

### 14.1 Conclusions

#### 14.1.1 Wet Weather Monitoring Conclusions

The current monitoring program has allowed the region to gain an understanding of wet weather conditions at the base of watersheds throughout the County. It has provided both long-term trend analyses at historic stations, and the foundation for long-term trends throughout the County. TIEs conducted during wet weather events at stations with persistent exceedances of toxicity have identified causes of toxicity in the Tijuana River. A comparison between watersheds has determined that the Tijuana River and Chollas Creek consistently have more wet weather water quality objective exceedances than other watersheds in the County. The results for Agua Hedionda Creek have indicated increasing long-term trends for a number of constituents that appear to be related to greater sediment loads and increasing nutrients in wet weather flows. From a regional perspective, the consistent wet weather water quality issues in the region include coliform bacteria, total suspended solids, and turbidity. Table 14-1 shows persistent wet weather constituents of concern and statistically significant trends observed for each mass loading station.

The single event and annual mean concentrations for key constituents and toxicity at the Tijuana River MLS were statistically different and concentrations and magnitude of exceedances of WQO were significantly higher compared to all the other MLS, particularly those associated with untreated wastewater and highly urbanized land use, including fecal coliform bacteria, TSS, metals, pesticides, and nutrients. This is a pattern that has been consistent throughout the past four years of monitoring. This MLS has also had the most consistent toxicity results with toxicity to *Ceriodaphnia* and *Hyalella*.

On a regional basis, TSS annual mean concentrations have exceeded the WQO in 7 of the 11 MLS over the last 4 monitoring years indicating that TSS, which is an indicator of sediment loading, is a regional water quality issue. Higher TSS can be associated with an increase in land disturbance activities in the watershed, and increased impervious areas upstream of creek and river sections that may be subject to bank erosion from greater and more sustained peak flows. Temporal patterns in TSS concentrations indicate higher concentrations during greater intensity storm events. Across watersheds, the highest exceedances were observed for the 2004-2005 monitoring period which corresponds to the year of greatest precipitation. Larger and greater intensity storm events will mobilize a greater amount of sediment that would then correlate to greater TSS concentrations. As presented in Table 14-1, long-term significant trends include increasing turbidity and TSS in Agua Hedionda Creek and increasing turbidity in Chollas Creek. Turbidity and TSS concentrations at these MLS were above the WQO.

Regionally, the concentration of fecal coliform has exceeded the WQO in all watersheds in multiple years. The highest exceedances occurred at the Tijuana River, which has multiple water quality issues likely associated with the reported discharges of untreated sewage. Bacteria appears to be a consistent regional water quality issue. As summarized in Table 14-1, notable long-term trends for bacteriological indicators demonstrate increasing trends for enterococci in Tecolote Creek, the San Luis Rey River, and the Tijuana River, and for fecal coliform in the San Luis Rey River and Agua Hedionda Creek. Concentrations of fecal coliform were generally above the WQO. Concentrations of indicator bacteria in the San Luis Rey River have increased from below to above the WQO.

**Table 14-1. Mass Loading Station Persistent Wet Weather Constituents and Trends.**

Mass Loading Station	Persistent Wet Weather Constituents of Concern	Significant Trends Observed
Santa Margarita	Fecal Coliform Turbidity	No observed trends
San Luis Rey	Total Dissolved Solids	Increasing nitrate, total coliform, fecal coliform, and enterococcus
Agua Hedionda Creek	Fecal Coliform Total Suspended Solids Turbidity Enterococcus	Increasing chemical oxygen demand, total Kjeldahl nitrogen, total and dissolved phosphorus, total suspended solids, turbidity, fecal coliform, and total lead  Decreasing conductivity
Escondido Creek	Fecal Coliform Total Coliform Total Dissolved Solids Turbidity	Increasing pH  Decreasing Diazinon
San Dieguito River	Total Dissolved Solids	Increasing nitrate and total and dissolved phosphorus  Decreasing total chromium
Peñasquitos Creek	Total Dissolved Solids	Decreasing Diazinon
Tecolote Creek	Fecal Coliform Total Coliform Enterococcus Turbidity	Increasing total phosphorus and enterococcus  Decreasing MBAS, ammonia as N, Diazinon, total cadmium and lead
San Diego River	Fecal Coliform Total Coliform Enterococcus Turbidity	Decreasing conductivity and Diazinon
Chollas Creek	Fecal Coliform Total Coliform Enterococcus Turbidity Diazinon Total and Dissolved Copper Total Zinc	Increasing turbidity and nitrite  Decreasing total lead
Sweetwater River	Fecal Coliform	Decreasing Diazinon
Tijuana River	Fecal Coliform Total Coliform Enterococcus Total Suspended Solids Turbidity Diazinon	Increasing total suspended solids and enterococcus  Decreasing total dissolved solids, conductivity, dissolved arsenic and nickel

Additional notable trends based on regression analysis and listed in Table 14-1 include:

- Nutrients - Increasing nitrate concentration in the San Luis Rey and San Dieguito Rivers. Increasing total and dissolved phosphorus concentrations in Agua Hedionda Creek and the San Dieguito River, total phosphorus in Tecolote Creek, and nitrite in Chollas Creek. Concentrations of nitrate and dissolved phosphorus are below the WQO.

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- Pesticides - Diazinon concentrations indicate significant decreasing trends in Escondido Creek, Peñasquitos Creek, Tecolote Creek, the San Diego River, and Sweetwater River. Concentrations have decreased from above to below the WQO.
- Metals - Trend analysis based on regression analysis of the wet-weather data indicate a significant increasing trend for total lead in Agua Hedionda Creek. Decreasing trends are noted for total lead concentrations in Tecolote Creek and Chollas Creek; for total chromium in the San Dieguito River; for total cadmium in Tecolote Creek, and for dissolved arsenic and nickel in the Tijuana River.

Relationships between *Ceriodaphnia dubia* toxicity and COC based on the four years of data showed strong relationships for increasing toxicity with higher amounts of Diazinon, dissolved phosphorus, and dissolved nickel. Strong relationships based on the threshold analysis were also found for Diazinon.

### 14.1.2 Stream Bioassessment Conclusions

A total of 27 different stream monitoring reaches were assessed in San Diego County in October 2004 and May 2005. Four of these sites represented reference conditions. A total of 49 different monitoring reaches have been sampled since May 2001.

Taxonomic identification of samples collected in October 2004 produced 110 taxa from a total of 18,460 individuals. The May 2005 samples produced 91 taxa from 21,534 individuals.

