# Catch Basin Inlet Cleaning Pilot Study: Final Report

*Submitted to:*

The City of San Diego
9370 Chesapeake Drive, Suite 100, MS 1900
San Diego, CA 92123

*Submitted by:*

Tetra Tech
9444 Balboa Ave, Suite 215
San Diego, CA 92123

*FINAL*

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# 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 (Tecolote), and a mixed commercial and office/retail area off of Scripps Poway Parkway (Scripps-Poway) and I-15 - from four clean-outs during the winter season of 2011 to 2012, along with a dry-season clean-out conducted in the summer season of 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
- Field experience with draft reporting and information collection protocols

The most important and lasting benefit to the City from successful completion of this pilot project is the initial base of high-quality information on catch basin cleaning methods in different land use settings. From this base of information, the City should be able over time to:

1) Develop and implement new record keeping protocols for City and contracted crews that continue to improve the City's information base on catch basin cleaning
2) From an improved information base, identify those catch basins that may be acting as storage devices within the drainage network, and target these for more frequent cleaning
3) Add further analysis of catch basin cleaning frequencies and rates of material accumulation in different areas and land use settings, including dry-season accumulation rates
4) Combine the information with other GIS and mapping inputs, such as slopes, erodible soils, and potential sources of contaminants, to develop a predictive model of areas that may benefit from more frequent cleaning.

# 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 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** and Tecolote areas were classified as mixed residential and commercial use areas. The 29 catch basins in the Scripps-Poway area are along the parkway and in the parking lots around the commercial buildings (Figure 2). The Scripps -Poway P 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.

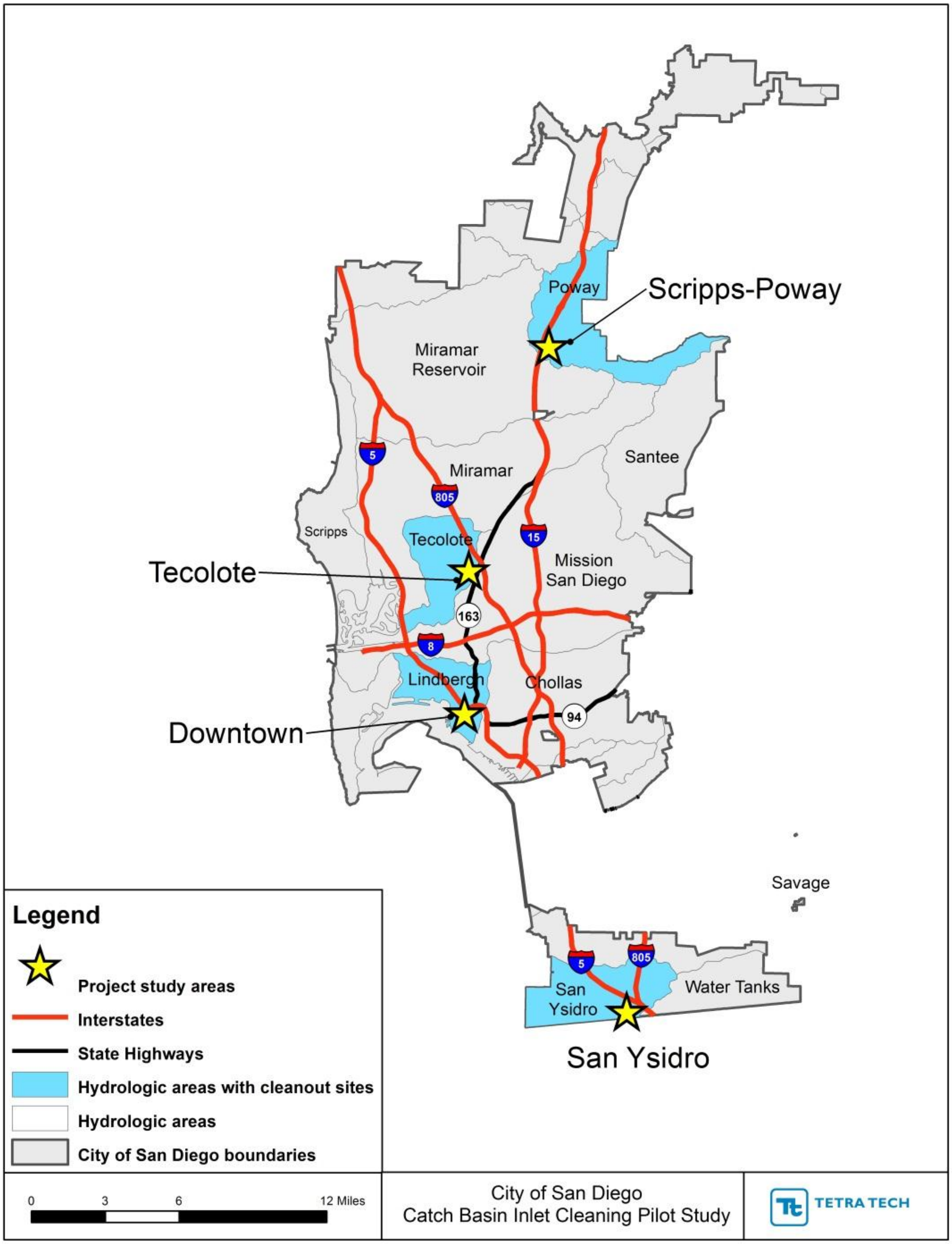


**Figure 1. Study area locations.**

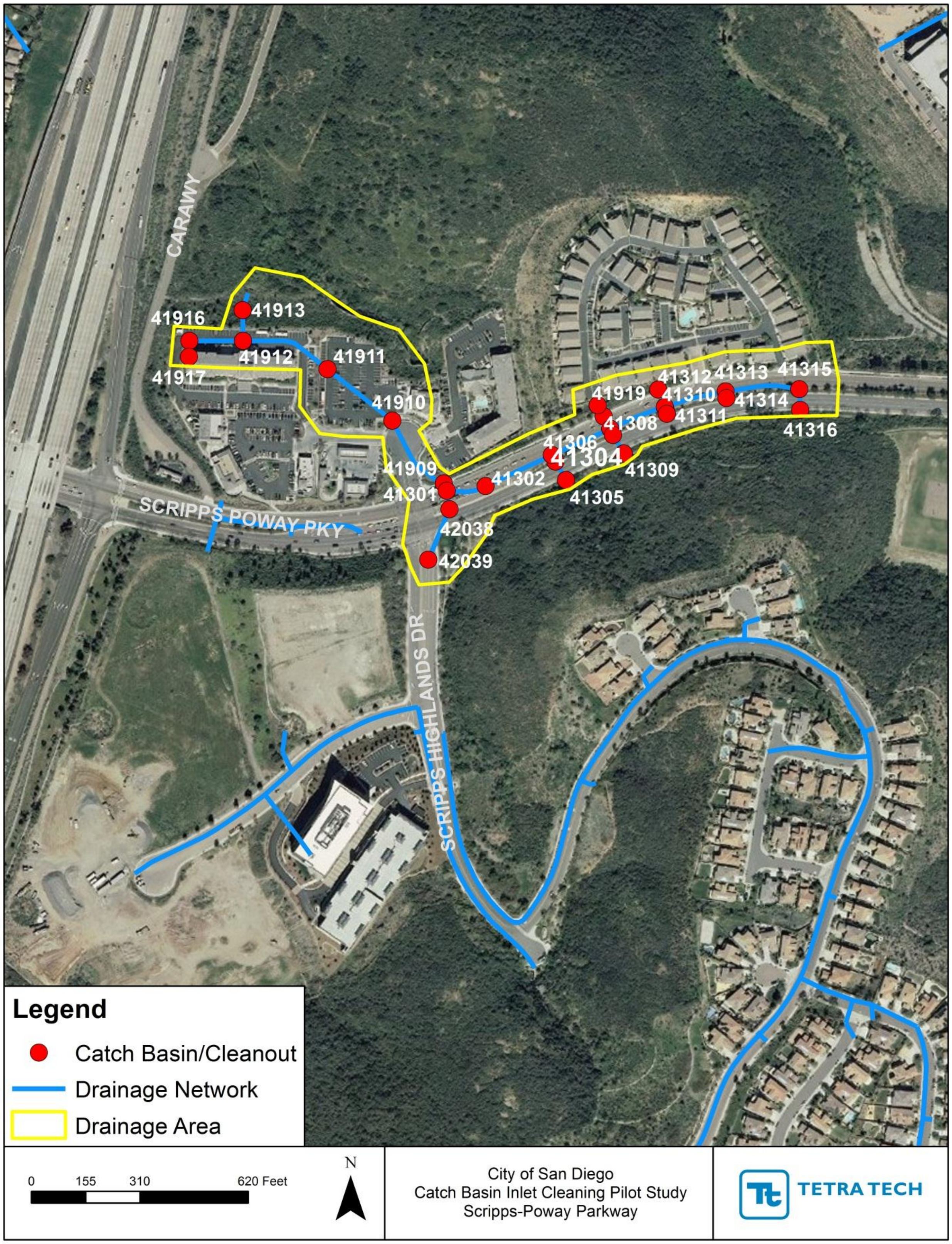


**Figure 2. Scripps - Poway Parkway drainage area and associated catch basins.**

The roughly 7 acre **Tecolote** 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 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 clean-out 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.**

