APPENDIX A

AUTOMATED STORMWATER MONITORING EQUIPMENT

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1 Automated Stormwater Monitoring Equipment

Monitoring of stormwater runoff at the outfall mass emission monitoring sites will require use of automated stormwater sampling equipment. This section addresses equipment and sampling procedures that will be used for the City of Long Beach IMP estuarine monitoring program.

Flow-weighted and time-weighted sampling will generally require similar equipment. Similar equipment will be necessary regardless of the selected sampling approach. Time-weighted composite samples simply allow for more mobile installations that do not require flow meters, rain gauges, solar panels, or communication equipment. In lieu of communications equipment, such sites require added field personnel to monitor and track performance of the equipment along with added sensors to trigger the equipment to initiate the sampling.

Sampling at mass emission sites for collection of stormwater samples will require flow weighted composite samples in order to obtain data on pollutant loads discharged to the receiving waters. An additional requirement for pollutant load determinations is that the entire hydrograph for each storm be covered by proportional sampling. This requirement means that monitoring for more than a 24-hour time period for storms that exceed this length of time. We thus intend to vary slightly from the guidelines in the Permit. The historical database for the City of Long Beach is based upon an attempt to sample 100% of the runoff from a given amount of rainfall regardless if the monitoring period requires sampling more than a 24-hour time period. At sites where we are collecting composite stormwater samples, we plan to collect samples that fully represent all runoff from each storm event without limiting the time period to 24 hours. This will enable data to be directly compared with data collected over a 14 year time period under the City's MS4 NPDES Monitoring Program. This control over appropriate storm event sampling is made possible by telecommunications and control of each station from our central Storm Control Center which is operational for each storm event.

For purposes of this CIMP, it is assumed that all sites requiring collection of flow-weighted composite samples will be established as "permanent" or "long-term" sites with appropriate security to protect the equipment and intake structures from debris coming down the stream or vandalism. As noted, collection of time-weighted samples will be utilize the same types of autosamplers and composite containers but will not include flow meters, rain gauges and telecommunication packages. Monitoring stations designed to take time-weighted composite samples will require sensors to detect initial flows and trigger the sampler. This will allow for use of smaller security enclosures that can temporally be secured at a site or, if necessary, equipment can be deployed in a manhole.

Fixed monitoring sites will utilize automated stormwater sampling stations that

incorporate an autosampler (American Sigma or Isco), a datalogger/flow module to monitor flow and pace the autosampler, a rain gauge to monitor and record local rainfall, and telecommunications to allow for remote monitoring and control of each site. Sites without access to AC power will be powered by deep-cycle marine batteries. Sites without direct access to AC power will utilize solar panels to provide the energy needed to maintain the charge on two deep cycle batteries used to power the autosampler, flow meter and datalogger. Providing reliable telecommunications for real-time access to data and to provide command and control functionality has greatly improved efficiency and contributed to improved stormwater data.

Both types of automated stormwater monitoring systems considered for this monitoring program use peristaltic pumping systems. When appropriate measures are taken, it has been demonstrated that these types of systems are capable of collecting blanks that are uncontaminated and high quality, reproducible data using detection limits appropriate to water quality criteria. In order to accomplish this, extreme care must be taken to avoid introduction ofcontaminants.

Requirements include:

- Assuring that all materials coming into contact with the samples are intrinsically low in trace metals and do not adsorb/absorb metals or other target.
- Materials coming into contact with the sample water are subjected to intensive cleaning using standardized protocol and subjected to systematic blanking to demonstrate and document that blanking standards are met.
- All cleaned sampling equipment and bottles are appropriately tracked so that blanking data can be associated with all component deployed in the field.
- Samples are collected, processed and transported taking care to avoid contamination from field personnel or their gear, and
- Laboratory analysis is conducted in a filtered air environment using ultrapure reagents.

Table 2-1 of the USGS National Field Manual (http://pubs.water.usgs.gov/twri9A/) provides a summary of acceptable materials for use sampling organic and inorganic constituents. The stormwater monitoring stations will primarily utilize 20-L borosilicate glass media bottles for the composite samples, FEP tubing for the sample hose and either 316 SS or Teflon-coated intake strainers. Ten (10) liter borosilicate glass media bottles will be considered for sites where required sample volumes are low and lower sample volumes are acceptable. The peristaltic hose is a silicone- base material that is necessary for operation of the autosamplers. The peristaltic hose can be as source of silica which is not a target compound.

Although the technical limitations of autosamplers are often cited, they still provide the most practical method for collecting representative samples of stormwater runoff for characterization of water quality and have been heavily utilized for this purpose for the

past 20 years. The alternative, manual sampling, is generally not practical for collection of flow-weighted composite samples from a large number of sites or for sampling events that occur over an extended period of time. Despite the known drawbacks, autosamplers combined with accurate flow metering remain the most common and appropriate tool for monitoring stormwater runoff.

1.1 Sampler Intake Strainer, Intake Tubing and Flexible Pump Tubing

Intake strainers will be used to prevent small rocks and debris from being drawn into the intake tubing and causing blockages or damage to the pump and peristaltic pump tubing. Strainers will be constructed of a combination of Teflon and 316 stainless or simply stainless steel. The low profile version is typically preferred to provide greater ability to sample shallow flows. Although high grade stainless steel intake strainers are not likely to impact trace metal measurements, it is preferable to use strainers coated with a fluoropolymer coating. If the stainless steel intake is not coated, the strainer will not be subjected to cleaning with acids. Cleaning will be limited to warm tap water, laboratory detergents and MilliQ water rinses.

Tubing comprised of 100% FEP (Fluorinated Ethylene Propylene) will be used for the intake tubing. Several alternative fluoropolymer products are available but 3/8" ID solid FEP tubing has the chemical characteristics suitable for sampling metals and organics at low levels and appropriate physical characteristics. The rigidity of FEP tubing provides resistance to collapse at high head differentials but still is manageable for tight configurations.

The peristaltic hose used in autosamplers is a medical-grade silicon product. The specifications for the peristaltic pump hoses used in these samplers are unique to the samplers. It is very important that hose specified and provided by the manufacturers of the autosamplers be used. Minor differences in the peristaltic hose can cause major deterioration in performance of the samplers. Use of generic peristaltic pump hose from other sources can lead to problems with the ability to calibrate the samplers and maintain intake velocities of greater than 2.5 feet per second with higher lift requirements.

The peristaltic hose is connected to the FEP tubing and fed through the pump head leaving the minimum amount necessary to feed the peristaltic pump hose into the top of the composite bottle. The composite container will always have a lid to prevent dust from settling in the container.

1.2 Composite Containers

The composite containers used for monitoring must be demonstrated to be free of contaminants of interest at the desired levels (USEPA 1996). Containers constructed of fluoropolymers (FEP, PTFE), conventional or linear polyethylene, polycarbonate, polysulfone, polypropylene, or ultrapure quartz are considered optimal for metals but borosilicate glass has been shown to be suitable for both trace metals and organics at limits

appropriate to EPA water quality criteria. High capacity borosilicate media bottles (20-liters or ~5-gallons) are preferred for storm monitoring since they can be cleaned and suitably blanked for analysis of both metals and organic compounds. The transparency of the bottles is also a useful feature when subsampling and cleaning the containers for reuse.

Figure 1. Composite Bottle with Label and installed Tubing inside Brute® Container.

These large media bottles are designed for stoppers and thus do not come with lids. Suitable closure mechanisms must be fabricated for use during sampling, transport and storage of clean bottles. The preferred closure mechanism is a Teflon® stopper fitted with a Viton® O-ring (2 3/8" - I.D. x 23/4"- O.D.) that seals the lid against the media bottle. A polypropylene clamp (Figure 2) is used to seal the Teflon® stopper and O-ring to the rim of the composite sample bottle. Two polypropylene bolts with wing-nuts are used to maintain pressure on the seal or to assist in removal of the lid.

Every composite bottle requires one solid lid for use in protecting the bottle during storage and transport. A minimum of one Teflon® stopper should be available for each monitoring site during storm events. Each field sampling crew should have additional stoppers with holes ("sampling stopper") that would be available if a sampling stopper is accidentally contaminated during bottle changes or original installations.

The holes in the sampling stoppers should be minimally larger than the external diameter of the peristaltic hose. If a tight fit exists, the pressure created when water is pumped into the bottle will cause the hose to be ejected and the sampling event will to be abandoned.

Transporting composite bottles is best accomplished by use of 10-gallon Brute® containers to both protect them from breakage and simplify handling. They also provide additional capacity for ice while transporting full bottles to the laboratory or subsampling site.

Figure 2. Composite bottle showing bottle bag used for transport and lifting.

Bottle bags (Figure 2) are also useful in allowing full bottles to be handled easier and

reduce the need to contact the bottles near the neck. They are important for both minimizing the need to handle the neck of the bottle and are also an important Health and Safety issue. The empty bottles weigh 15 pounds and they hold another 40 pounds of water when full. These can be very slippery and difficult tohandle when removing them from the autosamplers. Bags can be easily fabricated out of square- mesh nylon netting with nylon straps for handles. Use of bottle bags allows two people to lift a full bottle out of the ice in the autosampler and place it in a Brute® container. Whether empty or full, suitable restraints should be provided whenever the 20-L composite bottles and Brute® containers are being transported.

1.3 Flow Monitoring

Retrieval of flow-weighted stormwater samplers requires the ability to accurately measure flow over the full range of conditions that occur at the monitoring site. The ability to accurately measure flow at an outfall site should be carefully considered during the initial site selection process. Hydraulic characteristics necessary to allow for accurate flow measurement include a relatively straight and uniform length of pipe or channel without major confluences or other features that would disrupt establishment of uniform flow conditions. The actual measurement site should be located sufficiently downstream from inflows to the drainage system to achieve well-mixed conditions across the channel. Ideally, the flow sensor and sample collection inlet should be placed a minimum of five pipe diameters upstream and ten pipe diameters downstream of any confluence to minimize turbulence and ensure well-mixed flow. The latest edition of the *Isco Open Channel Flow Measurement Handbook* (Walkowiak 2008) is an invaluable resource to assist in selection of the most appropriate approach for flow measurements and information on the constraints of each method.

The existing mass emission site has an established flow rating curve (Stage-Flow relationships) that only requires measurement of water level to estimate flow. Additional sites requiring flow monitoring are expected to utilize area-velocity sensors that use Doppler-based sensors to measure

the velocity of water in the conveyance, a pressure sensor to measure water depth, and information regarding channel dimensions to allow for real-time flow measurements to pace the autosamplers.

1.4 Rainfall Gauges

Electronic tipping bucket rain gauges will be installed at each fixed monitoring location to provide improved assessment of rainfall in the smaller drainages. Use of a localized rain gauge provides better representation of conditions at the site. A variety of quality instruments are available but all require substantial maintenance to ensure maintenance of high data quality.

Tipping bucket rain gauges with standard 8-inch diameter cones will be used at each site. These provide 1 tip per 0.01” of rain and have an accuracy of ± 2% up to 2"/hr. The

accuracy of tipping bucket rain gauges can be impacted by very intense rainfall events but errors are more commonly due to poor installation.

Continuous data records will be maintained throughout the wet season with data being output and recorded for each tip of the bucket. The rainfall data is downloaded at the same rate as the flow and stormwater monitoring events.

1.5 Power

Stormwater monitoring equipment can generally be powered by battery or standard 120VAC. If 120VAC power is unavailable, external, sealed deep-cycle marine batteries will be used to power the monitoring site. Even systems with access to 120VAC will be equipped with batteries that can provide backup power in case of power outages during an event. All batteries will be placed in plastic marine battery cases to isolate the terminals and wiring. A second battery will be provided at each site to support the telecommunication packages. Sites relying on battery power will also be equipped with a solar panel to assure that a full charge is available when needed for a storm event.

1.6 Telecommunication for System Command/Control and Data Access

The ability to remotely communicate with the monitoring equipment has been shown to provide efficient and representative sampling of stormwater runoff. Remote communication facilitates preparation of stations for storm events and making last minute adjustments to sampling criteria based upon the most recent forecasts. Communication with the sites also reduces the number of field visits by monitoring personnel. Remote two-way communication with monitoring sites allows the project manager (storm control) to make informed decisions during the storm as to the best allocations of human resources among sampling sites. By remotely monitoring the status of each monitoring site, the manager can more accurately estimate when composite bottles will fill and direct field crews to the site to avoid disruptions in the sampling. Real time access to flow, sampling and rainfall data also provides important information for determining when sampling should be terminated and crews directed to collect and process the samples. Increases in both efficiency and sample quality make two-way communication with monitoring stations a necessity for most monitoring programs.

APPENDIX B

CLEANING AND BLANKING PROTOCOL
FOR
EQUIPMENT AND SUPPLIES USED IN COLLECTION OF
FLOW OR TIME-WEIGHTED COMPOSITES

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CLEANING PROTOCOL FOR:

20-L Borosilicate Glass Composite Bottles (Media Bottles) and Closures

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the cleaning of 20-liter composite sample bottles and the related equipment necessary to complete the task. The purpose of these procedures is to ensure that the sample bottles are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of 20-liter composite sample bottles and stoppers.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of 20-liter composite-sample bottles and associated equipment involves hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemical-resistant gloves, laboratory coats, chemical-resistant aprons, and goggles. To ensure that you are aware of the hazards involved, the material safety data sheets (MSDSs) for nitric acid and laboratory detergents should be reviewed before beginning any of these procedures.

Note: Preparations should be made to contain and neutralize any spillage of acid. Be aware of the location of absorbent, neutralizing, and containment materials in the bottle cleaning area.

4.0 DEFINITIONS

4.1 **Composite sample bottle** - 20 liter borosilicate glass bottle that is used with autosamplers to collect a stormwater composite sample.

4.2 **Stopper** - a Teflon® cap used to seal the composite sample bottle (either solid, or drilled with holes for the silicon inlet tubing).

4.3 **O-Ring** - Viton O-ring 23/8"- I.D. x 23/4"- O.D. that is located around the base of stopper.

4.4 **Clamp** - Polypropylene clamp, 2 bolts, and wing nuts specifically designed to fasten the stopper and the O-ring to the rim of the composite sample bottle.

4.5 **De-ionized (DI) water** - commercial de-ionized water (12-13 Megohm/cm)

4.6 **Laboratory Detergent** - 2% solution of Contrad 70® or Micro-90® detergent

5.0 EQUIPMENT

5.1 Instrumentation:

1) Peristaltic pump with a protocol-cleaned sub-sampling hose setup

5.2 Reagents:

1) ACS Reagent Grade nitric acid in a 2 Normal solution (2N HNO_3)
2) Contrad 70® non-phosphate laboratory detergent
3) Contrad 70® anti-foaming agent
4) Micro-90® non-phosphate laboratory detergent
5) Baking soda or equivalent to neutralize acid
6) pH paper

5.3 Apparatus:

1) Bottle Rolling Rack
2) DI Rinse Rack
3) Yellow Neutralization Drip Bucket
4) Neutralization Tank

5.4 Documentation:

The status of each composite sample bottle must be tracked. Bottles should be washed in batches of 10, 20, or 30 and the status of each batch must be made apparent to all personnel by posting a large status label (including the start date) with each batch. This will ensure that all required soak times have been attained and that each bottle was subjected to the proper cleaning procedures. Information on each batch of bottles cleaned (including bottle number, QA batch, date cleaning started, date finished, date blanked, and cleaning technicians) should be entered in the **Bottle Cleaning Log Sheet**.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling tubing tips, dirty fingers/gloves, automobile emissions, etc.) is increased significantly.

6.1 Teflon® Bottle Stoppers with Holes and Field Extras:

To be performed whenever required for field use.

1) Wash with laboratory detergent using a clean all-plastic brush.
2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water.

6) Allow to dry in a dust-free environment.

7) Store in two sealed clean Ziploc® bags.

6.2 NPS 20 liter composite sample bottle Cleaning:

6.2.1 Preliminary Bottle Cleaning:

Bottles should undergo a preliminary rinse with tap water as soon as possible after they are available. This includes dumping any remaining stormwater into a sanitary drain and rinsing the bottles and stoppers. This prevents material from adhering to the interior surface of the bottle.

6.2.2 **48 Hour Soak:** Place the bottle to be cleaned into a secondary containment bucket. Prepare a 2% solution of laboratory detergent with tap water directly in the bottle. Note: Since laboratory detergent is a foaming solution, add 3/4 of the tap water first, add the detergent, then add the rest of the water. Should excessive foam be generated, a few drops of Contrad 70® anti-foaming agent may be added. **Make sure that the bottle is filled to the rim and scrub the rim with an all-plastic scrub brush.** Scrub a Teflon® stopper with 2% solution of laboratory detergent and place stopper over the full bottle so overflowing happens. This will allow both the stopper and the bottle to soak for 48 hours. After the 48 hour soak, this solution may be may be retained for reuse (i.e., siphoned into other dirty bottles) or it can be poured off into a sanitary drain.

6.2.3 Teflon® Bottle Stopper and O-ring Cleaning:

This procedure should be performed prior to the bottle washing process so that the stopper can follow the bottle through the acid wash.

1) Rinse thoroughly (minimum of three times) with tap water.

2) Rinse thoroughly (minimum of three times) with DI water.

3) Store temporarily in a similarly cleaned

6.2.4 **Tap Water Rinse:** Tap water rinses detergent better than DI water. Flush upside down bottle with tap water for 20 sec. Rinse each bottle 3 times with tap water being careful not to contaminate the clean surfaces.

6.2.5 **DI Rinse:** Rinse the top and neck of the bottles with DI water using a squirt bottle and then rinse upside down for three minutes on the DI rinse rack for bottles. Make sure to tip bottles from side to side for a more thorough rinsing. Allow 1-2 minutes for the bottles to

drain as much as possible. Rinse each stopper with DI water squirt bottle 3 times (being careful not to touch the clean surfaces).

6.2.6 **Acid Wash:** Note that it is important to Wash the bottle with 2N nitric acid according to the following procedure:

1) Place the empty bottle near the 2N nitric acid carboy and peristaltic pump. The location should be able to safely contain a spill if the 20L bottle breaks.

2) Pump acid into the bottle using the peristaltic pump fitted with a protocol-cleaned sub-sampling hose setup

3) Fill the bottle slightly more than half full.

4) Place a protocol-cleaned solid Teflon® stopper (with a properly seated O-ring) (Refer to Section 6.2.3 above) on the bottle and clamp it securely.

5) **Carefully** lift and place the bottle on the roller rack and check for leakage from the stopper. Neutralize any spillage. Often small leaks can be corrected by a slight tightening of the clamp. Roll the bottles for twenty minutes.

6) Pump the acid into another bottle for rolling or back into the 2N nitric acid carboy.

6.2.7 **DI Rinse for Sub-sampling Hose**: After use, the sub-sampling hose setup should be rinsed by pumping 1-2 gallons of DI water through the hoses and into a neutralization tank. Carefully rinse the outside of the hose to remove any acid that may be on the exterior of the hose. pH paper should be used to insure that the fluid in and on the hose is 6.8 or higher. Continue rinsing until your reach neutral pH. Store hose in a clean, large plastic bag between uses. Dispose of rinsate in accordance with all federal, state, and local regulations

6.2.8 **DI Rinse for Bottles**: Allow the bottles to drain into a yellow neutralization bucket for at least 1 minute. Place four bottles at a time on the DI rinse rack and rinse for 5 minutes. Move bottles around to ensure complete and thorough rinsing. Rinse the outside of the bottle with tap water. Allow bottles to drain for 2 minutes.

6.2.9 **DI Rinse for Stoppers**: Rinse caps thoroughly 3 times over neutralization tank. Place on a clean surface where the clean side of the stopper will not be contaminated.

6.3 **Storage:** Clamp a stopper (one that went through the entire cleaning procedure) on the bottle. Properly label the bottle as to the date cleaned and by whom and place on the bottle storage rack or in a secondary containment bucket in a safe area. Also, fill out the **Bottle Cleaning Log Sheet**.

7.0 QUALITY ASSURANCE REQUIREMENTS

7.1 The NPS 20 liter sample bottles must be evaluated ("blanked") for contaminants after they have completed the decontamination procedure. The analytical laboratory performing the evaluation should supply Milli-Q® water that is used as a blanking rinsate, and sample

bottles for the appropriate constituents of concern. This evaluation will be accomplished by randomly blanking 10% of the washed bottles, or 1 bottle per batch (whichever is greater) and having the blanking rinsate analyzed by the laboratory for the appropriate constituents.

7.2 If any of the bottles fail the analyses (concentration of any analytes are at or above the limit of detection), all of the bottles from that batch must be decontaminated. Again, 10% of these bottles must be subjected to the blanking process as described-above.

7.3 If results of the evaluation process show that the bottles are not contaminant-free, the cleaning procedure must be re-evaluated. Consult with the Quality Assurance/Quality Control Officer to determine the source of contamination.

CLEANING PROTOCOL FOR:

Miscellaneous Laboratory Equipment used for Cleaning and Blanking

1.0 SCOPE

This Standard Operating Procedure describes the procedures for cleaning the miscellaneous items necessary to complete the tasks of cleaning 20- liter composite sample bottles and hoses. The purpose of these procedures is to ensure that the items are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of ancillary items necessary to complete the tasks of cleaning 20 liter composite sample bottles and NPS hoses.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of the following items may involve contact with hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemically-resistant protective gloves, laboratory coats, chemically-resistant aprons, and goggles. In addition, to ensure that you are aware of the hazards involved and of any new revisions to the procedure, the material safety data sheets (MSDSs) for nitric acid and the laboratory detergent should be reviewed before beginning any of these procedures.

4.0 DEFINITIONS

4.1 Polyethylene Squirt Bottles - ½ and 1 liter squirt bottles for washing and/or rinsing with DI water or nitric acid.

4.2 Polycarbonate and Polyethylene De-ionized Water Jugs - For holding DI water.

4.3 Polyethylene Bucket - For holding tap water, DI water or detergent solutions during hose washing procedures.

4.4 Four-inch Teflon® Connector - For connecting two lengths of silicon peristaltic tubing together.

4.5 Four-inch Silicon Connector - For connecting two lengths of Teflon® hose together.

4.6 Orange Polypropylene Hose Caps - For placing over the ends of clean Teflon® hose to prevent contamination.

4.7 De-ionized (DI) water - Commercial de-ionized water

4.8 Laboratory Detergent - 2% solution of Contrad 70® or Micro-90® detergent.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable.

5.2 Reagents:

1) ACS Reagent Grade nitric acid as a 2 Normal solution (2N HNO_3)

2) Micro-90® non-phosphate laboratory detergent

3) Contrad 70® non-phosphate laboratory detergent

4) Contrad 70® anti-foaming agent.

5) pH paper or pH meter

6) Baking soda ($NaHCO_3$) or equivalent to neutralize acid

5.3 Apparatus:

1) Clean polyethylene squirt bottles.

2) Clean polyethylene trays or 2000 ml glass beakers.

3) Neutralization Tank

5.4 Documentation:

Label each squirt bottle, DI jug, storage container holding clean items, etc. as to the date each was cleaned and the initials of the cleaning technician.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during these procedures. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dirty sinks, dirty counter tops, dirty fingers/gloves, dirty hose ends, etc.) is increased significantly.

Rinsing properly is essential to ensure proper cleaning. This is done by squirting the liquid over the item to be cleaned in a top-down fashion, letting the water flow off completely **before** applying the next rinse. Rinse the item in this fashion **a minimum** of three times. **Numerous rinses of relatively small volumes are much better than one or two rinses of higher volume.** Be aware of handling: use clean gloves (it is best if they have gone through the same prior wash as the item to be rinsed) and rinse off the fingers prior to grasping the item to be cleaned. Try to grasp the item in a slightly different place between rinses so ones fingers do not cover a portion of the item throughout the rinses.

6.1 Polyethylene Squirt Bottles:

1) Soak in a 2% solution of laboratory detergent in a protocol-cleaned bucket for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.2 Polycarbonate and Polyethylene DI Water Jugs:

1) Fill to the rim with a 2% solution of laboratory detergent, cap the jug, and let soak for 48 hours. Wash cap with an all-plastic scrub brush after soak.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.3 Polyethylene Bucket:

1) Fill to the rim with a 2% solution of laboratory detergent and let soak for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. **Label as to the date cleaned and initial**.

6.4 Four-inch Teflon® and Silicon Hose Connectors and Orange Polypropylene Hose Caps. The purpose of the four-inch sections of Teflon® and silicon hose is to connect longer lengths of each type of hose together during the hose cleaning procedures. The orange polypropylene hose caps are for the ends of cleaned FEP hoses to prevent contamination prior to use in the field or laboratory.

1) Using a 2% solution of laboratory detergent, soak the four-inch sections of FEP hose, silicon tubing, and orange caps for 48 hours.

2) Rinse thoroughly with tap water (minimum of three rinses).

3) Rinse thoroughly with DI water (minimum of three rinses).

4) Using a squirt bottle filled with 2N (10%) HNO_3, thoroughly rinse the interior and exterior of the connectors and caps thoroughly OR, roll/agitate them in a shallow layer of 2N (10%) HNO_3 in a laboratory detergent cleaned glass beaker or other appropriate, clean container for a more thorough washing.

5) Thoroughly rinse connectors and caps with DI water (minimum of three rinses). Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. Keep clean connectors and caps in a similarly cleaned (or certified clean) widemouth glass jar or detergent-cleaned resealable bag and **label as clean, date cleaned, and initial**.

NPS 20-Liter Bottle Subsampling Procedure

1.0 Scope

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) 20 liter sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the 20-L bottle (or bottles). In order to prevent confusion, it should be noted that in other KLI SOPs relating to 20-L bottles they are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these 20-L "composite" bottles.

2.0 Application

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS 20 liter sample bottles.

3.0 Health and Safety Considerations

The compositing and sub-sampling of NPS 20 liter sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 Definitions

4.1 **20 liter sample bottle:** 20 liter borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 **Large-capacity stirrer**: Electric motorized "plate" that supports a 20 liter bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 **Stir-bar**: Teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a 20 liter bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample. Pre-cleaned using cleaning protocols provided in KLI SOP for *Cleaning Procedures for Miscellaneous Items Related to NPS Sampling*.

4.4 **Sub-sampling hose**: Two ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Pre-cleaned using cleaning protocols provided in SOP for *Teflon Sample Hose and Silicon Peristaltic Tubing Cleaning Procedures*. Used with a peristaltic pump to transfer sample water from the 20-L sample bottle to sample analyte containers.

4.6 **Volume-to-Sample Ratio (VSR):** A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes

the flow-meter the sampler collects a sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus

1) Large capacity stirrer.

2) Stir bar.

3) Sub-sampling hose.

4) Peristaltic pump.

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APPENDIX C

QUALITY ASSURANCE/QUALITY CONTROL

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1. Quality Assurance/Quality Control

Elements of a Quality Assurance and Quality Control (QA/QC) Plan have been incorporated into the CIMP in order to detail critical activities conducted to assure that both chemical and physical measurements meet the standard of quality needed to evaluate measurements at levels relevant to applicable water quality criteria. With many different monitoring programs being implemented within the region, comparability should remain of the primary goals of the QA/QC monitoring program. The Intergovernmental Task Force on Monitoring Water Quality (ITFM, 1995) defines comparability as the "characteristics that allow information from many sources to be of definable or equivalent quality so that it can be used to address program objectives not necessarily related to those for which the data were collected."

One important aspect of comparability is the use of analytical laboratories that are accredited under a program such as the National Environmental Laboratory Accreditation Program (NELAP), California's Environmental Laboratory Accreditation Program (ELAP) or a well-qualified research laboratory. In addition, the laboratory should be a participant in a laboratory proficiency and intercalibration program. Laboratories have not been selected for this program but participation in the Stormwater Monitoring Coalition's (SMC) intercalibration program will be a primary consideration. Unfortunately, the SMC has not fully completed implementation of a program the full range of analyses included in the MRP Table E-2 list.

Evaluation of data quality will be based upon protocols provided in the *National Functional Guidelines for Inorganic Superfund Data Review (USEPA540-R-10-011)* (USEPA 2010), *National Functional Guidelines for Superfund Organic Methods Data Review (EPA540/R-08-01),* and the *Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring (EPA/821/B/95/002)* (USEPA 1996).

The sections that follow address activities associated with both field sampling and laboratory analyses. Quality assurance activities start with procedures designed to assure that errors introduced in the field sampling and subsampling processes are minimized. Field QA/QC samples are collected and used to evaluate potential contamination and sampling error introduced into a sample prior to its submittal to the analytical laboratory. Laboratory QA/QC activities are used to provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness.

1.1.1 Sample Handling, Containers and Holding Times.

Table **1** provides a summary of the types of sample volumes, container types, preservation and holding times for each analytical method. Analytical methods requiring the same preservation and container types may be transferred to the laboratory in one container in order to minimize handling prior to transfer to the laboratory.

Table 1. Constituents, Sample Container, Preservation and Holding Times.

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Conventionals							
pH	150.1	15 minutes		glass or PE	none	+/- 0.1	std. units
Oil and Grease	1664A	28 days	1 L	Glass	HCl	5	mg/L
TPH	418.1	28 days	1 L	Glass	HCl	5	mg/L
Total Phenols	420.1	28 days	500mL-1 L	Glass	H_sSO_4	5	mg/L
Cyanide	SM4500-CN-E	14 days	500 mL	HDPE	NaOH	0.003	mg/L
Turbidity	SM2130B	48 hours	100-250mL	Glass	4-6°C	1	NTU
TSS	160.2	7 days	1 L	HDPE	4-6°C	4	mg/L
SSC[1]	ASTMD3977B	7 days	1 L	HDPE	4-6°C	4	mg/L
TDS	160.1	7 days	1 L	HDPE	4-6°C	1	mg/L
VSS	160.4	7 days	1 L	HDPE	4-6°C	1	mg/L
TOC; DOC	415.1	28 days	250 mL	glass	4°C and HCl or H_2SO_4 to pH<2	1	mg/L
BOD_5	SM5210B	48 hours	600mL-1L	HDPE	4-6°C	3	mg/L
COD	410.1	28 days	20-250 mL	Glass	H_sSO_4	4	mg/L
Alkalinity	SM 2320B	Filter ASAP, 14 days	100-250 mL	HDPE	4-6°C	1	mg/L
Conductivity	SM 2510	28 days	100-250 mL	HDPE	4°C; filter if hold time >24 hours	1	µmho/cm
Hardness	130.2	6 months	100-250 mL	HDPE	and HNO_3 or H_2SO_4 to pH<2	1	mg/L
MBAS	425.1	48 hours	250-500 mL	HDPE	4-6°C	0.02	mg/L
Chloride	300	28 days	250-500 mL	HDPE	4-6°C	2	mg/L
Fluoride	300	28 days	250-500 mL	HDPE	4-6°C	0.1	mg/L
Perchlorate	314.0	28 days	100-250 mL	HDPE	4-6°C	4	µg/L
Volatile Organics							
MTBE	624	14 days	3 40mL VOA	Glass	HCl	1	µg/L
Sulfate	375.2	28 days	250-500 mL	HDPE	4-6°C	2	mg/L

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Bacteria							
Total Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Fecal Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Enterococcus	SM9230B or C	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
E. coli	SM 9223 COLt	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Nutrients							
TKN	351.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.5	mg/L
Nitrate-N	300	48 hours	50-125mL	HDPE	4-6°C	0.1	mg/L
Nitrite-N	300	48 hours	50-125mL	HDPE	4-6°C	0.05	mg/L
Total Nitrogen	Calculation					NA	mg/L
Ammonia-N	350.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.1	mg/L
Total Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	H_sSO_4	0.1	mg/L
Dissolved Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	4-6°C	0.1	mg/L
Organic Compounds (pesticides and herbicides)							
Organochlorine Pesticides & PCBs[1]	608 & 8270	7days:40days	1L	Amber glass	4-6°C	0.005-0.5	µg/L
Organophosphate Pesticides	507	14days	1L	Amber glass	$Na_sS_2O_3$ 4-6°C	0.01-1	µg/L
Glyphosate	547	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C	5	µg/L
Chlorinated Acids	515.3	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C		
2,4-D						0.02	µg/L
2,4,5-TP-Silvex						0.2	µg/L
Semivolatile Organic Compounds	625;8270D	7days;40days	1L	Amber glass	4-6°C	0.05-10	µg/L

Metals (Total)

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Aluminum	1620	6 months to analysis	250 to500 mL	HDPE	4°C and HNO_3 to pH<2	100	µg/L
Antimony	1620					0.5	µg/L
Arsenic	1620					0.5	µg/L
Beryllium	1620					0.5	µg/L
Cadmium	1620					0.25	µg/L
Chromium (Total)	1620					0.5	µg/L
Copper	1620					0.5	µg/L
Iron	1620					25	µg/L
Lead	1620					0.5	µg/L
Nickel	1620					1	µg/L
Selenium	1620					1	µg/L
Silver	1620					0.25	µg/L
Thallium	1620					0.5	µg/L
Zinc	1620					1	µg/L
Chromium (Hexavalent)	218.6	24 hours	250 ml	HDPE	4°C	5	µg/L
Mercury	1631E	28 days	250 ml	Glass or Teflon	4°C and HNO3 to pH<2	0.0005	µg/L

Abbreviations

TSS=Total Suspended Solids
SSC=Suspended Sediment Concentration
TDS=Total Dissolved Solids
TPH=Total Petroleum Hydrocarbons
VSS=Volatile Suspended Solids
TOC=Total Organic Carbon
BOD_5=Five-day Biochemical Oxygen Demand
COD=Chemical Oxygen Demand
MBAS=Methylene Blue Active Substances
MTBE= Methyl Tertiary Butyl Ether
TKN=Total Kjeldahl Nitrogen
PCBs=Polychlorinated Biphenyls

1. Monitoring for PCBs will be reported as the summation of aroclors and a minimum of 50 congeners. 54 PCB congeners include: 8, 18, 28, 31, 33, 37, 44, 49, 52, 56, 60, 66, 70, 74, 77, 81, 87, 95, 97, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 132, 138, 141, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 174, 177, 180, 183, 187, 189, 194, 195, 201, 203, 206, and 209. These include all 41 congeners analyzed in the SCCWRP Bight Program and dominant congeners used to identify the aroclor

1.1.2 Precision, Bias, Accuracy, Representativeness, Completeness, and Comparability

The overall quality of analytical measurements is assessed through evaluation of precision, accuracy/bias, representativeness, comparability and completeness. Precision and accuracy/bias are measured quantitatively. Representativeness and comparability are both assessed qualitatively. Completeness is assessed in both quantitative and qualitative terms. The following sections examine how these measures are typically applied.

