San Dieguito Lagoon: Coastal Wetlands Field Ecology Project

High School Curriculum

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Dated March 17, 2017
ACKNOWLEDGMENTS

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SAN DIEGUITO LAGOON:
COASTAL WETLANDS FIELD ECOLOGY PROJECT

The San Dieguito Lagoon: Coastal Wetlands Field Ecology Project provides students and teachers an opportunity to visit the San Dieguito Lagoon, learn about the importance of wetlands, and become involved in the conservation of the San Dieguito Watershed. It asks students to research, carry out field ecology studies, and gather and analyze data to address the complex issue of development and its impacts on our natural environment based on the following scenario:

A developer wants to build a water park and hotel adjacent to the San Dieguito Lagoon. Based on field ecology studies conducted on the project site – do you support the development of the site (and if so, with what mitigation measures) or should it be preserved to protect its natural resources?

The project activities in this curriculum are unique in that they allow students to focus on solving a real world problem at the local level. It includes two site visits to the San Dieguito Lagoon to conduct field assessments and collect data. Field data collected for this project will contribute to the watershed-wide San Dieguito Citizen Science Monitoring Program and provide a unique opportunity for students to participate in real world monitoring and management of the San Dieguito River Park.

ORGANIZATION

The curriculum is divided into five different field studies for: 1) Wetland Soils, 2) Vegetation Communities, 3) Mammals, 4) Birds, and 5) Water Quality. Each field study activity is organized into the following sections:

- Summary
- Objectives
- Key Terms
- Procedures (Pre-visit, In the Field, Post-visit)
- Background Information
- References & Suggested Readings
- Field Study Instructions

SUGGESTIONS FOR USE

This project is founded on the principles of project-based learning. Using scientific analysis, critical thinking, and communication skills, students are asked to become field ecologists using...
standards set forth in the County of San Diego CEQA guidelines. Using a combination of in-class research and field data collection, students will analyze their data and use evidence from their research to support their recommendation to develop the project site (with or without mitigation measures) or preserve it for its natural resources.

Teachers should work with students to organize tasks, set checkpoints and deadlines, use resources, and create products in order to make a final presentation supporting their recommendation in a student-led symposium. Ideally, students would present their findings in a public forum to include representatives from local government and community groups such as the San Dieguito River Park Joint Powers Authority (JPA) and San Dieguito River Valley Conservancy (SDRVC).

The project includes two field site visits to the San Dieguito Lagoon Complex to conduct field studies and collect data. River Park JPA and/or SDRVC staff will host these field site visits, direct the collection of data in the field, and supply all necessary equipment.

An optional field trip to the San Diego Zoo Institute for Conservation Research’s Eddy Family Outdoor Learning Lab prior to beginning the field studies is highly recommended. The Outdoor Learning Lab is designed to increase knowledge about native plants and animals and introduce students to research techniques used to monitor them. For more information on the Outdoor Learning Lab or to schedule a field trip, please email ConservationEducation@sandiegozoo.org.

The suggested project sequence is as follows:
1. Introduction to the project and CEQA
2. In-class activities and research to prepare for field studies (Pre-visit)
3. Site visits to San Dieguito Lagoon to conduct field studies and collect data
4. In-class data analysis & determination of impacts (Post-visit)
5. Presentation of findings at student-led symposium

**KEY TERMS/GLOSSARY**

Key terms are listed at the beginning of each section and are indicated by bold/green text throughout the curriculum. Definitions for key terms can be found in the Glossary (Appendix A).

**NGSS STANDARDS**

The *San Dieguito Lagoon: Coastal Wetlands Field Ecology Project* provides information and activities aligned to the Next Generation Science Standards (NGSS). The standards addressed by the curriculum are provided in Appendix B.
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Coastal wetlands are among the most endangered habitat types in the world. It is estimated that the U.S. loses more than 18,000 acres of coastal wetlands every year. In California, 75% of the wetlands have been destroyed in less than 140 years due to development and human impacts.

The San Dieguito Lagoon was once one of the largest of the six coastal lagoons in San Diego. The lagoon is the terminus of the San Dieguito River, which flows approximately 55 miles from its headwaters on Volcan Mountain near Julian to the ocean at Del Mar, and is vitally important for the ecology of the region. It provides several ecosystem services including water purification, flood protection, and shoreline stabilization. The lagoon also serves as a stopover for migratory birds on the Pacific Flyway, as a fish hatchery, and as important nesting and foraging habitat for threatened and endangered species.

Historically, the lagoon supported a diverse array of habitat types including salt marsh, mud flats, and freshwater/brackish wetland. The lagoon’s salt marsh habitat dominated the area and was believed to encompass about 600 acres while the entire lagoon probably covered 1,000 acres. The lagoon has since lost over half of its marshes due to development including:

- Highway 101
- Jimmy Durante Blvd.
- Residential areas
- Del Mar Racetrack & Fairgrounds
- Former World War II military airport
- Lake Hodges & Sutherland dams (upstream)

Large-scale restoration efforts in recent years (2006-2013) have helped compensate for this loss and the lagoon currently covers about 500 acres, the majority of which is salt marsh. In 2007-2008, a series of storm water treatment ponds were constructed to capture and treat polluted runoff from adjacent development before it enters the lagoon. Future restoration of an additional 141 acres of tidal wetland and upland habitat is planned to be completed as mitigation to compensate for environmental impacts associated with the I-5 widening project and the realignment of the El Camino Real bridge.

**REFERENCES & SUGGESTED READINGS**


San Dieguito Wetlands Restoration Project website: [www.sdlagoon.com](http://www.sdlagoon.com)
PROJECT INTRODUCTION

PROJECT SCENARIO

A developer wants to build a 60-acre water park and hotel adjacent to the San Dieguito Lagoon (see Appendix C. Project Site Map). As part of the County of San Diego development and permitting process, the developer is required to complete an environmental review of the project to determine if it would have significant impacts as required by the California Environmental Quality Act (CEQA).

As part of the consulting firm hired by the developer to conduct an initial environmental review of the project, your team is tasked with conducting required field studies for biological resources and surface water quality, and evaluating potential adverse environmental effects. Before a determination of significance can be made, the presence, nature and extent of the biological and water resources must be established per the County’s CEQA guidelines.

Based on your data, your team will identify potential environmental effects that may be caused by developing the site and determine if they are considered significant. Will it be possible to mitigate for these effects? If so, what mitigation measures would you propose? Would the site be better off being preserved to protect its natural resources? Does it provide more value as a mitigation site?

Based on this determination, your team must make a recommendation to either support development of this site or preserve it to protect its natural resources. You will present your findings, along with your specific recommendations in a public forum.

WHAT IS CEQA?

CEQA, or the California Environmental Quality Act, is a statute that was passed into law in 1970. CEQA sets statewide policies that require both state and local agencies to identify and consider the environmental impacts of decisions that involve changes to the environment. The purposes of CEQA are to:

1) Provide information about the environmental effects of projects.
2) Identify ways that environmental damage can be avoided or reduced.
3) Prevent significant environmental damage through mitigation measures or alternatives.
4) Disclose the reasons why a project was approved despite significant environmental impacts.

Most development projects in California are subject to CEQA. Every development project that
requires a permit or other governmental approval will require at least some environmental review pursuant to CEQA. Below are a few examples of local, state and federal permits and approvals that trigger CEQA:

- County of San Diego - Grading Permit
- Regional Water Control Board - General Construction Storm Water
- California Coastal Commission - Coastal Development Permit
- California Department of Fish & Wildlife - Lake and Streambed Alteration Agreement
- U.S. Army Corps of Engineers – Section 404 (Clean Water Act) Permit
- U.S. Fish & Wildlife Service – Section 10 (Endangered Species Act) Incidental Take Permit

**What is Environmental Review?**

Environmental review is the evaluation process that CEQA requires public agencies to conduct before taking action to approve a project. Environmental review is a set of procedures used to identify a project's potential impacts, develop ways to reduce those impacts, and report the results of the analysis to the public.

CEQA requires review of many different environmental factors that may be potentially affected by a project including:

- Aesthetics
- Agriculture & Forestry Resources
- Air Quality
- **Biological Resources**
- Cultural Resources
- Greenhouse Gas Emissions
- Hazards & Hazardous Materials
- Hydrology/Water Quality
- Land Use/Planning
- Mineral Resources
- Noise
- Population/Housing
- Public Services
- Recreation
- Transportation/Traffic
- Utilities/Service Systems
- Mandatory Findings of Significance

For this project, we will only be looking at Biological Resources and Water Quality.

**What is a Significant Impact?**

The term "significant impact" means substantial adverse damage to the physical environment. The CEQA analysis relies upon independent judgment to decide whether a project may have the potential to cause substantial environmental harm. Sometimes, significant impacts are identified which can be eliminated or significantly reduced using various strategies. In these cases, impact reduction strategies (mitigation measures) are recommended to reduce or eliminate harmful impacts.
**WHAT IS A MITIGATION MEASURE?**

A mitigation measure is a strategy taken to reduce or eliminate a project's expected environmental damage (e.g., "No oak trees may be removed"). Sometimes mitigation measures are designed to repair, restore or rehabilitate a damaged area (e.g., "All illegal fill will be removed from the floodplain and natural vegetation restored"). Others may provide compensation for losses by providing substitute resources or environments (e.g., "Trees will be planted off-site to replace those removed during construction").

**DOESN'T CEQA STOP PROJECTS THAT HARM THE ENVIRONMENT?**

An agency is permitted to approve projects that cause significant environmental damage. However, the agency must make findings, which clearly explain the circumstances surrounding the project analysis and the approval. Then the agency must explain their decision to approve the project, despite expected environmental damage, by adopting a Statement of Overriding Considerations. This type of statement points out the reasons why a project's benefits outweigh its environmental costs.

