer, or if no Dealer, to Orenco Systems, 814 Airway Avenue, Sutherlin, OR 97479.

Date: _____ **Site:** _____ **Operator:** _____

Maintenance Activity	Activity Check-Off/Notes
A) Inspect Control/Alarm Panel	
1) Check pump operations in manual mode	☐ _____
2) Check/record pump amperage and voltage	☐ _____
Voltage at rest: _____ Amps at rest: _____ Amps while pumping: _____	
3) Check timer settings	☐ _____
4) Record elapsed time meter and counter readings (if applicable)	☐ _____
5) Confirm operation of audible and visual alarms	☐ _____
B) Inspect/Test Pumping System	
1) Verify no leaks in riser	☐ _____
2) Inspect splice box for moisture and secure connections	☐ _____
3) Verify condition of and correct operation of all floats	☐ _____
4) Verify neat wrap of float cords	☐ _____
5) Pull pump and clean intake screen if necessary	☐ _____
6) Visually inspect recirculating splitter valve and liquid level	☐ _____
C) Inspect Effluent Filters/Pump Screens	
1) Clean as needed	☐ _____
2) Visually inspect and comment on biomat growth	☐ _____
D) Inspect Processing Tank	
1) Verify no inlet flow	☐ _____
2) Inspect liquid depth, odor, scum color, effluent characteristics	☐ _____
3) Measure sludge and scum; recommend tank pumping, if necessary	☐ _____
E) Inspect AdvanTex Filter	
1) Inspect for ponding; assess character and color of biomat	☐ _____
2) Check squirt height	☐ _____
3) Verify proper orifice position, equal spray under orifices, no clogged orifices	☐ _____
4) Check for odors; adjust recirculating time if necessary	☐ _____
Normal: ☐ Musty ☐ Earthy ☐ Moldy	
Pungent: ☐ Sulfide ☐ Cabbage ☐ Decay	
5) Clean and flush manifold (if necessary)	☐ _____
6) Re-check squirt height	☐ _____
7) Flush underdrain	☐ _____
8) Inspect intake vent and clean as necessary	☐ _____
F) Miscellaneous	
1) Exercise all valves	☐ _____
2) Return valves, control panel to proper settings	☐ _____
3) Submit required documentation	☐ _____

Field Alarm Report Form

Operator Responding: _____
Date/Time Responded: _____
Total Field Time: _____
Total Travel Time: _____

Alarm call by: _____
Alarm call Date/Time: _____

Alarm Call Addendum

Conditions Leading to Call

- ☐ Alarm
- ☐ Odor
- ☐ Noise
- ☐ Other:
- ☐ Tank Overflow
- ☐ Surface Runoff
- ☐ Sewage Backup

Odor

Normal: ☐ Musty ☐ Earthy ☐ Moldy
Pungent: ☐ Sulfide ☐ Cabbage ☐ Decay
Date/Time Discovered: /
Method of Detection:

Alarm

- ☐ High Liquid Level
- ☐ Low Liquid Level
- ☐ Off

Pump

- ☐ On
- ☐ Off

Tank Liquid Level

- ☐ Normal
- ☐ High
- ☐ Low

Circuit Breaker

- ☐ On
- ☐ Off
- ☐ Tripped
- ☐ Switched

Cause of Malfunction

Mechanical	Physical or Process-Related
☐ Control Panel	☐ Power
☐ Pump	☐ Back Pressure
☐ Float Switch	☐ Air Bound
☐ Screened Vault	☐ Sludge & Scum
☐ Hose & Valve	☐ Clog
☐ Check Valve	☐ Infiltration/Inflow
☐ Building Sewer	☐ Exfiltration
☐ Service Line	☐ Siphoning
☐ Other:_____	☐ Other:_____

Repair: _____
Replace: _____
Notes: _____

Field Sampling Report Form

Date: _____

Inspector: _____

Address: _____

System Type: _____

The following effluent tests can be easily and routinely performed in the field. Perform annually, or as frequently as necessary per the methodology indicated. For AXN systems, there is to be a minimum of four sampling events the first two years and then annual sampling thereafter. Record your results/observations in the space provided:

Parameter	Methodology	Typical	Field Observations	Pre-Test Lab Concurrence
Clarity	Visual[1]	Clear (15 ± NTUs)	_____	
			_____	_____
Odor	Sniff[2]	Non-offensive (no smell of rotten eggs or cabbage; a musty, earthy, or moldy odor is normal)	_____	_____
			_____	_____
			_____	_____
			_____	_____
			_____	_____
Oily film	Visual; inside tank	None (no red, blue, green, or orange sheen)	_____	
			_____	
			_____	
Foam	Visual; inside tank	None	_____	
pH	Field	6-9	_____	
			Date_____	Date: _____
			Signature Field Sampler	*Signature* Lab Technician

[1] *To check for clarity, service providers can carry a lab-prepared sample bottle or bottles with known turbidities of 15 NTUs and 30 NTUs, to compare against, or can use a portable turbidity meter. Always put effluent sample in a clear glass container or beaker to evaluate clarity. Using a small, removable sticker, write the date, place it low on the beaker, and photograph for documentation.*

[2] *To check for odor, service providers can simply sniff the effluent sample with the assistance of an olfactory snifter device and/or sulfide odor measuring packet. Whenever possible, interview system users about odor occurrences and request user's assistance in verifying or detecting odors.*

ETM/CT Log & Worksheet

Electronic Time Meter Log

Date	ETM Reading	ETM Differential (Current - Prev.)	Number of Intervening Days	Duration: Minutes/Cycle (ETM Diff. / Interv. Days)

Comments: _____

Cycle Log

Date	Cycle Reading	CT Differential (Current - Prev.)	Number of Intervening Days	Frequency: Cycles/Day (CT Diff. / Interv. Days)

Comments: _____

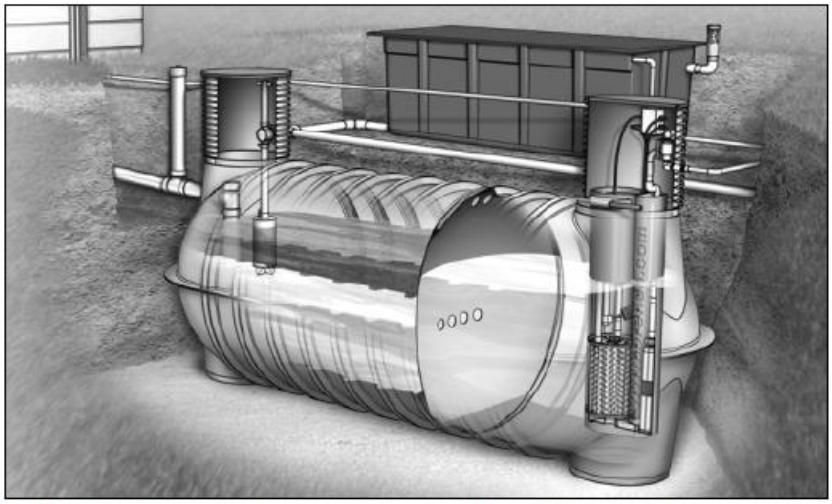
Scum & Sludge Monitoring

Two-Compartment Tank

Operator Responding: _____ Date/Time Responded: _____

Address: _____ Date of Installation: _____

Phone: _____ Date of Last Pumping: _____



First Compartment Scum

Date	Depth (Inches)	Rate of Accumulation

First Compartment Sludge

Date	Depth (Inches)	Rate of Accumulation

Second Compartment Scum

Date	Depth (Inches)	Rate of Accumulation

Second Compartment Sludge

Date	Depth (Inches)	Rate of Accumulation

Comments: _____

Appendix 1: The Nitrogen Reduction Process and Key Indicators

The Process

Nitrogen removal (or "nitrification/denitrification") is a biochemical process in which ammonia is converted to nitrate (nitrification) ($2NH_3$ converts to $2NO_3 + 3H_2O$) and then reduced through bacterial action (denitrification) to nitrogen gas, which can be released harmlessly to the atmosphere.

During the nitrification process, about 9 parts oxygen are consumed in converting 2 parts ammonia to nitrate. Therefore, depending on the concentration of ammonia, a considerable amount of air may be needed. Other processes, like biological (BOD) reduction, may occur simultaneously and further elevate the demand for aeration, especially if the organic level is high.

In an abundance of air, all the aerobic or facultative microbes compete for their share of oxygen. When the organic concentration is high, the microbes that oxidize organic matter, primarily the heterotrophic bacteria, are aggressive and tend to outcompete other microbes for the available free oxygen in solution. The oxidation of ammonia is accomplished by autotrophic bacteria, which do not have as aggressive of a growth rate, so if there isn't an abundance of oxygen, nitrification suffers. Consequently, the nitrification process usually lags until the organic concentration is depleted or until sufficient oxygen is present. At a 2.5:1 BOD/TKN ratio, the nitrifiers may only make up about 10 percent of the microbial population. At 0.5:1 BOD/TKN, the nitrifiers make up about 35 percent of the population.

In a filtering process, the filter column must be deep enough, or the filter media must be efficient enough at filtering organic particles, to deplete organic concentrations to a level in which a sufficient population of nitrifiers will be sustained. The physical (dimensional) features of the filter will vary depending on the media's characteristics — void ratio, moisture holding capacity, and effective surface area per unit volume ratio. Tankage, surge capacity, application rates, and loading characteristics are other design considerations that play a role in the sizing of the filter unit.

Performance Indicators

To judge the nitrogen-reducing performance (or potential) of any wastewater treatment system, be sure to check the following performance indicators:

Clear, Odorless Effluent — Simple, "see and sniff" tests can be performed easily in the field. Effluent from packed bed filters (recirculating textile filters, recirculating sand filters, intermittent sand filters) that are performing well should be clear (with turbidity $\leq$20 NTUs±) and odorless.

Tests for Ammonia and Nitrate Nitrogen — If your system is oxidizing ammonia to nitrate (nitrifying), lab tests should measure relatively low ammonia levels and relatively high nitrate levels in the filtrate. Because nitrification responds to many and varying conditions within the aerobic treatment processes, ammonia and nitrate nitrogen levels in the filtrate are the most ideal constituents to watch for any changes in performance. Start-up times can be plotted, optimum recirc ratios can be gauged, cleaning frequencies can be predicted, and nonvisible clogging or saturation detected by watching either of these constituents.

Typical nitrification in single-family residential systems is expected to be in the 98-99% range. You'll want to investigate if the process appears to degrade by 5 percentage points or more.

BOD — The nitrification process requires oxygen, which is why nitrification is enhanced when BOD is extremely low. Measures of filtrate BOD should be <15 mg/L, although higher BOD may not necessarily correlate with low levels of nitrification.

Typical influent characteristics are shown on page 7. When BOD_5 is high, there is a greater organic demand for oxygen, which may hamper the nitrogenous demand for oxygen. Increasing the recirc ratio should help establish oxygen balance.

Dissolved Oxygen — Dissolved oxygen also provides critical information with which to diagnose how well a system is performing. Measures of Dissolved Oxygen should be in the range of 2.5 to 6 mg/L. If the DO level drops, the degree of nitrification will normally drop as well, which could be a sign of blinding or saturated flow conditions — anything that might inhibit free air from flowing into the system. (Though it's quite possible to have low filtrate DOs and still have high effluent quality, as measured by BOD and TSS levels.)

Biological Growth on Filter — With "fixed film" treatment systems, biological growth on the filter media is natural. The biomat should appear light-brown to dark-brown in color and gelatinous in texture.

Influent Characteristics — Influent characteristics (see page 7) will greatly affect the amount of nitrogen reduction that is possible from any wastewater treatment system. High solids and/or fats and cooking oils increase the oxygen demand and accumulation of material on and within the media, affecting the available oxygen for nitrification.

pH — For normal residential nitrogen loads, pH is typically maintained between 6 and 8.

Alkalinity — The nitrification process releases hydrogen ions into solution, which tends to lower the pH level. Alkalinity is essential for nitrification. For each part ammonia that is nitrified, 7.14 parts alkalinity are consumed (buffering the acidity caused by the release of hydrogen ions). Consequently, if the degree of nitrification is less than expected, it could simply be a lack of sufficient alkalinity to support more. Typical residential nitrification requires alkalinity above 250± mg/L for recirculating processes and double that for single pass processes. *Many wastewater streams do not have sufficient alkalinity to support complete nitrification.*

Wastewater streams without sufficient alkalinity to support complete nitrification may, depending on the type of process, cause a depletion in the alkalinity to the point where its ability to buffer stops. The pH correspondingly drops to a level that retards the microbial activity (<6±). Recirculating the effluent helps, since half the alkalinity can be restored in the recirc or process tank, wherever denitrification occurs (and adjusting the recirc ratios may also bring the pH back to preferred operating levels). But wastewater streams that are alkalinity-starved can't provide for 100% nitrification.

The use of low flush fixtures requires special consideration. Low flush fixtures tend to reduce hydraulic loads, which causes elevation of wastewater constituents (i.e., higher concentrations of BOD, TSS, TKN, etc.). In this case, the available alkalinity in the water supply may not be adequate to accomplish the full level of nitrification desired.

These constraints exist for all wastewater treatment operations, regardless of whether the operation involves a suspended growth contact stabilization process or an attached growth packed bed filter. Packed bed systems will perform better, especially if they have a large attached growth surface area per unit volume ratio, because the micro-sites near the attached side of the biomat, where denitrification typically occurs, return some of the alkalinity. Textile packed bed filters, because of their large surface area per unit volume ratio, tend to perform even better. Nevertheless, additional buffering may be necessary to accomplish the level of nitrification desired. In low alkalinity conditions, pH adjustment can be made with the addition of Quick or Hydrated lime, soda ash, or caustic. (Note: at process points preceding sedimentation zones, lime adjustment — buffering — would be preferred. Soda ash and caustic both contain sodium, which is a dispersant.)

Appendix 2: Abbreviations & Definitions

3D	Three dimensional (typically refers to a drawing)
amps	Amperage
alkalinity	Alkalinity is not a specific polluting substance, but a combination of factors. It is the ability of water to neutralize an acid, and is due primarily to the presence of carbonate (see pH). Alkalinity is also essential for nitrification (for each part ammonia nitrified, 7.14 parts alkalinity are used.) Insufficient alkalinity will result in incomplete nitrification.
AX	AX stands for Aligned Textile (hanging style) treatment media.
AWG	American Wire Gauge
BOD_5	Five-day biochemical oxygen demand
CB	Circuit breakers
cfm	Cubic feet per minute
CT	Counter (a device that counts)
dia.	Diameter
diff.	Differential
DO	Dissolved oxygen
EC	E. Coli *(Escherichia coli)*
ETM	Elapsed time meter
F	Fahrenheit
FC	Fecal coliform bacteria
ft.	Feet
H_20	Water
hp	Horsepower
I & I	Infiltration and inflow
interv.	Intervening
gal.	Gallon
G&O	Fats, oils, and grease (aka FOG). Fats and oils are the third major component of foodstuffs. The term "grease" as commonly used includes the fats, oils, waxes, and other related constituents found in wastewater. Fats and oils are contributed to domestic wastewater in butter, lard, margarine, and vegetable fats and oils. Fats are also commonly found in meats, in the germinal area of cereals, in seeds, in nuts, and in certain fruits. Fats are among the more stable of organic compounds and are not easily decomposed by bacteria.
gpd	Gallons per day
gpm	Gallons per minute
grab sample	An individual discrete sample collected over a period of time not to exceed 15 minutes
min.	Minute(s)
mg/L	Milligrams per liter
Mode 1	AdvanTex Treatment System configuration in which the textile filter's filtrate returns to the outlet end of the processing tank
Mode 3	AdvanTex Treatment System configuration in which the textile filter's filtrate returns to the inlet end of the processing tank
MOA	Manual/On/Off switch in control panel
NEC	National Electric Code
NH_3	Ammonia gas
NH_4	Free ammonia
NO_2	Nitrite
NO_3	Nitrate
NTU	Nephelometric turbidity unit (see turbidity unit)
O&M	Operation and maintenance
pH	pH is a measure of the activity of hydrogen ions. A pH of 7.0 indicates neutrality, greater than 7.0 indicates alkalinity, lower than 7.0 indicates acidity. Overall pH ranges from 0.0 to 14.0.
prev.	Previous
psi	Pounds per square inch
PVC	Polyvinyl chloride
recirc	Recirculating
RSV	Recirculating Splitter Valve
SMUG	Scum Measuring Utility Gauge
STEP	Septic Tank Effluent Pump
STEP System	Used to refer to an effluent (pressure) sewer
TDS	Total dissolved solids
TKN	Total Kjeldahl nitrogen (organic and ammonia nitrogen)
TP	Total phosphorus
TN	Total nitrogen (organic and ammonia nitrogen, plus nitrite and nitrate nitrogen)
TSS	Total suspended solids
turbidity unit	A measure of particulate and color in water and wastewater streams
V	Volts

Appendix 3: Timer Settings

Start with these typical timer settings for households of various sizes. Calculations assume water usage of 50 gallons per person per day and a return recirculation ratio of 3 : 1. For more detailed instructions about timer settings, consult the *AX20 Timer Settings Worksheet,* NDA-ATX-SET-2, available from the Document Library at www.orenco.com.

Number of People	Time ON (seconds)	Time OFF (minutes)
2	15	29.75
3	15	19.75
4	30	29.75
5	30	23.75
6	30	19.75

Notes

Record of System Facts

(Record in Pencil)

Property Address

Property Owner Name(s)

Property Owner Phone

Property Owner E-Mail

Start-Up Date

AdvanTex Model #

AdvanTex Serial Number (on filter pod)

Control Panel Model #

Float Model #(s)

Pump(s) Model #(s)

Pump(s) Design Specifications:

_____ gpm _____ gpm

Design Flow

Tank(s) Size(s)

Recirc Ratio (start-up)

Recirc Timer Settings

Discharge Timer Settings (when applicable)

Initial Squirt Height

Dispersal Method

Distributed by:

Dealer Name

Dealer Phone

Engineer Name

Engineer Phone

Installer Name

Installer Phone

Service Provider Name

Service Provider Phone

Regulatory Authority

Permit # (if applicable)

Contact Name

Contact Phone

AdvanTex® Treatment System AXN Models meet the requirements of NSF-ANSI Standard 40 for Class I Systems.

Orenco Systems® Incorporated

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ATTACHMENT E

GEOFLOW® SUBSURFACE DRIP IRRIGATION TECHNICAL LITERATURE

TABLE OF CONTENTS

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INTRODUCTION

Geoflow's WASTEFLOW®[1] drip system disperses effluent below the ground surface through ½" pressurized pipes. It is designed using the grid concept with supply and flush manifolds at each end of the dripline creating a closed loop system. The grid design provides a complete subsurface wetted area.

The objective with effluent dispersal is usually to disperse the effluent using the minimum area as quickly and safely as possible at an approximately uniform rate throughout the year. If the main purpose of the Geoflow system is to irrigate, then please use the standard irrigation manual for landscape available from Geoflow, Inc.

Subsurface drip is a highly efficient method to dispose of effluent. Small, precise amounts of water are uniformly applied under the soil surface from multiple points.

The main advantages of Geoflow's subsurface drip system for effluent dispersal are:

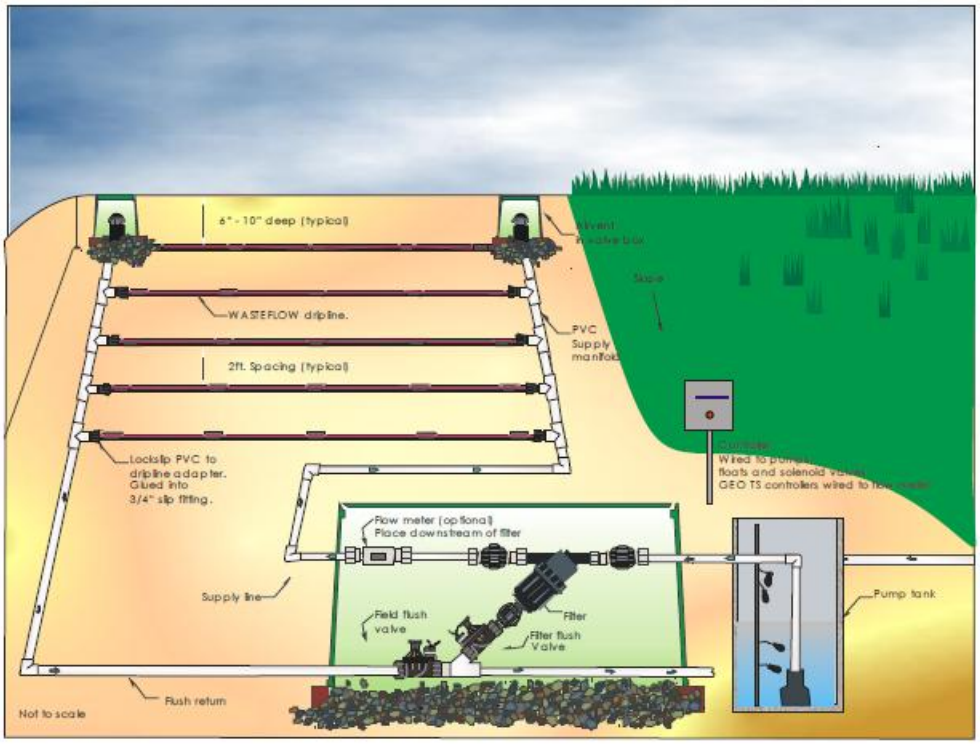
- Human and animal contact with effluent is minimized, reducing health risks.
- Correctly designed systems will not cause puddling or runoff.
- It can be used under difficult circumstances of high water tables, tight soils, rocky terrain, steep slopes, around existing buildings, trees or other vegetation, and on windy sites.
- Disposal of water is maximized by means of evapotranspiration.
- The system requires no gravel. It is easy to install directly into indigenous soils and the natural landscape can be maintained.
- Minimizes deep percolation.
- Consumption of nitrates by the plant material is increased.
- Invisible and vandal proof installations.
- Fifteen-year warranty for root intrusion, workmanship and materials. Systems are durable with a long expected life of approximately 30 years.
- Non intrusive. It allows use of the space while operating.
- Easily automated.
- Effluent can be re-used for irrigation.

NOTES

- These guidelines are for secondary treated effluent. When using primary treated effluent, Geoflow recommends automating all the self flushing valves, and increasing the number of emission points in the dispersal field. For more information on septic tank dispersal, please check our website at www.geoflow.com or telephone Geoflow at 800-828-3388.
- Please follow your State and County Regulations for onsite wastewater dispersal. These guidelines are intended to be a guide to users of the Geoflow drip system and should be used only as a supplement to your local regulations.
- Occasionally, in forested area, the dripline is placed on the surface and covered with mulch.

1 WASTEFLOW® is a registered trademark of A.I.Innovations.

Diagram 1: Typical Dripfield layout



SYSTEM COMPONENTS

See Diagram 1 on page 3.

A typical drip system installation will consist of the elements listed below:

1. WASTEFLOW® DRIPLINE

(See product sheet for specification)

WASTEFLOW dripline carries the water into the dispersal/reuse area. The dripline is connected to the supply and return manifolds with Compression or Lockslip fittings. Typical spacing between each dripline and between drip emitters is 24" on center.

Twelve-inch spacing is used regularly for soils with very low or high permeability. Dripline is usually buried 6"-10" below ground. Standard coil length is 500-ft. Rolls of alternative lengths, diameters and dripper spacings may be special ordered.

WASTEFLOW dripline features:

a.) nano-ROOTGUARD®[2]

In 2008 Wasteflow dripline will have new nano-ROOTGUARD which has an extended expected life of 30 years. The risk of root intrusion with an emitter slowly releasing nutrient rich effluent directly into the soil is well known to anyone who has observed a leaking sewer pipe. All Geoflow drip emitters are guaranteed to be protected against root intrusion with nano-ROOTGUARD. This patented process fuses the root-growth inhibitor, TREFLAN®[3] into each drip emitter during manufacturing. Treflan is registered with the United States EPA for this application. The nano-ROOTGUARD technology holds Treflan for extended time inside the plastic, slowly releasing it in minute quantities to prevent root cells from dividing and growing into the barrier zone. It is chemically degradable, non-systemic, and virtually insoluble in water (0.3 ppm). nano-ROOTGUARD carries a **15-year warranty** against root intrusion.

b.) *Geoshield™*[4] protection

Geoflow's WASTEFLOW has an inner lining impregnated with an antimicrobial, Tributyl tin maleate, to inhibit adhesion of biological growth on the inside walls of the tube and on the emitters. It does not have any measurable biological effect on the effluent passing through the tube. This minimizes the velocity required to flush WASTEFLOW dripline. The velocity only needs to move out the fine particles that pass through the 130 micron filter that, if not flushed, will ultimately accumulate at the distal end of each lateral. It is not necessary to scour growth off the inside wall of WASTEFLOW tubing. Since all pumps deliver more volume given less resistance to flow, just opening the flush valve will usually achieve this degree of flushing. When a minimum flushing velocity is requested by regulators, 0.5 feet per second is used with Wasteflow dripline to get the settled particles at the bottom of the pipe back into suspension. This equates to 0.375 gpm per dripline when using standard WASTEFLOW dripline (0.55"ID)

c.) Turbulent Flow Path

WASTEFLOW drip emitters are pre-inserted in the tube usually spaced 6", 12", 18", or 24" apart with 24" being the most popular. Angles in the emitter flow path are designed to cause turbulence in order to equalize flow between emitters and keep the emitters clean. Geoflow emitters boast large flow paths, which, coupled with turbulent flow, have proven over the years to be extremely reliable and dependable.

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2 nano-ROOTGUARD is a registered trademark of A.I.Innovations
3 Treflan is a registered trademark of Dow Agro Sciences
4 Geoshield is a registered trademark of A.I.Innovations

d.) Wasteflow Classic and Wasteflow PC Dripline

Both WASTEFLOW Classic and WASTEFLOW PC have turbulent flow path emitters with nano-ROOTGUARD and *Geoshield* protection.

The WASTEFLOW PC has the added element of a silicone rubber diaphragm that moves up and down over the emitter outlet to equalize flows regardless of pressure between 7 and 60 psi. To ensure a long life the recommended operating range is 10 to 45 psi.

For Wasteflow Classic, the flow rate delivered by the emitter is a function of the pressure at the emitter. The Classic dripline has the advantage of no moving parts or rubber that may degrade over time. Also, when minimum flushing velocities are required, the flows during a dosing cycle and flushing cycle are very similar with the Wasteflow Classic because when the flush valve is opened, the pressure is reduced, causing the flows from the emitters to decline. PC dripline requires significantly higher flow for flushing than dosing as the emitter flow does not go down during the flushing cycle.

We generally recommend using WASTEFLOW Classic, unless the economic advantages to using PC is substantial.

i. Wasteflow PC can run longer distances than Wasteflow Classic.

ii. Steep slopes. Systems should be designed for the dripline lateral to follow the contour. When this is practical, the extra cost of installing pressure regulators required for Wasteflow Classic would likely be less than the incremental cost of Wasteflow PC.

iii. Rolling terrain. If the difference in height from trough to peak exceeds six feet then Wasteflow PC should be used. Vacuum relief valves must be placed at the top of each rise.

2. Controllers

(See product sheet for specification)

Controllers are used for time dosing and time flushing of the filter and dripfields. GEO controllers include a programmable logic controller to increase flexibility and reliability in the field. They can be used on systems ranging in size from one to eight zones at the time this manual was printed. All controllers include a surge arrestor, elapsed time meter and counter. In 2007 Geoflow added a new controller with a touchscreen interface. It can vary dose times in each zone, monitor flow, ultraviolet, blower, and other optional inputs.

3. Pumps, Pump Tanks & Floats

Wasteflow dripfields depend on pumps to dose effluent under pressure to the field. These must be sized according to flow and pressure requirements. Look for submersible effluent pumps from a dependable source. Geoflow does not endorse a single manufacturer, but does advocate you use a pump that is readily serviced in your area. Two (duplex) pumps may be used. These will normally alternate at each signal from the control panel and are often used on commercial or large drip systems. Pump tanks should be sized according to your local rules and regulations. Geoflow controllers are set-up for 4 floats with the lowest one in the tank being the *redundant off float*. The *primary timer on/off float* is second from the bottom, followed by the *secondary timer float* third from the bottom and the *high level alarm float* on the top.

4. Filters

(See product sheet for specifications)

Geoflow systems require 120 mesh or 130 micron filtration to keep any oversized upstream contaminants from entering the dripline. Geoflow offers a full range of drip filters, with the tried and true Vortex screen filters for small commercial and residential systems, BioDisc filters with anti bacterial protection, and GeoVac suction cleaning filters for larger commercial and industrial systems.

5. Supply Manifold and Line

This carries the water from the dosing tank to the dispersal area. Rigid PVC schedule 40 is usually used. Schedule 80 is at times used to either avoid dips in the line that can collect water and freeze, or if pressure of at least 20 psi is required to pump water from the dose tank to the dripfield. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated. Refer to the PVC pipe sizing chart in the appendix to determine the best diameter for your application.

6. Return Manifold and Line

In order to help clean the system, the ends of the drip lines are connected together into a common return line, most often made of rigid PVC. This line will help equalize pressures in the system. Flushing should be done frequently during the installation period. Periodic flushing will help to keep the manifolds clean. Many designers use the same size return line as they do the supply line for simplicity, or some down size the return line since return flow is lower than supply. To prevent water from freezing, the pipes should slope back to the pump tank, be buried below frost depth and/or be insulated.

7. Pressure Regulator

(See product sheet for specification)

Pressure regulators fix the inlet pressure at a given rate. Under normal operating conditions, pressure in the drip lines should be 10 psi to 45 psi. With WASTEFLOW Classic it helps to know exactly what the pressure is in the dripline, so system flow can be easily calculated. With all dripline it is prudent to have a pressure regulator to avoid oversized pumps from blowing out fittings.

8. Air Vacuum Breaker

(See product sheet for specification)

Air vacuum breakers are installed at the high points, above dripline and below grade to keep soil from being sucked into the emitters due to back siphoning or backpressure. This is an absolute necessity with underground drip systems. They are also used for proper draining of the supply and return manifolds in sloping conditions. One is used on the high end of the supply manifold and one on the high point of the return manifold. Additional air vents may be required in undulating terrain. Freezing conditions require the air vacuum breaker be protected with insulation.

9. Filter Flush Valves

(See product sheet for specifications)

Used to flush debris from the filter cleanout port back to the pretreatment or dosing tank, this can be an electronically activated solenoid valve or a manual valve. If manual, it should be opened for a full flushing at least every six months and left cracked open slightly to flush continuously. Cracking open a manual valve may be used to increase flow through the system to be within the efficient flow rate of the filter and/or pump, if necessary. Certain States may require automated electronic flushing. Please refer to your State codes.

10. Field Flush Valves

(See product sheet for specifications)

Used to flush out fine particles that have passed through the filter and accumulated on the bottom of the tube at the end of each lateral, the field flush valve can be manual or electronic. If manual, it should be opened for full flushing at least every six months and left cracked open slightly to flush continuously and provide for drainage of the flush line in freezing conditions. Cracking open a manual valve can also be used to; increase the flow through the system to be within the efficient flow rate of the filter and/or pump, or to set system pressure instead of a pressure regulator. Certain States do require automated electronic flushing. Please refer to your State codes.

11. Zone Valves

Used to divide single dispersal fields into multiple zones, these can be hydraulically activated index valves or electrical solenoid valves. Index valves are hydraulically operated, while solenoids use electricity.

12. Wasteflow Headworks

(See product sheet for specifications)

WASTEFLOW Headworks is a pre-assembled unit including the filter, valves and pressure gauge in a box or on a skid. It is installed between the pump and the field. Be sure to insulate the box in freezing climates.

DESIGN PARAMETERS

1. Select area

Select the area with careful consideration of the soil, the terrain and your State and County regulations. Be sure the field is not in a flood plain or bottom of a slope where excessive water may collect after rain. Surface water should be directed away from the proposed field area.

2. Water Quality

Determine the quality of the water entering the system. Is it secondary treated or primary treated? If using primary treated effluent, please refer to Geoflow's article for direct septic. Be aware of water conditions intrinsic to the area. If iron or iron bacteria are prevalent, please be sure to eliminate it upstream of the drip system with ozone, ultraviolet or chemical treatment. Iron can be recognized as orange stain on plumbing fixtures and may be treated prior to entering the facility.

3. Soil Application Design

Note: This section is based on Subsurface Trickle Irrigation System for On-Site Wastewater Disposal And Reuse by B. L. Carlile and A. Sanjines. The basis of the information is from the Texas Health Department regulations. The rules in your County and State may vary.

The instantaneous water application rate of the system must not exceed the water absorption capacity of the soil. A determination of the instantaneous water absorption capacity of the soil is difficult, however, since the value varies with the water content of the soil. As the soil approaches saturation with water, the absorption rate reduces to an equilibrium rate called the "saturated hydraulic conductivity." Wastewater application rates should be less than 10 percent of this saturated equilibrium.

Even though the trickle irrigation system maximizes the soil absorption rate through the low rate of application, thus keeping the soil below saturation, there will be times when the soil is at or near saturation from rainfall events. The design must account for these periods and assume the worst case condition of soil saturation. *By designing for a safety factor of 10 or 12, based on the saturated hydraulic conductivity, the system will be under-loaded most of the time but should function without surface failure during extreme wet periods.*

By applying wastewater slowly for a few hours daily, particularly if applied in "pulses" or short doses several times per day near the soil surface where the soil dries the quickest would keep the soil absorption rate at the highest value and minimize the potential of water surfacing in poor soil conditions.

As stated previously, this design criterion will under-load the system at all times except when the soil is at or near saturation from rainfall. If designing for an efficient irrigation system, the water supply may not be sufficient to meet the demands of a lawn or landscaped area during peak water demand months. This problem can be overcome by either of two solutions: add additional fresh-water make-up to the system during the growing season to supply the needed water for plants in question; or split the system into two or more fields with necessary valves and only use one of the fields during the peak water demand months and alternate the fields during winter months or extremely wet periods, or use both fields simultaneously if the pump capacity will so allow.