1.1.2.1 Precision

Precision provides an assessment of mutual agreement between repeated measurements. These measurements apply to field duplicates, laboratory duplicates, matrix spike duplicates, and laboratory control sample duplicates. Monitoring of precision through the process allows for the evaluation of the consistency of field sampling and laboratory analyses.

The Relative Percent Difference (RPD) will be used to evaluate precision based upon duplicate samples. The RPD is calculated for each pair of data is calculated as:

$$RPD=[(x_1-x_2)*100]/[(x_1+x_2)/2)$$

Where:

x_1=concentration or value of sample 1 of the pair

x_2=concentration or value of sample 2 of the pair

In the case of matrix spike/spike duplicate, RPDs are compared with measurement quality objectives (MQOs) established for the program. MQOs will be established to be consistent with the most current SWAMP objectives in the SWAMP Quality Assurance Project Plan (2008) including the most recent updates as well as consultations with the laboratories performing the analyses. In the case of laboratory or field duplicates, values can often be near or below the established reporting limits. The most current SWAMP guidelines rely upon matrix spike/spike duplicate analyses for organic compounds instead of using laboratory duplicates since one or both values are often below detection limits or are near the detection limits. In such cases, RPDs do not provide useful information.

1.1.2.2 Bias

Bias is the systematic inherent in a method or caused by some artifact or idiosyncrasy of the measurement system. Bias may be either positive or negative and can emanate from a number of different points in the process. Although both positive and negative biases may exist concurrently in the same sample, the net bias is all that can be reasonably addressed in this project. Bias is preferably measured through analysis of spiked samples so that matrix effects are incorporated.

1.1.2.3 Accuracy

Accuracy is a measure of the closeness of a measurement or the average of a number of measurements to the true value. Accuracy includes of a combination of random error as measured by precision and systematic error as measured by bias. An assessment of the accuracy of measurements is based on determining the percent difference between measured values and known or "true" values applied to surrogates, Matrix Spikes (MS), Laboratory Control Samples (LCS) and Standard Reference Materials (SRM). Surrogates and matrix spikes evaluate matrix interferences on analytical performance, while laboratory control samples, standard reference materials and blank spikes (BS) evaluate analytical performance in the absence of matrix effects.

Assessment of the accuracy of measurements is based upon determining the difference between measured values and the true value. This is assessed primarily through analysis of spike recoveries or certified value ranges for SRMs. Spike recoveries are calculated as Percent Recovery according to the following formula:

$$\text{Percent Recovery} = [(t-x)/\alpha]*100\%$$

Where:

t=total concentration found in the spiked sample

x=original concentration in sample prior to spiking, and

α=actual spike concentration added to the sample

1.1.2.4 Representativeness, Comparability and Completeness

Representativeness is the degree to which data accurately and precisely represents the natural environment. For stormwater runoff, representativeness is first evaluated based upon the automated flow-composite sample and the associated hydrograph. To be considered as representative, the autosampler must have effectively triggered to capture initial runoff from the pavement and the composite sample should:

- be comprised of a minimum number of aliquots over the course of the storm event,
- effectively represent the period of peak flow,
- contain flow-weighted aliquots from over 80% of the total runoff volume, and
- demonstrate little or no evidence of "stacking".

Stacking occurs when the sampling volume is set too low and commands back up in the memory of an autosampler causing it to continuously cycle until it catches up with the accumulation of total flow measured by the stormwater monitoring station.

Representativeness is also assessed through the process of splitting or subsampling 20 L composite bottles into individual sample containers being sent to the laboratory. The first subsamples removed from the composite bottle should have the same composition as the last. Subsampling should be conducted in accordance with guidance in the subsampling SOP. This SOP is based upon use of large laboratory magnetic stir plate, an autosampler, and precleaned subsampling hoses to minimize

variability. Sample splitting can introduce a substantial amount of error especially if significant quantities of coarse sediments (greater than 250 µm) represent as significant fraction of the suspended sediments. Use of a USGS Teflon churns or Decaport cone splitter may also be used but would require development of a separate SOP.

Comparability is the measure of confidence with which one dataset can be compared to another. The use of standardized methods of chemical analysis and field sampling and processing are ways of insuring comparability. Application of consistent sampling and processing procedures is necessary for assuring comparability among data sets. Thorough documentation of these procedures, quality assurance activities and a written assessment of data validation and quality are necessary to provide others with the basic elements to evaluate comparability.

Completeness is a measure of the percentage of the data judged valid after comparison with specific validation criteria. This includes data lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Implementation of standardized Chain-of-Custody procedures which track samples as they are transferred between custodians is one method of maintaining a high level of completeness.

A high level of completeness is essential to all phases of this study due to the limited number of samples. Of course, the overall goal is to obtain completeness of 100%, however, a realistic data quality indicator of 95% insures an adequate level of data return.

1.1.3 Laboratory Quality Assurance/Quality Control

The quality of analytical data is dependent on the ways in which samples are collected, handled and analyzed. Data Quality Objectives provide the standards against which the data are compared to determine if they meet the quality necessary to be used to address program objectives. Data will be subjected to a thorough verification and validation process designed to evaluate project data quality and determine whether data require qualification.

The three major categories of QA/QC checks are accuracy, precision, and contamination were discussed in the previous section. As a minimum, the laboratory will incorporate analysis of method blanks, and matrix spike/spike duplicates with each analytical batch. Laboratory duplicates will be analyzed for analytical tests where matrix spike/spike duplicate are not analyzed. Use of Certified Reference Materials (CRM) or Standard Reference Materials (SRM) is also recommended as these allow assessment of long term performance of the analytical methods so that representativeness can be assessed. Laboratories often use an internal CRM that is analyzed with each batch to evaluate any potential long-term shift in performance of the analytical procedures. Recommended minimum quality control samples will be based upon SWAMP QAPP (2008) and the associated 2013 Quality Control and Sample Handling Tables for water (http://www.swrcb.ca.gov/water_issues/programs/swamp/mqo.shtml).

1.1.4 Field QA/QC

1.1.4.1 Blanks

A thorough system of blanking is an essential element of monitoring. Much of the blanking processes are performed well in advance of the actual monitoring in order to demonstrate that all equipment expected to contact water is free of contaminants at the detection limits established for the program. Equipment components are cleaned in batches. Subsamples from each cleaning batch are rinsed with Type 1 laboratory blank water and submitted to the laboratory for analysis. If hits are encountered in any cleaning batch, the entire batch is put back through the cleaning and blanking process until satisfactory results are obtained. If contaminants are measured in the blanks, it is often prudent to reexamine the cleaning processes and equipment or materials used in the cleaning process. Equipment requiring blanks and the frequency of blanks is summarized below and in Table 2.

Table 2. Summary of Blanking Requirements for Field Equipment.

System Component	Blanking Frequency
Intake Hose	One per batch
Peristaltic Pump Hose	One per batch[1] or 10% for batches greater than 10
Composite Bottles	One per batch or 10% for batches greater than 10
Subsampling Pump Hose	One per batch or 10% for batches greater than 10
Laboratory Sample Containers	2% of the lot[2] or batch, minimum of one
Capsule Filter Blank[3]	One per batch or 10% for batches greater than 10
Churn/Cone Splitter[4]	When field cleaning is performed, process one blank per session

[1] A batch is a group of samples that are cleaned at the same time and in the same manner.

[2] If decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles.

[3] If filtration is performed in the laboratory, the capsule filter blanks would be considered part of laboratory QA/QC.

[4] This is applicable to use of a churn or cone splitter to subsample flow-weighted composite samples into individual containers. Splitting may be performed by the sampling team in a protected, clean area or by the laboratory.

1.1.4.2 Field Duplicates

Composite subsampling duplicates associated with flow-weighted composite samples are often referred to as field duplicates but, in fact, they are subsampling replicates. These replicates help assess combined variability associated with subsampling from the composite container and variability associated with the analytical process. They are evaluated against the same criteria as used for laboratory duplicates.

1.1.5 Equipment Cleaning, Blanking and Tracking

Sample collection, handling, and processing materials can contribute and/or sorb trace elements within the time scales typical for collection, processing and analysis of runoff samples. Sampling artifacts are especially important when measured concentrations that are at or near analytical detection limits (Horowitz 1997). Therefore, great care is required to collect and process samples in a manner that will minimize potential contamination and variability in the sampling process (Breault and Granato 2000).

Sampling conducted to measure dissolved metals and other trace contaminants at levels relevant to EPA water quality criteria requires documentation that all sampling equipment is free of contamination and that the processes used to obtain and handle samples do not introduce contamination. This requires documentation that methods used to collect, process and analyze the samples do not introduce contamination. Documentation for the CIMP includes written procedures provided in Appendix B for cleaning all components of the sampling system, blanking processes necessary to verify that system components and sample handling are not introducing contamination, and a system of tracking deployment of protocol-cleaned equipment in the field as described in this section.

All composite containers and equipment used for sample collection in the field and/or sample storage in the laboratory will be decontaminated and cleaned prior to use. These include the FEP tubing, Teflon® lids, strainers and hoses/fittings that are used in the subsampling process (USGS 1993). Personnel assigned to clean and handle the equipment are thoroughly trained and familiar with the cleaning, blanking, and tracking procedures. In addition, all field sampling staff will be trained to be familiar with these processes so that they have a better understanding of the importance of using clean sampling procedures and the effort required to eliminate sources of contamination.

Sample contamination has long been considered one of the most significant problems associated with measurement of dissolved metals and may be accentuated with use of High Resolution Mass Spectroscopy (HRMS) methods for trace levels of organic constituents at levels three orders of magnitude lower than conventional GCMS methods. One of the major elements of QA/QC documentation is establishing that clean sampling procedures are used throughout the process and that all equipment used to collect and process the water samples are free of contamination.

Cleaning protocols are consistent with ASTM (2008) standard D5088 – 02 that covers cleaning of sampling equipment and sample bottles. The generalized cleaning process is based upon a series of washings that typically start with tap water with a phosphate-free detergent, a tap water rinse, soaking in a 10% solution of reagent grade nitric acid, and a final series of rinses with ASTM Type 1 water. Detailed procedures for decontamination of sampling equipment are provided in Appendix A. In addition, Appendix G of the most recent Caltrans Stormwater Monitoring Guidance Manual (Caltrans, 2013) provides alternative cleaning procedure that incorporate use of methylene chloride to remove potential organic contaminants. Experience indicates that this step can be eliminated and still result in blanking data suitable for most target organic contaminants. Addition of this cleaning step or a comparable step to address organic contaminants may be necessary if satisfactory equipment blanks cannot be attained. Significant issues exist with respect to use of methylene

chloride. This chemical is highly toxic, must be handled and disposed as a hazardous waste and is difficult to fully remove from the 20-L media bottles used as composite containers.

In order to account for any contamination introduced by sampling containers, blanks must be collected for composite bottles and laboratory bottles used for sample storage for trace contaminants. A sampling container blank is prepared by filling a clean container with blank water and measuring the concentrations of selected constituents (typically metals and other trace contaminants for composite bottles and metals analysis only for metals storage bottles). Blanking of the 20-L composite bottles will be performed by using the minimum amount of blank water necessary for the selected analytical tests. This is typically requires one to two liters. The bottle is capped and then manipulated to assure that all surfaces up to the neck of the bottle are rinsed. The water is then be allowed to sit for a minimum of one hour before decanting the rinse water into sample containers. In order to provide adequate control, media bottles are labelled and tracked. All media bottles cleaned and blanked in one batch are tracked to allow for recall if laboratory analyses reveal any contamination. Further tracking is required in the field to document where bottles from each cleaning batch are used and to assist in tracking of any contamination that might be detected after bottles have been deployed since laboratory turnaround in the middle of the storm season may require use of decontaminated bottles prior to receiving the results of the blank analyses.

Selected constituents for blanking will be dependent upon the list of contaminants with reasonable potential to be present at levels that could impact sample results. Minimum parameters used for blank analyses will include total recoverable trace metals, TDS, TOC and nutrients. Analysis of total metals will allow for detection of any residual metal contamination which will be of concern for all sampling. Nutrients, particularly nitrogen compounds, will assure that residual nitrogen from acid cleaning has been fully removed. TDS and TOC are useful for accessing presence of any residual contaminants. Additional blanking may be added when sampling other constituents with ultra-low analytical methods. These blanks may be submitted "blind" to the laboratory by field personnel or prepared internally by the laboratory.

Certified pre-cleaned QC-grade laboratory containers can be used. These bottles are cleaned using acceptable protocol for the intended analysis and tracked by lots. They come with standard certification forms that document the concentration to which the bottles are considered "contaminant-free" but these concentrations are not typically suitable for program reporting limits required for measurement of dissolved metals. Manufacturers may provide an option of certification to specific limits required by a project but it is preferable to purchase the QC bottles that are tracked by lot and conduct internal blanking studies. Lots not meeting project requirements should be returned to the manufacturer and exchanged for containers from another lot. At least 2% of the bottles in any "lot" or "batch" should be blanked at the program detection limits with a minimum frequency of one bottle per batch. A batch is considered to be a group of samples that are cleaned at the same time and in the same manner; or, if decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles. Cleaned bottles are stored in a clean area with lids properly secured.

Subsampling hoses consist of a length of peristaltic hose with short lengths of FEP tubing attached to each end. These are required to be cleaned inside and out since the FEP tubing is immersed in the

composite bottle during the subsampling process. Once cleaned, the ends of the subsampling hoses are bagged. All hoses associated with the batch are then stored in large zip-lock containers labeled to identify the cleaning batch. Blanking of subsampling hoses is conducted as part of the composite bottle blanking process. A clean subsampling hose is used to decant blank water from the 20-L composite bottles into clean laboratory containers. Detection of any contaminants in the bottle blanks therefore requires that the subsampling hoses also are subjected another decontamination process. After cleaning, the subsampling hoses should only be handled while wearing clean, powder-free nitrile gloves.

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APPENDIX D

NON-STORMWATER IC/ID AND OUTFALL TRACKING

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Operation Procedures	
Illicit Discharge Detection & Elimination: Initial Outfall Screening	
Purpose:	This provides a basic checklist for field crews conducting initial survey of storm drainage system outfalls for use in identification of illicit discharges

Reference: Brown et al., *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments,* Center for Watershed Protection, Ellicott City, 2004.

Planning Considerations:

- ❑ Employees should have reviewed and understand the information presented in Chapter 11 of the reference manual
- ❑ Inspections are to occur during dry weather (no runoff producing precipitation in last 72 hours)
- ❑ Conduct inspections with at least two staff per crew
- ❑ Conduct inspections during low groundwater (if appropriate).
- ❑ Complete ***Site Info section on Outfall Reconnaissance Inventory Form*** before leaving the office. Additional forms should be available for undocumented outfalls

Field Methods:

- ❑ Ensure outfall is accessible.
- ❑ Inspect outfall only if safe to do so.
- ❑ Characterize the outfall by recording information on the ***LCC Outfall Reconnaissance Inventory Form.***
- ❑ Photograph the outfall with a digital camera (use dry erase board to identify outfall).
- ❑ Enter flow information on form if dry weather flow is present and ***easily*** obtained. If not, provide rough estimate of flow.
- ❑ Document clean, dry outfalls for potential elimination during future screening programs.
- ❑ Water samples will not be collected during the initial survey. In-situ measurements of temperature, conductivity, and pH should be taken if significant flow is present.
- ❑ Do not enter private property without permission.
- ❑ Photograph each site with the site identification written on the dry erase board.

Equipment List:

1. System map
2. Outfall Reconnaissance Inventory Forms
3. City identification or business cards
4. Digital camera (spare batteries)
5. Cell phone
6. GPS unit
7. Clip board and pencils
8. Dry erase board and pens
9. Hand Mirror
10. Flashlight (spare batteries)
11. Disposable gloves
12. Folding wood ruler or comparable
13. Temperature, Conductivity probe
14. pH probe/strips
15. ***Ammonia test strips***
16. ***Ten1-liter (polyethylene) sample bottles***
17. Watch with second hand
18. Calculator
19. Hand sanitizer
20. Safety vests
21. First aid kit
22. ***Cooler***
23. Permanent marker

Bolded, italicized items will only be needed for later surveys. No water quality samples will be taken for laboratory analysis during the first survey.

LOWER LONG BEACH ESTUARIES OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subbasin:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

☐ Industrial ☐ Open Space

☐ Ultra-Urban Residential ☐ Institutional

☐ Suburban Residential Other: _____

☐ Commercial Known Industries: _____

Notes (e.g.., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Elliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Yes ☐ No	***If No, Skip to Section 5***			
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Meter
pH			pH Units	Meter
Ammonia			mg/L	Test strip

Lower Long Beach Estuaries Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No (*If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No (*If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

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APPENDIX E

MAJOR AND MINOR OUTFALLS IN THE LOWER LONG BEACH ESTUARIES

(Los Ceritos Channel, Alamitos Bay and San Gabriel River Estuaries)

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Major Outfalls (>36 inches) in the Lower Long Beach Estuaries

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
SAN GABRIEL RIVER	33.75782	-118.09867	SAN GABRIEL RIVER / S/O 2ND ST	UNK (HEADWALL)	-264		ACTV
SAN GABRIEL RIVER	33.74893	-118.11026	SAN GABRIEL RIVER /	UNK (HEADWALL)	-267		ACTV
SAN GABRIEL RIVER	33.74903	-118.11011	SAN GABRIEL RIVER /	UNK (HEADWALL)	-268		ACTV
SAN GABRIEL RIVER	33.74663	-118.11280	MARINA DR / SAN GABRIEL RIVER	UNK (HEADWALL)	-269		ACTV
SAN GABRIEL RIVER	33.74484	-118.11355	SAN GABRIEL RIVER / S/O MARINA DR	UNK (HEADWALL)	-270		ACTV
ALAMITOS BAY	33.74508	-118.11685	OCEAN BLVD / 72ND PL	UNK (HEADWALL)	-309		ACTV
BOUTON CREEK	33.78582	-118.12016	BOUTON CREEK DR / EARL WARREN DR	UNKNOWN	-368		ACTV
LOS CERRITOS CHANNEL	33.77954	-118.10340	STUDEBAKER RD / 9TH ST	36'' DISCHARGE	72-T12	36	ACTV
ALAMITOS BAY	33.75574	-118.11234	ALAMITOS BAY / BASIN NO. 3	36'' DISCHARGE	25-S05	36	ACTV
LOS CERRITOS CHANNEL	33.76718	-118.12503	5517 CHINA PT	36'' DISCHARGE	-166	36	ACTV
BOUTON CREEK	33.78774	-118.12747	ATHERTON ST / TULANE AVE	36'' DISCHARGE	-376	36	ACTV
BEACH	33.75890	-118.14808	39TH PL / ALLIN ST	39" DISCHARGE	-113	39	ACTV
ALAMITOS BAY	33.75261	-118.10891	ALAMITOS BAY / BASIN NO. 3	39'' DISCHARGE	-149	39	ACTV
LOS CERRITOS CHANNEL	33.76607	-118.12162	5950 WATERFRONT PL	39'' DISCHARGE	-168	39	ACTV
LOS CERRITOS CHANNEL	33.77454	-118.10396	LOS CERRITOS CHANNEL / 7TH ST	39'' DISCHARGE	-177	39	ACTV
SIMS POND	33.76884	-118.11812	357 SEVILLE WAY	39" DISCHARGE	-398	39	ACTV
ALAMITOS BAY	33.75887	-118.12950	201 BAY SHORE AVE	5-8" DISCHARGE	-163	40	ACTV
LOS CERRITOS CHANNEL	33.76456	-118.11996	6138 CORSICA CIR	42'' DISCHARGE	83-R8	42	ACTV
LOS CERRITOS CHANNEL	33.77759	-118.10388	6491 BIXBY HILL RD	42'' DISCHARGE	4-T11	42	ACTV
LOS CERRITOS CHANNEL	33.76275	-118.11532	6264 PACIFIC COAST HWY	42'' DISCHARGE	16-S07	42	ACTV
BOUTON CREEK	33.78148	-118.11156	6251 STATE UNIVERSITY DR	42" DISCHARGE	-420	42	ACTV
COLORADO LAGOON	33.77172	-118.13193	MONROVIA AVE / 4TH ST	48'' DISCHARGE	51-Q10	48	ACTV
LOS CERRITOS CHANNEL	33.77477	-118.10343	LOS CERRITOS CHANNEL / 7TH ST	48'' DISCHARGE	35-T11	48	ACTV
COLORADO LAGOON	33.77192	-118.13684	PARK AVE / 4TH ST	48" DISCHARGE	66-P10	48	ABND
SAN GABRIEL RIVER	33.77495	-118.09825	6930 SEPTIMO ST	48'' DISCHARGE	-263	48	ACTV
BOUTON CREEK	33.78624	-118.12100	BOUTON CREEK / E/O BELLFLOWER BLVD	48'' DISCHARGE	-369	48	ACTV
BIXBY GOLF COURSE POND	33.76955	-118.11662	6180 BIXBY VILLAGE DR	48" DISCHARGE	-401	48	ACTV
BEACH	33.76244	-118.16156	OCEAN BLVD / MOLINO AVE	51'' DISCHARGE	44-L7	51	ACTV
BEACH	33.75993	-118.15079	36TH PL / OCEAN BLVD	54" DISCHARGE	2-M6	54	ACTV
COLORADO LAGOON	33.77335	-118.13257	6TH ST / NIETO AVE	54'' DISCHARGE	9-Q10	54	ACTV
LOS CERRITOS CHANNEL	33.76755	-118.10450	LOS CERRITOS CHANNEL FC / LOYNES DR	60'' DISCHARGE	29-T09	60	ACTV
LOS CERRITOS CHANNEL	33.76753	-118.12492	SPINNAKER BAY DR / ELIOT ST	60'' DISCHARGE	-167	60	ACTV
COLORADO LAGOON	33.77273	-118.13635	6TH ST / ALLEY E/O PARK AVE	63'' DISCHARGE	6-P10	63	ACTV
LOS CERRITOS CHANNEL	33.76350	-118.11578	LOS CERRITOS CHANNEL / COSTA DEL SOL	64" DISCHARGE	5-S07	64	ACTV

Major Outfalls (>36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
BOUTON CREEK	33.78698	-118.13803	4645 PACIFIC COAST HWY	69" DISCHARGE	-412	69	ACTV
MARINE STADIUM	33.76775	-118.12992	PAOLI WAY / MARINA PARK LN	72" DISCHARGE	15-Q8	72	ABND
BOUTON CREEK	33.78785	-118.12858	ATHERTON ST / LITCHFIELD AVE	72'' DISCHARGE	-377	72	ACTV
LOS CERRITOS CHANNEL	33.78127	-118.10342	STUDEBKAER RD / ANAHEIM RD	81'' DISCHARGE	-178	81	ACTV
ALAMITOS BAY	33.75368	-118.13080	5437 OCEAN BLVD	1-36" & 2-30" & 1-6" DISCHARGE	-161	36	ACTV
MARINE STADIUM	33.76765	-118.12983	PAOLI WAY / MARINA PARK LN	108" DISCHARGE	-22	108	ACTV
BOUTON CREEK	33.80229	-118.13412	CLARK AVE / VERNON ST	120'' DISCHARGE	-392	120	ACTV
BOUTON CREEK	33.79526	-118.13415	5090 LOS COYOTES DIA	132'' DISCHARGE	-387	132	ACTV

Minor Outfalls (12-36 inches) in the Lower Long Beach WMP

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
RIVO ALTO CANAL	33.75273	-118.12346	219 RIVO ALTO CAN	12'' DISCHARGE	62-R4D	12	ACTV
LOS CERRITOS CHANNEL	33.76571	-118.10314	STUDEBAKER RD / LOYNES DR	12" DISCHARGE	8-T08	12	ACTV
RIVO ALTO CANAL	33.75290	-118.12348	218 RIVO ALTO CAN	12'' DISCHARGE	69-R4D	12	ACTV
RIVO ALTO CANAL	33.75568	-118.12460	RIVO ALTO CAN /	12" DISCHARGE	-135	12	ACTV
RIVO ALTO CANAL	33.75562	-118.12352	89 RIVO ALTO CAN	12" DISCHARGE	-136	12	ACTV
RIVO ALTO CANAL	33.75559	-118.12338	93 RIVO ALTO CAN	12'' DISCHARGE	-137	12	ACTV
RIVO ALTO CANAL	33.75542	-118.12343	129 RIVO ALTO CAN	12" DISCHARGE	-140	12	ACTV
RIVO ALTO CANAL	33.75516	-118.12242	118 RIVO ALTO CAN	12" DISCHARGE	-141	12	ACTV
ALAMITOS BAY	33.75085	-118.11345	225 MARINA DR	12'' DISCHARGE	-143	12	ACTV
LOS CERRITOS CHANNEL	33.76840	-118.10419	6238 MARIQUITA ST	12'' DISCHARGE	-169	12	ACTV
LOS CERRITOS CHANNEL	33.76956	-118.10407	6333 ELIOT ST	12'' DISCHARGE	-170	12	ACTV
LOS CERRITOS CHANNEL	33.77030	-118.10407	6333 COLORADO ST	12'' DISCHARGE	-172	12	ACTV
LOS CERRITOS CHANNEL	33.77104	-118.10407	6333 VERMONT ST	12'' DISCHARGE	-173	12	ACTV
LOS CERRITOS CHANNEL	33.77180	-118.10404	LOS CERRITOS CHANNEL / 5TH ST	12'' DISCHARGE	-174	12	ACTV
BOUTON CREEK	33.78682	-118.12262	BOUTON CREEK / BELLFLOWER BLVD	12'' DISCHARGE	-370	12	ACTV
CHANNEL W/O CLARK AVE	33.79654	-118.13413	2209 CLARK AVE	12'' DISCHARGE	-388	12	ACTV
MARINE STADIUM	33.76044	-118.11976	MARINE STADIUM / MARINA DR	15'' DISCHARGE	100-R6	15	ACTV
MARINE STADIUM	33.76779	-118.12786	BOATHOUSE LN / ELIOT ST	15'' DISCHARGE	27-Q9	15	ACTV
ALAMITOS BAY	33.75271	-118.11806	97 VISTA DEL GOLFO	15'' DISCHARGE	8-R4A	15	ACTV
RIVO ALTO CANAL	33.75338	-118.12150	171 RIVO ALTO CAN	15" DISCHARGE	18-R4A	15	ACTV
ALAMITOS BAY	33.74832	-118.11547	205 MARINA DR	15'' DISCHARGE	-114	15	ACTV
ALAMITOS BAY	33.74950	-118.11560	205 MARINA DR	15'' DISCHARGE	-115	15	ACTV

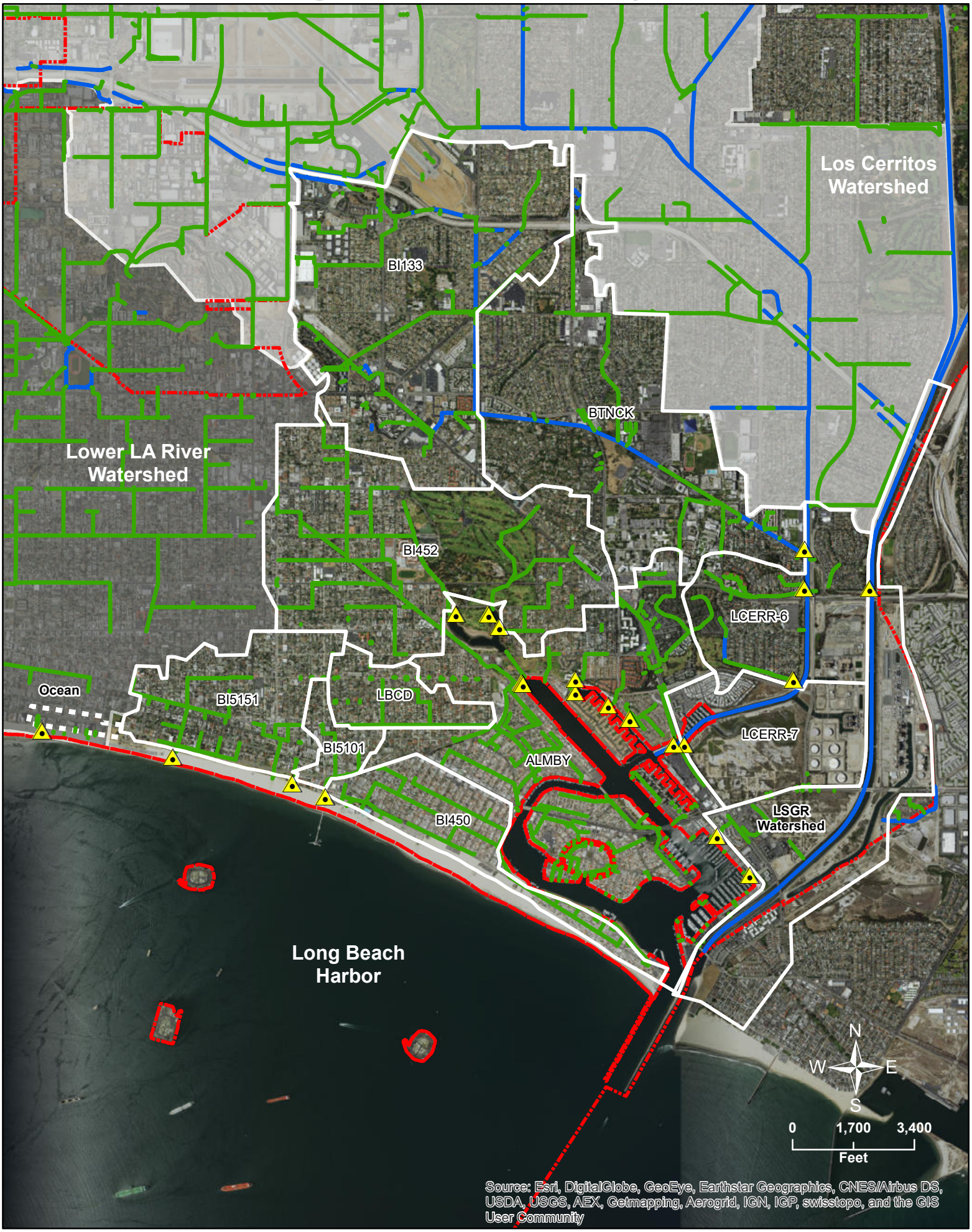
Minor Outfalls (12-36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
ALAMITOS BAY	33.74794	-118.11538	205 MARINA DR	15'' DISCHARGE	-116	15	ACTV
ALAMITOS BAY	33.74825	-118.11497	205 MARINA DR	15'' DISCHARGE	-117	15	ACTV
ALAMITOS BAY	33.74806	-118.11412	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-118	15	ACTV
ALAMITOS BAY	33.74875	-118.11339	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-119	15	ACTV
ALAMITOS BAY	33.74923	-118.11286	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-120	15	ACTV
SAN GABRIEL RIVER	33.74752	-118.11344	MARINA DR / SAN GABRIEL RIVER	15'' DISCHARGE	-121	15	ACTV
SAN GABRIEL RIVER	33.74790	-118.11308	MARINA DR / SAN GABRIEL RIVER	15'' DISCHARGE	-122	15	ACTV
ALAMITOS BAY	33.75078	-118.11322	225 MARINA DR	15'' DISCHARGE	-144	15	ACTV
ALAMITOS BAY	33.75100	-118.11293	225 MARINA DR	15'' DISCHARGE	-145	15	ACTV
ALAMITOS BAY	33.75100	-118.11033	ALAMITOS BAY / BASIN NO. 2	15'' DISCHARGE	-147	15	ACTV
ALAMITOS BAY	33.75168	-118.10920	ALAMITOS BAY / BASIN NO. 2	15'' DISCHARGE	-148	15	ACTV
ALAMITOS BAY	33.75314	-118.10952	ALAMITOS BAY / BASIN NO. 3	15'' DISCHARGE	-150	15	ACTV
ALAMITOS BAY	33.75231	-118.11430	APPIAN WAY / LIDO LN	15'' DISCHARGE	-151	15	ACTV
ALAMITOS BAY	33.75477	-118.11127	ALAMITOS BAY / BASIN NO. 3	15'' DISCHARGE	-152	15	ACTV
ALAMITOS BAY	33.75323	-118.11474	6201 APPIAN WAY	15'' DISCHARGE	-155	15	ACTV
ALAMITOS BAY	33.75423	-118.11585	APPIAN WAY / THE TOLEDO	15'' DISCHARGE	-156	15	ACTV
ALAMITOS BAY	33.75450	-118.11614	APPIAN WAY / THE TOLEDO	15'' DISCHARGE	-157	15	ACTV
ALAMITOS BAY	33.75517	-118.11688	APPIAN WAY / SAVONA WK	15'' DISCHARGE	-158	15	ACTV
ALAMITOS BAY	33.75587	-118.11654	APPIAN WAY / 2ND ST	15'' DISCHARGE	-159	15	ACTV
ALAMITOS BAY	33.75368	-118.13080	5437 OCEAN BLVD	1-36" & 2-30" & 1-6" DISCHARGE	-161	30	ACTV
ALAMITOS BAY	33.75656	-118.11713	2ND ST / MARINE STADIUM	2-24" & 2-18" & 1-6" DISCHARGE	-164	18	ACTV
ALAMITOS BAY	33.75656	-118.11713	2ND ST / MARINE STADIUM	2-24" & 2-18" & 1-6" DISCHARGE	-164	24	ACTV
MARINE STADIUM	33.75837	-118.11754	MARINA DR / MARINE STADIUM	15'' DISCHARGE	-165	15	ACTV
LOS CERRITOS CHANNEL	33.77107	-118.10338	LOS CERRITOS CHANNEL /	15'' DISCHARGE	-175	15	ACTV
BOUTON CREEK	33.78749	-118.12493	1492 BRYANT DR	15'' DISCHARGE	-375	15	ACTV
BOUTON CREEK	33.78778	-118.12785	1495 LA PERLA AVE	15'' DISCHARGE	-378	15	ACTV
CHANNEL W/O CLARK AVE	33.79793	-118.13412	2244 CLARK AVE	15'' DISCHARGE	-391	15	ACTV
ALAMITOS BAY	33.75258	-118.12711	5575 CORSO DI NAPOLI	16" DISCHARGE	-123	16	ACTV
CHANNEL W/O CLARK AVE	33.79262	-118.13416	CLARK AVE / GARFORD ST	16'' DISCHARGE	-384	16	ACTV
LOS CERRITOS CHANNEL	33.77606	-118.10395	6499 SADDLE RD	18'' DISCHARGE	15-T11	18	ACTV
LOS CERRITOS CHANNEL	33.78239	-118.10337	1229 STUDEBAKER RD	18'' DISCHARGE	26-T13	18	ACTV
ALAMITOS BAY	33.75588	-118.11248	ALAMITOS BAY / BASIN NO. 3	18'' DISCHARGE	-153	18	ACTV
LOS CERRITOS CHANNEL	33.76929	-118.10336	LOS CERRITOS CHANNEL /	18'' DISCHARGE	-171	18	ACTV
BOUTON CREEK	33.77832	-118.10534	881 RANCHO DR	18'' DISCHARGE	-362	18	ACTV