**WHY DOES THE COUNTY NEED CEQA GUIDELINES?**

All public agencies are required to adopt specific criteria, objectives and procedures for implementing CEQA. These are in addition to the statewide guidelines, which are more general and apply to all agencies in the state. Some jurisdictions adopt the state-prepared CEQA guidelines as their CEQA procedures. San Diego County’s guidelines supplement the state guidelines: [http://www.sandiegocounty.gov/pds/procguid.html](http://www.sandiegocounty.gov/pds/procguid.html)

**REFERENCES & SUGGESTED READINGS**

California Natural Resources Agency (2014). Frequently Asked Questions About CEQA: [http://resources.ca.gov/ceqa/more/faq.html](http://resources.ca.gov/ceqa/more/faq.html)

1. WETLAND SOILS

SUMMARY

Students will learn about the properties of wetland soils and how they are tested to determine if an area is a wetland. Working in small groups, students will collect soil samples from various areas at the project site (upland, transition zone, and potential wetland area) and analyze the data to determine if the project site is considered a wetland.

**CEQA Checklist:** Specifically, this activity is designed to help address the following CEQA Environmental Checklist questions for Biological Resources (Appendix D):

Would the project:

c) **Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?**

OBJECTIVES

Students will be able to:

- Describe the three characteristics (hydrology, vegetation and soil) of all wetlands.
- Identify different types of wetland habitats.
- Identify characteristics related to hydric soils such as soil color, moisture and texture.
- Perform various soil tests, and interpret data and results of tests.

KEY TERMS

- Anaerobic
- Estuary
- Hydric soils
- Hydrology
- Hydrophytic
- Loam
- Mineral
- Organic
- Peat
- Riparian
- Wetland

PROCEDURES

**Pre-visit**

- Review background information with students.
- Have students review the County of San Diego Guidelines for Determining Significance for Riparian Habitats and Wetlands:
• Have students discuss potential impacts they might expect from building a water park and hotel.
• Have students go to the online NRCS Soil Survey Map and look up what types of soils are expected to be found on the project site: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
• **Optional:** Have students practice testing and collecting data from soils collected at the school or their homes.

**In the Field**

• Students will perform the Wetland Soils Field Study and complete the Wetland Soils Data Sheet and Wetland Analysis Worksheet.

**Post-visit**

• Have students analyze their field survey data and compare it to the data obtained from the NRCS Soil Survey map of the project site. *Is the data collected in the field similar to what you expected to find based on the NRCS Soil Survey data?*
• Have students collectively map the field sampling locations on Google Earth.
• Have students use evidence from their research and field studies to determine and map the presence of wetlands on the project site.
• Have students use evidence from their research and field studies to complete the corresponding CEQA Environmental Checklist questions and Determination of Significance (*Appendix D*).

**BACKGROUND INFORMATION**

**What is a Wetland?**

The U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency define wetlands as:

> Those 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.

Simply stated, in order for an area to be considered a wetland, it must possess three things: 1) presence of water (*hydrology*), 2) *hydrophytic* or water-loving vegetation or plants, and 3) certain soil characteristics (*hydric soils*).
Wetlands comprise a diverse array of habitat types such as marshes, estuaries, ponds and riparian areas, which may look very different from one another. They occur in all parts of the world from the ocean to the mountains and even in deserts. The San Dieguito Lagoon is an example of an estuary. An estuary is a coastal wetland where freshwater from a river or stream meets the ocean.

**How can you determine if an area is a wetland?**

Indicators of all three wetland criteria must be present during some portion of the year for an area to be a wetland unless the area has in some way been altered.

**Hydrology**

In some instances, wetlands are easy to identify because standing or flowing water is present on site, but this is not always the case. Some wetlands may not have standing water for up to 97% of the year. In these cases, other clues can indicate the presence of water including:

- Water marks on trees, rocks or other objects – this indicates that water periodically covers an area to the depth shown on the objects.
- Drift lines or small piles of debris lodged or piled against another object – these often occur during flooding and show the extent of the flooded area.
- Thin layers of mud or sediment deposited on objects – this indicates an area was once wet and has since dried out.

**Hydrophytic Plants**

Nearly 5,000 different wetland plant species occur in the United States including, grasses, mosses, shrubs and trees. This may seem daunting unless you are a professional botanist, but you can narrow the list down by knowing a few key plants common to your area. Common indicator species for wetlands in the San Dieguito River Park include:

- Grasses and grass-like plants – reeds, rushes, and cattails are often indicative of freshwater marshes. Coastal salt marshes tend to favor more salt-tolerant plants such as cordgrass and pickleweed.
- Shrubs – Mulefat and poison oak are two common shrubs found in wetland habitats along the entire San Dieguito River.
- Trees – willows, cottonwoods and sycamores are usually associated with riparian habitats along rivers, streams and drainages.
Hydric Soils

Hydric soils are strongly influenced by the presence of water. A soil is considered hydric if it has been flooded or saturated with water long enough to become deprived of oxygen or anaerobic. They may be saturated all year long, or seasonally/intermittently flooded for a portion of the year.

Anaerobic conditions change the soil’s color, as well as other characteristics, such as texture and organic content. Scientists use a complex set of color charts – A Munsell soil color book – to classify soils into different types based on color, lightness and darkness, and the degree of mixture of colors. Even when water is not present, the color of the soil can be used to identify a wetland. Wetland soils are divided into two major types:

1. **Organic** (upper layers) – appears black or dark brown. Color may be influenced by accumulated organic materials that don’t break down due to anaerobic conditions.

2. **Mineral** (deeper layers) - range in color from gray and bluish-gray to black. May also be mottled or gray with splotches of brown, orange, red or yellow as a result of being alternately wet and dry. When oxygen mixes with iron, manganese, water and other components, oxidation occurs creating these splotches of color (similar to rust on garden tools or wrought iron).

The look and feel of soil is referred to as soil texture and is determined by the size and type of particles that make up the soil. Soil particles are classified as clay, silt or sand. Clay particles are the smallest and feel sticky and easily roll into a ball when wet. Silt particles are moderate in size and feel smooth like baking flour and are slippery when wet. Sand is the largest of the particles and is visible to the naked eye and gritty to the touch. Soils made up of a roughly equal proportion of clay, silt, and sand particles are called loam. Hydric soils often consist of fine particles, silts and clays, that tend to hold water at the surface.

Most hydric soils have very distinguishing characteristics making it relatively simple to tell whether a soil may be hydric. Some common indicators of hydric soils include:

- Soil has a thick layer of decomposed plant material or peat.
- Soil has a “rotten egg” or earthy smell.
- Soil is bluish-gray or dark brown-black below the surface.
- Soil has dark stains or streaks of organic material that feel slimy and stain your fingers.
**Why is it necessary to know if an area is a wetland?**

Impacts to wetlands can require permits from federal, state, and local agencies. On the federal level, wetlands are regulated by the Clean Water Act, which requires that anyone proposing to deposit dredged or fill material into “waters of the United States, including wetlands,” must receive authorization (a permit) for such activities. Regulated activities that require a permit include, but are not limited to:

- Mechanized land clearing
- Grading
- Building/road construction
- Placement of fill material

**REFERENCES & SUGGESTED READINGS**


FIELD STUDY – WETLAND SOILS

TIME & MATERIALS:
This field study should take about 60 minutes to complete and will require the following materials:

- Trowels
- Zip-top bags
- Markers
- Rulers
- Water
- Paper towels
- Wetland Soil Color Chart
- GPS units
- Field study instructions & data sheets
- Clip boards
- Pens/Pencils

The methods set forth in this field study were adapted from the Our Wetlands, Our World curriculum developed by the California Coastal Commission (2004).

1. Collecting Soil Samples

Procedures:

(1) In small groups, visually inspect the project site to see if there is an area that may potentially be classified as a wetland. Look for clues such as low lying areas, wet and muddy areas, and sites with wetland vegetation (e.g., cattails and reeds).

(2) Choose 3 different locations at the wetland to collect soil samples:
   - Sample #1 - Suspected wetland area
   - Sample #2 - Transitional area (edge of wetland)
   - Sample #3 - Upland area

(3) At each location, use a trowel to remove a scoop of soil about the size of a Ping Pong ball at two-inch intervals to a depth of 12 inches (6 samples).

(4) Place each sample in a zip-top bag and label with the location and depth of the sample.

(5) Refill the hole when finished.
2. Color Classification

Procedures:
(1) Hold the Wetlands Soil Color Chart in one hand. In the other hand, hold a sample of soil behind the chart so that it is visible through the hole. Move the sample around until you find the color that nearly matches the main color of the soil.

(2) Record this classification on the data sheet.

3. Soil Moisture (Dampness)

Procedures:
(1) Remove each soil sample from the zip-top bag. Squeeze the soil sample firmly in your hand several times to form an irregularly shaped “ball.” Does the soil feel moist? Does it retain this shape? Does the soil stain or aggregate and remain on your fingers?

(2) Record your findings on the data sheet.

4. Ribbon Test (Soil Texture)

While professional scientists perform exact laboratory procedures to determine the exact proportions of clay, silt or sand in the soil, the results from the ribbon test below can give reasonably good guesses.
**Procedures:**

1. Place approximately one tablespoon of each soil sample in your palm. Add water a drop at a time and knead the soil to break down all the aggregates. Soil is at the proper consistency when it can be shaped into a ball when squeezed and feels like putty. Add additional water or soil as needed to obtain this consistency.

2. Place the ball of soil between your thumb and forefinger, gently pushing the soil with the thumb working it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over your forefinger, breaking from its own weight.

3. If a ribbon is formed:
   - If the ribbon is long, flexible, and can sustain its own weight = **Clay**
   - If the ribbon is weak, breaks readily, but forms a ball which withstands much handling = **Clay Loam**
   - If the clay loam is soapy or slippery feeling, and appears powdery when dry = **Silty Clay Loam**
   - If the clay loam has lots of visible sand = **Sandy Clay Loam**

4. If the soil will not form a ribbon, instead giving a broken appearance:
   - If wet soil is friable, somewhat gritty and sticky, and the ball does not break = **Loam**
   - If the dry soil feels soft and floury, slippery when wet, and the ball does not break = **Silty Loam**
   - If sand can be seen, and the ball breaks and falls apart when handled = **Sandy Loam**

5. Record your observations on the data sheet.
WETLAND SOILS DATA SHEET

Student Name(s): _____________________________________________________________ Date: ______
Latitude: __________________________________ Longitude: _______________________
Description of Location: _______________________________________________________
____________________________________________________________________________
Description of Plants Present: ___________________________________________________
____________________________________________________________________________
Potential water sources: _________________________________________________________

Sample #1 - Suspected wetland area

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<thead>
<tr>
<th>Depth of Soil Sample</th>
<th>Color Classification</th>
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Sample #2 - Transitional area (edge of wetland)

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<th>Depth of Soil Sample</th>
<th>Color Classification</th>
<th>Soil Moisture (Dampness)</th>
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Sample #3 - Upland area

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<th>Depth of Soil Sample</th>
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<th>Soil Moisture (Dampness)</th>
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WETLAND ANALYSIS WORKSHEET

Location of sample(s): ____________________________________________________________

Depth of sample(s): _____________________________________________________________

Color Classification: ____________________________________________________________

Describe the texture of the soil. (Does it feel gritty or smooth?)

