Source Water Study

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Division of Financial Assistance

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The Power of Commitment

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GHD has prepared the preliminary cost estimates set out in section 7.6 of this study ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this study; and based on assumptions and judgments made by GHD.

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Executive Summary

This study evaluates existing and potential water sources for the Mendocino City Community Services District (MCCSD or District) in Mendocino County, California.

MCCSD treats wastewater and manages groundwater resources for approximately 855 residents, multiple businesses, a school district, two state parks, and an average of 2,500 tourists a day. For potable water, the community relies on approximately 400 wells, many old, shallow, or hand-dug. Water scarcity has been a continuing issue for the town for decades, with some wells often running dry in the summer and fall. Neighboring water systems supplemented supply in the past by selling water to water haulers but ceased during extended droughts (2012–2015 and 2020–2021). A resilient and sustainable water supply is not currently available.

MCCSD is the groundwater management authority within the District boundary and has previously developed a groundwater management plan. MCCSD has needed to impose groundwater withdrawal restrictions by allotments per parcel, and additional restrictions during times of drought to manage declining groundwater levels during those times. To address the ongoing scarcity, MCCSD submitted a technical assistance request to the California State Water Resources Control Board (SWRCB). The SWRCB assigned GHD as the technical assistance provider and charged them with preparation of this study to evaluate existing and potential new water supply sources.

The study area is the region within 1 mile of the existing MCCSD service boundary. Within the study area are 24 identified public water systems and four community water systems (CWS), many facing their own water scarcity issues. Additional unpermitted water systems may exist in the study area. Numerous studies have quantified water scarcity in the area and proposed solutions over many decades, but recommendations have not been implemented for a variety of complex reasons.

This study estimates the existing Average Daily Demand (ADD) for the study area of approximately 356,000 gallons and a Maximum Day Demand (MDD) of 534,000 gallons. Title 22 § 64554 of the California Code of Regulations requires a public water system's water source(s) to have the capacity to provide the system's MDD at all times. Current supplies are inadequate for a community water system serving this study area to meet even the ADD, with an estimated 116,000 gallons required to reach that level, and an additional 271,000 gallons required to reach the MDD (Table ES1). These deficits will need to be met by new water sources for any centralized community water system to be viable for the entire study area.

Table ES1 Summary of Existing Demands and Potential Existing Supply

	ADD (gallons)	Annual Projection (AFY)	MDD (gallons)	Source Water Requirement (gpm)
Existing Demand	356,000	399	534,000	371
Existing Supply	210,000	235	233,000	162
Potential Recycled Water Supply	30,000	34	30,000	21
Net Balance	**(116,000)**	**(130)**	**(271,000)**	**(198)**

Consolidating existing supplies into a centralized community water system would require agreement by the water systems and residences included. Potential new water supply sources (surface water, groundwater, desalination, and recycled water), their ability to offset the demand deficit (net balance), and feasibility challenges, are summarized in Table ES2.

Table ES2 Water Source Options

Water Source	Can Meet Deficit	Challenges
Surface Water	Yes	Location specific, where the permitting process is long and there is no guarantee that a new water right permit could be obtained. Significant storage needed to mitigate low flows during the summer months.
Groundwater	No	Limited areas of moderate production. Well fields would be large, spread out and not centrally located. Water yields are dependent on annual precipitation. Significant land use or land acquisition would be required, but several wellfields together with existing wells could augment the source water supply.
Desalination	Yes	Costly treatment, operation & maintenance, and waste (brine) management. Would require additional centralized water treatment and storage systems necessitating potentially significant new land use or land acquisition.
Recycled Water	No	Existing planned improvements supply 60 percent of the potential dry weather recycled water production by the WWTP. Recycled water is non-potable and can only be used to offset potable water as irrigation.

Concept level cost estimates to develop new sources were prepared. These conceptual cost estimates do not include non-construction implementation costs (permitting, studies, environmental impact reports, etc.) and many unknown construction costs, as designs have not been prepared to properly estimate these elements. These conceptual cost estimates should not be used for comparison purposes until more details are known but resulted in a range of $6M-$15.6M, depending on the source to be developed.

Community and stakeholder review and discussion is necessary to collaborate, unify, and define a path forward. The potential service area needs to be refined in this process, which will lead to more accurate and feasible demand estimations. Areas within the community experiencing water shortages and/or substandard water quality should be prioritized.

Understanding existing system sentiment towards consolidation is also necessary to determine the existing source supply that will be available. Knowing the quantity of water available is crucial to determining which combination of supplementary sources is best.

Potential new sources can be combined in a number of ways. Groundwater is the least costly source option yet represents the smallest potential source and has been developed to near its maximum potential yield within the MCCSD service boundary. Recycled water can be used to offset demands and should continue to be pursued and included in any future centralized CWS design, regardless of other sources selected, however, it represents a small fraction of the total demand. Each new source has unique challenges to development that must be considered. Surface water is the most reliable source supply to meet the many challenges detailed here.

Project stakeholders MCCSD, GHD, California Department of Fish and Wildlife and Mendocino Headlands State Park, Big River Unit agree that diversion of surface water from the Big River is not desired or consistent with the Big River Unit's mission "*to provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources and creating opportunities for high-quality outdoor recreation*." Over the past few decades, State Parks has acquired property encompassing the Big River with the goal of restoring and protecting the Big River. The Big River is the longest undeveloped estuary in California and is ecologically important, containing aquatic and terrestrial habitats for many rare and listed species. Additionally, community sentiment is strongly opposed impacts to the Big River. For these reasons and more described in this study it is not recommended to pursue the Big River as a source.

The findings in this study point to the following conclusions, recommendations and additional tasks and studies:

1. *Service Area Delineation.* It is recommended that a service area delineation exercise be performed to refine a potential service area for a centralized CWS. Critical factors to consider in this exercise include population density (number of service connections), topography (pressure zones), vulnerability (wells that have gone

dry), proximity to potential sources and consolidation of existing public and community water systems. This is an iterative exercise that will need to consider funding limitations per connection in parallel with the factors mentioned above. Refining a service area will result in more realistic demand estimations and therefore, source capacity and storage required. Once a service area is established, a more focused inventory of available sources can be determined as well as a poll of those in the service area agreeable to consolidation and connection into a centralized CWS.

2. *Surface Water Diversion Studies.* Surface water diversion studies are recommended on Slaughterhouse Gulch, Jack Peters Gulch and Russian Gulch. These studies should include; installation of stream gauges to obtain flow data over several wet and dry season periods, investigation and initial consultation with jurisdictional agencies to understand permitting requirements and establish relationships. Jurisdictional agencies include, but are not limited to, State Parks, Mendocino County, Caltrans, California Department of Fish & Wildlife (CDFW), Army Corps of Engineers, and the California Coastal Commission. Studies should include cost estimates associated with conceptual designs. Conceptual design considerations should include, but are not limited to, environmental studies related to possible infrastructure installation such as; points of diversion or intake structures, raw water storage structures, pump stations, and pipeline alignments. Studies should include constructability considerations as well as property analyses.

3. *Reservoir Siting Study.* Completion of a detailed study and siting analysis for a water storage reservoir(s) is recommended. The most likely viable location for a reservoir large enough to serve a centralized CWS will be upgradient off Little Lake Road and outside of the Coastal Zone. Using current demand estimations for the entire study area, a reservoir approximately 400 acre-feet is needed. Collaboration with large landowners such as State Parks, logging companies or other private landowners will be crucial, as there could be opportunity for a land agreement, purchase, or lease where reservoir water is a shared benefit, or otherwise. Early consultation with CDFW should occur to inform maps with regards to previously mapped environmentally sensitive habitat areas which will provide insight into reservoir location siting.

4. *Stormwater Collection System Mapping.* The existing County owned and operated stormwater collection system within town should be located and surveyed. Outfalls should be identified and surveyed, the collection system contributing watershed should be delineated and hydrographs developed to understand the potential for stormwater capture and storage near outfalls. If promising, environmental studies should occur to consider stormwater capture and storage impacts on environmentally sensitive habitat areas.

5. *Update the MCCSD Groundwater Model.* The existing Todd Groundwater Model should be updated to include previously mapped higher elevation marine terraces with the objective of potentially developing new wellfields for source water augmentation. Since MCCSD already has an existing numerical groundwater model, with boundaries defined as the District service area limits, the model can be updated to include groundwater data collected from areas higher in elevation (northeast, east, and southeast) outside the current service area. Marine terrace mapping as indicated in this report (Figure 16) shows a promising aerial extent of potentially suitable shallow aquifer materials capable of limited groundwater storage.

Community Feedback Acknowledgments

An informed, engaged, and cooperative community, unified in their search for a long-term solution to provide a sustainable and reliable water supply for the community of Mendocino is critical to the success of this project. As such, community engagement has been a priority since the initiation of this project. Consolidating water systems, new connections, expansion of an existing service area or the creation of new service areas requires collaboration and agreement by property owners and water systems. Property owners within any service area identified would need to agree to the terms of connection and each connection contributes financially to the potential funding available.

During the development of this study seeking community input and feedback has been a priority. MCCSD has reported that this project has garnered as much or more community attention and feedback than any previous project. Community engagement efforts have included several community meetings, generation of a project website, and response to community questions and suggestions. Below is a summary of community feedback and acknowledgements of common questions or concerns regarding this project.

Summary of Community Feedback Surveys

During the first community meeting on December 3, 2024, approximately 60 surveys were completed by community members, detailing their experience and perspectives on the community's water scarcity problem and potential solutions.

Water Scarcity:

- 33% reported experiencing water shortages at least once and had purchased water to meet their needs.

Past Participation:

- 37% had attended previous MCCSD board meetings.
- 63% were first-time attendees.

Service Area Preferences:

- 5% favored including Surfwood in the service area.
- 10% supported focusing on areas west of Highway 1.
- 20% preferred a community water system limited to the MCCSD boundary.
- 60% were undecided.

Preferred Water Sources (in order of popularity):

Groundwater

Surface Water

Recycled Water

Desalination

Top Concerns Written in feedback Surveys:

- 33% highlighted environmental impacts, particularly to the Big River and from desalination.
- 15% stressed the importance of conservation, rainwater collection, and recycled solutions in the short term, with one suggesting a monitoring system to regulate usage.
- 13% expressed concern over the ongoing costs of the system, emphasizing that costs should be proportional to usage.
- 13% raised concerns about the system's long-term viability, administration, and equitable water security.
- 7% called for a multifaceted approach to enhance climate resilience.
- 3% objected to any water system being implemented.

– Multiple attendees suggested extending the study area beyond the 1-mile boundary from the MCCSD limits, particularly to the east, outside the coastal zone.

Comments on Surveys

A large number of participants remain undecided on solutions to the community's water scarcity problem likely due to concerns of costs and/or hesitation to connect to a centralized water system. This emphasizes the importance of seeking solutions that will minimize ongoing costs. The preferred water sources and top survey comments indicate the importance of considering environmental impacts, particularly to the Big River.

Frequently Asked Questions

In addition to the surveys, the draft Source Water Study was made available to the public via the project website. Comments on the Source Water Study were made through a submission box on the website and were reviewed and responded to by GHD. Below is a summary of these comments as well as comments made during the community meetings. GHD responses to these frequently asked questions are in *italics*.

Use of Recycled Water

Many community members have advocated for an increased use in recycled water including potentially direct potable reuse or advanced greywater systems that can be used in residences for non-potable uses.

> *The community's interest in expanding the recycled water uses exceeded the initial expectations with some community members in support of "toilet to tap" direct potable reuse which is generally not seen as a palatable option by communities in the United States. While this is not a viable option for this project's funding opportunity due to the required treatment plant upgrades, operator requirements, and other funding limitations, the community's openness to the concept opens the possibility to look at more ways to use recycled water such as for fire suppression or more extensive non-potable applications. Based on the community's sentiment, additional opportunities for recycled water will be considered in the Alternatives Analysis Engineering Report.*

Use of Rainwater/Stormwater

Rainwater collection (and similarly stormwater collection) was identified by multiple community members as a favored potential water source. Suggestions included creation of a collection system and/or exploring rainwater catchment infrastructure on the headlands to intercept runoff before it reaches the ocean.

> *Rainwater or stormwater collection is limited to the seasonal rainy season and at risk of limitation during below average rainfall years and drought. However, discussions have been initiated with the County Roads Department to potentially map the existing stormwater collection system within the town and identify outfall locations. Once outfall locations are identified, collection and storage options can be considered. The possibility of collection, pumping and storage of stormwater for eventual potable treatment and distribution has not been eliminated, however, additional information is needed to determine viability.*
>
> *Private rain barrels or equivalent rainwater storage are encouraged to offset non-potable water use. However, a more reliable alternative to rainwater collection is collecting and storing streamflow from a series of gulches or springs. This would provide more water over a longer duration and may provide some additional water storage, which is a paramount consideration for any surface water collection concept.*
>
> *Regarding capturing shallow groundwater along the headlands before it reaches the ocean, the terrace deposits along the coast where groundwater is running down along the cliffs is shallow, shallow wells are likely to be found under the influence of surface water and will require additional treatment. Deeper wells with adequate surface seal in this region would be within bedrock that is low yielding and not worthwhile to pursue. Many wells, and therefore, development footprint, would be required to capture the flow running down along the cliffs followed by a network of raw water pipelines to transfer raw water to a centralized treatment facility. Environmental permitting would be required, collaboration with State Parks and other property owners, as well as approval by the Coastal Commission would be required. Overcoming the likely pushback from permitting agencies and/or other groups could be a costly and lengthy challenge. At minimum, potential impacts would include staging equipment, pipeline installation, installation of collection infrastructure such as storage tanks,*

installation of pump station(s) or pumping infrastructure, electrical and communications utilities installation, lighting and power distribution installation at infrastructure locations, access improvements such as service roads and parking areas; all within the highly valued headlands vista. Additionally, it is unclear whether the state funding being considered for any future project would be applicable to this type of project and most importantly, this idea doesn't eliminate the primary problem (limited groundwater during droughts). A more efficient means of capturing water is preferred, which is why earlier studies recommended developing storage facilities to intercept and capture gulch discharge.

Reservoirs

Water storage is a particular point of interest for the community due to the significant environmental permitting and potential impact a reservoir could have.

There is growing community interest in developing a reservoir outside of the study area, upgradient and to the east of town. A reservoir siting study is outside the scope of this work plan. Considerations for storage siting and design is paramount and gulches from non-salmonid bearing reaches outside of the Big River watershed and outside of the Coastal Zone should be prioritized for initial study screenings.

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Abbreviations and Acronyms

AAER	Alternatives Analysis Engineering Report (Feasibility Study)
ACP	Asbestos Cement Pipe (transite pipe)
ADD	Average Daily Demand
AF	Acre-Feet
AFY	Acre-Feet per Year
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CDP	Census Designated Place
cfs	cubic feet per second
County	Mendocino County
CWS	Community Water System
District	Mendocino City Community Services District
DWR	California Department of Water Resources
eAR	electronic Annual Reports
EIR	Environmental Impact Report
ESD	Equivalent Single-family Dwelling unit
Feasibility Study	Alternative Analysis Engineering Report
GIS	Geographical Information System
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
LAFCo	Local Agency Formation Commission
MDD	Maximum Day Demand
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MCCSD	Mendocino City Community Services District
MHS	Mendocino High School
MSL	Mean Sea Level
MUSD	Mendocino Unified School District
NTNC	Non-Transient Non-Community (public water system)
PHD	Peak Hourly Demand
POD	Points of Diversion
PVC	Polyvinyl Chloride
RP	Reference Point
RO	Reverse Osmosis
SR	State Route
SWRO	Sea Water Reverse Osmosis
Study Area	Region within one mile of the existing MCCSD service boundary
Study	Source Water Study
SWRCB	State Water Resources Control Board

TA	California's Technical Assistance funding program
TDS	Total Dissolved Solids
TNC	Transient Non-Community (public water system)
TMDL	Total Maximum Daily Load
Town	town of Mendocino
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WCP	Well Completion Report
WSCP	Water Shortage Contingency Plan

1. Introduction

The Mendocino City Community Services District (MCCSD or District) in Mendocino County, California, seeks to address current and predicted water scarcity in its service area and greater community. Using funds from the California State Water Resources Control Board's (SWRCB's) Technical Assistance (TA) Funding Program, GHD was engaged to prepare this study, which evaluates existing and potential water sources. This study will be used to inform an alternative analysis engineering report in which three options for a centralized community water system (CWS) will be presented.

Founded in 1851, Mendocino is located in a beautiful setting on the rugged California coastline approximately 165 miles north of San Francisco (Figure 1) and is a popular destination for tourists. Because Mendocino is unincorporated, there is no boundary, and the community is commonly known as a town (or village). In this study, "town" refers to the area west of State Route (SR) 1 (the most populated and contiguous portion) and within MCCSD's boundaries. MCCSD treats wastewater and manages groundwater resources for the town's businesses, school district, and approximately 855 residents, as well as for two state parks and an average of 2,500 tourists a day.

1.1 Purpose

The purpose of this Source Water Study is to provide an evaluation of the existing water supplies within the area, identify potential new water sources within the area, and to provide analysis for the development of new public water supply sources. This study has been prepared to quantify available water against that needed by potential users of a centralized CWS. The study is intended for use in planning and discussion of a potential future water system and will be used to inform the Alternatives Analysis Engineering Report. The intent of this effort is to identify long-term solutions to the critical water supply issues faced by the community of Mendocino.

1.2 Problem Description

The town has experienced water scarcity for decades, relying on approximately 400 privately owned wells. Many of the wells are old, shallow, and hand-dug. Well depths range from 10 to 200 feet, and typical yield is between 1 and 10 gallons per minute (gpm). Although MCCSD has a groundwater management plan, some wells' production is inadequate. Additionally, some wells run dry during droughts and in the summer and fall, compelling property owners to purchase trucked-in water to fill their individual storage tanks. Neighboring water districts supplemented supply in the past, but ceased during extended droughts (2012–2015 and 2020–2021). Water quality is also a concern, as many wells are likely under the influence of surface water.

Local geology limits groundwater availability and storage capacity. Wells harvest water from shallow marine terraces and fractured bedrock, but bedrock yields are low, and the Mendocino Headlands Aquifer has limited ability to store groundwater over an extended period. This results in groundwater levels closely associated with precipitation (Todd, 2020), leaving the wells vulnerable to drought.

A resilient and sustainable water supply is not currently available.

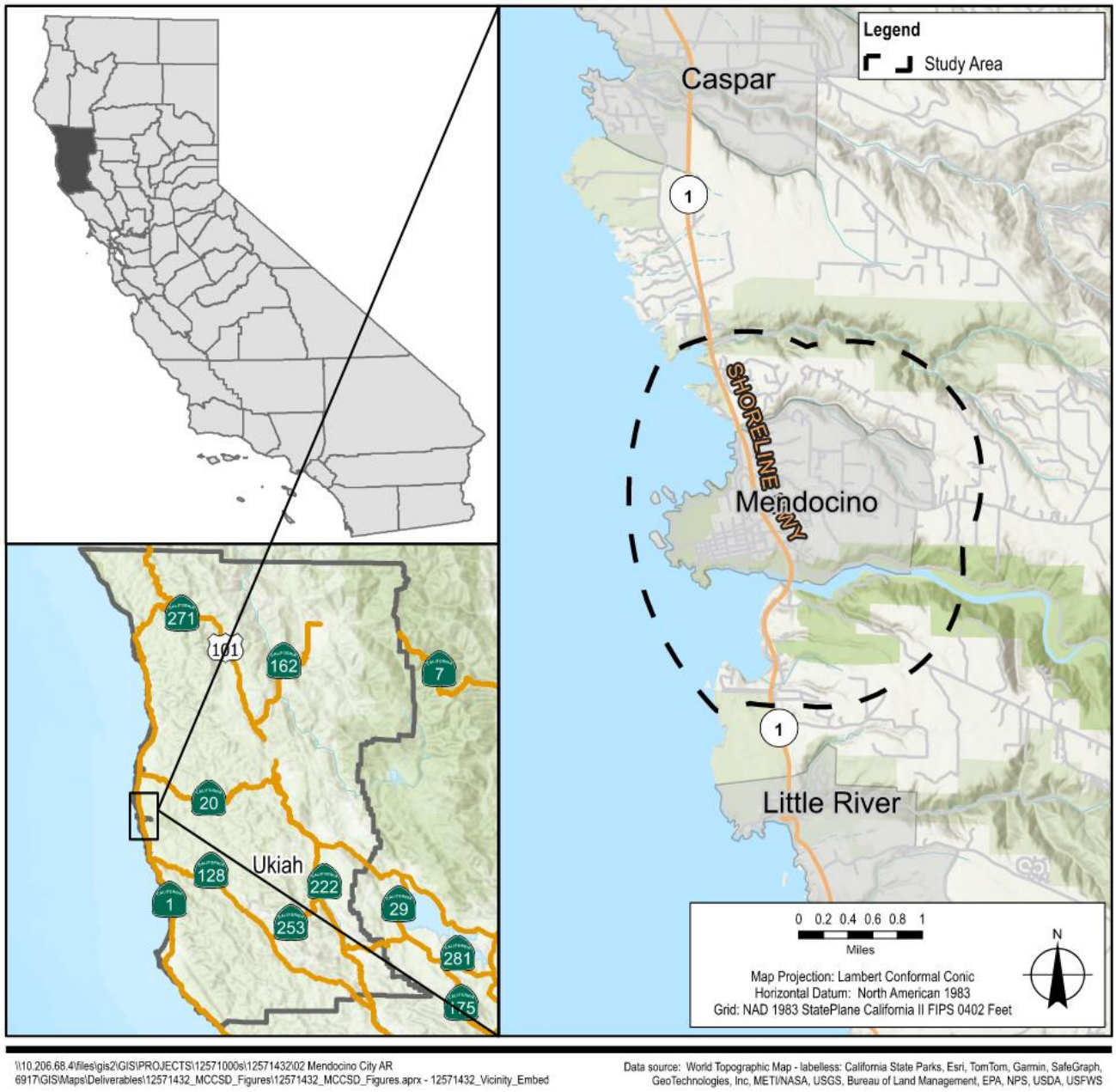
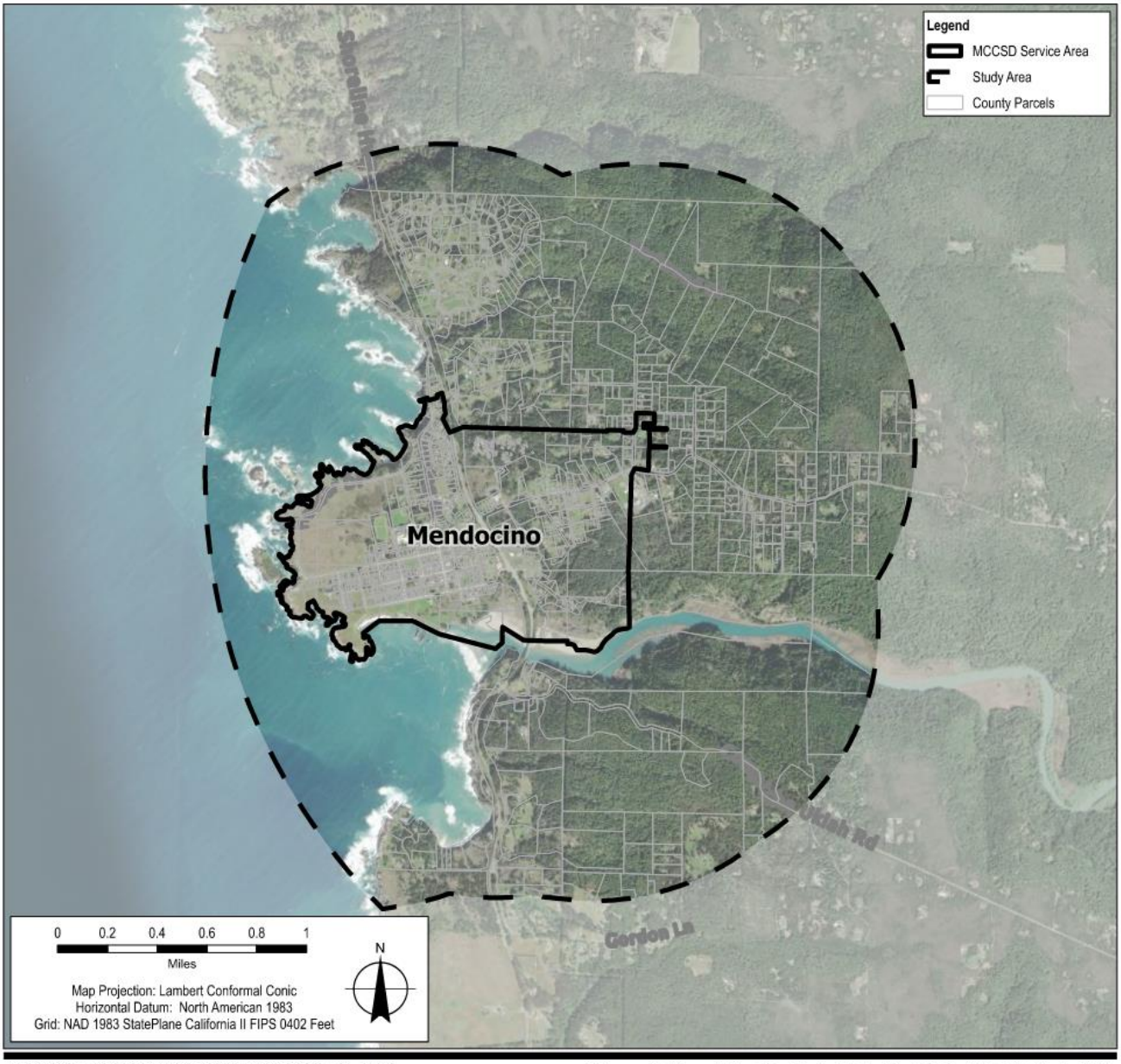


Figure 1 Vicinity and Location Map

2. Study Area Characteristics

2.1 Study Area

The study area for the purposes of this analysis is the region currently served by MCCSD and the area encompassing a one-mile radius outside the MCCSD service boundary, shown in Figure 2.



