

An aerial photograph of a coastal region. In the foreground, there is a large, light-colored sandy area, possibly a beach or a sandbar, that curves along the edge of a body of water. The water is a deep blue-green color. To the left of the sandy area, there is a dense forest of dark green trees. In the background, the land is a mix of green fields and brownish areas, with a large body of water extending towards the horizon. The overall scene is a natural, coastal landscape.

NUMERICAL MODELING IN THE WATER ENVIRONMENT

**Capabilities and Experience
Noble Consultants, Inc.**

NUMERICAL MODELING SERVICES IN THE WATER ENVIRONMENT

NCI utilizes the most advanced numerical models in the analysis and design of projects involved with the water environment. These models include 1-D, 2-D and 3-D hydrology, hydraulic, hydrodynamic, sediment transport and water quality models for Coastal & Ocean projects, Riverine & Estuarine projects, and Waterfront Development & Restoration projects.

Our experience includes numerical model application for the following types of projects:

COASTAL & OCEAN

- Wave Generation & Propagation
- Tide and Wind Induced Circulation
- Wave Induced Circulation
- Sediment Transport & Coastal Morphology
- Storm Surge & Coastal Flooding
- Constituent Transport & Water Quality



RIVERINE & ESTUARINE

- Hydrology, Hydraulics & Flooding
- Hydrodynamics
- Sediment Transport & Morphology
- Constituent Transport & Water Quality



WATERFRONT DEVELOPMENT & RESTORATION

- Marinas & Ports
- Lagoons & Lakes
- Wetland Restoration
- Creek Restoration
- Coastal & Marine Structures
- Hydraulic Structures
- Cooling Water Desalination & Outfalls



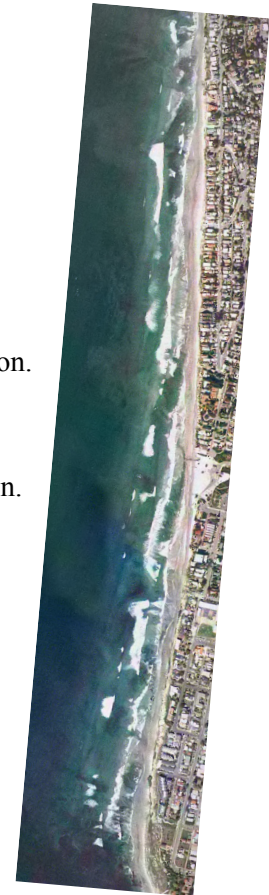
Please visit our website at www.nobleconsultants.com to learn more about us or contact us at either (415) 884-0727 or (949) 752-1530 to discuss your particular project needs.