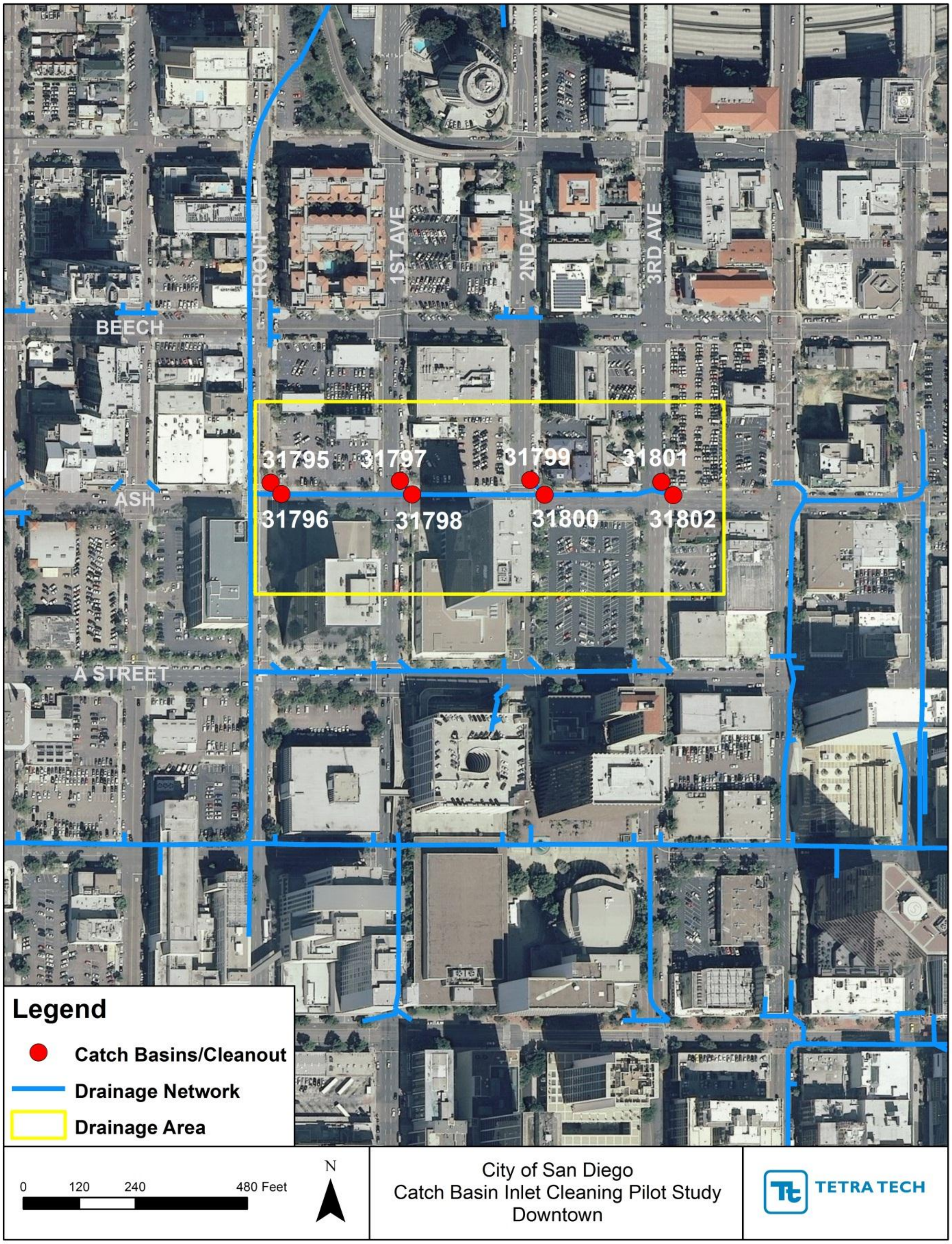


**Figure 4. Downtown drainage area and associated catch basins.**

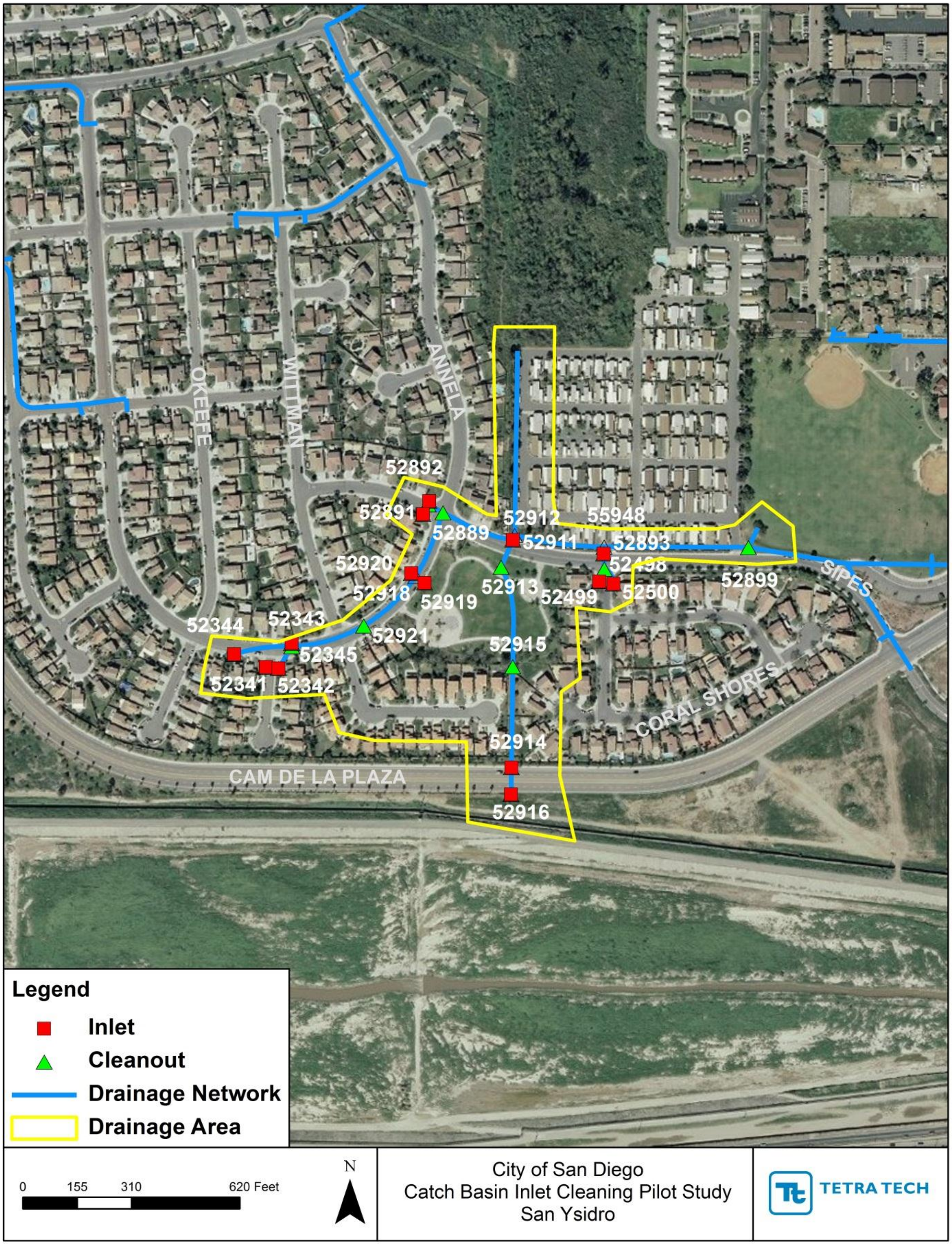


**Figure 5. San Ysidro drainage area and associated catch basins.**

### *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 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 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 Scripps-Poway areas.**

### *Schedule*

Catch basins in each network were cleaned four times between December 2011 and March 2012 and once in September 2012. The variability of winter season weather was the major driver behind the selected wet-weather 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. The dry weather clean-out event was scheduled to occur before the rainy season began in late September 2012.

### *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 area for the first sampling event. There was some concern that the volume of material collected from the catch basins in the Scripps-Poway 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 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 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.

Concentrations are provided on a unit mass basis (i.e., mg/kg). To obtain the total mass of nutrients and metals removed in a given project area,  analyte concentrations were multiplied by weight of the material removed. The estimated mass removed were standardized to a 30-day accumulation period and 10 acre drainage area to facilitate project area comparison. To standardize the masses removed the following equation was used:

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

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. 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 five clean-out events. The timing of the wet-weather 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. A dry-weather clean-out occurred before the start of the 2012/2013 wet-weather season. Figure 9 illustrates the timing of the catch basin cleanings and the material sampling for all wet-weather clean-out events. Table 2 summarizes the timing of catch basins and number of preceding days with no rainfall.

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. CO5 took place about five months after CO4 before the start of the next wet-weather season. CO5 is representative of a dry-weather clean-out at the end of the dry-weather season.

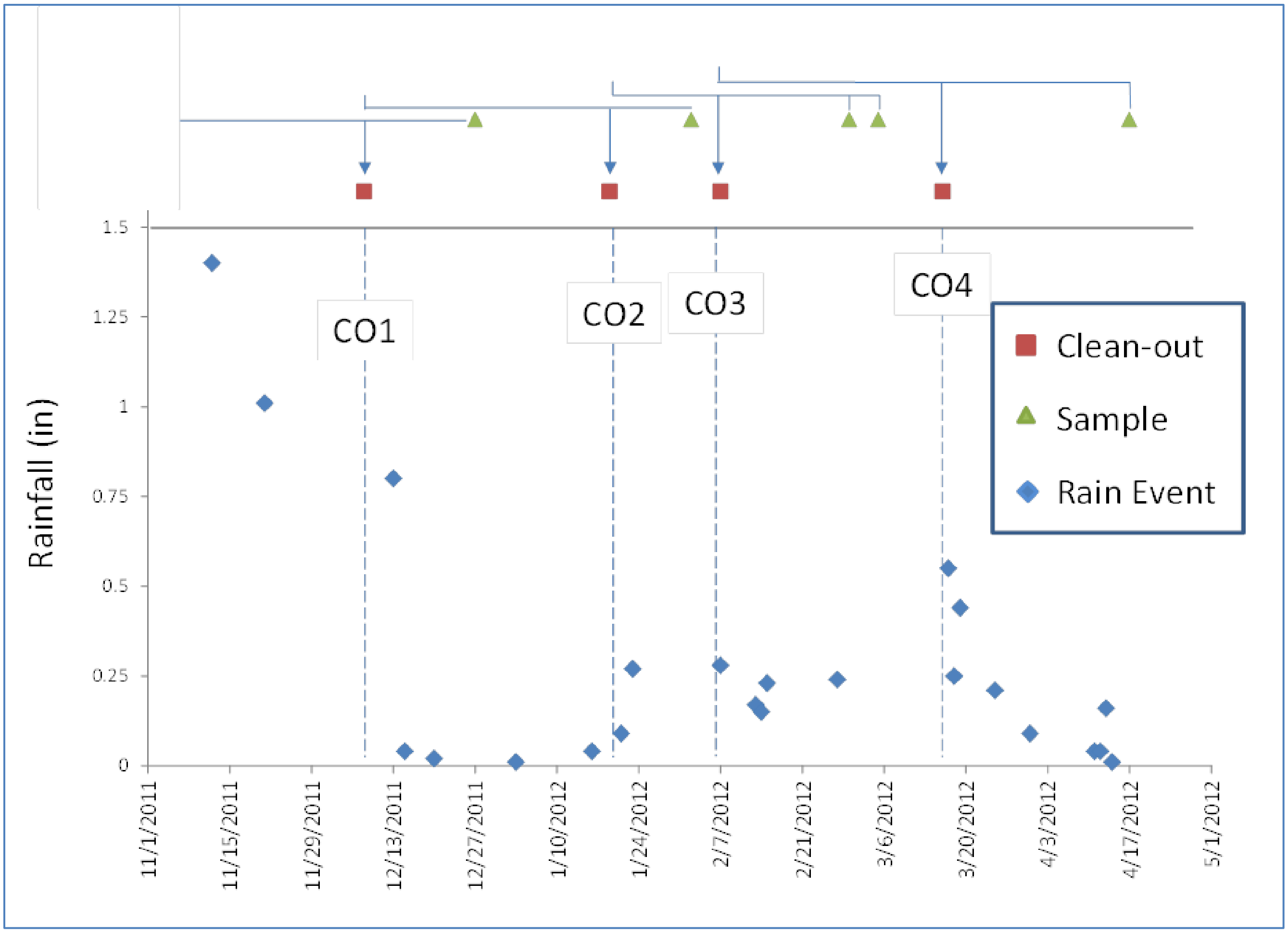


**Figure 9. Timeline of wet-weather catch basin clean-out (CO1-CO4), sampling, and rain events.**

The sediments removed during clean-outs were allowed to dry adequately, though one sample (Scripps-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 clean-out dates were: December 8, 2011; January 19, 2012; February 7, 2012; March 15 (early AM) to 16, 2012; and September 25, 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. Clean-out and sampling dates.**

| Clean-out Event | Date | Days after last rainfall | Days after last clean-out |
|---|---|---|---|
| CO1 Initial (wet) | 12/8/2011 | 16 | Unknown |
| CO2 (wet) | 1/19/2012 | 10 | 42 |
| CO3 (wet) | 2/7/2012 | 2 | 19 |
| CO4 (wet) | 3/16/2012 | 7 | 38 |
| CO5 (dry) | 9/25/2012 | 122 | 189 |