Table 1 shows the recommended hydraulic loading rates for various soil conditions, using a safety factor of at least 12 with regard to the equilibrium saturated hydraulic conductivity rate of the soil. These loading rates assume a treated effluent with BOD and TSS values of less than 30 mg/l is produced in the pre-treatment system and that any anomalies such as iron bacteria have been removed prior to dosing.

Table 1.

Minimum Surface Area Guidelines to Dispose of 100 gpd of Secondary Treated Effluent

Soil Class	Soil Type	Soil Absorption Rates		Design Hydraulic Loading Rate (gal / sq. ft. per day)	Total Area Required sq. ft./ 100 gallons per day
		Est. Soil Perc. Rate minutes/in	Hydraulic Conductivity inches/hr		
I	Coarse- sand	<5	>2	1.400	71.5
I	Fine sand	5-10	1.5-2	1.200	83.3
II	Sandy loam	10-20	1.0-1.5	1.000	100.0
II	loam	20-30	0.75-1.0	0.700	143.0
III	Clay loam	30-45	0.5-0.75	0.600	167.0
III	Silt-clay loam	45-60	0.3-0.5	0.400	250.0
IV	Clay non-swell	60-90	0.2-0.3	0.200	500.0
IV	Clay - swell	90-120	0.1-0.2	0.100	1000.0
IV	Poor clay	>120	<0.1	0.075	1334.0

Dispersal field area calculation:
Total square feet area of dispersal field = Design flow divided by loading rate

NOTES:

1) The above chart is provided as a guide only. States and Counties may have regulations that are different. Check your State guidelines and consult with your local health department.
2) Problems with drip dispersal fields occur when soils are misinterpreted. If in doubt, choose the more restrictive soil type from the table above.
3) "Soil type" should be based on the most restrictive layer within two feet of the dripline. In many soils 1-ft. vertical separation from the limiting layer has proven successful with secondary treated effluent. Geoflow recommends you follow State and Local guidelines.
4) Table 1 above, with only minor modifications over the years, has served us well since 1990 with tens of thousands of systems operating successfully based upon this data. However, thanks to work by Jerry Tyler and his associates at the University of Wisconsin-Madison soil structure has become better understood and can now be used as a comprehensive tool to determine optimal hydraulic loading rates as seen in Table 2.

Table 2

Drip Loading Rates Considering Soil Structure.

Table 2 is taken from the State of Wisconsin code and was prepared by Jerry Tyler.

Soil Textures	Soil Structure	Maximum Monthly Average BOD_5<30mg/L TSS<30mg/L (gallons/ft²/day)
Course sand or coarser	N/A	1.6
Loamy coarse sand	N/A	1.4
Sand	N/A	1.2
Loamy sand	Weak to strong	1.2
Loamy sand	Massive	0.7
Fine sand	Moderate to strong	0.9
Fine sand	Massive or weak	0.6
Loamy fine sand	Moderate to strong	0.9
Loamy fine sand	Massive or weak	0.6
Very fine sand	N/A	0.6
Loamy very fine sand	N/A	0.6
Sandy loam	Moderate to strong	0.9
Sandy loam	Weak, weak platy	0.6
Sandy loam	Massive	0.5
Loam	Moderate to strong	0.8
Loam	Weak, weak platy	0.6
Loam	Massive	0.5
Silt loam	Moderate to strong	0.8
Silt loam	Weak, weak platy	0.3
Silt loam	Massive	0.2
Sandy clay loam	Moderate to strong	0.6
Sandy clay loam	Weak, weak platy	0.3
Sandy clay loam	Massive	0.0
Clay loam	Moderate to strong	0.6
Clay loam	Weak, weak platy	0.3
Clay loam	Massive	0.0
Silty clay loam	Moderate to strong	0.6
Silty clay loam	Weak, weak platy	0.3
Silty clay loam	Massive	0.0
Sandy clay	Moderate to strong	0.3
Sandy clay	Massive to weak	0.0
Clay	Moderate to strong	0.3
Clay	Massive to weak	0.0
Silty clay	Moderate to strong	0.3
Silty clay	Massive to weak	0.0

4. Depth and Spacing

WASTEFLOW systems usually have emitter lines placed on 2 foot (600 mm) centers with a 2 foot emitter spacing such that each emitter supplies a 4 sq. ft (0.36 m^2) area. These lines are best placed at depths of 6-10 inches (150 - 250 mm) below the surface. This is a typical design for systems in sandy and loamy soils with a cover crop of lawn grass. Closer line and/or emitter spacing of 12 inches is used on heavy clay soils or very coarse sands where lateral movement of water is restricted. Using closer spacing should not reduce the size of the field.

5. Soil Layers and Types

The shallow depth of installation is an advantage of the subsurface dripfield since the topsoil or surface soil is generally the most biologically active and permeable soil for accepting effluent. The topsoil also dries the fastest after a rainfall event and will maintain the highest water absorption rate. The quality and homogeneity of the soil may present a problem. If the soil was not properly prepared and there are pieces of construction debris, rocks and non-uniform soils, it is very difficult to obtain uniform water spread. In many cases, particularly if the soil is compacted, soil properties can be greatly improved by ripping and disking.

6. Adding Fill to the Dispersal Field

Some dispersal sites require additional soil be brought in for agronomic reasons or to increase separation distances from the restrictive layer. Restrictive layers stop or greatly reduce the rate of downward water movement, as a result surfacing may occur during part of the year. In soils with high water tables treatment is minimized due to a lack of oxygen.

Placing drip lines in selected fill material above the natural soil provides an aerated zone for treatment. Dispersal however still occurs in the natural soil and the field size must be based on the hydraulic capability of the natural soil to prevent hydraulic overload.

Any time fill material is to be used, the area to receive the fill should have all surface grasses and other organic material removed or it must be incorporated into the natural soil to prevent an organic layer from forming and restricting downward water movement. Removal must be performed under dry conditions. Divert surface and subsurface water prior to adding fill.

Soils to be used should be determined by a soils expert. Uniform soil material with good structure should be chosen. Avoid platy or massive materials with no structure. Do not use topsoil.

The fill material should be applied in shallow layers with the first 4 to 6 inches incorporated into the natural soil to prevent an abrupt textural interface. Placement of fill should be uniform so preferential bypass flows do not occur. Soil should not be compacted. Continue this process until all fill has been incorporated.

The fill area should be left crowned to shed surface water and may need diversion ditches or some other devices to prevent surface water from infiltrating. The entire fill area should have a vegetative cover to prevent erosion. If possible, allow the fill to set at least seven to ten days before installing Wasteflow dripline.

It is generally agreed that fill should not be used on slopes greater than 20% unless means for controlling erosion, such as netting, are used. Consult a soils engineer on a case by case basis.

7. Slopes or Hilly Sites

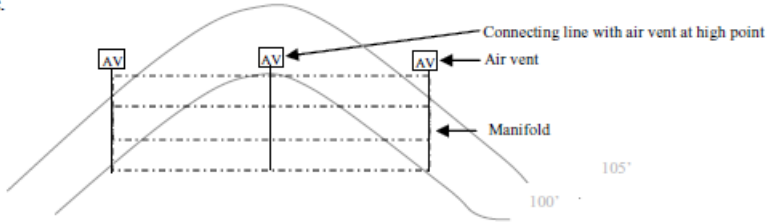
a.) High Points and siphoning

A potential problem with buried drip lines is siphoning dirt into the emitters when the pump is switched off. For this reason:

i) At least one vacuum breaker should be installed at the highest point in each zone. It is best practice to install one at the high point of the supply and one at the high point of the return manifold.

ii) Drip lines should be connected at the end to a common return line with a flush valve.

iii) Run dripline along a contour if at all possible. Avoid installing lines along rolling hills where you have high and low points more than 3 ft. off contour along the same line. If the dripline is installed over a ridge, as shown below, connect all the high points together and install a vacuum breaker on the connecting line.



b.) Dripline Pressure Tolerances

As water travels through a manifold or uphill, pressure decreases, or conversely, if water moves downhill pressure increases, which can affect the flow variation between the first dripline and the last dripline on the manifold.

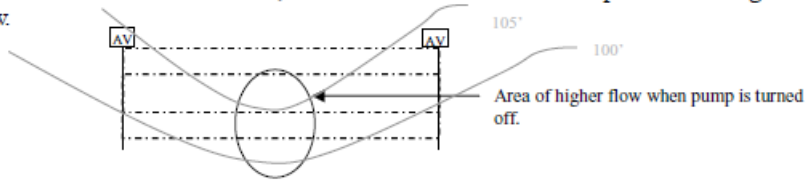
WASTEFLOW Classic: The Classic dripline can be operated in a range of 10 to 45 psi, however too wide a variance in the pressure in a single field will result in too high a variance in flow within that field. As a rule of thumb, if the level variation within a WASTEFLOW Classic zone exceeds six feet, individual pressure regulators should be placed for each six-foot interval.

WASTEFLOW PC: PC dripline can tolerate very large height variations provided the pressure remains within the 7 to 60 psi range, and preferably within 10 to 45 psi.

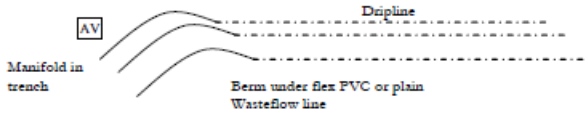
c.) Low Head Drainage

At the end of each dosing cycle, consideration must be taken for gravity. Where is the water going to drain when the pump shuts off? Water in the dripline will flow down to the lowest point within the drip zone. This is called "lowhead drainage." Use the following precautions to mitigate lowhead drainage.

i. The dripline should run along the contour if at all possible because water will run to the lowest point of the line every time the pump is turned off. If the lowest point in the line is in the middle of the lateral, there will be excess flow at this point. See Diagram below.



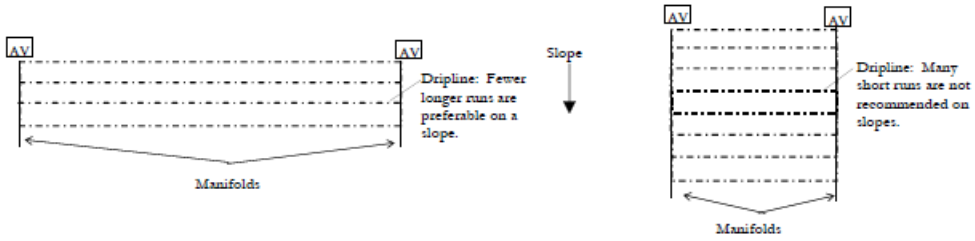
ii Have the dripline pass over an elevated berm between the manifold and beginning of the tubing to reduce gravity flow out of the lateral. In looped systems, elevating the loop will keep the effluent in its respective run.



iii. Use check valves or multiple zones to isolate the drip laterals. Check valves should only be used if there is no risk of freezing in the manifolds. They are placed on the supply and return manifolds coupled with an airvent on the downhill side. If unsure, as a rule of thumb, use a maximum of 1500 ft of Geoflow dripline within each zone or section.

iv. Install short manifolds with fewer longer dripline runs.

v. Slope the supply and return manifolds down to the pump tank so the effluent drains back down to the tank when the pump is turned off. Open the zone valves fully to drain the lines quickly.



Concentrate drip lines at the top of the hill with wider spacing towards the bottom. In the case of compound slopes consult a professional irrigation designer or engineer.

8. Multiple Zones

Drip dispersal fields can be divided into multiple zones or sections with solenoid valves or index valves for the following reasons:

a.) Steep slopes with a risk of lowhead drainage can be subdivided to distribute the water at system shut-down more uniformly in the field.

b.) Smaller zones reduce the required flow per minute which consequently reduces the size of the pump ,valves filters, supply and return lines.

c.) Subdividing the field is a tool used to achieve the optimum ranges required to efficiently operate the pumps, filters and valves.

d.) If the dispersal field is located in multiple areas on the property.

e.) To accommodate varying soils or vegetation on a single site.

Note. On multiple zones, a single Wasteflow Headworks can be used for filtration and flushing by placing zone valves downstream of the Headworks box. All zones would require a check valve on the individual flush lines upstream of each line joining a common flush line to keep flush water from one zone entering any other zone during the flush cycle. (See Geoflow Design Detail No. 588)

If the effluent has not been through secondary treatment, then each zone should have a dedicated filter or Wasteflow Headworks.

9. Winterization

Buried drip systems are not prone to frost damage because, in their design, vacuum release and drain valves are provided. The dripline itself is made of polyethylene and not susceptible to freezing. It drains through the emitters so it will not be full of water after pumps are turned off. Please follow these precautions:

a.) Manifolds, supply lines and return lines must be sloped back to their respective dosing or treatment tanks or buried below frost depth and or insulated. These lines need to drain rapidly. Be sure drain valve on flush line remains open long enough for entire field to drain.
b.) Remove the check valve at the pump.
c.) Insulate equipment boxes, including Headworks box or filter and field flush valve boxes as well as zone dosing valves, pressure regulator and air vacuum relief valves. Use closed-cell insulation such as Perlite in a plastic bag. Place metal pins near, or in, the boxes to help locate them when under snow.
d.) In severe freezing conditions, use heat tape or small heater in the Headworks box.
e.) When installing PVC supply and return lines and manifolds be sure there are no dips in the lines. This can be avoided by using large diameter pipes (over 2") or by using schedule 80 pipe.
f.) The top of air vacuum relief valves must be no higher than soil surface.
g.) If using an index valve to split field zones, be sure it is capable of self-draining.
h.) WASTEFLOW lines will self-drain through the emitters into the soil. If the cover crop over the dripfield is not yet adequately established, add hay or straw over the field for insulation.
i.) Mark the valve box with a metal pin so you can find it in the winter when covered in snow.
j.) If using manual filter flush valves or manual field flush valves, they should be left cracked open slightly to provide for rapid drainage of the flush line in freezing conditions.
k.) Fields dosed with relatively small quantities of effluent are more likely to freeze than those dosed with design quantities. If winter use is less than summer use, then only use proportional number of fields to maintain water application rates in the field being dosed.

10. Lightning Protection

A direct lightning strike on your valve, controller or wire is going to cause unpreventable damage. It is difficult to completely prevent electricity from spreading as it jumps across air, runs along electrical wires and may even travel along your water pipes. Power fluctuations can be prevented. The controllers are built to take some electrical surge and pass it through to the ground without damage. This requires a ground wire connected to a grounding stake driven deep into the ground. The best protection would be to use a separate ground wire or rod, do not rely on the third ground wire in the building's electrical wiring circuits. If you are installing this system in an area with frequent lightning storms, we advise you to install a separate grounding rod. Each field controller must have at least one eight foot copper clad steel ground rod 5/8" in diameter, driven all the way into the ground, as close as possible to the controller. This is to be connected to the grounding lug on the back-plate of the panel. If the rod can't be driven in all the way, cut if off and drive in the remaining piece 2-3' from the other rod and connect the rods together with 6 AWG solid copper wire. Follow local electrical codes. Inputs to the controller are more sensitive than outputs, so Geoflow offers a metal oxide varistor that protects the incoming power. It includes a metal strip for the controller power and relays for the floats. If hit, the metal or the relays are merely replaced. These are wired into the Geo controller.

11. Reuse for Irrigation

A good vegetative cover is an advantage to prevent erosion from the field and utilize water applied to the rooting zone. Sites should be planted or seeded immediately after installation. Grasses are particularly suitable for this application. Most lawn grasses will use 0.25" to 0.35" (6.3-8.9mm) of water per day during the peak growing season. This calculates to be about 0.16 to 0.22 gal/ft^2/day. By over-seeding lawns with winter ryegrass, this use efficiency can be continued through much of the year. For vegetation using 0.16 to 0.22 gal/ft^2/day by evapotranspiration, a sewage flow of 1000 gallons per day would supply the water needs of a landscaped area of 4600 to 6400 sq. ft. without having to add fresh water. For areas larger than this, the plants will suffer water stress during the hot months unless additional fresh water is applied.

12. Water Application Formula

To determine the rate of application for various drip irrigation designs, use the following formula:

Water application (inches per hour) = (231 × (emitter flow rate gph)) / ((Emitter spacing inches) × (dripline spacing inches))

Example: Dripline with 1.3 gph flow rate emitters spaced 24" apart and dripline spaced 24" apart.

Water application = (231×1.3)/(24×24) = 0.52 inches of water per hour.

WORKSHEET:

The following worksheet is a simplistic guideline and is available as an Excel spreadsheet. It can be downloaded from Geoflow's homepage at www.geoflow.com. If you would like a copy sent to you at no charge, phone 800-828-3388.

To calculate the area required for your drip dispersal system you must know:

1. the quantity of effluent to be disposed of (in gallons per day) and
2. the soil acceptance rate (i.e. gallons per day per square foot).

Make a sketch of the dispersal area with contour lines.

WORKSHEET 1 - DISPERSAL FIELD DESIGN FOR SINGLE ZONE SYSTEM

Worksheet Dispersal Field	Formula
A. Quantity of effluent to be dispersed per day _____ *gpd*	
B. Soil type or hydraulic loading rate _____ *loading rate (gal/sq. ft./day)*	*Based on soil analysis* *Refer to State or Local regulations. If none, refer to Table 1 and 2 on page 9 & 10*
C. Determine the total area required _____ *square ft*	*Divide gpd by loading rate.* *A/B*
D. Choose the spacing between each WASTEFLOW line and each WASTEFLOW emitter *i)*_____ *ft. between WASTEFLOW lines* *ii)*_____ *ft. between WASTEFLOW emitters*	*Standard spacing is 2 ft.*
E. How many linear feet of dripline in the total area?_____ *ft.*	*(Area / 2) for 2ft. line spacing.* *C/2.0 or* *(Area / 1) for 1 ft. line spacing..* *C/1.0 or* *(Area / 1.5) for 1.5ft line spacing.* *C/1.5*
F. Calculate the number of emitters _____ *emitters*	*(Linear ft. of dripline / 2) for 2 ft emitter spacing.* *E/2 or* *(Linear ft. of dripline / 1) for 1 ft emitter spacing.* *E/1 or* *(Linear ft. of dripline /1.5) for 1.5 ft emitter spacing* *E/1.5*

Worksheet Dispersal Field	Formula
G. Choose pressure compensating or Classic dripline _____ *WASTEFLOW Classic dripline or* _____ *WASTEFLOW PC ½ gph dripline* _____ *WASTEFLOW PC 1 gph dripline*	*See page 4 and Appendix 1 for details*
H. Determine dripfield pressure _____ *psi*	*Standard pressure is 20 psi.* *WASTEFLOW Classic systems need between 15 and 45 psi (34.7 and 104 ft.) at the start of the dripfield.* *WASTEFLOW PC systems need between 10 and 45 psi (23.1 ft. to 104 ft.) at the start of the dripfield.*
I. Determine feet of head required at dripfield _____ *ft. of head*	*Multiply pressure by 2.31 to get head required.* *H x 2.31*
J. What is the flow rate per emitter? _____ gph / emitter	*See WASTEFLOW flow rates in Appendix 1.*
K. Determine total flow for the area _____ *gph* _____ *gpm*	*Number of emitters multiplied by the emitter flow rate at the design pressure.* *Gph = No of emitters (F) x gph per emitter (J)* *Gpm = gph/60*
L. Select pipe diameters for manifolds and submains _____inches	*Based on total flow from (K) above, in gpm. See schedule 40 friction loss charts at the back of the appendixes. Optimum velocity is between 2 and 5 ft. per second.*
M. Select Filter or WASTEFLOW Headworks _____ Filter _____ WASTEFLOW Headworks	*Based on total flow from (K) above, in gpm. See minimum and maximum flow recommendations for each filter in Appendix 2.*
N. Sketch a layout of the WASTEFLOW lines in the dispersal plot to make sure that the maximum lateral length of each WASTEFLOW line is not exceeded.	*See Maximum Length of Run table in Appendix 1.*

Worksheet 2 - Select Pump

Worksheet - Pumps		Formula
O. Minimum pump capacity	_____ gpm	*From (K)*
P. Header pipe size	_____ inches	*From (L)*
Q. Pressure loss in 100 ft. of pipe	_____ psi	*Refer to PVC charts.*
R. Friction head in 100 ft. of pipe	_____ ft. of head	*Multiply psi from (Q) above by 2.31*
S. Static head		
i) Height from pump to tank outlet	_____ft.	*Number of ft.*
ii) Elevation increase or decrease	_____ft.	*Height changes from pump to dripfield*
T. Total static head	_____ft.	*Add (Si) + (Sii)*
U. Friction head		
i) Equivalent length of fittings	_____ft.	*Estimate loss through fittings – usually inconsequential for small systems.*
ii) Distance from pump to field. X 2	_____ft.	*Measure length of sub-main supply & return*
iii) Total equivalent length of pipe.	_____ft.	*Add (Ui) + (Uii)*
iv) Total effective feet.	_____ft.	*(Uii)/ 100 x (R)*
v) Head required at dripfield	_____ft.	*See line (I) in Worksheet 1 above.*
vi) Head loss through filter or Headworks	_____ft.	*See pressure loss for filters in Appendix or see pressure loss for Headworks box in Appendix Multiply pressure by 2.31 to get head loss.*
vii) Head loss through zone valves	_____ft	
V. MINIMUM Total friction head	_____ft	*Add (Uiv) + (Uv) + (Uvi) + (Uvii)*
W. MINIMUM Total Dynamic Head	_____ft.	*Add (T) + (V)From line item (O) above*
X. MINIMUM pump capacity NOTE: Some States and Counties require additional flow for flushing. Please check your local regulations. If you need help on flushing design, see Geoflow's flushing worksheet at www.geoflow.com or call Geoflow at 800-828-3388.	_____gpm	
Y. Choose the pump. ____ model number _____ Manufacturer	_____ _____	*Based on pressure from line (W) above and flow from line (X) above.*

SYSTEM INSTALLATION

1. Installation Guidelines

All Geoflow drip systems require:

- Filtration with 120 mesh/130 micron
- Filter flush valve
- Field flush valve
- 2 Air vents in each zone
- All Wasteflow Classic drip systems require pressure regulation

Handle your dripline and components with care. nano-ROOTGUARD® is temperature sensitive. To assure a long life, store the dripline out of direct sunlight in a cool place.

a) All dripfield construction shall be done in accordance with Local rules and regulations.

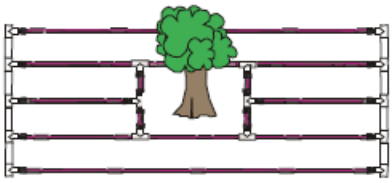
b) Protect the site prior to installation. Construction traffic and material stockpiling can change the soil profile. Fence off entire dripfield prior to any construction. No utilities, cable wire, drain tile, etc shall be located in dripfield.

c) System is not to be installed when ground is wet or frozen. When the moisture in the soil is near the plastic limit (soils will ribbon and not easily crumble), it will be prone to smearing.

d) Prior to construction note if any water is accessing the location of the dripfield. Dripfield should not be located at the low point of a site. Divert all downspouts and surface waters away from dripfield. If a curtain drain is to be used be sure it is serviceable and properly screened.

e) Excavation, filling and grading should have been finished prior to installation of the subsurface drip system. Be sure to minimize soil disturbance when clearing and grubbing the dripfield. Preserve as many trees as possible. Use light track equipment for tree removal and grind out roots to below dripline depth rather than fully removing the entire root.

f) Be sure you have everything required for the installation before opening trenches. Pre-assemble as many sets of components as practical above ground and in a comfortable place. Compression or Lockslip adapters should be glued to PVC tees, riser units should be pre-assembled, and the sub-main manifold with tees can be pre-assembled and used to mark the beginning and end of WASTEFLOW lines.



Loop dripline around trees

g) For particularly tough soil conditions, soil moisture the day before opening trenches or installing WASTEFLOW. Remember it is much easier to install the system in moist soil. The soil should be moist but still allow the proper operation of the installation equipment and not cause smearing in the trenches. The soil surface should be dry so that the installation equipment maintains traction.

h) Mark the four corners of the field. The top two corners should be at the same elevation and the bottom two corners should be at a lower elevation. In freezing conditions the bottom dripline must be higher than the supply and return line elevation at the dosing tank.

i) Install the dosing tank. It is critical that the tank is waterproof. If installing a riser, check that it is watertight, and the entry and exit ports are completely sealed. In freezing conditions the dosing tank should be at the lowest elevation of the entire system. Lid should be placed at grade and water should be able to shed over it.

j) Install zone valves; solenoid or hydraulic index valves.

k) Install the PVC supply line from the dosing tank, up hill through one lower and one upper corner stake of the dispersal field. Please refer to your State guidelines for depth of burial.

l) Paint a line between the two remaining corner stakes.

m) Install the Geoflow WASTEFLOW dripline from the supply line trench to the painted line, approximately 6" to 10" deep as specified. Upon reaching the painted line, pull the plow out of the ground and cut the dripline 1' above the ground. Tape the end of the dripline to prevent debris from entering. The tubing expands in warm temperatures and contracts in cold temperatures. If installing during the warmer months, be sure to allow some play in the tubing so it will not pull out of the fittings when it gets cold. Continue this process until the required footage of pipe is installed. Geoflow dripline must be spaced according to specification (2 ft. is standard). Depth of burial of dripline must be consistent throughout the field. Take care not to get dirt into the lines.

n) If the system is looped, install the looped ends with Geoflow plain tubing or flex PVC. If in a cold climate be sure to pitch these slightly so they do not hold water and freeze. The loops are to be installed on the outside of the measured field.

o) Install the supply header with tees lined up at each Geoflow line. Hook up the Geoflow lines to the supply header. Do not glue WASTEFLOW dripline.

Lockslip Fittings Installations

i. Hold the fitting in one hand and position the tubing with the other hand.
ii. Move the sleeve back, and push the tubing onto the exposed stem as far as possible.
iii. Push the sleeve out over the tubing and thread the sleeve onto tubing, as though tightening a nut to a bolt. Hand tighten. Do not use tools.
iv. Test the connection to make sure the sleeve threads have gripped the tubing tightly.

p) Install the filter headworks between the field and the pump tank on the supply line. Insulate the box in freezing conditions. When using an open bottom headworks box, place a rodent barrier down first. This can be made from bricks, paving stones, chicken wire, 3 layers of filter fabric or a 6" minimum depth of 1" gravel. Support the pipes entering and exiting the headworks with gravel.

q) If using a pressure regulator, install it downstream of the filter headworks, just ahead of the dispersal field, on the supply line. Although the pressure regulator can be buried directly into the soil, it is preferable to install it inside a small valve box for easy access. *Insulate the box in freezing conditions.

r) Install the floats in the dosing tank and wire up to the timer control. The timer control should be set to pump no more than the design flow, do not set to match the treatment capacity.

s) Install the pump. Fill the dosing tank with fresh water and turn on the pump. Check for flow out the ends of all of the Geoflow lines. Let the pump run for about five minutes to flush out any dirt. Shut off the pump and tape the ends of the lines.

t) Dig the return header ditch along the line painted on the ground and back to the pre-treatment tank. Start the return header at the farthest end from the dosing tank. The return line must have slope back to the treatment tank, septic tank or pump tank.

u) Install the return header and connect all of the Geoflow lines. Care must be taken not to kink the dripline.

v) Install air vacuum breakers at the highest points in the dispersal field. Use pipe dope or Teflon tape and hand tighten. Use a 6" minimum depth of 1" gravel below the boxes to keep rodents out. Insulate in freezing climates.

w) Install a ball or solenoid field flush valve on the return line to the pretreatment or pump tank unless a pre-assembled Wasteflow Headworks is being used. If a Headworks was installed on the supply line, connect the return line back through the Headworks box. Support the return pipe before it enters the Headworks with gravel. If using electric solenoid valves, connect the valve common and an individual output wire to the solenoid leads using watertight electrical connectors.

x) Allow glue fittings 1 – 2 hours to set. Open the field flush valve and turn on the pump to flush lines then close the valve and check the field and all piping and connections for leaks. Turn off the system

y) Check filters and valves for construction debris.

z) Turn on the pump and check:

i. Pressure at the air vacuum breaker(s) against design pressure. Check the pressure in the **Wasteflow Headworks.** It should be five PSI or higher. If pressure gauges are on each side of the filter, noter these for benchmark differential pressure across the filter. If using a manual valve for field flushing, crack it open until at least on PSI is lost or design pressure is reached and leave in that position.

ii. Flow rates from flow meter or draw down on tank. Compare to design flow.

iii. Wet spots in the field. If any sections are particularly wet, determine if they are caused by faulty connections, drippers or shallow burial.

iv. Check that solenoid valves are functioning. Close the internal manual bleed after flushing the system. If solenoid will not close, first clean the solenoid with caution not to lose small spring, and if this fails, open the bonnet and clean the inside.

aa) Establish vegetation cover as specified.

bb) Provide owner with final as-built diagrams flow measurements and pressure readings at startup.

cc) Provide controller records at startup, including elapsed time meter, pump counts, secondary override counts, highwater counts and primary float counts.

dd) Solenoid Valve Installation and Operation

i. Wrap male adapters with 2 wraps of Teflon tape and thread the adapters into the valve inlet and outlet 1 turn past hand tight. CAUTION: over tightening may cause damage to the valve. The solenoid is located on the downstream side of the valve.

ii. Flush the laterals by opening the internal manual bleed lever on the downstream side of the solenoid. Turn the flow control stem fully open (counterclockwise) for flow control models.

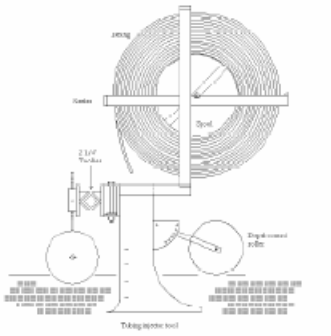
iii. Check that solenoid valves are functioning.

Table 3. Subsurface Drip Installation Methods

NOTE: Disturbing the soil may affect the pore structure of the soil and create hydraulic conductivity problems. Please consult with your soil scientist or professional engineer before making the installation technique decision.

INSTALLATION METHOD *	ADVANTAGES	DISADVANTAGES
a) Hand Trenching*	• Handles severe slopes and confined areas • Uniform depth	• Slow • Labor intensive • Disrupts existing turf and ground • Back fill required
b) Oscillating or vibrating plow . Use the type that inserts the dripline directly in place, not one that pulls the dripline through the soil.	• Fast in small to medium installations • Minimal ground disturbance • No need to back fill the trench	• Depth has to be monitored closely • Cannot be used on steeper slopes(>20%) • Requires practice to set and operate adequately • Tends to "stretch" pipe. Shorter runs are required
c) Trenching machine: Ground Hog, Kwik-Trench, E-Z Trench*	• Faster than hand trenching • May use the 1" blade for most installations • Uniform depth	• Slower, requires labor • Disrupts surface of existing turf • Back fill required
d) Tractor with dripline insertion tool - see diagram 2.	• Fast • Little damage to existing turf because of the turf knife • Minimal ground disturbance • Does not stretch drip line • Adaptable to any tractor	• The installation tool is designed specifically for this purpose.
e)Tractor mounted 3-point hitch insertion implement	• Fastest. Up to four plow attachments with reels • A packer roller dumps back soil on top of the pipe	• Suitable for large installations only

* Installation methods are left to the discretion of the contractor and/or the engineer. Other installation methods may be used as long as care is taken to protect the tubing and the soil.



Diag. 2 Installation Tool

Worksheet 3 - As Built System Description

1. Site name: _____
2. Site address including State: _____
3. Dripfield designed by: _____
4. Dripfield installed by: _____
5. Date of installation: _____
6. Daily design flow: _____ gpd.
7. Soil percolation rate: _____
8. Is there secondary treatment on this job site? _____Yes _____No

   If "Yes" to question 8 above, please name manufacturer and model number:_____
9. Number of zones in dripfield: _____ If more than 1 zone, circle the valve used Hydraulic or Solenoid
10. Amount of dripline installed in each zone:

    Zone 1_____ ft. Zone 2_____ ft. Zone 3_____ ft. Zone 4_____ ft.
11. Wasteflow dripline model number &/or description: _____
12. Flow rate per zone:

    Zone 1_____ gpm. Zone 2_____ gpm. Zone 3_____ gpm. Zone 4_____ gpm.
13. Depth dripline installed below grade: _____ inches
14. Pump manufacturer, model number and number of pumps:_____
15. Filter or Headworks model number &/or description:_____
16. Pressure in each zone:

    Zone 1_____ psi Location pressure measured:_____

    Zone 2_____ psi Location pressure measured:_____

    Zone 3_____ psi Location pressure measured:_____

    Zone 4_____ psi Location pressure measured:_____
17. Size of filter flush valve: _____ inches. Is the filter flush valve manual or automatic? _____
18. Size of field flush valve: _____ inches. Is the field flush valve manual or automatic?_____

If more than 1 zone, do the zones (a) share 1 flush valve or (b) does each zone have its own flush valve?

19. Was any fill material supplied on the dripfield? _____

If "yes" to 18 above describe fill quality and quantity added. _____ _____
_____

20. Please provide owner with as-built drawings, including but not limited to direction of drip lines, location of air vents, pressure regulators if applicable, Headworks (filter and valves) and pump tank.
21. Startup Controller readings:

    ETM____ Pump ct.____ Secondary timer ct.____ High alarm ct.____ Primary ct.____
22. Note how long it takes to drain return line in freezing climates, and set controller

SYSTEM MAINTENANCE

The best way to assure years of trouble free life from your system is to continuously monitor the system and to perform regular maintenance functions. For large systems or systems with a BOD > 30 mg/l automation of maintenance is essential. For smaller systems with a BOD < 30 mg/l inspection and maintenance should be performed every six months.

