Catch Basin Inlet Cleaning Pilot Study: Final Report

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Table of Contents

List of Figures

List of Tables

1 Introduction

The maintenance and management of the nearly 40,000 catch basin inlets in the City of San Diego represents one of the most time- and resource-intensive of the City's many efforts to prevent pollutants from reaching the City's waterways and beaches. Catch basins[1] may trap many different types of solids and chemicals that wash off the landscape, from fine particulates and leaves to gross pollutants, floatables and trash. Many of the pollutants of concern in San Diego, including nutrients, metals, and chemical pollutants, are bound up in these sediments, and bacteria growth can occur when leaves and other organic material accumulate in catch basins. If not removed prior to storm events, all of these pollutants can wash out of catch basins into the municipal separate storm sewer system (MS4) and ultimately into surface waters, making effective and timely cleaning (particularly in light of San Diego's dry and wet season cycles) an important operation and maintenance function to meet water quality objectives.

Catch basin cleaning frequencies and methods represent both an important area of pollution prevention and a major investment of municipal labor and financial resources. The City cleans each catch basin at least once per year, some manually and some with a vactor truck, with some areas receiving additional cleaning and maintenance visits. Given differences in land use types, drainage system ages and conditions, and the sensitivity of receiving waters, observations long have suggested that the pollution prevention impact of cleaning must vary among different land use areas, arguing for cleaning regimens that were tailored to these local conditions. While the San Diego County MS4 permit previously dictated the minimum cleaning frequencies the City observed, upcoming changes to the permit may provide more flexibility in designing an optimized cleaning program. The City's literature review and draft workplan development project in 2011 (Tetra Tech 2011) highlighted some of the nuances of catch basin cleaning methods and frequencies that can affect pollutant removal and municipal costs. There is evidence from the literature survey that optimizing catch basin cleaning, both by using the most effective and efficient cleaning techniques and by tailoring frequencies to different drainage areas, can maximize the return on investment in terms of both pollutant reduction, and municipal labor and funds. Data collection and GIS analysis, which the City improved substantially in 2011 on a city-wide basis by establishing a unique identifier for each inlet, are vital to this type of optimization.

With the diversity of land use types, neighborhoods, and drainage system ages and conditions found throughout the City of San Diego, developing a more specific or tailored plan for catch basin cleaning frequency and techniques requires some understanding of how accumulation rates and pollutant concentrations in catch basin materials differ among land use types and settings. Identifying land use settings or areas with rapid rates of pollutant accumulation – and potential mobilization – as well as areas with high concentrations of pollutants of concern, may be used to suggest the most efficient and effective timing, frequency, and method of catch basin cleaning. Land use settings or areas where pollutants accumulate slowly, with minimal mobilization, or low concentrations of pollutants of concern for a particular watershed, would suggest different maintenance schedules to achieve the same water quality results.

[1] For purposes of this report, "catch basin" refers to the structures into which storm drainage flows after entering drainage inlet openings (principally in curbs along streets). It is recognized, and discussed in this report, that some of these structures feature a sump between the bottom of the structure and the drain pipe outlet into which water and accumulated material flow; other structures do not have a sump and are essentially a "flow-through" point in the drainage network. The differences in function between these two structural designs, and the importance of identifying structures with and without sumps for future efforts, is noted in the report.

Catch basin cleaning in San Diego also must be addressed in light of the region's weather pattern, typified by a long dry season from roughly May through October during which catch basin materials are expected to accumulate without mobilization into the MS4, followed by a wet weather season with sporadic but occasionally very significant rain events (i.e. greater than one inch of precipitation in a 24-hour period). While this Pilot Study did not begin until December 2011, which was after substantial precipitation had fallen, the information base nonetheless will be useful, particularly if and when the City is able to complete an end of season cleaning before rain events begin. Sampling prior to intensive rainfall may have yielded different results, possibly greater concentrations of analytes that accumulate over time and are not easily re-suspended (such as metals). Microbiology samples might also be different during the dry season, especially if incubation is dependent on wet sumps.

This report presents findings from the City of San Diego Catch Basin Inlet Cleaning Pilot Study, including characterization and analysis of sediments removed and assessment of the effectiveness of manual and vactor cleaning methods in different land use settings – Downtown San Diego (classified as downtown-high density mixed use), a recently-developed single-family residential area in San Ysidro, a residential area near Mesa College and Tecolote Creek, and a mixed commercial and office/retail area off of Scripps Poway Parkway and I-15 - from four clean-outs during the winter season of 2011 to 2012. It provides information for optimizing catch basin cleaning methods, locations and frequencies with observations on accumulation and pollutant removal in different land use settings, and based on different risks to waterways. The study focused on characterizing accumulation rates and pollutants in four land use settings that are broadly representative of large areas of San Diego, enabling as much transferability from the pilot study to general operations as possible.

The Management Questions posed in the original work plan are listed below. Due to changes in the work plan and limitations on the number of clean-out events, not all of the management questions were able to be answered in full by this scope of work. This Report and the information gathered does point to many possible directions for addressing these management questions, and poses additional considerations that can help future efforts and assessments do a more complete job of addressing these questions. On the whole, the management questions point to the essential importance of improving the City's base of information on the physical dimensions, conditions, and functions of catch basin inlets within the City's drainage network.

- To what extent do changes in catch basin cleaning frequency affect the amount of pollutants (pounds or other units) collected on an annual basis?
- At what catch basin cleaning frequency is pollutant capture optimized relative to the level of effort expended?
- Does the optimal cleaning frequency differ from one pilot area to the next? If so, what site-specific factors affect optimal cleaning frequency?
- Does increased catch basin cleaning frequency reduce the incidence of catch basin or storm drain pipe clogging or other maintenance problems on an annual basis?
- What is the annual calculated load reduction based on pilot scale data collection with catch basin inlet cleaning?
- Which cleaning method, manual versus mechanical, is the most cost effective method for removing sediment from catch basins?

The analysis conducted in the pilot study has provided insights for answering several key issues that can be used to help answer the management questions, and to further support optimization of the City's catch basin cleaning program:

- Accumulation rates by land use settings and specific area
- Pollutant presence and concentration in different land use settings and specific areas
- Observations regarding the storage capacity of catch basins with different sumps

2 Study Methodology

The catch basin cleaning study project methodology included development of a monitoring program and Quality Assurance Project Plan (Mactec/Amec 2011; Appendix A); identification of the four project study areas and catch basins to be cleaned; and a comparison of cleaning methods. The monitoring program was outlined in the Pilot Study Work Plan (Tetra Tech 2011) and further detailed in the Monitoring Plan. The work plan identified the catch basin areas, schedule for clean-outs, and general methods for collecting and analyzing clean-out samples. The following section describes the same elements of the monitoring program, as they have changed somewhat from the work plan. The intent of the methods was to assess the impact of catch basin cleanings using different methods, in four locations, over time. With respect to frequencies, the study evaluated accumulation rates and the pollutant loads associated with each clean-out after each period of time, enabling some inferences regarding optimal frequencies in different land use settings and for different pollutants. With respect to method, the study made observations as to the costs, equipment, and operational considerations involved with each method.

Monitoring Plan

A monitoring plan to guide data collection during the project was developed. The monitoring plan covered both field and laboratory operations and consisted of the following elements: project overview and description; monitoring sites; analytical constituents; data quality objectives; field equipment maintenance; monitoring preparation and logistics; sample collection, preservation, and delivery; quality assurance/quality control; laboratory sample preparation and analytical methods; data management and reporting procedures; clean sampling techniques and equipment cleaning protocols; and a health and safety plan.

An initial September 2011 field reconnaissance was conducted to determine the specific sites and drainage areas to be monitored. The potential drainages in each of the four study areas were reviewed with City staff and a draft monitoring plan was submitted. Efforts were made to relate each area to the City's condition assessment to determine if any damaged infrastructure (especially pipes) were present in each drainage area; however, no areas of damaged infrastructure were identified in any of the study areas. Field reconnaissance, including identification and supplemental mapping of the storm drainage networks and storm water treatment facilities in the four study areas, was performed to confirm the location of each catch basin shown in the City's SAP system.

Study Areas

Four study areas within the City were identified through mapping and site visits (Figure 1). These areas included the Scripps/Poway Parkway Area (Figure 2); an area near Mesa College in the Tecolote Creek watershed (Figure 3); a segment of the Downtown drainage area (Figure 4); and a residential neighborhood in San Ysidro (Figure 5). The drainage areas for each of these catch basin systems were estimated using GIS coverages and aerial photographs. Although each area has a unique character, they were classified by predominant land use types.

The **Scripps Poway Parkway** and Tecolote Creek/Mesa College areas were classified as mixed residential and commercial use areas. The 29 catch basins in the Scripps Poway Parkway area are along the parkway and in the parking lots around the commercial buildings (Figure 2). The Scripps/Poway Parkway area drains approximately 11.2 acres of surfaces, predominantly asphalt, though roof drainage and some vegetation along the road shoulders, medians, and parking islands are present. This area was constructed relatively recently (roughly in the late 1980s through the late 1990s) and as such observation suggests there is little infrastructure deterioration. This area was selected for vactor cleaning, in part because of the depth and large size of the catch basins which make manual cleaning especially difficult.

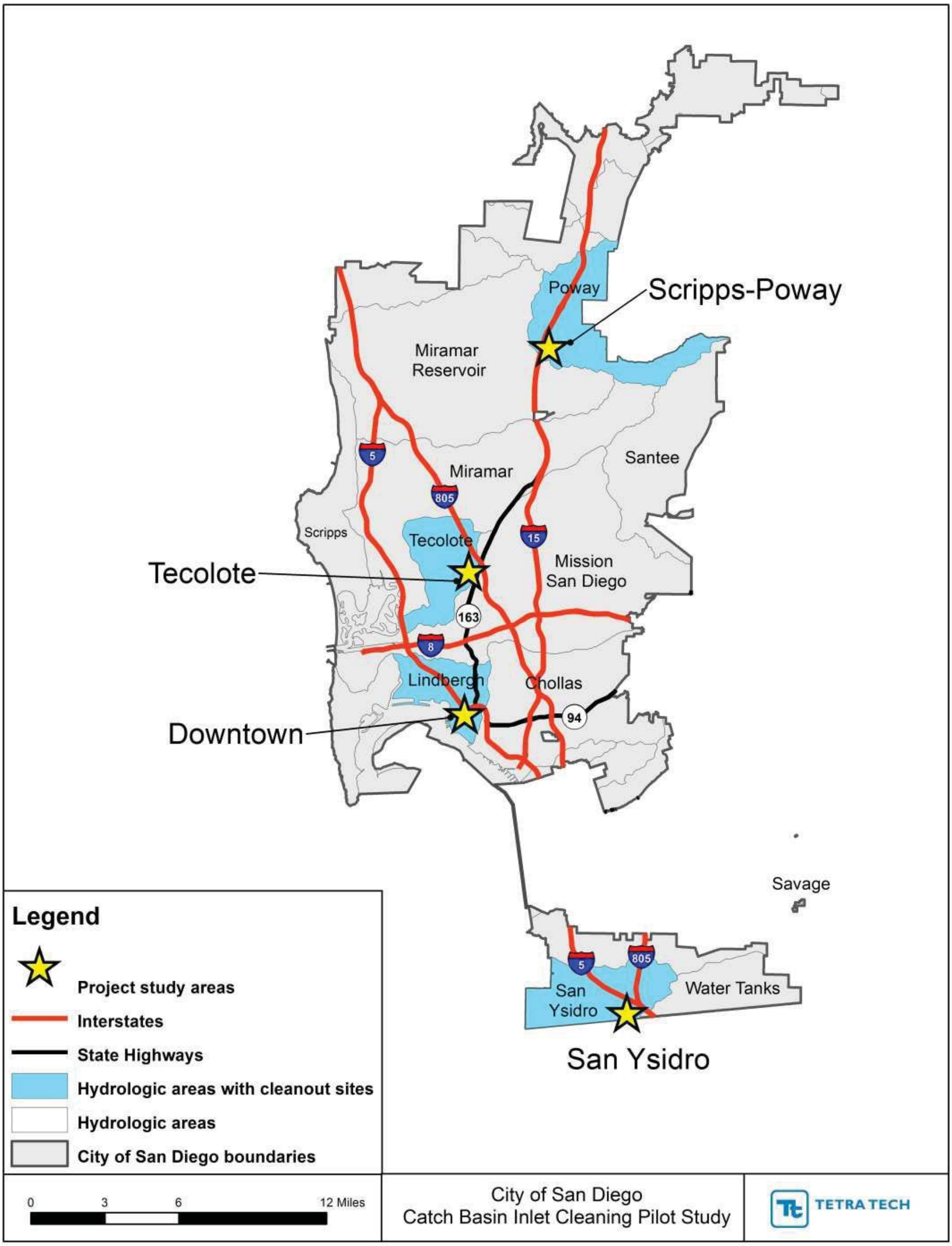

Figure 1. Study area locations.

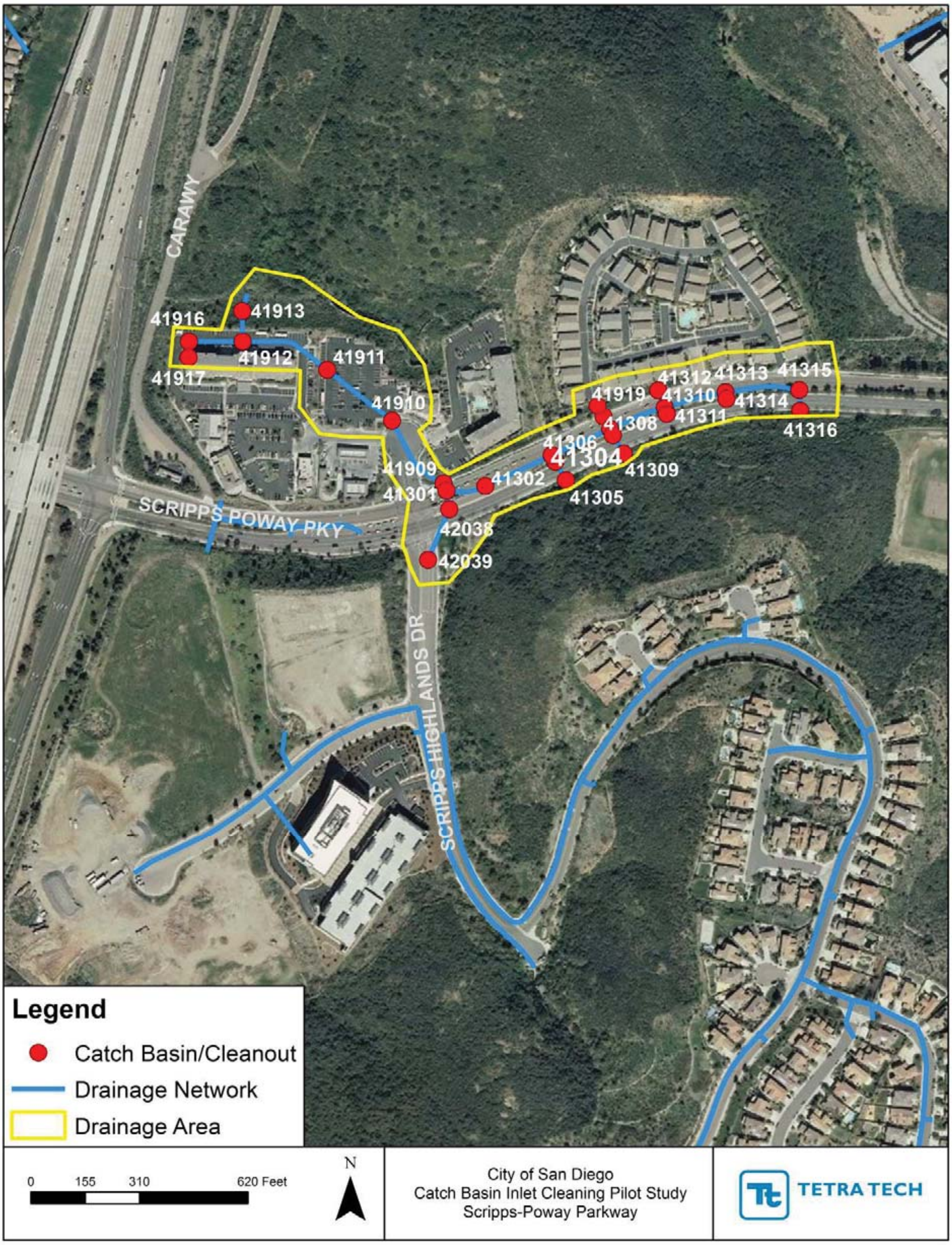

Figure 2. Scripps - Poway Parkway drainage area and associated catch basins.

The roughly 7 acre **Tecolote Creek/Mesa College** area is more residential than commercial, with 8 catch basins along residential feeder roads and the collector Armstrong Street (Figure 3). The surfaces include paved roads, driveways, sidewalks, and parking lots, as well as vegetated lawns. In contrast to the Scripps/Poway Parkway area, the residential areas around Mesa College that drain into the catch basin network appear to have been developed in the 1960s to 1970s, and as such, greater deterioration is expected though no significant problems were observed. Manual cleaning was used in this area, since all catch basins were regularly sized and none was excessively deep.

The **Downtown** area was classified as high density downtown mixed use. Eight catch basins along Ash Street and side streets collect runoff from an estimated 9.5 acres of roads, sidewalks, and parking lots (Figure 4). Roof area is substantial, though roof drainage to the surface or catchment basins is unconfirmed. Trees are only present in isolated planting beds along the sidewalks. Vactor cleaning was used in the downtown, since this area generally is cleaned by City crews using a vactor truck.

San Ysidro was classified as residential. It includes 16.6 acres of high density single family house sites, roads and a two-acre park (Figure 5). Like Scripps/Poway Parkway, the area was developed within the past 20 years and little deterioration was observed. Materials were removed from 25 cleanout structures. The inlets are located along the collector roads. The surfaces over which rainfall and runoff flow are predominantly lawns, roads, and roofs, and parking and play areas.

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Figure 3. Tecolote drainage area and associated catch basins.

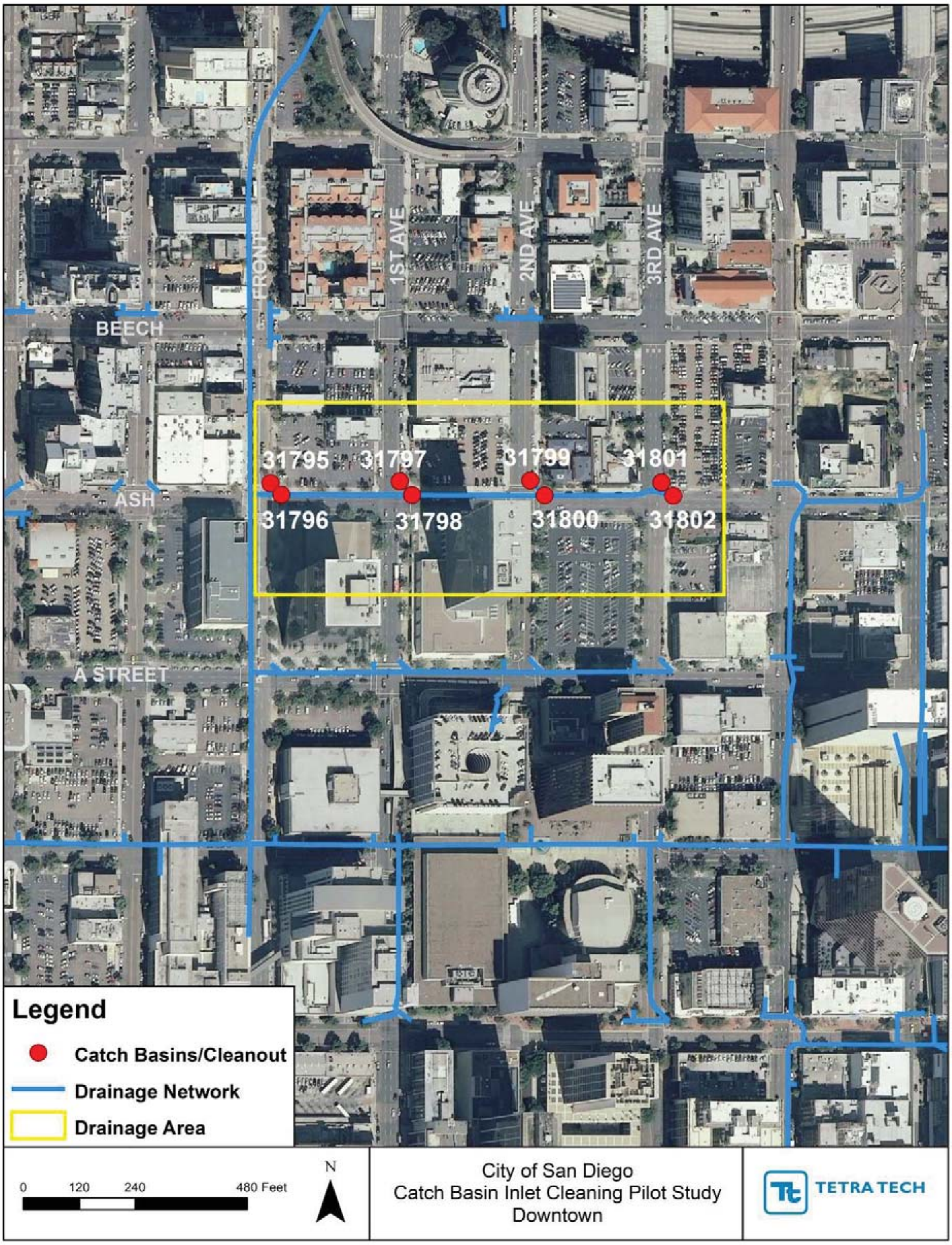

Figure 4. Downtown drainage area and associated catch basins.

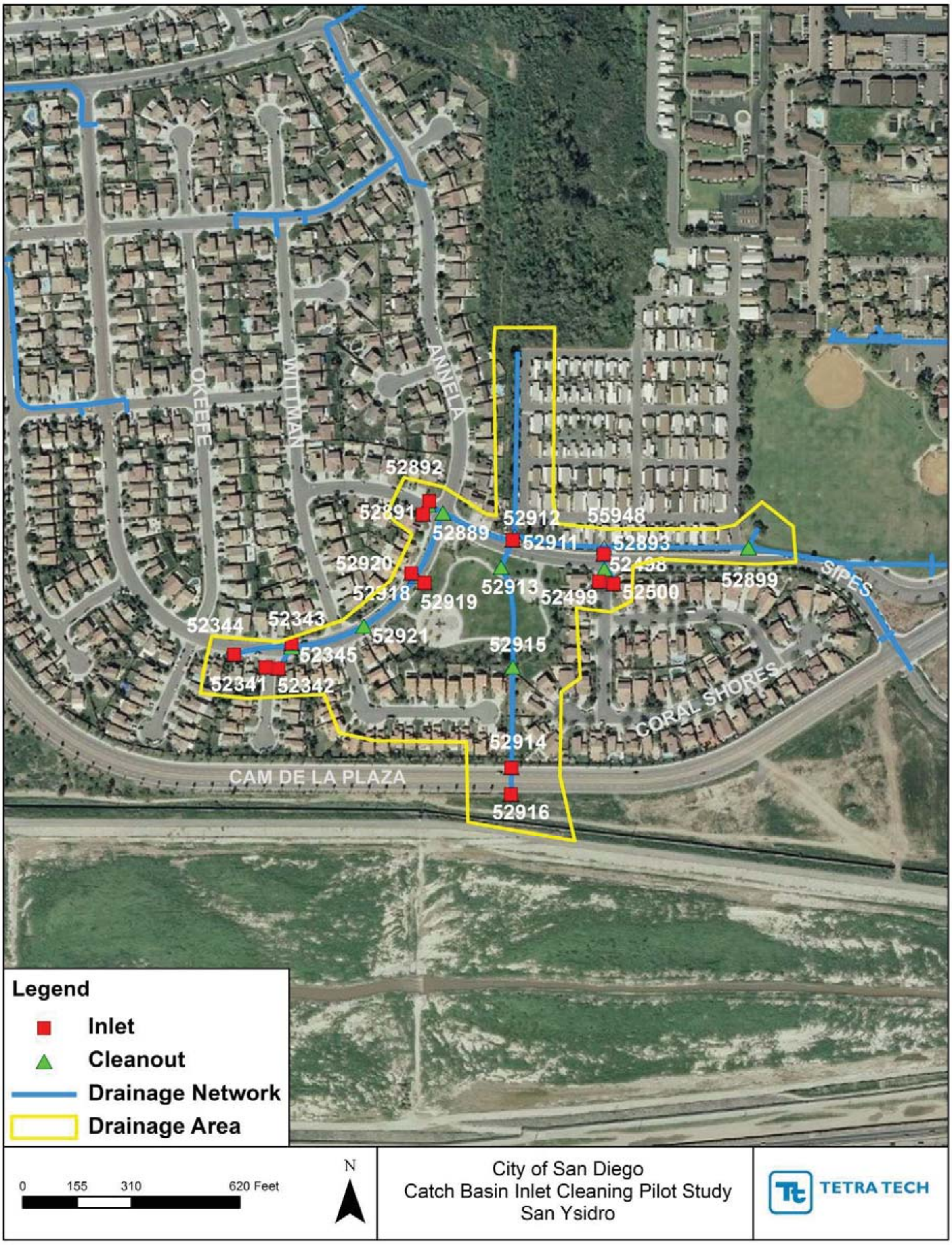

Figure 5. San Ysidro drainage area and associated catch basins.