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Data source: Road Names: California State Parks, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/ NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

Figure 2 Study Area

Mendocino City Community Service District

The Mendocino City Community Services District was formed on August 31, 1970, by Mendocino Local Agency Formation Commission (LAFCo) Resolution No. 70-7, to provide a community wastewater system. In 1971, the voters approved the formation of the MCCSD. MCCSD was granted the powers associated with the collection and treatment of sewage and the operation of electrical street lighting. The sewage collection system and treatment plant were completed in the mid-1970's.

In 1985 voters added community water powers to the MCCSD's jurisdiction "to supply the inhabitants of the District with water for domestic use, irrigation, sanitation, industrial use, fire protection, and recreation" by the passage of Resolution 93. As a result, MCCSD undertook numerous investigations and studies to determine the feasibility of a community water system. In 1985 the Department of Water Resources (DWR) prepared the Town of Mendocino

Groundwater Study which was followed by a Water System Feasibility Study authored by Winzler & Kelly in 1990, investigations into surface water diversions by Lawrence and Associates, and a Water Supply Cost Feasibility Study authored by SPH Associates in 1993. To date, the community has not implemented the cumulative recommendations to pursue the installation of a community water system. Residents continue to operate their individual private wells and MCCSD has remained as a provider of sewerage collection, treatment and disposal.

In 1987 the California Legislature passed California Water Code Section 10700-10717 as outlined in Assembly Bill No. 786, which provided the MCCSD with the authority to prepare and implement a Groundwater Management Plan and to establish programs for groundwater resource management within the MCCSD boundary. Exercising this authority, in 1990, MCCSD adopted a Groundwater Management Plan and Groundwater Extraction Permit Ordinance (Ordinance Nos. 90-1 & 91-3) and assumed responsibility of groundwater management from Mendocino County. Ordinance No. 90-1 requires parcel owners to obtain groundwater extraction permits to extract groundwater prior to the installation of new or modifications to existing wells, a change in use, or new developments. The permit requires the completion of a hydrological study for any new well or increase in use and the installation of water meters to meter withdrawal. Ordinance No. 91-3 required water allotments be determined during the permitting process, with the goal of equitably allocating the groundwater resources. Allotments are the maximum amount of water an applicant may extract daily, averaged over a thirty-day period. It is the intent of the MCCSD to protect the groundwater resources within its boundary for the common good of all present and potential users.

MCCSD's Ordinance 2020-1 is the current groundwater extraction regulation and requires all developed parcels to apply for and obtain a Groundwater Extraction Permit to limit and monitor groundwater extraction. A Groundwater Extraction Permit shall be obtained prior to issuance of a Mendocino County Use Permit or Coastal Development Permit, issuance of a Mendocino County Building Permit for other than minor repair or maintenance, and issuance of a Mendocino County Well Permit. Ordinance 2020-1 requires applicants to install water meters and report monthly meter readings to the MCCSD. Ordinance 2020-1 established water allotments with the goal of equitably allocating the groundwater resources to all developed parcels. The allotments are based on Equivalent Single-family Dwelling (ESD) water use of 200 gallons per day for a 1–2-bedroom single-family residence in MCCSD.

Faced with limited groundwater that is susceptible to drought, in 2020 MCCSD adopted a Water Shortage Contingency Plan (WSCP) that provides guidelines for implementing water conservation measures during drought years based on a series of drought contingency modeling scenarios developed for the Mendocino Headlands Aquifer (Questa 2006).

The Mendocino Local Agency Formation Commission (LAFCo) confirmed in 2005 that MCCSD has active water and groundwater management powers for

> "water services for any beneficial use in the same manner as a Municipal Water District, including a ground water management program as provided by Water Code Sections 10700-10717, and the District's Ordinance for Groundwater Extraction Permits and policies to manage and protect groundwater resources, to promote water conservation, increase the use of reclaimed water, reduce ground water extraction and to collect information on groundwater conditions in Mendocino (LAFCo, 2022)."

The MCCSD boundary is approximately one square mile in size. A boundary map of MCCSD is shown in Figure 3.

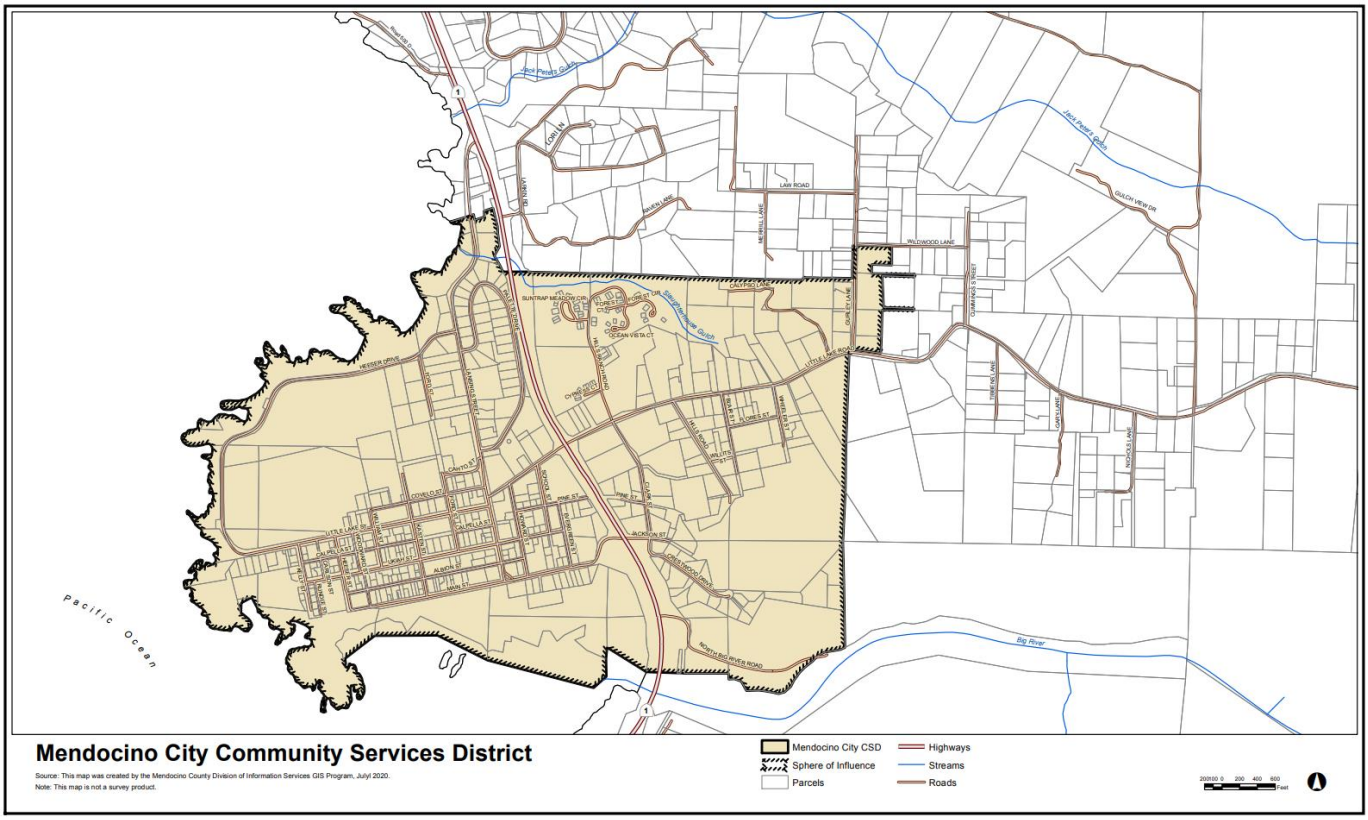


Figure 3 MCCSD Boundary (LAFCo, 2022)

2.2 Topographical Features

The town is built on a relatively flat coastal terrace headland that slopes west towards the Pacific Ocean. The headland forms a broad peninsula bounded by sea cliffs that range in height from approximately 40 to 100 feet above sea level with a broad gentle ridgeline roughly bisecting the peninsula. Elevations increase to approximately 360 feet along the eastern margin. Slopes are steeper east of town.

The Big River forms the southern edge of the community and joins the Pacific Ocean at Big River Beach, approximately 0.4 miles south of the center of town. Steep slopes are present on both sides of the Big River at approximately 400 feet, after which topography flattens out with gentle slopes.

Approximately 0.8 miles north of the center of town is Jack Peters Gulch, which extends approximately 0.6 mile east from the Pacific Ocean. Steep slopes are present on either side of Jack Peters Gulch at approximately 350 feet, after which topography flattens out with gentle slopes.

2.3 Hydrologic Setting

Within the study area, the community relies upon groundwater as their primary source of water. Wells draw from either the shallow alluvial and marine sediments that make up the regional aquifer system or bedrock sources, which are low yielding. The Surfwood community, located at the north end of the study area, is the only CWS that does not rely upon groundwater: it instead relies on extraction from Jack Peters Gulch. Jack Peters Gulch has a watershed of approximately 1.27 square miles.

There are three additional surface water bodies within the study area: Big River, Slaughterhouse Gulch and Russian Gulch. The Big River is by far the largest of the four drainages, with a watershed spanning nearly 181 square miles. The other two surface water watersheds span 4 square miles (Russian Gulch) and 0.5 square miles (Slaughterhouse Gulch). All four surface water bodies are west-trending coastal drainages that outlet into the Pacific Ocean.

In addition to the primary water bodies in the study area, there are numerous small springs and seeps along the coastline that outlet to the ocean and cumulatively represent a significant outlet of water for the study area.

Precipitation is the primary source of incoming water for the region. Annual average rainfall for the town is approximately 40-inches, with 97 percent of the annual rainfall occurring in the rainy season (October to May). Precipitation by year is shown in Figure 4. Estimated base flow to the Big River from the underlying groundwater is approximately 10 cubic feet per second (cfs) or 4,500 gpm or 7,240 Acre-Feet per Year (AFY) (Consulting Engineers, 1989). Also, contributing to the incoming water sources are return flows from septic systems and irrigation runoff. These flows, however, are relatively minor when compared to the contribution of annual rainfall.

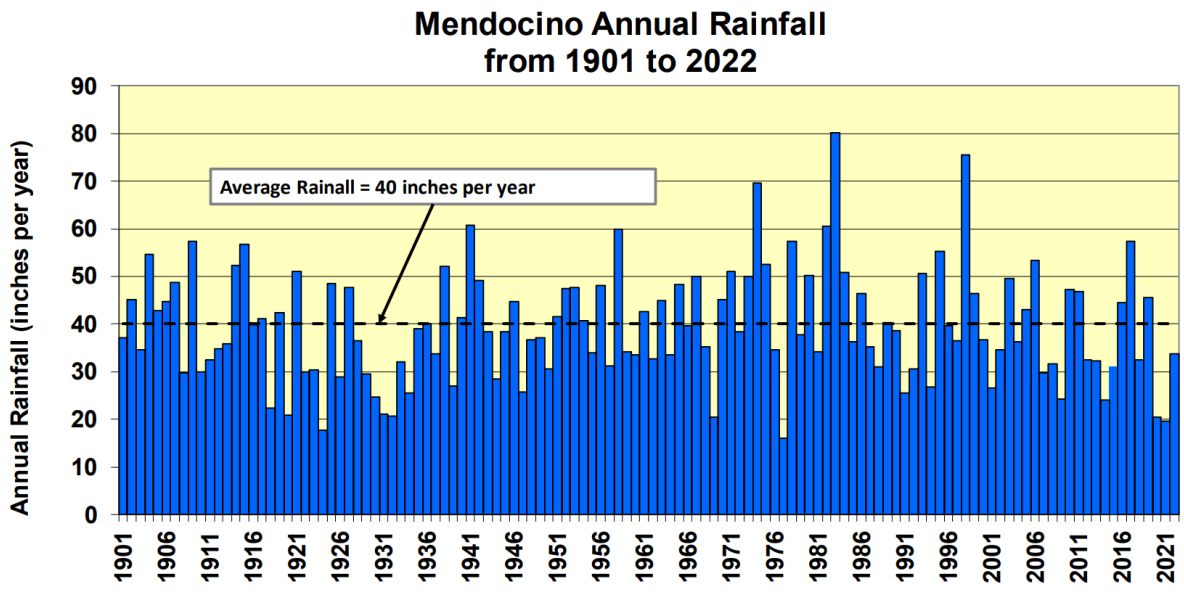


Figure 4 Mendocino Annual Rainfall from 1901 to 2022 (Todd 2022)

Another source of incoming water is imported water from other communities, primarily Fort Bragg, Westport, Irish Beach and Elk, that occurs when the demands of the community are unable to be met by groundwater wells.

2.4 Hydrogeologic Setting

The town of Mendocino is bounded by 40- to 100-foot-tall sea cliffs called the Mendocino Headlands. The headlands are comprised of a combination of Coastal Belt Franciscan Complex marine sedimentary rocks (bedrock) overlying elevated marine terraces. The Mendocino Headland's elevations ranges to 220 feet with elevation increasing as you travel inland. The southern end of the town of Mendocino is bounded by the Big River which contains recent alluvium deposits to a depth of more than 100 feet near its mouth.

The Mendocino Headlands aquifer is located within the Sustainable Groundwater Management Area designated as the Fort Bragg Terrace Area which does not have a current Groundwater Sustainability Plan, however, the area within the MCCSD boundary is regulated by MCCSD which maintains a local Groundwater Sustainability Plan. The Fort Bragg Terrace Area is a series of discontinuous uplifted marine terrace deposits located along the Mendocino County coastline (DWR, 2004).

The primary method of recharge for the aquifer is precipitation infiltration with excess surface runoff flowing into creeks and ultimately the Pacific Ocean to the west. Areas that have exposed bedrock tend to have poor infiltration rates resulting in the alluvial and marine terraces being primary recharge and storage areas. Due to the topographic setting of the Mendocino Headlands, a major portion of the annual groundwater outflow is through shallow springs along the surrounding cliffs, resulting in the shallow aquifer(s) having reduced long-term storage capacity influenced by annual weather patterns much more than typical alluvial California aquifers. This means that the Mendocino water supply is

very closely associated with year-to-year precipitation and is vulnerable to short period (single- and multi-year) droughts. In contrast, groundwater found in the bedrock is from long-term percolation over the span of hundreds to thousands of years.

Groundwater levels are typically lowest in the fall, prior to the first substantial rainfall of the rainy season, and they begin to rise after approximately 9-inches of precipitation (DWR, 1985). During droughts, the highest groundwater levels occur during the winter and are several feet lower than in the same months in an above average-precipitation year. During severe droughts, the average depth-to-water falls below 20 feet and results in a number of dry wells in the area. Groundwater pumping is metered and self-reported monthly, however, the MCCSD currently reads 79 meters on behalf of property owners. The total annual extractions within the MCCSD boundary ranged from 65 to 74 acre-feet from 2015 to 2021 (Todd, 2022).

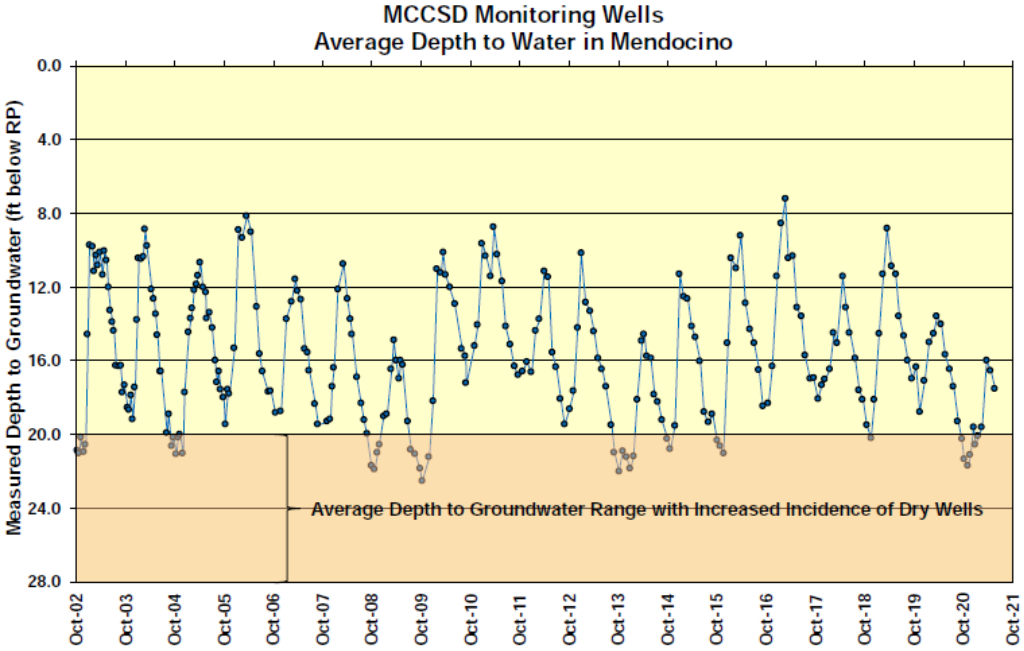


Figure 5 Mendocino City Community Service District Monitoring Wells – Depth to Groundwater (Todd 2021)

3. Previous Studies

The town of Mendocino has a long history of widespread water shortages during dry years, and in some localized areas, water shortages every year during the dry season. As a result, MCCSD and other agencies have commissioned numerous investigations and studies to determine the feasibility of a centralized community water system and to identify solutions to the town's water issue. Many of the previous studies contain valuable information used in the development of this Source Water Study.

In 1982 the Department of Water Resources (DWR) began evaluating the groundwater resources around the town of Mendocino. They found that groundwater along the Mendocino County coast is a limited resource that requires conservation and planned development. Additionally, they found that the aquifer system that the town of Mendocino relies upon, cannot store enough groundwater for the town due to seepage from the aquifer to the Pacific Ocean.

Following these findings, a series of studies were developed between 1990 and 1993 that were aimed to evaluate solutions to the community's water shortage through evaluating water supply alternatives. The three primary alternative water supplies that were considered were (1) groundwater from Big River alluvium, found to not be a viable

alternative, (2) a surface water intake in the Big River, and (3) capturing surface water from a collection of gulches. Conceptual designs and cost estimates were developed for alternatives 2 and 3 but neither were pursued.

With the town's continued reliance on groundwater MCCSD commissioned studies between 2006 and 2020 to evaluate the aquifers resiliency in drought conditions and determine thresholds for management action to inform the current groundwater use regulations.

More detailed summaries of findings and/or recommendations from these studies are provided in subsequent subsections. These summaries are meant to provide context on the limited water supply within the study area. Collective understanding of the local hydrological and hydrogeological system has developed over time. These summaries may not include all findings and/or recommendations. The following reports or studies are summarized in subsequent sections:

- 1982: Mendocino County Coastal Groundwater Study by the Department of Water Resources (DWR)
- 1985: Town of Mendocino Groundwater Study by DWR
- 1990: Water System Feasibility Study for MCCSD by Winzler and Kelly
- 1992: Summary of Drilling and Testing of MCCSD Test Hole 2 Drilled at Mud Flat 6 Big River Estuary by Lawrence & Associates
- 1992: Long Term Yield Analysis by Lawrence & Associates
- 1993: Points of Diversion of the Lower Gulches and Drydock Gulch Reservoir Tributary to the Big River by Lawrence and Associates
- 1993: Water Supply Cost Feasibility Study by SPH Associates Consulting Engineers
- 2006: Drought Scenarios of the Mendocino Headlands by Kennedy/Jenks Consultants
- 2009: Water Shortage Contingency Plan by Questa Engineering Corporation
- 2020: MCCSD Water Shortage Contingency Plan
- 2023: Hydrogeology Report by GHD (Tolerance Emergency Water Supply and Storage Improvements Project)

3.1 1982 Mendocino County Coastal Groundwater Study

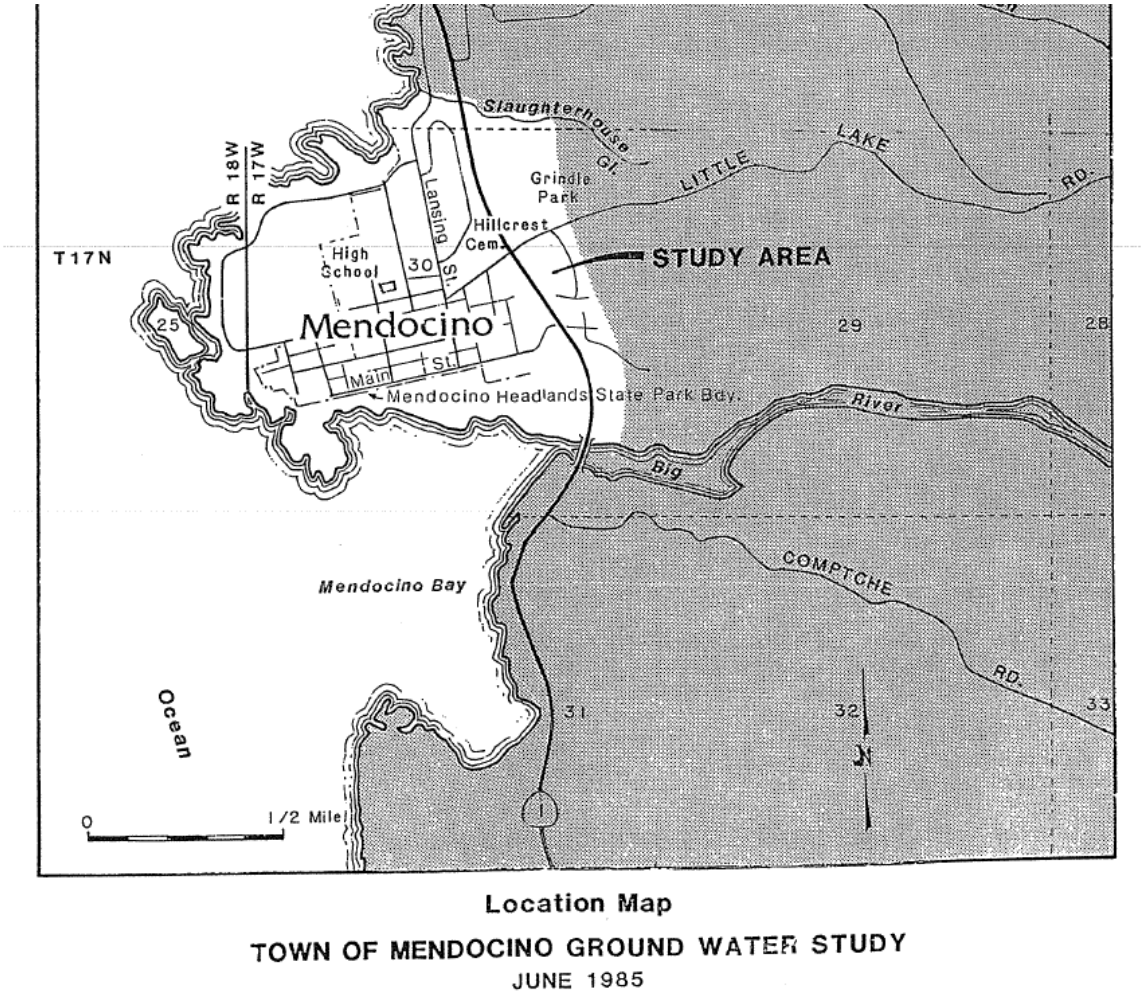
In 1982, DWR published a two-year study investigating the groundwater resources of the coastal area from Rockport to Gualala, providing specific recommendations for the management of the coastal Mendocino County groundwater resources. This study was initiated per concerns from the California Coastal Commission and County of Mendocino regarding annual water shortages along the Mendocino coastal region.