MODELS	COASTAL & OCEAN					RIVERINE & ESTUARINE				WATERFRONT DEVELOPMENT & RESTORATION				MODEL DESCRIPTION		
	WAVE GENERATION & PROPAGATION	TIDE AND WIND INDUCED CIRCULATION	WAVE INDUCED CIRCULATION	SEDIMENT TRANSPORT & COASTAL MORPHOLOGY	STORM SURGE & COASTAL FLOODING	HYDROLOGY, HYDRAULICS & COASTAL FLOODING	HYDRODYNAMICS	SEDIMENT TRANSPORT & WATER QUALITY	CONSTITUENT TRANSPORT & FLOODING	MARINAS & PORTS	LAGOONS & LAKES	WETLAND RESTORATION	CREEK RESTORATION		COASTAL & MARINE STRUCTURES	HYDRAULIC STRUCTURES
RMA2	■	▲	▲	▲	■	■	▲	▲	■	■	■	■	■	■	■	2-D HYDRODYNAMICS
MIKE 21-HD	■	■	▲	■	▲	■	■	▲	▲	■	■	■	■	■	■	2-D HYDRODYNAMICS
HIVEL2D						■	■	■	■			■		■		2-D HYDRODYNAMICS FOR HIGH-VELOCITY FLOW
SED2D			■			■	■	■	■	■	■	■	■	■	■	2-D SEDIMENT (SAND & MUD) TRANSPORT
MIKE 21-MT			■			■	■	■	■	■	■	■	■	■	■	2-D MUD TRANSPORT
MIKE 21-ST			■			■	■	■	■	■	■	■	■	■	■	2-D SAND TRANSPORT
FESWMS	■	■				■	■	■	■	■	■	■	■	■	■	2-D HYDRODYNAMICS & SEDIMENT TRANSPORT
RMA4				■		■	■	■	■	■	■	■	■	■	■	2-D CONSTITUENT TRANSPORT & WATER QUALITY
MIKE 21-AD				■		■	■	■	■	■	■	■	■	■	■	2-D CONSTITUENT TRANSPORT & WATER QUALITY
EFDC	■			■		■	■	■	■	■	■	■	■	■	■	HYDRODYNAMICS, CONSTITUENT TRANSPORT & WATER QUALITY
CEDAS/ACES	■	▲	▲	■	▲				■	●	●		■		●	AUTOMATED COASTAL ENGINEERING DESIGN & ANALYSIS
SPM	■	▲	▲	■	▲				■	●	●		■		●	SHORE PROTECTION MANUAL
CEM	■	▲	▲	■	▲				■	●	●		■		●	COASTAL ENGINEERING MANUAL
WAVEWATCH III	■	▲	▲	▲	▲				■	●	●		■		●	THIRD-GENERATION WAVE MODEL
WAM	■	▲	▲	▲	▲				■	●	●		■		●	WIND-WAVE PREDICTION
MIKE 21-SW	■	▲	▲	▲	▲				■	●	●		■		●	SPECTRAL WAVE GROWTH & TRANSFORMATION
MIKE 21-NSW	■	▲	▲	▲	▲				■	●	●		■		●	NEARSHORE SPECTRAL WAVE PROPAGATION
SWAN	■	▲	▲	▲	▲				■	●	●		■		●	THIRD-GENERATION WAVE MODEL
STWAVE	■	▲	▲	▲	▲				■	●	●		■		●	SPECTRAL WAVE GROWTH & PROPAGATION
RCPWAVE	■	▲	▲	▲	▲				■	●	●		■		●	MONOCHROMATIC WAVE PROPAGATION
CGWAVE	■	▲	▲	▲	▲				■	●	●		■		●	WAVE PROPAGATION
REFDIF	■	▲	▲	▲	▲				■	●	●		■		●	PARABOLIC MILD SLOPE WAVES
MIKE 21-PMS	■	▲	▲	▲	▲				■	●	●		■		●	PARABOLIC MILD SLOPE WAVES
MIKE 21-EMS	■	▲	▲	▲					■	●	●		■		●	ELLIPTIC MILD SLOPE WAVES
FUNWAVE	■	■	■	■					■	●	●		■		●	BOUSSINESQ WAVE MODEL
MIKE21-BW	■	■	■	■					■	●	●		■		●	BOUSSINESQ WAVE MODEL
ADCIRC	■	■	▲	■		■	■	■	■	●	●		■		●	2-D/3-D HYDRODYNAMIC CIRCULATION
SHORECIRC	■	■	▲	■		■	■	■	■	●	●		■		●	QUASI-3D NEARSHORE CIRCULATION
NCI/QIN FEATURED	■	■	■	■									■		●	COMPREHENSIVE NEARSHORE PROCESSES
GENESIS			■						■	●	●		■		●	SHORELINE & BEACH PLATFORM EVOLUTION
SBEACH			■	■					■	●	●		■		●	STORM INDUCED BEACH EROSION
GEOMETRIC MODEL			■	■					■	●	●		■		●	STORM INDUCED BEACH/DUNE EROSION
FEMA RUNUP2.0				■					■	●	●		■			WAVE RUNUP
HEC-HMS					■	▲	▲	▲		■	■		■			HYDROLOGY (PRECIPITATION-RUNOFF PROCESSES)
SAM					■	■	■			■	■		■			HYDRAULIC DESIGN PACKAGE FOR CHANNELS
HEC-RAS					■	■	■			■	■		■			1-D HYDRAULICS & SEDIMENT TRANSPORT
HEC-GEORAS					▲	■	■					▲	▲			ARCGIS EXTENSION FOR HEC-RAS
NCI/QIN FEATURED					■	■	■					■				1-D HYDRAULICS & SEDIMENT TRANSPORT
MIKE 11 & FLOOD					■	■	■			■	■		■			RIVER & FLOODPLAIN HYDRAULICS
SMS	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	PRE- & POST-PROCESSOR OF SMS
MIKE 21-PP	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	PRE- & POST-PROCESSOR OF MIKE 21

