



Local Wastewater Treatment and Disposal Alternatives Technical Memorandum #4

Paradise Sewer Project

November 11, 2020



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1. Introduction

The Town of Paradise (Town) is implementing the Paradise Sewer Project (Project), which involves identifying and implementing a long-term solution for collection, treatment, and reuse/disposal of its wastewater. HDR is under contract to assist the Town with the first two phases of the Project—final selection of a wastewater alternative (Phase 1), and preparation of an Environmental Impact Report (EIR) covering the selected alternative (Phase 2). This technical memorandum (TM) is part of the Phase 1 effort.

The purpose of this TM #4 is to develop and evaluate local wastewater treatment and disposal alternatives for the Town. These alternatives were developed based on design criteria established in TM #2 – Design Criteria for Local Wastewater Treatment Plant. The feasible local wastewater treatment and disposal alternatives were evaluated and compared based on economic and non-economic factors. Local alternative(s) recommended in this TM #4 will be compared to the regional alternative, which involves conveying raw sewage to the City of Chico for treatment and disposal.

This TM is organized as follows:

- Section 1: Introduction
- Section 2: Background
- Section 3: Development of Local Alternatives
- Section 4: Evaluation of Local Alternatives
- Section 5: Recommendation

Supporting information for this TM is provided in the following appendices:

- Appendix A: Environmental Constraints Analysis
- Appendix B: Process Equipment Information
- Appendix C: Recycled Water Criteria
- Appendix D: OMB Circular
- Appendix E: Cost Estimates

2. Background

Prior to the Camp Fire, Paradise was the largest unsewered community in California. A new wastewater management solution is needed to improve the local economy (e.g., encourage opening of new businesses) and to stop degradation of groundwater quality caused by failed or failing septic systems.

The need for a centralized wastewater treatment solution for the Town has been studied in seven prior reports. The most recent study was prepared by Bennett Engineering in June 2017, *Town of Paradise Sewer Project, Alternative Analysis and Feasibility Report: Determining a Preferred Option for Implementation* (2017 Report). Figure 1 presents the proposed sewer service area (SSA) identified in the 2017 Report; the Town has directed that this be the proposed SSA for this effort. A new collection system will be constructed in the proposed SSA to convey wastewater collected in the

area to a new local wastewater treatment plant (WWTP) or to the City of Chico Water Pollution Control Plant (WPCP). Based on the 2017 Report, the proposed SSA was defined to represent the area that had the most septic systems that had failed or were projected to fail within the next 5 years. The proposed SSA will serve 1,469 parcels through the Skyway, Clark Road, and Pearson Road corridors. (There are 11,000 total parcels in Paradise.) The 2017 Report analyzed the following five WWTP options:

- Option A: Localized WWTP with Effluent Land Application
- Option B: Localized WWTP with Surface Water Discharge Location
- Option C: Regional Connection to the City of Chico Water Pollution Control Plant
- Option D: Wastewater Treatment with Beneficial Reuse
- Option E: No Project

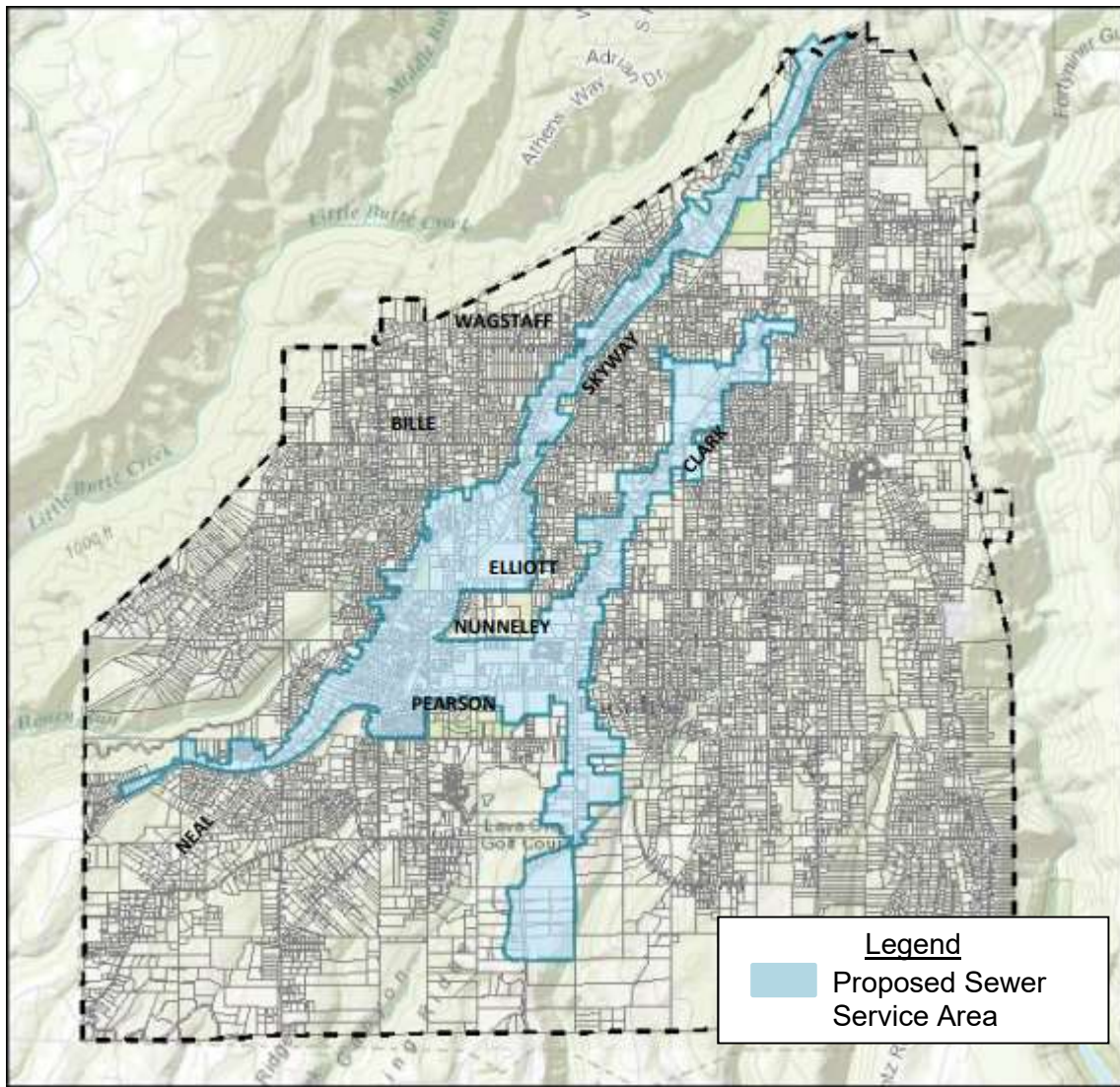


Figure 1. Proposed Town of Paradise Sewer Service Area

The 2017 Report also analyzed two sewer collection system options: a gravity sewer and a septic tank effluent pumping (STEP) system.



For the WWTP, the 2017 Report recommended Option C: Regional Connection to the City of Chico Water Pollution Control Plant. For the collection system, the 2017 Report recommended the STEP system.

Following the devastation caused by the November 2018 Camp Fire, the Town reconsidered the recommendations from the 2017 Report. In May 2019, the Town Council voted to pursue a localized wastewater treatment alternative for the following reasons:

- More funding opportunities became available since the 2017 Report was issued.
- More land became available to locate a local WWTP due to the devastation caused by the Camp Fire.
- The Town would have more control over future decisions related to wastewater management.

The type of collection system was also reconsidered. The 2017 Report recommended a STEP system, but the Town recently determined that a conventional gravity sewer system is the preferred collection system alternative. A gravity sewer was preferred because it eliminated continued use of the septic tanks and installation of new individual pumps that each parcel owner would need to maintain. The collection system was analyzed for this current effort in TM #3 – Evaluation of collection System.

3. Development of Alternatives

The local wastewater effluent disposal alternatives identified in TM #2 and an additional alternative involving discharge to the Miocene Canal are being further developed in this TM. These alternatives are as follows:

- Alternative 1: Local WWTP with Effluent Storage and Land Application
- Alternative 2: Local WWTP with a Surface Water Discharge
- Alternative 3: Local WWTP with Water Recycling within the Town
- Alternative 4: Local WWTP with Discharge to the Miocene Canal

TM #2 provided an overview of regulatory requirements and established design criteria and the basis of design for a new WWTP that will be owned and operated by the Town. The anticipated WWTP discharge requirements are provided in Table 1.

Table 1. Anticipated Discharge Requirements for Local WWTP Alternatives

Disposal Method	Basic Discharge Requirements (monthly average)			Level of Treatment
	BOD, mg/L	TSS, mg/L	Total N, mg/L	
1. Local WWTP with Effluent Storage and Land Application	30	30	10	Disinfected (23 MPN) secondary treatment meeting Total N of 10 mg/L.

Disposal Method	Basic Discharge Requirements (monthly average)			Level of Treatment
	BOD, mg/L	TSS, mg/L	Total N, mg/L	
2. Local WWTP with a Surface Water Discharge	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L. Additional stringent discharge requirements are likely, such as meeting priority pollutant (chemical pollutants the US Environmental Protection Agency regulates) criteria as well as the California Thermal Plan (limits wastewater increasing receiving water temperature).
3. Local WWTP with Water Recycling within the Town	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L.
4. Local WWTP with Discharge to the Miocene Canal	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L. Additional advanced treatment requirements must be met, including, as a minimum, processes to meet indirect potable reuse requirements such as ultrafiltration along with reverse osmosis.

BOD = biochemical oxygen demand; MPN = most probable number; N = nitrogen; TSS = total suspended solids

The recommended influent flows and loads for a proposed new local WWTP and separate septage treatment facility are presented in Table 2.

Table 2. Recommended Design Criteria for Local WWTP and Septage Facilities

Flow Type	Flow to WWTP, mgd		Flow to Septage Treatment, mgd	
Average Dry Weather Flow	0.448		0.026	
Peak Diurnal Flow	0.672		--	
Peak Wet Weather Flow	0.896		--	
Constituent	Annual Average Constituent Load, lbs/day	Maximum Month Constituent Load, lbs/day (1)	Concentration, mg/L	Annual Average Constituent Load, lbs/day (2)
Biochemical Oxygen Demand (BOD)	1,310	1,700	10,000	2,170
Total Suspended Solids (TSS)	1,500	1,950	40,000	8,675
Ammonia as Nitrogen	170	220	NA	NA
Total Kjeldahl Nitrogen (TKN)	NA	NA	700	152

(1) Based on flow of 0.448 mgd and peaking factor of 1.3

(2) Based on flow of 0.026 mgd

NA = not applicable

3.1 Alternative 1: Local WWTP with Effluent Storage and Land Application

Alternative 1 includes a local WWTP with effluent storage and land application. For land application, effluent from the WWTP must meet secondary treatment requirements and a total nitrogen concentration of 10 mg/L to ensure that no degradation of groundwater occurs. A conceptual schematic for secondary treatment is shown in Figure 2. For Alternative 1, treatment by means of a

package treatment plant manufactured by Aero-Mod was used. Information on the package secondary treatment process by Aero-Mod is provided in Appendix B, Attachment 1.

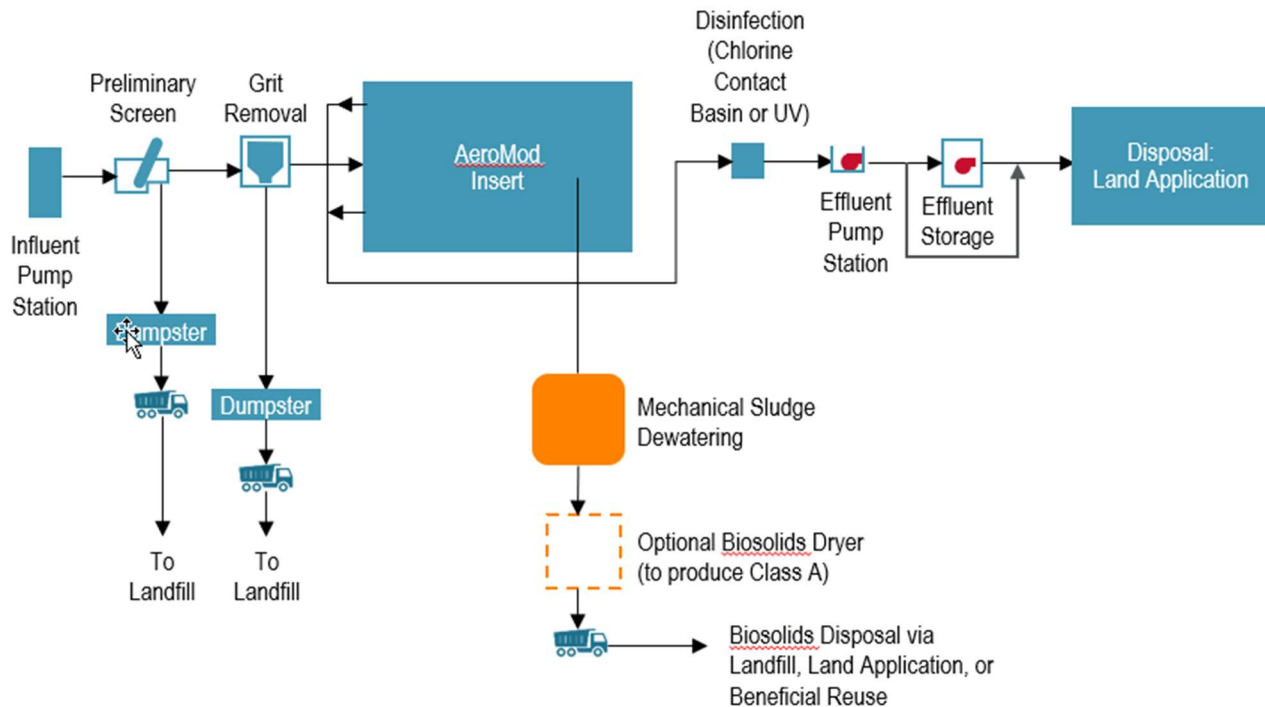


Figure 2. Conceptual Schematic for Secondary Treatment for Alternative 1

To determine the land requirements for effluent storage and disposal, a water balance was prepared. The following assumptions were used to develop the water balance:

- Storage of treated effluent would be required for 151 days per year when application of the effluent is not feasible because of rain or saturated soils. This is based on no irrigation for the months of December through March and for 15 days in April and November.
- The annual average rainfall is 55 inches.
- The 100-year return interval seasonal rainfall is 100 inches as reported by the Western Regional Climate Center for Paradise (046685) for 1957 through 2006.
- Pan evaporation is 67.63 inches annually as reported monthly by the Western Regional Climate Center for Chico Experiment Station for 1906 through 2005.
- Evapotranspiration is 49.9 inches annually as reported monthly in “Butte County Water Inventory and Analysis,” June 2016, Climate and Hydrology Document, Chapter 4, Figure 4.7, Durhan CIMIS (Station 12).

The water balance for the 100-year seasonal rainfall is presented in Table 3.



Table 3. Hydrologic Water Balance at 0.448 mgd Wastewater Flow and Estimated 100-year Precipitation

Parameter	Units	October	November	December	January	February	March	April	May	June	July	August	September
Days/Month		31	30	31	31	28	31	30	31	30	31	31	30
Pond Storage	days	151	151	151	151	151	151	151	151	151	151	151	151
Pond Volume	acre-ft	208	208	208	208	208	208	208	208	208	208	208	208
Pond Volume	MG	68	68	68	68	68	68	68	68	68	68	68	68
Pond Depth	feet	4	4	4	4	4	4	4	4	4	4	4	4
Pond Surface Area	acres	52	52	52	52	52	52	52	52	52	52	52	52
Land Disposal Area	acres	260	260	260	260	260	260	260	260	260	260	260	260
Precipitation	in	5.56	13.11	17.46	19.45	16.03	14.59	7.15	3.31	1.24	0.14	0.47	1.53
Pan Evaporation	in	4.46	2.09	1.3	1.26	2.13	3.82	5.63	8.28	10.11	11.48	9.71	7.36
Pond Evaporation	in	3.57	1.67	1.04	1.01	1.70	3.06	4.50	6.62	8.09	9.18	7.77	5.89
Evapo/Trans.	in	3.50	1.80	1.20	1.20	2.00	3.20	4.80	6.40	7.20	7.30	6.30	5.00
Net Evapotranspiration	in	-2.06	-11.31	-16.26	-18.25	-14.03	-11.39	-2.35	3.09	5.96	7.16	5.83	3.47
Net Evaporation	in	-1.99	-11.44	-16.42	-18.44	-14.33	-11.53	-2.65	3.31	6.85	9.04	7.30	4.36
Average Daily Flow	mgd	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Total Monthly Flow	MG	13.89	13.44	13.888	13.888	12.544	13.89	13.44	13.89	13.44	13.89	13.89	13.44
Monthly Flow	acre-feet	42.62	41.25	42.62	42.62	38.50	42.62	41.25	42.62	41.25	42.62	42.62	41.25
Net Evapotranspiration (land only)	acre-feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.95	129.13	155.13	126.32	75.18
Net Evaporation (ponds only)	acre-feet	-8.62	-49.47	-71.02	-79.77	-61.97	-49.89	-11.44	14.33	29.62	39.12	31.57	18.85
Allowable Crop Irrigation Rate	ac-ft/ac/yr	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
% of Days Land Application Occurs	%	100.00	50.00	0.00	0.00	0.00	0.00	50.00	100.00	100.00	100.00	100.00	100.00
Percolation Volume (land only)	acre-feet	88.33	42.74	0.00	0.00	0.00	0.00	42.74	88.33	85.48	88.33	88.33	85.48
Flow to Storage	acre-feet	-37.09	47.98	113.65	122.39	100.46	92.51	9.95	-126.99	-202.98	-239.96	-203.59	-138.26
Accumulative Flow to Storage ^a	acre-feet	0.00	47.98	161.63	284.02	384.49	477.00	486.95	359.96	156.98	-82.98	-286.57	-424.83

^a Assumes start of October ponds are empty.

Land requirements for storage and disposal generated from the water balance, and land needed for the WWTP, are noted in Table 4. The areas include the “active” area occupied by operating facilities and additional acreage around the operating facilities to help isolate them from adjacent neighbors (buffer).

Table 4. Land Requirements for Local Alternatives

Description	Active Acres	Total Acres with Buffer
Treatment Plant		
Secondary or Tertiary Treatment	4	5
Tertiary with Advanced Treatment	6	7
Effluent Storage	122	150
Land Application	260	310

Potential locations for the WWTP and land for effluent storage and land application are shown in Figure 3. The WWTP locations were chosen based on the following criteria:

- Relatively close to the Town limits, to minimize conveyance distance.
- Near a facility that is less desirable for development and more suitable for locating a WWTP (e.g., the Neal Road Recycling and Waste Facility).
- Currently available vacant parcels of the size needed for the WWTP and adjacent to Neal Road or Clark Road. Skyway was not included, as an industrial facility such as a WWTP was not considered compatible with the current and future uses of Skyway.

On Figure 3, the potential WWTP locations shown indicate general locations, not specific parcels or land requirements. The potential WWTP locations are generally as follows:

- Neal Road just south of the Town limits
- Neal Road near the Neal Road Recycling and Waste Facility
- Clark Road just south of the Town limits
- Clark Road near the Paradise Airport

The area within which effluent storage and land application could occur is shown in Figure 3. This blue-hatched area was defined based on the following criteria:

- The land topography must be flat enough to allow for piped spray irrigation. As you move south off of the ridge from Paradise, you encounter marginal grazing land that is hilly but could be irrigated (although almost none of it is at this time). This defines the undulating northern boundary of the area shown.

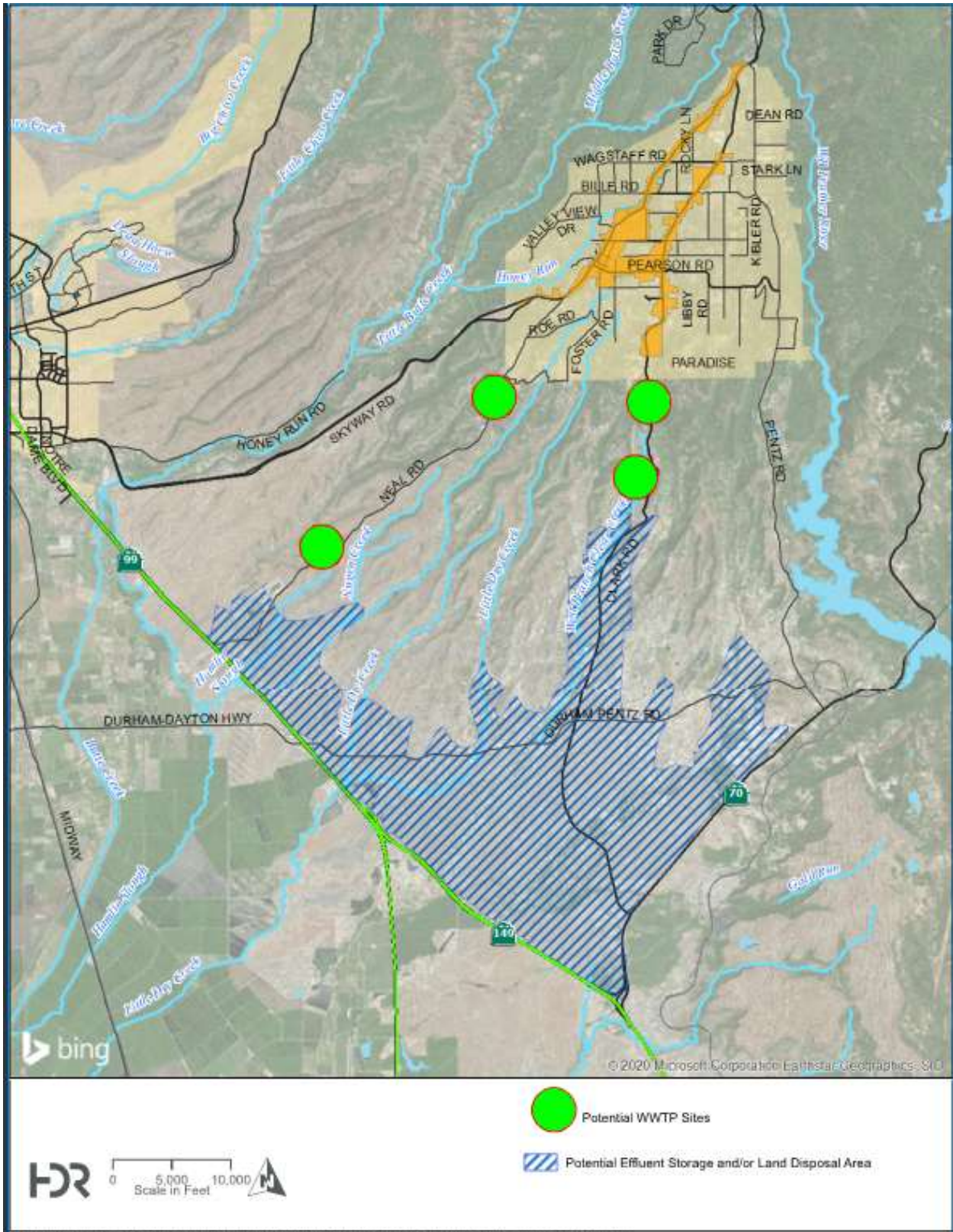


Figure 3. WWT Sites and Land for Effluent Storage and Land Application for Alternative 1

- As you continue to move south and west, the topography becomes flatter, until land use changes from marginal grazing land to high end agriculture (e.g., rice farming) at roughly Highway 99/149). Based on discussions with the Butte County Farm Bureau, it was determined that this high-end farming area has sufficient low-cost water available. It was also felt that farmers here might have concerns with using recycled water on their higher-end crops. Therefore, these high-end ag areas were not considered good candidates for land application, and Highway 99/149 was considered the western border of the potential land application area.
- Highway 70 was used as the southeast boundary, as topography east of there becomes quite steep again.

The blue-hatched area shown as potential storage and land application area in Figure 3 covers 16,020 acres. The total area needed for a Paradise land application system is 460 acres (150 acres for effluent storage and 310 acres for land application), or 2.9 percent of the 16,020 acres. A significant portion of the 16,020 acres may not be useable, due to environmental habitat restrictions (e.g., vernal pools), landowners unwilling to participate, or other reasons. However, it is felt that it would ultimately be feasible to obtain 460 usable acres within this 16,020-acre area.

Components needed to implement Alternative 1 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land, purchased by the Town, for construction of the WWTP
- Pipeline from WWTP to effluent storage facility
- Land, purchased by the Town, for construction of effluent storage facility
- Pipeline from effluent storage facility to land application area
- Land, either purchased by the Town or used through written agreements developed between the Town and landowners, for land application of treated effluent as irrigation

3.2 Alternative 2: Local WWTP with Surface Water Discharge

Alternative 2 includes a local WWTP, located on Neal Road, with discharge of treated effluent to a local surface water. Surface water discharge to Nugen Creek or Hamlin Slough, both ephemeral streams, was used for this alternative. (An ephemeral stream is a stream that flows only briefly during and following a period of rainfall in the immediate locality.) Figure 4 shows the location of Nugen Creek and Hamlin Slough; an exact location for the discharge into the creek or slough has not been identified at this time.

A surface water discharge would require the WWTP to produce disinfected (most probable number of coliform bacteria of 2.2) tertiary treated effluent meeting a total nitrogen concentration of 10 mg/L. Additional stringent discharge requirements are likely, such as meeting priority pollutant criteria (chemical pollutants the US Environmental Protection Agency regulates) as well as the California Thermal Plan (limits wastewater from increasing receiving water temperature).

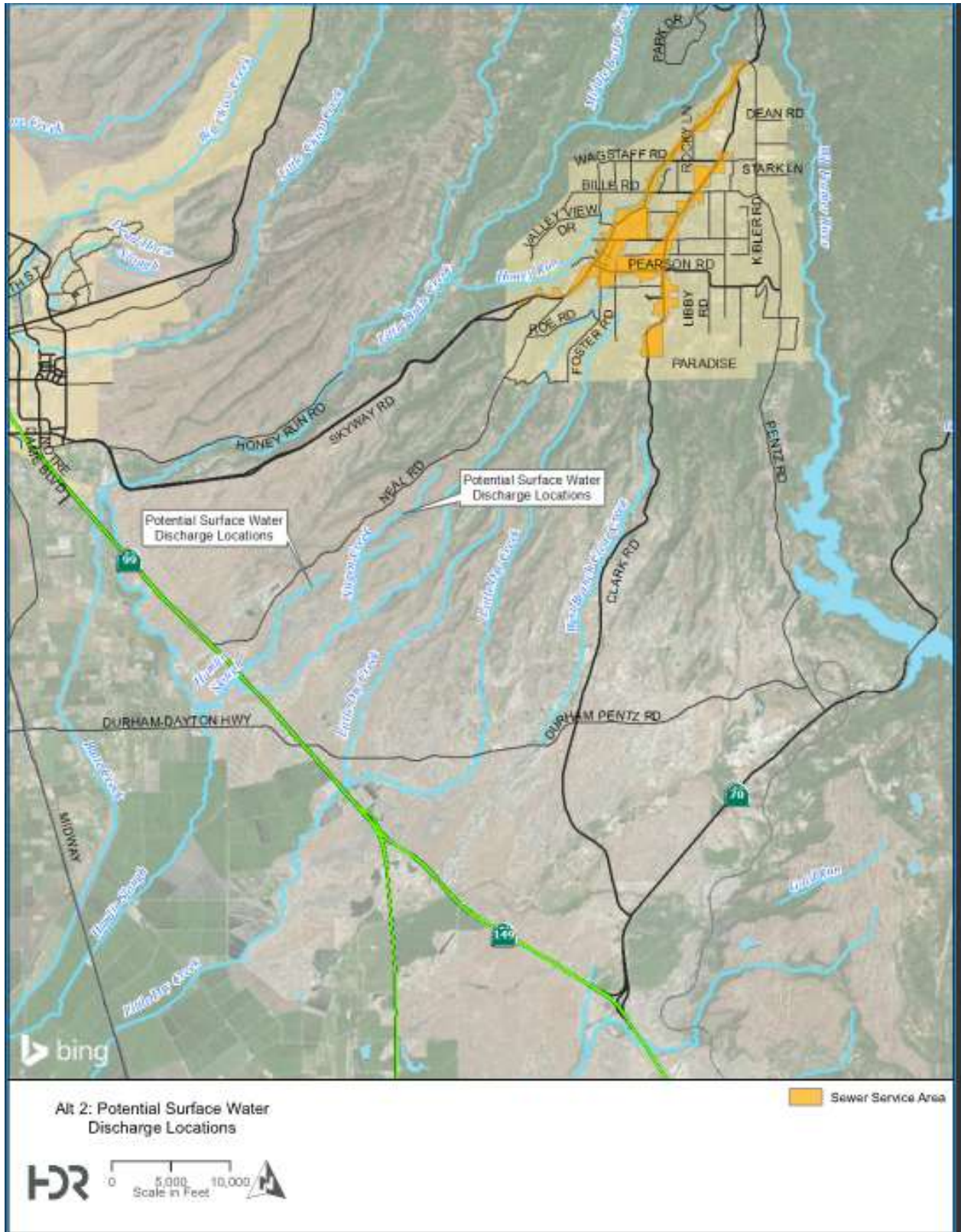


Figure 4. Location of Nugen Creek and Hamlin Slough

A conceptual schematic for tertiary treatment is shown in Figure 5. For Alternative 2, treatment by means of a membrane bioreactor was used. Information on a membrane bioreactor process by Suez is provided in Appendix B, Attachment 2.

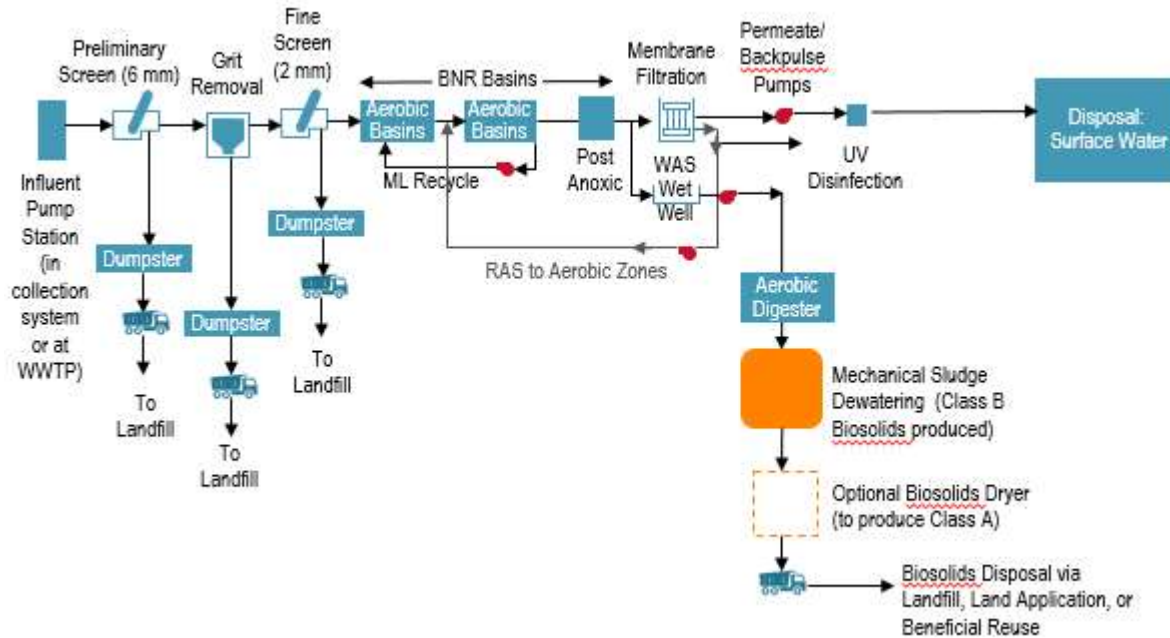


Figure 5. Conceptual Schematic for Tertiary Treatment under Alternative 2

Components needed to implement Alternative 2 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land for WWTP
- Pipeline from WWTP to Nugen Creek or Hamlin Slough outfall
- Outfall structure into Nugen Creek or Hamlin Slough

The Central Valley Regional Water Quality Control Board (Regional Board) staff, in recent meetings and calls, has indicated that it does not support a local surface water discharge and that it will be difficult to permit. If a permit is issued, it is anticipated to be very onerous.

3.3 Alternative 3: Local WWTP with Water Recycling

Alternative 3 includes a local WWTP with beneficial reuse of recycled water within the Town. Currently, there are no designated users for recycled water. As the Town rebuilds following the 2018 Camp Fire, potential users may be identified. To not limit the type of potential users in the future, it is recommended that recycled water meet unrestricted reuse requirements of Title 22, which requires a tertiary treated effluent meeting filtration and disinfection criteria presented in the State Water Resources Control Board Order WQ 2016-0068-DDW, Water Reclamation Requirements for Recycled Water Use.

A summary of uses for recycled water for various levels of treatment is provided in Appendix C. A conceptual schematic for tertiary treatment for unrestricted reuse is shown in Figure 6.

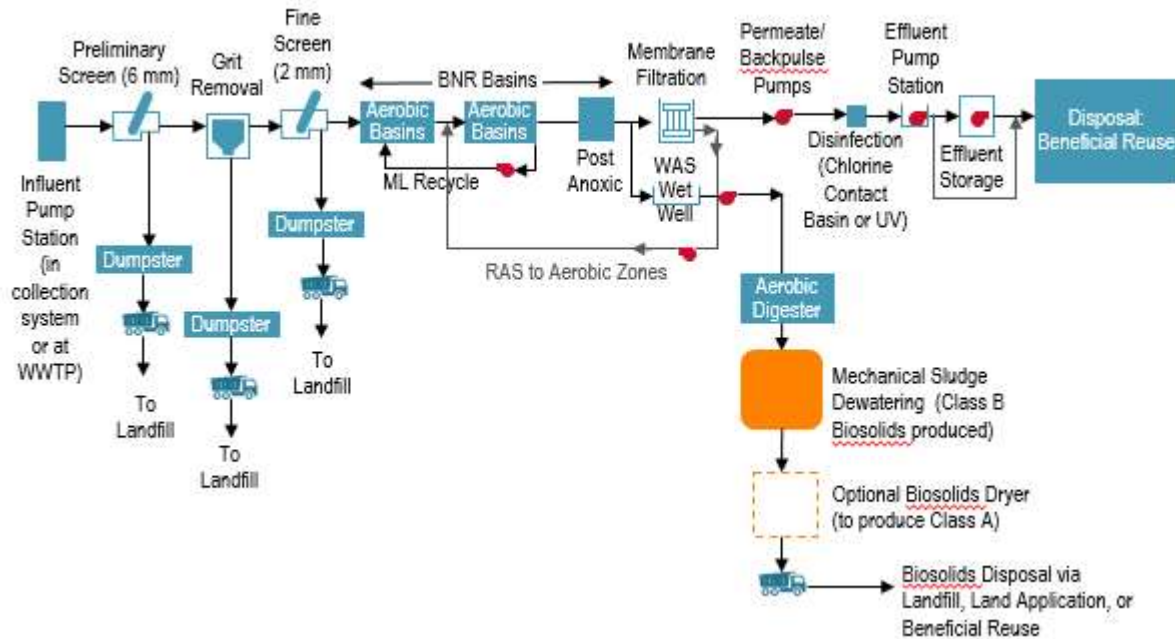
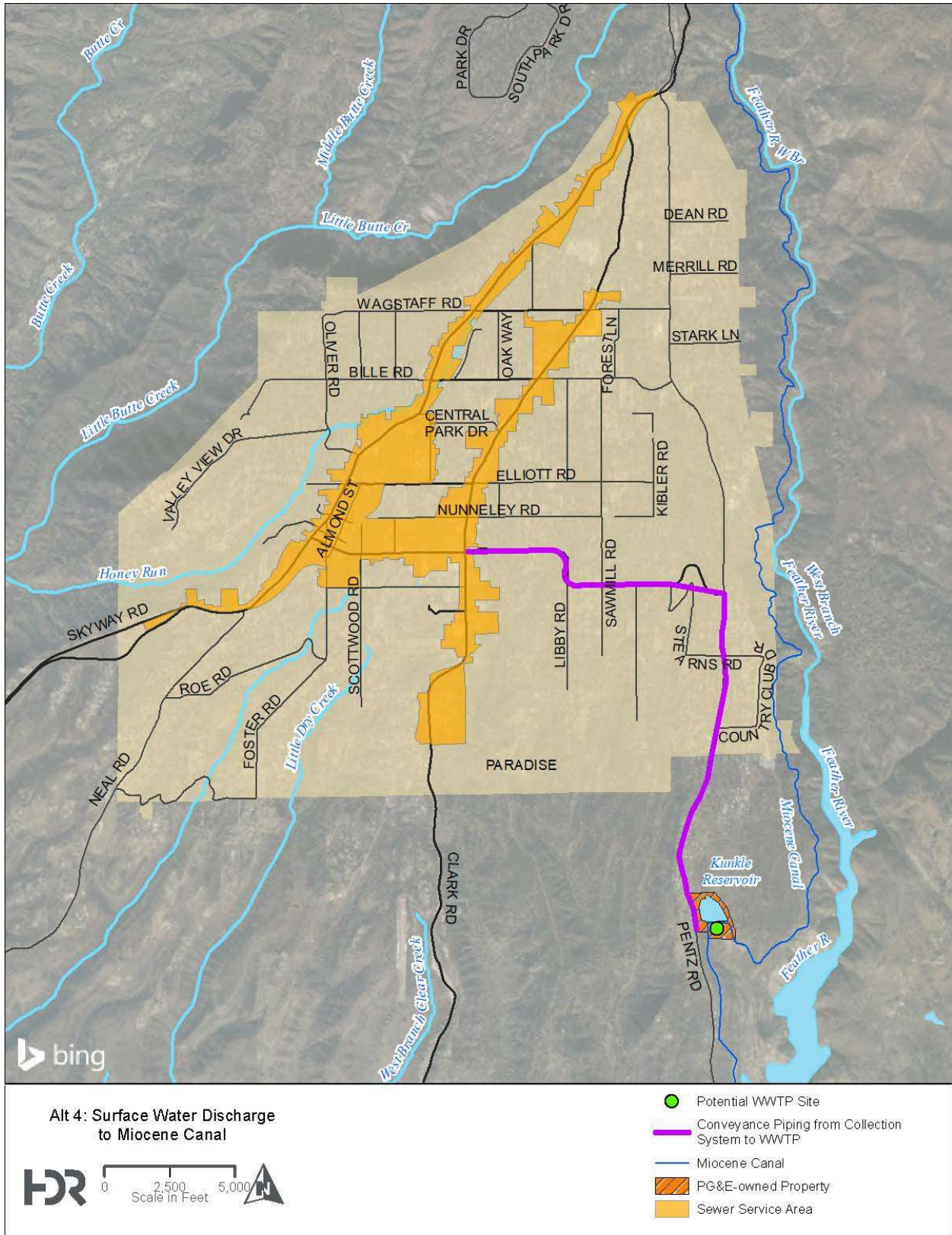


Figure 6. Conceptual Schematic for Tertiary Treatment for Unrestricted Reuse for Alternative 3

3.4 Alternative 4: Local WWTP with Discharge to the Miocene Canal

Alternative 4 includes a local WWTP with discharge to the Miocene Canal. The Miocene Canal begins north of the Town, runs along its eastern edge, and ultimately terminates near the city of Oroville. Just south of the Town, the canal empties into Kunkle Reservoir, and then continues out of Kunkle Reservoir in a pipe and later an open canal. Figure 7 shows the location of the Miocene Canal in the vicinity of the Town.

The Miocene Canal has been owned and operated by Pacific Gas and Electric Company (PG&E) since 1917. Prior to the 2018 Camp Fire, the Miocene Canal ran from a diversion on the West Branch of the Feather River to a small reservoir near Lake Oroville. Flows in the canal were about 50 cubic feet per second (cfs) through most of the year except between August and November, when flows were reduced to 30 cfs. The canal's upper reach runs from the diversion to Kunkle Reservoir and was completely destroyed in the 2018 Camp Fire. The canal's lower reach runs from Kunkle Reservoir to a small reservoir near Lake Oroville and is still intact. Water in the Miocene Canal is owned by PG&E and is sold to small diverters along the canal; diversions occur at various locations in the middle and lower reaches to irrigate orchards and for other land uses. Irrigation tailwater flows into a number of creeks in the area. In the past, water from the Miocene Canal was also used to supplement municipal supplies in Oroville, California.



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Figure 7. The Miocene Canal Alternative

PG&E estimates that there are about 18 water users along the middle and lower reaches of the Miocene Canal who pay PG&E for canal water under 60- to 70-year-old agreements. The agreements do not obligate PG&E to provide water. Instead, the agreements read that, if and when there is water in the canal, then people can take water out (and pay for it).

The only known feed into or out of the Kunkle Reservoir is the Miocene Canal. As the canal leaves the reservoir, it is in a pipe that serves as a penstock for the downstream Lime Saddle Powerhouse. The reservoir has remained full for the past several years, even after the Camp Fire destroyed the upper reach of the Miocene Canal. The exact source of the water filling Kunkle Reservoir is unknown, but it is believed that there are underground springs of some sort feeding water into the reservoir.

At the lower end of the Miocene Canal is a terminal reservoir, which is owned by the California Water Service Company (CalWater). It has been observed that, while the Miocene Canal has been completely dry for the past two years, the terminal reservoir has remained full, indicating that there is some other source of feed water into the reservoir. The source of this water is unknown.

The 2018 Camp Fire destroyed major portions of the Miocene Canal. Recently, PG&E has agreed to fund efforts to restore access to water for the next 5 years for residents impacted by the loss of the Miocene Canal. PG&E has indicated that it will not be restoring the upper reaches of the Miocene Canal, but as part of the recent settlement, PG&E has proposed to supply the canal with 10 cfs of water for 5 years. PG&E has proposed to pump water from a barge located at the Lake Oroville Marina, just south of the Lime Saddle Recreation Area, to discharge into the Miocene Canal approximately 0.5 miles due west of that location. At the end of the 5 years, PG&E intends to discontinue feeding water into the canal, and will look to a new entity to take over the pumping of the water.

The concept for Alternative 4 is to discharge 0.7 cfs (448,000 gallons per day) of treated wastewater either into Kunkle Reservoir or directly into the Miocene Canal at that location, where it will eventually mix with the 10 cfs of surface water from Lake Oroville that will be pumped by PG&E into the canal. For the development and evaluation of alternatives, the concept of direct discharge into the Miocene Canal was used.

For Alternative 4, the WWTP is envisioned to be located on property currently owned by PG&E, in an area south of Kunkle Reservoir, as shown in Figure 8.

The water conveyed in the Miocene Canal is used for many agricultural and municipal purposes. Because of these uses, it has been assumed that the Regional Board will require the treated effluent to meet indirect potable reuse (IPR) requirements. This means that, following membrane filtration, additional advanced water treatment processes would be necessary.



Figure 8. Land Available at Kunkle Reservoir to Site WWTP for Alternative 4

The advanced water treatment processes used are ultra-filtration (UF), reverse osmosis (RO), advanced oxidation (AOP), and ultraviolet (UV) disinfection. As part of the reverse osmosis process, a brine reject flow would be produced that would require disposal. The amount of brine reject flow would be approximately 20 percent of the total influent flow (448,000 gallons per day), which would equate to 89,600 gallons per day. Brine disposal could be accomplished by using evaporation ponds or trucking it away. Because of the high precipitation and low evaporation rate in the Paradise area, evaporation ponds would not be suitable and that the brine would need to be trucked away. To reduce the amount of brine to be trucked away, an additional process called vibratory, shear-enhanced processing (VSEP) would be needed. With VSEP, the amount of brine that would be trucked would be reduced by 75 percent to 22,400 gallons per day, or about 5 truckloads per day. One facility that has, in the past, taken brine and mixed it into the effluent prior to disposal is a WWTP in Oakland, California. For purposes of this TM, trucking brine to this Oakland WWTP was used.

A conceptual schematic for tertiary treatment followed by advanced water treatment for discharge into the Miocene Canal is shown in Figure 9.

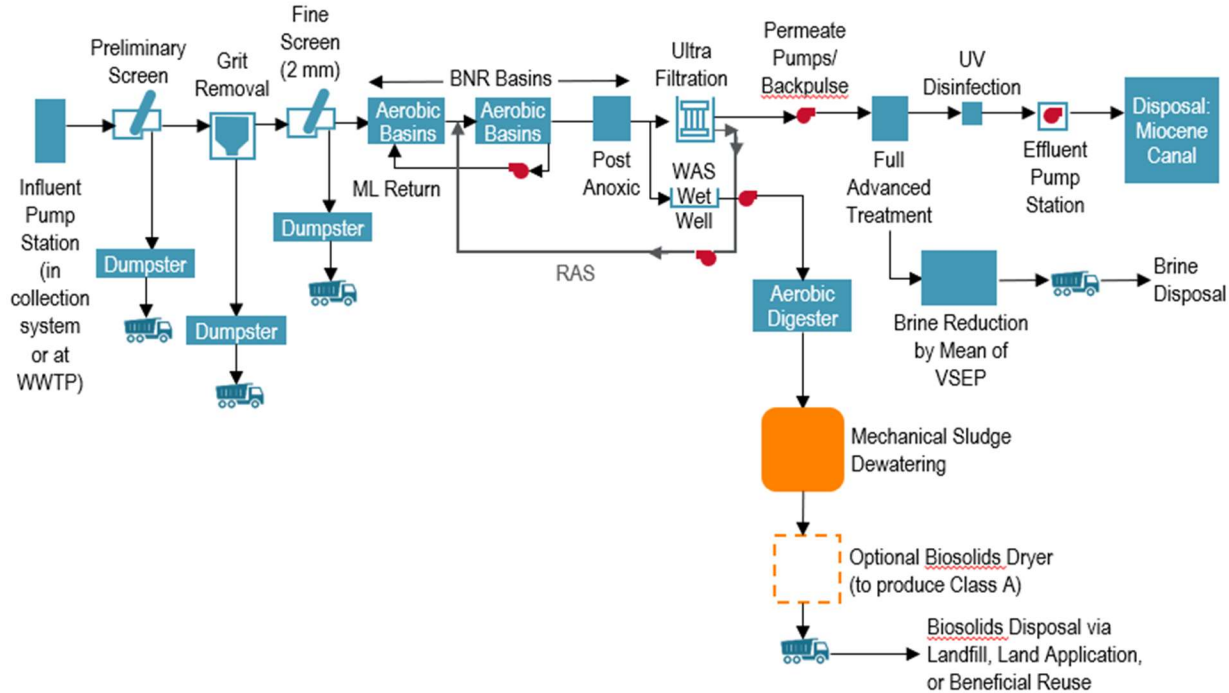


Figure 9. Advanced Treatment Schematic for Alternative 4

Components needed to implement Alternative 4 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land for WWTP at Kunkle Reservoir
- Pipeline from WWTP to Kunkle Reservoir or Miocene Canal
- Outfall structure into Kunkle Reservoir or Miocene Canal

3.5 Biosolids Management

Biosolids are a product of the wastewater treatment process. During wastewater treatment, liquids are separated from the solids. Those solids are then treated physically and chemically to produce a semisolid, nutrient-rich product known as Biosolids.

TM #2 reviewed the regulations regarding the end use and disposal of Biosolids and the classification of Biosolids. The information provided in TM #2 is summarized as follows:

- **End Use/Disposal.** It was noted that in California, smaller wastewater agencies typically dispose of Biosolids onto land or convey it to a landfill for use as alternative daily cover. However, Biosolids management has recently become increasingly challenging and complex, especially for smaller agencies. These challenges are due to California regulations mandating reductions in greenhouse gas emissions as well as emerging contaminants.
- **Classification of Biosolids.** Biosolids are designated as either Class A or Class B based on their treatment methods. Each class has specified treatment requirements for pollutants, pathogen and vector attraction reduction, and general requirements and management practices. Because of concerns over pathogens, odors, and future regulations, there is a distinct shift away from Class B use and toward Class A treatment solutions. To provide flexibility in Biosolids disposal, TM #2 recommended that Biosolids generated from a proposed local WWTP for the Town meet Class A criteria.

Since completion of TM #2, discussions with the City of Chico and Synagro, a Biosolids management firm, have occurred. The City of Chico produces Class B Biosolids and contracts with Synagro for year-round disposal of its Biosolids on land. During these discussions, Synagro indicated that the Town of Paradise could enter into a similar contract. Based on this information, it is now recommended that any local WWTP alternative produce Class B Biosolids and contract with Synagro for disposal.

3.6 Septage Handling

The proposed Project will serve 1,469 parcels out of the approximately 11,000 parcels in the Town. The parcels not served by the proposed Project would remain on septic tanks. It is possible to incorporate septage handling facilities into a local WWTP.

A conceptual schematic for septage handling is shown in Figure 10. The process shown in Figure 10 can be implemented only if a local WWTP is constructed as decant and sludge from the aerobic digester would be conveyed to the WWTP for further treatment.

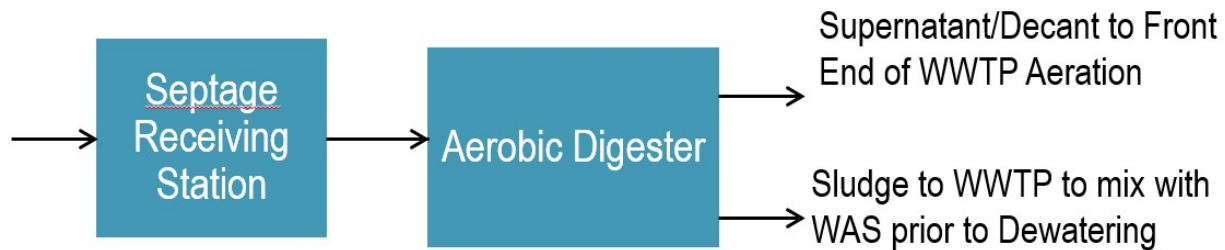


Figure 10. Process Flow Schematic for Septage Treatment

4. Evaluation of Alternatives

In this section, potentially feasible local wastewater and disposal alternatives developed in this TM are first screened based on whether they are deemed feasible or not. The alternatives that passed this screening were then evaluated based on economic and non-economic criteria to determine the highest ranked alternative(s). These local alternatives will be compared to a regional alternative, where raw sewage would be conveyed to the City of Chico for treatment and disposal, in TM #6 – Comparison of Local and Regional Alternatives.

4.1 Screening of Alternatives

The four alternatives were screened as follows:

- Alternative 1: Local WWTP with Effluent Storage and Land Application
 - This alternative was deemed feasible and carried forward. With no surface water discharge, it should be easier to permit with the Regional Board.
- Alternative 2: Local WWTP with a Surface Water Discharge
 - This alternative was deemed not feasible due to lack of support by the Regional Board for issuing a surface water discharge permit, and the potential for a very onerous discharge permit if one was issued.
- Alternative 3: Local WWTP with Water Recycling within the Town
 - This alternative was deemed not feasible at this time due to a lack of recycled water users in the area. It should be noted that the two local alternatives carried forward for consideration contain a sufficient level of treatment such that water recycling could still be implemented in the future, should sufficient recycled water uses develop.

- Alternative 4: Local WWTP with Discharge to the Miocene Canal
 - This alternative was deemed feasible and carried forward. While technically a surface water discharge, the Miocene Canal is an existing, constructed facility with agricultural users, and it was felt the Regional Board could support permitting it.

