BALLONA BASELINE MONITORING - PROTOCOLS ONLY (12-17-09)

1 Physical and Chemical Monitoring

1.1 Sediment and Water Quality

1.1.1 Water Quality

General water quality testing will be done quarterly in several locations throughout the tidal channels within Ballona. A handheld multi-probe YSI meter will be used to calculate dissolved oxygen, pH, temperature, salinity, specific conductance and turbidity. Water samples will be taken in order to test for additional constituents (Table 1). One additional sample will be taken after the first rain of the year. These samples will be processed at Loyola Marymount and through private contractors based on price and availability.

Table 1. Constituents of concern for water quality sampling.

CATEGORY	SPECIFIC PARAMETERS	FREQUENCY
General water quality	Dissolved oxygen, pH, temperature, salinity, specific conductance, and turbidity	Quarterly & permanent data sonde
Bacteria	Enterococci, fecal coliforms, total coliforms	Dry, wet, and post-wet seasons
Nutrients	Ammonia (as N), nitrite (as N), nitrate (as N), orthophosphate (as P), total Kjeldahl nitrogen, total phosphorous	TBD
Metals and toxins	Arsenic, cadmium, chromium, chloride, copper, hexavalent chromium, iron, lead, manganese, mercury, nickel, selenium, silver, zinc	Quarterly
Hydrocarbons	Oil, grease, TPH –recoverable, –extractable, –volatile	N/A
Organics and miscellaneous	PCBs, PAHs, VOCs, and pesticides	N/A
Phytoplankton	Chlorophyll *a*, HABs, diatoms, microalgae	Quarterly

In addition to the water quality samples, one permanent data logger (YSI 6600) will be permanently installed in the main tidal channel across from the tide gate to collect data throughout the year. Data collected will include depth, temperature, dissolved oxygen, pH, conductivity, salinity and total dissolved solids.

1.1.2 Sediment

Sediment quality samples will be collected at each water quality sampling location semi-annually in conjunction with the water sampling. Three samples will be collected and composited for analysis at each sampling location. Individual samples will be collected using a small sediment core that will collect the top 2-3cm of sediment. Samples will be analyzed for constituents of concern (e.g., metals, salinity, N and P, grain size, water content, bulk density, and organic content).

1.2 Hydrology and Topography

1.2.1 Channel Cross-Sections

Channels cross-sections will be surveyed within the tidal channels once annually at five permanent survey locations. A taut survey tape will be attached to station endpoint pins on the right and left banks. Using a level transit and stadia rod, measurements will be taken every 20cm and at every break in slope. Distance and height data will be recorded manually in the field book, with audible repetition of values to ensure quality control.

In addition to the annual surveys, seven permanent rebar stakes will be inserted horizontally into the sediment at targeted points along the bank edge and measured once annually to determine erosion or accretion levels within the main tidal channel.

1.2.2 Inundation

We will annually map areas of inundation within the salt marsh using GPS during a high spring tide. We will follow all the tidal creeks throughout Ballona to develop a comprehensive map. This information will indicate submerged and exposed acreages and water levels within Ballona.

We will also install several Hobo data loggers at transect points in close proximity to the tidal channels to determine inundation level and frequency.

2 Biological Monitoring

2.1 Plants

The general sampling design consists of identifying distinct marsh zones or habitat types (i.e., low marsh, mid-marsh, upper marsh, etc.) within the Ballona Wetlands and randomly locating transects within each zone. The habitat zones have been pre-defined based on preliminary GIS mapping of Ballona. The sampling methodology will be habitat dependent due to the high level of variability and diversity between habitats (Table 2). Transect locations were determined in advance using GIS to randomly allocate stratified sampling locations within each habitat. A minimum of five transects per habitat were allocated.

Plant surveys will occur semi-annually during the appropriate season for each habitat type (e.g., wetland in late summer, grassland/herbaceous in spring). Plant and root biomass will not be collected in order to minimize disturbance to the habitat.