The most abundant organisms in October 2004 in the study region were *Simulium* (Diptera: Simuliidae), non-biting midges (Diptera: Chironomidae), *Hyalella* (Amphipoda: Hyalellidae) and Ostracods (Ostracoda). The most abundant organisms in May 2005 in the study region were *Simulium* (Diptera: Simuliidae), *Baetis* (Ephemeroptera: Baetidae), and non-biting midges (Diptera: Chironomidae). The majority of organisms from the urban affected sites were moderately or highly tolerant to stream impairments. Organisms highly intolerant to impairments were encountered infrequently at the urban affected sites, but their presence even in low numbers is significant. Non-reference sites that supported highly intolerant organisms included San Dieguito River-Del Dios Highway and Santa Margarita River-Willow Glen Road.

The Index of Biotic Integrity ratings of the monitoring sites ranged from Very Good to Very Poor in both surveys. IBI scores for the reference sites were always higher than the scores for the urban influenced sites, although REF-SC2 was one point higher than the highest non-reference site in the May 2005 survey. The May 2005 survey produced consistently lower IBI scores across the entire region than the October 2004 survey. Comparison of IBI scores with the in-stream physical habitat quality of the monitoring reaches indicated a poor correlation between habitat quality and benthic macroinvertebrate community quality.

Of all of the watersheds in San Diego County, the Santa Margarita River watershed had the least impaired benthic macroinvertebrate communities. The remaining watersheds have substantially greater amounts of urbanization, and the IBI results generally indicate that increased water quality impairment occurs in the lower portions of the watersheds, as the impacts of urban runoff become cumulative.

After 4½ years of bioassessment surveys, the most significant observation is that the macroinvertebrate community quality has not shown any trend towards degradation or improvement. IBI scores for most of

the San Diego sites were similar between May 2001 to May 2005. Individual seasons or years have produced varying conditions for the macroinvertebrates, and many of the monitoring sites have shown a parallel response to the variability of the conditions.

### **14.1.3 Ambient Bay and Lagoon Program Conclusions**

In the summer of 2004 sediments in the twelve major coastal embayments in San Diego County were monitored to assess the potential for adverse effects from the watershed and to compare sediment quality among the embayments. In Phase I, a stratified random approach was used to identify the three sites in each embayment where COC were most likely to be found (i.e., those with the highest TOC and smallest grains size). Buena Vista Lagoon had a much higher percentage of TOC and fine grained sediments than the other embayments. In contrast, sediments in Santa Margarita River Estuary contained a much lower TOC content and percentage of fine-grained particles than the other embayments. This pattern was also seen in the 2003 ABLM sampling.

In Phase II of the assessment, the three sites identified in Phase I for each embayment were sampled and analyzed for chemistry, toxicity, and benthic community structure. For the chemistry assessment, composite sediment samples from each embayment were analyzed for metals, PCBs, PAHs, and pesticides. PCBs, PAHs, and pesticides were not detected in any of the embayments. A suite of six metals was found in all 12 embayments: arsenic, chromium, copper, lead, nickel, and zinc. In general, concentrations of metals were low in all embayments and there were no metals that exceeded their ERM thresholds. However, several metals exceeded ERL values, including copper (exceeded the ERL at three sites), arsenic (exceeded the ERL at four sites), zinc (exceeded the ERL at three sites), and lead (exceeded the ERL at one site). The mean ERM-Q value, which represents the cumulative impact from all COCs for which ERMs are available, was greatest at Mission Bay and Oceanside Harbor and lowest at the Santa Margarita River Estuary and San Elijo Lagoon.

For the toxicity assessment, the percent survival of a marine amphipod exposed to sediments from each of the embayments was compared to that of a control. Percent survival was not significantly different from that of the control for ten embayments: Santa Margarita River Estuary, Oceanside Harbor, San Luis Rey River Estuary, Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon, Los Peñasquitos Lagoon, Mission Bay, Sweetwater River Estuary, and Tijuana River Estuary. The two remaining embayments where percent survival was significantly different from that of the control were Batiquitos Lagoon and San Dieguito Lagoon.

For the benthic community assessment, animals collected from the sediment at three sites in each embayment were identified to the lowest possible taxonomic level. Several indices of benthic community structure were then calculated, including abundance, richness, diversity, evenness, and dominance. For each embayment the scores from these indices were ranked and the summed ranks were used to compare the benthic communities among the 12 embayments. Based on this overall ranking, the embayments with the best relative benthic communities were Mission Bay, Sweetwater River Estuary, Batiquitos Lagoon, Oceanside Harbor, Santa Margarita River Estuary, and San Dieguito Lagoon. Those with the worst relative benthic communities were Buena Vista Lagoon, Agua Hedionda Lagoon, Los Peñasquitos Lagoon, Tijuana River Estuary, San Luis Rey River Estuary, and San Elijo Lagoon.

The experimental design for the ABLM Program was based on a presumed positive correlation between COCs, TOC content, and grain size, where higher COC concentrations are expected in areas with higher TOC and smaller grain size. However, the relationships between sediment chemistry, toxicity,

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and benthic community structure were weak for the 2004 data set. This is likely due to the dynamic nature of coastal estuaries and a limited number of samples and analyses. Results from samples collected in subsequent years of the ABLM Program may help to strengthen these relationships.

### 14.1.4 Watershed Assessment Conclusions

#### 14.1.4.1 Santa Margarita River Watershed Management Area

The Santa Margarita River watershed is the second largest in the San Diego hydrologic region. The primary land use within the contributing runoff area is undeveloped (64%). For the Santa Margarita River WMA, turbidity and fecal coliform were identified as high frequency of occurrence COC, TSS was identified as a medium frequency of occurrence COC, and TDS and nitrate were identified as low frequency of occurrence COC. There was no evidence of persistent toxicity found in Santa Margarita River. The stream habitat quality varied between poor and fair which indicated that there was no evidence of benthic alteration. Based on the Ambient Bay and Lagoon Monitoring Program, the relative ranks for the Santa Margarita River Estuary were one for chemistry, two for toxicity and five for benthos. Compared to the other embayments in the 2004 ABLM program, the Santa Margarita River Estuary had an overall rank of one. The relative ranks for Oceanside Harbor were 10 for chemistry, 6 for toxicity, and 2 for benthos. The benthic community ranked second highest among other embayments within San Diego County. Compared to the other embayments in the 2004 ABLM program, Oceanside Harbor had an overall rank of six. The relative quality for both the Santa Margarita River Estuary and Oceanside Harbor increased from the ABLM 2003 monitoring year.

The WMA assessment findings agreed with the BLTEA rating priorities for the Santa Margarita River WMA, which found sediments to be a high priority (A rating) constituent. The BLTEA ratings also gave a B rating to nutrients, bacteria, gross pollutants and benthic alteration.

