Areas of Special Biological Significance – Newport Coast, California: Assessment of Impacts and Pilot Restoration Program

Integrated Coastal Watershed Management Plans
State Water Resource Control Board Agreement No. 05-230-550-2

June 22, 2009

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INTRODUCTION

The City of Newport Beach (City) entered into an agreement with the State Water Resource Control Board (SWRCB) on January 2, 2006 to perform a series of tasks primarily focused on assessing potential stressors to the three Areas of Special Biological Significance (ASBS) along Newport Coast and Laguna Beach, California:

- ASBS 32 - Newport Beach Marine Life Refuge located just South of Corona del Mar,
- ASBS 33 - Irvine Coast Marine Life Refuge located along the shoreline of Crystal Cove State Park, and
- ASBS 30 - Heisler Park Ecological Reserve located along Heisler Park in Laguna Beach.

A map showing these three ASBS is shown in Figure 1.

Figure 1: Locations of Orange County's Three ASBS.

Newport Coast and Laguna Beach ASBS Protection Program: Cross-Contamination Study
Main Report

Figure 1. Study Area

The objective of these assessments was to identify and quantify the environmental impacts that have most detrimental effects to the marine habitats of the ASBS. The three primary potential stressors to the ASBS along Newport Coast are thought to be:

1. Public trampling and take as well as public and commercial fishing,
2. Contaminated flows from the coastal canyons, or
3. Contaminated loads from Newport Bay.

To assess the relative importance of these potential stressors, the primary tasks covered under this grant agreement included preparing:

- A public use impact study (Task 2.2)
- An assessment of canyon flow and water quality (Task 2.3)
- An assessment of contaminant loads from Newport Bay (Task 2.4)

The results of these studies were tied together with a quantitative impact metric (Task 2.6.1) to assess the relative importance of these stressors. The Impact Assessment Report is an addendum to the Integrated Coastal Water Management Plan (Task 2.6.4) which recommends specific ASBS protection projects and management measures for the Newport Coast watershed and adjacent marine life areas.

A complimentary task performed under this agreement was the (successful) attempt to re-establish rockweed in the rocky intertidal area at Little Corona (Task 2.5). All work performed under this agreement was guided by a technical advisory committee composed of scientific, agency and community experts.

The SWRCB granted the City $397,500 to perform these assessment, restoration and analysis tasks. Funding for the agreement came from consolidated Proposition 40/50 funds. The 3-year term of the grant was amended to allow for completion of the agreement by June 30, 2009.

This final report is the final task for completing the terms of the grant agreement. This report summarizes the issues, challenges and results of the Public Use Impact Study, Urban Flow and Water Quality Assessment, Cross-Contamination Impacts from Newport Bay, Rockweed Re-Establishment Pilot Project, and the ASBS Impact Metric. The report concludes with a brief discussion of the grant agreement's budget and schedule.

PUBLIC USE IMPACT STUDY

The objectives Newport Coast ASBS Public Use Impact Study (Task 2.2) were to identify:

1. the types of human activities within ASBS areas,
2. the degree to which public use affects marine resources within ASBS areas, and
3. techniques and methods that can be used by the Cities of Newport Beach and Laguna Beach in implementing long-term ASBS monitoring surveys.

Public use surveys at four sites within the three ASBS in Orange County were conducted between January 30th, 2007 and February 18th, 2008. The survey effort included 50 surveys conducted over a 2.5 hour period during each survey. Twenty-six weekday and 24 weekend-day surveys were conducted at Little Corona and Morning Canyon sites in ASBS 32, in the Irvine Coast ASBS 33 (Rocky Bight), and Heisler Park ASBS 30. This 5.9 mile study area extends from Corona del Mar to Laguna Beach. The survey effort included 200 field days and 500 field-hours of observations to quantify the number of visitors, dogs, and birds, and to identify the types of, and amount of onshore-and-offshore visitor use activities.

Observations were made throughout the year during most weather conditions except heavy rains. While most data collection occurred during daily low tides of +0.5 ft MLLW or lower, it was also necessary to collect data during spring and summer periods when low tides less than +0.5 ft MLLW usually occur in the dark, or very early in the morning when the public was not present. Therefore, our data sets also included surveys when the tides were +2.3 ft or less in order to assess year-around public use of ASBS areas. Physical data displayed minimal variability with respect to tide levels, cloud cover, sea state, surf height, sea temperature, air temperature, and wind speed. The only noticeable trend observed was a slight decrease in air temperature with concurrent increases in wind speeds along an upcoast-to-downcoast gradient between Little Corona and Heisler Park. Never-the-less, the differences were slight, and the public use data collected at the four sites along the 6-mile stretch of Orange County shoreline were unlikely influenced by small variations in weather and sea conditions.

Here is a summary of the study's findings.

1. Visitor use, in terms of numbers of people per 100 meters of shoreline at the high-use ASBS sites was higher than at other rocky intertidal sites in Los Angeles County and comparable to levels observed at Treasure Island in Laguna Beach.

2. Weekend use was greater at all sites than during weekdays, although significant numbers of students visit Little Corona and Crystal Cove during K1-12 educational field trips. Each site was heavily utilized during all seasons.

3. All tidal levels were accessed by visitors. However, the highest percentages of visitors frequented the splash- to mid-tide zones. This has implications for the management of rockweed, since it is most prevalent in areas where most people were located. Trampling was the most observed destructive behavior observed. During summer and periods of higher tides, more people concentrate in a smaller area of rocky intertidal habitat than at low tides.

4. Heisler Park, (ASBS 31), also known as Bird Rock, is a high-use rocky intertidal habitat characterized by good public access. This site had the highest use-intensity of the four areas studied and visitors exhibited the highest levels of behaviors potentially damaging to rocky intertidal organisms (handling, collecting, and trampling) of all four sites studied. The highest use area in Heisler Park is Heisler Cove. No shoreline fishing was observed (as it is prohibited). Skin and SCUBA

diving activities were low and were observed throughout all areas in and around Heisler Park. Visitor use exhibited the greatest mix of local residents and out-of-area visitors. Commercial lobster fishing was high at this site and concentrated around Bird Rock.

5. Little Corona rocky intertidal area (ASBS 32) is a high-use rocky intertidal habitat and the most publically accessible site with equally heavy use by public and school groups. The area is used primarily by Orange County and nearby area residents. The site is a long-term research site. The most detrimental impact by visitors was trampling. Moderate-to-high levels of recreational/commercial fishing and recreational diving occur in the area. Overall, this site is the second-highest public use site behind Heisler Cove. Collecting and rock turning activities are less common than Heisler Park due to presence of CNB Tide Pool Rangers. Commercial lobster fishing activity was high at this site.

6. Crystal Cove (ASBS 33) is a moderate-use rocky intertidal habitat. Access is more difficult and expensive than at Heisler Park or Little Corona due to parking fees and the distance one has to walk from the State Park parking lot. It is located in an area of increasing development along Newport Coast and a destination resort that attracts numerous out-of-area visitors similar to Heisler Park. California Department of Parks manages the area and there are well-defined educational programs for the general public and school groups. Visitors at this site exhibited low-to-moderate levels of activities potentially detrimental to rocky intertidal organisms, although this site ranked second only to Heisler Park in collecting activity due to shore fishing activity and tourists not knowing tide pool regulations. Extensive rocky intertidal habitat along entire shoreline likely reduces public use stress within any one section of this ASBS. Commercial lobster fishing intensity and sport fishing activity at this site were high.