Routine and Preventative Maintenance

1) Clean the filter cartridge. This may be done with a pressure hose. The screen filter cartridge should be cleaned from the outside inwards, while the discs in the disc filter cartridge should be separated and then cleaned. If bacteria buildup is a problem, we advise first trying lye, and if the problem persists, soak the filter cartridge in a chlorine bath - a mixture of 50% bleach and 50% water.
2) Open the field flush valve and flush the field for 3-5 minutes by activating the pump in "manual" position. Close the flush valve. On automatic solenoid valves the manual bleed lever should always be in the closed position and the dial on top should be free spinning. This allows it to open when pulsed electrically. Clockwise rotation closes valve.
3) With the pump in the "manual" position, check the pressure in the drip field by using a pressure gauge on the schrader valve located on the air vents and by reading the pressure gauge located in the Wasteflow Headworks box. The pressure should be the same as shown on the initial installation records. On systems with manual flush valves, close the field flush valve completely and then open the valve slightly until there is a 1-2 psi drop or design pressure is reached. This will allow the field to drain after each dose to prevent the manifold lines from freezing.
4) Remove the lids on the vacuum breaker and check for proper operation. If water is seen leaking from the top of the vacuum breaker, remove the cap of the vacuum breaker and press down on the ball to allow any debris to be flushed out. Be careful not to come in contact with the effluent.
5) Turn off the pump and reset the controller for auto mode.
6) Periodically remove and clean the air vents, field flush and filter flush valves.
7) Visually check and report the condition of the drip field, including any noticeable wetness.
8) Treatment and distribution tanks are to be inspected routinely and maintained when necessary in accordance with their approvals.
9) Record the elapsed time meter, pump counter, override counter, high-level alarm and power failures. This information can be obtained from the controller.

Home Owners Guide For Care and Maintenance of Geoflow Drip Dispersal Field

A drip dispersal system has been installed on your property for the subsurface dispersal of the effluent from your home.

The drip dispersal system consists of a series of ½" diameter drip tubing installed at a shallow depth of 6-10" below the ground surface. It is designed to effectively disperse the treated effluent in the ground with a combination of soil absorption and plant uptake. Your drip dispersal system will function for many years with only minimal maintenance being required, provided the following recommendations are followed:

- Establish landscaping (preferably a grass cover) immediately. This will stabilize the soil and allow for the grass to take up the water.
- Do not discharge sump pumps, footing drains or other sources of clear water to the system, except for the effluent discharge from your treatment system.
- Maintain all plumbing fixtures to prevent excess water from entering the dispersal system.
- Do not drive cars, trucks or other heavy equipment over the drip dispersal field. This can damage the drip components or the soil and cause the system to malfunction. Lawn mowers, rubber wheeled garden tractors and light equipment can be driven over the drip field.
- Do not drive tent stakes, golf putting holes, croquet hoops etc., into the dispersal field.
- Contact your service company if your high water alarm should sound. The pump chamber is sized to allow additional storage after the high water alarm sounds but you should refrain from excessive water usage (i.e., laundry) until the system has been checked.
- After a temporary shut down due to a vacation or other reason, the treatment plant ahead of the drip field filter initially may not function effectively, resulting in the filter blocking.Refer to maintenance guidelines above to clean the filter.

  Contact your service company if you notice any areas of excessive wetness in the field. In most cases, this is usually caused by a loose fitting or a nicked dripline and can be easily repaired. Note: There may be some initial wetness over the dripline following the system's installation. This should cease once the ground has settled and a grass cover is established.

Site Inspection Sheet

Site Address _____ **Date**_____

Site observations

1. Is dripfield located at the lowest point in the site where all waters may pond?
2. Is there any water coming in from neighbors? Downspouts? Irrigation?
3. Construction debris anywhere near the site, or compaction from construction or other causes?
4. How wet is the field before digging?
5. Will effluent drain back to tank in freezing climates? If not, is equipment insulated from freezing?

Pump tank

1. Watertight?
2. At grade. Allow surface water to run off.
3. Inlet and outlet lines to be laid in gravel or compacted soils.
4. Float tree designed for easy removal for service and adjustment.
5. Float settings correct to design?
6. Pump set a few inches up from the bottom of the tank.
7. Waterproof wire nuts used to wire pump junction box.

Headworks - Filter and flush valves

1. Waterproof wire nuts used in wiring solenoid valves.
2. Is filter large enough to handle flow? Is it appropriate for the treatment unit?
3. Clean filter and valves after construction.
4. Check filter everytime system is serviced, and clean filter element.
5. Clean valves if they do not close properly. See if different valves have different toggles.
6. Insulate in freezing climates.
7. Have minimum of 1/2ft depth of 1" gravel under the Headworks for drainage and to keep gophers out.
8. Check pressure - across filter (if available).
9. Check pressure - on return line pressure should be as designed. Lower than 5 psi may be too low.

Zone valves

1. Index valves - Requires 10 gpm min. flow, needs to self drain in freezing climate.
2. Solenoids - Clean after installation if they do not close properly.

Supply and return lines

1. Make sure they are supported going into and out of the Headworks.
2. No dips.
3. Make sure water from dripline does not flow back into supply and return trenches.

Dripline

1. On contour.
2. Burial depth.
3. Check for kinking and local undulations (low areas) in installed driplines.
4. Flush lines during construction.
5. Is there ponding on surface?
6. Cover crop over field?

Airvents

1. Point of pressure measurement.
2. Insulate in freezing climates.
3. Make sure they are not in a position for surface or subsurface water to enter the system.
4. Check pressure at airvents. Should be as designed. Less than 7psi may be too low..

Return to?

1. Pump tank? Don't churn the tank on return.
2. Pretreatment? Can the equipment handle the additional flow.

Controller

1. Check field programmable settings against design.
2. Proper wiring of controller….wire floats and valves.
3. Keep moisture from running up wire into controller.

Notes

1. Use sheet for "As built" in Design Guidelines.
2. Keep a record of start-up pressures and system data screens.

Comments:

Trouble Shooting Guide:

Symptom: High water alarm activates periodically (1-2 times/week). During other times the water level in the pump chamber is at a normal level.

Possible cause: Peak water usage (frequently laundry day) is causing a temporary high water condition to occur.

Remedy: Set timer to activate the pump more frequently. Be sure to not exceed the total design flow. To avoid this, reduce the duration of each dose.

Remedy: Provide a larger pump tank to accommodate the peak flow periods.

Symptom: High water alarm activates during or shortly after periods of heavy rainfall.

Possible cause: Infiltration of ground/surface water into system.

Remedy: Identify sources of infiltration, such as tank seams, pipe connections, risers, etc. Repair as required.

Symptom: High water alarm activates intermittently, including times when it is not raining or when laundry is not being done.

Possible cause: A toilet or other plumbing fixture may be leaking sporadically but not continuously. Check water meter readings for 1-2 weeks to determine if water usage is unusually high for the number of occupants and their lifestyle. Also determine if water usage is within design range.

Remedy: Identify and repair fixture.

Symptom: High water alarm activates continuously on a new installation (less than 3 months of operation). Inspection of the filter indicates it is plugged with a gray colored growth. Water usage is normal. being done.

Possible cause: Slow start-up of treatment plant resulting in the presence of nutrient in the effluent sufficient to cause a biological growth on the filter. This is typical of lightly loaded treatment plants that receive a high percentage of gray water (i.e., from showers and laundry),

Remedy: Remove and clean filter cartridge in a bleach solution. Add a gallon of household bleach to pump tank to oxidize organics. Contact treatment plant manufacturer for advice on speeding up the treatment process possibly by "seeding" the plant with fresh activated sludge from another treatment plant.

Symptom: Water surfaces continuously at one or more isolated spots, each one foot or more in diameter.

Possible cause: Damaged drip line or a loose connection is allowing water be discharged under pressure and therefore at a much greater volume than intended.

Remedy: Dig up drip line. Activate pump and locate leak. Repair as required.

Possible cause: If water is at base of slope, can be caused by low-head drainage.

Remedy: Install check valves and airvents in the manifolds to redistribute water in the system after pump is turned off. This is not advised for freezing climates where manifold drainage is required.

Symptom: A portion of the drip field closest to the feed manifold is saturated while the rest of the field is dry.

Possible cause: Insufficient pump pressure. A pressure check at the return manifold indicates pressure of less than 10 psi.

Remedy: Check filter and pump intake to insure they are not plugged. If they are, clean as require.

Remedy: Leaks in the system may be resulting in loss of pressure. Check for water leaks in connections and fittings or wet spots in the field. Also check air vents to insure they are closing properly. Repair as necessary.

Remedy: Pump is worn or improperly sized. Pressure at feed manifold in less than 15 psi. Verify pressure requirements of system and provide a new or larger pump. As an alternate approach, the drip field may need to be divided into two or more zones.

Possible cause: The duration of each dose is of insufficient length to allow the drip field to become pressurized before the pump shuts off (or runs for only a brief time before turning off).

Remedy: Increase the pump run time and decrease the frequency of doses. Always calculate (or observe during field operation) how long the system takes to fully pressurize and add this time to the design dosing duration.

Symptom: High water alarm begins to activate continuously after a long period (1-2 years) of normal operation. Inspection of the filter indicates it is plugged with a heavy accumulation of sludge.

Possible cause: A buildup of solids in the pump tank due to carryover from the treatment plant.

Remedy: Replace the filter cartridge with a clean cartridge. Check the pump tank and if an accumulation of solids is noted, pump the solids out of the pump tank. Also, check the operation of the treatment plant to insure it is operating properly.

Symptom: Water surfaces at several spots in drip field during dosing periods. Installation is recent, less than 6 months of usage and the soil is a moderate to heavy clay. Possibly, the installation was completed using a non-vibratory plow.

Possible cause: Smearing of the soil may have occurred during installation of drip line. Also, the "cut" resulting from the installation allows an easy path for the water to surface during dosing.

Remedy: In most cases the sod will compact naturally around the drip line and the surfacing will diminish and ultimately cease. To help, reduce the duration of each dose and increase the number of doses/day. Also, it will help to seed the area to encourage the development of a good root zone.

Symptom: Entire area of drip field is wet, soft and spongy. It appears to be totally saturated with water. Situation occurs during dry season when there is little rainfall.

Possible cause: Water being discharged to drip field exceeds design. Excess water may be a result of infiltration, plumbing leaks or excessive water usage.

Remedy: Check water meter, elapsed time meter, pump counter, override counter or high level alarm counter to determine if water usage is in excess of design. Check for leaks or infiltration. Repair leaks as required. Reduce water usage by installing water saving fixture.

Remedy: If water usage cannot be reduced, enlarge drip field as required.

Possible cause: Area of drip field was inadequately sized and is too small.

Remedy: Provide additional soil analysis to verify sizing and enlarge as required.

Valve Troubleshooting

Symptom: Valve will not open manually

Check water supply and any possible master or gate valves to insure they are open.
Check that the valve is installed with the arrow pointing in the downstream direction
Check that the flow control is fully open, counterclockwise.
Turn off the water supply. Remove the solenoid and check for debris blocking the exhaust port.
Turn off the water supply. Remove the cover. Inspect the diaphragm for damage and replace if necessary.

Symptom: Valve will not open electrically

Check voltage at controller for 24 VAC station.
Check voltage across the solenoid lead wires for minimum 21 VAC.
Make sure handle on top of valve is free spinning. Not all the way open or all the way closed.
If the valve still does not operate, electrically replace the solenoid.

Symptom: Valve will not close

Insure the manual bleed lever is in the closed position.
Check for leaks around the flow control, solenoid or between valve cover and body.
Turn off the water supply. Remove the solenoid and check for debris or damage to the exhaust port.
Turn off the water supply. Remove valve cover and inspect for debris under diaphragm or debris in diaphragm ports.

Symptom: Slow leak

Check for dirt or gravel embedded in the diaphragm seat.
Check actuator and exhaust fitting for proper seating.

Appendix B

Capital Construction and Operations & Maintenance Cost Estimates

APPENDIX B
CAPITAL CONSTRUCTION COSTS, AND OPERATIONS AND MAINTENANCE COSTS

This Appendix contains the information on Capital Construction Costs, as well as the Annual Operations and Maintenance Costs that were used for cost estimation and for completing the Economic Feasibility Analysis. Separate spreadsheets are provided for each Alternative, including the initial construction costs, annual operations costs, and a sinking fund cost for fixed asset replacement. The following assumptions were used in developing the cost estimates:

CAPITAL CONSTRUCTION COST ESTIMATE ASSUMPTIONS

1. Mobilization and Site Protection. Costs estimated to be 4 to 5% of total construction. Includes ordering supplies and materials, getting all building supplies, materials and equipment to job site, and environmental protection and permit requirement compliance, such as tree protection and lake protection.

2. Survey, Stake out, Layout. This includes layout and field stake out of all improvements to avoid trees, and comply with plan requirements.

3. Site Work. This includes clear and grub, limited tree removal and trimming, minor earthwork and grading for roads, trails, parking and building pads, miscellaneous landscaping and fencing, and preparation and implementation of a SWPPP and erosion control plan.

4. Roads, Trails, and Parking Areas. This includes minor improvements, such as pullouts, to the main access road from Knoxville Road to the existing parking area and Camp Host site (already improved and graveled), relocation and improvements to the main access road from the parking area west to the proposed kiosk, and installation of the primary trail, secondary and interpretive paths, and parking area. Road surfacing will use 3 inches of 3/8-inch-minus blue shale gravel. Costs are estimated for road surface improvements consisting of grading, out-sloping and drainage, scarification and re-compaction of the subsoil, and gravel surfacing, at $2.50 per sq. ft.

5. Water Supply. Based on review of drillers log, field sounding of well, and discussions with several Napa County well drillers and well and pump companies who have information on project site. The working assumption is that a new 250' deep well will need to be drilled and completed near the existing well, with a pump, pressure tank, water treatment system, and large storage tank(s) of 5,000 to 7,000 gallon capacity. Depending on the results of the well drilling, (low yield) potentially a new, second well could be installed on the north side of the site, north of the perimeter access road, that would draw from a different local fractured rock aquifer system.

   The water supply system also includes installation of 4,000 l.f. of 1" water lines, and the installation of roof rainwater runoff capture system. A simple rain barrel system is assumed for the Storage and Office building area (all Alternatives), and a more elaborate commercial vendor system (Orinco or equivalent), for the central facilities in Alternatives C and D.

6. Wastewater Treatment and Disposal System. Costs for the Wastewater Treatment System were developed based on the Preliminary Engineering Report for the facility (Appendix A). The facility includes a large septic tank and overflow reservoir for special event storage, a small sand filter treatment system, and a subsurface drip disposal system contained within a low landscape mound. The wastewater system will also require controllers and a pump system for delivery of the wastewater to the subsurface disposal

system. Shallow monitoring wells will also be required to be installed to verify that the system is working correctly.

The assumption is that when the on-site wastewater disposal system is completed, it would be more cost effective to build a larger capacity system that meets the needs of all Alternatives, including Alternatives C and D, allowing growth of the facility. However, it would be possible to reduce initial capital costs about 25% to as much as 35% if the initial wastewater system was initially sized and constructed for just Alternatives A and B, and expanded in the future to cover build-out under Alternatives C and D.

7. Electrical and Energy System. The existing electrical system consists of a single phase service to a residential service meter, and a separate well pump meter. This will need to be updated and improved to accommodate the service demands of an institutional or commercial facility, with new over-head lines and panel, and a greater upgrade warranted for Alternatives C and D. The assumptions used in sizing and costing the system are described in the main body of the Study Report. Solar power and solar hot water heaters are included with the shade shelters for tent cabins in Alternatives B, C, and D.

   An on-site solar power system is also included in the cost estimate, including solar panels on the host site and storage building for all Alternatives, as well as on the central facilities for Alternatives C and D.

8. Minor Buildings and Structures Minor buildings and structures are primarily the small tent cabins and wood-sided cabins in Alternatives B, C, and D, composting toilets and shade shelters (all Alternatives) and restroom/shower facilities, with larger facilities planned for Alternatives C and D. Most of the minor structures are pre-engineered and can be erected on site. The tent cabins and wood sided cabins are located on hill slopes and will therefore have an elevated wood deck and small porch. The basis for the costs of shade shelters and associated amenities are included in the main body of the Study Report.

   Costs for minor buildings were based on discussions with manufacturer's representatives and review of on-line information.

9. Recreational and Outdoor Educational Amenities. Recreational areas proposed in the Master Plan and shown in the Cost Estimate include: a beach volleyball area, horseshoe pits, bocce ball courts, a remote archery range, and a rock climbing area, in addition to hiking trails and interpretive trails. Water sports include a swimming area with buoy line to separate the area from boaters on the lake, swimming platforms, and a kayak and canoe launch, with a suggested 12 kayaks and 8 canoes for rental.

10. Major Buildings and Structures. The major buildings and structures in this line item for Alternatives C and D include a central facility with kitchen, indoor dining area that can be used as a meeting room and classroom or museum, an outdoor trellised patio eating area. Also included in the major buildings category are small wood (KOA style) cabins, larger dorm cabins, and a large restroom and shower.

    The central facility is assumed to be custom designed by an architect, although some pre-engineered structures are available that might meet the needs of the facility. Costs of the 4,000-sq.-ft. facility were estimated at $120.00/sq. ft.

    The dorm cabins and small individual or family-style cabins can also be either pre-engineered, or custom designed and built on site. The cost estimate is based on pre-engineered structures built on elevated wood decking on sloping ground. Electricity is provided to the buildings, but not plumbing.

    The pre-engineered large restroom facility would be fully plumbed and connected to the wastewater facility. Costs are based on two four-stall restrooms, with six separated individual shower rooms at the back of the building per price quote from several pre-engineering manufacturers.

11. Interior Furnishings and Miscellaneous Equipment. This line covers furnishing the kitchen with commercial grade appliances, and the dining hall, outdoor dining area, and dorm rooms and cabins with tables and chairs, bunk beds and beds, etc. for Alternatives C and D Also included is a line item for cookware and dinner ware, towels, linens, etc., as appropriate for Alternatives C and D.

12. Miscellaneous One-Time Startup Costs. This part of the cost estimate covers one-time start up costs for such items as a) website design, stationary and camp brochures, b) initial costs of recreational sports equipment, c) furnishing a small office, d) purchasing tools, and cleaning and maintenance supplies, e) a small electric golf cart style utility vehicle with platform bed for all Alternatives (Cunningham or equivalent). A small hybrid pickup truck is included for Alternatives C and D only.

    The cost assumption also includes purchase of off the shelf materials, or consultant costs for development of some initial interpretive natural history/sustainability information.

CAPITAL CONSTRUCTION COST ESTIMATE - ALTERNATIVE A - RUSTIC

Item No.	Item Description	Est. Qty.	Unit	Unit Cost	Total (rounded to $100)
1	Mobilization & Site Protection (Approx. 5% of Total)	1	LS	$ 65,700.00	$65,700
2	Survey, Stakeout, & Layout (Allow)	1	LS	$ 10,000.00	$10,000
3	Site Work				
3a	Clear and Grub; Tree Removal; Demolition	1	LS	$ 8,000.00	$8,000
3b	Earthwork and Grading (roads, paths, building sites)	1	LS	$ 22,000.00	$22,000
3c	Miscellaneous Landscaping/Fencing	1	LS	$ 5,000.00	$5,000
3d	SWPPP and Erosion Control (Allow)	1	LS	$ 12,000.00	$12,000
				Item 3 Subtotal	$47,000
4	Roads, Trails, and Parking Areas				
4a	Entry Road Improvements (to Parking Area) (Allow)	1	LS	$ 10,000.00	$10,000
4b	Access Road (West of Parking to Kiosk)	13,200	SF	$ 1.75	$23,100
4c	Primary Trail, 3" of 3/8" Blue Shale	25,600	SF	$ 1.75	$44,800
4d	Secondary Path, Compacted Earth	12,200	SF	$ 0.75	$9,200
4e	Parking Area, 3" of 3/8" Blue Shale	15,000	SF	$ 1.75	$26,300
4f	Interpretive Trail, 3" of 3/8" Blue Shale,	3,200	LF	$ 1.75	$5,600
				Item 4 Subtotal	$119,000
5	Water Supply				
5a	Re-drill 250' Well; Casing; Pump; Storage Tank & Pressure System/Water Filter	1	LS	$ 40,000.00	$40,000
5b	Water Lines	4,000	LF	$ 4.00	$16,000
5c	Roof Runoff Capture System (Storage Office)	1	LS	$ 500.00	$500
				Item 5 Subtotal	$56,500
6	Wastewater Treatment & Disposal System				
6a	Delivery Piping and Septic Tanks	1	LS	$ 30,000.00	$30,000
6b	Storage Tanks	1	LS	$ 25,000.00	$25,000
6c	Treatment System	1	LS	$ 40,000.00	$40,000
6d	Pump & Dosing System/Controls	1	LS	$ 20,000.00	$20,000
6e	Fill Import & Placement	1	LS	$ 25,000.00	$25,000
6f	Drip System, including Tubing & Installation	1	LS	$ 30,000.00	$30,000
				Item 6 Subtotal	$170,000
7	Electrical and Energy System				
7a	Upgrade Main Service to Site, Including New Panel	1	LS	$ 20,000.00	$20,000
7b	Solar Panels (5kW, Host Site, Storage Bldg.)	1	LS	$ 5,000.00	$5,000
7c	Exterior Lighting	1	LS	$ 7,000.00	$7,000
7d	Wind Turbine Generator, 1 kW, 60' Tower	1	LS	$ 5,000.00	$5,000
				Item 7 Subtotal	$37,000
8	Minor Buildings and Structures				
8a	Improved Tent Camp Sites (graded platform)	48	EA	$ 1,000.00	$48,000
8b	Tent Cabin (12'x14', includes deck/platform)	*N/A*	*N/A*	*N/A*	*N/A*
8c	Shade Shelters (16'x20', concrete pad, utility sink, 2 tables & BBQ)	14	EA	$ 24,000.00	$336,000
8d	Host Site (12'x40', shade shelter, pad, hook-up)	1	EA	$ 25,000.00	$25,000
8e	Toilet (Vault) - Summer/Movable	2	EA	$ 2,500.00	$5,000
8f	Toilet (Compost)	2	EA	$ 35,000.00	$70,000
8g	Restrooms (Conventional Toilets/Showers)	1	EA	$ 157,000.00	$157,000
8h	Rinse-off Station (Allow)	2	EA	$ 2,000.00	$4,000
8i	Entry Sign at Knoxville Rd.; Kiosk	1	EA	$ 3,000.00	$3,000
8j	Amphitheatre	1	EA	$ 8,000.00	$8,000
8k	Storage/Office Building (pre-engineered 20' x 30' barn structure)	1	LS	$ 35,000.00	$35,000
8l	Activity Center	1	EA	$ 10,000.00	$10,000
8m	Day Use Area (picnic facilities/BBQ group, water)	1	LS	$ 25,000.00	$25,000
8n	Compost Facility (Host Site and Day Use Area) (Allow)	1	LS	$ 500.00	$500
				Item 8 Subtotal	$726,500
9	Recreational & Outdoor Educational Amenities				
9a	Bocce Ball, Horseshoe Courts, Beach Volleyball	1	LS	$ 15,000.00	$15,000
9b	Canoes, kayaks, life jackets, paddles	20	EA	$ 900.00	$18,000
9c	Archery Range	1	LS	$ 4,500.00	$4,500
9d	Ropes Course	1	LS	$ 7,000.00	$7,000
9e	Floating Dock/Kayak Launch	1	LS	$ 9,000.00	$9,000
9f	Boat Ramp Improvements	1	LS	$ 5,000.00	$5,000
9g	Buoy Line/Swim Area	4,000	LF	$ 3.00	$12,000
9h	Swim Platforms	3	EA	$ 3,500.00	$10,500
9i	Interpretive Trail Signage (Allow)	1	LS	$ 10,000.00	$10,000
9j	Miscellaneous Site Furniture (benches, etc.) (Allow)	1	LS	$ 10,000.00	$10,000
9k	Fish Cleaning Station	1	EA	$ 2,500.00	$2,500
				Item 9 Subtotal	$103,500
10	Major Buildings and Structures				
10a	Wood Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10b	Dorm Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10c	Kitchen/Laundry/Cafeteria Building/Museum/Office	*N/A*	*N/A*	*N/A*	*N/A*
10d	Outdoor Dining Area with Trellis	*N/A*	*N/A*	*N/A*	*N/A*
10e	Large Restroom/Shower	*N/A*	*N/A*	*N/A*	*N/A*
				Item 10 Subtotal	$0
11	Interior Furnishings and Miscellaneous Equipment				
11a	Kitchen Appliances - Commercial Range/Oven, Dishwasher, Refrigerator	*N/A*	*N/A*	*N/A*	*N/A*
11b	Laundry Appliances - Commercial Washer/Dryer	*N/A*	*N/A*	*N/A*	*N/A*
11c	Dining Area Furniture (interior) - Table and 10-Chair Set	*N/A*	*N/A*	*N/A*	*N/A*
11d	Dining Area Furniture (exterior) - Table and 4-Chair Set	*N/A*	*N/A*	*N/A*	*N/A*
11e	Beds, Bunk Beds, etc.	*N/A*	*N/A*	*N/A*	*N/A*
11f	Kitchen, Tableware, Linens, etc. (seating 40-60 each) (Allow)	*N/A*	*N/A*	*N/A*	*N/A*
				Item 11 Subtotal	$0
12	Miscellaneous One-Time Startup Costs				
12a	Website Design, Brochure, Stationary, Program Info.	1	LS	$ 11,500.00	$11,500
12b	Office (computer, copier/printer, phone/fax, desk)	1	LS	$ 6,000.00	$6,000
12c	Cleaning and Maintenance Supplies and Equipment	1	LS	$ 1,000.00	$1,000
12d	Small Utility Vehicle (electric)	1	LS	$ 7,000.00	$7,000
12e	Sustainability/Environmental Education Material	1	LS	$ 5,000.00	$5,000
12f	Reservation System Development	1	EA	$ 13,000.00	$13,000
				Item 12 Subtotal	$43,500
				SUBTOTAL	$1,378,700
				20% Contingency	
				PLANNING, DESIGN, & PERMITTING	
				20% Architecture/Engineering Design and Inspection	$275,700
				5% Environmental Review and Permitting	$68,900
				TOTAL PRELIMINARY PROJECT COST	$1,723,300

CAPITAL CONSTRUCTION COST ESTIMATE - ALTERNATIVE B - ENHANCED RUSTIC

Item No.	Item Description	Est. Qty.	Unit	Unit Cost	Total (rounded to $100)
1	Mobilization & Site Protection (Approx. 5% of Total)	1	LS	$ 88,700.00	$88,700
2	Survey, Stakeout, & Layout (Allow)	1	LS	$ 12,000.00	$12,000
3	Site Work				
3a	Clear and Grub; Tree Removal; Demolition	1	LS	$ 10,000.00	$10,000
3b	Earthwork and Grading (roads, paths, building sites)	1	LS	$ 25,000.00	$25,000
3c	Miscellaneous Landscaping/Fencing	1	LS	$ 5,000.00	$5,000
3d	SWPPP and Erosion Control (Allow)	1	LS	$ 12,000.00	$12,000
				Item 3 Subtotal	$52,000
4	Roads, Trails, and Parking Areas				
4a	Entry Road Improvements (to Parking Area) (Allow)	1	LS	$ 10,000.00	$10,000
4b	Access Road (West of Parking to Kiosk)	13,200	SF	$ 1.75	$23,100
4c	Primary Trail, 3" of 3/8" Blue Shale	25,600	SF	$ 1.75	$44,800
4d	Secondary Path, Compacted Earth	12,200	SF	$ 0.75	$9,200
4e	Parking Area, 3" of 3/8" Blue Shale	15,000	SF	$ 1.75	$26,300
4f	Interpretive Trail, 3" of 3/8" Blue Shale	3,200	LF	$ 1.75	$5,600
				Item 4 Subtotal	$119,000
5	Water Supply				
5a	Re-drill 250' Well; Casing; Pump; Storage Tank & Pressure System/Water Filter	1	LS	$ 40,000.00	$40,000
5b	Water Lines	4,000	LF	$ 4.00	$16,000
5c	Roof Runoff Capture System (Storage and Office)	1	LS	$ 500.00	$500
				Item 5 Subtotal	$56,500
6	Wastewater Treatment & Disposal System				
6a	Delivery Piping and Septic Tanks	1	LS	$ 30,000.00	$30,000
6b	Storage Tanks	1	LS	$ 25,000.00	$25,000
6c	Treatment System	1	LS	$ 40,000.00	$40,000
6d	Pump & Dosing System/Controls	1	LS	$ 20,000.00	$20,000
6e	Fill Import & Placement	1	LS	$ 25,000.00	$25,000
6f	Drip System, including Tubing & Installation	1	LS	$ 30,000.00	$30,000
				Item 6 Subtotal	$170,000
7	Electrical and Energy System				
7a	Upgrade Main Service to Site, Including New Panel	1	LS	$ 20,000.00	$20,000
7b	Solar Panels (26kW - Host Site, Day Use Area, Shade Shelters)	1	LS	$ 103,000.00	$103,000
7c	Exterior Lighting	1	LS	$ 10,000.00	$10,000
7d	Wind Turbine Generator, 1 kW, 25' Tower	1	LS	$ 5,000.00	$5,000
				Item 7 Subtotal	$138,000
8	Minor Buildings and Structures				
8a	Improved Tent Camp Sites (graded platform)	*N/A*	*N/A*	*N/A*	*N/A*
8b	Camping Cabin wood/canvas upper sides; 12'x14', includes electrical, deck/platform	28	EA	$ 16,000.00	$448,000
8c	Shade Shelters (16'x20', concrete pad, utility sink, 2 tables & BBQ)	16	EA	$ 18,000.00	$288,000
8d	Host Site (12'x40', shade shelter, pad, hook-up)	1	EA	$ 25,000.00	$25,000
8e	Toilet (Vault) - Summer/Movable	2	EA	$ 2,500.00	$5,000
8f	Toilet (Compost)	2	EA	$ 35,000.00	$70,000
8g	Restrooms (Conventional Toilets/Showers)	1	EA	$ 157,000.00	$157,000
8h	Rinse-off Station (Allow)	2	EA	$ 2,000.00	$4,000
8i	Entry Sign at Knoxville Rd.; Kiosk	1	EA	$ 3,000.00	$3,000
8j	Amphitheatre	1	EA	$ 8,000.00	$8,000
8k	Storage/Office Building (pre-engineered 20' x 30' barn structure)	1	LS	$ 35,000.00	$35,000
8l	Activity Center	1	EA	$ 10,000.00	$10,000
8m	Day Use Area (picnic facilities/BBQ group, water)	1	LS	$ 25,000.00	$25,000
8n	Compost Facility (Host Site and Day Use Area) (Allow)	1	LS	$ 500.00	$500
				Item 8 Subtotal	$1,078,500
9	Recreational & Outdoor Educational Amenities				
9a	Bocce Ball, Horseshoe Courts, Beach Volleyball	1	LS	$ 15,000.00	$15,000
9b	Canoes, kayaks, life jackets, paddles	20	EA	$ 900.00	$18,000
9c	Archery Range	1	LS	$ 4,500.00	$4,500
9d	Ropes Course	1	LS	$ 7,000.00	$7,000
9e	Floating Dock/Kayak Launch	1	LS	$ 9,000.00	$9,000
9f	Boat Ramp Improvements	1	LS	$ 5,000.00	$5,000
9g	Buoy Line/Swim Area	4,000	LF	$ 3.00	$12,000
9h	Swim Platforms	3	EA	$ 3,500.00	$10,500
9i	Interpretive Trail Signage (Allow)	1	LS	$ 10,000.00	$10,000
9j	Miscellaneous Site Furniture (benches, etc.) (Allow)	1	LS	$ 10,000.00	$10,000
9k	Fish Cleaning Station	1	EA	$ 2,500.00	$2,500
				Item 9 Subtotal	$103,500
10	Major Buildings and Structures				
10a	Wood Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10b	Dorm Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10c	Kitchen/Laundry/Cafeteria Building/Museum/Office	*N/A*	*N/A*	*N/A*	*N/A*
10d	Outdoor Dining Area with Trellis	*N/A*	*N/A*	*N/A*	*N/A*
10e	Large Restroom/Shower	*N/A*	*N/A*	*N/A*	*N/A*
				Item 10 Subtotal	$0
11	Interior Furnishings and Miscellaneous Equipment				
11a	Kitchen Appliances - Commercial Range/Oven, Dishwasher, Refrigerator	*N/A*	*N/A*	*N/A*	*N/A*
11b	Laundry Appliances - Commercial Washer/Dryer	*N/A*	*N/A*	*N/A*	*N/A*
11c	Dining Area Furniture (interior) - Table and 10-Chair Set	*N/A*	*N/A*	*N/A*	*N/A*
11d	Dining Area Furniture (exterior) - Table and 4-Chair Set	*N/A*	*N/A*	*N/A*	*N/A*
11e	Beds, Bunk Beds, etc.	*N/A*	*N/A*	*N/A*	*N/A*
11f	Kitchen, Tableware, Linens, etc. (seating 40-60 each) (Allow)	*N/A*	*N/A*	*N/A*	*N/A*
				Item 11 Subtotal	$0
12	Miscellaneous One-Time Startup Costs				
12a	Website Design, Brochure, Stationary, Program Info.	1	LS	$ 11,500.00	$11,500
12b	Office (computer, copier/printer, phone/fax, desk)	1	LS	$ 6,000.00	$6,000
12c	Cleaning and Maintenance Supplies and Equipment	1	LS	$ 1,000.00	$1,000
12d	Small Utility Vehicle (electric)	1	LS	$ 7,000.00	$7,000
12e	Sustainability/Environmental Education Material	1	LS	$ 5,000.00	$5,000
12f	Reservation Sytstem Development	1	EA	$ 13,000.00	$13,000
				Item 12 Subtotal	$43,500
				SUBTOTAL	$1,861,700
				20% Contingency	$372,300
				PLANNING, DESIGN, & PERMITTING	
				20% Architecture/Engineering Design and Inspection	$372,300
				5% Environmental Review and Permitting	$93,100
				TOTAL PRELIMINARY PROJECT COST	$2,699,400

