Iipay Nation of Santa Ysabel
Tribal Water Quality

Environmental Program

Nonpoint Source (NPS) Assessment and Management Plan

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Executive Summary

The Clean Water Act (CWA) established a program for the control of non-point source pollution. The objective is to develop and implement a management plan to control both point and nonpoint sources of pollution. Tribes with Treated as States (TAS) status are provided with the legal basis for implementing non-point source programs. Indian Tribes must meet certain requirements to qualify for assistance under the CWA Section 319. These are:

Part I: Nonpoint source assessment report
Part II: Nonpoint source management plan

The nonpoint source (NPS) assessment report is an analysis of water quality not in compliance with state or tribal standards. The management plan initiates a best management practice (BMP) process for correcting the water quality problem(s). For the Iipay Nation of Santa Ysabel (INSY) Reservation these two items will be considered together as the basis for non-point source decision-making. Part 1 of this report will discuss the non-point source assessment. Part 2 will cover a preliminary and/or a set of best management planning processes, based on the findings of the assessment.

The nonpoint source management plan identifies waters on the INSY reservation not in compliance and not supporting beneficial uses, and the types of activities or specific sources which cause these problems. The BMP plan describes the INSY process for identifying best management practices and programs and sources of funding for controlling NPS pollution. The INSY will use the National Resources Conservation Service (NRCS) "Best Management Practices" (BMPs), and/or the Bureau of Land Managements (BLM) proper functioning condition (PFC) assessment, as the model for conservation practice standards. This assessment will list existing funding from the EPA, other federal, state, and local funding sources which are in place or pending to control NPS pollution.

The Iipay Nation of Santa Ysabel (INSY) Reservation consists of four parcels totaling approximately 17,000 acres, with its runoff draining into three different watersheds (San Dieguito, San Luis Rey and Salton Sea). The nonpoint source (NPS) assessment indicates the primary pollutants on the INSY Reservation are sediment, nutrients, and pathogens with some trace metals and hydrocarbons (PAHs). Transport of sediment and nutrients from the upper reaches of these watersheds has resulted in algal blooms occurring in Sutherland and Henshaw reservoirs. The nonpoint source management plan is to assess the ecosystem status of the INSY Reservation stream and wetland riparian areas and improve the ecological functional conditions to reduce erosion, loss of habitat and the transport of sediment, nutrients and pathogens from tribal lands. The NPS Pollution Program promotes the development of watershed management plans with the primary goals of restoring and protecting designated uses from the impacts of NPS pollutants.

Part I: Nonpoint Source Assessment Report

Introduction

The Iipay Nation of Santa Ysabel (INSY) attained reservation status in 1893 and established a constitution in 2007. The Santa Ysabel Reservation is in northeastern San Diego County, California (Figure 1). The reservation is currently ~17,000 acres divided into three major parcels, and one small 13-acre parcel. The original reservation was founded in 1893 and encompassed ~15,000 acres. The INSY Reservation ranges from 3,200 feet to 5,700 feet in elevation. The reservation is in the mountains of the eastern Transverse Range and the Peninsular Ranges. Transverse and Peninsular ranges are north-to-south trending mountains gradually sloping west to the coastal plain. The eastern side sharply slopes eastward to the Salton Trough. This mountainous region is underlain by Jurassic aged plutons, which are primarily composed of uplifted granite, granodiorite, and quartz diorite overlying folded marine sediments (Todd, 2015). The ecology of this mountainous topography contains patches of mixed evergreen woodland consisting mostly of big cone Douglas-fir and canyon live oak. These fragmented, compact groves typically occur in deep canyons and on steep north-facing slopes. This area contains a mix of coniferous forest with ponderosa pine, Jeffrey pine, sugar pine, white fir, incense cedar, hardwoods such as canyon live oak and black oak, and areas of montane chaparral.

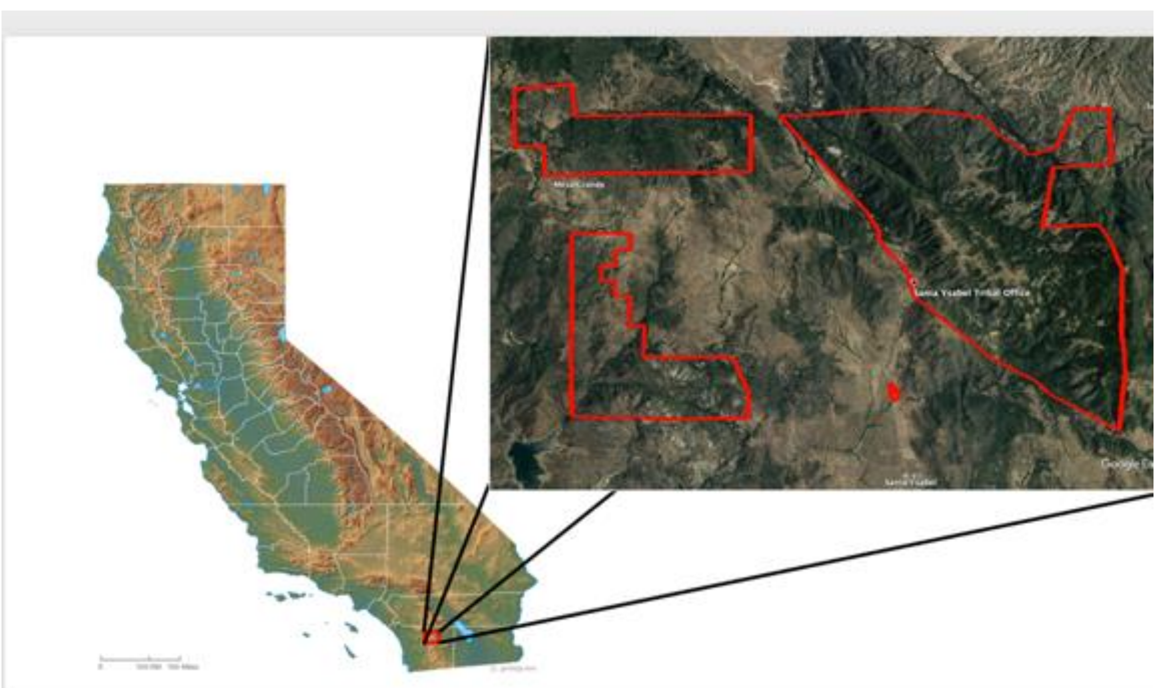

Figure 1. Location map of the Iipay Nation of Santa Ysabel Reservation in north-eastern San Diego County, CA. Inset is a Google Earth image of the three Iipay Nation land parcels.

Description of Land and Water Resources

The Santa Ysabel Creek and its tributaries (Figure 2) have traditionally defined the location and shape of the INSY Tribal ancestral lands, and account for virtually all waters entering or originating on the Iipay Nation of Santa Ysabel (INSY) Reservation. The INSY Reservation is located between the Carrizo Creek Watershed (San Luis Rey Watershed), the Santa Ysabel Creek Watershed (San Dieguito Watershed) and the San Felipe Creek Watershed (Salton Sea Watershed).

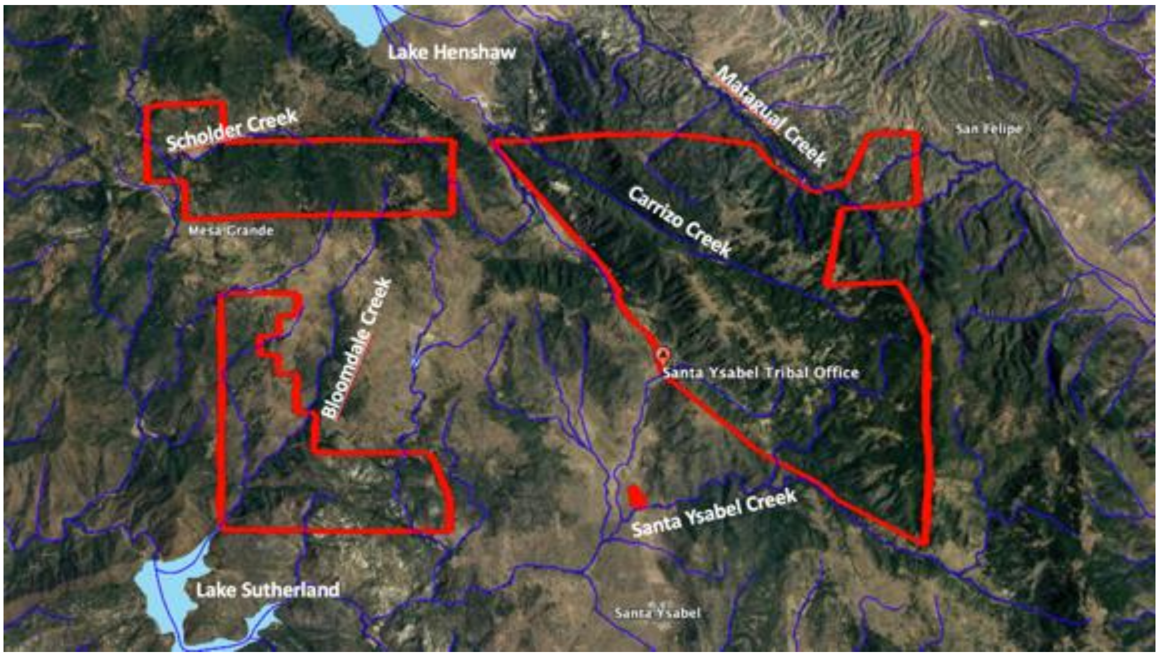

Figure 2. Iipay Nation of Santa Ysabel Reservation land parcels and locations of perennial streams - Santa Ysabel Creek, Carrizo Creek, Matagual Creek, Scholder Creek, Bloomdale Creek and their tributaries.