This study found that the marine terrace deposits are recharged directly by infiltration of precipitation and under normal rainfall conditions reach maximum storage by mid-January of each year. Terrace deposits less than approximately 5-feet in thickness do not store any usable groundwater, and deposits 5 to 16 feet are likely to experience 50 to 100 percent decline in storage by early fall. Alluvial aquifers, occupying perennial stream and river valleys, are continually recharged by surface flow, and are only marginally exploited due to their unlikely location for development and potential for seawater intrusion. Bedrock units in the study area, though considered "non-water bearing", often yield enough water for domestic needs.

Groundwater along the Mendocino County coast is a limited resource that requires conservation and planned development.

3.2 1985 Town of Mendocino Groundwater Study

In 1983 DWR conducted a two-year study of the geology, groundwater hydrology, and availability of groundwater from the marine terrace and bedrock formations of the Mendocino Headlands. The study area for this study included 350 acres between Slaughterhouse Gulch to the Big River, shown in Figure 6 below.



Location Map

TOWN OF MENDOCINO GROUND WATER STUDY

JUNE 1985

Figure 6 DWR 1985 Groundwater Study Area

Changes in groundwater conditions for an average precipitation year are described as follows:

> *"At the end of the fall dry season, just before the first winter storms, the groundwater levels are at the lowest point of the year. The springs on the north and west headlands cliffs have nearly all ceased flowing, but there are still several large spring or seep areas along the south cliff. Shallow wells in either the terrace deposits or the bedrock will be dry, some since August. In early November, after the first significant precipitation of about 9 inches, groundwater levels will start their winter recovery. With normal precipitation of 20 inches during late November and December, the groundwater levels will peak in early January. The springs around the headlands will be flowing up to 400 gallons per minute (gpm). Groundwater levels will then slowly decline between January and April. Each storm event will be visible on the continuous water well hydrographs (depth to water) but will rapidly disappear. Following the last heavy rainfall in April or early May, the groundwater surface starts its summer decline. The springs around the headland are now flowing at about 150 gpm. During the summer without any precipitation to recharge it, the groundwater levels continue to decline until the fall when the cycle repeats itself."*

Groundwater reservoir capacities were estimated by estimating a specific yield of the aquifer and multiplying it by an estimated saturated volume in the aquifer (areal extent * saturated thickness).

Specific yields of the marine terrace deposits were found to range from 3 to 25 percent, with an average value of approximately 9 percent. Estimates of the areal extents of the aquifers were obtained by use of a planimeter and geologic maps. The thickness of the terrace deposits were derived by interpretation of the well logs and from field observations. The saturated thickness was calculated from monthly monitoring well measurements.

The terrace deposits average approximately 20 feet in thickness and have a storage capacity of approximately 400 acre-feet if completely saturated. However, due to the aquifer's geometry and losses to the Pacific ocean, maximum terrace storage is approximately 200 acre-feet, and the minimum is approximately 55 acre-feet. The Coastal Belt bedrock stores a maximum of 270 acre-feet and a minimum of 155 acre-feet. Although it would seem that 210 acre-feet of groundwater is available during a dry period (55 acre-feet from terrace storage and 155 acre-feet from bedrock), its sporadic occurrence makes very little available to wells.

To evaluate the water-yielding characteristics of the marine terrace deposits and bedrock, wells were classed, after interpretation of the drillers' reports, as bedrock wells (wells completed wholly within bedrock), composite wells (wells drilled more than 10 feet into bedrock and having more than 5 feet of terrace deposits between the bedrock contact and the bottom of the sanitary seal), and terrace deposit wells (wells completed in the marine terrace deposit and not extending more than 10 feet into the bedrock). Data concerning yield of wells and specific capacity of wells were obtained from well drillers' reports on wells for which pump tests were conducted.

The average formation yields between May and October are only 25 percent of the yields expected between November and April. Well yields reported in Drillers' reports average 4.89 gpm from May to October and 13.11 gpm for tests conducted from November and April. As such, formation yields were calculated at 2.82 gpm from May to October and 11.32 gpm from November to April. It should be noted that drillers well yield estimates are approximate due to the limited length of air lift tests.

Findings from the 1985 Study

There is sufficient precipitation and deep percolation into the ground to satisfy the town of Mendocino's water needs. However, the marine terrace deposits that make up the Mendocino Headlands cannot store enough groundwater for the town because it lacks the lateral confinement typical of a normal groundwater basin. Approximately 70 percent of the annual percolation escapes through springs and seeps in the high sea cliffs that bound the study area.

The marine terrace deposits are the largest producing aquifers in the headlands. The Coastal Belt Franciscan rocks are considered non water bearing, however yield water to most wells. Drilling below sea level in the Coastal Belt rocks is not recommended and will likely result in saltwater intrusion.

The town of Mendocino has a per capita water use of 70 gallons per day (gpd). This represents 45 to 76 percent of water use in comparable north coast communities. The per capita residential use (non-commercial) is 22 gpd. Further water conservation by local residents is unlikely. In fact, a larger water supply could result in an increase in per capita water use.

3.3 1990 Water System Feasibility Study for MCCSD

In 1990 Winzler & Kelly prepared an evaluation of the existing water supply systems in the town of Mendocino and provided potential alternatives for the development of a public water system.

At the time of the report, most of the existing water supply systems were in violation of routine bacteriological and Title 22 chemical and radiological sampling requirements. Systems rely largely on shallow wells which are likely under the influence of surface water and require treatment. Additionally, most of the systems have an inadequate and unreliable source capacity and rely on water hauling to supplement their supply, a problem that persists. In their review, all systems reviewed at the time were not compliant with state requirements for cross connection and operator certification.

Systems were categorized into four groups: (1) systems requiring a new water source (assumed to be a new well), (2) systems requiring additional disinfection systems, (3) systems requiring new treatment facilities, and (4) systems requiring operator training and additional monitoring.

To address these issues, the following alternatives were presented:

1. The existing public water systems would continue to operate and maintain their own systems and make necessary upgrades to meet regulations and standards.

2. MCCSD would assume ownership of and responsibility for the public water systems within its boundary and facilitate the necessary upgrades for each system.
3. A new water system be developed, capable of providing domestic water supply, fire protection, and emergency storage for the community.

Consulting Engineers, a geohydrologist subconsultant on the project, developed an Assessment of Alternative Water Supplies for the project. The alternative assessment indicated that the Big River represented a viable water supply source and concluded in the study that it was one of two alternatives available to the MCCSD. The second alternative source water identified was groundwater in the Big River alluvium.

3.4 1992 Drilling and Testing of MCCSD Test Hole 2 Drilled at Mud Flat Six Big River Estuary

Following the recommendation of the Winzler & Kelley report, a test well was drilled at the Mud Flat Big River Estuary. The original location (approximately 1,000 feet upstream of the mouth of the Big River) was rejected in favor of a location with a greater supply potential further upstream (Mud Flat 6). The test well was drilled in 1992, approximately 2.3 miles upstream of the mouth of the Big River by Weeks Drilling & Pump Company and overseen by Lawrence & Associates, shown below in Figure 7.

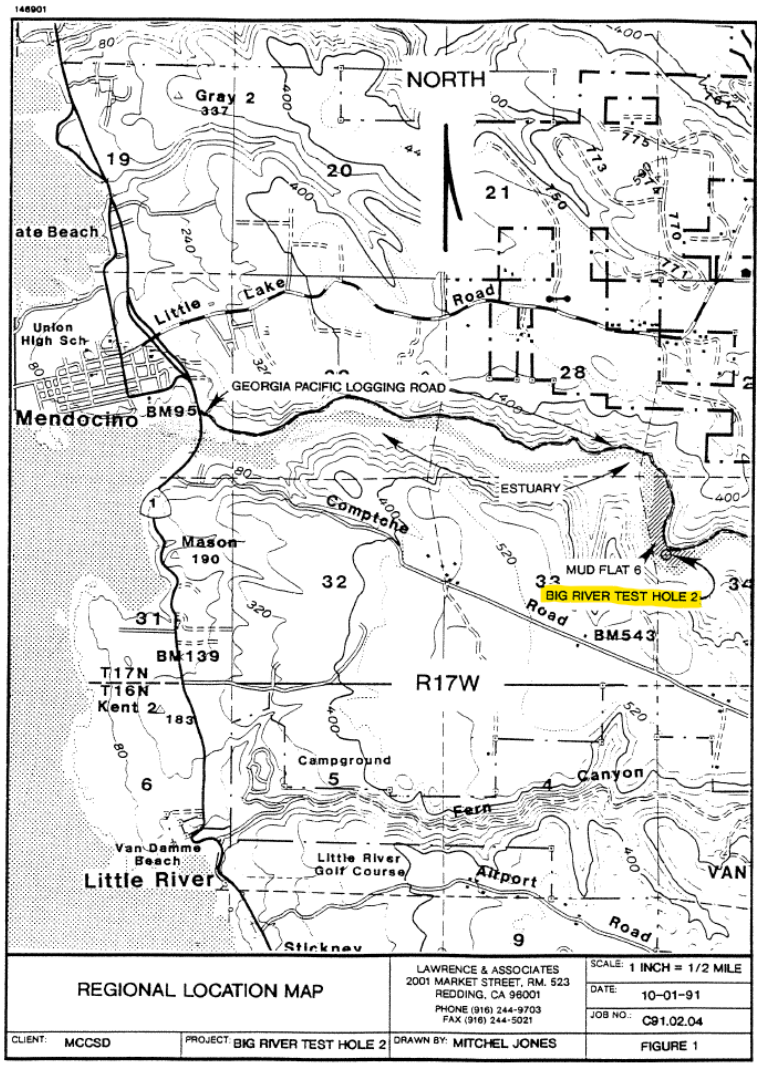


Figure 7 Mud Flat Test Well Location (Lawrence & Associates, 1992)

The well was test pumped for 400 minutes at a constant discharge of 34.9 gpm. Transmissivity was estimated to be approximately 135 gpd/ft of drawdown. The sustained yield of the well is estimated to be approximately 9 gpm. Conductivity, a measurement of Total Dissolved Solids (TDS), was monitored during the initial bailing of the well and during pump testing and a general-mineral analysis was taken at the end of the pump test.

The lithology of the well consisted of approximately 70 feet of soft fine-grained sediments (silt and clay) that is underlain by a thin layer of light-brown sandstone, 70 to 105 feet followed by dark gray shale that extended to the maximum depth explored of 150 feet below ground surface.

The water within the river alluvium and the underlying sandstone and shale was determined to be saline, not of potable quality, with a TDS concentration of approximately 19,800 mg/L. The alluvial deposits are approximately 70 feet thick and consist of relatively impermeable silt and clay.

3.5 1992 Long Term Yield Analysis of the Lower Gulches

Following the findings that groundwater under the Big River at the Mud Flat 6 Big River Estuary was unsuitable for potable water, Lawrence & Associates prepared a Long-Term yield Analysis of the Lower Gulches and Drydock Gulch Reservoir Tributary to the Big River as a potential water supply for the town of Mendocino.

The purpose of the investigation was to evaluate the long-term yield of the combined flow of the Lower Gulches (Thicket Draw, Beans Gulch, Waterspout Gulch, and Nelsons Gulch) for the 44-year period 1948 to 1992 and evaluate the long-term combined yield of the Lower Gulches and the Drydock Gulch under various alternatives reflecting the height and volume of storage within Drydock Gulch.

The analysis of the Lower Gulches during the 2-year period 1991 and 1992 is based on measured and estimated flows. The daily flows for each gulch were estimated for each year by straight-line interpretation between the days having observed and estimated flows. Figure 8 below shows the locations of the gulches of interest.

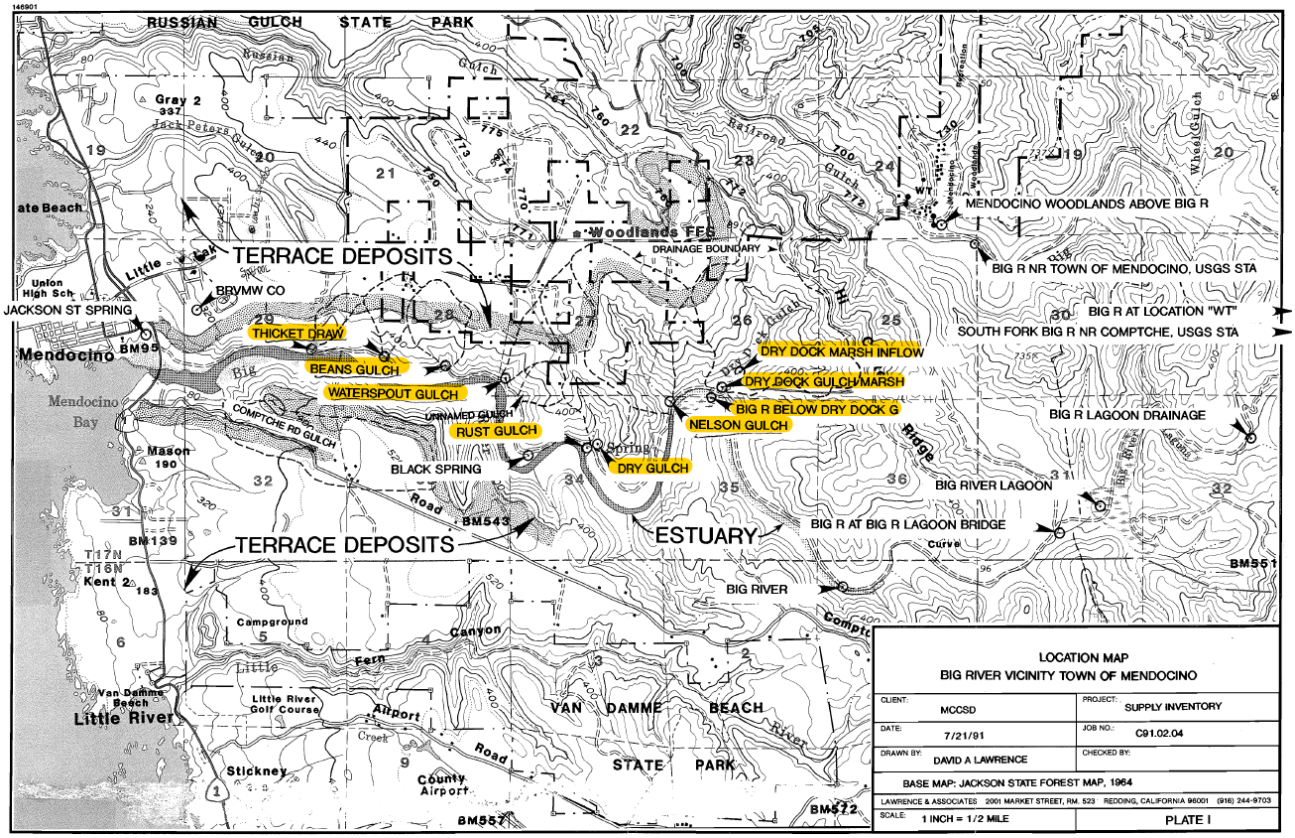


Figure 8 Location Map of Long-Term Gulch Yield Analysis (Lawrence & Associates, 1992)

Findings

Without performing any grading activities to adjust existing topography, installation of a dam at Drydock Gulch would result in a reservoir with a maximum capacity of 7.2 acre-feet (2.3 MG). Three larger possible reservoirs were also considered to store gulch yields. Reservoirs were modelled using a computer simulation of daily time-steps to reflect operations of Drydock Gulch under various conditions. Proposed reservoir capacities with sustainable gulch yields in gallons per minute (gpm) are shown in Table 1 below.

Table 1 Long-Term Gulch Yield (gpm) Analysis Lower Gulches and Drydock Gulch Reservoir Capacity

Water Year	Reservoir Capacity (Acre-feet) / Maximum Depth (feet)			
	40 / 13.6	25 / 9.2	15 / 6.3	7.2 / 4 (Existing)
1975-1976	234	**211**	196	184
1976-1977	171	**156**	140	124
1990-1991	210	**188**	172	161
1991-1992	253	**230**	215	203
Min Summer Yield*	237	**214**	199	188

**** Minimum summer yield excluding the critical-dry years of 1975-1977 and 1990-1992***

A dam was recommended to be constructed across Drydock Gulch with a capacity of approximately 25 acre-feet and a maximum depth of 9 feet, which would provide storage for the summer yield of 190 gpm.

3.6 1993 Points of Diversion of the Lower Gulches and Drydock Gulch Reservoir Tributary to the Big River

As a follow up to the Long-Term Yield analysis, in 1993 Lawrence and Associates prepared a conceptual design of gulch collection systems for five tributaries to the Big River identified as Thicket Draw, Beans Gulch, Waterspout Gulch, Nelsons Gulch, and Drydock Gulch. The design proposed the installation of dams paralleling existing or proposed logging roads, backfilled with large gravel, and the installation of collection galleries consisting of vertical casings, screening and pumps, as shown below in Figure 9.

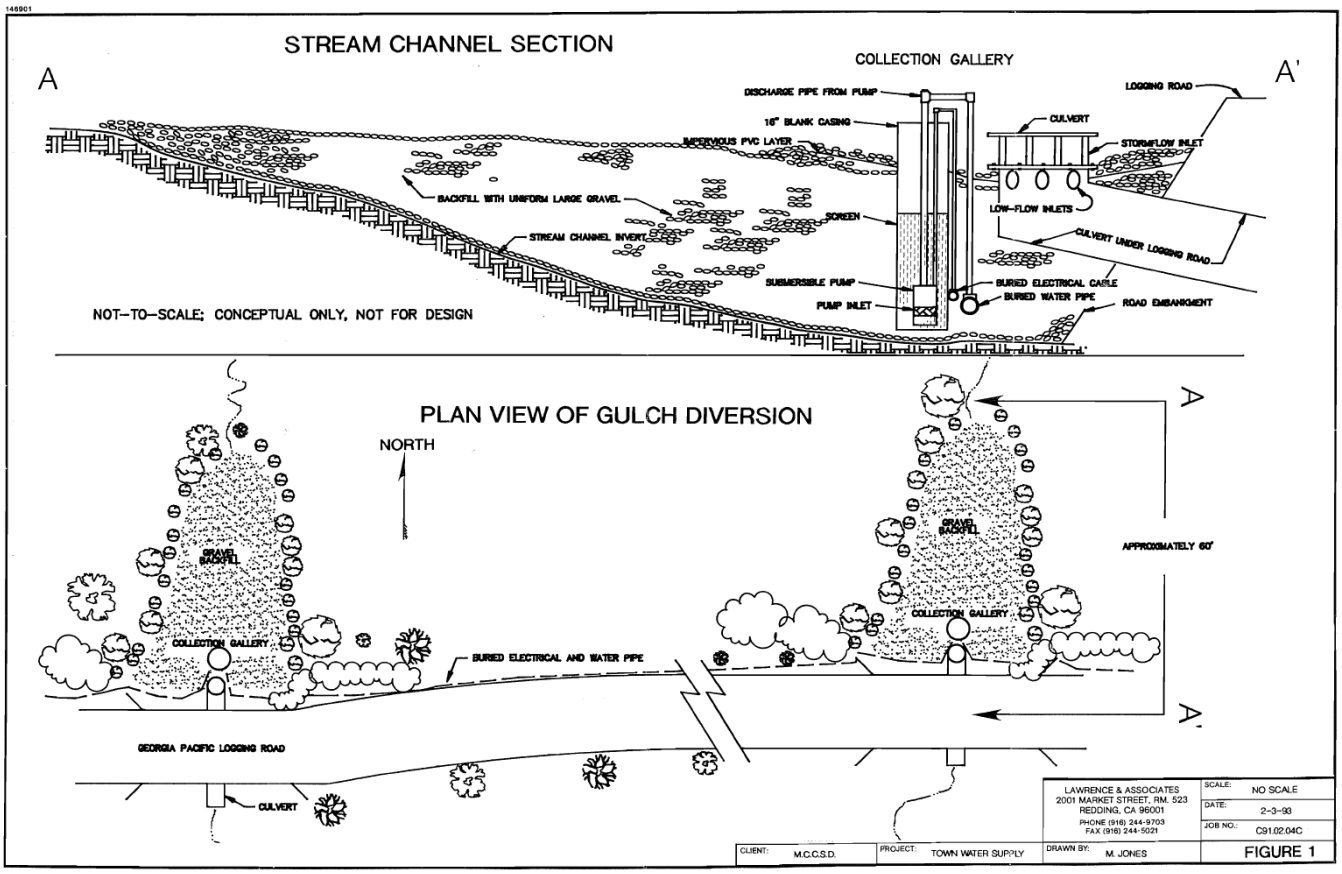


Figure 9 Conceptual Designs for Gulch Collection Systems

3.7 1993 Water Supply Cost Feasibility Study

In 1993 SPH Associates Consulting Engineers prepared an evaluation of the water supply alternatives available to MCCSD, including source development, transmission, treatment, and distribution to establish a cost estimate of a community water supply system for the town in order to establish the foundation for a project which would resolve the long-standing problem of inadequate water supply in the community.

Two different water source alternatives were identified and were developed in this study. Those alternatives were (1) the Gulch Diversion Alternative (based on the studies performed by Lawrence and Associates) which involved collection and pumping from five small watersheds on the north side of Big River (all within 4.5 miles of the town of Mendocino) and (2) a Big River Diversion Alternative which included a single point diversion from the Big River from a location above the furthest seasonal migration of brackish or saline water from the ocean.

Detailed construction cost estimates were developed for both alternatives along with total projects costs for the construction of a community water system. Total project costs for developing the Big River as a water supply source were estimated at $6,083,000 and total project costs for developing the gulches as water supply sources were estimated at $6,497,000. The gulch diversion alternative was the more expensive alternative due to the need to pump raw water 4.5 miles to town and the installation and extension of power to the proposed pump stations. As a result of the cost comparison, the Big River Diversion Alternative was the recommended alternative.

Operation and maintenance costs were also estimated for the Big River diversion alternative with an annual estimated costs of $78,000 based on treating up to 228 AFY (203,500 gpd) and delivering to the customer's tap for approximately $342 per acre-foot ($0.10 per gallon).

An environmental impact report (EIR) and initiation of permitting process were recommended as the next step, however, due to the high capital costs and community sentiment to the proposed alternative, no EIR was developed, and project development for a community water system ceased.

3.8 2006 Drought Scenarios of the Mendocino Headlands

A series of below average rainfall years in the early 2000's caused extended drought conditions for the town of Mendocino. In an effort to reduce water usage during droughts, in 2006 MCCSD contracted with Kennedy & Jenks Consultants to evaluate drought scenarios for the Mendocino Headlands, using a numerical groundwater model that was developed by Questa Engineering and ETIC, Inc in 2004.

3.8.1 Mendocino Headlands Groundwater Model Summary

The model was created using MODFLOW 2000. The model duration was 12-months, divided into twelve one month long stress periods. Boundary conditions include precipitation recharge, pumped groundwater, subsurface inflow and outflow, discharge to utility trenches, and evapotranspiration. Aquifer properties were estimated per previous aquifer tests, geologic descriptions, and model calibration.

The Model confirmed that precipitation infiltration is the primary recharge method, contributing approximately 98.4 percent of the total aquifer recharge (Table 2). Springs along the cliffs account for approximately 40 percent of the total groundwater discharge, followed by groundwater pumping (21 percent), discharge to surface drainages (16 percent), evapotranspiration (20 percent), and outflow to utility trenches (3 percent). The annual recharge ranges from 886 acre-feet in the 2000-01 water year to 1,604 acre-feet in the 1997-98 water year.