#### 14.1.4.2 San Luis Rey River Watershed Management Area

The San Luis Rey River watershed is the third largest watershed in San Diego County. The contributing runoff area is representative of the entire watershed which is approximately 29% open space and 25% agricultural. For the San Luis Rey River WMA, TDS was the only high frequency of occurrence COC, followed by turbidity, nitrate, ammonia, and all three bacterial indicators which were all low frequency of occurrence COC. There was no evidence of persistent toxicity in San Luis Rey River, however, the benthic community appeared to be limited by unknown factors. While high TDS levels may be affecting diversity, there may be other constituents not measured that are impacting the benthic invertebrate community. In the San Luis Rey River Estuary, the final receiving waters for the San Luis Rey River, relative rankings were five for sediment chemistry, four for toxicity and eight for the benthic community. The San Luis Rey River Estuary was rated intermediate compared against other embayments within San Diego County. Compared to last year's ranking, the San Luis Rey River Estuary experienced a decrease in relative quality.

In addition to the WMA assessment findings, the BLTEA findings suggest that sediments and bacteria are also high priority (A rated) constituents followed by benthic alteration which was given a B rating.

#### 14.1.4.3 Carlsbad Watershed Management Area

The Carlsbad watershed is the third most densely populated watershed in the San Diego region. For the Agua Hedionda sub-watershed which accounts for 11% of the Carlsbad watershed, land use within the contributing runoff area is primarily residential (33%), undeveloped (25%), and agriculture (11%). For

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Agua Hedionda Creek, TSS, turbidity, fecal coliform, and enterococcus were identified as high frequency of occurrence COC, TDS and diazinon were identified as medium frequency of occurrence COC, and pH, COD, ammonia, and total coliform were identified as low frequency of occurrence COC.

For the Escondido Creek sub-watershed which accounts for approximately 33% of the Carlsbad watershed, land use within the contributing runoff area is predominantly undeveloped (35%), residential (25%), and parks (16%). For Escondido Creek, TDS, turbidity, total coliform, and fecal coliform were identified as high frequency of occurrence COC, enterococcus was identified as a medium frequency of occurrence COC, and TSS and nitrate were identified as low frequency of occurrence COC.

In Agua Hedionda Creek, increasing trends were observed for fecal coliform, TSS, turbidity, COD, TKN, total and dissolved phosphorus, and total lead. Third party data collected in 2002 under SWAMP, indicated that sulfate, manganese, and toxicity were consistent problems throughout the Carlsbad watershed. The sources of the water quality problems in the watershed are unknown but likely come from several disperse sources. The water quality concerns were highlighted by poor and very poor ratings of the macroinvertebrate communities in the streams. Four lagoons within the Carlsbad watershed were monitored in the Ambient Bay and Lagoon Monitoring Program, including Buena Vista, Agua Hedionda, Batiquitos, and San Elijo Lagoons. For Buena Vista Lagoon, the relative ranks were nine for chemistry, one for toxicity, and nine for benthic community structure. Compared to the other embayments in the 2004 ABLM program, Buena Vista Lagoon had an overall rank of seven. The relative ranks for Agua Hedionda Lagoon were five for chemistry, seven for toxicity, and six for benthic community structure. Compared to the other embayments in the 2004 ABLM program, Agua Hedionda Lagoon had an overall rank of six. For Batiquitos Lagoon, the relative ranks were 6 for chemistry, 10 for toxicity, and 2 for benthic community structure. Compared to the other embayments in the 2004 ABLM program, Batiquitos Lagoon had an overall rank of six. For San Elijo Lagoon, the relative ranks were two for chemistry, five for toxicity, and seven for benthic community structure. Compared to the other embayments in the 2004 ABLM program, San Elijo Lagoon had an overall rank of three. The relative quality in all lagoons within the Carlsbad watershed increased compared to the 2003 ABLM rankings.

The WMA assessment findings agreed with the BLTEA rating priorities, which found sediments and bacteria to be high priority (A rating) constituents followed by nutrients and benthic alteration which were given a B rating.

### 14.1.4.4 San Dieguito River Watershed Management Area

The San Dieguito River MLS run-off area accounts for only 8% of the overall San Dieguito WMA. Approximately 86% of the watershed lies behind dams (Coastal Conservancy 2001). The major land uses within the contributing runoff area are undeveloped (24%), parks (24%), residential (21%), and agricultural (18%). For the San Dieguito River, only TDS was identified as a high frequency of occurrence COC, fecal coliform was identified as a medium frequency of occurrence COC, and turbidity, total coliform, and enterococcus were identified as low frequency of occurrence COC. The in-stream benthic community appears to be limited by unknown factors, and while high TDS levels may be affecting diversity, there may be other constituents not measured that are impacting the benthic community. In San Dieguito Lagoon, the relative rankings were 3 for chemistry, 10 for toxicity, and 4 for benthic community structure. Overall, the San Dieguito Lagoon was rated intermediate compared to other embayments within San Diego County. San Dieguito Lagoon experienced a decrease in relative quality compared to the 2003 ABLM program.

In addition to the WMA assessment findings, the BLTEA ratings found sediments as a high priority (A) rating followed by gross pollutants, bacteria, benthic alteration, and toxicity which were given a B rating.

#### **14.1.4.5 Los Peñasquitos Creek Watershed Management Area**

The Los Peñasquitos Creek run-off area accounts for approximately 60% of the Los Peñasquitos watershed management area. The major land uses within the contributing runoff area are parks (29%), residential (28%), and undeveloped (24%). For the Los Peñasquitos Creek WMA, only TDS was identified as a high frequency of occurrence COC, fecal coliform was identified as a medium frequency of occurrence COC, and turbidity, ammonia, orthophosphate, total coliform, and enterococcus were identified as low frequency of occurrence COC. Third party data collected in 2002 under SWAMP indicated that sulfate, manganese, and toxicity were consistent problems throughout Los Peñasquitos watershed. The in-stream benthic community appears to be limited by unknown factors, and while high TDS levels may be enough of a stress to insects, other constituents not monitored in the Los Peñasquitos Creek MLS watershed may also be affecting the benthic invertebrate community. In Los Peñasquitos Lagoon, the final receiving waters for Los Peñasquitos Creek, relative rankings were four for chemistry, three for toxicity, and six for benthic community structure. Compared to the other embayments in the 2004 ABLM program, Los Peñasquitos Lagoon had an overall rank of two. The relative quality within the lagoon increased compared to the 2003 ranking.

In addition to the WMA assessment findings, the BLTEA ratings found sediments and bacteria to be the highest priority (A rated) constituents for the Los Peñasquitos WMA followed by benthic alteration which was given a B rating.