4.2 Economic Comparison

The construction costs and operations and maintenance (O&M) costs of Alternatives 1 and 4 were then estimated based on the following assumptions:

- Opinions of Probable Construction Costs (cost estimates) were prepared for both alternatives. The estimates are considered to be Class 4, associated with a 1 to 15 percent level of project definition. When needed, the 20-Cities Average version of the Engineering News-Record Construction Cost Index (ENR CCI) was used to update costs.
- Alternative 1 includes the following for treatment and disposal:
 - Tertiary treatment: though secondary treatment is all that is needed to implement Alternative 1, tertiary treatment provides the Town flexibility to implement water recycling in the future.
 - Chlorine disinfection
 - Class B Biosolids produced
 - No land for effluent disposal will be purchased. Instead, agreements would be sought with local farmers to use treated effluent for agricultural irrigation.
- Alternative 4 includes the following for treatment and disposal:
 - Tertiary treatment followed by advanced treatment (ultra-filtration, reverse osmosis, advanced oxidation, and UV disinfection). Construction and O&M costs for advanced treatment processes were developed based on a report titled, "Recycled Water Feasibility Study for Oro Loma Sanitary District," prepared by RMC Water and Environment with support from HDR Engineering, dated March 2016.
 - Brine produced by the reverse osmosis process will be reduced in quantity by the vibratory shear enhanced processing (VSEP) process with remaining brine trucked to a WWTP in Oakland, California, for disposal. Construction and O&M costs for VSEP treatment of the brine were developed based on a Technical Memorandum titled, "DVI Brine Concentrator System Replacement Project," for the Deuel Vocational Institution in Tracy, California, prepared by Kjeldsen Sinnock and Neudeck, dated August 2018.
 - Brine hauling at \$0.32 per gallon
 - Class B Biosolids produced

- Equipment costs were obtained from equipment manufacturers or their respective representatives.
- Costs for Class B biosolids were obtained from John Pugliaresi of Synagro.
- A 20-Cities Average ENR CCI of 11439 (July 2020) is the basis of the cost estimates.
- Construction costs include a 30% percent contingency for undefined scope items to account for the level of accuracy at this phase of the project and a 10% construction contingency to be held in reserve for changes during construction.
- To calculate a capital cost, the following implementation cost factors were used (numbers are percentages of the construction cost):
 - Project Administration 2
 - Legal and Finance Council 1
 - Planning 3
 - Design 13
 - Environmental Documentation/Permitting 3
 - Right-of-Way Acquisition 3
 - Construction Management 8
 - Engineering Services During Construction 4
 - Environmental Monitoring/Regulatory Compliance 3
 - Environmental Mitigation 6
- The cost of electrical power is assumed at \$0.1704/kilowatt-hour.
- Land cost assumptions based on costs for properties shown for sale on the website Estatly.com:
 - \$40,000/acre for WWTP sites
 - \$20,000/acre for effluent storage
- Costs for on-site spray irrigation infrastructure for land disposal were assumed at \$5,000/acre.
- Net Present Value: To compare overall costs of the alternatives (i.e., combining construction and O&M costs), a net present value cost analysis was done, using a 20-year planning period. The net present value analysis also requires establishing a discount rate. A real discount rate of 0.3% was used, following the US Department of Agriculture (USDA) Bulletin 1780-2, which in turn refers to the real discount rate in the US Office of Management and Budget's Circular A-94 (see Appendix D).
- Salvage Value: Because the life span of wastewater components exceeds 20 years, salvage values were estimated, based on the life span of the asset and a straight-line depreciation of the value of the asset over the analysis period of 20 years (per USDA Bulletin 1780-2 guidance for analysis of wastewater projects). In determining salvage value, the following was assumed:

- Within the overall WWTP construction cost, equipment is 20 percent of the construction cost and has a 20-year life, with a discount rate of 0.3 percent.
- Within the overall WWTP construction cost, non-equipment is 80 percent of the construction cost and has a 50-year life, with a discount rate of 0.3 percent
- Salvage value of land purchased was assumed to be the estimated purchase price.

The estimated costs for wastewater treatment and disposal for Alternatives 1 and 4 are shown in Table 5. Detailed cost estimates for various combinations of treatment and disposal alternatives are included in Appendix E.

Table 5. Estimated Costs for Local Wastewater Treatment and Disposal Alternatives 1 and 4

Description	Alt 1: Local WWTP with Effluent Storage and Land Application	Alt 4: Local WWTP with Discharge to Miocene Canal
Treatment Method	Tertiary Treatment with Chlorine Contact Tank	Tertiary Treatment (Membrane Bioreactor) with Advanced Treatment (UF/RO/AOP) and UV Disinfection
Classification of Biosolids Produced	Class B	Class B
WASTEWATER TREATMENT PLANT		
Total WWTP Construction Cost with Contingency and Land Purchase	\$ 25,096,000	\$ 102,801,000
Total WWTP Capital Cost (includes implementation costs)	\$ 36,051,000	\$ 147,911,000
O&M Cost Net Present Value (20 yrs., 0.3%)	\$ 25,228,000	124,257,000
Total Net Present Value (includes salvage value)	\$ 49,824,000	\$ 225,540,000
EFFLUENT DISPOSAL		
Total Effluent Disposal Construction Cost with Contingency and Land Purchase	\$ 24,136,000	\$ 6,820,000
Total WWTP Capital Cost (includes implementation costs)	\$ 32,949,000	\$ 9,822,000
O&M Cost Net Present Value (20 yrs., 0.3%)	\$ 3,344,000	\$ 2,229,000
Total Net Present Value (includes salvage value)	\$ 20,896,000	\$ 8,225,000
TREATMENT AND DISPOSAL		
Total WWTP and Effluent Disposal Construction Cost with Contingency and Land Purchase	\$ 49,232,000	\$ 109,621,000
Total WWTP and Effluent Disposal Capital Cost (includes implementation costs)	\$ 69,000,000	\$ 157,733,000
O&M Cost Net Present Value (20 yrs., 0.3%)	\$ 28,572,000	\$ 126,486,000
Total Net Present Value (includes salvage value)	\$ 70,720,000	\$ 233,765,000

As shown in Table 5, Alternative 1 is less expensive in terms of capital cost, O&M costs, and overall net present value.

The estimated costs to receive and treat septage are shown in Table 6. A detailed cost estimate for the septage receiving and treatment facility is included in Appendix E.

Table 6. Estimated Costs for Septage Receiving and Treatment Facility

Description	Costs
Total Construction Cost	\$6,983,000
Total Capital Cost (includes implementation costs)	\$10,095,000
O&M Cost Net Present Value (20 yrs., 0.3%)	\$3,027,000
Total Net Present Value (includes salvage value)	\$9,827,000

Providing a septage receiving station is only feasible if a local WWTP is constructed.

4.3 Non-Economic Comparison

Alternatives 1 and 4 differ in terms of the following non-economic factors:

- Social
- Environmental
- Implementation
- Operations

An initial environmental constraints analysis for the local wastewater treatment and disposal alternatives was conducted. The environmental constraints analysis is provided in Appendix A, and the environmental constraints are summarized in Table A-1.

Table 7 compares the advantages and disadvantages of each treatment and disposal alternative for each non-economic factor.


Table 7. Advantages and Disadvantages of Wastewater Treatment and Disposal Alternatives for Non-Economic Factors

Non-Economic Factor	Alt 1: Local WWTP with Effluent Storage and Land Application		Alt 4: Local WWTP with Discharge to Miocene Canal	
	Advantages	Disadvantages	Advantages	Disadvantages
Social	Effluent may help farmers by improving value of marginal grazing land Town controls growth in its service area	Negotiating agreements with farmers to use treated effluent for irrigation of pastureland may be difficult because of public perception	Effluent provides current ag users along the Miocene Canal a year-round source of water Town controls growth in its service area	Current ag users along the Miocene Canal may not want treated effluent to be mixed with Lake Oroville water supplied to the canal
Environmental	Easier to permit with the Regional Board	Land intensive More mitigation for vernal pools, meadowfoam, and other rare plants on proposed storage and land application acreage	Provides a very high quality treated effluent suitable for indirect potable reuse	More land required for treatment facilities

Non-Economic Factor	Alt 1: Local WWTP with Effluent Storage and Land Application		Alt 4: Local WWTP with Discharge to Miocene Canal	
	Advantages	Disadvantages	Advantages	Disadvantages
Implementation	None identified	Soils south of Paradise and off the ridge are rocky, making land application more difficult Finding 150 acres of land to purchase for effluent storage may be difficult	Land owned by PG&E readily available for siting WWTP	Requires permits to be obtained from both the State Water Resources Control Board and the Regional Board More complex WWTP to construct
Operations	Potentially eliminates the need for farmers to relocate their cattle for grazing during the summer months WWTP facilities less complex and easier to operate	Need to oversee farmers' operations to ensure compliance with permit conditions	None identified	More complex WWTP to operate Very stringent discharge requirements

5. Recommendation

Based on information presented in this TM, it is recommended that both Alternatives 1 and 4 be carried forward and compared against the regional alternative in TM #6 – Comparison of Local and Regional Alternatives, where raw sewage would be conveyed to the Chico WPCP for treatment and disposal.



A

Environmental Constraints
Analysis



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Appendix A – Environmental Constraints Analysis – Local WWTP Alternative

A.1 Introduction

The Town of Paradise (Town) is implementing the Paradise Sewer Project (Project), which involves identifying and implementing a long-term solution for collection, treatment, and reuse/disposal of its wastewater. HDR is under contract to assist the Town with the first two phases of the Project—final selection of a wastewater alternative, which includes this environmental constraints analysis as part of the Local Alternatives Screening process (Phase 1), and preparation of an Environmental Impact Report (EIR) covering the selected alternative (Phase 2). This technical memorandum (TM) is part of the Phase 1 effort.

The purpose of this analysis is to identify the environmental constraints of the local collection, treatment, and reuse/disposal of wastewater locations. More specifically, the environmental constraints analysis considers the physical footprint of the proposed activities, along with the existing conditions and land uses of proposed locations, so as to identify those “constraints” or issues that should be considered when selecting the location and developing the preliminary design of the Project. This TM captures individual constraints from a local standpoint and involved the following:

- Preliminary desktop review of proposed and alternative local wastewater treatment plant (WWTP) site locations, collection system, storage and discharge locations, and related infrastructure and construction footprint.
- Historic records search of the local project area.
- Proposed definition of the preliminary area of potential effect (APE) to inform design, and tribal and agency coordination.
- Identification of environmental permits and agency consultations necessary to advance the Project.
- Geospatial cataloguing of all data.

A.2 Local Alternative General Overview

The local alternative includes siting, construction, and operation of the following:

- Collection system
- New WWTP
- Storage reservoir
- Related piping and infrastructure
- Surface water discharge location
- Land application discharge location

With the exception of the collection system, siting of the remaining project components includes an alternatives screening, as summarized in TM #4, Local Wastewater Treatment and Disposal Alternatives, based on the technical and land-based requirements defined in the *Town of Paradise Sewer Project, Alternatives Analysis and Feasibility Report: Determining a Preferred Option for Implementation* (2017 Feasibility Report) and subsequent engineering assessments pertaining to acreage needs (TM #3). This environmental constraints analysis for the local alternative considers the physical footprint of those alternatives, broadly allowing for a conservative estimate of where each project component might be placed. As such, the analysis identifies those constraints of the project area and those of the surrounding area, thus defining the study area, shown in Figure A-1. This further allows for flexibility in the specific footprint as the preliminary design matures.

The collection system, by contrast, was largely defined in the 2017 Feasibility Report and included a sewer service area (SSA) including 1,469 parcels within Paradise's urban core, as shown in Figure A-2. As of April 2020, there were 300 parcels with habitable structures within the SSA.¹ The SSA defined in 2017 will continue to be used as the SSA for the proposed collection system.

This constraints review includes a broad consideration of the footprint of each of these project components to encompass the range of alternatives being considered at this stage of the planning process. Not all of these project components and alternatives will necessarily be carried forward in future planning and review.

¹ The count of existing parcels with habitable structures was obtained from the Chico State Geographical Information Center, which compiled the data supplied by CAL FIRE. CAL FIRE defines a structure as habitable if it is less than 25 percent damaged.

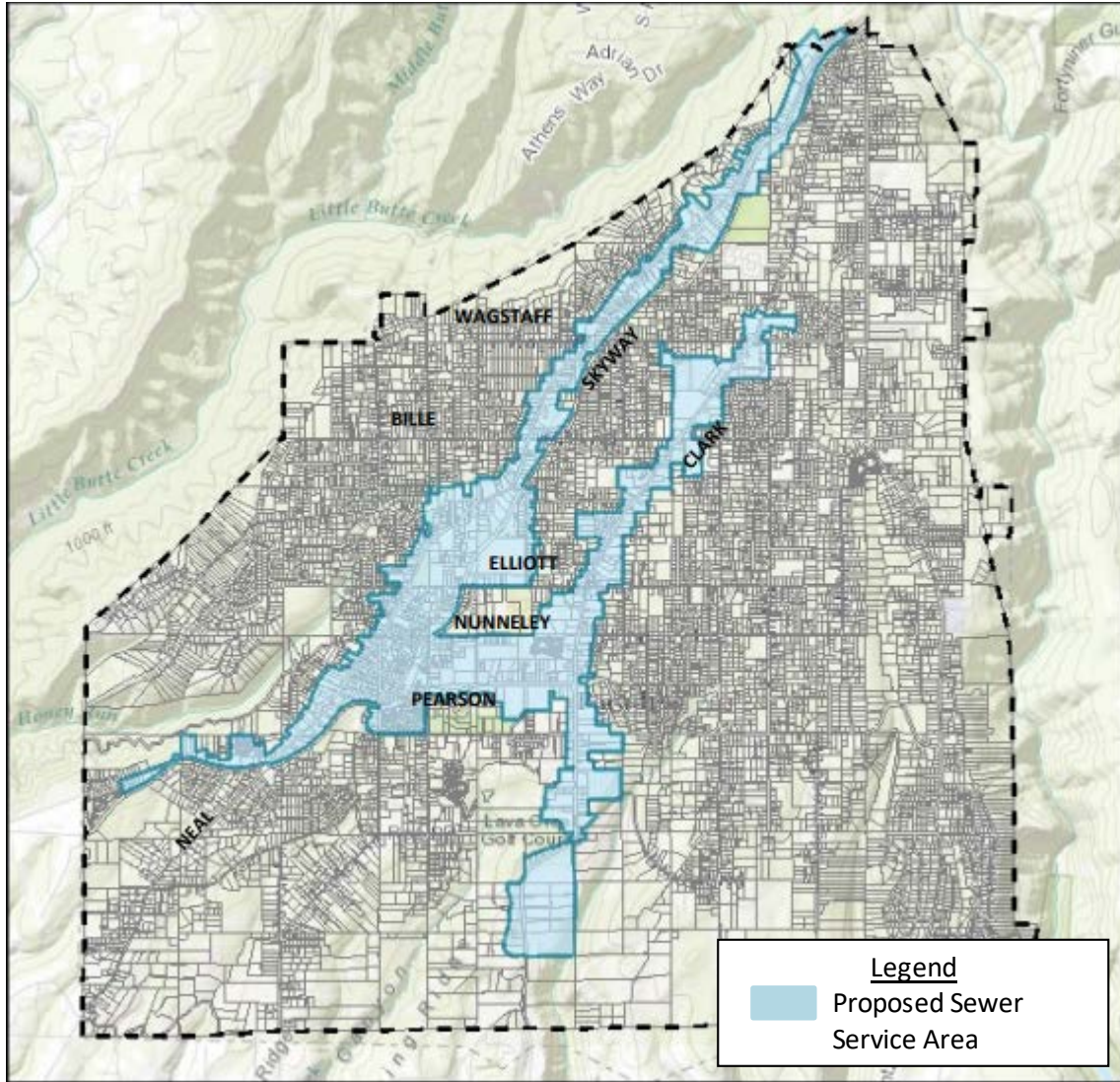


Figure A-2. Proposed Town of Paradise Sewer Service Area

A.3 Limitations of Consideration

Land use constraints discussed in Section A.4.2 are based on current and historic land uses as indicated through review of Google street view imagery and local (Town of Paradise and Butte County) mapping. Recognizing that areas damaged by fire are in a phase of reconstruction or remain vacant, the land use constraints assessment assumes areas would be redeveloped according to local plans and policies. The land use constraints analysis included examining impaired waterbodies as defined by Section 303(d) of the Clean Water Act and administered in California by the State Water Resources Control Board. California’s Clean Water Act Section 303(d) and 305(b) Integrated Report is developed in cycles, with each cycle occurring every 2 years. The most recent report, started in 2018, is in progress. The current active report is the 2014 and 2016 Integrated Report. Data used to identify impaired waters in the study area are from 2015.

Biological constraints summarized in Section A.4.3 include waters of the United States and waters of the state. Aerial imagery was analyzed and existing National Wetlands Inventory (NWI) data imported to show the general location of aquatic features in the study area. However, to determine the more precise extent and nature of waters of the United States, waters of the state, and wetlands in the study area, an aquatic resources delineation will need to be conducted as outlined in Section A.4.3.1.

Biological constraints also include special-status species that may be affected by project-related activities, and their associated California Wildlife Habitat Relationships (CWHR) habitat types. Special-status species that have the potential to occur in the study area, along with their general habitat characteristics, were identified using information from the United States Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), and the California Native Plant Society (CNPS). A biological habitat assessment was not conducted to validate these findings in the field. However, it is recommended that prior to finalizing conceptual design, such an assessment be conducted.

Sensitive cultural and tribal cultural resources constraints are summarized in Section A.4.4 and include preliminary findings of archaeological resources, built-environment resources, informally recorded cultural resources, and one known Indian Tribal Asset (ITA) that may be affected by project-related activities. The review conducted for this effort should not be considered an identification effort sufficient to complying with local, state, or federal laws and it is recommended that prior to finalizing conceptual design, an archaeological resources inventory and tribal cultural resources study be conducted.

A.4 Constraints Analysis

A.4.1 Summary of Constraints

The environmental constraints analysis of the local alternative's proposed collection, treatment, and reuse/disposal of wastewater is based on review of land use and zoning, biological resources, and cultural resources that would affect the constructability of the facilities. More specifically, the environmental constraints analysis considers the physical footprint of the proposed activities, along with the land uses and biological and cultural resources, so as to identify those constraints or issues that should be considered when developing the preliminary design of a project. Table A-1 summarizes the results of the environmental constraints analysis.

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Table A-1. Summary of Environmental Constraints

	Collection System	Local WWTP Site - Kunkle	Local WWTP Site - Clark Road	Local WWTP Site - Neal Road	Pipeline/Infrastructure - Pearson/Pentz Roads	Pipeline/Infrastructure - Clark Road	Pipeline/Infrastructure - Neal Road	Surface Water Discharge - Kunkle Reservoir	Surface Water Discharge - Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Land Use Constraints	None	None	None	None	None	None	None	None	None	None
Impaired Waters Constraints	None	None	None	None	None	None	None	Drains to West Branch Feather River, impaired	Drains to West Branch Feather River, impaired	None
Wetlands/Waters Constraints	Little Butte Creek, Little Dry Creek, Honey Run	Kunkle Reservoir and related drainages	West Branch Clear Creek	Nugen Creek, Hamlin Slough, seasonal wetland complexes	Little Butte Creek, Little Dry Creek, Honey Run	West Branch Clear Creek, seasonal wetland complexes	Nugen Creek, Hamlin Slough, seasonal wetland complexes	Kunkle Reservoir and related drainages	Miocene Canal	West Branch Clear Creek, Little Dry Creek, Hamlin Slough, seasonal wetland complexes
Species Constraints	Anadromous fish, foothill yellow-legged frog (FYLF), California red-legged frog (CRLF), bald and golden eagle, willow flycatcher (WIFL), peregrine falcon (PEFA), California spotted owl (SPOW), fisher	FYLF, CRLF, bald and golden eagle, PEFA	North and South: Anadromous fish, FYLF, bald and golden eagle, PEFA South only: Butte County meadowfoam, California black rail (BLRA)	North and South: Anadromous fish and FYLF North only: bald and golden eagle, PEFA South only: Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans, valley elderberry longhorn beetle (VELB), giant gartersnake (GGS), tricolored blackbird (TRBL), burrowing owl (BUOW), Swainson's hawk (SWHA), white-tailed kite (WTKI)	Anadromous fish, FYLF, CRLF, bald and golden eagle, WIFL, PEFA, SPOW, fisher	North and South: Anadromous fish, FYLF, bald and golden eagle, PEFA South only: Butte County meadowfoam, BLRA	North and South: Anadromous fish and FYLF North only: bald and golden eagle, PEFA South only: Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans, VELB, anadromous fish, FYLF, TRBL, BUOW, SWHA, WTKI	CRLF, FYLF	FYLF	Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans (vernal pool tadpole shrimp critical habitat), VELB, FYLF, GGS, TRBL (known colony), BUOW, SWHA, WTKI, BLRA
Cultural Resources Constraints	Survey coverage: <50% Site sensitivity: • P: moderate/high • H: moderate/high • HBE: low Note: ~50 resources previously recorded	Survey coverage: ~10% Site sensitivity: • P: moderate • H: low/moderate • HBE: low Note: no previously recorded resources identified	Survey coverage: <50% Site sensitivity: • P: moderate/high • H: moderate/high • HBE: low Note: 1 resource previously recorded	Survey coverage: ~10% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: 1 resource previously recorded along corridor	Survey coverage: ~10% Site sensitivity: • P: moderate • H: moderate • HBE: low Note: ~2 resources previously recorded	Regional constraint: Survey coverage: ~50% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: ~50 resources previously recorded along corridor	Local/Regional constraint: Survey coverage: ~30% Site sensitivity: • P: moderate/high • H: moderate • HBE: low Note: ~11 resources previously recorded along corridor	Survey coverage: ~10% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: 1 resource previously recorded near reservoir	Survey coverage: 0% Site sensitivity: • P: moderate/high • H: low • HBE: low Note: ~5 resources previously recorded nearby	Survey coverage: ~40% Site sensitivity: • P: moderate/high • H: low • HBE: low Note: ~40 resources previously recorded



	Collection System	Local WWTP Site - Kunkle	Local WWTP Site - Clark Road	Local WWTP Site - Neal Road	Pipeline/Infrastructure - Pearson/Pentz Roads	Pipeline/Infrastructure - Clark Road	Pipeline/Infrastructure - Neal Road	Surface Water Discharge - Kunkle Reservoir	Surface Water Discharge - Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Tribal Constraints	No known Tribal Cultural Resources (TCR), Indian Trust Assets (ITA), or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	One ITA in this area owned by the Mechoopda Indian Tribe No known TCR or resources of cultural importance Need to validate through tribal consultation
Additional Studies Required	Fish passage assessment Protocol surveys for FYLF and possibly, but unlikely, for CRLF, WIFL, SPOW, and fisher (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Protocol surveys for FYLF and possibly, but unlikely, for CRLF (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Additional surveys of rare plant populations if early and late season surveys dictate Protocol surveys possibly, but unlikely, for BLRA	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Elderberry mapping for VELB Protocol surveys possibly, but unlikely, for GGS (potential for BUOW, SWHA, WTKI, and TRBL to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF and possibly, but unlikely, for CRLF, WIFL, SPOW, and fisher (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Additional surveys of rare plant populations if early and late season surveys dictate Protocol surveys possibly, but unlikely, for BLRA	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Elderberry mapping for VELB Protocol surveys possibly, but unlikely, for GGS (potential for BUOW, SWHA, WTKI, and TRBL to nest will be assessed during habitat assessment) Cultural resources study TCR study	Protocol surveys for FYLF and possibly, but unlikely, for CRLF Cultural resources study TCR study	Protocol surveys for FYLF, as well as a thorough examination of full extent of canal route Cultural resources study TCR study	Additional surveys of rare plant populations if early and late season surveys dictate Elderberry mapping for VELB Protocol surveys for FYLF, TRBL, and possibly, but unlikely, for GGS and/or BLRA (potential for BUOW, SWHA, and WTKI to nest will be assessed during habitat assessment) Cultural resources study TCR study



	Collection System	Local WWTP Site - Kunkle	Local WWTP Site - Clark Road	Local WWTP Site - Neal Road	Pipeline/Infrastructure - Pearson/Pentz Roads	Pipeline/Infrastructure - Clark Road	Pipeline/Infrastructure - Neal Road	Surface Water Discharge - Kunkle Reservoir	Surface Water Discharge - Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Required Permits and Consultations	401/404/1602 if work within channel Potential consultation with NMFS for anadromous fish and/or Incidental Take Permit from CDFW (ITP) for FYLF Consultation with California Native American tribes	401/404 Potential ITP for FYLF Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Biological Opinion or Letter of Concurrence for vernal pool crustaceans and potentially for VELB Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Biological Opinion or Letter of Concurrence for vernal pool crustaceans and potentially for VELB Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404 Potential ITP for FYLF Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404/1602 Potential ITP for FYLF Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404/1602 Biological Opinion or Letter of Concurrence for vernal pool crustaceans (Critical habitat must be completely avoided), potentially for VELB, and possibly, but unlikely, for GGS Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA Consultation with California Native American tribes

Note: P = Prehistoric; H = Historical; HBE = Historic Built Environment; 401 = Water Quality Certification from Regional Water Quality Control Board; 404 = Clean Water Act Permit from the United States Army Corps of Engineers; 1602 = Streambed Alteration Agreement from California Department of Fish and Wildlife (CDFW)

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A.4.2 Land Use Constraints

A.4.2.1 Applicable Land Use Plans and Policies

The local Project alternatives are within the jurisdictions of the Town of Paradise and Butte County. The planning documents and policies of these jurisdictions that are applicable to the siting and development of the WWTP and ancillary facilities are the following:

- **Paradise Municipal Code Title 17 – Zoning:** This section of the code provides the zoning ordinance for the Town and identifies permitted and conditional uses according to zoning category. Wastewater treatment/disposal utilities are considered “permitted land uses upon town approval and issuance of an administrative permit.”
- **Butte County General Plan 2030 Water Resources Element:** This element of the general plan includes the following:
 - W-P4.4: Opportunities to recover and utilize wastewater for beneficial purposes shall be promoted and encouraged.
 - W-P4.5: The use of reclaimed wastewater for non-potable uses shall be encouraged, as well as dual plumbing that allows graywater from showers, sinks and washers to be reused for landscape irrigation in new developments.
- **Butte County General Plan 2030 Public Facilities and Services Element – Chapter 6, Wastewater:** This element of the general plan includes the following:
 - PUB-P12.1: Applicants shall be allowed to make case-by-case assessments of septic and other wastewater treatment systems to determine appropriate system designs and densities and shall be allowed to utilize new technologies that are supported by State and County practices.
 - PUB-P12.3: New community sewerage systems shall be managed by a public County sanitation district or other County-approved methods. Proponents shall demonstrate the financial viability of constructing, operating and maintaining the proposed community sewerage system.
 - PUB-P12.4: New sewer collection and transmission systems shall be designed and constructed to minimize potential inflow and infiltration.
 - PUB-P13.1: The County shall encourage all plant operators to begin planning and implementing expansions to the existing Regional Wastewater Treatment Master Plan to meet future demand for wastewater treatment generated by this General Plan at least four years prior to reaching the capacity of existing facilities.
 - PUB-P13.4: Installation of sewer lines shall occur concurrently with construction of new roadways to maximize efficiency and minimize disturbance from construction activity.

- Butte County Zoning Ordinance (Chapter 24 of the County Code):** Chapter 24 identifies land uses, including wastewater treatment systems, permitted in various zones. Wastewater treatment systems are categorized under *Utilities, Major*. Utilities, Major are defined as large-scale facilities of a regional nature, including Tier 4 solar energy systems, large wind energy systems, power plants, hydro-electric facilities, electricity transmission substations, water storage tanks, community wastewater treatment plants, commercial and industrial composting operations, and similar facilities. Utilities, Major includes uses that are permitted by a Conditional Use Permit in most zones.

A.4.2.2 Paradise Land Use and Zoning

In Paradise, the service area and collection system include the commercial district, public and institutional land uses, and residential areas. The collection system would be on parcels connecting to the main lines within the ROW of Skyway Road, Clark Road, Pearson Road, Elliott Road, and smaller arterials. Land use in the collection system area is shown in Figure A-3. Land use and zoning are described in Table A-2. There are no zoning or land use conflicts that would require a change in the location of the collection system.

Table A-2. Zoning and Land Use in Collection System Area

Zoning	Land Uses
Community Commercial	Locally and regionally oriented commercial land uses, including retail, retail centers, wholesale, storage, hotels and motels, restaurants, service stations, automobile sales and service, and professional and administrative offices
Community Facilities	Bike path, recreation center, town hall, and education facilities
Community Services	Community care facilities, such as day care facilities, shelters, and medical offices
Multiple Family Residential	Apartments, condominiums, and associated parking facilities
Town Residential (1, 1/2, and 1/3 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, and recreation facilities
Rural Residential (1/2 and 2/3 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Central Business	Commercial retail and services, public space, professional and administrative offices, and multiple-family residential uses
Neighborhood Commercial	Locally oriented commercial retail and services
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Industrial Services	Light industrial and manufacturing uses, warehouses, intensive nonretail commercial uses, and public uses

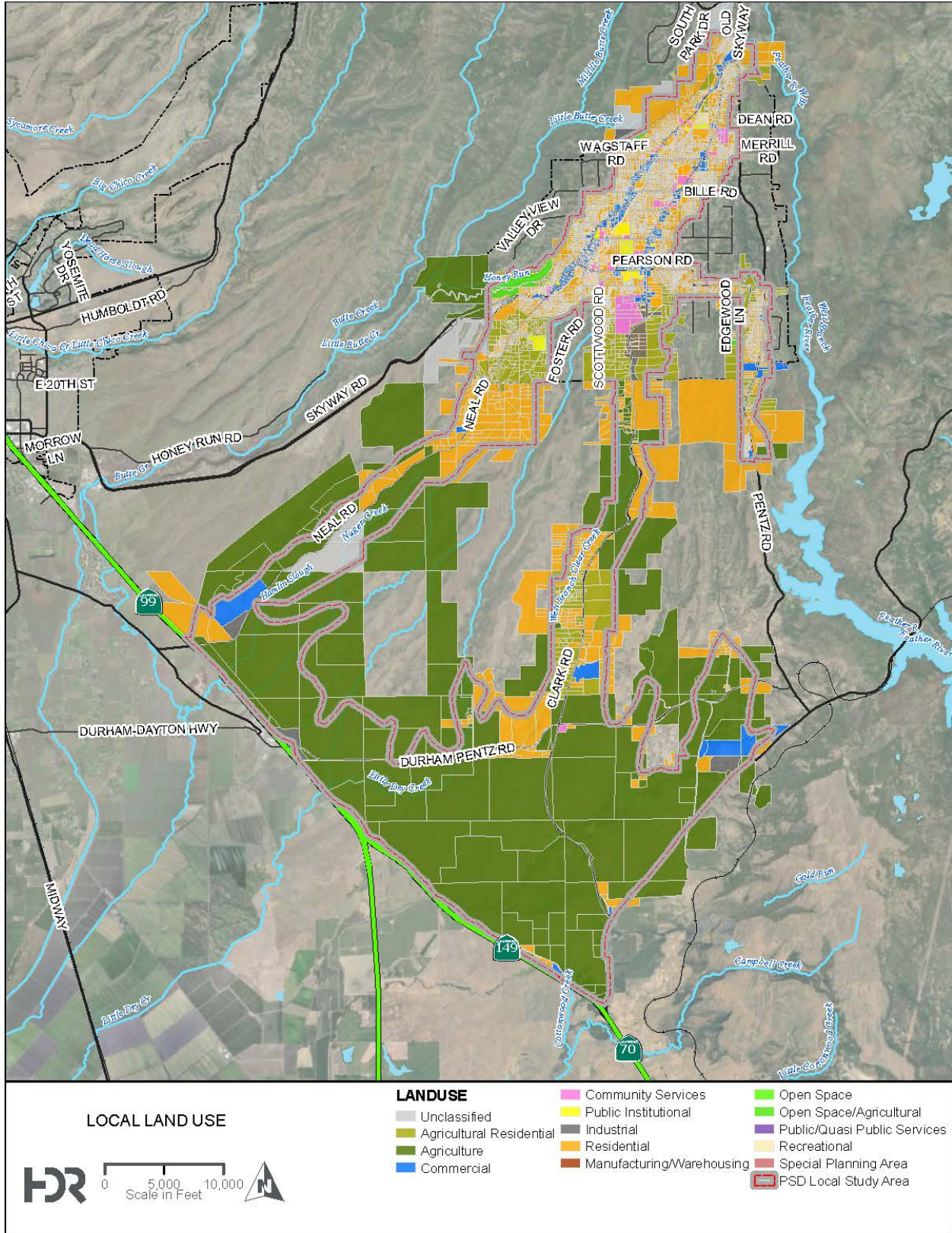


Figure A-3. Land Use

The primary zoning and land uses along the alternative pipeline corridors of Neal Road, Clark Road, and Pearson Road to Pentz Road in Paradise are described in Table A-3. The pipeline would be buried within the roadway corridor and would not present a conflict with zoning or land use in these areas. Under the local alternative, no WWTP, storage reservoir, land application discharge location, or surface water discharge location would be placed within the town limits.

Table A-3. Zoning and Land Use in Pipeline Corridors

Zoning	Land Uses
Neal Road	
Rural Residential (1/2 and 1 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Clark Road	
Industrial Services	Light industrial and manufacturing uses, warehouses, intensive nonretail commercial uses, and public uses
Agricultural Residential (3 acres minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Pearson Road to Pentz Road	
Rural Residential (1/2 and 1 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Town Residential (1/3, 1/2, and 1 acre)	Single-family residences on small-sized parcels; no accessory rural land uses, particularly the keeping of livestock
Multiple Family Residential	Multiple-family residential units with residential densities that do not exceed 10 dwelling units per acre and, for mobile home parks, 7 dwelling units per acre
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production

A.4.2.3 Butte County Land Use and Zoning

Project facilities in Butte County include the pipeline alternatives along Neal, Clark, and Pentz Roads, as well as the WWTP, storage reservoir, and land application or surface water discharge locations. These areas are generally characterized by rural, low-density development and open space. Land use in the areas identified for potential pipeline, WWTP, storage collection system, and land application development are shown in Figure A-3. All areas would require a conditional use permit for development of the WWTP, storage reservoir, and land application or surface water discharge locations.

Neal Road is a two-lane highway. Land adjacent to Neal Road in the northern segment is zoned as Low Density Foothill Residential and Country Residential. There are parcels zoned as Resource Conservation in an area identified as a possible site for the WWTP. The purpose of the Resource Conservation zone is to protect and preserve natural, wilderness, and scientific study areas that are critical to environmental quality in Butte County. This designation allows residential use (one single-family dwelling per 40-acre parcel), and limited recreational and commercial recreational uses that

do not detract from the area's value for habitat, open space, or research. South of the Resource Conservation parcels, Neal Road is bordered on both sides by land zoned as Agricultural with 40-acre minimum parcel sizes. The southern segment of the corridor crosses the Neal Road Recycling and Waste Facility overlay zone. The facility is operated by the Butte County Department of Public Works. The overlay zone was established to promote compatible development around the Neal Road Recycling and Waste Facility and to ensure adequate separation between the Neal Road Recycling and Waste Facility and land uses that are potentially incompatible with landfill activities. Another possible location for the WWTP is just north of the Neal Road Recycling and Waste Facility overlay zone.

Clark Road is State Route 191, extending north-south between Paradise and State Route 70. The corridor is predominantly open space and low density residential properties. Paradise Airport is just west of Clark Road, approximately 2 miles south of the Town border. Two general areas are considered possible locations for the WWTP on Clark Road: one north of the airport and one south of the airport. The entrance to Butte College from Clark Road is approximately 6 miles south of the Town border. In this corridor, Clark Road passes land zoned as Public, Foothill Residential, Rural Country Residential, and Agricultural with 40- and 160-acre minimum lot sizes. Land at the intersection of Clark Road and Durham Pentz Road is zoned General Commercial. South of Durham Pentz Road, most of the land is zoned as Agricultural with 160-acre minimum lot sizes. This area south of Durham Pentz Road is included as possible effluent storage and land disposal locations.

Pentz Road is a two-lane highway. The segment of Pentz Road in Butte County would be used for a pipeline corridor to Kunkel Reservoir, which would be the site of the WWTP with discharge to Miocene Canal. Just south of the Town border, land along Pentz Road is zoned for Medium Density Residential and Neighborhood Commercial. Land zoned as Very Low Density Residential borders the road as it continues south to Kunkel Reservoir. The Kunkel Reservoir parcel is zoned as Public and is used for recreational fishing and hiking. Across Pentz Road from the reservoir, land is within a Planned Unit Development. South of Kunkel Reservoir, Pentz Road is a Scenic Highway. The property that includes Kunkel Reservoir and surrounding land is owned by PG&E. PG&E supplies water from Kunkel Reservoir to agricultural users along Miocene Canal by adding 10 cubic feet per second into the canal.

A.4.2.4 Impaired Waters

Figure A-4 presents the locations of impaired waterbodies in the study area. There are no impaired waters, as identified by the California Environmental Protection Agency in accordance with Section 303(d) of the Clean Water Act, within the Town of Paradise; therefore, proposed facility locations in Paradise would not encroach on impaired waterbodies. The pipeline routes along Neal, Clark, and Pentz Roads do not cross impaired waters. The Pentz Road WWTP and Miocene Canal are within the drainage basin of the West Branch of the Feather River, which is an impaired waterbody based on toxicity. Discharge to Miocene Canal would need to demonstrate compatibility with total maximum daily loads for recovery of the impaired waterbody.

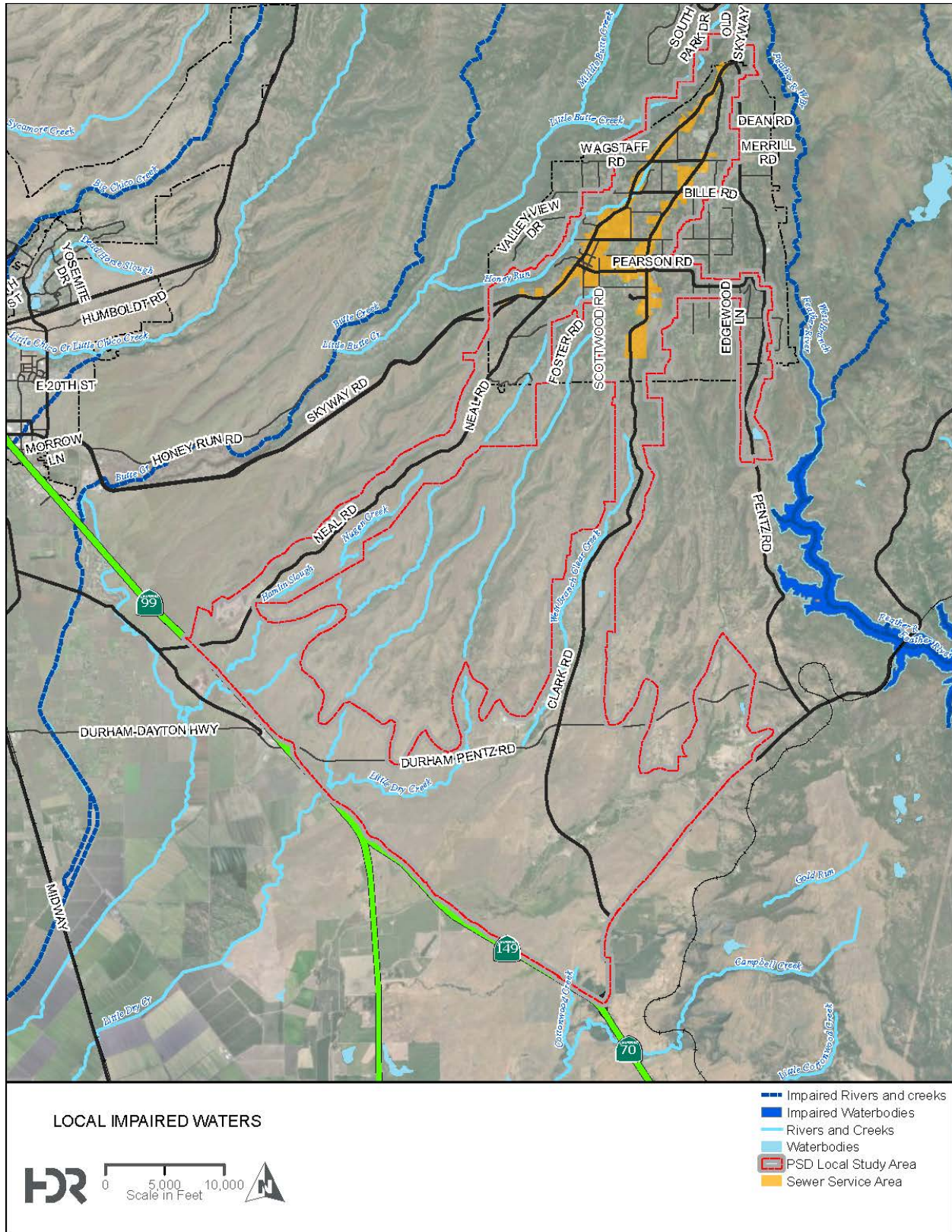


Figure A-4. Impaired Waters

A.4.3 Biological Constraints

This section identifies the biological resources in the study area and the potential constraints that should be considered for development of the WWTP and related facilities. The biological constraints analysis focused on waters of the United States and waters of the state, special-status species and their habitat, and critical habitat. These findings are based on desktop review and are described in the following sections.

A.4.3.1 Waters of the United States and Waters of the State

Section 401 of the Clean Water Act requires any applicant for a federal license or permit to conduct any activity that may result in a discharge of a pollutant into “waters of the United States” to obtain a certification that the discharge will comply with the applicable effluent limitations and water quality standards. The appropriate Regional Water Quality Control Board regulates Section 401 requirements. Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into “waters of the United States” without a permit from the United States Army Corps of Engineers (USACE). USACE and the United States Environmental Protection Agency administer the Clean Water Act. Waters of the United States include streams that have a defined bed and bank, and wetland areas “that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 Code of Federal Regulations [CFR] 328.3).

Waters of the state are regulated by the Regional Water Quality Control Board under the State Water Quality Certification Program, which regulates discharges of dredged and fill material under Section 401 of the Clean Water Act and the Porter-Cologne Water Quality Control Act. Waters of the state are defined as “any surface water or groundwater, including saline waters, within the boundaries of the state.”

There are several potential waters of the United States and waters of the state across all components of the study area. Named features such as Hamlin Slough, Clear Creek, and Dry Creek cross the study area, as do extensive seasonal wetland complexes and unnamed agricultural canals and ditches.

As a screening tool in this constraints analysis, aerial imagery was analyzed and existing NWI data imported to show the general location of aquatic features in the study area. An overview of the NWI aquatic features in the study area is shown in Figure A-5, and a more detailed set of figures showing these features at a larger scale is included as Attachment A.1. To determine the precise extent and nature of waters of the United States, waters of the state, and wetlands that could be affected by the Project, a delineation using the standards and procedures presented in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and as clarified in the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region* (USACE 2008) to the manual is needed.

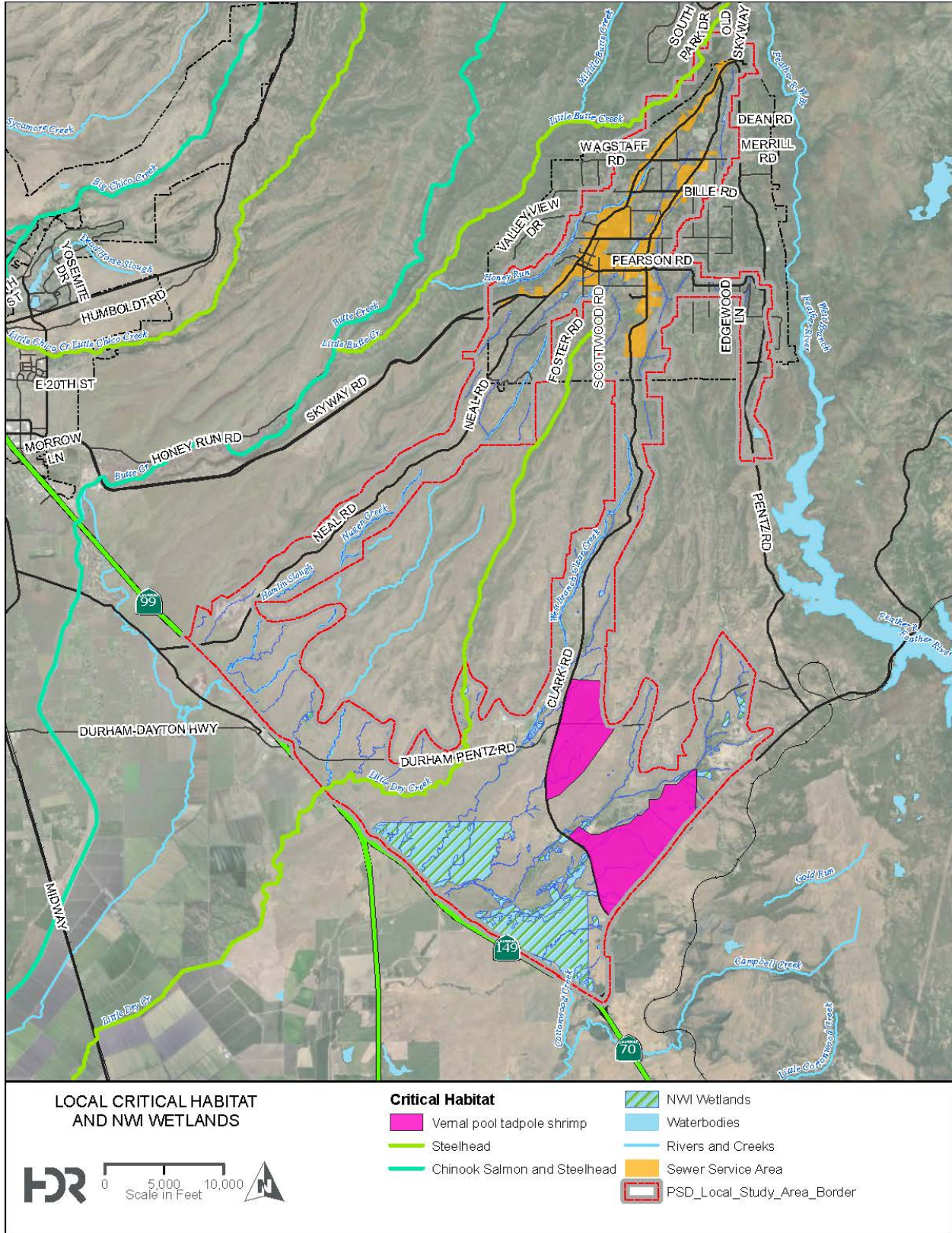


Figure A-5. National Wetlands Inventory Aquatic Features

A.4.3.2 Special-Status Species

Candidate, sensitive, or special-status species are commonly characterized as species that are at potential risk or actual risk in their persistence in a given area or across their native habitat. These species have been identified and assigned a status ranking by governmental agencies such as USFWS and CDFW, and by private organizations such as the CNPS. The degree to which a species is at risk of extinction is the determining factor in the assignment of a status ranking. Some common threats to a species' or population's persistence include habitat loss, degradation, and fragmentation, as well as human conflict and intrusion. For the purposes of this constraints analysis, special-status species are defined as follows:

- Listed, proposed, or candidates for listing under the federal Endangered Species Act (FESA; listed –50 CFR 17.11; candidates – 61 Federal Register 7591, February 28, 1996)
- Listed or proposed for listing under the California Endangered Species Act (CESA; California Fish and Game Code [FGC] 1992 Section 2050 et seq.; 14 California Code of Regulations [CCR] Section 670.1 et seq.)
- Designated as a Species of Special Concern (SSC) by CDFW
- Designated as Fully Protected (FP) by CDFW (FGC Sections 3511, 4700, 5050, 5515)
- Species that meet the definition of rare or endangered under CEQA (14 CCR Section 15380), including CNPS List Rank 1B and 2

A list of special-status species that have the potential to occur in the study area was prepared using information obtained from the USFWS Information for Planning and Conservation (IPaC) database, the USFWS Critical Habitat Portal, the CDFW California Natural Diversity Database (CNDDDB), and the CNPS Inventory of Rare and Endangered Plants of California. A search of the USFWS IPaC database was performed to identify species under USFWS jurisdiction that may be affected by the proposed Project. In addition, the USFWS Critical Habitat Portal was queried to identify designated critical habitat in or adjacent to the study area. The CNDDDB query provided a list of occurrences of special-status species identified within the United States Geological Survey (USGS) 7.5-minute quadrangles that are encompassed by all of the project components and the USGS quadrangles surrounding them. The CNPS database was also queried to identify those plant species classified as rare under the California Rare Plant Rank system with the potential to occur within the same USGS quadrangles.

The list of special-status species that have the potential to occur in the study area is provided in Attachment A.2, Table A.2-1. Table A.2-1 includes a compiled list of all special-status species identified in the search results, the habitat requirements for each species, and conclusions regarding the potential for each species to occur in which components of the proposed project area.

A.4.3.3 Wildlife Habitat

Wildlife habitat in the study area is classified according to the CWHR system. Attachment A.2, Table A.2-2 lists the CWHR habitat types present across the study area, and summarizes the species determined to have the potential to be affected by project-related activities based on the more detailed habitat requirements in Attachment A.2, Table A.2-1. The CWHR habitats listed in the

table are meant as a high-level reference to where these species could occur in the project area. The locations and extent of these habitats have not been verified in the field and species could potentially use habitats other than those identified in Attachment A.2. An overview of CWHR habitat types in the study area is shown in Figure A-6, and a more detailed set of figures showing the study area at a larger scale is included as Attachment A.3.

A.4.3.4 Critical Habitat

When USFWS lists a species as threatened or endangered under the FESA, areas of habitat considered essential to its conservation and survival may be designated as critical habitat. These areas may require special consideration and/or protection because of their ecological importance.

There are two critical habitat units for vernal pool tadpole shrimp (*Lepidurus packardii*) present in the potential land discharge portion of the study area. These units are situated just east of Clark Road between the Foothills Mobile Home Park and the junction of Highway 70 and Table Mountain Road.

Little Butte Creek and Little Dry Creek are critical habitat for Central Valley steelhead (*Oncorhynchus mykiss irideus*), while Butte Creek is critical habitat for both steelhead and Chinook salmon (*Oncorhynchus tshawytscha*). Critical habitat in the study area is shown along with the NWI aquatic features in Figure A-5 and Attachment A.1.

A.4.3.5 Biological Constraints Summary

Table A-4 lists the biological constraints that have the greatest potential to occur in the study area and for which federal, state, or local regulations dictate that survey work should be conducted.

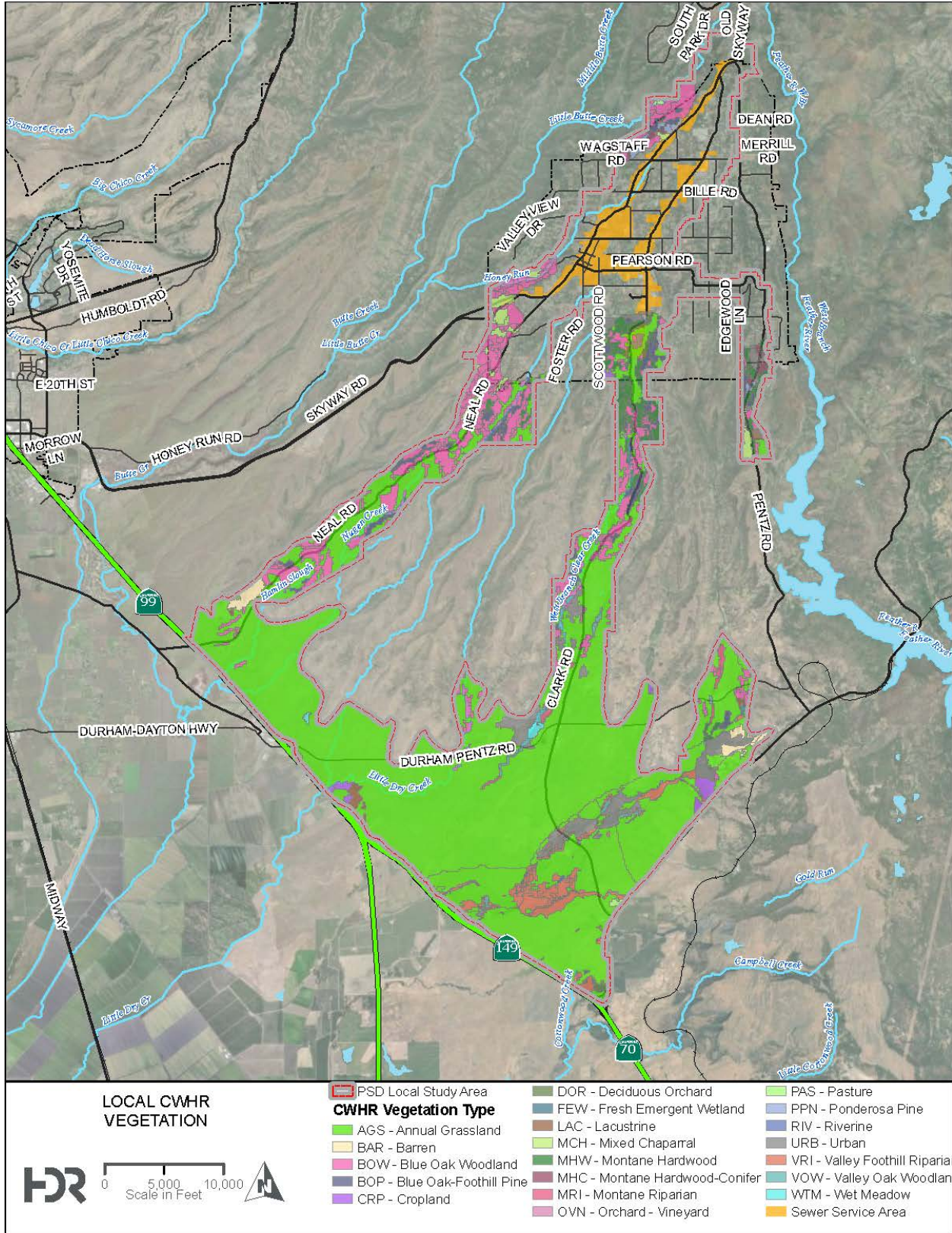


Figure A-6. California Wildlife Habitat Relationships Habitat Types

Table A-4. Biological Constraints with the Potential to Occur in the Study Area

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Rare plants (general)	Applies to all project components	Plants classified as rare in the California Rare Plant Rank system are protected under CEQA.	Rare plant surveys conducted during appropriate seasons according to the overlapping blooming periods of plant species identified as having potential to occur in the study area. An early season survey in April and a late season survey in July would capture the blooming periods of all such plants as shown in Attachment A.2.
Butte County meadowfoam	Local WWTP Site – Neal Road South and Clark Road South Pipeline/Infrastructure – Neal Road South and Clark Road South, Land Discharge	FE / SE	Critical habitat for this species is present immediately adjacent to the southern end of the potential land discharge portion of the study area. If this plant species is found during general rare plant surveys, more extensive surveys to quantify the extent of its presence in the study area should be conducted.
Vernal pool obligate rare plants	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road, Land Discharge	Hoover's spurge (FT) hairy Orcutt grass (FE / SE) Greene's tuctoria (FE / SR)	If habitat assessment / wetland delineation efforts identify vernal pool features within the study area, then surveys for these species should be conducted within those features during their overlapping blooming period (Jul-Sep).
Vernal pool crustaceans	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	Conservancy fairy shrimp (FE) vernal pool fairy shrimp (FT) vernal pool tadpole shrimp (FE)	Critical habitat for vernal pool tadpole shrimp is present within the potential land discharge portion of the study area. If habitat assessment / wetland delineation efforts identify vernal pool features within the study area, then presence of special-status vernal pool crustacean species will be assumed, and a Biological Opinion or Concurrence will be sought from USFWS.
Valley elderberry longhorn beetle	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	FT	If habitat assessment efforts identify elderberry shrubs within the study area, then those shrubs should be mapped and investigated for sign of the presence of this species. The 2017 USFWS Framework for Assessing Impacts to the valley elderberry longhorn beetle (VELB) states the following: <i>The majority of VELB have been documented below 152 meters (500 feet) in elevation. Areas above 152 meters (500 feet) with suitable habitat and known VELB occurrences in that drainage may contain VELB populations in certain circumstances. The Service can assist in determining the likelihood of occupancy above 500 feet.</i> Much of the study area is above 500 feet. However, there is a CNDDDB occurrence of the species from along the Feather River well east of the study area. If elderberry shrubs are found during habitat assessment, it is recommended that informal consultation with USFWS be carried out to determine next steps.

