# Newport Coast and Laguna Beach ASBS Protection Program

## Cross Contamination Study

## Main Report

*Submitted to:*


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# ACRONYMS

| | |
|---|---|
| ASBS | Areas of Special Biological Significance |
| ICWMP | Integrated Coastal Watershed Management Plan |
| SWRCB | State Water Resources Control Board |
| USACE | U.S. Army Corps of Engineers |

# 1. INTRODUCTION

The City of Newport Beach in cooperation with the City of Laguna Beach has obtained a State Water Resources Control Board (SWRCB) Proposition 50 grant for the Newport Coast and Laguna Beach ASBS Protection Program (Program) to provide for water quality improvement and habitat restoration across the three "Areas of Special Biological Significance" (ASBS) adjacent to the Cities' jurisdictions:

- 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.

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

The goal of the Program is to provide for water quality improvement and habitat restoration across the three ASBS regions and assist conformance with the protection of these ASBS under the Ocean Plan. The objectives of the Program are to identify and quantify the environmental impacts with the most detrimental effects on water quality and habitats in the ASBS and to prepare an Integrated Coastal Watershed Management Plan (ICWMP). The Program is composed of four components – Public Use Impact Study, Laguna Beach Flow and Water Quality Assessment, Pilot Restoration Experiment, and Cross Contamination Study. This study pertains to the Cross Contamination Study (Study).

As a component of the integrated watershed management plan, the Cross Contamination Study is being conducted to identify and quantify potential pollutant loadings from the coastal watersheds and to determine potential impacts of these pollutants to the ASBS in order to support the development of an ICWMP. This Study looked at potential pollutant discharges from Newport Harbor and major coastal creeks along the coastlines between Newport Harbor and Laguna Beach, but focused primarily on the loadings from the Harbor and Buck Gully where data are more available to estimate the loadings from these two sources. The Cross Contamination Study utilized analyses of water quality and pollutant loading data, sediment, and hydrodynamic and water quality numerical modeling to address the cross contamination issues.


**Figure 1. Study Area**

This report highlights the major findings of the Cross Contamination Study. Details of the Study are provided in two technical appendices. Appendix A – *Pollutant Loading and Sediment Budget Analyses Report* provides a detail summary of pollutant loading data available for the study area and a sediment budget analysis to evaluate long-term sediment transport trend along the Newport Beach coastline and whether the ASBS are eroding or accreting. The results of Appendix A are used in Appendix B – *Technical Report* as input to the hydrodynamic and water quality models which was used to evaluate potential cross contamination between the harbor, coastal creeks and ASBS.

# 2. STUDY AREA

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 summary of the watersheds and creeks within the Study Area are shown in Table 1. Detail descriptions of these watersheds and ASBS are provided in Appendix B.

## Table 1. Summary of Study Area

<table>
<tr><th>Watershed</th><th>ASBS</th><th>CCA</th><th>Creek / Beach</th><th>MMA</th></tr>
<tr><td rowspan="6">Newport Bay</td><td rowspan="6">--</td><td rowspan="4">69</td><td>San Diego Creek</td><td rowspan="4">Upper Newport Bay Ecological Reserve and State Marine Park</td></tr>
<tr><td>Santa Ana Delhi Channel</td></tr>
<tr><td>Santa Isabella Channel</td></tr>
<tr><td>Big Canyon</td></tr>
<tr><td></td><td>East Costa Mesa Channel</td><td></td></tr>
<tr><td></td><td>Big Corona Beach</td><td></td></tr>
<tr><td rowspan="11">Newport Coast</td><td rowspan="2">32</td><td rowspan="2">70</td><td>Buck Gully / Little Corona Beach</td><td rowspan="2">Robert E. Badham State Park</td></tr>
<tr><td>Morning Canyon</td></tr>
<tr><td rowspan="6">33</td><td rowspan="6">71</td><td>Pelican Point Creek</td><td rowspan="6">Irvine Coast State Marine Park and Crystal Cove State Marine Conservation Area</td></tr>
<tr><td>Pelican Point Middle Creek</td></tr>
<tr><td>Pelican Hill Waterfall Creek</td></tr>
<tr><td>Los Trancos Creek</td></tr>
<tr><td>Muddy Creek</td></tr>
<tr><td>El Moro Canyon</td></tr>
<tr><td></td><td></td><td>Irvine Cove</td><td></td></tr>
<tr><td></td><td></td><td>Cameo Cove</td><td></td></tr>
<tr><td></td><td></td><td>Emerald Canyon / Emerald Bay Beach</td><td></td></tr>
<tr><td rowspan="7">Laguna Canyon</td><td></td><td></td><td>Crescent Bay Point Beach</td><td rowspan="5">Laguna Beach State Marine Park</td></tr>
<tr><td></td><td></td><td>Crescent Bay Beach</td></tr>
<tr><td></td><td></td><td>Shaws Cove</td></tr>
<tr><td></td><td></td><td>Fisherman’s Cove</td></tr>
<tr><td rowspan="2">30</td><td rowspan="2">72</td><td>Diver’s Cove</td></tr>
<tr><td>Heisler Park / Rockpile Beach</td><td>Heisler Park State Marine Reserve</td></tr>
<tr><td></td><td></td><td>Laguna Canyon Channel / Main Beach</td><td>Laguna Beach State Marine Park</td></tr>
</table>