#### **14.1.4.6 Mission Bay Watershed Management Area**

For the Tecolote Creek sub-watershed, which accounts for approximately 14% of the Mission Bay watershed management area, the primary land uses within the contributing runoff area are residential (43%) and transportation (21%). For the Mission Bay WMA, turbidity and all three bacterial indicators were identified as high frequency of occurrence COC, TSS and Diazinon were identified as medium frequency of occurrence COC, and ph, COD, and orthophosphate were identified as low frequency of occurrence COC. Third party data collected in 2002 under SWAMP indicated that sulfate, manganese, and toxicity were consistent problems at the Tecolote Creek monitoring station. There was no evidence of persistent toxicity associated with samples collected from the Tecolote Creek MLS. However, the in-stream benthic community was ranked as poor and very poor, suggesting evidence of benthic alteration. In Mission Bay, the final receiving waters for Tecolote Creek, relative rankings were 11 for chemistry, 8 for toxicity and 1 for benthic community structure. Overall, Mission Bay received a ranking of eight compared to other embayments within San Diego County. Mission Bay experienced a decrease in relative quality compared with the 2003 ABLM program.

In addition to the WMA assessment findings, the BLTEA ratings found heavy metals and bacteria were the highest priority (A rated) constituents for the Mission Bay WMA followed by sediments, nutrients, and bacteria which were given B ratings. The heavy metals priority rating found in the BLTEA rating was primarily due to the 303(d) listings for metals in the Miramar and Tecolote sub-watersheds even though the WMA assessment did not indicate metals were an overall priority.

#### **14.1.4.7 San Diego River Watershed Management Area**

The San Diego River watershed is the second largest watershed in San Diego County. The contributing runoff area to the MLS is approximately 39% of the San Diego watershed land area. The major land uses

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within the contributing runoff area are residential (29%), parks (24%), and undeveloped (21%). For the San Diego River WMA, turbidity and all three bacterial indicators were identified as high frequency of occurrence COC followed by TDS, which was identified as a medium frequency of occurrence COC. TDS during wet weather monitoring and monthly monitoring within the watershed by Padre Dam showed a medium frequency of occurrence but appears to be related to groundwater influences and local conditions. As noted in Section 10.2.3, the TDS water quality objective may not accurately reflect the natural conditions of the San Diego River WMA. Dissolved oxygen in samples collected by Padre Dam exceeded the Basin Plan water quality objective 46% of the time. Although ammonia and orthophosphate in dry weather data may indicate localized issues within the WMA, the evaluation and combination of Padre Dam data in the assessment process suggests that on a regional scale these constituents do not frequently exceed water quality objectives. The occurrence of these constituents may be a result of numerous activities or sources. The stream habitat quality was rated Poor in Mission Trails, a large open recreation space, and Very Poor in Mission Valley, a highly urbanized residential and commercial corridor. The Very Poor rating in Mission Valley may be a result of physical disturbances to habitat, insecticides or other COC that are not analyzed for in this program, or algal growth observed and measured as chlorophyll within the stream.

In addition to the WMA assessment findings, the BLTEA ratings found sediments, bacteria, and benthic alteration were the highest priority (A rated) constituents for the San Diego River WMA followed by pesticides which was given a B rating.

### 14.1.4.8 San Diego Bay Watershed Management Area

The Chollas sub-watershed within the Pueblo San Diego watershed drains a very densely populated, urban area. Nearly 65% of the drainage area is residential and another 17% is commercial. Turbidity, all three indicator bacteria, Diazinon, total and dissolved copper, and total zinc were identified as high frequency of occurrence COC. Medium frequency of occurrence COC were identified for COD, and TSS, followed by BOD, MBAS, ammonia, orthophosphate, and total lead which were identified as low frequency of occurrence COC. The benthic community impacts and stream habitat impairments may be a result of elevated COC or physical alterations to the riparian corridor.

Since the EPA has banned the retail sale of Diazinon and Chlorpyrifos, and with the increased public outreach and education regarding the handling of pesticides in general, a decreasing trend for these compounds should continue.

The Sweetwater watershed drainage area consists of 50% vacant or undeveloped land, 30% residential and only 10% commercial. The contrast in land use compared to Chollas Creek may likely be the reason for better observed (based on data assessed) water quality in Sweetwater River. Only fecal coliform was identified as a high frequency of occurrence COC within Sweetwater River. TDS was identified as a medium frequency of occurrence COC, followed by turbidity, total coliform, enterococcus, and Diazinon, which were identified as low frequency of occurrence COC. The bioassessment monitoring identified Sweetwater River as having a Very Poor IBI score and was the lowest rated site in the county in the October Survey. In the ABLM program, the results of the chemistry assessment indicated that six of the nine metals assessed were found in Sweetwater River sediments. None of the six metals detected above the reporting limit exceeded its respective ERL or ERM value. The mean ERM quotient was 0.140 which exceeded the threshold value of 0.10. Sweetwater River Estuary ranked eight for chemistry, nine for toxicity, and three for benthic community structure relative to the other embayments assessed. Compared to the other embayments in the 2004 ABLM program, Sweetwater River Estuary had an

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overall rank of eight. The relative quality in the Sweetwater River Estuary increased in 2004 compared with the 2003 ranking.

For the San Diego Bay WMA, sediment was given a high priority (A) rating based on the BLTEA rating method followed by pesticides, bacteria, and benthic alterations which were given a B rating.

The BLTEA findings are similar to the WMA assessments for both Chollas Creek and Sweetwater River. Turbidity, bacteria and Diazinon had a high frequency of occurrence in Chollas Creek, while bacteria had a high frequency of occurrence in Sweetwater River. There was evidence of benthic alteration in both sub-watersheds.

### 14.1.4.9 Tijuana River Watershed Management Area

The Tijuana River watershed management area is the largest of the San Diego watersheds covering over 1.1 million acres. Mexico governs the majority of the Tijuana River watershed (73%) with the remaining areas belonging to the United States. Undeveloped areas account for 58% of U.S. lands, with another 25% devoted to parks. The River flows through Tijuana, Mexico and runoff contributions come from both Mexico and the United States. For the Tijuana River WMA, TSS, turbidity, all three bacterial indicators, and Diazinon were identified as high frequency of occurrence COC, followed by BOD, COD, ammonia, and total phosphorus which were identified as medium frequency of occurrence COC, and MBAS, dissolved phosphorus, Chlorpyrifos, Malathion, and total copper were identified as low frequency of occurrence COC. The elevated densities of all three bacterial indicators and elevated levels of BOD, COD, and nutrients (un-ionized ammonia as N and total phosphorus) are indicative of wastewater discharges. Pesticides are also a persistent problem in the watershed. Stream bioassessment monitoring rated the Tijuana River site as Poor, but the investigators in this study feel that this rating is much higher than the actual benthic community quality suggests. The two other bioassessment sites are upstream of any influence from the City of Tijuana and surrounding communities and are not representative of the lower reaches of the Tijuana River directly affected by runoff from these communities. Data collected during the Ambient Bay and Lagoon Monitoring program suggest the elevated concentrations of numerous constituents observed in the Tijuana River are not impacting estuarine sediments. The Tijuana Estuary sediments did not contain any PAHs, PCBs, or pesticides and results of toxicity tests were similar to those of a control. Overall, the Tijuana River Estuary received a rating of five compared to other embayments within San Diego County. The Tijuana River Estuary experienced a decrease in relative quality compared with the 2003 ABLM ranking.