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Anadromous fish (Central Valley steelhead and Central Valley spring-run chinook salmon)	Collection System, Local WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure – Pearson/Pentz Roads, Clark Road and Neal Road, Land Discharge	both FT / (chinook is FT / ST)	Critical habitat for steelhead is present in Little Butte Creek on the outskirts of the Collection System portion of the study area, and Little Dry Creek within the Land Discharge portion of the study area. Critical habitat for steelhead as well as chinook salmon is present in Butte Creek just to the north and west of the study area. These species could occur in multiple creek systems across the study area. A detailed assessment of the creeks within the study area is recommended and depending on results, a National Marine Fisheries Service (NMFS) Biological Assessment may be required if work is to affect these creek systems.
Foothill yellow-legged frog	Applies to all project components	ST / SSC	This species could occur in multiple creek systems across the study area and there are multiple known occurrences of the species from within the study area. Protocol surveys are recommended and depending on results, an Incidental Take Permit (2081) from CDFW may be required.
California red-legged frog	Collection System, WWTP Site – Kunkle, Surface Water Discharge – Kunkle, Pipeline/Infrastructure – Pearson/Pentz Roads	FT / SSC	There appears to be some appropriate habitat for this species within the study area. However, protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the east.
Giant gartersnake	Local WWTP Site – Neal Road South, Land Discharge	FT / ST	Any appropriate habitat for the species should be mapped during habitat assessment. Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west.
Tricolored blackbird	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	ST / SSC	This species is highly colonial and a colony has been present in the past near the south end of the potential land discharge portion of the study area. If during the habitat assessment appropriate nesting habitat for the species is found and the species is detected, then protocol surveys for the species may be warranted.
Western burrowing owl	Local WWTP Site – Neal Road, Pipeline/Infrastructure – Neal Road South, Land Discharge	SSC	Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west. Nevertheless, all small mammal burrow complexes will be mapped and assessed for sign of this species.

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Bald and golden eagles	Collection System, Local WWTP Site – Kunkle and Clark Road North, Pipeline/Infrastructure – Clark Road North, Pearson/Pentz Roads	BAGEPA	Large nests of bald and potential nest sites of golden eagles should be mapped during habitat assessment. Any such nests or nest sites should then be observed during subsequent avian surveys.
Swainson's hawk	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	ST	Any large nests in appropriate (oak savanna or cottonwood riparian) habitat should be assessed for this species during habitat assessment. Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west.
White-tailed kite	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	SFP	Any large nests in appropriate (oak savanna or willow riparian) habitat should be assessed for this species during habitat assessment. Any such nests or nest sites should then be observed during subsequent avian surveys.
American peregrine falcon	Collection System, Local WWTP Site – Kunkle and Clark Road North, Pipeline/Infrastructure – Clark Road North, Pearson/Pentz Roads	SFP	While there are multiple known occurrences of this species from within the study area, the species is more likely to forage in the study area than nest there. There isn't likely to be appropriate nesting habitat for this species in the study area, but that will be more precisely determined during habitat assessment.
California black rail	Local WWTP Site – Clark Road South Pipeline/Infrastructure – Clark Road South, Land Discharge	ST / SFP	There are multiple known occurrences of this species from wetland habitats in the region, including one from within the potential land discharge portion of the study area. Careful assessment of wetland habitats in the study area for their suitability to the needs of this species, may determine that protocol surveys are warranted, and depending on results, informal consultation with CDFW may be recommended, and they may determine an Incidental Take Permit (2081) is required.
Little willow flycatcher	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	SE	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted, but this is unlikely.
California spotted owl	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	SSC	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted.



Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Fisher (West Coast DPS)	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	ST / SSC	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted, but this is unlikely.
Nesting birds	Applies to all project components	California Fish and Game Code (CFGC)	The active nests of most native bird species are CFGC protected, and preconstruction surveys for nesting birds will be required prior to any ground disturbance or vegetation disturbance associated with the project.
Roosting bats	Applies to all project components	SSC	During the habitat assessment effort, any potential bat roosts (bridges, overpasses, buildings, large hollow trees) will be assessed in detail for their suitability and examined closely for sign of bat use. If it is determined that a site is likely used by roosting bats, protocol surveys will be conducted.

Status: Federal Endangered (FE); Federal Threatened (FT); State Endangered (SE); State Threatened (ST); State Candidate Endangered (SCE); State Fully Protected (SFP); State Rare (SR); State Species of Special Concern (SSC); Bald and Golden Eagle Protection Act (BGEPA)

A.4.4 Sensitive Cultural and Tribal Resources

This section represents a preliminary, high-level review of potential cultural resources constraints in the local Project alternatives study area and the area within a 0.25-mile buffer surrounding the study area.² The review should not be considered an identification effort sufficient to complying with local, state, or federal laws. It is recommended that prior to finalizing conceptual design, an archaeological resources inventory and tribal cultural resources study be conducted in compliance with appropriate regulatory framework, including consultation with the appropriate agencies and Native American tribes. About half of the study area has been previously surveyed for archaeological sites; however, most of these surveys occurred over 10 years ago. Professional cultural resources investigations methods and standards change over time, plus environmental factors can expose previously buried cultural resources, bury previously exposed cultural resources, or cause changes to the conditions of previously recorded resources, necessitating the need to conduct new field studies to confirm site locations, assess the current condition of sites, and to find and document previously unknown cultural resources that may exist within the study area.

Based on the records search review described in Section A.4.4.1, the study area exhibits a moderate to high sensitivity for prehistoric, ethnographic, and historical features and buildings in the vicinity of known cultural resources and is largely contingent on proximity to historic roadways, residences, and the town of Paradise, as shown in Figure A-7. Proposed Project activities have the potential to impact any of the cultural resources identified through these efforts and described below, should they be identified within, or potentially in the vicinity of, a proposed work area. Maps depicting archaeological and sensitive Native American site locations are not to be included in copies of documents for general distribution. Archaeological site locations are exempted from the California Public Records Act, as specified in Government Code 6254.10, and from the Freedom of Information Act (Exemption 3), under the legal authority of both the NHPA (PL 102 574, Section 304[a]) and the Archaeological Resources Protection Act (PL 96 95, Section 9[a]).

² This research includes a 0.25-mile buffer surrounding the study area to gather information on potential constraints to provide flexibility in project planning should the study area require expansions for any reason beyond the study area.

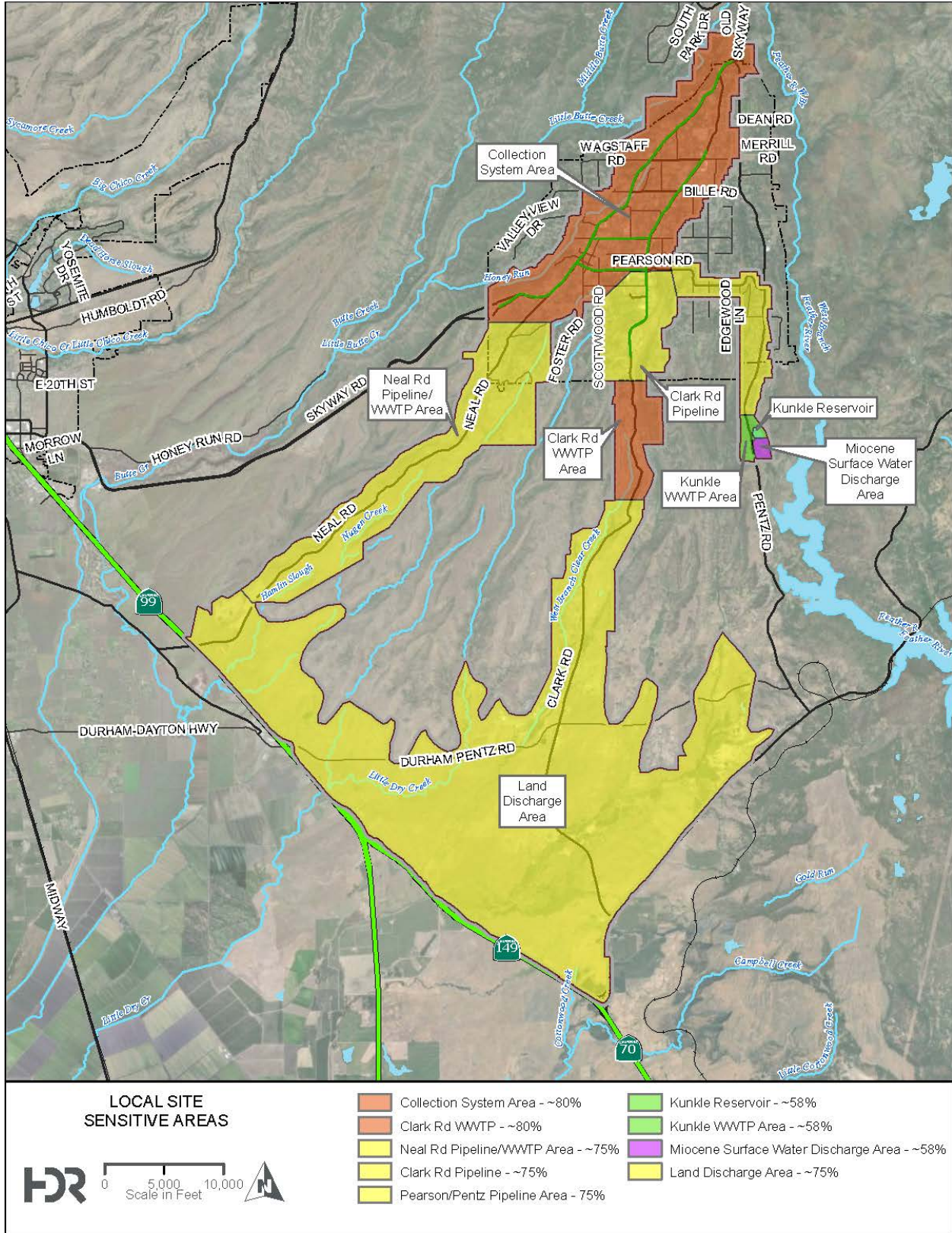


Figure A-7. Sensitivity for Cultural and Tribal Sites

A.4.4.1 Records Search and Results

HDR reviewed records from the California Historical Resources Information System (CHRIS), Northeast Information Center (NEIC) at California State University, Chico, in June and August 2020 to identify previous cultural resources investigations and previously recorded archaeological and historic-period properties within the study area. This research also served to obtain background information pertinent to understanding the archaeology, historical built environment, history, and ethnohistory of the Project vicinity. Relevant data on file at the NEIC included cultural resource records, cultural resource investigation reports, resource location maps, and historic-era maps, National Register of Historic Places (NRHP) listings, California Register of Historical Resources (CRHR) listings, Office of Historic Preservation (OHP) Archaeological Determinations of Eligibility and Built Environment Resource Directory (BERD), 2012 California State Historic Landmarks, 1976 California Inventory of Historic Resources, and the Built Environment Resource Directory. A summary of the information gathered during the records search is provided below, and supporting data is included in a confidential attachment to this memo (see Confidential Attachment A.4).

HDR identified a total of 182 previous cultural resources investigations or related communications within the study area and 0.25-mile buffer (see Confidential Attachment A.4). A total of 57 investigations were conducted within the study area only, 59 investigations were conducted in areas overlapping the study area and the 0.25-mile buffer around the study area, 56 were conducted within the 0.25-mile buffer only, and another 10 investigations were conducted within the 0.25-mile buffer and were immediately adjacent to the study area. The types of investigations previously conducted were for utility projects, private property and development projects, transportation projects, a landfill development, a vernal pool preserve, and tree improvement center projects. No tribal cultural resources were listed in the records search. Most of these investigations (n=162) occurred 10 or more years ago.

A total of 144 cultural resources have been formally recorded within the study area and 0.25-mile buffer examined by HDR and include 11 prehistoric isolated finds,³ three historic-period isolated finds; 45 prehistoric archaeological sites, 25 historic-period archaeological sites, five multicomponent archaeological sites,⁴ and 55 built-environment resources. An additional seven informally documented resources were also identified in the area and consist of two prehistoric archaeological sites and five possible multicomponent archaeological sites.⁵

A review of the United States Geological Survey (USGS) Chico (1949) 15', Paradise, California (1953) 15', and Oroville, California (1944) 15' topographic quadrangle maps was conducted to identify potential cultural resources that may be present in the study area but that may not yet be formally documented, not on file with the NEIC, and subsequently not included in the results of the NEIC records search. This review indicates that Paradise, Southern Pacific Railroad, Crouch Ravine, Coon Ridge, The Narrows, Nugen Canyon, Neal Highway, Clear Creek, Comanche Creek, Clark Road, Honey Run Creek, US Plant Introduction Gardens, Butte Creek, tailings, roads, and

³ Prehistoric isolates are defined herein as three or less artifacts (flakes, groundstone, etc.) per 50 square meters. Prehistoric isolated features, such as a bedrock mortar (BRM), are not treated as isolated finds, but as sites. Historic isolates consist of three or less artifacts per 50 square meters (i.e., several fragments from a single glass bottle are one artifact).

⁴ Multi-component sites are sites that have both prehistoric and historic-period artifacts and/or features.

⁵ These sites were not formally recorded on Department of Parks and Recreation forms and submitted to the CHRIS system for recordation, but the information was captured in reporting.

structures are within the study area and a 0.25-mile buffer, either wholly or partially, and may be considered historic properties which may need to be avoided by the Project, or taken into account to address Project impacts if they cannot be avoided.

Evaluations of resources for their potential eligibility to the NRHP and CRHR assist in determining whether significant resources (i.e., historic properties⁶ and historical resources⁷) are present in a project's boundary and, subsequently, whether a project is having any effects on eligible properties. Of the total 144 cultural resources, 59 were evaluated for eligibility to be listed on the NRHP and/or CRHR.⁸ Of these 59 evaluated resources, 55 were found to not be eligible for listing on the NRHP, one was evaluated as potentially eligible for both the NRHP and CRHR (P-04-1324/499461/499462), one is listed in the NRHP (P-04-3084), and two are recommended not eligible for the CRHR but remain unevaluated for the NRHP. Of note, many of the resources identified within the study area and 0.25-mile buffer were damaged or completely destroyed by the Camp Fire after recordation and evaluation efforts captured in the records search. The potentially eligible (P-04-1324/499461/499462) and one eligible (listed) resource (P-04-3084) are both built environment resources and both appear to have been completely destroyed by the fire from a desktop review of Google Earth and will need to be reassessed for eligibility and integrity if the Project design is unable to avoid them. Reassessment would include a field visit, documentation of current condition and integrity, and consultation the State Historic Preservation Officer. No previously recorded archaeological sites identified during the records search were evaluated as eligible for listing on the NRHP or CRHR and a majority (n=68) remain unevaluated for their potential to be listed on the NRHP or the CRHR.

Under both state and federal statutory requirements, eligible and unevaluated resources that cannot be avoided by the Project must be considered for CRHR and/or NRHP eligibility in order to address Project impacts/effects. Records searches only demonstrate site density within areas that have been previously surveyed. As the above summary demonstrates, numerous previously recorded but unevaluated resources are located throughout the Project study area. However, archaeological and built environment site locations are largely conditioned by the absence/presence of previous cultural resource surveys, i.e. the areas densest with previously recorded resources are also the same areas which have been subject to previous surveys. Additionally, sensitivity for prehistoric archaeological sites is based on a series of variables (landform, proximity to fresh water and tool stone, access to preferred resources, etc.) that are not necessarily equivalent to the variables associated with the absence or presence of historic-era archaeological sites. Accordingly, the absence/presence of previously recorded archaeological and built environment resources do not suggest superiority of any of the local alternatives.

⁶ Historic Properties are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in, the NRHP. Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR § 60.4.

⁷ Historical Resources are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in the CRHR.

⁸ Isolates typically do not provide enough data relevant to understanding past events to meet the NRHP significance criteria and are therefore not considered for potential listing on the NRHP or CRHR. Thus the isolated artifacts will not add constraints to the Project.

A.4.4.2 Tribal Cultural Resources and Potentially Interested Native American Contacts

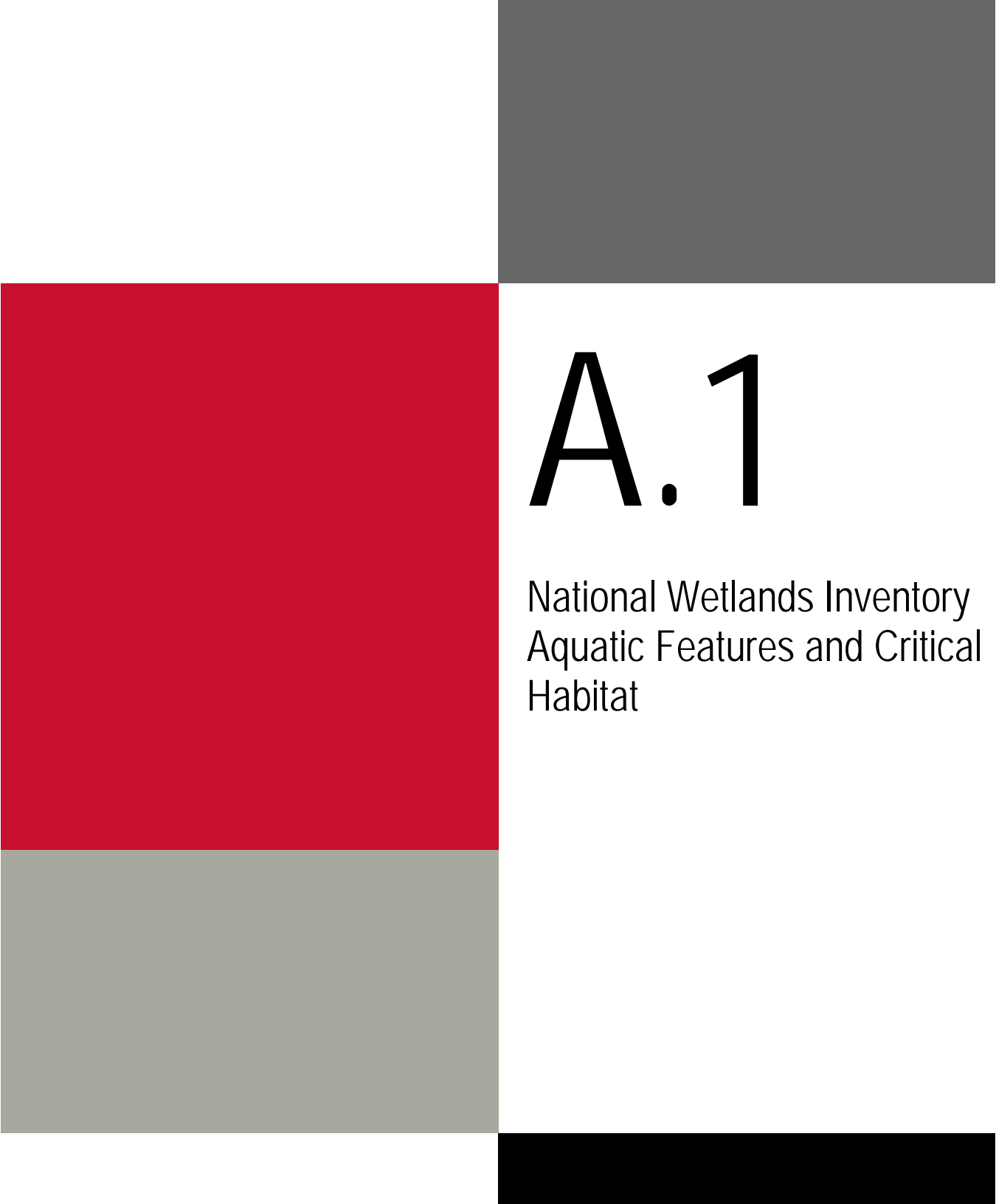
Table A-5 provides a list of tribes and tribal individuals who may have an interest in the Project and expert knowledge of cultural resources of importance to Native American tribes with ancestral ties to the Project area. A search of the Sacred Lands File (SLF) at the Native American Heritage Commission (NAHC) found no sacred lands in the study area or 0.25-mile buffer; however, the absence of specific site information in the SLF does not indicate the absence of cultural resources (see Confidential Attachment A.4).

Table A-5. Tribes and Tribal Representatives Identified by the Native American Heritage Commission Who May Have an Interest in the Project

Tribe	Tribal Representative
Enterprise Rancheria of Maidu Indians of California	Glenda Nelson, Chairperson Reno Franklin, THPO
Grindstone Indian Rancheria of Wintun-Wailaki Indians of California	Ron Kirk, Chairperson
KonKow Valley Band of Maidu	Jessica Lopez, Chairperson
Mechoopda Indian Tribe	Dennis Ramirez, Chairperson Kyle McHenry, THPO
Mooretown Rancheria of Maidu Indians	Benjamin Clark, Chairperson Guy Taylor, Representative
Shoshone Tribe of the Wind River Reservation, Wyoming	Vernon Hill, Chairperson Joshua Mann, THPO
Tsi Akim Maidu	Don Ryberg, Chair

Sources: Native American Heritage Commission (NAHC) letter July 1, 2020; data from Tribal Assessment Directory Tool (TDAT) developed by the Office of Environment and Energy (OEE), accessed July 23, 2020.

Tribal Cultural Resources (TCRs) are defined as a site, feature, place, cultural landscape, sacred place or object, which is of cultural value to a California Native American Tribe, and that is either listed on, or eligible for listing on, the CRHR or a local historical register. Additionally, a project’s lead agency, at its discretion, may choose to treat a resource as a TCR (PRC 21074 (a)(1)(A)-(B)). Traditional Cultural Properties (TCPs) are locations associated with cultural practices or beliefs of a living community that are: 1) rooted in that community’s history; or 2) important in maintaining the continuing cultural identity of a community, and that are listed on or eligible for listing on the NRHP. No TCRs or TCPs were identified in the records search, however, the absence of recorded TCRs and TCPs does not indicate the absence of cultural resources. Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States for Native American tribes or individuals. The Mechoopda Indian Tribe owns lands held in trust within the study area on the east side of the intersection of Highway 99 and Highway 149. Tribal consultation with the Mechoopda Indian Tribe will be necessary to identify potential impacts/effects to ITA.

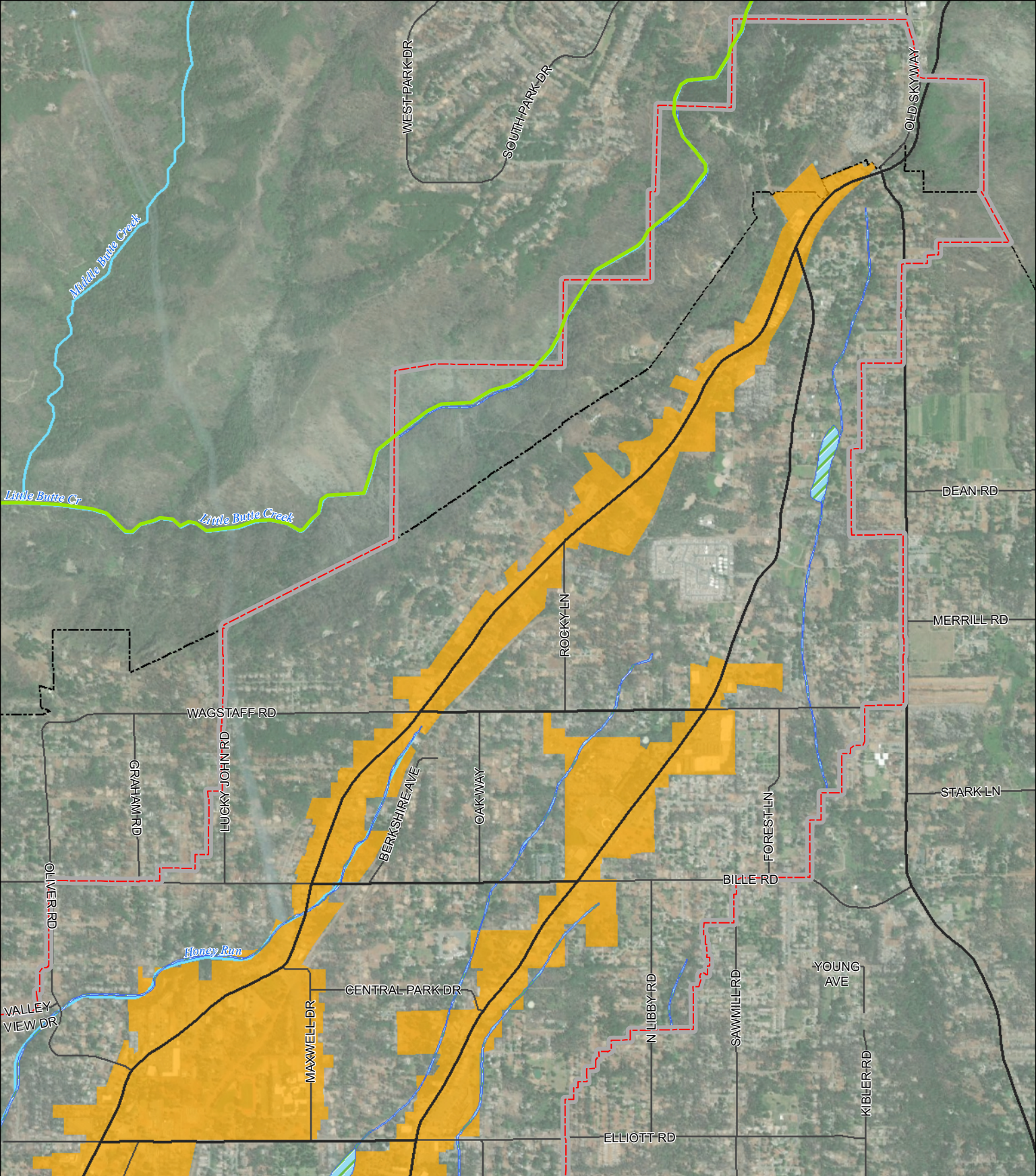


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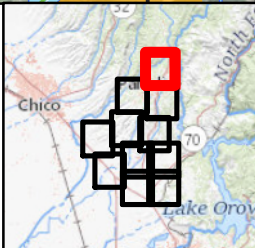
National Wetlands Inventory
Aquatic Features and Critical
Habitat



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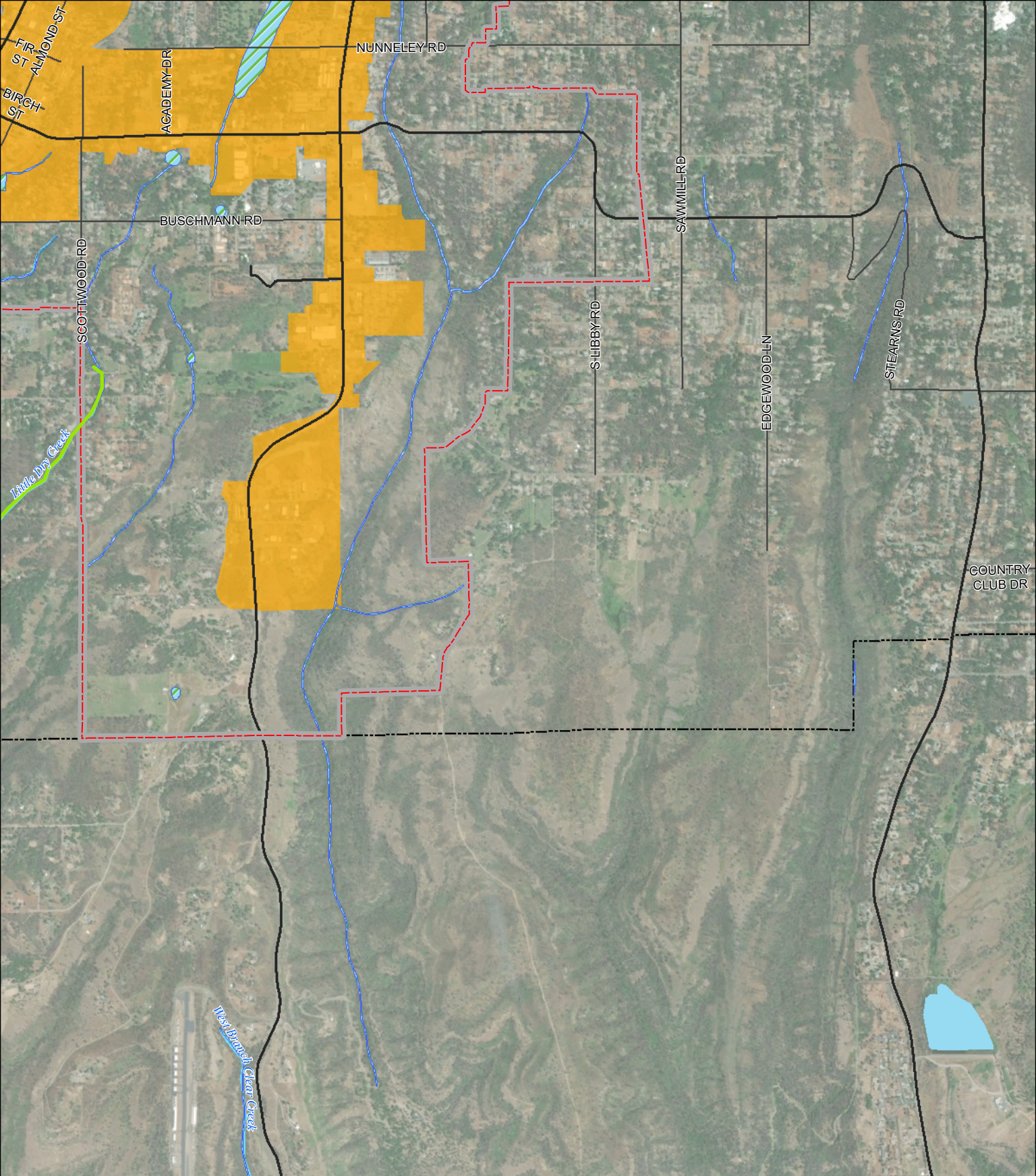
LOCAL CRITICAL HABITAT AND NWI WETLANDS



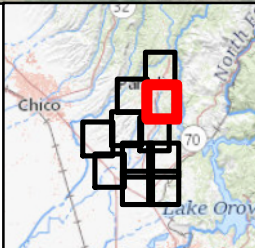
Critical Habitat

- Vernal pool tadpole shrimp
- Chinook Salmon and Steelhead
- Steelhead

- NWI Wetlands
- Waterbodies
- Rivers and Creeks
- Sewer Service Area



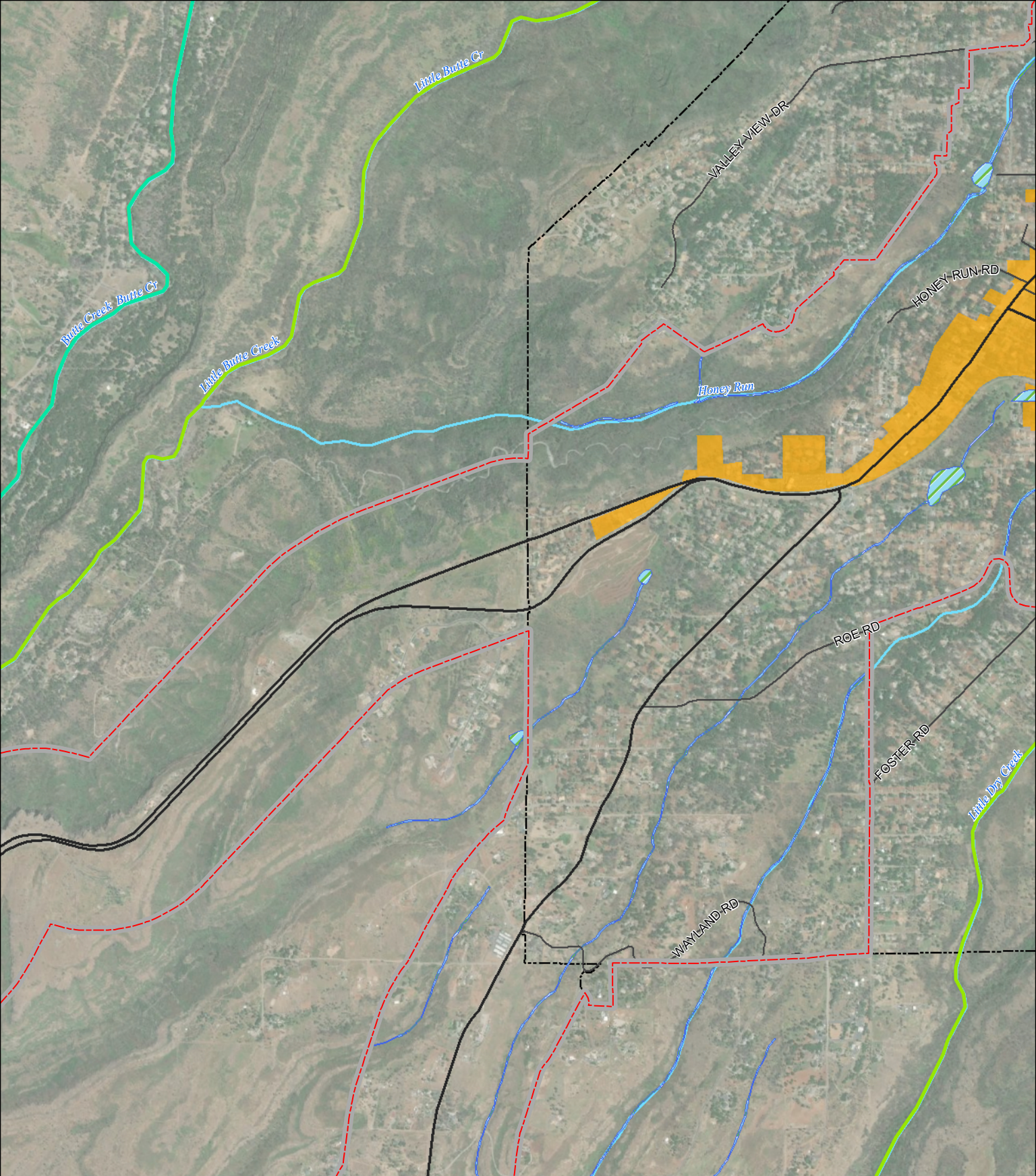
LOCAL CRITICAL HABITAT AND NWI WETLANDS



Critical Habitat

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- Chinook Salmon and Steelhead
- Steelhead

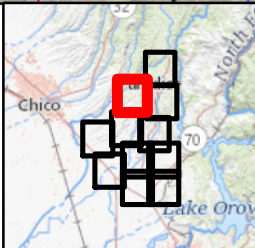
- NWI Wetlands
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- Sewer Service Area



**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



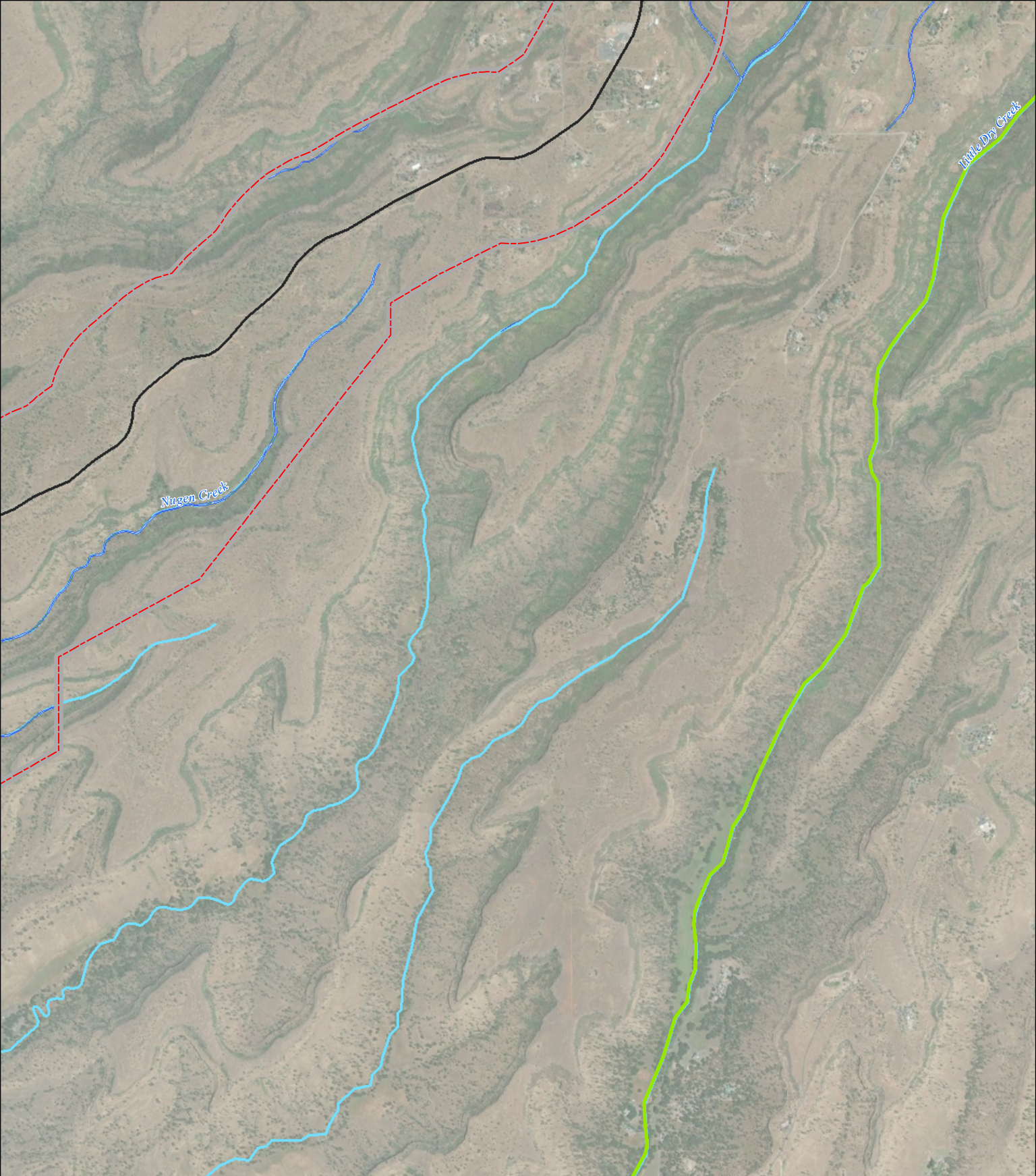
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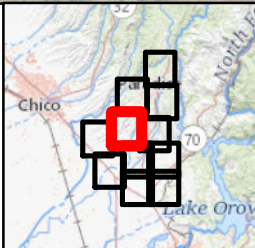
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**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**







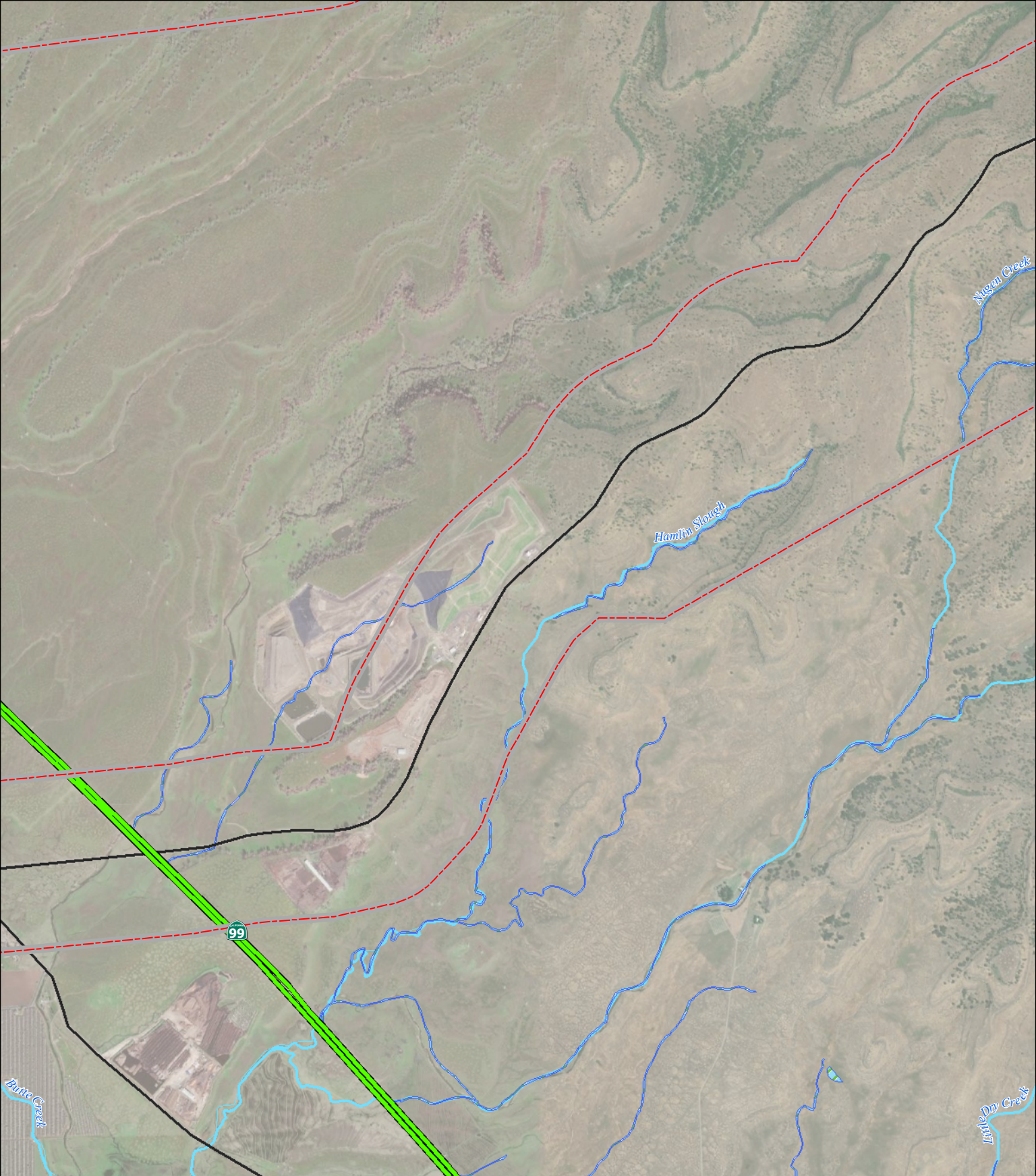
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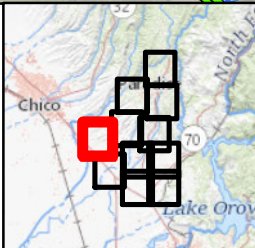
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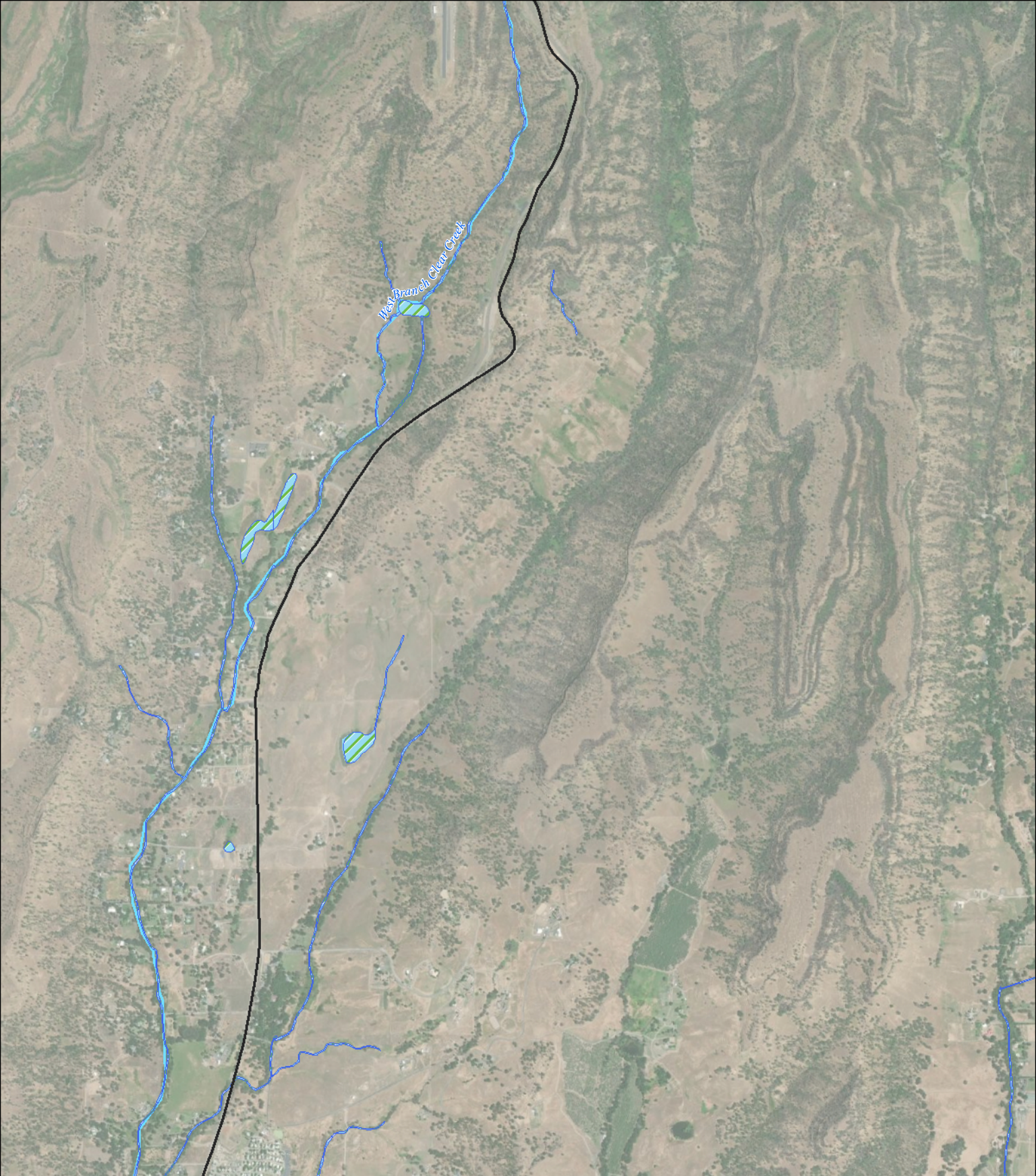
**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



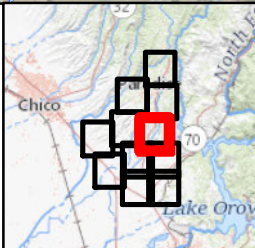
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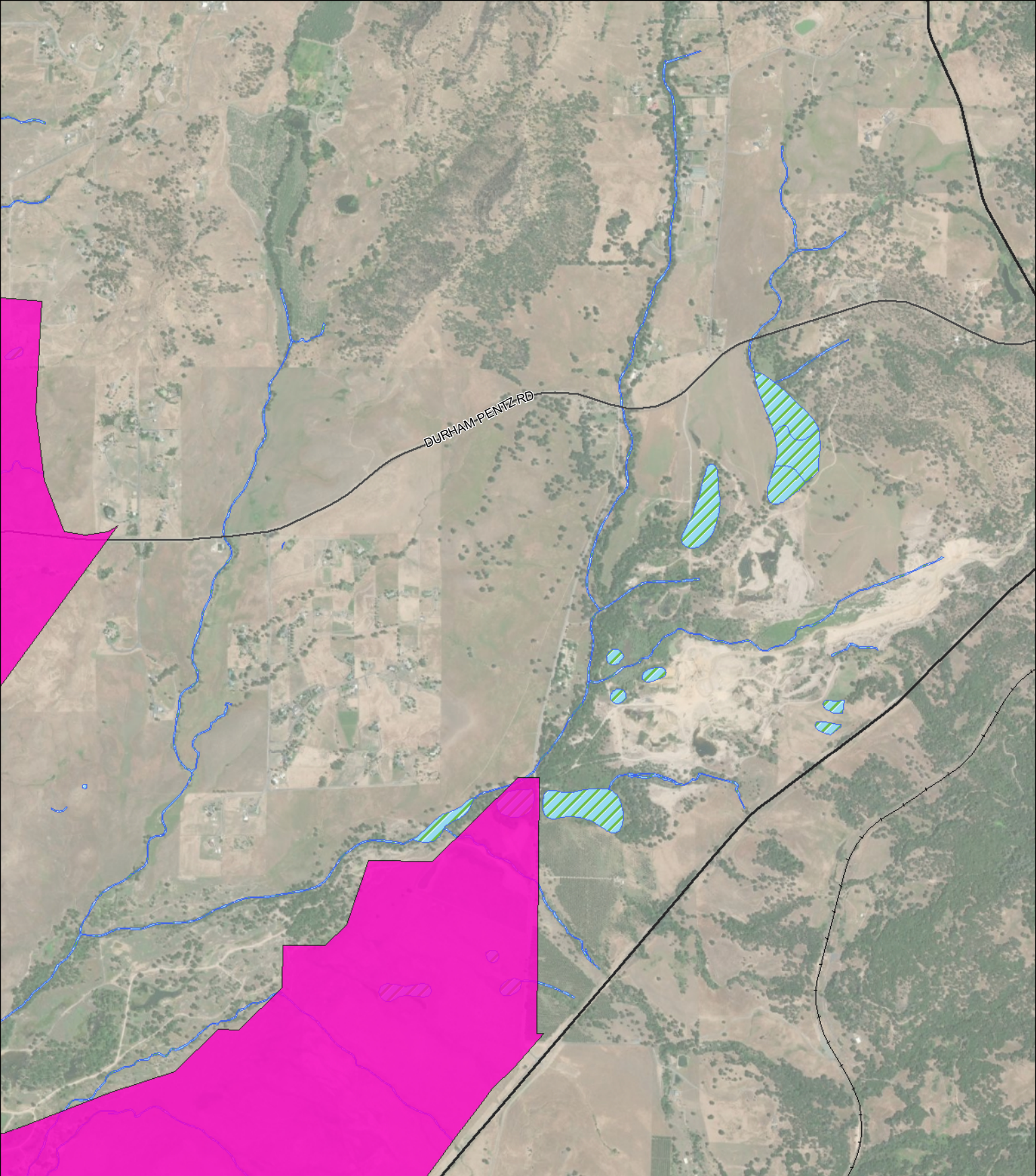
**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



