METALS TRANSLATOR STUDY
SANTA CLARA RIVER ESTUARY

VENTURA WATER RECLAMATION FACILITY
NPDES PERMIT NO. CA0053651, CI-1822

Prepared for:

CITY OF SAN BUENAVENTURA
Ventura, CA

Prepared by:

ENTRIX, INC.
Ventura, CA

Project No. 325402

August 23, 2002

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1.0 INTRODUCTION

The City of San Buenaventura's Ventura Water Reclamation Facility (VWRF) operates under waste discharge requirements contained in Order No. 00-143, which also serves as the National Pollutant Discharge Elimination System (NPDES) permit (CA0053651).

The Order provided effluent limits based upon levels protective of saltwater aquatic life. The California Toxics Rule (CTR) (40 CFR Part 131) specifies that freshwater criteria apply at locations where salinities of one part per thousand (ppt) and below exist 95% or more of the time, and marine water criteria apply at locations where salinities of ten ppt and above exist 95% or more of the time. At locations where salinities fall between one and ten ppt, such as the Santa Clara River Estuary, the more stringent of fresh and marine water criteria apply, unless the Environmental Protection Agency (EPA) approves the application of the freshwater or saltwater criteria based on an appropriate biological assessment. In describing the application of a biological assessment, the CTR states that "in evaluating appropriate data supporting the alternative set of criteria, EPA will focus on the species composition as its preferred method".

On November 12, 1999, the City submitted Phase 3 of the NPDES Limit Achievability Study, which addressed the applicability of freshwater aquatic standards for the VWRF discharge. The Los Angeles Regional Water Quality Control Board (Regional Board) found that Phase 3 of the City's study was incomplete. The characterization of the estuary was utilized to determine the applicability of freshwater or saltwater criteria was based on sampling the biotic community and salinity data taken from two sampling stations. Further, although the majority of organisms found were freshwater, a marine fish species was present. Finally, discussion between the Regional Board and U. S. Fish and Wildlife staff indicated that the species composition may be more heterogeneous than the Phase 3 study findings imply. The Regional Board desired a better-developed and in-depth salinity profile of the estuary which included documentation of the discharge plume and data from multiple sampling points to monitor salinity over time which would account for seasonal and yearly variations.

Accordingly, the Regional Board proposed a more thorough study, conducted under the guidance of the Regional Board's staff, to address the applicability of the freshwater standards, as follows:

- Bioassessment, including an analysis of the community structure of the instream macroinvertebrate assemblages at a minimum of two sites;

- Salinity Profile Study, including multiple sampling points representative of the entire estuary, and diurnal fluctuations;

- Metals Translator Study, to develop translators for copper, nickel, lead, and zinc; and

- Water Effects Ratio Study, to develop factors addressing site-specific receiving water characteristics.

The objective of this document is to report the findings of the first study: the Metals Translator Study.

1.1 Approach Overview

The principal objective of the Metals Translator Study for the Santa Clara River Estuary is to determine the metals translators for copper, nickel, zinc, and lead following guidance from *The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit From a Dissolved Criterion* (US EPA 1996). Additionally, other water quality and physical parameters were collected to aid in a fuller characterization of the estuary.

According to federal regulation (40 CFR 122.45(c)), NPDES permit limits must be expressed as total recoverable metal. Because there are chemical differences between the discharged effluent and the receiving water, there are expected to be changes in partitioning between the total and dissolved forms. In addition, the presence of suspended solids reduces the amount of dissolved metals, compared to the total amount present. A metals translator answers the question " what fraction of metal in the effluent will be dissolved in the receiving water body, and therefore bioavailable?" According to the metals translator guidance, the translator is the fraction of total recoverable metal in the downstream water that is dissolved; that is, the dissolved metal concentration divided by the total recoverable metal concentration. The translator can be determined by three methods:

1. Assumed to be equivalent to the default criteria conversion factors provided in the metals translator guidance;

2. Developed directly as the ratio of dissolved to total recoverable metal; or

3. Developed through the use of a partition coefficient that is functionally related to the number of metal binding sites on the adsorbent in the water column (that is, concentrations of TSS, TOC, or humic substances).