CAPITAL CONSTRUCTION COST ESTIMATE - ALTERNATIVE C - ENHANCED RUSTIC/CENTRAL FACILITIES

Item No.	Item Description	Est. Qty.	Unit	Unit Cost	Total (rounded to $100)
1	Mobilization & Site Protection (Approx. 5% of Total)	1	LS	$ 128,200.00	$128,200
2	Survey, Stakeout, & Layout (Allow)	1	LS	$ 16,000.00	$16,000
3	Site Work				
3a	Clear and Grub; Tree Removal; Demolition	1	LS	$ 10,000.00	$10,000
3b	Earthwork and Grading (roads, paths, building sites)	1	LS	$ 30,000.00	$30,000
3c	Miscellaneous Landscaping/Fencing	1	LS	$ 10,000.00	$5,000
3d	SWPPP and Erosion Control (Allow)	1	LS	$ 20,000.00	$20,000
				Item 3 Subtotal	$65,000
4	Roads, Trails, and Parking Areas				
4a	Entry Road Improvements (to Parking Area) (Allow)	1	LS	$ 20,000.00	$20,000
4b	Access Road (West of Parking to Kiosk)	13,200	SF	$ 1.75	$23,100
4c	Primary Trail, 3" of 3/8" Blue Shale	25,600	SF	$ 1.75	$44,800
4d	Secondary Path, Compacted Earth	12,200	SF	$ 0.75	$9,200
4e	Parking Area, 3" of 3/8" Blue Shale	15,000	SF	$ 1.75	$26,300
4f	Interpretive Trail, 3/8" Blue Shale	3,200	LF	$ 1.75	$5,600
				Item 4 Subtotal	$129,000
5	Water Supply				
5a	Re-drill 250' Well; Casing; Pump; Storage Tank & Pressure System/Water Filter	1	LS	$ 40,000.00	$40,000
5b	Water Lines	4,000	LF	$ 4.00	$16,000
5c	Roof Runoff Capture System (Storage &Office)	1	LS	$ 2,000.00	$2,000
				Item 5 Subtotal	$58,000
6	Wastewater Treatment & Disposal System				
6a	Delivery Piping and Septic Tanks	1	LS	$ 30,000.00	$30,000
6b	Storage Tanks	1	LS	$ 25,000.00	$25,000
6c	Treatment System	1	LS	$ 40,000.00	$40,000
6d	Pump & Dosing System/Controls	1	LS	$ 20,000.00	$20,000
6e	Fill Import & Placement	1	LS	$ 25,000.00	$25,000
6f	Drip System, including Tubing & Installation	1	LS	$ 30,000.00	$30,000
				Item 6 Subtotal	$170,000
7	Electrical and Energy System				
7a	Upgrade Main Service to Site, Including New Panel	1	LS	$ 20,000.00	$20,000
7b	Solar Panels (26kW - Host Site, Storage Building, Central Facilities, Shade Shelters)	1	LS	$ 191,000.00	$191,000
7c	Exterior Lighting	1	LS	$ 10,000.00	$10,000
7d	Wind Turbine Generator, 2 kW, 60' Tower	1	LS	$ 7,000.00	$7,000
				Item 7 Subtotal	$228,000
8	Minor Buildings and Structures				
8a	Improved Tent Camp Sites (graded platform)	*N/A*	*N/A*	*N/A*	*N/A*
8b	Tent Cabin - Wood/Canvas (12'x14', includes deck/platform)	28	EA	$ 16,000.00	$448,000
8c	Shade Shelters (16'x20', concrete pad, utility sink, 2 tables & BBQ)	16	EA	$ 28,000.00	$448,000
8d	Host Site (12'x40', shade shelter, pad, hook-up)	1	EA	$ 25,000.00	$25,000
8e	Toilet (Vault) - Summer/Movable	2	EA	$ 2,500.00	$5,000
8f	Toilet (Compost)	2	EA	$ 35,000.00	$70,000
8g	Restrooms (Conventional Toilets/Showers-see 10e)	*N/A*	*N/A*	*N/A*	*N/A*
8h	Rinse-off Station (Allow)	2	EA	$ 2,000.00	$4,000
8i	Entry Sign at Knoxville Rd.; Kiosk	1	EA	$ 5,000.00	$5,000
8j	Amphitheatre	1	EA	$ 8,000.00	$8,000
8k	Storage/Office Building (pre-engineered 20' x 30' barn structure)	1	LS	$ 35,000.00	$35,000
8l	Activity Center	1	EA	$ 25,000.00	$25,000
8m	Day Use Area (picnic facilities/BBQ group, water)	1	LS	$ 25,000.00	$25,000
8n	Compost Facility (Host Site and Day Use Area) (Allow)	1	LS	$ 2,000.00	$2,000
				Item 8 Subtotal	$1,100,000
9	Recreational & Outdoor Educational Amenities				
9a	Bocce Ball, Horseshoe Courts, Beach Volleyball	1	LS	$ 15,000.00	$15,000
9b	Canoes, kayaks, life jackets, paddles, etc.	20	EA	$ 900.00	$18,000
9c	Archery Range	1	LS	$ 4,500.00	$4,500
9d	Ropes Course	1	LS	$ 7,000.00	$7,000
9e	Floating Dock/Kayak Launch	1	LS	$ 9,000.00	$9,000
9f	Boat Ramp Improvements	1	LS	$ 5,000.00	$5,000
9g	Buoy Line/Swim Area	4,000	LF	$ 3.00	$12,000
9h	Swim Platforms	3	EA	$ 3,500.00	$10,500
9i	Interpretive Trail Signage (Allow)	1	LS	$ 15,000.00	$15,000
9j	Miscellaneous Site Furniture (benches, etc.) (Allow)	1	LS	$ 15,000.00	$15,000
9k	Fish Cleaning Station	1	EA	$ 2,500.00	$2,500
				Item 9 Subtotal	$113,500
10	Major Buildings and Structures				
10a	Wood Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10b	Dorm Cabins	*N/A*	*N/A*	*N/A*	*N/A*
10c	Kitchen/Laundry/Cafeteria Building/Museum/Office	4,000	SF	$ 120.00	$480,000
10d	Outdoor Dining Area with Trellis	1	LS	$ 60,000.00	$60,000
10e	Large Restroom/Shower	*N/A*	*N/A*	*N/A*	*N/A*
				Item 10 Subtotal	$540,000
11	Interior Furnishings and Miscellaneous Equipment				
11a	Kitchen Appliances - Commercial Range/Oven, Dishwasher, Refrigerator	1	LS	$ 30,000.00	$30,000
11b	Laundry Appliances - Commercial Washer/Dryer	1	LS	$ 3,000.00	$3,000
11c	Dining Area Furniture (interior) - Table and 10-Chair Set	6	EA	$ 3,000.00	$18,000
11d	Dining Area Furniture (exterior) - Table and 4-Chair Set	10	EA	$ 900.00	$9,000
11e	Beds, Bunk Beds, etc.	60	EA	$ 500.00	$30,000
11f	Kitchen, Tableware, Linens, etc. (seating 40-60 each) (Allow)	1	LS	$ 10,000.00	$10,000
				Item 11 Subtotal	$100,000
12	Miscellaneous One-Time Startup Costs				
12a	Website Design, Brochure, Stationary, Program Info.	1	LS	$ 11,500.00	$11,500
12b	Office (computer, copier/printer, phone/fax, desk)	1	LS	$ 6,000.00	$6,000
12c	Cleaning and Maintenance Supplies and Equipment	1	LS	$ 1,500.00	$1,500
12d	Small Utility Vehicle (electric)	1	LS	$ 7,000.00	$7,000
12e	Sustainability/Environmental Education Material	1	LS	$ 5,000.00	$5,000
12f	Reservation System Development	1	EA	$ 13,000.00	$13,000
				Item 12 Subtotal	$44,000
				SUBTOTAL	$2,691,700
				20% Contingency	$538,300
				PLANNING, DESIGN, & PERMITTING	
				20% Architecture/Engineering Design and Inspection	$538,300
				5% Environmental Review and Permitting	$134,600
				TOTAL PRELIMINARY PROJECT COST	$3,902,900

CAPITAL CONSTRUCTION COST ESTIMATE - ALTERNATIVE D - ENHANCED RUSTIC/CENTRAL FACILITIES & SERVICES

Item No.	Item Description	Est. Qty.	Unit	Unit Cost	Total (rounded to $100)
1	Mobilization & Site Protection (Approx. 5% of Total)	1	LS	$ 135,000.00	$135,000
2	Survey, Stakeout, & Layout (Allow)	1	LS	$ 19,000.00	$19,000
3	Site Work				
3a	Clear and Grub; Tree Removal; Demolition	1	LS	$ 10,000.00	$10,000
3b	Earthwork and Grading (roads, paths, building sites)	1	LS	$ 35,000.00	$35,000
3c	Miscellaneous Landscaping/Fencing	1	LS	$ 10,000.00	$10,000
3d	SWPPP and Erosion Control (Allow)	1	LS	$ 20,000.00	$20,000
				Item 3 Subtotal	$75,000
4	Roads, Trails, and Parking Areas				
4a	Entry Road Improvements (to Parking Area) (Allow)	1	LS	$ 10,000.00	$10,000
4b	Access Road (West of Parking to Kiosk)	13,200	SF	$ 1.75	$23,100
4c	Primary Trail, 3" of 3/8" Blue Shale	25,600	SF	$ 1.75	$44,800
4d	Secondary Path, Compacted Earth	12,200	SF	$ 0.75	$9,200
4e	Parking Area, 3" of 3/8" Blue Shale	15,000	SF	$ 1.75	$26,300
4f	Interpretive Trail, 3/8" of Blue Shale	3,200	LF	$ 1.75	$5,600
				Item 4 Subtotal	$119,000
5	Water Supply				
5a	Re-drill 250' Well; Casing; Pump; Storage Tank & Pressure System/Water Filter	1	LS	$ 40,000.00	$40,000
5b	Water Lines	4,000	LF	$ 4.00	$16,000
5c	Roof Runoff Capture System (Storage Office)	1	LS	$ 8,000.00	$8,000
				Item 5 Subtotal	$64,000
6	Wastewater Treatment & Disposal System				
6a	Delivery Piping and Septic Tanks	1	LS	$ 30,000.00	$30,000
6b	Storage Tanks	1	LS	$ 25,000.00	$25,000
6c	Treatment System	1	LS	$ 40,000.00	$40,000
6d	Pump & Dosing System/Controls	1	LS	$ 20,000.00	$20,000
6e	Fill Import & Placement	1	LS	$ 25,000.00	$25,000
6f	Drip System, including Tubing & Installation	1	LS	$ 30,000.00	$30,000
				Item 6 Subtotal	$170,000
7	Electrical and Energy System				
7a	Upgrade Main Service to Site, Including New Panel	1	LS	$ 20,000.00	$20,000
7b	Solar Panels (26kW - Host Site, Storage Building, Central Facilities, Shade Shelters)	1	LS	$ 191,000.00	$191,000
7c	Install Exterior Lighting	1	LS	$ 12,000.00	$12,000
7d	Wind Turbine Generator, 2 kW, 60' Tower	1	LS	$ 15,000.00	$15,000
				Item 7 Subtotal	$238,000
8	Minor Buildings and Structures				
8a	Improved Tent Camp Sites (graded platform)	*N/A*	*N/A*	*N/A*	*N/A*
8b	Tent Cabin (12'x14', includes deck/platform)	16	EA	$ 16,000.00	$256,000
8c	Shade Shelters (16'x20', concrete pad, utility sink, 2 tables & BBQ)	11	EA	$ 28,000.00	$308,000
8d	Host Site (12'x40', shade shelter, pad, hook-up)	1	EA	$ 25,000.00	$25,000
8e	Toilet (Vault) - Summer/Movable	2	EA	$ 2,500.00	$5,000
8f	Toilet (Compost)	2	EA	$ 35,000.00	$70,000
8g	Restrooms (Conventional Toilets/Showers)	*N/A*	*N/A*	*N/A*	*N/A*
8h	Rinse-off Station (Allow)	2	EA	$ 2,000.00	$4,000
8i	Entry Sign at Knoxville Rd.; Kiosk	1	EA	$ 8,000.00	$8,000
8j	Amphitheatre	1	EA	$ 8,000.00	$8,000
8k	Storage/Office Building (pre-engineered 20' x 30' barn structure)	1	LS	$ 35,000.00	$35,000
8l	Activity Center	1	EA	$ 25,000.00	$25,000
8m	Day Use Area (picnic facilities/BBQ group, water)	1	LS	$ 25,000.00	$25,000
8n	Compost Facility (Host Site and Day Use Area) (Allow)	1	LS	$ 2,000.00	$2,000
				Item 8 Subtotal	$771,000
9	Recreational & Outdoor Educational Amenities				
9a	Bocce Ball, Horseshoe Courts, Beach Volleyball	1	LS	$ 15,000.00	$15,000
9b	Canoes, kayaks, life jackets, paddles	20	EA	$ 900.00	$18,000
9c	Archery Range	1	LS	$ 4,500.00	$4,500
9d	Ropes Course	1	LS	$ 7,000.00	$7,000
9e	Floating Dock/Kayak Launch	1	LS	$ 9,000.00	$9,000
9f	Boat Ramp Improvements	1	LS	$ 5,000.00	$5,000
9g	Buoy Line/Swim Area	4,000	LF	$ 3.00	$12,000
9h	Swim Platforms	3	EA	$ 3,500.00	$10,500
9i	Interpretive Trail Signage (Allow)	1	LS	$ 15,000.00	$15,000
9j	Miscellaneous Site Furniture (benches, etc.) (Allow)	1	LS	$ 15,000.00	$15,000
9k	Fish Cleaning Station	1	EA	$ 2,500.00	$2,500
				Item 9 Subtotal	$113,500
10	Major Buildings and Structures				
10a	Wood Cabins	10	EA	$ 22,000.00	$220,000
10b	Dorm Cabins	2	EA	$ 40,000.00	$80,000
10c	Kitchen/Laundry/Cafeteria Building/Museum/Office	4,000	SF	$ 120.00	$480,000
10d	Outdoor Dining Area with Trellis	1	LS	$ 60,000.00	$60,000
10e	Large Restroom/Shower	1	LS	$ 190,000.00	$190,000
				Item 10 Subtotal	$1,030,000
11	Interior Furnishings and Miscellaneous Equipment				
11a	Kitchen Appliances - Commercial Range/Oven, Dishwasher, Refrigerator	1	LS	$ 30,000.00	$30,000
11b	Laundry Appliances - Commercial Washer/Dryer	1	LS	$ 3,000.00	$3,000
11c	Dining Area Furniture (interior) - Table and 10-Chair Set	6	EA	$ 3,000.00	$18,000
11d	Dining Area Furniture (exterior) - Table and 4-Chair Set	10	EA	$ 900.00	$9,000
11e	Beds, Bunk Beds, etc.	60	EA	$ 500.00	$30,000
11f	Kitchen, Tableware, Linens, etc. (seating 40-60 each) (Allow)	1	LS	$ 10,000.00	$10,000
				Item 11 Subtotal	$100,000
12	Miscellaneous One-Time Startup Costs				
12a	Website Design, brochure, stationary, program info.	1	LS	$ 11,500.00	$11,500
12b	Office (computer, copier/printer, phone/fax, desk)	1	LS	$ 6,000.00	$6,000
12c	Cleaning and Maintenance Supplies and Equipment	1	LS	$ 2,000.00	$2,000
12d	Small Utility Vehicle (electric)	1	LS	$ 7,000.00	$7,000
12e	Sustainability/Environmental Education Material	1	LS	$ 5,000.00	$5,000
12f	Half-ton Pickup	1	EA	$ 21,000.00	$21,000
12g	Reservation System Development	1	EA	$ 13,000.00	$13,000
				Item 12 Subtotal	$65,500
				SUBTOTAL	$2,765,000
				20% Contingency	$553,000
				PLANNING, DESIGN, & PERMITTING	
				20% Architecture/Engineering Design and Inspection	$553,000
				5% Environmental Review and Permitting	$138,300
				TOTAL PRELIMINARY PROJECT COST	$4,009,300

ANNUAL OPERATIONS and MAINTENANCE COST ASSUMPTIONS

1. Well and Water Supply. Small allowance for supplies for annual maintenance of water lines, well, and water filter. Labor costs assumed in either Camp Host or Contractor for Alternatives A and B, and On-site Maintenance Staff for C and D.

Pump and pressure tank sinking fund based on an assumed 10-year life, per search of literature and discussions with pump and well companies. Water pipeline and plumbing system has an assumed 40-year life before replacement. Minor leaks in plumbing are assumed to be handled by on-site maintenance personnel in Alternatives C and D. Annual Water Quality Testing is to meet Title 22 requirements.

2. Wastewater System. Annual O&M costs based on experience of Questa Engineering for a mound and drip system. The design life is 15 years for replacement of all components, other than the fill system. The system sizes for Alternatives A and B could potentially be half those of Alternatives C and D, with lower maintenance and replacement costs. However, as noted earlier, it could be more cost-effective to build a larger capacity system that meets the needs of all Alternatives, including Alternatives C and D, allowing growth of the facility; the O&M costs reflect this. Costs also include annual pump-out of central septic tank and wastewater storage tank, as well as septic tank service contractor pump-out and maintenance of vault toilets and compost toilets, as the assumption is Camp Hosts would not do this as part of their duties.

County and Regional Board permit will also require periodic inspection of system, including monitoring and testing of shallow monitor wells, inspection of piping, pump, filters, and controllers, and preparation of an Annual Self-monitoring Report.

3. Electrical System. There is a small annual cost to inspect and repair electrical system, including replacement of fixtures and bulbs. Solar panel system and wind turbine system are assumed to have a 20-year design life for replacement costs in sinking fund.

4. Roads, Trails, and Parking Areas. These are surfaced with 3 inches of 3/8-inch-minus blue shale gravel. Maintenance of roads and parking areas has an estimated five-year cycle before refreshing and repair, and seven years for secondary roads and paths. Some annual routine maintenance is included in Item 7, Grounds Maintenance. Refreshing of gravel surfaces is estimated at $.25/sq. ft., every five to seven years respectively. There is approximately 40,000 sq. ft., of primary roads and parking areas, and 15,000 sq. ft.of secondary roads and pathways.

5. Minor Building Maintenance. This includes maintenance of the tent cabins and small wood cabins in Alternatives B and C, the shade shelters, including utility sinks, site furnishings, and BBQ, and the small vault and compost toilet buildings and interior plumbing and fixtures common to all Alternatives. (Maintenance of the compost tank and periodic pumping of the vaults are included in Item 2d) Costs are for supplies and materials, as the on-site maintenance staff person in Alternatives B, C, and D would perform the work, and an outside contractor would provide as-needed maintenance in Alternatives A and B.

The sinking fund replacement cost is based on a 12-year life for the tent cabins, a 15-year life for Central Area Open Pavilion, and a 50-year life for the small wood structures and shade shelters.

6. Building Maintenance- a survey of literature for schools and office buildings indicates annual maintenance costs range from $0.37 to $0.75/sq. ft. A cost of $.50/sq. ft. was used in our estimates. Minor maintenance work can be completed by the maintenance staff or periodic contractor; major repairs (painting, floors, windows, roofing) are included in this cost.

All Alternatives assume a small office in the Storage Building or Dining area, with copier, phone, fax, printer, and computer. A five-year replacement life is assumed for the $8,000.00 in office equipment purchase for the sinking fund.

7. Grounds Maintenance. Allowance is for occasional large tree removal and safety limbing, as well as routine maintenance of vegetation along parking areas, roadways, and pathways. A tree professional would be contracted for major work; minor work could be done by facility staff. These costs may not be incurred every year, so the costs represent a long-term average allowance.

8. Recreational Supplies and Equipment. An annual allowance is provided for purchase of recreational supplies, (i.e. beach volleyball, badminton, archery, horse shoes, etc.) The major replacement cost in sinking fund is for swim buoy line, kayaks and kayak launch, swim platform and floating pier. A 12- to 20-year life is used for these items.

9. Utilities. Solar panel system and wind turbine generator are assumed to pay for up to 25% of annual electricity costs. Utility costs vary with Alternative. Propane tank is assumed for showers and Host Site in Alternatives B, and for kitchen, laundry, and showers as appropriate in Alternatives C and D.

Solar panel and wind turbine system are assumed to have a 20-year design life for sinking fund replacement costs.

10.Vehicles and Equipment All Alternatives assume the purchase, maintenance, and eventual replacement of an electric utility vehicle cart, with an initial purchase price of $7,700, and an operating life of 7 years. Annual expenses include items such as battery purchase and maintenance of the engine and running gear. An on-site pickup truck was not assumed for Alternates A and B, but was included for Alternatives C and D. On-site staff pickup truck and electrical utility cart are assumed for Alternatives C and D, The purchase price of the vehicle is estimated at $21,000.00, with seven-year replacement life. Annual vehicle operating expenses assume 5,000 miles at a cost of $.50/mile.

11. Interpretive and Educational Displays. This line item is for purchase or rental of educational supplies and interpretive materials, such as local ecology and natural history, solar energy and wind power, water conservation, etc. It is also expected that the educational materials will start out modestly, with visitor instructor-furnished materials and rentals, and will expand each year with purchase of new library, classroom, and museum materials from this annual allocation.

12. Advertising, Marketing, and Communications. Annual costs are for updating printed brochures and camp information, mail outs to schools and non-profit groups, as well as website management. A reservation clerk to monitor the automatic reservation system and mail out information and confirmations is also included in this cost.

13. Food and Beverage. No kitchen or laundry services provided for Alternates A and B. Full kitchen and guest services are provided for Alternatives C and D. A daily cost of $10.00 per person was assumed for costs of food and beverage.

14. Employee and Staffing Costs. The staffing requirements and associated costs, including payroll, benefits, and overhead vary by Alternative, with some costs varying with occupancy. The burden is assumed to be about 25 to 30% of direct salary. Staffing could either be provided by a vendor or contractor, or by County Parks and Open Space District staff during occasional site visits. Minimal on-site services are provided in Alternatives A and B. Alternative C includes a dining facility, but minimal housekeeping and laundry. Near-full guest services are provided in Alternative D, including meals, housekeeping and laundry. A site Maintenance person, ranging from part-time/seasonal in Alternative B to full-time in Alternative D, is assumed. A Seasonal Aid for five months is assumed for Alternatives B, C, and D.

The following summarize anticipated staffing needs by Alternative, showing fully burdened payroll costs:

Staffing Level Burdened Annual Payroll

A. Rustic	
• Volunteer Camp Host	
• Some minor maintenance provided by Host	unpaid
• Larger maintenance and repair by project Contractors (allow)	$8,000
	$8,000
B. Enhanced Rustic	
• Volunteer Camp Host	
• Some minor maintenance provided by Host,	unpaid
• Maintenance employee (part time) var. w/ occupancy	$40,000
• Larger maintenance and repair by project Contractors (allow)	$10,000
• Seasonal Aid, five months (March-July) @ $3,500/mo.	$17,500
	$67,500
C. Enhanced Rustic with Central Facilities	
• Site Manager/Director (No Camp Host, facility provided)	$75,000
• Maintenance employee (Part time)	$45,000
• Cook, light housekeeping (Seasonal Only)	$30,000
• Seasonal Aid, five months (March-July) @ $3,500/mo.	$17,500
	$167,500
D. Enhanced Rustic with Central Facilities and Services	
• Site Manager/Director (Full time)	$85,000
• Maintenance employee (Full time)	$62,000
• Full time cook (Seasonal)	$35,000
• Full time housekeeper/laundry/dining asst.(Seasonal)	$28,000
• Seasonal Aid five months (March-July) @ $3,500/mo.)	$17,500
	$227,500

15. Management and Administration. This line item covers costs for items such as a) legal fees, b) bookkeeping and accounting, c) insurance, and d) District administrative management. Costs for this item ranged from 8% to as much as 20% of total revenues, according to budgets examined for public facility campgrounds. These items varied by intensity of development. For District Administrative Oversight and Management, time varied from 20% of a full-time equivalent position for Alternative A to 35% for Alternative D. This was based on a fully burdened salary of $100,000 per year, which averages some clerical and secretarial salary expenses with management level salary.

OPERATION & MAINTENANCE COST ESTIMATE - ALTERNATIVE A - RUSTIC

Item No.	Item Description	Assumptions	Annual Replacement Cost Allocation Sinking Fund**	Low Occupancy**		High Occupancy**	
				Annual O&M Costs	Total (rounded to $100)	Annual O&M Costs	Total (rounded to $100)
1	Well and Water Supply						
1a	Pump, Pressure Tank, Filter & Treatment System	10-year life ($12,500)	$1,250	$250	$1,500	$250	$1,500
1b	Pipeline/Plumbing (supplies & materials)	40-year life ($16,000)	$400	$100	$500	$100	$500
1c	Water Quality Testing & Reporting	Full Title 22 Analysis	$0	$2,500	$2,500	$2,500	$2,500
			Well and Water Supply Subtotal		$4,500		$4,500
2	Wastewater System						
2a	Drip, Pump & Electrical System Inspection/Repair*	15 -year life ($95,000)	$6,400	$2,400	$8,800	$2,400	$8,800
2b	Septic Tank Pump-out - Main System	$2,500	$0	$2,000	$2,000	$3,000	$3,000
2c	Vault & Compost Toilet Maintenance	$1,500/year/unit	$0	$2,500	$2,500	$4,500	$4,500
2d	Monitoring & Reporting	SWRCB Requirement	$0	$3,600	$3,600	$3,600	$3,600
			Wastewater System Subtotal		$16,900		$19,900
3	Electrical & Lighting						
3a	Exterior Lighting Maint. (materials only/labor in 14a)*	30-year life ($10,000)	$350	$200	$600	$200	$600
3b	Misc. Electrical Maintenance (materials only)*		$0	$200	$200	$200	$200
3c	Solar Panels	20-year life ($30,000)	$1,500	$100	$1,600	$100	$1,600
			Electrical & Lighting Subtotal		$2,400		$2,400
4	Roads, Trails, & Parking Areas						
4a	Resurfacing - Parking & Primary Roads, (40, 000 SF)	5 yr. Cycle, @ $0.20 SF.	$0	$1,600	$1,600	$1,600	$1,600
4b	Resurfacing- Secondary Roads & Trails (18,000 SF)	7-yr. cycle; @ $0.20 SF	$0	$500	$500	$500	$500
			Roads, Trails, & Parking Areas Subtotal		$2,100		$2,100
5	Minor Buildings/Structures						
5a	Tent Cabins (materials only - allowance)*	decking maintance	$200	$100	$300	$400	$600
5b	Shade Structures & Outdoor Dining/Amphitheatre*	40-year life ($240,000)	$6,000	$100	$6,100	$200	$6,200
5c	Central Area Open Pavilion/Activity Center	10-year life ($10,000)	$1,000	$300	$1,300	$500	$1,500
5d	Vault/ CompostToilets (internal fixtures/plumbing)*	15-year life	$200	$100	$300	$100	$300
5e	Utility Sinks/Rinse-off Stations*	15-year life	$250	$50	$300	$150	$400
5f	Storage Building/Office	35-year life ($35,000)	$1,000	$100	$1,100	$100	$1,100
			Minor Buildings/Structures Subtotal		$9,400		$10,100
6	Major Buildings/Structures						
6a	Building Maintenance & Repair (materials)*	NA	$0	$0	$0	$0	$0
6b	Appliances (replacement)	NA	$0	$0	$0	$0	$0
6c	Furnishings (replacement)	NA	$0	$0	$0	$0	$0
			Major Buildings/Structures Subtotal		$0		$0
7	Landscape Maintenance						
7a	Tree Trimming/Removal & Grounds Maint.*	Annual allowance	$0	$400	$400	$400	$400
			Landscape/ Maintenance Subtotal		$400		$400
8	Recreational Supplies & Equipment						
8a	Sports Equipment, Including Kayaks and Cannoes	12-year life ($18,000)	$1,500	$200	$1,700	$300	$1,800
8b	Floating Platforms & Buoy, Docks (replacement)*	20-year life ($36,000)	$1,800	$200	$2,000	$200	$2,000
			Recreational Supplies & Equipment Subtotal		$3,700		$3,800
9	Utilities						
9a	Electricity	$30-$50/mo.	$0	$360	$400	$600	$600
9b	Propane	$100-$150/mo.	$0	$1,200	$1,200	$1,800	$1,800
9c	Garbage Service	$75-$125/mo.	$0	$900	$900	$1,500	$1,500
9d	Telephone, Cable, Internet (Office)/Storage Building	$100-$110/mo.	$0	$1,200	$1,200	$1,300	$1,300
			Utilities Subtotal		$3,700		$5,200
10	Vehicles & Equipment						
10a	Pickup Truck Maintenance Vehicle (incl. gas & oil)	NA	$0	$0	$0	$0	$0
10b	Electric Utility Cart	10-year life ($7,700)	$770	$200	$1,000	$300	$1,100
10c	Misc. Tools & Equipment	Allowance	$0	$200	$200	$300	$300
			Vehicles & Equipment Subtotal		$1,200		$1,400
11	Interpretive & Educational Displays						
11a	Fixed Display	Allowance	$0	$1,000	$1,000	$1,000	$1,000
11b	Rental	Allowance	$0	$1,000	$1,000	$1,000	$1,000
			Interpretive & Educational Displays Subtotal		$2,000		$2,000
12	Advertising, Marketing, & Reservations						
12a	Advertising & Marketing (allowance)	Allowance	$0	$2,500	$2,500	$2,500	$2,500
12b	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life ($6,000)	$1,200	$0	$1,200	$0	$1,200
12c	Reservation System, Including Clerk	Allowance		$8,000	$8,000	$10,000	$10,000
			Advertising, Marketing, & Reservations Subtotal		$11,700		$13,700
13	Food & Beverage, Laundry, Misc.						
13a	Food & Beverage	NA	$0	$0	$0	$0	$0
13b	Linens, Towels, etc. (10% annual turnover)	NA	$0	$0	$0	$0	$0
13c	Kitchen, Laundry & Misc. Cleaning Supplies	Allowance	$0	$100	$100	$200	$200
			Food & Beverage, Laundry, Misc. Subtotal		$100		$200
14	Employee/Staff Costs						
14a	Periodic Maintenance Contractor and (Camp Host)	Allowance	$0	$5,000	$5,000	$8,000	$8,000
14b	Seasonal Aid	NA	$0	$0	$0	$0	$0
			Employee/Staff Costs Subtotal		$5,000		$8,000
15	Management & Administration						
15a	Legal Fees	County Counsel	$0	$5,000	$5,000	$5,000	$5,000
15b	Accounting & Bookkeeping	Allowance	$0	$4,000	$4,000	$6,000	$6,000
15c	Insurance	Allowance	$0	$20,000	$20,000	$20,000	$20,000
15d	District Administrative Management	20% Time ($100,000)	$0	$20,000	$20,000	$20,000	$20,000
			Management & Administration Subtotal		$49,000		$51,000
	TOTAL ANNUAL OPERATION & MAINTENANCE COSTS		$23,820	$88,160	$112,100	$100,800	$124,700
					LOW		HIGH

** Minor maintenance repair by camp host or contractor- annual O&M cost is mainly for materials. Labor is included in Item 14a.*