7. Morning Canyon rocky intertidal area (ASBS 32) is the least publically accessible site and is used primarily by residents of Cameo Shores who must pass through a locked gate. Public access is only across high-platform rocky intertidal habitat at mid-to-low tides. Despite its relatively low public use, collecting and rock-turning commonly occur at levels that equal the larger and more accessible study sites, principally by residents of the community. Tidepool management signage is lacking at this site and there is minimal patrolling of this site by City of Newport Beach tidepool ranger staff. In addition, this portion of ASBS 32 is a favorite shore fishing site. Collecting bait and illegal fishing is greater in this section of ASBS 32 than at Little Corona Tide Pools where there is a greater degree of active shoreline management.

8. Sixteen taxa of marine invertebrates and fish were observed handled or collected. The most handled organisms included hermit crabs, snails, and shore crabs. Mussels, gooseneck barnacles, brittle stars, opal-eye perch, rocks and shells were the most commonly collected items. Collecting and handling, although accounting for a small overall percentage of adverse behaviors, can result in substantial reductions of individual species and alter community structure.

9. ASBS public use monitoring can be conducted in the future by City docents or State Parks staff. It is recommended that future focused studies be conducted at all sites in a similar manner to this study to assess changes in public use impacts on rocky intertidal communities.

URBAN RUNOFF FLOW AND WATER QUALITY ASSESSMENT

A number of tasks were performed in order to characterize water quality impacts to the ASBS (Task 2.3):

- Baseline water quality data from the 2007 Newport Coast Flow and Water Quality Assessment was reviewed (Task 2.3.1).
- Newport Coast Kelp Toxicity Study and Mussel Bioaccumulation Study were performed (Task 2.3.2).
- Newport Coast and Laguna Beach Areas of Special Biological Significance Rocky Intertidal areas were monitored and assessed (Task 2.3.2).

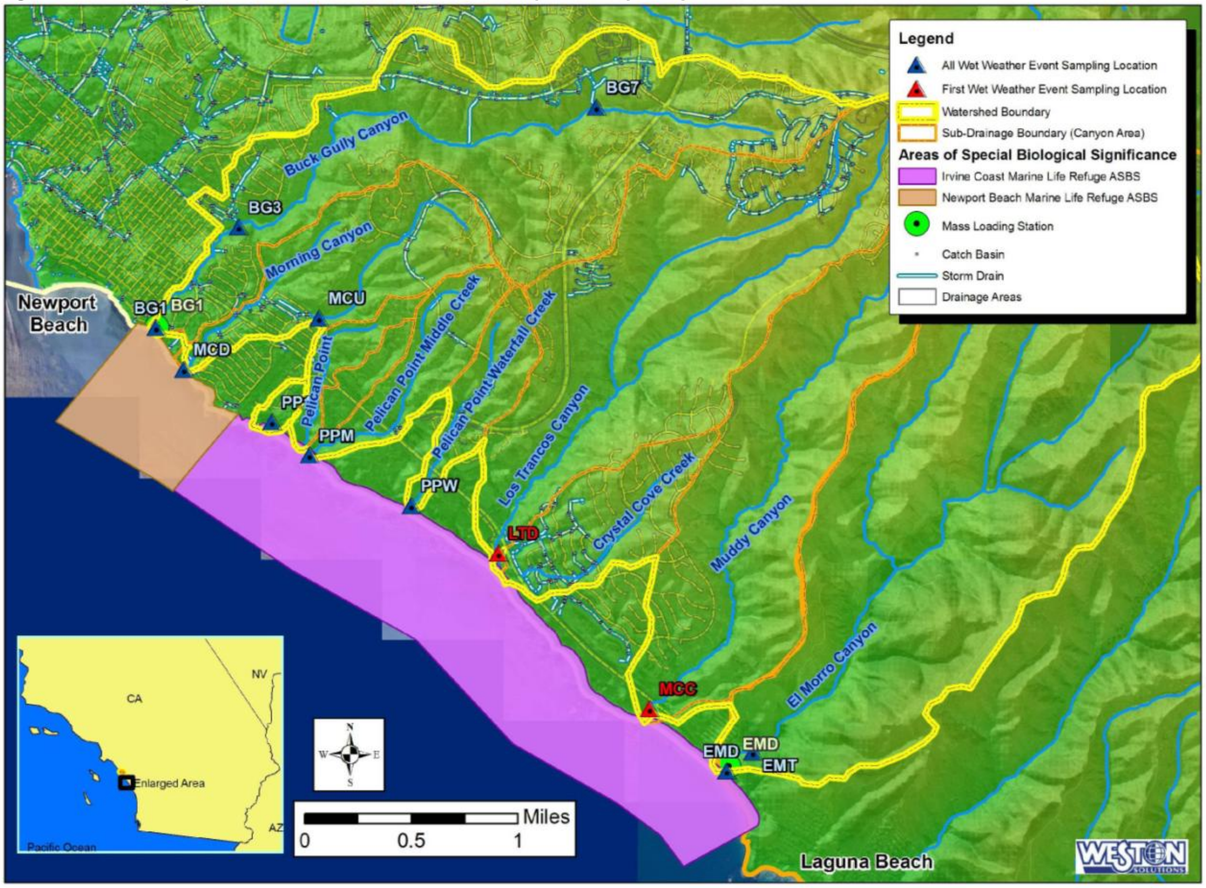
Based on these tasks, an ASBS Drainage Area Water Quality Assessment Report was prepared for the three ASBS (Task 2.3.3). These tasks are reviewed below.

1. 2007 Newport Coast Flow and Water Quality Assessment

The 2007 Newport Coast Flow and Water Quality Assessment focused on the eight canyon streams comprising the Newport Coast Watershed and the two ASBS along the Newport Coast. The assessment indicated that, with some exceptions, water quality conditions were generally protective of their listed beneficial uses. Samples collected from the watershed's canyon streams (see Figure 2 for the locations of the sampling points), some of canyons had wet weather or dry weather water quality exceedences for fecal indicator bacteria, dissolved cadmium, and dissolved copper. Dissolved cadmium concentrations exceeded the California Toxics Rule (CTR) chronic criteria for fresh water in dry weather samples and the CTR acute criteria in wet weather samples in Buck Gully, Morning Canyon and the three Pelican Point canyons.

Total cadmium at the Buck Gully Ocean site was the only constituent that was measured above Ocean Plan water quality objectives. Since the total cadmium concentration within the ocean mixing zone was greater than the concentration at the mouth of Buck Gully, the data suggested that offshore currents may be contributing cadmium from Lower Newport Bay to the ASBS or other nearby outfalls such as Morning Canyon or Pelican Point were contributing cadmium to the ASBS.

Figure 2. Canyon Stream Water Quality Sampling Locations



Dissolved copper concentrations exceeded the chronic CTR in the dry weather sample from Pelican Point Middle Creek, and in wet weather samples from Pelican Point Creek and Morning Canyon Creek. The total estimated annual dissolved copper load from El Morro Canyon, a largely undeveloped watershed, was calculated to be greater than either Pelican Point Middle Creek or Morning Canyon Creek. Only Buck Gully had a similar total annual dissolved copper load to El Morro Canyon.