What does the sample smell like? (A rotten-egg smell indicates the presence of hydrogen sulfide, a product of anaerobic bacteria.)

Is the soil organic or mineral? What evidence helped you decide?

Do your results indicate this area as a wetland?
2. VEGETATION COMMUNITIES

SUMMARY

Students will learn about some of the main vegetation communities found in San Diego and the dominant plant species used to identify them. Working in small groups, students will conduct a rapid assessment sampling technique on the project site to collect plant and general site data. They will analyze the data to determine the main vegetation communities found on the project site.

CEQA Checklist: Specifically, this activity is designed to help address the following CEQA Environmental Checklist questions for Biological Resources (Appendix D):

Would the project:
  b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?

OBJECTIVES

Students will be able to:
  • Identify five main types of vegetation communities found in San Diego County.
  • Identify indicator plant species used to identify different vegetation communities.
  • Perform a rapid assessment survey, and interpret data and results of survey.

KEY TERMS

- Biodiversity
- Degradation
- Ecology
- Habitat
- Indicator species
- Topography
- Vegetation community

PROCEDURES

Pre-visit
  • Review background information with students.
  • Have students review the County of San Diego Guidelines for Determining Significance for Riparian Habitat or Sensitive Natural Community and Federal Wetlands:
http://www.sandiegocounty.gov/content/dam/sdc/pds/ProjectPlanning/docs/Biological Guidelines.pdf

• Have students go the online Vegetation Communities of San Diego Map and look up what types of vegetation communities are expected to be found on the project site: https://databasin.org/datasets/ff2825e4cd144125b4acdf5e15755cdf
• Have students research the main indicator plant species for each vegetation community and learn how to identify them in the field: http://www.calflora.org
• Have students discuss potential impacts to vegetation communities they might expect from building a water park and hotel.

**In the field**

• Students will perform the Vegetation Communities Field Study and complete the Vegetation Communities Data Sheet and Analysis Worksheet.

**Post-visit**

• Have students collectively map the field sampling locations on Google Earth.
• Have students use their notes to identify the plant species found onsite and complete the Vegetation Community Analysis Worksheet.
• Have students use evidence from their research and field studies to determine and map the vegetation communities on the project site.
• Have students analyze their field survey data and compare it to the GIS data obtained from the Vegetation Communities of San Diego Map. *Is the data collected in the field similar to what you expected to find based on the GIS data?*
• Have students use evidence from their research and field studies to complete the corresponding CEQA Environmental Checklist questions and Determination of Significance (Appendix D).

**BACKGROUND INFORMATION**

California has the most diverse vegetation of any state in the U.S. with San Diego County being the most biologically diverse county in the state. This biodiversity arises as a result of our **topography**, unique climate, and geology.

**What is a vegetation community?**

A plant or **vegetation community** is an assemblage of plants represented by one or more **indicator species** and identified with a particular **habitat**, or physical environment. Defining and mapping vegetation communities is part of the science of **ecology**. Below are
some of the common vegetation communities found within San Dieguito County. Within the general categories outlined below, many smaller communities can be defined.

**Marsh**

Both freshwater marsh and coastal salt marsh occur in San Diego County. Coastal salt marsh is found within the tidal zone on the edge of lagoons and bays. It is the major vegetation community of the San Dieguito Lagoon.

The dominant plants in coastal salt marsh are pickleweed (*Salicornia virginica*), alkali heath (*Frankenia salina*), salt grass (*Distichlis spicata*) and cord grass (*Salicornia pacifica*). It’s estimated that marsh habitats in the County have been reduced by 85-90% (to less than 1,000 acres) from channelization, dredging and vegetation removal.

Two endangered birds occur within coastal salt marsh, Ridgway’s rail and Belding’s savannah sparrow. Coastal salt marsh is also important for shorebirds and the naturally occurring flow channels within salt marsh are important spawning areas for fish.

**Riparian**

Riparian vegetation communities are associated with land adjacent to year-round freshwater bodies such as the edges of lakes, and along rivers and streams. They range from relatively dense forests dominated by willow trees (*Salix* spp.), western cottonwood (*Populus fremontii*), and California sycamore (*Platanus racemosa*) to more open scrub habitats dominated by mule fat (*Baccharis salicifolia*), a shrub with greasy-scented leaves.

Riparian vegetation is a type of wetland and one of the most sensitive habitats in California. At one time, all the major riverbeds in San Diego County supported extensive riparian areas. However, thousands of acres of riparian vegetation has been lost due to clearing for agriculture, sand mining operations, and roadways. It’s estimated that only 29,000 acres of riparian vegetation remain in the County, but much of that is fragmented.

Riparian vegetation is one of the most significant vegetation communities for wildlife. It is vital to many bird species including the endangered least Bell’s vireo and southwestern willow flycatcher. Riparian vegetation and associated streams are critical for a variety of amphibians including the endangered arroyo toad.
Coastal Sage Scrub

Coastal sage scrub is characterized by a semi-open appearance and consists predominantly of low-growing (3-4 feet tall), aromatic and generally soft-leaved shrubs. The dominant species include California sagebrush (*Artemisia californica*), white sage (*Salvia apiana*), black sage (*Salvia mellifera*), flat-top (or California) buckwheat (*Eriogonum fasciculatum*), goldenbush (*Isocoma menziesii*) and bush sunflower (*Encelia californica*).

This community is generally found below 1,500 feet on south and west facing slopes. Many of the plants are summer deciduous losing their leaves during the dry hot summers and in times of drought. Nearly 70% of the County’s original coastal sage scrub has been lost to urban development. Approximately 264,000 acres of coastal sage scrub remain, but much of that exists as small patches of isolated habitat.

When coastal sage scrub is preserved, it helps protect a number of sensitive animal species that make this community their home including: California gnatcatcher, orange-throated whiptail, San Diego horned lizard, and black-tailed jackrabbit.

Chaparral

Chaparral is characterized by large (5-15 feet tall), drought-hardy, woody shrubs. Indicator species include: chamise (*Adenostoma fasciculatum*), lemonadeberry (*Rhus integrifolia*), toyon (*Heteromeles arbutifolia*), laurel sumac (*Malosma laurina*), several types of manzanita (*Arctostaphylos* spp.), scrub oak (*Quercus dumosa*), and several species of *Ceanothus* or wild lilac. Many of these species are adapted to drought and have waxy leaves that curl to minimize evaporation.

Chaparral is one of the most widespread vegetation communities in San Diego totaling more than 630,000 acres, and is generally found between 1,000-5,000 feet on north-facing slopes throughout the foothills. Like many native vegetation communities, chaparral plants are adapted to wildfire and resprout from underground roots or produce prolific seedlings after a fire.

Chaparral is home to a wide variety of birds including wrentit, western scrub-jay, spotted towhee, California towhee, and California thrasher. Other animals common to chaparral include woodrats, mule deer, fox, coyote, bobcat, the occasional mountain lion and a number of reptiles such as red diamond rattlesnake and San Diego horned lizard.
Oak Woodland

Oak woodlands have an open canopy (as opposed to forests that have a closed canopy) of one or several different species of oaks including: live oak (*Quercus agrifolia*), black oak (*Quercus kelloggii*), Engelmann oak (*Quercus engelmannii*), canyon oak (*Quercus chrysolepis*), and scrub oak (*Quercus dumosa*). Oak woodlands often have an understory of poison oak (*Toxicodendron diversilobum*) and various herbs.

Oak woodland typically occurs at elevations between 3,000-4,000 feet in areas with good soil and high moisture content such as stream and canyon bottoms, and north and east facing slopes. This habitat is important for a number of bird species including: California scrub-jay, Nuttall’s woodpecker, northern flicker, owls and flycatchers. It is also home to the same mammals that occur in the surrounding chaparral including raccoons, skunks, opossums, coyote, bobcat and mountain lion.

Urban or Disturbed Habitat

Urban or disturbed land means land that does not have habitat value for native species as a result of development or other human activities permitted by law. Roughly 420,000 acres of land in San Diego County are now classified as urban, and approximately 27% of the San Dieguito watershed includes urban/developed, highly disturbed, and/or agricultural lands.

What makes a vegetation community rare or sensitive?

The components of each vegetation community are influenced by soil type, topography, climate and human disturbance. A vegetation community can be rare (or sensitive) even if none of the dominant, indicator species that define it are rare. This is because the association of species and their relationship to their environment may be rare.

All the naturally vegetated, open water, and coastal habitats are considered sensitive by local, state and federal agencies. This is largely a consequence of the way the land has been managed in the past, but also includes specific threats such as fire, clearing, weeds and diseases. According to the San Dieguito Watershed Management Plan (City of San Diego 2006), a total of 15 sensitive vegetation communities occur in the watershed.

Why is it necessary to know what type of vegetation communities occur in an area?

Sensitive habitats are regulated by state and federal laws, and the County of San Diego Resource Protection Ordinance (RPO). The RPO establishes permitted uses and development criteria in order to prevent degradation and loss of the County’s wetlands and other sensitive
vegetation communities. In many instances, the RPO requires buffer areas and minimum mitigation ratios for impacts to sensitive habitats. For example, any impacts to wetlands shall be mitigated at a minimum ratio of 3:1, so for every acre of wetlands impacted, a developer must create and restore/enhance three acres of wetlands.