Minor Outfalls (12-36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
BOUTON CREEK	33.77867	-118.10603	6451 SHIRE WAY	18'' DISCHARGE	-363	18	ACTV
BOUTON CREEK DR	33.78056	-118.10976	940 HOLLY GLEN DR	18'' DISCHARGE	-367	18	ACTV
BOUTON CREEK	33.78731	-118.12397	1490 BRYANT DR E	18'' DISCHARGE	-374	18	ACTV
BOUTON CREEK	33.78798	-118.12985	1620 ELMFIELD AVE	18'' DISCHARGE	-379	18	ACTV
BOUTON CREEK	33.78798	-118.12990	1601 ELMFIELD AVE	18'' DISCHARGE	-380	18	ACTV
CHANNEL W/O CLARK AVE	33.79214	-118.13416	CLARK AVE / GARFORD AVE	18'' DISCHARGE	-383	18	ACTV
CHANNEL W/O CLARK AVE	33.79432	-118.13415	2102 CLARK AVE	18'' DISCHARGE	-385	18	ACTV
CHANNEL W/O CLARK AVE	33.79456	-118.13415	5002 LOS COYOTES DIA	18'' DISCHARGE	-386	18	ACTV
CHANNEL W/O CLARK AVE	33.79662	-118.13413	2200 CLARK AVE	18'' DISCHARGE	-389	18	ACTV
CHANNEL W/O CLARK AVE	33.79665	-118.13413	2200 CLARK AVE	18'' DISCHARGE	-390	18	ACTV
MARINE STADIUM	33.76081	-118.11975	MARINE STADIUM / MARINA DR	21" DISCHARGE	98-R6	21	ACTV
ALAMITOS BAY	33.76012	-118.12445	371 BAY SHORE AVE	21'' DISCHARGE	6-R6	21	ACTV
348 CALLE MARSEILLE	33.76851	-118.11845	SIMS POND	21" DISCHARGE	-397	21	ACTV
LOS CERRITOS CHANNEL	33.77720	-118.10340	LOS CERRITOS CHANNEL / BOUTON CREEK	24'' DISCHARGE	13-T11	24	ACTV
LOS CERRITOS CHANNEL	33.77398	-118.10338	LOS CERRITOS CHANNEL / 7TH ST	24'' DISCHARGE	2-T10	24	ACTV
LOS CERRITOS CHANNEL	33.77193	-118.10340	LOS CERRITOS CHANNEL /	24'' DISCHARGE	-176	24	ACTV
BOUTON CREEK	33.78831	-118.13326	5101 EL CEDRAL ST	24'' DISCHARGE	-381	24	ACTV
6180 BIXBY VILLAGE DR	33.76943	-118.11675	BIXBY GOLF COURSE POND	24" DISCHARGE	-400	24	ACTV
LOS CERRITOS CHANNEL	33.77513	-118.10395	LOS CERRITOS CHANNEL / SURREY DR	27'' DISCHARGE	57-T11	27	ACTV
LOS CERRITOS CHANNEL	33.78135	-118.10380	ANAHEIM RD / STUDEBAKER RD	27'' DISCHARGE	21-T12	27	ACTV
ALAMITOS BAY	33.75690	-118.11599	2ND ST / MARINE STADIUM	27" DISCHARGE	35-S06	27	ACTV
ALAMITOS BAY	33.75093	-118.11045	ALAMITOS BAY / BASIN NO. 2	27'' DISCHARGE	-146	27	ACTV
BOUTON CREEK	33.78003	-118.10871	910 HOLLY GLEN DR	27'' DISCHARGE	-366	27	ACTV
LOS CERRITOS CHANNEL	33.78147	-118.10386	ANAHEIM RD / STUDEBKAER RD	29'' DISCHARGE	26-T12	29	ACTV
BEACH	33.76035	-118.15274	OCENA BLVD / REDONDO AVE	30" DISCHARGE	11-M6	30	ACTV
LOS CERRITOS CHANNEL	33.76746	-118.10473	LOS CERRITOS CHANNEL / LOYNES DR	30'' DISCHARGE	6-T08	30	ACTV
ALAMITOS BAY	33.75998	-118.12841	261 BAY SHORE AVE	30" DISCHARGE	-162	30	ACTV
BOUTON CREEK	33.77973	-118.10810	BOUTON CREEK / PALO VERDE AVE	30'' DISCHARGE	-365	30	ACTV
BOUTON CREEK	33.78702	-118.12318	1720 BELLFLOWER BLVD	30'' DISCHARGE	-371	30	ACTV
BOUTON CREEK	33.78720	-118.12367	BOUTON CREEK / BELLFLOWER BLVD	30'' DISCHARGE	-372	30	ACTV
BOUTON CREEK	33.78701	-118.12315	BOUTON CREEK / BELLFLOWER BLVD	30'' DISCHARGE	-373	30	ACTV
BOUTON CREEK	33.78837	-118.13392	1661 GREENBRIER RD	30'' DISCHARGE	-382	30	ACTV
ALAMITOS BAY	33.75812	-118.12886	5425 SORRENTO DR	4-16" DISCHARGE	-395	16	ACTV
356 SEVILLE WAY	33.76888	-118.11786	SIMS POND	30" DISCHARGE	-399	30	ACTV

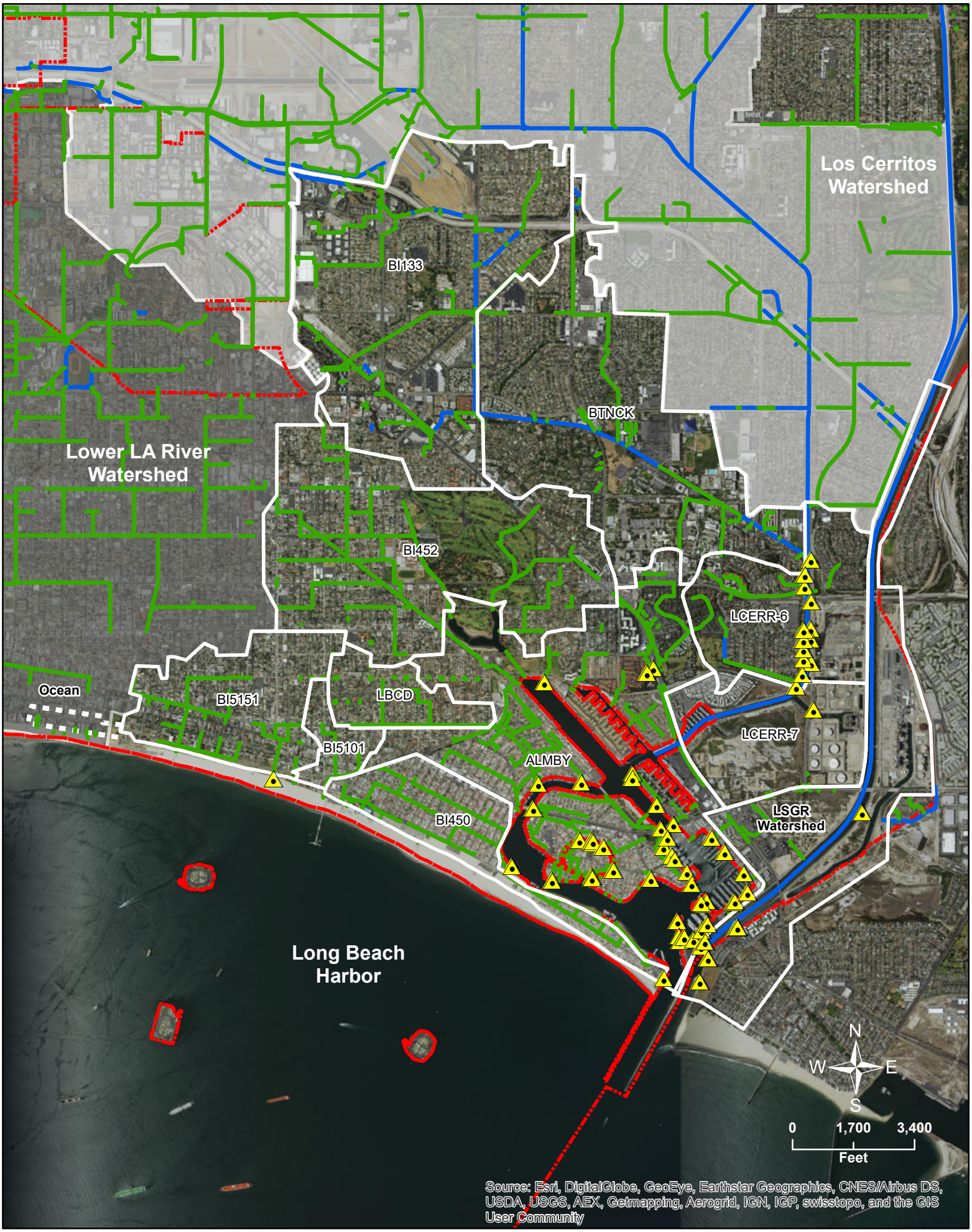
Lower Long Beach IMP Major Outfalls



KINNETIC LABORATORIES, INC.

Date: 7/1/2016

Lower Long Beach IMP Minor Outfalls To Receiving Water



KINNETIC LABORATORIES, INC.

Date: 7/1/2016

APPENDIX F

GENERAL FIELD SAMPLING PROCEDURES FOR

COMPOSITE AND GRAB SAMPLES

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GENERAL FIELD SAMPLING PROCEDURE FOR:

Composite Samples

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) "composite" sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the "composite" bottle (or bottles). In order to prevent confusion, it should be noted that the bottles are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these "composite" bottles.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS composite sample bottles.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The compositing and sub-sampling of composite sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 DEFINITIONS

4.1 "Composite" sample bottle: A borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 Large-capacity stirrer: Electric motorized "plate" that supports composite bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 Stir-bar: Pre-cleaned teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a composite bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample.

4.4 Sub-sampling hose: Two pre-cleaned ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Used with a peristaltic pump to transfer sample water from the composite sample bottle to sample analyte containers.

4.5 Volume-to-Sample Ratio (VSR): A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes the flow-meter the sampler collects a

sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus:

1) Large capacity stirrer.

2) Stir bar.

3) Sub-sampling hose.

4) Peristaltic pump.

5.4 Documentation: Information from the field logbook should include the volume-to-sample ratio for each composite sample bottle, each bottle's ID number, and the time of the last sample taken at a particular sampling site (for purposes of holding times). Previous documentation should exist for the cleaning batch numbers for the 20-L bottles and the sub-sampling hoses.

6.0 COMPOSITING AND SUB-SAMPLING PROCEDURES

Compositing sample water prior to sub-sampling may be necessary if more than one composite sample bottle was filled (or partially filled) during the course of a storm at a particular sampling site. Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the compositing is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling hose tips, dirty fingers/gloves, engine emissions, etc.) is increased significantly.

6.1 Determining the Fraction of Each Sample Bottle to be Composited: This is essential to producing a composite that is representative of the entire storm sampled and is not biased/weighted toward the first part of the storm (Bottle 1) or the last part of the storm (last bottle). In general, either the bottles have been sampled using the same volume-to-sample ratio (VSR), <u>OR</u> the VSR has been increased for the Bottle 2 in order to prevent over-filling of another bottle; this happens when the amount of rainfall and resulting runoff volume was underestimated.

6.1.1 Consult the field logbook and confirm that the bottles are from the same sampling station. Inspect the bottles' "ID" tags and confirm that the volume-to-sample ratio (VSR) numbers are the same as in the logbook.

6.1.2 If both bottles have the same VSR then equal parts of each sample should be mixed.

6.1.3 If the VSR of Bottle 2 is double that of Bottle 1 then 2-parts from Bottle 2 should be mixed with 1-part from Bottle 1. This is because Bottle 1 is, in a sense, twice as concentrated as Bottle 2, having sampled half as much flow per sample aliquot.

6.1.4 If there are more than two bottles to composite simply follow the rules above but apply it to all three bottles. For example, if Bottles 1, 2, and 3 had VSRs of 100, 200, and 400, respectively, then the composite would be composed of 4-parts from Bottle 3, 2-parts from Bottle 2, and 1-part from Bottle 1.

6.1.5 Volume-to-Sample Ratios are typically multiples of each other and are rarely fractions of each other. This is simply to make compositing bottles with different VSRs easier.

6.1.6 Rarely does an instance occur in which the VSR of Bottle 1 is HIGHER than that of Bottle 2. The only reason for this would be if the runoff was grossly overestimated and "Sample Control" instructed a field crew to pull Bottle 1 early and lower the VSR for Bottle 2.

6.2 Determining Water Volume Needed and the Fate of Any Excess Water: Compositing multiple composite bottles can often be done using only those bottles, or may require "dirtying" or "sacrificing" a clean composite bottle. The different reasons are described below.

6.2.1 Determine sample volume needed: The minimum volume of sample water needed for filling the numerous sample analyte containers must be known, or calculated on the spot. This is done by simply adding up the volumes of all sample containers to be filled. If there is not enough sample water (after compositing) to fill all the containers then consult with the project manager to determine what the order of priority is for the analyses (i.e., in what order to fill the containers). It is also useful to know the absolute minimum sample volumes needed by the laboratory to perform each analysis; some sample containers may not need to be filled completely.

6.2.2 Determine if excess water is to be saved: If the composite bottles are mostly full then it is likely that much of the sample water will be left over from the sub-sampling process. In this case it is sometimes prudent to save the left over sample water (on ice) for several days in case problems occur with the laboratory and more water is needed. Always check with the project manager on this point because it <u>may</u> require dirtying (sacrificing) a clean composite bottle to make the composite in. If any excess water is not to be saved then compositing can always be done in the existing composite

sample bottles: while being homogenized on a stir plate the excess sample water is simply discarded (pumped out in a calculated fashion), making room for the final composite.

6.2.3 **Plan on making as large a composite as possible:** If, for example, only 8 liters of sample water are needed but there is enough water to make a higher volume composite then it is prudent to do so. This is to account for any accidental spills and, if required, to the save enough excess water for possible re-analysis. There generally will never be a need to make a composite greater than a single 20-L composite bottle.

6.2.4 **If only one composite bottle exists from a station:** Simply follow the procedures for sub-sampling into numerous sample containers described in Section 6.5.

6.3 **Compositing Without Saving Excess Water:** This procedure also applies to instances in which there may not be excess water. For the sake of clarity an example will be used to explain the following steps. In this example three 20-L composite bottles are involved in creating a composite: Bottle 1 has 20 liters of sample water and was filled at a Volume to Sample Ratio (VSR) of 100; Bottle 2 has 20 liters and a VSR of 200; Bottle 3 has 20 liters and a VSR of 400. Sample water will be composited in Bottle 3. Most bottles have 1 liter graduations; if some don't then sample depth must be used to figure the fraction of water to be transferred.

6.3.1 Carefully place Bottle 3 on a large spin plate and gently drop a pre-cleaned stir-bar into the bottle and adjust the speed of the spin plate to optimize the mixing of the sample water throughout the bottle. The speed at which the stir-bar is spun should be adjusted so that even mixing is achieved. Speeds that are too fast will create a large vortex within the composite bottle that can actually concentrate heavier particles and should be avoided. Settling on a particular speed is based on a subjective visual assessment of what speed produces the most even, random mixing throughout the composite bottle.

6.3.2 Install a pre-cleaned sub-sampling hose into a peristaltic pump. Carefully remove the plastic cover which protects the approximately 18 inches of its exterior surface which has been cleaned. Insert this end into Bottle 3. Uncap the other end of the sub-sampling hose and ready it over a waste bucket.

6.3.3 While being mixed on the stir plate pump 10 liters into the waste bucket, leaving 10 liters in Bottle 3. This is best performed by two people. One person is responsible for filling the waste bucket and one person is responsible for moving the intake tubing up and down in the water column of the composite sample and controlling the pump. Based on experimental

evidence, this up and down movement of the intake helps obtain (or, in this case discard) a more representative sample. This is because there can still be some stratification of heavier particles in the sample bottle despite the mixing created by the stirrer. The up and down movement of the intake tubing should be limited to 80-90 percent of the water depth and should never touch the bottom of the sample bottle.

6.3.4 Remove Bottle 3 from the stir plate and replace with Bottle 2 and insert a new stir-bar and mix as described in Section 6.3.1. Keeping the sub-sampling hose clean (avoid setting it down or bumping it into objects), insert the intake end into Bottle 2. Using the methods described in Section 6.3.3 pump only 5 liters from Bottle 2 into Bottle 3, making a total of 15 liters. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO ANY BOTTLE.**

6.3.5 Repeat the actions in Section 6.3.4 with Bottle 1, pumping only 2.5 liters of Bottle 1 into Bottle 3, making a total of 17.5 liters of composited water.

6.3.6 Note that this process cannot generate any excess composite water because there is none left from Bottle 3 that has not been contaminated in the waste bucket.

6.4 Compositing While Also Saving Excess Water: This is identical to the procedures described in Section 6.3 with one difference: the first 10 liters of Bottle 3 is pumped into a clean 20-L bottle instead of into a waste bucket. This "dirties" a fourth bottle but ensures that excess sample water can be kept and composited again, if desired.

6.5 Sub-sampling Composited Water into Sample Containers: This is the final stage in successfully filling a suite of sample analyte containers with composited water that is representative of an entire sampling event.

6.5.1 Place the composite bottle containing the composited water on the stir plate and achieve proper mixing.

6.5.2 Uncap and arrange all the sample containers to be filled in such a way that they can be easily filled. Due to the vibration of the peristaltic pump on the sub-sampling hose it takes a very steady hand to efficiently guide the stream of sample water into the containers. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO THE SAMPLE CONTAINERS.** It is often necessary to steady the sample containers with a second hand so they do not fall over.

7.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment, as per the are allowed to complete this task. . The Laboratory Supervisor is responsible for training

personnel in the proper procedures in composite sample bottle, teflon sample hose and silicon peristaltic tubing, and stir bar cleaning.

8.0 QUALITY ASSURANCE REQUIREMENTS

The composite sample bottles and sub-sampling hoses must have been evaluated ("blanked") for contaminants after their initial decontamination procedure.

GENERAL FIELD SAMPLING PROCEDURE FOR:

Grab Samples

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the procedures involved in the discrete manual sampling (grab sampling) of storm water for a nonpoint source (NPS) monitoring program. The purpose of these procedures is to ensure contaminant free samples, and to ensure the safety of the personnel involved.

2.0 DEFINITIONS

2.1 Sample Containers – any EPA or laboratory specified clean container that is used to collect sample water.

2.2 Grab Pole – used to obtain grabs from locations where it is impossible or too dangerous (fast current, storm drain pipe, etc.) to manually obtain a sample.

3.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment are allowed to complete this task. Training needs to include the proper sampling techniques and station hazards that will be encountered while performing this task. The Project Manager is responsible for training personnel in these procedures.

4.0 EQUIPMENT

4.1 Instrumentation – see section 12.0 Physical Parameters

4.2 Reagents – preservatives will be supplied by the laboratory that supplies the sample bottles. Usually, the preservative is a concentrated acid (HNO_3, H_2SO_4, HCl or other).

4.3 Apparatus – a telescoping grab pole with a bottle holding device secured to one end. The bottle holding device is made of plastic and Velcro. It is designed to hold in place sample bottles of various sizes and types.

4.4 Documentation – time, date, location, number of containers and type of grab (whether for chemical analysis or physical parameters) must be noted in the station log book for that station.

5.0 PROCEDURES

Grab sampling methods will be discussed for the following analytes:

Metals and Total Cyanide

Oil and Grease

Fecal Coliform and Fecal Streptococci

Volatile Organic and Aromatic Compounds (VOA's)

Organic Compounds (Pesticides, PAHs, PCBs, SVOCs, etc.)

Physical Parameters

6.0 GRAB SAMPLING TECHNIQUES

6.1 Grab sampling may be conducted at any time during the storm event, depending upon the specific project requirements. The type of grab study might vary as the storm season progresses and the scope requirements deem necessary. These might include:

6.1.1 **Discrete Grabs** – Taken once during the storm event at a predetermined time, usually at peak flow.

6.1.2 **Persistent Grabs** – A schedule of discrete grabs which continue through the end of the storm to show a rate of change over time.

6.1.3 **First Flush** – A type of discrete grab to be taken within the first thirty minutes of the storm event.

For the majority of grab sample studies, discrete grabs will be required. Grabs will be taken on the rising hydrocurve of the storm event and as close to peak stage as is feasible. The times of these grabs will be decided by the Storm Control and/or Shift Leader and will be relayed to the field crews.

6.2 Depending upon then type of analyte being sampled, the technique may vary but all sampling **MUST** follow these general rules to minimize contamination:

6.2.1 Grab bottles are to be filled as near to the intake as is safely possible.

6.2.2 When unable to obtain a sample near the intake, take one as near to the center of flow as possible or in an area of sufficient velocity to ensure good mixing

6.2.3 The field personnel taking grab samples must be standing downstream from the sample bottle when filling.

6.2.4 The mouth of the bottle must be facing into the current.

6.2.5 Raise and lower the bottle through the water column so the sample is not biased with only one level sampled.

6.2.6 Manhole sites and inaccessible stream sites are best sampled with a grab pole.

7.0 METALS AND TOTAL CYANIDE

Samples to be analyzed for metals and cyanide are grabbed in a plastic or Teflon® container. Metals and total cyanide will require a preservative in the container (see Section 4.2). These grabs require extra care so as to not overfill the container and spill out any of the preservative, or allow the preservative to come into contact with the skin.

Metals sample bottles contain an acid preservative (HNO_3) and total cyanide sample bottles contain a base (NaOH) for a preservative. When the grab container is being filled manually, the level of water can be watched so the container is not overfilled. When the sample cannot be taken by hand and must be taken with a grab pole, the filling becomes a bit more difficult. Lower the container with the grab pole and watch for escaping air bubbles when submerged. Pull the sample bottle out frequently to check the water level accumulated and quit filling when that level has reached the "shoulder" of the bottle. Be sure **NOT TO OVERFILL THE SAMPLE BOTTLE**; this would spill the preservative compromising the sample and possibly endangering the person sampling.

8.0 OIL AND GREASE

Oil and grease samples are very similar to metals in that the bottles contain preservative and **MUST NOT BE OVERFILLED**. Oil and grease analysis requires that the sample be taken in glass containers, usually amber and usually in duplicate (in case of breakage). Fill these containers in the same exact way as mentioned above for metals analysis.

9.0 FECAL COLIFORM AND FECAL STREPTOCOCCI

Fecal coliform and fecal streptococci are usually grabbed in bacteria bottles or urine analysis cups. They contain a residual chlorine removal preservative tablet and should be filled to the sample container fill line when sampling. Wear protective gloves so that there is no skin contact with the interior of the container. The main precaution is not to contaminate the sample when opening the cup. Fill each cup completely and secure the cap.

10.0 VOLATILE ORGANIC AND AROMATIC COMPOUNDS (VOA'S)

Collecting water for Volatile Organic Compounds (VOA) requires extreme care. VOA's volatilize (enter the gaseous phase very quickly), thus, sample vials are designed to prevent this. These vials will leave no headspace (air bubbles) in a properly filled container because they have a septa cap , thereby minimizing loss of analyte to the atmosphere.

To fill a VOA vial, lower it into the water column and allow it to **FILL UP COMPLETELY** (until a water dome is formed over the top of the vial). VOA's must be preserved with HCl so take extra care not to spill any of this preservative. Very carefully place the septa cap onto the vial so no air is introduced, start with the cap tilted to one side and gently lower it until it is seated onto the threads of the vial and secure. Make sure there is no air in the vial by inverting the sample. If air bubbles show, a new sample must be taken using a new vial and the bad container and sample must be returned to the lab for proper disposal. **See Section 13.0 for additional precautions to be taken with VOA vials.**

11.0 ORGANIC COMPOUNDS (PESTICIDES, PAHs, PCBs, SVOCS, etc.)

Organic compound samples are collected in glass containers, usually amber. These samples generally do not require preservatives but should be filled in the same way as those collected for metals, and oil and grease analyses.

12.0 PHYSICAL PARAMETERS

Each time a station is visited during a storm event, certain physical parameters must be measured. Generally, at a minimum, pH and temperature are measured. Follow the instructions that are included with the field instrumentation used for the best results. There are many different brands of meters that require different techniques.

Take the measurements as close to the grab sampling point as possible while keeping safety a priority. A grab sample may be taken and analyzed somewhere more convenient and safe than the stream edge. Remember that the analysis on a grab sample should be performed "as soon as possible" to ensure as accurate measurements (pH, temperature, etc.) as possible. Record all results in the log book for that station and be sure to write in the units of measurement.

13.0 QUALITY CONTROL LIMITS

Grab sample containers must come from a reputable distributor and be certified clean for the analyte to be sampled. They must also be properly preserved and labeled prior to sampling. Transport the bottles in clean coolers accompanied with any required paperwork or instructions.

Immediately upon completion of sampling, return the sample bottles to a clean cooler and ice them down to 4°C. Recheck to be certain that all the information on the label is correct (date, time, location, analysis, preservative, etc.). Fill out the required paperwork and station log book sheets and transfer the samples to a predetermined pick-up location for the Analytical Laboratory.

13.1 For some storm sampling events, different Quality Assurance and Quality Controls (QA/QC) will be implemented. These will include:

13.1.1 Field Duplicates – Additional set of sample bottles grabbed at the same location and time as the actual sample. This sample may be given its own mock station identification and be submitted to the Analytical Laboratory blind.

13.1.2 Field Blanks – This is a full set of sample bottles (usually minus TSS and turbidity) containing reagent grade analyte free water provided by the Analytical Laboratory that will be doing the analysis. These samples are poured by hand from clean bottles containing the blank water into a labeled sample container. These sample bottles may be given a mock station identification and submitted blind as well.

13.1.3 Trip Blanks – Usually required for very sensitive samples (VOA's). The Analytical Laboratory will provide sample bottles already filled with reagent

grade analyte free water that will make the full "trip" from the lab, out into the field and back into the lab. **THESE CONTAINERS ARE NOT TO BE OPENED**.

Trip blanks are only analyzed if contamination is suspected. If analyzed and contamination is found, they usually warrant further investigation and subsequent sampling.

13.1.4 Matrix Spiking and Lab Replicates – These analyses can usually be taken from a sample bottle already sent into the field and do not require extra bottles, however, extra volume may be required at these stations.

13.2 While performing or preparing for grab sampling, be sure that no "outside" contamination will occur:

13.2.1 No engines are running in the general vicinity of sampling.

13.2.2 Sample containers are clean and intact.

13.2.3 Sample containers are properly labeled and meet bottle requirements for that analyte (size, type, preservative, type of cap liners, etc.).

13.2.4 Sample techniques are proper and safe.

13.3 Volatile Organic and Aromatic Compounds (VOA's) – require very special handling.

13.3.1 VOA vials are very fragile. Protect with adequate foam packing material.

13.3.2 VOA bottles should have no headspace (see Section 10.0). This means that they are subject to freezing. **Prevent direct contact of VOA vial with ice by using additional packaging.**