Table 2 Model-Based Hydrologic Budget Summary (Questa and ETIC 2004)

	INFLOW (acre-ft)			OUTFLOW (acre-ft)						
Year	**Percolation**	**Ground water Inflow**	**Total Inflow**	**Cliff Springs**	**Stream**	**Utility**	**Evapotranspiration**	**Wells**	**Total Outflow**	**Change in Storage**
1984-85	886	21	**908**	443	165	18	162	251	**1038**	-130
1997-98	1588	15	**1604**	553	253	70	348	251	**1476**	128
1998-99	1395	17	**1412**	520	221	43	285	251	**1320**	92
1999-00	1164	19	**1184**	481	187	23	217	251	**1158**	26
2000-01	863	23	**886**	421	143	9	150	251	**974**	-88
2001-02	1083	19	**1103**	477	196	34	202	264	**1174**	-71
2002-03	1370	18	**1338**	512	215	43	280	234	**1283**	105
Total	**8350**	**133**	**8484**	**3407**	**1379**	**240**	**1644**	**1752**	**8423**	**62**
7-year Average	**1193**	**19**	**1212**	**487**	**197**	**34**	**235**	**250**	**1203**	**9**
Percent of Total	**94.4%**	**1.6%**		**40.4%**	**16.4%**	**2.8%**	**19.5%**	**20.8%**		

3.8.2 Findings from Drought Scenarios

The 2004 drought scenario report determined a safe yield for the aquifer of 259 AFY (231,220 gpd). This safe yield is the minimum available groundwater supply and was estimated using long-term water budget data from the 2004 Groundwater Modeling Study (Questa and ETIC, 2004) and the 2006 Mendocino Drought Contingency Modeling Scenarios (Kennedy-Jenks, 2006).

In 1977 after two water shortage years, and in 1989, the community experienced the driest years and least available water supply. In these years, the available groundwater supply likely dropped to 40 percent of the average. Forty percent of the perennial supply of 259 AFY is 104 AFY. This supply (104 AFY) is assumed to be a reasonable estimate of minimum supply.

Drought scenarios were based on varying the monthly precipitation by a uniform percentage, five different scenarios were developed:

1. Baseline scenario– using current average annual precipitation.
2. 25% below average annual precipitation scenario.
3. 40% below average annual precipitation scenario.
4. 60% below average annual precipitation scenario, representative of the rainfall during the historic drought of 1977.
5. A no-rain scenario.

To run the drought scenarios, the probability of annual precipitation was estimated as follows:

– 25% below average annual precipitation, or 30.3 inches per year; the probability of which is 20%, which represents an occurrence of once in every 5 years.
– 40% below average annual precipitation, or 24.2 inches per year; the probability of which is approximately 7%, which represents an occurrence of once in every 15 years.
– 60% below average annual precipitation, or 16.2 inches per year; the probability of which is approximately 1%, which represents an occurrence of once in every 100 years.

Drought scenarios were run in one-year and two-year time periods and resulted in the development of drought condition definitions which were adopted by the MCCSD in their Water Shortage Contingency Plan.

3.9 2009 MCCSD Water Shortage Contingency Plan

MCCSD adopted a Water Shortage Contingency Plan in 2020 to guide emergency water supply shortage planning and response within MCCSD. In addition, the most recently adopted groundwater Ordinance (2020-1) requires developed parcels within the MCCSD boundary to obtain a valid Groundwater Extraction Permit and meter groundwater withdrawals. The Ordinance includes standards for allotment determination which is limited by parcel size and use.

MCCSD monitors cumulative precipitation and groundwater levels through a monitoring well network to evaluate drought conditions. Groundwater levels in the summer months are sensitive to the preceding wet season and are used as indicators for available groundwater. The four stages of groundwater shortage, with criteria for declaration of a water shortage, are presented in Table 3.

Table 3 Water Shortage Stage Criteria (Previous Year with Normal Rainfall)*

Water Shortage Stage	Severity	Rainfall (percent of normal)	Expected Recurrence (years)	Evaluation Date / Cumulative Rainfall Total		
				Jan. 31	March 31	May 31
1 - Alert	Mild	75% - 82.5%	± 5	14-19”	29-32” and <7” since Feb 1	32-35” and <12” since Feb 1
					26-29” and 7-18” since Feb 1	29-32” and 10-20” since Feb 1
					22-26” and >18” since Feb 1	24-29” and >20” since Feb 1
2 - Warning	Moderate	60% - 75%	± 8	10-14”	26-29” and <7”	29-32” and <10”

Water Shortage Stage	Severity	Rainfall (percent of normal)	Expected Recurrence (years)	Evaluation Date / Cumulative Rainfall Total		
				Jan. 31	March 31	May 31
					since Feb 1	since Feb 1
					22-26” and 7-18” since Feb 1	24-29” and 10-20” since Feb 1
					16-22” and >18” since Feb 1	20-24” and >20” since Feb 1
3 - Emergency	Severe	50% - 60%	± 15	8-10”	16-22” and 7-18” since Feb 1	20-24” and 10-20” since Feb 1
					16-22” and 7-18” since Feb 1	20-24” and 10-20” since Feb 1
4 - Crisis	Historic	<50%	± 50	<8”	16-22” and <7” since Feb 1	20-24” and <10” since Feb 1
					<16”	<20”

– Rainfall measured from October 1-September 30

If water shortage is not declared by the end of May, no further evaluation is required until the following January 31. However, if a water shortage condition is defined prior to May 31, additional evaluation occurs on August 31, November 30, and December 31 to evaluate whether the water shortage condition should be continued, increased in stage, or terminated. Depth to groundwater and rainfall criteria are used to determine if:

4. Initial voluntary water conservation or other mitigation measures were sufficient to ease the water shortage restrictions;
5. Conditions have worsened and more stringent water shortage restrictions and mandatory water conservation measures are necessary, or;
6. Conditions have remained unchanged.

August 31 Evaluation Date

Typically, no significant rainfall occurs during the period from May 31 to August 31; therefore, depth to groundwater levels are considered as the primary tool for groundwater supply evaluation. Depth to groundwater levels are defined for five indicator wells that are used as the primary basis for declaration of a potential water supply shortage during the summer months. Because a range of conditions may occur based on this analysis, the average condition should be considered as the indicator of the water shortage condition, in which a majority of wells (e.g., three out of five) fall within the depth-to-water criteria for a particular stage.

Table 4 Indicator Well Groundwater Levels (depth-to-groundwater in feet) to Trigger Water Shortage (Table 5 of MCCSD Water Shortage Contingency Plan)

	No Water Shortage	Stage 1	Stage 2	Stage 3	Stage 4
Well 139					
August	<18'	18'-22'	22'-26'	26'-34'	>34'
November or December	<15'	15'-19'	19'-23'	23'-29'	>29'
Well 25					
August	<38'	38'-40'	40'-44'	44'-50'	>50'
November or December	<35'	35'-37'	37'-41'	41'-47'	>47'
Well 134A					
August	<17'	17'-19'	19'-23'	23'-30'	>30'
November or December	<14'	14'-16'	16'-20'	20'-27'	>27'
Well 134B					
August	<17'	17'-19'	19'-23'	23'-30'	>30'
November or December	<13'	13'-15'	15'-19'	19'-25'	>25'
Well 136					
August	<14'	14'-16'	16'-20'	20'-24'	>24'
November or December	<14'	14'-16'	16'-20'	20'-24'	>24'

November 30 and December 31 Evaluation Dates

Modeling results indicate that unless rainfall is well below average in the fall, groundwater levels can be restored to near normal conditions, even when the previous year is drier than normal and there is a lack of significant carryover storage in the aquifer. This of course depends on the severity of the preexisting water shortage condition. The criteria are based on the December 31 conditions. November 30 is considered an interim date, such that if high rainfall occurs in November, water shortage conditions can be modified prior to December 31. For the November 30 and December 31 evaluations, the decision-making data will consist of both rainfall and depth to groundwater. If rainfall and depth to groundwater evaluations do not agree, then the more conservative (severe) of the conditions will be used. The rainfall conditions are defined as cumulative rainfall since October 1 in relation to the pre-existing water shortage condition. Table 5 shows the decision matrix, should there be a continuing water shortage.

Table 5 Water Shortage Stage Criteria (in inches of rainfall) for Continuing Water Shortage (Table 6 of MCCSD Water Shortage Contingency Plan)

Pre-existing Water Shortage Stage	November 30, December 31	Action
1	>12" since Oct 1	No Water shortage
	<12" since Oct 1	Continue Stage 1
2	>16" since Oct 1	No Water shortage
	12-16" since Oct 1	Change to Stage 1
	<12" since Oct 1	Continue Stage 2
3	>22" since Oct 1	No Water shortage
	16-22" since Oct 1	Change to Stage 1
	12-16" since Oct 1	Change to Stage 2
	<12"	Continue Stage 3
4	>22" since Oct 1	Change to Stage 1
	16-22" since Oct 1	Change to Stage 2
	12-16" since Oct 1	Change to Stage 3
	<12"	Continue Stage 4

When a Stage 3 Water Shortage Emergency is declared, withdrawal allotments are reduced 20 percent, with a 40-percent reduction during a Stage 4 Water Shortage Emergency.

4. Water Demands

In order to evaluate the suitability of water sources for a proposed centralized community water system, an estimate of the existing and future build-out water demands of the study area is needed. Previous studies (Winzler and Kelly, 1990) estimated an ADD of approximately 424,000 gallons (475 AFY) for a community water system serving the District. This section provides a basis for an updated estimated average daily demand for a community water system that would serve the entire study area.

4.1 Land Use and Population

Per Figure 10 Zoning Map, there are 1,118 parcels within the study area, 585 parcels within the MCCSD boundary and 533 parcels outside the MCCSD service area.

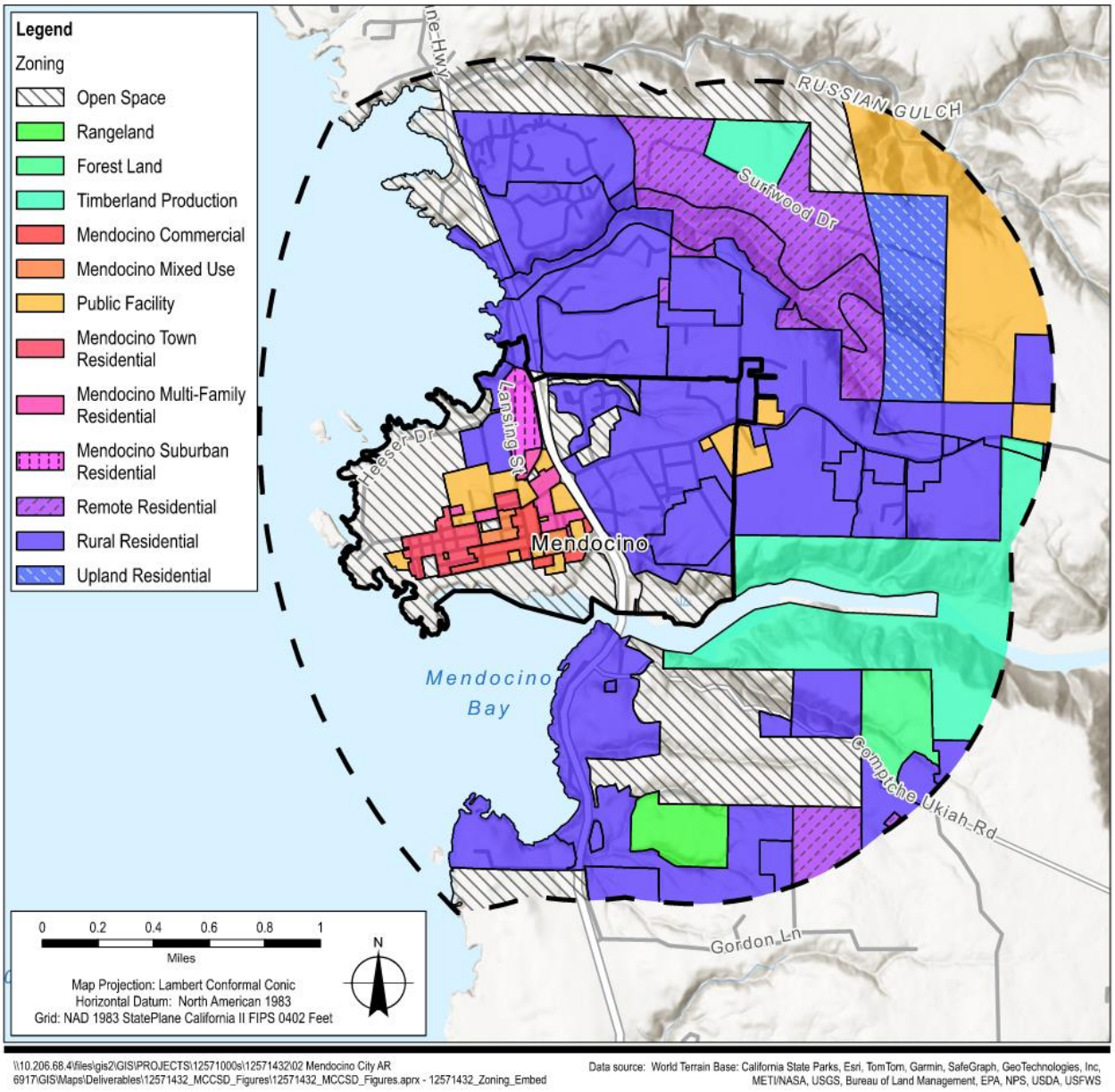


Figure 10 Zoning Map

Zoning within the study area is summarized in Table 6. Aside from Rural Residential 1 (RR-1), housing classification typically allows one primary and one secondary residential dwelling, depending on the size of the parcel. In some cases, the secondary dwelling has already been constructed. In other instances, the secondary dwelling remains to be constructed, allowing for future in-fill development and housing growth.

Table 6 Zoning Classifications in the Study Area and Housing Allowances

Zoning Classification	Housing Considerations	No. Parcels within Study Area
None		2
Forest Land, Rangeland, Open Space, and Parks	No housing	185
Public and Semi-Public Facilities	No housing	66
Commercial	Residential: Single-family, two-family and multifamily dwelling units, subject to density requirements; civic uses; and conditions uses such as retails stores or vacation rentals	62
Residential	Residential: Single family, two family and multifamily dwelling units	724
Residential Planned Development	Planned Development	79
Total		**1,118**

Existing Population within the Study Area

The U.S. Census 2020 indicates a population of 932 individuals within the Mendocino Census Designated Place (CDP), see Figure 11. This number aligns closely with the MCCSD's reported population served of 855 individuals and the CDP encompasses all of MCCSD. The Mendocino CDP does not include the entire study area as shown in Figure 11.

Four public water systems exist outside the CDP and within the study area for which populations served are reported; CSP-Russian Gulch State Park CA2310304, Surfwood Mutual Water Corporation CA2300590, Standford Inn By the Sea CA2300626 and Mendocino Grove Campground CA2300760. The combined population served by the water systems is 370 individuals.

Per communication with MCCSD, State Parks reports a daily visitor count of 2,500 individuals.

There are 196 parcels outside the CDP and not within any water system, with 113 being zoned residential and the other 83 forest land. Of the 113 residential parcels, 11 are zoned as planned development, thus 102 existing residential units are unaccounted for. Using the land use and zoning, conservatively assuming two dwellings per parcel and 1.88 individuals per dwelling (per the 2020 census) the estimated population in the remaining parcels is 384 (102 * 2 * 1.88). Thus, the total current population of the study area is 4,186 (See Table 7). It should be noted that a portion of the populations served by CSP-Russian Gulch State Park, Stanford Inn and Mendocino Grove Campground are transient and likely contribute to the daily visitors to the area's State Parks of 2,500.

Table 7 Existing Study Area Population

Population Area or Water System	Connections or Parcel Count	Population Served
Surfwood Mutual Water Corporation	107	160
CSP- Russian Gulch State Park	24	30
Stanford Inn by the Sea	6	153
Mendocino Grove Campground	2	27

Population Area or Water System	Connections or Parcel Count	Population Served
Mendocino Census Designated Place	NA	932
Remaining Study Area Parcels	102	384
Daily Visitors	NA	2,500
Total		**4,186**

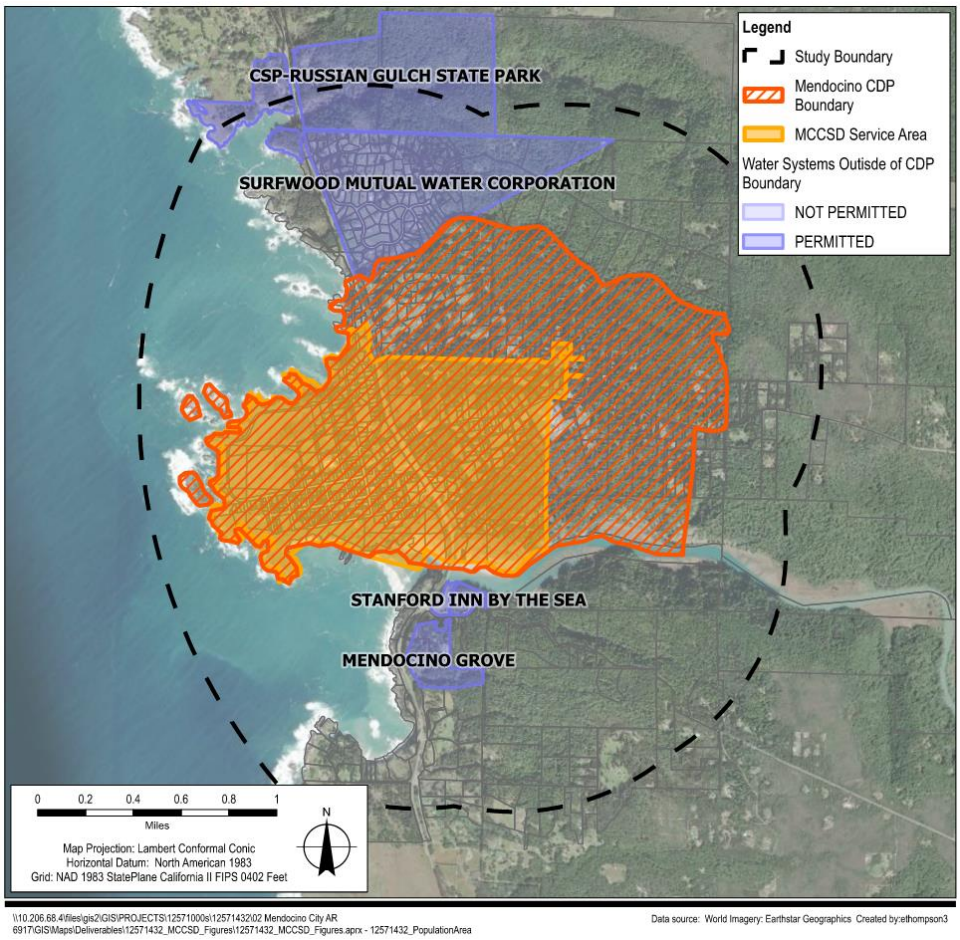


Figure 11 MCCSD Service Area against Mendocino CDP and Study Area

Future Build-Out Population of Study Area

The Mendocino Town Plan does not provide a population growth target but notes, “there continues to be general agreement that in growth in the town must be limited (Mendocino 2017).” The Mendocino Town Plan cites 2010 US census data with a town population of 894 individuals. As stated previously, census data from 2020 shows a population of 932 individuals and average household size of 1.88 people; however, that data excludes parcels within the study area and outside the CDP.

California Department of Finance’s 2024 data estimates the County’s 2024 population to be 88,782 individuals, increasing to 91,842 in the year 2060 (California Department of Finance 2024). Over the 36-year period, this represents a modest average annual growth rate of 0.0975% for the entire County, which extends beyond the study area.

Uncertainties affecting future population trends in the study area include the following:

- Post-COVID population migration from urban to rural areas, which are not currently reflected in the California Department of Finance projections through 2060;
- Changes in the future due to sea level rise adaptation and retreat, transportation, and energy system changes may lead to internal County migration and could increase population
- Fluctuations in the housing market related to affordability
- Water availability constraints

There are 120 parcels attributed as planned development (Rural Residential Development 2 (RR-2) or Rural Residential Development 5 (RR-5)). For the purposes of this report, it is assumed the planned development has not yet occurred. Therefore, each of the 120 parcels could support one primary and one secondary dwelling, resulting in 240 total future dwellings to support population growth. Assuming an average household size of 1.88 per the US Census 2020, 240 new dwellings could support up to 452 individuals. New secondary dwellings constructed on non-planned residential parcels could support additional individuals in the community. For the purposes of this study, the more conservative estimate using zoning and potential for new dwelling development was used to estimate a future build-out population of 4,638 people in the study area.

Table 8 Build-Out Study Area Population

	Population
Existing	4,186
Potential New Dwellings, Added Population	452
Total	**4,638**

4.2 Existing Water Demands

Existing water demands for the study area were estimated following the methods described in California Code of Regulations (CCR) Title 22, Section 64554.

Due to the lack of a water system encompassing the entire study area, the Average Daily Demand (ADD) was estimated using the population estimate described in the previous section.

To estimate a consumption per person per day existing water system usage within the study area was considered. Electronic Annual Reports (eARs) for the years 2012 to 2022 were used to calculate an average gallons per capita per day (gpcd) for each CWS in the study area. Monthly production data was used to calculate an average daily production per month and those values were averaged to calculate the ADD of each system. The Mendocino Unified School District water system was excluded from this exercise because usage at the school is not inclusive of all water demands in a typical residence such as showering and food preparation.

A peaking factor of 1.5 was used to calculate the Maximum Day Demand (MDD) for each system from the max month of usage in the last ten years. A peaking factor of 1.5 was used to calculate the system's Peak Hour Demand (PHD). The ADD, MDD and PHD for each CWS are summarized in Table 9.

Table 9 CWS Demand Summary

CWS	Permit No.	ADD (gallons)	MDD (gallons)	PHD (gallons)	Population Served	gpcd
Big River Vista Mutual Water Company	CA2300596	1,843	8,146	509	36	51
Hills Ranch Mutual Water Company	CA2300832	3,579	8,330	521	79	45
Point of View Mutual Water Company	CA2300604	2,211	5,088	318	56	39
Surfwood Mutual Water Corporation	CA2300590	27,089	80,937	5,059	160	169
Average						**76**

Populations served for each CWS on average use 76 gpcd. It should be noted that gpcd for systems averaged 45 gpcd for the smallest of the CWSs, however Surfwood usage per person weighted the average to 76 gpcd. In 2016 the California Legislative Analyst's Office reported an average residential water use in California of 85 gpcd. To account for a possible increase in water usage with the installation of a centralized CWS, this number (85 gpcd) was used in demand estimations.

Existing water demands for the study area were estimated following the methods described in California Code of Regulations (CCR) Title 22, Section 64554, see Table 10.

Table 10 Study Area Demands

	ADD (gallons)	MDD (gallons)[1]	PHD (gallons)[2]
Existing Demand	356,000 (399 AFY)	801,000 (556 gpm)	50,100
Build-Out Demand	394,000 (441 AFY)	887,000 (616 gpm)	55,400

[1] Calculated per Cal. Code Regs. Tit. 22, § 64554 using a peaking factor of 2.25
[2] Calculated per Cal. Code Regs. Tit. 22, § 64554 using a peaking factor of 1.5

Per Title 22 requirements a public water system's water sources shall have the capacity to meet the systems MDD. For the purposes of this Study, it is assumed a future centralized CWS to serve the community will have less than 1000 service connections. For systems with less than 1000 service connections, the system shall also have storage capacity equal to or greater than the MDD. Therefore, assuming build-out is not probable, a CWS proposed to serve the entire study area would need to have sources and storage, each capable of providing the MDD of 801,000 gallons.

An analysis of existing extractions and diversions follows to compare to the estimate of demands determined in this section.

4.3 MCCSD Reported Extractions

Groundwater extractions within the MCCSD are self-reported monthly to MCCSD by parcel. Extraction data from 2020 to 2024 provided by MCCSD is shown below.

Table 11 MCCSD Water Meter Data

Year	Average Use Reported (gpd)	Allotment (gpd)	Projected Annual Use (AF)	Annual Allotment (AF)
2020[1]	46,559	125,308[2]	52.3	141
2021	45,646	125,439[2]	51.1	141
2022	44,431	209,284	49.8	234
2023	47,776	211,791	53.5	237
2024	48,329	207,846	54.3	233

[1] Reporting in 2020 was not mandatory
[2] Stage 4 drought, annual were reduced by 40-percent.