2.1.1 Cover Surveys

For all salt marsh habitats and other habitats where the average vegetation height is less than 1 m, a quadrat methodology will be employed along the transects, and vegetation data collected within the

quadrats. Each habitat zone will contain a minimum of 5, 25m-transects and seven quadrats per transect. The beginning and end points of each transect will be mapped using GPS, and then permanently identified using thin PVC piping and a waterproof tag in order to easily return to the same sampling location on subsequent trips. Transects will be 25m in length and spaced a minimum of 10m apart to maintain independence.

A portable 0.5 m x 0.5 m (0.25 m^2) Plexiglas board supported by three independently adjustable legs will be positioned parallel to the substratum and leveled at each quadrat starting position along the transect. A laser pointer will be inserted successively into each of the 49 evenly distributed points in a 7 x 7 array so that the laser beam points down in a direction perpendicular to the substratum. Plants at the first laser contact will be identified and recorded. If the laser does not contact plant tissue, the ground type will be recorded as bare soil, sand, gravel, mud, trash, or wrack.

Areas with vegetation exceeding 1m will employ a rapid assessment method to determine groundcover, shrubs, and canopy, and a list of all species present within a 5m radius of the plot. Permanent 25-meter transects will also be used for the upland habitats. At each transect, vegetation data will be collected using a point-intercept method every 25cm for a total of 100 points per transect. Additionally, at every 1m interval on the transect, the canopy height will be recorded to determine average transect height as well as rugosity.

If upland habitats are inaccessible, then aerial photographs will be utilized to determine approximate percent cover. All trees with an average DBH (diameter at breast height) of >5 cm will be identified, its GPS coordinates and DBH recorded, and an approximate height determined.

Table 2. Survey methodologies and details for each habitat type within the Ballona Wetlands.

Habitat	Area	Acres	Transects	Quadrats	Methodology
Low marsh	B	8.5	10	70	1m-quadrat sampling & target species surveys
Mid-marsh	B	16.4	15	105	1m-quadrat sampling & target species surveys
Upper marsh	B	42.9	20	140	1m-quadrat sampling & target species surveys
Brackish marsh	B, C	3.1	5	35	1m-quadrat sampling & target species surveys
Riparian scrub	A, B, C	20.8	15	105	Point contact transect surveys & target species surveys
Riparian forest	B	2.9	5	35	Point contact transect surveys & target species surveys
Seasonal wetland	A, B, C	74.5	20	140	Point contact transect surveys & target species surveys
Freshwater marsh	B	26.0	----	----	None; the freshwater marsh is currently being monitored, and an annual report produced
Dunes	A, B, C	13.0	15	105	1m-quadrat sampling & target species surveys
Upland grassland	A, B, C	176.4	30	210	1m-quadrat sampling & target species surveys
Upland scrub	A, B, C	92.2	30	210	Point contact transect surveys & target species surveys
Upland forest	A, B	0.73	5	35	Point contact transect surveys & target species surveys
Salt pan	B	22.4	10	70	Point contact transect surveys & target species surveys
Unvegetated	B	10.9	5	35	Point contact transect surveys & target species surveys
TOTAL	**A, B, C**	**510.7**	**185**	**1295**	**----**

2.1.2 Targeted Surveys

A targeted survey program will be established and implemented for all listed (federal, state and DFG) species which may occur within the Ballona Wetlands in conjunction with the CEQA process. The target list of sensitive and invasive plant species will be noted as present or absent on the data sheet during a ten minute search of each zone. This data collection will allow rare species (<2%), such as salt marsh bird's beak (*Cordylanthus maritimus maritimus*), to be documented that may not otherwise show up in the dataset during the vegetation cover sampling. The documentation of sensitive and invasive species could lead to further sampling projects focused on those species.

2.1.3 Submerged aquatic vegetation and algae cover

One 30m-transect will be deployed parallel to the water's edge and with the same elevation contour in each tidal channel four times annually. Sampling will be done during the day of a spring, low tide in order to have the maximum amount of mudflat exposure and the least amount of water. Sampling will commence approximately one and a half hours before low tide for a total sampling time of approximately three hours. Quadrats will be placed along the shore at 10 random, pre-determined meter points along the transect. Quadrats will be $0.25m^2$, and will include a grid of 49 point intersections in a 7 x 7 array to estimate percent cover of each algae species (e.g., *Enteromorpha, Ulva*, cyanobacteria, and diatom films). Intersecting points that are over bare soil/mud are also counted. The maximum and minimum mat thicknesses will also be noted. Biomass samples of algae will also be collected at three quadrats on each transect to obtain dry weights.