As seen in Figure 2, INSY Reservation is in the headwaters of the Santa Ysabel Creek. Santa Ysabel Creek, Scholder Creek and Bloomdale Creek flow into Lake Sutherland. Carrizo Creek and Matagual Creek flow into Lake Henshaw. San Felipe Creek flows into the Salton Sea. San Diego County has a Mediterranean climate. The main creeks are perennial and fed by seasonal rainfall and springs during the dry season. These waterways support the INSY Reservation residents' household water needs and agriculture activities, predominantly cattle grazing. Soils of the Traverse and Peninsular ranges typically contain Quaternary alluvium (Calpine coarse sandy loam, Crouch coarse sandy loam, Crouch rocky coarse sandy loam, Holland fine sandy loam, Holland stony fine sandy loam - deep, Holland stony fine sandy loam, Loamy alluvial land, Reiff fine sandy loam, Sheephead rocky fine sandy loam, and Tollhouse rocky coarse sandy loam.

Geology, Soils, and Vegetation

The INSY reservation is underlain by fractured and weathered igneous and metamorphic rocks. San Diego's Peninsular Range Mountains were formed beginning 120 million years ago (Jurassic/Cretaceous boundary). The batholith of intrusive igneous material is composed of undifferentiated granite and tonalities. Julian schist is metamorphic rocks, formed in the Triassic period, are composed of micaceous schist, gneiss and quartzite.

Soils

The Iipay Nation of Santa Ysabel (INSY) Reservation ranges from 3,200 feet to 5,700 feet in elevation and is part of the San Dieguito River, San Luis Rey and San Felipe watersheds. The soils in the upper Santa Ysabel, San Luis Rey and San Felipe watersheds are derived from the weathering of the igneous-dominated mountains of the eastern Transverse Range and the Peninsular Ranges. The surficial soil types found within the Project Area include undocumented artificial fill (afu), topsoil/colluvium, young alluvium (Qal), older alluvium (Qoal), and landslide debris (Qls).

Vegetation

The mountainous topography of the INSY Reservation is home to a wide variety of indigenous plants and trees. Vegetation is a rich mosaic of mixed chaparral on north and western facing slopes. Chamise chaparral occurs on east facing slopes near Lake Sutherland, on Whale Mountain and on the southwestern slope of the Volcan Mountains. Coastal sage scrub is found intermixed with grassland savannahs on southern facing slopes. Engelmann oak (coast live oak) woodlands surround Lake Sutherland on northern facing slopes and drainages. Open coast live oak woodlands with a grass understory are present east of Lake Sutherland and within the Santa Ysabel Valley. Average annual rainfall in the area ranges from 18 to 32.5 inches and is sufficient to contribute to dense growth of the chaparral, scrub oak and chamise plant communities.

Ecoregions (Griffith et al., 2016) of the INSY reservation in the San Dieguito-Santa Ysabel, San Luis Rey and San Felipe watersheds are the Southern California Montane Conifer Forest and shrub and woodland. This Level IV ecoregion of chaparral-dominated landscape also contains patches of mixed evergreen woodland consisting mostly of big cone Douglas-fir and canyon live oak. These fragmented, compact groves typically occur in deep canyons and on steep north-facing slopes. Higher elevations, ranging from 5,000 to 8,500 feet, contain mixed coniferous forest with ponderosa pine, Jeffrey pine, sugar pine, white fir, incense cedar, hardwoods such as canyon live oak and black oak, and areas of montane chaparral.

In the San Felipe watershed is the Western Sonoran Mountains ecoregion, which includes the erosional highlands of exposed bedrock rising above the more gently sloping sediment-filled basins (Griffith et al., 2016). The terrain is dissected by dry washes that can flash flood during the infrequent rainfall events. Vegetation consists of Ocotillo, white bursage, teddy bear cholla, range ratany, barrel cactus, brittlebush, staghorn cholla, beavertail cactus, yucca, jojoba, Mormon tea, and a few junipers. Spring annual forbs include fiddleneck, popcorn flower, desert bells, and desert mariposa lily.

Aquatic Resources

The INSY Reservation has several sources of water from perennial springs and groundwater. The headwaters of the San Dieguito-Santa Ysabel, San Luis Rey and San Felipe watersheds are in the vicinity of Volcan Mountain in the eastern portion of the reservation**.** It is one of the high peaks along the crest of the Peninsular Ranges that run roughly north to south through central San Diego County. Small ravines drain westward from the vicinity of Volcan Mountain and merge to become the Santa Ysabel Creek**.** The stream is fed by winter seasonal rains and snow melt. Perennial flows come from springs and hyporheic/upwelling flows from the stream bed. Note: Upper reaches of the watershed drain along the Elsinore Fault rift valley, one of the more active earthquake faults in the region.

Surface Waters

The Santa Ysabel creek is fed by winter seasonal rains and snow melt. Perennial flows come from springs and hyporheic/upwelling flows from the stream bed. The stream flows westward into Lake Sutherland and the San Dieguito River. Note: Upper reaches of the watershed drain along the Elsinore Fault rift valley, one of the more active earthquake faults in the region.

The Carrizo Creek and Matagual Creek are fed by winter and seasonal rains and springs. The streams flow north-westward into Lake Henshaw and the San Luis Rey River.

San Felipe Creek originates in the eastern Volcan Mountains of San Diego County and runs eastward draining most of the eastern slope of the mountains and desert through the San Sebastian Marsh before it empties into the Salton Sea.

Groundwater

Springs occur in the fractured igneous or where weathered metamorphic material intersects the surface. Tribal drinking water wells derive their water from the alluvial deposits and fractured basement material. The groundwater has elevated iron (Fe) concentrations originating in the igneous rock and pyrite-bearing metamorphic rocks. Water flowing through metamorphic material usually has elevated concentrations of Sodium (Na) and Sulfer (S) found in groundwater and surface water. The water has been found to be of suitable quality for domestic and agricultural use. (Freckleton, 1981; Walawender, 2000). Potential trace elements within the Julian Mining District are silver (Ag), aluminum (Al), arsenic (As), gold (Au), calcium (CA), chlorine (Cl), cobalt (Co), copper (Cu), fluoride (F), iron (Fe), potassium (k) magnesium (Mg), nickel (Ni), sulfur (S), tellurium (Te), and titanium (Ti).

Water Quality

In a review of State Water Resources Control Board Region 7 and 9, Integrated Reports for 2000-2020, there are no total maximum daily load (TMDL) allocations for streams (Santa Ysabel Creek, Carrizo and Matagual, and the San Felipe watersheds) exiting the INSY Reservation. However, Santa Ysabel warm water "beneficial use" was impaired for the 2010 303(d) list. The beneficial uses that are impaired in State Water Resources Control Board (SWRCB) Region 9 for the upper San Dieguito-Santa Ysabel Creek 303(d)-listed waterbodies are defined in the Basin Plan as follows:

- AGR (Agricultural Supply) includes uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
- MUN (Municipal and Domestic Supply) includes uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply.
- REC-1 (Contact Water Recreation) includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, white water activities, fishing, or use of natural hot springs.
- REC-2 (Non-Contact Water Recreation) includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
- WARM (Warm Freshwater Habitat) includes uses of water that support warm water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

The beneficial uses in the San Dieguito WMA which are not impaired are defined in the Basin Plan as follows:

- COLD (Cold Freshwater Habitat) includes uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
- IND (Industrial Service Supply) includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water

supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
- PROC (Industrial Process Supply) includes uses of water for industrial activities that depend primarily on water quality.
- SPWN (Spawning, Reproduction, and/or Early Development) includes uses of water that support high quality habitats suitable for reproduction, early development and sustenance of marine fish and/or cold freshwater fish.
- WILD (Wildlife Habitat) includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

SWRCB Region 9, County of San Diego, and City of San Diego Public Utility District have identified contaminants present in source water, which include:

- Microbial contaminants, such as viruses and bacteria, may come from leaking septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, are naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, and/or farming.
- Pesticides and herbicides may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals (i.e., Polycyclic aromatic hydrocarbons (PAHs)) are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application, and septic systems.
- Naturally Occurring Radioactive Materials (NORMs) can be coming from the igneous intrusive country rock (i.e., granodiorite), and/or mining activities.