REFERENCES & SUGGESTED READINGS

Calflora website: http://www.calflora.org


FIELD STUDY – VEGETATION COMMUNITIES

TIME & MATERIALS:
This activity should take about 60 minutes to complete and will require the following materials:

- Plants of the San Dieguito River Valley brochure
- Field study instructions & data sheets
- Project site map
- Cover Estimate Diagrams
- Measuring tape
- Stake flags
- GPS units
- Clip boards
- Pens/Pencils

The methods set forth in this field study were adapted from protocol for vegetation rapid assessment and relevé sampling developed by the California Native Plant Society and the California Department of Fish & Wildlife.

1. Select a Plot to Sample

In order to assess the different vegetation communities on site, a stand of vegetation must first be delineated. A stand is the basic physical unit of vegetation in a landscape. Some stands are small, such as a meadow, and some are very large, such as a forest. A stand has two main characteristics:

- It has compositional integrity: The combination of plant species within a stand is similar throughout the site.
- It has structural integrity: The horizontal and vertical spacing of plant species within a stand are relatively similar.

For an area of vegetation to meet the requirements of a stand, it must be uniform in structure and composition throughout. When sampling a vegetation stand, you should select a plot in an area that is representative of the stand.

Procedures:
(1) Using the project site map, outline areas that appear to be similar in vegetation composition and structure. Select 1-3 different stands within the project site to sample.
(2) In order to select a plot, take a brief walk around or through each stand and look for variations in species composition and stand structure. Assess the stand and find an area that you think captures the stand’s common species composition and structure.
Once you select a representative plot, mark the center with a stake flag and measure out a 10-foot radius circle. Mark the boundary of the circle with additional stake flags. This will be your sampling plot.

2. Data Collection

Procedures:

Habitat & Vegetation Description

(1) **Community Type:** Indicate if the sample plot is in a wetland or upland.

(2) **% Surface Cover:** Using a Cover Estimate Diagram, estimate the total amount of each of the following classes covering the surface of the ground within the sample plot. It is helpful to imagine “mowing off” all of the live vegetation at the base of the plant leaving only the stems. The total should sum 100%.

  *% H2O:* Percent surface cover of running or standing water (ignore any substrate below the water).

  *% Living Stems:* Percent surface cover of living plant stems at the ground surface. Note that for most vegetation types this is usually 1-3%.

  *% Bedrock:* Percent surface cover of bedrock including any rock outcrops.

  *% Boulders:* Percent surface cover of rocks > 60 cm in diameter.

  *% Stone:* Percent surface cover of rocks 25-60 cm in diameter.

  *% Cobble:* Percent surface cover of rocks 7.5-25 cm in diameter.

  *% Gravel:* Percent surface cover of rocks 2 mm – 7.5 cm in diameter.

  *% Fines:* Percent surface cover of bare ground and sediment (e.g., dirt).

(3) **% Plant Cover:** Using a Cover Estimate Diagram, estimate the total canopy or leaf cover of each of the following vegetation classes within the sample plot.

  *% Tree:* Total canopy or leaf cover off all live tree species.

  *% Shrub:* The total canopy or leaf cover of all live woody shrubs.

  *% Herbaceous:* The total cover of all herbaceous (non-woody) species

(4) **Site Location and Plot Description:** Record a concise, but careful description that makes locating and/or revisiting the sample plot possible; give landmarks and directions. It is also helpful to briefly describe the topography and other environmental features of the site. Be sure to include any known history of the site or observed disturbance including fire, drought, flood or pest outbreak.
Plant Description

The collection of vegetation data continues with making a list of the most common plants within the sample plot. To do this, you should meander through the plot and record the following data for each plant species.

Try to identify the plant species using the “Plants of the San Dieguito River Valley” brochure. If you are unsure of the plant name, the data you collect will help you research and identify the species in the classroom.

(5) **Form:** Record if the plant species observed is a tree, shrub or herbaceous plant. A shrub is a small to medium-sized woody plant. It is distinguished from a tree by its multiple stems and shorter height. Herbaceous plants are smaller and lack a woody stem.

(6) **Ave. Height:** Estimate the average height of all individual plants for each species.

(7) **Leaf Color:** Indicate the general color of the leaves of each plant species (e.g., dark green, bluish-gray).

(8) **Leaf Shape:** Using the General Leaf Shape diagram shown on the worksheet, identify and record the leaf shape of each plant species (e.g., oval, pinnate, etc.).

(9) **% Cover:** Using a Cover Estimate Diagram, estimate the percent canopy or leaf cover for all individual plants of the same species within the sample plot.

(10) **Notes:** Indicate the plant species name (if known). If not, record any observations about each plant species that you think will help you identify the plant later on. Be sure to note items such as flower type (single flower, bunches of flowers, etc.), flower color, growth habit (erect, spreading, etc.), and feel of the leaves (sticky, velvety, etc.).
### VEGETATION COMMUNITIES DATA SHEET

Date: _______________  Latitude: _______________  Longitude: _______________

Name(s) of Volunteers: ____________________________________________________

<table>
<thead>
<tr>
<th>HABITAT &amp; VEGETATION DESCRIPTION</th>
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<tbody>
<tr>
<td>Community Type (Wetland or Upland): ________________________________</td>
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<table>
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<tr>
<th>% Surface Cover</th>
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<tr>
<td>Stone (25-60 cm): _____ Cobble (7.5-25 cm): _____ Gravel (2mm-7.5 cm): _____ Fines (dirt, sand &amp; mud): _____</td>
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<td><em>Note – all estimates for surface cover should add up to 100%</em></td>
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</table>

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<tr>
<th>% Plant Cover:</th>
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<tr>
<td>Tree: ___________ Shrub: ___________ Herbaceous: ___________</td>
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</tbody>
</table>

**Site Location and Plot Description** – Describe where the plot is located and main plant and environmental features. Include observations of site damage such as fire scars, insect/disease damage, human disturbance, etc.

### PLANT DESCRIPTION

<table>
<thead>
<tr>
<th>Form (Tree/Shrub/Herb)</th>
<th>Ave. Height</th>
<th>Leaf Color</th>
<th>Leaf Shape</th>
<th>% Cover</th>
<th>Species Name and/or Notes</th>
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</table>
VEGETATION COMMUNITIES ANALYSIS WORKSHEET

What are the most common plant species in the sample plot?

Based on your plant species data, what vegetation communities are present on the project site?

Common Leaf Shapes

- linear
- lanceolate
- oblanceolate
- oblong
- oval or elliptical
- ovate
- obovate
- cordate or heart-shaped
- sagitate
- hastate
- lobed
- pinnate
- divided or dissected
3. MAMMALS

SUMMARY

Students will learn about local mammal species native to the San Dieguito Watershed and how to recognize the clues and signs they leave behind. They will explore the concept of “wildlife corridors” and collect data to determine which species are found on the project site and how they are moving through the surrounding habitat.

CEQA Checklist: Specifically, this activity is designed to help address the following CEQA Environmental Checklist questions for Biological Resources (Appendix D):

Would the project:
   a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?
   
   d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

OBJECTIVES

Students will be able to:
   • Describe how habitat loss and fragmentation impact wildlife species.
   • Describe what a wildlife corridor is and how it functions.
   • Identify two ways researchers survey for wildlife (tracking surveys & camera traps).
   • Perform a wildlife track and sign survey and interpret data and results.

KEY TERMS

• Biodiversity
• Endangered species
• Fragmentation
• Habitat
• Invasive species
• Migration

• Organism
• Protocol
• Special status species
• Threatened species
• Transect
• Wildlife corridor
PROCEDURES

Pre-visit

- Review background information with students.
- Have students research and develop a list of mammals they would expect to find on the project site and determine if any are considered “special status species”.
- Have students review the County of San Diego Guidelines for Determining Significance for Special Status Species, and Wildlife Movement and Nursery Sites: http://www.sandiegocounty.gov/content/dam/sdc/pds/ProjectPlanning/docs/Biological_Guidelines.pdf
- Have students discuss potential impacts to wildlife and animal movement they might expect from building a water park and hotel.

In the Field

- Students will perform the Mammals Field Study and complete the Wildlife Tracking Survey Data Sheet.

Post-visit

- Have students collectively map the survey and camera trap locations on Google Earth.
- Optional: Have students review camera trap photos from the project site and complete the Wildlife Camera Data Sheet.
- Have students analyze their field survey data and compare it to Figure 2.2. “Biological Resource Areas and Linkages” of the Final San Diego MSCP Plan: http://www.sandiegocounty.gov/content/dam/sdc/pds/mscp/docs/SCMSCP/FinalMSCP_ProgramPlan.pdf
- Have students use evidence from their research and field studies to complete the corresponding CEQA Environmental Checklist questions and Determination of Significance (Appendix D).

BACKGROUND INFORMATION

Organisms depend on their specific habitat for survival – for food, water, shelter, and breeding sites. Habitat requirements vary greatly between species and smaller animals, like mice or squirrels, need less area to survive, while larger species, such as mountain lions and mule deer, can have home ranges of more than 50 square miles.

As the human population grows, more and more natural areas are being impacted by human activities and development. One of the greatest impacts of human activity on wildlife is loss of
habitat and habitat **fragmentation**. When large amounts of habitat are lost, this reduces wildlife populations and important resources that are available, threatening the survival of the species that live there. Sometimes habitats are not lost completely, but instead become fragmented.

Fragmented habitats consist of habitats that were once contiguous, but are now broken into several smaller pieces and are no longer connected. Fragmentation can cause problems because it restricts wildlife movement and can separate individuals within a population, as well as separate them from important resources. Within these fragmented areas, species may be isolated into small inbreeding populations. Inbreeding leads to overall lower genetic diversity in animal populations, which can ultimately weaken a population’s resilience against environmental change and other stressors.

**What is a wildlife corridor?**

A **wildlife corridor** or habitat linkage is an area of habitat joining two or more larger areas of similar wildlife habitat that are separated by human activities/disturbance or structures, such as roads and development. Animals use wildlife corridors to move across the landscape to access different areas and resources needed for their long-term survival. This movement is critical to species survival because it allows for important animal behaviors, such as foraging, **migration**, juvenile dispersal, genetic flow and colonization. Without these ecological processes, the probability of species extirpation and eventually extinction is significantly greater.