Over the past five years an average of 46,548 gpd was reported to be extracted within the MCCSD boundary, totalling nearly 17 million gallons a year (52.1 AFY). The total allotted amount of groundwater extraction in a normal rain year is approximately 210,000 gpd which is equivalent to 76.7 million gallons a year (235 AFY). Therefore, on average, community members are using 22 percent of their allotted water. Total extractions within MCCSD are down from the previous 5 years (2015 to 2020) when the total reported pumping was between 65 and 75 AFY (Todd 2022). This is likely in part due to the severe two-year drought from 2020 to 2022. Existing reported usage during a severe drought (2020 and 2021) withdrew 50 percent of the theoretical minimum supply during a drought (104 AFY) and existing allotments use 91 percent of the theoretical maximum yield of 259 AFY (Questa and ETIC, 2004). Based on the population within the MCCSD boundary (855 not including tourists), existing allotments represent a potential maximum

demand estimate of nearly 246 gpcd. This is 4-5 times the average historical use of the population over the last 10 years and is seen as overly conservative for use in an estimated average demand in this study.

Water use within the District is not evenly distributed throughout the year. Reported extractions indicate that water usage during the summer months (June to October) are higher by over 20 percent on average than in the winter months. This opposes groundwater availability which is highest in the winter months and lowest in the summer months.

Community extractions within MCCSD are often supplemented by water imported from the City of Fort Bragg Westport, Irish Beach and Elk. Mendocino County records of water hauling within the MCCSD indicate a total of 330,500 gallons transported to Mendocino from September 2021 to April 2022 (1,420 gpd). Projecting for an entire year this is approximately 520,000 gallons per year (1.6 AFY). Anecdotal reports from the community indicate that water trucks hauling water from outside sources is not uncommon and happens on a yearly basis, however, parcel owners do not report hauled water to MCCSD, only well meter readings.

Combining the hauled water with the reported extractions results in a total use of approximately 48,000 gpd. With a population of 855 within MCCSD this results in approximately 56 gpcd. This demand per person aligns with the previously calculated average daily demand per person within the smaller CWS of 39-51 gpcd. Based on the long history of water shortage within MCCSD it is safe to assume that community members are conservative with their water use and usage would likely increase if a more reliable water source were available.

4.4 Existing Points of Diversion

In addition to groundwater withdrawals, the State Water Resources Control Board Water Rights GIS system reports 15 points of diversion (POD) from surface waters within the study area. Five PODs are located within the Big River watershed including state parks which uses between 1 and 2 AFY. Five PODs are located within the Jack Peters Gulch watershed, two of which are not active, with the largest diverter being Surfwood Mutual Water Corporation. Two PODs are located in Russian Gulch watershed with use split between a private individual for domestic and irrigation and state parks. The remaining three PODs are located within Slaughterhouse Gulch watershed, one active, consisting of a private individual for domestic use. A summary of POD information is shown in Table 12, below.

Table 12 Points of Diversion (POD) within the Study Area

Water Right ID	Source Name	Water Right Type	Maximum Diversion (AFY)	Water Right Status	Entity Type
8646	South Fork Big River	Appropriative	2.3	Licensed	Individual
56820	Tan Oak Spring (Big River)	Statement of Diversion and Use	2[1]	Claimed	State
56846	Zen Spot Spring (Big River)	Statement of Diversion and Use	1[1]	Claimed	State
56847	Under Log Spring (Big River)	Statement of Diversion and Use	2[1]	Claimed	State
56849	Black Hole Spring (Big River)	Statement of Diversion and Use	2[1]	Claimed	State
20282	Jack Peters Gulch	Registration Domestic	0.5	Revoked	Corporation
36008	Jack Peters Gulch	Statement of Diversion and Use	0	Inactive	Individual
7941	Jack Peters Gulch	Appropriative	10.2	Licensed	Municipal (Surfwood CA2300590)

Water Right ID	Source Name	Water Right Type	Maximum Diversion (AFY)	Water Right Status	Entity Type
12400	Jack Peters Gulch	Appropriative	22.6	Licensed	Municipal (Surfwood CA2300590)
55928	Jack Peters Gulch	Statement of Diversion and Use	0	Claimed	Municipal
6062	Russian Gulch	Appropriative	12.9	Licensed	Individual
32198	Russian Gulch	Statement of Diversion and Use	25[2]	Claimed	State
12742	Slaughterhouse Gluch	Appropriative	3.1	Permitted	Individual (Searock CA2300621)
11285	Slaughterhouse Gluch	Appropriative	21	Revoked	Corporation
20239	Slaughterhouse Gluch	Registration Domestic	0.9	Revoked	Individual
Total Existing Diversions			**83.1[3]**		

[1] No reported maximum diversion, estimated from maximum amount reported to the Water Board.
[2] Supply capacity reported on Sanitary Survey reported to DWR.
[3] Total does not include Revoked water rights.

There are an additional 54 active or pending PODs spread throughout the Big River Watershed (outside the study area) that were not reviewed in detail. These PODs are relatively small and cumulatively represent less than one half a percent of the surface water outflow of the Big River. For the purposes of this report, existing PODs are not proposed to be replaced by a community water system but are considered against available source capacity. The existing diversions for each surface water source are shown in Table 13.

Table 13 Total Existing Diversions per Surface Water Source

Surface Water Source	Maximum Existing Diversion (AFY)
Big River	9.3
Jack Peters Gulch	32.8
Russian Gulch	37.9
Slaughterhouse Gulch	3.1
Total Existing Diversions	**83.1**

5. Existing Water Supply Assets

5.1 Public Water Systems

Within the study area there are eighteen (18) permitted public water systems and currently ten (10) water systems in the process of becoming permitted. There may be additional water systems operating without a permit.

Table 14 Water Systems within Study Area

No.	Permitted (Y/N)	Permit No.	System Type	Water System Name
1	Y	CA2300596	CWS	Big River Vista Mutual Water Company
2	Y	CA2300832	CWS	Hills Ranch Mutual Water Company
3	Y	CA2300604	CWS	Point of View Mutual Water Company
4	Y	CA2300590	CWS	Surfwood Mutual Water Corporation
5	Y	CA2300804	NTNC	Green Real Estate Enterprises, LLC
6	Y	CA2300802	NTNC	Harvest at Mendosas
7	Y	CA2300628	NTNC	Mendocino Hotel
8	Y	CA2300584	NTNC	Mendocino Unified School District
9	Y	CA2310316	TNC	CSP-Mendocino Headlands - Ford House
10	Y	CA2310308	TNC	CSP- Mendocino Headlands - Sea Arch-State Park Service
11	Y	CA2310304	TNC	CSP- Russian Gulch State Park
12	Y	CA2300872	TNC	Dick's Place
13	Y	CA2300746	TNC	Hill House, LLC
14	Y	CA2300740	TNC	Maccallum House Inn
15	Y	CA2300821	TNC	Mendocino Art Center
16	Y	CA2300760	TNC	Mendocino Grove
17	Y	CA2301004	TNC	Pattersons
18	Y	CA2300621	TNC	Searock
19	Y	CA2300626	TNC	Stanford Inn by the Sea
20	N	CA2301010	NTNC	Mendocino Presbyterian Church
21	N	CA2301001	TNC	Trillium Café and Inn
22	N	CA2301009	TNC	Luna Trattoria
23	N	CA2301008	TNC	Café Beaujolais
24	N	CA2301003	TNC	Frankies
25	N	CA2301012	TNC	Flow Restaurant
26	N	CA2301016	TNC	Fog Eaters
27	N	CA2301013	TNC	Mendo Market & Deli
28	N	CA2300517	TNC	Shell Building (Garden Bakery, Bay View Coffee, Gnar Bar)

Within the study area there are Transient Non-community (TNC) and Nontransient Non-community (NTNC) Public Water Systems as well as Community Water Systems (CWS).

5.1.1 Community Water Systems

Four of the systems are classified as CWS, indicating that they serve at least 25 yearlong residents or 15 or more service connections used by yearlong residents. Those systems are Big River Vista Mutal Water Company CA2300596, Hills Ranch Mutual Water Company CA2300832, Point of View Mutual Water Company CA2300604, and Surfwood Mutual Water Corporation CA2300590, each of which is described in greater detail below.

Table 15 CWS in Study Area

No.	Permit No.	Water System Name	Storage Capacity gallons (# of Tanks)	Source Water	Estimated Supply Capacity
1	CA2300596	Big River Vista Mutual Water Company	10,000 (1), 30,000 (1)	Well 01	4 gpm (5,760 gpd)
2	CA2300832	Hills Ranch Mutual Water Company	100,000 (1), 200,000 (1)	Wells 02, 04, 11 and 13	3 gpm (2,880 gpd)
3	CA2300604	Point of View Mutual Water Company	30,000 (1)	Wells 02, 03, 04 and 05	2 gpm (2,880 gpd)
4	CA2300590	Surfwood Mutual Water Corporation	56,000 (1), 200,000 (1)	Jack Peters Gulch	22.4 gpm (32,256 gpd)

Big River Vista Mutal Water Company CA2300596

Big River Vista Mutual Water Company was established in 1967 and serves approximately 36 residential customers through 19 metered connections. The Big River service area encompasses 19 parcels. The system is located east of Highway 1 and south of Little Lake Road and within the MCCSD service area boundary. The system is supplied by one 300 foot deep well (Well 01) that produces approximately 4 gpm. The system is equipped with one 10,000 gallon concrete storage tank and a 30,000 gallon redwood storage tank. Treatment includes chlorine disinfection and pH adjustment with caustic soda. The distribution system consists of 1 ¼-inch PVC, 3-inch galvanized and 4-inch asbestos cement piping (ACP) and wharf hydrants. The system's ADD was calculated from the previous ten years of eARs at 1,843 gallons or 51 gallons per capita.

The system has had no violations in the last 5 years; however, the distribution system is aging and valves are in need of replacement. The redwood storage tank was recently lined and in good condition. There is no backup power generation, however, the system is wired for future installation and gravity pressurized. The source well produces approximately 4 gpm, however, there is no secondary water source.

Hills Ranch Mutual Water Company CA2300832

The Hills Ranch Mutual Water Company was established in 1982 and serves 79 residential customers through 48 metered connections. The system also serves the Mendocino Volunteer Fire Department on Little Lake Road. The water system is located east of Highway 1 and north of Little Lake Road and is within the MCCSD service area boundary. The system is supplied by four wells (Wells 02, 04, 11 and 13) two of which are shallow wells (~20 feet deep) and two are deep wells that provide a combined yield of 3 gpm. The water system has abandoned several wells over the years including wells 8 & 10 which are surface water wells that draw from Slaughterhouse Gulch. There are no violations within the system in the last 5 years. The distribution system consists of 2-inch PVC raw water piping and 6-inch and 8-inch PVC distribution system piping and hydrants. The Hills Ranch service area includes 54 parcels, of which 47 have been developed. The water is treated and stored in two storage tanks, 200,000 gallon and 100,000 gallon redwood tanks. The treatment process includes the addition of soda ash, a 20 gpm package treatment plant followed by chlorine disinfection. The Mendocino Volunteer Fire Department owns rights to 100,000 gallons of storage and has access to the remaining 200,000 gallons if needed during a fire. The system's ADD was calculated from the previous ten years of eARs at 3,579 gallons or 45 gallons per capita.

The system has had no violations in the last 5 years. The tanks are in good condition, a liner is proposed to be installed in the 200,000 gallon tank in 2025. The distribution system is in good condition with valve clusters recently being replaced. Additional source capacity is desired as the source wells produce a combined 3 gpm. Water age is likely an issue with the excessive combined storage capacity of the system's tanks.

Point of View Mutual Water Company CA2300604

The Point of View Mutual Water Company was established in 1965 and serves approximately 56 residential and 20 transient customers through 31 metered connections along Palette Drive in Mendocino and is within the MCCSD service area boundary. The system is supplied by four deep (100 or 200 foot) wells (Wells 02, 03, 04 and 05) with an estimated combined capacity of 2 gpm. Treatment includes chlorine disinfection and pH adjustment with caustic soda. Water stored in a 30,000 gallon redwood tank. There are no violations within the system in the last 5 years. The distribution system consists of 2-inch PVC raw water piping and 4-inch ACP finished water piping as well as 1-inch plastic service lines. The Point of View Mutual Water Company service area includes 32 parcels of which 1 parcel is undeveloped. The system's ADD was calculated from the previous ten years of eARs at 2,211 gallons or 39 gallons per capita.

The system has had no violations in the last 5 years. The redwood storage tank is in good condition and was recently cleaned. There is no backup power generation in the event of power failure but the system is gravity pressurized. Additional source capacity is desired as the source wells produce a combined 2 gpm.

Surfwood Mutual Water Corporation CA2300590

The Surfwood Mutual Water Corporation was established in the 1960s to serve the Surfwood Residential Developments and serves approximately 160 residential customers through 107 metered connections. The water system is located east of Highway 1 and north of Little Lake Road and is outside the MCCSD service area boundary but within the study area. The system is supplied by Jack Peters Gulch through two PODs dating back to 1980 and 2004 (License ID's 011039 and 013598, respectively). These diversions are limited to a combined maximum of 0.05 cfs (22.4 gpm or 32,256 gpd) and an annual maximum of 32.8 AF (10.2 AFY+22.6 AFY).

The distribution system consists of nearly 3 miles of 3-inch to 8-inch ACP and PVC piping installed approximately 2 feet below grade. Raw water is stored in an underground 80,000-gallon concrete tank. Treatment includes injection of a coagulant and a floculant (NTU960 and Zetafloc) followed by sand filtration, chlorine disinfection and storage. Water is stored in a 56,000 redwood tank and a 200,000-gallon steel tank. Surfwood has had violations for total trihalomethanes (TTHM), haloacetic acids (HAA5) consistently, and coliform as recently as 2018. The system is listed as potentially at-risk on the SAFER Dashboard. The system is equipped with a 22kW Generac emergency generator in the event of a power failure. The system's ADD was calculated from the previous ten years of eARs at 27,089 gallons or 169 gallons per capita.

5.1.2 Non-community Water Systems

The majority of the NTNC and TNC systems are businesses such as restaurants or hotels. There are twenty-four (24) non-community water systems within the study area.

Table 16 Non-Community Water Systems in the Study Area

No.	Permitted (Y/N)	Permit No.	System Type	Water System Name	Source Water & Storage Capacity [gallons] (# of Tanks)	Estimated Supply Capacity[1] (gpm)
1	Y	CA2300802	NTNC	Harvest at Mendosas	Well 01 26 ft, Well 04 220 ft, 3,000 (1)	15, 4.5
2	Y	CA2300584	NTNC	Mendocino Unified School District	Wells 02, 03, 04, 05, 40,000 (1) 50,000 (2)	7.5[2]
3	Y	CA2310316	TNC	CSP-Mendocino Headlands-Ford House	Well 01 160 ft, 6,000 (1)	11.5
4	Y	CA2310308	TNC	CSP- Mendocino Headlands-Sea Arch-State Park Service	Well 01	10

No.	Permitted (Y/N)	Permit No.	System Type	Water System Name	Source Water & Storage Capacity [gallons] (# of Tanks)	Estimated Supply Capacity[1] (gpm)
5	Y	CA2310304	TNC	CSP- Russian Gulch State Park	Russian Gulch, 25,000 (2)	25
6	Y	CA2300740	TNC	Maccallum House Inn	Well 01, Well 02, 10,000 (1)	2, 8 (10)
7	Y	CA2300621	TNC	Searock (Shares with Agate Cove)	Slaughterhouse Gulch, 5,000 (2), 15,000 (1)	16[3]
8	Y	CA2300626	TNC	Stanford Inn by the Sea	Well 01 160 ft, Well 09 390 ft, Well 10 500 ft, 25,000 (1)	4.5, 5, 8.4 (18)
9	N	CA2301012	TNC	Flow Restaurant	Well 01 140 ft, 1,000 (1)	12
10	N	CA2301013	TNC	Mendo Market & Deli	Well 01 100 ft	10
11	N	CA2301016	TNC	Fog Eaters	Well 01, 1,000 (2)	3
12	Y	CA2300804	NTNC	Green Real Estate Enterprises, LLC	Well 03, 10,400 (1)	3-5
13	Y	CA2300628	NTNC	Mendocino Hotel	Heeser Well, Shallow Kelley Well, 15,000 (2)	4
14	N	CA2301010	NTNC	Mendocino Presbyterian Church	Well 01 200+/- ft, 5,000 (1)	5
15	Y	CA2300872	TNC	Dick's Place	Wishing Well	5
16	Y	CA2300746	TNC	Hill House, LLC	Well 02 80 ft, Well 04, 45,000 (1)	2
17	Y	CA2300821	TNC	Mendocino Art Center	Well 01 200 ft deep, 10,000 (1)	0.5
18	Y	CA2300760	TNC	Mendocino Grove	Well 01, 20,000 (1)	unknown
19	Y	CA2301004	TNC	Pattersons	Well 01 200+/- ft deep	2
20	N	CA2301001	TNC	Trillium Café and Inn	Well 01 100+/- ft, 2,000 (1)	1.5
21	N	CA2301009	TNC	Luna Trattoria	East and West Wells (shallow wells), 4,000 (1)	2.6
22	N	CA2301008	TNC	Café Beaujolais	Deep and Shallow Wells, 5,000 (1)	2, 4
23	N	CA2301003	TNC	Frankies	Well 01	unknown
24	N	CA2300517	TNC	Shell Building (Garden Bakery, Bay View Coffee, Gnar Bar)	Well 01	0.5

[1] Estimated supply capacity from sanitary surveys obtained from DDW.
[2] Includes 3 gpm of recycled water produced by the MUSD system.
[3] Limited to 3.1 AFY but has a withdrawal capacity of 16 gpm.

Sources for these non-community systems are generally low yielding wells and don't individually represent a significant source worthy of pursuing for a community water system. Consolidating these sources would require a complex network of raw water pipelines within utility easements that would need to be negotiated with property owners. The first ten (10) systems listed in the table above have the largest producing sources (minimum 7.5 gpm), and have been identified as possibly worth pursuing for consolidation of their water sources. The remaining non-community systems are likely not worth pursuing to incorporate their water sources on a cost per gpm capacity basis when compared to developing new water sources. Additional investigation is needed to confirm source capacity and consider existing deficiencies such as lack of sanitary seals and wellhead protection, when considering sources worthy of consolidation.

With the current available information these systems cumulatively represent a total of 139.5 gpm (200,880 gpd or 202.4 AFY) of potential water supply. A summary of the potential consolidation of non-community water systems is shown in Table 17.

Table 17 Potential Non-community Water Systems Worthy of Consolidation

Water Source	Water System Name(s)	Estimated Supply Capacity (gpm)	Estimated Supply Capacity (gpd)	Estimated Supply Capacity[1] (AFY)
Groundwater (undifferentiated bedrock, marine terrace, and alluvial sources)	Harvest at Mendosas, Mendocino Unified School District, California State Parks (Ford House and Sea Arch), Maccallum House Inn, Stanford Inn by the Sea, Flow Restaurant, Mendo Market & Deli	98.5	142,000	159
Slaughterhouse Gulch	Searock	16	23,000	3.1[2]
Russian Gulch	California State Parks	25	36,000	40.3
	Total	**139.5**	**201,000**	**202.4**

[1] Conversion factor of 1.613 gpm to AFY.
[2] Limited to 3.1 AFY but has a withdrawal capacity of 16 gpm.

For the ten (10) systems that are worthy of additional evaluation, it is important that during these evaluations existing deficiencies and water source capacity is documented. Following this evaluation a cost benefit analysis should be made for each water source to evaluate if the work that would be required to bring the source into compliance with the standards of a CWS is worth the supply capacity it would provide.

Reported well supply capacities were received from operators and sanitary surveys. However, for many of these non-community systems the current operating conditions from which these values were estimated consist of relatively short periods of pumping followed by long durations of well recovery. This can lead to overestimation of capacity. Increased pumping durations and decreased recovery times would likely result in lower well capacities than the numbers used in this study. Therefore, it is likely that under further evaluation many of these systems will not be found suitable for consolidation as a water source.

5.2 Private Individual Water Supply Wells

Private individual residences and businesses without a public water supply permit, receive their water from shallow wells and have storage tank capacities of less than 3,000 gallons. The majority of existing wells are hand dug wells and relatively shallow and have diminished yields in the summer months with many going dry during periods of drought. Similar to the non-community PWS sources, private wells and storage tanks are not considered worth the cost of consolidating them into a community water system. Figure 12 shows the mapped private domestic wells.

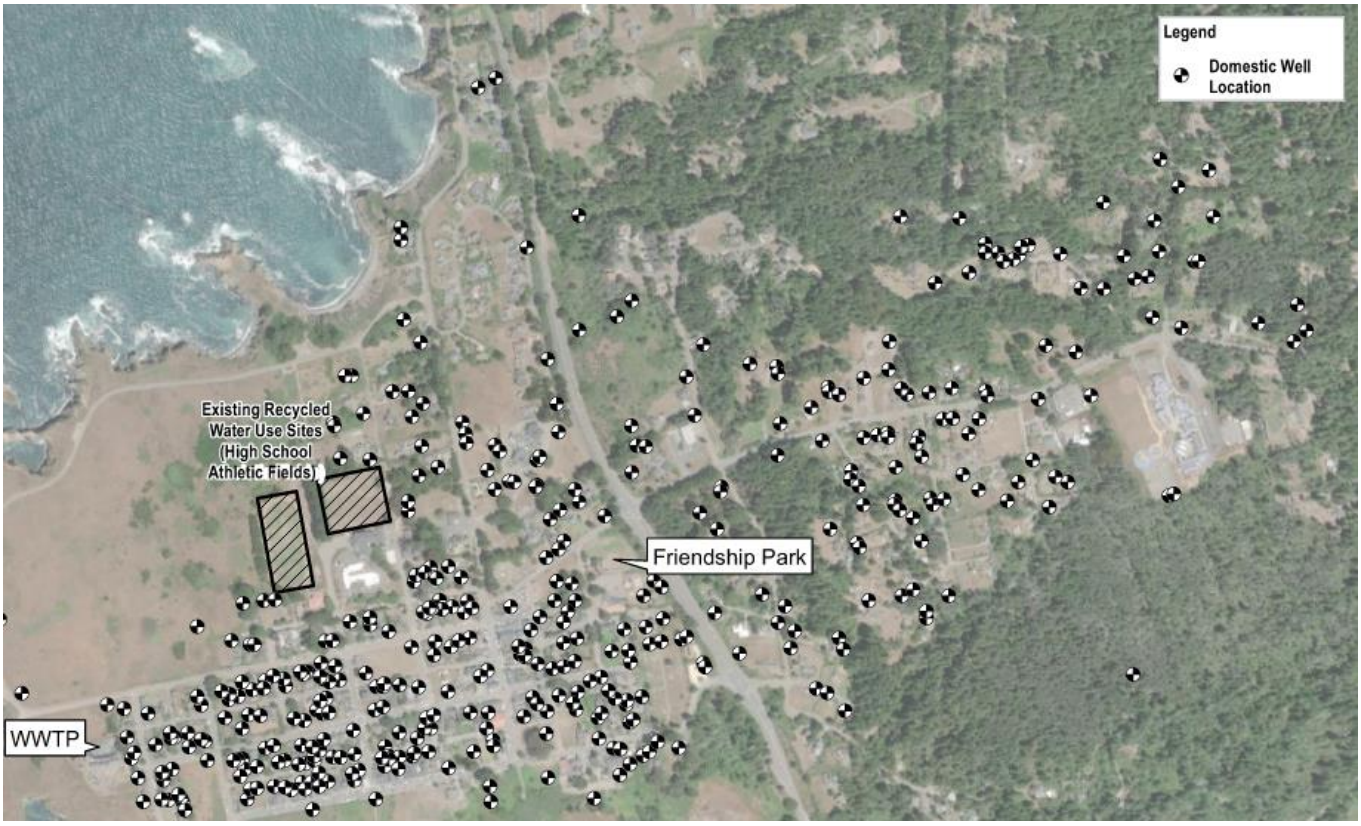


Figure 12 Existing Domestic Wells (GHD, 2021)

5.3 Summary of Existing Water Supply Assets

Of the 28 PWS reviewed, 11 have large enough capacity to be considered as potential assets to a future CWS, summarized in Table 18. Other systems may be desirable for consolidation based on proximity or existing infrastructure and storage assets, however, the table below only includes those that have significant water sources that are viewed as worthwhile to pursue consolidating as a water source for a CWS. Combining these existing water system sources results in a supply of 235.2 AFY. Locations of these systems are shown in Figure 13.