There was one incidence of inadvertently mixed sediments, which is not believed to have affected these results. Mactec (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) when CO4 was scheduled. The CO4 materials were delivered a day earlier than expected (3/15 instead of 3/16) and the Scripps-Poway materials were placed directly on top of the Memorial Park materials (Figure 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 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 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 materials was obtained by taking the Scripps-Poway sample from the top few inches of the materials pile. The remaining Scripps-Poway 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 materials removed from the catch basins varied over time and among the four project areas. Trends of material removal would warrant significantly more sample sites and a longer sampling period to cover a series of dry- and wet-weather seasons. For the purposes of this study, material accumulation is only a reflection of these sampling events and can serve as a basis for comparison or bearing of truth for more robust studies. In this study, material removed is helpful in characterizing the pollutant loads associated with it.

Quantity of materials removed in each area during each clean-out is illustrated in Figure 10. As shown, Scripps-Poway had a significant amount of material removed during each clean-out event, followed by San Ysidro. Unlike the other project areas, material removed at Scripps-Poway remained generally consistent during both wet- and dry-weather clean-outs. San Ysidro and Tecolote had the greatest amount of material removed in the dry-weather clean-out compared to wet-weather clean-outs.

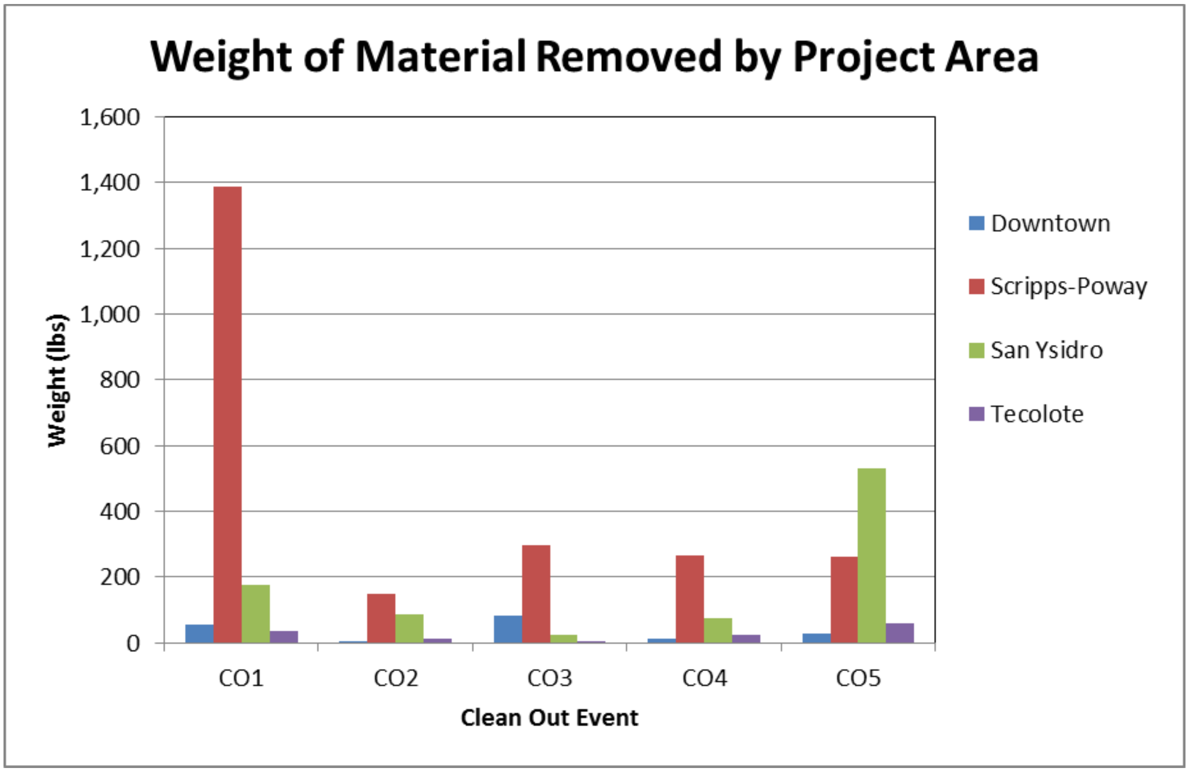


**Figure 10. Weight of materials removed from all catch basins in five clean-out events within the four areas.**

Dry-weather removal and wet-weather removal is further examined in Figure 11. Figure 11. Weight of materials removed from all catch basins within the four areas and in five sampling periods.As shown, more material was removed on average during wet-weather clean-out events in Scripps-Poway and Downtown compared to the material removed during the dry-weather clean-out event. The opposite trend is illustrated in San Ysidro and Tecolote where the dry-weather clean-out resulted in more material removed than the average wet-weather clean-out event.

In regards to the removal method, the vactor method was used in the Scripps-Poway and Downtown areas, which had significant and moderately significant amounts of materials removed. The manual method was used in San Ysidro and Tecolote areas which had moderate to low amounts of materials removed. In comparing two areas which both consist of mixed residential and commercial land uses (Scripps-Poway and Tecolote), the vactor method employed in Scripps-Poway resulted in greater material removed. Although this finding supports vactor methods in removing more material, 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 clean-out 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 material 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 materials in each drainage area and the shape of the catch basin sumps probably influence the materials removed from catch basins more than the general land uses.

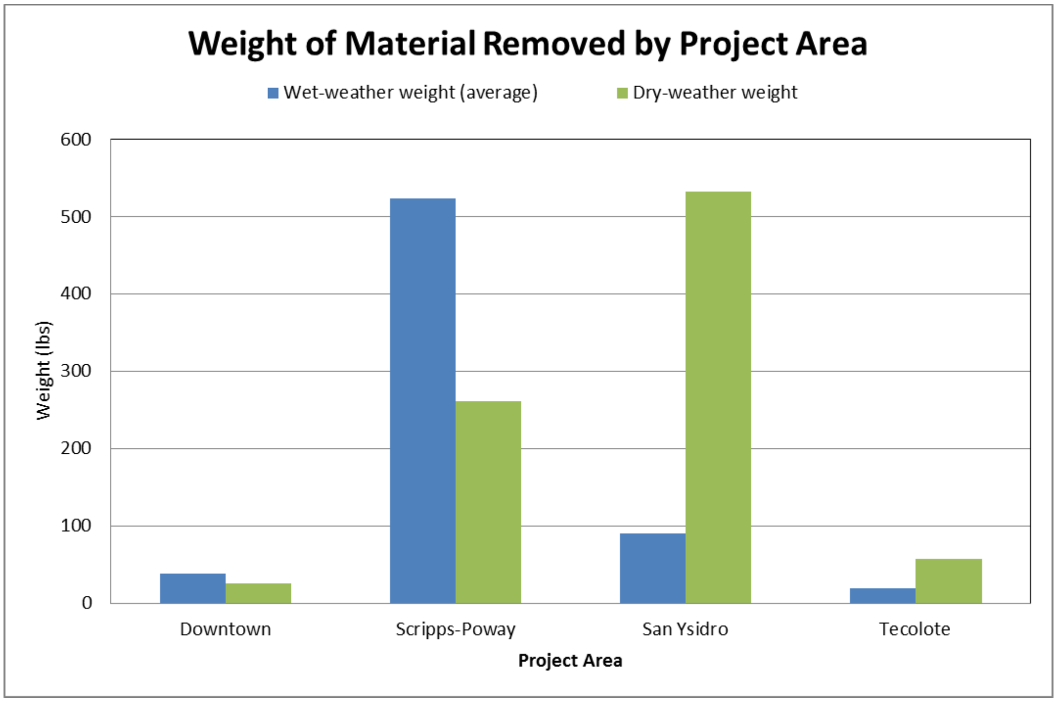


**Figure 11. Weight of materials removed from all catch basins within the four areas and in five sampling periods.**

An inspection based on visibility was used to estimate the composition of sediment, trash, and organic matter in the material removed from the catch basins (Figure 12). Most notably, material removed during the wet-weather clean-outs had greater variability in composition compared to material removed during the dry-weather clean-out. As shown in Figure 12, all samples were predominantly composed of sediment, but greater portions of trash and organics (and reciprocally, lesser portions of sediment) were consistently observed in wet-weather materials compared to dry-weather materials across all project areas. Trash was most significant in Downtown, Tecolote and San Ysidro during the wet-weather clean-outs. Trash could include such things as plastic, metal, paper, wrappers, glass, food, rubber, wood, or styrofoam. Organic materials were mostly leaves, grass, and twigs. As expected, a greater portion of sediment was observed in dry-weather materials across all project- areas due to prolonged opportunity between rain events for sediment accumulation.