During the quarterly sampling periods, any submerged vegetation seen within the tidal channels will also be noted on the datasheets.

2.1.4 Soils

Soil samples will be collected at all vegetation cover survey transects once before the restoration process, and once post-restoration. Three soil cores approximately 3cm in diameter and 10cm deep will be collected and composited for each transect. Soil samples will be analyzed for constituents of concern (e.g., metals, salinity, N and P, grain size, water content, bulk density, and organic content).

2.1.5 Seed bank

Three random transects will be sampled from each habitat once annually. Soil cores will be collected from 10 points along each vegetation transect in the mid- to late fall (November). Additional cores will be collected from channel ends and salt pan edges. Cores will have a depth of 4-7cm. Each soil core will be individually potted with steam-sterilized soil into 4" nursery pots and transported to our greenhouse for incubation. Core orientation and integrity will be maintained throughout the entire collection and incubation process. Cores will be grown out for several months. Each sprout will be identified and measured.

2.2 Wildlife

2.2.1 Birds

Professional surveys will be completed quarterly, with an additional post-rain set of salt pan surveys to assess target waterbirds. Professional surveys will be full area-searches in order to detect cryptic species. The routes will follow pathways and trails already established within Ballona in order to minimize impact and disturbance. All sighted birds will be identified and their activity (e.g. roosting, flying, singing) and location will be recorded. Professional surveys will be turned into a mapping database and habitat ranges will be identified. Abundances will be tallied quarterly.

To compliment the professional surveys and provide more frequent data, monthly bird surveys will be conducted throughout the year during the two hour window before and after sunrise and sunset. Volunteers will complete target waterbird surveys and target raptor surveys once per month. Each volunteer will attend a training session with a trained ornithologist and will receive a field guide including all target species. Quality control measures will be an important component of the volunteer monitoring program, and will require oversight by a skilled wildlife biologist.

2.2.2 Small Mammals

Small mammal live trapping will be conducted semi-annually for 4 consecutive nights. Sampling will be conducted in both spring and fall and will take place within each appropriate major habitat type comprising more than 40 acres (e.g., high marsh, seasonal wetland, and upland grassland). Three arrays of Sherman live traps will be deployed within each of these three habitats for a total of 9 arrays to determine density and abundance data for small mammals in each season. The Sherman traps will be quart-sized, folding aluminum with the dimensions 9 x 3.5 x 3 inches.

Each array will be 70m x 70m and will consist of one trap deployed every 10m (i.e., one trap per 100m^2), starting at the 10m position for a total of 49 traps per array. The traps will be baited with a spoonful combination of oats, peanut butter, and a drop of vanilla extract. They will be left open over night from dusk until dawn. After dawn each morning, the traps will be checked for mammals, handled carefully into buckets or large plastic bags where they will be identified, weighted, marked with a Sharpie, and released. Once checked, the traps will remain in the closed and locked position for the duration of the day. This process will be repeated each evening/morning for four nights.

2.2.3 Large Mammals

Large mammals will be surveyed semi-annually using baited camera traps. At least one camera trap will be set and baited in each habitat for several weeks. The traps will also be surveyed for a second 10-day period but baited with vegetables instead of meat. A minimum of 2 weeks will separate the two sets of surveys.

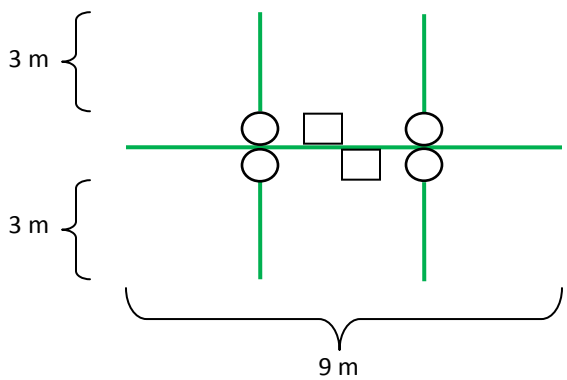
In addition to the active surveys, indirect evidence will also be recorded for large mammals (e.g., scat, footprints, and hair). Area searches of each habitat type will occur once annually.