Possible Sources of Pollution

Based on the Clean Water Act section 106 Annual Assessment Report for the fiscal year 2022, Iipay Nation of INSY reservation has several nonpoint source pollution problems. For the Iipay Nation of Santa Ysabel fee and trust lands, roads, highways, and bridges provide a significant input of nonpoint source (NPS) pollution to tribal waters. Stormwater runoff from roads and urban development release a broad diversity of chemicals into the environment. Contamination generated during road construction, maintenance and use is washed from roads and roadsides during precipitation. As runoff washes over roads, bridges, parking lots, and other impermeable surfaces, it picks up sediment, chemicals, fertilizers, automotive oils, litter, and other debris that can degrade water quality and harm aquatic life. Nonpoint source pollution can include:

- Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas

- Oil, grease and toxic chemicals from urban runoff and energy production
- Sediment from improperly managed construction sites, crop, range and forest lands, and eroding streambanks
- Salt from irrigation practices and acid drainage from abandoned mines
- Pathogens - Bacteria and nutrients from livestock, pet wastes and faulty septic systems
- Atmospheric deposition and hydromodification

Considering that the water from the springs, streams and groundwater is used for domestic and cultural practices, it is in the Tribe's best interest to eliminate any source of pollution and destruction of aquatic resources. The goals of the INSY monitoring and assessment program is to acquire water quality data to use for future protection and sustained use of Tribal water resources, protection of public health and welfare, and the enhancement of geomorphic physical processes and water quality. The Tribe intends to protect and improve water resources through habitat evaluation, planning, implementation, education, community outreach, and water quality monitoring.

Nonpoint Source Assessment

NPS pollution occurs when water as precipitation (rainfall, snow), from sprinklers, irrigation drainage, seepage or hydrologic modification moving over and through the ground, absorbs, or moves as bedload, carries away natural and human-made pollutants. U.S. Environmental Protection Agency (EPA), States and tribes identify nonpoint source pollution as the major cause of water quality problems in lakes, rivers, wetlands, coastal waters and groundwater. Nonpoint source pollutants have harmful effects on drinking water supplies, recreation, fisheries and wildlife.

This non-point source assessment study is designed to document contaminants moving through the Iipay Nation of Santa Ysabel trust and fee lands. The objective is to determine linkages between land uses, human activities, and fate and transport of nonpoint pollutants. The assessment study documents NPS pollution coming from rural, urban and residential areas (e.g., pesticides, oil and grease, household pet waste); hydromodification; atmospheric deposition; and natural sources. Best management practices can help reduce pollution impacts. Beneficial uses for the upper San Dieguito-Santa Ysabel and San Luis Rey watersheds include: municipal; agriculture; industrial service and process supply; recreation; special biological habitat; warm and cold freshwater habitat; wildlife habitat; and rare, threatened, or endangered species.

Nonpoint source (NPS) pollution to waters of the US originating from roadways with dense traffic volumes has long been known to be toxic to aquatic species (Marsalek et al., 1999). Urban development increases the potential transport of toxic chemical contaminants (organic, inorganic) to river and stream networks. Atmospheric deposition and motor vehicles (Du et al., 2017; Peter et al. 2018) release a broad diversity of chemicals into the environment. For example, mercury from the burning of fossil fuels and tire (6PPD-quinone) and brake pad wear accumulate on surface streets and highways, and other impervious surfaces (e.g., roof tops, driveways, parking lots, etc.). These chemicals are mobilized during rain events as stormwater runoff. The objective of this non-point source assessment is to identify potential pollutants, and their toxicity to human health and wildlife.

Categories and Subcategories of Nonpoint Source

The Iipay Nation of Santa Ysabel (INSY) has four parcels of trust and fee land in the San Dieguito-Santa Ysabel, San Luis Rey and Salton Sea-San Felipe watersheds (Figure 3). As seen in Figure 3, INSY lands are in three catchments San Dieguito (HUC 18070304, approximately 9000 acres), San Luis Rey (HUC 18070303, approximately 6,000 acres), and San Felipe (NHD 22597541, approximately 2,000 acres) (https://gotbooks.miracosta.edu/earth_science/images/watersheds_San_Diego.jpg). Water in the San Dieguito Watershed flow west, San Luis Rey watershed flows north than west, and the San Felipe sub-watershed flows east-southeast to the Salton Sea (Figure 4). Nonpoint source contaminants from atmospheric deposition, road runoff and historical mining operations will flow away from tribal lands. As seen in Figure 3 and 4, most of INSY Reservation is open space with a mix of rural agriculture (mostly grazing) and small urban areas.

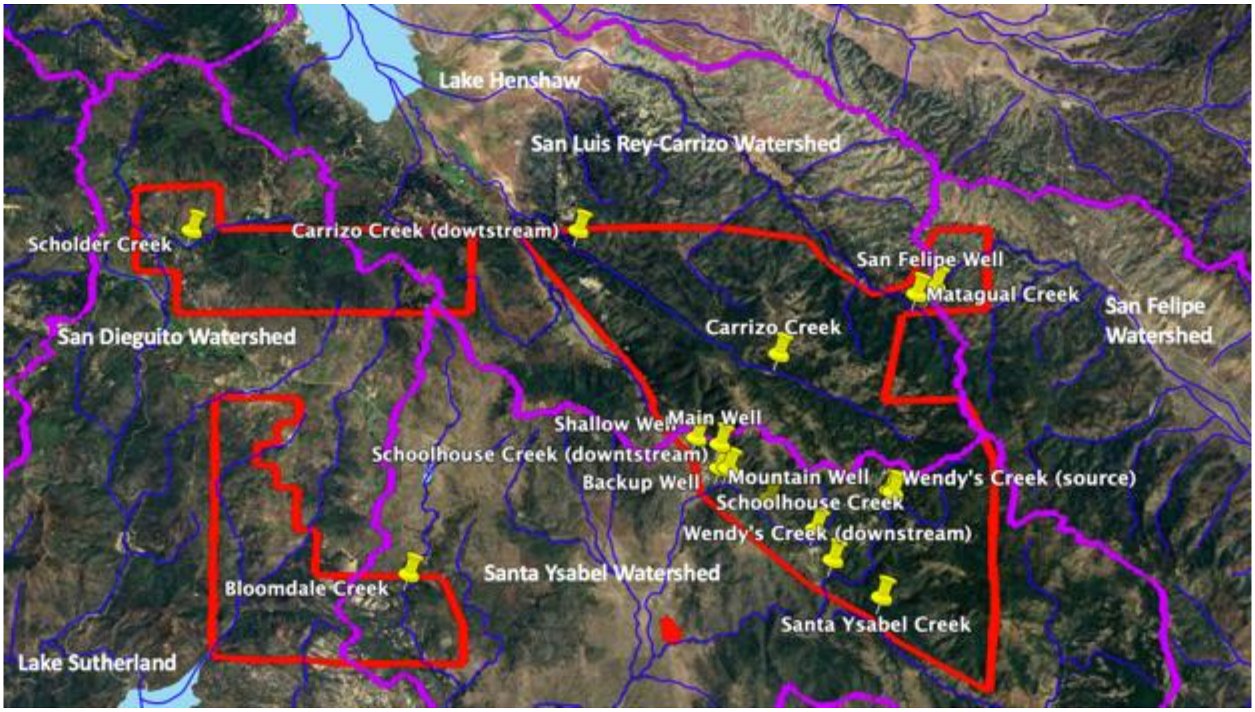

Figure 3. Location map of Iipay Nation of Santa Ysabel lands, which are in three hydrologic units (HU), San Dieguito Watershed HUC 18070304, approximately 9000 acres, San Luis Rey Watershed HUC 18070303, approximately 6,000 acres, and Salton Sea Watershed-San Felipe NHD 22597541, approximately 2000 acres. Catchment boundary is purple line. Streams are blue.