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APPENDIX G

REGIONAL DATA SOURCES

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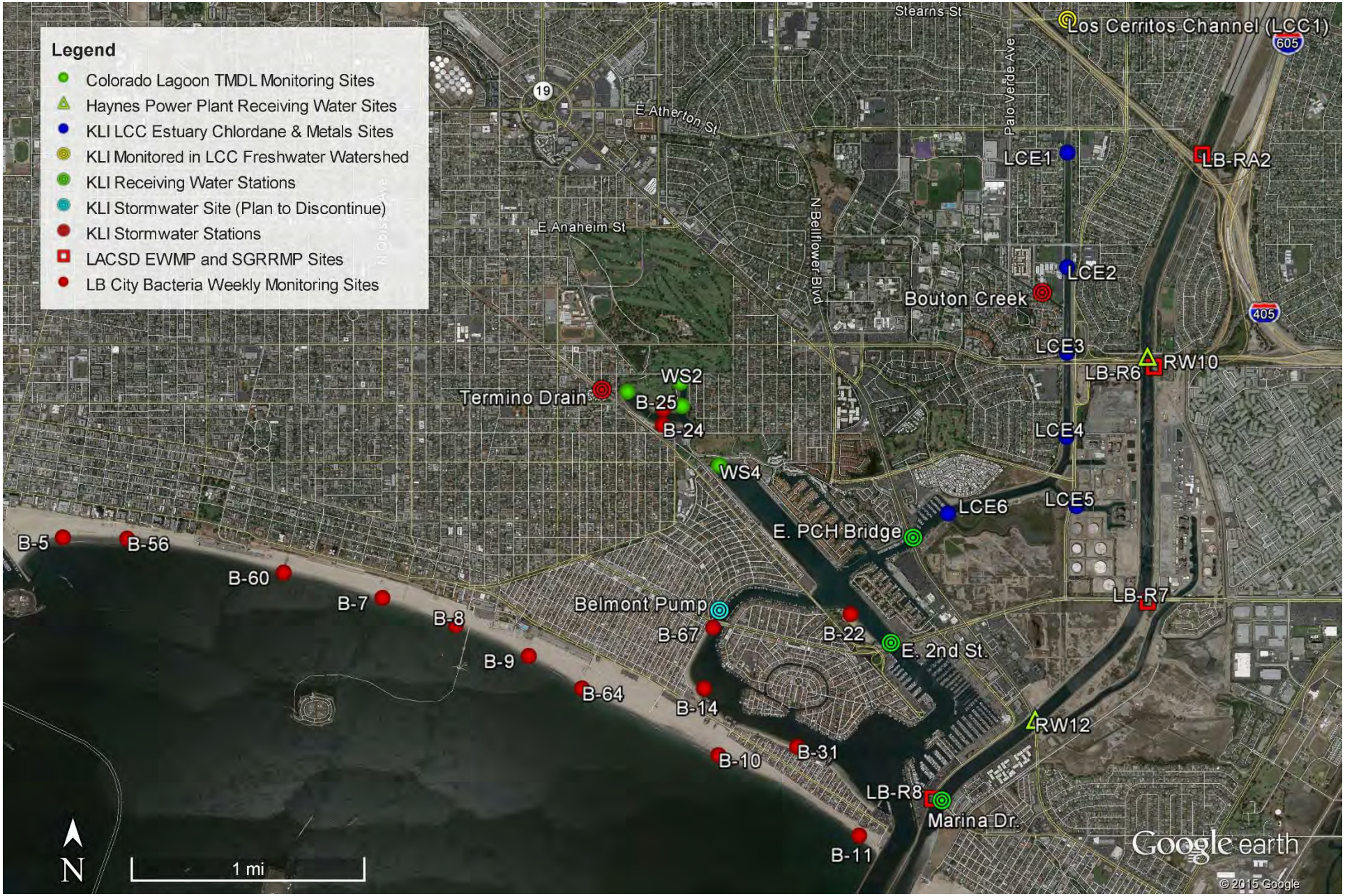
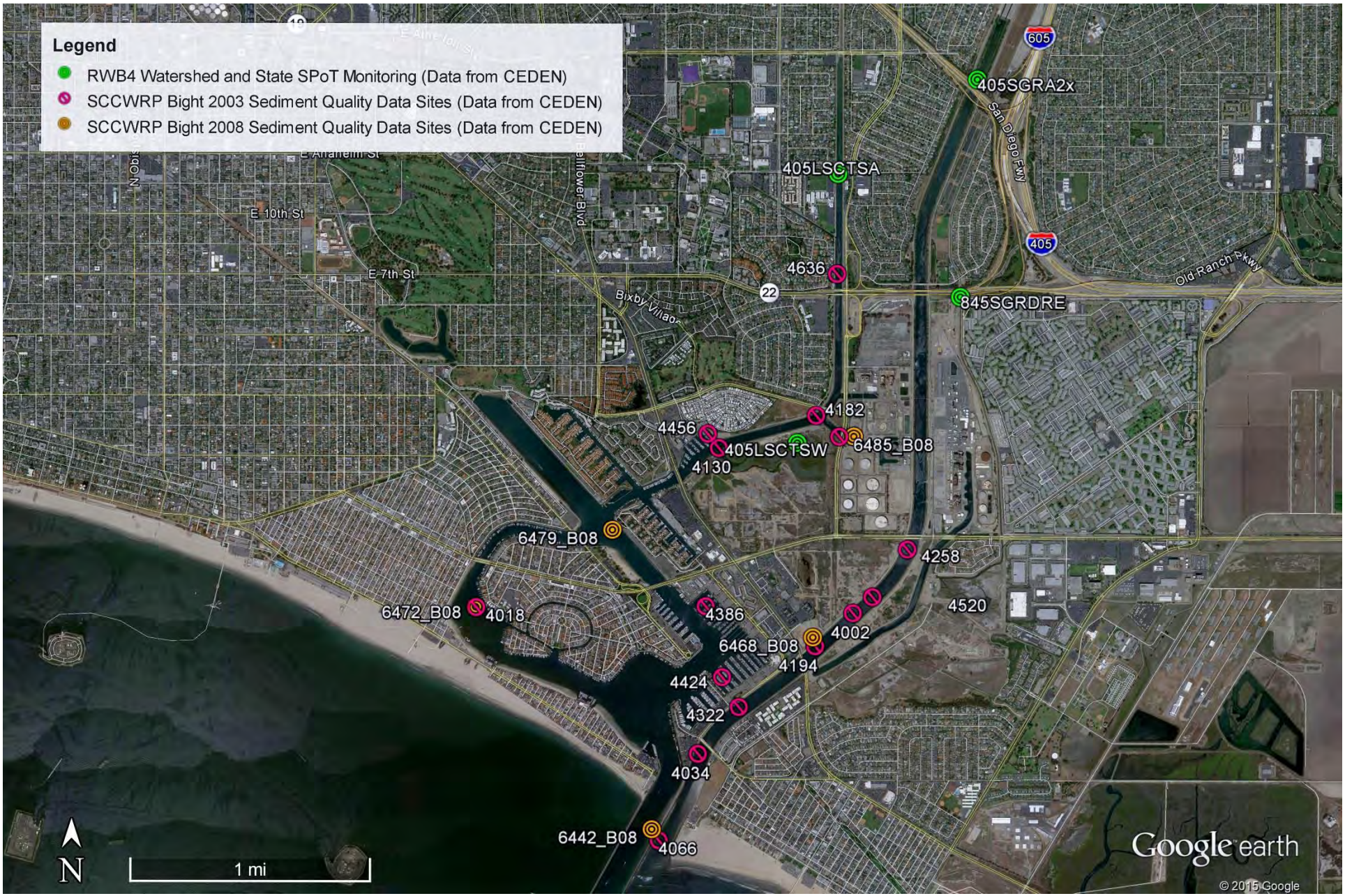
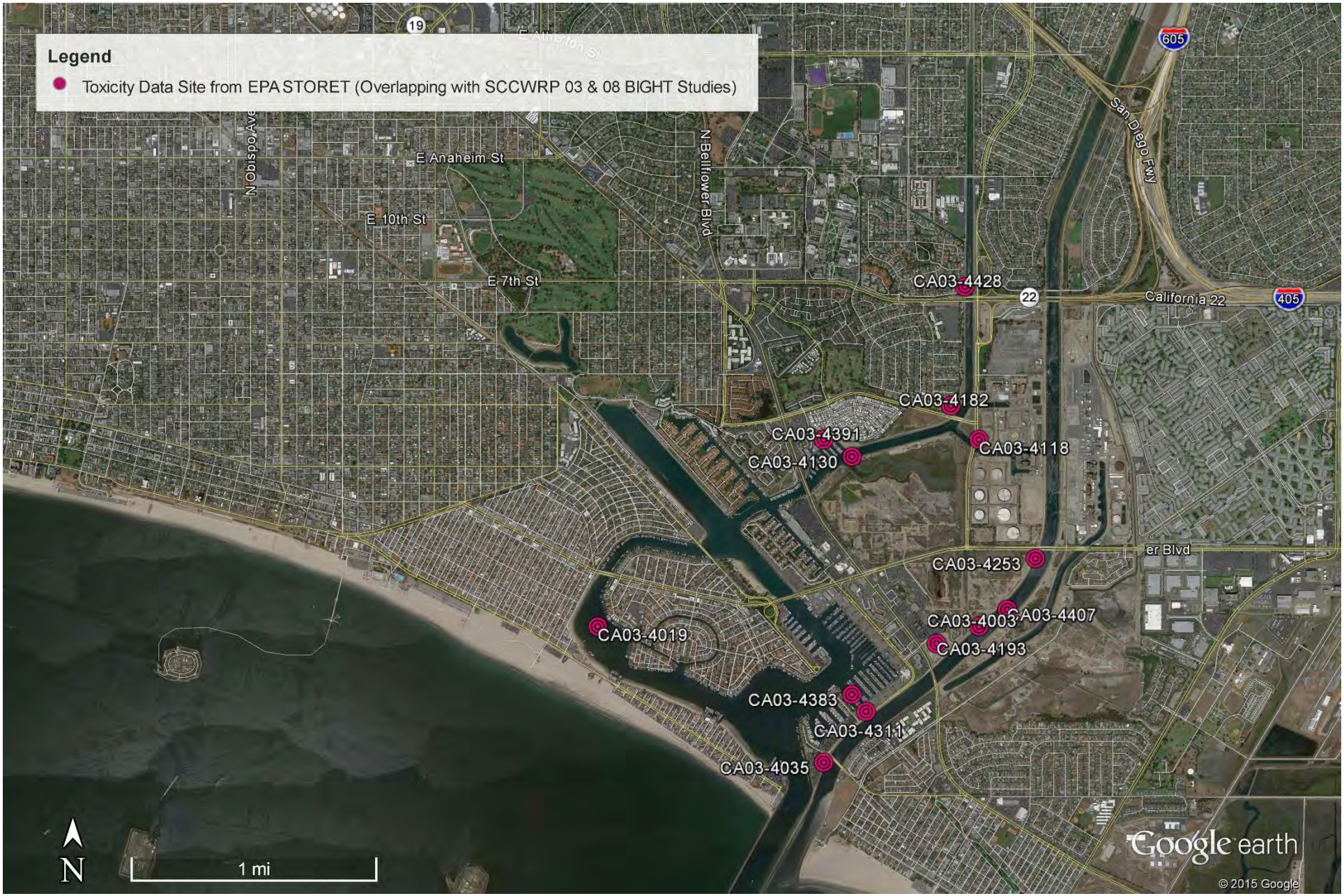
Station Map 1

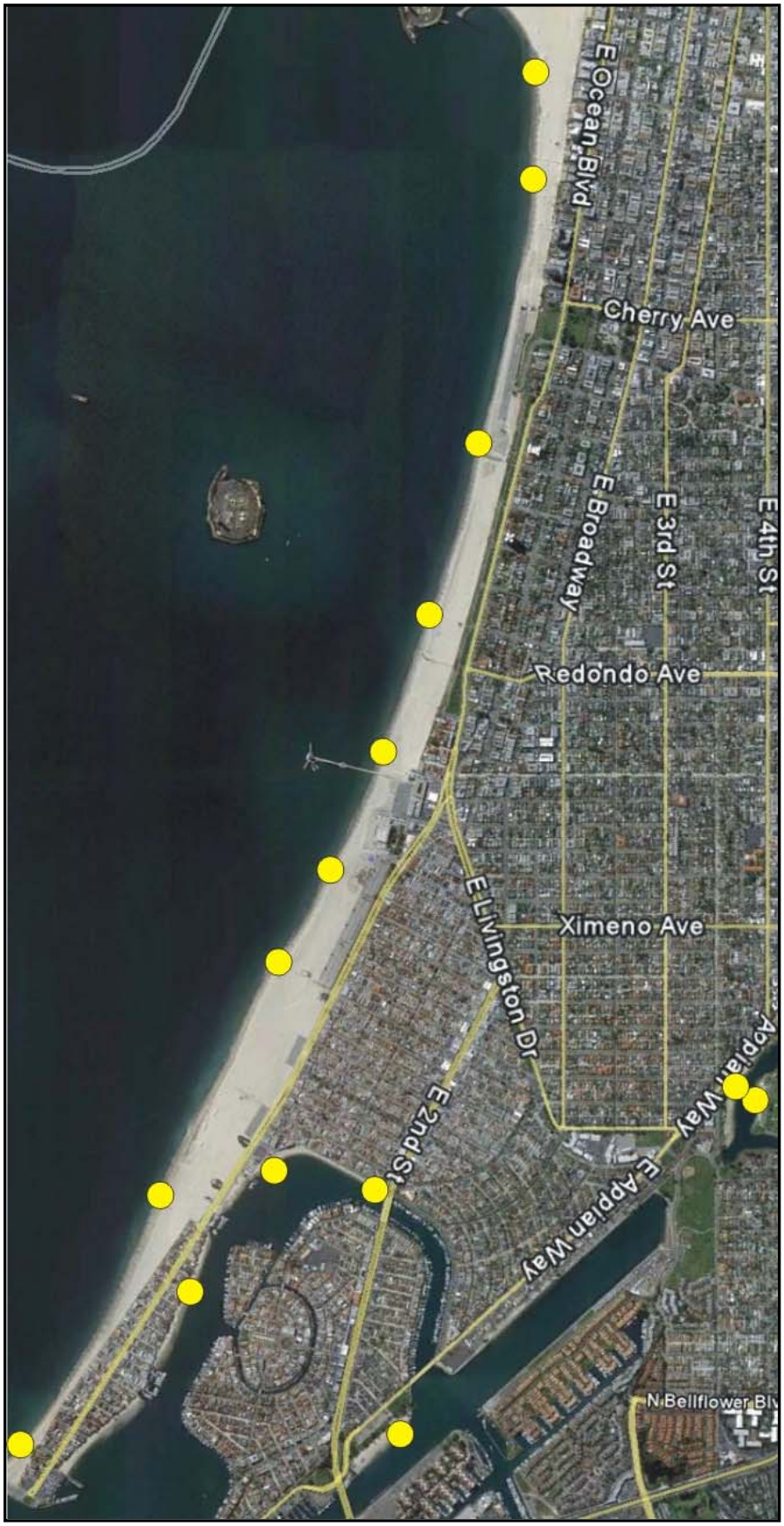


Station Map 2



Station Map 3





City of Long Beach Indicator Bacteria Monitoring Locations

LCC, AB, SGR Estuary Station Locations, Chemistry and Toxicity Data References, and Web Links	
The Southern California Coastal Water Research Project (SCCWRP) 2003 Bight Data	http://www.sccwrp.org/Data/SearchAndMapData/DataCatalog/Bight03Survey.aspx
The Southern California Coastal Water Research Project (SCCWRP) 2008 Bight Data	http://www.sccwrp.org/Data/SearchAndMapData/DataCatalog/Bight08Survey.aspx
City of Long Beach Stormwater Management Final Monitoring Reports & Shoreline Bacteria Data	http://www.longbeach.gov/pw/stormwater_management/reports.asp
1999-2000 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2000. City of Long Beach Stormwater Monitoring Report 1999-2000 NPDES Permit No. CAS004003 (CI 8052), July, 2000 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28563
2000-2001 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2001. City of Long Beach Stormwater Monitoring Report 2000-2001 NPDES Permit No. CAS004003 (CI 8052), July, 2001 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28564
2001-2002 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2002. City of Long Beach Stormwater Monitoring Report 2001-2002 NPDES Permit No. CAS004003 (CI 8052), July, 2002 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28565
2002-2003 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2003. City of Long Beach Stormwater Monitoring Report 2002-2003 NPDES Permit No. CAS004003 (CI 8052), July, 2003 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28566
2003-2004 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2004. City of Long Beach Stormwater Monitoring Report 2003-2004 NPDES Permit No. CAS004003 (CI 8052), July, 2004 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28571
2004-2005 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2005. City of Long Beach Stormwater Monitoring Report 2004-2005 NPDES Permit No. CAS004003 (CI 8052), July, 2005 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28567
2005-2006 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2006. City of Long Beach Stormwater Monitoring Report 2005-2006 NPDES Permit No. CAS004003 (CI 8052), July, 2006 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28568
2006-2007 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2007. City of Long Beach Stormwater Monitoring Report 2006-2007 NPDES Permit No. CAS004003 (CI 8052), July, 2007 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28569
2007-2008 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2008. City of Long Beach Stormwater Monitoring Report 2007-2008 NPDES Permit No. CAS004003 (CI 8052), July, 2008.
2008-2009 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2009. City of Long Beach Stormwater Monitoring Report 2008-2009 NPDES Permit No. CAS004003 (CI 8052), July, 2009. Appendix C - Los Cerritos Channel Chordane and Metals Sediment Survey.pdf
2009-2010 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2010. City of Long Beach Stormwater Monitoring Report 2009-2010 NPDES Permit No. CAS004003 (CI 8052), July, 2010
2010-2011 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2011. City of Long Beach Stormwater Monitoring Report 2010-2011 NPDES Permit No. CAS004003 (CI 8052), July, 2011
2011-2012 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2012. City of Long Beach Stormwater Monitoring Report 2011-2012 NPDES Permit No. CAS004003 (CI 8052), July, 2012
2012-2013 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2013. City of Long Beach Stormwater Monitoring Report 2012-2013 NPDES Permit No. CAS004003 (CI 8052), July, 2013
2013-2014 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2014. City of Long Beach Stormwater Monitoring Report 2013-2014 NPDES Permit No. CAS004003 (CI 8052), July, 2014
City of Long Beach Weekly Shoreline Bacteria Data	http://www.longbeach.gov/health/eh/water/water_samples.asp
Bay Protection and Toxic Cleanup Program (BPTCP) Region 4 Data and Station Locations	http://www.swrcb.ca.gov/water_issues/programs/bptcp/data.shtml
Los Angeles County Sanitation District	LACSD EWMP Data Request file (xls), from the Los Angeles County Sanitation District (LACSD) NPDES Monitoring Database for the San Gabriel River, 12/22/2012. Only data pertinent to the Long Beach Water Reclamation Plant receiving water in the lower San Gabriel River Estuary.

San Gabriel River Regional Monitoring Program Annual Reports	
San Gabriel River Regional Water Monitoring Program 2007 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2008. San Gabriel River Regional Monitoring Program Annual Report - 2007, Sept. 2008 http://watershedhealth.org/Files/document/449_SGRRMP%202007%20Report.pdf
San Gabriel River Regional Water Monitoring Program 2008 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2009. San Gabriel River Regional Monitoring Program Annual Report - 2008, Sept. 2009 http://watershedhealth.org/Files/document/531_SGR%20annual%20report%202008%20_14.pdf
San Gabriel River Regional Water Monitoring Program 2009 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2010. San Gabriel River Regional Monitoring Program Annual Report - 2009 http://watershedhealth.org/Files/document/606_SGR_annual_report_2009%20(FINAL).pdf
San Gabriel River Regional Water Monitoring Program 2010 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2011. San Gabriel River Regional Monitoring Program Annual Report - 2010 http://watershedhealth.org/Files/document/773_SGR_annual_report_2010.pdf
San Gabriel River Regional Water Monitoring Program 2011 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2012. San Gabriel River Regional Monitoring Program Annual Report - 2011 http://watershedhealth.org/Files/document/797_SGRRMP_2011_Rpt[2].pdf
San Gabriel River Regional Water Monitoring Program 2012 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2013. San Gabriel River Regional Monitoring Program Annual Report - 2012 http://www.watershedhealth.org/Files/document/868_SGRRMP_2012_Final%20Draft.pdf
City of LA Department of Water and Power Haynes Generating Station NPDES Permit	http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_4/2008/ref2735.pdf
CLADWP Haynes PS Receiving Water Data 2003 - 2004	http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_4/2008/ref2734.xls
California Environmental Data Exchange Network (CEDEN)	http://www.ceden.us/AdvancedQueryTool
EPAs My WATERS Mapper Site	http://watersgeo.epa.gov/mwm/?layer=305B&feature=CAR4051600020000229163853&extraLayers=null

APPENDIX H

BENTHIC INFAUNA FIELD SAMPLING
AND
BIOLOGICAL LABORATORY PROCEDURES

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VEEN GRAB – OPERATION AND SAMPLE COLLECTION

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the operation and collection of sediment samples with a Van Veen or Ponar grab. Various models of these grabs are available to the scientific community; this SOP refers to a modified Van Veen (sometimes referred to as a Young grab) which is equipped with a stabilizing frame and to the smaller hand operated Ponar grab. The purpose of this SOP is to ensure the proper operation and collection of samples and decontamination procedures used during the collection of samples for scientific analyses and to ensure the safety of personnel involved. Some procedures presented in this SOP (e.g. solvent cleaning) may not apply to all programs and will need to be addressed in the project specific sampling plan.

2.0 APPLICATION

This SOP applies to the collection of all sediment samples with either a Van Veen or Ponar grab including samples destined for physical, chemical, geological, and biological analyses.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Proper safety procedures should be followed for the lifting, deployment, and retrieval of all gear, including the Van Veen grab. Proper hand signals should be used to direct the hydraulics operator at all times. In addition, the grab should be secured when not in use. The modified Van Veen grab is heavy (~200 lbs) when loaded with sediment and requires mechanical or hydraulic lifting when being deployed or retrieved whereas the small petite Ponar is only 25 lbs and may be manually deployed and retrieved and does not require a grab stand.

The grab stand should be tied down securely to the boat; the grab can then be tied to the stand. When underway, the scissor arms of the grab should be tied to one side of the frame so that they do not swing or become damaged with the rolling motion of the survey vessel.

The scissor mechanism of the grab is a potential hazard; care should be taken when cocking and cleaning the grab to avoid accidents. Also, the jaws of the grab come together with some force because of the weight of the grab. Avoid placing your fingers or hands between the jaws of the grab. Should the grab trip in air because of a sudden slacking of the line, the grab will drop some distance. Avoid getting under the grab or any other suspended equipment. The use of protective grip gloves is recommended while working with this grab. Also, when utilizing overhead lifting with an A-frame, boom, or davit, personnel should wear hard hats and safety glasses.

Decontamination chemicals/solvents and sample preservatives are hazardous substances and should be handled with caution. Protective gloves and safety glasses should be worn while using these substances. The Material Safety Data Sheets for each material should be reviewed for specific safety information. Solvent waste must be collected in approved, labeled containers and disposed of properly. Proper handling of solvents and/or sample preservatives including gloves,

safety glasses, and respiratory protection if necessary should follow the guidelines specified in the KLI's Chemical Hygiene/Hazardous Communication Program and Respiratory Protection Training Program. Since the previous sampling efforts in the area have determined that the sediment contaminant concentrations are at or near background levels, no chemical solvents will be utilized on this program. Cleaning of the grab for chemical analyses will utilize a dilute Alconox solution per Army Corps of Engineers dredge material sampling guidelines.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

The Van Veen grab and associated sampling utensils (scoops, spoons, etc.) are constructed of stainless steel and are generally coated with Teflon or similar coating (Kynar or Halar). This coating allows for the collection of sediments uncontaminated by trace metals and allows for easy cleaning for organic contaminants such as oil and grease.

The grab itself consists of two halves which make up a semi-circular bucket when the grab is in the closed position. These halves are joined together by a hinge; the pin through this hinge is secured to the frame which supports the grab. The top of each half of the grab consists of a hinged door. These doors are lifted to view and subsample the grab's contents. They are usually secured with small cams or wing nuts on each door corner.

The grab mechanism consists of a scissor-like arrangement. When the grab is open (cocked), the scissors are in the collapsed position. The grab is held open in this position by the use of pins and hooks on the scissor arms. When the grab is in the closed (tripped) position, the scissors are in the extended position. The grab line is attached to the top of the scissor arrangement with a shackle and swivel.

The Van Veen frame provides stability during sampling and facilitates deployment and retrieval of the grab. The frame consists of a circular base with a four-cornered vertical frame extending upward from it. The grab rests within this frame, secured by the center pin as noted above. The line which suspends the grab (hauling line) feeds through a hole in the top of the frame and is attached to a swivel which is shackled to the grab line. This swivel allows the grab (and frame) to rotate without kinking the hauling line.

The grab is deployed in the cocked position with tension on the line. When this tension is released as the grab hits the sea floor, the hook and pin arrangement is released. When tension is again exerted on the line, the scissor arms are pulled into the upright position. This causes the grab halves to close, enclosing the sediment sample inside.

The grab generally is used with a wooden grab stand, which serves as a platform on which to perform cleaning, sampling, and cocking operations. This stand is open so that discarded sediment may be released into a pan placed below the grab. Also, a catch pan for solvents is placed under

the grab stand during solvent rinsing, if applicable, to allow proper collection and disposal of the solvent waste.

6.0 PROCEDURE

6.1 GRAB DECONTAMINATION

Decontamination of the Van Veen grab must be performed directly prior to the collection of chemistry samples. For physical, geological, or biological sample collection, it is unnecessary to decontaminate the grab other than a thorough wash to remove sediment particles. As per the 2013 *Dredged Material Evaluation and Disposal Procedures* produced by the Dredged Material Management Office, U.S. Army Corps of Engineers, Seattle District, the grab will undergo a site water rinse, Alconox wash, site water rinse, and triple DI rinse prior to use on chemistry samples. When washing or rinsing the grab, it is important to clean all surfaces which come into contact with the sample. This includes the inner surfaces of the bucket, including the inner portions of the hinged lids.

In areas where no surface sheen or contamination is visible, the sampler is subject to the following general decontamination procedures prior to each deployment at a station as follows: These procedures should be used as general guidelines for decontamination of the Van Veen grab and associated sediment sampling utensils. Since no significant sediment contamination is expected, no other cleaning agents will be necessary for decontamination. If an obvious contaminant is present at site or on the grab, the rinsate solution used to decontaminate the grab must be contained and kept for proper disposal. All other equipment rinsate solutions, including Alconox solutions, should be disposed of as close as possible to original grab location since Alconox is water soluble, biodegradable and has been approved for environmental use by the U.S Department of Agriculture.

If other solvents or acids were to be used for decontamination, proper disposal, containment, and personal protective equipment protocols must be utilized. When rinsing the grab with solvents or acid, a basin is placed below the grab for collection of the waste; this waste material is subsequently transferred to a waste container. Separate containers and catchment basins should be utilized for solvent and acid waste material. In areas where a surface sheen or slick is visible or there is visible oil on the grab, the grab should be wiped clean and subject to detergent washing prior to following the above steps. This includes a detergent wash between each drop of the equipment (i.e., replicate drop) if a surface slick is present.

6.2 SAMPLE COLLECTION

6.2.1 Cocking of the Van Veen Grab

After decontamination of the grab, the grab must be cocked. The doors are first secured, using the cams or wing nuts provided, in the closed position. The grab is cocked by pulling the scissor arms into the collapsed position and engaging each of the two hooks over the pin on the opposite arm. There must be tension on the grab line in order to maintain this cocked position.

6.2.2 Deployment and Retrieval of the Van Veen Grab

The Van Veen grab is deployed using a crab block, winch, capstan, or other hydraulic hauling system. A smaller grab such as the petite Ponar may be lowered and retrieved by hand. The boat deck wash hose should be used during deployment and retrieval of the grab if a visible surface sheen is seen to keep it away from the grab as it enters and exits the water.

To deploy the grab, any slack in the line is first removed in order to keep the grab in the cocked position. The grab is then lifted above the rail and swung free of the boat. The line is then lowered to the bottom until it goes slack. At this time, haul back on the line is commenced.

The grab is retrieved by hauling back on the line at a rate of approximately 1 m/s. When the grab nears the surface, the haul back is slowed. The grab is brought up until it clears the rail and is then brought inboard and placed on the grab stand. The grab should be in the closed (tripped) position; the bucket should be closed and the scissors should be in the extended position.

6.2.3 Determination of Grab Success

This type of bottom grab is utilized to obtain samples of minimally disturbed bottom sediment. Visual inspection of each grab is necessary to determine adequacy of each cast. Successful grabs must have adequate penetration and water overlying the sediment surface. Unsuccessful grabs are discarded. Over penetration of the grab may also be a reason to discard the sample if sediment has pushed through the top of the grab or the sediment surface appears disturbed.

Proper penetration is dependent upon the sediment type (substrate) as well as the volume of sample required. For most sampling programs, the top 2-cm of sediment is collected for chemical and physical analysis. Infaunal (benthic) samples usually require the entire grab. Because of the semi-circular construction of the grab, the surface volume of top 2-cm sediment obtainable is dependent upon the depth of penetration of the grab. The greater the penetration, the greater the volume of the sample. Therefore, if a large volume of sediment is necessary from each replicate (or drop of the grab); penetration must be deep enough to provide that volume. Grab penetration may be controlled to a certain degree by weighting the grab or by installation of a bottom baffle plate to control over penetration in extremely soft sediments.

Overlying water should remain in each grab upon retrieval. The presence of this water indicates that the grab was completely closed upon retrieval, thereby excluding sources of potential contamination. In addition, the overlying water protects the sample from physical disturbance during grab retrieval.

6.2.4 Collection of Sediments from the Grab

Sediments are collected from each successful grab as dictated by program protocols. Samples are collected through the hinged doors on the top of the grab. Overlying water is removed from the grab by siphoning through a precleaned Teflon hose using a siphon bulb or allowed to slowly drain. If necessary this Teflon hose is subject to the decontamination procedure as outlined in Section 6.1.

Chemistry samples are removed from the grab prior to the removal of any other type of sample to avoid potential contamination. Samples for Volatile Organic Aromatics (VOA) should be removed from the grab immediately after the overlying water has been siphoned off (i.e., prior to the removal of other chemistry samples). After chemistry samples have been removed, other sample types are taken from the grab. These may include sediment grain size, total organic carbon, mineralogy, microbiology, or toxicity samples. Infaunal samples require a dedicated grab; it is typical to take an entire grab for infaunal analysis.

Chemistry samples are removed from the grab with stainless steel, Teflon or similar coated sampling utensils that have been decontaminated according to procedures outlined in Section 6.1. The top 10 cm of sediment will be utilized for chemical analyses. Sediments taken for chemistry or toxicology are taken away from the surfaces of the grab (i.e., no sediments that have been in contact with the grab surfaces should be used for chemical or toxicological analysis).

6.3 DISCARD OF THE REMAINING SEDIMENT

After all samples have been obtained from the grab, the remaining sediment is discarded. An open basin is placed beneath the grab on the grab stand. The grab jaws are opened by collapsing the scissor mechanism. This allows the sediment to drop out into the basin. The grab is rinsed with seawater from the boat's seawater system to remove all residual sediment. If the sediment is not contaminated and required to be retained, the remaining sediment may be disposed of on-site at the sampling location. The grab is then subject to decontamination procedures as outlined in Section 6.1 and prepared for another drop.

6.4 VAN VEEN MAINTENANCE

The Van Veen grab should be inspected periodically for wear and tear on the scissor mechanism, the doors, the hinge pins, and the Teflon coating. Door wing nuts or cams may need to be replaced. In addition, the line, shackles, and swivel suspending the grab when in operation should be visually inspected to ensure safe operation.

The Teflon, Halar, or Kynar coating of the grab often becomes worn when a grab is subject to heavy use. Re-coating of the grab must be done periodically to ensure adequate coverage of all metal portions of the grab that might come into contact with the sediments.

The center shaft of the grab may be greased periodically to ensure smooth operation. A silicone lubricant approved by program chemists should be used in order to avoid hydrocarbon or other organic contamination of the sediment samples obtained with the grab.

7.0 PERSONNEL

Only personnel that have been trained in the use of the Van Veen grab and in the proper handling of hazardous materials are allowed to complete this task. Training of personnel in the proper handling of the Van Veen grab may take place on a survey vessel under the direction of the crew

leader. Training of personnel in safety procedures and handling of hazardous materials must be performed according to KLI=s Safety Program.

8.0 QUALITY ASSURANCE REQUIREMENTS

Decontamination of the Van Veen grab may be checked by performing an equipment rinsate blank where appropriate for chemical analysis. A rinsate blank is obtained by pouring reagent grade deionized water over the inner grab surface and collecting the water into a sample container. The rinsate water may then be analyzed for the contaminants of concern. Collection and analysis of equipment rinsate blanks will vary depending on specific program requirements.

9.0 REFERENCE DOCUMENTS

- KLI's Chemical Hygiene/Hazardous Communication Training Program
- KLI's Respiratory Protection Training Program
- MSDSs for solvents and sample preservatives depending on specific program requirements.

VESSEL OPERATIONS FOR VIBRACORE AND VAN VEEN GRABS

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the operation of Kinnetic Laboratories Inc. (KLI) research vessels with a hydraulic A-frame, other sampling platforms (i.e., barges and small boasts), vibracore and related equipment, and Van Veen grab used for sediment sample collection. The purpose of this SOP is to establish the proper operating procedures, thus ensuring the safety of personnel involved.

2.0 APPLICATION

This SOP applies to KLI research vessels used in conjunction with vibracoring and a Van Veen grab for the collection of samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Proper safety procedures should be followed for the lifting, deployment, and retrieval of all equipment and gear when using a KLI research vessel to do so.

ALL PERSONNEL ARE REQUIRED TO REVIEW AND SIGN THE SPECIFIC PROJECT SITE SAFETY PLAN

- No alcohol or drug use during or prior to while working on any boat. If you are taking a prescription or over-the-counter medication that may effect your ability to perform some duty, you must notify the captain as soon as possible

NO ILLICIT DRUGS OR ALCOHOL ON BOARD AT ANY TIME – "ZERO TOLERANCE"

- Smoking prohibited
- Move carefully and cautiously. "Unexpected" vessel movement or slippery conditions can result in serious injuries. Each crew is one "hand," that is, one hand for the work of the boat, one hand for yourself. Use handholds and get help rather than risk injury. Wearing grip gloves while working is recommended.
- Wear U.S. Coast Guard approved work vests, float coat, or exposure suit in a closed fashion in skiffs, small boats, or launches unless in an enclosed cabin or cockpit or wherever there is a drowning hazard.
- Never stand under stressed rigging. Do not walk on or straddle rope. Never stand on a loop of line.
- Learn the location and operation of all fire extinguishers.
- Wear appropriate steel-toe boots or shoes.
- Learn the location, access and operation of thru-hull valves and shaft boxes.

- Do not obstruct passageways with gear.
- Learn the location of the first aid kit.
- Do not jump between vessel and docs. Decks can be slippery.
- Use extreme caution when accessing the engine room while the engine is running. Belts, shafts, voltages, and high temperatures are all considerations when entering the engine room.
- Avoid wearing loose clothing or rain gear near winches, tie back long hair.
- Wear safety glasses when appropriate.
- Beware of dangerous or unknown marine organisms on deck.
- If defective or damaged equipment is noticed, report it immediately.
- Do not discharge oil or oily waste overboard. Control and clean-up all spills of fuel, oil or hazardous materials immediately. Wash down area with soap when appropriate and collect wash and rinsate for disposal. No discharges of hazardous materials are allowed.
- Hard hats should be worn whenever heavy objects are being handled by the winch and A-frame.
- Use nonconducting tag lines (without knots in the end) to control a suspended load. Adequate tag lines must be available.
- Stay where the operator can see you.
- Hooks must have safety latches.
- Regular inspection of a winch. Make sure the line wraps smoothly on the drum and has no kinks.
- Proper hand signals should be used to direct the winch operator at all times.
- All shackles will be safety wired.
- Be aware of pinch points and cable spurs.
- Work requiring the use of the vessel will not take place during inclement weather.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

KLI research vessels are equipped with full electronics (including Differential GPS), hydraulic A-frame and winches, and with marine sampling equipment for field studies within harbors and inshore coastal waters. The winch cable spools up to the block at the apex of the A-frame and terminates at a chain bridal connection to the vibracore head. All vibracore equipment (generator,

speed controller, power cords) or Van Veen grab equipment (grab stand) will be situated on the deck of the vessel.

6.0 PROCEDURE

This procedure outlines the general course of action related to the use of KLI research vessels, vibracore and related equipment, and a Van Veen grab for the purpose of sample collection. All Health and Safety considerations mentioned in Section 3 apply to these procedures.

6.1 KLI RESEARCH VESSEL VIBRACORING

Motoring to sample locations will be done with great care. All equipment and supplies will be secured to avoid shifting and unsafe weight transfer while underway. All vibracore connections will be protected by wrapping with electrical tape. This will prevent water from entering the connection, causing a short within the system.

Once the vessel has reached its destination, it will be positioned on the sampling location and anchored to keep from moving laterally. Once the vessel is anchored on location, the vibracore head will be positioned on the deck using the winch. Care will be taken to keep the work surface area orderly and free of obstructions. The core tube will then be inserted into the clamp and tightened into place. Once the vibracore setup is complete, the operator will carefully lift the vibracore using the winch until it is standing vertical. The vibracore will then be carefully lowered into the water. When bottom is reached, the circuit breaker on the generator will be turned on, the generator will be started and the vibratory mechanism in the vibracore head will be started by pushing the start button on the speed controller and lowered carefully in the sediment.

After the target depth is reached, the vibracore will be stopped by pushing the stop button on the speed controller, turning off the circuit breaker and shutting the generator off. The vibracore will then be carefully pulled out of the sediment. If the pullout is difficult the tube will be vibrated out so that undue strain is not placed on the vessel and equipment. Once out of the sediment, the vibracore will be carefully maneuvered onto the deck and the core tube removed. The tube will be capped, taped, and marked with its proper sample location identification. Care should be taken when lifting and manipulating the core tube, as it will be heavy. After having removed the core, the vibracore will be placed back on deck and secured for transit. Equipment, gear and sample core will be properly secured on the deck before departing for the next location.