Method 2, direct measurement, is favored by EPA and is appropriate for the VWRF discharge to the Santa Clara River Estuary. As such, this study develops metals translators for copper, nickel, zinc, and lead using the method of directly measuring the ratio of dissolved to total metals.

1.2 Report Organization

This report is organized in the following way:

Section 1 – Introduction

Section 2 – Methods

Section 3 – Results

Section 4- Characterization of the Estuary

Section 5 – Development of Metals Translators

Section 6 – Conclusions

Section 7 - References

Tables and Figures are included in Appendix A.

Monthly monitoring and sampling summaries can be found in Appendix B.

Laboratory analytical reports are in Appendix C.

The methods used to develop metal translators for the Santa Clara River Estuary follow those described in the Revised Work Plan for Compliance with California Regional Water Quality Control Board, Los Angeles Region Time Schedule Order (Order 00-144) (NPDES Permit CA0053651) (ENTRIX 2001) and are summarized in this section. Special attention will be made to any variances from the Work Plan.

2.1 METALS TRANSLATOR STUDY SAMPLING DESIGN

In the simplest of conditions, understanding metal partitioning in receiving body waters is complicated. The highly variable Santa Clara River system adds additional levels of complexity and requires a robust sampling design in order to evaluate how this variability may affect metal partitioning in the estuary. Hydraulic conditions in the Santa Clara River Estuary depend upon a combination of:

1) flow in the river upstream of the estuary;
2) whether the sandspit is open or closed;
3) tidal stage; and
4) effluent flow rate from the VWRF.

Because of the variable hydraulic conditions found in the Santa Clara River Estuary, sampling was conducted monthly over the course of a year (Table 2-1). Additionally, daily records of whether the sandspit was open or closed and the estimated level of inundation (spatial extent of estuary inudated as percentage) of the estuary were taken to develop a "picture" of hydrographic conditions in the estuary over the course of a year.

In order to develop a translator for the metals of interest, the objective was to collect samples from at or near the beginning of the mixing zone over the course of the study. Samples were also collected that represent both (1) background concentrations upstream from the influence of the tidal prism and VWRF discharge to the Santa Clara River, (2) far-field concentrations related to non-point source runoff to the upper estuary, and (3) effluent concentrations from the discharge channel. General water quality parameters were collected in the field and water samples collected for laboratory analysis.

The following sections will describe in more detail the sampling protocol.

2.2 SAMPLING STATION LOCATIONS

Figure 2-1 presents the locations of the stations sampled over the study period. A hand-held Global Positioning System (GPS) unit was used to record the coordinates of all sampling or water quality parameter monitoring locations (see Tables 2-2 and 2-3). All sample locations were stationary over the period of the study except for the mixing zone station (MTS-2). Upstream background conditions were represented by sampling station MTS-1. In periods of high inundation in the estuary (after November of 2001), MTS-1A was added farther upstream to ensure sampling of water outside of the influence of the VWRF. Far field and upper estuary conditions were represented by MTS-3. The mixing zone was represented by MTS-2, and the effluent in the discharge channel as MTS-R. In order to monitor water quality in the river mouth, stations MTS-M and MTS–M-O were added in December of 2001. MTS-M represented conditions at the mouth within the estuary, and MS-M-O conditions in the mouth when the eastuary was open. As a result, MS-M-O was only sampled when the estuary was in an open phase.

During low flow conditions in the Santa Clara River, the VWRF discharge constitutes most of the flow into the estuary. In this situation, MTS-2 was collected either from the location where the discharge first encountered ambient water, or in cases where the discharge constituted the only flow in the estuary, samples were collected from the discharge channel. During high flow, or when the sand spit was open, it was difficult to visually identify the mixing zone. In these conditions, the mixing zone was determined in the field using a portable electrical conductivity (EC) meter. The meter was used to characterize EC conditions at Mixing Zone Parameter Monitoring Stations (MZ-1 through MZ-8, see Figure 2-1). The mixing zone sampling station (MTS-2) was then established at an intermediate EC or where in the area of the steepest EC gradient.

Variances to the Work Plan included the addition of one Mixing Zone parameter monitoring station (MZ-8) and the river mouth sampling stations MTS-M and MTS-M-O, approved by the Los Angeles Regional Water Quality Control Board (LARWQCB) on August 8, 2001 (LARWQCB 2001).