*** Some O&M costs vary with occupancy; Low = 2,628 visitors per year; High = 6,424 visitors per year.*

OPERATION & MAINTENANCE COST ESTIMATE - ALTERNATIVE B - ENHANCED RUSTIC

Item No.	Item Description	Assumptions	Annual Replacement Cost Allocation Sinking Fund**	Low Occupancy**		High Occupancy**	
				Annual O&M Costs	Total (rounded to $100)	Annual O&M Costs	Total (rounded to $100)
1	Well and Water Supply						
1a	Pump, Pressure Tank, Filter & Treatment System	10-year life ($12,500)	$1,250	$250	$1,500	$250	$1,500
1b	Pipeline/Plumbing (supplies & materials)*	40-year life ($16,000)	$400	$100	$500	$100	$500
1c	Water Quality Testing & Reporting	Full Title 22 Analysis	$0	$2,500	$2,500	$2,500	$2,500
			Well and Water Supply Subtotal		$4,500		$4,500
2	Wastewater System						
2a	Drip, Pump & Electrical System Inspection/Repair*	15 -year life ($95,000)	$6,400	$2,400	$8,800	$2,400	$8,800
2b	Septic Tank Pump-out - Main System	$2,500	$0	$2,400	$2,400	$2,400	$2,400
2c	Vault & Compost Toilet Maintenance	$1,500/year/unit	$0	$2,000	$2,000	$3,000	$3,000
2d	Monitoring & Reporting	SWRCB Requirement	$0	$3,600	$3,600	$3,600	$3,600
			Wastewater System Subtotal		$16,800		$17,800
3	Electrical & Lighting						
3a	Exterior Lighting Maint. (materials only/labor 14a)*	30-year life ($10,000)	$350	$200	$600	$200	$600
3b	Misc. Electrical Maintenance (materials only)*	Allowance	$0	$200	$200	$200	$200
3c	Solar Panels	20-year life ($80,000)	$4,000	$100	$4,100	$100	$4,100
			Electrical & Lighting Subtotal		$4,900		$4,900
4	Roads, Trails, & Parking Areas						
4a	Resurfacing - Parking & Primary Roads, (40, 000 SF)	5 yr. Cycle, @ $0.20 SF.	$0	$1,600	$1,600	$1,600	$1,600
4b	Resurfacing- Secondary Roads & Trails (18,000 SF)	7-yr. cycle; @ $0.20 SF	$0	$500	$500	$500	$500
			Roads, Trails, & Parking Areas Subtotal		$2,100		$2,100
5	Minor Buildings/Structures						
5a	Tent Cabins (materials only - allowance)*	40-year life ($448,000)	$11,200	$600	$11,800	$900	$12,100
5b	Shade Structures & Outdoor Dining/Amphitheatre*	40-year life ($280,000)	$7,000	$100	$7,100	$200	$7,200
5c	Central Area Open Pavilion/Activity Center	10-year life ($10,000)	$1,000	$300	$1,300	$500	$1,500
5d	Vault/Compost Toilets (internal fixtures/plumbing)*	15-year life	$200	$100	$300	$100	$300
5e	Utility Sinks/Rinse-off Stations*	15-year life	$250	$50	$300	$150	$400
5f	Storage Buildings/Office	35-year life ($35,000)	$1,000	$100	$1,100	$100	$1,100
			Minor Buildings/Structures Subtotal		$21,900		$22,600
6	Major Buildings/Structures						
6a	Building Maintenance & Repair (materials)*	NA	$0	$0	$0	$0	$0
6b	Appliances (replacement)	NA	$0	$0	$0	$0	$0
6c	Furnishings (replacement)	10-year life ($17,000)	$1,700	$100	$1,800	$100	$1,800
			Major Buildings/Structures Subtotal		$1,800		$1,800
7	Grounds Maintenance						
7a	Tree Trimming/Removal & Grounds Maint.*	Annual allowance	$0	$400	$400	$400	$400
			Landscape/ Maintenance Subtotal		$400		$400
8	Recreational Supplies & Equipment						
8a	Sports Equipment, Including Kayaks and Cannoes	12-year life ($18,000)	$1,500	$200	$1,700	$300	$1,800
8b	Floating Platforms & Buoy, Docks (replacement)*	20-year life ($36,000)	$1,800	$200	$2,000	$200	$2,000
			Recreational Supplies & Equipment Subtotal		$3,700		$3,800
9	Utilities						
9a	Electricity	$30-$50/mo.	$0	$360	$400	$600	$600
9b	Propane	$100-$150/mo.	$0	$1,200	$1,200	$1,800	$1,800
9c	Garbage Service	$75-$125/mo.	$0	$900	$900	$1,500	$1,500
9d	Telephone, Cable & Internet (office)	$100-$110/mo.	$0	$1,200	$1,200	$1,300	$1,300
			Utilities Subtotal		$3,700		$5,200
10	Vehicles & Equipment						
10a	Pickup Truck Maintenance Vehicle (incl. gas & oil)	NA	$0	$0	$0	$0	$0
10b	Electric Utility Cart	10-year life ($7,700)	$770	$200	$1,000	$300	$1,100
10c	Misc. Tools & Equipment	Allowance	$0	$200	$200	$300	$300
			Vehicles & Equipment Subtotal		$1,200		$1,400
11	Interpretive & Educational Displays						
11a	Fixed Display	Allowance	$0	$1,000	$1,000	$1,000	$1,000
11b	Rental	Allowance	$0	$1,000	$1,000	$1,000	$1,000
			Interpretive & Educational Displays Subtotal		$2,000		$2,000
12	Advertising, Marketing, & Reservations						
12a	Advertising & Marketing (allowance)	Allowance	$0	$2,500	$2,500	$2,500	$2,500
12b	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life ($6,000)	$1,200	$0	$1,200	$0	$1,200
12c	Reservation System, Including Clerk	Allowance		$8,000	$8,000	$10,000	$10,000
			Advertising, Marketing & Reservations Subtotal		$11,700		$13,700
13	Food & Beverage, Laundry, Misc.						
13a	Food & Beverage	NA	$0	$0	$0	$0	$0
13b	Linens, Towels, etc.	NA	$0	$0	$0	$0	$0
13c	Misc. Cleaning Supplies	Allowance	$0	$100	$100	$200	$200
			Food & Beverage, Laundry, Misc. Subtotal		$100		$200
14	Employee/Staff Costs						
14a	P/T Maintenance Staff & Periodic Contractor		$0	$40,000	$40,000	$50,000	$50,000
14b	Seasonal Aid	5 months @ $3500/mo.	$0	$17,500	$17,500	$17,500	$17,500
			Employee/Staff Costs Subtotal		$57,500		$67,500
15	Management & Administration						
15a	Legal Fees (County Counsel)	County Council		$7,000	$7,000	$7,000	$7,000
15b	Accounting & Bookkeeping	Allowance	$0	$4,000	$4,000	$6,000	$6,000
15c	Insurance	Allowance		$22,000	$22,000	$22,000	$22,000
15d	District Administrative Oversight	25% Time ($100,000)		$25,000	$25,000	$25,000	$25,000
			Management & Administration Subtotal		$58,000		$60,000
	TOTAL ANNUAL OPERATION & MAINTENANCE COSTS		$40,020	$150,160	$190,300	$167,800	$207,900
					LOW		HIGH

** Minor maintenance repair by camp host, staff or contractor- annual O&M cost is mainly for materials. Labor is included in Item 14a.*

*** Some O&M costs vary with occupancy; Low = 2,628 visitors per year; High = 6,424 visitors per year.*

OPERATION & MAINTENANCE COST ESTIMATE - ALTERNATIVE C - ENHANCED RUSTIC/CENTRAL FACILITIES

Item No.	Item Description	Assumptions	Annual Replacement Cost Allocation Sinking Fund**	Low Occupancy**		High Occupancy**	
				Annual O&M Costs	Total (rounded to $100)	Annual O&M Costs	Total (rounded to $100)
1	Well and Water Supply						
1a	Pump, Pressure Tank, Filter & Treatment System	10-year life ($12,500)	$1,250	$250	$1,500	$250	$1,500
1b	Pipeline/Plumbing (supplies & materials)*	40-year life ($16,000)	$400	$100	$500	$100	$500
1c	Water Quality Testing & Reporting	Full Title 22 Analysis	$0	$2,500	$2,500	$2,500	$2,500
			Well and Water Supply Subtotal		$4,500		$4,500
2	Wastewater System						
2a	Drip, Pump & Electrical System Inspection/Repair*	15 -year life ($95,000)	$6,400	$2,400	$8,800	$2,400	$8,800
2b	Septic Tank Pump-out - Main System	$2,500	$0	$5,000	$5,000	$7,000	$7,000
2c	Vault & Compost Toilet Maintenance	$1,500/year/unit	$0	$6,000	$6,000	$8,000	$8,000
2d	Monitoring & Reporting	SWRCB Requirement	$0	$3,600	$3,600	$3,600	$3,600
			Wastewater System Subtotal		$23,400		$27,400
3	Electrical & Lighting						
3a	Exterior Lighting Maint. (materials only/labor in 14a)*	30-year life ($10,000)	$350	$200	$600	$200	$600
3b	Misc. Electrical Maintenance (materials only)*		$0	$200	$200	$200	$200
3c	Solar Panels	20-year life ($80,000)	$4,000	$100	$4,100	$100	$4,100
			Electrical & Lighting Subtotal		$4,900		$4,900
4	Roads, Trails, & Parking Areas						
4a	Resurfacing - Parking & Primary Roads, (40, 000 SF)	5 yr. Cycle, @ $0.20 SF.	$0	$1,600	$1,600	$1,600	$1,600
4b	Resurfacing- Secondary Roads & Trails (18,000 SF)	7-yr. cycle; @ $0.20 SF	$0	$500	$500	$500	$500
			Roads, Trails, & Parking Areas Subtotal		$2,100		$2,100
5	Minor Buildings/Structures						
5a	Tent Cabins (materials only - allowance)*	40-year life ($448,000)	$11,200	$600	$11,800	$900	$12,100
5b	Shade Structures & Outdoor Dining/Amphitheatre*	40-year life ($280,000)	$7,000	$100	$7,100	$300	$7,300
5c	Central Area Open Pavilion/Activity Center	15-year life ($45,000)	$3,000	$300	$3,300	$500	$3,500
5d	Vault/Compost Toilets (internal fixtures/plumbing)*	15-year life	$150	$150	$300	$250	$400
5e	Utility Sinks/Rinse-off Stations*	15-year life	$250	$50	$300	$150	$400
5f	Storage Building/Office	50-year life ($35,000)	$700	$100	$800	$100	$800
			Minor Buildings/Structures Subtotal		$23,600		$24,500
6	Major Buildings/Structures						
6a	Building Maintenance & Repair (materials)*	4000 sf @$0.40-$0.45/annual	$10,000	$1,600	$11,600	$1,800	$11,800
6b	Appliances (replacement)	10-year life (33,000)	$3,300	$200	$3,500	$400	$3,700
6c	Furnishings (replacement)	10-year life(27,000)	$2,700	$100	$2,800	$400	$3,100
6d	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life	$1,600	$0	$1,600	$0	$1,600
			Major Buildings/Structures Subtotal		$19,500		$20,200
7	Landscape Maintenance						
7a	Tree Trimming/Removal & Grounds Maint.*	Annual allowance	$0	$500	$500	$500	$500
			Landscape/ Maintenance Subtotal		$500		$500
8	Recreational Supplies & Equipment						
8a	Sports Equipment Including Kayaks and Cannoes	12-year life ($18,000)	$1,500	$200	$1,700	$300	$1,800
8b	Floating Platforms & Buoy, Docks (replacement)*	20-year life ($36,000)	$1,800	$200	$2,000	$300	$2,100
			Recreational Supplies & Equipment Subtotal		$3,700		$3,900
9	Utilities						
9a	Electricity	$40-$60/mo.	$0	$500	$500	$720	$700
9b	Propane	$200-$250/mo.-	$0	$2,400	$2,400	$3,000	$3,000
9c	Garbage Service	$85-$200/mo.	$0	$1,020	$1,000	$1,020	$1,000
9d	Telephone & Cable (Host Site)	$100-$1,100/mo.	$0	$1,200	$1,200	$1,300	$1,300
			Utilities Subtotal		$5,100		$6,000
10	Vehicles & Equipment						
10a	Pickup Truck Maintenance Vehicle (incl. gas & oil)	7-year life, 5000-6000 mi@.50	$3,000	$2,500	$5,500	$3,000	$6,000
10b	Electric Utility Cart	7-year life ($7,700)	$770	$200	$1,000	$300	$1,100
10c	Misc. Tools & Equipment	Annual - $200-$300	$0	$200	$200	$300	$300
			Vehicles & Equipment Subtotal		$6,700		$7,400
11	Interpretive & Educational Displays						
11a	Fixed Display	Allowance	$0	$1,000	$1,000	$1,000	$1,000
11b	Rental	Allowance	$0	$1,000	$1,000	$1,000	$1,000
			Interpretive & Educational Displays Subtotal		$2,000		$2,000
12	Advertising, Marketing, & Reservations						
12a	Advertising & Marketing	Allowance	$0	$3,500	$3,500	$3,500	$3,500
12b	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life ($6,000)	$1,200	$0	$1,200	$0	$1,200
12c	Reservation System	Allowance		$1,200	$1,200	$1,200	$1,200
			Advertising, Marketing & Reservations Subtotal		$5,900		$5,900
13	Food & Beverage, Laundry, Misc.						
13a	Food & Beverage**	$10.00/person/day	$0	$26,280	$26,300	$131,400	$131,400
13b	Linens, Towels, etc.	NA	$0	$0	$0	$0	$0
13c	Kitchen, Laundry & Misc. Cleaning Supplies	Allowance	$0	$200	$200	$300	$300
			Food & Beverage, Laundry, Misc. Subtotal		$26,500		$131,700
14	Employee/Staff Costs						
14a	Site Manager, Maintenance, Cook		$0	$150,000	$150,000	$150,000	$150,000
14b	Seasonal Aid	5 months @ $3500/mo.	$0	$17,500	$17,500	$17,500	$17,500
			Employee/Staff Costs Subtotal		$167,500		$167,500
15	Management & Administration						
15a	Legal Fees	County Counsel	$0	$10,000	$10,000	$10,000	$10,000
15b	Accounting & Bookkeeping	Allowance	$0	$9,000	$9,000	$9,000	$9,000
15c	Insurance	Allowance	$0	$25,000	$25,000	$25,000	$25,000
15d	District Administrative Management	30% Time ($100,000)	$0	$30,000	$30,000	$30,000	$30,000
			Management & Administration Subtotal		$74,000		$74,000
	TOTAL ANNUAL OPERATION & MAINTENANCE COSTS		$60,570	$309,250	$369,900	$421,890	$482,500
					LOW		HIGH

** Minor maintenance repair by staff or contractor - annual O&M cost is mainly for materials. Labor is included in Item 14a.*

*** Some O&M costs vary with occupancy; Low = 2,628 visitors per year; High = 13,140 visitors per year.*

OPERATION & MAINTENANCE COST ESTIMATE - ALTERNATIVE D - ENHANCED RUSTIC/CENTRAL FACILITIES & SERVICES

Item No.	Item Description	Assumptions	Annual Replacement Cost Allocation Sinking Fund**	Low Occupancy**		High Occupancy**	
				Annual O&M Costs	Total (rounded to $100)	Annual O&M Costs	Total (rounded to $100)
1	Well and Water Supply						
1a	Pump, Pressure Tank, Filter & Treatment System	10-year life ($12,500)	$12,500	$250	$12,800	$250	$12,800
1b	Pipeline/Plumbing (supplies & materials)*	40-year life ($16,000)	$400	$100	$500	$100	$500
1c	Water Quality Testing & Reporting	Full Title 22 Analysis	$0	$2,500	$2,500	$2,500	$2,500
			Well and Water Supply Subtotal		$15,800		$15,800
2	Wastewater System						
2a	Drip, Pump & Electrical System Inspection/Repair*	15 -year life ($95,000)	$6,400	$2,400	$8,800	$2,400	$8,800
2b	Septic Tank Pump-out - Main System	$2,500	$0	$6,000	$6,000	$8,000	$8,000
2c	Vault & Compost Toilet Maintenance	$1,500/year/unit	$0	$7,000	$7,000	$8,000	$8,000
2d	Monitoring & Reporting	SWRCB Requirement	$0	$3,600	$3,600	$3,600	$3,600
			Wastewater System Subtotal		$25,400		$28,400
3	Electrical & Lighting						
3a	Exterior Lighting Maint. (materials only/labor in 14a)*	30-year life ($10,000)	$350	$200	$600	$200	$600
3b	Misc. Electrical Maintenance (materials only)*		$0	$200	$200	$200	$200
3c	Solar Panels	20-year life(80,000)	$4,000	$100	$4,100	$100	$4,100
			Electrical & Lighting Subtotal		$4,900		$4,900
4	Roads, Trails, & Parking Areas						
4a	Resurfacing - Parking & Primary Roads, (40, 000 SF)	5 yr. Cycle, @ $0.20 SF.	$0	$1,600	$1,600	$1,600	$1,600
4b	Resurfacing- Secondary Roads & Trails (18,000 SF)	7-yr. cycle; @ $0.20 SF	$0	$500	$500	$500	$500
			Roads, Trails, & Parking Areas Subtotal		$2,100		$2,100
5	Minor Buildings/Structures						
5a	Tent Cabins (materials only - allowance)*	40-year life ($256,000)	$6,400	$600	$7,000	$900	$7,300
5b	Shade Structures & Outdoor Dining/Amphitheatre*	40-year life ($280,000)	$7,000	$100	$7,100	$300	$7,300
5c	Central Area Open Pavilion/Activity Center	15-year life ($45,000)	$3,000	$300	$3,300	$500	$3,500
5d	Vault/Toilets (internal fixtures/plumbing)*	15-year life	$150	$150	$300	$250	$400
5e	Utility Sinks/Rinse-off Stations*	15-year life	$250	$50	$300	$150	$400
5f	Storage Buildings/Office	50-year life (35,000)	$700	$100	$800	$100	$800
			Minor Buildings/Structures Subtotal		$18,800		$19,700
6	Major Buildings/Structures						
6a	Building Maintenance & Repair (materials)*	7000 sf @$0.40. - annual	$20,000	$1,600	$21,600	$1,800	$21,800
6b	Appliances (replacement)	10-year life (33,000)	$3,300	$200	$3,500	$400	$3,700
6c	Furnishings (replacement)	10-year life (27,000)	$2,700	$100	$2,800	$400	$3,100
6d	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life	$1,600	$0	$1,600	$0	$1,600
			Major Buildings/Structures Subtotal		$29,500		$30,200
7	Grounds Maintenance						
7a	Tree Trimming/Removal & Grounds Maint.*	Annual allowance	$0	$600	$600	$600	$600
			Landscape/ Maintenance Subtotal		$600		$600
8	Recreational Supplies & Equipment						
8a	Sports Equipment, Including Kayaks and Cannoes	12-year life ($18,000)	$1,500	$200	$1,700	$300	$1,800
8b	Floating Platforms & Buoy, Docks (replacement)*	20-year life ($36,000)	$1,800	$200	$2,000	$300	$2,100
			Recreational Supplies & Equipment Subtotal		$3,700		$3,900
9	Utilities						
9a	Electricity	$50-$70/mo.	$0	$600	$600	$840	$800
9b	Propane	$250-$350/mo.-	$0	$3,000	$3,000	$3,600	$3,600
9c	Garbage Service	$100-$250/mo.	$0	$1,200	$1,200	$1,200	$1,200
9d	Telephone & Cable Host & Office	$150-$200/mo.	$0	$1,800	$1,800	$2,400	$2,400
			Utilities Subtotal		$6,600		$8,000
10	Vehicles & Equipment						
10a	Pickup Truck Maintenance Vehicle (incl. gas & oil)	7-year life, 5000-6000 mi@.50	$3,000	$2,500	$5,500	$3,000	$6,000
10b	Electric Utility Cart	7-year life ($7,700)	$770	$200	$1,000	$300	$1,100
10c	Misc. Tools & Equipment	Annual - $200-$300	$0	$200	$200	$300	$300
			Vehicles & Equipment Subtotal		$6,700		$7,400
11	Interpretive & Educational Displays						
11a	Fixed Display	Allowance	$0	$2,500	$2,500	$2,500	$2,500
11b	Rental	Allowance	$0	$1,000	$1,000	$1,000	$1,000
			Interpretive & Educational Displays Subtotal		$3,500		$3,500
12	Advertising, Marketing, & Reservations						
12a	Advertising & Marketing	Allowance	$0	$4,000	$4,000	$4,000	$4,000
12b	Telephone, Computer, Fax, Copier, etc. (replacement)	5-year life ($6,000)	$1,200	$0	$1,200	$0	$1,200
12c	Reservation System	Allowance		$1,200	$1,200	$1,200	$1,200
			Advertising, Marketing, & Communications Subtotal		$6,400		$6,400
13	Food & Beverage, Laundry, Misc.						
13a	Food & Beverage**	$10.00/person/day	$0	$64,240	$64,200	$175,200	$175,200
13b	Linens, Towels, etc.	10% annual turnover	$0	$1,000	$1,000	$1,000	$1,000
13c	Kitchen, Laundry & Misc. Cleaning Supplies	Allowance	$0	$400	$400	$600	$600
			Food & Beverage, Laundry, Misc. Subtotal		$65,600		$176,800
14	Employee/Staff Costs						
14a	Site Manager, Maintenance, Cook, Housekeeping		$0	$210,000	$210,000	$210,000	$210,000
14b	Seasonal Aid	5 months @ $3500/mo.	$0	$17,500	$17,500	$17,500	$17,500
			Employee/Staff Costs Subtotal		$227,500		$227,500
15	Management & Administration						
15a	Legal Fees	County Counsel		$10,000	$10,000	$10,000	$10,000
15b	Accounting & Bookkeeping	Allowance		$12,500	$12,500	$12,500	$12,500
15c	Insurance			$30,000	$30,000	$30,000	$30,000
15d	District Administrative Management	35% Time ($100,000)		$35,000	$35,000	$35,000	$35,000
			Management & Administration Subtotal		$87,500		$87,500
	TOTAL ANNUAL OPERATION & MAINTENANCE COSTS		$77,020	$427,490	$504,600	$545,590	$622,700
					LOW		HIGH

** Minor maintenance repair by staff or contractor - annual O&M cost is mainly for materials. Labor is included in Item 14a.*

*** Some O&M costs vary with occupancy; Low = 6,424 visitors per year; High = 17,520 visitors per year.*

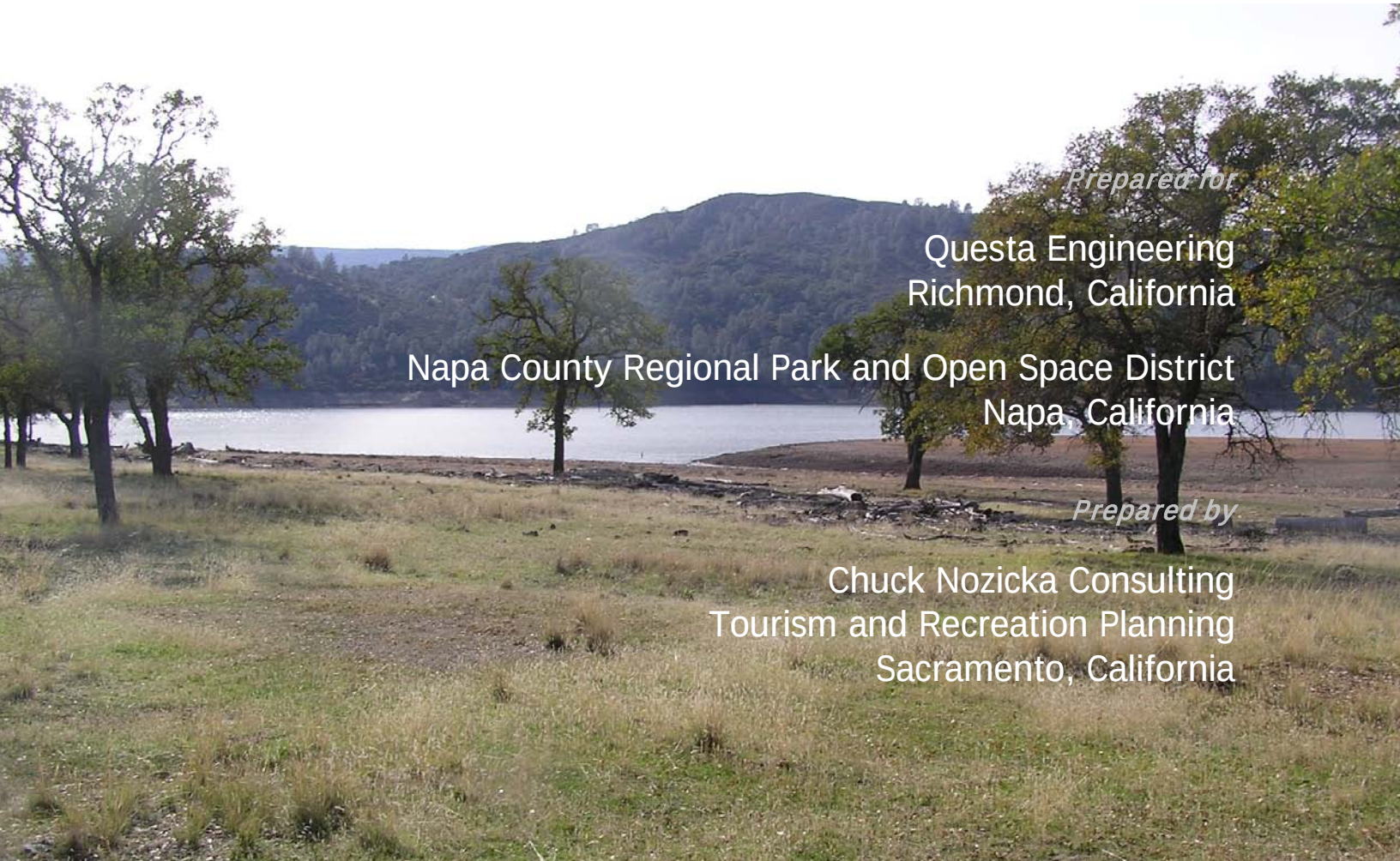
Appendix C

Market and Economic Feasibility Analysis

Camp Berryessa
Feasibility Study and Master Plan
Market and Economic Analysis

DRAFT REPORT

December 2009



Prepared for

Questa Engineering
Richmond, California

Napa County Regional Park and Open Space District
Napa, California

Prepared by

Chuck Nozicka Consulting
Tourism and Recreation Planning
Sacramento, California

CAMP BERRYESSA
FEASIBILITY STUDY AND MASTER PLAN
MARKET AND ECONOMIC ANALYSIS

DRAFT REPORT

December 2009

Prepared for

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CAMP BERRYESSA FEASIBILITY STUDY
MARKET AND ECONOMIC ANALYSIS

This report investigates the market demand and provides an economic analysis for proposed development at the Camp Berryessa site on the Putah Creek arm of Lake Berryessa. Located on approximately 10 acres at Lake Berryessa, the site features a peninsula configuration offering significant shoreline and shallow water access, excellent views, a flat easily developed topography, abundant oak shade tress, and an existing access road and ingress directly off of the Knoxville-Berryessa Road, which is the primary road accessing this regional recreation destination.

These base characteristics, in combination with market demand factors, indicate that Camp Berryessa is an ideal location for a science education camp as well as a group use destination facility for Napa and adjacent county student and group markets, with additional potential visitation from nearby Sacramento Valley and San Francisco Bay Area county markets. Each of four proposed Camp Berryessa design alternatives, to varying degrees, offers an opportunity for sustainable science and environmental education and targeted group use activities.

SUMMARY OF FINDINGS

Recreation and Population Findings

- Activities that may be made available at Camp Berryessa constitute an excellent representation of high-demand adult and youth recreation opportunities – including but not limited to beach activities, day hiking, boating, wildlife viewing and bird watching, camping in developed areas, swimming, fishing, and paddle sports.

- Activities with significant latent demand (unfulfilled demand) for both adult and youth populations are also well represented at Camp Berryessa, indicating a strong position within regional markets. These activities include swimming, canoeing, kayaking, hiking, bicycling, nature photography, and wildlife viewing.

- Projections thru 2018 show a steadily increasing elementary and high school student population for Napa and adjacent counties.

- General population projections within the wider region show similar increases in total growth.

Factors Impacting Demand:

- Primary competition in the local market area comes from Walker Creek Ranch, Clem Miller Education Center at Pt. Reyes, and Slide Ranch, all in Marin County. Regional competitors include Sly Park and Camp Arroyo in the Sacramento area. The 4-H Camp at Las Posadas in Napa County, which serves the six-county Bay Area, also partially competes for some potential camp users.

- There are currently no similar facilities in Napa County or immediately adjacent Solano or Sonoma Counties.

- Each of these competing facilities has long established use patterns with regional schools and community groups.

- In addition to user fees, these facilities also enjoy significant revenue (up to 40%) from external sources such as donations from local businesses, and supporting non-profit foundations, as well as generating a portion of their operating funds from grant sources.

- Additionally, the majority of these facilities are fully developed group destinations in line with alternative C and particularly alternative D scenarios.

- These and other comparable facilities draw 75% of their attendees from targeted markets which are either the home county in some combination with an adjacent county, or a specifically targeted effort to attract San Francisco Bay Area populations.

- In addition to Napa County, the nearby counties with the most robust school age population trends include Solano and Yolo and to a lesser extent, Sonoma County. Other regional growth is most apparent in central valley counties.

Projection Assumptions

- There are significant un-served or underserved markets within school age populations in this area.

- Education camp agreements with Napa County Office of Education and directly with local schools could be obtained. However, like most school districts and county educational offices, resources are currently very limited for making any commitments that require expenditure of funds.

- The fully developed facility (Alternatives C and D) will be operated by a professional manager (typically a not for profit organization) with knowledge in the educational camp market including building relationships with school and community groups and associated marketing activities.

- Fees for use will be within the range of existing competitive facilities.

- In addition to dedicated education activities, Camp Berryessa will host special use group activities including but not limited to recreational (triathlon, Bass fishing, kayaking tours, etc.) and other events (weddings, family reunions, training sessions, Native American groups, astronomy groups, etc.). Revenues from these special use group activities are critical to filling in the gaps between primary target user groups in generating sufficient revenues for the facility to be financially self-sufficient.

- As the level of site development increases, so will market penetration and potential days of use per year.

- Increased use increases potential revenues proportionally, while many operation and maintenance costs are fixed.

- Grants and donations may contribute somewhat to capital and replacement costs, but more likely to development of educational materials and scholarships.

Observations

- The Rustic (Alternative A) scenario represents the least amount of monetary risk, though likely also represents the lowest rate of site utilization, especially for the target environmental education market. Other special interest groups (kayak outings, triathlon and bicycle races, etc.) will still be attracted to the more rustic facilities of Alternatives A and B.

- Given existing information, convenience camping (tent cabin and rustic cabin Alternatives B, C and D) represent a unique development type for the Lake Berryessa region. Until other facility concession agreements are finalized by the Bureau of Reclamation, we assume that Camp Berryessa will not significantly compete with current or anticipated private or public sector facilities; this assumption could change depending on what new private concession facilities are approved by the Bureau of Reclamation.

- Hosting general events such as bass tournaments, weddings, and other public group uses may compete in the future with other Lake Berryessa facilities, although there are currently no similar facilities at the Lake area.

- Camp Berryessa is ideally positioned to work with Napa area schools, which had during this research no formal connection with a science or outdoor education facility.

- There may exist opportunities to work with several University of California, Davis science departments (for example Lake Berryessa is home to a robust raptor population and UCD has a raptor research center).

- Sponsorship and or donation opportunities may be developed with Napa county businesses including the wine industry and its association with the enology institute and the UC Davis.

- The highest percentage of students that might use the facility is assumed to come from within the home county of Napa. Though a small overall population, we would expect a fairly dramatic increase in the number of Napa County 5th graders attending a Camp Berryessa science camp as the site features more amenities and as the site manager develops closer relationships over time with Napa County schools.

- The next most important market is in the sub-regional market or adjacent county schools. We assume a somewhat lower percentage of attendance from them due to distance and the availability of other competitive camp locations.

- The large regional Sacramento Valley and San Francisco Bay markets need limited market penetration activity in order to provide good numbers of attendees. However, even as the site is developed with greater amenities, distance and competing alternatives will mean that market growth in these regions will be steady and moderate.

- Finally, a percentage of use may be targeted toward other special use groups. A successful science and environmental education camp project will need to have flexibility in its programming, especially in initial facility development years, when it may need to offer facilities to the general camping public. However, in the long term we do not anticipate that the site will need to offer facilities to the general camping public; rather targeted group use – many within the overall science and environmental mission – should be adequate.

- Some of these groups may include but are not limited to:
    - Other education groups including high school, community college, and university.
    - Kayak and canoe camps and eco tours up the adjacent the creek watershed.
    - Other associated boating groups
    - Trails and hiking groups.
    - Birding and associated wildlife viewing groups.
    - Scouting and other youth groups.
    - Stargazing and astronomy groups.
    - Other science or heritage oriented groups
    - Retreats for corporate, eco, or teacher education purposes.
    - Training, especially water rescue and emergency response.

Primary Conclusions

- The market and economic analysis indicates that the Camp Berryessa project is feasible. However, this feasibility is dependent on a range of assumptions including market penetration and visitation growth, adequate fee structure, professional management, an active marketing program, and the capacity to build relationships with educators and other stakeholders in the immediate region.

- Given the necessary use levels, fees, and associated operations and maintenance costs, we recommend a phased approach beginning with Alternative A, but targeting Alternative D type development as the final objective. Accordingly each development alternative could serve, in some form, as a phase in long term facility planning. This approach allows Camp Berryessa management the opportunity to generate grants and other capital development funding, build stakeholder partnerships, establish programming, identify potential education audiences, attract early user groups, and begin to assess the extent to which special users other than education specific use may be attracted to the facility. In short, developing Camp Berryessa into a successful Napa County education institution and special use destination facility will take time and a sustained long-term effort.

INTRODUCTION

This section provides a market and economic analysis for the *Camp Berryessa Feasibility Study and Master Plan* document. The following analysis, findings and recommendations are designed to first, determine the project's economic feasibility – either a go or no-go finding – and secondly, identify the conditions necessary for success. The market and economic analysis has been conducted for Questa Engineering (QE) – the prime consultant on the project. The Camp Berryessa planning work has been commissioned by the Napa County Regional Park and Open Space District (Napa County Parks).

Facility Site

While a detailed analysis of the subject site is discussed elsewhere in the overall planning document, this introduction describes those characteristics that may impact Camp Berryessa's comparative advantages or disadvantages in the destination science education camp or group use market. Accordingly, Camp Berryessa features several distinguishing elements that differ from other facilities. These include:

Lake Berryessa shoreline access. The most advantageous feature is the site's peninsula shape as it extends into the Putah Creek arm of Lake Berryessa. Direct access to a recreational water body is relatively unique and in fact is in static supply in Northern California with no new reservoir construction anticipated in the foreseeable future. While new development on existing lakes in Northern California may occur – including general public facilities on Lake Berryessa – the region's growing population and the limited number of recreational lakes and reservoirs puts any planned recreation site development on Lake Berryessa in a very positive competitive position.

PHOTO 1: CAMP BERRYESSA SHORELINE ACCESS *(Low Water)*

Source: Chuck Nozicka Consulting

Putah Creek recreation use patterns. According to observed physical properties and input from Napa County Parks, the waters around Camp Berryessa are open to limited motorized boat use. Jet ski and water-ski recreation, which is quite loud, takes place several hundred yards off shore, especially on peak summer weekends when windy conditions make such recreation on the open waters of Lake Berryessa less attractive. However, the Bureau of Recreation has indicated that if Camp Berryessa is developed, it will be allowed to install floating booms to prevent such motorized boating in the area closest to the camp, and beginning a relatively short distance to the north heading up Putah Creek the waterway narrows, thereby eliminating noisy high speed motorized craft, thus allowing for safe and enjoyable paddle craft use. As a result, Camp Berryessa is blessed with maximum flexibility for aquatic programming.

Camp Berryessa site topography. Lake access is further enhanced by site topography which allows easy walk-to shallow water access. As a result the site may provide numerous aquatic programming opportunities that can serve large groups concurrently. Limitations such as steep slopes, single access entry points, or deep water limits do not exist at the subject site. In addition, the site's relatively gently sloping topography allows for good recreation user sight lines to the water further enhancing the sites attractiveness to potential education and associated recreational users groups.

PHOTO 2: CAMP BERRYESSA VIEW TO LAKE

Source: Chuck Nozicka Consulting

Ingress and site privacy. The Camp Berryessa site is immediately adjacent to the Knoxville-Berryessa Road, – the primary access to Lake Berryessa recreational facilities on the north side of the lake – thus providing easy access for those arriving at the site. Note also that the site features an existing private access road and a shape and topography that provide significant privacy features, thus limiting unauthorized intrusion by means other than waterborne craft. For education camps and targeted associated group use these two access features lend further comparative advantage to the proposed Camp Berryessa.