Critical Habitat

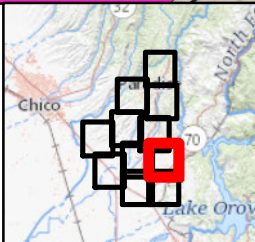
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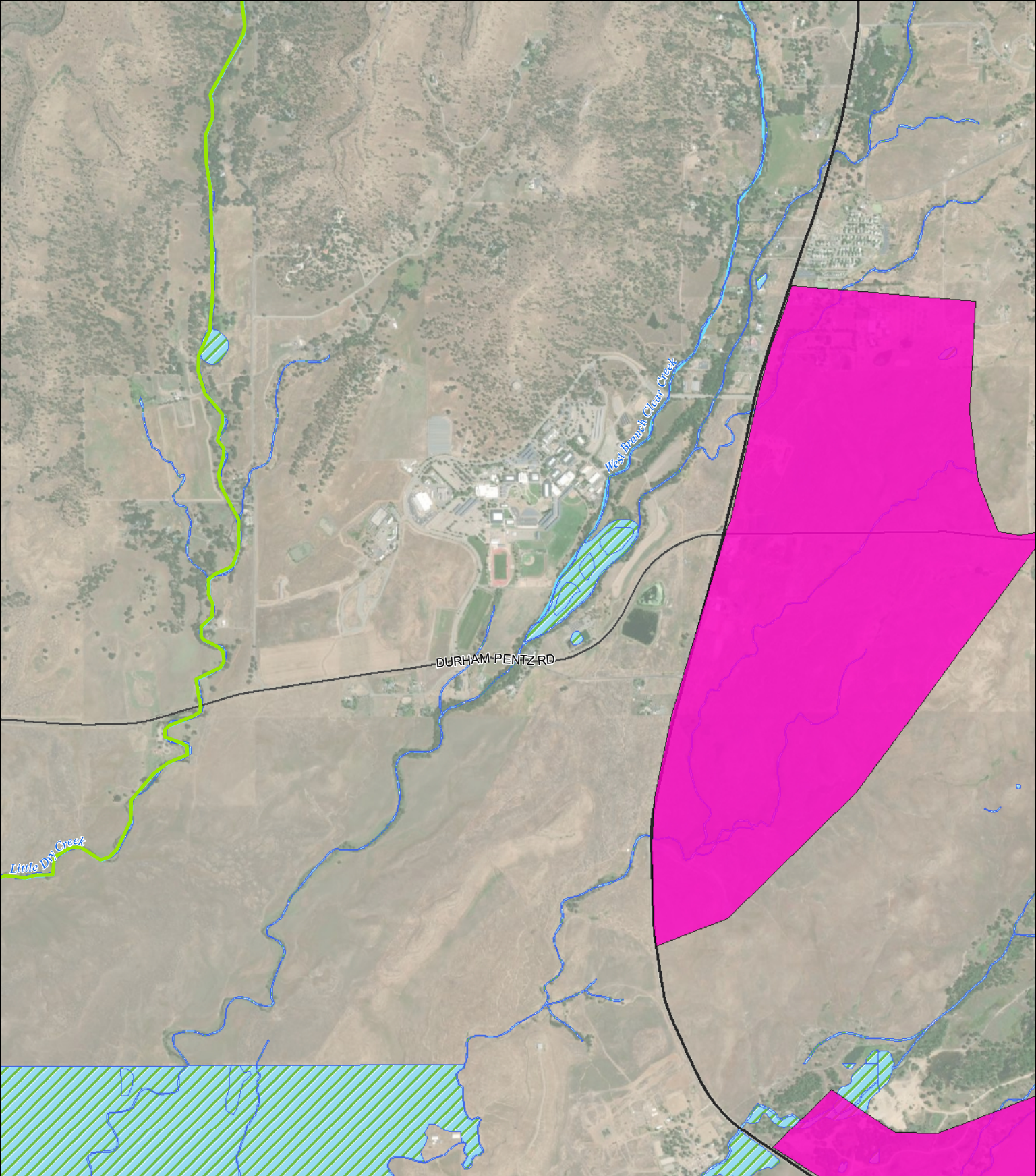
**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



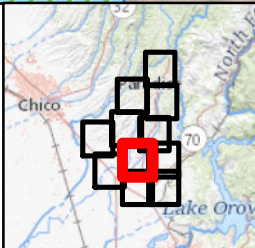
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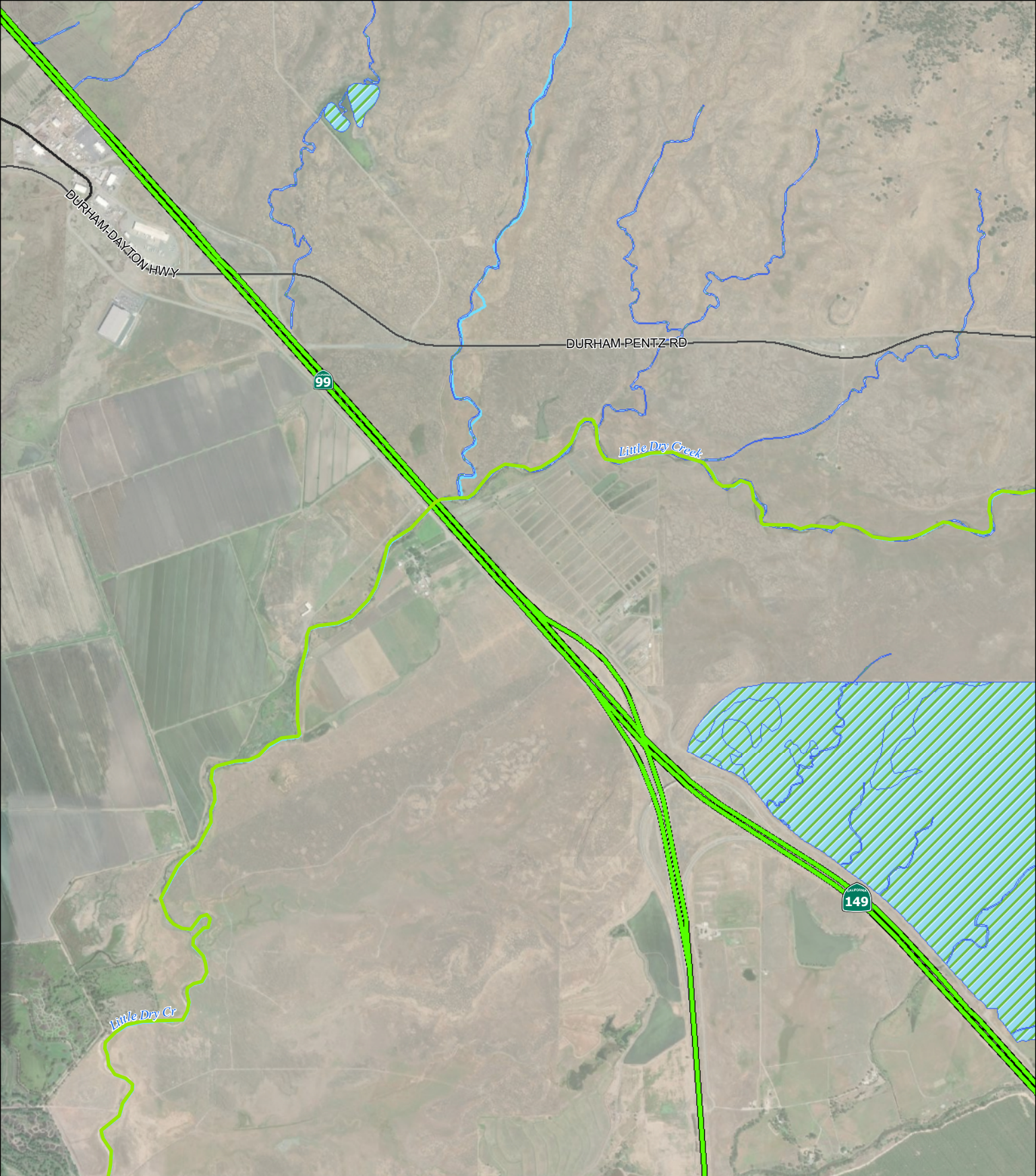
**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



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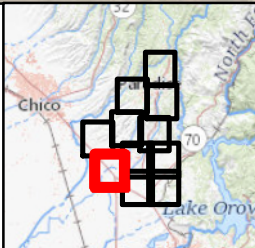
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**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



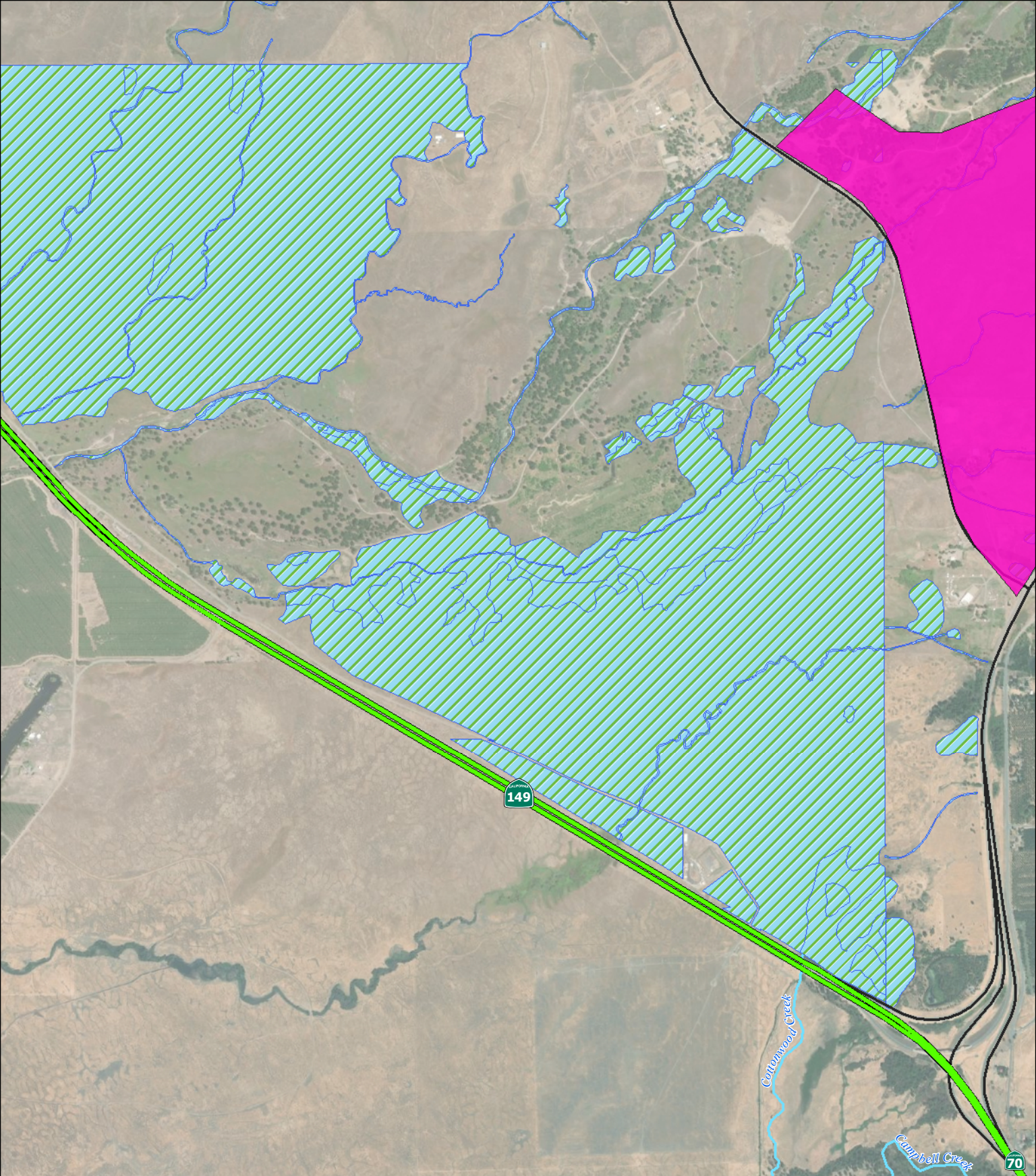
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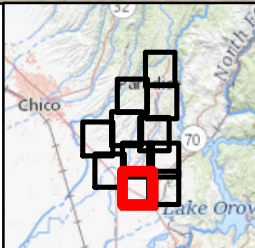
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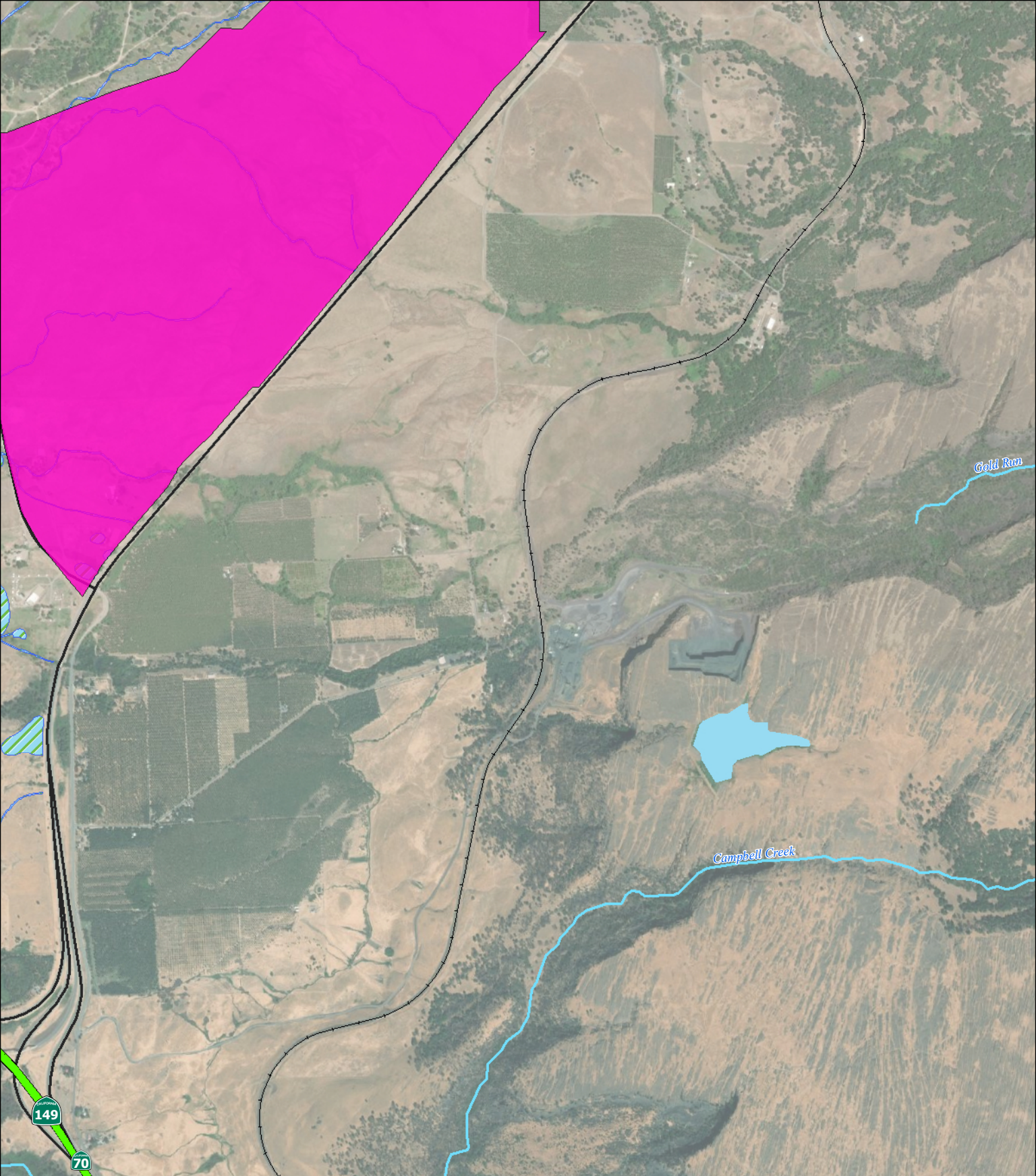
**LOCAL CRITICAL HABITAT
AND NWI WETLANDS**



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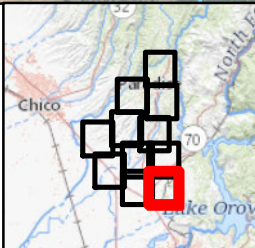
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AND NWI WETLANDS**



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NWI Wetlands

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A.2

Sensitive Biological
Resources



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Attachment A.2 – Sensitive Biological Resources

Table A.2-1. Sensitive Biological Resources with Potential to Occur in the Study Area (Local)

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Plants							
<i>Allium jepsonii</i>	Jepson's onion	None	None	1B.2	Serpentine or volcanic soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 980–4,330 feet. Blooming period: April–August	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Balsamorhiza macrolepis</i>	big-scale balsamroot	None	None	1B.2	Occasionally in serpentine soils in chaparral, cismontane woodland, and grassland. Elevation: 295–5,100 feet. Blooming period: March–June	Y	Collection System, WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center, Land Discharge
<i>Botrychium crenulatum</i>	scalloped moonwort	None	None	2B.2	Bogs, fens, meadows, seeps, marshes, freshwater swamps, montane coniferous forests. Elevation: 4,159–10,758 feet. Sporing period: June–September	N	Entire proposed project area is below the elevational range of the species.
<i>Botrychium minganense</i>	Mingan moonwort	None	None	2B.2	Mesic soils in bogs, fens, lower and upper montane coniferous forest. Elevation: 4,773–7,152 feet. Sporing period: July–September	N	Entire proposed project area is below the elevational range of the species.
<i>Botrychium montanum</i>	western goblin	None	None	2B.1	Mesic soil in meadows, seeps, and montane coniferous forest. Elevation: 4,805–7,150 feet. Sporing period: July–September	N	Entire proposed project area is below the elevational range of the species.



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Campylopodia stenocarpa</i>	flagella-like atractylocarpus	None	None	2B.2	Cismontane woodland, roadsides. Elevation: 935–1,410 feet. (Bryophyte)	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Cardamine pachystigma</i> var. <i>dissectifolia</i>	dissected-leaved toothwort	None	None	1B.2	Chaparral, lower montane coniferous forest, Serpentine outcrops and gravelly serpentine talus. Elevation: 984–3,117 feet.	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Carex xerophila</i>	chaparral sedge	None	None	1B.2	Serpentine and gabbro soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 1,440–2,525 feet. Blooming period: March–June	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - TOP Urban Center
<i>Castilleja rubicundula</i> var. <i>rubicundula</i>	pink creamsacs	None	None	1B.2	Serpentine soils in meadows, seeps, grassland, cismontane woodland, and openings of chaparral. Elevation: 65–2,985 feet. Blooming period: April–June	Y	Potential to occur within any of the project components
<i>Clarkia gracilis</i> ssp. <i>albicaulis</i>	white-stemmed clarkia	None	None	1B.2	Sometimes on serpentine soils in chaparral and cismontane woodland. Elevation: 800–3,560 feet. Blooming period: May–July	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Clarkia mildrediae</i> ssp. <i>mildrediae</i>	Mildred's clarkia	None	None	1B.3	Sandy, usually granitic, soils in cismontane woodland and lower montane coniferous forest. Elevation: 800–5,610 feet. Blooming period: May–August	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Clarkia mosquinii</i>	Mosquin's clarkia	None	None	1B.1	Rocky soils and roadsides in cismontane woodland and lower montane coniferous forest. Elevation: 605–4,890 feet. Blooming period: May–July	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Delphinium recurvatum</i>	recurved larkspur	None	None	1B.2	Alkaline soils in chenopod scrub, cismontane woodland, and grassland. Elevation: 9–2,591 feet. Blooming period: March–June	Y	Potential to occur within any of the project components
<i>Eremogone cliftonii</i>	Clifton's eremogone	None	None	1B.3	Usually in granitic soils in openings of chaparral and montane coniferous forests. Elevation: 1,490–6,825 feet. Blooming period: April–September	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Eriogonum umbellatum</i> var. <i>ahartii</i>	Ahart's buckwheat	None	None	1B.2	Serpentine soils on slopes in openings of chaparral and cismontane woodland. Elevation: 1,310–6,560 feet. Blooming period: June–September	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Erythranthe filicifolia</i>	fern-leaved monkeyflower	None	None	1B.2	Usually in slow-draining ephemeral seeps that are among exfoliating granitic slabs in meadows, chaparral, and lower montane coniferous forest. Elevation: 1,360–5,610 feet. Blooming period: April–June	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Euphorbia hooveri</i>	Hoover's spurge	FT	None	1B.2	Vernal pools. Elevation: 80–820 feet. Blooming period: July–October	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Frangula purshiana</i> ssp. <i>ultramafica</i>	Caribou coffeeberry	None	None	1B.2	Serpentine soils in chaparral, montane coniferous forests, meadows, and seeps. Elevation: 2,705–6,330 feet. Blooming period: May–July	N	Entire proposed project area is below the elevational range of the species.
<i>Fritillaria pluriflora</i>	adobe-lily	None	None	1B.2	Adobe soils in chaparral, cismontane woodland, and grassland. Elevation: 195–2,315 feet. Blooming period: February–April	Y	Potential to occur within any of the project components
<i>Hibiscus lasiocarpus</i> var. <i>occidentalis</i>	woolly rose-mallow	None	None	1B.2	Often in riprap on sides of levees in freshwater marshes and swamps. Elevation: 0–395 feet. Blooming period: June–September	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Imperata brevifolia</i>	California satintail	None	None	2B.1	Mesic soils in chaparral, coastal scrub, Mojavean desert scrub, riparian scrub, meadows and seeps (often alkali). Elevation: 0–3,985 feet. Blooming period: September–May	Y	Potential to occur within any of the project components
<i>Juncus leiospermus</i> var. <i>leiospermus</i>	Red Bluff dwarf rush	None	None	1B.1	Vernally mesic soils in chaparral, cismontane woodland, meadows, seeps, grassland, and vernal pools. Elevation: 110–4,100 feet. Blooming period: March–June	Y	Potential to occur within any of the project components
<i>Layia septentrionalis</i>	Colusa layia	None	None	1B.2	Sandy serpentine soils in chaparral, cismontane woodland, and grassland. Elevation: 325–3,595 feet. Blooming period: April–May	Y	Potential to occur within any of the project components
<i>Lewisia cantelovii</i>	Cantelow's lewisia	None	None	1B.2	Mesic and granitic soils and occasionally serpentine seeps in broadleaved upland and lower montane coniferous forests, chaparral, and cismontane woodland. Elevation: 1,080–4,495 feet. Blooming period: May–October	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Limnanthes floccosa</i> ssp. <i>californica</i>	Butte County meadowfoam	FE	SE	1B.1	Vernal pools and mesic grassland. Elevation: 150–3,050 feet. Blooming period: March–May	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
<i>Monardella venosa</i>	veiny monardella	None	None	1B.1	Heavy clay soils in cismontane woodland and grassland. Elevation: 195–1,345 feet. Blooming period: May and July	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
<i>Orcuttia pilosa</i>	hairy Orcutt grass	FE	SE	1B.1	Vernal pools. Elevation: 150–655 feet. Blooming period: May–September	Y	WWTP Site – Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Packera eurycephala</i> var. <i>lewisrosei</i>	Lewis Rose's ragwort	None	None	1B.2	Serpentine soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 895–6,200 feet. Blooming period: March–September	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Paronychia ahartii</i>	Ahart's paronychia	None	None	1B.1	Cismontane woodland, grassland, and vernal pools. Elevation: 95–1,675 feet. Blooming period: February–June	Y	Potential to occur within any of the project components
<i>Penstemon personatus</i>	closed-throated beardtongue	None	None	1B.2	Metavolcanic soils in chaparral and montane coniferous forests. Elevation: 3,490–6,955 feet. Blooming period: June–October	N	Entire proposed project area is below the elevational range of the species.
<i>Poa sierrae</i>	Sierra blue grass	None	None	1B.3	Openings in lower montane coniferous forest. Elevation: 1,195–4,920 feet. Blooming period: April–July	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Rhynchospora californica</i>	California beaked-rush	None	None	1B.1	Bogs, fens, meadows, seeps, freshwater marshes and swamps, and lower montane coniferous forest. Elevation: 145–3,315 feet. Blooming period: May–July	Y	Potential to occur within any of the project components
<i>Rhynchospora capitellata</i>	brownish beaked-rush	None	None	2B.2	Mesic soils in meadows, seeps, marshes, swamps, and montane coniferous forests. Elevation: 145–6,560 feet. Blooming period: July–August	Y	Potential to occur within any of the project components
<i>Rupertia hallii</i>	Hall's rupertia	None	None	1B.2	Roadsides and openings of cismontane woodland and lower montane coniferous forest. Elevation: 1,785–7,380 feet. Blooming period: June–September	Y	Collection system
<i>Sagittaria sanfordii</i>	Sanford's arrowhead	None	None	1B.2	Fresh water marshes and swamps that are typically shallow. Elevation: 0–2,132 feet. Blooming period: May–October	Y	Land Discharge, Surface Water Discharge - Kunkle
<i>Sedum albomarginatum</i>	Feather River stonecrop	None	None	1B.2	Serpentine soils in chaparral and lower montane coniferous forest. Elevation: 850–6,400 feet. Blooming period: May–June	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Sidalcea robusta</i>	Butte County checkerbloom	None	None	1B.2	Chaparral and cismontane woodland. Elevation: 295–5,250 feet. Blooming period: April–June	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Stuckenia filiformis</i> ssp. <i>alpina</i>	slender-leaved pondweed	None	None	2B.2	Shallow freshwater marshes and swamps. Elevation: 15–7,055 feet. Blooming period: May–July	Y	Land Discharge, Surface Water Discharge - Kunkle
<i>Trifolium jokerstii</i>	Butte County golden clover	None	None	1B.2	Mesic grassland and vernal pools. Elevation: 160–1,575 feet. Blooming period: March–May	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
<i>Tuctoria greenei</i>	Greene's tuctoria	FE	SR	1B.1	Vernal pools. Elevation: 95–3,510 feet. Blooming period: May–September	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Invertebrates							
<i>Branchinecta conservatio</i>	Conservancy fairy shrimp	FE	None	---	Endemic to California vernal pools, almost entirely in the Central Valley, with the exception of one population along the central coast in Ventura County. Majority of sites inhabited by this species are large and turbid pools which remain inundated much longer than typical vernal pools (USFWS 2012).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Branchinecta lynchi</i>	vernal pool fairy shrimp	FT	None	---	Endemic to the grasslands of the Central Valley and the Central and South Coast Range mountains of California, and the Agate Desert of southern Oregon. Found only in cool water vernal pools and vernal pool-like habitats; does not occur in riverine, marine, or other permanent bodies of water (USFWS 2007).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Desmocerus californicus dimorphus</i>	valley elderberry longhorn beetle	FT	None	---	Dependent on host plant, elderberry (<i>Sambucus</i> spp.), which most commonly grows in riparian woodlands, but also in some upland habitats such as oak savannas and annual grasslands. Current presumed range in Central Valley extends from Shasta County south to Fresno County, including the valley floor and lower foothills up to about 500 feet in elevation (USFWS 2017).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Lepidurus packardii</i>	vernal pool tadpole shrimp	FE	None	---	Found only in ephemeral freshwater habitats, including alkaline pools, clay flats, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands. Patchily distributed across the Central Valley from Shasta County south to Tulare County with isolated occurrences in the East Bay Area (USFWS 2007).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge (Critical Habitat present)
Fish							
<i>Acipenser medirostris</i>	green sturgeon (southern DPS)	FT	SSC	---	Spawning occurs primarily in the Sacramento River, but those that spawn in the Feather and Yuba Rivers are also part of the southern DPS. Oceanic waters, bays, and estuaries during non-spawning season. Enters San Francisco Bay late winter through early spring, and spawn occurs from April through early July. Spawn in cool sections of river mainstems in deep pools containing small to medium-sized gravel, cobble, or boulder substrate (NMFS 2015).	N	Sacramento River only
<i>Hypomesus transpacificus</i>	delta smelt	FT	SE	---	Endemic to open waters of San Francisco Bay and Sacramento-San Joaquin River Delta. Distribution includes San Pablo Bay up through Suisun Bay, upstream through the delta to the Sacramento River below Isleton, and the San Joaquin River below Mossdale. Spawning has not been observed in the wild, but is thought to take place in sloughs and shallow edge-water channels in the upper delta and in Montezuma Slough near Suisun Bay. (USFWS 2010).	N	The proposed project area is completely outside the range of this species.



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Mylopharodon conocephalus</i>	hardhead	None	SSC	---	Small to large streams in low to mid-elevation environments. May also inhabit lakes or reservoirs. Preferred stream temperature might easily exceed 68°F, though these fish do not favor low dissolved oxygen levels. Usually found in clear deep streams with a slow but present flow. Though spawning may occur in pools, runs, or riffles, the bedding area will typically be characterized by gravel and rocky substrate. Occurs from Sacramento-San Joaquin and Russian River drainages from the Pit River, Modoc County in the north, to the Kern River, Kern County in the south (UC Davis 2017).	Y	Potential to occur within any of the project components
<i>Oncorhynchus mykiss irideus</i> (pop. 11)	steelhead (Central Valley DPS)	FT	None	---	Includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS does include steelhead from two artificial propagation programs: Coleman National Fish Hatchery Program and Feather River Fish Hatchery Program. Spawning habitat includes gravel-bottomed, fast-flowing, well-oxygenated rivers and streams. Non-spawning habitat includes estuarine and marine waters (NOAA 2019).	Y	Potential to occur within any of the project components (Critical Habitat present)
<i>Oncorhynchus tshawytscha</i> (pop. 6)	chinook salmon (Central Valley spring-run ESU)	FT	ST	---	Currently found in the Sacramento-San Joaquin River Delta, the Sacramento River and its tributaries, including American, Yuba and Feather Rivers, and Mill, Deer, and Butte Creeks. The numbers of adults are dependent on pool depth and volume, amount of cover, and proximity to gravel. Water temperatures greater than 80°F are lethal to adults (NMFS 2016).	Y	Potential to occur within any of the project components (Critical Habitat present)



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Oncorhynchus tshawytscha</i> (pop. 7)	chinook salmon (Sacramento River winter-run ESU)	FE	SE	---	Currently found in the Sacramento River below Keswick Dam. Spawns in the Sacramento River but not its tributaries. Requires clean, cold water over gravel beds with water temperatures between 42 and 57°F for spawning (NMFS 2011).	N	Sacramento River only
Amphibians							
<i>Rana boylei</i>	foothill yellow-legged frog	None	ST, SSC	---	Ranges in the northern half of California except for the Central Valley, Modoc Plateau, and eastern side of the Sierra Nevada Mountains. Generally found in shallow flowing streams and rivers with at least cobble sized substrate. Breeding generally occurs at the margins of wide shallow channels with reduced flow variation near tributary confluences. Specifically, egg masses are placed in low flow locations on or under rocks with preferred substrates being boulders, cobbles, or gravel. Eggs have been found at depths to 34 inches in water velocities of 0 – 0.69 feet per second and at most 40 feet from shore. Maximum water temperature for breeding is 79°F and 48 to 70°F is the preferred range. Tadpoles avoid areas below 55°F and prefer temperatures between 62°F and 72°F (Thomson et al. 2016).	Y	Potential to occur within any of the project components
<i>Rana cascadae</i>	Cascades frog	None	SCE, SSC	---	Ranges in the Cascade Mountains in Shasta, Siskiyou, and Trinity Counties and the northern Sierra Nevada Mountains in Butte, Plumas, Shasta and Tehama Counties. Generally found in a wide range of aquatic habitats and wet meadows that do not freeze. Not often seen on land. Breeding habitat generally consists of montane lentic areas with a preference for small shallow spring fed ponds (Thomson et al. 2016).	N	The proposed project area is completely outside the range of this species.



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Rana draytonii</i>	California red-legged frog	FT	SSC	---	Ponds and streams in humid forests, woodlands, grasslands, coastal scrub, and streambanks with plant cover in lowlands or foothills. Breeding habitat includes permanent or ephemeral water sources; lakes, ponds, reservoirs, slow streams, marshes, bogs, and swamps. Ephemeral wetland habitats require animal burrows or other moist refuges for estivation when the wetlands are dry. Occurs from sea level to 5,000 feet in elevation. Occurs along the Coast Ranges from Mendocino County south to northern Baja California, and inland across the northernmost reaches of the Sacramento Valley and locally south through portions of the Sierra Nevada foothills as far south as northern Tulare County (Nafis 2020).	Y	Potential to occur within any of the project components
<i>Spea hammondi</i>	western spadefoot	None	SSC	---	Generally found in grasslands, oak woodlands, coastal sage scrub, and chaparral in washes, floodplains, alluvial fans, playas, and alkali flats. Natural and artificial water bodies are used for breeding. Specifically, vernal pools used by this species have an average ponding duration of 81 days, and successful recruitment occurs in ponds that last on average 21 days longer than larval development time. Pool temperature requirements are from 48 to 90°F. Pools with invasive species, such as crayfish (<i>Pacifasticus</i> spp.), or bullfrogs (<i>Lithobates catesbeianus</i>) often, but not always, exclude this species. (Thomson et al. 2016).	Y	Potential to occur within any of the project components
Reptiles							
<i>Actinemys marmorata</i>	northwestern pond turtle	None	SSC	---	Generally occurs in various water bodies including permanent and ephemeral systems either natural or artificial. Upland habitat that is at least moderately undisturbed is required for nesting and overwintering, in soils that are loose enough for excavation (Thomson et al. 2016).	Y	Potential to occur within any of the project components

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Phrynosoma blainvillii</i>	Blainville's horned lizard	None	SSC	---	Ranges in the southern half of California outside of the desert, along the foothills of the Sierra Nevada Mountains to Butte County, and along the Central Coast ranges up to Contra Costa County. Generally occurs in sage scrub, dunes, alluvial scrub, annual grassland, chaparral, oak, riparian, and Joshua tree woodland, coniferous forest, and saltbush scrub. Needs loose, fine soils for burrowing, open areas for basking, and dense foliage for cover. Negatively associated with Argentine ants (<i>Linepithema humi</i>) (Thomson et al. 2016).	Y	Potential to occur within any of the project components
<i>Thamnophis gigas</i>	giant gartersnake	FT	ST	---	Marshes, sloughs, ponds, small lakes, low gradient streams, irrigation and drainage canals, rice fields and their associated uplands from sea level to 400 feet in elevation. Upland habitat should have burrows or other soil crevices suitable for snakes to reside during their dormancy period (November- mid March). Formerly ranged in the Central Valley from Butte County to Buena Vista Lake in Kern County, but now thought to be absent south of Fresno and in Stanislaus County (USFWS 2012).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Birds							
<i>Accipiter gentilis</i>	northern goshawk	None	SSC	---	Nests in mature and old-growth coniferous forests at high elevations in the Sierra Nevada, Cascade, North Coast, and Transverse Ranges. Prefers stands with Pacific Ponderosa pine (<i>Pinus ponderosa</i> var. <i>pacifica</i>), Jeffrey pine (<i>Pinus jeffreyi</i>), Lodgepole pine (<i>Pinus contorta</i>), Douglas-fir (<i>Pseudotsuga menziesii</i>), and rarely pinyon-juniper (<i>Pinus monophylla</i> and <i>Juniperus</i> spp.) or quaking aspen (<i>Populus tremuloides</i>). Prefers stands with larger trees, denser canopies, and relatively open understories (Shuford and Gardali 2008).	Y	Collection System

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Agelaius tricolor</i>	tricolored blackbird	None	ST, SSC	---	Mostly a year-round resident in California. Common locally throughout Central Valley and in coastal districts from Sonoma County south. Breeds locally in northeastern California. In winter, becomes more widespread along the central coast and San Francisco Bay area, and can be found in portions of the Colorado Desert (Hamilton 2004). Preferred nesting habitat includes cattails (<i>Typha</i> spp.), bulrushes (<i>Schoenoplectus</i> spp.), Himalayan blackberry (<i>Rubus armeniacus</i>), and agricultural silage. Dense vegetation is preferred but heavily lodged cattails not burned in recent years may preclude settlement. Need access to open water. Strips of emergent vegetation along canals are avoided as nest sites unless they are about 30 feet or more wide but in some ponds, especially where associated with Himalayan blackberries and deep water, settlement may be in narrower fetches of cattails. (CDFW 2020).	Y	WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
<i>Aquila chrysaetos</i>	golden eagle	BGEPA	SFP	---	Uncommon resident in hills and mountains throughout California, and an uncommon migrant and winter resident in the Central Valley and Mojave Desert. Prefers rolling foothills and mountain terrain, wide arid plateaus deeply cut by streams and canyons, open mountain slopes, cliffs, and rock outcrops. (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Athene cunicularia</i>	burrowing owl	None	SSC	---	Resident in much of the state in open, dry grasslands and various desert habitats. Requires open areas with mammal burrows; especially those of California ground squirrel (<i>Otospermophilus beecheyi</i>) Inhabits rolling hills, grasslands, fallow fields, sparsely vegetated desert scrub, vacant lots and other open human disturbed lands such as airports and golf courses. Absent from northwest coast and elevations above 5,500 feet (CDFW 2020).	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Buteo swainsoni</i>	Swainson's hawk	None	ST	---	Nests in oak savanna and cottonwood riparian areas adjacent to foraging habitat of grasslands, agricultural fields, and pastures where they often follow farm equipment to gather killed and maimed rodents. Increasingly also nests in sparse stands of gum trees (<i>Eucalyptus</i> spp.) and Australian pines (<i>Casuarina equisetifolia</i>) and often forage along roadsides and grassy highway medians. Breeding resident in the Central Valley, Klamath Basin, Northeastern Plateau, and in juniper-sagebrush flats of Lassen County. Limited breeding reported from Lanfair Valley, Owens Valley, Fish Lake Valley, and Antelope Valley. Winters primarily in Argentina, with most birds absent from California October through February, though a few overwinter in the Sacramento-San Joaquin River Delta. Prolific migrant through southern California in spring and fall, with large mixed-age groups of birds frequently observed kettling high overhead on thermals or foraging together on freshly cut agricultural fields (CDFW 2020).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Circus hudsonius</i>	northern harrier	None	SSC	---	Nests on the ground in patches of dense, tall vegetation in undisturbed areas. Breed and forage in a variety of open habitats such as marshes, wet meadows, weedy borders of lakes, rivers and streams, grasslands, pastures, croplands, sagebrush flats, and desert sinks (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Coccyzus americanus occidentalis</i>	western yellow-billed cuckoo	FT	SE	---	Has declined drastically in California due primarily to loss of habitat. Requires riparian woodland with dense cover; primarily old-growth cottonwood (<i>Populus</i> spp.) forests with willow (<i>Salix</i> spp.) understory, but will also nest in overgrown orchards adjacent to streams and dense thickets alongside marshes. Persists in small numbers along the Sacramento River between Red Bluff and Colusa, the Feather River between Yuba City and the Bear River, Owens Valley, the Kern River Valley, the Colorado River Valley, the Santa Ana River near Prado Basin, and the San Luis Rey River in northern San Diego County (USFWS 2019).	N	Sacramento River only
<i>Contopus cooperi</i>	olive-sided flycatcher	None	SSC	---	Nests in a wide variety of forest and woodland habitats below 9,000 feet in elevation in the coastal and mountainous portions of California. Occurs only as a migrant elsewhere in the state. Prefers forests and woodlands with adjacent meadows, lakes, or open terrain for foraging (CDFW 2020)	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Elanus leucurus</i>	white-tailed kite	None	SFP	---	Fairly common resident of the Central Valley, coast, and Coast Range Mountains. Nests in oak savanna, oak and willow riparian, and other open areas with scattered trees near foraging habitat. Forages in open grasslands, meadows, farmlands, and emergent wetlands. Often seen hover foraging over roadsides or grassy highway medians (CDFW 2020).	Y	Collection System, WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Empidonax traillii brewsteri</i>	little willow flycatcher	None	SE	---	Uncommon summer resident in wet meadows and montane riparian habitats from 2,000 to 8,000 feet in elevation. Breeds in California from Tulare County north, along the western side of the Sierra Nevada and Cascade Ranges, extending to the coast in northern California (Craig and Williams 1998).	Y	Collection System



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Falco peregrinus anatum</i>	American peregrine falcon	None	SFP	---	Breeds near wetlands, lakes, rivers, or other waters on cliffs, banks, dunes or mounds, mostly in woodland, forest, and coastal habitats. Nest is a scrape on a depression or ledge in an open site. May use man-made structures (such as bridges, skyscrapers, or electrical towers), large snags, or trees for nesting (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Haliaeetus leucocephalus</i>	bald eagle	BGEPA	SE, SFP	---	Permanent resident in the highest Coast Range mountains, across the Cascade Range, and down the Sierra Nevada to the eastern Transverse Ranges of San Bernardino and Riverside Counties. Uncommon migrant and winter visitor to lowland rivers, lakes, and reservoirs. Nests in large, old-growth, or dominant live trees with open branchwork, especially ponderosa pine (<i>Pinus ponderosa</i>). Requires large bodies of water or rivers with abundant fish, and adjacent snags (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
<i>Icteria virens</i>	yellow-breasted chat	None	SSC	---	Nests in early-successional riparian habitats with a well-developed shrub layer and an open canopy. Restricted to narrow borders of streams, creeks, sloughs, and rivers. Often nest in dense thickets of blackberry (<i>Rubus</i> spp.) and willow (<i>Salix</i> spp.) (Shuford and Gardali 2008).	Y	Collection System, WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center, Land Discharge
<i>Lanius ludovicianus</i>	loggerhead shrike	None	SSC	---	Shrublands and open woodlands with a fair amount of grass cover and areas of bare ground. Requires tall shrubs or trees, fences, or power lines for hunting perches and territorial advertisement. Also requires open areas of short grasses, forbs, or bare ground for hunting, large shrubs or trees for nest placement, and thorny vegetation or barbed wire fences for impaling prey. Ranges across most of the state, but absent from the highest mountains and the northwest forests and coast (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Laterallus jamaicensis coturniculus</i>	California black rail	None	ST, SFP	---	Saline, brackish, and fresh emergent wetlands. Scarce, but true abundance difficult to determine due to small size and extremely secretive nature. Known to nest at scattered locations in the San Francisco Bay Area and Delta region, Point Reyes National Seashore, San Luis Obispo and Orange Counties, as well as the Imperial and Lower Colorado River Valleys. Appears intermittently and sparingly at a few locations in the Sacramento Valley (CDFW 2020).	Y	WWTP Site –Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
<i>Melospiza melodia</i>	song sparrow (Modesto population)	None	SSC	---	Often found in emergent freshwater marshes dominated by bulrushes (<i>Scirpus</i> spp.), cattails (<i>Typha</i> spp.), and willow (<i>Salix</i> spp.). Also nests in riparian forests of valley oak (<i>Quercus lobata</i>) with a sufficient understory of blackberry (<i>Rubus</i> spp.), along vegetated irrigation canals and levees, and in recently planted valley oak restoration sites. Found throughout the Sacramento Valley, from the delta north to Chico (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
<i>Progne subis</i>	purple martin	None	SSC	---	Present in California from mid-March through late September. Requires concentrations of nesting cavities, relatively open air space above accessible nest sites, and relatively abundant aerial insect prey. In the coastal mountains, Cascade Range, and Sierra Nevada foothills, inhabits open forests, woodlands, and riparian areas. Extirpated as a breeder from most of the Central Valley except the Sacramento area where it has taken to nesting in hollow-box bridges.	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Riparia riparia</i>	bank swallow	None	ST	---	A colonial nester in riparian and lacustrine bluffs or cliffs with fine-textured or sandy soils into which the nest cavities are dug. Also nests in earthen banks as well as sand and gravel pits. Declined drastically in the state over the 20th Century due to loss of riparian habitat and stabilization of natural banks. Currently most numerous in the Sacramento Valley along the Sacramento, Feather, and American Rivers, and Cache Creek in western Yolo County. Scarce and very local on the central coast. Occurs elsewhere in the state as an uncommon to rare migrant (CDFW 2020).	N	Sacramento River only
<i>Setophaga petechia</i>	yellow warbler	None	SSC	---	Usually found in riparian deciduous habitats in summer: cottonwoods (<i>Populus</i> spp.), willows (<i>Salix</i> spp.), alders (<i>Alnus</i> spp.), and other small trees and shrubs typical of low, open-canopy riparian woodland. Also breeds in montane shrubbery in open coniferous forests (CDFW 2020).	Y	Potential to occur within any of the project components
<i>Strix nebulosa</i>	great gray owl	None	SE	---	Breeds in red fir (<i>Abies magnifica</i>), lodgepole pine (<i>Pinus contorta</i> ssp. <i>murrayana</i>), and mixed coniferous habitats, always near wet meadows. Nests in large, broken-topped snags usually 25 to 72 feet above the ground. A rarely seen resident at 4,500 to 7,500 feet in elevation in the Sierra Nevada Range, from the vicinity of Quincy south to the Yosemite region. (CDFW 2020).	N	The proposed project area is completely below the elevation range of this species.
<i>Strix occidentalis occidentalis</i>	California spotted owl	None	SSC	---	Older forests in areas of high canopy cover, with a multi-layered canopy, old decadent trees, a high number of large trees, and coarse downed woody debris. In California, ranges throughout the west slopes of the Sierra Nevada Mountains, and down the Coast Range Mountains from Carmel south through the Transverse Ranges nearly to Baja California (Shuford and Gardali 2008).	Y	Collection System

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Vireo bellii pusillus</i>	least Bell's vireo	FE	SE	---	Once occupied much of the Central Valley, but has disappeared from most its former range, and is now restricted to southern California from southern Inyo and Monterey Counties south through the South Coast and Inland Empire regions. Obligate riparian breeder, favoring cottonwood (<i>Populus</i> spp.), willow (<i>Salix</i> spp.), and oak (<i>Quercus</i> spp.) woodlands, and mule fat (<i>Baccharis salicifolia</i>) scrub along watercourses (USFWS 2006).	N	Extirpated from Sacramento Valley since the mid-1980s.
<i>Xanthocephalus xanthocephalus</i>	yellow-headed blackbird	None	SSC	---	Nests in fresh marshes with tall, emergent vegetation such as bulrushes (<i>Schoenoplectus</i> spp.) and cattails (<i>Typha</i> spp.) adjacent to deep water (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure – Neal Road, Land Discharge
Mammals							
<i>Antrozous pallidus</i>	pallid bat	None	SSC	---	Ranges across nearly all of California except for high elevation portions of the Sierra Nevada Mountains and Del Norte, western Siskiyou, Humboldt, and northern Mendocino Counties. Generally found in a wide variety of habitats but with some preference for drier areas. Day roosts are in caves, crevices, mines, and occasionally in hollow trees and buildings (CDFW 2020).	Y	Potential to occur within any of the project components
<i>Aplodontia rufa californica</i>	Sierra Nevada mountain beaver	None	SSC	---	Ranges across the Sierra Nevada Mountains from Shasta and Lassen Counties south to Tulare County. Generally found in dense riparian forests and open shrubscapes around most forest types. Specifically found in forests with open to moderate canopy cover and a dense understory near water. Requires deep friable soils and a cool moist microclimate (CDFW 2020).	N	The proposed project area is completely outside the range of this species.



Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
<i>Corynorhinus townsendii</i>	Townsend's big-eared bat	None	SSC	---	Ranges throughout California except for high elevation portions of the Sierra Nevada Mountains. Generally prefers mesic habitats but known to occur in all non-alpine habitats of California. Roosting occurs in caves, tunnels, mines, buildings, or other structures and this species may use different roosting sites for day and night (CDFW 2020).	Y	Potential to occur within any of the project components
<i>Eumops perotis californicus</i>	western mastiff bat	None	SSC	---	Ranges throughout all of Southern California, the central coast, and the Sierra Nevada Mountains. Generally occurs in open, arid, or semi-arid habitats. Roosts in rock crevices and buildings. (CDFW 2020).	Y	Potential to occur within any of the project components
<i>Lasiurus blossevillii</i>	western red bat	None	SSC	---	Ranges across the Central Valley, as well as the coast and Coast Range mountains from Mendocino County south, and east across the Los Angeles area into the Inland Empire region. Occurs in most habitats except desert and alpine areas. Roosts in trees, sometimes shrubs, and typically at the margins of habitats (CDFW 2020).	Y	Potential to occur within any of the project components
<i>Pekania pennanti</i>	fisher (West Coast DPS)	None	ST, SSC	---	Large areas of mature, dense forest stands with snags and greater than 50% canopy closure. Uncommon permanent resident of the Sierra Nevada, Cascades, and Klamath Mountains; also found in a few areas in the North Coast Ranges (USFWS 2014).	Y	Collection System
<i>Taxidea taxus</i>	American badger	None	SSC	---	Ranges across nearly all of California except northernmost Humboldt and Del Norte Counties. Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils (CDFW 2020).	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge

Status: Federal Endangered (FE); Federal Threatened (FT); State Endangered (SE); State Threatened (ST); State Candidate Endangered (SCE); State Fully Protected (SFP); State Rare (SR); State Species of Special Concern (SSC); Bald and Golden Eagle Protection Act (BGEPA); California Native Plant Society (CNPS) State Rare Plant Rankings: 1B = Rare, Threatened, or Endangered in California and Elsewhere, 2B = Rare, Threatened, or Endangered in California, but More Common Elsewhere, Threat Ranks – 0.1 = Seriously threatened in California, 0.2 = Fairly threatened in California, 0.3 = Not very threatened in California

The CWHR habitat types mapped in the project area include:

- Annual Grassland (AGS)
- Barren (BAR)
- Blue Oak-Foothill Pine (BOP)
- Blue Oak Woodland (BOW)
- Cropland (CRP)
- Deciduous Orchard (DOR)
- Fresh Emergent Wetland (FEW)
- Lacustrine (LAC)
- Mixed Chaparral (MCH)
- Montane Hardwood Conifer (MHC)
- Montane Hardwood (MHW)
- Montane Riparian (MRI)
- Pasture (PAS)
- Ponderosa Pine (PPN)
- Riverine (RIV)
- Urban (URB)
- Valley Oak Woodland (VOW)
- Valley Foothill Riparian (VRI)
- Wet Meadow (WTM)

Table A.2-2. Special-Status Species with the Potential to Occur in the Project Area and Associated CWHR Habitats

Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations ^a
Plants					
<i>Allium jepsonii</i>	Jepson's onion	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
<i>Balsamorhiza macrolepis</i>	big-scale balsamroot	—	—	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, PAS, PPN, VOW
<i>Campylopodia stenocarpa</i>	flagella-like atractylocarpus	—	—	2B.2	BAR, BOP, BOW, MHC, MHW, MRI, PPN, VOW
<i>Cardamine pachystigma</i> var. <i>dissectifolia</i>	dissected-leaved toothwort	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
<i>Carex xerophila</i>	chaparral sedge	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
<i>Castilleja rubicundula</i> var. <i>rubicundula</i>	pink creamsacs	—	—	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
<i>Clarkia gracilis</i> ssp. <i>albicaulis</i>	white-stemmed clarkia	—	—	1B.2	ASP, BOP, BOW, MCH, MHC, MHW, PPN
<i>Clarkia mildrediae</i> ssp. <i>mildrediae</i>	Mildred's clarkia	—	—	1B.3	ASP, BOP, BOW, MHC, MHW, PPN
<i>Clarkia mosquinii</i>	Mosquin's clarkia	—	—	1B.1	ASP, BAR, BOP, BOW, MHC, MHW, PPN
<i>Delphinium recurvatum</i>	recurved larkspur	—	—	1B.2	AGS, ASP, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW
<i>Eremogone cliftonii</i>	Clifton's eremogone	—	—	1B.3	BOP, MCH, MCP, MHC, MHW, MRI, PPN
<i>Eriogonum umbellatum</i> var. <i>ahartii</i>	Ahart's buckwheat	—	—	1B.2	ASP, BOP, BOW, MCH, MCP, MHC, MHW, PPN
<i>Erythranthe filicifolia</i>	fern-leaved monkeyflower	—	—	1B.2	BOP, MCH, MHC, MRI, PPN, WTM
<i>Euphorbia hooveri</i>	Hoover's spurge	FT	—	1B.2	AGS, WTM
<i>Fritillaria pluriflora</i>	adobe-lily	None	None	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, PAS, PPN, VRI, VOW



Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations ^a
<i>Hibiscus lasiocarpus</i> var. <i>occidentalis</i>	woolly rose-mallow	None	None	1B.2	BAR, FEW, WTM
<i>Imperata brevifolia</i>	California satintail	None	None	2B.1	MCH, MCP, MHC, MRI, VRI, WTM
<i>Juncus leiospermus</i> var. <i>leiospermus</i>	Red Bluff dwarf rush	None	None	1B.1	AGS, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
<i>Layia septentrionalis</i>	Colusa layia	None	None	1B.2	AGS, BOP, BOW, MCH, MCP, MHC, MHW, PAS, PPN, VOW, WTM
<i>Lewisia cantelovii</i>	Cantelow's lewisia	None	None	1B.2	ASP, BOP, BOW, MCH, MHC, MHW, MRI, PPN, WTM
<i>Limnanthes floccosa</i> ssp. <i>californica</i>	Butte County meadowfoam	FE	SE	1B.1	AGS, WTM
<i>Monardella venosa</i>	veiny monardella	None	None	1B.1	AGS, BOP, BOW, MHC, MHW, PAS, PPN, VOW
<i>Orcuttia pilosa</i>	hairy Orcutt grass	FE	SE	1B.1	AGS, WTM
<i>Packera eurycephala</i> var. <i>lewisrosei</i>	Lewis Rose's ragwort	None	None	1B.2	BOP, BOW, MCH, MHC, MHW, PPN, VOW
<i>Paronychia ahartii</i>	Ahart's paronychia	None	None	1B.1	AGS, BOP, BOW, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
<i>Poa sierrae</i>	Sierra blue grass	None	None	1B.3	BOP, MHC, PPN, WTM
<i>Rhynchospora californica</i>	California beaked-rush	None	None	1B.1	BOP, FEW, MHC, MRI, PPN, WTM
<i>Rhynchospora capitellata</i>	brownish beaked-rush	None	None	2B.2	BOP, FEW, MHC, MRI, PPN, WTM
<i>Rupertia hallii</i>	Hall's rupertia	None	None	1B.2	BAR, BOP, BOW, MHC, MHW, PPN
<i>Sagittaria sanfordii</i>	Sanford's arrowhead	None	None	1B.2	FEW
<i>Sedum albomarginatum</i>	Feather River stonecrop	None	None	1B.2	BOP, MCH, MHC, PPN
<i>Sidalcea robusta</i>	Butte County checkerbloom	None	None	1B.2	BOP, BOW, MCH, MHC, MHW, MRI, PPN
<i>Stuckenia filiformis</i> ssp. <i>alpina</i>	slender-leaved pondweed	None	None	2B.2	FEW
<i>Trifolium jokerstii</i>	Butte County golden clover	None	None	1B.2	AGS, PAS, WTM
<i>Tuctoria greenei</i>	Greene's tuctoria	FE	SR	1B.1	AGS, WTM
Invertebrates					
<i>Branchinecta conservatio</i>	Conservancy fairy shrimp	FE	None	---	AGS, WTM
<i>Branchinecta lynchi</i>	vernal pool fairy shrimp	FT	None	---	AGS, WTM
<i>Desmocerus californicus dimorphus</i>	valley elderberry longhorn beetle	FT	None	---	AGS, VRI
<i>Lepidurus packardii</i>	vernal pool tadpole shrimp	FE	None	---	AGS, WTM
Fish					
<i>Mylopharodon conocephalus</i>	hardhead	None	SSC	---	LAC, RIV
<i>Oncorhynchus mykiss irideus</i> (pop. 11)	steelhead (Central Valley DPS)	FT	None	---	RIV



Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations ^a
<i>Oncorhynchus tshawytscha</i> (pop. 6)	chinook salmon (Central Valley spring-run ESU)	FT	ST	---	RIV
Amphibians					
<i>Rana boylei</i>	foothill yellow-legged frog	—	ST, SSC	—	MRI, RIV
<i>Rana draytonii</i>	California red-legged frog	FT	SSC	—	AGS, LAC, MCH, MHC, MRI, PPN, RIV, WTM
<i>Spea hammondi</i>	western spadefoot	None	SSC	---	AGS, BOP, BOW, LAC, MRI, RIV, WTM
Reptiles					
<i>Actinemys marmorata</i>	northwestern pond turtle	None	SSC	---	FEW, LAC, MRI, RIV, VRI
<i>Phrynosoma blainvillii</i>	Blainville's horned lizard	None	SSC	---	AGS, BAR, BOP, BOW, MCH, MHC, MRI, PPN, VRI, VOW
<i>Thamnophis gigas</i>	giant gartersnake	FT	ST	---	FEW, LAC, RIV
Birds					
<i>Accipiter gentilis</i>	northern goshawk	—	SSC	—	BOP, MRI, PPN
<i>Agelaius tricolor</i>	tricolored blackbird	None	ST, SSC	---	AGS, CRP, FEW, PAS, VRI, WTM
<i>Aquila chrysaetos</i>	golden eagle	—	FP	—	AGS, BOP, MHC, PAS
<i>Athene cucularia</i>	burrowing owl	None	SSC	---	AGS, BAR, PAS, URB
<i>Buteo swainsoni</i>	Swainson's hawk	None	ST	---	AGS, BOW, PAS, URB, VRI, VOW, WTM
<i>Circus hudsonius</i>	northern harrier	None	SSC	---	AGS, CRP, FEW, PAS, WTM
<i>Contopus cooperi</i>	olive-sided flycatcher	—	SSC	—	BOP, LAC, MHC, MRI, PPN, RIV, WTM
<i>Elanus leucurus</i>	white-tailed kite	—	FP	—	AGS, BOP, BOW, CRP, FEW, PAS, URB, VRI, VOW, WTM
<i>Empidonax traillii brewsteri</i>	little willow flycatcher	—	SE	—	MRI, WTM
<i>Falco peregrinus anatum</i>	American peregrine falcon	None	SFP	---	BOP, FEW, MRI, PPN, URB
<i>Haliaeetus leucocephalus</i>	bald eagle	—	SE, FP	—	LAC, MHC, MRI, PPN, RIV
<i>Icteria virens</i>	yellow-breasted chat	None	SSC	---	MRI, VRI
<i>Lanius ludovicianus</i>	loggerhead shrike	None	SSC	---	AGS, BAR, BOW, PAS, VOW
<i>Laterallus jamaicensis coturniculus</i>	California black rail	None	ST, SFP	---	FEW, WTM
<i>Melospiza melodia</i>	song sparrow (Modesto population)	None	SSC	---	FEW, VRI
<i>Progne subis</i>	purple martin	None	SSC	---	BOP, MHC, MHW, MRI, PPN
<i>Setophaga petechia</i>	yellow warbler	—	SSC	—	BOP, MHC, MRI, PPN, VRI
<i>Strix occidentalis occidentalis</i>	California spotted owl	—	SSC	—	BOP, MHC, MRI, PPN
<i>Xanthocephalus xanthocephalus</i>	yellow-headed blackbird	—	SSC	—	FEW



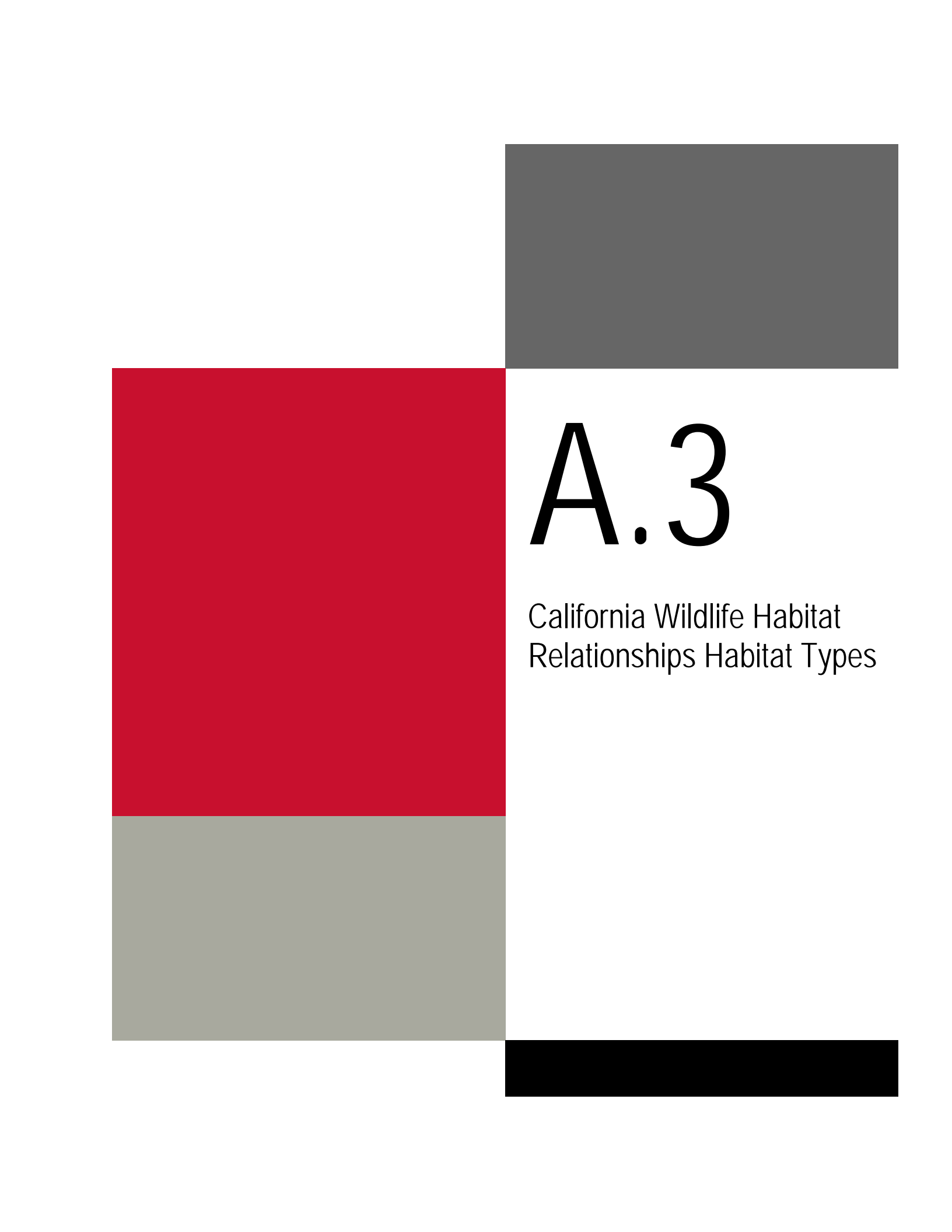
Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations ^a
Mammals					
<i>Antrozous pallidus</i>	pallid bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
<i>Corynorhinus townsendii</i>	Townsend's big-eared bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
<i>Eumops perotis</i>	western mastiff bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, PPN, URB, VOW
<i>Lasiurus blossevillii</i>	western red bat	None	SSC	---	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
<i>Pekania pennanti</i>	fisher	FC	ST, SSC	—	MHC, PPN
<i>Taxidea taxus</i>	American badger	—	SSC	—	AGS, BAR

^a Associations are derived from detailed habitat description in species table.

CWHR habitat acronyms are defined in text above.

Notes: FE = federal endangered; FT = federal threatened; FC = federal candidate; SE = state endangered; ST = state threatened; FP = fully protected; SSC = species of special concern; SR = state rare; CRPR = California Rare Plant Rank; 1B = plants rare, threatened, or endangered in California and elsewhere; 2B = plants rare, threatened, or endangered in California, but more common elsewhere.

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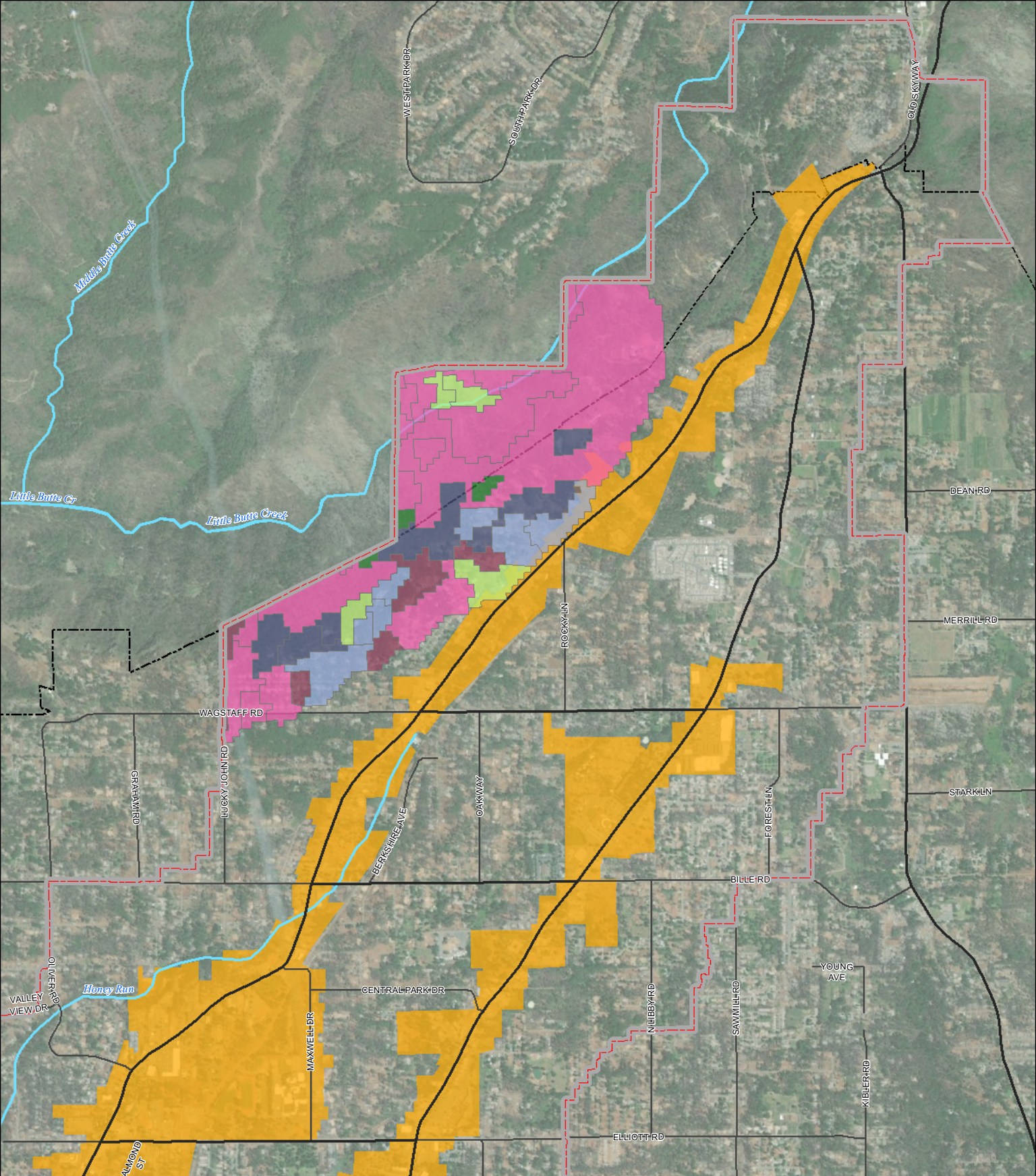


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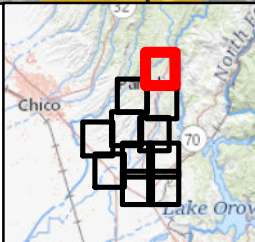
California Wildlife Habitat
Relationships Habitat Types



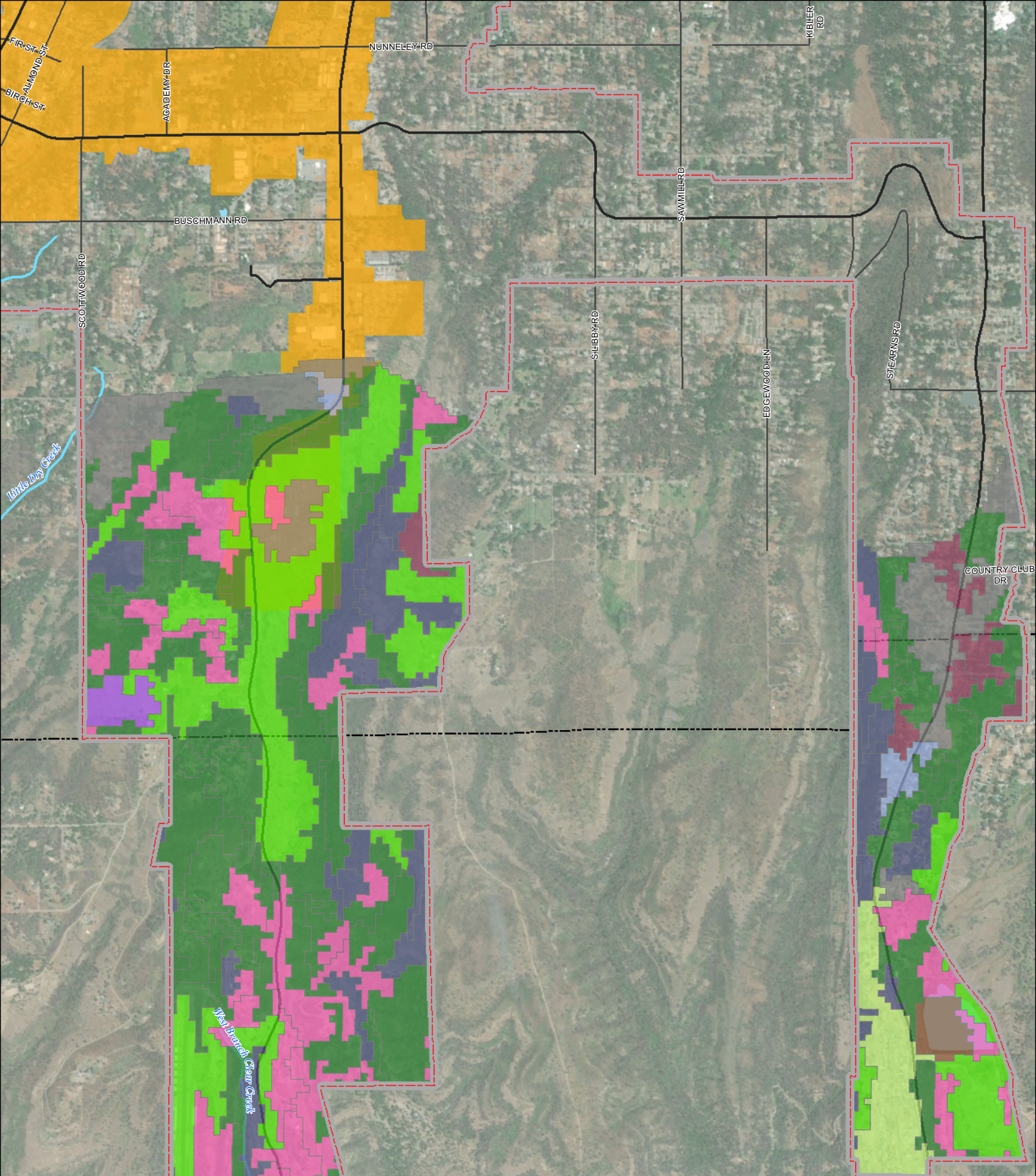
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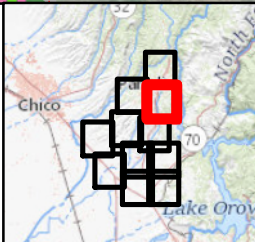
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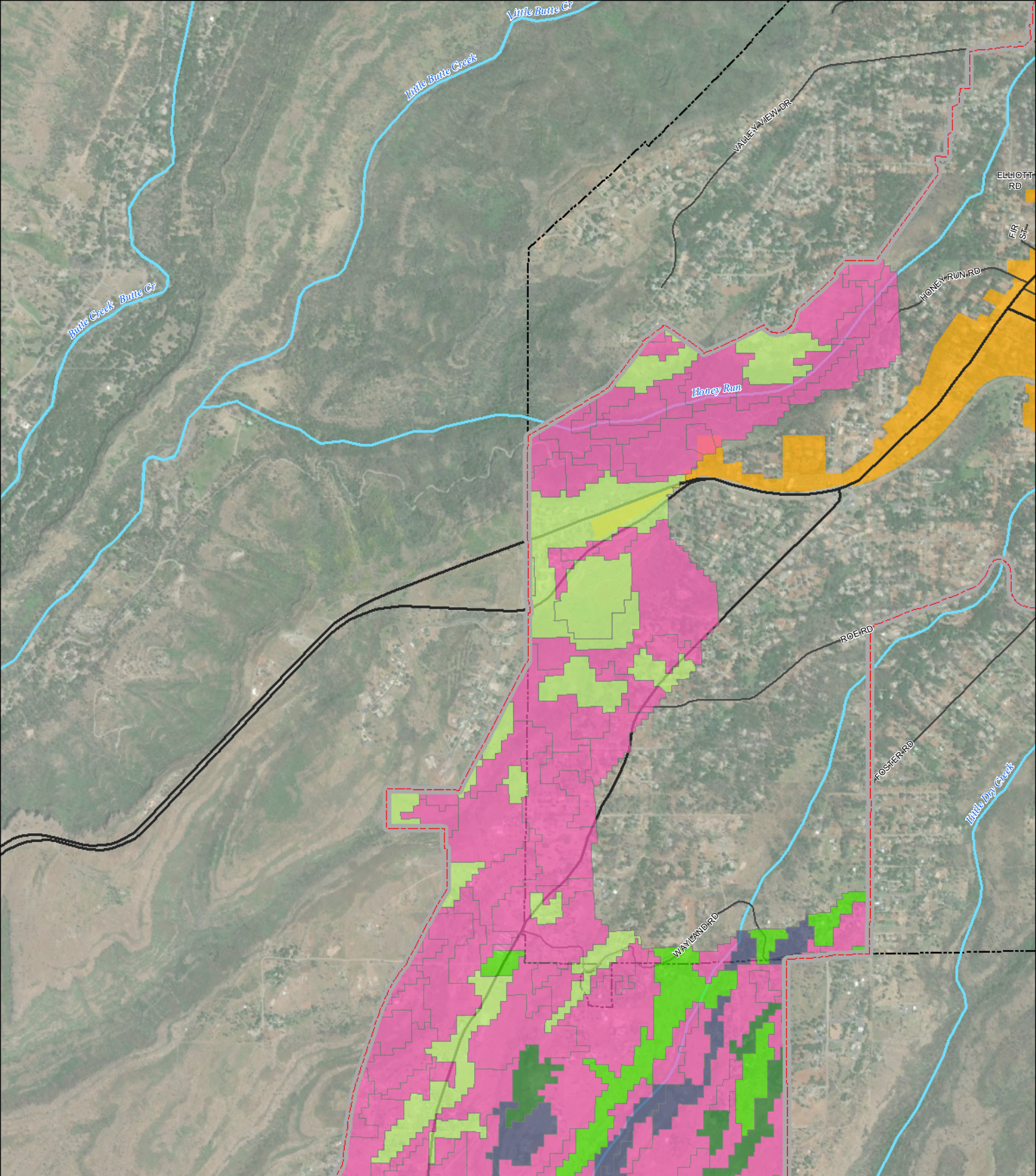
- PSD Local Study Area
- CWHR Vegetation Type**
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- PPN - Ponderosa Pine
- Sewer Service Area
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- MHC - Montane Hardwood-Conifer



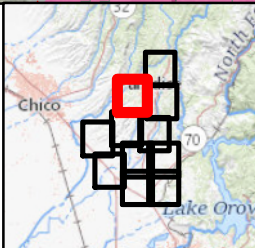
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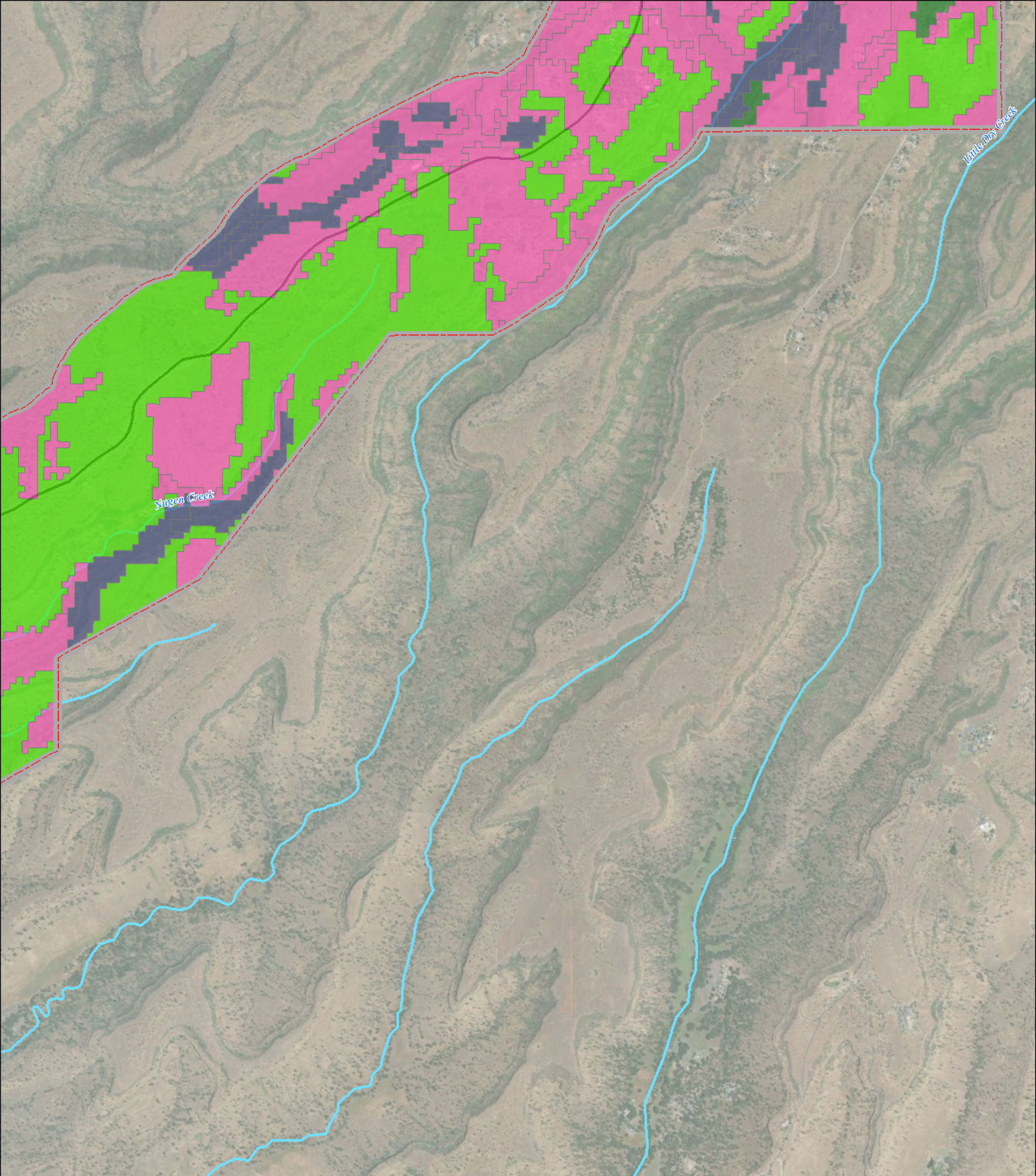
- PSD Local Study Area
- CWHR Vegetation Type**
- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- CRP - Cropland
- LAC - Lacustrine
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- MHC - Montane Hardwood-Conifer
- PPN - Ponderosa Pine
- URB - Urban
- Sewer Service Area



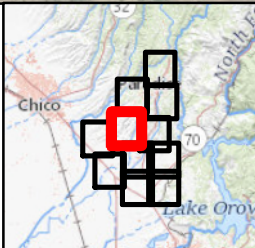
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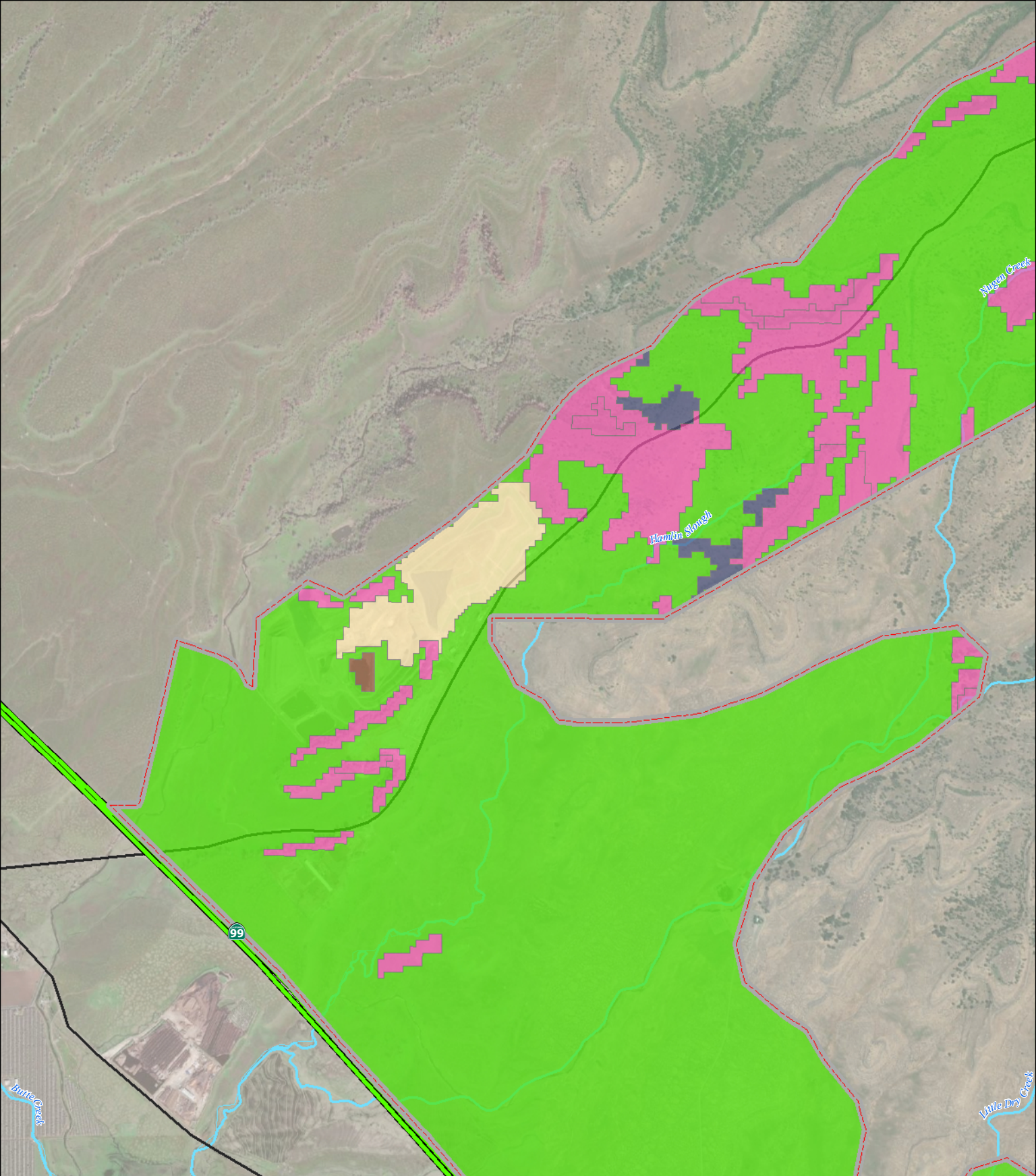
- PSD Local Study Area
- CWHR Vegetation Type**
- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- URB - Urban
- Sewer Service Area



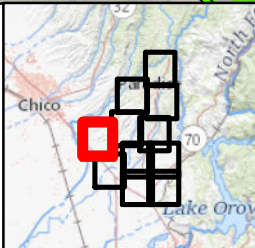
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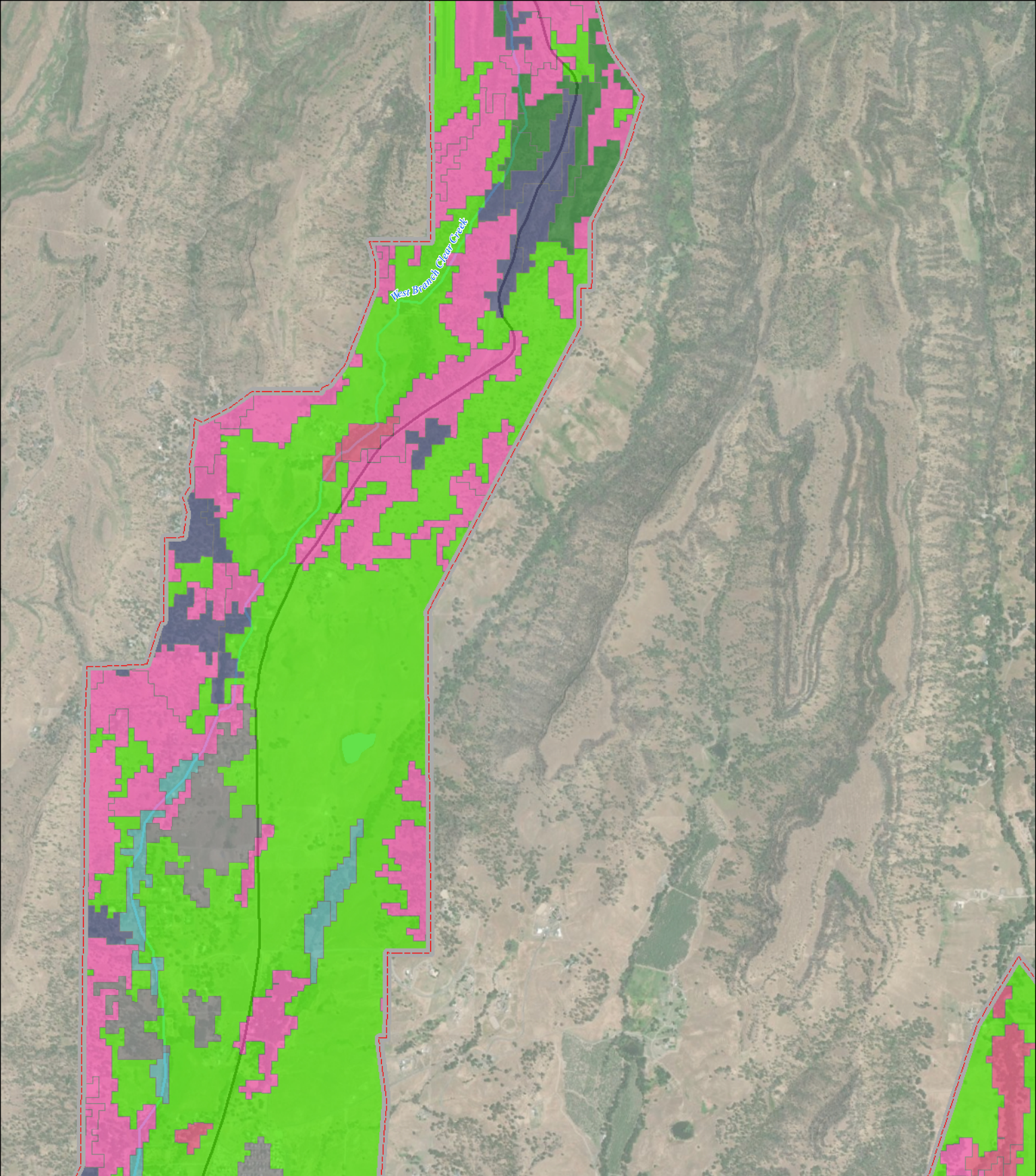
- PSD Local Study Area
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- AGS - Annual Grassland
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- Sewer Service Area



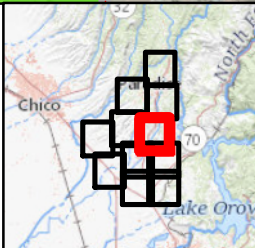
LOCAL CWHR
VEGETATION



- PSD Local Study Area
- BAR - Barren
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- AGS - Annual Grassland
- LAC - Lacustrine
- Sewer Service Area



LOCAL CWHR
VEGETATION

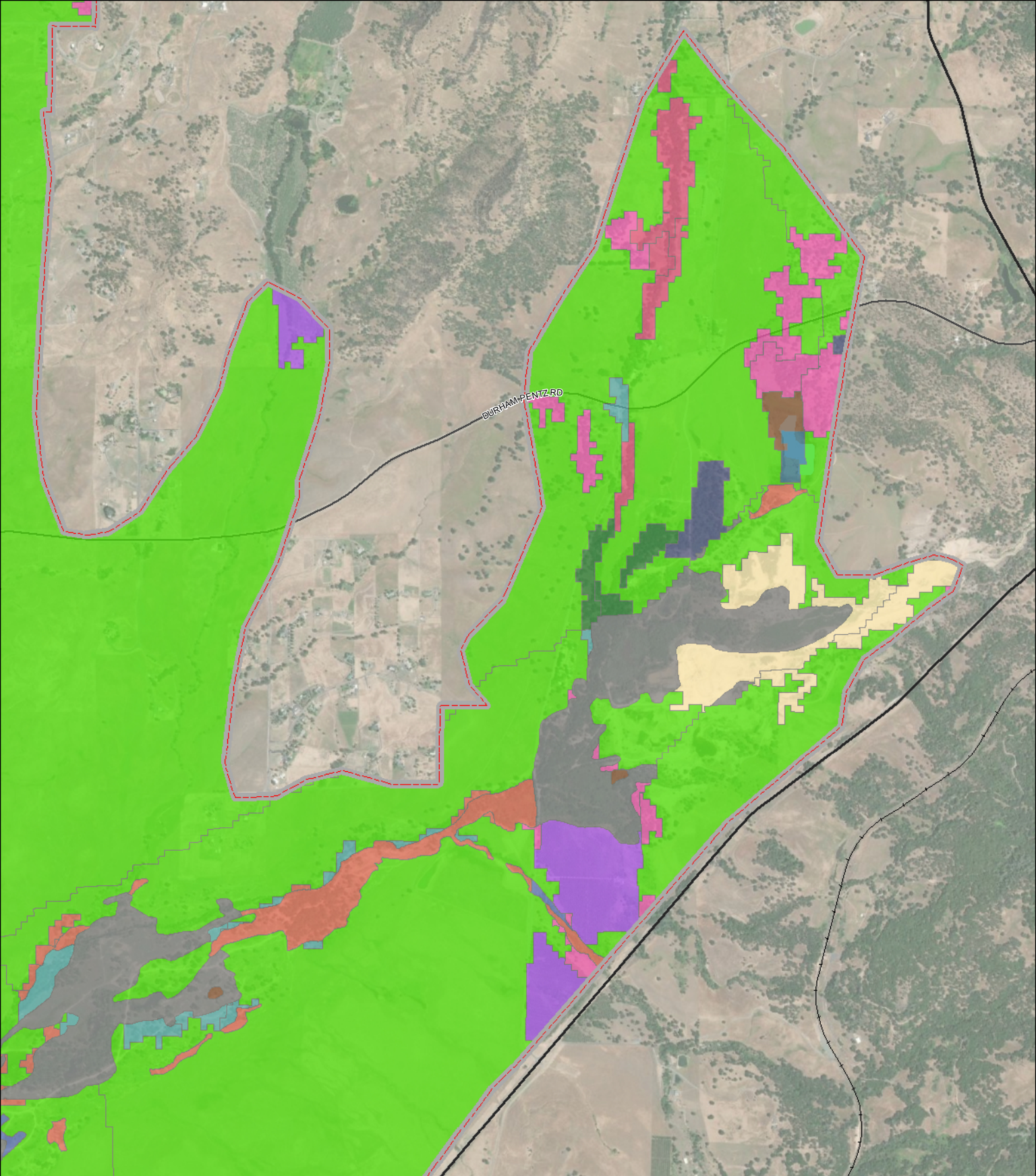


PSD Local Study Area

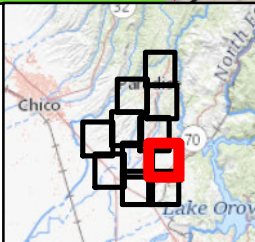
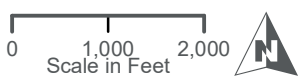
CWHR Vegetation Type

- AGS - Annual Grassland
- BOW - Blue Oak Woodland

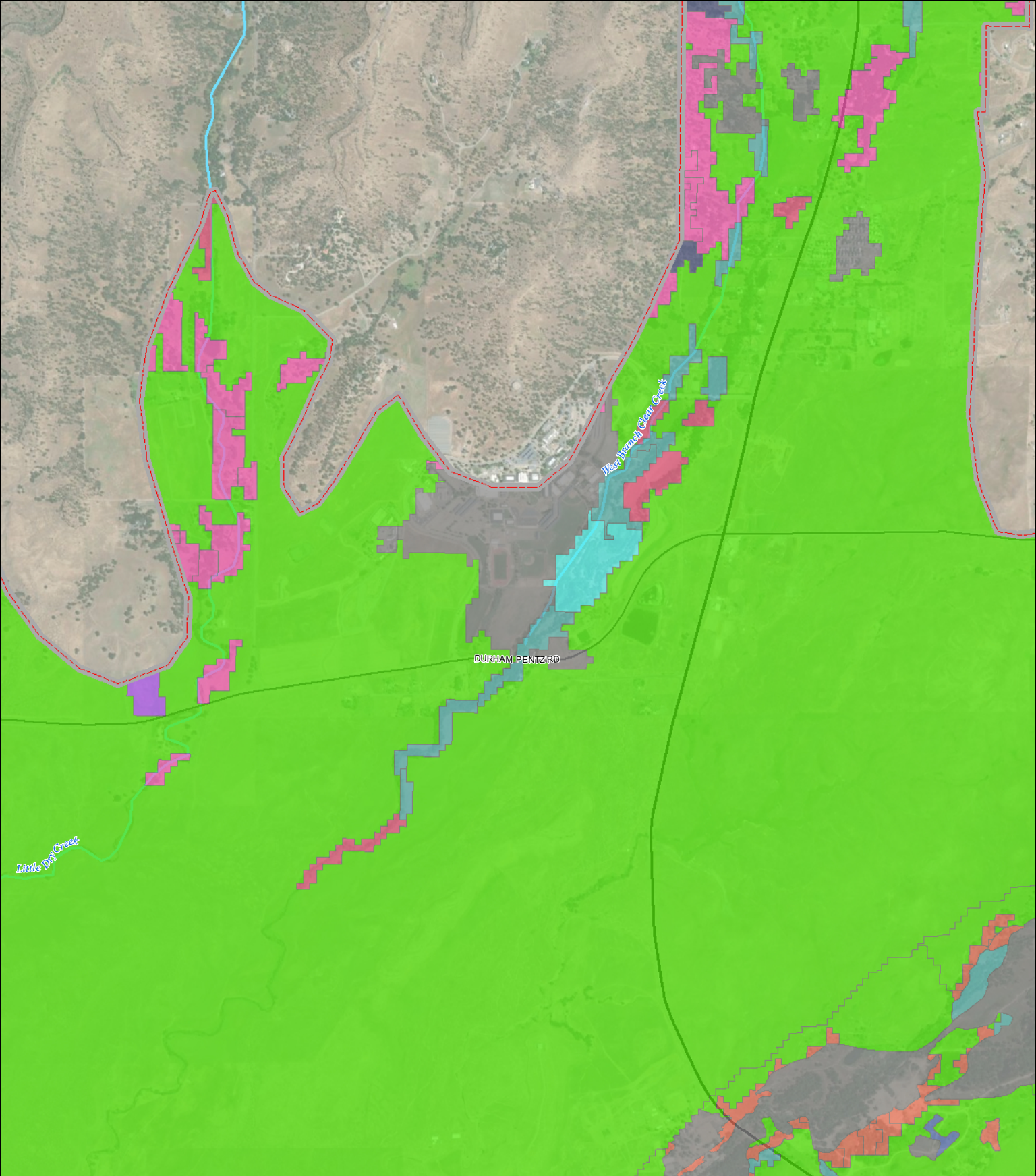
- BOP - Blue Oak-Foothill Pine
- MHW - Montane Hardwood
- MRI - Montane Riparian
- URB - Urban
- VOW - Valley Oak Woodland
- Sewer Service Area



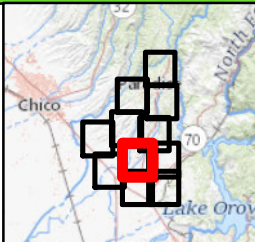
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VEGETATION



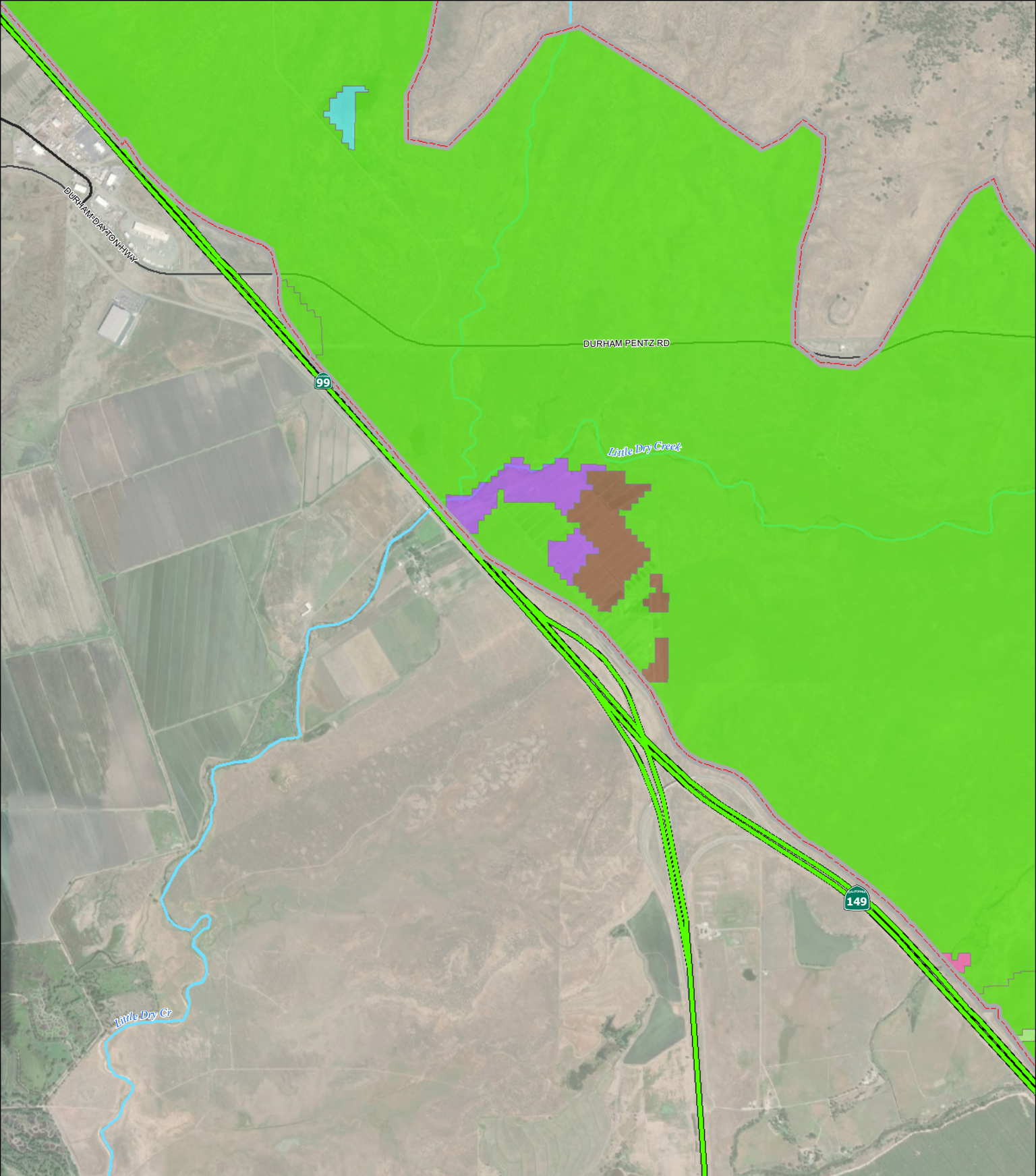
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|------------------------------|--------------------------------|
| PSD Local Study Area | FEW - Fresh Emergent Wetland |
| CWHR Vegetation Type | LAC - Lacustrine |
| AGS - Annual Grassland | MHW - Montane Hardwood |
| BAR - Barren | MRI - Montane Riparian |
| BOW - Blue Oak Woodland | RIV - Riverine |
| BOP - Blue Oak-Foothill Pine | URB - Urban |
| CRP - Cropland | VRI - Valley Foothill Riparian |
| | VOW - Valley Oak Woodland |
| | Sewer Service Area |



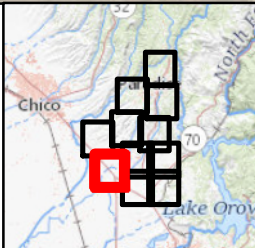
**LOCAL CWHR
VEGETATION**



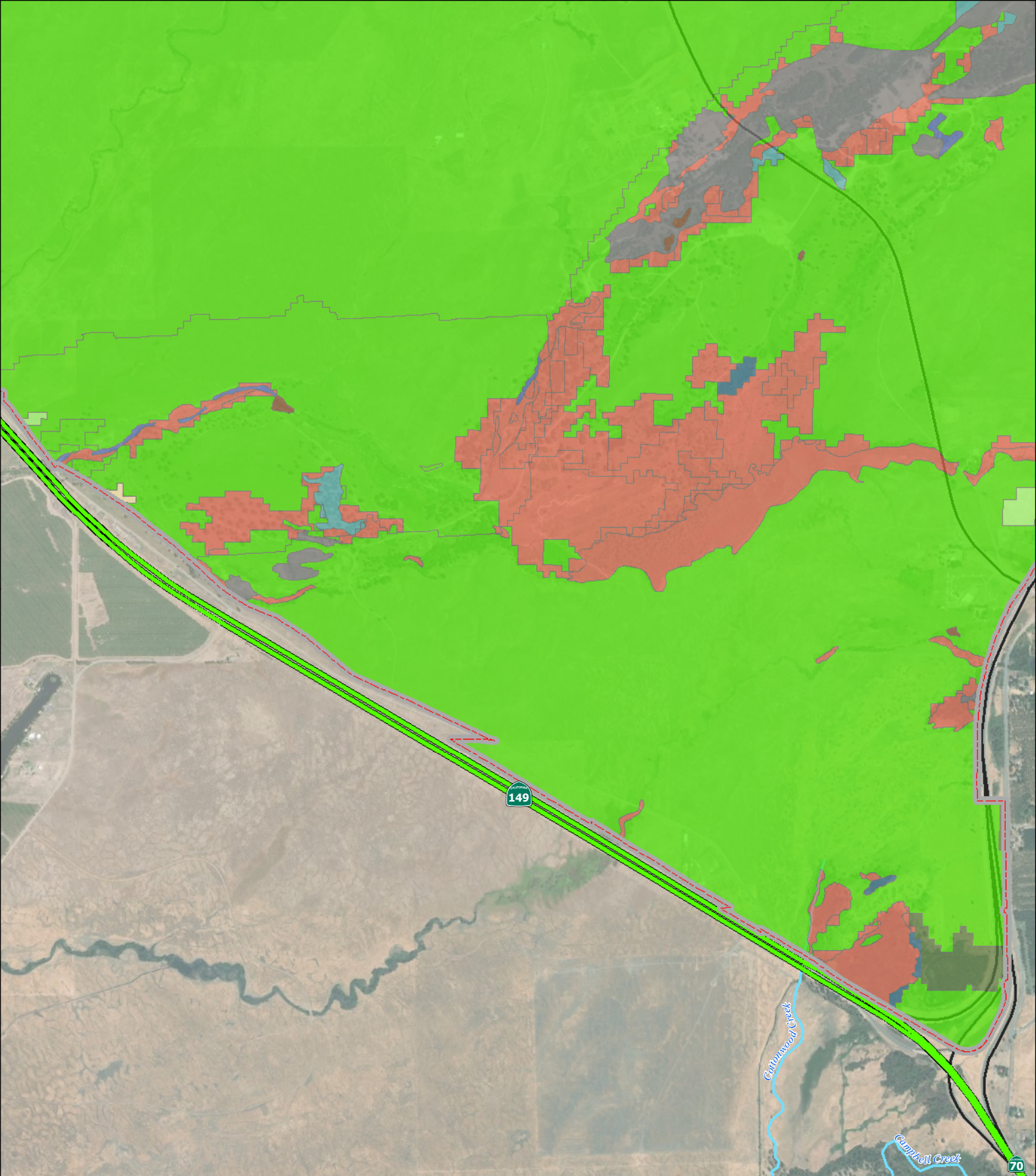
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| PSD Local Study Area | MRI - Montane Riparian |
| CWHR Vegetation Type | RIV - Riverine |
| AGS - Annual Grassland | URB - Urban |
| BOW - Blue Oak Woodland | VRI - Valley Foothill Riparian |
| BOP - Blue Oak-Foothill Pine | VOW - Valley Oak Woodland |
| CRP - Cropland | WTM - Wet Meadow |
| | Sewer Service Area |



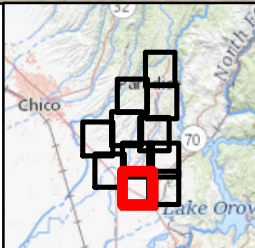
**LOCAL CWHR
VEGETATION**



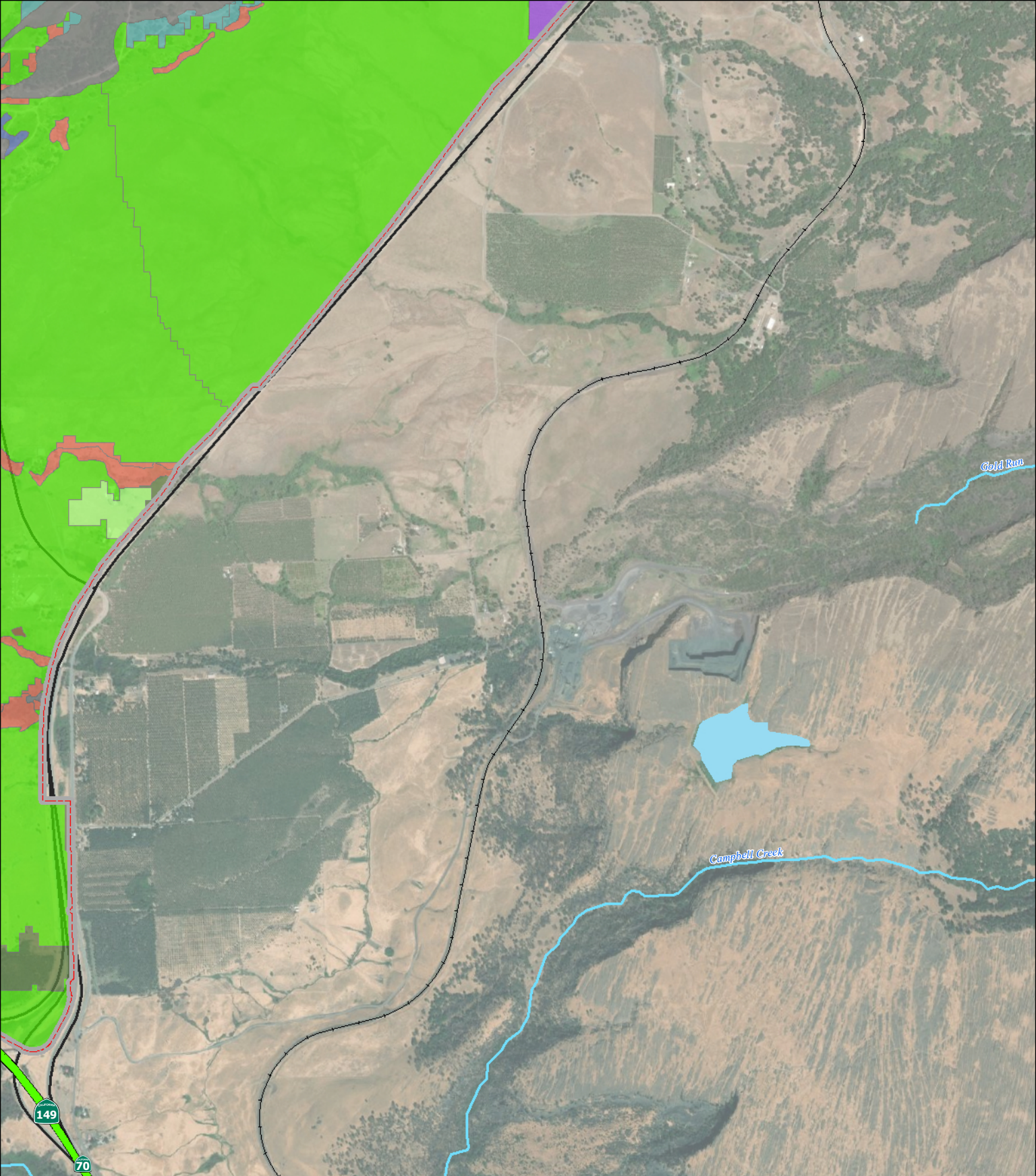
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| PSD Local Study Area | CRP - Cropland |
| CWHR Vegetation Type | LAC - Lacustrine |
| AGS - Annual Grassland | PAS - Pasture |
| BOW - Blue Oak Woodland | WTM - Wet Meadow |
| | Sewer Service Area |



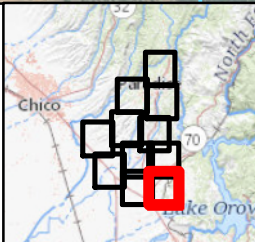
LOCAL CWHR
VEGETATION



- | | |
|------------------------------|--------------------------------|
| PSD Local Study Area | LAC - Lacustrine |
| CWHR Vegetation Type | PAS - Pasture |
| AGS - Annual Grassland | RIV - Riverine |
| BAR - Barren | URB - Urban |
| DOR - Deciduous Orchard | VRI - Valley Foothill Riparian |
| FEW - Fresh Emergent Wetland | VOW - Valley Oak Woodland |
| | Sewer Service Area |




LOCAL CWHR VEGETATION



- PSD Local Study Area
- CWHR Vegetation Type**
- AGS - Annual Grassland
- PAS - Pasture
- RIV - Riverine
- URB - Urban
- CRP - Cropland
- DOR - Deciduous Orchard
- LAC - Lacustrine
- VRI - Valley Foothill Riparian
- VOW - Valley Oak Woodland
- Sewer Service Area

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A.4

Background Research for
Sensitive Cultural Resources

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Attachment A.4 – Background Research for Sensitive Cultural Resources

Previously Conducted Cultural Resources Investigations

HDR identified a total of 182 cultural resources investigations or related communications conducted within the Study Area and 0.25-mile buffer between 1973 and 2017. A total of 57 investigations were conducted within the Study Area only, 59 investigations were conducted in areas overlapping the Study Area and the 0.25-mile buffer around the Study Area, 56 were conducted within the 0.25-mile buffer only, and another 10 investigations were conducted within the 0.25-mile buffer and were immediately adjacent to the Study Area. The types of investigations previously conducted were for utility projects, private property and development projects, transportation projects, a landfill development, a vernal pool preserve, and tree improvement center projects. No tribal cultural resources were listed in the records search. Most of these investigations (n=162) occurred 10 or more years ago (Table A.4-1). Professional cultural resources investigations methods and standards change over time, plus environmental factors can expose previously buried cultural resources, bury previously exposed cultural resources, or cause changes to the conditions of previously recorded resources, necessitating the need to conduct current field studies to confirm site locations, assess the current condition of sites, and to find and document previously unknown cultural resources that may exist within the Study Area so that these resources may either be avoided by the Project or the potential Project impacts addressed if they cannot be avoided.