2.3 SAMPLING PROTOCOL

During each sampling event, samples were collected from MTS-1 (or MTS-1A), MTS-2, MTS-3, MTS-R, MTS-M and MTS-MO (when the estuary was open to the ocean). When more than one sample was obtained at a single site, the samples were composited in the laboratory. During each sample round, a duplicate was sampled at one of the sampling locations and was analyzed to evaluate data quality. Sampling protocol followed that described in the Work Plan.

To avoid sample contamination, the following guidelines were implemented:

1. Given the low metals concentrations expected, extreme care was taken to ensure that samples were not contaminated during sample collection. Smoking or eating was not permitted while on station, at any time when sample bottles were being handed, or during filtration in the laboratory.

2. Each person on the field crew wore clean clothing, i.e., free of dirt, grease, etc. that could contaminate sampling apparatus or sample bottles.

3. Sampling gloves were worn by the field technician dedicated to collecting and handling each sample. The second field technician located each sampling location, took notes and photographs, and obtained physical water parameters at one foot intervals. When the water depth was one foot or less, physical water parameters were obtained at mid-depth. The second field technician did not

handle the sample bottles eliminating the chance of cross contamination. All samples bottles were opened and closed under water to further reduce contamination.

In the field, typical steps included:

1. Before embarking, number and type of sample bottles was confirmed, and checklist of equipment/supplies reviewed.

2. Before sampling was initated, chain-of-custody forms and bottle labels with all information except time were filled out. Chain-of-custody forms were pre-prepared with everything but the sampling date and time.

3. At each station, the date, sampling time, location ID, and sampler name was labeled on each sample bottle. Samples were collected following the procedure outlined above. GPS coordinates, weather, hydrologic conditions, plant operating status (if known), sample bottle numbers and collection time, and unusual observations or circumstances were noted in the field notebook or log form.

4. The chain-of-custody was then completed and the bottle carrier checked to ensure bottles were upright and well packed.

5. The bottles were delivered to the VWRF laboratory immediately after collection. Samples were then delivered to the laboratory. The sample custodian then signed the chain-of-custody for receipt of samples, and a copy of the chain-of-custody was obtained.

2.4 ANALYTICAL PARAMETERS.

When multiple samples were collected at each station, they were composited in the laboratory and split. After the first two sampling events were complete, the laboratory requested that ENTRIX collect samples filling a single 4-liter cubitanor to eliminate the need to composite samples from a single site. Analyses of total recoverable and dissolved metals were conducted on each split composite. For the dissolved analyses, the composited split was filtered in the VWRF laboratory. Table 2-4 summarizes the analytical parameters, method and detection limits obtained. Samples were analyzed at the City's contract laboratory, American Scientific Laboratories (ASL), certified by the State of California and the California Department of Health Services to perform these analyses. Additionally, one discrete sample was collected and analyzed for total dissolved solids (TDS) and total suspended solids (TSS) representing each sample station.

Water quality parameters were also measured in the field using a Horiba U10 water quality meter (Table 2-5).

As described in Section 2.0, twelve sampling events were conducted from May 2001 through April 2002.

A summary of the analytical results can be found in Appendix B for each of the 12 sampling events. Copies of the laboratory analytical results can be found in Appendix C. The following sections will discuss the water quality data and the analytical metals data.

3.1 WATER QUALITY DATA

Water quality data results are presented for each sampling event in Appendix B and summarized in Tables 3-1 and 3-2. Throughout the estuary, pH varied from a minimum of 7.04 at the mixing zone station (MTS-2) to a maximum of 10.65 at the mouth of the estuary (MTS-M). Conductivity ranged from 1.93 ms/mc to 45.20 ms/mc and turbidity from 0 to 130 NTU. Dissolved oxygen was measured from 1.22 mg/L to a maximum of 14.30 mg/L, while temperature varied from 10.60° C to 26.80° C.