PHOTOS 3 & 4: ACCESS FROM LAKE BERRYESSA ROAD (left photo)
CAMP BERRYESSA PRIVATE ACCESS ROAD (right photo)

Source: Chuck Nozicka Consulting

Site size. The subject site consists of approximately 10 acres with the site shape and lake boundaries limiting any further expansion. Other comparable facilities are significantly larger or have land areas available for growth. Accordingly Camp Berryessa has a limited development capacity, with long term use growth confined to additional days of use rather than single day user volume. Potential growth is also constrained by available water supply and wastewater disposal limitations.

Objectives

This section provides an assessment of the project's market and economic feasibility with the work conducted via completion of the following tasks:

1) Market analysis. The primary mission proposed for Camp Berryessa is as a science education facility. Within Napa County the grade for standardized elementary level science testing is the 5th grade, though many school districts offer science camp opportunities during the 6th grade as well. For purposes of this report we will use 5th grade student populations in our analysis.

   To further identify market potential beyond this education level we infer possible other targeted recreational use growth via a profile of the region's overall population trends. Finally we present a brief discussion of recreation use trends for those activities that may be provided at Camp Berryessa or are available in the immediate vicinity and that may serve future demand.

2) Comparable facilities. We have identified other facilities within the market area (existing and planned) which serve targeted users, describe their operations (location, amenities and services, fees, types of users and occupancy rates), and then utilize this information to provide a range of market penetration and revenue scenarios for each of the four design Alternatives (A, B, C and D). Comparable facilities investigated for this analysis include:

- Walker Creek Ranch
- Clem Miller Environmental Education Center at Point Reyes
- Emandal Family Camp
- Mendocino Woodlands
- The Farm at Putah Creek
- Coloma Outdoor Discovery School, etc.
- Sly Park Environmental Education Center
- Slide Ranch
- Camp Arroyo, YMCA Environmental Education Camp
- Caritas Creek Environmental Education Program
- Camp Latieze
- Camp Adahi
- 4-H camp at Las Posadas

3) Financial pro forma for development concepts. We utilized the market profile data and the information collected from comparable facilities to develop a range of revenue scenarios for each development alternative. We applied operations and maintenance estimates to these scenarios to identify the range of use and fees for each development concept that may be necessary for economic sustainability. These four development concepts or alternatives include:

   - A, Rustic. Tent camping and amenities.
   - B, Enhanced rustic. Tent cabins and amenities.
   - C, Enhanced rustic with central facilities. Tent cabins, central kitchen and dining and amenities.
   - D, Enhanced rustic with central facilities and services. Cabins, central kitchen and dining, amenities, and services.

Phased Development. Alternative D appears to be the preferred alternative from an economic feasibility perspective, but because of high annual operation and maintenance costs, also presents the highest economic risk. Alternative D also requires a substantially higher initial investment which, in the current economic climate, will be challenging to fund. Alternative A has the least initial costs and presents the lowest risk. The preferred alternative is therefore a phased development process, starting with Alternative A or Alternative B, and working toward ultimate build-out along the lines of Alternative D. In addition to phasing development, it will also be necessary to maintain flexibility in terms of programs and user groups. In this regard, it is important to note that all alternatives contain discrete activity nodes to allow for the camp to be used by one or more groups of different sizes at the same time. The layouts for each alternative are also compatible with each other, so that infrastructure put in place under Alternative A would be usable when the camp is upgraded to Alternative B; similarly Alternative B improvements could be upgraded over time to Alternative C, and Alternative C improvements could be upgraded further to full build-out along the lines of Alternative D. 4. Research Methodology. The research approach for this analysis relies on secondary data including general population and school enrollment data derived from the California Department of Finance Demographics Unit, and recreation demand information from the California State Parks *2009 Survey on Public Opinions and Attitudes on Outdoor Recreation in California*.

In addition, we have gathered available information from a range of identified comparable facilities through on-site interviews, telephone interviews, and via internet based research. We have then used the demographic and comparable information to develop a range of facility annual occupancy, student, and fee assumptions. Via these assumptions we calculate a low, mid, and high revenue and market penetration scenario for each Camp Berryessa Development alternative.

Research Limitations

Because we rely on secondary data sources, the analysis contained in this report approximates potential development at the Camp Berryessa site including scenarios ranging from low to high use and low to high revenue estimates. However, actual use levels will depend on a range of future demand conditions, including but not limited to: general and school population fluctuations, school curriculum and funding, macro economic conditions and regional employment, the types of facilities which are developed at Lake Berryessa by the private sector pursuant to new concessionaire agreements which the Bureau of Reclamation is currently negotiating, and finally, the selected Camp Berryessa site management model and marketing approach.

In addition, comparable information varied greatly in terms of quantity and specificity. In most cases estimates of visitation were necessary, with several comparables directing us to the facility internet site for the most recent information. Finally, while we did collect budget and cost data at several comparables – primarily from private and not-for-profit operations – facility managers were reluctant to provide what was viewed as propriety financial or competitive positioning information. Accordingly, the projections included in this section of the report represent the best professional opinion of the consultant and as such are intended to function as a planning tool for Camp Berryessa stakeholders, decision-makers, land and facility managers, and elected officials.

MARKET TRENDS

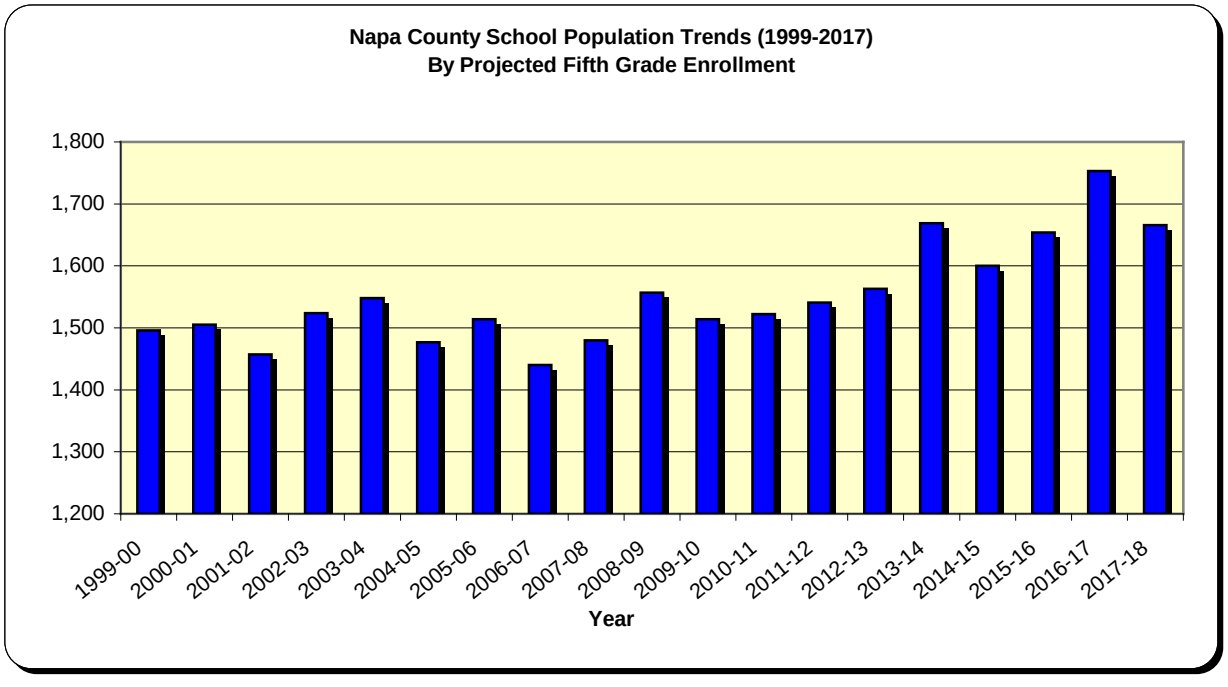
At this stage in the planning process the primary stated mission for a future Camp Berryessa facility is to function as a science and environmental education facility, as a result we have focused on school enrollment trends and projections as source data for projected development scenarios. In addition, we provide a wide market perspective by looking at pertinent regional general population trends and a recent survey of statewide attitudes toward outdoor recreation to further investigate demand, especially for those activities that may be made available at Camp Berryessa. In order to guide the analysis we have identified four primary geographic market areas including the following:

- Napa County
- Adjacent counties (Lake, Marin, Solano, Sonoma, Yolo and Colusa)
- Sacramento Valley (Valley counties most proximate to Lake Berryessa: Sacramento, Sutter, San Joaquin)
- San Francisco Bay Area (Bay Area counties most proximate to Lake Berryessa: Contra Costa, Alameda, San Francisco, San Mateo, Santa Clara)

School Enrollment Trends

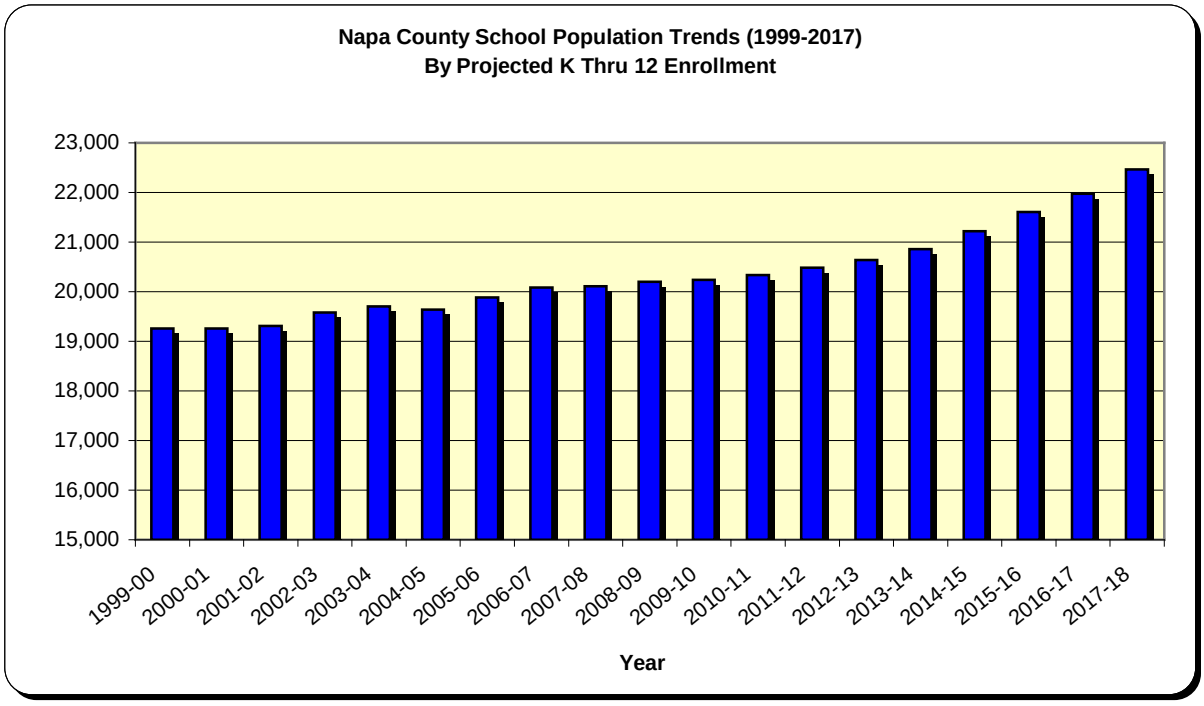
Projected 5th grade enrollments show steadily increasing growth among Napa County student populations, with 2010 fifth grade enrollment at 1,514, rising to 1,666 by 2018. (See Figure 1.) Overall K-12 enrollments also show steady projected increases from a 2010 enrollment of 20,337, rising to 22,462 by 2018. These data indicate rising demand for facilities such as the proposed Camp Berryessa. (See figure 2.)

FIGURE 1: NAPA COUNTY FIFTH GRADE ENROLLMENTS



Source: California Department of Finance, Demographics Unit

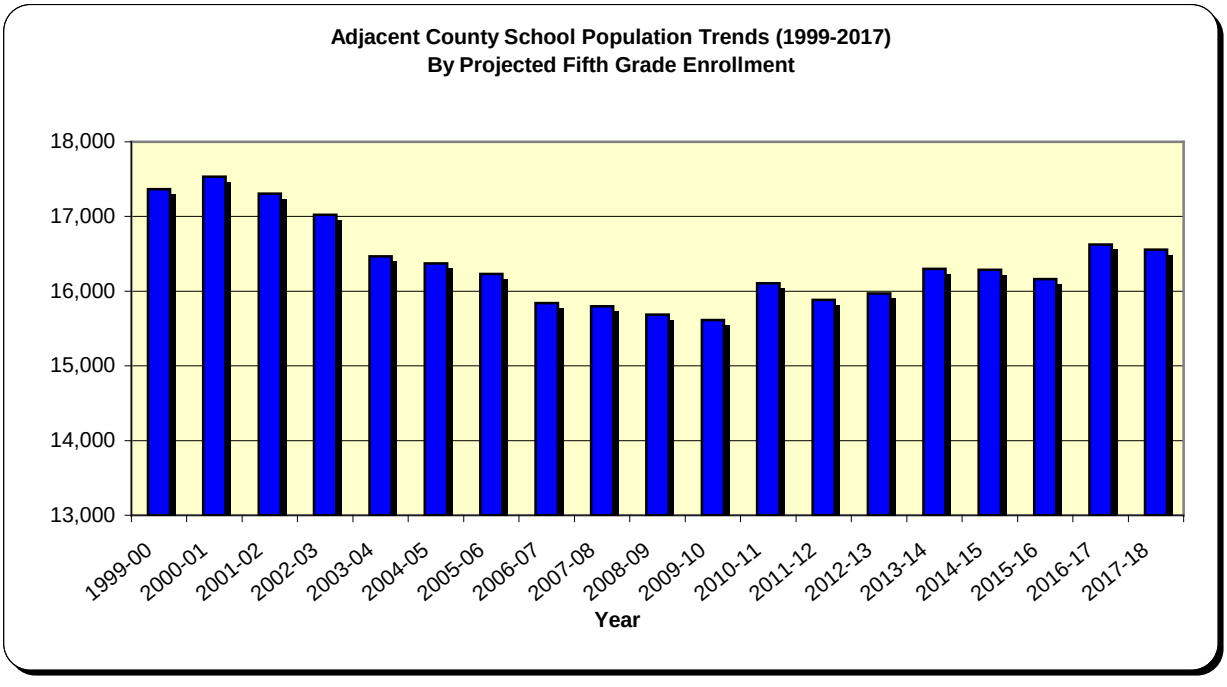
FIGURE 2: NAPA COUNTY K-12 ENROLLMENTS



Source: California Department of Finance, Demographics Unit

Among adjacent counties, 2010 fifth grade enrollment totals 15,615 students, with enrollments projected to slowly rise to 16,556 in 2018. See Figure 3.

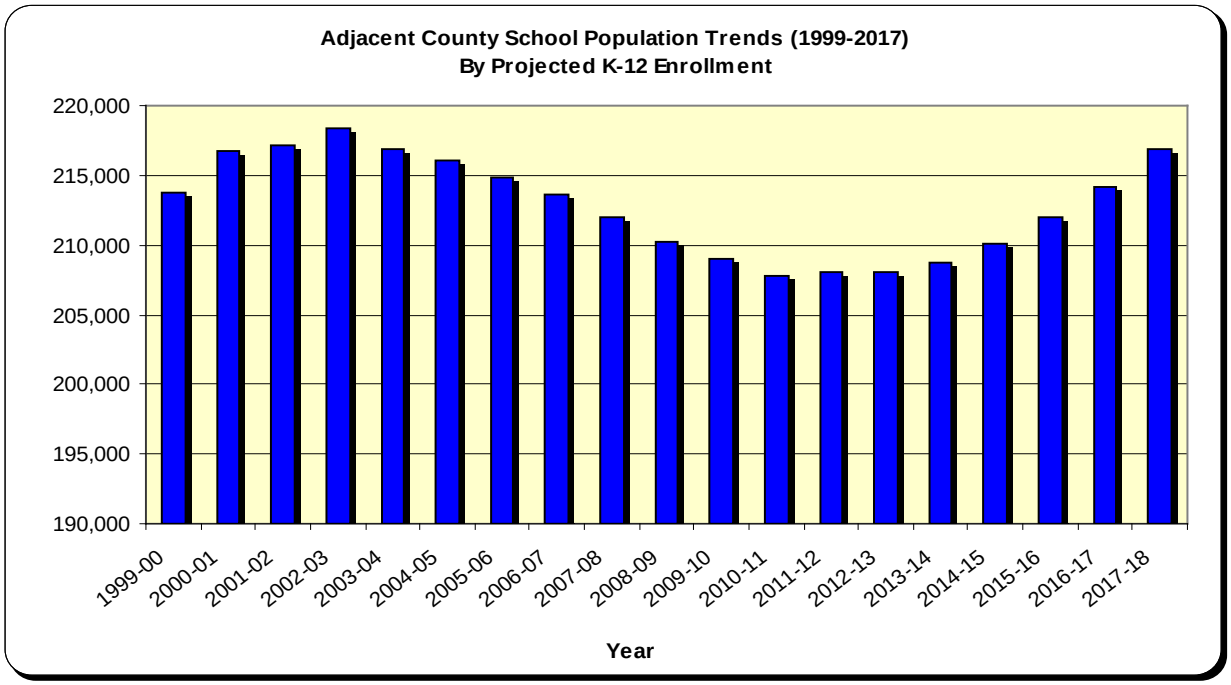
FIGURE 3: ADJACENT COUNTY FIFTH GRADE ENROLLMENTS



Source: California Department of Finance, Demographics Unit

Overall K-12 enrollments in adjacent counties rise from 208,954 in 2010 to 216,812 in 2018 indicating slow but steady growth among youth populations and continued demand for facilities such as proposed Camp Berryessa. See Figure 4.

FIGURE 4: ADJACENT COUNTY K-12 ENROLLMENTS



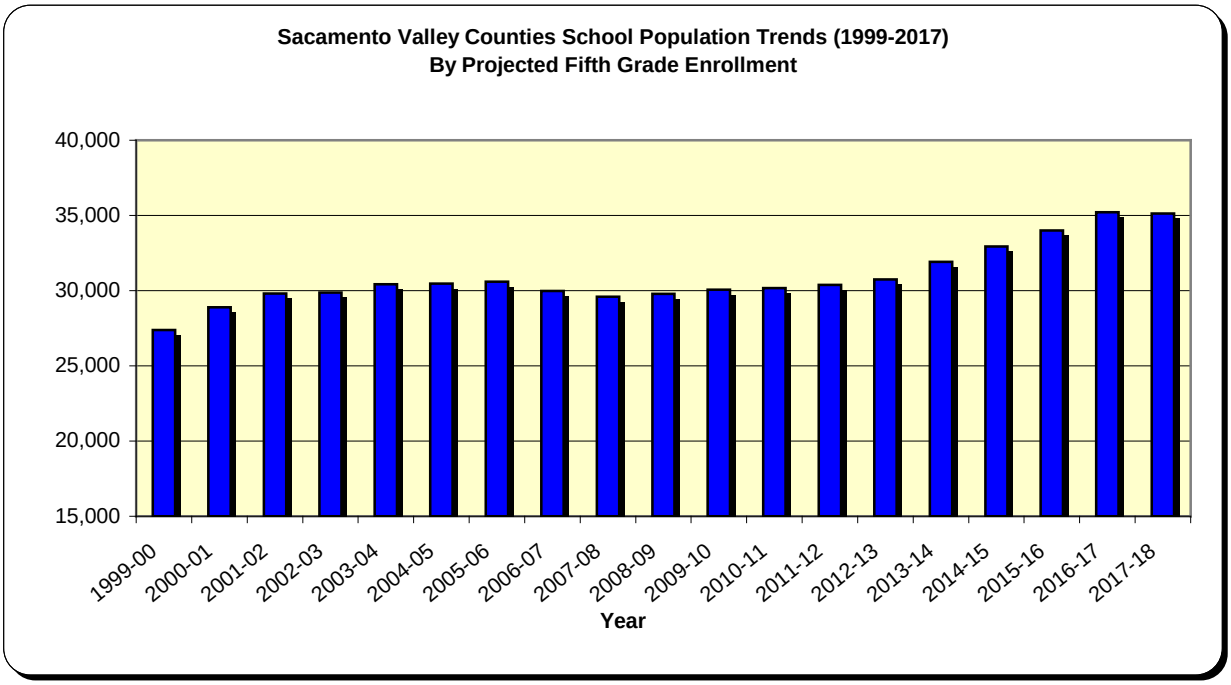
Source: California Department of Finance, Demographics Unit

Enrollment projections for the larger Sacramento Valley and San Francisco Bay Area regions are significant, simply because of the total numbers of students. Fifth grade enrollments in the selected Sacramento Valley counties alone exceed Napa County total K-12 numbers, with total science grade 2010 enrollment of 30,069. This number is projected to rise to 35,134 by 2018. (See Figure 5.)

Overall K-12 Sacramento Valley 2010 enrollments total 395,058 students, with strong growth rates projected. As indicated, this market remains robust even with the current economic contraction. Of course market in-roads into existing science programs that may have well established working relationships with facilities comparable to those proposed at Camp Berryessa will take time and effort. (See Figure 6.)

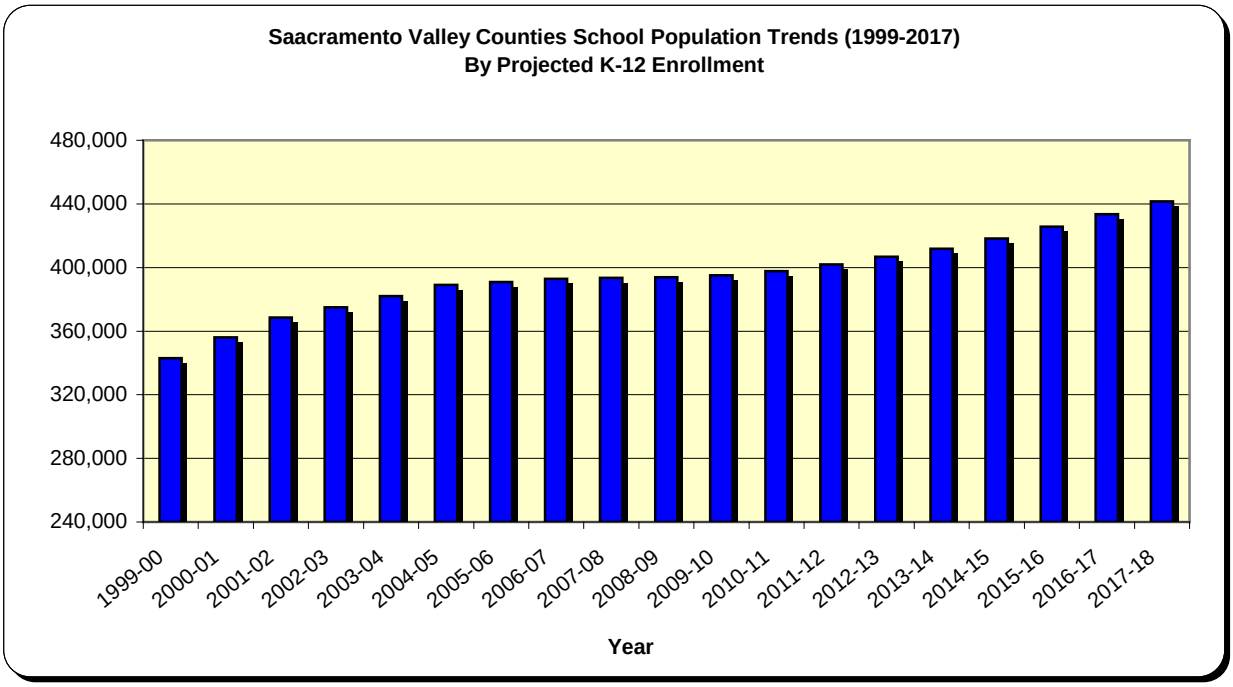
The San Francisco Bay Area by virtue of its aggregate population provides significant numbers for science education and associated youth destination facilities. In fact, many of the researched comparables currently market to and rely on student markets from the greater Bay Area. Interestingly, projected growth rate among student populations in the Bay Area show static or slightly declining numbers – with this trend reflected in fifth grade projections. While the sheer size of the Bay Area offers opportunities for Lake Berryessa, capturing market share from competing facilities will be somewhat more difficult in this region. (See Figures 7 and 8.)

FIGURE 5: SACRAMENTO VALLEY FIFTH GRADE ENROLLMENTS



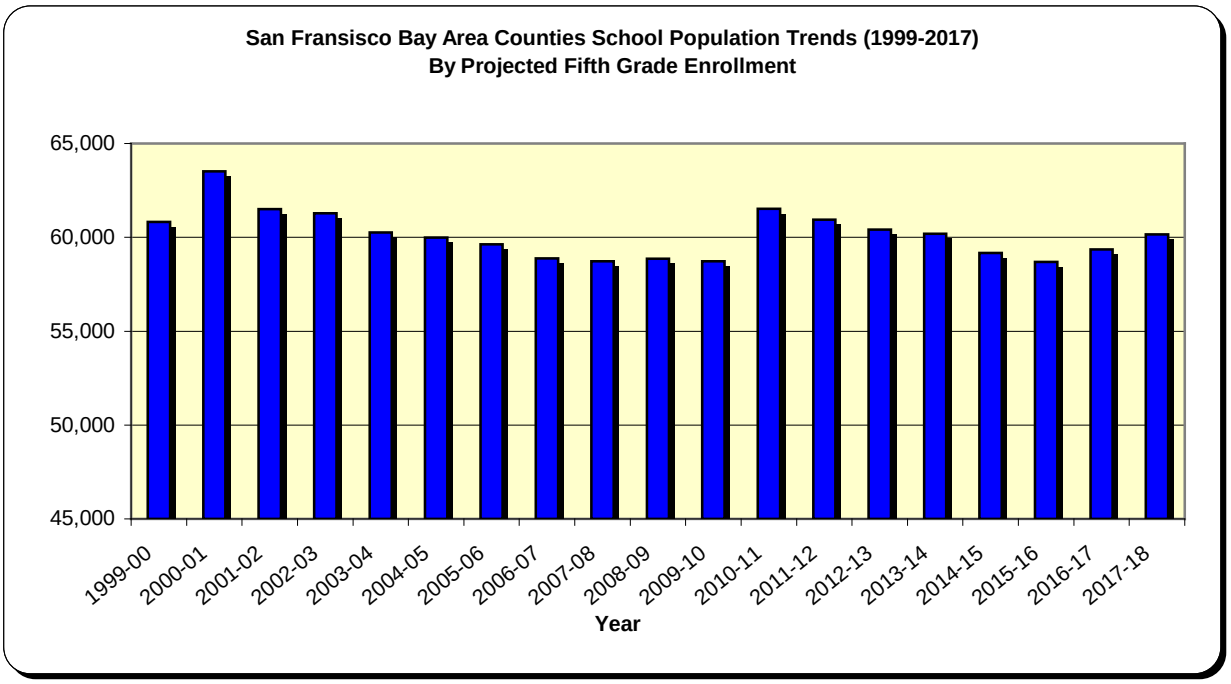
Source: California Department of Finance, Demographics Unit

FIGURE 6: SACRAMENTO VALLEY K-12 ENROLLMENTS



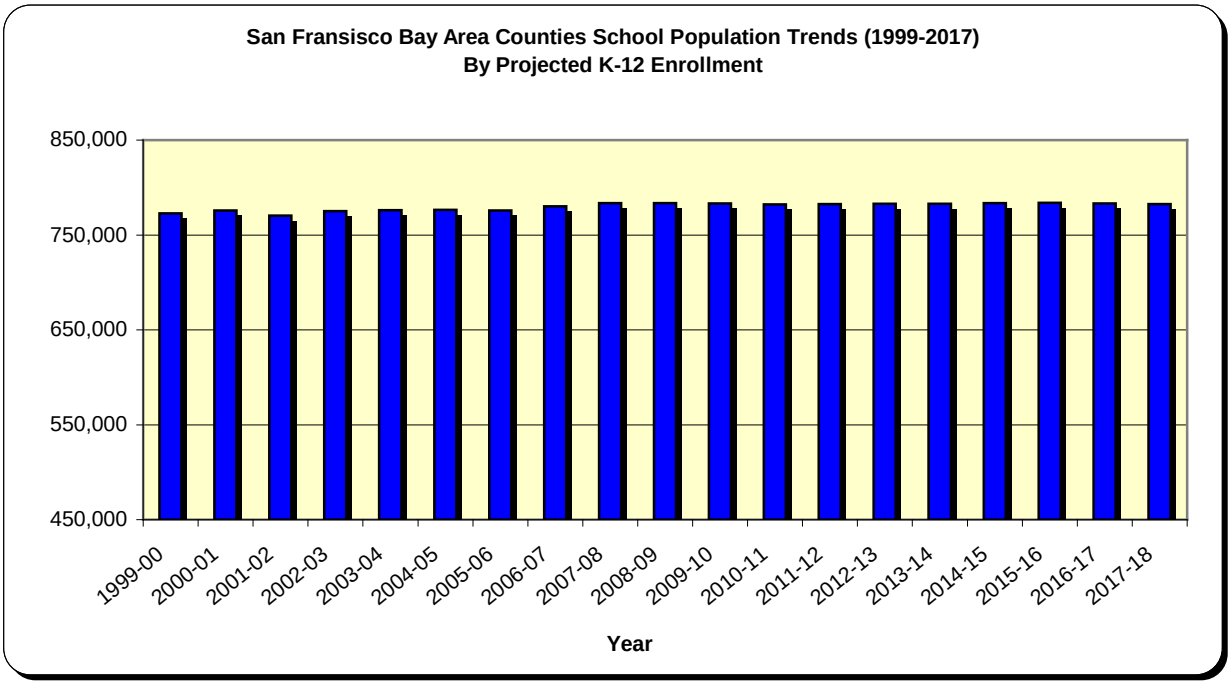
Source: California Department of Finance, Demographics Unit

FIGURE 7: SAN FRANCISCO BAY AREA FIFTH GRADE ENROLLMENTS



Source: California Department of Finance, Demographics Unit

FIGURE 8: SAN FRANCISCO BAY AREA K-12 ENROLLMENTS

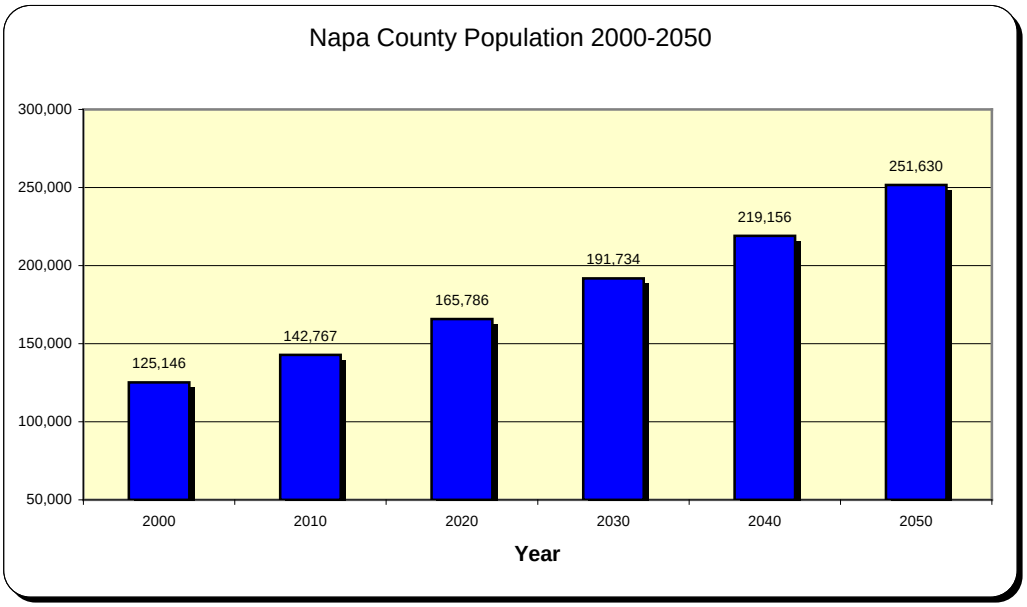


Source: California Department of Finance, Demographics Unit

Population Trends

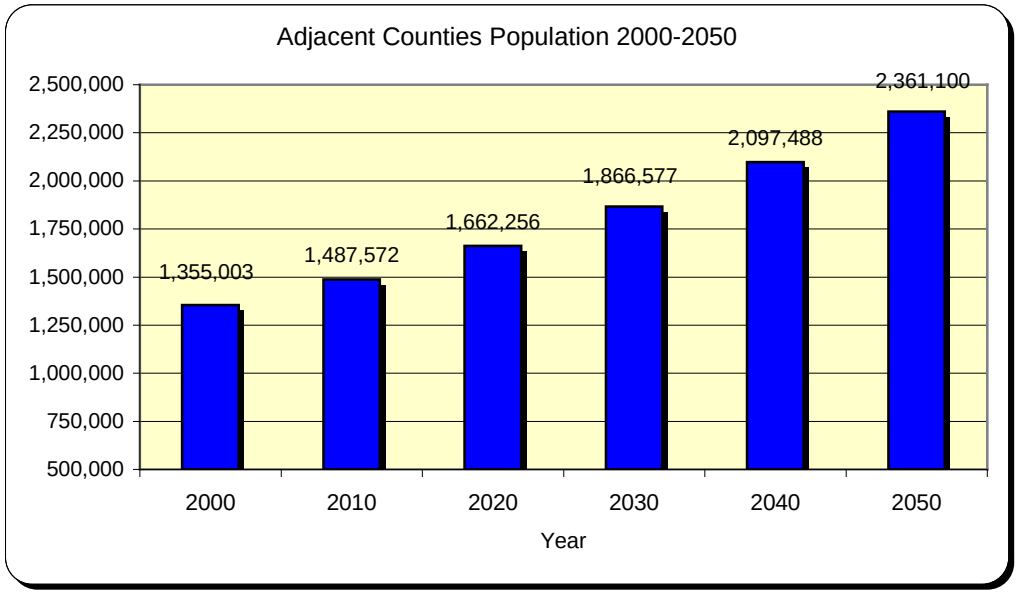
Long term population trends indicate continued market demand for lakeshore recreational facilities and imply anticipated long term demand by special use groups for facilities like those that can be provided at Camp Berryessa. To the extent that Camp Berryessa may augment science education activities with visitation by other targeted group use, the trends and volume among potential visitors is strong. These trends show steady and active growth among the most accessible regional markets of Napa County and adjacent counties. See Figures 9 and 10.