Method Comparison

Originally, one objective of the pilot study was to evaluate the effectiveness of vactor versus manual cleaning in comparable land use settings. The vactor method uses a vacuum truck and hose to suck sediment, debris and water from the catch basin sumps. The manual method requires entering the catch basin and using a shovel, broom, and dustpan to collect the materials. Ultimately, a comparison of the two methods in the same land use area was not pursued; instead, the vactor method was used in the Downtown and Scripps Poway Parkway areas and the manual method was used in the Tecolote and San Ysidro areas. While a comparison of the effectiveness of the two approaches in the same areas is thus not possible from the results of this study, a number of transferable observations have been made about the appropriateness and use of each technique in different settings, and the cost considerations.

For the study work, two private contractors were engaged to complete the catch basin cleanings in the four study areas, to deliver the materials to containment berms that they set up at the Rose Canyon Operations Yard, and to dispose of the catch basin materials after sampling was completed. These contractors were Ron's Maintenance using the manual method shown in Figure 6. Manual clean-out by Ron's Maintenance in the Tecolote and San Ysidro areas.Figure 6 and Downstream Services, Inc. using the vactor method shown in Figure 7. Downstream Services used its Truck #71, a 2001 Isuzu MiniVac (shown in Figure 7), with a capacity of 750 gallons. This truck is used by Downstream Services for routine inlet cleaning; a larger vactor is used only in the event that a large mechanical separator or an impacted/collapsed area is to be cleaned.

Figure 6. Manual clean-out by Ron's Maintenance in the Tecolote and San Ysidro areas.

Figure 7. Vactor clean-out by Downstream Services, Inc. in the Downtown and Poway areas.

Schedule

Catch basins in each network were cleaned four times between December 2011 and March 2012. The variability of winter season weather was the major driver behind the selected clean-out dates, which were timed based on ten- and three-day National Weather Service forecasts for rain events predicted to bring one or more inches of precipitation to the metropolitan area. The intent was to separate clean-out dates by roughly two months, and to time clean-outs immediately preceding a significant rain event to attempt to capture the build-up period between rain events. As the winter season weather played out, the clean-outs occurred with greater frequency over a shorter overall period than originally anticipated, but each was timed in advance of a rain event as shown and discussed in Section 3, Figure 9.

Sediment Characterization

The sediment and materials removed from the catch basin networks during cleaning were brought to the City's Rose Canyon Operations Yard and stored in the pop-up containment berms shown in Figure 8, which were supplied by MACTEC (Amec) and have been retained for future sampling efforts. Sediment and materials collected from each area were stored in a single pop up berm and allowed to air dry, with the exception of the Scripps Poway Parkway area for the first sampling event. There was some concern that the volume of material collected from the catch basins in the Scripps Poway Parkway area may exceed the capacity of the pop up berm; as such, a single roll off bin was used for the first event only for the Scripps Poway Parkway area, until it was determined that the volume of material could be contained in the pop up berm. Once the sediment/debris was air dried, the following activities were conducted to characterize the collected sediment from each drainage network:

1. Determine the total dry weight of the collected sediment/debris.
2. Characterize the percentage of sediment, trash, and organic material.
3. Collect a composite sample for analysis of nutrients, metals, microbiology, and organic compounds

Figure 8. Delivery of materials to the containment berms for storing and drying before sampling and analysis.

Determining Sediment Weight and Composition

The weight of the dry materials collected from the drainage networks were measured using 40-gallon buckets and a scale. Once the materials were weighed, the percent composition of the materials (sediment, trash, or organic matter) was visually estimated.

Composite Sediment Sample

A stainless steel spoon was used to collect samples from the complete drainage area sediment pile. Samples were taken from each cell or parts of a single cell. These samples were placed in a pre-cleaned plastic bucket and then thoroughly mixed and placed in appropriate sample containers for each intended analysis. Large pieces of trash were intentionally avoided so that analysis would emphasize the sediment and organic components. The composite sample was analyzed for the variables listed in The total amounts of nutrients and metals removed during the clean-out process were calculated by multiplying analyte concentrations by the weight of the material removed. The estimates for each analyte in each clean-out event were standardized to a 30-day accumulation period and 10 acre drainage area using the following calculation:

$$Load_{30} = W \cdot pSO \cdot C \cdot D_{30} \cdot Ac_{10}$$

where:

W = Total weight of the material removed in pounds (x 2.2 to convert to kilograms)
pSO = % sediment and organics (assuming trash is inert or unsampled for analytes)
C = Analyte concentration (converted to kilograms/kilogram)
D_{30} = 30 day standard divided by the number of days of accumulation between cleanouts
Ac_{10} = 10 acre standard divided by the number of acres in the specific area

Sample Tracking and Handling

Sediment samples were chilled and transferred to the analytical laboratory within specified holding times (six hours for bacteriological samples). To ensure proper tracking and handling of the samples, documentation (Chain-of-Custody [COC] Forms) accompanied the samples from the initial pickup to the final extraction and analysis. All samples collected, including the composite containers, were labeled with information regarding Project name, Date, Time, Sampling location name and number, Preservative, Collector's initials, Sample I.D. number, and Analytes to be quantified.

Table 1. Equipment used for sampling was cleaned using a standard three-step cleaning process with Alconox and de-ionized water. The equipment was cleaned between the sampling of each drainage network to prevent cross-contamination.

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Table 1. Analytical Parameters and Methods - Sediment

Analytical Parameter	Method
GENERAL CHEMISTRY	
Percent Solids	SM 2540B
pH	EPA 9045C
Particle Size Distribution	ASTM D422/4464
METALS	
Total Cadmium (Tecolote Only)	EPA 6020
Total Copper	EPA 6020
Total Lead	EPA 6020B
Total Zinc	EPA 6020
NUTRIENTS	
Total Phosphorus	EPA 365.3 M

Total Nitrogen (By calculation)	TKN: EPA 351.2 plus Nitrite + Nitrate: EPA 353.2
ORGANICS	
Total Organic Carbon	SM 5310C
Organochlorine Pesticides (Downtown only)	EPA 8081A
Polynuclear Aromatics-SIM (Downtown only)	EPA 8270C-SIM
Polychlorinated Biphenyls (Downtown only)	EPA 8082
MICROBIOLOGY	
Total Coliform – 3 Dilutions	SM 9221B/E Modified
Fecal Coliform – 3 Dilutions	SM 9221B/E Modified
Enterococci	SM 9230B Modified

3 Results

This section presents the results of the analysis of the catch basin materials removed in the four clean-outs. The timing of the catch-basin clean-outs started somewhat later than originally planned, and were then spaced at intervals of 42, 19, and 38 days, with rain events intervening. Figure 9 and **Error! Reference source not found.** illustrate the timing of the catch basin cleanings and the material sampling. For two of the clean-out events in the pilot study, the interim period between cleanings was similar (42 and 38 days for CO2 and CO4, respectively). The number of rainfall events was also similar during these two periods, though the amounts of rain per event were somewhat different. In CO2, one larger rainfall event occurred at the beginning of the period and the subsequent events were much smaller. In CO4, all of the events were of a moderate amount and mostly during the first half of the period. The interim period for CO3 was 19 days, about half the time of CO2 and CO4. Only two days had measureable rain during that period with small and moderate amounts of precipitation. For the initial cleaning (CO1), information was not available about previous clean-out events. In some analyses, 90 days was assumed, though the amount could be much higher (as much as one year). Two large rainfall events occurred in the month before the initial clean-out.

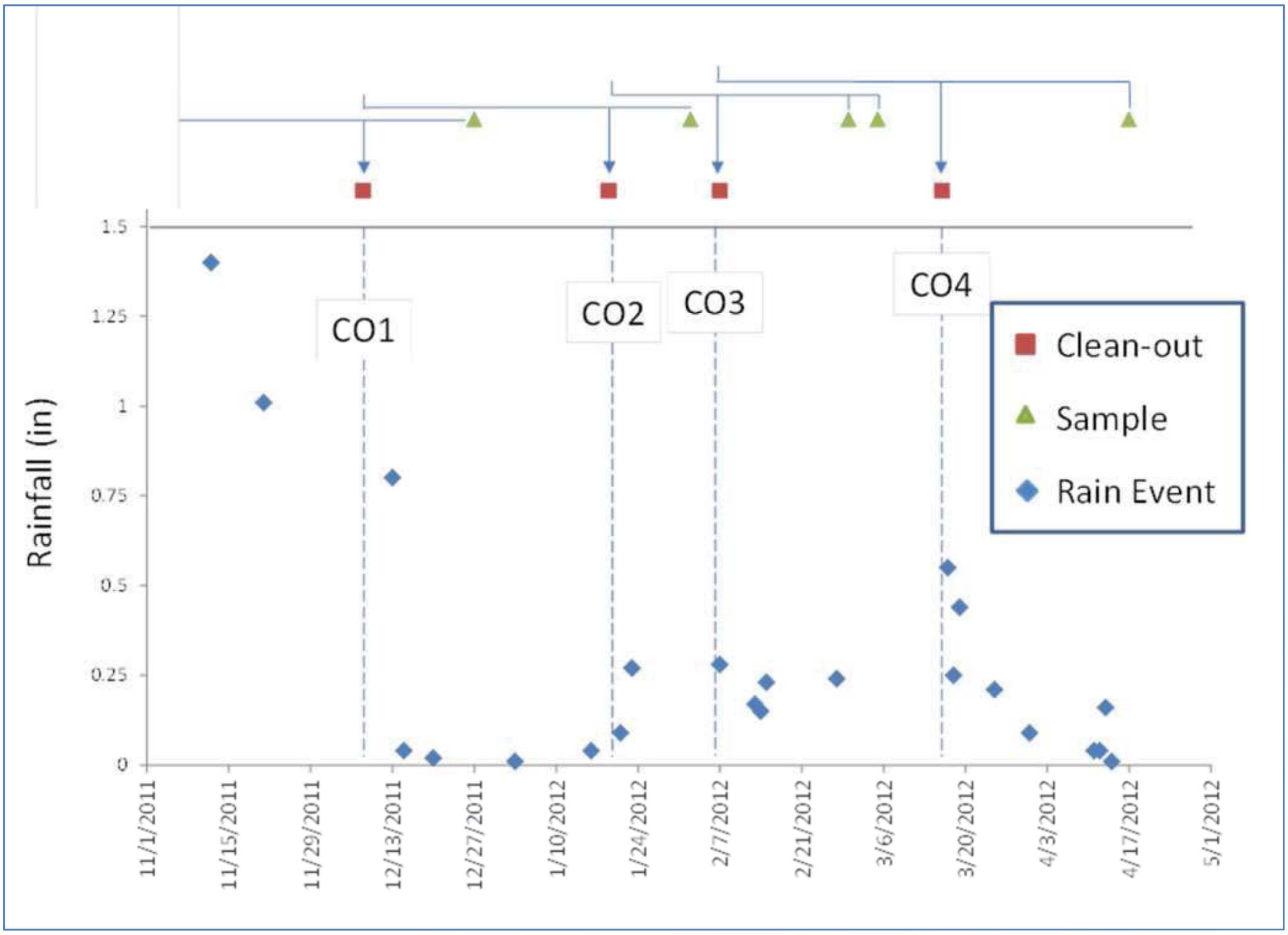

Figure 9. Timeline of catch basin clean-out (CO1-CO4), sampling, and rain events.

The sediments removed during clean-outs were allowed to dry adequately, though one sample (Poway in CO3) was analyzed a day after a rain event. The drying time was between 1 to 3 weeks depending on the amount of sediment. The cleanout dates were: December 8, 2011; January 19, 2012; February 7, 2012; and March 15 (early AM) to 16, 2012. Data were collected in the field during sample collection, at the time of sampling, and in the analytical laboratories. To facilitate analysis, these data were transcribed from field and laboratory data sheets into spreadsheets (Appendix B).

Table 2. Cleanout and sampling dates.

Activity	Date	Comment
CO1 Initial Clean-out	12/8/2011	
CO1 Sample	12/27/2011	7 days after last rain day
CO2 Clean-out	1/19/2012	42 days (10 with measureable rain) since CO1
CO2 Sample	2/2/2012	10 days after last rain day
CO3 Clean-out	2/7/2012	19 days (2 with measureable rain) since CO2
CO3 Sample (PO site only)	2/29/2012	1 day after last rain day
CO3 Sample (DO, TE, SY Sites)	3/5/2012	6 days after last rain day
CO4 Clean-out	3/16/2012	38 days (7 with measureable rain) since CO3
CO4 Sample	4/14/2012	3 days after last rain day

There was one incidence of inadvertently mixed sediments, which is not believed to have affected these results. Macetc (Amec) field technicians determined that the error was inconsequential and that the sediment sample was truly representative of the materials removed from the catch basins (email communications, Kristina Schneider, AMEC, 3/22/2012). After the CO3 sampling event, the containment berms were used to temporarily hold debris removed from the Memorial Park hydrodynamic separator. Though those Memorial Park materials should have been removed before the CO4 clean-out, a rain event occurred much sooner than expected and Memorial Park sediment was still present in one of the two vactor containment berms (Scripps Poway Parkway) when CO4 was scheduled. The CO4 materials were delivered a day earlier than expected (3/15 instead of 3/16) and the Scripps Poway Parkway materials were placed directly on top of the Memorial Park materials (Figure 8Figure 8, right photo).

The sediment from Memorial Park was a thin layer of fine sediment on the bottom of the containment berm. The Scripps Poway Parkway materials were placed in a large pile in the bin on top of the Memorial Park materials. The containment berm was covered with a new tarp before a large rain event and no rainfall entered the containment berm. The top layer of the Scripps Poway Parkway materials did not appear to contact the Memorial Park materials and rainfall did not appear to have entered the containment berm. Therefore, a representative sample of the Scripps Poway Parkway materials was obtained by taking the Scripps Poway Parkway sample from the top few inches of the materials pile. The remaining Scripps Poway Parkway materials were characterized (% organic, trash, sediment, etc.) per standard project practices since they were distinct from the Memorial Park materials.

3.1 Material Characterization

Material Quantity and Composition

The quantity and composition of sediments removed from the catch basins varied over time and among areas. The greatest amounts of materials were removed in the first clean-out and the least amounts were removed in the second and third cleanouts, depending on the area (Figure 10). In the San Ysidro area, the amounts of material removed were proportional to the period of time between cleanouts, suggesting a linear rate of accumulation. This pattern was somewhat similar in the Tecolote area but was not observed in the Scripps Poway Parkway and Downtown areas, which had more material removed in the short CO3 period than in CO2 or 4.

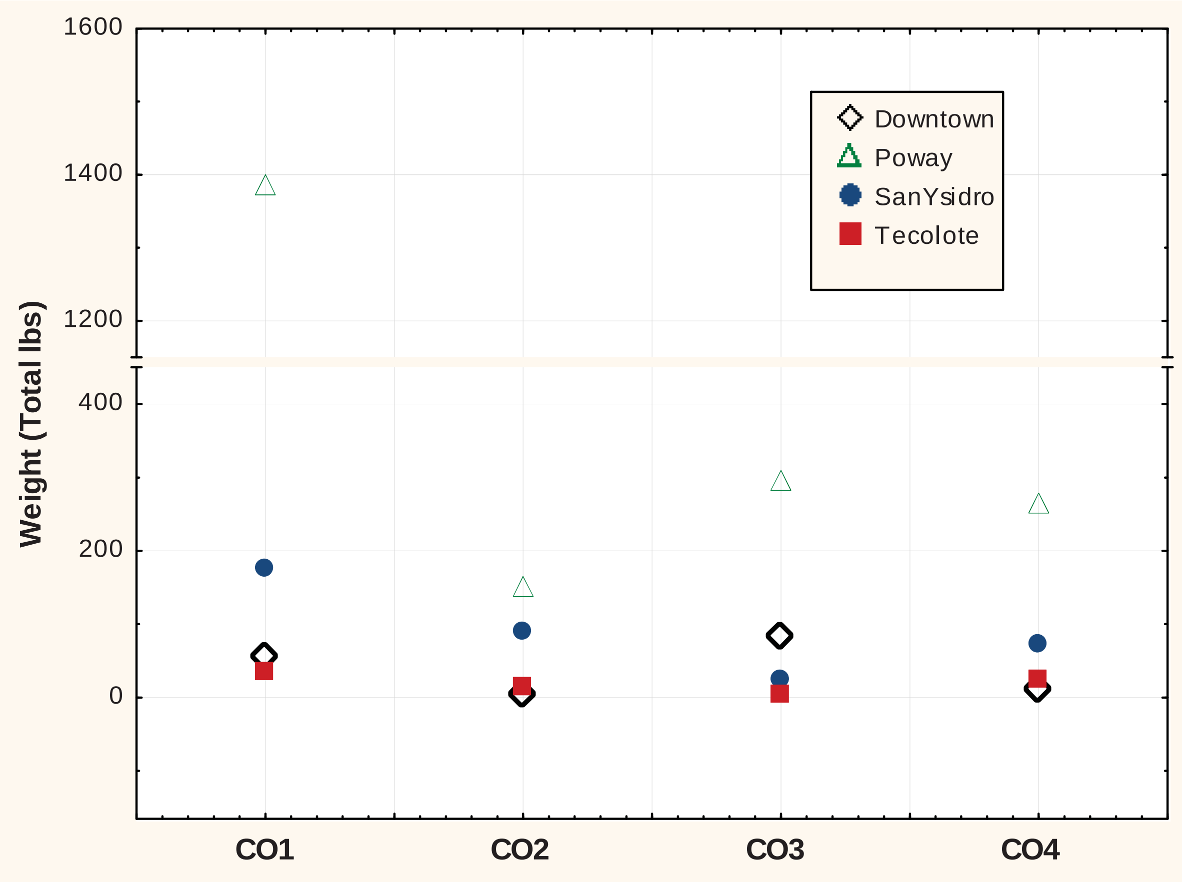

Figure 10. Weight of materials removed from all catch basins in four clean-out periods and within the four areas.

The greatest amounts of materials removed overall and per catch basin were in the Scripps Poway Parkway area (Figure 11), which had 7x more material in the first cleanout than any other area. For all materials, the San Ysidro area had the second most materials and the downtown and Tecolote had similar amounts that were less than the other areas. When calculated per catchment basin, the Downtown area had the second most materials removed.

The vactor method of cleanout was used in the Scripps Poway Parkway and Downtown areas, which had the most and moderate amounts of materials removed. The manual method was associated with moderate and least amounts of materials in the San Ysidro and Tecolote areas. The vactor method is associated with more materials removed in general. In the two areas that are both mixed residential and commercial land uses, the vactor method removed more material. However, other factors may contribute to these findings (e.g., accumulation period, rainfall and runoff intensity, specific land use patterns, sediment sources, and sump capacities) and the sample size is too small to definitively attribute cleanout methods to amounts of materials removed.

Areas with both the most and least amounts of materials removed were categorized as having mixed residential and commercial land uses. Moderate amounts of sediments were from high density and residential areas. These results are inconclusive regarding the association of land use with amounts of materials removed from catch basins. The sources of sediments in each drainage and the shape of the catch basin sumps probably influence the amounts of sediments removed from catch basins more than the general land uses.

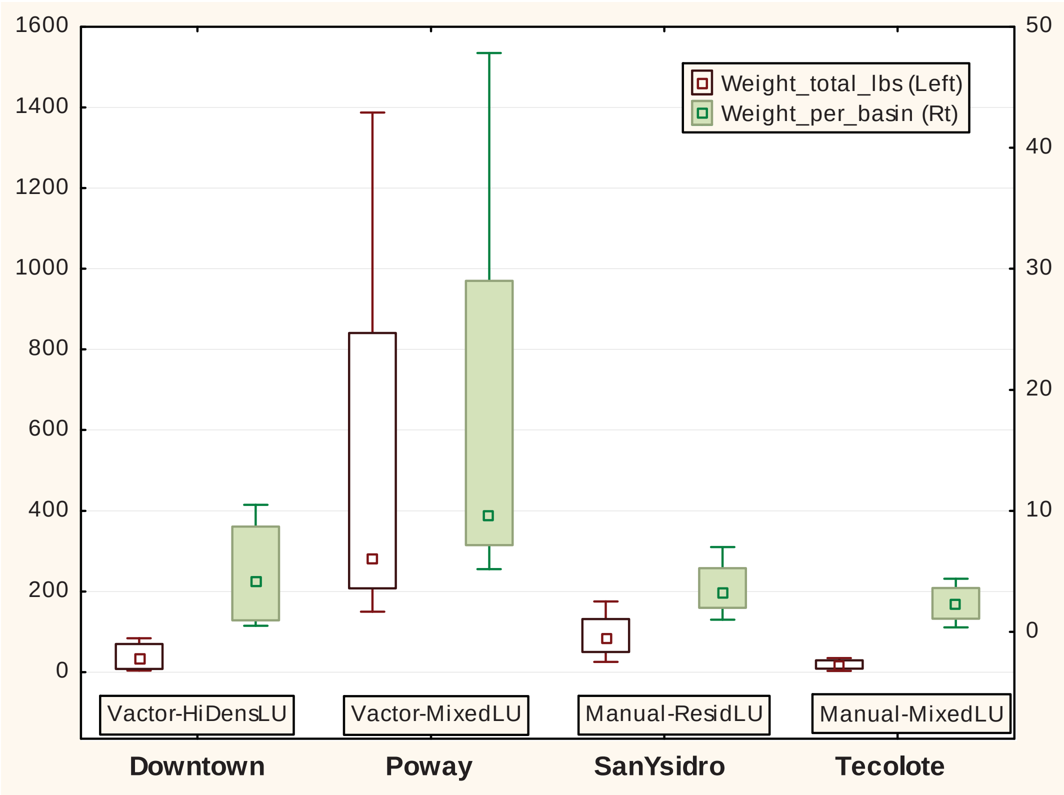

Figure 11. Weight of materials removed from all catch basins and per inlet within the four areas and in four sampling periods. Diagram shows minimum, maximum, quartile, and median values.

The composition of materials varied over time and among areas (Figure 12). While all areas had relatively low percentages of trash, the percentage of sediments was higher in the Downtown and Scripps Poway Parkway areas compared to the San Ysidro and Tecolote areas. Increasing amounts of organic materials were found in the Downtown, Scripps Poway Parkway, San Ysidro, and Tecolote areas. Trash could include such things as plastic, metal, paper, wrappers, glass, food, rubber, wood, or styrofoam. Organic materials were mostly leaves, grass, and twigs.

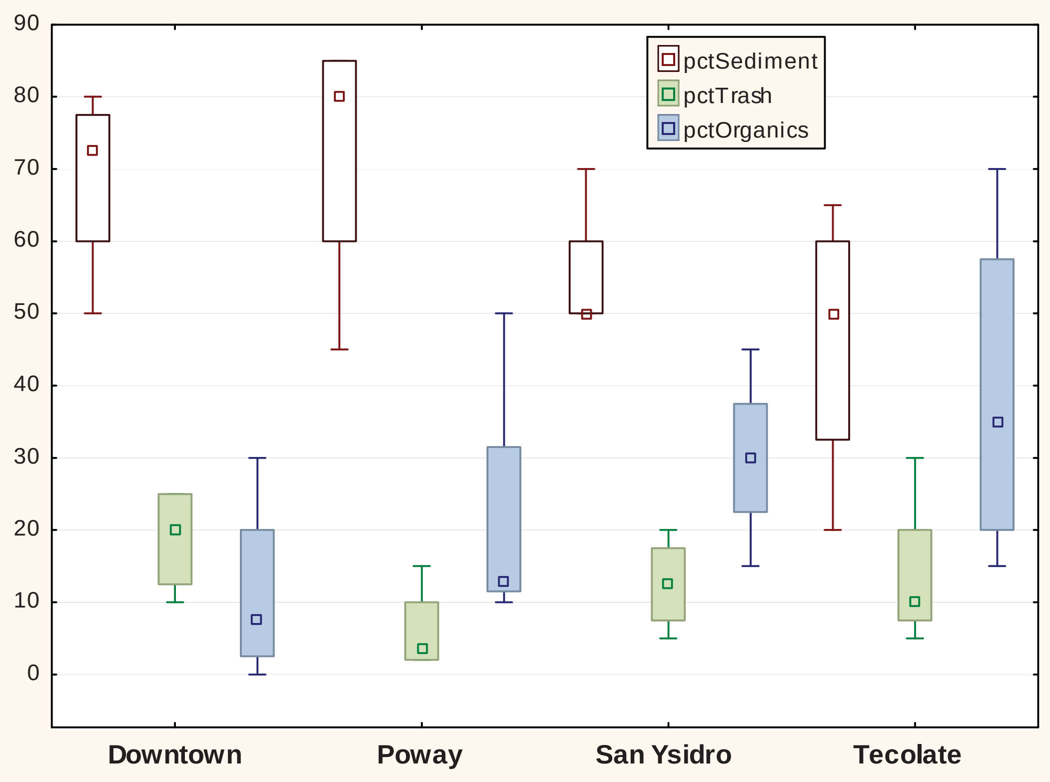

Figure 12. Percentages of sediment, trash, and organic material in the material removed in each area (by visual inspection). Diagram shows minimum, maximum, quartile, and median values.

The sediment component of the samples were analyzed for pollutants, including nutrients, heavy metals, microbiology, and organic compounds. The sediments were also characterized by particle size (Figure 13). In each area, medium sand particles were most common in the sediment, especially during the last cleanout event (Figure 14). Gravels, which were predominant in the Tecolote area and in earlier samples, were completely absent in the final cleanout event. The reduction in gravel and coarse sand sized particles in each successive cleanout event can be seen when the percentages of particle sizes are converted to total weights (

Figure 15). Gravels may accumulate over longer periods of time or with storm events with sufficient flows to carry the larger particles.