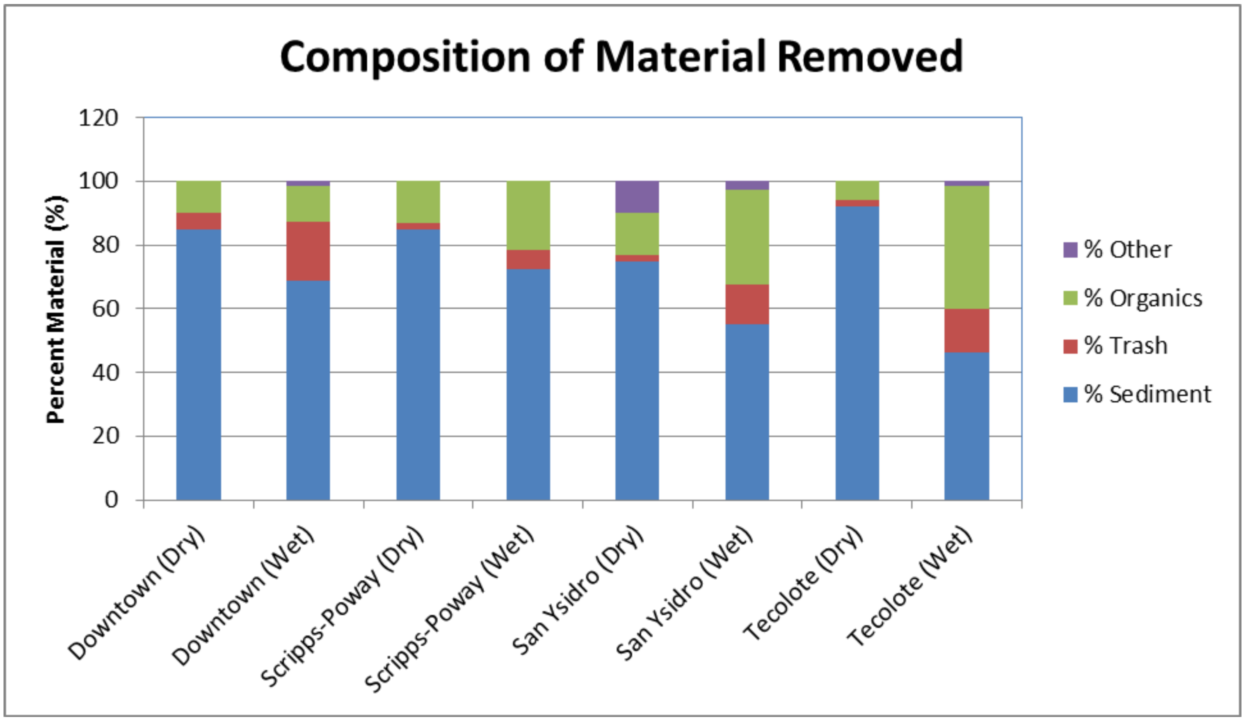


**Figure 12. Percentages of sediment, trash, and organic material in the material removed in each area (by visual inspection). Note: % Other includes gravel bags and rocks.**

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 (Figure 14). Gravel, which was predominant in earlier samples, was completely absent in the final wet-weather clean-out event (CO4) and in the dry-weather clean-out event (CO5). The reduction in gravel and coarse sand sized particles in each successive clean-out event can be seen when the percentages of particle sizes are converted to total weights (Figure 15). Gravel may accumulate over longer periods of time and may be carried into the catch basin by storm events with sufficient flows.

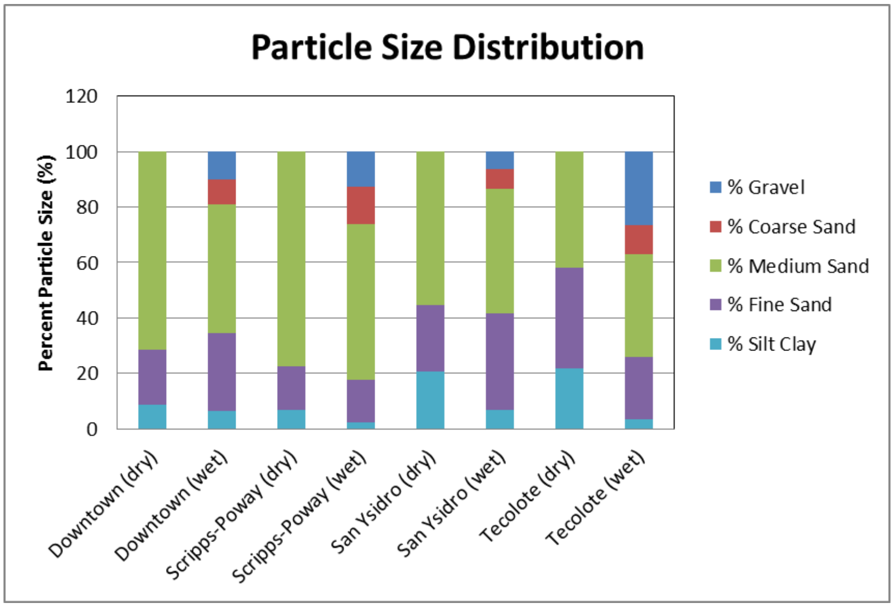


**Figure 13. Percentage sediment particle sizes by area.**

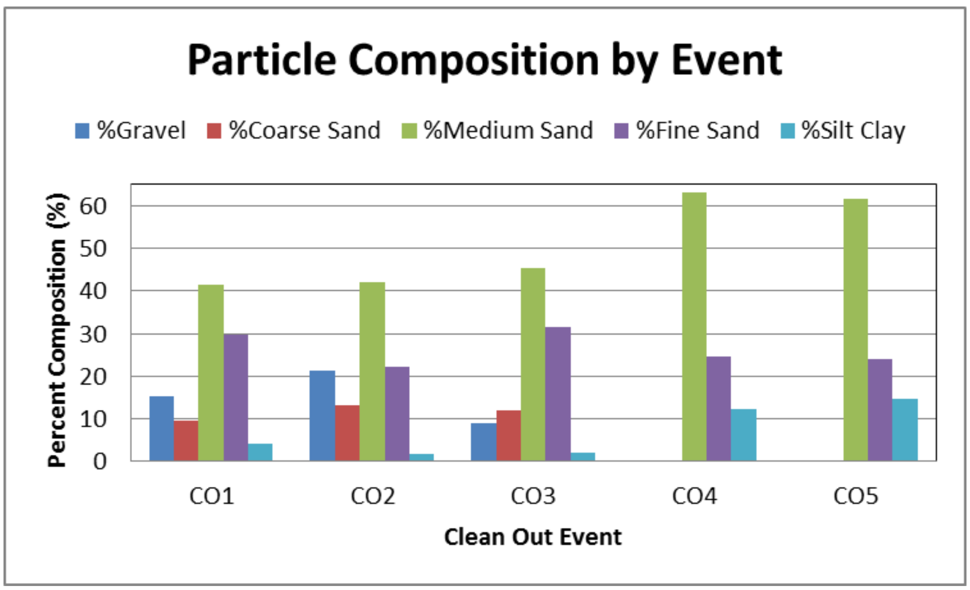


**Figure 14. Percentage sediment particle sizes by clean-out event, including four areas.**

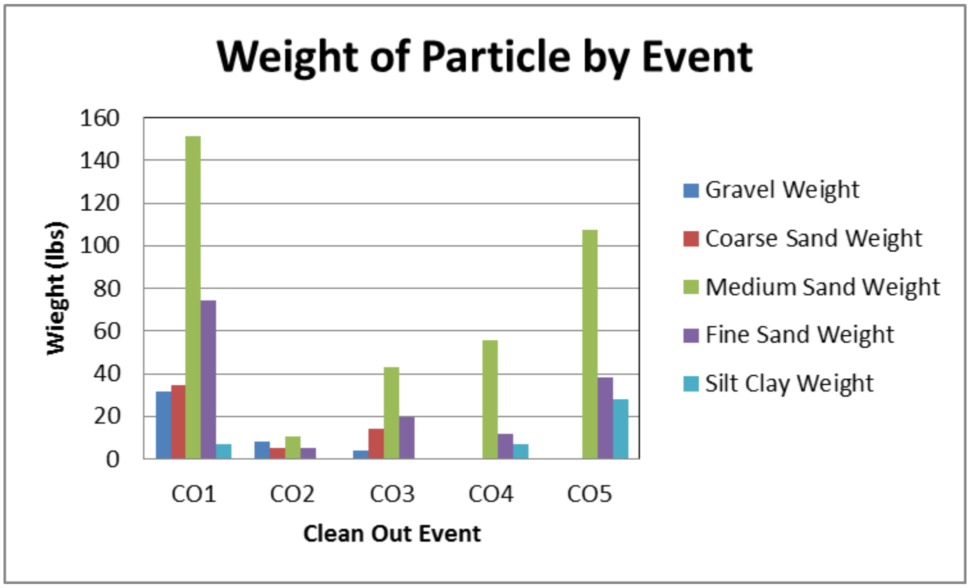


**Figure 15. Weight of sediment particle sizes by clean-out event, including four areas.**

## 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 clean-out 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 clean-out management.