# 3. HYDRODYNAMIC AND WATER QUALITY MODELING

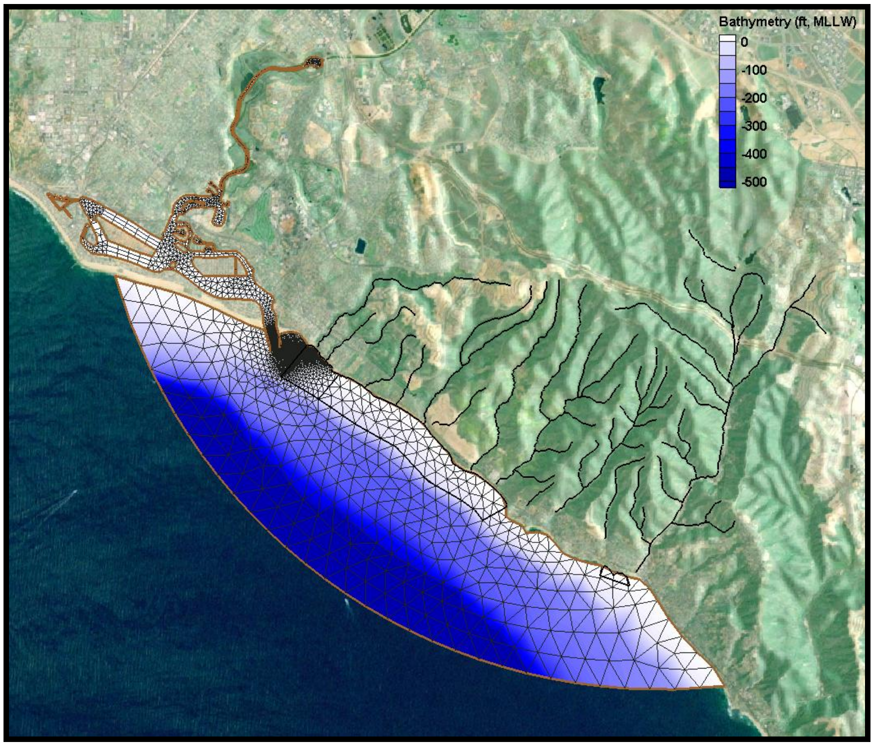
## 3.1 Model Development

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 (USACE). 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.

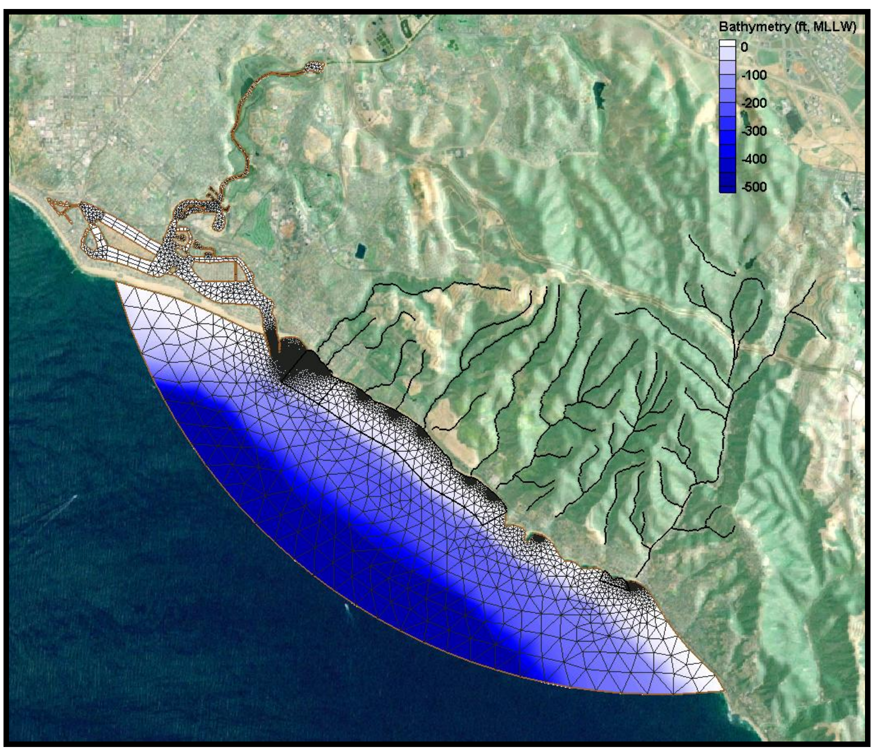
The numerical model grid used for this Study was a composite of two model grids previously developed for the City (Everest 2004 and 2005). In order to improve the model efficiency, two grids, which are shown in Figure 2, were developed with different resolutions. The first grid has very fine grid resolutions between the entrance and ASBS 32, as well as near Buck Gully, while the second grid has fine grid resolutions near the mouths of all other coastal creeks. The hydrodynamic model had previously been verified with tide and current data to provide good predictions of tidal elevations and currents within the harbor (Everest 2005).

The hydrodynamic and water quality models were used to evaluate the potential impacts to the ASBS from various discharges in two ways. The first was to use the model 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. Secondly, the water quality model was used to simulate the mixing and dispersion of pollutants being discharged along the coastline. By releasing pollutants from different discharge locations, the relative impacts of pollutants from different sources on the ASBS can be evaluated.

Details of the selection of model inputs (e.g. tide, flow, pollutant loadings) and model scenarios are provided in Appendix B. Only the highlights of the particle tracking and dispersion and mixing results are provided in the following sections.




*a) Refined near Harbor Entrance and Buck Gully*




*b) Refined near Harbor Entrance and Coastal Creeks*

**Figure 2. Numerical Model Grids**

### 3.2 Particle Tracking

A particle tracking analysis was conducted to show the potential transport of pollutants from the harbor and coastal creeks to the ASBS. The RMA2 model described above was used to track the movement of "numerical tracers" representing pollutants discharged from the Harbor and coastal creeks. This method called "particle tracking" allows efficient assessment of transport conditions to determine if hydrodynamic conditions are capable of transporting pollutants to the ASBS. The transport conditions were evaluated for a range of tide, flow, as well as release times and release locations of the particles.