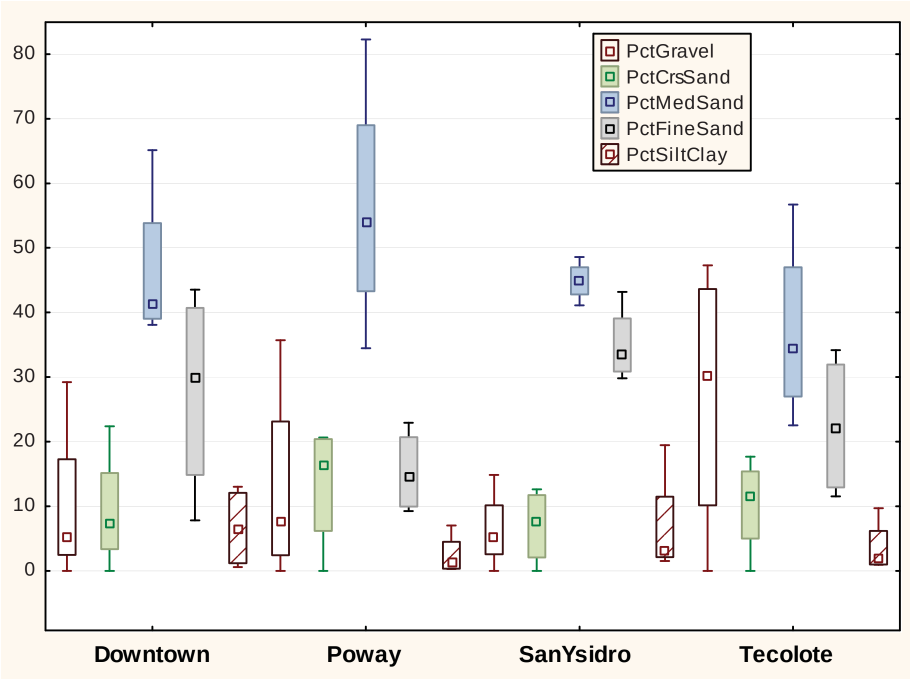

Figure 13. Percentage sediment particle sizes by area.

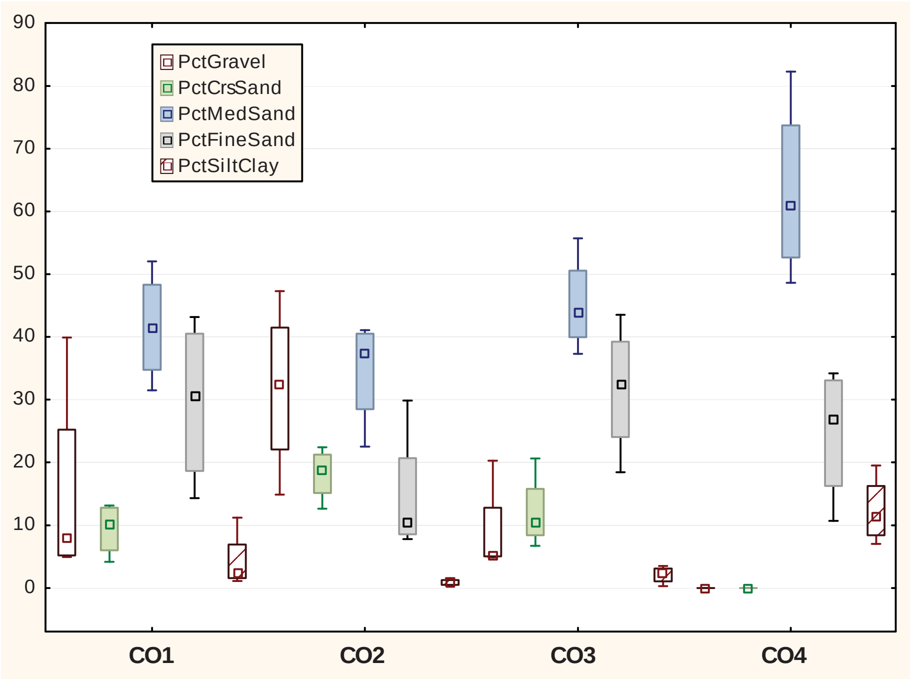

Figure 14. Percentage sediment particle sizes by clean-out event, including four areas.

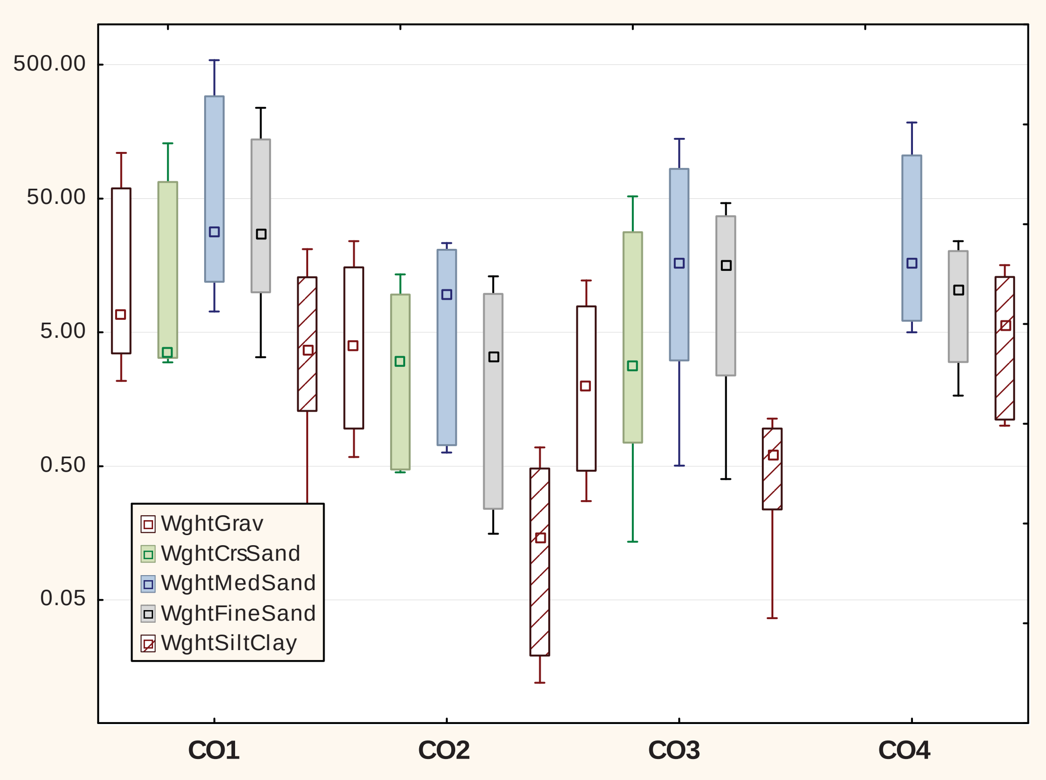

Figure 15. Weight of sediment particle sizes by cleanout event, including four areas.

3.2 General Chemistry

The percent solids, pH, and total organic carbon (TOC) in the samples are illustrated in Figure 16, Figure 17, and Figure 18, respectively. Percent solids were >75% in all samples, and were always greater than 90% in samples from Downtown, Tecolote, and during cleanout CO3. The pH ranged from 6.1 to 8.6 and most samples were between 6.4 and 7.3, circumneutral. TOC ranged from 15,000 to 81,000 mg/Kg in most cases, with one outlier at 260,000 mg/Kg in Tecolote during CO2. While these variables help to characterize the materials, they are generally unremarkable and do not contribute to decisions regarding basin cleanout management.

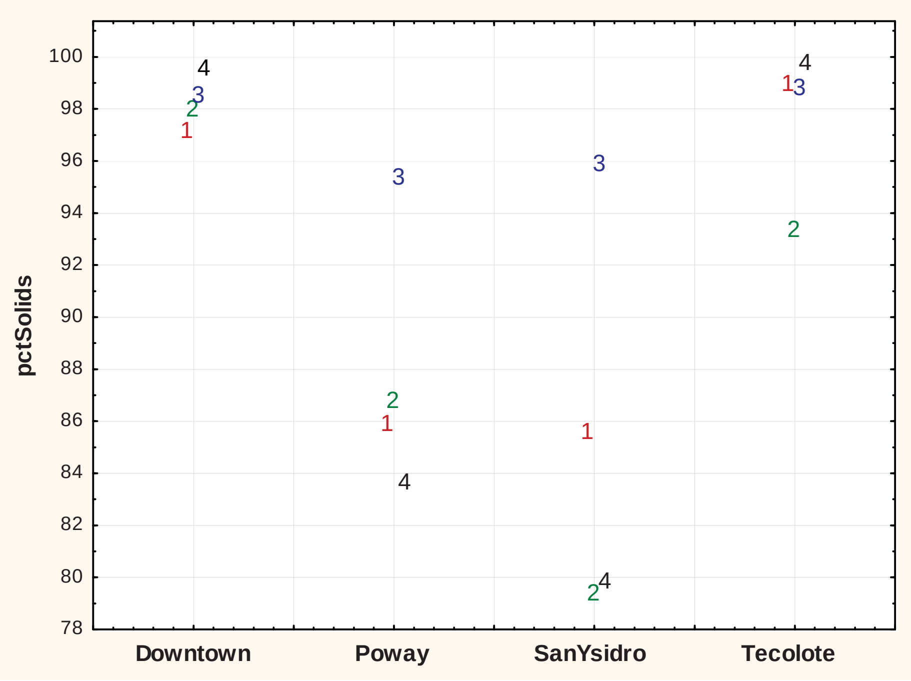

Figure 16. Percent solids in each location, by clean-out number.

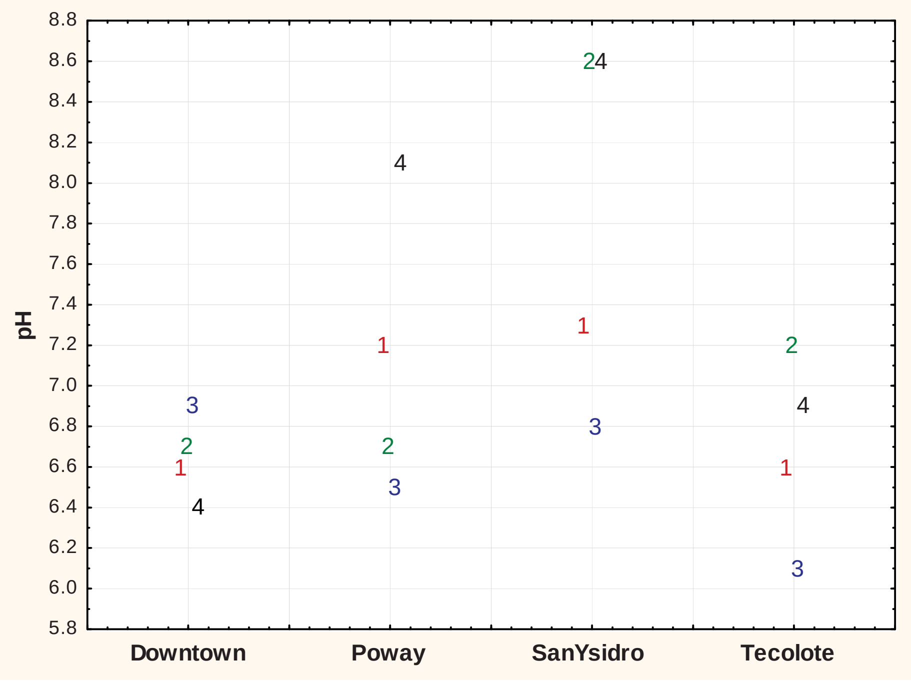

Figure 17. pH in each location, by clean-out number.

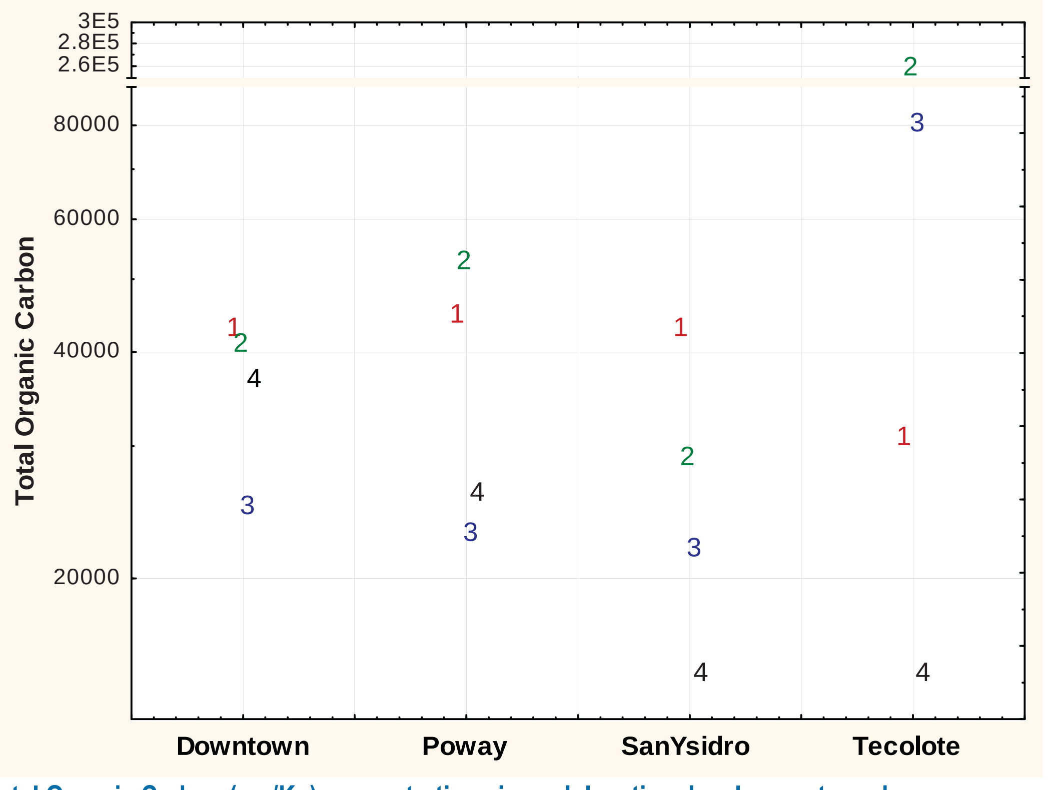

Figure 18. Total Organic Carbon (mg/Kg) concentrations in each location, by clean-out number.

3.3 Nutrients

Nutrient concentrations were higher for total N and lower for total P in San Ysidro during most cleanout periods (Figure 19 and Figure 20). This pattern suggests that there may be some specific nitrogen sources in the San Ysidro area. The Downtown area never had the lowest nutrient concentrations and had the highest of all total phosphorus readings during CO1.

Because the weight of material removed from the Scripps Poway Parkway area was greater than from the other areas, the loads of nutrients removed were also greater there (Figure 21 and Figure 22**).** The high nitrogen load in the last clean-out in San Ysidro may be related to residential fertilization patterns. Average nitrogen and phosphorus loads removed from each study area are presented in Table 3. As seen from the high concentrations in loads following the first clean-out, it appears that nutrients can accumulate quickly in the catch basins.

Table 3. Average mass of nutrients removed in each study area

Location	Nitrogen (g)	Phosphorus (g)
Downtown	100	44
Poway	450	214
SanYsidro	220	22
Tecolote	40	12

* standardized to 30 day accumulation and 10 acre drainage area

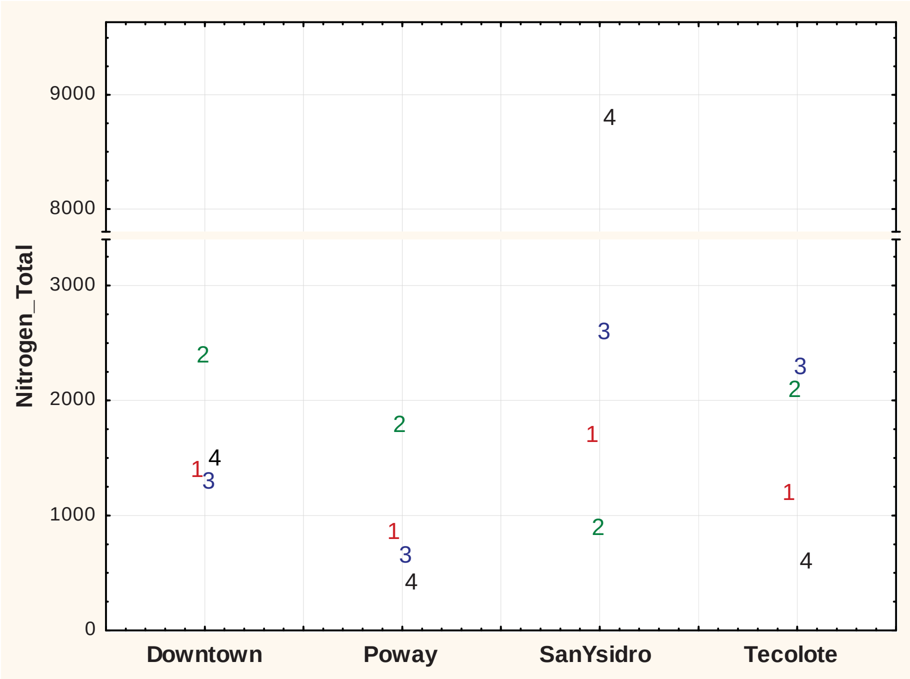

Figure 19. Total Nitrogen concentrations in each location, by clean-out event.

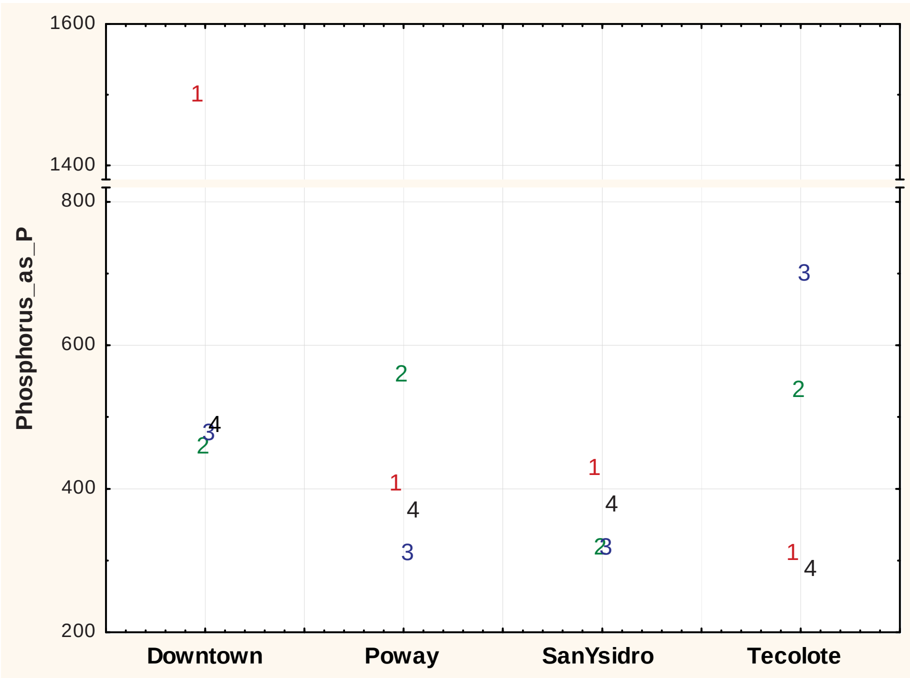

Figure 20. Total Phosphorus concentrations in each location, by clean-out event.

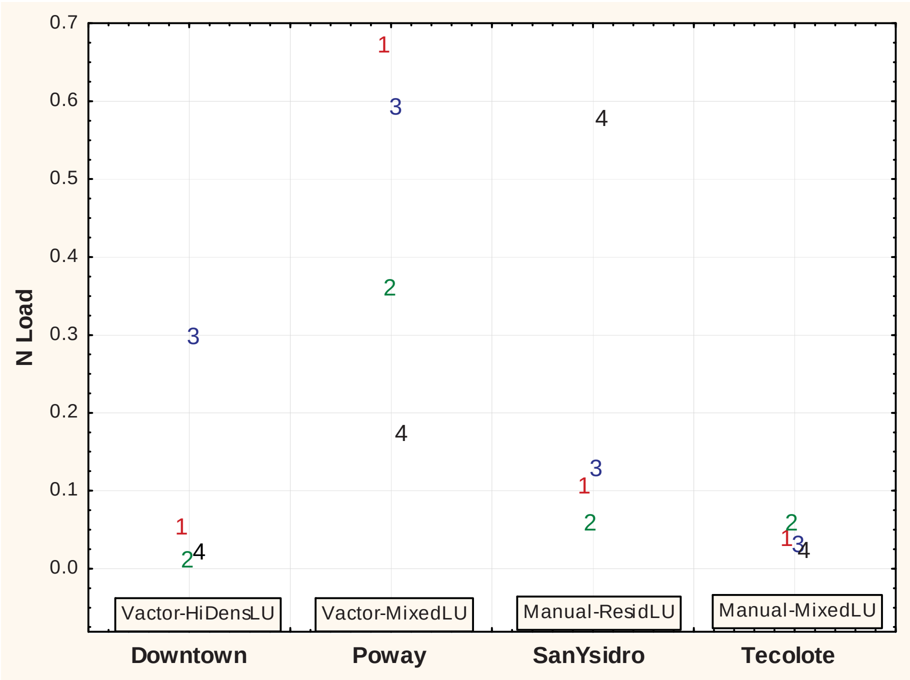

Figure 21. Nitrogen load removed for each location and clean-out event (standardized to a 30-day period and 10 acres).

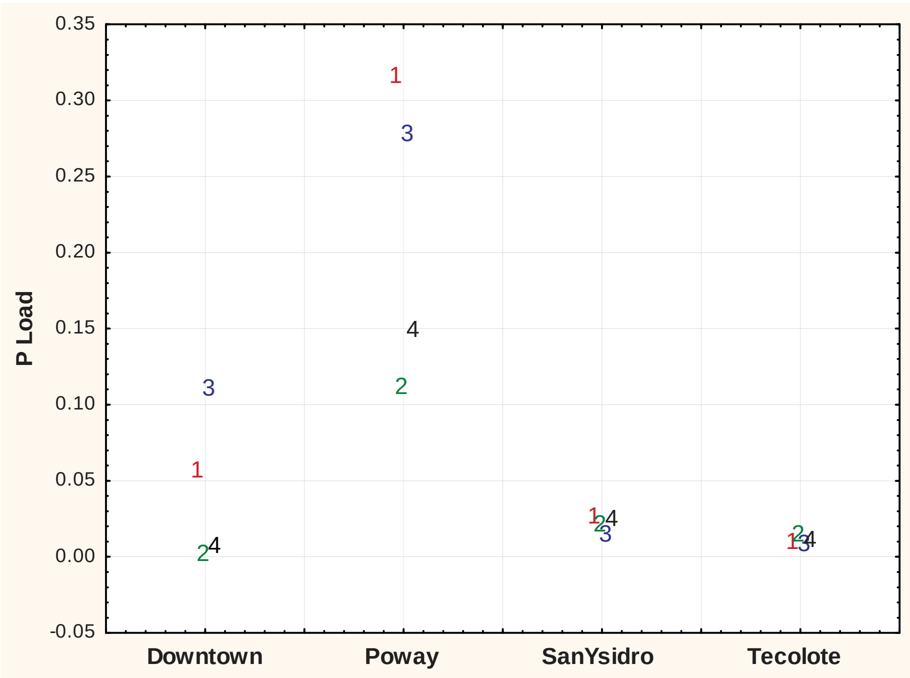

Figure 22. Phosphorus load removed for each location and clean-out event (standardized to a 30-day period and 10 acres).

3.4 Metals

Copper, lead, and zinc were sampled in each area for each sampling event. The highest concentrations of these three metals were observed in the Downtown area during the first cleanout event (Figure 23**,** Figure 24, and Figure 25). During other sampling events, higher conceFigure 25. Zinc concentrations in each area for each clean-out event.ntrations were observed in the Downtown and Tecolote areas. Concentrations were higher in CO1 and CO4 in the Downtown area and in CO2 and CO3 in the Tecolote area. The lowest concentrations overall were consistently in the San Ysidro residential area. For all but the Tecolote area, the lowest concentrations were observed in CO3, which also had the shortest accumulation period. Except for the anomaly in the Tecolote area, this suggests that metals accumulate linearly over time. The total amounts of metals removed in the catch basin clean-out process are summarized in Table 4 standardized to a 30 day accumulation and a 10 acre drainage area. Sampling prior to intensive rainfall may have yielded different results, possibly greater concentrations of metals.

Cadmium was only of concern in the Tecolote area, in which it was not detected in the sediments collected during the first three cleanout events. The detection limit was 0.40 mg/Kg. In CO4, cadmium was detected at a concentration of 1.3 mg/Kg.