The BLTEA rating priorities agreed with the WMA assessment findings for the Tijuana Valley sub-watershed but since this sub-watershed is only 7% of the entire Tijuana River WMA, it suggests that the high priorities and COCs may be more localized to the area near the MLS. The Tijuana River WMA did not have any high priority (A) ratings for the overall WMA. The highest rated constituents were sediments, nutrients, gross pollutants, bacteria, and benthic alteration which were all given a B rating.

## 14.2 Program Review

During the 2001-01 permit issuance, the Copermitees were required to review historical data and develop future recommendations. This was developed in the "San Diego Region Previous Storm Water Monitoring and Future Recommendations Report" (MEC 2001). This report put forth monitoring objectives for the 2001-01 permit term. The overall goal of monitoring expressed in the report was to "understand conditions of receiving waters within each watershed, identify water quality problems within

each watershed, and take actions to correct those problems so that beneficial uses are not degraded or impaired.” The design of the program included core monitoring, regional monitoring, and special studies.

The intent of the monitoring design was to identify watersheds with water quality problems using the information collected during wet weather events at the base of the watershed, benthic community information, and information collected in the lagoons and embayments. This “prioritization” of watersheds was intended to provide a mechanism to focus special studies and upstream investigations into identification of the contributing sources to the water quality problems, as well as to provide additional characterization of those watersheds.

The program design that was implemented in the 2001-2002 permit year was intended to provide:

- Information relating to chemical, physical, and biological impacts to receiving waters resulting from urban runoff,
- Indication of the overall health and long-term trends in water quality in the receiving waters.

To date these two over-arching goals have been met by the monitoring design, however, additional questions resulting from the collected data have yet to be answered. Such questions include “What are the dry weather (ambient) concentrations of the urban runoff constituents?” and “How do the constituents of concern vary throughout the watershed?”

In 2004, the Storm Water Monitoring Coalition (SMC) developed a Model Storm Water Monitoring Guidance Document. San Diego Region Copermittees had representatives who participated in the development of the guidance document. The SMC developed the guidance by framing five management questions which urban runoff monitoring should consider. The SMC acknowledged that these questions may not all be of equal import to jurisdictions, but rather can assist jurisdictions and jurisdictional groups in refining their monitoring programs. The five questions are:

1. What are the water quality conditions in the watershed?
2. Are water quality conditions in the watershed getting better or worse?
3. Are beneficial uses being impacted?
4. What is the relative contribution of urban runoff to the conditions in the watershed?
5. What are the sources to urban runoff that contribute to water quality conditions?

The current Copermittee monitoring program can partially address these questions, however the program was initially designed to be adaptive through time and focus efforts toward identifying water quality problems in watersheds. Once watersheds with problems were identified, the adaptive part of the program is intended to move monitoring and assessment upstream in those priority watersheds to fully answer the management questions (MEC 2001).

The current Copermittee monitoring program’s ability to fully answer the five management questions is limited by the present prescriptive requirements of the NPDES permit 2001-01. Currently the watershed data assessment utilizes the wet weather monitoring data at the mass loading stations, the benthic community assessments within the watersheds, dry weather information, limited third party data, and the Clean Water Act 303(d) listing to provide a management tool to stakeholders.

The following describes the current monitoring program’s ability to address each question:

**Question 1: What are the water quality conditions in the watershed?** This question is partially addressed through the current NPDES program, but a comprehensive watershed assessment is not

provided by the current program. The current monitoring program evaluates wet weather discharges at the base of the watershed for toxicity effect to freshwater organisms and chemical, bacterial, and general physical parameters. The current program provides bacterial monitoring at coastal outfalls, benthic community assessment at several locations within the watershed, and chemistry at limited locations within the watershed's MS4 system. While these data are evaluated to provide an indication of potential water quality problems within the watershed, these disparate monitoring groups were not strategically designed to answer question 1 but are designed to meet permit requirements.

**Question 2: Are water quality conditions in the watershed getting better or worse?** This question is partially addressed in the following ways:

- Long-term trend assessment at the mass loading stations can provide an indication of improvements in the watershed.
- Long-term trend assessment of the quality of the benthic community within the watershed.

**Question 3: Are beneficial uses being impacted?** This question is only addressed through comparison to water quality objectives. For example, bacterial counts exceeding water quality objectives indicate an impact to recreational beneficial use.

**Question 4: What is the relative contribution of urban runoff to the conditions in the watershed?** To answer the question of "relative" contribution requires knowledge of baseline conditions or a reference (non-urbanized) area for comparison. This question is not directly addressed in the current program; however, the current program does provide comparison between watersheds. This comparison of watersheds together with an assessment of different land use characteristics and an evaluation of concentrations of constituents of concern, occurrence and magnitude of toxic effects, and benthic community health yields an understanding of the impacts related to urbanization and various land uses.

**Question 5: What are the sources to urban runoff that contribute to water quality conditions?** There are a variety of approaches to answer this question. The current program provides a mechanism to understand potential sources in urbanized watersheds. For example, Diazinon in urban watersheds comes from residential, commercial, or agricultural pest control. Where further source characterization and identification is required, a more focused study would be needed to answer the question.

As outlined above, the current Copermittee monitoring program can partially address these questions, however the program was initially designed to be adaptive through time and focus efforts toward identifying water quality problems in watersheds. Once watersheds with problems were identified, the adaptive part of the program is intended to move monitoring and assessment upstream in those priority watersheds to provide additional information for management actions (MEC 2001). This adaptive philosophy is the same philosophy presented in the Model Monitoring Document. The SMC did not intend that permit monitoring would comprehensively address all five questions, nor was the intent that the stepwise approach as presented in the Model Monitoring Document would be followed in a linear, stepwise fashion, but rather that monitoring would be conducted based upon a prioritization of needs (SMC 2004).