2.2.4 Herpetofauna

Herpetofauna sampling will be conducted semi-annually for 10 consecutive days throughout appropriate habitats (e.g., high marsh and uplands). Herpetofauna sampling will be conducted during the same months and the same approximate locations as the small mammal sampling, but not within one week of the last small mammal trap deployment.

Herpetofauna sampling will be conducted by drift net and funnel trap sampling in order to obtain presence/absence data on reptiles and amphibians within Ballona. A minimum of three arrays will be utilized in each habitat type. Arrays will consist of green nylon mesh net transects held in place by wooden dowels or stakes. Three long main transects (9 m) will be randomly placed in each habitat. These main transects will be intersected perpendicularly by two sets of smaller (3 m) transects on either side of the main transect, evenly spaced every 3m (Figure 1). At each corner intersection, one plastic bucket will be buried so that the bucket edge is flush with the ground and will be covered by a piece of plywood propped slightly open. The buckets will be checked twice daily in the morning and mid-afternoon. Individuals will be identified, recorded, weighted, measured, and subsequently released.

Figure 1. Drift net conceptual design. Note that the sizes are not drawn to scale.



Two double-ended funnel traps will be placed along either side of each of the drift net arrays in the spring surveys only. They will be made using 1.5 mm aluminum window screen mesh in a rectangular pattern with funnels on either end. The mesh will be sewn together with heavy gauge wire.

Intensive site searching will be undertaken several times within each sampling period in order to target species that are often missed by the drift net and funnel trap arrays (e.g., turtles, salamanders, and semi-aquatic reptiles and amphibians). Individuals will be taxonomically identified, counted, and size-class estimated when possible. Holes, crevices, logs, rocks, and overhangs will be thoroughly searched.

2.2.5 Fish

The Ballona Wetlands baseline assessment will test several fish survey methods at each sampling location in order to determine the most appropriate methods. Sampling methods will include one or a combination of the following: shrimp trawls, beach seines, enclosure traps, and minnow traps. Sampling will be conducted twice annually during late spring and early fall within Ballona Creek, the tidal channels, and Marina Ditch. For each sampling event, fish will be surveyed on a high tide during the day and once again at night.

For all sampling methods, fish will be transferred immediately from the nets, cages, and trawls to buckets filled with seawater to be worked up. If there are less than 30 individuals of a species, all fish will have their standard length measured to the nearest centimeter and then weighed to the nearest gram. If there are more than 30 individuals but less than 100, only the first 30 will be measured and weighed. The rest will be counted and a batch weight taken. If more than 100 individuals of a species are caught in a replicate of any gear type, a separate batch sample procedure will be utilized. First, the standard length and weight will be determined for 30 randomly selected individuals. Second, the batch weight will be determined for 100 additional randomly selected individuals. Finally, the batch weight will be determined for all of the remaining uncounted individuals caught in the replicate. Abundance estimates will be calculated from the total weight of the aliquots. Fish will be returned to the water immediately after processing.

Presence/absence data will be noted for any macroinvertebrates collected in the nets and trawls. Quantitative and size data will be collected for macroinvertebrates caught in the minnow and enclosure traps as these are targeted methodologies.

2.2.5.1 Ballona Creek

Fish sampling within Ballona Creek will employ shrimp trawls deployed from a small vessel (4 m). All fish will be identified, measured for length, and released using the methodology described above. Five replicate trawls or purse seines will be completed.

Minnow Trap Protocol

Commercially available minnow traps will be deployed at 3 randomly chosen points at each site. Traps will be baited with standardized amounts of dry dog food (Kibbles and Bits™) and deployed at each location just before tidal inundation and recovered on the outgoing tide before exposure. Each fish will be identified, measured, weighed and placed in an adjacent bucket according to the methodology described above.

2.2.5.2 Tidal channels and Marina Ditch

Six permanent survey locations have been selected: three in the Marina Ditch, and three in the tidal channels. Multiple sampling methods will be employed to ensure all species are represented and to best obtain accurate densities for each species of fish. Methods will include blocking nets and seines, minnow traps and enclosure traps.