Organophosphate pesticide concentrations of Diazinon and Malathion were detected at several sites during wet weather sampling. The Diazinon concentration exceeded the water quality objective (80 ng/L) during the first storm event in the upper reaches of Buck Gully and was also measured just below the water quality objective in the third storm event at the same site. This suggested that a potential source for Diazinon was likely residential pesticide application upstream of Site BG7. Malathion concentrations were higher in Morning Canyon than in any of the other canyon streams during each of the three storm events. Malathion was also detected in the ocean mixing zone at the mouth of El Morro Creek.

Acute and chronic toxicity tests were performed with water collected from the ASBS ocean receiving water in front of Buck Gully and from the mouth of Buck Gully during two storm events. Results of these tests indicated that exposures to Buck Gully effluent and ASBS receiving water during storm events was not toxic to purple sea urchin fertilization, mysid shrimp survival, or giant kelp growth. Some toxicity to giant kelp germination was observed in the ocean receiving water sample, though the specific cause of the toxicity to kelp germination could not be determined. A Toxicity Identification Evaluation test was recommended to determine the potential cause of the measured toxicity.

Exceedances of the freshwater fecal coliform water quality criteria were observed in all coastal canyons for multiple wet weather events. Mixing zone samples in the ASBS at the mouths of Buck Gully and El Morro Canyon Creek were above Ocean Plan water quality criteria for enterococci. Fewer exceedances of water quality criteria occurred during dry weather at Pelican Point Creek, Upper Los Trancos Canyon and Muddy Creek sample locations than during storm events, though flows from Los Trancos Creek and Muddy Creek are diverted to the sewer system during dry weather. The analysis of estimated total annual loads indicated the total dry and wet weather annual loads for fecal coliform are of the same magnitude at the mouths of Buck Gully and El Morro, the most and least developed watersheds respectively. Estimated enterococci loads were one order of magnitude greater at Buck Gully than at the reference site (El Morro).

A separate study in 2006, entitled Groundwater Seepage Study, prepared by Todd Engineers, concluded that a significant portion of the flow found in the canyon streams was from groundwater seepage as a result of infiltration of imported irrigation waters.


A kelp bass swimming within a Southern California kelp forest.

2. Newport Coast Kelp Toxicity Study

Giant kelp (*M. pyrifera)* is the dominant canopy-forming Laminarian alga in Southern and Central California and forms extensive subtidal forests along the coast. Because kelp forests support a rich diversity of marine life, providing food and habitat for hundreds of marine invertebrate and vertebrate species, their health is critical to maintaining the diversity of species currently residing the Newport Coast ASBS. In February 2006, effluent from Buck Gully was evaluated for acute and chronic toxicity using three standardized marine toxicity tests with giant kelp, mysid shrimp, and purple sea urchin. While no toxicity was observed in shrimp or sea urchin exposures to water collected from the Buck Gully mixing zone, significant reduction in kelp spore germination was observed.

A germination and growth bioassay for the giant kelp was conducted to confirm the results of a previous study in which toxicity to giant kelp had been observed in exposures to Buck Gully effluent. In addition to conducting the kelp bioassay test under the standard protocol, a modified version of the test in which particules were removed from the water was also conducted to determine if any observed toxicity was due to the presence of dissolved chemical contaminants in the water or instead was caused by particulate debris. Results of the bioassay tests indicated that exposure to water collected from Buck Gully, the near-shore intertidal mixing zone, and from the outer edge of the mixing zone did not produce toxic effects on kelp germination in either the modified test (large particulates removed) or the standard test.

3. Mussel Bioaccumulation Study

Bioaccumulation studies were conducted with blue mussels (*Mytilus galloprovincialis*) to investigate potential anthropogenic impacts of urban runoff, harbor contamination, and stormwater runoff on rocky intertidal communities living within the Newport Coast Area of Special Biological Significance (ASBS). Results from a previous study indicated that Buck Gully effluent exceeded water quality standards for concentrations of cadmium and copper, two metals known to bioaccumulate in animal tissues. Blue mussels were chosen for this study based on their propensity to rapidly bioaccumulate contaminants from their environment through actively filtering up to 50 liters of water per day. Additionally, because blue mussels can represent a significant food source for a variety of animals (e.g., shore birds, crabs, snails, and sea stars) they can also be representative of potential toxicity within the marine food web.

The potential bioaccumulation of contaminants of concern were investigated by outplanting Vexar cages containing blue mussels at several locations within the Newport Coast ASBS near the mouth of Buck Gully. Mussels were also deployed in the entrance channel to Newport Harbor to evaluate Harbor water contamination and to compare against tissue concentrations of mussels residing within the Newport Coast ASBS. Mussel cages deployed in January 2007 were dislodged from all sites, and no mussels were recovered. Mussels were re-deployed at the same locations and later retrieved from three intertidal locations and one harbor location after three-month and six-month field exposures. No mussels were recovered from the Site BG-Subtidal due to sand burial of the cages.

Results of this study within the Newport Coast ASBS indicated that contaminants contained in Buck Gully runoff did not bioaccumulate in outplanted mussels to concentrations that have been shown to cause significant biological effects, regardless of the duration of exposure (e.g., three-month or six-month exposures). Several analytes (cadmium, selenium, and total PAHs) were statistically elevated in Newport ASBS mussels compared to Newport Beach Mussel Watch mussels. However, concentrations of cadmium and total PAHs in Newport Coast ASBS mussels, were two or more orders of magnitude below levels in which chronic effects would be expected (McCarty and MacKay, 1993). Statistically elevated 4,4'-DDE, barium, cobalt, iron, and manganese was observed in the tissue of mussels deployed within the ASBS in comparison to mussels deployed in the entrance channel to Newport Harbor. These results indicate that organisms living within the influence of Buck Gully's effluent may be subject to low-level doses of these constituents. Although deployment sites were located upstream, downstream, and directly in line with the mouth of Buck Gully, no statistical differences in tissue concentrations were observed among ASBS sites.

4. Newport Coast and Laguna Beach Areas of Special Biological Significance Intertidal Monitoring Study

Impacts to intertidal and subtidal habitats include sedimentation, scouring, contamination, and dilution of the saline water via dry weather flows and wet weather flows. Additional types of intertidal disturbance include direct harvesting, scavenging, trampling, and collecting of organisms by humans. The Newport Coast and Laguna Beach ASBS Intertidal Monitoring Study was designed to assess the magnitude and extent of multiple types of anthropogenic impacts to these areas and to create a baseline dataset for the intertidal zone. Through the monitoring of the intertidal community over time, changes to the community can be assessed and informed management decisions can be made to mitigate deleterious impacts.

A baseline Intertidal Monitoring Survey was carried out designed to help to determine which anthropogenic activities might be deleterious to species living within the ASBS as well as to create a base-line dataset from which to monitor restoration efforts and future impacts. Data were collected within the Newport Coast and Heisler Park ASBS to identify the presence, abundance, and distributions of species regularly monitored at nearby rocky intertidal sites (e.g., Shaw's Cove, Crystal Cove, Treasure Island, and Dana Point) as part of the Minerals Management Service program and as part of California's Critical Coastal Area long-term monitoring program. Three sites, located in the rocky intertidal zones at Little Corona (Buck Gully), Morning Canyon, and Heisler Park, were selected for biannual intertidal monitoring surveys. A result of extensive public use of the rocky intertidal shoreline within Orange County, no true reference sites were known to exist within the vicinity of the study area. As a result, a weight-of-evidence approach was used to compare impacts between high-use sites (Buck Gully and Heisler Park) and a low-use site (Morning Canyon). Monitoring surveys were conducted along permanent transect lines stratified by habitat type and tidal level following methods comparable to other long-term monitoring programs. Transect lines were oriented across the reef, perpendicular to the alongshore axis of the beach, and surveys were conducted from the lower to upper intertidal zone along each transect. During each survey, several different monitoring designs were employed, including point contact line transects, point-contact quadrat plots, photo-plots, and band transects following standardized Minerals Management Service methods for Orange County sites. To assess impacts from urban runoff, transects were aligned upcoast and downcoast of the mouths of Buck Gully and Morning Canyon and in close proximity to storm drain outfalls at Heisler Park. Dramatic differences in algal cover at the three sites were noted.