Wildlife corridors may be natural or artificial. Many animals use large-scale natural corridors, such as strips of land along the tops of mountain ridges or through riparian areas along rivers and streams, to move throughout the landscape. Artificial corridors can provide connectivity on a smaller scale, such as land bridges and wildlife tunnels or undercrossings, which provide a safe way for animals to cross roads.

**How can you determine what wildlife species occur in an area?**

In order to determine potential adverse impacts from human activity and make appropriate land use decisions, we must first understand how species use our local habitats and move through the landscape in a given area. Two ways that scientists do this is by conducting track and sign surveys and camera trapping.

**Wildlife Track & Sign Surveys**

Animals are all around us, even though we may not see them everyday. Learning how to recognize the tracks and signs they leave behind can provide researchers with useful
information. Tracks and signs include any kind of mark or disturbance left by the passing and activity of an animal on a landscape.

While tracks are usually the easiest to recognize, other clues of an animal’s presence include, but are not limited to:

- Game trails
- Burrows/Tunnels
- Temporary resting areas called beds or lays
- Visible bite marks on vegetation (also called “browse”)
- Scat (animal feces)

In many parts of the world, researchers use wildlife track and sign surveys to conduct large-scale biodiversity monitoring, habitat and land use impact assessments, invasive species management, and monitoring of endangered populations. Locally, citizen scientists from the San Diego Tracking Team conduct regular wildlife track and sign surveys to evaluate the health of key species and the connectivity of open space areas in the County including the River Park.

The advantage of using track and sign surveys is that they are simple, practical and inexpensive. With minimal equipment, time and effort, data from these surveys can inform us about:

- Species presence/apparent absence
- Changes in wildlife populations over time
- How animals use different habitats
- Which areas are critical areas and which areas they use as corridors

*Note: Not finding a track or sign from a particular species could mean: 1) the species isn’t there; 2) the species is there, but not in the survey area around the time of the survey; or 3) the species was in the survey area, but not detected.*

**Camera Traps**

A camera trap is a remotely activated camera (also called wildlife or trail camera) that is equipped with a motion sensor, infrared sensor, or light beam as a trigger. Camera trapping is a method for capturing photographs of wild animals when researchers are not present. Camera traps can be easily strapped to stationary objects (like posts or trees) in remote areas and record video or photos 24/7 allowing researchers to collect photographic evidence of elusive and rarely seen species.
Camera traps have several benefits including minimal expense, relative ease of use, and very little disturbance to wildlife. Globally, researchers are now using camera traps to document wildlife presence, abundance and population changes. The San Dieguito River Valley Conservancy is currently using camera traps as part of the San Dieguito Citizen Science Monitoring Program to collect baseline inventory data on wildlife occurring in the River Park.

Why is it necessary to know what wildlife species occur in an area?

The California Endangered Species Act (CESA), and the federal Endangered Species Act (ESA) were established to protect animal and plant species that are biologically determined to be threatened or endangered species. These special status species and their habitats are provided special protections and any project that threatens one of these species must undergo an intensive review.

The CESA & ESA prohibit actions that may pose direct or indirect impacts to special status species including those that may “harm” or “harass” species such as:

- Loss of foraging or breeding habitat
- Increased human access
- Increased predation or competition from domestic cats & dogs
- Increased noise and/or nighttime lighting

San Diego County has more threatened and endangered species than any other county in the continental U.S. According to the San Dieguito Watershed Management Plan (City of San Diego 2006), a total of 77 sensitive wildlife species have been observed in the San Dieguito Watershed, 15 of which are listed as endangered and/or threatened by federal and state agencies.

References & Suggested Readings


Haddad et al. (2015). Habitat Fragmentation and its lasting impact on Earth’s ecosystem: http://advances.sciencemag.org/content/advances/1/2/e1500052.full.pdf


San Diego Tracking Team website: www.sdtt.org
FIELD STUDY – MAMMALS

TIME & MATERIALS:
This activity should take about 60 minutes to complete and will require the following materials:

- Animal track field guide
- Mammal track replicas
- Measuring tape
- Rulers
- GPS units
- Camera trap
- Field study instructions & data sheets
- Clip boards
- Pens/Pencils

The methods set forth in this field study were adapted from protocol developed by the San Diego Tracking Team and approved by the U.S. Fish and Wildlife Service, California Department of Fish & Wildlife, and the City and County of San Diego.

The purposes of this study are to: 1) determine the presence or apparent absence of animals on the project site, and 2) determine the use of different habitats by animals.

1. Designate the Survey Transect

Procedures:

(1) Choose a start point for your survey transect. Survey transects must follow existing trails. Look for areas that have favorable tracking conditions, such as loose soil and open areas free of vegetation. Try to avoid areas that are highly compacted or heavily used.

(2) Have one person from your team fill in the Date, Start Time, and Name(s) of all team members at the top of the Wildlife Tracking Survey Data Sheet.

(3) Using the GPS unit, locate and record the latitude/longitude coordinates at the top of the Wildlife Tracking Survey Data Sheet.

(4) Record a brief description of the temperature and weather in the General Comments section on the backside of the data sheet.

2. Make Observations

Team members should be at least 95% confident that they have correctly identified a particular track or sign before recording the observation on the data sheet. All conclusions must be defensible and consistent with the field guides, and all team members must be in agreement.
**Tracks:** Document a track only when it is clearly identifiable beyond a reasonable doubt. If a track is distorted or questionable, you can confirm it by trailing or backtracking several meters to look for clear prints. When a series of tracks are encountered (e.g., a line of deer tracks down the trail), it should be counted as one individual animal.

**Scat:** Scat must be positively identified as that of a particular species. A positive identification should be based on shape, size and contents.

**Other sign:** All other documented sign must be clearly caused by an animal.

**Procedures:**
1. As a team, spread out across the width of the transect/designated trail. All team members should remain on the trail at all times to avoid disturbing the adjacent habitat.
2. Slowly walk the trail looking carefully for animal tracks, scat and/or signs including:
   - Game trails
   - Burrows
   - Beds/Lays
   - Browse

   When a track or sign is observed, the team should consult their field guides and attempt to identify the species that created it. All team members must be in agreement and 95% confident of their identification before recording the observation on the data sheet.

**3. Data Collection**

**Procedures:**
1. **Species:** For each track/sign observed, place a check mark in the column next to the species that created it. In the same column, indicate what evidence was found (tracks or scat). Separate columns should be used for each observation.
2. **Presence of:** Check the box next to each species (rabbit, squirrel or small rodent) if evidence of their presence is found along the transect. Presence only needs to be recorded once for the entire transect.
3. **Metadata:** The metadata section of the data sheet should only be filled out once to reflect the transect as a whole. Check the appropriate box to indicate if the transect is being used by more than wildlife.
4. **Comments:** Feel free to record any comments or observations you would like. You might like to note specific details about one of the sightings, provide measurements, or even include a drawing. You may also use this section to record other species that you observed that are not included on the data sheet.
### WILDLIFE TRACKING SURVEY DATA SHEET

Date: _______________  Start Time: _______________  End Time: _______________

Transect Start Point  
Latitude: _______________  Longitude: _______________

Transect End Point  
Latitude: _______________  Longitude: _______________

Name(s) of Volunteers: ___________________________________________________

<table>
<thead>
<tr>
<th>OBSERVATIONS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>Comment?</td>
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### SPECIES

(Use a checkmark “✓” to record your observations below)

- Bobcat
- Coyote
- Gray Fox
- Mule Deer
- Opossum
- Raccoon
- Skunk
- Mountain Lion
- Roadrunner
- Unknown Bird
- Snake

### EVIDENCE

- Tracks
- Scat

### PRESENCE OF

- Cottontail Rabbit
- Ground Squirrels
- Small Rodents

### METADATA

- Use by Dogs
- Use by Hikers
- Use by Horses
- Use by Bikers
- Use by Motor Vehicles
GENERAL COMMENTS (e.g., temperature, weather, unusual activity, etc.):

OBSERVATION SPECIFIC COMMENTS (include observation #):
POST-VISIT ACTIVITY – CAMERA TRAP PHOTO REVIEW

TIME & MATERIALS:
This activity will require the following materials:

- Computer with email access
- Camera trap photos
- Activity instructions & data sheets
- Pens/Pencils

The time required to review the photos is dependent on the number of photos captured on the camera trap.

INSTRUCTIONS: This in-class activity is designed to supplement the transect survey data collected during the mammal field study.

Step 1. Camera trap photos are shared via a Google Photos link, which is sent to your email address. Open the email and click on the provided link to access the photos. You may use Google Photos, iPhoto, Picasa, or any other photo program you prefer to sort and view photos.

Step 2. Fill out the information at the top of the data sheet (camera number, site name, latitude & longitude, photo dates, and names of people reviewing the photos).

Step 3. Review each photo for presence of wildlife. Be sure to look very carefully – sometimes animals are very hard to see or the photo may only show a small portion of the animal, such as the tip of a tail.

Step 4. When you find a photo with an animal in it, fill in the table on the data sheet.

- **Species**: In the dropdown box, select the name of each species (e.g., coyote, bobcat, deer, etc.) shown in the photo. If you are unable to identify an animal, select “unknown”. For photos of humans, please indicate the activity they are engaged in (e.g., “on bike”, “walking dog”). If more than one species occurs in the photo, list the other species in the “Notes” column.

- **Date**: Enter the date found in the bottom right hand corner of each photo.

- **Start Time/End Time**: The time can be found in the bottom right hand corner of each photo. Multiple photos that clearly show the same individuals within a few minutes of each other are considered discrete “events” and all data provided should be for the entire event. Please consider photos more than 15 minutes apart as separate events.
Please indicate the start time of the first photo in the “event” and the end time of the last photo.

• **# of Individuals**: In the dropdown box, select the number of individual animals shown in each photo and/or “event”. Please note that additional animals may not be shown in all photos, but please include them if they appear in at least one of the photos in the “event”.

• **Start Photo #/End Photo #**: Write the file name for the photo (e.g., EK000055.jpg can be shortened to “55”).
CAMERA TRAP PHOTO REVIEW DATA SHEET

Camera Number:_____________________	Latitude:_____________________
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4. BIRDS

SUMMARY

Students will learn about local birds native to the River Park and how to identify four of our native threatened and endangered species. They will explore why wetlands support such a wide range of birds and collect data to determine which species are found on the project site and how they are moving through the surrounding habitat.