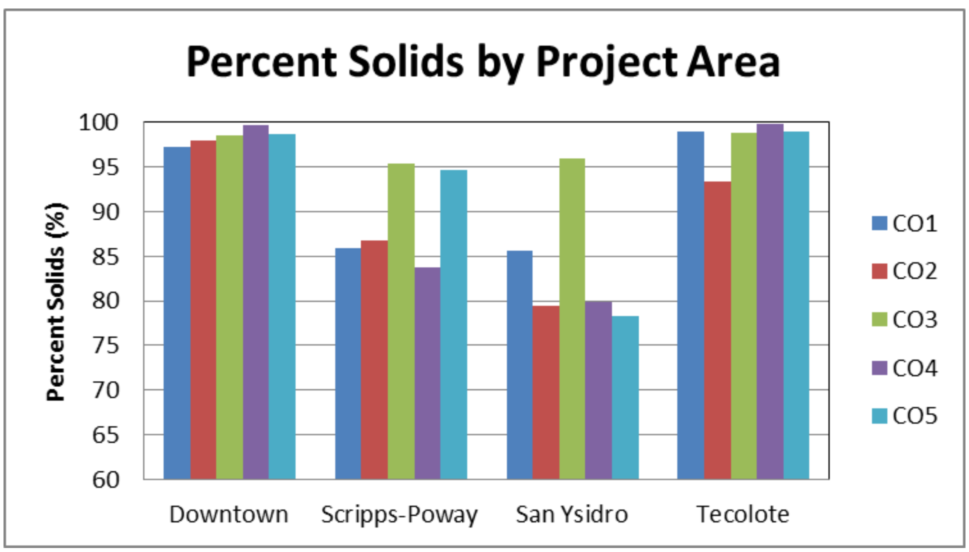


**Figure 16. Percent solids in each location, by clean-out number.**

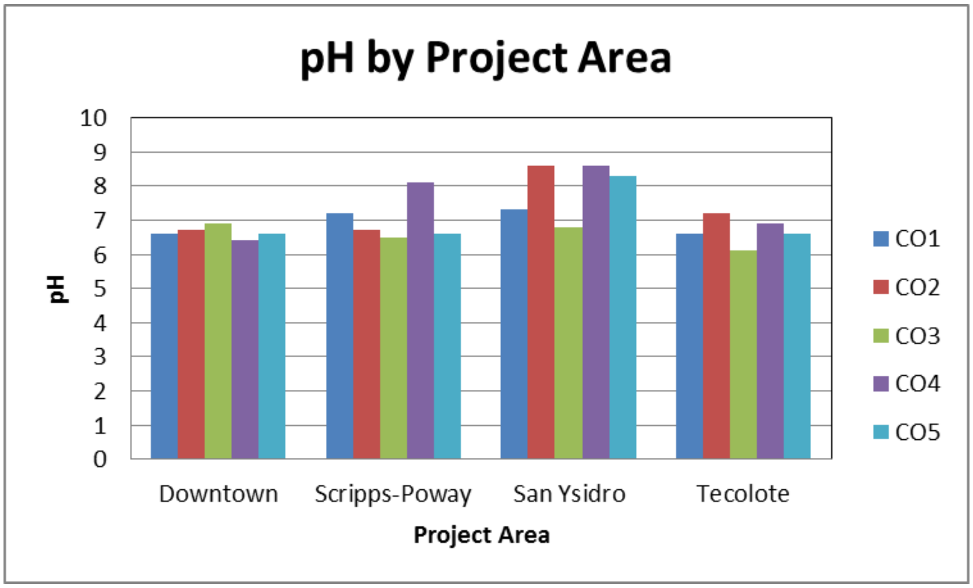


**Figure 17. pH in each location, by clean-out number.**

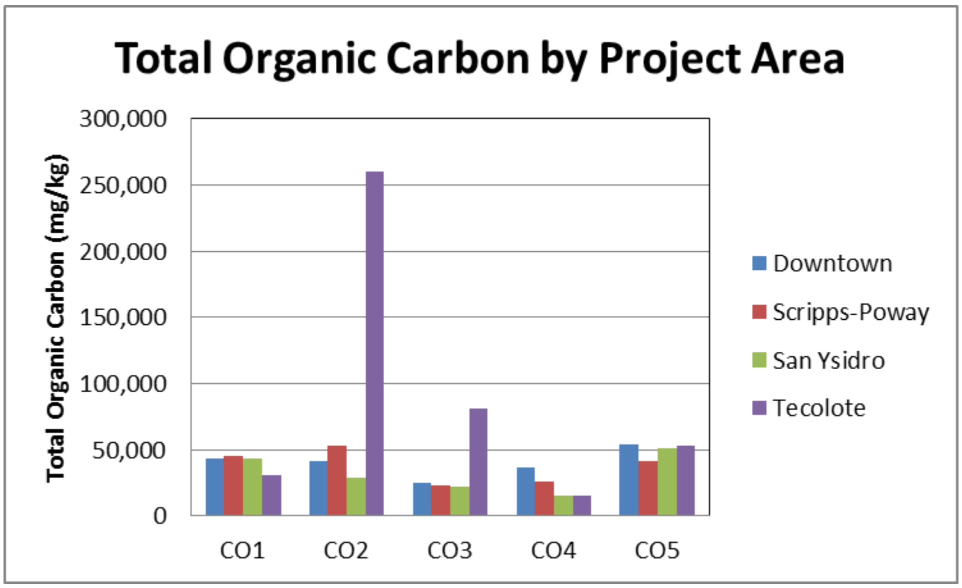


**Figure 18. Total Organic Carbon (mg/Kg) concentrations in each location, by clean-out number.**

## 3.3 Nutrients

Nutrients in materials removed varied between clean-out events and across all project areas. Most notably, substantially more nutrients are present during dry-weather clean-out events compared to nearly all wet-weather clean-out events across all project areas. Scripps-Poway, in particular, contained the most nitrogen and phosphorous loading throughout most wet-weather clean-out events and relatively high loading during the dry-weather clean-out. San-Ysidro had the greatest nitrogen and phosphorus loading during the dry-weather clean-out. During most of the wet-weather clean-out events, nutrient concentrations for San Ysidro were higher for total N and lower for total P, suggesting the presence of nitrogen sources and phosphorus uptake in the San Ysidro area (Figure 19 and Figure 20).

Because the weight of material removed from the Scripps-Poway 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 and between the fourth and fifth cleanouts, it appears that nutrients can accumulate quickly in the catch basins.

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

| | Wet-weather | | Dry-weather | |
|---|---|---|---|---|
| Location | Nitrogen (g) | Phosphorus (g) | Nitrogen (g) | Phosphorus (g) |
| Downtown | 100 | 44 | 324 | 84 |
| Poway | 450 | 214 | 2,347 | 704 |
| San Ysidro | 220 | 22 | 9,917 | 1,480 |
| Tecolote | 40 | 12 | 1,252 | 627 |

* standardized to 30 day accumulation and 10 acre drainage area

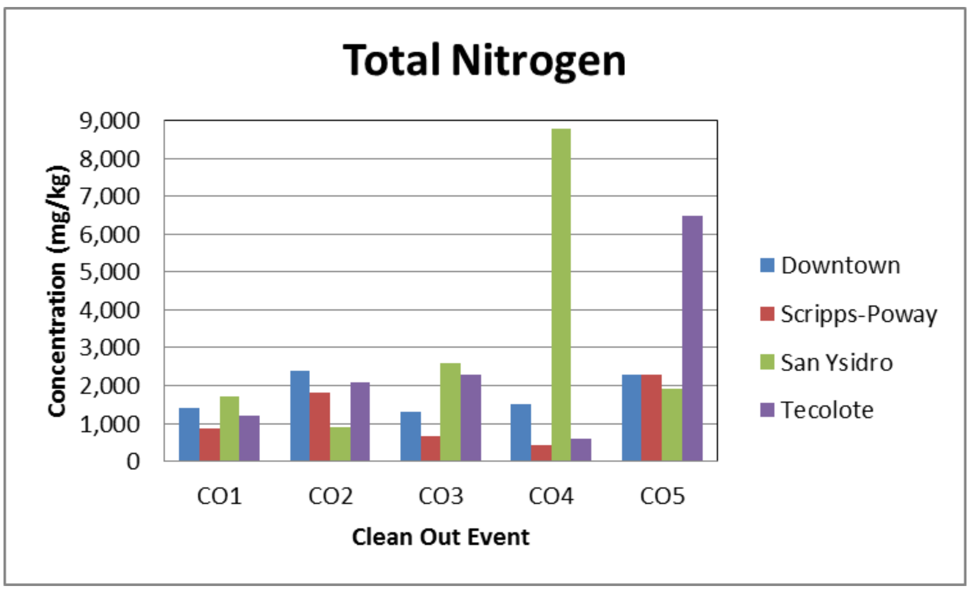


**Figure 19. Total Nitrogen concentrations in each location, by clean-out event.**

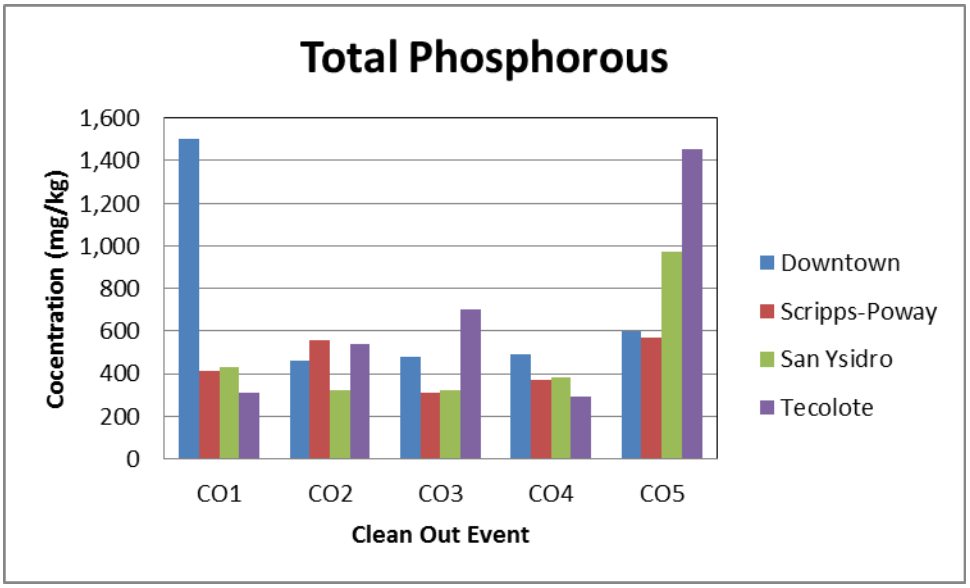


Figure 20. Total Phosphorus concentrations in each location, by clean-out event.

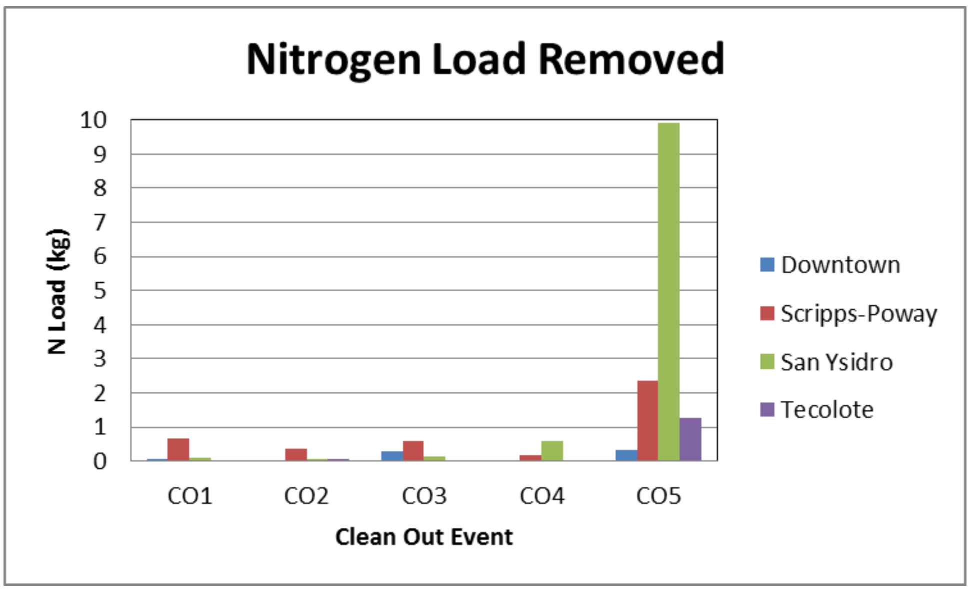


Figure 21. Nitrogen load removed for each location and clean-out event (standardized to a 30-day period and 10 acres).