Point-contact transect data indicated that although season variability existed within sites, species densities and species richness between high-use sites and low-use sites were generally not substantially different. Two target species, however, were found exclusively at Morning Canyon during both summer and winter surveys and, thus, were negatively associated with the number of yearly tidepool visitors. Rockweed and sea urchins were observed in relatively low densities along the Morning Canyon transects. Rockweed constituted approximately five percent of the total coverage in both summer and winter transects, whereas sea urchins constituted six percent of the coverage in summer and one percent of the coverage in winter at Morning Canyon. Surf grass was not observed at Buck Gully but was detected along all three transects at both Morning Canyon and Heisler Park.

The absence of rockweed at Buck Gully and Heisler Park (high public use sites) is thought to be significant since the thalli of rockweed are delicate and easily damaged, making the species highly susceptible to impacts from trampling. This alga was commonly seen throughout the upper intertidal zone along all semi-protected, low-use to moderate-use coves located within approximately one mile of Buck Gully. Similarly, sea urchins would be expected to be found in lower densities and smaller sizes at high-use sites as a result of handling and the selective collecting of larger specimens. Observations made during the summer survey at Morning Canyon noted that the rockweed beds appeared to be significantly thinner than they had been during the winter survey.

CROSS-CONTAMINANT IMPACTS FROM NEWPORT BAY

The study area, as shown in Figure 1, is comprised of three coastal watersheds – Newport Bay, Newport Coast, and Laguna Canyon Watersheds. Discharges into Newport Bay will mix with the bay before exiting the Harbor entrance into the coastal areas. Coastal creeks discharging into Upper Newport Bay include San Diego Creek, Santa Ana-Delhi Channel, Santa Isabella Channel, and Big Canyon. ASBS 32 and 33 are located along the Newport Coast Watershed with Buck Gully and Morning Canyon draining into ASBS 32 and Pelican Point Creek, Pelican Point Middle Creek, Pelican Hill Waterfall Creek, Los Trancos Creek, Muddy Creek, and El Moro Canyon discharging into ASBS 33. Emerald Canyon flows to the coastline between ASBS 33 and 30, while Laguna Canyon Channel empties into the ocean just downcoast of ASBS 30.

A hydrodynamic and water quality model of Newport Bay and the ASBS was developed to evaluate potential impacts to the three ASBS from various pollutant and sediment sources. The model was developed using RMA2 and RMA4 models developed by the U.S. Army Corps of Engineers. RMA2 is a depth-averaged two-dimensional hydrodynamic model, which can be used to simulate changes in water elevations and depth-averaged velocities of a water body due to tidal forcing or other inflows. The RMA2 model results can then be used to drive the water quality model RMA4 to simulate water quality conditions of the water body including mixing and dispersion characteristics. The numerical model grid used for this Study was a composite of two model grids previously developed for the City (Everest 2004 and 2005). The hydrodynamic model had previously been verified with tide and current data to provide good predictions of tidal elevations and currents within the harbor.

The hydrodynamic and water quality models were used to evaluate the potential impacts to the ASBS from various discharges. Firstly, the hydrodynamic model was used to track the movement of “numerical tracers” representing pollutants discharging from the Harbor and coastal creeks. This method called “particle tracking” allows the efficient assessment of transport conditions by releasing numerical tracers from the discharge locations for different tide and flow conditions. The particle tracking was used to determine if pollutants from the Harbor and other coastal creeks have the potential to reach the ASBS and the most probable direction of transport. The transport conditions were evaluated for a range of tide, flow, as well as release times and release locations of the particles

<u>Predicted Contaminant Loading from Newport Harbor</u>

Example particle tracking results for the Harbor under dry and wet weather conditions are shown in Figures 3 and 4. Each figure shows the particle tracks, indicated by the colored lines, for each particle release location under a different tide conditions in each of the four panels. The gray shaded area indicates ASBS 32 and 33. Under dry weather conditions, pollutants exiting the Harbor are transported downcoast along the coastline to ASBS 32 and 33. Movement of the particle into or out of the Harbor show the oscillation attributed to tide conditions with transport into the Harbor under flood tide and transport out of the Harbor during ebb tide. As expected, the wet weather results shown in Figure 4 illustrate a more prominent offshore transport direction under extreme wet weather conditions (e.g., 100-year storm event).