6.2 KLI RESEARCH VESSEL SAMPLING USING A VAN VEEN GRAB

Please see SOP: Operation and Collection of Sediment Samples with a Van Veen Grab.

7.0 PERSONNEL

Personnel will be trained onsite.

8.0 REFERENCE DOCUMENTS

Project Specified Site Safety Plan

SOP: Operation and Collection of Sediment Samples with a Van Veen Grab.

OTTER TRAWL SAMPLING PROCEDURES

1.0 SCOPE

1.1 INTRODUCTION

Otter trawls are used for collection of demersal fishes and epibenthic invertebrates for varying purposes. As examples, animals may be collected to assess epibenthic community structure or to provide tissue for chemical analyses to assess bioaccumulation. An otter trawl is a long conical net, with otter boards (doors) on either side of the large opening, towed at the end of long bridle lines. As the net is towed, the boards are forced away from the centerline of the net, stretching the opening. The top of the large net opening is fitted with floats and the bottom of the opening is fitted with chain or a lead line to keep the net open.

1.2 DESCRIPTION

KLI owns and uses three sizes of Marinovich Otter Trawl: 10 foot head rope, 16-foot head rope, and a 25-foot head rope. Each net requires the same type of components, although they are scaled to an appropriate size. The smallest is appropriate for hand hauling and small skiff operations.

2.0 APPLICATION

The descriptions and methods in this SOP apply to all otter trawls that KLI owns as of this writing.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Safety is a concern during the deployment of nets, as with the deployment of any lines from the deck of a moving vessel. Special care must be observed during deployment and retrieval to ensure crew members do not become entangled in the bridles or the net. The force of the water on the moving net is tremendous and can easily pull an entangled individual overboard, where it is possible for the individual to become further entangled and drown. Work gloves, float vests and hard hats should be worn during deployment and retrieval of the net. Gloves should also be worn at all times especially when handling fish with sharp spines and lines from the trawl.

Caution: Formalin is a health hazard and a suspected carcinogen, and may cause blindness if splashed in eyes. Wear chemical-proof gloves and protective goggles and avoid breathing vapors.

4.0 DEFINITIONS

Otter Boards: Weighted wooden doors attached to the large front opening of the net to apply spreading force while net is towed through the water.

Bridals: Long lines (2) each attached on one end to a door, and joined on the other end at a swivel.

Swivel: Device allowing free rotation of the towing cable relative to the bridals of the trawl.

Otter Trawl: Conical net with a large rectangular opening at the fore end, and a small closable end aft.

Cod-end: A special piece of netting, usually of a finer mesh than the rest of the net, at the small aft end of the net where animal collect during towing.

Spreader Bar: A bar approximately 1 m long attached between the bridals at the end near the swivel to prevent the bridals from winding around one another during towing.

5.0 EQUIPMENT

Each of the devices defined in the section above is a necessary component of the otter trawl. Among the otter trawls that KLI owns the three sizes (10-foot, 16-foot, and 25-foot head rope) differ only in net size, door dimension, and bridal length. All the same components are required for each size of net.

6.0 PROCEDURE

6.1 FIELD SAMPLING

The otter trawl is deployed from the rear deck of the towing vessel. Although the smaller nets may be towed in shallow water by a small boat (e.g., a whaler), the nets are generally towed from a larger boat with a wire spool and winch mounted on deck (e.g., R/V PROPHESY or larger). The net, with boards and bridals attached is laid on the deck, so that it may be deployed over the stern with the float line at top and the chain or lead line at bottom. The cod-end is tied closed with several wraps of a 1/4-inch line and a double hitch.

The net is deployed over the stern, cod-end first, as the vessel slowly moves forward. A crew member on either side of the vessel guides the trawl until the boards are ready to be released. Holding the bridals, the boards are lowered into the water taking care they do not flip over and close the net. As the boards enter the water, the bridles are held to allow the water to force them away from the centerline of the net. As the net opens, the bridles are released and finally, the whole trawl is lowered into the water on the cable.

The trawl should be towed into the prevailing current at approximately 2.5 kts. The requirements of many sampling programs override this preference. A minimum scope (length of tow cable:depth of water) of 3:1 should be maintained at all times while towing, and as much as 5:1 is preferable, especially in deeper waters. The vessel must maintain forward progress during all times the trawl is in the water, both to ensure the catch remains in the net, and to avoid entanglement of the net in the screw of the vessel.

6.2 HANDLING OF CATCH

Trawling can result in the collection of large numbers of live fish and invertebrates. Stress during capture and subsequent handling may be a significant source of mortality in some species. Handling procedures will be designed to minimize stress. It is intended that the majority of the catch will be returned to the water live, thus, the catch will be quickly placed in water-filled buckets or totes as soon as the net is recovered. Towing time will be kept short to minimize crushing, bruising, or suffocating fish caught in the cod end. Fish will be handled with smooth rubber gloves or bare wet hands to minimize damage to the mucus coating on the outside of the fish.

6.3 LENGTH MEASUREMENTS

Length will be measured on all fish captured in the trawl. Maximum standard (total) length will be measured from the most anterior part of the fish to the tip of the tail for fish without forked tails. Fork length will be measured from the most anterior portion of the fish to the tip of the median caudal fin ray for salmonids or other fish with forked tails. Where numerous fish of a given species and size group are taken in a single haul, a minimum of 20 randomly selected fish from each cohort will be measured and the total number of that cohort will be counted. Fish identifications and lengths will be recorded on a Trawl I Fish Catch Record form.

Invertebrates in the trawl catch may be counted by species and released, or preserved for laboratory identification and enumeration. For abundant invertebrate groups, representative samples may be preserved for later measurements to characterize size groupings present.

6.4 PRESERVATION

Fish and invertebrates to be retained will be preserved in a buffered formalin and seawater solution.

7.0 PERSONNEL

A minimum of two crew members and a skipper are required to perform otter trawls. When large numbers of fish are to be processed, more crew are helpful. Each crew member must read this SOP, as well as sections of the KLI Safety Manual regarding vessel safety.

All personnel involved should be trained in basic ecological field techniques. The field crew leader should have experience with the sampling gear and sampling design that are to be utilized. At least one member of the crew should be familiar with any piece of sampling gear used. For trawling, field personnel must be trained in basic field sampling techniques and identification of fish and invertebrates.

8.0 QUALITY ASSURANCE REQUIREMENTS

Logs must be maintained for all the time the trawl is in the water, indicating the time of deployment, the time the trawl reaches the bottom, the duration of towing, the vessel speed, and the GPS positions of the beginning and end of trawls.

Depending on the requirements of a given study, project-specific data sheets will be produced. These will include accounting of all relevant individuals caught (e.g., all individuals of all species and their standard lengths for community analysis; numbers, sex, standard lengths of target species for bioaccumulation collections).

All logs and data sheets must be completely filled in by the end of the work day and signed by the vessel=s skipper or task leader. All appropriate chains of custody must be maintained and samples preserved as appropriate and described in the SOP dealing with the task at hand.

9.0 REFERENCE DOCUMENTS

Mearns, A.J. and H.H. Stubbs. 1974. Comparison of otter trawls used in southern California coastal surveys. Southern California Coastal Water Research Project. Report TM 213.

Puget Sound Estuary Program (PSEP). 1990. Recommended Guidelines for Sampling Soft-Bottom Demersal Fishes by Beach Seine and Trawl in Puget Sound, Appendix B, Net Plans for Standard and Alternate Beach Seines and Trawls. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington, and Puget Sound Water Quality Authority, Olympia, Washington.

FIELD INFAUNA SAMPLE PROCESSING

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the field processing of infaunal samples. Infaunal samples are generally collected with a Van Veen grab, but may be taken by variety of other methods such as Smith-MacIntyre grab, box corers, hand corers, or by divers. These samples must be handled carefully to avoid damaging the infaunal specimens; broken or damaged specimens are extremely difficult to systematically identify. The purpose of this SOP is to ensure the proper field processing and preservation of infauna samples prior to their arrival at the infauna sorting laboratory. This SOP does not cover the actual collection of samples as it has been assumed that the samples have already been properly collected as outlined by methods described in other SOPs.

2.0 APPLICATION

This SOP applies to the field processing and preservation of all infauna taxonomic samples that have been collected from subtidal, intertidal, or wetland areas.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Formalin and alcohol used in the preservation of infaunal samples are extremely hazardous substances. Protective gloves, safety glasses, and an apron or other protective clothing should be worn while using either of these chemicals. In addition, respirators should be worn when handling an open container, pouring, or transferring formalin or formalin preserved samples from one container to another (e.g., from a stock container to a dispensing carboy

4.0 EQUIPMENT AND SUPPLIES

As noted above, infaunal samples are collected with the use of bottom grabs such as the Van Veen sampler. Additional equipment needed for the collection and processing of infaunal samples includes sieves (1.0, 0.5-mm mesh size), a seawater hose system, a squirt bottles filled with seawater, funnels, siphon hose (non-Teflon is acceptable), forceps, and sample containers.

5.0 INFAUNAL SAMPLE COLLECTION AND PROCESSING

Infaunal samples are quantitative in nature and include the entire contents of a dedicated grab. Upon retrieval of the grab, the overlying water is siphoned off through a 1.0 or 0.5-mm mesh sieve depending on project requirements in order to retain any animals that are in the liquid layer of the sample. After removal of the overlying water, the sediment is transferred from the grab to a basin for processing.

Sediment from the basin is then sieved through the 1.0 or 0.5-mm sieve using one of two techniques. The objective of this sieving procedure is to remove the bulk of the sediment in a gentle but thorough manner so that remaining animals (and sediment) can be adequately preserved. If the sediment is fine enough to be easily washed through the sieve with a gentle

stream of water from the wash hose, this method is used to sieve the entire sample. Small portions of the grab may be washed in the sieve at one time to ensure careful handling and avoid damaging the specimens.

In some cases, however, a large amount of heavy sediments (e.g., clay) or terrestrial or algal debris will make this sieving process difficult. In this instance, the sample is sieved by repeatedly dipping the sieve into a shallow container of water, taking care not to allow any water to flow over the top of the sieve. This dipping technique acts to suction some of the silt and finer sediments through the bottom of the sieve, thereby freeing up the specimens for adequate preservation and reducing the bulk of the sample. Again, small portions of the sample may be added to the sieve at one time to facilitate the sieving process.

After the sieving process is complete, the animals and sediment remaining on the sieve are transferred to a plastic jar. A gentle stream of wash water and/or seawater in a squirt bottle are used to facilitate this transfer. A funnel is placed in the mouth of the sample jar to ensure that no animals are lost during this transfer. Forceps may be used to gently pull adhering animals or debris from the mesh so that they also may be transferred to the sample container. After sieving, the sieve is visually inspected to ensure that all animals have been included in the sample. This inspection also reduces potential risk of cross-contamination between samples.

Samples are preserved using a 10% solution of buffered formalin in seawater. Formalin is a 37% formaldehyde solution which must be buffered with borax to eliminate decalcification of the calcareous portions of animals in the sample. Formalin is a carcinogen and respiratory irritant and should be handled with extreme caution. See the Material Safety Data Sheets and SOP regarding the use and handling of formalin, including emergency response to overexposure.

Samples are labeled with all pertinent information required by project protocols. Internal labels of durable, waterproof paper are generally used to identify infaunal samples. Refer to project protocols for further information regarding labeling procedures.

PRESERVATION OF BIOLOGICAL SAMPLES

1.0 SCOPE

This Standard Operating Procedure (SOP) document describes the procedures involved in the use of propylene phenoxytol and formaldehyde in relaxing, fixing and preservation of biological samples. The purpose of these procedures is to ensure the proper preservation of samples and the safety of the personnel involved.

2.0 APPLICATION

This SOP applies to all field and laboratory activities involving the relaxing, fixing and preservation of biological samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The relaxing, fixing and preservation of biological samples may involve contact with hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate chemically-resistant protective gloves, laboratory coats, chemically-resistant aprons and goggles. Respiratory protection against hazardous vapors can be accomplished using the proper respirator and cartridge combination. In addition, the MSDS's for propylene phenoxytol, formaldehyde, and alcohol (ethanol and/or isopropanol) need to be reviewed before beginning, to ensure that you are aware of the hazards involved and of any new revisions.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

5.1 INSTRUMENTATION

- Respirator fitted with organic or formaldehyde cartridge
- Chemically resistant PPE – gloves, apron, rain gear, goggles

5.2 REAGENTS

- Propylene phenoxytol
- 37% Formaldehyde (full strength buffered w/borax)
- Alcohol (70% ethanol and/or 70% isopropanol)

5.3 APPARATUS

- Sieve - specific size is project-related

- Squirt bottles - for alcohol and seawater
- Spoon and forceps - for handling sample

6.0 PROCEDURE

With all appropriate safety equipment on, access is now possible to the propylene phenoxytol in the safety cabinet, and the 37% formaldehyde solution stored in labeled containers with appropriately sized over packs. Benthic organisms need to be relaxed with an addition of propylene phenoxytol for a minimum of 2 hours and up to 8 hours before fixing samples with formaldehyde. Check with task leader as to amount of propylene phenoxytol to use, as it depends on sample size and type. RESPIRATOR MUST BE WORN ON OPENING OF FORMALDEHYDE OVER PACK, as there is usually a buildup of gaseous vapors inside. Add enough concentrated buffered formaldehyde to sample container to produce an approximately 10% solution upon addition of site or tap water.

Samples need to be transferred to 70% alcohol (ethanol for most samples, isopropanol for larger organisms such as fish) within 48 to 96 hours and in no case later than 7 days. When transferring samples you need all the required safety equipment again. Pour off the formaldehyde solution, rinse three times with seawater and dispose of in the waste formaldehyde drum.

Finally, preserve the samples with a 70% alcohol solution.

7.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment, as per the KLI Chemical Hygiene/Hazardous Communication Training Program are allowed to complete this task. Training needs to include proper use and fitting of respiratory protective equipment as per the KLI Respiratory Protection Training Program. The Laboratory Supervisor is responsible for training personnel in the proper procedures in sample fixing and preservation.

8.0 REFERENCE DOCUMENTS

- MSDS's for propylene phenoxytol, formaldehyde, ethanol and isopropanol.
- KLI's Chemical Hygiene/Hazardous Communication Training Program.
- KLI's Respiratory Protection Training Program.

LABORATORY – BENTHIC SORTING & BIOMASS PROCESSING

1.0 SCOPE

This Standard Operating Procedure (SOP) document describes the procedures involved in the benthic sample sorting and wet weight biomass process. The purpose of these procedures is to ensure the proper sorting and handling of organisms from field collected samples as well as biomass measurements of the sorted groups.

2.0 APPLICATION

This SOP applies to all laboratory activities involving the sorting and weighing of benthic organisms from benthic biological samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The process of sorting biological samples will involve contact with potentially hazardous substances, reasonable caution should be exercised. The Material Safety Data Sheets (MSDS) for alcohol (ethanol and /or isopropanol) should be reviewed before beginning the sorting process to ensure that you are aware of the hazards involved and of any new revisions that may be available. The sorting lab should be adequately ventilated at all times during the sorting process to prevent the buildup of harmful or irritating vapors.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

5.1 INSTRUMENTS AND SUPPLIES

- Stereo dissecting microscopes (10- to 40 -power) (one per sorter)
- Analytical balance (good to 0.01 gm wet weight)
- Alcohol (70% ethanol and/or 70% isopropanol)
- Jewelers forceps, spoons, eye droppers, petri dishes, and scissors
- Sieves (appropriate to project)
- Squirt bottles (for alcohol)
- Label paper (Right in the Rain©)
- Nytex screen and watch

6.0 PROCEDURE

6.1 SORTING

Prior to beginning the sorting process the appropriate MSDS=s should be consulted. The primary technique used to sort organisms from sediment starts with placing approximately one teaspoon of the sample into a petri dish and using a pair of forceps to sort through the sample in a methodical manner removing each organism that is present. This process is to be performed using a dissecting microscope and repeated if necessary until all organisms are removed from each spoonful. Only one person should sort each sample from beginning to end. All organisms should be sorted into five major taxonomic categories or groups: Annelida, Arthropoda, Mollusca, Echinodermata, and combined miscellaneous phyla. All sorted organisms will be placed into their respective group screw cap vials with 70 percent alcohol. The appropriate internal sample tracking information label will be placed into each vial. Each label will include the pertinent field information as well as the name of each sorter doing the sorting.

6.2 BIOMASS

Biomass estimates for the major taxonomic groups should be made prior to the identifications. The weights should be estimated to the nearest 0.01 gm wet weight and recorded in the laboratory on separate biomass data sheets. All fragments encountered during sorting should be weighed with their respective group. Each taxonomic group will be air-dried on absorbent paper for a period of one minute prior to weighing. The organisms will be placed on a tarred weighing Nytex screen and allowed to air-dry for one minute. The weight of the group is then subtracted from the weight of the screen to obtain the biomass estimate that is recorded.

7.0 PERSONNEL

Only personnel that have been trained in the sorting and biomass process will handle sample sorting and wet weight biomass determination. The Laboratory Supervisor is responsible for training personnel in the proper sorting and biomass methodologies to be used. The QA/QC officer will determine which samples have not been adequately sorted and weighed and require corrective action.

8.0 QUALITY ASSURANCE REQUIREMENTS

All sorted samples will be resorted a minimum of 30 percent by a person different from the original sorter of the sample. Any sample not passing the initial 30 percent resort will be completely resorted over again by a person other than the person performing the original sorting of the sample. Records of this process are recorded for each resorted sample and kept on file.

9.0 REFERENCE DOCUMENTS

- Benthic Sample Sorting and QA/QC Log
- Taxonomic Identification Chain of Custody Record
- Sample Tracking and Sorting Worksheet

ATTACHMENT A
Benthic Sample Sorting and QC/QC Log

KINNETIC LABORATORIES INCORPORATED

Benthic Sample Sorting and QA/QC Log

Project:_____ **Sample ID #** _____ Sampling Date:_____

Station:_____ Replicate:_____ Sieve Fraction:_____

Volume Debris Before Sorting:_____ Split Fraction:_____

Start Sorting Date:_____ End Sorting Date:_____

Total Time Sorting:_____ Sorter's Name:_____

Date Start Stop Time	**Itemized Sorting Time** Date Start Stop Time	Date Start Stop Time

(***VIAL COUNTS must be filled out***)

____ Annelida (vials) ____ Arthropoda (vials) ____ Mollusca (vials) ____ Echinodermata (vials) ____ Miscellaneous (vials)

Comments:_____

Total # of Organisms _____ (All vials)

Resort Volume	**# of Org. Removed**	**Cumulative Total**	**Total # Org. Missed**	**% of Org.[1] Sorted**	**Outcome of Resort Effort**
30%_____ ml	_____	_____ x 3.33 =	_____	_____	**Pass**____**%** **Fail**____**%** *
100%_____ ml	_____	_____ x 1 =	_____	_____	**Pass**____**%** **Fail**____**%** **

[1][% of Org. Sorted = (Sorters Total # of Org. ÷ (Sorters Total # of Org. + Resorters Total # of Org. Missed)) x 100]

_____ **(30%) Pass/Fail*** Date:_____ Re-sort time:_____ Resorter:____

_____ **(100%) Pass/Fail**** Date:_____ Re-sort time:_____ Resorter:____

* *If less than 95%*, failure occurs, the remainder of the sample is to be resorted.

***If less than 95%*, failure occurs, the sample is to be resorted again using a SECOND tracking log.

Major Phyla Missed:(30%) _____

Major Phyla Missed:(100%) _____

Comments:_____

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APPENDIX I

TABLE OF AVAILABLE WATER QUALITY OBJECTIVES (FRESHWATER AND SALTWATER)

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Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
	Instantaneous	Acute	30-day	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	**Single Sample**	**Max. Level**	**Average**	**CMC**	**CCC**	**CMC**	**CCC**	**CMC**	**CCC**
Conventionals (mg/L unless noted)									
Oil and Grease									
Total Phenols									
Cyanide		0.15		22	5.2				
pH (pH Units)		6.5 - 8.5							
Temperature		≤20°F of Ambient							
Dissolved Oxygen		≥5							
Total Ammonia (as N)[1]									
Bacteria (MPN/100 ml) [2]									
Enterococcus	104		35						
Fecal Coliform	400		200						
Total Coliform	10000		1000						
Ratio of Fecal to Total Coliform	FC/TC≥0.1 & TC>1000								
General (mg/L unless noted)									
Dissolved Phosphorus									
Total Phosphorus									
Turbidity (NTUs)									
Total Suspended Solids									
Total Dissolved Solids									
Volatile Suspended Solids									
Total Organic Carbon									
Total Petroleum H}'drocarbon									
Biochemical Oxygen Demand									
Chemical Oxygen Demand									
Total Ammonia-NitroQen									
Total Kjeldahl Nitrogen									
Nitrate-Nitrite		10							
Nitrite		1							
Alkalinity									
Specific Conductance (umho/cm)									
Total Hardness									
MBAS		0.5							
Chloride									
Fluoride		2							
Methyl tertiary butyl ether (MTBE}		0.013							
Perchlorate (ug/L)		6							
Dissolved Metals (µg/L) [3]									
Aluminum									
Antimony									
Arsenic				340	150				
Beryllium									
Cadmium				4.3	2.2				
Chromium (total)									
Chromium (Hexavalent)				16	11				
Copper				13	9				
Iron									
Lead				65	2.5				
Mercury									
Nickel				470	52				
Selenium									
Silver				3.4					
Thallium									
Zinc				120	120				
Total Metals (µg/L)									
Aluminum		1000							
Antimony		6							
Arsenic		10							
Beryllium		4							

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
	Instantaneous	Acute	30-day	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	**Single Sample**	**Max. Level**	**Average**	**CMC**	**CCC**	**CMC**	**CCC**	**CMC**	**CCC**
Cadmium		5							
Chromium (total)		50							
Chromium (Hexavalent)									
Copper									
Iron									
Lead		100							
Mercury		2							
Nickel		100							
Selenium		50		20	5				
Silver									
Thallium		2							
Zinc									
Semivolatile Organic Compounds **(ug/L)**									
Acids									
2-Chlorophenol									
4-Chloro-3-methylphenol									
2,4-Dichlorophenol									
2,4-Dimethylphenol									
2,4-Dinitrophenol									
2-Nitrophenol									
4-Nitrophenol									
Pentachlorophenol		1		19	15				
Phenol									
2,4,6-Trichlorophenol									
Base/Neutral									
Acenaphthene									
Acenaphthylene									
Anthracene									
Benzidine									
1,2 Benzanthracene									
Benzo(a)pyrene		0.2							
Benzo(g,h,i)perylene									
3,4 Benzoflouranthene									
Benzo(k)flouranthene									
Bis(2-Chloroethoxy) methane									
Bis(2-Chloroisopropyl) ether									
Bis(2-Chloroethyl) ether									
Bis(2-Ethylhexl) phthalate									
4-Bromophenyl phenyl ether									
Butyl benzyl phthalate									
2-Chloroethyl vinyl ether									
2-Chloronaphthalene									
4-Chlorophenyl phenyl ether									
Chrysene									
Dibenzo(a,h)anthracene									
1,3-Dichlorobenzene									
1,4-Dichlorobenzene		5							
1,2-Dichlorobenzene		600							
3,3-Dichlorobenzidine									
Diethyl phthalate									
Dimethyl phthalate									
di-n-Butyl phthalate									
2,4-Dinitrotoluene									
2,6-Di nitrotoluene									
4 ,6 Dinitro-2-methylphenol									
1,2-Diphenylhydrazine									
di-n-Octyl phthalate									
Fluoranthene									
Fluorene									

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
Analyte Group	Instantaneous Single Sample	Acute Max. Level	30-day Average	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC
Hexachlorobenzene		1							
Hexachlorobutadiene									
Hexachloro-cyclopentadiene		50							
Hexachloroethane									
Indeno_{1,2,3-cd)pyrene									
Isophorone									
Naphthalene									
Nitrobenzene									
N-Nitroso-dimethyl amine									
N-Nitroso-diphenyl amine									
N-Nitroso-di-n-propyl amine									
Phenanthrene									
Pyrene									
1,2,4-Trichlorobenzene		5							
Aroclors (µg/L)									
Aroclor-1016									
Aroclor-1221									
Aroclor-1232 .									
Aroclor-1242									
Aroclor-1248									
Aroclor-1254									
Aroclor-1260									
PCBs (Total)		0.5			0.014				
Chlorinated Pesticides **(µg/L)**									
Aldrin				3					
alpha-BHC									
beta-BHC									
delta-BHC									
gamma-BHC (lindane)		0.2		0.95					
alpha-chlordane									
gamma-chlordane									
4 4'-DDD									
4,4'-DDE									
4,4'-DDT				1.1	0.001				
Dieldrin				0.24	0.056				
alpha-Endosulfan				0.22	0.056				
beta-Endosulfan				0.22	0.056				
Endosulfan sulfate									
Endrin		2		0.086	0.036				
Endrin aldehyde									
Heptachlor		0.01		0.52	0.0038				
Heptachlor Epoxide		0.01		0.52	0.0038				
Toxaphene		3		0.73	0.0002				
Methoxychlor		30							
Mirex									0.001
Total Chlordane		0.1		2.4	0.0043				
Organophosphates **(µg/L)**									
Atrazine		1							
Chlorpyrifos						0.02	0.014	0.01	0.01
Cyanazine									
Diazinon						0.16	0.1	0.2	0.07
Malathion						0.43	0.1	0.17	0.028
Prometryn									
Simazine		4							
Herbicides **(ug/L)**									
2,4-D		70							
Glyphosate		700							
2,4,5-TP-SILVEX		50							

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
Analyte Group	Instantaneous Single Sample	Acute Max. Level	30-day Average	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC
Pyrethroids **(ng/L)**									
Bifenthrin		3						4	0.6
Cyfluthrin		2						0.3	0.05
Cypermethrin								1	0.2
L-Cyhalothrin								1	0.5
Permethrin								10	2
Total Deltamethrin/Tralomethrin									
Total Esfenvalerate/Fenvalerate									

1. The one-hour average ammonia-N criterion applicable to storm events is pH dependent. The 30-day ammonia-N criterion applicable to dry weather is both temperature and pH dependent.
2. Saltwater bacteria standards
3. CTR freshwater dissolved metals are hardness dependent. The values listed here are computed for a hardness of 50 mg/L.
   CTR freshwater dissolved cadmium and lead coefficients for conversion of total recoverable to dissolved criteria are also hardness dependent.

General

· Minimum Level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

· Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

· Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

· CTR freshwater dissolved metals are hardness dependant. The values listed here are computed for a hardness of 50 mg/L.

· CTR freshwater dissolved cadmium and lead conversion coefficients for total to dissolved are also hardness dependent.

· CTR freshwater and saltwater dissolved metal criteria are "CCC" except for silver which are "CMC".

· CTR freshwater and saltwater organics are "CCC" except for aldrin and gamma-BHC which are "CMC".

LA Basin Plan, 2013

Bacteria are instantaneous or single sample criteria.

LA Basin Plan contains Title 22 Drinking Water standards

Ammonia listed is Acute 1-hour average objective for waters not designated COLD and/or MIGR and is pH dependent. The value listed is for a pH of 7.5. Chronic criteria are applied to Dry Weather results and are pH and temperature dependent

California Fish and Game - Siepmann and Finlayson, 2000, Siepmann & Slater 1998 (malathion)

All values are "CMC" criteria. CMCs are considered acute criteria.

UC Davis - Werner and Oram, 2008, Palumbo, et al. 2012 (for orthophosphates), and Fojut, et al. 2012 (for pyrethroids)

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	**CMC**	**CCC**	**CMC**	**CCC**	**CMC**	**CCC**
Conventionals (mg/L unless noted)						
Oil and Grease						
Total Phenols						
Cyanide	1	1				
pH (pH Units)						
Temperature						
Dissolved Oxygen						
Total Ammonia (as N)						
Bacteria (MPN/100 ml)						
Enterococcus						
Fecal Coliform						
Total Coliform						
Ratio of Fecal to Total Coliform						
General (mg/L unless noted)						
Dissolved Phosphorus						
Total Phosphorus						
Turbidity (NTUs)						
Total Suspended Solids						
Total Dissolved Solids						
Volatile Suspended Solids						
Total Organic Carbon						
Total Petroleum Hydrocarbon						
Biochemical Oxygen Demand						
Chemical Oxygen Demand						
Total Ammonia-NitroQen						
Total Kjeldahl Nitrogen						
Nitrate-Nitrite						
Nitrite						
Alkalinity						
Specific Conductance (umho/cm)						
Total Hardness						
MBAS						
Chloride						
Fluoride						
Methyl tertiary butyl ether (MTBE}						
Perchlorate (ug/L)						
Dissolved Metals (**µg/L*)**						
Aluminum						
Antimony						
Arsenic	69	36				
Beryllium						
Cadmium	42	9.3				
Chromium (total)						
Chromium (Hexavalent)	1100	50				
Copper	4.8	3.1				
Iron						
Lead	210	8.1				
Mercury						
Nickel	74	8.2				
Selenium	290	71				
Silver	1.9	-				
Thallium						
Zinc	90	81				

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	**CMC**	**CCC**	**CMC**	**CCC**	**CMC**	**CCC**
Total Metals (**µg/L*)**						
Aluminum						
Antimony						
Arsenic						
Beryllium						
Cadmium						
Chromium (total)						
Chromium (Hexavalent)						
Copper						
Iron						
Lead						
Mercury						
Nickel						
Selenium						
Silver						
Thallium						
Zinc						
Semivolatile Organic Compounds **(ug/L)**						
Acids						
2-Chlorophenol						
4-Chloro-3-methylphenol						
2,4-Dichlorophenol						
2,4-Dimethylphenol						
2,4-Dinitrophenol						
2-Nitrophenol						
4-Nitrophenol						
Pentachlorophenol	13	7.9				
Phenol						
2,4,6-Trichlorophenol						
Base/Neutral						
Acenaphthene						
Acenaphthylene						
Anthracene						
Benzidine						
1,2 Benzanthracene						
Benzo(a)pyrene						
Benzo(g,h,i)perylene						
3,4 Benzoflouranthene						
Benzo(k)flouranthene						
Bis(2-Chloroethoxy) methane						
Bis(2-Chloroisopropyl) ether						
Bis(2-Chloroethyl) ether						
Bis(2-Ethylhexl) phthalate						
4-Bromophenyl phenylether						
Butyl benzyl phthalate						
2-Chloroethyl vinylether						
2-Chloronaphthalene						
4-Chlorophenyl phenylether						
Chrysene						
Dibenzo(a,h)anthracene						
1,3-Dichlorobenzene						
1,4-Dichlorobenzene						
1,2-Dichlorobenzene						

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	**CMC**	**CCC**	**CMC**	**CCC**	**CMC**	**CCC**
3,3-Dichlorobenzidine						
Diethyl phthalate						
Dimethyl phthalate						
di-n-Butyl phthalate						
2,4-Dinitrotoluene						
2,6-Dinitrotoluene						
4,6 Dinitro-2-methylphenol						
1,2-Diphenylhydrazine						
di-n-Octyl phthalate						
Fluoranthene						
Fluorene						
Hexachlorobenzene						
Hexachlorobutadiene						
Hexachloro-cyclopentadiene						
Hexachloroethane						
Indeno_{1,2,3-cd)pyrene						
Isophorone						
Naphthalene						
Nitrobenzene						
N-Nitroso-dimethylamine						
N-Nitroso-diphenylamine						
N-Nitroso-di-n-propylamine						
Phenanthrene						
Pyrene						
1,2,4-Trichlorobenzene						
Aroclors (µg/L)						
Aroclor-1016						
Aroclor-1221						
Aroclor-1232 .						
Aroclor-1242						
Aroclor-1248						
Aroclor-1254						
Aroclor-1260						
PCBs (Total)		0.03				
Chlorinated Pesticides **(µg/L)**						
Aldrin	1.3					
alpha-BHC						
beta-BHC						
delta-BHC						
gamma-BHC (lindane)	0.16					
alpha-chlordane						
gamma-chlordane						
Total Chlordane	0.09	0.004				
4 4'-DDD						
4,4'-DDE						
4,4'-DDT	0.13	0.001				
Dieldrin	0.71	0.0019				
alpha-Endosulfan	0.034	0.0087				
beta-Endosulfan	0.034	0.0087				
Endosulfan sulfate						
Endrin	0.037	0.0023				
Endrin aldehyde						
Heptachlor	0.053	0.0036				

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	CMC	CCC	CMC	CCC	CMC	CCC
Heptachlor Epoxide	0.053	0.0036				
Toxaphene	0.21	0.0002				
Methoxychlor						
Mirex					0.001	
Organophosphates **(µg/L)**						
Atrazine						
Chlorpyrifos			0.02	0.009	0.011	0.0056
Cyanazine						
Diazinon						
Malathion			0.34	0.1	0.17	0.028
Prometryn						
Simazine						
Herbicides **(ug/L)**						
2,4-D						
Glyphosate						
2,4,5-TP-SILVEX						
Pyrethroids **(ng/L)**						
Bifenthrin					4	0.6
Cyfluthrin					0.3	0.05
Cypermethrin					1	0.2
L-Cyhalothrin					1	0.5
Permethrin					10	2
Total Deltamethrin/Tralomethrin						
Total Esfenvalerate/Fenvalerate						

General

· Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

· Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

· CTR freshwater and saltwater dissolved metal criteria are except for silver which are .

· CTR freshwater and saltwater organics are except for aldrin and gamma-BHC which are .

California Fish and Game - Siepmann and Finlayson, 2000, Siepmann & Slater 1998 (malathion)

All values are criteria. CMCs are considered acute criteria.

UC Davis - Werner and Oram, 2008.