Beach Seine Protocol

First, two blocking nets will be positioned perpendicular to the bank and will extend across the tidal channel. These nets will be of the same dimensions as the beach seines, though may extend farther than 7.6m depending on the width of the channel. Both blocking nets will be taken out simultaneously. Three rounds of beach seining will then occur between the blocking nets. The first beach seine will be extended to the blocking nets and pulled across the channel with the lead line in contact with the bottom of the channel. It will be hauled out on the far shore (lead line first), where several handlers will immediately place the fish into large buckets of water. Each fish will be identified, measured, weighed and placed in an adjacent bucket according to the methodology described above. This bucket and its contents will be returned to the area of collection upon completion of the seining process. The beach seine will be pulled across the channel three times. At this time, the blocking nets will be pulled to shore by bringing the ends together and then having one net drawn inside the other. The nets will be pulled up on shore one at a time, and the fish identified in the same manner as with the beach seines.

Enclosure Trap Protocol

Enclosure traps will have a 0.5m² area, 0.8m diameter, 0.9m height, and a circumference of 2.5m. They will be made using two standard white polypropylene sheets of plastic (2.4m x 1.2m x 3mm). They will be stored flat but curved into a cylinder with 0.1m overlap at the seam for deployment. A pair of lead weights (1.8kg each) will be bolted to opposite sides of the enclosure (pre-sampling) approximately 10cm above the bottom of the enclosure to prevent the trap from floating off the creek bottom while deployed. Each fish and macroinvertebrate will be identified, measured, weighed and placed in an adjacent bucket according to the methodology described above.

Minnow traps will be employed within the tidal channels and the Marina Ditch using the same methodologies as Ballona Creek.

2.2.6 Invertebrates

2.2.6.1 Tidal Channels and Mudflats

Five permanent sampling locations have been selected in each of three different habitats (e.g., tidal channels, Marina Ditch, and mudflats). Sampling will be done semi-annually in conjunction (same time and location) with fish trapping. Sampling will coincide with neap tidal conditions in order to avoid extremes in water depth and current velocity (Zedler 2001).

Benthic Infauna

Deep dwelling infauna (e.g., clams and shrimp) will be collected using a 10cm diameter corer pushed in the sediment to a depth of 30cm. Three replicate samples (left, mid, and right bank) will be collected at each sampling location and rinsed using a 2.5mm seine in the nearby creeks. The remainder of the sample which does not fit through the seine (organisms, sediment, and debris) will be carefully collected, placed in a screw top jar, and preserved with 10% formalin for later analysis in the laboratory.

Smaller invertebrate infauna (e.g. polychaetes) will be collected using a 5cm diameter corer pushed into the sediment to a depth of 5cm and rinsed with a 0.5mm mesh sieve. Three cores will be collected and composited for each sample, and three samples (left, mid, right bank) will be taken at each location. The samples will be collected and preserved in the same manner as the larger infauna.

Benthic Epifauna

Benthic epifauna such as the California Horn Snail, *Cerithidea californica,* as well as mussels and other sessile invertebrates will be sampled with band transects. Three sampling locations will be established for the tidal creeks and marked with PVC stakes. Each sampling location will consist of three band transects. Transects will run from 1.5 m into the vegetation on the marsh plain (typically *Salicornia* canopy) down to the creek thalweg (or until no snails are present in the tidal channel, whichever comes first). Vegetation and mudflat transect data will be treated separately in our analyses.

Snails are sampled within continuous 50cm x 10cm quadrats along each transect. Transects begin 3m upstream from a location's PVC marker stake, at the marker stake, and 3m downstream from the marker stake. All living snails (*Cerithidea californica*, *Melampus olivaceus*, and *Acteocina inculta*) within a given quadrat will be counted and (for the central transect) measured to the nearest 5mm size class. We also record our visual estimation of percent algae and/or vegetation cover and the slope of the quadrat. The first 100 *Cerithidea* of the 20-25 mm-size class encountered will be retained for later parasite analysis.