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 event).

Particle tracks from the coastal creeks under dry weather conditions are shown in Figure 5. As shown in the figure, the dominant transport is in the downcoast direction with the greatest transport from the creeks that are closer to the Harbor entrance. Transport from Buck Gully and Morning Canyon initially moves in the upcoast direction, but reverses to the downcoast direction into ASBS 32 and 33 upon entrainment into the Harbor flows. The results also indicate that particles discharging from Buck Gully and Morning Canyon can move into the Harbor during flood tide. 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 from Emerald Canyon does not indicate transport to any of the ASBS. Transport from Laguna Canyon Channel shows an upcoast direction into ASBS 30.

Transport patterns for a wet weather event from a coastal creek are shown for Buck Gully in Figure 6. Transport is predominantly in the downcoast direction along ASBS 32 and 33. Similar to the dry weather results, pollutants discharged from Buck Gully can also be transported into the Harbor during flood tide.

The particle tracking results are consistent with the sediment budget analyses (Appendix A) which show that there is a small but net downcoast (from north to south) longshore sediment transport along the Newport Beach coastline.

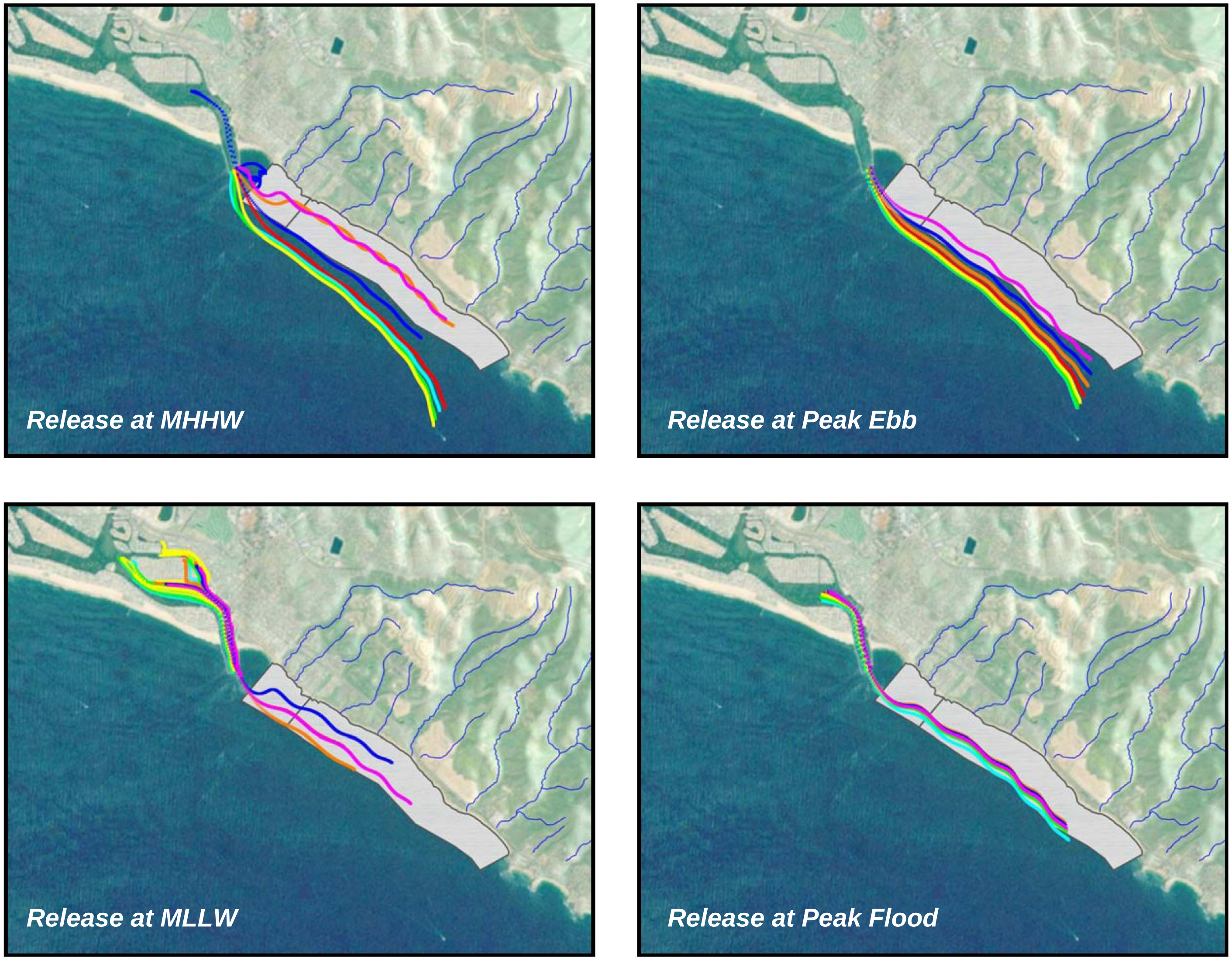



**Figure 3. Dry Weather Particle Tracking Results for Harbor**

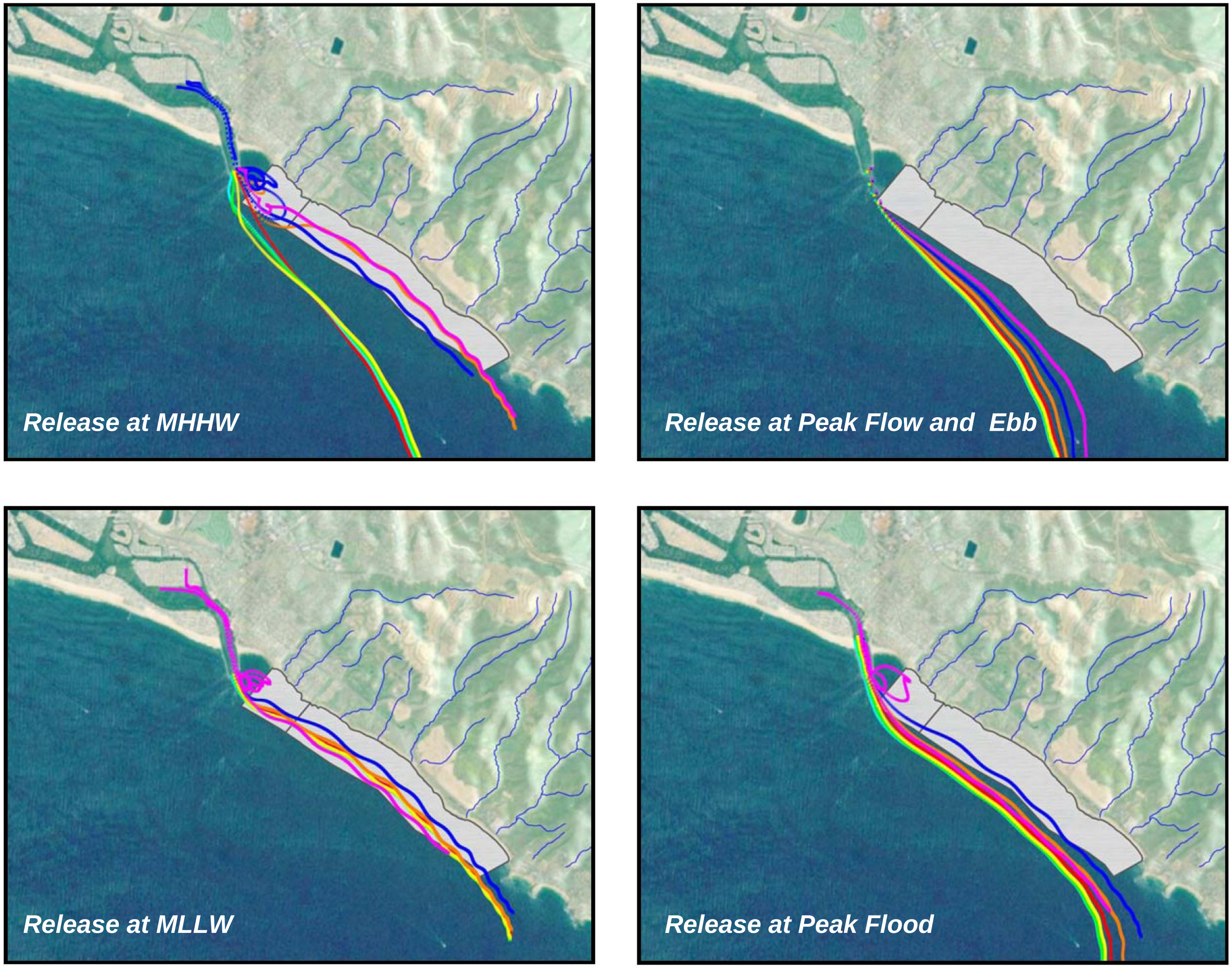



**Figure 4. Wet Weather Particle Tracking Results for Harbor**

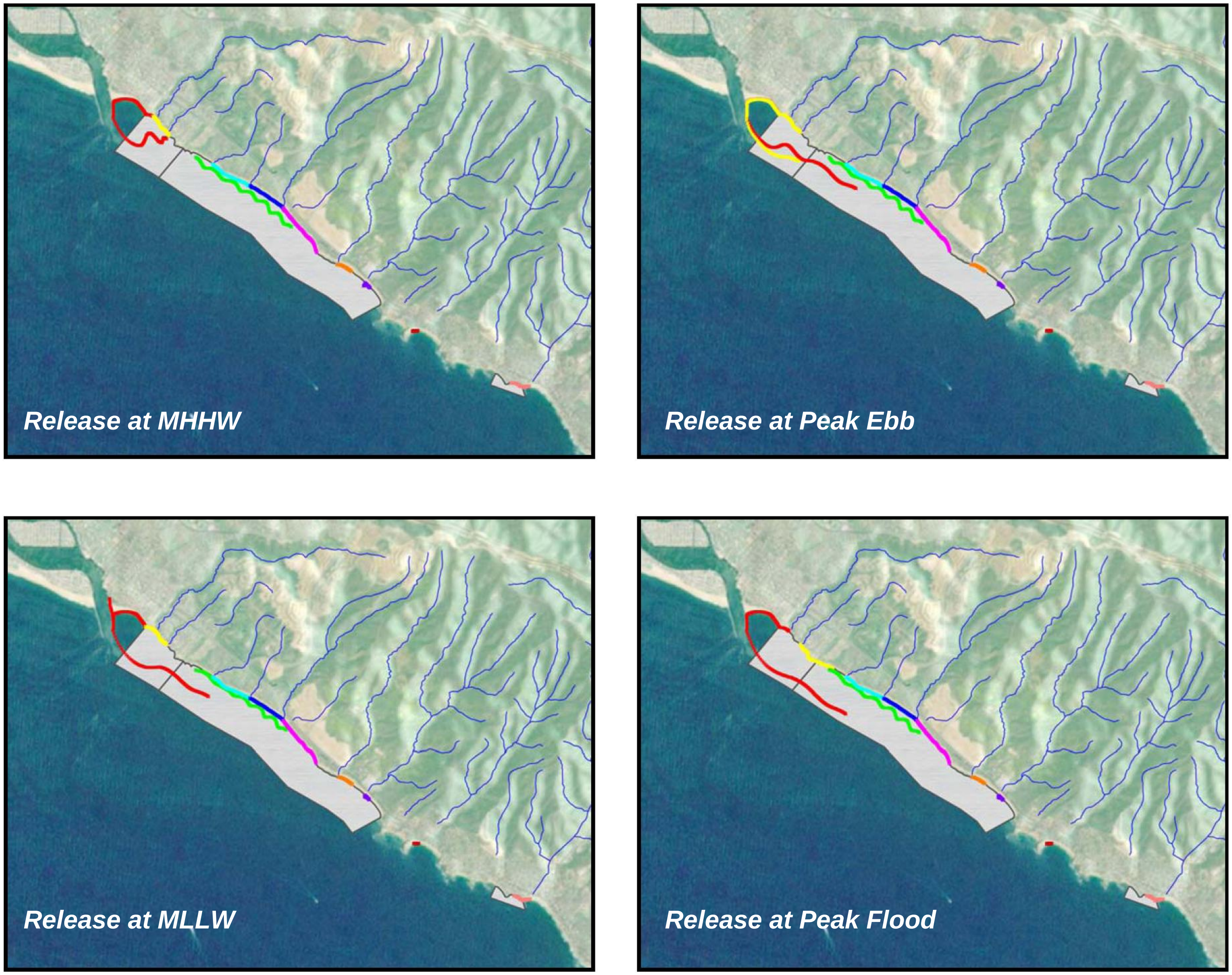



**Figure 5. Dry Weather Particle Tracking Results for Coastal Creeks**

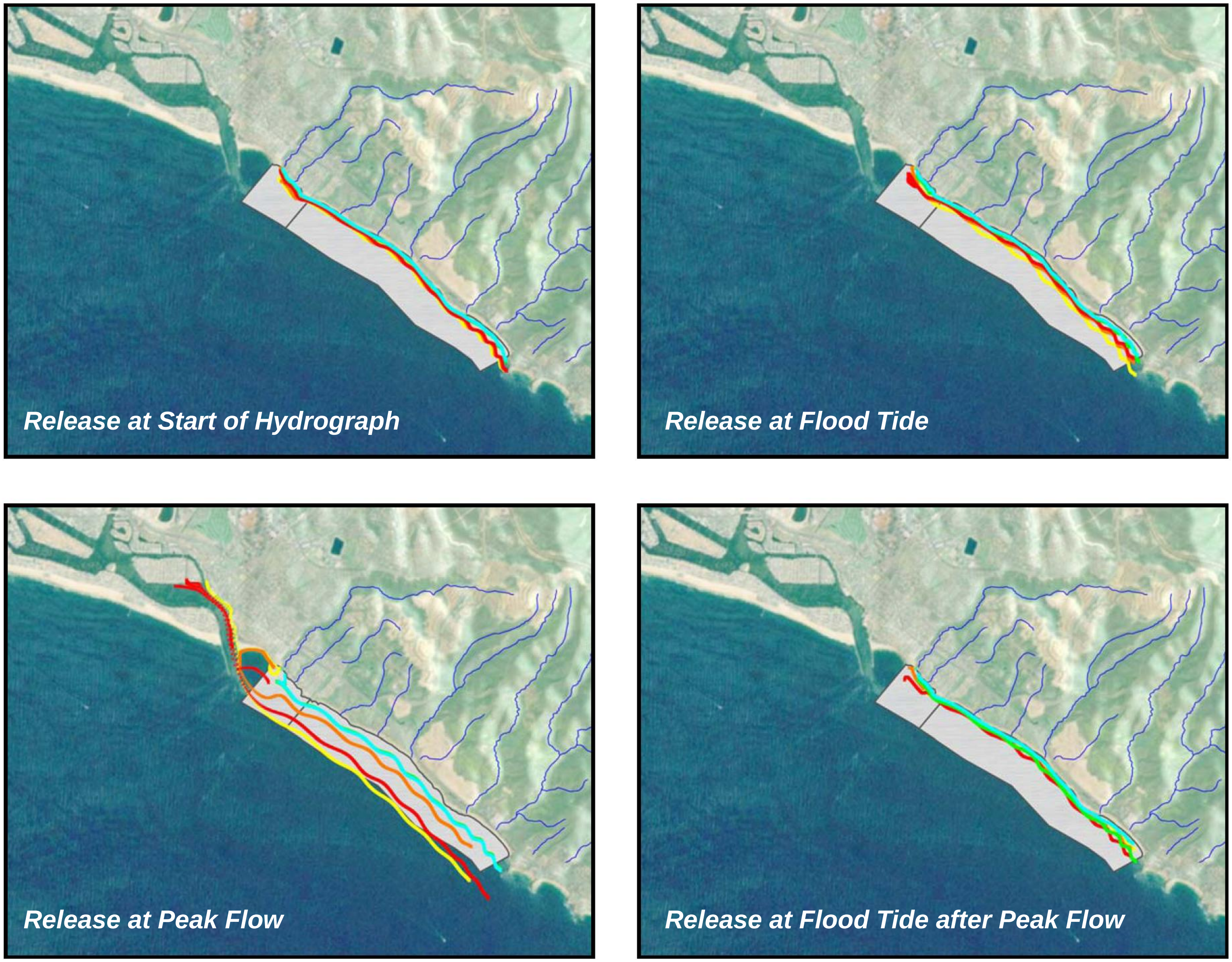



**Figure 6. Wet Weather Particle Tracking Results for Buck Gully**

### 3.3 Mixing and Toxicity

The particle tracking results show that pollutants discharging from the Harbor and coastal creeks have the potential of reaching the ASBS. To evaluate the potential impact of the pollutants to the ASBS, the water quality model RMA4 was used to simulate the mixing and dispersion of pollutants discharged from the Harbor and Buck Gully into the coastal waters to determine the resulted concentration of the pollutants reaching the ASBS. 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 pollutants 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. Example model results for the maximum dry and wet weather copper loading from the Harbor are shown in Figures 7 and 8. Figure 7 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 dry weather copper loading from the Harbor resulted in toxic copper concentrations within ASBS 32. Under wet weather condition, as shown in Figure 8, toxic copper concentrations were observed throughout ASBS 32, as well as part of ASBS 33.