Of particular interest to this study was the spatial and temporal variability of salinity in the Estuary. As can be seen in Table 3-2 and Figures 3-1 and 3-2, no station in the estuary, including the upstream background station (MTS-1) and the effluent station (MTS-R) can be defined as strictly freshwater. Conversely, no station within the Estuary can be described as strictly saltwater (MTS-M-O is not considered an Estuary station since it was sampled at the ocean side of the Estuary mouth when the mouth was opened). Figure 3-1 summarizes the salinity data graphically for the metals translator stations (all MTS stations). Stations sampled for the establishment of the mixing zone (all MZ stations) are graphically summarized in Figure 3-2. A more specific discussion on salinity and other water quality parameters in the Estuary can be found in Section 4.0.

3.2 METALS DATA

Summaries of the analytical data collected from the Estuary can be found in Tables 3-3 through 3-7. Data are also visually presented in Figures 3-3 through 3-7. Copper was frequently detected in the Estuary and concentrations exceeded both the Daily and Monthly Maximum Permit Limits at all stations except MTS-MO (Table 3-3). Copper concentrations among stations tended to show similar patterns with very low concentrations detected in the summer months (July through October) when the sand spit was closed and the Estuary was inundated at its highest level (Figure 3-3a through c). Copper concentrations tended to increase in the latter months of sampling (January through April 2002). This is also the period when the Estuary was at its most dynamic (as discussed in more detail in Section 4.0).

Lead was never detected at any station in the Estuary (Table 3-4). The lead detection limit was adequately sensitive at 0.5 ug/L, an order of magnitude less than the Monthly

Permit Limit at 7 ug/L (Figures 3-4a through c). Thus, lead is not assumed to be a metal of concern for the Estuary or the VWRF.

Nickel was frequently detected at all stations in the Estuary (Table 3-5). In the first half of the sampling year (through October 2001), nickel did not exceed either the daily or monthly Permit Limits in the Estuary (Figures 3-5a through c). As with copper, the highest concentrations of nickel were detected in the second half of the sampling year throughout the Estuary. In the latter half of the year, nickel concentrations exceeded the Daily Maximum Permit Limit throughout the estuary. Only once, however, (November 2001 at MTS-R) did nickel ever exceed the Monthly Maximum Permit Limit.

Zinc was frequently detected in the Estuary (Table 3-6). However, unlike the other metals, zinc concentrations showed a different pattern in the effluent station (MTS-R) than the other stations (Figures 3-6a through c). Elsewhere in the Estuary zinc concentrations were low throughout the year and rarely exceed the Daily Maximum Permit Limit and never the Monthly Average Permit Limit. However, at MTS-R, zinc concentrations were low in the first part of the sampling year and increased toward the latter part. The one high dissolved concentration detected in MTS-R in March 2002 seems to be an outlier since there is a large discrepancy between the total and dissolved concentrations measured that sampling period.

TSS and TDS is summarized in Table 3-7 and depicted graphically in Figure 3-7a through c. TSS and TDS seemed to vary most in the middle portion of the estuary (MTS-2, MTS-3 and MTS-M) and least at the upstream station MTS-1 and the effluent station MTS-R. Since TSS has been shown to have an important impact on partitioning in other receiving water bodies, it will be evaluated with the analytical metals data further in Section 5.0 to develop the metals translator.

During the course of this study, several environmental parameters were monitored in the interest of characterizing the physical and chemical nature of the Santa Clara River Estuary. The Estuary is, by its nature, a very dynamic environment where hydrologic parameters can vary greatly over the course of any given year. The Estuary is influenced by three primary hydrologic factors: 1) the Santa Clara River inflow; 2) Pacific Ocean tides; and 3) the VWRF discharge. The Santa Clara River inflow varies in quantity, duration, frequency, and intensity from year to year, depending on rainfall and upstream diversions. The Santa Clara River also delivers varying quantities of sediment to the Estuary which factors into sandspit formation at the mouth. Tidal influence from the Pacific Ocean is more consistent; however, regional weather patterns, such as El Nino and La Nina, can dramatically influence tidal intensity and local near-shore currents. The Pacific Ocean and its tides also play a major role in forming the sand bar that seasonally impounds the Estuary, as well as causing wave action and degradation of the sandspit. The VWRF discharge is relatively constant, delivering between 7 and 10 million gallons of treated effluent per day. During the dry season, the VWRF discharge may contribute as much as 100 percent of the non-tidal inflow to the Estuary. There is also runoff contribution from non-point sources, such as nearby agricultural fields.