Table A.4-1. Summary of Previously Conducted Cultural Resources Investigations Documented in the Study Area and 0.25-mile Buffer Around the Study Area

Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1973	Boynton, Michael J.	Environmental Impact Report for Archaeological Resources at the Proposed Mathews Readymix, Inc. Portable Batch Plant, Clark Road and Easy Street Below Paradise, California	007830	Study Area
1975	Johnson, Keith	Oroville-Quincy Highway FAS Project 1046(3), Humboldt Road Bridge @ Butte Creek (FAO) Project 91422-75-1, Messilla Valley Road Bridge @ Dry Creek (FAO) Project 41442-75-1	000147	Study Area and buffer
1977	Jensen, Susan M.	Archaeological Reconnaissance: Clark Road from Pearson to the Skyway	009276	Study Area and buffer
1977	Markley, Richard	Archaeological Reconnaissance of the John Maran Property (AP 52-25-69) located in Paradise, California.	008055	Study Area
1977	Markley, Richard E.	Archaeological Reconnaissance of approximately 16 acres (Parcel #AP50-19-48) in Paradise, Butte County, California.	009240	Study Area
1977	Markley, Richard E.	Archaeological Reconnaissance of three parcels located within Butte County: Byrd Construction Co., AP 54-09-22; Vineyard Acres, AP 50-013-21; Skyway widening from Woodward Rd. to Steiffer Rd. (Butte County Public Works)	007674	Study Area
1977	Wirt, John C.	Environmental Impact Report for the John Maran Mobile Home Park, Paradise, California	008055-1	Study Area
1978	Manning, James	An Archaeological Reconnaissance of three properties located within Butte County: John Wray - AP#30-16-53, Woodland Creek Estates - AP#55-261-61, Sars Clifford - AP#51-01-96	007714	Buffer
1978	Manning, James	An Archaeological Reconnaissance of three properties located within Butte County: Richard Larson - AP#41-25-64, Gary Ravencroft et al., Church of Christ	007715	Study Area
1978	Manning, James P.	Archaeological Reconnaissance for the Olive Grove Apartment Complex, Paradise, Butte County, California	009245	Study Area
1978	Manning, James P.	Archaeological Reconnaissance for the Proposed Green Pines Subdivision, Paradise, Butte County, California	009277	Buffer
1978	Manning, James P.	Archaeological Reconnaissance for two properties located in Butte County, California: Tom Tellefsen & Peter Bajka	008032	Study Area
1978	Manning, James P.	Archaeological Reconnaissance of 160 acres owned by Robert A. Braun - AP# 55-25-23	007765	Immediately adjacent to buffer
1978	Manning, James P.	Archaeological Reconnaissance of the Richard M. Gillenwaters Property, Butte County, California	008031	Study Area and buffer
1978	Manning, James P.	Archaeological Reconnaissance of the Robert Kellogg, et al. Property - AP#50-01-06/ 50-01-14/ 50-01-15/ 66-51-03/ 66-44-22	009236	Study Area



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1978	Manning, James P.	Archaeological Reconnaissance of two properties: Debernardi, and Bozzer, c.35 acres, Butte County, California, Letter Report to Earl Nelson, Director, Environmental Review Dept.	005968	Buffer
1978	Markley, Richard E.	Archaeological Reconnaissance of 320 acres of land belonging to Mr. Ed Van Gooden, east of Butte Community College	007856	Study Area and buffer
1978	Markley, Richard E.	Archaeological Reconnaissance of 8.5 acres of land located adjacent to Clark Road, Paradise.	007691	Study Area and buffer
1979	Jensen, Peter M.	Archaeological Reconnaissance of a Proposed Aggregate Development Site, Butte County, California	000188	Study Area
1979	Manning, James	An Archaeological Reconnaissance of Blaine Bounous and William Horvath Property - AP#50-05-01, 02, & 05	007717	Study Area and buffer
1979	Manning, James P	An Archaeological Reconnaissance of Four Properties Located within Butte County. John and Renee McAmis AP#046-55-0-032, Wilbur Sypherd, Kenneth L. Dennis, Ilene Hemmingsen AP#55-02-74	007037	Study Area and buffer
1979	Manning, James P	Archaeological Reconnaissance of 92 acres of land owned by Joseph Janko	007764	Buffer
1979	Manning, James P	Archaeological Reconnaissance of three properties: George Baker - AP#58-21-80, Barbara Richardson - AP#41-09-29, and Steve Cummings - AP#41-09-24	007755	Immediately adjacent to buffer
1979	Manning, James P	Archaeological Reconnaissance of two parcels of land owned by John Long and Barney Kukolsky AP#54-32-01 & 04.	007679	Buffer
1979	Manning, James P.	An Archaeological Survey of four properties located in Butte County: Troy B. Allison - AP#55-202-11, Brian Heinz - AP#55-37-19, Fred Jahn, OSO Properties - AP#31-01-63	007844	Buffer
1979	Manning, James P.	Archaeological Reconnaissance for Clear Creek Estates	007766	Study Area and buffer
1979	Manning, James P.	Archaeological Reconnaissance of Four Properties: MIAC Subdivision, Thomas Fanning, Jerome Hanley, Robert Quirk, Butte County, California	005980	Study Area and buffer
1979	Manning, James P.	Archaeological Reconnaissance of the Eaton Property - AP#50-02-01, 50-03-01 & 02.	009248	Buffer
1979	Manning, James P.	Archaeological Reconnaissance of the Hagen Ridge Park, the Edwin Allen Property - AP# 72-29-67, and John Franklin Property - AP# 55-19-28, Butte County, California	005994	Study Area
1979	Manning, James P.	Archaeological Reconnaissance of two properties located in Butte County: E.M. Burgess - AP#55-31-04, B.R. Culp - AP#55-37-63	007759	Buffer
1979	Sheeders, Donna J.	Cultural Resources Field Report for the Griggs On Stream Reservoir Project, Butte County, California	008036	Buffer
1980	Jensen, Peter M. and Gordon W.M. Tomlinson	Archaeological Reconnaissance of the Campbell and Tangeman Property, Butte County, California	008049	Study Area and buffer
1980	Manning, James	An Archaeological Reconnaissance of three properties within Butte County: Robert & Patricia Bailes - Little Grand Canyon Estates, Unit #2; Albert Brown - AP#54-22-56; Joe Vielbig - AP#58-33-09	007721	Study Area and buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1980	Manning, James P	An Archaeological Reconnaissance of Three Properties Located within Butte County. Gerald Oliver AP#41-08-55, Vance Hanrion AP#53-15-25, Ronnie and Sharon Heckenliable AP#72-06-2-14 and 72-07-0-14.	007028	Buffer
1980	Manning, James P.	Archaeological Reconnaissance of four properties located within Butte County: D.L. Gerber - AP#51-200-08, Commercial Rezone A2-Ltd to C-2, Duane C. Engdahl, et ux - AP#55-30-53, Ernest E. Hodson - AP#55-17-26	007688	Study Area
1980	Manning, James P.	Archaeological Reconnaissance of four properties located within Butte County: Lou Mariotti - AP#55-37-17, Larry Nelson - AP#55-37-20, Charles & Toni Pierce - AP#41-41-02, Oliver Jackson - AP#41-43-28	008057	Buffer
1980	Manning, James P.	Archaeological Reconnaissance of the Northwest Pacific Resources, Inc. (AP 51-20-24/ERD Log 79-09-06-02) and Gary Stratton (AP 47-23-33) Properties, Butte County, California	005995	Buffer
1980	Manning, James P.	Archaeological Reconnaissance of the Proposed Neal Road Sanitary Land Fill Site #2, Butte County, California	008051	Study Area and buffer
1980	Manning, James P.	Archaeological Reconnaissance of two properties located within Butte County, Collier-West Commercial Rezone - AP#53-103-10, Floyd Damschen - AP#54-11-31 & 32	007673	Study Area
1980	Offermann, Janis K. and Robert I. Orlins	An Archaeological Survey of the Cottonwood-Elverta # 3 Transmission Line in Shasta, Tehama, and Butte Counties, California	000407	Study Area and buffer
1981	Jensen, Peter M.	Archaeological Reconnaissance of the Proposed Harlan Baker Subdivision, Butte County, California	000567	Buffer
1981	Manning, James P.	Archaeological Reconnaissance for the City of Paradise Storm Drainage System, Butte County, California	007664	Study Area and buffer
1981	Manning, James P.	Archaeological Reconnaissance of 148 Acres of Land Owned by Paradise West Associates	007689	Study Area
1981	Manning, James P.	Archaeological Reconnaissance of 40.7 acres owned by Martin G. De Smet - A.P. #41-11-105.	007853	Buffer
1981	Manning, James P.	Archaeological Reconnaissance of the proposed Paradise Bluffs Subdivision.	009250	Immediately adjacent to buffer
1982	Henton, Dawn M.	Archaeological Reconnaissance of three properties in Butte County: Dave Wise - A.P.# 56-11-02, James Smith and Bill Anderson - A.P.# 58-33-01, Walter H. Poirier - A.P. # 41-08-108	007838	Buffer
1982	Manning, James P.	Archaeological Reconnaissance of the land owned by Donald T. Comer and Peter Bajka - A.P.# 55-02-96, 97 & 98.	008058	Study Area
1983	Jensen, Peter M.	Archaeological Reconnaissance of the Proposed Robley Point Hydroelectric Project, Butte County, California	000876	Study Area and buffer
1983	Manning, James P.	An Archaeological Survey of Two Properties Located In Butte County. Lowell Smith A.P. #28-17-85, Estella Gregory A.P. #41-12-98	007056	Study Area and buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1983	Manning, James P.	Archaeological Survey for Proposed Acorn Ridge Estates	003500	Buffer
1983	Manning, James P.	Archaeological Survey of two properties: Tillman Daley - A.P.#55-30-81, Sandra Wherry - A.P.#65-49-26	007760	Buffer
1984	Jensen, Peter M	Archaeological Reconnaissance of the Proposed Martin Van Ert Subdivison, Butte County, California.	007855	Buffer
1984	Manning, James	An Archaeological Survey of the land contained within the West Paradise Study Area.	007748	Buffer
1985	Jensen, Peter M.	Addendum to: Archaeological Reconnaissance, Robley Point Hydroelectric Project, Butte County, California	000876-1	Study Area and buffer
1985	Manning, James P.	Archaeological Survey for the Heritage Convalescent Center, City of Paradise, Butte County, California	009263	Study Area
1987	Farber, Alfred	An Archaeological Reconnaissance of the Proposed South Park Development, Paradise, California	008060	Study Area and buffer
1987	Farber, Alfred	Archaeological Investigation of the Proposed Barnett / Hardy Land-Split and Rezoning, Butte County, California	000845	Buffer
1988	Farber, Alfred	An Archaeological Survey of the Proposed Nor-Cal Nut Company Facility Near Durham, Butte County, California	008064	Study Area and buffer
1988	Farber, Alfred	Archaeological Survey of the James Wilson Parcel Map Area AP 55-03-14, Paradise, California	000877	Study Area and buffer
1988	Farber, Alfred	Archaeological Survey of the Paradise Industrial Park Master Plan Project Area Paradise, California	000879	Study Area
1988	Farber, Alfred	Archaeological Survey, Proposed Plantation Mobile Home Park, Paradise	001669	Buffer
1988	Farber, Alfred	Archaeological Survey of the Bultema Brothers Parcel Map Project Area, Butte County, California	000939	Buffer
1988	Farber, Alfred	Evaluation of Three Archaeological Sites on the John Maran Property (AP #52-25-109) Paradise, Butte County, California	008065	Study Area
1989	Farber, Alfred	Archaeological Survey of the Proposed Oak Knoll Estates Retirement Center, Town of Paradise, Butte County, California	007675	Study Area
1989	Farber, Alfred	Archaeological Survey of the Ken Colgan Tentative Parcel Map Area, Butte County, California	008063	Buffer
1989	Farber, Alfred	Archaeological Survey of the Proposed Paradise Manor Residential Care Facility Project Area, Town of Paradise, Butte County, California	009278	Study Area and buffer
1989	Farber, Alfred	Archaeological Survey of the Proposed Timber Ridge Subdivision, Town of Paradise, Butte County, California	009257	Immediately adjacent to buffer
1989	Farber, Alfred	Archaeological Survey of the Rod Kopsa, Inc. Tentative Parcel Map Area, Town of Paradise, Butte County, California	008062	Study Area
1989	Farber, Alfred	Archaeological Surveys of the Proposed Delia Estates (Donalson) Subdivision, Dippel Tentative Parcel Map Area, and Spencer Tentative Parcel Map Area, Paradise, Butte County, California	007738	Study Area and buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1990	Derr, Eleanor H.	A Cultural Resources Study for Roe Road Extension Project, Town of Paradise, Butte County, California.	001040	Study Area
1990	Dreyer, William	An Archaeological Reconnaissance of the Proposed Paradisewoods Estates, Paradise, California	009260	Buffer
1990	Fong, Michael R., Colin I. Busby, and Donna M. Garaventa	Negative Archaeological Survey Report: PM 21.6-24.6 State Route 99 Butte County, California	007408	Immediately adjacent to buffer
1990	Furry, John	Archaeological Reconnaissance of 35.89 acres Belonging to the Paradise Cemetery District, Butte County, California	008068	Study Area and buffer
1990	Jensen, Peter M.	Archaeological Inventory Survey of the Proposed Durham-Dayton Industrial Partners' Development Project Involving Approximately 18 acres near Butte College, Butte County, California.	008076	Immediately adjacent to buffer
1990	Jensen, Peter M.	Archaeological Inventory Survey of the Proposed Kasza Subdivision Project involving approximately 40 acres near Paradise, Butte County, California.	007762	Buffer
1991	Bevill, Russell W.	Archaeological Survey of the Courtain Parcel, Perkins Ridge, Butte County, California	008067	Study Area and buffer
1991	Jensen, Peter M.	Archaeological Inventory Survey for a Proposed Subdivision Project Involving 87 Acres Located Near Lime Saddle, Butte County, California.	0007913	Buffer
1991	Jensen, Peter M.	Archaeological Inventory Survey of the Proposed Diduca Development Project, c. 3 AC, Southeast Paradise, Butte County, California.	007676	Buffer
1992	Jensen, Peter M.	Archaeological Inventory Survey for Ray Clark's Proposed Subdivision Project, c. 19 Acres Adjacent to Clark Road near Pentz, Butte County, California.	007848	Study Area and Buffer
1992	Neuenschwander, Neal	Cultural Resource Assessment of Assessor's Parcel Number 55-18-46, Paradise, Butte County, California	007690	Study Area
1992	Ritter, Eric W.	An Archaeological Survey of the Rudy Schott Parcel Split near Butte College, California	007847	Study Area and buffer
1992	Ritter, Eric W.	An Archaeological Survey of the Tomek/Clarke Parcel in Paradise, California (PM-11-91) (AP 054-080-067)	007687	Buffer
1993	Janevein, Steve and Blossom Hamusek	Archaeological Reconnaissance of the Neal Road Improvement Project, Butte County, California	008071	Study Area
1993	Jensen, Peter M.	Archaeological Inventory Survey of the Gerard & Lambert Proposed Subdivision Project, c. 38 Acres Along the Skyway, Town of Paradise, Butte County, California.	008072	Study Area and buffer
1993	Jensen, Peter M.	Archaeological Inventory Survey: Exum's Proposed Sunbridge Estates Subdivision Project, c. 33.3 Acres Adjacent to Dry Creek, South Paradise, Butte County, California.	007678	Buffer
1993	Ritter, Eric W.	An Archaeological Survey of the Wentland and Johnson Proposed Parcel Split in Magalia, California	009242	Study Area and buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
1993	Ritter, Eric W.	Archaeological Survey of the Merry Barker Parcel Split, Paradise, California	007677	Immediately adjacent to buffer
1994	Hamusek, Blossom	Archaeological Reconnaissance of the Paradise Fuel Break Project, Butte County, California	001290	Study Area and buffer
1994	Holanda, Kim and Blossom Hamusek	Archaeological Reconnaissance of the Palmer Parcel, Butte County, California	002442	Study Area
1994	Jenevein, Steve	Archaeological Reconnaissance of the Mock Parcel Split, Butte County, California	008069	Study Area and buffer
1994	Levy, David and Lucky Gillett	Archaeological and Historical Resources Survey and Impact Assessment for the Magalia Church Timber Harvest Plan, Butte County, California	002976	Study Area and buffer
1995	Jensen, Peter M.	Archaeological Inventory Survey for the Levine & Collado Subdivision Project, Overall Parcel Size of 421 acres, Upper Nance Canyon, Adjacent to the Skyway, Butte County, California.	008080	Buffer
1995	Jensen, Peter M.	Archaeological Inventory Survey of Paradise School District's 15-acre Development Site, Paradise, Butte County, California.	009268	Study Area
1995	Jensen, Peter M.	Archaeological Inventory Survey of Robert Jacobsen's Proposed Subdivision Project, c. 5 Acres at Paradise, Butte County, California.	008078	Study Area
1995	Levy, David and Lucky Gillett	Archaeological and Historical Resources Survey and Impact Assessment for the Sir Timber Harvesting Plan, Butte County, California	005093	Study Area and Buffer
1995	McGann, Daniel and Blossom Hamusek	Archaeological Reconnaissance of Jackson Ranch, Butte County, California	008079	Buffer
1995	Offermann, Janis K.	An Archaeological Survey Report for a Proposed Road Improvement Project on State Route 191 from State Route 70 to Just North of Clear Creek, Butte County, California	001533	Study Area and buffer
1996	Ritter, Eric	An Archaeological Inventory and Assessment of the Richard Hall Property, Paradise, California	001529	Buffer
1998	Carter, Craig	CDF Project Review Report for Archaeological and Historical Resources: Paradise Fuel Break	001290	Study Area and buffer
1998	Carter, Craig	CDF Project Review Report for Archaeological and Historical Resources: Paradise Fuel Break	001290-1	Study Area and buffer
1998	Ritter, Eric W.	The Carli Property Archaeological Survey in Paradise, California: Results and Recommendations	001980	Study Area
1999	Cardin, Andrew	Confidential Archaeological Addendum for the Bader Mine Timber Harvesting Plan, Butte County, California	002961	Buffer
1999	Jensen, Peter M.	Archaeological Inventory Survey of the Proposed Paradise Park Acquisition Project, Multiple Parcels Totalling Approximately 120 acres Located in Paradise, Butte County, California.	008490	Study Area
1999	Jensen, Peter M.	Archaeological Survey, 22.8 acre Falling Rock Subdivision, Butte County, California	002977	Study Area and buffer
2000	Jenkins, Richard C.	Archaeological and Historical Resources Review for the Butte Forest Fire Station (FFS) Barracks and Engine Bay Replacement Project, Butte County, California	003150	Study Area



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
2000	Jensen, Peter M	Phase I Archaeological Testing Report, the Neal Road Rockshelter, Site P04-001561	003436	Study Area and buffer
2000	Jensen, Peter M.	Archaeological Inventory Survey for the Neal Road Landfill Development and Expansion Project, c. 165 acres along Neal Road, South of Chico, Butte County, California	003440	Study Area and buffer
2000	Jensen, Peter M.	Archaeological Inventory Survey: Joel Arthur Subdivision Project, c. 14-acres on Neal Road, Southwest Paradise, Butte County, California	002978	Buffer
2000	Jones & Stokes	Cultural Resources Inventory Report for the North Esplanade and East Paradise Project Areas, Butte County, California	003445	Study Area
2001	Derr, Eleanor	Historical and Cultural Resource Assessment for the South Magalia, Site No. SA-877-03, 6705 Moore Road, Paradise, California	004366-1	Study Area
2001	Losee, Carolyn	Cultural Resources Survey for Cingular "South Magalia" (Paradise) California Site (Ref#SA-877-03): Negative Results, Butte County, California	004366	Study Area
2001	Ritter, Eric. W	An Archaeological Survey of the Johansson Subdivision, Paradise, California	005646	Buffer
2001	Vaughan, Trudy	Archaeological Reconnaissance of the Lucky 7 Borrow Pit, Between Chico and Oroville, Butte County, California	003553	Study Area and Buffer
2002	Derr, Eleanor	Historical and Cultural Resource Assessment: South Magalia, Site No. SA-877-04, 9065 Skyway Avenue, Paradise, California	006070	Study Area
2002	Jensen, Peter	Archaeological Inventory Survey: Proposed Memorial Trailway Park Development Site, 10.69 Acres Adjacent to Black Olive Drive and Pearson Road, Town of Paradise, Butte County, California	004365	Study Area
2002	Jensen, Peter M.	Archaeological Inventory Survey: Proposed Berry Creek Park Development Project, Approximately 5-ac Site on Berry Creek Drive south of Buschmann, Town of Paradise, Butte County, California	004780	Study Area and buffer
2002	Jensen, Peter M.	Archaeological Inventory Survey for the Proposed Willow Street Water Line Project, Approximately 335 Feet of Linear Corridor Along Willow Street, Town of Paradise, Butte County, California	004336	Study Area
2003	Harrington, Lori	An Archaeological Evaluation of Butte Ranch Butte County, California: Report on 100-Acre Survey, USGS Hamlin Canyon and Paradise Quadrangles (T22 North, R3 East Sections 20 & 21)	005929	Buffer
2003	Jensen, Peter M.	Archaeological Inventory Survey: Proposed Dippel Subdivision Project, Approximately 45 acres adjacent to Honey Run Creek, Town of Paradise, Butte County, California.	005593	Buffer
2004	Billat, Scott	Cultural Resource Assessment for the Butte College (CA-1441F) Cellular Facility on 2822 Clark Road, North of Oroville, Butte County, California	006071	Study Area
2004	Dwyer, Erin	Cultural Resources Inventory of the Proposed Shanna Ranch Project, Butte County, California	006181	Study Area and buffer
2004	Jensen, Chris	Request for SHPO Review of FCC Undertaking, Magalia (CA-1612C) Project, Butte County, California	006070-1	Study Area
2004	Jensen, Peter M.	Archaeological Inventory Survey for the Proposed Neal Road/ Nance Canyon Subdivision Project, c. 350 acres along Neal Road, Butte County, California.	006391	Buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
2004	Jensen, Peter M.	Archaeological Survey, 2.8-acre McDonald Residential Development Project, Paradise, Butte County, California	005793	Buffer
2004	Jensen, Peter M.	Archaeological Survey, c. 20-acre Jacobson Parcel Split Project.	006390	Study Area and buffer
2004	Peak and Associates	Cultural Resources Assessment of Assessor's Parcel Numbers 054-090-008 and 054-090-009, Located at Dudley Lane and Buschmann Road, Town of Paradise, Butte County, California	006580	Buffer
2004	Peak, Melinda A.	Cultural Resource Assessment of the Proposed Butte College Solar Panel Project Area, Butte County, California	006680	Buffer
2005	Arrington, Cindy J.	An Archaeological Evaluation: The Top of Paradise Fuel Reduction Project, Paradise, California	006265	Study Area and buffer
2005	Edwards, Douglas M.	Historic Property Survey Report, Historical Resource Evaluation Report, Archaeological Survey Report, Skyway/Wagstaff Intersection Project, Butte County, California	008308	Study Area
2005	Harrington, Lori	An Archaeological Evaluation of the Paradise Land Exchange Project, Paradise California.	006751	Study Area
2005	Jensen, Sean	Archaeological Inventory Survey: Proposed Ballou Equestrian Facility Development Project, c. 1,600 acres, west of State Route 191, and east of State Route 99, Butte County, California.	006392	Study Area and buffer
2005	Jensen, Sean M.	Archaeological Survey, c. 2-acre Anderson Parcel Split Project, Paradise, Butte County, California.	007988	Buffer
2005	Ritter, Eric W.	Archaeological Survey and Clearance for the Giraldes Lot Split, Paradise California	006515	Buffer
2006	Billat, Lorna	New Tower ("NT") Submission Packet, FCC Form 620: Clark Windmill, SC-14159	007956	Study Area
2006	Harrington, Lori	An Archaeological Evaluation of the Skyway Land Project, Paradise California.	007989	Study Area and buffer
2006	Jensen, Sean M.	Archaeological Inventory Survey for the Pentz Rock Mine Permit and Reclamation Project, c. 40 acres, Butte County, California	007281	Study Area and buffer
2006	Jensen, Sean M.	Archaeological Survey, 1.37-acre Ransom Parcel Split Project, Paradise, Butte County, California.	007990	Buffer
2006	Losee, Carolyn	New Tower ("NT") Submission Packet, FCC Form 620: Durham Pentz, CN0821-C1	007956-1	Study Area
2006	Nadolski, John A.	Historic Property Survey Report for the Butte County Association of Governments Vernal Pool Preserve, District 3, Butte County, Highways 70 and 149	013830	Study Area and buffer
2006	Nelson, James S. and Denise M. Furlong	Cultural Resources Inventory for the Palmer Property, APN: 055-190-064, Paradise, Butte County, California	006767	Study Area and buffer
2006	Ritter, Eric W.	An Archaeological Inventory and Evaluation of the Proposed Muhlbaier Lot Split, Paradise, California	007960	Study Area and buffer
2006	Vasquez, Randolph	An Archaeological Survey Report for the Valley Vista Timber Harvesting Plan, Butte County, California	006849	Study Area and buffer
2007	Billat, Scott	New Tower ("NT") Submission Packet, FCC Form 620: Butte College, SC-BU001	007957	Study Area



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
2007	Davy, Douglas, Humphrey Calicher, and William Shapiro	Cultural Resources Inventory for the North Area Right-of-Way Maintenance Environmental Assessment CVP and Pacific AC Intertie	013255	Study Area and buffer
2007	Harrington, Lori	An Archaeological Evaluation of the Durham-Pentz Road-Butte Campus Drive Signalization Project, Butte County, California.	010044	Study Area
2007	Jensen, Peter M.	Archaeological Survey, c. 11.57-acre Diamond Ridge Estates Subdivision, Butte County, California.	010200	Buffer
2007	Jensen, Sean M.	Archaeological Survey, c. 2-acre Foster Parcel Split Project, Paradise, Butte County, California.	010206	Buffer
2008	Harrington, Lori	An Archaeological Evaluation of the Paradise Youth Sports and Family Center Project, Butte County, California.	009538	Study Area
2008	Hatoff, Brian	Results of Archaeological and Architectural History Survey for Verizon Cellular Communications Tower Site	009610	Study Area
2008	Jensen, Sean M.	Archaeological Survey, c. 1/8-acre Newland Road Septic Replacement Project (APN: 054-060-027), Paradise, Butte County, California.	010205	Buffer
2008	Kersey, Kim	Cultural Resources Constraints Study for the Replacement of 33 Poles on the Centerville to Table Mountain to Oroville 60kV Transmission Line	010037	Study Area and buffer
2008	Kersey, Kim	Cultural Resources Negative Finds Study for the Replacement of 2-Poles on the PG&E Paradise #2 Tap (Order Number 30557776) 60kV Transmission Line, Butte County.	010036	Buffer
2008	Leach-Palm, Laura, Pat Mikkelsen, Paul Brandy, Jay King, and Lindsay Hartman	Cultural Resources Inventory of Caltrans District 3 Rural Conventional Highways in Butte, Colusa, El Dorado, Glenn, Nevada, Placer, Sacramento, Sierra, Sutter, Yolo and Yuba Counties	009539	Study Area and buffer
2008	Ritter, Eric W.	An Archaeological Inventory and Cultural Resource Evaluation of the Proposed Rice Lot Split, Paradise, California	010353	Buffer
2009	Jones, John	Cultural Resources Inventory Negative Report for 6141 and 6151 North Libby Road, Paradise, California	010328	Study Area and buffer
2010	Billat, Lorna	Collocation Submission Packet, FCC Form 621, Project Name: Paradise, Project Number: SAC-494A	011062	Study Area
2010	Jensen, Sean	Archaeological Survey, Moniz Septic Replacement Project (APN: 054-220-004), c. 0.5-acres, Paradise, Butte County, California.	010828	Immediately adjacent to buffer
2010	Jensen, Sean	Archaeological Survey, Rinehart Parcel Split Project, Town of Paradise, Butte County, California.	011383	Study Area and buffer
2010	Jensen, Sean	Archaeological Survey, Worthington Parcel Split Project, Town of Paradise, Butte County, California.	011384	Study Area



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
2010	Peak & Associates	Determination Of Eligibility And Effect For The Paradise Irrigation District (PID) Corporation Yard Facility Project Area, Paradise, Butte County, California	014364	Study Area
2010	Smith, Monte	Cultural Resource Investigation for the Paradise-Butte 115kV Transmission Line Pole Replacement Project, Paradise, California	011093	Study Area and buffer
2011	Billat, Lorna	Collocation Submission Packet FCC Form 621, Project Name: Skyway Road, Project Number: CV0794	009610-1	Study Area
2011	Jensen, Sean	Archaeological Inventory Survey: Butte College Development Project. C. 912 Acres, Butte County, California	011583	Study Area and buffer
2011	Jensen, Sean	Archaeological Survey, Gallatin Septic Replacement Project (APN: 052-360-028), c. 1-acre, Paradise, Butte County, California.	011380	Buffer
2011	Jensen, Sean	Archaeological Survey, Rees Septic Replacement Project (APN: 052-241-005), c. 0.5 acres, Paradise, Butte County, California.	011382	Study Area
2011	Ritter, Eric	An Archaeological Survey of the Visinoni Brothers Proposed Parcel Split, Paradise, California	012216	Study Area and buffer
2013	Andolina, Darren	Cultural Resources Constraints Report: Paradise 1104 Buschman Road Reconductor Report	012447	Study Area and buffer
2014	Fink, Andrea	A Cultural Resources Survey for the Elliot Sky/Ensite #21629 (265204), 6553 Skyway Road, Paradise, Butte County, California	013734	Study Area
2014	Jensen, Sean	Archaeological Survey, Bicknell Septic Replacement Project (6375 Tabernacle Lane), circa .25- acres, Paradise, Butte County, California	013979	Study Area
2014	Jensen, Sean	Archeological Survey, Parker Septic Replacement Project (5777 Copeland Road), circa .79-acres, Paradise, Butte County, California.	012659	Buffer
2015	Jensen, Sean	An Archaeological Survey, Tuell Housing Rehabilitation Project (7181 Pentz Road), circa 0.74-acres, Paradise, Butte County, California	013770	Buffer
2015	Jensen, Sean	Archaeological Inventory Survey for the Oroville-Chico Highway Development Project, circa 108-acres, Butte County, California	012979	Immediately adjacent to buffer
2015	Jensen, Sean	Archaeological Survey, Davis Housing Rehabilitation Project (681 Memorial Way), circa .18-acres, Paradise, Butte County, California	012953	Study Area
2015	Jensen, Sean	Archaeological Survey, Goss Housing Rehabilitation Project (5211 Bennett Road), circa 1.1-acres, Paradise, Butte County, California	012962	Buffer
2015	Jensen, Sean	Archaeological Survey, Harlan Housing Rehabilitation Project (5380 Clark Road), circa .42-acres, Paradise, Butte County, California	012960	Study Area
2015	Jensen, Sean	Archaeological Survey, Kavanagh Housing Rehabilitation Project (4949 Foster Road), circa 1-acre, Paradise, Butte County, California	012971	Buffer



Date	Author(s)	Title	NEIC No.	Located within Study Area or 0.25-mile buffer
2015	Jensen, Sean	Archaeological Survey, Lawrence Septic Replacement Project (6248 Virginia Way), circa 1-acre, Paradise, Butte County, California	012946	Immediately adjacent to buffer
2015	Jensen, Sean	Archaeological Survey, Martin Housing Rehabilitation Project (7148 Clark Road), circa 1-acre, Paradise, Butte County, California	012947	Buffer
2015	Jensen, Sean	Archaeological Survey, Pearson Road Improvements Project, Town of Paradise, Butte County, California	012857	Study Area and buffer
2015	Jensen, Sean	Archaeological Survey, Tuell Housing Rehabilitation Project (7181 Pentz Road), circa ~ 0.74-acres, Paradise, Butte County, California.	014008	Buffer
2015	Jensen, Sean	Archeological Survey, Double Septic Replacement Project (5892 Maxwell Drive), Circa .18-acres, Paradise, Butte County, California.	012660	Study Area
2016	Koenig, Heidi and Joshua Garr	Almond Street Multi-Modal Improvements Project, Town of Paradise, Butte County, Cultural Resources Survey Report	012996	Study Area
2017	Nayyar, Margo and Nichole Davis	Black Olive Village Project, Town of Paradise, Butte County, California, Cultural Resources Identification and Evaluation Study	013922	Study Area

NEIC- Northeast Information Center

Previously Recorded Cultural Resources

A total of 144 cultural resources have been formally recorded within the area examined by HDR and include 11 prehistoric isolated finds¹ (Table A.4-2), 3 historic-period isolated finds (Table A.4-2), 45 prehistoric archaeological sites (Table A.4-3), 25 historic-period archaeological sites (Table A.4-4), 5 multicomponent archaeological sites² (Table A.4-5), and 55 built-environment resources (Table A.4-6). An additional seven informally documented resources were also identified in the area and consist of two prehistoric archaeological sites and five possible multicomponent archaeological sites (Table A.4-7).³

Evaluations of resources for their potential eligibility to the NRHP and CRHR assist in determining whether significant resources (i.e., historic properties⁴ and historical resources⁵) are present in a project's boundary and, subsequently, whether a project is having any effects on eligible properties. Of the total 144 cultural resources, NRHP and/or CRHR evaluations were conducted for 59 of these known resources. Of these 59 evaluated resources, 55 were found to not be eligible for listing on the NRHP, one was evaluated as potentially eligible for both the NRHP and CRHR (P-04-1324/499461/499462), one is listed in the NRHP (P-04-3084), and two are recommended not eligible for the CRHR but remain unevaluated for the NRHP. Of note, many of the resources identified within the Study Area and 0.25-mile buffer were damaged or completely destroyed by the Camp Fire after recordation and evaluation efforts captured in the records search. The potentially eligible (P-04-1324/499461/499462) and one eligible (listed) resource (P-04-3084) are both built environment resources and both appear to have been completely destroyed by the fire and will need to be reassessed for eligibility and integrity. No previously recorded archaeological sites identified during the records search are eligible for listing on the NRHP or CRHR and a majority (n=68) remain unevaluated for their potential to be listed on the NRHP or the CRHR. The unevaluated sites will need to be avoided by the Project, or taken into account to address Project impacts if they cannot be avoided.

Isolated Finds

A total of 14 isolated finds were identified in the background research, including 11 prehistoric isolates and 3 historic-period isolates (Table A.4-2). The prehistoric isolates consist of hand tools; 7 are located within the Study Area, and 4 are located within the 0.25-mile buffer. The historic-period isolates include two separate well shafts, one each in the Study Area and the 0.25-mile buffer, and a fenceline that crosses both the Study Area and the 0.25-mile buffer. Isolates typically do not provide

¹ Prehistoric isolates are defined herein as three or less artifacts (flakes, groundstone, etc.) per 50 square meters. Prehistoric isolated features, such as a bedrock mortar (BRM), are not treated as isolated finds, but as sites. Historic isolates consist of three or less artifacts per 50 square meters (i.e., several fragments from a single glass bottle are one artifact).

² Multi-component sites are sites that have both prehistoric and historic-period artifacts and/or features.

³ These sites were not formally recorded on Department of Parks and Recreation forms and submitted to the CHRIS system for recordation, but the information was captured in reporting.

⁴ *Historic Properties* are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in, the NRHP. Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR § 60.4.

⁵ *Historical Resources* are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in the CRHR.

enough data relevant to understanding past events to meet the federal or state significance criteria and are therefore not considered eligible for potential listing on the NRHP or CRHR. Thus the isolated artifacts will not add constraints to the Project.

Table A.4-2. Summary of Previously Documented Archaeological Isolates

Isolate Number(s)	Description	Temporal Period	Located within Study Area or 0.25-mile buffer
P-04-001761	Biface end fragment	Prehistoric	Study Area
P-04-001762	Basalt flake	Prehistoric	Study Area
P-04-001763	Basalt core	Prehistoric	Buffer
P-04-001764	Chert cobble core	Prehistoric	Buffer
P-04-001765	1 basalt flake, 1 chert flake	Prehistoric	Buffer
P-04-001766	Basalt biface midsection	Prehistoric	Study Area
P-04-001767	Hand dug well	Historic	Study Area
P-04-001768	Basalt flake	Prehistoric	Buffer
P-04-001769	Well	Historic	Buffer
P-04-001770	Basalt biface end fragment	Prehistoric	Study Area
P-04-001771	Old fence line	Historic	Study Area and buffer
P-04-002751	2 basalt flakes	Prehistoric	Study Area
P-04-002757	Unifacially utilized basalt flake	Prehistoric	Study Area
P-04-002758	Cobble mano	Prehistoric	Study Area

Prehistoric Archaeological Sites

The 45 prehistoric sites within the Study Area and 0.25-mile buffer represent Native American occupation prior to the presence of Euro-Americans (Table A.4-3). Twenty-one of these sites are located directly within the Study Area, 23 are located within the 0.25-mile buffer, and one site that was removed by construction grading and no longer exists. Forty of these sites are unevaluated for inclusion in the NRHP and/or CRHR, two have been recommended not eligible for the CRHR and remain unevaluated for the NRHP, and three are not eligible for the NRHP or CRHR. Several sites are associated with the manufacture of lithic tools and quarries. Numerous sites also represent longer occupation of the area as they include midden soil deposits, rock shelters, and petroglyphs.

Table A.4-3. Summary of Previously Documented Prehistoric Archaeological Sites

Site Number(s)	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-000256 CA-BUT-0256	Lithic scatter consisting of projectile points and scraper, BRM, pestles, manos, metate, petroglyphs	Unevaluated for NRHP; recommended not eligible for the CRHR	Study Area
P-04-000259 CA-BUT-0259	BRMs	Unevaluated	Study Area
P-04-000260 CA-BUT-0260	Pestles and 6 BRM	Unevaluated	Study Area
P-04-000261 CA-BUT-0261	BRM with 5 mortars	Unevaluated	Buffer



Site Number(s)	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-000262 CA-BUT-0262	BRM with 115 mortars	Unevaluated for NRHP; recommended not eligible for the CRHR	Buffer
P-04-000263 CA-BUT-0263	Magalia Church THP, rock outcrop with BRM	Unevaluated	Buffer
P-04-000305 CA-BUT-0305	Village site with 11 BRM	Unevaluated	Buffer
P-04-000315 CA-BUT-0315	Village site with BRM, midden, and lithic scatter	Unevaluated	Buffer
P-04-000322 CA-BUT-0322	Elliot Spring House Site: Lithic scatter consisting of flakes, BRMs	Unevaluated	Study Area
P-04-000334 CA-BUT-0334	BRM and midden area	Unevaluated	Buffer
P-04-000433 CA-BUT-0433	Pentz Road Caves: BRMs, small cave in rimrock	Unevaluated	Buffer
P-04-000500 CA-BUT-0500	167 BRMs	Unevaluated	Buffer
P-04-000502 CA-BUT-0502	6 BRMs, mortar fragment, metate fragments	Unevaluated	Study Area
P-04-000506 CA-BUT-0506	51 BRMs	Unevaluated	Buffer
P-04-000507 CA-BUT-0507	11 BRMs	Unevaluated	Buffer
P-04-000527 CA-BUT-0527	BRMs	Unevaluated	Buffer
P-04-000587 CA-BUT-0587	Lithic scatter consisting of flakes and a projectile point, a millingstone, and a quartz crystal	Not eligible (Site no longer exists) ¹	Site no longer exists ¹
P-04-000588 CA-BUT-0588	BRMs	Unevaluated	Study Area
P-04-000647 CA-BUT-0647	Lithic debitage, BRM	Unevaluated	Study Area
P-04-000676 CA-BUT-0676	5 BRMs	Unevaluated	Buffer
P-04-000684 CA-BUT-0684	2 flakes, 4 BRMs	Unevaluated	Buffer
P-04-000685 CA-BUT-0685	4 BRMs	Unevaluated	Buffer
P-04-000686 CA-BUT-0686	BRM and grinding slick	Unevaluated	Buffer
P-04-000687 CA-BUT-0687	20 BRMs, rock shelter	Unevaluated	Study Area
P-04-000748 CA-BUT-0748	BRM	Unevaluated	Buffer
P-04-000750 CA-BUT-0750	4 BRMs	Unevaluated	Buffer



Site Number(s)	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-000807 CA-BUT-0807	Obsidian and chert flakes and flake tools, 2 BRMs, mano fragment, pestle fragment, midden	Not eligible	Study Area
P-04-000813 CA-BUT-0813	Flakes, projectile point, BRM, midden	Unevaluated	Study Area
P-04-001091 CA-BUT-1091	5 BRMs	Unevaluated	Study Area
P-04-001128 CA-BUT-1128	4 BRMs	Not eligible	Study Area
P-04-001153 CA-BUT-1153	BRM and grinding slick	Unevaluated	Study Area
P-04-001282 CA-BUT-1282	4 BRMs	Unevaluated	Buffer
P-04-001315 CA-BUT-1315	85 BRMs	Unevaluated	Study Area
P-04-001561	Lithic scatter and midden	Unevaluated	Buffer
P-04-002772	Lithic scatter, groundstone, fire-cracked rock, midden	Unevaluated	Study Area
P-04-002773	Lithic scatter, BRM, groundstone, midden	Unevaluated	Study Area
P-04-002774	Lithic scatter, BRM	Unevaluated	Study Area
P-04-002775	Lithic scatter, groundstone, fire-cracked rock, midden	Unevaluated	Study Area
P-04-002779	Lithic scatter, BRM, groundstone, fire-cracked rock, midden	Unevaluated	Study Area
P-04-003278 CA-BUT-3278	BRM and milling slick	Unevaluated	Buffer
P-04-003314	9 BRMs	Unevaluated	Buffer
P-04-003441 CA-BUT-3441	13 BRMs	Unevaluated	Buffer
P-04-004315	4 BRMs	Unevaluated	Buffer
P-04-004371 CA-BUT-4371	Millingstones, handstones, pestles, cobble mortar	Unevaluated	Study Area
P-04-004372 CA-BUT-4372	Pestle, millingstone, handstones	Unevaluated	Study Area

NRHP – National Register of Historic Places

CRHR – California Register of Historical Resources

¹ 1988 updated documentation of P-04-000587/CA-BUT-0587 indicates that the site was completely destroyed during construction grading for an anticipated housing development after the initial site recording in 1977.

Historic-Period Archaeological Sites

The 25 historical archaeological sites include refuse scatters, historic-period farming tools, mining sites, water resources facilities, an airfield, an agricultural worker’s camp, habitation sites, and road segments (Table A.4-4). Five of these sites are located within both the Study Area and the 0.25-mile buffer, five are strictly within the Study Area, and the other 15 sites are located within the 0.25-mile

buffer. Two of these sites are documented as not eligible for listing in the NRHP and CRHR, and the remaining 23 are unevaluated for their eligibility.

Table A.4-4. Summary of Previously Documented Historic-Period Archaeological Sites

Site Number(s)	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-001254 CA-BUT-1254H	Dogtown/Oroville Road Segments, rockwall	Unevaluated	Study Area and buffer
P-04-001280 CA-BUT-1280H	Thompson Flat Ditch: earthen water ditch	Unevaluated	Study Area and Buffer
P-04-001476 CA-BUT-1476H	Trash scatter consisting of 50-75 cans, glass jars, ceramics, building materials	Not eligible	Study Area
P-04-001477	Historic Neal Road Segment	Unevaluated	Study Area
P-04-001512	Ditch	Unevaluated	Buffer
P-04-001858	Earthen ditch	Unevaluated	Study Area and buffer
P-04-002648 CA-BUT-2648H	Shanna Ranch Wagon Road	Not eligible	Study Area and buffer
P-04-002750	Plow-like or drag farm equipment	Unevaluated	Buffer
P-04-003123	Stone masonry water fountain and trough	Unevaluated	Buffer
P-04-003132	Rock wall	Unevaluated	Study Area
P-04-004336 CA-BUT-4336H	Trash scatter	Unevaluated	Study Area and buffer
P-04-000667 CA-BUT-0667H	Mining flume	Unevaluated	Buffer
P-04-000715 CA-BUT-0715H	Mining flume	Unevaluated	Buffer
P-04-001246 CA-BUT-1246H	Habitation complex	Unevaluated	Buffer
P-04-001247 CA-BUT-1247H	Trash scatter	Unevaluated	Buffer
P-04-001518	Mine tailings	Unevaluated	Buffer
P-04-001519	WWII airfield	Unevaluated	Buffer
P-04-001520 CA-BUT-1520H	Berkeley Olive Association Camp	Unevaluated	Buffer
P-04-001521 CA-BUT-1521H	Gold Run Creek Homestead	Unevaluated	Buffer
P-04-001673	Magalia Church THP, mining tunnel	Unevaluated	Buffer
P-04-002776	Habitation site with refuse and root cellar	Unevaluated	Study Area
P-04-002777	Habitation site with refuse, well, and root cellar	Unevaluated	Study Area
P-04-003312	Possible root cellar	Unevaluated	Buffer
P-04-003318	Reservoir	Unevaluated	Buffer
P-04-004238	Trash scatter	Unevaluated	Buffer

NRHP – National Register of Historic Places

CRHR – California Register of Historical Resources



Multicomponent Archaeological Sites

The five multicomponent archaeological sites include prehistoric components consisting of artifacts associated with the manufacture of lithic tools and quarries, and historic-period components consisting of artifacts that are consistent with residential/homestead sites. Two of these sites are within the Study Area and three are located within the 0.25-mile buffer. All five of these sites remain unevaluated for eligibility for inclusion in the NRHP and the CRHR.

Table A.4-5. Summary of Previously Documented Multicomponent Archaeological Sites

Site Number(s)	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-000255 CA-BUT-0255/H	Bedrock mortar, stone club/axe head, rock wall	Unevaluated	Study Area
P-04-000320 CA-BUT-0320/H	2 BRMs, remnants of a ranch	Unevaluated	Buffer
P-04-000749 CA-BUT-0749/H	1 BRM, historic trash scatter	Unevaluated	Buffer
P-04-001253 CA-BUT-1253/H	Possible pestle, BRM, house and barn foundations, bottle fragments, wagon parts, irrigation pond, ditches, dirt roads, farming equipment, corral	Unevaluated	Buffer
P-04-002778	Lithic scatter, cores, flake tools, midden; historic root cellar and trash scatter	Unevaluated	Study Area

NRHP – National Register of Historic Places

CRHR – California Register of Historical Resources

Historic-Period Built Environment Resources

A total of 55 historic-period built environment resources were included in the records search results provided by the NEIC and are presented below in Table A.4-6. Of these 55 resources, 13 sites were documented on DPR forms. Of the 55 resources, 35 are located strictly within the Study Area and the remaining 20 resources are located within the 0.25-mile buffer. Fifty of these resources are identified by the NEIC as not eligible for inclusion in the NRHP or CRHR and, thus, would not require further management. Of the remaining resources, three are unevaluated for their eligibility, one resource has been identified as potentially eligible for the NRHP or CRHR, and one is listed on the NRHP (P-04-003084). However, a majority of these resources were damaged or destroyed by the Camp Fire which would affect a resource’s integrity and its potential eligibility for inclusion in the NRHP and/or CRHR. Resources affected by the fire and unevaluated resources will need to be avoided by the Project, or taken into account to address Project impacts if they cannot be avoided.