Sediment Screening Values for Selected Analytes

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	Salt ERM	Residential	Industrial	Residential	Commercial/ Industrial
Arsenic	mg/kg	8.2	70	0.39	1.6	0.07	0.24
Cadmium	mg/kg	1.2	9.6	70	800	1.7	7.5
Chromium	mg/kg	81	370			100,000	1,000,000
Copper	mg/kg	34	270	3,100	41,000	3,000	38,000
Lead	mg/kg	46.7	218	400	800	18	180
Mercury	mg/kg	0.15	0.71	10	43	1,600	16,000
Nickel	mg/kg	20.9	51.6	1,500	20,000	150	3,500
Selenium	mg/kg			390	5,100	380	4,800
Silver	mg/kg	1	3.7	390	5,100	380	4,800
Zinc	mg/kg	150	410	23,000	310,000	23,000	100,000
1-Methylnaphthalene	µg/kg			22,000	99,000		
2-Methylnaphthalene	µg/kg	70	670	310,000	4,100,000		
Acenaphthene	µg/kg	16	500	3,400,000	33,000,000		
Acenaphthylene	µg/kg	44	640				
Anthracene	µg/kg	85.3	1100	17,000,000	170,000,000		
Benzo (a) Anthracene	µg/kg	261	1600	150	2100		
Benzo (a) Pyrene	µg/kg	430	1600	15	210	38	130
Benzo (b) Fluoranthene	µg/kg			150	2100		
Benzo (k) Fluoranthene	µg/kg			1500	21,000		
Biphenyl	µg/kg						
Chrysene	µg/kg	384	2800	15,000	210,000		
Dibenz (a,h) Anthracene	µg/kg	63.4	260	15	210		
Fluoranthene	µg/kg	600	5100	2,300,000	22,000,000		
Fluorene	µg/kg	19	540	2,300,000	22,000,000		
Indeno (1,2,3-c,d) Pyrene	µg/kg			150	2100		
Naphthalene	µg/kg	160	2100	3600	18,000		
Phenanthrene	µg/kg	240	1500				
Pyrene	µg/kg	665	2600	1,700,000	17,000,000		
Total Low Weight PAHs	µg/kg	552	3160				
Total High Weight PAHs	µg/kg	1700	9600				
Total PAHs[4]	µg/kg	4022	44792				
Benzyl butyl phthalate	µg/kg			260,000	910,000		
bis-(2-Ethylhexyl)phthalate	µg/kg			35,000	120,000		
Diethyl phthalate	µg/kg			49,000,000	490,000,000		
Di-n-butyl phthalate	µg/kg			6,100,000	62,000,000		
2,4,6-Trichlorophenol	µg/kg			44,000	160,000		
2,4-Dichlorophenol	µg/kg			180,000	1,800,000		
2,4-Dimethylphenol	µg/kg			1,200,000	12,000,000		
2,4-Dinitrophenol	µg/kg			120,000	1,200,000		
2-Chlorophenol	µg/kg			390,000	5,100,000		
Pentachlorophenol	µg/kg			890	2,700	4,400	13,000
Phenol	µg/kg			18,000,000	180,000,000		
4,4'-DDD	µg/kg	2	20	2,000	7,200	2,300	9,000
4,4'-DDE	µg/kg	2.2	27	1,400	5,100	1,600	6,300
4,4'-DDT	µg/kg	1	7	1,700	7,000	1,600	6,300
Total DDT	µg/kg	1.58	46.1				
Aldrin	µg/kg			29	100	33	130
Chlordane	µg/kg			1,600	6,500	430	1,700
Cis-nonachlor	µg/kg						

Sediment Screening Values for Selected Analytes

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	Salt ERM	Residential	Industrial	Residential	Commercial/ Industrial
DCPA (Dacthal)	µg/kg	0.02	8	610,000	6,200,000		
Dieldrin	µg/kg			30	110	35	130
Endosulfan I	µg/kg			370,000	3,700,000		
Endrin	µg/kg			180,000	1,800,000	21,000	230,000
Heptachlor	µg/kg			110	380	130	520
Heptachlor Epoxide	µg/kg			53	190		
Methoxychlor	µg/kg			310,000	3,100,000	340,000	3,800,000
Mirex	µg/kg			27	96	31	120
Toxaphene	µg/kg			440	1600	460	1,800
PCB077	µg/kg			34	110		
PCB081	µg/kg			11	38		
PCB105	µg/kg			110	380		
PCB114	µg/kg			110	380		
PCB118	µg/kg			110	380		
PCB123	µg/kg			110	380		
PCB126	µg/kg			0.034	0.11		
PCB156	µg/kg			110	380		
PCB157	µg/kg			110	380		
PCB167	µg/kg			110	380		
PCB169	µg/kg			0.11	0.38		
PCB170	µg/kg			30	99		
PCB180	µg/kg			300	990		
PCB189	µg/kg			110	380		
Total PCB Congeners	µg/kg	22.7	180			89	300

1. Effects Range Low (ERL) and Effects Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010).
3. California Human Health Screening Levels for Soil (Cal/EPA, 2005).

APPENDIX J

COLORADO LAGOON TMDL MONITORING PLAN (CLTMP)

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FINAL
COLORADO LAGOON TMDL MONITORING PLAN (CLTMP)

COLORADO LAGOON ORGANOCHLORINE PESTICIDES, PCBs, SEDIMENT TOXICITY, PAHs, and METALS TMDL

Prepared for:

City of Long Beach
Los Angeles County Flood Control District
California Department of Transportation (Caltrans)

Prepared by:

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Santa Cruz, California 95060

December 17, 2012

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COLORADO LAGOON TMDL MONITORING PLAN (CLTMP)

COLORADO LAGOON ORGANOCHLORINE PESTICIDES, PCBs, SEDIMENT TOXICITY, PAHs, and METALS TMDL

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1.0 INTRODUCTION AND PURPOSE

Colorado Lagoon is located in Long Beach, California and is connected tidally by an underground culvert to the northwestern end of Marine Stadium in Alamitos Bay. Beneficial uses include water contact and non-contact water recreation, commercial and sport fishing, warm freshwater habitat, wildlife habitat, and shellfish harvesting.

Colorado Lagoon is listed as an impaired water body on the California Regional Water Quality Control Board, Los Angeles Region (CRWQCB-LA) 2006 Clean Water Section 303(d) list. This listing is based on sediment toxicity and levels of lead, zinc, chlordane, and polycyclic aromatic hydrocarbons (PAHs) in sediments. Bioaccumulation of certain organochlorine pesticides (chlordane, DDT, and dieldrin) and polychlorinated biphenyls (PCBs) in fish and mussels are also cited as contributing to impairment of the lagoon. The RWQCB has adopted a Total Maximum Daily Load (TMDL) action for Colorado Lagoon. This TMDL action amends the Water Quality Control Plan that was adopted by the Board on October 1, 2009 with specific requirements and an implementation schedule for improvements of water and sediment quality in Colorado Lagoon. The goal of the Colorado Lagoon TMDL is to protect and restore the habitat in order to provide conditions necessary to support both a healthy aquatic community and one that protects human health. This includes controlling further discharges of sediments to the Lagoon that may be capable of transporting persistent pollutants, accumulate in the benthic environment and subsequently bioaccumulate in fish and invertebrate tissues to levels that are deleterious to both human and aquatic health.

The City of Long Beach, in partnership with various local, State and Federal agencies, has been planning the improvement and restoration of Colorado Lagoon since the early 2000s. In 2006, the City of Long Beach completed a Feasibility Study that identified multiple possible improvements. In 2007, the Long Beach City Council certified an Environmental Impact Report for the Colorado Lagoon Restoration Project and approved Phase I of the Restoration Plan. Phase I consists of the following water and sediment quality improvements:

Improvement	Status
a) Clean Culvert, Remove Sill and Other Structural Impedances, and Repair Tidal Gates.	Complete
b) Remove Contaminated Sediment in the Western Arm.	Complete
c) Remove Sediment in the Central and Northern Arms.	Complete
d) Storm Drain Upgrades (Trash Traps and Low Flow Diversion).	Complete
e) Replace Local Hard Drain Outlets in the Lagoon with a Vegetated Bioswale.	Partially Completed

In addition, Los Angeles County recently redirected four storm drains from Colorado Lagoon to Marine Stadium as part of the Termino Avenue Storm Drain Project.

1.1 Background

Colorado Lagoon is a Y-shaped body of water situated at the northwestern end of Alamitos Bay, Long Beach, California. The Lagoon is connected tidally by an underground culvert to the Marine Stadium area of Alamitos Bay (Figure 1). It serves three main functions: 1) hosting sensitive estuarine habitat; 2) providing public recreation; and 3) retaining and conveying storm flows (LARWQCB 2009).

The Colorado Lagoon watershed is approximately 1,172 acres and divided into five sub-basins that discharge stormwater and urban dry weather runoff to the Colorado Lagoon (LARWQCB 2009). Each sub-basin formerly discharged through individual storm drainage systems to the Colorado Lagoon. Several smaller storm drains serve areas immediately adjacent to the lagoon which are expected to contribute very limited amounts of contaminants and cause only minor impacts to sediment quality.

1.2 Review of Previous Data

A number of previous studies have been conducted in Colorado Lagoon to characterize environmental conditions within the Lagoon. These studies have mostly focused on contamination in the sediments, in the water column, and in fauna.

Figure 1. Major Features of Colorado Lagoon and Vicinity.

1.2.1 Sediment Quality

Sediment core sampling results indicate a strong contamination gradient with high levels of certain contaminants in the western arm transitioning to much lower levels in the northern arm (Kinnetic Laboratories and Moffatt & Nichol 2006). Concentrations of many of these contaminants differ by an order of magnitude between the western arm and the northern arm. Five metals including cadmium, copper, lead, mercury, and zinc exhibited this distributional pattern. Among the organic contaminants, DDT compounds, chlordane, dieldrin, PCBs, and PAHs also demonstrated this strong gradient. Sediments within the western arm of the lagoon were found to exceed state requirements for lead and are considered hazardous materials. Sediment from core samples collected in the central part of the lagoon contained levels of DDT and chlordane above ERLs (Effects Range Lows). The Effects Range Low (ERL) guideline represents the 10^{th} percentile concentration value in the NOAA database, for any given contaminant, that might be expected to cause adverse biological effects.

Previously, surficial sediment sampling in Colorado Lagoon was conducted by the Bay Protection and Toxics Control Program (BPTCP) and Tetra Tech EM Inc. BPTCP (CSWRCB 1998) sampled from one site in the western arm in January 1993 and Tetra Tech (2000) sampled two locations in December 2000 with one station in the western arm and one in the northern arm. Results for each of these samplings showed a high degree of similarity for metals and organochlorine pesticides. Both copper and lead exceeded ERMs (Effects Range Medians) in both data sets. The Effects Range Median (ERM) guideline represents the 50th percentile concentration value in the NOAA database, for any given contaminant, than might be expected to cause adverse biological effects. Five to six other metals exceeded ERLs and concentrations of DDT compounds, chlordane, and dieldrin were well above ERMs in both sets of samples. Total PCBs were reported at a concentration of 100.5 µg/kg (dry weight) in 1993 but seven years later they were no longer detected in concentrations greater than the detection limits (<25 µg/kg [dry weight]). Concentrations of PAHs in surficial sediments from the western arm in 2000 were half of those reported by the BPTCP in 1993. Total PAH concentrations from core samples collected in 2004 were 15 percent of the concentrations measured in 1993, with only two PAH compounds exceeding ERLs in 2004 (Kinnetic Laboratories and Moffatt & Nichol 2006). Contaminant concentrations in sediment from the two sites sampled by Tetra Tech in 2000 also indicated a spatial gradient going from high concentrations in the western arm to substantially lower concentrations in the northern arm. Differences between these two areas were not as extreme as found in core composite samples from these two regions in 2004 (Kinnetic Laboratories and Moffatt & Nichol 2006).

1.2.2 Water Quality

The City of Long Beach Health Department has been conducting weekly surveys of indicator bacteria in Colorado Lagoon since January 2001 as part of AB411 sampling requirements. Sites are located on the pedestrian bridge that crosses the western arm of the lagoon and at beach swash zone sites located on both the north and south sides of the bridge. Water quality results reviewed in 2004 (Kinnetic Laboratories and Moffatt & Nichol 2004) showed that exceedances of AB411 or Basin Plan criteria are often attributable to high levels of total coliform (>10,000 MPN/100 ml) or a combination of total coliform (>1,000 MPN/100 ml) and *E. coli* concentrations that exceed 10 percent of the total coliform. A one-time examination of indicator bacteria and dry weather discharges and receiving waters of Colorado Lagoon demonstrated high concentrations in the dry weather flows and in receiving waters at 0700 (Kinnetic Laboratories and Moffatt & Nichol 2004). Concentrations in the receiving waters exceeded AB411 criteria but by noon the concentrations of indicator bacteria had declined and no longer exceeded the criteria. It is suspected that UV radiation, known to cause die off of indicator bacteria, likely leads to a reduction in bacterial concentrations that are present earlier in the day.

Water quality data was collected along with sediment during the December 2000 one day survey by Tetra Tech EM Inc. (2000). Dissolved oxygen, turbidity, temperature, and conductivity were profiled at 1 meter intervals for six stations. Hydrogen ion concentration (pH) was measured at the surface at all six stations while TSS was measured at a depth of 1 meter for two stations. The key result of this survey was the low dissolved oxygen values found throughout the lagoon.

Water quality testing was conducted in association with the sediment testing performed in 2004 (Kinnetic Laboratories and Moffatt & Nichol 2004). Water samples were collected at the centroid of each of the three sediment coring sites on June 29th, 2004 prior to the starting of the sediment testing program. Samples were analyzed for total and dissolved metals, nutrients, TSS, organochlorine pesticides, PCBs, and organophosphate pesticides. In addition, water quality profiles were performed at each of these three sites for temperature, conductivity, salinity, pH, and dissolved oxygen. A fourth sample was taken from a storm drain on the eastern shoreline of Colorado Lagoon but only tested for nutrients and salinity. This was the only storm drain that exhibited dry weather flows at the time of sampling. Overall concentrations of most analytes tested were extremely low. All organochlorine pesticides, PCBs and organophosphate pesticides were below detection limits and none of the trace metals exceeded California Toxics Rule criteria. Nutrient concentrations within the lagoon were typical of coastal waters while the dry weather flow sampled from the storm drain sampled were an order of magnitude higher than the receiving waters. At the time of the survey, flow from this storm drain was reported to be trickling out from under the flapper gate.

Additional water quality testing was conducted during both pre- and post-construction monitoring periods (Kinnetic Laboratories, Inc. and Moffatt & Nichol, 2011). Low concentrations of most trace metals were measured in the water column during both pre- and post construction surveys. Dissolved copper slightly exceeded CTR water quality at two sites during one of the pre-construction surveys but levels were well below these criteria during all other surveys. Organochlorine Pesticides and PCBs were not detected in any of the pre- or post-construction surveys despite use of extremely low detection limits. This is consistent with previous surveys conducted in the Lagoon. Concentrations of nutrients (both nitrogen and phosphorus) were low during all pre- and post-construction surveys. Nitrogen was predominantly in the form of organic nitrogen. Concentrations of Total Suspended Solids (TSS) were consistently low in both the pre-construction (1.7 to 5.2 mg/L) and most post-construction surveys (1.1 to 7 mg/L). Slightly higher TSS (10.3 to 16 mg/L) was measured during the 23 May 2011 post construction survey. The low concentration of TSS in all samples is consistent with the high water clarity and low concentrations of total recoverable trace metals.

1.2.3 Marine Biota

Fishes

A total of 152,169 fishes from 23 species were caught in monthly beach seine hauls during 1973 in Colorado Lagoon (Allen and Horn 1975). The impetus for this study was when Allen noticed the disparity in kinds and numbers of fishes between summer and winter months while studying an introduced clam population in Colorado Lagoon (Crane et al. 1975). Numbers of species and individuals were highest during the summer (May-September) and were both highly correlated with lagoon temperature. The most abundant species collected was the northern anchovy (*Engraulis mordax*) but showed up seasonally being extremely abundant in August and September but rare or absent during the other sampling periods. Five species were considered to be residents of the lagoon. In order of abundance they were topsmelt (*Atherinops affinis*), slough anchovy (*Anchoa delicatissima*), shiner surfperch (*Cymatogaster aggregate*), California killifish (*Fundulus parvipinnis*), and staghorn sculpin

(*Leptocottus armatus*). Only two of these five resident species, topsmelt and shiner surfperch, were collected in all twelve months. Topsmelt was the only species collected in abundance throughout the year with total number of individuals ranging from 180 (June) to 1600 (October). Shiner surfperch ranged from less than ten individuals (January-March, November and December) to 923 individuals (May).

Chambers Group (2004) performed three beach seines in July 2004 with one in the western arm, one in the center of the lagoon, and one in the northeastern arm. A total of thirteen species were collected in the three seine hauls with an additional species, staghorn sculpin, observed but not collected. Topsmelt, like in the 1973 survey, was the most abundant resident species accounting for 99% of the individuals collected from the combined three seine hauls.

Invertebrates

From the spring of 1970 to June 1973 an extensive survey of Colorado Lagoon was conducted to determine growth rates, distribution, spawning, and density of an introduced clam species the Atlantic quahog (cherrystone clam) *Mercenaria mercenaria* (Crane et al. 1975). Other common clams observed in Colorado Lagoon during this survey included cockles (*Chione undatella* and *C. fluctifraga*), little necks (*Protothaca staminea*), California jackknife clams (*Tagelus californianus*), and mussels [*Geukensia* (=*Modiolus*) *demissa* and *Mytilus edulis*]. *Mytilus edulis*, the common bay mussel has since been determined to be the species *M. galloprovincialis*. Two clams described as being found occasionally were the California fat-tellin [*Leporimetis* (=*Florimetis*) *obesa*] and the giant eggcockle (*Laevicardium elatum*).

Chambers Group (2004) collected four species of clam during a clam survey along the shore of Colorado Lagoon. These species included *C. fluctifraga*, *P. staminea*, *T. californianus*, and *Venerupis philipinarum* (Japanese littleneck clam). In addition, bay mussels (*M. galloprivincialis*) were observed growing on pilings and floats, and the introduced green mussel (*Musculista senhousia*) was observed during a reconnaissance dive in the lagoon. Though populations of the Atlantic quahog (*M. mercenaria*) were said to reach 556 individuals per square meter (Crane et al. 1975), none were collected during the Chambers Group survey suggesting that this species has either been eliminated or greatly reduced in abundance in Colorado Lagoon (Chambers 2004).

Epifaunal invertebrates observed include the colonial sea vase tunicate *Ciona intestinalis* during summer months and the abundant solitary leathery tunicate or pleated sea squirt (*Styella plicata* (Crane et al. 1975). *S. plicata* was observed to be common on the bottom of the lagoon and pier pilings during the Chambers Group (2004) survey. The most abundant epifaunal invertebrate observed by Chambers Group was the colonial spaghetti bryozoan *Zoobotryton verticullatum*. The Chambers Group also reported observing the California bubble snail (*Bulla gouldiana*) during the Lagoon reconnaissance dive and the California horn snail (*Cerithidea californica*) very abundant along the intertidal edges of the lagoon.

Benthic infauna was investigated by Chambers Group (2004) where three replicate samples at three stations in Colorado Lagoon produced a total of 35 invertebrate taxa. The number of taxa ranged from 4 in the western arm to 26 in the center of the lagoon. 18 taxa were collected in the northern arm. The

mean number of organisms per square meter ranged from 2,089 in the northern arm to 3,822 in the center of the lagoon. The Shannon-Wiener Diversity Index (H') ranged from 0.76 in the western arm to 2.55 in the northern arm. Diversity was low in the western arm since 2 of the 4 taxa collected there accounted for 97% of the organisms in the samples. Higher numbers of taxa with a more even distribution of individuals per taxa was responsible for the higher diversity values for the center and northern sections of the lagoon. Samples from the western arm of Colorado Lagoon were dominated by two herbivorous taxa, a snail (*Assiminea californica*) and an isopod crustacean (*Paracerceis sculpta*). The two dominant species collected in the northern arm of Colorado Lagoon were the snail *A. californica* and the foraminifera grazing rude-bubble barrel gastropod snail *Acteocina inculta*. Polychaete worms were the next dominant organisms in the northern arm and consisted of suspension and deposit feeding spionid tube worms (*Streblospio benedicti* and *Pseudopolydora paucibranchiata*), the burrowing lumbrinerid worm *Scoletoma* sp. C, and the filter feeding sabellid worm *Euchone limnicola*. The only crustacean collected was the seed shrimp *Euphilomedes carcharodonta*. Unidentified cnidarians (sea anemones) and the non-native tube building amphipod *Grandidierella japonica* were the two most abundant taxa in the center section of Colorado Lagoon. *A. californica* was the most abundant mollusk and *S. benedicti* was the most abundant polychaete worm in the center of the lagoon.

Aquatic Vegetation

The green alga *Enteromorpha intestinalis* was described as the dominant macroscopic alga in Colorado Lagoon during 1970 through 1973 (Crane et al. 1975) and was stated as one of the dominant algae, along with the grean alga *Ulva lobata*, in the northern part of the lagoon by the Chambers Group (2004). The red alga *Gracilaria* sp. was the dominant bottom vegetation in the western part of Colorado Lagoon. A few scattered eelgrass (*Zostera marina*) plants were observed in Colorado Lagoon during Chambers (2004) reconnaissance dive.

1.2.4 Bioaccumulation

The California Department of Fish and Game (CDF&G) State Mussel Watch program provides some of the only information on tissue burdens from biota in Colorado Lagoon. This approximately 25 year old data set provides a glance into past and the contaminants accumulated over time in the Lagoon (Kinnetic Laboratories and Moffatt & Nichol 2004). CDF&G collected resident mussels from Colorado Lagoon in January 1982, and January and December 1985. Additionally, California mussels were transplanted to Colorado Lagoon for a four month period in 1986. Lead was the only metal that was consistently elevated. Initial levels of lead in resident mussels were reported as high as 8.73 mg/kg (wet weight) but declined to 2.91 mg/kg (wet weight) in 1985. A similar level of lead (3.19 mg/kg [wet weight]) was measured in the transplanted mussels in 1986. Similar trends were evident for total chlordane and DDT compounds. Most chlordane compounds in resident mussels remained at levels above the EDL85 criteria. EDL85 is the 85^{th} percentile for each contaminant and were developed for resident bivalves and transplanted bivalves based upon twenty years of data from 1977 through 1997.

1.3 Purpose

The purpose in developing a Colorado Lagoon TMDL Monitoring Plan (CLTMP) is to monitor and evaluate implementation of the TMDL and refine the understanding of current sediment loads. The stated goals of the CLTMP are as follows:

- Determine compliance with organochlorine pesticides, PCBs, metals, and PAHs waste load and load allocations, and, when appropriate, request delisting of Colorado Lagoon from the 303(d) list of impaired water bodies.
- Monitor the effectiveness of implementation actions proposed by the responsible agencies on water and sediment quality, including potential impacts of redirecting discharges from the Termino Avenue Drain and from cleaning the culvert between Marine Stadium and Colorado Lagoon.
- Monitor contaminants in Lagoon sediments and determine if additional implementation actions are necessary to achieve the TMDL, and
- Implement the CLTMP in a manner consistent with other TMDL implementation plans and regulatory actions within the Colorado Lagoon watershed.

1.4 Specific Issues

There are a number of issues that are unique to Colorado Lagoon. These include aggressive actions to improve Colorado Lagoon. Multiple improvements have been completed and others are underway to address the problems at Colorado Lagoon. Efforts have also been made to assess the impacts of these improvements. With extensive modifications focusing upon a relatively small area, it is expected that completion of these activities will allow the objectives of the TMDL program to be rapidly met. Some time will be necessary to assure that contaminants are not accumulating in Marine Stadium sediments and to demonstrate that the improvements have effectively reduced sources of contamination and interrupted the process of bioaccumulation in local fish and mussels.

Monitoring within Colorado Lagoon indicates that the pollutants of concern in the Lagoon are not an issue in the water column during periods of dry weather. A total of six prior surveys have been conducted (Kinnetic Laboratories and Moffatt & Nichol 2004, Kinnetic Laboratories and Moffatt & Nichol 2011) that indicate that, with minor exceptions, dry weather water quality standards were met before completion of the improvements. No exceedences of standards were evident during two surveys following completion of recent improvements, which includes trash traps at major storm drains, cleaning of the underground culvert, and construction of a low-flow diversion system that redirects up to 110,000 gallons per day of urban runoff into the sanitary sewer system.

Given the extreme actions being taken and the plan to extend dredging to the entire Lagoon, interim evaluations of the monitoring program and requirements are recommended after the first year of monitoring and again after the first three years in order to examine overall progress and reassess whether reduction or elimination of some elements is warranted, or if objectives have been met. If monitoring results demonstrate that remediation actions were effective in removing contaminants, the benthic

community returns to a fully functional and healthy condition, and fish tissue and sediment quality objectives have been achieved, responsible agencies may submit a formal request to reduce monitoring frequency to the Executive Officer for consideration.

1.4.1 Completed and On-Going Implementation Actions

This CLTMP program requires approval by the CRWQCB-LA prior to initiation of monitoring. The responsible agencies (City of Long Beach, Los Angeles County Flood Control District, and California Department of Transportation) have identified TMDL Implementation Actions and have carried out studies and embarked upon carrying out some selected actions.

At this time, the improvements on the culvert connecting Colorado Lagoon with the Marine Stadium area of Alamitos Bay have been completed. Accumulated sediment, debris, and fouling organisms have been removed from the underground culvert. The tidal gates have been repaired, and the existing sill and structural impairments to water exchange in this culvert have been removed. A vegetative bioswale was constructed between the golf course and a western lagoon culvert. Low flow diversions now prevent the majority of dry weather discharges from entering the lagoon and trash traps are effectively reducing litter and debris.

Construction of the Termino Avenue Drain Project (TADP) was completed prior to the current storm season and now conveys a significant portion of the stormwater runoff past Colorado Lagoon to Marine Stadium. This project incorporated trash excluder screens and filtration systems at each catch basin to exclude trash and sediment from being discharged into Marine Stadium. A major element of the TADP included complete removal of two of the major storm drains discharging to the Lagoon. Removal of these drains eliminated any runoff from subbasins D and E of the Lagoon.

Pre- and post-construction monitoring efforts show marked improvements in bacterial water quality at the swimming beach in the central part of Colorado Lagoon. The last Heal the Bay summer beach water quality grades for Colorado Lagoon (Heal the Bay 2011) indicated that grade assignments changed from the usual "F" grades to "A." The Heal the Bay Annual Beach Report Card (2012) stated the following:

> "As a result of the Long Beach's efforts, the Colorado Lagoon dropped off of the Beach Bummer list for 2012. In addition to improving from one of the state's most polluted beaches, Colorado Lagoon exhibited excellent water quality this year by receiving all A and B grades during summer and winter dry weather."

The observed improvements are promising.

Dredging to remove contaminated sediments from Colorado Lagoon was completed this summer (2012), prior to implementation of the monitoring effort. The entire Lagoon was dredged to assure that concentrations of lead and other compounds of concern are below ERL sediment guidelines from the National Oceanic and Atmospheric Administration (NOAA) Sediment Quality Guidelines (Long and Morgan 1990; Buchman 1999) or meet SQOs. The TMDL only required dredging of the western arm but recent testing (Kinnetic Laboratories, Inc. 2010) identified moderate contamination in the northern arm that was highest adjacent to the storm drain outlet. The City of Long Beach opted to remove all sediment

exceeding ERLs in order to avoid the likelihood of needing to remobilize for more dredging if levels in the Northern Arm did not show evidence of dropping due to reduction of loads and mixing with cleaner sediment. With removal of these contaminated sediments from the lagoon, sediment concentrations are expected to be near pre-development levels and enable re-colonization by benthic infauna and epifauna. Although it will immediately be possible to assess contaminant concentrations based upon ERLs or SQOs, the biological community will require time to fully re-establish. Dredging of the entire Lagoon to remove all sediment exceeding ERLs is expected to accelerate recovery of the benthic community and provide an opportunity for the monitoring program to be reassessed. We recommend a full reassessment of the monitoring effort within the first three years to determine which elements of the program could be reduced or eliminated.

1.4.2 Numeric TMDL Targets

The TMDL established Waste Load Allocations (WLAs) for annual mass loads of each constituent of concern at each major stormwater outfall and indicated that compliance assessment for these mass-based WLAs would be determined by measurement of annual loads at each outfall. In addition to the mass-based WLAs, both interim and final concentration-based WLAs were established for sediments within the Lagoon. Interim WLAs were established based upon 95th percentile monitoring data in order to provide time for completion of improvements. The final WLAs are based directly on ERLs for each pollutant. If final concentration-based WLAs are not attained, alternative strategies may be necessary. Exceedance within a confined portion of the Lagoon may trigger implementation of intensive, continuous load monitoring at selected outfalls to directly measure compliance with annual, mass-based WLAs or even reassessment of WLAs necessary to meet the concentration-based WLAs in the receiving waters.

Although the present TMDL numeric sediment quality targets are based upon the ERL (Long and Morgan 1990; Buchman 1999), these reference values were never meant to be used as sediment criteria. New Sediment Quality Objectives (SQOs) developed by the California State Water Resources Control Board (CSWRCB) use a "Multiple Lines of Evidence" approach that take into account sediment chemistry, toxicity, and benthic community condition. These SQOs are now the regulatory standard against which ambient sediment quality in bays and estuaries are determined and managed, such as to serve as the basis for evaluating water body impairment (e.g. 303(d) listings) with regard to sediment quality. They do not however directly address impairment attributable to individual contaminants in Colorado Lagoon, but are likely to be critical in assessing future sediment quality within the lagoon after implementation actions are taken. The single ERL numeric guideline value may turn out to be unnecessarily conservative. The appropriateness of utilizing the SQOs was affirmed during the SWRCB Public Hearing on October 1, 2009 and in subsequent discussions with RWQCB and SWRCB staff. For this reason, the TMDL monitoring plan incorporates an option for conducting additional monitoring necessary to evaluate sediment quality consistent with the new SQO approach while still providing information required for evaluation relative to ERLs.

1.4.3 Special Studies

Additional special studies, including those mentioned in the Staff Report have not been made part of this CLTMP. The effort required for this project is already quite substantial so these special studies are currently unnecessary. With extensive efforts being taken to improve habitat, sediment quality, and water quality in the lagoon, we are not anticipating that these additional studies will be necessary or warranted, especially if dredging is performed in all three segments of the lagoon as anticipated. Special studies or modifications of the basic monitoring plan would only be considered after results of existing implementation measures are fully evaluated.

2.0 TMDL MONITORING SCHEDULE

Monitoring will begin six months after the CLTMP is approved by the Executive Officer of the CRWQCB-LA. A tentative schedule of monitoring activities is provided in Figure 2. The schedule was developed based upon the assumption that initial monitoring activities will start in January 2013. This schedule may need to be shifted depending upon the actual approval date for the monitoring plan. The monitoring schedules are considered tentative since certain sampling frequencies are designed to be modified if any objectives are exceeded.

Water quality samples are to be collected quarterly the first year and then semi-annually thereafter. If water quality objectives (numeric targets) are exceeded at any time, sampling frequency shall be accelerated to quarterly until water quality objectives are not exceeded (Table 1). Once clean results are demonstrated for a period of four successive quarterly sampling efforts, sampling frequency will return to quarterly. Water quality testing during pre and post construction monitoring would suggest that quarterly sampling will not be necessary after the first year. Sampling is expected to be conducted during dry weather conditions. Sampling shall be deferred for at least 72 hours after any rainfall exceeding 0.1 inches.

Sediment samples are to be collected annually for analysis of target constituents and toxicity testing. Sampling is scheduled to be conducted during the summer months which should give almost a full year for the recovery process to progress. If sediment objectives (numeric targets) are exceeded or sediment toxicity is observed at any time, sampling frequency for both sediment and sediment toxicity will be accelerated to semi-annually until sediment objectives are not exceeded for three consecutive surveys and sediment toxicity is not observed (Table 1).

Fish tissue samples are to be collected annually. The same rationale used for establishing sampling frequency for sediments is used to establish fish tissue sample collection frequency. Tissues from resident bay mussels (*Mytilus galloprovincialis*) are to be collected annually and analyzed to further assess and track impairment. If fish and/or mussel tissue objectives (numeric targets) are exceeded at any time, sampling frequency will be accelerated to semi-annually until fish tissue objectives are not exceeded (Table 1).

Benthic community analysis is an optional task and would not be initiated until January 2015 in order to provide time for initial colonization of the sediments to occur and successional development to progress sufficiently towards an equilibrium condition. This task will only be performed if deemed necessary in order to support a comprehensive re-evaluation using SQOs.

Reassessment of all monitoring tasks and sampling frequencies is recommended after completion of the first and third annual monitoring reports. Due to extensive efforts to eliminate both sources and sinks for contaminants, we expect recovery to be rapid. It is also anticipated that the entire Lagoon will be dredged thus eliminating earlier concerns regarding contaminant concentrations present in surficial sediments in the Northern Arm. Since the project was extended to include removal of sediment from the northern arm, concerns regarding the rate of decline of contaminant concentrations in this region are no longer justified. If early surveys show that dredging was effective in removing the remaining contaminants, the benthic community returns to a fully functional and healthy condition, and the bioaccumulation pathway is effectively interrupted, then the monitoring program shall be modified to extend time periods between sampling. A formal request shall be made to the Executive Officer when appropriate. The revised goal would be to assure that the improvements are capable of preventing recontamination of the site and to identify developing problems before they reach a level causing impairment to return.