NOTE: ■ DIRECT MODEL APPLICATIONS; ▲ MODELS REQUIRED BY DIRECT MODEL APPLICATIONS; ● MODEL APPLICATIONS FOR COASTAL DEVELOPMENT & RESTORATION ONLY.

COASTAL & OCEAN MODEL APPLICATION

- **Wave Generation & Propagation**
 - ▶ Wave hindcasting, wind generated waves, spectral sea states, wave growth and decay.
 - ▶ Spectral and monochromatic wave propagation, wave shoaling, refraction, diffraction and breaking.
 - ▶ Wave transmission, reflection and wave structure interaction.
- **Tide and Wind Induced Circulation**
 - ▶ Tidal harmonics analysis and tidal prediction.
 - ▶ Tidal circulation and flushing.
 - ▶ Wind induced circulation.
- **Wave Induced Circulation**
 - ▶ Radiation stresses.
 - ▶ Wave induced alongshore and cross-shore currents and vertical profiles.
 - ▶ Wave setup and wave-current interaction.
- **Sediment Transport & Coastal Morphology**
 - ▶ Alongshore and cross-shore sediment transport and sediment concentration.
 - ▶ Long-term shoreline evolution and sediment budgets.
 - ▶ Storm induced beach, dune, bluff and shoreline erosion.
 - ▶ Beach nourishment performance, inlet stability and offshore bar migration.
- **Storm Surge & Coastal Flooding**
 - ▶ Wave runup and overtopping.
 - ▶ Storm surge and storm induced beach/dune erosion.
 - ▶ Coastal flood mapping.
- **Constituent Transport & Water Quality**
 - ▶ Water quality parameters, residence time and water exchange time.
 - ▶ Pollutant transport, dispersion, decay and fate.
 - ▶ Point source discharge.
 - ▶ Salinity distribution.

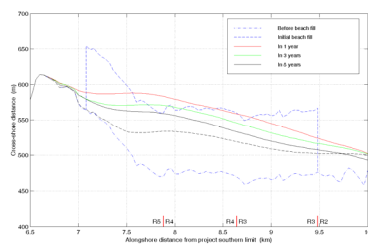


	2-D HYDRODYNAMICS, SEDIMENT TRANSPORT & WATER QUALITY										WIND WAVES, NEARSHORE CIRCULATION, LITTORAL TRANSPORT & COASTAL MORPHOLOGY																					
	RMA2	MIKE 21-HD	HVEL2D	SED2D	MIKE 21-MT	MIKE 21-ST	FESWMS	RMA4	MIKE 21-AD	EFDC	CEADSI/ACES	SPM	CEM	WAM	WAVEWATCH III	MIKE 21-SW	MIKE 21-HSW	SWAN	STWAVE	RCPWAVE	CGWAVE	REFDIF	MIKE 21-PMS	FUNWAVE	MIKE 21-BW	ADDIRC	SHORECIRC	NCIQM FEATURED	GENESIS	SBEACH	GEOMETRIC MODEL	RUNUP2.0
WAVE GENERATION & PROPAGATION																																
TIDE AND WIND INDUCED CIRCULATION	■	■						■																								
WAVE INDUCED CIRCULATION		■									▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		
SEDIMENT TRANSPORT & COASTAL MORPHOLOGY	▲	▲	■	■	■	■	■	■	■		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		
STORM SURGE & COASTAL FLOODING	■	■																														
CONSTITUENT TRANSPORT & WATER QUALITY	▲	▲									▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		