FIGURE 9: NAPA COUNTY POPULATION PROJECTIONS



Source: California Department of Finance, Demographics Unit

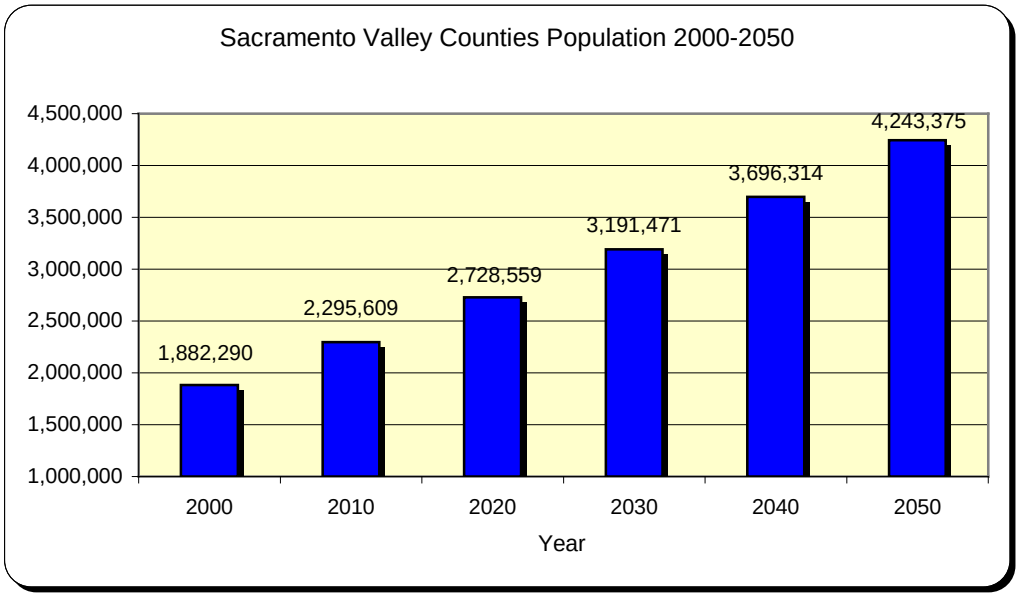
FIGURE 10: ADJACENT COUNTY POPULATION PROJECTIONS



Source: California Department of Finance, Demographics Unit

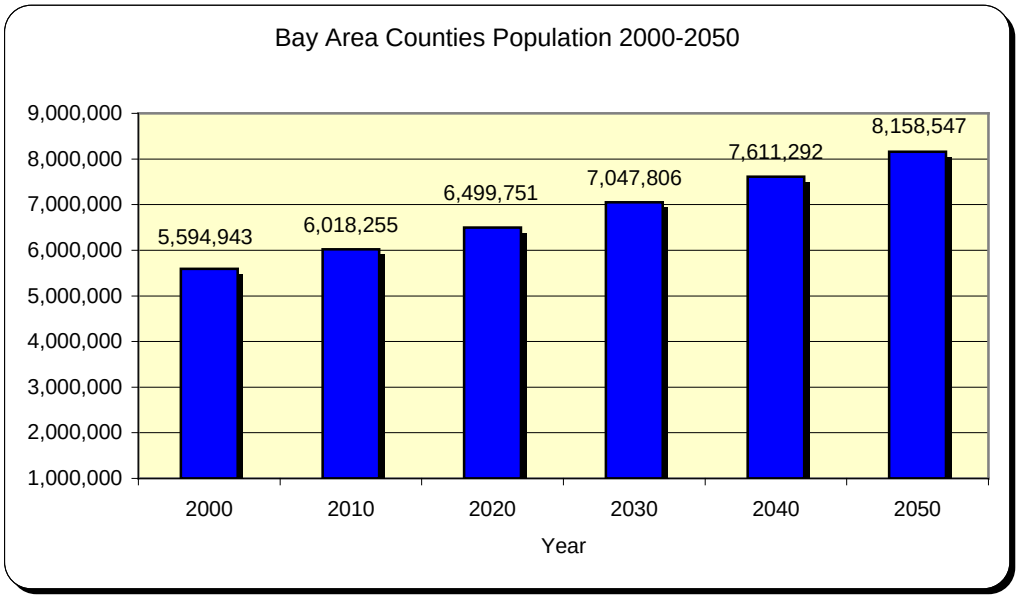
By virtue of their size, both populations in the Sacramento Valley and in the Bay Area can provide a source for targeted special interest user groups. The supply of lake shore facilities such as those proposed for Camp Berryessa, are not expected to dramatically increase, especially considering current economic conditions. Population trends however, continue to show growth, thus indicating strong long-term demand for Camp Berryessa among special interest and recreation user groups that may be targeted to augment the facility's primary science education mission. See Figure 11 and 12.

FIGURE 11: SACRAMENTO VALLEY COUNTY POPULATION PROJECTIONS



Source: California Department of Finance, Demographics Unit

FIGURE 12: SAN FRANCISCO BAY AREA COUNTY POPULATION PROJECTIONS



Source: California Department of Finance, Demographics Unit

Recreation Demand

Recreation research has consistently shown that Californians rate outdoor recreation areas, services, and facilities as essential to their quality of life. The most recent survey of attitudes toward recreation conducted by California State Parks (*Public Opinions & Attitudes on Outdoor Recreation in California 2009*) provides insight into the demand for those activities that may be made available at Camp Berryessa. The study demonstrated both adult and youth participation in, and unmet demand for, a variety of outdoor recreation activities within natural, undeveloped areas as well as those provided by developed nature-oriented parks and recreation areas.

Activity Participation Rates

Among the studied outdoor recreation preferences, several high participation outdoor activities were identified that may be made available at Camp Berryessa or, are accessible in the Lake Berryessa recreation area. See Figure 13. Foremost among the outdoor recreation rated by surveyed adults are beach activities (59.2%), day hiking (46.9%) wildlife viewing and bird watching (45.9%) and camping in developed sites with facilities (39.0%). A second tier of preferred activities includes outdoor photography (33.3%), swimming in freshwater lakes (31.2%), freshwater fishing (21.4%), and paddle sports (15%). These preferences indicate that Camp Berryessa may be well-positioned as a group use destination, as all of these can be accommodated at Camp Berryessa.

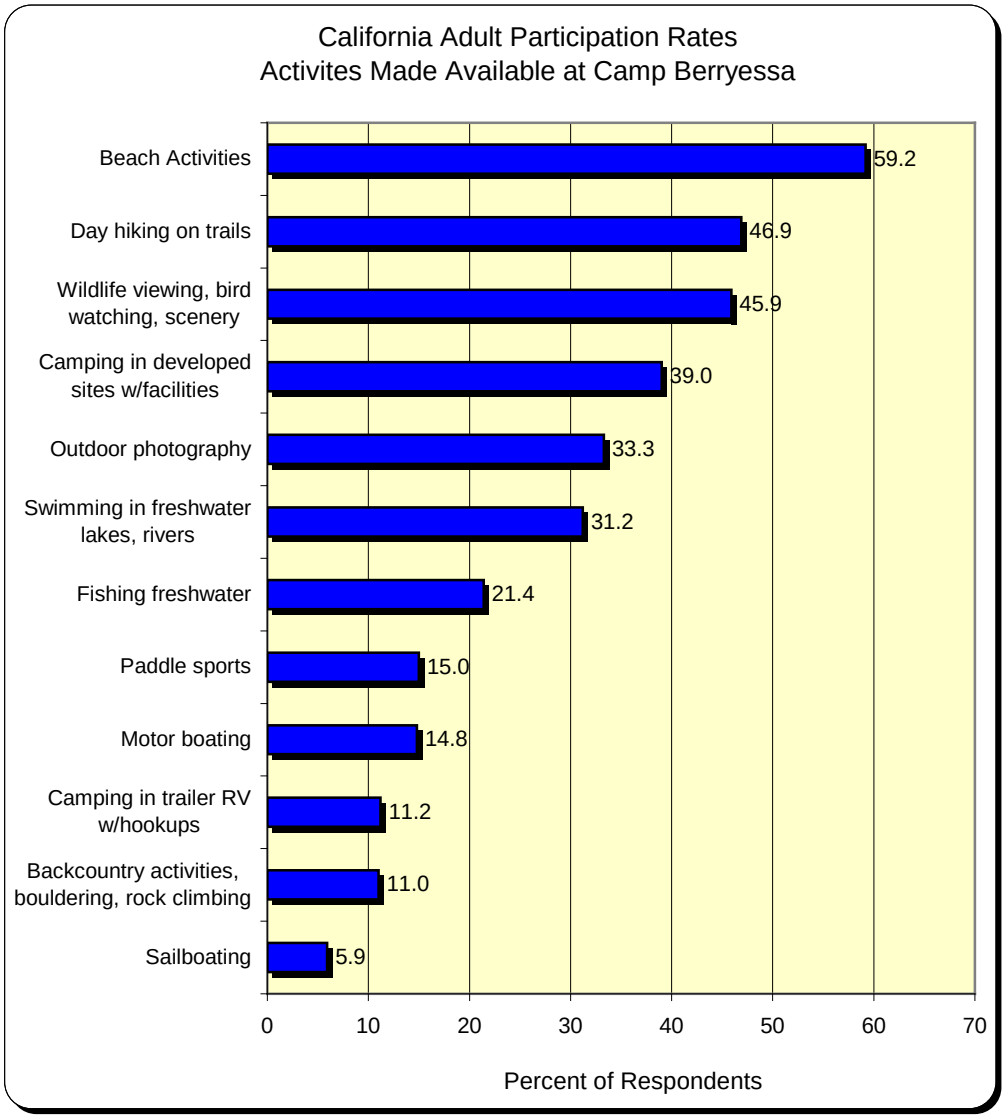
Among surveyed youth, participation rates for many of these same activities that may be made available at Camp Berryessa are higher than those for adults, and include beach activities (69.8%), day hiking (51.1%), picnicking (50.6%), and camping in tent or RV (45.1%). A second tier of youth outdoor recreation shows robust interest including wildlife viewing and bird watching (37.3%), fishing (29.2%), paddle sports (24.4), and rock climbing (24.4%).

Latent Demand for Recreation Activities

In addition, the California State Parks study listed activities that would have had higher rates of participation if opportunities to participate had been available to respondents – these responses were used to identify latent demand for a range of outdoor recreation activities. In other words, an identified undersupply for these activities is greater than known levels of participation, with an associated need for facilities that support the specific listed activities. Figure 14 shows activities by adult respondents that may be made available at Camp Berryessa but that are in under supply including, camping in developed area with facilities (45.0%), day hiking (44.1%), picnicking (41.9%), and beach activities (41.7%). An additional second tier of activities may also be featured at Camp Berryessa including wildlife viewing and bird watching (32.4%), outdoor photography (28.4%), swimming in lakes (28.2%) and fishing (28.1).

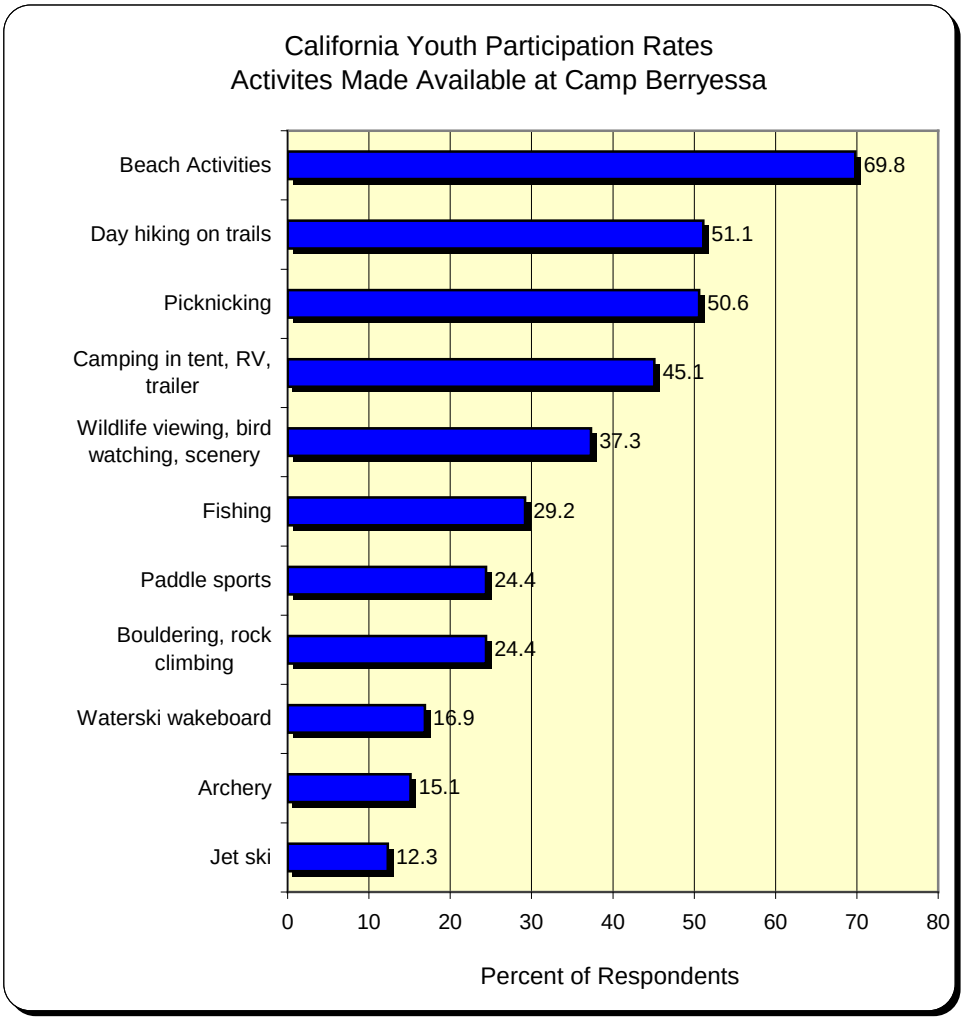
As shown in Figure 15, one if this study's most interesting findings were the array of outdoor recreation activities that youth say are in undersupply and that they would do more if made available to them. Camp Berryessa offers many of these activities and thus is well positioned to host education camps that offer outdoor recreation as an additional activity or for targeted youth groups seeking outdoor recreation activities as a primary focus. Camp Berryessa can offer a critical opportunity for the region's young people to learn about and enjoy California's outdoor environment.

FIGURE 13: RECREATION PARTICPATION BY ADULTS



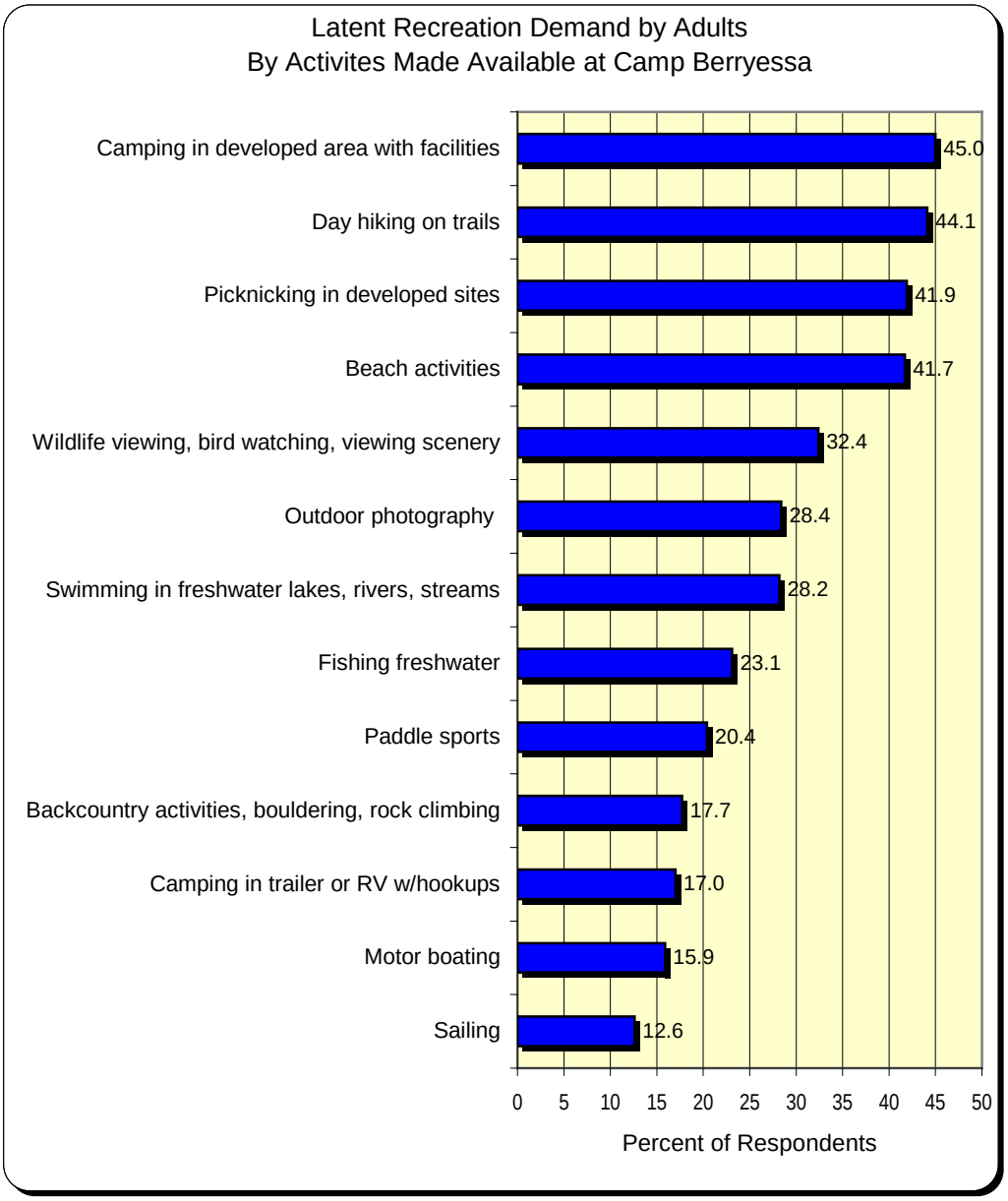
Source: California State Parks

FIGURE 13: RECREATION PARTICPATION BY YOUTH



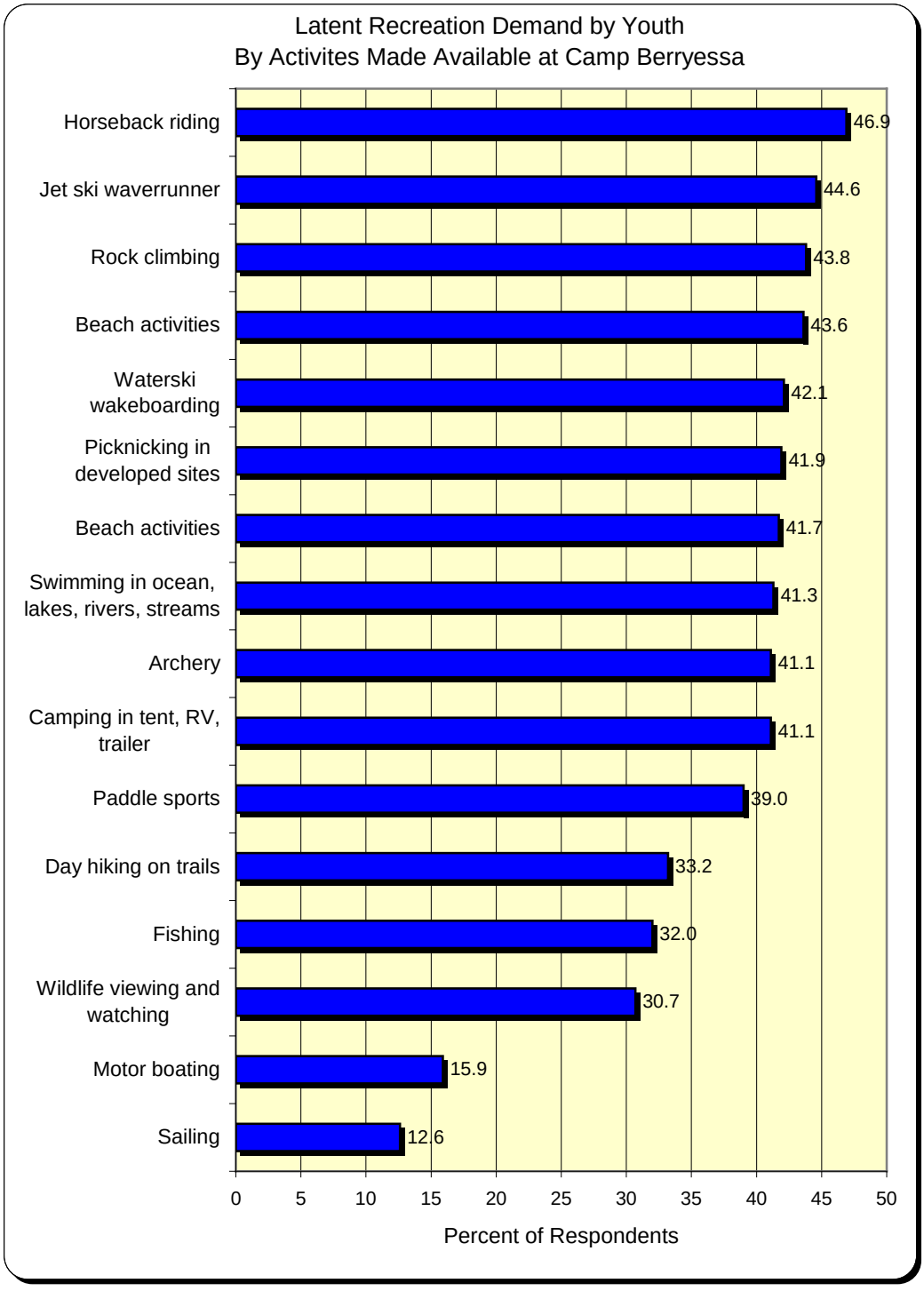
Source: California State Parks

FIGURE 14: UNMET RECREATION DEMAND BY ADULTS



Source: California State Parks

FIGURE 15: UNMET RECREATION DEMAND BY YOUTH



Source: California State Parks

COMPARABLE FACILITIES

This part of the report reviews the selected comparable facilities used for the revenue and market penetration estimates. We have included information gathered during sites visits, telephone interviews, mailed materials such as annual reports, and available via internet research. To inform the analysis we gathered several categories of information including the following:

- Facility type (by Camp Berryessa development alternatives)
- Property size (acres)
- Programming (education and other)
- Facilities (accommodations, and central facilities)
- Budget (annual operating budget)
- Annual visitation (visitor days – one visitor per one day of visitation)
- Visitor origin (geographic origin of student attendees)
- User group (student and others served)
- Length of Stay and PAOT (average length of stay, average number of persons-at-one-time, and facility capacity)
- Program fees (fees per average stay or per night)

The following provides a narrative description of the selected comparable facilities followed by a summary table listing all pertinent data available for each.

Point Reyes/Clem Miller Educational Center

Point Reyes National Seashore
Point Reyes, CA
Enhanced Rustic with Central Facilities – No Services

The Clem Miller Education Center is a part of the Point Reyes National Seashore and contains a 4,500 square foot central lodge with a dining hall, science room, teacher's room and a fully equipped kitchen. The central bathroom facility includes solar-heated showers. Accommodations are made up of four 16-person and one 20-person dormitory style cabins to house up to 80 people. A separate building has an infirmary, laundry room, two bunk rooms and a manager's office. None of the structures are heated.

The Clem Miller Center does not provide programs to visiting students and teachers. With the exception of the manager, the center is not staffed and visiting groups must therefore provide their own education programs and services, including food preparation, cleaning and student supervision. Teacher training workshops provided throughout the year are mandatory prior to classes coming to the center. The workshops are curriculum-based and comply with the California State Science Framework. Approximately 85% of attendees originate in Bay Area counties, with the remainder coming from other Northern California counties.

PHOTOS 5, 6, 7, & 8: STUDENT DORMS (upper left photo)
SHOWER AND BATHROOMS (upper right photo)
CENTRAL BUILDING KITCHEN AND MEETING ROOMS (lower right photo)
GROUP BUILDING INTERIOR (lower left photo)




Source: Chuck Nozicka Consulting

Walker Creek Ranch

1700 Marshall-Petaluma Road
*Petaluma, CA
Enhanced Rustic with Central Facilities and Services

Walker Creek Ranch is operated by the Marin County Office of Education. It is a 1,741 acre property serving as an outdoor school, conference center and summer camp facility. Structures include 14 dormitory-style cabins that sleep 8-12 people, six semi-private lodges accommodating two to five beds per room, a central dining hall, a central bathhouse with showers, a ranch store, community garden, an outdoor amphitheatre, 20 miles of hiking trails, a challenge course and waterfront facilities with swimming and canoeing. The property receives approximately 10,000 visitors per year. Meals are provided by staff.

*Petaluma Post Office, but located in western Marin County.

In addition to the Marin County Outdoor School and the summer camp, (Camp Soulajule), it is available to the general public as a retreat and conference center. The Outdoor School offers four and five-day residential camp experiences primarily for fifth and sixth grade students, and is fully staffed. It is a member of the California Outdoor School Administrators (COSA), a statewide body of County and District operated residential outdoor science schools, and complies with California curriculum standards. Approximately 80% of attendees originate in Marin County, with the remainder from adjacent counties.

Sly Park Environmental Education Center

5600 Sly Park Road
Pollock Pines, CA
Enhanced Rustic with Central Facilities and Services

The Sly Park Environmental Education Center is a non-profit facility operated in cooperation with the Sacramento County Office of Education. Situated on a 27-acre property, the center's accommodations have a capacity of approximately 200, and include eight 26-bed cabins, one 16-bed staff cabin, and a central dining/cafeteria building with fully staffed kitchen. All cabins are heated and include bathrooms. Also on the property are classroom buildings, a gymnasium with adjacent outdoor sport court, and an additional structure containing staff offices. The center receives approximately 8,000 visitors per year.

Education programs last 3, 4 or 5 days and conform to California curriculum standards. Over 90% of the students attending are in the sixth grade, less than 10% are fifth graders. Approximately 75-80% of students are from within Sacramento County. The additional 20-25% of attendees originates in 10 surrounding counties but primarily come from those adjacent to Sacramento County. Facility rental by non-student groups is reserved for the summer months and weekends from March through October each year.

PHOTOS 9 & 10: OOUTDOOR AMPHITHEATER (left photo)
DORM BUILDING (right photo)

Source: Chuck Nozicka Consulting

Camp Arroyo, YMCA Environmental Education Camp

5535 Arroyo Road
Livermore, CA
Enhanced Rustic with Central Facilities and Services

The YMCA's Camp Arroyo is a 138-acre green-built facility completed in 2001 and is made up of six 24-person cabins, a dining hall with multi-purpose room, two bathhouses and a pool. These facilities accommodate 144 campers and staff. The proposed Phase II will add additional permanent facilities for the residential environmental education part of the project, providing service to 225 campers and staff, and is expected to be completed over a five to ten-year period.

Educational programs include the East Bay Outdoor School, a 3-5 day residential environmental education for third through sixth grade students. During the summer months, the property is used as a camp for children with life threatening illnesses. East Bay Regional Park District coordinates the residential environmental education program; The Taylor Family Foundation is responsible for the summer camp program. Camp Arroyo is also rented for business retreats, conferences, youth groups and special events. Approximately 70% of the attendees to the East Bay Outdoor School originate in Alameda and Contra Costa Counties. The remaining visitors arrive from other Bay Area counties. In addition to camp income and rental fees, funding is provided by the East Bay Regional Parks Foundation, Alameda County Integrated Waste Management Authority and Recycling Board, and the Taylor Family Foundation.

Mendocino Woodlands

Mendocino Woodlands Camp Association
P.O. Box 267
Mendocino, CA
Enhanced Rustic with Central Facilities – No Services

Mendocino Woodlands is a group camp facility operated by the Mendocino Woodlands Camp Association, a 501 (c) (3) nonprofit corporation. The overall property is 700-acres with approximately 50-acres developed. The accommodations are split into three camps. Camp One contains 46 4-bed cabins and has a capacity of 200 people. The cabins are clustered into three groups, each with a central bathroom facility. There are two dining halls that share a kitchen, as well as an 1,800 square foot recreation hall with stone fireplace. Camp Two contains 8 2-bed cabins, 24 4-bed cabin, 2 houses and 2 tent cabins; its capacity is 130 people. The cabins are clustered into two groups, each with a cold water toilet facility. There is one central bathhouse and a dining hall/kitchen building. Camp Three contains 16 4-bed tent cabins and has a capacity of 64 people. The tent cabins are clustered into two groups, each with a cold water toilet facility. There is a central bathhouse and a kitchen/dining building.

The primary use of Mendocino Woodlands is as an adult group camp facility, and it is recognized for its music and ethnic dance cultural events. These events subsidize the environmental and outdoor education programs offered. The primary program is the Residential Outdoor Science School (ROSS) which is offered for 12 weeks each spring and for 6 weeks in the fall. ROSS is utilized by fourth through 8th grade students with approximately

1,000 attendees annually. Approximately 75% of the students come from Bay Area counties, with the remaining 25% from all areas of Northern California.

Emandal Family Camp

16500 Hearst Post Office Road
Willits, California
Enhanced Rustic with Central Facilities and Services

Emandal is a privately owned and operated family camp and guest ranch facility consisting of 19 redwood cabins with a capacity of approximately 70 people. There are central bath and shower facilities. In addition, there is a farmhouse on the site with three all-season rooms each with private baths. The environmental education program operates from late April through the end of May each year with students spending five days on the working farm.

The facility operates year around and features heated lodging facilities. In addition to environmental education programs the Emandal Family Camp hosts a range of special uses including but not limited to: weddings, meetings, family reunions, and retreats. Use groups have included but are not limited to: writers, Bar Association, cowboy poetry, painters, slow food advocates, quilters, musicians, painters, hikers, cooking enthusiasts, log splitters, reunions, and birders.

PHOTOS 11 & 12: CENTRAL BUILDING (left photo)
BARN (right photo)

Source: Facility Internet Site

Slide Ranch

2025 Shoreline Highway
Muir Beach, California
Golden Gate National Recreation Area
Enhanced Rustic

Slide ranch is located 35 miles north of San Francisco on 134 acres of coastal lands in western Marin County. Facility programs include a national training internship for teachers in residence, a summer camp for 5 to 12 year olds and junior counselors 14 to 18 years old. The site also hosts school and community day and overnight trips for Bay Area schools, with special emphasis on inner city populations. Family days for inter-generational learning about food, ecology, and organic farming are also provided. In addition to education programming, Slide Ranch is also available for group rentals including weddings, a fire circle and other site uses. The rustic buildings at Slide Ranch are part of an historic dairy farm and are used today as housing and office space to run the teaching farm. However, many of the buildings are in great need of repair and are beyond historic renovation. Only the yurt and Geodesic Dome are open to the public.

A group campsite includes the refurbished geodesic dome and propane stove for cooking but the dome is not constructed to accommodate sleeping. The Yurt is a circular canvas structure with a domed skylight, wooden floor, and wood burning stove. The Yurt can comfortably accommodate 30 to 40 people for meetings, workshops, dancing, performance art and other celebrations. The facility provides tables and chairs for 25 people. The Yurt also has electricity, an outside source of cold drinking water and port-o-potty located nearby. Coffee percolators, plates, silverware and mugs can also be rented.

As part of the Golden Gate National Recreation Area lands, Slide Ranch's outdoor grounds are open to the public for hiking, picnicking and fishing. A public parking lot is available down the hill from our main entrance, and there are trails and three public outhouse facilities with hand washing stations nearby.

Las Posadas 4-H Camp

755 Las Posadas Road
Angwin, CA
Rustic with Central Facilities

Camp Las Posadas is a 4-H (members only) camp located in Las Posadas State Forest, near Angwin and northeast of Saint Helena, Napa County. It is on property owned by the State of California, Division of Forestry with an 800-acre portion of land that has been developed for use and lease by the Regents of the University of California as a summer camp for the 4-H clubs of six Bay Area counties. It has operated at this location since 1929.

The summer-only camp is located in the rugged, coast range mountains and contains second growth forests of redwood, Douglas fir, ponderosa pine, oak and madrone. Campers and staff sleep outside under a canopy of madrone on raised wooden platforms. A perennial creek flows past a group campfire and open air amphitheatre. Restrooms and hot shower rooms are located

in girls and boys separate sleeping areas of the camp. A commercial kitchen is utilized by cooks who prepare 3 meals per day, served under a covered, open sided dining patio.

Camp activities include, nature studies, orienting, hiking, archery, swimming, camp fires, arts & crafts, star gazing, basketball, ping pong and other activities. The focus of the camp is outdoor activities consistent with the 4-H theme, and although adult chaperons and councilors are present at camp, there are no specific educational instructors or teachers present per se. Cost of the camp, which appears to be partially offset by 4-H local fund raising activities and on facilities developed by UC Extension, are $8.50 per camper per day.