Table A.4-6. Summary of Previously Documented Historic-Period Built Environment Resources

Primary Site Number/ NEIC Tracking ID	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
510444	Residence	Not eligible	Buffer
510552	Residence*	Not eligible	Buffer
513111	Residence*	Not eligible	Buffer
515740	Residence*	Not eligible	Study Area
516134	Residence*	Not eligible	Study Area
518044	Residence*	Not eligible	Study Area
525199	Residence*	Not eligible	Buffer
525200	Residence*	Not eligible	Buffer
528779	Residence*	Not eligible	Study Area
536337	Residence*	Not eligible	Study Area
540864	Residence*	Not eligible	Study Area
544428	Residence*	Not eligible	Buffer
545322	Residence*	Not eligible	Study Area
545471	Commercial/residential building*	Not eligible	Study Area
545478	Kemper Chiropractic*	Not eligible	Study Area
545481	Paradise Industrial Park*	Not eligible	Study Area
545484	Heinke Property*	Not eligible	Buffer
545486	Heinke Property*	Not eligible	Study Area
545655	Paradise Manor Bed & Breakfast	Not eligible	Study Area
545658	Visinoni General Contractor*	Not eligible	Study Area
545662	Gallagher Chiropractic	Not eligible	Study Area
545665	Commercial building	Not eligible	Study Area
565531	Residence*	Not eligible	Buffer
657284	Residence*	Not eligible	Study Area
657804	Residence*	Not eligible	Study Area
658708	Residence*	Not eligible	Buffer
658713	Residence*	Not eligible	Buffer
659016	Residence*	Not eligible	Study Area
659266	Residence	Not eligible	Study Area
664169	Residence*	Not eligible	Study Area
666611	Residence*	Not eligible	Study Area
666632	Residence*	Not eligible	Buffer
668689	Residence*	Not eligible	Buffer
670824	Residence*	Not eligible	Study Area
672460	Residence*	Not eligible	Study Area
672464	Residence*	Not eligible	Buffer
672727	Residence*	Not eligible	Buffer
678216	Residence*	Not eligible	Study Area
685142	Residence*	Not eligible	Buffer
685151	Residence*	Not eligible	Buffer
685166	Residence*	Not eligible	Study Area
685169	Residence*	Not eligible	Buffer



Primary Site Number/ NEIC Tracking ID	Description	NRHP and CRHR Eligibility	Located within Study Area or 0.25-mile buffer
P-04-001324 499461, 499462	Paradise Forest Fire Station – barracks* ¹	Potentially Eligible	Study Area
P-04-001779 487596	Paradise Depot/Butte County Railroad Depot*	Unevaluated	Study Area
P-04-001780	2 single-family homes*	Not eligible	Study Area
P-04-002883	Shed*	Unevaluated	Buffer
P-04-003018 543354	Duke's Cork 'n' Bottle Discount Liquors commercial structure	Not eligible	Study Area
P-04-003021 543356	Serenity Woods Art Gallery commercial building*	Not eligible	Study Area
P-04-003022 543355	Commercial building	Not eligible	Buffer
P-04-003084	Pence Hotel & Mesilla Valley School property site*	Listed on the NRHP	Study Area
P-04-003634	Visinoni Site: Apple, almond, fig, grapes, cherry orchard, and shrubs, low stone wall, cinderblock building*	Unevaluated	Buffer
P-04-004252	1 folk-style single-family building, 1 traditional- style family building, car service station, shop building, garage, sheds, mobile home, and trash scatter*	Not eligible	Study Area
P-04-004253	Two-story single-family building, garage, storage building, mobile home, and shed*	Not eligible	Study Area
P-04-004254	Ranch-style single-family building, apple trees*	Not eligible	Study Area
P-04-004255	Ranch-style single-family building, garage, sheds*	Not eligible	Study Area

NRHP – National Register of Historic Places

CRHR – California Register of Historical Resources

* This resource was damaged or completely destroyed by the Camp Fire, and may no longer exist.

¹ This resource has been rebuilt since the Camp Fire.

Informally Recorded Sites


The records search resulted in the identification of seven informally recorded sites (Table A.4-7) discussed in an unfinished report (Manning 1982). Each of these sites are within the 0.25-mile buffer. Two of these sites are noted by the NEIC as prehistoric sites lacking associated information or descriptions other than one consists of a rockshelter and the other consists of a rockshelter and pestles. The remaining five sites were not formally recorded on DPR forms or submitted to the CHRIS system for recordation as archaeological sites. Based on information provided in the report, these five informally recorded resources are likely some of the 20 rockshelters identified in the document and some or all may have historic-period artifacts or features.



Table A.4-7. Summary of Informally Recorded Resources

Temporary Resource Designations	Description	NRHP Eligibility	Located within Study Area or 0.25-mile buffer
IDR-15	"arch sites"	Unevaluated	Buffer
IDR-22	"arch sites"	Unevaluated	Buffer
IDR-23	"arch sites"	Unevaluated	Buffer
IDR-24	"arch sites"	Unevaluated	Buffer
IDR-25	"arch sites"	Unevaluated	Buffer
IDR-33	pestles and rockshelter	Unevaluated	Buffer
IDR-34	rockshelter	Unevaluated	Buffer

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B

Process Equipment
Information

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B.1

Secondary Treatment
Process by Aero-Mod

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AEROMOD
Wastewater Process Solutions

Wastewater Treatment Plant Budgetary Estimate

for

**Paradise, CA
HDR**

6,550 Population Equivalent

6-Jul-20

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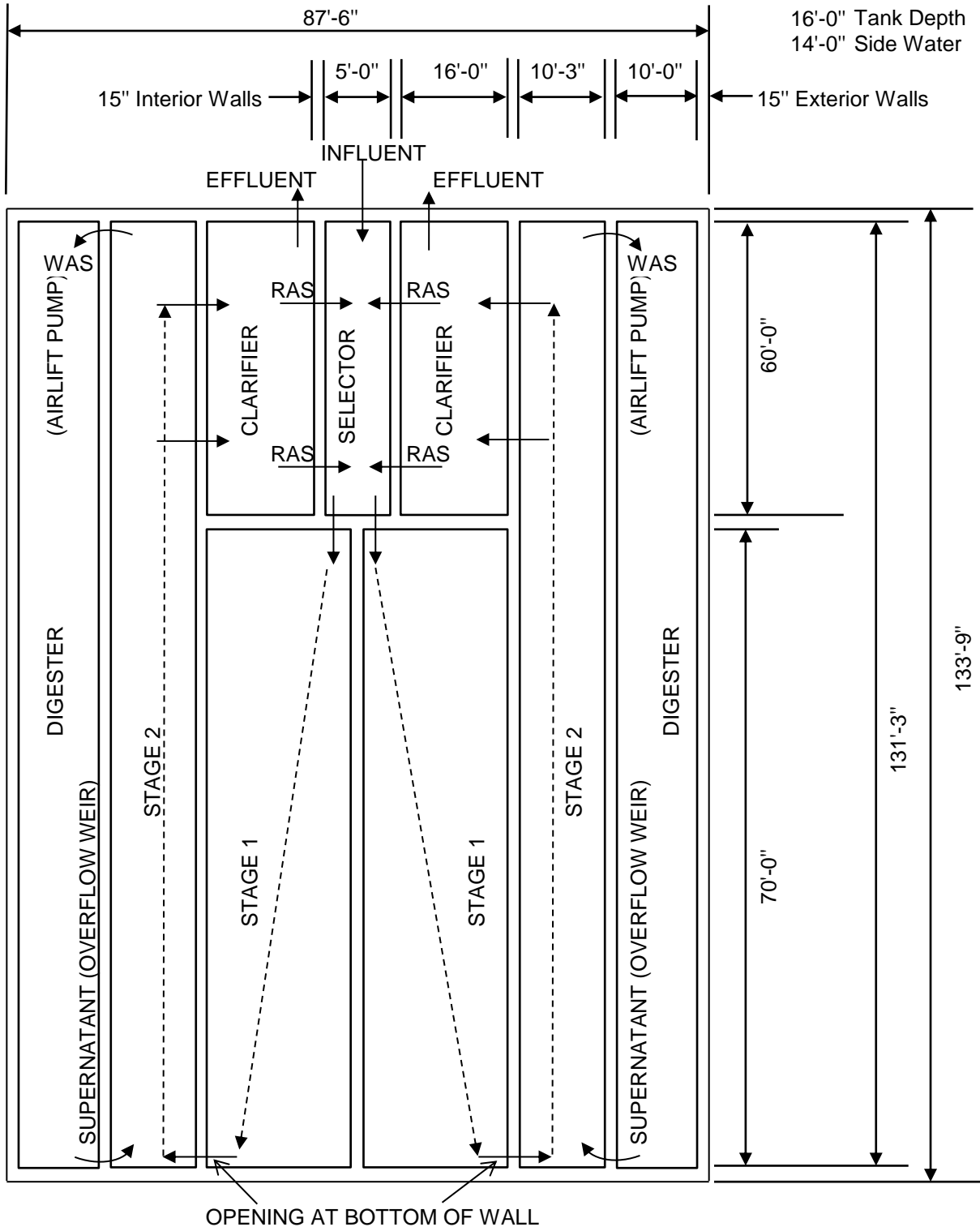
ITEMIZED EQUIPMENT AND SERVICES (& CONCRETE ESTIMATES)

Aero-Mod, Inc.

GENERAL ARRANGEMENT DRAWING

Project: Paradise, CA
Engineer: HDR

Date: 6-Jul-20
 Tank Dimensions (Not to Scale)

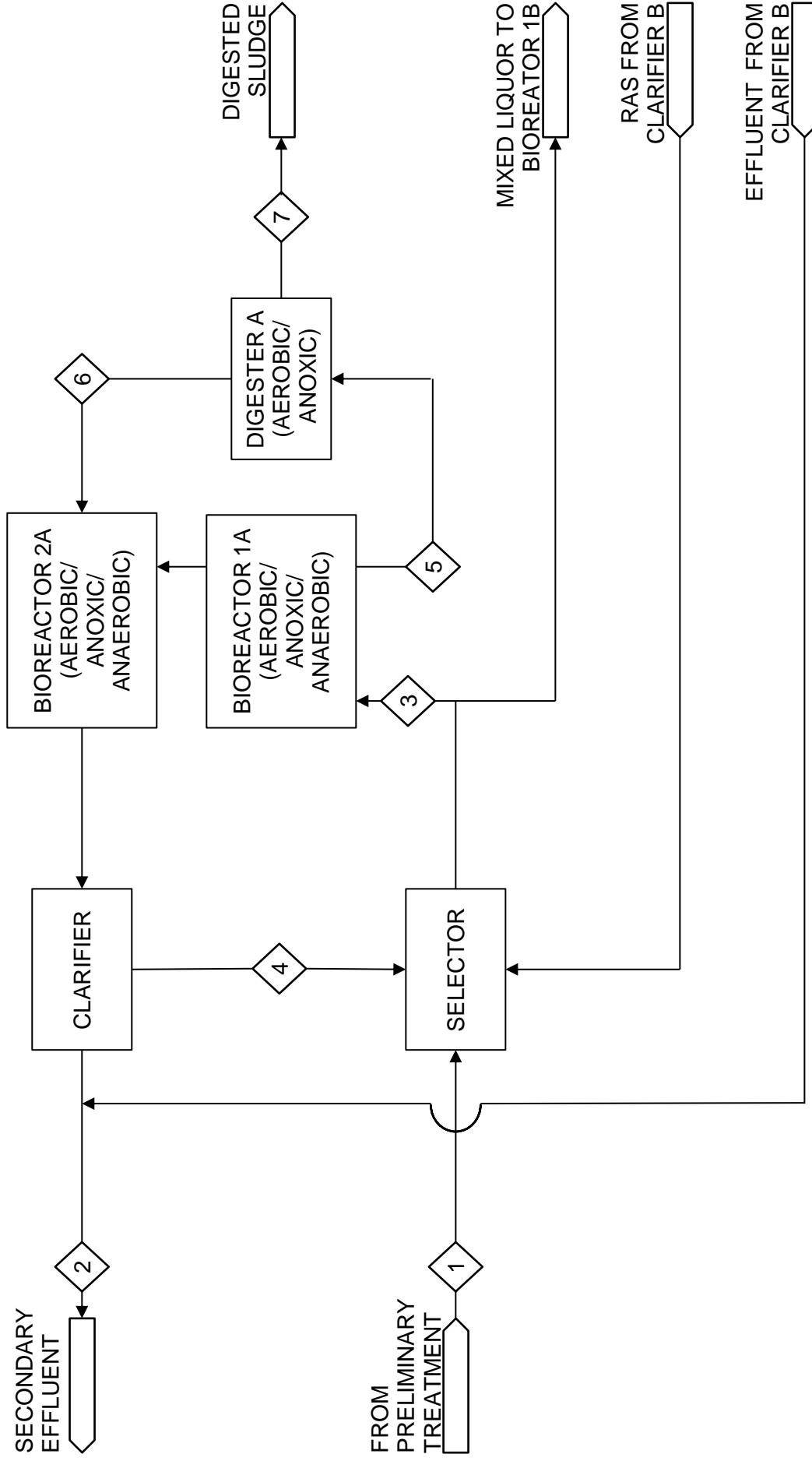


Aero-Mod, Inc.

PROCESS FLOW DIAGRAM

Project: Paradise, CA
 Engineer: HDR

July 6, 2020
 US Customary Units
 Prepared by: BWN



STREAM NO.	1	2	3	4	5	6	7	(1) - (2) - (7)
DESCRIPTION (AVERAGE)	INFLUENT	SECONDARY EFFLUENT	MIXED LIQUOR	RETURN ACTIVATED SLUDGE	WASTE ACTIVATED SLUDGE	DIGESTER DECANT	DIGESTED SLUDGE	
FLOW, MGD	0.448	0.438	0.448	0.224	0.040	0.030	0.010	0.0
BOD, LB/D	1,310	37	N/A	N/A	872	5	600	674
TSS, LB/D	1,500	37	12,938	12,188	1143	8	951	513
VSS, LB/D	1,056	27	6,969	6,565	616	3	424	605
TKN, LB/D	258	11	N/A	N/A	40	0.22	28	219
TIN, LB/D	170	22	N/A	N/A	2.0	0.0	0.0	148
TN, LB/D	258	29	N/A	N/A	41	0.22	28	201
SOL P, LB/D	12.8	16.0	N/A	N/A	1.45	11.9	4	-7.0
TP, LB/D	25.8	18.3	N/A	N/A	40	12.1	7	0.0

Aero-Mod, Inc.

ACTIVATED SLUDGE DESIGN CALCULATIONS - AVERAGE

Project: Paradise, CA
Engineer: HDR
Act. Sludge Process: SEQUOX Plus

July 6, 2020
 US Customary Units
 Prepared by: BWN

DESIGN CONDITIONS & PARAMETERS

	Influent	Effluent		
Flow (Q), MGD	0.448		0.20 lb BOD/capita-day = 6550 Pop. Equiv.	
BOD ₅ , mg/L	351	10	Plant Elevation, FASL	1,778
BOD ₅ , lbs/day	1,310	37	Aeration Basin	
BOD _L , mg/L	513		Retention Time, hours	32
TSS, mg/L	401	10	Aeration Tank Volume, Mgal	0.594
Soluble P, mg/L	3.4	0.00	MCRT, days	15.0
Total P, mg/L	6.9	5.00	Wastewater Temperature, °C	10
NH ₃ -N, mg/L	45	1.00	Net Alkalinity Loss, mg/L as CaCO ₃ ⁽³⁾	(210)
NO ₃ -N, mg/L		5.00	Aerobic Digester	
TIN, mg/L (NO _x -N + NH ₃ -N)		6.00	Volume, Mgal	0.285
rDON, mg/L (Assumed)		1.50	Max MLSS, mg/l	12,000
TKN, mg/L (Total)	69	2.84	Digester Temperature, °C	10
		0.34	Energy Intensity, kWh/m ³	0.9
TN, mg/L (TIN+rDON+pTKN)		7.84	kWh/MG	3,292
Notes:	N/A			
	N/A			
	(3) Alkalinity addition may be required (by others)			
	NA			

PROJECTED OPERATING CONDITIONS - AERATION BASIN

Mixed Liquor Suspended Solids, mg/L	3,463
Mixed Liquor Volatile Suspended Solids, %	54%
F/M Ratio, lbs BOD ₅ /lb MLVSS	0.14
F/M Ratio, lbs BOD ₅ /lb MLSS	0.08
Organic Loading, lb BOD ₅ /1000 cf of tank/day	16.5
BOD ₅ Oxidized ⁽¹⁾ , BOD _{inf} [(351, mg/L)*0.448 mgd*8.34], lb/d	1,310
TKN in WAS	
PTKN [(1143 lb WAS/day)*(0.54 VSS/TSS)*(0.064 TKN/WAS VSS)], lb/d	39.4
STKN [(39,571 gal WAS/d)/(10 ⁶)*(1.0 mg NH ₃ N/L+1.5 mg rDON/L)*8.34], lb/d	0.8
Total, lb/d	40.2
Total, Influent Equivalent, mg/L	10.8
TKN Nitrified ⁽²⁾ =TKNin-rDON-TKNwas	
Total [(68.9-1.5-10.8), mg/L]*0.448 mgd*8.34], lb/d	212
Total, Influent Equivalent [(212 lb/d)/(0.45 mgd)/8.34], mg/L	53.8
TKN Denitrified=NO ₃ Nproduced-NO ₃ Neffl-NO ₃ Nwas	
Total [(((53.8-5) mg/L*0.448 mgd)-(5 mg/L*(39,571/10 ⁶ mgd)))*8.34], lb/d	181
Total, Influent Equivalent [(181 lb/d)/(0.45 mgd)/8.34], mg/L	48.4
Solids Yield (Y), lb TSS/lb BOD ₅	0.87
WAS - Solids Wasted, lbs/day	1,143
WAS - Solids Wasted, gal/day	39,571
WAS - Pumping Time, min/(day-pump) @ 400 gpm	49
(1) Conservative: does not account for removal in effluent or WAS	
(2) Conservative: does not account for removal in effluent	

PROJECTED OPERATING CONDITIONS - AEROBIC DIGESTER

Digester Degree C-Days	300
Volatile Solids Reduction in Digester	31.2%
(Net Volatile Solids Reduction Through Process, %)	31.2%
Solids To Waste from Digester, lbs/day	951
Volume to Waste from Digester, gallons/day	9,501
Digester Sludge Age, days	30
Volatile Suspended Solids	45%

Aero-Mod, Inc.

ACTIVATED SLUDGE DESIGN CALCULATIONS - MAX MONTH

Project: Paradise, CA
Engineer: HDR
Act. Sludge Process: SEQUOX Plus

July 6, 2020
 US Customary Units
 Prepared by: BWN

DESIGN CONDITIONS & PARAMETERS

	Influent	Effluent		
Flow (Q), MGD	0.582		0.2 lb BOD/capita-day = 6550 Pop. Equiv.	
BOD ₅ , mg/L	350	10	Plant Elevation, FASL	1,778
BOD ₅ , lbs/day	1,700	49	Aeration Basin	
BOD _L , mg/L	512		Retention Time, hours	24
TSS, mg/L	401	10	Aeration Tank Volume, Mgal	0.594
Soluble P, mg/L	3.4	0.0	MCRT, days	15.0
Total P, mg/L	6.9	0.62	Wastewater Temperature, °C	10
NH ₃ -N, mg/L	45	1.0	Net Alkalinity Loss, mg/L as CaCO ₃ ⁽³⁾	(210)
NO ₃ -N, mg/L		5.0	Aerobic Digester	
TIN, mg/L (NO _x -N + NH ₃ -N)		6.0	Volume, Mgal	0.285
rDON, mg/L (Assumed)		1.50	Maximum MLSS, mg/l	12,000
TKN, mg/L (Total)	69	2.85	Digester Temperature, °C	10
		(Particulate, pTKN)		
		0.35		
TN, mg/L		7.85		
Notes:	N/A			
	N/A			
	(3) Alkalinity addition may be required (by others)			

PROJECTED OPERATING CONDITIONS - AERATION BASIN

Mixed Liquor Suspended Solids, mg/L	4,483
Mixed Liquor Volatile Suspended Solids, %	54%
F/M Ratio, lbs BOD ₅ /lb MLVSS	0.14
F/M Ratio, lbs BOD ₅ /lb MLSS	0.08
Organic Loading, lb BOD ₅ /1000 cf of tank/day	21.4
BOD ₅ Oxidized ⁽¹⁾ , BOD _{inf} [(350, mg/L)*0.5824 mgd*8.34], lb/d	1,700
TKN in WAS	
PTKN [(1479 lb WAS/day)*(0.54 VSS/TSS)*(0.064 TKN/WAS VSS)], lb/d	51.1
STKN [(39,571 gal WAS/d)/(10 ⁶)*(1.0 mg NH ₃ -N/L+1.5 mg rDON/L)*8.34], lb/d	0.8
Total, lb/d	51.9
Total, Influent Equivalent, mg/L	10.7
TKN Nitrified ⁽²⁾ =TKNin-rDON-TKNwas	
Total [(68.6-1.5-10.7), mg/L]*0.5824 mgd*8.34], lb/d	274
Total, Influent Equivalent [(274 lb/d)/(0.58 mgd)/8.34], mg/L	53.6
TKN Denitrified=NO ₃ Nproduced-NO ₃ Neffl-NO ₃ Nwas	
Total [(((53.6-5) mg/L*0.5824 mgd)-(5 mg/L*39,571/10 ⁶ mgd))*8.34], lb/d	234
Total, Influent Equivalent [(234 lb/d)/(0.58 mgd)/8.34], mg/L	48.2
Solids Yield (Y), lb TSS/lb BOD ₅	0.87
WAS - Solids Wasted, lbs/day	1,479
WAS - Solids Wasted, gal/day	39,571
WAS - Pumping Time, min/(day-pump) @ 400 gpm	99

(1) Conservative: does not account for removal in effluent or WAS

(2) Conservative: does not account for removal in effluent

PROJECTED OPERATING CONDITIONS - AEROBIC DIGESTER

Digester Degree C-Days	300
Volatile Solids Reduction in Digester	31%
(Net Volatile Solids Reduction Through Process, %)	54%
Solids To Waste from Digester, lbs/day	1,231
Volume to Waste from Digester, gallons/day	12,295
Digester Sludge Age, days	23
Volatile Suspended Solids	45%

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - FIRST STAGE - AVERAGE

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th

July 6, 2020
 US Customary Units
 Prepared by: BWN

AERATION REQUIREMENTS - FIRST STAGE

		<u>Consumption</u>
Carbonaceous (= 1.20 lb O ₂ /lb BOD * (1,310 * 0.75) lb BOD/d/24), lb O ₂ /hr	49.1	75%
Nitrogenous (= 4.60 lb O ₂ /lb N Nitrified * (201 * 0.75) lb N Nit./day/24), lb O ₂ /hr	28.9	75%
Denit. Credit (= 2.86 lb O ₂ /lb N Denit. * (182 * 0.75) lb N Denit./day/24), lb O ₂ /hr	-16.3	75%
Actual Oxygenation Rate (AOR), lb O ₂ /hr	61.7	1,482

Standard Oxygenation Rate (SOR), lbs O₂/hr 169.2

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]]$$

Where: C _{s,T,H} D.O. Saturation @ Sea Level and T, mg/l	8.26
C _{s,20} D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
C _{s,act} D.O. Saturation in Wastewater, mg/l	7.36
α O ₂ Transfer Correction for Wastewater	0.55
θ Oxygen Transfer T Correction Factor	1.024
T Temperature of Water, °C (Design Maximum)	25
τ Oxygen Saturation Correction Factor (C _{s,T,H} /C _{s,20})	0.909
β Salinity-Surface Tension Correction Factor	0.95
P _H Pressure at Site Elevation	13.8
Ω Pressure Correction Factor (P _H /P _s)	0.937
C _L Residual D.O. Concentration, mg/l	2.00

Air Requirement at Standard Conditions

$$= [SOR / (\text{Oxygen Density} * TE\% * \text{Diffuser Depth}) / 60], \text{ scfm} \quad \text{699}$$

Where: Oxygen Density, lbs O ₂ /cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	1.60%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{\text{icfm}}{\text{scfm}} = \frac{(T_{\text{air}}+460)}{T_{\text{std}}+460} \times \frac{14.7-RH\%_{\text{std}} \times SVP_{\text{std}}}{14.7-RH\%_{\text{act}} \times SVP_{T_{\text{air}}}} \times \frac{14.7}{P_H}$$

Where: T _{std} = 68°F	
RH% _{std} = 36%	
SVP _{std} = 0.34 psi	
T _{air} - Air Temperature, °F	90
RH% - Relative Humidity, %	25%
SVP _{T_{air}} - Saturated Vapor Pressure of Air @ T _{air} , psi	0.70
	icfm/scfm 1.12

Process Air Required in First Stage Aeration Basins, icfm 780
 Minimum Air for Mixing First Stage Aeration Basins, icfm 418

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - FIRST STAGE - MAX MONTH

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th

July 6, 2020
 US Customary Units
 Prepared by: BWN

AERATION REQUIREMENTS - FIRST STAGE

		<u>Consumption</u>
Carbonaceous (= 1.20 lb O ₂ /lb BOD * (1,700 * 0.75) lb BOD/d/24), lb O ₂ /hr	63.8	75%
Nitrogenous (= 4.60 lb O ₂ /lb N Nitrified * (260 * 0.75) lb N Nit./day/24), lb O ₂ /hr	37.4	75%
Denit. Credit (= 2.86 lb O ₂ /lb N Denit. * (236 * 0.75) lb N Denit./day/24), lb O ₂ /hr	-21.1	75%
Actual Oxygenation Rate (AOR), lbs O ₂ /hr	80.1	1,922

Standard Oxygenation Rate (SOR), lbs O₂/hr 219

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]]$$

Where: C _{s,T} D.O. Saturation @ Sea Level and T, mg/l	8.26
C _{s,20} D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
C _{s,act} D.O. Saturation in Wastewater, mg/l	7.36
α O ₂ Transfer Correction for Wastewater	0.55
θ Oxygen Transfer T Correction Factor	1.024
T Temperature of Water, °C (Design Maximum)	25
τ Oxygen Saturation Correction Factor (C _{s,T,H} /C _{s,20})	0.909
β Salinity-Surface Tension Correction Factor	0.95
P _H Pressure at Site Elevation	13.8
Ω Pressure Correction Factor (P _H /P _s)	0.937
C _L Residual D.O. Concentration, mg/l	2.00

Air Requirement at Standard Conditions

$$= [SOR / (\text{Oxygen Density} * \text{TE}\% * \text{Diffuser Depth}) / 60], \text{ scfm} \quad 907$$

Where: Oxygen Density, lbs O ₂ /cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	1.60%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{\text{icfm}}{\text{scfm}} = \frac{(T_{\text{air}}+460)}{T_{\text{std}}+460} \times \frac{14.7\text{-RH}\%_{\text{std}} \times \text{SVP}_{\text{std}}}{14.7\text{-RH}\%_{\text{act}} \times \text{SVP}_{T_{\text{air}}}} \times \frac{14.7}{P_H}$$

Where: T _{std} = 68°F	
RH% _{std} = 36%	
SVP _{std} = 0.34 psi	
T _{air} - Air Temperature, °F	90
RH% - Relative Humidity, %	25%
SVP _{T_{air}} - Saturated Vapor Pressure of Air @ T _{air} , psi	0.70
	icfm/scfm 1.12

Process Air Required in First Stage Aeration Basin, icfm 1,012
 Minimum Air for Mixing Half First Stage Aeration Basins, icfm 418

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - SECOND STAGE - AVERAGE

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th

July 6, 2020
 US Customary Units
 Prepared by: BWN

AERATION REQUIREMENTS - SECOND STAGE

		<u>Consumption</u>
Carbonaceous (= 1.20 lb O ₂ /lb BOD * (1,310 * 0.25) lb BOD/d/24), lb O ₂ /hr	16.4	25%
Nitrogenous (= 4.60 lb O ₂ /lb N Nitrified * (201 * 0.25) lb N Nit./day/24), lb O ₂ /hr	9.6	25%
Denit. Credit (= 2.86 lb O ₂ /lb N Denit. * (182 * 0.25) lb N Denit./day/24), lb O ₂ /hr	-5.4	25%
Actual Oxygenation Rate (AOR), lbs O ₂ /hr	20.6	494

Standard Oxygenation Rate (SOR), lbs O₂/hr 34.8

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]]$$

Where:	C _{s,T} D.O. Saturation @ Sea Level and T, mg/l	8.26
	C _{s,20} D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
	C _{s,act} D.O. Saturation in Wastewater, mg/l	7.36
	α O ₂ Transfer Correction for Wastewater	0.75
	θ Oxygen Transfer T Correction Factor	1.024
	T Temperature of Water, °C (Design Maximum)	25
	τ Oxygen Saturation Correction Factor (C _{s,T,H} /C _{s,20})	0.909
	β Salinity-Surface Tension Correction Factor	0.95
	P _H Pressure at Site Elevation	13.8
	Ω Pressure Correction Factor (P _H /P _s)	0.937
	C _L Residual D.O. Concentration, mg/l	1.00

Air Requirement at Standard Conditions

$$= [SOR / (\text{Oxygen Density} * \text{TE}\% * \text{Diffuser Depth}) / 60], \text{ scfm} \quad \text{419}$$

Where:	Oxygen Density, lbs O ₂ /cf air	0.0187
	Clean Water Transfer Efficiency/Foot of Submergence, %	0.55%
	Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{\text{icfm}}{\text{scfm}} = \frac{(T_{\text{air}}+460)}{T_{\text{std}}+460} \times \frac{14.7-\text{RH}\%_{\text{std}} \times \text{SVP}_{\text{std}}}{14.7-\text{RH}\%_{\text{act}} \times \text{SVP}_{T_{\text{air}}}} \times \frac{14.7}{P_H}$$

Where: T_{std} = 68°F

RH%_{std} = 36%

SVP_{std} = 0.34 psi

T_{air} - Air Temperature, °F 90

RH% - Relative Humidity, % 25%

SVP_{T_{air}} - Saturated Vapor Pressure of Air @ T_{air}, psi 0.70

icfm/scfm 1.12

Process Air Required in Second Stage Aeration Basins, icfm 467

Minimum Air for Mixing Second Stage Aeration Basins, icfm 420

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - SECOND STAGE - MAX MONTH

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th

July 6, 2020
 US Customary Units
 Prepared by: BWN

AERATION REQUIREMENTS - SECOND STAGE

		<u>Consumption</u>
Carbonaceous (= 1.20 lb O ₂ /lb BOD * (1,700 * 0.25) lb BOD/d/24), lb O ₂ /hr	21.3	25%
Nitrogenous (= 4.60 lb O ₂ /lb N Nitrified * (260 * 0.25) lb N Nit./day/24), lb O ₂ /hr	12.5	25%
Denit. Credit (= 2.86 lb O ₂ /lb N Denit. * (236 * 0.25) lb N Denit./day/24), lb O ₂ /hr	-7.0	25%
Actual Oxygenation Rate (AOR), lbs O ₂ /hr	26.7	

Standard Oxygenation Rate (SOR), lbs O₂/hr 45

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]]$$

Where:	C _{s,T} D.O. Saturation @ Sea Level and T, mg/l	8.26
	C _{s,20} D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
	C _{s,act} D.O. Saturation in Wastewater, mg/l	7.36
	α O ₂ Transfer Correction for Wastewater	0.75
	θ Oxygen Transfer T Correction Factor	1.024
	T Temperature of Water, °C (Design Maximum)	25
	τ Oxygen Saturation Correction Factor (C _{s,T,H} /C _{s,20})	0.909
	β Salinity-Surface Tension Correction Factor	0.95
	P _H Pressure at Site Elevation	13.8
	Ω Pressure Correction Factor (P _H /P _s)	0.937
	C _L Residual D.O. Concentration, mg/l	1.00

Air Requirement at Standard Conditions

$$= [SOR / (\text{Oxygen Density} * \text{TE}\% * \text{Diffuser Depth}) / 60], \text{ scfm} \quad \text{543}$$

Where:	Oxygen Density, lbs O ₂ /cf air	0.0187
	Clean Water Transfer Efficiency/Foot of Submergence, %	0.55%
	Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{\text{icfm}}{\text{scfm}} = \frac{(T_{\text{air}}+460)}{T_{\text{std}}+460} \times \frac{14.7-\text{RH}\%_{\text{std}} \times \text{SVP}_{\text{std}}}{14.7-\text{RH}\%_{\text{act}} \times \text{SVP}_{T_{\text{air}}}} \times \frac{14.7}{P_H}$$

Where:	T _{std} = 68°F	
	RH% _{std} = 36%	
	SVP _{std} = 0.34 psi	
	T _{air} - Air Temperature, °F	90
	RH% - Relative Humidity, %	25%
	SVP _{T_{air}} - Saturated Vapor Pressure of Air @ T _{air} , psi	0.70
	icfm/scfm	1.12

Process Air Required in Second Stage Aeration Basin, icfm	606
Minimum Air for Mixing Half Second Stage Aeration Basins, icfm	420

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - DIGESTER - AVERAGE

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Coarse Bubble

July 6, 2020
 US Customary Units
 Prepared by: BWN

AERATION REQUIREMENTS - DIGESTER

Net O ₂ Required, lb O ₂ /hr @ 1.80 lb O ₂ /lb VSS _{dest} (incl. nit./denite)	14.4
Actual Oxygenation Rate (AOR), lbs O ₂ /hr	14.4
Standard Oxygenation Rate (SOR), lbs O ₂ /hr	43.4

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]]$$

Where: C _{s,T} D.O. Saturation @ Sea Level and T, mg/l	8.26
C _{s,20} D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
C _{s,act} D.O. Saturation in Wastewater, mg/l	7.36
α O ₂ Transfer Correction for Wastewater	0.50
θ Oxygen Transfer T Correction Factor	1.024
T Temperature of Water, °C (Design Maximum)	25
τ Oxygen Saturation Correction Factor (C _{s,T,H} /C _{s,20})	0.909
β Salinity-Surface Tension Correction Factor	0.95
P _H Pressure at Site Elevation	13.8
Ω Pressure Correction Factor (P _H /P _s)	0.937
C _L Residual D.O. Concentration, mg/l	2.0

Air Requirement at Standard Conditions = [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm	574
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Where: Oxygen Density, lbs O ₂ /cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	0.50%
Diffuser Depth Below Water Surface, ft	13.5

Denitrification Penalty (= 0 if sequential aeration IS used) = (TKN _{oxy} -O ₂ in Effluent NO ₃) * 50%, lb O ₂ /hr	0.0
Air Penalty = O ₂ Penalty * Air Requirement / AOR, scfm	0

Net Process Aeration Required in Digester, scfm	574
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Air Requirement at Plant Conditions	
$\frac{\text{icfm}}{\text{scfm}} = \frac{(T_{\text{air}}+460)}{T_{\text{std}}+460} \times \frac{14.7-RH\%_{\text{std}} \times SVP_{\text{std}}}{14.7-RH\%_{\text{act}} \times SVP_{T_{\text{air}}}} \times \frac{14.7}{P_H}$	

Where: T _{std} = 68°F	
RH% _{std} = 36%	
SVP _{std} = 0.34 psi	
T _{air} - Air Temperature, °F	90
RH% - Relative Humidity, %	25%
SVP _{T_{air}} - Saturated Vapor Pressure of Air @ T _{air} , psi	0.70
icfm/scfm =	1.12

Process Air Required for Digestion, icfm	640
Minimum Air Required for Mixing, icfm	425

Aero-Mod, Inc.

BLOWER DESIGN CALCULATIONS

Project: Paradise, CA
Engineer: HDR
Process Configuration: SEQUOX Plus

July 6, 2020
 US Customary Units
 Prepared by: BWN

AIR REQUIREMENTS

	Process scfm	icfm	Mixing, icfm	Required icfm	scfm
First Stage Aeration	699	780	418	780	699
Second Stage Aeration	419	467	420	467	419
Digesters (Mix Half Digesters)	574	640	425	640	574
Anoxic Selector				0	0
Clarifier RAS Airlift Pumps & Skimmers				154	138
Design Load Air Required (Mix Half Digesters)				2,041	1,830

BLOWER SIZING

Pressure (w/Allowance for Blower Inlet/Outlet)	In. H ₂ O	psig
First Stage Aeration	198	7.2
Second Stage Aeration, Selector, Clarifiers & Digesters	186	6.7

Estimated Power Requirements for Operation, hp	Full Load	Minimum (Mixing)
First Stage Aeration Basins	34	24
Second Stage Aeration, Selector, Clarifiers & Digesters	55	39
Total	88	63

	Total	Sizing Data	Total
Number of Blowers		scfm ea.	915
Total (Including Backup)	3	P ₁ , psig	13.8
Backup	1	P ₂ , psig	7.2
Blower Motor Size, hp	75	RH	25%
		T _{inlet} , °F	90
		icfm ea.	1,021

BLOWER SELECTION

	Motor hp	Hz	rpm	hp	icfm	Outlet T
Total	75					
Maximum		60.0	2,690	67.0	1,511	183 F
Design Point		56.9	2,550	63.1	1,421	183 F
Minimum		18.0	810	19.0	314	225 F

Aero-Mod, Inc.
CLARIFIER DESIGN CALCULATIONS

Project: Paradise, CA
Engineer: HDR
Clarifier Type: Split-ClarAstor

July 6, 2020
US Customary Units
Prepared by: BWN

FLOW CONDITIONS

	Annual Ave	Max Mo	Max Wk	Max Day	Max Hr	Max Flow Through Clarifier
Flow, mgd	0.448	0.582	0.627	0.672	0.896	2.304
Peaking Factor		1.30	1.40	1.50	2.00	5.14
Duration, min				1,440	60	
RAS Flow, mgd	0.448	0.448	0.448	0.448	0.448	0.448

EQUIPMENT SIZING & SELECTION

Number of Clarifiers	2	Surface Area per Clarifier, sf	960
Clarifier Unit Model	16320	Total Surface Area, sf	1,920
Bridge Length, ft	16	Total Weir Length, ft	174
Clarifier Unit Width, ft	60.0	Tank Wall Height, ft	16.0
Bridges per Clarifier	3.0	Tank Water Depth, ft	14.0

CLARIFIER OPERATION

	Surface Overflow, gpd/sf	Weir Loading, gpd/lin. ft	Solids Loading, lb/(sf-day)	Solids Loading Limit	Retention Time (Incl. RAS), hr
Annual Average	233	2,575	13		5.4
Max Month	303	3,347	20	30	4.7
Max Wk	327	3,605	21	38	4.5
Max Day	350	3,862	22	41	4.3
Max Hr	467	5,149	26	45	3.6

PEAK FLOW HANDLING: SURGE STORAGE

	Flow Entering Plant, gph	Flow Exiting Plant, gph	Excess Flow, gpm	In-Tank Surge Storage, gal	Capacity of Surge Storage, min	Add'l Surge Storage Req'd, gal	Max Water Depth w/o Add'l Storage, ft
Annual Average	18,667	18,667	0	22,715	n/a	0	
Max Month	24,267	24,267	0	22,715	n/a	0	
Max Wk	26,133	26,133	0	22,715	n/a	0	
Max Day	28,000	28,000	0	22,715	n/a	0	
Max Hr	37,333	37,333	0	22,715	n/a	0	13.9

EFFLUENT PIPE SIZING

Target Max Month Velocity, ft/sec	2.00	
Clarifier Effluent Piping	Plant Effluent Piping	
Number of Pipes per Clarifier	1	Number of Main Effluent Pipes 1
Hazen-Williams C	150	Hazen-Williams C 150
Pipe Diameter, in.	8	Pipe Diameter, in. 10
Velocity and Headloss	V, fps	HL, in./100 ft
Annual Average	0.99	0.5
Max Month	1.29	0.9
Max Wk	1.39	1.0
Max Day	1.49	1.9
Max Hr	1.99	11.2

Aero-Mod, Inc.
TANKAGE DESIGN CALCULATIONS

Project: Paradise, CA
Engineer: HDR
Tank Construction: Cast-in-Place Concrete

July 6, 2020
US Customary Units
Prepared by: BWN

<u>SELECTOR TANK</u>		Volume Required, gal	29,556	
Number of Tanks	1	Tank Width, ft	5.000	
Tank Wall Height, ft	16.0	Tank Length, ft	60.000	
Tank Water Depth, ft	14.0	Total Volume, gal	31,416	
Freeboard, ft	2.0	Retention Time (for $Q_{forward}$), min		101

<u>AERATION TANK</u>		Volume Required, gal	560,000
Tank Wall Height, ft	16.0	Number of Trains	2
Tank Water Depth, ft	14.0	Number of Stages/Train	2

	Stage 1	Stage 2
Number of Tanks	2	2
Tank Length, ft	70.000	131.250
Tank Width, ft	19.125	10.250
Area of Each Tank, sf	1,339	1,345
Total Volume, gal	280,388	281,762

Total Volume, gal 562,150

CLARIFIER TANK

Number of Tanks	2	Tank Width, ft	60.000
Tank Wall Height, ft	16.0	Tank Length, ft	16.000
Tank Water Depth, ft	14.0	Total Volume, gal	201,062

<u>AEROBIC DIGESTER TANK</u>		Volume Required, gal	285,029
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Number of Tanks	2	Tank Width, ft	10.000
Tank Wall Height, ft	16.0	Tank Length, ft	131.250
Tank Water Depth, ft	14.5	Total Volume, gal	284,708

TANKAGE DIMENSIONS

Wall Height, ft	16	Wall Thickness, in.	
Plan Length, ft	133.75	Interior	15
Plan Width, ft	87.50	Exterior	15
Total Plan Area, sf	11,703	Floor Thickness, in.	20
Wall Length, lineal ft		Total Concrete for Slab, cy	924
Interior	765	Total Grout for Clarifier, cy	127
Exterior	428	Total Concrete for Walls, cy	927
Total	1,192		

Aero-Mod, Inc.

POWER, PARTS, CONSUMABLES AND LABOR COST ESTIMATES

Project: Paradise, CA
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/Coarse 3rd/Coarse 4th

July 6, 2020

Prepared by: BWN

POWER REQUIREMENTS

Power Requirements, hp	Max Month	Minimum (Mixing)	Design Yr Ave
Process			
Stage 1 Aeration (Includes Cyclic Aeration)	43.0	24.2	32.3
Stage 2 Aeration (Includes Cyclic Aeration)	25.8	14.5	19.3
Stage 3 Aeration (Includes Cyclic Aeration)	0.0	0.0	0.0
Stage 4 Aeration (Includes Cyclic Aeration)	0.0	0.0	0.0
Clarifier & Selector	1.2	0.5	0.9
Digester	35.3	19.8	26.5
Subtotal	105.2	59.0	78.9
Ancillary			
Blower VFD Control Panels	4.31	2.42	3.23
PLC-based Process & D.O. Control	0.30	0.17	0.23
Subtotal	4.61	2.58	3.46
TOTAL (hp)	109.8	61.6	82.4
Annual Power Costs @ \$0.10 /kWh	\$71,782	\$40,234	\$53,837

REPLACEMENT PARTS, CONSUMABLES AND MAINTENANCE LABOR REQUIREMENTS

	Qty/ Unit	Events/yr	Unit Cost	Units	Annual Allowance	Labor Hrs/Unit	Labor Hrs/Yr
Service Blowers		1	\$280	3.0	\$840	8.00	24
Service Compressors		1	\$130	2.0	\$260	4.00	8
*Replace:		Frequency					
Fine Bubble Diffusers Every		7.00 yrs	\$72	30.00	\$2,156	1.00	30.00
Blowers & VFDs Every		20.00 yrs	\$65,106	3.00	\$9,766	40.00	6.00
Chemical Requirements		Dosage					
Alkalinity (as CaCO ₃)		0 lb/MG	\$0.07		\$0		
Precipitant (as Al)		0 lb/MG	\$1.00		\$0		
Allowance for Other @		20% of total (excl chemicals)			\$4,439		19.00
Estimated Totals					\$22,194		93.40

*Sinking fund costs excluding interest

OPERATIONS LABOR REQUIREMENTS

	Hrs/ Event	Events/yr	Total Hours/yr	
		Design	Design	
Collect Process Samples	1.0	52	52	
Analyze Process Samples	6.0	52	312	TOTAL ESTIMATED O&M LABOR
Evaluate & Record Data	1.0	52	52	
Reporting	4.0	12	48	Design
Inspect/Clean Diffusers	32.0	2	64	1,609 hr/yr
Inspect/Clean DO Probes	1.0	52	52	31 hr/wk
Plant Housekeeping	8.0	52	416	\$31.00 /hr
Rounds/Other Activities	2.0	260	520	\$49,891 /yr
Estimated Yearly Hours			1,516	

Aero-Mod, Inc.

ITEMIZED EQUIPMENT AND SERVICES (& CONCRETE ESTIMATES)

Project: Paradise, CA
Engineer: HDR

July 6, 2020
 US Customary Units
 Prepared by: BWN

EQUIPMENT SUPPLIED

AERATION EQUIPMENT

3	Aeration Blower w/Sound Enclosure, P.D.,	75	HP - 230/460 V, 3 ph,	1,511	icfm
	Outdoor Enclosure(s)?	N			
2	First-Stage SEQUOX butterfly valve, pneumatically-actuated, 10"				
2	First Stage air isolation butterfly valve, gear-operated, 10"				
52	Wall mounted aeration assembly, 1st Stage Basins, Model WA-PFL4-2				
2	Second-Stage Air Flow Control Assembly, 8" x 6"				
28	Wall mounted aeration assembly, 2nd Stage Basins, Model WA-PS2-2				

SELECTOR TANK EQUIPMENT

4	Wall mounted aeration assembly, Selector, Model WA-HSS2-2				
1	Isolation Butterfly Valve, 4"				

CLARIFIER & RAS EQUIPMENT

6	Aero-Mod Split-ClarAtor Clarifier System, Model 16320,	320	sf/each		
---	--	-----	---------	--	--

WAS & DIGESTION EQUIPMENT

2	WAS airlift pump, Model AL-600				
30	Wall mounted aeration assembly, Model WA-PS2-2				
2	Digester Air Flow Control Assembly, 8" x 6"				

ELECTRICAL & CONTROLS EQUIPMENT

1	SEQUOX Control Panel, Model: PLC SQC-200-PLC - 115 V				
3	Blower VFDs - 460 V, 3 ph 75 HP				
2	Air compressor system(s),	2	hp each,	460 V, 3 ph	
2	Air compressor auto-drain - 115 V wall outlet				
2	Regenerative desiccant dryer mounted on dry storage tank - 115 V wall outlet				
1	Dissolved Oxygen Control System(s)	4	Probes Total		

WALKWAYS & ANCILLARY EQUIPMENT

889	Wall mounted walkway & handrail, LF				
2	Wall mounted stop plates & frames				
2	Sonication algae control system(s)				
LS	Spare Parts				
LS	Interior tank installation materials - SS brackets, SS bolts, PVC wall inserts, pneumatic tubing, misc.				

SERVICES

LS	Freight to Jobsite				
LS	Aero-Mod equipment dry inspection,	1	Days		
LS	Aero-Mod equipment wet inspection,	1	Days		
LS	Aero-Mod equipment final startup,	1	Days		
LS	Aero-Mod post-startup review,	1	Days		
LS	Post-Start Op School,	2	days at Factory in Manhattan, KS	2	Person(s)
LS	Seismic Analysis of Equipment Anchorage				

BUDGET EQUIPMENT COST (Excluding all taxes, duties, fees and similar charges) \$1,389,000

ESTIMATED EQUIPMENT & INTERIOR PIPING INSTALLATION COST (BY OTHERS) \$181,000

ESTIMATED CONCRETE TANK COST (BY OTHERS) \$1,385,000

Concrete for Tank Walls, cy	927		
<u>Assumed</u> Installed Concrete Cost, \$/cy			\$700
Concrete for Tank Slab, cy	924		
<u>Assumed</u> Installed Concrete Cost, \$/cy			\$700
Grout for Clarifier Bottom, cy	127		
<u>Assumed</u> Installed Concrete Cost, \$/cy			\$700

TOTAL ESTIMATED COST **\$2,955,000**

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B.2

Tertiary Treatment
Membrane Bioreactor by
Suez

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budget proposal for the
Town of Paradise, CA
ZeeWeed membrane bioreactor package system

submitted to:
HDR

August 10th, 2020

proposal number: 416612-Rev 1

submitted by:
Chris Allen, P.E. - Regional Manager
cell: (503) 307-2238
email: chris.allen@suez.com

local representation by:
Brad Leidecker, P.E.
Coombs Hopkins

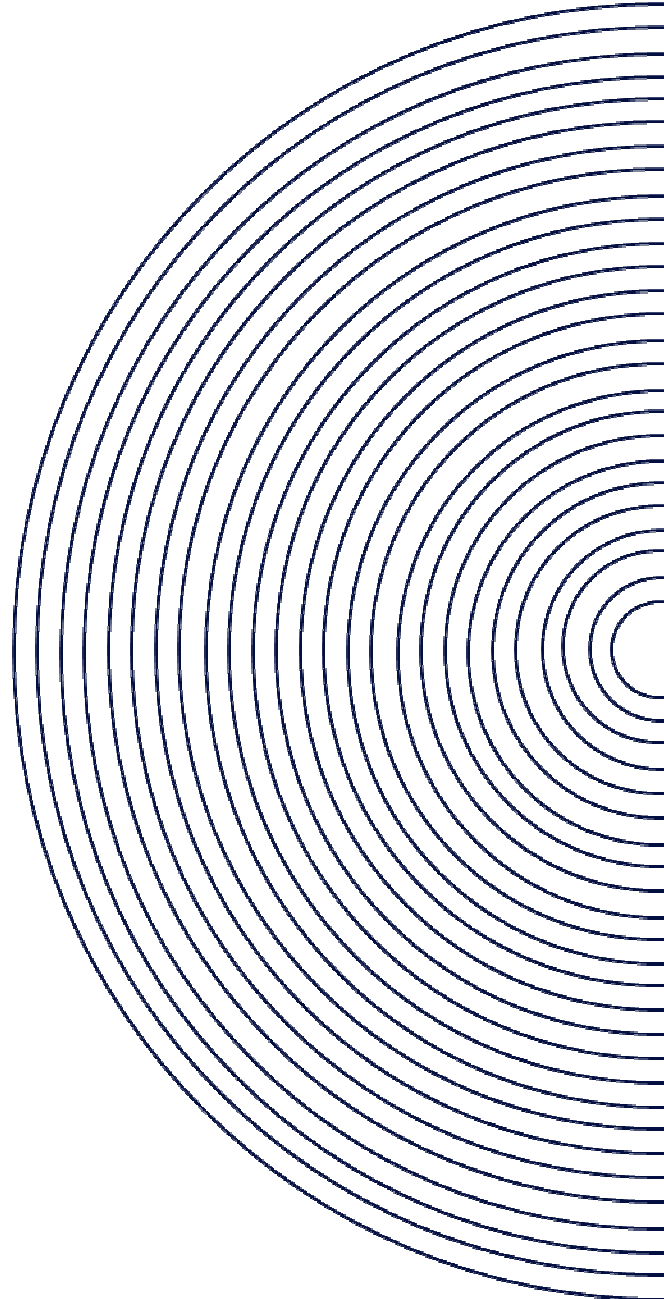


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1 benefits of SUEZ system design

At SUEZ, our goal is to create long term partnerships with our customers, which is why we design our systems with you in mind. Our approach to the proposed ZeeWeed membrane bioreactor system has been optimized around the following three key system attributes;

- ❑ robust design – proven design parameters with scope and configuration options for a wide variety of conditions
- ❑ simple operations – simple & automated operations coupled with SUEZ support for the operating team
- ❑ lowest cost of ownership for the Owner

We are continuously striving to improve our system designs to provide optimal solutions for our customers. Highlighted below are several systems that we have optimized to meet your needs.

1.1 pre-engineered Z-MOD L process pump skid

The Z-MOD L process pump skid is a pre-engineered equipment skid that helps simplify ZeeWeed membrane filtration system design and installation. The Z-MOD L skid is a “plug and go” skid that incorporates most of dedicated membrane train equipment onto a single pre-fabricated equipment skid for simple onsite installation.



The Z-MOD L skid is designed to handle all membrane train flow conditions and includes a bi-directional process pump that performs both permeation and backpulse duty. A train-dedicated remote I/O panel is installed on the Z-MOD L skid, with all skidded equipment and instrumentation pre-wired and tested within the panel.

1.2 membrane aeration system design

Aeration is one of the most important operating parameters for successful long term MBR operations and is a significant component of operating cost.

SUEZ MBR system utilizes a very simple aeration strategy which minimizes the amount of instrumentation and controls required to achieve energy efficient membrane aeration.

No complex control loops or complicated airflow measurement devices are required for LEAPmbr aeration technology to achieve energy efficiency.

1.3 membrane cleaning systems

SUEZ has developed membrane design principles based on best engineering practices that ensure the permeability of the membrane is maintained over the life of the membranes.

A fully automated suite of membrane maintenance procedures will ensure long-term, successful operation, including:

- ❑ in-situ chemical membrane cleaning performed directly in the membrane process tanks so your operators don't waste time moving cassettes;
- ❑ the ability to increase or decrease the frequency of chemical cleans to fit the operating conditions;
- ❑ the ability to backpulse, when needed, to greatly improve your operator's ability to recover from non-design conditions.

The above cleaning systems can be automated, resulting in operators having available a full suite of comprehensive cleaning systems which are simple to use and initiate.

2 basis of design

The following proposed ZeeWeed membrane bioreactor design for the town of paradise WWTP has been designed based on the design parameters summarized in the follow sections.

2.1 influent flow data

The influent design flows are summarized in the table below.

average day flow (ADF)	0.45	mgd
maximum month flow (MMF)	0.56	mgd
maximum day flow (MDF)	0.68	mgd
peak hour flow (PHF)	0.90	mgd
maximum flow with one train offline for maintenance or cleaning (less than 24 hours)	0.56	mgd

note 1: any flow conditions that exceed the above-noted flow limits must be equalized prior to treatment in the ZeeWeed membrane bioreactor system.

- ADF – the average flow rate occurring over a 24-hour period based on annual flow rate data.
- MMF – the average flow rate occurring over a 24-hour period during the 30-day period with the highest flow based on annual flow rate data.
- MDF – the maximum flow rate averaged over a 24-hour period occurring within annual flow rate data.
- PHF – the maximum flow rate sustained over a 1-hour period based on annual flow rate data.