The model predicted dispersion pattern of pollutants exiting the harbor entrance during wet weather condition matches well with visual observation at the site. Figure 9 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 the model predicted plume matches the general shape and extend of the plume shown in the photograph.

Based on available data, copper concentration from 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 is shown in Figure 10. The extent of the toxic copper concentration (shown in red) is within ASBS 32. Despite results for particle tracking indicating potential transport of pollutants from Buck Gully to both ASBS 32 and 33, the mixing and dispersion of pollutants from Buck Gully appears to be localized. It is expected that pollutant loadings from the other coastal creeks would result in similar localized effects.

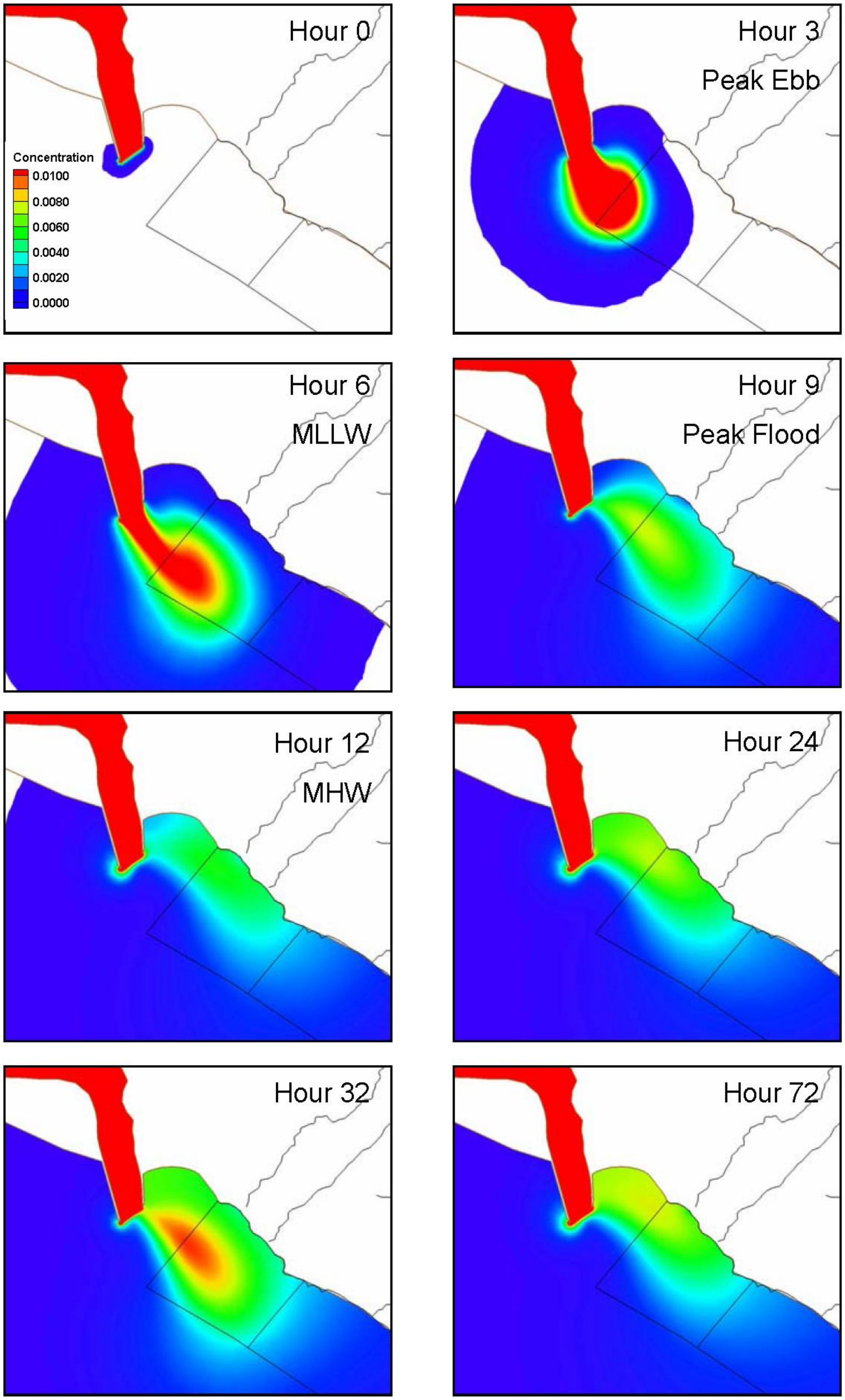



**Figure 7. Maximum Dry Weather Loading from the Harbor**

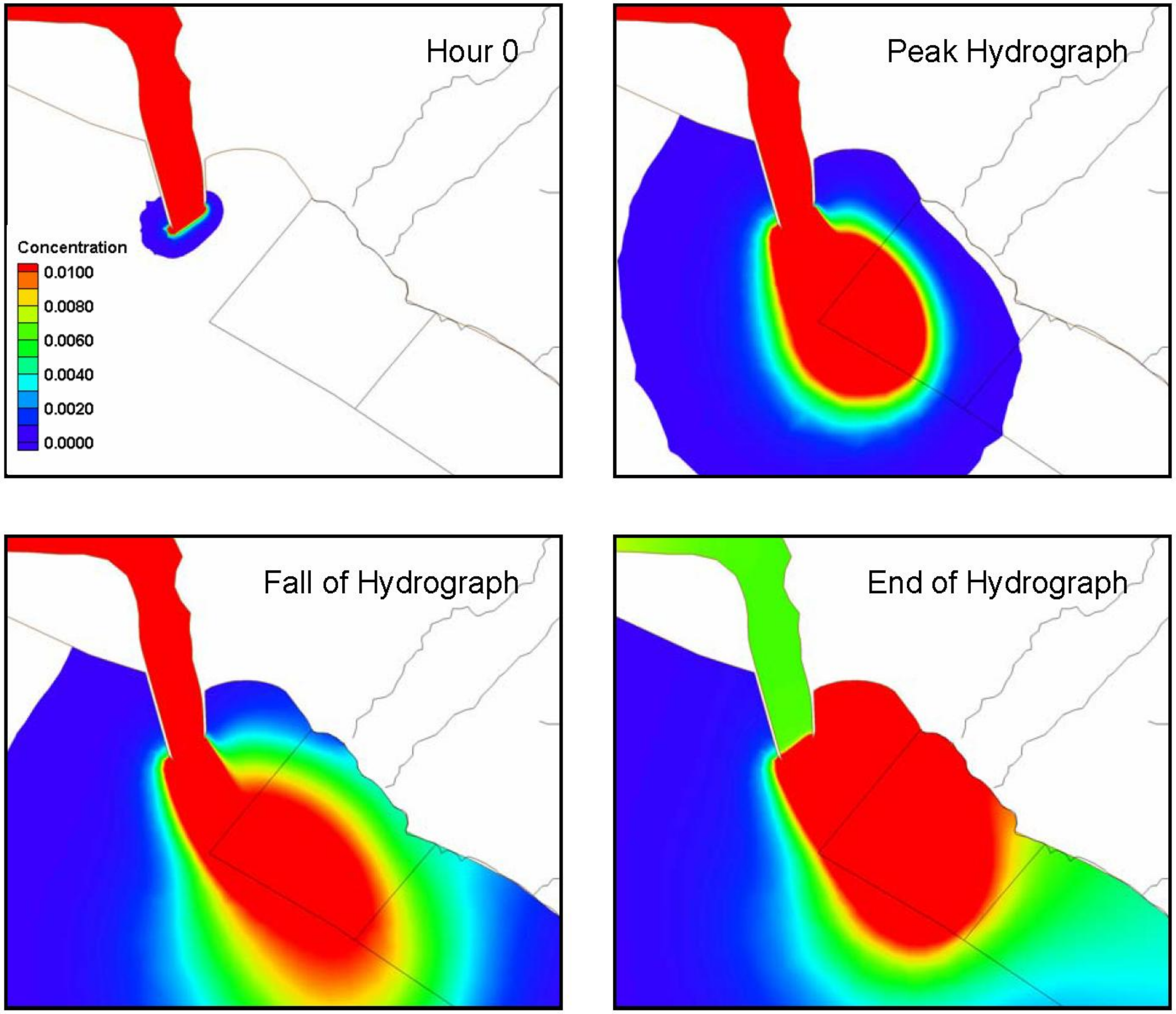



**Figure 8. Maximum Wey Weather Loading from the Harbor**

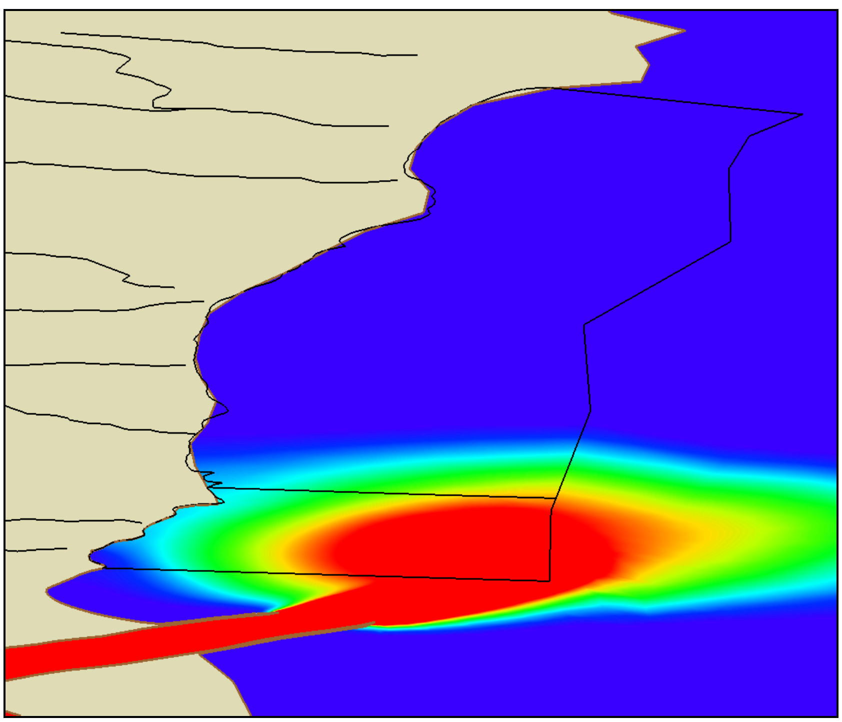


**Figure 9. Dispersion Pattern Comparison with Visual Observation**

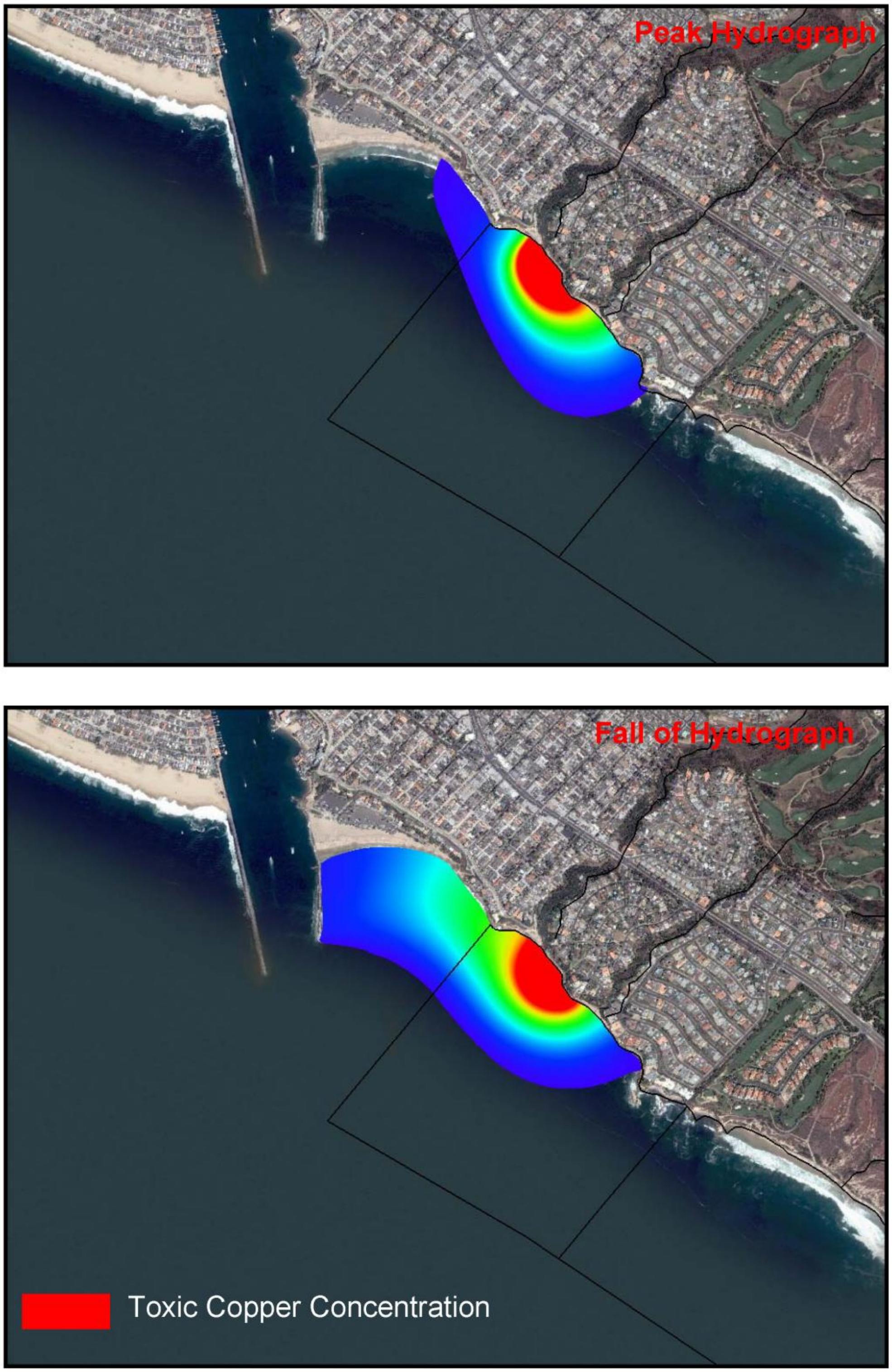