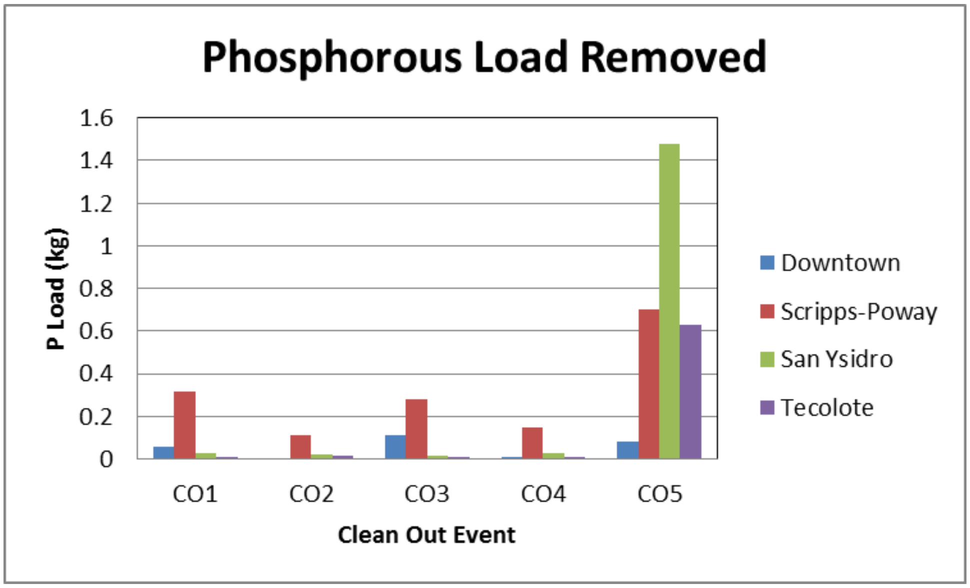


**Figure 22. Phosphorus load removed for each location and clean-out event (standardized to a 30-day period and 10 acres).**

## 3.4 Metals

Copper, lead, and zinc were sampled in each area for each sampling event. Significant variability in metal concentration occurred across all project areas during wet-weather clean-out events. The highest concentrations of copper and zinc were observed in the Downtown area during the first clean-out event (Figure 23, Figure 24, and Figure 25). The highest concentration of lead was observed during the dry-weather clean-out event (CO5) in the Tecolote Area. The lowest concentrations overall were consistently in the San Ysidro residential area for wet-weather clean-outs. 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 (as further described in Section 2). In considering dry-weather data, metal concentrations during the dry-weather clean-out were generally higher.

Cadmium was only of concern in the Tecolote area, in which it was not detected in the sediments collected during the first three clean-out events. The detection limit was 0.040 mg/Kg. In CO4, cadmium was detected at a concentration of 1.3 mg/Kg and a concentration of 1.0 mg/Kg in CO5.

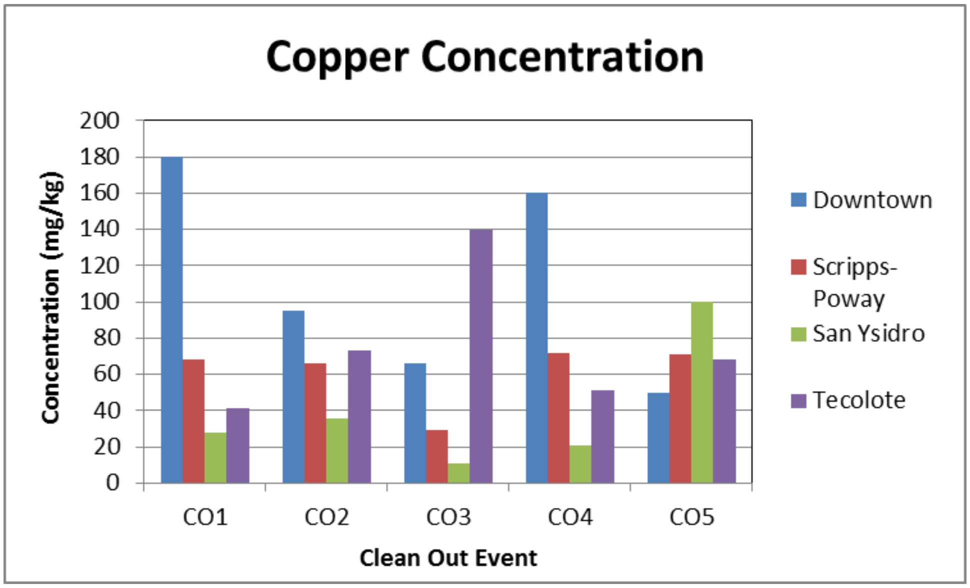


Figure 23. Copper concentrations in each area for each clean-out event.

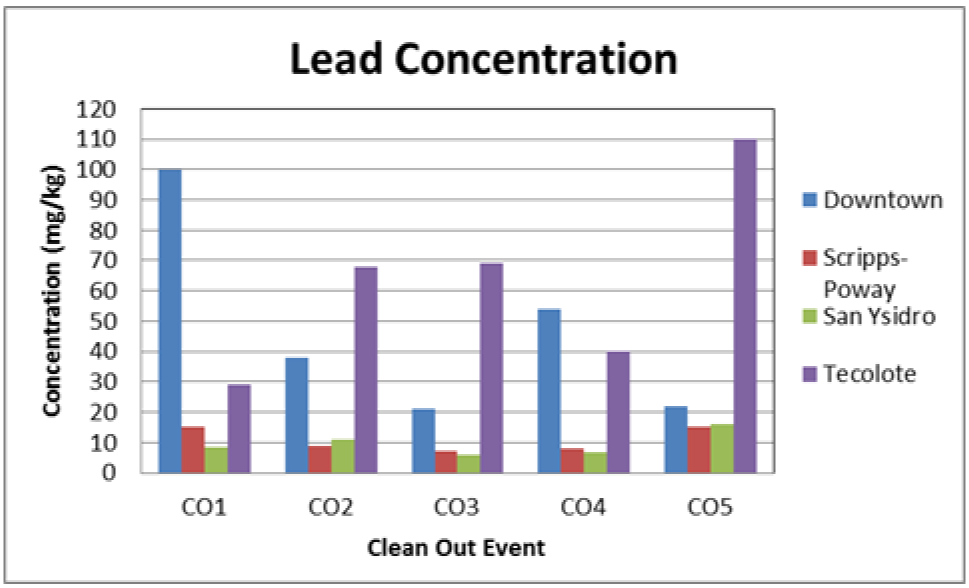


Figure 24. Lead concentrations in each area for each clean-out event.

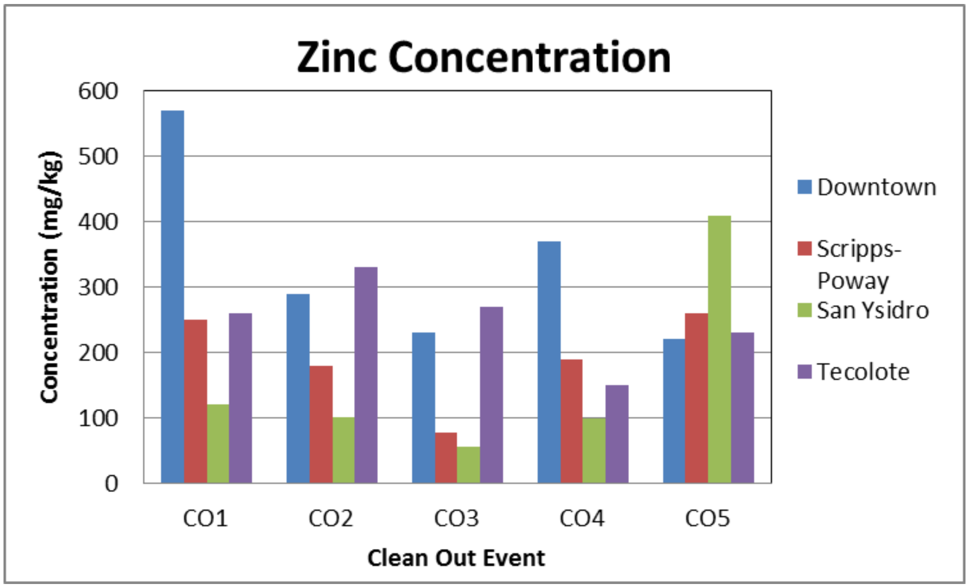


**Figure 25. Zinc concentrations in each area for each clean-out event.**

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**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 | CO5 (dry) | | 7.03 | 3.09 | 30.94 |
| | CO1 | | 6.88 | 3.82 | 21.78 |
| | CO2 | | 0.50 | 0.20 | 1.54 |
| | CO3 | | 15.20 | 4.84 | 52.98 |
| | CO4 | | 2.41 | 0.81 | 5.58 |
| | *Wet mean* | | *6.25* | *2.42* | *20.47* |
| Scripps-Poway | CO5 (dry) | | 87.72 | 18.53 | 321.22 |
| | CO1 | | 52.49 | 11.58 | 192.98 |
| | CO2 | | 14.40 | 1.80 | 35.99 |
| | CO3 | | 26.00 | 6.55 | 69.94 |
| | CO4 | | 29.00 | 3.26 | 76.52 |
| | *Wet mean* | | *30.47* | *5.80* | *93.86* |
| San Ysidro | CO5 (dry) | | 152.57 | 24.41 | 625.54 |
| | CO1 | | 1.73 | 0.53 | 7.42 |
| | CO2 | | 2.40 | 0.73 | 6.66 |
| | CO3 | | 0.55 | 0.29 | 2.73 |
| | CO4 | | 1.38 | 0.45 | 6.52 |
| | *Wet mean* | | *1.51* | *0.50* | *5.83* |
| Tecolote | CO5 (dry) | 0.431705 | 29.36 | 47.49 | 99.29 |
| | CO1 | ND** | 1.35 | 0.96 | 8.58 |
| | CO2 | ND** | 2.06 | 1.92 | 9.33 |
| | CO3 | ND** | 1.88 | 0.92 | 3.62 |
| | CO4 | 0.05193 | 2.04 | 1.60 | 5.99 |
| | *mean* | *0.05* | *1.83* | *1.35* | *6.88* |

*standardized to 30 day accumulation and 10 acre drainage area.
**ND stands for non-detect.

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. For lead, most values fell between LEL and PEL. The two lead PEL exceedances occurring during CO1 and CO5 in Downtown and Tecolote, respectively. For zinc, most values fell between LEL and PEL across all project areas. Zinc exceedances beyond PEL occurred in Downtown, San Ysidro, and Tecolote in varying clean-out events.