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ENCINITAS/SOLANA BEACH SHORELINE STUDY, SAN DIEGO COUNTY, CALIFORNIA

The shoreline of the cities of Encinitas and Solana Beach in San Diego County is characterized by a narrow shore platform in front of coastal bluffs up to 80 feet high. The continuous loss of the protective beach strand results in direct wave attack at the toe of the bluffs, episodically triggering upper bluff collapses and shoreline retreat. NCI conducted a feasibility study to statistically quantify the bluff-top/shoreline retreat in response to the wave-induced bluff-toe erosion, developed shoreline protection alternatives and conducted alternative optimizations.

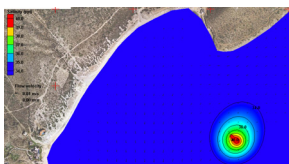
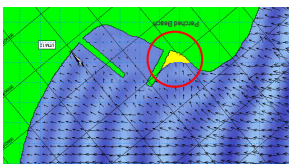
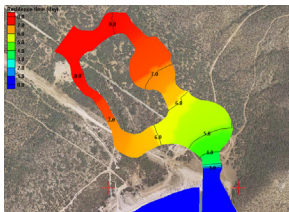
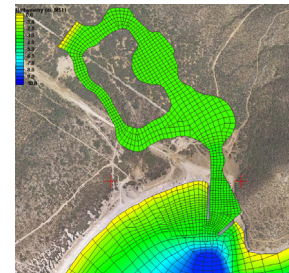


NCI performed the following scope of services:

- Long-term offshore wave hindcasting with WAVEWATCH III.
- Modeled wave induced bluff-toe erosion.
- Developed a Monte Carlo model to simulate shoreline/bluff-top retreat over a 50-year design life cycle, considering the random characteristics of bluff collapses and wave climates.
- Developed shoreline protection alternatives including beach fills, notch fills, seawalls and revetments.
- Modeled beach evolution for various beach fill design options using GENESIS with STWAVE and RCPWAVE models.
- Optimization of shoreline protection alternatives based on cost and benefit analysis.

COASTAL ENGINEERING FEASIBILITY STUDY: BAHIA DE LOS SUEÑOS

This study was conducted on behalf of the Owner to evaluate, from a coastal engineering perspective, the feasibility of six waterfront development alternatives that the Owner was contemplating for a real estate development at the Bahia de los Sueños, Baja California, Mexico. The six alternatives consist of (1) Open Deep Water Lagoon, (2) Open Shallow Water Lagoon, (3) Closed Salt Water Lagoon, (4) Open Mooring Facility, (5) Docking Facilities at “El Manglito”, and (6) RO Seawater Desalination Plant Discharge.