Figure 3: Dry Weather Particle Tracking Results from Newport Harbor Jetty

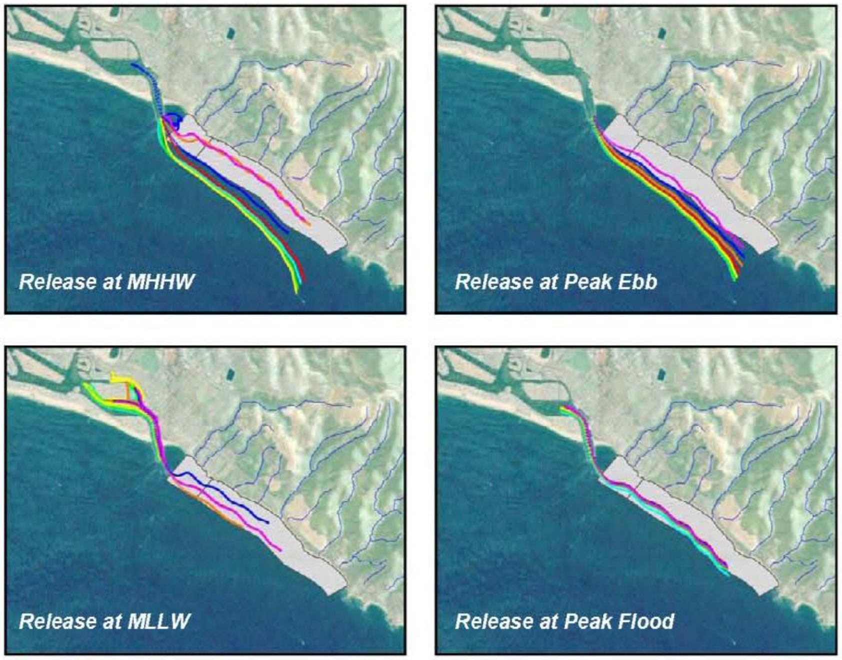


Figure 3 – Dry Weather Particle Tracking Results for Harbor

Figure 4: Wet Weather Particle Tracking Results from Newport Harbor Jetty

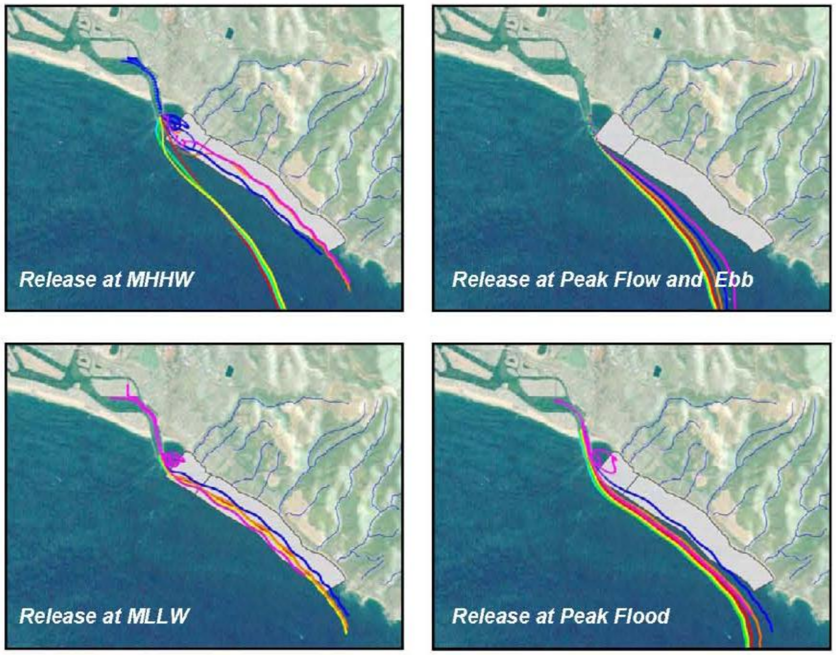


Figure 4 – Wet Weather Particle Tracking Results for Harbor

The second part of the analysis used the RMA4 water quality model to simulate the mixing and dispersion of pollutants being discharged along the coastline. The predicted pollutant concentrations at the ASBS were than compared with toxicity values for marine species found in the ASBS to assess the cross contamination impact of the Harbor and creek discharges to the ASBS. Only pollutant loads from the Harbor and Buck Gully were modeled because of the lack of data to estimate pollutant loadings for the other coastal creeks.

Direct measurements of pollutant loadings from the Harbor are not available, hence, pollutant loadings from the Harbor was estimated based on the average pollutant concentration throughout Newport Bay and Harbor and the associated estimated flows out of the Harbor. It was assumed that dissolved metal concentrations exiting the Harbor (i.e., simulated as a point source similar to a creek discharge at the Harbor exit) are the same as the dissolved metal concentrations within the Newport Bay. Example model results for the maximum dry and wet weather copper loading from the Harbor are shown in Figures 5 and 6. Figure 5 tracks the change in copper concentrations discharging from the Harbor over 72 hours. The color scale in the figure is selected such that “red” indicates copper concentration higher than toxicity values for some marine species found in the ASBS. As shown in the figure, the maximum predicted dry weather copper loading from the Harbor resulted in toxic copper concentrations within ASBS 32. Under wet weather condition, as shown in Figure 6, modeled predicted toxic copper concentrations are indicated throughout ASBS 32, as well as part of ASBS 33. Note that these model predictions have not been validated by field measurements.

Figure 5: Dry Weather Copper Concentrations Discharging from Harbor over 72 Hours

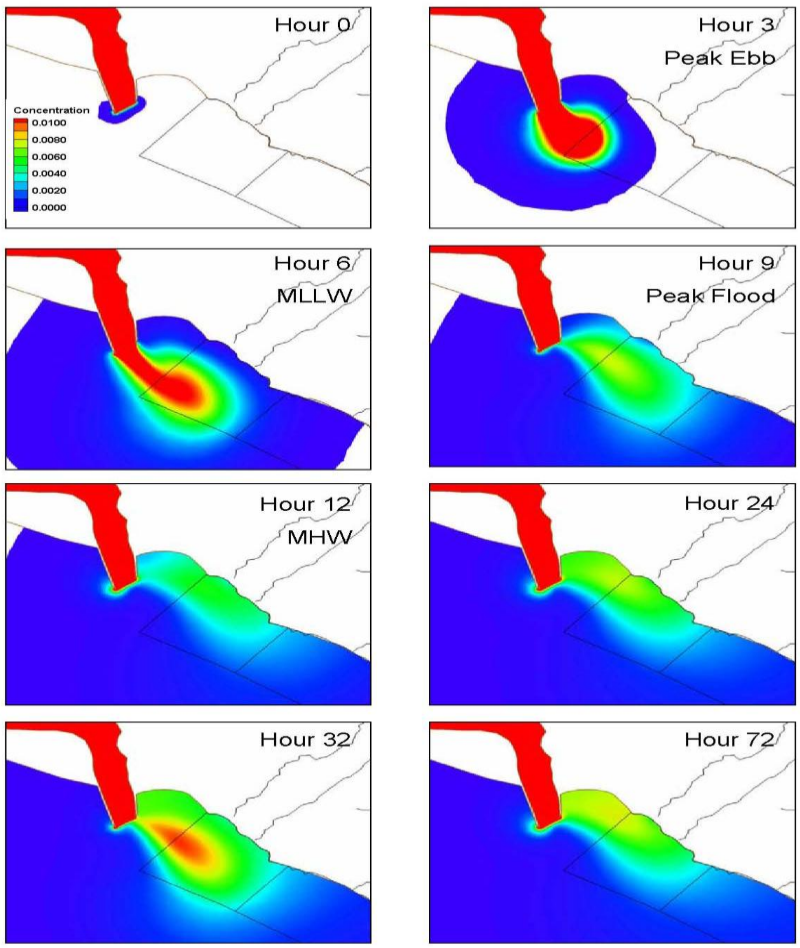


Figure 7 Maximum Dry Weather Loading from the Harbor

Figure 6: Wet Weather Copper Concentrations Discharging from Harbor over 72 Hours

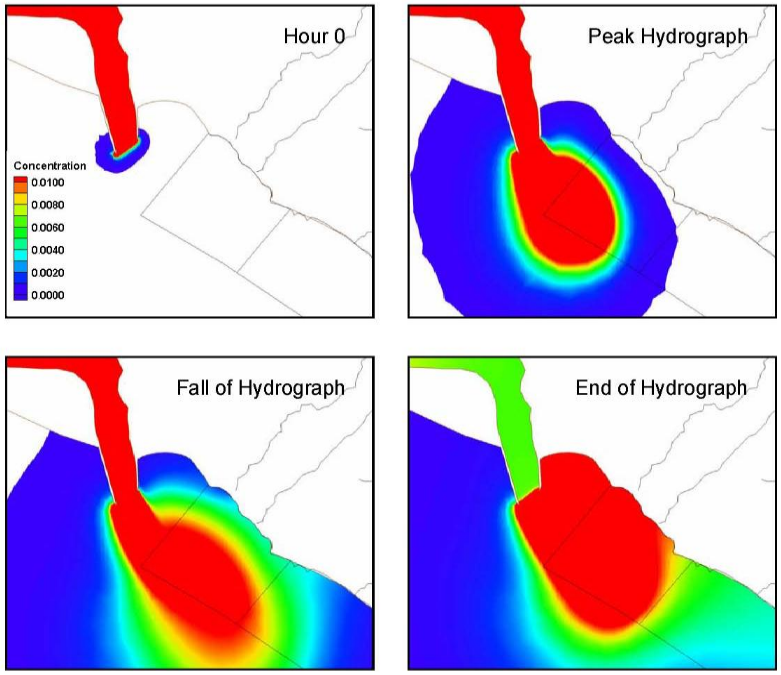


Figure 8 Maximum Wet Weather Loading from the Harbor

The model predicted dispersion pattern of pollutants exiting the harbor entrance during wet weather condition matches well with visual observation at the site as shown in Figure 7 which compares the model predicted pollutant plume exiting the harbor with an aerial photo taken after a rain event. It can be seen in the figure that the model predicted plume matches the general shape and extend of the plume shown in the photograph.