**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

| Metal | LEL (ppm, mg/kg dry wt) | PEL (ppm, mg/kg dry wt) | DO (mg/kg dry wt) | | | | | PO (mg/kg dry wt) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
| Cadmium | 0.6 | 3.53 | - | - | - | - | - | - | - | - | - | - |
| Copper | 16 | 197 | **180** | **95** | **66** | **160** | **50** | **68** | **66** | **29** | **72** | **71** |
| Lead | 31 | 91.3 | **100** | **38** | 21 | **54** | 22 | 15 | 9 | 7.3 | 8.1 | 15 |
| Zinc | 120 | 315 | **570** | **290** | **230** | **370** | **220** | **250** | **180** | 78 | **190** | **260** |
| Bold text represents samples between LEL and PEL.<br>Bold/Red text represents samples above PEL. | | | | | | | | | | | | |

| Metal | LEL (ppm, mg/kg dry wt) | PEL (ppm, mg/kg dry wt) | SY (mg/kg dry wt) | | | | | TE (mg/kg dry wt) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
| Cadmium | 0.6 | 3.53 | - | - | - | - | - | ND | ND | ND | 1.3 | 1 |
| Copper | 16 | 197 | **28** | **36** | 11 | **21** | **100** | **41** | **73** | **140** | **51** | **68** |
| Lead | 31 | 91.3 | 8.5 | 11 | 5.9 | 6.9 | 16 | 29 | **68** | **69** | **40** | **110** |
| Zinc | 120 | 315 | **120** | 100 | 55 | 99 | **410** | **260** | **330** | **270** | **150** | **230** |
| Bold text represents samples between LEL and PEL.<br>Bold/Red text represents samples above PEL. | | | | | | | | | | | | |

## 3.5 Microbiology

Microbiology samples demonstrate significant variability between project areas and clean-out events. Generally, higher bacteria concentrations occur during the wet season compared to the dry season as shown in Figure 26, Figure 27 and Figure 28. Considering wet-weather clean-out data, there is significant variability across all project areas and clean-out events for fecal coliform and total coliform. For enterococcus wet-weather data, no distinct trends can be seen between clean-out events, but Scripps-Poway and Tecolote had consistently higher concentrations compared to Downtown and San Ysidro for all wet-weather clean-outs. It is important to note that the variability in the data is not directly representative of bacteria entering the catch basin as the basin itself may provide breeding media for bacteria allowing greater amounts of bacteria to flow downstream.

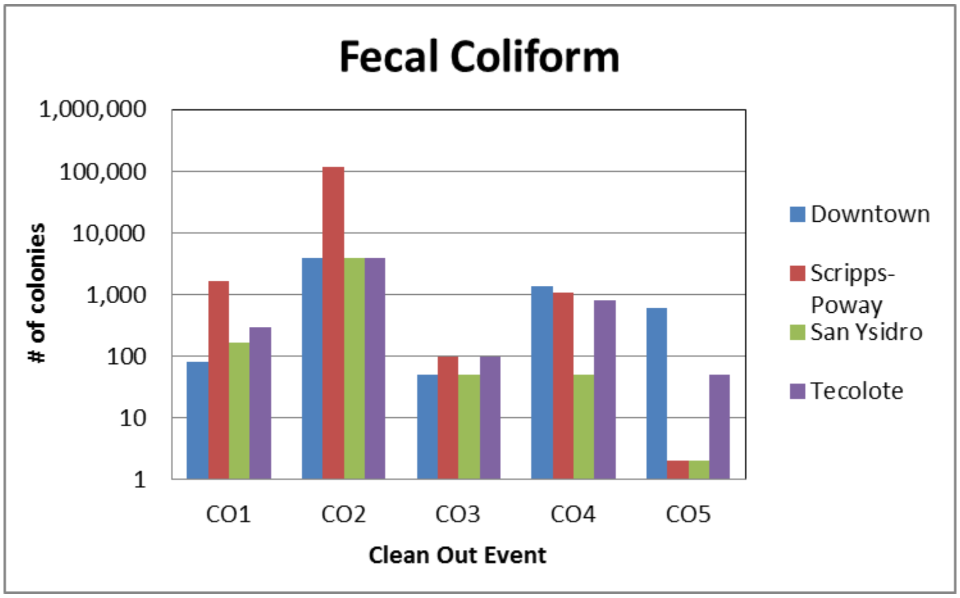


Figure 26. Fecal coliform colonies in each location for each clean-out.

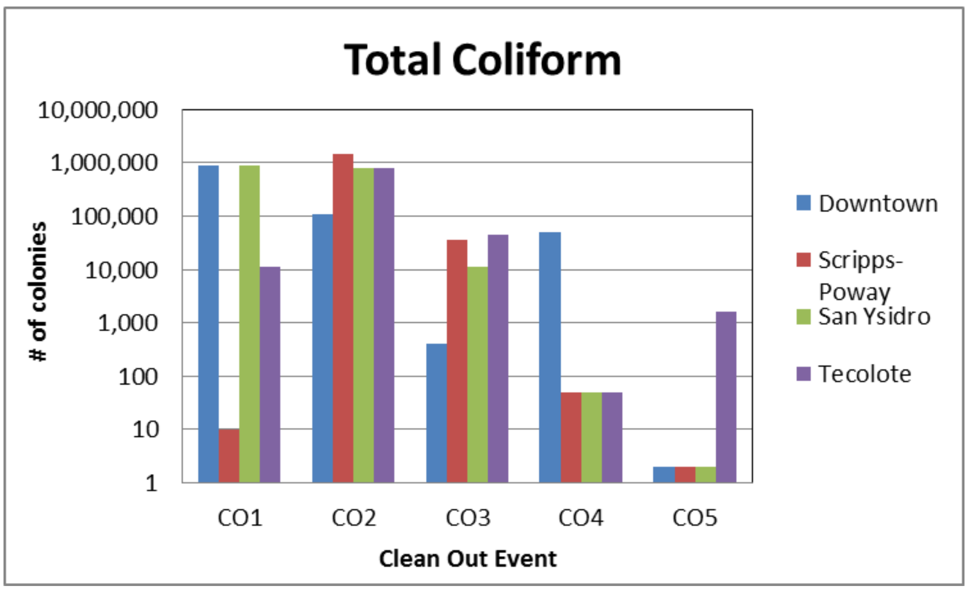


Figure 27. Total coliform colonies in each location for each clean-out.

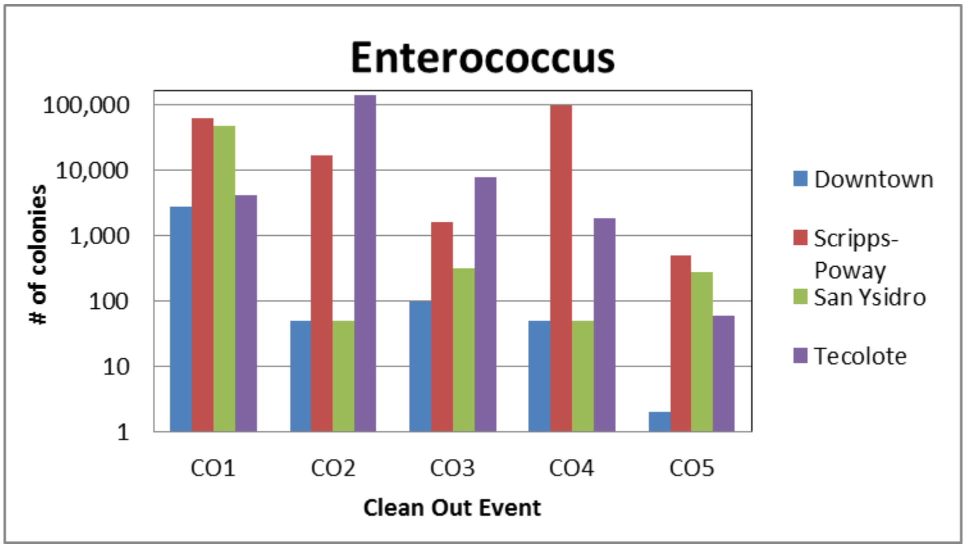


**Figure 28. Enterococcus colonies in each location for each clean-out.**

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**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 | CO5 (dry) | 8.44E-02 | 2.81E-04 | 2.81E-04 |
| | CO1 | 3.06E+06 | 3.44E+10 | 1.07E+08 |
| | CO2 | 2.12E+07 | 5.82E+08 | 2.65E+05 |
| | CO3 | 1.15E+07 | 9.21E+07 | 2.30E+07 |
| | CO4 | 2.11E+07 | 7.54E+08 | 7.54E+05 |
| | *Wet mean* | *1.42E+07* | *8.95E+09* | *3.28E+07* |
| Scripps-Poway | CO5 (dry) | 2.47E-03 | 2.47E-03 | 5.00E+02 |
| | CO1 | 1.31E+09 | 7.72E+06 | 4.71E+10 |
| | CO2 | 2.40E+10 | 3.00E+11 | 3.40E+09 |
| | CO3 | 8.97E+07 | 3.14E+10 | 1.43E+09 |
| | CO4 | 4.43E+08 | 2.01E+07 | 3.95E+10 |
| | *Wet mean* | *6.46E+09* | *8.28E+10* | *2.28E+10* |
| San Ysidro | CO5 (dry) | 3.05E-03 | 3.05E-03 | 4.27E-01 |
| | CO1 | 1.05E+07 | 5.57E+10 | 2.84E+09 |
| | CO2 | 2.67E+08 | 5.33E+10 | 3.33E+06 |
| | CO3 | 2.48E+06 | 5.47E+08 | 1.54E+07 |
| | CO4 | 3.29E+06 | 3.29E+06 | 3.29E+06 |
| | *Wet mean* | *7.07E+07* | *2.74E+10* | *7.17E+08* |
| Tecolote | CO5 (dry) | 2.16E-02 | 6.91E-01 | 2.59E-02 |
| | CO1 | 9.90E+06 | 3.63E+08 | 1.35E+08 |
| | CO2 | 1.13E+08 | 2.26E+10 | 3.96E+09 |
| | CO3 | 1.34E+06 | 6.03E+08 | 1.03E+08 |
| | CO4 | 3.20E+07 | 2.00E+06 | 7.19E+07 |
| | *Wet mean* | *3.91E+07* | *5.90E+09* | *1.07E+09* |

## 3.6 Organic Pollutants

Organic pollutants were of concern in the Downtown area and were only analyzed in that area. For those pollutants that were analyzed consistently in each clean-out 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. Dry-weather data from CO5 is unremarkable compared to wet-weather clean-out data.

The timing of the clean-out prior to CO1 in this study may have affected the degree of buildup. The date of the previous clean-out is unknown; if the prior clean-out took place well prior to CO1, then the pollutant apparently built up over that time. With regular clean-out, the concentrations mostly diminished to undetectable levels. However, that was not true for Decachlorobiphenyl (Surrogate), Fluorobiphenyl, 2-(Surrogate), Nitrobenzene-d5(Surrogate), Terphenyl-d14(Surrogate), and Tetrachloro-m-xylene(Surrogate); all of which had their highest concentrations in CO3, which was the shortest period between clean-outs.