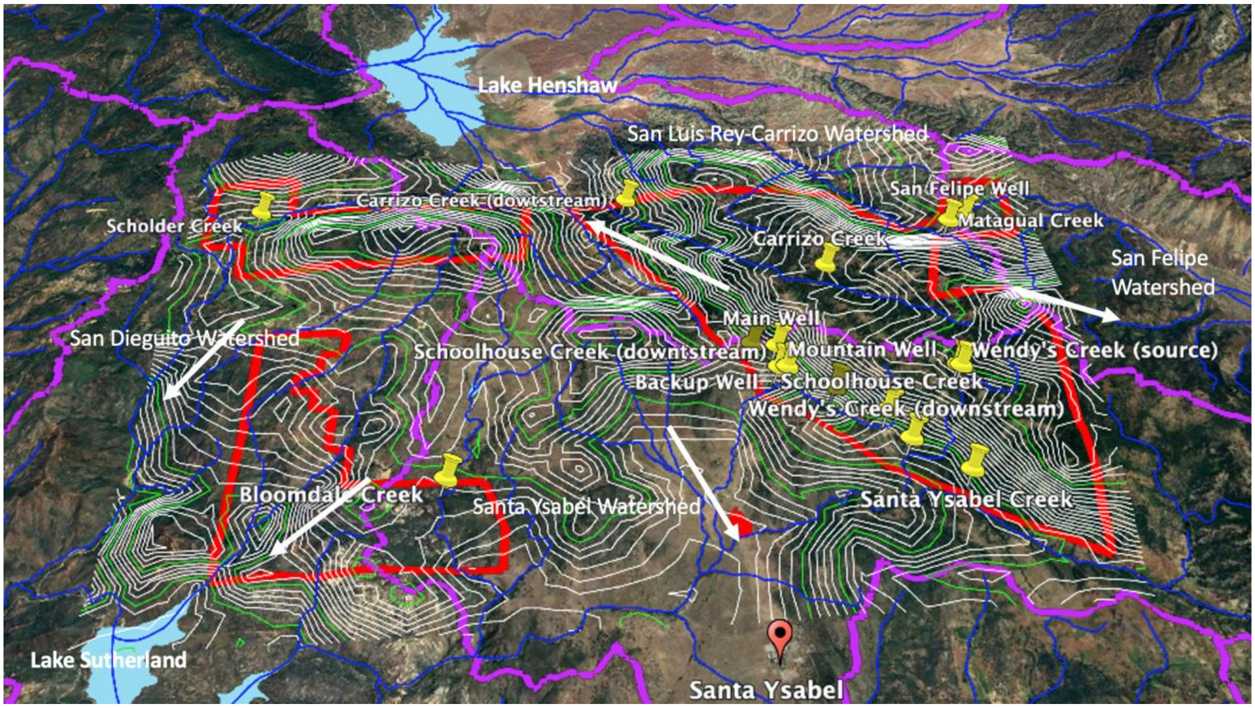

Figure 4. Topographic map of Iipay Nation of Santa Ysabel indicates water in catchment San Dieguito River-Santa Ysabel Creek flows to the west, San Luis Rey-Carrizo Creek flows to the northwest, and the San Felipe flows to the east. Contour lines are 20 meters. Green line is every 100 meter contour.

Water Quality Impacts

Review of the Surface Water Ambient Monitoring Program (SWAMP) studies and State Water Resources Control Board (SWRCB) reports for Region 7 and 9 indicate several contaminates are present, though decreasing over time, and are mobilized during rain events.

San Luis Rey Watershed

The Upper San Luis Rey hydrologic unit (HU) consists of tributaries Matagual and Carrizo creeks, which flow into Lake Henshaw (Figure 3). Land use in the Upper San Luis Rey HU is extensively open space with some agriculture and urbanization around Henshaw Reservoir (https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/reglrpts/903sanluisreyrpt.pdf). The Carrizo and Matagual beneficial uses include municipal, agriculture, industrial service supply, freshwater replenishment, hydropower generation, recreation, warm and cold freshwater habitat, wildlife habitat, rare, threatened, or endangered species, and spawning habitat. The data gathered under SWAMP (Mazor and Schiff, 2008) and other programs indicate the San Luis Rey HU is in poor ecological health. As per Mazor and Schiff, 2008, all indicators showed signs of human impacts. Multiple stressors (e.g., degraded water quality, sediment, and physical habitat) are some of the likely causes of impact. Henshaw Reservoir has seasonal harmful algal blooms (HABs). Future studies regarding ecological physical processes are necessary to determine which stressors are responsible for the impacts seen in the watershed (Hall, E.S., et al., 2019; Hall, R.K., et al., 2018a; Hall, R.K., et al., 2018b; Hall, R.K., et al., 2018c; Aron et al., 2017; Swanson et al., 2017).

San Dieguito Watershed

The Santa Ysabel is the largest tributary in the San Dieguito River hydrologic unit (HU). Main tributaries flowing into Sutherland Reservoir are Santa Ysabel and Bloomdale. Scholder Creek originates on or near Iipay Nation of Santa Ysabel (INSY) Reservation land and flows into the Santa Ysabel Creek below Sutherland Reservoir. Land use above Sutherland Reservoir is predominantly open space, agriculture and residential development on the San Ysabel Reservation. Several tributaries in the San Dieguito HU are listed as impaired on the SWRCB R9 303(d) list of water quality limited segments, affecting a total of 4.09 stream miles (Mazor and Schiff, 2008) and Southerland Reservoir (toxicity). Nineteen sample sites with PAHs were detected in the upper Santa Ysabel Creek (located between INSY reservation parcels 1 and 4, Figure 3). Additionally, pesticides were detected at the Santa Ysabel designated reference site (Mazor and Schiff, 2008).

Several organic compounds were widespread throughout the watershed (https://www.waterboards.ca.gov/sandiego/water_issues/programs/swamp/docs/905sandieguitorpt.pdf). For example, the PAHs C2-Dibenzothiophene (a potential rubber compound) and C1-Phenanthrene/Anthracene (petroleum/gas compounds) were detected at every site (Mazor and Schiff, 2008). In contrast, pesticides were less widespread. Pesticides were not frequently detected at reference sites. However, Diazinon and Oxadiazon were detected at the majority of sites (Mazor and Schiff, 2008). In contrast, reference sites in Santa Ysabel Creek had fewer exceedances, although ammonia-N, manganese, and pH exceeded thresholds on at least one sampling date at one or both sites. The PAH benzo(a) pyrene exceeded aquatic life thresholds on one sampling date at the upstream Santa Ysabel reference site.

All sites in the San Dieguito HU failed to achieve certain aquatic life and human health thresholds (Mazor and Schiff, 2008). The Santa Ysabel reference sites had the lowest number of exceedances (i.e., 3) indicating water quality deteriorates along a gradient from the headwaters to the mouth of the San Dieguito River.

Biological health ranged from poor to very poor throughout the San Dieguito HU (Mazor and Schiff, 2008). The upper Santa Ysabel reference site had an index of biological indicators (IBI) scores above 40 (Mazor and Schiff, 2008). The EPT-taxa metric appeared to be the most sensitive at this site. Despite the overall high mean scores at most sites, habitat degradation was observed at nearly every site. For example, embeddedness received very low scores (>10) at all but the upstream Santa Ysabel reference site (Mazor and Schiff, 2008).

Every site sampled in the San Dieguito HU showed evidence of impact from multiple stressors (Mazor and Schiff, 2008). For example, the two reference sites in Santa Ysabel Creek were in the upper part of the watershed (i.e., above and below Sutherland Reservoir). These sites had better water chemistry than sites downstream, with only three constituents exceeding aquatic life thresholds (Mazor and Schiff, 2008).

Bioassessment samples collected at these sites were in "fair condition," which is lower in value than what is normally expected at reference sites (Mazor and Schiff, 2008). In addition, SWRCB R9 303(d) has listed Sutherland Lake for excessive algae growth in the reservoir. Cyanobacteria blooms are typically a result of excessive nutrients (nitrogen and phosphorous). However, actual concentrations of nitrogen and phosphorous did not exceed current Basin Plan objectives (SWRCB 2012 Monitoring Report), which could be the result of the algae using up available nutrients.

Anza-Borrego Watershed – San Felipe Creek

Western Imperial Valley is drained by San Felipe Creek, which has perennial reaches in the mountains and ephemeral reaches in the valley. The San Felipe Creek-Superstition Hills area, north of Superstition Mountain and between the central Imperial Valley surface drainage is mostly to San Felipe Creek and into the Salton Sea (Loeltz et al., 1975). Low gradient portion of San Felipe is flat enough to be cultivated, and sufficient wells are indicated on old maps to suggest that attempts have been made to develop groundwater. The San Felipe Creek contributes most of the recharge to the Borrego Valley groundwater (Loeltz et al., 1975).

Pollution Sources

INSY Tribal Environmental Protection Agency (TEPA) has assembled existing information on water quality impacts caused by pollution sources (Table 1). Table 1 summarizes the potential nonpoint source impacts to the Reservation's surface waters. The INSY Reservation land is divided into four parcels (Figure 2), the bulk of which, 92%, is open space (Table 1). Rural residential, offices, light industrial and agriculture areas are concentrated within 8% of the total tribal land area. Runoff from the INSY Reservation drains into three main watersheds (Figure 4). San Dieguito has 53% of the INSY Reservation land. San Luis Rey watershed has 35%, and 12% of the INSY Reservation is in the San Felipe watershed. Waters from tribal lands in Parcel 1 flow into all three primary hydrologic units (San Dieguito-Santa Ysabel, San Luis Rey, San Felipe). Waters from the INSY Reservation lands in Parcels 2, 3, and 4 flow into the San Dieguito-Santa Ysabel HU (Figure 4).