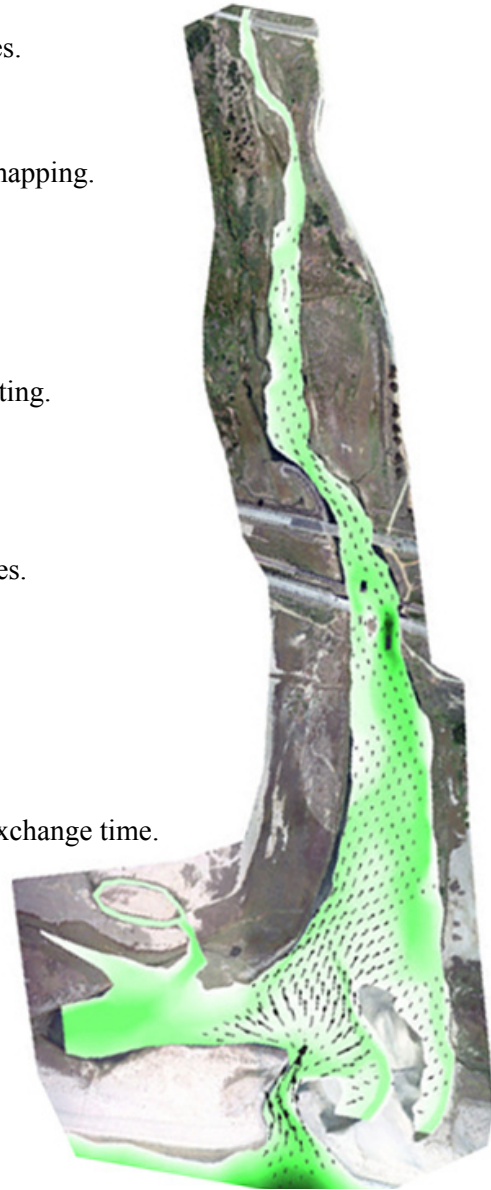


NCI performed the following scope of services:

- Tidal harmonics analysis and tidal prediction.
- Wind analysis and 36-year deepwater wave hindcasting.
- Wave transformation with Mike 21-PMS.
- Hurricane wave generation and transformation with Mike 21-SW.
- Littoral process, shoreline impact and beach erosion analysis.
- 2-D lagoon tidal circulation modeling with RMA2.
- 2-D lagoon water quality modeling with RMA4.
- Evaluated lagoon water quality based on water exchange time and residence time.
- Tidal inlet hydrodynamic analysis to optimize the inlet design.
- Modeled salinity distribution with RMA4 adjacent to the desalination discharge to optimize outfall placement and desalination plant design.
- Analyzed Open Mooring Facilities and Docking Facilities.

RIVERINE & ESTUARINE MODEL APPLICATION

- **Hydrology, Hydraulics & Flooding**
 - ▶ Hydrologic analysis and precipitation-runoff processes.
 - ▶ Water budgets and supply.
 - ▶ 1-D steady & unsteady hydraulics.
 - ▶ Flood dynamics, flood hazard assessment and flood mapping.
- **Hydrodynamics**
 - ▶ 1-D & 2-D hydrodynamics.
 - ▶ River discharge and currents.
 - ▶ Water levels, water depths and flow velocities.
 - ▶ Estuarine tidal circulation, tidal flushing and tidal muting.
 - ▶ Estuarine inundation frequencies.
- **Sediment Transport & Morphology**
 - ▶ Non-cohesive and cohesive sediment transport.
 - ▶ Suspended sediment concentration and vertical profiles.
 - ▶ River morphology and sediment budgets.
 - ▶ Reservoir sedimentation.
 - ▶ Stable channel and erosion control.
 - ▶ Estuarine sedimentation and inlet stability.
- **Constituent Transport & Water Quality**
 - ▶ Water quality parameters, residence time and water exchange time.
 - ▶ Pollutant transport, dispersion, decay and fate.
 - ▶ Point source discharge.
 - ▶ Water quality of rivers and estuaries.
 - ▶ Lake and reservoir water quality.
 - ▶ Salinity intrusion and mixing zone definition.