It appears that some organic pollutants accumulate over time in the catch basin sediments. Regular clean-outs 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 five clean-out periods (CO1 – 5).**

| Analyte | CO1 | CO2 | CO3 | CO4 | CO5 | Units | LEL/PEL[a] |
|---|---|---|---|---|---|---|---|
| Acenaphthene | *0.36* | *0.34* | *0.75* | *0.05* | *0.01* | mg/Kg | /0.09 |
| Acenaphthylene | *0.25* | *0.235* | *0.5* | *0.05* | *0.01* | mg/Kg | /0.13 |
| Aldrin | *5.5* | *11* | *5.5* | *2.2* | *5.5* | ug/kg dw | 2/ |
| Anthracene | **1.5** | *0.37* | *0.8* | *0.05* | *0.01* | mg/Kg | 0.22/0.25 |
| Benz(a)anthracene | | | | **0.19** | 0.06 | mg/Kg | 0.32/0.39 |
| Benz(a)anthracene-d12(Surrogate) | **2.1** | *0.305* | *0.65* | | 0.09 | mg/Kg | |
| Benzo(a)pyrene | **2.6** | *0.44* | *0.95* | 0.3 | 0.12 | mg/Kg | 0.37/0.78 |
| Benzo(b)fluoranthene | **3.4** | *0.5* | *1.1* | 0.4 | 0.12 | mg/Kg | |
| Benzo(e)pyrene | | | | **0.26** | 0.09 | mg/Kg | |
| Benzo(g,h,i)perylene | | | | **0.32** | 0.17 | 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 | 0.05 | mg/Kg | 0.24/ |
| Biphenyl | | | | *0.05* | *0.01* | mg/Kg | |
| Chlordane | **130** | *95* | *50* | *19* | *48.5* | ug/kg dw | 7/8.9 |
| Chlordane, cis- | *6.5* | *12* | *6.5* | *2.45* | *6* | ug/kg dw | |
| Chlordane, gamma- | *4.9* | *9.5* | *4.9* | *1.9* | *4.5* | ug/kg dw | |
| Chrysene | **3** | *0.37* | *0.8* | 0.25 | 0.16 | 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* | *2.3* | ug/kg dw | 8/8.5 |
| DDE(o,p') | | | | *4.7* | | ug/kg dw | |
| DDE(p,p') | *3.75* | *7* | *3.75* | *1.45* | *3.65* | ug/kg dw | 5/6.75 |
| DDT(o,p') | | | | *4.7* | | ug/kg dw | |
| DDT(p,p') | *2.7* | *5* | *2.7* | *1.05* | *2.6* | ug/kg dw | 8/4.8 |
| Decachlorobiphenyl(Surrogate) | 198.5 | 151.5 | **221** | 72.95 | 134 | ug/kg dw | |
| Dibenz(a,h)anthracene | *0.55* | *0.5* | *1.1* | *0.05* | 0.06 | mg/Kg | 0.06/0.14 |
| Dieldrin | *3.65* | *7* | *3.65* | *1.4* | *3.55* | ug/kg dw | 2/6.7 |

| Analyte | CO1 | CO2 | CO3 | CO4 | CO5 | Units | LEL/PEL[a] |
|---|---|---|---|---|---|---|---|
| Dimethylnaphthalene, 2,6- | | | | *50* | | ug/kg dw | |
| Endosulfan I | *2.8* | *5.5* | *2.8* | *1.05* | *2.7* | ug/kg dw | |
| Endosulfan II | *1.55* | *3* | *1.55* | *0.6* | *1.5* | ug/kg dw | |
| Endosulfan sulfate | *2.7* | *5* | *2.7* | *1.05* | *2.6* | ug/kg dw | |
| Endrin | *6.5* | *12.5* | *6.5* | *2.5* | *6.5* | ug/kg dw | 3/62.4 |
| Endrin Aldehyde | *3.4* | *6.5* | *3.4* | *1.3* | *3.35* | ug/kg dw | |
| Endrin Ketone | | | | *0.85* | | ug/kg dw | |
| Fluoranthene | **7** | *0.475* | *1.05* | 0.38 | 0.14 | mg/Kg | |
| Fluorene | **1.3** | *0.135* | *0.295* | *0.05* | *0.01* | mg/Kg | 0.75/2.4 |
| Fluorobiphenyl, 2-(Surrogate) | 1.3 | 0.586 | **1.82** | 0.206 | 0.30 | mg/Kg | |
| HCH, alpha | *7* | *13.5* | *7* | *2.75* | *7* | ug/kg dw | |
| HCH, beta | *3.85* | *7.5* | *3.85* | *1.5* | *3.75* | ug/kg dw | |
| HCH, delta | *2.8* | *5.5* | *2.8* | *1.05* | *2.7* | ug/kg dw | |
| HCH, gamma | *6.5* | *12.5* | *6.5* | *2.45* | *6* | ug/kg dw | |
| Heptachlor | *6.5* | *12.5* | *6.5* | *2.55* | *6.5* | ug/kg dw | |
| Heptachlor epoxide | *4.45* | *8.5* | *4.45* | *1.7* | *4.35* | ug/kg dw | |
| Indeno(1,2,3-c,d)pyrene | **1.9** | *0.75* | *1.65* | 0.29 | 0.12 | mg/Kg | 0.2/ |
| Kepone | | | | *41.5* | | ug/Kg dw | |
| Methoxychlor | *2.7* | *5* | *2.7* | *1.05* | *0.01* | ug/kg dw | |
| Methylnaphthalene, 1- | | | | *50* | *11* | ug/Kg dw | |
| Methylnaphthalene, 2- | | | | *50* | *11* | ug/Kg dw | |
| Methylphenanthrene, 1- | | | | *50* | *11* | ug/Kg dw | |
| Mirex | | | | *1.45* | | ug/Kg dw | 7/ |
| Naphthalene | *0.36* | *0.34* | *0.75* | *0.05* | *0.01* | mg/Kg | /0.39 |
| Nitrobenzene-d5(Surrogate) | 1.23 | 0.541 | **1.68** | 0.2 | 0.29 | 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* | *80* | ug/kg | |
| PCB AROCLOR 1221 | *700* | *140* | *145* | *55* | *145* | ug/kg | |
| PCB AROCLOR 1232 | *500* | *95* | *100* | *39.5* | *100* | ug/kg | |
| PCB AROCLOR 1242 | *550* | *110* | *115* | *45* | *115* | ug/kg | |
| PCB AROCLOR 1248 | *900* | *175* | *185* | *70* | *180* | ug/kg | |
| PCB AROCLOR 1254 | *600* | *120* | *125* | *49* | *125* | ug/kg | |
| PCB AROCLOR 1260 | *100* | 70 | 44 | *8* | **71** | ug/kg | 60/340 |
| Perylene | | | | *50* | *11* | ug/kg dw | |
| Phenanthrene | **8.1** | *0.55* | *1.2* | 0.15 | 0.09 | mg/Kg | 0.56/0.52 |
| Pyrene | **5** | *0.34* | *0.75* | 0.31 | 0.15 | mg/Kg | 0.49/0.88 |
| Terphenyl-d14(Surrogate) | 1.35 | 0.721 | **2.07** | 0.169 | 0.31 | mg/Kg | |
| Tetrachloro-m-xylene(Surrogate) | 139 | 179.5 | **243.5** | 59.35 | 164 | ug/kg dw | |
| Toxaphene | **42** | *80* | *42* | *16* | *41* | 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***

- Trends between dry-weather and wet-weather material removed are variable and cannot be directly or conclusively related to land use or removal method used.
- The vactor method in the Scripps-Poway 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. Scripps-Poway area also yielded significant amounts of material on a consistent basis (throughout all clean-out events).
- Organic materials (leaves, twigs) were most prevalent in the Tecolote area.
- Trash was most prevalent during wet-weather clean-outs compared to dry-weather clean-outs. Of the four project areas, Downtown had the highest composition of trash during both wet- and dry-weather clean-outs.
- Sediment dominated the composition across all project areas with medium-sized sand as the most common sediment particle size.
- Proportion of sediment was greater for dry-weather clean-outs compared to wet-weather clean-outs.
- With successive clean-outs, larger gravels became less common.

***General Chemistry***

- Percent solids, pH, and total organic carbon patterns were unremarkable during both wet- and dry-weather clean-outs.

***Nutrients***

- Nitrogen and phosphorus concentrations were higher during the dry-weather clean-out than the wet-weather clean-outs.
- Scripps-Poway contained the most nitrogen and phosphorous loading throughout most wet-weather clean-out events and relatively high loading during the dry-weather clean-out.
- San-Ysidro had the greatest nitrogen and phosphorus loading during the dry-weather clean-out.
- Nutrient concentrations were higher for total N and lower for total P in San Ysidro during most wet-weather clean-out periods.

***Metals***

- Metal concentrations are greater during the dry-weather clean-out compared to wet-weather clean-out concentrations.

- Metal concentrations between project areas varied during wet-weather clean-out events. However, during the dry-weather clean-out, less variability between project areas was evident.
- The highest concentrations of copper, lead, and zinc were observed in the Downtown area, during the first clean-out event.
- The lowest concentrations overall were consistently in the San Ysidro residential area.
- Cadmium was only tested in the Tecolote area, where it was only detected in CO4 and CO5 in concentrations that fell between LEL and PEL .

*Microbiology*

- Wet-weather clean-out samples had greater bacteria concentrations than the dry-weather clean-out sample.
- 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.
- There is no remarkable trend between dry-weather and wet-weather clean-out data.

## 4.2 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 area, it appears that the vactor method would be most efficient for especially deep catch basins and where standing water in the system is typical (Figure 29, left photo). Manual cleaning appears to be warranted for shallower catch basins, 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 clean-out 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 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.**

## 4.3 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.

Location and frequency trends will be further analyzed as part of Phase 2 of this study using historical manual clean-out data from 2008 through 2012 as well as this report. As part of Phase 2, a mapping analysis of local characteristics (storm drain systems/networks, soils, impaired water bodies, land uses) compared with clean-out data will guide the formulation of a catch basin cleaning prioritization matrix.

## 4.4 Study Data Limitations

The data acquired through this study provide insight into the material accumulated in select areas of San Diego and only broadly represent larger areas of San Diego. Conclusions drawn with regards to material quantity, pollutant patterns, location priority, and frequency and timing of clean-outs are limited in their validity due to the small sample size and short sampling period. These data, however, can be ground-truthed with literature values representative of the San Diego Region. Conclusions drawn in this study are general and exclusive to the timeframe and locations from which the data was acquired. Future efforts in optimizing catch basin cleaning methods as part of Phase 2 of this project (Task Order 51) will rely and expand on these data to further validate conclusions based on frequency, dry-and wet-weather historic trends, and land use characteristics. Manual clean-out data from 2008 through 2012 covering much of the City's catch basins will be mapped and analyzed for trends. These results will be compared to the results from this study, allowing for more robust conclusions and trends analyses. The catch basin cleaning prioritization matrix resulting from Phase 2 will allow City staff to further focus cleaning efforts to those areas deemed to provide the most pollutant load reduction potential per unit effort expended.

# 5 References

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