PHOTOS 13 & 14: OOUTDOOR AMPHITHEATER (left photo)
COVERED DINING AREA (right photo)

Source: Facility Internet Site

TABLE 1: COMPARABLE FACILITY CHARACTERISTICS

Site	Property Type	Property	Programs	Facilities	Budget
Walker Creek Ranch Petaluma, CA Marin County Office of Ed	Enhanced Rustic w/ Facilities and Services	1741 Acres	Outdoor Science School based on California science standards	Semi-pvt. Lodges (2-5) Econ cabins (dorms) camping dining/conf center	$2.8mil
Point Reyes/Clem Miller Ctr Point Reyes Nat'l Seashore	Enhanced Rustic w/ Facilities and Optional Services	8-10 Acres Developed Associated with Pt Reyes Nat'l Seashore	Teacher Training Provided; No Program Administered by Facility	4 cabins @ cap. 16 1 teacher cabin bathhouse & mtg. hall	$300,000
Las Posadas, 4-H Camp Angwin, CA	Rustic w/ Facilities		4-H Programs No Formal Environmental Education Program	Open Air Camping Amphitheatre Kitchen & Outdoor Covered Dining	N/A
Mendocino Woodlands Mendocino, CA Mendocino Wdlnds Camp Assoc.	Enhanced Rustic w/ Facilities and Services	700 Acres 50 Acres Developed	Outdoor Ed Program Supported by Ethnic Music and Dance Prog	Three Camp Areas w/ Cabins: 70 4-Bd, 8 2-Bd 16 4-Bd Tent Cabins	$550,000
Camp Arroyo Livermore, CA YMCA & Taylor Family Foundation	Enhanced Rustic w/ Facilities and Services	138 Acres	Environmental Educ Through School Year & Ill Kids Summer Camp	6 24-Person Cabins 2 Bathhouses, Dining Hall/Meeting Rm, Pool	
Slide Ranch Muir Beach, CA Slide Ranch Non-Profit Corp.	Enhanced Rustic w/ Facilities and Services	134 Acres on the Coast Within the Golden Gate Nat'l Rec Area	Teaching Farm Offering	yurt (30-40) group camp	$705,000
Sly Park Environmental Ed Center Pollock Pines, CA Sacramento County Office of Ed	Enhanced Rustic w/ Facilities and Services	27 Acres Agreement with Forest Service for Access	Environmental Educ Provided by Certified Teachers	8 26-Bed Cabins w/ Ba 1 16-Bed Staff Cabin Dining/Cafeteria	$2.06m
Emandal Family Farm Willits, CA	Enhanced Rustic w/ Facilities and Services		6-Week Environmental Ed Program, Family Camp June-Sept	19 Cabins Separate Bath/Shower Facilities	N/A
Camp Herms El Cerrito, CA Boy Scouts of America	Rustic		Boy Scout Programs No Formal Environmental Education Program		
Camp Adahi Oakhurst, CA Campfire USA	Rustic	5AC Long Term Land Lease Agreement w/ Forest Svc	No formal environmental Education Labor to Mem Days	Tent Camping Only Kitchen and Shower Bldg Portable Toilets	N/A

TABLE 2: COMPARABLE VISITATION CHARACTERISTICS

Site	Visitation	Visitor Origin	Users	Length of Stay/PAOT	Fees
Walker Creek Ranch Petaluma, CA Marin County Office of Ed	10,000 Per Year	85% Marin County Remainder from adjacent counties	School groups special events Community	563 Cap.	lodge $75 cabin 42 camp $18.50 educ. $209-$279
Point Reyes/Clem Miller Ctr Point Reyes Nat'l Seashore	1,600 Per Year	85% Bay Area Counties 15% Surrounding Counties	School groups Community groups	Minimum group size or fees for 40	$15/person x 40 600 per group
Las Posadas, 4-H Camp Angwin, CA	N/A	Napa, Sonoma, Marin, Solano, Contra Costa, Alameda Counties	4-H Club of Bay Area	175 Cap (5-day stay typ.) Kids 9-15+ Counselors & Chaperones	Open Air Camping $8.50/day 3 meals/day provided
Mendocino Woodlands Mendocino, CA Mendocino Wdlnds Camp Assoc.	40,000 "Camper Days Per Year"	70% Bay Area Counties Remainder distributed between surrounding counties, all US	Primarily Adult 18 Weeks/Yr Outdoor Ed Served 4th-8th Grades	Primarily Full Week Also 2-3 Weekend Days 394 Total Capacity	
Camp Arroyo Livermore, CA YMCA & Taylor Family Foundation	6,000 Per Year	70% Alameda & Contra Costa Counties 25% SF County	65% 6-11 Years 10% 12-17 Years 19% 30-54%	3-5 Days 144 Capacity	Environmental Ed: $197-$225 Per Student $180-$253 Per Adult
Slide Ranch Muir Beach, CA Slide Ranch Non-Profit Corp.	8,000 Per Year	Primarily Bay area	School groups retreat/conf/workshops special events	40 cap.	$350 per student week $850-$1,100 group camp yurt $650-$850
Sly Park Environmental Ed Center Pollock Pines, CA Sacramento County Office of Ed	8,000 Per Year	75% Sacramento County 25% 11 Surrounding Counties	90% 6th Graders 10% 5th Graders	3-5 Days (6th Graders stay for the full 5 days) 196 kids/215 Total Capacity	$235/5 days Per student
Emandal Family Farm Willits, CA	N/A	Northern California	Environmental Education Special Use Group	Ideal Persons at One Time is 60-65; Capacity 70	Week Adult $725 Teen $505 Youth $394
Camp Herms El Cerrito, CA Boy Scouts of America			Boy scout troops		
Camp Adahi Oakhurst, CA Campfire USA	500-600 Per Year	75% Madera County 25% Fresno, Merced, Curran	Primarily 3rd - 8th Grade Students Also Serve Ages 8-18	One Week/165 Person Capacity	$80 per week Per camper

OTHER FACILITIES REVIEWED

Coloma Outdoor Discovery School

6921 Mt. Murphy Road
Coloma, CA
Enhanced Rustic with Central Facilities and Services

Coloma Outdoor Discovery School (CODS) is a non-profit, outdoor learning center which has provided educational programs since 1990. The campus is located on the banks of the South Fork American River, across from the Marshall Gold Discovery State Historic Park. Residential programs offer one to five day programs in the following areas: gold rush history, science, and ropes challenge. The facility serves public and private organizations throughout the state.

Bunkhouses sleep between 12-24 individuals each and are supervised by two or more Parent Counselors. The rooms are climate-controlled and are equipped with a restroom. Additional shower houses are available for student use. Visiting teachers stay in separate, centrally located accommodations. Aside from the bunkhouses and a small clubhouse, all teaching and meeting areas occur outdoors or under covered, outdoor areas. Students arriving in the winter months should be prepared for inclement weather.

In addition, the facility offers tent cabins, sturdy framed canvas tents built on plywood floors with bunk beds and mattresses. The tent cabins accommodate 8-10 individuals and are supervised by one or more Parent Counselors from the attending school. Water, electricity hook-ups, tables and awnings are immediately outside the tent cabins, and restrooms and showers are close by. Visiting teachers stay in separate, centrally located accommodations.

PHOTOS 15 & 16: TENT CABIN BUNKS (left photo)
TENT CABINS (right photo)

Source: Facility Internet Site

Caritas Creek Environmental Education Program

At Camp Cazadero
Cazadero, CA
Program headquartered in Occidental, CA; utilizes Camp Cazadero for its overnight facilities.

Caritas Creek's mission is to help young people discover the connection between all living things; to build bridges between diverse socio-economic and ethnic groups; and to foster in youth a deeper connection to the natural environment, to self, and to community. To accomplish this mission, Caritas Creek established an environmental education program for schools and a summer camp for children and youth, founded in 1975. Former locations were in Mendocino and Occidental, California. The Environmental Education program has been operating at Camp Cazadero (Sonoma County near the Russian River) since fall 2007.

Meal service includes homemade family-style meals or buffet available for all groups, served in the dining hall or on the outside patio by staff. There is an own-cooking option in a fully equipped kitchen in Redwood Lodge for groups of 10-26 people. Program space includes a dining hall that serves as a dining and meeting space for large groups. This building has hardwood floors and a large floor to ceiling fireplace. In addition, the Redwood Lodge provides a meeting room with stone fireplace and outdoor deck for groups of up to 40. The Campfire Bowl offers a large stage, electricity and wood-bench seating for up to 195 people. The Mesa is a large flat concrete area suitable for games and dancing (lit by floodlights). The Vesper Point facility provides log seating for groups of up to 195, in a beautiful forested setting. Recreation includes a swimming pool (seasonal) and a large meadow in the center of camp with areas for baseball, basketball, volleyball and horseshoes. There are miles of hiking trails, with one trail leading to a spectacular waterfall.

Students attending the Caritas Creek Web of Life School (WOLF) program stay in modern dormitory or cabin style lodgings equipped with comfortable bunk beds. Each room accommodates 4-14 students. Bathroom and shower facilities are modern and centrally located. Accommodations vary from rustic to retreat style, depending on the campus. For example some offer bathrooms inside the cabin and others offer a central bath house. Comfortable living quarters are provided for visiting teachers in modern cabin or dormitory style rooms. Bathroom and shower facilities are modern and centrally located. Accommodations vary depending on the campus.

PHOTO 17: CABIN DORM

Source: Facility Internet Site

Camp Latieze

Redding, CA
Enhanced Rustic with Facilities – no services

The camp is owned and operated by the Shasta County Board of Education. It is located on 163 acres of natural forest at the base of Mount Lassen, only a few miles from either entrance to Lassen Volcanic National Park. In addition to education camps, various churches, scout troops, community organizations and business groups also visit the camp as a retreat center or for group gatherings and family reunions.

The camp has two primary buildings on the grounds. The first is the Main Lodge and Galley. The fully equipped kitchen is located within this building. Meals are prepared in the kitchen and served in the Main Lodge. The lodge features a knotty pine interior, wood-burning fireplace and propane fireplace. The size of this facility also makes it the best for meetings or events involving an entire group. A new building houses a classroom and a separate meeting room. Each of these rooms can accommodate up to 40 people. The meeting room is also used by groups needing a chapel or reflective area, while the classroom is for education needs.

There is a Counselor Cabin that is available to renters of the Camp. There is also a three-bedroom, two bath house on the grounds. It has its own full kitchen and living area. This house is wheelchair accessible. It is a comfortable accommodation for the camp leaders, elderly or handicap visitors. The Camp House can comfortably accommodate 6-8 people. There are eleven sleeping cabins in addition to the Camp House. One of these cabins has a wheelchair ramp and a bathroom. There is also a cabin with a small sitting area and a bathroom. All of the other cabins house eight people in four bunk-beds. These cabins can accommodate a total of approximately 80 people. The facility also offers an in-ground swimming pool.

The Farm on Putah Creek

5265 Putah Creek Road
Winters, CA
Educational Meeting Facilities – no overnight accommodations

The Farm on Putah Creek is located on private lands, on privately held land protected by an agricultural conservation easement. It is open to the public nearly every day of the week. It features 40 acres of prime farmland on Putah Creek near Winters, California. The Farm on Putah Creek features the FARMS Leadership Program and the SLEWS Program. Visitors come for wildlife-friendly demonstration projects, native plant nursery and propagation facilities. The facility is a collaboration between the Center for Land-Based Learning and Audubon California's Landowner Stewardship Program. The Farm is also home to two other organizations; Putah Creek Council, a local educational, community-based group focused on the long-term stewardship of Putah Creek and its tributaries, and The Xerces Society (specifically, the education, outreach, and research components of the California Agricultural Pollinator Project).

The Farm on Putah Creek hosts visitors of all ages and backgrounds interested in seeing real-world applications of the principles underlying its wildlife-friendly agricultural and conservation practices. This includes tailwater ponds and sediment traps, riparian buffer strips and upland

restoration, insectary hedgerows including native pollinator habitat, and native windbreaks. Portions of the Farm are available for rental, and there are a variety of additional activities and events that occur year-round.

The Farmhouse facility has a capacity of up to 30 people ($350 per half day and $500 per day). The largest room, complete with a 100-year old pine and oak-inlaid table, seats 20 comfortably. There are chairs for an additional 10-15 people to sit around the room edge. Additionally, there are two fully-furnished smaller rooms which are for breakout sessions, food service, or information lay-out. The facility includes a full kitchen for food preparation or serving up to 40. Spacious lawns surround the Farmhouse on all sides; up to 160 stackable lawn chairs are included with the rental for outdoor use. There is also a wrap-around covered porch overlooking farm fields, walnut orchards and the Coastal Range. The Barn classroom and workshop facility ($400 per day, $200 per half-day) is an improved barn with extras including lights, tables, a large pull-down screen for presentations, propane space heaters, outdoor chairs, and an outdoor kitchen facility with large sinks and outdoor facilities including a 150-seat amphitheater. The entire farmhouse barn and outdoor facilities including 150 seat amphitheater is available for $425 half day or $750 full day.

NET REVENUE SCENARIOS

This section presents a range of revenue scenarios for each Camp Berryessa development alternative. We present two net revenue tables; a), Table 3 shows net revenue projections developed using only estimated annual operations and maintenance (O&M) costs; b), Table 4 shows net revenue projections for operations and maintenance that also includes facility replacement (or sinking fund) costs. We have included these two comparative sets of calculations because in some cases – as described by comparable facility managers – replacement costs may be covered by grants and donations. Accordingly, note that net revenue projections for operations and maintenance alone will be higher than net revenues which consider for costs of facility replacement.

For each Camp Berryessa development alternative we calculate three scenarios according to annual occupancy – or site utilization. These occupancy scenarios are based on data derived from the selected comparables as well as occupancy rates for a range of recreation accommodations from primitive camp sites to commercial rustic lodging properties. We have included the recreation component to illustrate the range of potential use, and to provide decision makers and stakeholders with information to address a wide ranging outlook for future use at Camp Berryessa. The analysis applies the following assumptions and data points:

Assumptions

- Length of stay. We have used a 5-day average length of stay which was most commonly found during comparable research. However, note that during the current economic contraction some facilities have begun offering shorter stay packages – usually three days. As a result, shorter packages would require increased market penetration – more visitors per targeted market – to maintain revenue streams.
- Camp Berryessa capacity. While the site may be designed for greater capacity we assume that average daily use (80 persons) will be lower than strict user capacity. In addition, the

average number of persons per day or persons-at-one-time (PAOTS) is within the anticipated limits of the sites future water and wastewater processing facilities.
- Fee structure. Since recreation users typically demonstrate a higher willingness to pay as facilities provide greater accommodations and supporting facilities and services, we increase the range of possible per day user fees for each increasingly developed alternative.
- Costs. Similarly as use increases so do facility operation, maintenance, and replacement costs. Therefore we provide three use levels with each having an associated cost for each Camp Berryessa development alternative.

Data points

- Fees. User fee per day.
- Occupancy rate/Days of Use. Annual occupancy or facility utilization, similar to typically used campground or lodging facility measures. This is also described as days of use per year (365 days), and is used for revenue calculations.
- Visitor Days. Number of attendees x the average length of stay (5 days). A visitor day is one day at the facility per single visitor.
- Revenue. Fees per visitor per day x total number of visitor days for each occupancy rate. High occupancy rates increase the number of visitors per year and accordingly generate higher revenues.
- Net revenue. Revenues less estimated operations and maintenance cost for each occupancy, or utilization, level. As revenues rise with occupancy, costs follow, though not on a one to one basis. This is because many fixed costs remain stable regardless of use levels.

Alternative A: Rustic – Tents and Amenities

This represents the least developed Camp Berryessa alternative: a tent camping facility with toilet and shower facilities somewhat similar to a State Park or Forest Service campground. There is no central kitchen but shower facilities are provided. This alternative is also similar to the previous Boy Scout camp use at the site. Fees range from a low of $10 per night to $15 and a high of $20 per user per night. Low range of use represents 33 days per year (9%) primarily with a focus on education or associated youth group outings. The mid range of use is 55 days per year (15%) and high use level is 80 days per year (22%) which approximates a state park tent camping season.

In all scenarios except one, the facility will need augmented fee sources or funds to operate at this alternative. At the highest fee and occupancy level revenue in excess of cost is shown. Increased fees and/or increased rates of use (such as making the facility open to the public during the summer) would be necessary to generate net revenues beyond the assessed high use high fee scenario. (See Table 3 Alternative A.)

Alternative B: Enhanced Rustic – Tent Cabins and Amenities

Alternative B provides on-site tent cabins for camping; otherwise it is similar to Alternative A. The addition of enhanced accommodations in the form of tent cabins increase the range of fees from a low of $12 to a mid of $21 and a high of $27 per user per night. Better shelter but no additional amenities increases days of use somewhat. The low range remains at 33 days per

year (9%) with the mid range rising slightly to 62 days per year (17%). The high range of use is at 91 days per year (25%), representing a very active shoulder and summer season that should be attainable by the added attraction of tent cabin facilities. For Alterative B, revenues exceed costs only in the high use/high fee scenario, with increased use fees or augmented funds such as by opening the facilities to the public during the summer being necessary to sustain operations. (See Table 3 Alternative B.)

Alternative C: Enhanced Rustic with Central Facilities – Tent Cabin, Kitchen and Amenities

This alternative expands on Alternative B by providing a central kitchen dining/classroom area, and a larger restroom shower facility which should attract increased numbers of group users and allow for higher user fees (low $17; mid $27; high $35). Overall low use remains at 33 days per year (9%) in this scenario to show revenue for a more developed alternative but still operating at a very modest level of utilization. Similarly, the mid use scenario is fairly modest at 80 days per year (22%) and the same use as the high scenario for tent camping. The high use is 110 days per year (30%) which extends use over the previous two alternatives due to tent cabins and the provision of central facilities including a kitchen and dining room. A small professional and maintenance staff is assumed, but housekeeping is not provided. The higher costs associated with operations and maintenance of a central facility indicates that higher use or fees, or additional revenue sources, would be necessary to generate revenue in excess of annual operations and maintenance cost in all but the indicated high use/high fee scenario. (See Table 3 Alternative C.)

Alternative D: Enhanced Rustic with Central Facilities and Services – Cabins, Kitchen, Amenities, and Services.

This development alternative adds additional permanent rustic cabins, some dormitory cabins, a central facility with kitchens and showers, a group gathering place (amphitheater seating 40-50), and a larger professional and maintenance staff. Unlike Alternative C, housekeeping is provided. The presence of rustic cabins further extends the operating season and the enhanced amenities increases the likelihood of increased rates of use. In addition to the enhanced facilities, a staff that can engage in market development may substantially increase market awareness by building relationships with user groups for repeat visitation as well as developing new user markets. As a result, fees can be increased with the low rate at $35; the mid at $47 and the high at $65.

For development Alternative D, use levels also increase substantially, with the low at 80 days per year (22%) and the mid level rate of use increasing to 146 days per year (40%). The high rate of use at 219 days per year (60%) combined with the highest user fee of $65 are slightly less than but approaching those that might be generated by a commercial rustic cabin lodging facility open to the general public for any purpose. Overall the increased rate of use and fees indicates that revenue can exceed costs in the middle and high use scenarios. Low cost and/or low use scenarios indicate that enhanced moneys though additional revenue sources or programming would be necessary to sustain Alternative D at these lower levels. (See Table 3 Alternative D.) As with Alternatives A, B and C, opening the facility to a wider use group, including family oriented camping would likely be necessary in order to meet operations and maintenance costs.

Operations and Maintenance including Replacement Costs

Table 4 adds replacement cost in addition to annual operations and maintenance costs into the net revenue calculations. As indicated, these additional costs add a challenging factor to the calculations. When replacement costs are met by solely applying facility user fees, in Alternative A only the high use and high fee rate operates positively. When looking at Alternative B and Alternative C neither show revenues in excess of costs when replacement costs are added.

Alternative D provides greater flexibility, with the mid and high fee rate in the mid use level (40%) providing excess revenues, while the high use category (60%) generates excess revenues at all fee levels.

However, note that grants and donations are typically used to cover replacement costs and to the extent that these funds can be generated at Camp Berryessa, adding the replacement costs into the annual net revenue calculations should be used to focus on planning for annual grant and donations activities rather than for determining whether a particular alternative is feasible.

TABLE 3: REVENUE SCENARIOS BY DEVELOPMENT ALTERNATIVE
ESTIMATED UTILIZATION AND REVENUES BY ANNUAL OPERATIONS AND MAINTENANCE COST

Alternative A: Tent and Amenities (average use @80persons per day)												
		Days of Use*	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				15%				22%			
	O&M Cost				$88,160				$94,480				$100,800
Fee**	$10.00	32.85	2,628	$26,280	($61,880)	54.75	4,380	$43,800	($51,680)	80.3	6,424	$64,240	($36,560)
	$15.00	32.85	2,628	$39,420	($48,740)	54.75	4,380	$65,700	($29,780)	80.3	6,424	$96,360	($4,440)
	$21.00	32.85	2,628	$55,188	($32,972)	54.75	4,380	$91,980	($3,500)	80.3	6,424	$134,904	$34,104

Alternative B: Tent Cabin and Amenities (average use @80 persons per day)												
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				17%				25%			
	O&M Cost				$150,160				$158,980				$167,800
Fee	$12.00	32.85	2,628	$31,536	($118,624)	62.05	4,964	$59,568	($99,412)	91.25	7,300	$87,600	($80,200)
	$21.00	32.85	2,628	$55,188	($94,972)	62.05	4,964	$104,244	($54,736)	91.25	7,300	$153,300	($14,500)
	$27.00	32.85	2,628	$70,956	($79,204)	62.05	4,964	$134,028	($24,952)	91.25	7,300	$197,100	$29,300

Alternative C: Tent Cabin, Kitchen, and Amenities (average use @80 persons per day)												
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				22%				30%			
	O&M Cost				$309,250				$365,570				$421,890
Fee	$17.00	32.85	2,628	$44,676	($264,574)	80.3	9,636	$163,812	($201,758)	109.5	13,140	$223,380	($198,510)
	$27.00	32.85	2,628	$70,956	($238,294)	80.3	9,636	$260,172	($105,398)	109.5	13,140	$354,780	($67,110)
	$35.00	32.85	2,628	$91,980	($217,270)	80.3	9,636	$337,260	($28,310)	109.5	13,140	$459,900	$38,010

Alternative D: Cabins, Kitchen, Amenities, and Services (average use @80 persons per day)													
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use*	Visitor Days	Revenue	Net Rev
	Percent Use	22%				40%				60%			
	O&M Cost				$427,490				$486,540				$545,590
Fee	$35.00	80.3	6,424	$224,840	($202,650)	146	11,680	$408,800	($77,740)	219	17,520	$613,200	$67,610
	$47.00	80.3	6,424	$301,928	($125,562)	146	11,680	$548,960	$62,420	219	17,520	$823,440	$277,850
	$65.00	80.3	6,424	$417,560	($9,930)	146	11,680	$759,200	$272,660	219	17,520	$1,138,800	$593,210

**By Listed Annual Occupancy/Utilization Rate; ** Fee per day per user*

TABLE 4: REVENUE SCENARIOS BY DEVELOPMENT ALTERNATIVE
ESTIMATED UTILIZATION AND REVENUES BY ANNUAL OPERATIONS AND MAINTENANCE AND REPLACEMENT COST

Alternative A: Tent and Amenities (average use @80persons per day)												
		Days of Use*	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				15%				22%			
	O&M Replace				$112,100				$118,400				$124,700
Fee**	$10.00	32.85	2,628	$26,280	($85,820)	54.75	4,380	$43,800	($75,100)	80.3	6,424	$64,240	($60,460)
	$15.00	32.85	2,628	$39,420	($72,680)	54.75	4,380	$65,700	($53,200)	80.3	6,424	$96,360	($28,340)
	$21.00	32.85	2,628	$55,188	($56,912)	54.75	4,380	$91,980	($26,920)	80.3	6,424	$134,904	$10,204

Alternative B: Tent Cabin and Amenities (average use @80 persons per day)												
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				17%				25%			
	O&M Replace				$190,300				$199,100				$207,900
Fee	$12.00	32.85	2,628	$31,536	($158,764)	62.05	4,964	$59,568	($139,532)	91.25	7,300	$87,600	($120,300)
	$21.00	32.85	2,628	$55,188	($135,112)	62.05	4,964	$104,244	($94,856)	91.25	7,300	$153,300	($54,600)
	$27.00	32.85	2,628	$70,956	($119,344)	62.05	4,964	$134,028	($65,072)	91.25	7,300	$197,100	($10,800)

Alternative C: Tent Cabin, Kitchen, and Amenities (average use @80 persons per day)												
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	9%				22%				30%			
	O&M Replace				$369,900				$426,200				$482,500
Fee	$17.00	32.85	2,628	$44,676	($325,224)	80.3	9,636	$163,812	($262,388)	109.5	13,140	$223,380	($259,120)
	$27.00	32.85	2,628	$70,956	($298,944)	80.3	9,636	$260,172	($166,028)	109.5	13,140	$354,780	($127,720)
	$35.00	32.85	2,628	$91,980	($277,920)	80.3	9,636	$337,260	($88,940)	109.5	13,140	$459,900	($22,600)

Alternative D: Cabins, Kitchen, Amenities, and Services (average use @80 persons per day)												
		Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev	Days of Use	Visitor Days	Revenue	Net Rev
	Percent Use	22%				40%				60%			
	O&M Replace				$504,600				$563,650				$622,700
Fee	$35.00	80.3	6,424	$224,840	($279,760)	146	11,680	$408,800	($154,850)	219	17,520	$613,200	($9,500)
	$47.00	80.3	6,424	$301,928	($202,672)	146	11,680	$548,960	($14,690)	219	17,520	$823,440	$200,740
	$65.00	80.3	6,424	$417,560	($87,040)	146	11,680	$759,200	$195,550	219	17,520	$1,138,800	$516,100

**By Listed Annual Occupancy/Utilization Rate; ** Fee per day per user*

Science and Environmental Education Market Penetration

The net revenue scenarios outlined use levels and fees for each Camp Berryessa development alternative but do not specify user type. Considering the facility's anticipated primary education mission, we now focus on the percent of the science education market (market penetration) necessary to attain the described use levels. For this analysis we use the elementary grade tested for science in California – the 5th grade – as the basis for determining total potential education market population. To demonstrate potential market penetration we apply the middle use scenario for each development alternative as that is the use scenario most likely to be achieved. Finally, note that as the facility develops over time, marketing and repeat visitation is anticipated to play a more prominent role in the facility's operations and success.

Primary Markets

As indicated in Table 5, we look at four markets including Napa County, the adjacent counties, Sacramento Valley counties near Napa and San Francisco Bay Area counties near Napa. For this analysis we assume that the bulk of Camp Berryessa science education attendees will arrive from within Napa County or those counties adjacent to Napa. While the larger population centers in the Sacramento Valley and the San Francisco Bay area offer large student enrollments they are subject to intense competition for attendance and require more distant travel to Camp Berryessa. Marketing to these regions would take significant resources. Napa and adjacent counties may have greater access to and familiarity with Camp Berryessa. In addition, these local and sub-regional markets may be more accessible to marketing and public relations efforts. Accordingly we anticipate that attendance by students from these nearby markets will be a focus for increased visitation and increased market penetration as the Camp Berryessa facility evolves. As a result, we assume that approximately 70-75% of student visitors will arrive from Napa County and the adjacent counties.

Number of Students Visiting

Starting with a modest percentage of the 5th grade population (measured by 2010 enrollments), the market penetration scenarios indicate it is likely that under Alternative A 8% of Napa 5th grade students and 1% of 5th grade students from surrounding counties may be successfully attracted to Camp Berryessa. A small percentage of the Valley and Bay Area student population are needed to augment the primary market. Each stage of facility development increases the percentage of likely Napa and adjacent county students who might attend science education programs at Camp Berryessa, with Alternative D hosting up to 40% of Napa County 5th graders and 5% of 5th graders from adjacent counties. While possibly feasible in the long term, a 40% penetration rate is extremely ambitious and probably not realistic in the short term given the current fiscal constraints facing public schools in California.

Education Ratio

The ratio of targeted education visitors is shown in the sixth column of Table 5. As indicated in the table, the percent of total visitation derived from targeted science education population increases as the facility provides greater amenities and thus can compete for a larger share of the education camp market in this region. With a successful marketing program, the development of good working relationships with Napa County Department of Education and individual schools, and the active support of charitable organizations, Camp Berryessa could eventually attract up to 80% of its visitation from education markets at Alternative D development levels.

Since education programs are focused on school year activity – primarily in the spring and fall months – Camp Berryessa could augment its primary mission with attendance by other user groups. This approach is used by many of the researched comparable facilities. . Curriculum and funding for science programming at regional schools vary by school district. The ability of students to participate also depends on family budgets. Further, school-based programs typically end with the school year in early June. For all these reasons, it will be essential in order for Camp Berryessa to be financial successful and viable that it attract other user groups, and extend its operational period through the summer months by opening the facility to select user groups, and perhaps even general family oriented camping. This could potentially be handled by a seasonal concessionaire, or by a separate non-profit foundation such as is done at several comparable educational campground facilities we reviewed. This "summer use" model may be particularly important early in the development of the facilities, before they are fully built-out, and before a successful history and reputation is established.

TABLE 5: SCIENCE EDUCATION CAMP ATTENDANCE
MARKET PENETRATION BY DEVELOPMENT ALTERNATIVE (MIDDLE-SCENARIO)

Alternative A: Tent and Amenities (4,380 Visitor Days)

School Market	MP	5th Grade Enrollment*	Students	Visitor Days	Education Ratio	Student Origin
Napa	8.0%	1,514	121	606	0.14	30.6%
Adjacent	1.0%	15,615	156	781	0.18	39.4%
Valley	0.2%	30,069	60	301	0.07	15.2%
SF Bay	0.1%	58,729	59	294	0.07	14.8%
TOTAL		105,927	396	1,981	0.45	100.0%

Alternative B: Tent Cabin and Amenities (4,964 Visitor Days)

School Market	MP	5th Grade Enrollment	Students	Visitor Days	Education Ratio	Student Origin
Napa	15.0%	1,514	227	1,136	0.23	33.5%
Adjacent	1.8%	15,615	273	1,366	0.28	40.3%
Valley	0.3%	30,069	90	451	0.09	13.3%
SF Bay	0.2%	58,729	88	440	0.09	13.0%
TOTAL		105,927	679	3,393	0.68	100.0%

Alternative C: Tent Cabin, Kitchen, and Amenities (9,636 Visitor Days)

School Market	MP	5th Grade Enrollment	Students	Visitor Days	Education Ratio	Student Origin
Napa	25.0%	1,514	379	1,893	0.20	27.8%
Adjacent	4.0%	15,615	625	3,123	0.32	45.9%
Valley	0.6%	30,069	180	902	0.09	13.3%
SF Bay	0.3%	58,729	176	881	0.09	13.0%
TOTAL		105,927	1,360	6,799	0.71	100.0%

Alternative D: Cabins, Kitchen, Amenities, and Services (11,680 Visitor Days)

School Market	MP	5th Grade Enrollment	Students	Visitor Days	Education Ratio	Student Origin
Napa	40.0%	1,514	606	3,028	0.26	32.5%
Adjacent	5.0%	15,615	781	3,904	0.33	41.9%
Valley	0.8%	30,069	241	1,203	0.10	12.9%
SF Bay	0.4%	58,729	235	1,175	0.10	12.6%
TOTAL		105,927	1,862	9,309	0.80	100.0%

*Source: California Department of Finance, Demographics Unit; *2009-2010*

OBSERVATIONS AND CONCLUSIONS

The following presents a series of consultant observations and conclusions pertaining to Camp Berryessa market and economic feasibility and facility planning and development.

1. Project is Feasible

The primary finding is positive for Camp Berryessa market and economic feasibility, especially for either the most primitive or rustic alternative (Alternative A) and for the alternative that produces the greatest facilities and services (Alternative D). Given site characteristics pertaining to market demand, market population trends, and the competitive situation, Camp Berryessa can be a financially self sustaining facility. Of course this feasibility depends on a range of assumptions including professional management, an active marketing program, and the capacity to build relationships with educators in the immediate region. Moreover, a competitive but adequate fee structure and meeting a minimum annual use target will be necessary.

2. Phased Approach

Given the necessary use levels, fees and associated development alternative operations and maintenance costs, the most likely scenario for long-term success is found in Alternative D. However, this is the highest development alternative and as such would require significant investment and some associated risk in the short term as this has the greatest investment needs as well as annual operations and maintenance costs. Perhaps this initial start up (3-5yr) period is also the time period when replacement costs or sinking fund costs can safely be ignored. As a result a phased approach beginning with Alternative A would allow the Camp Berryessa management team the opportunity to build programming, identify potential education partners or users, and begin to assess the extent to which special group users other than education specific use may be attracted to the facility. In short, developing Camp Berryessa into a dedicated education camp facility will take time. Other comparable facilities have been in operation for many years and indicate the long term commitment necessary to establish an education and environmental destination facility.

3. Donations and Grants

Revenue derived only from user fees are not likely to cover all expenses, especially capital and replacement costs. Most of the comparable facilities we researched do use grants and donations to offset costs, especially unusual needs such as roof repair, wastewater system maintenance, etc. Our analysis does show some scenarios for certain options where annual operations and maintenance can be covered by user fee revenues. However, hard costs – capital and replacement – may need alternative funding sources (grants) to make Camp Berryessa sustainable over the long term.

4. Education Markets Need to be Augmented

Every comparable facility we studied uses off season user rentals to supplement revenues. In particular those that serve school science education need summer use to complement the spring and fall focus of school programs. The market penetration analysis indicates that, especially during the facility's early development – and until a strong repeat education program business is established – Camp Berryessa will need to generate revenue from other user markets. Fortunately the site offers ideal characteristics and a location to do this. Thus,

the Napa County Regional Park and Open Space District should look into attracting special use groups such as but not limited to: other education groups including high school, community college, and university; kayak and canoe camps and eco tours up the adjacent Putah Creek watershed; other associated boating groups; trail-based recreation groups; birding and associated wildlife viewing groups; scouting and other youth groups; stargazing and astronomy groups; photography and associated arts groups; other science or heritage oriented groups; and retreats for corporate, eco, emergency response training, or teacher education purposes.