The current data from the monitoring program provides a strong foundation to form the basis of existing knowledge about water quality that was not available for all watershed management areas prior to 2001-2002. Using this information, the Copermittees can refine their monitoring program to better address specific management questions and yield more baseline information against which improvements in water

quality can be measured. As the Copermittees enter into a new permit cycle in 2006-2007, it presents an opportune time to reassess the existing monitoring program together with the management questions to define the future monitoring program approach in the next permit cycle.

Based on the review of the information obtained from the existing monitoring program and historical monitoring data, recommendations are presented in the next subsections for the next iteration of monitoring program to move the San Diego Region forward to continuing to understand urban runoff and its impacts.

### **14.3 Recommendations**

#### **14.3.1 2005-2006 Recommendations**

The recommended actions from the triad assessments are summarized in Table 14-2 and include continuing water quality monitoring in all watersheds to gather long-term trend information, investigating upstream sources of contaminants, and conducting TIEs in Chollas Creek and Sweetwater River.

Since the EPA has banned the retail sale of Diazinon and Chlorpyrifos, and with the increased public outreach and education regarding the handling of pesticides in general, a decreasing trend for the organophosphate pesticide compounds is evident and should continue. Continued monitoring of the organophosphate compounds should show an overall decrease in the number of WQO exceedances and concentrations over time with the expectation that residual public supply and use will eventually be exhausted. However, the pesticide manufacturer's shift to synthetic pyrethroids does warrant concern and monitoring should be considered for these analytes.

Additional recommendations for 2005-2006 are to conduct a qualitative assessment of streambank erosion around mass loading and stream bioassessment stations, as well as to monitor for organochlorine and organophosphate pesticides, PAHs, PCBs, and synthetic pyrethroids at the Ambient Bay and Lagoon sampling locations.

**Table 14-2. Recommended actions from the triad assessment.**

Watershed	Chemistry	Toxicity	Benthic Alteration	Possible Conclusion(s)	Possible Actions or Decisions
Santa Margarita	Persistent exceedances of water quality objectives	No persistent evidence of toxicity	No Indications of alteration	Limited dataset makes conclusions difficult. Test organisms not sensitive to problem pollutants. Contaminants are not bioavailable.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) Continue monitoring for toxic and benthic impacts. Consider whether different or additional test organisms should be evaluated.</li> <li>3) Initiate upstream source identification as a low priority.</li> <li>4) TIE would not provide useful information with no evidence of toxicity.</li> </ol>
San Luis Rey	No persistent exceedances of water quality objectives	No persistent evidence of toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) No action necessary based on toxic chemicals.</li> <li>3) Consider whether different test organisms should be evaluated.</li> <li>4) Consider potential role of physical habitat disturbance.</li> </ol>
Agua Hedionda	Persistent exceedances of water quality objectives	No persistent evidence of toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) Evaluate upstream source identification as a high priority.</li> <li>3) Consider whether different test organisms should be evaluated.</li> <li>4) Consider potential role of physical habitat disturbance.</li> <li>5) TIE would not provide useful information with no evidence of toxicity.</li> </ol>
Escondido Creek	Persistent exceedances of water quality objectives	No persistent evidence of toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) Evaluate upstream source identification as a high priority.</li> <li>3) Consider whether different test organisms should be evaluated.</li> <li>4) Consider potential role of physical habitat disturbance.</li> <li>5) TIE would not provide useful information with no evidence of toxicity.</li> </ol>
San Dieguito River	No persistent exceedances of water quality objectives	No evidence of persistent toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) No action necessary based on toxic chemicals.</li> <li>3) Consider whether different test organisms should be evaluated.</li> <li>4) Consider potential role of physical habitat disturbance.</li> </ol>
Los Peñasquitos	No persistent exceedances of water quality objectives	No evidence of persistent toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	<ol style="list-style-type: none"> <li>1) Continue monitoring to gather long-term trend information.</li> <li>2) No action necessary based on toxic chemicals</li> <li>3) Consider whether different test organisms should be evaluated.</li> <li>4) Consider potential role of physical habitat disturbance.</li> </ol>

**Table 14-2. Recommended actions from the triad assessment.**

Watershed	Chemistry	Toxicity	Benthic Alteration	Possible Conclusion(s)	Possible Actions or Decisions
Mission Bay	Persistent exceedances of water quality objectives	No evidence of persistent toxicity	Indications of alteration	Benthic impact due to habitat disturbance, not toxicity. Test organisms not sensitive to problem pollutants.	1) Continue monitoring to gather long-term trend information. 2) Evaluate upstream source identification as a high priority. 3) Consider whether different test organisms should be evaluated. 4) Consider potential role of physical habitat disturbance. 5) TIE would not provide useful information with no evidence of toxicity.
San Diego River	Persistent exceedances of water quality objectives	No evidence of persistent toxicity	Indications of alteration	Test organisms not sensitive to problem pollutants. Benthic impact due to habitat disturbance, not toxicity.	1) Continue monitoring to gather long-term trend information. 2) Evaluate upstream source identification as a high priority. 3) Consider whether different or additional test organisms should be evaluated. 4) Consider potential role of physical habitat disturbance. 5) TIE would not provide useful information with no evidence of toxicity.
Chollas Creek	Persistent exceedances of water quality objectives	Evidence of persistent toxicity	Indications of alteration	Evidence of current pollution-induced degradation	1) Continue monitoring to gather long-term trend information. 2) Continue to perform TIE to identify contaminant(s) of concern based on TIE metric.
Sweetwater River	No persistent exceedances of water quality objectives	Evidence of persistent toxicity	Indications of alteration	Toxicity may be caused by contaminants not currently monitored for or synergistic effects of multiple constituents at low levels. The benthic alterations may be due to physical habitat disturbances.	1) Continue monitoring to gather long-term trend information. 2) Continue to perform TIE to identify contaminant(s) of concern based on TIE metric.
Tijuana River	Persistent exceedances of water quality objectives	Evidence of persistent toxicity	Indications of benthic alteration	Connections of water quality degradation and toxicity to benthic condition difficult due to spatial disparity.	1) Continue monitoring to gather long-term trend information. 2) Evaluate upstream source identification as a high priority.