2.2.6.2 Ballona Creek Intertidal Invertebrates

Sampling will be done at low tide once annually in the spring and during a neap tide. Intertidal monitoring for invertebrates along Ballona Creek will involve dividing up the length of the Creek adjacent to the Ballona Wetlands into three subsections: lower, middle, and upper, and surveying three transects (10m) within each section. The main transect will be placed along the edge of the cement Creek barrier which is parallel to the road above Ballona Creek. Three 0.25m x 0.25m quadrat rows will be surveyed on each transect. One quadrat will be sampled above the transect line, and contiguous quadrats will be taken below the main transect line in the rip-rap until the final quadrat is partially submerged. All organisms within each quadrat will be counted and mobile organism presence/absence will be noted (e.g. brittle stars, crabs, etc). Datasheets for each quadrat will be labeled with the corresponding subsection, bank (north or south), transect number, and quadrat number.

2.2.6.3 Terrestrial – Including Pollinators

To analyze insect abundance and diversity within Ballona Wetlands, insect traps will be set out at five randomly chosen vegetation transects within each habitat. Flying insects will not be sampled at the same time as vegetation. Insect transects will consist of 3 sticky traps suspended with wire hangers set 10m apart. If vegetation is present, trap height will be set so that the bottom of the trap is 2cm above the vegetation. In cases of short or sparse vegetation, the insect traps will be set a minimum of 10cm above the ground to prevent inundation by tidal water. Traps will be left in the field for five consecutive days. When a deployment cycle is completed, traps are covered with clear plastic wrap (i.e. Saran Wrap) and returned to the lab for processing. The traps will be stored in a freezer at LMU until analysis.

A targeted survey program will be established and implemented for all listed (federal, state and CNPS) species which may occur within Ballona in conjunction with the CEQA process.

2.2.6.4 Insect collection and preserved specimens

We will provide taxonomic identification of as many insect species as possible from the Ballona Wetlands in the form of a comprehensive insect collection. Individuals will be collected using butterfly nets, hand collecting, pitfall traps, overturning debris, and baited sites. A minimum of three individuals from each species will be collected: one to send as a voucher specimen, one as an educational/public component, and one as a backup reference. Each individual insect will be collected using ethyl acetate and either immediately labeled and displayed appropriately on polyethylene foam or labeled and stored in a freezer until such time that it can be displayed and identified properly. Individuals will be stored with a label including the Area within Ballona (i.e., A, B, or C), specific habitat and location (e.g., high marsh, south of the tide gate), plant association, date, time, and collector. Endangered, threatened or special status species will not be collected, but will be noted in a field book.

3 Human Activity

Human use of the Ballona Wetlands will be tracked through correspondence with other non-profit groups and restoration groups (e.g., Friends of Ballona Wetlands, Audubon Society). Visitors and volunteers will be included in the data.

Trash will be incorporated throughout the survey protocols. For example, there is a 'trash' category within the vegetation surveys. It will be noted as presence/absence in each habitat/area.

All data will be subject to thorough QAQC protocols.

BASELINE MONITORING PROTOCOL FIGURES

Figure 1. Map of Ballona including sites for water quality, sediment, fish and benthic invertebrate sampling:

Water Quality: 1, 3, 4, 5, 6, 7 and 8
Sediment: 1, 2, 4, 5, 6, 7 and 8
Fish: 1, 2 (plus one site in-between); 4, 5, 7; trawls throughout Ballona Creek
Benthic Invertebrates: 1, 2, 4, 5, 6, 7 and 8