CEQA Checklist: Specifically, this activity is designed to help address the following CEQA Environmental Checklist questions for Biological Resources (Appendix D):

Would the project:
   b) *Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?*

   d) *Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?*

OBJECTIVES

Students will be able to:

• Describe the importance of wetland habitats to birds.
• Identify some of our local threatened and endangered bird species.
• Perform a bird survey, and interpret data and results.
• Develop an appreciation for the diversity of bird species that live in our coastal wetlands and other native habitats.

KEY TERMS

• Biodiversity
• Degradation
• Ecosystem
• Endangered species
• Indicator species

• Migration
• Organism
• Pacific Flyway
• Threatened species
PROCEDURES

Pre-visit

• Review background information with students.
• Have students research and develop a list of birds they would expect to find on the project site and determine if any are considered “special status species”.
• Have students review the County of San Diego Guidelines for Determining Significance for Special Status Species, and Wildlife Movement and Nursery Sites: 
  http://www.sandiegocounty.gov/content/dam/sdc/pds/ProjectPlanning/docs/Biological_Guidelines.pdf
• Have students discuss potential impacts to wildlife and animal movement they might expect from building a water park and hotel.

In the field

• Students will perform the Birds Field Study and complete the Bird Survey Data Sheet

Post-visit

• Have students use their bird description data to research and identify bird species observed during the survey.
• Have students use evidence from their research and field studies to complete the corresponding CEQA Environmental Checklist questions and Determination of Significance (Appendix D).

BACKGROUND INFORMATION

Why are wetlands important to birds?

Wetlands are widely recognized as one of the most productive ecosystems on earth and support a wide range of biodiversity. With their abundance of food, vegetative cover (shelter), and water, they provide breeding, resting and wintering habitats for thousands of resident and migratory birds. Scientists estimate that 80% percent of all breeding bird populations in the U.S. and more than 50% of migratory bird species rely on wetland habitats at some point in their lifecycle.

The San Dieguito Lagoon is located along the Pacific Flyway, a major route for migrating birds. It supports birds that use the area as a stopover during their annual migration as well as year-round populations of resident birds. Monthly bird surveys conducted at the San Dieguito
Lagoon have recorded over 230 different bird species using the lagoon at various times throughout the year.

The lagoon and surrounding area supports a number of threatened and endangered species including: California least tern (*Sterna antillarum browni*), Ridgway’s rail (*Rallus obsoletus*), coastal California gnatcatcher (*Polioptila californica californica*) and Belding’s savannah sparrow (*Passerculus sandwichensis beldingi*).

*How does wetland loss and degradation affect birds?*

Habitat loss and degradation is of particular concern for bird populations. Changes to wetland habitats can negatively affect bird abundance and habitat use, reproduction rates, and survival. For most wetland-dependent birds, habitat loss in breeding areas results in direct losses to bird populations. As the habitat is degraded or destroyed, some birds may move to less suitable habitats where they tend to have lower reproduction rates and higher mortality rates.
Breeding success for some species can potentially be lower in degraded and fragmented habitats. Loss of habitat and decreased water levels can make wetland areas more accessible to predators that prey on birds and their nests. Human activities, such as construction and traffic, can increase noise levels and disrupt nesting birds. In addition, an influx in non-native, invasive species in a wetland can negatively impact the native plant and invertebrate communities that wetland birds use for food.

**What can birds tell us about the health of an ecosystem?**

The presence and behavior of birds can tell us a lot about biodiversity and changing ecosystems. Birds are useful indicator species because they are found almost everywhere, are relatively easy to see and identify, and because we already know a lot about their biology and life history.

One of the most useful things that birds can indicate is overall habitat quality. The presence or absence of very specialized species can indicate how well an ecosystem is functioning. For example, the threatened coastal California gnatcatcher is closely tied with coastal sage scrub habitat for reproduction. Scientists have found that the density of gnatcatchers is highest in high-quality habitat and decreases as habitat quality decreases.

Birds are also good indicators of environmental pollutants. Because they are high in the food chain, they are vulnerable to accumulating chemicals. One of the best-known examples of this is the decline of bird species due to the use of DDT, a pesticide that is now banned in many countries. Birds were the first group of animals whose populations began to noticeably decline as a result of DDT. Accumulation of DDT in birds often resulted in females laying eggs with very thin shells that were crushed during incubation, greatly decreasing breeding success.

In certain situations and at particular scales, trends in bird populations correlate with those of other species making them a valuable biodiversity indicator. In Europe, scientists are using bird population trend data to inform and assist land managers and conservation policy makers. Scientists have been monitoring birds at the San Dieguito Lagoon as part of the San Dieguito Wetlands Restoration Project. They have documented a nearly three-fold increase in bird species since the restoration project started in 2006 indicating the success of the project.

**REFERENCES & SUGGESTED READINGS**

FIELD STUDY – BIRDS

TIME & MATERIALS:
This activity should take about 45 to 60 minutes to complete and will require the following materials:

- Binoculars
- Birds of San Dieguito Lagoon brochure
- Clip boards
- Field study instructions & data sheets
- Pens/Pencils

The objective of this survey is to record the overall number and diversity of the bird community on the project site. You do not need to be a bird expert to undertake this survey. You will be recording the total number of different species on the project site and the number of individuals of each species. You are encouraged to record as much detail about the birds you see so that you can try to identify them later.

1. Make Observations

Procedures:
(1) The survey route will follow the designated trail. All team members should remain on the trail at all times to avoid disturbing the adjacent habitat.
(2) Have one person from your team fill out the information at the top of the data sheet (DATE, SURVEY LOCATION & OBSERVERS).
   Record the START TIME you begin walking along the survey route and the general WEATHER conditions, including wind intensity (no wind, slight, gusty or strong wind), temperature, and estimated percent cloud cover (e.g., 50% cloud cover).
(3) As a team, begin walking slowly and quietly along the survey route. Look and listen for signs of birds including movement, bird calls, feathers, nests or droppings.
(4) When you observe birds in the vicinity, stop and stand silently for 1-2 minutes to allow any nearby birds to acclimate to your presence. Observe and record data for 5 minutes before moving on to the next location.

2. Data Collection

Procedures:
(1) Bird Description: For each bird species observed, indicate its size (small, medium, large), color of its head, wings and belly (underside). This data will help you identify the species
so be sure to include any details that you think are important (e.g., note any visible adaptations such as shape of beak, color of legs, toe arrangement, etc.)

(2) **# of Individuals:** Record the total number of individuals observed for each species.

(3) **Notes:** Use this section to record any other details you find interesting, such as where the bird was found, what it was doing (e.g., foraging) or specific details about its appearance.

(4) **Species Name:** If known, write in the name of the species of the bird observed. You may use the bird brochure or field guide to try and identify the species, or write down sufficient details about the bird to help you identify it later in class.
BIRD SURVEY DATA SHEET

DATE: ___________________________  SURVEY LOCATION:____________________________________________________________________________________________________
WEATHER:____________________________________________________________________________________________________
OBSERVER(S) NAME:__________________________________________________________________________________________________________
START TIME:____________________  END TIME:____________________

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Coastal Wetlands Field Ecology Project
5. WATER QUALITY

SUMMARY

Students will learn about different factors that affect water quality and the health of our watershed. Working in small groups, students will collect and test water samples from the project site and rank the water quality on site. They will compare this to existing data collected from San Diego Coastkeeper and analyze potential impacts caused by development.

CEQA Checklist: Specifically, this activity is designed to help address the following CEQA Environmental Checklist questions for Hydrology and Water Quality (Appendix D):

Would the project:
  e) Violate any water quality standards or waste discharge requirements?

  f) Otherwise substantially degrade water quality?

OBJECTIVES

Students will be able to:
  • Identify different factors that can affect water quality.
  • Describe the difference between point source and non-point source pollution.
  • Perform various water quality tests, and interpret data and results of tests.

KEY TERMS

• Dissolved oxygen
• Eutrophication
• Groundwater
• Non-point source pollution
• pH
• Point source pollution
• Reservoir
• Urban runoff
• Watershed

PROCEDURES

Pre-visit

• Review background information with students.
• Have students visit the San Diego Coastkeeper website and review the water quality ratings for the San Dieguito Watershed:
o San Diego Water Quality:  
http://www.sdcoastkeeper.org/learn/swimmable/san-diego-water-quality

o Water Quality 2015 – San Dieguito Watershed:  

• Have students research the beneficial uses and water quality objectives for the San Dieguito Lagoon in the Water Quality Control Plan for the San Diego Region (Tables 2-3 & 3-2): http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/

• Have students review the County of San Diego Guidelines for Determining Significance for Surface Water Quality:  
http://www.sandiegocounty.gov/content/dam/sdc/pds/docs/water_quality_guidelines.pdf

• Have students discuss potential impacts to water quality and sources of pollution they might expect from building a water park and hotel.

In the field
• Students will perform the Water Quality Field Study and complete the Water Quality Data Sheet.

Post-visit
• Have students analyze their field survey data and compare it to the data obtained from the San Diego Coastkeeper website and the Water Quality Control Plan for the San Diego Basin. Is the data collected in the field similar to what you expected to find based on the Coastkeeper data? Does the data exceed any of the water quality objectives for the San Dieguito Lagoon?

• Have students use evidence from their research and field studies to complete the corresponding CEQA Environmental Checklist questions and Determination of Significance (Appendix D).

BACKGROUND INFORMATION

Water is necessary for the survival and well being of people, plants and wildlife. We rely on our water resources to: ensure a clean and available drinking water supply; support agriculture, commercial, industrial, recreational, residential, and military uses; and support wildlife and habitat.

Groundwater and surface waters flow across the landscape from headwaters in the mountains and eventually drain to the ocean forming a watershed. A watershed is defined as an area of
land where all the water under it (groundwater), or that drains off of it (rain or surface water) collects into the same place.

The San Dieguito Watershed is one of 11 watersheds in San Diego County. It begins at the headwaters of Santa Ysabel Creek on Volcan Mountain, which flows into the San Dieguito River and ends where the river drains into the ocean in Del Mar. The County’s watersheds are characterized by it’s rivers, streams, lakes, reservoirs, and lagoons. In the San Dieguito Watershed, the San Dieguito River connects reservoirs at Lake Sutherland and Lake Hodges and discharges to the San Dieguito Lagoon.