The composition of waters contributing to the Santa Clara River Estuary is quite variable. During the wet season Santa Clara River flows can easily exceed 5,000 cfs during intense storm events. Winter near-shore ocean conditions can also contribute storm-induced tidal flooding and overwash. The Estuary is most dynamic under winter and spring conditions because river and ocean influences are quite strong. Frequent flushing and inundation occurs due to breaching of the sand spit, promoting increased tidal connectivity. Summer river inflow is diverted upstream of the Estuary and typically drops and becomes intermittent. The summer and fall inflow is typically limited to the VWRF discharge, and the large sand spit impoundment formed at the mouth causes constant inundation. In the dry months, the only sand spit breaching factor is the shear volume of water impounded in the Estuary.

4.1 OBSERVED ESTUARY CONDITIONS

Daily observations of hydrologic conditions were conducted over the course of this study to temporally document the "state" of the Estuary. The date, mouth phase (open vs. closed), and relative inundation were recorded on a map sheet to document daily variation. Figure 4-1 depicts these data, including the sampling event dates.

The Santa Clara River Estuary undergoes periodic and alternating filling and draining. In some cases, inundation or open drained conditions may persist over several months. Over the course of this study, two distinct patterns have emerged. During the first six months of the study (May to November 2001) the Estuary was impounded (closed phase) for between 25 and 100 days before breaching. This condition is likely due to lower inflow from the Santa Clara River during the drying summer and fall seasons. The dry season (summer/fall) is when sand spit formation typically occurs due to beach sand deposition. In November 2001, the first rains fell in the Ventura area and runoff from the Santa Clara River increased. From November 2001 to May 2002, the Estuary was generally more open and inundation levels varied frequently. This variability is likely due to increased river inflow, wave action, and tidal interaction. The increased wave action and sand spit scour typically occurs during the November to May (winter to spring) season. Figures 4-2 and 4-3 depict the Estuary in typical closed and open phases.

4.2 NATURAL HYDROLOGIC INFLUENCES

Natural hydrologic data, such as Santa Clara River streamflow and local precipitation, were collected for the study period. Daily Santa Clara River streamflow data were obtained from the Montalvo (USGS) gaging station for the study period. In addition, monthly precipitation totals were obtained from Santa Paula (NWS) rainfall station. Figure 4-4 depicts the streamflow hydrograph and monthly precipitation for the May 2001 through April 2002 study period. The 7.69 inches of total rainfall recorded at the Santa Paula station during the 12 month study represents roughly half of the 14.33 inches of normal Ventura area rainfall. The streamflow conditions observed during the study period correspond with a dry rainfall and runoff year. Generally, lower precipitation and subsequent runoff results in a diminished influence of streamflow on sand spit breaching and lagoon flushing, as well as limited influence of freshwater inflow by volume.

4.3 SALINITY MONITORING OBSERVATIONS

During each monthly sampling events, salinity was measured a various pre-established monitoring stations throughout the Estuary (Figure 2-1). The salinity monitoring results for each station are summarized in Section 3.0. Freshwater, marine, and brackish, estuarine waters are defined by the pre-dominant salinity regime, occurring more than 95 percent of the time. Freshwater is characterized as being 1 ppt or less, marine being greater than 10 ppt, and brackish falling in between (>1<10).

Salinity measurements, using a handheld water quality meter, were collected at each station by 1 ft. intervals to develop a salinity profile for each station. In addition, the salinity data statistics were calculated for each station over the course of the study. Overall, lower salinities (1 to 4 ppt) were observed in the northern portion of the Estuary in proximity to the discharge channel, and in the eastern, upper Estuary where the Santa Clara River flows in. The middle area of the Estuary, where the lagoon tends to persist, was more brackish (5 to 10 ppt). More marine-like (>10 ppt) conditions were generally isolated to a small area near the mouth and the far southwestern portion of the Estuary. Generally, the only freshwater (<1 ppt) conditions were observed at MTS-R, where VWRF inflow is discharged. The upstream Santa Clara River inflow (MTS-1) was brackish (>1<10 ppt), however the mean and maximum salinities measured at MTS-1 were 1.36 and 2.00 ppt, respectively. Salinity profiles (Figures 3-1 and 3-2) developed from the monitoring and sampling station data indicate that under inundated conditions (open or closed) a "salt wedge" forms along the western and southern periphery of the

Estuary. The salt wedge characterizes salinity statification, where surface salinity can be nearly fresh (~ 1 ppt) and bottom salinity can be marine (~ 30 ppt).