COLORADO LAGOON MONITORING PROGRAM

Project Lead: TBD
Start Date: 6/1/2011 (Wednesday)

WBS	Tasks	Task Lead	Start	End	Duration (Days)
1	**Water Quality**		Tue 1/01/13	Mon 11/06/17	1771
1.1	1st Quarter		Tue 1/01/13	Wed 2/06/13	37
1.2	2nd Quarter		Mon 4/01/13	Tue 5/07/13	37
1.3	3rd Quarter		Tue 7/02/13	Wed 8/07/13	37
1.4	4th Quarter		Tue 10/01/13	Wed 11/06/13	37
1.5	5th SemiAnnual		Wed 1/01/14	Thu 2/06/14	37
1.6	6th SemiAnnual		Wed 10/01/14	Thu 11/06/14	37
1.7	7th SemiAnnual		Wed 4/01/15	Thu 5/07/15	37
1.8	8th SemiAnnual		Thu 10/01/15	Fri 11/06/15	37
1.9	9th SemiAnnual		Fri 4/01/16	Sat 5/07/16	37
1.10	10th SemiAnnual		Sat 10/01/16	Sun 11/06/16	37
1.11	11th SemiAnnual		Sat 4/01/17	Sun 5/07/17	37
1.12	12th SemiAnnual		Sun 10/01/17	Mon 11/06/17	37
2	**Sediment Quality**		Mon 7/01/13	Sun 7/30/17	1491
2.1	1st Annual		Mon 7/01/13	Tue 7/30/13	30
2.2	2nd Annual		Tue 7/01/14	Wed 7/30/14	30
2.3	3rd Annual		Wed 7/01/15	Thu 7/30/15	30
2.4	4th Annual		Fri 7/01/16	Sat 7/30/16	30
2.5	5th Annual		Sat 7/01/17	Sun 7/30/17	30
3	**Sediment Toxicity**		Mon 7/01/13	Tue 8/29/17	1521
3.1	1st Annual		Mon 7/01/13	Thu 8/29/13	60
3.2	2nd Annual		Tue 7/01/14	Fri 8/29/14	60
3.3	3rd Annual		Wed 7/01/15	Sat 8/29/15	60
3.4	4th Annual		Fri 7/01/16	Mon 8/29/16	60
3.5	5th Annual		Sat 7/01/17	Tue 8/29/17	60
4	**Benthic Community**		Wed 7/01/15	Thu 9/28/17	821
4.1	3rd Annual (start)		Wed 7/01/15	Mon 9/28/15	90
4.2	4th Annual		Fri 7/01/16	Wed 9/28/16	90
4.3	5th Annual		Sat 7/01/17	Thu 9/28/17	90
5	**Fish Tissue Burden**		Mon 7/01/13	Mon 8/14/17	1506
5.1	1st Annual		Mon 7/01/13	Wed 8/14/13	45
5.2	2nd Annual		Tue 7/01/14	Thu 8/14/14	45
5.3	3rd Annual		Wed 7/01/15	Fri 8/14/15	45
5.4	4th Annual		Fri 7/01/16	Sun 8/14/16	45
5.5	5th Annual		Sat 7/01/17	Mon 8/14/17	45
6	**Resident Mussel Tissue Burden**		Mon 7/01/13	Mon 8/14/17	1506
6.1	1st Annual		Mon 7/01/13	Wed 8/14/13	45
6.2	2nd Annual		Tue 7/01/14	Thu 8/14/14	45
6.3	3rd Annual		Wed 7/01/15	Fri 8/14/15	45
6.4	4th Annual		Fri 7/01/16	Sun 8/14/16	45
6.5	5th Annual		Sat 7/01/17	Mon 8/14/17	45
7	**Project Mgmt & Reporting**		Tue 1/01/13	Fri 3/30/18	1915
7.1	1st Annual - Draft		Sat 2/01/14	Sun 3/02/14	30
7.1.1	1st Annual - Final		Sat 3/01/14	Sun 3/30/14	30
7.2	2nd Annual-Draft		Sun 2/01/15	Mon 3/02/15	30
7.2.1	2nd Annual-Final		Sun 3/01/15	Mon 3/30/15	30
7.3	3rd Annual-Draft		Mon 2/01/16	Tue 3/01/16	30
7.3.1	3rd Annual-Final		Tue 3/01/16	Wed 3/30/16	30
7.4	4th Annual-Draft		Wed 2/01/17	Thu 3/02/17	30
7.4.1	4th Annual-Final		Wed 3/01/17	Thu 3/30/17	30
7.5	5th Annual-Draft		Thu 2/01/18	Fri 3/02/18	30
7.5.1	5th Annual-Final		Thu 3/01/18	Fri 3/30/18	30

Figure 2. Schedule of Monitoring and Reporting Activities through March 2018.

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3.0 STUDY WORK PLAN

3.1 Approach

The small size of Colorado Lagoon and the extensive measures already taken to reduce contaminant loads and remove existing contamination provide unique circumstances. The dredging now being completed is expected to result in a new sediment interface with contaminant concentrations that are near or below associated ERLs (Table 1). Removal of the contaminated sediments is expected to eliminate both sediment and tissue burdens associated with the benthic community. This will also effectively interrupt the primary pathway for bioaccumulation. In fact, after completion of dredging, concentrations of many of the target contaminants in Colorado Lagoon sediments are likely to be lower than those that currently exist in Marine Stadium and Alamitos Bay. Drainage and circulation improvements already completed were designed to further improve water quality within the Lagoon both in terms of toxics and bacterial water quality criteria (Table 1).

Major sources of contaminants have been addressed by diverting low flows to the sanitary system, trapping trash and debris before it reaches the Lagoon and redirecting high flows through the new Termino Avenue Drain. Although the contaminants have been removed and the primary sources of contamination addressed, it is likely to take at least a year or two for tissue burdens currently associated with the resident fish, mussels and other filter-feeding species in the Lagoon to show signs of significant declines.

The dredging of the entire Lagoon will require recruitment of a new benthic community from the adjacent waters of Marine Stadium and Alamitos Bay. In the early phases of recovery, opportunistic benthic species will first colonize the Lagoon. The successional process of developing into a diverse, well-balanced benthic community may take several years before conditions approach those typical of other shallow, coastal embayments.

Given these circumstances, we shall revisit the monitoring plan after the first 3 years to assess whether any elements should be reduced or eliminated from the monitoring effort. Triggers are already in place for increasing the monitoring effort under certain conditions but the TMDL did not include triggers that would reduce or eliminate monitoring given evidence that concentrations of target contaminants are maintained below critical levels.

Table 1. Numeric Targets for Water, Fish Tissue, and Sediment for Organochlorine Pesticides, PCBs, PAHs, and Metals.

Constituents	Water Quality Target[1] (µg/L)	Fish Tissue Target[2] (µg/kg)	ERL Sediment Target[3] (µg/dry kg)
Chlordane[4]	0.00059	5.60	0.50
DDTs	0.00059	21.00	1.58[5]
Dieldrin	0.00014	0.46	0.02
PCBs	0.00017[6]	3.60[7]	22.70
Total PAHs[8]	0.049[9]	5.47	4,022
Total LPAHs[10]	NA[11]	NA	552
Total HPAHs[12]	NA	NA	1,700
Cadmium[14] (optional)	NA	NA	
Copper[14] (optional)	NA	NA	
Lead	8.10[12]	NA	46,700
Mercury[14] (optional)	NA	NA	
Zinc	81.00[12]	NA	150,000

1 The California Toxics Rule (CTR) water quality criteria for consumption of organisms only are applied as the numeric targets for Chlordane; 4,4' DDT; Dieldrin; and PCBs for protection of human health. The CTR aquatic life criteria for saltwater are applied as the numeric targets for protection of aquatic life for lead and zinc.

2 Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goals is applied as numeric targets for Chlordane, DDTs, Dieldrin, and PCBs. The U.S. Environmental Protection Agency (USEPA) screening value is applied as the numeric target for total PAHs.

3 Effect Range Low (ERL) sediment criteria from National Oceanic and Atmospheric Administration (NOAA) Sediment Quality Guidelines are applied as numeric targets.

4 Chlordane should be reported as cis- and trans-chlordane, heptachlor, heptachlor epoxide, cis and trans-nonachlor, and oxy chlordane consistent with SCCWRP Bight '08 protocol

5 DDTs in sediment are measured as the sum of o,p'- and p,p'- isomers of DDT, DDE, and DDD.

6 PCBs in water are measured as the sum of congeners 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, 206 (optional 8, 27, 29, 31, 33, 56, 60, 64, 95, 97, 141, 146, 158, 174, 198/199, 200, 203, 209).

7 PCBs in fish tissue and sediment are measured as the sum of all congeners.

8 PAHs: Polycyclic aromatic hydrocarbons (sum of acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene).

9 CTR human health criteria were not established for total PAHs, therefore, the lowest CTR criteria for individual PAHs of 0.049 µg/L is applied to the sum of benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. Other PAH compounds in the CTR shall be screened as part of the TMDL monitoring plan.

10 LPAHs: Low molecular weight PAHs

11 NA: Not Applicable

12 HPAHs: High molecular weight PAHs

13 Saltwater criteria for metals are expressed in terms of the dissolved fraction of metals in water column.

14 Metals listed as optional are included to complete the list of analytes currently necessary for calculation of Sediment Quality Objectives. These metals were not part of the 303(d) listing.

4.0 MONITORING STUDY DESIGN

The study design addresses water quality, sediment quality and maintenance of minimal body burdens of bioaccumulative compounds in fish and bivalves. Sites have been selected in order to monitor conditions within both Colorado Lagoon and the northern end of Marine Stadium near both the new Termino Avenue Drain and the culvert connecting to Colorado Lagoon. If necessary, the TMDL responsible agencies should have the option to monitor within their own jurisdiction to demonstrate its own compliance individually. This monitoring program does not currently address individual annual mass-based WLAs which would require installation of monitoring sites at all major storm drains to measure flow and collect water quality samples throughout the year. This approach would only be considered if concentration-based WLAs in one portion of the Lagoon necessitated assessment of inputs from specific storm drains that contribute to that a particular segment of the Lagoon.

4.1 Monitoring Sites

Water quality monitoring, sediment quality testing and, eventually, benthic community assessments will be performed at the three locations within Colorado Lagoon and another at the head of Marine Stadium near where the culvert from Colorado Lagoon enters the Marine Stadium. Fish will be collected from each of the three main segments of the Lagoon (Northern, Central and Western) as well as from the head of Marine Stadium. Mussels are expected to reestablish on the foot bridge and near the tide gate in Central Colorado Lagoon that allows for control of water levels. Mussels are also expected to develop on the hard structures of the new Termino Avenue Drain outfall and shallow waters near the outfall. Sampling schedules were established with consideration of expectations that mussels should approach population densities and sizes necessary for the program. Assuming new populations are successfully established at each location, these sites would continue to be used for collection of mussels for purposes of bioaccumulation testing.

4.1.1 Water Quality Monitoring Sites

Water quality samples are to be collected at four locations. Water quality monitoring sites will be located approximately 100 feet from each of the remaining three major storm water outfalls for drainage area sub-basins A, B, C (WS1 through WS3) and a location 200 feet from the outlet from Colorado Lagoon into Marine Stadium (WS4). Sampling in Marine Stadium should be conducted during an incoming tide to avoid water directly exiting the Lagoon. Due to the close proximity of the outfall for the new Termino Avenue storm drain and the culvert connecting to Colorado Lagoon, this single site is considered appropriate for documenting water quality conditions in the northern end of Marine Stadium (Table 2 and Table 3; Figure 3 and Figure 4).

Table 2. Key Comparing Subbasin and Storm Drain Project Designations.

Subbasin Name	Storm Drain Designation	Jurisdictional Responsibility
Subbasin A	Project 452 – 63-inch RCP	Los Angeles County Flood Control District and City of Long Beach
Subbasin B	Line I – 54 inch RCP	City of Long Beach and Caltrans
Subbasin C	Line K – 48-inch RCP	City of Long Beach
Subbasin D	Line M - 24-inch RCP ***(Eliminated)***	City of Long Beach
Subbasin E	Line M – 48-inch RCP, Termino Ave. Drain ***(Eliminated)***	Los Angeles County Flood Control District and City of Long Beach

Note Stormwater drainage from Subbasins D and E was intercepted and redirected to Marine Stadium as part of the Termino Avenue Drain project.

4.1.2 Sediment Quality Monitoring Sites

Similar assumptions were used to select sites for collection of samples for purposes of sediment quality and toxicity testing. Sediment samples are to be collected annually at the same locations used for the water quality sampling (Table 3 and Figure 3).

4.1.3 Marine Biota Monitoring Sites

Based on historical data, few resident fish or macroinvertebrate species utilize the Lagoon on a year-round basis. In addition, few species targeted by recreational fishermen are typically encountered within Colorado Lagoon especially at life stages suitable for recreational fishing. As a result fish sampling will focus on species that are ecologically important as food resources for birds and other fish species higher in the food web. Anchovy can be highly abundant in August and September as young-of-the-year tend to migrate into shallow, warm and productive coastal waters and/or embayments. Topsmelt and shiner perch are the primary candidates for collection on a year-round basis. Since both are highly mobile, separate collection and analysis of tissues from fish collected within each of the three major segments of the Lagoon would not be expected to result in significant differences in the uptake of contaminants. Due to the small size of the Lagoon and the mobility exhibited by resident fish, fish will be collected from each of the three major segments of the Lagoon (F1a, F1b and F1c) and composited into a single sample (F1) for chemical analysis. Fish collections will also be made at the northern end of Marine Stadium (F2). A single sampling station will be located along the soft bottom beach located the west of the culvert from Colorado Lagoon. This is one of the few sites suitable for deployment of a beach seine. Sampling in Marine Stadium will be conducted during an incoming tide to avoid or minimize the influence of Colorado Lagoon waters (Table 3 and Figure 3).

Resident bay mussels are to be collected annually at two sites within Colorado Lagoon (M1 and M2) and one in Marine Stadium (M3). Colorado Lagoon sites include hard substrates near the tide gates and the pilings of the foot bridge across the western arm of the lagoon. The third sample will be taken in Marine Stadium near the new Termino Ave. Drain Outfall. The abundance of resident mussels in appropriate

size ranges will need to be considered during the field sampling effort. Since mussels are resident at the selected sites and provide information on possible long-term gradients in pollutant loading and reflect the health of that specific area of the waterbody, samples from the two Lagoon sites should be collected at each site and may not be combined. If there are an inadequate number of mussels to be collected at the Lagoon sites due to the fact that the dredging project was just completed in August 2012 and time is needed for the mussels to re-establish at the sites, the sampling event should be rescheduled to a later date and documented clearly in the report. Mussel sampling from the Marine Stadium sites can be rescheduled to the same date to provide relevant information and perform the most cost effective protocol.

Table 3. Station Sampling Matrix and Sampling Frequency

Station	Station Description[1,6]	Water Sampling[2]	Sediment Quality and Toxicity Sampling[3]	Benthic Community Analysis[4]	Fish Tissue Sampling[5]	Mussel Tissue Sampling
F1a	Western Arm				Annually	
F1b	Central Arm				Annually	
F1c	Northern Arm				Annually	
F2	Marine Stadium				Annually	
WS1	Outfall Sub-Basin A	Quarterly	Annually	Annually		
WS2	Outfall Sub-Basin B	Quarterly	Annually	Annually		
WS3	Outfall Sub-Basin C	Quarterly	Annually	Annually		
WS4	CL Outfall to MS	Quarterly	Annually	Annually		
M1	CL Footbridge					Annually
M2	CL near Tide Gates					Annually
M3	Termino Ave. Drain - MS					Annually

1 CL: Colorado Lagoon; MS: Marine Stadium

2 After one year water sampling is to be performed semi-annually unless water quality objectives are exceeded. If objectives are exceeded, sampling will revert to quarterly until objectives are not exceeded.

3 Sampling is to be accelerated to semi-annually if sediment quality objectives are exceeded. Sampling reverts to annual sampling when objectives are not exceeded.

4 Benthic Community analysis is ***optional*** and would not be implemented until at least the summer of 2014.

5 Sampling is to be accelerated to semi-annually if fish tissue quality objectives are exceeded. Sampling reverts to annual sampling when objectives are not exceeded. Sampling reverts to a semi-annual schedule when tissue objectives are again achieved.

6 Note that monitoring stations associated with Outfall Sub-basins D and E identified in the TMDL have been eliminated due to the fact that outfalls associated with these two sub-basins were removed as part of the Termino Drain Project. Water from these sub-basins no longer discharge to Colorado Lagoon.

Figure 3. CLTMP Sampling Station Locations for Colorado Lagoon and Marine Stadium.

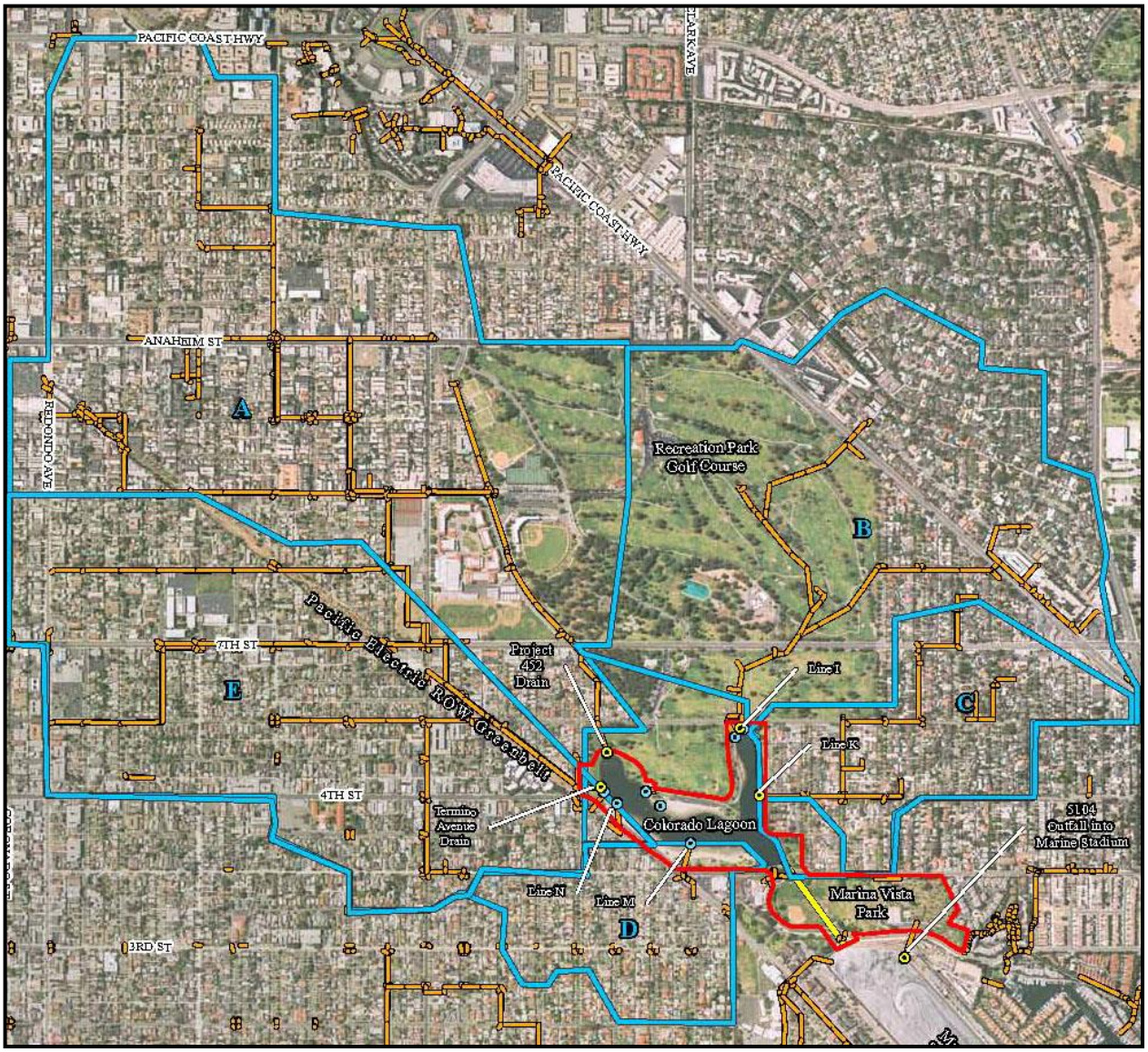

Figure 4. Major Subbasins and Location of Storm Drain Inputs to Colorado Lagoon.

4.2 Chemical Analyses

The following sections describe general analytical requirements for receiving waters, sediment and tissues.

4.2.1 Water Quality Analyses

Prior to the collection of grab samples, water column profiles are to be performed at each of the four water quality sampling locations. Temperature, pH, dissolved oxygen, conductivity and salinity will be measured using a YSI 6920 Sonde or equivalent instrument. Water quality samples are to be collected at each of the sampling locations for the analysis of general water quality constituents (GWQC) including orthophosphate-P, total phosphorus, total suspended solids (TSS), total ammonia as nitrogen, total Kjeldahl nitrogen, and nitrate as nitrogen. In addition, water samples will be collected for analysis of total recoverable and dissolved metals, organochlorine pesticides (including DDTs, chlordane and dieldrin), total PCBs, and total PAHs.

The receiving waters within Colorado Lagoon are saline and require use of specialized analytical methods in order to analyze trace metals at levels necessary to compare with water quality criteria. Appropriate sampling and analytical methods are discussed in Section 5.

4.2.2 Sediment Quality Analyses

Sediment quality samples are to be collected at each of the four sediment quality sampling locations. Sediment from the top 5 centimeters will be used for the analysis of total metals (including lead and zinc), organochlorine pesticides (including DDTs, chlordane and dieldrin), total PCBs, total PAHs, particle size, percent solids, and total organic carbon (TOC). Total chlordane will consist of the combined totals of alpha chlordane, gamma chlordane, cis and trans nonachlor, heptachlor, heptachlor epoxide and oxychlordane.

4.2.3 Fish and Mussel Tissue Analyses

Organochlorine pesticides (including DDTs, chlordane and dieldrin), total PCBs, total PAHs, and percent lipids are required to be analyzed in both fish and mussel tissues.

4.2.3.1 Fish

It is intended that fish species with the most potential for human and wildlife consumption are to be targeted. As noted earlier, few species are present in either Colorado Lagoon or Marine Stadium that are targeted by recreational fisherman or are of sufficient size to be targeted by sport fishermen. Emphasis will likely need to be directed towards ecologically important species that serve a prey species for birds

and other fish species that are higher in the food web. Tissues analyzed will be based on the most appropriate and common preparation for the selected fish.

Topsmelt (*Atherinops affinis*) appear to be the only fish available in Colorado Lagoon that will provide a continual year round sampling source. Topsmelt were found to be the most abundant resident fish collectible throughout the year in Colorado Lagoon (Allen and Horn 1975 and Chambers Group 2004). Although young of the year are most abundant, individuals classified as I and II year age classes were also present.

Topsmelt were collected at three locations in 2002 as part of a multi-purpose survey of contaminants in marine fish along the Southern California Coast between Ventura and Dana Point (NOAA and U.S. EPA Region IX 2007). These three sampling locations were 1) Santa Monica Beach to El Segundo, 2) Redondo Beach to Flat Rock Point, and 3) Cabrillo/Los Angeles Breakwater – inland side. Topsmelt were analyzed as whole body composites because of their small size and additionally, that fishers may eat them as whole bodies (OEHHA 2009). Mean concentrations of PCBs and DDT were 113 and 217 µg/kg (wet weight) respectively for the three sampling locations. The Office of Environmental Health Hazard Assessment (OEHHA) determined since topsmelt clearly have the potential to accumulate high PCB concentrations, it was prudent to advise fishers not to consume topsmelt in the same geographic area where they are not advised to eat white croaker (bounded by Santa Monica Beach south of the Santa Monica Pier in the north to Seal Beach Pier in the south). The addition of inner estuarine waters of Colorado Lagoon and the Marine Stadium will not only assess levels of bioaccumulation in resident fish but also be comparable to the historical results provided by the OEHHA for the Southern California Coast.

4.2.3.2 Mussels

Resident Bay Mussels (*Mytilus galloprovincialis*) were collected previously from Colorado Lagoon by the CDF&G State Mussel Watch program in January 1982, and January and December 1985. They were likely collected from mussels near the outlet structure leading to the Marine Stadium. Mussel sampling locations initially selected would include this location and as well as the pilings of the footbridge which are expected to continue to maintain a fouling community. Due to the fixed locations of mussels within the Lagoon, these two sampling locations should provide information on any possible long-term gradients in pollutant loading between the outlet structure and the western arm of the lagoon. The culvert leading from Colorado Lagoon to the Marine Stadium was recently cleaned to increase tidal range, tidal flushing, water circulation, and improve water and sediment quality. In addition, dredging will be conducted throughout the Lagoon which may impact the presence of mussels in suitable densities and size ranges to support sampling of resident mussels. If mussel populations are insufficient to provide annual collections, this information will be reported in the annual report and sampling may need to be deferred to a later time when the population has had time to reestablish.

4.3 Toxicity Analyses

Additional sediment will be collected for toxicity testing when sampling for sediment quality. Sampling protocol used for sediment quality testing also applies to collection of sediment for toxicity testing. All sediment will be collected from the top five (5) centimeters. The TMDL suggested that toxicity testing for amphipods initially be conducted using both 28-day and 10-day protocol. Currently 28-day protocol are only published for *Leptocheirus plumulosus*. Published 10-day protocols are only available for the two species, *Eohaustorius estuaries* and *Rhepoxynius abronius*, most suitable for testing in Colorado Lagoon and Marine Stadium sediments. Therefore, toxicity testing will be conducted using 10-day amphipod (*Eohaustorius estuaries*) tests, the sea urchin (*Strongylocentrotus purpuratus*) fertilization test using sediment pore water, and the bivalve (*Mytilus galloprovincialis*) embryo test for the sediment water interface. The permit requires that the monitoring frequency for toxicity testing and sediment quality analysis be accelerated to a semi-annual testing frequency if either sediment objectives are exceeded or toxicity is detected at levels in excess of ambient conditions in Alamitos Bay/Marine Stadium.

The Sediment Quality Objectives (SQOs) require fewer tests than specified in the monitoring program specified for Colorado Lagoon. A minimum of one short term survival test and one short-term sublethal test are specified for purposes of evaluating SQOs. The 10-day amphipod test using *Eohaustorius estuaries* will serve as the short term survival test and the bivalve embryo test using *Mytilus galloprovincialis* will provide information necessary for the sublethal test. Integration of test responses from these two tests will be used for the sediment toxicity LOE needed for the SQO evaluations.

It is suggested that requirement to incorporate the sea urchin (*Strongylocentrotus purpuratus*) fertilization test using sediment pore water be eliminated from the TMDL monitoring requirements. This would allow the testing program to match the SQO testing requirements recently adopted by the State. Standardization would avoid potential complications in application of the three methods for data interpretation.

4.4 Benthic Biota (Optional)

The composition of the benthic community constitutes an essential line of evidence (LOE) for sediment quality assessment (Bay et al. 2009). Analysis of the Colorado Lagoon benthic community would provide a direct measure of the effect of sediment contamination on the benthic biota and complete the third component of an SQO assessment. Current plans to remove contaminated sediments from Colorado Lagoon by dredging this winter (2011-2012) make it pointless to perform a benthic analysis at this time. Benthic community analyses, if desired, would be initiated after two summer seasons when the substrate is expected to have stabilized and the benthic community has transitioned from an assemblage of opportunistic species to a more stable community.

4.5 Data Analyses and Evaluations

Methods used to assess data from each the monitoring program listed below. These comparisons represent the minimum level of data analysis that will be applied. Additional comparisons are expected to be necessary to completely address each monitoring component and effectively compare results to similar environments.

Water Quality - Results will be compared to numeric water quality targets (Table 1) for the organochlorine pesticides chlordane, DDTs, and dieldrin; total PCBs; total PAHs; and dissolved lead and zinc.

Sediment Quality - Results will be compared to numeric ERL sediment targets (Table 1) for the organochlorine pesticides chlordane, DDTs, and dieldrin; total PCBs; total PAHs, total LPAHs, total HPAHs; and lead and zinc. As an option, additional sediment analyses will be performed for cadmium, copper, and mercury to provide the complete chemical data set necessary for calculation of the Chemical Score Index (CSI) and California Logistic Regression Model CA LRM. This will allow assessment ofsediment quality exposure which comprises one leg of the Sediment Quality Objectives.

Sediment Toxicity – Sediment toxicity will be evaluated by using the California SQO process for integrating the bioassay results under a single toxicity Line of Evidence using the most current sediment toxicity characterization values (Table 4 of the SQO guidance).

Benthic Biota – The optional analysis of the community structure of the benthic community scheduled to start in the third summer of the monitoring program was included to address the third element of the SQO evaluation process. Four benthic community indices specified in the SQO guidance document will be calculated. These will include 1) the Benthic Response Index (BRI), which was originally developed for the southern California mainland shelf and extended into California's bays and estuaries, 2) the Index of Biotic Integrity (IBI), which was developed for freshwater streams and adapted for California's bays and estuaries, 3) the Relative Benthic Index (RBI), which was developed for embayments in California's Bay Protection and Toxic Cleanup Program, and 4) the River Invertebrate Prediction and Classification System (RIVPACS), which was originally developed for British freshwater streams and adapted for California's bays and estuaries. Benthic index response categories are determined based upon each measure and the median of all benthic index response categories determines the benthic condition LOE category for purposes of the SQOs.

Tissue evaluations – Results will be compared to numeric tissue targets (Table 1) for the organochlorine pesticides chlordane, DDTs, and dieldrin; total PCBs; and total PAHs. In addition, fish tissue results will be compared against available OEHHA Fish Contaminant Goals and Advisory Tissue Levels (Table 4). Concentrations of contaminants in mussel tissues will be compared against historical site data and

available EDL85s for each contaminant developed for resident bivalves based upon twenty years of data from 1977 through 1997.

Table 4. Fish Contaminant Goals for Common Contaminants in California Sport Fish (Klasing, S. and R. Brodberg. 2008)

Contaminants Based on Cancer and Non-Cancer Risk* Using an 8-Ounce/Week (prior to cooking) Consumption Rate (32 g/day)**	
	FCGs (ppb, wet weight)
Contaminant Cancer Slope Factor (mg/kg/day)-1	
Chlordane (1.3)	**5.6**
DDTs (0.34)	**21**
Dieldrin (16)	**0.46**
PCBs (2)	**3.6**
Toxaphene (1.2)	**6.1**
Contaminant Reference Dose (mg/kg-day)	
Chlordane (3.3x10-5)	100
DDTs (5x10-4)	1600
Dieldrin (5x10-5)	160
Methylmercury (1x10-4)[S]	**220**
PCBs (2x10-5)	63
Selenium (5x10-3)	**7400**
Toxaphene (3.5x10-4)	1100

*The most health protective Fish Contaminant Goal for each chemical (cancer slope factor- versus reference dose-derived) for each meal category is bolded.

**g/day represents the average amount of fish consumed daily, distributed over a 7-day period, using an 8-ounce serving size, prior to cooking.

[S]Fish Contaminant Goal for sensitive populations (i.e., women aged 18 to 45 years and children aged 1 to 17 years.)

5.0 SAMPLING AND HANDLING METHODS

The follow sections provide guidelines for sample collection as well as detailed analytical methods and associated reporting limits. All chemical and toxicological testing is to be conducted by laboratories with analytical laboratories that are accredited under California's Environmental Laboratory Accreditation Program (ELAP), the National Environmental Laboratory Accreditation Program (NELAP) or a well-qualified research laboratory. In addition, the laboratory should be a participant in a laboratory proficiency and intercalibration program.

This section also provides recommended analytical methods and reporting limits. Alternative methods may be used provided that detection limits are maintained that are below established targets for water, sediment and tissues and all data quality objectives are met. Ideally, reporting limits should be a minimum of one-half the criterion in order to assure that reliable results can be achieved when values approach the criteria. If the lowest practical reporting limits are not sufficient to provide direct comparison with the objectives, then reporting limits must meet Minimum Levels as defined in the State Implementation Plan.

5.1 Water Sampling

Measurements of specified water quality parameters (temperature, pH, dissolved oxygen, conductivity, and salinity) are be made at each site. A YSI 6920 Sonde or equivalent instrument will be used to generate water column profiles for each of the listed parameters.

Water quality samples are to be collected at each sampling location for the analysis of general water quality constituents (GWQC) including orthophosphate-P, total phosphorus, total suspended solids (TSS), total ammonia as nitrogen, total Kjeldahl nitrogen, and nitrate as nitrogen. In addition, samples will be collected for total recoverable and dissolved metals, organochlorine pesticides (including DDTs, chlordane and dieldrin), total PCBs, and toal recoverable and dissolved PAHs. Collections of water samples for analysis of trace metals will require clean sampling techniques specified under EPA Method 1669.

A summary of sample containers, volumes, initial field preservation, and holding times for water samples are listed in Table 5. Separate bottles are used to collect water for laboratory analysis of the ancillary parameters. Water samples are collected at the surface. Sample bottles that do not contain preservative are rinsed three times with sample water prior to sample collection, and sealed. Upon completion of sampling, all bottles are packed with bubble wrap and placed in an insulated cooler with ice or an equivalent for shipment to the appropriate laboratory under proper chain of custody.

Table 5. Summary of Sample Container, Volume, Initial Field Preservation, and Holding Time Recommendations for Water Samples.