Nonpoint source runoff can vary from land parcel to land parcel, and from watershed to watershed. When a defined land area is devoted to a single use, the relative impacts by source category can be more accurately identified. For an area with multiple stressors, it is difficult to partition load allocations to the varying land uses. In the case of the INSY Reservation (trust and fee lands), land use within the total watershed cannot be accurately compared (e.g., grazing, light industrial, residential). Also, the overall ecological functional condition of the land plays a major role in determining the fate and transport of contaminants. This especially affects sediment transport, chemicals from atmospheric deposition and paved and unpaved road runoff. Overall, impacts from livestock grazing and rural roads have not been fully investigated or values determined (i.e., downstream impacts off the reservation) due to the restriction of only analyzing Reservation waters and not the ecosystem physical functions. Therefore, this type of analysis does not show the complete impacts of nonpoint pollution.

Table 1 Estimated summary of source categories within catchments 18070303 (6000 acres), 18070304 (9000 acres), and NHD 22597541 (1500 acres), includes private (urban, rural) and tribal lands (trust and fee). Within the three catchments the nonpoint source runoff is from pervious surface (unpaved roads, and livestock management, and paved roads along reservation boundaries).

Table 1. Summary of potential non-point source impacts to the Reservation's surface waters.

Source	Category	Miles effected	Acres effected	Acres Percentage
San Luis Rey 18070303				
Lt. Industrial				
	Impervious surface, Storm water runoff	2.0	50	0.8%
Tribal Land				
	Storm runoff	7.0	6450	99%
San Dieguito 18070304				
Rural				
	Storm water runoff	1.4	500	5.2%
Tribal Land				
	Storm runoff	7.8	8500	94.8%
San Felipe NHD 22597541				
Rural				
	Storm runoff	0.7	40	2.6%
Tribal Land				
	Storm runoff	0.7	1460	97.4%

Water Quality

Iipay Nation of Santa Ysabel (INSY) Tribal Environmental Protection Agency (TEPA) has sampled 16 sites (Figures 3 and 4). There are 10 streams (INSY S1-S10) and 6 wells (INSY W11

– W16) monthly for the last year (2023-2024). Stream sample sites are on the perennial waterbodies and drinking water wells (Table 2).

Table 2. Iipay Nation of Santa Ysabel Tribal Environmental Protection Agency (TEPA) sample sites and data collection events.

Site ID	Sampled	Comments
INSY S1	Schoolhouse Creek	
INSY S2	Schoolhouse Creek Downstream	Source
INSY S3	Wendy's Creek	
INSY S4	Wendy's Creek Downstream	
INSY S5	Santa Ysabel Creek	
INSY S6	Carrizo Creek	
INSY S7	Carrizo Creek Downstream	
INSY S8	Matagual Creek	
INSY S9	Scholder Creek	
INSY S10	Bloomdale Creek	
INSY W11	Main Well	
INSY W12	Shallow Well	
INSY W13	Backup Well	
INSY W14	Canyon Well	
INSY W15	Mountain Well	
INSY W16	San Felipe Well	

Every site sampled in the San Dieguito HU showed evidence multiple stressors. In general, downstream sites were more severely affected than upstream reference sites. For example, the two reference sites in Santa Ysabel Creek had better water chemistry than sites downstream, with only three constituents exceeding aquatic life thresholds. Toxicity was moderate at the upstream reference site. Bioassessment samples at the Santa Ysabel sites ranged from fair condition to poor condition. Most samples were in poor or very poor condition. According to Mazor and Schiff, 2007, the cause of the low IBI scores at these sites is not clear. Observations from other sources indicate excess stream sediment, moderate to high nutrient loads, and loss of habitat as possible stressors.

Water quality data in the upper San Luis Rey Watershed-Carrizo and Matagual creeks area is sparse, especially below the INSY Reservation western boundary. However, advisories have been posted in Henshaw Reservoir for mercury and selenium, and harmful algal blooms (HABs). Possible sources of mercury (Hg) and selenium (Se) is from atmospheric deposition (coal fired power plant in Tijuana, Mexico), and/or from historical acid mine drainage (AMD) from gold mining activity, and/or naturally occurring acid rock drainage (ARD). The HABs in Henshaw Reservoir could result from excess stream sediment, moderate to high nutrient loads, and loss of habitat in the streams (Carrizo, Matagual) above the lake.

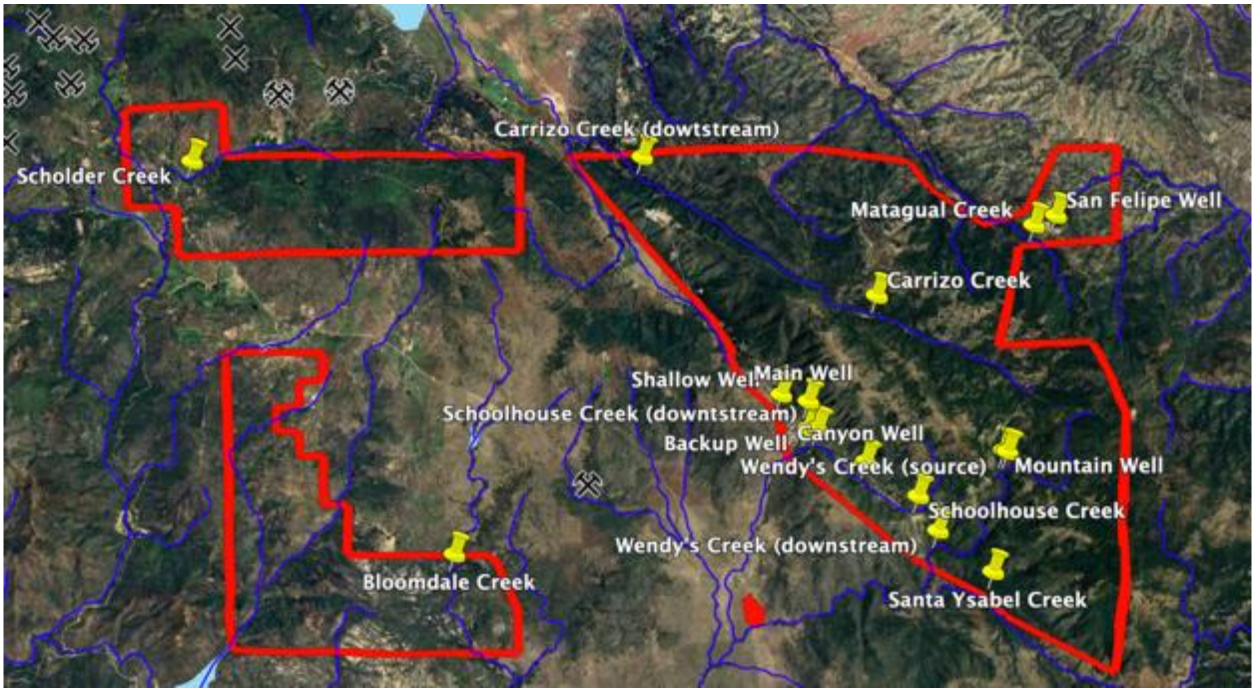

Figure 5. Location map of historical gold mining activity. ⚒ mine, closed mine, and occurrence, or prospect.

Selenium concentrations in the Anza-Borrego-San Felipe Creek watershed have been changed from “fully supporting” to “insufficient.” State Water Resources Control Board (SWRCB) Region 7 indicates the change in status is due to insufficient sample size required by the Listing Policy to determine if the water quality objectives are met. The presence of selenium indicates there are acid rock drainage sources within the watershed.

Nonpoint source (NPS) pollution (sediment, metals, PAH, etc.), as indicated in Table 1, is a result of storm runoff. A NPS management plan should concentrate on reducing flow away from the source(s) by improving geomorphic physical processes (i.e., ecological functions).

Part II: Nonpoint Source Management Plan

Introduction

The Iipay Nation of Santa Ysabel nonpoint source assessment indicates trace metals, polycyclic aromatic hydrocarbons (PAHs) and pesticides are a problem on the INSY Reservation and in the Santa Ysabel, San Luis Rey and San Felipe watersheds, but the major pollutants of concern are sediment, nutrients and bacteria (i.e., e_coli, fecal coliform). State Water Resources Control Board (SWRCB) Region 7, 2023 report, indicated San Diego County contaminants have decreased over the last 20 years, whereas PAHs and nutrients have shown a slight increase in the Santa Ysabel Watershed. However, in some areas there has been a proliferation of other aquatic impacts (e.g., HABs). SWRCB, 2003 report, states urban expansion has altered the natural hydrologic regime in the San Diego County watersheds. Construction activity can change the ratio of water and sediment being supplied to the stream (Swanson et al., 2017; Dickard et al., 2015), and nutrients (Hall et al., 2019b; Hall et al., 2018a). With increasing development pressure and changes in land management have altered the stream and wetland functional processes. For example, construction activities on the INSY Reservation (Figure 6). As seen in Figure 6, satellite image A, roadwork development began in 2004. By 2006, satellite image B, clearing of vegetation and pad cutting has exposed the soil to erosion and oxidation resulting in release of minerals (i.e., acid rock drainage). Exposure and acidification of the minerals in the soils and basement granitic material, and transport from rainfall, trace metals, nutrients (i.e., C, N, P) and excess sediment into streams. As seen Figure 6, satellite image C, from the construction of the building (lower center) and development at the site at the top of the ridge (top left), the amount of impervious surface has increased. This will result in more water running over the surface and mobilizing hydrocarbons (PAHs) from the roads and parking lots and available sediment. Net result is during construction more sediment is being supplied to the streams and wetlands resulting in stream embeddedness and loss of habitat. After construction there is more water being supplied to the stream, which would lead to erosion and incision of the stream channel (i.e., loss of aquatic habitat) and increased PAHs (SWRCB R9 and SWAMP reports) and other contaminants.