### 14.3.2 2007-2010 Recommendations

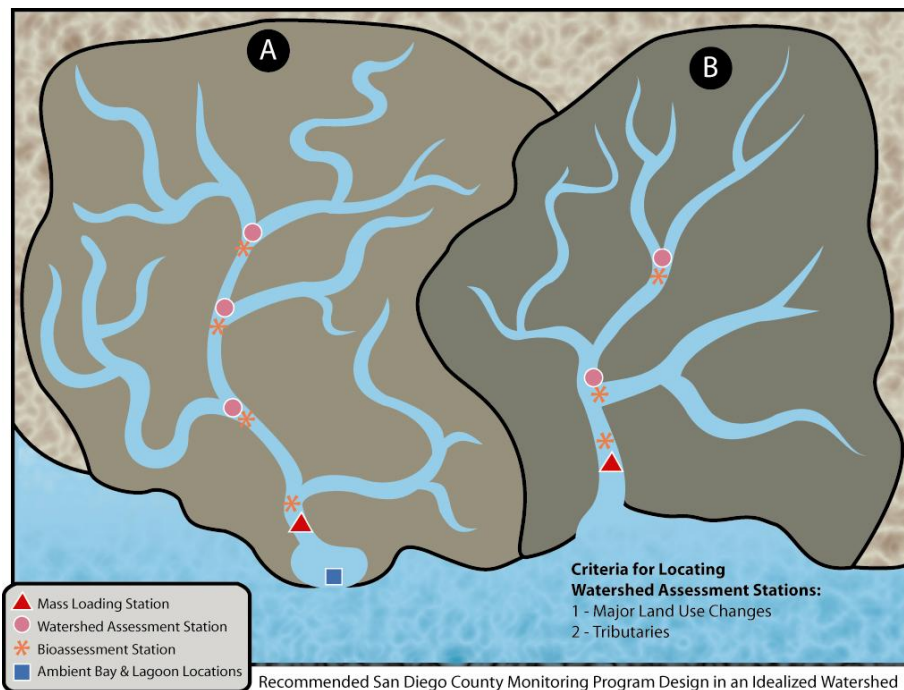
As summarized in the above conclusions, the current monitoring program has addressed the overall objective of the 2001-01 permit term of identifying water quality issues and priorities on a watershed basis. Based on the results of the monitoring program, water quality priority ratings on a watershed basis were presented in the Regional Assessment section using the methodology developed in the Baseline Long-Term Effectiveness Assessment (BLTEA) report (WESTON, MOE, & LWA 2005). However, the current Copermittee monitoring program's ability to fully answer the five management questions from the Model Monitoring Document (SMC 2004) is limited by the present prescriptive requirements of the NPDES permit 2001-01. In order to move the program forward using the current knowledge base and

## Conclusions and Recommendations

the tools from the Model Monitoring Document and BLTEA, an adaptive monitoring approach is recommended for the next permit cycle. The fundamental recommended modification is an integrated and adaptive management approach to better address the key questions listed above and to utilize available resources effectively in the assessment of water quality in the region's receiving waters.

The major components of this recommended integrated and adaptive monitoring approach are summarized below, followed by more specific recommendations. The recommended monitoring approach would rely on both weight of evidence to assess conditions, as well as, comparison to water quality objectives. This integrated and adaptive approach will provide a better ability to answer the SMC's five management questions. The recommended integrated monitoring program would provide a better linkage between the regional monitoring and the municipal dry weather IC/ID monitoring in the MS4. The recommended adaptive approach would provide a mechanism for moving upstream and segmenting the watershed. The recommended program would allow for development of complete load estimates and provide additional data for understanding watersheds and meeting TMDL needs.

The recommended program would be a holistic approach that integrates monitoring both spatially and temporally. This program would include seasonal sampling to provide an indication of loads from urban runoff both during wet weather (storm events) and dry weather (non-storm events). It would link together information from the mass loading stations with information from assessment stations upstream in the watersheds together with co-located bioassessment stations. It would continue to provide the triad perspective of evaluating constituents of concern, biological response in the environment, and toxicity to test organisms. Figure 14-1 presents the recommended monitoring program in an idealized watershed where A is representative of a watershed that discharges to an enclosed bay or lagoon and B is representative of a watershed that discharges directly to the ocean. This graphic is similar to a graphic presented in the SMC Model Monitoring Program and incorporates many of the same monitoring elements.



**Figure 14-1. Recommended Monitoring Stations in an Idealized Watershed.**

More specific recommended modifications to the current program are summarized below to provide an integrated and adaptive approach to better meet the long-term objectives in a resource efficient manner:

### **Mass Loading Stations (MLS)**

Mass loading stations (MLS) would remain at the same sites where they have been established for the 2001-2005 program. These stations would be sampled on a rotating schedule of every other year. They would be flow-weighted composite samples collected during two wet weather storm events and two dry weather flow events. They would be tested for the existing constituent list, including toxicity testing. Bioassessment stations would be co-located as close as possible to MLS and be sampled during the same period (spring/fall).

### **Watershed Assessment Stations (WAS)**

Watershed Assessment Stations (WAS) would be located in the upstream areas of each watershed management area. The scientific design rationale for selecting site locations shall be:

1. At major land use changes on water course.
2. Immediately downstream of tributaries.

These assessment stations will be sampled in the same manner as the MLS. They will be on the same rotational schedule of every other year coincident with the MLS. They would include two wet weather events and two dry weather events with the existing constituent list and toxicity testing. Bioassessment stations would be co-located as close as possible to WAS and sampled during the same dry period (spring/fall).

### **Bioassessment Monitoring (BA)**

Bioassessment monitoring locations would be co-located as much as possible with both mass loading stations and watershed assessment stations. Bioassessment monitoring would continue to occur twice per year, once in late spring (to represent the influence of wet weather on the communities) and one in late summer/October (to represent the influence of dry weather flows on the communities). These would also be on the same rotational cycle coincident with the MLS and WAS. Whenever possible the two dry weather sampling events at both MLS and WAS would be collected during the same period (late spring and late summer) as the bioassessment monitoring. This will provide temporal informational linkage for the data assessment process.

Using this program design strategy, every other year a watershed will have all three monitoring elements: MLS, WAS, and bioassessment. The resultant information from this integrated monitoring approach will provide a solid basis for management activities.

### **Toxicity Evaluation Identification Testing (TIE)**

TIEs would continue to be a useful tool to identify the constituents of concern responsible for causing persistently observed toxicity. In the event that emerging chemicals that are not tested for are discharged through the MS4s and result in toxicity, this analytical tool would allow for the evaluation and detection of these compounds. A possible example of this could be the shift from the use of organophosphate pesticides to the use synthetic pyrethroids. The TIE triad assessment approach would continue to be employed for this monitoring program. No additional TIE assessment would be performed for Tijuana because of the known continued source of toxicity from untreated sewage discharges. Until this source is addressed, additional TIE assessment will not provide additional data from which management actions can be further defined.