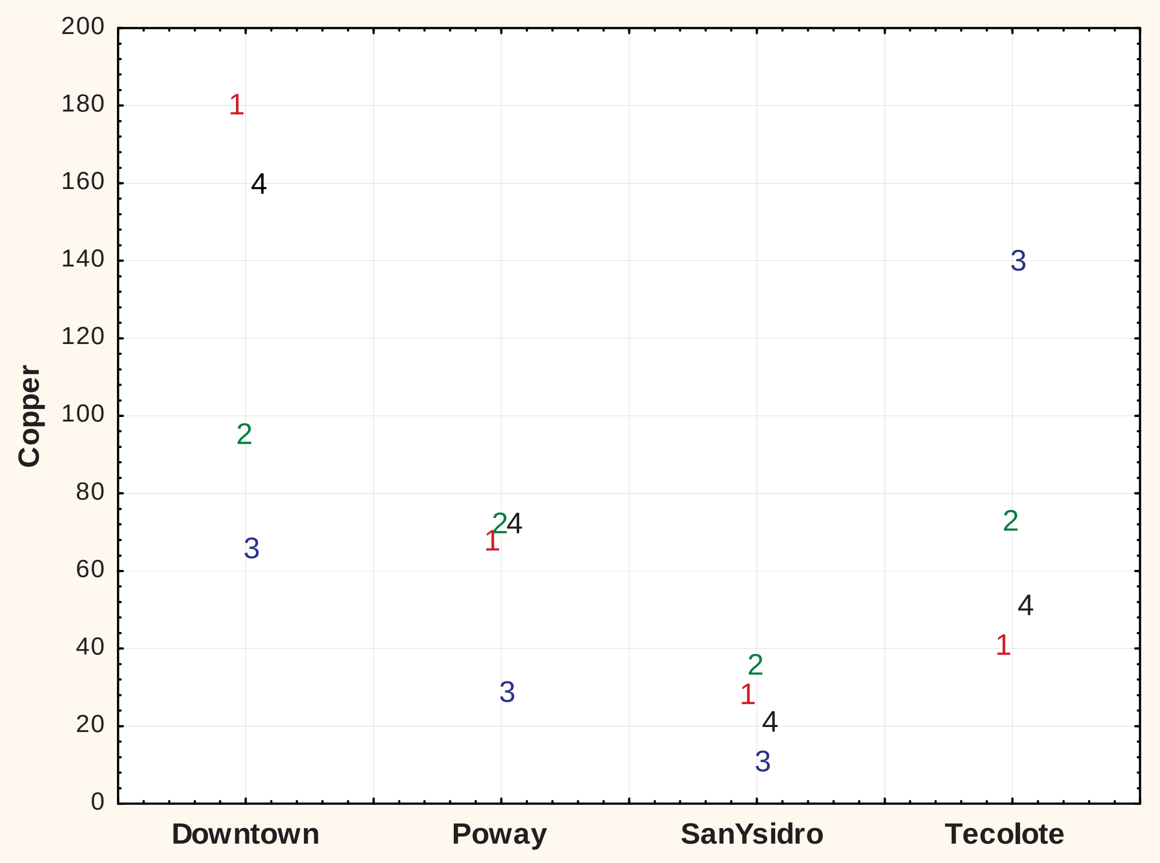

Figure 23. Copper concentrations in each area for each clean-out event.

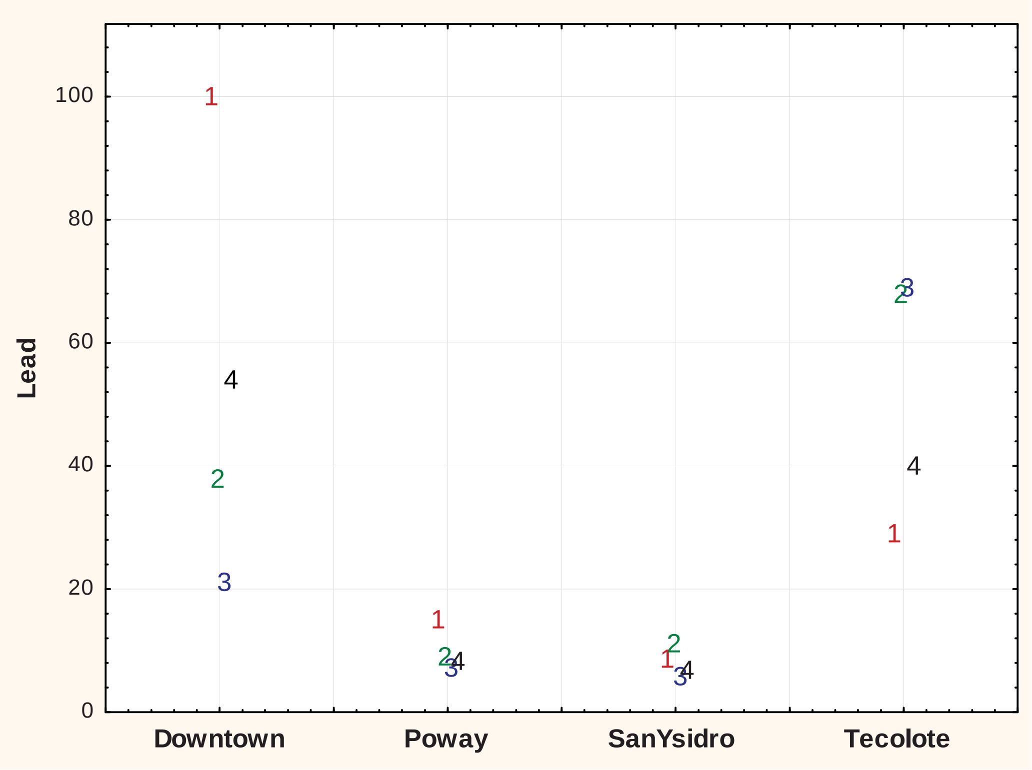

Figure 24. Lead concentrations in each area for each clean-out event.

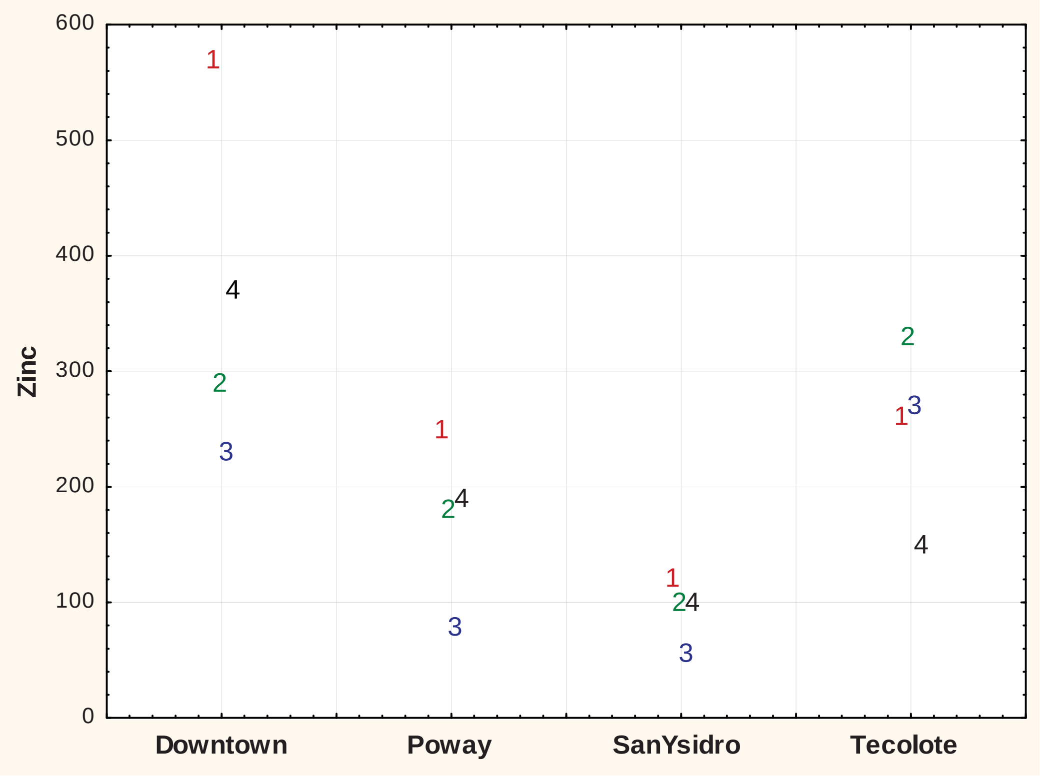

Figure 25. Zinc concentrations in each area for each clean-out event.

Table 4. Total metal load removed in each area and clean-out event

Location	Clean-out	Cadmium (g)	Copper (g)	Lead (g)	Zinc (g)
Downtown	CB1		6.88	3.82	21.78
	CB2		0.50	0.20	1.54
	CB3		15.20	4.84	52.98
	CB4		2.41	0.81	5.58
	mean		6.25	2.42	20.47
Poway	CB1		52.49	11.58	192.98
	CB2		14.40	1.80	35.99
	CB3		26.00	6.55	69.94
	CB4		29.00	3.26	76.52
	mean		30.47	5.80	93.86
SanYsidro	CB1		1.73	0.53	7.42
	CB2		2.40	0.73	6.66
	CB3		0.55	0.29	2.73
	CB4		1.38	0.45	6.52
	mean		1.51	0.50	5.83
Tecolote	CB1	0.00066	1.35	0.96	8.58
	CB2	0.00057	2.06	1.92	9.33
	CB3	0.00027	1.88	0.92	3.62
	CB4	0.05193	2.04	1.60	5.99
	mean	0.01	1.83	1.35	6.88

*standardized to 30 day accumulation and 10 acre drainage area.

Metals in the sediments of catch basins are not regulated for protection of aquatic life uses, but if these sediments are not cleaned out and continue to be transported and deposited in surface water systems, the concentrations of metals would then be of interest. Therefore, we mention the effect levels for sediments in freshwater systems as a scale upon which to judge the severity of the observed metals concentrations. For copper, almost all values are between the Lowest Effect Level (LEL) and Probable Effect Level (PEL) shown in Table 5. Only one value is outside of that range (lower in San Ysidro). For lead, all values in Scripps Poway Parkway and San Ysidro are below the LEL. Values in Downtown and Tecolote are mostly between the LEL and PEL. For zinc, all values in Scripps Poway Parkway and one value in San Ysidro are below the LEL. Values in Downtown, Scripps Poway Parkway, and Tecolote are mostly between the LEL and PEL, with a few values in Downtown and Tecolote above the PEL.

Table 5. The Lowest Effect Level (LEL) and Probable Effect Level (PEL) values recommended as screening levels for freshwater sediments (NOAA Screening Quick Reference Tables[a]).

Metals (ppm, dry wt)		
Analyte	**LEL**	**PEL**
Cadmium	0.6	3.53
Copper	16	197
Lead	31	91.3
Zinc	120	315

a: http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf

3.5 Microbiology

Microbiology samples showed patterns that seem to be most dependent on the cleanout period for total and fecal coliform. For fecal coliform, the highest number of coliform units (MPN/g) was consistently during CO2 and the lowest were consistently during CO3 (Figure 26). Numbers during CO1 and CO4 were variable and lower in the Downtown and San Ysidro areas. For total coliform, the highest numbers were again during CO2, but were below detection for three of the four locations during CO4 (Figure 27). For enterococcus, the mixed use areas, Scripps Poway Parkway and Tecolote, usually had higher numbers than Downtown and San Ysidro (Figure 28). The catch basins may provide breeding media for bacteria, allowing greater amounts of bacteria to flow downstream than entered the system in the first place. Bacterial concentrations during the dry season could be quite different than what was observed after intensive rains, which is a consideration when source tracking bacteria.

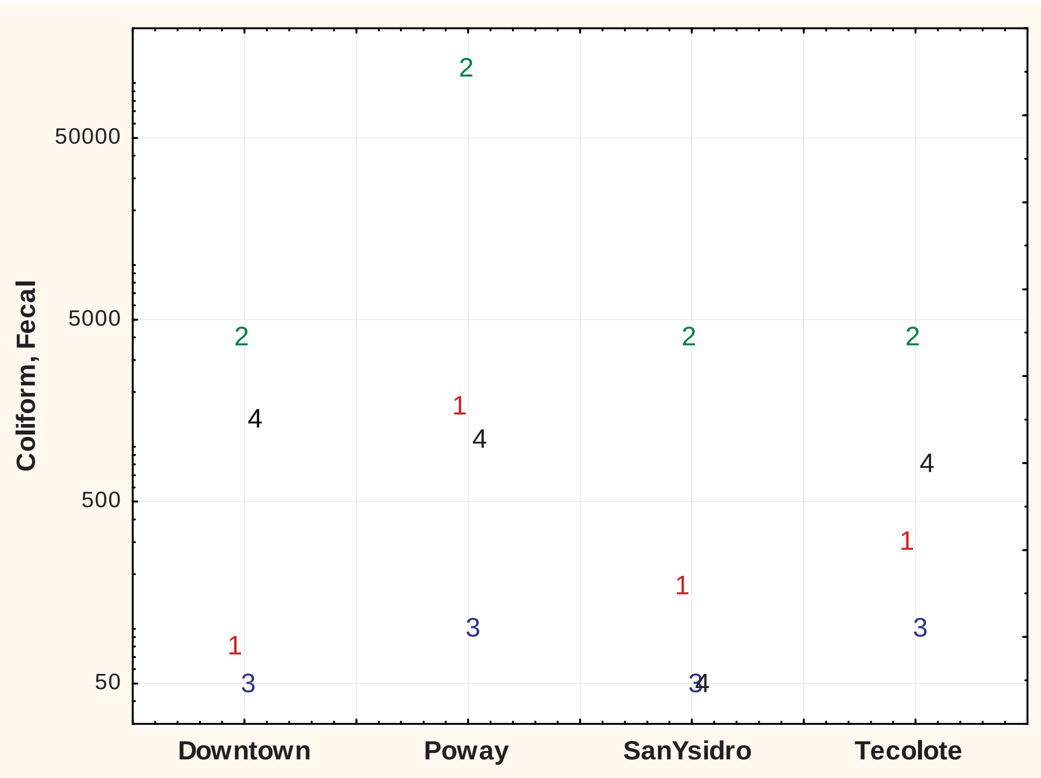

Figure 26. Fecal coliform colonies in each location for each clean-out.

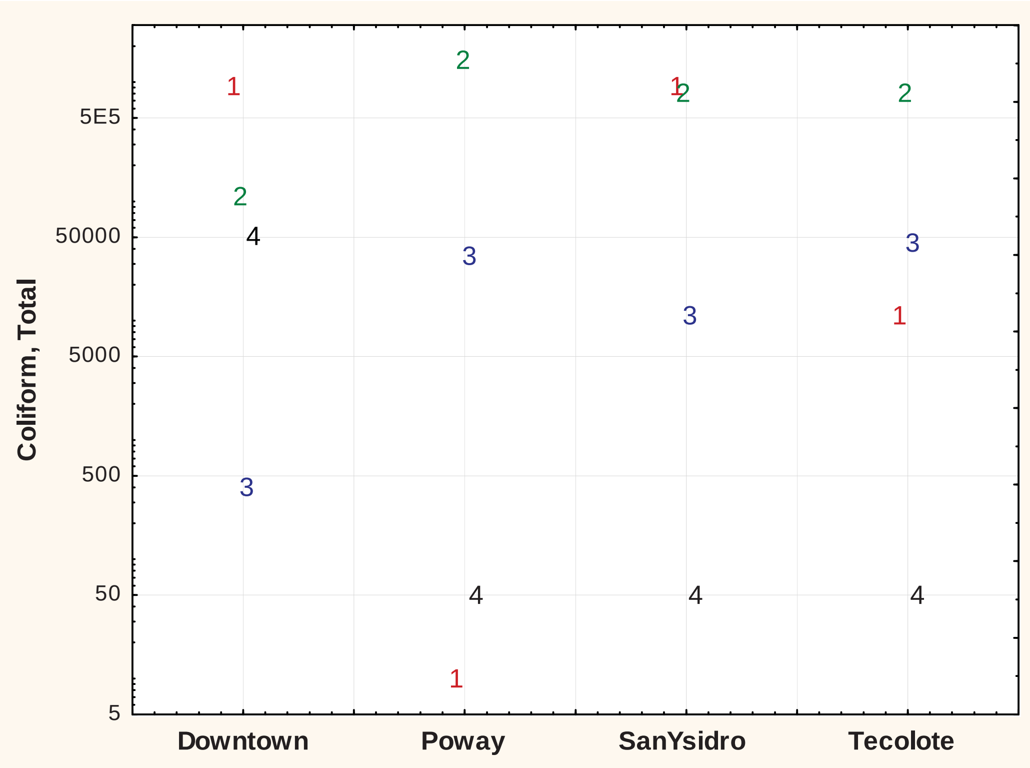

Figure 27. Total coliform colonies in each location for each clean-out.

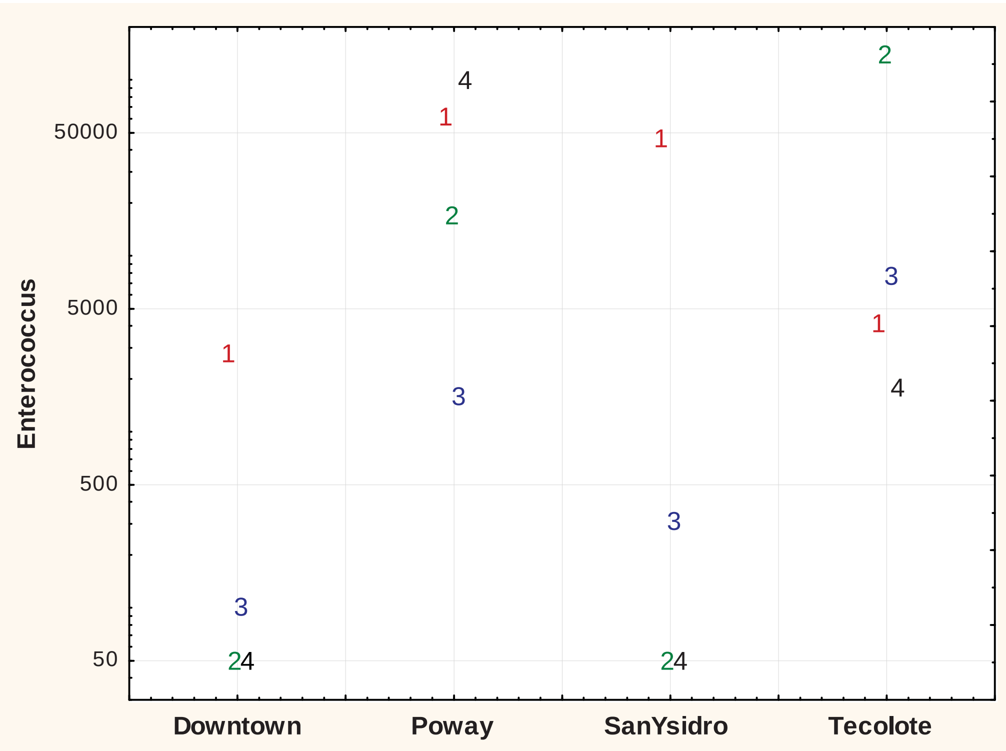

Figure 28. Enterococcus colonies in each location for each clean-out.

Table 6. Bacterial colonies removed in each area and clean-out event, standardized to 30 day accumulation and 10 acre drainage area.

Location	Clean-out	Fecal Coliform (MPN)	Total Coliform (MPN)	Enterococcus (MPN)
Downtown	CB1	3.06E+06	3.44E+10	1.07E+08
	CB2	2.12E+07	5.82E+08	2.65E+05
	CB3	1.15E+07	9.21E+07	2.30E+07
	CB4	2.11E+07	7.54E+08	7.54E+05
	mean	1.42E+07	8.95E+09	3.28E+07
Poway	CB1	1.31E+09	7.72E+06	4.71E+10
	CB2	2.40E+10	3.00E+11	3.40E+09
	CB3	8.97E+07	3.14E+10	1.43E+09
	CB4	4.43E+08	2.01E+07	3.95E+10
	mean	6.46E+09	8.28E+10	2.28E+10
SanYsidro	CB1	1.05E+07	5.57E+10	2.84E+09
	CB2	2.67E+08	5.33E+10	3.33E+06
	CB3	2.48E+06	5.47E+08	1.54E+07
	CB4	3.29E+06	3.29E+06	3.29E+06
	mean	7.07E+07	2.74E+10	7.17E+08
Tecolote	CB1	9.90E+06	3.63E+08	1.35E+08
	CB2	1.13E+08	2.26E+10	3.96E+09
	CB3	1.34E+06	6.03E+08	1.03E+08
	CB4	3.20E+07	2.00E+06	7.19E+07
	mean	3.91E+07	5.90E+09	1.07E+09

3.6 Organic Pollutants

Organic pollutants were of concern in the Downtown area and they were only analyzed in that area. For those pollutants that were analyzed consistently in each cleanout event, the highest detected concentration was commonly in the first sample (CO1) (Table 7). This was especially true for the Benz- compounds, which had much lower or undetected concentrations in subsequent samples. Five compounds had the highest concentrations in CO3 and one was highest in CO2. When the values were highest in CO4, it was because the analyte was not sampled previously.

The timing of the clean-out prior to CO1 in this study may have affected the degree of buildup. The date of the previous cleanout is unknown; if the prior cleanout took place well prior to CO1, then the pollutant apparently built up over that time With regular cleanout, the concentrations mostly diminished to undetectable levels. However, that was not true for Decachlorobiphenyl(Surrogate), Fluorobiphenyl, 2-(Surrogate), Nitrobenzened5(Surrogate), Terphenyl-d14(Surrogate), and Tetrachloro-m-xylene(Surrogate); all of which had their highest concentrations in CO3, which was the shortest period between cleanouts.

It appears that some organic pollutants accumulate over time in the catch basin sediments. Regular cleanouts Downtown may remove organic pollutants, especially Benz- compounds, so that concentrations never accumulate to detectable levels. Other pollutants may be transient; not accumulating in the catch basin sediments, but passing through with storm events or specific sources.

Table 7. Organic analyte concentrations in sediment samples from the Downtown basins in each of four clean-out periods (CO1 – 4).

Analyte	CO1	CO2	CO3	CO4	Units	LEL/PEL[a]
Acenaphthene	*0.36*	*0.34*	*0.75*	*0.05*	mg/Kg	/0.09
Acenaphthylene	*0.25*	*0.235*	*0.5*	*0.05*	mg/Kg	/0.13
Aldrin	*5.5*	*11*	*5.5*	*2.2*	ug/kg dw	2/
Anthracene	**1.5**	*0.37*	*0.8*	*0.05*	mg/Kg	0.22/0.25
Benz(a)anthracene				**0.19**	mg/Kg	0.32/0.39
Benz(a)anthracene-d12(Surrogate)	**2.1**	*0.305*	*0.65*		mg/Kg	
Benzo(a)pyrene	**2.6**	*0.44*	*0.95*	0.3	mg/Kg	0.37/0.78
Benzo(b)fluoranthene	**3.4**	*0.5*	*1.1*	0.4	mg/Kg	
Benzo(e)pyrene				**0.26**	mg/Kg	
Benzo(g,h,i)perylene				**0.32**	mg/Kg	
Benzo(g,h,I)perylene-d12(Surrogate)	**1.9**	*0.27*	*0.6*		mg/Kg	
Benzo(k)fluoranthene	**1.2**	*0.5*	*1.1*	0.19	mg/Kg	0.24/
Biphenyl				*0.05*	mg/Kg	
Chlordane	**130**	*95*	*50*	*19*	ug/kg dw	7/8.9
Chlordane, cis-	*6.5*	*12*	*6.5*	*2.45*	ug/kg dw	
Chlordane, gamma-	*4.9*	*9.5*	*4.9*	*1.9*	ug/kg dw	
Chrysene	**3**	*0.37*	*0.8*	0.25	mg/Kg	340/826
Dacthal				*4.7*	ug/kg dw	
DDD(o,p')				*4.7*	ug/kg dw	
DDD(p,p')	*2.35*	*4.5*	*2.35*	*0.9*	ug/kg dw	8/8.5
DDE(o,p')				*4.7*	ug/kg dw	
DDE(p,p')	*3.75*	*7*	*3.75*	*1.45*	ug/kg dw	5/6.75
DDT(o,p')				*4.7*	ug/kg dw	
DDT(p,p')	*2.7*	*5*	*2.7*	*1.05*	ug/kg dw	8/4.8
Decachlorobiphenyl(Surrogate)	198.5	151.5	**221**	72.95	ug/kg dw	
Dibenz(a,h)anthracene	*0.55*	*0.5*	*1.1*	*0.05*	mg/Kg	0.06/0.14
Dieldrin	*3.65*	*7*	*3.65*	*1.4*	ug/kg dw	2/6.7
Dimethylnaphthalene, 2,6-				*50*	ug/kg dw	
Endosulfan I	*2.8*	*5.5*	*2.8*	*1.05*	ug/kg dw	
Endosulfan II	*1.55*	*3*	*1.55*	*0.6*	ug/kg dw	
Endosulfan sulfate	*2.7*	*5*	*2.7*	*1.05*	ug/kg dw	
Endrin	*6.5*	*12.5*	*6.5*	*2.5*	ug/kg dw	3/62.4

Analyte	CO1	CO2	CO3	CO4	Units	LEL/PEL[a]
Endrin Aldehyde	*3.4*	*6.5*	*3.4*	*1.3*	ug/kg dw	
Endrin Ketone				*0.85*	ug/kg dw	
Fluoranthene	**7**	*0.475*	*1.05*	0.38	mg/Kg	
Fluorene	**1.3**	*0.135*	*0.295*	*0.05*	mg/Kg	0.75/2.4
Fluorobiphenyl, 2-(Surrogate)	1.3	0.586	**1.82**	0.206	mg/Kg	
HCH, alpha	*7*	*13.5*	*7*	*2.75*	ug/kg dw	
HCH, beta	*3.85*	*7.5*	*3.85*	*1.5*	ug/kg dw	
HCH, delta	*2.8*	*5.5*	*2.8*	*1.05*	ug/kg dw	
HCH, gamma	*6.5*	*12.5*	*6.5*	*2.45*	ug/kg dw	
Heptachlor	*6.5*	*12.5*	*6.5*	*2.55*	ug/kg dw	
Heptachlor epoxide	*4.45*	*8.5*	*4.45*	*1.7*	ug/kg dw	
Indeno(1,2,3-c,d)pyrene	**1.9**	*0.75*	*1.65*	0.29	mg/Kg	0.2/
Kepone				*41.5*	ug/Kg dw	
Methoxychlor	*2.7*	*5*	*2.7*	*1.05*	ug/kg dw	
Methylnaphthalene, 1-				*50*	ug/Kg dw	
Methylnaphthalene, 2-				*50*	ug/Kg dw	
Methylphenanthrene, 1-				*50*	ug/Kg dw	
Mirex				*1.45*	ug/Kg dw	7/
Naphthalene	*0.36*	*0.34*	*0.75*	*0.05*	mg/Kg	/0.39
Nitrobenzene-d5(Surrogate)	1.23	0.541	**1.68**	0.2	mg/Kg	
Nonachlor, cis-				*4.7*	ug/kg dw	
Nonachlor, trans-				*4.7*	ug/kg dw	
Oxychlordane				*4.7*	ug/kg dw	
PCB AROCLOR 1016	*405*	*80*	*85*	*32*	ug/kg	
PCB AROCLOR 1221	*700*	*140*	*145*	*55*	ug/kg	
PCB AROCLOR 1232	*500*	*95*	*100*	*39.5*	ug/kg	
PCB AROCLOR 1242	*550*	*110*	*115*	*45*	ug/kg	
PCB AROCLOR 1248	*900*	*175*	*185*	*70*	ug/kg	
PCB AROCLOR 1254	*600*	*120*	*125*	*49*	ug/kg	
PCB AROCLOR 1260	*100*	**70**	44	*8*	ug/kg	60/340
Perylene				*50*	ug/kg dw	
Phenanthrene	**8.1**	*0.55*	*1.2*	0.15	mg/Kg	0.56/0.52
Pyrene	**5**	*0.34*	*0.75*	0.31	mg/Kg	0.49/0.88
Terphenyl-d14(Surrogate)	1.35	0.721	**2.07**	0.169	mg/Kg	
Tetrachloro-m-xylene(Surrogate)	139	179.5	**243.5**	59.35	ug/kg dw	
Toxaphene	**42**	*80*	*42*	*16*	ug/kg dw	

a: Lowest Effect Level (LEL) and Probable Effect Level (PEL) values recommended as screening levels for freshwater sediments (NOAA Screening Quick Reference Tables) http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf

*Values below the minimum detection limit (MDL) were estimated as half the detection limit and shown in italics. The greatest detected value for each analyte is shown in bold type.