Figure 6. Sediment and water are/are not in balance. Excess sediment is generated at the start of construction in 2004 as part of road development on the hill. In 2006, slope stabilization and cutting of construction pad. In 2023, plants stabilize the hillslope, but the creation of roads and development structures increase water flow from impervious surfaces. A. December 31, 2004, Maxa Technologies; B. August 15, 2006, Maxar Technologies; C. June 23, 2023, Airbus. All images are from Google Earth.

An examination of Wendy's Creek shows how land management changes affect vegetation and water bodies. As seen Figure 7, a bend in Wendy's Creek has a low partial dam, or check dam, across the stream channel to retain water as a cattle watering pond. In May 2014, the pond is present with some floodplain vegetation (Figure 7A). Note: Vegetation type cannot be determined from this image. In August 2018, the pond is dry, most likely from drought condition, and the floodplain vegetation is not present. As pointed out in Dickard et al., 2015, and Gonzalez and Smith, 2020, if stabilizing vegetation is present (i.e., sedge, rush, cattails) chances are water would be retained in the riparian soils. If annual upland and/or colonizing plants, not having the root mass of stabilizer plants, are present, there is a higher probability water in the soils will not be retained. Some riparian plants (e.g., sedge and willow) are more palatable to livestock than other vegetation. Also, because of the presence of water livestock will hang out/linger longer in the area. A seen in Figure 7B, riparian vegetation has been depleted indicating the stabilizing plant community is absent.

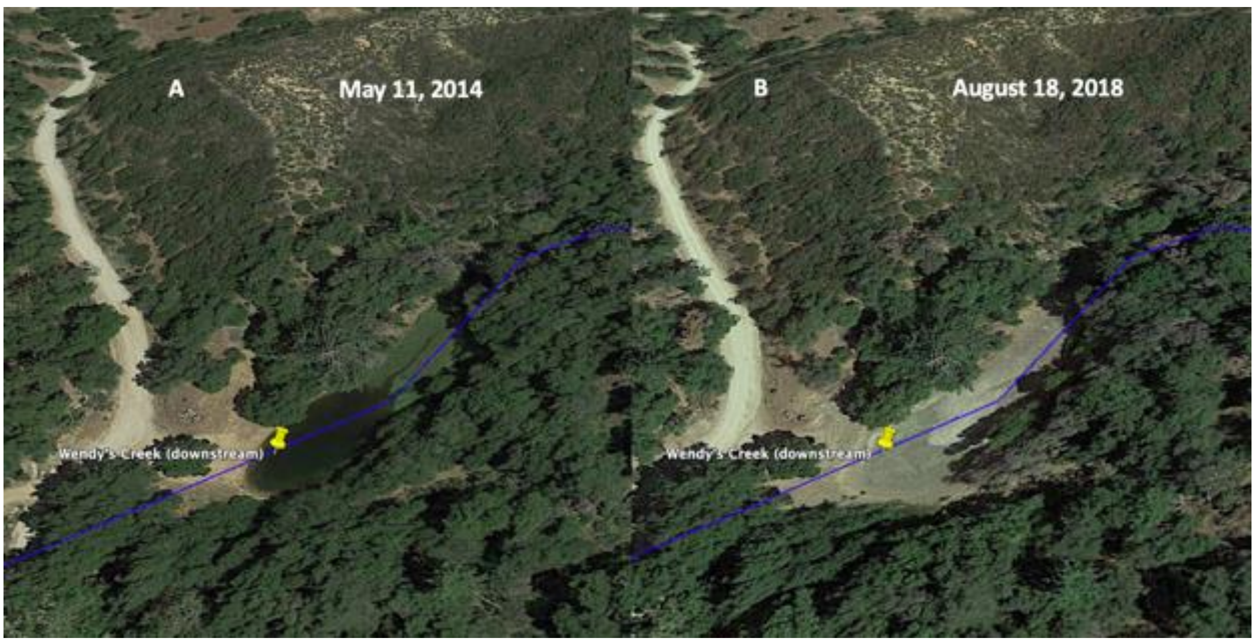

Figure 7. Pond at Wendy's Creek Downstream sampling station. A bend in the stream has a low partial dam, or check dam, to retain water as a cattle watering pond. In May 2014, the pond is present with some floodplain vegetation. Note: Vegetation type cannot be determined from this image. In August, 2018, late season grazing, the pond is dry and the floodplain vegetation is not present. Images were taken by Maxar Technologies, Google Earth.

A similar pattern of ecologic functional changes as seen at Wendy's Creek downstream (Figure 7) occurs at the Wendy's Creek upstream site (Figure 8). As seen in Figure 8, the pond at Wendy's Creek upstream sampling station transitioned from functional at-risk man-made pond to a nonfunctional intermittent pond. In image A, May 1994, Wendy's Creek upstream pond hasn't been created. As seen in image B, prior to June 1996, a low partial dam, or check dam, is constructed in the bend in the stream. From about 2000 to 2018, livestock use at the Wendy's Creek upstream cattle pond has been filling up with sediment. The ponds check dam had been expanded to allow for water to accumulate and cover more surface area because of the increased sediment deposition rate. In image C, August 2018, a delta from a large load of sediment is forming in the pond. This large amount of sediment could be the result of a nick point, or head cut working its way upstream into the headwaters (i.e., spring). If this happened, the damage to the spring would result in lowering the water table, and the spring becoming intermittent to ephemeral. In June 2023, the embankment to the north has incised resulting in more sediment filling in the pond, the pond is dry and the floodplain vegetation is not present.

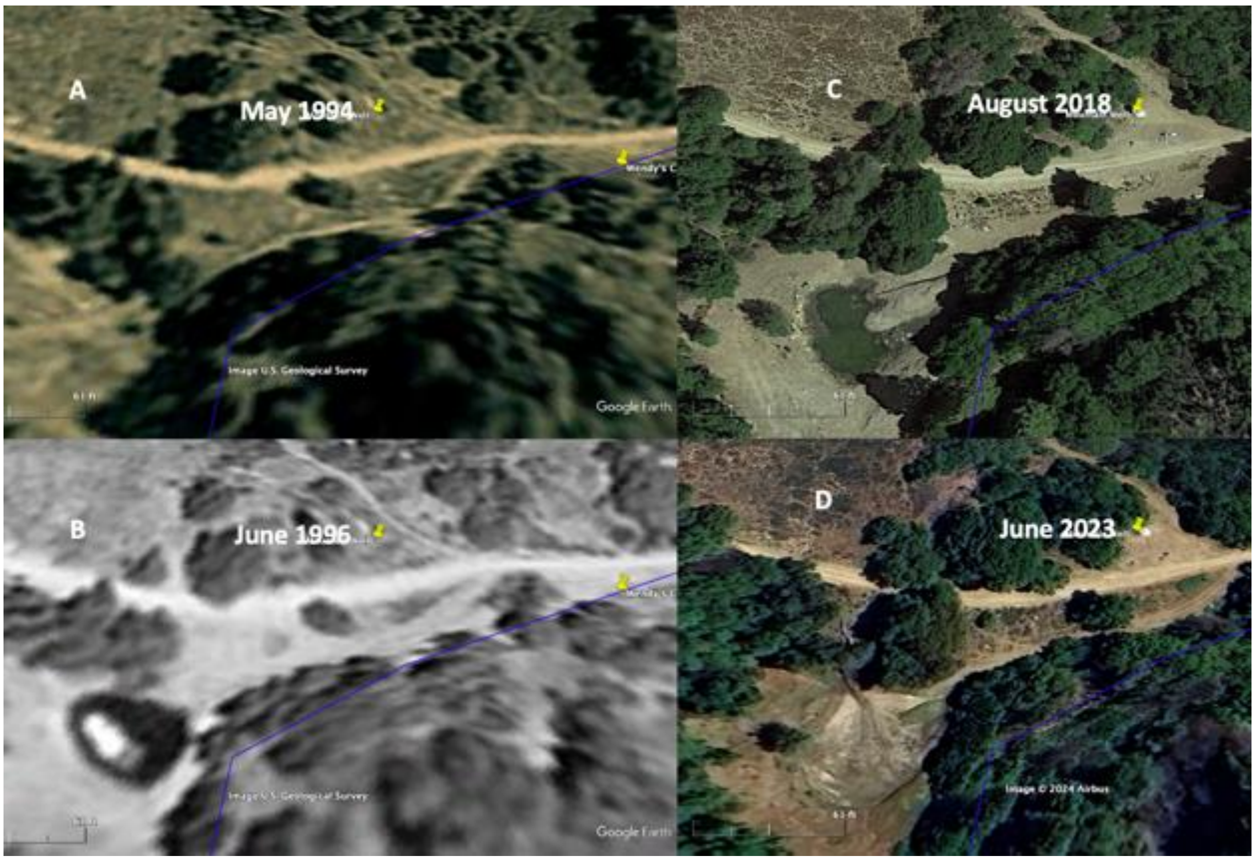

Figure 8. Pond at Wendy's Creek upstream sampling station. In image A, May 1994, Wendy's Creek upstream is not damned. As seen in image B, prior to June 1996, a low partial dam, or check dam, is constructed in the bend in the stream. From about 2000, livestock use at the Wendy's Creek upstream cattle pond filling in with sediment. The ponds check dam had been expanded to allow for water to accumulate. In image C, August 2018, a delta from a large load of sediment is forming in the pond. In June 2023, the embankment to the north has incised resulting in more sediment filling in the pond, the pond is dry and the floodplain vegetation is not present. Images were taken by US Geological Survey, Maxar Technologies and Airbus, Google Earth.