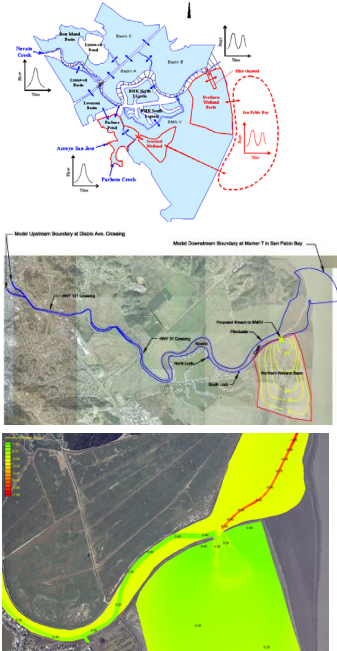


	HYDROLOGY, 1-D HYDRAULICS & SEDIMENT TRANSPORT										2-D HYDRODYNAMICS, SEDIMENT TRANSPORT & WATER QUALITY										WIND WAVES, NEARSHORE CIRCULATION, LITTORAL TRANSPORT & COASTAL MORPHOLOGY																	
	HEC-HMS	SAMI	HEC-RAS	HEC-GEORAS	NCI/QUIN FEATURED	MIKE 11 & FLOOD	RMA2	MIKE 21-HD	HIVEL2D	SED2D	MIKE 21-MT	FESWIMS	RMA4	MIKE 21-AD	EPDC	CEADSI/ACES	SPM	CEM	WAVEWATCH III	MIKE 21-SW	SWAN	STWAVE	RCPWAVE	CGWAVE	REFDIF	MIKE 21-PMS	MIKE 21-EMS	FUNWAVE	MIKE 21-BW	ADDCIRC	SHORECIRC	NCI/QUIN FEATURED	GENESIS	SBEACH	GEOMETRIC MODEL	RUNUP2.0		
HYDROLOGY, HYDRAULICS & FLOODING	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																							
HYDRODYNAMICS			■																																			
SEDIMENT TRANSPORT & MORPHOLOGY	▲		■				▲	▲	▲	▲	▲	▲	▲	▲	▲	▲																						
CONSTITUENT TRANSPORT & WATER QUALITY	▲						▲	▲	▲	▲	▲	▲	▲	▲	▲	▲																						

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NOVATO CREEK HYDRAULIC, HYDRODYNAMIC & SEDIMENTATION STUDY

Novato Creek is a perennial stream that extends about 17 miles from its headwaters at Stafford Dam to San Pablo Bay. This study was performed to (1) investigate hydrology, hydraulics, tidal hydrodynamics, and sedimentation in Novato Creek, and (2) assess the impact of a proposed Hamilton Wetland Restoration Project on the flooding dynamics, morphology and navigability in Novato Creek.

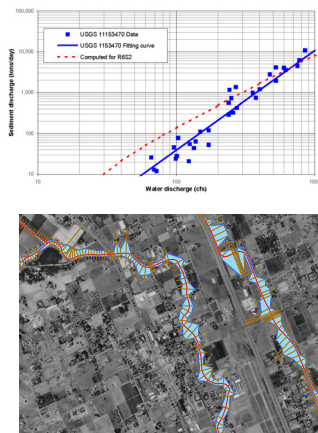


NCI performed the following scope of services:

- Field sampling and measurements of water levels, flow velocities, suspended sediment concentrations and sediment properties.
- Bathymetric survey and mapping.
- Hydraulic modeling with HEC-RAS for nineteen flood potential scenarios, incorporating the creek, the bay, storage basins, ponds, and hydraulic structures such as levees, bridges, culverts, gates and weirs.
- 2-D tidal hydrodynamic modeling with RMA2 for water levels, water depths and flow velocities.
- 2-D (cohesive) sediment transport modeling with SED2D for morphology adjustment in Novato Creek.
- Assessed project impacts to flooding dynamics in the creek and adjacent storage basins, and to creek morphology and navigability.
- Predicted flow conditions and sedimentation pattern in the proposed wetland basin.
- Developed mitigation alternative to minimize adverse project impacts to Novato Creek.

UPPER LLAGAS CREEK HYDRAULIC, SEDIMENTATION & STABLE CHANNEL MODELING

The Upper Llagas Creek Flood Control Project is located in Santa Clara County, California. This project consists of channel improvements and a diversion channel providing a 100-year level of flood protection to urban areas and maintaining existing levels of protection in agricultural areas. This modeling study was conducted to support a final design by providing a more reach specific sediment assessment, stable low-flow channel design, and updated floodplain mapping.

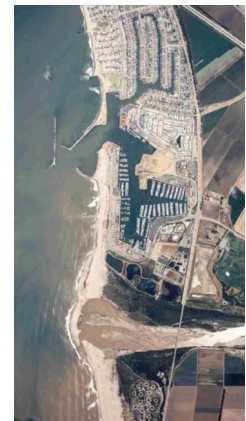


NCI performed the following scope of services:

- Field reconnaissance investigation and bed material sampling.
- Determined stable low-flow channel discharge with SAM program.
- Reach specific stable low-flow channel design with SAM.
- Sediment budget analysis for various flood scenarios with SAM to assess creek stability.
- Assessed diversion channel initial and long-term conditions.
- Floodplain mapping for the 2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year flood events using HEC-RAS and HEC-GeoRAS.
- Formulated mitigation alternatives to alleviate identified sedimentation problems, and conducted alternative optimization.