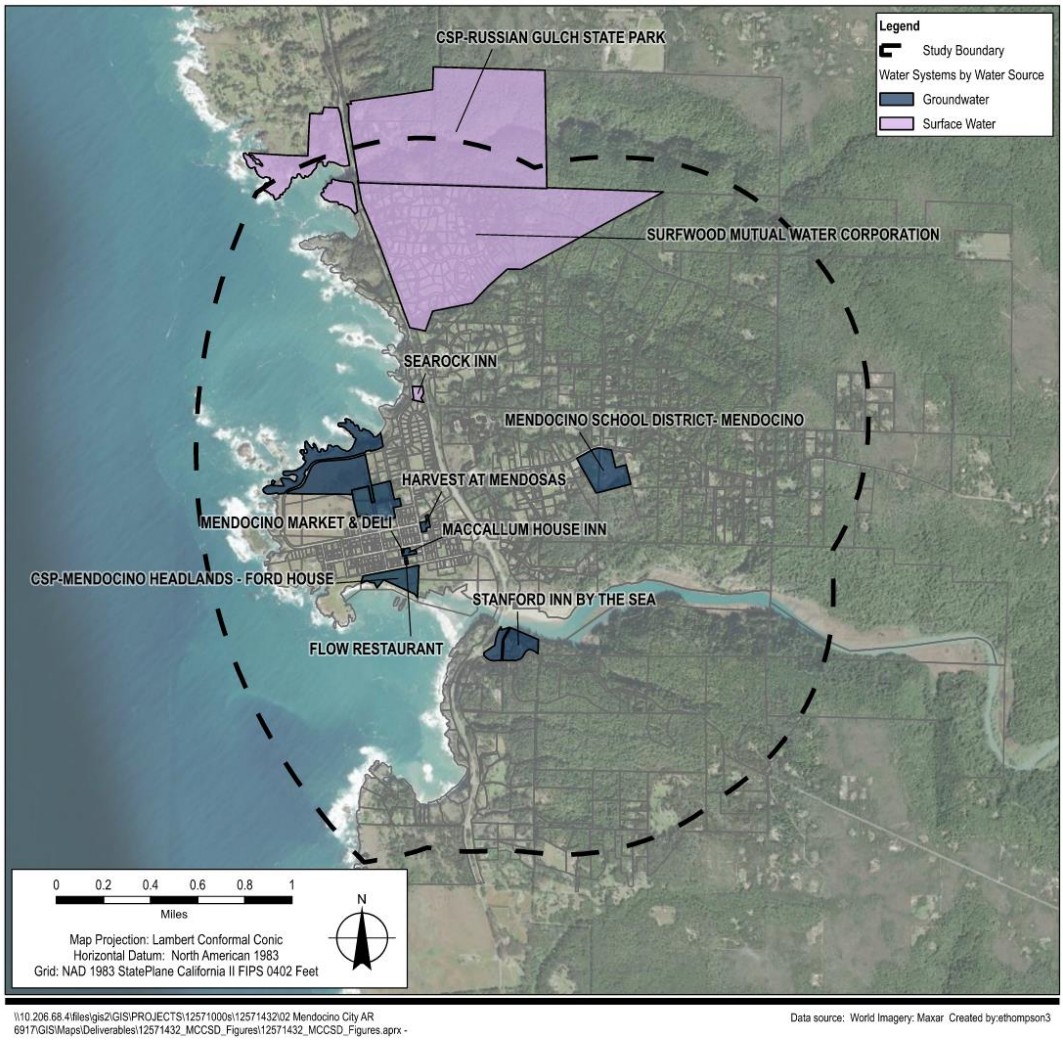
It is assumed for the purpose of this report that these public water systems would be agreeable to consolidation. If one or more of these systems do not desire to consolidate their water source capacity would need to be met with a new water source.

Table 18 Estimated Existing Source Capacity of Water Systems within Study Area - Worthy of Consolidation Pursuit

Permit No (Permitted)	Water System Name	Water Source	Capacity (gpm)	Capacity (gpd)	Annual Capacity (AFY)[1]
CA2300590 (Yes)	Surfwood Mutual Water Corporation	Jack Peters Gulch	22.4	32,300	32.8[2]
CA2300802 (Yes)	Harvest at Mendosas	Well 01, Well 04	19.5	28,000	31.5
CA2300584 (Yes)	Mendocino Unified School District	Well 02, 03, 04, 05	7.5[3]	10,800	12.1
CA2310316 (Yes)	CSP-Mendocino Headlands- Ford House	Well 01	11.5	16,600	18.5

Permit No (Permitted)	Water System Name	Water Source	Capacity (gpm)	Capacity (gpd)	Annual Capacity (AFY)[1]
CA2310308 (Yes)	CSP- Mendocino Headlands- Sea Arch- State Park Service	Well 01	10	14,400	16.1
CA2310304 (Yes)	CSP- Russian Gulch State Park	Russian Gulch	25	36,000	40.3
CA2300740 (Yes)	Maccallum House Inn	Well 01, Well 02	10	14,400	16.1
CA2300621 (Yes)	Searock	Slaughterhouse Gulch	16	23,000	3.1[2]
CA2300626 (Yes)	Stanford Inn by the Sea	Well 01, Well 09, Well 10	18	25,900	29.0
CA2301012 (No)	Flow Restaurant	Well 01	12	17,300	19.4
CA2301013 (No)	Mendo Market & Deli	Well 01	10	14,400	16.1
Total			**161.9**	**233,100**	**235.2**

[1] Conversion factor of 1.613 gpm to AFY.
[2] Limited by Permit.
[3] Includes 3 gpm of recycled water produced by MUSD.



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Data source: World Imagery: Maxar Created by:ethompson3

Figure 13 Existing Water Systems Worthwhile to Pursue for Consolidation

6. New Water Supply Sources

6.1 Groundwater Sources

6.1.1 Shallow Alluvial/Terrice Deposits

In the Mendocino headlands area, there are two types of unconsolidated materials that can store and facilitate groundwater flow. The first are poorly sorted, unconsolidated to semi consolidated marine terrace deposits and the second, fluvial channel derived alluvium. Due to historically fluctuating sea levels and the uplift of the Franciscan over time, the terrace deposits occupy elevated benches while the fluvial channel deposits may extend greater than 100 feet below mean sea level (msl) and extend 1 to 2 miles inland.

Mendocino Headlands Aquifer

The Mendocino Headlands Aquifer consists of hard, dark-colored rock (Franciscan Complex or bedrock) containing numerous fractures overlain by sand layers (terrace deposits). The terrace deposits are marine sands that represent former beach and near shore environments (DWR, 1985). The terraces form a flat surface that covers the underlying Franciscan Complex. The terraces are also overlain by a 1 to 4 foot thick sandy organic soil horizon (DWR, 1985).

The sandy terrace deposits have relatively high infiltration rates, so they act as highly efficient recharge areas. In addition, the distribution of the perennially saturated areas of terrace deposits plays a key role in sustaining the water supply throughout the Mendocino Headlands Aquifer. Pumping tests performed on private wells in the town of Mendocino indicate that the transmissivity of the terrace deposits is approximately 1,000 gpd (0.694 gpm) per foot of drawdown (Winzler and Kelly, 1990). Within the Mendocino Headlands area there are four marine terraces that have been well documented by DWR and others:

- **Casper Point**: Occurs between elevation of 40- to 80-feet elevation and is the youngest terrace (approximately 100,000 years old). The terrace is composed of medium-grained loose sand with few fines and is approximately 10 feet thick.
- **Jughandle Terrace**: Occurs between 80- to 160-feet elevation and is the second youngest terrace (approximately 200,000 years old). The terrace is composed of fine-grained silty sand and is approximately 20 feet thick with a maximum thickness of 35 feet.
- **Railroad Terrace**: Occurs between 160- to 200-feet elevation and is the third youngest terrace (approximately 300,000 years old). The terrace is composed of fine-grained sand with a higher percentage of silt and clay than the younger terraces.
- **Fern Creek Terrace**: Occurs between 300- to 400-feet elevation and is the oldest marine terrace (approximately 400,000 years old). The terrace is composed of fine-grained silt and clayey sand and is approximately 15 feet thick.

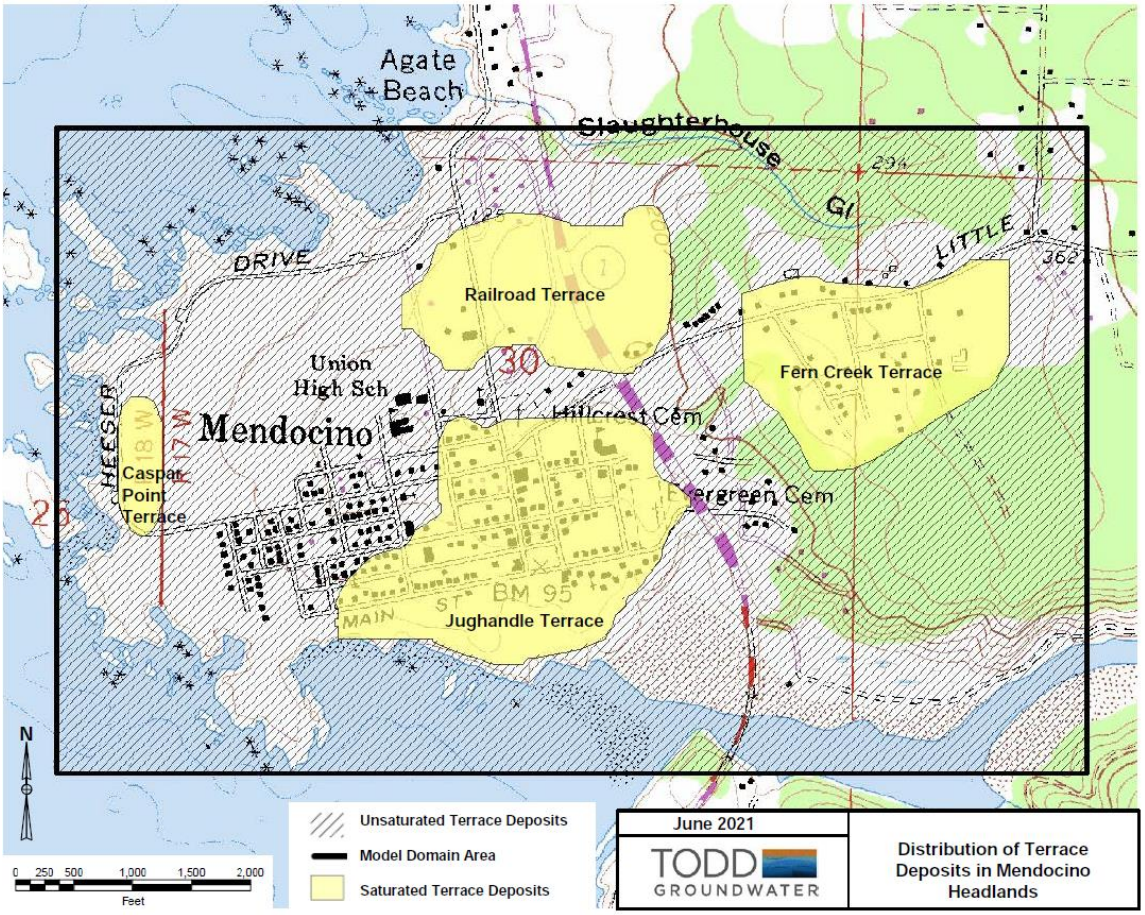

Figure 14 Distribution of Terrace Deposits in Mendocino Headlands (Todd 2021)

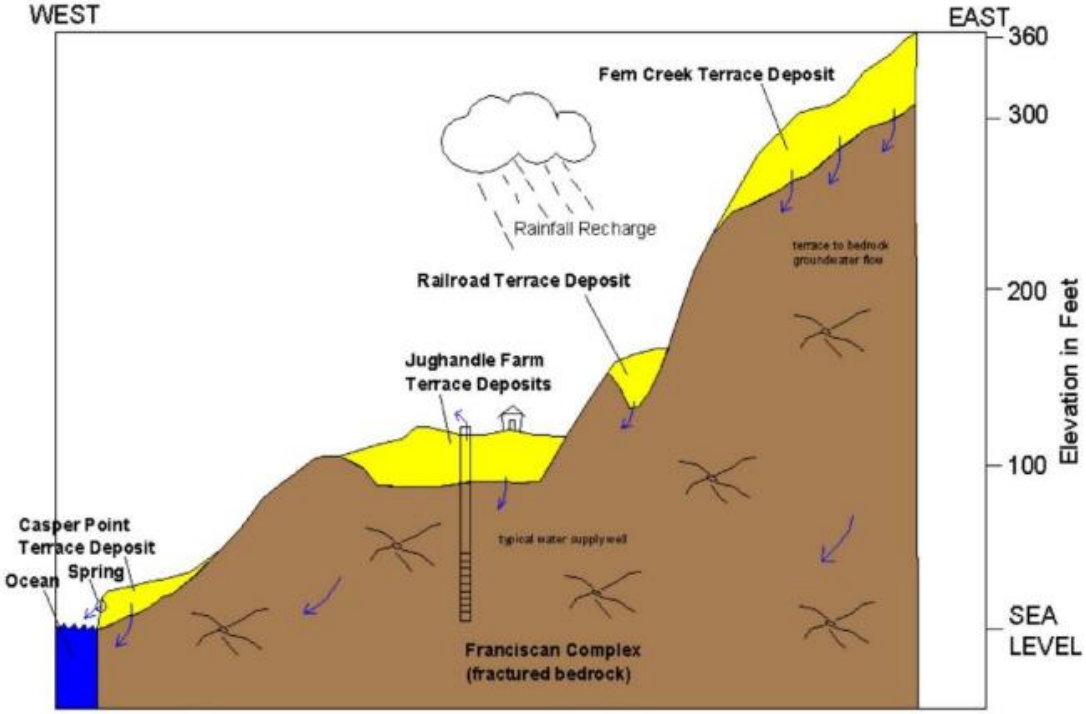

Figure 15 Town of Mendocino's Shallow Marine Terrace Aquifers (MCCSD)

Precipitation is the only source of recharge for these aquifers and due to their geometry, a majority of the outflow of the aquifer is through natural seepage through the bluffs and is lost to the Pacific Ocean. Groundwater levels are fairly quick to respond to changing conditions and can recover to their highest levels after only a single normal rainy season.

Due to the high number of wells and relatively small groundwater aquifer, the terrace aquifers within the Mendocino Headlands Aquifer have been practically developed to their maximum potential yields and do not represent a significant water source for new water demands unless large storage volumes can be achieved during the wet season. The minimum supply of the Mendocino Aquifer is estimated to by 104 AFY (Questa, 2004). Between 2015 and 2020 the total reported pumping to MCCSD is between 65 and 75 AFY which represents approximately 50 gpd per person and less than 0.2 AFY per well (Todd, 2022). Recent pumping accounts for nearly 72 percent of the theoretical minimum yield of the aquifer that could be relied upon during drought. Historical pumping has likely exceeded this minimum and resulted in wells going dry.

Beyond the Mendocino Headlands Aquifer

A recent review of the marine terrace deposits beyond the traditionally mapped extent of the Fern Creek Terrace (GHD, 2023), located approximately ¼ mile northeast of the boundary shown in Figure 14, shows evidence from well completion reports indicating that the alluvial thickness on the northern side of Little Lake Road is similar to that of the Fern Creek Terrance (approximately 15 feet). There is a grade break that increases the elevation by approximately 30 feet which directly translates to an increase of the marine terrace thickness to approximately 50 feet. This additional terrace area may be an extension of the Fern Creek Terrace or part of an unknown older and unnamed marine terrace, and it is unclear if they are hydrologically connected. Arial mapping of the Mendocino Headlands greater area suggests that these terrace deposits are connected and extend an additional 2 miles to the east wrapping around Jackson State Forest the southern edge of the Russian Gulch, shown in Figure 16, however this has not been confirmed by field studies.

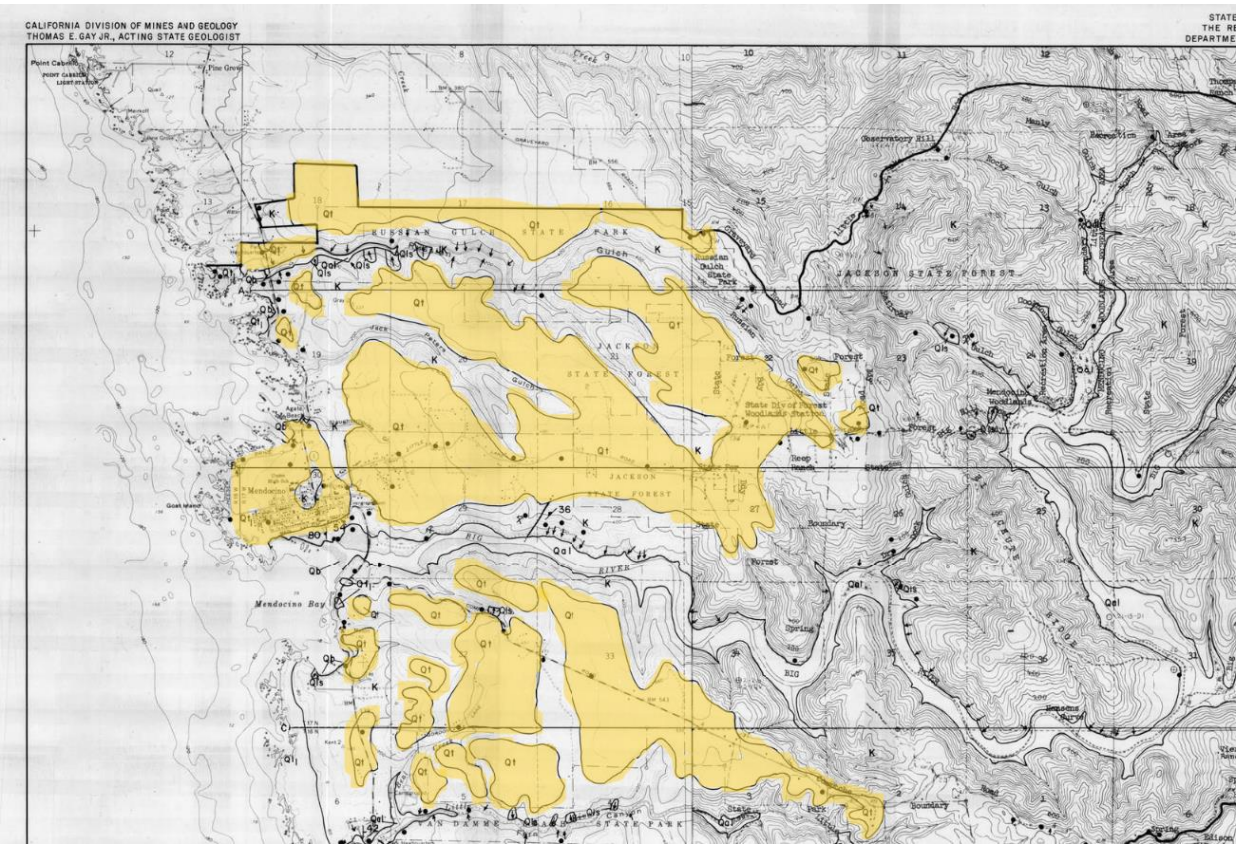

Figure 16 Reconnaissance Areal Geology Russian Gulch to Buckhorn Cove – Plate 1 with Terrace Deposits Highlighted Yellow (Williams and Bedrossian 1976)

While less explored, the more elevated marine terrace deposits north and south of the MCCSD boundary are seen to exhibit similar hydrologic characteristics to the Mendocino Headlands Aquifer and are not expected to yield significantly more quantities of groundwater. A desktop review of available well completion reports (WCR) from DWR indicates that domestic wells in these areas are screened in both the marine terrace deposits and bedrock aquifer and yield less than 20 gpm and have significant drawdown during yield tests, often to the bottom of the well within a 1-2 hour testing period. Sustained long term yield of these wells are likely to be reduced to at least 5 to 10 gpm, similar to the wells in the Mendocino Headlands. Well capacity is expected to be closely related to seasonal rainfall with reduced yields in the summer months and shallow wells going dry during the summer months and droughts.

Marine terrace deposits mapped south of the Big River are relatively unexplored as most are private domestic wells and extend into bedrock with well yields less than 5 gpm. Marine terrace deposits mapped north of the town are relatively sparse along the coast near the Surfwood community area. Terrace deposits mapped between the Slaughterhouse and Russian Gulches are likely similar to the upland areas of the Mendocino Headlands.

Yields in these areas are likely similar to the Mendocino Headlands and with a targeted well field design to minimize well interference a maximum anticipated yield is on the order of 5-10 gpm (GHD, 2023) which is 8-16 AFY under normal rainfall conditions. To obtain this maximum, yield storage solutions would likely be required to allow over pumping during the winter months when groundwater is available and storing for use during the summer months when yields are lower.

6.1.2 Bedrock Aquifer

Bedrock is generally considered non-water bearing. Nevertheless, small quantities of water have been developed from bedrock wells in Mendocino. Yields of less than 5 gpm are typical for wells that are greater than 100 feet deep. Fractures and secondary permeability in bedrock tend to decrease with depth, therefore wells drilled below sea level are not expected to yield significantly larger quantities of groundwater (Winzler and Kelley, 1990) and would likely become more saline over time.

All watershed basins near the town of Mendocino are underlain by Tertiary to Cretaceous aged Franciscan bedrock (Jennings and Strand, 1960) and can be assumed to be hydrologically similar in all drainage basins. Anticipated yields for bedrock wells are less than 1 AFY.

6.1.3 Big River Alluvium

Groundwater beneath the Big River was considered as a potential source and explored with drilling Mud Flat Test Well located at the Mud Flat Big River Estuary approximately 2.3 miles upstream of the mouth of the Big River. The results of studying that test well indicated that the channel deposits in that area are primarily fine grained (clay and silt) and that groundwater is brackish (TDS concentrations of approximately 20,000 mg/L) and unsuitable for potable water.

Freshwater may be located beyond the maximum tidal fluctuation limit of Big River, which is the location at which saltwater cannot migrate beyond. Maximum tidal fluctuation is approximately five feet above MSL. This elevation is approximately 7.5 river miles upstream from the mouth of Big River and is known locally as “Hansen’s Curve”.

Channel deposit thicknesses are unknown this far upstream, but based on the shallow gradient of the Big River, are anticipated to be comparable or thinner to that of the Mud Flat Estuary (approximately 70 feet thick) and are not likely to be able to provide sufficient sustained flows required for a community water system. The Mud Flat Test Well produced a sustained 35 gpm for the 6 ¾ hour test period while being screened through both the channel alluvium (50-70 feet bgs) and into bedrock (80-135 feet bgs). Recovery data from the Mud Flat Test Well pump test (July 1992) estimated a long-term yield of 8.8 gpm. Where a suitable location for a Ranney Collector well or similar well structure could be sited could result in approximately 14 AFY. This source would likely be able to provide this yield year-round and be far more drought resilient than groundwater wells in the marine terrace deposits.

Based on results of testing the Mud Flat Well, sourcing groundwater in the Big River alluvium, closer to the mouth of Big River than Hansen’s Curve, would require desalination which is discussed further in Section 6.3. Additionally, a Ranney Collector well or similar well structure has the potential to be under the direct influence of surface water and

which would require additional treatment and permitting than other groundwater sources. Based on the known thickness and extent of the Big River alluvium upstream it is likely that a Ranney Collector would be under the direct influence of surface water.

6.2 Surface Water Sources

Surface water sources in the study area have significantly more yield potential than groundwater sources but they accompany more complex permitting, environmental, and treatment challenges. Within the study area there are six (6) identified hydrologic basins that flow out to the ocean:

- Big River Basin
- Slaughterhouse Gulch
- Jack Peters Gulch
- Russian Gulch
- Town of Mendocino (No centralized gulch-Not shown in Figure 17)
- Area between Slaughterhouse Gulch and Jack Peters Gulch (no centralized gulch- Not shown in Figure 17)

  These last two hydrologic basins have been ignored in this study due to their small size and lack of a significant gulch to capture outflow.