For this study, the most straightforward method for calculating the metals translators has been chosen: direct measurement. Direct measurement is the method preferred by EPA for metals translator calculations. In this approach, the ratio of the dissolved and total recoverable fractions in a water sample is used to translate from a dissolved water quality criterion to a total recoverable effluent concentration. The translator is then applied by dividing the dissolved criterion by the translator to produce a total recoverable permit limit.

The translator is meant to show the relationship between dissolved and total recoverable metal concentrations in the mixing zone in the receiving body water. Thus the development of translators will focus on data collected from MTS-2.

Translators were calculated for each of the data pairs (e.g., total and dissolved concentrations) for the metals of interest at MTS-2. Values below the detection limit were treated as equal to one-half the detection limit, as recommended in *The Metals Translator Guidance* (US EPA 1996). For those data pairs where both the dissolved and the total recoverable concentration were non-detect, the data pairs were eliminated from the calculation as outlined in the Guidance. In situations where the dissolved concentration exceeded the total recoverable concentration, the ratio was set at the default of 1 (US EPA 1996). Tables 5-1 through 5-3 present the translator (defined as fD or the dissolved fraction) for copper, nickel and zinc respectively in the mixing zone in the Santa Clara River Estuary sampled at MTS-2. A translator was not developed for lead because it was never detected above the detection limit at MTS-2.

In some receiving water bodies, factors such as TSS, pH and salinity have been found to affect partitioning. TSS in particular has been found to have a significant affect. To evaluate whether such a relationship exists in the Santa Clara River Estuary, TSS measurements at MTS-2 were regressed against fD to determine whether the translators are a function of TSS. As can be seen in Figure 5-1, fD is not related to TSS, thus the translator was defined directly as the ratio of dissolved to total recoverable. The translator for each metal (copper, nickel and zinc) was then calculated as the geometric mean of the ratios of dissolved metal to total recoverable metal for all sample pairs (Tables 5-1 through 5-3). The geometric mean is proposed as the translator, as it best describes central tendency in these types of datasets (US EPA 1996).

The translators, based on the geometric mean, varied little between metals, 0.86 for copper, 0.81 for nickel; and 0.84 for zinc. The impact of these translators on the total recoverable permit limit for each metal of interest is dependent on whether the translator is going from a dissolved freshwater or a saltwater criterion. Thus the results of the Metals Translator Study must be interpreted in coordination with the results of the Resident Species Study currently being conducted in the Estuary. To provide a preliminary assessment, the impact of the translator on both marine and freshwater criteria is presented in Table 5-4.

As can be seen from Table 5-4, because the translators vary from 0.81 to 0.86, their impact on the VWRF's Permit Limits (as defined in the RWQCB's order from 2000) are small (between 19% and 14%). The largest impact is related to whether the dissolved criteria should be based on freshwater or marine protection. To visually illustrate this, total recoverable criteria as translated using Santa Clara River Estuary translators were compared to the metals concentration data sampled over the twelve month period in this study at the station closest to the point of compliance – MTS-R (Figures 5-2 through 5-4). For all metals with detected concentrations (copper, nickel and zinc), translating the 2000 Permit Limits (which are based on protection of marine organisms) did not reduce the number of exceedances. The biggest reduction in exceedances occurred when the sampling data over the twelve month period were compared to translated criteria protective of freshwater organisms (assuming a hardness of 100). Thus the ability of the VWRF to be in compliance with the permit limits is not significantly improved by the addition of a site-specific translator when using the 2000 Permit Limits. However, within the effluent channel as defined by MTS-R, the VWRF has been in compliance if the Permit Limits are based on dissolved criteria protective of freshwater life rather than marine life. This comparison highlights the importance of the Resident Species Study currently being conducted in the Estuary as it will help to define what are the appropriate water quality criteria from which to set permit limits.