WATERFRONT DEVELOPMENT & RESTORATION

- **Marinas & Ports**
 - ▶ Tides, water circulation, sedimentation/erosion, pollutant transport and water quality.
 - ▶ Wave climate, wave runup and wave forces.
 - ▶ Inlet stability and impacts to coastal processes, beaches/shoreline and water quality.
- **Lagoons & Lakes**
 - ▶ Water circulation, sedimentation/erosion, pollutant transport and water quality.
 - ▶ Impact to riverine processes.
 - ▶ Waves, tides, and impacts to coastal processes and beaches/shorelines.
- **Wetland Restoration**
 - ▶ Hydrologic analysis, surface runoff, hydraulics, water circulation, inundation frequencies, sedimentation/erosion, pollutant transport and water quality.
 - ▶ Waves and tidal muting for tidal wetlands.
- **Creek Restoration**
 - ▶ Hydrologic analysis and precipitation-runoff processes.
 - ▶ Hydraulics, flow conditions, sediment transport, sedimentation/erosion, stable channel, pollutant transport, water quality and/or tidal flushing.
- **Coastal & Marine Structures**
 - ▶ Tides, waves, wave runup, storm surge, wave forces, wave structure interaction, sediment transport and erosion.
 - ▶ Impacts to coastal processes, beaches/shoreline and water quality.
- **Hydraulic Structures**
 - ▶ Hydrologic analysis, flow conditions and hydraulic loading.
 - ▶ Impacts to creek's flood capacity, morphology and water quality.
- **Cooling Water, Desalination & Outfalls**
 - ▶ Water circulation and water quality.
 - ▶ Tracing temperature effects, salinity distribution and placement of outfalls.
 - ▶ Tides, waves and impacts to coastal processes.

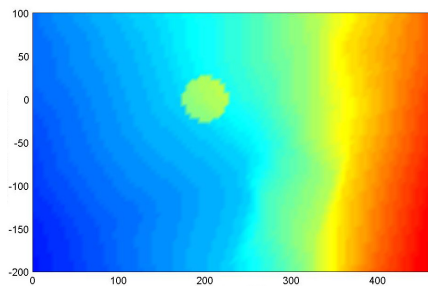


	HYDROLOGY, 1-D HYDRAULICS & SEDIMENT TRANSPORT					2-D HYDRODYNAMICS, SEDIMENT TRANSPORT & WATER QUALITY					WIND WAVES, NEARSHORE CIRCULATION, LITTORAL TRANSPORT & COASTAL MORPHOLOGY																										
	HEC-HMS	SAM	HEC-RAS	HEC-GEORAS	NCI/QIN FEATURED	MIKE 11 & FLOOD	RIIA2	MIKE 21-HD	HVEL2D	SED2D	MIKE 21-MT	FESWMS	RIMA4	MIKE 21-AD	EFDC	CEADSIACES	SPM	CEM	WAVEWATCH III	MIKE 21-SW	MIKE 21-NSW	SWAN	STWAVE	RCPWAVE	CGWAVE	REFDIF	MIKE 21-PMS	FUNWAVE	MIKE 21-BW	ADIRC	SHORECIRC	NCI/QIN FEATURED	GENESIS	SBEACH	GEOMETRIC MODEL	RUNUP2.0	
MARINAS & PORTS							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
LAGOONS & LAKES							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
WETLAND RESTORATION	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
CREEK RESTORATION	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
COASTAL & MARINE STRUCTURES	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
HYDRAULIC STRUCTURES	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
COOLING WATER, DESALINATION & OUTFALLS							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

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COASTAL ENGINEERING ASSESSMENT: PRC-421 REMNANT STRUCTURE REMOVAL

The PRC-421 remnant structure is located within the central portion of the Santa Barbara Channel along a stretch of shoreline known as Ellwood. The existing remnant structure and proposed hard-bottom substrate feature site is approximately 850 feet offshore with a water depth of 34 feet. Approximately 12,000 tons of quarry stone will be placed on the existing bottom to form a flat crested mound for the purpose of forming a protective cover around and over the toppled caissons and for providing habitat enhancement benefits. This modeling study was performed to estimate the potential long-term oceanographic impacts associated with the proposed construction.