**Figure 10. Wet Weather Toxic Concentration from Buck Gully**

# 4. FINDINGS AND RECOMMENDATIONS

## 4.1 Findings

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 the 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 dependent on the pollutant loadings from the Harbor. Based on the limited data, it is possible that some of the pollutants reaching ASBS 32 could be higher than the toxicity values for some marine species.

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 tidal flow of the Harbor and is in the upcoast direction until being entrained into the Harbor flows. Potential pollutants from Buck Gully may impact ASBS 32 and 33; the magnitude of the impact is dependent on the pollutant loading. Transport and mixing conditions for potential pollutants from Morning Canyon is similar to 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. Potential pollutants from these creeks may impact ASBS 33, but is dependent on the pollutant loading.

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

## 4.2 Recommendations

The major finding for the study is that the hydrodynamic conditions at the study area are suitable to transport potential pollutants from the Harbor and the coastal creeks to the ASBS; however, the magnitude of the impact cannot be determined because of the lack of pollutant loading data. Hence, it is recommended to continue the baseline monitoring of water quality of the coastal creeks, particularly the downstream end, and the coastline areas within the ASBS.

For coastal watershed management strategies to address pollutant sources impacting ASBS 32 and 33, it is recommended that pollutant sources into Newport Bay also be addressed, in addition to the coastal creeks discharging directly into ASBS 32 and 33.

For coastal watershed management strategies to address pollutant sources impacting ASBS 30, it is recommended that pollutant sources focus on Laguna Canyon Channel and the local storm drains discharging directly into ASBS 30.

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.

# 5. REFERENCES

Everest. 2004. City of Newport Beach Storm Drain Diversion Study. Prepared for City of Newport Beach. Prepared by Everest International Consultants, Inc. November 2004.

Everest. 2005. City of Newport Beach Newport Bay Model. Prepared for City of Newport Beach. Prepared by Everest International Consultants, Inc. April 2005.