Analyte	Recommended Container	Initial Field Preservation	Maximum Holding Time
General Water Quality Constituents in Water			
Orthophosphate-P	1-500 ml HDPE	4°C	48 hours
Nitrate as Nitrogen			
Total Phosphorus	1-500 ml HDPE	H_2SO_4 and 4°C	28 days
Total Ammonia as Nitrogen			28 days
Total Kjeldahl Nitrogen			28 days
Total Suspended Solids (TSS)	1-L HDPE	4°C	7 days
Metals in Water			
Dissolved Metals	1-L HDPE	4°C	Acidify in lab within 48 hours. Once sample is filtered and acidified, can store up to 6 months
Total Metals			
Synthetic Organic Compounds in Water			
Organochlorine Pesticides	2 1-L amber glass bottle	4°C	7 days to extract; 40 days after extraction to analyze
PCB congeners			
PAHs			

5.2 Sediment Sampling for Chemistry and Toxicity

Sediment quality samples are be collected for the analysis of general sediment quality constituents (GSQC) including particle size, percent solids, and TOC. Samples will also be collected for total metals (lead and zinc), organochlorine pesticides (including DDTs, chlordane and dieldrin), total PCBs, and total PAHs. Cadmium, copper, and mercury are optional analytes necessary to calculate one element of the State's SQOs. Additional sediment is to be collected for toxicity testing. A summary of sample containers, volumes, initial field preservation, and holding times for sediment samples are listed in Table 6.

Sediment samples are to be obtained using a $0.1m^2$ Van Veen or similar grab. Use of this type and size of grab is most critical when benthic community analysis is being performed. Additional equipment necessary includes compositing pans and spoons or scoops. Stainless steel or Tefzel coated equipment are to be the only equipment to come in contact with the samples. All equipment is to be cleaned prior to sampling with a 2% Micro® solution (detergent) and deionized water. Equipment is then rinsed three times with tap water to assist in the removal of the detergent followed by a rinse three times with deionized water. The equipment is then rinsed with a 1.0% solution of hydrochloric acid, followed by a triple rinse with deionized water to eliminate the acid. A rinse is then conducted with methanol, followed by another set of three rinses with deionized water. The equipment is then allowed to dry in a clean place

ready for deployment. Between sampling sites, the grab and other sampling equipment is to be cleaned following the same protocol as the initial cleaning with the exception of a site water rinse instead of allowing the equipment to dry.

One grab will be collected from each sampling location. After the grab is retrieved, the surface water is allowed to drain off, and the top five centimeters of sediment is removed with a Tefzel coated spoon/scoop and placed in a compositing pan. In order to be considered acceptable, the grab samples are required to satisfy a set of quality criteria. Samples are to be rejected if the grab did not close fully allowing sample to wash out or if removal of the overlying water resulted in significant wash out of sediment fines. No sieving of sediments will be performed in the field, however, larger debris and cobble can be removed from the samples using a Tefzel (or other fluropolymer) coated spoon/scoop. At the conclusion of sample collection at each site, all sediment composited in the pan will be subsampled into the appropriate containers for distribution to the laboratories. Disposable powder free nitrile gloves will be worn while collecting and compositing samples to mitigate potential contamination. Gloves are to be changed between each sampling location to reduce the potential for cross-contamination.

At the conclusion of sample processing at each sampling location, all samples are to be wrapped in protective material and stored on ice in the field. At the conclusion of a day's sampling, all samples are to be stored in a freezer for temporary storage prior to distribution to the analytical laboratories under proper chain of custody procedures.

Table 6. Summary of Sample Container, Volume, Initial Field Preservation, and Holding Time Recommendations for Sediment Samples.

Analyte	Recommended Container	Initial Field Preservation	Maximum Holding Time
Total Metals	1 1L WMGJ	4°C	6 months
Mercury			28 days
Organochlorine Pesticides			14 days to extract, 40 days to analyze
PCB congeners			
PAHs			
Particle Size			NA
Percent Solids			NA
TOC			28 days
Sediment Toxicity	Polyethylene Bag in HDPE bucket	4°C , dark	14 days

NA=not applicable
WMGJ = Wide Mouth Glass Jar

5.3 Fish and Mussel Sampling

The following sections provide details of the collection of fish and mussels for analysis of tissues to assess bioaccumulation. The fish are to be collected with a beach seine. The typical dimensions are 10-foot (depth) by 100-foot (long) for a standard beach seine but smaller versions may be considered as long as the same seine is used for all collections. Mussel sampling will be conducted manually.

5.3.1 Fish Tissue Sampling

All fish collected are identified to species and counted. Standard length is measured and recorded for up to one hundred of each individual species. Fish are to be visually inspected for the presence of lesions, parasites, or deformities and the observations will be recorded in the field logbook. Assuming topsmelt are still the only suitable species (see Figure 5), composites will consist of a minimum of fifteen undamaged "whole" topsmelt for each sample. The target size for topsmelt used in each composite sample should be between 130 and 240 mm total length but modifications may be necessary depending upon the

Figure 5. Fish captured in a Beach Seine within Colorado Lagoon. (Chambers Group)

availability of fish of within this size range at each site. Minimum and maximum lengths are based on the middle 80% of observed catch from RecFin angler intercept studies to exclude potential outlier sizes (NOAA and U.S. EPA Region IX 2007).

Every effort should be made to minimize mortality to non-target and excess catch by proper handling of the fish and minimizing time out of the water for measurements. In addition, the catch should be held in the bunt within the water or placed in buckets that are provided with pumped water to provide a high exchange rate and prevent oxygen deprivation.

Each composite of topsmelt is to be double wrapped in aluminum foil and then double bagged in two Ziploc® bags. Once packaged, samples should be labeled and placed on ice immediately prior to transfer to the analytical laboratory under proper chain of custody procedures.

5.3.2 Mussel Tissue Sampling

Fifty bay mussels (*Mytilus galloprovincialis*), 40-60 mm in shell length, are to be collected at each site. Mussel collection and processing will be consistent with the California Department of Fish and Game's most recent Standard Operating Procedures (CDFG 2001). Samples and equipment are handled with powder free nitrile-gloved hands only. In addition, gloves are to be changed between the handling of different samples. Mussels are collected from the hard substrate by gloved hands.

Mussels collected from each site are stored in pre-cleaned heavy-duty aluminum foil bags. The heavy-duty aluminum foil is cleaned with Micro® detergent, rinsed with tap water (to ensure removal of the detergent), rinsed with deionized water, and then rinsed with methanol. Mussels only contact the dull side of the foil bags. Each foil bag is then double-bagged in two Ziploc® bags. Samples are to be placed on ice and maintained at 2-4°C for transfer to the laboratories. In order to prevent the mussels collected from gaping, resections are conducted immediately or the next day in order to avoid the need to initially freeze the samples.

Resections are to be performed in a clean room or in clean glove boxes. Equipment used to remove the tissues are washed in a hot Micro® detergent solution, rinsed thoroughly with tap water (to ensure removal of the detergent) and then rinsed deionized water. This is then followed by a methanol rinse. Mussels are individually removed from the bag and cleaned of epiphytic organisms under running deionized water. Mussels are allowed to thaw, if frozen, on a pre-cleaned sheet of heavy-duty aluminum foil. Resection is to be performed on pre-cleaned Teflon™ cutting boards. A pre-cleaned stainless steel scalpel is used to sever the adductor mussel and remove the byssal threads. The remaining tissue, including the gonads are placed in certified clean glass jars and frozen at or below -20°C until ready for distribution to the analytical laboratory under proper chain of custody procedures.

6.0 LABORATORY METHODS

The following analytical methods are suggested methods for meeting the reporting limiting necessary for the program. Alternative methods may be used as long as the method reporting limits can be achieved and data quality objectives are met. At a minimum, reporting limits are required to meet minimum levels (MLs) for analytical tests specified in the State Implementation Plan (SWRCB 2005). Wherever possible, reporting limits are also required to be less than the ERLs or other benchmarks being used to assess conditions in Colorado Lagoon. In some cases such as for chlordane compounds, available reporting limits are very near ERLs and may require alternative analytical methods or additional cleanup procedures.

6.1 Water Analyses

Analytical methods and suggested Reporting Limits for water testing are summarized in Table 7.

Table 7. Analytical Methods and Reporting Limits for Water Quality Analyses.

Analyte	Units	Method	Method Reporting Limit
General Water Quality Constituents in Water			
Orthophosphate-P	mg/L	EPA 301	0.01
Total Phosphorus	mg/L	SM 4500-P	0.1
TSS	mg/L	SM 2540D	1
Total Ammonia as Nitrogen	mg/L	SM 4500-NH3	0.1
Total Kjeldahl Nitrogen	mg/L	EPA 351.3	0.5
Nitrate as Nitrogen	mg/L	EPA 301	0.1
Metals in Water			
Dissolved Metals	µg/L	EPA 1640(m)	0.02
Total Metals	µg/L	EPA 1640(m)	0.02
Synthetic Organic Compounds in Water			
Organochlorine Pesticides	µg/L	EPA 625(m)/8270C(m)	0.005
PCB congeners	µg/L	EPA 1668	0.02
PAHs	µg/L	EPA 8272	0.5

6.2 Sediment and Tissue Analyses

Analytical methods and reporting limits are similar for sediment and tissues. Suggested methods and reporting limits are provided in Table 8.

Table 8. Analytical Methods and Reporting Limits for Sediment and Tissue Quality Analyses.

Analyte	Units (dry wt.)	Method	Method Reporting Limit
Trace Metals	mg/kg	EPA 6020m	0.05
Organochlorine Pesticides	µg/kg	EPA 8270Cm	0.1
PCB congeners	µg/kg	EPA 8270Cm	5
PAHs	µg/kg	EPA 8270Cm	5
Particle Size	%	ASTM D422M	-
Percent Solids	%	EPA 160.3	0.1
Percent Lipids (tissue only)	%		0.1
TOC (sediment only)	%	EPA 9060A	0.1

7.0 QUALITY ASSURANCE PROJECT PLAN

The following sections provide the basis for development of a final Quality Assurance Project Plan for the CLTMP. Some adjustments will be required depending upon the laboratories selected to do the analytical work and toxicity testing. Selection of analytical and toxicological laboratories should occur at least two to three months prior to the expected start of field work. The laboratories will need to demonstrate the capability of meeting or exceeding all reporting limits and data quality objectives. The QAPP will need to be expanded and finalized to recognize any minor adjustment in methods and reporting limits.

7.1 Measurements of Data Quality

The overall QA objective is to ensure that data of known and acceptable quality are provided. To achieve this goal, data must meet established criteria for accuracy, precision, completeness, comparability, and representativeness. The definition of each data quality measure is described below.

Accuracy: Assessment of the accuracy of measurements is based upon determining the difference between measured values and the true value.

Precision: Precision provides an assessment of mutual agreement between repeated measures. These measures apply to field and laboratory duplicate analyses of contaminants being applied in this study. Monitoring of precision throughout the process allows evaluation of the consistency of sampling and sample processing.

The Relative Percent Difference (RPD) will be used to evaluate precision based upon duplicate samples. The RPD is calculated for each pair of data is calculated as:

$$RPD=[(x_1-x_2)*100]/[(x_1+x_2)/2)$$

Where:

x_1=concentration or value of sample 1 of the pair
x_2=concentration or value of sample 2 of the pair

Completeness: Completeness is a measure of the percentage of the data judged to be valid after comparison with specific validation criteria. This includes data that are lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Utilization of Chain-of-Custody procedures whenever the samples are transferred to a new custodian is one method of maintaining a high level of completeness. Close adherence to SOPs is another way to help assure that a high degree of completeness is obtained.

A high level of completeness is essential in all phases of this study. The overall goal is to obtain completeness of 100%; however, the data quality objective is established at 95% to ensure an adequate level of data return.

Comparability: Comparability is the measure of confidence with which one data set can be compared to another. The implementation of thorough QA/QC methods also helps assure comparability. The use of consistent sampling methods, analytical methods, and data quality objectives are intended to assure comparability of the data set.

Representativeness: Representativeness is the degree to which data accurately and precisely represent the natural variability and characteristics of the environmental conditions. Representativeness of the data is ensured by adherence to the sampling plan and following proper sample collection, preservation, and shipping procedures.

7.2 Quality Assurance and Quality Control for Chemical Analyses

QAQC requirements apply both to the manner in which sampling is conducted in the field and the process of handling and analyzing the samples in the laboratory. QAQC requirements for both the sampling process and laboratory are outlined in the following sections.

7.2.1 Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined below. Field QC Samples are reported with the data report.

Blind Field Duplicates - A blind field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, using identical techniques. The samples are submitted blind to the laboratory to evaluate overall variability in the sampling and analytical process. This applies to all cases of routine surface water collection procedures. Duplicate samples are sealed, handled, stored, shipped, and analyzed in the sample manner as the primary sample. Precision of duplicate results is calculated by the relative percent difference (RPD) as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$\mathbf{RPD = [(X_1 - X_2)/ \langle (X_1+X_2)/2 \rangle]* 100}$$

Field duplicates will be collected at a frequency of 10% or greater. The RPD between field duplicates should be less than 40%. If the RPD of the field duplicates exceeds 40%, the laboratory should communicate this to the sampling team so that the source of error can be identified and corrective measures taken before the next sampling event.

Field Blanks - Field blanks consist of sterile water that is taken to the field and transferred to the appropriate container in precisely the same manner as a sample during the course of a sampling event. They are used to assess the contamination from field sources such as airborne materials, containers, and preservatives. The analysis of field blanks should yield values less than the detection limit. Field blanks will be collected at a frequency of 5% or greater.

7.2.2 Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within each individual method. The minimum requirements are stated below.

Laboratory duplicate - Laboratory duplicates are used to assess precision. A laboratory duplicate is prepared by splitting aliquots of a single sample (or a matrix spike or a laboratory control standard) in the laboratory. Both samples are carried through the entire preparation and analytical process. Laboratory duplicates are analyzed on 5% of samples analyzed. Examples of acceptability criteria are outlined in

Table 9 and Table 10. Actual recovery accuracy would be based on the analytical laboratory's actual method performance records. At a minimum, reporting limits must meet Minimum Levels (MLs) as listed in the State Implementation Plan (SIP). Precision for an analytical chemistry sample is calculated by the relative percent difference (RPD) of duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$\mathbf{RPD = [(X_1 - X_2)/ \langle (X_1+X_2)/2 \rangle]* 100}$$

Table 9. Data Quality Objectives for Water Analyses

ANALYTE	PROJECT DETECTION LIMIT	ACCURACY %		PRECISION %	
		SPIKE RECOVERY	SRM RECOVERY	MATRIX SPIKE RPDS	LABORATORY DUPLICATE RPDS
NUTRIENTS AND TSS					
Orthophosphate-P	0.01 mg/L	-	-	-	25
Total Phosphorus	0.1 mg/L	-	-	-	25
Total Suspended Solids	1 mg/L	-	-	-	25
Total Ammonia as Nitrogen	0.1 mg/L	-	-	-	25
Total Kjeldahl Nitrogen	0.5 mg/L	-	-	-	25
Nitrate as Nitrogen	0.1 mg/L	-	-	-	25
METALS					
Arsenic	0.02 µg/L	-	75-125	25	25
Cadmium	0.02 µg/L	-	75-125	25	25
Chromium	0.02 µg/L	-	75-125	25	25
Copper	0.02 µg/L	-	75-125	25	25
Lead	0.02 µg/L	-	75-125	25	25
Nickel	0.02 µg/L	-	75-125	25	25
Selenium	0.02 µg/L	-	75-125	25	25
Silver	0.02 µg/L	-	75-125	25	25
Zinc	0.02 µg/L	-	75-125	25	25
ORGANICS					
Chlorinated Pesticides/PCBs	0.02-0.005 µg/L	50-150	70-130	25	25
Lindane		50-150	70-130	25	25
Heptachlor		50-150	70-130	25	25
Aldrin		50-150	70-130	25	25
Dieldrin		50-150	70-130	25	25
Endrin		50-150	70-130	25	25
DDT		50-150	70-130	25	25
PAHs	0.5 µg/L	50-150	70-130	25	25

Table 10. Data Quality Objectives for Sediment and Tissue Analyses.

ANALYTE	PROJECT DETECTION LIMIT	ACCURACY %		PRECISION %	
		SPIKE RECOVERY	SRM RECOVERY	MATRIX SPIKE RPDS	LABORATORY DUPLICATE RPDS
CONVENTIONALS					
Percent Solids	0.10%	-	-	-	25
Percent Lipids	0.10%	-	-	-	25
Total Organic Carbon	0.1 %-dry	-	75-125	-	25
METALS					
Cadmium	0.1 mg/kg-wet	-	75-125	25	25
Copper	0.1 mg/kg-wet	-	75-125	25	25
Lead	0.1 mg/kg-wet	-	75-125	25	25
Mercury	0.1 mg/kg-wet	-	75-125	25	25
Zinc	1.0 mg/kg-wet	-	75-125	25	25
ORGANICS					
Chlorinated Pesticides/PCBs	0.1-5.0 µg/kg	50-150	70-130	25	25
Lindane		50-150	70-130	25	25
Heptachlor		50-150	70-130	25	25
Aldrin		50-150	70-130	25	25
Dieldrin		50-150	70-130	25	25
Endrin		50-150	70-130	25	25
DDT		50-150	70-130	25	25
PAHs	5.0 µg/kg	50-150	70-130	25	25

Matrix Spike/Matrix Spike Duplicate – Matrix Spike/Matrix Spike Duplicate (MS/MSD) percent recoveries are evaluated to determine acceptable accuracy based on method-specified percent recoveries. Precision is also evaluated by calculating the RPD of the MS and MSD percent recoveries. QA/QC guidelines indicate that no action should be taken on MS/MSD data alone. The data reviewer may use the MS and MSD results in conjunction with other QC criteria and determine the need for some qualification of the data. MS/MSDs are required for each analytical batch.

Standard or Certified Reference Materials - Standard or Certified Reference Materials (SRMs or CRMs) and calibration standards are analyzed to evaluate accuracy. The results of the SRM analysis will be compared to the established laboratory upper and lower limits. Appropriate SRMs or CRMs should be analyzed for each matrix at a minimum frequency of once ever monitoring year.

7.2.3 Instrument/Equipment Testing, Inspection, and Maintenance

Several field water quality instruments may be used to measure parameters such as temperature, pH, dissolved oxygen, conductivity and salinity. A maintenance log is to be maintained for all instruments used. This log details the dates of instrument and sampling gear inspection, calibrations performed in the laboratory, battery replacement, the dates reagents and standards are replaced, and any problems noted

with instruments, samplers, or reagents. Records of field calibrations are to be maintained in the project field logs.

Before each use, meters are checked to see if they are clean and in good working order. Meters are calibrated before each use. Conductivity standards and pH buffers are replaced at least annually. Conductivity standards are stored with the cap firmly in place and in a dry place kept away from extreme heat.

Membranes and solutions for polarographic dissolved oxygen probes are replaced according to manufacturer's specifications, but no less frequently than quarterly. Membranes are checked for bubbles after replacement and allowed to stabilize prior to recalibration.

Instruments are to be calibrated and reagents checked against standards prior to each sampling event. Standards will be purchased from a chemical supply company or prepared by (or with the assistance of) a professional laboratory. Calibration records are kept in the maintenance log at the headquarters location where it can be easily accessed before and after equipment use. Calibrations that are performed by monitors in the field are recorded on the field data sheets, also archived at the headquarters.

7.3 Quality Assurance and Quality Control for Bioassay Testing

Quality assurance measures applied to aquatic toxicity testing are explicitly stated in all standard protocols. Such measures include test temperatures and acceptable limits or variation, minimum acceptable dissolved oxygen levels with aeration procedures to be used as required, and acceptable pH ranges. Salinity ranges are specified for marine tests. A schedule of monitoring these environmental parameters is usually provided, and bioassay results must include these monitoring data. Organism assignment to test tanks and test tank positioning in the laboratory are randomized.

The single most important quality assurance measure in bioassay tests is the inclusion of an experimental control, wherein organisms are simultaneously exposed to laboratory test conditions in the absence of any toxicant stress. For suspended particulate phase test media, control organisms are generally exposed to dilution water only; for sediment testing the control exposure consists of a known non-toxic or artificial sediment. All protocols require that an identified minimum level of normal organism end point behavior (e.g. survival, normal development, fertilization) be achieved in order for the test to be considered valid. If, for example, less than 90% control survival in a 96-hour acute bioassay is observed, then the test must be repeated.

Organism culture and collection, transportation, feeding, and acclimation procedures are designed to minimize stress and to maintain organisms in optimal condition. Laboratory water supply and environmental control systems should be redundant wherever possible to avoid undue variation during holding and acclimation.

Another important QA measure that is routinely implemented in bioassay testing is the reference toxicant bioassay. Documented biological variations in test organisms themselves can affect toxicity test results. Routine parallel reference toxicant bioassays provide a way to normalize this category of variability. In addition, the routine use of reference toxicants provides useful data towards calibrating individual laboratory performance in programs where different laboratories are providing test data from the same protocol. In this situation, comparable reference toxicant results would support the assumption of comparable test performance quality and therefore would increase confidence in overall program data comparability.

7.4 Data Verification and Validation Processes

7.4.1 Data Review, Verification and Validation

Data sheets or data files are reviewed quarterly by the QA Officer to determine if the data meet the Quality Assurance Project Plan objectives. Data reviews are intended to identify outliers, spurious results or omissions. The QA Officer will also evaluate compliance with the data quality objectives and suggest any corrective actions that may be necessary by the monitoring team or laboratory. Problems with data quality and corrective action will be reported in final reports.

7.4.2 Verification and Validation Methods

As a part of data validation, the QA Officer ensures that:

- Any data that are hand-entered (i.e., typed) are 100% validated by qualified personnel prior to use in calculations or entry into the database.
- All manual calculations are performed by a second staff member to verify that calculations are accurate and appropriate.
- Calculations performed by software are verified at a frequency sufficient to ensure that the formulas are correct, appropriate, and consistent, and that calculations are accurately reported.

Electronic data loading and transfer are swift and routine. Electronic submissions are loaded to temporary files prior to incorporation into the database, and are analyzed selectively using methods such as scatter plots, univariate and multivariate analyses, and range checks to identify suspect values. Values outside of known environmental ranges by more than a factor of two or that strongly deviate from other data in the set will be examined to assess whether such deviations are likely and if concentrations of other constituents support the validity of the data point. Routine system back-ups are performed daily. Once data have been generated and compiled in the laboratory, senior project scientists review data to identify and make professional judgments about any suspicious values. All suspect data are reported with a qualifier and justification for the qualifier will be provided. These data may not be used in calculations or data summaries without the review and approval of a knowledgeable Senior Scientist. No data measurements are eliminated from the reported data or database and data gaps are never filled based on other existing data. If samples are lost during shipment or analysis, it is documented in the data reports

and noted in the database. A series of reviews by technical personnel will be implemented to ensure that the data meet the data quality objectives. These reviews will include the following activities.

- Data and related project records will be reviewed by laboratory personnel at the end of each working day to ensure that analytical activities are completely and adequately documented.
- The Task Leaders will be responsible for reviewing analytical results and supporting documentation. The results of QC sample analyses will be compared to pre-established criteria as a measure of data acceptability.

The review of quality control data is a critical step in the data validation process because quality control data that are within the QAPP acceptance criteria indicate that the sample processing and analysis systems are in control. All quality control data that do not meet the data quality objectives will be flagged and brought to the attention of the Project Manager who will determine the appropriate corrective action (e.g., re-analysis or data reported with qualifiers). As an additional data validation step, the Project Manager will review all data for technical reasonableness.

The Field Manager will be responsible for validation of the *in situ* water quality data and navigation data. As part of standard field protocols, any sample readings out of the expected range will be reported to the field monitoring leader or laboratory QA officer as appropriate. The field monitoring leader will review the field logs to confirm results and verify field log entries. If practical, a second sample will be taken as soon as possible to verify the condition. If the data is invalid, then the data will be noted (flagged) on the data sheet. Further actions will then be taken to trace the sources of error, to correct those problems (if possible), and prevent future occurrences. If the error is a result of improper monitoring procedures, then field procedures will be reviewed with the monitoring team to correct deficiencies or eliminate deviations from the prescribed methods.

7.4.3 Reconciliation with User Requirements

If data do not meet the project's specifications, the following actions will be taken. First, the Project Manager working with the Field Team Leaders will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. They will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the Project Manager will review the Data Quality Objectives (DQOs) and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to DQOs will be appended to this QA plan with the revision date and the reason for modification.

Identification of problems regarding technical performance is the responsibility of all staff members working on this project. Responsibility for overall conduct of the project, including schedule, costs, and technical performance lies with the Project Manager. The Project Manager is responsible for identifying

and resolving problems that (1) have not been addressed promptly or successfully at a lower level, (2) influence other components of the project, (3) require changes in this QAPP, or (4) require consultation with higher level management. Technical problems relating to sample collection in the field (schedule changes, modifications to the sampling plan, etc.) will be resolved through discussion with the Project Manager and appropriate Task Managers.

Identification of problems and corrective action at the laboratory level will be resolved by the laboratory staff. Issues that affect schedule, cost, technical performance, or data quality will be reported to the Project Manager. The Project Manager will be responsible for evaluating the overall impact to the project and for discussing corrective actions with the City.

8.0 REFERENCES CITED

Allen, L.G. and M.H. Horn. 1975. Abundance, Diversity and Seasonality of Fishes in Colorado Lagoon, Alamitos Bay, California. *Estuarine and Coastal Marine Science (1975) 3, 371-380.*

Bay, S.M., D.J. Greenstein, J. A. Ranasinghe, D.W. Diehl and A.E. Fetscher. 2009. Sediment Quality Assessment Draft Technical Support Manual. Southern California Coastal Water Research Project. Technical Report 582 – May 2009.

Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, Washington, Coastal Protection and Restoration Division, NOAA.

CDFG (California Department of Fish and Game). 2001. Standard Operating Procedure – Field Collection of Organisms for Tissue Specimens for Analysis of Trace Metals and Synthetic Organic Compounds (Marine Mussels, Freshwater Clams, Marine Crabs, and Marine/Freshwater Fish). California Department of Fish and Game Marine Pollution Studies Laboratory. July 20, 2001.

Chambers Group, Inc. 2004. Habitat Assessment for the Colorado Lagoon Restoration Feasibility Study for the City of Long Beach. Prepared for Moffatt & Nichol. July 2004.

CSWRCB (California State Water Resources Control Board). 1998. Sediment Chemistry, Toxicity, and Benthic Community Conditions in Selected Water Bodies of the Los Angeles Region. Final Report. August 1998.

Crane, J.M., L.G. Allen, and C. Eisemann. 1975. Growth Rate, Distribution, and Population Density of the Northern Quahog *Mercenaria mercenaria* in Long Beach, California. *California Fish and Game (1975), 61(2): 82-94.*

Heal the Bay. 2011 End of Summer Beach Report Card

Heal the Bay. 2012. Heal the Bay's 2011-2012 Annual Beach Report Card.

Kinnetic Laboratories, Inc. and Moffatt & Nichol. 2004. Colorado Lagoon: Water Quality Assessment Report. August 2004.

Kinnetic Laboratories, Inc. and Moffatt & Nichol. 2006. Colorado Lagoon: Sediment Testing and Material Disposal Report. Original July 30, 2004 revised October 27, 2006.

Kinnetic Laboratories, Inc. 2010. Sediment Testing in the Northern Arm of Colorado Lagoon. June 2010.

Kinnetic Laboratories, Inc. and Moffatt & Nichol. 2011. Final Pre- and Post-Construction Water Quality Monitoring Report, Colorado Lagoon Improvements Water Quality Monitoring Program. Grant Agreement Numbers: 06-266-550-0, Amendment 1 and ARRA 08-300-550-1

Klasing, S. and R. Brodberg. 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium and Toxaphene. June 2008 ,Pesticide and Environmental Toxicology Branch ,Office of Environmental Health Hazard Assessment ,California Environmental Protection Agency

LARWQCB (California Regional Water Quality Control Board Los Angeles Region). 2009. Substitute Environmental Document for the Colorado Lagoon OC Pesticides, PCBs, Sediment Toxicity, PAHs, and Metals TMDL. July 2009.

Long, E.R. and L.G. Morgan. 1990. The Potential for the Biological Effects of Sediment Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration, Seattle, Washington, 175 pp. + appendices.

NOAA and U.S. EPA Region IX. 2007. 2002-2004 Southern California Coastal Marine Fish Contaminants Survey. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Long Beach, California *on behalf of the Natural Resource Trustees*; and U.S. Environmental Protection Agency, Region IX, San Francisco, California. June 2007.

OEHHA (Office of Environmental Health Hazard Assessment, California EPA). 2009. Health Advisory and Safe Eating Guidelines for Fish from Coastal Areas of Southern California: Ventura Harbor to San Mateo Point. June 2009.

State Water Resources Control Board (SWRCB). 2005. Policy for Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California. (SIP) California Environmental Protection Agency

Tetra Tech, EMI. 2000. Unpublished surficial sediment data from two sites in Colorado Lagoon.

USEPA (1996). Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring - Draft. Office of Water, Office of Science and Technology, E. A. D. (4303), M. S. SW and D. Washington.

USEPA (1996). Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels.

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APPENDIX K

DETERMINATION OF DEFINITION OF SIGNIFICANT OUTFALL DISCHARGES

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Determination of Definition of High Flow and Potentially Significant Discharges from Outfalls during Dry Weather Conditions

KINNETIC LABORATORIES, INC.

Due to the substantial differences within each of the watersheds, the NPDES permits specified that each watershed should define what constitutes high flows and potentially significant flows***. High or elevated flows are determined during each site visitation. Potentially significant flows are determined based on encountering high flows in at least two out of three non-stormwater outfall surveys*****.**

Two general approaches have been discussed with respect the determining whether flows from an outfall should be considered to have high or elevated flow. The first approach is based upon using fixed flow rates ranging from expected flows from one or more garden hoses to temporary flows produced by hydrant testing. The second approach is based upon utilizing available, longer term measurements (1 day to several weeks) of dry weather flow in watershed segments in order to determine average flows from the built urban environment. This latter approach normalizes measured flow rates to the total acreage of the contributing segment of the watershed. The average flow per unit area is calculated to establish the typical range of dry weather flow.

A combination of these two approaches was used to evaluate if discharges from an outfall during dry weather conditions would be classified as high flows in the case of the freshwater portion of the Los Cerritos Channel Watershed. This same approach will be utilized for surveys of non-stormwater discharges within the area defined by the City of Long Beach IMP. For drainages greater than 200 acres, high flows were evaluated as instantaneous flow measurements greater than 150 gallons/acre/day. This criterion was developed based upon examination of a variety of dry weather flow measurements (Table 1) for Colorado Lagoon and the Belmont Pump Station. In both cases, measurements represented multiple weeks of monitoring. A set of more recent 24-hour flow measurements at the Belmont Pump Station provided confirmation that dry weather flows are still comparable to flows measured soon after installation of a low flow diversion system. The average non-stormwater discharge rates measured in the Colorado Lagoon and the Belmont Pump Station drainages equate to roughly 100 gallons/acre/day. Although this provides a reasonable estimate for long-term average dry weather flows, recent Proposition 84 studies using flumes to provide long-term measurement of dry weather flows in the Los Cerritos Channel watershed identified surges where dry weather flows temporarily increased by factors of 2-5 times with no clear temporal pattern. These surges would not be considered persistent flows. A flow rate of 50% greater than the long-term average flow rate was considered to provide a reasonable indicator of high flow rates from large drainage areas (those greater than 200 acres). This would help account for some of the surges that would not be considered persistent and are more episodic.

Watersheds smaller than 200 acres are more likely to be impacted by relatively small discharges. Thus, high flow rates will be determined based upon a fixed flow rate for drainages less than 200 acres. Based upon the 150 gallon/acre/day criterion, a 200-acre watershed would be considered to have high

flow if the measured instantaneous discharge exceeded 21 gpm. The 21-gpm criterion will apply to all drainages of less than 200 acres in size. This flow rate is only slightly greater than the maximum discharge that might result from a ¾ inch garden hose and far less than any discharge from testing of fire hydrants. Water pressure, the size and length of hoses, and any fitting attached to these hoses can greatly influence flow rates. The maximum flow rates for a 100-foot length of hose with residual water pressure of 40 psi ranges from 6 gpm for a ½ inch hose to 11 gpm for a ⅝ inch hose to 18 gpm for a ¾ inch hose[1]. According to the Lowe's *Garden Hose Buying Guide*, most standard garden hoses in the United States are ⅝ inch in diameter. Similarly, flows generated by hydrant flushing or testing can exhibit substantial variation depending upon ambient water pressure. A 2.5-inch diameter orifice (using a 0.9 coefficient) at a hydrant can produce 750 gpm at an orifice pressure of 20 psi and 1500 gpm at an orifice pressure of 80 psi[2].

To be defined as potentially significant discharges, high flows must be encountered at an outfall during at least two out of three surveys. Evidence of persistent discharges from an outfall is necessary to effectively develop a monitoring program capable identifying the source and characteristics of the discharge. If an outfall is considered to have potentially significant non-stormwater discharges an initial field survey will be conducted to determine if the discharges can be quickly identified and eliminated if deemed to be inappropriate. If the field survey cannot establish the source of the discharge and eliminate any illegal/illicit discharges, the discharge will be considered a significant discharge and a monitoring program will be implemented in accordance with the Permit.

Table 1. Comparison of dry weather flow rates (gallons/acre/day) measured at Colorado Lagoon and Belmont Pump Station

Site	Drainage Area (acres)	Time Period	Average Flow (gallons/acre/day)
Colorado Lagoon	**1,172**	**2005** Two weeks of continuous flow measurements	**101**
Belmont Pump Station	**203**	**2005 dry season**	**99**
		24-hour measurements 1 day (2/18/2014) 1 day (5/16/2014) 1 day (7/19/2014) 1 day (1/8/2015) 1 day (4/3/2015) 1 day 6/15/2015)	 109 147 109 128 136 55
		6-day average	**119**

[1] (http://www.irrigation.wsu.edu/Content/Calculators/Residential/Garden-Hose-Flow.php)

[2] *Flow Test Calc* – IOS application for calculation of flows from fire hydrants during flow testing