2.2 influent quality

The design solution proposed is based on the wastewater characteristics entering into the MBR bioreactor tanks. The below concentrations are specific to the flow used for the biological design as listed in section 2.5 below.

design influent temperature range	10-20	°C
BOD ₅	350	mg/L
TSS	400	mg/L
inert solids fraction of TSS	20	%
NH ₃ -N	45	mg/L
TKN	68	mg/L
soluble alkalinity as CaCO ₃ ¹	250	mg/L

note 1: SUEZ is assuming that sufficient influent alkalinity is available for proper performance of the biological system. Should influent alkalinity be insufficient, chemical addition by buyer will be required.

note2 : pH adjustment system (if needed- by others)

2.3 effluent quality

The following performance parameters are expected upon equipment startup and once the biological system has stabilized based on the data listed in sections 5.1 and 5.2.

BOD ₅	≤ 5	mg/L
TSS	≤ 1	mg/L
NH ₃ -N	≤ 1	mg/L
TN ¹	≤ 10	mg/L
turbidity ²	≤ 0.5 100% of the time ≤ 0.2 NTU 95% of the time	NTU

note 1: TN ≤ 10 mg/L corresponds to a minimum design temperature of 10°C and <1.5 mg/L recalcitrant dissolved organic nitrogen in the influent.

note 2 : as per title 22

2.4 influent variability

Influent wastewater flows or loads in excess of the design criteria defined above must be equalized prior to entering the membrane tanks. In the event that the influent exceeds the specifications used in engineering this proposal, or the source of influent changes, the ability of the treatment system to produce the designed treated water quality and/or quantity may be impaired. Buyer may choose to continue to operate the system, but assumes the risk of damage to the system and/or additional costs due to increased membrane cleanings, potential for biological upset and/or increased consumable usage.

2.5 biological system design

The biological system for this project consists of anoxic and aerobic zone. The corresponding volumes for each zone are listed in the table below.

design parameters	design value	units
flow basis for biological design	0.56	mgd
number of biological trains	2	
total pre anoxic tank working volume	70,000	US gallons
pre anoxic tank volume per train	35,000	US gallons
total post anoxic tank working volume	110,000	US gallons
post anoxic tank volume per train	55,000	US gallons
total aerobic working volume	300,000	US gallons
aerobic tank volume per train	150,000	US gallons
total design HRT ²	21	hours
aerobic design SRT ²	16	days
waste sludge volume (based on ADF and 10 g/L)	15,500	US gpd /day
design MLSS concentration in bioreactor	≤ 8,000	mg/L
AOR	2,600	lb O ₂ /day

design liquid depth in bioreactor	18	ft
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note 1: standby carbon-dosing system is highly recommended to keep up with any fluctuations of the WW quality.

note 2: excluding membrane tank volume

note 3: the biological system is designed for installation within concrete tanks supplied by buyer

2.6 ZeeWeed ultrafiltration system design

The ZeeWeed ultrafiltration system design is summarized in the table below. Membrane modules are assembled into cassettes and cassettes are installed in concrete tanks supplied by buyer.

type of membrane	ZeeWeed 500D RX12
Module surface area (ft ²)	422
number of trains	2
number of Z-MOD L-630 process pump skids	2
type of cassette	52M
number of cassette spaces per train	2
number of cassettes installed per train	2
total number of cassettes installed per plant	4
Cassette configuration	52 x 1 + 32 x 1
total number of modules installed per train	84
total number of modules installed per plant	168
spare space (%)	19
membrane tank internal dimensions (L x W x H) (ft)	15 x 8 x 13

note 1: dimensions are preliminary only and may change during detailed engineering design.

3 equipment description

The following is a description of the equipment included in SUEZ's scope of supply. Pre-assembled components include the process pump skids, membrane cassette assemblies, and membrane cleaning chemical pump panels. Critical items that will be shipped loose for installation by buyer include the master control panel, tank, blowers, RAS pumps and other associated equipment. Please refer to section 3.1 below for a complete list of SUEZ supplied equipment.

master PLC panel

An Allen-Bradley Compact Logix Programmable Logic Controller (PLC) and Panel View Plus 6 1250 Human Machine Interface (HMI), installed in the UL Type 4 main control panel, monitors and manages all critical process operations.

The master PLC panel communicates using Ethernet TCP/IP, and includes I/O for common equipment items such as membrane blowers, air compressors, RAS pumps and other items (if included in SUEZ Scope).

Level transmitters monitor the level of mixed liquor in the membrane tanks and transmit this information to the SUEZ PLC. The PLC will automatically adjust the process pumps based on the influent flowmeter signal and liquid level in the membrane tanks. RAS pumps are controlled proportionally to the process pump speed.

Z-MOD L process pump skid

One reversible process pump per train is used to draw water through the membranes. The process pump, associated valves, and pump suction and discharge spools are mounted on a factory assembled, epoxy-coated carbon steel skid.

Each Z-MOD L process pump skid is designed with a remote I/O panel UL type 4, which distributes control wiring to the pump, skid mounted VFD UL type 4 and instrumentation including a magnetic flowmeter required to operate the pump system, all located on the process pump skid.

Optional turbidity meter is available for inclusion onto the Z-MOD L process pump skid for train-dedicated permeate turbidity monitoring.

air ejector system

One air ejector system per train is used to prime the dedicated process pump. The air ejector system is installed at the highest point between the membranes installed and process pump, to ensure that all air is removed in the process pump suction line.

membrane scour aeration system

One duty membrane blower per train will be supplied with one common standby blower to be shared by all trains.

Blowers will typically come complete with required isolation valves, check valves, pressure relief valve, pressure indicators and flow indicators.

process aeration system

The process aeration blowers provide air for the biological tank and ensure that sufficient oxygen is available to maintain the biological processes in the tank.

For best efficiency and reduction of the aeration energy, SUEZ has used 1 duty blower per train with a 1 same-size standby common blower.

fine bubble diffusers

A fine bubble diffused aeration system delivers air from the process aeration blowers to the aerobic zone of the process tank.

process mixers

Process mixers are used for mixing in the anoxic chambers to prevent solids from settling.

mixed liquor recirculation equipment

Recirculation (RAS) pumps are used to transfer mixed liquor from the the membrane tanks to the bioreactor at a rate of $4 \times \text{ADF}$.

Recirculation pumps will be supplied with check valves, isolation valves magmeter and pressure indicator.

sodium hypochlorite dosing system

The sodium hypochlorite dosing system is used for membrane cleaning to remove organic foulants from the membrane surface.

citric acid dosing system

The citric acid dosing system is used for membrane cleaning to remove inorganic foulants from the membrane surface.

effluent flow measurement

Each train will include a flow meter to provide discharged permeate flow measurements.

effluent turbidity analyzer

Effluent turbidity analyzers monitor effluent water quality and alert operators if effluent turbidity rises beyond acceptable set point. For optimal performance monitoring, one turbidity analyzer per train has been included.

InSight Basic – digital asset monitoring

Water and process applications generate vast amounts of operating data. InSight, SUEZ's easy-to-use, cloud-based knowledge management platform, captures and transforms your plant data into meaningful and actionable information, ultimately providing the knowledge you need to maximize performance, avoid operational interruptions, optimize your processes, and reduce the total cost of operation.

InSight Basic – Digital Asset Monitoring has been provided with your MBR system for the first year of operation. With InSight Basic, you will gain visibility into your plant's current and future performance by having complete access to your plant data through InSight. InSight Basic allows you to perform your own process monitoring, trending and

analysis suited to your individual plant operations and success criteria. You will have access to the tools in InSight to add your own annotations, load your own analytical data and configure your own reports and alerts.

InSight Basic is enhanced with weekly automated performance reports and daily alarm notification summaries, allowing you to identify emerging problems earlier so that action can be taken now, before a failure can occur. In addition, InSight Basic customers will have access to InSight's built in analytics workspace where you can go beyond standard time based data analytics to uncover more valuable information and understand the underlying causal factors of your plant.

InSight Basic customers have access to personnel from SUEZ's Service Reliability Center (SRC) who will provide training and support on the use and features of InSight.

3.1 scope of supply by SUEZ

quantity	description
The MBR system will include the following equipment:	
ZeeWeed membranes & tankage	
lot	membrane tank cassette mounting assemblies
4	ZeeWeed 500D membrane cassettes
168	membrane modules
2 sets	permeate collection & air distribution header piping
2	membrane tank level transmitter
ejector & associated equipment	
2	air ejector and air supply assemblies
master control panel	
1	master control panel w/ Allen Bradley Compact Logix PLC, Panelview plus 6 1250 HMI, and Flexlogic I/O
Z-MOD L-630 process pump skid	
2	process pump equipment skid - epoxy coated carbon steel
2	positive displacement, bi-directional rotary lobe process pump
2	required pump isolation valves and check valves
2	remote I/O panel - includes Allen Bradley Flexlogic I/O
2	process pump VFD
2	motor disconnect
lot	pressure gauge and flow meter
lot	chemical injection ports and valves
2	Turbidimeter- one per membrane train; includes isolation valves, throttle valve and backplate
backpulse system	
incl	process pumps will also provide backpulse duty
1	flow through backpulse water storage tank, with tank level control and associated valves
membrane air scour blowers	
3	membrane air scour blowers (2 duty + 1 standby) - includes isolation valves, flow switches, pressure gauges and acoustical enclosures
mixed liquor recirculation equipment	
2	Membrane train dedicated recirculation (RAS) pumps (2 duty), used to transfer mixed liquor from the membrane tanks to the bioreactor – includes isolation valves
biological equipment	
2 lot	fine bubble diffused air system for process aeration - loose shipped (without tank downcomer piping)
3	process blowers (2 duty + 1 standby) - includes flow switches, isolation valves and

quantity	description
	acoustical enclosures
4	process mixers for pre anoxic and post anoxic tank
2	supplementary recirculation pumps, used to transfer mixed liquor from the aerobic zone to the pre-anoxic zone – includes isolation valves and flow meters
2	aerobic dissolved oxygen sensor
2	pH sensor
membrane cleaning systems	
1	loose shipped sodium hypochlorite chemical feed system - includes dosing pump and associated valves
1	loose shipped citric acid chemical feed system - includes dosing pump and associated valves.
miscellaneous	
2	air compressor (2 duty + 1 standby) for pneumatic valve operation and refrigerated air drier
1	RS4000 ethernet router for InSight/Remote Connectivity
general	
included	P&IDs and equipment general arrangement and layout drawings for SUEZ supplied equipment
included	operating & maintenance manuals
included	field service and start-up assistance - 35 days support over 3 site visits from SUEZ field-service personnel for commissioning, plant start-up and operator training
included	InSight Basic – digital asset monitoring – 1 year
included	24/7 emergency phone support – 1 year
included	equipment mechanical warranty - 1 year or 18 months from shipment
included	membrane warranty– 5 year (2 year cliff and 3 year prorated)

note 1: additional man-hours will be billed separately from the proposed system capital cost at a rate of \$1,400 per day plus living and traveling expenses. Detailed SUEZ service rates are available upon request.

note 2: all SUEZ supplied equipment is designed for installation in an unclassified area.

note 3: to receive complete 24/7 Emergency Telephone Technical Support Service and to allow for InSight Monitor Service, a suitable secure remote internet connection, by buyer, is required.

4 buyer scope of supply

The following items are for supply by buyer and will include, but are not limited to:

- overall plant design responsibility
- installation on site of all SUEZ-supplied skids and loose-shipped equipment
- review and approval of design and design parameters related to the biological process and membrane separation system
- review and approval of SUEZ supplied equipment drawings and specifications
- detail drawings of all termination points where SUEZ equipment or materials tie into equipment or materials supplied by others
- equipment foundations, civil work, full floor coverage equipment contact pads, buildings, etc.
- receiving, unloading and safe storage of SUEZ-supplied equipment at site until ready for installation
- HVAC equipment design, specifications and installation (where applicable)
- UPS, Power Conditioner, Emergency power supply and specification (where applicable)
- lifting devices including crane able to lift 5,000 kg (10,000lbs) for membrane removal, lifting davits and guide rails for submersible mixers and pumps, hoists, etc...
- MCC, VFD's, or Starters for 3-ph motors, including loose ship SUEZ supplied equipment
- 1 to 2 mm pretreatment fine screens
- equalization tank and associated equipment – as required
- bioreactor tank – complete with anoxic and aerobic zones
- membrane tanks c/w tank covers, grating, and their support over membrane tanks.
- sludge wasting pumps or sludge wasting valves and flow meters
- all chemical storage tanks, day tanks, and secondary containments
- treated water storage tank – as required
- process and utilities piping, pipe supports, hangers, valves, etc. including but not limited to:
 - piping, pipe supports and valves between SUEZ-supplied equipment and other plant process equipment
 - piping between any loose-supplied SUEZ equipment
 - process tank aeration system air piping, equalization tank system piping, etc.

- interconnecting piping between SUEZ-supplied skids, loose shipped equipment and tanks (as applicable)
- electrical wiring, conduit and other appurtenances required to provide power connections as required from the electrical power source to the SUEZ control panel and from the control panel to any electrical equipment, pump motors and instruments external to the SUEZ-supplied enclosure
- suitable, secure remote internet connection for 24/7 emergency telephone technical support service and InSight remote monitoring & diagnostics service
- all bolts, brackets and fasteners to install SUEZ-supplied equipment.
- seismic structural analysis and anchor bolt sizing
- alignment of rotating equipment
- raw materials, chemicals, and utilities during equipment start-up and operation
- supply of seed sludge for biological process start-up purposes
- disposal of initial start-up wastewater and associated chemicals
- weather protection as required for all SUEZ supplied equipment. Skids and electrical panels are designed for indoor operation and will need shelter from the elements.
- laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation
- touch up primer and finish paint surfaces on equipment as required at the completion of the project
- all permits

5 commercial

5.1 pricing

Pricing for the proposed equipment and services, as outlined in section 3, is summarized in the table below. All pricing is based on the design operating conditions and influent characteristics that are detailed in section 2 of the proposal. The pricing herein is for budgetary purposes only and does not constitute an offer of sale. No sales, consumer use or other similar taxes or duties are included in the pricing below.

price: all equipment & service	
Proposed system price as per scope of supply proposed in section 3.1	\$ 1,145,000

5.2 annual power & chemical consumption estimates

The data presented below is for information purposes only and is based on the design information provided by the Buyer and presuming that the equipment is operated according to the design basis and in accordance with Seller's Operations and Maintenance manuals.

annual power consumption estimate ¹

equipment	kWh/year
process pumps ²	32,500
membrane blowers	140,000
process blowers	303,000
recirculation (RAS) pumps	58,000
process mixers	13,000
air compressors	8,000
Total	554,500

note 1: annual power consumption estimate is calculated at ADF condition.

note 2: assumes membrane relaxation mode used.

annual chemical consumption estimate

chemical	USgal/year
sodium hypochlorite (10.3% w/w, SG: 1.168)	855
citric acid (50.0% w/w, SG: 1.24)	690

note 1: cleaning chemical consumption estimates are based on the frequencies and concentrations summarized in the table below. Frequencies are typical for ZW-MBR operation, actual frequency of maintenance and recovery cleans may change with final design, or may change once system is in operation.

basis of chemical consumption estimates

chemical		maintenance clean	recovery clean
sodium hypochlorite solution (10.3% w/w, SG: 1.168)	frequency	2 times per week	2 times per year
	concentration	200 mg/L	1,000 mg/L
citric acid solution (50.0% w/w, SG: 1.24)	frequency	1 time per week	2 times per year
	concentration	2,000 mg/L	2,000 mg/L

5.3 freight

The following freight terms used are as defined by INCOTERMS 2010.

All pricing is FCA, project site.

5.4 equipment shipment and delivery

Equipment shipment is estimated at 24 to 36 weeks after order acceptance. The buyer and seller will arrange a kick-off meeting after contract acceptance to develop a firm shipment schedule.

typical drawing submission and equipment shipment schedule

	6-8 weeks	2 weeks	16-26 weeks		2 weeks
acceptance of PO					
submission of drawings					
drawings approval					
equipment manufacturing					
equipment shipment					
plant operations manuals					

SWTS would like to note that under the current exceptional circumstances under the COVID 19 Pandemic situation, SWTS may not be in a position to guarantee and comply with the planned schedule for project delivery or performance and that should there be any new measures taken by any governmental authority which may impede or delay the said schedule or performance, SWTS reserves the right to modify the schedule / contract accordingly. SWTS will promptly inform you of any changes which may impact the contract or the project.

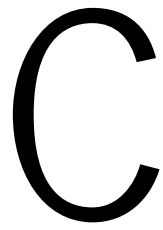
The delivery schedule is presented based on current workload backlogs and production capacity. This estimated delivery schedule assumes no more than 2 weeks for buyer review of submittal drawings. Any delays in buyer approvals or requested changes may result in additional charges and/or a delay to the schedule.

5.5 conditional offering

Buyer understands that this proposal has been issued based upon the information provided by buyer, and currently available to seller, at the time of proposal issuance. Any changes or discrepancies in site conditions (including but not limited to system influent characteristics, changes in environmental health and safety (“EH&S”) conditions, and/or newly discovered EH&S concerns, buyer’s financial standing, Buyer’s requirements, or any other relevant change, or discrepancy in, the factual basis upon which this proposal was created, may lead to changes in the offering, including but not limited to changes in pricing, warranties, quoted specifications, or terms and conditions. Seller’s offering in this proposal is conditioned upon a full seller EH&S, and buyer financial review.

5.6 terms and conditions of sale

This proposal has been prepared and is submitted based on seller’s standard terms and conditions of sale.



C

Recycled Water Criteria

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RECYCLED WATER USES* ALLOWED IN CALIFORNIA

This summary is prepared by WaterReuse Association of California, from the December 2, 2000, Title 22 adopted Water Recycling Criteria, and supersedes all earlier versions.

Recycled Water Use	Treatment Level			
	Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 2.3 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation for:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Parks and playgrounds				
School grounds				
Residential landscaping				
Unrestricted-access golf courses				
Any other irrigation uses not specifically prohibited by other provisions of the <i>California Code of Regulations</i>				
Food crops, surface-irrigated, above-ground edible portion, not contacted by recycled water		ALLOWED		
Cemetaries			ALLOWED	
Freeway landscaping				
Restricted-access golf courses				
Ornamental nursery stock and sod farms with unrestricted public access				
Pasture for milk animals for human consumption				
Nonedible vegetation with access control to prevent use as a park, playground or school grounds				
Orchards with no contact between edible portion and recycled water				ALLOWED
Vineyards with no contact between edible portion and recycled water				
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest				
Fodder and fiber crops and pasture for animals not producing milk for human consumption				
Seed crops not eaten by humans				
Food crops undergoing commercial pathogen-destroying processing before consumption by humans				
Ornamental nursery stock, sod farms not irrigated less than 14 days before harvest				
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	ALLOWED ²	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Restricted recreational impoundments and publicly accessible fish hatcheries	ALLOWED	ALLOWED		
Landscape impoundments without decorative fountains			ALLOWED	
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED ³	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED	ALLOWED	ALLOWED	

Prepared by Bahman Sheikh and edited by EBMUD Office of Water Recycling, who acknowledge this is a summary and not the formal version of the regulations referenced above.

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RECYCLED WATER USES* ALLOWED IN CALIFORNIA

This summary is prepared by WaterReuse Association of California, from the December 2, 2000, Title 22 adopted Water Recycling Criteria, and supersedes all earlier versions.

Recycled Water Use	Treatment Level			
	Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 2.3 Recycled Water	Undisinfected Secondary Recycled Water
Other Uses:				
Groundwater Recharge	ALLOWED under special case-by-case permits by the RWQCB ⁴			
Flushing toilets and urinals	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Priming drain traps	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that may contact workers	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Structural fire fighting	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Decorative fountains	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial laundries	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Consolidation of backfill material around potable water pipelines	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Artificial snow making for commercial outdoor use	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial car washes, not heating the water, excluding the general public from the washing process	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that will not come into contact with workers	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Industrial boiler feed	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Nonstructural fire fighting	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Backfill consolidation around nonpotable piping	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Soil compaction	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Mixing concrete	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Dust control on roads and streets	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Cleaning roads, sidewalks and outdoor work areas	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Flushing sanitary sewers	ALLOWED	ALLOWED	ALLOWED	ALLOWED

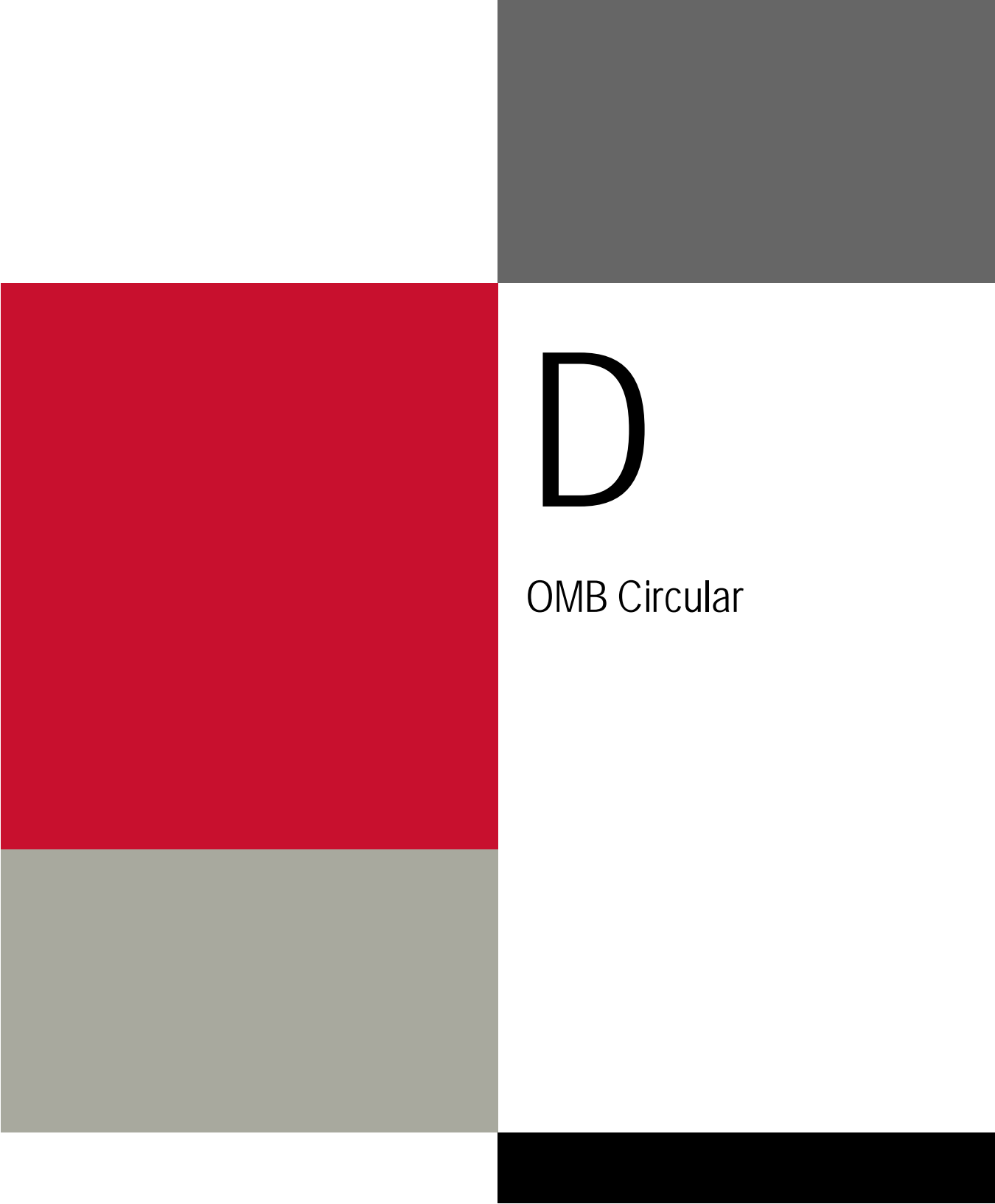
* Refer to the full text of the December 2, 2000 version Title 22: **California Water Recycling Criteria**. This chart is only an informal summary of the uses allowed in this version. Adapted for use in Site Supervisor Training Workshops by **South Bay Water Recycling**, San Jose, California. October 29, 2002. Jerry Brown, Coordinator, Site Supervisor Training. The complete and final 12/02/2000 version of the adopted criteria can be downloaded from:

http://dhs.ca.gov/ps/ddwenm/publications/regulations/recycleregs_index.htm

² With "Conventional tertiary treatment". Additional monitoring for two years or more is necessary with direct filtration.

³ Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

⁴ Refer to Groundwater Recharge Guidelines, available from the California Department of Health Services.



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OMB Circular

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APPENDIX C
(Revised November 2019)

**DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE,
AND RELATED ANALYSES**

Effective Dates. This appendix is updated annually. This version of the appendix is valid for calendar year 2020. A copy of the updated appendix can be obtained in electronic form through the OMB home page at <https://www.whitehouse.gov/wp-content/uploads/2019/12/Appendix-C.pdf>. The text of the Circular is found at <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf>, and a table of past years' rates is located at <https://www.whitehouse.gov/wp-content/uploads/2019/12/discount-history.pdf>. Updates of the appendix are also available upon request from OMB's Office of Economic Policy (202-395-3585).

Nominal Discount Rates. A forecast of nominal or market interest rates for calendar year 2020 based on the economic assumptions for the 2021 Budget is presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

**Nominal Interest Rates on Treasury Notes and Bonds
of Specified Maturities (in percent)**

<u>3-Year</u>	<u>5-Year</u>	<u>7-Year</u>	<u>10-Year</u>	<u>20-Year</u>	<u>30-Year</u>
1.6	1.7	1.8	2.0	2.3	2.4

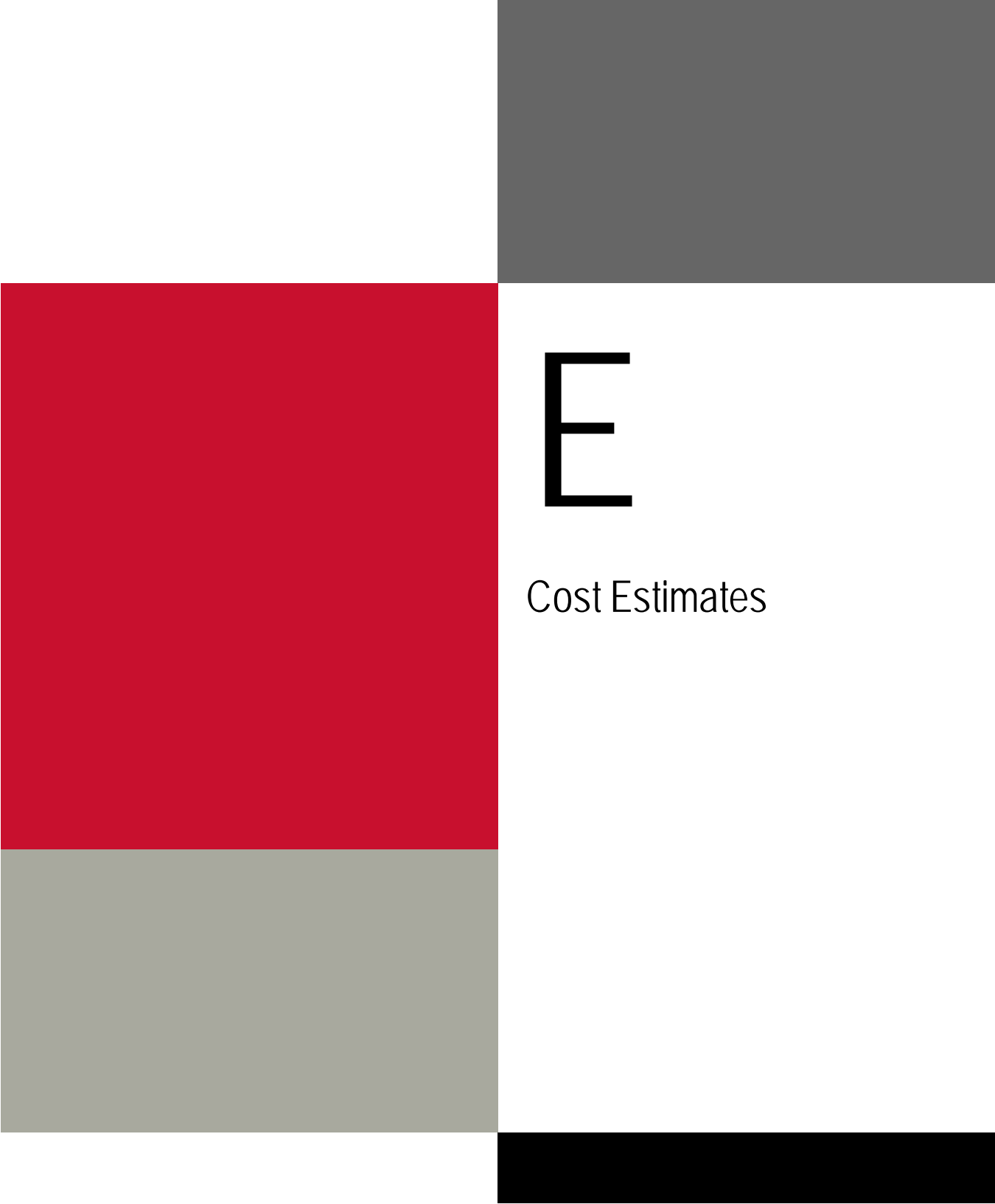
Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2021 Budget is presented below. These real rates are to be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis.

**Real Interest Rates on Treasury Notes and Bonds
of Specified Maturities (in percent)**

<u>3-Year</u>	<u>5-Year</u>	<u>7-Year</u>	<u>10-Year</u>	<u>20-Year</u>	<u>30-Year</u>
-0.4	-0.3	-0.2	0.0	0.3	0.4

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

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Cost Estimates

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ESTIMATED COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Surface Water Discharge to Miocene Canal	
	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Influent Pump Station (submersible in 6 ft dia circular wet well)	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000
Headworks (screenings, grit removal and metering)	\$1,200,000	\$1,200,000	\$1,427,000	\$1,427,000	\$1,427,000	\$1,427,000	\$1,427,000	\$1,427,000	\$1,427,000	\$1,427,000
Odor Control (biological with carbon scrubber w/ redundancy)	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000	\$1,430,000
AeroMod System (Secondary Treatment and Aerobic Digestion)										
Equipment	\$2,469,000	\$2,469,000	NA	NA	NA	NA	NA	NA	NA	NA
Concrete Basins (process and aerobic digester)	\$2,291,000	\$2,291,000	NA	NA	NA	NA	NA	NA	NA	NA
Suez MBR										
Equipment	NA	NA	\$2,004,000	\$2,004,000	\$2,004,000	\$2,004,000	\$2,004,000	\$2,004,000	\$2,004,000	\$2,004,000
Concrete Basins (process only)	NA	NA	\$1,295,000	\$1,295,000	\$1,295,000	\$1,295,000	\$1,295,000	\$1,295,000	\$1,295,000	\$1,295,000
Blower Building (20' x 20')	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000
Disinfection (chlorine contact basin)	\$188,000	\$188,000	\$188,000	\$188,000	\$188,000	\$188,000	NA	NA	NA	NA
Disinfection (UV)	NA	NA	NA	NA	NA	NA	\$813,000	\$813,000	NA	NA
Chemical Feed and Storage	\$95,000	\$95,000	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
Chemical Building	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000	\$131,000
Effluent Pump Station	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000
Supply Pump Station to Land Disposal Sites	\$250,000	\$250,000	\$250,000	\$250,000	NA	NA	NA	NA	NA	NA
Aerobic Digester (MBR alt only)	Included in AeroMod Equipment Cost		\$831,000	\$831,000	\$831,000	\$831,000	\$831,000	\$831,000	\$831,000	\$831,000
Solids Handling (mechanical dewatering w/odor control)	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000	\$1,118,000
Sludge Drying (Class A sludge only)	NA	\$4,123,000	NA	\$4,123,000	NA	\$4,123,000	NA	\$4,123,000	NA	\$4,123,000
Utility Water Pump Station	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000
Potable Water to Site (pipeline and connection fee)	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000
Electrical Building (20' x 30')	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000	\$300,000
Generator w/Enclosure and Integral Fuel Tank (outdoor installation)	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000
Advanced Treatment (Ultra-filtration, reverse osmosis, advanced oxidation process, UV disinfection)	NA	NA	NA	NA	NA	NA	NA	NA	\$29,500,000	\$29,500,000
Brine Treatment (resulting in 22,400 gallons/day of brine solution needing disposal)	NA	NA	NA	NA	NA	NA	NA	NA	\$3,130,000	\$3,130,000
Subtotal 1	\$10,722,000	\$14,845,000	\$10,324,000	\$14,447,000	\$10,074,000	\$14,197,000	\$10,699,000	\$14,822,000	\$42,516,000	\$46,639,000
Sitework and Yard Piping (@15% of Subtotal 1)	\$1,608,000	\$2,227,000	\$1,549,000	\$2,167,000	\$1,511,000	\$2,130,000	\$1,605,000	\$2,223,000	\$6,377,000	\$6,996,000
Electrical/Instrumentation (@25% of Subtotal 1)	\$2,681,000	\$3,711,000	\$2,581,000	\$3,612,000	\$2,519,000	\$3,549,000	\$2,675,000	\$3,706,000	\$10,629,000	\$11,660,000
Subtotal 2	\$15,011,000	\$20,783,000	\$14,454,000	\$20,226,000	\$14,104,000	\$19,876,000	\$14,979,000	\$20,751,000	\$59,522,000	\$65,295,000
Mobilization/Demobilization (2%)	\$300,000	\$416,000	\$289,000	\$405,000	\$282,000	\$398,000	\$300,000	\$415,000	\$1,190,000	\$1,306,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	\$218,000	\$301,000	\$210,000	\$293,000	\$205,000	\$288,000	\$217,000	\$301,000	\$863,000	\$947,000
Contractor Profit (15%)	\$2,252,000	\$3,117,000	\$2,168,000	\$3,034,000	\$2,116,000	\$2,981,000	\$2,247,000	\$3,113,000	\$8,928,000	\$9,794,000
Bonds and Insurance (2%)	\$300,000	\$416,000	\$289,000	\$405,000	\$282,000	\$398,000	\$300,000	\$415,000	\$1,190,000	\$1,306,000
Subtotal 3	\$18,081,000	\$25,033,000	\$17,410,000	\$24,363,000	\$16,989,000	\$23,941,000	\$18,043,000	\$24,995,000	\$71,693,000	\$78,648,000
Undefined Scope (30%)	\$5,424,000	\$7,510,000	\$5,223,000	\$7,309,000	\$5,097,000	\$7,182,000	\$5,413,000	\$7,499,000	\$21,508,000	\$23,594,000
Total WWTP Construction Cost	\$23,505,000	\$32,543,000	\$22,633,000	\$31,672,000	\$22,086,000	\$31,123,000	\$23,456,000	\$32,494,000	\$93,201,000	\$102,242,000
Construction Contingency (10%)	\$2,351,000	\$3,254,000	\$2,263,000	\$3,167,000	\$2,209,000	\$3,112,000	\$2,346,000	\$3,249,000	\$9,320,000	\$10,224,000
Land Costs										
Wastewater Treatment Plant (5 acres secondary and tertiary, 7 acres for advanced treatment)	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$280,000	\$280,000
Effluent Disposal (312 acres)	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	\$0	\$0	\$0	\$0	\$0	\$0
Total WWTP Construction Cost with Contingency and Land Purchase	\$26,056,000	\$35,997,000	\$25,096,000	\$35,039,000	\$24,495,000	\$34,435,000	\$26,002,000	\$35,943,000	\$102,801,000	\$112,746,000

ESTIMATED COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Surface Water Discharge to Miocene Canal	
Biosolids Classification	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Implementation (Soft) Costs (percentage of Total Construction Cost w/o Land Costs)										
Project Administration (2%)	\$517,000	\$716,000	\$498,000	\$697,000	\$486,000	\$685,000	\$516,000	\$715,000	\$2,050,000	\$2,249,000
Legal Council/Bond Council (1%)	\$259,000	\$358,000	\$249,000	\$348,000	\$243,000	\$342,000	\$258,000	\$357,000	\$1,025,000	\$1,125,000
Planning (3%)	\$776,000	\$1,074,000	\$747,000	\$1,045,000	\$729,000	\$1,027,000	\$774,000	\$1,072,000	\$3,076,000	\$3,374,000
Design (13%)	\$3,361,000	\$4,654,000	\$3,236,000	\$4,529,000	\$3,158,000	\$4,451,000	\$3,354,000	\$4,647,000	\$13,328,000	\$14,621,000
Environmental Documentation/Permitting (3%)	\$776,000	\$1,074,000	\$747,000	\$1,045,000	\$729,000	\$1,027,000	\$774,000	\$1,072,000	\$3,076,000	\$3,374,000
ROW Acquisition (1%)	\$259,000	\$358,000	\$249,000	\$348,000	\$243,000	\$342,000	\$258,000	\$357,000	\$1,025,000	\$1,125,000
Construction Management (8%)	\$2,068,000	\$2,864,000	\$1,992,000	\$2,787,000	\$1,944,000	\$2,739,000	\$2,064,000	\$2,859,000	\$8,202,000	\$8,997,000
Engineering Services During Construction (4%)	\$1,034,000	\$1,432,000	\$996,000	\$1,394,000	\$972,000	\$1,369,000	\$1,032,000	\$1,430,000	\$4,101,000	\$4,499,000
Environmental Monitoring/Regulatory Compliance (3%)	\$776,000	\$1,074,000	\$747,000	\$1,045,000	\$729,000	\$1,027,000	\$774,000	\$1,072,000	\$3,076,000	\$3,374,000
Environmental Mitigation (6%)	\$1,551,000	\$2,148,000	\$1,494,000	\$2,090,000	\$1,458,000	\$2,054,000	\$1,548,000	\$2,145,000	\$6,151,000	\$6,748,000
Implementation Cost Total	\$11,377,000	\$15,752,000	\$10,955,000	\$15,328,000	\$10,691,000	\$15,063,000	\$11,352,000	\$15,726,000	\$45,110,000	\$49,486,000
TOTAL WWTP CAPITAL COST	\$37,433,000	\$51,749,000	\$36,051,000	\$50,367,000	\$35,186,000	\$49,498,000	\$37,354,000	\$51,669,000	\$147,911,000	\$162,232,000
O&M COSTS										
O&M Cost (annual)	\$1,261,000	\$1,314,899	\$1,301,492	\$1,355,872	\$1,675,874	\$1,730,245	\$1,669,525	\$1,723,901	\$6,410,403	\$6,464,792
O&M Cost NPV (20 yrs, 0.3%)	\$24,434,000	\$25,488,000	\$25,228,000	\$26,282,000	\$32,485,000	\$33,538,000	\$32,361,000	\$33,415,000	\$124,257,000	\$125,311,000
SALVAGE VALUE										
Land Cost Value, Infinite Life, no escalation or depreciation	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$280,000	\$280,000
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	\$5,171,000	\$7,159,000	\$4,979,000	\$6,968,000	\$4,859,000	\$6,847,000	\$5,160,000	\$7,149,000	\$20,504,000	\$22,493,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	\$20,685,000	\$28,638,000	\$19,917,000	\$27,871,000	\$19,436,000	\$27,388,000	\$20,642,000	\$28,594,000	\$82,017,000	\$89,973,000
Salvage Value of Land	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$280,000	\$280,000
Salvage Value of Equipment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Salvage Value of Non-Equipment	\$12,411,000	\$17,183,000	\$11,950,000	\$16,723,000	\$11,662,000	\$16,433,000	\$12,385,000	\$17,156,000	\$49,210,000	\$53,984,000
Net Present Value of Salvage Value of Land	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$280,000	\$280,000
Net Present Value of Salvage Value of Equipment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Net Present Value of Salvage Value of Non-Equipment	\$11,689,000	\$16,184,000	\$11,255,000	\$15,751,000	\$10,984,000	\$15,477,000	\$11,665,000	\$16,158,000	\$46,348,000	\$50,845,000
TOTAL NET PRESENT VALUE	\$49,978,000	\$60,853,000	\$49,824,000	\$60,698,000	\$56,487,000	\$67,359,000	\$57,850,000	\$68,726,000	\$225,540,000	\$236,418,000

ESTIMATED COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Discharge to Miocene Canal	
	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Collection System Pump Station	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000	\$250,000
Forcemain from Collection System Pump Station to WWTP Site to Disposal Location	\$7,461,000	\$7,461,000	\$7,461,000	\$7,461,000	\$4,963,000	\$4,963,000	\$4,963,000	\$4,963,000	\$4,467,000	\$4,467,000
On-Site Irrigation System (\$5,000/acre)	\$1,300,000	\$1,300,000	\$1,300,000	\$1,300,000						
Effluent Disposal Equipment	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs and No Equipment Costs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Effluent Storage (excavation for 150 MG of unlined storage, 4 ft deep plus 2 ft of freeboard)	\$3,884,000	\$3,884,000	\$3,884,000	\$3,884,000	NA	NA	NA	NA	NA	NA
Effluent Disposal Land Leveling	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Effluent Disposal Equipment	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Subtotal 1	\$12,895,000	\$12,895,000	\$12,895,000	\$12,895,000	\$5,213,000	\$5,213,000	\$5,213,000	\$5,213,000	\$4,717,000	\$4,717,000
Mobilization/Demobilization (2%)	\$109,000	\$109,000	\$109,000	\$109,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	\$79,000	\$79,000	\$79,000	\$79,000	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000
Contractor Profit (15%)	\$815,000	\$815,000	\$815,000	\$815,000	\$38,000	\$38,000	\$38,000	\$38,000	\$38,000	\$38,000
Bonds and Insurance (2%)	\$109,000	\$109,000	\$109,000	\$109,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
Subtotal 3	\$14,007,000	\$14,007,000	\$14,007,000	\$14,007,000	\$5,265,000	\$5,265,000	\$5,265,000	\$5,265,000	\$4,769,000	\$4,769,000
Undefined Scope (30%)	\$4,202,000	\$4,202,000	\$4,202,000	\$4,202,000	\$1,580,000	\$1,580,000	\$1,580,000	\$1,580,000	\$1,431,000	\$1,431,000
Total Construction Cost	\$18,209,000	\$18,209,000	\$18,209,000	\$18,209,000	\$6,845,000	\$6,845,000	\$6,845,000	\$6,845,000	\$6,200,000	\$6,200,000
Construction Contingency (10%)	\$1,821,000	\$1,821,000	\$1,821,000	\$1,821,000	\$685,000	\$685,000	\$685,000	\$685,000	\$620,000	\$620,000
Land Costs										
Effluent Storage (150 acres)	\$4,106,000	\$4,106,000	\$4,106,000	\$4,106,000	\$0	\$0	\$0	\$0	\$0	\$0
Effluent Disposal (312 acres)	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	\$0	\$0	\$0	\$0	\$0	\$0
Total Construction Cost with Contingency and Land Purchase	\$24,136,000	\$24,136,000	\$24,136,000	\$24,136,000	\$7,530,000	\$7,530,000	\$7,530,000	\$7,530,000	\$6,820,000	\$6,820,000

ESTIMATED COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
Disposal Method	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Discharge to Miocene Canal	
Biosolids Classification	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Implementation (soft) Costs (percentage of Total Construction Cost w/o Land Costs)										
Project Administration (2%)	\$401,000	\$401,000	\$401,000	\$401,000	\$151,000	\$151,000	\$151,000	\$151,000	\$136,000	\$136,000
Legal Council/Bond Council (1%)	\$200,000	\$200,000	\$200,000	\$200,000	\$75,000	\$75,000	\$75,000	\$75,000	\$68,000	\$68,000
Planning (3%)	\$601,000	\$601,000	\$601,000	\$601,000	\$226,000	\$226,000	\$226,000	\$226,000	\$205,000	\$205,000
Design (13%)	\$2,604,000	\$2,604,000	\$2,604,000	\$2,604,000	\$979,000	\$979,000	\$979,000	\$979,000	\$887,000	\$887,000
Environmental Documentation/Permitting (3%)	\$601,000	\$601,000	\$601,000	\$601,000	\$226,000	\$226,000	\$226,000	\$226,000	\$205,000	\$205,000
ROW Acquisition (1%)	\$200,000	\$200,000	\$200,000	\$200,000	\$75,000	\$75,000	\$75,000	\$75,000	\$68,000	\$68,000
Construction Management (8%)	\$1,602,000	\$1,602,000	\$1,602,000	\$1,602,000	\$602,000	\$602,000	\$602,000	\$602,000	\$546,000	\$546,000
Engineering Services During Construction (4%)	\$801,000	\$801,000	\$801,000	\$801,000	\$301,000	\$301,000	\$301,000	\$301,000	\$273,000	\$273,000
Environmental Monitoring/Regulatory Compliance (3%)	\$601,000	\$601,000	\$601,000	\$601,000	\$226,000	\$226,000	\$226,000	\$226,000	\$205,000	\$205,000
Environmental Mitigation (6%)	\$1,202,000	\$1,202,000	\$1,202,000	\$1,202,000	\$452,000	\$452,000	\$452,000	\$452,000	\$409,000	\$409,000
Implementation Cost Total	\$8,813,000	\$8,813,000	\$8,813,000	\$8,813,000	\$3,313,000	\$3,313,000	\$3,313,000	\$3,313,000	\$3,002,000	\$3,002,000
TOTAL CAPITAL COST	\$32,949,000	\$32,949,000	\$32,949,000	\$32,949,000	\$10,843,000	\$10,843,000	\$10,843,000	\$10,843,000	\$9,822,000	\$9,822,000
O&M COSTS										
O&M Cost (annual)	\$173,000	\$173,000	\$173,000	\$173,000	\$58,000	\$58,000	\$115,000	\$115,000	\$115,000	\$115,000
O&M Cost NPV (20 yrs, 0.3%)	\$3,344,000	\$3,344,000	\$3,344,000	\$3,344,000	\$1,115,000	\$1,115,000	\$2,229,000	\$2,229,000	\$2,229,000	\$2,229,000
SALVAGE VALUE										
Land Cost Value, Infinite Life, no escalation or depreciation	\$4,106,000	\$4,106,000	\$4,106,000	\$4,106,000	\$0	\$0	\$0	\$0	\$0	\$0
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	\$19,980,000	\$19,980,000	\$19,980,000	\$19,980,000	\$7,480,000	\$7,480,000	\$7,480,000	\$7,480,000	\$6,770,000	\$6,770,000
Salvage Value of Land	\$4,106,000	\$4,106,000	\$4,106,000	\$4,106,000	\$0	\$0	\$0	\$0	\$0	\$0
Salvage Value of Equipment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Salvage Value of Non-Equipment	\$11,988,000	\$11,988,000	\$11,988,000	\$11,988,000	\$4,488,000	\$4,488,000	\$4,488,000	\$4,488,000	\$4,062,000	\$4,062,000
Net Present Value of Salvage Value of Land	\$4,106,000	\$4,106,000	\$4,106,000	\$4,106,000	\$0	\$0	\$0	\$0	\$0	\$0
Net Present Value of Salvage Value of Equipment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Net Present Value of Salvage Value of Non-Equipment	\$11,291,000	\$11,291,000	\$11,291,000	\$11,291,000	\$4,227,000	\$4,227,000	\$4,227,000	\$4,227,000	\$3,826,000	\$3,826,000
TOTAL NET PRESENT VALUE	\$20,896,000	\$20,896,000	\$20,896,000	\$20,896,000	\$7,731,000	\$7,731,000	\$8,845,000	\$8,845,000	\$8,225,000	\$8,225,000

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with UV Disinfection		Tertiary Treatment with Advanced Treatment (UF/RO/AOP/UV)		Septic Receiving and Handling
	Land Application		Land Application		Beneficial Reuse		Surface Water Discharge, Water Recycling		Surface Water Discharge to Miocene Canal		
	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	
Advanced Treatment											
UF/RO/AOP/UV Treatment Cost									\$722,300	\$722,300	
VSEP Treatment									\$370,599	\$370,599	
Brine Disposal Cost (\$0.32 per gallon)									\$2,616,320	\$2,616,320	
Advanced Treatment Disposal Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,709,219	\$3,709,219	\$0
Equipment and Maintenance: (20% of Construction Cost with 2% set aside for equipment and maintenance)	\$94,020	\$130,172	\$90,532	\$126,688	\$88,344	\$124,492	\$93,824	\$129,976	\$372,804	\$408,968	\$24,460
SUBTOTAL OPERATION AND MAINTENANCE COSTS	\$1,096,107	\$1,143,391	\$1,131,732	\$1,179,020	\$1,457,282	\$1,504,561	\$1,451,761	\$1,499,044	\$5,574,263	\$5,621,558	\$135,773
General Administration (15% of subtotal operation and maintenance costs)	\$164,416	\$171,509	\$169,760	\$176,853	\$218,592	\$225,684	\$217,764	\$224,857	\$836,139	\$843,234	\$20,366
TOTAL OPERATION AND MAINTENANCE COSTS PLUS GENERAL ADMINISTRATION	\$1,260,523	\$1,314,899	\$1,301,492	\$1,355,872	\$1,675,874	\$1,730,245	\$1,669,525	\$1,723,901	\$6,410,403	\$6,464,792	\$156,139
NET PRESENT VALUE OF TOTAL O&M COSTS: (20 years, 0.3%, 19.38362)	\$24,433,508	\$25,487,507	\$25,227,628	\$26,281,716	\$32,484,504	\$33,538,414	\$32,361,440	\$33,415,439	\$124,256,806	\$125,311,073	\$3,026,533

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with UV Disinfection		Tertiary Treatment with Advanced Treatment and UV Disinfection	
	Land Application		Land Application		Beneficial Reuse		Surface Water Discharge, Beneficial Reuse		Surface Water Discharge to Miocene Canal	
Biosolids Classification	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Effluent Disposal										
Forcemain Maintenance	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
Storage Pond Maintenance	\$100,000	\$100,000	\$100,000	\$100,000						
Outfall Maintenance							\$50,000	\$50,000	\$50,000	\$50,000
Total Effluent Disposal Costs	\$150,000	\$150,000	\$150,000	\$150,000	\$50,000	\$50,000	\$100,000	\$100,000	\$100,000	\$100,000
SUBTOTAL OPERATION AND MAINTENANCE COSTS	\$150,000	\$150,000	\$150,000	\$150,000	\$50,000	\$50,000	\$100,000	\$100,000	\$100,000	\$100,000
General Administration (15% of subtotal operation and maintenance costs)	\$22,500	\$22,500	\$22,500	\$22,500	\$7,500	\$7,500	\$15,000	\$15,000	\$15,000	\$15,000
TOTAL OPERATION AND MAINTENANCE COSTS PLUS GENERAL ADMINISTRATION	\$172,500	\$172,500	\$172,500	\$172,500	\$57,500	\$57,500	\$115,000	\$115,000	\$115,000	\$115,000
NET PRESENT VALUE OF TOTAL O&M COSTS: (20 years, 0.3%, 19.38362)	\$3,343,674	\$3,343,674	\$3,343,674	\$3,343,674	\$1,114,558	\$1,114,558	\$2,229,116	\$2,229,116	\$2,229,116	\$2,229,116

ESTIMATED SEPTAGE TREATMENT COSTS

Description	Septic Receiving Station/Treatment
Septic Receiving Equipment	\$262,000
Aerobic Digester	
Concrete	\$2,389,000
Equipment	\$245,000
Subtotal 1	\$2,896,000
Sitework and Yard Piping (@15% of Subtotal 1)	\$434,000
Electrical/Instrumentation (@25% of Subtotal 1)	\$724,000
Subtotal 2	\$4,054,000
Mobilization/Demobilization (2%)	\$81,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	\$59,000
Contractor Profit (15%)	\$608,000
Bonds and Insurance (2%)	\$81,000
Subtotal 3	\$4,883,000
Undefined Scope (30%)	\$1,465,000
Total Septic Tank Construction Cost	\$6,348,000
Construction Contingency (10%)	\$635,000
Implementation (soft) Costs (percentage of Total Construction Cost w/o Land Costs)	\$6,983,000
Project Administration (2%)	\$140,000
Legal Council/Bond Council (1%)	\$70,000
Planning (3%)	\$209,000
Design (13%)	\$908,000
Environmental Documentation/Permitting (3%)	\$209,000
ROW Acquisition (1%)	\$70,000
Construction Management (8%)	\$559,000
Engineering Services During Construction (4%)	\$279,000
Environmental Monitoring/Regulatory Compliance (3%)	\$209,000
Environmental Mitigation (6%)	\$419,000
Implementation Cost Total	\$3,072,000
Land Costs (1 acre @ \$40,000 per acre)	\$40,000
TOTAL CAPITAL COST	\$10,095,000
O&M COSTS	
O&M Cost (annual)	\$156,000
O&M Cost NPV (20 yrs, 0.3%)	\$3,027,000
SALVAGE VALUE	
Land Cost Value, Infinite Life, no escalation or depreciation	\$40,000
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	\$1,223,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	\$5,760,000
Salvage Value of Land	\$40,000
Salvage Value of Equipment	\$0
Salvage Value of Non-Equipment	\$3,456,000
Net Present Value of Salvage Value of Land	\$40,000
Net Present Value of Salvage Value of Equipment	\$0
Net Present Value of Salvage Value of Non-Equipment	\$3,255,000
TOTAL NET PRESENT VALUE	\$9,827,000

Description	Septic Receiving Station/Treatment
TOTAL CAPITAL COST	\$10,095,000
O&M Cost NPV (20 yrs, 0.3%)	\$3,027,000
TOTAL NET PRESENT VALUE	\$9,827,000