The effect levels of organic compounds for sediments in freshwater systems is a scale upon which to judge the severity of the observed organic compound concentrations. Of the 68 compound tested, eight were detected at levels that exceed the screening LEL or PEL (or both). These included Benzo(a)pyrene, Benzo(k)fluoranthene, Chlordane, Fluorene, Indeno(1,2,3-c,d)pyrene, PCB AROCLOR 1260, Phenanthrene, and Pyrene. Several other compounds were not detected above the LEL or PEL or the freshwater effect levels were not readily available.

4 Summary

Results of the monitoring efforts for catch basin cleaning in four areas with different land use patterns, catch basin configurations, and cleaning methods show variations in amounts of materials and concentrations of analytes collected in each area and over time. The observations suggest overarching patterns and provide baseline information for ongoing monitoring and analysis. Because the samples were not sufficiently replicated, it is not possible to attribute statistical significance to any of the observed differences among treatments (area, timing, frequency, method, or catch basin configuration).

4.1 Pollutants

The general patterns observed may be summarized as follows:

Material quantities

- The greatest quantities of materials were removed during the first clean-out (CO1).
- The vactor method in the Scripps Poway Parkway area yielded the most material, but the catch basin configurations or sediment sources may be more influential than the method in determining the amounts of materials cleaned
- Organic materials (leaves, twigs) were most prevalent in the Tecolote area.
- Trash was most prevalent Downtown.
- Medium-sized sand was the most common sediment particle size in all areas.
- With successive clean-outs, larger gravels became less common.

General Chemistry

- Percent solids, pH, and total organic carbon patterns were unremarkable.

Nutrients

- Nutrient concentrations were higher for total N and lower for total P in San Ysidro during most cleanout periods.
- The Downtown area never had the lowest nutrient concentrations.
- It appears that nutrients can accumulate quickly in the catch basins.

Metals

- The highest concentrations of copper, lead, and zinc were observed in the Downtown area, during the first cleanout event.
- The lowest concentrations overall were consistently in the San Ysidro residential area.
- Except for one anomaly in the Tecolote area, metals appear to accumulate linearly over time.
- Cadmium was only tested in the Tecolote area, where it was only detected in the last clean-out event.

Microbiology

- Microbiology patterns were variable, with some patterns possibly associated with clean-out event.
- The patterns may be dependent on unmeasured factors related to sources or incubation in the catch basin.

Organic Pollutants

- Organic pollutants were of concern in the Downtown area and they were only analyzed in that area.

- For certain compounds, the highest detected concentrations were in the first clean-out event.
- It appears that some organic pollutants accumulate over time in the catch basin sediments, while others are more transient.

4.2 Location, Frequency and Timing of Clean-Outs

From these observations and ongoing monitoring, it may be possible to approach catch basin cleaning frequencies and timing by (1) impairment (especially metals and nutrients), (2) likely buildup from erosiveness or pollutant sources in the drainage area, and (3) presence or availability of in-system storage (i.e. catch basin structures with sumps) before the point where the system discharges to the surface water network (i.e. the last catch basin in line, and preferably with a sump). While greater frequency of clean-out would result in greater removal of some pollutants, the costs associated with frequent clean-outs would need to be weighed against the benefits, so that the most practical schedule and method can be recommended for each area, pollutant, climatic period, and catch basin configuration. An assessment of appropriate schedules based on the limited information from this pilot study would be conjecture, though it does provide the basis for continued evaluation especially as data collection is improved.

In establishing the frequency and timing of clean-outs, it does appear that it would be especially valuable to identify the storage capacity of each catch basin network prior to the discharge point to surface waters. The storage capacity of each catch basin network is based on the size of catch basin sumps, and the position of larger sumps relative to the drainage network and discharge to receiving waters. Sites at the bottom of a network without a sump or storage might be noted as opportunities for possible capital improvements to create some storage in the system, especially in watersheds where nutrient, organic and metal pollutants are of greatest concern. As an example of how this information may be used with respect to timing and frequency, in a catch basin network with a sump and ample capacity at the end of the network, the final catch basin may be targeted for more frequent clean-outs, while the upstream inlets could receive periodic inspection and less frequent clean-outs.

4.3 Methods and Costs

As the City uses both its own crews and contracted services to accomplish its catch basin cleaning schedules, the experience with the contracted manual and vactor cleaning crews in this study provides some findings with respect to costs, equipment, and crew size required to accomplish the various clean-outs, and on the applicability of each cleaning approach in different settings.

Based on quantities of materials removed in the Scripps Poway Parkway area, it appears that the vactor method would be most efficient where there is a sizable sump and especially where standing water in the system is typical (Figure 29, left photo). Manual cleaning appears to be warranted where there are no sumps and where background conditions generally are dry (Figure 29, right photo). Only the manual method allows quantifying materials removed per inlet, which could be an issue for future monitoring designs. In addition, disposal of removed materials is easier with the manual method because materials are easier to unload at the dump compared to unloading an entire vactor truck.

Based on the proposals sought from vactor cleaning contractors and manual cleaning contractors, it appears (from this limited sample) that on a per- catch basin basis, manual cleaning services are the least costly ($35 per catch basin inlet for this study) and vactor crew costs, as may be expected, are higher ($50 per catch basin inlet for this study). Proposed costs for contracted vactor services differed widely among the contractors who were contacted for this study, with costs ranging from $50 to $125 per catch basin inlet cleaned. In each case, the proposed cost per inlet included crew time (two persons), comparable equipment (a vactor truck and jet cleaning), and material disposal (provided no sanitary or hazardous waste was detected by the crew during the cleaning).

A significant cost variable in the proposals received related to traffic control. One vactor contractor submitting a bid intended to charge for traffic control (approximately $2000 for an initial traffic control plan and approximately $2250 per site per cleanout for traffic safety and control), while others (including Downstream Services, which was selected) did not propose to charge for additional traffic control costs. Downstream Services reported that by following the procedures in the California Manual on Uniform Traffic Control Devices for Streets and Highways (FHWA's MUTCD 2003 Edition including Revisions 1 and 2, as amended for use in California; Caltrans 2010) for brief procedures of under 15 minutes per inlet, and by performing the Downtown and Scripps Poway Parkway clean-outs during the very early morning hours of 3 AM to 5 AM when traffic is lightest, they are able to include traffic control in their per catch basin inlet cost rather than adding a supplemental charge (Kimberly Carr, personal communication, June 6, 2012). The manual cleaning crew selected likewise did not propose a supplemental charge for traffic control. It appears that for contracted services, this is an important cost and logistical issue to review with potential contractors.

Figure 29. Catch basin interiors, showing deep and shallow sumps in Tecolote and San Ysidro.

5 References

Amec (Mactec). 2011. Quality Assurance Project Plan for the Catch Basin Inlet Cleaning Pilot Study. Prepared for the City of San Diego.

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Carr, Kimberly. Personal Communication with Juli Beth Hinds, Tetra Tech. Inc., regarding traffic control costs and procedures for cost estimating. June 6, 2012.

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Catch Basin Inlet Cleaning Pilot Study Monitoring Plan

November 2011

City of San Diego

think BLUE
San Diego

Prepared by:
AMEC E&I, Inc.
Project No. 5013-11-0023

IMPORTANT NOTICE

This report was prepared exclusively for the City of San Diego by AMEC E&I, Inc. (AMEC). The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

CONTENTS

TABLES

FIGURES

APPENDICES

1.0 PROJECT DESCRIPTION, ORGANIZATION, AND RESPONSIBILITIES

1.1 PURPOSE

The purpose of the Catch Basin Inlet Cleaning Pilot Study is to evaluate the potential pollutant removal efficiency and cost-effectiveness of San Diego's catch basin cleaning efforts. This pilot study will help develop a standardized system for future cleanings of catch basins within the City of San Diego (City). The City's catch basin inlet system has the potential to play a significant role within each hydrologic area as a Best Management Practice (BMP) to protect downstream water sources from potential pollutants-of-concern (POCs). The catch basin inlet system may serve as a BMP by capturing trash, soil, and organic debris and allowing them to settle as flow passes through each individual catch basin. Common hydrologic characteristics such as land use, soil type, and known historical pollutants provide background information on the performance of any catch basin inlet system.

The main objectives of this pilot study are to: (1) improve field logs of maintenance activities and catch basin debris removal, (2) compile all existing records into a GIS database, (3) evaluate the quality and quantity of catch basin debris collected, and (4) evaluate the efficiency and effectiveness of different clean-out methods.

This Monitoring Plan will detail the methods for collecting samples to help evaluate the quality and quantity of catch basin debris removal from four different catch basin inlet systems within the City. The other three objectives of this pilot study will be addressed separately by Tetra Tech. The catch basin inlet systems are located within the hydrologic areas of Poway, Tecolote, San Ysidro, and Lindbergh/Downtown. Two different clean-out methods, manual and vacuum cleaning, will be utilized to remove the catch basin debris.

1.2 DESCRIPTION OF CATCH BASIN INLET SYSTEMS

The four catch basin inlet systems to be evaluated in this study are located within four different hydrologic areas (Poway, Tecolote, San Ysidro, and Lindbergh/Downtown) of the City. These systems have been selected to assess their overall catch basin debris removal performance and they represent typical examples of specific land use categories. Table 1-1 presents the catch basin inlet systems of interest, the locations of the downstream inlets of each system, the number of storm drains to be cleaned out, and the corresponding method of debris removal that will be used. Figure 1-1 shows the locations of the end point of each catch basin inlet system within the City.

Table 1-1: Catch Basin Inlet Systems

Catch Basin Inlet System	End Point of System		Number of Storm Drains	Method of Debris Removal
	Street Intersection	Geographical Coordinates		
Poway Hydrologic Area	Scripps Poway Parkway and Scripps Drive	32º56’05.48” N, 117º05’20.24” W	29	Vactor
Tecolote Hydrologic Area	Armstrong Street and Mesa College Drive	32º48’11.03” N, 117º09’48.36” W	8	Manual
San Ysidro Hydrologic Area	Anella Road and Sipes Lane	32º32’45.03” N, 117º03’00.50” W	25	Manual
Lindbergh/Downtown Hydrologic Area	Ash and Front Streets	32º43’11.60” N, 117º90’53.19” W	8	Vactor

Figure 1-1: Catch Basin Systems Location

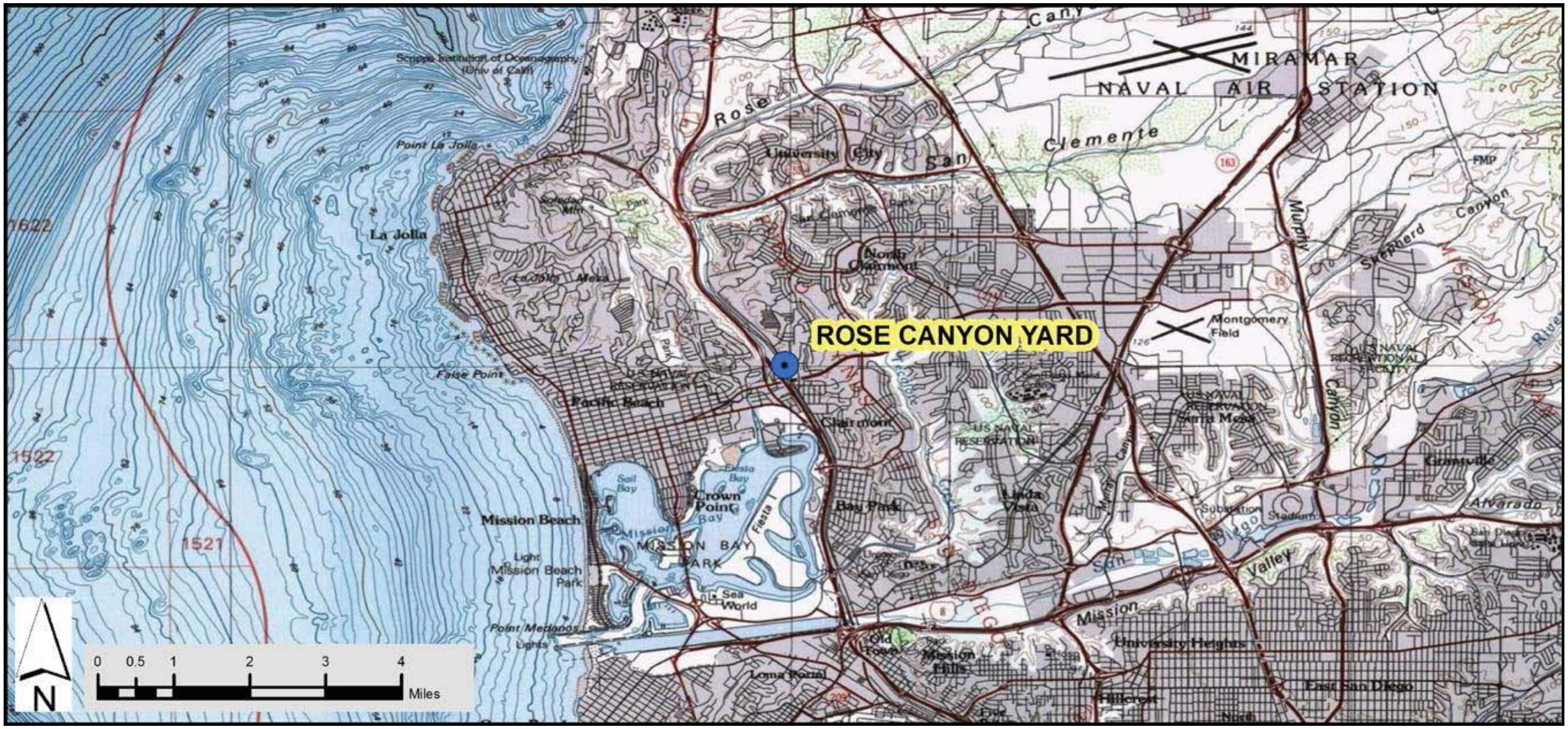
1.3 MONITORING ACTIVITIES

Monitoring activities will occur during the 2011-2012 wet season, starting on October 1, 2011, and will continue through May 2012. This monitoring program will be comprised of catch basin debris removal and characterization. Catch basin debris removal will occur at the four different hydrologic areas (Table 1-1) after two significant storm events during the wet season and one event late in the wet season to allow for greater buildup of material. Each catch basin inlet system will have one method of debris removal. The debris removal methods are: (1) manual and (2) vacuum cleaning with a vactor truck. The manual debris removal method will be performed by Ron's Maintenance, while the vactor debris removal method will be performed by Downstream Services, Inc. (Downstream).

Catch basin debris will be transported to and deposited at the Rose Canyon Operations Yard (Rose Canyon). AMEC staff will be available to observe that the catch basin debris is properly placed into the primary containment unit on site, where the debris will be allowed to dry prior to sampling. Catch basin debris will be taken to Rose Canyon, located at 3775 Morena Blvd, San Diego, CA 92117. Figure 1-2 shows a general vicinity map of Rose Canyon.

Once the catch basin debris has dried, a full characterization of the debris will be performed. The characterization will consist of: (1) volume and weight determination, along with visual observation of the debris content; and (2) collection of sub-samples to generate a composite sample. The characterization of the catch basin debris will be documented through field forms and pictures. A composite sample will be collected and sent to a laboratory for analytical analysis. Analytical results will provide a better understanding of the potential POCs within each hydrologic area.

Figure 1-2: Rose Canyon Operations Yard Location



1.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

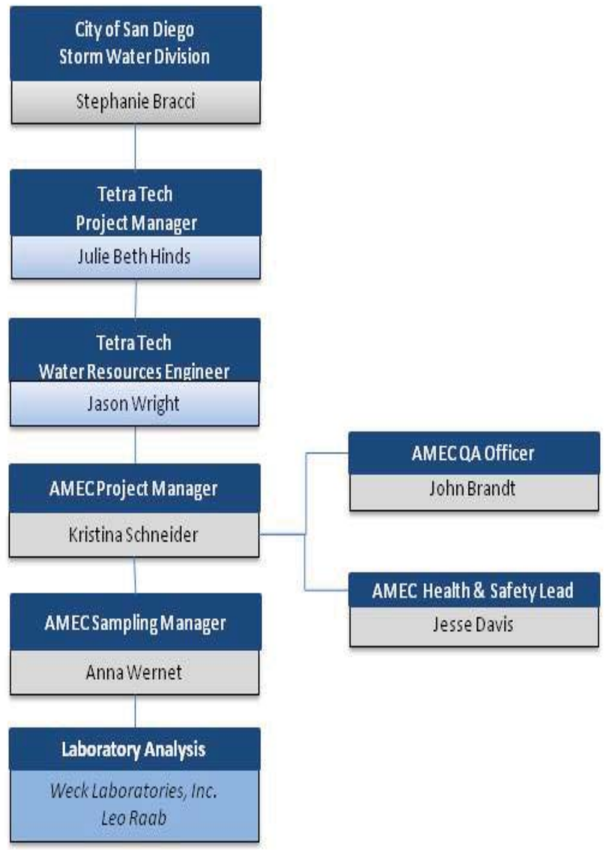
The City of San Diego is the municipal government overseeing this study. Stephanie Bracci, an Associate Planner from the Storm Water Division, will have the responsibility for program oversight.

The Tetra Tech Project Team will be comprised of personnel from Tetra Tech and AMEC E&I, Inc. (AMEC). The Tetra Tech Project Team organization is summarized on Figure 1-3. Tetra Tech will be responsible for the oversight of the project and the reporting of results. Julie Beth Hinds is the Project Manager and will be responsible for managing the contract. Jason Wright is the Water Resources Engineer and will be the technical lead. AMEC will be responsible for the development and implementation of the monitoring program.

AMEC will coordinate sample collection, laboratory analysis, data management, data analysis, and reporting. Kristina Schneider is the AMEC Project Manager and will be responsible for project coordination, scheduling, budget management, and oversight of project plans and deliverables. Anna Wernet is the AMEC Sampling Manager and will be responsible for developing the monitoring approach, preparing and implementing the monitoring activities, coordination with the laboratories, and for developing and maintaining project data. John Brandt is the AMEC Quality Assurance Officer and will be responsible for the project quality assurance and quality control procedures implemented during sampling, laboratory analysis, data management, and data analysis. Jesse Davis is the AMEC Health and Safety Officer and will be responsible for overseeing the Health and Safety Plan and its practices.

Weck Laboratories, located in the City of Industry, California, will be responsible for the analysis of sediment samples. Leo Raab is the Weck Laboratories Manager. He will ensure that samples are analyzed in accordance with the methods and quality assurance requirements outlined in this Monitoring Plan.

Figure 1-3: Project Team Organization

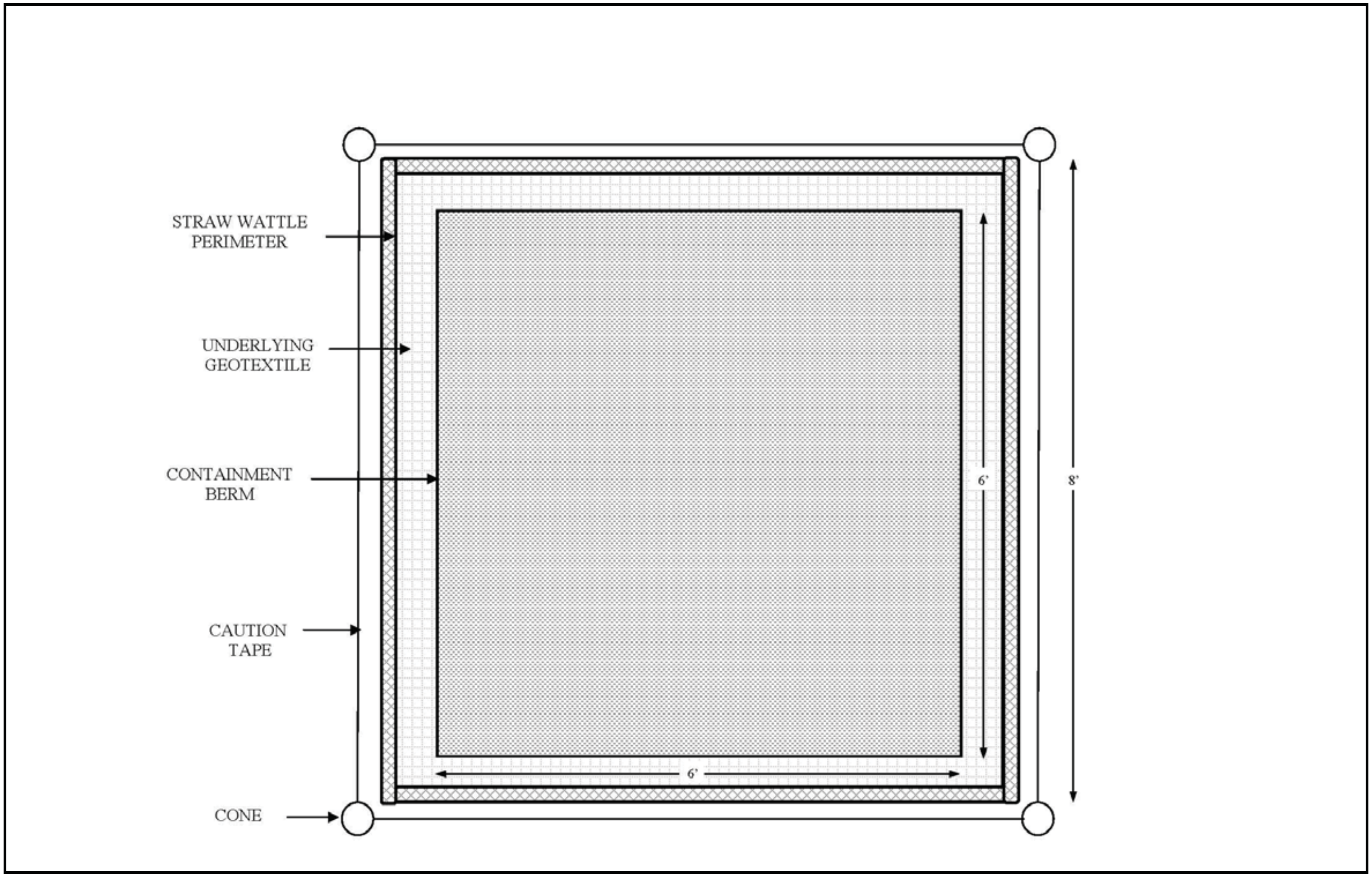


2.0 DESCRIPTION OF OPERATIONS YARD

Material collected from each catch basin inlet system, via manual or vactor method, will be transported to and deposited at the Rose Canyon Operations Yard located at 3775 Morena Boulevard, San Diego, CA 92117. This Operations Yard was selected as the sample storage site since security gates will be closed during non-operational hours. All containment berms will be placed in an area that will not interfere with other daily activities performed on site.