In contrast to Wendy's Creek (Figures 7 and 8), which is rated as nonfunctional or low status functional at risk, Bloomdale Creek, from a satellite image analysis, appears to be at proper functioning condition or at a high state of functional at risk (Figure 9). As seen in Figure 9, Bloomdale Creek meanders through a narrow meadow. The meandering nature of the creek indicates the channel is a Rosgen C type channel with a well-developed flood plain and a riffle/pool morphology (https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=1199). The shape and form of this steam channel type is dependent on the natural stability of the streambanks (i.e., bedrock controlled, presence of stabilizing vegetation – sedges and rushes).

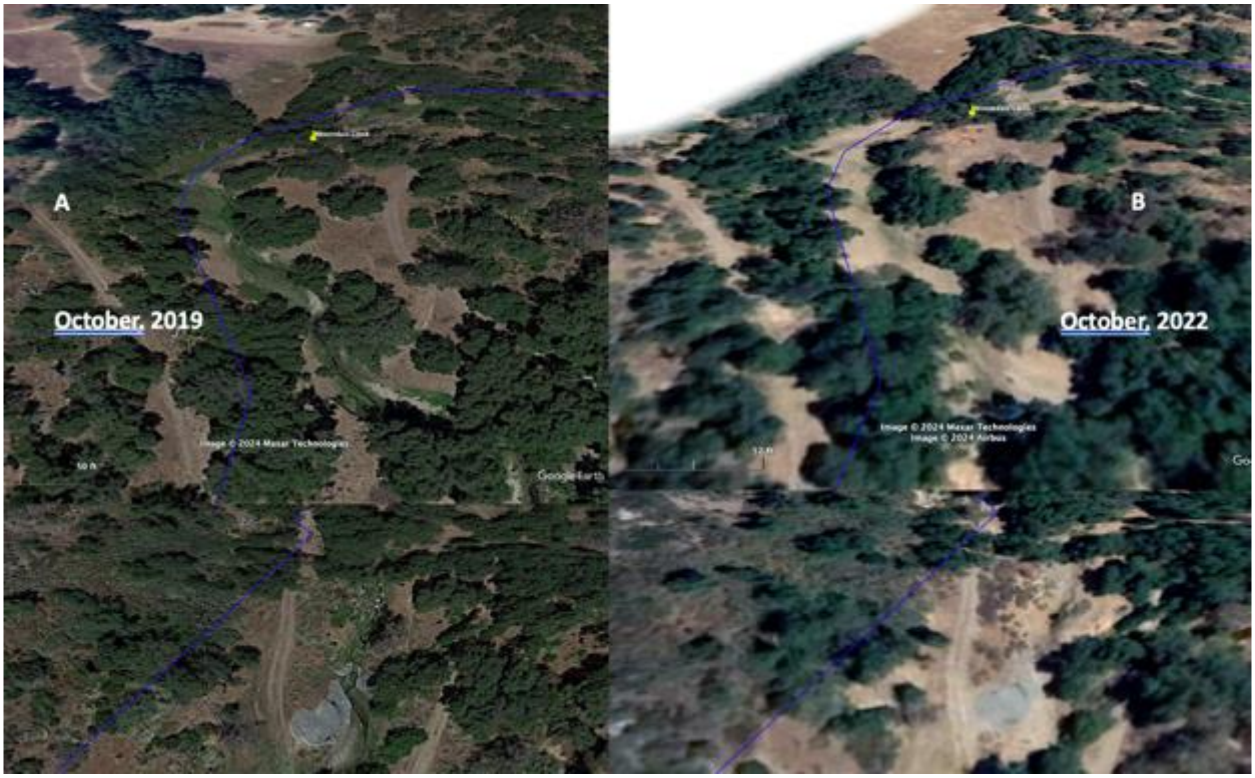

Figure 9. Bloomdale Creek just below the water quality sampling site. In image A, October 2019, water is flowing in the creek. Stream channel is very distinct by the water (black) present in the upper part of the image and in the pond in the lower portion next to the granitic rock outcrop. In image B, October 2022, the channel is obscure because of the lack of water (i.e., low flow). Except in the ponded areas at the top and bottom of the image. Even in this low flow condition, the sinuosity of the channel is visible because of the riparian forbes are still green. Green vegetation and water still in the ponds indicate the water table is still high and still providing aquatic habitat. Images were taken by Maxar Technologies, Google Earth.

In October 2019 (Figure 9-A), water is flowing in the creek. Stream channel is very distinct by the water (black) present in the upper part of the image and in the pond in the lower portion next to the granitic rock outcrop. The overall width of the floodplain is distinguished by the green vegetation adjacent to the channel. In image B, October 2022, the channel is obscured because of the lack of water (i.e., low flow conditions). Except in the ponded areas at the top and bottom of the image. Even in this low flow condition, the sinuosity of the channel is visible because of the riparian forbes are still green. Green vegetation and water still in the ponds indicate the water table is still high and still providing, though stressed, aquatic habitat.

Water Quality Standards

The INSY TEPA has not adopted water quality standards for the Reservation. The State of California water quality standards (https://www.mywaterquality.ca.gov/water_quality_standards/index.html) and USEPA water quality criteria (https://www.epa.gov/wqc) were used to determine water quality impairment. However, water quality issue originating from the INSY Reservation are PAHs and trace metals (SWAMP/SWRCB 2007 report). However, the satellite image analysis indicates the predominant stressor to the aquatic ecosystem of the INSY Reservation is the release of excess sediment (Figures 6, 7, 8 and 9). Loss of stream and wetland riparian and instream aquatic habitat has led to lower macroinvertebrate scores, and generation of excess nutrients to downstream lakes (SWAMP/SWRCB R7 and R9 reports). The objective is to identify best management practice (BMP), or combination of practices, that are an effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources on the INSY Reservation and increases ecological function physical processes to assist in sequestering excess pollutants and reducing toxicity (Swanson et al. 2017; Hall et al., 2018 a and b; Hall et al., 2019 a, b and c).

Formulation of Best Management Practices

The USEPA Code of Federal Regulations (CFR) Clean Water Act, Sections 106 and 319 require state and tribes to describe tribal and local programs for controlling pollution from non-point sources. The State of California and INSY nonpoint source program is intended to encourage adoption and implementation of best management practices (BMPs). The Iipay Nation of Santa Ysabel (INSY) Tribal Environmental Protection Agenc (TEPA) conducts water quality monitoring, assesses, and prioritizes non-point and point source problems, develops solutions, and provides management solutions to these problems. A priority list is kept of stream segments that have assessed human-caused water quality problems. The list is used to focus and conserve limited management resources. As seen in Table 3, following categories and subcategories of non-point sources have been designated by INSY TEPA and used in this report. All have to some extent caused impairment of INSY Reservation waters (Table 3).

Table 3. List of nonpoint sources and associated impacts.

Nonpoint Source	Impacts
Urban/Rural Residential Runoff	Surface runoff, Sediment, Nutrients, Chemicals, Pathogens**
Rural Runoff	Surface runoff, Sediment, Nutrients, Pathogens**
Construction Land Development	Surface runoff, Channelization, Sediment, Chemicals*
Storm Sewers	Channelization, Streambank erosion, Pathogens,** Chemicals*
Hydromodification	Channelization, Streambank erosion, Sediment, Nutrients, Pathogens,**

Atmospheric Deposition	Chemicals*

*Chemicals – Sediment, nutrients (lawns and gardens), pesticides, herbicides, heavy metals, oils and grease, and other toxic substances and debris
**Pathogens - Viruses, bacteria, and nutrients from pet waste and failing septic systems

The results of this study's analysis show nonpoint pollution sources cause water quality impairment widely within the INSY water catchments. However, the different watersheds may experience unique conditions of impaired water quality, because of the different proportions of land-use activities contributing to nonpoint pollution problems. As seen in Table 3, urban/rural residential stormwater can contribute bacteria, sediments, toxic chemicals, nutrients, and petroleum hydrocarbons. Categories of urban and residential sources include impervious surfaces and transportation systems, onsite septic systems, landscaping, construction, and livestock and domestic animals.