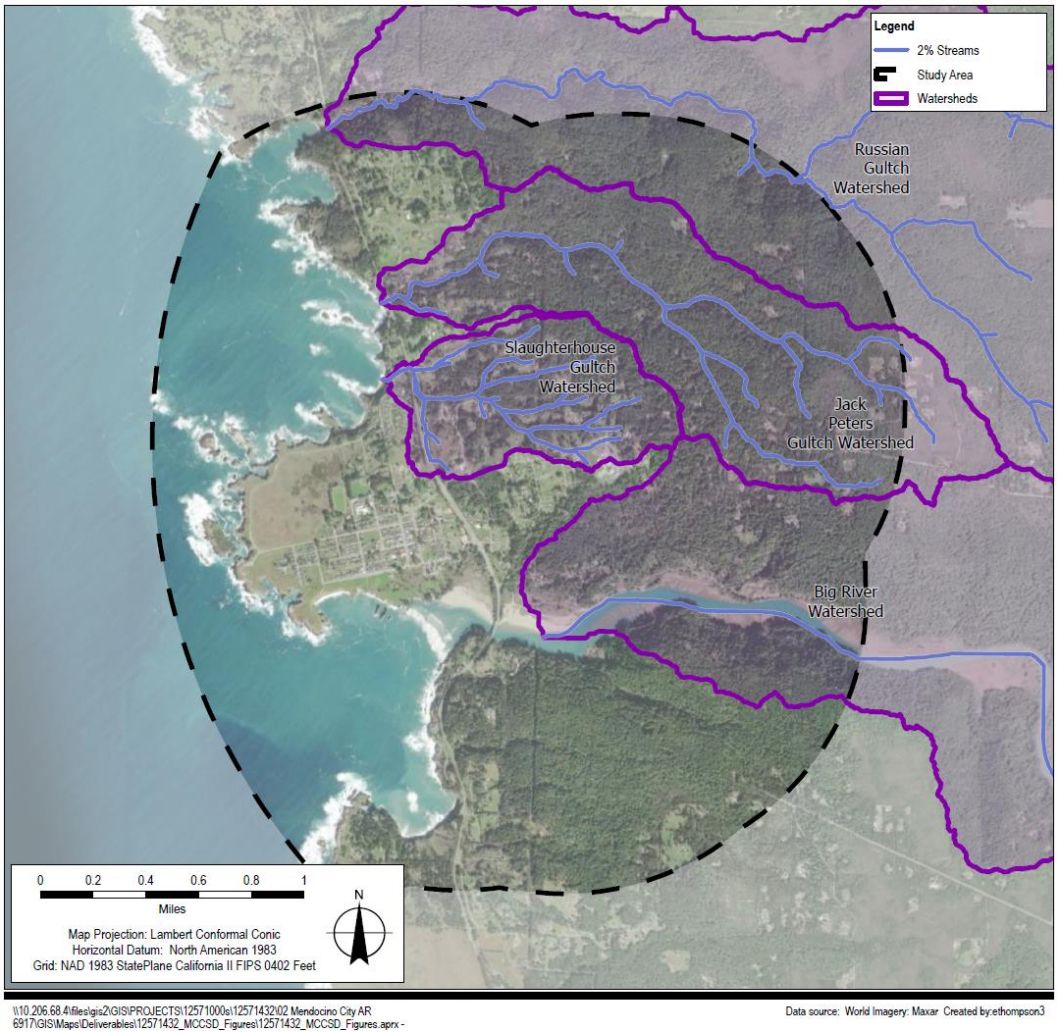

Figure 17 ***Surface Water Bodies within Study Area (streamlines defined as receiving flow from a minimum of 2% of the watershed tributary area).***

These surface water outlets are all currently and historically unmonitored with exception to the Big River Basin which has historically been monitored at two locations:

- USGS Gauge 11468070 SF Big River North Comptche is an inactive station that was monitored from August of 1960 to September of 1971 and from March to September in 2001. It is located at latitude 30°13’45”, longitude -123°24’55” NAD27 and has a drainage area of 36.2 square miles and a gauge datum 500 feet above NGVD29.
- USGS Gauge 11468092 Big River Below Two Log Creek is an inactive station that was monitored from June 2001 to July 2002 and October 2003 to September 2007. It is located at latitude 39°19’06”, longitude -123°36’49” NAD27 and has a drainage area of 88.7 square miles with a gauge datum 1120 feet above NGVD 29.

Both gauges on the Big River were only active for relatively short periods (12 years and 5 years, respectively) which is insufficient record length for a long-term estimate of average streamflow at the mouth of the Big River.

Annual streamflow for the four identified potential surface water sources was estimated using the drainage basin area ratio method which utilizes a stream gauge from another basin with a sufficiently long record (ideally 30+ years) and estimates the streamflow of a basin with an insufficient record.

$$Q_{ug} = Q_g \times \frac{A_{ug}}{A_g} \times \frac{I_{ug}}{I_g} \qquad (4)$$

where

Q_{ug} is flow volume (acre-ft), mean daily flow (ft^3/s), or February median flow (ft^3/s) at ungaged location,

Q_g is flow volume (acre-ft), mean daily flow (ft^3/s), or February median flow (ft^3/s) at gaged location,

A_{ug} is watershed area above ungaged site (acres),

A_g is watershed area above gaged site (acres),

I_{ug} is mean annual precipitation above ungaged site, from GIS-based isohyetal map (ft), and

I_g is mean annual precipitation above gaged site, from GIS-based isohyetal map (ft).

The closest identified stream gauge on the north coast with a historical record approaching the desired record length is the USGS 11467600 Garcia Point Arena station, located approximately 27 miles south of the Big River (latitude 38°55’35”, longitude -123°37’45” NAD 27). The Garcia Point Arena station was monitored from August 1962 to August 1983 (21 years) on the Garcia River which has a drainage area of 98.5 square miles and a gauge datum of 55.31 feet above NGVD29. This station was selected despite not having the total record length desired for the area ratio method due to its proximity to the project location relative to other gauges with sufficiently long records, similar proximity to the ocean, and because it includes records during the two most critical drought years (1976 and 1977) since the 1920’s. The mean daily streamflow between August 1962 and August 1983 is shown in Table 19 below. The corresponding mean daily flow and February median flow, are shown in Table 20.

Table 19 USGS Daily Mean Streamflow (cfs) at the Garcia Point Arena Station 1962-1983

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	428	825	1,090	758	156	55	30	19	16	15	42	506
2	443	637	804	462	143	59	30	19	16	16	53	592
3	478	520	656	336	134	54	29	18	15	15	40	936
4	1,190	679	588	300	128	52	28	18	14	13	72	857
5	1,360	653	572	328	134	51	28	18	14	13	103	641
6	889	714	481	477	129	50	27	18	14	14	132	384
7	522	844	498	370	131	49	27	18	14	20	154	343
8	409	855	746	349	121	48	28	17	14	16	173	284
9	798	1,010	565	357	115	48	28	17	15	16	287	248
10	650	760	495	376	112	46	27	17	17	23	391	427
11	903	630	564	347	106	45	26	17	14	61	496	276
12	1,710	869	663	421	99	44	25	17	14	139	336	372
13	1,620	1,130	897	438	96	43	25	16	13	81	301	391
14	1,670	769	520	529	92	42	24	16	13	49	431	527
15	1,600	887	418	472	90	41	24	17	13	46	476	605
16	2,980	954	622	387	86	40	23	16	13	39	698	566
17	1,380	795	497	313	83	39	23	16	13	27	491	778
18	978	850	515	299	83	38	23	17	13	22	448	509
19	905	817	473	287	79	37	23	17	19	21	408	848
20	1,330	689	424	259	76	37	22	17	17	20	345	1,330
21	1,760	671	562	239	73	36	22	19	16	22	350	2,130
22	1,260	566	514	222	71	35	22	17	15	50	320	1,800
23	1,400	490	431	284	69	35	21	16	14	54	653	1,410
24	1,180	472	419	268	67	34	21	15	14	36	446	1,210
25	709	498	513	256	66	34	21	15	13	55	266	700
26	1,260	495	556	220	64	33	20	15	14	43	271	564
27	1,250	550	775	295	62	33	20	15	15	37	272	586
28	1,070	970	590	245	60	32	20	14	17	103	391	774
29	933	761	771	192	59	31	19	14	19	55	339	728
30	899	---	884	171	57	31	19	15	16	64	572	576
31	1,180	---	881	---	56	---	19	17	---	35	---	502

Table 20 Mean Daily Flow, February Median Flow Estimates Using the Drainage Basin Area Ratio Method

	Area (acres)[1]	Average Precipitation (inch)[2]	Mean Daily Flow (cfs)	February Median Flow (cfs)
Garcia River (Gaged)	**63,040**	**55**	**341**	**760**
Big River	115,385	47	538	1,198
Slaughterhouse Gulch	315	42.2	1.3	3.0
Jack Peters Gulch	811	41.4	3.3	7.4
Russian Gulch	2,620	45.7	11.9	26.4

[1] Area was estimated using GIS mapping of drainage areas.
[2] Average precipitation was obtained from USGS Streamstats for an average precipitation within the watershed for each respective surface water body.

For comparison purposes, mean daily flow for the mouth of the Big River using the data from the North Comptche and Two Log Creek gauges are 272 cfs and 500 cfs, respectively which is within the expected range of values.

6.2.1 Minimum Stream Flows

The presence or absence of fish or non-fish aquatic species in a stream affects the extent of the fishery protection needed at water diversions. Streams that contain fish require a higher level of protection than streams that do not contain fish, in large part because fish are mobile and require more physical aquatic habitat (living space) than non-fish species. Studies have shown that there are no presumptive environmental effects from diversion so long as they are kept during times where flow is a minimum of the 90th percentile daily flow between December 1 and March 31 and diversions are kept to a maximum of 20 percent of the available flow (Woodard, 2013). In practice, this 90th percentile flow is often estimated using the February Median flow and is the recommended bypass flow by the Northcoast Regional Water Quality Control Boad.

Using the Garcia River streamflow record as an indicator of how often these criteria are met, average daily streamflow data indicate that there are 48 days a year (13 percent) in which streamflow is above its February median flow, all which fall between December and March. On these days there is a maximum capture volume (sum of the 20 percent of the streamflow on those days) of nearly 248,000 AFY or approximately 10 percent of the cumulative volume measured by the average daily streamflow. Using this as a basis, an estimated volume of 10 percent of the cumulative volume was used as the maximum capture volume for surface water sources within the study area, shown in Table 21.

Table 21 Estimate of Diversion Volumes while Maintaining February Median Streamflows

	Mean Daily Flow (cfs)	February Median Flow (cfs)	Cumulative Volume (AFY)[1]	Maximum Capture Volume (AFY)
Garcia River (Gauged)	**341**	**760**	**248,000**	**24,600**
Big River	538	1,200	390,000	39,000
Slaughterhouse Gulch	1.3	3.0	940	94
Jack Peters Gulch	3.3	7.4	2,400	240
Russian Gulch	12	26	8,200	820

[1] Conversion factor of 724 to convert from cfs to AFY

6.2.2 Rainwater Collection

Rainwater collection systems capture rainwater runoff from impervious areas such as roofs, patios, streets and driveways. These types of systems vary depending on volume captured and intended use. Rainwater cannot be used directly as a potable source without treatment and disinfection. In most rainwater collection systems rainwater is collected from roof gutter downspouts and stored in barrels or cisterns. The most common use of rainwater in California is landscape irrigation. Without installing large storage tanks at every property or an extensive collection

system that would collect rainwater from each property and convey it to a central storage and treatment facility, rainwater collection capacity is limited. However, if every person within MCCSD installed a 55-gallon rain barrel to collect and store rainwater, 47k gallons or 11 percent of the estimated ADD of the study area could be stored and used for irrigation, allowing for a significant contribution to offset demands.

6.3 Desalination

Desalination is the process of removing salts and minerals from sea water to create potable drinking water. When considering seawater desalination in California, it is important to follow the California Ocean Plan. Per the California Ocean Plan, there are preferred design methods listed in the 2015 Desalination Amendment. The preferred design method for the intake system is a subsurface intake system (such as wells). The preferred design method for brine discharge is brine disposal at existing wastewater treatment plant outfalls. If these alternatives are not available, other design features can be considered but incorporating the Ocean Plan preferences typically results in less permitting challenges. Additionally, there are existing state and federal funding sources to help develop desalination technologies and increase desalination use in which design following the preferences would be favored.

Currently the United States Bureau of Reclamation (USBR) will fund up to 25 percent of desalination construction projects and up to 50 percent of feasibility studies or pilot studies for emerging technologies. The California DWR also has a grant program specifically for desalination that can be explored.

There are several methods for the process of desalination that involve a distillation or membrane filter process. This study reviews two potential options: desalination of the Big River brackish water and desalination of seawater through Oneka Technologies wave-powered offshore system.

6.3.1 Desalination of Big River Groundwater

The closest potential location for subsurface intakes appears to be along the northern beaches at the mouth of the Big River, as shown in Figure 18 below.

Figure 18 Potential Desalination Subsurface Intake Locations

Desalination facilities typically require 2 - 2.5x the volume of potable water produced as intake volume with the excess discharged as a saline brine, which would need to be discharged to the ocean. An advantage of placing the intake in the alluvium of the Big River is potentially utilizing highly brackish water rather than sea water which would reduce the volume of Reverse Osmosis (RO) concentrate (or brine) that would need to be disposed of. Sea water on average has a total-dissolved-solids (TDS) concentration of approximately 35 parts per thousand. Water quality tests from the Mud Flat test well, approximately 2.3 miles upstream, revealed concentrations of nearly 20 parts per thousand. TDS concentrations within the alluvium of the big river would likely fall between 20 to 35 parts per thousand.

A desalination facility would need be constructed to treat the brackish water. One potential location for the desalination facility is near the existing wastewater treatment plant, which would allow for RO concentrate to be disposed via the existing WWTP outfall which would reduce the length of discharge piping required. A review of the existing wastewater treatment plant's capabilities would be required to identify if any upgrades would be required to facilitate this use. Land would need to be acquired if space is not available at the WWTP site to allow for the desalination facility.

Improvements that would be required for a desalination facility would include the following:

- Desalination treatment buildings: These may be constructed in a custom facility or in modular units that are housed in cargo shipping containers with approximately two (2) 40 ft long shipping containers required for every 200,000 gallons of production capacity.
- Finish treatment facility: Processed water from the desalination facility would require a secondary treatment of chlorination.
- Finish water storage tank(s) capable of holding the MDD for the community system (combined 533,715 gallons).

The combined footprint of these facilities is approximately 6,000 – 10,000 square feet. This does not include any booster stations that would be required to deliver water from the finish water tank(s) to distribution. Discharge from the desalination process would be ideally connected to the existing WWTP outfall.

6.3.2 Alternative Seawater Desalination

As an alternative to a direct surface intake for desalination near the Mendocino coastline, Oneka Technologies has designed a green energy desalination alternative that uses wave energy to push sea water (off the Mendocino Coast) through RO membranes. This technology is currently undergoing pilot testing for the City of Fort Bragg as part of their efforts to address the City's drought concerns. Through the Blue Economy Initiative and California's potential for water powered desalination, Oneka Technologies has deployed California's first wave-powered desalination project.

This project showcases a high level of sustainability and efficiency, highlighting the ability to do no damage to the coastal ecosystems and produce a sufficient amount of water to address the underlying drought problem. Some of this project's highlights include:

- A production of 13,200 gallons per day over a 1-year period
- Low-impact brine generation that is dispersed through wave action:
  - Low-impact brine generation is specifically stated to be a 30% increase in salinity compared to seawater, as opposed to the conventional desalination brine that is 100-150% higher in salt concentration.
  - The wave action disperses the brine so that buoys detect no salinity difference within 6 feet of the buoys
- This project emits zero greenhouse gas emissions, along with an estimated 50 tons of CO_2 saved per year (1-ton of CO_2 per year for each cubic meter of fresh water produced daily)
- There is a heavy focus on ecosystem conservation in this project:
- The intake contains a 60-micron mesh that is designed to keep marine ecosystems safe, while the entire reverse osmosis process occurs offshore, preserving terrestrial ecosystems

Units or buoys are estimated to produce 13,200 gpd with wave heights of 5 feet and minimum ocean depths of 43-98 feet. Large-scale buoy arrays can be deployed that produce a minimum of 53,000 gpd per array making this a viable option to offset or produce all needed demands.

6.4 Recycled Water

Water reuse or recycled water is derived from reclaimed water streams that might otherwise be considered waste streams. Water reuse is the process of reclaiming water from a variety of sources, treating it and reusing it for beneficial purposes. Municipal sewage that has been treated and complies with recycled water regulations is the most common source of recycled water.

Recycled water is regulated by the SWRCB under Title 22, Division 4, Chapter 3 of the California Code of Regulations. There are four levels of treatment for recycled water, depending on the intended use or application:

- Disinfected tertiary
- Disinfected secondary-2.2
- Disinfected secondary-23
- Undisinfected secondary

Recycled water can be used for potable reuse or non-potable reuse.

Potable reuse is differentiated into three types:

1. Indirect Potable Reuse (groundwater recharge)
2. Reservoir Water Augmentation
3. Direct Potable Reuse

Recently the State approved regulations for Direct Potable Reuse, however costs and community sentiment is crucial in determining whether that may be an option in Mendocino. Indirect potable reuse requires the treatment of recycled water to potable standards to recharge groundwater that is later recovered by groundwater wells.

Because the Mendocino aquifers have limited storage capability, there is no centralized CWS with a reservoir, and community sentiment toward direct potable reuse is unknown, only non-potable reuse was considered as an option for the use of recycled water in this study.

Recycled water from sources can be used for a variety of non-potable applications in California including irrigation, flushing of sanitary sewers (such as toilet flushing), and industrial or commercial cooling.

Recycled water is treated by filtration and disinfected prior to use. Many municipalities utilize recycled or reclaimed water to augment their water supply, in some cases recycled water accounts for more than 20 percent of a system's demand.

Since the 1990s MCCSD has delivered approximately 1.5 MG annually to Mendocino Unified School District (MUSD) to irrigate the Mendocino High School (MHS) athletic fields. Recycled water is pumped in batches of 32,000 gallons to 40,000 gallons to a tank at the MHS.

The MCCSD WWTP treats domestic and commercial wastewater and has an average dry weather design treatment capacity of 0.3 million gallons per day (mgd) and a peak daily wet weather treatment capacity of 1.0 mgd. During the dry weather season (generally May through October) and other periods, as needed, tertiary-treated effluent is distributed to the recycled water system.

Tertiary filtration at the WWTP is provided by four dual-media filters. The filters are designed to filter out 50 to 70% of suspended matter from the sedimentation tank. Pumps responsible for transferring recycled water to the storage tank are run manually. Additional details regarding the WWTPs recycled water process can be found in the Recycled Water System Feasibility Study Report prepared by GHD in 2021.

Currently, MCCSD is the only producer and distributor of recycled water within the study area and MUSD is the only user of recycled water produced by MCCSD.

Title 22, Section 60304 of the CCR (SWRCB, 2015) requires that recycled water used for irrigation meet disinfection and filtration effluent limitations associated with the disinfected tertiary recycled water standard. The disinfected tertiary recycled water standard is the most stringent standard for non-potable reuse.

MCCSD is currently pursuing the expansion of their recycled water delivery capabilities. The project includes a new 250,000-gallon recycled water storage tank, transmission / distribution pipelines, fire hydrants, and new recycled water services at MHS, Friendship Park and the K-8 School. The maximum month irrigation demand for existing recycled water use at MUSD owned playfields and landscaped areas was estimated at approximately 30,070 gpd.

Improvements at MCCSD's WWTP required to enable the expanded recycled water delivery include:

- New chlorination system.
- New below-grade chlorine contact chamber and recycled water storage.
- New recycled water pumping system.
- Abandonment of the existing recycled water distribution system and the existing 55,000 gallon concrete tank and irrigation booster pumps at MHS.
- Installation of new recycled water quality monitoring and chlorination facilities with monitoring. Include system flow monitoring and tank level control.
- Disconnect the existing potable water service and provide a new recycled water service for the K-8 school irrigation system.

Increasing recycled water storage and use will increase the available potable water supply, reduce usage of limited groundwater resources for irrigation and increase available fire water storage. The average dry weather flow to the MCCSD wastewater treatment plant is 76,000 gpd with recent flows averaging closer to 50,000 gpd in dry weather months. Therefore, in dry weather months an additional 20,000 gpd of recycled water could be produced beyond what is planned with the current recycled water expansion project (30,000 gpd).

7. Conclusions

If a centralized CWS were planned for the entire study area the ability for combined sources to produce an existing ADD of 356,000 gallons and a MDD of 801,000 gallons would be required. Title 22 § 64554 of the California Code of Regulations requires a public water system's water source(s) to have the capacity to provide the systems MDD at all times. The following table compares the estimated existing demands to the potential supply of systems with water sources worth pursuing for consolidation.

Water sources are described by their capacity on an annual basis in AFY or on an instantaneous basis in gpm. Surface water sources are regulated and described in AFY often with instantaneous limits in gpm. Groundwater source capacities are typically described in gpm. However, demands are estimated and described on the basis of daily use in gallons (gpd). As such, the following table shows demands in gallons per day and projected over a year to AFY to compare the demands to the supply. Similarly, the MDD is shown in gpm to compare to instantaneous source water withdrawal capacities.

Table 22 Summary of Existing Demands and Potential Existing Supply

	ADD (gallons)	Annual Projection (AFY)[1]	MDD (gallons)	Source Water Requirement (gpm)
Existing Demand[2]	356,000	399	801,000	556
Existing Supply[3]	210,000	235	233,000	162
Potential Recycled Water Supply	30,000	34	30,000	21
Net Balance	**(116,000)**	**(130)**	**(538,000)**	**(373)**

[1] *Annual projection is based on the ADD and a conversion factor of 0.00112 from gpd to AFY*
[2] *See Table 10*
[3] *See Table 18*

The difference between the potential existing supply and estimated demand ADD is 130 AFY. This difference would need to be eliminated to allow for service to the entire study area. Additionally, the combined source water capacity would need to be increased by 373 gpm to be able to meet the systems MDD.

Due to the uncertainty of consolidation sentiment among existing public water systems and uncertainty in capacity data, potential new source solutions are discussed in the following sections and their ability to meet the difference between the estimated supply of consolidated sources and MDD or 538,000 gallons. Figure 19 shows a breakdown of the needed source water capacity against the maximum potential existing consolidated source capacity.

Not considered in this study is the reduction of the service area of a future centralized CWS and thereby the reduction of estimated demands.

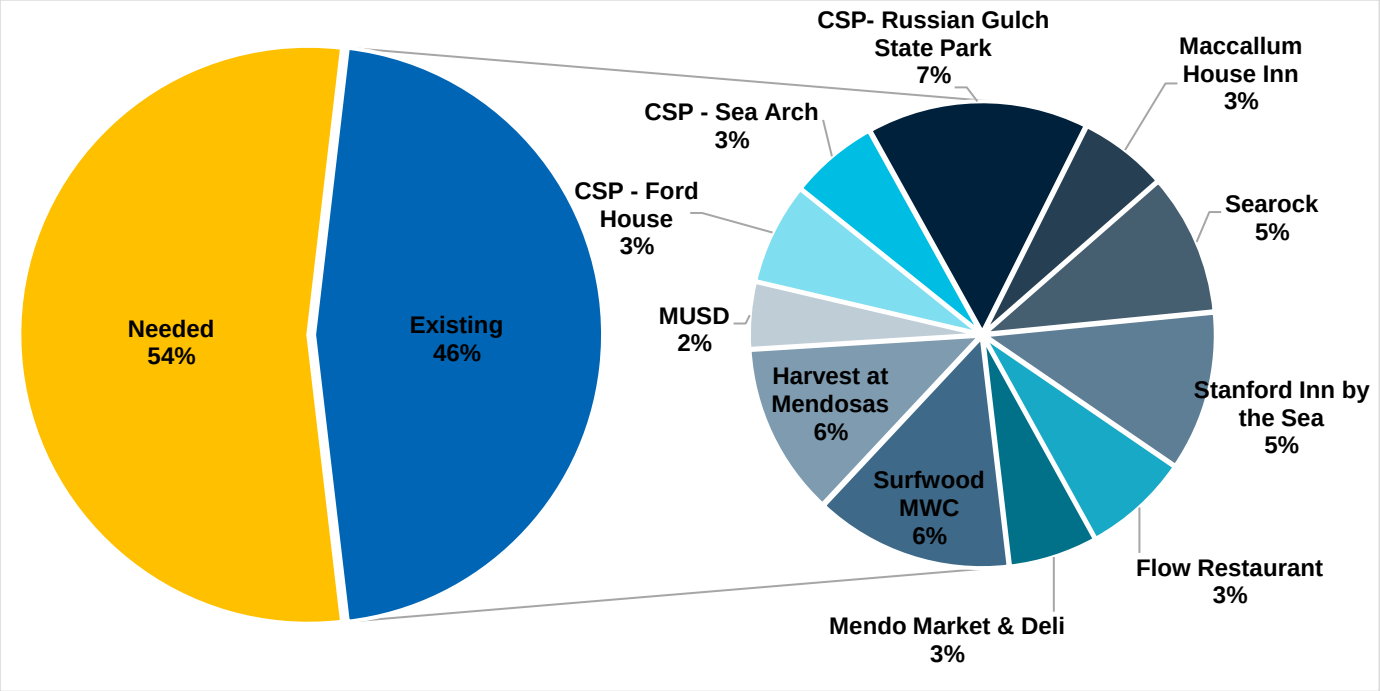

Figure 19 Study Area Source Water Demands against Existing Supplies

7.1 Groundwater Sources

Bedrock sources of groundwater do not provide sufficient yield to be a viable source of water for a community water system. Similarly, a freshwater Ranney well or similar structure using groundwater in the Big River alluvium does not provide a sufficient yield for a CWS without utilizing a desalination treatment process.