### **Ambient Bay and Lagoon Monitoring Program (ABLM)**

The Ambient Bay and Lagoon Monitoring started collecting samples in 2003. At the present time there have been two monitoring events. It is recommended that this program continue as designed to collect at least three years worth of data. After the third monitoring year's information has been collected the program shall be assessed to adapt the monitoring design. Following three years of monitoring, information/data shall be assessed to look for a relationship/linkage between the mass loading stations and ABLM stations. If a relationship is observed, then the Ambient Bay and Lagoon monitoring program shall be linked into the program design as a monitoring element to be conducted with the MLS, WAS, and BA monitoring and the information/data assessed as an additional weight of evidence element. However, if a relationship between the mass loading stations and the ABLM program is not observed, then the ABLM program will be adapted to conduct special investigations on those areas which have been identified as having the most water quality issues based on toxicity, chemistry, and/or benthos.

#### **14.3.2.1 Recommended 2008/2009 Program**

For monitoring year 2008-2009, it is recommended that a single sampling event be collected during wet weather at each MLS to continue the trend data record. The remaining effort for that year is recommended to be used for participation in the Southern California Bight Monitoring Program. Participating in the Bight monitoring program provides many benefits to the San Diego Region and it matches the SMC Model Monitoring Program recommendation that regional monitoring participate in larger scale regional monitoring programs. The benefits to the region include the ability to obtain a regional comparison (a larger spatial comparison) of San Diego County to the rest of Southern California to provide a bigger picture assessment of our region in context with other similar areas. It provides a larger-scale approach to monitoring and typically includes more spatial distribution of monitoring as well as a more lengthy constituent list and additional measures (such as fish communities). Further, the Bight monitoring typically provides additional information about the current status of receiving waters.

#### **14.3.2.2 Sampling Schedule**

The recommended monitoring program greatly increases the number of monitoring stations throughout the county. To accomplish the program, stations would be rotated to maximize monitoring resources. This approach is supported by the SMC Model Monitoring program.

“Rotating designs, in which a different subset of stations is sampled during each sampling event, with the goal of sampling the entire set over a certain period of time. ...Maximizes the impact of limited monitoring resources. Locations of stations can be random, systematic, or early warning depending upon the type of questions asked.”

A more detailed schedule for station rotation shall be developed in coordination with the Copermitees.

#### **14.3.2.3 Consistency with SMC 2004 Document**

The Model Monitoring document provides a process for “improving the program’s ability to build appropriate linkages among the five core management questions.” The document defines a process to adapt a monitoring program to improve ability to answer those questions based upon specific needs and the prioritization of those needs. The steps described in the document to adapt a monitoring program are:

1. Evaluate a program’s ability to answer each of the five management questions.
2. Identify critical gaps in knowledge relevant to each program’s circumstances.

3. Use the monitoring designs in the model monitoring program as a framework for developing monitoring components suited to each program's circumstances.

Through this process the ultimate goal of regionally consistent programs that directly address the key management questions in a scientifically rigorous and cost effective manner can be achieved (SMC 2004).

### **How effectively does the proposed monitoring design answer the SMC Model Monitoring Program's five key management questions?**

#### **Question 1: What are the water quality conditions in the watershed?**

This question will be more fully answered with the recommended program design. The recommended design will provide increased spatial coverage to understand water quality conditions in the watersheds by segmenting each watershed with WAS and BA stations. It will provide increased temporal coverage by collecting samples during both wet weather events and dry weather events. This will provide a complete load estimate and allow for understanding of water quality conditions during dry weather periods both in the spring when rain has increased the baseflow of the creeks, streams and rivers, and in fall at the end of the summer period. Further, the recommended monitoring design will provide a complete ability to conduct a weight-of-evidence assessment of water quality, in addition to a compliance assessment to water quality objectives by holistically linking monitoring sites to allow the most effective spatial and temporal assessment.

#### **Question 2: Are water quality conditions in the watershed getting better or worse?**

The ability to detect trends is not significantly reduced. Statistical assessments using power analyses and other statistical tools for 95 different scenarios utilizing existing Copermittee MLS data found a time extension to detect trends in some instances, while not in other instances. For all statistically significant decreasing trends in water quality constituents currently measured in the program, modifying the program to the recommended approach will result in an increased time period of 6.4% until the mean measured value crosses the water quality objective. For increasing trends in water quality constituents currently measured in the program, an assumption of increase and then slope change to decreasing concentrations toward the water quality objective were modeled. Using this model, modifying the program resulted in NO change in time period to be able to observe the mean measured value drop below the water quality objective. For those constituents currently measured with no apparent trend in water quality, there will also be NO change in time period to detect a trend.

It is important to note that the simulations used empirical data from the existing program. If the current trend slope is changed due to increases in constituents in the watershed or decreased concentrations of constituents in the watershed, the recommended program will have the ability to detect these changes.

The ability to determine if water quality conditions are getting better or worse is currently only answered with storm water discharge, however, the new program design will provide the ability to answer this question during dry weather flow conditions as well.

#### **Question 3: Are beneficial uses being impacted?**

This question can be answered more effectively with the proposed monitoring design. The holistic approach to bioassessment station placement co-located at or near MLS and WAS will provide the ability to address this question with both a weight-of-evidence and a compliance approach.

**Question 4: What is the relative contribution of urban runoff to the conditions in the watershed?** To answer the question of "relative" contribution requires knowledge of baseline

conditions or a reference (non-urbanized) area for comparison. This question is not directly addressed in the current program; however, the current program does provide comparison between watersheds. This comparison of watersheds together with an assessment of different land use characteristics and an evaluation of concentrations of constituents of concern, occurrence and magnitude of toxic effects, and benthic community health yields an understanding of the impacts related to urbanization and various land uses. The information resultant from the recommended program will be beneficial baseline information from which to gain a better understanding of relative contribution of urban runoff, however, it will not directly answer this question.

**Question 5: What are the sources to urban runoff that contribute to water quality conditions?**

The recommended program will result in more information relative to sources and provide a better linkage to understanding existing sources both in wet and dry weather. Segmenting the watershed using WAS will result in a better understanding of locations of sources and linkage to the municipal dry weather IC/ID program will allow further information relative to sources of water quality problems.

In conclusion, the recommended program will advance the understanding of conditions in San Diego County watersheds. It is a holistic program that uses both a weight-of-evidence plus a compliance approach. The program is designed to better address the five SMC key management questions and provide an integration with the jurisdictional dry weather IC/ID program. Through segmenting the watersheds and adding new stations it will provide additional watershed information relative to magnitude and extent, as well as provide increased spatial coverage to focus management efforts. Linkage with the jurisdictional dry weather IC/ID program and watershed segmentation will provide a better mechanism to identify potential sources. Further, the recommended program provides an integration of program elements while resulting in little loss of the ability to detect trends. Moreover, the recommended program provides a more comprehensive view of the watersheds with the addition of dry weather monitoring to complete the loading picture and provide increased information value for future TMDLs.