Figure 7: Comparison between the Actual Rain-Induced Plume and the Model Predicted Pollutant Plume

Figure 9. Dispersion Pattern Comparison with Visual Observation

Predicted Contaminant Loading from Buck Gully

Based on limited available data, copper concentration found in Buck Gully was below the toxicity values during dry weather condition and hence was not modeled. The loading from Buck Gully during wet weather conditions was estimated based on collected water quality data. The model predicted spatial extent of toxic copper concentrations from Buck Gully under wet weather conditions. For pollutants from Buck Gully, the mixing and dispersion was simulated based on the average and maximum wet weather loadings for dissolved copper. The average copper loading did not result in a toxic concentration within ASBS 32.

The following summarizes the findings and recommendations of the Cross-Contamination Study.

1. The general direction of transport for pollutants from the Harbor is in the downcoast direction and the hydrodynamic conditions of the study area are likely to transport pollutants from Newport Harbor to ASBS 32 and 33 under both dry and wet weather conditions. The magnitude of the impact of the pollutants from the Harbor to ASBS 32 and 33 would be dependent on pollutant loadings from the Harbor. Based on the limited data, modeling shows that certain pollutants, e.g. copper, could reach ASBS 32 at levels higher than the literature toxicity values, in this case, sea urchins..

2. Hydrodynamic conditions are suitable to transport pollutants from Buck Gully to the Harbor, ASBS 32, and ASBS 33. In general, transport from Buck Gully is affected by the Harbor tidal flow and is in the upcoast direction toward Big Corona Beach until being entrained into the Harbor flows. Potentially, pollutants from Buck Gully may impact enter the harbor jetty or circulate back into ASBS 32 and 33.

   The pollutants that are of potential concern from Buck Gully and the other coastal canyons are cadmium, copper, lead, zinc and fecal indicator bacteria. Modeling shows that mixing and dispersion of storm flows would result in only localized transport of pollutants into the ASBS. The potential for transport of pollutants from Morning Canyon is similar to that of Buck Gully.

3. Further down the coast, transport of pollutants from Pelican Point Creek, Pelican Point Middle Creek, Pelican Point Waterfall Creek, Los Trancos Creek, Muddy Creek, and El Moro Creek are likely to be confined within ASBS 33. Transport within ASBS 33 is generally in the downcoast direction. Additional pollutant loading data is needed before an assessment of transport into the ASBS can be made.

4. Hydrodynamic conditions are suitable to transport of potential pollutants from Laguna Canyon Channel to ASBS 30. The general direction of transport is in the upcoast direction. The impact of these potential pollutants is dependent on the pollutant loading.

5. To quantify the impacts of potential pollutants from the Harbor to ASBS 32 and 33, it is recommended that the water quality (e.g., pollutant loading) exiting the Harbor be determined. Determination of pollutant loadings from the Harbor can be achieved either by a field data collection program or by expanding the numerical modeling effort to include the mixing characteristics within the entire Harbor based on loadings from creeks and storm drains.

6. It is also recommended that flow and water quality monitoring continue in order to more accurately characterize pollutant loading from coastal creeks and storm drains that discharge close to the ASBS.

ROCKWEED RE-ESTABLISHMENT PILOT EXPERIMENT

Flora and fauna in the rocky intertidal zones in southern California and elsewhere have exhibited changes in abundance and community composition over the past several decades. Although re-establishment is a common technique to combat ecological change as a result of human influences, to our knowledge only one restoration project has been attempted in the rocky intertidal zone which was the reintroduction of a brown algae on Alaskan rocky shores following the Exxon Valdez oil spill. This attempt was not successful.

In the ASBS at Robert E. Badham Park (Little Corona), changes in seaweed communities are particularly evident including the disappearance of the important habitat-forming, brown-algal rockweed, *Silvetia compressa.* The purpose of this study was to test several methods for experimentally re-establishing rockweed and examining the factors that might affect survival. The goals of this project were to: a) re-establish rockweed at Little Corona where it was abundant during the 1950s; b) determine an effective procedure that can be used to re-establish rockweed at this and other sites; and c) to determine the importance of biotic and abiotic factors in the success of re-established rockweed.

This study investigated several methods for re-establishing rockweed:

1. Transplanting juveniles (Figure 8) on horizontal (Figure 9) and vertical surfaces with grazing or canopy-protection
2. Relocation of fertile reproductive structures to seed the area with rockweed germlings.
3. Transplanting large fertile adults (Figure 10) on horizontal and vertical surfaces
4. Transplanting large fertile adults on vertical surfaces

The last method of transplanting rockweed on vertical surfaces was successful of a survival rate of nearly 40 percent. It is hypothesized that this method confers an ecological advantage to rockweed by decreasing the amount of damage due to loss of water, as well as decreasing the amount of trampling by human visitors.

Although monitoring needs to be continued, it is likely that this trial has successfully re-established a self-sustaining rockweed population at the site, given the survival rates of transplanted materials and the presence of more than a dozen “naturally” recruited individuals that likely originated from our transplanted rockweed adult samples.

Figure 8. Juvenile *Silvetia* thallus attached to small section of bedrock.

Figure 9. Reattached section of bedrock and juvenile *Silvetia* thallus.

Figure 10. Fertile Rockweed thallus.

IMPACT METRIC

Marine ecosystems have been adversely affected for many years by anthropogenic impacts along the coastline of Southern California. For intertidal communities, these impacts can range from being crushed underfoot or collected by tide pool visitors to suffering lethal or sub-lethal toxicity from exposure to contaminated urban runoff and storm water flows. Assessing the condition of the intertidal community and the anthropogenic impacts currently affecting it was the overarching goal of the Newport ASBS Protection and Restoration Monitoring Plan. This plan was designed to distinguish the magnitude and extent of impacts to intertidal communities living within the ASBS by:

- examining the distribution and abundance and contamination levels in key species residing within the ASBS,
- evaluating water quality within the waters that discharge to the ASBS (canyon creeks and Newport Bay).
- examining public use impacts on the ASBS, and
- reviewing natural trends in the weather and ocean conditions.

Through the implementation of this program, an initial baseline dataset for the ASBS is being established. This baseline dataset has been used to generate an impact metric ranking (see Figure 11) for each of the identified environmental stressors. The metric uses a five point, color-coded system:

1) dark green (no observed impact),
2) light green,
3) yellow (impact present but extent unclear),
4) orange, and
5) red (clear negative impact)

From Figure 11, the metric indicates that public trampling and collecting within the tidepools is the most important stressor to the ASBS.

Future monitoring results will be incorporated into this baseline dataset to determine trends indicative of the overall health of the intertidal communities living within the ASBS. Based on these trends, informed management actions can be made to protect the health of the ASBS.