Why is water quality important and what factors affect water quality?

Almost everything we do affects water quality. When the physical, chemical and biological components of water are altered, it causes the watershed to become unhealthy. There are a number of different measurable characteristics of water that can give us clues to a watershed’s health including ambient measurements (temperature, pH, and dissolved oxygen) and pollutants (nitrate and phosphate).

Temperature

Temperature is very important to water quality. Most aquatic plants and animals require a specific range of temperatures to survive and reproduce. Construction, agriculture, urban runoff, and changes to hydrology and habitat can increase water temperatures leading to impacts such as reducing the growth and health of fish and their resistance to disease, reducing the amount of dissolved oxygen in the water, and causing an overgrowth of plants and algae.

pH

The pH of aquatic systems affects the diversity and productivity of aquatic life. It is a measurement of how acidic or alkaline (basic) water is. The pH scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. The pH of natural water is usually between 6.5 and 8.5. Most aquatic plants and animals are adapted to specific ranges of pH and may cease to function or reproduce when the pH is outside their range of tolerance. Fertilizers and other man-made substances found in urban runoff can have varying effects on pH, and usually tend to make water more acidic.

1 All of the lakes in San Diego County are actually reservoirs created by damming rivers.
Dissolved Oxygen

Oxygen is as important to life in water as it is to life on land. Most aquatic plants and animals require oxygen that is dissolved in water for survival. The amount of available dissolved oxygen in a water body determines how well it can support life and is an important measure of its health and condition. Water with consistently high dissolved oxygen levels help support a healthy and diverse aquatic environment.

Dissolved oxygen levels are influenced by both natural and human-induced factors. Temperature and pollution can limit the amount of oxygen that can be dissolved in water. Cold water can hold more dissolved oxygen than warm water. Polluted runoff containing fertilizers or sewage can cause eutrophication, a process where excessive nutrients (see discussion of nitrates and phosphate below) cause excessive plant growth and decay, which depletes the oxygen supply ultimately killing animal life from lack of oxygen.

Nitrates

Nitrates are a form of nitrogen that is needed by all aquatic plants and animals to build protein. Nitrates occur naturally in aquatic systems and generally come from the decomposition of dead plants and excretions of animals. However, at very high levels, nitrates can: increase plant growth and decay; promote bacterial decomposition, which decreases the amount of available oxygen in water; and can be toxic to humans and animals. Typical sources of excessive nitrates include sewage and fertilizer runoff from residential, agricultural or recreational areas, such as golf courses.

Phosphate

Phosphate is a nutrient needed for plant and animal growth and is also a fundamental element in metabolic reactions. Phosphate can be naturally occurring, such as through the erosion of rocks, but also comes from human sources including human and animal waste, and fertilizers and detergents found in agricultural and urban runoff. High levels of phosphate can lead to overgrowth of plants, increased bacterial activity, and decreased oxygen levels.

Why is it important to test water quality?

Our nation’s waters are monitored by federal, state and local agencies, universities, dischargers, and volunteers. Water quality data are used to: characterize waters, identify trends over time, identify emerging problems, determine whether pollution control programs are working, and help direct pollution control efforts and response to emergencies such as floods and spills.
Since 2000, San Diego Coastkeeper has monitored our local waterbodies in San Diego. Trained volunteers sample and test water collected from 9 of the 11 watersheds in the County. This data is used to identify polluted waters and reduce sources of pollution. In San Diego, the vast majority of San Diego’s water quality problems are caused by non-point source pollution. Non-point sources come from many areas at once, like urban runoff, as opposed to a factory that discharges pollutants from a single pipe (point source pollution).

**What laws and regulations protect our nation’s waters?**

The Federal Water Pollution Control Act (more commonly known as the Clean Water Act) is the primary federal law in the U.S. governing water pollution. Passed in 1972, the Clean Water Act established a national commitment to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters”. It sets up a system of water quality standards, discharge limits and permits including urban and stormwater runoff regulations. At the state level, the Porter-Cologne Water Quality Control Act (1969) establishes nine Regional Water Quality Control Boards that have the “primary responsibility for the coordination and control of water quality”.

These and other laws oversee and regulate the primary causes of point source pollution. Typical adverse effects on water quality occur when discharges associated with a particular project create pollution or contamination. Typical pollutants that can occur in runoff from residential and commercial activities include, but are not limited to: sediment, nutrients, trash and litter, oil and grease, pathogens (bacteria and viruses), pesticides and herbicides, fertilizers and animal waste.

The most common contributors of point source pollution from development include:

- Grading or clearing of land so that soil material is discharged into a water body, drainage channel or stormwater drain.
- Placing development in, or discharging material into, a river, stream, lake, wetland or water of the U.S., or into a buffer area for one of these water bodies.
- Increasing impervious surface areas and, therefore, runoff.

The San Diego Regional Water Quality Control Board has established a list of beneficial uses for water bodies in the San Diego Region and establishes water quality objectives to protect those beneficial uses. Violations in water quality standards occur when projects exceed these water quality objectives or degrade one of the beneficial uses identified for a water body.
REFERENCES & SUGGESTED READINGS


San Diego Coastkeeper website: www.sdcoastkeeper.org


FIELD STUDY – WATER QUALITY

TIME & MATERIALS:
This activity should take about 45 to 60 minutes to complete and will require the following materials:

- LaMotte Water Monitoring Kit
- Water sample jar
- Liquid waste container
- Gloves
- Field study instructions & data sheets
- Clip boards
- Pens/Pencils

The team will break into small groups of 2-4 students. Each group will focus on one of the four procedures below and share their results with the rest of the team. All team members must wear protective gloves at all times during the testing. When finished with the tests, students should dump all test liquids into the liquid waste container and dispose of gloves.

1. Measuring Dissolved Oxygen (DO)

Procedures:
(1) Place thermometer 4 inches below the water surface for one minute. Remove the thermometer from the water, and record the result on the data sheet.
(2) Submerge a small tube into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top.
(3) Drop two (2) Dissolved Oxygen TesTabs into the tube. Water will overflow when tablets are added.
(4) Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no air bubbles are present in the sample.
(5) Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.
(6) Wait 5 more minutes for the color to develop.
(7) Compare the color of the sample to the Dissolved Oxygen color chart. Record the result on the data sheet.
(8) Locate the temperature of the water sample on the % Saturation chart. Locate the Dissolved Oxygen result of the water sample at the top of the chart. The % Saturation of the water sample is where the temperature row and the Dissolved Oxygen column intersect. Record this number of the data sheet.
For example: if the water sample temperature is 16°C and the Dissolved Oxygen result is 4 ppm, then the % Saturation is 41.

2. Measuring Nitrate

Procedures:
(1) Fill a large test tube to the 5 mL line with the water sample.
(2) Add one (1) Nitrate Wide Range CTA TesTab into the tube. Immediately slide the test tube into the silver Protective Sleeve.
(3) Cap and mix by inverting for two minutes to disintegrate the tablet. Bits of material may remain in the sample.
(4) Wait 5 minutes for the red color to develop. Remove the tube from the Protective Sleeve.
(5) Compare the color of the sample to the Nitrate color chart. Record the result as ppm.

3. Measuring Phosphate

Procedures:
(1) Fill a large test tube to the 10mL line with the water sample.
(2) Add one (1) Phosphorus TesTab into the tube.
(3) Cap the tube and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
(4) Wait 5 minutes for the blue color to develop.
(5) Compare the color of the sample to the Phosphate color chart. Record the result as ppm. Note: if the sample does not develop a blue color (sample is colorless), record the result as 0 ppm.

4. Measuring pH

Procedures:
(1) Fill a large test tube to the 10mL line with the water sample.
(2) Add one (1) pH Wide Range TesTab into the tube.
(3) Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
(4) Compare the color of the sample to the pH color chart. Record the result on the data sheet.
WATER QUALITY DATA SHEET

Date: ________________________________

Location: ________________________________________________________________

Name(s) of Surveyors: _______________________________________________________

<table>
<thead>
<tr>
<th></th>
<th>Sample #1</th>
<th>Sample #2</th>
<th>Sample #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen (ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Saturation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate (ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate (ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Rank (use worksheet below)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WATER QUALITY ANALYSIS & RANKING WORKSHEET

% Saturation Chart

<table>
<thead>
<tr>
<th>Temp °C</th>
<th>0 ppm</th>
<th>4 ppm</th>
<th>8 ppm</th>
</tr>
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<tbody>
<tr>
<td>6</td>
<td>0</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>34</td>
<td>68</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>35</td>
<td>71</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
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<td>74</td>
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<td>14</td>
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<td>39</td>
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<td>16</td>
<td>0</td>
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<td>28</td>
<td>0</td>
<td>51</td>
<td>102</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
<td>53</td>
<td>106</td>
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</table>

<table>
<thead>
<tr>
<th>Test Factor</th>
<th>Result</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved Oxygen Saturation</td>
<td>91-110%</td>
<td>4 (Excellent)</td>
</tr>
<tr>
<td></td>
<td>71-90%</td>
<td>3 (Good)</td>
</tr>
<tr>
<td></td>
<td>51-70%</td>
<td>2 (Fair)</td>
</tr>
<tr>
<td></td>
<td>&lt;50%</td>
<td>1 (Poor)</td>
</tr>
<tr>
<td>Nitrate</td>
<td>5 ppm</td>
<td>2 (Fair)</td>
</tr>
<tr>
<td></td>
<td>20 ppm</td>
<td>1 (Poor)</td>
</tr>
<tr>
<td></td>
<td>40 ppm</td>
<td>1 (Poor)</td>
</tr>
<tr>
<td>Phosphate</td>
<td>1 ppm</td>
<td>4 (Excellent)</td>
</tr>
<tr>
<td></td>
<td>2 ppm</td>
<td>3 (Good)</td>
</tr>
<tr>
<td></td>
<td>4 ppm</td>
<td>2 (Fair)</td>
</tr>
<tr>
<td>pH</td>
<td>4-5</td>
<td>1 (Poor)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3 (Good)</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>4 (Excellent)</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>3 (Good)</td>
</tr>
<tr>
<td></td>
<td>9-10</td>
<td>1 (Poor)</td>
</tr>
</tbody>
</table>
APPENDIX A. Glossary

Anaerobic
occurring in the absence of oxygen or not requiring oxygen to live.