The City of San Buenaventura's Ventura Water Reclamation Facility (VWRF) discharges to the Santa Clara River Estuary under NPDES Permit No. CA0053651. Regional Board Order No. 00-143 required the City to conduct a study to develop metals translators for four inorganic constituents in support of developing alternative permit limits. The objective of this study was to develop metals translators for copper, nickel, lead, and zinc. The study was initiated in May 2001, in accordance with the Regional Board-approved Work Plan. In general, water quality monitoring and sampling was conducted once per month over the course of twelve months to capture natural hydrologic variability. Eight water quality parameter monitoring and four surface water sampling stations were established within the Santa Clara River estuary.

Copper, nickel and zinc were detected frequently within the estuary, while lead was never detected. Copper, nickel and zinc concentrations had a similar pattern among stations with concentrations being lowest during the summer months (July through October 2001) when the sand spit was closed and the estuary was fully inundated. Concentrations tended to increase during the winter months (December through April 2002) when the estuary was most dynamic, experiencing frequent runoff and tidal flushing. Copper concentrations exceeded both the Daily and Monthly Maximum permit limits at all stations except MTS-MO. The other metals infrequently exceeded permit limits.

Three primary waters contribute to the Estuary, including the Santa Clara River inflow, Pacific Ocean tides, and the VWRF discharge. The Santa Clara River Estuary experienced two distinctly different conditions over the course of this study. During the summer and fall (dry season), the sand spit impounded the Estuary inflow from the VWRF with prolonged, extensive inundation. The winter and spring (wet season) condition was highly dynamic; winter runoff breached the sand spit where strong river and ocean flushing occurred frequently. The wet season was below average compared to average Ventura area precipitation and runoff. Monitoring during the study indicated that upstream and near the discharge channel salinities were relatively low, between 1 and 5 ppt. The central portion of the Estuary, where the lagoon persists, was more brackish with salinities between 5 and 10 ppt. An isolated area near the mouth comprised the only marine-like conditions where salinities exceeded 10 ppt. The higher salinities were measured during the winter, when runoff was far below normal.

The metals translator was calculated using direct measurement from MTS-2 data. The translators were calculated as follows: copper (0.86); nickel (0.81); zinc (0.84); no translator was calculated for lead since it was not detected in any of the samples. Application of these translators is dependent on whether freshwater or marine water quality criteria are applied. EPA guidance focuses on using species composition as the preferred method to support selection of alternative water quality criteria. Therefore, the Resident Species Study, being conducted concurrently, will help define the appropriate water quality criteria.

Although not conclusive, some insight to conditions in the Santa Clara River Estuary tidal prism and the origins and the fate of the four metals as they pass through the tidal prism is offered by the data collected in this study:

- Metal concentrations entering the study area from upstream closely approximate those found in the VWRF reclaimed water flow also reaching the estuary. Nickel levels are slightly lower in the reclaimed water, zinc appears to be slightly higher (though generally within any potential limits) and copper appears to be approximately the same.

- Salinity measurements within the tidal prism are predominantly below the saltwater threshold of 10 parts per thousand.

- At sample point MTS-MO, the point of discharge to the Pacific Ocean when the river mouth is open and where saltwater conditions do clearly dominate, all four metal concentrations are well within saltwater criteria.

In conclusion, the ability of the City to be in compliance with the Board's permit limits is not significantly improved by the addition of a site-specific translator when applying the current marine water quality criteria. The more appropriate approach to understanding how metals may impact the habitats of the Santa Clara River Estuary appears to be the Resident Species Study, being conducted in parallel with the now complete Metals Translator. EPA guidance focuses on using species composition as the preferred method to support selection of alternative water quality criteria.

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USGS 2002. Montalvo Santa Clara River Streamflow discharge gaging data for April 2001 through May 2002. (www.usgs.gov)

APPENDIX A

TABLES AND FIGURES

APPENDIX B

MONTHLY MONITORING & SAMPLING SUMMARIES

APPENDIX C

LABORATORY ANALYTICAL REPORTS

TABLES

FIGURES