Figure 11: ASBS Impact Metric

IMPACT METRIC SUMMARY FOR LITTLE CORONA DEL MAR

	Impact Type	Test	Test Score	Mean Score	Code	Overall
Local Contaminants - Wet Weather	**Water Quality**					
	Frequency of water quality exceedances	Contaminants exceeded WQO	5			
	Magnitude of WQ exceedances	Ratio of measured concentration to WQO	2.5	4.17		
	Wet weather particulate tracking - Buck Gully	Intertidal Zone is influenced by Buck Gully	5			
	Bioaccumulation					
	Elevated constituent concentrations	Treatment significantly different from controls	5			
	Toxic levels of constituents	Comparison to ERAD Database	0			
	Total coliform bacteria concentration in tissue	EPA methods/comparison to controls	0			
	Fecal coliform bacteria concentration in tissue	EPA methods/comparison to controls	0	0.63		
	Vibrio spp. concentration in tissue	Comparison to controls	0			
	F-coliphage concentration in tissue	EPA methods/comparison to controls	0			
	Adenovirus concentration in tissue	Comparison to controls	0			
	Domoic acid concentration in tissue	Comparison to controls	0			
	Toxicity					
	Toxicity to *Strongylocentrotus purpuratus*	Significant toxicity in post-storm samples	0	0.00		
		MEAN SCORE:		1.60		
Local Contaminants - Dry Weather	**Water Quality**					
	Frequency of water quality exceedances	Contaminants exceeded WQO	5			
	Magnitude of WQ exceedances	Ratio of measured concentration to WQO	2.5	3.33		
	Dry weather particulate tracking - Buck Gully	Intertidal Zone is influenced by Buck Gully	2.5			
	Bioaccumulation					
	Elevated constituent concentrations	Treatment significantly different from controls	5			
	Toxic levels of constituents	Comparison to ERAD Database	0			
	Total coliform bacteria concentration in tissue	EPA methods/comparison to controls	0			
	Fecal coliform bacteria concentration in tissue	EPA methods/comparison to controls	0	0.63		
	Vibrio spp. concentration in tissue	Comparison to controls	0			
	F-coliphage concentration in tissue	EPA methods/comparison to controls	0			
	Adenovirus concentration in tissue	Comparison to controls	0			
	Domoic acid concentration in tissue	Comparison to controls	0			
	Toxicity					
	Macrocystis pyrifera reproduction	EDGE - EPA methods/comparison to controls	0			
	Macrocystis pyrifera reproduction	MIX - EPA methods/comparison to controls	0			
	Macrocystis pyrifera Growth	EDGE - EPA methods/comparison to controls	0			
	Macrocystis pyrifera Growth	MIX - EPA methods/comparison to controls	0	0.36		
	Mytilus spp. chronic toxicity	Concentrations below NOED levels	0			
	Mytilus spp. chronic toxicity	Selenium concentrations elevated, effects unclear	2.5			
	Mytilus spp. acute toxicity	Sensitivity of larvae compared to controls	0			
		MEAN SCORE:		1.44		
Regional Inputs - Newport Harbor	**Harbor Cross Contamination**					
	Dry weather influence	Model indicates potential toxicity to ASBS	2.5	2.50		
	Wet weather influence	Model indicates potential toxicity to ASBS	2.5			
		MEAN SCORE:		2.50		
Public Use	**Shoreline Fishing/Consumption**					
	Frequency of occurrence per visitor	Observations/comparison to control site	2.5	2.50		
	Treading					
	Public Use Intensity - Weekdays	Observations/comparison to control site	5			
	Public Use Intensity - Weekends	Observations/comparison to control site	5			
	Walking and Trampling	Observations/comparison to control site	5	5.00		
	Sitting and Standing	Observations/comparison to control site	5			
	Silvetia compressa Cover	Observations/comparison to control site	5			
	Capture/Handling					
	Handling/Touching Organisms	Observations/comparison to control site	5	5.00		
	Collecting Shells, live organisms, rocks	Observations/comparison to control site	5			
		MEAN SCORE:		4.17		
Restoration	**Habitat Restoration**					
	Silvetia compressa Transplant Success	Transplant success rate > 25%	0	0.00		
		MEAN SCORE:		0.00		

NEWPORT COAST INTEGRATED COASTAL WATERSHED MANAGEMENT PLAN

Based on the identification of sources of impacts to the watershed, assessment findings, and evaluation of the current health and quality of the Newport Coast Watershed and the two Area of Special Biological Significance (ASBS) as characterized in the Newport Coast Flow and Water Quality Assessments, Groundwater Seepage Study, Canyon Ecological Assessment, ASBS Impact Assessment and other studies, the Newport Coast Integrated Coastal Watershed Management Plan was prepared. The purpose of the Water Management Plan is to provide the City and watershed stakeholders with a structured guide to protect and restore the Newport Coast Watershed and ASBS and to set in motion those steps that will allow for the ecological health of the watershed and marine life areas to be sustained. Watershed management is defined as the integration and coordination of activities that affect natural resources and water quality within a geographically defined drainage area. The Newport Coast Integrated Coastal Watershed Management Plan can be found on the City's watershed website.

The Newport Coast Watershed and ASBS contain sensitive ecological communities that, due to anthropogenic and natural stressors require protection and, in some cases, restoration in order to be sustainable. This Water Management Plan defines objectives and strategies to accomplish the long-term sustainability of the watershed such that ecological needs are balanced with the other community requirements, e.g. water use, recreation, planned land use, fire protection and canyon stability. The Plan strategies will be implemented through restoration actions and supplemented by community and stakeholder outreach and education. This Plan explicitly includes the prioritization of actions based on the level of impact, availability of resources and regulatory requirements. The end goal is a sustainable watershed maintained through continued assessment of the effectiveness of the protection, preservation and restoration measures.

As this is the City's first attempt at creating a comprehensive watershed-wide management plan, the structure of the plan mimics the framework used by the SWRCB for evaluating and scoring management plans (State Water Resources Control Board, 2007). The Plan includes:

- Regional Description – including the watershed and the ASBS
- Objectives - identifies the goals of the Water Management Plan
- Water management Strategies and Integration - provides an action plan of recommended strategies to meet these goals
- Regional Priorities - prioritizes these actions based on regulatory, technical and financial criteria
- Implementation
- Impacts and Benefits
- Technical Analysis and Plan Performance
- Data Management
- Financing

- Relation to Local Planning
- Stakeholder Involvement and Coordination
- Disadvantaged Communities

This planning document provides the City and stakeholders with a framework to implement projects that will meet the watershed goal for creating an ecologically sound and sustainable watershed.

The Water Management Plan includes the following components:

- Assessment of Existing Conditions – Assess the current health and quality of the water, habitat, marine areas, and environment through scientifically based studies. These studies are summarized in the Water Management Plan and appendices.

- Study of Potential Impacts – Identify the sources and the level of impact of existing and potential impacts to the quality and health of the watershed through scientifically based studies. Several of these studies have been completed or are underway and are outlined in this Water Management Plan.

- Specific Protection Measures – Design and implement specific measures to address the defined current impacts and prevent future impacts in order to protect the watershed resources using the outlined strategies and priorities of this Water Management Plan as a guide.