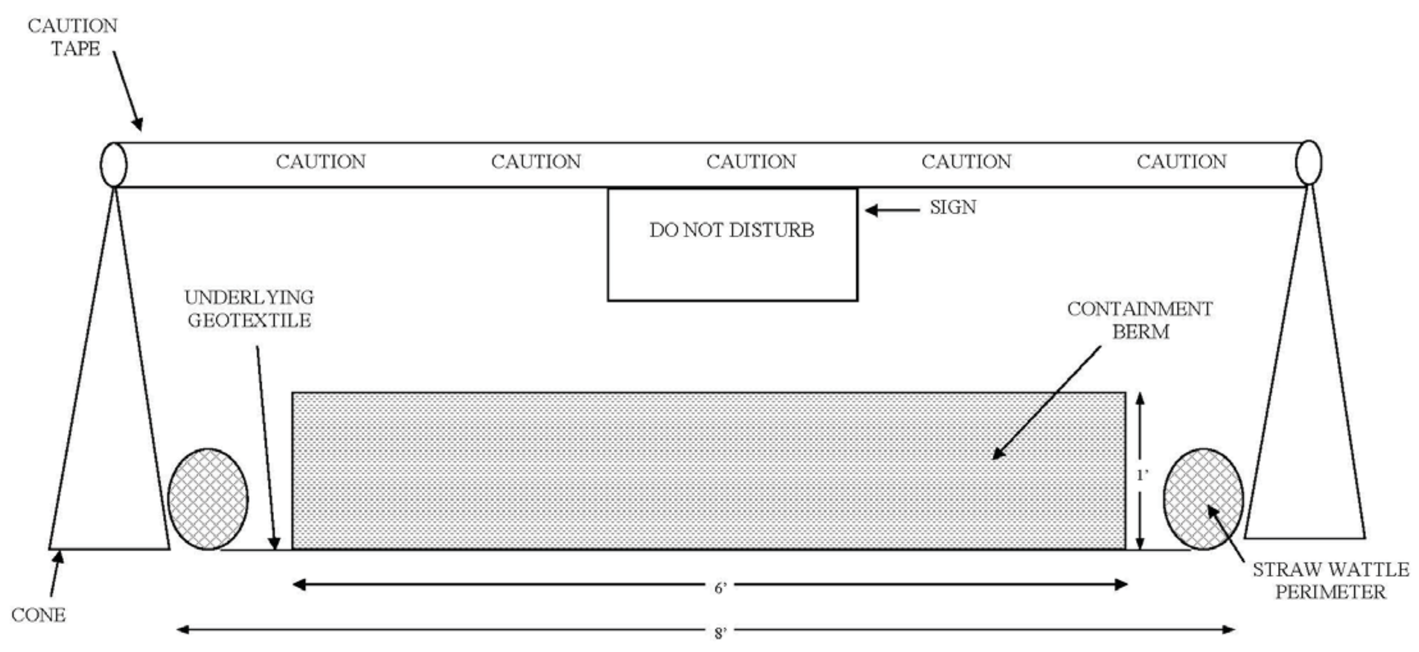
Each containment berm system will include a primary and secondary containment unit. These units will utilize the following materials: containment berm, ground mats, underlying geotextile, straw wattle perimeter, caution tape, cones, and signs. A schematic plan and profile view of the containment berm system is shown in Figures 2-1 and 2-2. Prior to deploying the containment berms, selected installation areas will be manually swept to remove any rocks or debris that could potentially cause a tear or puncture the containment material.

Figure 2-1: Schematic Plan View of Containment Berm Setup at Operations Yard



Schematic not to scale

Figure 2-2: Schematic Profile View of Containment Berm Setup at Operations Yard



Schematic not to scale

Once the area has been cleaned, straw wattles will be positioned, without staking, to form an 8-foot by 8-foot secondary retention area. A 12-foot by 12-foot polyethylene geotextile material will be placed over the straw wattles. The edges of this geotextile material will be tucked and rolled underneath each straw wattle. Wooden stakes will be driven partially through each straw wattle, placed at a distance of three to five feet apart, to form a secondary containment unit. Gravel bags will be placed on the perimeter to make sure that the secondary containment unit remains in place. Detailed specification sheets for the straw wattles are provided in Appendix A.

With the secondary containment unit in place, the ground mat to the primary containment unit will be put in place. This ground mat is made out of 61-inch, 22-oz Vinyl Tex PVC Coated Polyester and will provide additional puncture protection to the containment unit. The primary containment unit, better known as a "Snap-Up Berm", is commonly used as a standalone secondary containment unit. Figure 2-3 shows a picture of an empty Snap-Up Berm. The Snap-Up Berm containment walls are made of CoolGuard ® HRL36 and are designed with snap-up supports that help retain all liquid and debris within the unit. A detailed specification sheet for the ground mat and Snap-Up Berms are provided in Appendix A.

Figure 2-3: Empty Snap-Up Berm

Source: S&G Environmental

In addition, four cones, caution tape, and signs will be placed around the perimeter of the containment berms to limit disturbance. Signs will provide contact information if there are questions regarding the project. All catch basin debris will be stored within the primary containment unit and will be covered at the end of each business day to avoid the release of any catch basin debris.

3.0 ANALYSES

This monitoring study will conduct analysis to characterize the quality and quantity of the extracted catch basin debris from each of the four catch basin inlet systems located within the Poway, Tecolote, San Ysidro, and Lindbergh/Downtown hydrologic areas.

All catch basin debris samples will be analyzed for general chemistry, metals, nutrients, organics, and microbiological constituents. Table 3-1 presents the list of analytical constituents, methods, method detection limits (MDLs), and target reporting limits (RLs). These constituents are the target POCs for the Catch Basin Inlet Cleaning Pilot Study.

Table 3-1: Analytical Parameters and Methods – Catch Basin Debris

Analytical Parameter	Method	MDL	RL	Units
General Chemistry				
Percent Solids	EPA 160.3 M	--	0.100	% by weight
pH	EPA 9045C			
Particle Size Distribution	ASTM D422/4464	--	--	% by weight
Metals				
Total Cadmium (Tecolote Only)	EPA 6020	0.20	0.20	mg/kg
Total Copper	EPA 6020	0.29	0.50	mg/kg
Total Lead	EPA 6020	0.21	0.50	mg/kg
Total Zinc	EPA 6020	2.3	5.0	mg/kg
Nutrients				
Total Phosphorus as P	EPA 365.3 M	0.070	2.5	mg/kg
Total Nitrogen	By calculation (TKN EPA 351.2 and Nitrite + Nitrate EPA 353.2)	0.33	1.0	mg/kg
Organics				
Total Organic Carbon	SM 5310C		30.0	mg/kg
Organochlorine Pesticides (Lindbergh Only)	EPA 8081A	See note (a)	See note (a)	mg/kg
Polynuclear Aromatics-SIM (Lindbergh Only)	EPA 8270C-SIM	See note (a)	See note (a)	mg/kg
Polychlorinated Biphenyls (Lindbergh Only)	EPA 8082	See note (a)	See note (a)	mg/kg
Microbiology				
Total Coliform – 3 Dilutions	SM 9221B/E Modified	2.0	2.0	MPN/100mL
Fecal Coliform – 3 Dilutions	SM 9221B/E Modified	2.0	2.0	MPN/100mL
Enterococcus	SM 9230B Modified	1.0	1.0	MPN/100mL

(a) An extended list of all constituents associated with Organochlorine Pesticides, Polynuclear Aromatics-SIM, and Polychlorinated Biphenyls is presented in Appendix B.

4.0 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative statements that define project objectives and specify the acceptable ranges of laboratory performance. Numerical DQOs for the constituents being analyzed are listed in Table 4-1.

4.1 COMPOSITE SAMPLES REPRESENTATIVENESS

A catch basin debris composite sample will consist of a mixture of sub-samples collected from the study area of interest. The representativeness of any catch basin debris composite sample is dependent upon many factors, but is most heavily dependent upon: (1) the equivalent volume collected from each sub-sample, and (2) homogenized samples that effectively represent collected sub-samples.

4.2 REPORTING LIMITS, ACCURACY, PRECISION, AND COMPLETENESS

Analytical method numerical DQOs for constituent reporting limits, accuracy, precision, and completeness are summarized in Table 4-1.

Table 4-1: Data Quality Objectives

Analytical Parameter	RL	Units	Accuracy (Recovery)	Precision (% RPD)	Completeness	Hold Time
General Chemistry						
Percent Solids	0.100	% by weight	--	20	90%	7 days
pH	0.01	pH units	--	--	90%	
Particle Size Distribution	--	% by weight	--	--	90%	180 days
Metals						
Total Cadmium (Tecolote Only)	0.20	mg/kg	87-115	20	90%	180 days
Total Copper	0.50	mg/kg	62-135	20	90%	180 days
Total Lead	0.50	mg/kg	85-114	20	90%	180 days
Total Zinc	5.0	mg/kg	--	--	90%	180 days
Nutrients						
Total Phosphorus as P	2.5	mg/kg	70-130	20	90%	28 days
Total Nitrogen	1.0	mg/kg	90-110	20	90%	28 days
Organics						
Total Organic Carbon	30.0	mg/kg	--	--	90%	28 days
Organochlorine Pesticides (Lindbergh Only)*	2.5	mg/kg	See note (a)	See note (a)	90%	14 days
Polynuclear Aromatics-SIM (Lindbergh Only)*	0.025	mg/kg	See note (a)	See note (a)	90%	14 days
Polychlorinated Biphenyls (Lindbergh Only)*	50	mg/kg	See note (a)	See note (a)	90%	14 days
Microbiology						
Total Coliform – 3 Dilutions	2.0	MPN/100Ml	--	--	90%	8 hours
Fecal Coliform – 3 Dilutions	2.0	MPN/100Ml	--	--	90%	8 hours
Enterococcus	1.0	MPN/100Ml	--	--	90%	8 hours

(a) An extended list of all constituents associated with Organochlorine Pesticides, Polynuclear Aromatics-SIM, and Polychlorinated Biphenyls is presented in Appendix B.

5.0 PREPARATION AND LOGISTICS

5.1 MOBILIZATION AND STAFFING

Monitoring for catch basin inlet systems requires planning prior to actual sampling. Each catch basin inlet system sampling event will require extensive coordination between the City of San Diego Storm Water Division, maintenance crews (Downstream and Ron's Maintenance), Tetra Tech, and AMEC.

Catch basin inlet system sampling events will not be scheduled during or near certain holidays if either the mobilization or the laboratory analysis is projected to continue through that holiday. This includes the following holidays and dates:

- Thanksgiving: November 24 and 25, 2011
- Christmas: December 24 and 25, 2011
- New Year's: December 31, 2011, and January 1, 2012

Couriers may be needed to deliver bacteria samples to the analytical laboratory in order to meet the short holding times for those analyses.

5.1.1 Communication Channels

The City of San Diego Storm Water Division will coordinate first with Tetra Tech and AMEC to determine a schedule to clean out each catch basin inlet system. Once dates have been scheduled, the City of San Diego will direct maintenance crews to perform clean outs at the locations of catch basin systems provided by Tetra Tech. Tetra Tech personnel will accompany maintenance crews for the initial catch basin debris clean out activities. AMEC personnel will be present at the Rose Canyon Operations Yard to receive all catch basin debris collected.

Communication channels will be established between Tetra Tech, AMEC, the City of San Diego, maintenance crews, and Weck Laboratories for appropriate communication before and during each event. To aid in communication, the project field notebook will include a phone list with work numbers of the maintenance crews, the City of San Diego, AMEC personnel, and Weck Laboratories.

5.1.2 Equipment Mobilization

Equipment needed for catch basin debris sampling includes: sampling equipment and containers, personal protective equipment (PPE), field kits, and vehicles equipped with mobile communication and safety equipment (See Table 5-1). The necessary equipment should be inspected and loaded into an appropriate vehicle a day prior to the sampling event. During the monitoring season, field crews will utilize the safety equipment, PPE, and other site maintenance equipment listed below.

Table 5-1: Field Kit Equipment and Mobilization List

Field Kit Equipment List	Mobilization List
Maps	Field notebook (including JHA and Tailgate Safety Meeting Forms)
Spare sample labels	Paper towels
Pencils and indelible markers	Spare sample labels
Cable ties (assorted sizes)	Sample control paperwork
Utility knife	Extra-fine indelible markers
Ziploc baggies (assorted sizes)	Grab sample bottles
Packing Tape	Cellular phone
Nitrile gloves	Personal gear
Keys (if necessary)	Digital or disposable camera
Scale for sediment and debris analysis	Necessary safety gear (see Appendix C - Health and Safety Plan)
Buckets	Disposable mixing dishes
Plastic Trash bags	Alconox
Shovel	DI Water
Mixing spoons	

5.2 OPERATIONS YARD PREPARATION

Prior to beginning sampling, all containment berms at Rose Canyon will be installed on site. Site preparations will include transporting containment units, installation of appropriate tarps and ground mats where necessary, and setting up secondary containment around the primary units. Detailed containment berm installation is described in Section 2.0.

5.2.1 General Inspection

The general functionality of the surrounding site will be inspected. Each primary and secondary containment unit should be visually inspected for any punctures, cracks, or tears of the geotextile fabrics. Additionally, any remaining catch basin debris within the primary containment unit should be manually removed.

5.2.2 Iced Sample Bottles

Prior to initiating a sampling event, ice will be placed in coolers and maintained on site. All bacteria sample bottles will be iced prior to the sampling event and will be kept in separate coolers from each other. As samples are collected, these will be placed on sufficient ice to maintain a constant sample temperature of six degrees Celsius or less.

5.2.3 Documentation

Each time a catch basin inlet system is visited a record of the visit will be made. The field data log sheets in Appendix D are a guide for the exact data that needs to be recorded during every field visit.

The following general information should be entered during each catch basin inlet system visit:

- Alphanumeric Site ID
- Date
- Time
- Monitoring Program
- Field Team
- Field Measurements
- Weather Conditions
- Equipment Condition
- Miscellaneous Comments

5.2.4 Training

Field personnel will be properly trained in the use of the monitoring equipment and clean sample handling techniques, along with all appropriate health and safety protocols (Appendix C). Specifically, the following elements will be included in the training of all field personnel:

- Review of Health and Safety Plan
- Field equipment training

Each field team member will review the Health and Safety Plan and consult with the Sampling Manager if they have any questions before mobilization. The Sampling Manager will train field personnel in sampling protocols and procedures in accordance with the Monitoring Plan.

6.0 SAMPLING, LABORATORY PREPARATION, AND ANALYTICAL METHODS

6.1 CATCH BASIN DEBRIS REMOVAL

Catch basin debris will be removed by either Ron's Maintenance or Downstream crews. Tetra Tech will provide maps and catch basin identifiers to the crews to direct removal teams to the appropriate locations. It is expected that Tetra Tech personnel will accompany removal teams during the first clean out event before the beginning of the wet season.

Ron's Maintenance removal teams will use a manual method to remove catch basin debris. The manual cleaning method is performed by bailing the water from the catch basin and using a shovel or other hand tool to remove the accumulated solids. Downstream removal teams will utilize a vactor truck to remove the catch basin debris. Vacuum cleaning uses an air blower to generate negative pressures that draw the waste material in. The air is allowed to release to the atmosphere while the waste solids and storm water are captured. Large debris will typically pass through a vacuum cleaning unit. (Lager et al. 1977)

The collected catch basin debris will then be transported to the Rose Canyon Operations Yard for sample processing.

6.2 CATCH BASIN DEBRIS SAMPLING AND ANALYSIS

AMEC personnel will be on site to direct crews on the placement of the catch basin debris into the appropriate containers for sample processing, and to ensure that the debris is evenly distributed into the primary containment unit. Catch basin debris will be placed within the primary containment unit of the containment berm, which will store the catch basin debris as the sediment dries. The goal is to collect a dry weight catch basin debris sample, which may require a one- to two-week drying period depending on the moisture content of the collected catch basin debris. The primary containment unit will be covered by a tarp and marked with required signage to prevent tampering with the sample as it dries.

After the appropriate drying period, staff will inspect the deposited catch basin debris to determine if it is dry enough to be processed. Moisture content of catch basin debris must be less than or equal to 25 percent in order to collect and process samples for analysis. A ball squeeze test will be performed to determine the moisture content of the debris. This test will be subject to the best professional judgment of field personnel. Field staff will take a handful of debris, squeeze it tightly with one hand, and use Table 6-1 to interpret observed debris conditions to determine initial debris moisture content (Miles, et al. 1998). Field crews will also take photographs of squeezed debris to document the test. This will be done with handfuls from four locations throughout the containment unit to ensure that samples are drying evenly. If the initial moisture content is greater than 25 percent, the catch basin debris will need to continue to air dry. This process may take an additional one to two weeks.

Table 6-1: Soil Moisture Interpretation Chart

Soil Moisture Deficiency	Moderately Coarse Texture	Medium Texture	Fine and Very Fine Texture
0% (field capacity)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.		
0-25%	Forms weak ball, breaks easily when bounced in hand.[a]	Forms ball, very pliable, slicks readily.[a]	Easily ribbons out between thumb forefinger.[a]
25-50%	Will form ball, but falls apart when bounced in hand.[a]	Forms ball, slicks under pressure.[a]	Forms ball, will ribbon out between thumb and forefinger.[a]
50-75%	Appears dry, will not form ball with pressure.[a]	Crumbly, holds together from pressure.[a]	Somewhat pliable, will ball under pressure.[a]
75-100%	Dry, loose, flows through fingers.	Powdery, crumbles easily.	Hard, difficult to break into powder.

(a)Squeeze a handful of soil firmly to make ball test.
Source: Miles, D.L. and Broner,I. 1998. Estimating Soil Moisture. Irrigation Colorado State University Extension.no.4.700

After determining that the catch basin debris is dry enough for sampling, field crews will process and sample the debris. Field crews will first determine the sub-sample locations for the composite catch basin debris sample. Once the sample locations are determined, visual observations will be recorded, the volume of debris removed will be estimated, the composite sample will be compiled, and then the mass of the material will be measured. For each catch basin inlet system sampling event, the procedures for the sampling and analysis will be as detailed below. All observations will be recorded on the Catch Basin Debris Data Sheet provided in Appendix D.

1. Clean all sampling equipment (i.e., spoons, scoops, cores, plastic dishes, and buckets) prior to sampling using a standard three-step cleaning process with Alconox and de-ionized water. Repeat this procedure between sampling of different catch basin inlet systems to prevent cross-contamination.
2. Ensure that debris is evenly distributed within primary containment unit.
3. Determine composite sampling location by stratified random approach. The procedure for this approach is as follows:
   - Divide each containment unit into four quadrants.
   - Divide each quadrant into a grid that has 16 sub-sample cells by splitting the quadrant into half lengthwise and 8 cells vertically as shown in Figure 6-1.

- Each sub-sample cell will be given a number based on the quadrant.
  - Quadrant I Values = 1 – 16
  - Quadrant II Values = 17 – 32
  - Quadrant III Values = 33 – 48
  - Quadrant IV Values = 49 – 64
- Eight sub-samples will be taken during each sample event to create the composite samples.
- The random function within Microsoft Excel will be used to determine the sub-sample locations to be taken during each sample event before going to the field. For example, after running the random function the following were determined: 4, 14, 18, 36, 48, 51, 56, and 61. Figure 6-1 shows a schematic of the selected sub-sample locations within the four quadrants.

4. Before the sub-samples are taken, visually characterize the composition of the catch basin debris within each quadrant. Record percent of sediment, trash, and organic matter observed. Take pictures of each quadrant and the full containment unit. A minimum of eight (8) pictures is required.
5. Estimate volume of catch basin debris by taking depth, width, and length measurements within each quadrant.
6. Collect sub-samples for the composite sample. It is important that the sub-samples are of equal volume.
   - Depending on the depth of debris a stainless steel core, scoop, or spoon will be used to ensure that equal volume sub-samples are taken.
   - Place sub-samples in a pre-cleaned plastic dish.
   - Take pictures of sub-samples per quadrant before compositing.
   - Place sub-samples in a larger disposable dish and mix to make one composite sample.
   - Take a final picture of composited sample.
   - Weigh the composited sample and record.
   - Fill samples bottles provided by the laboratory with composited catch basin debris and place the sample bottles on ice.
7. Determine total catch basin debris weight by weighing the remaining catch basin debris by quadrant. Use a pre-cleaned, weighed, and labeled five-gallon bucket to collect debris. Weigh bucket with debris and record on field forms. Determine the total weight of the debris collected.
8. Properly dispose of all catch basin debris.

Figure 6-1: Containment Unit Quadrants and Sub-Sample Locations

Quadrant I		Quadrant II	
1	**9**	**17**	**25**
2	**10**	**18**	**26**
3	**11**	**19**	**27**
4	**12**	**20**	**28**
5	**13**	**21**	**29**
6	**14**	**22**	**30**
7	**15**	**23**	**31**
8	**16**	**24**	**32**
Quadrant III		Quadrant IV	
33	**41**	**49**	**57**
34	**42**	**50**	**58**
35	**43**	**51**	**59**
36	**44**	**52**	**60**
37	**45**	**53**	**61**
38	**46**	**54**	**62**
39	**47**	**55**	**63**
40	**48**	**56**	**64**

6.3 LABORATORY SELECTION

Weck Laboratories, Inc., located in City of Industry, California, will be providing laboratory services for this project, including analytical testing for all constituents:

Weck Laboratories, Inc.
14859 East Clark Avenue
City of Industry, CA 91745
Phone: (626)336-2139
Fax: (626) 336-2634

6.4 HOLDING TIMES, SAMPLE VOLUMES, AND PRESERVATION REQUIREMENTS

All sample containers and preservation methods have been confirmed with the laboratory and are presented in Table 6-2. The laboratory will provide appropriate sample containers and preservatives for the microbiology grab samples.

Chains-of-Custody (COCs) will be pre-printed along with the bottle labels. The COCs will contain the same data as the labels, and will be completed in the field with dates, times, and sample team names. COCs will be cross-checked with the bottle labels to make sure they match.

When the complete composite sample has been collected, the label will be filled out, and the bottles will be immediately placed on ice in a cooler for transportation to the laboratory. The start of the holding time, for all samples, is considered to be the time that the last sub-sample was collected. Microbiology has a hold time requirement of eight (8) hours, which allows for six (6) hours between time of collection and delivery to the laboratory, and two (2) hours for laboratory processing. This will require close coordination between the laboratory and AMEC to make sure microbiology tests are started within holding times.

Transport of the samples will be coordinated by the Sampling Manager to make sure samples are processed and analyzed within the proper holding times. The COCs will be reviewed by personnel at the receiving laboratory to verify that all samples are accounted for and received within the holding times.

Table 6-2: Holding Times, Sample Volumes, Containers, and Preservation Recommendations

Analytical Parameter	Method	Container Type	Preservation	Holding Time(a)	Amount Needed
General Chemistry					
Percent Solids	EPA 160.3 M	4 oz. Jar	Unpreserved	7 days	100 g
pH	EPA 9045C				
Particle Size Distribution	ASTM D422/4464	4 oz. Jar	Unpreserved	180 days	100 g
Metals					
Total Cadmium (Tecolote Only)	EPA 6020	4 oz. Jar	Unpreserved	180 days	300 g
Total Copper	EPA 6020	4 oz. Jar	Unpreserved	180 days	100 g
Total Lead	EPA 6020	4 oz. Jar	Unpreserved	180 days	100 g
Total Zinc	EPA 6020	4 oz. Jar	Unpreserved	180 days	100 g
Nutrients					
Total Phosphorus as P	EPA 365.3 M	4 oz. Jar	Unpreserved	28 days	250g
Total Nitrogen	By calculation (TKN EPA 351.2 and Nitrite + Nitrate EPA 353.2)	4 oz. Jar	Unpreserved	28 days	3 g
Organics					
Total Organic Carbon	SM 5310C	4 oz. Jar	<6ºC	28 days	100 g
Organochlorine Pesticides (Lindbergh only)	EPA 8081A	4 oz. Jar	<6ºC	14 days	100 g
Polynuclear Aromatics-SIM (Lindbergh Only)	EPA 8270C-SIM	4 oz. Jar	<6ºC	14 days	100 g
Polychlorinated Biphenyls (Lindbergh Only)	EPA 8082	4 oz. Jar	<6ºC	14 days	100 g
Microbiology					
Total Coliform – 3 Dilutions	SM 9221B/E Modified	4 oz. Jar	<6ºC	8 hours(b)	10 g
Fecal Coliform – 3 Dilutions	SM 9221B/E Modified	4 oz. Jar	<6ºC	8 hours(b)	10 g
Enterococcus	SM 9230B Modified	4 oz. Jar	<6ºC	8 hours(b)	10 g

(a) Holding time includes field crew holding times and laboratory staff holding times.
(b) Eight (8) hour holding time includes six (6) hours from time of collection and laboratory drop off and two (2) hours for laboratory processing.

6.5 SAMPLE LABELING

Sediment and gross solids quality sample bottles will be pre-labeled, to the extent possible, before each monitoring event. Pre-labeling bottles simplifies field activities and leaves only date, time, sample ID, and sampling personnel names to be filled out in the field. Each sample collected will be labeled with the following information:

- Project Name
- Event Number
- Date and Time
- Site ID Number
- Bottle __ of __ (for multi-bottle samples)
- Collected by
- Analysis

Field samples, field blanks, and field duplicate samples will be labeled as described below. These samples will be labeled, recorded on the COC form, and then transported to the analytical laboratory.

Each catch basin debris sample will receive a unique alphanumeric code (Sample I.D. Number) for tracking. This code will be standardized for all samples and contain information as it relates to the site, event, and type of sample. The required sample identification numbers, applicable to all samples, are listed below. Example identification numbers are shown in Table 6-3:

- Event Number
  - CB1 = Catch Basin Event 1
  - CB2 = Catch Basin Event 2
  - Etc.
- Site ID
  - PO = Poway
  - TE = Tecolote
  - LI = Lindbergh
  - SY = San Ysidro
- Sample Code
  - G = Grab sample
- Sample Type
  - 01 = Primary sample
  - 02 = Field duplicate

Table 6-3: Example Sample Identification Numbers

Sample ID	Description			
	Sample Type ID/ Bottle Number	Site ID	Event	Sample Type
CB1-PO-G-01	Grab Sample	Poway	Catch Basin Event 1	Primary Sample
CB3-LI-G-02	Grab Sample	Lindbergh	Catch Basin Event 3	Field Duplicate

6.6 LABORATORY DATA PACKAGE DELIVERABLES

Laboratories will be required to provide a three-week turn-around on the deliverable package per event. The deliverable package will include a hard copy and electronic data files. The hard copy will include standard narratives identifying any analytical problems, QA/QC exceedances, and corrective actions. Individual data sets may be submitted to the consultant as either Microsoft Excel workbook files or as Microsoft Access database files.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

7.1 FIELD QUALITY ASSURANCE/QUALITY CONTROL

This section addresses Quality Assurance/Quality Control (QA/QC) activities associated with field sampling. The field QA/QC samples are used to evaluate potential contamination and sampling errors applicable to catch basin debris grab sampling introduced prior to submittal of the samples to the analytical laboratory.