Atmospheric deposition is another potential source of nonpoint source pollution. Predominate wind direction is west to east. Nutrients and toxics are the most common pollutants, and generally occur from burning of fossil fuels and/or wind-borne soil erosion. Sources may originate from cities and highways within coastal California and from Mexico.

Natural sources (e.g., springs) can also affect water quality, through natural geologic instability, geomorphology, and wildlife and waterfowl. Natural sources may be difficult to distinguish, especially where human actions have worsened a natural condition.

Best Management Practices

Best Management Practices (BMPs) are utilized to control water pollution by managing the sources from which pollutants are released. Riparian Area BMPs focus on stream and wetland riparian areas (i.e., hydrology, channel morphology, soils and sediment, vegetation) and involve restoring ecological functioning conditions and physical processes. Upland BMPs emphasize improving vegetation and soil conditions in upland areas reducing the amount of sediment, nutrients and other contaminates. Healthy soils are fundamental to building prosperous and resilient ecosystems and to reducing greenhouse gas emissions and enhancing overall environmental impacts.

Ecosystems are defined as interconnected communities of vegetation, soils and landform, hydrology, and micro-organisms linked by physical and chemical interactions. An appropriate management strategy incorporates ecosystem patterns, attributes (vegetation, soils, landform) and processes (hydrology) to attain sustainable ecosystem functions supporting biological diversity. Ecosystem function physical processes empower sustainable management of many goods and services, including water quality through assimilation, water stability (aquifer recharge), wildlife habitat, and enhancement of focal niches. Focusing on the interconnections between hydrology, vegetation, soil and landform can often determine if resource goals and objectives are being met. Understanding ecosystem physical processes assists the natural resource manager to prioritize actions for maintaining and restoring the foundation needed for ecological resilience. For example, when determining potential, and/or desired natural condition (DNC), it is necessary to determine a site's ecological status (Figure 8). Ecological status is defined as the degree of similarity between existing hydrologic, vegetative, geomorphic, and soil conditions and its potential. Potential is defined as the highest ecological status a riparian-wetland area can attain in the present uses. This status is sometimes referred to as potential natural condition (PNC). As seen in Figure 6, that portion of the INSY Reservation has undergone physical changes over time. In 2004, road construction is present. In 2006, clearing of vegetation and creating downhill flow patterns. By 2023, construction on the lower structure is complete and the hillside grading scars are starting to heal.

The potential of this site (Figure 6) and its surrounding area is native oak and chaparral. For Wendy's Creek (Figure 7), the natural landcover is oak, chaparral and grassland savannah. For the stream and wetland riparian area, potential is a mix of stabilizing forbes (sedge and rush) and woody plants (various species of willow). Land management for both areas has been altered by construction and livestock grazing, respectively. For the other two western INSY Reservation parcels very little has changed.

Proper functioning condition (PFC) defines a state of resiliency allowing the ecosystem the ability to resist impairment from energy stressors. Stressor examples can include overland flow events, wind and direct physical stressors from human activities and wild and domestic ungulates. Resiliency allows an area to then produce desired values, such as waterfowl habitat, neotropical bird and/or pond turtle habitat, or livestock forage over time.

To address nonpoint source impacts from environmental stressors it is essential to understand and manage the drivers of ecosystem function, and recognize their role in water capture, storage and safe release appropriate for the landscape setting. The hydrologic, physical and ecological alterations resulting from terrestrial activity can have a pronounced impact on the natural function of uplands, and stream and wetland riparian areas (Figure 7). Physically, ecosystems are always in motion reacting to natural climatic changes and anthropogenic conditions. These changes in environmental condition will affect the chemical and biological community structure, which cause further alterations to the environment. For example, disturbance within a watershed or adjacent to a stream produces a causal effect, which may temporarily and/or permanently alter one or more attributes and processes (Figures 6 and 7).

Best Management Plan (BMP)

The comparability and maintenance of wildlife and aquatic habitat is dependent on the development of an upland and riparian area management strategy, which considers and adapts to certain basic ecological and economic relationships. Proper functioning condition (PFC) concepts (i.e., ecosystem physical process) directly relate to resource management needs.

Infrastructure needs are usually solved by development of pollution control structure(s). PFC concepts can be used to develop infrastructure projects that mimic natural processes in lieu of grey, engineered infrastructure that often interrupts natural processes, and degrades over time. For example, native vegetation must be planted on disturbed sites. Native vegetation should be salvaged from areas where ground disturbances will be occurring on projects. Salvaged vegetation should then be replanted after the completion of project activities. The use of nonnative vegetation will be strictly limited and will apply to situations where native vegetation (i.e., grasses) is not commercially available. All nonnative vegetation must be a close subspecies or variety to native species or reproductively altered (i.e., sterilized) to avoid future ecological complications with native species. Vegetative planting techniques must not cause major disturbances to soils and slopes. Plantings must occur during the optimal seasonal growth period for the respective plant species involved. Vegetation growth should also be enhanced by bank sloping/grading, seedbed and site preparations, mulching, or fertilizing.

Other potential BMPs:

- **Buffer strips** are strips of grass located between and around impervious paving materials such as parking lots and sidewalks, and a body of water. The buffer strip absorbs soil, fertilizers, pesticides, and other pollutants before they can reach the water.
- **Retention ponds** capture runoff and stormwater. Sediments and contaminants settle out of the water when they are trapped in the retention pond.
- **Constructed wetlands** are a recent innovation; the land is then used to slow runoff and absorb sediments and contaminants. The constructed wetland also provides habitat for wildlife.
- **Porous paving materials** are used in parking lots and highways. The porous pavement allows rainwater and stormwater to drain into the ground beneath it, reducing runoff. In some cases, there is also a stone reservoir underneath the pavement to allow filtration of the water before it reaches the groundwater.
- **Sediment fences**, or knee-high black fabric fences, are often used at construction sites to trap large materials, filter sediment out of rainwater, and slow runoff.
- **Grass planting and laying** of straw around construction sites help reduce runoff and associated nonpoint source pollution.

Conclusion

Possible nonpoint issues on the Iipay Nation of Santa Ysabel include:

- Sediment erosion from channel incision.
- Elevated bacteria levels in creeks and wetlands from livestock, birds and other wildlife.
- Temperature, nutrient and sediment problems from hydromodification (e.g., cattle ponds, culverts, etc.).
- Polycyclic aromatic hydrocarbons (PAH)s, 6PPD-Quinone from vehicle tires, road runoff.

Recommendations from this study include:

- Improve the identification, quantification, and prioritization of nonpoint sources.
- Explore GIS techniques that link land uses and BMPs to pollutant sources.
- Perform an ecological function assessment survey of the Tribes surface waters (streams and wetlands) (Dickard et al., 2015; Gonzales and Smtih, 2020).
- Consider improving reporting under state and federal grants to provide more accurate and consistent information about nonpoint sources.
- Consider working with the State of California to improve tracking of water quality enforcement actions to categorize permit-related or nonpoint sources.
- Continue studying the effectiveness of BMP implementation in controlling nonpoint pollution.
- Provide clearer and more organized and centralized guidance on BMPs to address land-use activities and pollutant sources in coordination with the State of California.
- Explore improving communication with the public and regulated community about NPS pollution.
- Coordinating with Intertribal Agricultural Council for agriculture and livestock grazing solutions and improvements.

This plan is a work in progress. The first steps in the development of the INSY nonpoint source management plan will start with identifying Best Management Practices (BMP) per category of identified NPS. These BMP's will be used as the key element in the INSY planning process. Realistic goals, objectives, action items and timelines will be established to correct problems. Ongoing and updating of those plans are now underway and include land use mapping and rulemaking, master planning, solid waste planning, water resources planning, water resource inventory planning, and environmental permitting. All these planning processes will be incorporated into the finished NPS management planning document, which should be reviewed annually. INSY TEPA monitoring programs should included when reviewing NPS implementation projects.

Best Management Practices (Potential)

- Buffer strip(s) of native grasses to reduce flow velocities of nonpoint sources storm water runoff from urban and roads and hydromodifications (culverts).

- Retention ponds and/or constructed wetlands to trap/minimize contaminates from land use (roads, open land areas).
- Native plantings, retention ponds and/or constructed wetland(s) BMP’s will be used to site, design and maintain onsite wastewater treatment (septic) systems, and urban runoff (e.g., pet wastes, lawn and garden fertilizers and pesticides, household chemicals that are improperly disposed of (i.e., illegal dumping), automobile fluids, and vehicle emissions).
- Development of a computerized electronic livestock management program.

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