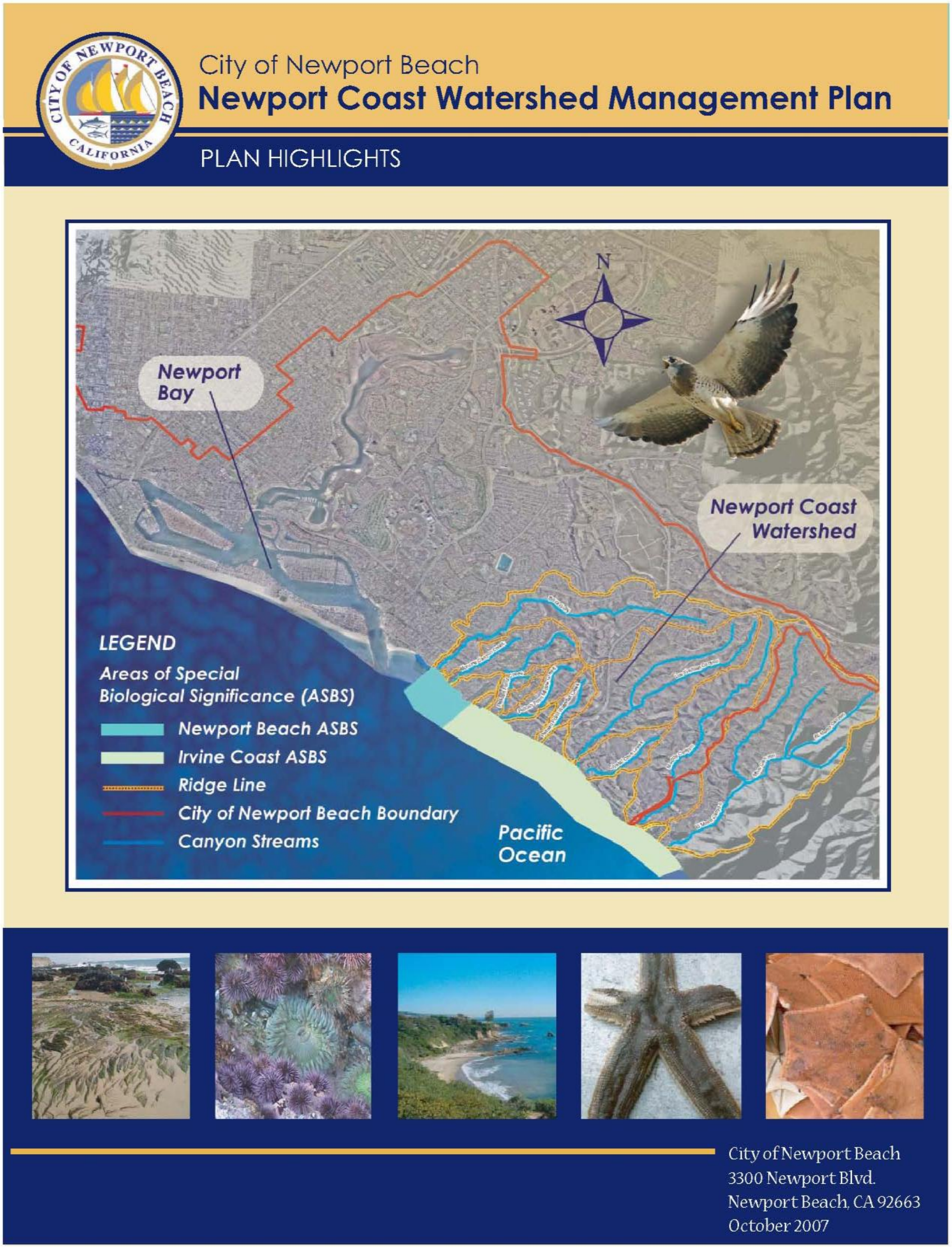
- Specific Restoration Measures – Design and implement measures to restore habitats where applicable using the outlined strategies and priorities of this Water Management Plan as a guide.

- Effectiveness Assessment – Continue assessment of the protection and restoration programs in terms of their effectiveness in meeting the long-term sustainability goal. Continue implementation, revise or end actions based on the results of the effectiveness assessment. An adaptive management approach using the results of the effectiveness assessment will continue implementation, revise or end management actions with the ultimate goal of creating a sustainable watershed.

This Water Management Plan will need to be coordinated with plans being developed and implemented for the Harbor Area, Newport Bay, San Diego Creek, Laguna Canyon Creek, other Areas of Special Biological Significance, and other regional receiving waters and watersheds. As part of the steps to finalize this plan, coordination with these plans through the associated watershed managers and stakeholders is needed to meet program/project effectiveness targets. In addition, this plan incorporates a regional perspective which integrates with the strategies of surrounding watersheds and statewide initiatives. This approach will enhance the effectiveness of the Water Management Plan and other regional management efforts.

The proposed management plan was presented to the WMAC for review. Because the final document is thick and includes a lot of technical information, it is a difficult read. To partially remedy this, a 20-page, full-color “Plan Highlights” was created to provide a more accessible bridge for the reader. Figure 12 shows the Plan Highlights title page. Based on the lessons learned in preparing this management plan, a more readable and systematic approach was used in preparing the Central Orange County Integrated Regional and Coastal Water Resource Management Plan, 2009. This more comprehensive plan includes the Newport Coast area and can be found on the City’s watershed website page.

Figure 12: Newport Coast Watershed Management Plan – Plan Highlights Title Sheet



AGREEMENT SCHEDULE

There were no major problems in meeting the schedule, however, there were some smaller problems, summarized below that prompted the City to ask for an extension of the agreement timeline.

- While the agreement start date is January 2, 2006, agreement was not formally executed until May 16, 2006. This, coupled with City delays in getting out requests for proposals for the major assessments, resulted in one year delay in starting the assessment work.
- In general, all consultants performed the field studies per the project schedules. However, all consultants were slow in performing the analyses and writing final reports.
- Cal State Fullerton's trial study for the rockweed was launched successfully, however the survival rates of the rockweed were disappointing. Cal State Fullerton regrouped and came up with an alternate plan. Professor Smith requested a time extension, which was granted. The Phase 2 plan was launched and was successful

COST SUMMARY

Per the grant agreement, the SWRCB awarded the City $397,500 in grant funds. Per the agreement, the City's costs share would be $131,250. The City of Laguna Beach agreed to reimburse the City of Newport Beach $30,000 for work performed in Heisler Park. Additionally, the City of Newport Beach agreed to provide $79,000 in in-kind services.

The costs for the consultant contracts were quite good, e.g. lower than expected. This was fortunate as once the consultant work got underway some additional costs were incurred:

- Based on initial findings showing that water quality could be impacting the giant kelp, Weston Solutions' contract was extended to include further assessment of toxics bioaccumulation in the giant kelp. The City also paid for additional re-deployment of mussels when the initial deployment was washed away on due to heavy seas in March 2007.

- The City also decided to bolster the assessment of the potential contaminant loads emanating from Newport Bay by installing two velocity detectors outside the harbor jetty.

With these additional tasks, expenditures totaled $561,600. When the grant funds of $397,500 are subtracted out, the remaining total to be matched by the Cities was $164,100, about $33,000 more than originally anticipated. These additional costs were absorbed by the City of Newport Beach.

CLOSING REMARKS

The funds provided under this Proposition 40/50 Consolidated Grant provided budget for City's efforts to create a baseline, quantitative assessment of the primary stressors to the health of the three ASBS in Orange County. The results of ASBS assessment tasks have been pivotal in the City's decision making process in crafting an ASBS protection program that includes:

- Strengthening our tidepool docent program,
- Bolstering our irrigation run-off reduction program,
- Creating a greater impetus for implementing a tier-water rate structure,
- Continuing with restoration efforts in our tidepool and coastal wetland areas, and
- Continuing with a monitoring program that includes the coastal canyon, intertidal areas and subtidal areas.

The comprehensive baseline assessments of the ASBS have also be helpful in creating a cohesive core of stakeholders and consultants who now have a higher level of expertise to deal with the increasingly complex issues for protecting and restoring our valuable coastal resources.

Attachments:

- Final Progress Report
- Final ASBS Impact Assessment Study with Appendices
- Newport Coast Watershed Management Plan – Plan Highlights