Field duplicates will be the main type of field QA/QC samples that will be utilized. Field duplicates will evaluate sampling error introduced by field sampling as well as sample matrix variability. Field duplicates are submitted blind to the laboratory. Procedures for collecting field duplicates should be the same as those used for collecting field samples. Duplicates of grab samples will be collected by filling two buckets simultaneously and alternating between buckets. Table 7-1 lists the frequency and the constituent classes for the field duplicates.

Table 7-1: Field Quality Control Sample Frequency

QA/QC Sample Type	Minimum Sampling Frequency	Constituent Class
Field Duplicate	Every 10 samples collected at a given site per the sampling program or per sampling event.	Metals, Nutrients, Organics and Microbiology

7.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

This section addresses QA/QC activities associated with laboratory analyses. Laboratory QA/QC samples provide information to assess potential laboratory contamination, analytical precision, and accuracy. Analytical quality assurance for this program includes the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, United States Environmental Protection Agency (USEPA) approved methods, and written Standard Operating Procedures (SOPs).
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates, and Standard Reference Materials (SRMs).
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks will include the use of laboratory replicates, method blanks, matrix spikes/matrix spike duplicates (MS/MSDs), and laboratory control samples (LCSs) as follows. The frequency of the laboratory QA/QC samples is presented in Table 7-2.

- **Laboratory Replicate/Split** – A sample is split by the laboratory into two portions and each portion is analyzed. Once analyzed, the results are evaluated by calculating the relative percent difference (RPD) between the two sets of results. This serves as a measure of the reproducibility, or precision, of the sample analysis. Typically, replicate results should fall within an accepted RPD range, depending upon the analysis.
- **Method Blanks** – A method blank is an analysis of a known clean sample matrix that has been subjected to the same complete analytical procedure as the field sample to determine if potential contamination has been introduced during processing. Blank analysis results are evaluated by checking against reporting limits for that analyte. Results obtained should be less than the reporting limit for each analyte.
- **Matrix Spike and Matrix Spike Duplicates (MS/MSDs)** – Matrix spikes and matrix spike duplicates involve adding a known amount of the analyte(s) of interest to one of the actual samples being analyzed. One sample is split into three separate portions. One portion is analyzed to determine the concentration of the analyte in question in an un-spiked state. The other two portions are spiked with a known concentration of the analytes of interest. The recovery of the spike, after accounting for the concentration of the analyte in the original sample, is a measure of the accuracy of the analysis. An additional precision measure is made by calculating the RPD of the duplicate spike recoveries. Both the RPD values and spike recoveries are compared against accepted and known method dependent acceptance limits. Results outside these limits are subject to corrective action.
- **Laboratory Control Sample (LCS)** – The laboratory control sample procedure involves spiking known amounts of the analyte of interest into a known, clean, sample matrix to assess the possible matrix effects on spike recoveries. High or low recoveries of the analytes in the matrix spikes may be caused by interferences in the sample. Laboratory control samples assess these possible matrix effects since the LCS is known to be free from interferences.

Table 7-2: Laboratory Quality Control Sample Frequency

QA/QC Sample Type	Minimum Sampling Frequency
Laboratory Replicate/Split	One per batch or per 20 samples (5%) per sampling event.
Method Blank	One per batch or per 20 samples (5%) per sampling event.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per batch or per 20 samples (5%) per sampling event.
Laboratory Control Sample (LCS)	One per batch or per 20 samples (5%) per sampling event.

7.3 CORRECTIVE ACTION

Corrective action is taken when an analysis is deemed suspect for some reason. The reasons include exceedances of the RPD ranges, spike recoveries, and blanks. The corrective action varies somewhat from analysis to analysis, but typically involves the following:

- Check of procedure
- Review of documents and calculations to identify any possible error
- Error correction
- Re-analysis of the sample extract, if available, to see if results can be improved
- Complete reprocessing and re-analysis of additional sample material, if it is available.

Any failures (e.g., instrument failures) that occur during data collection and laboratory analyses will be the responsibility of the field crew or laboratory conducting the work, respectively. In the case of field instruments, problems will be addressed through instrument cleaning, repair, or replacement of parts or the entire instrument, as warranted. Field crews will carry basic spare parts and consumables with them, and will have access to spare parts to be stored at the office. Records of all repairs or replacements of field instruments will be maintained at AMEC. The laboratories have procedures in place to follow when failures occur, and will identify individuals responsible for corrective action and develop appropriate documentation.

8.0 DATA MANAGEMENT AND REPORTING PROCEDURES

8.1 DATA MANAGEMENT

The responsibility for laboratory data management will be lead by the Project Manager. The laboratory will be requested to provide data in both hard copy and electronic formats.

The Reporting and Laboratory Coordinator will be responsible for tracking the analytical process to make sure that laboratories are meeting the required turnaround times and are providing a complete deliverable package. The Reporting and Laboratory Coordinator receives the original hard copy from the laboratory, verifies completeness, and logs the date of receipt. The hard copy originals are then transferred to the Project Manager and filed with all other original project documentation in order to maintain complete project records.

Laboratory data will be maintained and managed with Microsoft Excel by the Sample Manager. Data from the monitoring site will also be stored in the same format and linked to the laboratory file.

8.2 REPORTING PROCEDURES

AMEC will complete one EDD (Electronic Data Deliverable) following the last monitored event. Copies of the EDD will be submitted to the City of San Diego and Tetra Tech. Each EDD will contain the following:

- Laboratory results
- Field forms
- Photographs

The laboratory results will be submitted in Microsoft Excel format. The field form will include the completed Field Data Log Sheets in PDF format. The Tetra Tech team will prepare a draft and final summary project report and submit to the City of San Diego. The report will provide a review and analysis of the data provided in the EDD.

9.0 REFERENCES

Lager, J.A., W.G. Smith, and G. Tchobanoglous. 1977. “Catchbasin Technology Overview and Assessment.” USEPA 60012-77-051. Cincinnati, OH. May 1977.

Miles, D.L. and Broner,I. 1998. “Estimating Soil Moisture”. Irrigation Colorado State University Extension.No.4.700

Tetra Tech. 2011. “Catch Basin Inlet Cleaning Pilot Study: Final Work Plan.” Prepared for the City of San Diego.

APPENDIX A

PRODUCT SPECIFICATION SHEETS

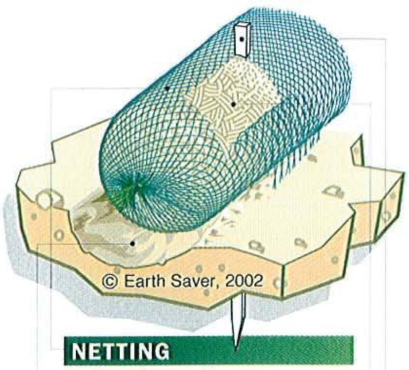
Straw Wattle® Specifications

Straw Wattle Properties Certification

Application & Design Information Table

PHYSICAL PROPERTIES				
BMP Device Type: Pre-manufactured fiber roll /Wattle	7.5"	8.5"	11.5"	19"
Unit Weight (Lbs/lft)	1.6	1.9	3.2	11
Functional Longevity (Months)	24	24	24	24
Installed Free Board Height (Inches)	5.5	6.5	9.5	17
University Laboratory Tested	Yes	Yes	Yes	Yes
Additional On Site Rolling Required	No	No	No	No
Manufactured Ready To Use (RTU)	Yes	Yes	Yes	Yes
Seamless Construction	Yes	Yes	Yes	Yes
Best Available Technology (CWA)*	Yes	Yes	Yes	Yes

*Clean Water Act (CWA) Sections 301 & 402 provisions require controls of pollutant discharges that utilize best available technology.



NETTING
- Photodegradable
- Biodegradable
- Natural Fiber

FIBER CONTENT
- 100% Compacted Rice Straw Fiber

ANCHOR
- 1x Wood Center Stake

TRENCHING
- 2-3 Inch Anchor Furrow

The Straw Wattle to meet the following requirements:

1. Erosion control and Sediment Retention Wattles (ESW) or Slope Interruption Devices (SID) commonly known as Wattles, are elongated tubes of compacted straw and/or other fibers that are installed along contours or at the base of slopes to help reduce soil erosion and retain sediment. They function by shortening slope length, reducing runoff water velocity, trapping dislodged soil particles and ameliorating the effects of slope steepness. Wattles are used as water flow dissipaters, trapping sediment when located prior to Drain Inlets (D.I.)'s, etc. Wattles are highly effective when they are used in combination with other surface soil erosion/re–vegetation practices such as surface roughening, straw mulching, erosion control blankets, hydraulic mulching and application of bonded fiber matrix or other hydraulic soil stabilizers.
2. The Wattle shall be a straw-filled tube of flexible netting material exhibiting the following properties. It shall be a machine-produced tube of compacted rice straw that is Certified Weed Free Forage under California Food & Agriculture Code Sec. 5101-5205, by a manufacturer whose principal business is wattle manufacturing. The netting shall consist of seamless, high-density polyethylene and ethyl vinyl acetate and contain ultra-violet inhibitors.
3. Wattles to be an Earth Savers® Wattle, manufactured using R.H Dyck Inc. patented process.

Testing And Properties

TESTING & PROPERTIES			7.5"	8.5"	11.5"	19"
	Standard Item #		ES07.525PRP	ES08.525PRP	ES11.518PRP	ES1908PRP
Property	Test Method	Units	Min. Value	Min. Value	Min. Value	Min. Value
Mass per Unit Weight	Field Measured	(Lbs/ft.)	1.6	1.9	3.2	11
Dimension	Field Measured	(Dia/In.)	7.5	8.5	11.5	19
Installed Free Board Ht.	Field Measured	(Height/In.)	5.5	6.5	9.5	17
Soil Loss[1]	Rainfall Sim.[1]	% Effect.	58[2]	62[2]	73[2]	84[2]
Fiber Content	Certified[3]	% Rice Straw	100	100	100	100

[1] Minimum of three repetitive 10 year predicted storm events on 2 to 1 (11.5" & 19" dia.) and 3 to 1 (7.5" & 8.5" dia.) slopes with clayey sand type soil.

[2] Minimum sediment yield reduction value.

[3] Certified Weed Free under Food and Agriculture Code sections 5101 and 5205.

The Straw Wattles are to have the above minimum physical properties and test values. This specification does not apply to other types of straw logs or fiber rolls such as rolled erosion control straw or wood fiber blankets rolled up to create an imitation wattle type device.

seattle textile
COMPANY

3434 2ND AVENUE SOUTH • SEATTLE, WA 98134
(206) 233-0595 • FAX (206) 233-0536
e-mail: sales@seatex.com

61" 22oz VINYL TEX
PVC Coated Polyester
- SPECIFICATIONS -

Width	**61 inches**
Base Fabric (polyester)	**1500D x 1500D, 16x16**
Weight (FS-191-5041)	**22oz/square yard**
Grab Tensile Strength (FS-191-5100)	**500 lbs. x 500 lbs.**
Strip Tensile Strength (FS-191-5102)	**430 lbs. x 380 lbs.**
Tongue Tear Strength (FS-191-5134)	**145 lbs. x 145 lbs.**
Adhesion (FS-191-5970)	**15 X 12 lbs./inch**
Abrasion Resistance (FS-191-5306)	**600 cycles**
Hydrostatic Resistance (FS-191-5512)	**At least 600 lbs. p.s.i.**
Cold Crack (FS-191-5874)	**-40 degrees F**
U.V. Resistance (Weather-O-Meter)	**Not excessive fading after 300 HRS**
High Temperature Resistance (FS-191-5872)	**180 degrees F (does not Block)**

Please Note: Above values represent typical data and are subject to slight variations. No warranty is expressed or implied regarding the accuracy of these data.

The COOLEY Group *Revision Date:* 10-19-05
Ref: 4-19-05
By: LSR

PRODUCT SPECIFICATION

CoolGuard® HRL36

1.0 BASE FABRIC

1.1	Base Fabric Weight	8 *oz/yd²*	(270 *g/m²*)
1.2	Fiber / Style	Polyester / Leno	

2.0 COATED FABRIC

2.1	Thickness (±10%)	36 *mils*	(0.91 *mm*)
2.2	Total Weight (nominal)	30 *oz/yd²*	(1,015 *g/m²*)
2.3	Coating Type	Ethylene Terpolymer PVC Alloy	
2.4	Coating Distribution	50 / 50	
2.5	Sealing Properties	X Dielectric	X Thermal

3.0 MATERIAL PROPERTIES (Minimum)

		Standard	Metric	ASTM TEST METHODS
3.1	Tensile Strength, Grab			
	Warp (MD)	625 *lbs*	2,780 *N*	D751A
	Fill (TD)	600 *lbs*	2,670 *N*	
3.2	Tear Strength, Tongue			
	Warp (MD)	120 *lbs*	534 *N*	D751B (Mod)
	Fill (TD)	120 *lbs*	534 *N*	
3.3	Puncture, Flat Tip	220 *lbs*	979 *N*	D4833
3.4	Puncture, Ball	1,000 *lbs*	4,450 *N*	D751
3.5	Puncture, Pyramid	475 *lbs*	2,110 *N*	FTMS 101C, 2031
3.6	Hydrostatic Resistance	800 *psi*	5.52 *MPa*	D751A
3.7	Dimensional Stability (212°F/1 hr)	2.5 *% max*	2.5 *% max*	D1204
3.8	Ply Adhesion	30 *lbs/2 in*	133 *N/5 cm*	D751 (Mod)
3.9	Thermal/R.F. Adhesion	20 *lbs/in*	35 *N/cm*	D751
3.10	Low Temp Bend (1" mandrel)	-40 *°F max*	-40 *°C max*	D2136
3.11	UV Resistance	8,000 *hrs*	8,000 *hrs*	G23

A variety of standard widths and colors are available. Contact Cooley Engineered Membranes for details.

APPENDIX B

DATA QUALITY OBJECTIVES FOR

EPA 8081A, EPA 8270C-SIM & EPA 8082

Analyte	MDL	MRL	Units	Surr. % R	DUP RPD	Matrix Spike		Blank Spike		CASNumber
						% R	RPD	% R	RPD	
EPA 8270C - Polynuclear Aromatics-SIM by EPA 8270C-SIM (Soil)										
Acenaphthene	0.01	0.025	mg/kg	-	30	20-150	30	40-120	30	83-32-9
Acenaphthylene	0.007	0.025	mg/kg	-	30	20-150	30	40-120	30	208-96-8
Anthracene	0.011	0.025	mg/kg	-	30	20-150	30	40-120	30	120-12-7
Benzo (a) anthracene	0.009	0.025	mg/kg	-	30	20-150	30	40-120	30	56-55-3
Benzo (a) pyrene	0.013	0.025	mg/kg	-	30	20-150	30	40-120	30	50-32-8
Benzo (b) fluoranthene	0.015	0.025	mg/kg	-	30	20-150	30	40-120	30	205-99-2
Benzo (g,h,i) perylene	0.008	0.025	mg/kg	-	30	20-150	30	40-120	30	191-24-2
Benzo (k) fluoranthene	0.015	0.025	mg/kg	-	30	20-150	30	40-120	30	207-08-9
Chrysene	0.011	0.025	mg/kg	-	30	20-150	30	40-120	30	218-01-9
Dibenzo (a,h) anthracene	0.015	0.025	mg/kg	-	30	20-150	30	40-120	30	53-70-3
Fluoranthene	0.014	0.025	mg/kg	-	30	20-150	30	40-120	30	206-44-0
Fluorene	0.004	0.025	mg/kg	-	30	20-150	30	40-120	30	86-73-7
Indeno (1,2,3-cd) pyrene	0.022	0.025	mg/kg	-	30	20-150	30	40-120	30	193-39-5
Naphthalene	0.01	0.025	mg/kg	-	30	20-150	30	40-120	30	91-20-3
Phenanthrene	0.016	0.025	mg/kg	-	30	20-150	30	40-120	30	85-01-8
Pyrene	0.01	0.025	mg/kg	-	30	20-150	30	40-120	30	129-00-0
2-Fluorobiphenyl	-	-	Surrogate	15-128		-		-		321-60-8
Nitrobenzene-d5	-	-	Surrogate	11-135		-		-		4165-60-0
Terphenyl-dl4	-	-	Surrogate	7-104		-		-		1718-51-0
8270C Soil PAH Low SIM by EPA 8270C-SIM (Solid)										
1-Methylnaphthalene	1	5	ug/kg	-	30	20-150	30	40-150	30	90-12-0
1-Methylphenanthrene *	1	5	ug/kg	-		-		-		832-69-9
2,6-Dimethylnaphthalene *	1	5	ug/kg	-		-		-		581-42-0
2-Methylnaphthalene	1	5	ug/kg	-	30	20-150	30	40-150	30	91-57-6
Acenaphthene	1	5	ug/kg	-	30	20-150	30	40-120	30	83-32-9
Acenaphthylene	1	5	ug/kg	-	30	20-150	30	40-120	30	208-96-8
Anthracene	1	5	ug/kg	-	30	20-150	30	40-120	30	120-12-7
Benzo (a) anthracene	1	5	ug/kg	-	30	20-150	30	40-120	30	56-55-3
Benzo (a) pyrene	1	5	ug/kg	-	30	20-150	30	40-120	30	50-32-8
Benzo (b) fluoranthene	1	5	ug/kg	-	30	20-150	30	40-120	30	205-99-2
Benzo (e) pyrene *	1	5	ug/kg	-		-		-		192-97-2
Benzo (g,h,i) perylene	1	5	ug/kg	-	30	20-150	30	40-120	30	191-24-2
Benzo (k) fluoranthene	1	5	ug/kg	-	30	20-150	30	40-120	30	207-08-9
Biphenyl *	1	5	ug/kg	-		-		-		92-52-4
Chrysene	1	5	ug/kg	-	30	20-150	30	40-120	30	218-01-9
Dibenzo (a,h) anthracene	1	5	ug/kg	-	30	20-150	30	40-120	30	53-70-3
Fluoranthene	1	5	ug/kg	-	30	20-150	30	40-120	30	206-44-0
Fluorene	1	5	ug/kg	-	30	20-150	30	40-120	30	86-73-7
Indeno (1,2,3-cd) pyrene	1	5	ug/kg	-	30	20-150	30	40-120	30	193-39-5
Naphthalene	1	5	ug/kg	-	30	20-150	30	40-120	30	91-20-3
Perylene *	1	5	ug/kg	-		-		-		198-55-0
Phenanthrene	1	5	ug/kg	-	30	20-150	30	40-120	30	85-01-8
Pyrene	1	5	ug/kg	-	30	20-150	30	40-120	30	129-00-0
2-Fluorobiphenyl	-	-	Surrogate	39-100		-		-		321-60-8
Nitrobenzene-d5	-	-	Surrogate	49-105		-		-		4165-60-0
Terphenyl-dl4	-	-	Surrogate	36-106		-		-		1718-51-0
EPA 8081A - Organochlorine Pesticides by EPA 8081A (Solid)										
2,4'-DDT	2.5	2.5	ug/kg	-	-	-	-	-	-	789-02-6
2,4'-DDE	2.5	2.5	ug/kg	-	-	-	-	-	-	3424-82-6
2,4'-DDD	2.5	2.5	ug/kg	-	-	-	-	-	-	53-19-0
4,4´-DDD	0.48	2.5	ug/kg	-	25	36-158	25	60-140	25	72-54-8
4,4´-DDE	0.77	2.5	ug/kg	-	25	20-165	25	60-147	25	72-55-9
4,4´-DDT	0.55	2.5	ug/kg	-	25	34-174	25	40-174	25	50-29-3
Aldrin	1.2	2.5	ug/kg	-	25	24-173	25	57-137	25	309-00-2
alpha-BHC	1.5	2.5	ug/kg	-	25	44-146	25	64-131	25	319-84-6
alpha-Chlordane	1.3	2.5	ug/kg	-	-	-	-	-	-	5103-71-9
beta-BHC	0.79	2.5	ug/kg	-	25	31-184	25	60-140	25	319-85-7
Chlordane (tech)	10	50	ug/kg	-	25	70-130	25	70-130	25	57-74-9
cis-Nonachlor	2.5	2.5	ug/kg	-	-	-	-	-	-	5103-73-1
DCPA	2.5	2.5	ug/kg	-	30	70-130	30	70-130	30	1861-32-1
delta-BHC	0.57	2.5	ug/kg	-	25	32-157	25	59-136	25	319-86-8
Dieldrin	0.75	2.5	ug/kg	-	25	29-148	25	61-134	25	60-57-1

Analyte	MDL	MRL	Units	Surr. % R	DUP RPD	Matrix Spike		Blank Spike		CASNumber
						% R	RPD	% R	RPD	
EPA 8081A - Organochlorine Pesticides by EPA 8081A (Solid)										
Endosulfan I	0.57	2.5	ug/kg	-	25	29-137	25	53-124	25	959-98-8
Endosulfan II	0.32	2.5	ug/kg	-	25	37-145	25	53-127	25	33213-65-9
Endosulfan sulfate	0.55	2.5	ug/kg	-	25	40-159	25	59-147	25	1031-07-8
Endrin	1.3	2.5	ug/kg	-	25	32-168	25	54-157	25	72-20-8
Endrin aldehyde	0.70	2.5	ug/kg	-	25	0.1-167	25	35-140	25	7421-93-4
Endrin ketone	0.46	2.5	ug/kg	-	-	-	-	-	-	53494-70-5
gamma-BHC (Lindane)	1.3	2.5	ug/kg	-	25	51-153	25	68-129	25	58-89-9
gamma-Chlordane	1.0	2.5	ug/kg	-	-	-	-	-	-	5566-34-7
Heptachlor	1.4	2.5	ug/kg	-	25	28-173	25	59-146	25	76-44-8
Heptachlor epoxide	0.91	2.5	ug/kg	-	25	58-138	25	62-138	25	1024-57-3
Kepone	22	50	ug/kg	-	-	-	-	-	-	143-50-0
Methoxychlor	0.55	2.5	ug/kg	-	25	23-173	25	38-184	25	72-43-5
Mirex	0.78	2.5	ug/kg	-	25	70-130	25	70-130	25	2385-85-5
Oxychlordane	2.5	2.5	ug/kg	-	-	-	-	-	-	26880-48-8
Toxaphene	8.6	75	ug/kg	-	25	70-130	25	70-130	25	8001-35-2
trans-Nonachlor	2.5	2.5	ug/kg	-	25	65-135	25	65-135	25	39765-80-5
Decachlorobiphenyl			Surrogate	16-167	-	-	-	-	-	2051-24-3
Tetrachloro-meta-xylene			Surrogate	0.2-151	-	-	-	-	-	877-09-8
EPA 8082 -Polychlorinated Biphenyls by EPA 8082 (Solid)										
Aroclor 1016	17	50	ug/kg	-	25	24-169	25	54-132	25	12674-11-2
Aroclor 1221	30	50	ug/kg	-	-	-	-	-	-	11104-28-2
Aroclor 1232	21	50	ug/kg	-	-	-	-	-	-	11141-16-5
Aroclor 1242	24	50	ug/kg	-	-	-	-	-	-	53469-21-9
Aroclor 1248	38	50	ug/kg	-	-	-	-	-	-	12672-29-6
Aroclor 1254	26	50	ug/kg	-	-	-	-	-	-	11097-69-1
Aroclor 1260	4.3	50	ug/kg	-	25	14-188	25	55-132	25	11096-82-5
Tetrachloro-meta-xylene			Surrogate	28-143	-	-	-	-	-	877-09-8
Decachlorobiphenyl			Surrogate	26-171	-	-	-	-	-	2051-24-3

APPENDIX C

HEALTH AND SAFETY PLAN (HASP)

HEALTH AND SAFETY PLAN

For

CATCH BASIN INLET CLEANING PILOT STUDY

September 2011

AMEC E&I, Inc.
9177 Sky Park Court
San Diego, CA 92123

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

This Health and Safety Plan (HASP) is intended to address the health and safety concerns that relate to the field work associated with the Catch Basin Inlet Cleaning Pilot Study. Field team members and the subcontractor's field teams must be familiar with the contents of this document and site-specific safety concerns.

The project Health and Safety Officer (HSO) will be responsible for assuring that all members of the field team are familiar with the requirements of the HASP and have received appropriate training for their specific roles. The field crew will be responsible for enforcing and following site-specific health and safety protocols. Site-specific health and safety protocols include emergency response/contingency plans. The Project Manager and individual employees have authority to suspend work, if necessary, due to health and safety concerns.

1.1 FIELD ACTIVITIES

Field activities associated with the Catch Basin Inlet Cleaning Pilot Study will be performed by AMEC employees. Such activities will include:

1.1.1 Travel

Travel to and from the selected monitoring sites will occur for continuous flow monitoring activities, maintenance activities, and storm event monitoring. Although travel during the storm events will be minimized by use of automated equipment, some access is typically necessary during storm events and often at night to document observations, replace composite sample containers, and repair any malfunctioning equipment. Efforts will be made to locate equipment in safe work zones, far from high-traffic and high-use areas.