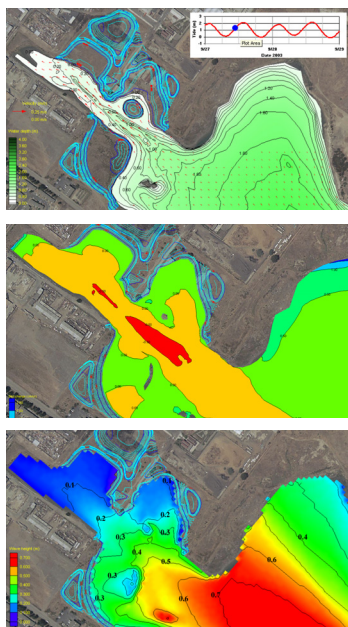
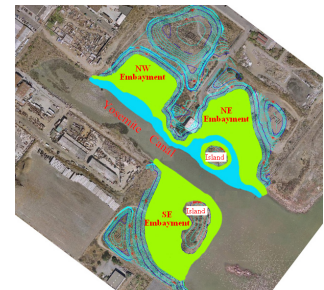


NCI performed the following scope of services:

- Offshore CDIP buoy data analysis and wave transformation.
- Nearshore wave climate modeling with REFDIF.
- Nearshore circulation modeling with SHORECIRC.
- Alongshore and cross-shore sediment transport modeling with NCI/Qin featured sediment transport model.
- Assessed potential project impacts to the nearshore wave climate, currents, and sediment transport processes.

MODELING STUDY FOR YOSEMITE CANAL WETLAND RESTORATION PROJECT

The Yosemite Wetland Restoration Project is located within the Candlestick Point State Recreation Area in San Francisco. The modeling study was conducted to assist in the evaluation and design of this wetland restoration project. The objectives were to assess the tidal hydrodynamics, waves, long-term sedimentation pattern and storm wave induced erosion potential at the project site. Both the existing baseline conditions and the project conditions were investigated.



NCI performed the following scope of services:

- Field measurements of water levels, flow velocities, and soil sampling and analysis.
- Bathymetric survey and aerial topographic mapping.
- 2-D water circulation modeling with RMA2 to assess water levels, water depths, inundation frequencies and flow velocities.
- 2-D (cohesive) sediment transport modeling with SED2D to predict bottom shear stresses and sediment deposition/erosion patterns.
- Wind analysis, wind-wave hindcasting with CEDAS/ACES, and return frequency analysis of storm wave events.
- Wave propagation modeling with STWAVE.
- Developed a model for storm wave induced bed erosion potential.
- Determined the thickness of the clean material layer capped on the contaminated bed material.
- Evaluated project impacts to the water circulation, morphological conditions, and environment at the project site and adjacent area of South San Francisco Bay.

Noble Consultants, which specializes in ocean, coastal, estuarine and riverine engineering, traces its history to 1958. Despite growth throughout the years, the firm maintains its founding philosophy of hands-on involvement on every project by its principals or key senior personnel.

Although rooted in traditional values of close, personal attention, Noble Consultants is renowned for its leading edge engineering techniques and environmentally sensitive solutions to new challenges.

Noble Consultants utilizes the most advanced numerical models in the analysis and design of projects involved with the water environment. These models include 1-D, 2-D and 3-D hydrology, hydraulic, hydrodynamic, sediment transport and water quality models for Coastal & Ocean projects, Riverine & Estuarine projects, and Waterfront Development & Restoration projects.

Noble Consultants is available to work with you on your next project. Please contact one of the offices below to discuss your particular project needs.



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