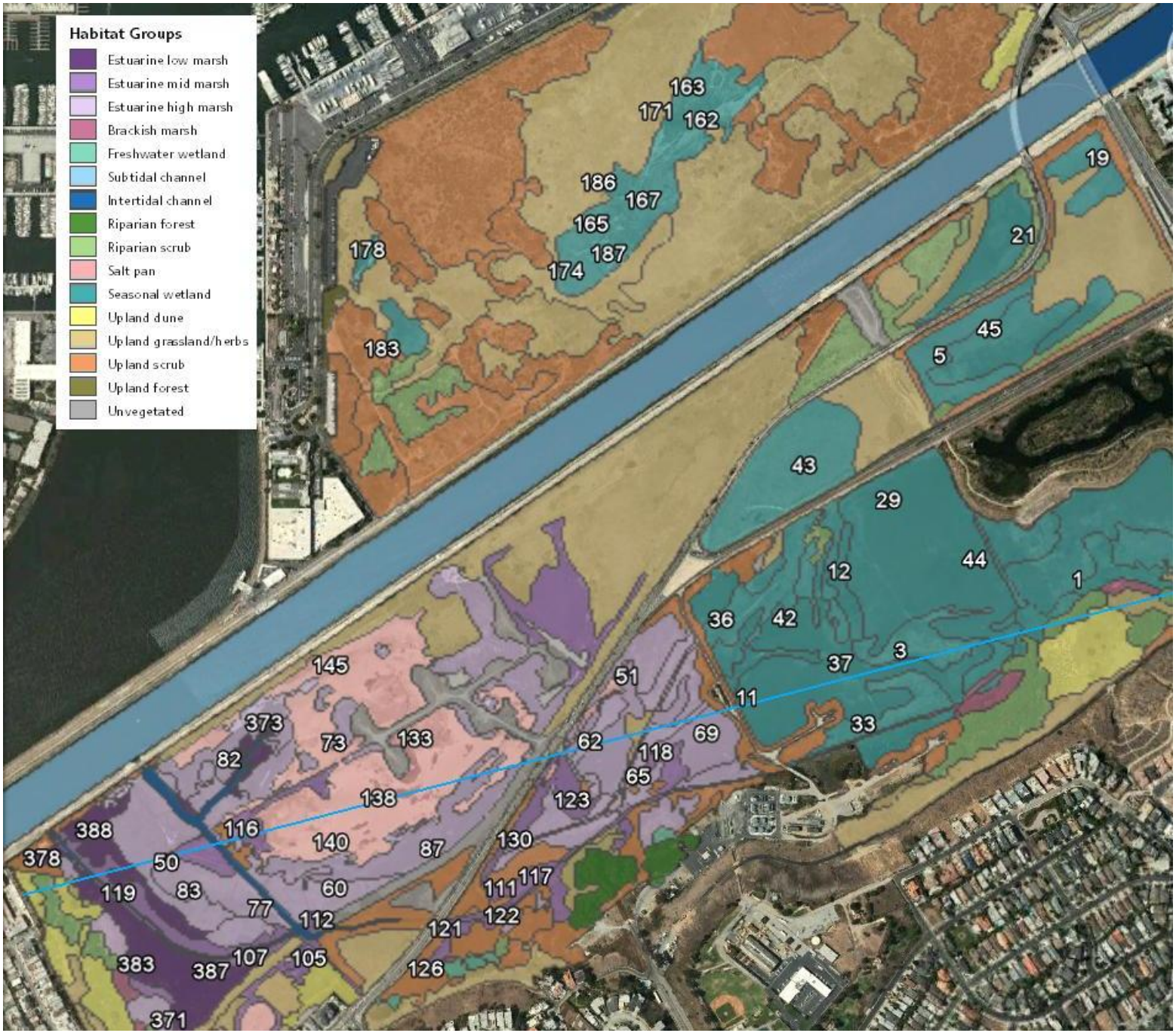


Figure 2. Completed vegetation transects (marsh habitats only). Blue line indicates marsh-wide transect location.

Table 1. Number of vegetation transects (and identification number) for each habitat type.

HABITAT	# TRANSECTS	FID's
Estaurine low marsh	10	369, 370, 371, 373, 378, 380, 381, 383, 387, 388
Estuarine high marsh	15	50, 51, 54, 60, 62, 65, 67, 69, 73, 77, 80, 82, 83, 87, 88
Estuarine mid marsh	15	105, 107, 111, 112, 114, 116, 117, 118, 119, 121, 122, 123, 126, 129, 130
Salt Pan	5	133, 138, 140, 145, 156
Seasonal wetland (A)	10	162, 163, 165, 167, 171, 174, 178, 183, 186, 187
Seasonal wetland (B)	15	1, 3, 5, 11, 12, 19, 21, 29, 33, 36, 37, 42, 43, 44, 45
TOTAL	**70**	**----**

Figure 3. Map of volunteer birding locations. The yellow lines indicate the two waterbird survey pathways, and the red outlines each raptor survey parcel.

Figure 4. Map of herpetofauna and mammal array locations (same for both types of sampling). Three arrays were placed in each habitat greater than 40 acres.