Biodiversity
the number and variety of living organisms found in an area.

Brackish
a mixture of fresh water and salt water.

Degradation
the process in which the quality of something is destroyed or spoiled.

Dissolved oxygen (DO)
gaseous oxygen mixed in water that is available to aquatic organisms for respiration.

Disturbance
temporary change in environmental conditions that causes a pronounced change in an ecosystem.

Ecology
branch of biology that studies the relationship between living organisms and their environment.

Ecosystem
community and interactions of living and nonliving things in an area.

Ecosystem services
the direct and indirect contributions of ecosystems to human well-being.

Endangered species
any species in danger of extinction throughout all or a significant portion of its range.

Environment
all the living and nonliving things that surround and affect an organism.

Estuary
a semi-enclosed shallow body of water where a river meets salt water.
Eutrophication
the enrichment of a body of water with excessive nutrients, resulting in lowered oxygen levels.

Fragmentation
the process or state of breaking or being broken into small or separate parts

Groundwater
water held underground in the soil or in ports and crevices in rock.

Habitat
a specific type of environment inhabited by particular animal and/or plant species; a place where an animal or plant lives.

Hydric soil
a soil that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions.

Hydrology
the circulation and distribution of water.

Hydrophytic
growing wholly or partially in water; a plant adapted to grow in water.

Indicator species
an organism whose presence, absence or abundance reflects a specific environmental condition.

Invasive species
an introduced, non-native species that does or is likely to cause economic or environmental harm to the environment.

Loam
soil made up of roughly equal proportions of clay, silt, and sand

Migration
the periodic, long-distance movement of animals, usually from breeding grounds to overwintering locations.
Mineral
a naturally formed, inorganic substance occurring in soil, typically derived from rocks.

Mitigation
actions taken to reduce negative impacts on the environment and wildlife.

Mud flat
unvegetated wetland areas consisting of low muddy land that is covered at high tide and exposed at low tide.

Native species
species that have evolved over thousands of years in a particular region, and have adapted to the geography, hydrology and climate of that region.

Non-native species
species that have been introduced into an environment in which they did not evolve.

Non-point source pollution
pollution that enters water from dispersed and uncontrolled sources, such as rainfall or snowmelt, moving over and through the ground rather than from single, identifiable sources.

Organic
any substance containing carbon-based compounds, especially produced by or derived from living organisms.

Organism
a living thing, such as an animal, plant, alga, bacterium or fungus.

Pacific Flyway
the route followed by birds migrating along the west coast of North America.

Peat
Organic matter of partially decayed plant material found in damp environments.

pH
numeric value indicating the relative acidity or alkalinity of a substance on a scale of 0-14 with 7 being neutral and acidic substances less than 7 and alkaline (basic) substances greater than 7.
**Point source pollution**
a source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plan or a factory is a point source.

**Population**
a group of individuals belonging to the same species that live in the same region at the same time.

**Protocol**
detailed plan or specific methods for a scientific experiment.

**Reservoir**
a natural or artificial lake used for the storage and regulation of water.

**Riparian**
an ecosystem along the edges of a freshwater drainage system such as a river or stream.

**Salt marsh**
a coastal ecosystem in the upper coastal intertidal zone between land and open salt water or brackish water that is regularly flooded by the tides.

**Special status species**
a universal term used in the scientific community for species that are considered sufficiently rare that they require special consideration and/or protection and should be, or have been, listed as rare, threatened or endangered by the Federal and/or State governments.

**Species**
group of similar organisms that can reproduce with each other.

**Threatened species**
any species likely to become an endangered species in the future.

**Topography**
the physical appearance of the natural features of an area of land, especially the shape of its surface.
**Transect**
a straight or narrow section through a natural feature or across the earth’s surface along which observations are made or measurements taken.

**Urban runoff**
rain or wastewater from urban landscapes, such as city streets and residential and commercial properties, that carries various pollutants into storm drain systems and receiving waters.

**Vegetation community**
a collection or association of plant species within a designated geographical area, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types.

**Vernal pool**
temporary pools of water that provide habitat for distinctive plants and animals.

**Watershed**
an area of land that drains rain falling onto it or water running through it into a common body of water, such as a creek or stream, which flows into a larger body of water, such as a river, lake, or estuary, and eventually flows to the ocean.

**Wetland**
area where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season.

**Wildlife corridor**
an area of habitat connecting wildlife populations separated by human activities/disturbance or structures (such as roads, houses, etc.).
APPENDIX B. NGSS Standards

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

**HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Using Mathematics and Computational Thinking**  
  • Use mathematical and/or computational representations of phenomena or design solutions to support explanations. | **LS2.A: Interdependent Relationships in Ecosystems**  
  • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. | **Scale, Proportion, and Quantity**  
  • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. |

**HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

<table>
<thead>
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  • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. |
individuals) of species in any given ecosystem.

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

*A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods or time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original state.*

**HS-LS2-3.** Construct and revise an explanation based on evidence of the cycling of matter and flow of energy in aerobic and anaerobic conditions.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
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<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Constructing Explanations and Designing Solutions**
  *Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.* | **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**
  *Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.* | **Energy and Matter**
  *Energy drives the cycling of matter within and between systems* |

**HS-LS2-6.** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Engaging in Argument from Evidence**
  *Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.* | **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**
  *A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods or time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original state.* | **Stability and Change**
  *Much of science deals with constructing explanations of how things change and how they remain stable.* |
**HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Constructing Explanations and Designing Solutions**  
  • Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**  
  • Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. | **Stability and Change**  
  • Much of science deals with constructing explanations of how things change and how they remain stable. |

**HS-LS4 Biological Evolution: Unity and Diversity**

**HS-LS4-5.** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Engaging in Argument from Evidence**  
  • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. | **LS4.C Adaptation**  
  • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.  
  • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ evolution is lost. | **Cause and Effect**  
  • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |

**HS-LS4-6.** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

<table>
<thead>
<tr>
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<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **Using Mathematics and Computational Thinking** | **LS4.C Adaptation**  
  • Changes in the physical | **Cause and Effect**  
  • Empirical evidence is required to |
Create or revise a simulation of a phenomenon, designed device, process, or system. The environment, whether naturally occurring or human induced, has thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.

**LS4.D: Biodiversity and Humans**

*Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.*

**HS-ESS2 Earth’s Systems**

**HS-ESS2-5.** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning and Carrying Out Investigations</strong></td>
<td><strong>ESS2.C: The Roles of Water in Earth’s Surface Process</strong></td>
<td><strong>Structure and Function</strong></td>
</tr>
<tr>
<td><em>Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data.</em></td>
<td><em>The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water’s exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.</em></td>
<td><em>The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shapes and used, and the molecular structures of its various materials.</em></td>
</tr>
</tbody>
</table>
### HS-ESS3 Earth and Human Activity

**HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practice</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructing Explanations and Designing Solutions</strong>&lt;br&gt;• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td>
<td><strong>ESS3.A Natural Resources</strong>&lt;br&gt;• Resource availability has guided the development of human society.&lt;br&gt;<strong>ESS3.B Natural Hazards</strong>&lt;br&gt;• Natural hazards and other geological events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations</td>
<td><strong>Cause and Effect</strong>&lt;br&gt;• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
</tr>
</tbody>
</table>

**HS-ESS3-3.** Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practice</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Using Mathematics and Computational Thinking</strong>&lt;br&gt;• Create a computational model or simulation of a phenomenon, designed device, process, or system.</td>
<td><strong>ESS3.C Human Impacts on Earth Systems</strong>&lt;br&gt;• The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.</td>
<td><strong>Stability and Change</strong>&lt;br&gt;• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</td>
</tr>
</tbody>
</table>

**HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructing Explanations and Designing Solutions</strong>&lt;br&gt;• Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated evidence, prioritized criteria, and tradeoff considerations.</td>
<td><strong>ESS3.C Human Impacts on Earth Systems</strong>&lt;br&gt;• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.</td>
<td><strong>Stability and Change</strong>&lt;br&gt;• Feedback (negative or positive) can stabilize or destabilize a system.</td>
</tr>
</tbody>
</table>
**HS-ETS1 Engineering Design**

**HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practice</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking Questions and Defining Problems • Analyze complex real-world problems by specifying criteria and constraints for successful solutions.</td>
<td>ETS1.A Defining and Delimiting Engineering Problems • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. • Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.</td>
<td>Influence of Science, Engineering, and Technology on Society and the Natural World • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.</td>
</tr>
</tbody>
</table>

**HS-ETS1-3.** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural and environmental impacts.

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practice</th>
<th>Disciplinary Core Idea</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing Explanations and Designing Solutions • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.</td>
<td>ETS1.B Developing Possible Solutions • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.</td>
<td>Influence of Science, Engineering, and Technology on Society and the Natural World • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.</td>
</tr>
</tbody>
</table>
APPENDIX D. CEQA Environmental Checklist & Determination

CEQA Environmental Checklist

This checklist identifies biological and water quality factors that might be affected by the proposed project. The questions in this form are intended to encourage the thoughtful assessment of impacts and do not represent thresholds of significance.

<table>
<thead>
<tr>
<th>BIOLOGICAL RESOURCES: Would the project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?</td>
</tr>
<tr>
<td>b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?</td>
</tr>
<tr>
<td>c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?</td>
</tr>
<tr>
<td>d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HYDROLOGY AND WATER QUALITY: Would the project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>e) Violate any water quality standards or waste discharge requirements?</td>
</tr>
<tr>
<td>f) Otherwise substantially degrade water quality?</td>
</tr>
</tbody>
</table>
DETERMINATION:

On the basis of this initial evaluation:

- [ ] I find that the proposed project COULD NOT have a significant effect on the environment.

- [ ] I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the project has been modified to include mitigation measures as described below.

- [ ] I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required to further review the project.

Recommended mitigation measures to avoid significant impacts to biological resources and/or water quality:

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APPENDIX E. CNPS Cover Estimate Diagrams