Groundwater resources within the Mendocino Headlands are nearly fully developed to their maximum theoretical sustainable yield and are not a viable potential new water source for a community system.

Groundwater in marine terrace formations beyond the Mendocino Headlands may provide a potential source of water with the marine terrace deposits on the north and south side of the Russian Gulch being the most promising locations. As the marine terrace deposits are likely very similar to the Mendocino Headlands terraces, groundwater would likely need to be extracted with a series of shallow wells in a well field. Based on sustained pumping analysis of existing MUSD wells (GHD, 2023) each new well is estimated to be able to provide up to a sustained 6 gpm (10 AFY).

As each individual well is estimated to have a relatively low annual yield, multiple well fields would be required to obtain the 373 gpm net balance MDD. A total of 62 new wells would be required in well fields consisting of 5-10 wells each, would need to be located in areas with favorable hydrogeologic conditions. Assuming a conservative radius of influence of 100 feet for each well, to avoid interference effects between wells, each well field would be approximately 3.6-7.2 acres in size depending on the number of wells in each well field. Therefore, a cumulative area of approximately 45 acres of land for well field development would be required.

The shallow nature of the aquifer formations would necessitate sanitary surface seal exemptions from DWR. Surface seals are required to protect groundwater from becoming under the influence of surface water and vulnerable to harmful bacteria and other pollutants. Minimum seal depths for community water wells are 50 feet however, they can be reduced to 10 ft with a sanitary surface seal exemption. Based on the anticipated groundwater levels and thin marine terrace thicknesses, a maximum surface seal of 20 ft is anticipated to obtain the estimated 6 gpm (10 AFY) annual yield from each well field.

Should a well field be pursued as a new water supply source the proposed location(s) should be reviewed with a well siting study to evaluate well field design prior to construction. Additionally, an Environmental Impact Report (EIR) for each well field location would need to be prepared.

7.2 Surface Water Sources

Surface water sources reviewed in the study area are a potential significant source of water within the study area with cumulative volume estimates ranging from 940 AFY in Slaughterhouse Gulch to 390,000 AFY in the Big River. Either a POD on the Big River or a combination of PODs of the smaller surface water sources would be able to meet the net balance MDD and ADD requirements.

While there is sufficient water to meet the demand of the entire study area, the process of obtaining a new appropriative water right for a POD is difficult and time-consuming process with no guarantee of success. A complete assessment and EIR would be required for any project proposing withdrawal from a POD to evaluate for impacts to the environment.

The presence or absence of fish or non-fish aquatic species in a stream affects the extent of fishery protection needed at water diversion. Streams that contain fish require a higher level of protection than streams that do not contain fish, in large part because fish are mobile and require more physical aquatic habitat than non-fish species (SWRCB, 2014). The SWRCB classifies streams into three tiers (Class I, II, and III) based on specific biological determinations to regulate habitat protection. Class I are streams known to sustain fish, Class II are streams with known habitat for aquatic non-fish vertebrates and or aquatic benthic macroinvertebrates, and Class III as intermittent or ephemeral streams.

The Big River and its tributaries contain critical habitat to Endangered Species Act-listed species including endangered Coho Salmon, threatened Steelhead Trout, and others. Big River, Russian Gulch, and Jack Peters Gulch all support fish in some portion of the watershed so there are portions of each stream classification (I, II, III) in each watershed. Slaughterhouse Gulch has a waterfall at its mouth that precludes fish from accessing the gulch so it only has Class II or Class III reaches.

Additional environmental considerations for the Big River are that it is listed on Section 303(d) of the federal Clean Water Act as an impaired waterbodies for Total Maximum Daily Loads (TMDLs) for sedimentation, dissolved oxygen, and temperature.

To mitigate these and other potential environmental impacts this study has limited potential diversion to only during periods when flows are above their February median flow and limited to 20 percent maximum diversion. A volume depletion study, or other studies required to develop an EIR, would likely be required by regulators to validate this assumption or determine if another diversion limitation is more appropriate to protect environmental interests. With these limitations, a potential capture volume was estimated and shown in Table 23, below.

Table 23 Estimated Maximum Diversion Volumes for Surface Water Sources

	Cumulative Volume (AFY)	Maximum Capture Volume (AFY)[1]	Existing POD (AFY)	Existing POD (percent of maximum capture volume)	Potential Capture Volume (AFY)
Big River	390,000	39,000	9.3[2]	0.024	38,990.7
Slaughterhouse Gulch	940	94	3.1	3.3	90.9
Jack Peters Gulch	2,400	240	32.6	14	207.4
Russian Gulch	8,200	820	37.9	4.6	782.1

[1] 10% of the Cumulative Volume
[2] Diversions limited to the Study Area

A major limitation with surface water sources is that the potential capture volume is not available year-round as flows are highest during the winter months and lowest during the summer months. For example, only 48 days on average between December and March maintained the required minimum stream flow in the Garcia River to allow for extraction.

Previous studies performed by Lawrence and Associates prepared a preliminary design and analysis for installing reservoirs in the lower gulches to allow for a combined 40 AF of storage. This and other alternatives for storage solutions would need to be evaluated and presented to the stakeholders should a surface water source be pursued.

A new appropriative water right permit would need to be obtained from SWRCB, Division of Water Rights in conjunction with review and approval from other jurisdictional agencies such as CDFW. This permit would require analysis and documentation of the following:

1. There is water available for use.
2. The water use would not deprive anyone with a higher priority water right the use of water.
3. The project will not harm public trust resources where it is likely feasible to protect those resources.
4. The project is in the public interest.
5. The project follows CEQA.

In addition to the water rights permit the following permits would likely be required for construction and operation of the POD.

1. A Streambed Alteration Agreement from CDFW.
2. A “take” permit from CDFW, U.S. Fish and Wildlife Service and the National Marine Fisheries Service.
3. A permit from the U.S. Army Corps of Engineers under Section 404 of the federal Clean Water Act with the corresponding certification from the SWRCB that the water diversion project would not violate California water quality standards (separate from the Water Rights Permit).
4. A National Pollutant Discharge Elimination System permit from the North Coast Regional Water Quality Control Board.
5. A permit from Division of Dam Safety (if a reservoir with a capacity of more than 49 AF is proposed).

The permit application process for a surface water right is a lengthy process and would likely take at least 3-4 years to complete and could take longer should other issues arise.

7.3 Desalination

Desalination of Big River groundwater could provide the required net balance ADD and MDD. An intake facility capable of withdrawing approximately 2-2.5 times the required demand (746-932.5 gpm) from the alluvium under the mouth of the Big River would be needed. Brackish raw water would decrease the cost of desalination treatment and

reduce brine volumes that would be discharged through the WWTP's outfall system. If desired, the total estimated demand could be supplied by a desalination system.

As an alternative to a direct subsurface intake for desalination, offshore seawater desalination could be pursued by the installation of wave-powered offshore technology. This is an emerging technology with several successful projects in Florida and a pilot study soon to be underway for the City of Fort Bragg. With an estimated production of 13,200 gpd per modular floating unit or buoy, approximately 41 units would be required to meet the net balance MDD, while only 9 units would be required to meet the net balance ADD.

7.4 Recycled Water

Increasing recycled water storage and use will increase the available potable water supply, reduce usage of limited groundwater resources for irrigation and increase available fire water storage. The average dry weather flow to the MCCSD wastewater treatment plant is 76,000 gpd with recent flows averaging closer to 50,000 gpd in dry weather months. The planned expansion of the WWTP will increase the supply of recycled water to a total of 30,000 gpd. Therefore, an additional 20,000 gpd of recycled water could be produced beyond what is planned with the current recycled water expansion project. On the basis that the plant is in the process of upgrading their recycled water capabilities to 60 percent of the potential maximum recycled water possible, additional upgrades are not anticipated for the purposes of this study and 30,000 gpd is anticipated to be available for a centralized CWS.

7.5 Source Water Assessments

Source water assessments are required for any new water source proposed for use by CWS, to ensure that the source is protected from contamination. Source water assessment requirements differ for a surface water source and a groundwater source and are summarized in the below subsections.

Minimum Components of a Drinking Water Source Assessment

Groundwater

- Description of System and Water Source
- Delineation of Protection Zones (including calculation method)
- Physical Barrier Effectiveness
- Possible Contaminating Activities Inventory
- Possible Contaminating Activities Vulnerability Ranking
- Completion of Assessment and Vulnerability Summary (submitted to Department of Health Services Drinking Water Program District office or local county Primacy Agency).

Surface Water and Desalination

- Location of the Drinking Water Source.
- Delineation of Source Area and Protection Zones.
- Drinking Water Physical Contaminant Barrier Effectiveness Checklist.
- Inventory of Possible Contaminating Activities.
- Possible Contaminating Activities Vulnerability Ranking.
- Assessment Map.
- Completion of Assessment and Vulnerability Summary (submitted to Department of Health Services Drinking Water Program district office or local county Primacy Agency).
- Public Notification (annual Consumer Confidence Report).

7.6 Cost Estimates of Potential Water Sources

Concept level cost estimates to develop new sources are provided in the following subsections. Cost estimates do not include non-construction implementation costs such as administration, reporting, right-of-way or land acquisition, engineering design, general permitting and environmental permitting, bid phase services, labor compliance, monitoring and close out efforts, for example. Non-construction costs can be significant, depending on the scope of the project. Cost estimates do not include construction costs such as site development, electrical and instrumentation improvements as well as raw water collection, centralized treatment, and distribution, as designs have not been prepared to properly estimate these elements. Estimates were prepared per the Association for the Advancement of Cost Engineering cost estimating classification system. Class 5 estimates for conceptual screening and comparison were prepared, a 30% estimating contingency has been included.

7.6.1 Groundwater

Groundwater sources are insufficient to be the sole source of water for a new centralized CWS. However, groundwater could be a cost-efficient supplemental supply. Costs for drilling, well construction, well development and well head improvements are expected at an estimated $45,000 per well (assumed depth of approximately 50 feet bgs). In addition to those items listed above, costs do not include pump testing, drilling oversight, or collection system to a centralized location.

7.6.2 Surface Water

Due to the number of unknowns, costs prepared in the Water Supply Cost Feasibility Study authored by SPH Associates in 1993 were used as a basis for this study's conceptual cost estimate for development of new surface water source(s). Costs were increased using the California Department of General Services Construction Cost Indices (CCI). The Department of General Services CCI online records only go back to 1996, with an average 1996 CCI of 3470. The February 2025 CCI is 9922. The difference between the CCIs is a factor of 2.86 and was applied to the 1993 study costs, costs were reduced to account for the reduction in demands needed to be met, see

Table 24. It should be noted that the 1993 cost estimate included preliminary costs for land acquisition but not costs to obtain a new surface water right permit, which, if possible, are expected to be significant. Only the Gulch Diversion option for surface water development was considered in this study. Costs to develop the lower gulches increased from $6.5M to $15.6M in 2025 dollars. Costs for a surface water source were not included as the vast majority of the cost would be in the permitting and construction of a reservoir capable of meeting the source water requirements for a CWS year-round.

TABLE 4-1
TOTAL ESTIMATED PROJECT COSTS
WATER SUPPLY, TREATMENT AND DISTRIBUTION FACILITIES
MENDOCINO CITY COMMUNITY SERVICES DISTRICT

Description of Cost Component	Estimated Cost	
	Gulch Diversion	Big River Diversion
Water Supply and Treatment Facilities	$2,139,550	$1,851,400
Water Distribution System	2,636,000	2,636,000
Land Acquisitions	180,000[1]	120,000[2]
Easement Acquisitions[3]	30,000	25,000
Acquisition of Existing Facilities[4]	200,000	200,000
Engineering and Environmental Services		
Preliminary Design	25,000	22,000
Environmental Documents[5]	35,000	35,000
Surveying (Aerial and Ground)[6]	80,000	70,000
Geotechnical	25,000	20,000
Final Design[7]	430,000	420,000
Construction Administration/Inspection[8]	120,000	120,000
Administration and Legal[9]	50,000	50,000
Construction Cost Inflation @ 4%[10]	237,450	223,600
Project Cost Contingency @ 5%[11]	309,000	290,000
TOTAL ESTIMATED PROJECT COSTS[12]	$6,497,000	$6,083,000

1 Land acquisition cost for five gulch pump stations.
2 Land acquisition cost for one Big River pump station.
3 Easement acquisition costs are for pipelines across Georgia Pacific property.
4 The $200,000 estimated assumed cost covers acquisition of storage tanks, pipelines in Hills Ranch and in Big River Vista.
5 Environmental costs assume the project will require an EIR of average complexity and that it will not be challenged by preservationist/conservationist special interest groups.

TABLE 4-1 (Continued)

6 The town will be covered by an aerial survey. A ground survey will be used for intake station and pipeline design.
7 The $10,000 differential in design cost between the two alternatives represents the additional costs to design multiple gulch diversion pump stations.
8 The $120,000 estimated cost assumes full-time management/inspection of all construction activities over a 14-month construction period.
9 A $50,000 allowance is included to cover Mendocino City Community Services District's legal and administration services throughout the planning, design, and construction phases of the project.
10 The 4% construction cost inflation is included to project the costs to a 1994-95 construction season.
11 A 5% project cost contingency is included which is optimistic but appears to provide an adequate cushion for unanticipated additional engineering, administrative or legal costs.
12 The total estimated project costs do not include the cost of financing the project.

Figure 20 SPH Cost Feasibility Study Table 4-1

Table 24 Conceptual Capital Costs- Surface Water – Gulch Diversion

Item Description	Cost	
Gulch Diversion	$	12,000,000
SUBTOTAL - CAPITAL CONSTRUCTION COSTS	**$**	**12,000,000**
Estimating Contingency -30%	$	3,600,000

Item Description	Cost
TOTAL - CAPITAL CONSTRUCTION COSTS	**$ 15,600,000**

7.6.3 Desalination

Desalination of Big River Groundwater

A conceptual cost estimate for a 0.801 million gpd Seawater Reverse Osmosis (SWRO) Plant & ancillary facilities was prepared and is shown in Table 25. Costs were based on the assumption that the plant will be used to treat Seawater with a TDS of 35,000 mg/l and the existing MCCSD WWTP outfall will be used to discharge brine.

Table 25 Conceptual Capital Costs- SWRO Desalination

Item Description	Cost
Intake Well (Slant Well Drilling and Infrastructure)	$ 1,500,000
Raw Water Conveyance ($400/LF)	$ 1,200,000
SWRO Treatment System	$ 2,500,000
Storage- 0.5 MG	$ 2,400,000
Brine Disposal Improvements	$ 500,000
SUBTOTAL - CAPITAL CONSTRUCTION COSTS	**$ 8, 100,000**
Estimating Contingency -30%	$ 2,430,000
TOTAL - CAPITAL CONSTRUCTION COSTS	**$ 10,530,000**

Alternative Desalination Capital Costs

Potable water produced by Oneka offshore wave-powered desalination units is sold by the cubic meter or thousand gallons (KGal) by Oneka. Oneka maintains ownership of units deployed and provides all operation and maintenance, offering the sale of treated water as a service only. Once on shore, additional final treatment will be required to disinfect desalinated water. At $11/KGal it would cost approximately $1.1 million per year to produce the net balance MDD, in addition to initial capital costs outside of the units.

Table 26 Conceptual Capital and Annual Costs- Alternative Desalination

Item Description	Cost
Annual Water Production Costs (MDD) $11/Kgal	$ 2,200,000
Raw Water Conveyance ($400/LF)	$ 1,200,000
Storage- 0.5 MG	$ 2,400,000
SUBTOTAL - INITIAL CAPITAL AND ANNUAL COSTS	**$ 5,800,000**
Estimating Contingency -30%	$ 1,740,000
TOTAL - INITIAL CAPITAL AND ANNUAL COSTS	**$ 7,540,000**

8. Summary of Preferred Sources and Recommendations

The following section summarizes this study's conclusions and recommendations.

Desalination is not currently viewed as a desirable source option due to regulatory requirements, operations & maintenance requirements, waste (brine) management, and potential environmental impacts of subsurface intake structures. Additionally, the intended use plan for the funding opportunity supporting this study precludes funding for desalination system design. However, there are other state and federal funding sources available for pursuit.

Groundwater sources within the CWS are insufficient to solely supply a centralized CWS serving the entire study area. However, considering the extensive distribution of marine terraces upgradient and outside of the existing modelled groundwater system, updating the MCCSD groundwater model to include these marine terraces is warranted. The objective of potentially developing new wellfields for source water augmentation in upgradient marine terraces cannot be eliminated until further investigations are undertaken.

Recycled water and rain barrels should be utilized to offset source water as conjunctive uses for irrigation.

Stormwater capture and storage near outfalls should be further investigated as a potential source.

Surface waters are the preferred primary source of water for a centralized CWS. Water availability from surface water sources is sufficient to meet the needs of a centralized CWS, however, diversions are limited to times when flows are above the February Median flows, with the potential exception of cliff outfall flows from Slaughterhouse Gulch.

Storage, on the order of 130-400 acre-feet (42-130 million gallons) is needed for a centralized CWS serving the entire study area. The service area needs to be refined down from the 1-mile radius outside the MCCSD boundary of this study area to identify a fundable project and to estimate realistic demands and thus, storage requirements.

To evaluate potential locations for a reservoir further studies will be needed:

A reservoir siting study evaluating potential locations of a reservoir(s) is needed. This would include an initial screening of locations (on-channel and off-channel) based on topographic relief, proximity to town, proximity to sources, the Coastal Zone, and environmentally sensitive habitat areas. After the initial screening, site specific environmental studies should be conducted to evaluate potential environmental impacts.

Initial considerations for screening of a reservoir location are as follows:

Big River - The largest nearby source of water, is not a feasible source or location for a reservoir due its extensive brackish water estuary and protected status as well as ongoing protection and restoration projects that include the removal of historical logging roads and dams. This effort is headed by the Mendocino Headlands State Park, Big River Unit. The Big River Unit's mission is "*to provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources and creating opportunities for high-quality outdoor recreation*". In 2002 a large portion of the Big River watershed was purchased from the Hawthorne Timber Company and is owned by State Parks to further conservation efforts. The Big River is the longest undeveloped estuary in California and is ecologically important, containing aquatic and terrestrial habitats for many rare and listed species. The acquisition of this property involved many stakeholders acquiring both public and private monies for its protection. The terms and conditions of the acquisition are to "use and manage the Property for the purposes of estuarine, wetlands, aquatic and wildlife preservation, wildlife-oriented education, and research and for compatible public park and other uses consistent with estuarine, wetlands, aquatic, fish and wildlife habitat preservation and restoration."

Russian Gulch - the second largest nearby surface water source, is a sensitive habitat (Class I stream) and is surrounded by the Russian Gulch State Park that extends approximately 2-miles east of the mouth of the gulch. Developing a reservoir within the Russian Gulch would not be an option, however, installation of a minor diversion

may be possible. One potential exception to this reservoir limitation is the southern fork of the Gulch, approximately 2-miles upstream that is outside of state park and has significant topographic relief.

Jack Peters Gulch - the third largest nearby surface water source, is a sensitive habitat (Class I stream) with less topographic relief compared to the Russian Gulch and Big River but is relatively undeveloped with a small number of private residences on both the north and south sides of the gulch. Diversion water in the wet season is feasible and reservoir locations in the uppermost portions of the watershed may be feasible. Additional studies would be required.

Slaughterhouse Gulch - the smallest of the nearby surface water sources, doesn't have the topographic relief for a reservoir of significant size and is heavily developed along the sides of the gulch with some residences having wells or other intakes inside the channel. For these reasons it is not a suitable location for a reservoir, however, it is a Class II or III stream without salmonids, it does have significant discharge out the cliffs into the ocean that could potentially provide enough source water to supply a centralized CWS. Additional studies would be required.

Areas East of the Study Area – the potential for both small surface water source contributions and reservoir storage is relatively promising east of the study area off Little Lake Road. Initial discussions with State Park representatives, CDFW, and community feedback, indicate a willingness and desire to identify locations for a reservoir. The State's Biogeographic Information and Observation System (BIOS) contains previously mapped environmental sensitive habitat areas indicating where sensitive plants and ecosystems are located. The BIOS system can aid as a preliminary screening tool in finding a suitable reservoir location and potentially additional sources.

For the reasons summarized above and detailed in this study, the following additional tasks and studies are recommended:

1. *Service Area Delineation.* It is recommended that a service area delineation exercise be performed to refine a potential service area for a centralized CWS. Critical factors to consider in this exercise include population density (number of service connections), topography (pressure zones), vulnerability (wells that have gone dry), proximity to potential sources and consolidation of existing public and community water systems. This is an iterative exercise that will need to consider funding limitations per connection in parallel with the factors mentioned above. Refining a service area will result in more realistic demand estimations and therefore, source capacity and storage required. Once a service area is established, a more focused inventory of available sources can be determined as well as a poll of those in the service area agreeable to consolidation and connection into a centralized CWS.
2. *Surface Water Diversion Studies.* Surface water diversion studies are recommended on Slaughterhouse Gulch, Jack Peters Gulch and Russian Gulch. These studies should include; installation of stream gauges to obtain flow data over several wet and dry season periods, investigation and initial consultation with jurisdictional agencies to understand permitting requirements and establish relationships. Jurisdictional agencies include, but are not limited to, State Parks, Mendocino County, Caltrans, California Department of Fish & Wildlife (CDFW), Army Corps of Engineers, and the California Coastal Commission. Studies should include cost estimates associated with conceptual designs. Conceptual design considerations should include, but are not limited to, environmental studies related to possible infrastructure installation such as; points of diversion or intake structures, raw water storage structures, pump stations, and pipeline alignments. Studies should include constructability considerations as well as property analyses.
3. *Reservoir Siting Study.* Completion of a detailed study and siting analysis for a water storage reservoir(s) is recommended. The most likely viable location for a reservoir large enough to serve a centralized CWS will be upgradient off Little Lake Road and outside of the Coastal Zone. Using current demand estimations for the entire study area, a reservoir approximately 400 acre-feet is needed. Collaboration with large landowners such as State Parks, logging companies or other private landowners will be crucial, as there could be opportunity for a land agreement, purchase, or lease where reservoir water is a shared benefit, or otherwise. Early consultation with CDFW should occur to inform maps with regards to previously mapped environmentally sensitive habitat areas which will provide insight into reservoir location siting.
4. *Stormwater Collection System Mapping.* The existing County owned and operated stormwater collection system within town should be located and surveyed. Outfalls should be identified and surveyed, the collection

system contributing watershed should be delineated and hydrographs developed to understand the potential for stormwater capture and storage near outfalls. If promising, environmental studies should occur to consider stormwater capture and storage impacts on environmentally sensitive habitat areas.

5. *Update the MCCSD Groundwater Model.* The existing Todd Groundwater Model should be updated to include previously mapped higher elevation marine terraces with the objective of potentially developing new wellfields for source water augmentation. Since MCCSD already has an existing numerical groundwater model, with boundaries defined as the District service area limits, the model can be updated to include groundwater data collected from areas higher in elevation (northeast, east, and southeast) outside the current service area. Marine terrace mapping as indicated in this report (Figure 16) shows a promising aerial extent of potentially suitable shallow aquifer materials capable of limited groundwater storage.

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