1.1.2 Removal and Replacement of Sample Containers

Composite sample containers will need to be removed and replaced immediately after each storm/dry event and, perhaps, during storm/dry events.

1.2 GENERAL SAFETY

In addition to traffic hazards, field teams may face a variety of potential dangers while maintaining the facilities, installing equipment, and performing environmental monitoring. Some of these dangers include:

- Slippery conditions
- Lightning
- Unstable earth

- Poor visibility
- Lifting heavy objects
- Transients
- Muggers and other criminals
- Elevated places
- Sharp edges and broken glass
- Overhead dangers
- Dogs and other biological hazards
- Electrical hazards posed by equipment malfunctions

In the event of a spill from an accident occurs:

- Back away from the area in the upwind direction.
- Deny entry to the area.
- Allow emergency personnel to handle the situation.

Always be aware of these dangers and all other hazards. Here are some tips that will help increase your safety and the safety of others while working in the field:

- Stay six feet away from the edge of a fast moving body of water. These edges are usually slippery and unstable during rainy conditions.
- If sampling is required at the edge of a fast moving body of water, use a lifeline and a personal flotation device (PFD). Have on hand a grabbing device when possible.
- Never work alone at night, and avoid working alone during the day. At a minimum, two people are required during each site visit.
- Avoid leaving materials, tools, and equipment lying around where someone can trip over them.
- Maximize lighting at all times, especially at night.
- Always keep a charged cellular phone or other means of communication nearby.
- Do not use your back to lift heavy objects. Get help.
- Never use drugs or alcohol while working.
- Always wear an orange reflective vest, appropriate shoes, and a hard hat when overhead dangers exist.
- Do not use power tools and heavy equipment unless trained in the proper use and care of the specific power tools.

- Always wear eye protection when working with tools or chemicals.
- Never leave open holes unattended or not barricaded.
- Do not sample during a lightning storm.
- Clean up the work area before leaving.
- Always carry drinking water with you.
- Be aware of the nearest toilet and hand washing facilities.
- Workers will complete the following personal hygiene procedures:
  - Personal protective equipment (PPE) shall be kept clean and in good repair. Safety devices, including protective clothing worn by the employee, shall not be interchanged among the employees until properly cleaned.
  - All equipment leaving the site will be free of gross hazardous and non-hazardous waste (i.e., mud and/or soil).

2.0 SITE-SPECIFIC SAFETY CONCERNS

This section provides information on unique hazards and necessary precautions for the types of sites that will be monitored during this study. Appropriate emergency response numbers and routes to the nearest medical emergency facilities can be found at the end of this appendix. Field personnel will be responsible for adhering to the requirements of this plan for installation, maintenance, and storm monitoring. If additional measures are necessary due to unforeseen or temporary changes to the work environment, the on-site team leader will make the final judgment for any safety procedure changes.

2.1 SITE SPECIFIC SAFETY CONCERNS

2.1.1 Physical Hazards

Always be alert and use adequate protection to safeguard against the physical hazards associated with working at these sites. The most common hazard encountered is falling or tripping. The following are some other common hazards:

- Falling objects
- Sharp objects
- Electrical shock
- Grinding
- Chipping
- Moving vehicles and heavy equipment operation
- Mechanical energy

2.1.2 Biological Hazards

Beware of poison ivy, poison oak, and other plants that cause allergic reactions. Also, use protection against bacteria and other microbiota that could be present in the water and sediment. Be aware that mosquitoes are a common vector for human diseases.

2.1.3 Heat Stress

Heat stress is a major hazard, especially for workers wearing protective clothing. The same protective materials that shield the body from chemical exposure also limit the dissipation of body heat and moisture. In its early stages, heat stress can cause rashes, cramps, discomfort, and drowsiness, resulting in impaired functional ability that threatens the safety of both the individual and coworkers. Continued heat stress can lead to heat stroke and death. Avoiding overprotection; careful training and frequent monitoring of personnel who wear protective clothing, judicious scheduling of work and rest periods, and frequent replacement of fluids can protect against this hazard.

Heat stress is a possibility on this project. Breaks in a shaded area will be taken if any worker exhibits symptoms of heat stress such as excessive sweating, muscle spasms, thirst, dizziness, rapid/weak pulse, flushed skin, loss of consciousness, or convulsions. The breaks will last until symptoms are relieved and/or the pulse of the worker is less than 110 beats per minute. As a preventive measure, workers will be instructed to drink fluids to keep hydrated. For severe heat stress, workers will be examined by a health-care professional as soon as possible.

Additionally, during periods of hot weather or other potential heat stress conditions the following safe work practices must apply:

- Be on the alert to signs and symptoms of heat illness during periods of abnormally high heat.
- Know the symptoms of heat illness to watch for, including excessive sweating, headaches, poor concentration, muscle pain, cramping, dizziness, irritability, loss of coordination, vomiting, blurry vision, confusion, lack of sweating, fainting, or seizures.
- Drink plenty of water throughout the day. Employees working in the heat need to drink 4 eight-ounce glasses of water per hour, including at the start of the shift to replace the water lost to sweat.
- Dress for conditions. Wear lightweight, light-colored, loose clothing. Wear a wide-brimmed hat if possible.
- Wear sunscreen and sunglasses.
- Use cool compresses to stay cool.
- Take scheduled rest periods and spend them in the shade.
- Tell your supervisor immediately if you feel you may be getting sick from the heat.
- Know the locations of your closest drinking water supplies.
- Keep track of your coworkers. You all need to look out for each other.
- Know how to contact emergency services in the event of heat illness and how to effectively report the work location to 911.

2.1.4 Cold Exposure

Winter conditions can bring unusual cold weather to the area. Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures and wet conditions. To guard against this hazard, workers should wear appropriate clothing, have warm shelter readily available, should carefully schedule work and rest periods, and should always monitor each other's physical conditions.

2.2 WORKER SAFETY

Only personnel trained in the use of the proper safety equipment will be allowed to complete the required tasks.

2.2.1 Personal Protective Equipment (PPE)

Recommended personal protective equipment includes hard hats, safety vests, work boots, gloves, and sturdy clothing. This equipment will not only help protect against numerous potential hazards but will also allow others to identify you as belonging to the work site. Additionally, Nitrile, latex, or other plastic-based personal protective equipment will be used by any personnel who is likely to come in contact with stormwater runoff, as the contents of the water are unknown and potentially dangerous.

The safety officer will select the PPE ensemble based on the potential hazards. In general the following in Table 2-1 applies:

Table 2-1: Standard PPE for Non-Hazardous Work Zones

Activity	**Head/Face/Ear**	**Foot**	**Hands**	**Respirator**	Clothing
General Site Labor	Hard hat (Class B or E) Safety glasses Hearing protection[b]	Steel-toed boots w/ puncture-resistant insoles	Leather/Nitrile gloves as needed	None[a]	Shirt w/ sleeves Long pants High-visibility reflector vest
Activity	**Head/Face/Ear**	**Foot**	**Hands**	**Respirator**	Clothing
Supervision of Work	Hard hat (Class B or E) Safety glasses Hearing protection[b]	Steel-toed boots w/ puncture-resistant insoles	Leather/Nitrile gloves as needed	None[a]	Shirt w/ sleeves Long pants High-visibility reflector vest
Site Visitors	Hard hat (Class B or E) Safety glasses Hearing protection[b]	Steel-toed boots w/ puncture-resistant insoles	None	None[a]	Shirt w/ sleeves Long pants High-visibility reflector vest

(a) Voluntary use of respirators is authorized for nuisance dusts and exposures known to be below PEL levels. For nuisance dust use disposable N, R, or P95 or better (dispose of N or R types daily and P type weekly). For odors use half mask with OV or OV/P95 or better (change at start of week).
(b) Hearing protection with adequate noise reduction rating (if consistently exposed to greater than 85 decibels steady-state or 140 decibels impulse). Workers should use clean hands to insert earplugs. Ample supplies of disposable earplugs will be available onsite.

Each worker will be responsible for maintaining his or her own PPE.

2.2.2 Special Circumstances

Extreme caution will be used when maintaining pole-mounted equipment. Qualified individuals will perform this task with proper equipment due to the danger of potential falls.

2.3 INSTALLATION SAFETY

The following precautions will be taken while installing containment berms and sampling:

- Always wear protective gloves, a reflective vest, as described above, and a hard hat when overhead dangers exist.
- Do not eat or smoke while on the job site.
- Use proper lifting techniques and get assistance when moving coolers and large sample composite containers or other equipment.

2.4 EMERGENCY PROCEDURES

2.4.1 Medical Emergencies

Even with full safety awareness and compliance by field teams, medical emergencies can and do occur. To handle minor injuries, field teams will have a basic first aid kit on-site at all times. Table 2-2 is a list of site-specific emergency contacts. Driving directions to the hospital nearest each site are presented in Table 2-3. Maps showing driving routes are presented on Figure 2-1.

Table 2-2: Emergency Contacts

Site	Name	Phone	Comments
All	San Diego Police Department	911	From cell phone
All	Kristina Schneider Project Manager	619-889-7752	From cell phone

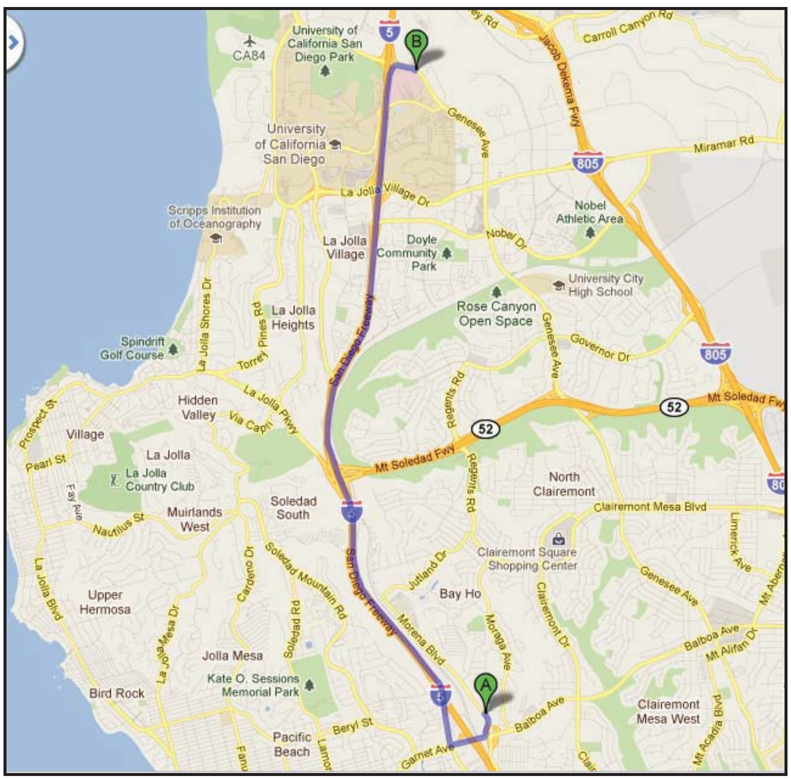
<u>Document all information related to the accident or incident that resulted in injury or damage and report it to the Health and Safety Manager.</u>

Table 2-3: Driving Directions to Hospital

(See Figure 2-1: Hospital Map for Nearest Hospital to Applicable Site on Following Page)

Site	Address	Directions/Hospital Name/Address	
Rose Canyon Yard	3775 Morena Blvd, San Diego, CA 92117	Scripps Memorial Hospital La Jolla 9888 Genesee Avenue La Jolla, CA 92037 (858) 626-4123	• Head southeast on Morena Blvd S • Take the ramp to I-5/Garnet Ave • Merge onto Balboa Ave • Turn right onto Mission Bay Dr • Take the ramp onto I-5 N • Take exit 29 for Genesee Ave • Turn right onto Genesee Ave • Destination will be on the right

Figure 2-1: Hospital Map Rose Canyon Yard



2.5 HAZARDOUS SPILLS

Hazardous substances may be used for various purposes at and around the site. When working with hazardous substances, leaks and spills are always a concern. With the close proximity of the site to the roadway or operation yard activities, the probability also exists of potential hazardous spills originating from traveling vehicles.

A spill may present a number of hazards. The specific hazards depend on the substance(s) involved. Among the possibilities are:

- Fire
- Explosion
- Contamination of individuals who come in contact with the spilled substance
- Hazardous substances entering the water supply

Spill response procedures are designed to minimize the risk of any of these things occurring as a result of a spill or, at the very least, reducing the degree of hazard. The primary concern of spill contamination is to stop or retard the spill before it becomes serious.

Field teams working with potentially hazardous materials will be trained in the use of proper personal protective equipment, the safe usage or handling of the substances, and contingency plans for spills and leaks. In the event of a hazardous material spill, follow the procedures listed in Section 1.3 of this HASP. The hazards posed by a spill of a particular substance are detailed on the Material Safety Data Sheet (MSDS) for that substance. In the event of a hazardous material spill originating from an external source such as an accident on the roadway, follow the procedures listed in Section 1.3 of this HASP.

2.6 TAILGATE SAFETY TRAINING

The HSO or another designated Safety Officer will conduct tailgate safety training sessions regularly. These meetings will be held on-site prior to work operations. New personnel working on site will be required to attend a tailgate meeting prior to work operations. The purpose of the safety-training meeting is to ensure that field team members understand and will abide by all safety and potential emergency response measures that may be necessary for the well being of the field team.

The following items will be discussed at each safety meeting:

- Traffic safety
- Safe entering and exiting of the site
- Use of personal protective clothing and equipment
- Potential chemical and physical hazards and how to deal with them
- Nearest hospital information
- Emergency response procedures
- Any other site-specific safety issues

Field team members must sign the tailgate safety training meeting form in acknowledgment of understanding all issues discussed. An example of a tailgate meeting form is included as Figure 2-5.

Figure 2-2: Tailgate Safety Meeting Form

Project No.:___________________________
Client: _______________________________ Site Location: _________________________

Safety Topics Discussed
1. Protective Clothing and Equipment: • PPE – Use the PPE that has been provided to prevent injury, exposure to the cold and wet weather conditions, and exposure to stormwater runoff containing diluted levels of chemical contaminates. Typical PPE may consist of a hard hat, rain gear, rubber rain boots, nitrile gloves, pants, long-sleeved shirts, and layered clothing. Use and wear a personal floatation device (PFD) if working over water, on piers or quay walls. • Equipment and tool use – Use proper equipment for the task in the prescribed manner to prevent injury.
2. Chemical Hazards: • Dermal/eye contact with water contaminants – Do not overfill containers. Fill bottles only to the neck or as otherwise instructed by the site manager. • Food, drinks, or cigarettes will not be consumed while observing or sampling. Prior to handling food, drinks, or cigarettes, personnel will wash hands and face.
3. Physical Hazards: • Lifting – Use proper equipment and lifting and motion technique. Do not twist back, stay balanced and use your legs. • Vehicle Hazards – Be aware of vehicle operations in your area. Make eye contact with vehicle operators on approaching equipment. • Driving – Drive vehicle in accordance with company policy. Drive in right lane, use 3-second rule or extended distance from vehicle in front of you. Drive speed limit or slower depending on road conditions and visibility. • Working over water – Exercise care and alertness when working around water. Use the buddy system and wear a PFD if working over water, on piers or quay walls.
4. Vehicle Hazards: • Wear seat belt while vehicle is in motion. • Do not exceed the posted speed limit. • Reduce speed in adverse weather conditions. • Always drive with headlights on. • Drive vehicle in accordance with AMEC policy. Drive in the right lane and maintain an extended distance (3-second rule) from the vehicle in front of you. • Drive defensively and follow traffic regulations. • Do not make sudden lane changes, weave through traffic, or cut off other drivers. • **Do not use handheld or hands-free cell phones while driving.** • Stop at intersections and give the right-of-way to other vehicles and pedestrians. • Check tires for proper inflation.

5. Traffic Hazards: • Be aware of vehicles in your area. Make eye contact with approaching vehicle operators. • In dry weather, a reflective vest should be worn for maximum visibility in high-traffic areas. • Use traffic cones around the work zone in high-traffic areas. • At least two persons must be present to perform any work in high-traffic areas. One of these persons must monitor approaching traffic for any potential hazards. • Watch out for moving vehicles and equipment and equipment.
6. Environmental and Biohazards: • Dangerous animals and insect bites and stings – Be aware of your surroundings and watch for dangerous animals and insects such as spiders and snakes. Wear appropriate clothing such as pants, long sleeved shirts, and steel toe boots. • Watch for Poison Oak.
7. Equipment Hazards: • Pinch Points – Use proper equipment in the prescribed manner in conjunction with proper lifting techniques to avoid pinch points. • Wear leather or canvas gloves - to protect the hands when performing manual labor, such as moving manhole covers
8. Decontamination Procedures: • If an exposure or eye contact occurs, respond with appropriate first aid and immediately notify the supervisor.
9. Other: • The supervisor will review any other significant safety matters specific to sampling and observation activities at this base.
10. Review of Emergency Procedures: • In case of emergency, immediately dial 911.

			Attendees	
Date	**Site Activity**	**Topic Discussed**	**Printed Name**	**Signature**

Meeting Conducted by:

Name: ______________________________ Title: ______________________________

Signature: ___________________________ Date: ______________________________

APPENDIX D

FIELD FORMS

Catch Basin Debris Data Sheet

Operations Yard ______________ **Field Crew** ______________

Catch Basin System: ______________ **Date** ______________ **Time** ______________

Determine Moisture content (MC). Must be less than 25% to collect samples.

MC Sample	0%	0-25%	25-50%	50-75%	75-100%
1	___	____	____	____	____
2	___	____	____	____	____
3	___	____	____	____	____
4	___	____	____	____	____
5	___	____	____	____	____
6	___	____	____	____	____

Select Predominante Range = ______ %

Soil Moisture Interpretation Chart

Soil Moisture Deficiency	Moderately Coarse Texture	Medium Texture	Fine and Very Fine Texture
0% (field capacity)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.		
0-25%	Forms weak ball, breaks easily when bounced in hand.[a]	Forms ball, very pliable, slicks readily.[a]	Easily ribbons out between thumb forefinger.[a]
25-50%	Will form ball, but falls apart when bounced in hand.[a]	Forms ball, slicks under pressure.[a]	Forms ball, will ribbon out between thumb and forefinger.[a]
50-75%	Appears dry, will not form ball with pressure.[a]	Crumbly, holds together from pressure.[a]	Somewhat pliable, will ball under pressure.[a]
75-100%	Dry, loose, flows through fingers.	Powdery, crumbles easily.	Hard, difficult to break into powder.

(a)Squeeze a handful of soil firmly to make ball test.

Source: Miles, D.L. and Broner,I. 1998. Estimating Soil Moisture. Irrigation Colorado State University Extension.no.4.700

VISUAL OBSERVATIONS

TRASH

Type (Circle all that apply): Plastic Metals Paper Products Glass Food Scraps Rubber Wood Styrofoam Food Wrappers
Other:

ORGANICS

Type (Circle all that apply): Leaves Grass Twigs Other______________

ESTIMATE THE PERCENTAGE OF EACH COMPONENT:

% Total Sediment ______ % Total Trash ______ % Total Organics ______

% Others ______ Describe: ______________

Photos Total Number Taken _____

Number/Name

1.________________ 4.________________ 7.________________
2.________________ 5.________________ 8.________________
3.________________ 6.________________ 9.________________

NOTES/COMMENTS: ____________________

FIELD MEASUREMENTS

Determine the Volume

	Length (L)	Width (W)	Height (H)	Volume (L x W x H)
Units				
Q1	______	______	______	______
Q2	______	______	______	______
Q3	______	______	______	______
Q4	______	______	______	______

SCHEMATIC OF CATCH BASIN CONTAINMENT

Photos Total Number Taken _____

Number/Name

1.________________ 4.________________ 7.________________
2.________________ 5.________________ 8.________________
3.________________ 6.________________ 9.________________

NOTES/COMMENTS: ____________________

WEIGH CATCH BASIN DEBRIS

1- If it is not possible to zero out the scale record weight of empty buckets.
2- If you can zero the scale, zero before measuring weight.
3- Measure buckets with debris.

Sample Quadrant	Empty Buckets	Buckets+ Debris	☐ Lbs ☐ Kgs Debris

Total Weight ☐

Use calculation only if not zeroed, Debris= (Buckets + Debris) - Empty Buckets

NOTES/COMMENTS:

San Diego Catch Basin Study

Appendix B

Analytical Sediment Chemistry Results and Field Dry Weights

Data spreadsheets (Excel files) were submitted to the City of San Diego on 6/9/2012

Analytical chemistry from individual reports compiled by AMEC
Laboratories included: Weck Laboratories, Inc.;
Calscience Environmental Laboratories, Inc.; and PTS Laboratories, Inc.

Transmittal letters:

amec

To: Julie Beth Hinds
Tetra Tech, Inc.

From: Kristina Schneider
AMEC Environment & Infrastructure, Inc.

Date: March 12, 2012

Subject: Catch Basin Inlet Cleaning Pilot Study
Electronic deliverable (First Sampling Event (12/27/11)
AMEC Project Number: 5013-11-0023

AMEC Environment & Infrastructure, Inc. is pleased to submit electronically the first sampling event (12/27/11) data deliverable for the Catch Basin Inlet Cleaning Pilot Study. This data deliverable includes the following:

- Analytical laboratory reports with original chains-of-custody.
- A summary electronic data deliverables (EDD), all original Weck Laboratories provided EDD, and an EDD log that details the contents of the original EDDs.
- Field data sheets for the pre-event sediment inspections and sampling event.
- Excel sheet summarizing the sediment weights from pre-sampling and sampling event notes. There are only pre-sample weights from the catch basin systems that were cleaned by Ron's maintenance.
- Photographs
  - Pre-sampling Event (12/9/11, 12/19/11, & 12/22/11)
  - Sampling Event (12/27/11)

If you have any questions, please contact us at your convenience. We look forward to continuing to work with you and the rest of the team on this important project.

Sincerely,

Kristina Schneider, P.E.
Cc: Jason Wright, Tetra-Tech, Inc.

Environment & Infrastructure
9177 Sky Park Court, Suite A • San Diego, CA 92123 USA

To: Julie Beth Hinds
Tetra Tech, Inc.

From: Kristina Schneider
AMEC Environment & Infrastructure, Inc.

Date: April 26, 2012

Subject: Catch Basin Inlet Cleaning Pilot Study
Electronic deliverable (Second Sampling Event (02/02/12) and Third Sampling Event (02/29/12 and 03/05/12))
AMEC Project Number: 5013-11-0023

AMEC Environment & Infrastructure, Inc. is pleased to submit electronically the second (02/02/12) and third (02/29/12 and 03/05/12) sampling events data deliverable for the Catch Basin Inlet Cleaning Pilot Study. This data deliverable includes the following:

- Analytical laboratory reports with original chains-of-custody.
- A summary electronic data deliverables (EDD), all original Weck Laboratories provided EDD, and an EDD log that details the contents of the original EDDs.
- Field data sheets for the pre-event sediment inspections and sampling event.
- Excel sheet summarizing the sediment weights from pre-sampling and sampling event notes. There are only pre-sample weights from the catch basin systems that were cleaned by Ron's maintenance.
- Photographs

If you have any questions, please contact us at your convenience. We look forward to continuing to work with you and the rest of the team on this important project.

Sincerely,

Kristina Schneider, P.E.
Cc: Jason Wright, Tetra-Tech, Inc.

To: Julie Beth Hinds
Tetra Tech, Inc.

From: Kristina Schneider
AMEC Environment & Infrastructure, Inc.

Date: April 27, 2012

Subject: Catch Basin Inlet Cleaning Pilot Study
Electronic deliverable (Fourth Sampling Event (04/17/12)
AMEC Project Number: 5013-11-0023

AMEC Environment & Infrastructure, Inc. is pleased to submit electronically the fourth sampling event (04/27/12) data deliverable for the Catch Basin Inlet Cleaning Pilot Study. This data deliverable includes the following:

- Letter explaining sediment delivery and Memorial Park Sediment placement.
- Field data sheets for the sampling event and Ron Maintenance log sheet.
- Excel sheet summarizing clean out, sampling, rain events dates and times elapsed between all dates.
- Excel sheet summarizing the sediment weights from pre-sampling and sampling event notes. There are only pre-sample weights from the catch basin systems that were cleaned by Ron's maintenance.
- Photographs

If you have any questions, please contact us at your convenience. We look forward to continuing to work with you and the rest of the team on this important project.

Sincerely,

Kristina Schneider, P.E.
Cc: Jason Wright, Tetra-Tech, Inc.

Environment & Infrastructure
9177 Sky Park Court • San Diego, CA 92123 USA
Tel: +1 858. 278.3600 • Fax: +1 858. 278.5300

amec

To: Julie Beth Hinds
Tetra Tech, Inc.

From: Kristina Schneider
AMEC Environment & Infrastructure, Inc.

Date: May 1, 2012

Subject: Catch Basin Inlet Cleaning Pilot Study
Electronic deliverable (Fourth Sampling Event (04/17/12)
AMEC Project Number: 5013-11-0023

AMEC Environment & Infrastructure, Inc. is pleased to submit electronically the completion of the fourth sampling event (04/27/12) data deliverable for the Catch Basin Inlet Cleaning Pilot Study. This data deliverable includes the following:

- Analytical laboratory reports with original chains-of-custody.
- A summary electronic data deliverables (EDD), all original Weck Laboratories provided EDD, and an EDD log that details the contents of the original EDDs.

If you have any questions, please contact us at your convenience. We look forward to continuing to work with you and the rest of the team on this important project.

Sincerely,

Kristina Schneider

Kristina Schneider, P.E.
Cc: Jason Wright, Tetra-Tech, Inc.